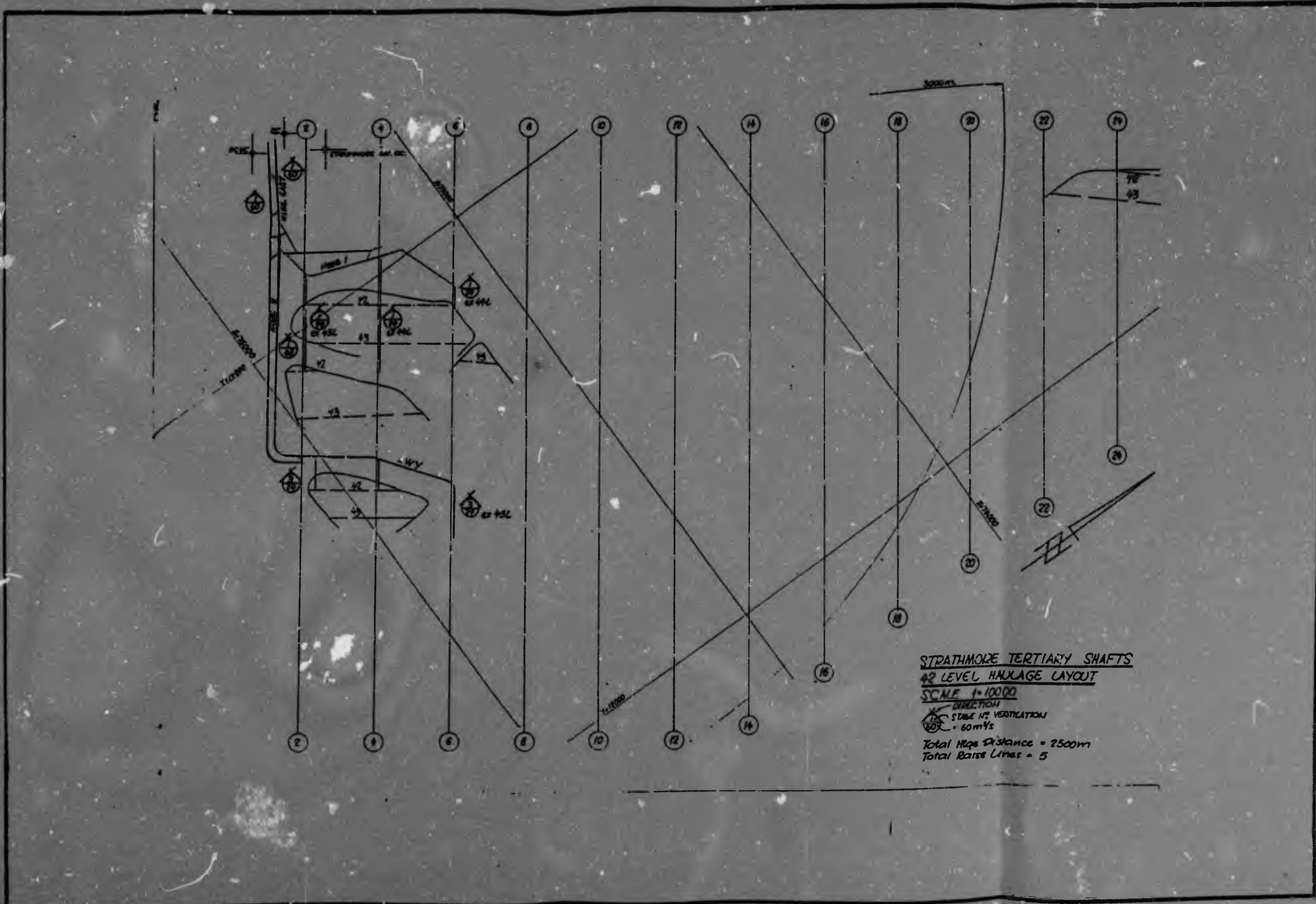
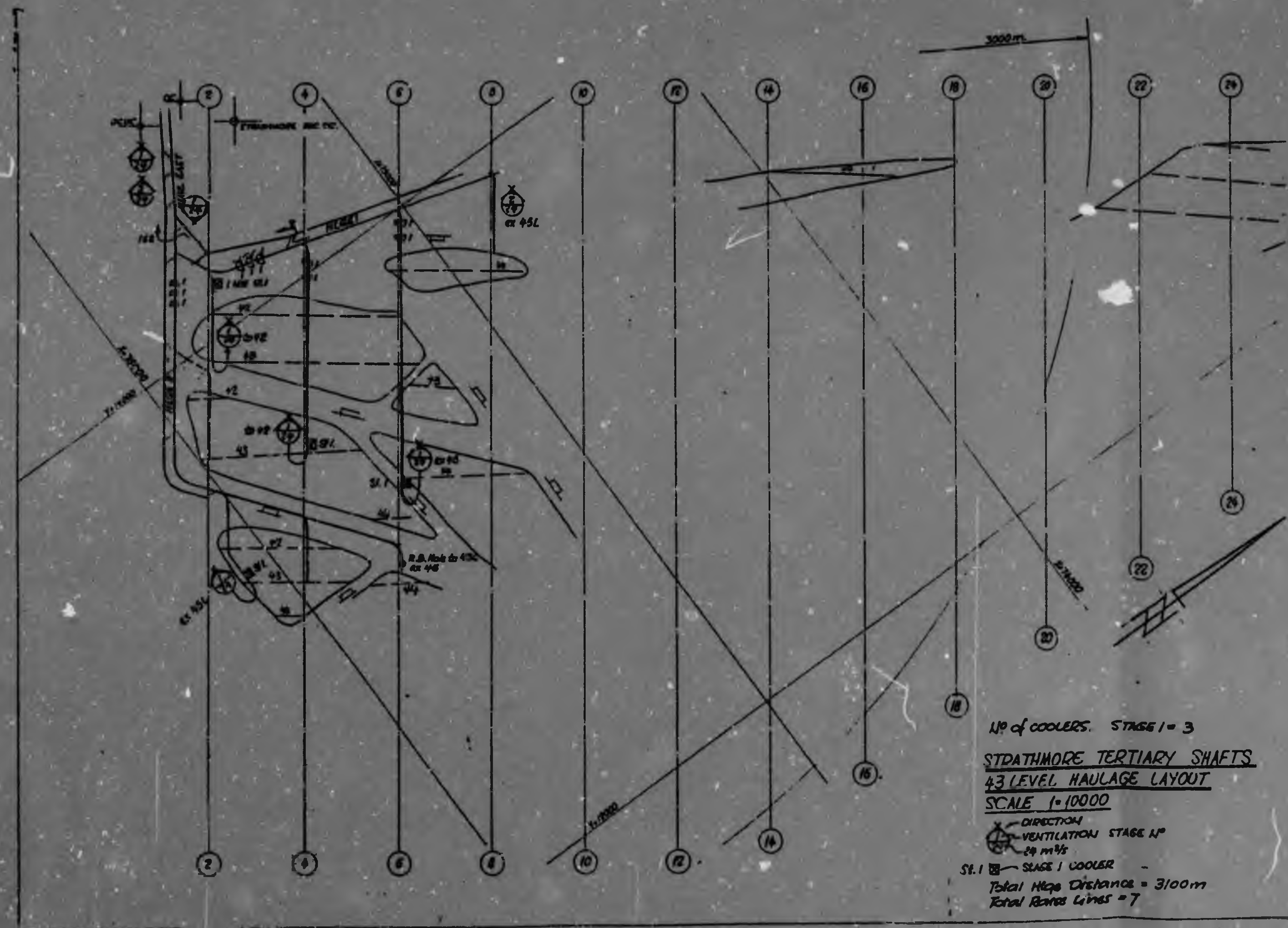
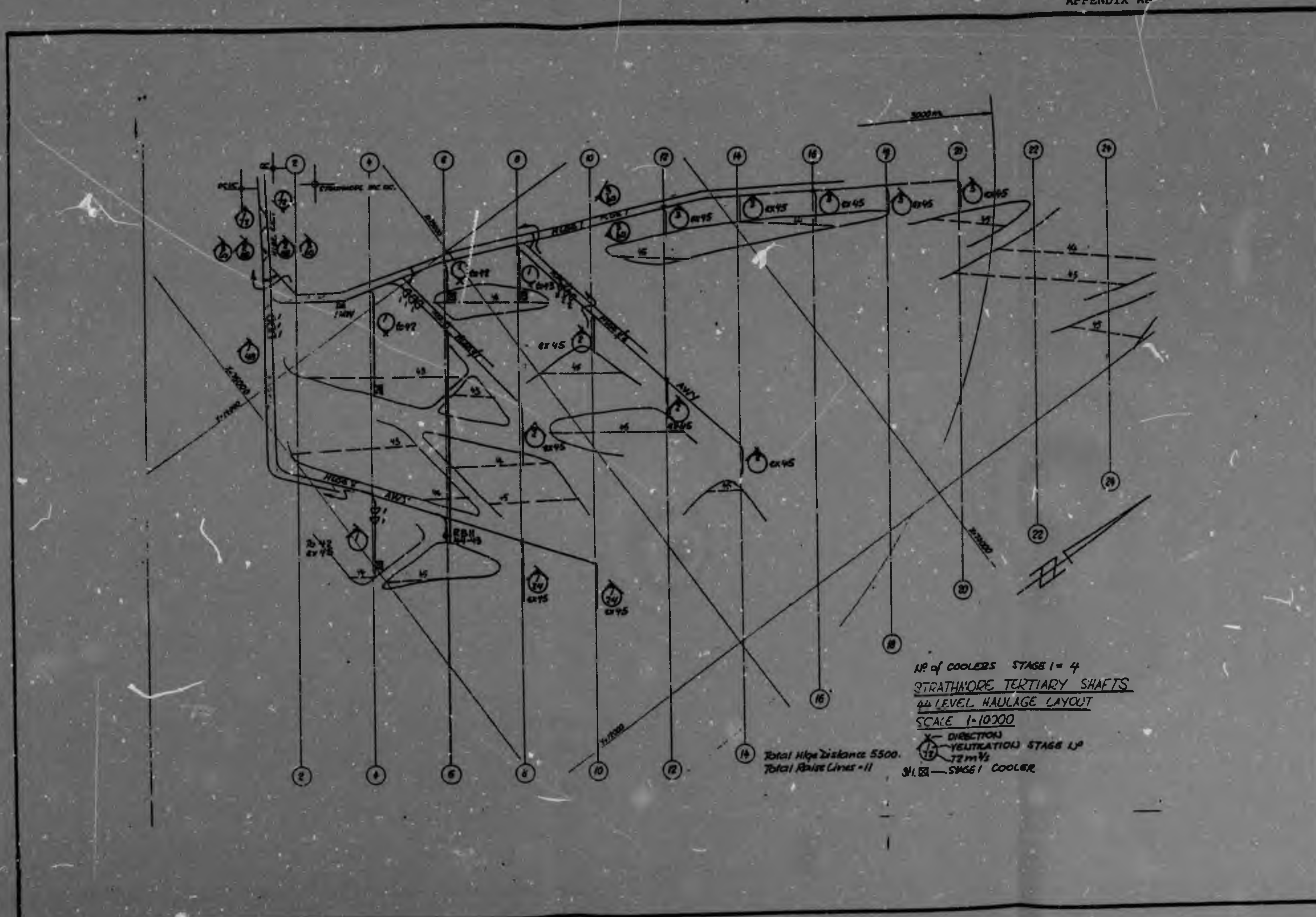
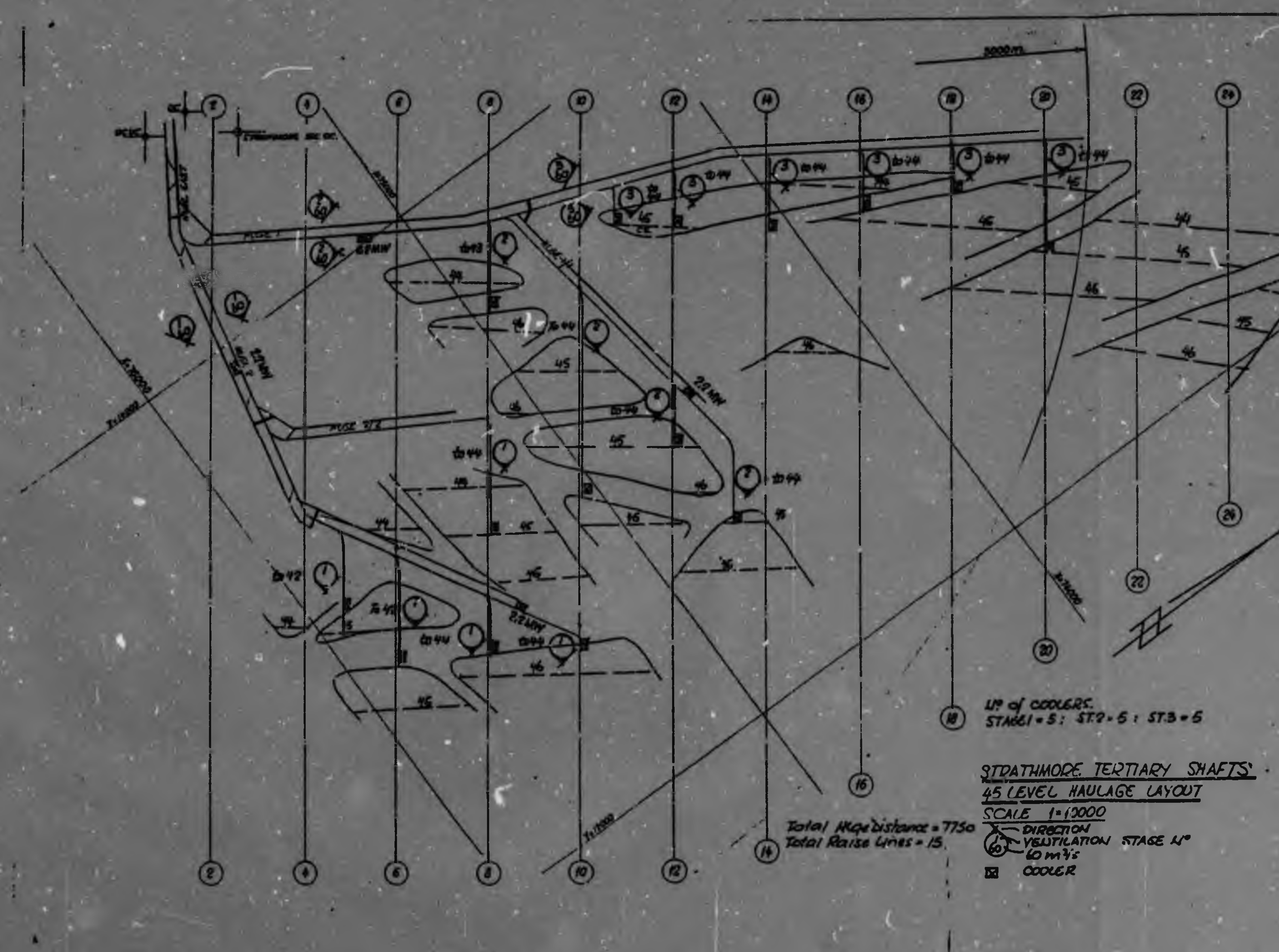


