

GEOCRES No. 30M3-205DIST. 4 REGION W.P. No. 224-92-00CONT. No. W. O. No. STR. SITE No. HWY. No. Q.E.W.LOCATION Hwy 420 to S of Mountain Rd.
H.M.L.No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ministry of
Transportation and
Communications

FILE COPY

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP	224-92-00	REGION	Central
HWY	QEW	STR SITE	-

High Mast Lights
from Hwy. 420 to South of Mountain Road

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GEOCRES 30M3-205

DATE

MAY 11 1995

FOUNDATION INVESTIGATION REPORT
For
High Mast Lights
from Hwy 420 to south of Mountain Road
WP 224-92-00, Site N/A
Hwy QEW, Central Region

INTRODUCTION

This report presents soil information for the proposed high mast light poles at the above mentioned site. Soil information was obtained from previous subsurface investigations in the area. This report was produced at the request of Central Region Structural Section.

SUBSURFACE CONDITIONS

The appended 6 Record of Borehole sheets (details below) have been selected from previous projects to represent the soil conditions for this project.

The overburden is essentially composed of 10m of silt overlying dolomite bedrock. At some locations, especially between Mountain Street and Thorold Stone Road, the upper portion of the overburden may consist of clayey silt. At some locations, especially between Thorold Stone Road and Hwy 420, 2m of clayey silt till overlies the bedrock. Groundwater is generally within 2m of the ground surface.

The closest boreholes (listed below) should be referred to for the soil conditions at the HML locations.

<u>Boreholes</u>	<u>Coordinates</u>	<u>Elevation</u>	<u>WP #</u>
BH 4	N 4,777,060; E 335,700	185.6	154-64
BH 8	N 4,775,294; E 335,682	193.4	388-88-00
BH 1	N 4,774,950; E 335,710	191.6	388-88-00
BH 5	N 4,774,800; E 335,690	193.2	155-64-03
BH 85	N 4,773,210; E 335,835	193.7	168-64-6
BH 61	N 4,772,800; E 335,835	193.1	168-64-13

DISCUSSION AND RECOMMENDATIONS

It is proposed to install 28 high mast lighting poles (P1 through P28) on Hwy QEW from Hwy 420 to south of Mountain Road.

The High Mast Lighting poles will be founded on single reinforced concrete caissons. The foundations for HML should be designed in accordance with the methods described by B.B. Broms in the following two papers:

Broms, B.B.; Lateral Resistance of Piles in Cohesive Soils.
Journal of the Soil Mechanics and Foundations Division,
ASCE, Vol.90, No.SM2, Paper 3825, March 1964.

Broms, B.B.; Lateral Resistance of Piles in Cohesionless Soils.
Journal of the Soil Mechanics and Foundations Division,
ASCE, Vol.90, No.SM3, Paper 3909, May 1964.

The locations and details of HML's are indicated on the appended Table 1.

There are two options for the design of the HML foundations:

Option 1 (Preferred)

Assume that the soil conditions at any HML pole location is similar to the soil condition shown in the borehole log closest to the proposed HML location.

Use the following soil parameters for design:

In Clayey Silt

Q_u	= Unconfined Compressive Strength = 250 kPa
γ	= Unit Weight = 20 kN/m ³
Water Level	= As shown on the log sheet closest to the HML location.

In Silt and Sandy Silt

ϕ	= Angle of Internal Friction = 28°
γ	= Unit Weight = 20 kN/m ³
Water Level	= As shown on the log sheet closest to the HML location.

In Glacial Till

ϕ	= Angle of Internal Friction = 32°
γ	= Unit Weight = 20 kN/m^3
Water Level	= As shown on the log sheet closest to the HML location.

In Limestone Bedrock

Q_u	= Unconfined Compressive Strength = 1500 Kpa
γ	= Unit Weight = 22.5 Kn/m^3
Water Level	= As shown on the log sheet closest to the HML location.

For any existing fill overlying the native soil following parameters should be used taking into consideration that only half of the fill height would provide lateral support:

ϕ	= 30°
γ	= 20 kN/m^3

It should be assumed that soil in the zone of frost penetration does not provide any lateral resistance. The depth of frost penetration at this site is 1.2m.

Option 2

If the project schedule does not permit for a detailed design of the foundation using these parameters, then all the caisson foundations could be 10m deep.

Construction Considerations:

Since the recommendations for the HML foundation designs have been provided without detailed foundation investigation at each foundation location, it is recommended that the caissons should be inspected at the time of construction to verify that the soil conditions are similar to those encountered in previous investigations. It is proposed that Foundations Design recommend an expert inspector that could be retained on a contract basis by the Construction Office to carry out this task. This process has been used successfully at a number of sites including 401/Rouge River and 407 MacMillan

Yard. In our opinion, it is a cost effective way to verify design assumptions and deal with quality assurance for High Mast Light Foundations.

It is recommended that the appended non-standard special provision for the construction of HML foundations should be incorporated in the contract.

Miscellaneous

The subsurface information for this project was obtained from previous Foundation Investigation in this area. This report was prepared by D. Dundas, Senior Foundation Engineer.



