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HWY. # 69

WIDENING

REGENT STREET

SUDBURY CITY

W.P. 927-61-

REPORT ON  
SUBSURFACE CONDITIONS  
PROPOSED WIDENING OF HIGHWAY #69  
(REGENT ST.)

CITY OF SUDBURY, ONTARIO

6-1-61



THE CITY OF SUDBURY  
c/o M. M. Dillon Limited  
Consulting Engineers  
Sudbury Ontario

REPORT  
ON  
SUBSURFACE CONDITIONS  
PROPOSED WIDENING OF HIGHWAY # 69 (REGENT ST.)  
CITY OF SUDBURY ONTARIO

Submitted by  
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SUMMARY

The investigation, consisting of forty-one exploratory boreholes, indicates that the subgrade along the approximately 1.5 mile long section of Highway #69 consists predominantly of cohesive clayey soils, but occasionally granular substrata or bedrock are also encountered. This is depicted on the subsurface Profiles (Enclosures No. 26, 27, 28 and 29).

The existing flexible pavement is constructed on top of 3 to 5 feet of predominantly granular fill material. The damage to the pavement is generally severe and its condition can be described as fair to poor with only isolated "good" sections.

A study of the probable causes of the damage indicates that the deterioration of the pavement may be attributed to the insufficient thickness of the bituminous surface, the lack of a proper non-frost-susceptible granular base course material, high ground water table, and the improper treatment of transition points from rock cut to earthfill sections. In the design and construction of the new pavement, special attention should be given to these factors, in particular to the thickness of the pavement and the quality of the base and subbase course materials. It is recommended that the new asphalt pavement be constructed on top of at least 36 inches of a non-frost-susceptible granular fill material and it should have a minimum thickness of 4 inches.

The finished grade in the new fill sections will be only a few feet higher than the natural ground surface. Therefore, generally no stability or settlement problems are foreseen from the construction of the embankments. From the stability and settlement point of view, the most critical conditions exist in the vicinity of Loach's Rd. where an approximately 20 foot high embankment will be constructed over weak and compressible substrata. The safety factor against the shear failure of the subsoil under the embankment was calculated to be 1.4 which is considered to be adequate. The maximum total settlement under the widened 20 foot high section of the embankment is estimated to be 4 inches and to take place over a period of 6 to 12 months. Therefore, it would be advisable to construct the embankment as much in advance of fine grading and paving as possible.

There are no bedding or serious construction problems foreseen from the construction of the storm sewer. The use of First Class, Class 'B' type of bedding is recommended throughout, with flexible joints where the sewer passes from rock cut to earth fill sections. Dewatering problems, as discussed in the text, should only be anticipated in areas where granular subsoils were encountered.

## INTRODUCTION

Dominion Soil Investigation Limited was retained by Messrs. M. M. Dillon, Consulting Engineers, to carry out a subsurface investigation for the City of Sudbury. The purpose of the investigation was to determine the subsurface conditions along an approximately 1.5 mile long section of Highway No. 69 (Regent Street) which extends between Algonquin and Martindale Roads, and along a short section of Highway No. 543 (Paris Street) just south of Regent Street. It is proposed to widen these sections of the above highways and information about the subsurface conditions was required for pavement and embankment design as well as the drainage measures as pertinent to the construction of the highway.

To obtain the necessary information, a total of forty-one boreholes was put down approximately 200 feet apart, exploring the subsurface generally to a depth of 10 feet. The boreholes were located on the shoulders of the existing road, and their positions were referred to the intersection of the centrelines of Highway #69 and Algonquin Rd. taken as Station 0 + 00.

Both disturbed and undisturbed soil samples were recovered continuously or at very close intervals and, where conditions permitted or warranted, the in-situ shear strength of the soil was tested by a four-bladed vane apparatus. The visual classification of the soil samples, which was carried out both in the field and the laboratory, was supplemented by a number of laboratory tests for the purpose of determining the index and engineering properties of the soil types more accurately.

The results of the borings and field tests are presented on the individual borehole logs and on the simplified soil profiles given on Enclosures No. 26, 27, 28 and 29. The laboratory test results are plotted on the borehole logs and are also summarized in Appendix "B", Table 3.

The engineering interpretation of the field and laboratory tests will be discussed under separate headings, each dealing with the design of the pavement, embankment and storm sewer respectively.

#### SITE AND GEOLOGY

The investigated section of the highway lies at the southern part of the City of Sudbury and extends from the south city limit to approximately 1.5 miles north of this point. Starting from the city limit, the highway passes through uninhabited, commercial and residential areas.

The terrain along this section is uneven and irregular. The ground surface ranges between elevations 890 and 820 feet. At many places, on both sides of the highway the bedrock outcrops to the ground surface, standing in strong contrast with the flats occupying the areas between them. These flats vary in size and elevation but poor drainage appears to be a common feature to them.

Sudbury is underlain by a complex series of early and late Precambrian rocks which, if not exposed at the ground surface, are covered by unconsolidated Pleistocene and more recent deposits. The bedrock consists mostly of igneous and sedimentary rocks from the Archeozoic and Proterozoic eras, and rocks derived from these



by metamorphosis. Proceeding from the south towards north, the most common rock types encountered are: quartzite, conglomerate, gabbro, diorite and greywacke. The overburden which was laid down during and subsequent to the Wisconsin Ice Age, consists mostly of stratified silts, sands and varved clays.

#### SUMMARIZED SUBSURFACE CONDITIONS

Since all but two boreholes were located on the shoulders of the existing roadway, the first stratum encountered was a predominantly granular fill varying in thickness between 1.5 and over 10 feet.

Below the fill, the nature of the subsoil varied along the road and basically five different subgrade materials could be distinguished. Between station 0 + 00 and 10 + 00, the roadbed is underlain by deep varved clay deposits of stiff to soft consistency. From station 10 + 00 practically to Paris Street (station 23 + 00) the grade of the road goes through a deep rock cut. From here to the end of the project, the subgrade is mostly a stiff clay till or varved silty clay. At isolated locations, silty sand and gravel and bedrock was also encountered.

Where the conditions permitted the observation of water levels in the boreholes, the position of the ground water table was generally recorded at 4 to 5 feet below the ground surface.

For a more detailed account of the subsurface conditions, reference should be made to the individual borehole logs, the subsurface profiles and the appropriate sections of Appendix "A" where

the "SOIL CONDITIONS" and "GROUND WATER CONDITIONS" are discussed.

#### PAVEMENT DESIGN

##### a) Existing Pavement Conditions

Since a great deal of pavement design even today is based on experience and local practice, before going into the discussion of the proposed pavement design it may be worthwhile to consider the existing pavement conditions and design.

During the field work, notice was made of the existing pavement conditions between the boreholes, describing it in terms of the failures noticeable at the surface. A list of the failures which are described as longitudinal, transverse or alligator cracking, frost boils, dishing, etc., is given in Table 2 of Appendix "A". The most common type of failure noticed was longitudinal and transverse cracking of the pavement, the intensity of which, however, varied considerably from place to place. The intensity of the cracking and other types of failures could basically be divided into three major groups fitting into the categories of good, fair or poor pavement conditions. These purely subjective and arbitrary terms are also listed on Table 2 and for convenience shown in a graphical form below the subsurface profiles (Enclosures 26, 27, 28 and 29). The purpose of this was to see whether a correlation between the existing pavement and subsurface conditions existed.

The existing pavement construction was investigated by six shallow test holes. Three of these (testholes A, B and C) were

located in an area where the existing pavement was in a very poor condition, and the other three holes (testholes D, E and F) where the pavement conditions were found to be good. In testholes A, B and C, the thickness of the asphalt surfacing was found to be 2 to 2½ inches, whereas in testholes D, E and F, the asphalt pavement was 3 to 4 inches thick.

The fill underlying the asphalt surface varies both in thickness and composition. The thickness of the fill ranges between 1½ to more than 10 feet, but on the average it is about 3 to 5 feet. The fill consists mostly of sand and gravel particles with a variable amount of soil fines. The amount of soil fines (the particles passing the 200 mesh sieve size) ranges between 5 and 50%. Typical grain-size distribution curves are shown on Enclosures No. 2, 3 and 4, which show also the limits of a non-frost-susceptible granular fill material as recommended by the D. H. O. specification No. 314.

When comparing the existing pavement conditions with the thickness of the fill, no definite relationship could be established between the thickness of the granular base course material and performance of the pavement. A better correlation, however, appears to exist between the gradation and composition of the fill material and the pavement conditions. The samples recovered from areas where poor pavement conditions exist, notably from the test holes A, B and C, and boreholes 17, 18, 30 and 36, indicate that the fill material in these areas does not satisfy the requirements of a selected, granular base course, class 'B' material specified and recommended

by the Department of Highways of Ontario. Conversely, the samples recovered from areas where good pavement performance was observed do satisfy these requirements (see Enclosures No. 2 and 3). Other locations where deterioration of the pavement was noticed are generally associated with transition points between rock cuts to earth fill and also with areas where the ground water table lies close to the ground surface.

Even though the picture is not complete, from the above observations the following conclusions may be drawn. The poor pavement conditions are possibly due to the lack of a proper non-frost-susceptible granular base course material, the insufficient thickness of the asphalt surfacing, high ground water table and the insufficient depth of the granular fill material, especially in the transition zones.

b) New Pavement Design

The effect of the subgrade on the design thickness of the base course and on the pavement is evaluated on its supporting strength and frost susceptibility. In the case of frost-susceptible soils and a high ground water table, the design is usually governed by the latter if differential heaving conditions exist. The investigation has indicated that the subgrade soil along the highway is variable. It varies from a varved clay to a clayey till, varved silty clay or occasionally a silty gravel and sand. The clay soil types are classified as group A-6 and A-7-6 material on the A.A.S.H.O. Classification System. The more granular silty gravel and sand could probably be classified

as an A-2-4 material. On this basis, they all rate as poor to very poor subgrade materials and they are also considered to be moderately or highly frost-susceptible.

It is usual to provide a depth of non-frost-susceptible material to minimize frost heave by limiting the depth of frost penetration into a susceptible subgrade. Commonly, this is carried to about 50% of the expected depth of frost penetration, that is, to about 36 inches at this site. Since the existing fill below the pavement is generally over 3 feet in thickness, it appears that the existing thickness of the fill is adequate. Only at the transition points where two subgrades of different heaving characteristics meet should the existing construction thickness be improved. In these areas, to avoid differential frost heave, the full depth of frost penetration, which is estimated to be 6 feet, should be constructed with non-frost-susceptible material. Between these sections and the normal pavement sections, where the full depth of treatment is not provided, the depth of base course material should be changed gradually at a rate not exceeding 1 vertical in 10 horizontal.

The recommended design thickness of the new asphalt surfacing is 4 inches.

Successful performance of the pavements depends on the provision of adequate drainage. For this purpose, longitudinal drains should be provided at the edges of the pavement below the subgrade level. The invert of these drains should be so located that they keep the ground water table at least 4 feet below the

A  
Subdrains

pavement. Where it is necessary for drains or other services to cross under the pavement, the proper depth of base course material should be maintained and the transition zone of backfill materials sloped at 1 in 10 should be provided.

#### STABILITY OF EMBANKMENTS

The height of the embankments is generally negligible ranging only between 3 and 10 feet. Therefore, generally there are no stability problems foreseen. There is only one critical area between station 0 + 00 and 10 + 00 where the height of the embankment reaches as much as 20 feet and where the subsoil is a soft to stiff varved clay. In addition to the regular boreholes, two deep boreholes (boreholes No. 4A and 4B) were put down at the toe of the existing embankment, exploring the subsurface to a depth of 50 feet below the ground surface. These indicate that the subsoil consists of about 45 feet of varved clay underlain by a compact silt deposit. The undrained shear strength of the varved clay was determined by field vane tests and laboratory unconfined compression tests. Both the field and laboratory tests indicate that the clay has an approximately 10 foot thick desiccated crust within which the shear strength ranges between 1100 and 2600 pounds per square foot. Below this desiccated crust, the undrained shear strength of the clay ranges between 480 and 800 lbs. per square foot, assuming the shear strength to be half the compressive strength. Thus, the critical stratum from the point of view of embankment stability is this lower zone of the varved clay extending between elevations 855 and 820. In the analysis, the undrained shear strength of the crust was assumed to be 1500 lbs. per

DEFECTS IN NEGATIVE DUE TO  
 CONDITION OF ORIGINAL DOCUMENT

TOTAL STRESS ANALYSIS

LEGEND

+ ... POINT OF ROTATION  
 SAFETY FACTOR { 1.7 } SHALLOW SHEAR FAILURE  
 { 1.6 } DEEP SHEAR FAILURE

Elev.

885

865

845

825

Elev.

885

865

845

825

FILL

$\gamma = 125 \text{ p.c.f.}$

$\phi = 40^\circ$

EXISTING

PROPOSED EMBANKMENT

SLOPE

G.W.L.

$C_u = 1500 \text{ p.s.f.}$

$C_u = 600 \text{ p.s.f.}$

CRITICAL

SHALLOW

SLIP CIRCLE

CRITICAL

DEEP

SLIP CIRCLE

VARVED

CLAY

COMPACT

SILT

EMBANKMENT CROSS-SECTION AT STATION 8+00

(B.H. Nos 4, 4A & 4B)

SHOWING STABILITY ANALYSIS OF PROPOSED EMBANKMENT

SCALE: 1" = 20 Feet

square foot and of the underlying zone as 600 lbs. per square foot.

For embankments constructed at a normal rate, an estimate of the stability at the end of construction can be based on the undrained shearing resistance of the embankment and subsoil. Such a total stress analysis was carried out for the maximum embankment height of 20 feet, assuming the side slopes of the fill to be 2 horizontal to 1 vertical. The results of the analysis are shown on Figure 1 of Page 11, indicating that the factor of safety against both shallow and deep-seated shear failures along a circular arc plane is about 1.4. This is considered to be adequate in the present case.

Settlement of the proposed embankment will occur due to the consolidation of the earth fill proper and of the subsoil under the additional weight of the fill. The settlement within a properly compacted, essentially granular fill should be negligible and therefore it will not be considered. To estimate the probable settlement of the subsoil under the weight of the fill, two laboratory consolidation tests were performed, one on a sample taken from the crust and the second on a sample from the lower and more compressible zone. The resultant log pressure-void ratio curves are given on Enclosures No. 8 and 9. From these figures, the modulus of compressibility or 'K' was calculated for a pressure increment corresponding to the weight of the proposed embankment. The 'K' values obtained for the crust and for the underlying zone are 100 and 40 tons per square foot respectively. Based on the assumed height and shape of the embankment, the estimated settlement at the middle of the new embankment



will be approximately 4 inches.

The time required for the total settlement to take place was estimated from the laboratory consolidation curves assuming that free drainage is available only at the top and at the bottom of the stratum, that is, at elevation 820 feet. Based on these assumptions, the time required for 90% of consolidation is estimated to be about 5 years. However, due to the difficulty in estimating the probable length of drainage path in a stratified subsoil, it is difficult to predetermine the exact time rate of settlement of the embankment. Based on experience, it is believed that the settlement will take place faster and probably the major portion of it will be completed within 6 to 12 months. Therefore, it is recommended that the new embankment be constructed as much in advance of the fine grading and paving as possible.

#### DRAINAGE SYSTEM

At the time of the investigation, neither the location nor the size or elevation of the storm sewer was known. However, it was believed that the invert will generally not be deeper than 10 feet below the grade. An inspection of the soil profiles on Enclosures 26, 27, 28 and 29 indicates that the invert of the storm sewer will pass through a great variety of subsoils. The subgrade, over the major part of the storm sewer, is a clayey soil and only exceptionally will the sewer pass through cohesionless granular sandy soils. Also there will be areas where the sewer will be laid in a trench cut in bedrock.

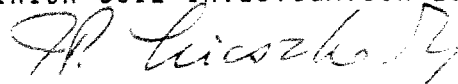
Generally, the subsoil has adequate bearing capacity to support a properly bedded storm sewer. Because of the clayey and compressible nature of the subsoil, it is recommended that First Class, Class B type of bedding be used throughout. The construction and the compaction of the granular bedding material below the spring line of the sewers should be thoroughly controlled, especially in the areas of borehole No. 1 to borehole No. 5, and borehole No. 28 to borehole No. 32. Here, in view of the generally soft consistency of the subgrade, the performance of the sewer will largely depend on the construction method employed. Since the grade will be raised on an average of about 5 feet over a rather extensive area, long term consolidation settlement of the subsoil should be anticipated. This would inevitably result in the settlement of the sewer itself. The magnitude of this settlement will vary throughout the profile, but its maximum value is estimated not to exceed 1 inch. Unless the sewer is laid on a marginal grade, this settlement is believed to be tolerable and not to create problems. The only areas where problems from even these relatively small settlements could be anticipated are the transition areas where the invert of the sewer will pass from bedrock to unconsolidated subsoil. In these areas, therefore, it may be advisable to use flexible joints.

