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Trow

Geotechnical Investigation
York/Peel Feedermain
Brampton, ON

Prepared for:

KMK Consultants Ltd.
220 Advance Blvd.
Brampton, Ontario
L6T 4J5

Trow Consulting Engineers Ltd.

1595 Clark Boulevard
Brampton, Ontario L6T 4V1
Telephone: (905) 793-9800
Facsimile: (905) 793-0641

brge0065425a
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Part A
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1. Introduction

This report presents the results of a geotechnical investigation carried out for the proposed York/Peel feedermain project. The purpose of the investigation was to establish the subsurface conditions along the route of the feedermain by putting down a limited number of boreholes, and based on the results, provide geotechnical design recommendations for the feedermain, and discussion of construction conditions.

At the request of KMK Consultants Limited, this report is prepared for that section of the feedermain south of Queen Street. A separate report will be issued for the remainder of the feedermain on Queen Street and Airport Road.

The investigation was authorized by KMK on behalf of the Regional Municipality of Peel. This investigation has been carried out in general accordance with a proposal submitted by Trow Consulting Engineers to Peel Region dated September 6, 2002.

2. Project Description

The project consists of the installation of a 2.1 m diameter feedermain from the existing Beckett Sproule Pumping Station on Heart Lake Road south of Glidden Road, to a proposed pumping station to be located east of Airport Road and north of Williams Parkway, in the City of Brampton. The total length of the feedermain is approximately 11 km, and its approximate location is shown in Drawing No. 1 in Appendix F. The pipe material could be steel or reinforced or prestressed concrete.

The proposed route of the feedermain south of Queen Street is shown in Drawing Nos. L1 to L14 attached to this report. In most areas the feedermain will be installed in open trenches at invert depths varying from 4.5 to 9 m ± below existing ground surface. The watermain will cross a number of water courses, highway, roads and railways. At these crossings, tunneling techniques are expected to be used for the feedermain installation. Table 1 below summarizes the locations and expected depths of the crossings.

Table 1 - Location of Crossings

Location	Proposed Invert Elevation (m)	Approximate Invert Depth (m)	Approximate Length (m)
CN Rail on Heart Lake Road	199.3	9.5 - 10.5	30
Water course on Heart Lake Rd.	204.3	9.8	16
Highway 410	201.5 - 201.7	13 - 17	153
Clark Boulevard	204	7.6 - 7.9	35
West Drive	209.2 - 209.3	8.1 - 9.3	114

The comments and recommendations given in this report are based on the assumption that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review those modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

3. Method of Investigation

The scope of the investigation, as requested by the Client, was to put down seventy eight (78) boreholes along the route of the feedermain. Borehole 15A was subsequently added after consulting KMK. Twenty six (26) of the boreholes are located within this section of the feedermain. A set of site plans showing the proposed feedermain alignment and profile was provided by KMK Consultants.

The boreholes were put down between October 29, 2002, and November 20, 2002, at the locations shown on the borehole location plans, Drawing Nos. L1 to L14 in Appendix A of this report, which are based on the site plans provided to us by KMK. The borehole co-ordinates and elevations were established using precision Global Positioning equipment, with reference to the control monuments shown in Table 2 below. The actual borehole co-ordinates and elevations are shown in the individual borehole logs.

Table 2 - Survey Control Monuments

Monument No.	Location	Northing	Easting	Elevation (m)
920157	Airport Rd. at railway bridge north of Williams Parkway	4845730.304	603505.713	
042910134	SW corner of Queen Street and Torbram Road	4843109.834	604168.444	
042900009	SW corner of Queen Street and Dixie Road	4840955.409	602470.259	213.95
042910135	NW corner of Torbram Road and Central Park Drive	4843649.427	603625.450	211.59

The bottom elevation of Boreholes 8 to 12 were specified by KMK as 202.5 m, and for BH's 17 to 25 as 206.0 m. The other boreholes were drilled to generally one pipe diameter (~2 m) below proposed invert elevations. Boreholes 10A and 12 were deepened after initial results indicated more fill is present under Highway 410.

Two power auger drill rigs, one mounted on a truck and the other on a bombardier vehicle, were used to drill the boreholes under the full time supervision of a senior technician from our office. In the boreholes, samples were taken at 0.76 m intervals of depth in the upper 5 m, and at 1.5 m intervals below, using a split spoon sampler in conformance with the standard penetration test (ASTM D-1557). A portable gas detector was lowered into the boreholes to detect the possible presence of methane gas. After confirming the presence of bedrock in Boreholes 2, 5, 8, 10A, 12 and 15A, the holes were advanced another 3 to 7.6 m

by coring the rock using NX size double tube core barrels, which recovered 48 mm diameter rock cores.

The soil and rock samples were identified in the field, and forwarded to our laboratory for detailed classification by a senior engineer and selectively tested. Representative samples were tested for their natural moisture content, grain size distribution, consistency (Atterberg) limits, and point load strength and uniaxial compressive strength. In addition, 3 selected soil samples were taken to Entech for corrosivity tests, and chemical analyses for the inorganic parameters listed in the 1997 MOEE Guidelines for Use at Contaminated Sites in Ontario, and for leachate tests (inorganic parameters) for classification under Ontario Regulation 558/00. The results of the moisture content, unit weight and Atterberg limits tests are summarized on the borehole logs, and the results of the grain size analyses are shown on Figure Nos. 1 to 4 in Appendix C. The tables in Appendix D summarizes the results of the point load tests on the rock cores. The results of the chemical and corrosivity tests are shown in the tables in Appendix E of this report.

After drilling the boreholes, piezometers were installed in the holes at selected locations to monitor the groundwater conditions. The water levels in the piezometers were read several time after drilling until they had stabilized.

All the boreholes were backfilled with the soil cuttings after drilling.

As part of the investigation, a preliminary Environmental Site Assessment of lesser scope than a Phase 1 ESA was carried out. This consisted of a brief visual examination of the properties adjacent to the proposed route of the feedermain to identify existing gas stations and other businesses which could potentially cause soil/groundwater contamination. We have also briefly reviewed available tenancy and ownership records for those properties. The results of the preliminary ESA are presented in Appendix F.

4. Subsurface Conditions

The boreholes in this section of the feedermain encountered a variety of soil types including fill, glacial deposits, sand and shale bedrock. The glacial deposits can be further sub-divided into cohesive (silty clay to clayey silt) till, and non-cohesive (sandy silt to silty sand) till. The cohesive tills are found mostly on Heart Lake Road south of Clark Boulevard. The non-cohesive tills predominate in Clark Boulevard and the south end of West Drive. Sand forms the majority of the soil profile in the north end of West Drive and south of Queen Street. The relevant properties of the various soil deposits are briefly described in the following paragraphs. For details of the subsurface conditions encountered at the borehole locations, reference should be made to the borehole logs, Drawing Nos. 1 to 24 and 26, in Appendix B of this report.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during the drilling. These boundaries are intended to reflect transition zones, for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Description" preceding the borehole logs are an integral part of and should be read in conjunction with this report.

4.1 Fill

Fill was found in about one-half of the boreholes spread throughout the project area. The composition of the fill materials is quite variable, being a heterogeneous mixture of sand to clay with a trace to some gravel. Some of the fill materials are relatively free from organics and construction debris, while in some boreholes, a trace to some topsoil, rootlets and other organics were found. In a few boreholes, the fills also contain traces of asphalt.

The thickness of the fill in the boreholes ranged from 1.1 to 5.6 m. The greatest amount of fill was found in Boreholes 8 (3.7 m), 9 (3.0 m), 10B (2.6 m), 11 (3.7 m), 13 (5.6 m) and 15 (2.8 m). In the other boreholes, the thickness of the existing fill materials is mostly less than 2.5 m. It is possible that a greater depth of fill materials could be found in between the boreholes, particularly where there are existing underground utility trenches near to the proposed feedermain alignment.

The standard penetration blow counts (SPT 'N' values) of the fill materials vary from 6 to 45 blows per 0.3 m. Its moisture contents range from 5 to 24%.

4.2 Silty Clay to Clayey Silt Till

These deposits were encountered in Boreholes 1 to 10B inclusive, 12, 14 and 16. It is usually found at ground surface or under the existing fills, and extends to the top of the shale bedrock. They are about 7 m thick in Boreholes 1 and 7, but are otherwise about 1 to 3 m

thick. These are well graded deposits containing gravel to clay size particles in which silt and clay dominate. The results of four grain size analyses indicate that these deposits are composed of 4 to 16% (average 8%) gravel, 20 to 35% (average 26%) sand, 40 to 50% (average 45%) silt, and 18 to 26% (average 21%) clay. Grading curves of the silty clay to clayey silt till are shown in Figure 1 in Appendix C of this report. These materials also contain some boulders and some sand seams.

Standard penetration blow counts ('N' values) of 10 to over 100 blows per 0.3 m were recorded in the tills, suggesting firm to hard, but mostly stiff to hard, consistency. The natural moisture contents of the tills are between 8 and 21%. Their liquid limit, plastic limit, and plasticity index are 23 to 41%, 16 to 23%, and 7 to 18, respectively.

4.3 Sandy Silt to Silty Sand Till

These materials form the majority of the soil profile in Boreholes 17 to 20 on West Drive, and were also contacted in Boreholes 1,7,9,10A to 13, 15, 21, 22 and 26.

The results of six grain size analyses indicate that these materials are composed of 5 to 22% gravel, 40 to 50% sand, 30 to 45% silt, and 3 to 10% clay. They also contain some boulders. Grading curves of these materials are shown in Figure 2 in Appendix C.

SPT 'N' values of 13 to over 100 blows per 0.3 m indicate compact to very dense, but mostly dense to very dense conditions. The natural moisture contents of the till range from 7 to 15%.

4.4 Sand

Sand was found in Boreholes 19 to 23 and 26, south of Queen Street. In BH 22, it extends from ground surface to 11.6 m depth (interbedded with a 0.9 m thick layer of silt), and is underlain by silty sand till. In the other boreholes, it was found generally at 2 to 3.7 m depth, and about 3.3 to 8 m thick. This deposit can range from silty fine sand, to gravelly sand.

Figure 3 in Appendix C shows the grain size curves of the sand, which are composed of 84 to 87% sand, 10 to 13% silt, and 3% clay. The natural moisture contents of the sand deposits vary from 2 to 18%. Some of the sand samples are saturated.

The sands are in a loose to very dense state, as indicated by 'N' values of 1 to over 100 blows per 0.3 m. It is dense to very dense in Boreholes 19, 20, 23 and 26. The very low blow counts in Boreholes 21 and 22 could have been affected by the hydrostatic pressure in the sand. A dynamic cone test performed next to BH 21 suggests that the sand from 2 m below the surface of this deposit is dense to very dense.

4.5 Shale Bedrock

Shale bedrock was encountered in every borehole except Boreholes 7, 19 to 23, and 26, where the boreholes were terminated before penetrating into the shale. The depth to rock ranges from 2.1 to 8.5 m. In terms of elevation, the surface of the rock varies from 209.8 on Clark Boulevard, to 193.6 at the south end of Heart Lake Road. It should be noted that the surface of the shale is not well defined. This is because that the materials immediately above the rock are hard, and also contain shale fragments, whereas the top of the shale is often highly weathered and weak.

The shale at the site is an Upper Ordovician gray shale belonging to the Georgian Bay Formation. It is generally a weak to strong shale which contains some limestone stringers. In the boreholes, it was possible to auger into the shale for up to 6.4 m without encountering refusal.

In Boreholes 2, 5, 8, 10A and 12, the rock was cored using NX size core barrel for 3 to 7.6 m. The total recovery ranged from 50% near the rock surface, to 100% at depth, and the RQD (Rock Quality Designation) was 0 to 83%. The percentage of hard layers (siltstone and limestone) in the recovered rock cores varies from about 6% to 82%.

The shale is horizontally bedded with numerous near horizontal fractures. The spacing of the fractures is generally less than 300 mm. The fracture index (number of fractures per 0.3 m) of the shale is between 2 to 6. A few near vertical fractures were also found in the rock cores, but the actual frequency of vertical fractures in the rock mass is expected to be higher.

In general, the upper 1 to 1.5 m of the shale is highly to completely weathered. At greater depth, the degree of weathering changed to moderate to slight. In many boreholes, the materials recovered from the surface of the shale (by using a split spoon sampler) resemble hard clay till. Some of the shale samples near the surface were wet.

Point load tests were performed on suitable core samples, and the results (summarized in Appendix D) ranged from as low as 0.6 MPa for the shale to 124 MPa for the limestone. Published data indicates that the uniaxial compressive strength of the rock can be estimated by multiplying the point load strengths by 24.

Uniaxial compression tests were performed on four pieces of rock core, with results ranging from 58.0 to 93.1 MPa. These results represent the strength of the harder siltstone and limestone layers. Due to the fractures in the rock, the overall strength of the rock mass could be much lower.

No slake durability test was done, but the shale is known to deteriorate (sometimes rapidly) upon exposure to the atmosphere.

4.6 Groundwater Conditions

The groundwater levels in the open boreholes were observed during and upon completion of drilling. In addition, piezometers were installed in 12 boreholes at creek, highway and railway crossings, to allow for longer term observation. The water levels in the piezometers were read several times after installation, until a stabilized water level had been recorded.

The groundwater conditions observed in the open boreholes are summarized in Table 3 below.

Table 3 - Groundwater in Open Boreholes

Borehole	Water Depth, m	Water Elevation, m	Caved Depth, m	Caved Elevation, m
1	9.9	190.8	10.7	190.0
2	1.7*	199.0*	Open	-
3	5.5	196.3	19.8	181.0
4	6.6	198.4	Open	-
7	Dry	-	7.6	206.9
13	11.0	206.5	Open	-
14	6.7	205.5	Open	-
15	6.1	206.4	6.4	206.1
17	Dry	-	Open	-
18	2.1	212.0	3.0	211.1
19	5.9	210.6	6.2	210.3
22	5.9	212.3	6.2	212.0

* due to water used for coring

The groundwater levels observed in the open boreholes may not represent the true groundwater conditions due to the short period of observation, the low permeability of the site soils, and possibly surface water infiltration.

The results of the piezometer readings are summarized in Table 4 below. Based on the piezometer readings, the groundwater at the site varies from about Elevation 212 m at the north end to about 206 m at the south end. In the long term, some fluctuation of the groundwater table is expected.

Table 4 - Summary of Groundwater Conditions in Piezometers

BH No.	Date Installed	Water Level			Remarks
		Final Reading	Depth (m)	Elevation (m)	
5	06.11.2002	03.12.2002	2.1	206.7	
6	31.10.2002	03.12.2002	2.2	207.4	
8	01.11.2002	03.12.2002	3.0	210.9	
9	21.10.2002	03.12.2002	5.3	208.7	
10A	30.10.2002	03.12.2002	2.8	211.8	
10B	01.11.2002	03.12.2002	4.7	210.3	
11	04.11.2002	03.12.2002	4.5	212.5	
12	30.10.2002	03.12.2002	2.2	210.9	
15A	28.11.2002	03.12.2002	6.6	204.7	
16	29.10.2002	03.12.2002	2.5	209.4	
20	29.11.2002	03.12.2002	5.9	212.0	
21	26.11.2002	03.12.2002	7.7	210.8	
24	03.12.2002	06.12.2002	2.6	212.0	
26	26.11.2002	03.12.2002	8.2	210.4	

4.7 Gas Monitoring Results

In eighteen boreholes, a portable methane gas probe was lowered into the hole after taking the third or forth sample. No methane gas was detected in any of the boreholes.

4.8 Results of Preliminary Environmental Site Assessment

The results of the preliminary environmental site assessment are presented in Appendix F of this report. The assessment identified petroleum stations located on the south east corner of Clark Boulevard and West Drive, and on the south east corner of West Drive and Queen Street. In addition, auto parts businesses and brick and glass manufacturing facilities were found, mostly along West Drive. However, the boreholes in that area did not encounter any contaminated or suspicious soils.

Three soil samples, one each from Boreholes 2, 5 and 15, were sent to Entech for corrosivity tests, and chemical analyses for the inorganic parameters listed in the MOEE Guidelines for Use at Contaminated Sites in Ontario (revised February 1997), and for leachate tests (inorganic parameters) for classification under Ontario Regulation 558/00. The results are summarized in the tables in Appendix E. For all the parameters tested, the levels in the soil samples are below those listed in Table A of the MOEE guideline. Furthermore, the results are well below the Schedule 4 (O.R. 558/00) concentrations. Based on these results, the soils can be re-used on site or be disposed of at any landuse sites accepting fill materials.

The results of corrosivity tests on three soil samples indicate that they are non corrosive towards cast iron, steel or concrete.

Part B
Discussion & Recommendations

5. Discussion of Results

5.1 Engineering Evaluation of Subsurface Conditions

In summary, a variety of materials were encountered in the boreholes, including fill, cohesive and non-cohesive tills, sand, and shale bedrock. Although **fill** was encountered in many boreholes, and the fill materials are quite variable, it should have little impact on the support of the feedermain since the thickness of the fill is mostly less than 4 m. The existing fill materials contain some topsoils and traces of asphalt, but are not contaminated based on the results of a limited number of tests. It should be possible to reuse the fill materials for backfilling in areas where good compaction is not required, or dispose of them in any suitable landfill site.

The native **tills** are expected to behave in a similar manner as far as feedermain support and stability in open cuts are concerned. These soils are generally very stiff to hard or dense to very dense, and should provide excellent support for the feedermain pipes. These deposits are well graded, and contain a significant amount of clay size particles, which give the soils an apparent cohesion and low permeability. These soils are expected to remain temporarily stable in an open trench excavated in accordance to the Occupational Health and Safety Act. Seepage through these materials are expected to be minimal (clay till) to moderate (silty sand till), except where there are thick sand seams in the tills. These soils contain boulders and the excavation contract should allow for boulder removal.

For tunnel construction, the cohesive tills and the non-cohesive tills are expected to behave slightly differently. In Terzaghi's Classification for Soils in Tunneling, the **silty clay till** and the **clayey silt till** are classified as hard or firm. In general, these materials should have sufficient standup time (hours to days) at the face of a tunnel for hand mining operation. The crown of a tunnel in these materials should be supported at all times.

The **sandy silt** and the **silty sand tills** are classified as firm, slow ravelling or fast ravelling in Terzaghi's tunnel classification, depending on the fines content in the soils and the position of the groundwater table. Where the water table is below tunnel invert, these materials should be temporarily stable at the face of a tunnel. On the other hand, if groundwater level in high, a tunnel in these materials may require immediate full face support. The crown of a tunnel in these materials should be supported at all times. These soils contain boulders which may require hand removal, and could slow the tunneling process.

At the north end of West Drive, **sand** forms the majority of the soil profile in Boreholes 20, 21, 22, and 26. The sands are mostly dense to very dense, and should provide good support for the feedermain, provided that they are not disturbed. However, the sand is cohesionless and is below the groundwater table. Therefore the sand would not be stable in either open cut or at the face or unsupported crown of a tunnel. Where sand is encountered in a trench, caving conditions would develop. In a tunnel, running or flowing conditions would occur. In

order to maintain stability, the sand materials will have to be stabilized. One of the often used means of stabilization is temporary dewatering. In the areas where open trench installation is expected, it should be possible to dewater the sands using deep sumps, wells, or well points, depending on the depth of the sand layer, and the amount of drawdown required. Provided that the drawdown is not more than 4 m, the temporary dewatering should not cause significant settlements of the nearby roads, utilities, and structures, but this should be reviewed before construction begins. As an alternative to dewatering, open trenches could be excavated within interlocking sheeting, and tunneling could be accomplished with either earth pressure balance (EPB) shield, slurry shield, or grouting. Further discussion of the applicability of the various construction methods is presented in Section 5.3 of this report. The excavated sand materials would be too wet to be reused for backfilling. They should be stockpiled and allowed to drain, or be mixed with dry, non-clayey fill materials before reusing.

Along most of the feedermain on Heart Lake Drive and Clark Boulevard, the pipe is expected to be founded in **shale bedrock**. Pipe support on even highly weathered shale should be satisfactory. The thickness of the bedding material under the feedermain pipe should be at least 300 mm in order to avoid unyielding support condition. Although the shale at the site is classified as a weak rock, it is still much stronger than the overburden materials, and considerable higher effort will be needed to excavate the shale. Tunneling in the shale is feasible using either hand mining or tunnel boring machines (TBM). In the more weathered shale, immediate primary support will be required for the tunnels.

The shale is not a durable material, and deteriorates when it is exposed to the atmosphere, particularly in the presence of groundwater, rain or snow. If the shale is exposed for an extended period of time, it could disintegrate, become clay like, and lose its support for the feedermain. If that occurs, it may be necessary to cover the surface of the shale with a skim coat of lean concrete shortly after it is exposed.

It should be noted that the drilling and sampling methods used do not allow the recovery of large cobbles or boulders. Experience indicates that boulder of 300 mm or smaller are very common in the glacial deposits, and boulders of 600 mm or larger have been found. The construction methods, particularly those that do not involve open cut, should allow for the removal of boulders.

5.2 Pipe Support and Bedding

Most of the materials encountered in the boreholes should provide good support for the feedermain, which should be bedded on granular materials meeting the OPSS or its equivalent for the Regions of York and Peel. If fill materials are found at pipe level, the fills should be visually inspected. Unsuitable fills should be re-excavated and replaced with clean fills or pipe bedding materials.

Pipe bedding materials should be well graded. If clear stone or other poorly graded materials are used as pipe bedding, they must be completely wrapped with a filter fabric.

5.3 Rock Squeeze

The shale in southern Ontario is known to experience lateral stresses higher than the vertical stress due to the weight of the shale and the overburden materials. When the shale is excavated, the horizontal rock stresses are partially dissipated due to elastic expansion of the rock. However, after the initial elastic expansion, the rock will continue to creep and move towards the face of the excavation. If a structure is constructed tight against the rock before the creep movements are completed, it could be subjected to very high and potentially damaging stresses. Theoretically the stresses on the structure could be calculated based on the insitu rock stresses, the rheological properties of the rock mass, and the time delay between excavation and structure placement. Since the first two factors cannot be determined with any degree of accuracy, a more practical approach is to avoid the overstressing of the structure by either allowing sufficient time for the creep movements to occur, or to incorporate a layer of compressible materials between the shale and the structure. The high lateral stresses tend to have been released near the top of the bedrock and this relief has caused most of the vertical jointing that is encountered in the top about 1.5 m of the rock.

Theoretical calculations suggest that in sound rock it could take a long time for the creep movements to complete. Where the feedermain will be more than 1.5 m into the rock, we recommend that the lateral movement of the rock be monitored during construction. It should be possible to verify the rate of the rock creep movements by installing inclinometers adjacent to the excavations and monitor them for one to two weeks. If the results indicate little to no movement, the feedermain can be backfilled normally. Should there be insufficient time for monitoring, or the results indicate substantial movements, a layer of compressible material should be placed between the rock cut face and the bedding or backfill materials around the feedermain. A layer of compressible foam up to 100 mm should be adequate for this purpose.

Since the tunnels are expected to be deeper into rock, there is a greater risks of structural damage due to rock squeeze. Nevertheless, the movement monitoring approach can also be applied to the tunnels, as part of the performance monitoring which will be required by MTO and CN for the crossings under Highway 410 and the CN railway.

5.4 Construction Conditions

The following discussion is for the benefit of the designer so that the anticipated construction conditions can be taken into consideration in the design of the feedermain. It is not meant to pin point all potential construction problems. Some of the boreholes are more than 200 m apart, and may not have exposed all conditions relevant to construction. The contractors bidding for the construction of the feedermain are urged to select the appropriate construction method and equipment based on their own experience with similar projects. If necessary, the

contractor should carry out additional investigation to clarify the subsurface conditions and resolve any construction related issues.

5.4.1 Open Trench Construction

No unusual construction conditions are expected for open trenches excavated in the native tills. The trenches should be temporarily stable when excavated according to OHSA. For the purpose of OHSA, the glacial till deposits can be classified as Type 2 soils. Groundwater seepage through these materials is expected to be minimal to moderate, except where there are major sand seams in the tills. It should be possible to handle the seepage by gravity drainage and pumping with filtered sump pumps. If space limitation does not allow the trench to be excavated to the required angle, the side walls of the trench should be supported by shoring, which should be designed for the lateral earth and water pressures given in Section 6.3 of this report.

Sand is expected in the north half of West Drive. The sand below the water table is classified as Type 4 soils. OHSA states that support (i.e. shoring) is not required for 3H:1V excavation in Type 4 soils. However, even at this very gentle angle, caving conditions would develop since the sand and the sand will be below the groundwater table at pipe level. To maintain stability, this soil should either be temporarily dewatered, or be supported by interlocking sheeting. It should be possible to dewater the sands using deep sumps, wells or well points, with proper filtering. For well points, it may be necessary to lower the header pipe in order to be effective.

For the purpose of OHSA, the existing fill materials may be classified as Type 3 soils. It should be noted that if an excavation is made in more than one soil type, the soil shall be classified as the type with the highest number.

Bedrock excavation is expected along most of the feedermain on Heart Lake Road and Clark Boulevard. It should be possible to excavate the shale by heavy hydraulic excavators equipped with rippers and/or rock buckets, but progress would be slower than in overburden. Where thick slabs of limestone are encountered, it may be necessary to break down the rock with a hoe ram or pneumatic jacks. The more weathered shale in the upper about 1.5 m should be should be temporarily stable at 45 degrees to the horizontal. Slightly weathered to fresh shale may be cut to near vertical, provided any loose blocks are scaled off, or stabilized with rock bolts or shotcrete. Some groundwater seepage is expected in the upper part of the shale which is often highly weathered, fractured or both. The water seepage should not affect excavation stability, however, and pumping from sumps should be adequate to handle the seepage.

5.4.2 River, Railway and Highway Crossings

General

The feedermain will cross a number of rivers, railways and highways using trenchless technology. The anticipated subsurface conditions at the crossings are summarized in Table 5.

Table 5 - Anticipated Subsurface Conditions at Crossings

Location	Proposed Invert Elev. (m)	Invert Depth (m)	Approx. Length (m)	BH	Expected Soil Type at Pipe Level	Groundwater Elev. (m)
CN Rail on Heart Lake Road	199.3	9.5 - 10.5	30	5,6	Silty clay/clayey silt till in upper half, shale in lower half	206.7 to 207.4
Water course on Heart Lake Road	204.3	9.8	16	8,9	Shale	208.8 to 210.9
Highway 410	201.5 - 201.7	5.6 - 10.5	153	10A, 10B, 11, 12	Shale	210.2 to 211.9
Clark Boulevard	204	7.6 - 7.9 (5.0 at creek)	35	15A, 16	Shale (Clayey silt till at crown)	209.5
West Drive	209.2 - 209.3	8.1 - 9.3	114	20, 21, 26	Sandy silt to silty sand till (Sand at crown)	212?

A number of trenchless techniques such as jacking and boring, micro tunneling, and conventional tunneling, are available for the installation of underground services. Considering the size of the feedermain, the tunnels for the crossings are expected to be about 3 m in diameter, for which conventional tunneling would be appropriate.

Traditional tunneling technique using tunneling shield with hand mining, or full face mechanical TBM can be used for this project. Hand mining is suitable in stable ground, and may also be used to tunnel through sand and silt provided that these materials can be stabilized ahead of the tunneling operation. Stabilization could be accomplished by dewatering, grouting, or freezing. Compressed air can also be used within a tunneling shield to balance the hydrostatic pressure. In stable soil in which large boulders are expected, hand mining is often preferable to other methods. Where soil stabilization is not feasible or practical, TBM's with full face support and EPB (earth pressure balance) shields or slurry shields may be used. TBM's in the range of 2400 to 3600 mm diameter are available in Ontario, however, only a few TBM's are equipped with EPB shields. Compressed air may also be used in conjunction with a TBM to counter balance the water pressures. Using compressed air will require air locks and other safety equipment and personnel, and the rate of production could be affected depending on the magnitude of the air pressure above atmospheric. Regardless of the tunneling method used, a primary support system, such as steel ribs with timber lagging, segmental steel or concrete liner, will be required.

CN Rail Crossing

At this location, Boreholes 5 and 6 encountered 1.1 to 2.5 m of fill, underlain by 2.4 to 3.1 m of silty clay till, which is in turn underlain by shale bedrock. At its presently proposed elevation, the crown of the tunnel should be about 2 m into shale. The face of the tunnel should be sufficiently stable, but the crown of the tunnel may require full and immediate support since the surface of the rock is highly weathered. In our opinion, it should be feasible to advance the tunnel using a tunneling shield with forward hood, and hand mining, or with a full face TBM with appropriate rock cutting teeth. The primary support could be steel ribs with timber lagging, which is sufficiently flexible for the creep movement of the shale to occur.

Piezometers installed in the shale recorded groundwater level at about Elevation 206.7 to 207.4 m, or about 4.7 to 5.4 m above the crown of the tunnel. During tunnel construction, some groundwater seepage is expected, but the rate of seepage should be slow to moderate. It should be feasible to handle the flow by sump pumps. A 1% grade for the tunnel should greatly facilitate the removal of the groundwater.

With good workmanship, we estimate that the settlement of the rails should be less than 10 mm.

As the tunnel will be in shale, allowance should be made to provide a layer of compressible materials between the rock and the permanent liner, as discussed above. The thickness of the compressible materials should be 100 mm, and the diameter of the tunnel should be sufficiently large to accommodate the compressible materials and the primary and permanent liners. If monitoring shows that the actual creep rate of the rock is insignificant, the compressible materials may be omitted.

Water Course Crossing

This crossing was investigated by Boreholes 8 and 9. The subsurface conditions at this crossing is similar to those at the CN crossing described above. The surface of the rock was found at El. 207.9 to 209.0 m. At its proposed elevation, the crown if the tunnel at the north end is only 0.9 into the shale. Since the upper part of the shale is highly weathered, and the clayey silt till on which the existing box culvert is founded may have been softened by seepage from the culvert, we recommend that the tunnel be lowered such that the crown is at least 1.5 m into the shale bedrock. The other comments for the CN crossing are also applicable for this crossing.

Highway 410

This tunnel is about 150 m long, and at its proposed elevation, its crown will be about 12.5 to 14.5 m below the highway. This tunnel could be mined using hand mining or with a TBM, within a tunnel shield.

Boreholes 10A to 12 put down at this location encountered up to 3.7 m of fill, underlain by sandy silt to silty sand till and clayey silt till. Shale bedrock was found at about 5 to 7 m depth. The crown of the tunnel as proposed is expected to be about 3.5 m below the surface of the rock. The upper 1.5 m of the shale is highly weathered and fractured, and immediate primary support will be required. The shale contains up to 65% of hard layers (siltstone and limestone). The design of the TBM should consider these hard layers.

With good workmanship, the highway should experience less than 10 mm settlement due to the tunneling work.

Clark Boulevard

At this location, the tunnel should be entirely in shale, which is overlain by hard clayey silt till. In our opinion, it should be feasible to advance the tunnel using a shield with a forward hood, and hand mining or TBM. The crown of the tunnel will be about 5.6 m below the railway spur line. With good workmanship, the railway should experience less than 10 mm settlement due to the tunnel construction. Other comments for CN crossing regarding primary support and groundwater seepage are also applicable to this crossing.

West Drive

After crossing West Drive, this tunnel will be extended to the east until it passes the Salvation Army building. The length of this tunnel will be about 110 m.

Boreholes 20, 21 and 26 put down at this location encountered about 2 m of fill, followed by sand to between 6.2 and 7.1 m depth, which is underlain by silty sand and sandy silt tills. The groundwater level in the piezometers, which were sealed in the silty sand and sandy silt tills, was at about El. 210.4 to 212.0 m, or about the spring line to crown of the tunnel. Judging from the moisture content of the sand, a perched water table existed in the sand at about 1 m above the proposed tunnel crown. At its proposed elevation, the crown of the tunnel will be in sand, which is a non cohesive material. Flowing condition will likely develop and the crown of the tunnel will not be stable unless the sand is stabilized. The face of the tunnel is expected to encounter sand, silty sand till and sandy silt till. Although the till deposits contain a substantial amount of soil fines, they are below the groundwater table, and past experience indicates that rapid raveling conditions could develop. Great care must be used in the construction of this tunnel or loss of ground, settlements, and damage to nearby structures and utilities could result.

Several methods may be used to overcome the problems of tunneling in the saturated sand, including stabilization of the sand by dewatering, or grouting, or use of a TBM with EPB shield to excavate the tunnel. One commonly used and effective means of stabilizing the sand is temporarily drawing down the water table during construction. Based on the results of a limited number of grain size tests for the sand, it should be possible to draw down the water using deep wells. A series of wells would be required on both sides of the tunnel to provide

sufficient drawdown. The wells should be properly filtered to avoid the removal of fine soil particles during pumping, and should be provided with backup power supply. Depending on the quantity of water to be extracted from the wells, it may be necessary to apply a permit for the dewatering works. Since the sand is dense to very dense, lowering the water table by a few metres should not cause significant settlements to nearby structures or utilities.

The glacial till deposits, on the other hand, cannot be easily dewatered or grouted. Dewatering of silty sand tills has met with only partial success, and it is our opinion that a TBM with full and immediate face and crown support will be required to maintain tunnel stability. Ground freezing could also be considered to stabilize the till deposits.

After stabilization, the sand and the glacial tills can be excavated with a TBM, but full and immediate primary support will still be required. Segmental steel or concrete plates may be used to serve as both primary and permanent lining. The space behind the liner plates should be grouted to minimize ground settlement.

Instead of stabilizing the sand, a TBM with a EPB shield could be considered to construct the tunnel. The forward chamber pressure should be sufficient to balance the earth and groundwater pressure at the time of construction. Since the soils are not dewatered, full and immediate support will be required behind the tunnel shield. One potential problem with EPB shield is that the till deposits contain boulders which may require hand removal.

Provided that flowing or running conditions do not occur, and with good workmanship, the construction of the tunnel should cause less than 10 mm settlements at ground level. Nevertheless, it is recommended that, prior to tunneling, a condition survey of the structures on both sides of the tunnel be undertaken, and that the actual settlements be monitored during construction.

The two access shafts for this crossing would encounter similar conditions. They will likely require stabilization of the sand, or full support using interlocking sheet piles or contiguous caissons, with shorings at suitable depth intervals. Conventional shoring system with soldier piles and timber lagging may be used after the sand is stabilized

5.5 Reuse of Excavated Materials

It should be possible to reuse most of the excavated sandy silt and silt sand till materials, and the non-organic fill materials, for backfilling. It should be feasible to compact these materials to a high density at their natural moisture contents. The excavated silty clay and clayey silt tills may also be reused, but some of these soils may be too wet for good compaction. It may be necessary to allow partial drying of these materials, or mix them with imported dry, non-clayey fills, before reusing. Fill materials with contain a significant amount of organic matter, and clayey native soils which are too wet to be compacted may be reused in areas where high compaction is not required.

In general, the excavated shale may also be reused, provided that there are no individual pieces larger than 200 mm. Preferably, the excavated shale should be mixed with soils before re-using. Where long term settlement is to be avoided, the shale materials should be placed in thin (150 mm) layers and compacted with a heavy vibratory roller. Since this may be difficult to achieve within a narrow trench, the shale should not be reused for backing the spaces between the pipes and the trench walls.

