

**HYDRAULICS DIVISION
TECHNICAL NOTE**

DATE: March 1983 **REPORT NO:** 83-08

TITLE: Particle Size and Geotechnical Data Report

AUTHOR: G. A. Duncan

REASON FOR REPORT: This report responds to a request for particle size and geotechnical data from Dr. J. W. Kamphuis, Queen's University.

CORRESPONDENCE FILE NO:
5105 (Study No. 302)

1.0 INTRODUCTION

This report provides the results of grains size and geotechnical analysis on 12 samples from Port Burwell.

2.0 PROCEDURES

Two procedures were used for particle size analysis:

- (1) The Sieve and Short Pipette Method, which provides gravel, sand, silt and clay percentages was used to analyse 9 samples.

Briefly, the procedure consists of:

1. Splitting the sample to 20 g.
2. Sieving the split at -1 PHI (2.00 mm).
3. Dispersing the sample in 50 ml of Calgon solution (50 g/l) and mixing it for 15 minutes.
4. Recovering two pipette aliquots of 25 ml for sand, silt and clay percentages.
5. Processing the results with SIZDIST: a FORTRAN IV computer program (Sandilands and Duncan, 1980).

- (2) The Sieve and Sedigraph Method which provides sand, silt and clay percentages was used to analyse three samples.

Briefly the procedure consists of:

1. Splitting the sample to 2g.
2. Removing particles large enough to block Sedigraph Suction Tube (0.088 mm).
3. Dispersing sample in a Calgon suspension.
4. Automatic analysis with the Sedigraph.
5. Processing the results with SIZDIST: a FORTRAN IV computer program (Sandilands and Duncan, 1980).

Geotechnical analyses performed on the samples were:

1. Moisture content.
2. Atterberg limits (Lambe, T.W., 1951).

3.0 RESULTS

Appendix 2 lists the size analysis for each sample.

- (1) For the Sieve and Short Pipette Method, the output consists of:
 1. Percent gravel, sand, silt and clay.
 - =2. Ratios used to plot Folk's Ternary Classification.
 3. Shepard (1954) and Folk (1974) Ternary Classification.

- (2) For the Sieve and Sedigraph Method, the output consists of:
 1. A histogram of the frequency distribution.
 2. The percentage and cumulative percentages of the material occurring within each 1/2 PHI unit.
 3. Moment measure (Krumbein & Pettijohn, 1938) and graphic (Folk and Ward, 1957) statistics.
 4. Percentiles.
 5. Percent gravel, sand, silt and clay.
 6. Ratios used to plot Folk's Ternary Classification.
 7. Shepard (1954) and Folk (1974) Ternary Classifications.

Appendix 3 lists the results of the moisture content and the Atterberg limits.

REFERENCES

- Duncan, G. A. and LaHaie, G. G., 1979. "Size Analysis Procedures Used in the Sedimentology Laboratory, NWRI". NWRI, CCIW, Hydraulics Division Manual, September 1979.
- Folk, R. L., 1968. "Petrology of Sedimentary Rocks". Hemphill Publishing Co., Austin, Texas 182 p.
- Folk, R. L. and Ward, W. C., 1957. "Brazos River Bar: A Study in the Significance of Grain Size Parameters". Jour. Sed. Petrology, V. 27, pp. 3-26.
- Krumbein, W. C. and Pettijohn, F. J., 1938. "Manual of Sedimentary Petrography". Appleton-Century-Crofts, New York, 549 p.

- Lambe, T. W., 1951. "Soil Testing for Engineers". John Wiley & Sons Inc., New York.
- Sandilands, R. G. and Duncan, G. A., 1980. "SIZDIST - A Computer Program for Size Analysis". NWRI, CCIW, Hydraulics Division Technical Note, Report No. 80-08.
- *Shepard, F. P., 1954. "Nomenclature Based on Sand-Silt Ratios". Jour. Sed. Petrology, V. 24, pp. 151-158.

PHI CONVERSION

The results of samples analysed in the Sedimentology Lab are presented using the PHI scale (Krumbein, 1934). The conversion from this PHI equation, $\phi = -\log_2 \xi$ (where ξ is the diameter in millimeters) to the Wentworth scale is listed below.

| PHI (ϕ) | Millimeters | Microns | Wentworth Size Class |
|----------------|-------------|---------|---------------------------|
| -5.0 | 32 | | |
| -4.5 | 24 | | |
| -4.0 | 16 | | Pebble (-2 to -6 ϕ) |
| -3.5 | 12 | | |
| -3.0 | 8 | | |
| -2.5 | 6 | | |
| -2.0 | 4 | | |
| -1.5 | 2.83 | | Granule |
| -1.0 | 2.00 | | |
| -0.5 | 1.41 | | Very coarse sand |
| 0.0 | 1.00 | | |
| 0.5 | 0.71 | | Coarse sand |
| 1.0 | 0.51 | 500 | |
| 1.5 | 0.35 | 350 | Medium sand |
| 2.0 | 0.25 | 250 | |
| 2.5 | 0.177 | 177 | Fine sand |
| 3.0 | 0.125 | 125 | |
| 3.5 | 0.088 | 88 | Very fine sand |
| 4.0 | 0.0625 | 62.5 | |
| 8.0 | 0.0039 | 3.9 | Silt + Clay+ |

APPENDIX 1

P.O. Box 938, Thornhill
Ontario, Canada L3T 4A5
Telephone (416) 889-1976
Telex: 06-986766 Tor.

Keith Philpott
Consulting Limited

HB 81 4349

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By hand to accompany samples.

February 5, 1983

Dr. T. M. Dick,
Head,
Hydraulics Division
National Water Research Institute
Canada Centre for Inland Waters
P. O. Box 5050
Burlington, Ontario
L7R 4A6

Dear Milne,

Re: Port Burwell Study. Soil Sample Analysis.

As requested via Ron Seawright, we are providing herewith a description of the soil tests proposed. They are to be made using remaining parts of the nearshore bottom till samples which have already been tested for erodibility in a water tunnel flume at Queen's University Coastal Engineering Laboratory. I am also taking the opportunity to outline another matter on which the advice and assistance of your staff would also be helpful.

First with respect to the tests now proposed:

1. A total of twelve till samples, each 24"x6"x4", were cut from the nearshore bottom at the locations indicated on the attached plan. They are samples numbered 8, 9, 11, 12, 13, 15, 16, 17, 18, 20, 21. Each sample is being subjected to erosion testing for six hours. At the conclusion of the test a portion of the sample approximately 6"x6" is cut off and submitted for analysis. Two samples accompany this letter, numbered 11 and 17, the remainder will be available in one week.
2. The tests required:
 - a. Particle size analysis to define the clay and silt fractions, the sand sizes at 0.5 phi increments and any coarser fractions as appropriate.

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T. M. Dick, February 5, 1983

page 2

b. Moisture contents.

c. Preconsolidation pressure tests (if possible).

The question which I would like to introduce concerns the possibility that the coarser sediment particles from the bluff and nearshore might be subject to significant abrasion after release from the matrix of the bluff or nearshore bottom till by erosion. A careful determination and comparison of the combined grain size distribution of the eroded bluff and bottom till from the contributing part of the shore with the averaged distribution of the harbour deposit at Port Burwell shows a systematic and progressively increasing deficit of fractions coarser than 2 phi in the harbour deposit compared to the updrift shore. Of the several factors that might be responsible for this result the most interesting, from the point of view of the case, is that larger sediment particle sizes are worn down by abrasion or broken into smaller fragments by impact. We are getting some mineralogical data from Dr. Dreimanis and are conducting a literature study on particle abrasion. The question is: can anything more be done? For example, would the amount of agitation involved in standard geotechnical sample preparation and sieve analysis compared to your freeze drying and settling column technique provide any information? Better still, is there any simple way of testing sediment samples for abrasion? Comments of members of your staff would be welcome.

Yours sincerely,

KEITH PHILPOTT CONSULTING LIMITED



K. L. Philpott, P.Eng.

Enclosure.