Because of the mostly clayey and impervious nature of the subsoil, there are no serious dewatering problems foreseen. There are, however, isolated areas where the subsoil was found to be pervious and water bearing, and at these locations the dewatering of

the trench could create difficulties. Such problems may be anticipated in the areas of boreholes 18, 21, 22, 24 and 32. The amount of water flowing into the excavation in these areas may be excessive and therefore, it will be necessary to exclude the water from the trenches by closed sheeting. It may also be necessary to drive this sheeting below the bottom of the excavation in order to avoid piping and heaving of the trench bottom. In other areas, the sides of the trenches will need only nominal support mainly to comply with the Trench Excavator's Protection Act and also to support the upper granular fill stratum.

Excavation problems are only foreseen in areas where the invert of the sewer lies below the surface of the bedrock. Because of the sound nature of the bedrock excavation could only be achieved by explosives.

DOMINION SOIL INVESTIGATION LIMITED,



I. P. Lieszkowsky, P. Eng.,  
Project Engineer.

IPL/jvm



APPENDIX "A"

PROCEDURES

SOIL CONDITIONS

GROUND WATER CONDITIONS

LIST OF BOREHOLE LOCATIONS

TABLE 1

DESCRIPTION OF EXISTING PAVEMENT  
CONDITIONS

TABLE 2

LIST OF SYMBOLS, ABBREVIATIONS  
AND NOMENCLATURE

Encl. 1

APPENDIX "A"PROCEDURES

Forty-one exploratory boreholes were put down at the site at the locations shown on Enclosures No. 26, 27, 28 and 29. A list of the borehole locations given as offsets of Stations along the centreline of the existing highway is shown in Table 1 of this Appendix. Since the investigation has started at the south end of the highway widening project, Station 0 + 00 was taken arbitrarily at the intersection of Algonquin Road and Highway No. 69. Ground surface elevations at the locations of the boreholes were determined by levelling, using a set of bench marks given by the Consulting Engineers, Messrs. M. M. Dillon and Associates. These bench marks and therefore the elevations are believed to be referred to the Geodetic datum.

The field work was carried out during the period of November 23rd to December 14th, 1965, and on January 8th, 1966. The boreholes were advanced by a skid-mounted diamond drill machine equipped for soil sampling and drilling, using both washboring and dry boring technique. Disturbed soil samples were recovered either continuously or at very close intervals of depth by a 2" diameter split-spoon sampler. When obtaining disturbed soil samples, Standard Penetration tests were also performed with the purpose of determining the relative density or consistency of the subsoil. The Standard Penetration test consists of driving the 2" diameter split-spoon sampler into the undisturbed ground by a 140-lb. hammer falling freely 30 inches. The number of blows required for 12 inches of penetration are recorded as

the Standard Penetration resistances or "N" values. A number of undisturbed samples were also recovered from boreholes No. 4A and 4B with 2" inside diameter thin-walled shelly tube samplers. The recovered soil samples were sealed in air-tight jars or, in the case of the shelly tubes, with wax. The samples were then shipped to the Soil Mechanics Laboratories of Dominion Soil Investigation Limited for testing. The purpose of the laboratory testing was to classify the soil strata more accurately and to determine their engineering properties. Laboratory testing consisted of determining the undrained, unconfined shear strength of the strata; their compressibility; the consistency limits; the natural moisture contents; the natural unit weights and the particle size distributions. The tests were performed on selected representative samples and the results are presented on the individual Geotechnical Data Sheets and are also tabulated in Table 3 of Appendix "B". The results of the borings are plotted on the Geotechnical Data Sheets, and the main soil types are described and discussed under SOIL CONDITIONS below. Detailed logs of the boreholes are given on the Geotechnical Data Sheets. The following paragraphs describe the relevant engineering properties of the various soil strata which underly the site as depicted on the soil profiles.

#### SOIL CONDITIONS

##### Fill

The thickness of the fill ranges between 1½ to over 10 feet, but on the average it is 3 to 5 feet. Even though the fill consists essentially of granular material, its composition ranges

between fairly wide limits. Typical grain-size distribution curves of the fill are given on Enclosures No. 2, 3 and 4, indicating that it consists from 5 to 20% gravel, 40 to 75% sand with 5 to 50% of soil fines, that is, silt and clay particles. In the area of boreholes No. 3, 4, and 5, the fill consists mostly of large boulders and cobbles. The relative density of the fill as indicated by the Standard Penetration tests ranges between loose and dense.

#### Varved Clay

A grey-coloured varved clay stratum was encountered in boreholes No. 1, 2, 4A and 4B. A maximum thickness of 45 feet was penetrated in borehole No. 4B. The stratum consists of alternative layers of grey or reddish-brown clay and thin silt or fine sand seams. The Liquid Limit of this stratum ranges between 38 and 58% with a corresponding Plastic Limit of 19 and 23% and Plasticity Index of 19 to 35. On the basis of these consistency limits, the plasticity of the clay can be described as being intermediate to high. The natural moisture content ranges between 27 and 57% and the Liquidity Index, which relates the moisture content to the consistency limits, ranges between 0.65 and 1.0. A Liquidity Index of 1.0 indicates that the natural moisture content is equal to the liquid limit of the soil. The undrained shear strength of the stratum was measured both in the field by a 4-blade vane apparatus and also in the laboratory by means of unconfined compression tests. In accordance with the theory of truly cohesive soils, the undrained shear strength of the soil was taken as half of the compressive strength. Both the field and laboratory tests indicate that the clay has a desiccated crust which extends about 10 feet below the ground surface. Within this crust the shear strength values range

between 1100 and 2600 lbs. per square foot, with an average value of about 1500 lbs. per square foot. Below the desiccated crust, the shear strength of the soil shows a marked decrease and ranges only between 480 and 800 lbs. per square foot. The sensitivity of the clay, that is, the ratio of the undisturbed and remoulded shear strength of the soil, was measured in the field indicating that the clay has a very high sensitivity ranging between 4 and 22. The unit weight of the soil was measured to be 104 to 118 lbs. per cubic foot. The compressibility and consolidation characteristics of the clay stratum were measured in the laboratory, the results of which are presented on Enclosures No. 8 and 9.

#### Varved Silty Clay

In boreholes Nos. 28, 29, 30, 31 and 32, a stratum of light grey-coloured silty clay was encountered with intermittent thin seams of silt or fine sand. The thickness of this stratum is not known since these boreholes were generally terminated within this stratum. As indicated by the Atterberg tests, the plasticity of this stratum is low: the Liquid Limit ranges between 26 and 37%; the Plastic Limit between 16 and 20% with a corresponding Plasticity Index of 10 to 18. The natural moisture content varies between 24 and 29%, that is, it is generally close to the liquid limit of the stratum. The measured Liquidity Indices range between 0.5 and 1.3. Based on the Standard Penetration test results (N=1 to 7 blows per foot) the consistency of the stratum is very soft to firm. This range of consistency is, however, not confirmed by the unconfined



compression test performed on an undisturbed sample recovered from borehole No. 30. The measured shear strength of the sample was 1900 lbs. per square foot, indicating a stiff consistency. In the same borehole, the Standard Penetration tests indicated only a very soft to soft consistency with "N" values ranging between 2 and 3.

#### Clay Till

The predominant soil type encountered throughout this project is a brown to grey-coloured clay till. The thickness of this stratum is variable but its maximum thickness is not known since the boreholes have not penetrated deep enough. The stratum consists mostly of clay particles and has a subtle varved or layered structure. These varves, however, are not always horizontal but appear to be distorted or to have a random orientation. This fact, and the large number of embedded small gravel in the clay matrix, suggests that it may have been an interglacial deposit which was later overridden and remoulded by advancing glaciers. This hypothesis seems to be substantiated by the great similarity between the plastic properties of the clay till and the previously described varved clay. The range of the Liquid Limit is between 35 and 60% and of the Plastic Limit between 21 and 22%. The Plasticity Index varies between 13 and 38. The natural moisture content has a range of 23 to 38%, but on the average 32% is a more typical value. The Liquidity Index varies between 0 and 0.6.

#### Gravelly or Silty Sand

Occasionally, at isolated locations such as in boreholes No. 18, 21, 22, 24, 32 and 35, a stratum of gravelly or silty sand

was encountered either immediately under the fill or below a thin layer of the typical cohesive soils found elsewhere.

Some grain size distribution curves of this deposit are shown on Enclosures No. 5, 6 and 7, indicating that it consists of 20 to 30% of gravel, 50 to 75% of sand, and 20 to 30% of silt and clay. Because of its relatively high permeability, as compared with the other soil types, the stratum was found to be saturated and the free standing ground water level was established within this stratum. The "N" values range between 4 and 50 blows per foot indicating a loose to dense relative density.

#### Bedrock

The presence of the Precambrian bedrock was proven by coring in boreholes Nos. 6, 8, 11, 19, 34 and 39, and was inferred from the refusal at the bottom of boreholes Nos. 7, 9, 14, 15, 18, 35 and 36. From the different elevations where the bedrock was encountered at these locations and the numerous rock outcrops in the area, the surface of the bedrock is known to be very irregular.

The rock has a light to dark grey colour with a vitreous-like luster. The fracture surface is uneven and splintery and the individual grains are large enough to be perceptible to the naked eye. The majority of the grains are believed to be quartz with various amount of dark coloured minerals, probably feldspar, biotite, etc. Based on visual inspection, the rock is classified as a Quartzite, derived possibly from sedimentary (sandstone and conglomerate) and igneous (rhyolite) rocks. It is very sound and relatively free of

joints.

#### GROUND WATER CONDITIONS

Observations to determine the position of the free ground water table in the boreholes were carried out both during the boring and after the boreholes were completed. The final water levels are marked on the individual borehole logs and are also tabulated in Table 1 following this section.

Since the majority of the boreholes was advanced without the use of wash-water and precautions were taken to minimize surface water infiltration, it is believed that the observations represent the true ground water conditions at the site at the time that the investigation was performed.

The lack of ground water in some of the boreholes may be explained by the generally low permeability of the subsoil and the insufficient time available for observations. Because of their locations, the boreholes could not be left open for prolonged observations.

From these observations, it appears that with the exception of the low lying areas, the ground water table lies at about elevation 866 feet. Towards the northerly end of the project where the ground surface ranges between elevations 820 and 840 feet, the ground water table follows approximately the ground contours and lies close to the surface.

APPENDIX A

TABLE 1

LIST OF BOREHOLE LOCATIONS

<u>B.H. No.</u>	<u>Location</u>	<u>Elevation</u>	<u>Ground W.L.</u>
1	16' Rt. of Sta. 2 + 00	871.6	866.1
2	19' Lt. of Sta. 4 + 00	870.6	866.1
3	15' Lt. of Sta. 6 + 00	874.5	875.5
4	15' Lt. of Sta. 8 + 00	880.3	-
4A	63' Lt. of Sta. 9 + 05	867.6	865.6
4B	85' ± Lt. of Sta. 8 + 00	867.6	-
5	36' Lt. of Sta. 10 + 00	885.0	-
6	15' Lt. of Sta. 12 + 00	889.4	-
7	15' ± Rt. of Sta. 14 + 00	891.5	-
8	16' Rt. of Sta. 16 + 00	891.5	-
9	16' Rt. of Sta. 18 + 00	890.1	-
10	16' Rt. of Sta. 20 + 00	885.9	-
11	18' Rt. of Sta. 22 + 00	881.3	879.0
12	30' Lt. of Sta. 24 + 00	875.2	-
13	On Paris St. 200' W of Hwy 69	873.4	-
14	On Paris St. 400' W of Hwy 69	873.9	869.9
15	On Paris St. 600' W of Hwy 69	875.5	868.7
16	20' Lt. of Sta. 26 + 00	871.3	-
17	19' Lt. of Sta. 28 + 00	870.3	866.2
18	20' Rt. of Sta. 30 + 00	870.5	863.4
19	17' Rt. of Sta. 32 + 00	871.4	-
20	18' Rt. of Sta. 34 + 10	871.1	-
21	16' Rt. of Sta. 36 + 00	872.0	866.8
22	18' Lt. of Sta. 38 + 00	872.2	-
23	18' Rt. of Sta. 40 + 00	870.8	-
24	18' Rt. of Sta. 42 + 00	869.5	865.6
25	19' Rt. of Sta. 44 + 00	866.8	-
26	21' Rt. of Sta. 46 + 00	862.2	-
27	18' Rt. of Sta. 48 + 00	846.1	-
28	17' Rt. of Sta. 52 + 00	834.6	-
29	17' Rt. of Sta. 54 + 00	825.0	-
30	19' Rt. of Sta. 56 + 00	821.8	-
31	18' Lt. of Sta. 58 + 00	821.5	815 ± ?
32	19' Lt. of Sta. 60 + 00	823.8	816 ± ?
33	40' Lt. of Sta. 64 + 35	836.3	835.1
34	24' Lt. of Sta. 66 + 00	841.6	-
35	19' Lt. of Sta. 68 + 00	843.4	-
36	18' Rt. of Sta. 70 + 00	844.0	-
37	17' Rt. of Sta. 72 + 00	843.0	839.0
38	17' Rt. of Sta. 74 + 00	843.3	-
39	17' Rt. of Sta. 76 + 00	844.7	844.4

TABLE 1 - continuedTEST HOLES

A	5'6" Rt. of Sta. 47 + 41
B	6" Rt. of Sta. 47 + 20
C	6" Rt. of Sta. 46 + 99
D	4'6" Rt. of Sta. 15 + 34
E	5' Rt. of Sta. 15 + 16
F	5'6" Rt. of Sta. 14 + 97

APPENDIX ATABLE 2DESCRIPTION OF EXISTING PAVEMENT CONDITIONS

<u>LOCATION</u> <u>FROM TO</u>	<u>PAVEMENT</u> <u>CONDITIONS</u>	<u>TYPE OF FAILURE</u>
BH 1 BH 5	GOOD	Longitudinal and some transverse cracking.
BH 5 BH 6	GOOD TO FAIR	Longitudinal and transverse cracking. Some <u>dishing</u> .
BH 6 BH 8	GOOD	Some transverse cracking.
BH 8 BH 10	FAIR	Transverse and longitudinal cracking. Extensive cracking at transition point
BH 10 BH 11	FAIR	" " "
BH 11 BH 12	FAIR	Longitudinal and some transverse cracking.
BH 12 BH 16	FAIR	Transverse cracking, some longitudinal and alligator cracking.
BH 16 BH 17	FAIR TO GOOD	Short transverse and longitudinal cracks.
BH 17 BH 18	FAIR TO POOR	Transverse, longitudinal and alligator cracking.
BH 18 BH 19	FAIR	Longitudinal and some transverse cracks.
BH 19 BH 20	FAIR	Longitudinal and transverse cracking. Some alligator cracks.
BH 20 BH 21	FAIR	Transverse and alligator cracking.
BH 21 BH 22	FAIR TO POOR	Mostly transverse cracking with many alligator cracks and frost boils in west lane.
BH 22 BH 23	POOR TO FAIR	Longitudinal, transverse and alligator cracks. <u>Dishing</u> .

