

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P2-~~32~~32

DIST. 4 REGION

W.P. No. 5-69-01

CONT. No. 85-24

W. O. No.

STR. SITE No.

HWY. No. 403

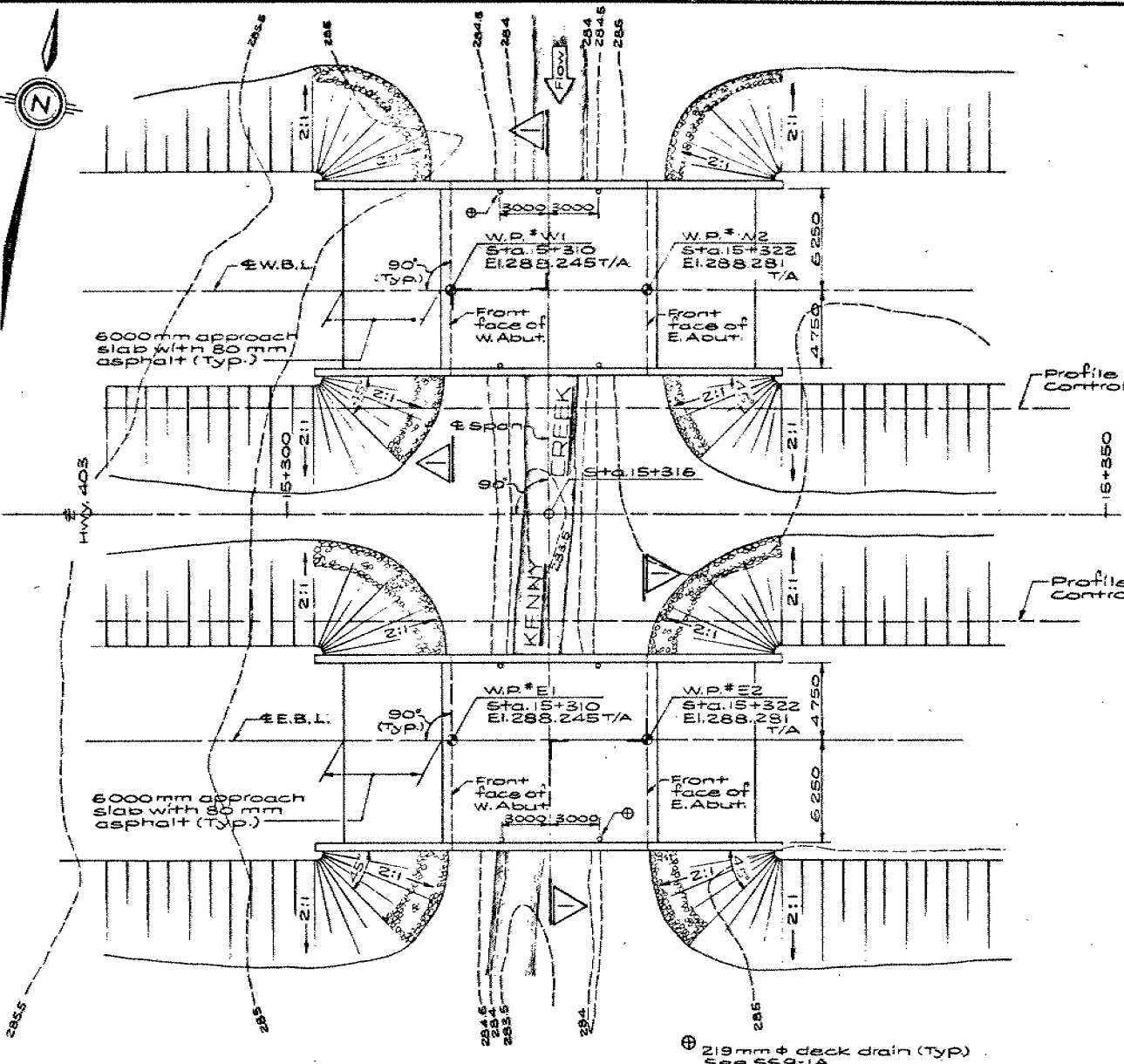
LOCATION Kenny Creek Twin Bridges

No of PAGES -

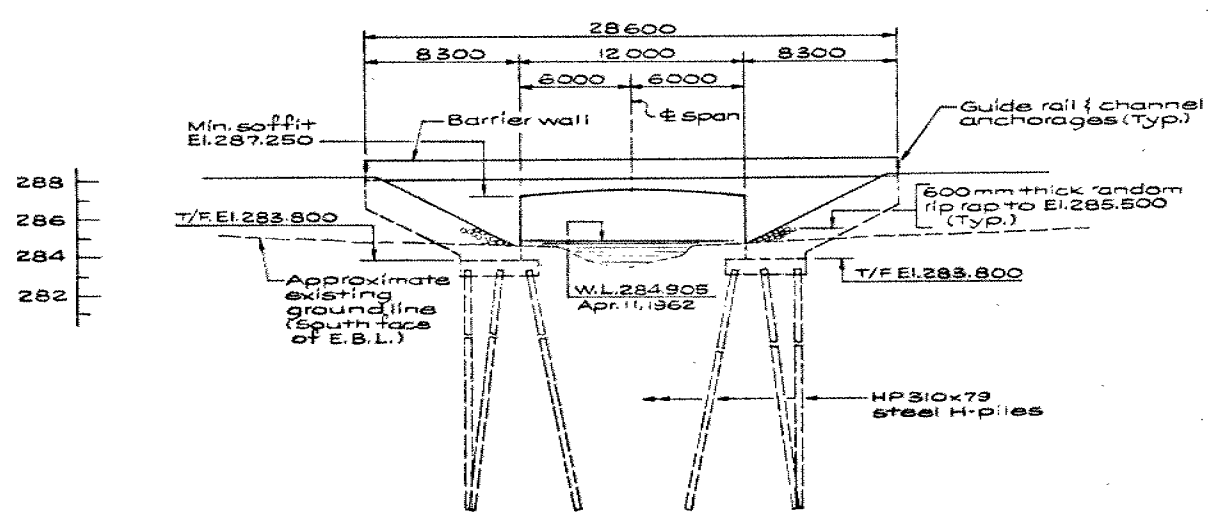
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

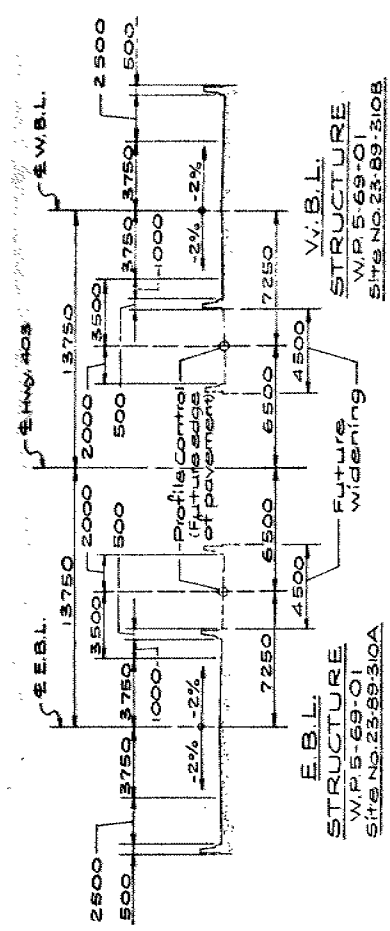
REMARKS:



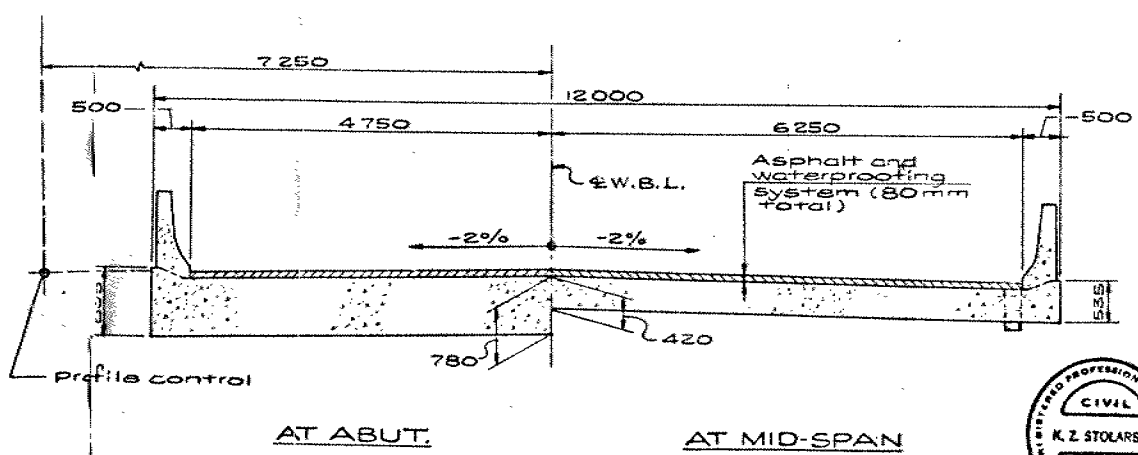
PLAN
1:200



ELEVATION
(Typ. for E.B.L. & W.B.L. structures)
1:200



PROFILE OF HWY 403
N.T.S.



AT ABUT.

AT MID-SPAN



METRIC
DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

DIST. 4		SHEET
CONT No	WP No 5-69-01	
KENNY CREEK (OPPEL CREEK) STRUCTURES 1.4 km west of Hwy 53 GENERAL ARRANGEMENT		
W. B. L. STRUCTURE		

NOTES

- CLASS OF CONCRETE**
Footings & approach slabs... 20MPa
Remainder... 30MPa
- REINFORCING STEEL**
Grade 400
Bar marks with suffix 'C' denotes coated bar
- NOMINAL CLEAR COVER AND TOLERANCE TO REINFORCING STEEL**
- | | mm |
|----------------------------------|----------|
| Footings | 100 ± 25 |
| Abutments & wingwalls | 80 ± 20 |
| Deck-top | 70 ± 20 |
| Deck-bottom & sides | 50 ± 10 |
| Remainder unless otherwise noted | 70 ± 20 |
- CONSTRUCTION NOTES**
Falsework supporting wingwalls shall not be removed until concrete in the deck has reached a minimum strength of 20MPa.
Backfill shall be placed simultaneously behind both abutments keeping the heights of the backfill approximately the same. At no time shall the difference in elevation be greater than 600mm.

LIST OF DRAWINGS

- 23-89-310 - 1 General Arrangement
" 2 Bore Hole Location & Soil Strata
" 3 Footing Layout & Reinforcing
" 4 Rigid Frame
" 5 Wingwalls
" 6 Barrier Walls
" 7 6000mm Approach Slab
" 8 As Constructed Elev. & Dim.
" 9 Bridge Data & Site Number Data
" 10 Pile Driving - Steam & Diesel Hammers
" 11 Pile Driving - Drop Hammers
" 12 Standard Details
" 13 Quantities
" 14 Quantities

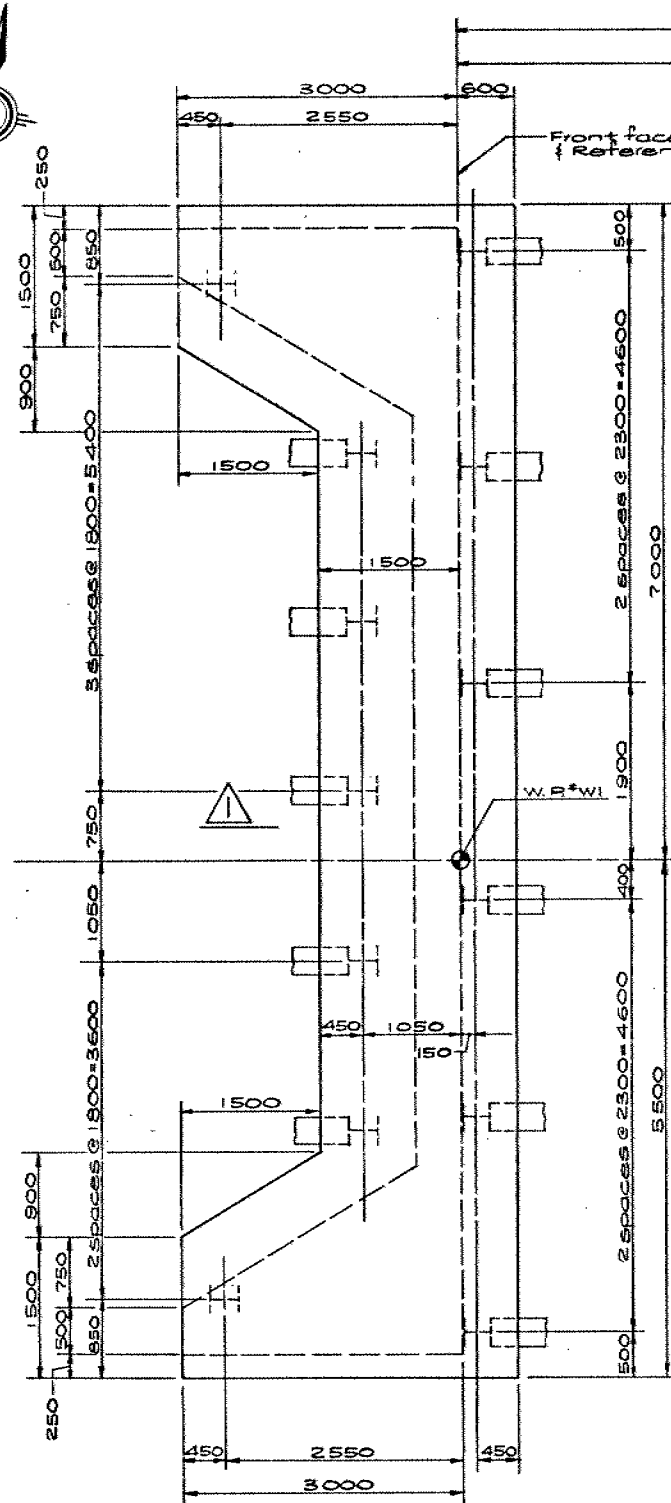
LIST OF ABBREVIATIONS

- W.P. = Working point
T/A = Top of asphalt
T/F = Top of footing
F.F. = Front face
B.F. = Back face
E.F. = Each face

B.M. 285.470
N & W in S Root 0.76 Elm
46.3 Lt. 15+326.3

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	2.25	CHECK	2.25
DRAWING	2.25	CHECK	2.25

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



West & east Abutment footings similar, west footing showing typical dimensions & pile layout; east footing showing typical reinforcing.

