REPORT ON 1977 FIELD PROGRAMME

CARMACKS COAL PROJECT

Whitehorse Mining District

Yukon Territory

N.T.S. 115-I-1

Latitude: 62°05'N
Longitude: 136°15'W

By:

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Cyprus Anvil Mining Corporation

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TABLE OF CONTENTS

	Page
List of Tables	iii
List of Illustrations	iv
PART A - CARMACKS NORTH	
1. INTRODUCTION AND SUMMARY	1
2. AGE OF TANTALUS FORMATION	3
3. SPRING ROTARY DRILLING PROGRAMME	4
4. LINECUTTING AND GEOPHYSICS	8
5. SUMMARY ROTARY DRILLING PROGRAMME	10
6. PHOTOGRAMMETRY AND LEASE SURVEY	27
7. GEOLOGICAL COMPILATION OF OPEN PIT AREA	29
8. CONCLUSIONS AND RECOMMENDATIONS	31
PART B - CARMACKS SOUTH	
1. INTRODUCTION AND SUMMARY	32
2. PETROGRAPHIC ANALYSIS	33
3. LINECUTTING AND GEOPHYSICS	35
4. GEOPHYSICAL LOGGING	41
5. CONCLUSIONS AND RECOMMENDATIONS	42
List of References	43
APPENDIX I - 1977 Rotary Drill Records - Carmacks North	

LIST OF TABLES

		Page
TABLE 1	Results of Analyses - Samples and Composites, 1977 Rotary Cuttings	16
TABLE 2	Cluster Listing - Individual Samples, Analytical Data for 1977 Rotary Cuttings	19
TABLE 3	Analytical Data for 1976 Composites Recalculated at S.G. 1.8	21
TABLE 4	Cluster Listing - 1976 and 1977 Composites	22
TABLE 5	Petrographic Analysis of Composites T-5 and T-7	34

LIST OF ILLUSTRATIONS

Figures

1	Drill Hole Location Map, Carmacks North	Page 5
2	Carmacks North Trench Plans	In Pocket
3	EM-16 Profiles	Page 38
4	EM-16 Contours	Page 39

Maps

1	Carmacks North, Geological Map of Open Pit Area	In Pocket
2	Coal Leases in Carmacks Area	In Pocket
3	Geological Map of Carmacks South Coal Lease Area	In Pocket

PART A

CARMACKS NORTH

1. INTRODUCTION AND SUMMARY

Exploration activity on Carmacks North in 1977 was confined to those areas with previous indication of coal reserves down-dip from the present underground working and in the area around the small open pit. The objectives of the 1977 programme were to outline sources of coal for the short-term supply to the Anvil Mine.

Forty-two rotary drill-holes, ranging in depth from 83 feet to 628 feet, were drilled. Three of these were sited in the mine yard to test the feasibility of opening a second, lower adit. The remaining holes were drilled around the open pit to test the geological interpretation and outline reserves. Rotary cuttings of coal intersections in selected holes were sampled for analysis. Geophysical logs were obtained for 33 of the holes and for part of 1976 diamond drill-hole C-76-11. Lithological descriptions, based upon cuttings logs and/or geophysical logs, depending upon availability, were compiled.

A programme of experimental geophysics was carried out in the Carmacks area during the summer of 1977. The objective was to assess the usefulness of various geophysical methods in prospecting for coal in areas of thick overburden. On Carmacks North, these tests were carried out on three east-west lines 100 feet apart, perpendicular to strike, across the open pit area. Of the methods employed, only side-looking dipole-dipole resistivity appeared to show promise as a method for detecting coal seams.

New aerial photographs of the Carmacks properties were obtained, and all necessary control surveys for tying the area to the Territorial Plane Coordinate System and Geodetic datum were undertaken. Coal Mining Lease and

Lot cornerposts were located and targetted, and a map showing actual locations of all the leases was prepared. A new topographic map of the open pit area, at a scale of 1 inch to 100 feet, was obtained and, using this map, a new geological compilation of the open pit area was prepared.

Since the structure of the area to the east of the open pit is not fully understood, further exploratory drilling will be required before any coal can be mined here. South of the open pit, reserves of approximately 40,000 raw short tons of coal are present in the syncline at a stripping ratio of 2.5:1.

Continued trenching and drilling is recommended.

2. AGE OF TANTALUS FORMATION

Fossil plant specimens collected from core from Hole C-76-5 during 1976 were sent to Professor Wilson N. Stewart, Department of Botany, University of Alberta for identification. It was hoped that these specimens might provide a more precise age determination for the Tantalus Formation.

Professor Stewart identified the following specimens:

At 540-foot depth: *Cladophlebis* sp. (poorly preserved)

At 871-foot depth: *Cladophlebis* c.f. *angustifolia*
Cladophlebis virginiensis
Equisetites (nodal region)
Phoenicopsis angustifolia
Phyllites sp.
Pityophyllum nordenskioldii

With the exception of *Equisetites*, all have previously been reported from the Tantalus Formation. Unfortunately all are wide-ranging Mesozoic species. Professor Stewart's judgement is that these rocks probably span the Jurassic-Cretaceous boundary. Hence they are approximately time-correlative with the Kootenay Formation of southern B.C. and Alberta.

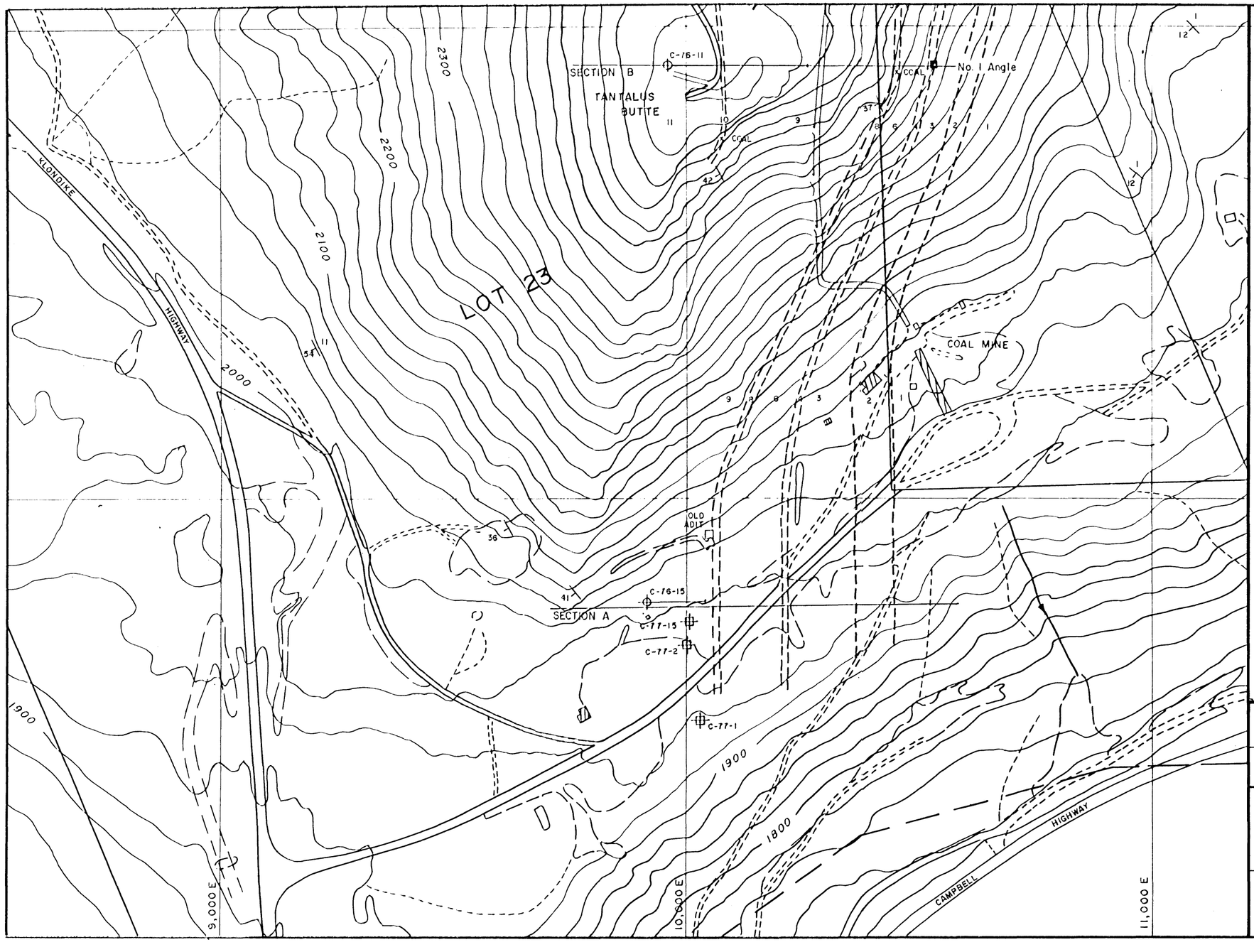
3. SPRING ROTARY DRILLING PROGRAMME

3.1 Mine Yard Area

During April, three rotary holes totalling 859 feet were drilled in the mine yard. The purpose of these holes was to investigate the feasibility of starting a new adit at a lower level, in order to recover reserves down-dip from the present main entry level (see Hampton, 1977). The three holes were intended to locate accurately No. 3 Seam ("Main seam") at depth and to determine thickness of overburden. Locations of these holes are shown on Figure 1. The first two holes (C-77-1 and 2) were drilled with tricone rock-bits (rotary drilling), using mud in overburden and air in bedrock. This process proved extremely slow and very destructive on bits. The third (C-77-15) was drilled with tricone using mud in overburden, and with down-hole hammer (rotary-percussion drilling) in bedrock. The latter process proved much faster and more efficient. All-inclusive average cost for the three holes was $23.29 per foot.

The first hole bottomed at 242 feet, still in overburden. The second penetrated 127 feet of overburden; a black coaly mudstone horizon which was initially taken to be No. 3 Seam was intersected from 282 to 287 feet, and the hole was terminated at 300 feet. Subsequently it was suggested that hole no. 2 did not reach No. 3 Seam. This was confirmed by hole C-77-15, which passed through 98 feet of overburden and ten feet of rather dirty coal from 293 to 303 feet, below the coaly mudstone encountered in hole C-77-2.

Results of the drilling indicated that the proposed lower portal would require considerable expense for a long tunnel through gravel



Road ——— Trail = = = = = =

Surface projection of Main Entry

Location of raise or angle

Diamond Drill Hole

Rotary Drill Hole

LOWER CRETACEOUS AND/OR UPPER JURASSIC

TANTALUS FORMATION

11	Conglomerate and pebbly sandstone
10	No. 1 Coal Seam
9	Conglomerate and pebbly sandstone.
8	No. 2 Coal Seam
7	Brown mudstones and siltstones
6	Conglomerate and pebbly sandstone
5	Brown and dark grey siltstones and mudstones
4	No. 3 Coal Seam
3	Thin-bedded, Light grey sandstones and siltstones
2	Dark brown and dark grey mudstones, black carbonaceous mudstones and thin coal seams
1	Conglomerate, pebbly sandstone and coarse grained sandstone

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

TANTALUS BUTTE COAL MINE
CARMACKS, Y. T.
DRILLING IN MINE YARD AREA

DATE: APR 28, 1978
SCALE: 1"= 200'
DRAWN BY: C. L. C.

0 100 200 300 400
SCALE IN FEET

To Accompany Report by
R.P. HILL, FEB., 1978
FIGURE 1

overburden before underground development for extraction of coal could begin. It was considered that these high initial costs would result in coal which would still be lower in price than an equivalent quantity of fuel oil, but substantially more expensive than opencast coal obtained by further development in the open pit area (M. O. Hampton, personal communication, 1977). It was therefore decided that work on a new adit would not commence until the potential of the open pit area was better known.

3.2 Open Pit Area

During April twelve rotary-percussion holes were drilled south of the present open pit, in order to test the writer's hypothesis that No. 3 Seam in the pit occupied a tight syncline extending southwards (Hill, 1977). Aggregate drilled depth was 1,824 feet, at an average all-inclusive cost of $19.37 per foot. Since the rig being used was restricted to vertical holes, and the hypothetical syncline was presumed to be rather tight with steeply-dipping limbs, holes were drilled on 40 to 50 foot spacings on lines 100 to 150 feet apart. Locations of these holes (C-77-3 to C-77-14 inclusive) are shown on Map 1 and the accompanying cross-sections.

In retrospect, several of these holes could have been drilled deeper to eliminate alternative interpretations. However, the results are considered to have confirmed the writer's hypothesis, and established the presence of a tight, asymmetrical syncline. Observations within the pit indicate that the syncline is complicated by steeply-dipping strike faults. The fold plunges about 10^{o} to the south; the coal seam is greatly thickened in the hinge zone and somewhat attenuated in the limbs (see Map 1 and accompanying sections). Rock "lenses"

were intersected within the thickened portions of the seam, and these may be fault slices or blocks of footwall sandstone emplaced tectonically, or rock partings (e.g. channel fillings) originally present within the seam.

4. LINECUTTING AND GEOPHYSICS

4.1 Linecutting

In order to facilitate geophysical test procedures on Carmacks North several cut lines perpendicular to strike were required. It had been proposed that the tests should be conducted on three lines one hundred feet apart and four thousand feet long. It was therefore considered desirable to erect a line grid-system which would accommodate these requirements, and which could later be extended to locate lines for any further geophysics or drilling. The original 1971 C.E.M. grid was considered unsuitable because of inconsistent orientation and spacing of the lines.

The new grid was erected by selecting Line 60+00 feet north to fall east-west through drill-holes C-77-5 to C-77-8 inclusive (see Map 1), thus causing Line 0+00 to fall at the extreme southern end of the property. A north-south baseline was located by selecting an arbitrary point of origin (0+00) about 15 feet east of hole C-77-8 on Line 60+00. Lines 58, 59 and 60 were chosen for the geophysical tests in order to compare the profiles with the drill-hole data, and were cut from 18+00 feet west to 22+00 feet east.

4.2 Geophysics

The geophysical testing consisted of the following:

(a) Induced Polarisation (Gradient-array Resistivity and Chargeability), on Lines 58 and 60 from 5+00W to 5+00E. No response was apparent over the known coal subcrops on the limbs of the syncline.

(b) Bouguer Gravity, on Line 58 from 5+00W to 5+00E. A slight, constant gravity gradient, apparently unrelated to known bedrock geology, was found over the length of the profile.

(c) Very low frequency (V.L.F.) electromagnetic, using the EM-16 system, on Lines 58 and 60 from 5+00W to 20+00E. There appeared to be no particular response over the known coal seams, but a very pronounced anomaly was encountered at about 17+00E. This anomaly is as yet unexplained, but it does occur in the general vicinity of the expected Laberge/Tantalus contact.

(d) Side-looking dipole-dipole resistivity on Line 59 towards Line 60, from 5+00W to 10+00E. A rather irregular profile was obtained, but the response appeared quite closely linked to known or suspected bedrock geology. Two moderate peaks at 1+70W and 0+50E appeared to coincide approximately with No. 3 Seam subcrops in the west and east limbs of the syncline respectively. A third, larger peak was located slightly to the west (at 3+50W) at approximately the expected position of No. 3 Seam in the west limb of the postulated accompanying anticline (see Hill, 1977; p. 16). Two still larger peaks, at 2+25E and 4+25E, appear to coincide quite closely with thick coal seams which were subsequently discovered by drilling and trenching. These anomalies are shown on Cross-Section 60+00.

Of the various geophysical methods tried, the side-looking resistivity appears to be the only method which might be useful for detecting and tracing coal seams in this area. A more detailed treatment of these results is expected in a separate report by Peter E. Walcott.

5. SUMMER ROTARY DRILLING PROGRAMME

5.1 Drilling

Drilling in the open pit area was resumed in June, the initial objectives being to trace the syncline further south and to determine whether or not an anticline was present west of the syncline.

During this project, a dust-collector was employed in an attempt to sample rotary cuttings from the coal intersections for analysis, in order to give an approximate determination of coal quality. Sampling and analytical techniques are described in Section 5.2. Since the sampling method proved far from satisfactory, it was decided that geophysical logs should be run also (see Section 5.3).

Five holes, 80 to 200 feet apart, were drilled on two lines 200 feet apart (C-77-16 to 20 inclusive - see Map 1 and Sections 57+00 and 59+00). The presence of the accompanying anticline was apparently confirmed, and the trend length of the syncline south of the pit was extended to about 600 feet. Evidence of seam splitting was found in several of the holes, hence the "rock lenses" encountered in the April drilling may be of sedimentary origin (partings or channel-fillings) rather than tectonic slices or blocks. This indicates that the term "Main Seam", if used at all, must be confined to that thick portion of No. 3 Seam which was mined underground.

After these five holes were completed, it became apparent that the existing interpretation of 1976 diamond drill-hole data on Section D (Hill, 1977) was not correct. A rotary-percussion hole (C-77-21) was drilled on this section, sited to hit the synclinal axis at depth. A revised interpretation of Section D is presented in this report as

Section 54+00.

During July, it was suggested that whilst the drill was on site it would be advantageous to drill several holes in the "undulating plateau" area east and northeast of the open pit. No trenching or drilling had ever been done here, an area without a single outcrop. The rationale for this decision was based on two hypothyses:

1. since the topography of the area was rather subdued, it was more likely to be underlain by recessive rocks such as mudstones and siltstones (and hence, possibly, coal) rather than by Tantalus conglomerates, which invariably produce prominent features;

2. the presence of a tight, faulted fold structure within the pit suggested the possibility of repeated fold and/or fault structures in this area also, and any such structures might yield substantial additional surface-minable reserves.

The first hole (C-77-22, see Map 1 and Section 60+00) intersected four coal horizons from 6 to 31 feet thick between 26 feet and 108 feet depth, and the second hole (C-77-23) intersected 14 feet from 42 feet depth. As a result of this success, it was decided to drill off a large part of the "plateau" on regular spacings. Three lines eight hundred feet apart were chosen, the first being Line 60+00 for purposes of comparison with the geophysical data. Initially, holes were spaced at 200 foot intervals along the lines, but inability to trace lithologies between adjacent holes led to the siting of several intermediate holes, locally reducing the spacing to 100 feet.

In addition, two holes were drilled north of the pit to test possible continuity of the known synclinal structure. Of 22 holes drilled in this area (C-77-22 to 42 inclusive), 15 intersected appreciable thicknesses of coal. Geological interpretations are discussed in Section 7. As it turned out, the plateau area is underlain largely by Tantalus conglomerates, but with interbedded coal/mudstone horizons.

The Summer drill programme resulted in 27 holes with an aggregate depth of 8,724 feet at an average all-inclusive cost of $15.39 per foot. Aggregate drilled depth in 1977 was 11,406.5 feet at an overall average all-inclusive cost of $16.62 per foot, or slightly more than half the cost of the previous year's diamond drill programme.

5.2 Sampling and Analytical Procedures

(a) Sample Collection

During the summer drilling programme, a standard dust-collector was used in an attempt to sample coal cuttings for analysis. It was hoped that by analysing the cuttings, some approximate coal quality data could be obtained. Such data would be useful for two purposes:

1. determining which areas of coal were suitable and could be economically mined;

2. distinguishing between different seams, hence assisting with stratigraphic correlation.

The method was fairly successful at collecting the cuttings,

since a fairly large sample (10 to 20 lb.) could be collected over a given 5-foot interval. However, there were considerable difficulties encountered which cast doubts on the usefulness of this method as a means of obtaining reliable and representative coal quality data. These difficulties, and attempts made to circumvent them, are outlined below.

1. It proved to be extremely difficult to anchor the collector into the ground around the hole; as a result perhaps 30 to 40% of air and cuttings by-passed the collector altogether and were lost. Welding the collector to a short piece of casing did not help much. This difficulty could probably be overcome if the collector were modified to enable it to be attached to a standard length of casing after the casing is installed in the hole; however, the necessity of installing casing in every hole would likely increase costs substantially.

2. Cuttings were slow in arriving at the surface, particularly when drilling at depth. Thus it was impossible to obtain accurate footages for changes in lithology or for coal intersections. (Geophysical logs later showed that the driller's footage was often in error by as much as three feet.)

