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GEOCRES No.

REPORT ON THE  
FOUNDATION CONDITIONS  
PROPOSED BRIDGE REPLACEMENT  
LEMIEUX, ONTARIO

STRUCTURE SITE No. 27-231
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316-26
GEOCRES No.

REPORT ON THE  
FOUNDATION CONDITIONS  
AT  
PROPOSED BRIDGE  
CROSSING OF SOUTH NATION RIVER & BOUNDARY ROAD  
NEAR THE VILLAGE OF LEMIEUX, ONTARIO.  
FOR  
UNITED COUNTIES OF PRESCOTT & RUSSELL  
BY  
F O N D E X    L I M I T E D

File No. 3305-S

June 10th, 1974.

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## SUMMARY

1. The subsoil investigation was carried out to appraise the stability of the slopes at the proposed bridge site and the foundation conditions for the bridge. The site lies in an area where numerous large landslides have occurred in the past and in recent times surficial slides have been observed.
2. The field work consisted of nine conventional borings, two cone penetrometer tests and one test pit. A preliminary report was prepared from the field data obtained during the period July 17 to August 2, 1973. This was supplemented by additional testing in the field, which was carried out between November 6, 1973 and February 5, 1974.
3. The groundwater conditions at the site were monitored with 20 piezometers and standpipes from January to May 1974.
4. The bridge site lies within the physiographic region known as the Russell and Prescott Sand Plains. In this area 5 to 15 feet of sand is underlain by marine clay which is in turn underlain by glacial till overlying bedrock. Erosion by the South Nation River has cut deep valleys in the clay deposit and mass slumping of the clay from the valley walls has produced the profile which currently exists. The valley at the site is about 600 to 800 feet wide with the river flowing along the north wall of the valley. The height of the clay slope along the north side is about 90 feet and at its steepest section has a gradient of 1.7 horizontal to 1 vertical.

The south side of the river is an apron of an ancient landslide and is composed of slide debris covered with river alluvium. The surface of the terrace is approximately 30 feet above the existing river bottom.

5. The piezometer data indicates a strong downward flow in the clay deposit, which is considered to be caused by the relatively pervious till and bedrock acting as base drains below the clay stratum.
6. The proposed bridge will be carried on piers across the landslide debris terrace to the south valley slope and no approach fill will be placed on the slide apron. For the south end of the bridge, it is recommended that the foundations for the piers be founded on bedrock. The field data indicates that piles driven into the bedrock will provide the most satisfactory foundation and this alternative is recommended. In the event that footings are considered, the sound bedrock below any weathered material is considered to have a safe net bearing value of 40 ksf.

On the north side of the river the structure will be founded on end bearing piles driven into the very dense till or underlying bedrock. It is recommended that low displacement piles, such as H piles be used at this end of the bridge.

7. The south valley slope is of a height and gradient that the instability of the slope is not a problem. It is not expected that pore water pressure increases due to pile driving will endanger this slope.

The north valley slope is currently being eroded by the



river and several small slides have occurred recently, close to the bridge site. Excluding any surficial sliding due to the undercutting by the river, the computer stability analysis of the existing slope gave a factor of safety of 1.2 against a deep seated landslide. This factor of safety is not considered to be adequately high in view of the conditions which exist at this site. To be specific, if groundwater conditions higher than those experienced in the spring of 1974 were to occur, the factor of safety would be reduced. In addition, no allowance has been provided in the stability analysis for possible seismic forces. A flatter slope of 3 horizontal to 1 vertical produces a factor of safety of about 1.5, which is considered to be adequate even though seismic forces have not been accounted for in the analysis.

8. While the south valley slope needs no treatment for stability, it is recommended that the north valley slope be flattened to 3 horizontal to 1 vertical. The width of the flattened area need only be sufficient to accommodate the roadway, shoulders and ditches. The side slopes of the cut section should be no steeper than 2 horizontal to 1 vertical.
9. The toe of the north slope must be protected against erosion by rock rip-rap, extending from the bottom of the slope to approximate elevation 165. The rip-rap will be required over a distance of about 1400 feet between the two deep gullies on each side of the bridge site.
10. The upper fine sand deposit and the thick sand bands in the clay should be protected from erosion by the flow of groundwater by employing sand and gravel filters, and good surface drainage must be maintained.

11. The centreline of the alignment proposed is in the vicinity of a recent surficial slip at approximate Sta. 11+00. In order to prevent further undercutting of the toe at this location, it is recommended that Moose Creek be re-aligned for a distance of about 600 feet. The existing steep slope should be re-graded or filled to a gradient of 2.5 horizontal to 1 vertical. A granular filter will be required over the existing clay face to control erosion due to seepage.

The above points are discussed in detail in the following report.

REPORT ON THE  
FOUNDATION CONDITIONS  
AT THE PROPOSED BRIDGE CROSSING OF THE  
SOUTH NATION RIVER AND BOUNDARY ROAD  
NEAR THE VILLAGE OF LEMIEUX, ONTARIO

1. INTRODUCTION

This report presents an appraisal of the foundation conditions at the site of a proposed bridge crossing of the boundary road over the South Nation River between the Townships of South Plantagenet and Cambridge, and between lot 24, Concession XIV, United Counties of Prescott and Russell, Ontario. The appraisal and report were requested by Mr. A. J. Lynch, P.Eng., Counties Engineer, United Counties of Prescott and Russell.

The investigation was carried out to appraise the stability of the slopes of the banks of the South Nation River at the proposed bridge site, as well as to assess the foundation conditions for the piers and abutments for the proposed structure and to assess the stability of the south approach fill. The stability analyses of the slopes was carried out using computer techniques, and the testing program and analyses were directed by Dr. D. Scott.

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## 2. LOCATION OF SITE

The site of the crossing is about 0.33 miles west of the Village of Lemieux, Ontario. The proposed alignment of the crossing is shown on the Site & Location Plan (Dwg. 3305-S-I).

The alignment and location of the proposed bridge were established by McNeely, Lecompte & Associates Ltd.

The site lies in an area where numerous landslides have occurred in the past. The south side of the bridge site is an old landslide face with the slide scars evident. Further west, smaller slides have occurred recently within older land slide faces. In the spring of 1973, a landslide occurred within the north slope on the proposed centerline, and in the spring of 1974, additional sliding occurred on the north slope and well south of the crossing adjacent to Moose Creek at approximate station 11 + 00.

## 3. DATUM

All elevations given in this report refer to the geodetic benchmark no. 70-U-105, elevation 219.158 feet. The benchmark is a tablet on the wall near the most westerly corner of the Community Center building on the south side of the road to Lemieux, about 0.2 miles west of the Village of Lemieux, Ontario.

## 4. FIELD INVESTIGATION

The field investigation, for this study, consisted

of nine boreholes and one test pit put down to identify the subsoil, obtain samples, and to make field vane shear tests for the purpose of establishing the in-situ undrained strength of the undisturbed cohesive soils. Standard penetration tests were carried out on the cohesionless soils to determine their relative densities. In addition, two cone penetrometer test holes were put down to determine the depth to dense material.

The fieldwork was carried out in two stages. The first three boreholes were put down between July 17th and August 2nd, 1973, and these were reported in the preliminary report for this study. In the second stage, additional borings and cone penetrometer tests were made between the 6th of November 1973 and the 5th of February 1974, to obtain the necessary additional information for the final report. The locations of the boreholes are shown on the appended site plan (Dwg. 3305-S-I). The field work was carried out with conventional wash boring equipment, with technical supervision by Fondex Limited.

Samples of cohesionless material were obtained using a 2 inch O.D. split spoon sampler. Cohesive soils were sampled with 2 7/8 inch I.D. thin walled Shelby tubes. Bedrock was encountered in six boreholes and samples of the rock were obtained with a BXT core barrel sampler. Packer tests were made in the rock in borehole # 1 to estimate the permeability of the rock.

The borehole records in the appendix give detailed descriptions of the materials encountered together with a stratigraphic plot. The number and type of samples taken, the results of the field vane tests,

standard penetration and cone penetration tests also are shown on the borehole logs.

A test pit was excavated by hand in the critical north slope on the 15th and 16th of January 1974. The purpose of this pit was to obtain undisturbed block samples of the clay for testing and analysis of its properties.

The groundwater conditions at the site were determined by recording the water levels in standpipes embedded in the surficial sand deposit as well as in piezometers sealed in the rock and in the subsurface cohesive soil horizons. Seventeen standpipes and regular piezometers were sealed in the boreholes. In addition, three Geonor type piezometers were installed in the critical north slope. Each piezometer was installed with a bentonite seal having a thickness of at least 2 feet, above and below the piezometer. The remainder of the borehole was filled with granular material. The locations of the piezometers and standpipes are shown on the appropriate borehole logs and location plan, as well as on the piezometer logs in the appendix.

##### 5. LABORATORY INVESTIGATION

All samples of cohesive soils were extruded from the sampling tubes and, together with the jar samples of cohesionless soils recovered from the field, were identified and their descriptions logged in the laboratory. Portions of selected samples were used to determine the index properties of the soils in order to assist in the assessment of their engineering properties.

Natural moisture contents and Atterberg limits were determined on parts of selected samples obtained from the boreholes and test pit. Other portions were subjected to one-

dimensional consolidation tests and to consolidated-drained triaxial compression tests to determine the compressibility and shear strength characteristics of the clay

The results of these tests were used to classify the soil with regard to type and consistency to assess the compressibility characteristics of the soil, and to analyse the stability of slopes at the site. The test results are plotted on the borehole logs and other appropriate figures in the appendix.

#### 6. GEOLOGICAL SETTING

The site lies within the physiographic region known the Russell and Prescott Sand Plains. In this ar sand mantle from 5 to 15 feet thick occurs with a surface elevation of approximately 220 feet.

The sand is underlain by a deposit of marine clay which, generally, covers a stratum of glacial till resting on bedrock. The thickness of the marine clay deposit varies with the elevations of the till and bedrock on which the clay was deposited.

Rivers and streams draining the area have eroded deep valleys in the clay deposit. Lateral erosion of the valleys appears to take place by mass slumping of the clay from the valley walls with large scale flow slides sometimes occurring. The grade of the rivers and streams is, generally, very flat with the base level of the river beds being controlled by bedrock outcrops at several locations in the river bottom. Where the valleys are wide, a flood plain has developed, and an alluvial deposit of fine sand and silt occurs as a terrace on one or both sides of the stream channel.

The river bottom is at elevation 132 at the bridge site with the surface of the terrace to the south of the river at approximate elevation 165. The top of the valley slope to the north of the river is at approximate elevation 223. The height of the clay slope along the north side of the river is approximately 80 to 90 feet and this slope at its steepest section has a present gradient of about 1.7 horizontal to 1 vertical.

## 7. SOIL AND ROCK DEPOSITS

A detailed description of the soils and rock encountered at the bridge site is given on the borehole logs in the appendix. The soils encountered are described and an evaluation of some of their engineering properties is given in the following paragraphs.

### 7.1 BANDED CLAY DEPOSIT

#### 7.1.1 Description of Deposit

The banded clay deposit is the predominant soil deposit in the area and because of its properties presents major problems with slope stability and foundations.

The deposit has a "varved" appearance with a regular sequence of horizontal stratification. The "varves" range in thickness from close to one foot down to smaller than one inch. A "varve" is composed of a band of red clay over a band of gray silty clay over a band of gray silty sand. This sequence is repeated for the full thickness of the deposit with the "varves" becoming thinner and more fine grained with depth. The



contact between the red clay and the gray silty clay is gradual, fairly sharp between the gray silty clay and the gray silty fine sand, and very sharp between the sand and red clay.

The sand bands decrease in thickness with depth. A 2 foot band of sand occurs near the surface of the deposit (at a depth of 11 feet). The sand bands at a depth of 22 feet are approximately 7 inches thick and at a depth of 28 feet are approximately 2 inches thick. Below a depth of 40 feet the sand occurs in seams 1/16 to 1/8 of an inch in thickness and near the base of the deposit the sand occurs in small pockets.

#### 7.1.2 Undrained Shear Strength

The field vane shear tests show that the undrained shear strength varies considerably throughout the silty clay deposit probably depending on whether the vane was shearing clay, silty clay, or sand layers. The average undrained shear strength of the undisturbed material can be taken as 1500 psf for most of the deposit except perhaps near its base where it becomes much stiffer. The field vane shear strengths on the remolded material generally varied between approximately 200 psf and 400 psf. The sensitivity of the material, based on the results of the field vane tests, varied between approximately 4 and 6, classifying it as sensitive.

#### 7.1.3 Index Properties

The water contents and Atterberg limits of the deposit show a large variation due to the banding. The liquidity indices of the gray silty clay and red clay have values of approximately 1.0 and larger. These are shown in Table 1.

## 7.2 UPPER SILTY SAND

A sand layer from 10 to 20 feet in thickness overlies the clay deposit on the upper plain. The sand is fine and silty and is poorly drained. Cuts in the sand below the water table are subject to sloughing and running from groundwater flow.

## 7.3 GLACIAL TILL

A stratum of dense to very dense glacial till was encountered below the clay deposit at boreholes 3 and 8 north of the river. Generally coarse grained, being mainly composed of sand and gravel, it is considered to be fairly pervious.

## 7.4 SLIDE DEBRIS AND ALLUVIUM

The south side of the river at the bridge site is considered to be an old apron of a landslide and is composed of slide debris covered with river alluvium. Its stratigraphy is therefore complex, but is generally composed of a loose to compact sandy silt overlying a silty clay, which is probably slide debris. A thin layer of sand and gravel, which is considered to be glacial till, occurs below the clay, and bedrock occurs immediately below the till.

## 7.5 BEDROCK

Bedrock was encountered in borehole 7 on the north side of the river, in boreholes 1, 2, 4 and 11 on the south side of the river underneath the landslide apron, and in borehole 10 at the south side of the valley.

A detailed description of the rock is given in the

borehole logs. It is a shaly limestone except at borehole 10 where shale was encountered.

The elevation of the rock surface is fairly consistent south of the river, but is much lower north of the river. The location of the rock surface between boreholes 7 and 11 varies considerably and cannot be inferred from this investigation. It would appear that a rock fault scarp or an erosional canyon exists at this location. The rock surface between boreholes 7 and 11 may slope consistently from one location to the other but more likely it is quite irregular and may even be lower between the boreholes than at borehole 7.

#### 8. GROUNDWATER CONDITIONS

Groundwater pressure conditions were measured in piezometers in boreholes 1, 2, 3, 5, 7, 8, 9, 12, and 13 from January to May 1974 to ascertain the groundwater flow pattern during this period, especially during the rapid rise and fall of the river level at spring runoff. The piezometer readings are shown on Drawing Number 3305-S-3. The river elevation readings also are shown on this drawing.

The groundwater flow pattern shows a strong downward flow in the clay deposit. The underlying till and rock strata appear to be acting as base drains. The bedrock and perhaps the till outcrop several hundred feet to the east in the channel of the river.

The deeper piezometers showed a rapid rise and fall in groundwater pressure when the river rose and fell. The upper piezometers did not show much response to the change in river elevation. All piezometers are of the open tube type construction which requires some flow of water into or out of the piezometer to show a change in groundwater pressure. Therefore, there may be some lag in the piezometer response times, and when the river peaked and dropped

quickly the piezometers may not have recorded the maximum rise in groundwater pressure.

