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FOUNDATION INVESTIGATION REPORT

Highway 427 - High Mast Lighting

W.P. 127/128-85-00 Site No. N/A

From Evans Avenue northerly to Highway 401



Report Distribution:

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Nature, to be commanded, must be obeyed.

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Ministry of Transportation, Ontario, Central Region

1. INTRODUCTION

Strata Engineering Corp. has been retained by ERES Consultants, Inc., Champaign, Illinois, to investigate the foundation conditions for high mast lighting (HML) standards being proposed along Highway 427, from the vicinity of Evans Avenue northerly to just south of the Hwy. 401 interchange. It is believed the HML standards will be spaced approximately 150 m apart, along the median centreline of Highway 427, with additional standards being provided at interchanges. The locations and numbers of HML standards were not finalized at the time of the field investigation. Hence, boreholes were drilled at ~300 m intervals along the inner northbound paved shoulder of Highway 427. Boreholes were also drilled within interchange ramp areas at accessible locations free from underground services.

This report contains the factual information obtained from a number of boreholes drilled between Stations 9+000 (south end of project) and 15+500 (north end of project), median centreline chainage, Highway 427. Subsurface information from other foundation investigations within the project area was obtained from the GEOCREC data base files of the Pavements and Foundations Section, Engineering Materials Office, MTO, and is referenced in this report.

Subsurface information from previous investigations by the Ministry and others should be included in any contractual documents provided to potential bidders, so as to avoid the appearance of withholding available information.

2.0 SITE AND GEOLOGY

The site is located along Highway 427 in Metropolitan Toronto. The project location extends from just north of Evans Avenue, Station 9+000, northerly to north of Eglinton Avenue, vicinity Station 15+500. The topography of the area is generally flat on either side of the highway. The profile grade of the highway increases by about 55 m from south to north within the project limits. Drainage is generally towards the south.

South of Dundas Street, the surficial overburden soils are derived from glacial Lake Iroquois. They form a thin veneer above underlying glacial tills and/or shale bedrock. The Lake Iroquois Shoreline is located just south of Dundas Street (Map P.2204, "Quaternary Geology - Toronto and Surrounding Area", Ontario Geological Survey). North of Dundas Street, the overburden soils consist predominantly of Halton Till. This till sheet extends northwards beyond the north limit of the project. The bedrock consists of shale of the Georgian Bay Formation. The shale bedrock is interbedded with dolomitic siltstone and limestone. Upper portions of the shale bedrock are weathered and amenable to drilling as if it were a soil, except where interbeds of indurated siltstone or harder limestone occur.

Highway 427 through the project area is a controlled access core-collector urban freeway. It was developed in stages to its present status in mid to late 1960's. Several foundation investigation studies were conducted by the Ministry and various consultants during the early to mid 1960's at proposed bridge and interchange sites. Relevant reports are on file in the GEOCREST data base system of the Ministry.

3.0 PROCEDURES

The field work for this project was carried out on weekends only, between September 13 and 20, 1998. Two truck mounted CME 55 drilling machines were used for drilling along the highway centreline. Only one machine was used for all off-centreline boreholes. For the holes drilled along the inside shoulder of the northbound core lane, the inside lane (Lane 1) was closed off for 2-3 km at a time.

Crash trucks conforming to Ministry requirements were provided behind each machine in the direction of traffic travel. Crash trucks were also provided at all borehole locations within interchange areas.

Boreholes were drilled at the locations indicated in Table 1, using continuous flight solid stem augers. Upon completion of drilling and sampling, each hole was backfilled with the native soil cuttings, which were compacted with the hydraulic power of the machine. The final cover consisted of sand and gravel placed above the compacted backfill soil before capping with cold mix asphalt, placed flush with the existing paved shoulder surface.

Table 1 - Borehole Locations and Depths

BH	Elev.	Station	Offset (m)	Coordinates		Depth (m)
1	103.8	9+060 SB Core	4.2 Lt. E/P	N: 4 830 210	E: 300 834	5.3
2	107.6	10+297 Ramp E-S QEW	3.3 Rt. E/P	N: 4 830 527	E: 300 744	6.1
3	113.1	10+220 Ramp W-N Q'way	27.0 Lt. E/P	N: 4 830 617	E: 300 943	6.1
4	111.5	10+579 Ramp W-N QEW	4.5 Rt. E/P	N: 4 830 712	E: 300 773	4.6
5	121.4	9+900 NB Core	3.0 Rt. CL	N: 4 830 940	E: 300 568	10.8
6	126.9	10+200 NB Core	2.9 Rt. CL	N: 4 831 226	E: 300 475	14.0
7	128.6	10+500 NB Core	1.6 Rt. CL	N: 4 831 511	E: 300 382	13.0
8	127.4	10+800 NB Core	2.0 Rt. CL	N: 4 831 796	E: 300 291	9.2
9	124.3	10+537 Ramp S-W Dundas	11.0 Lt. E/P	N: 4 832 084	E: 300 365	4.7
10	121.9	10+183 Ramp E-S Dundas	8.0 Lt. E/P	N: 4 832 050	E: 300 075	4.6
11	128.8	11+200 NB Core	2.1 Rt. CL	N: 4 832 180	E: 300 178	5.9
12	129.5	11+700 SB Coll.	8.9 Rt. E/P	N: 4 832 636	E: 299 967	6.2
13	131.2	11+811 NB Gore	35.0 Rt. CL	N: 4 832 779	E: 300 055	7.7
14	134.2	12+300 NB Core	1.9 Rt. CL	N: 4 833 245	E: 299 905	6.6
15	137.5	12+650 NB Core	2.8 Rt. CL	N: 4 833 582	E: 299 811	7.8
16	144.3	10+155 W-N Burnhamthorpe	19.0 Rt. E/P	N: 4 833 942	E: 299 791	11.1
17	142.0	13+191 SB Coll.	21.0 Lt. E/P	N: 4 834 071	E: 299 587	9.3
18	140.9	13+200 NB Core	2.8 Rt. CL	N: 4 834 108	E: 299 646	8.1
19	142.9	13+600 NB Core	2.0 Rt. CL	N: 4 834 486	E: 299 520	6.6
20	144.5	13+900 NB Core	2.3 Rt. CL	N: 4 834 769	E: 299 419	6.6
21	150.7	10+805 Ramp N-E Rathburn	9.0 Rt. E/P	N: 4 834 977	E: 299 438	9.4
22	150.0	10+088 Ramp E-S Rathburn	10.5 Rt. E/P	N: 4 834 923	E: 299 257	8.1
23	146.5	14+300 NB Core	2.4 Rt. CL	N: 4 835 144	E: 299 278	12.3
24	147.0	14+600 NB Core	2.4 Rt. CL	N: 4 835 428	E: 299 180	12.6
25	145.7	14+875 NB Core	1.8 Rt. CL	N: 4 835 691	E: 299 098	6.6
26	146.2	15+200 NB Core	2.0 Rt. CL	N: 4 836 002	E: 299 006	6.5
27	148.7	15+500 NB Core	2.0 Rt. CL	N: 4 836 289	E: 298 918	8.1
28	158.2	Ramp 401 W-427 S	E/P Outer Shldr	N: 4 836 738	E: 298 192	9.1

* CL refers to offset from the median centreline of Highway 427

Coll. refers to Collector lanes; Core refers to Core lanes; NB = Northbound; SB = Southbound

E/P refers to edge of paved lane or ramp

Rt., Lt. refer to Right and Left of Median Centreline, respectively

N, E refer to Northing and Easting coordinates respectively

Shldr. refers to paved shoulder

Groundwater observations were made in the boreholes during sampling and immediately after completion. Long term observations of stabilized groundwater levels were not made since piezometers were not installed.

Borehole locations referred to in this report with respect to north and east coordinates were determined by scaling off Ministry supplied B Plans. In this report, and the appended borehole log sheets, CL refers to median centreline of Highway 427; E/P refers to edge of pavement; and o/s refers to offset in metres from the median centreline or E/P, as applicable. Ground elevations at borehole locations were inferred from elevation contour lines drawn on the Ministry supplied B Plans, and are presumed to refer to Geodetic Datum.

Sampling was performed in each borehole at depth intervals ranging from 0.75 m to 1.5 m, in the Standard Penetration Test (ASTM D 1586), with the accompanying N values being noted in blows/0.3 m. Soft cohesive soils requiring thin walled tube sampling or in situ undrained shear strength vane tests were not encountered.

Recovered soil or weathered shale bedrock samples were classified in the field in accordance with the Unified Soil Classification System (ASTM D 2487) and placed in moisture proof zip-lock bags for subsequent visual examination under controlled conditions in the laboratory. Based on the visual laboratory examination, some samples were assigned testing for moisture content, grain size distribution, Atterberg Limits and unit weight determinations. All samples designated for such testing were delivered to the Agra Earth and Environmental Laboratory in Scarborough, a Ministry approved laboratory for such testing. The results of testing by Agra Earth and Environmental are appended.

Borehole logs were prepared in accordance with Ministry protocol, and are appended, along with pertinent figures and drawings. The locations of all drilled boreholes are shown on part plan drawings copied from the supplied Ministry B Plans, and are appended.

4.0 SUBSURFACE CONDITIONS

4.1 Summary

The subsurface stratigraphy consists of asphaltic concrete pavement of the paved shoulders, over sand and gravel (or granular base and sub-base), followed by a firm to stiff cohesive fill, mixed with organics in some cases, overlying the natural soil which is a stiff to hard clayey silt glacial till, interspersed at depth with dense to very dense silt and silty sand to sandy silt layers and/or thicker strata. A summary of the soil conditions encountered is provided in the appendix, Table A1.

4.2 Asphalt Pavement

Where encountered, asphalt concrete thickness on the paved shoulder and in gore areas ranged from 150 mm to 250 mm.

4.3 Granular Base

The granular base materials below the paved shoulders consisted of crushed granular (Granular A) and sand and gravel (Granular B), with a wide variation in encountered thicknesses. Refer to Table A1 for specific types and thicknesses.

4.4 Topsoil

In boreholes drilled in unpaved areas, topsoil was encountered at ground surface. The topsoil thickness ranged from 50 mm to 200 mm.

Topsoil was also encountered below filled ground in some boreholes, and denotes the original ground level prior to filling. Refer to Table A1 for locations and thicknesses encountered.

4.5 Fill Material

Granular fill material (150 mm to 1.05 m in some locations) is generally present below paved areas. Below the granular material or topsoil in unpaved areas, the filled ground consists of essentially a cohesive clayey silt soil, likely derived from excavations within the native clayey silt glacial till soil.

The fill material was found to be mixed with organics and in some instances, cobbles and boulders, in isolated locations. The filled ground thickness ranges from none (Boreholes 9 and 23) to over 12 m (Borehole 7). The consistency of the cohesive clayey silt fill ranges from firm to stiff generally. In Borehole 8, the filled ground consisted of a heterogeneous mixture of sand and gravel with topsoil, in a compact to dense condition. In one borehole (Borehole 27) a boulder or large cobble is presumed to have been encountered within the fill material.

From visual observations, it is evident that fills in excess of 10 m thickness are present in the vicinity of the CNR bridge and North Queen Street.

4.6 Clayey Silt (Glacial Till)

The predominant natural soil within the study limits is a clayey silt glacial till containing some sand and occasional gravel (CL), as shown by the Atterberg Limits of Figure 1. Plasticity tests on some samples indicate the cohesive till can also be classified as a silty clay till, as shown on Figure 2, which also includes the Atterberg Limits for the cohesive fill and shale bedrock. The clayey silt glacial till is underlain either by shale bedrock or by a silt or sand glacial till.

The consistency of the clayey silt glacial till ranged generally from stiff to hard.

4.7 Sands and Silts (Glacially derived)

The clayey silt native glacial till soil is underlain at some locations by layers and deposits of sands and silty sands to sandy silts, which are considered to be of glacial origin. Sand and silt deposits were encountered generally in all boreholes drilled north from Station 9+900 (Borehole 5). These non-cohesive deposits were encountered either directly below the fill, as in Boreholes 8, 10 and 17, or below the clayey silt glacial till deposit.

Standard Penetration Resistance N values indicate these non-cohesive glacially derived layers and deposits of sands and silts and sand-silt mixtures are generally in a dense to very dense state of existence. In Borehole 17, an unusually high N value is attributed to the presence of a cobble or random boulder located within the silty sand deposit.

4.8 Weathered Shale

Weathered shale was encountered in the south part of the project, in Boreholes 1 to 4, at depths ranging from 1.0 to 3.2 m below prevailing ground surface. Examination of borehole data from this and prior investigations within the Highway 427 corridor indicates the weathered shale and the sound shale bedrock is more or less "bowl" shaped in the north-south direction along Highway 427. It is shallow at the south end and beyond the north limits of the project, being deeper in the middle zone. The sound shale rock below the weathered zone, as well as the weathered shale in some instances, are interspersed with limestone beds, some of which may require hoe ramming for removal, where encountered.

4.9 Groundwater Conditions

Observations of groundwater conditions were made during augering and sampling, and upon completion of drilling and auger withdrawal. Free water was observed in Boreholes 2, 5, 19, and 24, at respective depths of 3.2, 5.3, 6.0 and 10.7 m. These water levels were measured prior to hole abandonment and are considered to be unstabilized levels. A perched water condition was noted in Borehole 25 at a depth of 2 m. Some wetness at the base of the completed borings was observed in Boreholes 11, 13 and 18. However, no free water accumulated in these holes after about 5 minutes of observation.

The groundwater conditions encountered in this investigation are summarized in Table 2.

Table 2 - Groundwater Conditions (Present Investigation)

BH No.	Depth to GWL*	In Deposit	Comments
2	3.2 m	Weathered Shale	Water level not stabilized
5	5.3 m	Fine Sand (in Fill)	Water level not stabilized**
11	5.9 m	Clayey Silt	Wetness only - no free water
13	7.7 m	Sandy Silt	Wetness only - no free water
18	8.1 m	Silty Sand	Seepage, 5.6-7.8 m depth
19	6.0 m	Clayey Silt/Silty Sand	Water level not stabilized
24	10.7 m	Clayey Silt/Silty Sand	Water level not stabilized
25	2.0 m	Fill Material	Seepage, perched water

* GWL = Groundwater level

** The water level rose from a depth of 7.2 m to 5.3 m once the fine sand layer was penetrated.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

It is proposed to install high mast lighting (HML) standards (poles) along Highway 427, from just south of the Highway 401 interchange southerly to the QEW. The precise locations of the proposed HML poles are not known. However, it is assumed that they will be spaced approximately 150 m apart along the median centreline of Highway 427, and at strategic locations at interchanges. Hence, for pole design at specific locations, reference may be made to the borehole logs of the nearest holes. It should be noted that fill thicknesses can vary between borehole locations; therefore, the design should assume the worst possible scenario when interpolating or extrapolating soils data and fill thickness (and associated fill design parameters) from the boreholes of this and other site investigations.

5.2 Previous Investigations

Previous foundation investigations conducted by the Ministry (and/or its retained consultants) are shown on Figure A1 in the appendix, which is a copy of the GEOCRETS data base system NTS map (Map 30M11) showing, by numbers, the locations investigated in the mid to late 1960's when the then existing Highway 27 was being developed into the first stages of the present Highway 427 core-collector system. A partial listing of some relevant projects for which the Ministry obtained subsurface data are indicated in Table 3.

A review of the available GEOCRETS data base system reports, log sheets and stratigraphic sections indicates a relatively good match between the site subsurface conditions encountered in this investigation and those described in the original 1965 to 1967 foundation investigations.

It should be noted that the reference coordinate system in use in the 1960's was different from the one currently in use by the Ministry. Therefore, a one-on-one correspondence by reference to N and E coordinates is not possible between the two systems. It should also be recalled that Highway 427 as it presently exists in no way resembles Highway 27 when the first four lane divided highway was constructed between the QEW and Highway 401. Hence, care is required in interpreting borehole locations for the development of specific soil stratigraphic cross-sections or profiles.

It should also be recognized that ground elevations (grades) may have changed due to cutting and filling when the present core-collector system was finalized.

Table 3 - Examples of Foundation Investigation Reports, GEOCRES Data Base

Ministry File No.	Location	Year of Investigation	GEOCRES No.
65-F-104 (various suffix letters, A, C. &c.)	Hwy. 27 and QEW IC	1965-66	30M11-10 30M11-11 30M11-12 30M11-14
W.P. 279-64-01	Hwy. 27 O'Pass at Dundas St.	1967	30M11-31
W.P. 266-66	NB Basketweave, S. of Bloor St.	1967	30M11-33
W.P. 267-66	SB Basketweave, S of Bloor St.	1967	30M11-34
W.P. 37-66	Hwy. 27 U'pass at Bloor St.	1967	30M11-35
W.P. 279-64-4	Bridge No. 2 NB Collector over Dundas Street	1967	30M11-38
W.P. 275-64-2 40	Hwy. 27 and Dundas St.	1967	30M11-39,
W.P. 275-64-2/3	Hwy. 27/Dundas St. Storm Sewer	1967	30M11-42
W.P. 201-62	Hwy. 401 & 27 Trunk Sewer	1967	30M11-44, 45
W.P. 201-62-1	Hwy. 401/27 Richview Expwy IC	1967	30M11-46, 56
W.P. 262-65	Hwy. 27 / Burnhamthorpe Rd.	1967	30M11-49

5.3 Design

Loads from high mast lighting standards may be transferred to the subsoil by means of cast in place concrete caissons founded at the maximum elevation needed to provide the required lateral resistance. The foundation design should be conducted in accordance with the method outlined in the following technical publications, for both cohesive and non-cohesive soils:

Brohms, B. B. 1964. Lateral resistance of piles in cohesive soil. ASCE Journal of the Soil Mechanics and Foundations Division, vol. 90, SM 2, Paper 3285, March.

Table 4 - Design Parameters

BH No.	Ground Elev.	Soil Boundary Elev.		Soil Types	Phi angle degrees.	q _u kN/m ²	unit wt. kN/m ³	Assumed Water Level
		Upper	Lower					
1	103.8	102.4	98.5	Cohesive	-	1000	23.0	DUC
2	107.6	106.4	101.5	Cohesive	-	1000	23.0	DUC
3	113.1	111.9	110.7	Non-cohesive	35	-	22.0	DUC
		110.7	109.9	Cohesive	-	300	21.5	
		109.9	107.0	Cohesive	-	1000	23.0	
4	111.5	110.3	106.9	Cohesive	-	1000	23.0	DUC
5	121.4	120.2	115.2	Cohesive (FILL)	-	120	19.5	5.3 m depth
		115.2	114.2	Cohesive	-	100	19.0	
		114.2	111.2	Non-cohesive	32	-	22.0	
		111.2	110.6	Cohesive	-	600	23.0	
6	126.9	125.7	117.1	Cohesive (FILL)	-	100	19.0	DUC
		117.1	113.0	Cohesive	-	200	21.0	
		113.0	112.9	Non-Cohesive	35	-	22.0	
7	128.6	127.4	119.2	Cohesive (FILL)	-	100	20.0	DUC
		119.2	116.1	Non-Cohesive (FILL)	27	-	19.0	
		116.1	115.6	Cohesive	-	200	21.0	
8	127.4	126.2	124.0	Non-Cohesive (FILL)	27	-	19.0	DUC
		124.0	121.4	Non-Cohesive (FILL)	30	-	20.0	
		121.4	119.8	Non-Cohesive	32	-	21.0	
		119.8	118.2	Non-Cohesive	36	-	22.0	
9	124.3	123.1	121.9	Cohesive	-	600	23.0	DUC
		121.9	119.6	Non-cohesive	36	-	23.0	
10	121.9	120.7	117.3	Non-cohesive	36	-	22.0	DUC
11	128.8	127.6	124.1	Cohesive (FILL)	-	100	20.0	5.9 m depth
		124.1	122.9	Cohesive	-	600	23.0	
12	129.5	128.3	127.1	Cohesive	-	600	23.0	DUC
		127.1	123.3	Non-Cohesive	36	-	23.0	
13	131.2	130.0	128.8	Cohesive (FILL)	-	80	18.0	7.7 m depth
		128.8	126.0	Cohesive	-	500	22.0	
		126.0	123.5	Non-cohesive	36	-	23.0	
14	134.2	133.0	132.3	Cohesive (FILL)	-	100	20.0	DUC
		132.3	128.2	Cohesive	-	600	23.0	
		128.2	127.6	Non-cohesive	35	-	22.0	
15	137.5	136.3	133.5	Cohesive	-	200	21.0	DUC
		133.5	129.7	Non-cohesive	35	-	22.0	
16	144.3	142.9	136.5	Cohesive (FILL)	-	100	20.0	DUC
		136.5	135.0	Cohesive	-	500	22.5	
		135.0	133.2	Non-cohesive	36	-	23.0	
17	142.0	140.8	139.6	Cohesive (FILL)	-	50	18.0	DUC
		139.6	134.2	Non-cohesive	30	-	21.0	
		134.2	133.2	Non-cohesive	36	-	23.0	
18	140.9	139.4	137.4	Cohesive	-	200	21.0	8.1 m depth
		137.4	133.1	Non-cohesive	36	-	23.0	
		133.1	132.8	Cohesive	-	600	23.0	

DUC = dry upon completion

This Table continues on the next page

NOTES

- Design parameters shown for (FILL) should be reduced by 50% in computing lateral support.
- Design parameters for (FILL) materials are applicable only within about 5 m of the locations drilled.
- The material designated as (FILL) is unacceptable as an end bearing stratum. HML standards should not be terminated within fill, even if the shaft capacity in (FILL) satisfies the design requirements.
- If HML standard is placed on sloping ground, use the lowest ground elevation as a reference elevation for design and subtract 1.2 m for frost penetration. See Figure 3.

Table 4 - Design Parameters (continued from previous page)

BH No.	Ground Elev.	Soil Boundary Elev.		Soil Types	Phi angle degrees	q_u kN/m ²	unit wt. kN/m ³	Assumed Water Level
		Upper	Lower					
19	142.9	141.4	140.3	Cohesive	-	150	20.0	6.0 m depth
		140.3	138.9	Cohesive	-	500	22.5	
		138.9	136.6	Non-cohesive	36	-	23.0	
		136.6	136.3	Cohesive	-	600	23.0	
						500	22.5	
20	144.5	143.3	138.4	Cohesive	-	-	21.5	DUC
		138.4	137.9	Non-cohesive	32	-	-	
21	150.7	149.5	145.8	Cohesive (FILL)	-	80	19.5	DUC
		145.8	141.3	Cohesive	-	600	23.0	
22	150	148.8	146.0	Cohesive (FILL)	-	80	20.0	DUC
		146.0	141.9	Cohesive	-	500	22.5	
23	146.5	145.3	142.5	Cohesive	-	500	22.5	DUC
		142.5	136.3	Cohesive	-	200	21.0	
		136.3	134.8	Cohesive	-	600	23.0	
		134.8	134.2	Non-cohesive	36	-	23.0	
						-	-	
24	147.0	145.5	138.8	Cohesive	-	200	21.5	10.7 m depth
		138.8	136.3	Cohesive	-	600	23.0	
		136.3	134.4	Non-cohesive	36	-	22.5	
25	145.7	144.5	143.3	Non-cohesive (FILL)	28	-	20.0	Seepage at 2 m depth
		143.3	140.1	Cohesive	-	600	23.0	
		140.1	139.1	Non-cohesive	36	-	23.0	
26	146.2	145.0	139.7	Cohesive	-	500	23.0	DUC
27	148.7	146.8	145.0	Cohesive (FILL)	-	100	19	DUC
		145.0	140.6	Cohesive	-	400	22.5	
28	158.2	157.0	154.5	Non-cohesive (FILL)	30	-	21.5	DUC
		154.5	153.9	Cohesive (FILL)	-	80	18.0	
		153.9	149.1	Cohesive	-	450	21.5	

DUC = dry upon completion

NOTES

1. Design parameters shown for (FILL) should be reduced by 50% in computing lateral support.
2. Design parameters for (FILL) materials are applicable only within ~5 m of the locations drilled.
3. The material designated as (FILL) is unacceptable as an end bearing stratum, and no HML standards should be terminated within fill, even if the shaft bearing capacity satisfies the design requirements.
4. If HML standard is placed on sloping ground, use the lowest ground elevation as a reference elevation for design and subtract 1.2 m for frost penetration. See Figure 3.

Brohms, B. B. 1964. Lateral resistance of piles in cohesionless soil. ASCE Journal of the Soil Mechanics and Foundations Division, vol. 90, SM 3, Paper 3285, May.

Based on the current investigation, and a review of the available previous data, the calculated parameters to be used for design of the proposed high mast lighting standards are indicated in Table 4, which also provides values of the effective angle of internal friction, ϕ' , in degrees, for the cohesionless natural soils; q_u , the unconfined compressive strength of the cohesive soils, in kN/m^2 ; and, the unit weight of the soils, γ , in kN/m^3 . In fill materials the q_u values shown in Table 4 should be reduced by 50 % to account for fill variability and other uncertainties.

Note that below the prevailing water table, the buoyant unit weight, γ' , may apply, where $\gamma' = \gamma - \gamma_w$, where $\gamma_w = 9.8 \text{ kN/m}^3 = \text{unit weight of water}$.

For design purposes, the top 1.2 m of soil support has been discounted completely, as the soil in this zone is subject to freezing and thawing and loss of lateral resistance.

If some high mast lighting standards are to be placed in areas where grade raises are proposed, the following parameters may be applied to granular fill materials, placed and compacted to minimum 95 per cent Standard Proctor density: $\phi' = 28^\circ$, and $\gamma = 20.0 \text{ kN/m}^3$.

If high mast light standards are placed on sloping ground, the lowest ground elevation adjacent to the caisson shaft should be used for design purposes, after deducting 1.2 m for frost action. The earth pressure from the higher ground against the caisson shaft should be included in the design calculation, using $k_A = 1$ for the spring thaw condition when the soil exhibits no shear strength. The earth pressures to use on sloping ground installations is illustrated in Figure 3 in the appendix.

It is recommended that in designing the pole shaft penetration depth, the base of the shaft be founded within a natural soil deposit (any cohesive or non-cohesive glacial till, or weathered shale), regardless of the fact that the calculated shaft adhesion within any overlying fill material may be adequate to resist the estimated design loads. Hence, pole shafts should not be terminated within any filled ground.

Care should be exercised in interpolating or extrapolating soils data from one borehole to the next, keeping in mind the natural variability which can occur between boreholes and within filled ground soil strata. Once the pole locations have been finalized, we can provide services relative to the interpretation of subsurface data between boreholes.

