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REPORT No. 4

OF 1944

RAPPORT No.

VAN

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA.

BRANDSTOF-NAVORSINGS-INSTITUUT

VAN SUID-AFRIKA.

SURVEY REPORT NO. 67.

SUBJECT:
ONDERWERP: REPORT ON BOREHOLES PUT DOWN BY THE SOUTH AFRICAN IRON AND STEEL CORPORATION ON THE FARMS WELSTAND 34, RIETKUIL 27, DIEPSPRUIT 25 AND ROODEPOORT 24, IN THE BETHAL DISTRICT OF TRANSVAAL.

DIVISION:
AFDELING: CHEMISTRY

NAME OF OFFICER:
NAAM VAN AMPTENAAR: DR. B. GAIGHER

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

REPORT NO. 4 OF 1944.

SURVEY REPORT NO. 67.

REPORT ON BOREHOLES PUT DOWN BY THE SOUTH AFRICAN IRON AND STEEL INDUSTRIAL CORPORATION ON THE FARMS WELSTAND 34, RIETKUIL 27, DIEPSPRUIT 25 AND ROODEPOORT 24, IN THE BETHAL DISTRICT OF TRANSVAAL.

During 1942 a series of 14 boreholes was put down by the South African Iron and Steel Industrial Corporation on the farms Welstand 34, Rietkuil 27, Diepspruit 25 and Roodepoort 24, in the Bethal District of Transvaal.

The area drilled lies approximately halfway between Witbank and Bethal Stations and is situated near the southern boundary of the Witbank coal field.

The locations of the boreholes are given in the accompanying sketch map (see back of report).

The main area covered lies on Welstand 34 and is about 3¾ square miles in extent, with the distance between boreholes varying from about 450 to 1500 yards. A few isolated holes were also put down on the neighbouring farms Rietkuil 27, Diepspruit 25 and Roodepoort 24 to the west of Welstand.

The details of the boreholes indicating the coal seams and the strata encountered and the depths below the surface are given in Table I (see back of report, page 7).

As the coal seams encountered in the boreholes on the farms Rietkuil 27, Diepspruit 25 and Roodepoort 24 were of very poor quality, further discussion will be limited to the boreholes 6 to 16 on Welstand 34. The analyses of the samples taken from boreholes RK1, D1, D2 and Rd2 are, however, recorded in the tables.

Dwyka was encountered in all the boreholes, excepting boreholes 10 and 15. The elevation of the Dwyka varies between 4900 and 5080' a.m.s.l. the highest level being to the south east, (boreholes 12 & 16). There is a dip towards the centre of the farm (boreholes 11, 14 and 8) and a rise again towards the north west (boreholes 6, 7 and 9). Dolerite was encountered in boreholes 12 and 16.

In most of the boreholes all the seams of the Witbank area were encountered. These are numbered 1 to 5 with No. 1 the lowest and No. 5 the topmost seam.

The No. 1 seam does not exist in the south eastern portion of the area (boreholes 16, 12 and 15), where the Dwyka is at its highest elevation. Over the rest of the area the No. 1 seam was intersected 0 to 8 feet above the Dwyka. The seam is 2 to 5 feet wide, being narrowest towards the north west (boreholes 6 and 7).

The No. 2A seam is present as a separate seam in boreholes 15 and 8. It lies 12 feet above the Dwyka and 2½ feet above the No. 1 seam in borehole 8. The 2A seam is separated from the No. 2 seam by 15 inches of parting and has a width of 3 to 4½ feet.

The No. 2 seam is present over the whole of the area, excepting in borehole 12 where it has been destroyed by dolerite. In borehole 16 it was apparently not affected by the dolerite. The elevation of the seam floor varies between 4931 and 5050 feet a.m.s.l., with contours agreeing more or less with those of the

Dwyka/.....

Dwyka. The seam thickness varies from 13 feet (in borehole 9) to 17 feet and increases to 27 and 20 feet in boreholes 11 and 14 where the No. 2 and No. 2A seams have joined together.

The No. 3 seam is present in all the boreholes excepting 12 and 16 where it has probably been destroyed by dolerite. It was intersected 37 to 53 feet above the No. 2 seam and has a thickness of 19 to 36 inches.

The No. 4 seam is split up into a Lower No. 4, an Upper No. 4 and a No. 4A seam over the whole area, excluding boreholes 12 and 15 where only one seam is present, and borehole 16 where the coal was probably destroyed by dolerite. The distance between the Lower No. 4 and the No. 2 seam varies from 48 to 81 feet with an average of about 60 feet.

The No. 5 seam exists where there is sufficient cover to contain it i.e. in boreholes 6, 10, 11 and 14. It has probably been denuded in boreholes 7, 8, 9, and 16. It was intersected 167 to 183 feet above the No. 2 seam and has a width of 8 inches to 3 feet.

The following is a generalised vertical section of the coal seams and the strata encountered:-

Surface soil, sandstone and clay	65 to 95 feet
No. 5 Seam	¾ feet to 3 feet
Sandstone and shale	80 to 100 feet
No. 4A Seam	½ to 1 foot
Sandstone and shale	1½ to 7 feet
Upper No. 4 Seam	2½ to 4 feet
Shale	9 to 11 feet
Lower No. 4 Seam	7 to 13 feet
Shale and sandstone	8 to 15 feet (39' in B.H. 8)
No. 3 Seam	¾foot to 3 feet
Shale and sandstone	37 to 53 feet
No. 2 Seam	13 to 17 feet
Sandstone and shale	0 to 1 foot
No. 2A Seam	3 to 4 feet
Sandstone and shale	2 to 3 feet
No. 1 Seam	2 to 5 feet (9' in B.H. 8)
Sandstone and shale	0 to 9 feet
Dwyka.	

ANALYTICAL METHODS AND THEIR SIGNIFICANCE.

Descriptions of the analytical methods employed in the Coal Survey work and the significance to be attached to the results are given in the appendix (see back of report).

SECTION A : PROXIMATE ANALYSES.

The cores from all the boreholes were sampled by officers of the Fuel Research Institute. The details of the samples taken are given in Table 2 (see back of report, page 15). The core of each seam in each borehole is given a distinctive sample number and each subdivision of such a core a distinctive letter, starting from the bottom of the seam with the letter A.

Table 3 (see back of report, page 25) gives the proximate analyses on an air-dried basis of the samples detailed in Table 2 together with:

(a) The percentage float at a S.G. of 1.45
(b) The percentage ash on the float at 1.45
(c) The swelling number on the float at 1.45
(d) The percentage float at a S.G. of 1.6

(e) The/.....

(e) The percentage ash on the float at 1.6
(f) The swelling number on the float at 1.6

From the individual analytical data given in Table 3, certain average proximate analyses of various sections of the seams which might be considered workable, have been drawn up and are tabulated in Table 4 (see back of report, page 32). In this table an attempt has been made to arrive at the maximum mining width of good coal and with this object in view, inferior bands which could be removed by picking during production have been excluded from both the widths and the analyses. Certain widths which may be too narrow or inferior for mining purposes, are included purely for correlative purposes.

SECTION B : ULTIMATE ANALYSIS.

For the purpose of further and more detailed investigation, composite samples based on the characteristics of the coals revealed by the proximate analyses in section A were made up. These are made by mixing - in proportion to the amount of coal they represent - samples of the same type of coal from different boreholes, provided that proximate analyses have confirmed their general similarity. A series of samples are thus obtained representing the various types of coal found in each seam and on these more advanced work is carried out. The composition of and the type of coal represented by these sampled is given in Table 5 (see back of report, page 34).

A composite sample was made of the No. 5 Seam representing the western portion of the area (boreholes 6, 10 and 11).

The No. 3 seam samples from boreholes 6, 7, 8, 9, 11, 14 and 15 were mixed to represent the north western portion of the area. Six samples were made up of the No. 2 seam in the north western portion of the area (boreholes 6, 7, 8, 9, 11, 14 and 15), representing:

(1) The bottom bright coal
(2) The mixed coal above the bottom bright coal
(3) The dull coal in the middle of the seam
(4) The composite seam over this portion of the area
(5) The mixed coal below roof coal (only boreholes 7, 8 and 15)
(6) At the request of the South African Iron and Steel Corporation a composite sample (sample No. M 40) was made up of the bottom portion of the No. 2 seam in boreholes 6, 7, 8, 9, 10, 11, 14 and 15. This was done with the purpose of determining the effect of floating the coal at a S.G. of 1.6, on the melting point of the coal ash.

In Table 6 (see back of report, page 35) are given the proximate analyses of the samples listed in Table 5.

Table 7 (see back of report page 36) gives the ultimate analyses of the samples listed in Table 5.

In all cases the analyses have been carried out on the float at a S.G. of 1.6 and the results are expressed on a dry, ash-free basis so as to present the composition of the coal substance itself.

Table 8 (see back of report, page 36) shows the sulphur distribution in the composite samples. These analyses have been carried out on the whole coal including adventitious mineral matter. The total sulphur contents of the floats at 1.6 S.G. are also included in this table for comparative purposes.

The carbon contents are normal for the Witbank area. High carbon and low hydrogen contents are associated with the dull coals,

while/.....

while the carbon content decreases and hydrogen content increases as the coals become brighter in appearance. The nitrogen contents are all high but uniformly so, a feature which is characteristic of South African coals.

The total sulphur contents are medium to high, with the highest values in the bright coals, probably due to the presence of pyrites, which is generally found associated with the bright coals. The total sulphur contents are appreciably reduced by floating the samples at a S.G. of 1.6. The organic S-contents are consistently low as is usual for Witbank Coals.

SECTION C : CARBONIZATION ASSAYS.

(a) Low Temperature (600°C).

Low temperature carbonization assays have been made on the floats at 1.6 S.G. of the samples listed in Table 5. The results of these analyses are given in Table 9 (see back of report, page 37).

High tar and gas yields are associated with bright coals having high hydrogen and high volatile matter contents, while dull coals yield more coke residue and less tar and gas.

(b) High Temperature (900°C).

High temperature carbonization assays were carried out on the floats at 1.45 S.G. of composite samples of (1) the No. 5 seam (2) the No. 3 seam and (3) the bottom bright coal in the No. 2 seam. The results obtained are given in Table 9 (see back of report, page 37). The yields of gas are high in all three cases, while both the Nos. 3 and 2 seam coals yielded standard cokes.

SECTION D : FLOAT AND SINK ANALYSES.

Float and sink analyses together with their attendant swelling number determinations have been carried out on the samples listed in Table 5. The results are given in Table 10 (see back of report, page 38).

SECTION E : ASH FUSION TEMPERATURES.

Ash fusion temperatures have been determined on the whole coal as well as the float at 1.6 S.G. of the samples listed in Table 5. The results are given in Table 11 (see back of report, page 40). The ash fusion temperatures of the duller coals are high, while those of the brighter coals are low probably due to the higher pyrites content of the brighter coals. By floating the coals at a S.G. of 1.6 their ash fusion temperatures are all increased to + 1400°C. In a sample of the bottom portion of the No. 2 seam (sample M 40) the ash fusion temperature was increased from + 1400°C to + 1550°C by floating at a S.G. of 1.6.

SECTION F : GENERAL SUMMARY.

The No. 1 Seam:

The No. 1 seam is present in the western half of the area only (boreholes 6, 7, 8, 9, 10, 11 and 14) and is generally thicker where the Dwyka is at its lowest elevation (boreholes 8, 9, 11 and 14). It becomes thinner as the elevation of the Dwyka rises towards the north west (borehole 7). The thickness of the seam varies from 106 inches in borehole 8 to 20 inches in borehole 7. The coal is poor, the ash content varying from 17% in borehole 10 to 36% in borehole 14. It is separated from the No. 2 seam by 3 to 8 feet of sandstone and shale.

The No. 2A Seam:

Both the No. 1 and the No. 2A seams were encountered over the central/....

central portion of the area (boreholes 11, 14 and 8). Towards the north west (boreholes 10, 9, 6 and 7) only the No. 1 seam is present, while towards the south east in boreholes 15 and 16, only the No. 2A seam was intersected.

In boreholes 11 and 14 the No. 2A seam apparently becomes part of the No. 2 seam. Where it exists as a separate seam, it is 36 to 52 inches wide, with a parting of 14 to 15 inches between it and the No. 2 seam. It generally consists of inferior coal with a narrow band of bright coal at the bottom of the seam.

