

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 31G-146

DIST. 9 REGION

W.P. No. 256-66-00

CONT. No.

W. O. No.

STR. SITE No. 31-287

HWY. No. 34

LOCATION CNR OVERHEAD STRUCTURE

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

K&E 20 X 20 TO THE INCH 47 1242
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

NOR

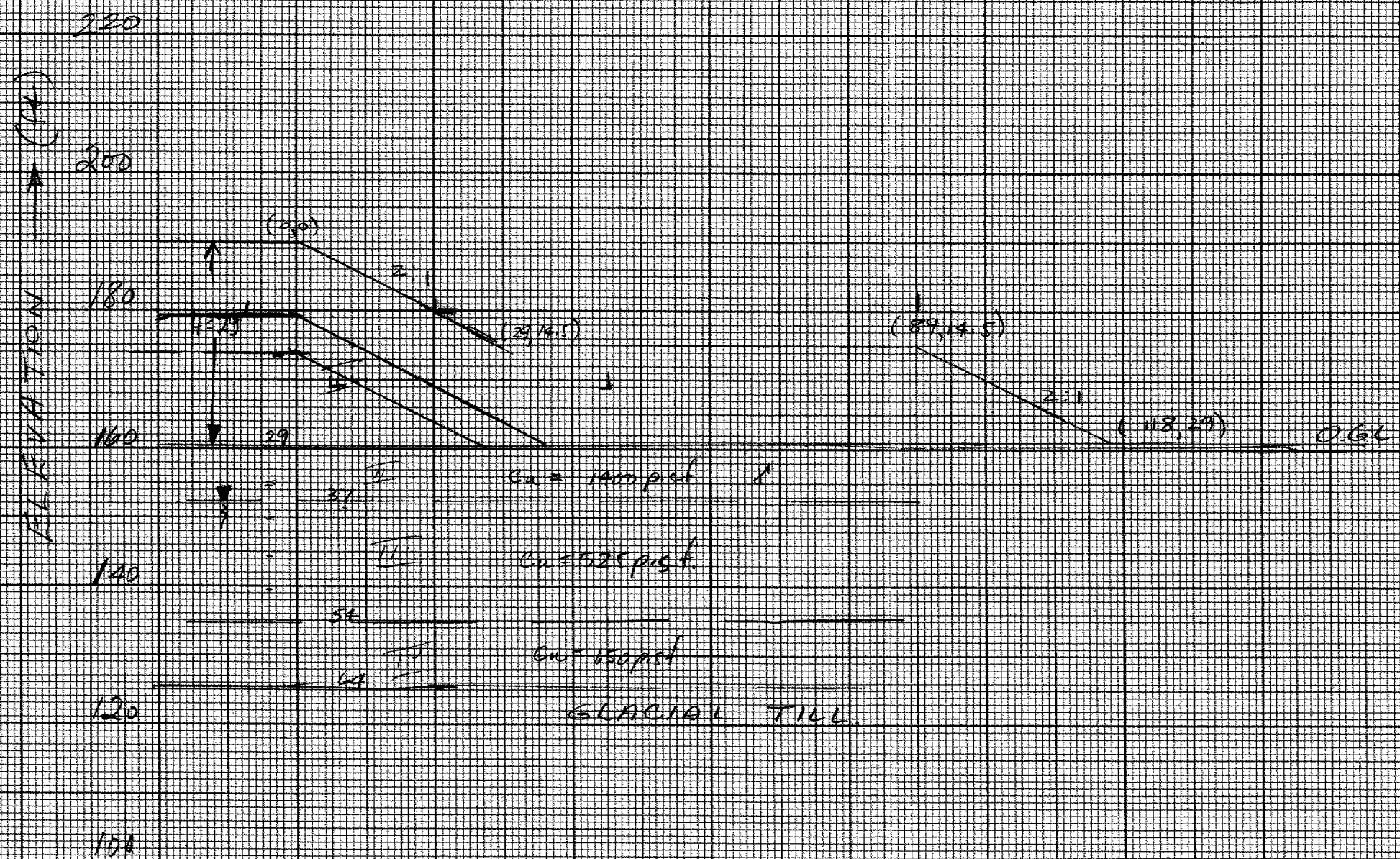
69-F-7

SCHEME #1

&

SCHEME #2

NORTH APPROACH



29
31
28
764

LANCASTER-CNR -LINE #1 NORTH APP

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. 2-X< | NO. PTS. 2&X< | CUT-OFF 2-X< | CUT-OFF 2&X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|---------------|---------------|--------------|--------------|
| 25 | 55 | -25 | 7.0 | 7.0 | 35.0 | 4.0 | 8 | 12.00 | 1 | 4 | -100.0 | 200.0 | |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 100.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 29.00 | 14.50 | 79.00 | 14.50 | 108.00 | 29.00 | 200.00 | 29.00 | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 37.00 |
| 1 | | 2 | 29.00 | |
| 1 | | 3 | 37.00 | |
| 1 | | 4 | 54.00 | |
| 2 | 0.0 | 1 | 0.0 | 37.00 |
| 2 | | 2 | 29.00 | |
| 2 | | 3 | 37.00 | |
| 2 | | 4 | 54.00 | |
| 3 | 29.00 | 1 | 0.0 | 37.00 |
| 3 | | 2 | 29.00 | |
| 3 | | 3 | 37.00 | |
| 3 | | 4 | 54.00 | |
| 4 | 79.00 | 1 | 0.0 | 37.00 |
| 4 | | 2 | 29.00 | |
| 4 | | 3 | 37.00 | |
| 4 | | 4 | 54.00 | |
| 5 | 108.00 | 1 | 0.0 | 37.00 |
| 5 | | 2 | 29.00 | |
| 5 | | 3 | 37.00 | |
| 5 | | 4 | 54.00 | |
| 6 | 200.00 | 1 | 0.0 | 37.00 |
| 6 | | 2 | 29.00 | |
| 6 | | 3 | 37.00 | |
| 6 | | 4 | 54.00 | |

HEIGHT = 29'

BERM = 50'

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
| 3 | 550. | 0.0 | 35.0 | 35.0 |
| 4 | 650. | 0.0 | 35.0 | 35.0 |

BERM LENGTH

FACTOR OF SAFETY

RADIUS

X COORD OF CENTRE

Y COORD OF CENTRE

50.00 FEET

1.303

116.0 FEET

55.0 FEET

-53.0 FEET

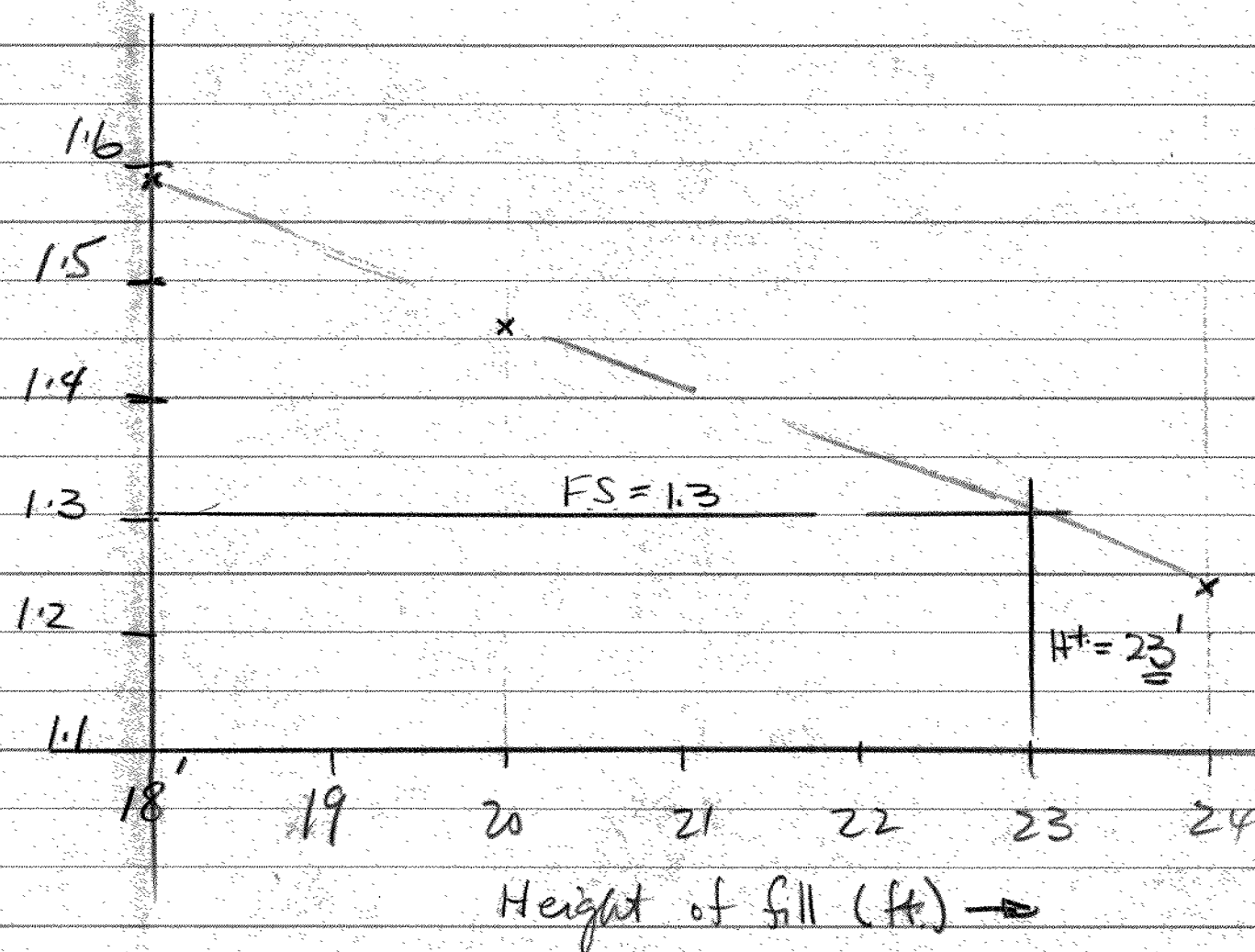
THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 59 SECONDS

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. %X< | NO. PTS. %X< | CUT-OFF %X< | CUT-OFF %X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 4.0 | 4.0 | 24.0 | 4.0 | 8 | 9.00 | 1 | 2 | -100.0 | 150.0 | |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 36.00 | 18.00 | 150.00 | 18.00 | | | | | | |

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 26.00 |
| 1 | | 2 | 18.00 | |
| 1 | | 3 | 26.00 | |
| 1 | | 4 | 43.00 | |
| 2 | 0.0 | 1 | 0.0 | 26.00 |
| 2 | | 2 | 18.00 | |
| 2 | | 3 | 26.00 | |
| 2 | | 4 | 43.00 | |
| 3 | 36.00 | 1 | 0.0 | 26.00 |
| 3 | | 2 | 18.00 | |
| 3 | | 3 | 26.00 | |
| 3 | | 4 | 43.00 | |
| 4 | 150.00 | 1 | 0.0 | 26.00 |
| 4 | | 2 | 18.00 | |
| 4 | | 3 | 26.00 | |
| 4 | | 4 | 43.00 | |

| SOIL TYPE | COHESION | SOIL PROPERTIES | | |
|-----------|----------|-----------------|--------------|-------------------|
| | | PHI | BULK DENSITY | SUBMERGED DENSITY |
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
| 3 | 550. | 0.0 | 35.0 | 35.0 |
| 4 | 650. | 0.0 | 35.0 | 35.0 |



CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 50.00 | 17.00 | 2.00 | 1.591 |
| 50.00 | 21.00 | 2.00 | 1.596 |
| 50.00 | 13.00 | 2.00 | 1.608 |
| 46.00 | 17.00 | -2.00 | 1.610 |
| 66.00 | 17.00 | -18.00 | 1.610 |
| 66.00 | 21.00 | -18.00 | 1.614 |
| 70.00 | 17.00 | -22.00 | 1.615 |
| 46.00 | 21.00 | -2.00 | 1.617 |
| 70.00 | 21.00 | -22.00 | 1.619 |
| 58.00 | 17.00 | -18.00 | 1.621 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 81 SECONDS

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 4.0 | 4.0 | 26.0 | 4.0 | 8 | 10.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 40.00 | 20.00 | 150.00 | 20.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-------|-------|
| 1 | -100.00 | 1 | 0.0 | 28.00 |
| 1 | | 2 | 20.00 | |
| 1 | | 3 | 28.00 | |
| 1 | | 4 | 45.00 | |
| 2 | 0.0 | 1 | 0.0 | 28.00 |
| 2 | | 2 | 20.00 | |
| 2 | | 3 | 28.00 | |
| 2 | | 4 | 45.00 | |
| 3 | 40.00 | 1 | 0.0 | 28.00 |
| 3 | | 2 | 20.00 | |
| 3 | | 3 | 28.00 | |
| 3 | | 4 | 45.00 | |
| 4 | 150.00 | 1 | 0.0 | 28.00 |
| 4 | | 2 | 20.00 | |
| 4 | | 3 | 28.00 | |
| 4 | | 4 | 45.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
| 3 | 550. | 0.0 | 35.0 | 35.0 |
| 4 | 650. | 0.0 | 35.0 | 35.0 |

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 52.00 | 21.00 | -10.00 | 1.457 |
| 64.00 | 21.00 | -14.00 | 1.462 |
| 52.00 | 17.00 | -10.00 | 1.463 |
| 60.00 | 21.00 | -10.00 | 1.465 |
| 64.00 | 17.00 | -14.00 | 1.465 |
| 48.00 | 21.00 | 6.00 | 1.469 |
| 60.00 | 17.00 | -10.00 | 1.469 |
| 64.00 | 25.00 | -14.00 | 1.473 |
| 52.00 | 25.00 | -10.00 | 1.474 |
| 48.00 | 17.00 | 6.00 | 1.474 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 81 SECONDS

LANCASTER -CNR- NORTH-LINE1 -24 JAN 8 69 69-F-74

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|--------------|-------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 30.0 | 4.0 | 8 | | 12.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 48.00 | 24.00 | 150.00 | 24.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-------|-------|
| 1 | -100.00 | 1 | 0.0 | 32.00 |
| 1 | | 2 | 24.00 | |
| 1 | | 3 | 32.00 | |
| 1 | | 4 | 49.00 | |
| 2 | 0.0 | 1 | 0.0 | 32.00 |
| 2 | | 2 | 24.00 | |
| 2 | | 3 | 32.00 | |
| 2 | | 4 | 49.00 | |
| 3 | 48.00 | 1 | 0.0 | 32.00 |
| 3 | | 2 | 24.00 | |
| 3 | | 3 | 32.00 | |
| 3 | | 4 | 49.00 | |
| 4 | 150.00 | 1 | 0.0 | 32.00 |
| 4 | | 2 | 24.00 | |
| 4 | | 3 | 32.00 | |
| 4 | | 4 | 49.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
| 3 | 550. | 0.0 | 35.0 | 35.0 |
| 4 | 650. | 0.0 | 35.0 | 35.0 |

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 59.00 | 25.00 | -5.00 | 1.240 |
| 73.00 | 25.00 | -15.00 | 1.245 |
| 84.00 | 25.00 | -30.00 | 1.246 |
| 59.00 | 20.00 | -5.00 | 1.246 |
| 78.00 | 25.00 | -20.00 | 1.247 |
| 68.00 | 25.00 | -10.00 | 1.248 |
| 84.00 | 20.00 | -30.00 | 1.250 |
| 73.00 | 20.00 | -15.00 | 1.250 |
| 78.00 | 20.00 | -20.00 | 1.251 |
| 83.00 | 25.00 | -25.00 | 1.251 |

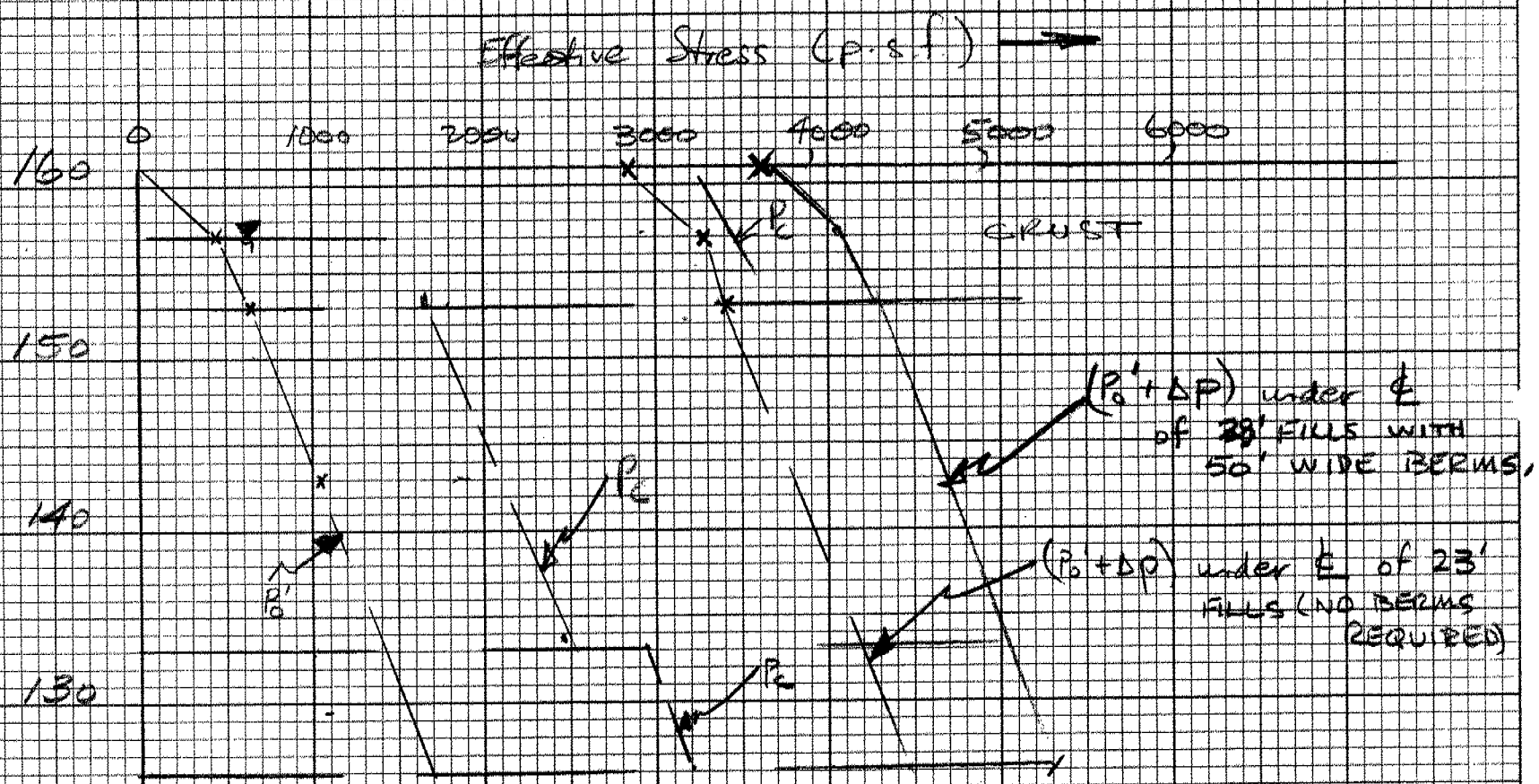
THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 80 SECONDS

LINE #1 and 2

NORTH APPROACH

$$\Delta q = \frac{H_f \text{ of Fill } 29'}{H_f \text{ of FILL}} = \frac{29 \times 125}{23 \times 125} = 3600 \text{ p.s.f.}$$

$$\Delta q = \frac{H_f \text{ of FILL}}{H_f \text{ of FILL}} = \frac{23 \times 125}{23 \times 125} = 2850 \text{ p.s.f.}$$



SETTLEMENT - HEIGHT OF FILL - $H_f = 29 \text{ ft}$

$$\Delta H = 8 \left[\frac{0.05}{1+2.2} \left(\log \frac{3500}{1400} \right) + \frac{1.5}{1+2.2} \left(\log \frac{4100}{3500} \right) \right] + 20 \left[\frac{0.05}{1+2.2} \left(\log \frac{3100}{1050} \right) + \frac{1.5}{1+2.2} \left(\log \frac{4700}{2100} \right) \right] + 7 \left[\frac{0.05}{1+2.2} \left(\log \frac{3100}{1600} \right) + \frac{1.5}{1+2.2} \left(\log \frac{4300}{3100} \right) \right]$$

$$\Delta H = 8 \left[\frac{0.05}{1+2.2} \left(\log \frac{3300}{1400} \right) + \frac{1.5}{1+2.2} \left(\log \frac{4100}{3300} \right) \right] + 20 \left[\frac{0.05}{1+2.2} \left(\log \frac{2100}{1050} \right) + \frac{1.5}{1+2.2} \left(\log \frac{3800}{2100} \right) \right] + 7 \left[\frac{0.05}{1+2.2} \left(\log \frac{3100}{1600} \right) + \frac{1.5}{1+2.2} \left(\log \frac{4350}{3100} \right) \right]$$

Time Rate ($C_v = 0.008 \text{ m}^2/\text{min.}$, Double Drainage)

$$t_{90\%} = \frac{0.848 \times (15 \times 12)^2}{0.8 \times 10^{-2} \times 60 \times 24 \times 365} = 6 \frac{1}{2} \text{ years}$$

$$t_{50\%} = \frac{0.196}{0.848} \times 6.5 = 1.5 \text{ years}$$

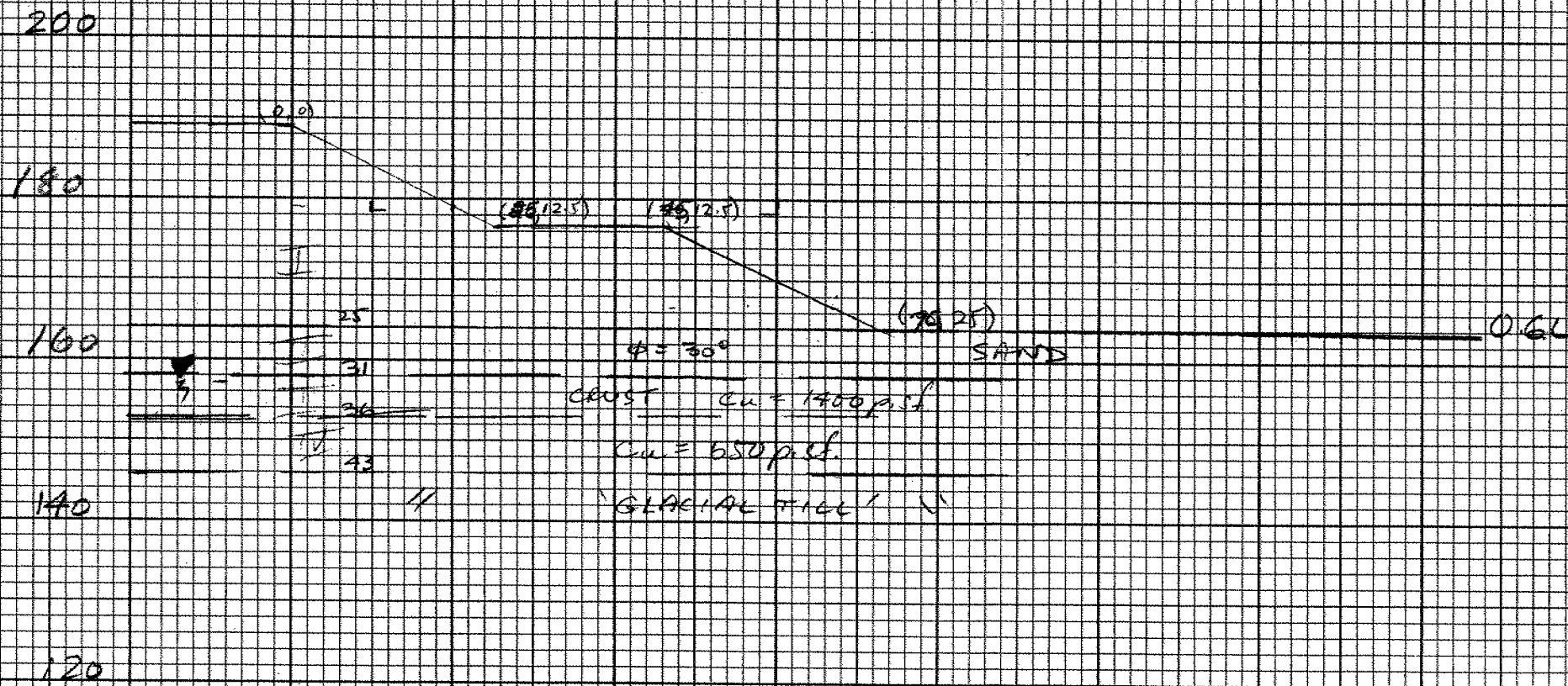
I
69-F-74

LINES# 1 & 2.

NORTH APPROACH.

STABILITY AND SETTLEMENT COMPUTATIONS.

B9-E-74
SCHEME #1
SOUTH APPROACH



LANCASTER-CNR-LINE#1-SOUTH APP

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. %X< | NO. PTS. %X< | CUT-OFF %X< | CUT-OFF %X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 35 | -15 | 5.0 | 5.0 | 32.0 | | 2.0 | 8 | 12.00 | 1 | 4 | -100.0 | 150.0 |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 100.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 25.00 | 12.50 | 45.00 | 12.50 | 70.00 | 25.00 | 150.00 | 25.00 | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 31.00 |
| 1 | | 2 | 25.00 | |
| 1 | | 3 | 31.00 | |
| 1 | | 4 | 36.00 | |
| 2 | 0.0 | 1 | 0.0 | 31.00 |
| 2 | | 2 | 25.00 | |
| 2 | | 3 | 31.00 | |
| 2 | | 4 | 36.00 | |
| 3 | 25.00 | 1 | 0.0 | 31.00 |
| 3 | | 2 | 25.00 | |
| 3 | | 3 | 31.00 | |
| 3 | | 4 | 36.00 | |
| 4 | 45.00 | 1 | 0.0 | 31.00 |
| 4 | | 2 | 25.00 | |
| 4 | | 3 | 31.00 | |
| 4 | | 4 | 36.00 | |
| 5 | 70.00 | 1 | 0.0 | 31.00 |
| 5 | | 2 | 25.00 | |
| 5 | | 3 | 31.00 | |
| 5 | | 4 | 36.00 | |
| 6 | 150.00 | 1 | 0.0 | 31.00 |
| 6 | | 2 | 25.00 | |
| 6 | | 3 | 31.00 | |
| 6 | | 4 | 36.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 0. | 30.0 | 125.0 | 65.0 |
| 3 | 1400. | 0.0 | 50.0 | 50.0 |
| 4 | 650. | 0.0 | 35.0 | 35.0 |

BERM LENGTH FACTOR OF SAFETY RADIUS X COORD OF CENTRE Y COORD OF CENTRE

20.00 FEET 1.400 66.0 FEET 30.0 FEET -20.0 FEET

10.00 FEET 1.303 44.0 FEET 30.0 FEET 0.0 FEET

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 154 SECONDS

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 29.0 | 2.0 | 8 | 11.00 | 1 | 2 | -100.0 | 150.0 | |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 44.00 | 22.00 | 150.00 | 22.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 28.00 |
| 1 | | 2 | 22.00 | |
| 1 | | 3 | 28.00 | |
| 1 | | 4 | 33.00 | |
| 2 | 0.0 | 1 | 0.0 | 28.00 |
| 2 | | 2 | 22.00 | |
| 2 | | 3 | 28.00 | |
| 2 | | 4 | 33.00 | |
| 3 | 44.00 | 1 | 0.0 | 28.00 |
| 3 | | 2 | 22.00 | |
| 3 | | 3 | 28.00 | |
| 3 | | 4 | 33.00 | |
| 4 | 150.00 | 1 | 0.0 | 28.00 |
| 4 | | 2 | 22.00 | |
| 4 | | 3 | 28.00 | |
| 4 | | 4 | 33.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 0. | 30.0 | 125.0 | 65.0 |
| 3 | 1400. | 0.0 | 50.0 | 50.0 |
| 4 | 650. | 0.0 | 35.0 | 35.0 |

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 41.00 | 20.00 | 0.0 | 1.370 |
| 41.00 | 25.00 | 0.0 | 1.374 |
| 41.00 | 15.00 | 0.0 | 1.378 |
| 36.00 | 20.00 | 5.00 | 1.390 |
| 36.00 | 25.00 | 5.00 | 1.397 |
| 36.00 | 15.00 | 5.00 | 1.412 |
| 63.00 | 20.00 | -20.00 | 1.417 |
| 43.00 | 20.00 | 0.0 | 1.417 |
| 63.00 | 25.00 | -20.00 | 1.419 |
| 68.00 | 20.00 | -25.00 | 1.422 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 73 SECONDS

LINE #1

SOUTH APPROACH

STABILITY COMPUTATIONS.