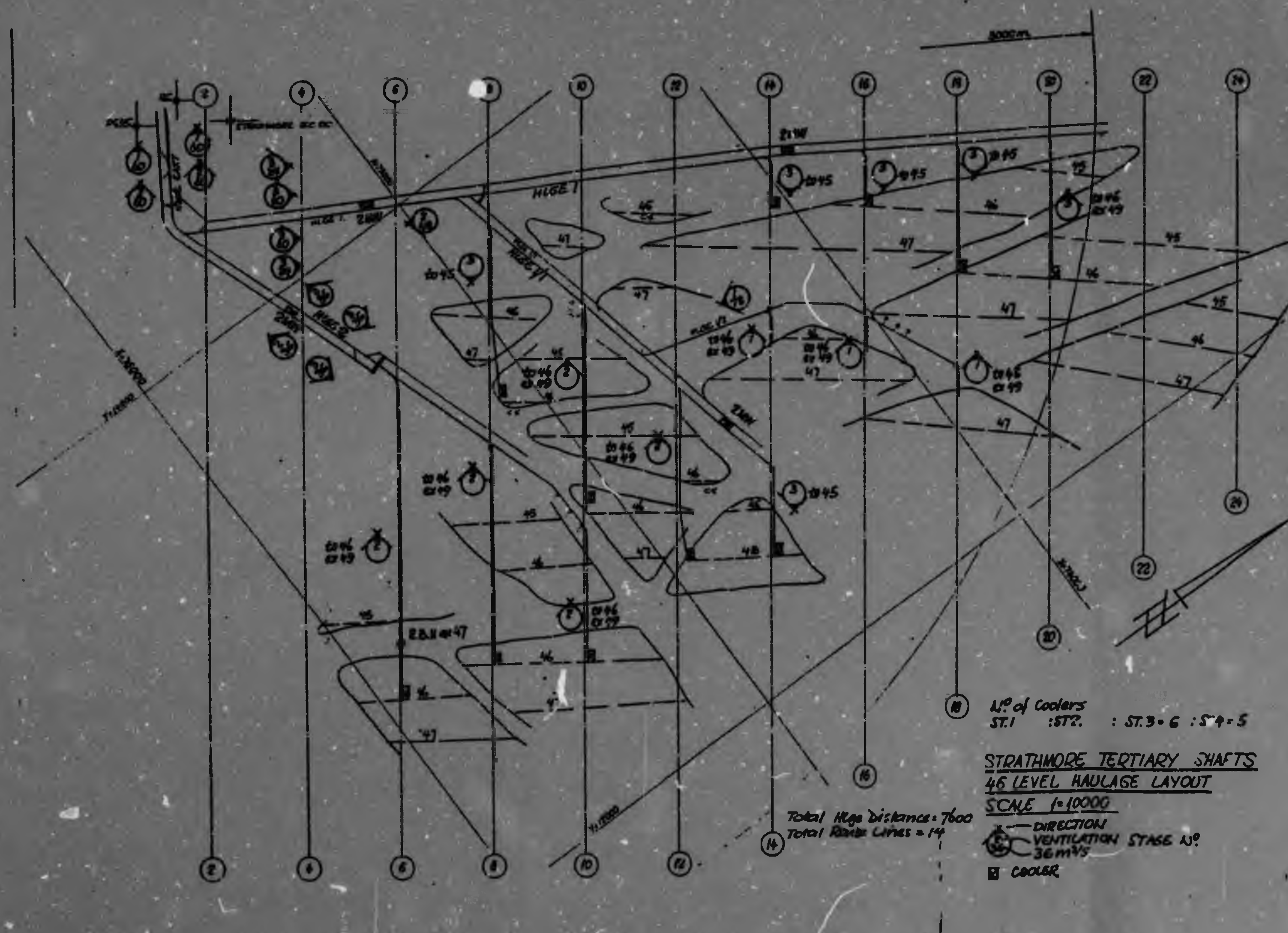
STRATHMORE TERTIARY SHAFTS
42 LEVEL HAULAGE LAYOUT
SCALE 1:10000
DIRECTION
STAGE No VENTILATION
60 m³/s
Total Hlge Distance = 2500m
Total Raise Lines = 5
3000m
42
43


3000m
ex 45L
Nº of COOLERS. STAGE 1 = 3
STRATHMORE TERTIARY SHAFTS
43 LEVEL HAULAGE LAYOUT
SCALE 1:10000
DIRECTION
VENTILATION STAGE Nº
24 m³/s
St.1 STAGE 1 COOLER
Total Hlge Distance = 3100m
Total Rams Lines = 7

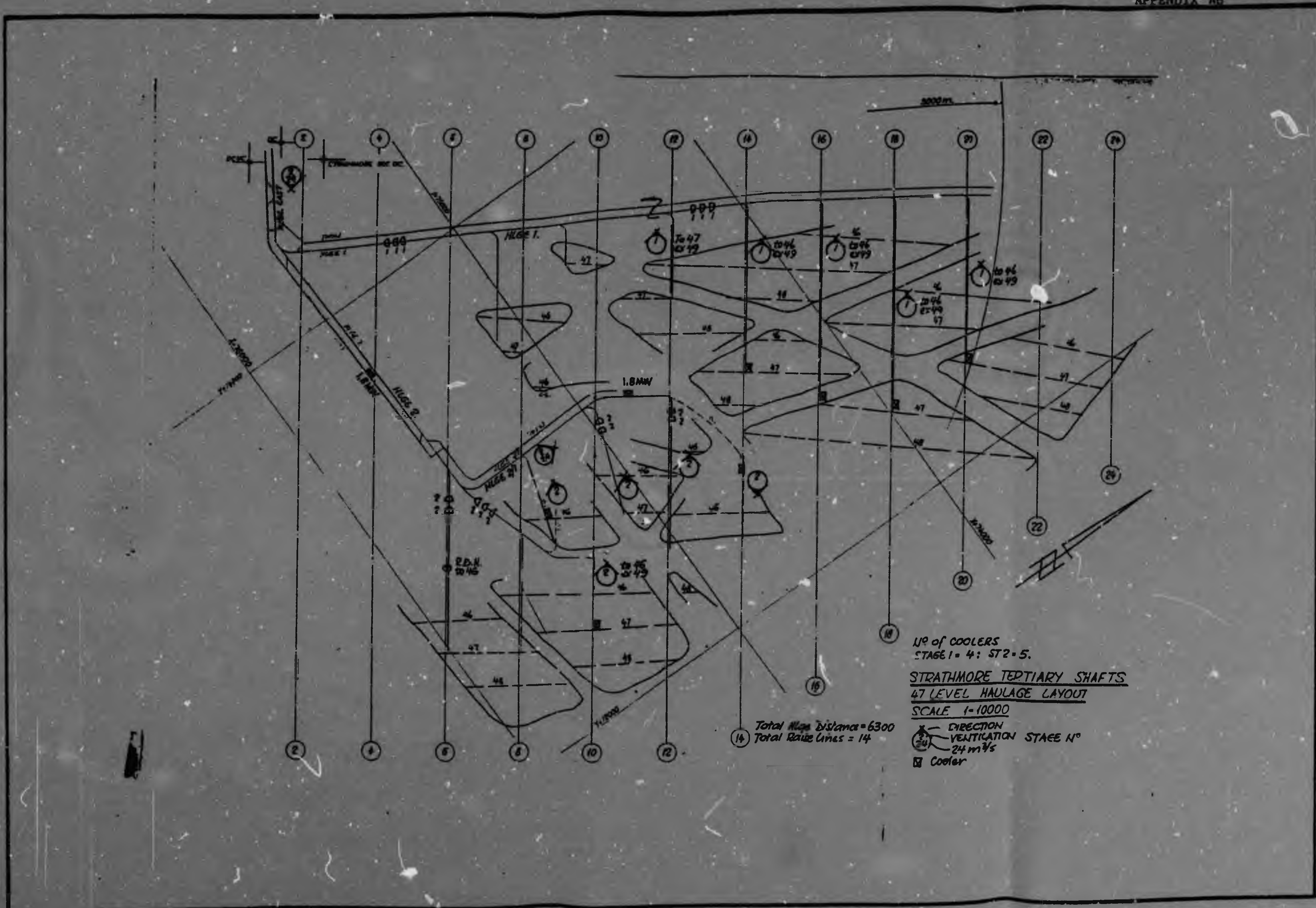

Total Hlge Distance 5500.
Total Raise Lines = 11
No of COOLERS STAGE 1 = 4
STRATHMORE TERTIARY SHAFTS
44 LEVEL HAULAGE LAYOUT
SCALE 1:10000
DIRECTION
VENTILATION STAGE No
72 m³/s
STAGE 1 COOLER

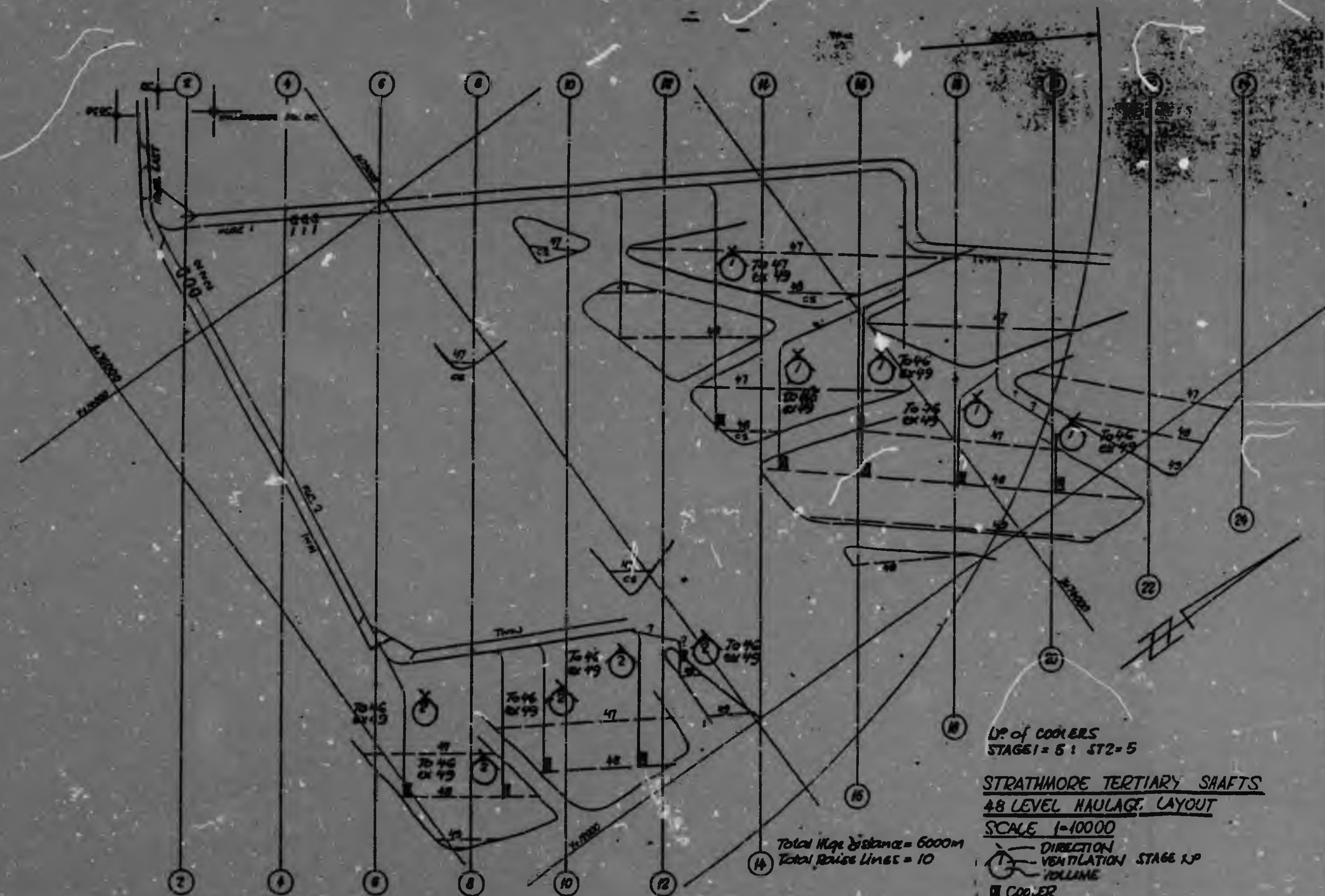


N° of COOLERS.
STAGE1 = 5 : ST.2 = 5 : ST.3 = 5
STRATHMORE TERTIARY SHAFTS'
45 LEVEL HAULAGE LAYOUT
SCALE 1:10000
Total Hge Distance = 7750
Total Raise Lines = 15
DIRECTION
VENTILATION STAGE N°
60 m³/s
COOLER



