THE MILLBROOK FIRE, MARCH 8 1990

A Summary Compiled from:

1. Woods & Forests Department; Mount Crawford District Forester's and Supervisors' records and observations, information from Principal Forest Management Officer.

2. CFS Headquarters records (Major Incident 060/12/89).

3. Information from the Bureau of Meteorology, Adelaide.

4. Oblique colour prints supplied by S.A. Police C.I.B., Holden Hill.

5. Video tape material supplied by Channel 9, Adelaide.

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SENIOR FORESTER, SOUTH EAST
WOODS AND FORESTS DEPARTMENT
June, 1990

Forecast Weather Conditions - Adelaide Hills

Detailed forecast data provided by the Bureau of Meteorology for issue to forest units both at 1500 hrs. the previous day and at 0730 hrs. on March 8, 1990 were:

Maximum Temp.	29°C
Dew Point	4
Minimum RH%	20
Wind	NE-N 10 km/h tending NW 20 during afternoon
Forest Fire Danger	V.H.26
Grassland Fire Danger	H.15

Actual Weather Conditions at Mount Crawford Forest Headquarters

The nearest meteorological recording station to the fire area is at Mount Crawford Forest H.Q., approximately 14 km to the NNE.

Readings and derived data at 1200, 1500 and 1630 hours were:

	1200 hours	1500 hours	1630 hours
Dry Bulb °C	28.0	31.6	32.0
Dew Point °C	-0.3	-2.8	-6.5
Relative Humidity %	16	12	8
Wind - Direction	NW	NW	W
- Strength, km/h	30	30	30
Forest Fire Danger Index (McArthur Mk. 5 Meter)	VH36	E47*	E55
Grassland Fire Danger Index (McArthur Mk. 4 Meter)	VH32	VH40	VH46

*Note: Woods & Forests Dept. uses FFDI 45 as the V.H.-E. boundary.

Comment on 1630 hrs. data is appropriate in respect to RH% and dew point (DP). Readings originally recorded showed a D.B. of 33.0°C with DP -9.5 and RH 6%. Theoretically, 1630 hrs. recordings at Mount Crawford should bear some resemblance to data from readings taken an hour earlier at Edinburgh Airport, viz. 34° D.B. -4° and 9% RH. This and other comparisons raised doubts concerning the validity of the Mount Crawford 1630 figures in the mind of Andrew Watson, Met. Bureau. Subsequently, the Mount Crawford District Forester checked the maximum temperature recorded at 0900 hrs. March 9, 1990 for the previous 24 hours and found it to be 32.0°C. With the 1630 hrs. D.B. amended to 32.0°C, DP becomes -6.5 and RH 8%; figures that do not appear to be unreasonable.

The lowest DP recorded at nearby recording stations was -8°C at both Edinburgh and Parafield Airports at 1030 hrs.

Synoptic Chart

A copy of portion of the Regional Analysis at 1500 hrs. as supplied by the Bureau of Meteorology, Adelaide Regional Office is included as Appendix 1.

Atmospheric Stability

Although radiosonde data is only gathered at 0900 and 2100 hrs. daily at Adelaide Airport, it is reasonable to interpolate 0900 and 2100 hrs. recordings for times in between, using the measured ground level screen dry bulb temperature as a starting point.

The estimated situation at 1500 hrs. was that from the surface up to 1000m the atmosphere was neutral to slightly unstable to the dry adiabatic lapse rate (D.A.L.R.). From 1000 to 2000m the air was stable to the D.A.L.R. (and neutral to the saturated adiabatic lapse rate - S.A.L.R.).

Between 2000m and 3000m the situation was neutral to stable in respect to D.A.L.R. and unstable to neutral regarding the S.A.L.R. Since no cumulus-type clouds were observed in the smoke column only comparison with the D.A.L.R. is relevant.

This means that significant convective activity with (likely short to medium-distance) conveyance of fire-brands and spot-fire development could be expected within the lower 1000m or so of the atmosphere.

See Appendix 2 for a copy of the estimated trace to 3000m.

Upper Winds

The nearest meteorological station at which upper winds are measured is situated at Adelaide Airport.

At 1500 hrs. the wind direction at ground level and up to 600m was NW with a strength of approximately 20 km/h up to 800m.

Above 600m wind direction became WNW and from 1000m to 2500 was W. Wind strength above 800m was 34 to 38 km/h and between 2500m and 3000m averaged 56 km/h.