5.4 Construction Considerations

In this investigation several of the boreholes drilled were dry upon completion. However, groundwater was encountered, or the near presence of groundwater was noted, in the following boreholes (see also Table 2, page 7): 2, 5, 11, 13, 18, 19, 24 and 25. Free water was observed in Boreholes 2, 5, 19 and 24 at depths ranging from 3.2 m to 10.7 m below existing ground or paved surface. The water level had not stabilized and therefore, the true water table elevation is not known. In Boreholes 11 and 13 the near presence of groundwater was observed at the final depth of the boreholes as a wetness. No free water accumulated in these holes. A perched water table at the 2.0 m depth was noted in Borehole 25. Groundwater seepage was noted in Borehole 18 from depths of 5.6 m to 7.8 m, below which the seepage was less prominent due to the smearing and hole wall sealing effects of the drilling procedures used.

It is important to maintain the existing dense to very dense condition of the non-cohesive natural soil strata when constructing the HML poles. For this reason, any unbalanced hydrostatic heads within caisson excavations should be balanced using water or a bentonite mud slurry, as appropriate for the soil strata being stabilized. A conservative approach is to assume that the unstabilized water levels are the lowest water levels which can be expected, and therefore, the hydrostatic head balancing in shaft excavations at or near boreholes exhibiting such groundwater conditions must commence at least 3 m above these minimum levels.

It is also recommended that as a precautionary measure caissons penetrating any saturated non-cohesive natural soil strata, or organically contaminated soft fill materials which may "ooze" into the excavation, be cased-off, to serve as a seal against intrusion of soil and groundwater.

Of the 28 boreholes drilled in this investigation, boulders or large cobbles are presumed to have been encountered in only two holes, namely in Borehole 17 at a depth of about 3 m, and in Borehole 27 within the fill material at a depth of about 1.5 m.

Hence, the majority of the fill material and natural soils can be presumed to be free of large boulders which may obstruct the advance of caisson shaft excavations using conventional rotary drilling machines. However, as a precautionary measure, it is recommended that appropriate chopping bits and tools be provided during shaft construction.

Shaft drilling into weathered and sound shale bedrock should prevent the softening and stress-relief related deterioration of the native weathered and sound shale bedrock. Once the design shaft toe or base elevation has been reached, a 75 mm (minimum, 150 mm preferred) thick concrete seal should be placed at the base to prevent further deterioration of the underlying shale bedrock.

Tremie methods of concreting should be employed where it is known that the shaft and its base will extend below the prevailing groundwater table in non-cohesive soil strata.

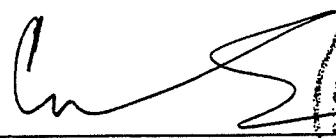
The appropriate Special Provisions for the construction of caisson foundations for high mast lighting standards should be included with the contract documents.

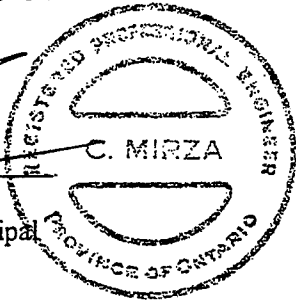
6.0 CLOSURE


The foundation investigation was performed under the overall guidance of C. Mirza, P. Eng. The field work was supervised by C. Mirza, P. Eng. and Gordon Lo, P. Eng. Drilling services were provided by Master Soil Investigation Limited, Weston, Ontario. Traffic protection services were provided by Trademark Safety Inc., Aurora, Ontario. Laboratory testing services were provided by Agra Earth and Environmental, Scarborough, Ontario.

The subsurface conditions described in this report have been determined from borings and infrequent sampling within each borehole. We assume no responsibility or liability for soil and groundwater subsurface conditions which may be different from those described at the locations drilled in this investigation. Should changed ground conditions be encountered at the locations drilled, we should be advised immediately so that we may assess the impact of such changed conditions on the design parameters used, and constructability. Furthermore, no liability is assumed for consequences resulting from the use of subsurface soils and groundwater data provided by others, or referenced in this report.

Respectfully submitted:
STRATA ENGINEERING CORP.


C. Mirza, P. Eng., Sr. Principal




Gordon Lo, P. Eng., Project Engineer

Report Distribution:

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Report Submission Date: 1999 03 14

APPENDIX

Explanation of Terms Used in Report

Figure A1 - Key Map - MTO GEOCRES Data Base

Table A1 - Summary of Subsurface Conditions

Logs of Boreholes 1 - 28 inclusive

Figures 1 and 2 - Atterberg Limits

Figure 3 - Design of HML Poles on Sloping Ground

Plans Showing Borehole Locations

Test Results - Gradation Curves
(Agra Earth & Environmental)

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 63.5 kg, 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 1" 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 - 100mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MCD. 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
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'_{v0}	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_f	kPa	REMOULDED SHEAR STRENGTH
S_r	1	SENSITIVITY = $\frac{c_u}{\tau_f}$

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						

Table A1 - Summary of Subsurface Conditions - Highway 427 High Mast Lighting

BH No.	Final Depth (m)	Fill Thick (m)	Fill Type	Topsoil (mm)	Asphalt (mm)	Granulars (mm)	Natural Soil & Bedrock Types	Depth to Bedrock (m)	Depth to Water (m)
1	5.3	1.4	sand & gravel	50	NA	Fill	weathered shale	1.4	Dry
2	6.1	0.8	clayey silt	200	NA	NP	clayey silt till/shale	1.0	~ 2.2 (ns)
3	6.1	0.9	sand & gravel	125	NA	Fill	topsoil/silty sand/clayey silt/shale	3.2	Dry
4	4.6	0.8	sand & gravel	50	NA	Fill	clayey silt till/shale	1	Dry
5	10.8	6.2	clayey silt	NA	200	400	clayey silt/fine sand/sandy silt (tills)	NE	~ 5.1 (ns)
6	14.0	9.8	clayey silt	400*	175	250	clayey silt till/silty sand	NE	Dry
7	13.0	12.5	clayey silt	150*	200	1000	probable clayey silt till	NE	Dry
8	9.2	6.0	silty sand+topsoil	NA	150	650	sand/sandy silt till	NE	Dry
9	4.7	NP	NA	125	NA	NP	clayey silt/sandy silt (tills)	NE	Dry
10	4.6	1.2	sand & gravel	75	NA	Fill	sandy silt till	NE	Dry
11	5.9	4.7	clayey silt	NA	150	Fill	clayey silt till	NE	Wet
12	6.2	0.4	clayey silt	175	NA	NP	clayey silt till/fine sand till	NE	Dry
13	7.7	2.4	clayey silt	NA	225	875	clayey silt till/sandy silt till	NE	Wet
14	6.6	1.9	clayey silt	NA	100	500	clayey silt till/sandy silt till	NE	Dry
15	7.8	0.7	clayey silt	NA	250	175	clayey silt till/fine sand till	NE	Dry
16	11.1	7.8	clayey silt	125	NA	1275	clayey silt till/silt and sand till	NE	Dry
17	9.3	2.4	clayey silt	125	NA	NP	silt-fine sand/sand (tills)	8.8	Dry
18	8.1	1.5	clayey silt	NA	175	Fill	clayey silt/silty sand/clayey silt (tills)	NE	Wet
19	6.6	1.5	clayey silt	NA	188	188	clayey silt/silty sand/clayey silt (tills)	NE	~ 6.0 (ns)
20	6.6	0.9	sand & gravel	NA	175	Fill	clayey silt/sandy silt tills	NE	Dry
21	9.4	4.9	clayey silt	125	NA	NP	clayey silt till	NE	Dry
22	8.1	4.0	clayey silt	88	NA	NP	clayey silt till	NE	Dry
23	12.3	NP	NA	NA	175	288	clayey silt till/silty sand (tills)	NE	Dry
24	12.6	1.5	clayey silt	NA	175	250	silty clay/clayey silt/silty sand (tills)	NE	~ 10.7 (ns)
25	6.6	2.4	silty sand	NA	150	Fill	clayey silt/silty sand (tills)	NE	P/S ~ 2.0
26	6.5	1.2	clayey silt	NA	150	150	clayey silt till	NE	Dry
27	8.1	3.7	clayey silt, stoney	NA	150	150	clayey silt till	NE	Dry
28	9.1	4.3	sand/clayey silt	150*	180	520	clayey silt till	NE	Dry

* topsoil encountered below fill, at surface of natural soil.

NP = Not Present; NA = Not applicable; NE = Not encountered; (ns) = not stabilized

Dry = dry upon completion; Wet = wetness noted without standing water in borehole

P/S = perched water table/seepage

RECORD OF BOREHOLE No 1

METRIC

W P 127/128-85-00 LOCATION Sta. 9+060 4.2 m Lt E/P SB Core N: 4 830 210 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 300 834 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 13 CHECKED BY C.M.

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					
103.8	Ground Surface																
0.0	50 mm Topsoil		1	SS	29	*											
	Fill																
	Brown Sand & Gravel		2	SS	23												
102.4	Compact																
1.4			3	SS	50/8	cm	102										
	Grey																
	Weathered Shale																
			4	SS	50/8	cm											
	Hard						100										
			5	SS	50/8	cm											
98.5																	
5.3	End of Borehole Auger Refusal on lime- stone bed (probable). * Borehole dry upon completion																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC

W P 127/128-85-00

LOCATION Sta. 10+297 3.3 m Rt. E/P Ramp E-S, QEW IC N: 4 830 527

ORIGINATED BY G.L.

DIST C.R. HWY 427

BOREHOLE TYPE Solid Stem Auger, Truck

E: 300 744

COMPILED BY G.P.

DATUM Geodetic

DATE 1998 09 13

CHECKED BY C.M.

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					
107.6	Ground Surface																
0.0	200 mm Topsoil - Fill - Brown clayey silt with gravel very stiff		1	SS	22												
106.8	Grey Clayey Silt		2	SS	39												
106.6	(Glacial Till) Hard		3	SS	78												
1.0			4	SS	50/8	cm											
	Grey																
	Weathered Shale		5	SS	50/12	cm											
	Hard																
101.5			6	SS	50/1	cm											
6.1	End of Borehole																
	* Water level on 1998 09 13 (not stabilized)																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

METRIC

W P 127/128-85-00 LOCATION Sta. 10+220 27.0 m Lt. E/P Ramp W-N, Queensway IC ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 830 617; E: 300 943 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 13 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

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					
113.1	Ground Surface																
0.0	125 mm Topsoil		1	SS	40	*											
	Fill - Brown sand & gravel - dense																
112.2	125 mm Topsoil		2	SS	35		112										
0.9	Silty Fine Sand	orange-brown															
	Dense grey	brown	3	SS	42												
110.7	Grey Clayey Silt (Glacial Till)																
2.4	Hard		4	SS	50/5	cm	110										
109.9																	
3.2	Grey																
	Weathered Shale		5	SS	50/2	cm											
	Hard						108										
107.0			6	SS	50/1	cm											
6.1	End of Borehole																
	* Borehole dry upon completion																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 127/128-85-00 LOCATION Sta. 10+579 4.5 m R.L. E/P Ramp QEW W - 427 N ORIGINATED BY G.L.
DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 830 712; E: 300 773 COMPILED BY G.P.
DATUM Geodetic DATE 1998 09 13 CHECKED BY C.M.

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					
111.5	Ground Surface															
0.0	50 mm Topsoil		1	SS	29	*										
	Fill - Brown sand & gravel, compact															
110.7			2	SS	50/8	cm										
110.5	Grey Clayey Silt, Hard															
1.0	(Glacial Till)		3	SS	50/10	cm										
	Grey weathered Shale															
	Hard		4	SS	50/8	cm										
106.9			5	SS	50/1	cm										
4.6	End of Borehole															
	* Borehole dry upon completion															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5

METRIC

W P 127/128-85-00 LOCATION Sta. 9+900 3.0 m Rt. CL Med. N: 4 830 940; E: 300 568 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

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					
121.4	Paved Shoulder																GR SA SI CL
0.0	200 mm Asphalt																
120.8	Sand and Gravel		1	AS	-												
0.6	occasional sand & gravel seams		2	SS	15												
	Fill		3	SS	11												
	Grey clayey silt with shale fragments		4	SS	16												
	Stiff - Very Stiff																
	brown		5	SS	26												
	mixed with sand & gravel																
115.2			6	SS	13												
6.2	Brown Clayey Silt (Glacial Till)																
114.2	Stiff																
7.2	Brown Fine Sand		7	SS	50/15	cm											
	Very Dense																
112.4			8	SS	50/10	cm											3 22 68 7
9.0	Grey Sandy Silt																
111.2	Very Dense																
10.2	Grey Clayey Silt with shale (Glacial Till)		9	SS	78/15	cm											
110.6																	
10.8	End of Borehole																
	* Water Level on 1998 09 20 (not stabilized)																

+3, x5: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

METRIC

W P 127/128-85-00 LOCATION Sta. 10+200 2.9 m Rt. CL Med. N: 4 831 226; E: 300 475 ORIGINATED BY G.L.
DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck COMPILED BY G.P.
DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

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	VALUES		20	40	60	80	100					
126.9	Paved Shoulder															
0.0	175 mm Asphalt															
	250 mm Sand & Gravel															
	Hard		1	SS	39											
			2	SS	13											
	Fill															
	Brown clayey silt some sand, gravel		3	SS	9											
			4	SS	13											
	Stiff															
			5	SS	10											
			6	SS	13											
			7	SS	8											
117.1	400 mm mixed w/ peat															
9.8	Topsoil		8	SS	31											
	Brown															
	Clayey Silt with sand, some gravel (Glacial Till)															
	Hard		9	SS	75											
	grey															
113.0																
13.9	Grey Silty Sand		10	SS	50/1	cm										13 43 36 8
112.9	V Dense															
14.0	End of Borehole															
	* Borehole dry upon completion															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 127/128-85-00 LOCATION Stra. 10+500 1.6 m Rt. Cl Med. N: 4 831 511; E: 300 382 ORIGINATED BY C.M.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.L.

OFFICE REPORT ON SOIL EXPLORATION

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								WATER CONTENT (%)		
								SHEAR STRENGTH kPa								W _p W W _L		
							○ UNCONFINED + FIELD VANE						GR SA SI CL					
							● QUICK TRIAXIAL × LAB VANE											
128.6	Paved Shoulder																	
0.0	200 mm Asphalt					*												
	Brown Sand and Gravel						128											
127.4																		
1.2	Fill		1	SS	31													
							126											
	Brown to Grey clayey silt		2	SS	19													
	Stiff - Very Stiff						124											
			3	SS	17													
	occasional pieces of brick, egg shells, organic inclusions						122											
			4	SS	7													
	Random shale fragments throughout																	
			5	SS	25		120											
119.2	mixed with topsoil		6	SS	17													
9.4	Black Organic Sand						118											
117.5			7	SS	7													
11.1	End of Borehole Start Dynamic Cone penetration test Probable Fill																	
116.1																		
12.5																		
115.6	Probable Clayey Silt																	
13.0	End of Cone Test Probable Glacial Till																	
	* Borehole dry upon completion																	

+3, x5: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

METRIC

W P 127/128-85-00 LOCATION Sta. 10+800 2.0 m Rt. CL Med. N: 4 831 796; E: 300 291
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck
 DATUM Geodetic DATE 1998 09 20
 ORIGINATED BY C.M.
 COMPILED BY G.P.
 CHECKED BY G.L.

OFFICE REPORT ON SOIL EXPLORATION

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					
127.4	Paved Shoulder												
0.0	150 mm Asphalt												
	150 mm crushed gravel												
126.6	Sand & Gravel		1	SS	22								
0.8	Fill												
	Brown silt to sandy silt		2	SS	3								
	Very Loose - Compact												
124.0	Topsoil		3	SS	14								
3.4	Heterogeneous mixture sand, gravel and topsoil		4	SS	31								
	Compact- Dense												
121.4	Coarse Sand well-graded, trace silt		5	SS	24								
6.0	Brown												
	Compact		6	SS	50/15	cm							
119.8	Grey												
7.6	Sandy Silt - Silty Sand (Glacial Till)												
	Very Dense		7	SS	100/40	cm							
118.2	End of Borehole												
9.2	* Borehole dry upon completion												

+3, x5: Numbers refer to Sensitivity
 20
 15 5 (%) STRAIN AT FAILURE
 10



RECORD OF BOREHOLE No 9

METRIC

W P 127/128-85-00 LOCATION Stra. 10+537 11.0 m Lt. E/P Ramp. S-W, Dundas St. TC ORIGINATED BY G.L.
DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 832 084; E: 300 365 COMPILED BY G.P.
DATUM Geodetic DATE 1998 09 19 CHECKED BY C.M.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p W W _L					
124.3	Ground Surface												
0.0	125 mm Topsoil	1	SS	24	*	124							
	Brown Clayey Silt (Glacial Till)	2	SS	50/8	cm								
	Hard												
	grey	3	SS	50/12	cm								
	with sand & gravel seams												
121.9						122							
2.4	Grey	4	SS	80/15	cm								
	Sandy Silt, with gravel (Glacial Till)												
	Very Dense					120							
119.6		5	SS	100/12	cm								
4.7	End of Borehole												
	* Borehole dry upon completion												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

METRIC

W P 127/128-85-00 LOCATION Sta. 10+183 8.0 m Lt. E/P Ramp Dundas St. E - Hwy 427 S. ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 832 050; E: 300 075 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 19 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L	
121.9	Ground Surface														
0.0	75 mm Topsoil		1	SS	13/15 cm										
	Fill - Brown sand and gravel		2	SS	50/15 cm										
120.7	Very Dense														
1.2	Grey		3	SS	62	120									23.0
	Sandy Silt with gravel														
	(Glacial Till)														
	slightly plastic		4	SS	78/15 cm										
	Very Dense					118									
117.3	End of Borehole		5	SS	60/8 cm										
4.6	* Borehole dry upon completion														

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 11

METRIC

W P 127/128-85-00 LOCATION Sta. 11+200 2.1 m Rt. CL Med. N: 4 832 180; E: 300 178 ORIGINATED BY G.M.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.L.

OFFICE REPORT ON SOIL EXPLORATION

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					
128.8	Paved Shoulder																
0.0	150 mm Asphalt																
	Crushed Gravel																
	Sand & Gravel (Fill)		1	SS	8		128							o			
127.6	Greyish Brown																
1.2	Clayey Silt (Fill)		2	SS	17									10			
	occ. sand seams & stones						126										
	Firm - V. Stiff		3	SS	13									o		21.6	
	grey																
124.1	occ. sand seams																
4.7	Clayey Silt with sand, occ. gravel (Glacial Till)		4	SS	75/22	cm	124							o		22.8	
	Hard		5	SS	100									o		23.1	
122.9	End of Borehole																
5.9	* Borehole dry upon completion, but wet auger tip upon withdrawal from bottom of hole.																

+3, x5: Numbers refer to
Sensitivity.

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 12

METRIC

W P 127/128-85-00 LOCATION Sta. 11+700 8.9 m Rt. E/P SB Collector N: 4 832 636 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 967 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 13 CHECKED BY C.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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				W _p	W	W _L		
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
129.5	Ground Surface												10 20 30			
0.0	175 mm Topsoil		1A	SS	12	*								22.4		
129.1	Fill - light brown clayey silt, stiff		1	SS	67											
0.4			2	SS	50/2	cm										
	Brown fissured Clayey Silt, some gravel (Glacial Till) Hard															
127.1														11 49 35 5		
2.4	Grey Silty Fine Sand some gravel, trace clay (Glacial Till) Very Dense		3	SS	50/10	cm										
			4	SS	50/10	cm										
123.3			5	SS	50/15	cm										
6.2	End of Borehole * Borehole dry upon completion															

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 13

METRIC

W P 127/128-85-00 LOCATION Sta. 11+811 35 m Rt (Gore Area) Cl. Med. N: 4 832 779 ORIGINATED BY G.L.
DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 300 055 COMPILED BY G.P.
DATUM Geodetic DATE 1998 09 13 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

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					
131.2	Gore Area Pavement																
0.0	225 mm Asphalt					*											
	Sand and Gravel																
	Compact		1	SS	19												
130.1	Fill brown																
1.1	clayey silt grey		2	SS	7												
	Firm with gravel																
128.8	Brown																
2.4	Clayey Silt with some sand, gravel (Glacial Till)		3	SS	42										22.3		
	Hard																
	grey		4	SS	50/15	cm									22.5		
126.0	Grey																
5.2	Sandy Silt with gravel (Glacial Till)		5	SS	50/8	cm											
	Very Dense																
123.5	End of Borehole		6	SS	50/14	cm											
7.7	* Borehole wet upon completion - seepage between 4.6 and 6.7 m.																

+3, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 14

METRIC

W P 127/128-85-00 LOCATION Sta. 12+300 1.9 m Rt. CL Med. N: 4 833 245 ORIGINATED BY C.M.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 905 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.L.

OFFICE REPORT ON SOIL EXPLORATION

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					
134.2	Paved Shoulder																GR SA SI CL
0.0	100 mm Asphalt						134										
133.6	Crushed Gravel																
0.6	Sand and Gravel		1	SS	9												3 40 37 20
	Fill																
	Brown clayey silt																
132.3	Stiff		2	SS	18												
1.9	brown stiff						132										
	Grey Clayey Silt, some sand, occ. gravel (Glacial Till)		3	SS	50/8 cm												
	Hard		4	SS	80/28 cm		130										
128.2	Grey Sandy Silt - Silty Sand (Glacial Till) V. Dense		5	SS	100		128										
6.0																	
127.6	End of Borehole																
6.6	* Borehole dry upon completion																

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 15

METRIC

W P 127/128-85-00 LOCATION Sta. 12+650 2.8 m Rt. CL Med. N: 4 833 582 ORIGINATED BY G.L.
DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 811 COMPILED BY G.P.
DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

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					
137.5	Paved Shoulder															
0.0	250 mm Asphalt					*										
136.8	175 mm Crushed Gravel															
0.7	Fill - brown clayey silt		1	SS	18										21.9	
	Brown Clayey Silt, with gravel (Glacial Till)		2	SS	41											
	V. Stiff - Hard		3	SS	21											
133.5	Grey Silt and Fine Sand with gravel (Glacial Till)		4	SS	60/15	cm										
4.0	Very Dense		5	SS	60/15	cm										5 44 45 6
129.7	End of Borehole		6	SS	87/15	cm										
7.8	* Borehole dry upon completion															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16

METRIC

W P 127/128-85-00 LOCATION Sta. 10+155 19.0 m Rt. E/P Ramp W-N Burnhamthorpe Rd IC ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 833 942 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 19 E: 299 791 CHECKED BY C.M.

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									WATER CONTENT (%)	10 20 30	
								SHEAR STRENGTH kPa											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 17

METRIC

W P 127/128-85-00 LOCATION Sta. 13+191 21.0 m t.t. E/P SB Collector N: 4 834 071 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 587 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 19 CHECKED BY C.M.


OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y 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	W _p	W	W _L		
142.0	Ground Surface															
0.0	125 mm Topsoil		1	SS	18	*										
	Fill															
	Brown clayey silt with sand		2	SS	16											
	Firm - V. Stiff															
	mixed with wood chips		3	SS	7							o			21.8	8 35 37 20
139.6																
2.4	Brown Silt and Fine Sand with fine gravel, trace clay, occ. stones		4	SS	65/18	cm**						o				11 41 39 9
	Compact		5	SS	17							o	I			
136.7																
5.3	Brown Fine Sand		6	SS	15							o				
	Compact															
134.2																
7.8	V. Dense brown Silt and Fine Sand, with fine gravel		7	SS	103							o			22.5	
133.2	(Glacial Till) grey															
8.8	Grey Clayey Silt Fill															
132.7	shale pieces, Hard		8	SS	100/2	cm										
9.3	End of Borehole															
	* Borehole dry upon completion															
	** N value not representative of general soil conditions due to presence of cobble or boulder,															

RECORD OF BOREHOLE No 18

METRIC

W P 127/128-85-00 LOCATION Sta. 13+200 2.8 m Rt. CL Med. N: 4 834 108 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 646 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.M.

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
140.9	Paved Shoulder																
0.0	175 mm Asphalt					*	140										
	250 mm Crushed Gravel																
	Fill - brown clayey silt mixed with topsoil very stiff		1	SS	26												
139.4	Brown sand & gravel																
1.5	Brown Clayey Silt fissured (Glacial Till) occ. sand layers V. Stiff - Hard		2	SS	25		138										
137.4			3	SS	35												
3.5	Brown Silty Sand, trace gravel and clay (Glacial Till) Very Dense		4	SS	50/10	cm	136										
			5	SS	50/9	cm											
133.1	Grey Clayey Silt (Glacial Till) Hard		6	SS	85		134										
8.1	End of Borehole * Borehole wet upon completion - seepage between 5.6 and 7.8 m.																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 19

METRIC

W P 127/128-85-00 LOCATION Sta. 13+600 2.0 m Rt. CL Med. N: 4 834 486 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 520 COMPILED BY C.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _p	W	W _L		
142.9	Paved Shoulder															
0.0	188 mm Asphalt															
	188 mm Crushed Gravel															
	Fill															
	Brown clayey silt					142										
141.4																
1.5	Stiff - V. Stiff		1	SS	17											
	Brown															
	Clayey Silt to															
	Silt															
140.3	(Glacial Till) ---					140										
2.6	Hard		2	SS	54											
138.9																
4.0	Grey					138										
	Silty Sand		3	SS	50/12											
	(Glacial Till)															
	Very Dense															
136.6	Grey Clayey Silt															
	(Glacial Till) Hard		4	SS	45											
136.3																
6.6	End of Borehole															
	* Water Level on															
	1998 09 20															
	(not stabilized)															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 20

METRIC

W P 127/128-85-00 LOCATION Sta. 13+900 2.3 m Rt. CL Med. N: 4 834 769 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 419 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

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					
144.5	Paved Shoulder																GR SA SI CL
0.0	175 mm Asphalt					*	144										
	263 mm Crushed Gravel																
143.6	Brown fine sand Loose																
0.9	Brown Clayey Silt fissured (Glacial Till)		1	SS	11												
	V. Stiff - Hard		2	SS	45		142										
	grey		3	SS	48												
			4	SS	50		140										
138.4																	
6.1	Sandy Silt Dense	Brown	5	SS	49		138										1 19 74 6
137.9		Grey															
6.6	End of Borehole																
	* Borehole dry upon completion																

+³, x⁵: Numbers refer to Sensitivity
 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 21

METRIC

W P 127/128-85-00 LOCATION Sta. 10+805 9.0 m Rt. E/P Ramp N-E Rathburn Rd. IC ORIGINATED BY G.I.
 DIST G.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 834 977 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 19 E: 299 438 CHECKED BY C.M.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	VALUES		20	40	60	80	100	W _p	W	W _L		
150.7	Ground Surface															GR SA SI CL
0.0	125 mm Topsoil		1	SS	23	*										
	Fill		2	SS	20											
	Brown clayey silt occ. organics		3	SS	16											
	Firm - V. Stiff															
	grey		4	SS	8											
	with decayed wood															
145.8			5	SS	18											
4.9	Brown Clayey Silt with sand (Glacial Till) V. Stiff - Hard		6	SS	95											2 32 47 19
	grey		7	SS	50/10 cm											
141.3			8	SS	50/12 cm											
9.4	End of Borehole * Borehole dry upon completion															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity
















20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 22

METRIC

W P 127/128-85-00 LOCATION Sta. 10+088 10.5 m Rt. E/P Ramp E-S Rathburn Rd. IC ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 834 923 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 19 E: 299 257 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

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			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
150.0	Ground Surface																
0.0	88 mm Topsoil		1	SS	33	*	148									22.6	
	Fill																
	clayey silt to brown		2	SS	28												
	silty clay																
	occ. gravel		3	SS	10												
	grey																
	Stiff - Hard																
	with organics		4	SS	12		146										
146.0																	
4.0	Brown																
	Clayey Silt		5	SS	51												
	occ. fissures																
	(Glacial Till)																
	Hard		6	SS	63		144										
	grey																
141.9			7	SS	37		142										
8.1	End of Borehole																
	* Borehole dry upon completion																

+³, x⁵: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 23

METRIC

W P 127/128-85-00 LOCATION Sta. 14+300 2.4 m Rt. CL Med. N: 4 835 144 ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 278 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

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				
146.5	Paved Shoulder														
0.0	175 mm Asphalt														
	288 mm Crushed Gravel														
	Brown Clayey Silt, fissured (Glacial Till)		1	SS	19										
			2	SS	53										
	Stiff to Hard														
			3	SS	58										
	grey														
			4	SS	25										
	Stiff - V. Stiff														
			5	SS	18										
			6	SS	12										
	with wet sand seams														
			7	SS	16										
	hard														
			8	SS	93/28 cm										
134.8	Grey Silty Sand (Glacial Till)														
11.7	Very Dense														
134.2			9	SS	61/15 cm										
12.3	End of Borehole														
	* Borehole dry upon completion														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 24

METRIC

W P 127/128-85-00 LOCATION Sta. 14+600 2.4 m Rt. CL Med. N: 4 835 428 ORIGINATED BY G.L.
DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 180 COMPILED BY G.P.
DATUM Geodetic DATE 1998 09 20 CHECKED BY C.M.

