

63-F-272 m

COUNTY ROAD <sup>#</sup>6  
&

ADELAIDE CREEK

BRIDGE <sup>#</sup>28

LINE D

BA 1668

19-453

ADDENDUM  
TO  
REPORT  
TO  
R. C. DUNN & ASSOCIATES LIMITED  
ON  
SOIL CONDITIONS AND FOUNDATIONS  
PROPOSED COUNTY BRIDGE NO. 28  
COUNTY OF MIDDLESEX, ONTARIO

63-F-272 M

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Toronto, Ontario.

June, 1963

6268

GOLDER & ASSOCIATES

# H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER  
V. MILLIGAN  
L. G. SODERMAN

2444 BLOOR STREET WEST  
TORONTO 9, ONTARIO  
767-9201  
763-4103

June 26, 1963

R. C. Dunn & Associates Limited,  
Consulting Engineers,  
250 Commissioners Road West,  
London, Ontario.

Attention: Mr. N.M. Warner, P. Eng.

RE: SOILS INVESTIGATION  
PROPOSED CO. BRIDGE NO. 28 - LINE D  
CO. ROAD NO. 6 & ADELAIDE CREEK  
TWP OF WEST WILLIAMS  
CO. OF MIDDLESEX, ONTARIO

Dear Sirs:

This letter reports the results of an investigation carried out at the site of a proposed bridge replacement (County Bridge No. 28) and roadway realignment over Adelaide Creek on County Road No. 6, some 4 miles north of Highway 22 near Adelaide, Ontario. A previous investigation was carried out by us at the site (our report 6268, dated April, 1963) along proposed alignment, Line B. The present report discusses an investigation carried out along a proposed new alignment, Line D, which is located as shown on Figure 1.

## PROCEDURE

The field work for the investigation along Line D was carried out between June 3, 1963 and June 6, 1963. Three boreholes were put down by means of a machine drillrig and two additional shallow probings by hand auger. Details of the boreholes and auger holes are given on the Records of Boreholes and a section of the inferred soil stratigraphy along Line D is shown on Figure 1, which also shows the locations of the borings. The elevations and locations of the boreholes were supplied by R. C. Dunn & Associates Limited. The datum is local.

## SUBSOIL CONDITIONS

The borings put down at the proposed bridge site encountered essentially similar soil conditions to those at the bridge site on abandoned Line B, and only a brief description will be given here. The upper floodplain deposit of very loose to loose organic silts and sands ranged from about 3 to 7 feet in thickness at the site, and was underlain by a grey and brown to grey silty clay, which is probably of lacustrine origin. Some of the properties of the clay, which was found to be about 20 feet in thickness in boreholes 101 and 102, are summarized on Figure 4 in plots of undrained shear strength, natural moisture contents, liquid and plastic limits and wet unit weights versus elevation. The measured undrained shear strength of the clay ranged from about 2,100 to 3,400 lb/sq.ft., indicating the clay to be stiff

to very stiff. The relatively high undrained shear strength close to present ground surface indicates that the clay is overconsolidated, probably by at least 3 tons/sq.ft. The lacustrine clay graded to a brown to grey silty clay with some sand and gravel size particles scattered throughout. This material, which was penetrated for a maximum depth of about 19 feet in borehole 101, is probably a glacial till. Some of the properties of this clay till are summarized on Figure 4. The plasticity characteristics of this material and the overlying lacustrine clay are compared on the plasticity chart on Figure 2.

Borehole 103, which was put down to a depth of 28 feet in a proposed cut section on Line D to the south of the creek crossing, encountered a brown to grey silty clay with an occasional sand or gravel size particle embedded in it. This clay, which is considered to be of lacustrine origin, is estimated to be very stiff to stiff with increasing depth.

The water levels in boreholes 101, 104 and 105 at the proposed bridge location were approximately at creek level during the investigation. The water level in borehole 102 was about 4 feet below creek level shortly after completion of the boring. It is expected this water level would rise to about creek level with time.