DATA

PILE DATA TABLE

FILE DATA

- All piles are HP310x79 steel H-piles.
- Pile spacing to be measured at the underside of footings
- Pile length shown in the 'Pile Data Table' is the theoretical length below cut-off
- Pile shoes to be provided on all piles in accordance with standard 003301

PILE DESIGN DATA

- Design load at S.L.S. Type II : 625 kN/pile
- Factored capacity at U.L.S. : 850 kN/pile

PILE CONSTRUCTION

DATA

- Piles to be driven in accordance with standard SS103-10 or SS103-11 using an ultimate capacity of 1875 kN/pile but must also be driven to El.263.000 or below.
- The driving energy should not be less than 50000 J per blow.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

METRIC

DIMENSIONS ARE IN MILLIMETRES
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ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
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DIST. 4

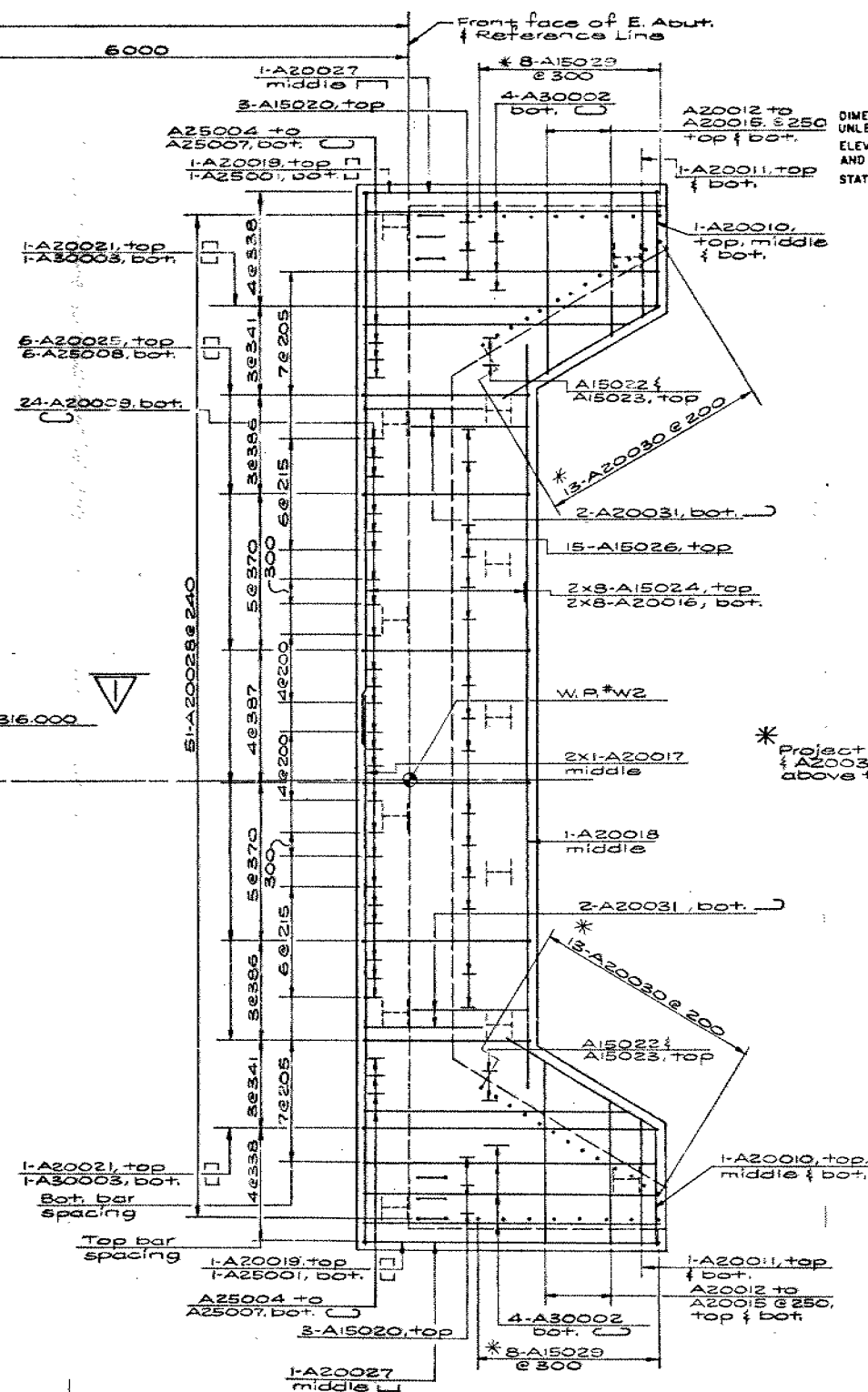
CONT	No
WP	No

5-59-01

KENNY CREEK (OPPEL DRAIN)
STRUCTURES
FOOTING LAYOUT & REINFORCING

W.B.L. STRUCTURE

SHEET



* Project A15029 600 mm
 1 AZ0030 650 mm
 above top of footing

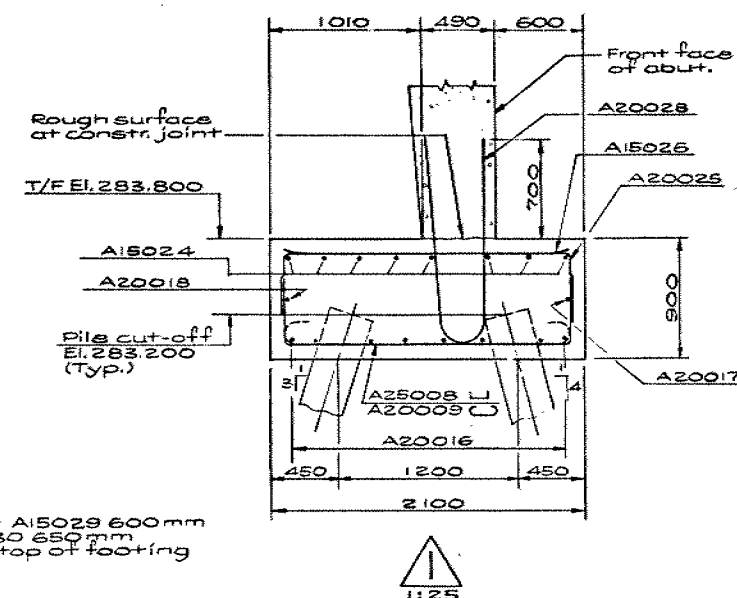
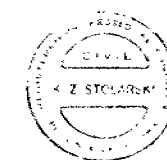


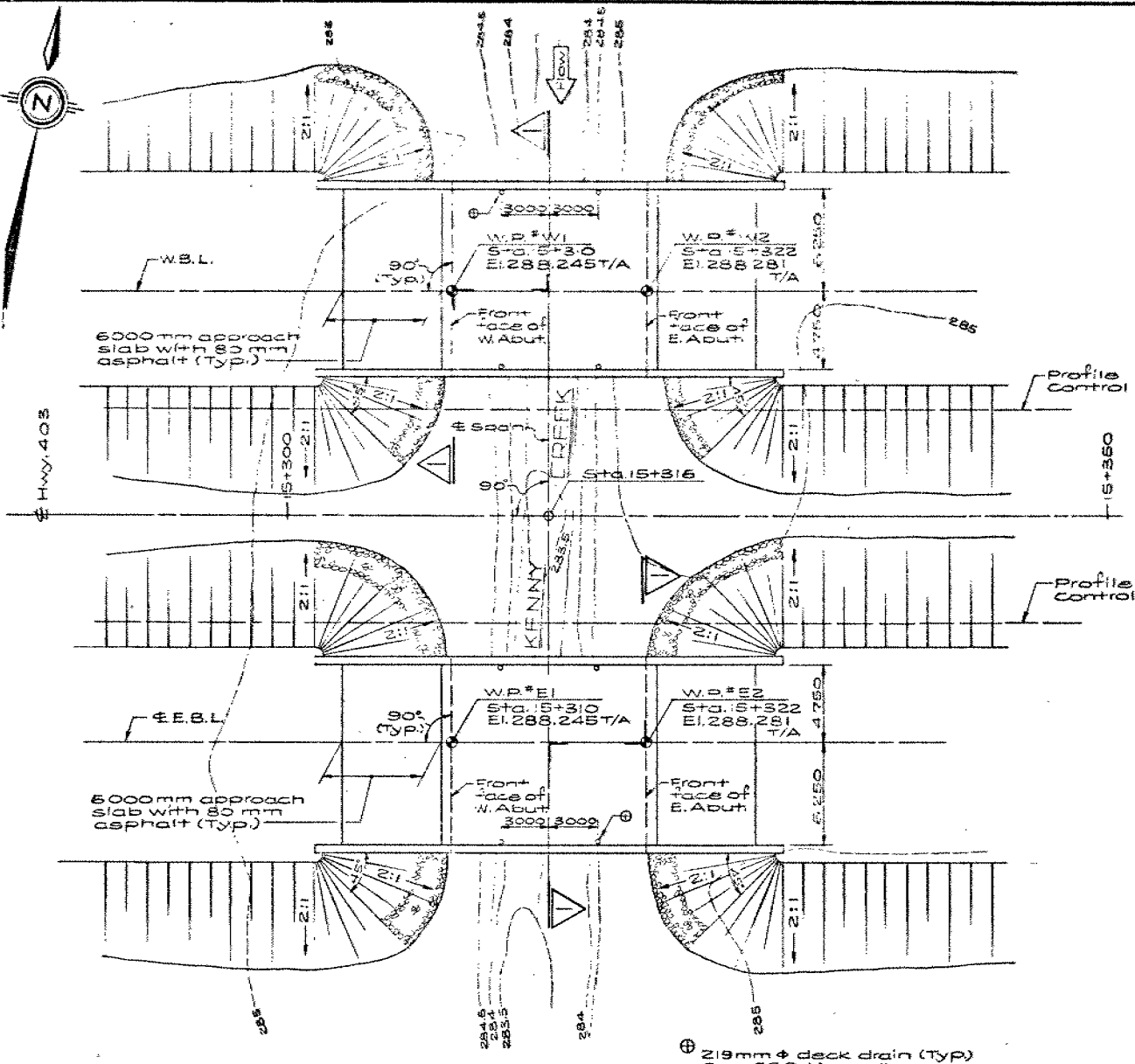
Diagram illustrating the cross-section of a bridge deck with dimensions and stationing:

- Front face of W. Abut. & Reference Line**: Indicated at the top left.
- Front face of E. Abut. & Reference Line**: Indicated at the top right.
- Edges of deck**: Indicated by vertical lines.
- W.P.*W1 Sta. 15+310.000**: Stationing for the left profile control point.
- W.P.*W2 Sta. 15+322.000**: Stationing for the right profile control point.
- ± W.B.L.**: Water Benchmark Line, indicated by a horizontal dashed line.
- ± Span**: Indicated by a horizontal dashed line between the two profile control points.
- Edge of deck**: Indicated by horizontal lines.
- Profile Control**: Indicated by vertical lines.
- ± Hwy. 403**: Highway 403, indicated at the bottom.
- Sta. 15+316.000**: Stationing for the center of the bridge deck.
- Dimensions**:
 - Horizontal dimensions: 6000 (from left edge to center), 6000 (from center to right edge).
 - Vertical dimensions: 13750 (from Hwy. 403 to W.B.L.), 6500 (from W.B.L. to top of deck), 7250 (from top of deck to top of abutment), 5250 (from W.B.L. to top of abutment).

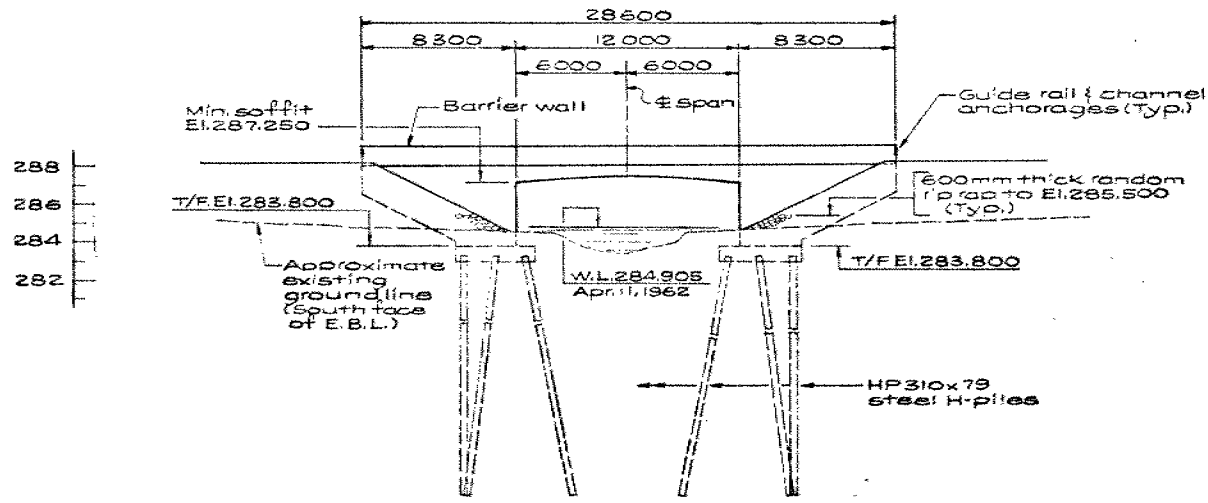
SITE LAYOUT PLAN
N.T.S.