R. Seawright

T.L. James

T.O. Kolberg

J.W. Kamphuis

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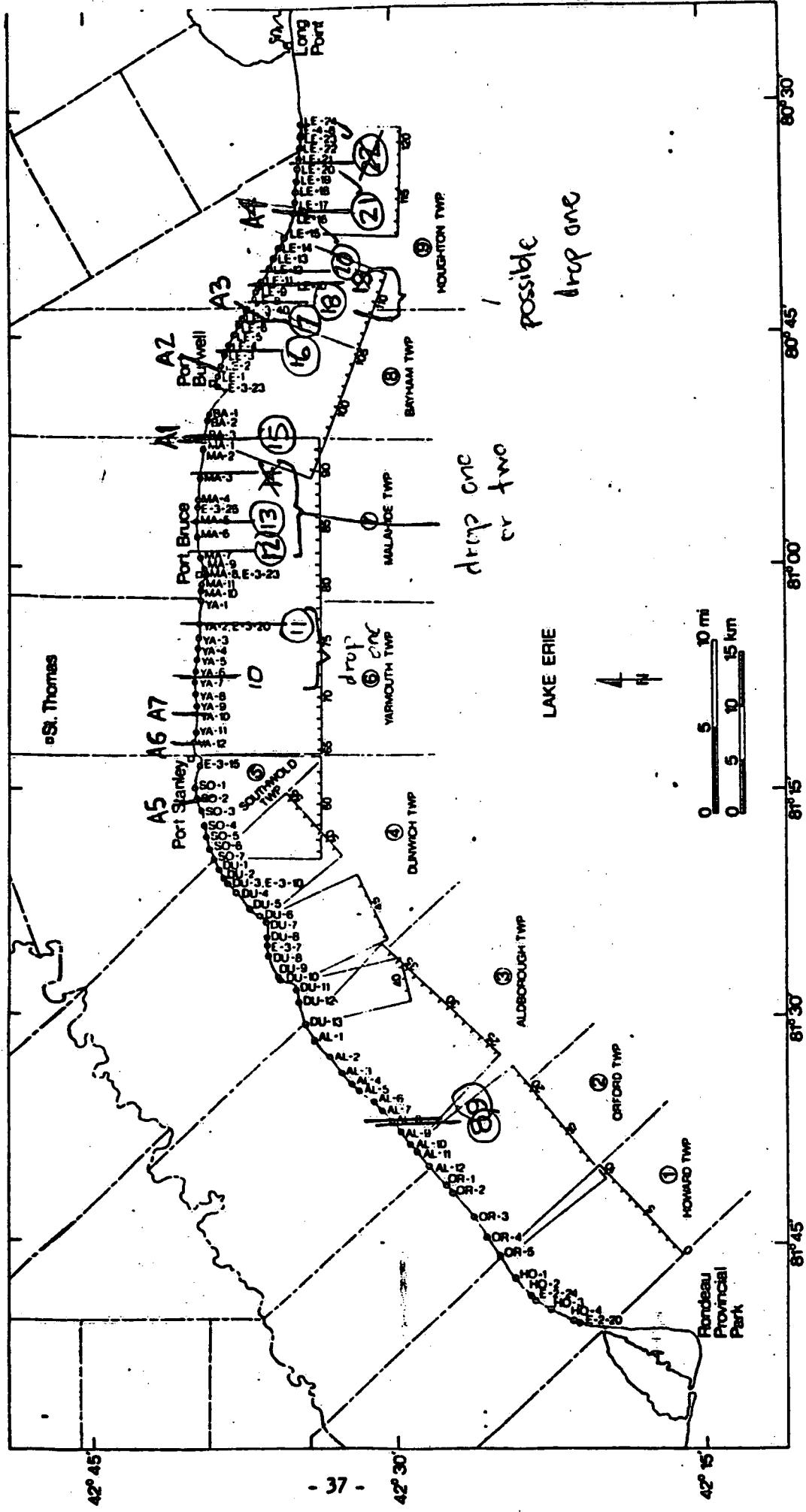