#### DISCUSSION - LINE D

##### Foundations for Proposed Structure

It is understood that it is proposed to span Adelaide Creek

with a 58 feet skew span rigid frame bridge structure at the location shown on Figure 1. It is further understood that the structure is to be founded on spread footings at elevation 19. Retaining wing walls up to about 20 feet in height are to be constructed at the four corners of the bridge structure to prevent the approach earthfill embankments from spilling into the creek.

The structure may be founded as proposed on spread footings founded in the lacustrine clay stratum at elevation 19. Based on the pattern of undrained shear strength versus elevation for the clay (see Figure 4) a net allowable bearing pressure of 2 tons/sq. ft. may be used for design of such footings.

If founded as discussed above, the settlement of either footing due to consolidation of the underlying clay strata under the additional weight of the structure and backfill behind the abutments should not exceed about 1 inch, provided no softening of the clay at foundation grade due to water or construction operations is permitted. The differential settlement between the footings should not exceed about 3/4 inches.

The backfill to be placed behind the abutments and wing walls at the proposed structure should be a clean free-draining granular material such as Class B pit run granular borrow (D.H.O. Form 314). Granular fill should also be used for the portions of the approach fill that are below the expected high water level for the

creek. Two samples of granular borrow material designated Barnes' Pit and Harrington's Pit which are discussed in our letter to you dated June 25, 1963, would be suitable for the above purposes. The material should be compacted in uniform layers, each layer being not greater than 9 inches in uncompacted thickness, to at least 95 percent of the Standard Proctor Compaction Test maximum dry density.

#### Construction of Footings for Bridge Structure

The founding of the footings for the proposed structure at elevation 19 will necessitate an excavation down to about 15 feet below present river bank level. The upper 3 to 6 feet of excavation will be through the loose organic silts and sands of the floodplain deposit and the remainder in the lacustrine clay. Assuming the creek will be diverted prior to construction, it is anticipated that the principal problem during construction will be to control groundwater seepage into the excavations, mainly from the floodplain deposit which overlies the relatively impermeable lacustrine clay. This seepage might be controlled for example by construction of an impervious earth dyke resting on the clay around the perimeters of the proposed excavations.

#### Road Alignment

The proposed alignment and grade along Line D necessitates a cut section to about station 19+00, Line D, and an earthfill embankment section between about stations 19+00 and 22+00. The maximum depth of cut will be about 22 feet at road centreline, and the maximum em-

bankment height will be about 14 feet above ground level at the banks of Adelaide Creek.

To ensure the surficial stability of the side slopes in the cut, they should not be steeper than 2 horizontal to 1 vertical and in view of the height of the cut, it is considered advisable to place a berm about 8 to 10 feet in width at about the mid-height of the cut slope.

A few thin lenses or layers of fine sand, one of them water bearing, were noted in the clay samples recovered from borehole 103 put down in the proposed cut. Any such water bearing lenses could cause erosion in the slopes of the proposed cut; however, since the number and size of such lenses is probably small the seepage from them, if serious, could probably best be controlled by providing a shallow gravel filled trench from the zone of seepage down the cut slope to the road ditch. The slopes of the cut should be sodded or seeded and mulched to combat erosion due to surface water. If the slopes are not treated, gullyng and local sloughing of the slope faces will occur.

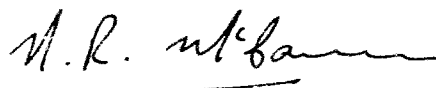
The side slopes of the proposed earthfill embankment should not be steeper than 2 horizontal to 1 vertical to maintain the surficial stability of the slopes. Growth should be encouraged on the slopes to minimize surface water erosion. All topsoil should be stripped prior to placing the fill and the organic silts and sands of the floodplain deposit should be removed, where present, and replaced with granular

material such as that from Barnes' Pit and Harrington's Pit. All embankment slopes should be rip-rapped for scour protection to at least 2 feet above creek high water level.