D. Dundas
D. Dundas, P. Eng.
Senior Foundation Engineer

A P P E N D I X

W.P. 224-92-00
QEW / THOROLD STONE ROAD
HIGH MAST POLE LOCATIONS

HML POLE NO.	LOCATION	POLE HEIGHT (m)	STATION	OFFSET FROM CL (m)	SIDE	EAST CO-ORDINATE	NORTH CO-ORDINATE	EXISTING & FINAL CONTROL LINE ELEVATION	TOP OF BARRIER WALL ELEVATION
P1	QEW	25	12+845.6	CL		333 523	4775 964	192.62	193.67
P2	QEW	25	12+979.7	CL		335 571	4775 839	192.34	193.39
P3	QEW	25	13+098.6	CL		335 606	4775 725	192.87	193.92
P4	QEW	25	13+219.0	CL		335 633	4775 608	193.54	194.59
P5	QEW	25	13+335.6	CL		335 652	4775 493	194.10	195.15
P6	QEW	25	13+451.5	CL		335 663	4775 378	193.97	195.02
P7	QEW	25	13+577.2	CL		335 669	4775 252	193.19	194.24
P8	QEW	30	13+698.4	CL		335 674	4775 131	192.46	193.51
P9	QEW	30	13+818.3	CL		335 679	4775 011	192.53	193.58
P10	RAMP N-EW	30	10+420.2	66.9	WEST	335 612	4775 013	192.00	
P11	RAMP E-N	35	10+199	53.4	EAST	335 738	4774 880	195.20	
P12	RAMP E-S	35	10+078.8	107.6	WEST	335 577	4774 879	195.00	
P13	RAMP W-N	35	10+057.8	93.2	EAST	335 782	4774 796	192.00	
P14	RAMP W-S	35	10+238.8	55.9	WEST	335 633	4774 791	190.00	
P15	RAMP S-EW	30	10+171.5	60.6	EAST	335 755	4774 659	195.50	
P16	QEW	30	14+187.7	CL		335 695	4774 642	193.63	194.68
P17	QEW	25	14+305.5	CL		335 700	4774 525	193.80	194.85
P18	QEW	25	14+426.4	CL		335 705	4774 404	193.99	195.04
P19	QEW	25	14+551	CL		335 711	4774 279	194.07	195.12
P20	QEW	25	14+675.1	CL		335 716	4774 155	193.66	194.71
P21	QEW	25	14+802.5	CL		335 722	4774 028	193.59	194.64
P22	QEW	25	14+929	CL		335 727	4773 902	194.00	195.05
P23	QEW	25	15+054.2	CL		335 735	4773 777	194.48	195.53
P24	QEW	30	15+177.9	CL		335 746	4773 654	195.08	196.13
P25	HWY 420	30	10+045.3	CL		335 763	4773 509	197.70	198.75
P26	HWY 420	35	10+181.5	CL		335 719	4773 374	201.41	202.46
P27	HWY 420	35	10+320.5	CL		335 798	4773 236	203.60	204.65
P28	RAMP QEW - DORCHESTER	30	10+678.1	73.8 (HWY 420)		335 866	4773 277	187.90	

NOTE:

ALL ELEVATIONS ARE AT GROUND LEVEL.

NON STANDARD SPECIAL PROVISION

Sheet _____ of _____
Date _____

WP NO _____ Contract No _____ District No _____ Hwy No _____
Location _____ Type of Work _____

This SP in new (✓) []

This SP replaces No _____

Remarks:

Explanation of Intent: To define High Mast Pole construction

Item No	Spec No	Title or Item Description
		CONCRETE FOOTING FOR HIGH MAST POLES

CONSTRUCTION

The Contractor is advised that variable types of subsurface materials may be encountered at the high mast light pole locations; for addition information regarding soil conditions the Contractor is referred to the Foundation Investigation Report.

For bidding purposes it may be assumed that:

- Ground water is at or near the surface.
- If cohesionless material is encountered, it would be susceptible to disturbance under conditions of unbalanced hydrostatic head.
- If glacial deposits are encountered, there is a probability that occasional cobbles and boulders may be encountered within the deposit.

The Contractor is responsible for constructing the high mast pole foundations without disturbing the material at the sides or bases of the foundations. Sloughing conditions should be anticipated at this site. Temporary liners and mud drilling techniques are probably necessary. The Contractor shall submit eight copies of the proposed construction method to the Engineer for review a minimum of 15 working days prior to the commencement of construction of these foundation elements.

BASIS OF PAYMENT

Payment at the contract price for the above tender item shall be full compensation for all labour, equipment and materials required to do the work.

WP 224-92-00

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. FORMER 388 - 88 - 00 LOCATION CO - ORDS: N 4 774 950.5; E 335 710.0 ORIGINATED BY M V
DIST 4 HWY QEW BOREHOLE TYPE CONE TEST, HOLLOW STEM AUGER & NW CASING COMPILED BY M V
DATUM GEODETIC DATE 1992 06 01 CHECKED BY M V

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 * 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 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
191.6	Ground Surface											
0.0	Topsoil											
	SILT, Trace of Sand, Compact		1	SS	11		191					
			2	SS	14		190					0 14 (86)
			3	SS	25		189					
			4	SS	25		188					
			5	SS	24		187					0 2 (98)
			6	SS	23		186					
			7	SS	-		185					
185.1			8	SS	-		184					
6.5	SANDY SILT, Trace of Gravel, Compact		9	SS	16		183					5 24 (71)
184.1	Heterogeneous Mixture of GRAVEL, SAND and SILT, Very Dense (Glacial Till)		10	SS	53		182					21 40 (39)
7.5							181					
182.4	DOLOSTONE BEDROCK Unweathered		12	RC	REC		180					RQD = 88%
9.2												
179.4			13	RC	REC							RQD = 100%
12.2	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

WP 224-92-00

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4 IMPERIAL

FOUNDATION SECTION

JOB 67-F-26

LOCATION Mountain Rd., Revn., Sta. 30 + 78 o/s 43' Lt.

