

SECOND PROGRESS REPORT

**VEGETATION MONITORING PROGRAMME
McCARLEY'S SWAMP**

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Prepared For Department of Conservation and Land Management

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1. SUMMARY

The vegetation monitoring plots established at McCarley's Swamp, south of the township of Capel, in January 1987 were re-assessed in July, 1987. The latter inspection followed concern expressed by Government officials at the condition of the vegetation.

As discussed in the previous report (E.M. Mattiske & Associates, 1987), the proposed pumping in the summer months was undertaken with assistance from Associated Minerals Consolidated.

Results reflected a rapid deterioration in the condition of the vegetation in the swamp (particularly, the stands of Melaleuca raphiophylla in the lower areas of the swamp). It has been argued, that this further deterioration may have been brought on by the pumping. Results indicated that many trees were under stress prior to the pumping, and therefore it is likely that the changes would have occurred despite the adopted management option of summer pumping.

It is considered that in the past McCarley's Swamp has undergone a series of major changes. Amongst the most obvious is the burning some 25 years ago (see even aged M. raphiophylla on Bentley's property in the swamp). Although the results from the July monitoring appear to reflect a similar dramatic event, there was some limited recovery in stem conditions of the Melaleuca species on Plot 3 (and to a lesser degree Plot 7) and some of the "Dead" stems from the January monitoring period have since grown adventitious or epicormic shoots. These signs of recovery, particularly in Plot 3, occurred on the fringes of the deeply inundated swamp areas, thereby adding weight to the theory that the depth and/or length of inundation has not assisted in maintaining the vigour of the Paperbarks in the swamp. These signs of regrowth hold promise for the lake, although it is important to recognize that this recovery may occur over a time period of 3 to 5 years.

Of note, were the observations which appeared to relate to improved water quality (in particular on the north-west and western fringes). The latter was reflected in the clarity of the water and the presence of a range of aquatic plants and invertebrates.

In view of the recent changes in the condition of wetlands, the large numbers of birds previously utilizing the wetland may be affected. Although at the time of the July inspection, many birds

were only resting on the vegetation, observations indicated that there were at least five pairs of Swans nesting (with egg numbers ranging from three to six per nest).

Consequently, it is recommended that regular monitoring of the water levels, water quality and vegetation monitoring plots is continued by the Department of Conservation and Land Management. The monitoring period should be determined by the local wildlife officer.

As discussed previously, in addition to the revegetation programme (planting of seedlings) by the mining company (Associated Minerals Consolidated Limited - AMC), positive management options have been proposed for the vegetation. The latter should be discussed with the private land-owners. These are discussed in further detail in the Recommendations (Chapter 7.).

2. BACKGROUND

E.M. Mattiske & Associates was commissioned by the Department of Conservation and Land Management to assess the condition of the vegetation after a period of six months in the wetlands, known as McCarley's Swamp (named after a former landowner), located south of the township of Capel.

McCarley's Swamp overlaps the boundaries of the two properties owned respectively by Mr N. Bentley and Miss E. Higgins.

As reported in the earlier review (E.M.Mattiske & Associates, 1987) McCarley's Swamp has been influenced by man's activities for some 60 years (pers. comm., E. Higgins). The patterns discussed implied that these swamps were seasonally inundated, and depending on the seasonal rainfall, pumping was necessary to enable crops of potatoes to be grown and dug before the winter rains commenced in April-May. Miss E. Higgins also referred to the increased water levels in the paddocks since mining commenced near McCarley's Swamp. This is despite the series of below average annual rainfall years since the mid 1960's, Table 1. In fact, only five years in this recent period exceeded the average annual rainfall of 846 mm.

TABLE 1: SUMMARY OF ANNUAL RAINFALL RECORDINGS FOR CAPEL, 1965-1987

Year	Annual Rainfall (mm)	Year	Annual Rainfall (mm)
1965	* 1030	1976	755
1966	741	1977	619
1967	* 886	1978	686
1968	770	1979	672
1969	551	1980	742
1970	* 860	1981	689
1971	764	1982	641
1972	674	1983	* 892
1973	N.A.	1984	706
1974	* 896	1985	728
1975	686	1986	704

Note: Capel Average Annual Rainfall 1914-1986 = 846 mm
 * = Annual Rainfall exceeds Average Annual Rainfall
 N.A. = Not Available
 1987 (Jan. to June = 336.9), supplied by the Capel Post Office.

Therefore, the increased water levels must relate to factors associated with clearing (mining, forestry and agriculture), thus decreased evapo-transpiration, and to changes in water flows from the adjacent mining operations.

To counteract these increased water levels, the mining company (Associated Minerals Consolidated Limited) arranged for pumping of the wetlands during the summer months of 1986-1987. The pumping lowered the water table by an additional 0.5 metres above the "natural" fall due to evaporation and loss during summer months. This pumping had commenced in January 1987, prior to the establishment of the vegetation monitoring programme.

The plant communities on the wetlands are dominated by dense stands of Paperbark (mainly Melaleuca raphiophylla, and to a lesser extent Melaleuca lateritia and Melaleuca hamulosa). This report reviews the status of the native flora and vegetation in July 1987.