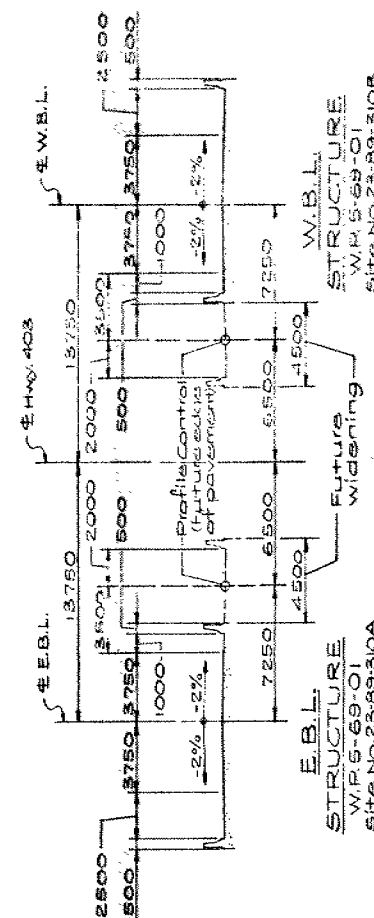
REVISES						
	DATE	BY	DESCRIPTION			
DESIGN	2-25		CHECK	LOADING	8-30-07	DATE 8-30-07
DRAWING	D.C.		CHECK	SITE 23-89-510	OWG	8



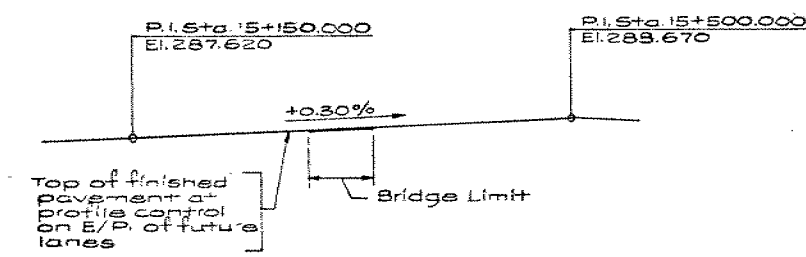
PLAN
1:200



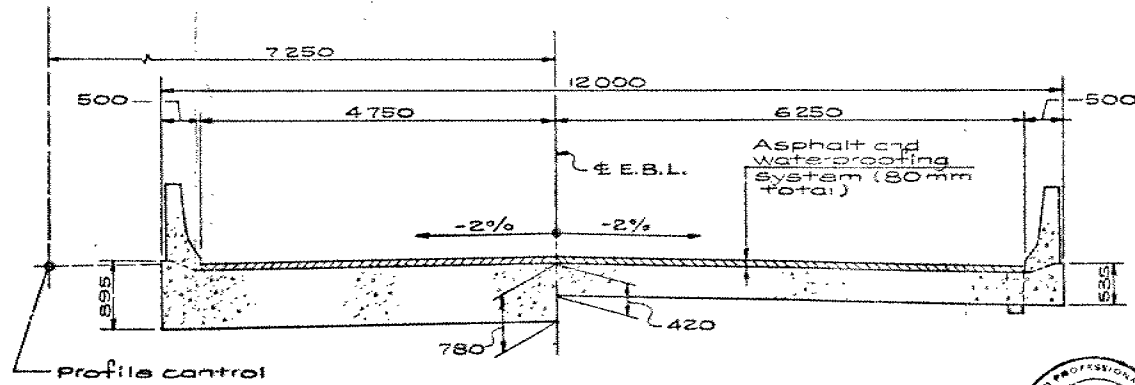
ELEVATION
(Typ. for E.B.L. & W.B.L. structures)
1:200



W.B.L. STRUCTURE
W.P. 5-69-01
SITE NO. 23-89-310B



PROFILE OF HWY 403
N.T.S.



AT ABUT. AT MID-SPAN



METRIC

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DIST. 4	CONT No	SHEET
	WP No 5-69-01	
KENNEDY CREEK (OPPEL DR.)		E.B.L. STRUCTURE
GENERAL ARRANGEMENT		

NOTES

- CLASS OF CONCRETE**
Footings, approach slabs, 20MPa
Remainder, 30MPa
- REINFORCING STEEL**
Grade 400
Bar marks with suffix 'C' denotes coated bar
- NOMINAL CLEAR COVER AND TOLERANCE TO REINFORCING STEEL**
- | Location | mm |
|----------------------------------|---------|
| Footings | 50 ± 25 |
| Abutments & wingwalls | 80 ± 20 |
| Deck - top | 70 ± 20 |
| Deck - bottom & sides | 50 ± 10 |
| Remainder unless otherwise noted | 70 ± 20 |
- CONSTRUCTION NOTES**
Falsework supporting wingwalls shall not be removed until concrete in the deck has reached a minimum strength of 20MPa.
Backfill shall be placed simultaneously behind both abutments keeping the heights of the backfill approximately the same. At no time shall the difference in elevation be greater than 600mm.

LIST OF DRAWINGS

- 23-89-310 - 1 General Arrangement
2 Bore hole location & Soil Strata
3 Footing layout & Reinforcing
4 Rigid Frame
5 Wingwalls
6 Barrier Walls
7 6000mm Approach Slab & Dim.
8 As Constructed Elev. & Dim.
9 Bridge Data & Site Number Data
10 Pile Driving - Steam & Diesel Hammers
11 Pile Driving - Drop Hammers
12 Standard Details
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14 Quantities

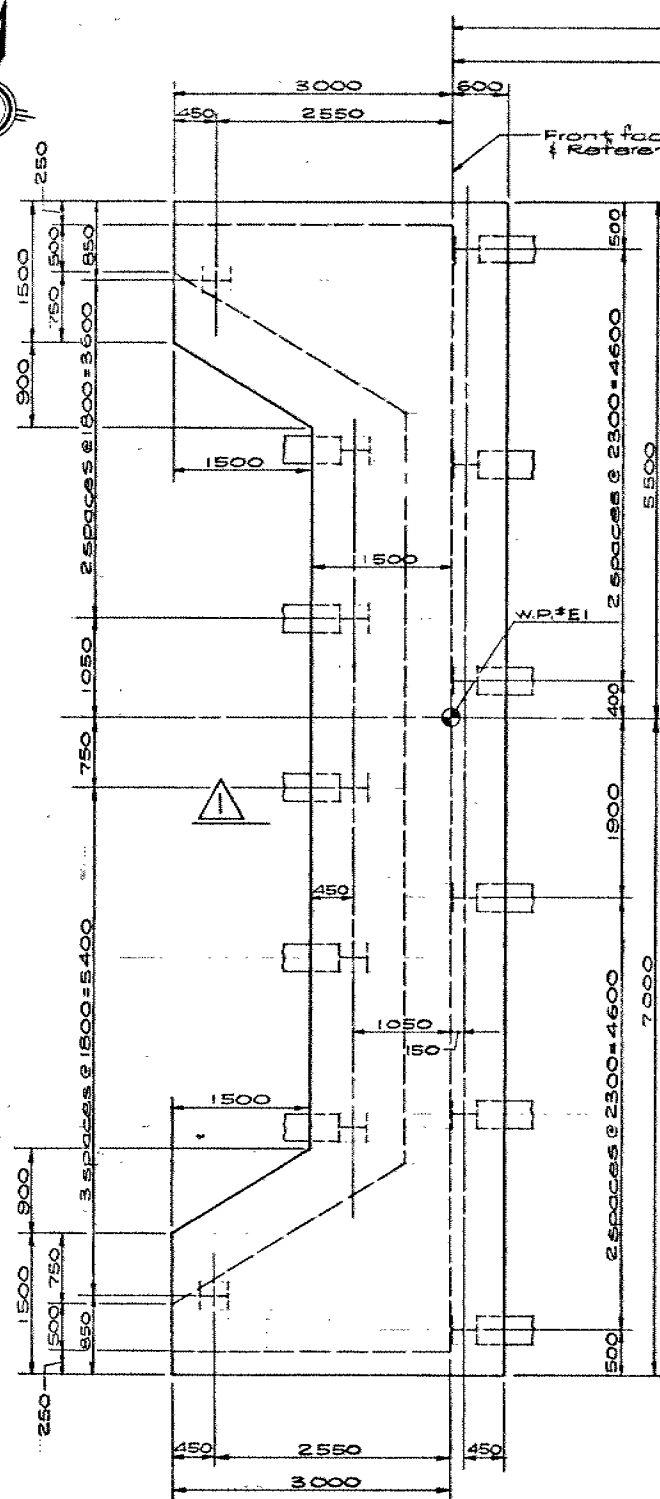
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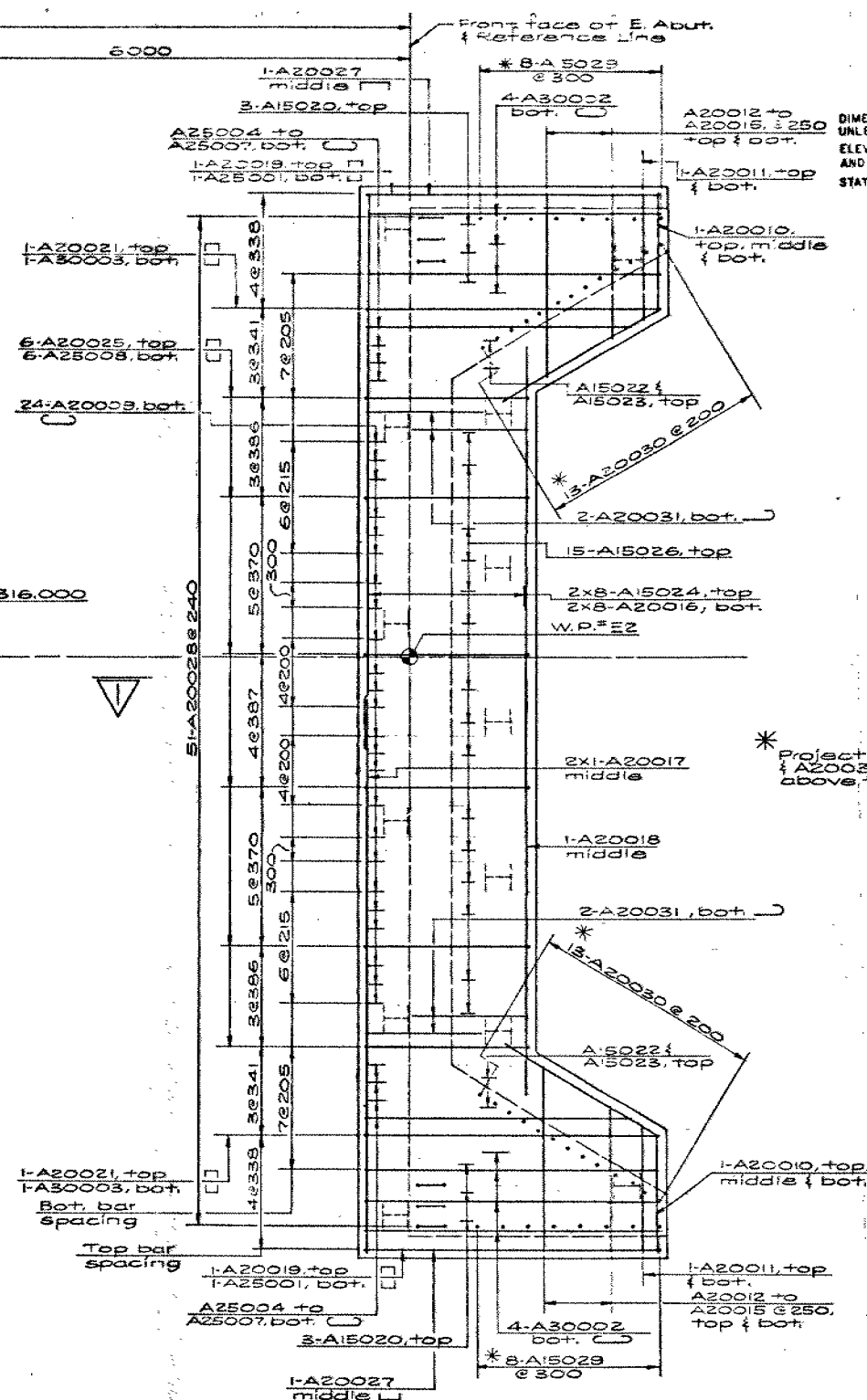
B.M. 285.470
N & W in S Root 0.76 Elm
46.3 L. 15+326.3

REVISIONS	DATE	BY	DESCRIPTION
1			
2			
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DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

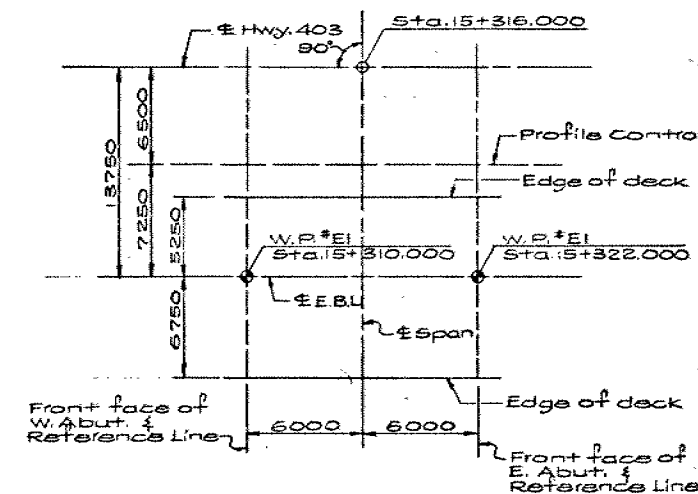
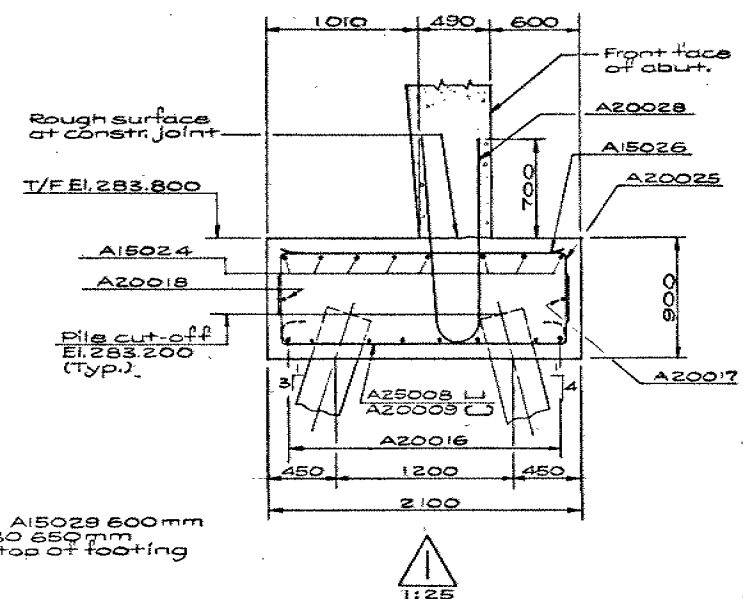


West & east Abutment footings similar, west footing showing typical dimensions & pile layout; east footing showing typical reinforcing.