TABLE 2 - continued

<u>LOCATION FROM TO</u>	<u>PAVEMENT CONDITIONS</u>	<u>TYPE OF FAILURE</u>
BH 23 BH 24	POOR TO FAIR	Severe longitudinal cracking Some alligator cracks.
BH 24 BH 25	POOR	Alligator cracks. Some longitudinal cracking.
BH 25 BH 26	POOR	Alligator, longitudinal and transverse cracking. Frost boils.
BH 26 BH 27	POOR TO FAIR	" " "
BH 27 BH 28	FAIR TO GOOD	Some transverse, longitud- inal and alligator crack- ing.
BH 28 BH 29	FAIR	Longitudinal and some trans- verse cracking.
BH 29 BH 30	FAIR TO GOOD	Longitudinal and some transverse cracking.
BH 30 BH 31	POOR	Alligator and longitudinal cracking.
BH 31 BH 32	POOR TO FAIR	Alligator, transverse and longitudinal cracks.
BH 32 BH 33	FAIR TO GOOD	Mainly longitudinal crack- ing. Some alligator and transverse cracks.
BH 33 BH 34	GOOD TO POOR	Transverse and alligator cracking.
BH 34 BH 35	FAIR	Mostly longitudinal and alligator cracking. Signs of <u>dishing</u> .
BH 35 BH 36	GOOD	Some longitudinal cracking.
BH 36 BH 37	FAIR TO POOR	Alligator, transverse and longitudinal cracks.
BH 37 BH 38	GOOD	Some longitudinal and alligator cracks.
BH 38 BH 39	FAIR	Longitudinal, transverse and alligator cracks.

# LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

## SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
Ø	> 8"	3"	¾"	4.76mm	2.0	0.42	0.074	0.002	>	NO SIZE LIMIT		
U.S. Standard Sieve Size :				No. 4	No. 10	No. 40	No. 200					

## SAMPLE TYPES.

AS Auger sample	RC Rock core	TP Piston, thin walled tube sample
CS Sample from casing	% Recovery	TW Open, thin walled tube sample
ChS Chunk sample	SS Split spoon sample	WS Wash sample

SAMPLER ADVANCED BY	static weight : w	OBSERVATIONS	Steady pressure
"	pressure : p	MADE WHILE CORING	No pressure
"	tapping : t		Intermittent pressure

	Washwater returns
	Washwater lost

## PENETRATION RESISTANCES.

**DYNAMIC PENETRATION RESISTANCE** : to drive a 2" Ø, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

**STANDARD PENETRATION RESISTANCE, -N-** : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

### EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SYMBOL :



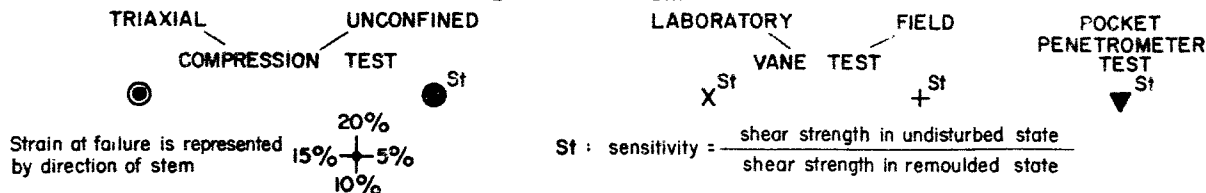
322

## SOIL PROPERTIES.

W % Water content	γ <sub>n</sub> Natural bulk density (unit weight)	k Coeff. of permeability
LL % Liquid limit	e Void ratio	C Shear strength in terms of total stress
PL % Plastic limit	RD Relative density	φ Angle of int. friction in terms of effective stress
PI % Plasticity index	C <sub>v</sub> Coeff. of consolidation	C' Cohesion
LI Liquidity index	m <sub>v</sub> Coeff. of volume compressibility	φ' Angle of int. friction

## UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —



## SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq ft.
Very loose	0 - 15 %	Very soft	less than 250
Loose	15 - 35 %	Soft	250 - 500
Compact	35 - 65 %	Firm	500 - 1000
Dense	65 - 85 %	Stiff	1000 - 2000
Very dense	85 - 100 %	Very stiff	2000 - 4000
		Hard	over 4000



APPENDIX B

TABLE OF LABORATORY TEST RESULTS

GRAIN SIZE DISTRIBUTION CURVES

CONSOLIDATION TEST RESULTS

TABLE 3

Enclosures Nos.  
2, 3, 4, 5, 6 and 7

Enclosures No.  
8 and 9

APPENDIX B - TABLE 3  
TABLE OF LABORATORY TEST RESULTS

BH #	Sample #	Natural Moisture Content %	Liquid Limit %	Plastic Limit %	Plas- ticity Index %	Liqui- dity Index %	Unit Weight P.C.F.	Undrained Shear Strength P.S.F.	Remarks
1	SS-2								Fill; Grain Size Distribution (Encl. 3)
2	SS-3 4	40 36	51	21	30	0.65			
4A	SS-1	27							Consolidation Test (Encl. 8)
	TW-2	34	38	19	19	0.79	118	1030	
	SS-3	44							
	TW-4	56	58	23	35	0.93	104	770	Consolidation Test (Encl. 9)
	SS-5	50							
	TW-6	55	56	22	34	0.98	104	720	
	SS-7	57							
4B	TW-4	46					105	496	
	TW-5	42	45	21	24	0.88	111	445	
	TW-7	65					111	822	
	TW-8	52					104	700	
10	SS-4	28	57	22	35	0.17			
	SS-6	33	51	22	29	0.38			
16	SS-4	30	45	21	24	0.38			
	SS-5	36							
	SS-6	38							
17	SS-1								Fill; Grain Size Distribution (Encl. 4)
18	SS-1								
19	SS-2	31							
	SS-3	32	60	22	38	0.26			
	SS-4	31							
22	SS-1								Fill; Grain Size Distri- bution (Encl. 3) Subgrade; Grain Size Dis- tribution (Encl. 5)
	SS-6								

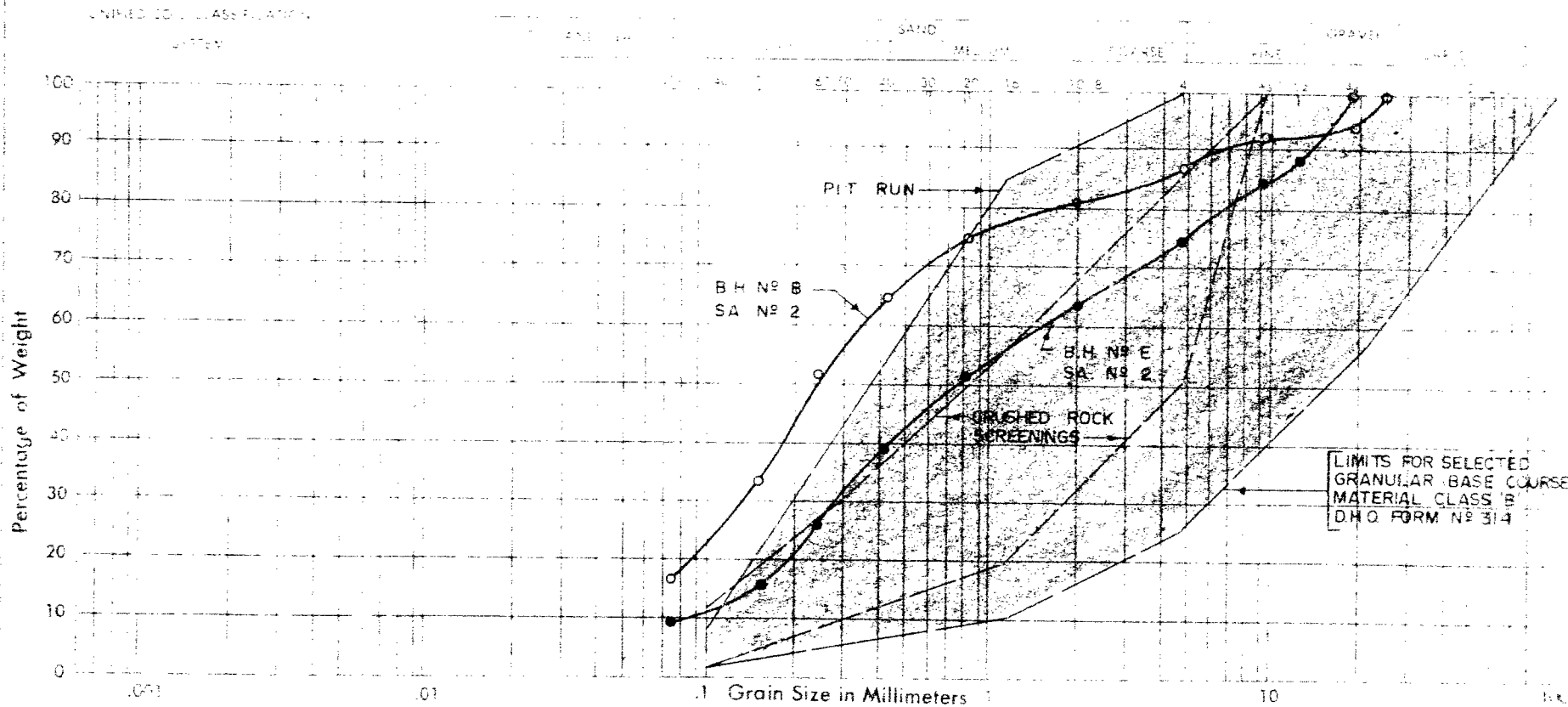
TABLE OF LABORATORY TEST RESULTS - continued

BH #	Sample #	Natural Moisture Content %	Liquid Limit %	Plastic Limit %	Plas- ticity Index %	Liqui- dity Index %	Unit Weight P.C.F.	Undrained Shear Strength P.S.F.	Remarks
23	SS-5	22	35	22	13				
	SS-6	36							
24	SS-5								
27	SS-6	34	41	22	19	0.63			Subgrade; Grain Size Dis- tribution (Encl. 6)
28	SS-6	29	26	16	10	1.3			
30	SS-1	13	27	17	10				Fill; Grain Size Distri- bution (Encl. 4)
	SS-4	24							
	SS-5	26							
	TW-6	28	37	19	18	0.5	121	1900	
32	SS-8								Subgrade; Grain Size Dis- tribution (Encl. 7)
33	SS-3	34	49	21	28	0.45			
	SS-4	36							
	SS-5	35							
36	SS-1								Fill; Grain Size Distri- bution (Encl. 4)
37	SS-3	35	56	23	33	0.36			
	SS-4	36							
38	SS-4	23	37	22	15	0.07			
	SS-5	25	28	21	7	0.57			

# DOMINION SOIL INVESTIGATION LIMITED

## GRAIN SIZE DISTRIBUTION

5-1-7



PROJECT HWY No 69 - WIDENING

LOCATION SUDBURY, ONTARIO

DRILL NO. B & E

SAMPLE NO.

DEPTH 1.5M

ELEVATION OF SAMPLE

PERCENT OF UNIFORMITY

PERCENT OF CURVATURE

Classification of Sample and Group Symbol

SAND & GRAVEL with some

FILL

PLASTIC PROPERTIES

LIQUID LIMIT  $w_L$

PLASTIC LIMIT  $w_P$

PLASTICITY INDEX  $I_P$

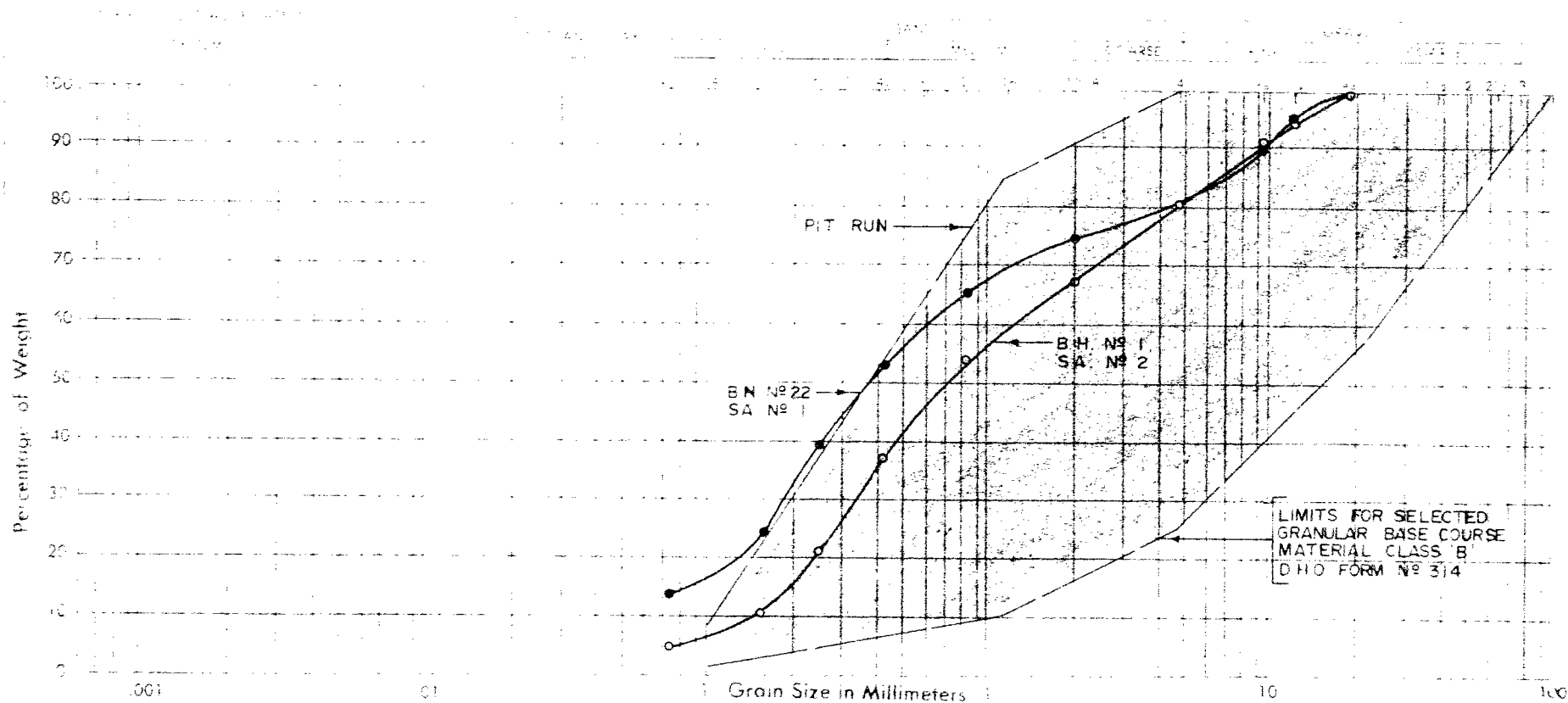
MOISTURE CONTENT  $w$

ACTIVITY  $A$

# DOMINION SOIL INVESTIGATION LIMITED

## GRAIN SIZE DISTRIBUTION

5-11-7



HWY. 1269 - WIDENING  
SUDBURY, ONTARIO  
BORINGS 1 & 22  
FAMILY 10  
TYPE OF SOIL  
GRAIN SIZE ANALYSIS

### Classification of Sample and Group Symbol:

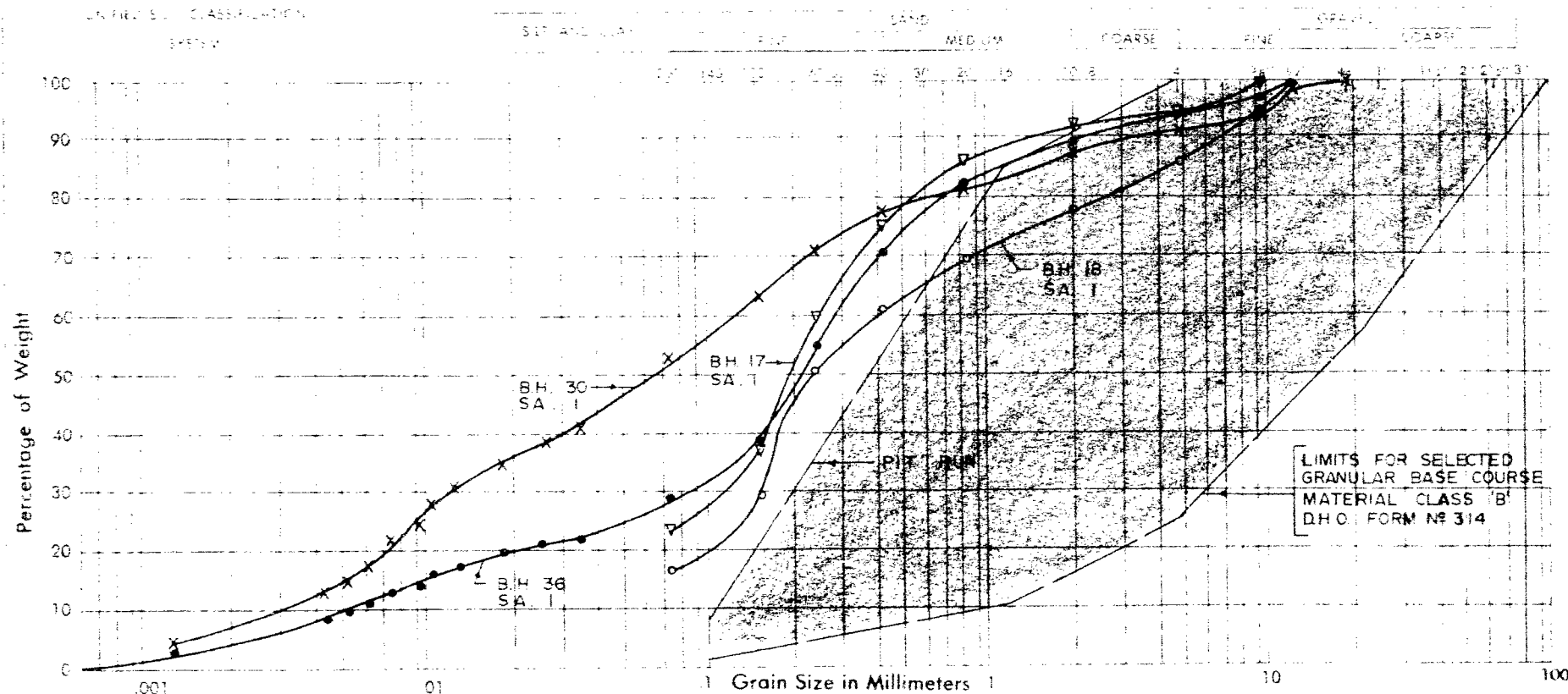
SAND & GRAVEL with some silt  
FILL

PLASTIC REGION  
LIQUID LIMIT  
PLASTIC LIMIT  
FLUIDITY INDEX  
MOISTURE CONTENT  
ATWATER

# DOMINION SOIL INVESTIGATION LIMITED

## GRAIN SIZE DISTRIBUTION

LABORATORY NO. 5-11-7



PROJECT HWY. NO. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
BORING NO. 17, 18, 30 & 36  
SAMPLING  
DATE OF SAMPLE  
ELEVATION OF SAMPLE