There may be excess materials which may require off site disposal. Based on the results of chemical tests on three samples of the materials recovered from the boreholes, the site soils may be re-used at any suitable landfill site or construction site for residential, commercial or industrial developments.

6. Recommendations

6.1 Soil Parameters

The parameters shown in Table 6 below may be used for the design of the feedermain and associated works.

Table 6 - Soil Parameters

Soil Type	Total Unit Wt., kN/m³	Effective		Ultimate Skin Friction Factor	
		Cohesion, kPa	Angle of Shearing Resistance	Soil/ steel	Soil/ concrete
Silty clay till, clayey silt till	22	2	28	0.25	0.3
Sandy silt till, silty sand till	22	0	33	0.35	0.40
Sand	21	0	33	0.35	0.45

6.2 Pipe Bedding

The feedermain pipes in trenches should be provided with granular bedding in accordance with OPSD 802.030 to 802.032, or the equivalent Peel and York Region standards. The bedding materials should be well graded, e.g. Granular 'A'. Clear stone bedding may be used provided that it is completely wrapped with a Class II non woven filter fabric with a filtration opening size of 100 microns or smaller.

Where fills are found at pipe level, the fill materials should be visually inspected. Unsuitable materials (materials which are wet, soft or highly organic) should be removed and replaced with suitable clean fills or bedding materials, which should be compacted to minimum 95% standard Proctor maximum dry density (SPMDD).

6.3 Earth Pressure

6.3.1 Temporary Shoring

Flexible strutted shoring for the temporary support of trenches and shafts should be designed for the lateral earth pressures given in Section 27.2 of the Canadian Foundation Engineering Manual (3rd Edition).

For sand, silty sand till, or sandy silt till, the earth pressure distribution shown in Figure 27.12 (a) of the CFEM should be used, with $K_A = 0.3$. Where it is necessary to limit the deflection of the shoring (e.g. near existing structures), the value of K_A should be increased to 0.5.

For silty clay till and clayey silt till, the pressure distribution shown in Figure 27.12 (c) may be used, with the maximum pressure being 0.25 $\sigma_{z=H}$. Where necessary, the maximum design pressure should be increased to 0.45 $\sigma_{z=H}$ to limit the deflection of the shoring.

Water pressure and surcharge loads should be taken into consideration as appropriate.

6.3.2 Drain Chambers, Deep Manholes

The relatively rigid concrete walls of drain chambers and deep manholes should be designed for the following earth pressure:

$$P = K \cdot \gamma' \cdot h + K \cdot q$$

where
P = earth pressure intensity at depth h, kPa
K = earth pressure coefficient = 0.5 for sand or granular backfill, or 0.55 for native backfill
γ' = effective unit weight of backfill
q = surcharge near wall, kPa
h = depth below level finished grade, m

Water pressure should be taken into consideration as appropriate.

6.3.3 Tunnel Liner

Tunnel liners in overburden soil should be designed for the following two situations:

1. Full overburden pressure, and lateral earth pressure as recommended in the preceding section of this report, with the modification that K should be taken as 0.35. The liner design should also consider full hydrostatic pressure.

2. Full radial pressure equal to $\gamma.z$, where γ is the total unit weight (kN/m^3) of the soil above the liner, and z is the depth (m) to spring line, plus the stresses due to a distortion equal to 0.5% of the diameter of the liner.

6.4 Rock Pressure

It is recommended that the actual creep rate of the rock be assessed by monitoring during construction. If the monitoring results indicate that most of the creep movements have taken place, compressible materials will not be required. However, if there is insufficient time for monitoring, or the results indicate significant on-going creep movements, the feedermain pipes where they are more than 1.5 m into rock, and the permanent tunnel liners should be

separated from the rock by a 100 mm thick layer of compressible materials such as expanded polyurethane foam.

Tunnel and shaft liners in rock should be designed for the lateral earth and hydrostatic pressure given in Section 6.3.3.

6.5 Thrust Blocks and Restraint Joints

Thrust blocks may be used to resist the unbalanced internal pressure in the feedermain in native soils or rock. The thrust blocks should be cast directly against undisturbed soil or rock. The allowable lateral bearing pressure can be taken as 200 kPa for shale. For thrust blocks constructed in soil, the ultimate lateral resistance can be taken as the passive pressure of the soil, plus the friction at the base of the thrust blocks. The passive pressure can be calculated using the equation in Section 6.3.2 above, and a K value of 3..4 and 2.8 for sandy silt to silty sand till, and silty clay to clayey silt till, respectively.

Restraint joints can also be used instead of thrust blocks. The friction coefficients and soil unit weights given in Table 6 above may be used for the design of the restraint joints, with appropriate reduction for submerged unit weight where the feedermain will be below the permanent groundwater table.

6.6 Cement Type

Based on the results of water soluble sulphate tests on three soil samples, the site soils are not corrosive towards concrete. Concrete in contact with site soils can be manufactured with ordinary Portland cement.

6.7 Backfill

Under roads, walkways, and other areas where long term ground settlement is not acceptable, the backfill materials should be placed in 300 mm loose lifts and compacted to minimum 95% SPMDD. The upper one metre of the backfill under the roads should be compacted to 98% SPMDD.

On Heart Lake Roads, the surface of the trenches should be provided with a pavement structure equal to that of the existing pavement. The approximate composition of the existing pavement is 100 to 250 mm asphalt on 380 to 500 mm granular base.

The existing granular road base materials often do not conform to OPSS Granular 'A'; nevertheless, for repair of the trenches, Granular 'A' base should be provided, which should be placed in 300 mm lifts and compacted to minimum 100% SPMDD.

6.8 Monitoring

During the construction of the feedermain at road, railway and highway crossings, monitoring should be carried out to verify the soil/rock behaviour, and to provide early indication of potential problems. The monitoring should include: groundwater level, if temporary dewatering is to be employed; ground and rail settlements; and movements of existing nearby structures. Pre-condition survey of the existing pavement and building structures should also be carried out prior to the start of tunneling. The monitoring program at each location should be determined after the method of installation, and the horizontal and vertical alignments of the liners have been decided.

For monitoring of the rock movement to determine if the compressible materials can be omitted, inclinometers should be installed at a short distance behind the liners and outside the trenches, to a depth below the liner inverts or bottom of the trenches. The inclinometers should be installed before construction begins.

6.9 Design / Construction Review

We recommend that the final design and the proposed construction method for all crossings be reviewed by Trow Consulting Engineers Ltd.

7. General Comments

Trow Consulting Engineers Ltd. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Trow Consulting Engineers Ltd. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, during the future development of the property, conditions not observed during this evaluation may become apparent; should this occur, Trow Consulting Engineers Ltd. should be contacted to assess the situation, and additional testing and reporting may be required. Trow has qualified personnel to provide assistance in regards to future geotechnical and environmental issues related to this property.

8. Closure

We trust that this report has provided all the necessary information for the design of the feedermain. Should you have any questions regarding this report, please do not hesitate to call the undersigned.

Trow Consulting Engineers Ltd.

James Ng, P.Eng., M.Eng., MICE
Senior Engineer
Geotechnical Division

Lloyd Gonsalves, P.Eng.
Vice President

Christopher Thompson, P.Eng.
Technical Director
Geotechnical Division

LICENSED PROFESSIONAL ENGINEER
C. D. THOMPSON
PROVINCE OF ONTARIO

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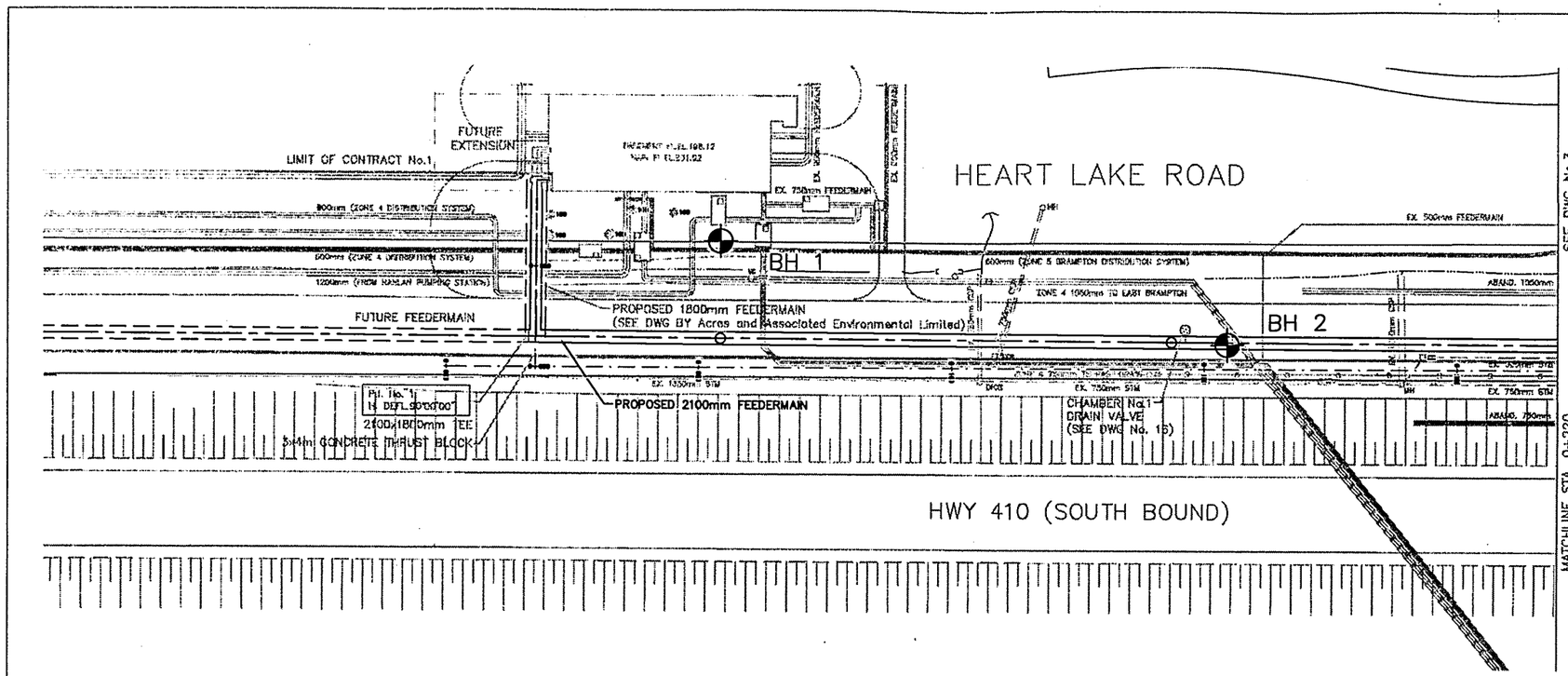
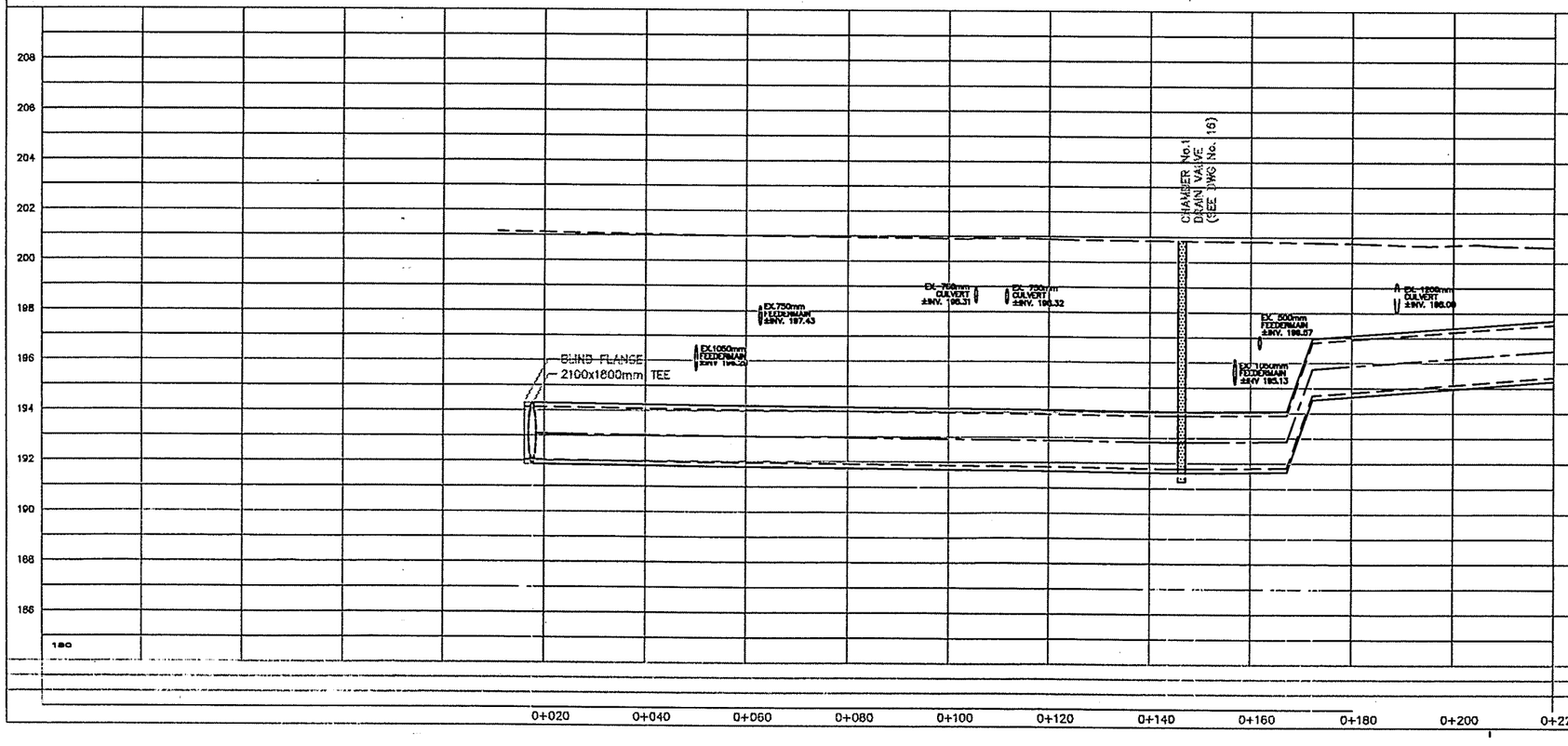
Appendix A:
Borehole Location Plans





SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
POLES & REG.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.

General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'B' Bedding Unless Otherwise Noted (SAND)

B.M. No. HH-179 Elev. 893.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

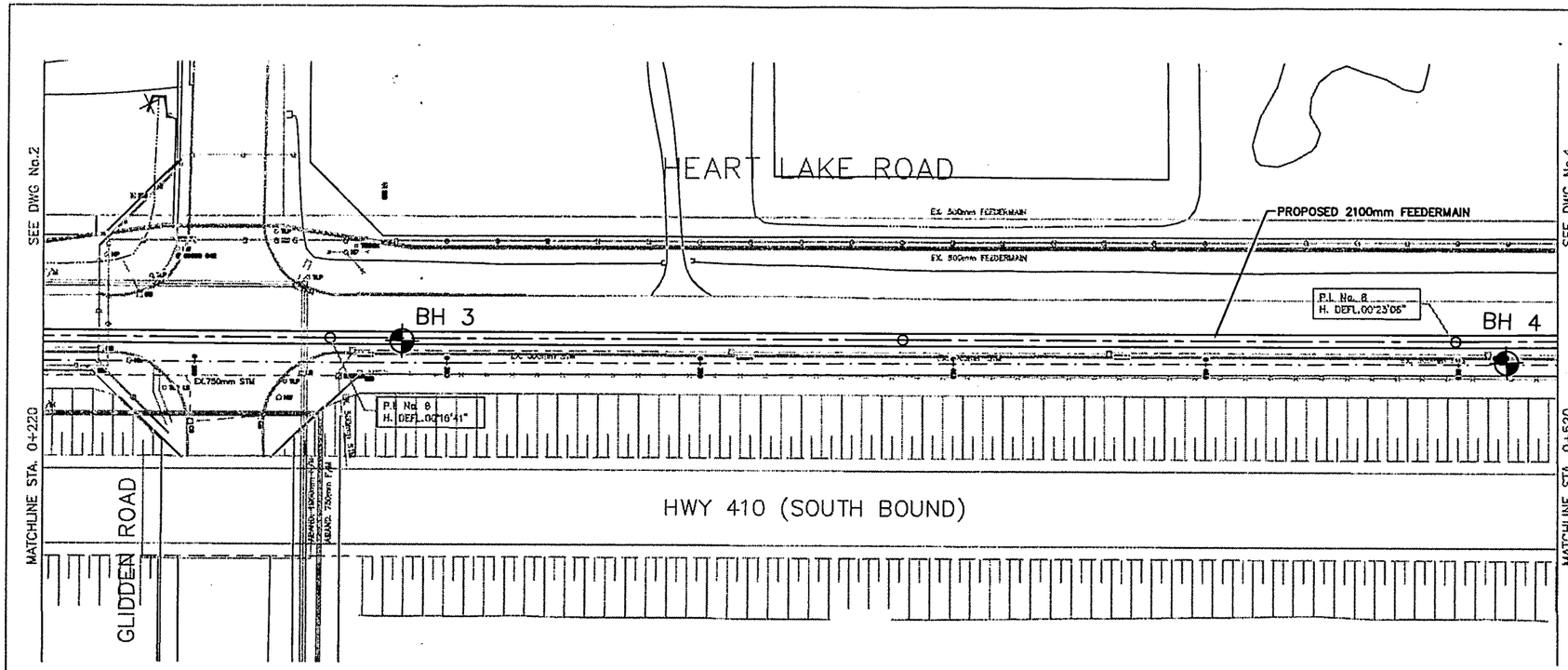
3m 0 2 4 6m VERTICAL SCALE

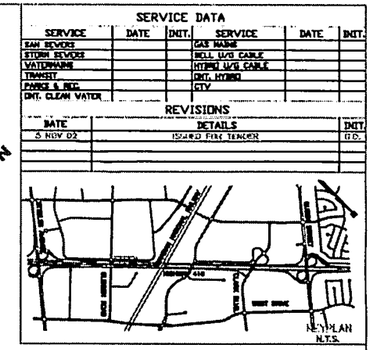
Region of Peel
Public Works

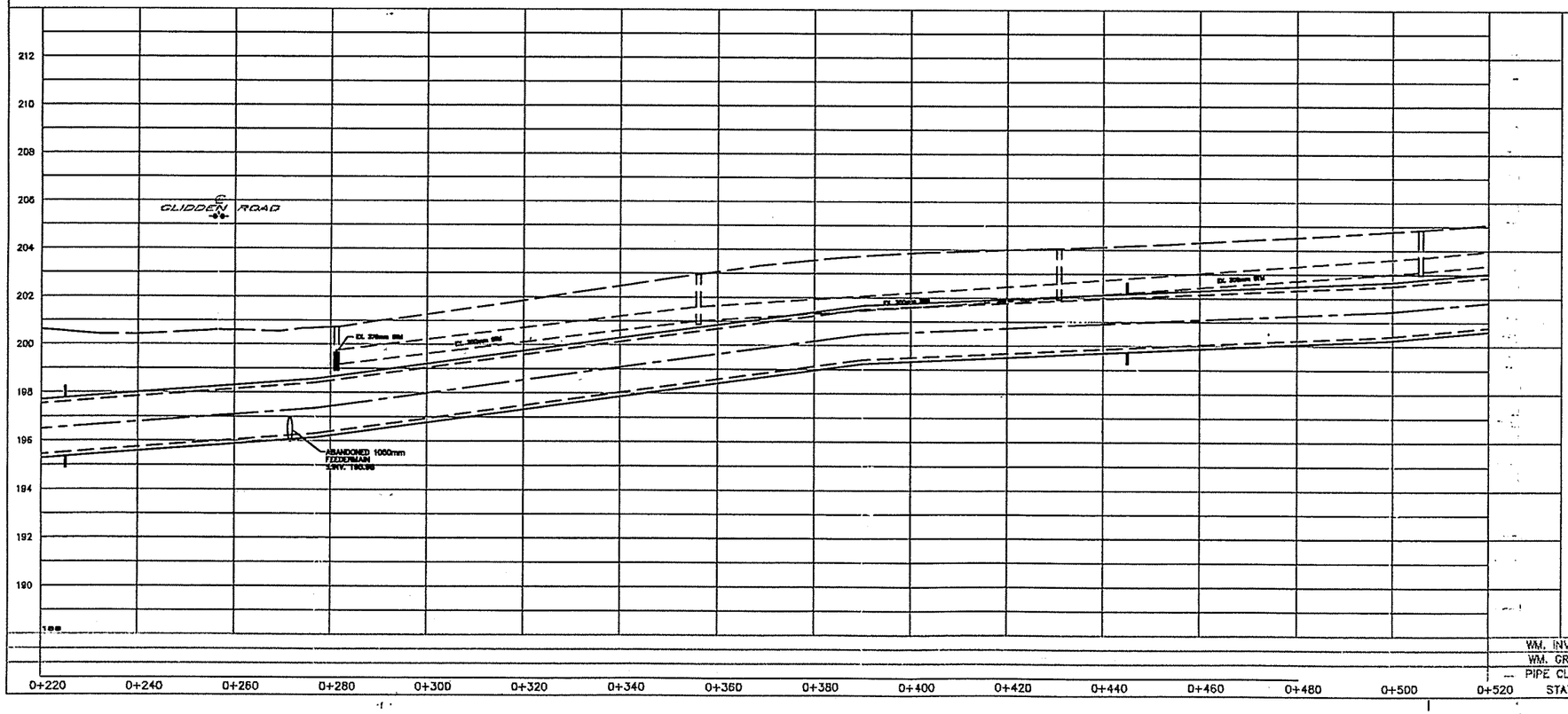
PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	Drawing No. L1







LEFT_MARGIN_#

General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Sewerbox Building - Not Located
- Sewerbox Building Located
- Type "B" Bedding Unless Otherwise Noted OPSD

B.M. No. HH-179 Elev. 253.382

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Trow Consulting Engineers Ltd.

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HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	L2

SEE DWG No.3

MATCHLINE STA. 0+520

HEART LAKE ROAD

SELBY ROAD

EX. 600mm WATERMAIN

EX. 600mm WATERMAIN

P.I. No. 11
H. DEFL 16°43'29"

P.I. No. 10
H. DEFL 16°25'44"

PROPOSED 2100mm FEEDERMAIN

CHAMBER No.2
1800mm BUTTERFLY VALVE
(SEE DWG No.17)

HWY 410 (SOUTH BOUND)

SEE DWG No.5

MATCHLINE STA. 0+820

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.

KEY PLAN
N.T.S.

LEFT_MARGIN_#

214 212 210 208 206 204 202 200 198 196 194 192

CHAMBER No.2 (SEE DWG No.17)

0+520 0+540 0+560 0+580 0+600 0+620 0+640 0+660 0+680 0+700 0+720 0+740 0+760 0+780 0+800 0+820

WM. INVERT
WM. GRADE
PIPE CLASS
STATION

General Notes

All Driveways ASPHALT Unless Otherwise Noted.
All Service Locations Are Approximate And Must Be Located Accurately In The Field
Service Building - Not Located
Service Building Located
Type 'B' Backing Unless Otherwise Noted CSA/O

B.M. No. HH-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

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NOTICE TO CONTRACTOR

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CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

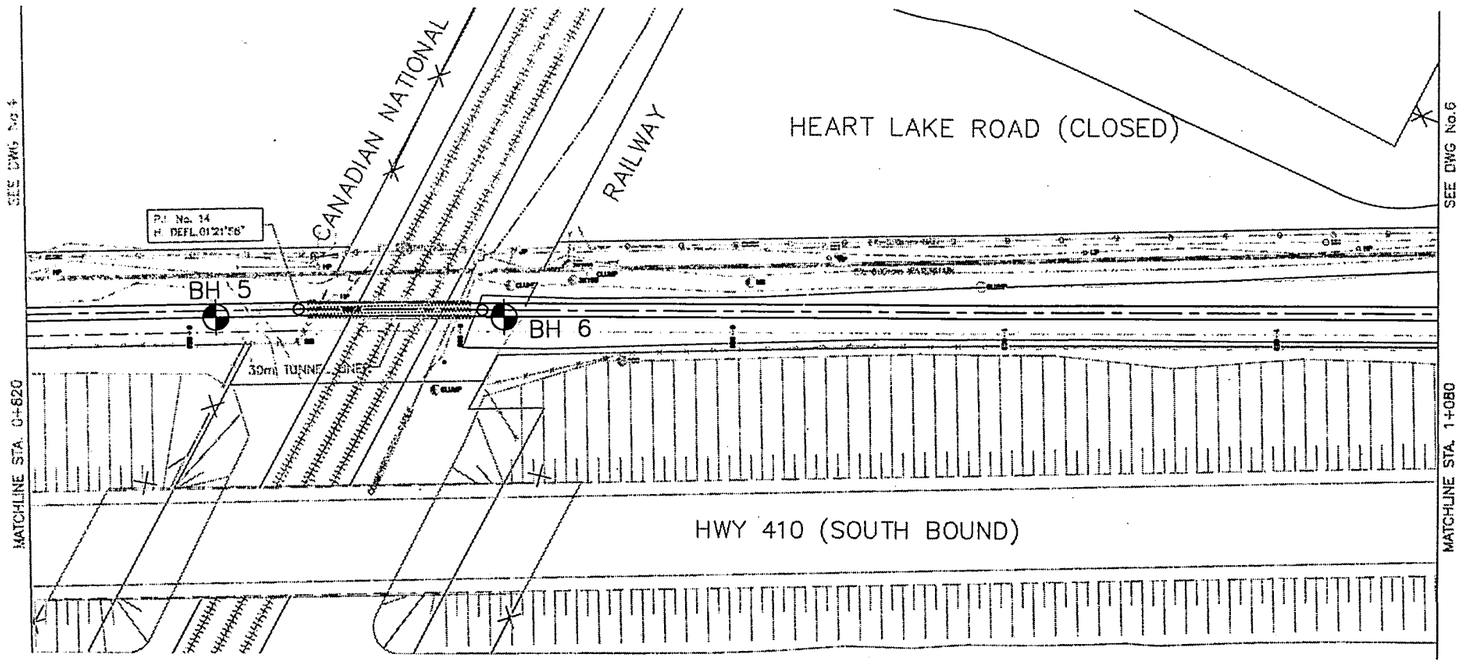
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	Drawing No. L3

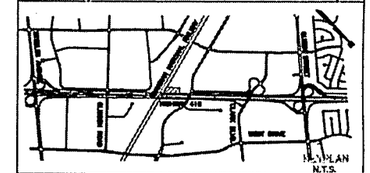


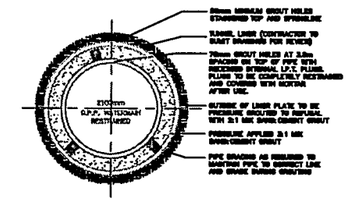
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			INT. HYDRO		
PARGE & REC.			CTV		
ENT. CLEAN WATER					

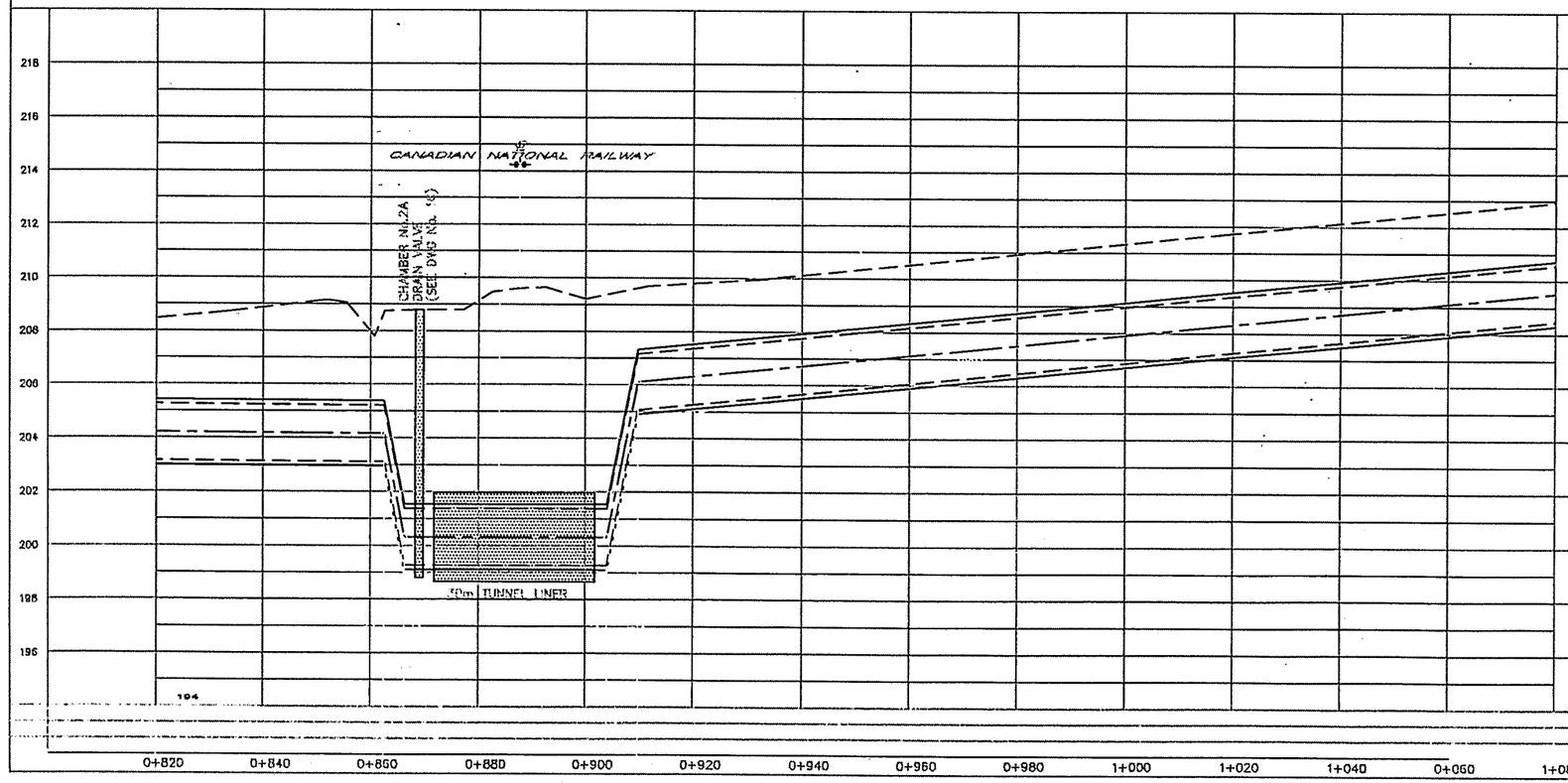
REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.





TUNNEL DETAIL



General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Service Building - Not Located
- Service Building Located
- Type 'S' Bedding Unless Otherwise Noted CLASS

B.M. No. 144-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field by Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

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CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

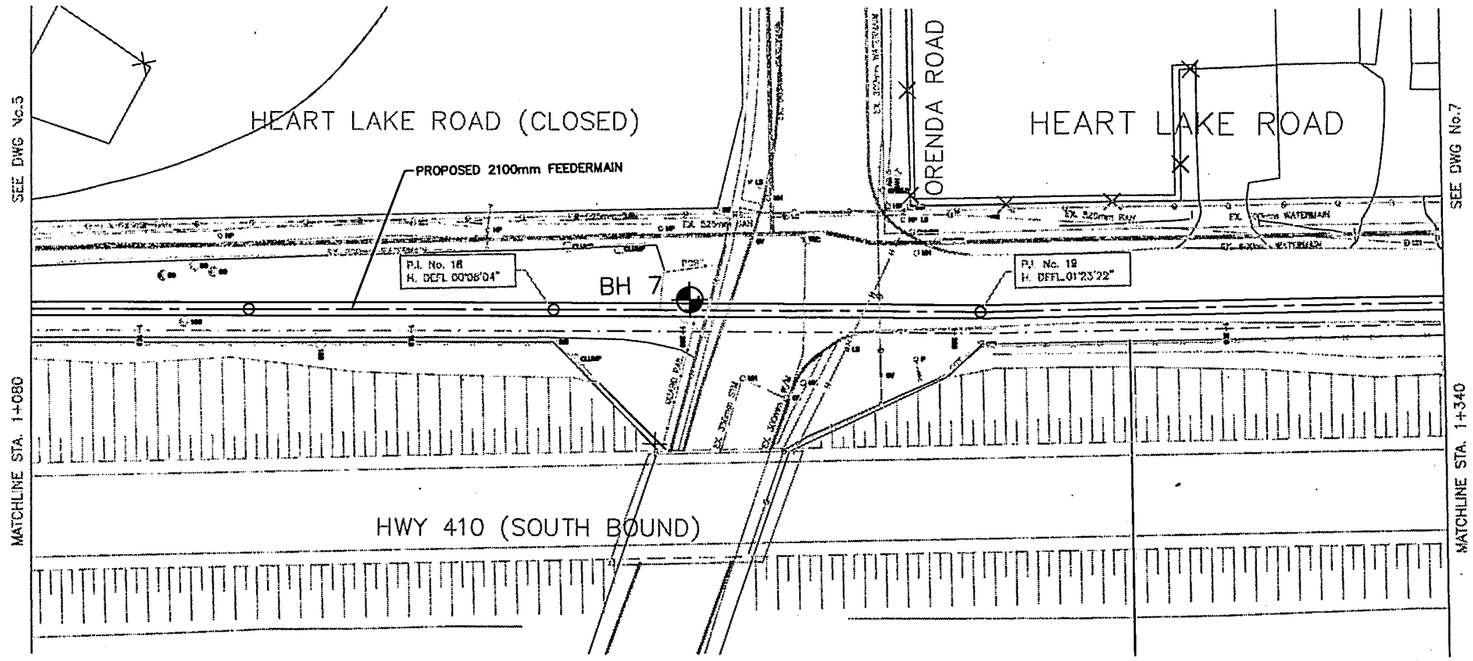
2m 0 2 4 6m VERTICAL SCALE

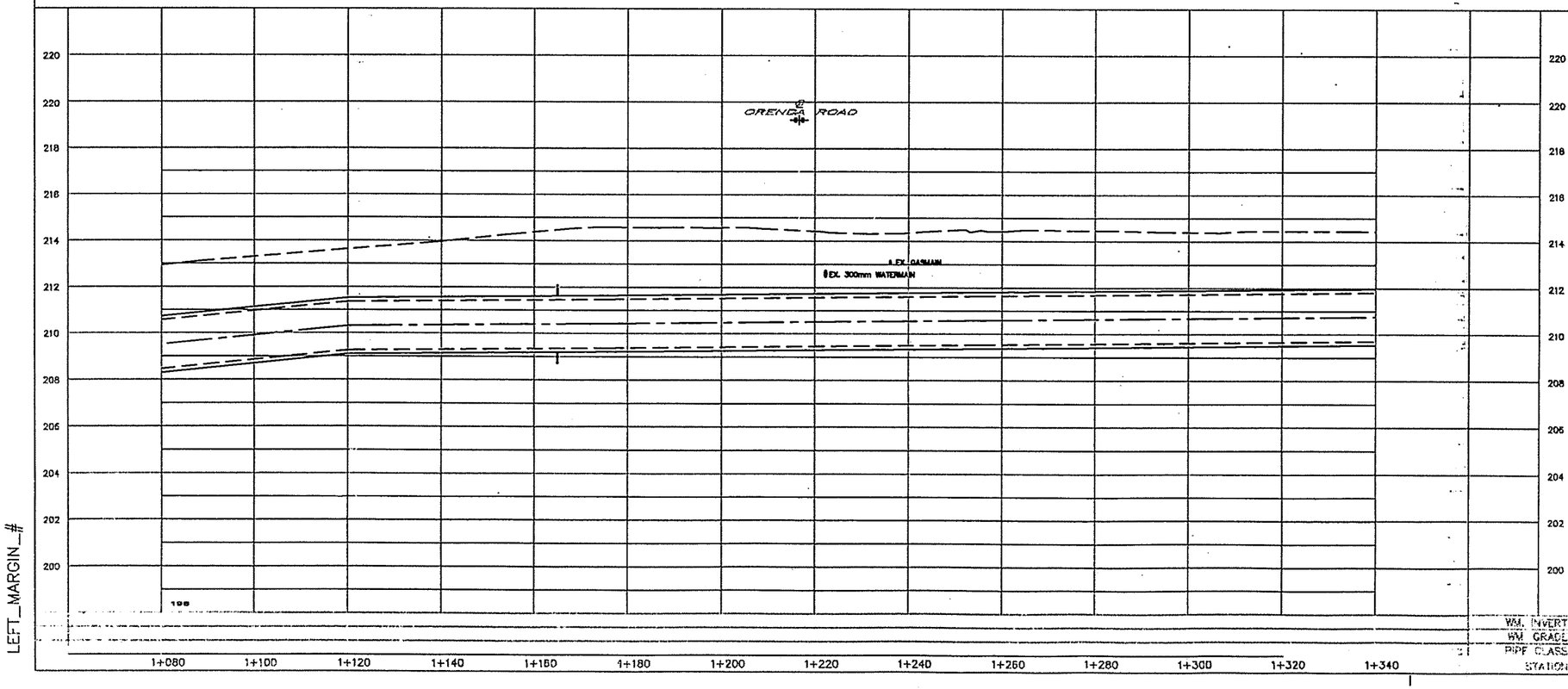
Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	
November 2002	brge0065425a	Drawing No. L4





SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.