The No. 2 Seam:

The No. 2 seam was proved over the whole area, excepting in borehole 12 where it was probably destroyed by dolerite. In borehole 16 the coal was very poor. The area of coal that could be exploited is contained in a more or less circular patch, 660 morgen in extent.

The floor elevation of the seam varies somewhat, the greatest variation being between boreholes 8 and 9 where the elevation rises from 4931 to 4976 'a.m.s.l. over a distance of about 500 yards. The seam width is uniform, varying between 15 and 17 feet, excepting in borehole 9 where it decreases to 13 feet and in boreholes 11 and 14 where it is composite with the 2A seam and has a total width of 27 and 20 feet respectively.

A generalised vertical section of the seam is as follows:

Roof:	Carbonaceous shale	
	Dull roof coal	43 to 77 inches
	Mixed coal below roof coal (boreholes 7, 8 and 15 only)	14 to 58 "
	Carbonaceous shale parting	½ to 38 "
	Dull coal	13 to 55 "
	Mixed coal	26 to 61 "
	Bright smithy-like coal	5 to 14 "
Floor:	Carbonaceous shale	

The bottom bright coal in the seam has a low ash and a high volatile matter content and is fairly strongly swelling. By washing at a S.G. of 1.5 about 90% of clean coal with 8% ash should be obtained. The high temperature carbonization assay gave good yields of tar and gas and a standard coke with a low S-content. The coal therefore appears to be suited for coke making. The narrow width of the band makes it doubtful, however, whether it can ever be exploited for this purpose. The band has a maximum width of 14 inches, excepting in borehole 14, where it assumed a width of 29 inches. Here, however it is split up by 4 inches of shale.

The mixed and dull coals in the seam are non-swelling, with low tar yields and these would be of no value in the carbonization industry. It therefore appears that, on the whole, the coal in the seam is of value only as a general combustion fuel.

In the south western portion of the area (boreholes 11, 10 and 14) the coal is of poor to medium quality, the cleanest sections having ash contents of 15 to 18% and calorific values of 11.5 to 12 lbs/lb. Over the rest of the area 5 feet (borehole 15) to 12½ feet (borehole 8) of clean coal could be extracted from the bottom of the seam, with an ash content of 11 to 15%, a volatile matter content of 26 to 28% and carrying a calorific value of 12.4 to 12.9 lbs/lb. Over the northern portion of the area (boreholes 6, 7, 8, excluding 9) 5 to 6 feet of clean coal could be extracted with a calorific value of over 13 lbs/lb and an ash content of about 11%.

/.....

Over the whole of the area, excluding borehole 11, the calorific value of the coal could probably be improved to 13 lbs/lb. by washing at a S.G. of 1.5. The yield of washed product would be from 85 to 90%.

The No. 3 Seam:

The No. 3 seam is present over the whole of the area under discussion and has the characteristic bright appearance of the No. 3 seam in the Witbank area. Although the coal may be suitable for coke making the narrowness of the seam makes it unlikely that the coal will ever be mined. The width of coal in the seam varies between 9 and 14 inches, excepting in borehole 11, where 31 inches of coal, split into two portions by a 4 inches shale band, were intersected.

The Lower No. 4 Seam:

A band of 3 to 6 feet of medium to poor quality coal is present at the bottom of the seam over the area. If the seam were mined it would be necessary to employ very careful picking in order to obtain a reasonably clean coal. By washing the coal at a S.G. of 1.5 about 75% of washed product could be expected with 13 to 15% ash and having a calorific value of about 12.0 - 12.3 lbs/lb.

The Upper No. 4 Seam:

The coal in this seam is inferior over the whole of the area, having an ash content of 22 to 28%.

The No. 4A Seam:

The No. 4A seam was sampled in boreholes 7 and 9 only. Here the coal was mixed or bright with an ash content of 30 to 33%.

The No. 5 Seam:

The No. 5 seam consists of bright coal usually associated with the No. 5 seam of the Witbank area. Its swelling propensities are not sufficiently developed here to consider it a source of coking coal, while the seam widths are too narrow to make the seam of economic importance. The composite seam sample contained 10% ash and had a volatile matter content of 30%.

GENERAL.

Prior to the drilling by the South African Iron and Steel Industrial Corporation a series of 6 boreholes was sunk on Welstand 34 by G. Sinclair Esq., (see F.R.I. Report No. 15 of 1943). The locations of these boreholes are also given on the accompanying sketch map (see back of report). The conclusions arrived at in the present report generally confirm those of Report No. 15 of 1943.

On considering the whole area covered by boreholes 1 to 15, the following statements can be made. The coal is comparatively poor along the southern boundary of the farm (boreholes 10 and 11) but its quality improves somewhat towards the north east (boreholes 1 and 2). The coal is of good quality over the rest of the area, excluding a bad patch in the vicinity of borehole 14. The best quality coal is found towards the northern boundary of the farm (boreholes 4 and 8).

B. Gaigher

B. Gaigher,

15th May, 1944.

ASSISTENT.

TABLE I.

RECORD OF BOREHOLES.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Welstand 34.		**Borehole No. 6.**		**Collar Level 5222' a.m.s.l.**
21	0	21	0	Surface soil and clay
40	0	19	0	Decomposed sandstone
57	0	17	0	Micaceous laminated sandstone
68	3	11	3	Shaly sandstone with laminations
68	4	0	1	Shale
69	0	0	8	COAL - NO. 5 SEAM
70	1	1	1	Carbonaceous shale
75	1	5	0	Shale
78	0	2	11	Sandy shale
78	2	0	2	COAL
78	11	0	9	Shaly sandstone
104	9	25	10	Sandstone with occasional shale bands
115	10	11	1	Shaly sandstone
139	0	23	2	Sandy shale
140	10	11	10	Shaly sandstone
148	1	7	3	Sandy shale
148	8½	0	7½	Shale
149	8	0	11½	COAL NO. 4A SEAM
155	1	6	3	Sandstone with shale bands
157	8	2	7	COAL - UPPER NO. 4 SEAM
166	11	9	3	Shale
173	10	6	11	COAL - LOWER NO. 4 SEAM
176	10	3	0	Shale
184	3	7	5	Shale and sandstone
185	0	0	9	COAL - NO. 3 SEAM
193	2	8	2	Sandstone
197	9	4	7	Sandy shale
218	9	21	0	Shaly sandstone
225	9	7	0	Sandy shale
236	4	10	7	Carbonaceous shale
237	4	1	0	Sandy shale
238	3	0	11	Carbonaceous shale
253	0	14	9	COAL - NO. 2 SEAM
255	0	2	0	Carbonaceous shale
258	5	3	5	Shale with sandstone laminations
260	7	2	2	COAL - NO. I SEAM
262	6	1	11	Sandy shale with carb. shale laminations
270	3	7	9	Dwyka tillite
Welstand 34.		**Borehole No. 7.**		**Collar Level 5197' a.m.s.l.**
20	0	20	0	Surface soil
40	0	20	0	Decomposed sandstone
62	6	22	6	Semi decomposed sandstone
73	1	10	7	Sandstone
97	10	24	9	Sandstone with shale bands
100	0	2	2	Sandstone
107	5	7	5	Sandy shale
108	1	0	8	COAL - NO. 4A SEAM
112	9	4	8	Sandstone
115	1	2	4	COAL - UPPER NO. 4 SEAM
124	7	9	6	Carbonaceous shale

132'11"/.....

TABLE I : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Welstand 34.		**Borehole No. 7** (Cont.)		
132	11	8	4	COAL - LOWER NO. 4 SEAM
135	7	3	8	Carbonaceous shale
142	3	6	8	Shaly sandstone
143	3	1	0	COAL - NO. 3 SEAM
150	0	6	9	Sandstone
154	9	4	9	Sandy shale
177	1	22	4	Shaly sandstone
188	10	11	9	Black shale
191	0	2	2	Shaly sandstone
206	6	15	6	COAL - NO. 2 SEAM
209	0	2	6	Shaly sandstone
210	8	1	8	COAL - NO. 1 SEAM
215	6	4	10	Sandstone
216	6	1	0	Sandstone with shale bands
222	3	5	9	Dwyka
Welstand 34.		**Borehole No. 8.**		**Collar Level 5156' a.m.s.l.**
25	0	25	0	Surface soil
36	11	11	11	Clay
40	9	3	10	Decomposed sandstone
50	0	9	3	Micaceous sandstone
68	6	18	6	Shaly sandstone
86	2	17	8	Sandy shale
90	2	4	0	Carbonaceous shale
91	5	1	3	Micaceous sandstone
93	5	2	0	Sandy shale
97	1	3	8	Sandstone with shale bands
102	7	5	6	Sandy shale
103	4	0	9	COAL - NO. 4A SEAM
108	3	4	11	Sandstone with shale bands
110	9	2	6	COAL - UPPER NO. 4 SEAM
119	7	8	10	Sandy shale
126	11	7	4	COAL - LOWER NO. 4 SEAM
134	3	7	4	Shaly sandstone
166	0	31	9	Sandstone
167	6	1	6	COAL - NO. 3 SEAM
180	1	12	7	Sandstone
188	2	8	1	Shaly sandstone
208	1	19	11	Carbonaceous shale
224	9	16	8	COAL - NO. 2 SEAM
225	11	1	2	Shale
230	3	4	4	COAL - NO. 2A SEAM
232	10	2	7	Shaly sandstone
241	8	8	10	COAL - NO. 1 SEAM
256	10	15	2	Shale and Dwyka

Borehole No. 9/...

TABLE I : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Welstand 34.		**Borehole No. 9.**		**Collar Level 5173' a.m.s.l.**
30	0	30	0	Surface soil
35	1	5	1	Sandstone
48	0	12	11	Laminated sandstone
63	10	15	10	Shaly sandstone
99	9	35	11	Sandy shale
100	6	0	9	Shale
101	0	0	6	COAL - NO. 4A SEAM
107	10	6	10	Sandstone
110	7	2	9	COAL - UPPER NO. 4 SEAM
120	4	9	9	Shale
127	11	7	7	COAL - LOWER NO. 4 SEAM
134	8	6	9	Shaly sandstone
142	11	8	3	Shale with core bands
144	0	1	1	COAL - NO. 3 SEAM
144	11	0	11	Sandy shale
155	8	10	9	Sandstone
161	9	6	1	Sandy shale
184	4	22	7	Shale
197	4	13	0	COAL - NO. 2 SEAM
199	9	2	5	Shale
203	4	3	7	COAL - NO. 1 SEAM
207	9	4	5	Shaly sandstone
213	5	5	6	Dwyka tillite
Welstand 34.		**Borehole No. 10.**		**Collar Level 5260' a.m.s.l.**
32	1	32	1	Surface soil
37	5	5	4	Sandstone
45	6	8	1	Decomposed sandstone
53	4	7	10	Micaceous sandstone
77	4	24	0	Sandstone
85	2	7	10	Sandstone with shale laminations
95	10	10	8	Alternating bands of sandy shale and shaly sandstone
96	7	0	9	Shale
97	11	1	4	COAL - NO. 5 SEAM
109	3	11	4	Shale
109	5	0	2	COAL
146	1	36	8	Sandstone with shale laminations
148	10	2	9	Shaly sandstone
154	3	6	5	Shale
165	0	10	9	Semi- decomposed dolerite
184	9	19	9	Shale
194	10	10	1	Sandstone with shale bands
196	3	2	5	Shale
196	11	0	8	COAL - NO. 4 A SEAM
197	6	0	7	Shale
199	0	1	6	Sandstone
199	9	0	9	Shale
202	1	2	4	COAL)
203	6	1	5	Shaly sandstone) UPPER NO. 4 SEAM
203	9	0	3	COAL)
212	8	8	11	Shale
220	6	7	10	COAL - LOWER NO. 4 SEAM

225' 9"/.....