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E.B.L. STRUCTURE



SITE LAYOUT PLAN
1:250

PLAN OF FOOTINGS
1140

Location	Row	No.	Length	Batter
West Abut.	Front	6	21000	1:4
	Centre	5	21500	1:3
	Back	2	20500	Vertical
East Abut.	Front	6	21000	1:4
	Centre	5	21500	1:3
	Back	2	20500	Vertical

PILE DATA TABLE

- All piles are HP310X79 steel H-piles.
- Pile spacing to be measured at the underside of footings
- Pile length shown in the Pile Cap Table is the theoretical length below cut-off
- Pile shoes to be provided on all piles in accordance with standard DD3301

- Design load at S.L.S. Type II : 625 kN/pile
- Factored capacity at U.L.S. : 850 kN/pile

- Piles to be driven in accordance with standard SS103-10 or SS103-11 using an ultimate capacity of 1875 kN/pile but must also be driven to El.263,000 or below.
- The driving energy should not be less than 50,000 J per blow.



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS					
	DATE	BY	DESCRIPTION		
1	DESIGN	C	CHECK	LOADING - 200 CARS	DATE 83/03
	DRAWING	C	CHECK	SITE 23-AB-300	DWG 54

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 85-24



Ministry of
Transportation and
Communications

INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3	M.T.C. Soil Classification System (For W.P. 5-69-01 & W.P. 165-60-01)
4 - 35	Foundation Investigation Report Kenny Creek Structures (E.B.L. and W.B.L.) W.P. 5-69-01 County Road 14 Underpass W.P. 165-60-01 County Rd. 4 Underpass W.P. 72-62-01

Note: For purposes of the contract these reports supercede all other Foundation Reports prepared by or for the Ministry in connection with the above-mentioned projects.

EXPLANATION OF TERMS USED IN REPORT

2

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

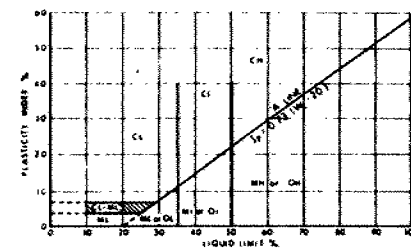
EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM

EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM													
FIELD IDENTIFICATION PROCEDURES <small>(EXCLUDING PARTICLES LARGER THAN 75 mm AND BASING FRACTIONS ON ESTIMATED MASS)</small>					GRP SYMB	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA					
COARSE GRAINED SOILS <small>MORE THAN HALF OF MATERIAL IS LARGER THAN 75 μm (75 μm IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)</small>	GRAVELS <small>(LITTLE OR NO FINES)</small>	CLEAN GRAVELS <small>(LITTLE OR NO FINES)</small>	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZE		GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX. % OF SAND & GRAVEL; MAX. SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESS OF THE COARSE GRAINS; LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION, & SYMBOL IN PARENTHESES FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS & DRAINAGE CHARACTERISTICS	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE, DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μm). COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS: LESS THAN 5% GW, GP, SM, SP MORE THAN 12% GM, GC, SM, SC 5% TO 12% BORDERLINE CASES REQ. USE OF DUAL SYMBOLS	$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 4 $C_c = \frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ BETWEEN ONE AND 3 NOT MEETING ALL GRADATION REQUIREMENTS FOR GW ATTERBERG LIMITS BELOW A-LINE, OR I_p LESS THAN 4 ABOVE A-LINE WITH I_p BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS ATTERBERG LIMITS ABOVE A-LINE WITH I_p GREATER THAN 7				
			PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING		GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES							
			GRAVEL WITH FINES <small>(APPRECIABLE AMOUNT OF FINES)</small>	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE PL BELOW)		GM				SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES			
				PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		GC				CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES			
	SANDS <small>MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN 4.75 mm</small>	CLEAN SANDS <small>(LITTLE OR NO FINES)</small>	WIDE RANGE IN GRAIN SIZES & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES							
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING		SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES							
			SANDS WITH FINES <small>(APPRECIABLE AMOUNT OF FINES)</small>	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE PL BELOW)		SM				SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES			
				PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		SC				CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES			
	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN 425 μm												
	FINE GRAINED SOILS <small>MORE THAN HALF OF MATERIAL IS SMALLER THAN 75 μm (75 μm IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)</small>	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 35%	DRY STRENGTH (CRUSHING CHARACTERISTICS)		DILATANCY (REACTION TO SHAKING)				TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML	INORGANIC SILTS & SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE & CHARACTER OF PLASTICITY, AMOUNT & MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESES. FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED & REMOULDED STATES, MOISTURE & DRAINAGE CONDITIONS.
NONE				QUICK	NONE		CL	CLAYEY SILTS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS					
MEDIUM TO HIGH				NONE TO VERY SLOW	MEDIUM		OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS					
LIQUID LIMIT BETWEEN 35% AND 50%			SLIGHT TO MEDIUM		SLOW	SLIGHT	ML	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY SILTS					
			NONE TO SLIGHT		SLOW TO QUICK	SLIGHT	CL	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY					
			HIGH		NONE	MEDIUM TO HIGH	OL	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY					
LIQUID LIMIT GREATER THAN 50%			SLIGHT TO MEDIUM		VERY SLOW	SLIGHT	ML	INORGANIC SILTS, HIGHLY COMPRESSIBLE HECAECOUS OR DIATOMACEOUS FINE SANDY SILTS, ELASTIC SILTS					
			SLIGHT TO MEDIUM		SLOW TO NONE	MEDIUM	CL	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS					
			HIGH TO VERY HIGH		NONE	HIGH	OL	ORGANIC CLAYS OF HIGH PLASTICITY					
MEDIUM TO HIGH		NONE TO VERY SLOW	SLIGHT TO MEDIUM	ML	PEAT & OTHER HIGHLY ORGANIC SOILS								
HIGHLY ORGANIC SOILS		READILY IDENTIFIED BY COLOUR, ODOUR, SPONGY FEEL & FREQUENTLY BY FIBROUS TEXTURE		PE	PEAT & OTHER HIGHLY ORGANIC SOILS								

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION

PLASTICITY INDEX %

FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

BOUNDARY CLASSIFICATIONS. SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS. FOR EXAMPLE GM-GC.
WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER

Foundation Investigation Report
for
Kenny Creek (Open Drain) Structures (E.B.L. & W.B.L.)
1.4 km West of Hwy. #53
W.P. 5-69-01; Hwy. #403
Site Nos.: 23-89-310A (E.B.L.) and 23-89-310B (W.B.L.)

Introduction

This report contains the results of a foundation investigation carried out at the aforementioned site between 72 05 29 and 72 06 01. The fieldwork consisted of three sampled boreholes and six dynamic cone penetration tests. The borings were advanced by a continuous flight auger machine mounted on muskeg vehicle and equipped with hollow stem augers.

Site Description

At the proposed crossing site Kenny Creek is approximately 3 m wide and 0.5 - 0.6 m deep, having moderate flow. The total depth of the creek bed is about 1.5 m. The immediate vicinity is gently rolling terrain, occupied by farmlands, the dominant crop being corn. The neighbouring ridges are drained by Kenny Creek, which is a tributary of the Grand River.

Geologically, the area belongs to the physiographic region known as the "Mount Elgin Ridges", consisting of a succession of ridges and vales. The ridges are moraines of pale brown calcareous clay or silty clay, while in the vales it is common to find alluvium of gravel, sand or silt. The ridges are well drained, while poor drainage prevails in the hollows.

Subsurface Conditions

General

Between layers of cohesive clayey silts, sands and silty sands were found in the borings around elevations 278.4 - 280.0 m. The coarse grain soils are aquifers, containing groundwater under pressure. At elevation 265.8 - 268.9 sandy silts with some clay were encountered. The latter deposit has dense to very dense relative density with penetration 'N' values up to 100 blows per 30 cm and over. A stratigraphical profile is shown on Drawing No. 2 of the Contract Documents.

A brief description of the deposits follows:

Clayey Silt, Traces of Sand

Clayey silts were registered in two layers, the first extending from ground level to elevations 278.4 - 280.0 m, a stratum of some 4.9 m - 6.7 m thickness. The second clayey silt layer follows the water bearing soils at elevations 274.1 - 276.7 and terminates around elevations 265.8 - 268.9. The overall thickness of this second deposit is 6.7 m - 8.2 m. Both layers were found to have similar physical properties, the lower, however, indicated slightly lower plasticity, thus it was classified to be clayey silt to silt (CL - ML). The consistency of the material varies between firm and hard. The range of natural moisture contents, Atterberg limits and grain-size analyses are tabulated below separately for the upper and lower clayey silt strata:

<u>Stratum</u>	<u>Atterberg Limits</u>			<u>Grain-Size Distribution</u>			
	W _%	W _p	W _L	Gr.	Sa.	Si.	Cl.
	—	—	% —	—	—	% —	—
Upper Clayey Silt	13-21	14-18	24-32	0-2	3-11	67-73	16-28
Lower Clayey Silt	12-24	12-16	19-24	0-3	2-15	61-87	11-21

The bulk densities of the clayey silts average 21.2 kN/m³.

Water Bearing Stratum

The water bearing soils were identified to be gravelly sands and layers of silty sands and sandy silts. Thin seams of clayey silts were also noted to intercept the more permeable soils. The thickness of this stratified material is 2.7 m - 5.9 m, being first observed around 4.9 m - 6.7 m below ground level, extending to 8.2 m - 10.8 m depths. Penetration 'N' values obtained within this deposit varied greatly, probably on account of the hydrostatic pressure. Disregarding the loosening effect of such pressures the relative density may be assumed to be dense to very dense. The plastic seams within the stratum had 11% plastic limit and 19% liquid limit, the range of natural moisture content being 11 - 24%. Laboratory grain-size analyses yielded some 3 - 4% gravel, 4 - 73% sand, 18 - 82% silt and 6 - 10% clay size particles within the specimens tested.

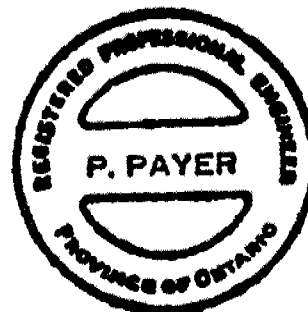
Sandy Silt, Some Clay and Traces of Gravel

Underlying the clayey silts in B.H.'s #1 and #4 a layer of sandy silt with some clay and traces of gravel was encountered at elevations 265.8 - 268.9. Penetration resistencies range from 34 blows per 30 cm to above 100 blows per 30 cm hence the relative density of the material is dense to very dense. The sandy silts exhibited quick dilatancy with very slight or no plasticity. Particle size analyses resulted in 6 - 14% gravel, 28 - 39% sand, 44 - 46% silt and 11 - 12% clay size grains.

Groundwater Conditions

Groundwater was first encountered in the boring at elevation 278.1, some 6.9 m below ground level. The water was noted to be under artesian pressure, rising quickly in the casings, and being stabilized around elevation 285.6, some 0.8 m above general ground level. After some 24 hours observation, the boreholes were sealed with bentonite pellets right above the upper surface of the aquifer, and thus, the flow was stopped.

P. Payer
P. Payer, P. Eng.
Foundations Engineer



K. G. Selby

K.G. Selby, P. Eng.
Chief Foundations Engineer
(West)

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 5-69-01 LOCATION Sta. 15 + 321.2 o/s 27.4 m Lt. E Hwy. 403 ORIGINATED BY LJH
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY LJH
 DATUM Geodetic DATE 1972 06 01 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
285.1	Ground Level															
0.0	Clayey Silt, Traces & occasional pockets of Sand		1	SS	7		284									
	Firm to Hard		2	SS	37		284									
	Brown and Grey		3	SS	47		282									
			4	SS	46		280									
			5	SS	50		278									
			6	SS	41		276									
			7	SS	48		274									
278.4	Layers of Silty Sand & Clayey Silt with Sand		8	SS	8		272									
6.7	(Aquifer)		9	SS	22		270									
275.6	Loose to Compact		10	SS	49		268									
9.5	Clayey Silt to Silt, Some Sand		11	SS	18		266									
	Stiff to Hard		12	TW	PM		264									
	Gray		13	SS	11		262									
268.9			14	SS	65		260									
16.2	Sandy Silt, Some Clay, Traces of Gravel		15	SS	74		258									
	Very Dense		16	SS	109		256									
264.3			17	SS	100		254									
20.8	End of Borehole						252									

+3, x5: Numbers refer to
Sensitivity

20
15
10
5
(%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 2

METRIC

W P 5-69-01 LOCATION Sta. 15 + 311.7 o/s 28.4 m Lt. of Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 05 29 CHECKED BY ep

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
284.6	Ground Level						284							
0.0														
282.2														
2.4	End of Cone Test							100/25 cm						



RECORD OF BOREHOLE No 3

METRIC

W P 5-69-01 LOCATION Sta. 15 + 319.1 @ Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 06 01 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
284.6	Ground Level												
0.0							284						
281.9							282						
2.7	End of Cone Test												

RECORD OF BOREHOLE No 4

METRIC

W P 5-69-01 LOCATION Sta. 15 + 311.2 f Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 05 29 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100	100					
284.9	Ground Level														
0.0	Clayey Silt, Traces & occasional pockets of Sand		1	SS	12		284.9								
			2	TW	PH		284							21.21	
	Stiff to Hard		3	SS	38		282							21.05	
	Brown & Grey		4	TW	PH										
			5	SS	39										
			6	SS	65										
279.3			7	SS	37		280								
5.6	Gravelly Coarse Sand														
	Dense to Very Dense		8	SS	38		278								
	(Aquifer)		9	SS	56		276.9								
	Grey		10	SS	37		276								
			11	SS	45										
274.1			12A	SS	55		274								
10.8	Clayey Silt to Silt Traces of Sand		13	SS	31										
	Very Stiff to Hard		14	SS	30		272								
	Grey		15	SS	46		270								
			16	SS	28		268								
			17	SS	26		266								
265.8			18	SS	34										
19.1	Sandy Silt, Some Clay & Gravel														
	Very Dense		19	SS	100/13 cm										
264.2															
20.7	End of Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5