KEY PLAN N.T.S.

General Notes

-- -- All Driveways ASPHALT Unless Otherwise Noted.
-- -- All Service Locations Are Approximate And Must Be Located Accurately In The Field.
● Denotes Building - Not Located
Denotes Building Located
Type "B" Bedding Unless Otherwise Noted OPSD

B.M. No. H4-179 Elev. 223.302

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

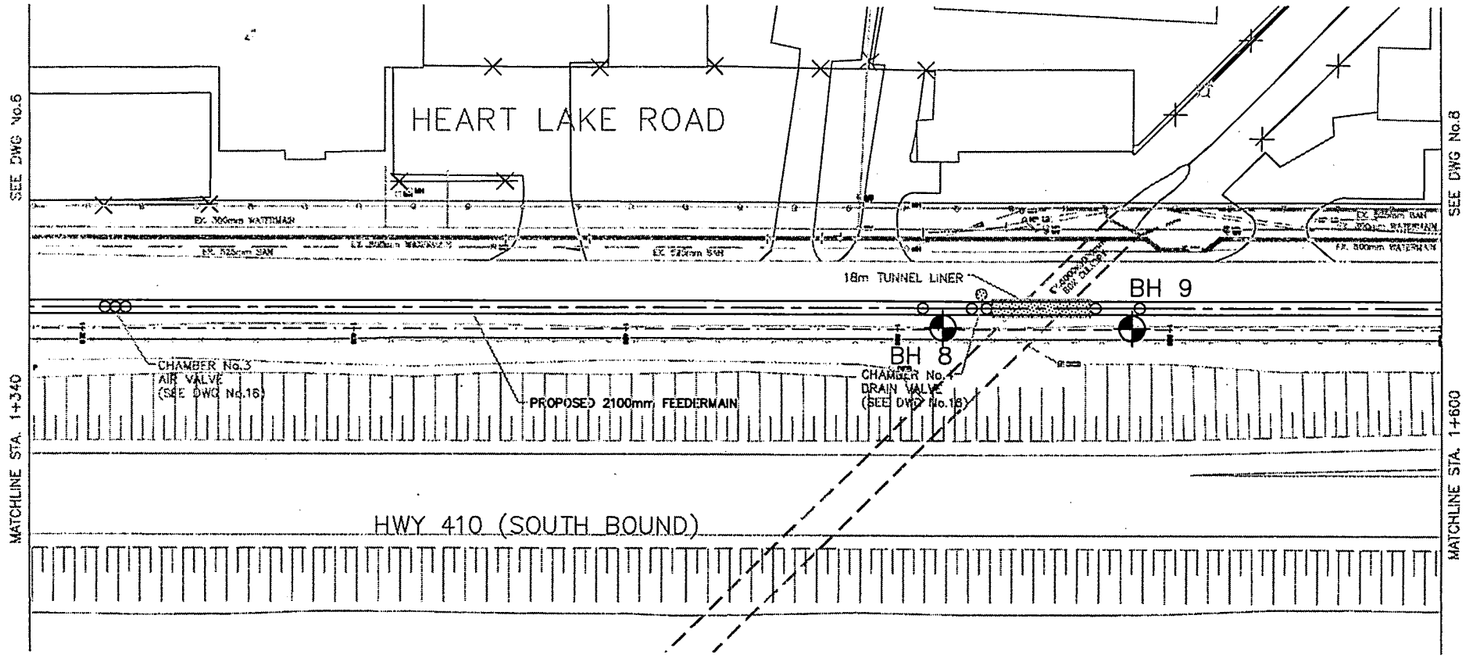
10m 0 10 20 30m HORIZONTAL SCALE
2m 0 2 4 6m VERTICAL SCALE

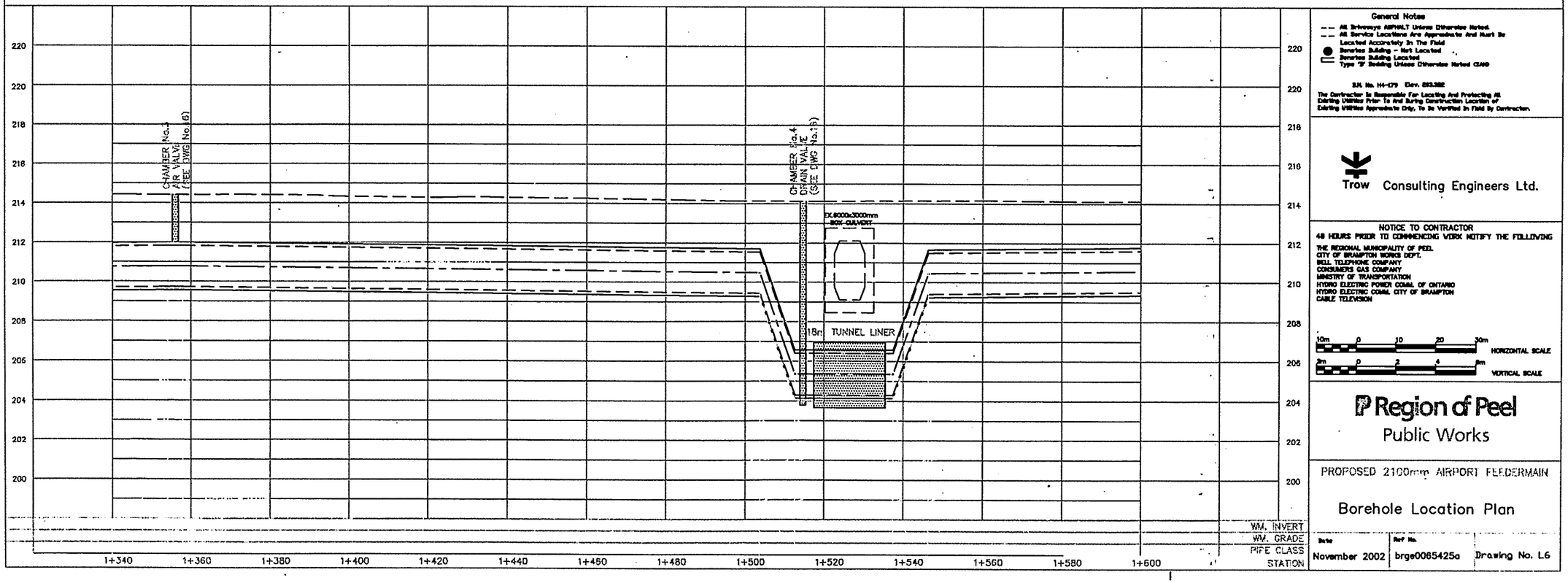
Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	Drawing No. L5





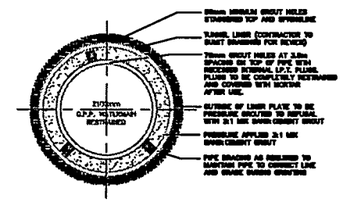
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL LV/D CABLE		
WATERMAINS			HYDRO LV/D CABLE		
TRANSIT			DIST. HYDRO		
PARKS & REC.			CTV		
DIST. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	D.D.

KEY PLAN N.T.S.



TUNNEL DETAIL

General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'B' Bedding Unless Otherwise Noted CLASS

B.M. No. HH-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

2m 0 2 4 6m VERTICAL SCALE

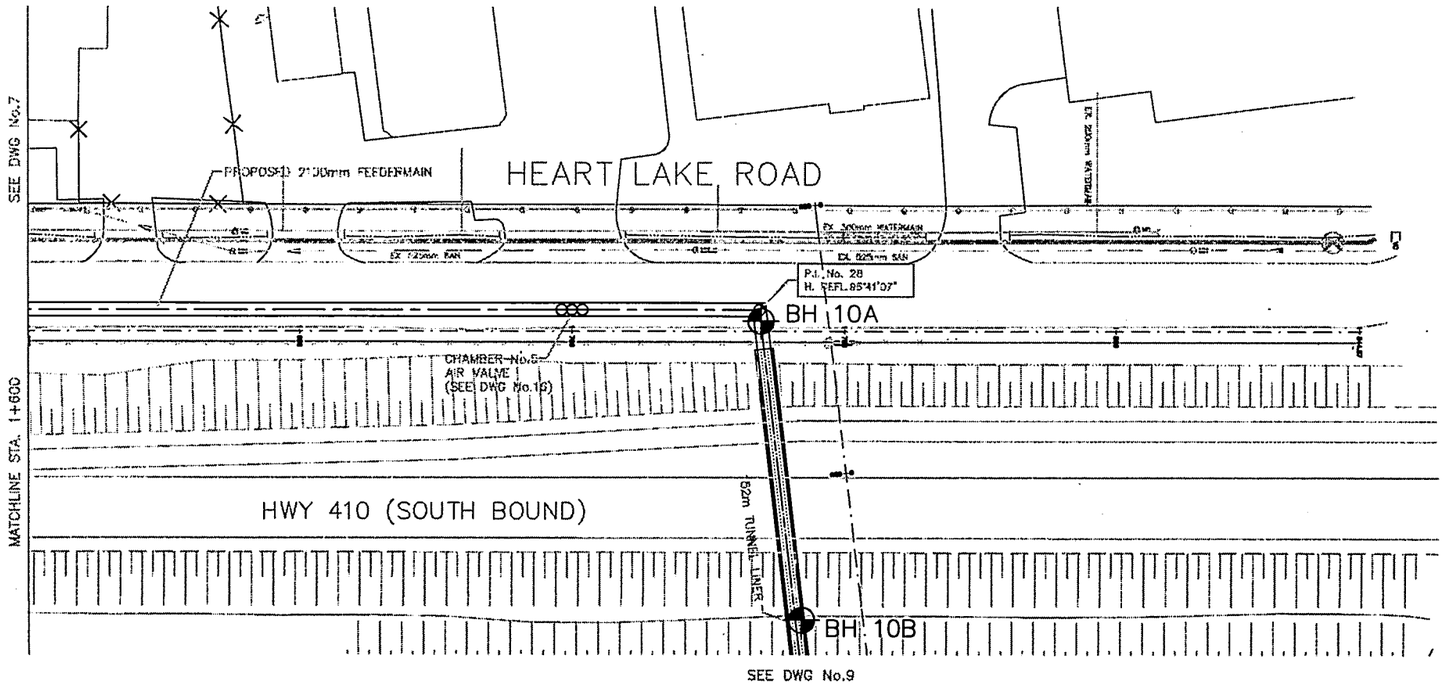
Region of Peel
Public Works

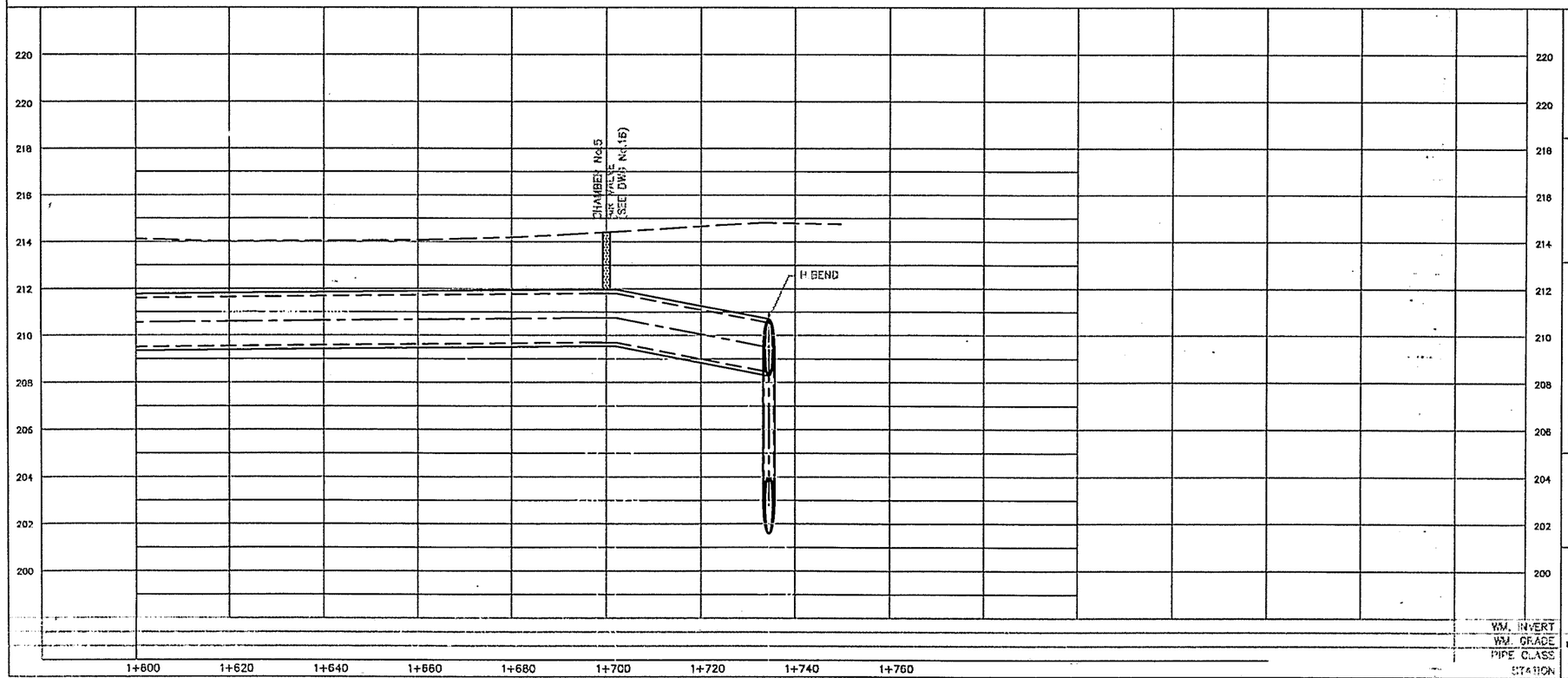
PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	
November 2002	brge0065425a	Drawing No. L6

LEFT_MARGIN_#





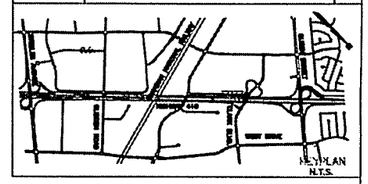
LEFT_MARGIN_#

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN. WATER					

REVISIONS

DATE	DETAILS	INIT.
6 NOV 02	ISSUED FOR TENDER	G.G.



General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'S' Bedding Unless Otherwise Noted (SAN)

B.M. No. HH-179 Elev. 253.302

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

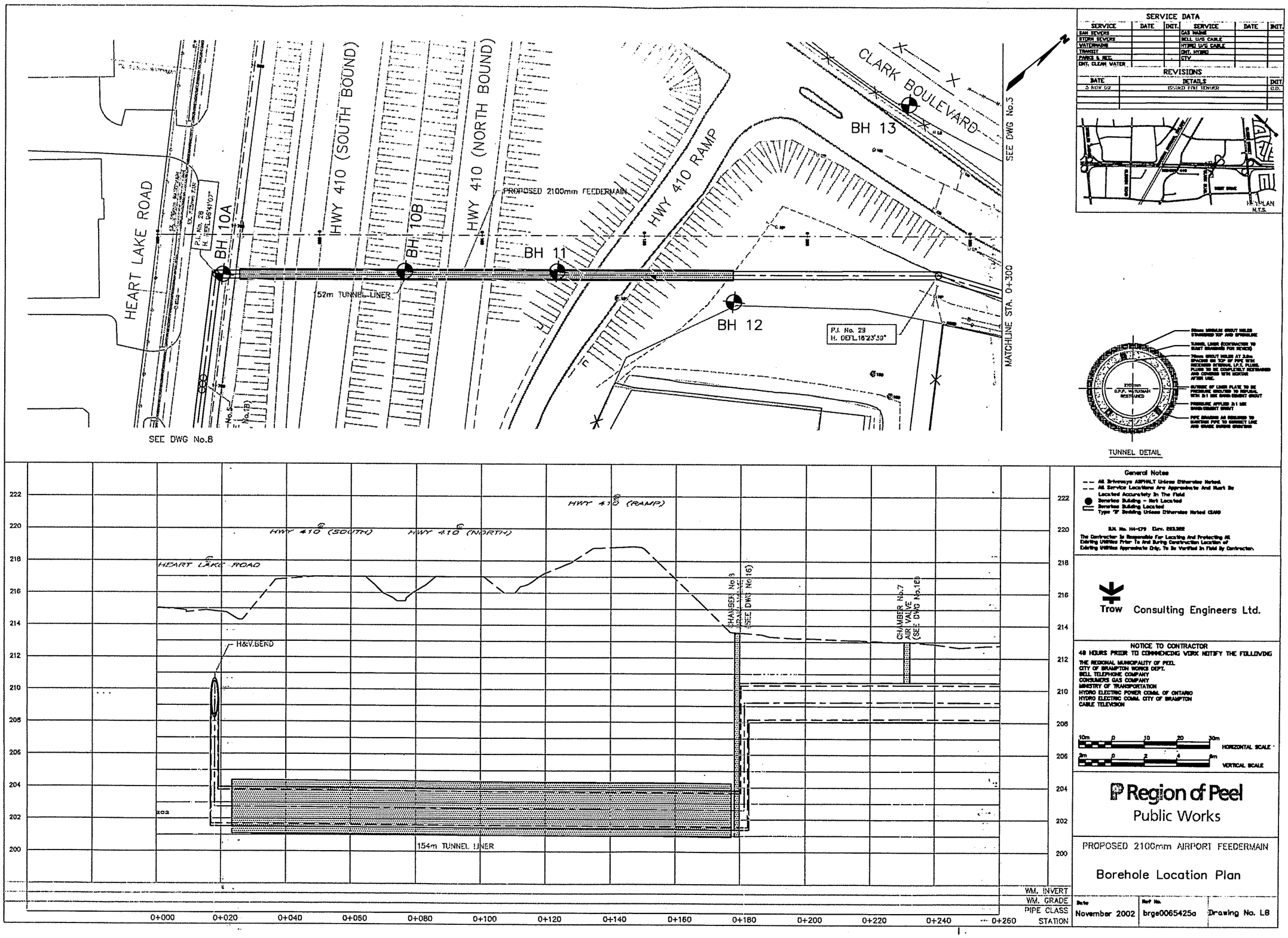
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	Drawing No. L7



SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT
5 NOV 02	ISSUED FINL TENDER	G.D.

KEY PLAN N.T.S.

TUNNEL DETAIL

General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'B' Bedding Unless Otherwise Noted (OPSD

B.M. No. H4-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE
2m 0 2 4 6m VERTICAL SCALE

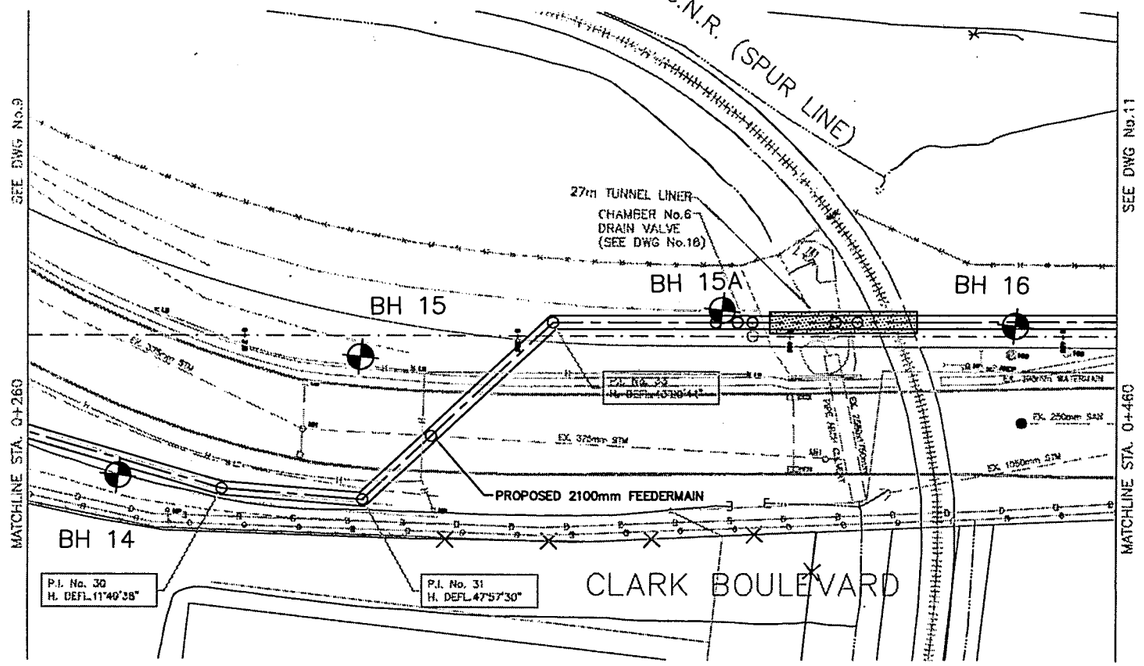
Region of Peel
Public Works

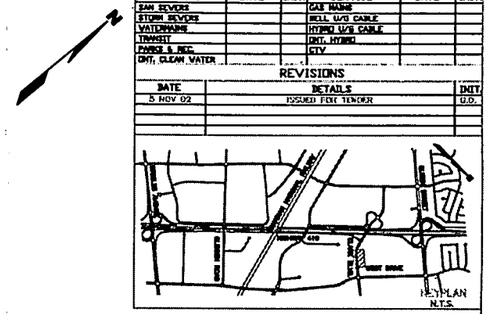
PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	L8

LEFT_MARGIN_#



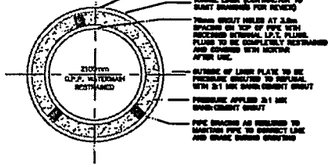


SERVICE DATA

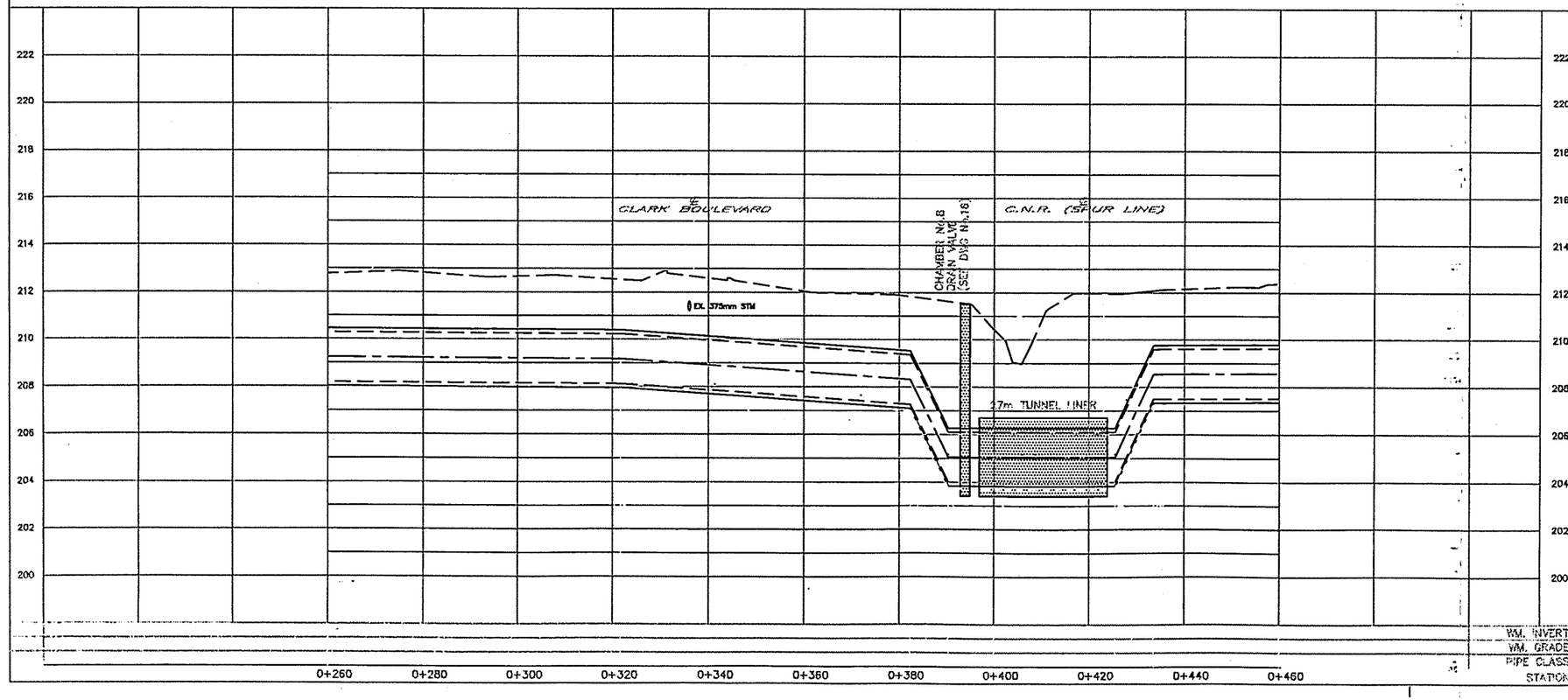
SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PHASE 5 REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.



TUNNEL DETAIL



General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Serviced Building - Not Located
- Serviced Building Located
- Type 'B' Bedding Unless Otherwise Noted (SAN)

B.M. No. HH-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

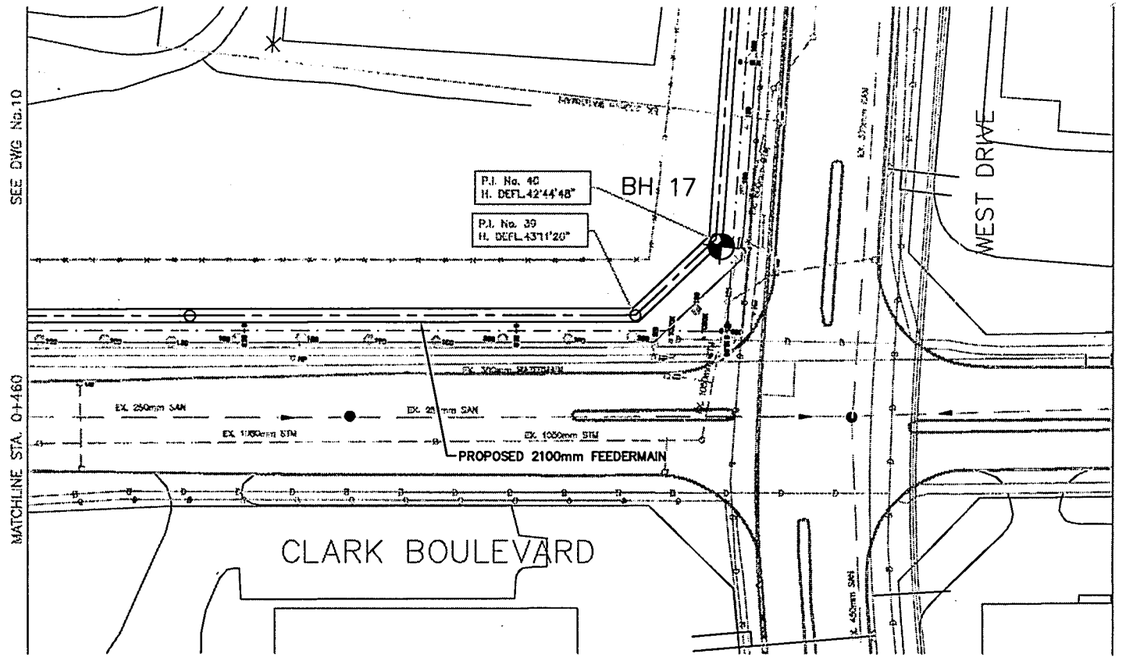
PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	
November 2002	brge0065425a	Drawing No. L9

LEFT_MARGIN_#

SEE DWG No.12

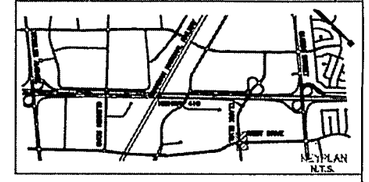


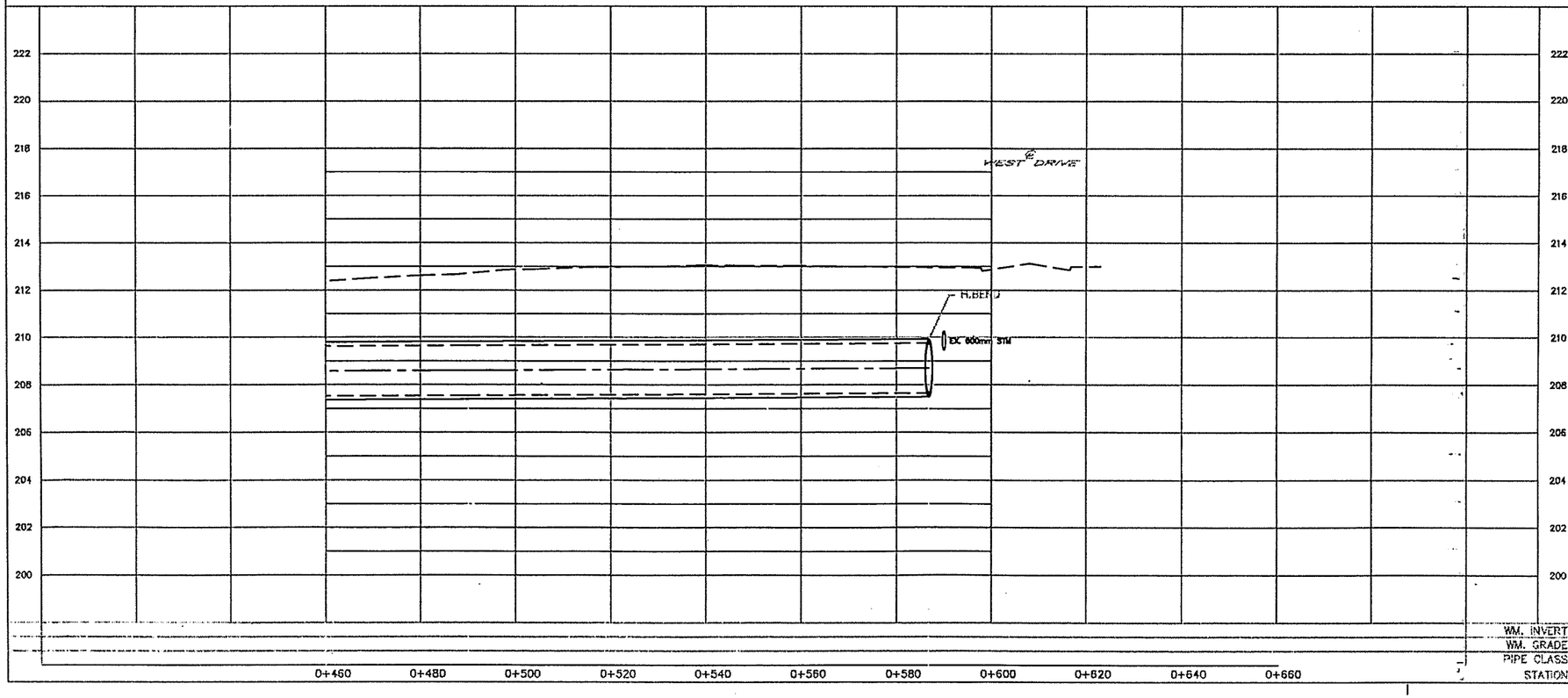
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL LV/G CABLE		
WATERMAINS			HYDRO LV/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN. WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.