## 9. FOUNDATION CONDITIONS

### 9.1 SOUTH END

As the bridge is to be carried on piers across the landslide debris terrace to the south valley slope, no approach fill is to be placed on the slide apron and the foundation conditions have to be considered for the piers and abutment.

The foundation conditions at this end of the bridge are heterogeneous and poor in the soil overlying the old failure surface of the landslide. At the location of borehole 1 there is also an indication that a very weak soil layer exists just above bedrock.

It is recommended that foundations for piers in this area be founded on the bedrock surface. Depending on the depth to bedrock, it may be more economical at some locations to excavate to the bedrock surface and found the piers on footings. Generally, however, the depths to bedrock indicate that piles driven to bedrock will provide the most satisfactory foundation and this alternative is recommended.

Although the bedrock is slightly weathered in its upper portion, piles may be designed for the allowable bearing stress of the pile material. At the location of boring 10, piles will have to be driven to penetrate the upper weathered and broken shale.

In the event that footing foundations are considered, the allowable bearing pressure of footings on the sound bedrock surface is 40 kips per square foot.

## 9.2 NORTH END

Foundations for piers and the abutment to the north of the river should be founded on piles endbearing on bedrock or driven into the very dense till. The piles may be designed for the allowable bearing stress of the pile material.

Piles driven into or near the clay slope should be minimum displacement piles, such as steel H piles. If piles which displace a considerable amount of soil when driven are used, then consideration of construction pore water pressure increases must be taken in slope stability calculations. In this regard, monitoring of the pore water pressure during construction will be required.

## 10. SLOPE STABILITY ANALYSES

### 10.1 SOUTH VALLEY SLOPE

The south valley slope is of a height and gradient that slope instability is not a problem. Pore water pressure increases because of construction procedures, such as pile driving, should not endanger this slope. It is assumed that the final grade of the bridge and road will not increase the height or steepness of the slope but will in general decrease the height of slope. The abutment at this location should be founded on piles endbearing on the rock below the clay.

## 10.2 NORTH VALLEY SLOPE

The South Nation River is actively eroding the north valley slope and numerous small landslides have taken place recently along this slope close to the bridge site. Some of these are shown on Drawing No. 3305-S-4.

In addition, scars of large flow slides occur on the south side of the river, just upstream of the present bridge and further upstream, including the large flow slide which took place in the spring of 1971.

The design of this slope includes measures to prevent a slope failure immediately at the bridge site even if some toe erosion took place at this location, and to control erosion of the toe of slope sufficiently up and down stream to guard against a large retrogressive landslide working backwards to include the bridge site. The large flow slides initiate from a small bank failure which retrogresses rapidly when soil, groundwater, and river conditions allow it. Therefore, it is imperative to design against the occurrence of these initial toe failures.

The present original north slope at the bridge centerline has been analyzed for stability using a wide range of shear strength parameters for the clay soil and the highest groundwater pressure conditions measured in the spring of 1974. For analysis, the river level was taken at its low level of elevation 144, on the basis that a rapid drop in river level could result, leaving the high ground water conditions that existed in the soil when the river was high.

The high groundwater table in the soil would not be dissipating as fast as the river fell. The factors of safety found for these conditions are shown in a table on Figure 1. The equipotential lines of groundwater head found from the piezometer readings are also shown on the section.

These factors of safety are summarized in Figure 2, which shows the required shear parameters for factors of safety of 1.0 and greater.

In addition, six triaxial shear strength tests, three consolidated-drained and three consolidated-undrained with pore pressure measurements, were performed on undisturbed Shelby tube samples of the clay to determine the effective stress shear strength parameters of this material. The stress-strain curves for these tests are given in Figures 3 to 8. All tests were carried out to large strains to show the relationship between peak strength and post-peak strengths. The peak strengths of all six tests are shown on Figure 9 which indicates that the clay has an effective stress shear strength of  $\phi' = 39^\circ$  and  $c' = 165$  psf. over a normal stress range between 4 and 12 psi.

This shear strength is also plotted on Figure 2 and indicates that the slope has a factor of safety of approximately 1.2. If higher groundwater conditions can exist than occurred in the spring of 1974, the factor of safety would be less. As the toe of the slope does not have a downward flow gradient and in the region of borehole 7 has a slight upward flow gradient, failure is likely to be initiated there. This condition requires that the toe be stabilized by flattening if necessary and by protection against erosion.

A slope of 3 horizontal to 1 vertical at the bridge centerline has also been analyzed for stability. The groundwater flow conditions assumed for this case are shown in Figure 10. The factors of safety found for a wide range of shear strength parameters is also shown in a table on Figure 10. These factors of safety are summarized in Figure 11. The triaxial test results are plotted on Figure 11 and indicate that a 3:1 slope would have a factor of safety of approximately 1.5. This would appear to be an adequate factor of safety even though seismic forces have not been taken into account in the design.

### 10.3 RECOMMENDATIONS FOR SLOPE STABILITY

1. The south valley slope needs no treatment for stability on the basis that it will not be steepened or increased in height and that the load of the abutment will be carried to rock by piles.
2. The north valley slope at the bridge site should be flattened to 3 horizontal to 1 vertical. The width of the flattened area need only be sufficient to accommodate the width of the roadway, shoulders and ditches. The side slopes of the cut section may be 2 horizontal to 1 vertical.
3. The toe of the north slope should be protected against erosion by rock rip-rap. This erosion protection should extend from the bottom of the slope up to elevation 165. The rip-rap should extend downstream from the bridge centerline



approximately 800 feet to and into the gully at this location and upstream from the bridge centerline approximately 600 feet to and into the gully at this location. This long section of protection is necessary to prevent toe failures in this section from developing, which may retrogress into large flow slides, which could engulf the bridge site. The two large, long, deep gullies act as natural barriers to prevent flow slides from further upstream or downstream spreading to the bridge site.

The rip-rap should have a slope no steeper than 2 horizontal to 1 vertical. If the present slope is flatter than this, it should be left and if steeper the rip-rap should be filled to this slope. No excavation at the toe should take place.

4. If any excavations for pier foundations take place in/or at the bottom of the north slope, the slope should be analyzed for stability for this condition. Pore pressures from driving piles which displace a considerable amount of soil when driven should be included in the analysis.
5. On the cut slopes on the north side, the upper fine sand deposit and the thick sand bands in the clay should be protected from erosion and piping by flow of groundwater by the use of sand and gravel filters. This protection should extend downward to approximately elevation 190. The extent of this protection can be best determined when the excavation is made.

6. Good surface and subsurface drainage should be maintained at all times.
7. No fill material should be placed above or at the top of any slope.

#### 10.4 MOOSE CREEK SLOPE

In the spring of 1974 several surficial slips occurred in the vicinity of the proposed bridge. While the stability considerations have been discussed for the area along the South Nation River, consideration also must be given to the Moose Creek area where a recent surficial slip occurred adjacent to the proposed road alignment. In this area, Moose Creek undercut the existing slope, which was scaled to be at approximately 2.3 horizontal to 1 vertical. Also in this area there is evidence of an ancient slide scar of significant magnitude, as indicated on Dwg. 3305-S-5.

The centre line of the proposed road alignment in the vicinity of the recent slip (Sta. 11+00) appears to be within about 50 feet from the top of the slip.

No stability analysis was made for the Moose Creek area as the recent movement of the slope was observed to be of a surficial nature. However, in order to prevent further toe erosion from occurring at the creek bend, it is recommended that Moose Creek be re-aligned for a distance of about 600 feet to flow in a more direct route into the South Nation River. In addition, it is recommended that the existing steep slope be re-graded or filled to a gradient of 2.5 horizontal to 1 vertical. If the slip area is to be filled, approximately 3 feet of pervious soil should be placed under the fill and up the side of

the exposed clay face, to control erosion due to seepage. In addition, the surface of the slope should be adequately protected to prevent erosion due to the run-off of rain and melt water.

11. PERSONNEL

All field work was supervised by Technicians of Fondex Ltd. under the direction of Dr. J.D. Scott, P. Eng. and Mr. R.D. Drouin, P. Eng.

The stability analyses of the slopes was carried out using computer techniques, and the testing program and analyses were directed by Dr. D. Scott.

The report was prepared by Dr. J.D. Scott, P. Eng., Mr. H. Krzywicki, P. Eng. and Mr. R.D. Drouin, P. Eng.

FONDEX LTD.

A handwritten signature in dark ink, appearing to read 'Drouin', with a stylized flourish at the end.

Roland D. Drouin, P. Eng.

APPENDIX

EXPLANATORY NOTES  
ON THE  
RECORDS OF BOREHOLES

The purpose of borehole records is to assemble on a single sheet all of the field and laboratory data obtained during the investigation regarding the soil, bedrock, and groundwater conditions at the location of the borehole.

SOIL PROFILE

Elevation: This column gives the elevations of boundaries between various geological strata. The elevation refers to the datum shown in the heading of the borehole record. The corresponding depths below the ground surface are also shown.

Description: Each geological stratum is described, using standard terminology, from examination and analyses of samples.

The relative density of granular soils is defined on the basis of the Standard Penetration Test. The consistency of cohesive soils is referred to in terms of either shear strength or unconfined compressive strength. The proportion of each constituent part as

defined by the grain size is denoted by the following terms.

Relative Density

(granular soils)

Standard Penetration

Test Value "N"

(Blows per foot)

Very loose

0 to 4

Loose

4 to 10

Compact or Medium

10 to 30

Dense

30 to 50

Very dense

over 50

Consistency

(cohesive soils)

Undrained Shear Strength (c)

(lbs/ sq. ft.)

Very soft

under 250

Soft

250 to 500

Medium or firm

500 to 1000

Stiff

1000 to 2000

Very stiff

2000 to 4000

Hard

over 4000

## GROUNDWATER CONDITIONS

The groundwater level as observed in the borehole is shown by the symbol Σ

## SAMPLES

Number: Each sample taken from the borehole is numbered as shown in this column; the exact location and the length of each sample are also shown.

Type: The symbols shown are referred to the following sample types:

AS : auger sample  
SS : split spoon sample  
ST : Shelby tube sample  
WS : washed sample  
RC : rock core sample

Blows/ft (N): Standard Penetration Test values "N" are shown in this column. This value corresponds to the number of blows required for a 140 pound hammer dropping 30 inches to drive a standard 2 inch outside diameter split spoon sampler a distance of 1 foot into the soil.

Plasticity of Cohesive Soils

Liquid Limit

Low

under 30%

Medium

30 to 50%

High

over 50%

Descriptive Terms

Range of Proportion

"Trace"

1 to 10%

"Some"

10 to 20%

Adjective (c.g. sandy, silty)

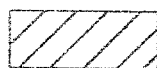
20 to 35%

"and" (c.g. sand and gravel)

35 to 50%

STRATIGRAPHIC PLOT

The following stratigraphical symbols are used to denote main soils types:



clay



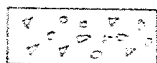
sand



cobbles and/or  
boulders



silt



gravel



organic soil



Recovery: Soil sample and rock core recoveries are given in percentages.

#### DYNAMIC PENETRATION RESISTANCE

When dynamic penetration tests are carried out on the casing or on a cone, the results are shown graphically in the "Dynamic Penetration Resistance" column. These tests differ from the standard penetration test, and the diameter of the casing or the cone, together with the driving energy, are shown.

#### STRENGTH

Results of field or laboratory strength tests on cohesive soils are shown graphically in the "Shear Strength" column using the indicated symbols.

#### CONSISTENCY

Results of moisture content, liquid limit, and plastic limit tests as determined in the laboratory are shown under "Consistency".

PROJECT BRIDGE OVER SOUTH NATION RIVER

LOCATION 0.33 mile WEST OF LEMIEUX QNT.

STATION 4+ 66

DRILLING DATE 17/7/73

REPORT DATE 4/9/73

DATUM GEODETTIC BOREHOLE TYPE WASH

DRAWN BY R. R.

Piezometer Feb. 4, 1974  
Standpipe Feb. 4, 1974

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.				CONSISTENCY:							
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY %	0	20	40	60	80	NATURAL MOISTURE CONTENT (W)					
							SHEAR STRENGTH				k.s.f.	LIQUID LIMIT (W <sub>L</sub> )					
							FIELD VANE SHEAR					PLASTIC LIMIT (W <sub>p</sub> )					
							LAB VANE SHEAR				X						
166.3'	GROUND SURFACE											20	30	40	50	%	
0'	Silty very fine SAND, brown becoming gray at 16'2". Some orga- nic content. Some mottled brown clay.		1	SS	4	46											
			1	SS	12	33											
			3	WS													
5'			4	SS	10	58											
			5	WS													
10'	16'-7" to 17'-0" very soft layer, silty. Water lost at 15' to 17'.		6	ST		96											
			7	WS													
15'	-- Loose to Compact --		8	SS	16	96											
147.2'	BEDROCK  Shaley limestone.  -- HARD --		9	RC		89						<b>BEDROCK DESCRIPTION</b>  Dark gray, fine grained, shaly lime- stone. The upper 2' of rock to about 21' 6" shows slight weathering and dissolution as powdery fracture pla- nes. Fractures are both observed horizontal and inclined generally occurring at shally partings. Bed- ding is more regular and horizontal with depth.					
19'1"																	
20'			10	RC		99											
25'			11	RC		70						<b>NOTE:</b>  A compression test on bedrock was made and reports as follows:  Sample 1, from 23'8" to 24'6" depth  compressive strength; 8000 lbs/in <sup>2</sup>					
135.5'																	
30'9"	END OF BOREHOLE																

PROJECT BRIDGE OVER SOUTH NATION RIVER

LOCATION 0.33 mile WEST OF LEMIEUX ONT.

STATION 6 + 88

DRILLING DATE 21/7/73

REPORT DATE 4/9/73

DATUM GEODETIC BOREHOLE TYPE WASH

DRAWN BY R.R.

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.					CONSISTENCY:				
Elev.	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY	0	20	40	60	80	NATURAL MOISTURE CONTENT (w)	LIQUID LIMIT (W <sub>L</sub> )	PLASTIC LIMIT (W <sub>p</sub> )	%
163.5	GROUND SURFACE														
0'	SAND and SILT, some clay, brown, mottled with rust spots. Upper 3" highly organic.		1	SS	25										
			2	SS	37										
			3	WS											
5'			4	ST	100										
6'8"	Silty CLAY, gray, mottled with yellow-brown and pink pockets. -- Firm to Stiff --		5	WS											
			6	ST	100										
			7	WS											
148.2			8	ST	0										
15'4"	Mixture of sand, gravel, cobbles, and boulders with some clay traces. -Dense-		9	SS	3150										
144.3			12	RC	28										
19'2"			13	WS											
20'			16	RC	98										
			17	WS											
	BEDROCK		18	RC	98										
25'	Shaley limestone - SOFT TO HARD -		19	RC	99										
30'															
31'4"	END OF BOREHOLE														

Standpipe  
August 30, 1974  
Piezometer  
Jan. 24, 1974

REMOULDED

NON-PLASTIC

UNDISTURBED

#### BEDROCK DESCRIPTION

Dark gray, fine grained, shaly limestone with irregular bedding and inclined shaly partings. Fractures are both observed inclined and horizontal mostly parallel to shaly partings. Nearly vertical, thin (less than 1/8") fractures are observed from 20'6" to 21'6" and 29'0" to 31'4".