3. In deeper holes, it appeared that denser particles remained suspended in the air column longer, and were discharged more slowly, than lighter particles. Hence if collection was begun at the first appearance of coal dust, a great deal of extraneous cuttings were collected along with the coal. In order to get around this problem, the hole was blown out as soon as coal cuttings were observed, and then after each 5-foot

interval of drilling in coal the cuttings could be blown into the collector. This procedure proved reasonably effective, except that the cuttings from the first couple of feet of a coal intersection were lost and hence could not be sampled. This method was, however, particularly time-consuming (especially as a great many coaly intersections were only a few inches or a foot or so thick and no sample could be obtained), and was later abandoned.

4. It proved impossible to collect cuttings from below water table since all that came out of the hole was black slime.

(b) Sample Analysis

In order to get around the problem of extraneous cuttings in the coal samples, coal and rock were separated by float-sinking all samples prior to analysis. On the advice of the analytical laboratory (Cyclone Engineering) a specific gravity of 1.80 was chosen as a suitable cut-off point. Unfortunately this method also resulted in removal from the samples of mudstone partings occurring within the coal seams. Thus ash values obtained cannot be taken as actual values of the coal in situ, and these results are not directly comparable with analyses obtained for 1976 core samples. However, internal correlation among the samples can be undertaken since all samples were treated similarly. The percentage recovery of coal at S.G. 1.80 may be taken as a very approximate guide to local proportions of coal to rock within the seam.

After float-sinking, each sample was split into two parts. Half was analysed separately, and the other half combined into seam composites. Proximate analyses, calorific values (B.T.U./lb.), F.S.I. and sulphur determinations were made on each of 108

individual samples and 25 seam composites. The results are presented in Table 1.

Initial inspection of the analytical data suggested that four samples (C-66, C-81, C-90 and C-106), being from near to surface, were oxidised. Indication was that most of the remainder could be placed in one of three groups:

1. a group with high moisture values (approx. 8 to 11%),
2. a group with high ash values (approx. 17 to 25%),
3. a large group with relatively much lower moisture and ash values.

At face value, this would tend to suggest correlation with Seams 1, 2 and 3 respectively (see Hill, 1977, p. 25). However, difficulties arose when applying this assumed correlation to a geological interpretation; e.g.

1. the seams in some holes appeared to lie in the wrong order, necessitating complex structural interpretations;
2. lack of previous data from No. 4 seam for comparison;
3. a few samples fell outside all three groups, and some could be placed in more than one group.

(c) Processing of Analytical Data

In an attempt to determine more definitively how many distinct seams were represented by the samples, a firm of consultant mathematicians (Tetrad Computer Applications Ltd.) was engaged to investigate statistical methods of handling the analytical data using computers. It was decided that the most appropriate test method would be Cluster Analysis. This method involves

TABLE 1

RESULTS OF ANALYSES - SAMPLES AND COMPOSITES, 1977 ROTARY CUTTINGS

Hole No.	Footage (Driller's)	Sample No.	Composite No.	Moist. %	Ash %	Volatiles %	Fixed Carbon %	Fixed Carbon % (DMMF)	S %	B.T.U. per lb. (raw)	B.T.U. per lb. (MMMF)	% Recovery @ SG 1.8	F.S.I.
C-77-16	209 - 214	C-50	R- 1	4.42	9.45	30.76	55.37	64.95	0.39	12,370	13,787	65.52	2
	215 - 223	C-51	R- 1	4.23	11.51	30.53	53.73	64.53	0.24	12,040	13,756	64.53	2
		Composite	R- 1	4.14	9.92	30.75	55.19	64.91	0.38	12,300	13,787	66.37	2
C-77-16	230 - 236	C-52	R- 2	5.82	8.38	26.66	59.14	69.58	0.40	12,210	13,436	92.64	½
	237 - 243	C-53	R- 2	3.90	12.30	26.39	57.41	69.40	0.26	11,890	13,719	90.89	2
		Composite	R- 2	4.08	10.12	26.78	59.02	69.53	0.30	12,220	13,728	90.90	½
C-77-18	237 - 241	C-54	R- 3	3.78	13.45	32.84	49.93	61.22	0.44	12,100	14,171	65.33	2
C-77-18	263 - 271	C-55	R- 4	3.16	16.73	30.38	49.73	63.24	0.44	11,510	14,063	68.25	½
C-77-19	107 - 112	C-56	R- 5	3.52	5.68	31.74	59.06	65.45	0.32	13,090	13,955	84.46	1½
	112 - 117	C-57	R- 5	3.21	9.06	31.09	56.64	65.15	0.21	12,550	13,917	87.86	½
	117 - 124	C-58	R- 5	3.19	8.42	29.71	58.68	66.95	0.21	12,580	13,845	87.94	½
		Composite	R- 5	3.24	7.02	30.92	58.82	66.01	0.23	12,910	13,976	85.05	1
C-77-20	239 - 244	C-59	R- 6	3.27	7.87	32.62	56.24	63.87	0.54	13,050	14,279	80.09	1
	244 - 250	C-60	R- 6	3.33	9.54	28.24	58.89	68.26	0.28	12,460	13,900	86.40	1½
	250 - 253	C-61	R- 6	4.24	12.91	28.66	54.19	66.31	0.31	11,750	13,663	75.46	½
		Composite	R- 6	3.15	9.29	29.56	58.00	66.92	0.43	12,680	14,107	78.63	1
C-77-20	308 - 310	C-62	R- 7	3.20	9.30	28.69	58.81	67.87	0.33	12,460	13,861	88.93	1½
	310 - 314	C-63	R- 7	3.50	8.49	33.09	54.92	62.94	0.24	12,480	13,747	14.78	1½
	314 - 319	C-64	R- 7	3.99	10.90	30.43	54.68	64.97	0.24	12,240	13,880	85.12	2
	319 - 324	C-65	R- 7	2.88	9.24	28.17	59.71	68.58	0.24	12,280	13,648	84.54	2
		Composite	R- 7	3.00	9.19	31.63	56.18	64.59	0.29	12,420	13,797	84.94	1½
C-77-22	30 - 35	C-66	R- 8	4.78	21.76	32.75	40.71	56.81	0.20	8,810	11,520	68.28	0
	35 - 44	C-67	R- 8	4.40	19.99	29.97	45.64	61.73	0.23	10,320	13,168	66.12	0
	47 - 52	C-68	R- 8	3.40	20.11	30.87	45.62	61.03	0.41	10,820	13,836	51.03	1
	52 - 57	C-69	R- 8	2.93	20.24	28.96	47.87	63.78	0.51	10,870	13,928	60.08	1½
		Composite	R- 8	3.94	20.12	29.84	46.10	62.09	0.26	10,330	13,205	65.93	0
C-77-22	64 - 70	C-70	R- 9	3.21	12.95	29.85	53.99	65.30	0.37	11,940	13,893	50.69	2
	70 - 73	C-71	R- 9	3.41	13.45	31.92	51.22	62.47	0.25	11,830	13,848	69.15	1½
		Composite	R- 9	3.29	13.10	31.73	51.88	62.90	0.28	11,930	13,905	56.12	1½
C-77-22	105 - 110	C-72	R-10	4.31	19.45	29.61	46.63	62.48	0.17	10,610	13,437	60.05	½
C-77-23	44 - 49	C-73	R-11	8.03	4.15	31.77	56.05	64.16	0.40	10,450	10,945	96.56	0
	49 - 54	C-74	R-11	9.01	5.37	34.60	51.02	59.97	0.40	9,800	10,401	98.27	0
	54 - 58	C-75	R-11	11.20	9.00	32.82	46.98	59.47	0.27	9,100	10,081	66.95	0
		Composite	R-11	8.99	5.45	33.33	52.23	61.43	0.32	9,850	10,469	85.79	0
C-77-23	66 - 71	C-76	R-12	10.08	12.30	30.45	47.17	61.66	0.45	9,160	10,567	58.26	0
	71 - 74	C-77	R-12	9.10	17.89	29.31	43.70	60.69	0.53	8,740	10,839	36.43	0
		Composite	R-12	9.34	14.58	29.98	46.10	61.66	0.49	9,090	10,794	45.92	0

TABLE 1 - page 2

Hole No.	Footage (Driller's)	Sample No.	Composite No.	Moist. %	Ash %	Volatiles %	Fixed Carbon %	Fixed Carbon % (DMMF)	S %	B.T.U. per lb. (raw)	B.T.U. per lb. (MMMF)	% Recovery @ SG 1.8	F.S.I.
C-77-27	276 - 281	C-78	R-13	3.54	13.66	28.51	54.29	66.57	0.48	11,860	13,928	60.46	1½
	281 - 286	C-79	R-13	2.88	4.67	31.19	61.26	66.65	0.50	13,490	14,221	87.24	1
	286 - 290	C-80	R-13	2.68	15.81	28.95	52.56	65.61	0.41	12,050	14,546	58.11	½
		Composite	R-13	2.77	9.43	30.48	57.32	65.94	0.38	12,720	14,174	66.07	1
C-77-34	21 - 26	C-81	R-14	9.31	25.29	27.72	37.68	59.54	0.30	7,030	9,673	64.12	0
	26 - 31	C-82	R-14	11.42	17.63	32.00	38.95	56.09	0.34	8,090	9,995	44.95	0
		Composite	R-14	9.64	22.55	29.81	38.00	57.65	0.30	7,620	10,075	56.74	0
C-77-34	33 - 38	C-83	R-15	10.95	22.68	28.46	37.91	58.84	0.43	7,720	10,228	64.76	0
	38 - 43	C-84	R-15	8.97	13.91	30.05	47.07	62.02	0.37	9,400	11,067	69.78	0
	43 - 48	C-85	R-15	9.68	25.56	26.62	38.14	60.90	0.29	7,500	10,363	63.07	0
	48 - 51	C-86	R-15	8.70	10.69	31.68	48.93	61.44	0.36	9,780	11,061	89.86	0
		Composite	R-15	9.04	15.95	30.62	44.39	60.29	0.36	9,060	10,950	67.67	0
C-77-34	71 - 77	C-87	R-16	9.41	16.61	29.55	44.43	61.26	0.40	8,890	10,838	77.76	0
C-77-34	168 - 174	C-88	R-17	3.17	20.99	25.81	50.03	67.57	0.36	10,770	13,940	80.05	½
	174 - 179	C-89	R-17	2.78	19.46	29.50	48.26	63.40	0.28	10,930	13,848	48.23	½
		Composite	R-17	2.86	19.97	27.55	49.62	65.74	0.30	10,870	13,869	62.61	½
C-77-35	46 - 53	C-90	R-18	7.34	20.37	35.79	36.50	51.71	0.29	8,360	10,721	70.63	0
C-77-35	203 - 208	C-91	R-19	7.23	6.08	29.40	58.95	68.53	0.54	11,960	12,812	97.00	½
	208 - 213	C-92	R-19	5.57	4.50	30.47	59.46	66.48	0.39	12,360	13,000	97.16	0
		Composite	R-19	6.03	5.65	28.38	59.94	68.31	0.37	12,170	12,969	97.08	0
C-77-38	189 - 194	C-93	R-20	6.13	13.83	29.32	50.72	64.37	0.42	11,220	13,201	76.59	½
	194 - 196	C-94	R-20	5.79	16.02	29.10	49.19	64.03	0.26	10,250	12,400	71.32	0
		Composite	R-20	5.83	15.02	29.20	49.95	64.16	0.29	10,960	13,090	67.68	0
C-77-39	178 - 183	C-95	R-21	3.55	18.26	32.78	45.41	59.25	0.29	10,800	13,462	73.02	1
C-77-39	266 - 271	C-96	R-22	4.06	13.30	30.62	52.02	63.84	0.27	11,760	13,741	78.36	½
	271 - 276	C-97	R-22	3.18	11.71	31.00	54.11	64.37	0.36	12,300	14,092	74.59	1
	276 - 281	C-98	R-22	5.15	13.19	30.67	50.99	63.39	0.53	11,580	13,519	76.16	½
	281 - 286	C-99	R-22	4.28	12.23	29.54	53.95	65.53	0.55	11,940	13,773	81.12	1½
		Composite	R-22	3.71	12.38	30.12	53.79	64.96	0.37	12,010	13,875	75.14	1½
C-77-39	292 - 296	C-100	R-23	4.15	16.29	27.55	52.01	66.61	0.55	11,180	13,583	82.33	½
	296 - 302	C-101	R-23	3.30	9.74	30.71	56.25	65.35	0.33	12,640	14,136	79.72	1
	302 - 307	C-102	R-23	5.24	12.49	29.15	53.12	65.45	0.35	11,520	13,326	70.69	½
	307 - 311	C-103	R-23	3.66	15.58	28.91	51.85	65.29	0.29	11,800	14,197	71.95	1½
		Composite	R-23	3.17	12.96	30.74	52.53	63.97	0.37	11,750	13,673	72.14	½
C-77-40	116 - 121	C-104	R-24	5.18	7.24	28.62	58.96	67.90	0.49	12,200	13,247	90.19	0
	121 - 126	C-105	R-24	3.47	10.06	29.92	56.55	66.10	0.34	12,500	14,034	79.81	½
		Composite	R-24	4.01	8.89	29.47	57.63	67.89	0.38	12,470	13,805	82.97	0
C-77-41	22 - 27	C-106	R-25	9.87	25.65	27.02	37.46	60.13	0.42	7,120	9,851	35.27	0
	27 - 32	C-107	R-25	8.91	24.07	26.35	40.67	62.61	0.45	7,970	10,775	56.65	0
	32 - 36	C-108	R-25	9.10	22.12	28.82	39.96	59.75	0.43	7,730	10,160	68.26	0
		Composite	R-25	9.50	24.26	25.63	40.61	63.33	0.45	7,800	10,574	52.51	0

plotting each sample in n-dimensional space (where n is the number of variables), thus identifying natural groupings or "clusters".

After several trial iterations of the cluster analysis on the 104 unoxidised samples, it was discovered that several of the variables could be discarded. Percentage of sulphur was eliminated since values were uniformly very low and did not contribute to the clustering process. Fixed Carbon (raw) and B.T.U./lb. (raw) were eliminated since they were partially dependent variables, i.e. depending upon ash content. It was found that percent ash and percent recovery at S.G. 1.8 were both random variables and did not contribute to the clustering process, i.e. they vary continuously within each seam.

The most meaningful clustering was achieved by using the variables Moisture, Volatiles (raw), Fixed Carbon (d.m.m.f.), B.T.U./lb. (m.m.m.f.) and F.S.I. It was found that with a single exception (sample C-93), all the samples could be grouped into three well-defined clusters which could be interpreted, consistent with available geological evidence, to represent three different seams. These clusters are listed in Table 2.

In order to compare the analytical data for 1977 rotary cuttings with those for 1976 core samples, it was necessary to recalculate the latter at specific gravity 1.8. This could be done approximately for those composites for which washability data was available, on the assumption that the value of Fixed Carbon (d.m.m.f.) is independent of specific gravity (in as

TABLE 2

Cluster Listing - Individual Samples
Analytical Data for 1977 Rotary Cuttings

Cluster	Sample	Moisture	Volatiles	FCDMMF	BTUMMMF	FSI
1	C- 50	4.42	30.76	64.95	13,787	2.0
1	C- 99	4.28	29.54	65.53	13,773	1.5
1	C- 51	4.23	30.53	64.53	13,756	2.0
1	C- 63	3.50	33.09	62.94	13,747	1.5
1	C- 96	4.06	30.62	63.84	13,741	0.5
1	C- 53	3.90	26.39	69.40	13,719	2.0
1	C- 61	4.24	28.66	66.31	13,663	0.5
1	C- 65	2.88	28.17	68.58	13,648	2.0
1	C- 56	3.52	31.74	65.45	13,955	1.5
1	C- 88	3.17	25.81	67.57	13,940	0.5
1	C- 57	3.21	31.09	65.15	13,917	0.5
1	C- 69	2.93	28.96	63.78	13,928	1.5
1	C- 78	3.54	28.51	66.57	13,928	1.5
1	C- 60	3.33	28.24	68.26	13,900	1.5
1	C- 70	3.21	29.85	65.30	13,893	2.0
1	C- 58	3.19	29.71	66.95	13,845	0.5
1	C- 71	3.41	31.92	62.47	13,848	1.5
1	C- 89	2.78	29.50	63.40	13,848	0.5
1	C- 68	3.40	30.87	61.03	13,836	1.0
1	C- 62	3.20	28.69	67.87	13,861	1.5
1	C- 64	3.99	30.43	64.97	13,880	2.0
1	C- 52	5.82	26.66	69.58	13,436	0.5
1	C- 72	4.31	29.61	62.48	13,437	0.5
1	C- 95	3.55	32.78	59.25	13,462	1.0
1	C- 98	5.15	30.67	63.39	13,519	0.5
1	C-100	4.15	27.55	66.61	13,583	0.5
1	C- 67	4.40	29.97	61.73	13,168	0.0
1	C- 93	6.13	29.32	64.37	13,201	0.5
1	C-102	5.24	29.15	65.45	13,326	0.5
1	C-104	5.18	28.62	67.90	13,247	0.0
1	C- 54	3.78	32.84	61.22	14,171	2.0
1	C-101	3.30	30.71	65.35	14,136	1.0
1	C- 55	3.16	30.38	63.24	14,063	0.5
1	C- 97	3.18	31.00	64.37	14,092	1.0
1	C-105	3.47	29.92	66.10	14,034	0.5
1	C- 59	3.27	32.62	63.87	14,279	1.0
1	C- 79	2.88	31.19	66.65	14,221	1.0
1	C-103	3.66	28.91	65.29	14,197	1.5
1	C- 80	2.68	28.95	65.61	14,546	0.5
1	Mean	3.7872	29.8444	65.0592	13,808.5	1.05128
2	C- 91	7.23	29.40	68.53	12,812	0.5
2	C- 92	5.57	30.47	66.48	13,000	0.0
2	C- 94	5.79	29.10	64.03	12,400	0.0
2	Mean	6.1967	29.6567	66.3467	12,737.3	0.16667
3	C- 73	8.03	31.77	64.16	10,945	0.0
3	C- 84	8.97	30.05	62.02	11,067	0.0
3	C- 86	8.70	31.68	61.44	11,061	0.0
3	C- 77	9.10	29.31	60.69	10,839	0.0
3	C- 87	9.41	29.55	61.26	10,838	0.0
3	C-107	8.91	26.35	62.61	10,775	0.0
3	C- 74	9.01	34.60	59.97	10,401	0.0
3	C- 85	9.68	26.62	60.90	10,363	0.0
3	C- 76	10.08	30.45	61.66	10,567	0.0
3	C- 75	11.20	32.82	59.47	10,081	0.0
3	C- 82	11.42	32.00	56.09	9,995	0.0
3	C- 83	10.95	28.46	58.84	10,228	0.0
3	C-108	9.10	28.82	59.75	10,160	0.0
3	Mean	9.5815	30.1908	60.6815	10,563.1	0.0

much as mineral-matter-free coal would have specific gravity less than 1.8). Using the Paar Formulae in reverse with experimental results for ash and moisture on a cumulative basis to S.G. 1.8, approximate values for Fixed Carbon and Volatiles at S.G. 1.8 were derived. Recalculated data for 1976 composites are shown in Table 3. Attempts were than made to cluster 1976 and 1977 composites together.

At first composite T-6 persistently grouped on its own. Re-examination of the analytical data, in particular its high apparent ash content and inability to wash to 8% ash, led to the supposition that T-6 is strongly oxidised, and this composite was thrown out. All other composites fell in three well-defined clusters. With one exception, all 1977 composites fell in the same cluster as their individual components. Composite R-8 has four components; one is strongly oxidised while the other three fell in cluster 1, resulting in a composite which fell in cluster 2. This composite was therefore thrown out. The clusters of the remaining composites are listed in Table 4.

Several points arose from the clustering of composites, including:

1. The lack of a fourth cluster may indicate either that no samples from No. 4 Seam were analysed, and this is possibly due to impersistence of this seam, or that No. 4 Seam is indistinguishable from No. 3 Seam.

2. If, in fact, composite T-6 is strongly oxidised, it is probably safe to assume that cluster 4 represents unoxidised coal from No. 1 Seam.