Fig. 1

Location Map of Sampling Stations and Stratigraphic Cross Sections

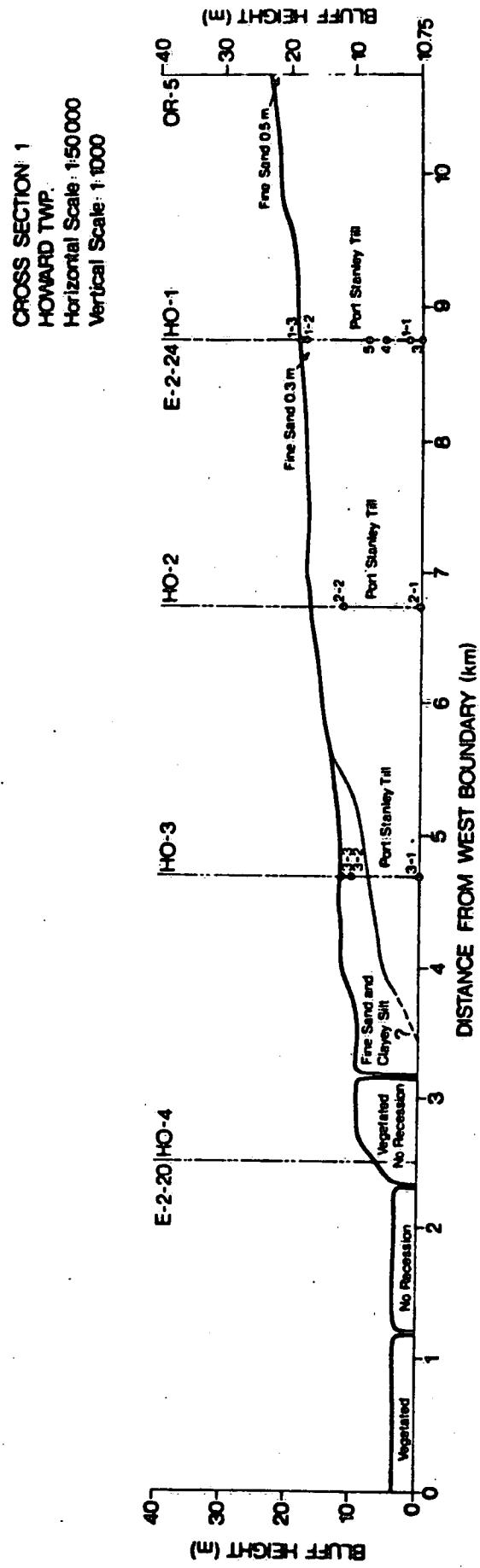


Fig. 2.1 Stratigraphic Cross Section 1, Howard Township

CROSS SECTION 2
ORFORD TWP.
Horizontal Scale: 1:50000
Vertical Scale: 1:1000

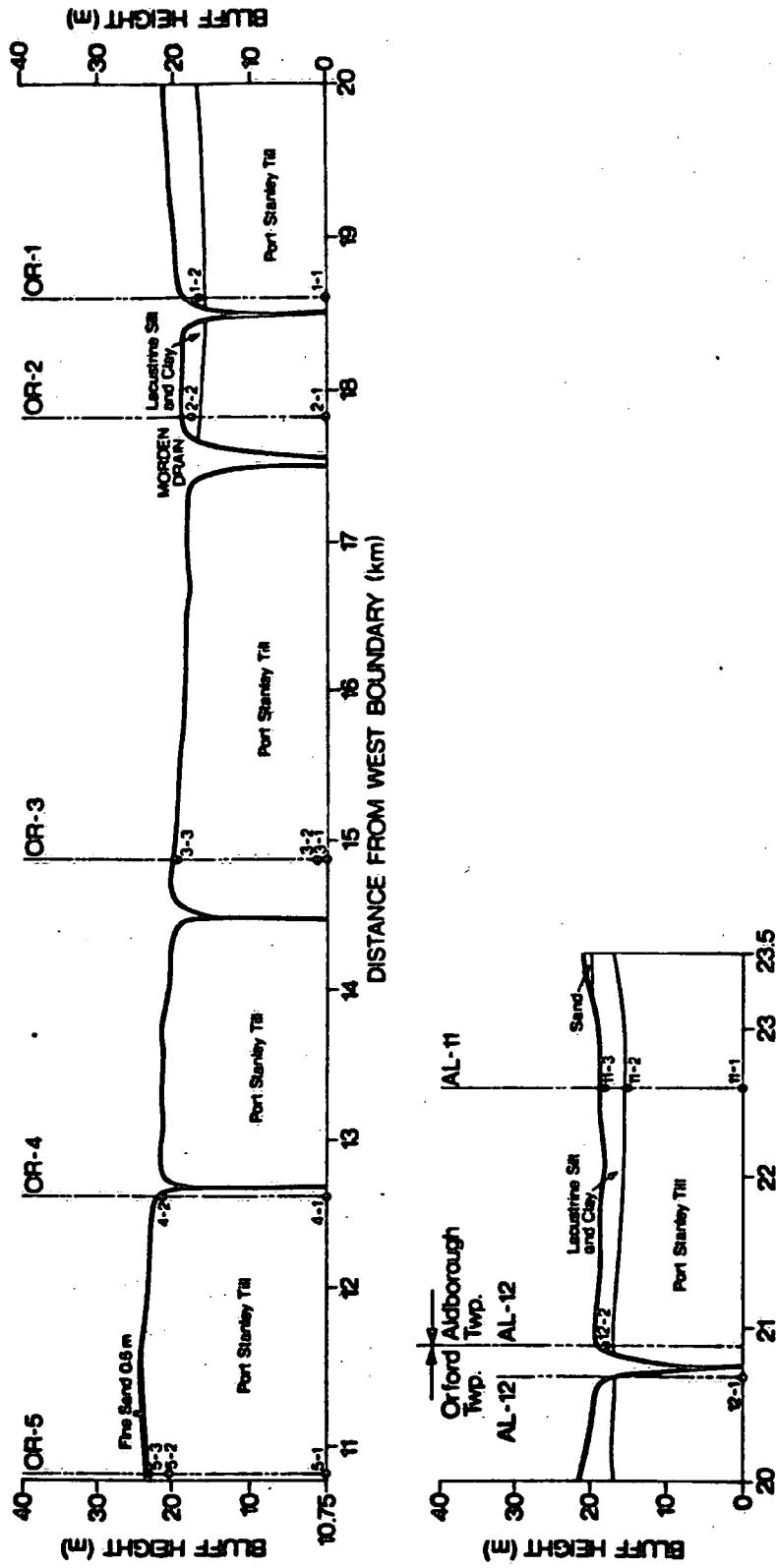


Fig. 2.2 Stratigraphic Cross Section 2, Orford Township and Aldborough Township

CROSS SECTION 3
ALDBOROUGH TWP.
Horizontal Scale: 1:50000
Vertical Scale: 1:1000

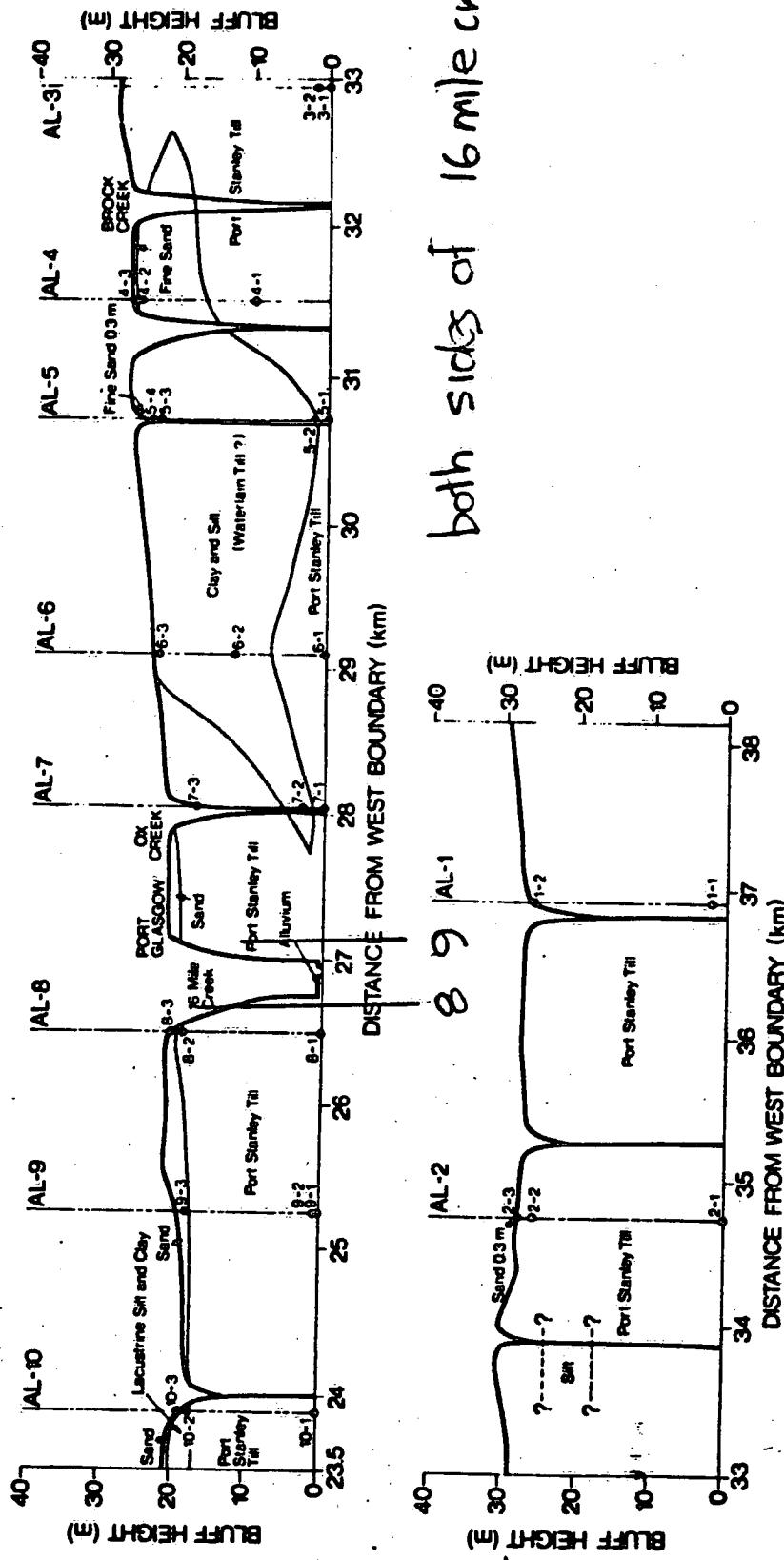


Fig. 2.3 Stratigraphic Cross Section 3, Aldborough Township

CROSS SECTION 4

DUNWICH TWP.
Horizontal Scale: 1:50,000
Vertical Scale: 1:1000

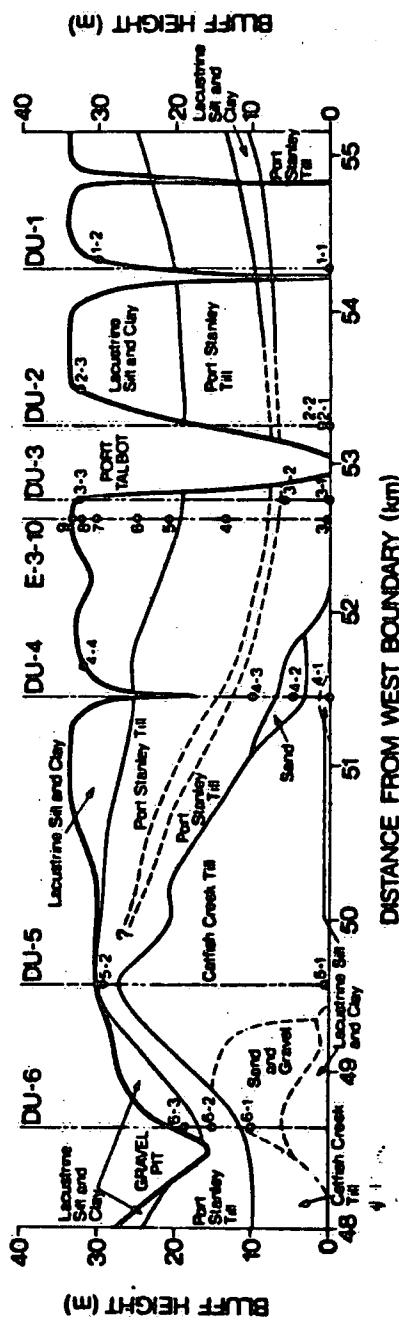
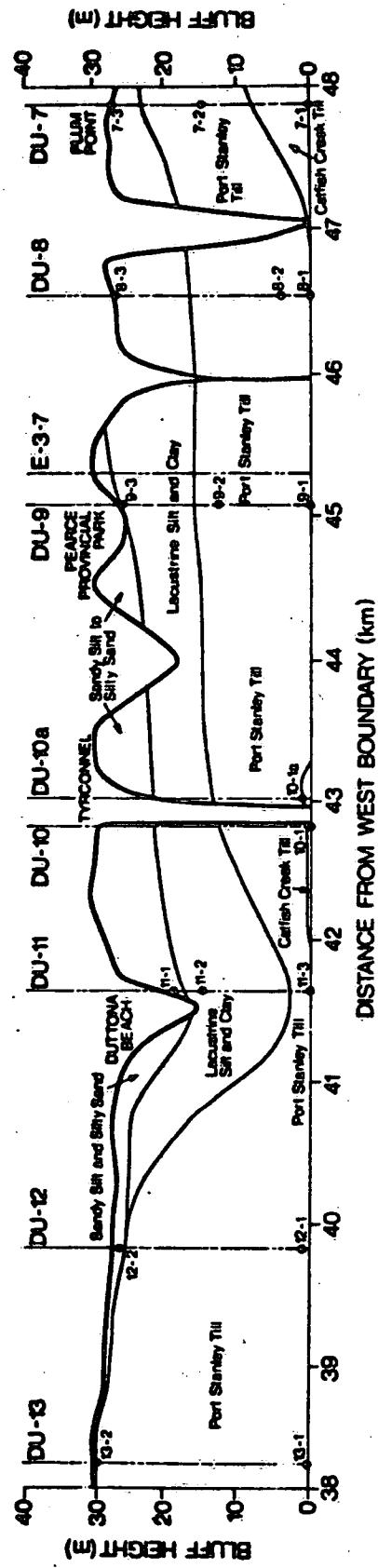