It should be noted that, due to friction with the earth's surface, wind direction with increasing height above ground level shows an anti-clockwise trend.

See Appendix 3 for a copy of the Adelaide Airport trace at 1500 hrs.

Detection

At 1416 hrs. Mt. Crawford Forest H.Q. received a radio call from truck driver M. Traeger at Kersbrook township and at 1417 hrs. a report of smoke on a bearing of 227° from the fire tower lookout, Mount Crawford F.R.

Simultaneously a passing motorist was telephoning CFS H.Q. from Houghton, at least 5 km from Millbrook Road, the scene of the fire. This report was logged at 1417.

It is therefore likely that the fire started on the eastern side of Millbrook Road not later than approximately 1410 hrs. Grid Ref. 996454 (Onkaparinga 1:50000). No cross-bearing was possible as the Mount Lofty fire tower was not staffed (due to the forecast maximum Grassland Fire Danger index not exceeding the minimum criterion of 20).

Fire Origin

Although no cause for the fire was evident it is apparent that the origin was at or near the eastern edge of Millbrook Road, the probable location being about 60-80m north of the SW corner of Sec. 1036 Hd. of Para Wirra.

Arson is suspected.

Fire Development and Suppression Action

The first Woods and Forests Department fire unit rolled from Kersbrook H.Q. at approx. 1420 hrs., arriving at Millbrook Road at approx. 1425 hrs. By this stage the fire was about 10 ha in size and spreading rapidly through privately-owned hilly woodland and, on the southern side, E. & W.S. reserve. The latter land, initially open woodland, becomes stunted native forest after about 500m from the fire origin.

Although hilly, terrain along the northern flank permitted suppression and CFS crews with one W&F crew gave this section high initial priority. Attack within the E. & W.S. native forest, unburnt since 1983, would have been hazardous and, due to spot-fires, very unlikely to succeed in the prevailing conditions (Forest Fire Danger Rating close to Extreme).

It was considered that the north-eastern arm of the Millbrook Reservoir would act as a firebreak and, with crews assembled to extinguish any spot-fires occurring to the east of this arm, enable the fire to be contained.

Thus numerous fire units and crews were assembled on the generally grassy area between the reservoir arm and the South Para Road as well as on the eastern side of this road. At 1502 hrs. the first spot-fire occurred between the reservoir and road. This spot-fire and several others were extinguished. However, the frequency of spot-fires increased and at 1517 hrs. a spot-fire east of the South Para Road was recorded. By 1520 hrs. the situation - including a spot-fire near the eastern side of 1949 Plantation, Cpt. 2 - was beyond control.

Crown fires developed extensively in 1969, 1973 and 1974 Plantations east of South Para Road. A combination of meteorological conditions, numerous spot-fires and 15-20 month old first thinning slash led to the spectacular Crown fires shown in the Channel 9 video. (This video can be viewed by arrangement with District Forester, Mount Crawford or author of this report).

For the next 1.1/2 hours or so, fire severity, topograhpy and the number of spot-fires occurring ahead of the main fire front in plantation, native forest and grassland precluded attack on the headfire: attention being focused on control of the flanks.

Generally, Woods and Forests forces worked on the northern flank and CFS crews on the southern flank.

Spot-fires occurring outside the flanks - probably arising from firebrands carried some distance - were a frequent problem. One notable instance occurred outside and ahead of the northern portion of the headfire when grass near the Woods & Forests Kersbrook H.Q. shearing shed commenced burning at 1550 hrs. Two minutes later the shearing shed was alight: it was totally destroyed. However, the nearby house was saved.

1984 and 1985 plantations, although grazed, carried sufficient continuous fuel to burn readily. However, well-grazed 1987 plantation, did not carry fire. A few spot-fires were observed in the 1987's but neither surface nor elevated fuels provided the continuity to allow these spots to develop. Spot-fires in a grazed 1986 plantation were readily controlled (late in the day i.e. 1703+ hours).

Control of flanks and spot-fires outside the flanks remained the basic tactic until weather conditions moderated between 1700 and 1800 hrs. By this stage the fire had burnt to the eastern extremity of the Gumeracha pine plantations with three spot-fires in grassland to the east being readily extinguished.

Native forest on E. & W.S. Reserve north of the Millbrook Reservoir and part-compartment 13, 1984 Plantation (approx. 0.5 km. east of the junction of South Para Road and the Chain of Ponds to Gumeracha Road) were permitted to burn out to secure lines. The final fire perimeter was reached at approximately 2000 hrs.