The silty clay excavated from the cut to the south of about station 19+00 may be used as non-granular borrow for the proposed embankment provided that the material can be compacted to at least 95 percent of its standard Proctor compaction test maximum dry density. To achieve this density it will probably be necessary to partially dry the material obtained in the cut prior to placing it in the embankment.

Yours faithfully,

H. Q. GOLDER & ASSOCIATES LTD.

A handwritten signature in dark ink, appearing to read "N. R. McCammon", with a horizontal line drawn underneath the name.

N. R. McCammon, P. Eng.

NRM:IMB  
6268

## LIST OF STANDARD ABBREVIATIONS

The standard abbreviations commonly employed on each "Record of Borehole", on the figures, and in the text of the report are as follows:

### SAMPLE TYPES

A.S. - Auger Sample	R.C. - Rock Core
C.S. - Chunk Sample	S.T. - Slotted Tube
D.O. - Drive Open	T.O. - Thin-walled, Open
D.S. - Denison Type Sample	T.P. - Thin-walled, Piston
F.S. - Foil Sample	W.S. - Wash Sample

### PENETRATION RESISTANCES

Dynamic Penetration Resistance - The energy required to drive a 2 inch diameter, 60 degree cone attached to the end of the drilling rods into the ground: expressed in blows per foot, where each blow represents 4,200 inch-pounds of energy.

Standard Penetration Resistance, N - The number of blows by a 140 pound hammer dropped 30 inches required to drive a 2 inch drive open sampler one foot into the ground.

Sampler advanced by static weight	- weight, hammer	- Wh
Sampler advanced by pressure	- pressure, hydraulic	- Ph
Sampler advanced by pressure	- pressure, manual	- Pm

### SOIL DESCRIPTION

The standard terminology for the descriptions of the relative density of cohesionless soils and the consistency of cohesive soils is as follows:

<u>Relative Density</u>	<u>N, Blows/ft.</u>	<u>Consistency</u>	<u>c, lb/sq. ft.</u>
Very Loose	0 to 4	Very Soft	Less than 250
Loose	4 to 10	Soft	250 to 500
Compact	10 to 30	Firm	500 to 1,000
Dense	30 to 50	Stiff	1,000 to 2,000
Very Dense	over 50	Very Stiff	2,000 to 4,000
		Hard	over 4,000

### SOIL TESTS

C - Consolidation Test	Q - Undrained Triaxial
H - Hydrometer Analysis	Qc - Consolidated Undrained Triaxial
M - Sieve Analysis	S - Drained Triaxial
MH - Combined Analysis, Sieve and Hydrometer	U - Unconfined Compression
	V - Field Vane Test

Note: Undrained triaxial tests in which pore pressures are measured are shown as Q' or Q'c.

### SOIL PROPERTIES

$\gamma$ - Total Unit Weight	K - Coefficient of Permeability
$\gamma_d$ - Dry Unit Weight	c - Undrained Shear Strength ( $\frac{1}{2}$ Compressive Strength)
$\gamma_b$ - Submerged Unit Weight	St - Sensitivity
$L_L$ - Liquid Limit	$\phi'$ - Effective Angle of Shearing Resistance
$P_L$ - Plastic Limit	$c'$ - Effective Cohesion Intercept
W - Natural Water Content	Cc - Compression Index
G - Specific Gravity	Cv - Coefficient of Consolidation
e - Void Ratio	

## PROJECT NO. \_\_\_\_\_

**BORING DATE** JUNE 4, 1963

LOCAL

WASH BORING

NX CASING

PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

W.L. IN BOREHOLE  
AT ELEV. 31.0  
JUNE 5, 1963

DRAWN *M. W.*  
CHECKED *M. W.*

# RECORD OF BOREHOLE 102

LOCATION SEE FIGURE 1 BORING DATE JUNE 5, 1963 DATUM LOCAL  
 BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX CASING  
 SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT - LB. DROP - INCHES