11

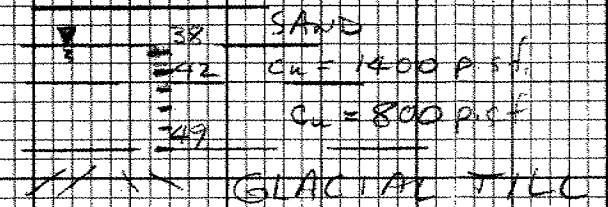
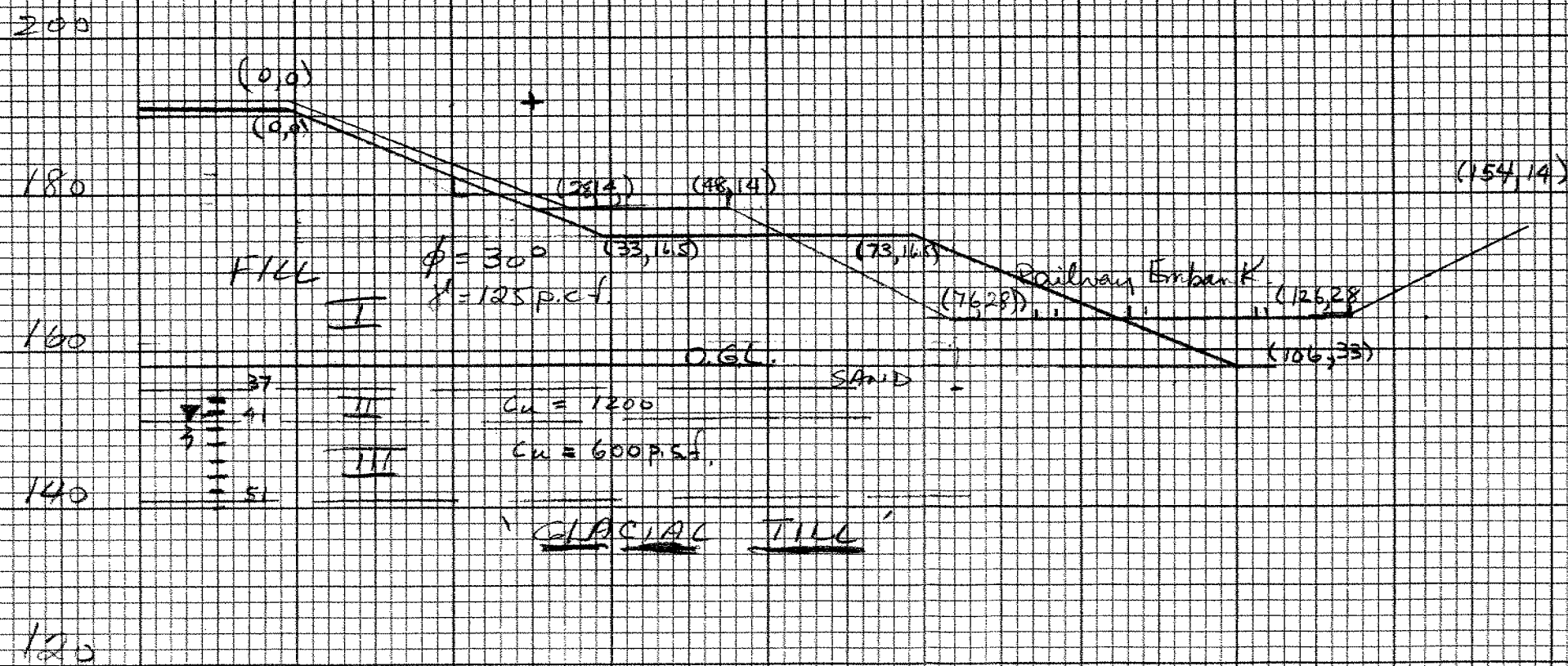
| STATION | WATER | WIND | WAVE |
|---------|-------|------|------|
| 000.0 | 0.0 | 0.0 | 0.0 |
| 005.0 | 0.0 | 0.0 | 0.0 |
| 010.0 | 0.0 | 0.0 | 0.0 |
| 015.0 | 0.0 | 0.0 | 0.0 |
| 020.0 | 0.0 | 0.0 | 0.0 |
| 025.0 | 0.0 | 0.0 | 0.0 |
| 030.0 | 0.0 | 0.0 | 0.0 |
| 035.0 | 0.0 | 0.0 | 0.0 |
| 040.0 | 0.0 | 0.0 | 0.0 |
| 045.0 | 0.0 | 0.0 | 0.0 |
| 050.0 | 0.0 | 0.0 | 0.0 |
| 055.0 | 0.0 | 0.0 | 0.0 |
| 060.0 | 0.0 | 0.0 | 0.0 |
| 065.0 | 0.0 | 0.0 | 0.0 |
| 070.0 | 0.0 | 0.0 | 0.0 |
| 075.0 | 0.0 | 0.0 | 0.0 |
| 080.0 | 0.0 | 0.0 | 0.0 |
| 085.0 | 0.0 | 0.0 | 0.0 |
| 090.0 | 0.0 | 0.0 | 0.0 |
| 095.0 | 0.0 | 0.0 | 0.0 |
| 100.0 | 0.0 | 0.0 | 0.0 |

LINE #4

69-F-74

NORTH APPROACH
LONGITUDINAL

TRANSVERSE



LANCASTER-CNR-LINE#4-NORTH-LONG

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. | R | TENSION CRACK | NO. | PTS.%-X< | NO. | PTS.%&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|-------|------|-------|-----|---|---------------|-----|----------|-----|----------|-------------|-------------|
| 25 | 45 | -15 | 5.0 | 5.0 | 38.0 | | 2.0 | 8 | | 14.00 | | 1 | | 5 | -100.0 | 154.0 |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 100.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 28.00 | 14.00 | 48.00 | 14.00 | 76.00 | 28.00 | 126.00 | 28.00 | 154.00 | 14.00 | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 41.00 |
| 1 | | 2 | 37.00 | |
| 1 | | 3 | 41.00 | |
| 2 | 0.0 | 1 | 0.0 | 41.00 |
| 2 | | 2 | 37.00 | |
| 2 | | 3 | 41.00 | |
| 3 | 28.00 | 1 | 0.0 | 41.00 |
| 3 | | 2 | 37.00 | |
| 3 | | 3 | 41.00 | |
| 4 | 48.00 | 1 | 0.0 | 41.00 |
| 4 | | 2 | 37.00 | |
| 4 | | 3 | 41.00 | |
| 5 | 76.00 | 1 | 0.0 | 41.00 |
| 5 | | 2 | 37.00 | |
| 5 | | 3 | 41.00 | |
| 6 | 126.00 | 1 | 0.0 | 41.00 |
| 6 | | 2 | 37.00 | |
| 6 | | 3 | 41.00 | |
| 7 | 154.00 | 1 | 0.0 | 41.00 |
| 7 | | 2 | 37.00 | |
| 7 | | 3 | 0.0 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1200. | 0.0 | 110.0 | 50.0 |
| 3 | 600. | 0.0 | 40.0 | 40.0 |

| BERM LENGTH | FACTOR OF SAFETY | RADIUS | X COORD OF CENTRE | Y COORD OF CENTRE |
|-------------|------------------|--------|-------------------|-------------------|
|-------------|------------------|--------|-------------------|-------------------|

| | | | | |
|------------|-------|-----------|-----------|------------|
| 20.00 FEET | 1.207 | 67.0 FEET | 40.0 FEET | -15.0 FEET |
|------------|-------|-----------|-----------|------------|

| | | | | |
|------------|-------|-----------|-----------|------------|
| 30.00 FEET | 1.192 | 82.0 FEET | 60.0 FEET | -30.0 FEET |
|------------|-------|-----------|-----------|------------|

| | | | | |
|------------|-------|-----------|-----------|------------|
| 40.00 FEET | 1.357 | 82.0 FEET | 60.0 FEET | -30.0 FEET |
|------------|-------|-----------|-----------|------------|

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 134 SECONDS

LANCASTER-CNR-LINE#4-NORTH APP.TRANS.

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. %<X< | NO. PTS. %<X< | CUT-OFF %<X< | CUT-OFF %<X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|---------------|---------------|--------------|--------------|
| 25 | 45 | -15 | 5.0 | 5.0 | 37.0 | 2.0 | 8 | 15.00 | 1 | 4 | -100.0 | 200.0 | |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 100.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 33.00 | 16.50 | 73.00 | 16.50 | 106.00 | 33.00 | 200.00 | 33.00 | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-------|-------|
| 1 | -100.00 | 1 | 0.0 | 40.00 |
| 1 | | 2 | 36.00 | |
| 1 | | 3 | 40.00 | |
| 2 | 0.0 | 1 | 0.0 | 40.00 |
| 2 | | 2 | 36.00 | |
| 2 | | 3 | 40.00 | |
| 3 | 33.00 | 1 | 0.0 | 40.00 |
| 3 | | 2 | 36.00 | |
| 3 | | 3 | 40.00 | |
| 4 | 73.00 | 1 | 0.0 | 40.00 |
| 4 | | 2 | 36.00 | |
| 4 | | 3 | 40.00 | |
| 5 | 106.00 | 1 | 0.0 | 40.00 |
| 5 | | 2 | 36.00 | |
| 5 | | 3 | 40.00 | |
| 6 | 200.00 | 1 | 0.0 | 40.00 |
| 6 | | 2 | 36.00 | |
| 6 | | 3 | 40.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|-----|--------------|-------------------|
|-----------|----------|-----|--------------|-------------------|

| | | | | |
|---|-------|------|-------|------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1200. | 0.0 | 110.0 | 50.0 |
| 3 | 600. | 0.0 | 40.0 | 40.0 |

BERM LENGTH

FACTOR OF SAFETY

RADIUS

X COORD OF CENTRE

Y COORD OF CENTRE

40.00 FEET

1.419

91.0 FEET

55.0 FEET

-40.0 FEET

30.00 FEET

1.268

71.0 FEET

50.0 FEET

-20.0 FEET

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 95 SECONDS

LANCASTER-CNR-LINE 4 NORTH 24' JAN 8 70 69-F-74

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. %X< | NO. PTS. %X< | CUT-OFF %X< | CUT-OFF %X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 28.0 | 2.0 | 8 | 12.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 48.00 | 24.00 | 150.00 | 24.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-------|-------|
| 1 | -100.00 | 1 | 0.0 | 31.00 |
| 1 | | 2 | 27.00 | |
| 1 | | 3 | 31.00 | |
| 2 | 0.0 | 1 | 0.0 | 3.10 |
| 2 | | 2 | 27.00 | |
| 2 | | 3 | 31.00 | |
| 3 | 48.00 | 1 | 0.0 | 31.00 |
| 3 | | 2 | 27.00 | |
| 3 | | 3 | 31.00 | |
| 4 | 150.00 | 1 | 0.0 | 31.00 |
| 4 | | 2 | 27.00 | |
| 4 | | 3 | 31.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1200. | 0.0 | 110.0 | 50.0 |
| 3 | 600. | 0.0 | 40.0 | 40.0 |

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 42.00 | 25.00 | 0.0 | 1.111 |
| 47.00 | 25.00 | -5.00 | 1.112 |
| 52.00 | 25.00 | -10.00 | 1.123 |
| 47.00 | 20.00 | -5.00 | 1.128 |
| 42.00 | 20.00 | 0.0 | 1.129 |
| 47.00 | 30.00 | -5.00 | 1.132 |
| 52.00 | 20.00 | -10.00 | 1.137 |
| 42.00 | 30.00 | 0.0 | 1.138 |
| 52.00 | 30.00 | -10.00 | 1.139 |
| 35.00 | 25.00 | 5.00 | 1.146 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 61 SECONDS

LANCASTER-CNR-LINE #4-NORTH 28 JAN 8 69 69-F-74

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. %X< | NO. PTS. %&X< | CUT-DFF%<X< | CUT-DFF%&X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|---------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 32.0 | 2.0 | 8 | 14.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 56.00 | 28.00 | 150.00 | 28.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 35.00 |
| 1 | | 2 | 31.00 | |
| 1 | | 3 | 35.00 | |
| 2 | 0.0 | 1 | 0.0 | 35.00 |
| 2 | | 2 | 31.00 | |
| 2 | | 3 | 35.00 | |
| 3 | 56.00 | 1 | 0.0 | 35.00 |
| 3 | | 2 | 31.00 | |
| 3 | | 3 | 35.00 | |
| 4 | 150.00 | 1 | 0.0 | 35.00 |
| 4 | | 2 | 31.00 | |
| 4 | | 3 | 35.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1200. | 0.0 | 110.0 | 50.0 |
| 3 | 600. | 0.0 | 40.0 | 40.0 |

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 46.00 | 30.00 | 0.0 | 1.038 |
| 46.00 | 25.00 | 0.0 | 1.041 |
| 41.00 | 30.00 | 5.00 | 1.056 |
| 41.00 | 25.00 | 5.00 | 1.059 |
| 46.00 | 35.00 | 0.0 | 1.069 |
| 51.00 | 30.00 | -5.00 | 1.078 |
| 51.00 | 25.00 | -5.00 | 1.081 |
| 46.00 | 20.00 | 0.0 | 1.082 |
| 56.00 | 30.00 | -10.00 | 1.084 |
| 49.00 | 30.00 | -5.00 | 1.086 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 67 SECONDS

LANCASTER-CNR- LINE 4-SOUTH 28 JAN 8 70 69-F-74

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 33.0 | 2.0 | 6 | 14.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 56.00 | 28.00 | 150.00 | 28.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-------|-------|
| 1 | -100.00 | 1 | 0.0 | 32.00 |
| 1 | | 2 | 32.00 | |
| 1 | | 3 | 36.00 | |
| 2 | 0.0 | 1 | 0.0 | 32.00 |
| 2 | | 2 | 32.00 | |
| 2 | | 3 | 36.00 | |
| 3 | 56.00 | 1 | 0.0 | 32.00 |
| 3 | | 2 | 32.00 | |
| 3 | | 3 | 36.00 | |
| 4 | 150.00 | 1 | 0.0 | 32.00 |
| 4 | | 2 | 32.00 | |
| 4 | | 3 | 36.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 55.0 | 55.0 |
| 3 | 800. | 0.0 | 45.0 | 45.0 |

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 48.00 | 30.00 | -5.00 | 1.427 |
| 48.00 | 25.00 | -5.00 | 1.432 |
| 46.00 | 30.00 | -5.00 | 1.432 |
| 43.00 | 30.00 | 0.0 | 1.432 |
| 53.00 | 30.00 | -10.00 | 1.434 |
| 41.00 | 30.00 | 0.0 | 1.434 |
| 43.00 | 20.00 | 0.0 | 1.434 |
| 53.00 | 25.00 | -10.00 | 1.439 |
| 43.00 | 25.00 | 0.0 | 1.439 |
| 51.00 | 30.00 | -10.00 | 1.444 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 49 SECONDS

LANCASTER-CNR-LINE 4-SOUTH 30 JAN 8 70 69-F-74

RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. 2-X< | NO. PTS. 2&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|---------------|---------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 35.0 | 2.0 | 6 | 15.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 60.00 | 30.00 | 150.00 | 30.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-----|-------|
| 1 | -100.00 | 1 | 0.0 | 34.00 |
|---|---------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 1 | | 2 | 34.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 3 | 38.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-----|---|-----|-------|
| 2 | 0.0 | 1 | 0.0 | 34.00 |
|---|-----|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 2 | | 2 | 34.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 3 | 38.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-------|---|-----|-------|
| 3 | 60.00 | 1 | 0.0 | 34.00 |
|---|-------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 3 | | 2 | 34.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 3 | 38.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--------|---|-----|-------|
| 4 | 150.00 | 1 | 0.0 | 34.00 |
|---|--------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 4 | | 2 | 34.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 3 | 38.00 | |
|---|--|---|-------|--|

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|-----|--------------|-------------------|
|-----------|----------|-----|--------------|-------------------|

| | | | | |
|---|----|------|-------|------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
|---|----|------|-------|------|

| | | | | |
|---|-------|-----|------|------|
| 2 | 1400. | 0.0 | 55.0 | 55.0 |
|---|-------|-----|------|------|

| | | | | |
|---|------|-----|------|------|
| 3 | 800. | 0.0 | 45.0 | 45.0 |
|---|------|-----|------|------|

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 50.00 | 30.00 | -5.00 | 1.354 |
| 40.00 | 25.00 | 5.00 | 1.355 |
| 45.00 | 30.00 | 0.0 | 1.360 |
| 55.00 | 30.00 | -10.00 | 1.367 |
| 48.00 | 30.00 | -5.00 | 1.369 |
| 50.00 | 35.00 | -5.00 | 1.373 |
| 43.00 | 30.00 | 0.0 | 1.375 |
| 50.00 | 25.00 | -5.00 | 1.376 |
| 53.00 | 30.00 | -10.00 | 1.378 |
| 45.00 | 35.00 | 0.0 | 1.380 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 50 SECONDS

-CNR-LINE #4- SOUTH APP.LONG. RUN DATE JAN 10, 1970
 -INIT. Y-INIT. DELX DELY TANG. R.L. INCR. NO. R TENSION CRACK NO. PTS.%-X< NO. PTS.%&X< CUT-OFF%-X< CUT-OFF%&X<
 45 -15 5.0 5.0 39.0 2.0 6 14.00 1 5 -100.0 144.0
 FACTOR OF SAFETY # 1.300
 TH INCREMENT # 10.00
 LENGTH ALLOWED # 100.0

| Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0.0 | 28.00 | 14.00 | 38.00 | 14.00 | 66.00 | 28.00 | 116.00 | 28.00 | 144.00 | 14.00 | | |

SECTIONAL DETAILS

| (COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|-----------|---------|-------------|
| 100.00 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |
| 0.0 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |
| 28.00 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |
| 38.00 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |
| 66.00 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |
| 116.00 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |
| 44.00 | 1 | 0.0 | 38.00 |
| | 2 | 38.00 | |
| | 3 | 42.00 | |

SOIL PROPERTIES

| COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|----------|------|--------------|-------------------|
| 0. | 30.0 | 125.0 | 65.0 |
| 1400. | 0.0 | 55.0 | 55.0 |
| 800. | 0.0 | 45.0 | 45.0 |

BERM LENGTH

FACTOR OF SAFETY

RADIUS

X COORD OF CENTRE

Y COORD OF CENTRE

10.00 FEET

1.397

54.0 FEET

35.0 FEET

-5.0 FEET

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 40 SECONDS

LANCASTER-CNR-LINE#4-SOUTH APP. TRANS.

RUN DATE JAN 12, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 45 | -15 | 5.0 | 5.0 | 38.0 | 2.0 | 6 | 16.00 | 1 | 4 | -100.0 | 150.0 | |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 100.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 33.00 | 16.50 | 53.00 | 16.50 | 86.00 | 33.00 | 150.00 | 33.00 | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 37.00 |
| 1 | | 2 | 37.00 | |
| 1 | | 3 | 41.00 | |
| 2 | 0.0 | 1 | 0.0 | 37.00 |
| 2 | | 2 | 37.00 | |
| 2 | | 3 | 41.00 | |
| 3 | 33.00 | 1 | 0.0 | 37.00 |
| 3 | | 2 | 37.00 | |
| 3 | | 3 | 41.00 | |
| 4 | 53.00 | 1 | 0.0 | 37.00 |
| 4 | | 2 | 37.00 | |
| 4 | | 3 | 41.00 | |
| 5 | 86.00 | 1 | 0.0 | 37.00 |
| 5 | | 2 | 37.00 | |
| 5 | | 3 | 41.00 | |
| 6 | 150.00 | 1 | 0.0 | 37.00 |
| 6 | | 2 | 37.00 | |
| 6 | | 3 | 41.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 55.0 | 55.0 |
| 3 | 800. | 0.0 | 45.0 | 45.0 |

BERM LENGTH

FACTOR OF SAFETY

RADIUS

X COORD OF CENTRE

Y COORD OF CENTRE

20.00 FEET

1.541

73.0 FEET

40.0 FEET

-25.0 FEET

10.00 FEET

1.375

53.0 FEET

35.0 FEET

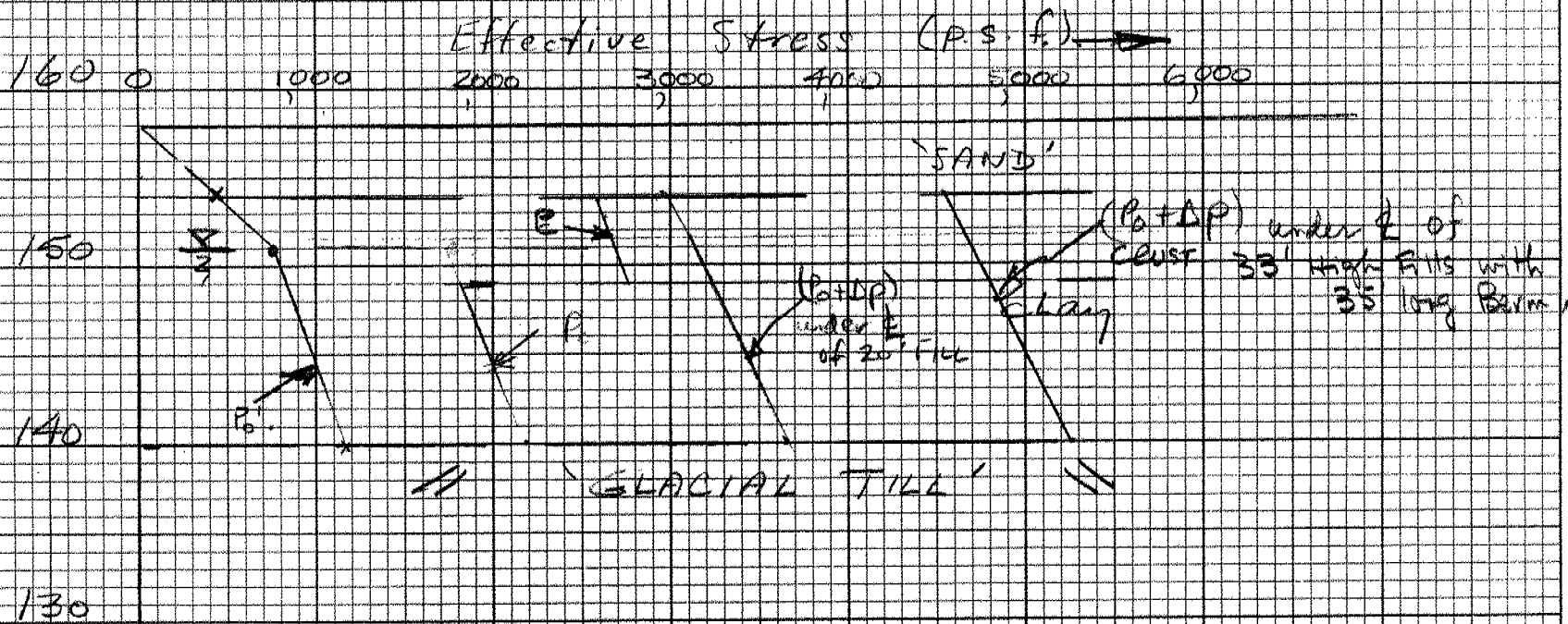
-5.0 FEET

THIS JOB COMPLETED. RUNNING DATE JAN 12, 1970 TIME ELAPSED # 87 SECONDS

69-F 74 SITE #4.

NORTH APPROACH

- a) HEIGHT - 33' (Berm 35' long)
 $\Delta H = 33 \times 125 = 4100 \text{ p.s.f.}$
b) HEIGHT - 20' $\Delta H = 20 \times 125 = 2500 \text{ p.s.f.}$



Settlement under E of Fill - 33' (Berm 35' Long)

$$\Delta H = 5 \left[\frac{0.05 \log \frac{3.6}{2700}}{1+2.2} + \frac{1.5 \log \frac{1.92}{2700}}{1+2.2} \right] + 9 \left[\frac{0.05 \log \frac{2.0}{1000}}{1+2.2} + \frac{1.5 \log \frac{2.53}{2000}}{1+2.2} \right]$$

$$= 2.5'$$

Settlement under E of Fill - 20' (No Berm Required)

$$\Delta H = 5 \left[\frac{0.05 \log \frac{3.6}{2700}}{1+2.2} + \frac{1.5 \log \frac{1.17}{2700}}{1+2.2} \right] + 9 \left[\frac{0.05 \log \frac{2.0}{1000}}{1+2.2} + \frac{1.5 \log \frac{1.725}{2600}}{1+2.2} \right]$$

$$= 1.4'$$

Time Rate of Settlement

Core 0.008 in./min.

Double Drainage

$$t_{90} = \frac{0.848 \times (7 \times 12)^2}{0.8 \times 10^{-2} \times 60 \times 24 \times 365}$$

$$= \frac{0.848 \times 0.7 \times 10^6}{0.8 \times 0.6 \times 2.4 \times 3.65 \times 10^5} = 0.7 \text{ year (2 years?)}$$

$$t_{50} = \frac{0.196 \times 1.4}{0.848} = 0.33 \text{ year (4 months.)}$$

Vertical scale: 160, 150, 140, 130, 120
Horizontal scale: 0, 1000, 2000, 3000, 4000, 5000, 6000
Labels: SAND, GLACIAL TILL
Notes: (P0 + ΔP) under E of 33' high fill with 35' long Berm, (P0 + ΔP) under E of 20' fill, P0

III
69-F-74

LINE # 4

NORTH AND SOUTH APPROACH

STABILITY & SETTLEMENT COMPUTATIONS.