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
147.0	Paved Shoulder													
0.0	175 mm Asphalt													
	250 mm Crushed Gravel													
	Fill - clayey silt brown, very stiff		1	SS	22		146							
145.5	125 mm Asphalt													
	Fill - silty sand													
1.5			2	SS	16									
	Brown													
	Silty Clay													
	(Glacial Till)		3	SS	29		144							
	Stiff - V. Stiff													
			4	SS	18		142							20.0
141.5														
5.5			5	SS	14									23.2
	Grey													
	Clayey Silt													
	(Glacial Till)													
	Stiff - V. Stiff		6	SS	27		140							
	with													
	gravel													
	hard		7	SS	103		138							
136.3														
10.7	Grey Silty Sand trace clay		8	SS	43		136							
	Dense - V. Dense													
134.4			9	SS	66									1 69 25 5
12.6	End of Borehole													
	* Water Level on 1998 09 20 (not stablized)													

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 25

METRIC

W P 127/128-85-00 LOCATION Sta. 14+875 1.8 m Rt. CL Med. N: 4 835 691 ORIGINATED BY C.M.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 098 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT 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		
145.7	Paved Shoulder															
0.0	150 mm Asphalt					*										
	150 mm Crushed Gravel															
	Fill															
	brown silty sand with clay		1	SS	7	**										7 58 23 12
143.3	Loose															
2.4	Grey Clayey Silt (Glacial Till)		2	SS	80										23.4	
	Hard		3	SS	100/22 cm										23.8	
140.1	Grey Silty Sand (Glacial Till)															
5.6	Very Dense		4	SS	100											3 84 (13)
139.1	End of Borehole															
6.6	* Borehole dry upon completion - seepage at 2.0 m depth. ** Perched water level on 1998 09 20															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 26

METRIC

W P 127/128-85-00 LOCATION Sta. 15+200 2.0 m Rt. CL Med. N: 4 836 002 ORIGINATED BY C.M.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 299 006 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.L.

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			SHEAR STRENGTH kPa										WATER CONTENT (%)		
146.2	Paved Shoulder																			
0.0	150 mm Asphalt					*	146													
	150 mm Crushed Gravel																			
	Fill - clayey silt mixed with topsoil																			
145.0																				
1.2																				
	Brown		1	SS	45															
	Clayey Silt (Glacial Till)						144													
	Hard		2	SS	49															
	occasional silt and fine sand seams		3	SS	27		142									23.2				
	grey																			
139.7			4	SS	60/22	cm	140									22.9				
6.5	End of Borehole																			
	* Borehole dry upon completion																			

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 27

METRIC

W P 127/128-85-00 LOCATION Sta. 15+500 2.0 m Rt. CL Med. N: 4 836 289 ORIGINATED BY C.M.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck E: 298 918 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 20 CHECKED BY G.L.

OFFICE REPORT ON SOIL EXPLORATION

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					
148.7	Paved Shoulder															
0.0	150 mm Asphalt															
148.1	150 mm Crushed Gravel															
0.6	Sand and Gravel					*										
	Fill															
	brown clayey silt		1	SS	**											
	occ. boulders or cobbles															
	some soft areas or zones		2	SS	16											
145.0																
3.7	Brown Clayey Silt (Glacial Till)		3	SS	45											
	Hard		4	SS	40											
	grey															
140.6			5	SS	35											
8.1	End of Borehole															
	* Borehole dry upon completion															
	** N value not representative of prevailing ground condition due to encounter with cobble or boulder.															

RECORD OF BOREHOLE No 28

METRIC

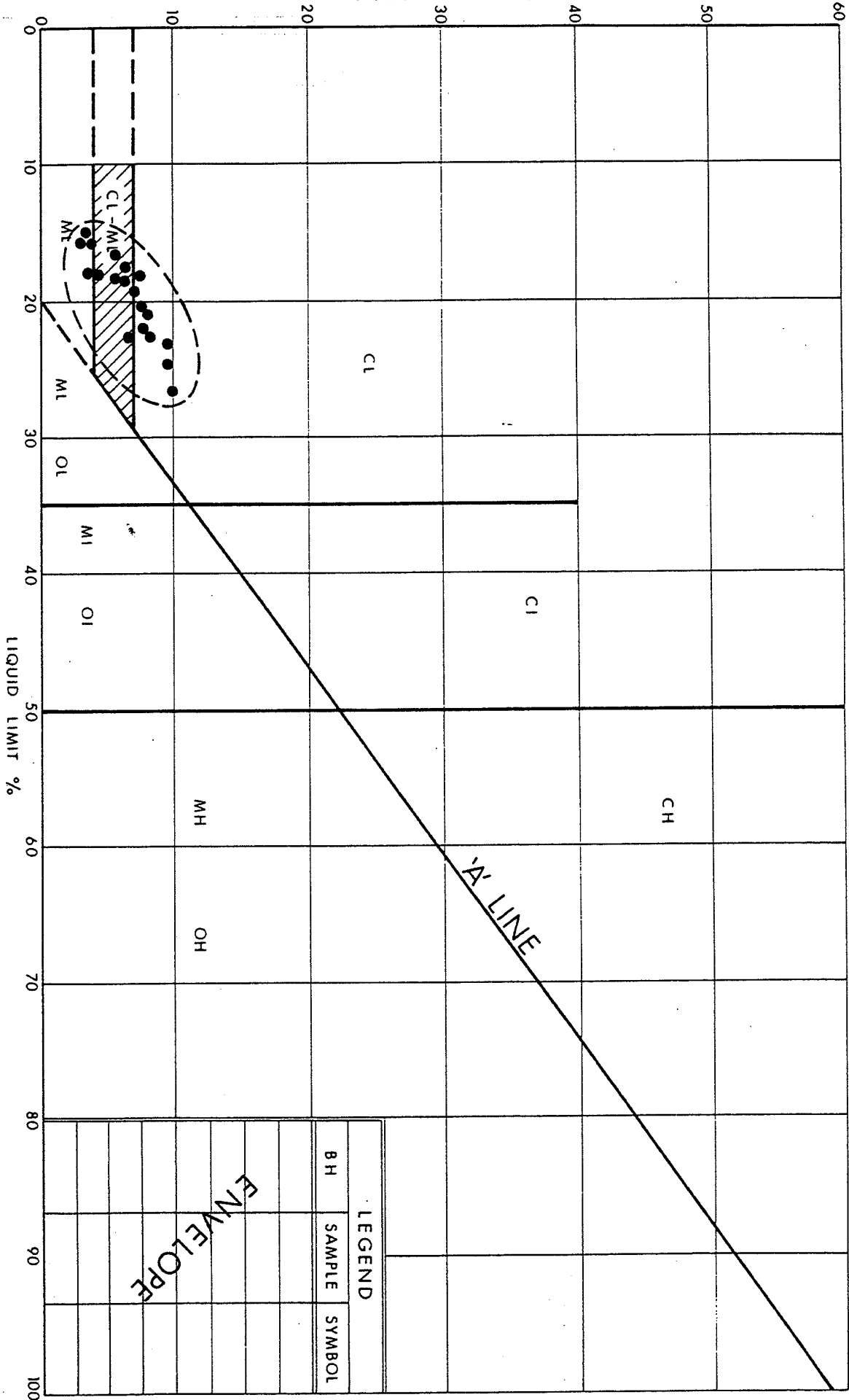
W P 127/128-85-00 LOCATION Ramp 401 West - 427 South E/P Outer Shoulder ORIGINATED BY G.L.
 DIST C.R. HWY 427 BOREHOLE TYPE Solid Stem Auger, Truck N: 4 836 738 COMPILED BY G.P.
 DATUM Geodetic DATE 1998 09 13 E: 298 192 CHECKED BY C.M.

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					
158.2	Paved Shoulder																
0.0	180 mm Asphalt					*	158										
157.5	520 mm Crushed Gravel																
0.7	Fill Brown fine sand		1	SS	35												
	dense		2	SS	44		156										
	dense		3	SS	42												
	sand and silt		4	SS	28												
154.5	compact																
3.7	clayey silt						154										
153.9	150 mm Topsoil		5	SS	31												
4.3	Brown Clayey Silt with sand, Hard		6	SS	50/10	cm	152										
	with gravel																
	(Glacial Till)																
	grey		7	SS	54		150									21.6	
149.1	End of Borehole - refusal to further auger progress																
9.1	* Borehole dry upon completion																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Ministry of
Transportation

Ontario

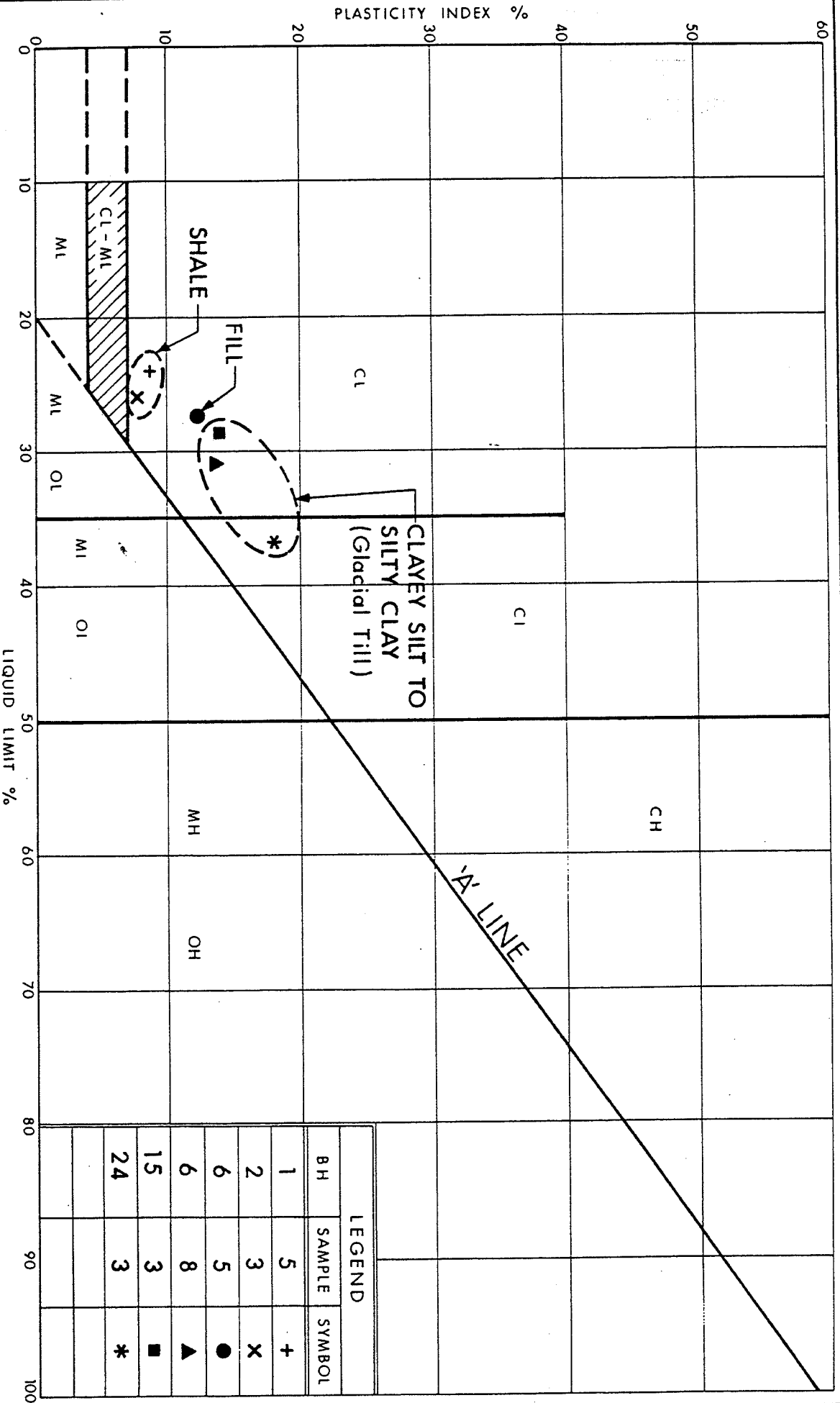
PLASTICITY CHART

CLAYEY SILT TO SILT (Glacial Till)

FIG No 1

W P 127/128-85-00

Hwy 427 H.M.L.



PLASTICITY CHART

FIG No 2

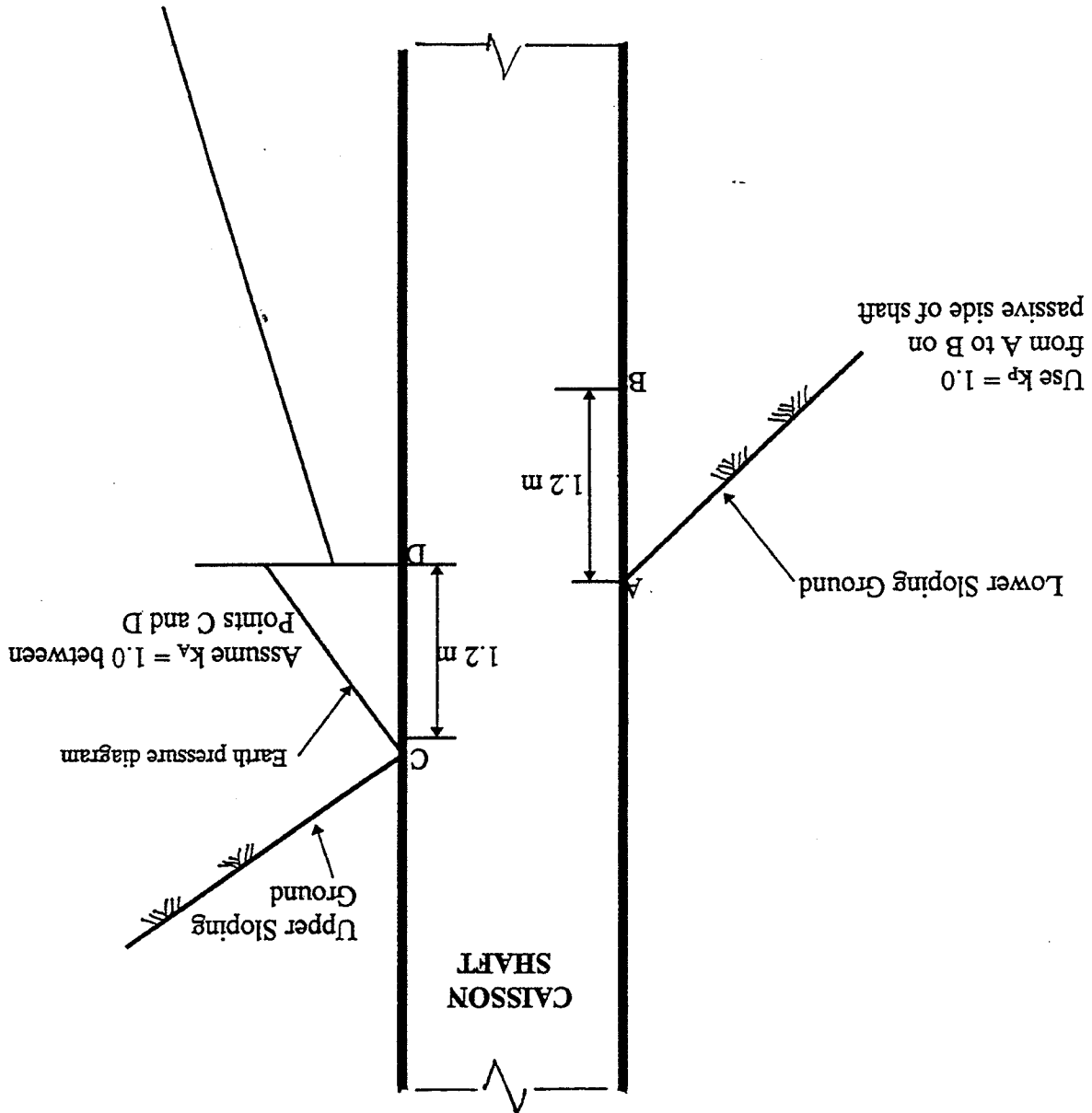
W P 127/128-85-00

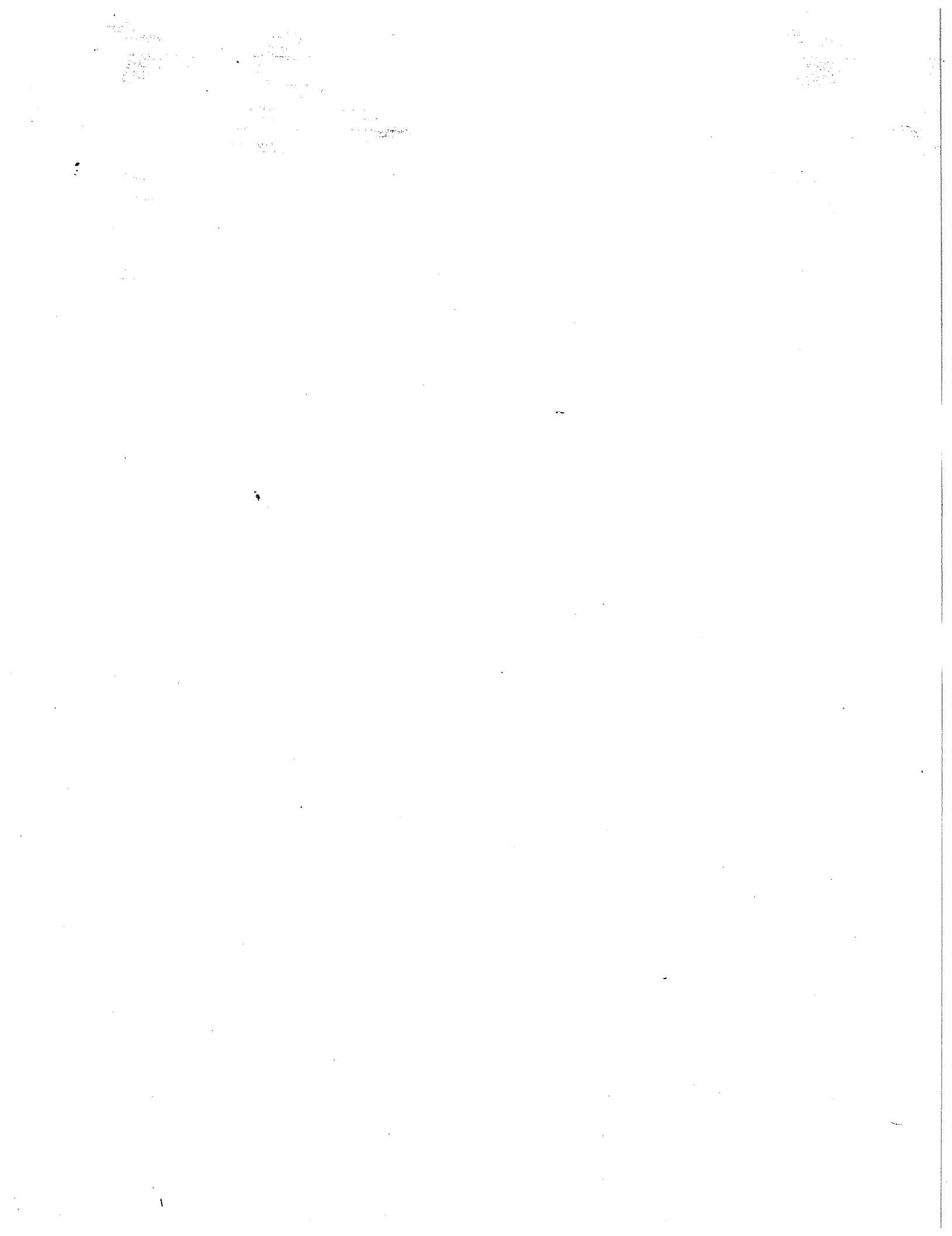
Hwy 427 H.M.L.

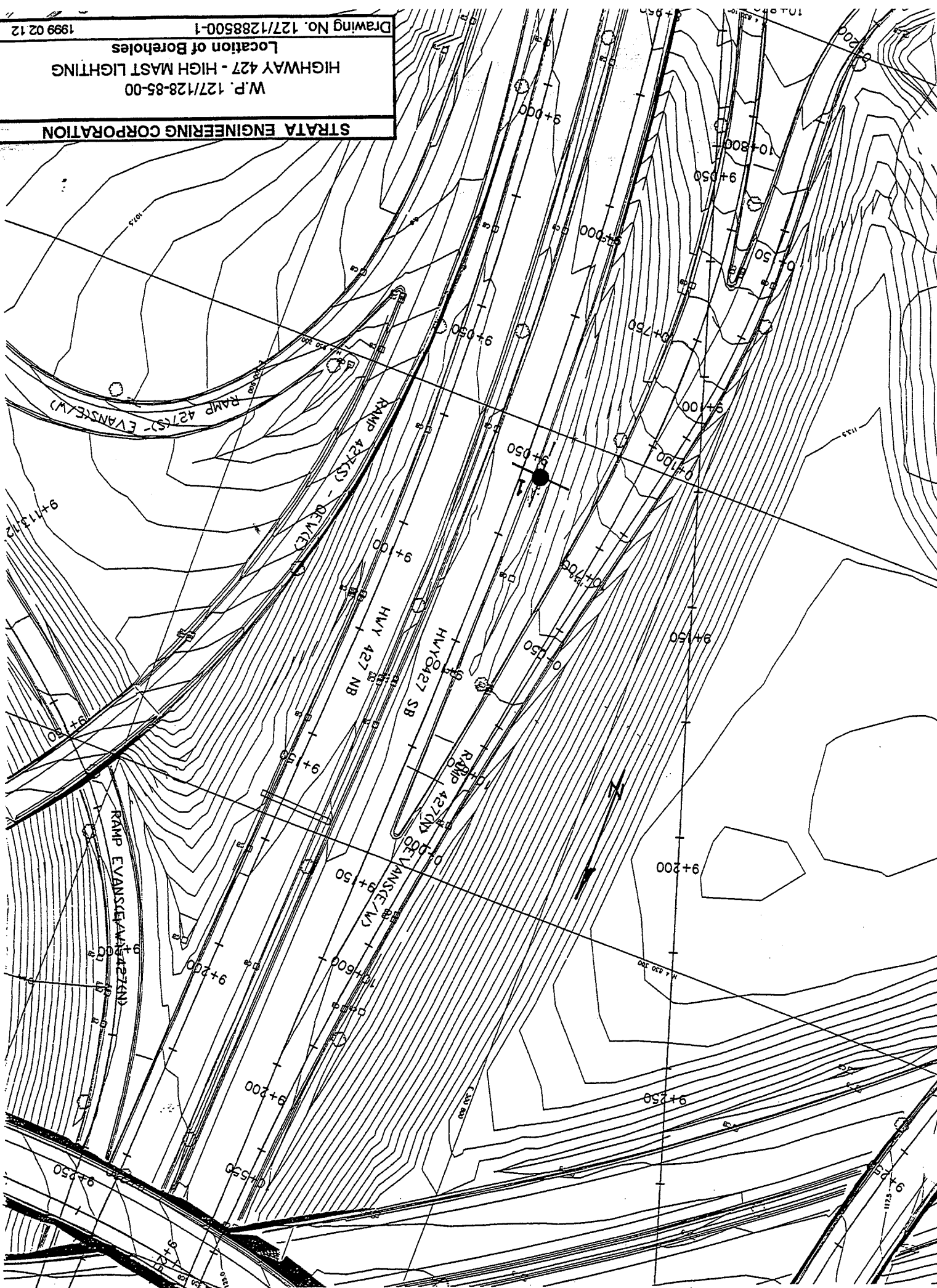
[This is an illustrative drawing only, not to scale, for use as a guide during detailed design.]

Figure 3 - Design of HML Poles on Sloping Ground

Use ϕ' and δ' (and δ , as appropriate) to compute lateral earth pressures below levels B and D. δ' is the angle of wall friction between concrete and soil.