SOIL PROFILE		SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					COEFFICIENT OF PERMEABILITY K, CM. / SEC.			
ELEV. / DEPTH	DESCRIPTION	STRAT. / PLOT	NUMBER	TYPE		SHEAR STRENGTH C, LB. / SQ. FT. • - UNCONFINED 1,000 2,000 3,000 4,000 5,000					WATER CONTENT, PERCENT P <sub>L</sub> W L <sub>L</sub> 10 20 30 40			
32.8	GROUND LEVEL													
0.0	VERY LOOSE BROWN SILTY FINE SAND WITH ROOTS AND ORGANIC MATTER		1	DO	3									
29.8			2	"	2									
3.0	VERY LOOSE GREY AND BLACK ORGANIC SILTY SAND SOME GRAVEL (ALLUVIUM)		3	To	Pm									
26.4			4	DO	15									
6.4	STIFF TO VERY STIFF MOTTLED GREY AND BROWN (GREY BELOW ABOUT EL. 20) SILTY CLAY. FEW LAYERS OF CLAYEY SILT AND OCCASIONAL THIN FINE SAND OR SILT SEAMS (LACUSTRINE CLAY)		5	"	10									
			6	To	Pm									
7.3			7	DO	9									
25.5	FIRM TO STIFF BECOMING VERY STIFF TO HARD BELOW ABOUT EL. -1 GREY SILTY CLAY WITH SOME SAND AND GRAVEL SIZE PARTICLES SCATTERED THROUGHOUT FEW GREY SILT ROCKETS TO 1/2" SIZE (CLAY TILL)		8	"	8									
			9	"	3									
-8.7			10	"	53									
41.5	END OF HOLE													

W.L. IN BOREHOLE  
 AT ELEV. 25.8  
 JUNE 5, 1963

γ=132

NOTE: THE ABOVE W.L. TAKEN 5 MIN. AFTER COMPLETION OF THE WASH BORING. PROBABLY DOESN'T INDICATE TRUE GROUND W.L.

γ=127



AXIAL STRAIN AT FAILURE, PERCENT

VERTICAL SCALE  
 1 INCH TO 10' 0"

GOLDER & ASSOCIATES

DRAWN M.W.  
 CHECKED H.M.B.

# RECORD OF BOREHOLE 103

LOCATION SEE FIGURE 1

BORING DATE JUNE 3, 1963

DATUM LOCAL

BOREHOLE TYPE

WASH BORING

BOREHOLE DIAMETER

NX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES

PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

SOIL PROFILE		SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					COEFFICIENT OF PERMEABILITY K, CM. / SEC.			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		SHEAR STRENGTH C, LB. / SQ. FT.					WATER CONTENT, PERCENT			
85.4	GROUND LEVEL			2"										
85.0	6 INS. SILTY TOP SOIL		1	DO	8									
			2	"	28									
			3	"	36									
			4	"	30									
			5	"	35									
			6	"	20									
			7	"	18									
57.4			8	TO Pm	60									
28.0	END OF HOLE		9	DO	22									

BROWN BECOMING GREY  
BELOW ABOUT EL. 72.0  
SILTY CLAY  
WITH SOME SAND AND  
GRAVEL SIZE PARTICLES  
SCATTERED THROUGHOUT  
OCCASIONAL THIN FINE  
SAND SEAMS  
(LACUSTRINE CLAY?)  
PROBABLY STIFF  
TO VERY STIFF

W.L. IN BOREHOLE  
AT ELEV. 74.4  
JUNE 3, 1963

NOTE: THE ABOVE W.L.  
TAKEN 15 MIN. AFTER  
COMPLETION OF THIS  
WASH BORING, PROBABLY  
DOESN'T INDICATE TRUE  
GROUND W.L.



VERTICAL SCALE  
1 INCH TO 10' - 0"

GOLDER & ASSOCIATES

DRAWN M.W.  
CHECKED A.W.S.