69-F-74

LINE #5

NORTH APPROACH

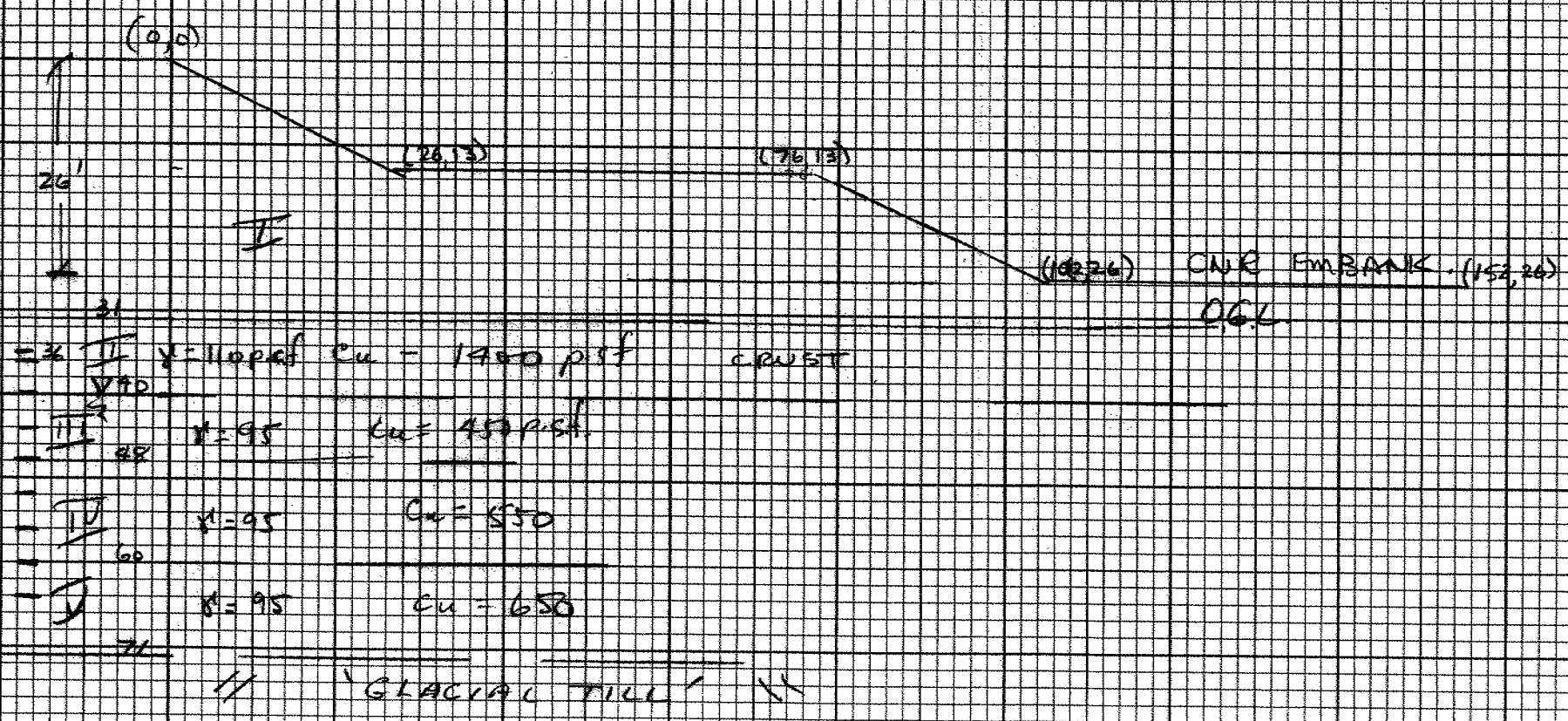
200

180

160

140

120



190
164
26

LANCASTER-CNR-LINE #5-NORTH APP. TRANS. RUN DATE JAN 10, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. | R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. Z-X< | NO. PTS. Z&X< | CUT-OFF Z-X< | CUT-OFF Z&X< |
|--------|---------|---------|------|------|-------|------|-------|-------|---------------|---------------|---------------|--------------|--------------|
| 25 | 55 | -25 | 7.0 | 7.0 | 36.0 | 4.0 | 8 | 15.00 | 1 | 4 | -100.0 | 200.0 | |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 150.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 31.00 | 15.50 | 91.00 | 15.50 | 122.00 | 31.00 | 200.00 | 31.00 | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 40.00 |
| 1 | | 2 | 31.00 | |
| 1 | | 3 | 40.00 | |
| 1 | | 4 | 48.00 | |
| 1 | | 5 | 60.00 | |
| 2 | 0.0 | 1 | 0.0 | 40.00 |
| 2 | | 2 | 31.00 | |
| 2 | | 3 | 40.00 | |
| 2 | | 4 | 48.00 | |
| 2 | | 5 | 60.00 | |
| 3 | 31.00 | 1 | 0.0 | 40.00 |
| 3 | | 2 | 31.00 | |
| 3 | | 3 | 40.00 | |
| 3 | | 4 | 48.00 | |
| 3 | | 5 | 60.00 | |
| 4 | 91.00 | 1 | 0.0 | 40.00 |
| 4 | | 2 | 31.00 | |
| 4 | | 3 | 40.00 | |
| 4 | | 4 | 48.00 | |
| 4 | | 5 | 60.00 | |
| 5 | 122.00 | 1 | 0.0 | 40.00 |
| 5 | | 2 | 31.00 | |
| 5 | | 3 | 40.00 | |
| 5 | | 4 | 48.00 | |
| 5 | | 5 | 60.00 | |
| 6 | 200.00 | 1 | 0.0 | 40.00 |
| 6 | | 2 | 31.00 | |
| 6 | | 3 | 40.00 | |
| 6 | | 4 | 48.00 | |
| 6 | | 5 | 60.00 | |

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|------|--------------|-------------------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
| 3 | 450. | 0.0 | 35.0 | 35.0 |
| 4 | 550. | 0.0 | 35.0 | 35.0 |
| 5 | 650. | 0.0 | 35.0 | 35.0 |

| BERM LENGTH | FACTOR OF SAFETY | RADIUS | X COORD OF CENTRE | Y COORD OF CENTRE |
|-------------|------------------|--------|-------------------|-------------------|
|-------------|------------------|--------|-------------------|-------------------|

| | | | | |
|------------|-------|------------|-----------|------------|
| 60.00 FEET | 1.273 | 110.0 FEET | 55.0 FEET | -46.0 FEET |
|------------|-------|------------|-----------|------------|

| | | | | |
|------------|-------|------------|-----------|------------|
| 70.00 FEET | 1.346 | 124.0 FEET | 60.0 FEET | -60.0 FEET |
|------------|-------|------------|-----------|------------|

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 118 SECONDS

| SUMMARY OF ERRORS FOR THIS JOB | ERROR NUMBER | NUMBER OF ERRORS |
|--------------------------------|--------------|------------------|
|--------------------------------|--------------|------------------|

| | | |
|--|-----|----|
| | 215 | 10 |
|--|-----|----|

LANCASTER-CNR-LINE 5 - NORTH APP.LONG.

RUN DATE JAN 12, 1970

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%&X< | CUT-OFF%-X< | CUT-OFF%&X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 55 | -25 | 7.0 | 7.0 | 36.0 | 4.0 | 8 | 13.00 | 1 | 5 | -100.0 | 178.0 |

ALLOWABLE FACTOR OF SAFETY # 1.300

BERM LENGTH INCREMENT # 10.00

MAX. BERM LENGTH ALLOWED # 100.0

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 26.00 | 13.00 | 76.00 | 13.00 | 102.00 | 26.00 | 152.00 | 26.00 | 178.00 | 13.00 |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-----|-------|
| 1 | -100.00 | 1 | 0.0 | 40.00 |
|---|---------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 1 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 5 | 60.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-----|---|-----|-------|
| 2 | 0.0 | 1 | 0.0 | 40.00 |
|---|-----|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 2 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 5 | 60.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-------|---|-----|-------|
| 3 | 26.00 | 1 | 0.0 | 40.00 |
|---|-------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 3 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 5 | 60.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-------|---|-----|-------|
| 4 | 76.00 | 1 | 0.0 | 40.00 |
|---|-------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 4 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 5 | 60.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--------|---|-----|-------|
| 5 | 102.00 | 1 | 0.0 | 40.00 |
|---|--------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 5 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 5 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 5 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 5 | | 5 | 60.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--------|---|-----|-------|
| 6 | 152.00 | 1 | 0.0 | 40.00 |
|---|--------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 6 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 6 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 6 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 6 | | 5 | 60.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--------|---|-----|-------|
| 7 | 178.00 | 1 | 0.0 | 40.00 |
|---|--------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 7 | | 2 | 31.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 7 | | 3 | 40.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 7 | | 4 | 48.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 7 | | 5 | 60.00 | |
|---|--|---|-------|--|

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|-----|--------------|-------------------|
|-----------|----------|-----|--------------|-------------------|

| | | | | |
|---|----|------|-------|------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
|---|----|------|-------|------|

| | | | | |
|---|-------|-----|-------|------|
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
|---|-------|-----|-------|------|

| | | | | |
|---|------|-----|------|------|
| 3 | 450. | 0.0 | 35.0 | 35.0 |
|---|------|-----|------|------|

| | | | | |
|---|------|-----|------|------|
| 4 | 550. | 0.0 | 35.0 | 35.0 |
|---|------|-----|------|------|

| | | | | |
|---|------|-----|------|------|
| 5 | 650. | 0.0 | 35.0 | 35.0 |
|---|------|-----|------|------|

BERM LENGTH

FACTOR OF SAFETY

RADIUS

X COORD OF CENTRE

Y COORD OF CENTRE

50.00 FEET

1.305

110.0 FEET

48.0 FEET

-46.0 FEET

THIS JOB COMPLETED. RUNNING DATE JAN 12, 1970 TIME ELAPSED # 64 SECONDS

| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS. %X< | NO. PTS. %X< | CUT-OFF %X< | CUT-OFF %X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 23.0 | 4.0 | 8 | 9.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 36.00 | 18.00 | 150.00 | 18.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
|---------|---------|-----------|---------|-------------|

| | | | | |
|---|---------|---|-----|-------|
| 1 | -100.00 | 1 | 0.0 | 27.00 |
|---|---------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 1 | | 2 | 18.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 3 | 27.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 4 | 35.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 1 | | 5 | 47.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-----|---|-----|-------|
| 2 | 0.0 | 1 | 0.0 | 27.00 |
|---|-----|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 2 | | 2 | 18.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 3 | 27.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 4 | 35.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 2 | | 5 | 47.00 | |
|---|--|---|-------|--|

| | | | | |
|---|-------|---|-----|-------|
| 3 | 36.00 | 1 | 0.0 | 27.00 |
|---|-------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 3 | | 2 | 18.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 3 | 27.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 4 | 35.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 3 | | 5 | 47.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--------|---|-----|-------|
| 4 | 150.00 | 1 | 0.0 | 27.00 |
|---|--------|---|-----|-------|

| | | | | |
|---|--|---|-------|--|
| 4 | | 2 | 18.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 3 | 27.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 4 | 35.00 | |
|---|--|---|-------|--|

| | | | | |
|---|--|---|-------|--|
| 4 | | 5 | 47.00 | |
|---|--|---|-------|--|

SOIL PROPERTIES

| SOIL TYPE | COHESION | PHI | BULK DENSITY | SUBMERGED DENSITY |
|-----------|----------|-----|--------------|-------------------|
|-----------|----------|-----|--------------|-------------------|

| | | | | |
|---|----|------|-------|------|
| 1 | 0. | 30.0 | 125.0 | 65.0 |
|---|----|------|-------|------|

| | | | | |
|---|-------|-----|-------|------|
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
|---|-------|-----|-------|------|

| | | | | |
|---|------|-----|------|------|
| 3 | 450. | 0.0 | 35.0 | 35.0 |
|---|------|-----|------|------|

| | | | | |
|---|------|-----|------|------|
| 4 | 550. | 0.0 | 35.0 | 35.0 |
|---|------|-----|------|------|

| | | | | |
|---|------|-----|------|------|
| 5 | 650. | 0.0 | 35.0 | 35.0 |
|---|------|-----|------|------|

CRITICAL CIRCLE

| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 52.00 | 20.00 | -5.00 | 1.502 |
| 52.00 | 15.00 | -5.00 | 1.506 |
| 52.00 | 25.00 | -5.00 | 1.532 |
| 47.00 | 20.00 | 0.0 | 1.533 |
| 47.00 | 15.00 | 0.0 | 1.537 |
| 52.00 | 10.00 | -5.00 | 1.543 |
| 66.00 | 20.00 | -15.00 | 1.564 |
| 71.00 | 20.00 | -20.00 | 1.565 |
| 66.00 | 15.00 | -15.00 | 1.566 |
| 71.00 | 15.00 | -20.00 | 1.567 |

THIS JOB COMPLETED. RUNNING DATE JAN 10, 1970 TIME ELAPSED # 78 SECONDS

LANCASTER-CNR-LINE 5-NORTH 22 JAN 8 70 69-F-74

RUN DATE JAN 12, 1970

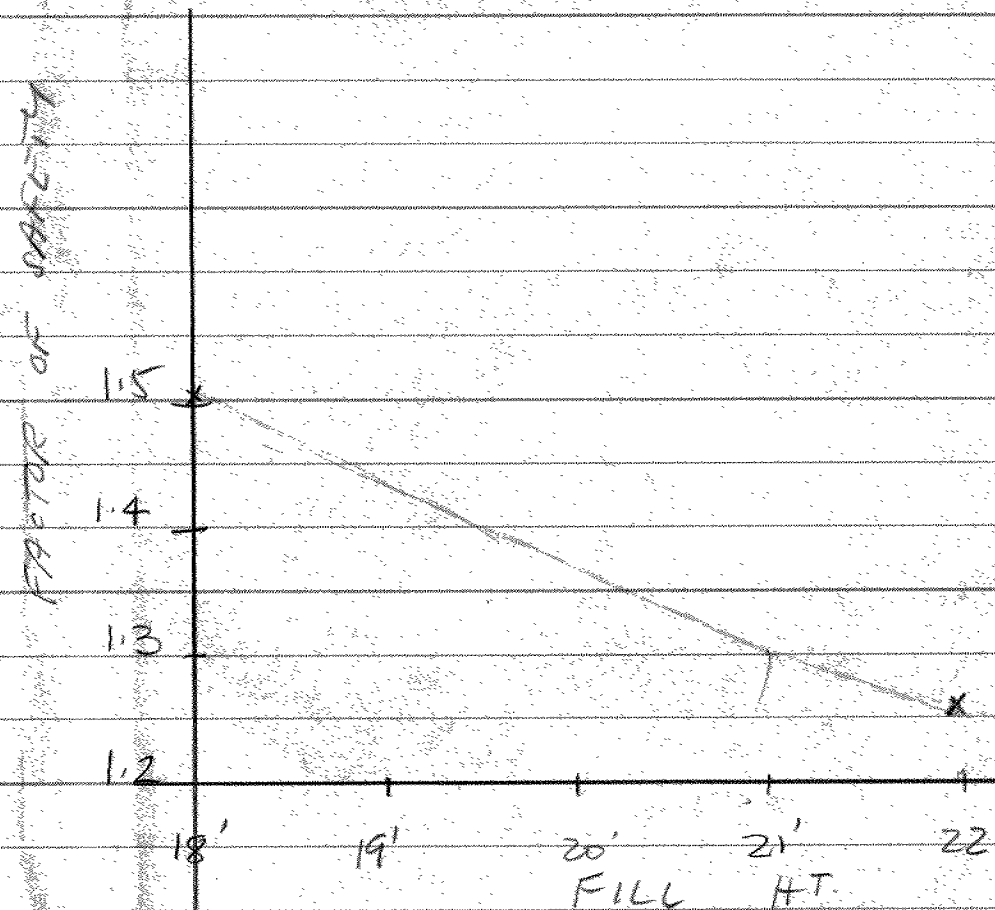
| SLICES | X-INIT. | Y-INIT. | DELX | DELY | TANG. R.L. | INCR. | NO. R | TENSION CRACK | NO. PTS.%-X< | NO. PTS.%&X< | CUT-OFF%-X< | CUT-OFF%-X< |
|--------|---------|---------|------|------|------------|-------|-------|---------------|--------------|--------------|-------------|-------------|
| 25 | 25 | -10 | 5.0 | 5.0 | 27.0 | 4.0 | 8 | 11.00 | 1 | 2 | -100.0 | 150.0 |

| X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD | X COORD | Y COORD |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -100.00 | 0.0 | 44.00 | 22.00 | 150.00 | 22.00 | | | | | | |

SECTIONAL DETAILS

| SECTION | X COORD | SOIL TYPE | Y COORD | WATER TABLE |
|---------|---------|-----------|---------|-------------|
| 1 | -100.00 | 1 | 0.0 | 31.00 |
| 1 | | 2 | 22.00 | |
| 1 | | 3 | 31.00 | |
| 1 | | 4 | 39.00 | |
| 1 | | 5 | 51.00 | |
| 2 | 0.0 | 1 | 0.0 | 31.00 |
| 2 | | 2 | 22.00 | |
| 2 | | 3 | 31.00 | |
| 2 | | 4 | 39.00 | |
| 2 | | 5 | 51.00 | |
| 3 | 44.00 | 1 | 0.0 | 31.00 |
| 3 | | 2 | 22.00 | |
| 3 | | 3 | 31.00 | |
| 3 | | 4 | 39.00 | |
| 3 | | 5 | 51.00 | |
| 4 | 150.00 | 1 | 0.0 | 31.00 |
| 4 | | 2 | 22.00 | |
| 4 | | 3 | 31.00 | |
| 4 | | 4 | 39.00 | |
| 4 | | 5 | 51.00 | |

| SOIL TYPE | COHESION | SOIL PROPERTIES | | |
|-----------|----------|-----------------|--------------|-------------------|
| | | PHI | BULK DENSITY | SUBMERGED DENSITY |
| 1 | 0. | 30.0 | 125.0 | 65.0 |
| 2 | 1400. | 0.0 | 110.0 | 50.0 |
| 3 | 450. | 0.0 | 35.0 | 35.0 |
| 4 | 550. | 0.0 | 35.0 | 35.0 |
| 5 | 650. | 0.0 | 35.0 | 35.0 |

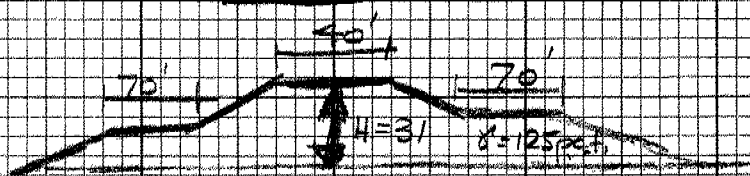


CRITICAL CIRCLE

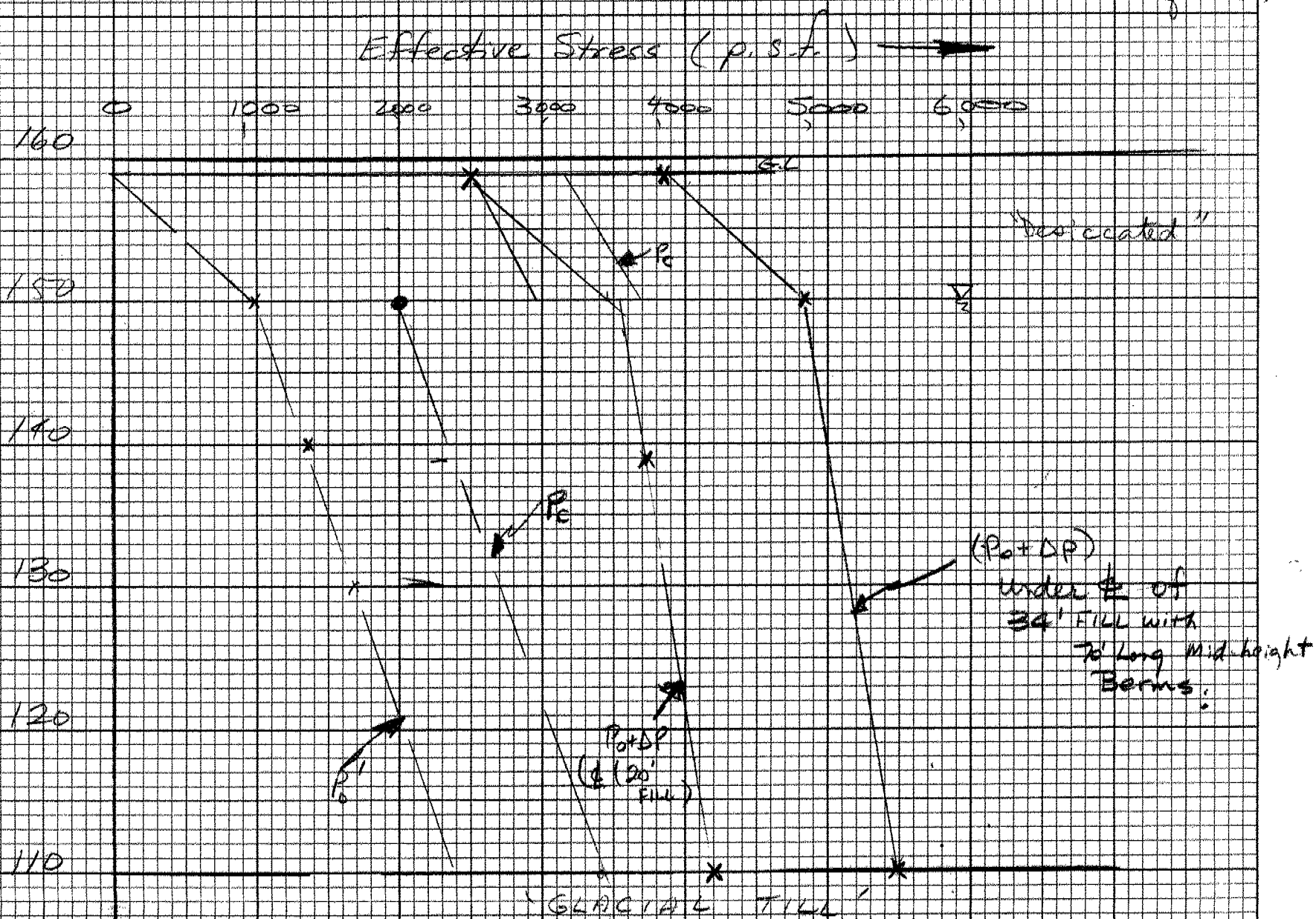
| RADIUS | XC | YC | F. OF S. |
|--------|-------|--------|----------|
| 51.00 | 20.00 | 0.0 | 1.258 |
| 51.00 | 25.00 | 0.0 | 1.260 |
| 51.00 | 15.00 | 0.0 | 1.284 |
| 62.00 | 20.00 | -15.00 | 1.286 |
| 70.00 | 20.00 | -15.00 | 1.288 |
| 62.00 | 25.00 | -15.00 | 1.289 |
| 70.00 | 25.00 | -15.00 | 1.290 |
| 65.00 | 20.00 | -10.00 | 1.292 |
| 51.00 | 30.00 | 0.0 | 1.293 |
| 65.00 | 25.00 | -10.00 | 1.293 |

THIS JOB COMPLETED. RUNNING DATE JAN 12, 1970 TIME ELAPSED # 85 SECONDS

69-F-74



$$\Delta P = 31' \times 125 = 3,875 \text{ p.s.f. (Berm 70')} \\ \Delta P = 20' \times 125 = 2,500 \text{ p.s.f. (No Berm Required)}$$



Under ϵ of 31' HIGH FILLS (WITH 70' WIDE BERMS)

$$\Delta H = \cancel{12 \times 9} \left[\frac{0.95}{1+2.2} \log \left(\frac{\cancel{3450}^{0.9}}{500} \right) \right] + \frac{1.5}{1+2.2} \log \left(\frac{\cancel{4250}^{1.26}}{\cancel{3450}} \right) + 40 \times \cancel{12} \left[\frac{0.95}{1+2.2} \log \left(\frac{\cancel{2700}^{1.59}}{\cancel{1700}} \right) - \frac{1.5}{1+2.2} \log \left(\frac{\cancel{5150}^{1.91}}{\cancel{2700}} \right) \right]$$

Under $\frac{1}{2}$ of 20' HIGH FILLS (no Boms Required)

$$\Delta H = 9 \left[\frac{0.05}{1+2.2} \log \left(\frac{2450}{500} \right) \right] + 40 \left[\frac{0.05}{1+2.2} \log \left(\frac{2300}{1000} \right) \right] + \frac{1.5}{1+2.2} \log \left(\frac{3050}{2000} \right)$$

Time Rate of Settlement

assume $C_r = 0.008 \text{ in}^2/\text{min}$ ~~Double~~ Drainage

$t_{90\%} = \frac{0.848 \times (20 \times 12)^2}{0.8 \times 10^{-2} \times 60 \times 24 \times 365} = 12 \text{ years}$

$t_{50\%} = \frac{0.196}{0.848} \times 12 = 3 \text{ years}$

IV
69-F-74

LINE #5

NORTH & SOUTH APPROACH

STABILITY & SETTLEMENT COMPUTATIONS.

DEPARTMENT OF HIGHWAYS - ONTARIO
ENGINEERING SURVEYS DIVISION

HWY. NO

34

69-F-74

TWP.

CHARLOTTENBURGH

COUNTY OR
DISTRICT

GLEN GARRY

FROM

VILLAGE OF LANCASTER

TO

BORE & CONG HOLE LOCATIONS

NOTES

LINE

From Station

To Station

REMARKS

PLAN NOS

PROFILE NOS

STUDY PLAN NOS

Survey By

Chief of Party

D. H. DOWDALL

Supervisor

Date of Survey

Book

Of

REGION

W.O. NO

DIST.

W.P. NO

BORE HOLE & CONE LOCATIONS
PROPOSED HWY 403A OVERPASS
"VILLAGE OF LANCASTER"

BORE HOLE N^o 1 = STA 3+00 "NORTH" SCHEME N^o 5

X BORE HOLE N^o 2 = STA 1+00 "SOUTH" SCHEME N^o 6

X BORE HOLE N^o 3 = STA 3+00 "NORTH" SCHEME N^o 4

CONE N^o 1 = STA 1+00 "NORTH" SCHEME N^o 5

X CONE N^o 2 = STA 5+00 "NORTH" SCHEME N^o 6

X CONE N^o 3 = STA 1+00 NORTH SCHEME N^o 4

DEPARTMENT OF HIGHWAYS - ONTARIO
ENGINEERING SURVEYS DIVISION

HWY. NO 34

(WJ. 69-F-74)

TWP. CHARLOTENBURGH

COUNTY OR
DISTRICT STORMONT DUNDAS & GLENGARRY

FROM LANCASTER

TO

PROPOSED C.N.R. CROSSINGS

NOTES

LINE PRELIMINARY

From Station

To Station

REMARKS

PAGE NO 1-5 SCHEME NO 6

PAGE NO 6-10 SCHEME NO 5

PAGE NO 11-15 SCHEME NO 4

PAGE NO 16-20 SOUNDINGS C.N.R.

PLAN NOS

PROFILE NOS

STUDY PLAN NOS

Survey By

Chief of Party R.H. DOWDALL

Supervisor

Date of Survey OCT 1969

Book 1 Of 1

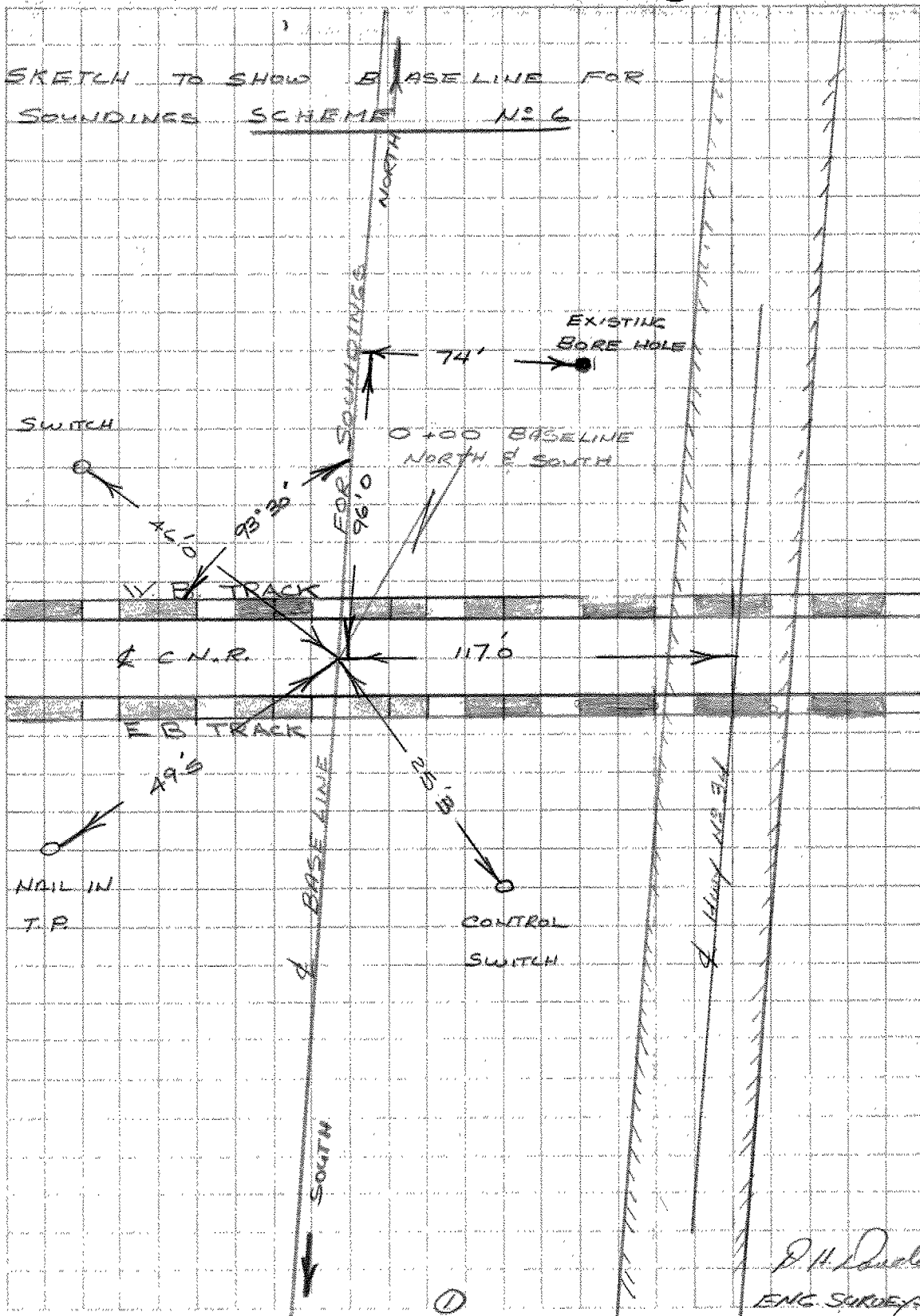
REGION EASTERN

W.O. NO

DIST. N^o 9 OTTAWA

W.P. NO 256-CC

SKETCH TO SHOW BASELINE FOR
SOUNDINGS SCHEME NO. 6



PARTY NAMES

W.P. No.