#### NOTE

Two samples from this core were taken for compression tests, they are as follows:

Sample 2, from 23'9" to 24'5" compressive strength; 6290 lbs/in<sup>2</sup>

Sample 3, from 29'7" to 30'6" compressive strength; 9375 lbs/in<sup>2</sup>

PROJECT BRIDGE OVER SOUTH NATION RIVER

LOCATION 0.33 mile WEST OF LEMIEUX ONT.

STATION 1+01

DATUM GEODETIC BOREHOLE TYPE WASH

DRILLING DATE 25/7/73

REPORT DATE 4/9/73

DRAWN BY R. R.

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.					CONSISTENCY:				
Elev.	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY %	0	20	40	60	80	NATURAL MOISTURE CONTENT (w)	LIQUID LIMIT (w <sub>L</sub> )	PLASTIC LIMIT (w <sub>p</sub> )	
Depth							SHEAR STRENGTH k.s.f.								
							FIELD VANE SHEAR								
							LAB VANE SHEAR								
							1.0	2.0	3.0	4.0		20	30	40	50 %
2/9.6	GROUND SURFACE														
0'	Silty very fine SAND, generally brown. Presence of organic material, with upper 5" highly organic.  -- Loose to Compact --		1	SS	4	71									
			2	WS											
5'			3	SS	21	67									
			4	WS											
2093			5	SS	8	67									
10'4"			6	WS											
15'	Silty CLAY, banded pink and gray. Random silt and sand layers with their thickness varying from 2 feet in the upper portion of the stratum to a fraction of an inch, the layer thickness decreasing with depth. Average layer thickness 1½-2".		7	ST	15										
			8	SS	5	37									
20'			9	SS	10	100									
			10	WS											
25'			11	ST	0										
			12	SS	7	100									
30'			13	ST	76										
			14	WS											
35'	continued...														

APRIL 7th, 1974

Stand Pipe at 17'

Piezometer at 87'

Piezometer at 54'

REMOULDED

UNDISTURBED

60

# FONDEX LTD.

FOUNDATION ENGINEERS

BOREHOLE NUMBER 3

PROJECT BRIDGE OVER SOUTH NATION RIVER

LOCATION 0.33 mile WEST OF LEMIEUX ONT.

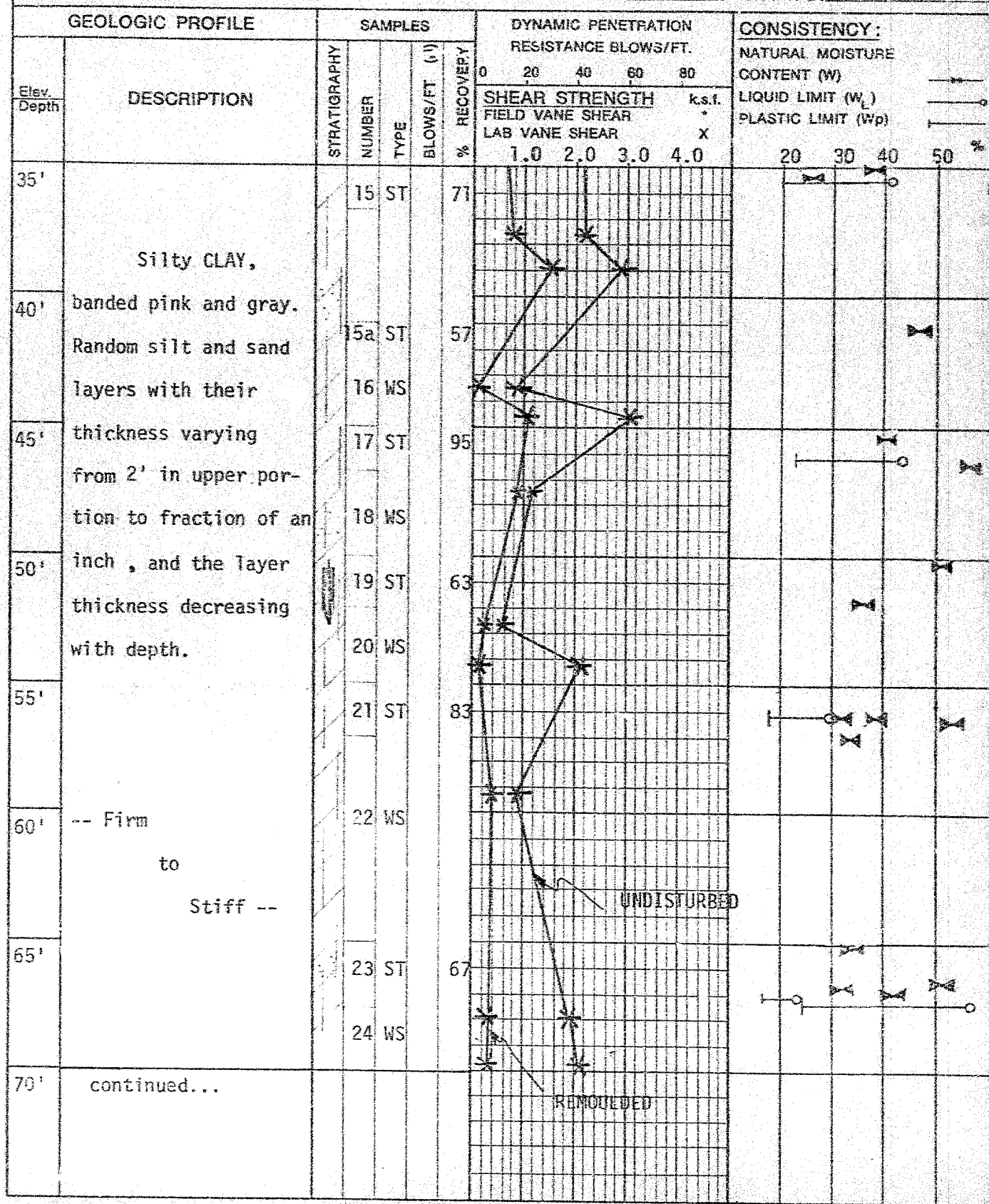
STATION 1+01

DRILLING DATE 25/7/73

REPORT DATE 4/9/73

DATUM GEODETIC BOREHOLE TYPE WASH

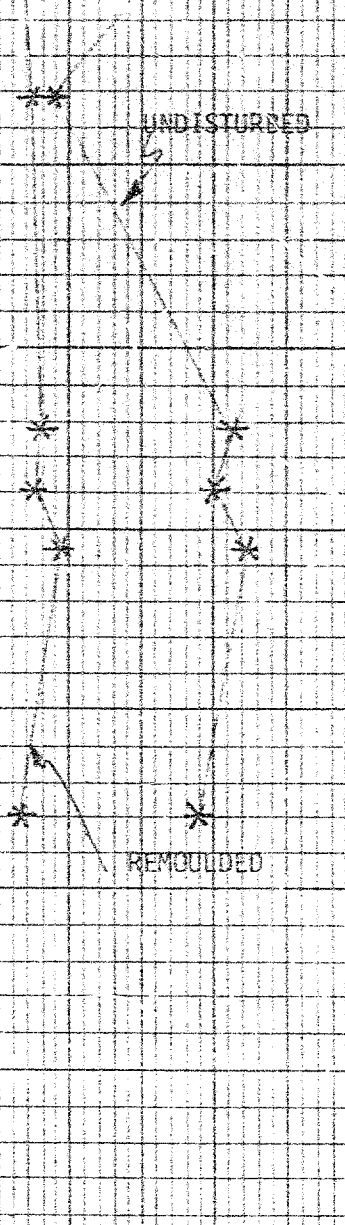
DRAWN BY R.R.



DRILLING DATE 25/7/73

REPORT DATE 4/9/73

DRAWN BY R.R.

GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS/FT.				CONSISTENCY: NATURAL MOISTURE CONTENT (W)								
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	% RECOVERY	0	20	40	60	80	LIQUID LIMIT (W <sub>L</sub> ) PLASTIC LIMIT (W <sub>p</sub> )							
							SHEAR STRENGTH				k.s.f.								
							FIELD VANE SHEAR				•								
							LAB VANE SHEAR				X								
							1.0	2.0	3.0	4.0		20	30	40	50 %				
70'	Silty CLAY, banded pink and gray.		25	ST	73														
75'			26	WS															
80'			27	ST	100														
85'			28	WS															
90'	-- same as above --		29	ST	90														
94'	Heterogeneous mix- ture of particles of all sizes from silt to boulders with clay traces.		30	SS67	66														
95'			31	RC	16														
100'			32	RC	10														
105'	continued....																		



DRILLING DATE 25/7/73

DRAWN BY RR

[illegible]

DRAWN BY           R.R.          

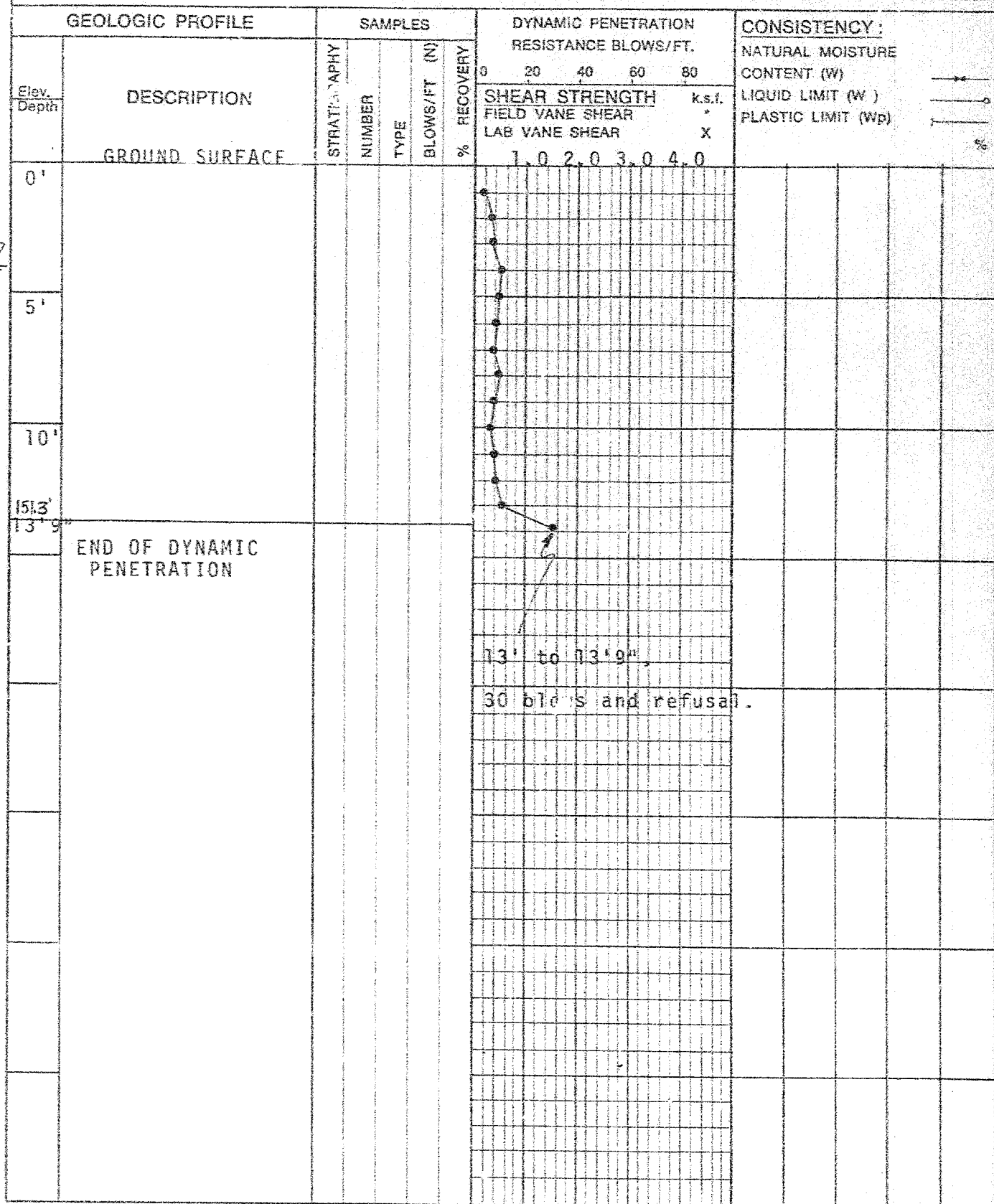
[illegible]



DRILLING DATE 8/11/73

REPORT DATE

DRAWN BY R. R.



DRILLING DATE 8/11/73

REPORT DATE

DRAWN BY R.R.

[illegible]

PROJECT BRIDGE OVER SOUTH NATION RIVER  
LOCATION 0.33 mile WEST OF LEMIEUX, ONTARIO  $\Delta$  2 + 26  
DATUM GEODETIC BOREHOLE TYPE WASH

DRILLING DATE 21/11/73  
REPORT DATE \_\_\_\_\_  
DRAWN BY R.R.

Piezometer @ 18.5' March 4, 1974  
Piez. @ 70' March 12, 1974  
Piezometer @ 39' March 4, 1974

GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS/FT.					CONSISTENCY:				
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY %	0	20	40	60	80	NATURAL MOISTURE CONTENT (W)				
							SHEAR STRENGTH					LIQUID LIMIT (W )				
							FIELD VANE SHEAR					PLASTIC LIMIT (Wp)				
							LAB VANE SHEAR					X				
							1.0	2.0	3.0	4.0		20	40	60	80	%
163.3'	GROUND SURFACE															
0'	<u>SILT</u>		1	SS	2	17										
	Gray, with some fine sand, overlain by 6" of organic top soil.		2	SS	8	0										
			3	SS	12	56										
5'	- VERY LOOSE		4	SS	14	83										
	to COMPACT-		5	SS	7	67										
155.3'																
8'			6	WS												
10'			7	ST		100										
	<u>CLAY</u>		8	WS												
15'	Silty, banded pink with the pink bands averaging from 1½" to 2" thick,		9	ST		88										
20'			10	ST		100										
25'	- STIFF-		11	ST		100										
	becoming		12	ST		100										
30'																
35'	continued...		13	ST		100										

REMOLDED

UNDISTURBED

DRAWN BY                      R.R.

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.				CONSISTENCY :			
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	% RECOVERY	SHEAR STRENGTH				NATURAL MOISTURE	%	
							FIELD VANE SHEAR		LAB VANE SHEAR		CONTENT (W)		
							0	20	40	60	80	LIQUID LIMIT (W)	PLASTIC LIMIT (Wp)
							1.0	2.0	3.0	4.0			
40'	gray throughout and fossiliferous around 45' depth -- VERY STIFF --		14	ST									
45'			15	ST									
50'	then gray, silty clay, organic, with some sand and gravel first noticed at about 60', becoming very gravelly and sandy with depth		16	ST									
55'			17	ST									
60'	-- COMPACT --		18	ST									
65'			19	WS									
			20	SS	16	44							
			21	WS									
70'	continued ...		22	SS	26	22							

DRILLING DATE 21/11/73  
REPORT DATE \_\_\_\_\_  
DRAWN BY R.R.

[illegible]



BOREHOLE NUMBER 8

PROJECT BRIDGE OVER SOUTH NATION RIVER

DRILLING DATE 18/12/73

LOCATION 0.33 Miles WEST OF LEMIEUX, ONTARIO 0+81

REPORT DATE

DATUM \_\_\_\_\_ GEODETIC \_\_\_\_\_ BOREHOLE TYPE \_\_\_\_\_ WASH \_\_\_\_\_

DRAWN BY R.R.