CONFIDENTIALITY  
CONFIDENTIALITY

Classification of Sample and Group Symbol:  
SILTY & CLAYEY SAND  
FILL

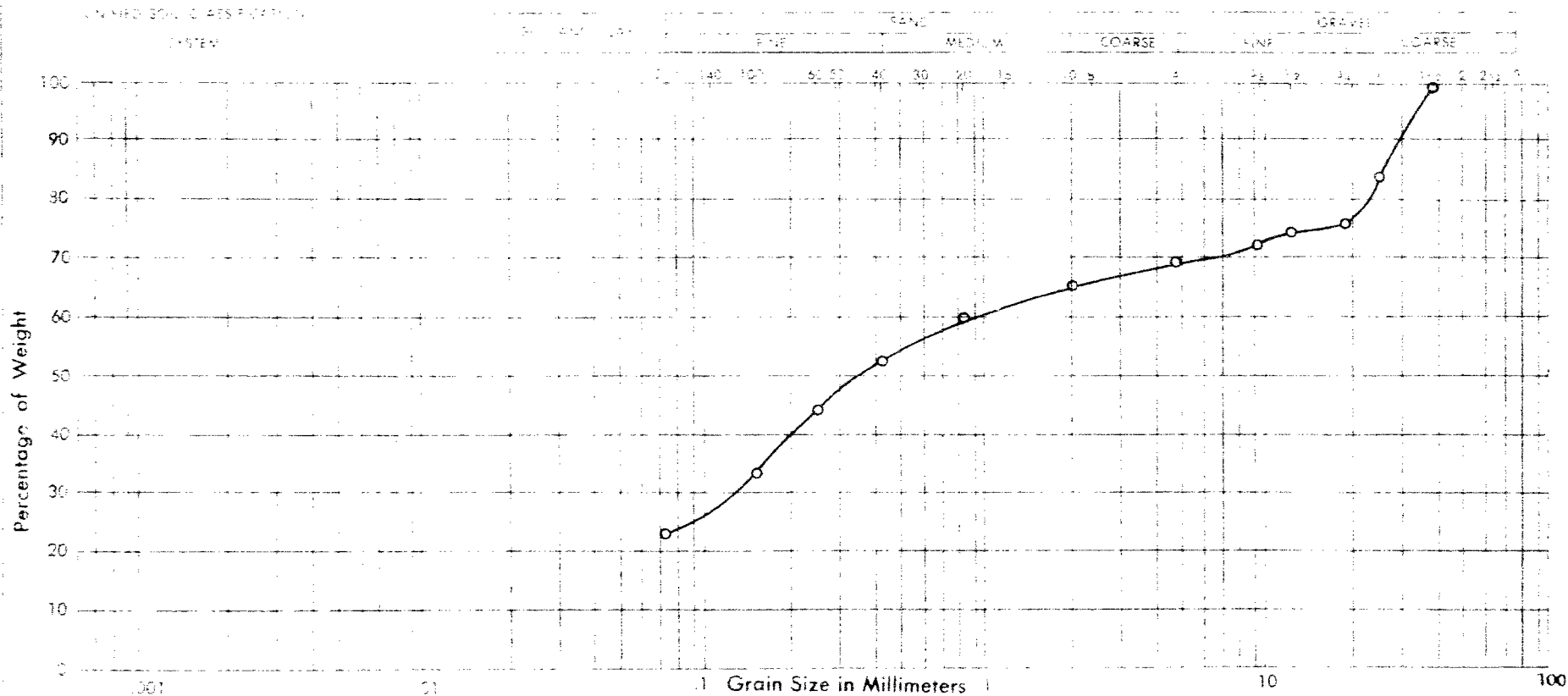
1.  $\frac{1}{2}$  2.  $\frac{1}{3}$  3.  $\frac{1}{4}$  4.  $\frac{1}{5}$  5.  $\frac{1}{6}$  6.  $\frac{1}{7}$  7.  $\frac{1}{8}$  8.  $\frac{1}{9}$  9.  $\frac{1}{10}$  10.  $\frac{1}{11}$  11.  $\frac{1}{12}$  12.  $\frac{1}{13}$  13.  $\frac{1}{14}$  14.  $\frac{1}{15}$  15.  $\frac{1}{16}$  16.  $\frac{1}{17}$  17.  $\frac{1}{18}$  18.  $\frac{1}{19}$  19.  $\frac{1}{20}$  20.  $\frac{1}{21}$  21.  $\frac{1}{22}$  22.  $\frac{1}{23}$  23.  $\frac{1}{24}$  24.  $\frac{1}{25}$  25.  $\frac{1}{26}$  26.  $\frac{1}{27}$  27.  $\frac{1}{28}$  28.  $\frac{1}{29}$  29.  $\frac{1}{30}$  30.  $\frac{1}{31}$  31.  $\frac{1}{32}$  32.  $\frac{1}{33}$  33.  $\frac{1}{34}$  34.  $\frac{1}{35}$  35.  $\frac{1}{36}$  36.  $\frac{1}{37}$  37.  $\frac{1}{38}$  38.  $\frac{1}{39}$  39.  $\frac{1}{40}$  40.  $\frac{1}{41}$  41.  $\frac{1}{42}$  42.  $\frac{1}{43}$  43.  $\frac{1}{44}$  44.  $\frac{1}{45}$  45.  $\frac{1}{46}$  46.  $\frac{1}{47}$  47.  $\frac{1}{48}$  48.  $\frac{1}{49}$  49.  $\frac{1}{50}$  50.  $\frac{1}{51}$  51.  $\frac{1}{52}$  52.  $\frac{1}{53}$  53.  $\frac{1}{54}$  54.  $\frac{1}{55}$  55.  $\frac{1}{56}$  56.  $\frac{1}{57}$  57.  $\frac{1}{58}$  58.  $\frac{1}{59}$  59.  $\frac{1}{60}$  60.  $\frac{1}{61}$  61.  $\frac{1}{62}$  62.  $\frac{1}{63}$  63.  $\frac{1}{64}$  64.  $\frac{1}{65}$  65.  $\frac{1}{66}$  66.  $\frac{1}{67}$  67.  $\frac{1}{68}$  68.  $\frac{1}{69}$  69.  $\frac{1}{70}$  70.  $\frac{1}{71}$  71.  $\frac{1}{72}$  72.  $\frac{1}{73}$  73.  $\frac{1}{74}$  74.  $\frac{1}{75}$  75.  $\frac{1}{76}$  76.  $\frac{1}{77}$  77.  $\frac{1}{78}$  78.  $\frac{1}{79}$  79.  $\frac{1}{80}$  80.  $\frac{1}{81}$  81.  $\frac{1}{82}$  82.  $\frac{1}{83}$  83.  $\frac{1}{84}$  84.  $\frac{1}{85}$  85.  $\frac{1}{86}$  86.  $\frac{1}{87}$  87.  $\frac{1}{88}$  88.  $\frac{1}{89}$  89.  $\frac{1}{90}$  90.  $\frac{1}{91}$  91.  $\frac{1}{92}$  92.  $\frac{1}{93}$  93.  $\frac{1}{94}$  94.  $\frac{1}{95}$  95.  $\frac{1}{96}$  96.  $\frac{1}{97}$  97.  $\frac{1}{98}$  98.  $\frac{1}{99}$  99.  $\frac{1}{100}$  100.  $\frac{1}{101}$  101.  $\frac{1}{102}$  102.  $\frac{1}{103}$  103.  $\frac{1}{104}$  104.  $\frac{1}{105}$  105.  $\frac{1}{106}$  106.  $\frac{1}{107}$  107.  $\frac{1}{108}$  108.  $\frac{1}{109}$  109.  $\frac{1}{110}$  110.  $\frac{1}{111}$  111.  $\frac{1}{112}$  112.  $\frac{1}{113}$  113.  $\frac{1}{114}$  114.  $\frac{1}{115}$  115.  $\frac{1}{116}$  116.  $\frac{1}{117}$  117.  $\frac{1}{118}$  118.  $\frac{1}{119}$  119.  $\frac{1}{120}$  120.  $\frac{1}{121}$  121.  $\frac{1}{122}$  122.  $\frac{1}{123}$  123.  $\frac{1}{124}$  124.  $\frac{1}{125}$  125.  $\frac{1}{126}$  126.  $\frac{1}{127}$  127.  $\frac{1}{128}$  128.  $\frac{1}{129}$  129.  $\frac{1}{130}$  130.  $\frac{1}{131}$  131.  $\frac{1}{132}$  132.  $\frac{1}{133}$  133.  $\frac{1}{134}$  134.  $\frac{1}{135}$  135.  $\frac{1}{136}$  136.  $\frac{1}{137}$  137.  $\frac{1}{138}$  138.  $\frac{1}{139}$  139.  $\frac{1}{140}$  140.  $\frac{1}{141}$  141.  $\frac{1}{142}$  142.  $\frac{1}{143}$  143.  $\frac{1}{144}$  144.  $\frac{1}{145}$  145.  $\frac{1}{146}$  146.  $\frac{1}{147}$  147.  $\frac{1}{148}$  148.  $\frac{1}{149}$  149.  $\frac{1}{150}$  150.  $\frac{1}{151}$  151.  $\frac{1}{152}$  152.  $\frac{1}{153}$  153.  $\frac{1}{154}$  154.  $\frac{1}{155}$  155.  $\frac{1}{156}$  156.  $\frac{1}{157}$  157.  $\frac{1}{158}$  158.  $\frac{1}{159}$  159.  $\frac{1}{160}$  160.  $\frac{1}{161}$  161.  $\frac{1}{162}$  162.  $\frac{1}{163}$  163.  $\frac{1}{164}$  164.  $\frac{1}{165}$  165.  $\frac{1}{166}$  166.  $\frac{1}{167}$  167.  $\frac{1}{168}$  168.  $\frac{1}{169}$  169.  $\frac{1}{170}$  170.  $\frac{1}{171}$  171.  $\frac{1}{172}$  172.  $\frac{1}{173}$  173.  $\frac{1}{174}$  174.  $\frac{1}{175}$  175.  $\frac{1}{176}$  176.  $\frac{1}{177}$  177.  $\frac{1}{178}$  178.  $\frac{1}{179}$  179.  $\frac{1}{180}$  180.  $\frac{1}{181}$  181.  $\frac{1}{182}$  182.  $\frac{1}{183}$  183.  $\frac{1}{184}$  184.  $\frac{1}{185}$  185.  $\frac{1}{186}$  186.  $\frac{1}{187}$  187.  $\frac{1}{188}$  188.  $\frac{1}{189}$  189.  $\frac{1}{190}$  190.  $\frac{1}{191}$  191.  $\frac{1}{192}$  192.  $\frac{1}{193}$  193.  $\frac{1}{194}$  194.  $\frac{1}{195}$  195.  $\frac{1}{196}$  196.  $\frac{1}{197}$  197.  $\frac{1}{198}$  198.  $\frac{1}{199}$  199.  $\frac{1}{200}$  200.  $\frac{1}{201}$  201.  $\frac{1}{202}$  202.  $\frac{1}{203}$  203.  $\frac{1}{204}$  204.  $\frac{1}{205}$  205.  $\frac{1}{206}$  206.  $\frac{1}{207}$  207.  $\frac{1}{208}$  208.  $\frac{1}{209}$  209.  $\frac{1}{210}$  210.  $\frac{1}{211}$  211.  $\frac{1}{212}$  212.  $\frac{1}{213}$  213.  $\frac{1}{214}$  214.  $\frac{1}{215}$  215.  $\frac{1}{216}$  216.  $\frac{1}{217}$  217.  $\frac{1}{218}$  218.  $\frac{1}{219}$  219.  $\frac{1}{220}$  220.  $\frac{1}{221}$  221.  $\frac{1}{222}$  222.  $\frac{1}{223}$  223.  $\frac{1}{224}$  224.  $\frac{1}{225}$  225.  $\frac{1}{226}$  226.  $\frac{1}{227}$  227.  $\frac{1}{228}$  228.  $\frac{1}{229}$  229.  $\frac{1}{230}$  230.  $\frac{1}{231}$  231.  $\frac{1}{232}$  232.  $\frac{1}{233}$  233.  $\frac{1}{234}$  234.  $\frac{1}{235}$  235.  $\frac{1}{236}$  236.  $\frac{1}{237}$  237.  $\frac{1}{238}$  238.  $\frac{1}{239}$  239.  $\frac{1}{240}$  240.