METRIC

W P 5-69-01 LOCATION Sta. 15 + 320.4 o/s 27.4 m Rt. of Hwy. 403 ORIGINATED BY LJH
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY LJH
 DATUM Geodetic DATE 1972 05 31 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80					
284.9	Ground Level															
0.0	Clayey Silt, Traces of Sand		1	SS	8		284									
	Stiff to Hard		2	SS	25											
	Brown & Grey		3	SS	39		282									
			4	SS	35											
			5	SS	34											
280.0			6	SS	27		280									
4.9	Layers of Sandy Silt, Silt & Clayey Silt		7	SS	86											
	(Aquifer)															
	Very Dense to Compact		8	SS	26		278									4 4 82 10
276.7																
8.2	Clayey Silt, Some Sand & Traces of Gravel		9	SS	26		276									
	Very Stiff to Hard		10	SS	28											3 15 61 21
	Gray		11	SS	36		274									
271.5			12	SS	20		272									
13.4	End of Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 6

METRIC

W P 5-69-01 LOCATION Sta. 15 + 310.0 o/s 27.4 m Rt. of Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 05 31 CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER 'CONDITIONS'	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
284.8	Ground Level												
0.0							284						
282.1													
2.7	End of Cone Test							100/25 cm					

+³, x⁵ : Numbers refer to
Sensitivity

20
15 - 5 (%) STRAIN AT FAILURE
10

Foundation Investigation Report
for
County Road 14 Underpass
1 km West of Hwy. #53
W.P. 165-60-01; Site: 23-89-292
District # 4 (Burlington)

Introduction

This report contains the results of a foundation investigation carried out at the aforementioned site between 72 04 26 and 72 05 01. The fieldwork consisted of five sampled boreholes and 10 dynamic cone penetration tests. The borings were advanced by a continuous flight auger machine mounted on muskeg vehicle and equipped with hollow stem augers.

Site Description

Oxford County Road #14 is an asphalt paved road of some 6.1 m width with very narrow shoulders, partially covered with grass. The surrounding area has a gently undulating topography, sloping westward, towards Kenny Creek, some 275 m west of the bridge site. The land use is agricultural, farms usually growing crops.

Geologically the terrain is part of the physiographic region known as the "Mount Elgin Ridges," consisting of a succession of ridges and vales. The ridges are moraines of pale brown calcareous clay or silty clay, while in the vales it is common to find alluvium of gravel, sand or silt. The ridges are usually well drained; in the hollows, however, poor drainage prevails. The nearby ridges are drained by Kenny Creek, which is a tributary of the Grand River.

Subsurface Conditions

General

Two distinct soil strata was found in the boreholes, the deepest of which extended to El. 276.9, some 11.9 m below ground level. The upper deposit was classified to be clayey silt to silt, the lower being silty fine sand. Due to the very dense relative density of the fine sands all the borings were terminated within this layer. A stratigraphical profile is shown on Drawing No. 2 of the Contract Drawings.

In the following sections a brief summary of the physical properties of the deposits is given.

Clayey Silt to Silt with Some Sand,
Traces of Gravel

From ground level extending to elevation 278.7 - 282.6 a 6.1 - 10 m thick layer of clayey silt to silt was encountered in every borehole. The deposit contains some sand and occasionally traces of fine gravel. The material has some cohesion, the consistency, measured by Standard Penetration Tests was found to vary between stiff and hard. The minimum "N" value obtained in the field was 9 blows per 30 cm., the maximum being 65 blows per 30 cm. The weighted average penetration resistance within the uppermost 4.6 m layer was computed to be 23 blows per 30 cm roughly the equivalent of an undrained shear strength of 150 kN.

Atterberg limit tests performed on representative samples resulted in plastic limits between 5%-11% and liquid limits between 16%-31%. The range of plasticity indices is 5 to 11. Some samples were subjected to sieve and hydrometer analyses. The tests yielded 0% - 4% gravel, 2% - 25% sand, 54% - 89% silt, and 8% - 30% clay size particles within the samples tested.

Silty Fine Sand

Underlying the cohesive clayey silts a granular type material, classified as silty fine sand was noted. Very high relative densities characterize this stratum; penetration 'N' values usually being over 100 blows per 30 cm. On a few occasions quick conditions occurred in the boreholes, indicating that the fairly uniform sand deposit is susceptible to conditions of unbalanced hydrostatic head. The few unreasonably low 'N' values, obtained within this layer, were believed to be caused by above phenomenon; consequently, these were disregarded. Particle distributions, determined by laboratory grain size analysis resulted in 71-89% fine sands, the remainder being silt and clay.

All the borings were terminated within this deposit between elevation 276.9 and 279.8, some 8.9 m - 11.6 m below ground level.

Groundwater Conditions

Water level observation was carried out in every borehole during and after drilling operations. Water levels were found to be very high, usually lying between elevation 288.3 and 289.3, some 0.2 m - 0.6 m below ground level. Since these water levels are some 4.6 m - 6.1 m higher than the water level of Kenny Creek, there appears to be a seepage towards the creek.

P. Payer

P. Payer, P. Eng.

Foundations Engineer



K. G. Selby

K.G. Selby, P. Eng.

Chief Foundations Engineer
(west)

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 165-60-01 LOCATION Sta. 10 + 034.0 6.1 m Rt Q, Cord. 14
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test
DATUM Geodetic DATE 1972 04 26
ORIGINATED BY AKB
COMPILED BY SO
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	10 20 30					
288.7 0.0	Ground Level													GR SA SI CL
	Clayey Silt to Silt with some sand Stiff to Hard Brown		1	SS	21									1 25 54 20
			2	SS	22									1 9 61 29
			3	SS	39									
			4	SS	20									
			5	SS	18									
			6	SS	11									
			7	SS	16									
282.6 6.1	Silty Fine Sand Loose to Very Dense Greyish-Brown		8	SS	9									0 74 (26)
279.8 8.9			9	SS	129									
	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10


METRIC

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			'N' VALUES					
288.8	Ground Level											
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					GR SA SI

Time	Penetration	Notes
0.0		
286.4		
2.4		End of Cone Test

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 4

METRIC

W P 165-60-01 LOCATION Sta. 10 + 024.2 4.0 m Lt. Q Co. Rd. 14 ORIGINATED BY AKB
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY SO
 DATUM Geodetic DATE 1972 05 01 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L	WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES							
289.5 0.0	Ground Level											
	Clayey Silt to Silt Traces of Coarse Sand Very Stiff to Hard		1	SS	17							
			2	SS	25							
			3	SS	28							
			4	SS	36							
			5	SS	19							
			6	SS	19							
			7	SS	61							
			8	SS	60							
281.0 8.5	Silty Fine Uniform Sand Very Dense		9	SS	100/9 cm							0 4 84 12
279.1 10.4	End of Borehole		10	SS	100/9 cm							0 89 (11)

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 165-60-01 LOCATION Sta. 9 + 999.6 6.4 m Rt. 6 Co. Rd. 14 ORIGINATED BY AKB
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY SO
 DATUM Geodetic DATE 1972 04 26 & 27 CHECKED BY 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
288.8 0.0	Ground Level												
	Clayey Silt to Silt Some Sand Stiff to Hard Brown		1	SS	20								
			2	SS	33								
			3	SS	36								
			4	SS	30								
			5	SS	16								
			6	SS	9								
			7	SS	15								
			8	SS	65								
280.2 8.6	Silty Fine Uniform Sand		9	SS	148								
	Seam of Clayey Silt		10	SS	100/	15 cm							
276.9 11.9	Very Dense		11	SS	100/	20 cm							
	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

METRIC

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7

METRIC

W P 165-60-01 LOCATION Sta. 9 + 975.4 7.0 m Rt. C Co. Rd. 14 ORIGINATED BY AKB
DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY SO
DATUM Geodetic DATE 1972-04-27 CHECKED BY [Signature]

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

METRIC

[illegible]

OFFICE, REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 9

METRIC

W P 165-60-01 LOCATION Sta. 9 + 964.4 7.9 m Rt. C Co. Rd. 14 ORIGINATED BY AKB
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY SO
DATUM Geodetic DATE 1972 04 27 & 28 CHECKED BY [Signature]

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

METRIC

W P 165-60-01 LOCATION Sta. 9 + 966.0 4.0 m Lt. Co. Rd. 14 ORIGINATED BY AKB
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY SO
 DATUM Geodetic DATE 1972 04 28 CHECKED BY SO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
289.6	Ground Level																
0.0																	
286.8	End of Cone Test																
2.8																	

FOUNDATION INVESTIGATION REPORT

For

W.P. 72-62-01, Site 23-89-298

Future Co. Rd. 4 Underpass

Hwy. 403, District 2, London

INTRODUCTION:

This report summarizes the results of the foundation investigation required for the proposed structure and approach embankments at this site.

The fieldwork was conducted during the period from 82 07 15 - 20 utilizing a continuous-flight auger machine equipped with 82 mm I.D. hollow-stem augers.

This work consisted of 3 sampled boreholes/dynamic cone penetration tests.

SITE DESCRIPTION

The site is located east of Co. Rd. 15 and south of Hwy. 401 at Woodstock (Lots 12 & 13, Con. II, Twp. Norwich, Geog. Twp. (East) Oxford, County of Oxford).

Physiographically, the site is located in the Oxford Till Plain.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets (Appendix) illustrate the conditions at the borehole locations. The location and elevations of the boreholes, and a stratigraphical profile based on the borehole data are shown on Drawing No. 2 of the Contract Drawings.

At the site, approximately 23 m (thickness) of firm to hard silty clay till overlies a very dense deposit of silty sand. None of the boreholes penetrated farther than this silty sand layer. A deposit (thickness estimated at 5m), containing occasional layers of silty sand, was encountered at a depth of approximately 14 m below the surface at all borehole locations. In addition, at BH #3, occasional layers of silty sand were encountered at elevation 297.1 m.

Silty Clay (CL), Some Sand, Trace/Some Gravel

This firm to hard till material is the main deposit at the site, extending from the surface (approx. elev. 299 m) to a depth of approximately 22.9 m. The deposit is generally silty clay of low plasticity containing some sand and traces to some gravel. The upper 1.8 to 2.7 m of the deposit contains traces of organics. Occasional layers of silty sand were encountered at all boreholes at elev. 285 m and extending for an estimated thickness of 5 m. In addition, at BH #3 occasional layers of silty sand were encountered at elev. 294.9, extending for a thickness of 2.1 m. The denseness of the silty sand layers ranged from loose to very dense. However, a denseness range from compact to very dense is considered to be more representative of the silty sand layers.

Physical properties of the cohesive portion of the material as determined from field and laboratory tests, are summarized below:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w) %	10.5-13.5%	11.9%	11.8%
Liquid Limit (W _L) %	14.5-28.5%	21.9%	26.0%
Plastic Limit (W _p) %	11.0-14.5%	12.8%	13.0%

The material did not fail during field vane shear testing, indicating undisturbed shear strengths in excess of 107 kPa. Shear strength values from unconfined compression tests of similar material in the immediate vicinity of this site led to the selection of 150 kPa as the average shear strength for the silty clay till deposit.

Figure 1 illustrates a typical grain size distribution for the cohesive portion of this deposit.

Silty Sand, with Gravel, trace Clay

This very dense till deposit was encountered below the silty clay layer at elev. 276.7 m at BH #1. It is anticipated that this material underlies the silty clay deposit across the entire site.

Groundwater

The groundwater elevation was estimated at 296 m. This estimate was based on field observations, data from previous foundation investigations in the immediate vicinity, and well records.



D. H. Dundas

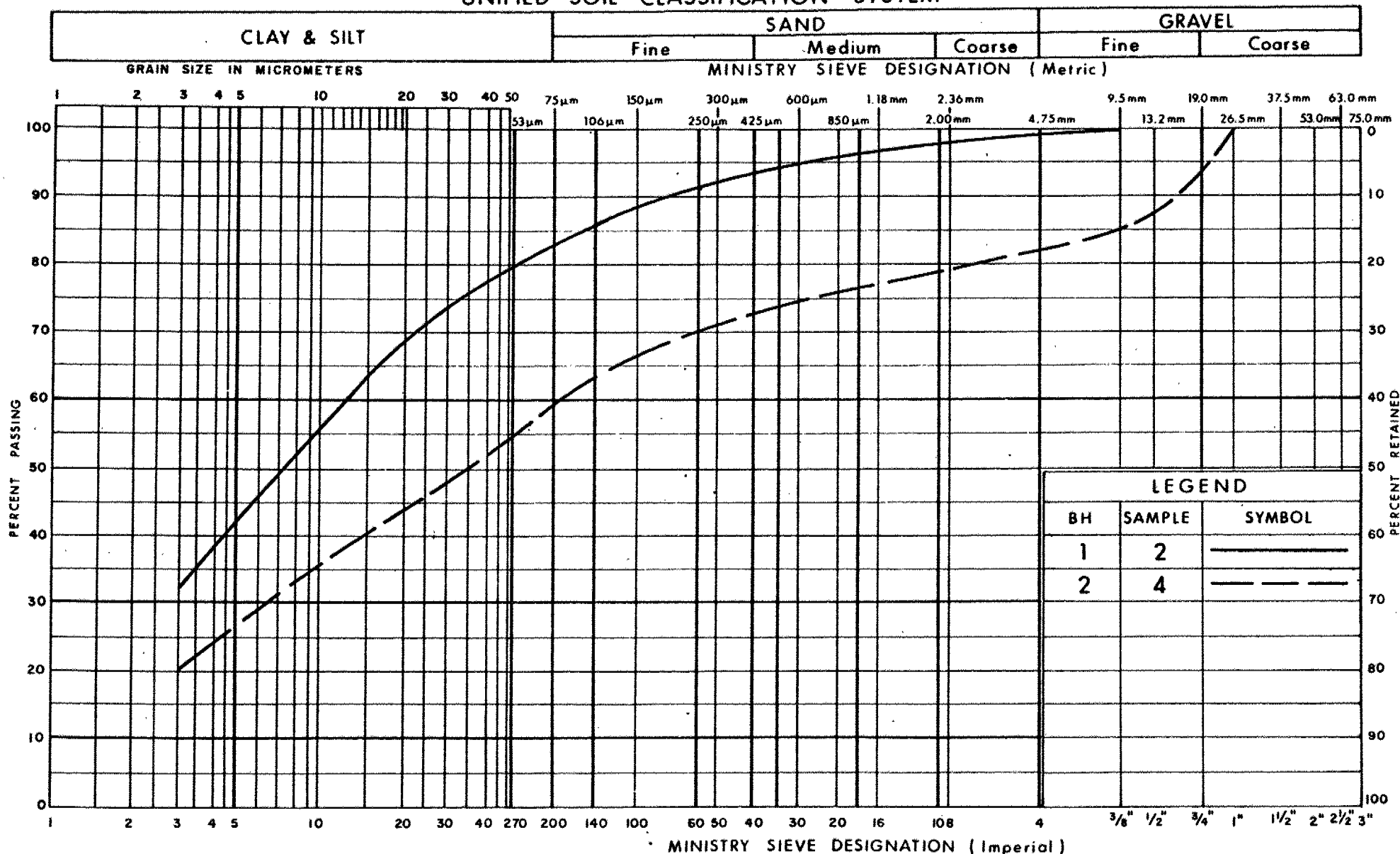
D.H. Dundas, P. Eng.
Foundations Engineer