LEFT_MARGIN_#

General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located Type 'F' Bedding Unless Otherwise Noted CSAO

B.M. No. HH-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

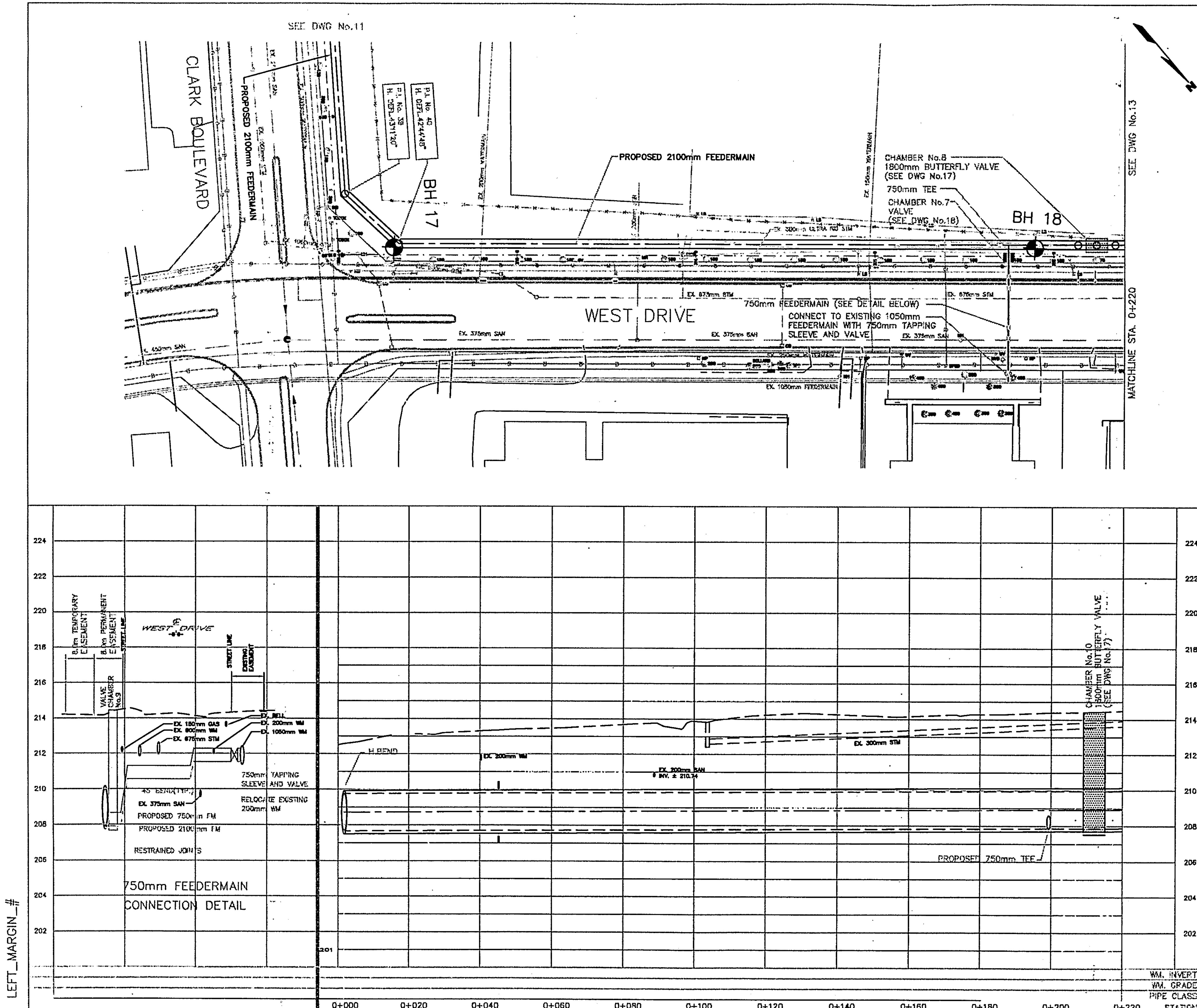
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	L10

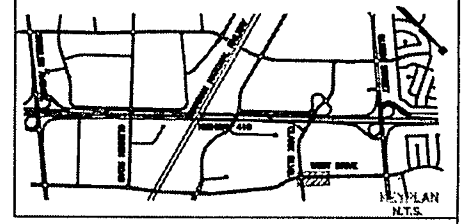


SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.



General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'B' Bedding Unless Otherwise Noted CIAO

B.M. No. H4-179 Elev. 213.302

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

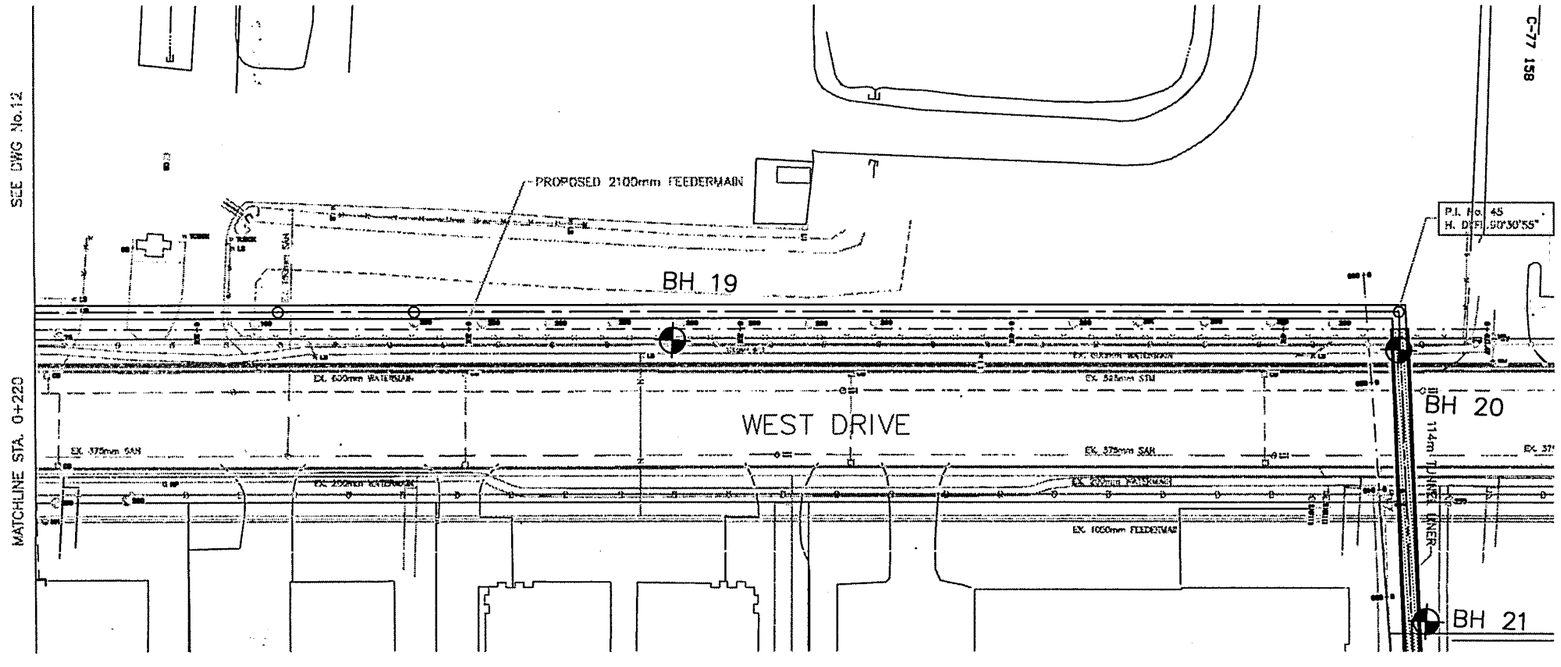
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	
November 2002	brge0065425a	Drawing No. L11

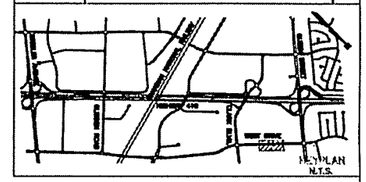


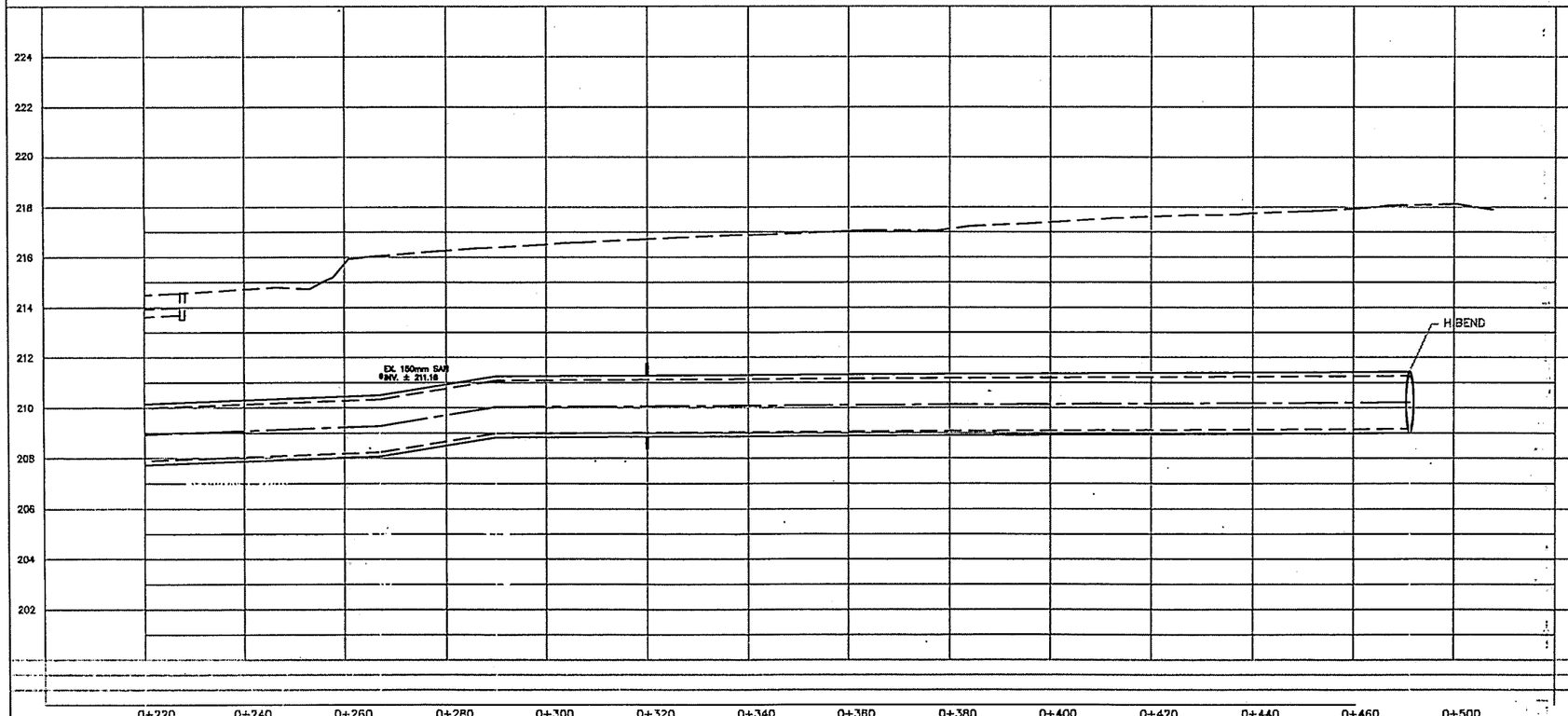
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			DMT. HYDRO		
PARKS & REC.			CTV		
DMT. CLEAR WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV. 02	ISSUED FOR TENDER	G.D.





General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'S' Bedding Unless Otherwise Noted CSA9

BM No. H4-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR
48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE
2m 0 2 4 6m VERTICAL SCALE

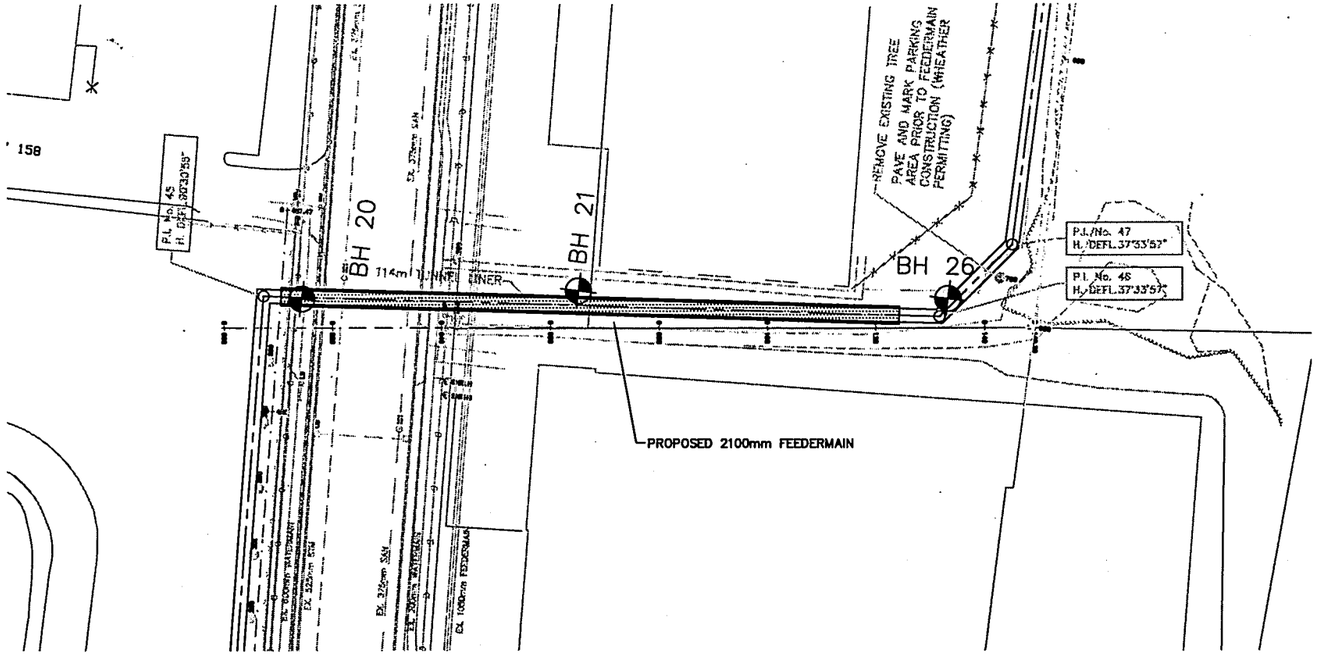
Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	Drawing No. L12

SEE DWG No.15



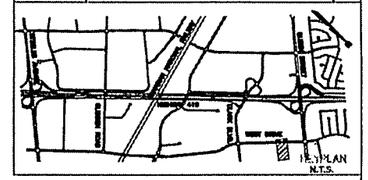
SEE DWG No.13

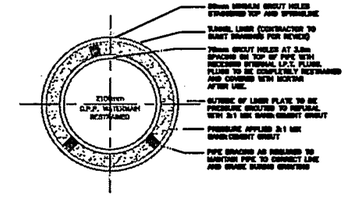
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			ONT. HYDRO		
PARKS & REC.			CTV		
ONT. CLEAN. WATER					

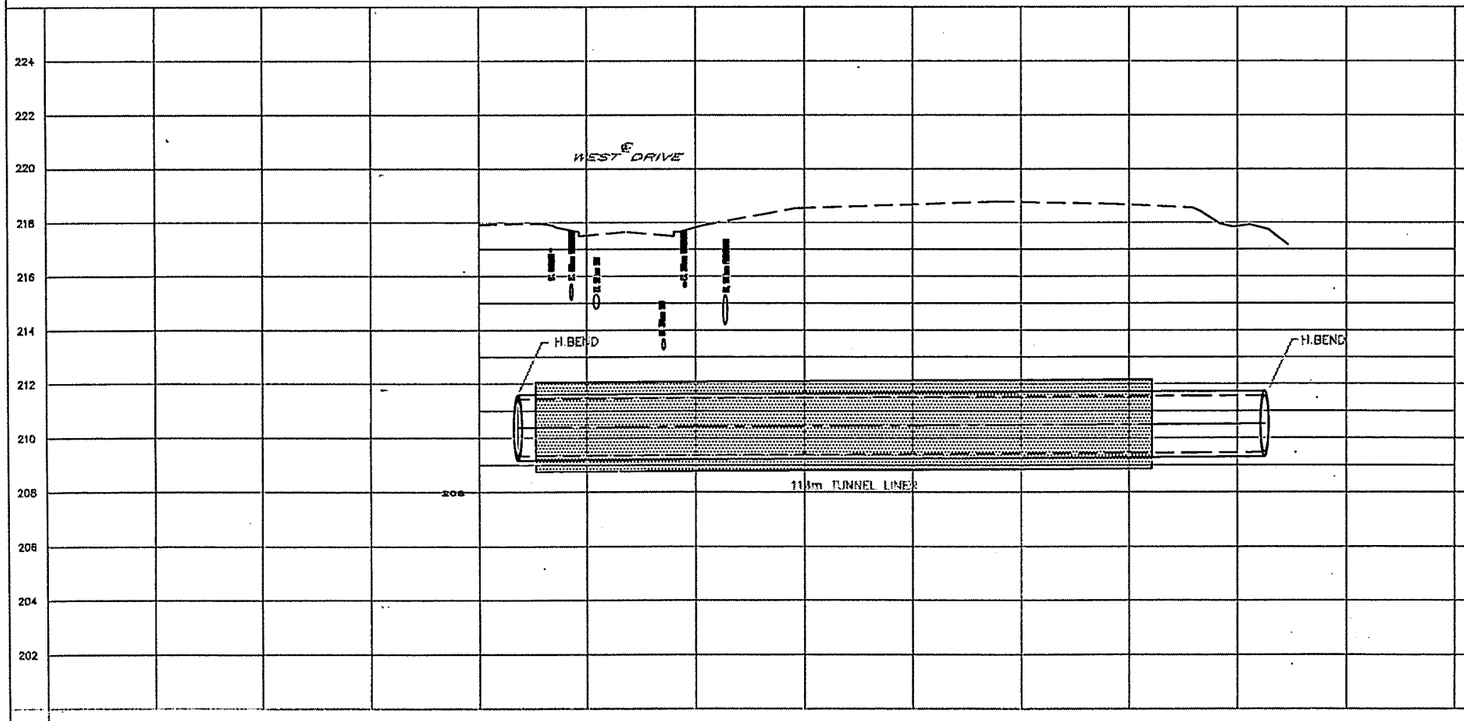
REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	R.D.





TUNNEL DETAIL



General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Boreholes Building - Not Located
- Boreholes Building Located Type 'S' Sealing Unless Otherwise Noted CSMD

B.M. No. HH-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMER'S GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE

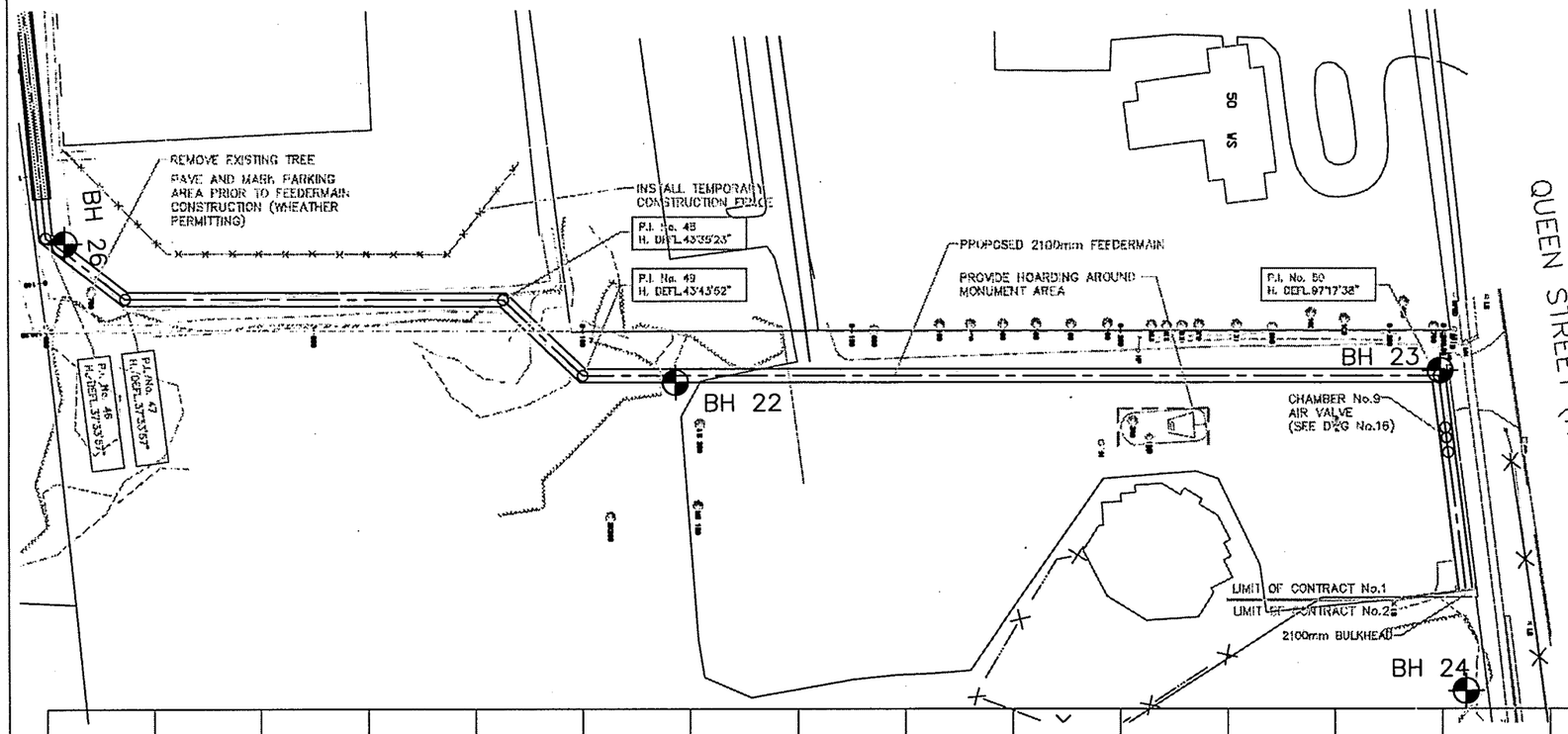
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	L13



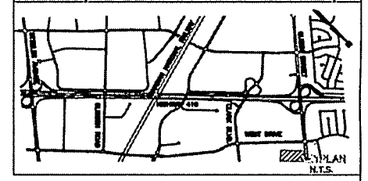
LEFT_MARGIN_#

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			DIST. HYDRO		
PARKS & REC.			CTV		
DIST. CLEAN WATER					

REVISIONS

DATE	DETAILS	INIT.
5 NOV 02	ISSUED FOR TENDER	G.D.



General Notes

- All Driveways ASPHALT Unless Otherwise Noted.
- All Service Locations Are Approximate And Must Be Located Accurately In The Field
- Denotes Building - Not Located
- Denotes Building Located
- Type 'B' Bedding Unless Otherwise Noted C3.1.9.0

B.M. No. HH-179 Elev. 253.382

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction Location of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Trow Consulting Engineers Ltd.

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF BRAMPTON WORKS DEPT.
BELL TELEPHONE COMPANY
CONSUMERS GAS COMPANY
MINISTRY OF TRANSPORTATION
HYDRO ELECTRIC POWER COMM. OF ONTARIO
HYDRO ELECTRIC COMM. CITY OF BRAMPTON
CABLE TELEVISION

10m 0 10 20 30m HORIZONTAL SCALE
2m 0 2 4 6m VERTICAL SCALE

Region of Peel
Public Works

PROPOSED 2100mm AIRPORT FEEDERMAIN

Borehole Location Plan

Date	Ref No.	Drawing No.
November 2002	brge0065425a	L14

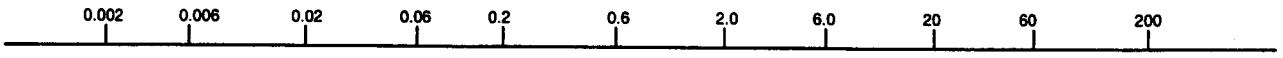
Appendix B:
Notes on Sample Description;
Borehole Logs

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Trow Consulting Engineers Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Explanatory Sheet To Core Log

Column No.	Description
1	Elevation of Geotechnical Boundary
2	Depth of Geotechnical Boundary in Borehole
3	Geological Symbol for Rock or Soil Material
4	General Description of Geotechnical Unit: Quantitative description including rock type (s), percentage of rock types, frequency and sizes of interbeds, colour, texture, weathering, strength and general joint spacing
5-11	Joint (Discontinuity) Characteristics.
5	Number of Joints in Set: A rock mass can be intersected by a number of joint sets of varying orientations
6	Joint Type: B = Bedding Joint; F = Fault; C = Cross Joint; S = Shear Plane
7	Orientation: Only variations in dip can be identified in core; dip direction is obtained from field mapping or orientated core F = Flat = 0 - 20° D = Dipping = 20 - 50° V = Vertical = 50 - 90°
8	Joint Spacing: This is an approximate measure of spacing between joints in specific joint sets VW = Very Wide = >3 m W = Wide = 1 to 3 m M = Moderate = 30 cm to 1 m C = Close = 5 to 30 cm VC = Very Close = <5 cm
9	Roughness RU = Rough Undulating RP = Rough Planar SU = Smooth Undulating SP = Smooth Planar LU = Slickensided Undulating LP = Slickensided Planar
10	Filling:
11	Aperture: Estimated size of joint opening
12	Degree of Weathering of Rock Material

	Approximate Φ_r
T = Tight, hard, non softening	25° - 35°
O = Oxidation, surface staining only	25° - 30°
SA = Slightly altered; clay free	25° - 30°
S = Sandy particles; clay free	25° - 35°
Si = Sandy and silty' minor clay	20° - 25°
NC = Non softening clays (<5 mm)	16° - 24°
SO = Softening clays (<5 mm)	12° - 16°
SC = Swelling clay fillings (<5 mm)	6° - 12°

Unweathered	= no signs of discolouration or oxidation
Slightly weathered	= partial discolouration; fractures (joints) typically oxidized
Moderately weathered	= total discolouration
Highly weathered	= total discolouration; typically friable & pitted
Completely weathered	= resembles soil; rock structure usually preserved

Explanatory Sheet To Core Log

Column No.	Description

13 Strength of Rock Material

		Approx. Uniaxial Compressive Strength
Very High strength	= specimen can only be chipped by geological hammer	>200 MPa
High strength	= specimen requires a number of blows to fracture it; cannot be scrapped with a pocket knife	50 – 200 MPa
Medium strength	= specimen can be fractured by a single blow of geological hammer; can be scrapped with pocket knife, not peeled	15 – 50 MPa
Low strength	= shallow indentations made with a firm blow of geological hammer; can be peeled by pocket knife with difficulty	4 – 15 MPa
Very low strength	= crumbles under firm blow with point of geological hammer; can be peeled by pocket knife	1 – 4 MPa

14 Fracture Frequency: Number of natural joints occurring over a metre length of core. All natural joints are counted irrespective of the number of joint sets.

Fracture Frequency		Joint Spacing	
<0.3/m	=	Very wide	= 3 m
0.3 – 1/m	=	Wide	= 1 – 3 m
1 – 3/m	=	Moderate	= 30 cm – 1 m
3 – 20/m	=	Close	= 5 – 30 cm
>20/m	=	Very Close	= <5 cm

15 Run Number: Drill run number

16 Core Recovery: Core recovery is the total length of core pieces, irrespective of their individual lengths, obtained in a core run and expressed as a percentage of the length of that core run.

17 Rock Quality Designation (RQD): The total length of those pieces of sound core which are 10 cm or greater in length in a core run expressed as a percentage of the total length of that core run. Sound pieces of rack are those pieces separated by natural breaks and not machine breaks or subsequent artificial breaks.

RQD	Rock Mass Classification (After Deere)
0 - 25%	very poor
25 – 50%	poor
50 – 75%	fair
75 – 90%	good
90 – 100%	excellent

18 Water Recovery: The estimated water returning out of the casing

19 Water Colour: The colour of the water returning out of the casing

Log of Borehole 1

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Heart Lake Road, 4838168 N, 603339 E

Drawing No. 1

Sheet No. 1 of 1

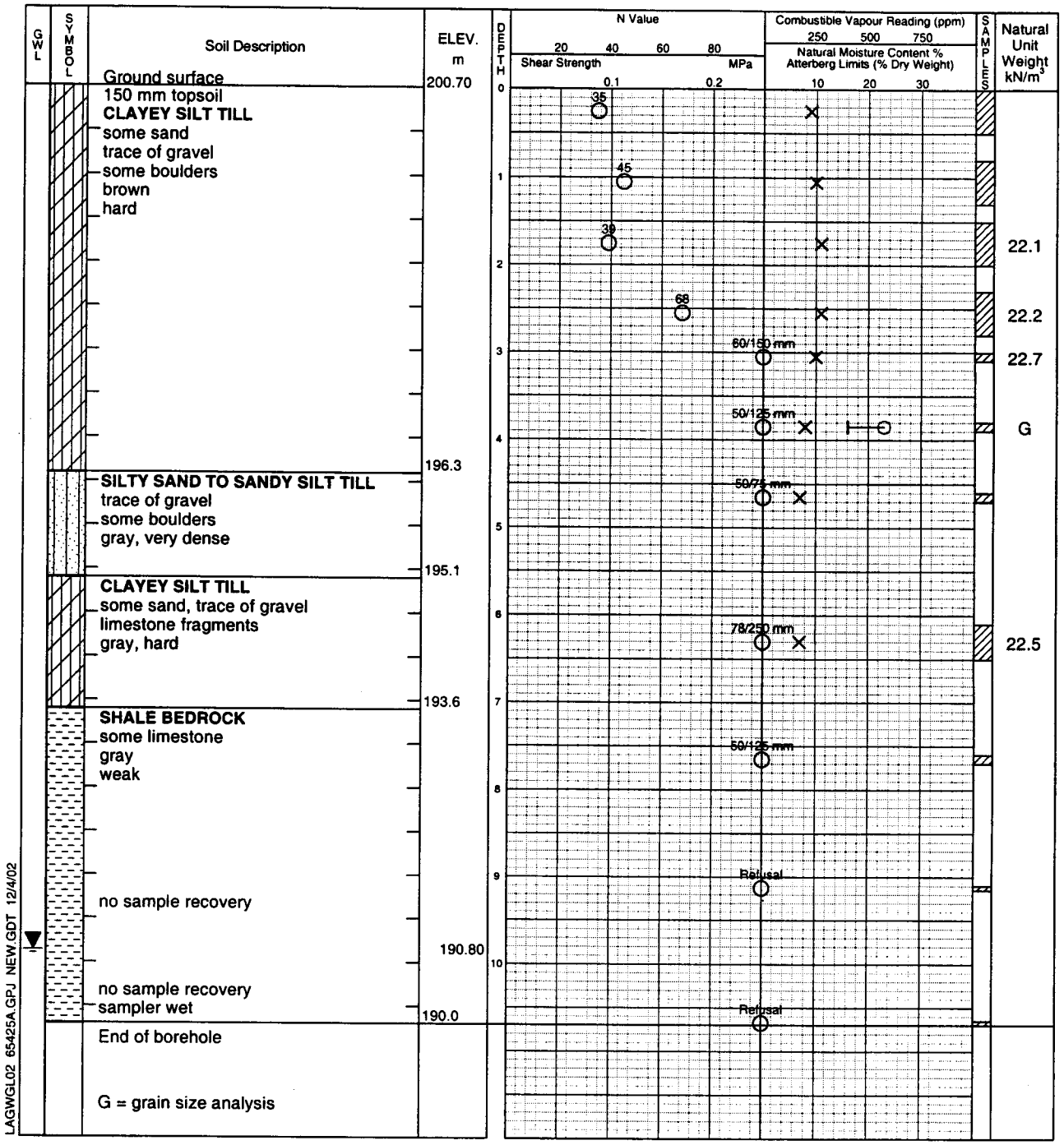
Date Drilled: 04.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



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Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	9.9	

Log of Borehole 2

Project No. brge0065425a

Drawing No. 2

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Heart Lake Road, 4838253 N, 603282 E

Date Drilled: 08.11.2002

Drill Type: Augering & Coring

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground surface	200.70	0
		250 mm asphalt 380 mm granular base **FILL** sand occasional gravel brown	199.3	1
		SILTY CLAY TO CLAYEY SILT TILL some sand, trace of gravel gray/brown mottled stiff to hard		2
		more silty some boulders	197.0	3
		SHALE BEDROCK some limestone stringers horizontally bedded highly weathered in upper about 1 m weak gray (Georgian Bay Formation)		4
		Augered to 7.3 m Coring below 7.3 m See core log in next page	190.3	7
		End of borehole		10

N Value: 20 40 60 80
Shear Strength MPa: 0.1 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

SAMPLES

Natural Unit Weight kN/m³
22.1
22.4
21.0

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)

CORE LOG

BH NO. 2

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	200.7	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/11/02	11/11/02	Siva	2a
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	1 of 1

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
193.4			**SHALE BEDROCK**	1	B	F	VC	RP	T									
			some interbedded limestone stringers	1	C	V	VC	RP	T									
			horizontally bedded															
			occasional 50 to 100 mm vertical fractures															
			gray															
			weak															
			(Georgian Bay Formation)															
	8		hard layer = 16%											1	92	0	95	Gray
			point load strength =1.2 to >31.4 MPa															
192.2			hard layers = 63%	1	B	F	C	RP	T									
			point load strength = 0.6 to 4.3 MPa	1	C	V	C	RP	T									
	9																	
														2	95	62	95	Gray
	10																	
190.6			hard layers = 47%	1	B	F	C	RP	T									
			point load strength = 0.9 to 1.8 MPa	1	C	V	C	RP	T					3	100	83	95	Gray
190.3			End of Borehole at 10.4 m															
	11																	
	12																	
	13																	

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Log of Borehole 3

Project No. brge0065425a

Drawing No. 3

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Heart Lake Road, 4838350 N, 603186 E

Date Drilled: 04.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground surface	200.80	0
		150 mm asphalt approx. 500 mm sand and gravel **CLAYEY SILT TILL** some sand, trace of gravel some boulder brown, hard		1
			198.7	2
		SHALE BEDROCK some limestone gray weak (Georgian Bay Formation)		3
		no sample recovery		4
		sampler wet		5
▼			195.30	
			194.7	6
		End of borehole		

N Value: 20 40 60 80
Shear Strength MPa: 0.1 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

32
45
50/125 mm
50/75 mm
50/50 mm
50/50 mm
50/50 mm
50/50 mm

SAMPLES	Natural Unit Weight kN/m³
	22.4
	22.5

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Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	5.5	

Log of Borehole 4

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Heart Lake Road, 4838506 N, 603033 E