TABLE 3

Analytical Data for 1976 Composites Recalculated at S.G. 1.8

Seam	Hole No.	Footage	Composite No.	Moist. %	Ash %	Volatiles %	Fixed Carbon %	Fixed Carbon (DMMF)	BTU/lb. (raw)	BTU/lb. (MMMF)	% Recovery @ SG 1.8	F.S.I.
3	Open Pit	Channel	C-1	2.36	6.72	30.91	60.01	66.40	12,930	13,942	96.25	½
3	Open Pit	Stockpile	C-2	2.20	8.90	32.90	56.00	63.50	12,290	13,597	87.59	0
2	C-76-1	386.0 - 394.0	T-1	4.35	7.30	35.69	52.66	60.14	12,050	13,097	92.79	0
3	C-76-1	668.5 - 681.5	T-2	1.58	11.47	30.17	56.78	66.00	12,770	14,576	95.21	1
3R	C-76-3	311.0 - 320.0	T-3	1.47	30.62	34.20	33.71	51.50	9,770	14,597	29.76	1
3	C-76-3	350.0 - 363.0	T-4	1.86	10.29	30.93	56.92	65.40	12,490	14,052	82.29	½
1	C-76-5	47.0 - 60.0	T-6	10.73	20.53	35.46	33.28	49.60	6,940	8,917	55.82	0
3	C-76-5	891.0 - 915.0	T-11	1.44	12.28	33.91	52.37	61.40	12,280	14,158	80.70	1

TABLE 4

Cluster Listing - 1976 and 1977 Composites

Cluster	Composite	Moist. %	Volatiles %	FCDMMF	BTUMMMF	FSI
1	R- 1	4.14	30.75	64.91	13,787	2.0
1	R- 7	3.00	31.63	64.59	13,797	1.5
1	R-24	4.01	27.47	67.89	13,805	0.0
1	R- 5	3.24	30.92	66.01	13,976	1.0
1	C- 1	2.36	30.91	66.40	13,942	0.5
1	R- 9	3.29	31.73	62.90	13,905	1.5
1	R-17	2.86	27.55	65.74	13,869	0.5
1	R-22	3.71	30.12	64.96	13,875	1.5
1	R- 3	3.78	32.84	61.22	14,171	2.0
1	R-13	2.77	30.48	65.94	14,174	1.0
1	T-11	1.44	33.91	61.40	14,158	1.0
1	R- 4	3.16	30.38	63.24	14,063	0.5
1	T- 4	1.86	30.93	65.40	14,052	0.5
1	R- 6	3.15	29.56	66.92	14,107	1.0
1	R- 2	4.08	26.78	69.53	13,728	0.5
1	R-23	3.17	30.74	63.97	13,673	0.5
1	C- 2	2.20	32.90	63.50	13,597	0.0
1	R-10	4.31	29.61	62.48	13,437	0.5
1	R-21	3.55	32.78	59.25	13,462	1.0
1	T- 2	1.58	30.17	66.00	14,576	1.0
1	T- 3	1.47	34.20	51.50	14,597	1.0
1	Mean	3.01	30.78	63.99	13,940	0.91
2	R-20	5.83	29.20	64.16	13,090	0.0
2	T- 1	4.35	35.69	60.14	13,097	0.0
2	R-19	6.03	28.38	68.31	12,969	0.0
2	Mean	5.40	31.09	64.20	13,052	0.0
3	R-11	8.99	33.33	61.43	10,469	0.0
3	R-25	9.50	25.63	63.33	10,574	0.0
3	R-12	9.34	29.98	61.66	10,794	0.0
3	R-16	9.41	29.55	61.26	10,838	0.0
3	R-15	9.04	30.62	60.29	10,950	0.0
3	R-14	9.64	29.81	57.65	10,075	0.0
3	Mean	9.32	29.82	60.94	10,617	0.0

Taking the above points into consideration, the 1977 composites have been tentatively assigned to seams as follows:

Composite	Seam	Composite	Seam
R- 1	3	R-14	1
R- 2	3	R-15	1
R- 3	3	R-16	1
R- 4	3	R-17	3
R- 5	3	R-18	? (oxidised)
R- 6	3	R-19	2
R- 7	3	R-20	2
R- 8	?3 (partly oxidised)	R-21	3R
R- 9	3	R-22	3
R-10	3	R-23	3
R-11	1	R-24	3
R-12	1	R-25	1
R-13	3		

These seam assignments have been used in the geological interpretation which follows (Section 7). At the time of writing, other mathematical methods designed to test the statistical significance of the clusters obtained were under investigation. One factor which should not be overlooked is that many of the intersections assigned above to No. 1 Seam are from close to surface. It is therefore possible that one, several, or even all of them may represent oxidised coal from No. 2 or No. 3 Seams. This possibility should be investigated.

5.3 Geophysical Logging

Because of apparent poor accuracy in determining depths of lithological contacts from rotary cuttings, and because of difficulties encountered in sampling the cuttings, it was decided that geophysical logs should be run on all holes. Natural gamma-ray, long-spaced density and single-point resistivity logs (hereinafter collectively referred to as "E-logs") were selected as being the most suitable logs for this application. All logs were run at a logging speed of 20 feet per minute and recorded at a chart speed of 10 feet per minute, giving a record at 10 feet to the inch. Since this drilling programme was essentially initial exploration, it was considered unnecessary to run detailed logs over the coal intersections at this time. Using the long-spaced density log, a precision of about $\pm$ 2 inches is obtained for lithological depths.

First of all, an attempt was made to log the 1976 diamond drill holes, since comparison between core log and E-log response would assist the operator in calibrating his instruments. Unfortunately, hole C-76-11 was the only one on Carmacks North which was still sufficiently open for the passage of the logging tool; E-logs were obtained to 395 feet depth (drill depth 887 feet). Most of the rotary holes drilled in April 1977 were plugged, since overburden, which was frozen when the holes were drilled, had melted and flowed in. An attempt was made in July to drill them out again for logging, but this was abandoned after it was discovered that the holes would have to be re-drilled with mud and then casing installed in order to keep them open.

Gamma and Density logs were obtained for close to the full depth of most of the rotary holes drilled in June-July 1977. It turned out

that in most areas the top of the water table was more than 300 feet deep; and since borehole fluid is required to obtain resistivity logs, this log was only obtained for short lengths near the bottom of a few of the holes.

Examination of the E-logs showed that intersections determined from rotary cuttings were in error by up to three feet. In addition some lithologic intervals including a few coal seams, which had been missed on logging the cuttings, were identified on the logs. One difficulty was encountered, however; some holes (e.g. C-77-20) yielded excellent logs with sharply-defined peaks while others yielded very poorly-defined logs. It was interpreted that the poor definition on some logs was a result of those holes intersecting bedding at high angles. This was apparently confirmed later by trenching.

Cuttings logs and/or E-logs, depending upon availability, were used to compile the Rotary Drill Records presented in Appendix I.

5.4 Trenching

In order to assist with geological interpretation of the drill-hole data in the "plateau" area, M. O. Hampton, Senior Coal Engineer, employed a D-7 bulldozer to dig trenches near those holes which had intersected thick coal seams close to surface. Seven new trenches were dug (Nos. 28 to 34 inclusive - see Map 1), and Trench No. 17 was lengthened. Detailed trench logs for all except No. 31 were prepared by the writer (see Figure 2). Trench No. 31 was not located or described in detail because of lack of time.

In all the trenches, dips were very steep (65 to 85^{o}); in Trench No. 33, bedding was overturned for part of its length. These steep dips

are apparently the reason for very thick coal intersections in some of the drill-holes, and for poorly-defined peaks on some of the E-logs. Information from the trenches proved invaluable for geologic interpretation in this area (see Section 7).

6. PHOTOGRAMMETRY AND LEASE SURVEY

Contour maps used for the 1976 exploration programme were 1" = 400' pencil manuscripts drawn from Government aerial photographs (approximate scale 1" = 1,000') taken in 1969. Contour interval was 50 feet, and horizontal control was taken from the N.T.S. 1:50,000 map. For the 1977 programme it was considered that further detailed work, particularly in the open pit area, would require much more accurate and more detailed basemaps - at 1" = 100' scale with 5 foot contour interval. Thus it was decided that new aerial photographs should be flown, and accurate horizontal and vertical control established. A new map of the open pit area could be produced, and maps of other areas as required.

In the past, all underground surveying at Tantalus Butte Mine has been tied to an arbitrary grid system established by Yukon Coal Company. Some discrepancies have arisen when trying to tie in underground surveys to surface data, and the actual location of the grid lines varies from map to map. The original monuments establishing the grid have all been destroyed. Projection of this grid up to ten miles to the south to cover the Carmacks South property has resulted in survey errors of ten feet or so, largely due to the fact that distances and angles on the mine grid system were not resolved to sea level. In order to remove these difficulties, it was decided that the mine grid system should be abandoned (except for local surveys within the mine), and that all past and future surface control surveys should be tied to the Territorial Plane Coordinate System (T.P.C.S.). This should allow easy conversion to the U.T.M. system if metrication takes place.

In order to obtain maximum advantage from the new photography, targets were placed at most of the 1976 diamond drill-holes, at many of the

original lot and coal mining lease cornerposts, and at several survey control stations.

Aerial photography covering both properties at approximate scales of 1" = 1,000' and 1" = 2,000' was flown in July, after most of the new access roads and drillsites in the open pit area had been built and part of the line grid systems had been cut. The new pencil manuscript of the open pit area was received in December 1977, and coordinates for the 1976 drill-holes, lease posts and survey control stations were received in March 1978.

Using coordinates for lease posts obtained photogrammetrically, a revised map showing actual locations of all the leases was prepared (see Map 2). This map shows that the leases staked by Dynasty Explorations in 1969 on Carmacks North are in fact located some distance to the north of where they were presumed to be. The revised map has been submitted to the Mining Recorder in Whitehorse for his approval, and for possible amendment of the lease documents.

7. GEOLOGICAL COMPILATION OF OPEN PIT AREA

After the new topographic map of the open pit area was received in December 1977, a re-compilation of all geological data was begun. Original field notes and sketches obtained during the 1972 and 1973 trenching programmes were located and examined, and summary logs for 1973 underground diamond drill-holes were examined. All these and more recent geological data were plotted on the map with the aid of the new aerial photographs. Selected survey stations in the underground workings were converted to T.P.C.S. co-ordinates and geodetic datum, allowing the surface projection of the workings to be plotted on the map.

Accurate cross-sections at a scale of 1 inch to 50 feet were drawn where drill-hole information was available. These are Sections 48+50, 50+00, 54+00, 57+00, 59+00, 60+00, 61+50, 68+00 and 76+00. The irregular line-spacing is accounted for by the fact that several holes were drilled before the line grid system was established. It is intended that future exploratory drilling should be carried out on lines 800 feet apart, to be reduced successively to 400-foot and 200-foot spacing by in-fill drilling. Lithological interpretations for the drill-holes (as presented in Appendix I) were plotted on the sections, and coal intersections were assigned tentatively to Seams 1 to 4 on the basis of quality data obtained from 1976 core samples and 1977 rotary cuttings.

The southerly continuation of the synclinal structure in the open pit, and the accompanying westerly anticline, are apparently confirmed. These structures probably extend at least as far south as Section 48+50, where they are responsible for the structural complications which have caused so much difficulty in the underground workings in recent years. The structures appear to be complicated by local splitting of No. 3 Seam, although the

situation may also be accounted for by a thrust fault emplaced prior to folding. The coal seams appear markedly thickened in the hinge zones and attenuated in the limbs of the folds.

The structure in the area to the east of the open pit is not sufficiently well known to allow completion of the compilation. Where seen in trenches, the rocks have westerly dips of between 65 and 75^{o}. In general, the structure in this area appears to be dominated by vertical or steeply-east or west-dipping normal and reverse faults; this interpretation depends upon the assignment of coal intersections to particular seams as outlined above. On the basis of extrapolating the stratigraphy established further south (by trenching and diamond drilling) into this area, the approximate locations of the seams not intersected by rotary holes can be inferred. This is particularly well shown on Section 60+00; if indeed the stratigraphic intervals between the seams in this area are approximately the same as seen in 1976 diamond drill-holes, then it is perfectly possible that even by drilling on closely-spaced centres (200 feet), several seams were missed. This interpretation needs to be tested, by trenching or (preferably) by diamond drilling selected easterly-inclined holes.

Because of uncertainties about the structure and stratigraphy in this area, it is not possible to arrive at accurate reserve figures, although it may be stated that several hundred thousand tons are inferred by the geological model. Much of this coal is likely to have ash contents, including inter-bedded mudstone partings, in the range 10 to 50% (see values for recovery at specific gravity 1.8 in Table 1). In addition, most of the coal within about 50 feet of the surface appears to be moderately to strongly oxidised.

8. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that appreciable reserves of coal are indicated in the area around the open pit, and this area should, for the time being, be given preference over a new portal at river level or any development at Carmacks South.

Further exploration work is required in the open pit area since not enough information is currently available to permit mining to commence. The information required may be summarised as follows:

1. Verification of the geological structure east of the open pit, shown here on Sections 60+00, 68+00 and 76+00. In the event that the present interpretation proves incorrect, formulation of a new interpretation would be required.

2. More precise information on attitude, thickness and lateral extent of each seam.

3. More reliable quality data, particularly:

   (a) depth of oxidised zone and degree of oxidation,

   (b) thickness of rock partings within seam (i.e. proportion of coal to rock),

   (c) accurate characterisation of each seam according to calorific value and rank.

This information could probably best be obtained by selective diamond drilling on the existing sections, with holes sited to intersect as much of the stratigraphy as possible. Two holes on each of Sections 60+00, 68+00 and 76+00 are recommended, with each hole inclined 50^{o} to the east. Further rotary drilling is not recommended unless a rig capable of drilling inclined holes is made available and geophysical logs are obtained.

PART B

CARMACKS SOUTH

1. INTRODUCTION AND SUMMARY

Only minimal exploration work was carried out on Carmacks South during 1977. Efforts were concentrated on finding a geophysical method which could be used to trace the coal horizon to the southeast beneath thick overburden. An extensive area was covered with EM-16. This method did not detect the coal itself, but did detect linear anomalies which probably represent structural features, and these may allow the coal seam to be traced some distance.

Several coal samples from 1976 drill core were sent for petrographic analysis to determine why some had high F.S.I. values while others had very low values. The results show that the low F.S.I. values are the result of oxidation of the coal. Geophysical logs were obtained from some of the 1976 diamond drill holes.

2. PETROGRAPHIC ANALYSIS

After the 1976 diamond drilling program on Carmacks South, some inconsistencies were observed in the analytical data. While all samples had raw essentially similar proximate analyses and calorific values, some had free-swelling-index (F.S.I.) values in the range 4 to 7 while others had values in the range 1/2 to 1 (see Hill, 1977, Table 7). In an attempt to explain this variation, several samples were sent to Robertson Research (North America) Ltd. for petrographic analysis.

The samples selected for analysis were composites T-5 and T-7 and their individual components. A maceral analysis was performed upon each component and composite, and the mean maximum reflectance of vitrinite ($\overline{R}_o max$) was determined for the composites. The resulted are presented in Table 5, and show that all the samples are of very similar coal type and rank.

After recalculating the mineral-matter percentage for ash and sulphur values obtained in the proximate analyses, it is possible to predict approximate F.S.I. values based upon coal type and rank. Predicted values, together with the observed values for F.S.I., are also shown in Table 5.

Predicted F.S.I. values for samples C-24 and C-25, and their composite T-7, compare favourably with the measured values. However, measured values for samples C-12 to C-18, and their composite T-5, are much lower than predicted values. This difference is ascribed to the affects of oxidation of the vitrinite in these samples. While oxidation does affect caking characteristics (F.S.I.), we are advised that these results should not be taken as an indication that this coal will not produce coke.

TABLE 5

PETROGRAPHIC ANALYSIS OF COMPOSITES T-5 AND T-7

SAMPLE	C-12	C-13	C-14	C-15	C-16	C-17	C-18	Calc. Comp. of C-12 to C-18 incl.	T-5 Comp.	C-24	C-25	Calc. Comp. of C-24 and C-25	T-7 Comp.
WEIGHT % IN COMPOSITE	16.85	15.14	14.36	13.57	8.83	13.47	17.78	100.00	100.00	38.71	61.29	100.00	100.00
ASH %	16.24	26.35	11.23	28.51	21.57	21.63	28.92	22.17	23.06	19.49	23.75	22.11	21.91
SULPHUR %	-	-	-	-	-	-	-	-	0.63	-	-	-	0.53
Maceral Analysis (as measured)													
Vitrinite	60.40	63.40	43.00	42.40	54.70	66.40	57.90	55.80	50.00	63.20	47.50	53.60	56.90
Exinite	0.40	0.00	0.00	0.00	0.00	0.20	0.20	0.10	0.00	0.10	0.00	00.00	0.00
Fusinite	0.80	0.20	0.20	1.00	0.40	0.90	0.40	0.60	0.20	0.50	0.40	0.40	0.20
Semifusinite	28.20	26.60	44.40	29.90	26.80	20.70	10.90	26.30	29.20	20.80	28.50	25.50	27.70
Micrinite	5.50	4.20	5.10	2.10	3.80	3.70	4.20	4.20	4.80	3.50	5.90	5.00	3.40
Mineral Matter	4.70	5.60	7.30	24.60	14.30	8.10	26.40	13.10	15.80	11.90	17.70	15.50	11.80
Vitrinite reflectivity	-	-	-	-	-	-	-	-	1.19%	-	-	-	1.23%
Recalculated maceral data using Parr's formula for mineral matter													
Vitrinite	57.60	57.50	43.50	47.40	56.30	63.60	66.20	56.40	51.90	64.00	50.20	55.80	56.80
Exinite	0.40	0.00	0.00	0.00	0.00	0.20	0.20	0.10	0.00	0.10	0.00	0.00	0.00
Fusinite	0.80	0.20	0.20	1.10	0.40	0.90	0.50	0.60	0.20	0.50	0.40	0.40	0.20
Semifusinite	27.00	24.10	44.90	33.40	27.60	19.80	12.50	26.60	30.30	21.10	30.10	26.50	27.60
Micrinite	5.30	3.80	5.20	2.40	3.90	3.60	4.80	4.20	5.00	3.60	6.30	5.20	3.40
Mineral Matter	8.90	14.40	6.20	15.70	11.80	11.90	15.80	12.10	12.60	10.70	13.00	12.10	12.00
Free Swelling Index (FSI)													
(a) Observed value	1	1	½	1	½	1	½	½-1	½	7	4½	5½	6
(b) Predicted value	7-7½	7-7½	5	6	7	8½	9	7	6	8½	6	7	7

3. LINECUTTING AND GEOPHYSICS

3.1 Linecutting

In order to facilitate geophysical test procedures on Carmacks South, several cut lines perpendicular to strike were required. It had been proposed that the tests should be conducted on pairs of lines two hundred feet apart and four thousand feet long. It was therefore decided to erect a line grid-system which could accommodate these requirements, and which could later be extended to locate lines for any further geophysics or drilling.

The new grid was erected by selecting line 40+00 feet south to coincide with cross-section B (Hill, 1977) at approximately 050° azimuth, thus causing line 0+00 to fall at the extreme northern end of the property. The baseline was arbitrarily drawn in at azimuth 140°, to bisect approximately the known syncline (see Map 3). Three pairs of lines were selected for the geophysical tests and were cut as follows:

(a) Lines 40 and 42, since a thick coal section was exposed in the trench and the structure was fairly well known from drill holes C-76-4 and C-76-7;

(b) Lines 90 and 92, situated just beyond the known strike length of coal proved in trenches;

(c) Lines 110 and 112, situated approximately 2,500 feet beyond the known strike length of coal proved in trenches, in an area where overburden was presumed to be thick.

In addition to the lines mentioned above, the baseline was cut from line 40 to line 250, an offset at 20+00 west was cut from line 70 to

line 200, and an offset at 20+00 east from line 90 to line 140.

3.2 Geophysical Testing

The initial geophysical testing consisted of the following:

(a) Induced polarisation (Gradient-array Resistivity and Chargeability) on lines 40 and 42 from 13+00 west to 24+00 west. A large, prominent anomaly was evident over the thick coal seam exposed in the trench. Gradient-array resistivity was also run on line 85 from 14+00 west to 21+00 west and on line 90 from 11+00 west to 24+00 west, but on these lines no large anomalies were found in the expected position over the coal seam.