Enclosure No. 5

# DOMINION SOIL INVESTIGATION LIMITED GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 5-11-7



PROJECT: HWY. NO. 69 - WIDENING  
LOCATION: SUDBURY, ONTARIO  
SECTION NO.: 24  
SAMPLE NO.: 5  
DEPTH OF SAMPLE: 7' - 8.5'  
ELEVATION OF SAMPLE: 862 ± ft

GRAIN SIZE DISTRIBUTION  
EQUATION OF CURVATURE

Classification of Sample and Group Symbol:

SILTY SAND & GRAVEL

PLASTIC PROPERTIES

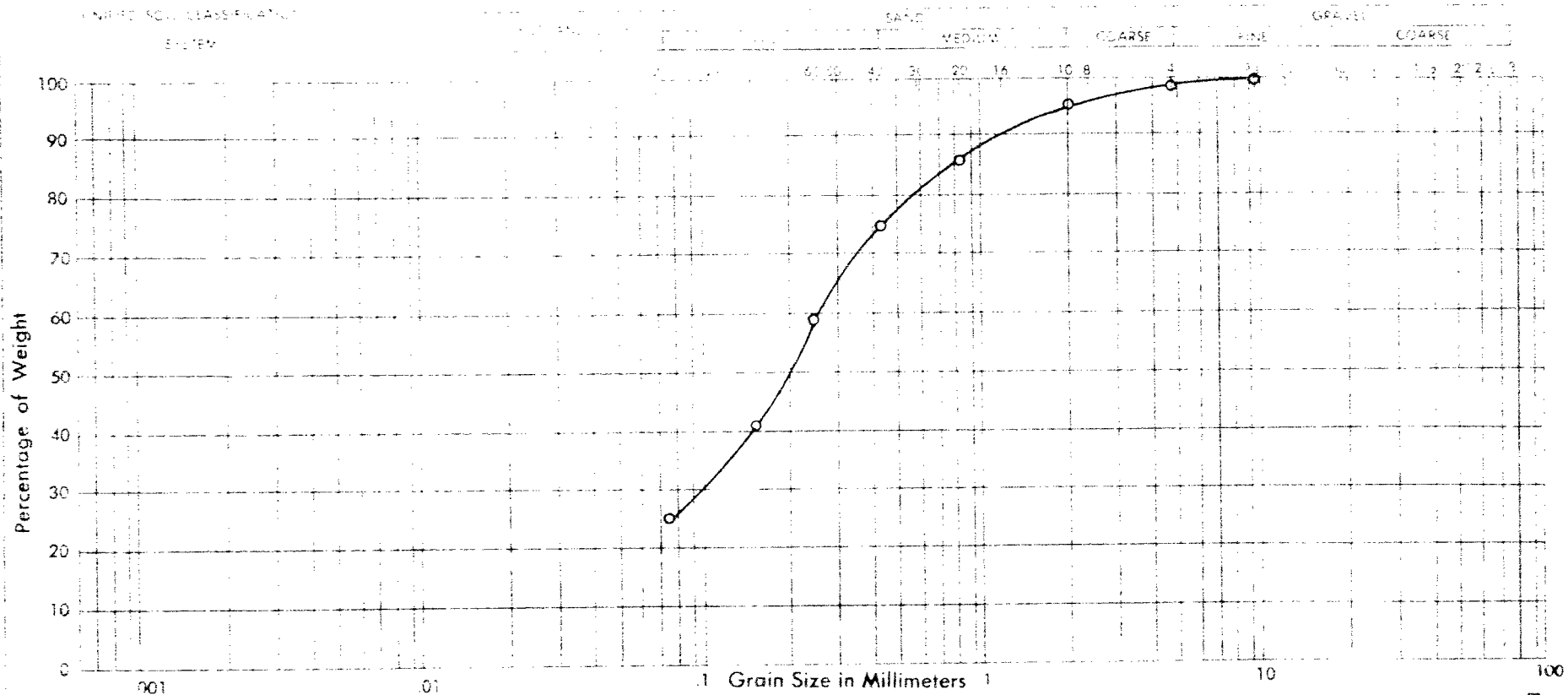
LIQUID LIMIT:  $w_L$  ---  
PLASTIC LIMIT:  $w_P$  ---  
PLASTICITY INDEX:  $I_P$  ---  
MOISTURE CONTENT:  $w$  ---  
ACTIVITY: ---

Enclosure No. 6



# DOMINION SOIL INVESTIGATION LIMITED GRAIN SIZE DISTRIBUTION

REPORT NO. 5-11-7



PROJECT HWY. NO. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
BOREHOLE NO. 32  
SAMPLE NO. 8  
DEPTH OF SAMPLE 14.5' - 17'  
ELEVATION OF SAMPLE 808 ± ft

DIFFERENTIAL UNIFORMITY  
COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

SILTY SAND

PLASTIC PROPERTIES

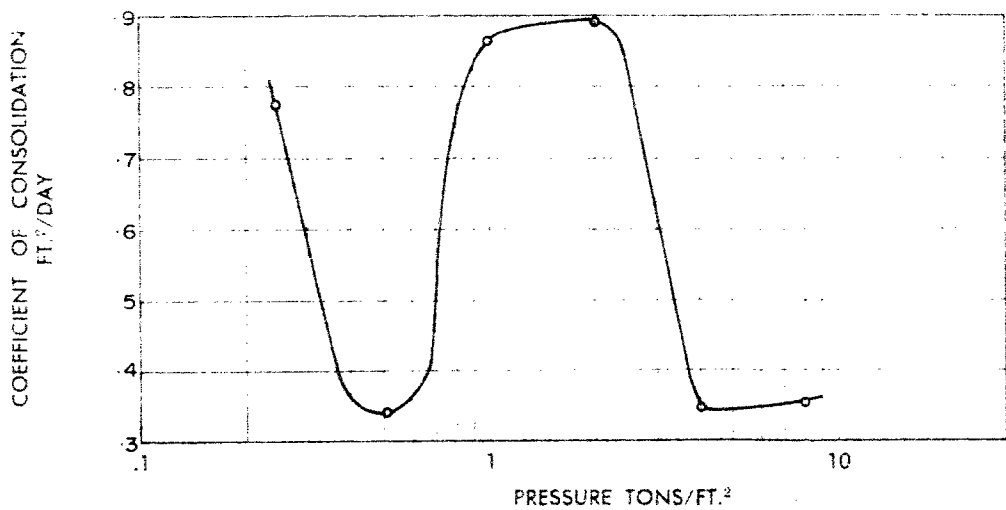
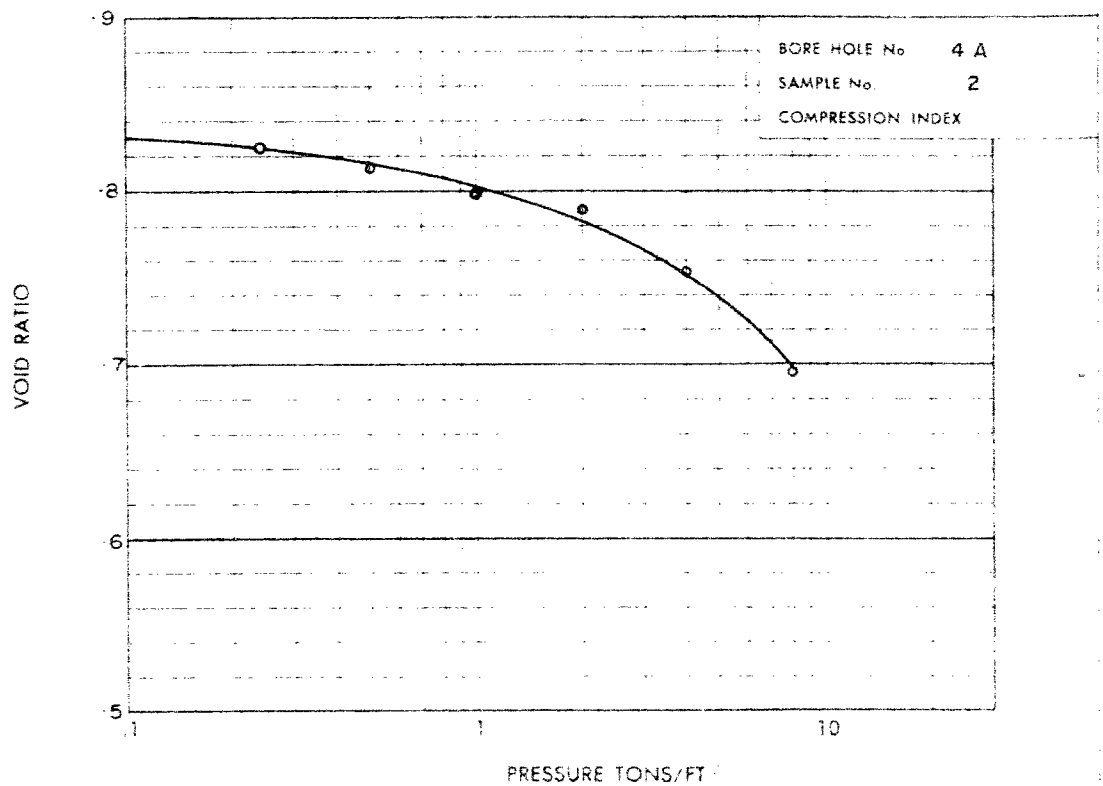
LIQUID LIMIT %

PLASTIC LIMIT %

PLASTICITY INDEX %

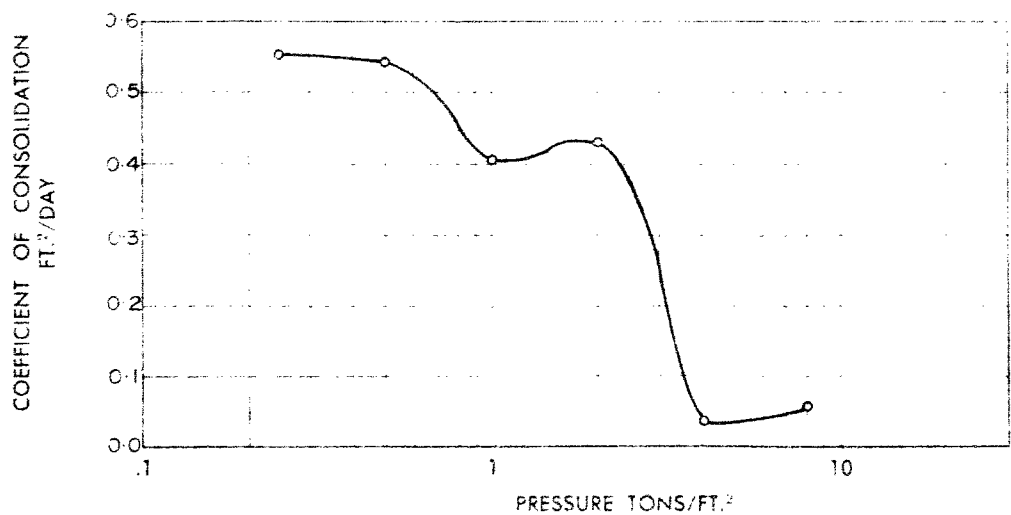
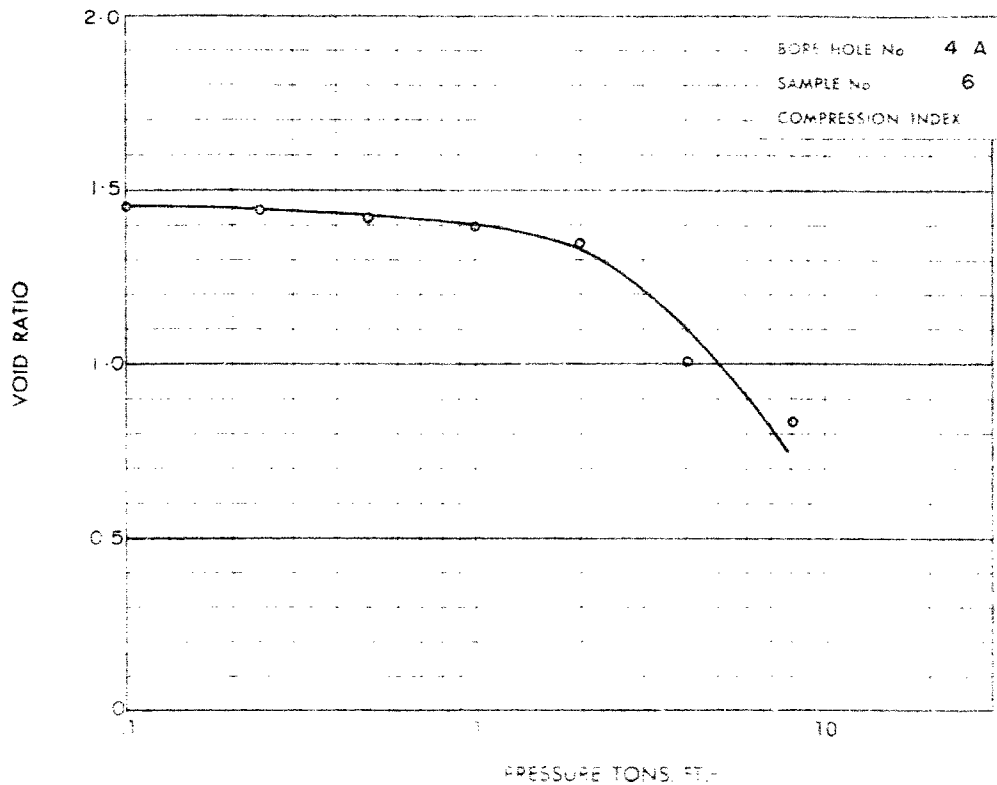
MOISTURE CONTENT %

ACTIVITY

**Dominion Soil Investigation Ltd.****CONSOLIDATION TEST**

**Dominion Soil Investigation Ltd.**

## CONSOLIDATION TEST



APPENDIX C

GEOTECHNICAL DATA SHEETS  
FOR BOREHOLES

ENCLOSURES NOS.  
10 to 25 incl.

BOREHOLE LOCATION PLANS AND  
SUBSURFACE PROFILES

ENCLOSURES NOS.  
26 to 29 incl.

# GEOTECHNICAL DATA SHEET FOR BOREHOLE . 1, 2 & 3

OUR REFERENCE NO. 5 - 11 - 7

CLIENT M. M. DILLON  
PROJECT HWY NO 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"  
DATE B.H. NO 1 - NOV. 23, 1965  
B.H. NO 2 - DEC. 15, 1965  
B.H. NO 3 - NOV 24, 1965

ENCLOSURE NO 10

ELEVATION "	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	2 - 8 Advance of Sampler	2.0	4.0	6.0	8.0	10.0	PL	W	LI			
							SHEAR STRENGTH 1000 lbf/sq ft										
							1	2	3	4	5	2.0	3.0	4.0	5.0		
871.6	0	GROUND SURFACE		BOREHOLE N° 1												3 + 70 - 10 - 1 - m	
870.0		Brown GRAVELLY SAND FILL		1	S.S.	35										GRAIN SIZE DISTR. (ENCL. 3)  W.L. El. 866.1 NOV 24, 1965	
				2	S.S.	34											
				3	S.S.	63											
865.0	5.5			4	S.S.	27											
				5	S.S.	11											
				6	S.S.	4											
860.0	10	Stiff to Firm CLAY															
855.0	15																
	17.6	END OF BOREHOLE															
870.6	0	GROUND SURFACE		BOREHOLE N° 2												5 + 70 - 10 - 2 - m	
		Brown SILTY - GRAVEL and SAND FILL		1	S.S.	260										EXTRAPOLATED 'N' VALUE 130/6"  W.L. El. 866.1 DEC. 15, 1965	
		some boulders															
865.0	5	PEAT		2 A	S.S.	5											
	6.0	Grey SILT		2 B	S.S.	3											
	7.0	Firm to Stiff Grey VARVED CLAY		3	S.S.	3											
860.0	10			4	S.S.	6											
	11.0	END OF BOREHOLE															
874.5	0	GROUND SURFACE		BOREHOLE N° 3												7 + 70 - 10 - 3 - m	
		Brown GRAVEL and SAND FILL		1	S.S.	89										W.L. El. 865.5 NOV. 24, 1965 EXTRAPOLATED 'N' VALUE 100/3"	
				2	S.S.	30											
870.0				3	S.S.	33											
	5			4	S.S.	36											
		many boulders		5	S.S.	35											
865.0	9.25			6	S.S.	52											
	10	END OF BOREHOLE (REFUSAL MAY BE ON BOULDER)		7	S.S.	400											

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D. A. M. CH'D

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 4. 8. 4 A

OUR REFERENCE NO. 5 - 11 - 7

CLIENT M. M. DILLON  
PROJECT HWY. NR 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"  
DATE B.H. NR 4 - NOV. 24, 1965  
B.H. NR 4A - DEC. 15, 1965

ENCLOSURE NO. 11

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	ADVANCEMENT of Sampler	2.0	4.0	6.0	8.0	10.0	PL	W	LI			
880.3	0	GROUND SURFACE					BOREHOLE N <sup>o</sup> 4										
875.0	5	Brown SAND and GRAVEL FILL some boulders		1	SS	20	0									HOLE DRY - NOV. 24/65     EXTRAPOLATED 'N' VALUE 15 / 6 " 65 / 3 "	
	2	SS		64													
	3	SS		6	0												
	4	SS		17	0												
	5	SS		27	0												
	6	SS		145													
870.0	10	END OF BOREHOLE REFUSAL, POSSIBLY ON BOULDER															
867.6	0	GROUND SURFACE					BOREHOLE N <sup>o</sup> 4 A										
865.0	10	PEAT		1	SS	9	0									W.L. EL. 865.6 DEC 15, 1965  γ = 118 p.c.f. CONSOLIDATION TEST (ENCL 8)  γ = 104 p.c.f.  γ = 104 p.c.f. CONSOLIDATION TEST (ENCL 9)	
860.0	5	Grey VARVED CLAY		2	TW	P		8.0									
	3	SS		3	0												
855.0	10	Stiff Firm		4	TW	P		12.5									
	5	SS		3	0												
850.0	15			6	TW	P		14.0									
	7	SS		2	0												
845.0	20	END OF BOREHOLE					6.0										

VERTICAL SCALE, 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D. A. M. CHD

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 4 B.