Drawing No. 4

Sheet No. 1 of 1

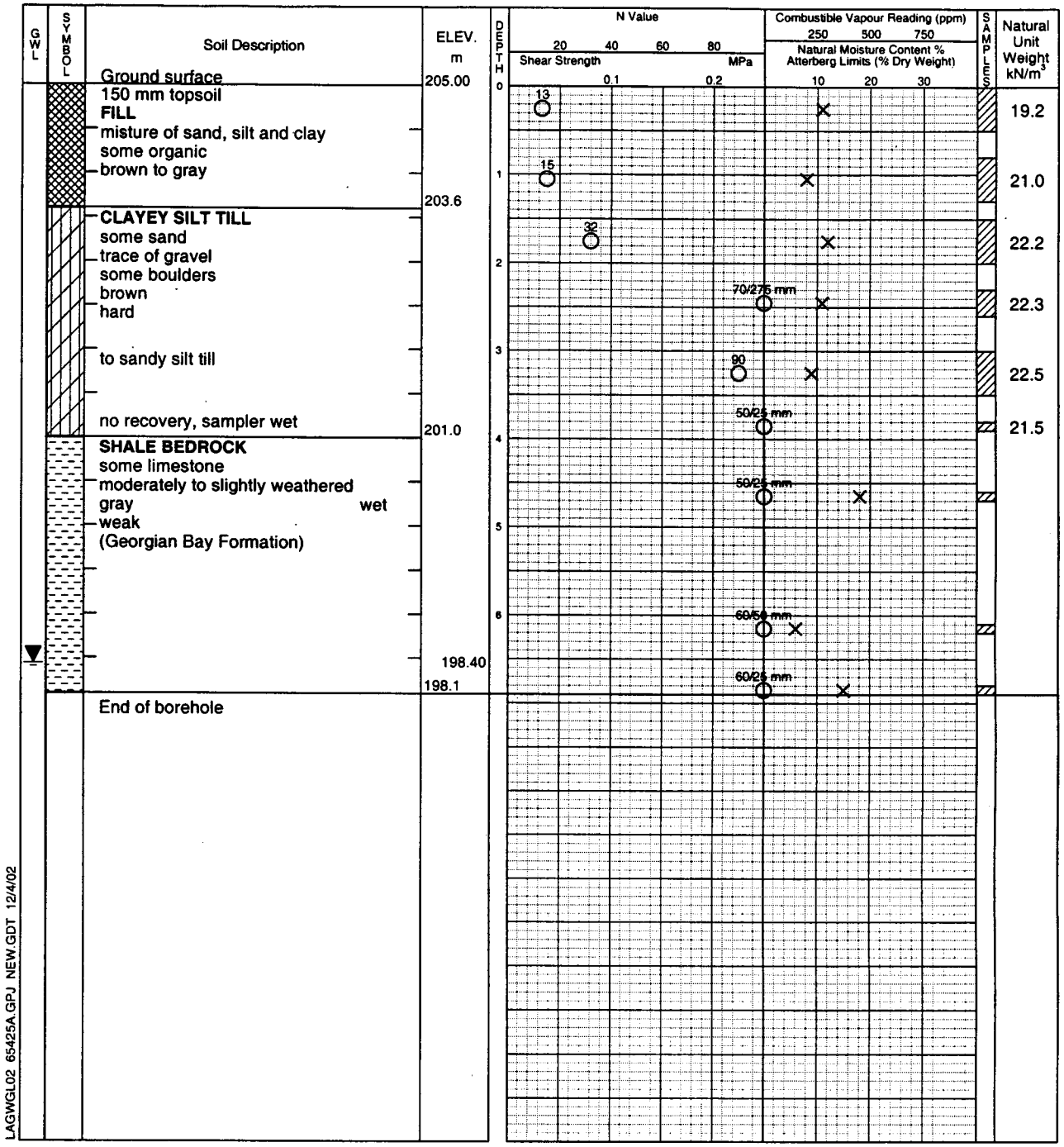
Date Drilled: 04.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



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Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	6.6	

Log of Borehole 5

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Heart Lake Road, 4838740 N, 602780 E

Drawing No. 5

Sheet No. 1 of 1

Date Drilled: 05.11.2002

Drill Type: Augering & Coring

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground surface	208.80	0
		150 mm topsoil **FILL** mixture of silty sand to gravel trace of asphalt moist to wet brown		1
			206.70	2
		SILTY CLAY TILL some sand, boulders trace of gravel gray/brown mottled very stiff to hard	206.3	3
		no sample recovery inferred silty clay	203.9	4
		SHALE BEDROCK moderately to slightly weathered some limestone weak (Georgian Bay Formation) Augered to 5.5 m, changed to coring See core log in next page		5
				6
				7
			200.3	8
		End of borehole		

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

18
50/100 mm
32
16
34
83
50/100 mm
50/125 mm

SAMPLES

Natural Unit Weight kN/m³: 24.8

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	2.1	
12.11.2002	2.1	
03.12.2002	2.1	

CORE LOG

BH NO. 5

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	208.8	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/05/02	11/06/02	Siva	5a
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	1 of 1

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
203.3			**SHALE BEDROCK** some interbedded limestone stringers thinly bedded with occasional vertical fractures moderately weathered in upper about 1 m about 50% hard layers shale: very low to low strength limestone: moderate to high strength gray (Georgian Bay Formation) uniaxial compressive strength = 80.1 MPa hard layers = 50% point load strength = 1.2 to 57.7 MPa	1	B	F	C VC	RP	T					1	87	25	95	Gray
6																		
201.8	7		hard layers = 52% point load strength = 2.5 to 24.5 MPa	1	B	F	C VC	RP	T					2	97	23	95	Gray
	8																	
200.3			End of Borehole at 8.5 m															
	9																	
	10																	
	11																	

CORE LOG 65425AR.GPJ CORE_LOG.GDT 11/20/02

Trow

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Log of Borehole 6

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Heart Lake Road, 4838778 N, 602743 E

Drawing No. 6

Sheet No. 1 of 1

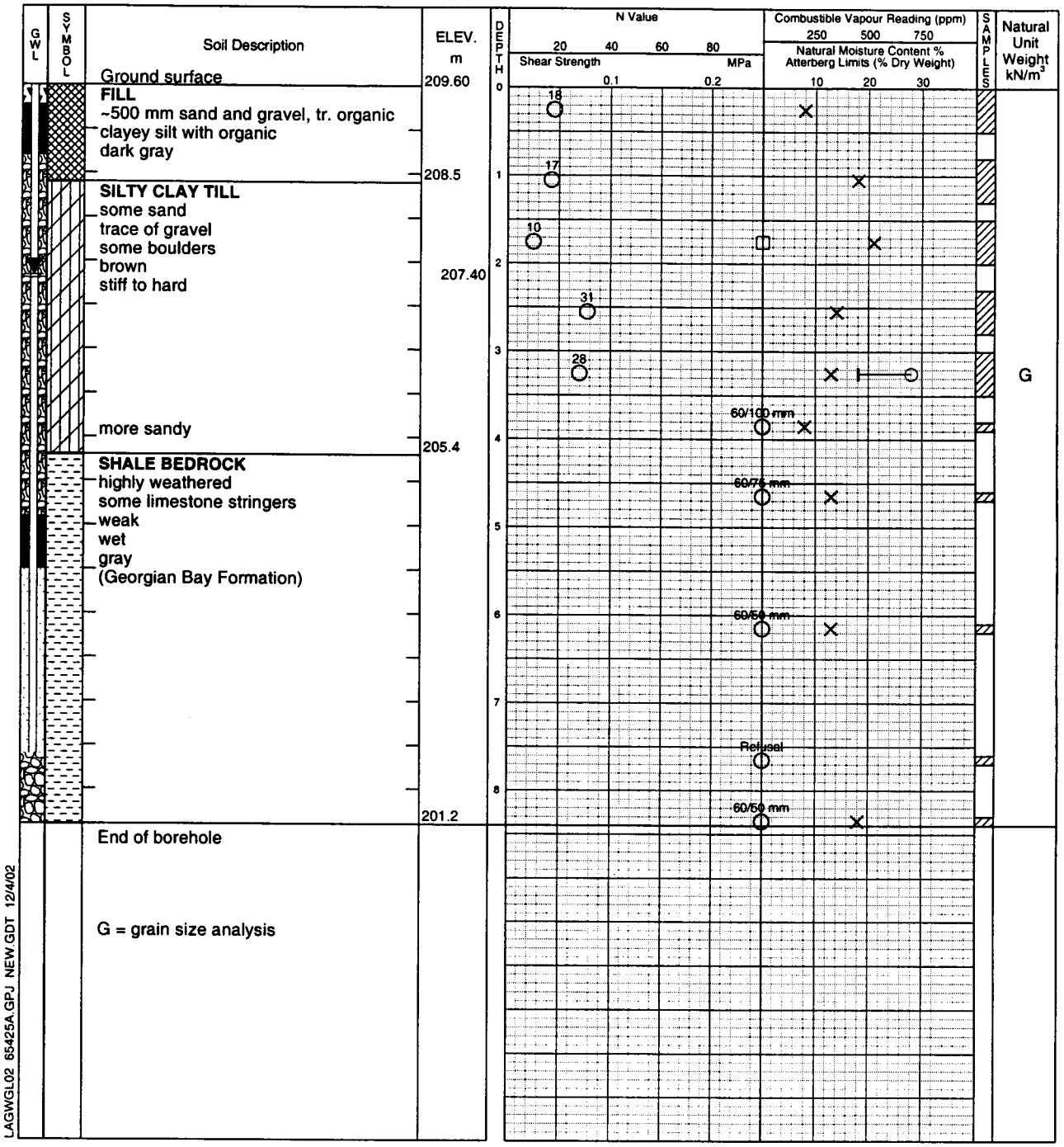
Date Drilled: 31.10.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



Time	Water Level (m)	Depth to Cave (m)
Completion	3.7	
12.11.2002	2.2	
03.12.2002	2.2	

Trow

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Log of Borehole 7

Project No. brge0065425a

Drawing No. 7

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Heart Lake Road, 4838896 N, 602537 E

Date Drilled: 04.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (MPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight kN/m³
		Ground surface	214.50	0				
		100 mm asphalt Approx. 400 mm sand **SILTY CLAY TILL** some sand, trace of gravel brown, hard			11			20.1
			213.1	1	47			21.7
		SILTY SAND TILL moist, brown, dense (possible sand seam in clay till)	212.4	2	37			
		SILTY CLAY TO CLAYEY SILT TILL some sand trace of gravel some boulders low plasticity gray very stiff to hard			42			22.1
				3	43			22.3
				4				
				5	24			
				6	85			22.4
			207.4	7				
		CLAYEY SILT TILL some sand, gravel and boulder shale fragments, gray, hard	206.8		50/75 mm			23.3
		End of borehole						

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Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	Dry	

Log of Borehole 8

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Heart Lake Road, 4839208 N, 602324 E

Drawing No. 8

Sheet No. 1 of 1

Date Drilled: 01.11.2002

Drill Type: Augering & Coring

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground surface	213.90	0
		300 mm sand and gravel at surface		
		FILL		
		silty clay with organic		
		gray		1
				2
		moist	210.90	3
			210.2	
		CLAYEY SILT TILL		
		trace of gravel		4
		some boulders		
		some shale fragments		
		gray, hard	209.0	5
		SHALE BEDROCK		
		highly weathered and wet in the upper 1.5 m		6
		horizontally bedded		
		some limestone stringers		
		gray		7
		weak		
		(Georgian Bay Formation)		
		Augered to 7.6 m, changed to coring		8
		See core log in next page		
				9
				10
				11
			202.5	
		End of borehole		

N Value: 20 40 60 80
Shear Strength MPa: 0.1 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content: % Atterberg Limits (% Dry Weight): 10 20 30

SAMPLES

Natural Unit Weight kN/m³

26
7
6
14
6
50/140 mm
50/100 mm
50/75 mm
50/75 mm

19.7
20.6
19.9
20.1
21.4
26.6

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
12.11.2002	3.0	
03.12.2002	3.0	

CORE LOG

BH NO. 8

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	213.9	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/01/02	11/01/02	Siva	8a
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	1 of 1

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
206.3			**SHALE BEDROCK** interbeded with limestone stringers hard layers = 10 to 40% thinly bedded moderately to slightly weathered shale: very low to low strength limestone: moderate to high strength gray (Georgian Bay Formation)	1	B	F	C VC	RP						1	91	23	100	Gray
	8		uniaxial compressive strength = 89 MPa point load strength = 0.6 to 54.6 MPa hard layers = 13%															
	9																	
204.8			point load strength = 4.3 to >43.9 MPa hard layers = 7%	1	B	F	C VC	RP						2	78	23	100	Gray
	10																	
203.2			point load strength = 18.4 to over 67.6 MPa hard layers = 37%	1	B	F	C VC	RP						3	93	0	100	Gray
	11																	
202.5			End of Borehole at 11.4 m															
	12																	
	13																	

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Log of Borehole 9

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Heart Lake Road, 4839232 N, 602299 E

Drawing No. 9

Sheet No. 1 of 1

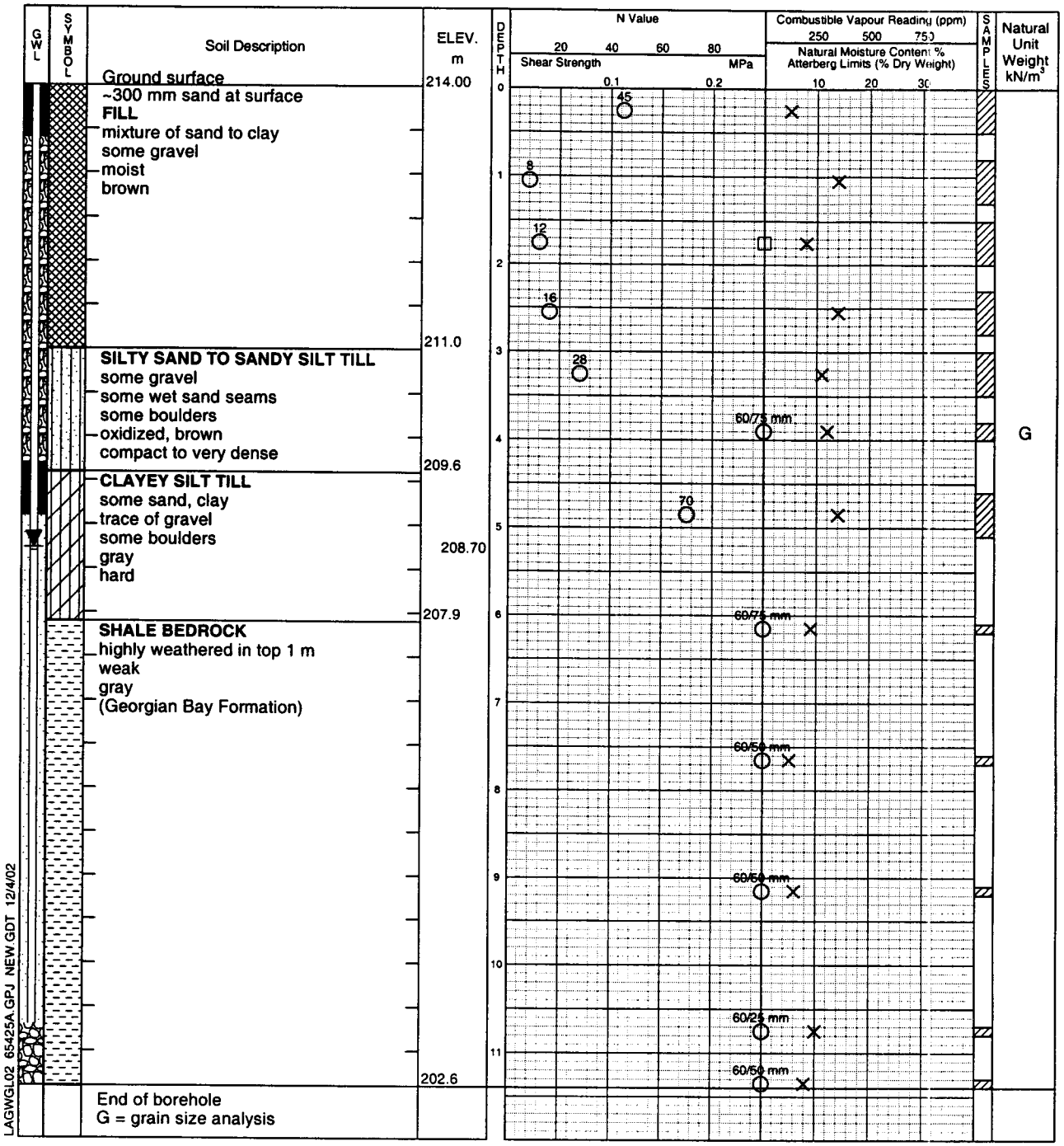
Date Drilled: 31.10.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



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Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	3.7	
12.11.2002	5.2	
03.12.2002	5.3	

Log of Borehole 10A

Project No. brge0065425a
Drawing No. 10A
Project: York/Peel Feedermain
Sheet No. 1 of 2
Location: City of Brampton - Heart Lake Road, 4839366 N, 602162 E

Date Drilled: 30.10.2002
Drill Type: Augering & Coring
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reacing
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground surface	214.60	0
		300 mm sand and gravel **FILL** mixture of sand to silt some clay, gravel, organic brown to black	213.2	1
		SANDY SILT TO SILTY SAND TILL trace of gravel some boulders brown dense to very dense	211.80	2
		G = grain size analysis	209.2	3
		CLAYEY SILT TILL trace of gravel some boulders gray hard	207.6	4
		SHALE BEDROCK moderately to highly weathered in upper 1.5 m some limestone stringerS gray weak (Georgian Bay Formation)		5
		Borehole was redrilled rock coring from 7.0 m see core logs on Drawing 10Aa		6
				7
				8
				9
				10
				11
				12

N Value: 20 40 60 80
Shear Strength: 0.1 MPa 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

33
20
45
65
60/125 mm
60/140 mm
60/125 mm
110/225 mm
60/50 mm
60/50 mm
Refusal

SAMPLES: G

Natural Unit Weight kN/m³: 23.2

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
Completion	4.3	
12.11.2002	2.7	
03.12.2002	2.8	

Trow

Log of Borehole 10A

Project No. brge0065425a

Drawing No. 10A

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 / Shear Strength MPa 0.1 0.2 Refusal	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
		SHALE as above see core log in next page	202.60	12 13 14				
		End of borehole	200.0					

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	4.3	
12.11.2002	2.7	
03.12.2002	2.8	

CORE LOG

BH NO. 10A

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	214.6	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/06/02	11/06/02	Siva	10Aa
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	1 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
207.6	7		**SHALE BEDROCK** some interbedded limestone stringers hard layer = 5 to 50% moderately to highly weathered in upper 1.5 m slightly to moderately weathered below 1.5 m shale: very low to low strength limestone: moderate to high strength horizontally bedded occasional vertical fractures gray weak (Georgain Bay Formation) point load strength = 1.5 to >57.7 Mpa hard layer = 5%											1	57	o	95	Gray
	8																	
206.1			uniaxial compressive strength = 58.0 Mpa point load strength = 1.5 to 124.2 MPa hard layers = 27%	1	B	F	VC C	RP						2	87	43	95	Gray
	9																	
	10																	
204.5			point load strength = 2.5 to >98.5 MPa hard layes = 37%	1 1	B C	F V	VC C	RP	T					3	93	27	95	Gray
	11																	
203.0			point load strength = 1.5 to >61.3 MPa hard layers = 17%	1 1	B C	F V	VC C	RP	T					4	100	47	95	Gray
	12																	

CORE LOG 65425AR.GPJ CORE_LOG.GDT 12/3/02

Trow

Trow Consulting Engineers Ltd.

CORE LOG

BH NO. 10A

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	214.6	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/06/02	11/06/02	Siva	10Aa
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	2 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
201.5	13		**SHALE BEDROCK** some limestone stringers slightly weathered gray, weak (Georgian Bay Formation) point load strength = 2.5 to 19.3 MPa hard layers <7%	1	B	F	VC C	RP						5	100	52	95	Gray
200.0	14		End of Borehole at 14.6 m															
	15																	
	16																	
	17																	
	18																	

Log of Borehole 10B

Project No. brge0065425a

Drawing No. 10B

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Highway 410, 4839411 N, 602196 E

Date Drilled: 01.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

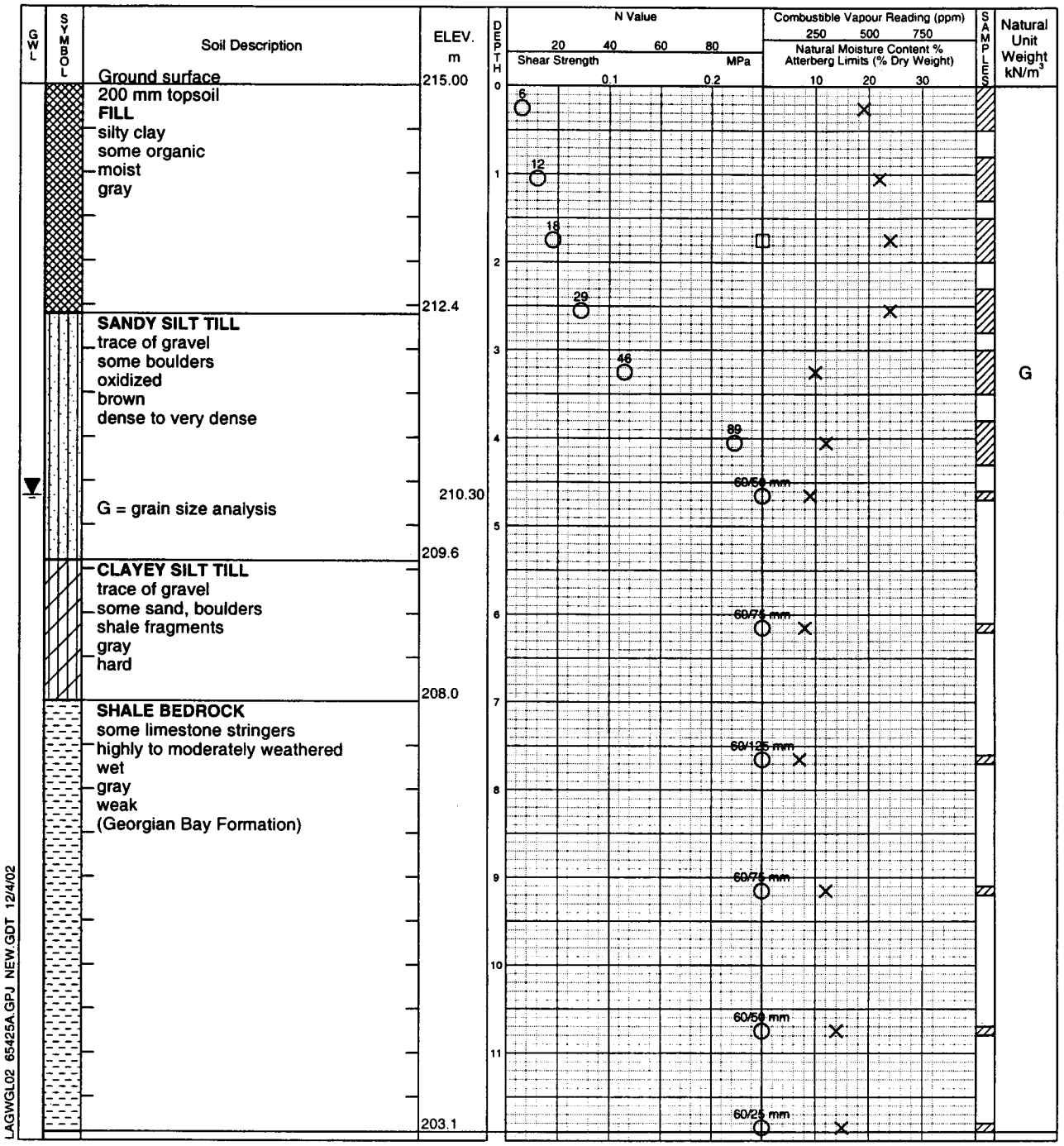
Combustible Vapour Reading

Natural Moisture

Plastic and Liquid Limit

Undrained Triaxial at % Strain at Failure

Penetrometer



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
12.11.2002	4.8	
03.12.2002	4.7	

Log of Borehole 11

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Highway 410, 4839448 N, 602225 E

Drawing No. 11

Sheet No. 1 of 2

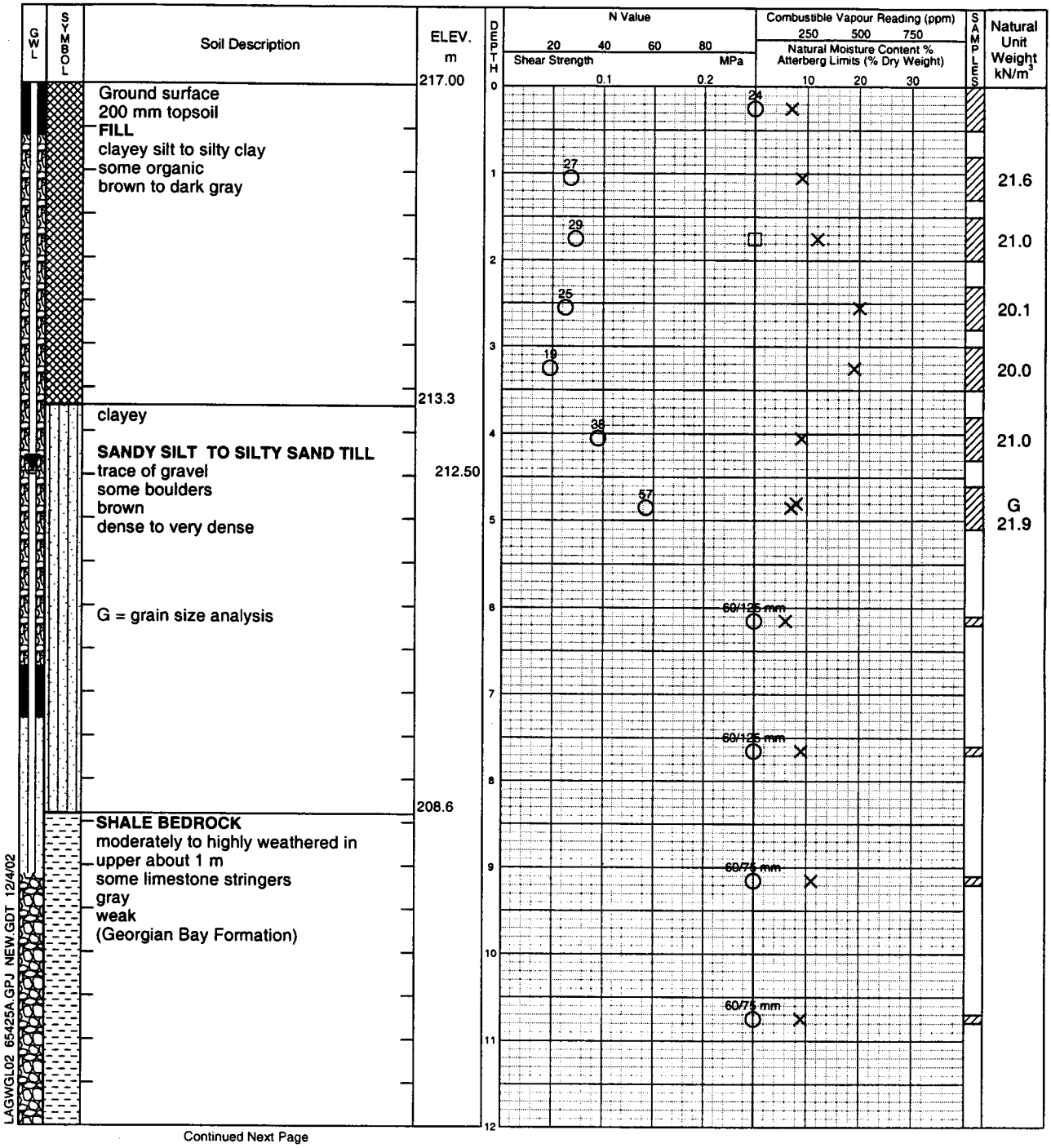
Date Drilled: 01.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
Completion	4.1	
12.11.2002	6.3	
03.12.2002	4.5	

Trow

Log of Borehole 11

Project No. brge0065425a

Drawing No. 11

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 12
		SHALE as above	205.00	
			204.1	
		End of borehole		

N Value 20 40 60 80

Shear Strength 0.1 0.2 MPa

60/75 mm

60/50 mm

Combustible Vapour Reading (ppm) 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30

SAMPLES

Natural Unit Weight kN/m³

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	4.1	
12.11.2002	6.3	
03.12.2002	4.5	

Log of Borehole 12

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Highway 410, 4839485 N, 602266 E

Drawing No. 12

Sheet No. 1 of 1

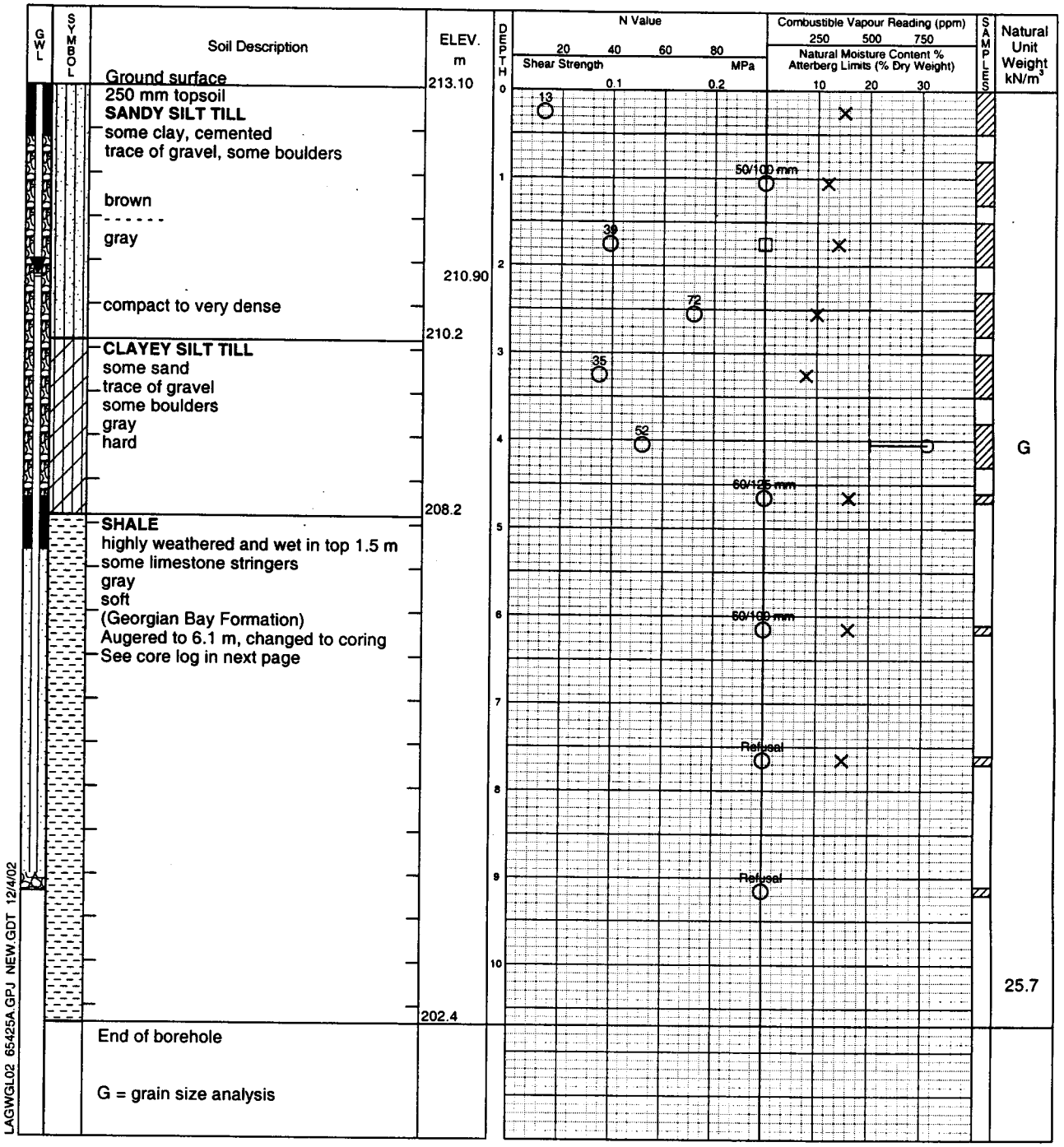
Date Drilled: 29.10.2002

Drill Type: Augering & Coring

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test ✚ UD

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
30.10.2002	2.7	
12.11.2002	2.8	
03.12.2002	2.2	

CORE LOG

BH NO. 12

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	213.1	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/07/02	11/07/02	Siva	12a
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	1 of 1

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
207.0			**SHALE BEDROCK** some limestone stringers highly to completely weathered in upper about 1 m slightly weathered below 1 m horizontally bedded with shale: very low strength	1	B	F	VC							1	50	0	95	Gray
	7		limestone: moderate to high strength gray weak (Georgian Bay Formation) point load strength = 2.8 to 25.8 MPa hard layers = 6%	1	B	F	VC							2	83	11	95	Gray
205.5			point load strength = 1.4 to >80.6 MPa hard layers = 27%	1	B	F	VC							3	98	28	95	Gray
	8			1	C	V												
	9																	
204.0			point load strength = 3.3 to 37.4 MPa hard layers = 65%	1	B	F	VC C							4	97	25	95	Gray
	10		uniaxial compressive strength = 93.1 MPa															
202.4			End of Borehole at 10.7 m															
	11																	
	12																	

CORE LOG 65425AR.GPJ CORE_LOG.GDT 11/20/02

Trow

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Log of Borehole 13

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Clark Boulevard, 4839565 N, 602251 E

Drawing No. 13

Sheet No. 1 of 1

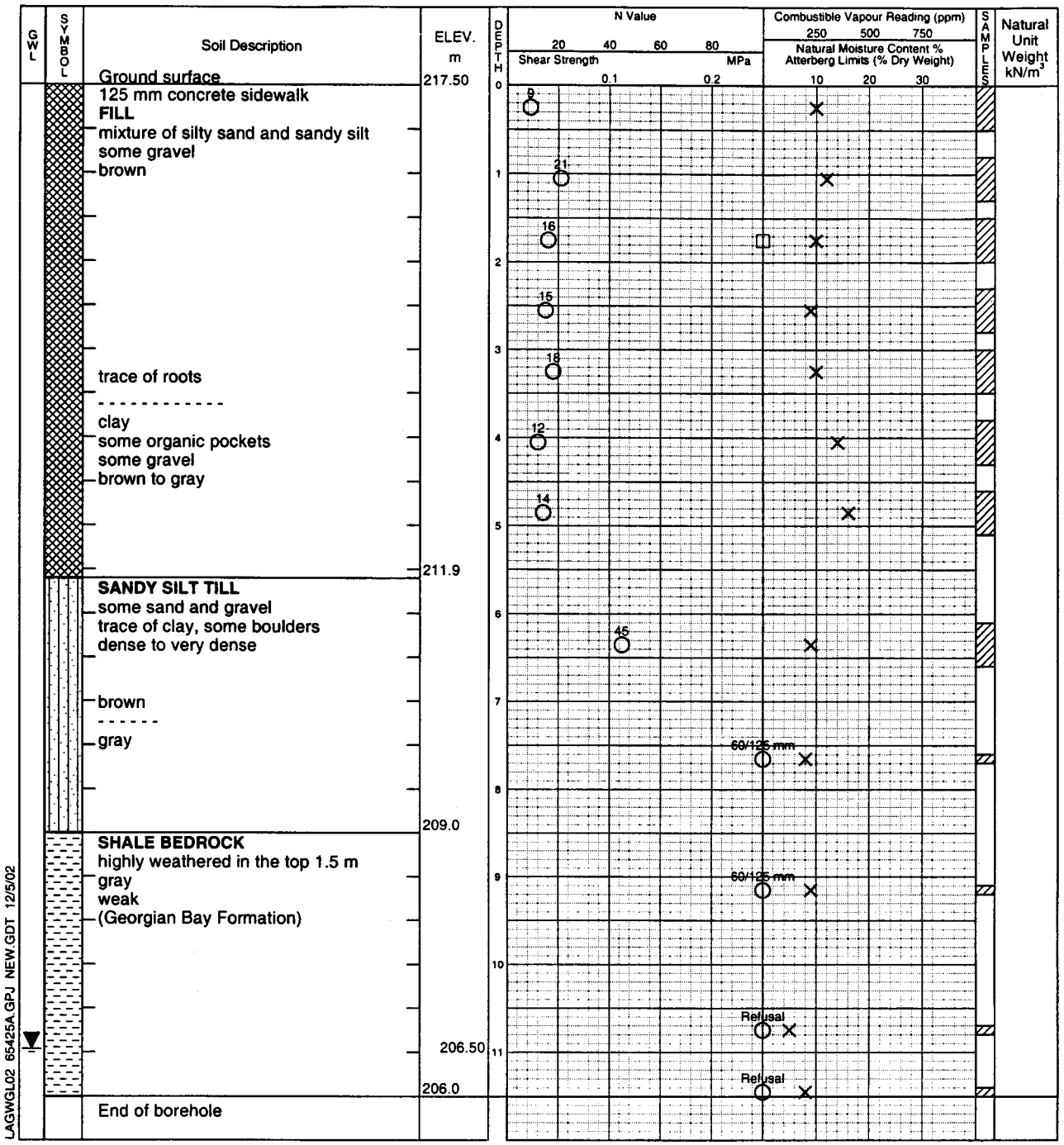
Date Drilled: 30.10.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/5/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	11.0	