ORIGINATED BY V.K.

FORMER

FORMER
W.P. 15 4-64

BORING DATE April 10, 1967

COMPILED BY SN, JM.

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY A.C.C.

[illegible]

WP 224-92-00

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

IMPERIAL

FOUNDATION SECTION

JOB 67-F-27

LOCATION Thorold Stone Rd. Rev'n., Stn. 29+87, o/s 36' Lt.

ORIGINATED BY VK

FORMER
W.P. 155-64-03

BORING DATE April 13, 1967

COMPILED BY SN, JM

DATUM Geodetic

BOREHOLE TYPE Penr Drill & Diamond Drill

CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — WP	WATER CONTENT — W		
633.8	GROUND LEVEL											
0.0	Silt with traces of sand & clay, occ. gravel.											
			1	SS	85	630						
			2	SS	143							
			3	SS	109							
	Very dense.		4	SS	97	620						
			5	SS	90							
			6	SS	84							
			7	SS	105							
608.3						610						
25.5	Bedrock			AXT	100%							
603.3					Rec							
30.5	End of Borehole					600						

WP 224-92-00

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

FORMER

W.P. 388 - 88 - 00

LOCATION CO - ORDS: N 4 775 293.5; E 335 682.0

ORIGINATED BY M V

DIST 4 HWY QEW

BOREHOLE TYPE CONE TEST, HOLLOW STEM AUGER & NW CASING

COMPILED BY M V

DATUM GEODETIC

DATE 1992 10 01 & 02

CHECKED BY M V

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 7 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				
193.4	QEW Shoulder															
0.0	GRAVELLY SAND, Some Silt.															
192.8	(Fill)															
0.6																
			1	SS	24											
			2	SS	24											
			3	SS	45											
	SILT, Trace of Sand, Trace of Gravel, Compact to Very Dense		4	SS	45											
			5	SS	62											
			6	SS	58											
187.8																
5.6			7	SS	18											
	SANDY SILT, Occasional Silt Seams, Compact		8	SS	24											
			9	SS	15											
183.0																
10.4			10	RC NX	REC 100%											
	DOLOSTONE BEDROCK Unweathered															
			11	RC NX	REC 97%											
179.9																
13.5	End of Borehole															

WP 224-92-00

IMPERIAL

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 61

FOUNDATION SECTION

JOB 69-F-2-6

LOCATION

Co-ords. 658,792 N; 101,824 E.

ORIGINATED BY

RS

FORMER

W.P. 168-64-13

BORING DATE

March 5, 6 & 7, 1969

COMPILED BY

PP

DATUM Geodetic

BOREHOLE TYPE

Washbore - BX Casing

CHECKED BY

H.

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 20 40 60 80 100					WATER CONTENT % 10 20 30				
							SHEAR STRENGTH, P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
633.4	Ground Level															
0.0	Clayey silt to silty clay, trace of sand (mottled brown)					630										
625.9	Very stiff		1	SS	20											
7.5	Silt, trace of sand and clay (Brown)					620										
	Dense to very dense		2	SS	36											
			3	SS	63											
612.4			4	SS	68											
21.0	Sandy silt to silty fine sand. (Brown)					610										
			5	SS	50											
603.9	Compact to dense.		6	SS	42											
29.5	Het. mix. of clay, silt, sand & gravel (Glacial Till) (Brown)					600										
	Dense to very dense or hard.		7	SS	15											
597.6			8	SS	33											
			9	SS	83											
35.8	Dolomite Bedrock (Grey)					590										
	Fractured to sound at elev. 594.		10	AXT	90%											
585.4			11	AXT	100%											
			12	AXT	100%											
48.0	End of Borehole															

0 4 96 2

0 84 (16)

609.9

0 72 (28)

0 50 (50)

8 28 54 10

7 31 51 11

WL in open

BH

IMPERIAL

FOUNDATION SECTION

JOB <u>60-F-2-2</u>	LOCATION <u>Co-ord. 660,142 N; 101,821 E.</u>	ORIGINATED BY <u>EP</u>
FORMER W.P. <u>168-64-6</u>	BORING DATE <u>March 6 - 7, 1969</u>	COMPILED BY <u>AKB</u>
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Pendrill & Washboring</u>	CHECKED BY <u>AK</u>

[illegible]

EXPLANATION OF TERMS USED IN REPORT

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

SS SPLIT SPOON	TP THINWALL PISTON
WS WASH SAMPLE	OS OSTERBERG SAMPLE
ST SLOTTED TUBE SAMPLE	RC ROCK CORE
BS BLOCK SAMPLE	PH TW ADVANCED HYDRAULICALLY
CS CHUNK SAMPLE	PM TW ADVANCED MANUALLY
TW THINWALL OPEN	FS FOIL SAMPLE