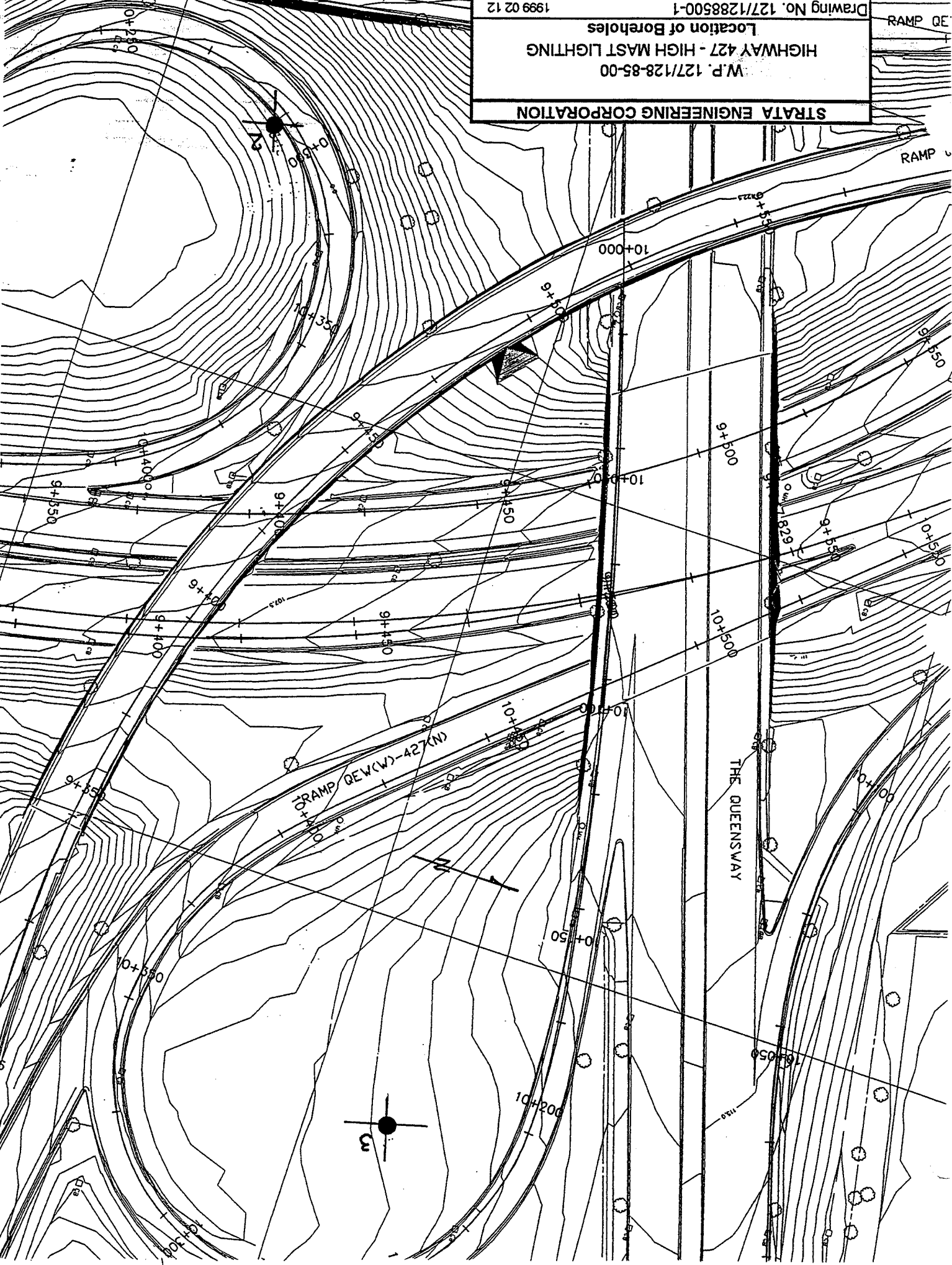




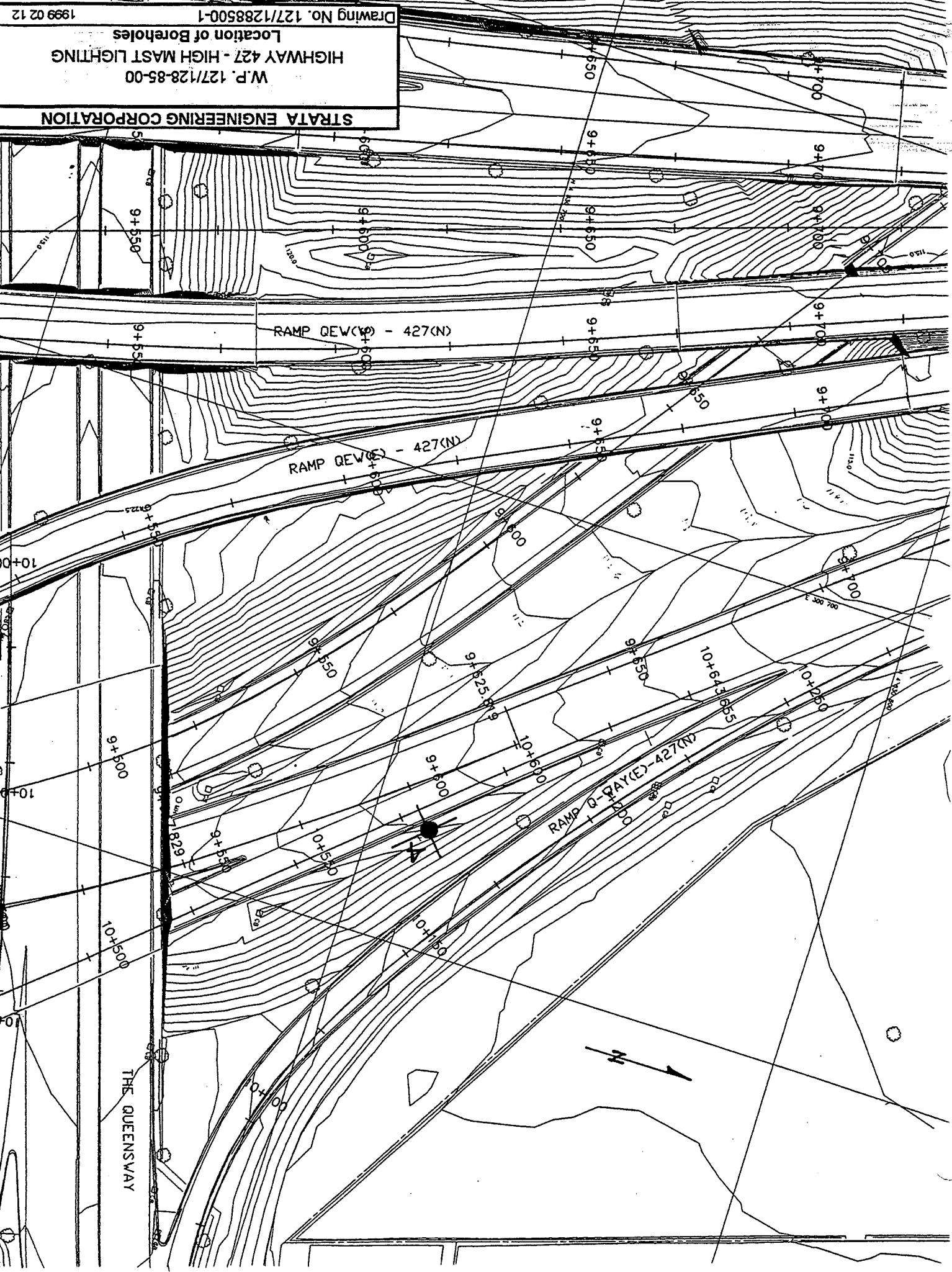
Drawing No. 127/1288500-1
1999 02 12

HIGHWAY 427 - HIGH MAST LIGHTING
W.P. 127/128-85-00
Location of Boreholes

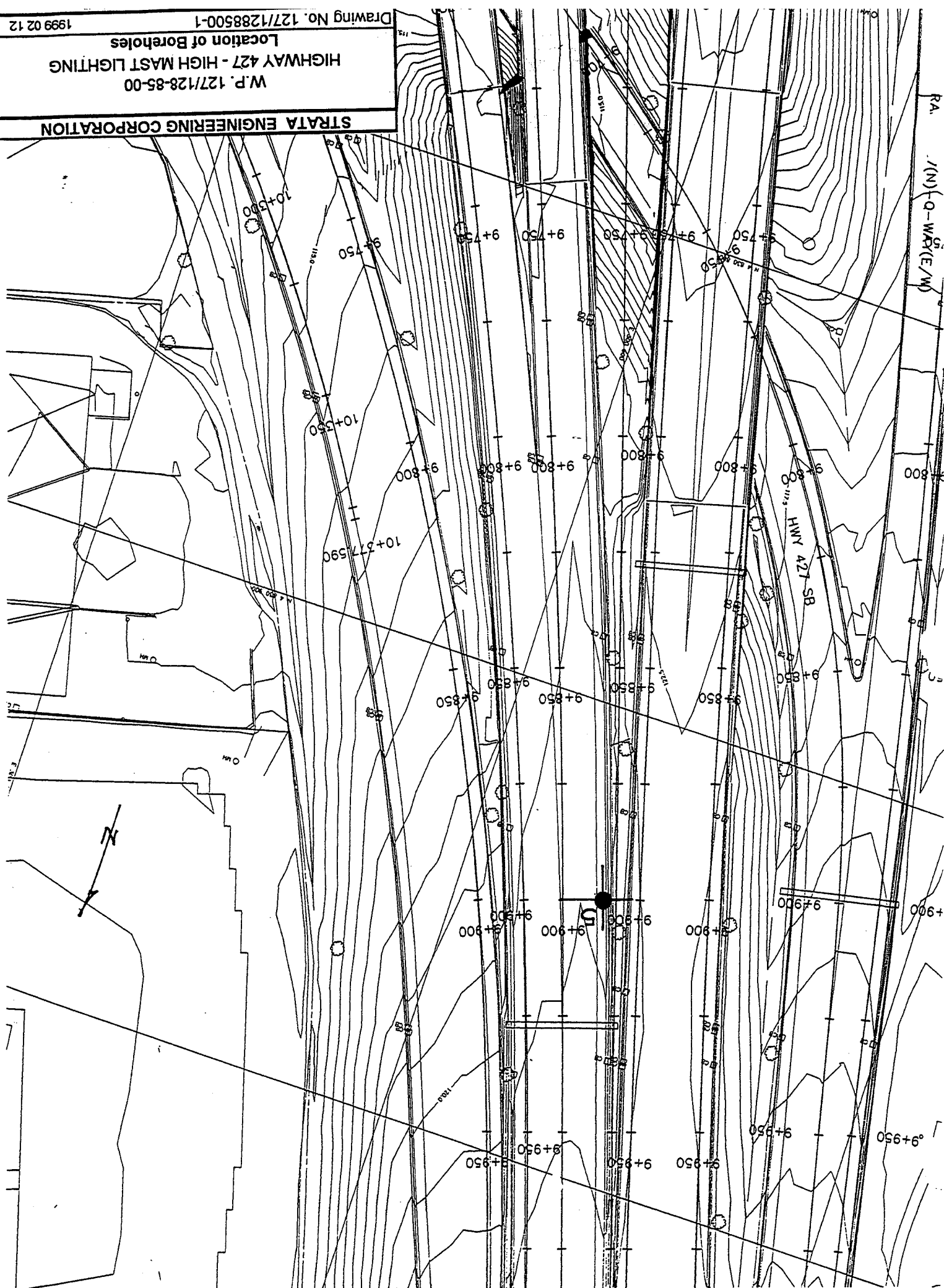
STRATA ENGINEERING CORPORATION

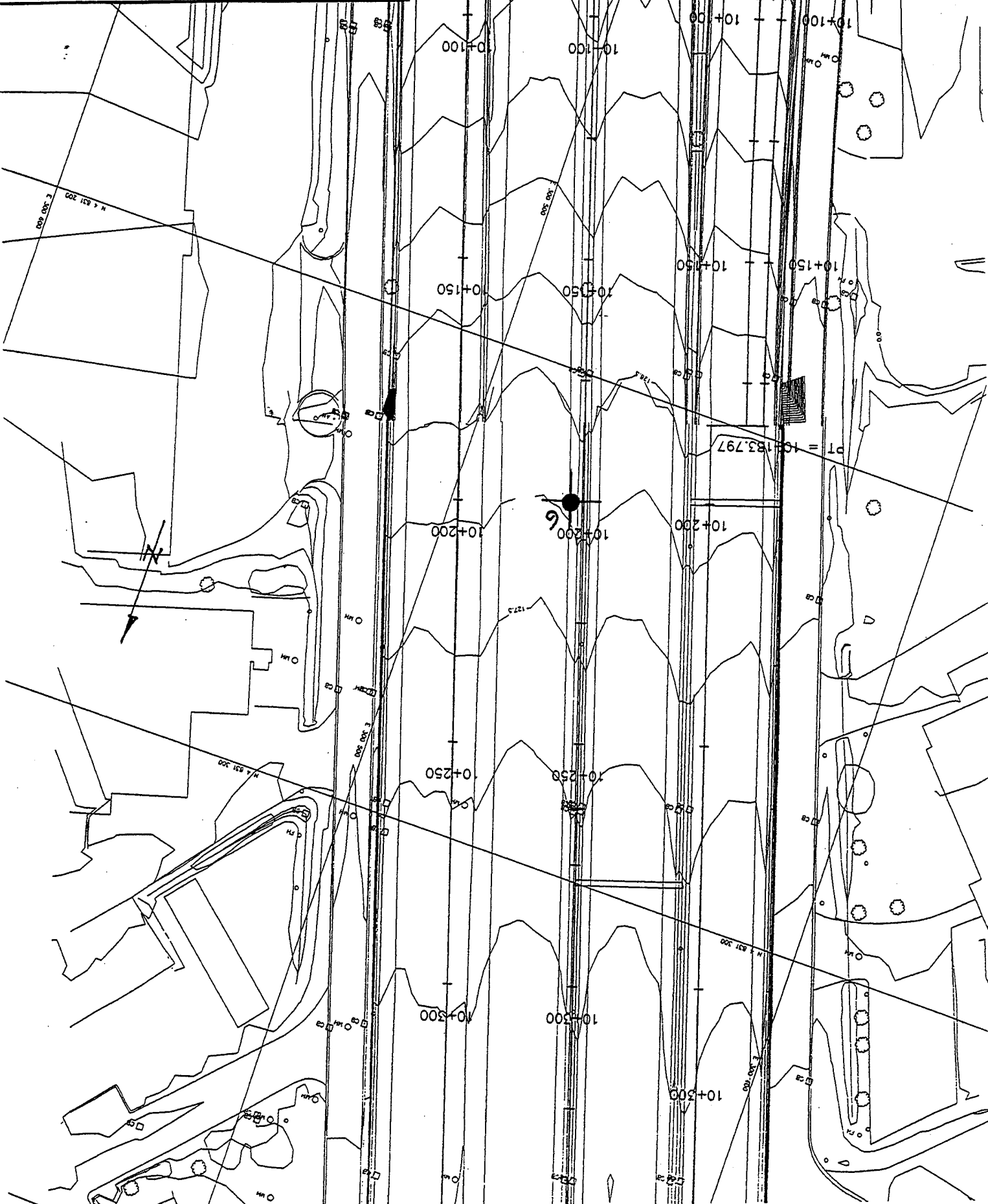


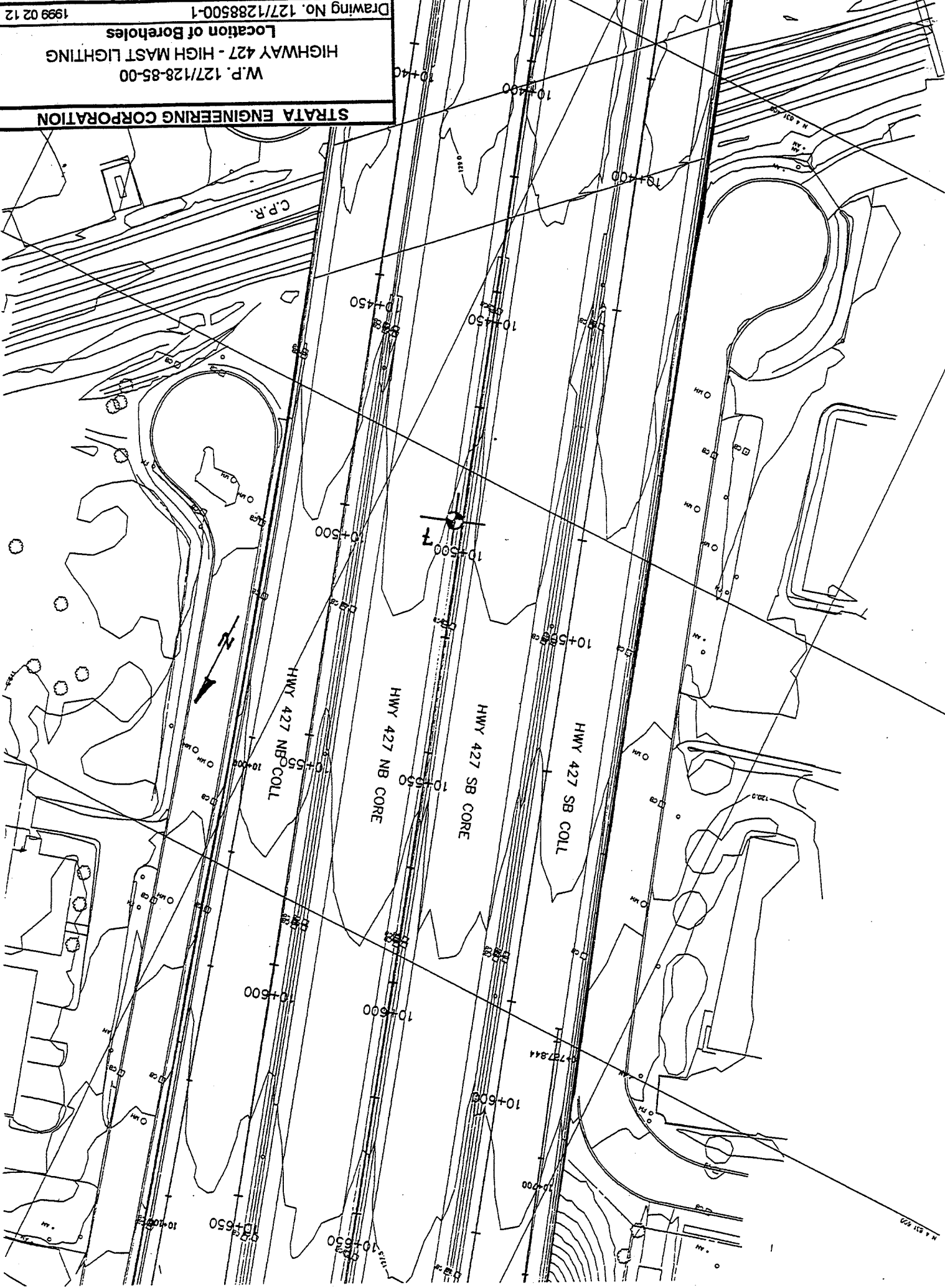
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W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes
STRATA ENGINEERING CORPORATION



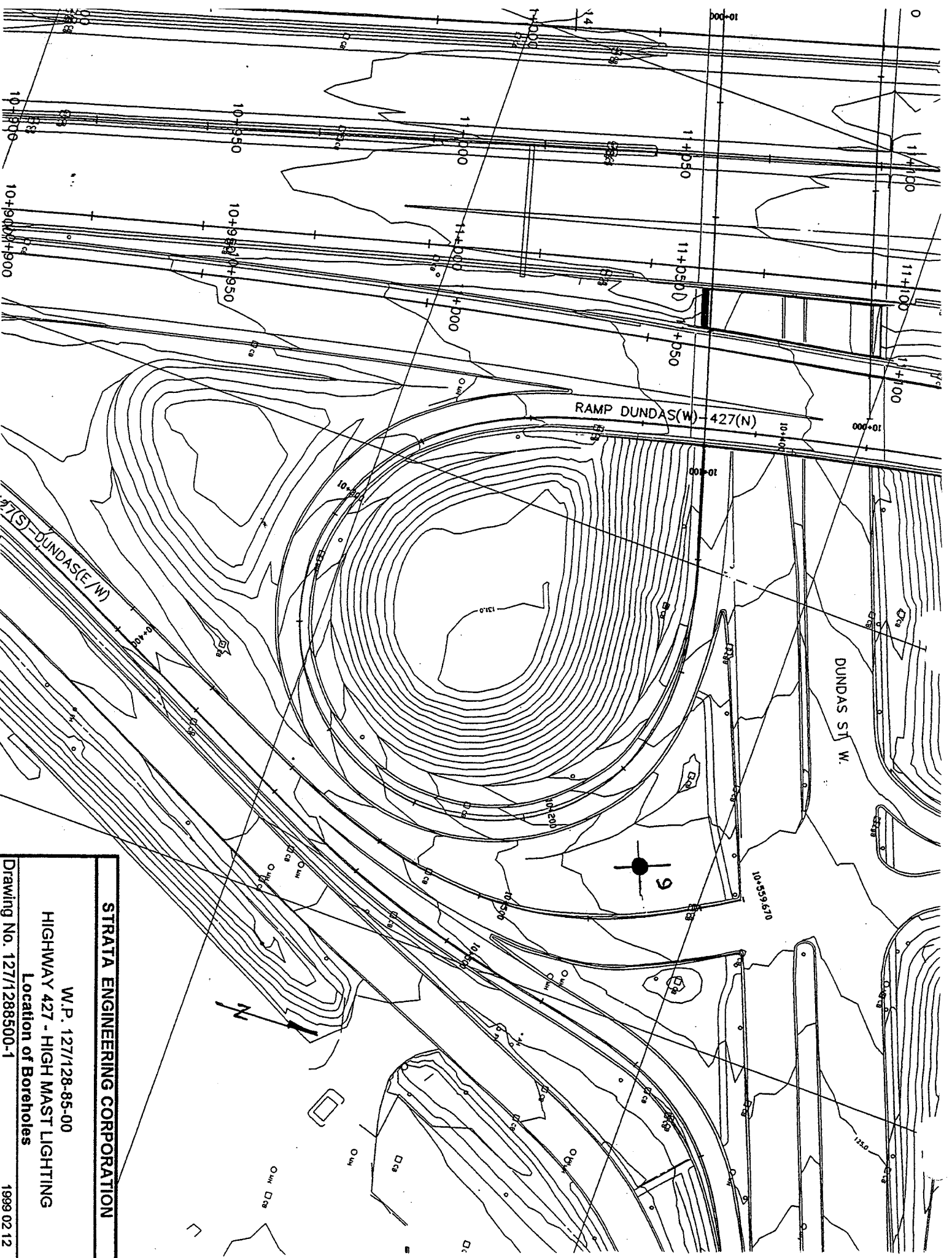
STRATA ENGINEERING CORPORATION



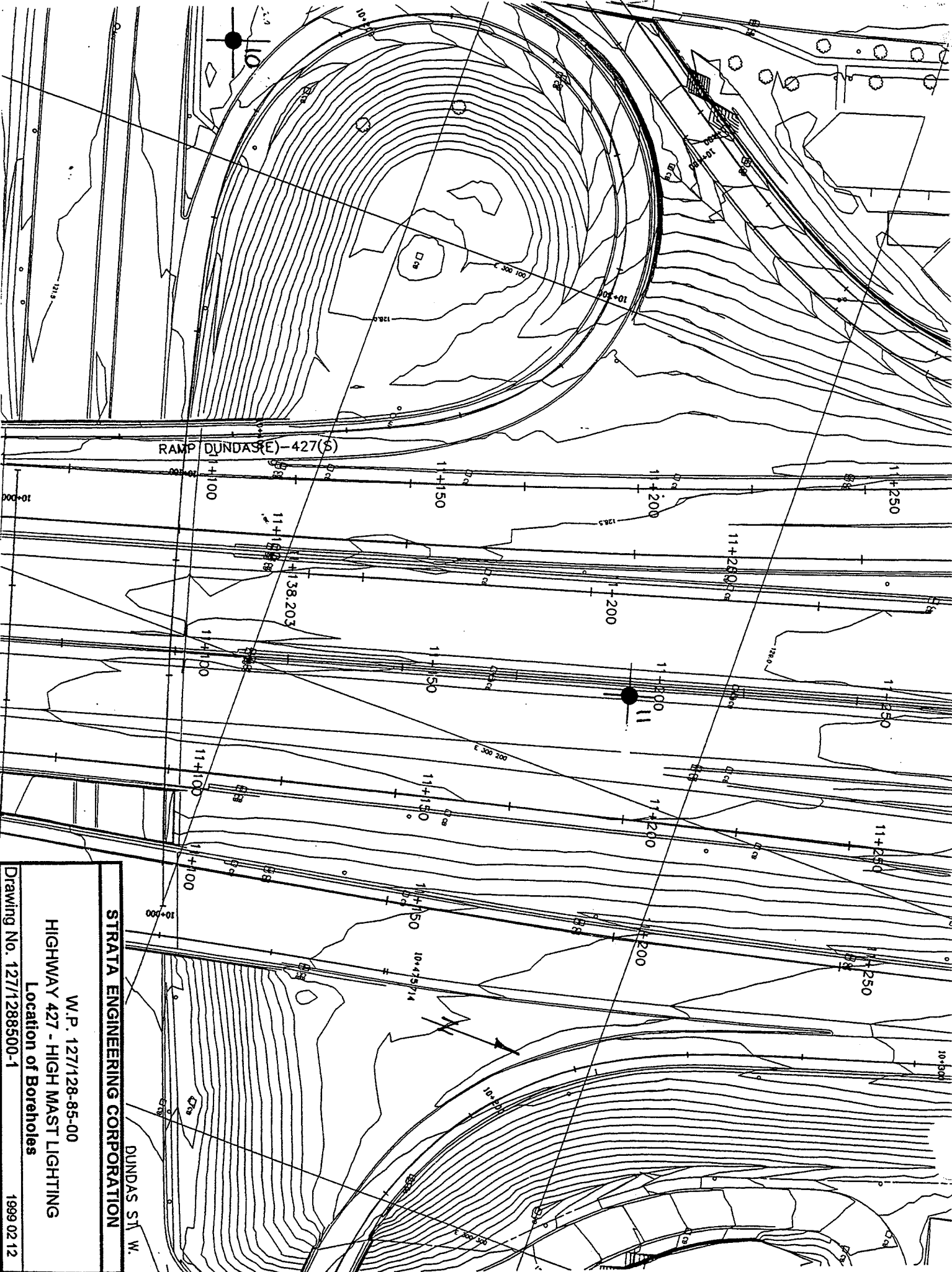








STRAITA ENGINEERING CORPORATION
W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes
Drawing No. 127/1288500-1
1999 02 12