(b) Bouguer Gravity, one line 42 from 14+00 west to 24+00 west. A fairly even gravity gradient was found over the length of the profile.

(c) Very low frequency (V.L.F.) electromagnetic, using the EM-16 system, on lines 40 and 42 from 14+00 west to 24+00 west, on line 92 from 5+00 east to 24+00 west, and on lines 110 and 112 from 10+00 east to 20+00 west.

In each case, very irregular profiles were obtained. On lines 40 and 42, a prominent anomaly was located approximately 250 feet to the west of the coal seam outcrop.

(d) Side-looking dipole-dipole resistivity on lines 41+00 and 41+50 from 16+00 west to 23+00 west. This method produced a much larger and more prominent anomaly than that revealed by gradient-array resistivity on the same lines.

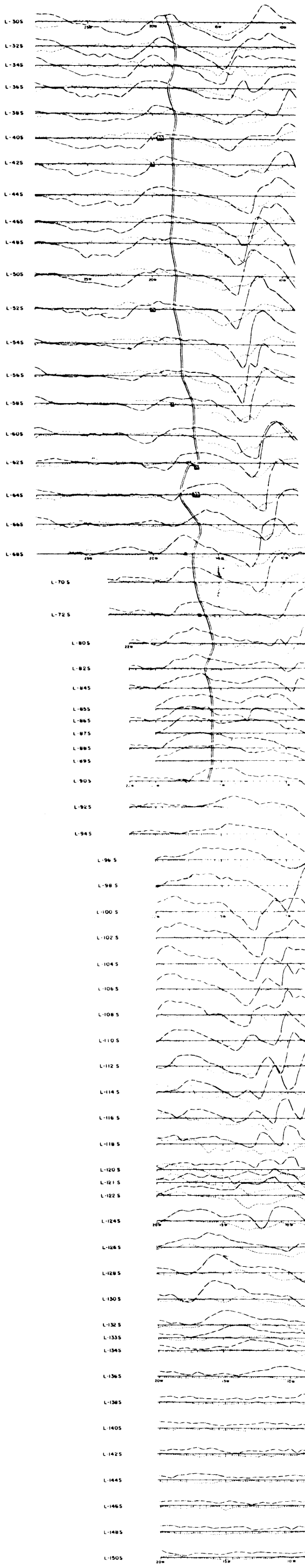
Of the various geophysical methods tried, the side-looking resistivity appears to be the only method which might be useful for detecting and tracing actual coal seam subcrops in this area.

3.3 EM-16 Survey

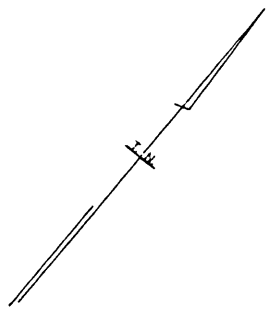
Since the test of EM-16 on lines 40 and 42 gave a prominent anomaly about 250 feet west of the coal seam, it was decided to run some more lines using this method to see if the anomaly could be traced parallel to the coal seam for any distance. The system was run on flagged lines through the bush; initially lines 30 to 90 were run on 200-foot line spacings, from 10+00 west to 30+00 west.

The results of the initial survey showed that the anomaly under investigation did, in fact, appear to lie approximately parallel to the coal seam at a distance of about 200 feet to the west. A second, larger, anomaly was located about 500 feet to the east of the coal seam, and again approximately parallel to it. While neither anomaly can readily be related to identifiable geological features, and the method does not detect the coal itself, it is evident that EM-16 has provided a kind of mapping technique which defines layering and/or structure in the sequence.

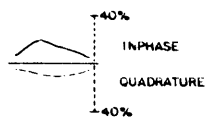
As a result of the initial success, the survey was extended south to line 150 between baseline 0+00 and 20+00 west, and on lines 100 to 140 between baseline and 20+00 east. The E.M. profiles and contoured values for the entire survey are shown in Figures 3 and 4 respectively at a scale of 1 inch to 800 feet. From the contoured data, it seems likely that the pair of anomalies referred to above can be traced more or less continuously at least as far south as line 134. If these anomalies are accepted as layering or structural



BASE LINE 00 Az 320°



LEGEND:



TX DIRECTION

APPROXIMATE LOCATION OF TRENCHES CONTAINING COAL

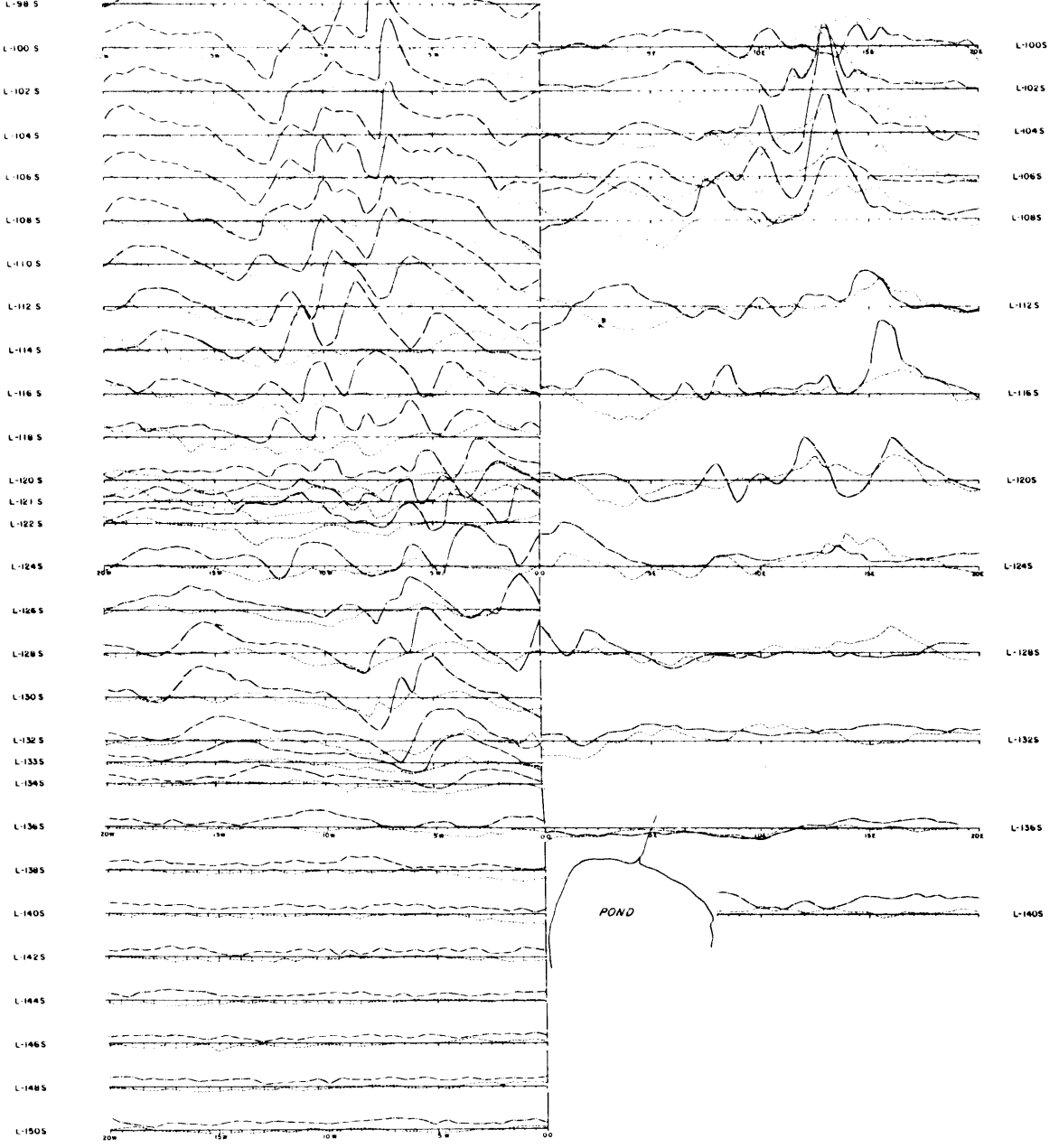


FIGURE 3

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

VLF

ELECTROMAGNETIC SURVEY

PROFILES OF INPHASE & QUADRATURE READINGS

MAP No.

TO ACCOMPANY A REPORT BY PETER E WALCOTT DATED- JAN. 1978

PETER E WALCOTT & ASSOC LTD

JUNE - OCTOBER , 1977

REVISED BY

SCALE IN FEET 200 0 200 400

NTS 115-1-1

DRAWN BY: RWR

DATE

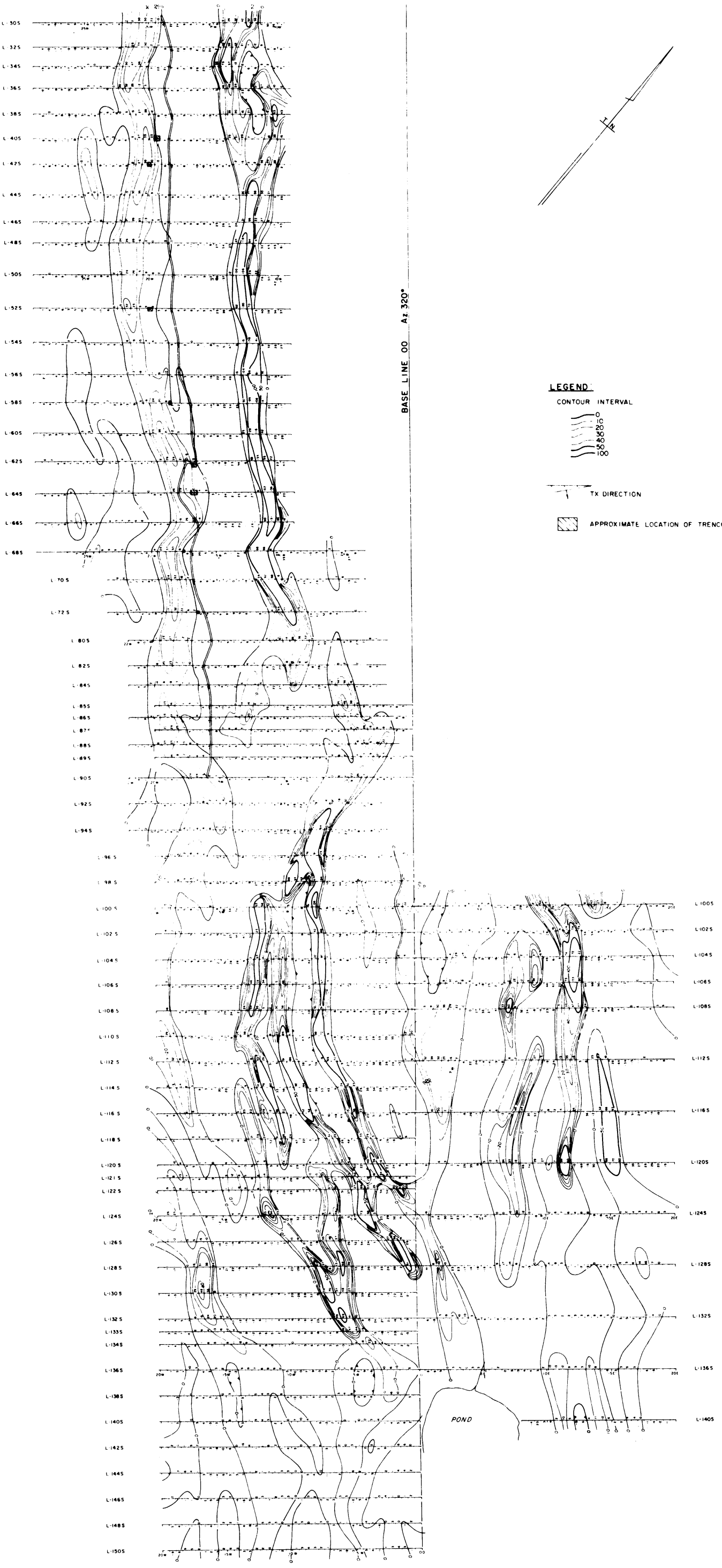


FIGURE 4

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

VLF
ELECTROMAGNETIC SURVEY
CONTOURS OF FRASER FILTERED IN PHASE READINGS

MAP No
TO ACCOMPANY A REPORT BY PETER E. WALCOTT DATED- JAN 1978

PETER E WALCOTT & ASSOC LTD
JUNE - OCTOBER , 1977

REVISED BY

SCALE IN FEET
200 0 200 400

NTS 115-1-1
DRAWN BY RWR
DATE

features in the sequence, then it is possible to infer an approximate coal seam subcrop trace. Unfortunately, south of line 140, E.M. response becomes rather flat, presumably the result of much increased overburden thickness. It is possible that the syncline closure occurs here, but this remains to be seen. Attempts to extend the surveyed area towards the south, and further west between lines 90 and 140, were thwarted when the E.M. transmitting station was shut down.

The geological map of Carmacks South, amended to reflect the interpretation of the EM-16 survey described above, is shown on Map 3 . This interpretation should be tested by drilling. A more comprehensive treatment of the geophysical tests and EM-16 survey is expected in a forthcoming report by Peter E. Walcott.

4. GEOPHYSICAL LOGGING

While the logging unit was in Carmacks for the rotary drilling programme, it was decided to attempt to obtain E-logs for the 1976 diamond drill holes on Carmacks South. Several of these holes were plugged, but partial E-logs were obtained for the following:

Hole	Drilled Depth	Logged Depth	Water Table Depth
C-76- 7	817'	800'	448'
C-76-10	967	960	520
C-76-12	524	380	289
C-76-16	212	206	196

5. CONCLUSIONS AND RECOMMENDATIONS

Petrographic analysis of selected samples has shown that all the coal intersected in drill-holes is coking coal, but that localised oxidation has reduced F.S.I. values. Carmacks South can therefore still be regarded as a potential source of metallurgical coal. Further sampling from a larger area is required to determine whether the high ash values determined in 1976 are representative of the whole property.

Very low frequency electromagnetic (EM-16) appears to be a good method of tracing structures, and hence the survey should be extended to the east, west and south in the hope of tracing the syncline closure and other structures. Once this survey is completed, it should be possible to outline drill targets aimed at defining more precisely the area underlain by coal.

Probably the most useful way to drill this property would be to drill on cross-sections 1,600 feet apart with holes 800 feet apart on the sections. This method would ensure that the synclinal closure area would be located more precisely. Holes at the western ends of these sections should be inclined at 50 or 60^{o} to the southwest in anticipation of steep or overturned dips. It is suggested that lines 110 and 126 are the most appropriate for this type of drilling but, after extension of the EM-16 survey, other lines may suggest themselves. Proposed hole locations are shown on Map 3. It is recommended that diamond drilling should be utilized for the present until such time that the stratigraphy and structure are sufficiently well known to be able to predict location and depth of the coal horizon.

References

HAMPTON, M.O. (1977) Preliminary Development Proposal for Tantalus Butte Coal Mine. Cyprus Anvil Mining Corporation, Faro.

HILL, R.P. (1977) Report on Preliminary Evaluation, Carmacks Coal Project. Cyprus Anvil Mining Corporation, Vancouver.

APPENDIX I

1977 ROTARY DRILL RECORDS

CARMACKS NORTH

ROTARY DRILL RECORD

HOLE NO.: C-77-1

COMPANY: Cyprus Anvil Mining Corporation
LEASE/LOT/CLAIM NO.: Lot 23
DRILLING CONTRACTOR: Midnight Sun
LOGGING CONTRACTOR: -
DEPTH DRILLED: 242 feet
LOGS RUN: None
T.P.C.S. COORDINATES: North
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 242 feet
OVERBURDEN DEPTH: 242 feet

PROPERTY: Carmacks North
PROVINCE/TERRITORY: Yukon
DATE(S) DRILLED: April 5-11, 1977
DATE LOGGED: -
DEPTH LOGGED: -
GRID LOCATION:
East Elevation:

DEPTH	AZIMUTH	DIP
-	-	-90°

WATER TABLE DEPTH: N/A

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	242	Overburden.			

ROTARY DRILL RECORD

HOLE NO.: C-77-2

COMPANY: Cyprus Anvil Mining Corporation
LEASE/LOT/CLAIM NO.: Lot 23
DRILLING CONTRACTOR: Midnight Sun
LOGGING CONTRACTOR: Data Probe
DEPTH DRILLED: 300 feet
LOGS RUN: Gamma, LS Density, Resistivity
T.P.C.S. COORDINATES: North
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 300 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 127 feet

PROPERTY: Carmacks North
PROVINCE/TERRITORY: Yukon
DATE(S) DRILLED: April 12-14, 1977
DATE LOGGED: July 13, 1977
DEPTH LOGGED: 300 feet
GRID LOCATION:
East Elevation:

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

WATER TABLE DEPTH: 257 feet

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	127	Overburden.			
127	282	Pebble conglomerate with sandstone			
		interbeds.			
282	287	Black coaly mudstone.			
287	300	Brown mudstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-3

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 17, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 84.5 feet
DEPTH LOGGED: 56 feet
LOGS RUN: Gamma, Density
GRID LOCATION: Line 61+30, 1+30W
T.P.C.S. COORDINATES: 22,611,570 North -216,090 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 84.5 feet
OVERBURDEN DEPTH: 28 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	28.0	Overburden.			
28.0	51.5	Medium grey mudstones and siltstones.			
51.5	55.5	COAL (4').			
55.5	84.5	Light grey sandstone with brown mud-			
		stone interbeds.			
		Note - E-logs of coal intersection			
		obscured by water in bottom of			
		hole.			

ROTARY DRILL RECORD

HOLE NO.: C-77-4 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 17, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 185 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 61+30, 0+50W
T.P.C.S. COORDINATES: 22,611,570 North -216,010 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 185 feet
OVERBURDEN DEPTH: 23 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	23	Overburden.			
23	72	Brown and grey mudstones and siltstones			
		with a few carbonaceous mudstone			
		partings.			
72	97	COAL (25 feet).			
97	115	Light grey sandstone.			
115	150	COAL (35 feet).			
150	185	Light grey sandstone with interbeds of			
		brown siltstone and mudstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-5

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 17, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 85 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 1+40W
T.P.C.S. COORDINATES: 22,611,440 North -216,100 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R.P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 85 feet
OVERBURDEN DEPTH: 24.5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	24.5	Overburden.			
24.5	34.0	Medium brown and medium grey mudstone			
		and siltstone.			
34.0	56.0	Dirty COAL with mudstone partings (22').			
56.0	65.0	Brown mudstone.			
65.0	85.0	Grey sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-6 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 18, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 243 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 1+00W
T.P.C.S. COORDINATES: 22,611,440 North -216,065 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 243 feet
OVERBURDEN DEPTH: 26 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
0	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	26	Overburden.			
26	85	Medium brown mudstone, and grey silt-			
		stone and mudstone. One foot of coal			
		at about 30 ft. depth.			
85	87	Coaly mudstone. -			
87	149	Grey and brown siltstones and mudstone.			
149	229	COAL (80 feet).			
229	235	Brown mudstone.			
235	243	Dark brownish-grey sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-7

COMPANY: Cyprus Anvil Mining Corporation
LEASE/LOT/CLAIM NO.: C.M.L. #2959
DRILLING CONTRACTOR: Midnight Sun
LOGGING CONTRACTOR: -
DEPTH DRILLED: 243 feet
LOGS RUN: None
T.P.C.S. COORDINATES: 22,611,440 North -216,035 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 243 feet
OVERBURDEN DEPTH: 25 feet

PROPERTY: Carmacks North
PROVINCE/TERRITORY: Yukon
DATE(S) DRILLED: April 18, 1977
DATE LOGGED: -
DEPTH LOGGED: -
GRID LOCATION: Line 60+00, 0+60W

DEPTH	AZIMUTH	DIP
-	-	-90°

WATER TABLE DEPTH: None

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	25	Overburden.			
25	145	Grey and brown mudstones and siltstones			
145	183	COAL (38 feet).			
183	243	Grey sandstone (6" coal at 219 feet).			