TABLE 1 : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Borehole No. 10 (Cont).				
225	9	5	3	Shale
226	0	0	3	COAL
228	0	2	0	Sandstone with Coal stringers
228	6	0	6	Shale
229	4	0	10	COAL - NO. 3 SEAM.
231	2	1	10	Sandstone with shale bands
235	8	4	6	Sandstone
242	3	6	7	Sandy shale
248	0	5	9	Sandstone
265	11	17	11	Shaly sandstone
278	0	12	1	Shale
279	4	1	4	Sandstone
281	0	1	8	Shale
298	1	17	1	COAL - NO. 2 SEAM
300	0	1	11	Shale
305	4	5	4	Sandy shale
308	4	3	0	COAL - NO. 1 SEAM
315	9	7	5	Coarse sandstone with carb. shale stringers.
Welstand 34. Borehole No. 11. Collar Level 5200' a.m.s.l.				
25	9	25	9	Surface soil
33	8	7	11	Micaceous sandstone
62	0	28	4	Coarse sandstone
65	10	3	10	Shaly sandstone
66	1	1	3	COAL)
68	0	1	11	Carb. shale) NO. 5 SEAM.
70	1	2	1	COAL)
79	2	9	1	Shaly sandstone
152	7	73	5	Sandy shale
153	0	0	5	COAL - NO. 4A SEAM
154	0	1	0	Shaly sandstone
154	5	0	5	Shale
156	5	2	0	COAL)
157	8	1	3	Sandstone with shale bands) UPPER NO.4
157	11	0	3	COAL) SEAM.
168	4	10	5	Sandy shale
180	4	12	0	COAL - LOWER NO. 4 SEAM
188	2	7	10	Sandstone
191	1	2	11	COAL - NO. 3 SEAM
207	10	16	9	Sandstone
240	8	32	10	Shaly sandstone
267	9	27	1	COAL - NO. 2 AND 2A SEAMS
272	6	4	9	Shale
273	5	0	11	COAL)
276	2	2	9	Shale) NO. 1 SEAM
276	8	0	6	COAL)
285	0	8	4	Sandy shale and shaly sandstone
288	0	3	0	Dwyka

TABLE I : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Welstand 34.		**Borehole No. 12.**		**Collar Level 5251' a.m.s.l.**
51	9	51	9	Surface soils
58	2	6	5	Soft sandstone
60	10	2	8	Clay
64	10	4	0	Sandy shale
65	10	1	0	Carbonaceous shale
77	3	11	5	(Bands of sandy shale and shaly sandstone
83	3	6	0	(COAL - Poor (burnt) NO. 4 SEAM
84	8	1	5	Carbonaceous shale
87	10	3	2	Sandstone
92	9	4	11	Carbonaceous shale
103	2	10	5	Shaly sandstone
109	8	6	6	Sandstone with shale bands
116	9	7	1	Shale
142	7	25	10	Decomposed dolerite
153	10	11	3	Shaly sandstone
170	0	16	2	Dwyka
Welstand 34.		**Borehole No. 14.**		**Collar Level 5213' a.m.s.l.**
35	0	35	0	Surface soil
39	6	4	6	Micaceous sandstone
40	2	0	8	Shale
66	5	26	3	Coarse sandstone
71	5	5	0	Grit
74	6	3	1	Sandstone with shale bands
74	10	0	4	COAL)
76	7	1	9	Carbonaceous shale) NO. 5 SEAM
77	5	0	10	COAL)
81	7	4	2	Sandy shale
83	3	1	8	Sandstone
86	5	3	2	Sandy shale
121	0	34	7	Sandstone with a few shale bands.
144	11	23	11	Sandy shale
151	9	6	10	Micaceous shale
161	5	9	8	Sandy shale
162	5	1	0	COAL - NO. 4A SEAM
167	6	5	1	Sandstone.
168	6	1	0	Shale
171	4	2	10	COAL - UPPER NO. 4 SEAM
183	1	11	9	Sandy shale
195	7	12	6	COAL - LOWER NO. 4 SEAM
200	8	5	1	Sandstone
204	3	3	7	Shaly sandstone
207	4	3	1	COAL - NO. 3 SEAM
210	0	2	8	Sandstone
214	1	4	1	Indurated sandstone
216	4	2	3	Sandstone
243	8	27	4	Sandy shale
263	8	20	0	COAL - NO. 2 & 2A SEAMS
264	3	0	7	Sandstone
265	3	1	0	Secondary dwyka
266	10	1	7	Shaly sandstone
269	8	2	10	COAL - NO. 1 SEAM
272	6	2	10	Dwyka

TABLE I : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Welstand 34. Borehole No. 15. Collar Level 5118' a.m.s.l.				
45	6	45	6	Surface soil and clay
51	7	6	1	Sandstone
52	9	1	2	Carbonaceous shale
53	11	1	2	Sandy shale
61	3	7	4	Sandstone
68	3	7	0	Sandy shale
69	4	1	1	Carbonaceous shale
77	9	8	5	COAL - LOWER NO. 4 SEAM
85	9	8	0	Sandstone
87	2	1	5	Carbonaceous shale
89	3	2	1	COAL - NO. 3 SEAM
101	10	12	7	Sandstone
114	3	12	5	Sandy shale
119	7	5	4	Carbonaceous shale
129	10	10	3	Shale
147	1	17	3	COAL - NO. 2 SEAM
148	4	1	3	Sandy shale
151	4	3	0	COAL - NO. 2A SEAM
153	4	2	0	Carbonaceous grit
Welstand 34. Borehole No. 16. Collar Level 5149' a.m.s.l.				
41	7	41	7	Surface soil and decomposed sandstone
50	7	9	0	Micaceous decomposed sandstone
52	2	1	7	Decomposed dolerite
57	9	5	7	Dolerite
58	3	0	6	Shale
63	6	5	3	Carbonaceous shale
78	8	15	2	Micaceous shale and sandstone
80	11	2	3	Sandy shale
81	4	0	5	Decomposed coal
82	2	0	10	Shaly sandstone
99	5	17	3	COAL - NO. 2 SEAM
102	3	2	10	Dwyka
107	7	5	4	Mottled indurated sandstone
Rietkuil 19. Borehole No. R.K.1.				
31	0	31	0	Surface soil and sandstone
37	8	6	8	Sandstone with shale bands
73	5	35	9	Sandstone
80	0	6	7	Shale
83	5	3	5	Sandstone
91	2	7	9	Shale
92	1	0	11	Black shale
92	9	0	8	Sandy shale
95	5	2	8	COAL)
95	9	0	4	Sandy shale) UPPER NO. 4 SEAM
96	4	0	7	COAL)
101	0	4	8	Sandy shale
108	0	7	0	SHALY COAL - LOWER NO. 4 SEAM
109	11	1	11	Carbonaceous shale
153	5	43	6	Sandstone
154	9	1	4	Shale
168	5	13	8	Sandstone
192	8	24	3	Shale

198'11"/.....

TABLE I : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata	
Rietkuil 19.		**Borehole No. R.K. 1 (Cont.)**			
198	11	6	3	Sandstone	
200	4	1	5	Shale	
210	4	10	0	COAL	)
210	11	0	7	Shale	)
214	8	3	9	COAL	)
216	5	1	9	Sandy shale	) NO. 2 SEAM
216	9	0	4	COAL	)
217	8	0	11	Sandy shale	)
218	5	0	9	COAL	)
243	5	25	0	Sandstone	
247	1	3	8	COAL - NO. 2A SEAM	
255	4	8	3	Sandstone with shale bands	
256	5	1	1	Carbonaceous shale	
262	0	5	7	COAL	)
262	9	0	9	Sandy shale with pebbles	) NO.1 SEAM
263	5	0	8	COAL	)
264	3	0	10	Sandstone with pebbles	
264	8	0	5	COAL	
269	2	4	6	Dwyka	
Diepspruit.		**Borehole No. D.1.** ✓			
22	0	22	0	Surface soil and clay	
70	8	48	8	Sandstone	
95	0	24	4	Laminated sandstone	
95	2	0	2	COAL	)
96	3	1	1	Carb. shale	) UPPER NO. 4
98	1	1	10	Sandstone	) SEAM
100	0	1	11	COAL	)
108	11	8	11	Sandstone and shale	
110	10	1	11	COAL - LOWER NO. 4 SEAM	
119	0	8	2	Shale	
159	9	40	9	Sandstone	
161	0	1	3	Shale	
164	0	3	0	Sandstone	
165	8	1	8	COAL - NO. 3 SEAM	
183	0	17	4	Laminated sandstone	
193	0	10	0	Micaceous sandy shale	
217	5	24	5	Micaceous shale	
235	3	17	10	COAL - NO. 2 SEAM	
Diepspruit.		**Borehole No. D.2.** ✓			
66	8	66	8	Surface soil and clay	
77	0	10	4	Shale and sandstone	
77	5	0	5	Sandstone	
83	9	6	4	Sandy shale	
85	2	1	5	SHALY COAL	)
92	6	7	4	Sandy shale	) No. 4 SEAM
99	3	6	9	Shale with coal buds	)
100	5	1	2	Shale	
101	3	0	10	COAL - NO. 3 SEAM	
102	3	1	0	Shale	
155	3	53	0	Coarse sandstone	
165	10	10	7	Shale	

169' 0"/.....

TABLE I : CONTINUED.

Depth below Surface Ft.	Ins.	Thickness of Strata Ft.	Ins.	Description of Strata
Diepspruit.		**Borehole No. D.2 (Cont.)**		
169	0	3	2	Sandstone
184	4	5	4	Shale
200	4	16	0	COAL - NO. 2 SEAM
202	1	1	9	Sandstone and shale
203	5	1	4	Sandy shale with coal buds - NO.2A SEAM
224	3	20	10	Sandy shale
225	0	0	9	Burnt COAL - NO. 1 SEAM
226	6	1	6	Secondary Dwyka
229	5	2	11	Shale
229	7	0	2	COAL
245	9	16	2	Dwyka tillite
Roodepoort 24.		**Borehole No. Rd. 2.**		
35	5	35	5	Surface soil and clay
40	10	5	5	Sandy shale
52	9	11	11	Sandstone
53	5	0	8	Shale
55	7	2	2	COAL
56	0	0	5	Shale
57	3	1	3	COAL
67	0	9	9	Sandstone
72	3	5	3	Secondary Dwyka
83	10	11	7	Sandstone
90	10	7	0	Felsite

TABLE 2.

DESCRIPTION OF SAMPLES.

Sample Number	Borehole Number	Width of Section Ins.	Description
SEAM I.			
L250	6		258' 5" Roof: Laminated shale
B		(4	Dull Coal
		(15	Mixed mainly bright Coal
A		7	Gas and smithy Coal
			260' 7" Floor: Sandy shale with carbonaceous shale laminations.
L246	7		209' 0" Roof: Shaly sandstone
		20	Mainly dull non banded Coal
			210' 8" Floor: Sandstone
L256	8		232'10" Roof: Shaly sandstone
		60	Dull non-banded Coal with a few shale bands
		46	Shale and shaly Coal - Not Sampled
			241' 8" Floor: Shale and Dwyka
L302	9		199' 9" Roof: Shale
B		30	Dull granular Coal
A		13	Bright banded Coal
			203' 4" Floor: Shaly sandstone
L349	10		305' 4" Roof: Sandy shale
		36	Mixed Coal - brighter at bottom
			308' 4" Floor: Coarse sandstone with carbonaceous shale
L375	14		266'10" Roof: Shaly sandstone
		34	Dull shaly coal - 1" bright coal 16" from bottom
			269' 8" Floor: Dwyka.
L388	RK.1		256' 1" Roof: Carboncaeous shale
		6	Dull coal - conchoidal fracture - thin bright stringers
		65	Mainly carb. shale - 2" bright coal at bottom - Not Sampled
			262' 0" Floor: Sandy shale
SEAM 2A.			
L257	8		225'11" Roof: Shale
B		40	Dull coal - cubical fracture
A		12	Finely banded bright coal - Gaslike (shaly)
			230' 3" Floor: Shaly sandstone