Fig. 2.4 Stratigraphic Cross Section 4, Greenwich Township

CROSS SECTION 5
SOUTHWOLD TWP.
Horizontal Scale: 1:50,000
Vertical Scale: 1:1000

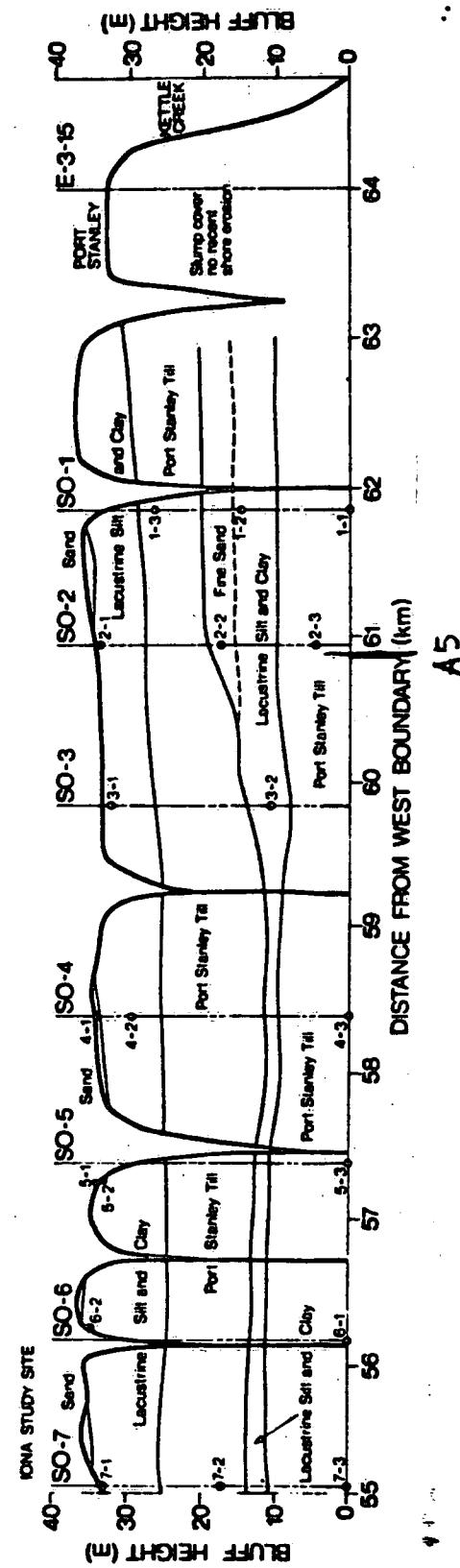


Fig. 2.5 Stratigraphic Cross Section 5, Southwold Township

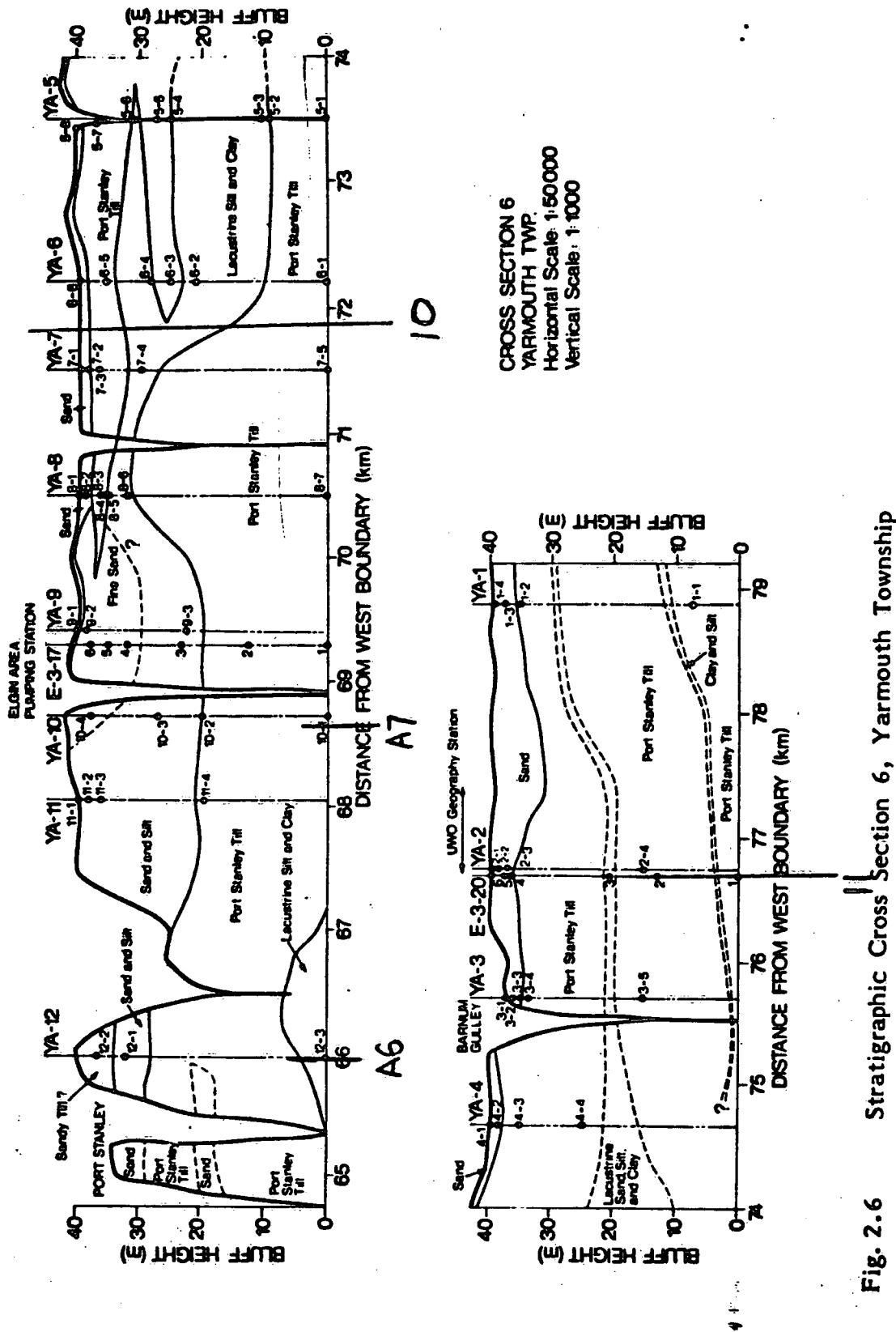


Fig. 2.6 Stratigraphic Cross Section 6, Yarmouth Township

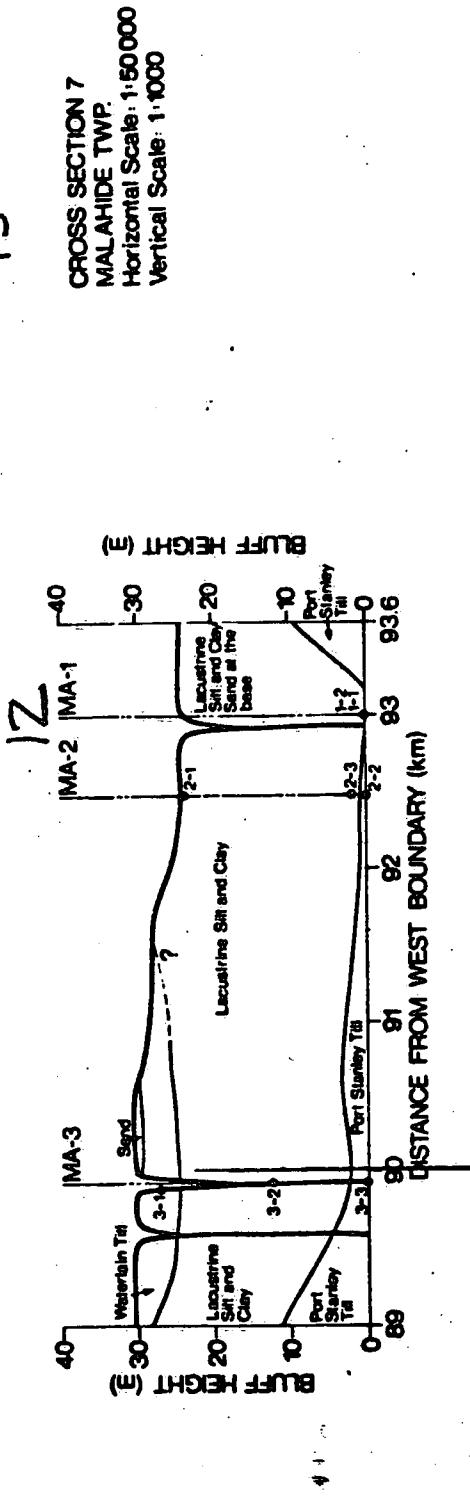
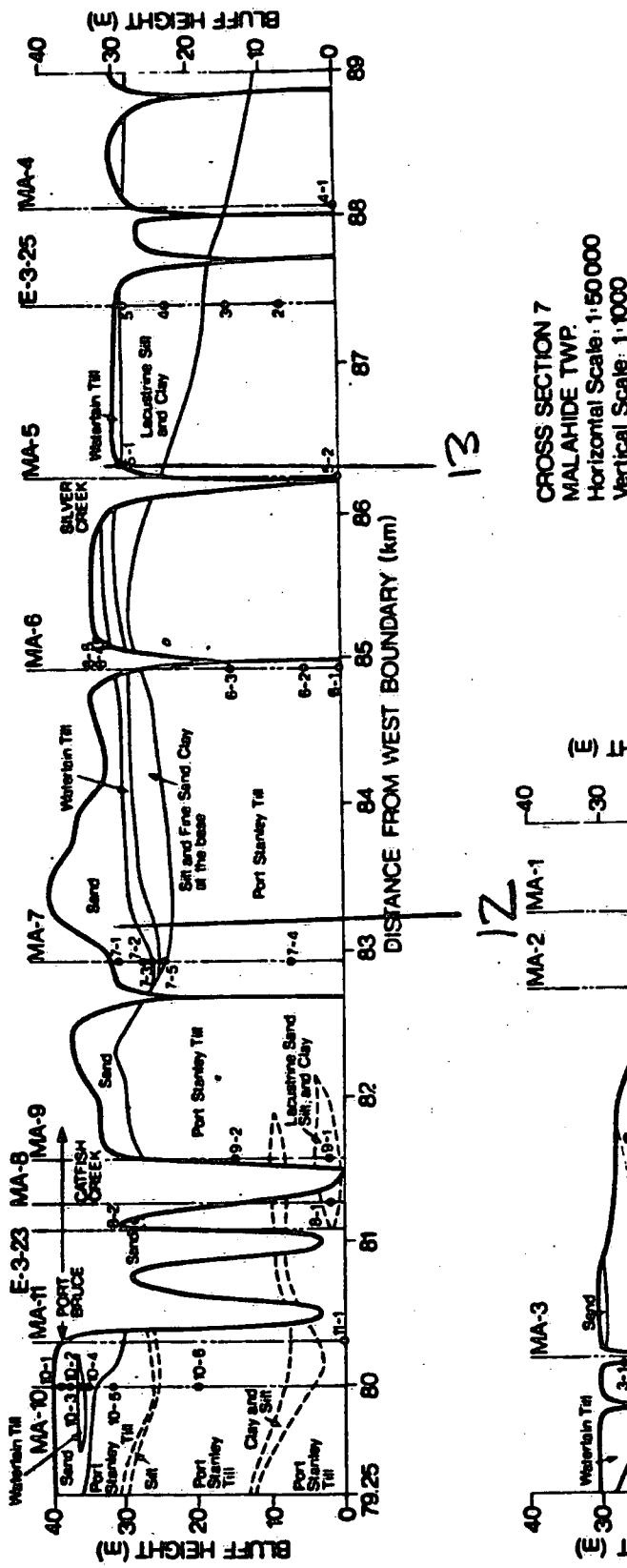