STRATA ENGINEERING CORPORATION

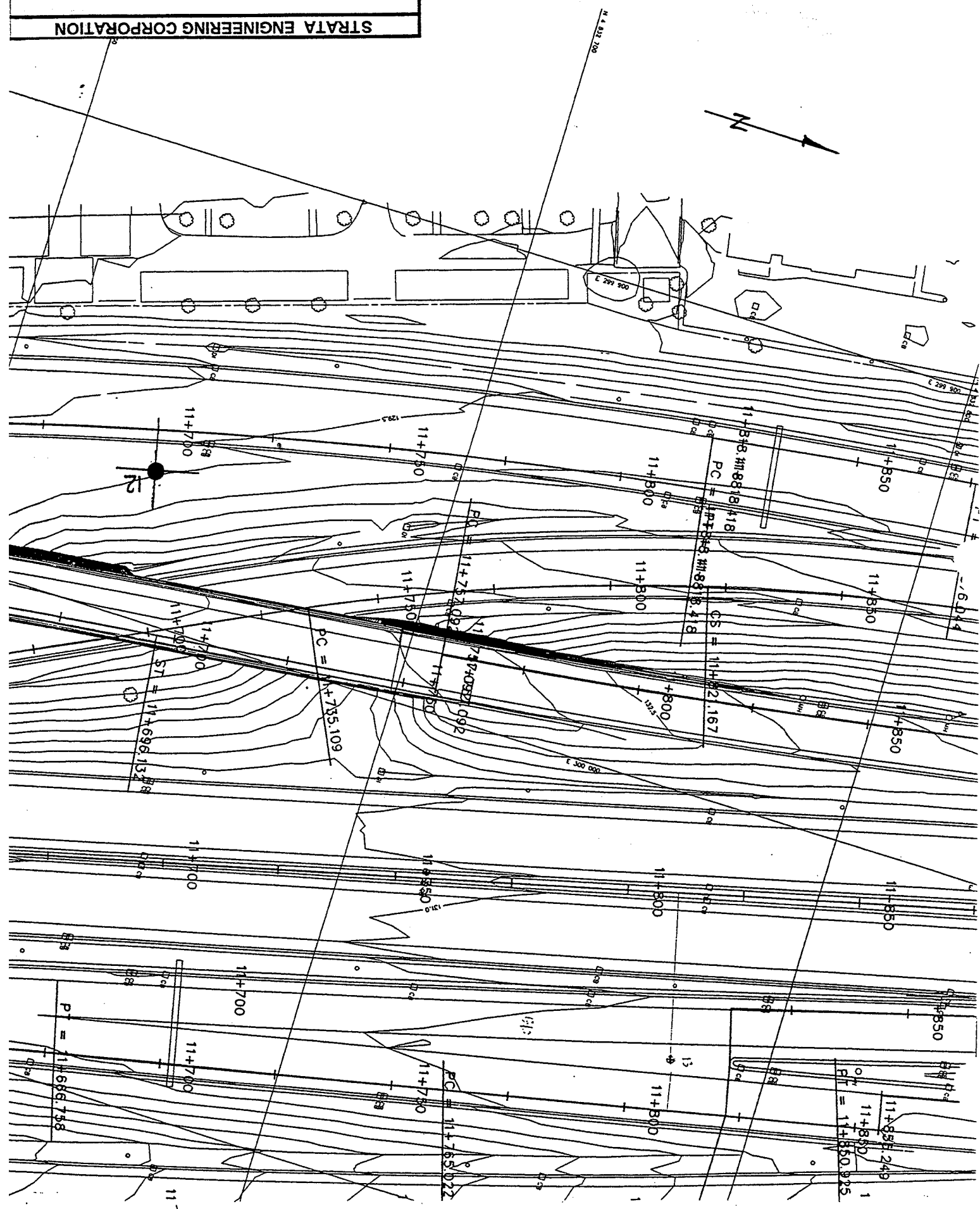
W.P. 127/128-85-00

HIGHWAY 427 - HIGH MAST LIGHTING

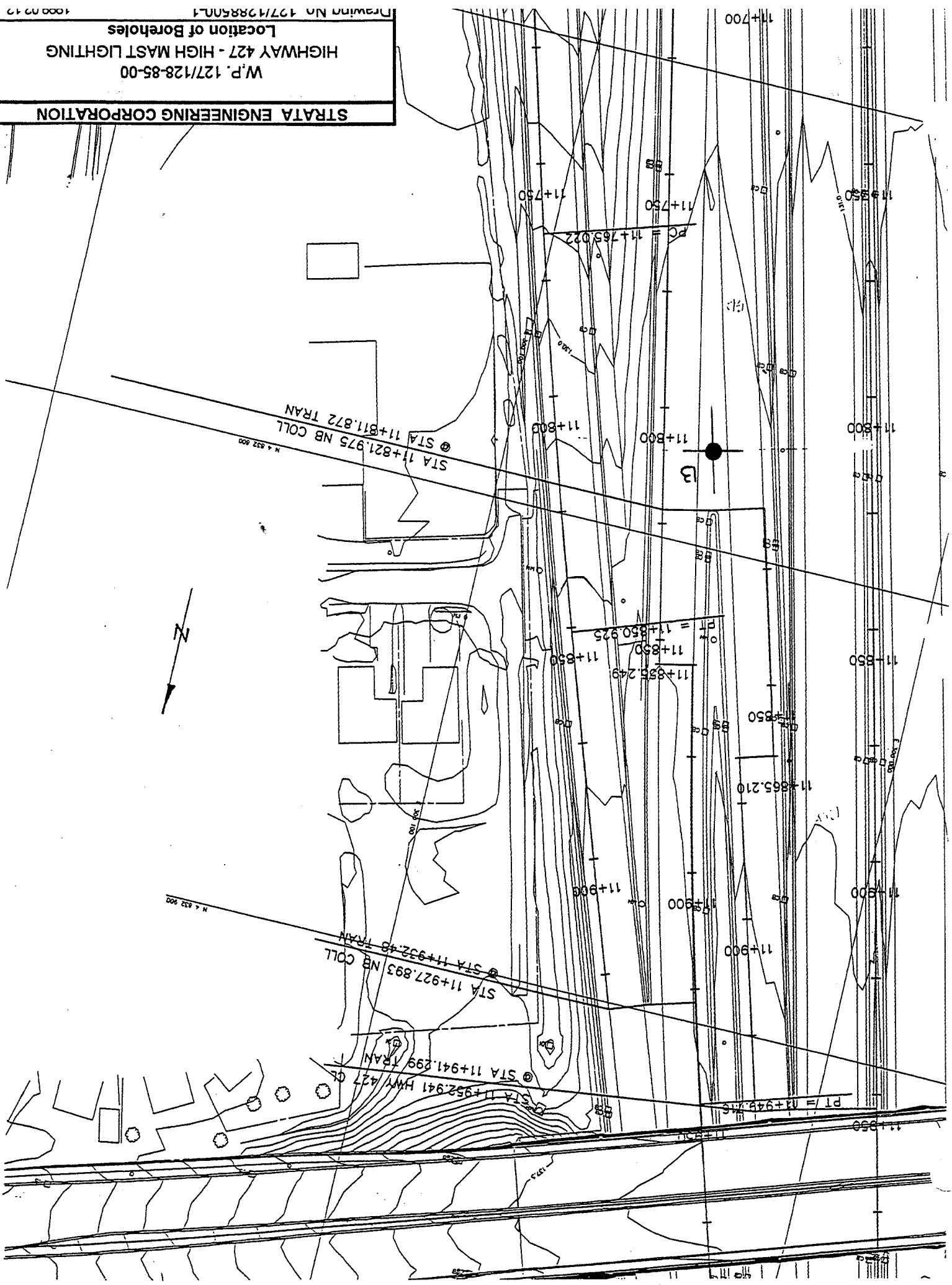
Location of Boreholes

Drawing No. 127/1288500-1

1999 02 12

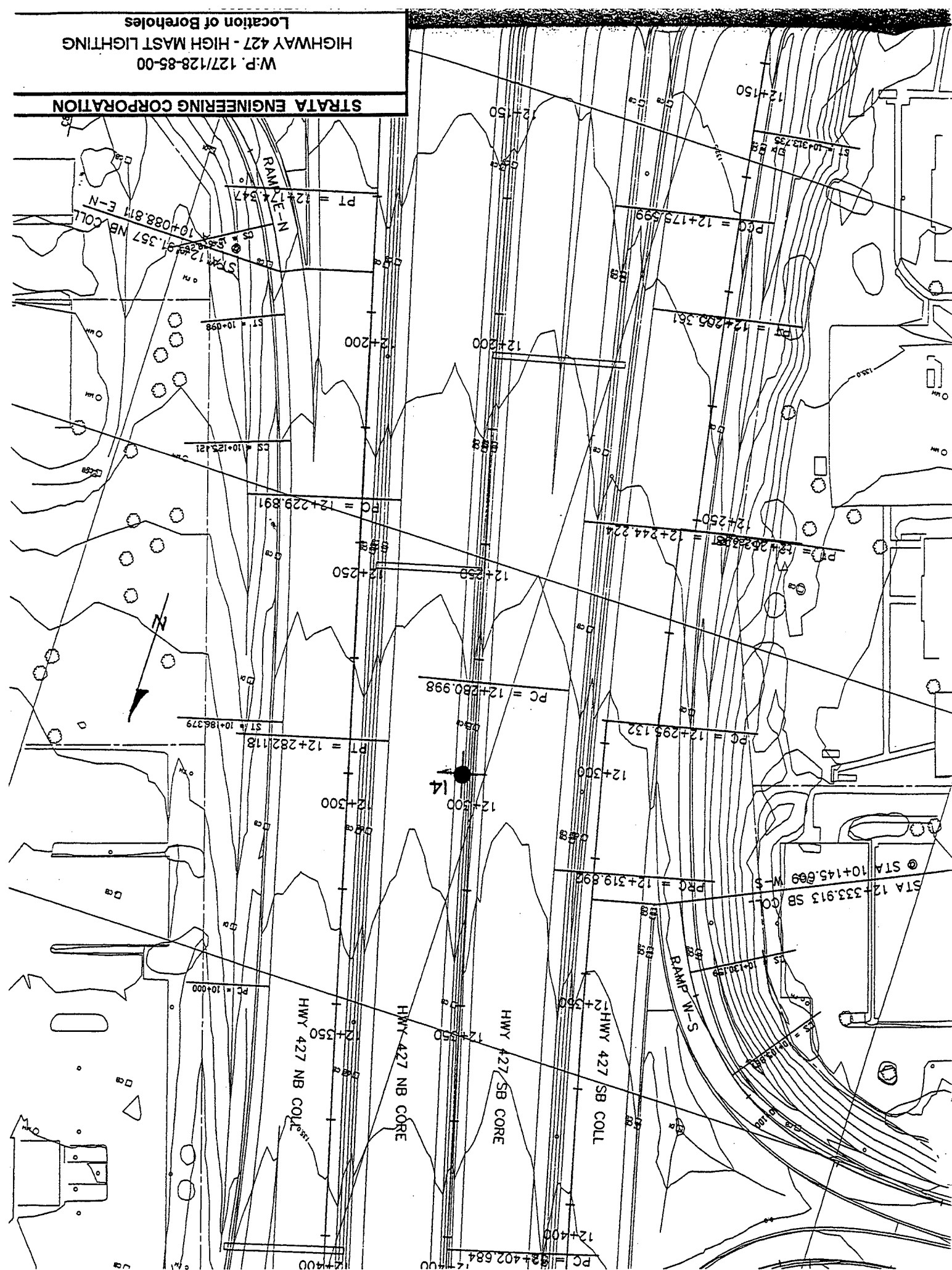


STRATA ENGINEERING CORPORATION
W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes
Drawing No 127/128-85-00-1



W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes

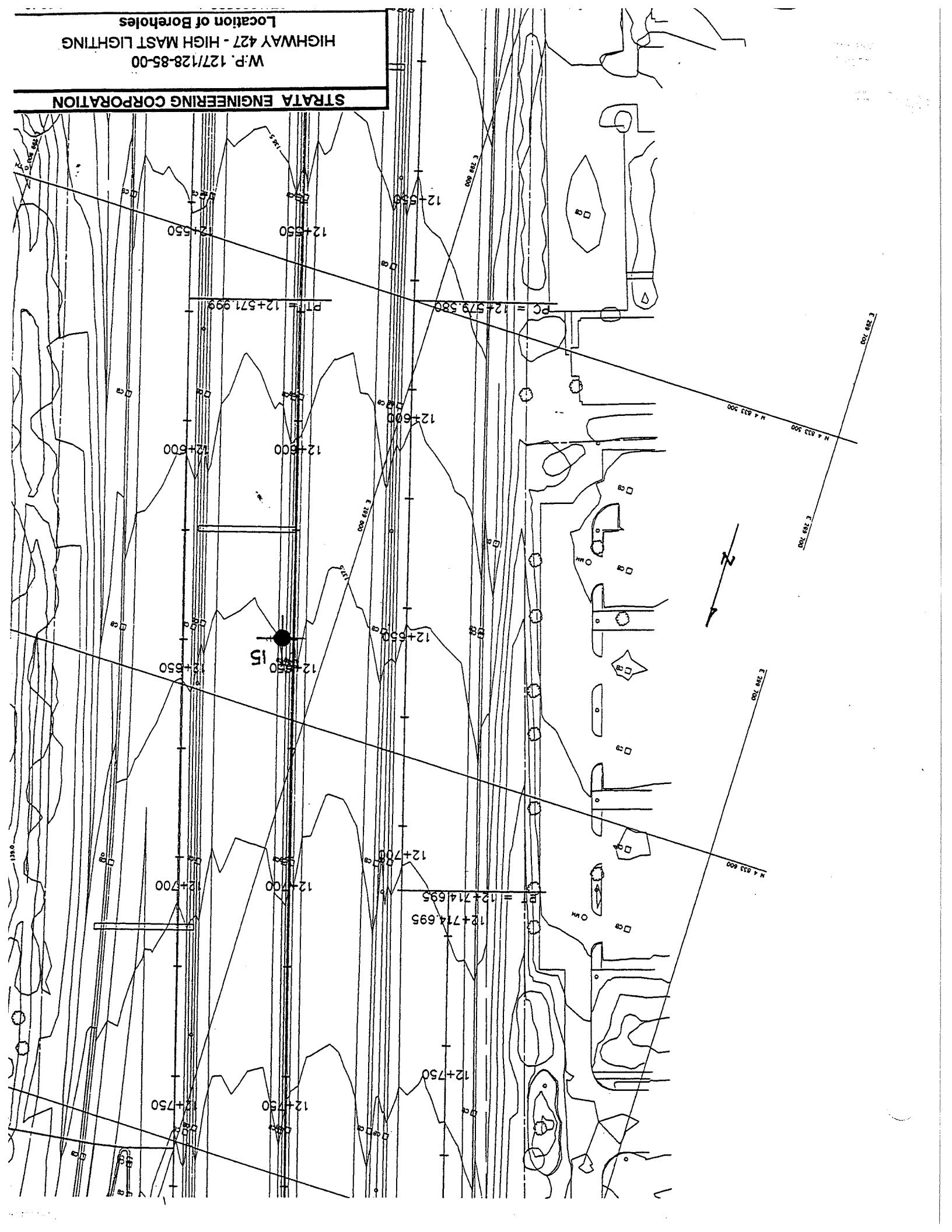
STRATA ENGINEERING CORPORATION



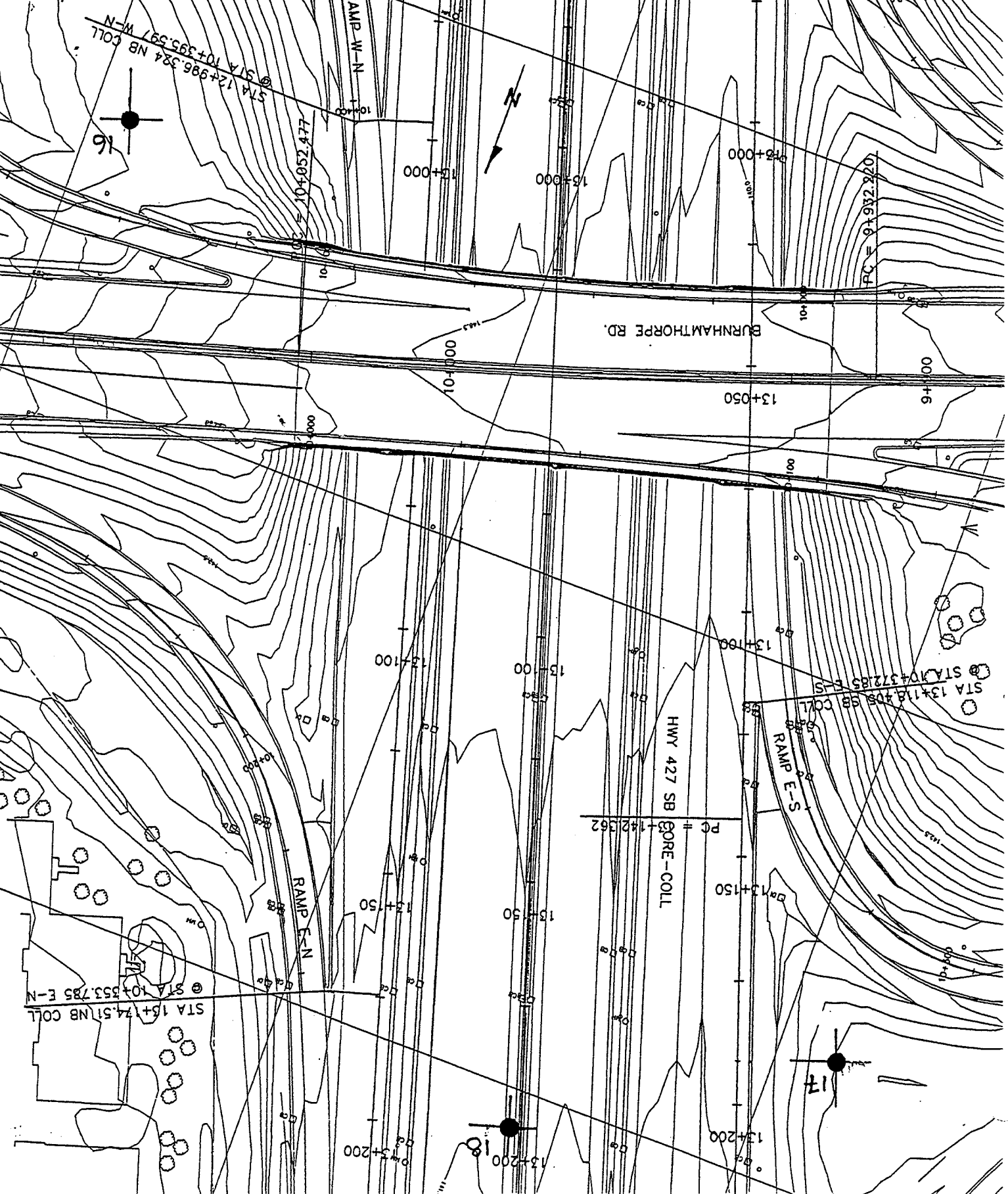
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HIGHWAY 427 - HIGH MAST LIGHTING

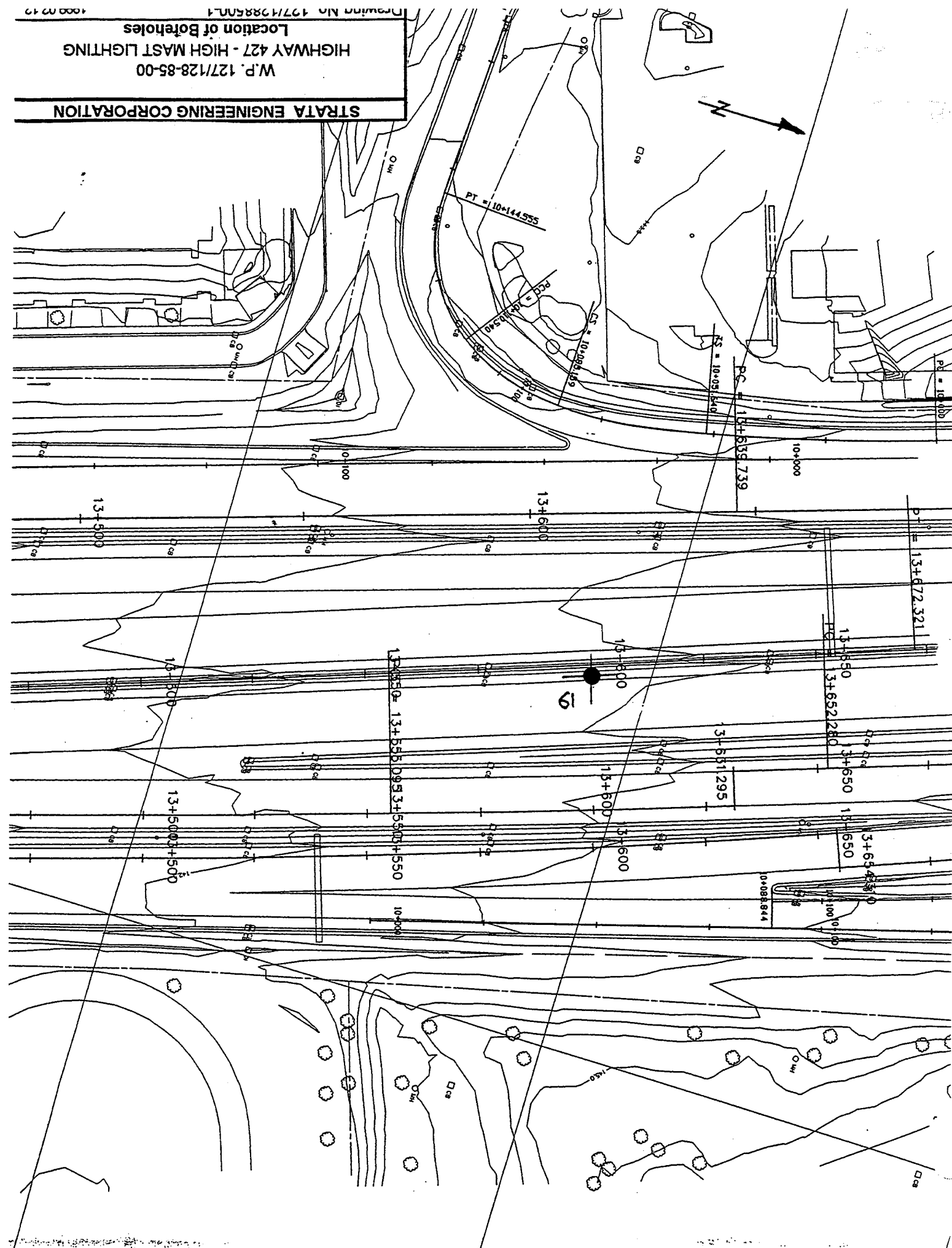
STRATA ENGINEERING CORPORATION

Location of Boreholes



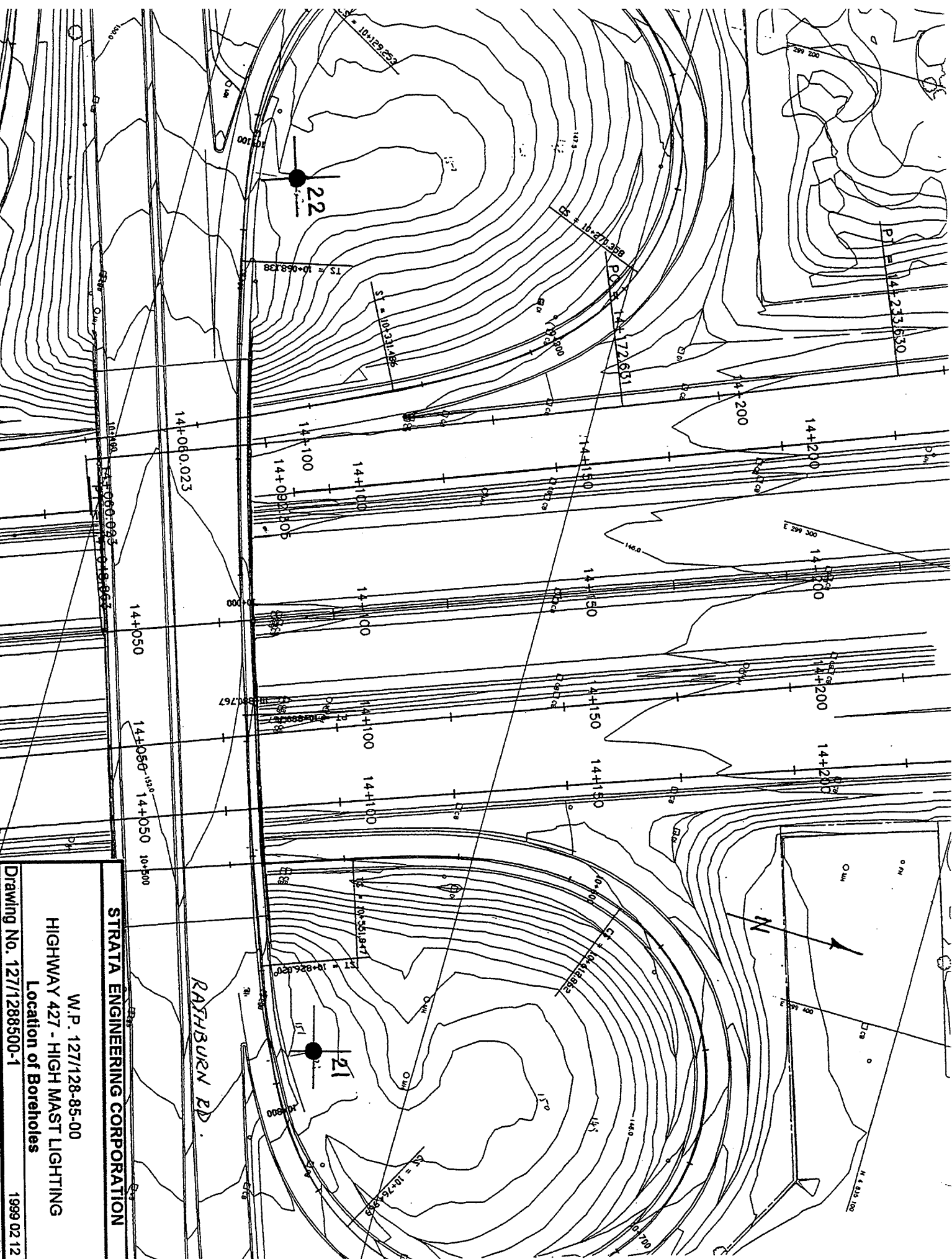
STRATA ENGINEERING CORPORATION
 W.P. 127/128-85-00
 HIGHWAY 427 - HIGH MAST LIGHTING
 Location of Boreholes
 Drawing No 127/1288500-1