DATE

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|------------|------|------|------|------|-------|--------------|
| | | | | | | 165.90 |
| GBM. | | | | | | ELEV. 165.90 |
| No D.L.XX/ | 2 90 | 1 68 | 86 | | | |

ELEVATIONS FOR SOUNDINGS NORTH

SCHEME 6

| | | | | | |
|------|--|--|----|--|-------|
| 0+00 | | | 1 | | 164.7 |
| 0+56 | | | 79 | | 160.9 |
| 1+00 | | | 80 | | 160.8 |
| 2+00 | | | 80 | | 160.8 |

②

RED. C. M. Decker
CHK'D. R. Carruth

W. P. No.

DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|---|------|---------------|------|------|--------|---------|
| | | 168.78 3.8 | | | | |
| ELEVATION of <u>SOUNDINGS SOUTH.</u> | | | | | | |
| <u>SCHEME C</u> | | | | | | |
| 0+00 | | | 4.05 | | 164.73 | |
| 1+00 | | | 5.34 | | 163.44 | |
| 2+00 | | | 5.15 | | 163.63 | |
| T.P. | 5.54 | 169.17 | 5.15 | | 163.63 | |
| 3+00 | | | 4.06 | | 165.14 | |
| 4+00 | | | 6.03 | | 163.14 | |
| <div style="text-align: right;"> RED. J. M. Jackson CH'K'D. J. M. Jackson </div> | | | | | | |

PARTY NAMES

W.P. No.

DATE

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|--------|------|----------|------|------|----------|-------------|
| | | 1 6 9 17 | | | | |
| 4+95 | | | 6 23 | | 1 6 2 94 | |
| 5+00 | | | 6 22 | | 1 6 2 95 | |
| T.P. | 2 64 | 1 6 9 31 | | 2 50 | 1 6 6 67 | |
| C.B.M. | | | | 3 28 | 1 6 5 98 | ELEV. 16590 |

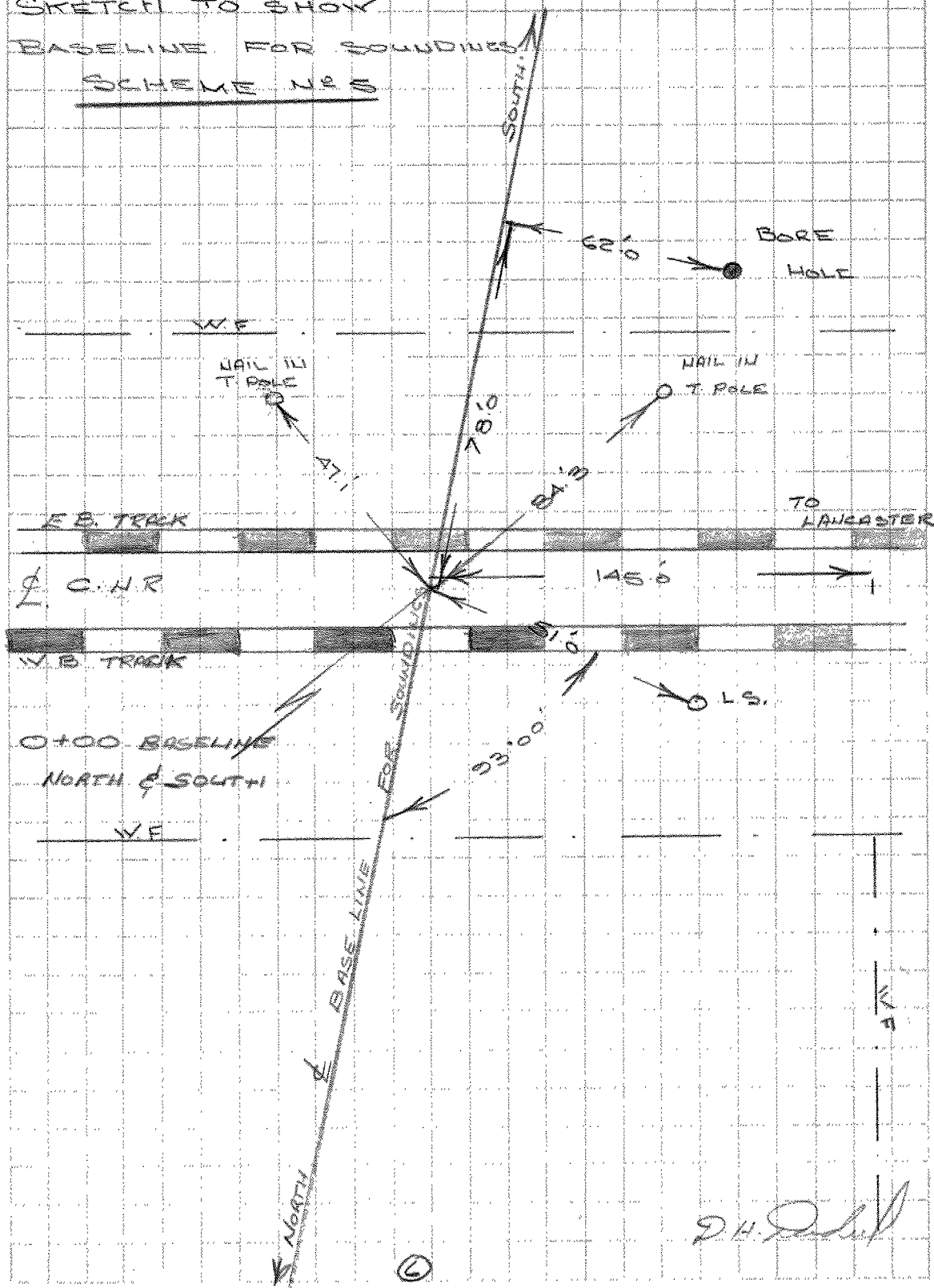
(5)

RED.

CHK'D

J. M. Smith
H. Campbell

SKETCH TO SHOW
BASELINE FOR SOUNDINGS
SCHEME 168



PARTY NAMES

W. P. No.

DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|---------------------------------------|-----------------|-------------------|------|-----------------|-------------------|-------------|
| G.B.M. | | | | | | |
| N ^o DLXXI | 3 ¹⁶ | 169 ⁰⁶ | | | | ELEV 165.90 |
| ELEVATIONS FOR SOUNDINGS <u>NORTH</u> | | | | | | |
| <u>SCHEME 2</u> | | | | | | |
| T.P. | 3 ⁹⁰ | 169 ⁰⁷ | | 3 ⁸⁹ | 165 ¹⁷ | |
| T.P. | 2 ⁸² | 167 ⁵³ | | 4 ³⁹ | 164 ⁶⁸ | |

⑦

RED. by *[Signature]*
 CH'K'D. *[Signature]*

W.P. No.

DATE _____

[illegible]

PARTY NAMES

W. P. No. _____

DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|--------------------------|------|--------------------------|----------------|------|-------------------|---|
| | | 167 ⁵³ 475 | | | | |
| ELEVATIONS FOR SOUNDINGS | | | | | | |
| <u>SOUTH</u> | | | | | | |
| <u>SCHEME 5</u> | | | | | | |
| 0+00 | | | 4 ² | | 163 ³ | ✓ |
| 0+78 | | | 8 ⁷ | | 158 ⁸ | ✓ |
| 1+00 | | | 8 ⁸ | | 159 ¹⁰ | ✓ |
| 2+00 | | | 8 ² | | 159 ³ | ✓ |
| 3+00 | | | 8 ⁴ | | 159 ¹¹ | ✓ |
| 4+00 | | | 7 ³ | | 160 ² | ✓ |
| | | | ⑨ | | | RED. J. M. Gibson CH'K'D. J. M. Gibson |

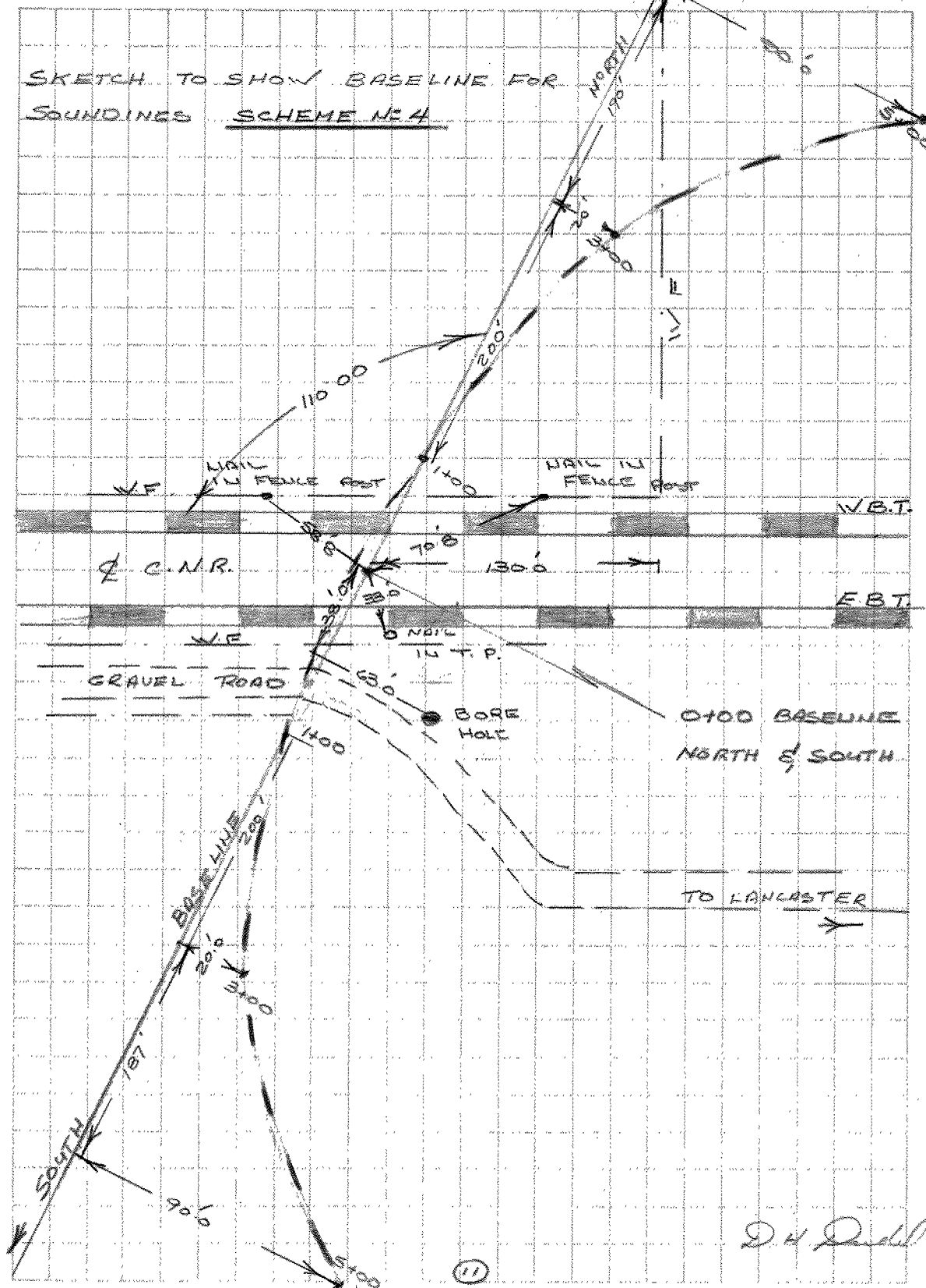
PARTY NAMES _____ W.P. No. _____
 _____ DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|-------------------------------|-----------------|-------------------|----------------|-----------------|-------------------|-------------|
| | | 167 ⁵⁸ | | | | |
| 5+00 | | | 7 ⁵ | | 160 ⁰⁰ | |
| T.P | 4 ³⁶ | 168 ⁹⁹ | | 2 ⁹⁰ | 164 ⁶³ | |
| T.P | 4 ⁰³ | 169 ⁵⁶ | | 3 ⁶⁶ | 165 ³³ | |
| G.B.M N ^o DLXXI | | | | 3 ⁴³ | 165 ⁹³ | ELEV 165.90 |

(10)

RED. *[Signature]*
CH'K'D. *[Signature]*

SKETCH TO SHOW BASELINE FOR
SOUNDINGS SCHEME No. 4



PARTY NAMES _____ W.P. No. _____

DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|--------------------------------------|-----------------|---------------------|----------------|-----------------|-------------------|--|
| CB.M | | | | | | |
| N ^o DLXXI | 2 ⁸⁵ | ✓ 163 ⁷⁵ | | | | ELEV. 16590 |
| TP | 2 ⁷⁵ | ✓ 166 ³⁰ | | 4 ⁷⁰ | 164 ⁰⁵ | |
| TP | 2 ⁸¹ | ✓ 166 ¹⁰ | | 3 ⁴⁵ | 163 ³⁵ | BRIDGE |
| ELEVATIONS OF SOUNDINGS <u>NORTH</u> | | | | | | |
| <u>SCHEME 4</u> | | | | | | |
| 0+00 | | | 3 ⁸ | | 162 ⁴ | |
| 1+00 | | | 8 ² | | 158 ⁰ | |
| | | | (12) | | | RED. J. M. [Signature] CH'K'D [Signature] |

W. P. No. _____

DATE

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|-----------------|------|-------------------|------|------|------------------|----------------------------|
| | | 166 ¹⁶ | | | | |
| 3+00 | | | 77 | | 158 ⁵ | ✓ |
| 5+00 | | | 57 | | 160 ⁵ | ✓ |
| ————— END ————— | | | | | | |
| | | | | | | RED. |
| | | | | | | CH'K'D. <i>[Signature]</i> |

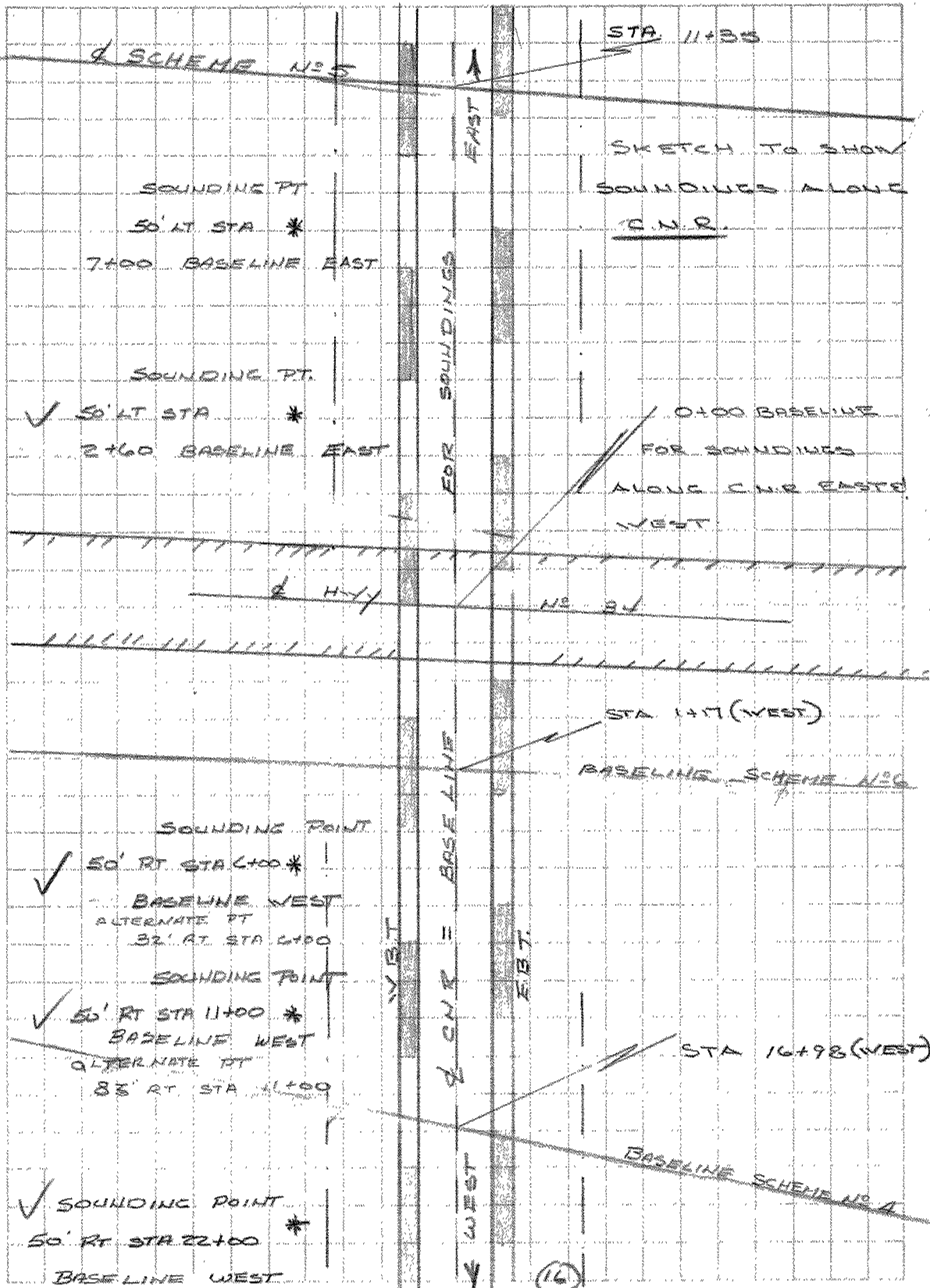
PARTY NAMES _____ W.P. No. _____
DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|--|------|--------|------|------|-------|---------|
| | | 166.16 | | | | |
| ELEVATIONS of SOUNDINGS <u>SOUTH</u> | | | | | | |
| <u>SCHEME 1</u> | | | | | | |
| 0+00 | | | 38 | | 162.4 | ✓ |
| 0+38 | | | 86 | | 157.6 | ✓ |
| 1+00 | | | 85 | | 157.7 | ✓ |
| 3+00 | | | 88 | | 157.4 | ✓ |
| 5+00 | | | 108 | | 155.8 | ✓ |
| RED. <i>J. M. [Signature]</i> CH'KD. <i>[Signature]</i> | | | | | | |

W.P. No. _____

DATE _____

| STA. | B.S. | H.I. | I.S. | F.S. | ELEV. | REMARKS |
|--------|------|---------------------|------|------|---------------------|--------------------------------|
| | | 166 ¹⁶ | | | | |
| | | . | | | | |
| T.P. | 490 | 168 ⁴⁶ ✓ | | 260 | 163 ⁵⁶ ✓ | |
| C.B.M. | | | | 256 | 165 ⁹⁰ ✓ | ELEV. 16990 |
| | | | | (15) | | RED. CH'K'D. J. [Signature] |



PARTY NAMES _____ W.P. No. _____
 _____ DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|-------------------------------|-----------------|--------------------|-----------------|--------------------|--------------------|--|
| C.B.M. | 2 ⁸³ | 1 68 ⁷³ | | | | ELEV. 16590 |
| T.P. | 3 ⁸² | 1 68 ⁸⁶ | 3 ⁷⁰ | 1 64 ⁹⁴ | | |
| ELEVATIONS FOR SOUNDING ALONG | | | | | | |
| "C.N.R." LINE "EAST." | | | | | | |
| 2+40 | | | | | | |
| 50 FT. | | | 8 ⁴ | | 1 60 ¹ | |
| 7+00 | | | | | | |
| 50 FT. | | | 5 ² | | 1 59 ¹³ | RED. <i>J. M. Wilson</i> CH'K'D. <i>P. Paul</i> |

| PARTY NAMES | W.P. No. | DATE |
|-------------|----------|------|
| | | |

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|--|-----------------|---------------------|----------------|-----------------|---------------------|---------|
| | | 1 6 8 ⁴⁶ | | | | |
| T.P. | 3 ⁷⁷ | 1 6 8 ⁷⁹ | ✓ | 3 ⁴⁴ | 1 6 5 ⁰² | ✓ |
| ELEVATIONS FOR SOUNDINGS | | | | | | |
| ALONG "C.N.R." LINE "WEST" | | | | | | |
| 6+00 | | | — | | | |
| SORT | | | 8 ² | | 1 6 0 ⁶ | ✓ |
| T.P. | 3 ⁰⁸ | 1 6 7 ³⁹ | ✓ | 4 ⁴⁸ | 1 6 4 ³¹ | ✓ |
| 11+00 | | | — | | | |
| SORT | | | 9 ³ | | 1 5 8 ¹ | ✓ |
| <div style="display: flex; justify-content: space-between; align-items: flex-end;"> (18) <div> RED. <i>J. H. [Signature]</i> CH'KD. <i>[Signature]</i> </div> </div> | | | | | | |

PARTY NAMES _____ W.P. No. _____
DATE _____

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|----------------|-----------------|-------------------|----------------|-----------------|-------------------|---|
| | | 167 ³⁰ | ✓ | | | |
| T.P. | 2 ⁸³ | 166 ¹⁶ | | 4 ⁰⁶ | 163 ³³ | ✓ |
| 22+00 50 RT | | | 9 ⁰ | | 156 ¹⁴ | ✓ |
| T.P. | 4 ⁸³ | 167 ³⁰ | | 3 ¹³ | 163 ⁰³ | ✓ |
| 11+00 85 RT | | | 7 ⁶ | | 159 ¹⁶ | ✓ |
| T.P. | 1 ²⁴ | 168 ²² | | 3 ⁸⁸ | 163 ⁹⁸ | ✓ |
| 6+00 32 RT | | | 3 ⁹ | | 164 ¹³ | ✓ |
| | | | | | | RED. <i>[Signature]</i> CH'K'D. <i>[Signature]</i> |

PARTY NAMES _____ W.P. No. _____

DATE

| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|--|------|-------------------|------|-----------------|-------------------|-------------|
| | | 168 ²² | ✓ | | | |
| G.B.M. | | | | 2 ³³ | 165 ⁸⁹ | ELEV. 16590 |
| — TIME END — | | | | | | |
| <div style="display: flex; justify-content: space-between; align-items: flex-end;"> (2) <div> RED. <i>M. Becker</i> CH'K'D. <i>D. L. Smith</i> </div> </div> | | | | | | |

OVERSIZE DRAWING

DEPARTMENT OF HIGHWAYS ONTARIO

Form
SB-OS-62
67-6700

ACTION SLIP

DATE

Sept 12th / 69

TO

Mr. M. Devata Foundation Section
Lab Rdg Downview

FROM

T.C. Kinghorn Kingston

☐NOTE AND
FILE☐PREPARE REPLY FOR
MY SIGNATURE☐NOTE AND
RETURN TO ME☐TAKE APPROPRIATE
ACTION☒RETURN WITH MORE
DETAILS☐PER YOUR
REQUEST☐NOTE
AND SEE ME☐FOR YOUR
SIGNATURE☐PLEASE
ANSWER☐FOR YOUR
INFORMATION☐FOR YOUR
APPROVAL☐INVESTIGATE AND
REPORT☐RETURN WITH YOUR
COMMENTS☐