A map showing estimated isopleths, based on the limited information available, is attached as Appendix 4.

Unexpected Fire Behaviour

Persons in charge of fire crews patrolling the grassland to the east of the NE arm of the Millbrook Reservoir did not anticipate the extreme intensity of spot-fire occurrence.

Forecast fire weather conditions had, in fact, been exceeded by 1200 hrs. (actual FFDI 36 at Mt. Crawford Forest H.Q. cf. forecast FFDI maximum of 26). By 1500 hrs. the FFD1 had reached 47 at Mount Crawford Forest H.Q. This information was not known on the fireground: had it been there may have been less confidence in the chosen tactic.

Coupled with the low humidity - and hence, very low fuel moisture contents resulting in high ignitability and flammability of fine, dead fuels - the very steep forested slopes in the E. & W.S. Reserve to the west of the Millbrook Reservoir arm fostered severe crown fire development. Slopes of 25^{o} to 34^{o} have been measured in this area. (S. Wiseman, pers. comm.).

(Note: The rate of spread and intensity of a fire are related to slope - doubling for 10^{o} upslope and quadrupling for 20^{o} upslope.)

In addition, the stunted nature of this forest would promote rates of spread and spotting well in advance of rates which may typify tall eucalypt forest (ref. McArthur Forest Fire Danger Meter Mk. 5, 1973).

The need for the fireline boss and sector bosses at a fire to have knowledge of topography and fuels as well as updates on meteorological conditions and fire danger is underscored.

Spot-fires were also recorded outside the actual or projected fire flanks. The spot at 1550 hrs. near the shearing shed and one at 1535 hrs. in 1985 cpt. 17 are notable examples on the northern and southern flanks respectively.

An anti-clockwise wind shift with altitude (see Upper Winds) could account for the 1550 hrs. spot but not for the one recorded at 1535 hrs.

A likely explanation for both instances is the tendency for vortices to develop at the outside edges of convection columns above intense head (i.e. crown) fires or in association with intense flank fires. Rotation in vortices is apparently induced by the ambient wind resulting in clockwise rotation (as seen from above) on the left-hand side (as viewed from the fire origin) and anticlockwise on the right-hand side. Such vortices over headfires may typically occur in contra-rotating pairs diverging from one another with altitude.

[This phenomenon has been investigated by A.J. Simard, D.A. Haines and others at the North Central Forest Experiment Station, USDA Forest Service, Lansing, Michigan. A videotape "Vortices in Wildland Fire", USDA Forest Services, shows evidence of vortex development. It is also evident in some of G.T. Laidlaw's film of the Caroline Fire, Feb. 2, 1979.]

Vortex development is evident in the Channel 9 video of the southern flank of the Millbrook fire.

[It is postulated that the presence of vortices in convection columns over forest fires in Australia is more common than previously thought, and may account for some observed unusual fire behaviour. Some crown "streets" in otherwise crowned-out areas are probably due to "horizontal roll vortices" where flank vortices are forced over parallel to the ground surface due to ambient winds having dominance over convective forces.

For detailed description of horizontal roll vortices see "The Mack Lake Fire" USDA Forest Service General Technical Report NC-83 available from the W&F Library].

Costs plus Loss

Departmental direct costs and losses resulting from the fire provided by the Principal Forest Management Officer as at May 1, 1990, were $366,091.

Appendix 5 shows a break-down of this total.

Acknowledgements

The ready assistance of the following persons in the provision of data and information on which this report is based is acknowledged with gratitude:

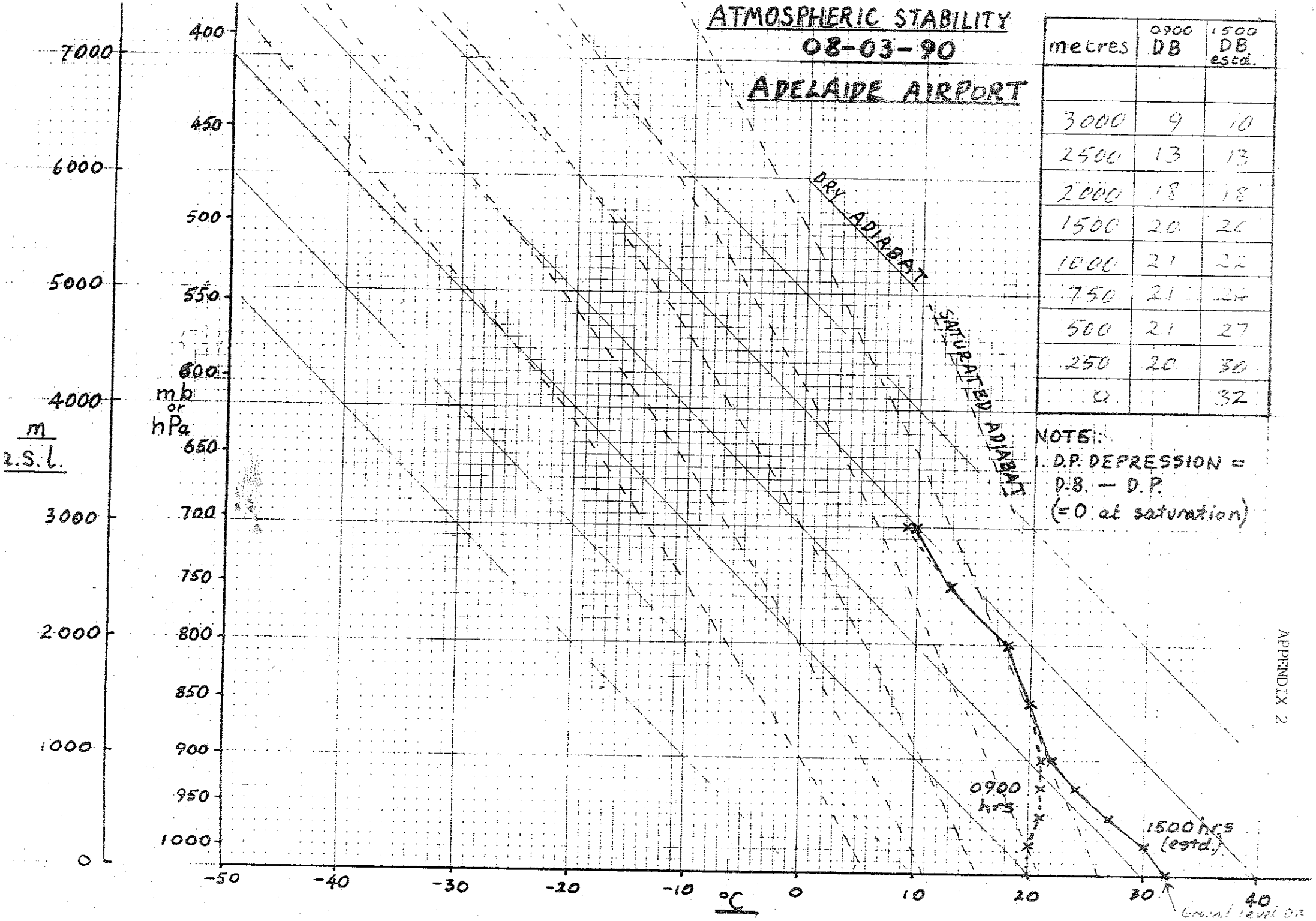
1. Woods and Forests Department:
   Principal Forest Management Officer, Andy Keeves
   Mount Crawford District Forester, Rick Underdown
   Mount Crawford Supervisor, Shane Wiseman
   Mount Crawford Supervisor, Richard Munn