STRATA ENGINEERING CORPORATION

~~RATHBURN RD.~~

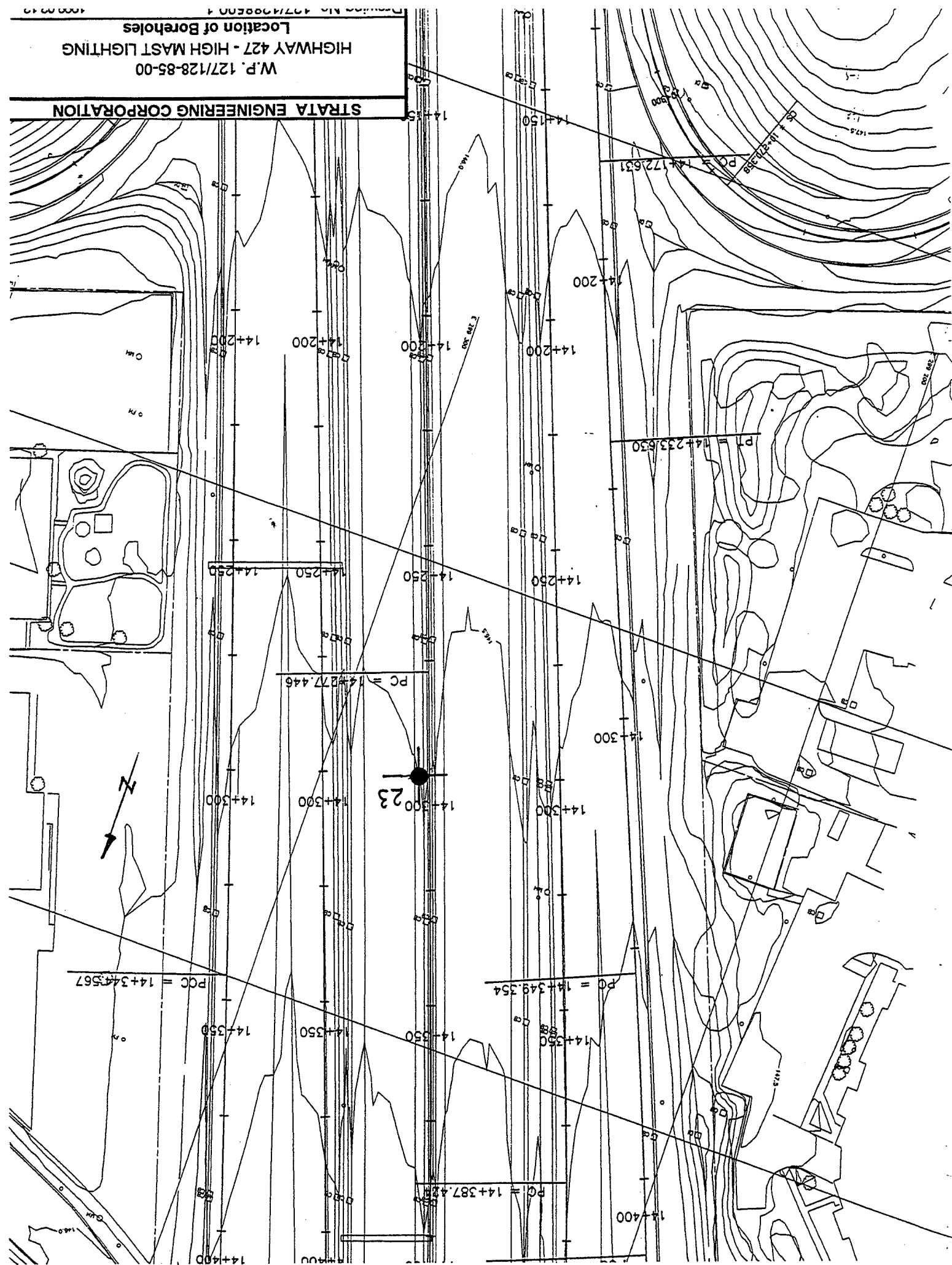


STRATA ENGINEERING CORPORATION

W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes
Drawing No. 127/1288500-1
1999 02 12

W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes

STRATA ENGINEERING CORPORATION

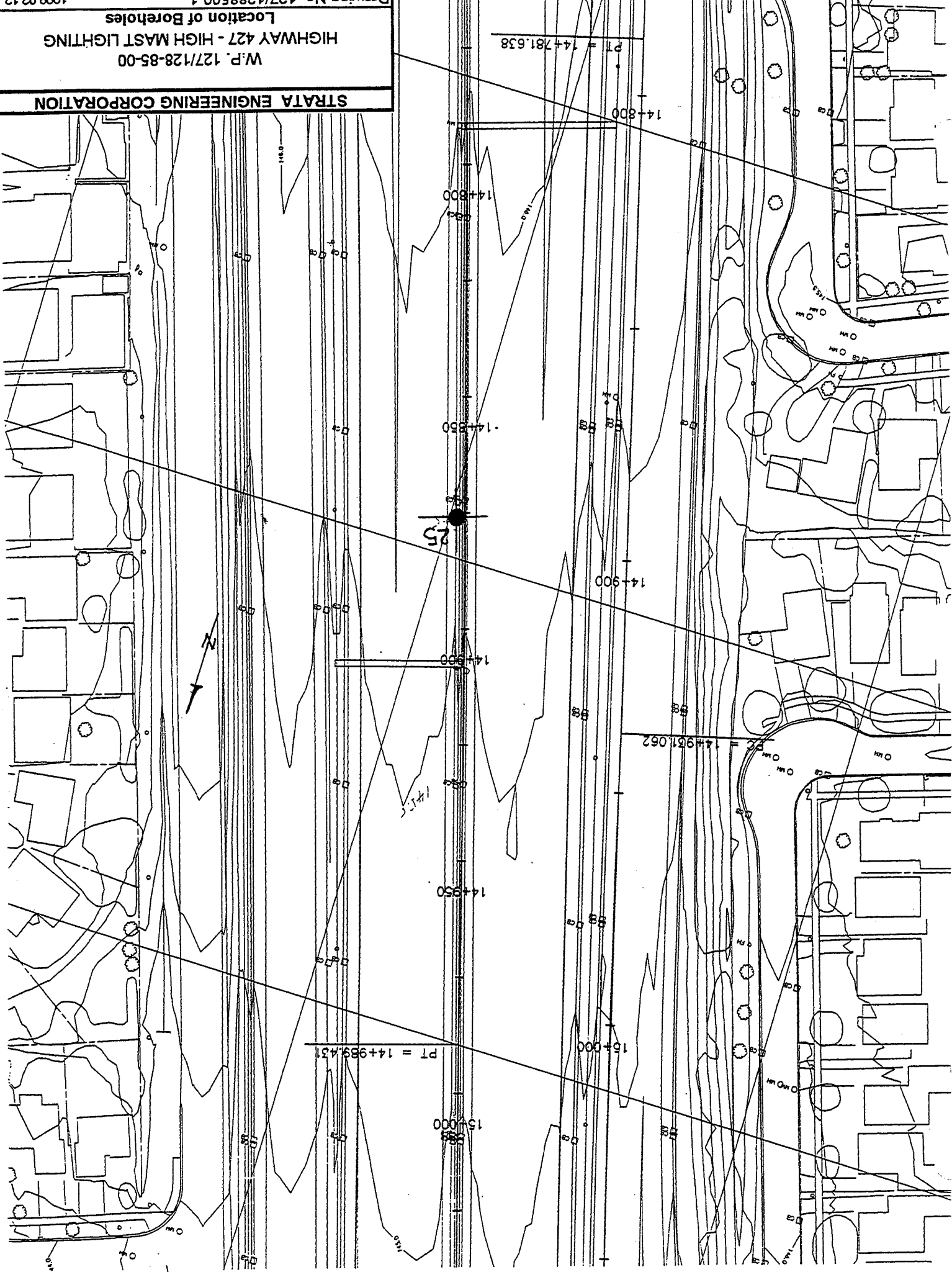




STRATA ENGINEERING CORPORATION

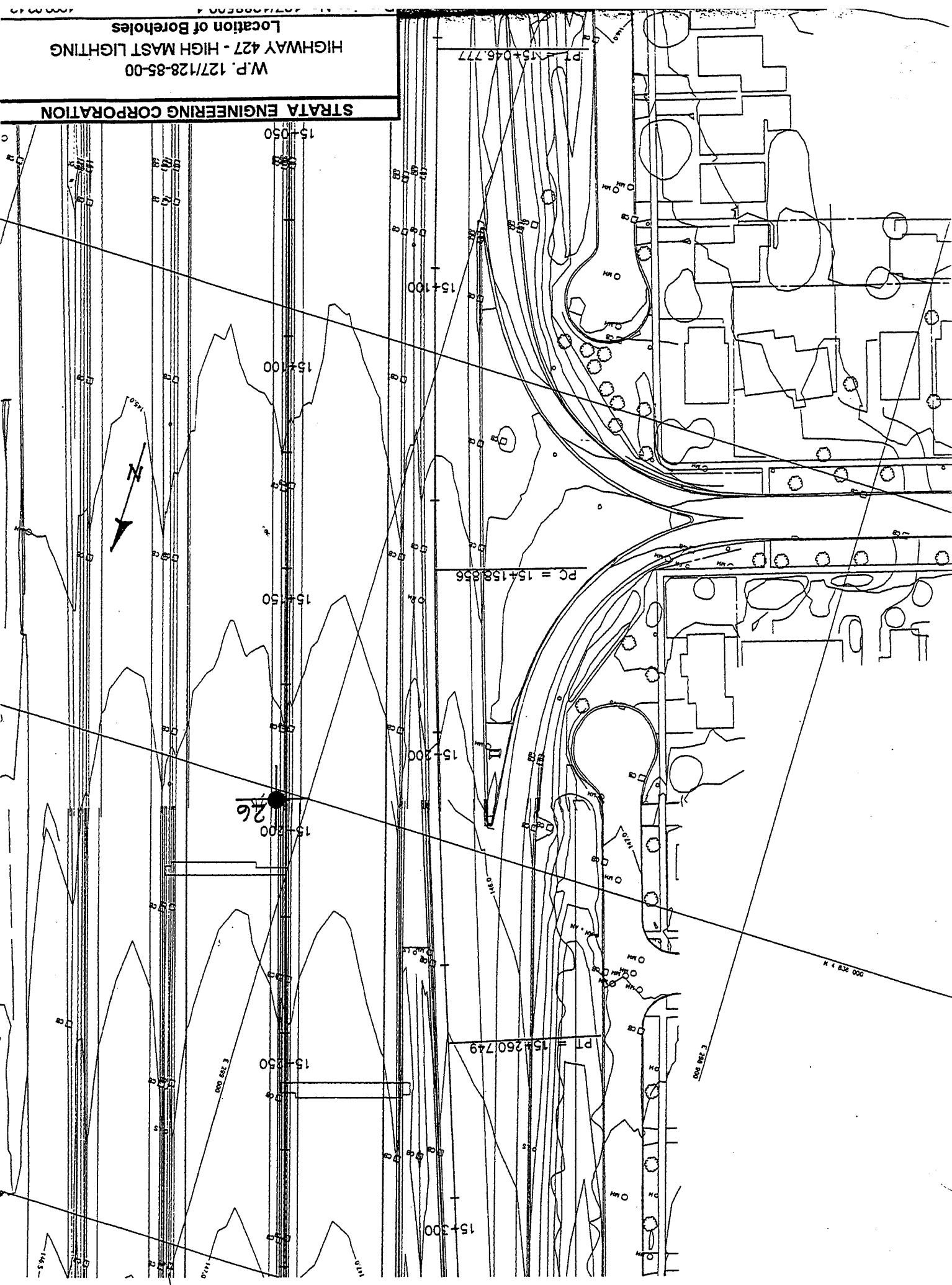
W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes

1999 02 12

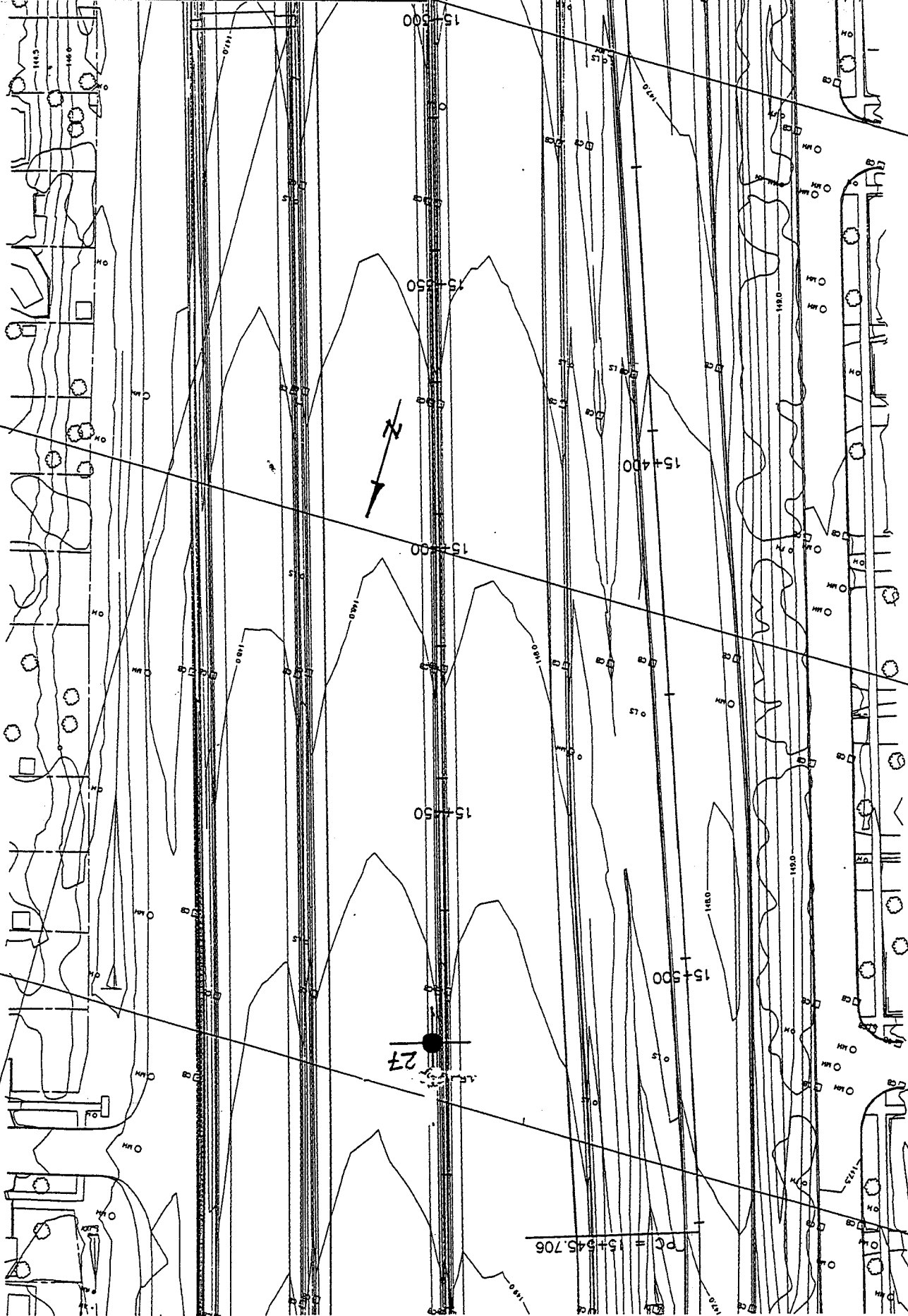


W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes

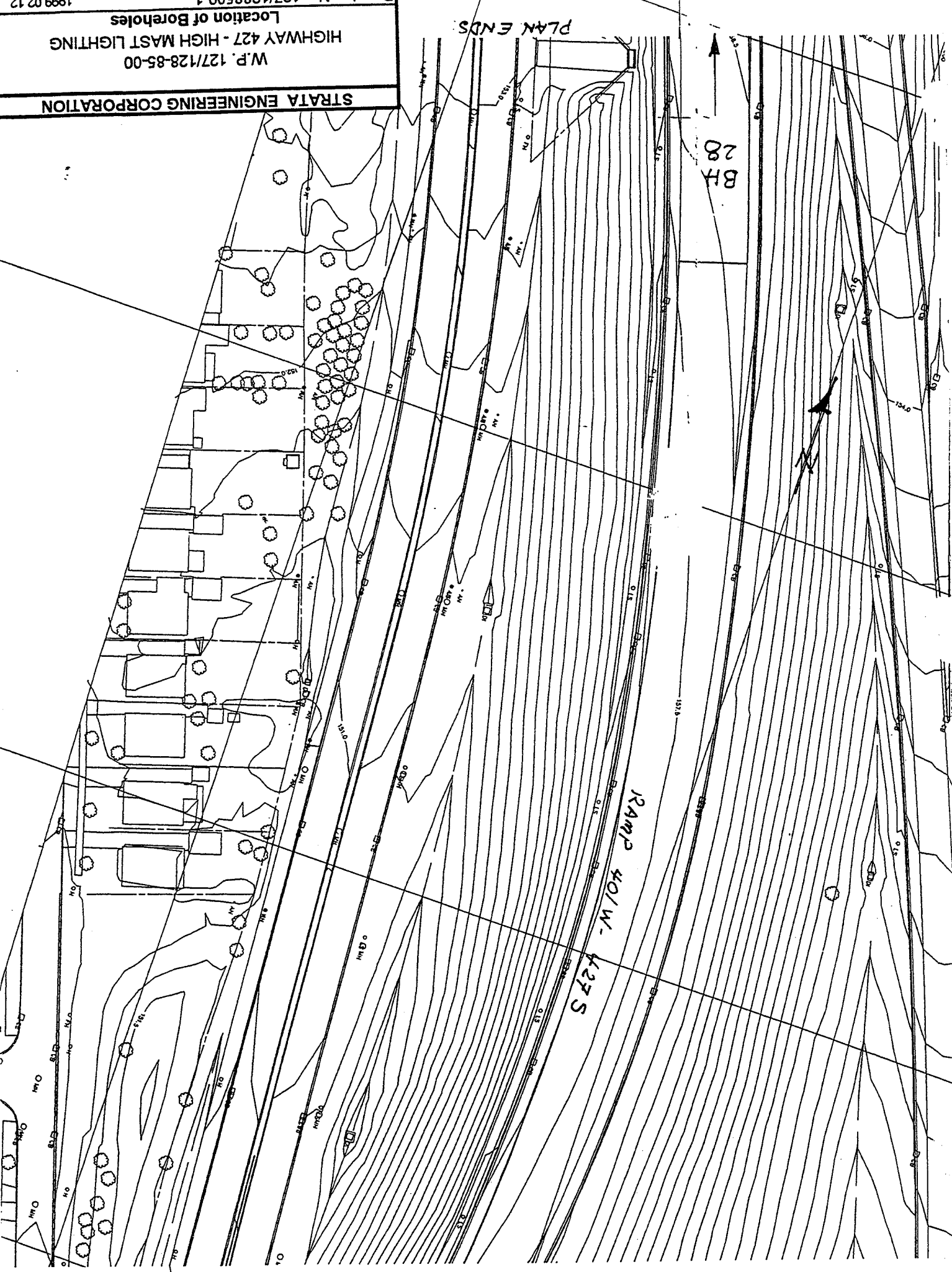
STRATA ENGINEERING CORPORATION



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STRATA ENGINEERING CORPORATION
W.P. 127/128-85-00
HIGHWAY 427 - HIGH MAST LIGHTING
Location of Boreholes
197/128-85-00-1
1999 02 12



BH 28

RAMP 401 W. 427 S

PLAN ENDS

[Faint, illegible text from bleed-through]



AGRA

ENGINEERING GLOBAL SOLUTIONS

AGRA

104 Crockford Blvd.
Scarborough, Ontario
Canada M1R 3C6
Tel (416) 751-6565
Fax (416) 751-7592

TRANSMITTAL

Project No: TT-98250
Date: November 20, 1998.

To: Strata Engineering Corporation
Suite 'B'
20 Trudy Road
North York, Ontario, M2J 2Y9
Canada

Attn: Mr. Cameran Mirza, P. Eng.

THE FOLLOWING TEST RESULTS ARE ENCLOSED

PROJECT: Highway 427, Pavement Condition Evaluation.

ITEM	NO. OF COPIES	DESCRIPTION AND REMARKS
1	1	Results of laboratory tests performed on samples obtained from the above noted project.

per:

Savio J. DeSouza, M.A.Sc., P. Eng.

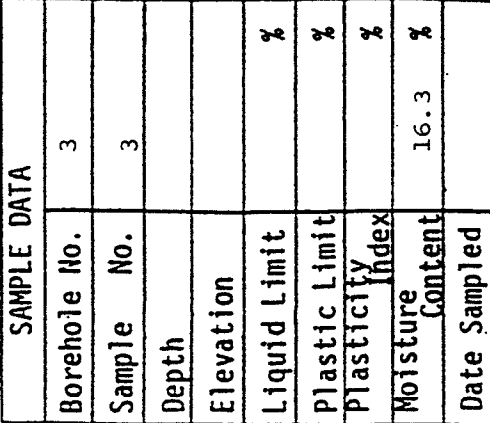
Client: Strata Engineering Corporation.					Date: Nov.19,1998.		
Project: Hwy 427, High Mast Lightings.					AGRA Job#: TT98250		
BH#	Sample#	MC (%)	Unit Wt. kN/m3	Atterberg Limits			Remarks
				(%)	(%)	(%)	
1	2	1.8					
1	5	3.9		15.0	23.9	8.9	CL
2	2	10.2	21.54				
2	3	6.4		18.0	25.8	7.8	CL
3	1	5.9					
3	2	12.5					
3	3	16.3					
4	2	8.6		14.3	22.6	8.3	CL
5	4	7.8					
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5	6	20.7					
5	7	19.7					
5	8	15.3					
5	9	8.6					
6	1	7.3					
6	2	11.9					
6	3	11.6					
6	4	13.5					
6	5	14.2		14.9	27.3	12.4	CL
6	6	18.8					
6	7	14.1					
6	8	13.1		17.3	30.8	13.5	CL
6	9	10.7					
6	10	7.6					
7	3	14.2	21.73				
7	3	14.9					
7	4	18.6					
7	5	13.5					
7	6	12.2					
7	7	25.9					
8	1	13.4					
8	2	22.0					
8	3	13.7					
8	4	9.8					
8	5	14.0					
8	6	6.4					
8	7	9.4					
9	1	8.6					
9	2	10.0					
9	3	6.2	23.03	12.0	15.7	3.7	ML
9	4	6.6					
9	5	4.4					

Client: Strata Engineering Corporation						Date: Nov.19,1998.	
Project: Hwy 427, High Mast Lightings						AGRA Job#: TT98250	
BH#	Sample#	MC (%)	Unit Wt. kN/m3	Atterberg Limits			Remarks
				(%)	(%)	(%)	
10	3	14.2	23.02	11.6	13.7	2.1	ML
10	4	5.2					
10	5	8.9					
11	1	12.5					
11	2	14.3		12.7	20.3	7.6	CL-ML
11	3	13.3	21.65				
11	4A	15.8					
11	4B	13.3	22.76	14.8	24.4	9.6	CL
11	5	8.2	23.08				
12	1	10.5	22.38				
12	2	14.0					
12	3	5.2					
12	4	6.0					
12	5	9.8					
13	2	21.5					
13	3	12.1 45.9	22.26				
13	4	13.4 44.3	22.54	13.5	23.1	9.6	CL
14	1	21.5					
14	2	16.6	22.82	12.4	19.3	6.9	CL-ML
14	4	7.5					
14	5	12.2	21.28	14.6	18.0	3.4	ML
15	1	11.6	21.89				
15	2	11.2					
15	3	18.8		14.7	28.5	13.8	CL
15	5	7.4					
16	3	9.5					
16	4	14.4					
16	5	15.1					
16	6	16.7					
16	7	14.0					
16	8	11.9					
16	9	19.5					
17	3	13.2	21.8				
17	4	7.1					
17	5	7.4		13.5	16.6	3.1	ML
17	6	6.0					
17	7	9.2	22.5				
18	2	13.1		15.9	22.7	6.8	CL-ML
18	3	13.7					
18	4	9.8					
18	6	9.6		11.7	15.2	3.5	ML
19	1	15.6					

Client: Strata Engineering Corporation							Date: Nov.19,1998.
Project: Hwy 427, High Mast Lightings							AGRA Job#: TT98250
BH#	Sample#	MC (%)	Unit Wt. kN/m3	Atterberg Limits (%) (%) (%)			Remarks
19	2	10.7		14.5	17.9	3.4	ML clay. Silt Till
19	3	5.6					
19	4	7.6	21.93				
20	1	12.9					
20	1A	19.4					
20	2	11.6					
20	3	8.4					
20	4	8.8		12.8	15.9	3.1	ML clay. Silt Till
20	5	9.4					
21	5	20.3					
21	6	8.7					
21	7	7.7					
21	8	7.2					
22	2	9.9					
22	3	18.5					
22	4	15.8		16.3	26.3	10.0	CL Fall Silt Till
22	5	12.1					
22	6	9.3	22.64				
22	8	9.1		12.6	18.4	5.8	CL-ML clay. Silt Till
23	1	15.1					
23	2	10.6					
23	3	9.4					
23	4	9.1		12.6	18.4	5.8	CL-ML clay. Silt Till
23	5	10.0					
23	6	12.7		11.3	17.8	6.5	CL-ML clay. Silt Till
23	7	21.0					
23	8	7.4	22.56				
24	2	12.2					
24	3	20.7		18.6	36.8	18.2	CI silt clay Till
24	4	23.9	20.05				
24	5	17.8	23.19	12.8	21.0	8.2	CL clay. Silt Till
24	6	8.7					
24	7	9.9					
24	8	18.9		15.1	17.4	2.3	ML silt Fine Sand
24	9	13.9					
25	1	16.2					
25	2	8.0	23.36	10.5	18.1	7.6	CL clay. Silt Till
25	3	6.3	23.82				
25	4	10.3					
26	1	11.1					
26	2	10.2					
26	3A	9.4		11.1	16.8	5.7	CL-ML clay. Silt Till

Client: Strata Engineering Corporation				Date: Nov.19,1998.			
Project: Hwy 427, High Mast Lightings				AGRA Job#: TT98250			
BH#	Sample#	MC (%)	Unit Wt. kN/m3	Atterberg Limits (%) (%) (%)			Remarks
26	3B	10.8	23.16				
26	4	8.6	22.91				
27	2	14.4					
27	3	11.9	22.72	13.6	18.2	4.6	CL-ML <i>1/2 in. 7.2</i>
27	4	9.0					
27	5	10.0		11.6	18.0	6.4	CL-ML <i>1/2 in. 7.2</i>
28	2	5.8					
28	3	7.6					
28	4	9.4					
28	5	11.2		14.1	22.2	8.1	CL <i>1/2 in. 7.2</i>
28	7	11.7	21.65				

CLAY & SILT	SAND		GRAVEL	
	Fine	Medium	Coarse	Fine



MINISTRY SIEVE DESIGNATION (Imperial)

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

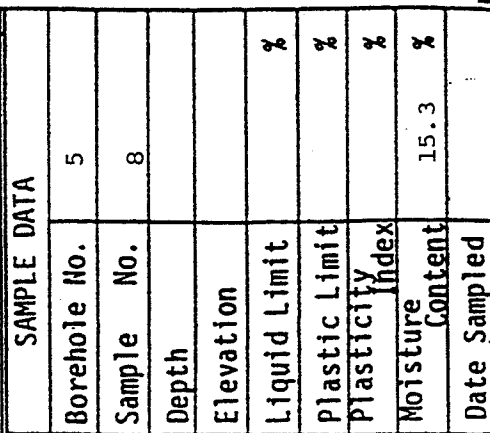
Location: Highway 427

Test date: October 27, 1998.