PROJECT NO. 6-55-1

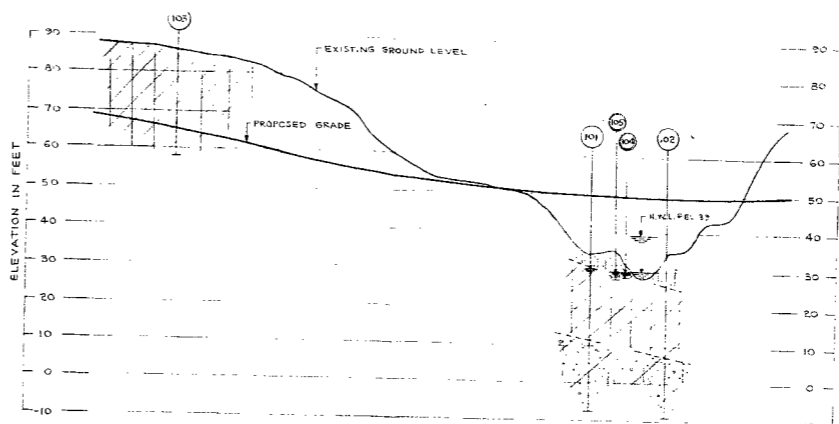
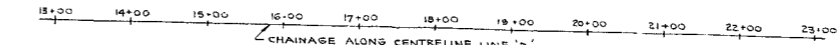
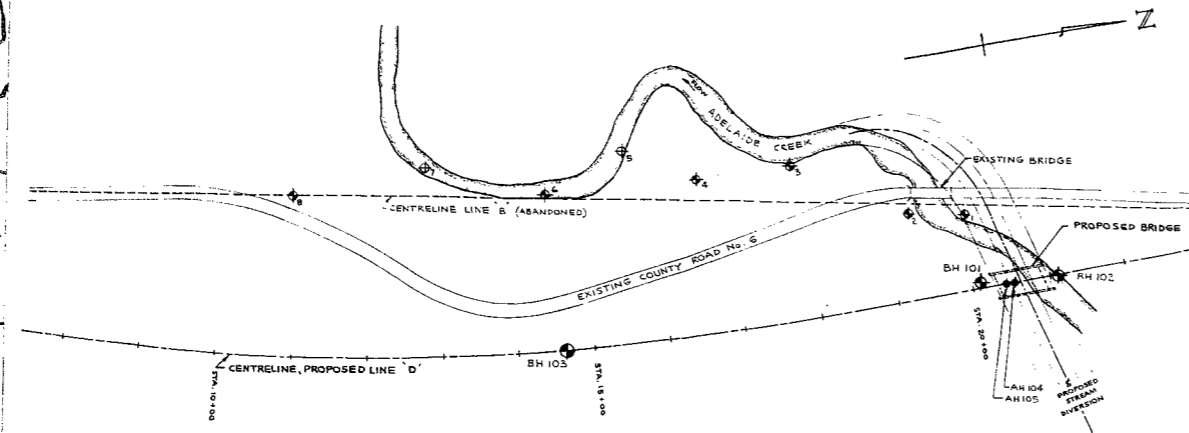
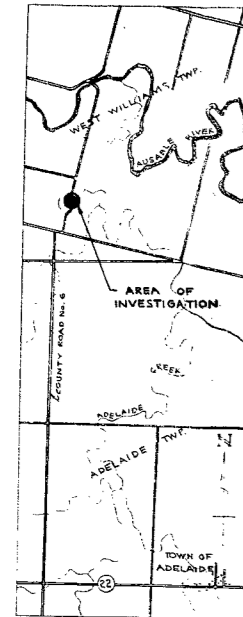
LOCATION	SEE FIGURE 1	BORING DATE	JUNE 5, 1963	DATUM	LOCAL
BOREHOLE TYPE	HAND AUGER BORING	BOREHOLE DIAMETER	4.5"		
SAMPLER HAMMER WEIGHT - LB.	DROP - INCHES	PEN. TEST HAMMER WEIGHT - LB.	DROP - INCHES		