STRATHMORE TERTIARY SHAFTS
46 LEVEL HAULAGE LAYOUT
SCALE 1:10000
No of Coolers
ST.1 :ST2. : ST.3 = 6 : ST.4 = 5
Total Hlge Distance = 7600
Total Route Lines = 14
DIRECTION
VENTILATION STAGE No
36 m³/s
COOLER
HLGE 1
2000m

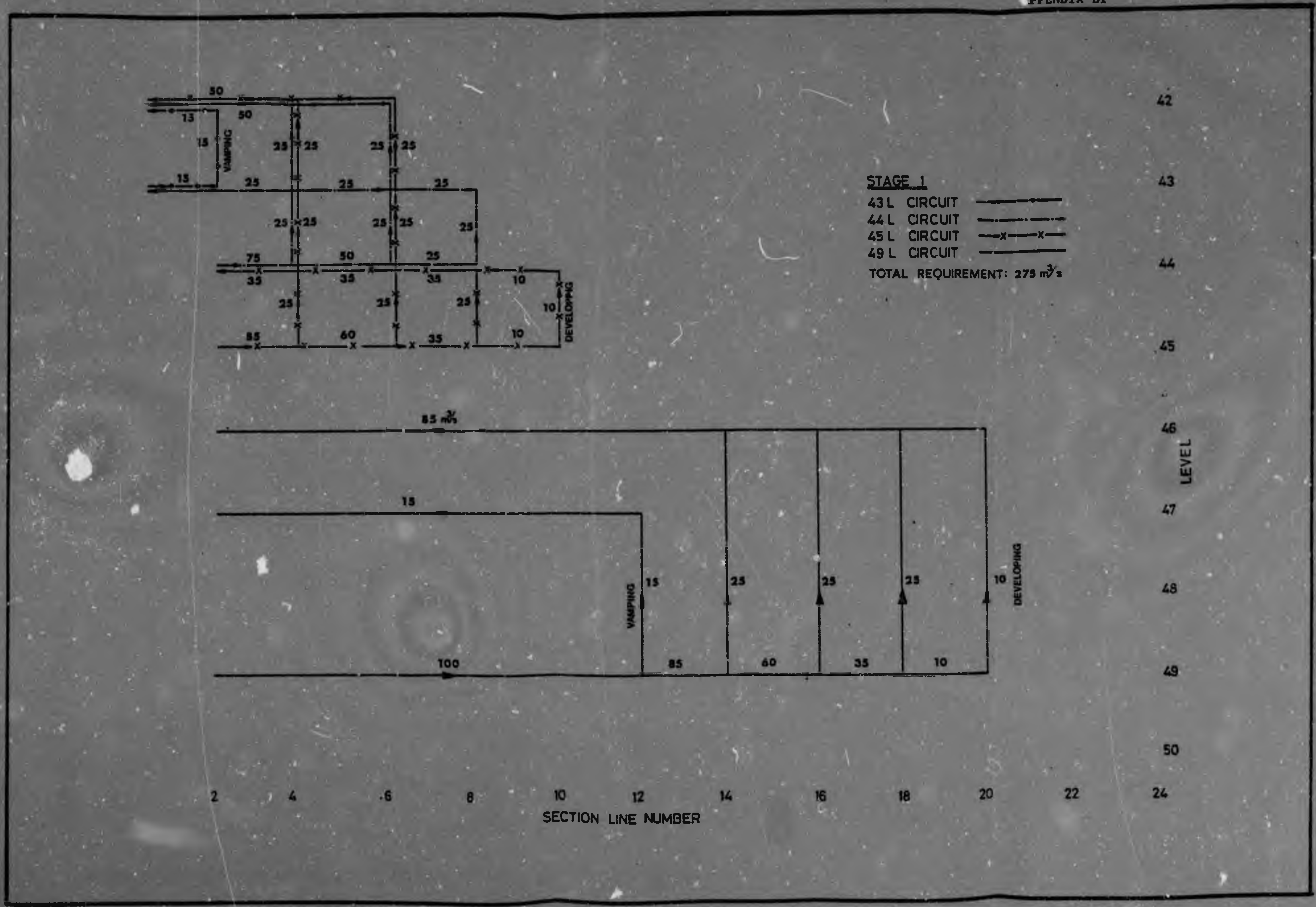

HLGE 1.
HLGE 2.
1.8MW
Nº of COOLERS
STAGE 1 = 4: ST2 = 5.
STRATHMORE TERTIARY SHAFTS
47 LEVEL HAULAGE LAYOUT
SCALE 1-10000
Total Raise Lines = 14
DIRECTION
VENTILATION STAGE Nº
24 m³/s
Cooler

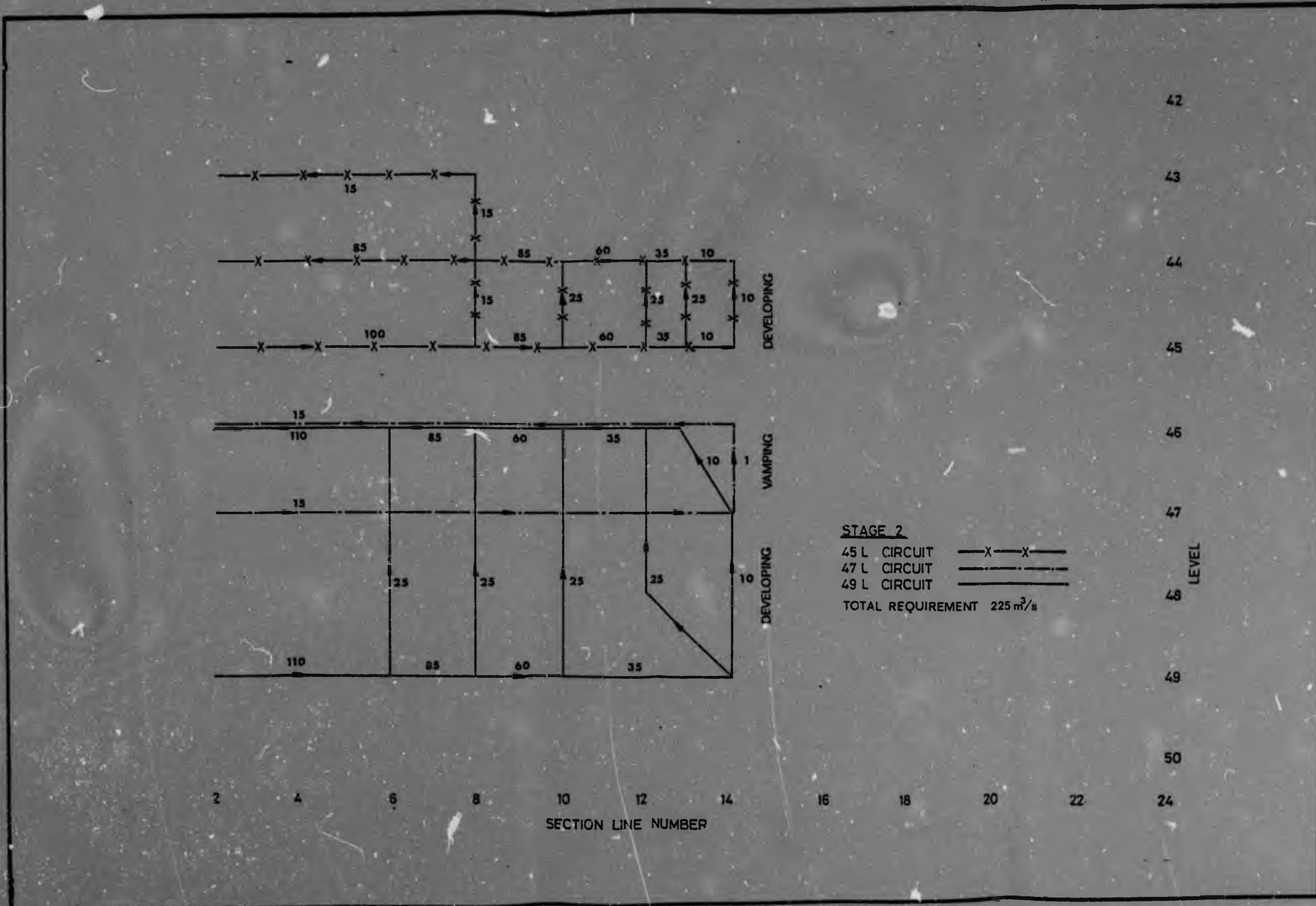


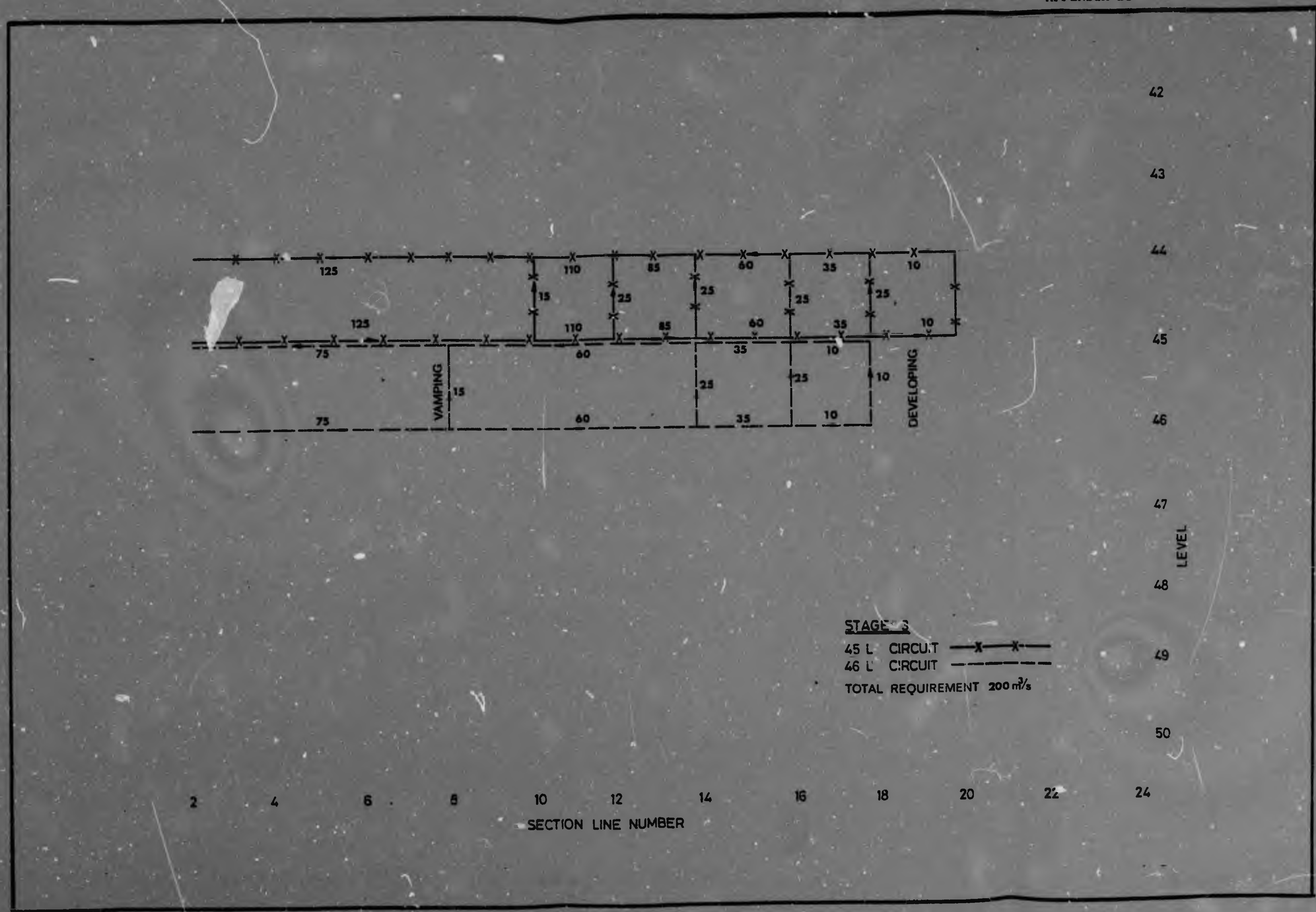
Page 255 omitted in the pagination.