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.	CONSISTENCY:	
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	% RECOVERY	SHEAR STRENGTH FIELD VANE SHEAR LAB VANE SHEAR	NATURAL MOISTURE CONTENT (W)  LIQUID LIMIT (WL) PLASTIC LIMIT (WP)
							k.s.f. X	
219.94'	GROUND SURFACE							
70'	From 0' to 90'							
75'	Same lithology as borehole # 3. No samples taken ....							
80'								
85'								
90'	<u>CLAY</u> gray, silty, organic with some gravel and sand, becoming more gravelly sandy and very dense at about 95'10"		1	SS	9	100		
95'10"	<u>HETEROGENEOUS</u> mixture of reddish silty sand, coarse sand and gravel.		2	SS	56-80	100		
100'	-- VERY DENSE --		3	SS	62-73	0		
104'2"	END OF BOREHOLE							

NOTE: Piezometer @ 97.5'  
Water level @ 58.6'  
March 8th, 1974.

PROJECT BRIDGE OVER SOUTH NATION RIVER

LOCATION 0.33 Mile WEST OF LEMIEUX, ONTARIO  $\Delta$  11+05

DATUM GEODETIC BOREHOLE TYPE WASH

DRILLING DATE 14/1/74

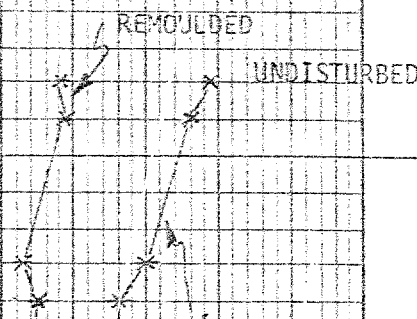
REPORT DATE

DRAWN BY R.R

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.					CONSISTENCY:				
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY %	0	20	40	60	80	NATURAL MOISTURE CONTENT (w)	LIQUID LIMIT (w)	PLASTIC LIMIT (wp)	
214.9'	GROUND SURFACE														
0'	<u>SILT</u>		1	SS	4	83									
	brownish, oxidized in upper portion underlying 1'6" of organic silty loam. Gray silt and pinkish clayey silt bands alternating, becoming more clayey with depth.		2	SS	16	100									
			3	SS	11	66									
5'			4	SS	10	83									
10'	-- COMPACT --		5	SS	7	66									
	changing to loose to very loose with depth														
15'			6	SS	4	100									
20'			7	SS	5	100									
191.9'															
23'	<u>CLAY</u>														
25'	gray, very silty, with faint pinkish bands about 1" thick and containing some gray silt bands in upper portion		8	ST	100										
30'	-- STIFF --		9	ST	100										
35'	Continued ...														

Standpipe @ 24'  
March 8, 1974

Piezometer @ 35'  
March 8, 1974



PROJECT BRIDGE OVER SOUTH NATION RIVER

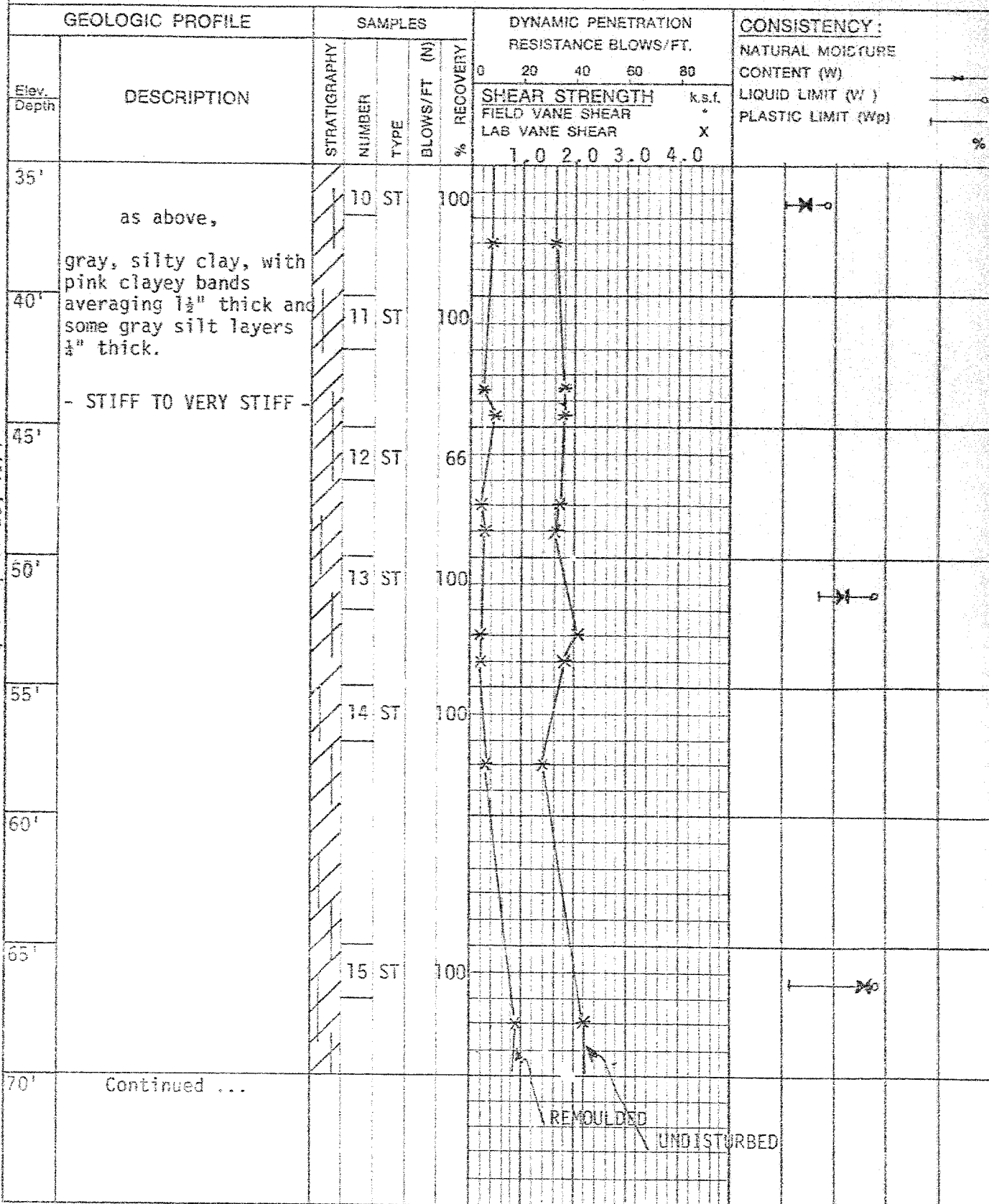
LOCATION 0.33 Mile WEST OF LEMIEUX, ONTARIO

DATUM GEODETIC BOREHOLE TYPE WASH  $\Delta$  11+05

DRILLING DATE 14/1/74

REPORT DATE

DRAWN BY R.R.





DRILLING DATE 14/1/74  
REPORT DATE \_\_\_\_\_  
DRAWN BY R.R.

GEOLOGIC PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS/FT.		CONSISTENCY:	
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	% RECOVERY	NATURAL MOISTURE CONTENT (W) LIQUID LIMIT (WL) PLASTIC LIMIT (WP)
70'	Banded clay as above; becoming gray through- out, organic, with no apparent bedding at about 70' depth						
75'	- VERY STIFF TO HARD -		16	ST	100		
135.4' 79'6"	END OF BOREHOLE						

PROJECT BRIDGE OVER SOUTH NATION RIVER

DRILLING DATE 22/1/74

LOCATION 0.33 Mile WEST OF LEMIEUX, ONTARIO

$\Delta$  8+90

REPORT DATE

DATUM GEODETTIC BOREHOLE TYPE WASH

DRAWN BY R.R.

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.					CONSISTENCY:				
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY %	0	20	40	60	80	NATURAL MOISTURE CONTENT (W)	LIQUID LIMIT (W)	PLASTIC LIMIT (Wp)	%
205.1'	GROUND SURFACE														
0'	<u>SAND</u>		1	SS	11	44									
	Silty brown, overlain by 10" organic silty loam.		2	SS	7	100									
			3	SS	7	100									
5'	Some pinkish clay bands in silty sand.														
	- LOOSE TO COMPACT -														
194.6'			4	SS	2	100									
10' 6"	<u>CLAY</u>														
	alternating silty gray clay, pink clay and gray silt layers varying in thickness from 1" to 2"														
15'	-- STIFF --		5	ST	91										
20'			6	ST	100										
	pink bands are up to 2" thick in upper portion and becoming thinner 1/2" at depth around 30".														
25'			7	ST	100										
30'			8	ST	100										
35'	Continued ...														

REMOULDED

UNDISTURBED

PROJECT BRIDGE OVER SOUTH NATION RIVER

DRILLING DATE 22/1/74

LOCATION 0.33 Mile WEST OF LEMIEUX, ONTARIO  $\Delta 8+90$

REPORT DATE

DATUM GEODETIC BOREHOLE TYPE WASH

DRAWN BY R.R.

GEOLOGIC PROFILE		SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS/FT.					CONSISTENCY:	
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	RECOVERY %	SHEAR STRENGTH k.s.f.					NATURAL MOISTURE CONTENT (w)
							0	20	40	60	80	LIQUID LIMIT (w)
												PLASTIC LIMIT (wp)
												%
35'							1.0	2.0	3.0	4.0		
40'	CLAY, as above, becoming varved with very faint pinkish bands at depth,		9	ST	100							
45'												
50'	organic, gravelly and very silty starting at about 55' depth,		10	ST	58							
55'	--VERY STIFF--											
60'			11	ST	100							
62.6'												
65'	BEDROCK		15	RC	62							
			17	RC	100							
			20	RC	87							
	black, fissile SHALE.		21	RC	100							
			22	RC	73							
70'	continued...											

Open hole to 62'6" January 28, 1974

UNDISTURBED

REMOULDED

DRILLING DATE 22/1/74

REPORT DATE

DRAWN BY R.R.

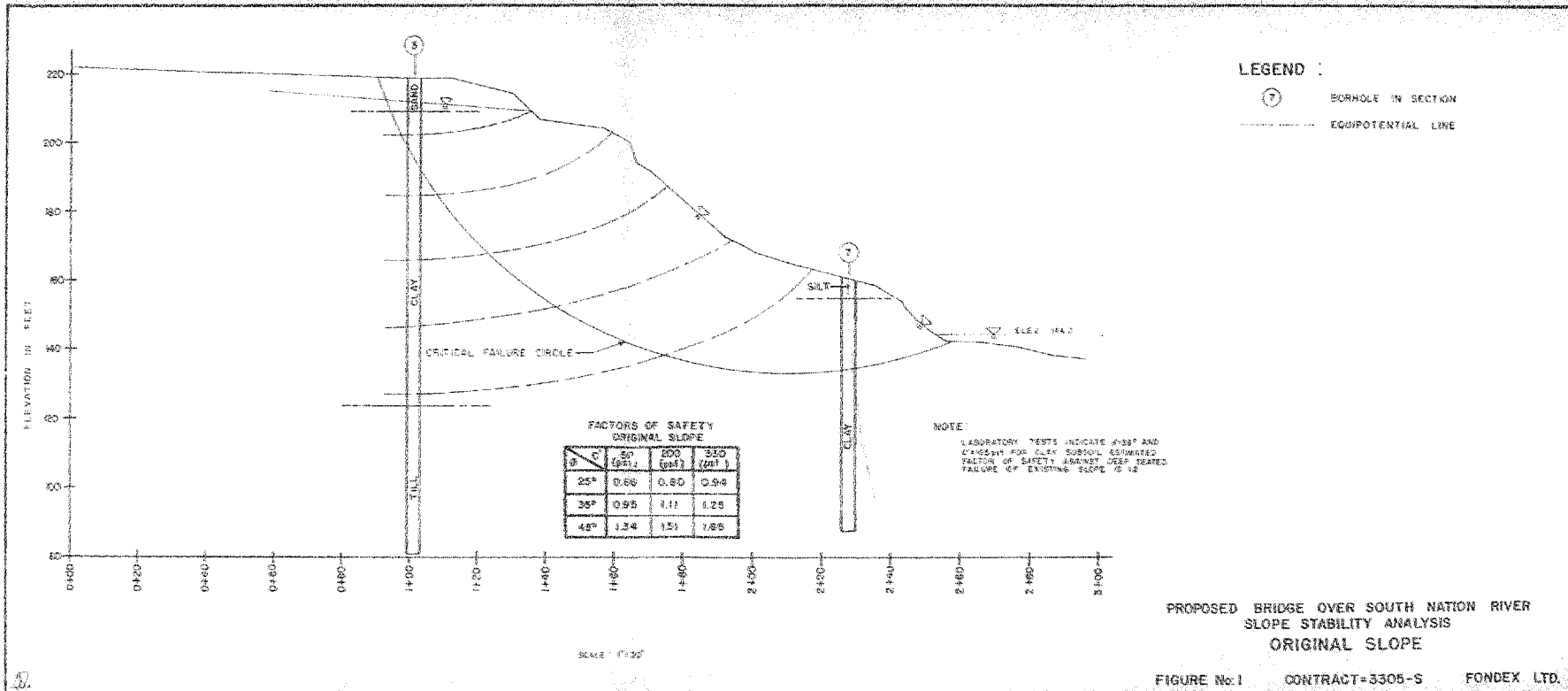
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Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS/FT (N)	% RECOVERY	0	20	40	60	80	NATURAL MOISTURE CONTENT (W)	LIQUID LIMIT (W )	PLASTIC LIMIT (Wp)	%			
							SHEAR STRENGTH					A.S.T.						
70'	black SHALE,	H H H H H	23	RC	81													
132'	as above.																	
72' 2"	END OF BOREHOLE																	
						</												