ROTARY DRILL RECORD

HOLE NO.: C-77-8

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 163 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 0+20W
T.P.C.S. COORDINATES: 22,611,440 North -215,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 163 feet
OVERBURDEN DEPTH: 25 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^0

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	25	Overburden.			
25	91	Brown and grey mudstones and siltstones			
91	119	COAL (28 feet).			
119	121	Brown mudstone.			
121	157	Brownish grey sandstone.			
157	163	Pebble conglomerate.			

ROTARY DRILL RECORD

HOLE NO.: C-77-9

COMPANY: Cyprus Anvil Mining Corporation
LEASE/LOT/CLAIM NO.: C.M.L. #2959
DRILLING CONTRACTOR: Midnight Sun
LOGGING CONTRACTOR: -
DEPTH DRILLED: 103 feet
LOGS RUN: None
T.P.C.S. COORDINATES: 22,611,570 North -215,970 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 103 feet
OVERBURDEN DEPTH: 5 feet

PROPERTY: Carmacks North
PROVINCE/TERRITORY: Yukon
DATE(S) DRILLED: April 19, 1977
DATE LOGGED: -
DEPTH LOGGED: -
GRID LOCATION: Line 61+30, 0+10W

DEPTH	AZIMUTH	DIP
-	-	-90°

WATER TABLE DEPTH: -

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	5	Overburden.			
5	36	Grey and brown mudstones and siltstones.			
36	53	COAL (17 feet).			
53	103	Grey siltstone and sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-10 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 83 feet
DEPTH LOGGED: 80 feet
LOGS RUN: Natural Gamma and L.S. Density
GRID LOCATION: Line 62+40, 1+30W
T.P.C.S. COORDINATES: 22,611,680 North -216,090 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 80 feet
CUTTINGS LOGS FROM 80 to 83 feet
OVERBURDEN DEPTH: 26 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	26.0	Overburden.			
26.0	39.0	Grey and brown mudstones.			
39.0	47.3	Grey siltstones.			
47.3	53.3	COAL (6.0 feet).			
53.3	83.0	Grey siltstone and sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-11

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 103 feet
DEPTH LOGGED: 95 feet
LOGS RUN: Natural Gamma, L.S. Density
GRID LOCATION: Line 62+40, 0+90W
T.P.C.S. COORDINATES: 22,611,680 North -216,050 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 95 feet
CUTTINGS LOGS FROM 95 to 103 feet
OVERBURDEN DEPTH: 12 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	12.0	Overburden.			
12.0	25.0	Grey and brown siltstones.			
25.0	28.0	Sandstone.			
28.0	40.0	Grey and brown mudstones, grading down			
		into:			
40.0	49.3	Siltstones.			
49.3	55.0	COAL (5.7 feet).			
55.0	65.3	Grey sandstone and siltstone.			
65.3	76.5	COAL (11.2 feet).			
76.5	78.3	Carbonaceous mudstone (1.8 feet).			
78.3	84.0	COAL (5.7 feet).			
84.0	103.0	Light grey siltstone and sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-12 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 20, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 183 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 0+30E
T.P.C.S. COORDINATES: 22,611,440 North -215,930 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 183 feet
OVERBURDEN DEPTH: 24 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	24	Overburden.			
24	183	Brown mudstone and grey siltstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-13 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 20, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 184 feet
DEPTH LOGGED: 183 feet
LOGS RUN: Gamma, L.S.D., Resistivity
GRID LOCATION: Line 58+90, 0+20W
T.P.C.S. COORDINATES: 22,611,330 North -215,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 183 feet
CUTTINGS LOGS FROM 183 to 184 feet
OVERBURDEN DEPTH: 24 feet
WATER TABLE DEPTH: 133 feet

DEPTH	AZIMUTH	DIP
-	-	-90^0

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	24.0	Overburden.			
24.0	28.0	Grey siltstone.			
28.0	46.0	COAL (18.0 feet).			
46.0	55.0	Brown mudstone.			
55.0	62.0	Grey siltstone.			
62.0	65.0	Grey sandstone.			
65.0	70.0	Grey siltstone.			
70.0	73.0	Grey sandstone (? Marker bed).			
73.0	86.0	Grey siltstone.			
86.0	101.0	Brown mudstone.			
101.0	108.0	Dirty COAL (7.0 feet).			
108.0	116.2	Brown siltstones.			
116.2	158.0	COAL with mudstone partings (41.8 feet)			
158.0	175.5	Brown siltstone and mudstone.			
175.5	184.0	?Pebble conglomerate with sandstone interbeds.			

ROTARY DRILL RECORD

HOLE NO.: C-77-14

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 20, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 164 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 58+90, 0+20E
T.P.C.S. COORDINATES: 22,611,330 North -215,940 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 164 feet
OVERBURDEN DEPTH: 34 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	34	Overburden.			
34	40	COAL (6 feet).			
40	164	Grey sandstone with brown and grey mudstone and siltstone partings.			

ROTARY DRILL RECORD

HOLE NO.: C-77-15

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: Lot 23
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 21-22, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 317 feet
DEPTH LOGGED: 147 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION:
T.P.C.S. COORDINATES: North East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 147 feet
CUTTINGS LOGS FROM 147 to 317 feet
OVERBURDEN DEPTH: 98 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	98	Overburden.			
98	252	Pebble conglomerate with sandstone and mudstone interbands.			
252	275	Interbanded mudstones, carbonaceous mudstones and thin coal bands.			
275	293	Sandstone with conglomerate and mudstone interbeds.			
293	303	Dirty COAL (10 feet).			
303	317	Grey sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-16 Page 1 of

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 22, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 272 feet
DEPTH LOGGED: 139 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 59+00, 1+00W
T.P.C.S. COORDINATES: 22,611,340 North -216,060 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 139 feet
CUTTINGS LOGS FROM 139 to 272 feet
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: Not known.

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	8.0	Overburden.			
8.0	78.0	Pebble conglomerate with sandstone			
		interbeds.			
78.0	84.0	Coaly mudstone.			
84.0	124.3	Brown siltstone and mudstone.			
124.3	131.3	COAL (7 feet).			
131.3	139.0	Black carbonaceous mudstone.			
139.0	209.0	Grey sandstone, passing down into grey			
		siltstone and mudstone.			
209.0	224.0	COAL (15 feet).	209	214	C-50
224.0	226.0	Black carbonaceous mudstone.	215	223	C-51
226.0	246.0	COAL (20 feet).	230	236	C-52
246.0	272.0	Rock type uncertain.	237	243	C-53

ROTARY DRILL RECORD

HOLE NO.: C-77-17 Page 1 of 2

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 22, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 243 feet
DEPTH LOGGED: 201 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 59+00, 1+80W
T.P.C.S. COORDINATES: 22,611,340 North -216,140 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 201 feet
CUTTINGS LOGS FROM 201 to 243 feet
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: 165 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	8.0	Overburden.			
8.0	70.0	Pebble conglomerate with sandstone			
		interbeds.			
70.0	72.5	Dirty COAL (2.5 feet).			
72.5	74.5	Dark brown and dark grey mudstones.			
74.5	79.0	Dirty COAL (4.5 feet).			
79.0	134.0	Light grey siltstone with sandstone and			
		mudstone interbeds.			
134.0	136.0	Dense sandstone (?MARKER).			
136.0	150.0	Light grey siltstone with sandstone and			
		mudstone interbeds.			
150.0	179.0	Dark brown and dark grey siltstones with			
		sandstone interbeds.			
179.0	184.7	COAL (5.7 feet).			
184.7	201.0	Mudstones and siltstones.			
		N.B. Logs show cave from 190 to 195',			
		then a pronounced increase in			
		density from 195 to 201' which is			
		difficult to interpret (could be conglomerate).			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
201.0	202.0	Coaly mudstone.			
202.0	209.0	Mudstone and siltstone.			
209.0	211.0	Coaly mudstone.			
211.0	243.0	Mudstone and siltstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-18 Page 1 of

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 23-24, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 364 feet
DEPTH LOGGED: 362 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 57+00, 5+00W
T.P.C.S. COORDINATES: 22,611,140 North -216,460 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 362 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: 272 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	8.0	Overburden.			
8.0	198.0	Pebble conglomerate with sandstone inter-			
		beds.			
198.0	202.0	Carbonaceous mudstone.			
202.0	232.5	Interbedded dark brown and dark grey mud-			
		stones and carbonaceous mudstone.			
232.5	236.0	Soft, coaly mudstone.			
236.0	237.0	Mudstone.			
237.0	243.5	COAL (6.5 feet).	237	241	C-54
243.5	258.5	Black carbonaceous mudstone with coaly			
		partings.			
258.5	267.3	COAL (8.8 feet)	263	271	C-55
267.3	277.5	Dark grey mudstones and siltstones.	(Driller's interval)		
277.5	280.2	Dirty COAL (2.7 feet).			
280.2	288.0	Dark grey mudstone.			
288.0	315.0	Medium grey siltstone.			
315.0	338.5	Light grey sandstone.			
338.5	341.9	Dirty COAL (3.4 feet).			
341.9	350.0	Siltstone and mudstone.			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
350.0	355.0	Coaly mudstone.			
355.0	364.0	Pebble conglomerate.			

ROTARY DRILL RECORD

HOLE NO.: C-77-19 Page 1 of 2

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 24, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 284 feet
DEPTH LOGGED: 276 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 57+00, 3+00W
T.P.C.S. COORDINATES: 22,611,140 North -216,260 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 276 feet
CUTTINGS LOGS FROM 276 to 284 feet
OVERBURDEN DEPTH: 7.5 feet
WATER TABLE DEPTH: 237 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.5	Overburden.			
7.5	51.7	Pebble conglomerate with sandstone			
		interbeds.			
51.7	57.6	Coaly mudstone.			
57.6	59.4	Light grey mudstone.			
59.4	64.3	Coaly mudstone.			
64.3	74.0	Dark brown mudstone.			
74.0	78.0	Dense sandstone (?MARKER).			
78.0	81.0	Grey siltstone.			
81.0	83.0	Coaly mudstone.			
83.0	101.3	Light grey siltstones.			
101.3	103.3	Dirty COAL (2.0 feet).			
103.3	104.6	Dark grey mudstone.			
104.6	120.3	COAL with mudstone partings (15.7 feet).	107	112	C-56
120.3	122.0	Soft, coaly mudstone.	112	117	C-57
122.0	147.0	Dark brown and dark grey siltstones and	117	124	C-58
		mudstones.	(Driller's intersections)		
147.0	184.0	Interbedded sandstones and siltstones.			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
184.0	200.0	Light grey siltstones with dark grey mudstone partings.			
200.0	206.5	Carbonaceous mudstone.			
206.5	233.0	Light grey siltstones with dark grey mudstone partings.			
233.0	239.0	Black coaly mudstone.			
239.0	242.0	Interbedded dark grey mudstone and carbonaceous mudstone.			
242.0	267.0	Light grey siltstone.			
267.0	270.0	Carbonaceous mudstone.			
270.0	284.0	Pebble conglomerate.			

ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 24-25, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 384 feet
DEPTH LOGGED: 368 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 57+00, 1+00W
T.P.C.S. COORDINATES: 22,611,140 North -216,060 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 368 feet
CUTTINGS LOGS FROM 368 to 384 feet
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: 178 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	137.5	Pebble conglomerate with sandstone			
		interbeds.			
137.5	189.0	Dark brown and dark grey siltstone with			
		mudstone partings.			
189.0	205.0	Mudstone.			
205.0	211.0	Siltstone.			
211.0	220.0	Mudstone.			
220.0	232.6	Siltstone.	(Driller's Footages)		
232.6	252.7	COAL (20.1 feet).	239	244	C-59
252.7	256.4	Dark grey and dark brown mudstone with	244	250	C-60
		carbonaceous mudstone partings.	250	253	C-61
256.4	262.9	COAL (6.5 feet).			
262.9	281.0	Dark brown and dark grey mudstone,			
		passing down into:			
281.0	299.6	Medium grey siltstones with sandy			
		interbeds.			
299.6	326.8	COAL (27.2 feet).	308	310	C-62
326.8	338.0	Medium grey siltstones.	310	314	C-63

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
338.0	342.5	Sandstone.	314	319	C-64
342.5	361.0	Medium grey siltstones.	319	324	C-65
361.0	384.0	Pebble conglomerate with sandstone interbeds.			
		Note: Resolution and definition on the E-logs among the best obtained for any hole. Could be used as standard for interpretations of Tantalus lithologies. (Probably indicates that hole is approximately normal to bedding.)			

ROTARY DRILL RECORD

HOLE NO.: C-77-21 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2950
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 26-27, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 628 feet
DEPTH LOGGED: 548 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 53+70, 1+30W
T.P.C.S. COORDINATES: 22,610,810 North -216,090 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 548 feet
CUTTINGS LOGS FROM 548 to 628 feet
OVERBURDEN DEPTH: 4 feet
WATER TABLE DEPTH: 372 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	4.0	Overburden.			
4.0	332.5	Pebble conglomerate with sandstone inter-			
		beds. Soft, fractured zones at approx.			
		160' & 230' where air and cuttings lost.			
332.5	334.1	Mudstone.			
334.1	335.8	Dirty COAL (1.7 feet).			
335.8	351.0	Interbedded mudstone and black			
		carbonaceous mudstone.			
351.0	356.1	Dirty COAL (5.1 feet).			
356.1	360.2	Black carbonaceous mudstone.			
360.2	375.0	COAL (14.8 feet).			
375.0	383.1	Black carbonaceous mudstone.			
383.1	401.9	COAL (18.8 feet).			
401.9	628.0	Lithology uncertain - appears to be			
		interbedded siltstones and sandstones,			
		possibly passing down into pebble			
		conglomerate somewhere below 548 feet.			

ROTARY DRILL RECORD

HOLE NO.: C-77-22

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 28, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 60+00, 2+10E
T.P.C.S. COORDINATES: 22,611,440 North -215,745 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH:

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	26.0	Interbedded Coal, carbonaceous mudstone			
		and mudstone.	(Drillers footages)		
26.0	56.5	Dirty COAL (31.5 feet)	30	35	C-66
56.5	60.0	Dark brown mudstone with coaly partings.	35	44	C-67
			47	52	C-68
60.0	68.4	COAL (8.4 feet).	52	57	C-69
68.4	71.1	Dark grey and dark brown mudstone.	64	70	C-70
			70	73	C-71
71.1	79.1	Dirty COAL (8.0 feet).			
79.1	101.7	Interbedded mudstone, carbonaceous mud-			
		stone and coal.			
101.7	108.0	COAL (6.3 feet).	105	110	C-72
108.0	121.5	Dark grey mudstone.			
121.5	146.7	Light grey siltstone with mudstone			
		partings.			
146.7	152.7	Coaly mudstone with mudstone partings.			
152.7	183.3	Light grey siltstone with mudstone			
		partings.			
183.3	194.8	Interbedded black coaly mudstone and			
		mudstone.			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
194.8	246.0	Light grey siltstone with interbeds of dark grey mudstone.			
246.0	282.0	Conglomerate with sandstone interbeds.			
282.0	284.5	Mudstone.			
284.5	286.0	Dense sandstone (?MARKER).			
286.0	304.0	Siltstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-23 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 28-29, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 296 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 60+00, 4+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,555 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 296 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 4 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	4.0	Overburden.			
4.0	27.0	Dark grey and dark brown mudstone and			
		siltstone.			
27.0	35.0	?Conglomerate (or sandstone).			
35.0	42.1	Dark grey and dark brown mudstone.	(Driller's footages)		
42.1	56.6	COAL (14.5 feet)	44	49	C-73
56.6	60.0	Sandstone.	49	54	C-74
60.0	63.5	Dark grey mudstone.	54	58	C-75
63.5	67.8	Dirty COAL, passing down into:	66	71	C-76
67.8	75.5	Coaly mudstone, passing down into:	71	74	C-77
75.5	84.4	Light grey siltstone and mudstone.			
84.4	100.8	Interbedded mudstone and coaly mudstone.			
100.8	120.0	Mudstone.			
120.0	304.0	?Conglomerate (or sandstone) with mud-			
		stone interbands.			
		Note: (1) gradual increase in rock den-			
		sity over the interval 220-250 ft.			
		(2) may not be Tantalus lithologies			
		throughout.			

ROTARY DRILL RECORD

HOLE NO.: C-77-24

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 29, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 60+00, 6+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,355 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	9	Overburden.			
9	195	?Conglomerate with sandstone interbeds.			
195	206	?Sandstone.			
206	237	Dark grey to black mudstone.			
237	304	Light grey sandstone, siltstone and mudstone, passing down into pebble conglomerate at approx. 292 feet. Note: Lithologies uncertain. May not be Tantalus.			

ROTARY DRILL RECORD

PRELIMINARY

HOLE NO.: C-77-25

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2950
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 29, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 300 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 60+00, 8+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,150 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 300 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: 280 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	9	Overburden.			
9	304	Probably pebble conglomerate with			
		sandstone interbeds throughout.			
		(May be non-Tantalus lithologies).			

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 6, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 73+70, 1+60W
T.P.C.S. COORDINATES: 22,612,805 North -216,125 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 12 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	12.0	Overburden.			
12.0	15.0	Coaly mudstone.			
15.0	21.7	COAL (6.7 feet).			
21.7	51.9	Interbedded mudstone and carbonaceous mudstone.			
51.9	57.4	COAL (5.5 feet).			
57.4	65.5	Mudstone and siltstone.			
65.5	68.3	Dirty COAL (2.8 feet).			
68.3	97.5	Mudstone and siltstone.			
97.5	99.0	Dense sandstone (?MARKER).			
99.0	102.5	Siltstone and mudstone.			
102.5	104.0	Dense sandstone (?MARKER).			
104.0	115.5	Siltstone and mudstone.			
115.5	117.5	Dense sandstone (?MARKER).			
117.5	123.6	Siltstone and mudstone.			
123.6	143.5	Interbedded coal, coaly mudstone and mudstone (coal about 30%).			
143.5	155.0	Siltstone and mudstone.			
155.0	157.0	Dense sandstone (?MARKER).			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
157.0	168.5	Siltstone and mudstone.			
168.5	170.5	Dense sandstone (?MARKER).			
170.5	182.0	Siltstone and mudstone.			
182.0	188.5	?Coaly mudstone.			
188.5	190.5	Dense sandstone (?MARKER).			
190.5	201.8	Siltstone and mudstone.			
201.8	217.5	Interbedded mudstone and coaly mudstone.			
217.5	227.0	Siltstone and mudstone.			
227.0	228.5	Dense sandstone (?MARKER).			
228.5	252.0	Interbedded coal, coaly mudstone and mudstone.			
252.0	274.0	Siltstone and mudstone.			
274.0	304.0	Pebble conglomerate with sandstone interbeds.			
		Note: Gamma log poorly defined and density log erratic, hence lithological interpretation open to question.			

ROTARY DRILL RECORD

HOLE NO.: C-77-27

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 6-7, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 344 feet
DEPTH LOGGED: 335 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 60+00, 3+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,655 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 335 feet
CUTTINGS LOGS FROM 335 to 344 feet
OVERBURDEN DEPTH: 18 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	18.0	Overburden.			
18.0	234.0	Pebble conglomerate with sandstone			
		interbeds.			
234.0	237.0	Dense sandstone (?MARKER).			
237.0	276.5	Pebble conglomerate with sandstone			
		interbeds.	(Driller's Footage)		
276.5	286.2	COAL (9.7 feet).	276	281	C-78
286.2	287.2	Mudstone.	281	286	C-79
287.2	289.8	Dirty COAL (2.6 feet).	286	290	C-80
289.8	315.0	Interbedded mudstone and coaly mudstone			
315.0	326.0	Mudstone.			
326.0	344.0	Light grey siltstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-28

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 7-8, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 364 feet
DEPTH LOGGED: 369 feet (!)
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 68+00, 1+65E
T.P.C.S. COORDINATES: 22,612,240 North -215,800 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 369 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	5.0	Overburden.			
5.0	42.0	Dark grey and dark brown mudstones and			
		siltstones.			
42.0	44.0	Dense sandstone (?MARKER).			
44.0	57.5	Dark grey and dark brown mudstones and			
		siltstones.			
57.5	59.0	Dense sandstone (?MARKER).			
59.0	68.5	Dark grey and dark brown mudstones and			
		siltstones.			
68.5	72.3	COAL (3.8 feet).			
72.3	74.2	Dark grey mudstone.			
74.2	77.0	COAL (2.8 feet).			
77.0	92.0	Mudstone, possibly coaly.			
92.0	94.5	Mudstone.			
94.5	103.0	Mudstone, possibly with coaly bands.			
103.0	190.0	Siltstone and/or mudstone.			
190.0	302.2	Pebble conglomerate with sandstone and			
		mudstone interbeds.			
302.2	308.4	COAL (6.2 feet).			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
308.4	319.1	Interbedded coal, coaly mudstone and mudstone.			
319.1	369.0	Medium grey mudstone and siltstone.			
		Note: E-logs poorly defined. Lithological interpretation open to question.			