TABLE 2: CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
SEAM 2A (CONT.)			
L384	15		148' 4" Roof: Sandy shale
		(1	Gaslike coal (shaly)
C		(1½	Sandstone - Not Sampled
		(5	Gaslike coal (shaly)
		1½	Sandstone
B		20	Mixed mainly dull coal
A		9	Dull coal, conchoidal fracture with fine bands of bright coal
			151' 4" Floor: Carbonaceous grit
L389	RK.1		243' 5" Roof: Sandstone
		44	Dull heavy coal - few bright bands at top. 1" sandstone 9" from bottom, excluded.
			247' 1" Floor: Laminated sandstone
SEAM 2.			
L251	6		238' 3" Roof: Carbonaceous shale
		(14	Dull coal
E		(2	Coal and mud - Not Sampled
		(27	Mixed mainly dull coal
		9	Carbonaceous shale - Not Sampled
		4	Dull granular coal with thin bright stringers - Not Sampled
		15	Carbonaceous shale - Not Sampled
D		27	Dull coal
C		21	Dull coal with a few bright stringers
B		44	Mixed, mainly dull coal - pyritic
A		14	Very bright coal
			253' 0" Floor: Carbonaceous shale
L245	7		191' 0" Roof: Black shale and shaly sandstone
		31	Carbonaceous shale - Not Sampled
F		55	Dull coal
		2	Pyrites lens - Not Sampled
E		14	Mainly bright coal
D		13	Dull coal
C		21	Mixed dull and bright coal (finely-banded)
B		40	Mixed mainly bright coal - pyritic
A		10	Very bright coal
			206' 6" Floor: Shaly sandstone
L258	8		208' 1" Roof: Carbonaceous shale
		10	Shale, carbonaceous - Not Sampled
F		40	Dull roof coal
E		58	Mainly dull coal with 9" bright coal at top
		2	Shale - Not Sampled
D		31	Dull coal
C		33	Mainly dull coal
B		19	Mixed dull and bright coal
A		9	Bright coal - smithy-like (pyritic)
			224' 9" Floor: Shale

TABLE 2: CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
SEAM 2. (CONT.)			
L304	9		184' 4" Roof: Shale
	D	70	Dull coal with a few bright, a few pyritic and a few shale bands
	C	34	Mainly dull coal - ½" shale band 3" from bottom excluded and ½" " " 11" " " "
	B	40	Mixed dull and bright coal
	A	12	Smithy coal with 2" gaslike coal at the bottom
			197' 4" Floor: Shale
L348	10		281' 0" Roof: Shale
	G	20	Mixed dull and bright coal
		(18	Dull coal with lustre
	F	(2	Shale and coal with mud inclusions - N.S.
		(35	Dull coal with lustre
	E	26	Dull coal, shaly, with a few bright stringers
		22	Carbonaceous shale and shaly coal - N.S.
	D	14	Dull coal
		23	Carbonaceous shale - Not Sampled
		7	Dull granular coal, shaly - Not Sampled
	C	20	Mixed coal, dull at top
	B	9	Dull coal
	A	9	Smithy coal - pyritic
			298' 1" Floor: Shale
L336	11		240' 8" Roof: Shaly sandstone
	H	52	Dull coal
		6	Carbonaceous shale - Not Sampled
	G	7	Bright coal
	F	90	Dull, non-banded coal - 3 thin shale bands in top 18"
		4	Shaly, very pyritic coal - Not Sampled
		6	Carbonaceous shale - Not Sampled
		12	Shale and grit - Not Sampled
		10	Grit - Not Sampled
	E	32	Dull holing band
	D	26	Mainly dull coal with thin bright bands
	C	7	Smithy coal - very pyritic
		6	Carbonaceous shale - Not Sampled
		1½	Sandstone - Not Sampled
	B	3	Gas coal
		2	Sandstone - Not Sampled
		(23	Dull coal
		(5	Dull granular coal - mud and pyritic
	A	(	inclusions
		(13	Mainly dull coal
		10	Carbonaceous shale, sandstone and pseudo bright coal - Not Sampled
			267' 9" Floor: Shale.

TABLE 2 : CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
SEAM 2 (CONT.)			
L376	14		243' 8" Roof: Sandy shale
F		77	Dull inferior coal
		29	Shale and shaly coal - Not Sampled
E		32	Mainly dull coal
D		23	Dull coal
		(17	Mixed coal
C		(4	Carbonaceous shale - Not Sampled
		(12	Mixed coal
		22	Carbonaceous shale - Not Sampled
B		19	Mixed coal
A		5	Smithy coal
			263' 8" Floor: Sandstone
L385	15		129'10" Roof: Shale
F		72	Dull, non-banded coal
		16	Carbonaceous shale and shaly coal - Not Sampled
		4	Dull granular coal with bright stringers Not Sampled
		38	Carbonaceous shale - Not Sampled
E		13	Dull coal
D		19	Mixed coal
C		12	Dull coal
B		26	Mixed coal
		3	Carbonaceous shale - Not Sampled
A		5	Bright coal
			147' 1" Floor: Sandy shale
L402	16		82' 2" Roof: Shaly sandstone
C		80	Dull heavy coal
		36	Carbonaceous shale - 1" coal band in centre - Not Sampled
		9	Dull heavy coal - Not Sampled
		17	Shale - Not Sampled
		25	Grit and gritty shale - Not Sampled
		33	Carb. shale with occasional dull coal bands - Not Sampled
B		3	Dull coal with 1" smithy coal in centre
A		4	Gas coal
			99' 5" Floor: Dwyka
L403	D.1.✓		217' 5" Roof: Micaceous shale
		2	Shale
D		66	Dull coal - (1" shale 40" from bottom (2" bright coal with mud (pellets 25" from bottom (½" shale 18" from bottom
		36	Carbonaceous shale - 4" dull coal 20" from bottom - Not Sampled
		3	Bright coal - Not Sampled
		13	Carb. shale with a few coal stringers - Not Sampled
C		51	Dull coal
		27	Carb. shale - Not Sampled

B/.....

TABLE 2: CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
SEAM 2 CONT.			
L403	D.1.		
B		11	Bright coal with mud pellets (semi-torbanite)
A		6	Smithy coal
			235' 3" Floor: Hole stopped in Coal.
L411	D.2.		184' 4" Roof: Shale
		(109	Dull coal
C		(1	Shale - Not Sampled
		(6	Dull coal
B		6	Mixed coal (shale stringers 1½" from bottom)
		24	Shaly coal and carb. shale - Not Sampled
		5½	Carbonaceous shale - Not Sampled
		1½	Dull coal - Not Sampled
		5	Shaly sandstone and carbonaceous shale
A		15	Smithy coal
		3	Carbonaceous shale (gaslike)
		10	Shale
		3	Grit
			200' 4" Floor: Sandstone and shale
L390	R.K.1.		200' 4" Roof: Shale
		10	Shaly coal - Not Sampled
D		42	Mainly dull coal
C		32	Dull coal
		87	Carb. shale and shaly coal - Not Sampled
		22	Shale and sandstone - Not Sampled
B		5	Bright coal
		10	Carbonaceous shale - Not Sampled
A		8	Gas and smithy coal (pyritic)
			218' 4" Floor: Sandstone
SEAM 3.			
L252	6		184' 3" Roof: Shale and sandstone
		9	Very bright coal
			185' 0" Floor: Sandstone
L243	7		142' 3" Roof: Shaly sandstone
		1	Shale - Not Sampled
		11	Bright coal
			143' 3" Floor: Sandstone
L259	8		166' 0" Roof: Sandstone
		1½	Bright coal with shale bands - Not Sampled
		1½	Shale - Not Sampled
		9	Bright coal (pyritic)
		1	Shale with bright coal stringers
			167' 6" Floor: Sandstone

TABLE 2: CONTINUED.

Sample Number	Borehole Number		Width of Section Ins.	Description
L303	9			142'11" Roof: Shale with coal bands
			13	Very bright coal (pyritic) shaly at top
				144' 0" Floor: Sandy shale
L337	11			188' 2" Roof: Sandstone
			13	Shale with bright coal stringers
			4	Mixed, shaly coal
			4	Shale - Not Sampled
			14	Bright, pyritic coal
				191' 1" Floor: Sandstone
L377	14			204' 3" Roof: Shaly sandstone
			20	Shale with bright coal stringers -Not Sampled
			3	Shale - Not Sampled
			14	Bright coal - pyritic with shale stringers
				207' 4" Floor: Sandstone
L386	15			87' 2" Roof: Carbonaceous shale
		B	7	Bright coal with thin shale bands
			6	Carb. shale - few bright stringers - N.S.
		A	12	Mixed mainly bright coal
				89' 3" Floor: Sandstone
L406	D.1.✓			164' 0" Roof: Sandstone
			8	Shale - Not Sampled
			12	Mixed coal - (Broken core)
				165' 8" Floor: Laminated sandstone
LOWER NO. 4 SEAM				
1253	6			166'11" Roof: Shale
		C	22	Mixed mainly dull coal
			11	Carb. shale and shaly coal bands - N.S.
		B	22	Mixed dull and bright coal (bright at bottom)
			6	Sandstone and coal - Not Sampled
		A	22	Mainly bright coal
				173'10" Floor:
L244	7			124' 7" Roof: Carbonaceous shale
			9	Shale - Not Sampled
		B	10	Mainly dull, very pyritic coal
			26	Shale and shaly coal - Not Sampled
		A	55	Mixed dull and bright coal
				132'11" Floor: Carbonaceous shale

TABLE 2 : CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
LOWER NO. 4 SEAM (CONT.)			
L260	8		119' 7" Roof: Sandy shale
B		9	Bright coal
		16	Shale with occasional coal bands-Not Sampled
A		49	Mixed dull and bright coal - dull at top
		14	Shale and shaly coal
			126'11" Floor: Shaly sandstone
L305	9		120' 4" Roof: Shale
		4	Mixed coal
		9	Shale - Not Sampled
		9	Dull coal
		30	Mixed coal
		15	Dull coal
		7	Carbonaceous shale - Not Sampled
		4	Dull coal
		4	Carbonaceous shale - Not Sampled
		9	Dull coal
			127'11" Floor: Shaly sandstone
L 350	10		212' 8" Roof: Shale
D		8	Mainly bright coal - pyritic
		10	Shaly coal and carb. shale - Not Sampled
C		9	Mixed mainly dull coal
		27	Shaly coal and carb.shale - Not Sampled
B		12	Dull coal with a few bright stringers
		(7	Mixed coal
A		(2	Shale - Not Sampled
		(19	Mixed mainly bright coal - pyritic
			220' 6" Floor: Shale
L 338	11		168' 4" Roof: Sandy shale
		63	Dull shaly coal - few bright bands and shale bands - Not Sampled
C		20	Mixed, mainly bright coal
		5	Grit - Not Sampled
B		16	Mainly dull coal
		22	Carb. shale and shaly coal - Not Sampled
A		18	Dull coal, mixed at bottom
			180' 4" Floor: Sandstone
L 412	12		77' 3" Roof: Bands of sandy shale and shaly Sandstone
		5	Sandy shale - Not Sampled
C		3	Mixed coal
		16	Shaly coal and carb. shale - Not Sampled
B		21	Mixed, mainly dull coal
		(14	Dull coal
		(6	Dull granular coal
A		(2	Carbonaceous shale - Not Sampled
		(4	Dull coal
			83' 4" Floor: Carbonaceous shale

TABLE 2 : CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
LOWER NO. 4 SEAM.			
L378	14		183' 1" Roof: Sandy shale
		11	Shale
	D	13	Mixed, mainly dull coal - ½" sandstone 5" from bottom excluded
		10	Shale - Not Sampled
		10	Dull shaly coal - Not Sampled
		10	Shale - Not Sampled
	C	30	Mixed coal - pyritic
		3	Shale - Not Sampled
	B	30	Mixed coal - pyritic
		18	Shale with a few bright stringers-Not Sampled
	A	15	Dull coal
			195' 7" Floor: Sandy shale
L387	15		69' 4" Roof: Carbonaceous shale
		27	Shale and shaly coal - Not Sampled
		10	Mainly dull coal - broken core
		7	Shale - Not Sampled
		30	Mainly dull coal
		15	Shale and shaly coal - Not Sampled
		14	Dull coal
			77' 9" Floor: Sandstone
L405	D.1.✓		108'11" Roof: Sandstone and shale
		3	Shale - Not Sampled
		2	Dull coal
		18	Bright coal (broken core)
			110'10" Floor: Shale
L391	R.K.1.		101' 0" Roof: Sandy shale
	D	6	Dull coal
		12	Shale - Not Sampled
	C	14	Dull coal
	B	18	Mixed coal
	A	12	Dull coal
		10	Shale and shaly coal - Not Sampled
			107' 0" Floor: Sandy shale
UPPER NO. 4 SEAM.			
L254	6		155' 1" Roof: Sandstone with shale bands
		7	Mixed coal
		1	Shaly sandstone - Not Sampled
		5	Mixed coal
		1	Shaly sandstone - Not Sampled
		17	Mixed coal
			157' 8" Floor: Shale

TABLE 2: CONTINUED.