Fig. 2.7 Stratigraphic Cross Section 7, Malahide Township

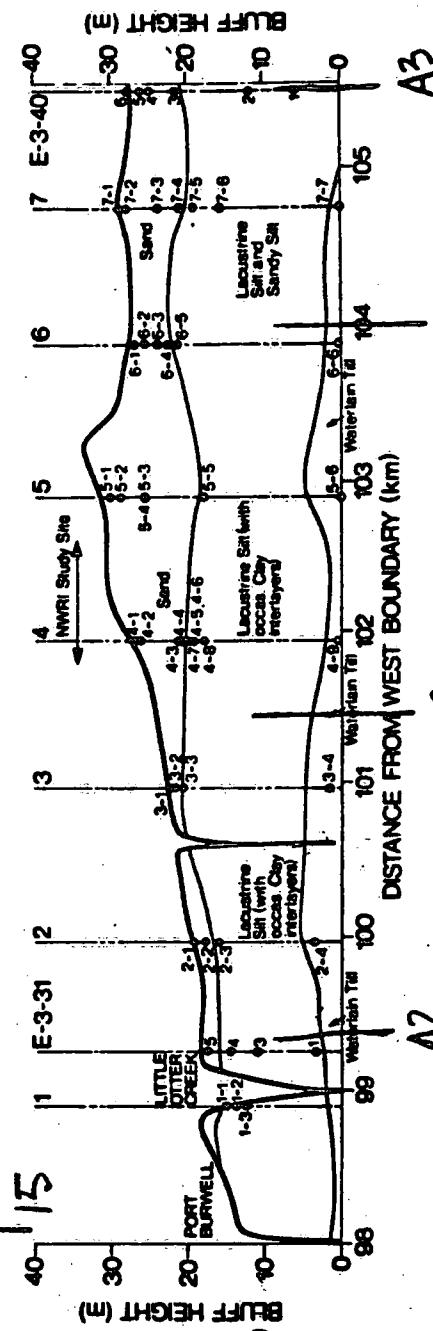
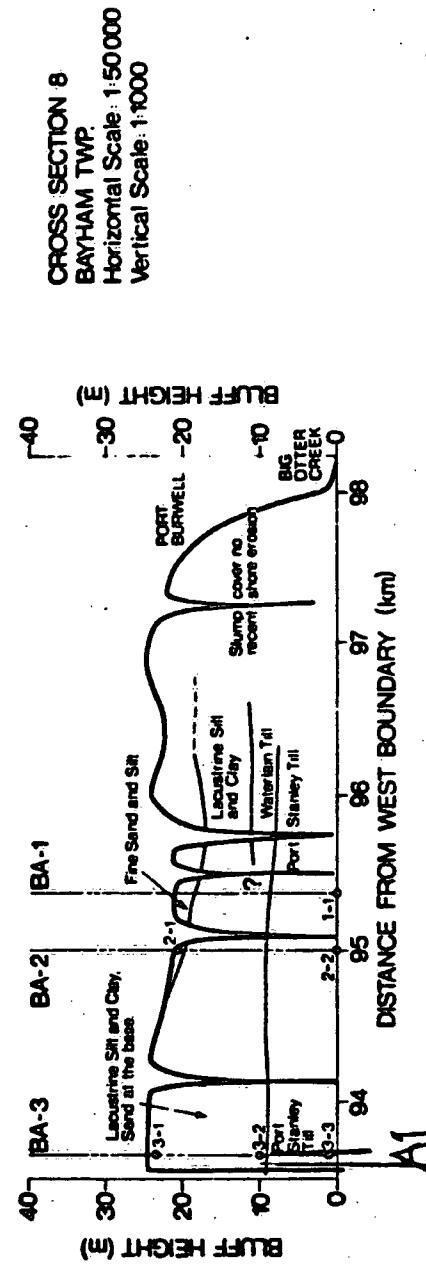


Fig. 2.8 Stratigraphic Cross Section 8, Bayham Township

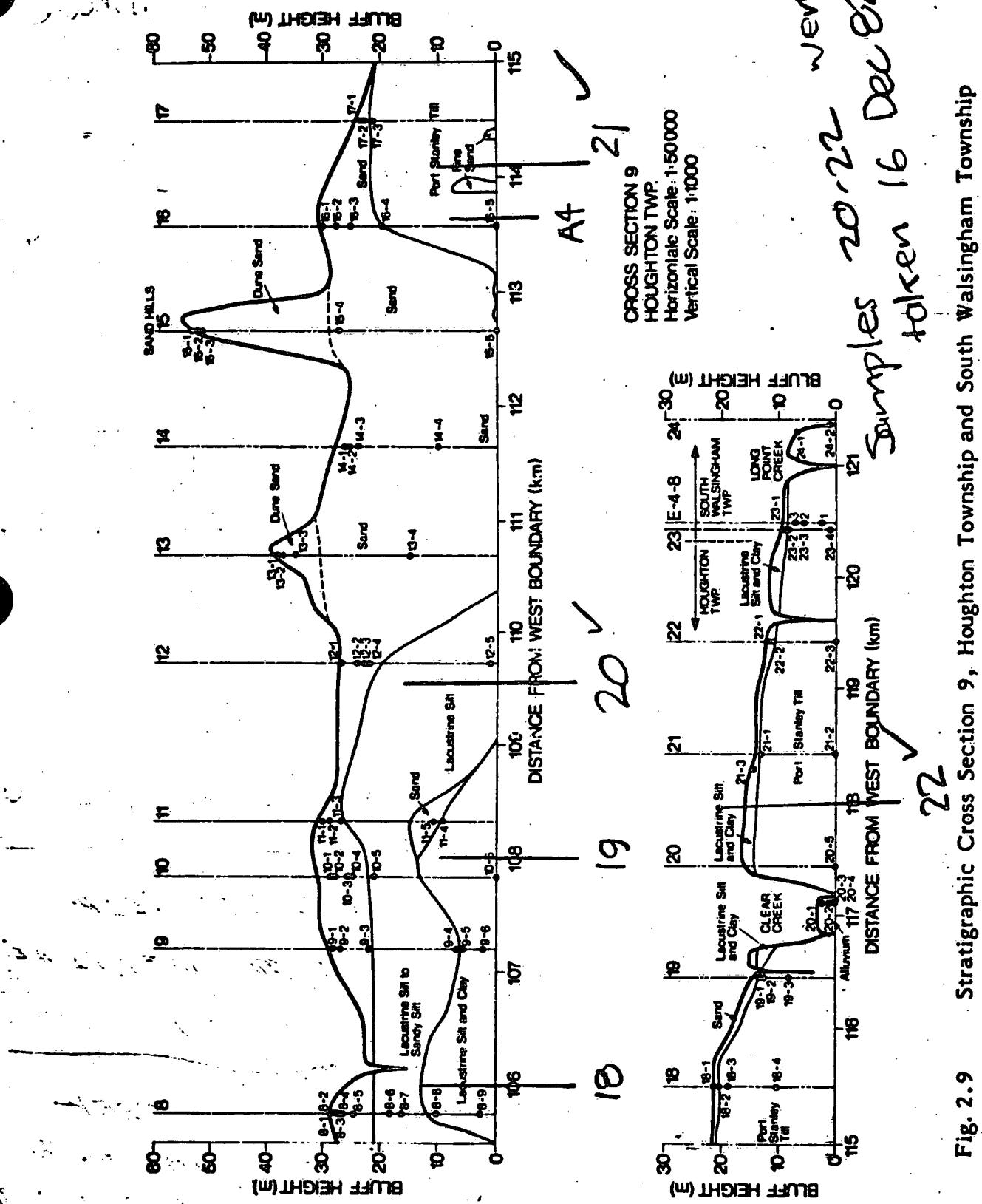


Fig. 2.9 Stratigraphic Cross Section 9, Houghton Township and South Walsingham Township