ROTARY DRILL RECORD

PRELIMINARY

HOLE NO.: C-77-29

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 8, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 297 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+90, 2+70E
T.P.C.S. COORDINATES: 22,612,235 North -215,695 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 297 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	89.0	Dark brown and dark grey siltstones			
		with interbeds of mudstone and sand-			
		stone.			
89.0	182.0	Pebble conglomerate with sandstone			
		interbeds.			
182.0	189.7	COAL (7.7 feet).			
189.7	192.6	Mudstone.			
192.6	194.4	Dirty COAL (1.8 feet).			
194.4	270.0	Light grey siltstone with sandstone			
		interbeds.			
270.0	303.0	Pebble conglomerate.			

ROTARY DRILL RECORD

HOLE NO.: C-77-30

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 9, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 289 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+80, 3+70E
T.P.C.S. COORDINATES: 22,612,220 North -215,595 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 289 feet
CUTTINGS LOGS FROM 289 to 303 feet
OVERBURDEN DEPTH: 4 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	4	Overburden.			
4	80	Siltstones with mudstone and sandstone			
		interbeds.			
80	125	Pebble conglomerate with sandstone			
		interbeds.			
125	133	Mudstones.			
133	303	Pebble conglomerate with sandstone and			
		mudstone interbeds.			
		Note: May include non-Tantalus			
		lithologies.			

ROTARY DRILL RECORD

HOLE NO.: C-77-31

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 9, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+60, 5+70E
T.P.C.S. COORDINATES: 22,612,195 North -215,395 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	5	Overburden.			
5	303	Pebble conglomerate with sandstone,			
		siltstone and mudstone interbeds.			
		Note: Lithology uncertain - may be			
		non-Tantalus lithologies.			

ROTARY DRILL RECORD

HOLE NO.: C-77-32

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 10, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 301 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+30, 7+70E
T.P.C.S. COORDINATES: 22,612,165 North -215,195 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 301 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	5	Overburden.			
5	282	?Pebble conglomerate with sandstone,			
		siltstone and mudstone interbeds,			
		2" of coal at approx. 192 feet.			
282	303	Siltstone.			
		Note: Lithologies uncertain - may			
		not be Tantalus.			

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 10, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 299 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 68+00, 0+50E
T.P.C.S. COORDINATES: 22,612,250 North -215,910 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 299 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 19 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	19.0	Overburden.			
19.0	65.0	Siltstone with sandstone and mudstone interbeds.			
65.0	71.5	Mudstone.			
71.5	73.0	Sandstone.			
73.0	91.0	Mudstone and coaly mudstone.			
91.0	92.5	Dense sandstone (?MARKER).			
92.5	103.0	Mudstone.			
103.0	112.0	Siltstone.			
112.0	148.0	Interbedded coal, coaly mudstone and mudstone.			
148.0	162.0	Mudstone.			
162.0	165.0	Dense sandstone (?MARKER).			
165.0	189.5	Mudstones and siltstones.			
189.5	191.5	Dense sandstone (?MARKER).			
191.5	213.0	Mudstones and siltstones.			
213.0	214.5	Dense sandstone (?MARKER).			
214.5	216.4	Siltstone.			
216.4	222.5	Dirty COAL (6.1 feet).			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
222.5	236.5	Mudstone and siltstone.			
236.5	244.6	Interbedded coal, coaly mudstone and mudstone.			
244.6	258.0	Coaly mudstone.			
258.0	265.6	Mudstone and siltstone.			
265.6	274.7	COAL with mudstone partings (9.1 feet).			
274.7	282.0	Mudstone and siltstone.			
282.0	286.0	Coaly mudstone.			
286.0	303.0	Mudstones and siltstones, passing down into sandstone.			

ROTARY DRILL RECORD

HOLE NO.: C-77-34

COMPANY: Cyprus Anvil Mining Corp.
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 11, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 299 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 76+00, 1+15W
T.P.C.S. COORDINATES: 22,613,035 North -216,080 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 299 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	20.0	Sandstone.	(Driller's footage)		
20.0	29.6	COAL (9.6 feet).	21	26	C-81
29.6	32.5	Mudstone.	26	31	C-82
32.5	51.8	COAL with mudstone interbeds (19.3 ft.).	33	38	C-83
51.8	55.8	Mudstone.	38	43	C-84
55.8	60.3	Dirty COAL (4.5 feet).	43	48	C-85
60.3	62.4	Mudstone.	48	51	C-86
62.4	65.1	Coaly mudstone.			
65.1	69.9	Mudstone.			
69.9	76.5	COAL (6.6 feet).	71	77	C-87
76.5	106.0	Interbedded siltstones and mudstones.			
106.0	107.0	Dense sandstone (?MARKER).			
107.0	110.0	Mudstone.			
110.0	118.5	Coaly mudstone.			
118.5	121.0	Mudstone.			
121.0	122.5	Dense sandstone (?MARKER).			
122.5	127.5	Siltstone and mudstone.			
127.5	128.5	Dense sandstone (?MARKER).			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
128.5	133.0	Siltstone and mudstone.			
133.0	146.0	Interbedded coal, coaly mudstone and			
		mudstone.			
146.0	152.0	Siltstone and mudstone.			
152.0	158.0	Interbedded coal, coaly mudstone and			
		mudstone.			
158.0	167.3	Siltstone and sandstone.			
167.3	180.8	COAL with coaly mudstone partings	168	174	C-88
		(13.5 feet).	174	179	C-89
180.8	183.0	Siltstone.			
183.0	185.2	Dirty COAL (2.2 feet).			
185.2	203.0	Mudstones and siltstones.			
203.0	205.0	Dense sandstone (?MARKER).			
205.0	218.0	Mudstones and siltstones.			
218.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			

ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 11, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 260 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 76+00, 0+15W
T.P.C.S. COORDINATES: 22,613,035 North -215,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 260 feet
CUTTINGS LOGS FROM 260 to 303 feet
OVERBURDEN DEPTH: 3 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	3.0	Overburden.			
3.0	4.5	Mudstone.			
4.5	8.8	COAL (4.3 feet).			
8.8	24.0	Interbedded coal, coaly mudstone and			
		mudstone.			
24.0	45.8	Siltstones and mudstones.	(Driller's footages)		
45.8	53.8	COAL with mudstone partings (8.0 feet).	46	53	C-90
53.8	56.6	Mudstone.			
56.6	59.2	Coaly mudstone.			
59.2	92.0	Mudstones and siltstones.			
92.0	200.0	Pebble conglomerate with sandstone			
		interbeds.			
200.0	201.8	Mudstone.			
201.8	213.2	COAL (11.4 feet).	203	208	C-91
213.2	217.0	Coaly mudstone.	208	213	C-92
217.0	234.6	Mudstone and siltstone.			
234.6	236.6	Coaly mudstone.			
236.6	260.0	?Pebble conglomerate with sandstone			
		interbeds.			

ROTARY DRILL RECORD

PRELIMINARY
HOLE NO.: C-77-36

COMPANY: Cyprus Anvil Mining Corporation
LEASE/LOT/CLAIM NO.: C.M.L. #2959
DRILLING CONTRACTOR: Midnight Sun
LOGGING CONTRACTOR: Data Probe
DEPTH DRILLED: 303 feet
LOGS RUN: Gamma, L.S. Density
T.P.C.S. COORDINATES: 22,612,515 North -215,780 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 295 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet

PROPERTY: Carmacks North
PROVINCE/TERRITORY: Yukon
DATE(S) DRILLED: July 12, 1977
DATE LOGGED: July 22, 1977
DEPTH LOGGED: 295 feet
GRID LOCATION: Line 75+75, 1+90E

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

WATER TABLE DEPTH: -

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	24.7	Lithology uncertain - possibly pebble conglomerate.			
24.7	26.3	Coaly mudstone.			
26.3	33.5	Mudstone and siltstone.			
33.5	35.4	Coaly mudstone.			
35.4	53.0	Mudstone - HIGHLY RADIOACTIVE ZONE.			
53.0	303.0	Pebble conglomerate with sandstone interbeds.			
		Note: May not be Tantalus lithologies.			

ROTARY DRILL RECORD

HOLE NO.: C-77-37

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 12, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+60, 3+90E
T.P.C.S. COORDINATES: 22,613,000North -215,580 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	8.0	Overburden.			
8.0	62.5	Pebble conglomerate with sandstone			
		interbeds.			
62.5	98.0	Mudstones and siltstones.			
98.0	225.0	Pebble conglomerate with sandstone			
		interbeds.			
225.0	254.0	Siltstones and sandstones.			
254.0	279.0	Pebble conglomerate with sandstone			
		interbeds.			
279.0	303.0	Lithology uncertain - possibly sand-			
		stone and siltstone.			
		Note: May include non-Tantalus			
		lithologies.			

ROTARY DRILL RECORD

PRELIMINARY

HOLE NO.: C-77-38

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 13, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+40, 5+85E
T.P.C.S. COORDINATES: 22,612,985 North -215,380 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	101.5	Pebble conglomerate with sandstone			
		interbeds.			
101.5	129.0	Sandstone and siltstone.			
129.0	166.0	Pebble conglomerate with sandstone			
		interbeds.			
166.0	176.0	Sandstone and siltstone.			
176.0	188.3	Mudstone.			
188.3	196.2	COAL (7.9 feet).	189	194	C-93
196.2	203.0	Mudstone.	194	196	C-94
203.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			

ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 13, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 382 feet
DEPTH LOGGED: 376 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+30, 7+85E
T.P.C.S. COORDINATES: 22,612,970 North -215,180 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 376 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: 324 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	5.0	Overburden.			
5.0	6.8	Coaly mudstone.			
6.8	17.0	Mudstone.			
17.0	165.0	Pebble conglomerate with sandstone			
		interbeds.			
165.0	172.3	Mudstone and siltstone.			
172.3	175.6	Dirty COAL (3.3 feet).			
175.6	176.7	Siltstone.			
176.7	183.0	COAL (6.3 feet).	178	183	C-95
183.0	186.8	Mudstone.			
186.8	192.2	COAL (5.4 feet).			
192.2	204.5	Mudstone and siltstone.			
204.5	205.5	Dense sandstone (?MARKER).			
205.5	210.7	Mudstone.			
210.7	215.0	COAL (4.3 feet).			
215.0	218.9	Siltstone.			
218.9	222.0	COAL (3.1 feet).			
222.0	225.0	Mudstone and siltstone.			
225.0	228.5	Carbonaceous mudstone.			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
228.5	234.8	Mudstone and siltstone.			
234.8	235.9	Carbonaceous mudstone.			
235.9	243.5	Mudstone and siltstone.			
243.5	247.5	Carbonaceous mudstone.			
247.5	250.0	Mudstone.			
250.0	253.0	Dense sandstone (?MARKER).			
253.0	261.0	Interbedded coal and coaly mudstone.			
261.0	263.6	Mudstone.	(Driller's footages)		
263.6	284.6	COAL (21.0 feet).	266	271	C-96
284.6	290.6	Mudstone.	271	276	C-97
290.6	311.1	COAL (20.5 feet).	276	281	C-98
311.1	314.0	Mudstone.	281	286	C-99
314.0	315.0	Dense sandstone (?MARKER).	292	296	C-100
315.0	323.0	Coaly mudstone.	296	302	C-101
323.0	348.0	Mudstone and siltstones.	302	307	C-102
348.0	382.0	Pebble conglomerate with sandstone	307	311	C-103
		interbeds.			

ROTARY DRILL RECORD

HOLE NO.: C-77-40

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 301 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+80, 0+90E
T.P.C.S. COORDINATES: 22,613,020 North -215,880 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 301 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	15.0	Mudstones.			
15.0	29.0	Siltstones.			
29.0	116.1	Pebble conglomerate with sandstone			
		interbeds.			
116.1	123.3	COAL (7.2 feet)	116	121	C-104
123.3	126.0	Coaly mudstone.	121	126	C-105
126.0	139.0	Mudstones and siltstones.			
139.0	166.0	Siltstones and sandstones.			
166.0	207.0	Pebble conglomerate with sandstone			
		interbeds.			
207.0	214.0	Siltstones.			
214.0	216.0	Dense sandstone (?Marker).			
216.0	222.0	Siltstones.			
222.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			

ROTARY DRILL RECORD

HOLE NO.: C-77-41

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 300 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+10, 9+85E
T.P.C.S. COORDINATES: 22,612,950 North -214,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 300 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 12 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	12.0	Overburden.			
12.0	14.0	Carbonaceous mudstone.			
14.0	22.3	Mudstone.			
22.3	36.0	COAL (13.7 feet).	22	27	C-106
36.0	46.5	Mudstone	27	32	C-107
46.5	57.0	Siltstone.	32	36	C-108
57.0	80.0	Sandstone and siltstone, passing down			
		into :			
80.0	114.5	Pebble conglomerate with sandstone			
		interbeds.			
114.5	116.5	Carbonaceous mudstone.			
116.5	121.0	Mudstone.			
121.0	132.6	Pebble conglomerate.			
132.6	135.0	Carbonaceous mudstone.			
135.0	139.0	Mudstone.			
139.0	160.0	Siltstone.			
160.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			

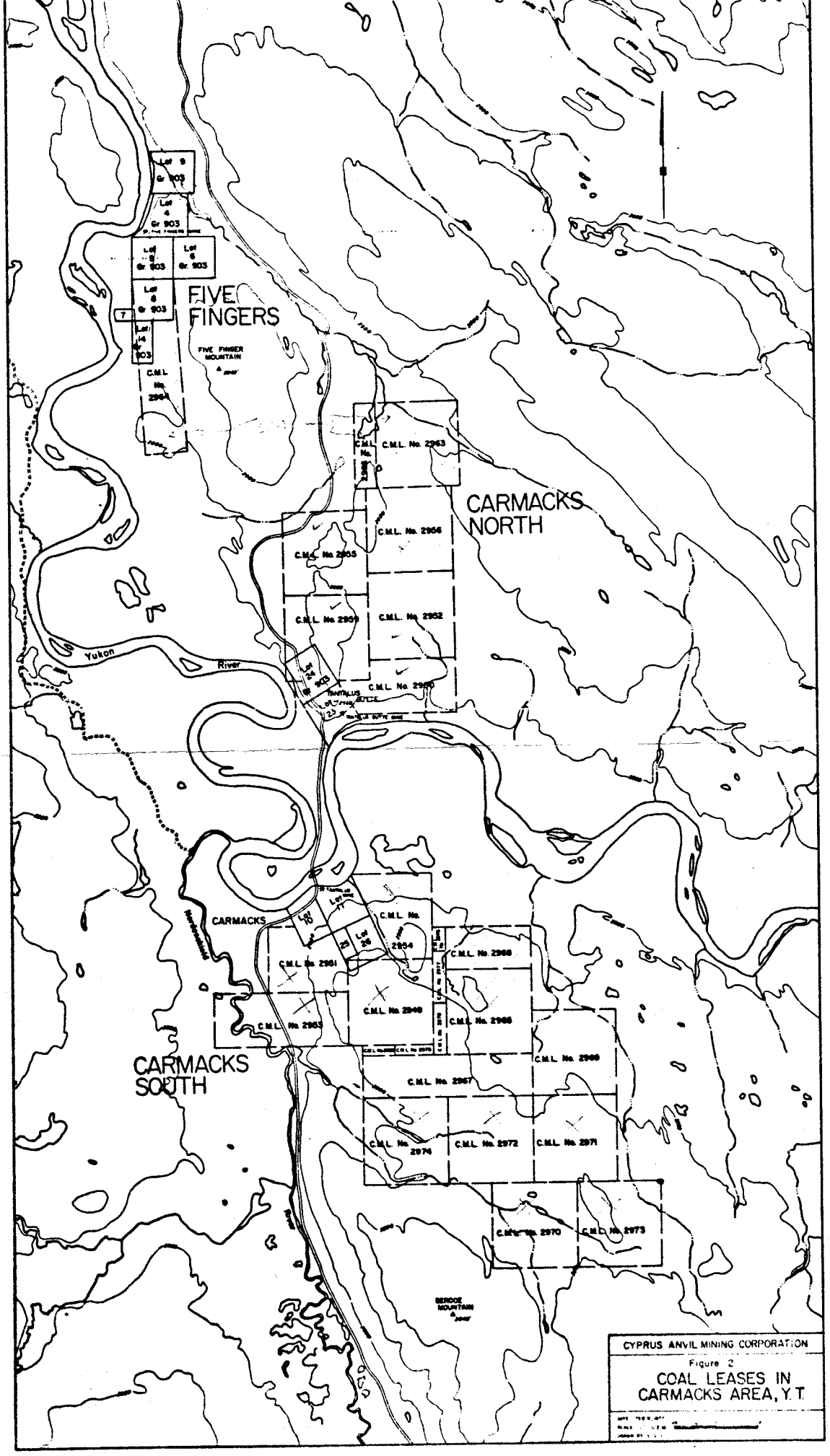
ROTARY DRILL RECORD

HOLE NO.: C-77-42 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 301 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 77+80, 0+40W
T.P.C.S. COORDINATES: 22,613,220 North -216,005 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 301 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	21.8	Mudstones and siltstones.			
21.8	43.1	Interbedded coal, coaly mudstone and			
		mudstone.			
43.1	49.0	Mudstone.			
49.0	61.7	COAL (12.7 feet).			
61.7	65.3	Mudstone.			
65.3	67.3	Dirty COAL (2.0 feet).			
67.3	90.0	Mudstones and siltstones.			
90.0	95.0	Sandstones and siltstones.			
95.0	224.0	Pebble conglomerate with sandstone			
		interbeds.			
224.0	233.5	COAL (9.5 feet).			
233.5	240.0	Mudstones.			
240.0	246.0	Siltstones.			
246.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			


FIVE FINGERS
FIVE FINGER MOUNTAIN
CARMACKS NORTH
CARMACKS SOUTH
CARMACKS
Yukon River
C.M.L. No. 2963
C.M.L. No. 2956
C.M.L. No. 2955
C.M.L. No. 2959
C.M.L. No. 2952
C.M.L. No. 2960
C.M.L. No. 2954
C.M.L. No. 2961
C.M.L. No. 2966
C.M.L. No. 2940
C.M.L. No. 2963
C.M.L. No. 2968
C.M.L. No. 2967
C.M.L. No. 2974
C.M.L. No. 2972
C.M.L. No. 2971
C.M.L. No. 2970
C.M.L. No. 2973
BERDOE MOUNTAIN
CYPRUS ANVIL MINING CORPORATION
Figure 2
COAL LEASES IN CARMACKS AREA, Y.T.

YUKON RIVER

CARMACKS

Tantalus Mine Coal

LOT 11

LOT 25

LOT 10

C.M.L. No. 2954

C.M.L. No. 2956

C.M.L. No. 2975

C.M.L. No. 2968

C.M.L. No. 2976

C.M.L. No. 2965

C.M.L. No. 2949

C.M.L. No. 2951

C.M.L. No. 2953

C.M.L. No. 2977

C.M.L. No. 2969

C.M.L. No. 2980

C.M.L. No. 2979

C.M.L. No. 2978

C.M.L. No. 2967

C.M.L. No. 2974

C.M.L. No. 2972

C.M.L. No. 2971

C.M.L. No. 2970

C.M.L. No. 2973

No Outcrop

? LKT

? JL1

eTcv

LEGEND

EOCENE OR YOUNGER

eTcv — CARMACKS GROUP: Basaltic and andesitic volcanics

LOWER CRETACEOUS AND / OR UPPER JURASSIC

LKT — TANTALUS FORMATION: Quartz - and chert - pebble conglomerate; minor sandstone, siltstone and mudstone

LOWER AND MIDDLE JURASSIC

JL2 — LABERGE GROUP: Mudstone, carbonaceous mudstone; coal seams

JL1 — LABERGE GROUP: Cobble conglomerate, arkose; tuffaceous arkose

Rock Outcrop

Bedding (upright, vertical, overturned)

Contact (approximate, assumed)

Anticline Axial Trace (upright, overturned)

Syncline Axial Trace (upright, overturned)

Fault (assumed)

Coal Mining Lease Boundary

Lot Boundary

Trail

Location of Diamond Drill Hole

Geology by R.P. Hill and T. J. Adamson, 1976

CYPRUS ANVIL MINING CORPORATION

GEOLOGICAL MAP OF CARMACKS SOUTH COAL LEASE AREA

DATE: FEB 24, 197

SCALE 1" = 800'

DRAWN BY: C. L.