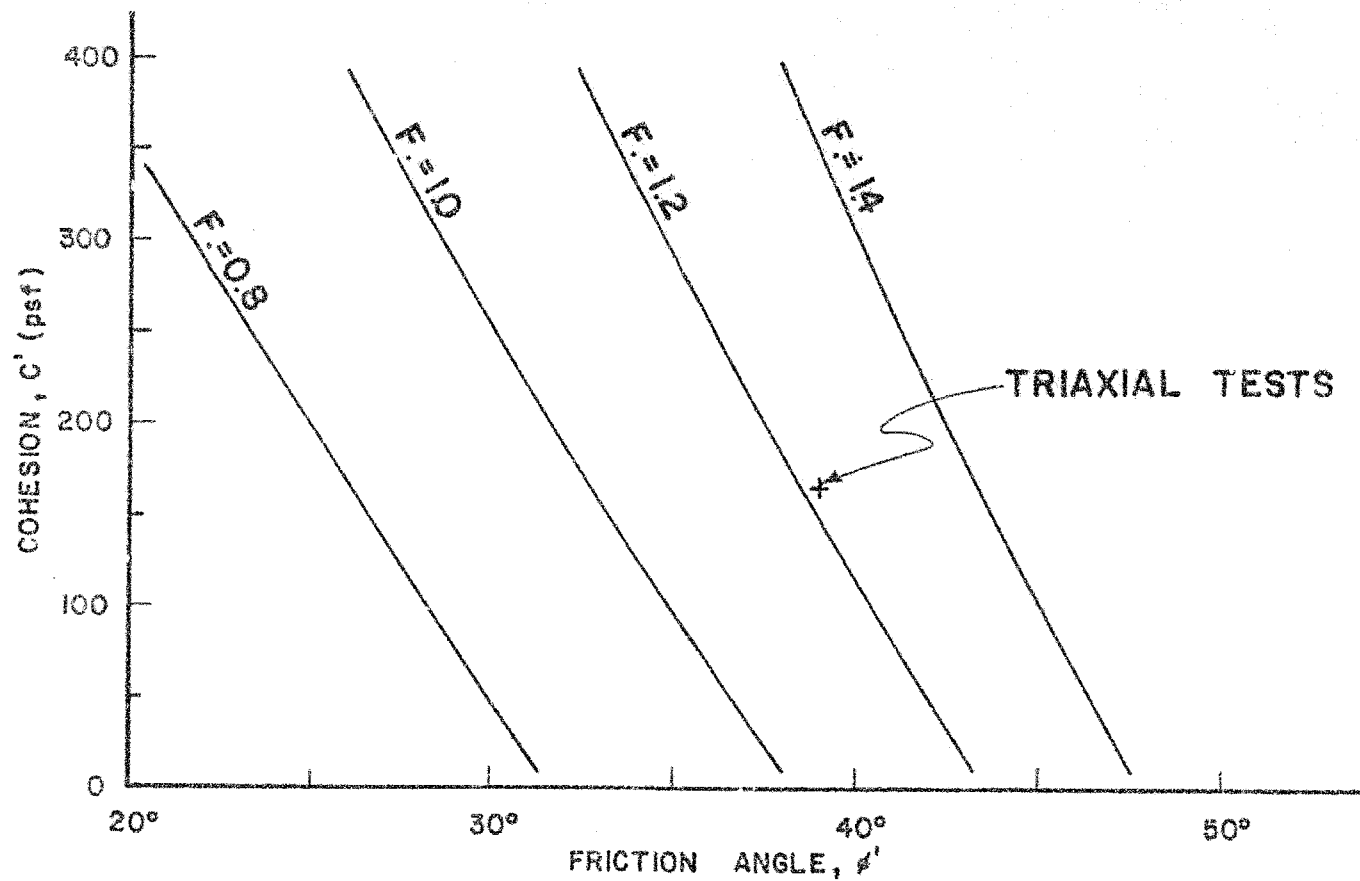
DRILLING DATE 1/2/74

REPORT DATE

DRAWN BY R. R.

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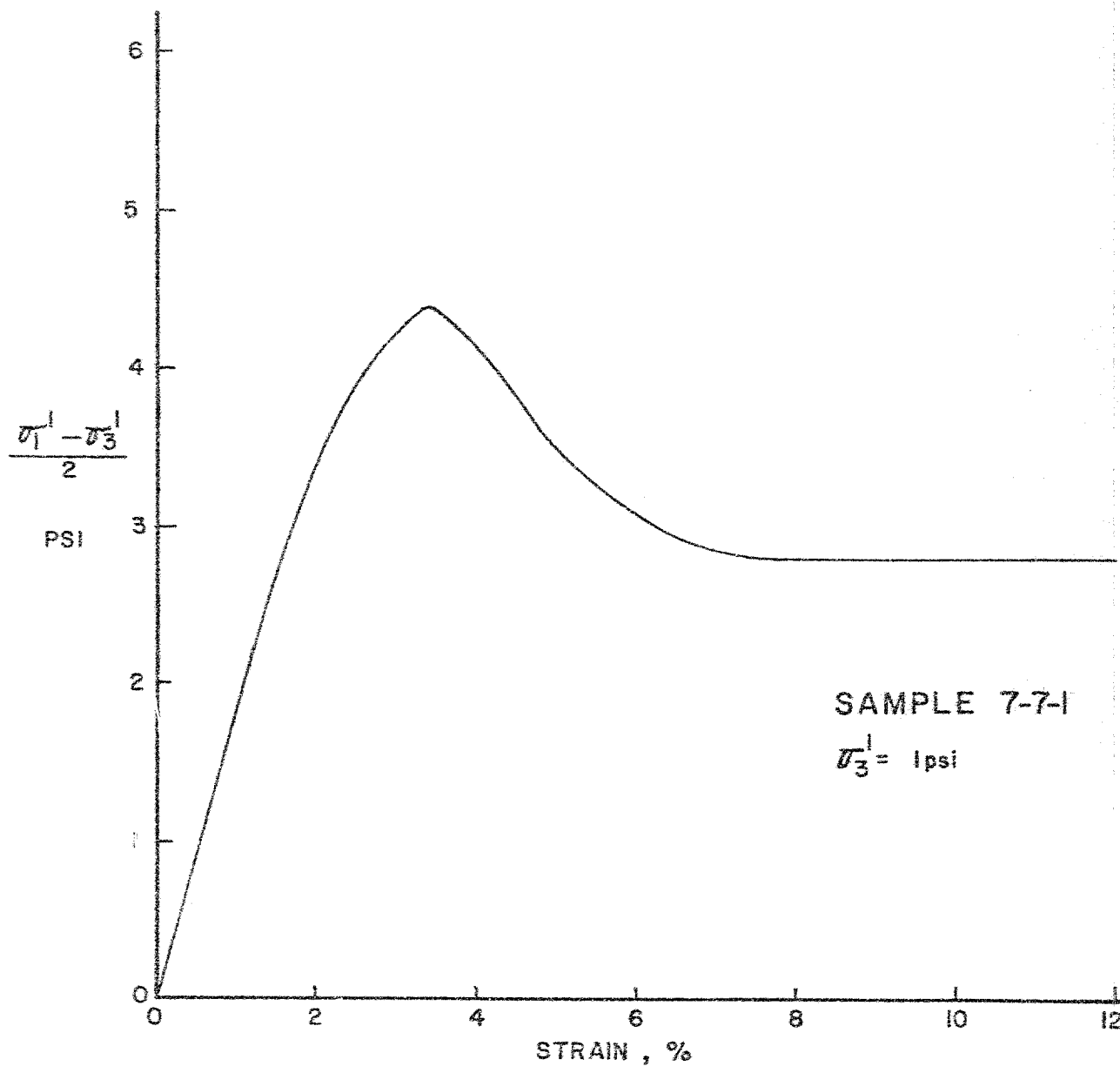
SLOPE STABILITY ANALYSIS  
ORIGINAL SLOPE

FONDEX LTD

FIGURE No: 2

CONTRACT No: 3305-S





CID TRIAXIAL TEST

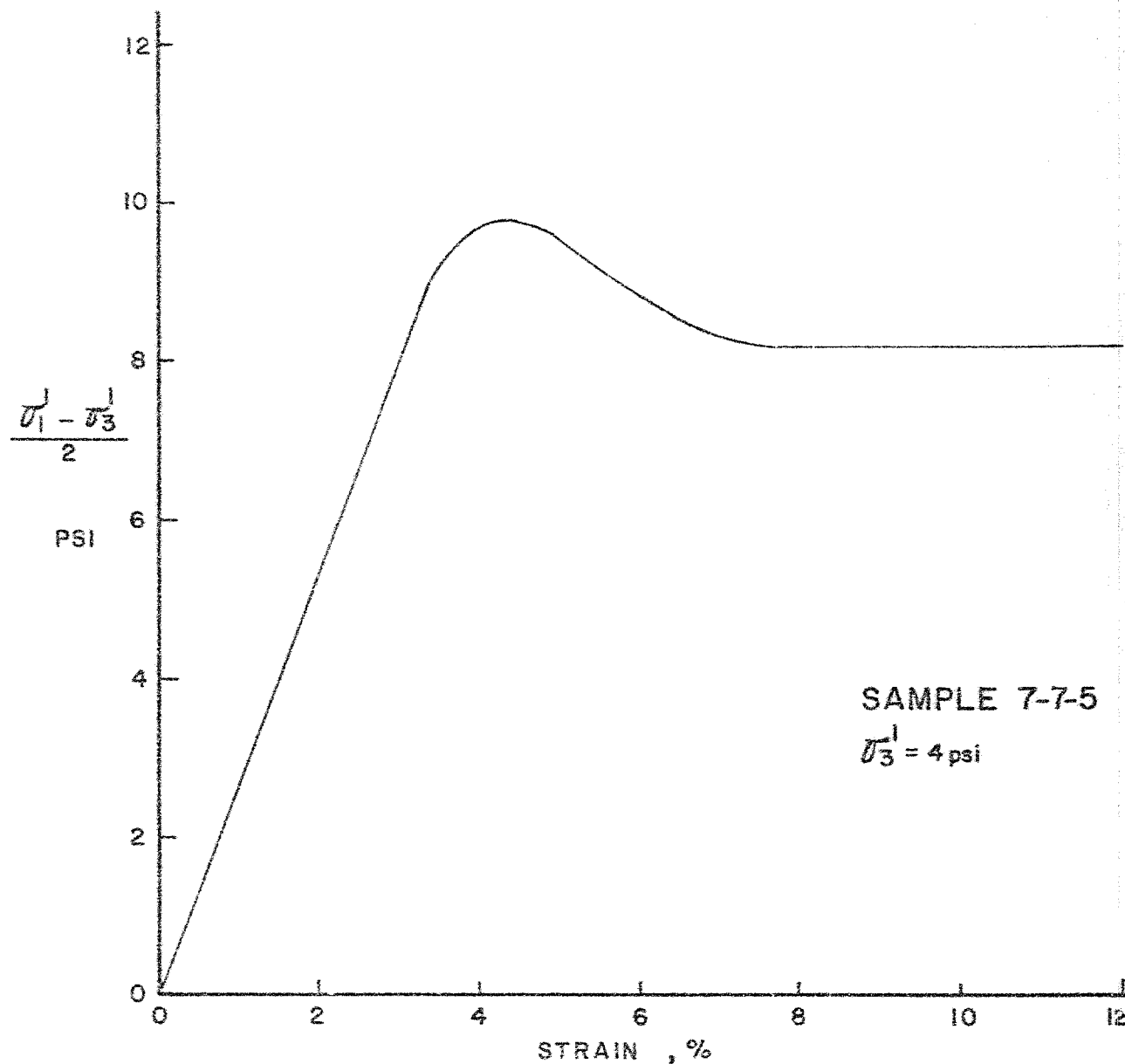
FONDEX LTD

FIGURE No: 3

CONTRACT No: 3305-S

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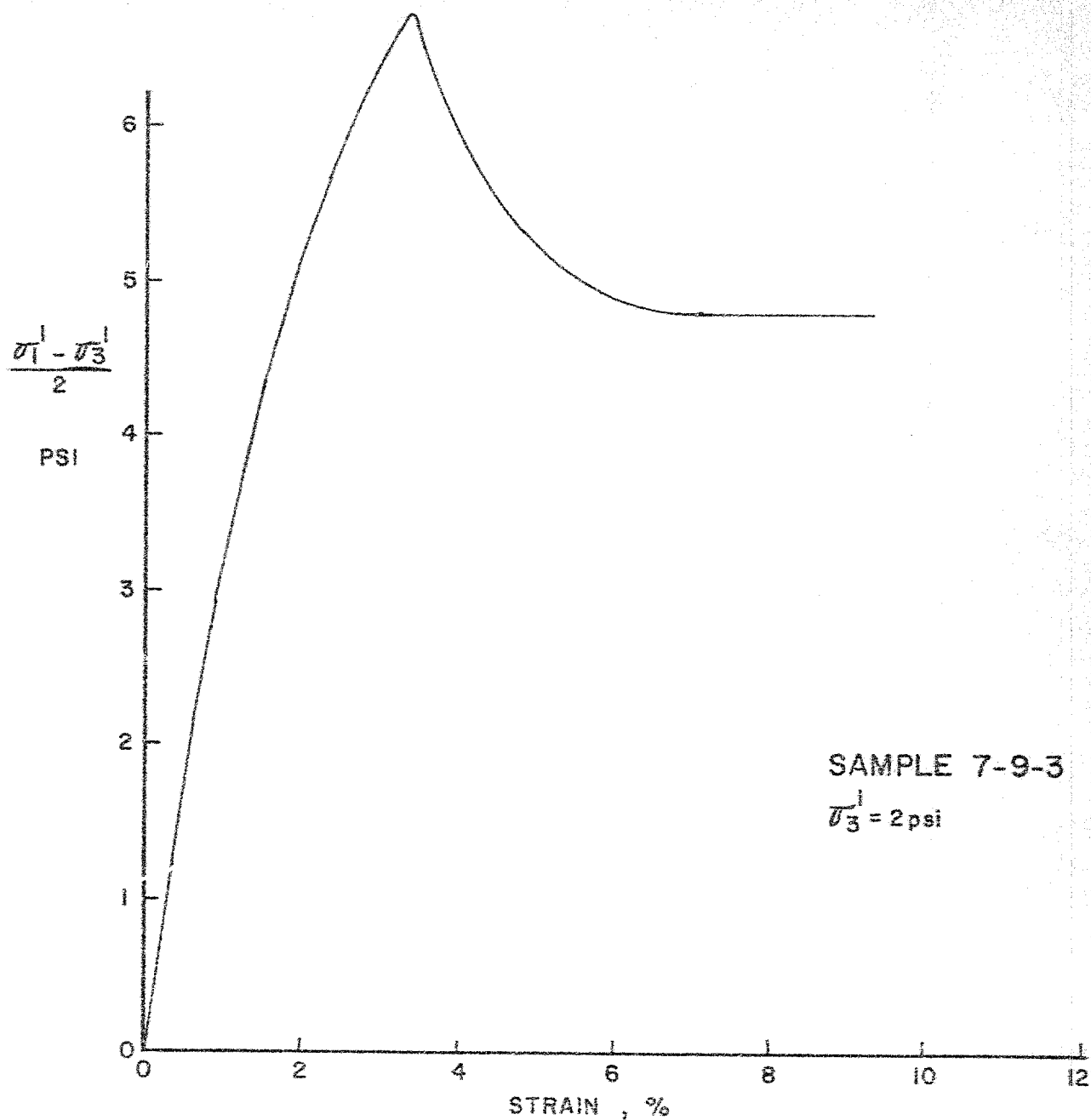
### CID TRIAXIAL TEST