Sample Number	Borehole Number		Width of Section Ins.	Description
UPPER NO. 4 SEAM.				
L242	7			112' 9" Roof: Sandstone
			28	Mixed dull and bright coal - ½" sandstone stringer 12" from top excluded
				115' 1" Floor: Carb. shale
L261	8			108' 3" Roof: Laminated sandstone
			2	Shale - Not Sampled
			28	Alternating dull and bright coal - 6" mixed coal at bottom
				110' 9" Floor: Sandy shale
L284	9			107'10" Roof: Sandstone
			33	Mixed dull and bright coal
				110' 7" Floor: Shale
L352	10			199' 9" Roof: Sandstone
		B	12	Mainly bright coal - dull at top
		A	16	Mixed dull and bright coal (shaly in parts)
				202' 1" Floor: Shaly sandstone
L339	11			154' 5" Roof: Shale
			24	Mixed coal
				156' 5" Floor: Sandstone with shale bands
L379	14			168' 6" Roof: Shale
			34	Mixed coal - 2" sandstone and shale 17" from bottom excluded
				171' 4" Floor: Sandy shale
L404	D.1. ✓			98' 1" Roof: Sandstone
			2½	Coal with shale bands - Not Sampled
			½	Sandstone - Not Sampled
			4	Shale - Not Sampled
		B	11	Mixed, mainly dull coal
			2	Carbonaceous shale - Not Sampled
		A	3	Bright coal
			2	Shale - Not Sampled
				100' 0" Floor: Sandstone and shale
L392	R.K.1.			92' 9" Roof: Black shale
			(11	Mainly dull coal
		B	(1	Shale - Not Sampled
			(19	Mainly dull coal
			5	Shale and sandstone - Not Sampled
		A	7	Bright coal
				96' 4" Floor: Sandy shale

TABLE 2 : CONTINUED.

Sample Number	Borehole Number	Width of Section Ins.	Description
NO. 4A SEAM.			
L241	7		107' 5" Roof: Sandy shale
		8	Shale - with very fine bands of bright coal
			108' 1" Floor: Sandstone
L285	9		100' 6" Roof: Shale
		6	Mixed dull and bright coal
			101' 0" Floor: Sandstone
SEAM NO. 5.			
L255	6		68' 4" Roof: Shale
		8	Very bright coal
			69' 0" Floor: Carbonaceous shale
L351	10		96' 7" Roof: Shale
		16	Bright coal
			97' 11" Floor: Shale
L340	11		68' 0" Roof: Carbonaceous shale
		17	Bright coal
		3	Shale - Not Sampled
		2	Bright coal
		3	Bright coal and shale
			70' 1" Floor: Shaly sandstone floor.

TABLE 3.

PROXIMATE ANALYSES.

Sample Number	Width Ins.	Cal. Val. Lbs/lb.	% H20	% Ash	% Vol. Matter	% Fixed Carbon	% Fl. 1.45	% Ash Fl.45	% Fl 1.6	% Ash Fl.6	Sw. No. Fl.45	Sw. No. Fl.6
NO. 1 SEAM												
L250 B	19	11.7	2.2	19.0	24.5	54.3	40.6	7.1	73.3	12.0	1	1
A	7	13.0	2.1	12.2	35.3	50.4	79.8	8.8	96.3	11.1	2	1
L246	20	-	2.2	29.2	20.4	48.2	13.0	10.5	49.0	18.5	1	1F
L256	60	-	2.1	24.9	22.7	50.3	27.8	9.7	65.8	15.6	1F	-
L302 B	30	-	2.4	33.2	14.2	50.2	-	-	-	-	-	-
A	13	12.6	2.4	13.2	29.8	54.6	75.3	7.9	90.0	9.4	1	1
L349	36	11.9	2.1	17.0	25.7	55.2	50.0	7.3	82.8	11.1	1	1F
L375	34	-	1.9	36.2	18.2	43.7	-	-	-	-	-	-
L388	6.	12.1	2.1	16.5	33.8	47.6	69.5	9.3	85.7	12.3	1	1
NO. 2A SEAM												
L257 B	40	-	2.2	30.3	16.0	51.5	4.9	-	38.2	15.3	-	-
A	12	12.3	2.1	15.3	29.8	52.8	62.7	8.2	88.5	10.9	1	1

L384/.....

TABLE 3 : CONTINUED.

Sample Number		Width Ins.	Cal.Val. lbs/lb	% H2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl 1.45	% Ash Fl.45	% Fl. 1.6	% Ash Fl.6	Sw. No. Fl.45	Sw. No. Fl.6
NO. 2A SEAM													
L384	C	6	-	2.0	24.3	32.6	41.1	64.7	9.3	76.8	13.3	1	1
	B	20.	11.8	2.2	18.0	27.3	52.5	61.3	7.0	84.1	11.1	3	1
	A	9	13.0	2.0	12.7	34.9	50.4	82.6	9.1	95.9	11.0	2	1½
L389		43	-	2.5	23.4	19.8	54.3	25.7	6.6	58.5	12.2	1F	-
NO. 2 SEAM													
L251	E	41	-	2.7	30.1	18.6	48.6	-	-	-	-	-	-
	D	27	-	2.1	42.3	17.2	38.4	-	-	-	-	-	-
	C	21	11.4	2.6	18.9	20.9	57.6	21.6	7.2	74.0	13.6	1F	-
	B	44	12.9	2.4	11.6	27.7	58.3	66.5	6.0	90.1	8.4	1	1
	A	14	13.6	2.2	8.7	36.6	52.5	86.6	4.7	91.5	5.2	4½	4
L245	F	55	-	2.5	36.0	20.3	41.2	3.9	-	27.1	15.4	-	1P
	E	14	11.5	2.3	19.5	28.8	49.4	43.5	8.3	78.8	13.0	1½	1F
	D	13	11.7	2.6	17.6	20.1	59.7	40.6	7.7	77.6	11.2	1F	-
	C	21	12.8	2.5	12.2	25.8	59.4	73.7	6.6	88.8	8.0	1F	-
	B	40	13.3	2.4	9.8	29.4	58.4	86.7	6.1	92.4	6.6	1	1
	A	10	13.5	2.7	9.3	37.0	51.0	90.0	6.3	93.9	6.6	3	2½
L258	F	40	-	2.2	31.7	17.5	48.6	-	-	-	-	-	-
	E	58	12.4	2.4	14.4	26.0	57.2	58.3	6.9	89.1	10.6	1F	-
	D	31	11.9	2.3	16.9	21.6	59.2	27.0	8.1	85.0	12.9	1P	-
	C	33	13.1	2.4	11.1	25.9	60.6	78.8	6.6	92.9	8.1	1F	-
	B	19	13.5	2.3	9.0	28.4	60.3	86.4	5.5	95.3	6.6	1F	-
	A	9	13.5	1.9	10.5	36.8	50.8	85.6	4.3	89.3	5.0	3½	3½

L304/.....

TABLE 3 : CONTINUED.

Sample Number		Width Ins.	Cal.Val. lbs/lb.	% H20	% Ash	% Vol. Matter	% Fixed Carbon	% Fl. 1.45	% Ash Fl.45	% Fl. 1.6	% Ash F 1.6	Sw. No. Fl.45	Sw. No. Fl.6
L304	D	70	-	2.7	25.5	19.2	52.6	29.8	8.3	56.6	12.5	1F	-
	C	33	12.0	2.5	18.1	22.9	56.5	43.8	7.7	78.8	12.0	1	1F
	B	40	12.6	2.5	13.2	26.4	57.9	72.4	7.4	88.3	9.0	1	1
	A	12	13.1	2.4	10.2	32.7	54.7	86.2	4.9	89.4	5.0	2½	2½
L348	G	20	-	2.6	24.4	18.9	54.1	21.8	6.9	62.5	12.5	1P	-
	F	53	-	2.6	25.5	18.0	53.9	9.8	11.1	48.9	13.3	1P	-
	E	26	-	2.0	38.3	18.2	43.5	-	-	-	-	-	-
	D	14	-	2.5	38.0	17.3	42.2	9.0	-	5.2	15.2	-	-
	C	20	11.3	2.1	19.4	28.3	50.2	56.6	6.5	76.9	10.0	1	1
	B	9	11.7	2.2	16.3	23.7	57.8	42.7	7.9	90.3	12.2	1F	-
	A	9	11.8	1.9	17.2	32.8	48.1	72.2	6.8	82.5	9.1	4	3
L336	H	52	-	2.2	30.2	19.4	48.2	-	-	-	-	-	-
	G	7	-	2.1	22.0	30.4	45.5	-	-	-	-	-	-
	F	90	-	2.3	34.9	17.5	45.3	-	-	-	-	-	-
	E	32	11.8	2.5	15.4	21.6	60.5	38.0	8.2	87.1	12.3	1P	-
	D	26	11.6	2.2	17.8	24.1	55.9	46.1	8.5	81.6	12.5	1F	-
	C	7	12.1	2.0	16.1	33.7	48.2	77.7	10.1	90.6	12.5	2	1
	B	3	11.3	2.0	20.1	34.0	43.9	71.5	9.0	80.7	10.8	1	1
	A	41	-	2.1	25.7	22.0	50.2	30.5	8.2	58.4	12.7	1F	-
L376	F	77	-	2.5	31.7	18.5	47.3	-	-	-	-	-	-
	E	32	-	2.3	20.4	24.3	53.0	51.0	6.3	64.7	8.3	1	1
	D	23	13.0	2.3	11.3	24.6	61.8	82.1	7.3	93.2	8.0	1P	-
	C	29	12.8	2.1	13.0	34.9	50.0	79.5	5.7	83.6	6.4	2½	2½
	B	19	12.9	2.1	11.5	31.0	55.4	78.9	7.0	91.7	8.8	1	1
	A	5	13.1	1.9	12.3	35.6	50.2	90.9	9.8	95.1	10.2	2½	2½

L385/.....

TABLE 3 : CONTINUED.

Sample Number		Width Ins.	Cal.Val. lbs/lb	% H_2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl 1.45	% Ash Fl.45	% Fl 1.6	% Ash F 1.6	Sw. No. Fl.45	Sw. No. Fl.6
NO. 2 : SEAM.													
L385	F	72	-	2.6	25.3	17.8	54.3	11.2	6.7	45.6	12.9	1F	-
	E	13	-	2.0	40.4	18.6	39.0	-	-	-	-	-	-
	D	19	12.7	2.5	11.4	28.0	58.1	72.8	6.8	90.0	8.5	1F	-
	C	12	13.0	2.4	9.6	26.6	61.4	75.5	6.1	91.5	8.0	1F	-
	B	26	12.9	2.4	10.8	28.1	58.7	79.5	6.1	89.9	7.4	1	1F
	A	5	12.8	2.2	12.8	29.9	55.1	73.9	5.0	83.3	6.4	1	1
L402	C	80	-	2.8	26.5	19.6	51.1	10.9	7.6	50.0	14.0	1P	-
	B	3	11.9	2.6	17.0	25.8	54.6	50.0	7.4	76.3	10.6	1	1
	A	4	13.0	2.0	11.9	37.4	48.7	84.3	8.6	95.0	10.2	2½	1½
L403	D	66	-	2.6	27.6	19.7	50.1	16.6	7.5	49.2	13.5	2½	1F
	C	51	-	2.5	32.9	18.3	46.3	9.0	12.9	26.0	14.2	1F	-
	B	11	-	1.6	26.1	35.8	36.5	38.3	9.6	60.0	12.7	3	2
	A	6	12.6	2 1	14.2	37.1	46.6	79.5	5.5	82.3	6.3	4	3½
L411	C	115	-	2.5	33.5	17.8	46.2	-	-	-	-	-	-
	B	6	-	2.5	23.2	26.3	48.0	46.3	5.7	61.3	9.0	1F	-
	A	15	11.9	2.4	16.2	32.6	48.8	72.3	5.8	79.7	7.1	2	1½
L390	D	42	-	2.6	25.1	19.3	53.0	20.5	8.5	54.9	14.4	1F	-
	C	32	-	2.6	27.1	17.4	52.9	10.2	6.9	43.6	13.4	1P	-
	B	5	11.7	2.2	17.9	33.0	46.9	69.8	9.4	83.7	11.7	1½	1
	A	8	12.3	2.2	14.6	34.4	48.8	80.1	6.4	83.7	7.4	2½	2½
NO. 3 SEAM:													
L252		19	12.4	2.5	14.5	32.7	50.3	68.6	7.6	90.0	11.5	3½	1½

L243/.....

TABLE 3 : CONTINUED.