K. G. Selby

K.G. Selby, P. Eng.
Chief Foundations Engineer
(West)

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

 Ministry of
 Transportation and
 Communications

GRAIN SIZE DISTRIBUTION
 SILTY CLAY (Till)
 SOME SAND TRACE / SOME GRAVEL

FIG No 1

WP 72-62-01

RECORD OF BOREHOLE No 1

METRIC

W P 72-62-01 LOCATION Sta. 9 + 965, 5.0 m Rt. 2 Twp. Rd. ORIGINATED BY BY
DIST 2 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DD
DATUM Geodetic DATE 82 07 15, 19 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	VALUES		20 40 60 80 100	20 40 60 80 100					
299.6	Ground Surface												
U.0													
	trace organics		1	SS	20								
			2	SS	24								2 15 58 25
			3	SS	25								
			4	SS	18	**							
			5	SS	12								
	Silty Clay (Cl)		6	SS	13								
	Some Sand												
	Trace/some Gravel		7	SS	12								
	Stiff to Hard (Till)		8	SS	14								
			9	SS	21								
			10	SS	21								
			11	SS	18								
	occ. layers of Silty Sand		12	SS	13								
	Compact to Dense												
			13	SS	36								
			14	SS	54								
276.7													
22.9	Silty Sand with Gravel, Trace Clay												
274.9	Very Dense		15	SS	120/ 30 cm								
24.7	End of Borehole												
	** Stabilized ground water level estimated from well records												*Cu > 107 kPa

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC

W P 72-62-01 LOCATION Sta. 9 + 999, 5.0 m Rt. 2 Twp. Rd. ORIGINATED BY BY
DIST 2 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DD
DATUM Geodetic DATE 82 07 16 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
299.3 0.0	Ground Surface													
	trace organics		1	SS	6									
			2	SS	10									
			3	SS	23									
			4	SS	13	**								17 23 44 16
			5	SS	19									
	Silty Clay (Cl)		6	SS	21									
	Some Sand		7	SS	20									
	Trace/some Gravel		8	SS	22									
	Firm to Hard (Till)		9	SS	33									
			10	SS	25									
			11	SS	22									
	occ. layers of Silty Sand, compact		12	SS	20									29 60 8 3
283.6 15.7	End of Borehole													
	** Stabilized ground water level estimated from wall records													*Cu > 107 kPa

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 72-62-01 LOCATION Sta. 10 + 034, 5.0 m Rt. # Twp. Rd. ORIGINATED BY BY
DIST 2 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DD
DATUM Geodetic DATE 82 07 20 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
298.9	Ground Surface										
0.0											
	trace organics		1	SS	19						
			2	SS	25						
			3	SS	29						
			4	SS	18						
	occ. layers of Silty Sand Some Gravel Trace Clay Compact		5	SS	21						20 43 32 5
			6	SS	15						5 36 47 12
			7	SS	24						
	Silty Clay (Cl) Some Sand Trace/some Gravel Very Stiff to Hard (Till)		8	SS	28						
			9	SS	27						
			10	SS	26						
			11	SS	24						
	occ. layers of Silty Sand Some/with Gravel Trace Clay Loose to Very Dense		12	SS	7						10 33 47 10
			13	SS	200/	30 cm					30 61 (9)
278.3											
20.6	End of Borehole		14	SS	000/	14 cm					22 42 28 8
	** Stabilized ground water level estimated from well records										*C _u > 107 kPa

+³, x⁵: Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. A. P. Watt, (2)
Reg. Structural Planning Eng.,
Southwestern Region,
London, Ont.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: August 10, 1972

OUR FILE REF.

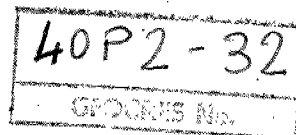
IN REPLY TO OCT 19 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

The Proposed Kenny Creek (Oppel Drain)
Structure of Hwy. #403; 0.9 Mi. West of Hwy. #53
District #4 Hamilton
W.O. 72-11049 .W.P. 5-69-01



Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ht
Attch.

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

c.c. Messrs. D. W. Farren
B. R. Davis
A. Rutka
A. McConnell
C. R. Robertson
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh

Foundations Files ✓
Documents

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 3. FIELD AND LABORATORY INVESTIGATIONS.
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-

FOUNDATION INVESTIGATION REPORT

For

The Proposed Kenny Creek (Oppel Drain)
Structure of Hwy. #403; 0.9 Mi. West of Hwy. #53
District #4 Hamilton

W.O. 72-11049

W.P. 5-69-01

1. INTRODUCTION:

A foundation investigation was carried out at the site of the proposed Kenny Creek (Oppel Drain) structure of Hwy. #403, on the request of Mr. S. Jants, Bridge Planning Technician, Southwestern Region. The request was submitted in a memo, dated March 9, 1972. The proposed Kenny Creek structure is one of the several crossings along Hwy. #403, having been investigated recently by this Office.

Presented in this report are the results of the field and laboratory investigations, followed by recommendations concerning structure foundations.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

At the proposed crossing site Kenny Creek is approximately 10 ft. wide and 1.5 - 2.0 ft. deep, having moderate flow. The total depth of the creek bed is about 5 ft. The immediate vicinity is gently rolling terrain, occupied by farmlands, the dominant crop being corn. The neighbouring ridges are drained by Kenny Creek, which is a tributary of the Grand River.

Geologically, the area belongs to the physiographic region known as the "Mount Elgin Ridges", consisting of a succession of ridges and vales. The ridges are moraines of pale brown calcareous clay or silty clay, while in the vales it is common to find alluvium of gravel, sand or silt. The ridges are well drained, while poor drainage prevails in the hollows.

3. FIELD AND LABORATORY INVESTIGATIONS:

Some three sampled borcholes and six dynamic cone penetration tests were carried out during the field investigations. A hollow stem

continuous flight auger (CME - 55) mounted on a Bombardier was used for the borings. Soil samples were recovered by means of Split Spoon and thin-walled Shelby Tube samplers. Split Spoons were advanced by the method known as the Standard Penetration Test, while Shelby Tubes were pushed 18 inches into the undisturbed soil by means of the hydraulic head of the auger.

All the soil samples were recorded in the fieldlogs upon recovery. In the laboratory every sample was visually examined and classified, using conventional techniques. Representative samples were further tested to define Atterberg limits, grain-size distributions and natural moisture contents of the soils. Undisturbed samples were subjected to unconfined compression tests, to determine undrained shear strengths and bulk densities. Field and laboratory test results are compiled on the accompanying borelogs. The locations and elevations of the boreholes and dynamic cone penetration tests are marked on Drawing No. 72-11049A in the Appendix.

4. SOIL CONDITIONS:

4.1) General:

Between layers of cohesive clayey silts, sands and silty sands were found in the borings around elevations 913 ft.-919 ft. The coarse grain soils are aquifers, containing groundwater under pressure. At elevation 872 ft. - 882 ft. sandy silts with some clay were encountered. The latter deposit has dense to very dense relative density with penetration 'N' values up to 100 blows/ft. and over.

A brief description of the deposits follows:

4.2) Clayey Silt, Traces of Sand:

Clayey silts were registered in two layers, the first extending from ground level to elevations 913 ft. - 919 ft., a stratum of some 16-22 ft. thickness. The second clayey silt layer follows the water bearing soils at elevations 898 ft. - 908 ft., and terminates around elevations 872 ft. - 882 ft. The overall thickness of this second deposit is 22-27 ft. Both layers were found to have similar physical properties, the lower, however, indicated slightly lower plasticity, thus it was classified to be clayey silt to silt (CL - ML). The consistency of the material varies between firm and hard, corresponding to penetration 'N' values of 7 blows/ft. and 65 blows/ft. The range of natural moisture contents, Atterberg limits and

grain-size analyses are tabulated below separately for the upper and lower clayey silt strata:

<u>Stratum</u>	<u>W%</u>	<u>Atterberg Limits</u>		<u>Grain-Size Distribution</u>			
		<u>W_p</u>	<u>W_L</u>	<u>Gr.</u>	<u>Sa.</u>	<u>Si.</u>	<u>Cl.</u>
		<u>%</u>	<u>%</u>				
Upper Clayey Silt	13-21	14-18	24-32	0-2	3-11	67-73	16-28
Lower Clayey Silt	12-24	12-16	19-24	0-3	2-15	61-87	11-21

The bulk densities of the clayey silts average 135 PCF.

4.3) Water Bearing Stratum:

The water bearing soils were identified to be gravelly sands and layers of silty sands and sandy silts. Thin seams of clayey silts were also noted to intercept the more permeable soils. The thickness of this stratified material is 9 - 18 ft., being first observed around 16 - 22 ft. below ground level, extending to 27 - 35 ft. depths. Penetration 'N' values obtained within this deposit varied greatly, probably on account of the hydrostatic pressure. Disregarding the loosening effect of such pressures the relative density may be assumed to be dense to very dense. The plastic seams within the stratum had 11% plastic limit and 19% liquid limit, the range of natural moisture content being 11 - 24%. Laboratory grain-size analyses yielded some 3 - 4% gravel, 4 - 73% sand, 18 - 82% silt and 6 - 10% clay size particles within the specimens tested.

4.4) Sandy Silt, Some Clay and Traces of Gravel:

Underlying the clayey silts in B.H.'s #1 and #4 a layer of sandy silt with some clay and traces of gravel was encountered at elevations 872 ft. - 882 ft. Penetration resistencies range from 34 blows/ft. to above 100 blows/ft., hence the relative density of the material is dense to very dense. The sandy silts exhibited quick dilatancy with very slight or no plasticity. Particle size analyses resulted in 6 - 14% gravel, 28 - 39% sand, 44 - 46% silt and 11 - 12% clay size grains.

4.5) Groundwater Conditions:

Groundwater was first hit in the boring at elevations 912 - 913 ft., some 22 - 23 ft. below ground level. The water was noted to be under artesian

pressure, rising quickly in the casings, and being stabilized around elevation 937.3 ft., some 2.5 ft. above general ground level. After some 24 hours observation, the boreholes were sealed with bentonite pellets right above the upper surface of the aquifer, and thus, the flow was stopped.

5. DISCUSSION AND RECOMMENDATIONS:

5.1) General:

According to the bridge site plan (No. E-5325-1) supplied by the Bridge Planning Office, Southwestern Region, Kenny Creek is proposed to be spanned with a box culvert or a single span bridge of some 20 ft. width and 179 ft. length. The design grade of Hwy. #403, line D at the crossing is roughly elevation 945 ft., necessitating 10 ft. high approach fills. As discussed above, subsoil at the site consists of layers of clayey silt with some sand, intercepted by gravelly sands, silty sands and sandy silts. The estimated stratigraphical section is shown on Drawing No. 72-11049A. At elevations 912 - 913 ft., groundwater under artesian pressures was encountered.

5.2) Foundations:

Beneath the surficial organic and oxidized soils the clayey silts exhibit sufficient shear strength to support the structure on spread footings. It is recommended that footing be placed at or below elevation 925 ft., but not below elevation 922 ft. Safe loads of 3 t.s.f. may be employed on the footing bases. Proper frost (4 ft.) and scour protections should be maintained for the footings. The Hydrology Office ought to be consulted as to the depth of scour. Excavations between the recommended footing elevations will remain within the cohesive clayey silts. On account of the internal strength of these soils, no dewatering problems are anticipated in the excavations. Seepage water may be handled by conventional open pumping. If the excavations are kept open for some time, a lean concrete working slab may be poured at the bottom in order to prevent it from softening.

The approximately 10 - 12 ft. high approach fills will be stable when constructed with 2 horizontal to 1 vertical side slopes.

6. MISCELLANEOUS:

The field work was carried out during May 29 - June 1, 1972, under the supervision of Mr. L.J. Hodge, Engineering Student.

Equipment used was owned and operated by P.V.K. Drilling Company, Burford, Ontario. This report was prepared by Mr. A. K. Barsvary, Senior Foundations Engineer, and revised by Mr. K. G. Selby, Supervising Foundations Engineer.