APPENDIX B

CROSS SECTIONAL LINE DIAGRAMS,
PHASE 1 TO 3, SHOWING INTER
LEVEL AIRWAYS AND EXPECTED
AIR QUANTITIES


STAGE 1
43 L CIRCUIT
44 L CIRCUIT
45 L CIRCUIT
49 L CIRCUIT
TOTAL REQUIREMENT: 275 m³/s
VAMPING
DEVELOPING
85 m³/s
15
100
85
60
35
10
25
LEVEL
42
43
44
45
46
47
48
49
50
2
4
6
8
10
12
14
16
18
20
22
24
SECTION LINE NUMBER


42
43
44
45
46
47
48
49
50
LEVEL
15
85
100
85
60
35
10
25
10
DEVELOPING
110
VAMPING
1
STAGE 2
45 L CIRCUIT
47 L CIRCUIT
49 L CIRCUIT
TOTAL REQUIREMENT 225 m³/s
2
4
6
8
10
12
14
16
18
20
22
24
SECTION LINE NUMBER


125
110
85
60
35
10
15
25
75
VAMPING
DEVELOPING
42
43
44
45
46
47
48
49
50
LEVEL
2
4
6
8
10
12
14
16
18
20
22
24
SECTION LINE NUMBER
STAGE 3
45 L CIRCUIT
46 L CIRCUIT
TOTAL REQUIREMENT 200 m³/s

APPENDIX C

CHAMBER OF MINES ANNUAL RETURN 1987

a) AIR CIRCULATION AND TONNAGES MINED

b) GRAPH OF INDUSTRY TRENDS OF AIR
PER KILOTON MINED

APPENDIX C1

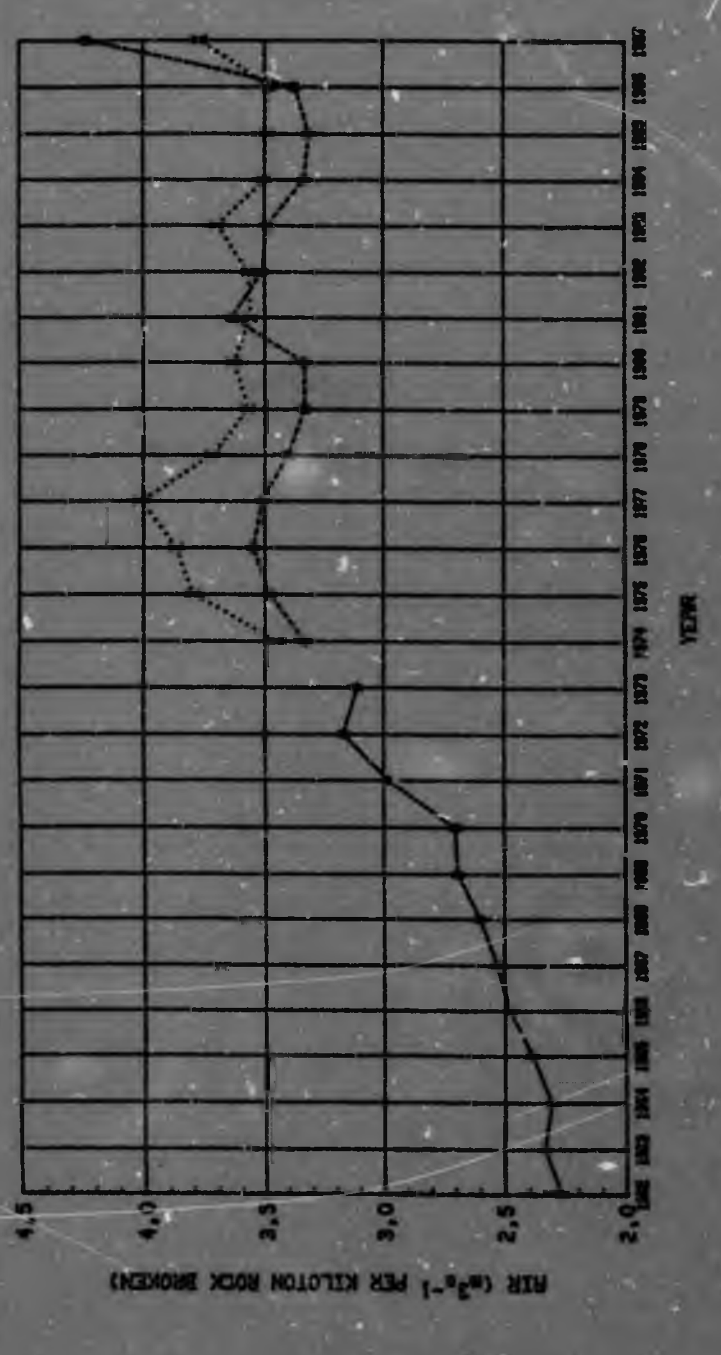
SUMMARY OF RETURNS FOR THE QUARTER ENDED SEPTEMBER 1987 IN DESCENDING ORDER OF VIRGIN ROCK TEMPERATURE (VRT) AT MEAN ROCKBREAKING DEPTH

MINE	DOWNCAST AIR (m³/s)	COMPRESSED AIR (m³/s)	KTONS ROCK BROKEN PER MONTH: STOPES	KTONS ROCK BROKEN PER MONTH: TOTAL	DOWNCAST AIR (m³/s/ktons/month)	COMPRESSED AIR (m³/s/ktons/month)	AVGE. AIR VELOCITY AT STOPE FACE (m/s)	AVGE. WET-BULB TEMP. AT STOPE FACE (°C)
President Steyn	2 083	64	184,11	238,29	8,75	0,26	0,74	27,7
Free State Saaiplaas	1 849	39	165,62	298,71	6,19	0,13	0,88	27,5
W. Deep Levels North	1 509	65	112,61	223,03	6,77	0,29	1,11	28,4
Loraine	1 227	47	151,61	213,19	5,76	0,22	0,66	29,0
Hartebeestfontein	2 115	37	234,48	437,19	4,84	0,13	0,83	28,0
Buffelsfontein	2 116	57	196,49	376,34	6,47	0,17	0,82	28,7
Unisel	411	15	93,60	118,72	3,46	0,13	1,08	27,7
Vaal Reefs South	1 467	80	187,87	273,13	5,35	0,29	1,15	28,2
President Brand	2 238	42	198,61	273,39	8,18	0,15	0,68	28,9
St Helena	1 502	51	127,55	176,01	8,49	0,29	0,78	27,0
Freddies	2 071	49	110,07	178,33	11,60	0,27	0,58	26,7
Kloof	938	62	104,69	313,24	2,99	0,20	0,64	31,1
Vaal Reefs West	1 252	48	165,74	219,27	5,71	0,21	0,77	28,5
Vaal Reefs East	2 206	67	165,11	265,90	8,30	0,26	0,70	28,2
Doornfontein	816	41	129,96	19[illegible],92	4,32	0,21	1,05	29,0
East Driefontein	1 109	68	213,53	326,84	3,39	0,21	0,67	28,8
Kinross	904	27	113,63	150,92	6,34	0,17	1,31	25,5
W. Deep Levels South	792	15	104,00	149,34	5,30	0,10	0,46	27,3
E.R.P.M.	945	63	145,98	251,56	3,76	0,33	1,07	29,8
Deelkraal	470	42	117,28	165,90	2,84	0,28	0,93	29,0
Free State Geduld	1 833	77	163,45	213,96	8,57	0,36	0,54	27,1
Western Holdings	1 939	56	248,07	327,68	5,92	0,17	0,49	28,1
Elandsrand	1 065	42	88,34	117,21	9,08	0,36	0,46	28,9
Venterspost	780	34	132,79	179,63	4,23	0,19	0,94	27,5
Harmony	2 800	141	662,69	840,13	3,37	0,17	1,05	27,4
Winkelhaak	539	31	138,24	153,64	3,46	0,30	0,62	27,6
Beatrix	607	53	151,77	226,43	2,70	0,23	1,90	27,4
Libanon	625	50	145,52	204,45	3,07	0,33	0,55	27,4
Western Areas	1 278	102	108,92	352,09	3,90	0,28	0,83	27,7
West Driefontein	1 006	37	216,78	328,85	3,06	0,17	0,98	27,1
Blyvooruitzicht	334	46	127,84	109,08	2,93	0,22	1,02	29,2
Leslie	296	17	57,33	71,06	4,09	0,24	0,45	28,9
Durban Roodepoort Deep	874	28	190,09	237,93	3,67	0,12	0,77	27,0
Grootvlei	455	9	87,18	94,31	4,83	0,10	0,39	25,1
Randfontein Estates	1 742	81	239,10	392,22	4,44	0,21	0,47	22,0
Bracken	292	15	64,39	63,79	4,58	0,24	0,37	24,9
Vaal Reefs Afrikander	56	6	24,05	29,88	1,88	0,12	0,30	19,8
Marievale	40	6	19,48	22,58	1,77	0,27	0,32	18,2
Barberton	104	7	62,10	98,93	1,09	0,07	0,58	25,3
West Rand Cons	451	12	97,06	121,55	3,71	0,10	0,51	21,9
Stilfontein	723	34	59,78	101,76	7,16	0,23	0,44	29,3

MINE	NUMBER OF STOPE PANELS IN EACH WET-BULB TEMPERATURE RANGE (°C): < 27	27,0 TO 27,9	28,0 TO 28,9	29,0 TO 29,9	30,0 TO 30,9	31,0 TO 31,9	≥ 32	TOTAL NUMBER OF STOPE PANELS	% OF STOPE PANELS WITH ... AND ABOVE: 29 °C	32 °C	AVERAGE ... IN STOPES
President Steyn	12	57	56	44	34	2	0	265	31	0	13,6
Free State Saaiplaas	67	16	13	36	10	1	0	165	33	0	15,9
W. Deep Levels North	41	25	33	36	24	8	0	167	41	0	14,5
Loraine	10	34	50	36	50	22	4	214	[illegible]	2	11,0
Hartebeestfontein	82	39	32	35	40	20	10	258	41	4	14,1
Buffelsfontein	56	28	79	112	73	0	0	298	65	0	12,1
Unisel	35	43	60	17	5	0	0	170	18	0	14,3
Vaal Reefs South	78	40	61	61	60	8	2	308	[illegible]	1	14,4
President Brand	138	49	23	36	27	5	0	269	28	0	14,8
St Helena	151	56	64	63	14	1	0	349	22	0	14,1
Freddies	146	34	37	16	19	4	2	255	15	1	14,2
Kloof	0	13	8	52	63	8	83	207	91	41	6,7
Vaal Reefs West	31	23	33	33	24	11	1	163	44	1	12,3
Vaal Reefs East	30	17	14	24	17	22	0	133	48	0	12,8
Doornfontein	11	29	51	62	34	7	0	195	53	0	12,6
East Driefontein	71	16	52	10[illegible]	61	21	4	325	50	1	12,0
Kinross	217	154	122	[illegible]	42	38	4	641	25	1	14,8
W. Deep Levels South	6	7	3	4	1	0	0	19	16	0	12,9
E.R.P.M.	21	7	13	30	47	36	31	175	77	12	11,0
Deelkraal	4	23	56	40	34	6	0	153	46	0	12,2
Free State Geduld	110	31	44	30	34	12	3	264	30	1	13,5
Western Holdings	82	3	46	45	66	32	5	307	48	2	11,2
Elandsrand	78	7	2	0	0	0	0	79	0	0	16,7
Venterspost	62	32	40	14	6	5	0	139	16	0	15,3
Harmony	304	82	91	107	107	69	13	775	38	2	15,1
Winkelhaak	111	60	72	71	44	10	0	376	35	0	12,3
Beatrix	83	30	23	22	29	8	0	189	27	0	13,0
Libanon	96	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Western Areas	33	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
West Driefontein	102	91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Blyvooruitzicht	30	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leslie	16	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Durban Roodepoort Deep	97	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Grootvlei	90	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Randfontein Estates	72	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bracken	58	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vaal Reefs Afrikander	3	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Marievale	30	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Barberton	10	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
West Rand Cons	112	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Stilfontein	19	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

MINE	DEPTH OF WORKINGS BELOW SURFACE AND VRT: DEEPEST STOPE m	°C	DEEPEST DEVELOPMENT m	°C	DEEPEST WORKINGS m	°C	WEIGHTED MEAN ROCK BREAKING DEPTH (RBD) m	°C
President Steyn	2 457	55,2	3 129	63,3	3 328	66,9	1 797	47,3
Free State Saaiplaas	2 139	[illegible]	2 153	50,8	2 265	52,4	1 864	47,1
W. Deep Levels North	3 325	33,4	3 310	53,2	3 582	56,9	2 291	46,2
Loraine	2 098	51,1	2 169	52,1	2 347	54,5	1 730	45,7
Hartebeestfontein	2 385	47,1	2 434	47,5	2 491	48,0	2 229	45,6
Buffelsfontein	2 687	49,7	3 141	54,6	3 376	54,7	2 290	45,3
Unisel	1 985	47,0	2 093	48,8	2 093	43,8	1 663	45,3
Vaal Reefs South	2 290	45,9	2 236	45,7	2 463	47,4	2 072	43,7
President Brand	2 230	52,5	2 286	53,4	2 365	54,5	1 553	42,4
St Helena	1 812	43,6	1 902	[illegible]	1 919	44,1	1 723	42,3
Freddies	1 798	46,2	1 806	[illegible]	1 843	46,9	1 516	42,1
Kloof	3 025	54,2	3 413	56,3	3 413	56,3	2 341	42,0
Vaal Reefs West	2 112	44,2	2 113	44,2	2 138	43,6	1 977	42,0
Vaal Reefs East	2 162	44,4	2 210	45,1	2 340	46,4	1 805	41,1
Doornfontein	2 637	45,8	2 857	45,6	3 212	51,1	2 138	40,7
East Driefontein	2 397	44,3	2 790	47,6	2 897	48,3	2 007	40,5
Kinross	1 809	42,7	1 818	42,8	1 921	43,9	1 383	40,0
W. Deep Levels South	[illegible]	40,4	2 517	[illegible]	2 376	42,0	2 173	39,8
E.R.P.M.	3 471	32,7	3 385	33,8	3 585	33,8	2 200	39,2
Deelkraal	2 310	40,1	2 611	44,3	2 876	44,8	2 189	39,0
Free State Geduld	1 709	44,9	1 812	46,5	2 061	48,8	1 300	38,9
Western Holdings	1 828	44,7	1 884	47,2	1 898	47,7	1 285	38,8
Elandsrand	2 981	38,6	2 862	47,6	2 928	48,3	1 971	37,8
Venterspost	2 182	43,7	2 277	45,9	2 281	46,0	1 528	37,0
Harmony	1 761	43,1	1 809	43,6	1 834	44,2	1 196	36,0
Winkelhaak	1 671	41,0	1 760	42,2	1 592	43,8	1 258	33,9
Beatrix	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Libanon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Western Areas	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
West Driefontein	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Blyvooruitzicht	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leslie	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Durban Roodepoort Deep	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Grootvlei	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Randfontein Estates	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bracken	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vaal Reefs Afrikander	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Marievale	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Barberton	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
West Rand Cons	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Stilfontein	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