COMMENTS

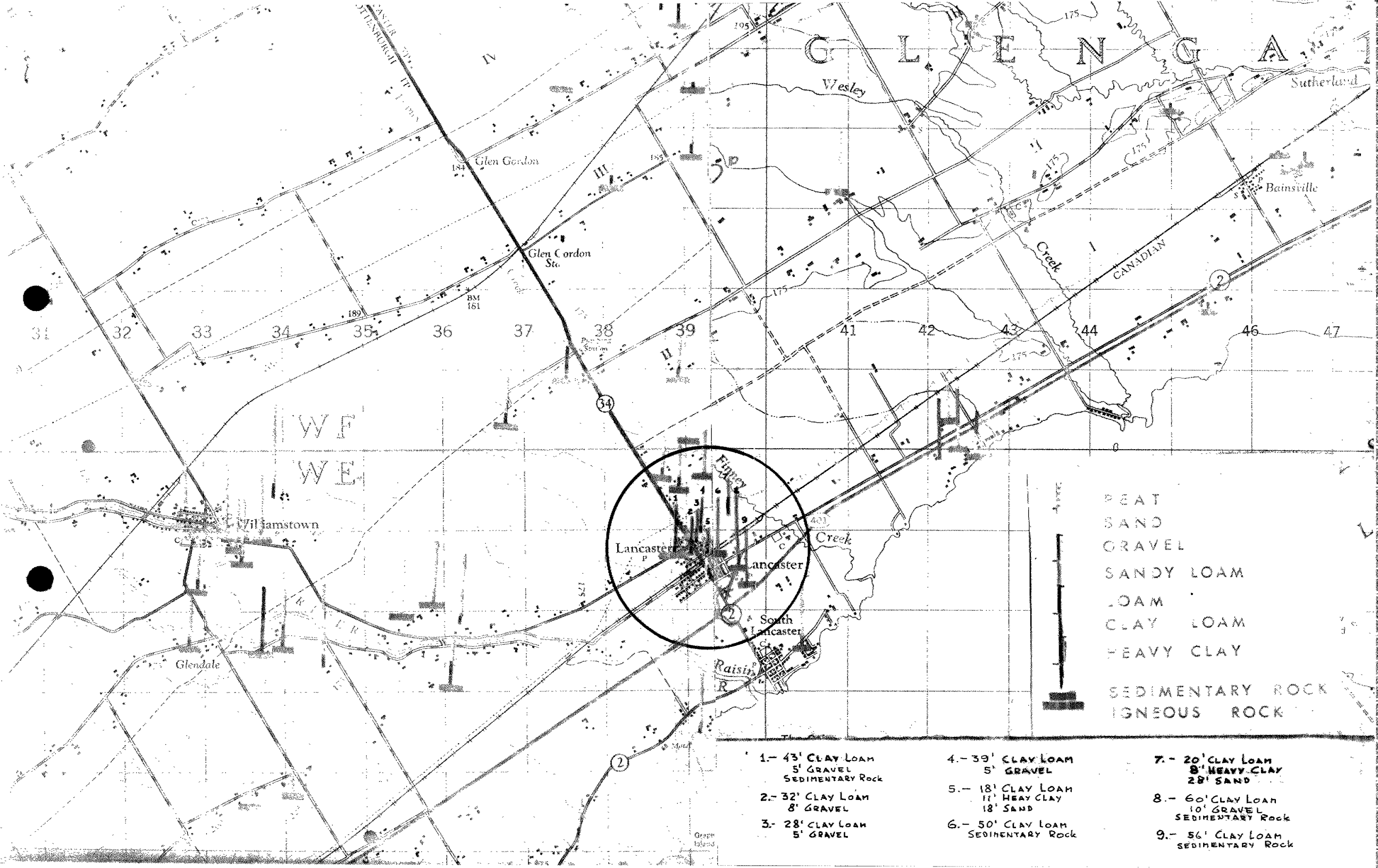
WP 256-66-00. CRR

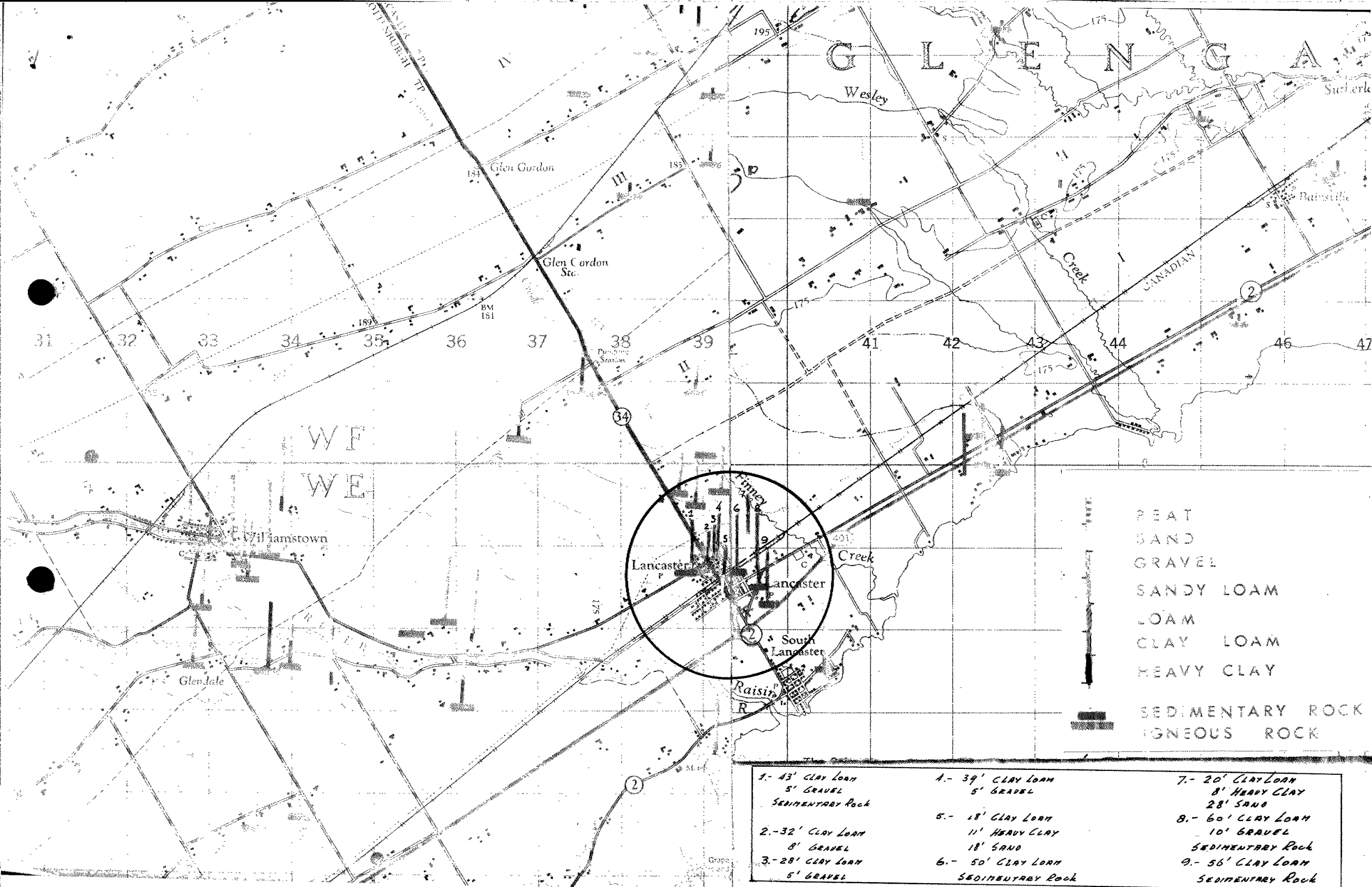
overhead at Lancaster

Hwy 34

Details of well-bore
enclosed as discussed with
you & Barry Karch.

T.C.H.





| | | |
|--|---|---|
| 1.- 43' CLAY LOAM 5' GRAVEL SEDIMENTARY ROCK | 4.- 39' CLAY LOAM 5' GRAVEL | 7.- 20' CLAY LOAM 8' HEAVY CLAY 28' SAND |
| 2.- 32' CLAY LOAM 8' GRAVEL | 5.- 18' CLAY LOAM 11' HEAVY CLAY 18' SAND | 8.- 60' CLAY LOAM 10' GRAVEL SEDIMENTARY ROCK |
| 3.- 28' CLAY LOAM 5' GRAVEL | 6.- 50' CLAY LOAM SEDIMENTARY ROCK | 9.- 56' CLAY LOAM SEDIMENTARY ROCK |

CONTENTS :

1. DRAWING (LOCATION OF BORING LOCATIONS AS WELL AS ~~RE~~ ELECTRICAL RESISTIVITY SURVEY BY M. M. DURY AND ASSOC. LTD. MONTREAL, P.Q.
2. SETTLEMENT & STABILITY ANALYSES
 - I LINE #1 & 2 (NORTH APPROACH)
 - II LINE #1 (SOUTH APPROACH)
 - III LINE #4 (NORTH & SOUTH APPROACH)
 - IV LINE #5 (NORTH & SOUTH APPROACH)
3. LETTER REPORT FROM J. J. DURY & ASSOC. LTD.
re: RESULTS AND INTERPRETATION OF ~~RES~~ ELECTRICAL RESISTIVITY SURVEY. (Dated NOV. 11/69)
3. FIELD BOREHOLE SHEETS (BH'S #1 to 11, inclusive).

J. J. DURY AND ASSOCIATES
ENGINEERS

1034 SHERBROOKE STREET WEST
MONTREAL 2, QUEBEC

TELEPHONE: 842-1174

69-F-74

Montreal, November 11th, 1969.

Department of Highways,
Downsview 64,
Ontario.

Attention: Mr. A. Rutka,
Materials and Testing Engineer.

Dear Mr. Rutka

As I understand from Mr. Stermak's telephone call, you are in a hurry to get the sounding results of Lancaster.

You will find herewith three prints of transverse and longitudinal cross sections.

These cross sections should be considered as preliminaries pending the confirmation of contact lines by additional boreholes.

The till interface is well in contrast with the overlying clay deposit. The rock line is as well in good contrast with the overlying granular material.

A formal report will be written when few additional boreholes are correlated to our finding.

In the meanwhile, the following comments are helpful.

. . . /2

.2

The contrast lines, temporarily drawn in pencil in our tracing, are given by group of resistivities. For example, in the cross section of line 6, the classifications are: from 13 to 25 ohms, from 25 to 60 ohms etc. The till interface is obviously between 60 - 75 ohms and 80 - 130 ohms, as indicated by the reported borehole. It is found between two similar groups at line 5 with the exception that the contrast is not as obvious at sounding 1 + 00 South. If these classifications are realistic, the till should be only 12 feet below ground surface at station 5 + 00 South, line 5.

At line 4, the till line is not as obvious and according to the borehole information, the till corresponds to the group 60 - 65 ohms rather than 80 - 100 as in the other two lines. If this is true, then what corresponds to the layer 80 - 100 ohms? This has to be investigated.

A sounding of calibration was achieved at each of the three boreholes. At line 5, the sounding results near the borehole are reliable but not so at lines 6' and 4. The reason for this is that the electrical sounding method is very sensitive to electro-filtration effects resulting from water circulation. We presume that water was percolating in the boreholes at the time of the sounding, and the resistivities came out affected by electrofiltration. At line 4 for example, two measures gave infinite values for the resistivity and at line 6, about all the resistivities were unrealistic.

We presume that the rock line corresponds to the resistivities over 110 ohms as shown by the solid lower line in all cross sections. Since no borehole was carried down to bedrock, this allegation has to be verified by boring.

The longitudinal cross section is quite eloquent and the interfaces correspond to good contrasts. We are however confused by the till interface from station 11 + 00 to 22 + 00 West as it seems according to borehole of line 4 shown near station 16 + 00, that the till line should step up to the upper classification that is, contrast 62 - 71 at line 4, 1 + 00S and 52 - 73 and sounding 22 + 00. Therefore, the layer 80 to 120 ohms would not

.3

necessarily belong to the till zone exclusively. It is therefore advisable to carry on a boring say at station 20 + 00 or somewhere near, along the line. All resistivities reported are absolute, in Ohms per cubic metre.

Line 6 presents two particularities:

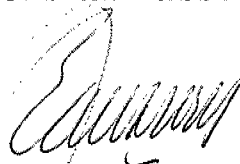
- 1 - in the till zone (from 80 to 130 Ohms), an island of high resistivity zone appears.
- 2 - below the till zone, a layer of low resistivity (from 50 to 80 Ohms) is present.

We can hardly explain these two phenomena.

Please do not hesitate to call on us for further information.

Yours very truly,

J. J. DURY AND ASSOCIATES



J.J. Dury, Eng.

JJD/11

FIELD BORING LOG

LINE #6
Sta. 1+00 South

| | | |
|---------------------------------|--|-------------------------|
| DRILLING CO. <u>Master Soil</u> | DATUM ELEV. _____ | B.H. NO. <u>2</u> |
| DRILLER <u>Doug Dickie</u> | GROUND ELEV. _____ | JOB NO <u>69-f-74</u> |
| ENGINEER _____ | CASING SIZE <u>4"</u> | DATE <u>Nov-20-1969</u> |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS <u>LINE #6</u> | <u>Cone Tests at</u> | |
| | <u>Sta's 1+00's and 5+00</u> | |
| | <u>Cone test No 2 A - STA 5+00 North</u> | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|-----------------------------------|--------|--------------------------------|-------------------------------------|----------------------------|
| FROM | TO | | | |
| 0 | 10 | 5-2-5-7-5-4-5-6-5-3= | <div>OK</div> <div>B.H. No. 9</div> | <div>5+00' N'</div> |
| 10 | 20 | 5-8-7-7-7-8-9-7 8-8= | | |
| 20 | 22 1/2 | 9-105 = 150 = For 3 in: #9 | | |
| End of Cone test 2A | | | | |
| Cone test No 2 "Sta" 1400's south | | | | |
| 0 | 10 | 9-11-4-3-18-7-7-7-7-7= | <div>OK</div> <div>B.H. No. 5</div> | <div>1+00' S'</div> |
| 10 | 20 | 10-12-10-17-91-63-87-49-30-25 | | |
| 20 | 30 | 18-30-25-21-23-18-20-25-21-25= | | |
| 30 | 38 | 17-25-42-52-55-70-97-100-131= | For 5" in | |
| End of Cone No 2. | | | | |

FIELD BORING LOG

LINE #6
Sta. 1+00'S.

DRILLING CO. MAster Soil DATUM ELEV. _____ B.H. NO. 2
 DRILLER Doug Dickie GROUND ELEV. _____ JOB NO. 69-F 94
 ENGINEER _____ CASING SIZE 4 DATE Nov-20/69
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS BH - Line #6 Sta. 1+00'S

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|--------|---|-----------------------------|----------------------------|
| FROM | TO | | | |
| 0 | 1 1/2 | took S-S = Crush Stone gravel = Sinders = | 1 BLOWS | 2-4-6 10 |
| 3 | 4 1/2 | CHANGE to top Soil. And Sand. took S-S- | 2 BLOWS | 6-6-3 9 |
| 6 | 7 1/2 | Drove NX = Change to Brown Clay = Sand = GRAY CLAY. took S-S- | 3 BLOWS | 1-2-3 |
| 9 | 10 1/2 | Drove NX: took Selly = Gray Clay VANE = 12-20+20 800 = 18" PM = 18" | | |
| 0/4 | | 6 = 8+7- | | |
| 12 | 13 1/2 | Drove NX = took Selly little Sand = Clay VANE No TURN. | 6" | PM-6" |
| 15 | 16 1/2 | Drove NX = took S-S = CHANGE to gravel. with some Clay. | BLOWS | 5-6-12 |
| 20 | 21 1/2 | Drove NX = took S-S = Gravel & Sand with Clay. | BLOWS | 4-5-7. |
| 25 | 26 1/2 | Drove NX = took S-S = Same As Above = | BLOWS | 4-12-19 |
| 30 | 31 1/2 | Drove NX = took S-S = gravel, Clay | BLOWS | 22-24-20 |

FIELD BORING LOG

DRILLING CO. M A S T E R S O I L DATUM ELEV. _____ B.H. NO. 2
DRILLER Doug D. C. A. C. GROUND ELEV. _____ JOB NO. 69-F74
ENGINEER _____ CASING SIZE 4 DATE Nov 21 / 69
SITE LOCATION _____
HOLE LOCATION _____
REMARKS _____

[illegible]

FIELD BORING LOG

| | | |
|-----------------------------|--------------------|------------------------|
| DRILLING CO. _____ | DATUM ELEV. _____ | B.H. NO. _____ |
| DRILLER _____ | GROUND ELEV. _____ | JOB NO. <u>69-1-74</u> |
| ENGINEER _____ | CASING SIZE _____ | DATE _____ |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS <u>STATION 3+00</u> | | |

[illegible]

12 ✓

11/6/52

11/6/52

11/6/52

11/6/52

11/6/52

11/6/52

FIELD BORING LOG

| | | |
|-----------------------------|--------------------|------------------------|
| DRILLING CO. _____ | DATUM ELEV. _____ | B.H. NO. _____ |
| DRILLER _____ | GROUND ELEV. _____ | JOB NO. <u>69-F-74</u> |
| ENGINEER _____ | CASING SIZE _____ | DATE _____ |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS <u>station 5+00</u> | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| | | <u>Cone test sta. original hole. BH #1</u> | <u>BH #1</u> | |
| 0 | 10 | 26-11-10-10-12-11-8-10-10-12 | <u>LINE 4</u> | |
| 10 | 18 2" | 24-16-15-15-15-16-16-67-150 2" | <u>BH #1</u> | |
| | | <u>Cone test 4. B.H. 4</u> | | |
| 0 | 10 | 2-2-4-6-3-4-4-5-5-4 | <u>Sta. 20+00 West</u> | |
| 10 | 20 | 6-5-5-6-6-7-8-7-19-20 | <u>50' North.</u> | |
| 20 | 26 4" | 18-20-27-42-79-105-150 4" | <u>BH #1</u> | |
| | | <u>Station 5+00 South LINE #6</u> | | |
| 0 | 5 | <u>fill crushed stone</u> | | |
| 5 | 7 1/2 | <u>sand</u> | | |
| 7 1/2 | 10 | <u>gravel tank SS</u> | <u>Blows</u> | <u>31-26-43</u> |
| 10 | 20 | <u>Washed ahead to 18 ft. with gravel</u> | | <u>67</u> |
| | | <u>no clay.</u> | | |
| | | <u>End of B. H.</u> | | |
| | | <u>Station 5+00</u> | | |


FIELD BORING LOG

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 5
 DRILLER _____ GROUND ELEV. _____ JOB NO. 69-1-14
 ENGINEER _____ CASING SIZE _____ DATE _____
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS station 4+00 north LINE # 6

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-----|---|-----------------------------|----------------------------|
| FROM | TO | | | |
| 0 | 1½ | fill took SS | 1 Blows | 1-3-4 |
| 3 | 4½ | fill sand took SS down N X casing to 3 ft. | 2 Blows | 7-5-8 |
| 6 | 7½ | changed to sand some clay | 3 Blows | 4-3-7 |
| 9 | 10½ | changed to clay took selby Vane 12-10-10 400 6-6-6 120 | 4 PM 18 | |
| 12 | 13½ | clay took selby Vane 12-12-12 480 6-4-4 80 | 5 PM 18 | |
| 15 | 16½ | clay took selby Vane 12-15-14 580 6-8-6 140 14 | 6 PM 18 | |
| 20 | 21½ | clay took selby Vane 12-12-12 480 6-6-6 120 12 | 7 PM 18 | |
| 25 | 26½ | clay took selby little harder Vane 12-16-16 640 6-8-8 160 | 8 PM 18 | |
| 30 | 31½ | clay took selby Vane 12-10-10 400 6-4-4 80 not plotted | 9 PM 18 | |

FIELD BORING LOG

| | | |
|---------------------------------|--------------------|------------------------|
| DRILLING CO. _____ | DATUM ELEV. _____ | B.H. NO. <u>5</u> |
| DRILLER _____ | GROUND ELEV. _____ | JOB NO. <u>69-F-74</u> |
| ENGINEER _____ | CASING SIZE _____ | DATE _____ |
| SITE LOCATION _____ | | |
| HOLE LOCATION <u>LINE #6</u> | | |
| REMARKS <u>Sta. 4+00 North.</u> | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|--------|--------------------------------|--|----------------------------|
| FROM | TO | | | |
| 33 | 35 | changed to till took SS. | 10 | Blows 39-42-45 87 |
| 40 | 41 1/2 | till took SS | 11 | Blows 44-45-54 94 |
| 45 | 46 1/2 | till sand clay took SS | 12 | Blows 54-55-49 99 |
| | | End of B.H. 5 Sta. 4-00 mark | | |
| | | Cone test 5 ft. from BH 5 | | |
| 0 | 10 | 12-13-13-14-7-8-10-13-8-7 | <div style="text-align: center;"> <u>3</u> LINE 6 B.H. 8  </div> | |
| 10 | 20 | 13-10-10-10-10-10-11-11-10-10 | | |
| 20 | 30 | 16-12-11-10-10-11-11-9-10-9 | | |
| 30 | 37 1/4 | 12-11-11-14-14-30-100 150 4" | | |
| | | Cone test sta. 1-00 | | |
| 0 | 10 | 12-8-11-7-5-4-4-4-5-7 | <div style="text-align: center;"> <u>B.H. (original)</u> <u>LINE #6</u> <u>#6</u> </div> | |
| 10 | 20 | 7-8-7-6-7-6-7-5-6-7 | | |
| 20 | 30 | 10-8-7-7-7-8-8-8-10-10 | | |
| 30 | 31 1/2 | 17-175 5" - V | | |
| | | <u>B.H. 6</u> <u>LINE 6</u> | | |

FIELD BORING LOG

LINE #4
Sta 3+00 North

| | | |
|--|-----------------------|-------------------------|
| DRILLING COM <u>MASTER SOIL</u> | DATUM ELEV. _____ | B.H. NO. <u>3</u> |
| DRILLER <u>Doug Dickie</u> | GROUND ELEV. _____ | JOB NO. <u>69-F 74</u> |
| ENGINEER _____ | CASING SIZE <u>4"</u> | DATE <u>Nov-17-1969</u> |
| SITE LOCATION _____ | | |
| HOLE LOCATION <u>BH</u> _____ | | |
| REMARKS <u>LINE #4 Sta 3+00 North</u> <u>NL</u> | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|--------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 6 | 9 | Wash out casing took Seibly Gray Clay. | 18" | P-M 18" |
| 9 | 10 1/2 | Vane = 12 = 16 + 16 = 640 6 = 2 + 2 = 40 | | |
| 9 | 12 | Wash and Drove N-X casing took Seibly Gray Clay. Same as above. | 18" | P-M 18" |
| 13 1/2 | 14 1/2 | Vane = 12 = 12 + 12 = 480 6 = 4 + 4 = | | |
| 12 | 15 | Wash AND Drove N-X Casing Took Seibly Gray Clay with some gravel. | 18" | P-M 18" |
| 16 1/2 | 17 1/2 | Vane 12 = 20 + 20 = 800 6 = 10 + 8 = | | |
| | | Change at 16 ft to gravel. | | |
| 17 1/2 | 19 | Wash AND Drove N-X took Spite - Spone. Ran Rock Roller (gravel) | BLOW | 6-7-5 |
| 18 | 25 | Drive N-X casing RAN ROLLER Took S-S = gravel = Clay | BLOW | 52-20-18 |
| 25 | 30 | Drive N-X Ran Rock Roller took S-S = gravel = Clay. | BLOW | 30-18-16 |

FIELD BORING LOG

DRILLING CO. MASTER SOIL DATUM ELEV. _____ B.H. NO. 3
DRILLER Doug Dickie GROUND ELEV. _____ JOB NO. 69-F-74
ENGINEER _____ CASING SIZE 4" DATE Nov-18-69
SITE LOCATION _____
HOLE LOCATION _____
REMARKS _____

OK

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|----|--|-----------------------------------|----------------------------------|
| FROM | TO | | | |
| 30 | 35 | Drive N.Y. RAN Rock Roller took = S.S. = gravel = Clay. | BLOW | 33-114-11 |
| 35 | 40 | Drive N.Y. RAN Rock Roller took = S.S. gravel = Clay. | BLOW | 63-76-103 |
| 40 | 43 | Drive BX = RAN Rock Roller Hit Boulder RAN Ax Cord Barrel to 48 FT. | 3 FT 8" | |
| | | Broke 5 FT of BX casing. | | |
| 48 | 52 | RAN Ax casing Hit gravel Hit Bedrock at 52 ft. No Sampled in gravel. | | |
| 52 | 58 | RAN Ax Cord Barrel | 4 1/2 FT. | |
| | 6' | END OF B-H-3. | | |

FIELD BORING LOG

| | | |
|---------------------|--------------------|---------------------------|
| DRILLING CO. _____ | DATUM ELEV. _____ | B.H. NO. <u>2 & 4</u> |
| DRILLER _____ | GROUND ELEV. _____ | JOB NO. <u>69 F 74</u> |
| ENGINEER _____ | CASING SIZE _____ | DATE <u>Nov 22</u> |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS _____ | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|--------------------------------------|--------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 43 | 45 | run BX casing with diamonds through bedrock | | |
| 45 | 47 | gravel drone BX casing to 47 ft. hit bedrock | | |
| 47 | 52 | run BX casing 5 ft. | | |
| End of B.H. 2 // | | | | |
| B#4 Sta. 20+00 West offset 50' North | | | | |
| 0 | 1 1/2 | top soil brownish grey clay | 1 Blow 2-2-3 | 2-2-3 |
| 3 | 4 1/2 | reddish brown clay | 2 Blows 4-6-5 | 4-6-5 |
| 6 | 7 1/2 | changed to grey clay soft. with brownish seams | 3 Blows 2-2-3 | 2-2-3 |
| 9 | 10 1/2 | silty grey clay soft. | 4 pm 18 in | |
| | | 15x20 Vane 12-8-7 300 6-4-3 70 | | |
| 12 | 13 1/2 | silty grey clay soft. | 5 pm 18 | |
| | | Vane 6-19-19 380 3-8-8 80 | | |
| 15 | 16 1/2 | silty grey clay harder | 6 pm 18 | |
| | | Vane 16-16-15 310 2-4-3 | | |

FIELD BORING LOG

| | | |
|---|--------------------|------------------------|
| DRILLING CO. _____ | DATUM ELEV. _____ | B.H. NO. <u>4</u> |
| DRILLER _____ | GROUND ELEV. _____ | JOB NO. <u>69-1-74</u> |
| ENGINEER _____ | CASING SIZE _____ | DATE _____ |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS <u>Sta. 2D+00 West</u> <u>offset 50' North</u> | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-----|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 20 | 21½ | Change to gravel with clay in it | 7 BLOW | 38-12-21 |
| | | Change to gravel about 19ft | | |
| 25 | 26½ | gravel Drive N x to 30 ft with clay in it | 8 BLOW | 8-7-4 |
| 30 | 31½ | gravel and Clay | 9 BLOW | 54-18-24 |
| | | No v 26 1969 | | |
| 32 | 33½ | Drive N x casing Hit a Boulder Ran B x casing 18" Hit gravel | | |
| 35 | 36½ | Change to TILL. Hard. Took S.S. | 10 BLOW | 109-25-68 |
| | | Drove A x to 37 ft would not go Ran Rock Roller. | | 93 |
| | | HIT BedRock AT | | |
| | | 37 ft Ran A x cord barrel | | |
| | | 10 ft ? 9 ft Recovery | | |
| | | End at BH 4. | | |

FIELD BORING LOG

DRILLING CO. J.E. Johnston DATUM ELEV. _____ B.H. NO. 4
 DRILLER H. Kerr GROUND ELEV. 158.9 JOB NO. 69-F-74
 ENGINEER _____ CASING SIZE NX & BX DATE Oct 15/69
 SITE LOCATION _____
 HOLE LOCATION 0-0.5' - SAND & gravel
 REMARKS 0.5' - 4.5' - COMPACT BROWN SILTY SAND
4.5' - 16.0' - FIRM GREEN CLAY
16.0' - 25.5' - VERY STIFF TO HARD GLACIAL TILL TOP 142.9

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-------|---|-----------------------------|----------------------------|
| FROM | TO | | | |
| 0 | 5' | NX Casing | | |
| 0 | 25' | BX Casing | | |
| 5' | 6'6" | Hard To Push | T.W. #1 | Pushed |
| 6'6" | 8' | { 46 + 46 at 12" } = 1880 p.s.f. { 12 + 12 at 6" } = 240 p.s.f. | Vanc. | |
| 10' | 11'6" | Easy To Push | T.W. #2 | Pushed |
| 11'6" | 13' | { 25 + 25 at 12" } = 1000 p.s.f. { 11 + 11 at 6" } = 220 p.s.f. | Vanc | |
| 13' | 14' | { 40 + 40 at 6" } = 800 p.s.f. { 12 + 12 at 3" } = 120 p.s.f. | Vanc | |
| 15' | 16'6" | Last 6" Hard To Push | T.W. #3 | Pushed |
| 16'6" | | Could Not Push Vanc. | | |
| 17'6" | 19' | Soft Grey clay Mixed with small stones. | SS, #4 | 12, 6, 5, 11 |
| 19' | | Tried Vane But could not Push. | | |
| 20' | 21'6" | Clay Till with a 2" seam of Fine Black Sand. | SS, #5 | 71-8-14 30 |
| 25' | 25'6" | Grey Till with flakes of Grey shale, { End of Hole 25'6" } Water level at end of Hole, - 5'3" | SS, #6 | 116, - 6" |

FIELD BORING LOG

| | | |
|------------------------------------|------------------------------------|------------------------|
| DRILLING CO. <u>J. E. Johnston</u> | DATUM ELEV. _____ | B.H. NO. <u>5</u> |
| DRILLER <u>D. Kerr</u> | GROUND ELEV. <u>159.2</u> | JOB NO. <u>69-F-74</u> |
| ENGINEER _____ | CASING SIZE <u>1 1/2" x 8 1/2"</u> | DATE <u>Oct 16/69</u> |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS _____ | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 0 | 5' | NX Casing | | |
| 0 | 45' | BX Casing | | |
| 5' | 6'6" | Pushed easily | T.W. #1 | Pushed |
| 6'6" | 8' | $\left(\begin{array}{l} 50 + 50 \text{ at } 12'' \\ 14 + 14 \text{ at } 6'' \end{array} \right) = \begin{array}{l} 2000 \text{ p.s.f.} \\ 280 \end{array}$ | Vanc | |
| | | | C. | |
| 10' | 11'6" | Pushed easily | T.W. #2 | Pushed |
| 11'6" | 13' | $\left(\begin{array}{l} 22 + 22 \text{ at } 6'' \\ 10 + 10 \text{ at } 3'' \end{array} \right) = \begin{array}{l} 440 \text{ p.s.f.} \\ 100 \text{ p.s.f.} \end{array}$ | Vanc | |
| 13' | 14' | $\left(\begin{array}{l} 20 + 20 \text{ at } 6'' \\ 12 + 12 \text{ at } 3'' \end{array} \right) = \begin{array}{l} 400 \text{ p.s.f.} \\ 120 \text{ p.s.f.} \end{array}$ | Vanc | |
| 15' | 16'6" | Pushed easily | T.W. #3 | Pushed |
| 16'6" | 18' | $\left(\begin{array}{l} 27 + 27 \text{ at } 6'' \\ 8 + 8 \text{ at } 3'' \end{array} \right) = \begin{array}{l} 540 \\ 80 \end{array}$ | Vanc | |
| 18' | 19'6" | $\left(\begin{array}{l} 30 + 30 \text{ at } 6'' \\ 6 + 6 \text{ at } 3'' \end{array} \right) = \begin{array}{l} 600 \\ 60 \end{array}$ | Vanc | |
| 20' | 21'6" | Pushed easily | T.W. #4 | Pushed |
| 21'6" | 23' | $\left(\begin{array}{l} 27 + 27 \text{ at } 6'' \\ 5 + 5 \text{ at } 3'' \end{array} \right) = \begin{array}{l} 540 \\ 50 \end{array}$ | | |