STRESS AND STRAIN

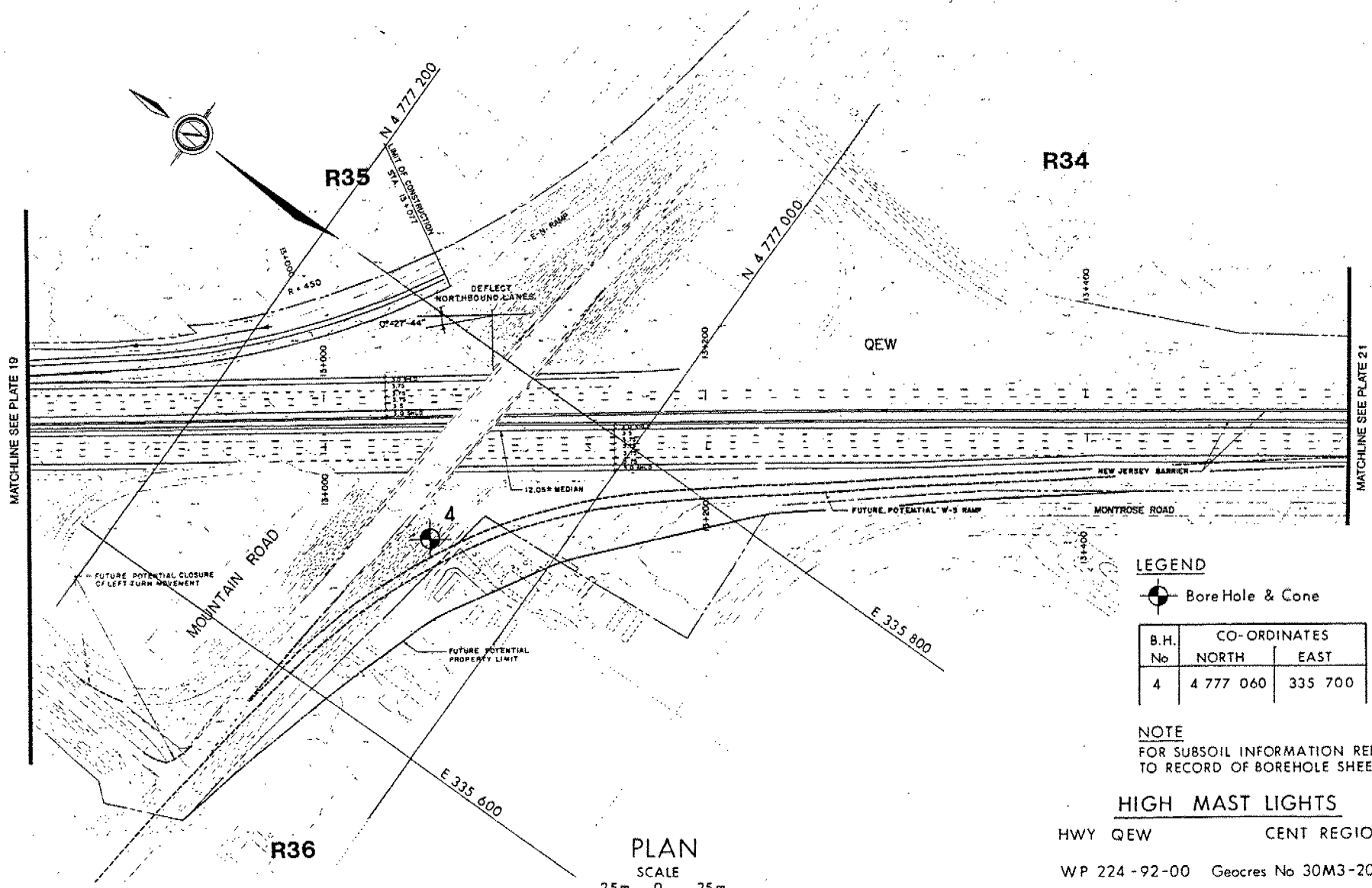
u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa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