APPENDIX C2



APPENDIX D

PRESSURE SURVEY RESULTS

SURVEY BAROMETER

TIME	POSITION	SURVBAR	FUESS	CONTROL	
07h40	CONT. ROOM	87216		87204	
07h55	CONT. ROOM	87229		87208	
08h06	CONT. ROOM	87228		87218	
08h17	CHANGE HOUSE	87216		87206	
08h23	EAST [illegible] BANK	87211	87309	87212	08h30
08h37	13L MAIN	102302	102760		
08h43	13L TOP SUB	102296	102720	87218	
08h49	23L STATION	110249	110875	87225	09h00
09h12	23L RUC	110012	110442	87226	09h15
09h17	23L TOP STR[illegible] U/C	109824	110442?		
09h22	23L D/C	109799	110376	87216	09h30
09h43	23L EAST SHAFT	108944	109577	87227	09h45
09h58	23L STATION(2)	110109		87211	10h00
10h03	13 TOP SUB VERT(2)	102146	110709?		
10h07	13L E[illegible] MAIN(2)	102170	102587	87206	10h15
10h20	" "	1021[illegible]2	102620	87196	10h30
10h34	" "	102[illegible]4[illegible]	1025[illegible]4		
10h43	" "	102104	102520	87199	10h45
11h02	" "	102110	102520	87187	11h00
				87179	11h15
11h29	CHANGE HOUSE	87192		87165	11h30
11h44	CONT. ROOM	87171		87141	
	E[illegible] U/C FANS				
11h12	OUTSIDE	87189			
11h14	AIRLOCK	82880	83015		
11h16	OUTSIDE	87194	87304		

7/3/89

CONTROL BAROMETER PRESSURE

08h00	87211Pa
08h15	87206Pa
08h30	87212Pa
08h45	87218Pa
09h00	87225Pa
09h15	87226Pa
09h30	87216Pa
09h45	87227Pa
10h00	87211Pa
10h15	87206Pa
10h30	87196Pa
10h45	87199Pa
11h00	87187Pa
11h15	87179Pa
11h30	87165Pa
11h45	87141Pa

1. EASTERN PRIMARY DOWNCAST

P loss = (BP BOTTOM - BP TOP) - wgh
= (102 302 - 87 211) - 1,089 x 9,79 x 1 502
= (15 091) - 16 013
= 922Pa @ f = 1,089kg/m^3

2. EASTERN SECONDARY DOWNCAST

P loss = (BP BOTTOM - BP TOP) - wgh
= (110 249 - 102 296) - 1,202 x 9,79 x 6,79
= (7 953) - 7 [illegible]
= -37Pa

Or

(110 109 - 102 1[illegible]) = 7 963 - 7 990 = -27

w = 1,1626 + 1,24./2 28/3[illegible]°C BP 110
= 1,202kg/m^3 w = 1,2[illegible]

3. 23L RETURN

f_1 40/41°C @ 109 --- [illegible],189

f_2 41/42 @ 108 --- 1,17[illegible]

f = 1,18kg/m^3

P loss = (108 944 - 109 824) @ 1,18kg/m^3
= 880Pa @ 1,18

4. EASTERN UPCAST

f_1 = 1,173kg/m^3

f fan = 0,945kg/m^3

f = 1,059kg/m^3

P loss (BP BOTTOM - BP TOP) + wgh
= (108 944 - 82 889) + 1,059 x 9,79 x 2 186
= (26 055) + 22 663 = 3 391Pa

5. MAIN FAN - EASTERN SHAFT

Fan Δ P = 4 [illegible]00 - 3 391 = 909

APPENDIX E

EASTERN MAIN SHAFT FAN PERFORMANCE TEST
AIRTEC HOWDEN 06 FEBRUARY 1989

APPENDIX E1

P v/d Merwe

Sect Eng East

AIRTEC HOWDEN

A division of

James Howden Holdings Limited
Reg. No. [illegible]

294 Brickfield Road Rietfontein District Germiston
Telephone: 53-8946 Telegraphic Address: Airblower or [illegible]
Telex: 4-21095 SA Telefax No.: (011) 53-7548
P.O. Box 512 Edenvale 1610 Transvaal

A Howden Group Company

Your Ref.

Our Ref.

Date 9/02/89

The General Manager
Buffelsfontein Gold Mine Eastern Shaft
Private Bag
STILFONTEIN

ATT: MR G. NELL (ASSISTANT RESIDENT ENGINEER)

c.c: MR P. V.D. MERWE ✓ SECTIONAL ENGINEER

c.c: MR J.P. CRAFFORD ENVIROMENTAL ENGINEER

Dear Sir,

RE: **EASTERN SHAFT MAIN FANS**

Herewith, report on Performance Tests performed on two of the three main fans on Monday 6th February 1989.

The results of the tests show that the two fans tested are performing satisfactorily.

We are hoping that this meets with your approval and hold ourselves available should you require any further information.

Yours faithfully

G.S. PORTER
AIRTEC HOWDEN

APPENDIX E2

Airtec Howden	REPORT	10/02/89
		ED/89/369

BUFFELSFONTEIN GOLD MINE
EASTERN SHAFT
MAIN FANS PERFORMANCE TEST

METHOD

The velocity in the up cast shaft was measured by means of a pitot tube in the centre of the shaft section at a position +- 5m below the collar. The fan's static pressure was measured at the intake of the fans by means of a side tube "Pipe" and a micromanometer.

RESULTS

	FAN NO. 1	FAN NO. 2
Fan Volume m /s	471	471
Fan Static Pressure Pa.	4392	4490
Fan Absorbed Power KW	3071	3500
Fan Static Efficiency %	68,6	61,6

DISCUSSION

The above results have been plotted on the enclosed fan performance curve.

1/ Both fans are operating very close to the assumed extension of the fan performance curve as far as volume and pressure are concerned.

2/ Both fans are apparently absorbing less power than the curve indicates. This may be due to the uncertainty of the accuracy of the amp - volt and power factor meters, as well as the assumed motor power efficiency chosen.

CONCLUSION

1/ The fans are operating very close to their specified performance.

2/ The mine resistance is very low and for this reason the fans are operating in a comparatively low efficiency area of their performance.

Airtec Howden	REPORT	10/02/89
		RD/89/369

READINGS

1/ In up-cast shaft :- Temperature : 25,0 C
Vel. Press : 480 Pa
Static Press: 3720 Pa
Ambient Barometer: 87.22 kPa

2/ At fan intake :- Fan Static Press.: 4700 Pa (No.1)
4800 Pa (No.3)

CALCULATIONS

1/ In Duct Density = (BP - S.P) /0.2881 (273 + t)
= (87.22 - 3.72) /0.2881 (273 + 25)
= 0,97258 kg/m

2/ Up-cast Shaft Air Velocity = $\sqrt{2\ VP/Density}$ = $\sqrt{2x480 \div 0.97258}$
= 31.418 m/s

3/ Up-cast Volume = V x Area
= 31.418x35.315 (D=6.7056m)
= 1109.527x0.85 (centre spot factor)
= 943 m /s

4/ Fan Static Pressure

A side guage pipe was inserted into the drift at the inlet to the fan. This pressure is numerically equal to fan total pressure. In order to find fan static pressure, one V.P. must be subtracted from this value.

(S.P. = T.P. - V.P.)

Total volume for 2 fans	=	943 m /s
Volume at each fan	=	943/2 = 471.5 m /s
Area at fan inlet	=	4.5x4.9 = 22.05 m
Vel. at fan inlet	=	471.5/22.05
	=	21.38 m/s
Vel. Pressure at inlet	=	(21.38 /2)x0.97258
	=	222.3 Pa
S.P. at fan inlet	=	4700 - 222
	=	4478 Pa
Correct for Chart Density	=	4478x0.[illegible] / 0.97258
	=	4392 Pa

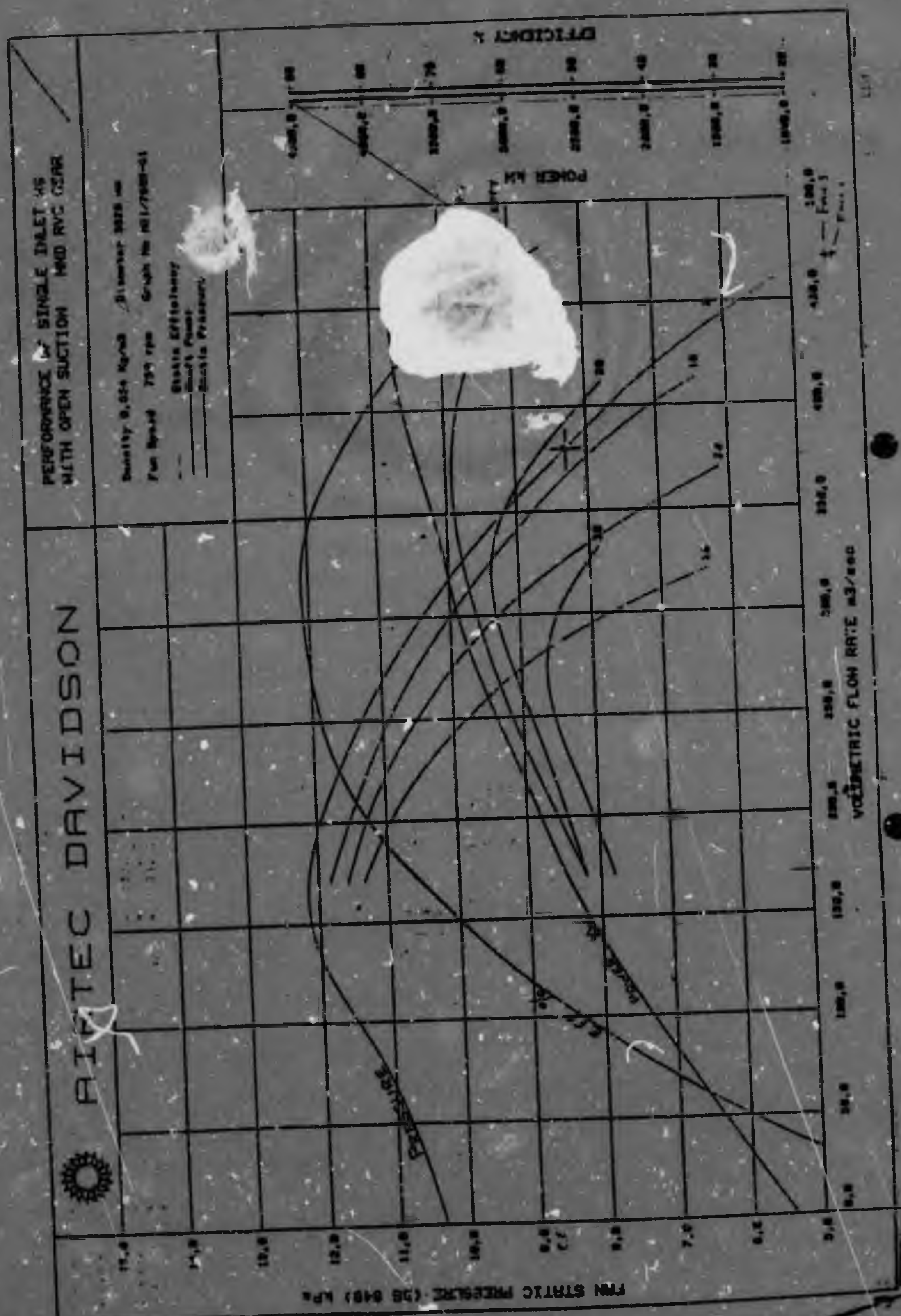
Final Duty Measured Fan No.1 = 471 m /s @ 4,392 kPa
Similarily Fan No. 3 = 471 m /s @ 4,490 kPa

Airtec Howden	REPORT	10/02/89
		ED/89/369

3/ Fan Absorbed Power

READINGS:-	FAN NO. 1	FAN NO. 3
Volts :	6750	7650
Amps :	360	339
Power Factor:	0.76	0.92
(Assumed) Motor efficiency:	0.96	0.96
Fan Absorbed Power kW :	3071	3500
Correct for Chart Density :	3012	3433