FOR REFERENCE ONLY

ENGINEER: M. M. BELLON  
PROJECT: HWY. NO. 60 - WIDENING  
LOCATION: SUDBURY, ONTARIO  
BATHYMETRIC ELEVATION: GEODETIC

WATER BOREHOLE: WASHBORING  
DIAMETER OF BOREHOLE: 2 3/8"  
DATE: JAN. 8, 1966

ENCLOSURE NO. 12

ELEVATION (FEET)	DEPTH (FEET)	STRATIFICATION DESCRIPTION	SAMPLE NO.	TEST	PENETRATION RESISTANCE (TONS PER SQ. FT.)	SHEAR STRENGTH (1000 LBS. PER SQ. FT.)	UNSATURATED WATER CONTENT (%)	REMARKS
867.6	0	GROUND SURFACE						
		SAND and GRAVEL						
865.0	1.5		1	TW	P			
	5	Grey	2	TW	P	5.0		
860.0						6.0		W.L. EL. 861.3 JAN. 8, 1965
	10	Stiff Soft	3	SS	3	4.0		
855.0		VARVED						
	15		4	TW	P	4.0		$\gamma = 105$ pcf
850.0		CLAY	5	TW	P	2.0		$\gamma = 111$ pcf
	20							
845.0			6	TW	P	4.0		
	25							
840.0		Soft Firm	7	TW	P	4.0		$w = 65\%$ $\gamma = 111$ pcf
	30							
835.0			8	TW	P	4.0		$\gamma = 104$ pcf
	35							
830.0								
	40		9	SS	7	3.7		
825.0								
	45	Compact	10	SS	11			
820.0		Grey SILT with a trace of clay						
	50		11	SS	14			
815.0	51.5	SILTY CLAY SEAM END OF BOREHOLE						

VERTICAL SCALE: 1 IN. TO 5'

DOMINION SOIL INVESTIGATION LIMITED

MADE: D.A.M. CHD

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 5, 6 & 7

OUR REFERENCE NO. 5 - 11 - 7

CLIENT M. M. DILLON  
PROJECT HWY NO 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRY BORING  
DIAMETER OF BOREHOLE 2 3/8"  
DATE B.H. 5 - NOV. 24, 1965  
B.H. 6 - NOV. 25, 1965  
B.H. 7 - NOV. 26, 1965

ENCLOSURE NO. 13

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	N or Advance of Sampler	20	40	60	80	100	PL	W	LI	
885.0	0	GROUND SURFACE					BOREHOLE No 5								
		Brown		1	SS	36									EXTRAPOLATED 'N' VALUE 18/6"
		SAND and GRAVEL		2	S.S.	200									EXTRAPOLATED 'N' VALUE 100/6"
880.0	5	FILL		3	SS	37									HOLE DRY
		many boulders		4	SS	62									
				5	SS	55									
875.0	10			6	SS	28									
		END OF BOREHOLE													
889.4	0	GROUND SURFACE					BOREHOLE No 6								
		Brown		1	S.S.	18									HOLE DRY
		SAND and GRAVEL		2	S.S.	19									
885.0	5	FILL		3	S.S.	200									EXTRAPOLATED 'N' VALUE 50/3"
				4	SS	29									
6.8				5	SS	300									EXTRAPOLATED 'N' VALUE 75/3"
		QUARTZITE		6	R.C.										
880.0	10	BEDROCK			100%										
	10.25	END OF BOREHOLE		7	R.C.										
891.5	0	GROUND SURFACE					BOREHOLE No 7								
890.0		SAND and GRAVEL		1	SS	28									HOLE DRY
		FILL		2	SS	870									EXTRAPOLATED 'N' VALUE 30/6"
	2.0	END OF BOREHOLE													70/0.5"
		REFUSAL ON BEDROCK													
885.0	5														

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D.A.M. CHD



# GEOTECHNICAL DATA SHEET FOR BOREHOLE 8, 9, & 10

OUR REFERENCE NO. 5-11-7

CLIENT M. M. DILLON  
PROJECT HWY. NO. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

WASHBORING - B.H. NO. 8  
METHOD OF BORING DRYBORING - B.H. NOS. 9 & 10  
DIAMETER OF BOREHOLE 2 3/8"  
DATE B.H. NO. 8 - NOV. 26, 1965  
B.H. NO. 9 - NOV. 30, 1965  
B.H. NO. 10 - DEC. 1, 1965  
ENCLOSURE NO. 14

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	Adv. or Sampler	20	40	60	80	100	PL	W	LI			
891.5	0	GROUND SURFACE					BOREHOLE Nº 8										
890.0		SAND and GRAVEL FILL		1	SS	29										HOLE DRY - NOV. 30, 1965  EXTRAPOLATED 'N' VALUE 17/5" 80/4"	
				2	SS	137											
885.0	3.8	QUARTZITE BEDROCK		3	RC	80%											
	5																
	8.75	END OF BOREHOLE															
880.0	10																
890.1	0	GROUND SURFACE					BOREHOLE Nº 9										
		GRAVELLY SAND FILL		1	SS	89										HOLE DRY - NOV. 30, 1965  EXTRAPOLATED 'N' VALUE 100/3"	
	1.75	END OF BOREHOLE REFUSAL ON BEDROCK		2	SS	400											
885.0	5																
885.9	0	GROUND SURFACE					BOREHOLE Nº 10										
885.0		Brown GRAVELLY SAND FILL		1	SS	36										HOLE DRY - DEC. 1, 1965	
		some clayey silt lenses		2	SS	10											
	4.0			3	SS	8											
	5			4	SS	12											
880.0		Brown, Stiff CLAY TILL		5	SS	14											
		(layered structure)		6	SS	12											
	10																
875.0		END OF BOREHOLE															

VERTICAL SCALE: 1 INCH = 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D.A.M. CHD

OUR REFERENCE NO. 5 - 11 - 7

B.H. N° 11 - WASHBORING  
METHOD OF BORING B.H. N° 12 & 13 - DRYBORING  
DIAMETER OF BOREHOLE 2 3/8" ENCLOSURE NO 15  
DATE B.H. N° 11 - DEC. 1, 1965

VERTICAL SCALE 1 IN TO 5 FT

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 14, 15 & 16










OUR REFERENCE NO. 5-11-7

CLIENT M. M. DILLON  
PROJECT HWY NO 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"

ENCLOSURE NO. 16

DATE B.H. NO 16 - DEC. 7, 1965  
B.H. NO 17 - DEC. 8, 1965  
B.H. NO 18 - DEC. 8, 1965

ELEVATION +	DEPTH +	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	N <sub>60</sub> Advancement of Sampler	2.0	4.0	6.0	8.0	10.0	PL	W	LI			
BOREHOLE N° 14																	
873.9	0	GROUND SURFACE															
	1.0	SANDY GRAVEL (FILL)		1	S.S.	200											EXTRAPOLATED 'N' VALUE 100/6"
		Very Stiff															
		Brown		2	S.S.	24											
870.0	5	SANDY CLAY TILL (layered structure)		3	S.S.	12											W.L. El. 869.9 DEC. 7, 1965
				4	S.S.	22											
865.0	8.0	Brown SILT		5	S.S.	317											EXTRAPOLATED 'N' VALUE 17/6" 100/2"
	9.2	END OF BOREHOLE REFUSAL, PROBABLY ON BEDROCK															
BOREHOLE N° 15																	
875.5	0	GROUND SURFACE															
	1.5	SAND, ASH (FILL)		1	S.S.	27											
		Brown		2	S.S.	12											
		Stiff to Firm		3	S.S.	6											
	5	CLAY TILL		4	S.S.	6											
870.0		occasional sand pockets.		5	S.S.	4											
	6.5	Loose, Grey		6	S.S.	8											W.L. El. 868.9 DEC. 7, 1965
	10	SILTY FINE SAND															
865.5		END OF BOREHOLE REFUSAL, PROBABLY ON BEDROCK															
BOREHOLE N° 16																	
871.3	0	GROUND SURFACE															
870.0		Brown		1	S.S.	26											
		GRAVELLY SAND		2	S.S.	9											
		FILL		3	S.S.	8											
	5	with pockets of silty clay		4	S.S.	10											
865.0	5.5	Brown, mottled		5	S.S.	19											
		CLAY TILL		6	S.S.	18											
		(layered structure)															
860.0	10	END OF BOREHOLE															

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D A M CHL

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 17, 18 & 19

OUR REFERENCE NO. 5-11-7

CLIENT M. M. DILLON  
PROJECT HWY. NO. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"

ENCLOSURE NO. 17

DATE B.H. 17 - DEC 8, 1965  
B.H. 18 - DEC 8, 1965  
B.H. 19 - DEC 8, 1965

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE Blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	Advance of Sample	2.0	4.0	6.0	8.0	10.0	PL	W	LI			
BOREHOLE Nº 17																	
870.3	0	GROUND SURFACE														GRAIN SIZE DISTR. (ENCL 4)	
		Brown SAND, SILT, CLAY, GRAVEL		1	SS	37											
				2	SS	11											
865.0	5	FILL		3	SS	6											
				4	SS	1											
	6.5	Dark Grey ORGANIC SILT Firm		5	SS	4											
	8.0																
860.0	10	Brown, mottled CLAY TILL		6	SS	8											
	11.0	END OF BOREHOLE															
BOREHOLE Nº 18																	
870.5	0	GROUND SURFACE														GRAIN SIZE DISTR (ENCL 4)	
		5" ASPHALT															
		Brown		1	SS	83											
		SILTY, GRAVELLY SAND, FILL		2 A B	SS	19											
865.0	5	Grey, Compact SILT		3	SS	28											
				4	SS	17											
	7.0	GRAVEL		5 A B	SS	102											
	8.0	END OF BOREHOLE														W.L. El 863.4 DEC. 8, 1965	
860.0	10	REFUSAL, PROBABLY ON BEDROCK															
BOREHOLE Nº 19																	
871.4	0	GROUND SURFACE														EXTRAPOLATED 'N' VALUE 100 / 6"	
		3" ASPHALT															
870.0	1.5	Brown, GRAVELLY SAND		1	SS	200											
		Brown, mottled CLAY TILL		2	SS	16											
	5	slightly varved structure		3	SS	16											
865.0	5.8			4	SS	206											
		QUARTZITE BEDROCK		5	RC	86.6%										EXTRAPOLATED 'N' VALUE 6 / 6" 100 / 3"	
860.0	10.75	END OF BOREHOLE															

VERTICAL SCALE 1 IN 10 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D. A. M. 1965

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 20, 21 & 22

OUR REFERENCE NO. 5-11-7

CLIENT M. M. DILLON  
PROJECT HWY. NO. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DAP.M. ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"  
DATE B.H. NO. 20 - DEC. 8, 1965  
B.H. NO. 21 - DEC. 8, 1965  
B.H. NO. 22 - DEC. 9, 1965

ENCLOSURE NO. 18

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS														
				NUMBER	TYPE	N. of Advancement of Sampler	2.0	4.0	6.0	8.0	10.0	SHEAR STRENGTH lbs. sq ft.																			
871.1	0	GROUND SURFACE															BOREHOLE Nº 20														
870.0		Brown GRAVELLY SAND FILL		1	SS	54												HOLE DRY - DEC. 8, 1965													
				2	SS	17																									
	3.5	ORGANIC CLAYEY SILT		3	SS	11																									
865.0	4.5	Brown-Grey, mottled CLAY TILL (layered structure)	4	SS	17																										
			5	SS	15																										
			6	SS	15																										
860.0	10	END OF BOREHOLE																													
872.0	0	GROUND SURFACE															BOREHOLE Nº 21														
870.0		Brown, SAND FILL		1	SS	38												W.L. 866.8 DEC. 8, 1965													
				2	SS	9																									
	3.5	Brown, Stiff CLAY TILL		3	SS	9																									
865.0	5	Grey SILT Dense, Grey SAND and GRAVEL with some silt	4	SS	48																										
	6.5			5	SS	40																									
				END OF BOREHOLE																											
860.0	10																														
872.2	0	GROUND SURFACE															BOREHOLE Nº 22														
870.0		Brown SILTY, GRAVELLY SAND FILL		1	SS	15												GRAIN SIZE DISTR. (ENCL. 3) HOLE DRY - DEC. 9, 1965													
				2	SS	8																									
	4.0			3	SS	9																									
865.0	5	Loose to Compact Brown SILTY SAND with some gravel	4	SS	13																										
			5	SS	4																										
			6	SS	15																										
860.0	10	END OF BOREHOLE															GRAIN SIZE DISTR. (ENCL. 5)														

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D. A. M. CHD

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 23, 24 & 25

OUR REFERENCE NO. 5-11-7

CLIENT M.M. DILLON  
PROJECT HWY NO 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"  
DATE DEC 9, 1965

ENCLOSURE NO 19

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	28 Day Strength psi	2.0	4.0	6.0	8.0	10.0	PI	W	FI			
BOREHOLE No 23																	
870.8	0	GROUND SURFACE															
870.0		Brown FINE SAND with a trace of gravel FILL		1	SS	50											EXTRAPOLATED 'N' VALUE 13/6" 100/4"  HOLE DRY - DEC. 9, 1965
				2	SS	163											
865.0	5	Dark Grey, ORG. SILT		3	SS	11											
	6.0	Brown-Grey, mottled Very Stiff CLAY TILL (layered structure)		4	SS	18											
				5	SS	19											
	10			6	SS	30											
860.0	11.0	END OF BOREHOLE															
BOREHOLE No 24																	
869.5	0	GROUND SURFACE															
		Brown GRAVELLY SAND FILL		1	SS	32											W.L. EL 863.6 DEC. 9, 1965  GRAIN SIZE DISTR. (ENCL 6)
				2	SS	39											
865.0	5	Dark-Grey ORGANIC CLAYEY SILT		3 A	SS	19											
	6.4	Compact, Brown GRAVELLY SAND with some silt		4 A	SS	29											
				5	SS	19											
860.0	10	END OF BOREHOLE		6	SS	19											
BOREHOLE No 25																	
866.8	0	GROUND SURFACE															
865.0		Brown SAND, GRAVEL SILT & ASH FILL		1	SS	110											EXTRAPOLATED 'N' VALUE 20/6" 60/4"  HOLE DRY - DEC. 9, 1965
				2	SS	49											
860.0	4.0	Grey SILT		3 A	SS	11											
	5	Very Stiff Brown, mottled CLAY TILL (layered structure)		4	SS	19											
				5	SS	18											
	10			6	SS	19											
		END OF BOREHOLE															
855.0																	

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 26, 27 & 28

OUR REFERENCE NO. 5-11-7

CLIENT M M DILLON  
PROJECT HWY No 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"

ENCLOSURE NO 20

DATE B.H. No 26 - DEC. 9, 1965  
B.H. No 27 - DEC. 9, 1965  
B.H. No 28 - DEC. 10, 1965

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	ADVANCEMENT of Sampler	2.0	4.0	6.0	8.0	10.0	PL	W	LI			

862.2	0	GROUND SURFACE		BOREHOLE Nº 26															
860.0		Brown		1	SS	45													
		GRAVELLY SAND		2	SS	82													
	5	FILL		3	SS	15													
855.0				4	SS	3													
	8.3	Brown, Stiff		5 A	SS	6													
	10	CLAY TILL		6	SS	9													
		END OF BOREHOLE																	
850.0																			
846.1	0	GROUND SURFACE		BOREHOLE Nº 27												49-70 - 18' RT			
845.0		Brown		1	SS	21													
		GRAVELLY SAND		2	SS	8													
	5	with some silt		3	SS	5													
		FILL		4	SS	5													
840.0				5 A	SS	6													
	8.0	Brown, Stiff		6	SS	8													
	10	CLAY TILL																	
		END OF BOREHOLE																	
835.0																			
834.6	0	GROUND SURFACE		BOREHOLE Nº 28															
		Brown		1	SS	17													
		GRAVELLY SAND		2	SS	11													
830.0	5	FILL		3	SS	8													
				4 A	SS	5													
	6.5	Soft		5	SS	3													
		Brown to Grey																	
825.0	10	VARVED		6	SS	4													
		SILTY CLAY																	
	12.0	END OF BOREHOLE																	

VERTICAL SCALE: 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D. A. M. CHD