FONDEX LTD

FIGURE No. 4

CONTRACT No. 3305-S

*gd.*



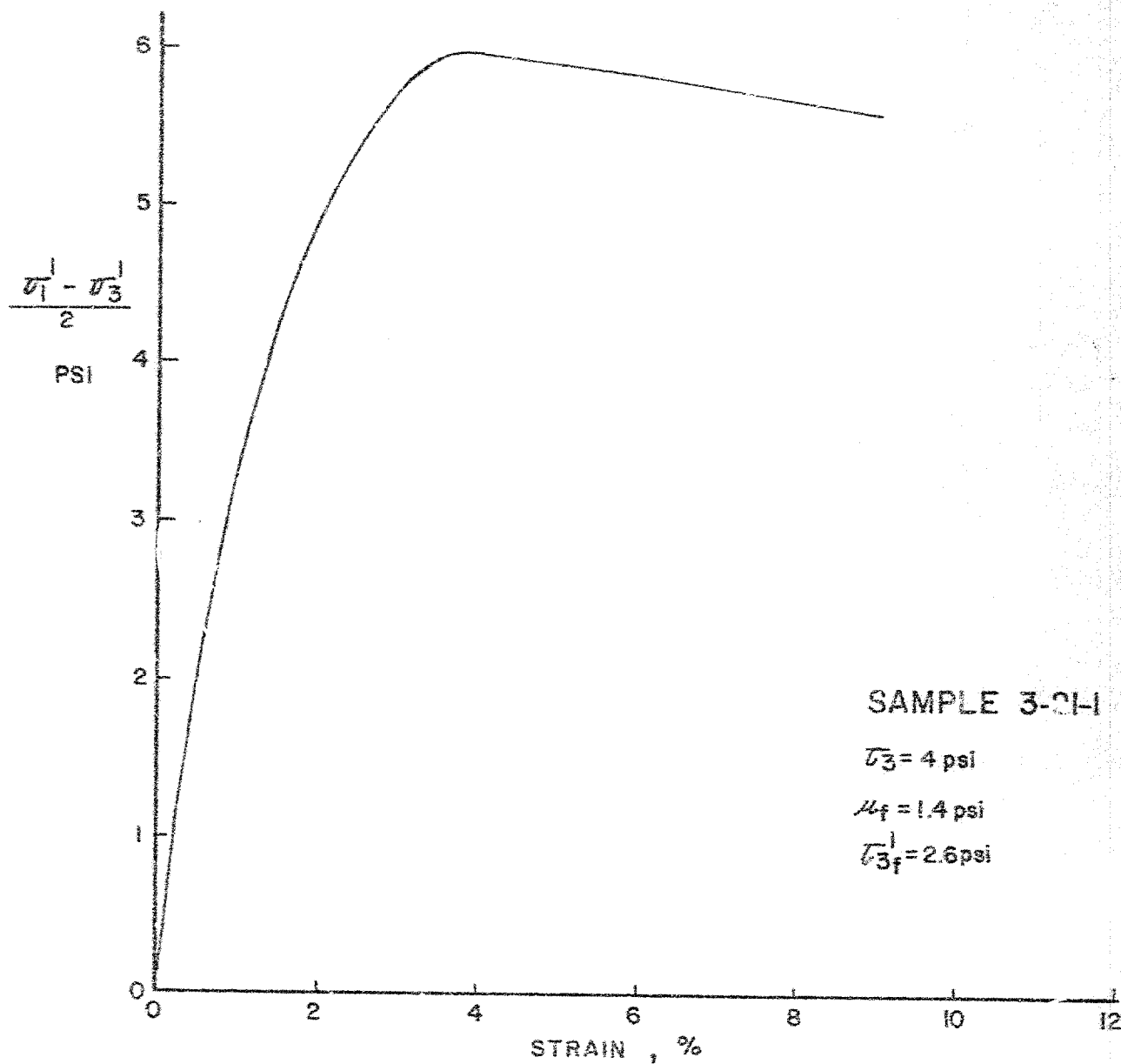
CID TRAXIAL TEST

FONDEX LTD

FIGURE No 5

CONTRACT No 3305-S

40

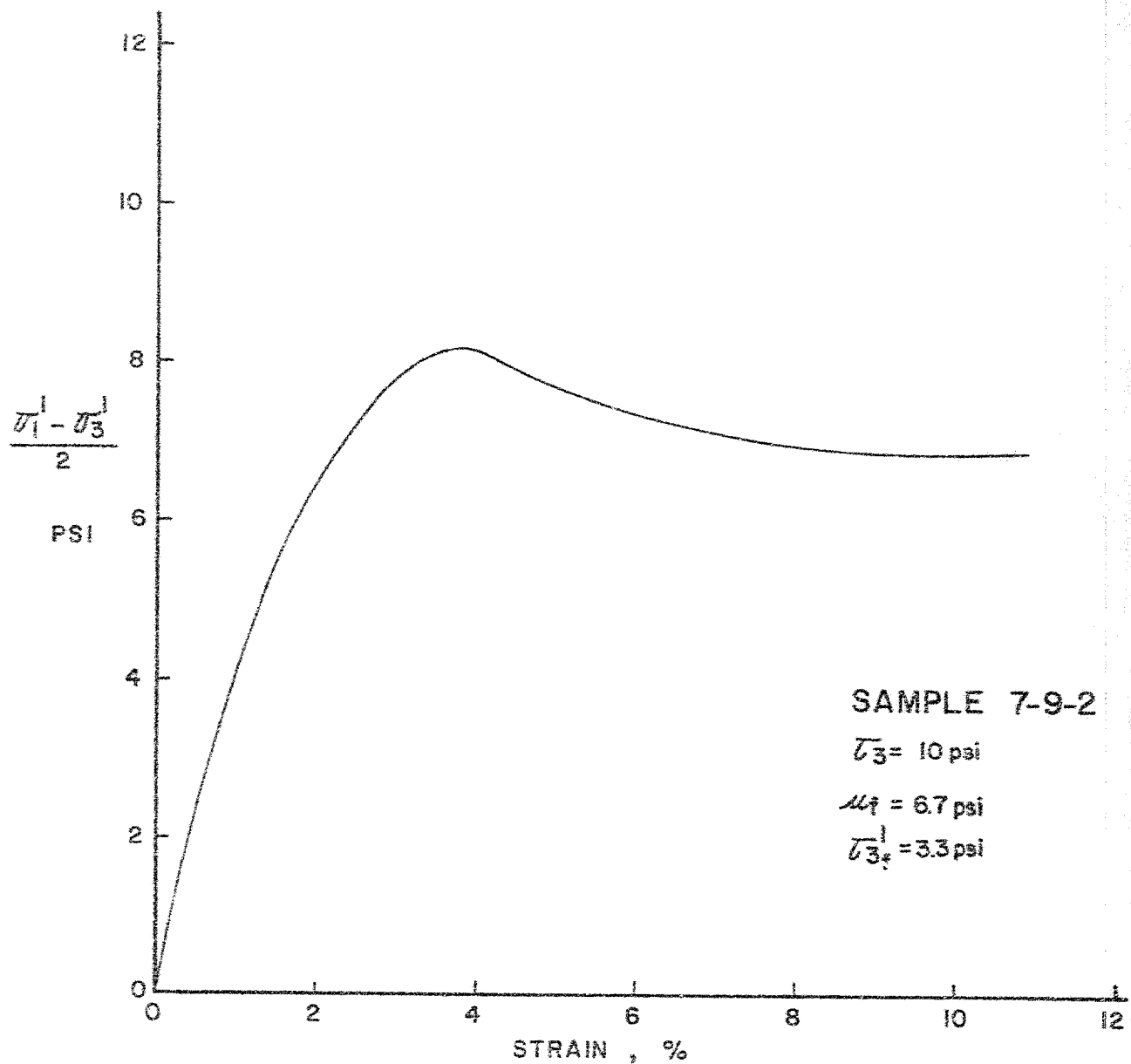


CIU TRIAXIAL TEST

FONDEX LTD

FIGURE No. 6

CONTRACT No. 3305-S



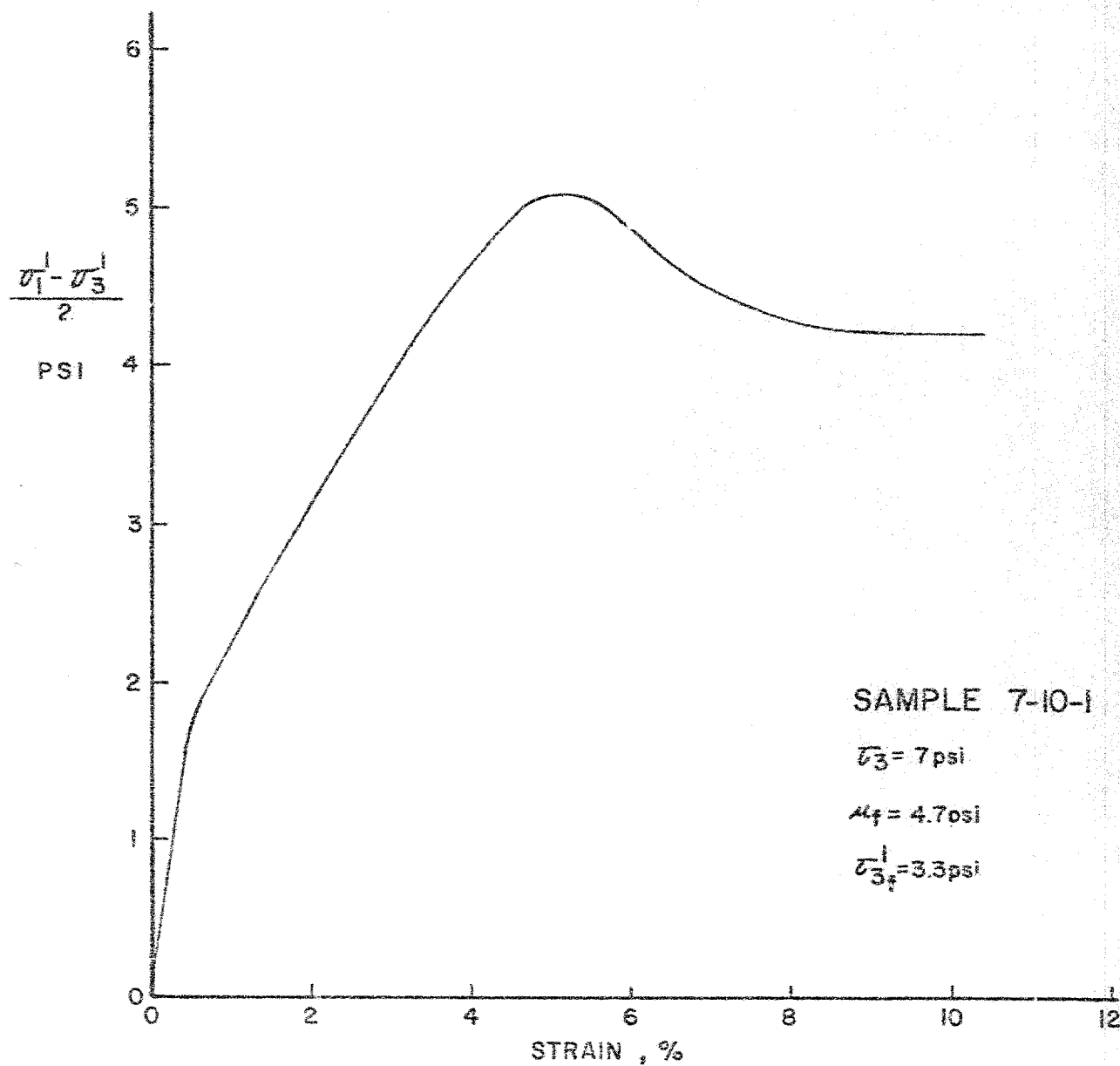
CIU TRIAXIAL TEST

FONDEX LTD

FIGURE No. 7

CONTRACT No. 3305-S

52



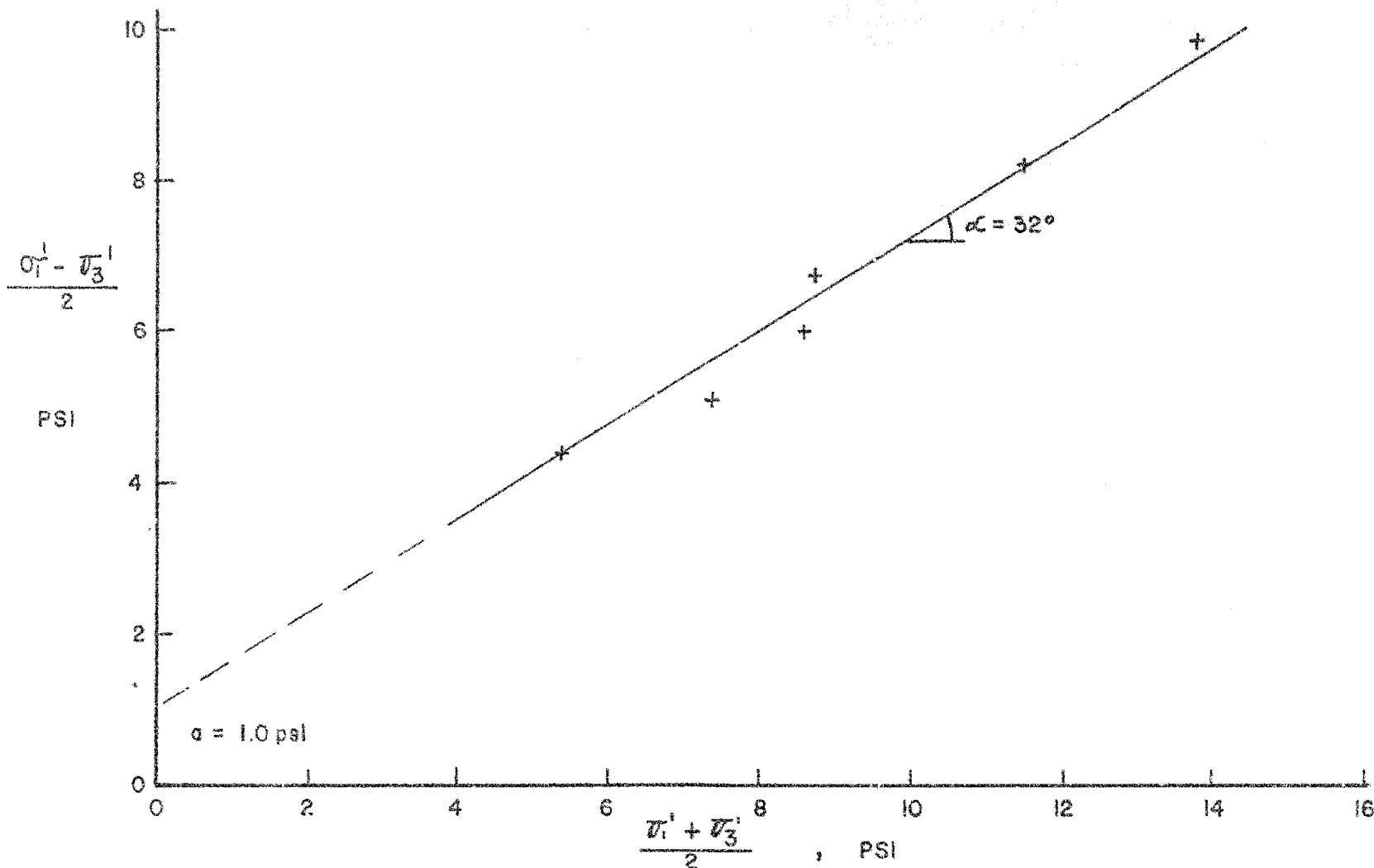
CIU TRIAXIAL TEST

FONDEX LTD

FIGURE No: 8

CONTRACT No: 3305-S

30.