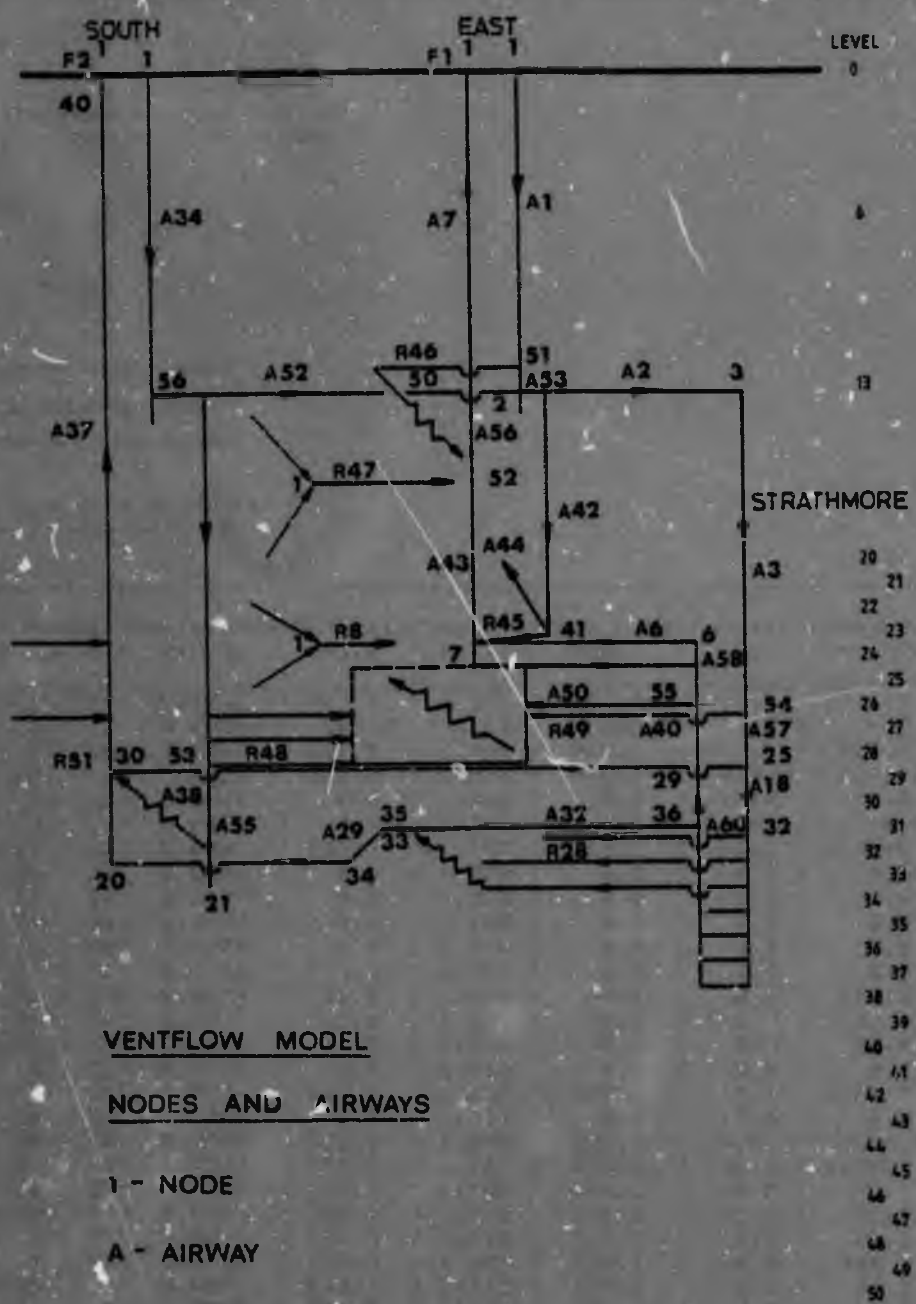
NOTE: THE FAN SPEEDS WERE ASSUMED TO BE 750 RPM. A CHECK WAS MADE TOWARDS THE END OF 1988 AND FOUND TO BE 749 RPM.


AIRTEC DAVIDSON
PERFORMANCE OF SINGLE INLET HS
WITH OPEN SUCTION AND RVC GEAR
Static Efficiency
Shaft Power
Static Pressure
PRESSURE
POWER
FAN STATIC PRESSURE (BS 848) kPa
VOLUMETRIC FLOW RATE m3/sec
POWER kW
EFFICIENCY %

APPENDIX F

VENTFLOW MODEL "CURRENT" COMPUTER PRINTOUT

APPENDIX F1



VENTFLOW MODEL

NODES AND AIRWAYS

1 - NODE

A - AIRWAY

R - REGULATOR

F - FAN

APPENDIX F2

```
*****************************************************************************
*                                                                           *
*                          VENTFLOW RESULTS FILE                            *
*                                                                           *
*****************************************************************************

file name              :  CURRENT
comment                :  PUFF[illegible]
date                   :  14-03-89
surface altitude       :  1262.7
electricity cost       :  5.00 c/kWh


# branches               78
# nodes                  [illegible]
# fans                   [illegible]
# fixed                  1[illegible]
```

NETWORK BRANCH DATA

Natural Quantity Branches

Branch number	Nodes From	To	Resistance R=P/m2	Quantity m3/s	Density kg/m3	Mass Flow kg/s	Pstatic kPa	Pressure drop Pa
1	1	51	0.0032	[illegible]	[illegible].071	645.1	15.0	1341.4
2	3	2	0.0021	-183.3	1.127	-206.6	0.0	-88.6
3	3	54	0.0016	353.5	1.16[illegible]	413.1	9.7	277.1
7	58	8	0.0023	880.0	1.012	890.4	-14.8	1847.5
13	9	10	0.0073	0.0	1.500	0.0	0.0	0.0
15	9	32	0.0074	-0.3	1.395	-0.5	-19.3	-0.0
18	25	32	0.0003	283.3	1.292	366.1	2.7	[illegible]
19	37	36	0.0007	0.0	1.279	0.0	-4.9	0.0
21	25	27	0.2538	0.0	1.275	0.0	0.0	0.0
24	26	29	0.2742	0.0	1.180	0.0	0.8	0.0
26	28	30	0.2096	0.0	1.219	0.0	0.0	0.0
27	27	31	0.2716	0.0	1.254	0.0	0.0	0.0
29	33	34	0.0676	31.8	1.259	40.0	0.9	108.2
31	34	35	0.0677	31.8	1.258	40.0	-0.9	108.3
32	35	36	0.0177	32.0	1.249	40.0	0.0	28.4
33	5	37	0.0025	0.0	1.312	0.0	0.0	0.0
34	1	56	0.0034	542.1	1.062	575.6	15.6	1126.7
35	20	31	0.0008	0.0	1.259	0.0	-3.6	0.0
37	30	40	0.0098	562.4	1.044	587.3	-24.7	3384.4
38	21	30	0.0067	399.3	1.238	494.3	-4.4	1638.7
39	36	29	0.0002	308.2	1.188	366.1	-2.5	32.5
40	29	55	0.0002	325.4	1.125	366.1	-1.6	27.1
42	2	41	0.0018	15[illegible].0	1.172	185.3	7.9	62.1
43	7	52	0.0006	463.5	1.109	514.1	-4.2	145.5
50	55	7	0.0021	143.3	1.112	159.3	-1.8	53.5
53	51	2	0.0002	496.9	1.137	565.1	0.7	71.0
54	56	53	0.0020	460.6	1.177	542.3	11.5	598.9
55	53	21	0.0008	395.9	1.249	494.3	3.5	185.6
56	52	50	0.0004	645.9	1.115	720.1	-3.3	220.8
57	54	25	0.0002	292.4	1.252	366.1	1.8	27.9
58	55	6	0.0002	186.2	1.110	206.6	-1.8	10.2
60	32	36	0.0190	256.8	1.270	326.1	0.0	2019.2
2	2	3	0.0021	183.3	1.127	206.6	0.0	88.6
6	7	6	0.0043	-93.6	1.104	-103.4	0.0	-46.1
6	6	7	0.004[illegible]	93.6	1.104	103.4	0.0	46.1
12	32	9	0.0151	-0.3	1.395	-0.5	1[illegible].3	-0.0

60	32 36	0.0190	256.8	1.270	326.1	0.0	2019.2
2	2 3	0.0021	183.3	1.127	206.6	0.0	88.6
6	7 6	0.0043	-93.6	1.104	-103.4	0.0	-46.1
6	6 7	0.0043	93.6	1.104	103.4	0.0	46.1
12	32 9	0.0151	-0.3	1.395	-0.5	19.3	-0.0
44	41 50	0.0705	146.0	1.166	170.3	-7.8	2042.6
52	56 2	0.0981	29.5	1.128	33.3	0.0	108.8

($P)

Fixed Quantity Branches

Branch number	Nodes From-To	Resistance R=P/m2	Quantity m3/s	Density kg/m3	Mass Flow kg/s	static kPa	Pressure drop Pa
8	1 7	0.1992	56.1	1.[illegible]	38.0	22.5	2101.0
10	1 3	0.0471	0.0	1.061	0.0	15.6	1308.1
14	10 4	0.0057	0.0	1.404	0.0	-14.0	2381.4
17	1 4	0.[illegible]196	0.0	1.149	0.0	35.0	38[illegible]1.9
17	32 1	0.0198	0.0	1.141	0.0	-30.3	-[illegible]135.0
22	27 28	0.06[illegible]	0.0	1.245	0.0	-0.9	192[illegible].0
23	27 26	0.0137	0.0	1.248	0.0	-0.9	183[illegible]
28	32 33	0.1737	31.4	1.275	40.0	0.0	1497.[illegible]
30	34 20	0.3091	0.0	1.267	0.0	0.0	-1859.[illegible]
36	31 30	0.0003	0.0	1.228	0.0	-0.9	1931.5
45	41 7	0.0080	12.9	1.160	15.0	0.0	2039.5
46	31 52	0.0496	[illegible]0.9	1.129	80.0	4.0	1631.0
47	1 32	0.1591	11[illegible].4	1.055	126.0	18.6	281.2
48	5[illegible] 7	0.0134	41.1	1.167	48.0	-3.5	1647.7
49	54 7	0.0135	40.5	1.160	47.0	-1.9	1699.2
51	1 38	0.2053	84.4	1.101	93.0	25.1	1678.0

($F)

NETWORK FAN DATA

Fans

Fan number	Nodes From-To	Pressure Pa	Quantity m3/s	Density kg/m3	air Power kW	cost R/hr	comment
3	4 5	0.0	0.0	1.312	0.0	0.00	reverse-
1	8 1	-440[illegible].1	931.5	0.956	4103.4	205.17	good----
2	40 1	-5474.6	620.4	0.947	3396.5	169.83	good----

($P)

APPENDIX F4

NETWORK NODE DATA

Node number	Depth m	Pressure kPa	Wet Bulb °c	Dry Bulb °c	Density kg/m3	Humidity g/kg
1	0.0	87.0	18.0	24.0	1.0000	12.5
2	1500.0	101.4	26.0	30.[illegible]	1.1295	19.6
3	1500.0	101.3	27.0	33.[illegible]	1.1259	21.1
4	3108.0	118.1	29.0	30.0	1.3123	21.4
5	3108.0	118.1	29.0	30.0	1.3123	21.4
6	2186.0	107.2	41.0	41.0	1.1025	48.6
7	2186.0	107.1	40.5	40.5	1.1060	47.3
8	10.0	82.7	28.0	28.0	0.9130	29.8
9	4124.0	134.5	29.0	30.0	1.5004	18.7
10	4124.0	134.5	29.0	30.0	1.5004	18.[illegible]
20	2784.0	116.0	31.0	33.0	1.2712	24.1
21	2784.0	115.7	31.0	33.0	1.2672	24.2
25	2496.0	112.5	22.0	24.0	1.2897	14.1
26	2424.0	109.8	26.0	29.0	1.2296	18.3
27	2496.0	112.5	26.0	29.0	1.2609	17.8
28	2424.0	109.7	26.0	29.0	1.2286	18.3
29	2496.0	110.6	42.0	42.0	1.1322	49.8
30	2424.0	109.7	29.0	32.0	1.2092	22.2
31	2496.0	112.5	28.0	31.0	1.2478	20.3
32	2713.0	115.2	25.0	29.0	1.2952	15.8
33	2713.0	113.4	29.0	31.0	1.2550	21.9
34	2784.0	114.2	29.0	31.0	1.2638	21.7
35	2713.0	113.[illegible]	29.0	31.0	1.2525	21.9
36	2713.0	113.7	30.0	32.0	1.2454	23.3
37	3108.0	118.1	29.0	30.0	1.3123	21.4
40	10.0	81.6	29.0	29.0	0.8950	32.1
41	2186.0	109.2	27.0	30.0	1.2163	19.7
50	1500.0	99.3	26.0	26.0	1.1174	21.8
51	1434.0	100.7	22.0	26.0	1.1452	15.0
52	1800.0	102.8	33.0	33.0	1.1126	32.0
53	2496.0	112.3	29.0	35.0	1.2301	20.3
54	2352.0	110.7	29.0	34.0	1.2150	21.1
55	2352.0	109.0	41.5	41.5	1.1185	49.2
56	1500.0	101.5	[illegible]	30.5	1.1261	21.1