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				COEFFICIENT OF PERMEABILITY K, CM. / SEC.			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.		SHEAR STRENGTH C, LB. / SQ. FT.				WATER CONTENT, PERCENT P <sub>L</sub> W      L <sub>L</sub>			
31.9	GROUND LEVEL					35								W.L. IN AUGER HOLE AT ELEV. 29.5 JUNE 5, 1963 
0.0	LOOSE BROWN SILTY FINE SAND TRACE CLAY AND SOME ORGANIC MATTER													
29.5						30								
28.4	LOOSE GREY ORGANIC SILTY SAND													
3.5	END OF HOLE AUGER TURNING ON GRAVEL AT EL. 28.4					25								
35.4	GROUND LEVEL					40								W.L. IN AUGER HOLE AT ELEV. 29.6 JUNE 5, 1963 
0.0	LOOSE BROWN SILTY FINE SAND TRACE CLAY AND SOME ORGANIC MATTER (MOSTLY ROOTS OR TWIGS) SOME GREY COLOURATION BELOW EL. 30.2 ±													
29.5						30								
28.9	SAND AND GRAVEL													
6.5	END OF HOLE					20								

VERTICAL SCALE  
1 INCH TO 5'-0"

**GOLDER & ASSOCIATES**








DRAWN *M. W.*  
CHECKED *N. M. B.*






## BORING PLAN &amp; SOIL STRATIGRAPHY

FIGURE 1

LEGEND

-  BORINGS FROM PREVIOUS INVESTIGATION IN PLAN. } OUR REPORT  
 PROBINGS FROM PREVIOUS INVESTIGATION IN PLAN. } DATED  
 APRIL, 1963
-  BOREHOLE IN PLAN, PRESENT INVESTIGATION.
-  HAND AUGER HOLE IN PLAN, PRESENT INVESTIGATION.
-  BOREHOLE IN ELEVATION, PRESENT INVESTIGATION.
-  HAND AUGER HOLE IN ELEVATION, PRESENT INVESTIGATION.
-  WATER LEVEL IN BORING, JUNE 5, 1963.

## STRATIGRAPHY

- 
 VERY LOOSE TO LOOSE BROWN TO GREY AND BLACK ORGANIC SILTY FINE SAND SOME GRAVEL, AND TRACE CLAY.  
 (FLOODPLAIN DEPOSIT)
- 
 STIFF TO VERY STIFF. MOTTLED GREY AND BROWN TO GREY SILTY CLAY. FEW LAYERS OF SILTY SAND AND OCCASIONAL THIN FINE SAND OR SILT BEANS (LAQUSTRINE CLAY)
- 
 GENERALLY STIFF TO HARD BROWNISH GREY SILTY CLAY WITH SOME SAND AND SILT SIZE PARTICLES SCATTERED THROUGHOUT. (CLAY TILL)

REFERENCE: R. EDWIN & ASSOCIATES, LTD. DRAWING P- (OF JOB #62-123) FOR  
COUNTY OF MIDDLESEX OF COUNTY BRIDGE NO. 28, LOCATED ON  
TOWNSHIP OF WEST WILLIAM, BETWEEN LOTS 6 & 11 IN CONGRESSION,  
DATED: MAY 29, 1962,  
COUNTY OF MIDDLESEX DRAWING 15/6/VIII OF PROPOSED  
NO. 1 ALIGNMENT AT BRIDGE NO. 28, COUNTY ROAD NO. 6  
DATED: APRIL 24, 1963.