Sample Number		Width Ins.	Cal.Val. lbs/lb.	% H_2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl 1.45	% Ash Fl.45	% Fl 1.6	% Ash F 1.6	Sw. No. Fl.45	Sw. No. Fl.6
L243		11	-	2.3	21.9	30.4	45.4	58.3	7.4	72.3	10.9	3	2
L259		9	12.0	2.1	18.2	30.2	49.5	56.2	8.8	81.7	12.3	2½	2
L303		13	12.0	2.7	17.2	29.0	51.1	64.5	7.9	83.9	11.0	2½	1½
L337		31	12.7	2.4	12.0	32.9	52.7	80.0	6.2	88.5	7.6	3	2½
L377		14	12.6	2.5	13.5	33.0	51.0	72.6	6.5	87.6	9.1	4	3
L386	B	7	-	2.0	36.7	25.9	35.4	-	-	-	-	-	-
	A	12	-	2.0	21.4	30.4	46.2	61.8	6.9	70.3	8.8	2½	2
L406		12	-	2.6	20.6	28.7	48.1	52.6	7.1	73.1	11.5	1P	-
LOWER NO. 4 SEAM:													
L253	C	22	-	2.2	38.7	18.3	40.8	-	-	-	-	-	-
	B	22	-	2.6	22.7	22.9	51.8	26.6	7.6	64.1	13.5	1	1F
	A	22	-	2.5	24.9	23.0	49.6	24.3	8.2	59.7	15.5	1F	-
L244	B	10	-	2.5	32.6	20.8	44.1	15.7	7.8	40.3	15.3	1F	-
	A	55	-	2.5	22.4	24.9	50.2	40.0	8.0	68.7	13.0	1	1F
L260	B	9	12.2	2.0	17.2	32.4	48.4	63.9	7.4	82.4	10.0	2½	1F
	A	49	11.8	2.3	18.4	23.6	55.7	48.6	7.5	79.9	11.3	3	1½
L305		71	-	2.8	22.5	20.9	53.7	40.1	7.4	65.4	11.0	1	1

L350/.....

TABLE 3 : CONTINUED.

Sample Number		Width Ins.	Cal.Val. lbs/lb	% H_2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl. 1.45	% Ash Fl.45	% Fl. 1.6	% Ash Fl.6	Sw. No. Fl.45	Sw .No. Fl.6
LOWER NO.4 SEAM. CONT.													
L350	D	8	-	2.1	28.5	17.8	51.6	44.0	7.3	57.9	10.4	1	1
	C	9	-	2.6	23.1	20.5	53.8	24.9	7.4	60.9	13.3	1F	-
	B	12	-	2.3	23.3	22.5	51.9	35.4	5.7	57.8	10.4	1	1F
	A	26	-	2.6	21.8	24.4	50.8	44.3	7.4	71.7	11.5	1	1F
L338	C	20	11.2	2.3	19.7	24.9	53.1	42.8	7.2	71.6	11.1	1	1F
	B	16	11.9	2.5	15.3	23.8	58.4	53.4	7.6	84.5	10.5	1F	-
	A	18	-	2.4	26.7	18.2	52.7	13.4	6.5	46.0	12.9	1F	-
L412	C	3	11.0	3.4	19.7	19.3	57.6	17.4	8.9	79.7	15.6	1P	-
	B	21	11.7	3.5	15.1	22.4	59.0	52.0	7.9	86.5	11.1	1P	-
	A	24	11.0	3.1	20.2	15.4	61.3	29.0	7.4	70.6	13.5	1P	-
L378	D	12½	-	2.4	39.6	20.8	37.2	-	-	-	-	-	-
	C	30	-	2.5	22.9	23.7	50.9	31.9	6.8	63.6	12.1	1	1F
	B	30	11.3	2.5	19.7	22.9	54.9	41.6	7.2	70.5	11.0	1F	-
	A	15	-	2.3	35.1	16.8	45.8	-	-	-	-	-	-
L387		54	-	2.5	21.3	23.4	52.8	45.2	7.2	70.7	10.6	1F	-
L405		20	11.6	2.5	18.2	26.6	52.7	55.4	6.9	75.0	9.6	1	1F
L391	D	6	-	2.6	25.8	22.3	49.3	16.9	9.6	49.1	15.8	1F	-
	C	14	-	2.3	33.9	18.9	44.9	-	-	-	-	-	-
	B	18	11.1	2.6	19.4	26.9	51.1	53.1	7.5	74.4	10.6	1	1
	A	12	-	2.6	22.0	22.2	53.2	48.6	6.0	65.9	8.8	1F	-

UPPER NO.4 SEAM/....

TABLE 3 : CONTINUED.

Sample Number		Width Ins.	Cal.Val. lbs/lb	% H2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl. 1.45	% Ash Fl.45	% Fl. 1.6	% Ash Fl.6	Sw. No. Fl.45	Sw. No. Fl.6
UPPER NO.4 SEAM.													
L254		29	-	2.2	26.3	24.0	47.5	25.7	7.3	59.2	13.6	3½	1
L242		28	-	2.3	25.9	24.1	47.7	32.2	8.4	64.1	15.0	1	1F
L261		28	-	1.8	28.4	21.8	48.0	13.0	8.6	56.5	14.7	1	1P
L284		33	-	2.7	24.4	20.4	52.5	31.1	9.0	66.8	14.4	1	1F
L252	B	12	-	2.1	25.4	24.9	47,6	34.8	8.1	58.5	12.7	2½	1
	A	16	-	2.6	27.2	22.4	47.8	25.9	5.6	55.8	12.7	2	1F
L339		24	-	1.9	27.0	22.7	48.4	22.8	8.3	52.7	14.7	1	1F
L379		32	-	2.2	21.5	25.1	51.2	40.9	8.2	76.7	14.9	1	1F
L404	B	11	-	2.5	25.7	21.9	49.9	24.5	8.5	59.6	15.7	1F	-
	A	3	11.7	2.3	17.5	31.6	48.6	65.6	6.7	79.8	10.3	1F	-
L392	B	30	-	2.1	31.7	23.0	43.2	-	-	-	-	-	-
	A	7	11.7	2.4	17.8	33.7	46.1	67.5	7.5	77.8	9.7	3½	3
NO. 4A SEAM.													
L241		8	-	1.7	33.1	29.1	36.1	-	-	-	-	-	-
L285		6	-	2.1	30.6	24.9	42.4	-	-	-	-	-	-
NO. 5 SEAM.													
L255		8	13.5	2.9	7.8	35.8	53.5	89.2	4.1	91.8	4.8	4	2½
L351		16	12.9	2.9	11.0	32.6	53.5	83.8	6.4	92.3	7.4	2	1½
L340		22	13.0	2.6	10.0	33.5	53.9	89.6	7.8	97.1	8.9	2	1½

TABLE 4.

AVERAGE PROXIMATE ANALYSES OF SEAM SECTIONS.

Sample No. & Sections Included	B.H. No.	Total Width Ins.	Width Excl. Ins.	Cal.Val. lbs/lb	% H_2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl. 1.45	% Ash Fl.45	% Fl. 1.6	% Ash F 1.6
NO. 1 SEAM:												
L250 A & B	6	26	0	12.1	2.1	17.2	27.4	53.3	51.2	7.8	79.5	11.7
L246	7	20	0	-	2.2	29.2	20.4	48.2	13.8	10.5	49.0	18.5
L256	8	60	0	-	2.1	24.9	22.7	50.3	27.8	9.7	65.8	15.6
L349	10	36	0	11.9	2.1	17.0	25.7	55.2	50.0	7.3	82.8	11.1
L375	14	34	0	-	1.9	36.2	18.2	43.7	-	-	-	-
NO. 2 A SEAM:												
L384 A & B	15	29	0	12.2	2.1	16.4	29.7	51.8	67.9	7.8	87.8	11.1
NO. 2 SEAM:												
L251 A & B	6	58	0	13.1	2.4	10.9	29.8	56.9	71.4	5.6	90.4	7.6
A,B & C		79	0	12.6	2.4	13.0	27.5	57.1	58.1	5.8	86.1	9.0
L245 A,B & C	7	71	0	13.2	2.5	10.4	29.4	57.7	83.3	6.3	91.5	7.0
A - E		98	0	12.7	2.5	12.7	28.1	56.7	72.0	6.5	87.9	8.3
L258 A - E	8	150	2	12.7	2.3	13.3	26.0	58.4	61.5	6.5	89.9	9.6
L304 A,B & C	9	85	1	12.4	2.5	14.7	25.9	56.9	63.2	7.0	84.8	9.5
L348 A,B & C	10	38	0	11.5	2.1	18.1	28.3	51.5	57.0	6.8	81.4	10.4
L336 C,D & E	11	65	0	11.8	2.3	16.4	23.9	57.3	45.5	8.5	85.3	12.4
L376 C,D & E	14	84	4	-	2.2	15.4	28.0	54.4	69.4	6.4	79.0	7.5
L385 A - D	15	62	3	12.9	2.4	10.9	27.9	58.7	76.2	6.2	89.7	7.8

TABLE 4 : CONTINUED.

Sample No. & Sections Included	B.H. No.	Total Width Ins.	Width Excl. Ins.	Cal. Val. lbs/lb	% H_2O	% Ash	% Vol. Matter	% Fixed Carbon	% Fl. 1.45	% Ash Fl.45	% Fl. 1.6	% Ash F 1.6
LOWER NO. 4 SEAM:												
L253 A & B	6	44	6	-	2.5	23.8	23.0	50.7	25.4	7.9	61.9	14.5
L244 A	7	55	0	-	2.5	22.4	24.9	50.2	40.0	8.0	68.7	13.0
L260 A	8	49	0	11.8	2.3	18.4	23.6	55.7	48.6	7.5	79.9	11.3
L305	9	71	20	-	2.8	22.5	20.9	53.7	40.1	7.4	65.4	11.0
L338 B & C	11	36	5	11.5	2.4	17.7	24.4	55.5	47.5	7.4	77.3	10.8
L412 A & B	12	45	2	11.3	3.3	17.8	18.7	60.2	39.7	7.7	78.0	12.3
L378 B & C	14	60	18	-	2.5	21.3	23.3	52.9	36.8	7.0	67.1	11.5
L387	15	54	22	-	2.5	21.3	23.4	52.8	45.2	7.2	70.7	10.6
UPPER NO. 4 SEAM:												
L254	6	29	2	-	2.2	26.3	24.0	47.5	25.7	7.3	59.2	13.6
L242	7	28	½	-	2.3	25.9	24.1	47.7	32.2	8.4	64.1	15.0
L261	8	28	0	-	1.8	28.4	21.8	48.0	13.0	8.6	56.5	14.7
L284	9	33	0	-	2.7	24.4	20.4	52.5	31.1	9.0	66.8	14.4
L352 A & B	10	28	0	-	2.4	26.4	23.5	47.7	29.7	6.9	57.0	12.7
L339	11	24	0	-	1.9	27.0	22.7	48.4	22.8	8.3	52.7	14.7
L379	14	32	2	-	2.2	21.5	25.1	51.2	40.9	8.2	76.7	14.9

TABLE 5.

COMPOSITION OF ULTIMATE ANALYSIS SAMPLES.