****

APPENDIX G

37 LEVEL BOOSTER FAN TECHNICAL SPECIFICATIONS

APPENDIX G1

FAN DESIGN SHEET 1

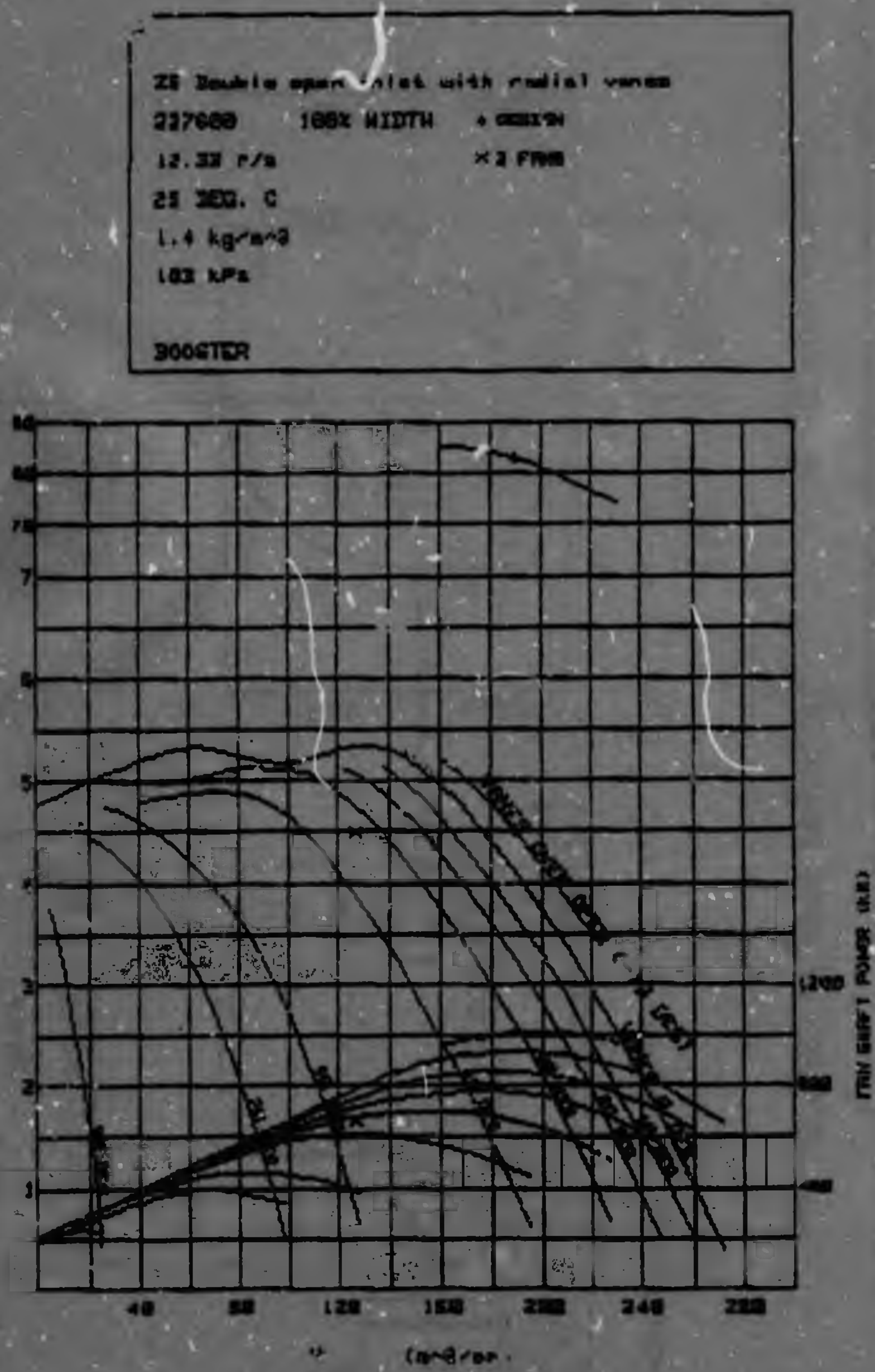
BOOSTER

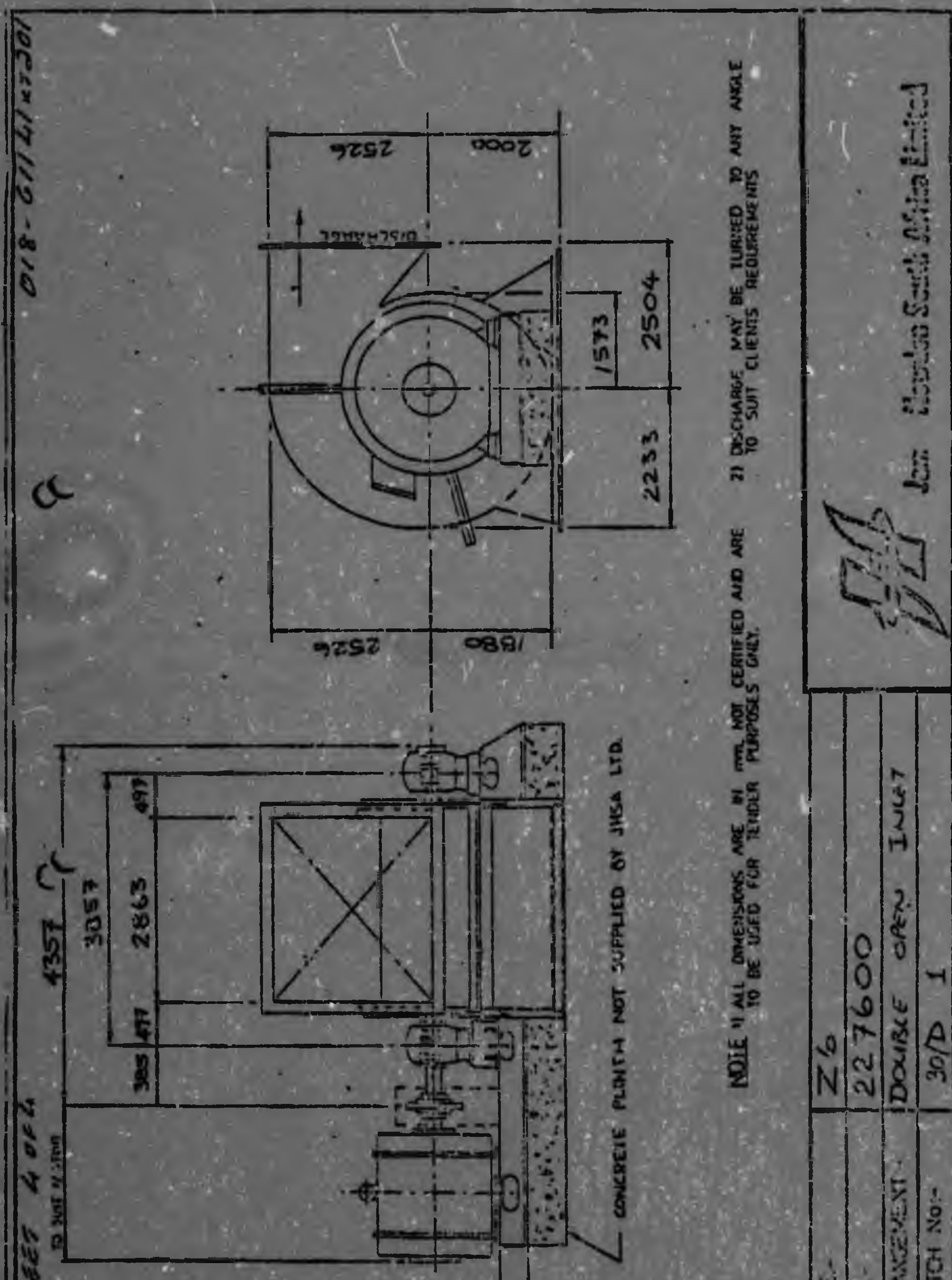
DATE 88/11/01 DUNKE KNB

Fan type........................:	Z6
Size............................:	227600
O/D.............................:	Standard
Effective diameter (mm)....:	2276
Standard diameter (mm).....:	2276*
Width...........................:	100 %
Arrangement...................:	Double open inlet with radial vanes

PERFORMANCE DATA

	TWO FANS DESIGN	3 FANS
[illegible]et volume (m^3/s)	190,00	127,00
[illegible]h. pressure (kPa)	[illegible],500	4,500
Inlet pressure (kPa)	0,0[illegible]	0,00
Temperature (DegC)	25,0	[illegible],0
Inlet density (Kg/m^3)	1,400	1,[illegible]
Speed (R/S)	12,33	12,33
Vane position (Deg)	-10	35
Absorbed power (Kw)	1012,5	659,7
Static efficiency (%)	82,9	85,3
Barometer (kPa)	103,0	103,0
Chart Volume (1m)	41,60	27,01
Chart pressure (1m)	4,07	4,07
Kp factor	0,98472	0,98472
Density relative to air	1,162	1,162
Standard chart no.	215109	
Evase area (m^2)	11,190	
Fan tip speed (m/s)	88,2	
Efficiency factor	1,000	


25 Double open inlet with radial vanes
100% WIDTH
12.33 r/s
25 DEG. C
1.4 kg/m^3
BOOSTER
40
80
120
160
200
240
280
1200
800
400
FAN SHAFT POWER (kW)


SHEET 4 OF 4
018-G1141 rev 301
4357
3057
385
497
2863
497
2526
1880
2526
2000
DISCHARGE
1573
2233
2504
CONCRETE PLINTH NOT SUPPLIED BY JHSA LTD.
NOTE 1) ALL DIMENSIONS ARE IN mm, NOT CERTIFIED AND ARE TO BE USED FOR TENDER PURPOSES ONLY.
2) DISCHARGE MAY BE TURNED TO ANY ANGLE TO SUIT CLIENTS REQUIREMENTS
TYPE.- Z6
SIZE.- 227600
ARRANGEMENT.- DOUBLE OPEN INLET
SKETCH No:- 30/D 1

APPENDIX H

DESIGN CONDITIONS AND ASSUMPTIONS

H DESIGN CONDITIONS AND ASSUMPTIONS

H.1 Fixed Parameters

H.1.1 Mining

H.1.2 Existing and planned infrastructure

H.1.2.1 Existing airways

H.1.2.2 Additional airways

H.1.2.3 Eastern shaft main surface

H.1.3 Station elevations

H.2 Environmental

H.2.1 General

H.2.1.1 Surface ambient air conditions

H.2.1.2 Air pollutants

H.2.1.3 Miscellaneous

H.2.2 Design parameters and assumptions

H.2.2.1 Heat load

H.2.2.2 Air temperatures

H.2.2.3 Airflow distribution

H.2.2.4 Air velocities

H.2.3 Station air density and pressure

H.2.4 Values of K (Atkinson friction factors) for airways

H.2.5 Miscellaneous

H DESIGN CONDITIONS AND ASSUMPTIONS

H.1 Fixed Parameters

H.1.1 Mining

- GEOLOGY

  - Reef Gradient: 20 - 36°
    27° Average

  - Reef Structure: Heavily faulted
    and scattered

  - Mining Horizon: 42 Level 3 529 mbs
    49 Level 4 054 mbs

  - Virgin Rock Temperature:

42 Level	61,1°C
49 Level	65,8°C
Mean	67,1°C
Max	68,6°C

- MINING AREA

Maximum distance from shaft 3 000 m

- PRODUCTION

Peak total production	180 000 tpm
Development to stoping ratio	40 %
Peak stoping tons	130 000 tpm
Peak development tons	50 000 tpm

WEIGHTED MEAN ROCKBREAKING DEPTH

LEVEL	DEPTH	m^2 (Ca)	Ca x DEPTH
42	3529	3 000	10,64
43	3604	71 800	260,06
44	3679	174 000	642,76
45	3754	310 000	1 167,50
46	3829	57 800	2 218,40
47	3904	636 000	2 486,80
48	3979	662 000	2 636,10
49	4054	315 000	1 277,00
		2 705 000	$10\ 700 \times 10^6$
		TOTAL Ca	TOTAL Ca x DEPTH

TABLE H.1
WEIGHTED MEAN ROCKBREAKING DEPTH

Weighted Mean Depth $= \dfrac{10\ 700}{2{,}785} \times \dfrac{10^6}{10^6}$

$= 3\ 842$ m

- STOPING

- Maximum Panel Face Advance	20 m/mth
- Average Width	1,2 m
- Maximum Width	1,4 m
- Area Mined	40 000 m²/month
- Total Face Length	3 780 m
- Panel Length	20 m
- Distance Between Slusher Gulleys	60 m
- Stope Line Length (with losses)	100 m
- Number of Stope Lines	27
- Number of Active Panels	135
- Vertical Level Interval	75 m
- Stope Length (without losses)	165 m

- DEVELOPMENT

- Crosscut Spacing	300 m
- Design Intake Cross Section	11,1 m^2
- Design RAW Cross Section	11,1 m^2
- Design Crosscut Cross Section	11,1 m^2
- Design Boxholes	3,4 m^2
- Design Raises	2,9 m^2
- Design Strike Slushers	6,4 m^2
- Design Dip Slushers	6,4 m^2
- Mean Face Advance Per End	3 mpd
- Maximum Face Advance Per End	5 mpd
- Total Face Advance	1 700 mpd

- BACKFILL

- Drainage Water From Backfill	40 % by Volume
- Stoped Out Area To Be Backfilled	60 %
- Maximum Distance From Face	5,0 m
- Mean Distance From Face	3,5 m
- Minimum Distance From Face	2,0 m

H.1.2 Existing and planned infrastructure

H.1.2.1 Existing airways

DOWNCAST SHAFTS

Shaft	Diameter	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m^2	Ns^2/m^4
Eastern P	8,5	8,5	1620,6	57,2	0,0065
Eastern Sec.	8,5	8,5	865,0[illegible]	57,2	0,0065
Strathmore	9,0	9,0	1751,[illegible]	63,6	0,0065

UPCAST SHAFTS

Shaft	Diameter	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m^2	Ns^2/m^4
Eastern	6,7	[illegible]	2184,9	35,4	0,0030
Strathmore	6,7	[illegible]	978,9	35,3	0,0030

MAIN INTAKE AIRWAYS

Airways	Dimension No x m x m	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m^2	Ns^2/m^4
13 Level	4 x 5,2 x 5,2	5,2	1900	27,0	0,0167
35 Level	1 x 4,4 x 4,4	4,4	300	19,1	0,0167
36 Level	1 x 4,2 x 4,2	4,2	300	17,8	0,0167

MAIN INTAKE AND RETURN AIRWAYS

Airways	Dimension No x m [illegible]	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m^2	Ns^2/m^4
42 Level	2 x 3,2 x 3,2	3,2	3000	10,2	[illegible],0167
43 Level	2 x 3,2 x 3,2	3.2	3000	10,2	0,0167
44 Level	2 x 3,2 x 3,2	3,2	3000	10,2	0,0167
45 Level	2 x 3,2 x 3,2	3,2	3000	10,2	0,0157
46 Level	2 x 3,2 x 3,2	3,2	3000	10,2	0,0167

Airways	Dimension No x m x m	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m²	Ns²/m⁴
47 Level	2 x 3,2 x 3,2	3,2	3000	10,2	0,0167
48 Level	2 x 3,2 x 3,2	3,2	3000	10,2	0,0167
49 Level	2 x 3,2 x 3,2	3,2	3000	10,2	0,0167