GRAIN SIZE DISTRIBUTION

SILT AND FINE SAND

CLAY & SILT	SAND		GRAVEL	
	Fine	Medium	Coarse	Fine



MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

SANDY SILT, traces of gravel and clay

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: Highway 427

October 28, 1998.

GRAVEL



Date Sampled

GRAIN SIZE DISTRIBUTION

SILTY SAND, some gravel, traces of clay

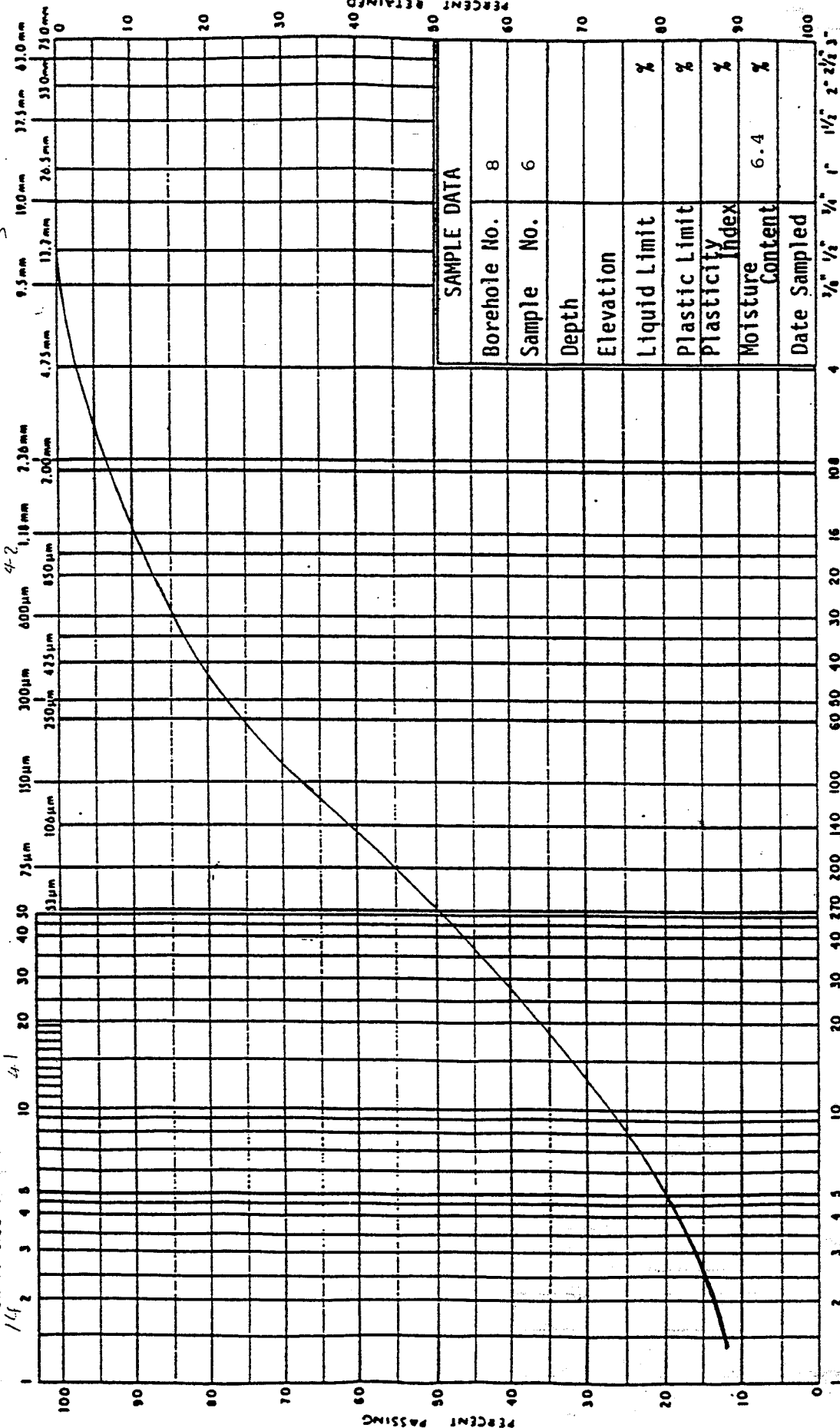
Test date: October 27, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS



SAMPLE DATA

Borehole No.	8
Sample No.	6
Depth	
Elevation	
Liquid Limit	%
Plastic Limit	%
Plasticity Index	%
Moisture Content	6.4 %
Date Sampled	

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, some sand, traces of gravel

AGRA
Earth & Environmental

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

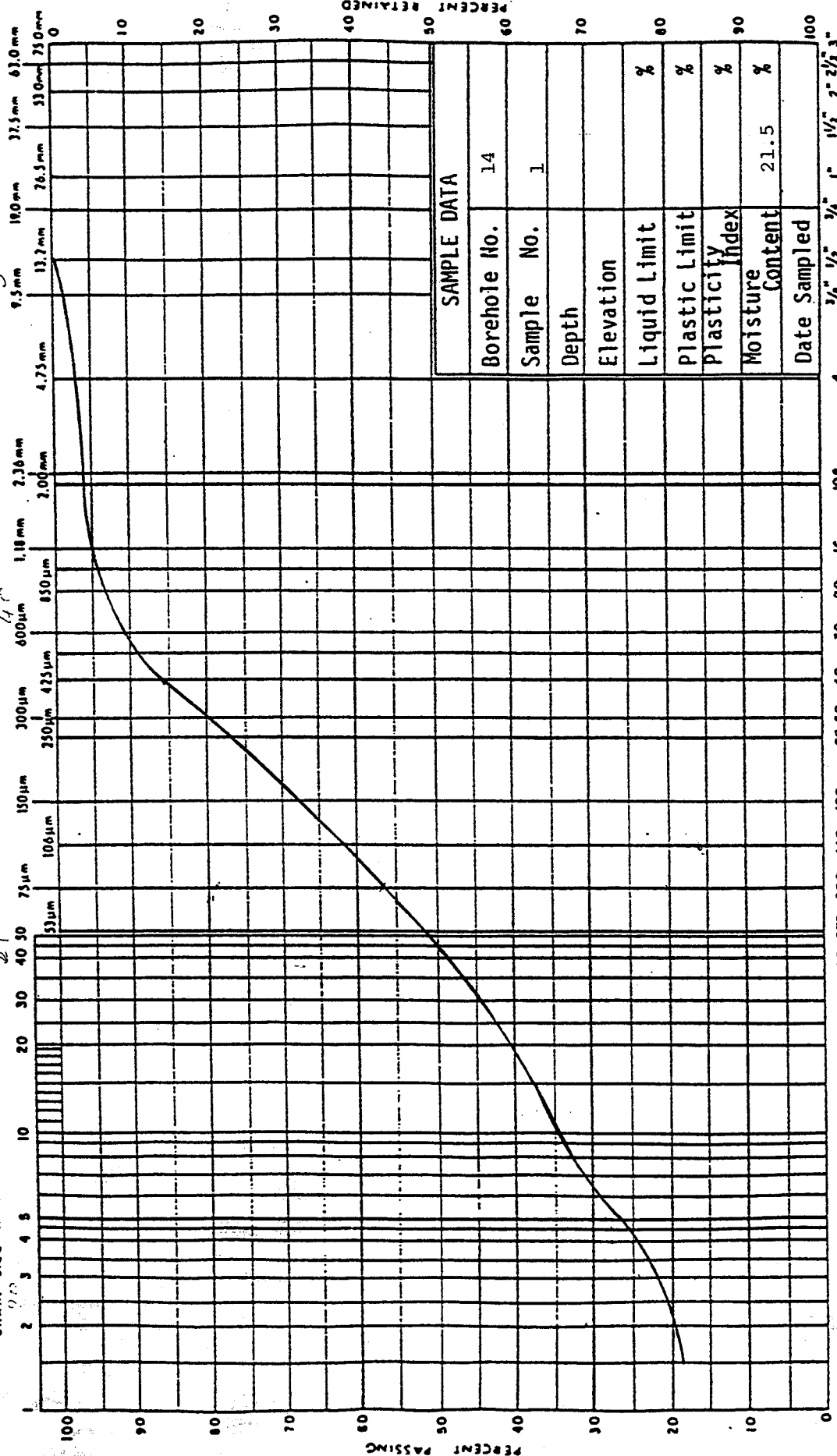
Location: Highway 427

Test date: October 27, 1998.

Course

MINISTRY SIEVE DESIGNATION (Metric)

七



SAMPLE DATA

Borehole No. 14

Sample No. 1

Depth

Elevation

Liquid Limit

Plastic Limit

Plasticity Index

Moisture Content

Date Sampled

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

SILTY CLAY with sand, traces of gravel

Client: Strata Engineering Job No.: TT-98250

Project: High Mast Lighting

Location: Highway 427

Test date: October 28, 1998.

Course

MINISTRY SIEVE DESIGNATION (Metric)



Borehole No. 15

Sample No.	5
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Depth

Elevation

liquid limit

Plastic limit

Plasticity

Moisture	7
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Date sampled	
07-1988	
08-1988	
09-1988	
10-1988	
11-1988	
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01-1989	
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06-2003	
07-2003	
08-2003	
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11-2003	
12-2003	
01-2004	
02-2004	
03-2004	
04-2004	
05-2004	
06-2004	
07-2004	
08-2	

$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{2}$	$2\frac{1}{2}$	3
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MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

SAND AND SILT, traces of gravel and clay

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: Highway 427

Test date: October 26, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

GRAIN SIZE IN MICRONS 36

SAND

Fine

Medium

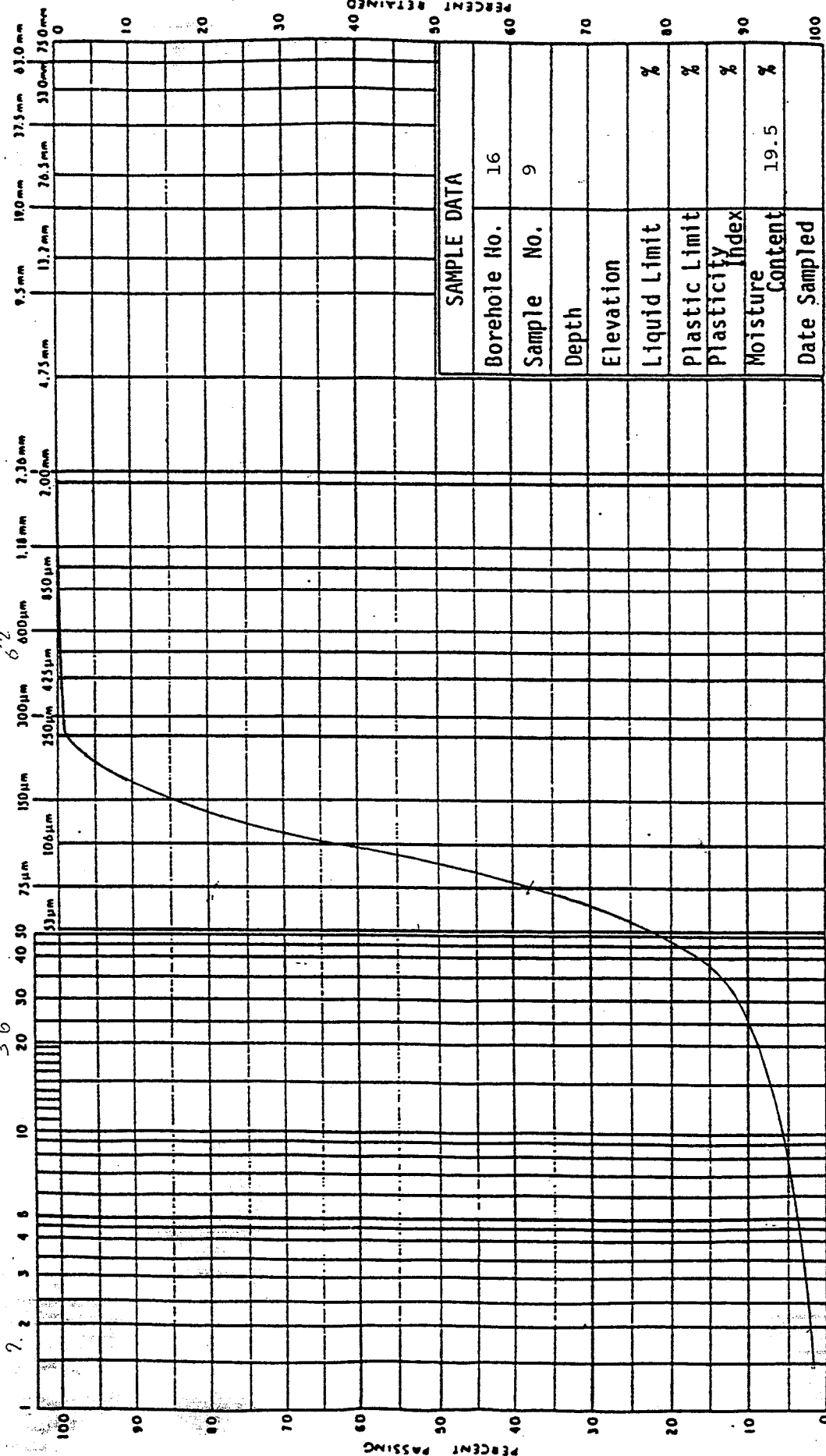
Coarse

GRAVEL

Fine

Coarse

MINISTRY SIEVE DESIGNATION (Metric)



SAMPLE DATA

Borehole No. 16

Sample No. 9

Depth

Elevation

Liquid Limit %

Plastic Limit %

Plasticity Index %

Moisture Content %

Date Sampled

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

Client: Strata Engineering Job No. ST-98250

Project: High Mast Lighting

Location: Highway 427

Test date: October 27, 1998.

SILTY FINE SAND

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

Fine

SAND

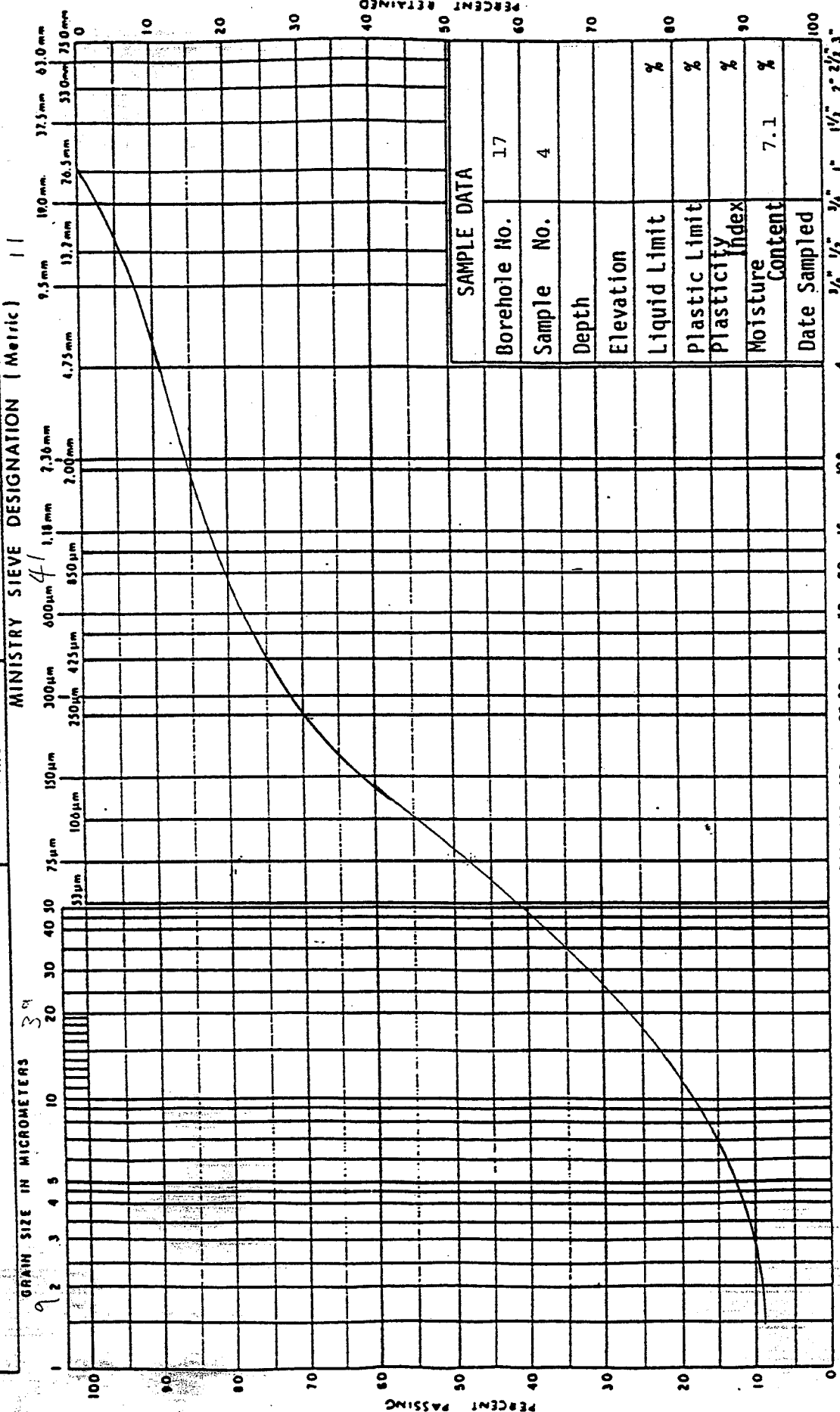
Medium

Coarse

GRAVEL

Fine

Coarse



SAMPLE DATA

Borehole No. 17

Sample No. 4

Depth

Elevation

Liquid Limit %

Plastic Limit %

Plasticity Index %

Moisture Content %

Date Sampled

GRAIN SIZE DISTRIBUTION

AGRA

Earth & Environmental

SILTY SAND, some gravel, traces of clay

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: Highway 427

Test date: October 28, 1998.

CLAY & SILT

GRAIN SIZE IN MICROMETERS

23

25

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS		MINISTRY SIEVE DESIGNATION (Metric)	
5	32	10	10
1	2	3	3
	3	4	4
	5	5	5
	10	10	10
	20	20	20
	30	30	30
	40	40	40
	50	50	50
	75 μ m	75 μ m	75 μ m
	100 μ m	100 μ m	100 μ m
	150 μ m	150 μ m	150 μ m
	200 μ m	200 μ m	200 μ m
	250 μ m	250 μ m	250 μ m
	300 μ m	300 μ m	300 μ m
	400 μ m	400 μ m	400 μ m
	1.18 mm	1.18 mm	1.18 mm
	2.36 mm	2.36 mm	2.36 mm
	4.75 mm	4.75 mm	4.75 mm
	9.5 mm	9.5 mm	9.5 mm
	19.0 mm	19.0 mm	19.0 mm
	37.5 mm	37.5 mm	37.5 mm
	63.0 mm	63.0 mm	63.0 mm
	0	0	0

REF ID: A55193

SAMPLE DATA

Borehole No. 18

Sample No. 4

Depth

Elevation

Liquid Limit

Plastic limit

Plasticity Index

Moisture Content

Date Sampled _____

$$\frac{1}{2}, \frac{3}{4}, \frac{5}{8}$$

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

Client: strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: Highway 427

Test date: Highway 42 / October 27, 1998.

SILTY SAND, traces of gravel and clay



GRAIN SIZE IN MICROMETERS

SAND

Fino

Medium

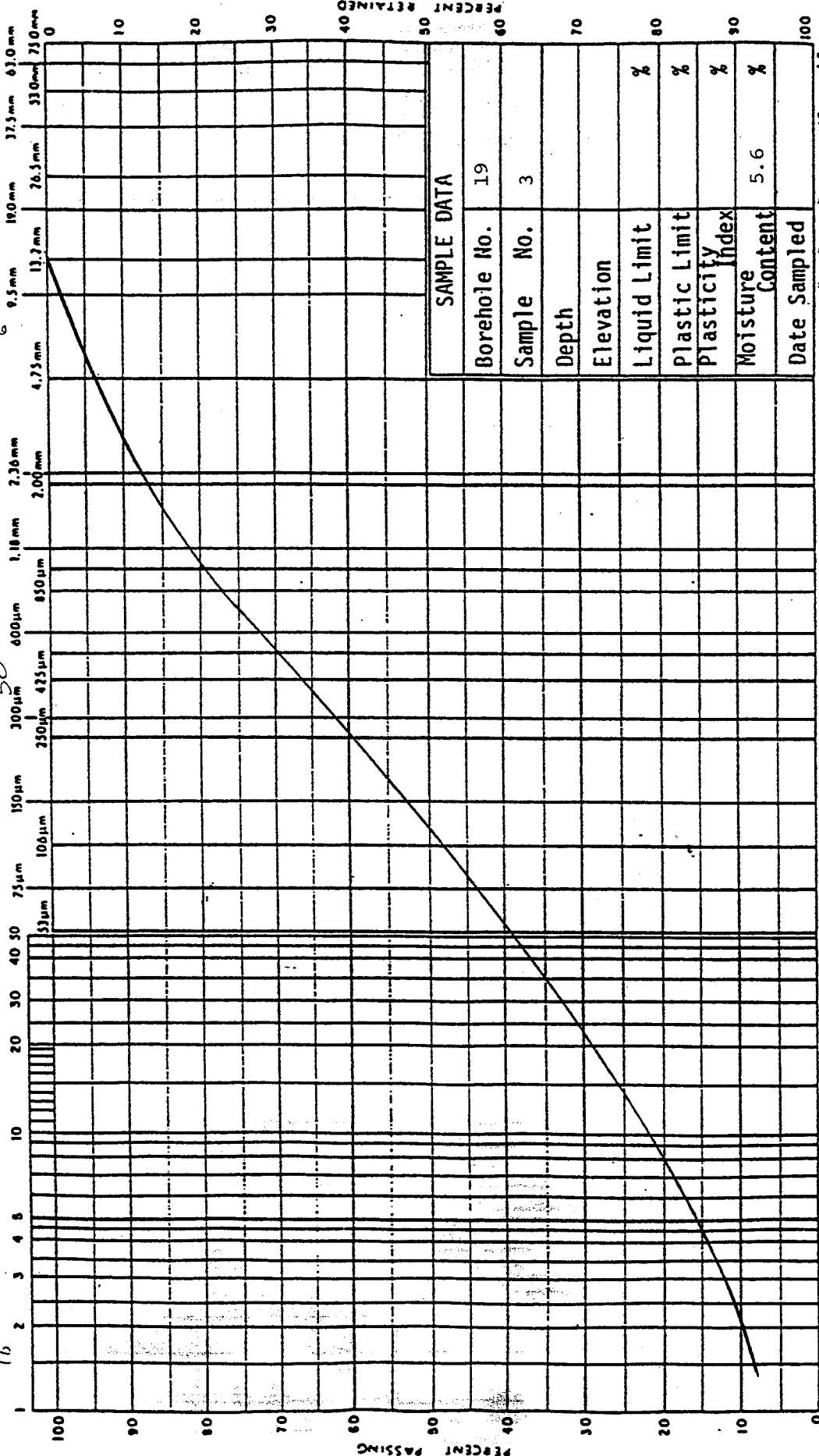
Coorse

GRAVEL

Course

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS



SAMPLE DATA

Borehole No. 19

Sample No.	3
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Depth

Elevation

Liquid Limit

plastic limit

Plasticity

Moisture Content

Date Sampled _____

 $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9}, \frac{1}{10}$

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

Earth & Environmental

Client: strata Engineering Job No.: TT-98250

Project: High Mast Lighting

Location: Highway 427

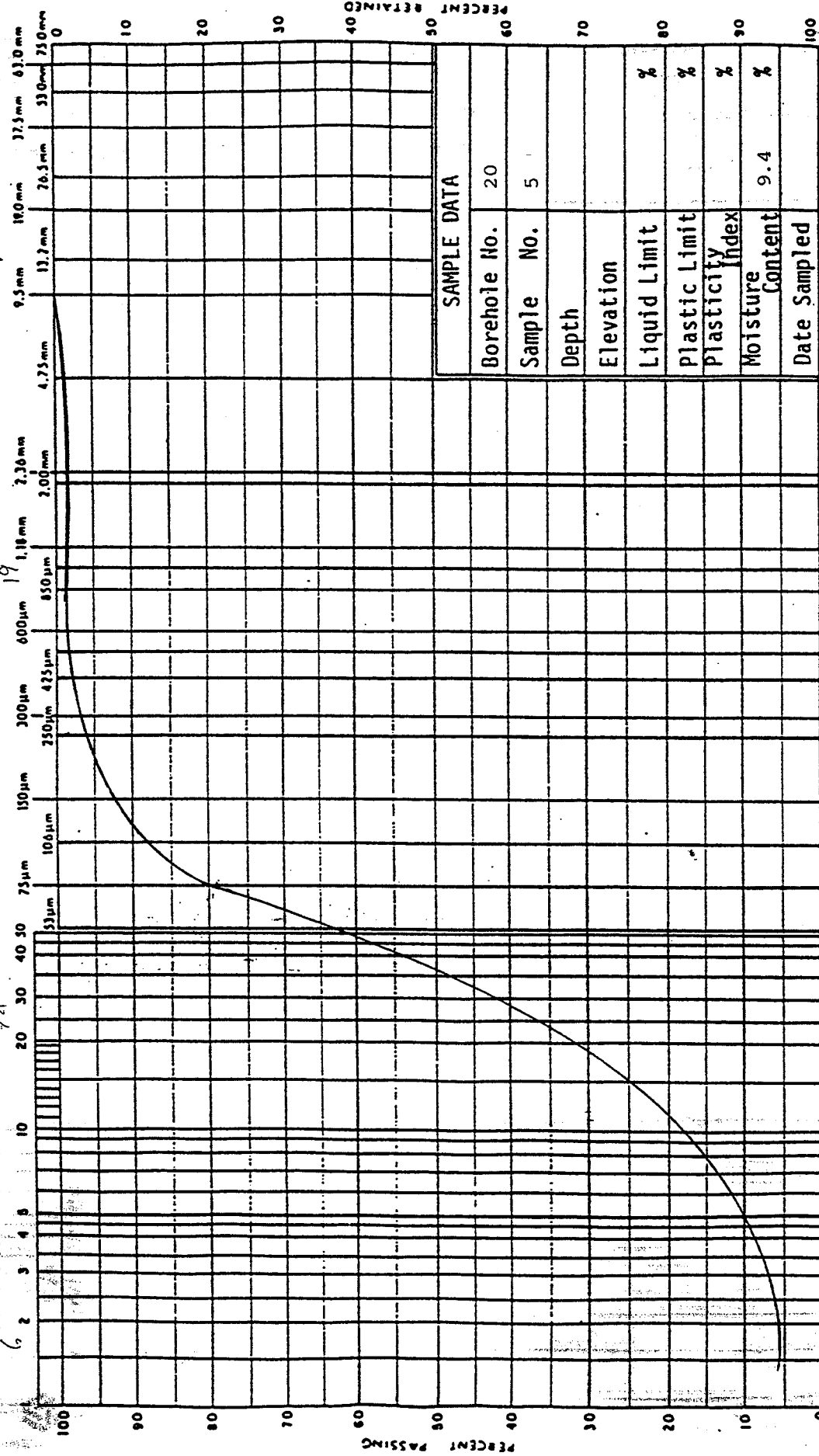
Test date: 01-27-2000

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND		GRAVEL	
Fine		Medium		Coarse	