Sample Number	Composition		Type of coal and area represented
NO. 2 SEAM:			
M109	L251 A - 14 pts. L245 A - 10 " . L258 A - 9 " . L304 A - 12 " .	L336 C - 7pts. L376 C - 29 " L385 A - 5 "	Welstand 34 North-western half of area Boreholes 6,7,8,9,11,14,& 15 Bottom bright coal
M110	L251 B - 44 pts. L245 B - 40 " . C - 21 " . L258 B - 19 " . C - 33 " .	L304 B - 40pts. L336 D - 26 " L376 D - 23 " L385 B - 26 "	Welstand 34 North-western half of area Boreholes 6,7,8,9,11,14,15 Mixed coal above bottom bright
M111	L251 C - 21 pts. L245 D - 13 " . L258 D - 31 " . L304 C - 33 " .	L336 E - 32pts. L376 E - 32 " L385 C - 12 "	Welstand 34. North-western half of area Boreholes 6,7,8,9,11,14,15 Dull coal in middle of seam
M112	L245 E - 14 pts. L258 E - 58 " . L385 D - 19 " .		Welstand 34 North-western half of area Mixed coal below roof coal Boreholes 7, 8 & 15
M113	L251 A - 14 pts. B - 44 " . C - 21 " . L245 A - 10 " . B - 40 " . C - 21 " . D - 13 " . E - 14 " . L258 A - 9 " . B - 19 " . C - 33 " . D - 31 " . E - 58 " .	L376 C - 29pts. D - 23 " E - 32 " L304 A - 12 " B - 40 " C - 33 " L336 C - 7 " D - 26 " E - 32 " L385 A - 5 " B - 26 " C - 12 " D - 19 "	Welstand 34 North-western half of area Boreholes 6,7,8,9,11,14,15 Composite seam sample
M40	L251 A - 14 pts. B - 44 " . C - 21 " . L245 A - 10 " . B - 40 " . C - 21 " . D - 13 " . L258 A - 9 " . B - 19 " . C - 33 " . D - 31 " . L376 A - 5 " . B - 19 " . C - 29 " . D - 23 " . E - 32 " .	L304 A - 12pts. B - 40 " C - 33 " L348 A - 9 " B - 9 " C - 20 " L336 A - 41 " B - 3 " C - 7 " D - 26 " E - 32 " L385 A - 5 " B - 26 " C - 12 " D - 19 "	Welstand 34 North-western half of area Boreholes 6, 7, 8, 9, 10, 11, 14 & 15 Composite bottom portion of seam. Made up to determine effect of floating at 1.6 S.G. on ash fusion temperature of coal.

NO. 3 SEAM/....

TABLE 5 : CONTINUED.

Sample Number	Composition				Type of coal and area represented
NO. 3 SEAM:					
M108	L252 - 9 pts.		L337 - 31pts.		Welstand 34 North-western half of area Boreholes 6, 7, 8, 9, 11, 14 & 15. Composite seam sample
	L243 - 11 " .		L377 - 14 " .		
	L259 - 9 " .		L368 A - 12 " .		
	L303 - 13 " .				
NO. 5 SEAM:					
M107	L255 - 8 pts.				Welstand 34. Western corner of area Boreholes 6, 10 & 11 Composite seam sample
	L351 - 16 "				
	L340 - 22 "				

TABLE 6.

PROXIMATE ANALYSIS OF COMPOSITE SAMPLES.

Sample Number	Whole Coal			Float at 1.6 S.G.			
	% Ash	% H_2O	% V.M.	% Ash	% H_2O	% V.M.	% Fl.6
NO. 2 SEAM:							
M109	11.9	2.5	33.5	6.6	2.7	35.7	88.0
M110	11.7	2.7	25.8	8.2	3.0	27.1	89.7
M111	17.1	3.0	21.9	11.5	3.1	23.3	79.5
M112	14.0	2.8	25.5	10.2	3.2	27.0	87.7
M113	13.4	2.8	26.4	9.3	3.1	27.8	86.8
M40	14.7	2.8	26.7	9.2	-	-	84.7
NO. 3 SEAM:							
M108	15.7	3.2	28.7	9.5	3.4	31.7	83.2
NO. 5 SEAM:							
M107	9.8	3.5	30.3	7.7	3.3	33.6	96.1

TABLE 7/.....

TABLE 11.

ASH FUSION TEMPERATURES.

Sample Number	Ash Fusion Temperature °C	
	Whole Coal	Float at 1.6 S.G.
NO. 2 SEAM:		
M109	1300	+ 1400
M110	1300	+ 1400
M111	+ 1400	+ 1400
M112	1400	+ 1400
M113	1400	+ 1400
M40	+ 1400	+ 1550
NO. 3 SEAM:		
M108	1300	+ 1400
NO. 5 SEAM:		
M107	1300	+ 1400

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APPENDIX.

ANALYTICAL METHODS AND THEIR SIGNIFICANCE.

1. SAMPLING:

Sampling is carried out according to South African Standard Specification, S.A. No. 13 of 1937, "Standard Methods for the Sampling of Coal in South Africa," issued by the South African Standards Institution.

11. PREPARATION OF SAMPLES:

The samples are prepared in the manner specified in Standard Methods for the "Sampling of Coal in South Africa", S.A. No. 13 of 1937. The laboratory samples are ground to pass a 60 mesh sieve (square aperture : 0.3 mm) except in the case of specific gravity analysis (float and sink tests) and hydrogenation tests, for which minus 20 mesh (square aperture : 1 mm) material is used.

111. PROXIMATE ANALYSIS:

(1) Moisture Content: This is the loss of weight obtained by heating 1 gram of coal at 101 - 105°C for one hour.

(2) Ash Content: This is the residual ash obtained by combusting 1 gram of coal in a muffle furnace. The coal is slowly heated to 800°C and kept at this temperature for one hour.

(3) Volatile Matter Content: This is the loss of weight obtained by heating 1 gram of coal at 920°C for 7 minutes minus the weight of water present in the coal.

(4) Fixed Carbon percentage: This is obtained by subtracting the sum of moisture, ash and volatile matter contents, expressed as percentages, from 100.

1V. CALORIFIC VALUE:

This value, reported in Evaporative Units (lbs/lb), is calculated from the rise in temperature obtained by combusting 1 gram of coal in oxygen at 30 atmospheres pressure in a Berthelot-Mahler-Kroeker bomb calorimeter.

The determination is carried out according to South African Standard Specification, S.A. No. 5 of 1940, "The Determination of the Comparative Calorific Values of Coals in South Africa".

V. PRELIMINARY FLOAT AND SINK ANALYSES:

Twenty gram portions of the coal are separated into different specific gravity fractions in a centrifuge using petrol and carbon tetrachloride mixtures of varying specific gravity. The apparatus and method used is described in the Journal of the Chemical, Metallurgical and Mining Society of South Africa, Vol. 34, No. 8 : "A Specific Gravity Investigation of Coal Samples" by P.E. Hall.

(a) The/.....

(a) The percentage float at a S.G. of 1.45 is the percentage by weight of the coal which has a S.G. less than 1.45. This float contains the majority of the swelling constituents of the coal when these are present in a sample.

(b) The percentage of float at a S.G. of 1.6 is the percentage by weight of the coal which has a S.G. less than 1.6. It represents approximately the amount of coal substance present and also gives a rough figure for the performance of an ordianry washer on the coal. This figure subtracted from 100 gives the amount of adventitious mineral matter in a coal sample.

(c) The percentage ash on the float at 1.45 gives some indication of the minimum ash content likely to be obtained by washing at this specific gravity.

(d) The percentage ash on the float at 1.6 represents the amount of mineral matter intimately associated with the coal substance and as such furnishes an approximate figure for the minimum ash content for a normal washed product from the particular sample.

(e) The Swelling Number is the ratio of the final to the initial volume of 1 gram of coal heated strongly under standard conditions and is a measure of the swelling propensities of the coal.

This test is carried out according to B.S.S. Specification, No. 804 of 1938. "The Crucible Swelling Test for Coal."

1 Denotes a residue of definite coke structure but no swelling. 1 f denotes a residue easily friable and possessed of no coke structure. 1 p denotes a residue in powder form. A value of 3 or more indicates definite coking possibilities.

(f) If the float 1.45 material exhibits swelling propensities, further swelling number determinations are carried out on the S.G. 1.6 fraction. These figures give an indication of the swelling propensity with this S.G. cut.

VI. ULTIMATE ANALYSIS:

The ultimate analysis is generally carried out on the float at a S.G. of 1.6. This procedure is adopted in order to eliminate as far as possible the effects due to the presence of adventitious mineral matter.

Carbon, hydrogen, nitrogen and sulphur contents are all determined by standard methods for coal analysis:- viz:

(a) Carbon and Hydrogen: The method used is described in B.S.S. No. 1016 of 1942, "Analysis and Testing of Coal and Coke", page 31.

(b) Nitrogen: The method followed is that described by Beet (Fuel in Science and Practice, volume XI of 1932, page 196; volume XIII of 1934, page 343) and Hall (Journ. Chem. Met. and Min. Soc. of South Africa, volume XXXVI of 1935, No. 2, page 28.)

(c) Total Sulphur: This is determined by the Eschka method, described in B.S.S. No. 1016 of 1942, "Analysis and Testing of Coal and Coke", page 43.

The oxygen/.....

The oxygen content is obtained by subtracting the sum of the carbon, hydrogen, nitrogen and sulphur percentages from 100. The value obtained therefore includes all analytical errors.

The results are expressed on a dry-ash-free basis, so as to present the composition of the organic substance itself, unmixed with mineral matter.

VII. SULPHUR DISTRIBUTION:

The figures showing the distribution of sulphur in a sample are on an "as received" basis, i.e. including adventitious mineral matter.

The total sulphur content of the floats at 1.6 S.G. is usually given in the same table as the sulphur distribution on the whole coal. This is done for comparative purposes since it indicates the change in sulphur content that would be brought about by washing the raw coal at a specific gravity of 1.6.

The total sulphur content is determined by the Exchka method and the mineral sulphur content by extraction with dilute nitric acid, according to the methods described in B.S.S. No. 1016 of 1942, page 45.

VIII. CARBONIZATION ASSAYS:

There are two forms of carbonization assays, viz: the low temperature (600°C) and the high temperature (900°C) and both are carried out in the Gray-King Apparatus.

Low Temperature Gray-King Assay:

This is carried out at a temperature of 600°C on the floats at a S.G. of 1.6 and is used, primarily for correlative purposes either as a means of characterising a new coal or for establishing the variation in a given type of coal. The results can also be used, however, for determining the type and quantity of the products which the coal under test would furnish in a large scale low temperature carbonization retort. The apparatus and method used is that described in the "Methods of Analysis of Coal" issued by the Fuel Research Station, Greenwich (Physical and Chemical Survey of the National Coal Resources, No. 7).

No direct relationship between the retort and assay yields obtained from South African coals has been deduced but the following interpretation has been found to be applicable overseas. Depending on the type of plant, the large scale tar yield varies from 70 - 80% of that given by the assay. The gas yield is also slightly higher than can be obtained in practice. The yield of coke will be very close to that given by the assay. "Standard" to "very swollen" coke residues indicate coals which will probably produce satisfactory smokeless fuels, while those which are appreciably more friable than "standard" indicate coals which will not yield suitable large scale coke products.

The assay is carried out on the float at 1.6 S.G. for the same reasons as are outlined in Section 7 (ultimate analysis) and also since that fraction would most nearly represent the ordinary washed product from the seam or section of the seam under consideration.

High temperature/.....

High Temperature Gray-King Assay:

This test is only made on such seams or sections of seams as appear to be possible sources of coking or gas coals. Usually the float at a S.G. of 1.45 is used as representing the optimum quality of coal which could be commercially produced by the best possible washing.

A temperature of 900°C is employed and a cracking unit kept at a constant temperature of 800°C is installed. The method and apparatus used is that described in "The Assay of Coal for Carbonization Purposes (Part III)", issued by the Fuel Research Station, Greenwich, (Technical Paper No. 24). The calorific value of the gas is determined by combustion of a measured volume in excess air in a Löffler Gas Calorimeter.

The High Temperature Gray-King Carbonization Assay has been designed specifically to simulate large scale gas making conditions both in horizontal and continuous vertical retorts. Here again no direct relationship between the retort and assay yields with South African coals has been deduced and it is necessary to rely entirely on overseas results. The assay conditions are such that the factors of comparison with horizontal retort practice approach unity. It is considered that the factors for coke oven practice should not diverge unduly from unity in spite of a number of variables such as type of plant, type of coal and size of coal. The factors retort/assay for gas yield, gas calorific value and coke yield are very close to unity. The assay yield of tar is low and the factor varies from 1.2 to 1.5 as the coal varies from strongly to weakly-swelling. The coke residues "friable" and "pulverulent" obtained from the assays indicate coals unsuitable for large scale coke production. Coke residues from "standard" to "very swollen" indicate that the coals will probably yield cokes under large scale conditions.

The best gas coals so far tested in South Africa give about 18 - 20% gas, and they yield 65 - 70 therms of gas per long ton of coal. The highest calorific values of the gas so far found vary from 5400 to 5700 Calories per cubic metre at N.T.P.

IX. DETAILED FLOAT AND SINK ANALYSIS:

Float and sink analyses together with their attendant ash and swelling number determinations, are made on composite coal samples ground to -20 mesh.

This work is usually carried out from three different aspects, viz:-

(i) the characterization of types of coal and the subsequent use of this data in correlation.

(ii) the investigation, in a more detailed manner, of the possibilities and results of washing.