A. K. Barsvary
A.K. Barsvary, P. Eng.



K. G. Selby
K.G. Selby, P. Eng.

AKB/ht

August 1, 1972

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 72-11049

LOCATION Sta. 129 + 41 90' Rt. Ø Hwy. 403 Line 'D'

ORIGINATED BY LJH

W.P. 5-69-01

BORING DATE June 1, 1972

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone 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 %				
							SHEAR STRENGTH P.S.F.									
935.3	Ground Level															
0.0	Clayey silt, traces and occasional pockets of sand.		1	SS	7	930									2 3 67 28	
			2	SS	37											
			3	SS	47											
			4	SS	46											
	Firm to Hard		5	SS	50											
			6	SS	41											
	Brown and Grey		7	SS	48											
913.3																
22.0	Layers of silty sand & clayey silt with sand. (Aquifer)		8	SS	8	910									3 73 18 6	
			9	SS	22											
904.3	Loose to Compact															
31.0	Clayey silt to silt, some sand.		10	SS	49	900									127	
			11	SS	18											
	Stiff to Hard		12	TW	PM											
			13	SS	11											
	Grey		14	SS	65											
882.3																
53.0	Sandy silt, some clay, traces of gravel.		15	SS	74	880									12 27 56 5	
			16	SS	109											
	Very Dense		17	SS	100 1/4"											
866.3																
69.0	End of Borehole															

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 72-11049

LOCATION Sta. 129 + 48 Ø Hwy. 403 Line 'D'

ORIGINATED BY LJH

W.P. 5-69-01

BORING DATE June 1, 1972

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY

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	20 40 60 80 100	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
						SHEAR STRENGTH P.S.F.		w_p ——— w ——— w_L WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE						
933.7	Ground Level					ELEV. SCALE						
0.0						930						
924.7												
9.0	End of Cone Test					920						

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB 72-11049

LOCATION Sta. 129 + 74 @ Hwy. 403 Line 'D'

ORIGINATED BY LJH

W.P. 5-69-01

BORING DATE May 29, 1972

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	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		20	40	60	80	100	w_p	w	w_L	
934.7	Ground Level														
0.0	Clayey silt traces and occasional pockets of sand.		1	SS	12	930									
			2	TW	PH										
			3	SS	38										
			4	TW	PH										
	Stiff to hard.		5	SS	39										
			6	SS	65	920									
	Brown & Grey		7	SS	37										
916.2	Gravelly coarse sand.		8	SS	38	910									
	Dense to Very Dense (Aquifer)		9	SS	56										
	Grey		10	SS	37										
			11	SS	45	900									
898.4			12A	SS	55										
35.3	Clayey silt to silt traces of sand.		12	SS	55										
			13	SS	31										
			14	SS	30	890									
	Very Stiff to Hard		15	SS	46										
			16	SS	28	880									
	Grey		17	SS	26										
872.2			18	SS	34	870									
62.5	Sandy silt, some clay & gravel.		19	SS	300	866.9									
866.9	Very Dense														
67.8	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO		RECORD OF BOREHOLE No. 5		FOUNDATION SECTION	
MATERIALS & TESTING OFFICE					
JOB 72-11049	LOCATION Sta. 129 + 44 90' Lt. of Hwy. 403 Line 'D'	ORIGINATED BY LJH			
W.P. 5-69-01	BORING DATE May 31, 1972	COMPILED BY LJH			
DATUM Geodetic	BOREHOLE TYPE Hollow Stem Auger & Cone Test	CHECKED BY <i>[Signature]</i>			

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		SHEAR STRENGTH P.S.F.		WATER CONTENT %							
							20	40	60	80	100			2000	4000	w_p	w	w_L
							UNCONFINED		+ FIELD VANE		WATER CONTENT %							
				QUICK TRIAXIAL		x LAB. VANE												
934.8	Ground Level																	
0.0	Clayey silt, traces of sand.		1	SS	8	930												
	Stiff to Hard.		2	SS	25													
	Brown & Grey		3	SS	39													
			4	SS	35													
			5	SS	34													
918.8		6	SS	27	920													
16.0	Layers of sandy silt, silt & clayey silt (Aquifer)		7	SS	86	910												
	Very Dense to Compact		8	SS	26													
907.8			9	SS	26	900												
27.0	Clayey silt, some sand and traces of gravel.	10	SS	28														
	Very stiff to hard.	11	SS	36														
	Grey	12	SS	20														
890.8																		
44.0	End of Borehole																	

20
15-5 % STRAIN AT FAILURE
10

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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	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_f	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_r	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

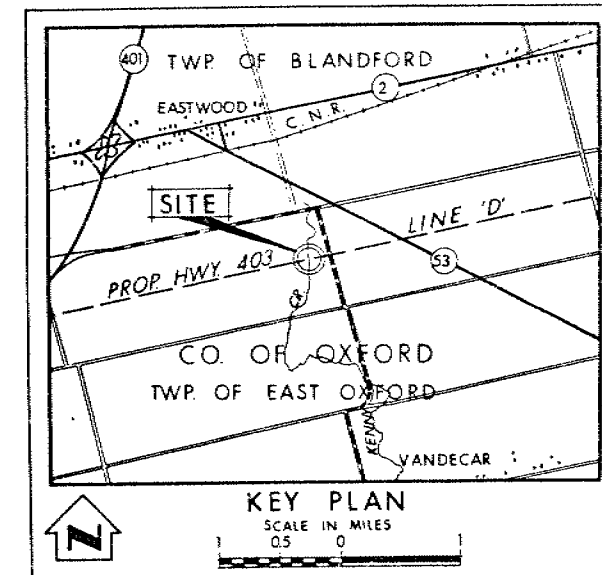
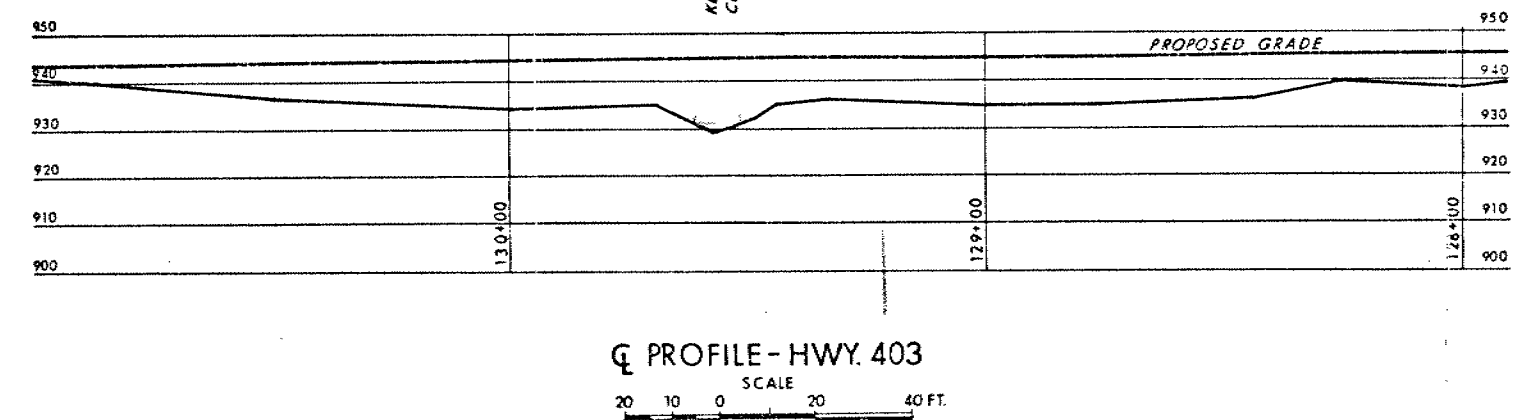
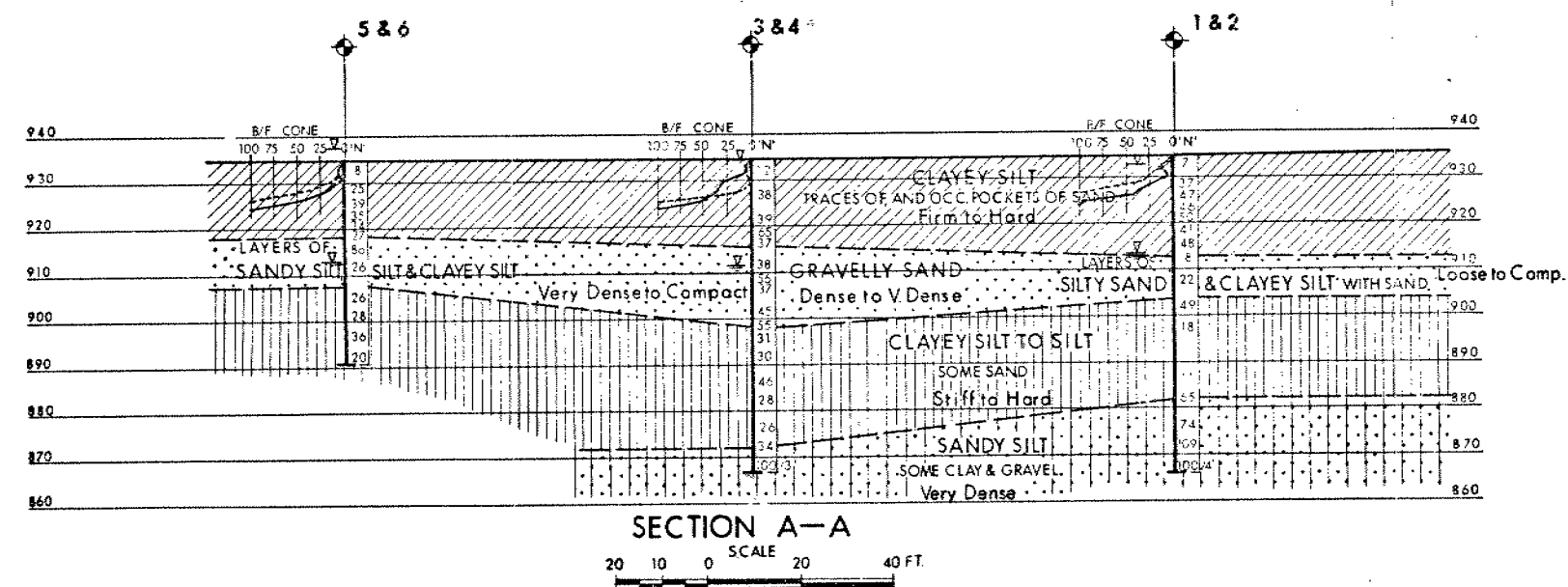
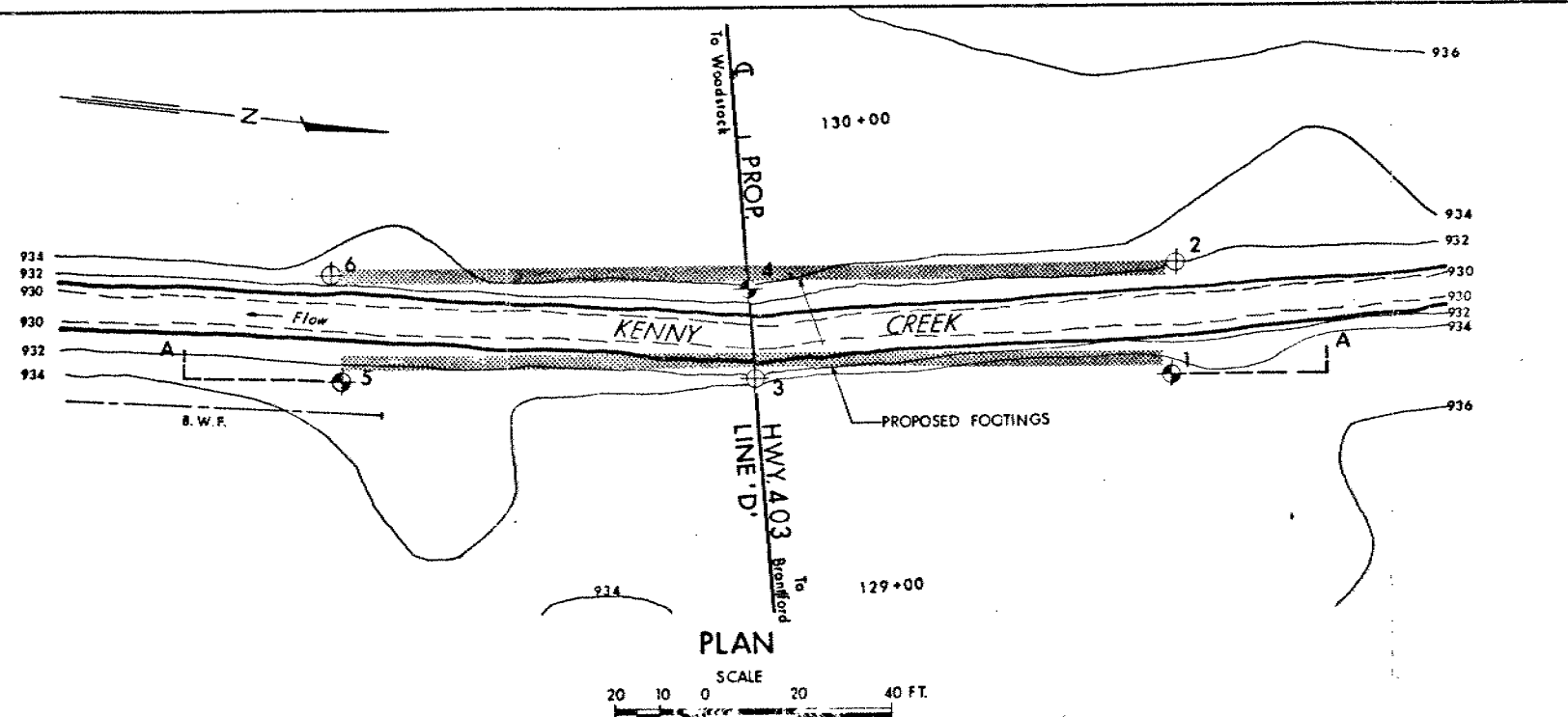
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, MAY, 1972		
	Head		
	ARTESIAN WATER		
	Encountered		
NO.	ELEVATION	STATION	OFFSET
1	935.3	129+41	90' RT.
2	933.6	129+66	93' RT.
3	933.7	129+48	Q
4	934.7	129+74	Q
5	934.8	129+44	90' LT.
6	934.5	129+78	90' LT.

— NOTE —
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

KENNY CREEK

HIGHWAY NO. 403 LINE 'D' DIST. NO. 2
CO. OXFORD
TWP. EAST OXFORD LOT 7 CON. II

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD A.B. CHECKED	WP NO 5-69-01	DRAWING NO.
DRAWN F.L. CHECKED	WD NO 72-11049	72-11049A
DATE OCTOBER 10, 1972	SITE NO.	BRIDGE DRAWING NO.
APPROVED	CONT. NO.	