2. Bureau of Meteorology, Adelaide:
   Severe Weather Specialist, Andrew Watson

3. Country Fire Service:
   Staff Officer, Paul Moran
   Regional Officer, Tony Wiedeman

4. S.A. Police, Holden Hill C.I.B.:
   Detective John Keep

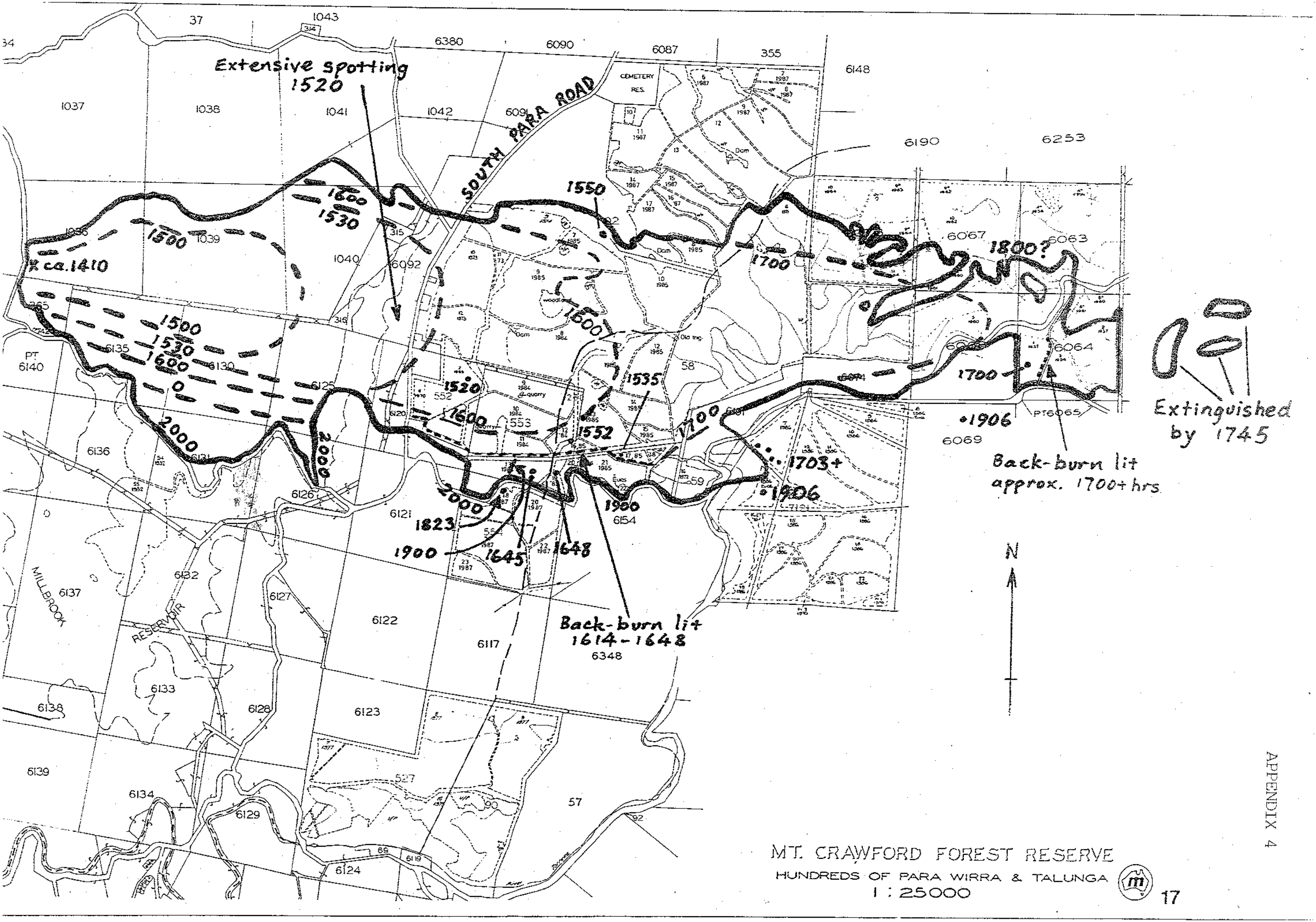
ATMOSPHERIC STABILITY
08-03-90
ADELAIDE AIRPORT



metres	0900 DB	1500 DB estd.
3000	9	10
2500	13	13
2000	18	18
1500	20	26
1000	21	22
750	21	24
500	21	27
250	20	30
0		32

NOTES:
1. D.P. DEPRESSION = D.B. − D.P. (=0 at saturation)

APPENDIX 2


Extensive spotting 1520
SOUTH PARA ROAD
CEMETERY RES.
ca.1410
1500
1530
1600
2000
1550
1535
1552
1520
1600
1700
1800?
1700
1703+
1906
1906
1823
1900
1645
1648
1900
Back-burn lit 1614-1648
Back-burn lit approx. 1700+hrs
Extinguished by 1745
N
MILLBROOK
RESERVOIR
MT. CRAWFORD FOREST RESERVE
HUNDREDS OF PARA WIRRA & TALUNGA
1 : 25000