APPENDIX 2
SIZDIST OUTPUT

PORT BURWELL E8
PCT. GRAVEL 0.00 SAND 10.13 SIEVE AND PIPETTE(2) SAMPLE WT.= 41.6436
0.00 SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00
GROUT+SAND 10.19 SILT/(SILT+CLAY) 23.46 PCT.GRAV+SAND/SILT+CLAY .11
LAUREL SHEPARD -SILTY CLAY FOLK(GRS)-SANDY MUD (SCS)-SANDY CLAY

FORT BUFWELL E9 SIEVE AND PIPETTE (2) SAMPLE WT.= 32.3120
PCT. GRAVEL 0.00 SAND 11.04 SILT (PIPETTE) 25.85 CLAY (PIPETTE) 63.12
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00

GRAV+SAND 11.04 SILT/(SILT+CLAY) 29.05PCT.GRAV+SAND/SILT+CLAY .12

LABELS SHEPARD -SILTY CLAY FOLK(GMS)-SANDY MUD (SCS)-SANDY CLAY

PORT BUEWELL E11 SIEVE AND PIPETTE(2) SAMPLE WT. = 35.7⁻⁴¹
PCT. GRAVEL 0.00 SAND 2.04 SILT (PIPETTE) 39.51 CLAY (PIPETTE) 58.4.
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00

GRA
SAND 2.04 SILT/(SILT+CLAY) = 40.34 PCT. GRAV+SAND/SILT+CLAY .32

LABEL SHEPARE -SILTY CLAY FOLK(GMS)-MUD

(SCS)-MUD

PORT BURWELL E12 SIEVE AND PIPETTE (2) SAMPLE WT.= 31.3017
PCT. GRAVEL 5.00 SAND 1.33 SILT (PIPETTE) 41.53 CLAY (PIPETTE) 57.6.
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.0
GRAVEL+SAND 1.33 SILT/(SILT+CLAY) 41.5 PCT. GRAV+SAND/SILT+CLAY .01
LAB SHEPARD -SILTY CLAY FOLK(GMS)-MUD (SCS)-MUD

SOFT BURWELL E13 SIEVE AND PIPETTE (2) SAMPLE WT. = 35.6752
PCT. GRAVEL 0.00 SAND 1.80 SILT (PIPETTE) 37.90 CLAY (PIPETTE) 1.30
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00
GRAV+SAND/SILT+CLAY 35.53 PCT. GRAV+SAND/SILT+CLAY 1.2
LABLES SHEPARD - SILTY CLAY FOLK(GMS)-MUD (SCS)-MUD

PCT. RUEWELL E1E SIEVE AND PIPETTE(2) SAMPLE WT.= 33.273g
PCY. (GEAVL 5.00 SAND 4.05 SILT (PIPETTE) 42.60 CLAY (PIPETTE) 53.31
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00

GRA. SAND 4.05 SILT/(SILT+CLAY) 44.42PCT.GEAV+SAND/SILT+CLAY .54

LAB. SHEPARD -SILTY CLAY FOLK(GMS)-MUD (SCS)-MUD

FORT BURWELL E16

SEDIGRAPH ANALYSIS

PHI PCT. CUMFCT.

03/02/63

ASSUMED UPPER LIMIT

| | 1.73 | |
|-------|--------|-------|
| 4.50 | 1.73 | |
| | 1.49 | * |
| 4.50 | 3.22 | |
| | .50 | |
| 5.00 | 3.72 | |
| | 0.00 | |
| 5.50 | 3.72 | |
| | 1.99 | ** |
| 6.00 | 5.70 | |
| | 3.47 | *** |
| 6.50 | 9.18 | |
| | 5.96 | ***** |
| 7.00 | 15.13 | |
| | 9.43 | ***** |
| 7.50 | 24.56 | |
| | 10.92 | ***** |
| 8.00 | 35.48 | |
| | 9.93 | ***** |
| 8.50 | 45.41 | |
| | 9.93 | ***** |
| 9.00 | 55.33 | |
| | 44.67 | ***** |
| ***** | 100.00 | ***** |

MEAN ST.DEV. SKEWNESS KURTOSIS

7.41 1.21 -.66 1.64 KRUMBEIN + FETT JOHN (1938) MOMENT MEASURES
FOR SIZE RANGE 4.0 TO 9.0 PHI

> 5 PERCENT OF THE FINES ARE NOT RESOLVED, OBTAIN FOLK STATS. GRAPHICALLY

| P | NTILES | MEDIAN | 8.73 | 5TH | 5.82 | 16TH | 7.85 | 25TH | 7.52 |
|---|--------|--------|------|------|-------|------|-------|------|-------|
| | | | | 75TH | ***** | 84TH | ***** | 95TH | ***** |

| PCT. | GRAVEL | .00 | SAND | 1.73 | SILT (PIPETTE) | 0.00 | CLAY (PIPETTE) | 0.00 |
|------|--------|-----|------|------|----------------|-------|----------------|-------|
| | | | | | (SEDIGRAPH) | 33.75 | (SEDIGRAPH) | 64.52 |

GRAVEL+SAND 1.73 SILT/(SILT+CLAY) 34.34 PCT.GRAV+SAND/SILT+CLAY .02

LABELS SHEPARD -SILTY CLAY FOLK(GMS)-MUD (SCS)-MUD

FORT BUPWELL E17

SEDIGRAPH ANALYSIS

03/02/63

PHI FCT. CUMFCT.

| <u>ASSUMED UPPER LIMIT</u> | | |
|----------------------------|--------|-------|
| 3.00 | .31 | |
| 4.00 | .31 | * |
| 4.50 | 1.01 | |
| 5.00 | 0.00 | 1.32 |
| 5.50 | 0.00 | 1.32 |
| | | * |
| 6.00 | 1.01 | 2.33 |
| 6.50 | 2.01 | ** |
| 7.00 | 3.02 | *** |
| 7.50 | 7.36 | **** |
| | 9.06 | ***** |
| 8.00 | 16.43 | ***** |
| 8.50 | 10.07 | ***** |
| 9.00 | 26.49 | ***** |
| 9.50 | 12.08 | ***** |
| 10.00 | 39.58 | ***** |
| 10.50 | 11.08 | ***** |
| 11.00 | 49.65 | ***** |
| 11.50 | 50.35 | ***** |
| | 100.00 | ***** |

MEAN ST.DEV. SKEWNESS KURTOSIS

7.74 .96 -.90 3.58 KRUMBETZ + PETT JOHN (1938) MOMENT MEASURES
FOR SIZE RANGE 4.0 TO 9.0 PHI

> 5 PERCENT OF THE FINES ARE NOT RESOLVED, OBTAIN FOLK STATS. GRAPHICALLY

| | | | | |
|----------------------------|---------------|------------------|---------------------|-----------------------------|
| PERCENTILES | MEDIAN***** | 5TH 6.61 | 16TH 7.48 | 25TH 7.93 |
| | | 75TH***** | 84TH***** | 95TH***** |
| PCT. GRAVEL | .00 | SAND .31 | SILT (PIPETTE) 0.00 | CLAY (PIPETTE) 0.00 |
| | | | (SEDIGRAPH) 26.18 | (SEDIGRAPH) 73.51 |
| GRAVEL+SAND | .31 | SILT/(SILT+CLAY) | 26.26 | PCT.GRAV+SAND/SILT+CLAY .00 |
| LABELS SHEPARD -SILTY CLAY | FOLK(GME)-MUD | | | (SCS)-CLAY |

FCAT BUFWELL E18

SEDIGRAPH ANALYSIS

03/02/83

PHI FCT. CUMFCT.

| <u>ASSUMED UPPER LIMIT</u> | |
|----------------------------|--------------|
| 3.5 | .05 |
| 4.0 | .05 |
| 4.50 | 3.00 .05 |
| 5.00 | .50 .55 |
| 5.50 | .50 1.05 |
| 6.00 | 1.00 2.05 |
| 6.50 | 7.00 9.05 |
| 7.00 | 7.50 16.55 |
| 7.50 | 11.49 28.04 |
| 8.00 | 3.93 38.03 |
| 8.50 | 9.00 47.03 |
| 9.00 | 10.99 58.02 |
| ***** | 41.98 103.00 |