FIELD BORING LOG

| | | |
|-----------------------------------|-----------------------------|------------------------|
| DRILLING CO. <u>J.E. Johnston</u> | DATUM ELEV. _____ | B.H. NO. <u>5</u> |
| DRILLER <u>D. Kerr</u> | GROUND ELEV. _____ | JOB NO. <u>69-F-74</u> |
| ENGINEER _____ | CASING SIZE <u>NX 4 BX.</u> | DATE <u>Oct 16/69</u> |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS _____ | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|---------|---|-----------------------------|----------------------------|
| FROM | TO | | | |
| 23' | 24 1/2" | { 27 + 27 at 6" } = 540 { 5 + 5 at 3" } = 50 | Vanc. | |
| 25' | 26 1/2" | Pushed easily | T.W. #5 | Pushed |
| 26 1/2" | 28' | { 28 + 28 at 6" } = 560 { 6 + 6 at 3" } = 60 | Vanc | |
| 28' | 29 1/2" | { 24 + 24 at 6" } = 480 { 5 + 5 at 3" } = 50 | Vanc | |
| 30' | 31 1/2" | Pushed easily | T.W. #6 | Pushed |
| 31 1/2" | 33' | { 38 + 38 at 6" } = 760 { 12 + 12 at 3" } = 120 | Vanc | |
| 33' | 34 1/2" | { 34 + 34 at 6" } = 680 { 8 + 8 at 3" } = 80 | Vanc | |
| 35' | 36 1/2" | Pushed easy | T.W. #7 | Pushed |
| 36 1/2" | 38' | { 38 + 38 at 6" } = 760 { 14 + 14 at 3" } = 140 | Vanc | |
| 38' | 39 1/2" | { 30 + 30 at 12" } = 600 { 12 + 12 at 6" } = 120 | Vanc | |
| 40' | 41 1/2" | Clay till, with pieces, of Broken Shale Tried Shelby But could not Push. | SS. # 8 | 9, 11, 6, 17 |

| | | |
|-----------------------------------|--------------------------------|------------------------|
| DRILLING CO. <u>F.E. Johnston</u> | DATUM ELEV. _____ | B.H. NO. <u>5</u> |
| DRILLER <u>G. Kerr</u> | GROUND ELEV. _____ | JOB NO. <u>69-F-74</u> |
| ENGINEER _____ | CASING SIZE <u>NX & BY</u> | DATE <u>Oct 16/69</u> |
| SITE LOCATION _____ | | |
| HOLE LOCATION _____ | | |
| REMARKS _____ | | |

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|--------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 45' | 45'10" | | SS, #9 | 43-6" 110-4" |
| | | Hammer was not Bouncing, Like Refusal, | | |
| | | Water Level at end of Hole 8' | | |
| | | <u>SIMPLIFIED SOIL STRATIGRAPHY</u> | | |
| 0' | 1.5' | TOPSOIL | | |
| 1.5' | 40.0' | SOFT TO FIRM GREY CLAY. | | |
| 40.0' | 45.9' | VERY STIFF TO HARD GREY CLAYEY SILT, with SAND & gravel (<u>GLACIAL TILL</u>) | TOP ELEV. 119 | |
| | | Bedrock ? | | |

FIELD BORING LOG

DRILLING CO. J.E. Johnston DATUM ELEV. _____ B.H. NO. 6
 DRILLER G. Kerr GROUND ELEV. 161.5 JOB NO. 68-F-74
 ENGINEER _____ CASING SIZE _____ DATE Oct 15/69
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS _____

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 0 | 5' | NX casing. | | |
| 0 | 30'6" | BX casing. | | |
| 5' | 6'6" | Pushed easily | T.W.#1 | Pushed |
| 6'6" | 8' | $\left\{ \begin{array}{l} 38 + 38 \text{ at } 12'' \\ 12 + 12 \text{ at } 6'' \end{array} \right\} = 1520 \text{ p.s.f.}$ $\left\{ \begin{array}{l} 12 + 12 \text{ at } 6'' \\ 12 + 12 \text{ at } 6'' \end{array} \right\} = 240 \text{ p.s.f.}$ | Vane | |
| 10' | 11'6" | Pushed easily | T.W.#2 | Pushed |
| 11'6" | 13' | $\left\{ \begin{array}{l} 32 + 32 \text{ at } 6'' \\ 9 + 9 \text{ at } 3'' \end{array} \right\} = 640 \text{ p.s.f.}$ $\left\{ \begin{array}{l} 9 + 9 \text{ at } 3'' \\ 9 + 9 \text{ at } 3'' \end{array} \right\} = 90 \text{ p.s.f.}$ | Vane | |
| 15' | 16'6" | Pushed easily | C. T.W.#3 | Pushed |
| 16'6" | 18' | $\left\{ \begin{array}{l} 26 + 26 \text{ at } 6'' \\ 10 + 10 \text{ at } 3'' \end{array} \right\} = 520 \text{ p.s.f.}$ $\left\{ \begin{array}{l} 10 + 10 \text{ at } 3'' \\ 10 + 10 \text{ at } 3'' \end{array} \right\} = 100 \text{ p.s.f.}$ | Vane | |
| 18' | 19'6" | $\left\{ \begin{array}{l} 43 + 43 \text{ at } 6'' \\ 11 + 11 \text{ at } 3'' \end{array} \right\} = 860 \text{ p.s.f.}$ $\left\{ \begin{array}{l} 11 + 11 \text{ at } 3'' \\ 11 + 11 \text{ at } 3'' \end{array} \right\} = 110 \text{ p.s.f.}$ | Vane | |
| 20' | 21'6" | Pushed easily | T.W.#4 | Pushed |
| 21'6" | 23' | $\left\{ \begin{array}{l} 33 + 33 \text{ at } 6'' \\ 10 + 10 \text{ at } 3'' \end{array} \right\} = 660 \text{ p.s.f.}$ $\left\{ \begin{array}{l} 10 + 10 \text{ at } 3'' \\ 10 + 10 \text{ at } 3'' \end{array} \right\} = 100 \text{ p.s.f.}$ | Vane | |
| 23' | 24'6" | $\left\{ \begin{array}{l} 35 + 35 \text{ at } 6'' \\ 10 + 10 \text{ at } 3'' \end{array} \right\} = 700 \text{ p.s.f.}$ $\left\{ \begin{array}{l} 10 + 10 \text{ at } 3'' \\ 10 + 10 \text{ at } 3'' \end{array} \right\} = 100 \text{ p.s.f.}$ | Vane | |

FIELD BORING LOG

DRILLING CO. J E Johnston DATUM ELEV. _____ B.H. NO. 6
 DRILLER D. Kerr GROUND ELEV. _____ JOB NO. 69-F-74
 ENGINEER _____ CASING SIZE NX, 4 BX DATE Oct 15/69
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS _____

| DEPTH FEET | | DESCRIPTION | SAMPLE TYPE, NO. & RECOVERY | METHOD OR BLOWS & DISTANCE |
|------------|-------|--|-----------------------------|----------------------------|
| FROM | TO | | | |
| 25' | 26'6" | Hard To Push | T.W. #5 | Pushed |
| 26'6" | 28' | $\left(\begin{array}{l} 36 + 36 \text{ at } 12'' \\ 12 + 12 \text{ at } 6'' \end{array} \right) = 1440 \text{ p.s.f.}$ $\left(\begin{array}{l} 36 + 36 \text{ at } 12'' \\ 12 + 12 \text{ at } 6'' \end{array} \right) = 240 \text{ p.s.f.}$ | | |
| 28'6" | 30' | Clay with clay till | S.S. #6 | 10, 10, 15, 25 |
| 30'6" | 32' | Clay Till; with pieces of grey shale | S.S. #7 | 10, 12, 15, 27 |
| | | (End of Hole 32') | | |
| | | Water level at end of hole | | |
| | | { 4'4" } | | |
| | | SIMPLIFIED SOIL STRATIGRAPHY | | |
| 0' | 1'5" | TOPSOIL (CLAYEY SANDY) | | |
| 15' | 28.5' | FIRM GREY CLAY | | |
| 28.5' | 32.0' | VERY STIFF CLAYEY SILT, with SAND & gravel (Glacial Till) | TOP ELEV. 133 | |
| | | Bedrock | TOP ELEV. ? | |

161
28.5
133.0

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Materials & Testing Office,
Downsview, Ontario.

FROM: Engineering Surveys Office,
Postal Bag 4000,
Kingston, Ontario,

ATTENTION:

DATE: Oct. 20/69.

OUR FILE REF.

IN REPLY TO

SUBJECT:

69-F-74

W. P. 256-66, Hwy # 34, District # 9, Ottawa,
C.N.R. Railway Lancaster, Twp. of Charlottenburgh,
Co. Glengarry.

I am enclosing one print of notes compiled on sites
as noted.



G. E. Costello,
for A. G. Boucher,
Regional Superintendent.

encl.

GEC/AGB/kg

450 Scheme 5

140

C.N. 84

#34

40

35

0

82

SCHEME 6

LANCASTER

413 SCHEME 4

PARTY NAMES

W.P. No.

DATE

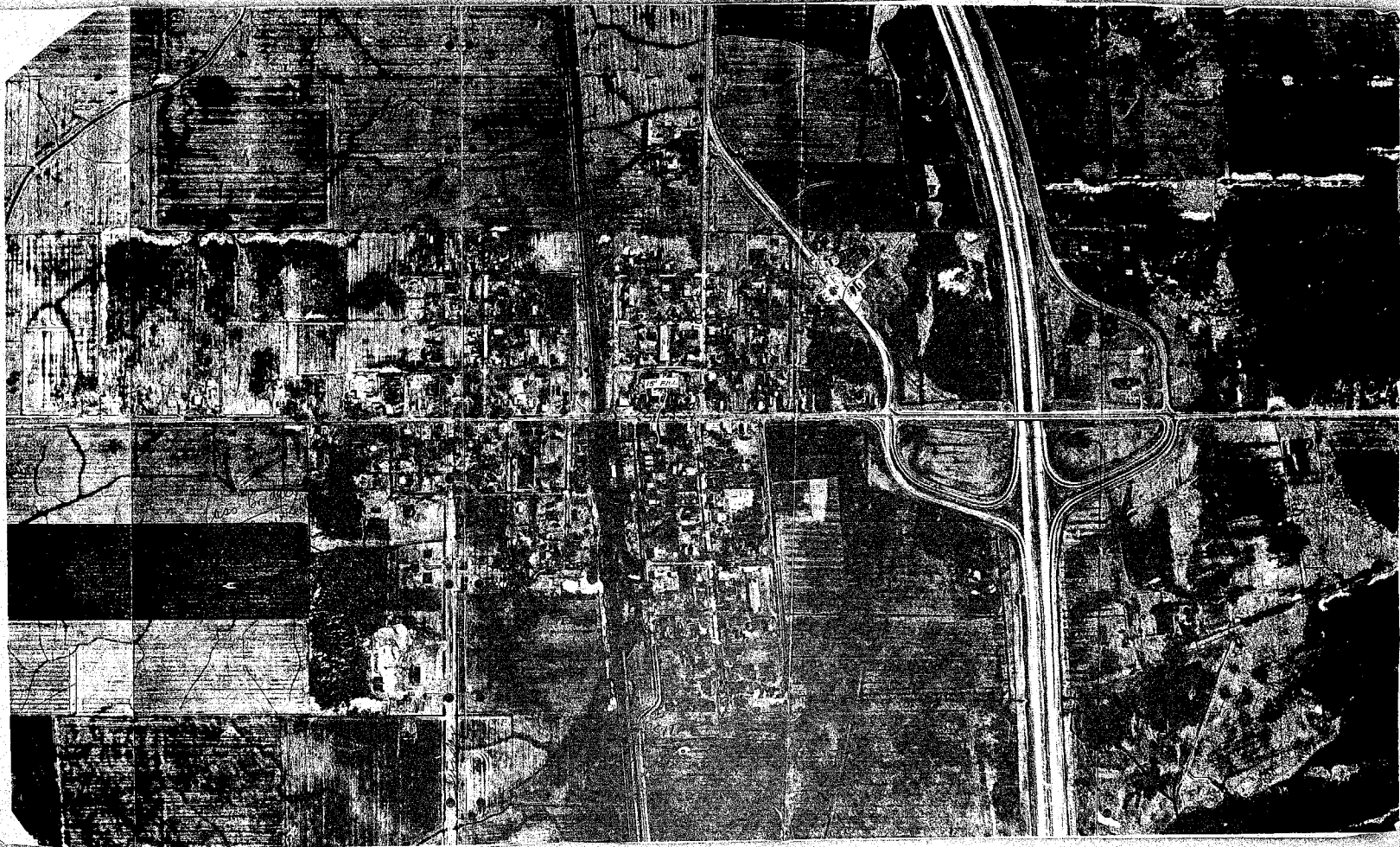
| STA. | B.S. | HI. | I.S. | F.S. | ELEV. | REMARKS |
|----------|-----------------|-------------------|----------------|-----------------|--------|---------------|
| | | | | | | 165.90 |
| GBM | 3 ⁸⁰ | 169 ¹⁰ | | | | CALL EXN |
| DLXXI | | | | | | N.E. CORNER |
| | | | | | | 3' FROM FRONT |
| | | | | | | CORNER IN |
| | | | | | | 10' CORNER |
| | | | | | | OF STATION |
| | | | | | | PUBLIC 19 |
| SCHEME 6 | | | 8 ² | | 161.5 | LANCASTER |
| SITE | | | | | | |
| TP | 3 ⁷ | 168 ³⁹ | | 5 ⁰² | 164.68 | |
| | | | | | | |
| TP | A ¹⁶ | 168 ⁰¹ | | 3 ⁷¹ | 164.65 | |
| | | | | | | |
| GBM | 3 ⁸⁸ | 169 ⁷⁹ | | 2 ⁹⁰ | 165.91 | 165.90 |
| | | | | | | DLXXI |
| TP | A ⁰⁷ | 169 ³⁰ | | A ⁵⁶ | 165.23 | |
| | | | | | | |
| TP | 3 ⁴⁶ | 167 ⁹⁸ | | A ⁷⁸ | 164.52 | |
| | | | | | | |
| SCHEME 5 | | | 9 ⁰ | | 159.10 | |
| SITE | | | | | | |
| TP | A ⁶⁴ | 169 ⁴⁵ | | 3 ¹⁷ | 164.81 | |
| | | | | | | |
| TP | A ³⁵ | 169 ⁴⁸ | | A ³³ | 165.13 | |
| | | | | | | |
| GBM | | | | 3 ⁶⁵ | 165.83 | 165.90 |
| DLXXI | | | | | | RED. 1/20 |
| | | | | | | CH'K'D. |

W. P. No.

DATE _____

[illegible]

THIS SIDE UP



69-F-74

LEGEND

- ◆ - Bare hole (11) put down during period of Oct. 18 and 19, 1969 - extend through clay into underlying gravel (1, 11)
- - Electrical Resistance Soundings (23+24) Bare hole (1) put down during period of Oct. 18 and 19, 1969 - extend through clay into underlying gravel (1, 11)

69-F-74

W.P. 256-66

H.W.Y. #34 AND C.N.R.

LINES 1, 2, 4, AND 5

OVERHEAD STRUCTURE

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

ATTENTION: Mr. S. McCombie

DATE: January 22, 1970

OUR FILE REF.

IN REPLY TO

FEB 2 1970

SUBJECT:

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For Proposed Overhead Structure
At the Crossing of Revised Hwy. #34
And the C.N.R.
Alternate Alignments Nos. 1, 2, 4 & 5
Village of Lancaster, Co. of Clengarry
District No. 9 (Ottawa)
W.J. 69-P-74 -- W.P. 256-66

Attached, we are forwarding to you, our Preliminary Foundation Investigation Report pertaining to the above sites. Presented in this report are the results of the investigation, together with our general comments pertaining to the stability of the approaches and recommendations regarding structure foundations at various crossings.

We believe that the information contained therein will prove adequate for your immediate use. Should you require further data, or clarification of the report, please feel free to contact this Office.

AGS/EdF
Attach.

cc: Messrs. B. R. Davis
H. A. Tregaskes
D. W. Parren
S. J. Markiewicz
C. R. Robertson
R. R. Brnesaks (2)
I. C. Kingsland (2)
I. C. Campbell
J. E. Gruspler
B. A. Singh

Foundations Files
Gen. Files

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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-

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For Proposed Overhead Structure
At the Crossing of Revised Hwy. #34
And the C.N.R.
Alternate Alignments Nos. 1, 2, 4 & 5
Village of Lancaster, Co. of Glengarry
District No. 9 (Ottawa)
W.J. 89-F-74 -- W.P. 256-66

1. INTRODUCTION:

The Foundation Section was requested to provide preliminary subsoil information to aid the Regional Functional and Bridge Planning Sections, (Eastern Region) in carrying out a feasibility study for the alternate alignments proposed for the crossing of revised Hwy. #34 and the C.N.R., in the vicinity of the Village of Lancaster, County of Glengarry. The investigation was requested in a memo from Mr. T. C. Kingsland, Regional Bridge Planning Engineer, dated October 9, 1969. An investigation was subsequently carried out by this Section to determine the subsoil conditions at the four alternate crossings, designated as Lines 1, 2, 4 and 5.

This report contains the data obtained from the investigation, together with preliminary comments relating to foundation design, as well as the stability of the approach fills, at the alternate sites.

2. DESCRIPTION OF THE AREA AND GEOLOGY:

The area under investigation is located in the immediate vicinity of the Village of Lancaster; specifically along the existing C.N.R. tracks both east and west of Hwy. #34. The terrain is flat to gently undulating in relief between elevations 158 and 162. The majority of the area is being utilized as farm land. The strip along Hwy. #34 is, however, built up. The C.N.R. tracks

2. DESCRIPTION OF THE AREA AND GEOLOGY: (cont'd.) ...

are carried on an embankment which is approximately 2 to 4 feet above the surrounding ground surface.

Physiographically the area is situated in the region known as the "Lancaster Flats". In this region the till plain is buried beneath water-laid deposits leaving exposed only the stoney crests of a few drumlins and ridges. The water-laid materials range from highly compressible clay to very fine sand; the thickness of these deposits vary from 10 to up to 45 feet. The glacial till is underlain by limestone and shale bedrock of the Chazy group, Ordovician Period.

Drainage of the area is towards the St. Lawrence River by way of the Raisin and Baudet Rivers, as well as a number of other shorter streams. The land is so flat that the area is poorly drained.

3. SUBSOIL AND BEDROCK CONDITIONS:

3.1) General:

Nine sampled boreholes, 6 of which were accompanied by a dynamic cone penetration test, were put down during the course of the recent field investigation. Two additional dynamic cone penetration tests were put down as well. The borings were advanced by means of conventional diamond drill rigs adapted for soil sampling purposes.

The predominant stratum across the area is composed of a soft to firm sensitive marine clay, the overall thickness of which varies from a few feet to up to 50 feet. In general, the thickness of the stratum increases in an easterly as well as a northerly direction. The cohesive stratum is underlain by a dense glacial till deposit, followed, in turn, by shale bedrock, the surface of which varies between elevations 107 and 120.

3. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

3.1) General: (cont'd.) ...

The clay is periodically overlain by a thin (2 to 4 feet thick) granular deposit; in the vicinity of Hwy. #34 up to 7 feet of fill was encountered.

The boundaries of the various deposits, as determined in the boreholes, are shown on the borelog sheets, contained in Appendix I of this report. The location and elevation of all the borings are shown on Drawing No. 69-P-74A, together with the estimated stratigraphical profile along the alternate alignments.

From ground surface downwards, the various soil types encountered are as follows:

3.2) Surficial Deposits:

South of the C.N.R. tracks, along Line #2 (in the vicinity of Hwy. #34), fill composed of a loose silty sand with cinders and crushed stone, was encountered. This fill was placed during the grading and levelling operations in this built-up area.

In the western portion of the area under investigation, a 2 to 4 foot thick surficial deposit of compact ('N' values between 12 and 13 blows/ft.) soil is present. The composition of this material varies from a silty sand with a trace of gravel to a silt with a trace of clay.

3.3) Clay Stratum (Sensitive):

The surficial deposits are underlain by the predominant stratum across the area, a grey sensitive marine clay, with a trace of sand and occasional inclusions of organic matter. The overall thickness of the clay varies from a few feet (400 to 500 feet south of the C.N.R. tracks) to greater than 50 feet (north of the C.N.R. along Line #5) - i.e., in general, the thickness increases in a northerly as well as an easterly direction in this area. The upper 5 to 10 feet of the stratum is mottled grey and

2. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

3.3) Clay Stratum (Sensitive): (cont'd.) ...

brown in colour, indicating that this zone has been desiccated forming a crust. Occasional randomly oriented seams and partings of silt and sand, up to 1/4 inch thick, are located throughout.

Atterberg limit tests were carried out on representative samples of the clay. The results of this testing, which are plotted on the borelog sheets, are also summarized on the Plasticity Chart, Figure #1. The results indicate that the clay is inorganic and of high plasticity. The natural moisture content is consistently greater than the liquid limit, which would indicate that the deposit is quite sensitive.

The field and laboratory undrained shear strength testing results are plotted on the Record of Borelog sheets. This testing indicates that the undrained shear strength of the lower, more compressible portion of the stratum varies from about 400 to 1,000 p.s.f., while in the upper desiccated zone the values range from 1,600 to greater than 2,000 p.s.f. Based on these results, it is estimated that the consistency of the lower zone is in the soft to firm range, while the crust varies from stiff to very stiff.

Three consolidation tests, the results of which are shown on Figure #2, were carried out on samples of the more compressible portion of the clay. The testing indicated that, in this area, the clay is preconsolidated by between 750 to 1,500 p.s.f. in excess of existing overburden pressure. The corresponding compression indices (C_c) and void ratio (e_0) were typically of the order of 1.5 to 1.9 and 2.0 to 2.4, respectively.

3.4) Glacial Till:

The clay stratum is underlain by a glacial till of heterogeneous composition; where fully penetrated, the overall thickness was found to vary from 18 feet (B.R. #10) to 35 feet (B.R. #3). The glacial till is generally granular in nature - i.e.,

3. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

3.4) Glacial Till: (cont'd.) ...

composed of silt, sand and gravel. There are cohesive zones throughout, however, where the matrix is composed of a clayey silt binding sand and gravel. The upper 5 to 7 feet of the deposit is often in a 'reworked' condition. At those locations where the deposit is most extensive (refer to B.H.'s #3 and 5), the lower zone is very bouldery in nature; it was necessary to employ diamond drilling techniques to advance the borings through this zone. The thickness of this bouldery area varies from 6 to 9 feet; the boulders were up to 12 inches in size. The range in the grain-size gradation of the matrix of this subsoil, other than in the bouldery zone, is indicated by the grading curves plotted on Figure #3.

Standard penetration resistance tests were carried out within this deposit; the results are plotted on the Record of Borelog sheets. This testing gave 'N' values which vary between 23 blows/ft. to 178 blows/9 inches, being generally greater than 35 blows/ft. In the upper 'reworked' zone the 'N' values range from 11 to 18 blows/ft. Based on these values, it is estimated that the relative density of the granular portions of the till is in the compact to very dense range, while the consistency of the zones with a cohesive matrix varies from very stiff to hard. The upper 'reworked' zone has a compact relative density (granular portion) or, alternatively, a stiff consistency (cohesive areas).

3.5) Shale Bedrock:

Bedrock was proven at three of the boring locations by obtaining between 6 and 10 feet of AXT size rock core. The surface of the bedrock varies from elevation 107 (B.H. #3) to 120 (B.H. #11), which corresponds to depths below ground surface of 52 and 37 feet, respectively.

3. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

3.5) Shale Bedrock: (cont'd.) ...

The bedrock is composed of a grey shale with randomly oriented interbeds of limestone. In general, it is sound throughout; some signs of fracturing and jointing were, however, observed in the upper 3 to 4 feet at B.H.'s #3 and 11.

4. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out in the open borings, during the period of the investigation. The observations are recorded on the borelog sheets and summarized on Drawing No. 69-F-74A. The results of the measurements indicate that the piezometric groundwater level, within the overburden deposits, generally varies from elevation 151 to 157, which corresponds to a depth of between 4 and 9 feet below existing ground surface.

5. DISCUSSION AND RECOMMENDATIONS:

5.1) General:

It is proposed to construct an overhead structure at the crossing of realigned Hwy. #34 and the C.N.R., in the vicinity of the Village of Lancaster, County of Glengarry. Four possible alignments are being considered; namely, Lines #1 and 2 (near Hwy. #34), #4 (most westerly) and #5 (most easterly). The respective locations of these alternate alignments are shown on Drawing No. 69-F-74A.

At this stage only preliminary design information is available for these crossings. This data is contained on separate unnumbered profiles, provided by the Eastern Region Functional Planning Section (dated October, 1969). Based on this information, however, preliminary recommendations pertaining to structure foundations, as well as the stability and consolidation settlement

5. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

5.1) General: (cont'd.) ...

of the approach fills at each location, will be given in tabular form in the sub-sections to follow:

5.2) LINE #1 (Approx. 250 ft. East of the Centre-line of Hwy. #34):

If this alignment is adopted, the proposed overhead structure will have three spans (approx. 120'-145'-115'), incorporating 'perched' abutments and two piers. The profile grade of Hwy. #34 will vary from elevation 190 (north approach) to elevation 184 (south approach). The C.N.R. tracks will be carried on an embankment, the crest of which is at about elevation 165 - i.e., 4 to 5 feet above the surrounding ground surface.

Because of space restrictions between the approach and existing structures, a portion of the east side of the south approach fill will be retained by a wall (maximum height - 15 to 16 feet above ground surface).