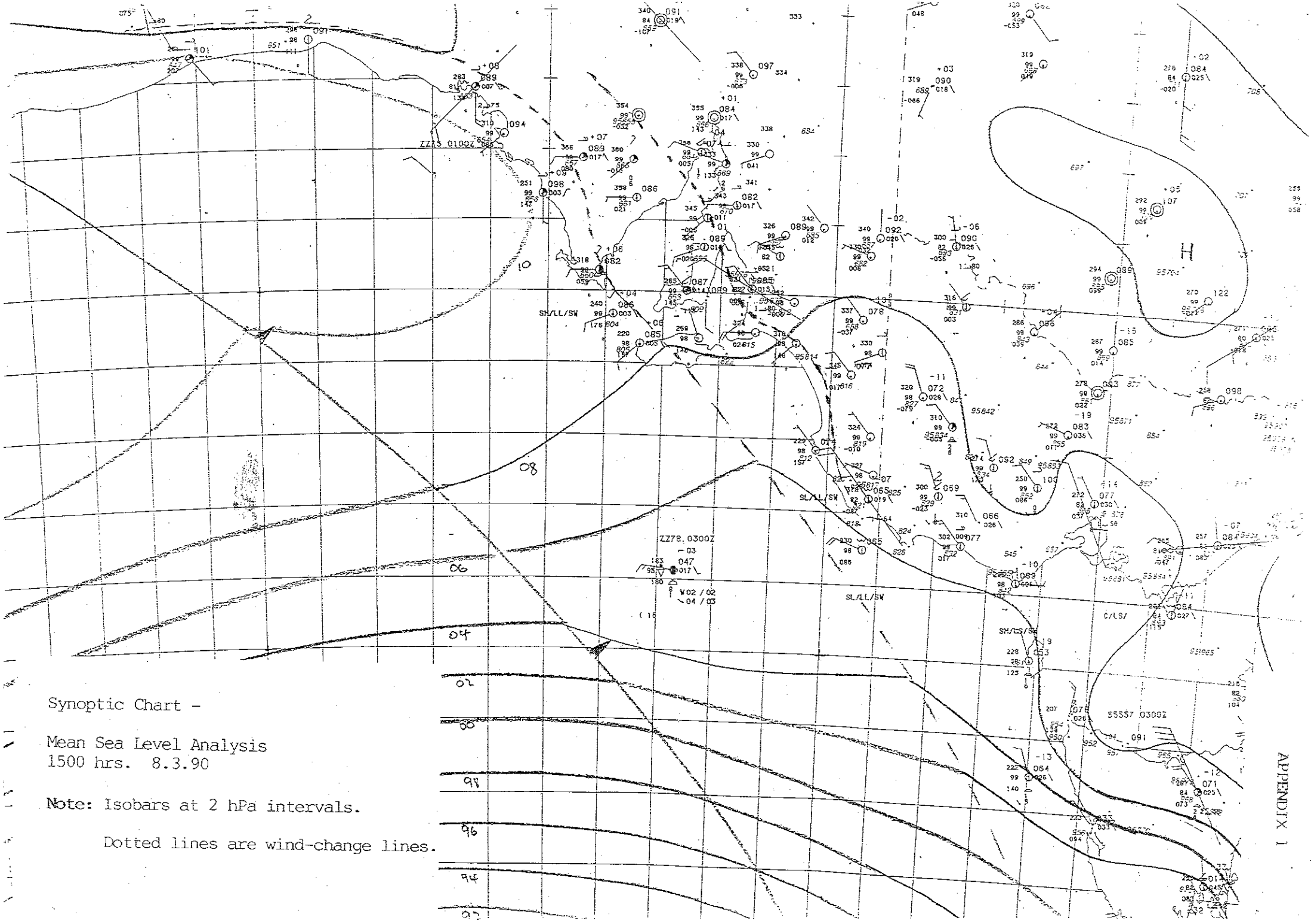
APPENDIX 5

WOODS AND FORESTS DEPARTMENT COSTS PLUS LOSSES
GUMERACHA FIRE MARCH 8, 1990

. Salvaged Plantations	$ 53,000	(estimated nett)
. Unmerchantable plantations	$258,000	(replacement)
	$311,000	
. Shed, Kersbrook H.Q.	$9,400*	(insured value)
. Contents of Shed Posts, timber, gates, signs and other materials	$5,000	(estimated by D.F.)
	$325,400	
. Labour, vehicle hire, and materials (fire fighting and subsequent)	$40,691	(to 1.5.90: continuing)
	$366,091	