To Accompany report by R.P. Hill, Feb. 1977

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH

GEOLOGICAL MAP OF OPEN PIT AREA

To Accompany Report By R.P.HILL, April 1978

PHOTOGRAPHY: July 1977

PROJECTION: Transverse Mercator

COORDINATES: Territorial Plane (feet)

SCALE IN FEET

100 0 100 200

CONTOUR INTERVAL: 5 FEET
Except 10 Feet within open pit

N.T.S. 115-I-1

DRAWN BY: R.W.R

DATE: MAY, 1978

MAP No. 1

TRUE NORTH

1° 06'

Grid North

Magnetic North

32° 22'

Approximate Magnetic Declination 1978 - 32° 22' East
Annual change decreasing 3.0'

LEGEND

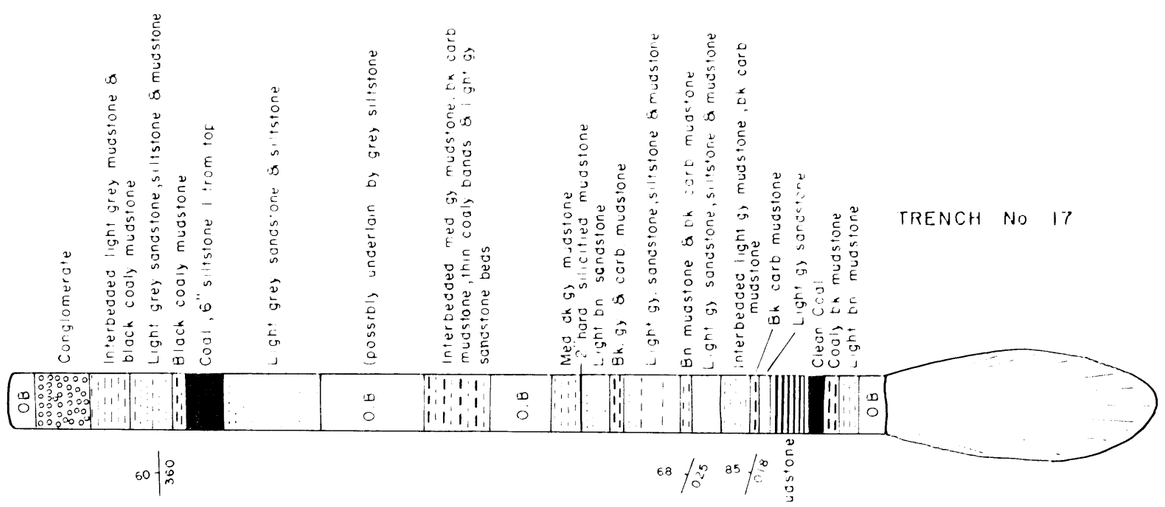
- Survey control point
- Road
- Cut line
- Trench outline with spoil
- Surface projection of main entry and working area
- Underground access
- Aerial photo target
- Cat trail
- Cleared areas
- Subsidence hole
- Airtrac drill-hole
- Diamond drill-hole
- Rotary drill-hole

SYMBOLS

- Contact (Defined, Assumed)
- Bedding (Indined, Vertical, Overturned)
- Anticline Axial Trace
- Syncline Axial Trace
- Fault at surface, showing dip of plane and sense of movement, where known (Approximate, Assumed)
- Fault underground (Approximate)

UPPER JURASSIC-LOWER CRETACEOUS TANTALUS FORMATION

11. Conglomerate and pebbly sandstone
10. No. 1 Coal Seam
9. Conglomerate and pebbly sandstone
8. No. 2 Coal Seam
7. Brown mudstones and siltstones
6. Conglomerate and pebbly sandstone
5. Brown and dark grey siltstones and mudstones
4. No. 3 Coal Seam
3. Thin-bedded light grey sandstone and siltstones
2. Dark brown and dark grey mudstones, black carbonaceous mudstones and thin coal seams
1. Conglomerate, pebbly sandstone and coarse grained sandstone



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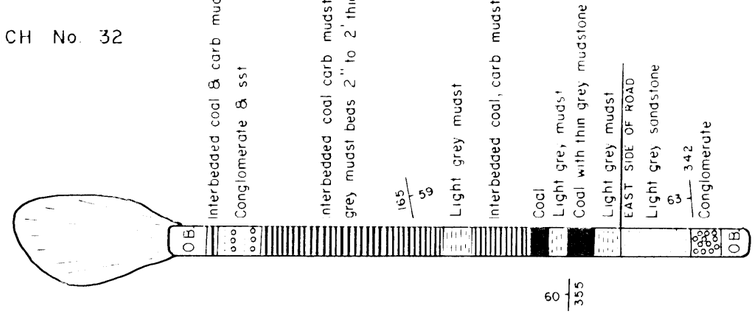

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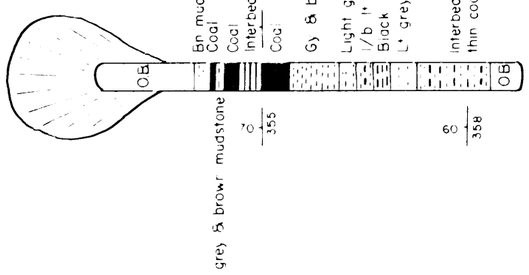
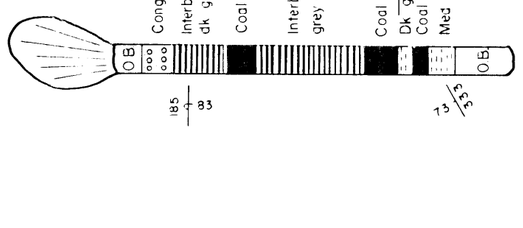


TRENCH No. 28



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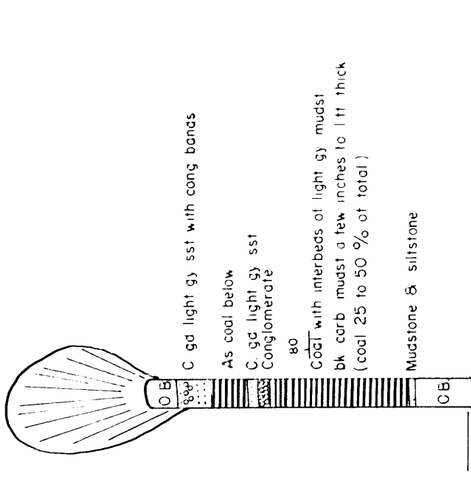

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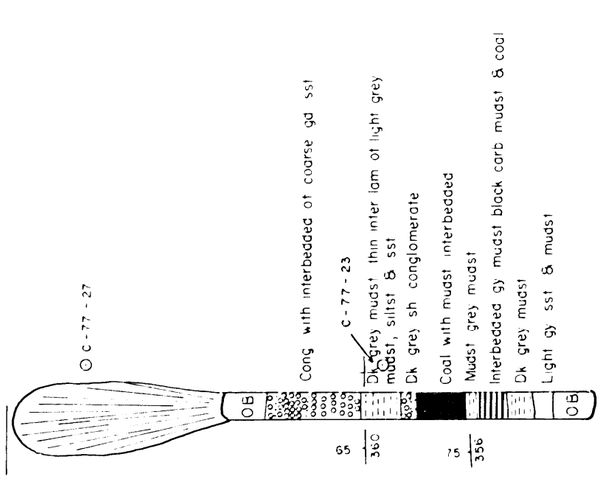

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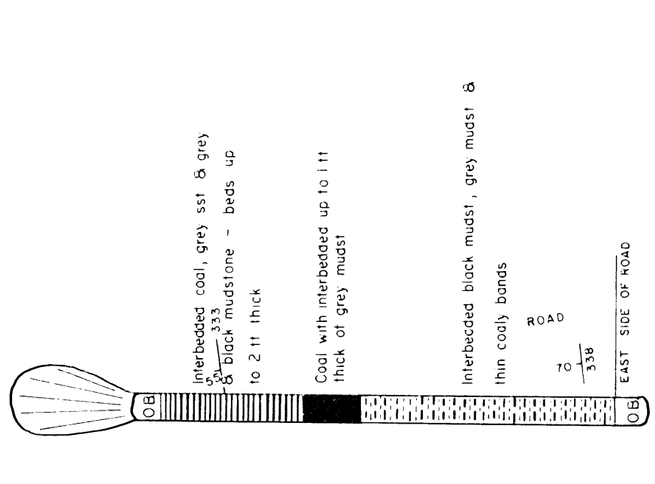


TRENCH No. 34

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH TRENCH PLANS

MAP REF 115 - I - 1

DATE APRIL 9, 1978
REVISED

0 50 100
Scale 1" = 50 ft

DRAWN BY C L C

FIGURE 2

8+00W 6+00W 4+00W 2+00W B.L. 0+00 2+00E 4+00E 6+00 8+00E 10+00E

2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400

Road

Top Bench

27A ANGLE

28D BACKANGLE

No. 3 (Main) SEAM

28C BACKANGLE

28 ANGLE

29 ANGLE

COUNTER

? FAULT ZONE

? No. 3 SEAMS

D.D.H. C-73-5 (-45°)

HHW - A

MAIN ENTRY

PROJECTION OF NORTH CROSS-CUT

D.D.H. C-73-6 (-35°)

D.D.H. C-73-4

Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH SECTION 48+50

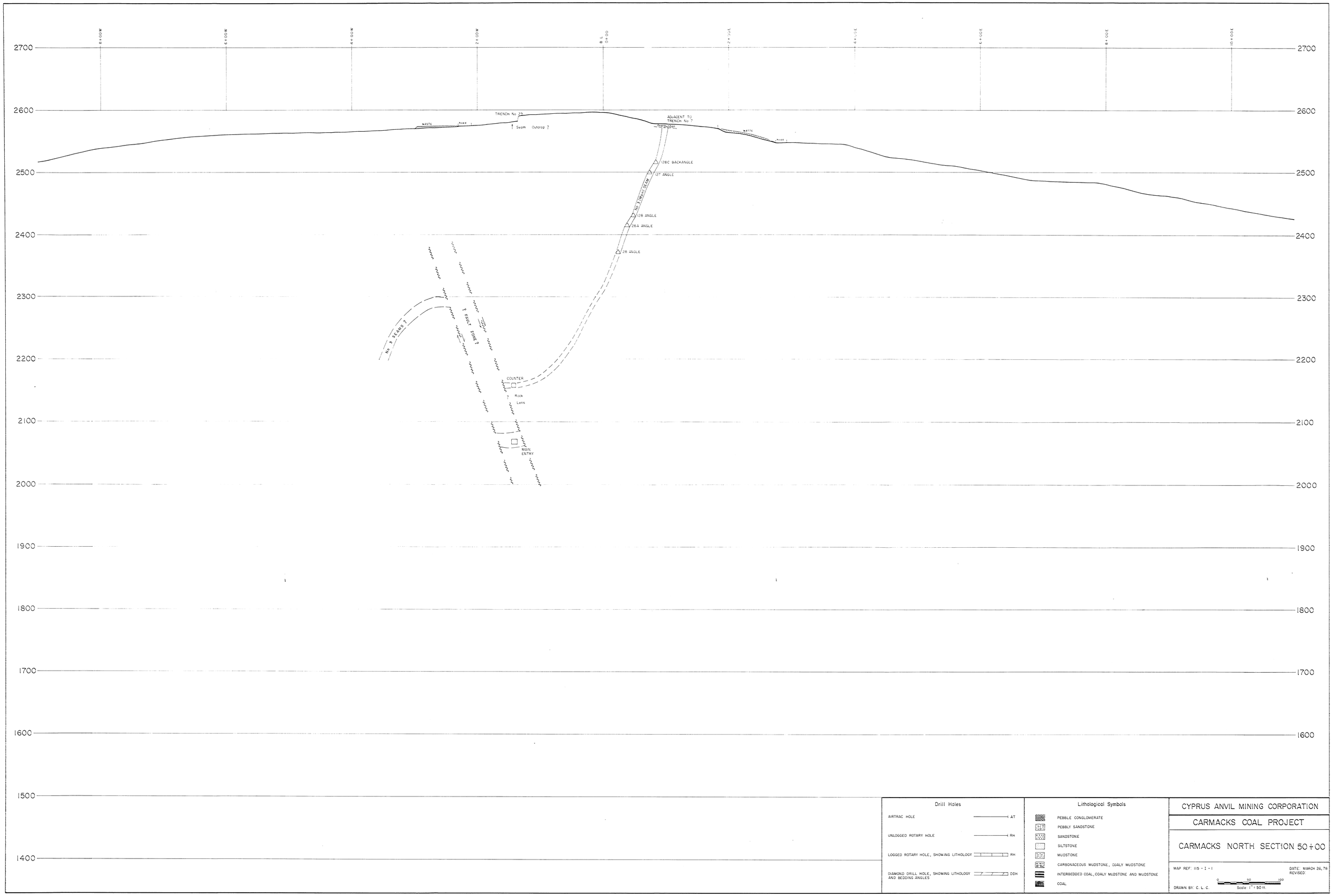
MAP REF: 115 - I - 1

DATE: MARCH 27, 78

REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH SECTION 50+00

MAP REF: 115 - I - 1

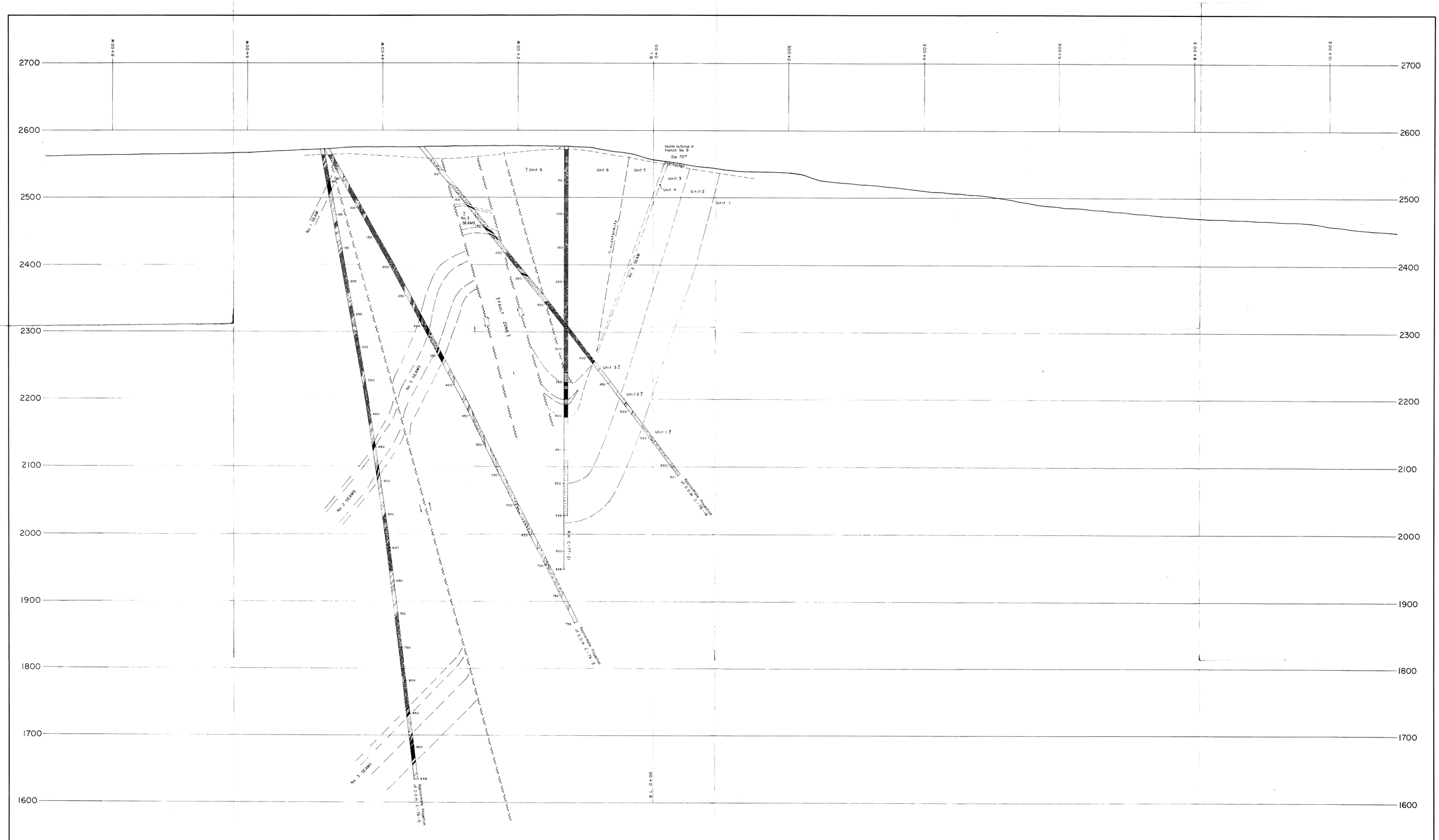
DATE: MARCH 26, 78

REVISED:

0 50 100

Scale: 1" = 50 ft.