MATCHLINE SEE PLATE 19

MATCHLINE SEE PLATE 21

LEGEND

 BoreHole & Cone

B.H. No	CO-ORDINATES	
	NORTH	EAST
4	4 777 060	335 700

NOTE
FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEET

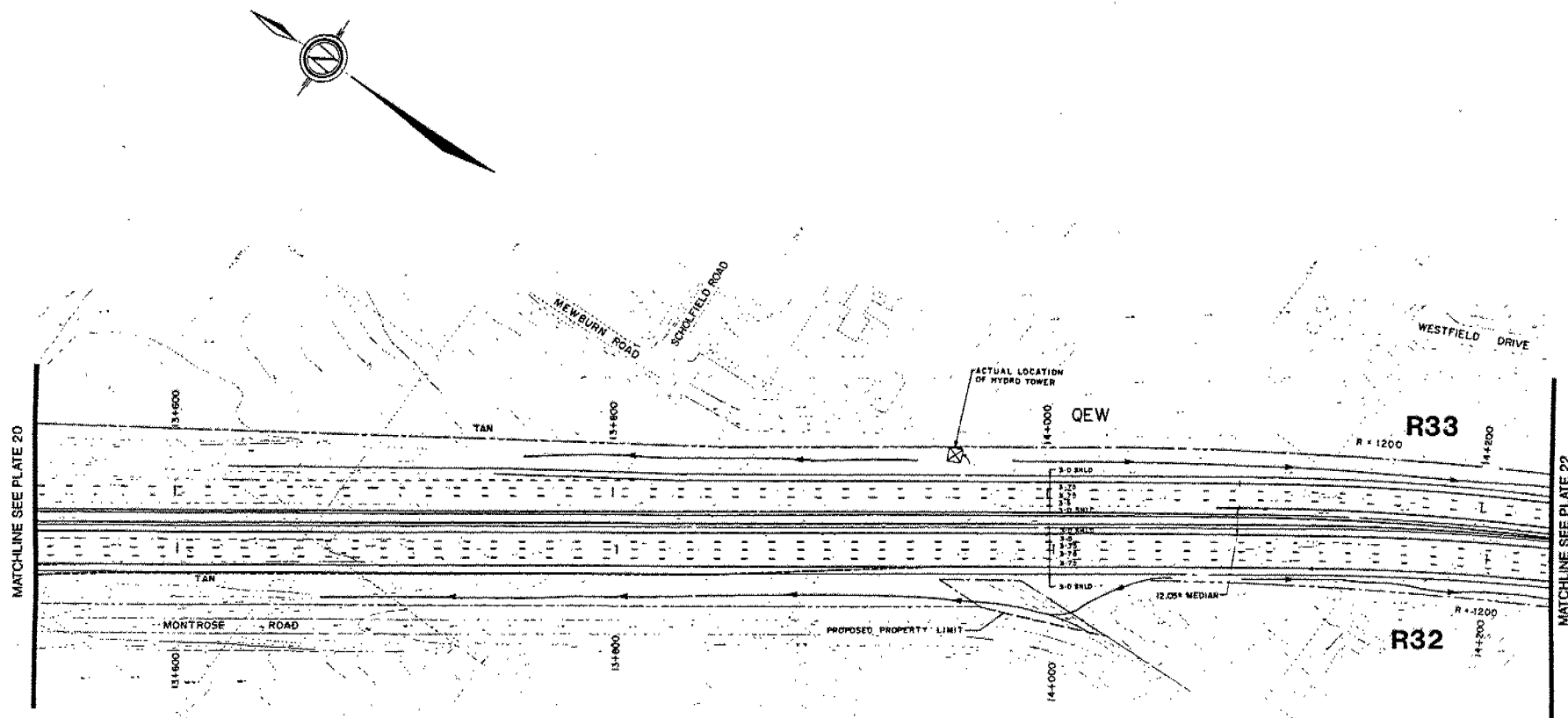
HIGH MAST LIGHTS

HWY QEWS CENT REGION

WP 224-92-00 Geocres No 30M3-205

DATE 1995 04 28





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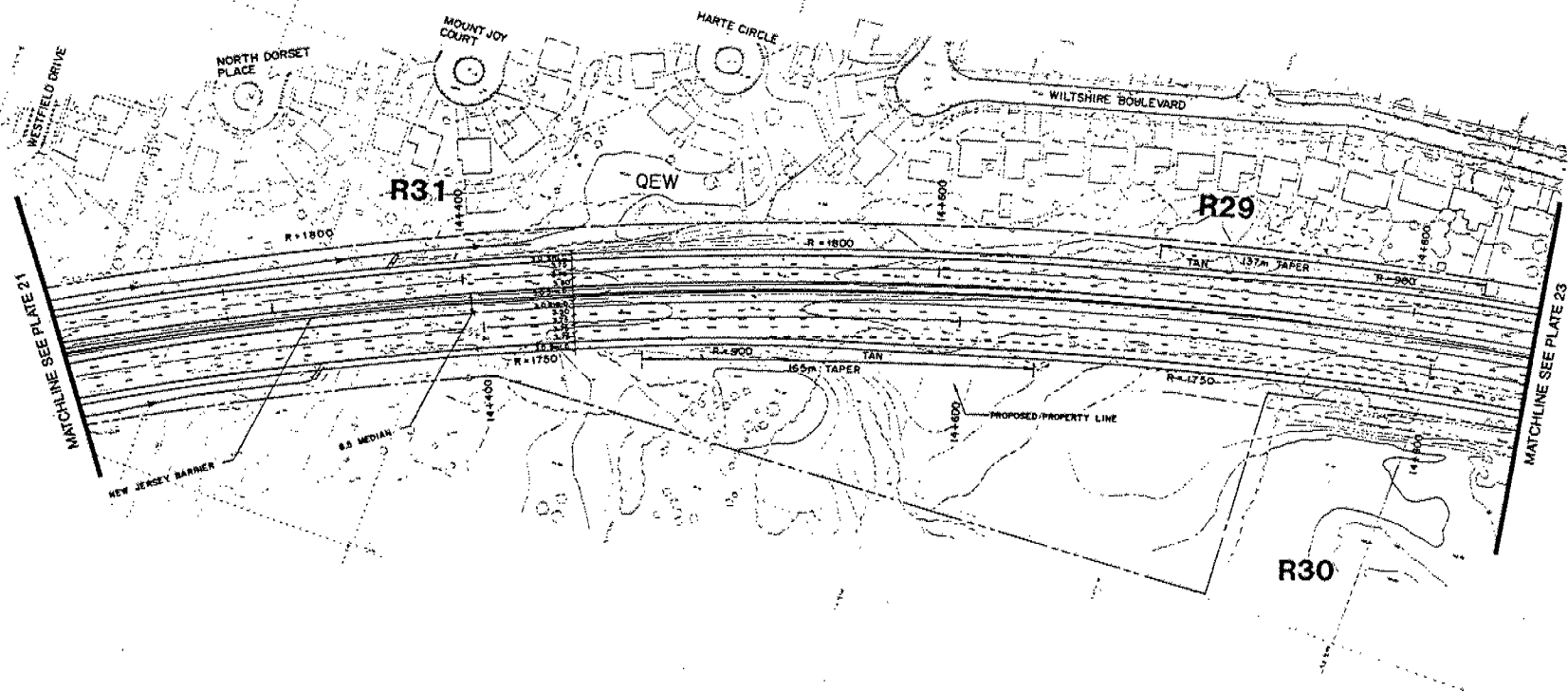
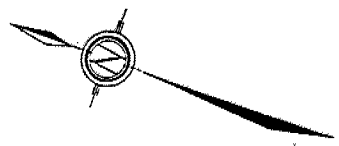
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HIGH MAST LIGHTS

HWY QEW CENT REGION

WP 224 -92-00 Geocres No 30M3-205.