MEAN ST.DEV. SKEWNESS KURTOSIS

7.52 .92 -.21 -.27 KRUMBEN + PETTIGEHN (1938) MOMENT MEASURES
FOR SIZE RANGE 4.0 TO 9.0 PHI

> 5 PERCENT OF THE FINES ARE NOT RESOLVED, OBTAIN FOLK STATS. GRAPHICALLY

| PERCENTILES | MEDIAN | 8.64 | 5TH | 6.21 | 16TH | 6.95 | 25TH | 7.37 |
|----------------|-------------|------------------|----------------|-------------------------|----------------|-------|-----------|------|
| | | | 75TH***** | | 84TH***** | | 95TH***** | |
| PCT. GRAVEL | .00 | SAND .05 | SILT (PIPETTE) | 8.00 | CLAY (PIPETTE) | 6.00 | | |
| | | | (SEDIGRAPH) | 37.98 | (SEDIGRAPH) | 61.97 | | |
| GRAVEL+SAND | .05 | SILT/(SILT+CLAY) | 38.00 | PCT.GRAV+SAND/SILT+CLAY | | | | |
| LABELS SHEPARD | -SILTY CLAY | FOLK(GMS)-MUD | | | (SCS)-MUD | | | |

PCT. BURWELL E20 SIEVE AND PIPETTE(2) SAMPLE WT.= 37.405g
PCT. GRAVEL 0.00 SAND 0.15 SILT (PIPETTE) 35.47 CLAY (PIPETTE) 64.43
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00

SAND 0.15 SILT/(SILT+CLAY) 35.27 PCT.GRAV+SAND/SILT+CLAY 0.01
LABEES SHEPARD -SILTY CLAY FOLK(GMS)-MUD (SCS)-MUD

PCT. BURWELL E21 SIEVE AND PIPETTE(2) SAMPLE WT.= 26.7746
PCT. GRAVEL 5.00 SAND 2.71 SILT (PIPETTE) 33.34 CLAY (PIPETTE) 63.95
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00

GRAVEL SAND 2.71 SILT/(SILT+CLAY) 34.27PCT.GRAV+SAND/SILT+CLAY .03
LABEES SHEPARD -SILTY CLAY FOLK(GMS)-MUD (SCS)-MUD

PCT. BUEWELL E22 SIEVE AND PIPETTE(2) SAMPLE WT.= 36.7-52
PCT. GRAVEL 0.00 SAND 4.19 SILT (PIPETTE) 34.60 CLAY (PIPETTE) 61.21
(SEDIGRAPH) 0.00 (SEDIGRAPH) 0.00

G.F. SAND 4.19 SILT/(SILT+CLAY) 36.11 PCT.GEAX+SAND/SILT+CLAY .04

LABELS SHEPARD -SILTY CLAY FOLK(GMS)-MUD

(SGS)-MUD

APPENDIX 3
GEOTECHNICAL RESULTS

PORT BUFWELL EB

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 23 | 21 | 40 |
| WT. OF WET SOIL + TARE | | |
| 12.8468 | 18.4687 | 13.972 |
| WT. OF DRY SOIL + TARE | | |
| 10.1211 | 14.7543 | 11.1901 |
| WT. OF WATER | | |
| 2.7257 | 4.1144 | 2.7819 |
| TARE WT. | | |
| 1.379 | 1.3794 | 1.3796 |
| WT. OF DRY SOIL | | |
| 9.7421 | 13.3743 | 9.8105 |
| WATER CONTENT % | | |
| 31.179 | 30.7621 | 28.3564 |

PLASTIC LIMIT DETERMINATION

| | |
|------------------------|---------|
| WT. OF WET SOIL + TARE | |
| 7.2781 | 8.1989 |
| WT. OF DRY SOIL + TARE | |
| 6.2776 | 8.1989 |
| WT. OF WATER | |
| 1.0005 | 1.1761 |
| TARE WT. | |
| 1.3788 | 1.3747 |
| WT. OF DRY SOIL | |
| 4.8988 | 5.6481 |
| WATER CONTENT % | |
| 20.4234 | 20.8229 |

=====

LIQUID LIMIT 30.5251
 PLASTIC LIMIT 20.6232
 NATURAL WATER CONTENT 23.3393
 LIQUIDITY INDEX .274309
 PLASTICITY INDEX 9.90197

PORT BURWELL E9

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 18 | 38 | 65 |
| WT. OF WET SOIL + TARE | | |
| 15.6432 | 15.574 | 15.8352 |
| WT. OF DRY SOIL + TARE | | |
| 12.151 | 12.2959 | 12.787 |
| WT. OF WATER | | |
| 3.4922 | 3.2782 | 3.0432 |
| TARE WT. | | |
| 1.3768 | 1.3793 | 1.3789 |
| WT. OF DRY SOIL | | |
| 10.7742 | 10.9165 | 11.4081 |
| WATER CONTENT % | | |
| 32.4126 | 30.0298 | 26.7196 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 6.2377 | 8.0127 | |
| WT. OF DRY SOIL + TARE | | |
| 5.4499 | 8.0127 | |
| WT. OF WATER | | |
| .7878 | 1.0382 | |
| TARE WT. | | |
| 1.3826 | 1.3867 | |
| WT. OF DRY SOIL | | |
| 4.0673 | 5.5378 | |
| WATER CONTENT % | | |
| 19.3691 | 19.6504 | |

=====

LIQUID LIMIT 30.9262
 PLASTIC LIMIT 19.5098
 NATURAL WATER CONTENT 23.2043
 LIQUIDITY INDEX .331541
 PLASTICITY INDEX 11.4164

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 8 | 21 | 95 |
| WT. OF WET SOIL + TARE | | |
| 12.5063 | 15.6448 | 17.5277 |
| WT. OF DRY SOIL + TARE | | |
| 9.6657 | 12.4787 | 14.1768 |
| WT. OF WATER | | |
| 2.6406 | 3.1661 | 3.3509 |
| TARE WT. | | |
| 1.3923 | 1.3839 | 1.3835 |
| WT. OF DRY SOIL | | |
| 8.4734 | 11.0948 | 12.7933 |
| WATER CONTENT % | | |
| 31.1634 | 28.5368 | 26.1926 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 8.5745 | 7.2985 | |
| WT. OF DRY SOIL + TARE | | |
| 7.5054 | 7.2935 | |
| WT. OF WATER | | |
| .7691 | .5421 | |
| TARE WT. | | |
| 1.3832 | 1.3897 | |
| WT. OF DRY SOIL | | |
| 6.5172 | 5.3667 | |
| WATER CONTENT % | | |
| 11.8911 | 10.1012 | |

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LIQUID LIMIT 30.2541
 PLASTIC LIMIT 10.9511
 NATURAL WATER CONTENT 21.4059
 LIQUIDITY INDEX .541611
 PLASTICITY INDEX 19.303

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|-----------------|---------|---------|
| 18 | 43 | 57 |
| WT. OF WET SOIL | + TARE | |
| 18.9872 | 20.7075 | 16.3141 |
| WT. OF DRY SOIL | + TARE | |
| 15.2048 | 16.8389 | 13.3244 |
| WT. OF WATER | | |
| 3.7831 | 3.8987 | 2.9797 |
| TARE WT. | | |
| 1.389 | 1.384 | 1.3891 |
| WT. OF DRY SOIL | | |
| 13.8166 | 15.4249 | 11.9353 |
| WATER CONTENT % | | |
| 27.3804 | 25.2754 | 24.9654 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 8.7277 | 10.5749 | |
| WT. OF DRY SOIL + TARE | | |
| 7.6071 | 10.5749 | |
| WT. OF WATER | | |
| 1.1206 | 1.4166 | |
| TARE WT. | | |
| 1.3822 | 1.3892 | |
| WT. OF DRY SOIL | | |
| 6.2139 | 7.7691 | |
| WATER CONTENT % | | |
| 18.0193 | 19.2338 | |

===== LIQUID LIMIT 26.7487

===== PLASTIC LIMIT 18.1255

===== NATURAL WATER CONTENT 21.1059

===== LIQUIDITY INDEX .345548

===== PLASTICITY INDEX 8.62222

LIQUID LIMIT DETERMINATION

| | NUMBER OF BLOW | |
|------------------------|----------------|---------|
| 6 | 42 | 33 |
| WT. OF WET SOIL + TARE | | |
| 19.3845 | 17.9558 | 15.8503 |
| WT. OF DRY SOIL + TARE | | |
| 15.2841 | 14.5261 | 12.8631 |
| WT. OF WATER | | |
| 4.1004 | 3.4297 | 3.0272 |
| TARE WT. | | |
| 1.3921 | 1.3953 | 1.3965 |
| WT. OF DRY SOIL | | |
| 13.892 | 13.1308 | 11.4566 |
| WATER CONTENT % | | |
| 29.5163 | 26.1195 | 26.4002 |

PLASTIC LIMIT DETERMINATION

| | WT. OF WET SOIL + TARE | |
|------------------------|------------------------|--|
| 10.701 | 10.7667 | |
| WT. OF DRY SOIL + TARE | | |
| 9.3145 | 10.7667 | |
| WT. OF WATER | | |
| 1.3865 | 1.5722 | |
| TARE WT. | | |
| 1.3929 | 1.3832 | |
| WT. OF DRY SOIL | | |
| 7.9216 | 7.8063 | |
| WATER CONTENT % | | |
| 17.5028 | 20.1401 | |

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 LIQUID LIMIT 27.3184
 PLASTIC LIMIT 18.6215
 NATURAL WATER CONTENT 22.5013
 LIQUIDITY INDEX .444354
 PLASTICITY INDEX 8.49692