Note: as at May 1, 1990

*Insured but W&F Department carries first $50,000 of any claim for each incident



Synoptic Chart -

Mean Sea Level Analysis
1500 hrs. 8.3.90

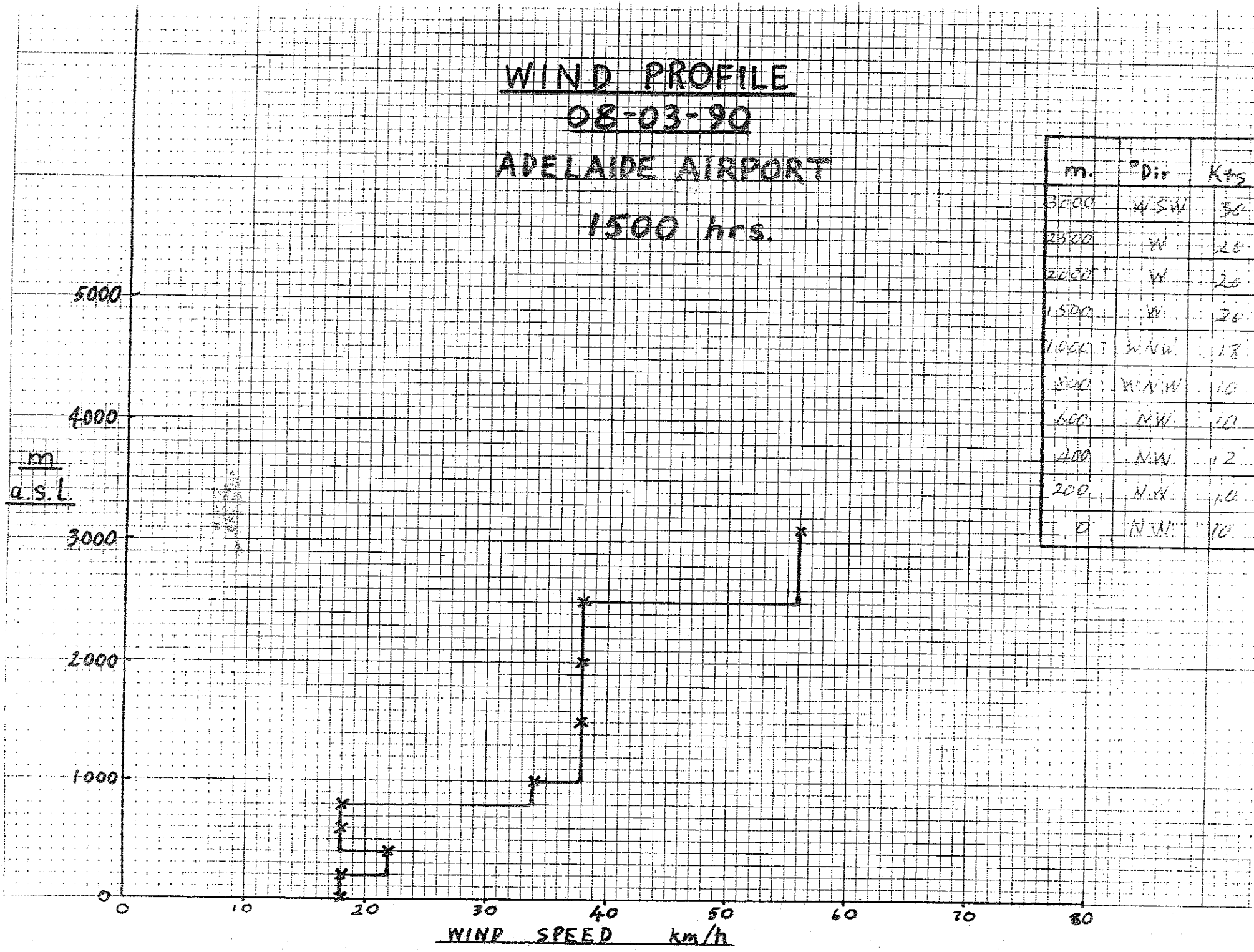
Note: Isobars at 2 hPa intervals.

Dotted lines are wind-change lines.

APPENDIX 1

WIND PROFILE
08-03-90
ADELAIDE AIRPORT
1500 hrs.

m.	°Dir	Kts	km/h
3500	WSW	36	5
2500	W	28	3
2000	W	28	5
1500	W	28	3
1000	WNW	18	3
800	NNW	10	
600	NW	10	1
400	NW	12	2
200	NW	10	1
0	NW	10	1



APPENDIX 3