REF No. E-5325-1

RECORD OF BOREHOLE No 1

METRIC

W P 5-69-01 LOCATION Sta. 15 + 321.2 o/s 27.4 m Lt. of Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 06 01 CHECKED BY *EP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
285.1	Ground Level							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	10 20 30					
0.0	Clayey Silt, Traces & occasional pockets of Sand		1	SS	7		284						19.95	2 3 67 28
	Firm to Hard		2	SS	37		284.4							
	Brown and Grey		3	SS	47		282							
			4	SS	46									
			5	SS	50									
			6	SS	41									
			7	SS	48									
278.4	Layers of Silty Sand & Clayey Silt with Sand		8	SS	8		278						3 73 18 6	
6.7	(Aquifer)		9	SS	22		276							
275.6	Loose to Compact													
9.5	Clayey Silt to Silt, Some Sand		10	SS	49									
	Stiff to Hard		11	SS	18		274							
	Grey		12	TW	PM		272							
			13	SS	11		270							
268.9	Sandy Silt, Some Clay, Traces of Gravel		14	SS	65								12 27 56 5	
16.2	Very Dense		15	SS	74		268							
			16	SS	109		266							
264.3			17	SS	100	10 cm							6 39 44 11	
20.8	End of Borehole													

RECORD OF BOREHOLE No 2

METRIC

W P 5-69-01 LOCATION Sta. 15 + 311.7 o/s 28.4 m Lt. E Hwy. 403 ORIGINATED BY LJH
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY LJH
 DATUM Geodetic DATE 1972 05 29 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
284.6	Ground Level											
0.0												
282.2												
2.4	End of Cone Test						100/25 cm					

+³, x⁵ : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 3

METRIC

W P 5-69-01 LOCATION Sta. 15 + 319.1 @ Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 06 01 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
284.6	Ground Level						284						
0.0													
281.9							282						
2.7	End of Cone Test												

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



Ministry of
Transportation and
Communications

RECORD OF BOREHOLE No 4

METRIC

W P 5-69-01 LOCATION Sta. 15 + 311.2 @ Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 05 29 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L	WATER CONTENT (%)		
284.9	Ground Level													
0.0	Clayey Silt, Traces & occasional pockets of Sand		1	SS	12									
			2	TW	PH									
	Stiff to Hard		3	SS	38									
	Brown & Grey		4	TW	PH									
			5	SS	39									
			6	SS	65									
279.3			7	SS	37									
5.6	Gravelly Coarse Sand													
	Dense to Very Dense		8	SS	38									
	(Aquifer)		9	SS	56									
	Grey		10	SS	37									
			11	SS	45									
274.1			12A	SS	55									
10.8	Clayey Silt to Silt Traces of Sand		13	SS	31									
	Very Stiff to Hard		14	SS	30									
	Grey		15	SS	46									
			16	SS	28									
			17	SS	26									
265.8														
19.1	Sandy Silt, Some Clay & Gravel		18	SS	34									
264.2	Very Dense		19	SS	100									
20.7	End of Borehole													

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5
0
5
10
15
20
(%) STRAIN AT FAILURE



Ministry of
Transportation and
Communications

RECORD OF BOREHOLE No 5

METRIC

W P 5-69-01 LOCATION Sta. 15 + 320.4 o/s 27.4 m Rt. of Hwy. 403 ORIGINATED BY LJH
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY LJH
DATUM Geodetic DATE 1972 05 31 CHECKED BY *[Signature]*

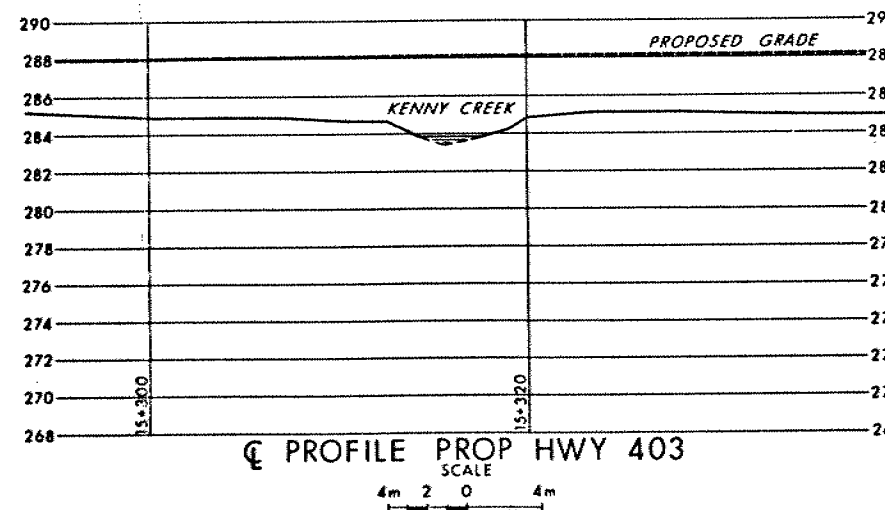
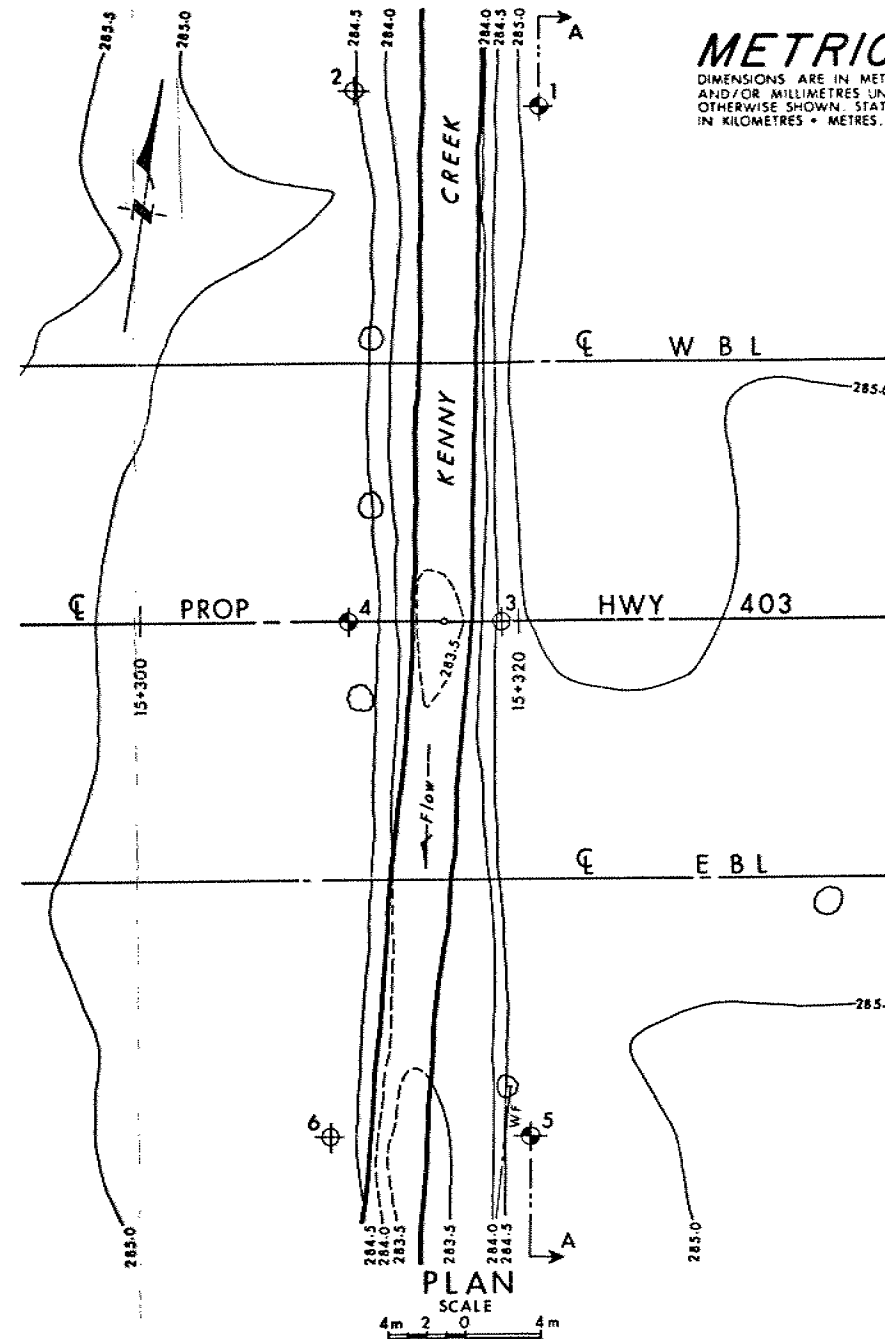
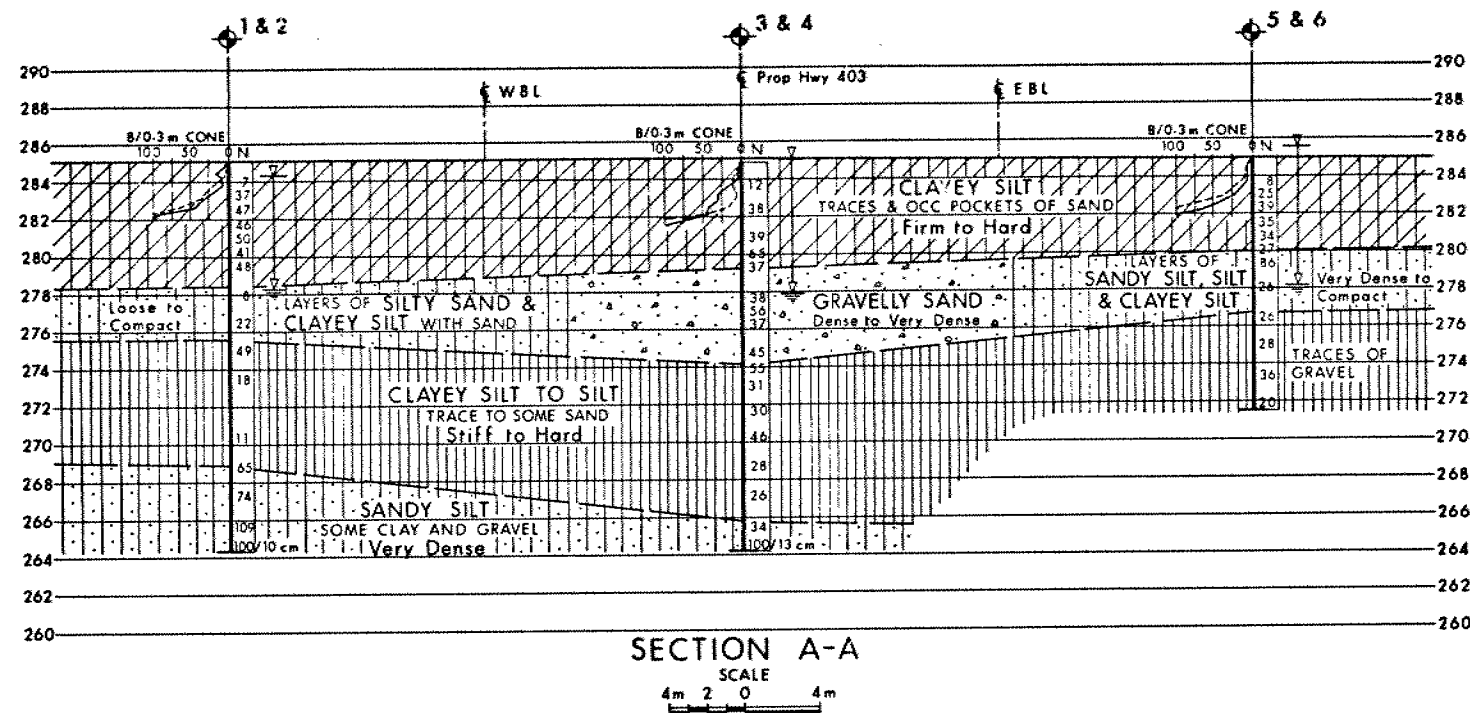
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
284.9	Ground Level												
0.0	Clayey Silt, Traces of Sand		1	SS	8		284						
	Stiff to Hard		2	SS	25								
	Brown & Grey		3	SS	39								
			4	SS	35								
			5	SS	34								
280.0			6	SS	27								
4.9	Layers of Sandy Silt, Silt & Clayey Silt		7	SS	86								
	(Aquifer)												
	Very Dense to Compact		8	SS	26		278						4 4 82 10
276.7													
8.2	Clayey Silt, Some Sand & Traces of Gravel		9	SS	26								
	Very Stiff to Hard		10	SS	28								3 15 61 21
	Grey		11	SS	36								
271.5													
			12	SS	20		272						
13.4	End of Borehole												

+³, x⁵: Numbers refer to
Sensitivity

20
15 ± 5 (%) STRAIN AT FAILURE
10

METRIC

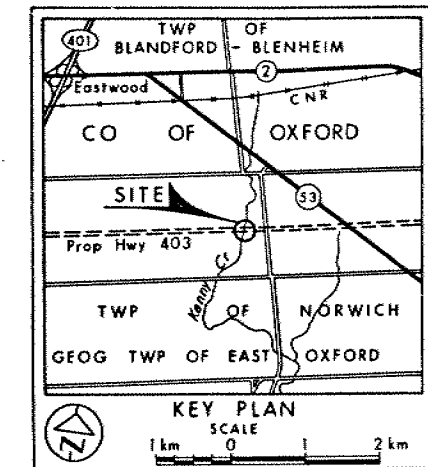
+3, x⁵: Numbers refer to Sensitivity



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 5-69-01
KENNY CREEK
(1.5 km West of Hwy 53)
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND			
◆	Bore Hole		
⊕	Dynamic Cone Penetration Test (Cone)		
⊕	Bore Hole & Cone		
N	Blows/0.3m (Std Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
W	WL at time of investigation 1972 05		
↑	Head		
↑	ARTESIAN WATER		
↑	Encountered		

No	ELEVATION	STATION	OFFSET
1	285.1	15+321.2	27.4m Lt
2	284.6	15+311.7	28.4m Lt
3	284.6	15+319.1	℄
4	284.9	15+311.2	℄
5	284.9	15+320.4	27.4m Rt
6	284.8	15+310.0	27.4m Rt

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

DATE	BY	DESCRIPTION
1982 12 08	DATE	1982 12 08
1982 12 08	DATE	1982 12 08
1982 12 08	DATE	1982 12 08