DATE 1995 04 28

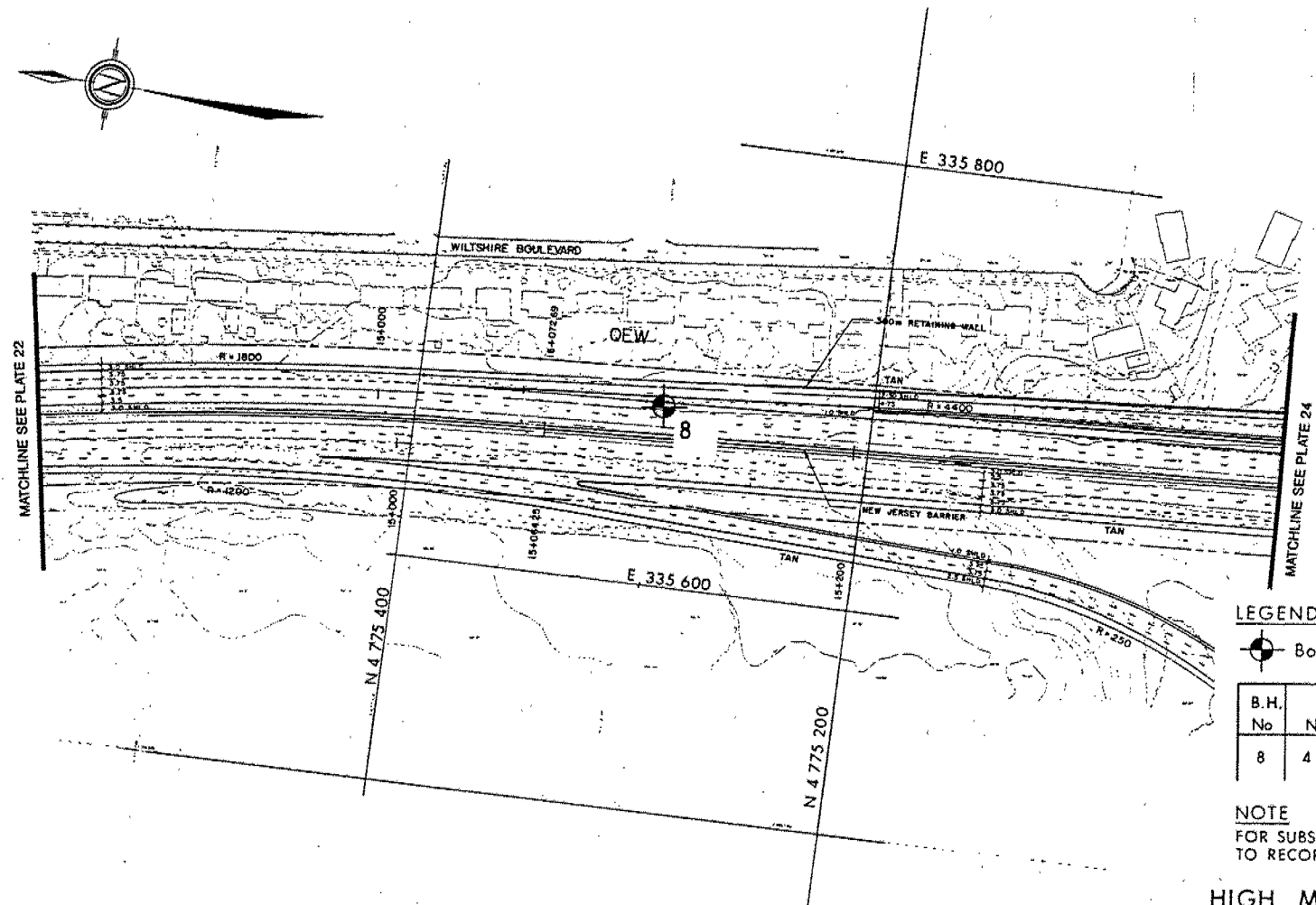
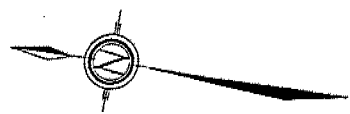


HIGH MAST LIGHTS

HWY QEWS CENT REGION

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DATE 1995 04 28



LEGEND

Bore Hole & Cone

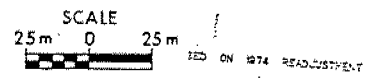
B.H. No	CO-ORDINATES	
	NORTH	EAST
8	4 775 294	335 682