DRAWN BY: C. L. C.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

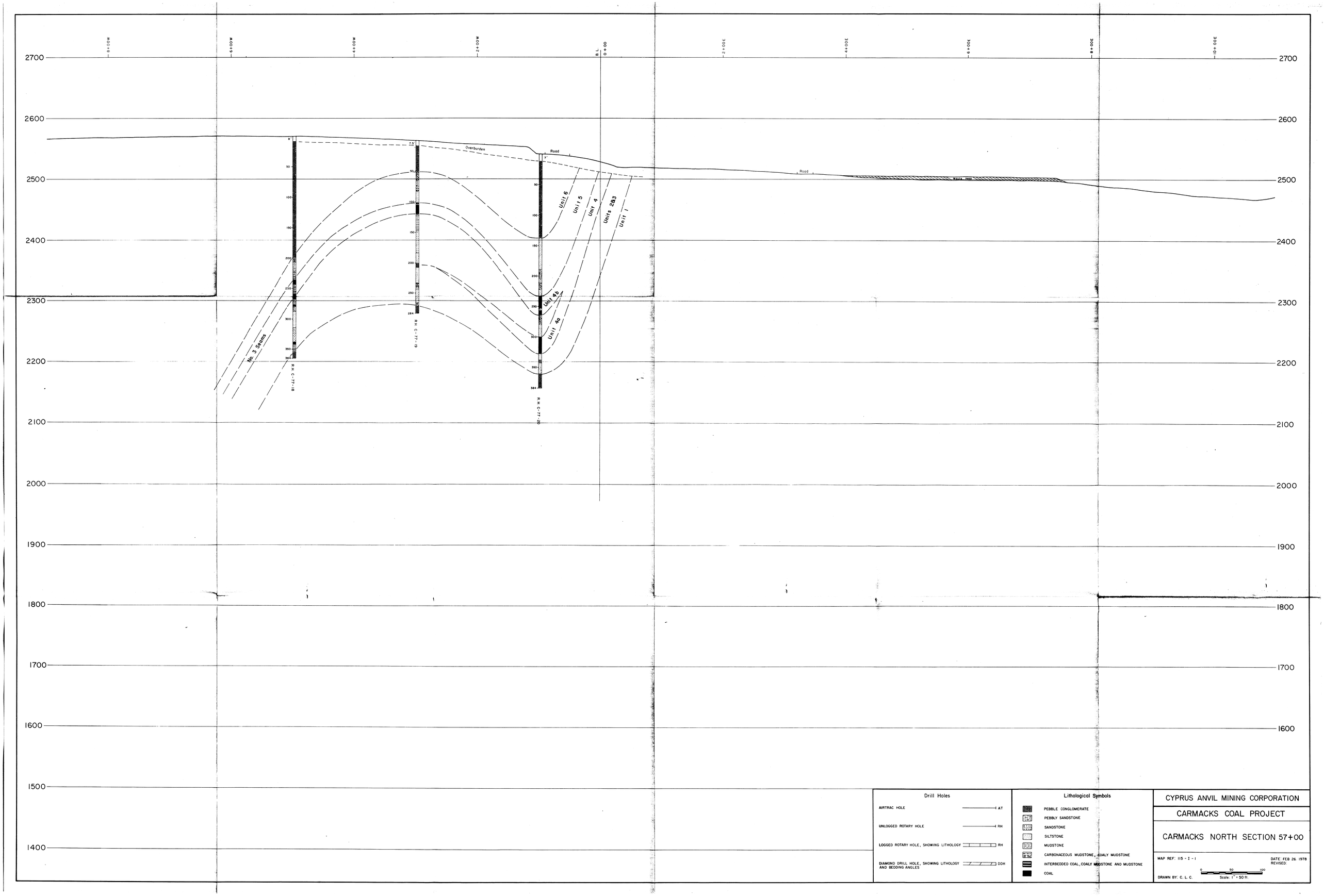
CARMACKS NORTH SECTION 54+00

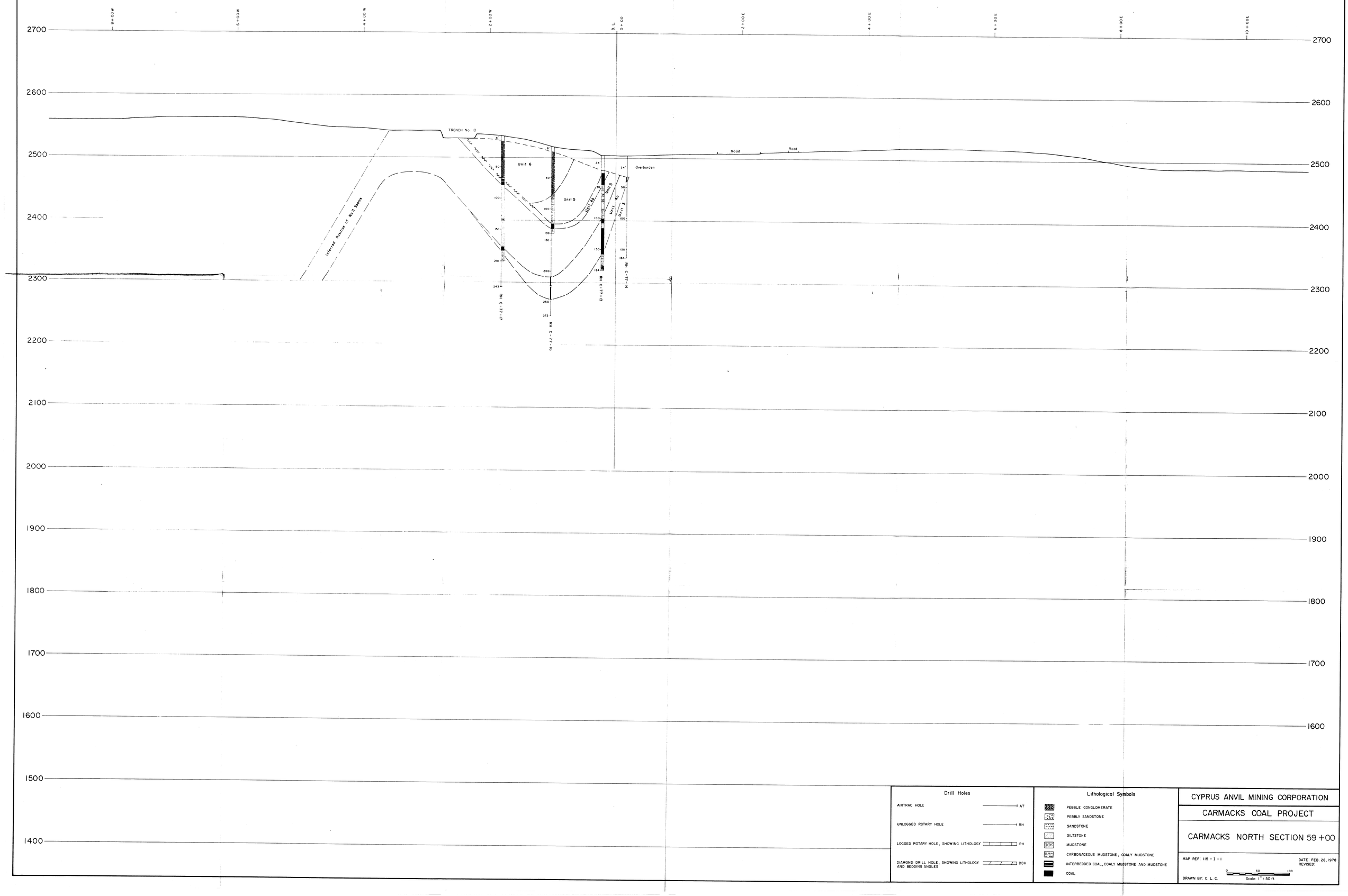
MAP REF: 115 - I - 1

DATE: MARCH 26, 78
REVISED.

DRAWN BY: C. L. C.

0 50 100
Scale: 1" = 50 ft.


M00+80
M00+40
M00+00
B.L. 0+00
3E0+40
3E0+80
3E1+20
3E1+60
3E2+00
3E2+40
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
Overburden
Road
Road
Waste Heap
Unit 6
Unit 5
Unit 4
Units 2&3
Unit 1
Unit 4b
Unit 4a
No. 3 Seams
R.H. C-77-18
R.H. C-77-19
R.H. C-77-20
Drill Holes
AIRTRAC HOLE AT
UNLOGGED ROTARY HOLE RH
LOGGED ROTARY HOLE, SHOWING LITHOLOGY RH
DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES DDH
Lithological Symbols
PEBBLE CONGLOMERATE
PEBBLY SANDSTONE
SANDSTONE
SILTSTONE
MUDSTONE
CARBONACEOUS MUDSTONE, COALY MUDSTONE
INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
COAL
CYPRUS ANVIL MINING CORPORATION
CARMACKS COAL PROJECT
CARMACKS NORTH SECTION 57+00
MAP REF: 115 - I - 1
DATE: FEB 26 1978
REVISED.
DRAWN BY: C. L. C.
0 50 100
Scale: 1" = 50 ft.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH SECTION 59+00

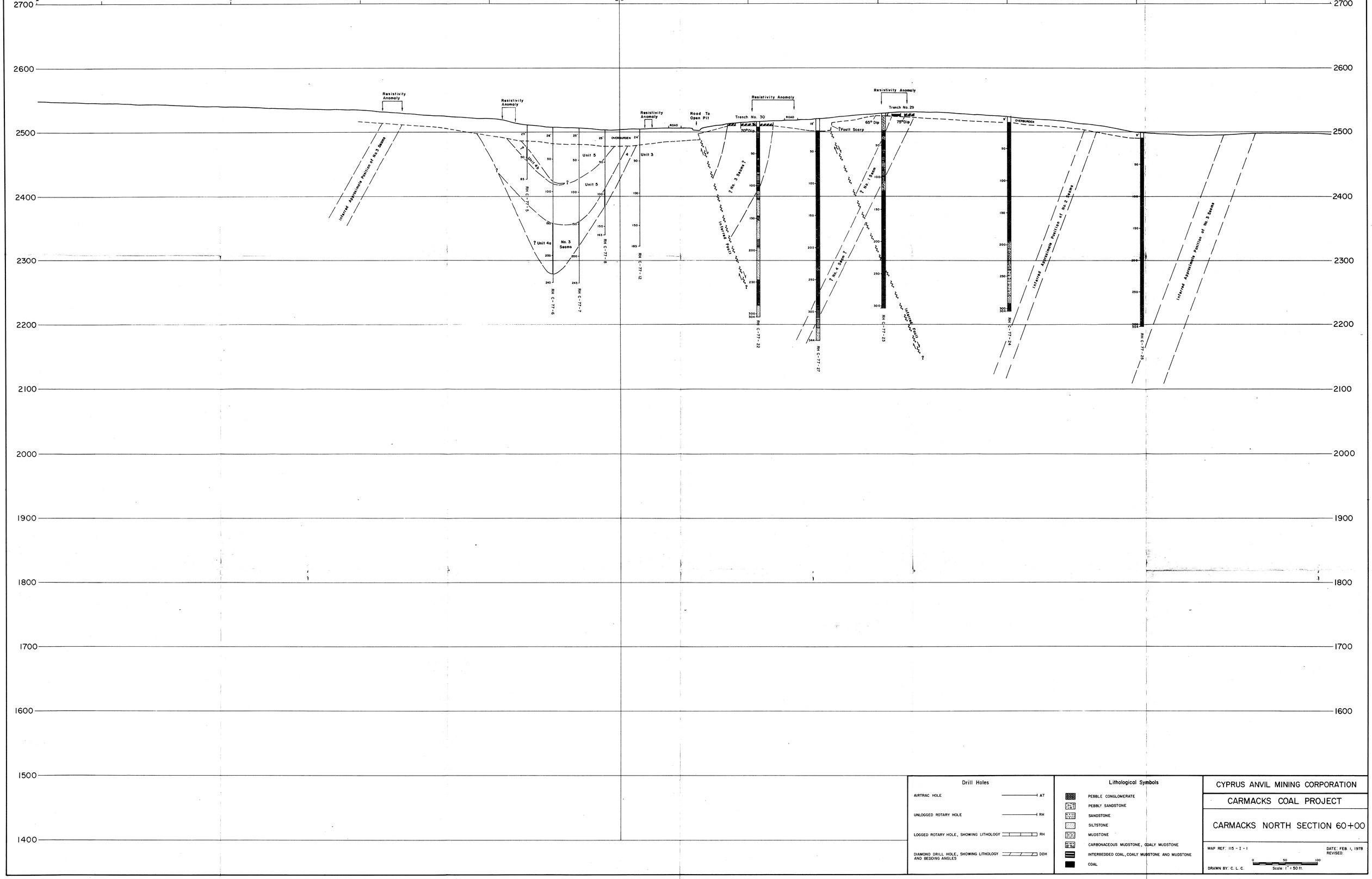
MAP REF: 115 - I - 1

DATE: FEB. 26, 1978

REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

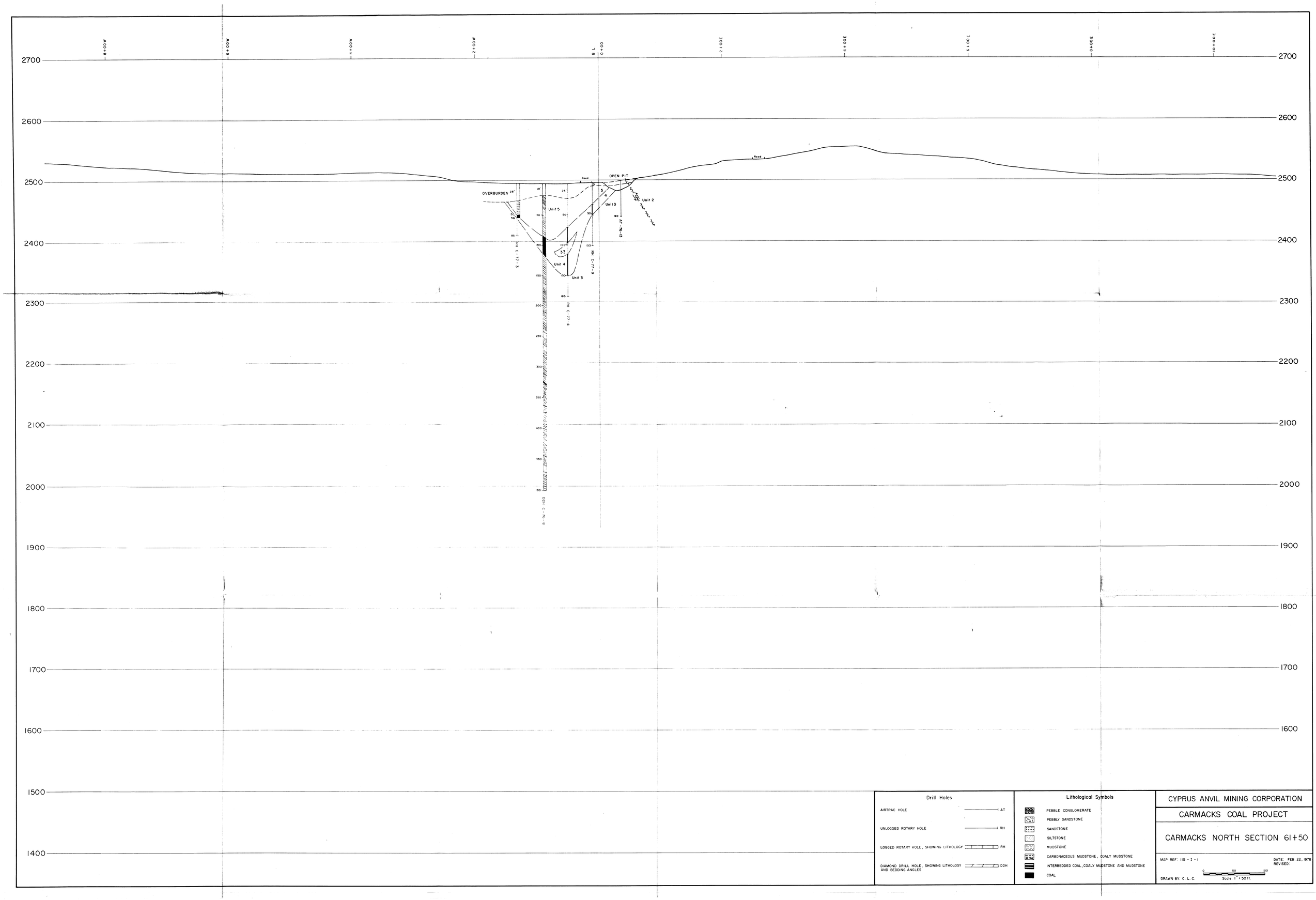
CARMACKS NORTH SECTION 60+00

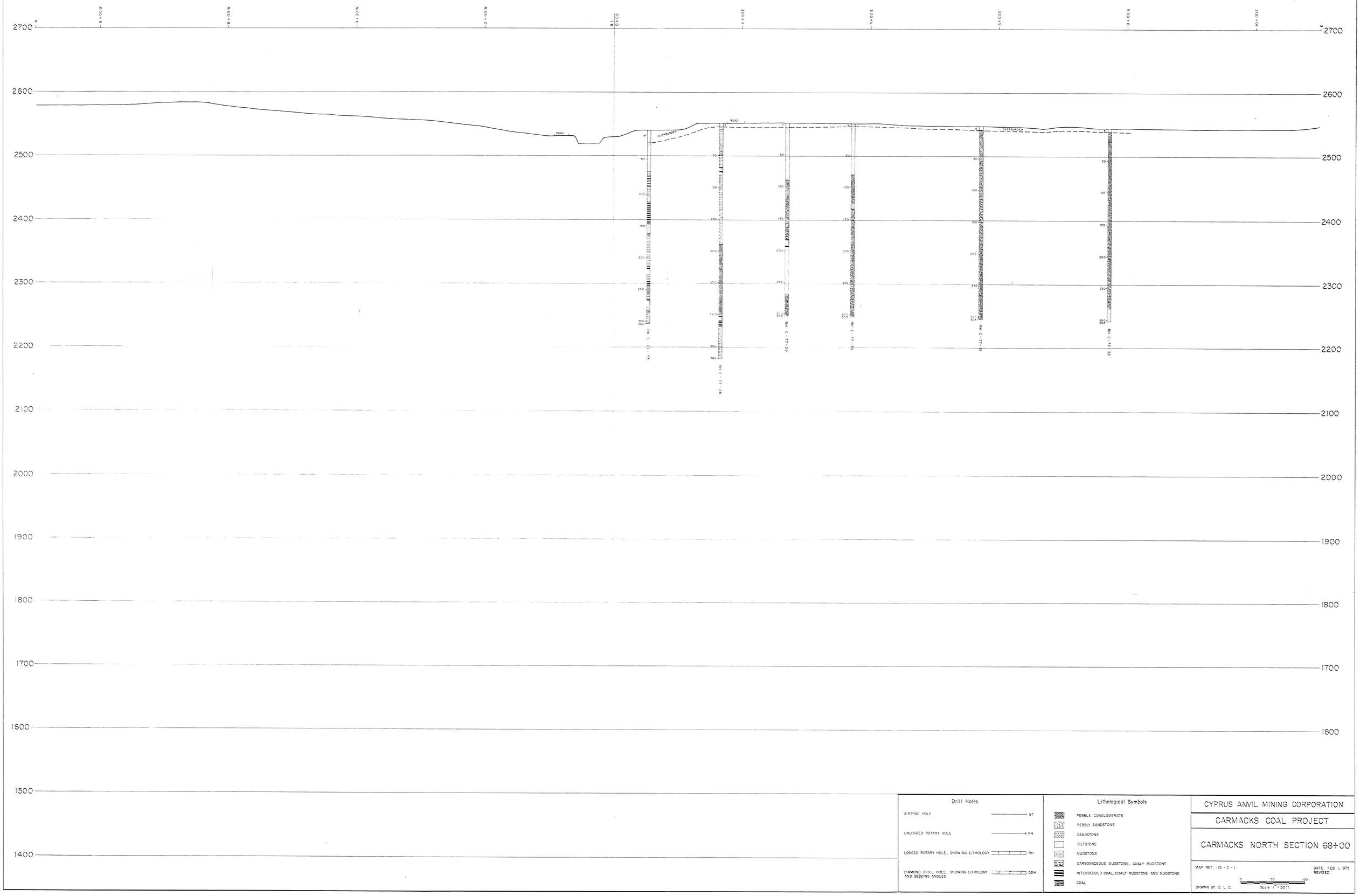
MAP REF: 115 - I - 1

DATE: FEB. 1, 1978
REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.


8+00W
6+00W
4+00W
2+00W
B L
0+00
2+00E
4+00E
6+00E
8+00E
10+00E
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
Road
OPEN PIT
OVERBURDEN
Unit 5
Unit 4
Unit 3
Unit 2
RH C-77-3
RH C-77-9
RH C-77-4
RH C-76-8
AT 76-13
Drill Holes
AIRTRAC HOLE
AT
UNLOGGED ROTARY HOLE
RH
LOGGED ROTARY HOLE, SHOWING LITHOLOGY
RH
DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES
DDH
Lithological Symbols
PEBBLE CONGLOMERATE
PEBBLY SANDSTONE
SANDSTONE
SILTSTONE
MUDSTONE
CARBONACEOUS MUDSTONE, COALY MUDSTONE
INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
COAL
CYPRUS ANVIL MINING CORPORATION
CARMACKS COAL PROJECT
CARMACKS NORTH SECTION 61+50
MAP REF: 115 - I - 1
DATE: FEB 22, 1978
REVISED:
DRAWN BY: C. L. C.
0
50
100
Scale: 1" = 50 ft.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH SECTION 68+00

MAP REF. 115 - I - 1

DATE: FEB. 1, 1978
REVISED

0 50 100
Scale 1" = 50 ft.

DRAWN BY: C. L. C.

W 00+80 | W 00+90 | W 00+40 | W 00+20 | 0+00 E | 2+00 E | 3+00 E | 3+90 E | 4+80 E | 5+00 E

2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400

STRUCTURE NOT KNOWN IN THIS AREA

ROAD

OVERBURDEN

OVERBURDEN

? No. 1 Seam

? No. 3 Seam

? No. 2 Seam

? No. 1 Seam

? No. 3 Seam

Inferred Approximate Position of No. 1 Seam

? No. 2 Seam

? No. 3 Seams

? No. 1 Seam

Inferred Fault

RH C-77-34 | RH C-77-35 | RH C-77-40 | RH C-77-36 | RH C-77-37 | RH C-77-38 | RH C-77-39 | RH C-77-41

Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

CARMACKS NORTH SECTION 76+00

MAP REF: 115 - I - 1

DATE: JAN. 30, 1978

REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.