TRIAXIAL TESTS  
PEAK FAILURE POINTS

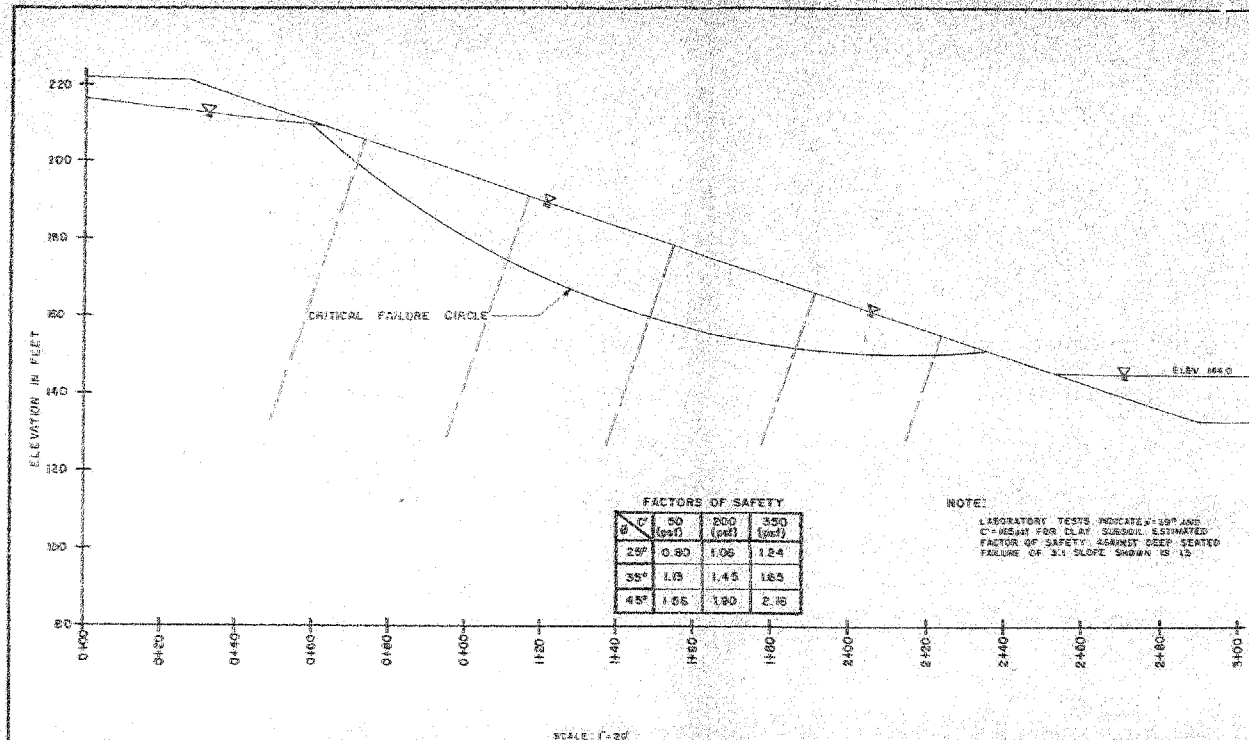
$\phi = 39^\circ$ ,  $c' = 165 \text{ psf}$

FONDEX LTD

FIGURE No.9

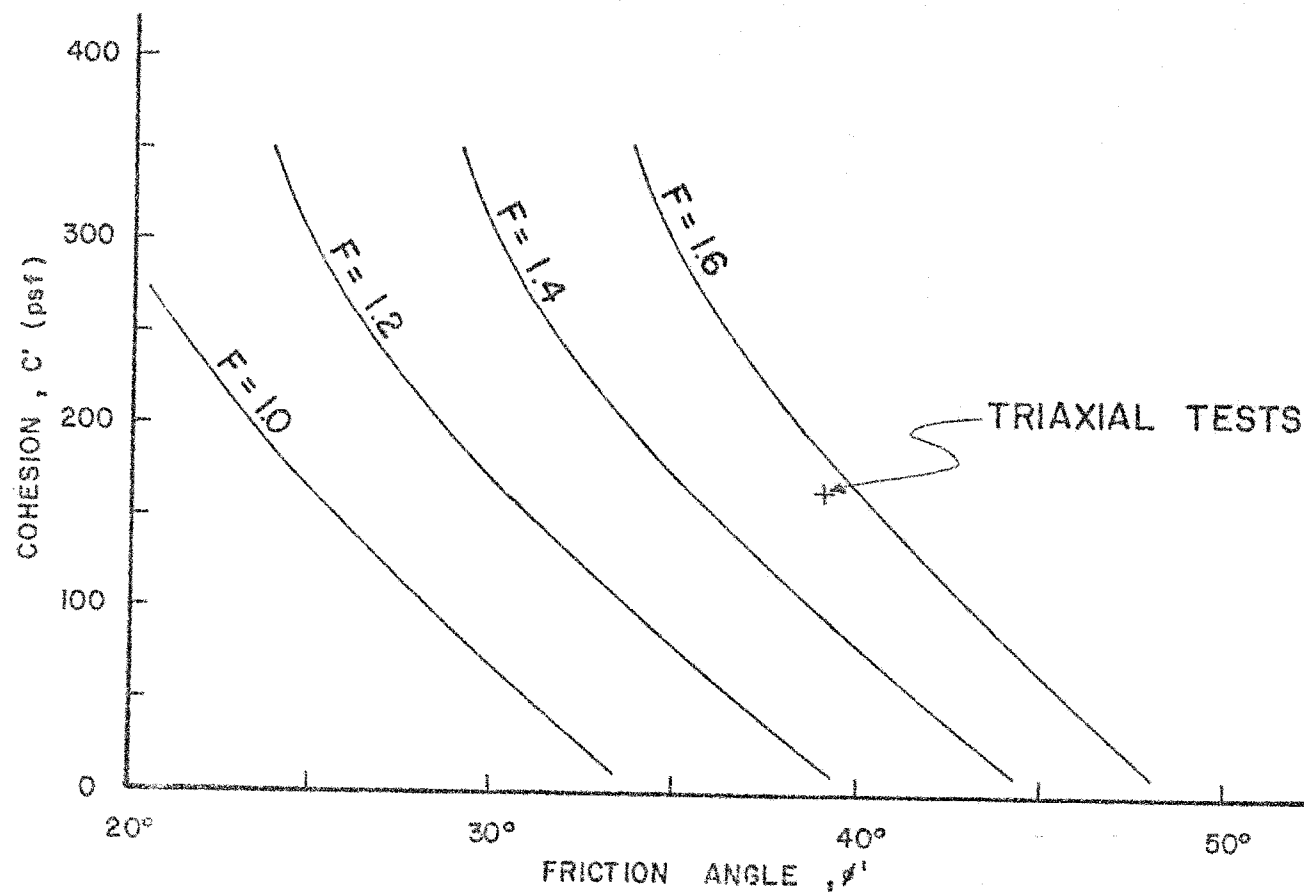
CONTRACT No.3305-S

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PROPOSED BRIDGE OVER SOUTH NATION RIVER  
SLOPE STABILITY ANALYSIS

SLOPE CUT = 3 HOR. TO 1 VERT.



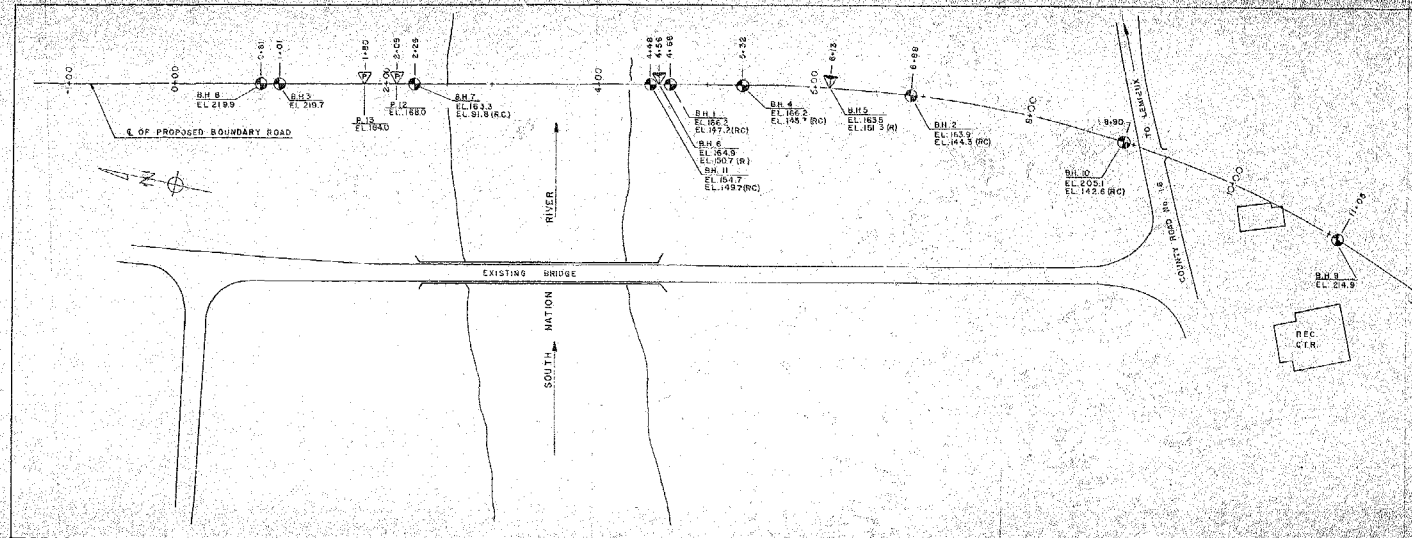
SLOPE STABILITY ANALYSIS  
3 : 1 SLOPE

FONDEX LTD

FIGURE No:II

CONTRACT No:3305-S





# **LEGEND**

- BOREHOLE IN PLAN
- ▽ PENETRATION IN PLAN
- ▽ PIEZOMETER (GEONOR) IN PLAN
- EL. 163.9 GROUND SURFACE ELEVATION
- EL. 151.3(R) REFUSAL
- EL. 144.3(RC) BEDROCK SURFACE ELEVATION

## **NOTES**

1. A DETAILED DESCRIPTION OF THE SOIL CONDITIONS IS GIVEN IN THE REPORT BY FONDEX LTD.
2. ALL ELEVATIONS REFER TO GEODETIC DATUM.
3. C.B.M. No. 70-1-105 ELEV. 219.158
4. BUILDING ON SOUTHEAST SIDE OF BOUNDARY ROAD, 0.2 MILE SOUTHWEST OF LEMIEUX, CLOSE TO ROAD WITH BRIDGE OVER SOUTH NATION RIVER, TABLET IN NORTHWEST WALL, NEAR MOST WESTERLY CORNER.

314-26  
GEOCREP No.

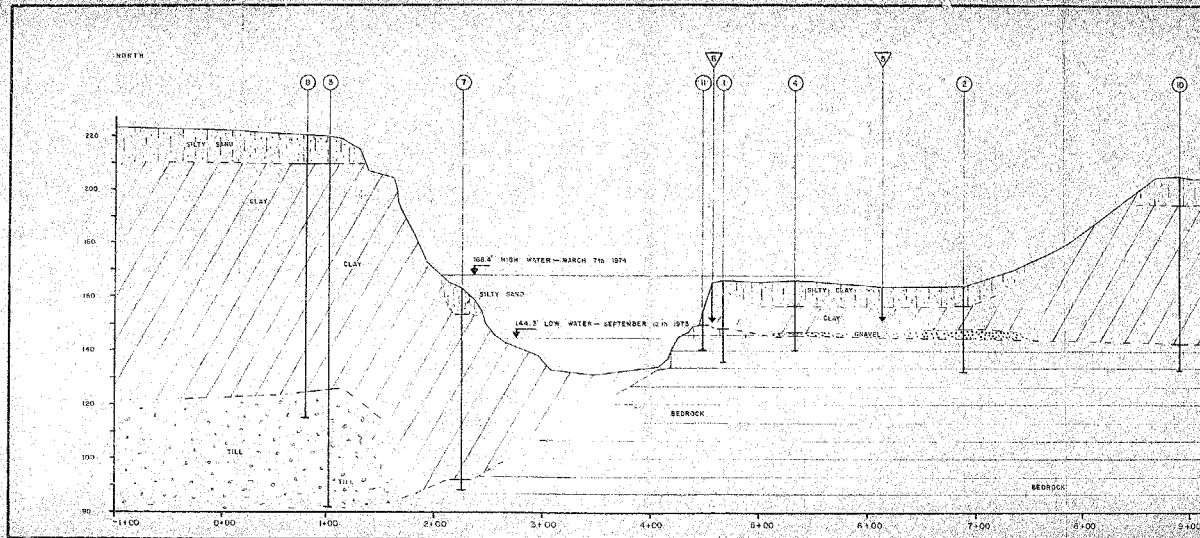
**UNITED COUNTIES OF  
PRESCOTT & RUSSELL**

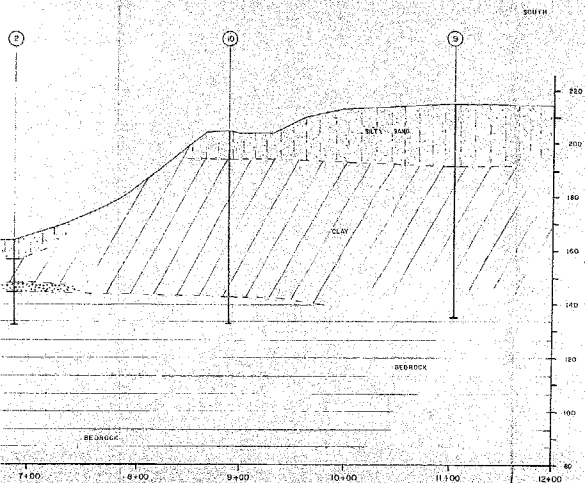
PROPOSED BRIDGE OVER SOUTH  
NATION RIVER, 0.33 MILES WEST  
OF LEMIEUX, ONTARIO

**SITE & LOCATION PLAN**





DRAWN BY: G.G. R.R. DRAWING NO. 3305-S-1

**FONDEX LTD.**  
OTTAWA, ONT. SCALE: 1" = 50'  
DATE: MAY 1974





### LEGEND

- ② BOREHOLE IN SECTION  
 ▼ CONE PENETRATION
-  SILTY SAND
-  SILTY CLAY
-  GLACIAL TILL & GRAVEL
-  BEDROCK  
 SHALY LIMESTONE & BLACK SHALE

### NOTES

1. A DETAILED DESCRIPTION OF THE SOIL CONDITIONS IS GIVEN IN THE REPORT BY FONDEX LTD.
2. ALL ELEVATIONS REFER TO GEODETIC DATUM.  
 C.D.M. No 70-U-105 ELEV. 219.158'  
 BUILDING ON SOUTHEAST SIDE OF BOUNDARY ROAD, 0.2 MILE SOUTHEAST OF LEMIEUX, CLOSE TO ROAD WITH BRIDGE OVER SOUTH NATION RIVER, TABLET IN NORTHWEST WALL, NEAR MOST WESTERLY CORNER.
3. THE GEOLOGICAL BOUNDARIES HAVE BEEN DETERMINED AT THE BOREHOLE LOCATIONS ONLY. THE STRATIGRAPHY GIVEN BETWEEN BOREHOLES IS INFERRED FROM GEOLOGICAL EVIDENCE AND DOES NOT NECESSARILY CORRESPOND TO THE TRUE STRATIGRAPHY.

31 G-26

GEOCRESS No.