GEOTECHNICAL DATA SHEET FOR BOREHOLE 29, 30 & 31

OUR REFERENCE NO. 5-11-7

CLIENT M. M. DILLON  
PROJECT HWY. No. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"  
DATE DEC. 10, 1965

ENCLOSURE NO. 21

ELEVATION	DEPTH	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	Notes Adjusted to Sample	20	40	60	80	100	PI	W	LI			
825.0	0	GROUND SURFACE					BOREHOLE No 29										
		Greyish		1	SS	29											
		SANDY, CLAYEY SILT		2	SS	6	0										
820.0	5	FILL		3	SS	9	0										
	5.5			4	SS	7	0										
		Firm, Grey		5	SS	6	0										
		VARVED SILTY CLAY		6	SS	11	0										
815.0	10	END OF BOREHOLE															
821.8	0	GROUND SURFACE					BOREHOLE No 30										
		Brown		1	SS	16	0										
820.0		CLAYEY		2	SS	11	0										
	5	FILL		3	SS	6	0										
	6.0			4	SS	3	0										
		Soft to Stiff		5	SS	2	0										
815.0		VARVED SILTY CLAY		6	TW	P											
	10	END OF BOREHOLE															
810.0																	
821.5	0	GROUND SURFACE					BOREHOLE No 31										
820.0		Brown - Grey		1	SS	23	0										
		CLAY, SILT,		2	SS	7	0										
	5	SAND and GRAVEL		3	SS	5	0										
815.0		FILL		4	SS	2	0										
				5	SS	1	0										
	10			6	SS	2	0										
		Soft to Firm		7	SS	1	0										
810.0		Grey		8A	SS	6	0										
	15	VARVED SILTY CLAY	8B	SS	6	0											

VERTICAL SCALE 1 IN TO 5 FT



# GEOTECHNICAL DATA SHEET FOR BOREHOLE 32, 33 & 34

OUR REFERENCE NO. 5-11-7

CLIENT: M. M. DILLON  
PROJECT: HWY. NO. 69 - WIDENING  
LOCATION: SUDBURY, ONTARIO  
DATUM ELEVATION: GEODETIC

WASHBORING - B.H. NO. 34  
METHOD OF BORING: DRYBORING - B.H. NO. 32 & 33  
DIAMETER OF BOREHOLE: 2 3/8" ENCLOSURE NO. 22  
DATE: B.H. NO. 32 - DEC. 10, 1965  
B.H. NO. 33 - DEC. 13, 1965  
B.H. NO. 34 - DEC. 14, 1965

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	Advancement of Sampler	2.0	4.0	6.0	8.0	100	PI	W	LI			
BOREHOLE Nº 32																	
823.8	0	GROUND SURFACE															
820.0	5	Brown  FINE SAND  FILL		1	SS	56											HOLE DRY - DEC 10, 1965  SOIL WET BELOW 8'
				2	SS	17											
				3	SS	6											
				4	SS	2											
815.0	9.0	VARVED SILTY CLAY		A		1										GRAIN SIZE DISTR (ENCL 7)	
				5	SS												
810.0	10	Loose, Brown  SILTY SAND		6	SS	7											
				7	SS	10											
				8	SS	7											
17.0		END OF BOREHOLE															
BOREHOLE Nº 33																	
836.3	0	GROUND SURFACE															
835.0	1.0	SAND FILL  Greyish CLAYEY SILT FILL		1	SS	28											W L EL 835.1 DEC. 13, 1965
				2	SS	13											
830.0	4.5	Stiff, Brown  CLAY TILL (layered structure)		3	SS	12											
				4	SS	15											
				5	SS	12											
825.0		END OF BOREHOLE															
BOREHOLE Nº 34																	
841.6	0	GROUND SURFACE															
840.0	2.5	1 1/2" ASPHALT SAND, SILT, CLAY, ASH FILL		1	SS	74											HOLE DRY - DEC. 13, 1965
				2	SS	608											
835.0	4.6	CLAY TILL		3	RC	94 %										EXTRAPOLATED 'N' VALUE 8 / 6" 100 / 1"	
8.25		END OF BOREHOLE															

VERTICAL SCALE: 1 IN. TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE: D. A. M. CH'D

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 35, 36 & 37

OUR REFERENCE NO. 5-11-7

CLIENT M. M. DILLON  
PROJECT HWY. NO. 69 - WIDENING  
LOCATION SUDBURY, ONTARIO  
DATUM ELEVATION GEODETIC

METHOD OF BORING DRYBORING  
DIAMETER OF BOREHOLE 2 3/8"

ENCLOSURE NO. 23

DATE B. H. NO. 35 - DEC. 13, 1965  
B. H. NO. 36 - DEC. 13, 1965  
B. H. NO. 37 - DEC. 14, 1965

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %					REMARKS
				NUMBER	TYPE	NO. OF ADJUSTED US SAMPLES	20	40	60	80	100	PL	W	LI			
BOREHOLE Nº 35																	
843.4	0	GROUND SURFACE															
		Brown FINE SAND with a trace of gravel and silty clay FILL		1	SS	34											
840.0				2	SS	22											
	5			3	SS	12											
				4	SS	33											
835.0	7.5	Dense GRAVEL		5	SS	50											
	10	END OF BOREHOLE REFUSAL, PROBABLY ON BEDROCK		6	SS	112											
BOREHOLE Nº 36																	
844.0	0	GROUND SURFACE															
		Brown GRAVELLY SAND and SILTY CLAY FILL		1	SS	45											
840.0	3.75	END OF BOREHOLE REFUSAL, PROBABLY ON BEDROCK		2	SS	400											
	5																
BOREHOLE Nº 37																	
843.0	0	GROUND SURFACE															
		Brown SILTY FINE SAND FILL		1	SS	28											
840.0				2A	SS	6											
	4.5			B	SS												
		Stiff, Brown MOTTLED CLAY TILL (layered structure)		3	SS	11											
835.0				4	SS	14											
	10	END OF BOREHOLE		5	SS	1											
830.0																	

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE D. A. M. CHD

# GEOTECHNICAL DATA SHEET FOR BOREHOLE 38 & 39

WATERLOO, ONT. 5 1 7

BY M. M. DILLON  
 HWY. NO. 69 - WIDENING  
 SUBSIDIARY, ONTARIO  
 DATE OF REPORT - GEOTECH.

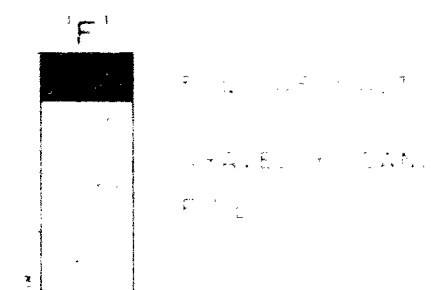
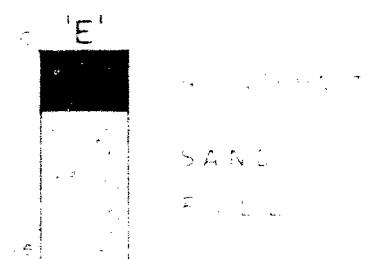
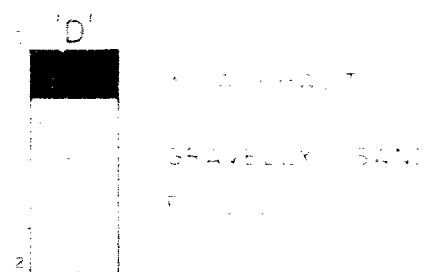
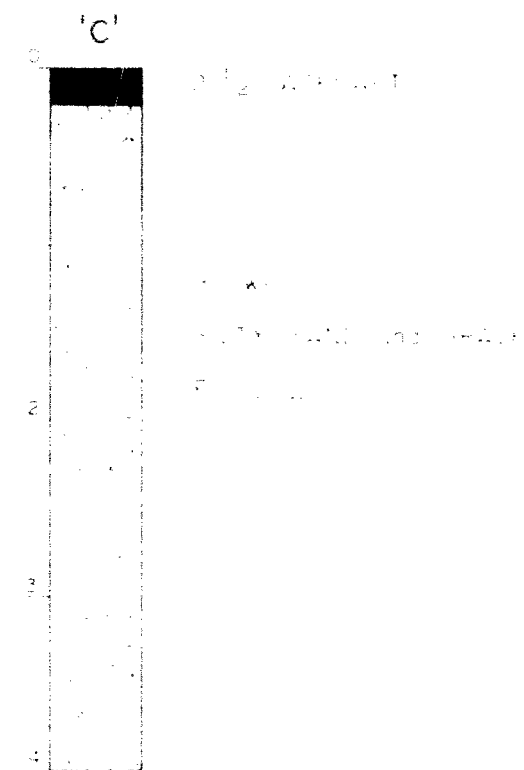
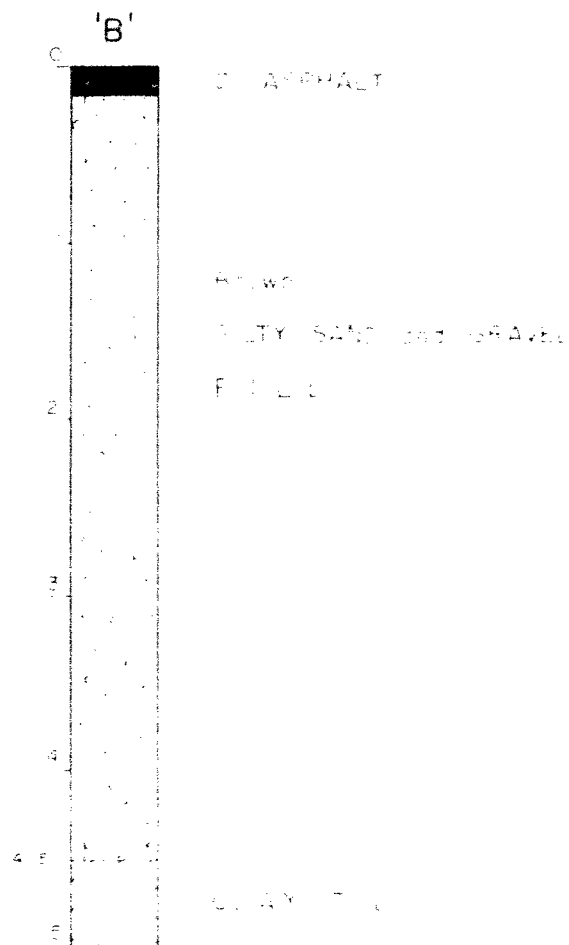
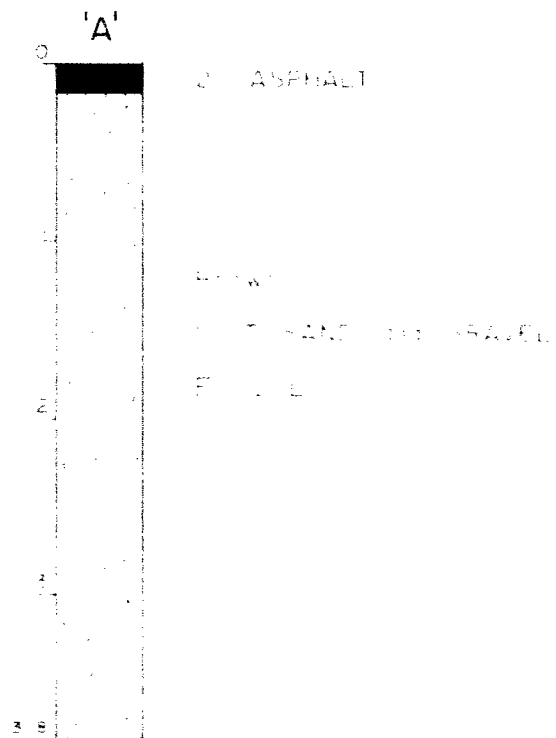
DRILLING - B.H. NO. 38  
 WA. DRILLING - B.H. NO. 39  
 SWELL - B.H. NO. 38  
 DEC. 14, 1965

ELEVATION (ft.)	DEPTH (ft.)	DESCRIPTION OF SOIL	SAMPLING NO.	SAMPLING DEPTH (ft.)	TESTS PERFORMED	RESULTS	REMARKS
843.3	0	GROUND SURFACE					
BOREHOLE NO 38							
		Brown					
840.0		GRAVELLY SAND	1	SS	20		
		FILL	2	SS	7		
835.0		Brown, Very Stiff CLAY, SILT TILL (layered structure)	3	SS	5		
			4	SS	14		
			5	SS	17		
		END OF BOREHOLE					
830.0							
844.7	0	GROUND SURFACE					
BOREHOLE NO 39							
		Brown					
		FINE SAND	1	SS	31		
840.0		FILL	2	SS	10		
		Stiff, Grey CLAYEY SILT TILL	3	SS	33		
835.0		QUARTZITE BEDROCK	4	RC	85%		
		END OF BOREHOLE					
830.0							

HOLE DRY DEC. 14, 1965

W. L. E. 844.4  
 DEC. 14, 1965

EXTRAPOLATED N VALUE  
 317.8  
 100.2

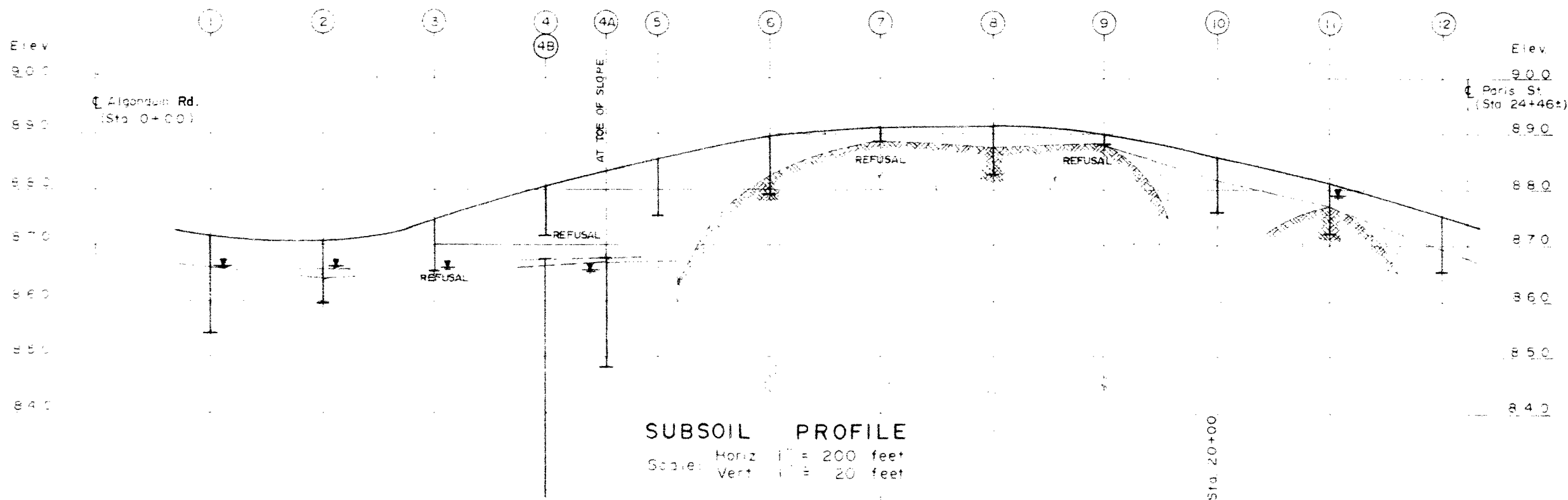
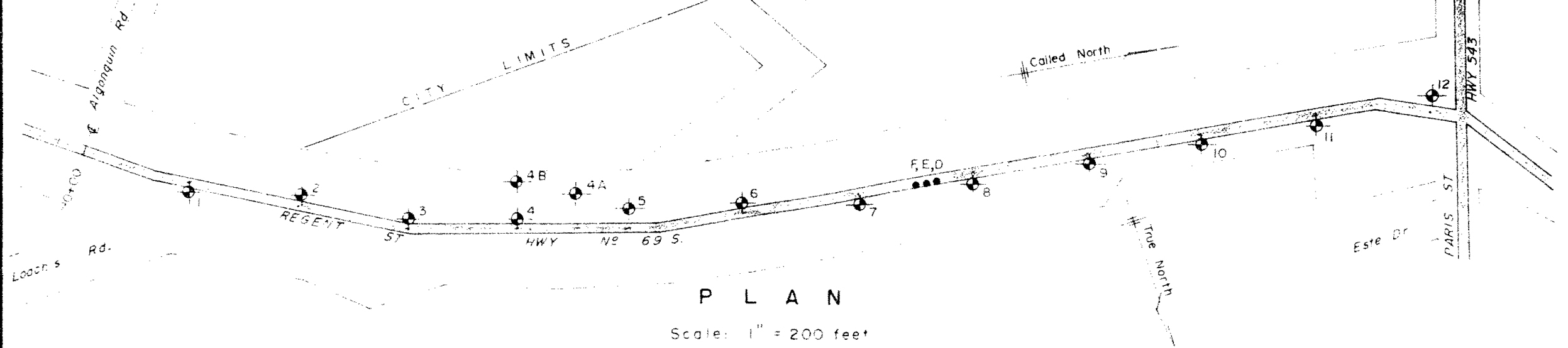