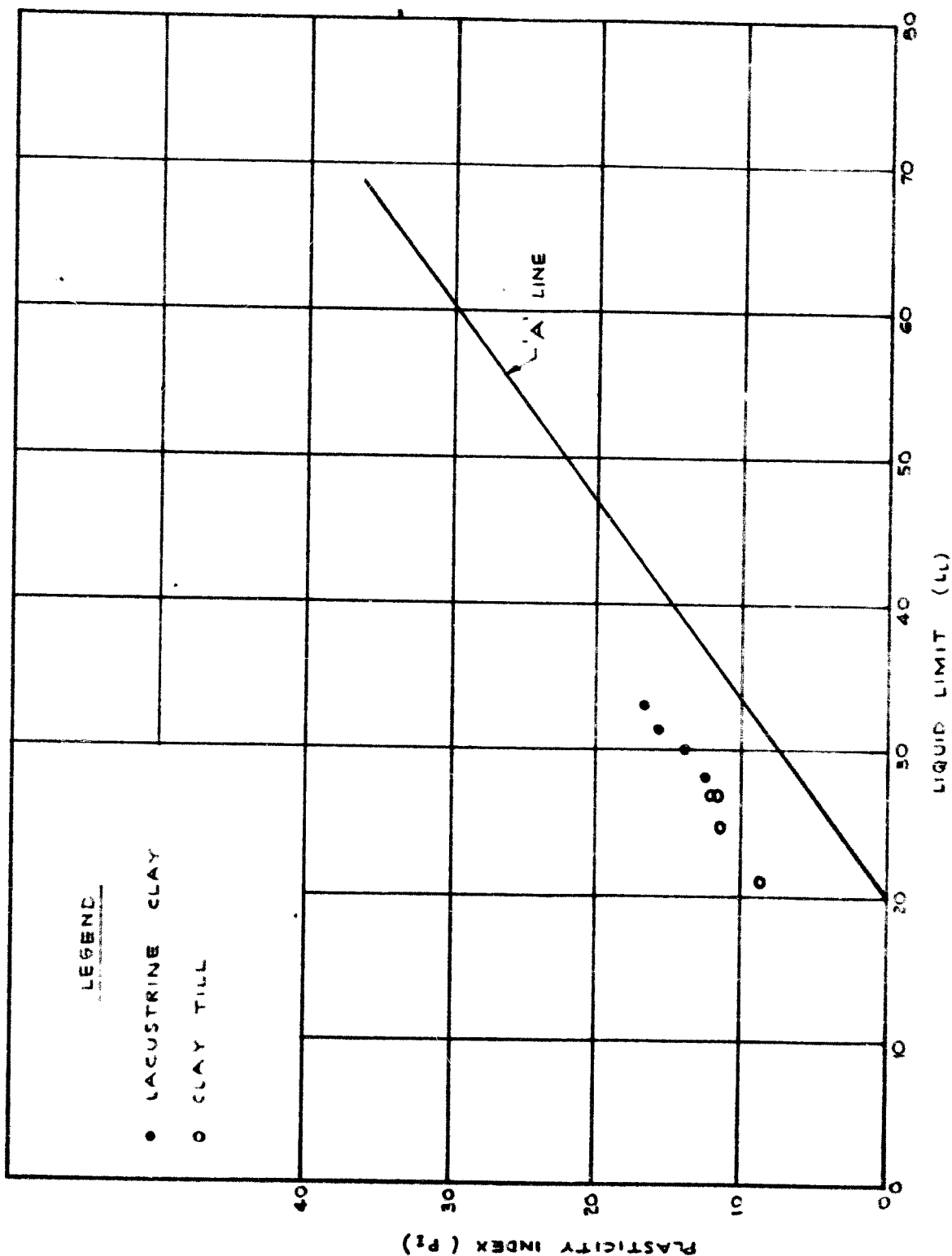
SPECIAL NOTE: DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT 204-HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

GOLDER &amp; ASSOCIATES

Mode Rel  
Chkd. 31.30  
Appd. 28

PLASTICITY CHART  
CLAYEY STRATA - BOREHOLES 101 & 102

FIGURE 2



GOLDER & ASSOCIATES

# UNCONFINED COMPRESSION TESTS STRESS - STRAIN CURVES

FIGURE 3