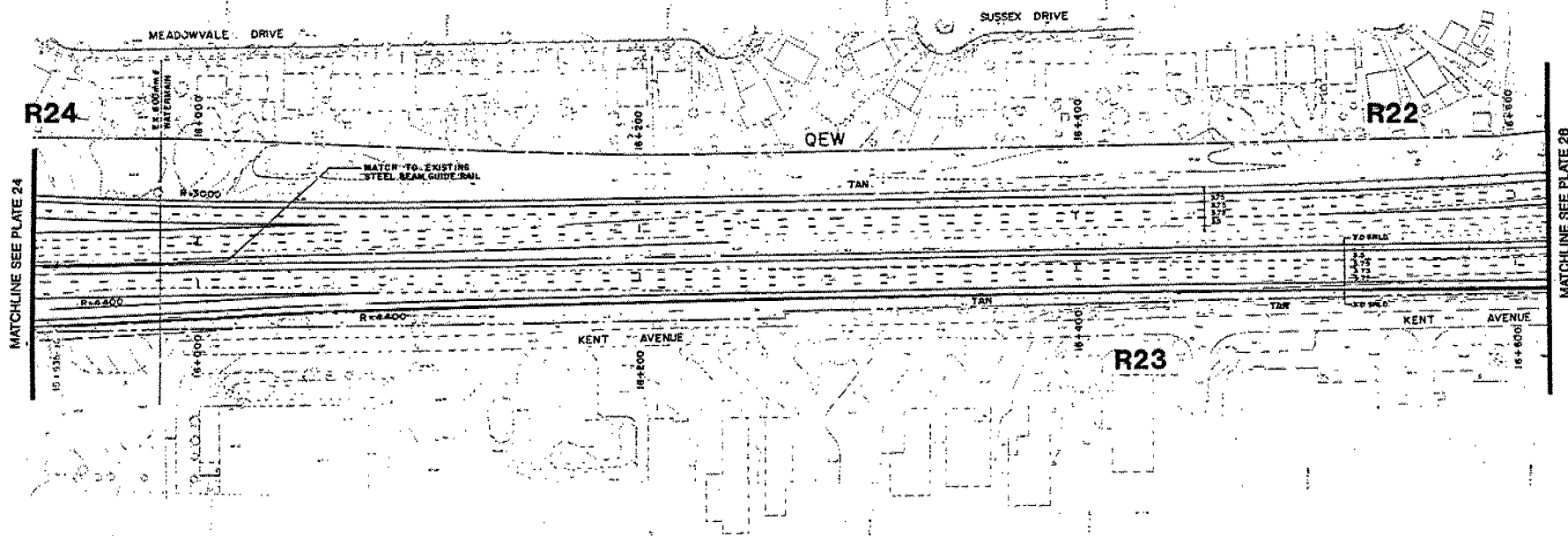
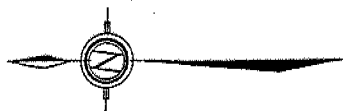
NOTE
FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEET

HIGH MAST LIGHTS

HWY QEW CENT REGION
WP 224 - 92-00 Geocres No 30M3-205
DATE 1995 04 28

PLAN





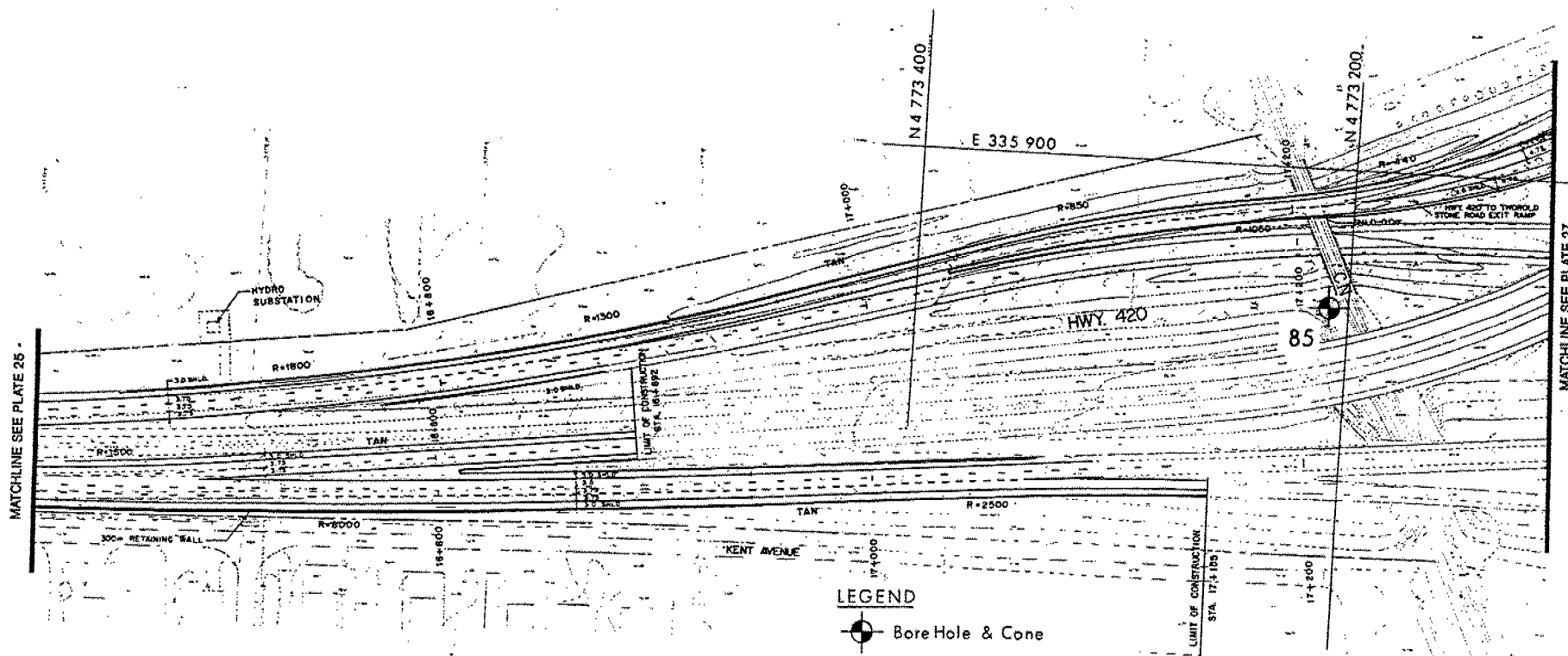
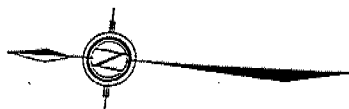
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HIGH MAST LIGHTS