## RESULTS OF PAVEMENT TESTING

(TEST HOLES A,B,C,D,E & F)

SCALE 1" = 1' 0"

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT



**PAVEMENT CONDITION**

GOOD	FAIR	POOR
------	------	------

**DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT**

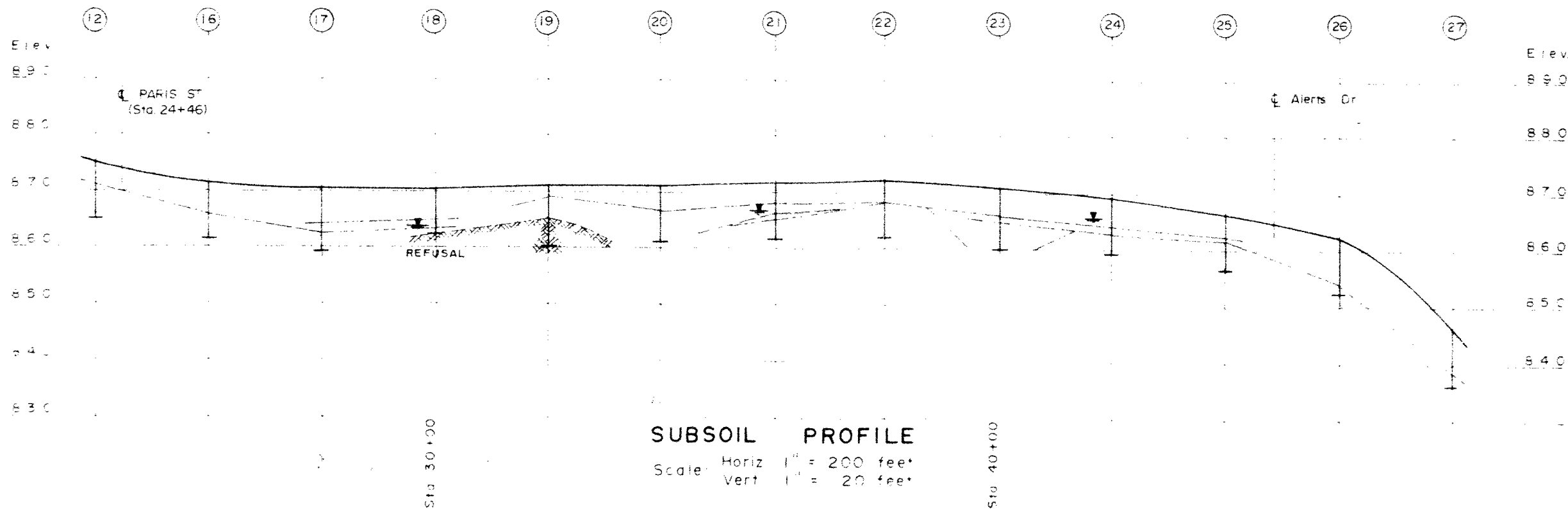
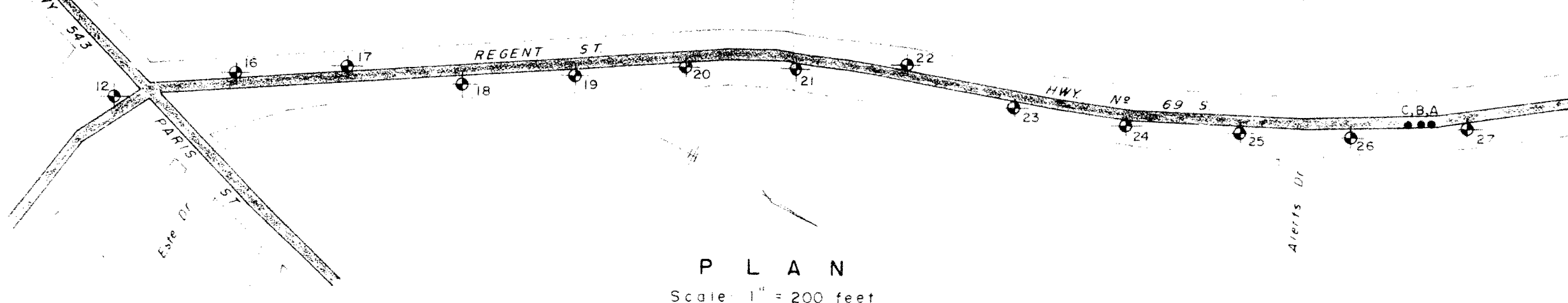
### EXISTING PAVEMENT CONDITION

**SOIL TYPES**

FILL	VARVED SILTY CLAY
CLAY TILL	SILT
VARVED CLAY	SAND & GRAVEL
	BEDROCK

### LEGEND

WATER TABLE  
BORE HOLE  
TEST HOLE



**PAVEMENT CONDITION**

	GOOD
	FAIR
	POOR

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

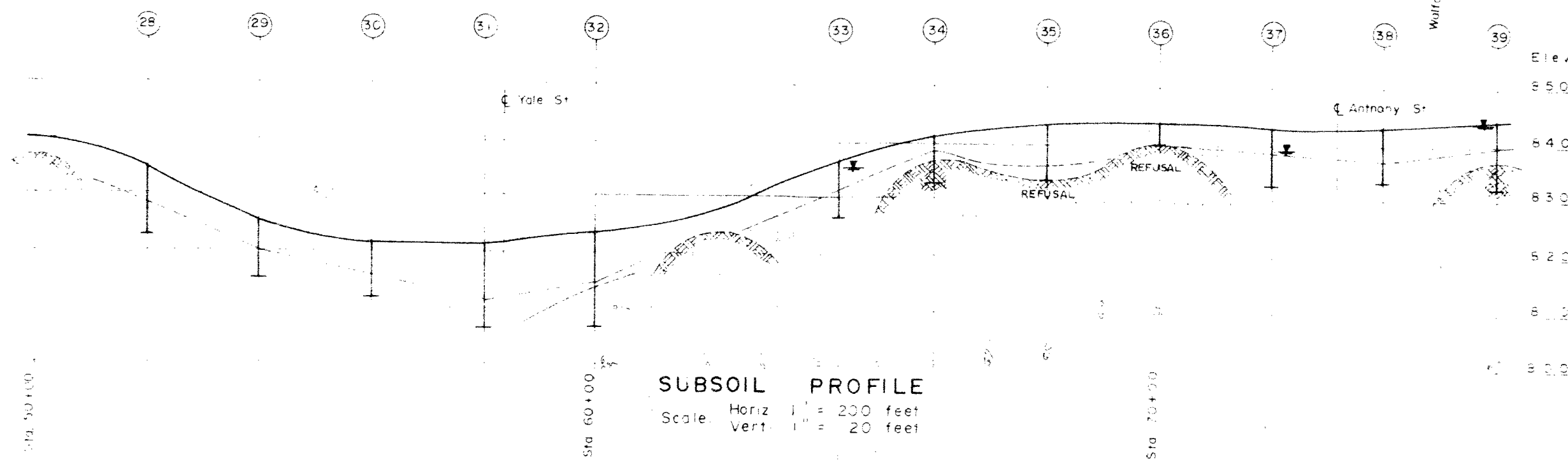
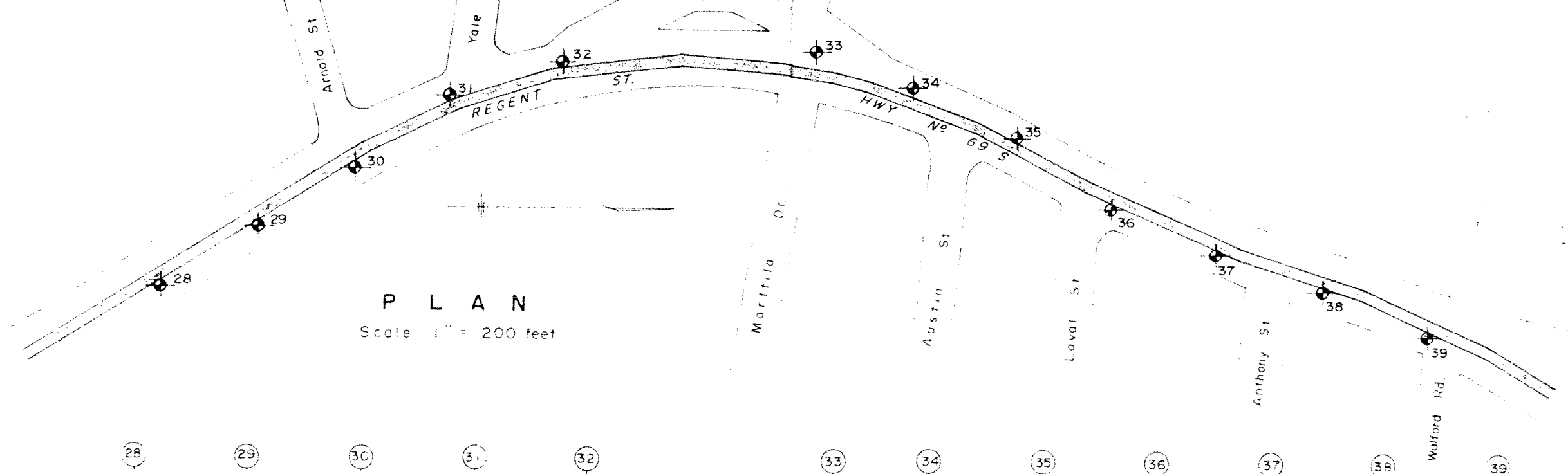
**EXISTING PAVEMENT CONDITION**

**SOIL TYPES**

	FILL		VARVED SILTY CLAY
	CLAY TILL		SILT
	VARVED CLAY		SAND & GRAVEL
			BEDROCK

**LEGEND**

- WATER TABLE
- BORE HOLE
- TEST HOLE



**PAVEMENT CONDITION**

[Pattern]	GOOD
[Pattern]	FAIR
[Pattern]	POOR

**EXISTING PAVEMENT CONDITION**

**SOIL TYPES**

[Pattern]	FILL	[Pattern]	VARVED SILTY CLAY
[Pattern]	CLAY TILL	[Pattern]	SILT
[Pattern]	VARVED CLAY	[Pattern]	SAND & GRAVEL
[Pattern]		[Pattern]	BEDROCK

**LEGEND**

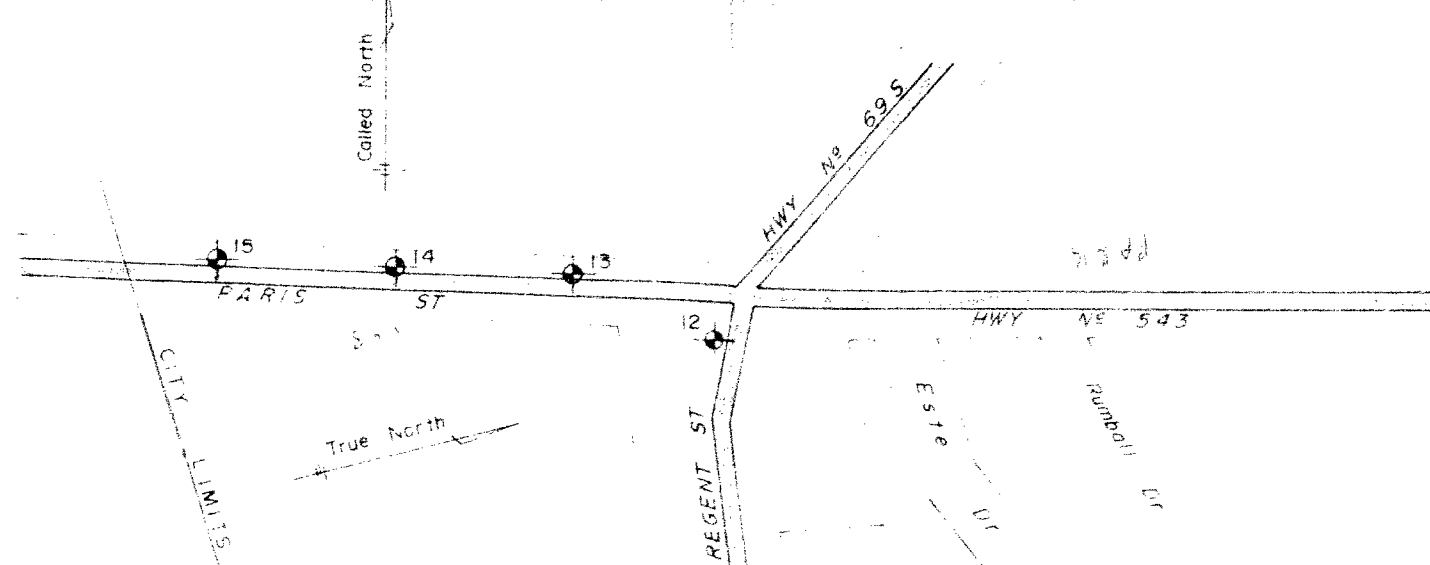
[Symbol]	WATER TABLE
[Symbol]	BORE HOLE

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT

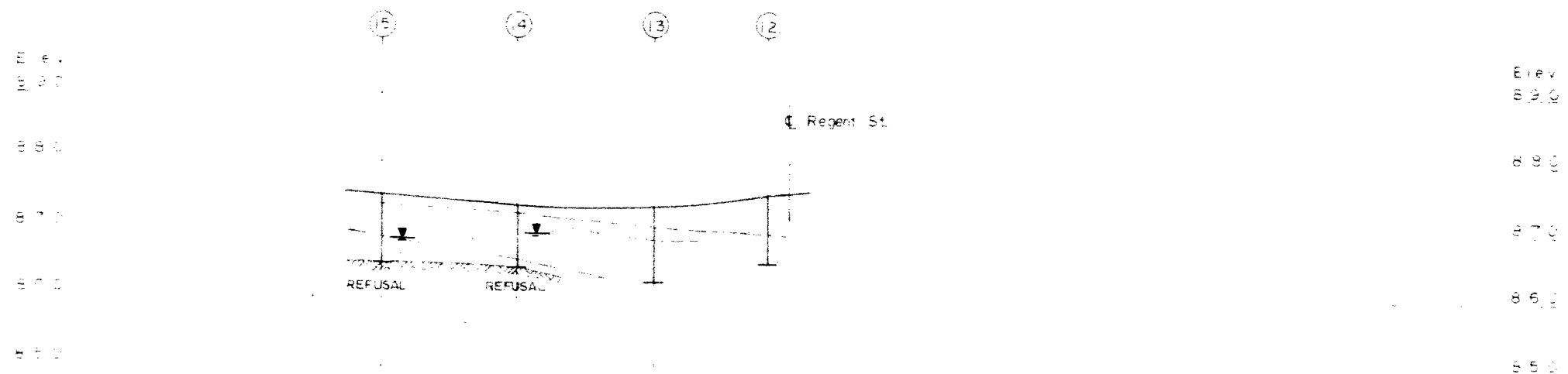
OUR REF. No. 5 - 11 - 7

**DOMINION SOIL INVESTIGATION LIMITED**

ENCLOSURE No. 28



**P L A N**  
Scale 1" = 200 feet



**SUBSOIL PROFILE**  
Scale Horiz 1" = 200 feet  
vert 1" = 20 feet

### EXISTING PAVEMENT CONDITION

PAVEMENT CONDITION	
	GOOD
	FAIR
	POOR

SOIL TYPES	
	FILL
	CLAY TILL
	VARVED CLAY
	VARVED SILTY CLAY
	SILT
	SAND & GRAVEL
	BEDROCK

### LEGEND

	WATER TABLE
	BORE HOLE