Log of Borehole 14

Project No. brge0065425a

Drawing No. 14

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Clark Boulevard, 4839560 N, 602331 E

Date Drilled: 04.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube ■
Field Vane Test ✤ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit |—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground surface	212.20	0
		300 mm topsoil		
		SILTY CLAY		
		some sand, trace of gravel		
		brown, stiff to hard		
		(possible FILL)	211.0	1
		CLAYEY SILT TILL		
		some gravel, boulders		
		gray		
		hard		2
			209.2	3
		SHALE BEDROCK		
		some limestone		
		moderately to highly weathered in upper ~1 m		4
		gray		
		weak		5
		(Georgian Bay Formation)		6
			205.3	
		End of borehole		

N Value: 20 40 60 80
Shear Strength: 0.1 MPa 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

SAMPLES

Natural Unit Weight kN/m³: 18.9 | 22.0 | 21.9

7
50/100 mm
50/125 mm
50/150 mm
85
50/125 mm
50/125 mm
50/75 mm
50/50 mm

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)

Log of Borehole 15

Project No. brge0065425a

Drawing No. 15

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Clark Boulevard, 4839608 N, 602342 E

Date Drilled: 29.10.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit |—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

GWL	SYMBOL	Soil Description	ELEV. m
		Ground surface	212.50
		200 mm topsoil **FILL** sandy silt trace of gravel trace of roots brown	
			209.7
		SANDY SILT TILL trace of gravel some boulders gray, very dense	208.8
▼		**SHALE BEDROCK** some limestone wet and highly weathered in upper ~1 m gray weak (Georgian Bay Formation)	206.40
			205.6
		End of borehole	

DEPTH 0 1 2 3 4 5 6

N Value: 20 40 60 80
Shear Strength MPa: 0.1 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

12
16
37
35
84/275 mm
60/100 mm
60/125 mm
60/75 mm
60/50 mm

SAMPLES

Natural Unit Weight kN/m³

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	6.1	

Log of Borehole 15A

Project No. brge0065425a

Drawing No. 15A

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Clark Boulevard, 602376 N, 4839666 E

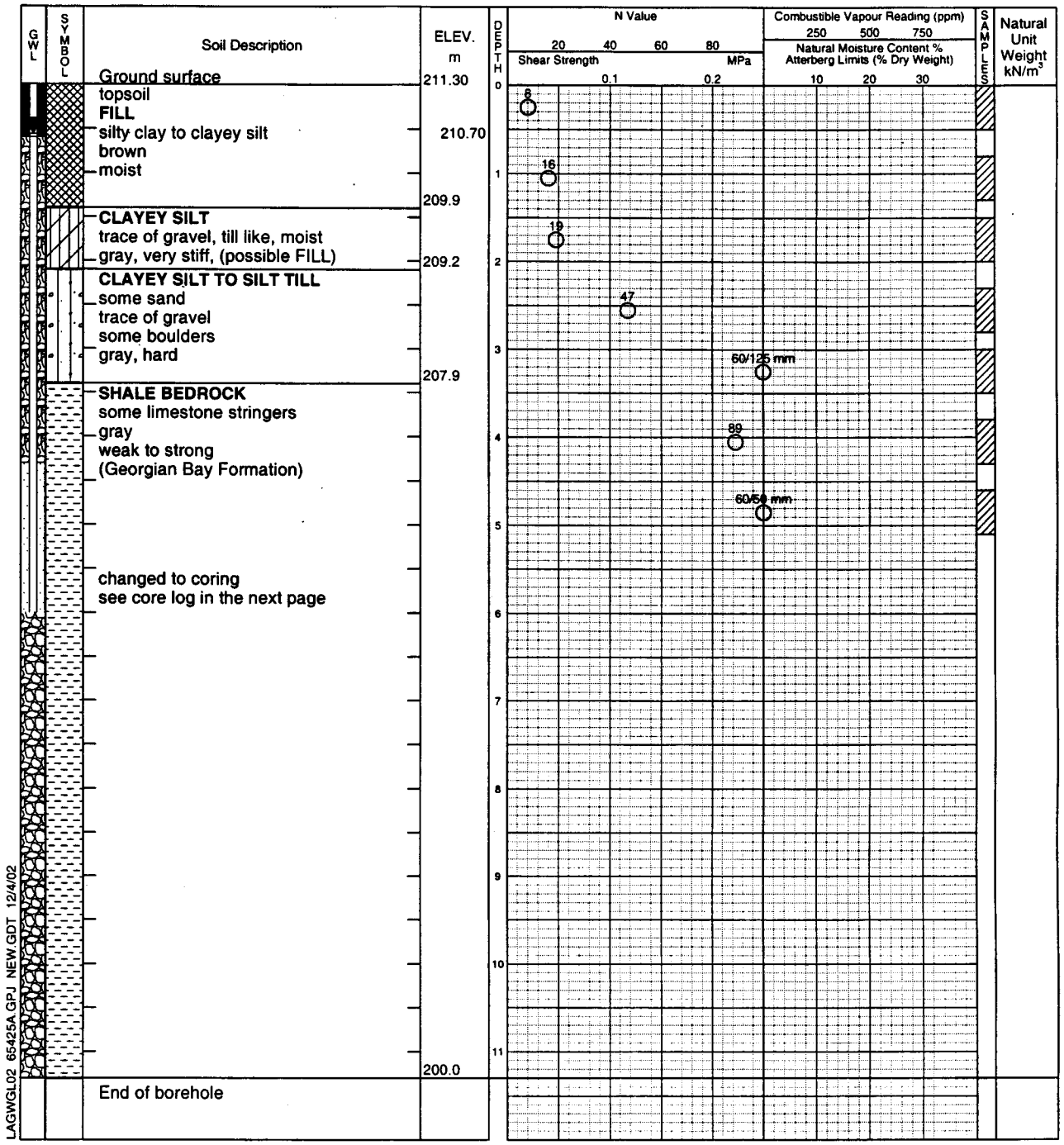
Date Drilled: 28.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
03.12.2002	0.6	

CORE LOG

BH NO. 15A

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	211.3	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/27/02	11/28/02	Siva	15Aa
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	1 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
206.1			**SHALE BEDROCK** some limestone stringers moderately to slightly weathered hard layers = 20% gray weak to strong (Georgian Bay Formation)	1	B	F	C							1	95	43	95	gray
	6																	
204.6			hard layers = 69%	1	B	F	C							2	97	28	90	gray
	7																	
203.5			hard layers = 82% 170 mm vertical fracture at 7.8 m depth 70 mm vertical fracture at 8.6 m depth	1 1 1	B C C	F V V	C							3	96	37	95	gray
	8																	
	9																	
202.0			hard layers = 72%	1	B	F	C							4	100	52	95	gray
	10																	
200.5			hard layers = 7%	1	B	F	C							5	100	72	95	gray
	11																	

CORE LOG 65425AR.GPJ CORE_LOG.GDT 12/2/02

Trow

Trow Consulting Engineers Ltd.

CORE LOG

BH NO. 15A

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
York/Peel Feedermain	Vertical	211.3	Geodetic	brge0065425a
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Heart Lake Road, Queen Street and Airport Road, Brampton	11/27/02	11/28/02	Siva	15Aa
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Region of Peel			NX	2 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS: NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
200.0			End of Borehole at 11.3 m															
	12																	
	13																	
	14																	
	15																	
	16																	
	17																	

Log of Borehole 16

Project No. brge0065425a

Project: York/Peel Feedermain

Location: City of Brampton - Clark Boulevard, 4839706 N, 602411 E

Drawing No. 16

Sheet No. 1 of 1

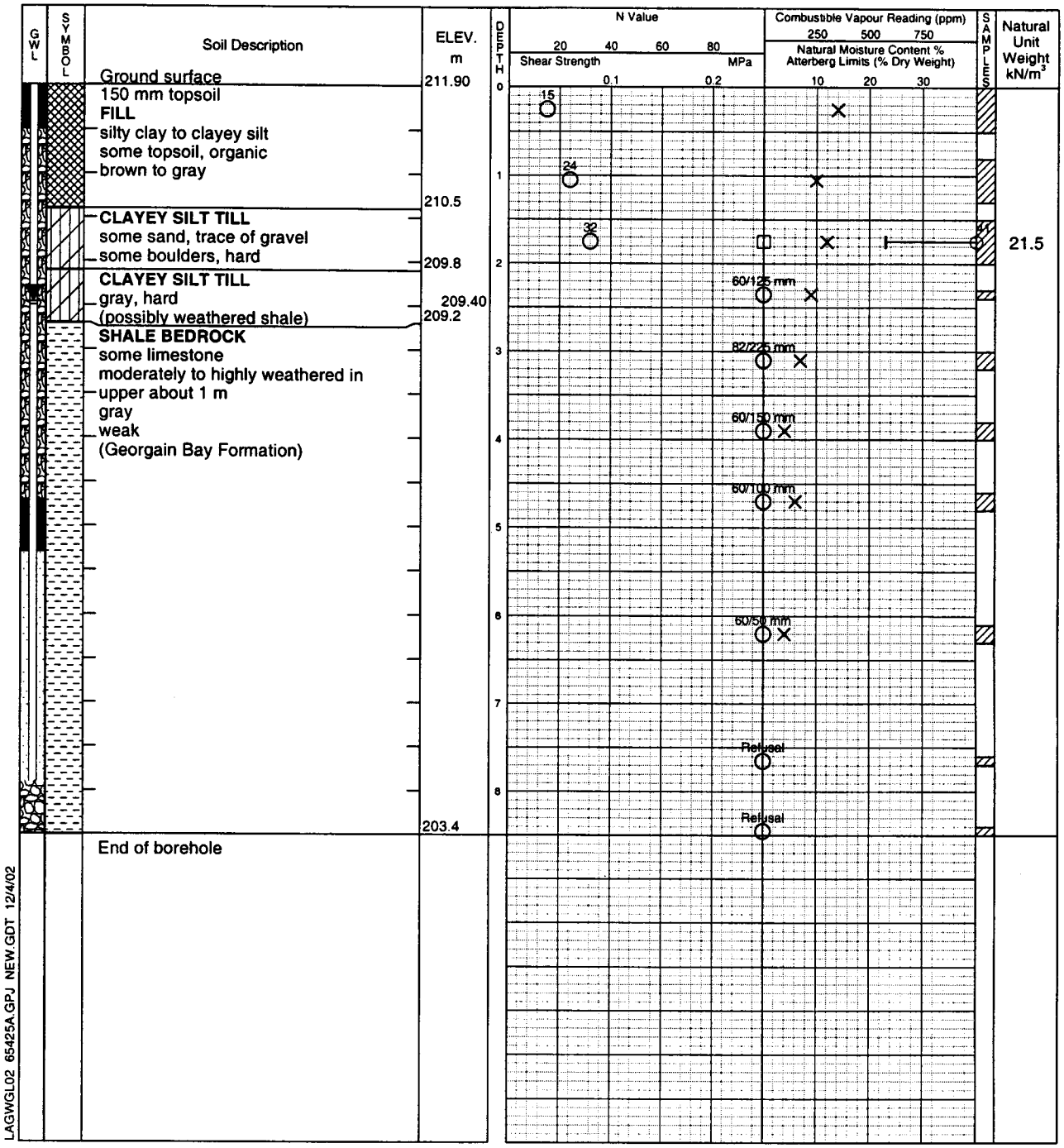
Date Drilled: 29.10.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	5.9	
12.11.2002	2.4	
03.12.2002	2.5	

Log of Borehole 17

Project No. brge0065425a

Drawing No. 17

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - West Drive, 4839830 N, 602491 E

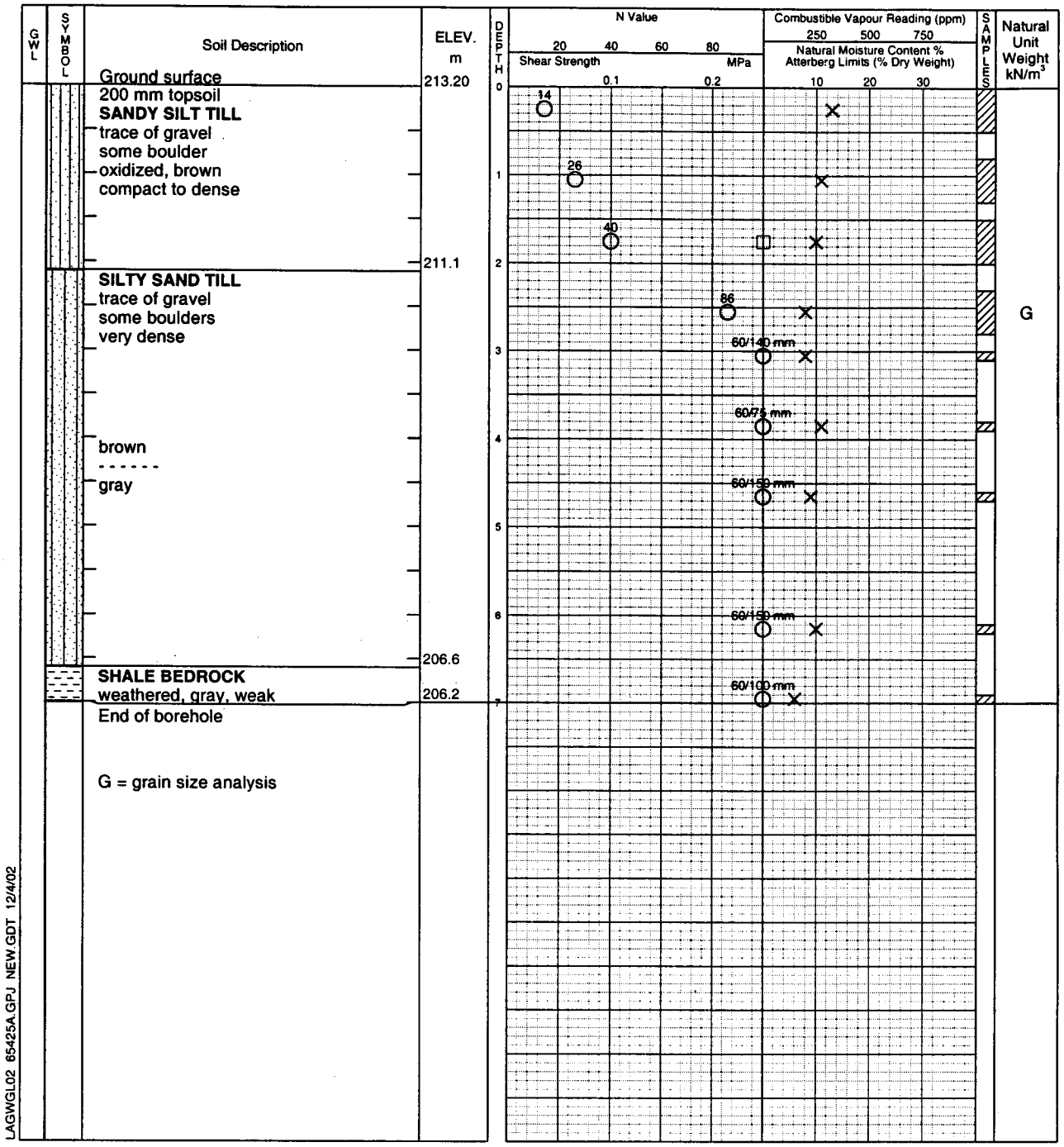
Date Drilled: 29.10.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Time	Water Level (m)	Depth to Cave (m)
Completion	Dry	

Trow

Log of Borehole 18

Project No. brge0065425a

Drawing No. 18

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - West Drive, 4839950 N, 602358 E

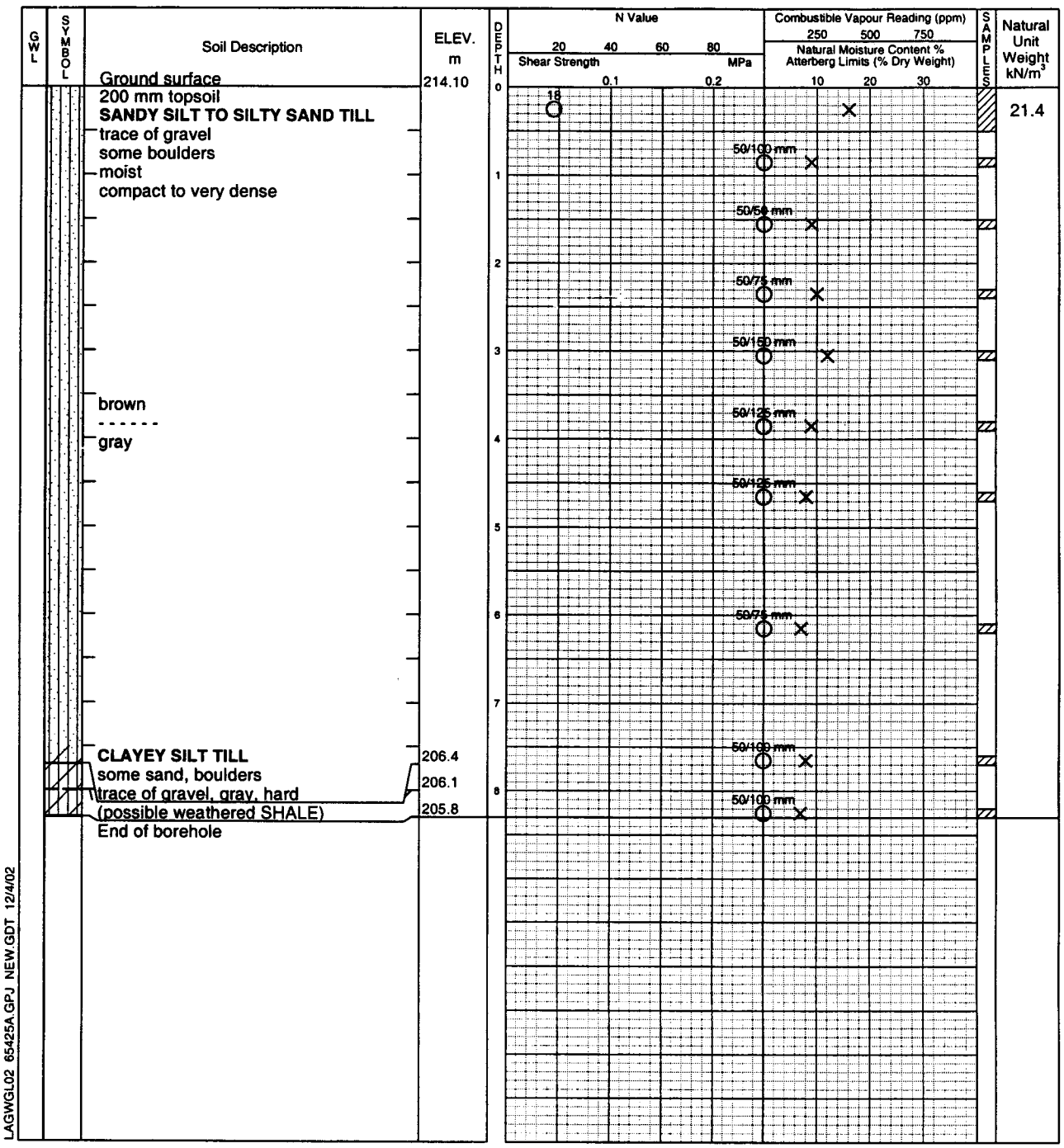
Date Drilled: 06.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	wet cave	3.0
6 hrs. later	2.1	3.0

Log of Borehole 19

Project No. brge0065425a

Drawing No. 19

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - West Drive, 4840049 N, 602255 E

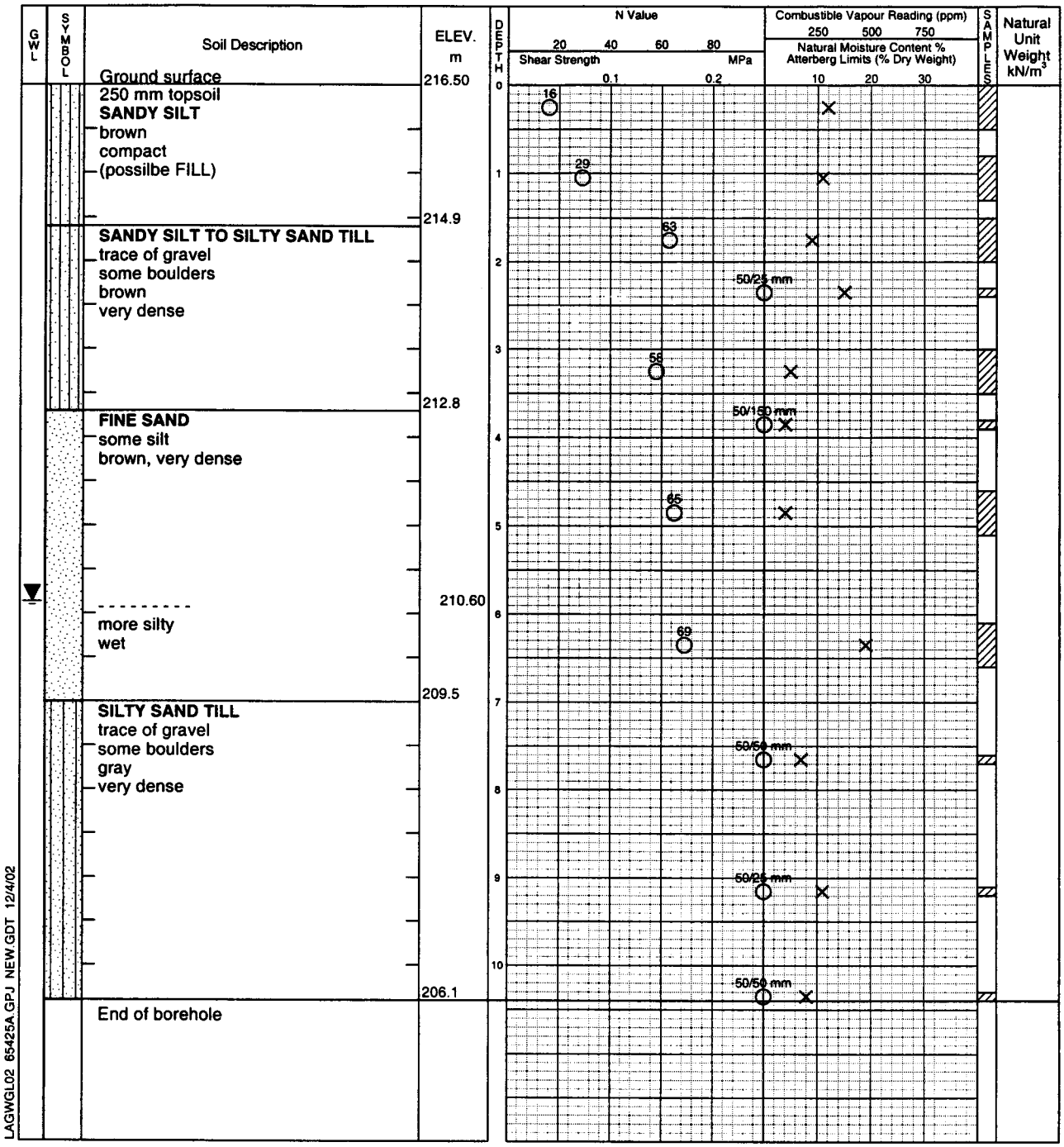
Date Drilled: 06.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	6.1	6.2
3 hrs. later	5.9	6.2

Log of Borehole 20

Project No. brge0065425a

Drawing No. 20

Project: York/Peel Feedermain

Sheet No. 1 of 2

Location: City of Brampton - West Drive, 4840140 N, 602157 E

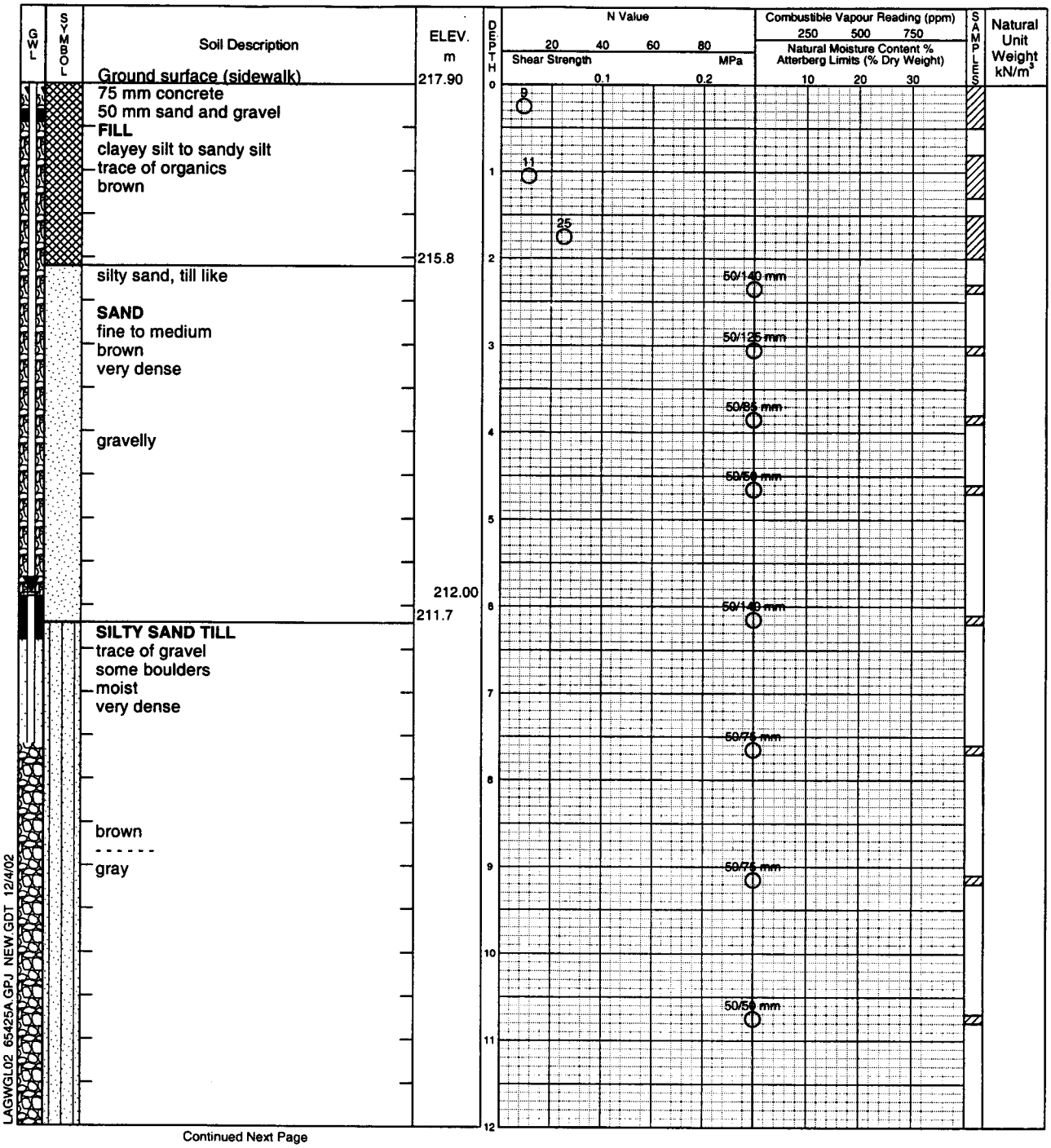
Date Drilled: 29.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
Completion	7.0	
03.12.2002	5.9	

Trow

Log of Borehole 20

Project No. brge0065425a

Drawing No. 20

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 12	N Value 20 40 60 80 / Shear Strength 0.1 0.2 MPa	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
			205.90					
			205.6		60/75 mm			
		End of borehole						

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	7.0	
03.12.2002	5.9	

Log of Borehole 21

Project No. brge0065425a

Drawing No. 21

Project: York/Peel Feedermain

Sheet No. 1 of 2

Location: City of Brampton - West Drive, 4840181 N, 602187 E

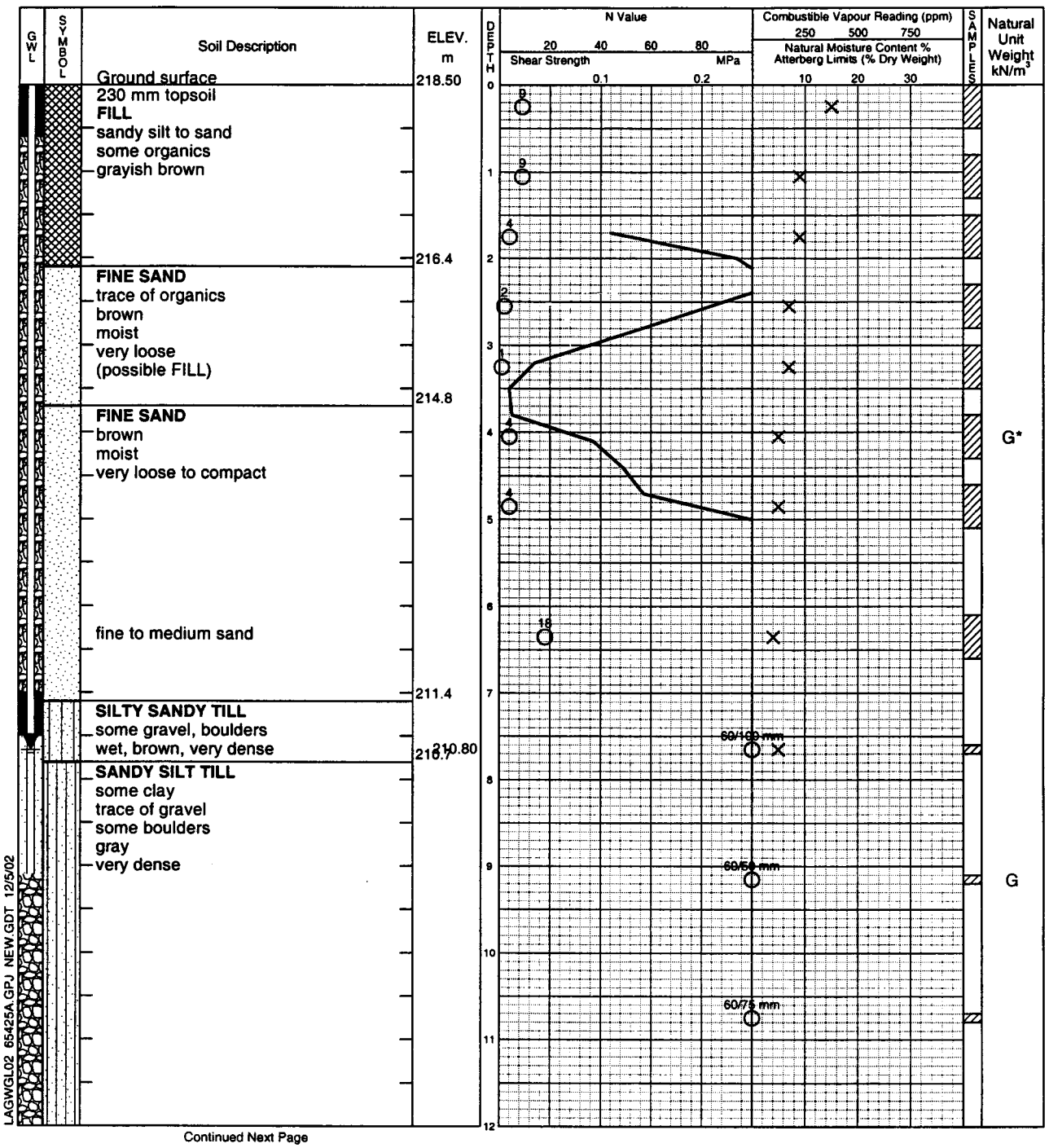
Date Drilled: 26.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/5/02

Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
Completion 03.12.2002	Dry 7.7	

Trow

Log of Borehole 21

Project No. brge0065425a

Drawing No. 21

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		SANDY SILT TILL	206.50	12
		as above		
				13
			204.7	
		End of borehole		
		*G = grain size analysis		

N Value
20 40 60 80
Shear Strength MPa
0.1 0.2

Combustible Vapour Reading (ppm)
250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight)
10 20 30

60/75 mm

60/50 mm

SAMPLES

Natural Unit Weight kN/m³

LAGWGL02 65425A.GPJ NEW.GDT 12/5/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion 03.12.2002	Dry 7.7	