UNITED COUNTIES OF PRESCOTT & RUSSELL

PROPOSED BRIDGE OVER SOUTH NATION  
 RIVER, 0.33 MILES WEST OF LEMIEUX, ONTARIO

STRATIGRAPHIC PROFILE

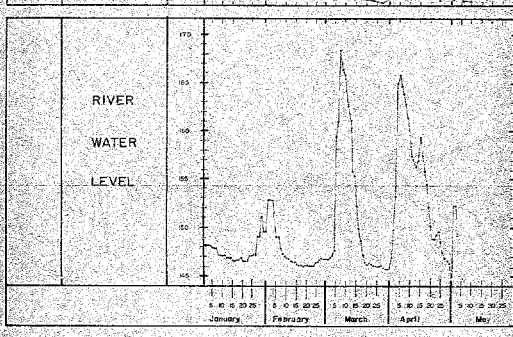
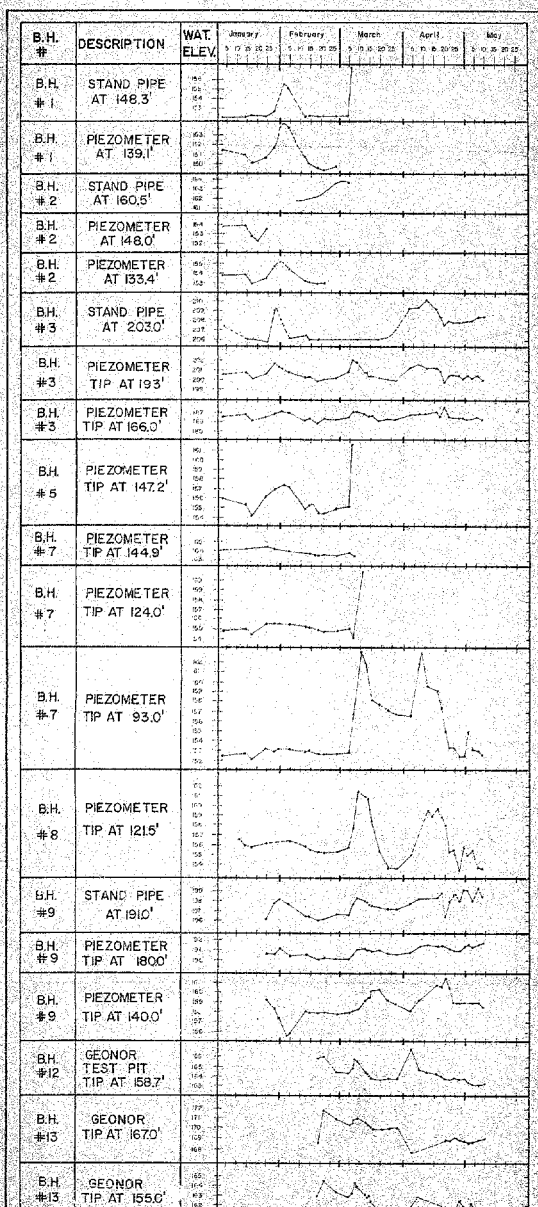
CONTRACT NO. 3305-S

DRAWN BY: R.T.  
 CHECKED BY: R.D.

DRAWING N° 3305-S-2

**FONDEX LTD.**  
 OTTAWA HALL

SCALE: 1" = 50' horizontal  
 DATE: 1" = 20' vertical  
 MAY 1974



#### NOTES:

1. ALL WATER LEVELS MEASURED BY  
PIEZOMETERS AND STAND PIPES REFER  
TO: GEODETIC DATUM.

2. DAILY WATER LEVELS OF THE  
SOUTH NATION RIVER REFER TO A  
GAUGE (NO DELBOS) ON EXISTING  
BRIDGE OVER SOUTH NATION RIVER  
AT LEMIEUX.

#### UNITED COUNTIES OF PRESCOTT & RUSSELL

PROPOSED BRIDGE OVER SOUTH NATION RIVER  
0.33 MILES WEST OF LEMIEUX, ONTARIO

#### WATER LEVELS

DRAWN BY: *LL*

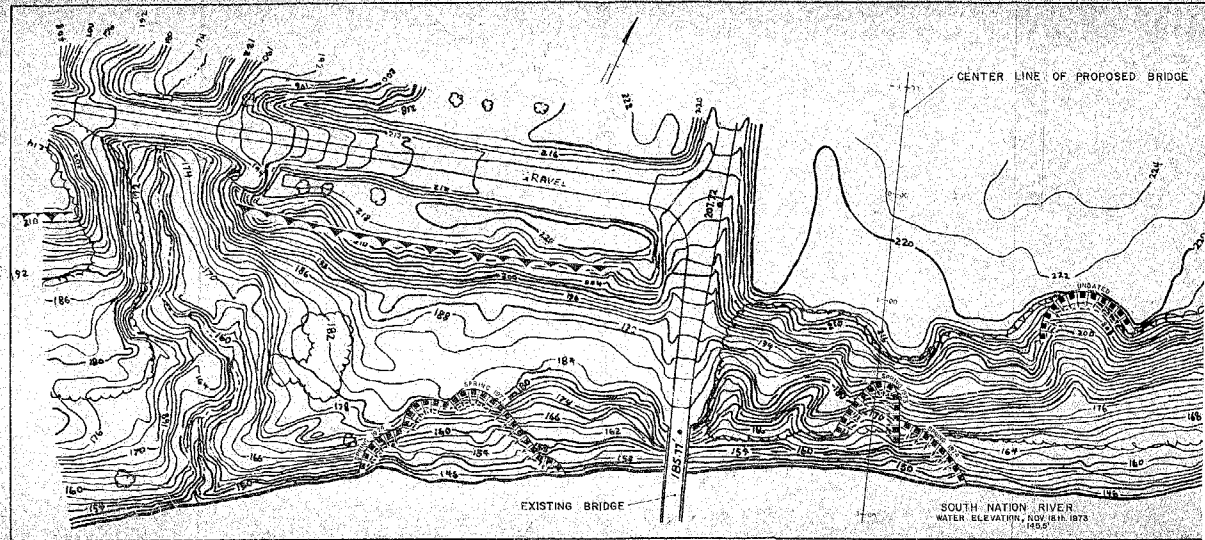
CHECKED BY: *LL*

DRAWING 3305-S-3

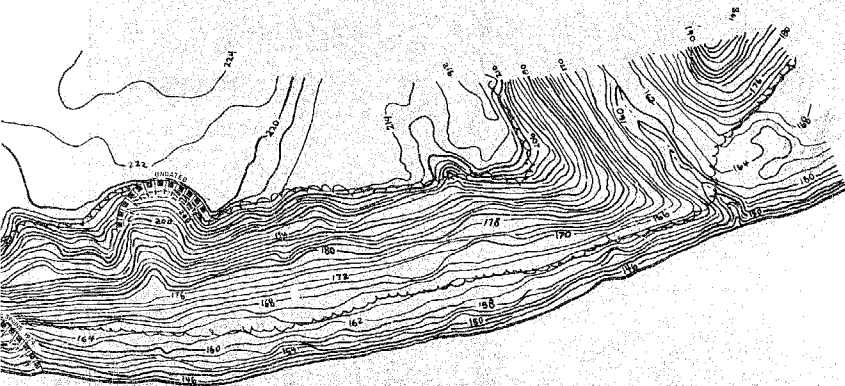
**FONDEX LTD.**  
OTTAWA HULL

SCALE: AS SHOWN

DATE: MAY 1974



CENTER LINE OF PROPOSED BRIDGE



# LEGEND.



GRAVITY LANDSLIDE  
SLOPE > 25°, AND HIGHER THAN  
20 FEET



INACTIVE SLOPES OLD LANDSLIDE  
SCAR

## NOTES

1. ALL ELEVATIONS REFER TO GEODETIC DATUM S.M. 8704105, ELEV. 219.158
2. TOPOGRAPHY DRAWN FROM ARIAL PHOTOGRAPHS BY PATRICKER LTD., NOV. 28th 1973, CONTOUR INTERVAL, 2 FEET.
3. DATA INTERPRETED FROM ARIAL PHOTOGRAPHS OF PROPOSED BRIDGE SITE

## UNITED COUNTIES OF PRESCOTT AND RUSSELL

PROPOSED BRIDGE OVER SOUTH NATION RIVER  
0.33 MILES WEST OF LEMIEUX, ONTARIO

### MINOR FAILURES

ON NORTH BANK OF SOUTH NATION RIVER  
AT PROPOSED CROSSING.  
CONTRACT 3305-S

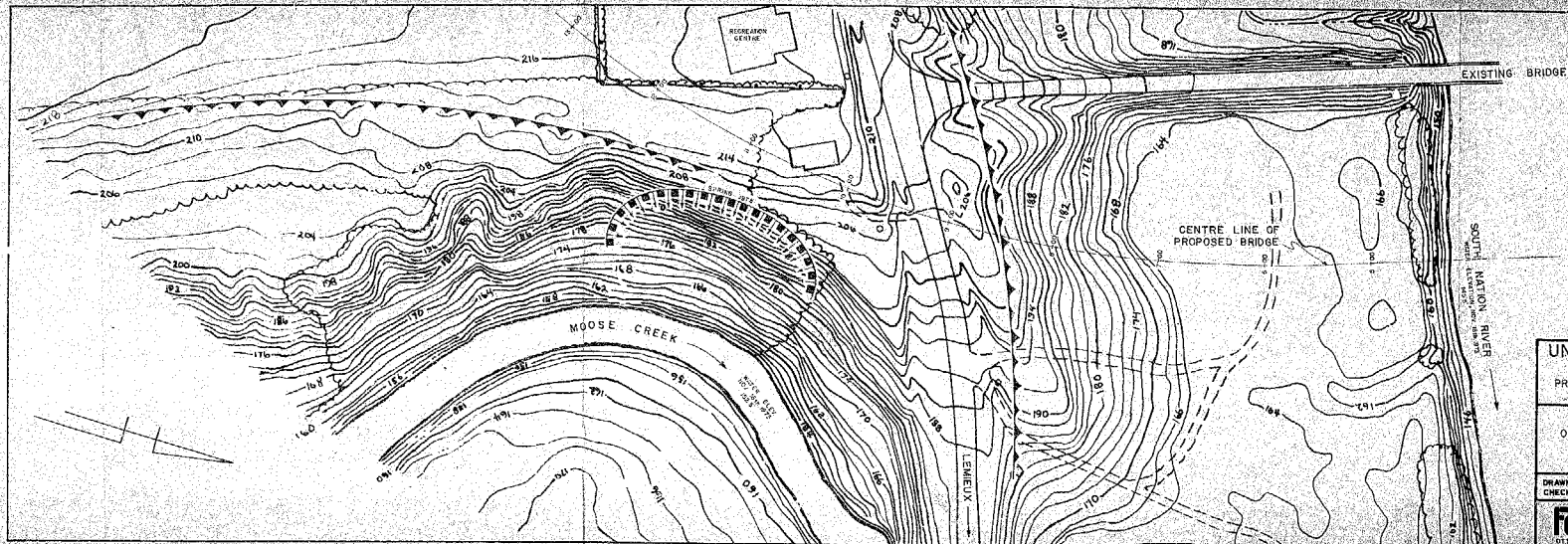
DRAWN BY : *L.H.*  
CHECKED BY :

DRAWING 3305-S-4

**FONDEX LTD.**  
OTTAWA

SCALE 1"=50'  
DATE MAY 1974

SOUTH NATION RIVER  
WATER ELEVATION, NOV. 19th 1973  
148.5'



# LEGEND:

- GRAVITY LAND FORMS ACTIVE SLOPE 25% AND HIGHER THAN 20%
- INACTIVE SLOPES - OLD LAND-USE SCARS

## NOTES:

- ALL ELEVATIONS REFER TO GEODETIC DATUM: B.M. 117000, ELEV. 219.50
- TOPOGRAPHY DRAWN FROM AERIAL PHOTOGRAPHS BY PATHINDER LTD., NOV. 8/9 1973, CONTOUR INTERVAL: 2 FEET
- DATA INTERPRETED FROM AERIAL PHOTOGRAPHS OF PROPOSED BRIDGE SITE

## UNITED COUNTIES OF PRESCOTT AND RUSSELL

PROPOSED BRIDGE OVER SOUTH NATION RIVER  
0.33 MILES WEST OF LEMIEUX, ONTARIO

## MINOR FAILURES

ON SOUTH BANK OF SOUTH NATIONS RIVER  
AT PROPOSED CROSSING  
CONTRACT 3305-S

DRAWN BY: *slp*  
CHECKED BY:

DRAWING N° 3305-S-5

**FONDEX LTD.**  
OTTAWA

SCALE: 1" = 50'  
DATE: MAY 1974

## PIEZOMETER LOGS

Disposition of piezometers, standpipes and bentonite seals in  
instrumental boreholes; Lemieux, Ontario.

Borehole # 1	Standpipe tip at elevation 148.3'
Station	Bentonite seal from elevation 147.0 to 142.8'
4+66	Piezometer (Golder) tip at elevation 139.1'
Borehole # 2	Standpipe tip at elevation 160.5'
Station	Bentonite seal from elevation 153.5' to 151.5'
6+88	Piezometer (Golder) tip at elevation 148.0'
	Bentonite seal from elevation 138.5' to 137.5'
	Piezometer (Golder) tip at elevation 133.4'
Borehole # 3	Standpipe tip at elevation 203.0'
Station	Bentonite seal from elevation 201.6 to 192.0'
1+01	Piezometer (Golder) tip at elevation 193.0
	Bentonite seal from elevation 193' to 190'
	Bentonite seal from elevation 172' to 169.5'
	Piezometer (Golder) tip at elevation 166.0'
	Bentonite seal from elevation 166' to 163'
Borehole # 4	Bentonite seal from 151.2' to 149.0'
Station	Piezometer (Golder) tip at elevation 147.2'
5+32	
Borehole # 7	Bentonite seal from elevation 158.3' to 154.0'
Station	Piezometer (Golder) tip at elevation 144.9'
2+26	Bentonite seal from elevation 128.3' to 126.0'
	Piezometer (Golder) tip at 124.0'
	Bentonite seal from elevation 119.3' to 115.3'
	Bentonite seal from elevation 103' to 99.0'
	Piezometer (Golder) tip at elevation 93.0'



PIEZOMETER LOGS (continued)

Borehole # 8  
Station  
0+81

Bentonite seal from elevations 154.0' to 149'  
Piezometer (Golder) tip at elevation 146.0'  
Bentonite seal from elevation 144' to 142'  
Bentonite seal from elevation 133' to 127'  
Piezometer (Golder) tip at elevation 121.5'

Borehole # 9  
Station  
11+05

Standpipe at elevation 191.0'  
Bentonite seal from elevation 190' to 185'  
Piezometer (Golder) tip at elevation 180'  
Bentonite seal from elevation 179' to 177'  
Bentonite seal from elevation 149' to 144'  
Piezometer (Golder) tip at elevation 140.0'

Piezometer nest  
# 12  
2+09

Piezometer (Geonor) tip at elevation 158.7'

Piezometer nest  
# 13  
1+80

Piezometer (Geonor) tip at elevation 167.0'  
Piezometer (Geonor) tip at elevation 155.0'

DRAWING # 3305-S-3, WATER LEVELS

NOTES:

1. Piezometers and standpipes on the south bank of South Nation River below elevation 167' were damaged by ice and sedimentation after the first flood of the South Nation River which reached its peak on March 7th, 1974 at an elevation of 168.5'. Monitoring of boreholes 1, 2, 4 was stopped.
2. Piezometers and standpipes on the north bank of the river were monitored continuously during both floods of the river which peaked on March 7th and April 5th, 1974.