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 22 | 19 | 17 |
| WT. OF WET SOIL + TARE | | |
| 19.2262 | 16.2358 | 21.2784 |
| WT. OF DRY SOIL + TARE | | |
| 15.5623 | 13.0104 | 16.696 |
| WT. OF WATER | | |
| 3.6439 | 3.2754 | 4.5824 |
| TARE WT. | | |
| 1.3867 | 1.3878 | 1.3939 |
| WT. OF DRY SOIL | | |
| 14.1956 | 11.6226 | 15.3021 |
| WATER CONTENT % | | |
| 25.6692 | 23.1813 | 29.9462 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 7.9084 | 8.1439 | |
| WT. OF DRY SOIL + TARE | | |
| 6.9054 | 8.1439 | |
| WT. OF WATER | | |
| 1.003 | .99 | |
| TARE WT. | | |
| 1.3924 | 1.39 | |
| WT. OF DRY SOIL | | |
| 5.513 | 5.7639 | |
| WATER CONTENT % | | |
| 18.1934 | 17.1759 | |

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LIQUID LIMIT 27.4143
 PLASTIC LIMIT 17.6846
 NATURAL WATER CONTENT 21.2997
 LIQUIDITY INDEX .371557
 PLASTICITY INDEX 9.72969

PORT BURWELL E16

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 7 | 19 | 56 |
| WT. OF WET SOIL + TARE | | |
| 21.3205 | 18.3134 | 22.4.11 |
| WT. OF DRY SOIL + TARE | | |
| 16.0545 | 14.3265 | 17.4319 |
| WT. OF WATER | | |
| 5.2664 | 4.0569 | 5.0032 |
| TARE WT. | | |
| 1.3876 | 1.3901 | 1.3919 |
| WT. OF DRY SOIL | | |
| 14.6669 | 12.9364 | 16.04 |
| WATER CONTENT % | | |
| 35.9067 | 31.3603 | 31.2294 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 7.7588 | 6.55-6 | |
| WT. OF DRY SOIL + TARE | | |
| 6.7653 | 8.5546 | |
| WT. OF WATER | | |
| .9935 | 1.2217 | |
| TARE WT. | | |
| 1.394 | 1.3939 | |
| WT. OF DRY SOIL | | |
| 5.3713 | 5.939 | |
| WATER CONTENT % | | |
| 18.4965 | 20.5709 | |

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 LIQUID LIMIT 33.0042
 PLASTIC LIMIT 19.5336
 NATURAL WATER CONTENT 25.7482
 LIQUIDITY INDEX .461347
 PLASTICITY INDEX 13.4706

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 18 | 31 | 21 |
| WT. OF WET SOIL + TARE | | |
| 16.109 | 15.0576 | 17.1269 |
| WT. OF DRY SOIL + TARE | | |
| 13.5476 | 11.5715 | 13.1455 |
| WT. OF WATER | | |
| 4.5619 | 3.4861 | 3.9814 |
| TARE WT. | | |
| 1.3945 | 1.3941 | 1.3972 |
| WT. OF DRY SOIL | | |
| 12.153 | 10.1774 | 11.7483 |
| WATER CONTENT % | | |
| 37.5369 | 34.2533 | 33.8892 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 8.8387 | 9.4864 | |
| WT. OF DRY SOIL + TARE | | |
| 7.2348 | 9.4864 | |
| WT. OF WATER | | |
| 1.6039 | 1.4223 | |
| TARE WT. | | |
| 1.3975 | 1.3898 | |
| WT. OF DRY SOIL | | |
| 5.8373 | 6.6743 | |
| WATER CONTENT % | | |
| 27.4767 | 21.3101 | |

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LIQUID LIMIT 34.0592

PLASTIC LIMIT 24.3934

NATURAL WATER CONTENT 31.6781

LIQUIDITY INDEX .753655

PLASTICITY INDEX 9.66573

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| B | 24 | 58 |
| WT. OF WET SOIL + TARE | | |
| 20.0392 | 17.1247 | 11.9567 |
| WT. OF DRY SOIL + TARE | | |
| 15.358 | 13.3599 | 9.5137 |
| WT. OF WATER | | |
| 4.6812 | 3.7648 | 2.443 |
| TARE WT. | | |
| 1.398 | 1.3887 | 1.3891 |
| WT. OF DRY SOIL | | |
| 13.96 | 11.9712 | 8.1246 |
| WATER CONTENT % | | |
| 33.533 | 31.4488 | 30.0692 |

PLASTIC LIMIT DETERMINATION

| | |
|------------------------|---------|
| WT. OF WET SOIL + TARE | |
| 8.0652 | 10.4685 |
| WT. OF DRY SOIL + TARE | |
| 6.8581 | 10.4685 |
| WT. OF WATER | |
| 1.2071 | 1.7147 |
| TARE WT. | |
| 1.3937 | 1.3939 |
| WT. OF DRY SOIL | |
| 5.4644 | 7.3599 |
| WATER CONTENT % | |
| 22.0903 | 23.2979 |

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LIQUID LIMIT 33.4068
 PLASTIC LIMIT 22.6941
 NATURAL WATER CONTENT 25.288
 LIQUIDITY INDEX .242133
 PLASTICITY INDEX 10.7127

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 16 | 25 | 41 |
| WT. OF WET SOIL + TARE | | |
| 16.0636 | 17.5957 | 20.2412 |
| WT. OF DRY SOIL + TARE | | |
| 13.1846 | 13.2099 | 15.3037 |
| WT. OF WATER | | |
| 4.879 | 4.3858 | 4.9375 |
| TARE WT. | | |
| 1.3907 | 1.3924 | 1.3918 |
| WT. OF DRY SOIL | | |
| 11.7933 | 11.8175 | 13.9119 |
| WATER CONTENT % | | |
| 41.368 | 37.1128 | 35.4912 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 7.9723 | 9.5316 | |
| WT. OF DRY SOIL + TARE | | |
| 6.6485 | 9.5316 | |
| WT. OF WATER | | |
| 1.1238 | 1.4736 | |
| TARE WT. | | |
| 1.3896 | 1.3935 | |
| WT. OF DRY SOIL | | |
| 5.4589 | 6.6625 | |
| WATER CONTENT % | | |
| 20.5866 | 22.0723 | |

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LIQUID LIMIT 38.5032
 PLASTIC LIMIT 21.3297
 NATURAL WATER CONTENT 28.5067

LIQUIDITY INDEX .423152
 PLASTICITY INDEX 17.1735

LIQUID LIMIT DETERMINATION

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 24 | 42 | 81 |
| WT. OF WET SOIL + TARE | | |
| 14.031 | 13.1288 | 12.3845 |
| WT. OF DRY SOIL + TARE | | |
| 10.8486 | 10.8072 | 12.0663 |
| WT. OF WATER | | |
| 3.1904 | 4.3216 | 3.3186 |
| TARE WT. | | |
| 1.394 | 1.3904 | 1.3908 |
| WT. OF DRY SOIL | | |
| 9.4466 | 13.4163 | 10.6755 |
| WATER CONTENT % | | |
| 33.773 | 32.2104 | 31.0861 |

PLASTIC LIMIT DETERMINATION

| WT. OF WET SOIL + TARE | | |
|------------------------|---------|--|
| 8.6751 | 13.2296 | |
| WT. OF DRY SOIL + TARE | | |
| 7.3685 | 10.2296 | |
| WT. OF WATER | | |
| 1.3066 | 1.6128 | |
| TARE WT. | | |
| 1.3911 | 1.396 | |
| WT. OF DRY SOIL | | |
| 5.9774 | 7.2208 | |
| WATER CONTENT % | | |
| 21.859 | 22.3355 | |

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LIQUID LIMIT 36.7625
 PLASTIC LIMIT 22.0972
 NATURAL WATER CONTENT 28.293
 LIQUICITY INDEX .422477
 PLASTICITY INDEX 14.6653

LIQUID LIMIT DETERMINATION

23741

| NUMBER OF BLOW | | |
|------------------------|---------|---------|
| 14 | 44 | 68 |
| WT. OF WET SOIL + TAPE | | |
| 16.3443 | 14.2149 | 16.4399 |
| WT. OF DRY SOIL + TAPE | | |
| 12.5214 | 11.26 | 13.2332 |
| WT. OF WATER | | |
| 3.7229 | 2.9549 | 3.2067 |
| TAPE WT. | | |
| 1.394 | 1.3925 | 1.3913 |
| WT. OF DRY SOIL | | |
| 11.2274 | 9.8675 | 11.8419 |
| WATER CONTENT % | | |
| 33.1591 | 29.9458 | 27.0793 |

PLASTIC LIMIT DETERMINATION

| | |
|------------------------|---------|
| WT. OF WET SOIL + TARE | |
| 10.5638 | 6.3587 |
| WT. OF DRY SOIL + TARE | |
| 8.931 | 6.3587 |
| WT. OF WATER | |
| 1.6328 | .7986 |
| TAPE WT. | |
| 1.3835 | 1.388 |
| WT. OF DRY SOIL | |
| 7.5425 | 4.1721 |
| WATER CONTENT % | |
| 21.648 | 19.1414 |

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LICUID LIMIT 35.2931
 PLASTIC LIMIT 20.3947
 NATURAL WATER CONTENT 25.1286
 LIQUILITY INDEX .317748
 PLASTICITY INDEX 14.8983