FOUNDATION RECOMMENDATIONS - LINE #1
(Subsoil Conditions Referenced to Line #2)

| STRUCTURES | A P P R O A C H E M B A N K M E N T S | | REMARKS |
|--|--|--|--|
| | <u>NORTH</u> Approx. Thickness of Clay Stratum - 38' maximum. Height of Fill Proposed - 29' | <u>SOUTH</u> Approx. Thickness of Clay Stratum - 8' maximum. Height of Fill Proposed - 25' | |
| <u>Piers and Abutments:</u> Supported on end-bearing piles driven to practical refusal within the glacial till, or to bedrock. - estimated tip elev. between 110 and 120. - designed for max. capacity of the pile section chosen. (Note: Capacity of piles supporting North Abutment may have to be reduced in order to allow for negative skin frictional effects.) <u>Retaining Wall:</u> Spread footings, founded within the glacial till (between elev.'s 153 and 155), using an allowable bearing value of 2.5 t.s.f. in design. | <u>Stability:</u> 1) Fills up to 23' (with 2:1 slopes) will be stable. 2) Fills in excess of 23' will require berms in all directions. - mid-height berms of 50' will be required for a fill height of 29' (F.S. ≥ 1.3). <u>Probable Consolidation Settlement:</u> 1) 23' fill (2:1 slopes) - 1½ to 1¾' in 18 months. 2.5' to 3' in 8 years(max.) 2) 29' fill with a berm length of 50' at mid-height - 2' to 2.5' in 18 months. 4' to 4.5' in 8 years(max.) | <u>Stability:</u> 1) Fills up to 23' (with 2:1 slopes) will be stable. 2) Fills in excess of 23' will require berms in all directions. - mid-height berm of 10' will be required for a fill height of 25'. <u>Probable Consolidation Settlement:</u> 25' fill with a berm length of 10' at mid-height. - within 0.5' | Consideration should be given to constructing the approach fills prior to construction of the structure foundations in order to minimize the post-construction settlement. <u>Note:</u> Retaining Wall (16' in height) will be inherently stable, provided the footings are located within the glacial till. |

5. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

5.3) LINE #2 (Approx. 175 ft. West of the Centre-line of Hwy. #34):

Along this alternate alignment the proposed overhead structure will have 4 spans (approx. 115'-80'-140'-170'), incorporating 'perched' abutments and three piers. The profile grade of Hwy. #34 will vary from elevation 130 (north approach) to 175 (south approach). The C.W.R. tracks will be carried on an embankment, the crest of which is at about elevation 165 - i.e., 2 to 4 feet above the surrounding ground surface.

Because of space restrictions between the approaches and existing structures, both the east and west sides of the south approach fill will be retained by a wall (maximum height of 15 feet above ground surface).

FOUNDATION RECOMMENDATIONS - LINE #2

| STRUCTURES | APPROACH EMBANKMENTS | | REMARKS |
|--|---|--|---|
| | NORTH | SOUTH | |
| | Approx. Thickness of Clay Stratum - 38' maximum. Height of Fill Proposed - 29' | Approx. Thickness of Clay Stratum - 5' maximum. Height of Fill Proposed - 15' | |
| <u>Piers and Abutments:</u> Supported on end-bearing piles driven to practical refusal within the glacial till, or to bedrock. - estimated tip elev. between 110 (North side) and 120 to 125 (South side) - designed for max. capacity of the pile section chosen. (Note: Capacity of piles supporting North Abutment may have to be reduced in order to allow for negative skin frictional effects.) <u>Retaining Walls:</u> Spread footings founded within the glacial till (between elev.'s 153 and 155), using an allowable bearing value of 2.5 t.s.f. in design. | <u>Stability and Consolidation Settlement</u> predictions similar to those discussed for Line #1 (Sub-Section 5.2)). | <u>Stability:</u> The approach fill will be inherently stable. <u>Consolidation Settlement:</u> - should be negligible. | Consideration should be given to constructing the approach fills - (particularly the North Approach' prior to construction of the structure foundations in order to minimize the post-construction settlement. <u>Note:</u> The retaining walls (15' in height) will be inherently stable, provided the footings are located within the glacial till deposit. |

5. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

5.4) LINE #4 (2,700 ft. West of the Centre-line of
Rwy. #34):

The overhead structure along this alignment would have three spans (approx. 115'-55'-115'), incorporating 'perched' abutments and two piers. The profile grade across the structure would vary between elevations 190 and 192. The C.N.R. tracks will be carried on an embankment, the crest of which is at about elevation 164 - i.e., approximately 6 feet above the surrounding ground surface.

FOUNDATION RECOMMENDATIONS - LINE #4

| STRUCTURE | A P P R O A C H E M B A N K M E N T S | | REMARKS |
|---|--|--|---|
| | NORTH | SOUTH | |
| | Approx. Thickness of Clay Stratum - 14' maximum. Height of Fill Proposed: Longitudinal - 28' Transverse - 33' | Approx. Thickness of Clay Stratum - 9' maximum. Height of Fill Proposed: Longitudinal - 28' Transverse - 33' | |
| <u>Piers and Abutments:</u> Supported on end-bearing piles driven to practical refusal within the glacial till stratum. - estimated tip elev. 115 to 130. - designed for max. capacity of the pile section chosen. | <u>Stability:</u> a) <u>Transverse Direction</u> - 1) Fills up to 22' (with 2:1 slopes) will be stable. 2) Fills in excess of 22' will require berms in all directions. - mid-height berm of 40' will be required for a fill height of 33' (P.S. ≥ 1.3) b) <u>Longitudinal Direction</u> - - mid-height berm of 35' will be required for a height of 28'. <u>Consolidation Settlement:</u> 1) 20' fill (2:1 slopes) - 1/2' in 4 months 1' to 1 1/2' in 5 years (max.) 2) 33' fill with a berm length of 40' at mid-height- 1' to 1 1/2' in 4 months. 2' to 2 1/2' in 5 years (max.) | <u>Stability:</u> a) <u>Transverse Direction</u> - 1) Fills up to 30' (with 2:1 slopes) will be stable. 2) Fills in excess of 30' will require berms in all directions. - mid-height berm of 10' will be required for a fill height of 33' b) <u>Longitudinal Direction</u> - - mid-height berm of 5' will be required for a fill height of 28'. <u>Consolidation Settlement:</u> 33' fill with a berm length of 10' at mid-height- 1/2' in 4 months. 3/4' to 1' in 5 years (max.) | 1) Consideration should be given to constructing the approach fills prior to construction of the structure foundations in order to minimize the post-construction settlement. 2) If it is economically feasible, consideration should be given to sub-excavating the clay deposit beneath the approaches. This will eliminate settlement and stability problems. |

5. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

5.5) LINE #5 (1,100 ft. East of the Centre-line of Hwy. #34):

The overhead structure along this alignment would have three spans (approx. 110'-55'-110'), incorporating 'perched' abutments and two piers. The profile grade across the structure would vary between elevations 190 and 192. The C.M.R. tracks will be carried on an embankment, the crest of which is at about elevation 164 - i.e., approximately 4 to 5 feet above the surrounding ground surface.

FOUNDATION RECOMMENDATIONS - LINE #5

| STRUCTURE | APPROACH EMBANKMENTS | | REMARKS |
|---|---|---|--|
| | NORTH | SOUTH | |
| | Approx. thickness of Clay Stratum - 50' maximum. Height of Fill Proposed: Longitudinal - 26' Transverse - 31' | Approx. Thickness of Clay Stratum - 34' maximum. Height of Fill Proposed: Longitudinal - 26' Transverse - 31' | |
| <u>Piers and Abutments:</u> Supported on end-bearing piles driven to practical refusal within the glacial till stratum. - designed for max. capacity of the pile section chosen at pier locations. (Note: Capacity of piles supporting abutments may have to be reduced in order to allow for negative skin frictional effects.) | <u>Stability:</u> a) <u>Transverse Direction</u> - 1) Fill up to 21' (with 2:1 slopes) will be stable. 2) Fills in excess of 21' will require berms in all directions. - mid-height berm of 70' will be required for a fill height of 31' (F.S. ≥ 1.3). b) <u>Longitudinal Direction</u> - - mid-height berm of 50' will be required for a height of 26'. <u>Consolidation Settlement:</u> 1) 20' fill (2:1 slopes) - 1½' in 2 years. 2½' to 3' in 10 years (max.) 2) 31' fill with a berm length of 70' at mid-height - 2½' to 3' in 2 years. 5' to 6' in 10 years (max.) | <u>Stability:</u> The stability requirements in both a) transverse direction, and b) longitudinal direction will be similar to those given for the North Approach fills. <u>Consolidation Settlement:</u> 1) 20' fill (2:1 slopes) - 1' in 2 years. 1½' to 2' in 10 years (max.) 2) 31' fill with a berm length of 70' at mid-height - 1½' to 2' in 2 years. 3½' to 4' in 10 years (max.) | Consideration should be given to constructing the approach fills prior to construction of the structure foundations in order to minimize the post-construction settlement. |

6. CONCLUSIONS - FEASIBILITY OF ALTERNATE ALIGNMENTS -
(Lines #1, 2, 4 and 5):

From a foundation point of view, it would be advantageous to select the alignment, along which the overall thickness of the compressible clay is least and the strength-compressibility characteristics of the deposit are as favourable as possible.

For comparison purposes, the preliminary predictions relating to the stability and settlement of the most critical approach at each of the alternate alignments (north approach), are presented in tabular form below:

-- NORTH APPROACH TO PROPOSED OVERHEAD STRUCTURE --

| <u>Line No.</u> | <u>Max. Thickness of Clay Stratum</u> | <u>Max. Ht. of Fill Prop.</u> | <u>Length of Berm Required (at Mid-Ht.)</u> | <u>Max. Predicted Consolidated Settlement</u> |
|-----------------|---|-----------------------------------|---|---|
| 4 | 14 ft. | 33 ft. | 40 ft. | 2' to 2½' in 5 yrs |
| 1 and 2 | 38 ft. | 29 ft. | 50 ft. | 4' to 4½' in 8 yrs |
| 5 | 50 ft. | 31 ft. | 70 ft. | 5' to 6' in 10 yrs |

Based on the information presented in the Table, it is concluded that Line #4 is the most favourable from a foundation point of view, the main reason being that the thickness of the compressible stratum is least along this alignment.

If possible, consideration should be given to lowering the profile grade of Hwy. #34, or alternatively, increase the span length of the structure (multi-span). The result of either of these proposals would be to reduce the embankment fill heights. This would have the effect of reducing: i) the berm requirements, and ii) the consolidation settlement occurring within the foundation subsoil.

6. CONCLUSIONS - FEASIBILITY OF ALTERNATE ALIGNMENTS -
(Lines #1, 2, 4 and 5): (cont'd.) ...

It should be stressed that this report is of a preliminary nature. A complete foundation investigation will be required at the structure location chosen, when design details become available.

7. MISCELLANEOUS:

The field work, performed during the periods of October 15 and 16, 1969 and November 14 to 29, 1969, was under the immediate supervision of Mr. B. T. Darch, Senior Foundation Engineer.

The drilling equipment, during the former and latter periods, was owned and operated by Johnston Drilling Co. Ltd., Ottawa, and Master Soil Investigation Ltd., Toronto, respectively.

The preparation of this report was undertaken by Mr. Darch, and reviewed by Mr. M. Davata, Supervising Foundation Engineer.

January, 1970

APPENDIX I

FOUNDATION SECTION

ORIGINATED BY BTD

COMPILED BY BTD

CHECKED BY *[Signature]*

BOREHOLE TYPE Washboring, NX, BX Casing
Dynamic Cone Penetration Test

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | | LIQUID LIMIT ——— w_L | | BULK DENSITY | REMARKS |
|--------------|--|-------------|---------|------|--------------|-------------|--------------------------------|-----------------------|------------------------|-----------------------|--------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | BLOWS / FOOT | WATER CONTENT ——— w | WATER CONTENT ——— w | WATER CONTENT ——— w | | |
| 158.9 | Ground Level | | | | | | | | | | | |
| 158.0 | Probably Fill | XXX | | | | | | | | | | |
| 154.4 | Silty Sand, trace of gravel (Brown) Compact | ... | | | | | | | | | | |
| 142.8 | Desiccated (Mottled, Brown) Stiff Clay, trace of sand, inclusions of organic matter (Grey) | | 1 | TW | PM | | | | | | | |
| 142.8 | Firm | | 2 | TW | PM | | | | | | | |
| 142.0 | Het. Mixt. of clay, silt, sand & gravel (Glacial Till) | o o o | 3 | TW | PM | | | | | | | |
| 133.4 | Grey Stiff to Hard or Compact to Very Dense | o o o | 4 | SS | 11 | | | | | | | |
| 25.5 | End of Borehole | | 5 | SS | 23 | | | | | | | |
| | | | 6 | SS | 116 1/2" | | | | | | | |

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

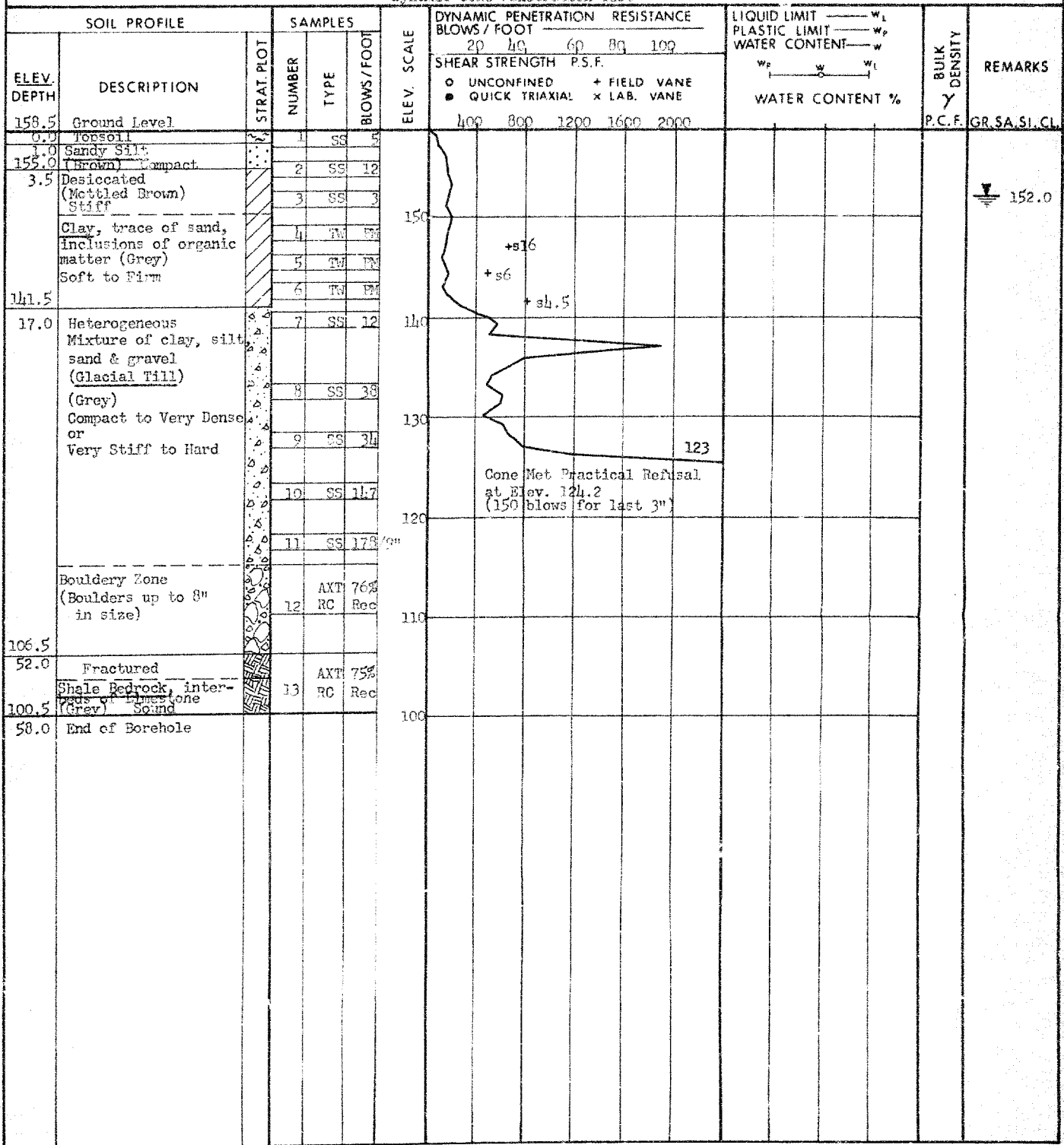
JOB 49-F-74 LOCATION Line No. 4-100' North of E CNR ORIGINATED BY HTD
 W.P. 256-66 BORING DATE November, 1969 COMPILED BY HTD
 DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY [Signature]

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|------------------|-------------|---------|------|--------------|-------------|--------------------------------|-----------------|--|--|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | BLOWS / FOOT | WATER CONTENT % | | | | |
| 158.0 | Ground level | | | | | | | | | | | |
| 0.0 | Probably | | | | | | | | | | | |
| 154.0 | Silt and sand | | | | | | | | | | | |
| 14.0 | Probably | | | | | | | | | | | |
| | Clay | | | | | | | | | | | |
| 140.0 | | | | | | | | | | | | |
| 18.0 | Probably | | | | | | | | | | | |
| | Glacial fill | | | | | | | | | | | |
| 124.0 | | | | | | | | | | | | |
| 33.1 | End of Cone Test | | | | | | | | | | | |

DYNAMIC PENETRATION RESISTANCE
 BLOWS / FOOT: 20 40 60 80 100
 SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE

Cone Met Practical Refusal
 at Elev. 124.9
 (150 blows for last inch)

| | | | | |
|----------------------------------|---|---------------------------------|--|--------------------|
| DEPARTMENT OF HIGHWAYS - ONTARIO | | RECORD OF BOREHOLE No. 3 | | FOUNDATION SECTION |
| MATERIALS & TESTING OFFICE | | | | |
| JOB <u>69-F-74</u> | LOCATION <u>Line No. 4 300' North of E. CNR</u> | ORIGINATED BY <u>BTD</u> | | |
| W.P. <u>256-66</u> | BORING DATE <u>November, 1969</u> | COMPILED BY <u>BTD</u> | | |
| DATUM <u>Geodetic</u> | BOREHOLE TYPE <u>Washboring-NX, BX Casing AXT Rock Core</u> | CHECKED BY <u>SR</u> | | |
| Dynamic Cone Penetration Test | | | | |



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-P-74 LOCATION Line No. 2-510 North of 8th CNR ORIGINATED BY BTD
W.P. 256-66 BORING DATE November, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY AK

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w | | | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|--|-------------|---------|------|--------------|-------------|--|--|--|--|--|--|--|--|--|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE | | | | | | WATER CONTENT % w_p ——— w ——— w_L | | | | |
| 162.9 | Ground Level | | | | | | | | | | | | | | | | |
| 0.0 | Silty Sand Crushed Stone (FILL) | | | | | 160 | | | | | | | | | | | |
| 157.9 | | | | | | | | | | | | | | | | | |
| 5.0 | Sand, trace of silt (Brown) | | | | | | | | | | | | | | | | |
| 155.4 | | | | | | | | | | | | | | | | | |
| 7.5 | Het. mixture of clay, silt, sand & gravel (Glacial Till) (Brown to Grey) Very Stiff to Hard or Dense to Very Dense | | 1 | SS | 69 | 150 | | | | | | | | | | | |
| 142.9 | | | | | | | | | | | | | | | | | |
| 20.0 | End of Borehole | | | | | | 140 | | | | | | | | | | |

153.6

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-74 LOCATION Line No. 2 - 100' South of G CNR ORIGINATED BY BTD
W.P. 256-66 BORING DATE November, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring-NX, BX Casing - AXT Rock Core CHECKED BY [Signature]

Dynamic Cone Penetration Test

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|--|-------------|---------|------|--------------|-------------|--------------------------------|-----|------|------|------|--|----|----|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | 20 | 40 | 60 | 80 | 100 | SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE | | | | |
| 163.4 | Ground Level | | | | | | 400 | 800 | 1200 | 1600 | 2000 | 20 | 40 | 60 | | |
| 160.4 | Clinders, ashes and slag (FILL) loose | | 1 | SS | 5 | 160 | | | | | | | | | | |
| 157.4 | Silty sand (Brown) Compact | | 2 | SS | 18 | | | | | | | | | | | |
| 150.9 | Desiccated V. Stiff Clay, trace of sand inclusions of organic matter (Grey) FILL | | 3 | SS | 5 | | | | | | | | | | | |
| 12.5 | Heterogeneous mixture of clay, silt, sand & gravel (Glacial Till) (Grey) | | 4 | TM | 15 | | | | | | | | | | | |
| | Compact to Very Dense or Very Stiff to Hard | | 5 | SS | 22 | | | | | | | | | | | |
| | | | 6 | SS | 18 | | | | | | | | | | | |
| | | | 7 | SS | 12 | | | | | | | | | | | |
| | | | 8 | SS | 31 | | | | | | | | | | | |
| | | | 9 | SS | 50 | | | | | | | | | | | |
| | | | 10 | SS | 72 | | | | | | | | | | | |
| | | | 11 | SS | 75 | | | | | | | | | | | |
| 116.4 | Bouldery Zone (Boulders up to 12" in size) | | 12 | RC | 202 | 120 | | | | | | | | | | |
| 111.4 | Shale Bedrock, interbeds of Limestone (Grey) Sound | | 13 | SS | - | | | | | | | | | | | |
| 52.0 | End of Borehole | | 14 | RC | Rec | 110 | | | | | | | | | | |

Cone Met Practical Refusal at Elev. 125
(131 blows for last 5")

156.0

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

| | | | | | |
|-------|----------|---------------|---|---------------|-----|
| JOB | 62-F-7h | LOCATION | Line No. 2 - 96' North of E CNR O/S 7h' R+. | ORIGINATED BY | DTD |
| W.P. | 256-66 | BORING DATE | October 15, 1969 | COMPILED BY | DTD |
| DATUM | Geodetic | BOREHOLE TYPE | Washboring-NY, BX Casing Dynamic Cone Penetration Test | CHECKED BY | AK |

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | Liquid Limit ——— w_L | BULK DENSITY | REMARKS | |
|--------------|---|-------------|---------|------|--------------|-------------|--------------------------------|-------------------------|-----------------|------------|---------------------------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | BLOWS / FOOT | PLASTIC LIMIT ——— w_p | | | |
| | | | | | | | 20 40 60 80 100 | WATER CONTENT ——— w | | | |
| | | | | | | | SHEAR STRENGTH P.S.F. | w_p ——— w ——— w_L | WATER CONTENT % | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE | | | P.C.F. | GR. SA. SI. CL. |
| | | | | | | | ● QUICK TRIAXIAL x LAB. VANE | | | | |
| | | | | | | | 400 800 1200 1600 2000 | 20 40 60 | | | |
| 161.5 | Ground Level | | | | | 160 | | | | | |
| 160.0 | Clayey, Top soil | | | | | | | | | | |
| 157.5 | Desiccated (Mottled Brown) Very Stiff to Stiff | | 1 | TN | PM | | | +2.5 2,575 | | 106 | ▼ 157.2 |
| | Clay, trace of sand, Inclusions of organic matter (occasional seams and partings of silt up to 1 1/2" thick) (Sensitive) (Grey) | | 2 | TN | PM | 150 | | +5 | | | W.L. in Open BH Oct 15/69 |
| | | | 3 | TN | PM | | | +5 | | | |
| | | | 4 | TN | PM | 140 | | +6.5 | | | |
| | Firm | | 5 | TN | PM | | +7 | | | | |
| 13.0 | | | | | | | +8 | | | | |
| 28.5 | Mixt. of clay, silt, sand & gravel | | 6 | SS | 25 | | | | | | |
| 129.5 | (Glauc Till) V. Stiff to compact | | 7 | SS | 27 | 130 | | | | 51-24-20-5 | |
| 32.0 | End of Borehole | | | | | 120 | | | | | |

FOUNDATION SECTION

ORIGINATED BY BTB

COMPILED BY BTB

CHECKED BY 

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE ELEV. FEET | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | Liquid Limit ———— w_L Plastic Limit ———— w_p Water Content ———— w | BULK DENSITY γ P.C.F. | REMARKS |
|----------------|---|-------------|---------|------|--------------|---------------------------|---|---|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | SHEAR STRENGTH PS.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE | WATER CONTENT % w_p ———— w ———— w_L | | |
| 160.6 | Ground Level | | | | | 160 | | | | |
| 0.0 | Top soil | | | | | | | | | |
| 1.0 | Silt, trace to some | | | | | | | | | |
| 155.6 | clay (Brown to Grey) | | | | | | | | | |
| 5.0 | Desiccated (Mottled Brown) Clay, trace of sand, inclusions of organic matter (Sensitive) (Grey) | | | | | 150 | | | | |
| | | | | | | 140 | | | | |
| | | | | | | 130 | | | | |
| | | | | | | 120 | | | | |
| 117.6 | | | | | | | | | | |
| 113.0 | Wet Mixt. of clay, silt, sand & gravel | | | | | | | | | |
| 112.1 | (Glacial Till) Hard | | 1 | SS | 37 | | | | | |
| 108.5 | End of Borehole | | | | | 110 | | | | |


DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-7h LOCATION Line No. 2 - 400' North of E CNR ORIGINATED BY BTD
 W.P. 256-66 BORING DATE November, 1969 COMPILED BY BTD
 DATUM Geodetic BOREHOLE TYPE Washboring-NX, BX Casing CHECKED BY *SK*
 Dynamic Cone Penetration Test

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w | | | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|---|-------------|---------|------|--------------|-------------|--------------------------------|------|------|------|--|--|--|--|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | SHEAR STRENGTH P.S.F. | | | | | WATER CONTENT % | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 162.5 | Ground Level | | | | | 400 | 800 | 1200 | 1600 | 2000 | | | | | | |
| 162.5 | Top Soil | | 1 | SS | 7 | 160 | | | | | | | | | | |
| 157.0 | Silt, trace to some clay (Brown to Grey) Loose to Compact | | 2 | SS | 13 | | | | | | | | | | | |
| 5.0 | Desiccated zone (Mottled Brown) Stiff | | 3 | SS | 10 | | | | | | | | | | | |
| | Clay, trace of sand, inclusions of organic matter (occasional partings and seams of silt up to 1/4" thick throughout) (Sensitive) (Grey) Soft to Firm | | 4 | TM | TM | 150 | + s3.5 | | | | | | | | | |
| | | | 5 | TM | TM | | + s6 | | | | | | | | | |
| | | | 6 | TM | TM | | + sh | | | | | | | | | |
| | | | 7 | TM | TM | 140 | | | | | | | | | | |
| | | | 8 | TM | TM | | + sh | | | | | | | | | |
| | | | | | | | + sh | | | | | | | | | |
| 129.0 | | | 9 | TM | TM | 130 | | | | | | | | | | |
| 33.0 | Het. Mixt. of clay, silt, sand & gravel (Glacial Till) (Grey) Very Dense or Hard | | 10 | SS | 87 | | | | | | | | | | | |
| | | | 11 | SS | 94 | 120 | | | | | | | | | | |
| 115.5 | | | 12 | SS | 99 | | | | | | | | | | | |
| 46.5 | End of Borehole | | | | | | | | | | | | | | | |

 155.0

FOUNDATION SECTION

ORIGINATED BY BTD

COMPILED BY BTD

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|-----------------------|-------------|---------|------|--------------|-------------|--------------------------------|----|--|----|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | 20 | 40 | 60 | 80 | | |
| 161.5 | Ground Level | | | | | | | | | | | |
| 0.0 | Probably Silt | | | | | 160 | | | | | | |
| 156.5 | | | | | | | | | | | | |
| 5.0 | Probably Clay | | | | | 150 | | | | | | |
| 140.5 | | | | | | | | | | | | |
| 20.0 | Probably Glacial Till | | | | | 140 | | | | | | |
| 22.2 | End of Cone | | | | | | | | | | | |

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE

Cone Penetration Test Met
 Practical Refusal at Elev. 138.3
 (150 blows 13")

FOUNDATION SECTION

CHECKED BY *[Signature]*

[illegible]