Log of Borehole 22

Project No. brge0065425a

Drawing No. 22

Project: York/Peel Feedermain

Sheet No. 1 of 2

Location: City of Brampton - West Drive, 4840333 N, 602168 E

Date Drilled: 06.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

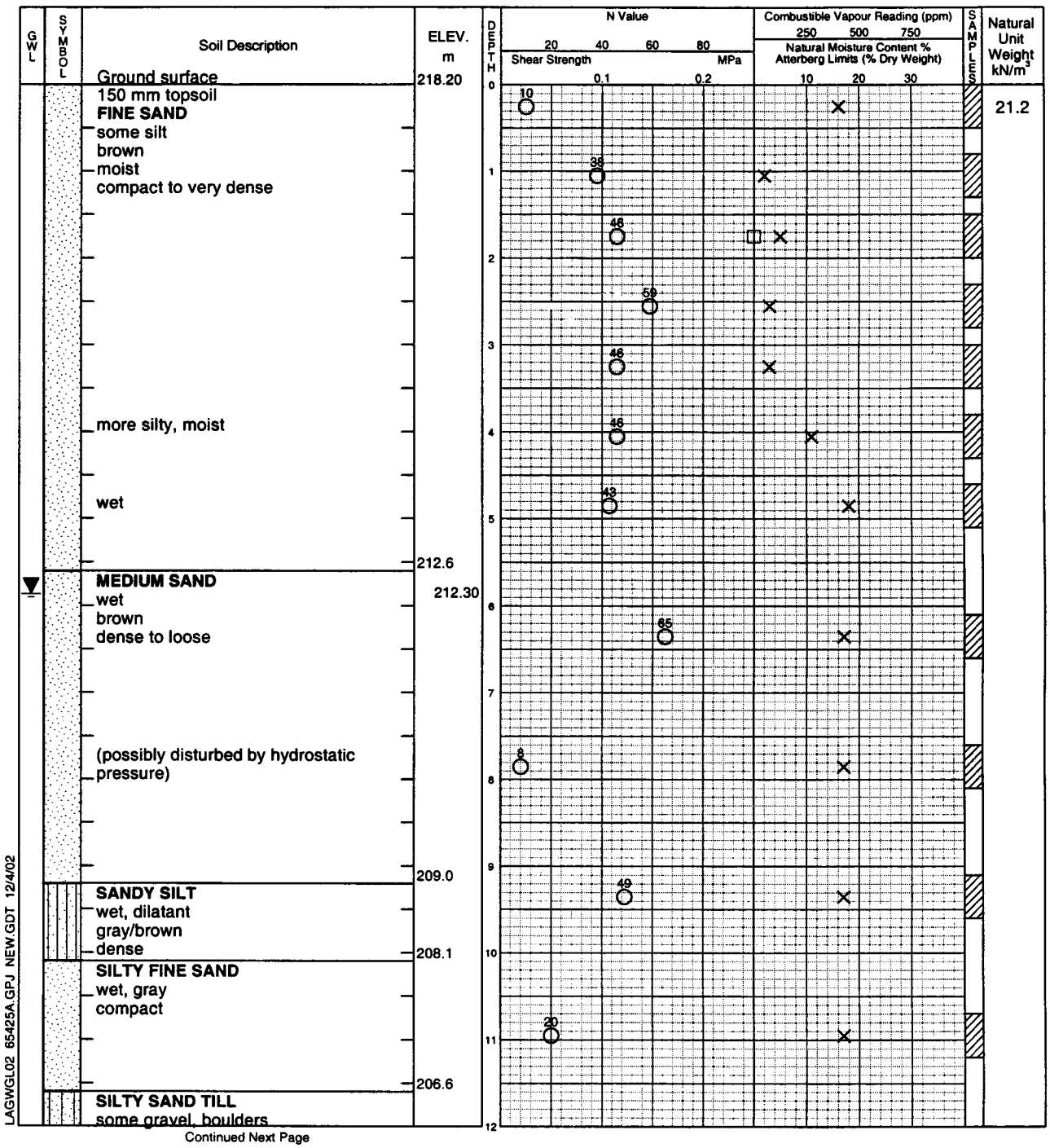
Combustible Vapour Reading

Natural Moisture

Plastic and Liquid Limit

Undrained Triaxial at % Strain at Failure

Penetrometer



LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Continued Next Page

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	5.9	6.2

Log of Borehole 22

Project No. brge0065425a

Drawing No. 22

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 12	N Value 20 40 60 80 / Shear Strength 0.1 0.2 MPa	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
		wet, gray very dense	206.20		89/275 mm			
			205.6					
		End of borehole						

LAGWGL02 65425A.GPJ NEW.GDT 12/4/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	5.9	6.2

Log of Borehole 23

Project No. brge0065425a

Drawing No. 23

Project: York/Peel Feedermain

Sheet No. 1 of 2

Location: City of Brampton - Queen Street, 4840432 N, 602066 E

Date Drilled: 26.11.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

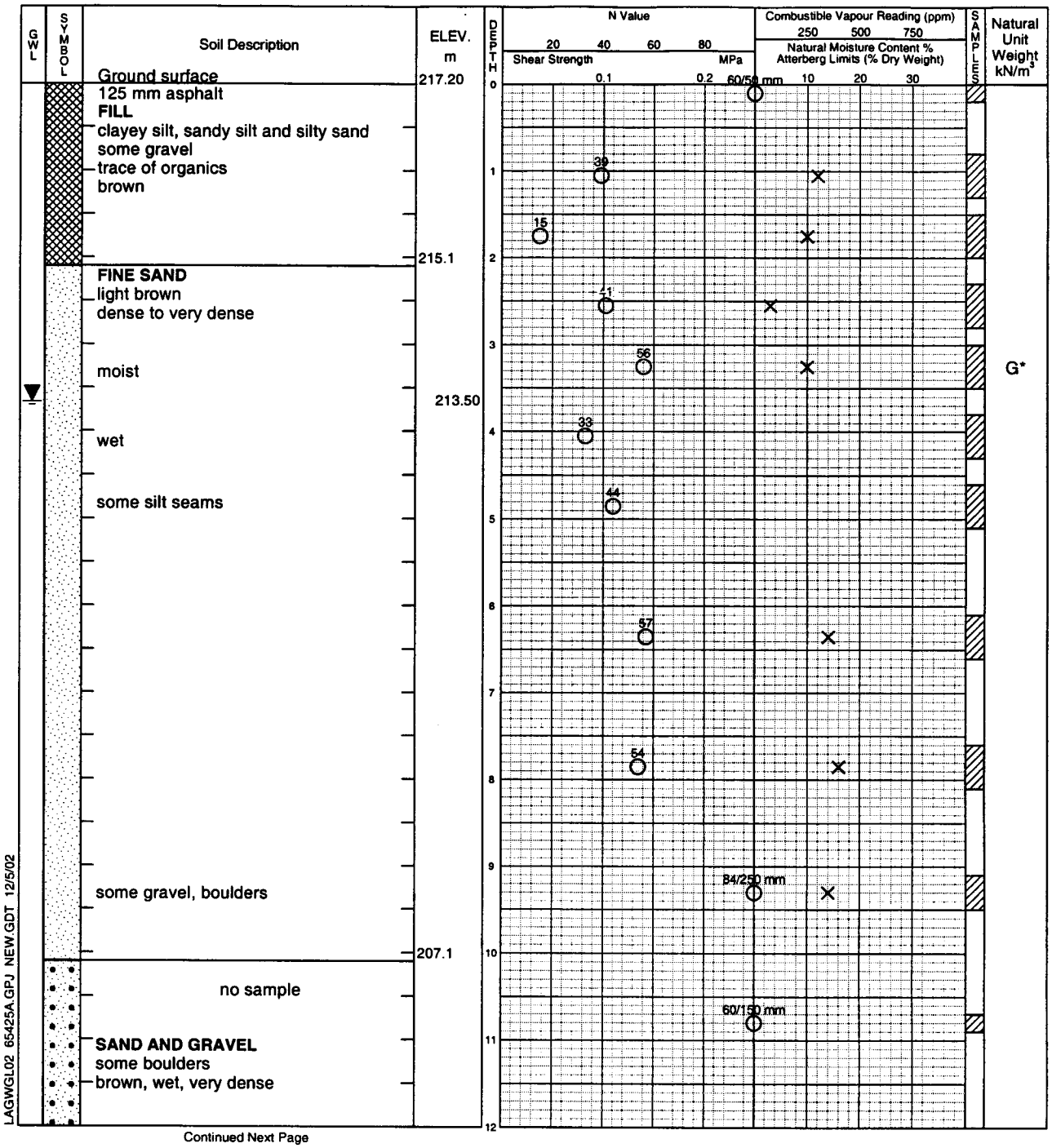
Combustible Vapour Reading

Natural Moisture

Plastic and Liquid Limit

Undrained Triaxial at % Strain at Failure

Penetrometer



Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
Completion	3.7	11.4

Trow

Log of Borehole 23

Project No. brge0065425a

Drawing No. 23

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 12	N Value 20 40 60 80 / Shear Strength 0.1 0.2 MPa	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
			205.20					
			204.9		60/100 mm			
		End of borehole *G = grain size analysis						

LAGWGL02 65425A.GPJ NEW.GDT 12/5/02

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	3.7	11.4

Log of Borehole 24

Project No. brge0065425a

Drawing No. 24

Project: York/Peel Feedermain

Sheet No. 1 of 1

Location: City of Brampton - Queen Street, 4840478 N, 602105 E

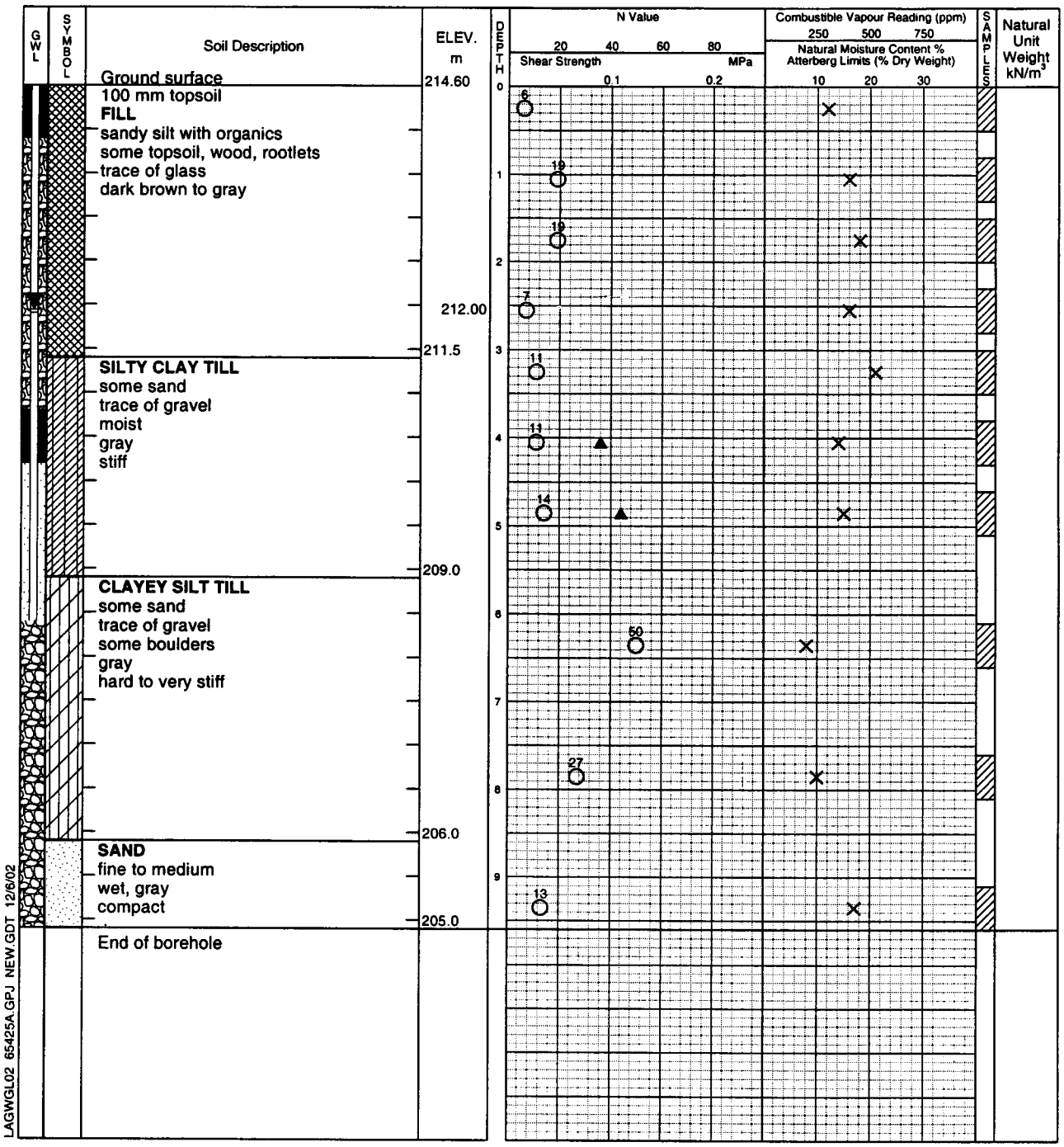
Date Drilled: 03.12.2002

Drill Type: Solid Auger

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

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



LAGWGL02 65425A.GPJ NEW.GDT 12/6/02

Trow

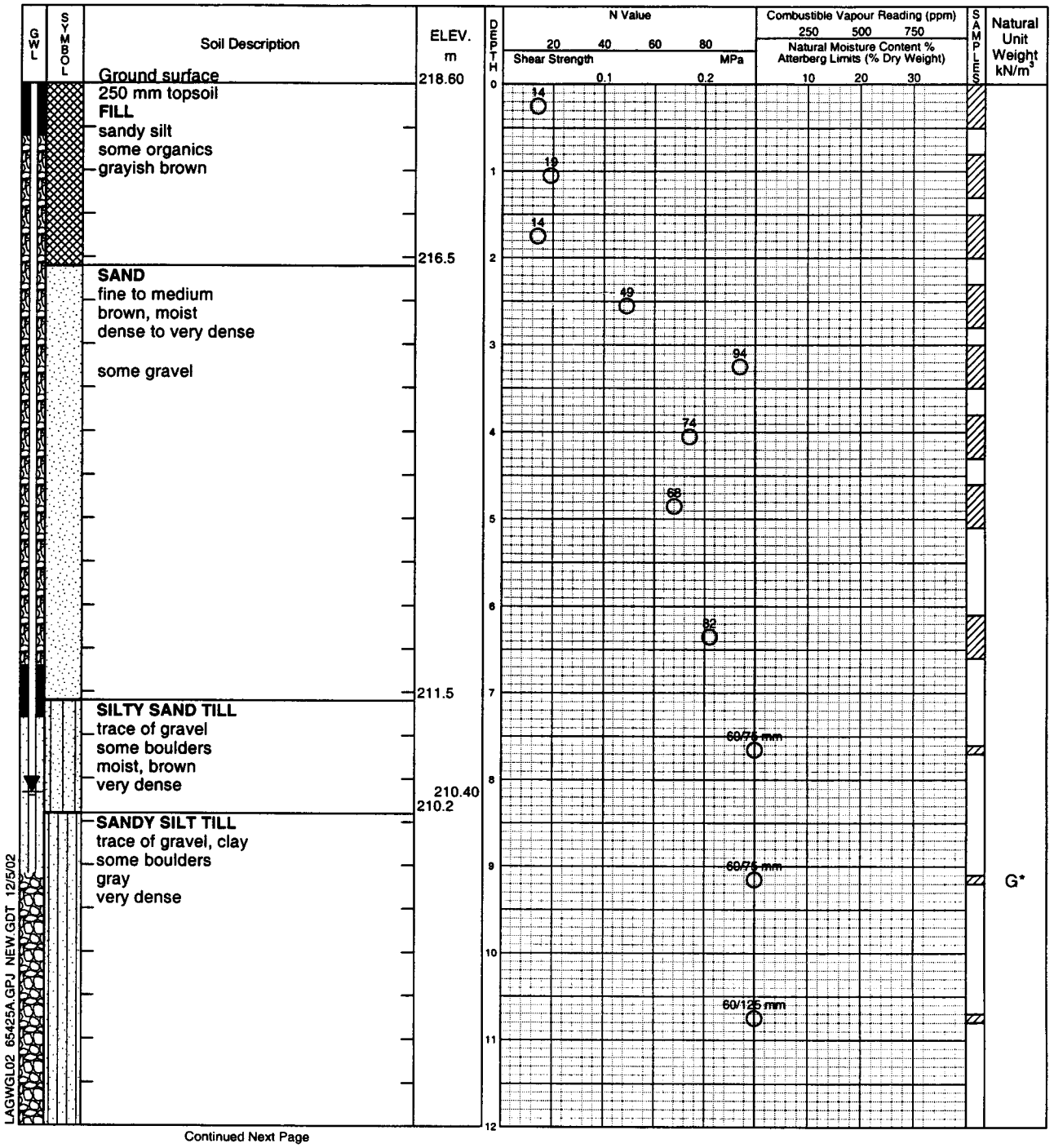
Time	Water Level (m)	Depth to Cave (m)
Completion	3.7	7.9
03.12.2002	7.6	
06.12.2002	2.6	

Log of Borehole 26

Project No. brge0065425a
Drawing No. 26
Project: York/Peel Feedermain
Sheet No. 1 of 2
Location: City of Brampton - Off West Drive, 4840234 N, 602230 E

Date Drilled: 26.11.2002
Drill Type: Solid Auger
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGL02 65425A.GPJ NEW.GDT 12/5/02

Continued Next Page

Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	Dry	
03.12.2002	8.2	

Log of Borehole 26

Project No. brge0065425a

Drawing No. 26

Project: York/Peel Feedermain

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 / Shear Strength 0.1 0.2 MPa	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
			206.60	12				
		End of borehole	206.4					
		*G = grain size analysis						

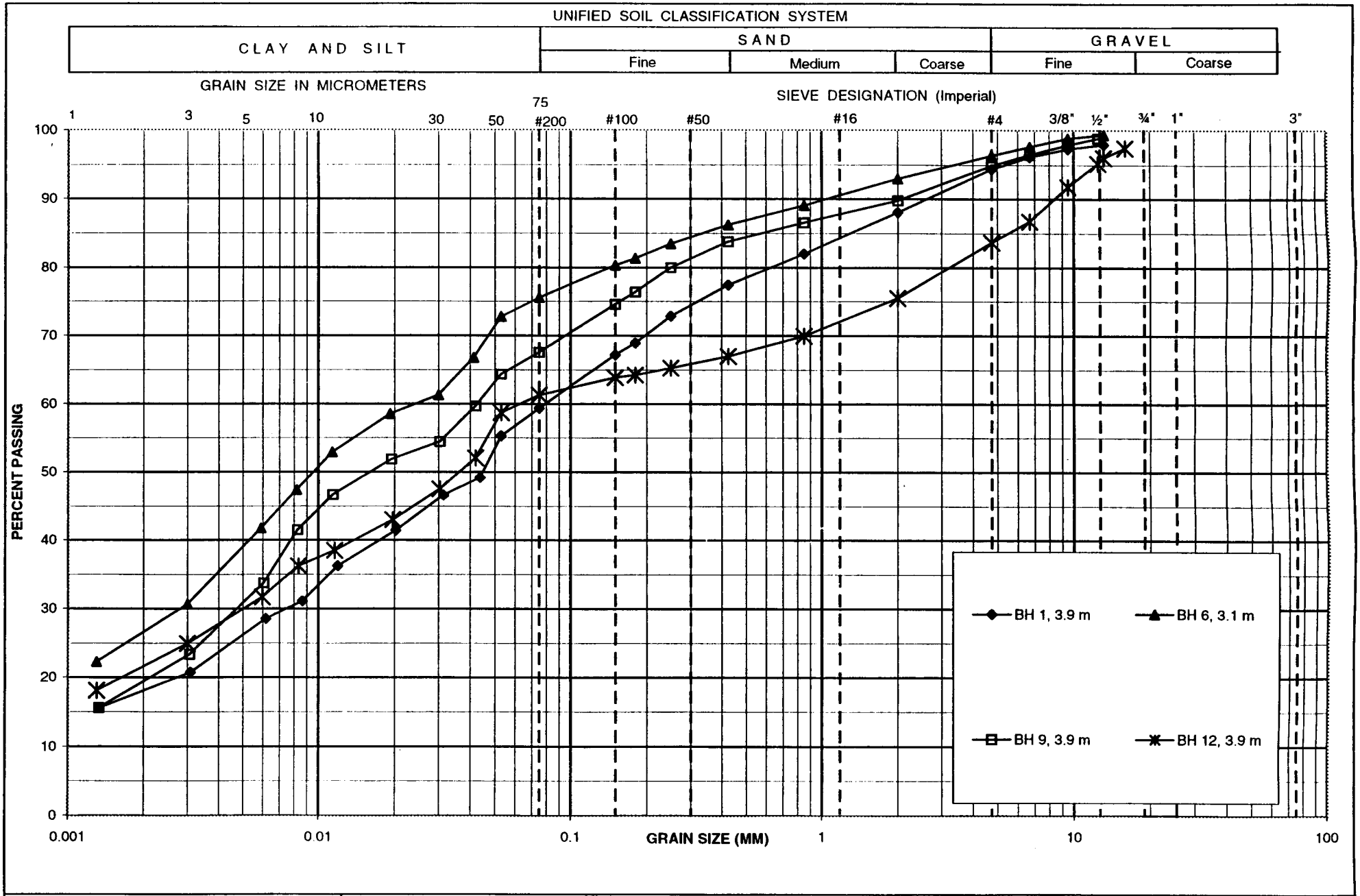
60/50 mm

LAGWGL02 65425A.GPJ NEW.GDT 12/5/02

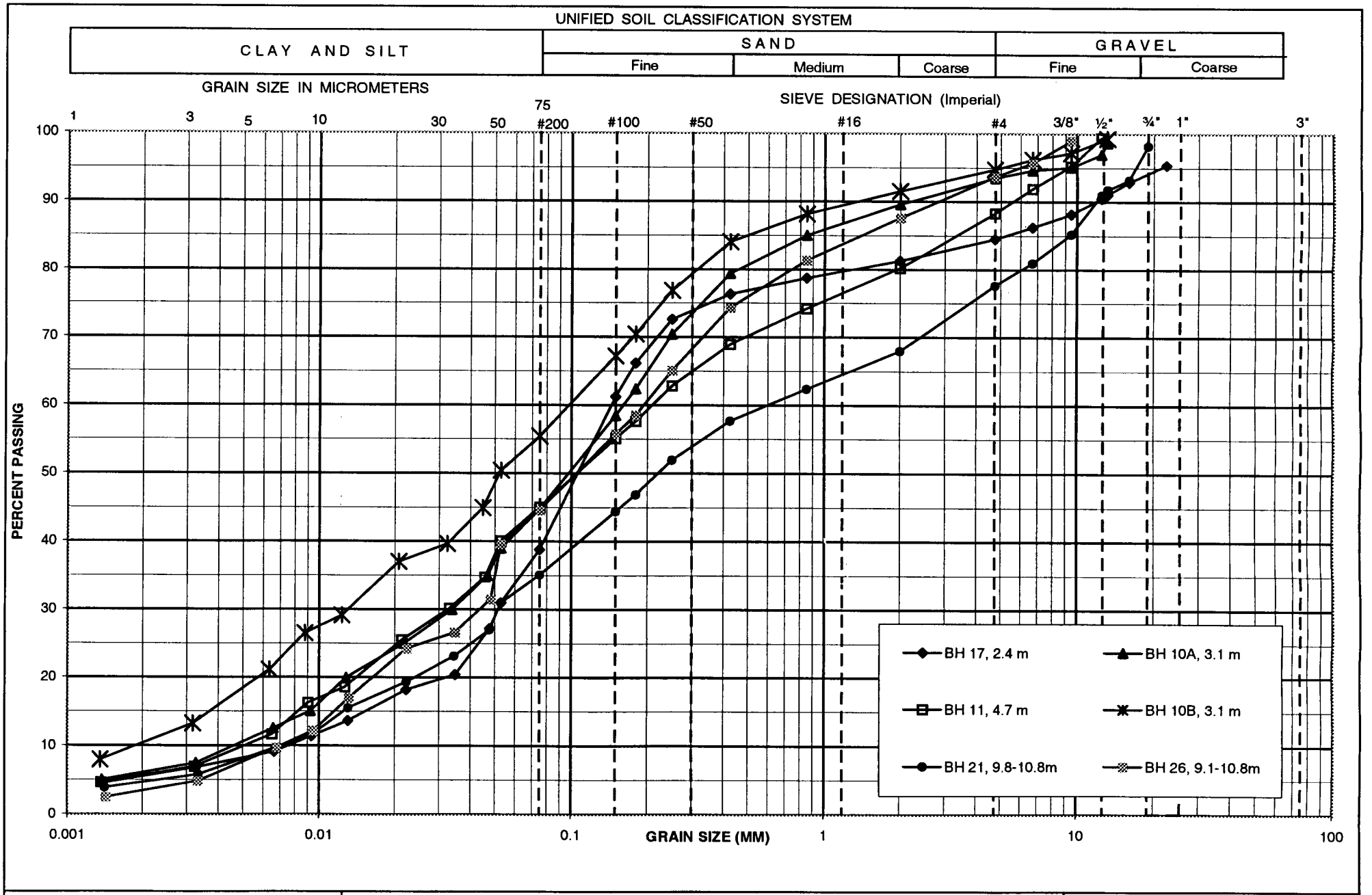
Trow

Time	Water Level (m)	Depth to Cave (m)
Completion	Dry	
03.12.2002	8.2	

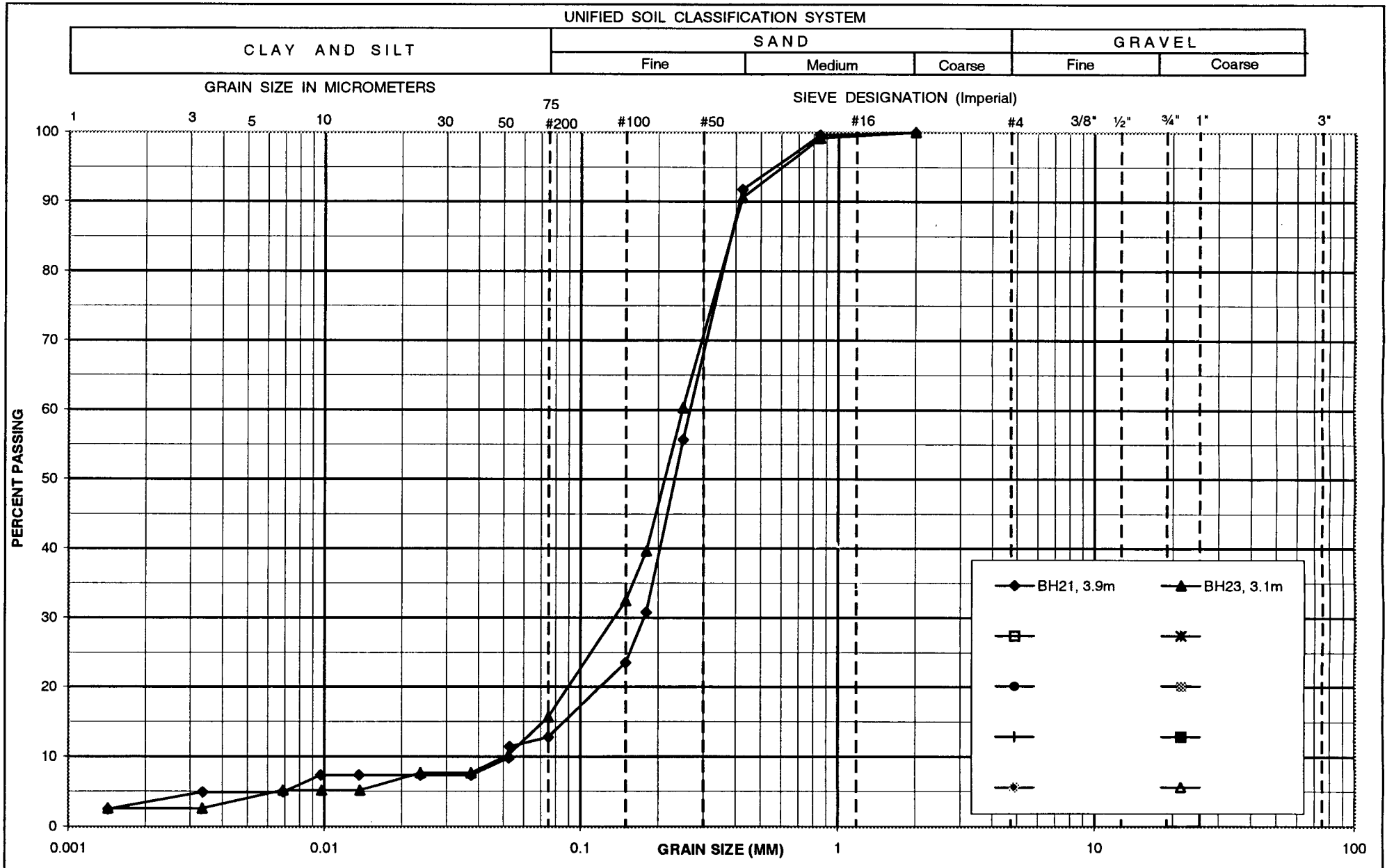
Appendix C:
Figures



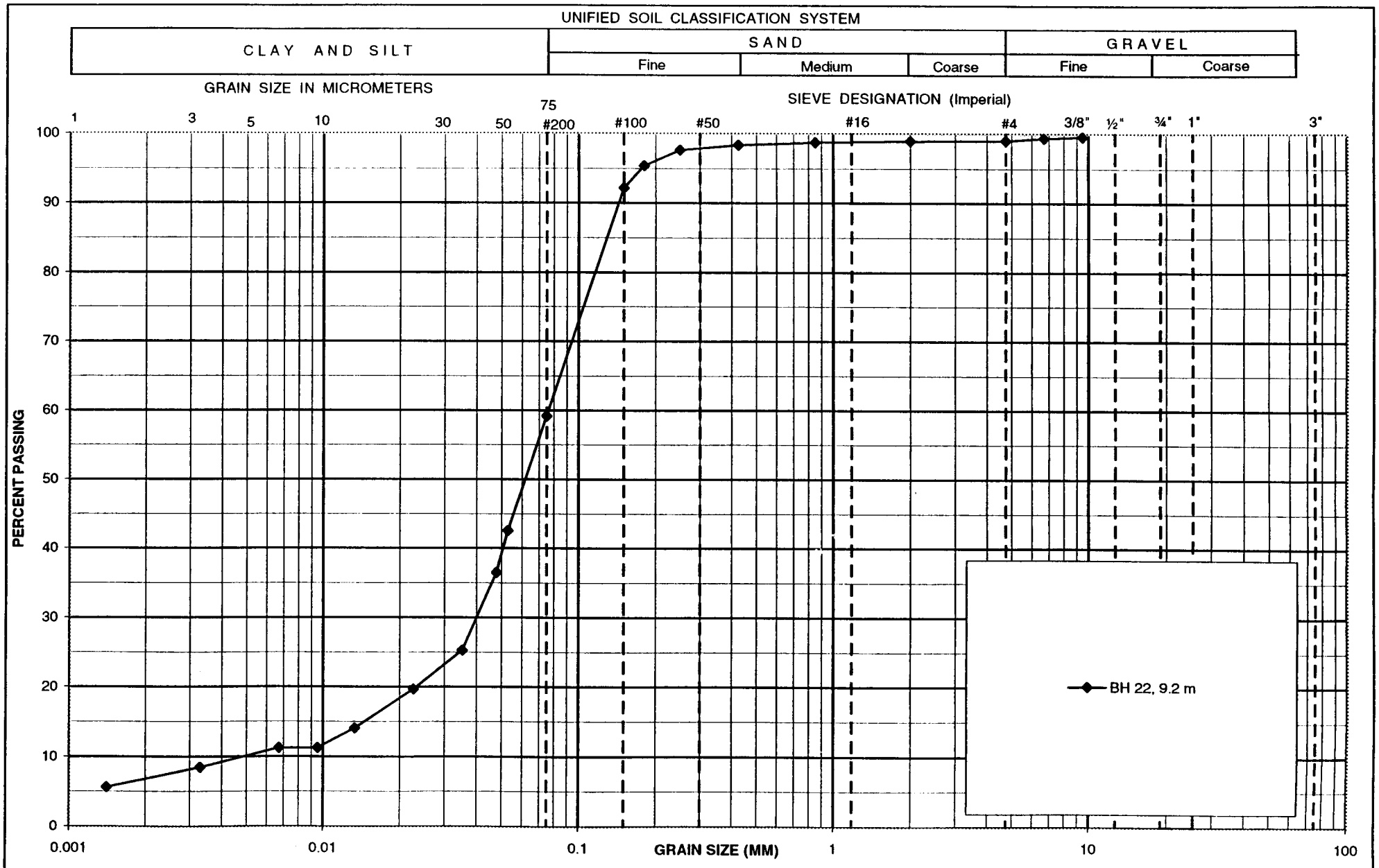
Trow Consulting Engineers Ltd.	GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY TILL	FIGURE No. 1 REF. No. brge0065425a DATE December 2002



Trow Consulting Engineers Ltd.	GRAIN SIZE DISTRIBUTION SILTY SAND TO SANDY SILT TILL	FIGURE No. 2 REF. No. brge0065425a DATE December 2002



Trow Consulting Engineers Ltd.	GRAIN SIZE DISTRIBUTION SAND	FIGURE No. 3 REF. No. brge0065425a DATE December 2002



Trow Consulting Engineers Ltd.	GRAIN SIZE DISTRIBUTION SANDY SILT	FIGURE No. 4 REF. No. brge0065425a DATE December 2002

Appendix D:
Point Load Test Results

York/Peel Feedermain
Brampton, Ontario

brge0065425a

Point Load Test Results

Specimen	Loading Direction	Ram Oil Pressure (MPa)	D (mm)	Is (MPa)	Is50 (MPa)	Remarks
Borehole 2 Run # 1						
1	Perpendicular*	100	75	25.6	31.4	>
2	Parallel*	2.5	48	1.6	1.5	
3	Perpendicular	2.5	45	1.8	1.7	
4	Parallel	2	48	1.3	1.2	
5	Perpendicular	10	50	5.8	5.8	
6	Parallel	13	48	8.1	8.0	
7	Perpendicular	3.5	60	1.4	1.5	
8	Parallel	5	48	3.1	3.1	
Borehole 2 Run # 2						
7	Perpendicular	2.5	60	1.0	1.1	
8	Parallel	1	48	0.6	0.6	
9	Perpendicular	2	55	1.0	1.0	
10	Parallel	1	48	0.6	0.6	
11	Perpendicular	5	60	2.0	2.2	
12	Parallel	3	48	1.9	1.8	
13	Perpendicular	15	80	3.4	4.3	
14	Parallel	5	48	3.1	3.1	
15	Perpendicular	3	65	1.0	1.2	
16	Parallel	3.5	48	2.2	2.1	
17	Perpendicular	5	65	1.7	1.9	
18	Parallel	3.5	48	2.2	2.1	
19	Perpendicular	4	55	1.9	2.0	
20	Parallel	2.5	48	1.6	1.5	
Borehole 2 Run # 3						
21	Perpendicular	3.5	55	1.7	1.8	
22	Parallel	1.5	48	0.9	0.9	

* perpendicular or parallel to bedding plane

York/Peel Feedermain
Brampton, Ontario

brge0065425a

Point Load Test Results

Specimen	Loading Direction	Ram Oil Pressure (MPa)	D (mm)	Is (MPa)	Is50 (MPa)	Remarks
Borehole 5 Run # 1						
1	Perpendicular*	7.5	40	6.8	6.0	
2	Parallel*	2	48	1.3	1.2	
3	Perpendicular	71.5	40	64.5	57.7	
4	Parallel	13	48	8.1	8.0	
5	Perpendicular	72.5	42	59.3	54.3	
6	Parallel	22	48	13.8	13.5	
7	Perpendicular	100	65	34.1	38.9	>
8	Parallel	9.5	48	5.9	5.8	
Borehole 5 Run # 2						
7	Perpendicular	17	40	15.3	13.7	
8	Parallel	5	48	3.1	3.1	
9	Perpendicular	20	55	9.5	10.0	>
10	Parallel	18	48	11.3	11.0	
11	Perpendicular	4	40	3.6	3.2	>
12	Parallel	4	48	2.5	2.5	
13	Perpendicular	22	50	12.7	12.7	
14	Parallel	22	48	13.8	13.5	
15	Perpendicular	76.5	90	13.6	18.3	
16	Parallel	40	48	25.0	24.5	

* perpendicular or parallel to bedding plane

York/Peel Feedermain
Brampton, Ontario

brge0065425a

Point Load Test Results

Specimen	Loading Direction	Ram Oil Pressure (MPa)	D (mm)	Is (MPa)	Is50 (MPa)	Remarks
Borehole 8 Run # 1						
1	Perpendicular*	36	30	57.7	44.7	
2	Parallel*	89	48	55.7	54.6	
3	Perpendicular	9	40	8.1	7.3	
4	Parallel	6	48	3.8	3.7	
5	Perpendicular	4	40	3.6	3.2	
6	Parallel	1	48	0.6	0.6	
Borehole 8 Run # 2						
7	Perpendicular	80	60	32.1	35.1	
8	Parallel	20	48	12.5	12.3	
9	Perpendicular	100	60	40.1	43.9	>
10	Parallel	7	48	4.4	4.3	
Borehole 8 Run # 2						
11	Perpendicular	100	45	71.2	67.6	>
12	Parallel	30	48	18.8	18.4	
13	Perpendicular	34	35	40.0	33.5	
14	Parallel	44	48	27.5	27.0	