(iii) the investigation of the effects of washing on the swelling properties of the coal.

Where the two latter aspects - which are, of course, closely related - command the most attention, floats corresponding to possible washery products are preferred, since from them the yields and characteristics of the cleaned products can be readily obtained. This involves making cuts at various specific gravities

and/.....

and analysing the resulting floats. Such a method is known as "cumulative" float and sink analysis.

On the other hand, where the characterisation and correlation of coal seams are involved, the separation into a series of fractions of narrow specific gravity range is adopted. In this way, any change in the nature or behaviour of the coal fractions with change in specific gravity is more easily appreciated and more strongly emphasised than would be the case in the cumulative method. This type is known as "fractional" float and sink analysis.

For those properties which are additive, e.g. ash content, the cumulative figures can be built up from the fractional and vice versa. This cannot be done in the case of non-additive properties. Nevertheless, swelling numbers - strictly speaking a non-additive property - can be calculated with fair accuracy from fractional to cumulative figures if the number for any fraction is not greater than 8 or less than 1½.

Where desirable, complete float and sink analyses of both types are determined.

When using float and sink analysis figures as guides to possible commercial results, it must always be remembered that the laboratory separations are made on fine coal and depend entirely on specific gravity differences. The products are, therefore, cleaner and more uniform than could ever be obtained from a commercial washer whether operating on run-of-mine or sized coal. The analytical figures represent optimum conditions and due allowance must be made for this when interpreting them into commercial practice.

Comparative figures obtained from many float and sink analyses carried out on both -20 mesh and commercial coal sizes have demonstrated the value of the laboratory scale tests and have suggested a reliable interpretation which can be given to the figures.

(1) The shape of the graph of percentage yield vs. Specific Gravity obtained from fine coal is similar to that obtained from the commercial sizes of the same coal. This means that the washability of the coal can be satisfactorily determined from the -20 mesh size float and sink analysis.

(2) The large scale percentage of float is always 5 - 10% more than the figure obtained in the laboratory on fine coal at the same Specific Gravity.

(3) The percentage ash on the float obtained at any Specific Gravity from large coal is usually from 2 - 4% higher than the value obtained from a laboratory separation.

(4) It has also been found that the smaller the size of the coal to be washed on a large scale, the more closely does the percentage yield and the percentage of ash in the product approach the fine coal float and sink analyses. That is to say, for example, that the allowance made in estimating the washability of pea coal need not be so great as that for, say round coal.

If the coal is poor (more than 18 - 20% ash) it is advisable to make liberal allowances, since with this material only

washers/.....

washers of the best type operated under strict control function at all satisfactorily.

X. ASH FUSION TEMPERATURES:

A knowledge of the composition and behaviour of the ash from any coal is of importance from both a fundamental and technical aspect. The use of coal in many industrial appliances, e.g. producers and forced draught boilers is seriously limited by the behaviour of the ash.

The mineral matter from which the ash is derived occurs in two forms:-

(a) Inherent mineral matter which occurs as an integral part of the coal and is not separable therefrom by ordinary means, e.g. picking or washing.

(b) Adventitious mineral matter which may be again subdivided into:

(i) more or less isolated pockets and more continuous bands included in the coal seams,

(ii) mineral matter derived from accompanying strata.

Run-of-mine coal would contain all the forms of mineral matter described above; effective picking should remove the greater portion of (b) (ii) and washed coals would contain (a), and (b) (i) to a limited extent only. In order to determine the ash fusion temperatures of ordinary picked but unwashed coal, these tests are carried out on the whole coal samples, including adventitious mineral matter. If a figure for washed coal is required, the determination is made on the floats at 1.6 S.G.

A direct correlation between the laboratory determinations of the ash fusion temperature and behaviour of the ash in practice has not so far been possible. Although the determinations are carried out under conditions designed to resemble as closely as possible those actually obtaining in a furnace, the differences between small and large scale conditions are appreciable. The results indicate, however, the probable behaviour of the ash in practice and the following scheme may be used for interpreting the laboratory determination of the ash fusion temperature.

(a) less than 1250°C - likely to cause clinkering trouble under all furnace conditions.

(b) 1250 - 1400°C - unlikely to produce clinker under general conditions, although trouble may be experienced with industrial appliances like producers and forced draught boilers.

(c) greater than 1400°C - highly refractory ash which will probably not clinker under any conditions.

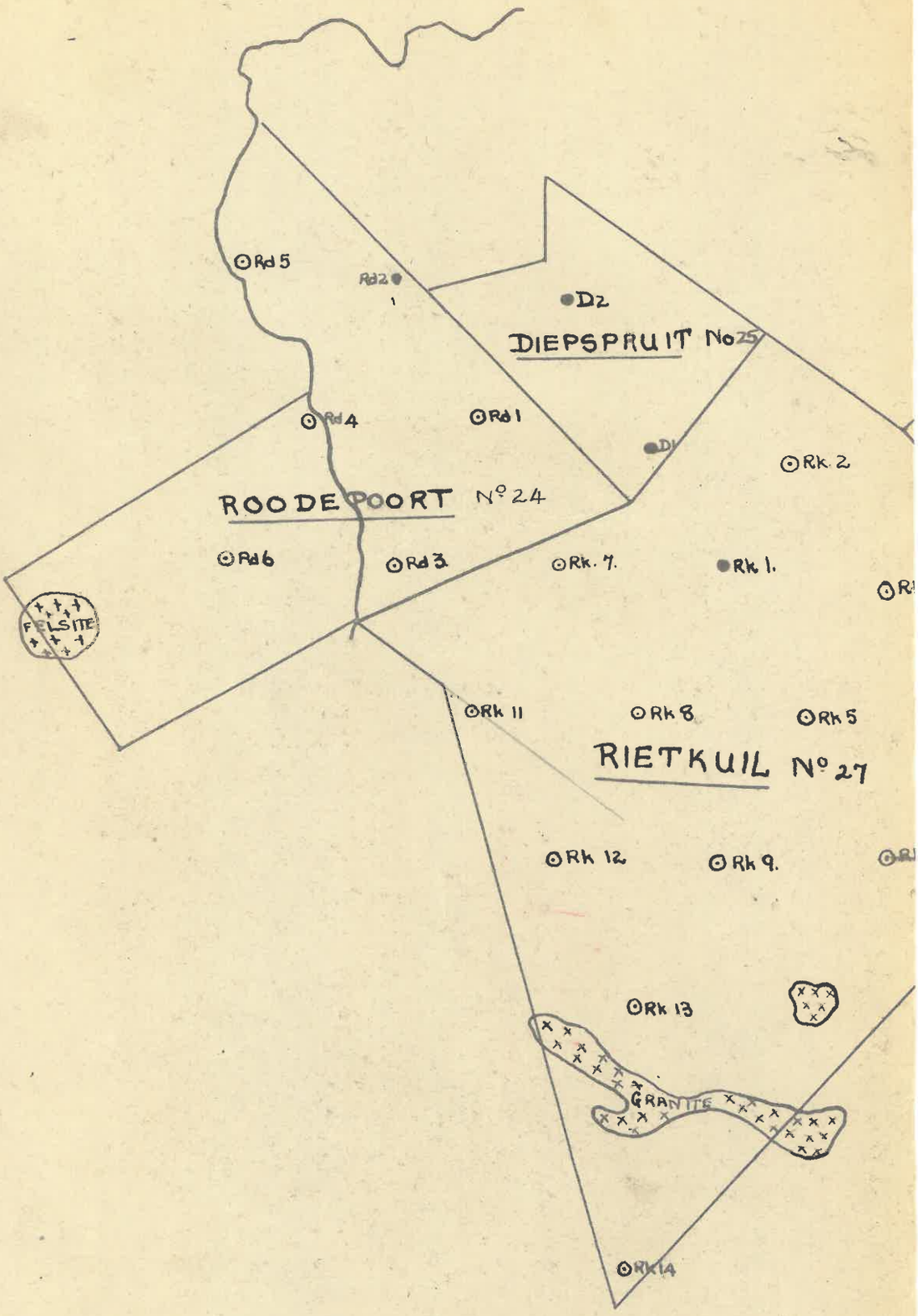
XI. Hydrogenation/.....

XI. HYDROGENATION:

The work done in this sphere constitutes a comparative hydrogenation survey. Consequently, a discontinuous rotary converter, though it affords no quantitive data as to the behaviour of the coal in a large scale continuous plant, can nevertheless be used. Under rigidly standard conditions, results obtained with this apparatus are qualitatively comparable.

The coals are treated in the form of a paste containing 57% of coal, 38% of oil and 5% of molybdenum sulphide as catalyst. After filling the converter with 440 grams of the paste and hydrogen to a pressure of 100 atmospheres, the converter is heated to 450°C and kept at this temperature for one hour, after which it is allowed to cool down and the products of hydrogenation examined.

In evaluating the results obtained from rotary converters, it has been found that the best guide to the probable behaviour of the coal is the percentage of organic benzene - insoluble material remaining after treatment reckoned on a dry-ash-free basis. Where this figure is low, the coal may be expected to give better large scale results than where it is high. The best coals so far tested in South Africa have yielded 8 - 11% of this insoluble residue. The average is about 31% and the maximum 60%.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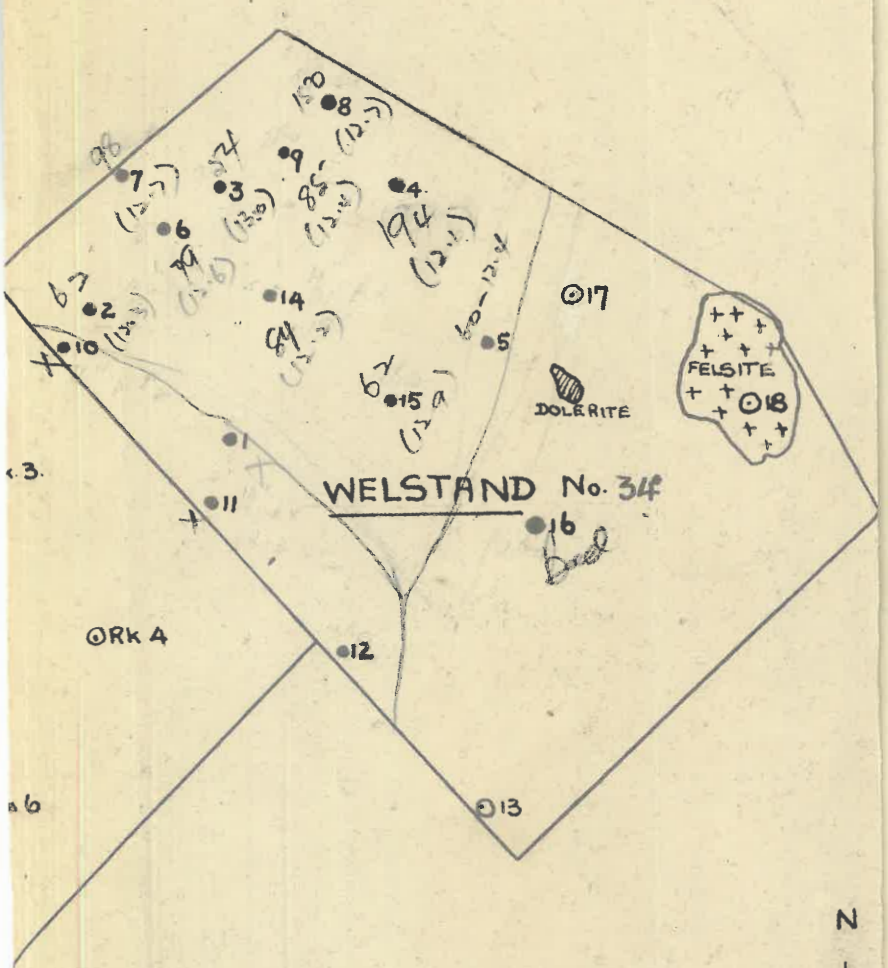
Rd 2
D2
DIEPSPRUIT No 25
Rd 4
Rd 1
D1
Rk. 2
ROODEPOORT N° 24
Rd 6
Rd 3
Rk. 7.
Rk 1.
FELSITE
Rk 11
Rk 8
Rk 5
RIETKUIL N° 27
Rk 12
Rk 9.
Rk 13
GRANITE
Rk 14



DRILLING BY ISCOR

WELSTAND AREA.

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