HWY QEW CENT REGION

WP 224-92-00 Geocres No 30M3-205

DATE 1995 04 28



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● Bore Hole & Cone

B.H. No	CO-ORDINATES	
	NORTH	EAST
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NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEET

HIGH MAST LIGHTS

HWY QEW CENT REGION

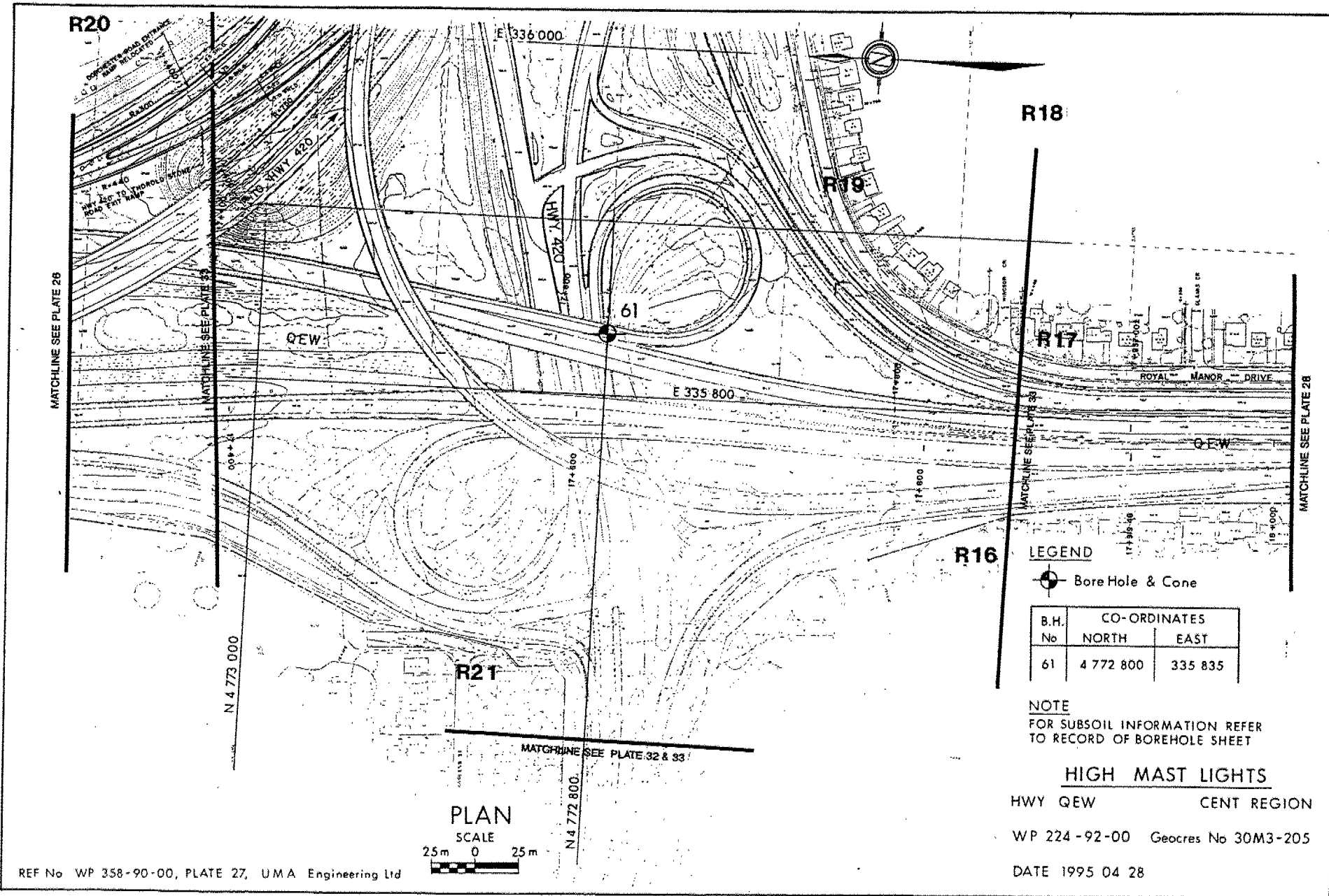
WP 224 -92-00 Geocres No 30M3-205

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PLAN

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R18


R19

R17

R16

R21

LEGEND

 Bore Hole & Cone

B.H. No	CO-ORDINATES	
	NORTH	EAST
61	4 772 800	335 835

NOTE

FOR SUBSOIL INFORMATION REFER
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HIGH MAST LIGHTS

HWY QEW CENT REGION

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REF No WP 358-90-00, PLATE 27, UMA Engineering Ltd