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



SAMPLE DATA

Borehole No.	20
Sample No.	5
Depth	
Elevation	
Liquid Limit	%
Plastic Limit	%
Plasticity Index	%
Moisture Content	9.4
Date Sampled	

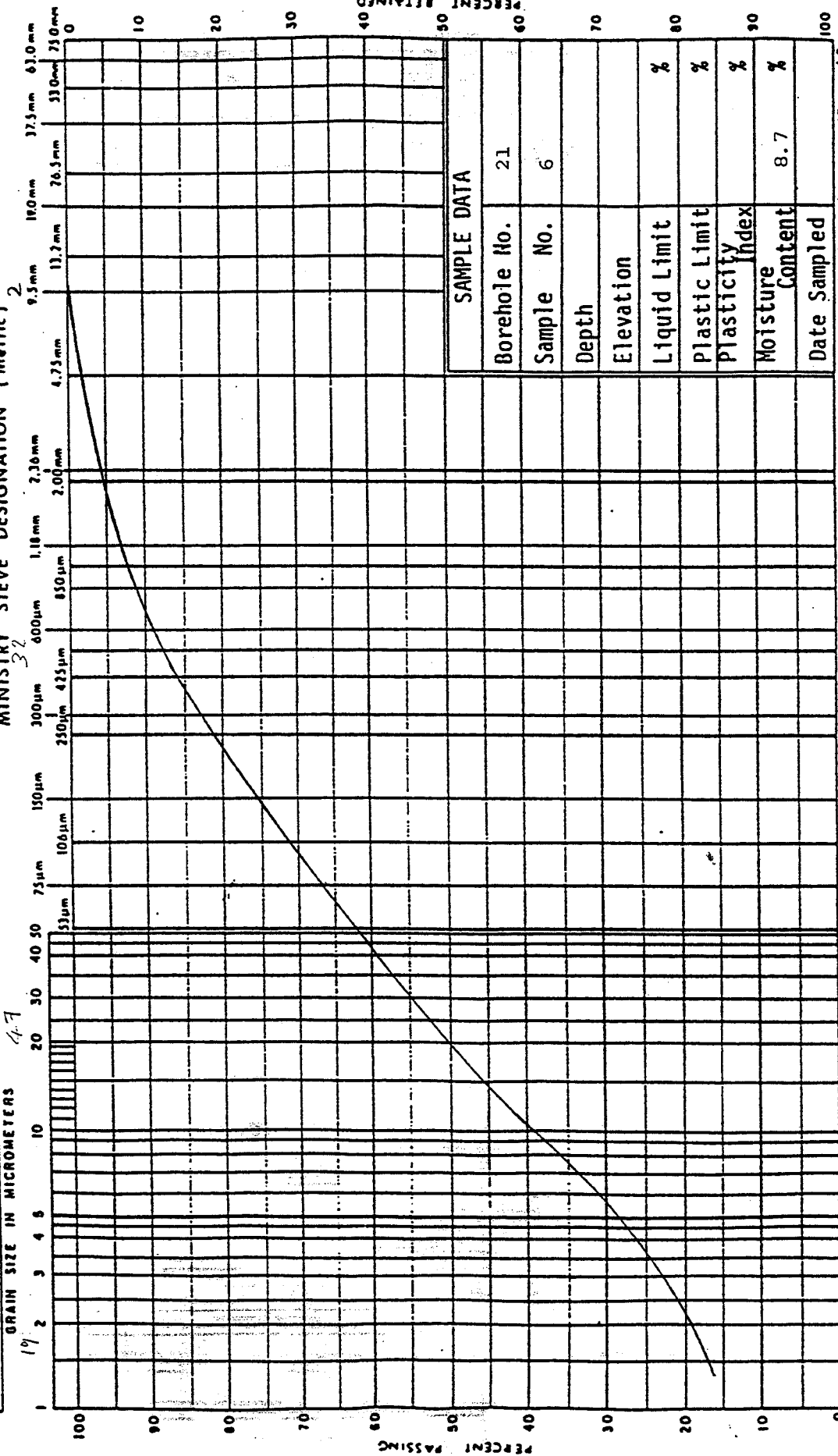
MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

Client: Strata Engineering	Job No. 98250
Project: High Mast Lighting	
Location: Highway 427	
Test date: October 26, 1998.	

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



CLAY & SILT

GRAIN SIZE IN MICROMETERS

1.3

MINISTRY SIEV

MINISTRY	SIEVE DESIGNATION (Metric)
1	75
2	150
3	300
4	600
5	1250
6	2500
7	5000
8	10000
9	20000
10	40000
11	80000
12	160000
13	320000
14	640000
15	1280000
16	2560000
17	5120000
18	10240000
19	20480000
20	40960000
21	81920000
22	163840000
23	327680000
24	655360000
25	1310720000
26	2621440000
27	5242880000
28	10485760000
29	20971520000
30	41943040000
31	83886080000
32	167772160000
33	335544320000
34	671088640000
35	1342177280000
36	2684354560000
37	5368709120000
38	10737418240000
39	21474836480000
40	42949672960000
41	85899345920000
42	171798691840000
43	343597383680000
44	687194767360000
45	1374389534720000
46	2748779069440000
47	5497558138880000
48	10995116277760000
49	21990232555520000
50	43980465111040000
51	87960930222080000
52	175921860444160000
53	351843720888320000
54	703687441776640000
55	1407374883553280000
56	2814749767106560000
57	5629499534213120000
58	11258999068426240000
59	22517998136852480000
60	45035996273704960000
61	90071992547409920000
62	180143985094819840000
63	360287970189639680000
64	720575940379279360000
65	1441151880758558720000
66	2882303761517117440000
67	5764607523034234880000
68	11529215046068469760000
69	23058430092136939520000
70	46116860184273879040000
71	92233720368547758080000
72	184467440737095516160000
73	368934881474191032320000
74	737869762948382064640000
75	1475739525896764129280000
76	2951479051793528258560000
77	5902958103587056517120000
78	11805916207174113034240000
79	23611832414348226068480000
80	47223664828696452136960000
81	94447329657392904273920000
82	188894659314785808547840000
83	377789318629571617095680000
84	755578637259143234191360000
85	1511157274518286468382720000
86	3022314549036572936765440000
87	6044629098073145873530880000
88	12089258196146291747061760000
89	24178516392292583494123520000
90	48357032784585166988247040000
91	96714065569170333976494080000
92	193428131138340667952988160000
93	386856262276681335905976320000
94	773712524553362671811952640000
95	1547425049106725343623905280000
96	3094850098213450687247810560000
97	6189700196426901374495621120000
98	12379400392853802748991242240000
99	24758800785707605497982484480000
100	49517601571415210995964968960000
101	99035203142830421991929937920000
102	198070406285660843983859875840000
103	396140812571321687967719751680000
104	792281625142643375935439503360000
105	

2.

MA

Corso

Coarse

PERCENT PASSING

SIEVE SIZE

2" 1 1/2" 1" 3/4" 3/8" 1/4" 1/8" 3/16" 1/32" 1/64" 1/128" 1/256" 1/512" 1/1024" 1/2048" 1/4096" 1/8192" 1/16384" 1/32768" 1/65536" 1/131072" 1/262144" 1/524288" 1/1048576" 1/2097152" 1/4194304" 1/8388608" 1/16777216" 1/33554432" 1/67108864" 1/134217728" 1/268435456" 1/536870912" 1/1073741824" 1/2147483648" 1/4294967296" 1/8589934592" 1/17179869184" 1/34359738368" 1/68719476736" 1/137438953472" 1/274877906944" 1/549755813888" 1/1099511627776" 1/2199023255552" 1/4398046511104" 1/8796093022208" 1/17592186044416" 1/35184372088832" 1/70368744177664" 1/140737488355328" 1/281474976710656" 1/562949953421312" 1/1125899906842624" 1/2251799813685248" 1/4503599627370496" 1/9007199254740992" 1/18014398509481984" 1/36028797018963968" 1/72057594037927936" 1/144115188075855872" 1/288230376151711744" 1/576460752303423488" 1/1152921504606846976" 1/2305843009213693952" 1/4611686018427387904" 1/9223372036854775808" 1/18446744073709551616" 1/36893488147419103232" 1/73786976294838206464" 1/147573952589676412928" 1/295147905179352825856" 1/590295810358705651712" 1/1180591620717411303424" 1/2361183241434822606848" 1/4722366482869645213696" 1/9444732965739290427392" 1/18889465931478580854784" 1/37778931862957161709568" 1/75557863725914323419136" 1/151115727451828646838272" 1/302231454903657293676544" 1/604462909807314587353088" 1/1208925819614629174706176" 1/2417851639229258349412352" 1/4835703278458516698824704" 1/9671406556917033397649408" 1/19342813113834066795298816" 1/38685626227668133590597632" 1/77371252455336267181195264" 1/154742504910672534362390528" 1/309485009821345068724781056" 1/618970019642690137449562112" 1/1237940039285380274899124224" 1/2475880078570760549798248448" 1/4951760157141521099596496896" 1/9903520314283042199192993792" 1/19807040628566084398385987584" 1/39614081257132168796771975168" 1/79228162514264337593543950336" 1/158456325028528675187087900672" 1/316912650057057350374175801344" 1/633825300114114700748351602688" 1/1267650600228229401496703205376" 1/2535301200456458802993406410752" 1/5070602400912917605986812821504" 1/10141204801825835211973625643008" 1/20282409603651670423947251286016" 1/40564819207303340847894502572032" 1/81129638414606681695789005144064" 1/162259276829213363391578010288128" 1/324518553658426726783156020576256" 1/649037107316853453566312041152512" 1/1298074214633706907132624082305024" 1/2596148429267413814265248164610048" 1/5192296858534827628530496329220096" 1/10384593717069655257060992658440192" 1/20769187434139310514121985316880384" 1/41538374868278621028243970633760768" 1/83076749736557242056487941267521536" 1/166153499473114484112975882535043072" 1/332306998946228968225951765070086144" 1/664613997892457936451903530140172288" 1/1329227995784915872903807060280344576" 1/2658455991569831745807614120560689152" 1/5316911983139663491615228241121378304" 1/10633823966279326983230456482242756608" 1/21267647932558653966460912964485513216" 1/42535295865117307932921825928971026432" 1/85070591730234615865843651857942052864" 1/170141183460469231731687303715884105728" 1/340282366920938463463374607431768211456" 1/680564733841876926926749214863536422912" 1/1361129467683753853853498429727072845824" 1/2722258935367507707706996859454145691648" 1/5444517870735015415413993718908291383296" 1/10889035741470030830827987437816582766592" 1/21778071482940061661655974875633165533184" 1/43556142965880123323311949751266331066368" 1/87112285931760246646623899502532662132736" 1/174224571863520493293247799005065324265472" 1/348449143727040986586495598010130648530944" 1/696898287454081973172991196020261297061888" 1/1393796574908163946345982392040522594123776" 1/2787593149816327892691964784081045188247552" 1/5575186299632655785383929568162090376495104" 1/11150372599265311570767859136324180752990208" 1/22300745198530623141535718272648361505980416" 1/44601490397061246283071436545296723011960832" 1/89202980794122492566142873090593446023921664" 1/178405961588244985132285746181186892047843328"

SAMPLE DATA

Borehole No. 23

Sample No	6
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Depth

<div style="display: flex; justify-content: space-between;"> <div> <p> 13 Elevation </p> </div> <div> <p> 14 Area </p> </div> </div>	<div style="display: flex; justify-content: space-between;"> <div> <p> 15 Volume </p> </div> <div> <p> 16 Weight </p> </div> </div>
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1. Principles of

[illegible]

Plasticity.

Moisture	10
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polymers of 0

3/4"	1 1/2"	3/4"	1"
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MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION



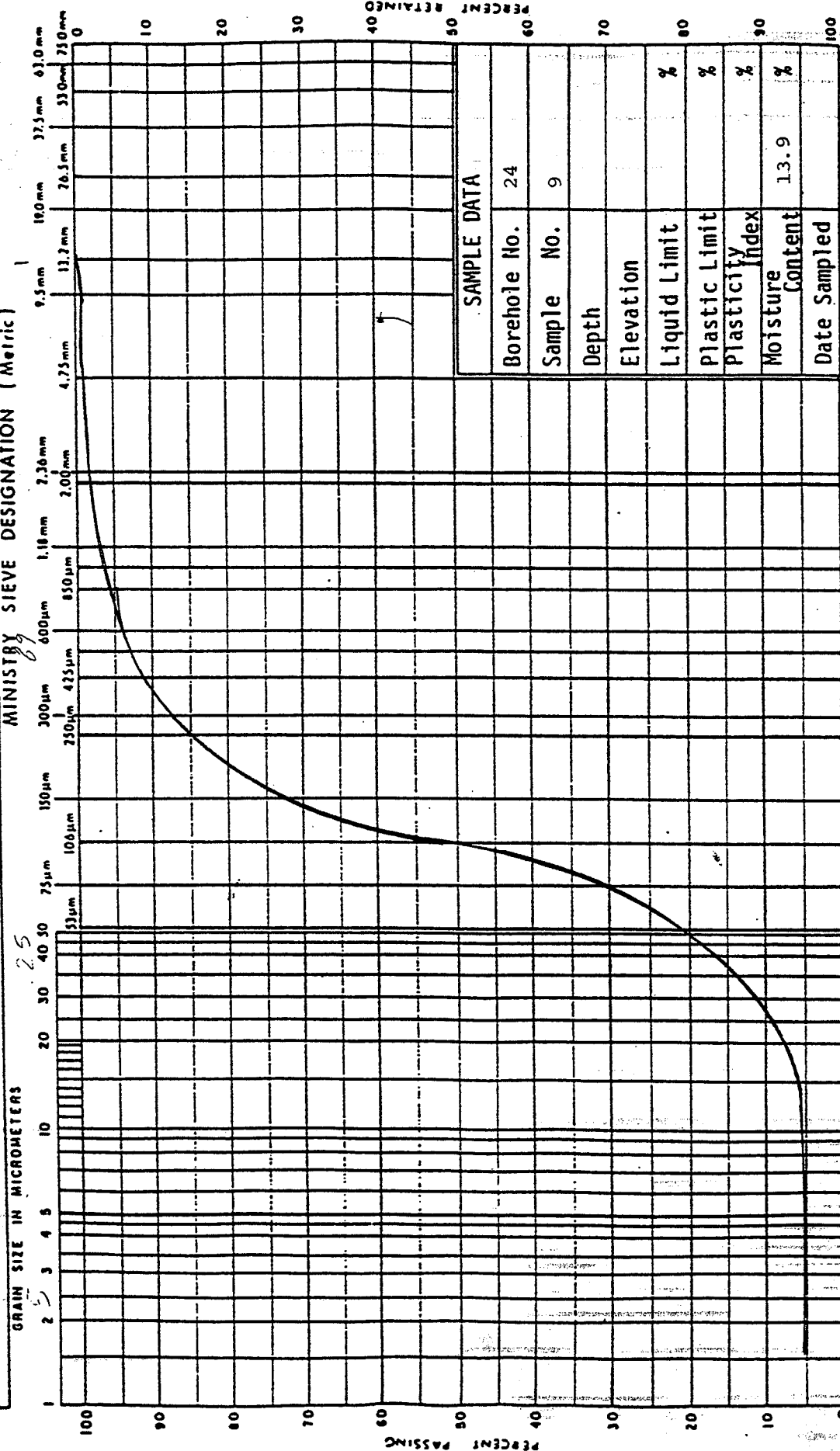
Client: strata Engineering Job No: 777-98250

Project: High Mast Lighting

Location: High rise

Test date: October 26, 1998.

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

SILTY SAND, traces of gravel and clay

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: Highway 427

Test date: October 28, 1998.



Course

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Borehole No.	25
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Sample No. 1

Dent

Elevation

liquid limit

Plastic limit

Plasticity

Moisture Content

Date Sampled _____

$$\frac{1}{2}, \frac{3}{4}, \frac{5}{8}$$

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION



CLAYEY SILT, some sand, traces of gravel

Client: Strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: High mass

Test date: October 28, 1998.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Coarse

Medium

Coarse

Fine

Coarse

Medium

Fine

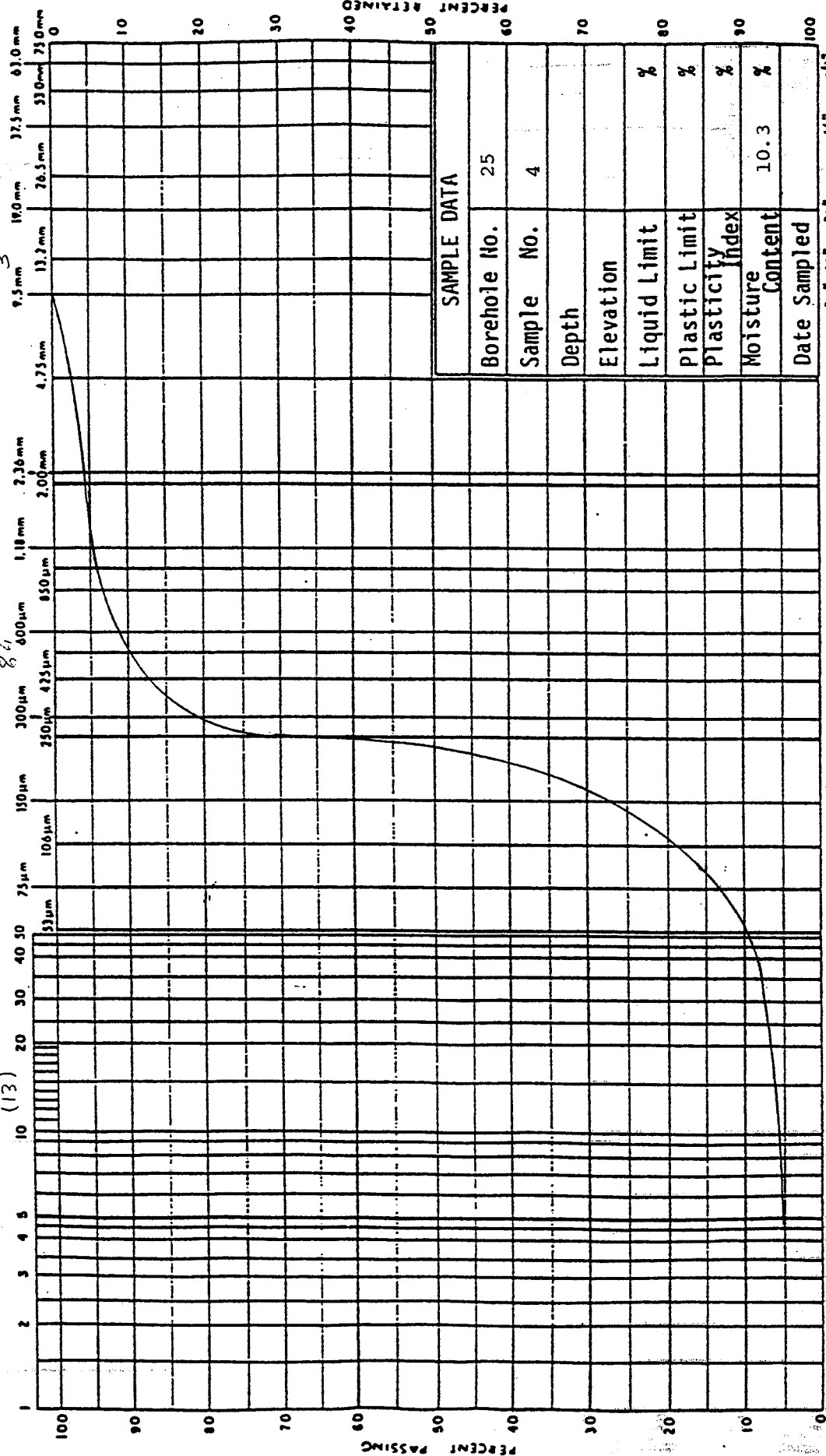
Coarse

GRAIN SIZE IN MICROMETERS
(13)

MINISTRY SIEVE DESIGNATION (Metric)

84

3



SAMPLE DATA

Borehole No.	25
Sample No.	4
Depth	
Elevation	
Liquid Limit	%
Plastic Limit	%
Plasticity Index	%
Moisture Content	10.3
Date Sampled	

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

Client: Strata Engineering Job No. ST-98250

Project: High Mast Lighting

Location: Highway 427

Test date: November 4, 1998.

SAND, traces of silt and gravel

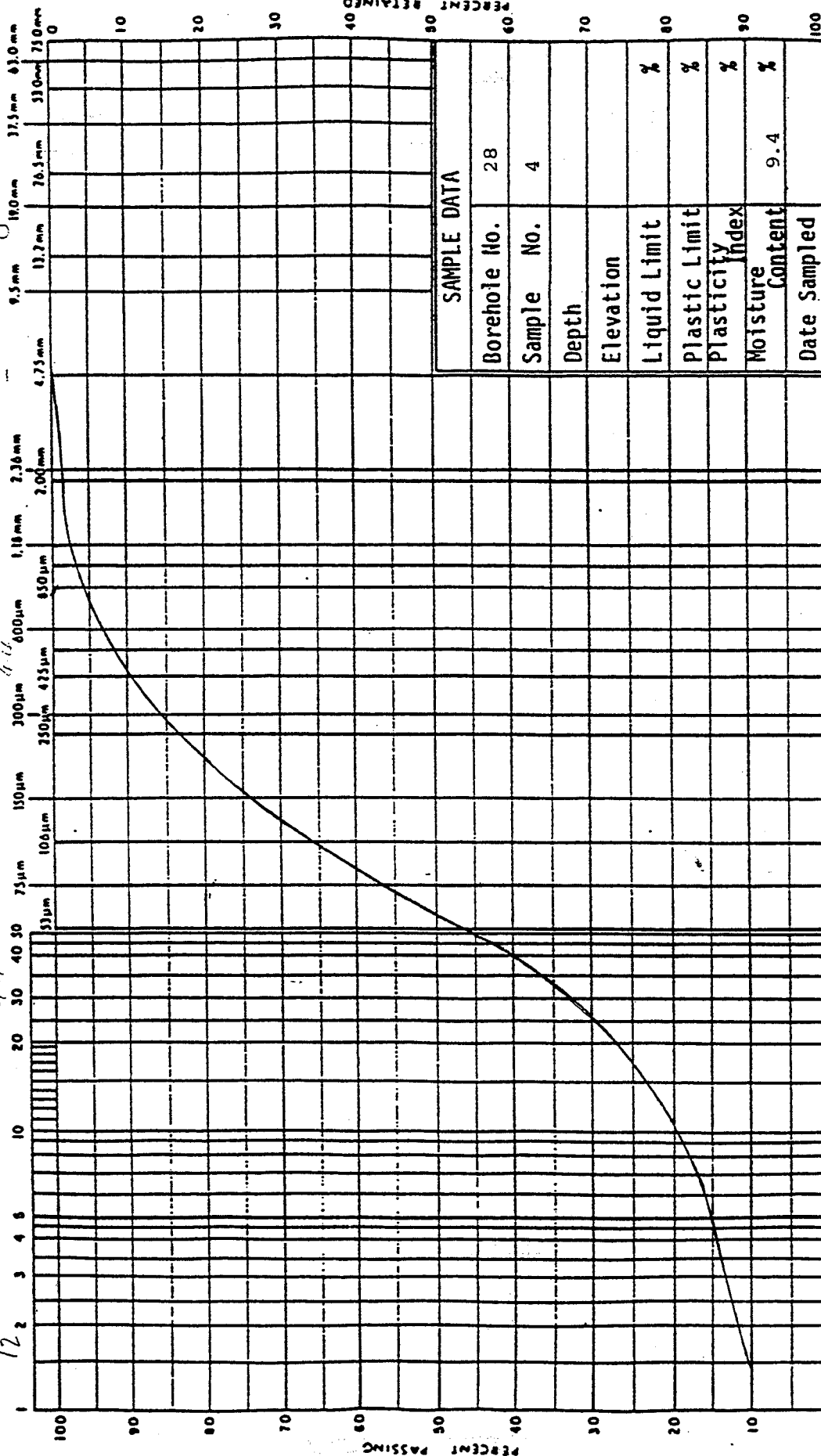
CLAY & SILT

GRAIN SIZE IN MICROMETERS

4.4.

MINISTRY SIEVE DESIGNATION (Metric)

STRY



GRAIN SIZE DISTRIBUTION

CLAYEY SILT, some sand

MINISTRY SIEVE DESIGNATION (Imperial)

Client: strata Engineering Job No. TT-98250

Project: High Mast Lighting

Location: Washington, DC

Test date: Highway 42 / October 26, 1998.