MAIN RETURN AIRWAYS

Airways	Dimension No x m x m	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m²	Ns²/m⁴
23 Level	2 x 4,2 x 4,2	4,2	2300	18,1	0,0117
26 Level	2 x 4,2 x 4,2	4,2	2300	17,9	0,0117
37 Level	1 x 6,3 x 5,3	[illegible],3	300	[illegible],7	0,0117

- <u>Service water consumption</u>

  1,0 ton/ton rock broken

- <u>Compressed air consumption</u>

  0,44 m^3/s/kt/m

H 1.2.2 Additional airways

Airways	Dimension No x m x m	Hydraulic Diameter	Length	Area	Atkinson Friction Factor
	m	m	m	m²	Ns^2/m^4
23 Level	2 x 4,2 x 4,2	4,2	2300	18,1	0,0167
Tertiary DC	6,8	6,8	1162	36,3	0,0065
Tertiary DC Split	7,8	5,9	1162	27,3	0,0065
Tertiary UE Split	7,8	5,1	1162	20,1	0,0040

H.1.2.3 Eastern shaft main surface fans

Make and Type – Airtec Davidson W6

Number – 3 Off; 2 Running 1 Standby

Single Fan Design Duty – Static Pressure 8300 Pascals
– Mass Flowrate 353 kg/s
– Power Rating 4250 kW

Stall (Surge) Point – Static Pressure 12300 Pascals
– Mass Flowrate 162 kg/s

H.1.3 Station elevations

LEVEL NUMBER	DEPTH BELOW SURFACE-METRES (COLLAR EASTERN SHAFT)
12	1434
13	1502
14	1574
15	1632
16	1705
17	1774
18	1842
19	1911
20	1979
21	2048
22	2116
23	2185
24	2239
25	2293
26	2353
27	2424
28	2496
29	2569
30	2641
31	2713
32	2785
33	2857
34	2929
35	3001
36	3073
37	3155
42	3529
43	3604
44	3679
45	3754
46	3829
47	3904
48	3979
49	4054
50	4124
TERTIARY SHAFT BOTTOM	4162

TABLE H.2
STATION ELEVATIONS BELOW SURFACE

H.2 Environmental

H.2.1 General

H.2.1.1 Surface ambient air conditions

Summer design wet-bulb temperature	18 °C
Summer design dry-bulb temperature	24 °C
Summer design barometric pressure	87,5 kPa

H.2.1.2 Air pollutants

CONTAMINANT	Maximum permissible concentration in the general atmosphere to comply with Mines and Works Act and Regulations
Total Dust	2,0 mg/m^3
Methane	1% By Volume
Carbon Dioxide	5000 ppm
Carbon Monoxide	100 ppm (2000 ppm Diesel Exhaust)
Nitrous Fumes	5 ppm (1000 ppm Diesel Exhaust)
Hydrogen Sulphide	20 ppm
Chlorine	1 ppm
Ammonia	25 ppm

TABLE H.3
MAXIMUM PERMISSIBLE CONCENTRATIONS OF AIRBORNE POLLUTANTS

H.2.1.3 Miscellaneous

Locomotives	260 kW/Level
Water and Flammable Gas	Not Forseen Cover drilling will be done

H.2.2 Design parameters and assumptions

H.2.2.1 Heat load

Tertiary heat Load	78 MW(R)

H.2.2.2 Air temperatures

Although it is the objective to design and operate the ventilation and cooling system to maintain a minimum Specific Cooling Power of 300 W/m² the following shall be adhered to:

All recruits shall be subjected to a medical examination and Heat Tolerance Test (HTT) as well as microclimate or climatic room acclimatization in accordance with the practices on Gold Mines in the RSA.

Intake airways	:	Minimum	14°C W.B.
	:	Maximum	30°C W.B.
Stopes	:	Design Reject	27°C W.B.
	:	Maximum	30°C W.B.
Return Airways	:	No Limits. No work, however to be undertaken at temperatures higher than 32°C maintaining 300 S.C.P.	

H.2.2.3 Airflow distribution

Total air mass flow for Tertiary shaft	600 kg/s
Overall air factor	3,33 kg/s per kiloton per month

Tertiary air distribution per level will be determined by:

- Geological continuity of orebody inter-level
- Relative geological placement of reef
- Mining access for production and grade control

Air Usage:

Air commitments to Shaft Stations	10 %
Air commitments on Levels and Crosscuts	20 %
Air leakages through sealed Crosscuts	10 %
Air to Stopes	60 %

Air for Stoping:

Each raise line face quantity	15 m^3/s
Crosscut air quantity	25 m^3/s

Air for development:

Statutory minimum	0,15 $m^3/s/m^2$
Design single shift minimum	0,25 $m^3/s/m^2$
Design multiblast minimum	0,50 $m^3/s/m^2$
Design Shaft Sinking	0,25 $m^3/s/m^2$

H.2.2.4 Air velocities

Downcast Shaft (Men and Material)

Minimum	0,5 m/s
Maximum	12 m/s
Design	7 m/s

Lower thermal limits associated with velocity must be observed. A lower wind chill eqivalent of 0°C is recommended (Weather Bureau). This equates to a maximum S.C.P. of 800 W/m².

Intake airways

Minimum	0,5 m/s
Maximum	7 m/s
Design	3 m/s

Stopes

Strike Gully

Minimum	0,5 m/s
Maximum	3,0 m/s

Centre Gully

Minimum	0,25 m/s
Maximum	0,5 m/s

Stope Face

Minimum	0,5 m/s
Maximum	3,0 m/s

Return Airways	
Minimum	0,5 m/s
Maximum	10 m/s
Design	6 m/s
Upcast Shaft	
Minimum	15 m/s
Maximum	NONE
Design	20 m/s

H.2.3 Station air density and pressure

LEVEL	EVEVATION BELOW SURFACE (m)	AIR DENSITY (kg/m^3)	PRESSURE (kPa)
SURFACE	0	1,02	87,5
35	3001	1,33	122,0
36	3073	1,35	123,1
37	3155	1,37	124,4
42	3529	1,40	129,3
43	3604	1,41	130,4
44	3679	1,41	131,3
45	3754	1,42	132,3
46	3829	1,42	133,2
47	3904	1,43	134,3
48	3979	1,44	135,4
49	4054	1,45	136,5
50	4124	1,46	137,6
SHAFT BOTTOM	4162	1,46	138,0

TABLE 16.4
STATION AIR DENSITY AND PRESSURE

H.2.4 Values of K (Atkinson friction factors) for airways

AIRWAY	K - FACTOR $Ns^2/m4$
Concrete lined Shafts with Streamlined Buntons	0,0045 - 0,025
Concrete Lined Shafts with RSJ Buntons	0,0075 - 0,0060
Concrete Lined Unobstructed	0,0030 - 0,0040
Rock Tunnel - No Support	0,0100
Rock Tunnel - Timbered	0,0160 - 0,0200
Rock Tunnel - Concrete Lined	0,0040
Raise bored holes	0,0025
Galvanized Steel Vent Duct	0,0037

TABLE 16.5
AIRWAY FRICTION FACTORS

H.2.5 Miscellaneous

- Thermal properties of reef

Density	2 690 kg/m^3
Thermal Capacity	837 J/kg°C
Thermal Conductivity	5,74 W/m°C

REFERENCES

Appelman, G, and Gardiner, L.R., Annual Ventilation Report for controlled Gold Mines for the period October 1986 to September 1987, C.O.M Industrial Hygiene Laboratory Report No. 27/88, August 1988.

Bluhm, S.J., Vost, K, and Stewart J.M., Effect of backfill on heat pick up in a stope, C.O.M. Research Report No. 3/84, August 1983.

Bluhm, S.J., The measurement of heat loads in a deep level stope in the Klerksdorp Goldfield, Journal of M.V.S., October 1986.

Bluhm, S.J., Evaluation of the heat loads for the Buffelsfontein Gold Mine Tertiary Shaft Project, C.O.M. Environmental Engineering Laboratory, December 1988.

Bottomly, P., and Van Rensburg, B., The insulation of Rock Surfaces - an Emperical Study, Journal of the M.V.S., April 1987

Bromilow, J.G., The estimation and the reduction of the aerodynamicresistance of Mine Shafts, Journal of M.V.S, Nov. 1961

Brackmann, N, The comissioning of South ventilation No. 2 and central ventilation fans at Selebi-Phikwe mine, Journal of the M.V.S, July 1988.

Chamber of Mines, The continuous scraper - design recommendations, C.O.M. Applications Report No. 18, 1988.

Chamber of Mines, Heatflow Users Guide, Users Guide No. 2, Version 1, August 1986.

Chamber of Mines, Compilation of geothermal data from the Witwatersrand Basin, Users Guide No. 13, October 1988.

Chamber of Mines, Re-assessment of the heat loads for the Buffelsfontein Gold Mine Tertiary Shaft Project - C.O.M. Environmental Engineering Laboratory, March 1989.

Chamber of Mines, Evaluation of the heat loads for the Buffelsfontein Gold Mine Tertiary Shaft Project, 13 December 1988.

Chamber of Mines, The prediction of refrigeration requirements in S.A. Gold Mines, i.e. 271, October 1984.

Rabia, H., Mine Environmental Engineering, ENTRAC Software, Newcastle Upon Tyne, 1988 page 139.

Steward , J.M., Heat Transfer and Limiting Physiological Criteria as a basis for setting heat stress limits for men working in hot humid mining environments. A Thesis submitted to the Faculty of Engineering, University of the Witwatersrand, Johannesburg, for the Degree of Doctor in Philosophy, Johannesburg 1981.

Stroh, R.M., Grave, D.F.H., Lloyd, F., McAdam E.S., A modern approach to Environmental Planning on Deep Gold Mines - 1977.

Van der Merwe, M.L., Power Recovery from Chilled Water at the Buffelsfontein Gold Mine Southern Shaft, Journal of M.V.S., March 1986.

Van der Walt, Dr. J., Predicting the nominal heat load in a mine, Journal of M.V.S., May 1986.

Van der Walt, J., and Whillier, A., Considerations in the design of integrated systems for distributing refrigeratio in Deep Mines, Journal of the M.V.S., December 1978.

Chamber of Mines, Ventflow, Application Report No. 10, August 1986.

Chasteau, V.A.L., and Gillard, D., The prediction of the resistance to Airflow of Mine Shafts Equipped with internal structures, Journal of the M.V.S., October and Novermber 1965.

Dumka, M., Specific cooling power - a representative heat stress index for Genmin Mines, Journal of M.V.S., May 1989.

Dumka, M., Roffe, A.E., development of an electronic barometer, 1987.

Environmental Engineering in S.A. Gold Mines, Mine Ventilation Society, 1982.

Gay, N.C., Jager, A.J., and Piper, P.S., Quantitive evaluation of fill performance in South African Gold Mines - C.O.M., Rock Mechanics Laboratory.

Grave, D.E.H., Stroh, R.M., The planning of Ventilation and Refrigeration Requirements in Deep Mines, Journal of the South African Institute of Mining and Metallurgy, January 1972.

Howes, M.J., Ventilation and refrigeration planning at Unisel Gold Mine - internal report, Environmental Engineering in S.A. Gold Mines, page 871.

Hemp, R., Air temperature increase in airways - further work, Journal of M.V.S., January 1987.

Kielblock, A.J., A critical review of parameters of heat tolerance with specific reference to indicies of heat stress May 1987, page 258 - 259.

Lynch, J.J., Refrigeration Requirements and distribution for the Strathmore Shaft, Journal of M.V.S., April 1986.

Matthews, M.K., McCreadie, H.N., and March, T.C.W., The measurement of heat flow in a backfilled stope, Journal of the M.V.S. of South Africa, November 1987.

Matthews, M.K., The implications of backfilling on Environmental Control, Backfill in South African Mines. Johannesburg, SAIMM 1988 pp. 561 - 582.

Matthews, M.K., The use of backfill for improved Environmental Control in South African Gold Mines, 4th International Symposium on Mining with Backfill, Montreal Canada, October 1989.

Matthews, M.K., Case studies on the effects of extensive backfilling on Environmental Control in Gold Mines. C.O.M. Research Report No. 25/88, September 1988.

McPherson, M.J., an analysis of the Resistance and Airflow Characteristics of Mine Shafts, fourth International Mine Ventilation Congress, Brisbane, Queensland, July 1988.

Mines and Works Act No. 27 of 1956, 6th edition 1988 - Lex Patria Publishers.

Mine Ventilation Society of South Africa, Computer Sub Committee - 1989.

Mine Ventilation Society of South Africa, Environmental Engineering in South African Gold Mines, 1982.

Murray-Smith, A.I., Equations for calculating cooling power using a pocket calculator - personal communications.

Partyka, J., A program for calculating the performance of a multi stage Horizontal Spray Chamber, Journal of M.V.S., August 1987.

Ramsden, R., Bluhm, S.J. and Sheer, T.J., Control of the underground thermal environment in South African Gold Mines, S.A. Refrigeration and Airconditioning, July 1988.

Ramsden, R., and de Carvalho, J., Water systems for distributing cooling in deep South African Mines, Fourth International mine Ventilation Congress, Brisbane, Queensland, July 1988.

Ramsden, R., and Bluhm, S.J., Statement on the use of ice for the Buffelsfontein Tertiary Shaft Cooling System, C.O.M. Environmental Engineering Laboratory, March 1989.

Von Glehn, F.H., Wernick, B.J., Chorosz, G., and Bluhm, S.J., ENVIRON - A computer program for the simulation of cooling and ventilation systems on South African Gold Mines, SAIMM 1987 pp. 319 - 330.

Weather Bureau Department of Environment Affairs, - Sensible temperature, Department of Transport, Pretoria.

Whillier, A and Steward, J.M., A guide to the measurement and assessment of heat stress in Gold Mines. Journal of the Mine Ventilation Society of South Africa, September 1979, page 173.

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