* perpendicular or parallel to bedding plane

York/Peel Feedermain
Brampton, Ontario

brge0065425a

Point Load Test Results

Specimen	Loading Direction	Ram Oil Pressure (MPa)	D (mm)	Is (MPa)	Is50 (MPa)	Remarks
Borehole 10A Run # 1						
1	Perpendicular*	17	40	15.3	13.7	
2	Parallel*	23.5	48	14.7	14.4	
3	Perpendicular	22.5	40	20.3	18.1	
4	Parallel	2.5	48	1.6	1.5	
5	Perpendicular	100	50	57.7	57.7	>
6	Parallel	3.5	48	2.2	2.1	
Borehole 10A Run # 2						
7	Perpendicular	6	45	4.3	4.1	
8	Parallel	2.5	48	1.6	1.5	
9	Perpendicular	13.5	35	15.9	13.3	
10	Parallel	4	48	2.5	2.5	
11	Perpendicular	16.5	70	4.9	5.7	
12	Parallel	11.5	48	7.2	7.1	
13	Perpendicular	100	30	160.3	124.2	>
14	Parallel	36.5	48	22.9	22.4	
15	Perpendicular	44	70	13.0	15.3	
16	Parallel	71	48	44.5	43.6	
Borehole 10A Run # 3						
17	Perpendicular	8	60	3.2	3.5	
18	Parallel	11.5	48	7.2	7.1	
19	Perpendicular	14.5	45	10.3	9.8	
20	Parallel	13.5	48	8.5	8.3	
21	Perpendicular	12.5	35	14.7	12.3	
22	Parallel	18	48	11.3	11.0	
23	Perpendicular	100	55	47.7	50.0	>
24	Parallel	100	48	62.6	61.3	>
25	Perpendicular	100	35	117.8	98.5	>
26	Parallel	4	48	2.5	2.5	
27	Perpendicular	36	40	32.5	29.0	
28	Parallel	36	48	22.5	22.1	
Borehole 10A Run # 4						
29	Perpendicular	100	70	29.4	34.8	>
30	Parallel	100	48	62.6	61.3	>
31	Perpendicular	66.5	80	15.0	19.0	
32	Parallel	100	48	62.6	61.3	
33	Perpendicular	3.5	45	2.5	2.4	
34	Parallel	2.5	48	1.6	1.5	
35	Perpendicular	37.5	45	26.7	25.3	
36	Parallel	63	48	39.4	38.6	
37	Perpendicular	47	55	22.4	23.5	
38	Parallel	62	48	38.8	38.0	
39	Perpendicular	44	65	15.0	17.1	
40	Parallel	33.5	48	21.0	20.6	
41	Perpendicular	100	75	25.6	31.4	>
42	Parallel	30.5	48	19.1	18.7	

York/Peel Feedermain
Brampton, Ontario

brge0065425a

Point Load Test Results

Specimen	Loading Direction	Ram Oil Pressure (MPa)	D (mm)	Is (MPa)	Is50 (MPa)	Remarks
Borehole 10A Run # 5						
43	Perpendicular	28.5	45	20.3	19.3	
44	Parallel	10.5	48	6.6	6.4	
45	Perpendicular	11	55	5.2	5.5	
46	Parallel	6	48	3.8	3.7	
47	Perpendicular	20	70	5.9	7.0	
48	Parallel	4	48	2.5	2.5	
49	Perpendicular	7.5	55	3.6	3.8	
50	Parallel	8	48	5.0	4.9	
51	Perpendicular	10.5	70	3.1	3.7	
52	Parallel	13.5	48	8.5	8.3	

* perpendicular or parallel to bedding plane

York/Peel Feedermain
Brampton, Ontario

brge0065425a

Point Load Test Results

Specimen	Loading Direction	Ram Oil Pressure (MPa)	D (mm)	Is (MPa)	Is50 (MPa)	Remarks
Borehole 12 Run # 1						
1	Perpendicular*	43.5	30	69.7	54.0	
2	Parallel*	6	48	3.8	3.7	
Borehole 12 Run # 2						
3	Perpendicular	5.5	40	5.0	4.4	
4	Parallel	5.5	48	3.4	3.4	
5	Perpendicular	19.5	65	6.7	7.6	
6	Parallel	19	48	11.9	11.7	
7	Perpendicular	74	70	21.8	25.8	
8	Parallel	5	48	3.1	3.1	
9	Perpendicular	10.5	40	9.5	8.5	
10	Parallel	4.5	48	2.8	2.8	
Borehole 12 Run # 3						
11	Perpendicular	100	40	90.2	80.6	>
12	Parallel	40	48	25.0	24.5	
13	Perpendicular	4.5	75	1.2	1.4	
14	Parallel	11.5	48	7.2	7.1	
15	Perpendicular	21.5	90	3.8	5.1	
16	Parallel	3	48	1.9	1.8	
17	Perpendicular	3.5	80	0.8	1.0	
18	Parallel	2.5	48	1.6	1.5	
19	Perpendicular	100	100	14.4	20.4	>
20	Parallel	100	48	62.6	61.3	>
21	Perpendicular	11	40	9.9	8.9	
22	Parallel	5	48	3.1	3.1	
23	Perpendicular	21.5	95	3.4	4.7	
24	Parallel	19.5	48	12.2	12.0	
Borehole 12 Run # 4						
25	Perpendicular	7.5	60	3.0	3.3	
26	Parallel	38.5	48	24.1	23.6	
27	Perpendicular	38	35	44.8	37.4	
28	Parallel	11	48	6.9	6.7	
29	Perpendicular	65	60	26.0	28.5	
30	Parallel	10	48	6.3	6.1	
31	Perpendicular	84	70	24.7	29.3	
32	Parallel	18.5	48	11.6	11.3	
33	Perpendicular	24	85	4.8	6.2	
34	Parallel	25	48	15.7	15.3	

* perpendicular or parallel to bedding plane

Appendix E:
Environmental Test Results

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Trow-Brampton
Attention: James Ng
Project: BRGE0065425A
P.O.:
Sample Type: Soil
Date Received: Nov 11/02
Date Analysed: Nov 14 & Nov 18/02
Date Reported: Nov 19/02

Sam Sanyal, M.Sc., C. Chem
Manager, Inorganic Analysis.

Certificate of Analysis

Data Pertain To Specific Sample(s) Tested

PARAMETER	Units	CONTROL SAMPLE			SAMPLE DATA						
		Expected	Found	Recovery %	11504 BH2 SS2	11505 BH5 SS3	11506 BH15 SS4	11506 BH15 SS4 Duplicate			
pH	units	6.70	6.69	100	8.8	8.7	8.6	8.6			
Resistivity	ohms-cm	6788.9	6711.4	99	4787	11225	11324	11598			
Redox Potential	mV	228	231	101	192	185	186	185			
Sulphide	-	-	-	-	-ve	-ve	-ve	-ve			
Moisture Content	%	-	-	-	7.9	8.4	8.4	8.4			

Sample Disposal: 30 Days from the Reporting Date.
Analyst(s): NL, SS

Client:	Trow Brampton
Attention:	James Ng
Project:	BRGE0065425A
P.O.:	
Sample Type:	Soil
Date Received:	Nov 11/02
Date Analysed:	Nov 11 to Nov 14/02
Date Reported:	nOV 18/02

Sam Sanyal, M.Sc. C. Chem.
Manager, Inorganic Analysis.

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit#4
Mississauga, ONT L5N 5M2
TEL: (905) 821-1112
FAX: (905) 821-2095

CERTIFICATE OF ANALYSIS FOR ONTARIO REGULATION 558/00

TCLP - LEACHATE QUALITY CRITERIA (INORGANICS)

Data Pertain To Specific Sample(s) Tested

CONTAMINANT	SCHEDULE 4 Concentration (mg/L)	Method Detection Limit (mg/L)	CONTROL SAMPLE			SAMPLE DATA (mg/L)			
			Expected Conc. (mg/L)	Found Conc. (mg/L)	Recovery %	Blank	11604 BH2 SS2	11605 BH5 SS3	11606 BH15 SS4
Arsenic	2.5	0.001	0.256	0.250	97	<0.001	<0.001	<0.001	<0.001
Barium	100	0.01	0.54	0.56	104	<0.01	0.19	0.21	0.22
Boron	500	0.01	0.63	0.67	107	<0.01	<0.01	<0.01	<0.01
Cadmium	0.5	0.005	0.175	0.176	101	<0.005	<0.005	<0.005	<0.005
Chromium	5.0	0.01	0.787	0.784	100	<0.01	<0.01	<0.01	<0.01
Cyanide Free	20.0	0.005	0.20	0.215	108	<0.005	<0.005	<0.005	<0.005
Fluoride	150	0.05	3.8	3.93	103	<0.05	0.20	0.22	0.26
Lead	5.0	0.02	0.63	0.68	108	<0.02	<0.02	<0.02	<0.02
Mercury	0.1	0.0001	0.0262	0.0263	100	<0.0001	<0.0001	<0.0001	<0.0001
(Nitrate+Nitrite)-N	1000	0.01	5.39	5.45	101	<0.01	0.04	0.05	0.04
Selenium	1.0	0.002	0.019	0.018	95	<0.002	<0.002	<0.002	<0.002
Silver	5.0	0.005	0.219	0.218	100	<0.005	<0.005	<0.005	<0.005
Initial pH (units)	-	-	-	-	-	4.93	9.26	9.22	9.24
Fluid No.	-	-	-	-	-	1	1	1	1
Fluid pH (units)	-	-	-	-	-	4.93	4.93	4.93	4.93
Final pH (units)	-	-	-	-	-	4.93	6.31	6.42	6.37

Sample Disposal: 30 Days from the Reporting Date.
All Results except pH are expressed in mg/L (parts per million).
Note: "+" means the result exceeds the Schedule 4 concentration.

Analyst(s): MD, SS, JW, AI, AV, MR

Method:

As, Se: HG-FAAS (EPA 3005/7062/7742)
Hg: CV-AAS (EPA 245.1)
Metals: ICP-AES (EPA 3005/200.7)
pH: Electrometric/pH-Meter (EPA 150.1)
Cyanide Free: Auto-Color (EPA 366.1)
Fluoride: ISE (EPA 340.2)
(NO3 + NO2)-N: Auto-Color (EPA 353.2)

Client:	Trow Brampton
Attention:	James Ng
Project:	BRGED065426A
P.O.:	
Sample Type:	Soil
Date Received:	Nov 11/02
Date Analysed:	Nov 11 to Nov 14/02
Date Reported:	Nov 18/02

Sam Sanyal, M.Sc. C. Chem.
Manager, Inorganic Analysis.

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit#4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

CERTIFICATE OF ANALYSIS FOR ONTARIO REGULATION 558/00

TCLP - LEACHATE QUALITY CRITERIA (INORGANICS)

Data Pertain To Specific Sample(s) Tested

CONTAMINANT	SCHEDULE 4 Concentration (mg/L)	Method Detection Limit (mg/L)	CONTROL SAMPLE Expected Conc. (mg/L)	Found Conc. (mg/L)	Recovery %	SAMPLE DATA (mg/L) 11506 BH16 SS4 Duplicate			
Arsenic	2.5	0.001	0.258	0.250	97	<0.001			
Barium	100	0.01	0.54	0.56	104	0.22			
Boron	500	0.01	0.63	0.67	107	<0.01			
Cadmium	0.5	0.005	0.175	0.176	101	<0.005			
Chromium	5.0	0.01	0.787	0.784	100	<0.01			
Cyanide Free	20.0	0.005	0.20	0.215	108	<0.005			
Fluoride	150	0.05	3.8	3.93	103	0.27			
Lead	5.0	0.02	0.63	0.68	108	<0.02			
Mercury	0.1	0.0001	0.0262	0.0283	100	<0.0001			
(Nitrate+Nitrite)-N	1000	0.01	5.39	5.45	101	<0.01			
Selenium	1.0	0.002	0.019	0.018	95	<0.002			
Silver	5.0	0.005	0.219	0.219	100	<0.005			
Initial pH (units)	-	-	-	-	-	9.24			
Fluid No.	-	-	-	-	-	1			
Fluid pH (units)	-	-	-	-	-	4.93			
Final pH (units)	-	-	-	-	-	6.37			

Sample Disposal: 30 Days from the Reporting Date.
Analyst(s): MD, SS, JW, AI, AV, MR
All Results except pH are expressed in mg/L (parts per million).
Note: "+" means the result exceeds the Schedule 4 concentration.

Method:

As, Se: HG-FAAS (EPA 3005/7062/7742)
Hg: CV-AAS (EPA 245.1)
Metals: ICP-AES (EPA 3005/200.7)
pH: Electrometric/pH-Meter (EPA 150.1)
Cyanide Free: Auto-Color (EPA 335.1)
Fluoride: ISE (EPA 340.2)
(NO3 + NO2)-N: Auto-Color (EPA 353.2)

ENTECH

A Division of Agri-Service Lab Inc.

6820 Kitimat Rd., Unit #4

Mississauga, ONT L5N 5M3

TEL: (905) 821-1112

FAX: (905) 821-2095

Client: Trow-Brampton

Attention: Mark Adams

Project: LAGM004923D

P.O.:

Sample Type: Water

Date Sampled: N/A

Date Received: Nov 13/02

Date Analysed: Nov 13 & Nov 14/02

Date Reported: Nov 18/02

Certificate of Analysis

Data Pertain To Specific Sample(s) Tested

PARAMETER	Method Detection Limit (µg/mL)	CONTROL SAMPLE			SAMPLE DATA (µg/mL)			
		Expected Conc. (µg/mL)	Found Conc. (µg/mL)	Recovery %	Blank	11622 G2002	11622 G2002 Duplicate	
Sulphate (µg/mL)	0.05	157	140.31	89	<0.05	3.16	3.32	
Chlorides (ug/ml)	0.05	29.6	27.66	93	<0.05	3.84	3.74	
pH (units)	-	6.7	6.69	100	-	7.81	7.85	

Sample Disposal: 30 Days from the Reporting Date.

Analyst(s): SS, AV

Method:

Chloride, Sulphate - Ion Chromatography (EPA 300.0)

pH - Electrometric/pH-Meter (EPA 150.1)

Sam Sanyal, M.Sc., C. Chem.
Manager, Inorganic Analysis.

ENTECH
A Division of Agri-Service Lab Inc.
5820 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3

TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Trow Brampton
Attention: James Ng
Project: BRGE0065425A
P.O.:
Sample Type: Soil
Date Received: Nov 11/02
Date Analysed: Nov 11 to Nov 15/02
Date Reported: Nov 18/02

Sam Sanyal, M.Sc., C.Chem.
Manager, Inorganic Analysis

CERTIFICATE OF CHEMICAL ANALYSIS - MOEE SOIL DECOMM. GUIDELINES FOR CONTAMINATED SITES IN ONTARIO (GENL. & INORGANIC)

Data Pertain To Specific Sample(s) Tested

PARAMETER	Soil Remediation Criteria (µg/g)		Method Detection Limit (µg/g)	CONTROL SAMPLE			SAMPLE DATA (µg/g)			
	Tables A & B Res./Ind. Comm	Tables C & D Res./Ind. Comm		Expected Concentration (µg/g)	Concentration Found (µg/g)	Recovery %	Blank	11504 BH2 SS2	11505 BH6 SS3	11506 BH15 SS4
Dry Matter (%)	-	-	-	-	-	-	-	92.09	91.61	91.59
pH (units)	5 to 9	5 to 11	-	6.7	6.69	100	-	8.6	8.7	8.6
E.C (µmhos/cm)	700/1400	N.A./N.A.	-	147.3	149.0	101	-	209	89	88
SAR	5/12	N.A./N.A.	-	-	-	-	-	0.74	1.09	1.34
Arsenic	20/40	40/N.V.	1	75	71.3	95	<1	<1	2.0	1.7
Cadmium	12/12	41/41	1	3.4	3.40	100	<1	<1	<1	<1
Chromium (VI) *	8/8	600/1100	1	0.71	0.70	99	<1	<1	<1	<1
Chromium (total)	750/750	2500/5000	1	6.4	6.93	108	<1	4.9	6.2	6.5
Cobalt	40/60	2500/3400	1	2.8	2.80	100	<1	<1	<1	<1
Copper	225/225	2500/2500	1	19.1	17.9	94	<1	2.1	25.0	6.9
Lead	200/1000	1000/N.V.	2	233	220	94	<2	<2	<2	<2
Mercury	10/10	57/57	0.05	0.28	0.254	91	<0.05	<0.05	<0.05	<0.05
Molybdenum	40/40	550/550	2	4	3.51	88	<2	<2	<2	<2
Nickel	150/150	710/710	2	5.4	5.10	94	<2	2.1	2.9	2.5
Boron(HWE) *	1.5/2.0	2.0/N.V.	0.02	1	1.04	104	<0.02	0.03	0.04	0.03
Cyanide Free *	100/100	100/390	0.1	0.20	0.194	97	<0.1	<0.1	<0.1	<0.1
Selenium	10/10	2500/2500	1	0.8	0.880	110	<1	<1	<1	<1
Silver	20/40	240/240	0.5	107	93.5	87	<0.5	<0.5	<0.5	<0.5
Zinc	600/600	2500/5000	1	467	475	102	<1	17	28	21
Antimony *	13/40	44/44	1	0.01	0.010	100	<1	<1	<1	<1
Barium	750/1500	2500/4100	1	102	98.7	97	<1	13.0	25.6	20.6
Beryllium	1.2/1.2	1.2/3.1	0.5	0.5	0.53	106	<0.5	<0.5	<0.5	<0.5
Vanadium	200/200	910/910	1	19	20.6	108	<1	<1	12.0	1.3

a) Table A: Surface soil criteria for a potable groundwater condition
b) Table B: Surface soil criteria for a non-potable groundwater condition
c) Table C: Sub-surface soil criteria for a potable groundwater condition
d) Table D: Sub-surface soil criteria for a non-potable groundwater condition
Sample Disposal: 30 Days from the Reporting Date.

All guideline criteria are for coarse textured soil
HWE - Hot water extractable
Sample data and MDL units are in µg/g unless otherwise specified

Analyst(s): NL, MR, AV, AI, MD, JW

Control Sample Unit is µg/mL for the specified parameter instead of µg/g unless otherwise specified.

Method:
pH: Extraction/Electrometric (EPA 9045)
EC: Extraction/Electrometric (EPA 120.1)
As, Se, Sb: Digestion/HGFAAS (EPA 3050A/7062/7742)
Hg: Digestion/CV-AAS (EPA 7471A/245.5)
SAR: Extraction/ICP-AES (EPA 200.7)
Metals: Digestion/ICP-AES (EPA 3050A/200.7)
Cyanide Free: Extraction/Auto-Color (EPA 335.4)
B (HWE): Extraction/ICP-AES
Cr(VI): Alkaline Digestion/Colorimetry (EPA 3060A/7196)

Appendix F:
Preliminary Environmental Site Assessment

Preliminary Environmental Site Assessment
York Peel Feedermain
Brampton, Ontario

The preliminary environmental site assessment entailed a site visit and a review of occupancy records. Our historical research and site visit identified several gas stations, and present and previous activities or land use which could potentially have an adversely effect on the properties from an environmental perspective. Our findings are detailed below.

Subject Site

The site is approximately eleven (11) kilometers long, starting at 331 Heart Lake Rd., Brampton to North Park Dr. Extension, Brampton, see Drawing 1.

Point A to B (See Drawing 1):

Property	Present Occupant
331 Heart Lake Rd.	Beckett Sproule Pumping Station
130 Glidden Rd.	Johnson Matthey Ltd.
195 Heart Lake Rd.	Travelers (trailers)
85 Selby Crt.	Apex Suspension Systems Auto-Kare Centre GSA Electric Ltd. Selby Auto Collision Mechanical Repairs Ltd. M & M Auto Body Nu-Seal Rust Protection
Selby Crt.	
62 Selby Crt.	Highway Freight System
CNR	
155-161 Orenda Rd.	Vulcan Call Dealers Tubex Manufacturing Ltd. Powder Tech Ltd. Converter Core Inc. (paperboard sales & sheeting)
Orenda Rd.	
150 Orenda Rd.	Wasteco
147 Heart Lake Rd.	Wasteco
145 Heart Lake Rd.	Crosby Canada
Heart Lake Rd.	Bell-Air Fence
143 Heart Lake Rd.	Budget Storage
105 Heart Lake Rd.	Can-Link Transport Ltd. Car and Truck Rentals
93 Heart Lake Rd.	Brafasco
89 Heart Lake Rd.	United Rentals (Aerial Equipment) Genie
85 Heart Lake Rd.	Blue Giant
Clark Blvd.	

Point B to C:

Property	Present Occupant
Clark Blvd.	Ryder
Clark Blvd.	Iron Mountain
80 West Dr.	Dundas-Jafine Development Co. Ltd.
West Dr.	
145 Clark Blvd.	Esso Gas Station
75 West Dr.	W. Ralston (Canada) Inc. (quality plastics) Canadian Technical Tape Ltd. (CanTech)
81 West Dr.	Elfa Group of Companies
83 West Dr.	Barnes Pumps Canada Inc.
87 West Dr.	Southwestern Petroleum Canada Ltd.
95 West Dr.	Brampton Precision Parts Inc.
99 West Dr.	Grand Sport Auto Covers Unlimited Warren's Supplies & Equipment Inc. Faraday Metaltron AIR Eastrock Mfg. & Technical Inc. Hieco Engineering Inc.
99 West Dr.	Katy Maintenance Group C-ing Graphics Ltd. Accurax Gateway Bakery & Deli Pexim International Inc. Dancy Metal Products Ltd.
100 West Dr.	Aluminum Brick & Glass Waters Local 260 Consumers Glass Dumglas Inc.
101 West Dr.	Platinum Lighting Lumiray International G.O. Imports Inc.
115 West Dr.	The Salvation Army (Family Service Centre)
119 West Dr.	Contract Testing Inc. R.E.A.C.T.
West Dr.	Sutton Group Optometrist offices
Queen St. East	

Point C to D:

Property	Present Occupant
Queen St. East, South Side	
Queen St. East	Sunoco Gas Station Green & Ross Mr. Lube Auto Glass
1105 Queen St. East	Custom Furniture for Sale
1133 Queen St. East	Royal Canadian Legion
Queen St. East	Residential apartment building
Queen St. East	Rogers Video CIBC Bank
Queen St. East, North Side	
Queen St. East	Residential buildings
9050 Dixie Rd.	Bramalea Baptist Church
Dixie Rd.	

Point D to E:

Property	Present Occupant
Queen St. East, South Side	
44 Peel Centre Dr.	Peel Region Building
40 Peel Centre Dr.	Medical-Dental Building
30 Peel Centre Dr.	Kapps Sport Bar and Restaurant Chez Monte Holiday Inn Select
Bramalea City Centre Dr.	
10 Peel Centre Dr.	Region of Peel
Queen St. East, North Side	condominium buildings
Central Park Dr.	
Queen St. East, South Side	
185 Central Park Dr.	Peel Region Police, Division 21
10 Kensington Rd.	Mackenzie Towers (residential)
Queen St. East	Petro-Canada Gas Station
Queen St. East	Twisters Restaurant and Night Club
1707 Queen St. East	Pioneer Gas Station Midas Sudsy's Car Wash
1729 Queen St. East	Bramalea's Fantasy Fruit Market
Queen St. East, North Side	Park, Ball Park
Bramalea Rd.	

Point E to F:

Property	Present Occupant
Queen St. East, South Side	
1775 Queen St. East	Jesell Centre: Lick's Restaurant Speedy Auto Service Millennium Hair Team Coffee Time Nando's Restaurant
1785 Queen St. East	Parkside Plaza: Oscar's Restaurant Hasty Market Clean Works Wing Machine (Take-out) Y2K Nails Changes (Unisex Beauty Salon and Spa) Dental office Money Mart GEM West Indian Grocery Willy's Jerk (Family Dining and Lounge)
	All People's Church Full Gospel
Finchgate Crt.	
40 Finchgate Crt.	Bestgate Professional Centre
Queen St. East, North Side	
	Residential buildings
2182 Queen St. East/ Highway 7	Harvey's Restaurant Macs convenience store Pet Value Photoland Adult Video First Choice Wines
Torbram Rd.	

Point F to G:

Property	Present Occupant
Highway 7, South Side	
8925 Torbram Rd.	Zellers
Highway 7, North Side	
9025 Torbram Rd.	Ristorante Hasty Market Bakery and Deli Gino's Pizza KFC Stop n Cash Shoe Repair Subway Sandwiches Rogers Video
2250 Highway 7	Acura 2000
2280 Highway 7	Lexus Car Dealership
2300 Highway 7	Bramalea Toyota
2400 Highway 7	Tim Horton Donuts
Highway 7	McDonalds
2454 Highway 7	Denny's Restaurant Williams Coffee Pub Boston Pizza A & W
2460 Highway 7	Imperial Garden Centre and Florist
Highway 7	Rona (Home and Garden)
Highway 7	Canadian Tire
Highway 7	Kelsey's Restaurant
Highway 7, South Side	
8925 Torbram Rd.	Zellers
	Shoeless Joe's Pizza Hut World Famous Meatballs Taco Bell Wendy's Swiss Chalet Gateway Chev Old Collision Centre Burger King
2925 Highway 7	Second Cup Canadian Bagel
	Payless Shoe Store CAA Everything for a Dollar Store Supercuts Mr. Sub
	Esso Gas Station

Point G to H:

Property	Present Occupant
800. Airport Rd.	Country Style Donuts Shell Gas Station
9050 Airport Rd.	Nestle
9150 Airport Rd.	GE Polymershapes
9250 Airport Rd.	Future Shop
9445 Airport Rd.	Requiste IMD Robotics (Home of Canadarm)
	Petro-Canada Gas Station
Airport Rd.	Diamler Chrysler (Brampton Assembly)
6 Automatic Rd.	Kawartha Envelopes Ltd.
8 Automatic Rd.	Commercial Ventilation Systems Ltd. Tuxedo Junction Co. Ltd. Mustangs Alley MCS Morse Canada Systems Inc. Prestige Travel
12 Automatic Rd.	Minotaur Software Ltd. Metal Craft Spinning and Stamping Ltd.
16 Automatic Rd.	North American paper Products. Inc.
14-18 Automatic Rd.	International Fine Chemical Inc. (Pharmaceutical & Industrial) Med Science Canada (Hospital & Laboratory Supplies)
Property	**Present Occupant**
14-18 Automatic Rd.	Induken Chemie Inc. (Pharmaceuticals)
CNR	
2600 North Park Dr.	TNT
9757 Airport Rd.	residential (farm house)

Site History

The purpose of the background historical research was to identify previous land uses and occupants of the subject property which may result in a potential environmental impact.

A review of the archive documents was made at the Metropolitan Toronto Resource Library. The objective of this task is to establish specifics regarding the nature of historical developments and operations on the subject property.

City Directories

Street City Directories were reviewed at the Metro Toronto Resource Library to aid in identify the occupancy history of the Site. Based on the reviewed directories, the tables summarizes the occupancy history of the Site.

Point A to B:

Property	Previous Occupants
311 Heart Lake Rd.	not listed
130 Glidden Rd.	Johnson Matthey Ltd.
195 Heart Lake Rd.	Travelers Transportation Service Blythe Matthey Colour & Print Division of Johnson
62 Selby Rd.	Highway Freight Systems Inc. Mamberger Polymers Inc. Transplas Systems McKaye Foods Ltd.
85 Selby Rd.	GSA Electric Ltd. Hollywood Car Care Nu-Seal Rust Protection Selby Auto Collision and Mechanical Repairs Ltd. Wilene and Associates Sheet Metal Co. Ltd. Rent-a-Dilly Inc. Superior Rust Proofing
150 Orenda Rd.	Sanderson Resource Recovery Ltd. Robio Industries Ltd. Wilkinson Co. Ltd.
155 Orenda Rd.	Converter Core Inc. Medis Health and Pharmaceutical Powder Tech Ltd. Tubex Mfg. Ltd.
155 Orenda Rd.	Noma Outdoor Products Inc. Dynamark Plastics
161 Orenda Rd.	Brewers Warehousing Ltd. Medis Outsource Logistics
147 Heart Lake Rd.	Sanderson Wasteco Reliable Disposal Systems Canadian Self Storage Inc.
145 Heart Lake Rd.	Crosby Canada Ltd. American Hoist of Canada Ltd.
143 Heart Lake Rd.	Amerco Rentals Budget Storage falcon Overhead Doors and Docks Ltd. U-Haul Co. Ltd.
105 Heart Lake Rd.	Can-Link Car and Truck Rentals Ltd. Can-Link Transport Ltd. Video Yachts Kar-King Sagness Advertising Ltd. Whitney Construction Ltd.
93 Heart Lake Rd.	Brafasco Brampton Fastener Co.
97 Heart Lake Rd.	Als Auto Centre Performance Centre
89 Heart Lake Rd.	Sky-King Equipment Brampton Foundries Ltd. West Bend of Canada Foundry Division
85 Heart Lake Rd.	Blue Giant Ltd. Blue Giant Equipment of Canada Ltd.

Point B to C:

Property	Previous Occupants
80 West Dr.	Dundas-Jafine Inc. Jafine Development Co. Ltd. Empire Maintenance Industries Inc.
75 West Dr.	Canadian Technical Tape Canada Games Co. Ltd. Waddington Sanders Ltd. Waddington Games Inc. Westport Press Ltd.
81 West Dr.	Canada Europe Hardware Import Ltd. Footprint Tools Canada Vitrex Jaybee Mfg. Ltd.
81 West Dr.	Key-Com Ltd. The Hobby Lobby
83 West Dr.	Barnes Pumps Canada Inc. GSW Water Products Co. Barnes Industrial Pumps
87 West Dr.	Southwestern Petroleum Canada Ltd.
95 West Dr.	Brampton Precision Parts Inc. Rotork Controls Ltd. Advance Laundry Systems Inc. Bell Textile Ltd. Kenalty Industries Ltd. Persona Vision Inc.
99 West Dr.	Accurax Mfg. Inc. Carquest Auto Parts Carquest Canada Ltd. Dancy metal Products Ltd. Faraday Metaltron Corp. Glosstech Finishing Ltd. The New Georgia Mills Raines Grandsport Auto Gateway 7 Bakery and Deli Hygrade Custom Carpentry Ltd. Menardi Iron Design Inc. Pinecone Post and Beam Inc. Warren's Supplies and Equipment inc. Architectural Plastics Mfg. Plant Area Lighting Research Inc. Eastrock Mfg. And Tech. Inc. Heico Machinery Engineering Inc.
100 West Dr.	Aluminum Brick and Glass Workers Local 26 Consumers Glass Dumglas Inc. Consumers Glass
120 West Dr.	Hudson Bay Diecastings Ltd.
125 West Dr.	Cal-Ink Chem Co of Canada Ltd.
129 West Dr.	Lorlea Enterprises Ltd.
101 West Dr.	Lumiray International Ltd. Onderwater J Warehouse Ronart Trading Inc.

	Liberty Electric
115 West Dr.	Salvation Army Canadian Red Cross Society Canameque Equipment Co. Ltd.
119 West Dr.	Contract Testing Inc. Maple Leaf REACT Brampton Real Estate Board

Point C to E:

Property	**Previous Occupants**
1133 Queen St. East	Royal Canadian Legion
1707 Queen St. East	Midas Muffler and Brake Shops Sudsy's Car Wash Sunny's Petroleum Inc.
1775 Queen St. East	Coffee Time Donuts Lick's Restaurant Millennium Hair Team Nando's Chicken Land
1783 Queen St. East	Speedy Auto Service
Prior to 1994 the street numbers have changed, in the late eighties many of the business did not have street numbers and are listed under highway 7, in the 1970's no listings were found for Brampton, some business were listed under Malton or Bramalea. Hence:	
Queen St. East / Highway 7 (~West Dr. to ~Bramalea Rd.	Bramalea Fruit market Jung's Car Wash Sunnys International Inc. Sudsys Coin Car Wash Gaydon Contractors Self Service Stations Petro Canada Car Wash Mothers Restaurant Midas Muffler Shops Branches

Point E to G:

Property	**Previous Occupants**
10 Peel Centre Dr.	Region of Peel Regional of Municipality of Peel Police Insurance Brokers Children's Aid Society
30 Peel Centre Dr.	Holiday Inn Brampton Kapps Sports Bar and Restaurant Optimum Relax Spa AJ's Car and Truck Rental Woody's
40 Peel Centre Dr.	Medical-Dental Building
44 Peel Centre Dr.	Commercial offices
1785 Highway 7	strip mall
2200 Highway 7	strip mall Kan-Reed Photographic Inc. Photoland Coles Cleaners Videolite

	Whellers Drive-In Cleaners
2250 Highway 7	Acura 2000 Rockets Soccer Club
2300 Highway 7	Bramalea Toyota Brampton Hyundai
2400 Highway 7	Tim Hortens Burger King
2460 Highway 7	Imperial Garden Centre and Florist
2838 Highway 7	Stake Technology Ltd.
2956 Highway 7	Shell Canada Products Ltd.
Prior to ~1987 the street numbers have changed, in the early eighties many of the business did not have street numbers, in the 1970's no listings were found for Brampton, some business were listed under Malton or Bramalea. Hence:	
Highway 7 (~from Bramalea Rd. to Airport Rd).	Lead Hammer Services (Division of Eagle Machinery) Burton Brothers Sheet Metal Ltd. A-1 Automobile Electric At- Cost Soil Drilling Inc. Photo-Camp Services Ltd. Skyway Sales Inc. Continental Guns of Canada Donlea Lumber Co. Premium Oil Co. Service Station Provincial Industrial Roofing and Sheet Metal Co. Ltd. Credit Valley Quarries Co. Ltd. Canada Building Materials Co. Head Office Delco Wine and Cable Ltd. Pupolin Plumping and Heating Ltd.

Point G to H:

Property	**Previous Occupants**
8003 Airport Rd.	Country Style Donuts Shell Canada Products Ltd.
8550 Airport Rd.	Bay Distribution Centre Zellers Distribution Centre Boots Drug Stores Distribution Centre
Property	**Previous Occupants**
9445 Airport Rd.	Spar Aerospace Spar Soace Systems Brampton Motorola Computer Systems (MCS Canada)
9495 Airport Rd.	Petro-Canada Gas Station

The buildings in many of the addresses listed in the above tables are being used for commercial and industrial purposes. Many of the businesses listed use hazardous materials, some have storage tanks and containers. Hence the activities of these business have the potential to have an adverse effect on the site from an environmental perspective.

Trow Consulting Engineers Ltd.
1595 Clark Boulevard
Brampton, Ontario
L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

SCALE: NTS		DWG. TITLE AND PROJECT: SITE PLAN	
DATE: OCTOBER 2002			
DWN.:	CHKD.:	PROJECT NO.: brge0065425a	DWG. NO.: 1