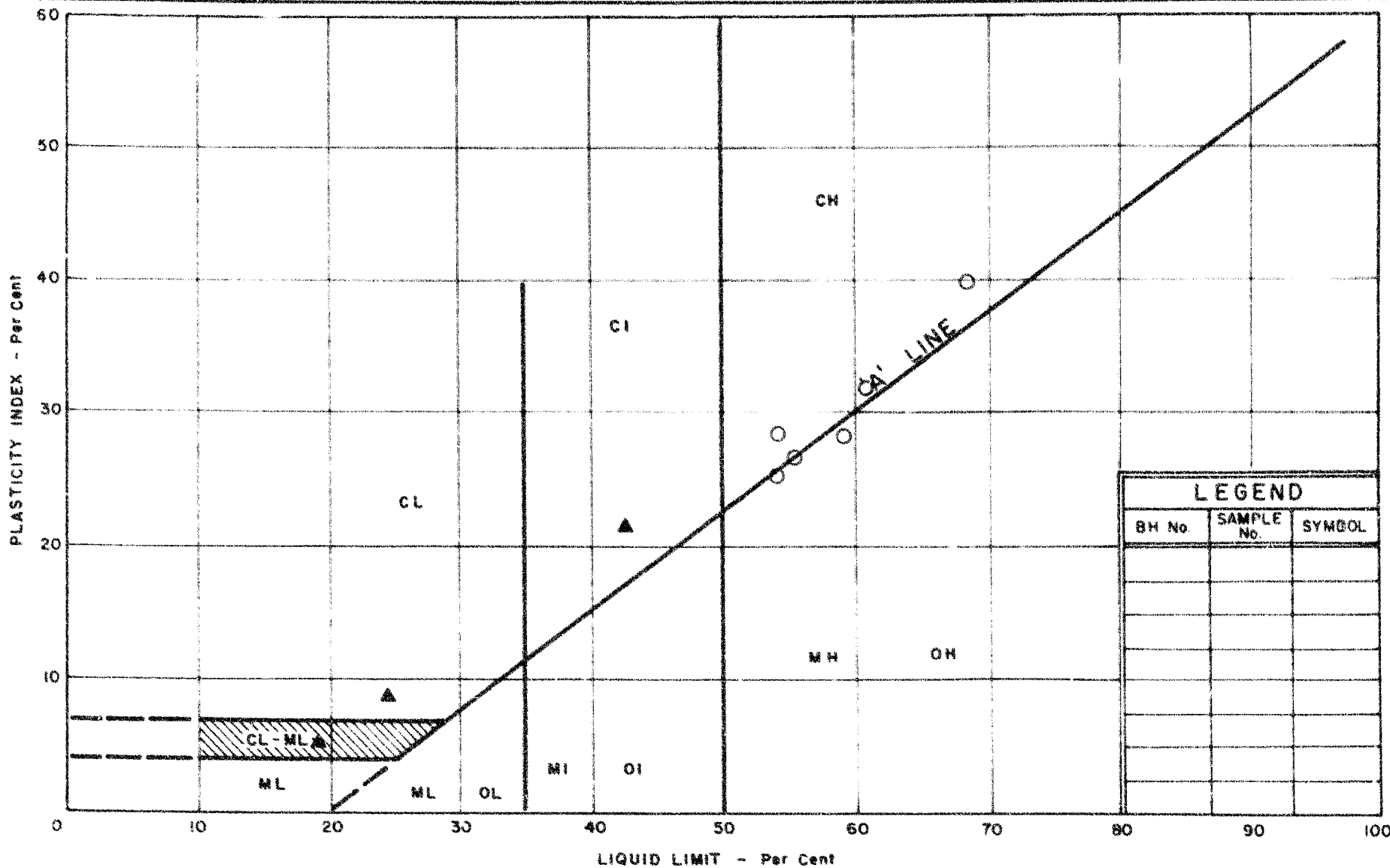
FOUNDATION SECTION

ORIGINATED BY BTD

COMPILED BY BTD

CHECKED BY 

| SOIL PROFILE | | | SAMPLES | | | DYNAMIC PENETRATION RESISTANCE | | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | BULK DENSITY γ P.C.F. | REMARKS |
|----------------|--|-------------|---------|------|--------------|--|-----|------|------|------|--|--|--|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | 20 | 40 | 60 | 80 | 100 | WATER CONTENT % | | | | |
| 152.0 | Ground Level | | | | | SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE | | | | | | | | | |
| 150.0 | Clayey Topsoil | | 1 | SS | 5 | 400 | 800 | 1200 | 1600 | 2000 | | | | | |
| 140.0 | Dislocated (Mottled Brown) Stiff to Very Stiff Clay, trace of sand, inclusions of organic matter (occasional partings of silt) (sensitive) (grey) Soft | | 2 | SS | 11 | | | | | | | | | | |
| | | | 3 | SS | 5 | | | | | | | | | | |
| | | | 4 | TN | PM | | | | | | | | | | |
| | | | 5 | TN | PM | | | | | | | | | | |
| | | | 6 | TN | PM | | | | | | | | | | |
| 138.0 | | | | | | | | | | | | | | | |
| 119.0 | Heterogeneous mixture of clay, silt, sand and gravel (Glacial Till) (Grey) Compact to Very Dense Very Stiff to Hard | | 7 | SS | 33 | | | | | | | | | | |
| | | | 8 | SS | 11 | | | | | | | | | | |
| | | | 9 | SS | 40 | | | | | | | | | | |
| 120.0 | | | 10 | SS | 93 | | | | | | | | | | |
| 137.0 | Fractured Shale Bedrock, inter- beds of limestone Sound | | 11 | RC | Rec | | | | | | | | | | |
| 110.0 | | | 12 | RC | Rec | | | | | | | | | | |
| 147.0 | End of Borehole | | | | | | | | | | | | | | |



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

O - CLAY STRATUM (Sensitive)

▲ - GLACIAL TILL

WP. No. 256-66

JOB No. 69-F-74

Fig. No. 1

VOID RATIO - PRESSURE CURVES

JOB NO. 69-F-74

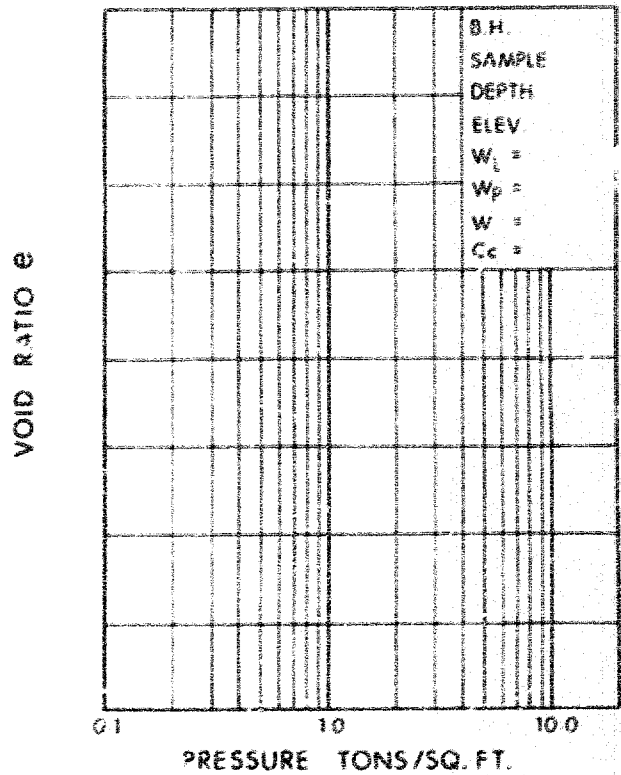
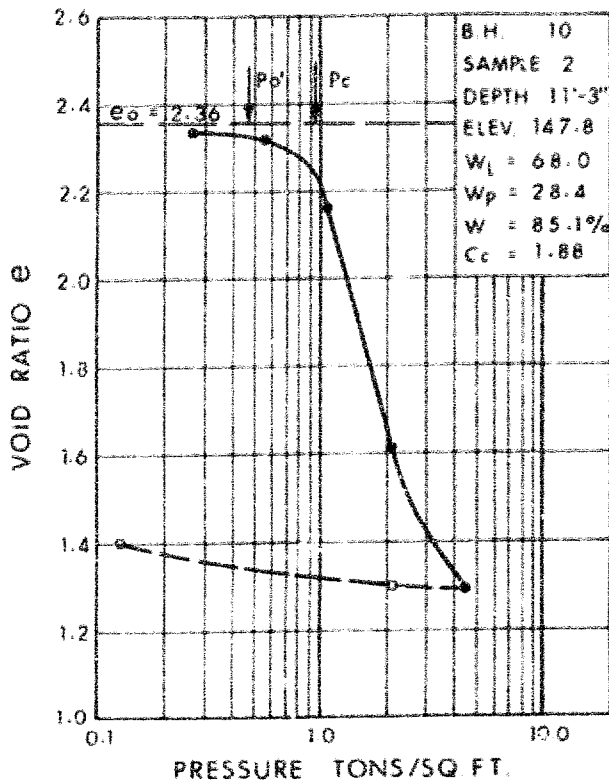
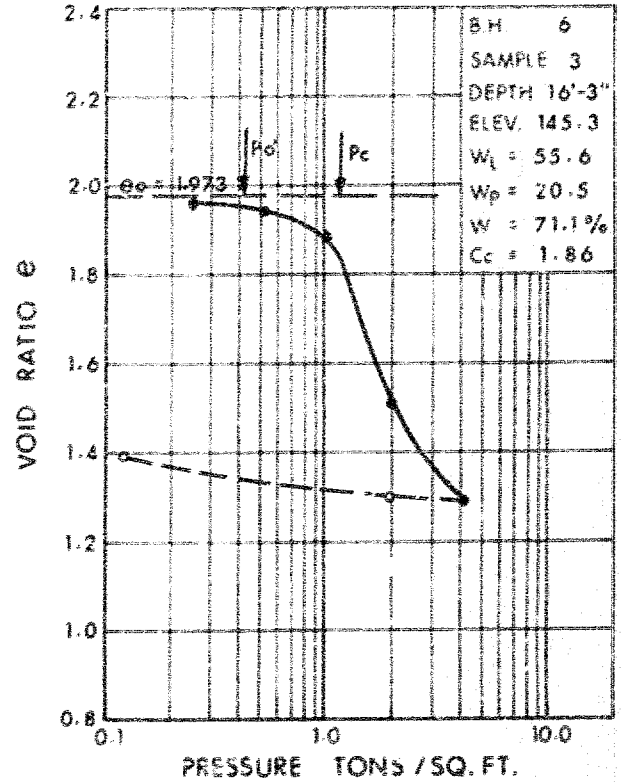
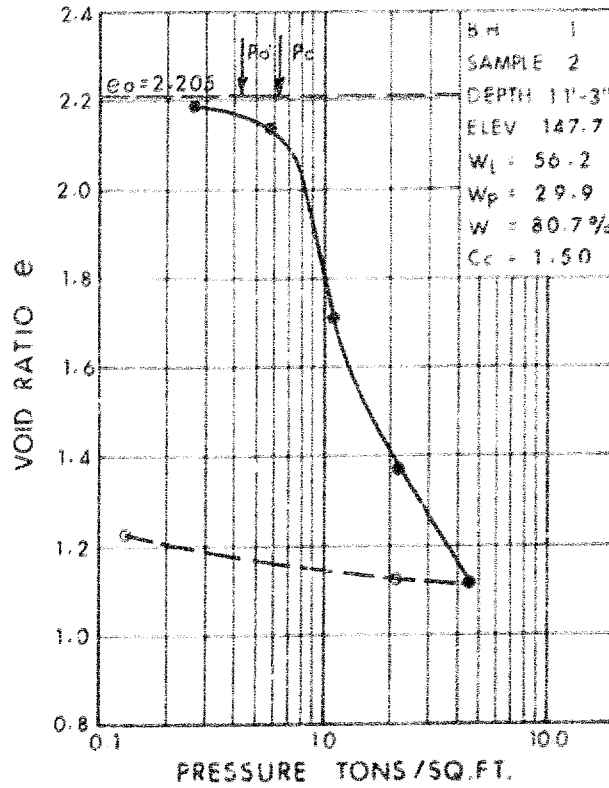
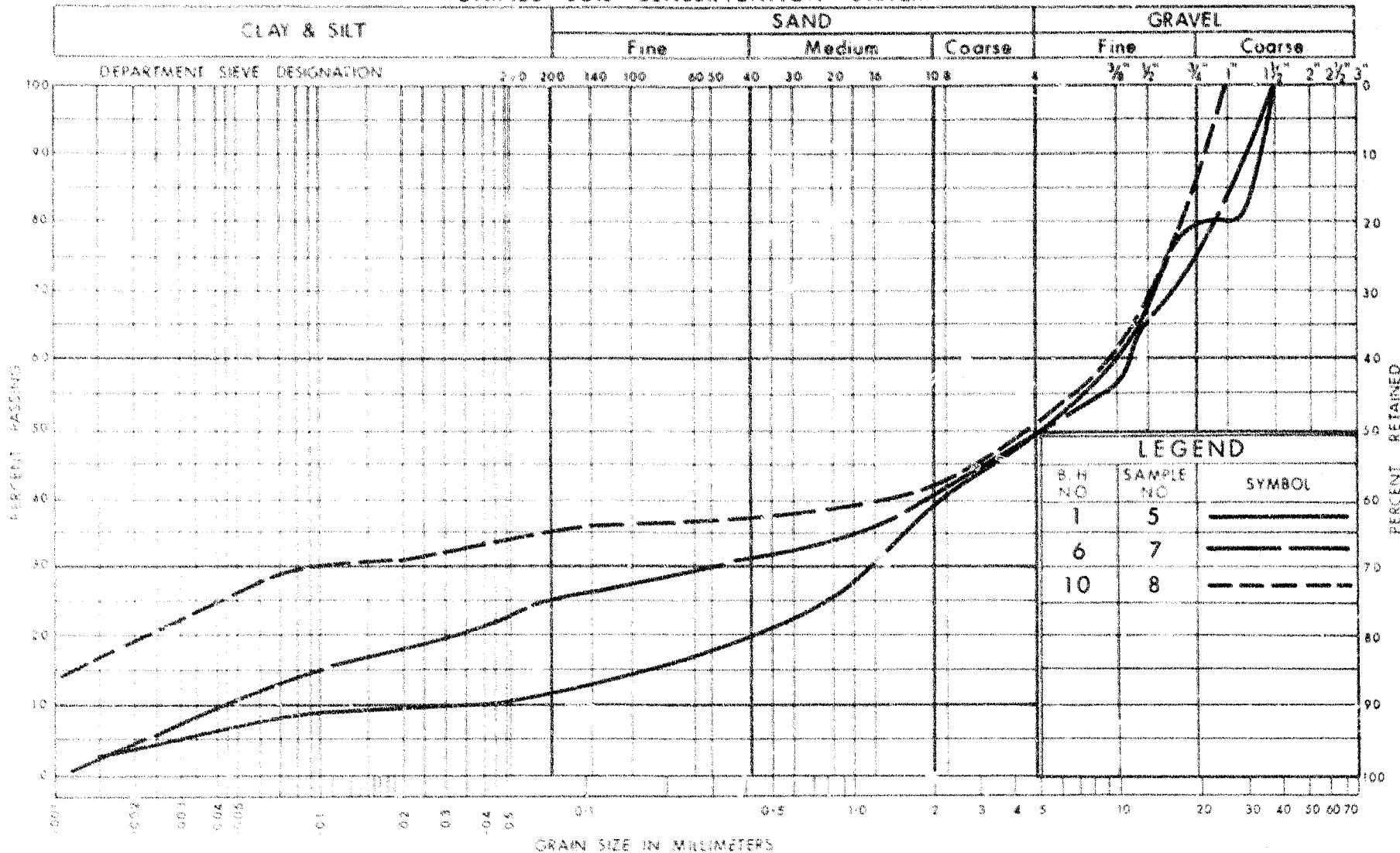


FIG. 2

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HET. MIXTURE OF CLAY, SILT, SAND & GRAVEL

W.P. No. 256-66

JOB No. 69-F-74

Fig. NO. 3

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS -

| <u>CONSISTENCY</u> | <u>'N' BLOWS / FT.</u> | <u>c LB. / SQ. FT.</u> | <u>DENSENESS</u> | <u>'N' BLOWS / FT.</u> |
|--------------------|------------------------|------------------------|------------------|------------------------|
| VERY SOFT | 0 - 2 | 0 - 250 | VERY LOOSE | 0 - 4 |
| SOFT | 2 - 4 | 250 - 500 | LOOSE | 4 - 10 |
| FIRM | 4 - 8 | 500 - 1000 | COMPACT | 10 - 30 |
| STIFF | 8 - 15 | 1000 - 2000 | DENSE | 30 - 50 |
| VERY STIFF | 15 - 30 | 2000 - 4000 | VERY DENSE | > 50 |
| HARD | > 30 | > 4000 | | |

TYPE OF SAMPLE

| | | | |
|------|------------------------------------|------|-------------------|
| S.S. | SPLIT SPOON | T.W. | THINWALL OPEN |
| W.S. | WASHED SAMPLE | T.P. | THINWALL PISTON |
| S.B. | SCRAPER BUCKET SAMPLE | O.S. | OESTERBERG SAMPLE |
| A.S. | AUGER SAMPLE | F.S. | FOIL SAMPLE |
| C.S. | CHUNK SAMPLE | R.C. | ROCK CORE |
| S.T. | SLOTTED TUBE SAMPLE | | |
| | P.H. SAMPLE ADVANCED HYDRAULICALLY | | |
| | P.M. SAMPLE ADVANCED MANUALLY | | |

SOIL TESTS

| | | | |
|-----------------|---------------------------------|------|-----------------|
| Q _u | UNCONFINED COMPRESSION | L.V. | LABORATORY VANE |
| Q | UNDRAINED TRIAXIAL | F.V. | FIELD VANE |
| Q _{cu} | CONSOLIDATED UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| Q _d | DRAINED TRIAXIAL | S | SENSITIVITY |

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

| | |
|------------|--|
| γ | UNIT WEIGHT OF SOIL (BULK DENSITY) |
| γ_s | UNIT WEIGHT OF SOLID PARTICLES |
| γ_w | UNIT WEIGHT OF WATER |
| γ_d | UNIT DRY WEIGHT OF SOIL (DRY DENSITY) |
| γ' | UNIT WEIGHT OF SUBMERGED SOIL |
| G | SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$ |
| e | VOID RATIO |
| n | POROSITY |
| w | WATER CONTENT |
| S_r | DEGREE OF SATURATION |
| w_L | LIQUID LIMIT |
| w_p | PLASTIC LIMIT |
| I_p | PLASTICITY INDEX |
| s | SHRINKAGE LIMIT |
| I_L | LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$ |
| I_c | CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$ |
| e_{max} | VOID RATIO IN LOOSEST STATE |
| e_{min} | VOID RATIO IN DENSEST STATE |
| I_D | DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$ |
| | RELATIVE DENSITY D_r IS ALSO USED |
| h | HYDRAULIC HEAD OR POTENTIAL |
| Q | RATE OF DISCHARGE |
| v | VELOCITY OF FLOW |
| i | HYDRAULIC GRADIENT |
| k | COEFFICIENT OF PERMEABILITY |
| j | SEEPAGE FORCE PER UNIT VOLUME |
| m_v | COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$ |
| C_v | COEFFICIENT OF CONSOLIDATION |
| C_c | COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$ |
| T_v | TIME FACTOR $= \frac{C_v t}{d^2}$ (d, DRAINAGE PATH) |
| U | DEGREE OF CONSOLIDATION |
| τ | SHEAR STRENGTH |
| c | EFFECTIVE COHESION INTERCEPT |
| ϕ' | EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| C_u | APPARENT COHESION |
| ϕ_u | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| μ | COEFFICIENT OF FRICTION |
| S_t | SENSITIVITY |

GENERAL

| | |
|-------------------------------------|-----------------------------------|
| π | $= 3.1416$ |
| e | BASE OF NATURAL LOGARITHMS 2.7183 |
| $\log_e \sigma$ OR $\ln \sigma$ | NATURAL LOGARITHM OF σ |
| $\log_{10} \sigma$ OR $\log \sigma$ | LOGARITHM OF σ TO BASE 10 |
| t | TIME |
| g | ACCELERATION DUE TO GRAVITY |
| V | VOLUME |
| W | WEIGHT |
| M | MOMENT |
| F | FACTOR OF SAFETY |

STRESS AND STRAIN

| | |
|------------|--|
| u | PORE PRESSURE |
| σ | NORMAL STRESS |
| σ' | NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED) |
| τ | SHEAR STRESS |
| ϵ | LINEAR STRAIN |
| γ | SHEAR STRAIN |
| ν | POISSON'S RATIO (μ IS ALSO USED) |
| E | MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS) |
| G | MODULUS OF SHEAR DEFORMATION |
| K | MODULUS OF COMPRESSIBILITY |
| η | COEFFICIENT OF VISCOSITY |

EARTH PRESSURE

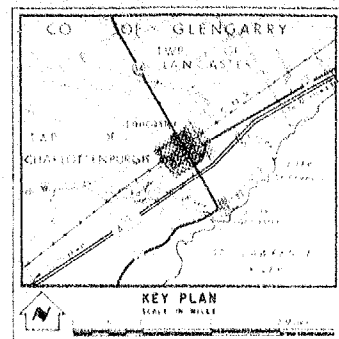
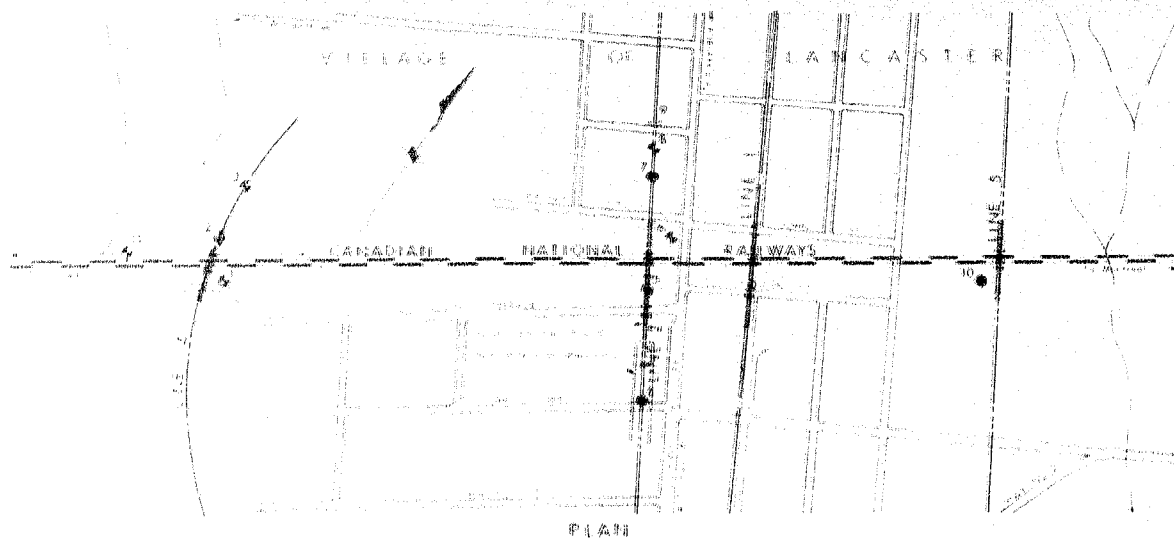
| | |
|----------|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| δ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| K_0 | COEFFICIENT OF EARTH PRESSURE AT REST |

FOUNDATIONS

| | |
|-------|--|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| K_s | MODULUS OF SUBGRADE REACTION |

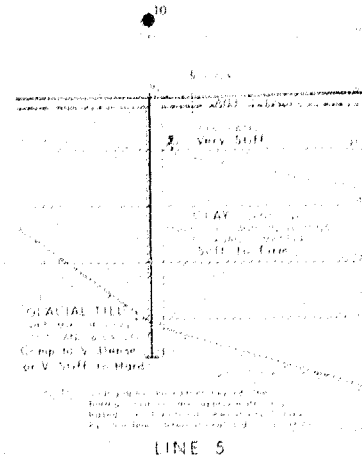
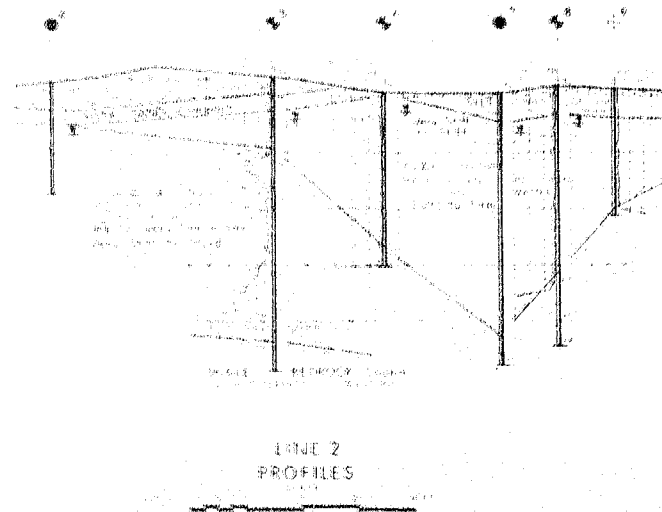
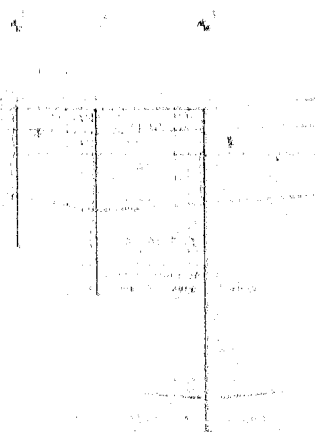
SLOPES

| | |
|---------|--|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| β | ANGLE OF SLOPE TO HORIZONTAL |



| LEGEND | |
|--------|---|
| | Bore Hole |
| | Core Penetration Hole |
| | Bore & Core Penetration Hole |
| | Water Levels established at time of field investigation |

| NO. | ELEVATION | LOCATION |
|-----|-----------|---|
| 1 | 100.0 | At intersection of Villeneuve & Lancaster |
| 2 | 100.0 | At intersection of Villeneuve & Lancaster |
| 3 | 100.0 | At intersection of Villeneuve & Lancaster |
| 4 | 100.0 | At intersection of Villeneuve & Lancaster |
| 5 | 100.0 | At intersection of Villeneuve & Lancaster |
| 6 | 100.0 | At intersection of Villeneuve & Lancaster |
| 7 | 100.0 | At intersection of Villeneuve & Lancaster |
| 8 | 100.0 | At intersection of Villeneuve & Lancaster |
| 9 | 100.0 | At intersection of Villeneuve & Lancaster |
| 10 | 100.0 | At intersection of Villeneuve & Lancaster |



NOTE
The boundaries between soil types have been established only at bore hole locations. Between bore holes the boundaries are assumed from geological evidence and may be subject to some degree of error.

| NO. | ELEVATION | LOCATION |
|-----|-----------|---|
| 1 | 100.0 | At intersection of Villeneuve & Lancaster |
| 2 | 100.0 | At intersection of Villeneuve & Lancaster |
| 3 | 100.0 | At intersection of Villeneuve & Lancaster |
| 4 | 100.0 | At intersection of Villeneuve & Lancaster |
| 5 | 100.0 | At intersection of Villeneuve & Lancaster |
| 6 | 100.0 | At intersection of Villeneuve & Lancaster |
| 7 | 100.0 | At intersection of Villeneuve & Lancaster |
| 8 | 100.0 | At intersection of Villeneuve & Lancaster |
| 9 | 100.0 | At intersection of Villeneuve & Lancaster |
| 10 | 100.0 | At intersection of Villeneuve & Lancaster |

DEPARTMENT OF HIGHWAYS & SURVEYS
DISTRICT & TOTAL STATION SURVEYING

CANADIAN NATIONAL RAILWAYS

KING'S HIGHWAY NO. 14 (Hwy. 14) DIST. NO. 2
CO. OF GLENGARRY TOWNSHIP OF LANCASTER
TOWNSHIP OF LANCASTER & LANCASTER

BORE HOLE LOCATIONS & SCALE STRATA

| | | |
|--------------------------|------------------|------------------|
| SURVEYED BY: CHESTER | DATE: 1969-11-12 | SCALE: 1" = 100' |
| DRAWN BY: J. J. JONES | DATE: 1969-11-12 | SCALE: 1" = 100' |
| CHECKED BY: J. J. JONES | DATE: 1969-11-12 | SCALE: 1" = 100' |
| APPROVED BY: J. J. JONES | DATE: 1969-11-12 | SCALE: 1" = 100' |