2.1 Available Resources

Subsequent information gathered includes:

- . Field studies in July, 1987.
- . Discussions with Department of Conservation and Land Management Officers.
- . Discussions with Department of Agriculture Officers.
- . Discussions with officers from Associated Minerals Consolidated.

3. OBJECTIVES

The following objectives were defined with Departmental officers, after discussions on time and costs.

- . To re-monitor the established vegetation monitoring sites within the swamp, utilizing the established tagging system to record the condition of individual stems, observing epicormic shoots, and recording the number and type (where possible) of bird nests of each stem,
- . To nominate possible causes of stress, which may be apparent in the vegetation,
- . To prepare two copies of the report summarizing findings.

4. METHODS

The plots which were established and recorded in January 1987 (E.M. Mattiske & Associates, 1987) were re-assessed in July 1987.

Field studies included the following:

- . All species present in the plot were recorded. Specimens were collected as required for taxonomic verification. Plant specimens were dried, fumigated and checked against current collections in the Western Australian Herbarium.

- . As the majority of plots were lacking an understorey, due to inundation, the study placed a greater emphasis on the overstorey. However where understorey species did occur (e.g. often in the forks of trees, above the current water levels) then detailed recordings were taken.
- . All labelled trees and shrubs were recorded as follows:

Condition of Each Stem using the following code:

H	=	Healthy
Sl.St	=	Slightly Stressed
St	=	Stressed
V.St	=	Very Stressed
Rd	=	Recently Dead
D	=	Dead
Fd	=	Fallen Dead
Adv	=	Adventitious Shoots
E	=	Epicormic Shoots
<BH	=	Below Breast Height

All results were summarized by stem, tree, shrub, species and plot for interpretation.

5. RESULTS

The area near Capel receives the majority of its rainfall in winter months (Groundwater Resources Consultants Report, 1986). Consequently it is expected that any replenishment of the water table would occur in these months. Further, there appears to be evidence that McCarley's Swamp was seasonally dry in the late summer months. Observations in other wetlands indicate that the dominant Paperbark Melaleuca raphiophylla can tolerate inundation for some length of time, although detailed information is generally lacking on the longer-term effects of inundation on this species.

5.1 Flora

A total of 22 families, 42 genera and 53 vascular plant species were recorded in the botanical studies at McCarley's Swamp, Appendix A.

Dominant families were Cyperaceae (8 species - 7 native and 1 introduced), Poaceae (8 species - all introduced), Myrtaceae (6 species - all native) and Asteraceae (5 species - 1 native and 4 introduced), Appendix A.

Several of the Paperbarks form extensive stands on the wetlands. Foremost amongst these is Melaleuca raphiophylla, which would provide the largest plant cover in the wetland area.

5.2 Vegetation

The vegetation communities were previously described by E.M. Mattiske & Associates (February, 1987). Results from the July monitoring period are presented by plot and then by species (Section 5.3). The location of individual trees and tagged plants are summarized in Appendix B.

Plot 1 : Low open-forest of Melaleuca raphiophylla with occasional understorey of Melaleuca hamulosa, Melaleuca lateritia and Astartea aff. fascicularis. Other understorey species generally lacking. The plot was inundated by approximately 30-50 cm of water in July, 1987. This level was higher than that recorded in January, 1987 (10-20 cm).

Plot 2: Low open-forest of Melaleuca raphiophylla, with a general lack of understorey species (except for the occasional plant growing from the forks of trees, above the water-line). The plot was inundated by approximately 100 to 130 cm of water in July 1987. This level was slightly higher than that recorded in January 1987 (80 to 100cm).

Plot 3: Variable plot ranging from an open-scrub to tall shrubland of mixed Paperbarks (Melaleuca hamulosa - Melaleuca raphiophylla - Melaleuca lateritia). The plot was inundated with 30-50 cm of water in July, 1987, which was slightly deeper than in January 1987 (10-20 cm).

TABLE 2 : SUMMARY OF SPECIES IN VEGETATION MONITORING PLOTS
(extracted from E.M. Mattiske & Associates, 1987)

Species	Plot No.							
	1	2	3	4	5	6	7	8
<i>Melaleuca raphiophylla</i>	++	++	++	++	-	++	++	+
<i>Melaleuca hamulosa</i>	+	-	++	-	+	+	-	++
<i>Melaleuca lateritia</i>	+	+	++	-	+	++	-	-
<i>Astartea</i> aff. <i>fascicularis</i>	+	+	-	+	-	-	+	-
<i>Cassytha racemosa</i>	+	-	+	-	-	+	+	-
<i>Alternanthera nodiflora</i>	-	+	-	+	+	+	-	+
<i>Cotula coronopifolia</i>	-	+	-	+	+	-	+	++
* <i>Chenopodium</i> ? <i>macrospermum</i>	-	+	-	-	+	+	-	+
* <i>Lythrum hyssopifolia</i>	-	+	-	-	++	-	-	-
* <i>Solanum nigrum</i>	-	+	-	-	-	-	+	-
<i>Epilobium billardierianum</i> ssp. <i>cinereum</i>	-	+	-	-	-	-	+	-
* <i>Zantedeschia aethiopica</i>	-	+	-	-	-	-	-	-
<i>Eucalyptus rudis</i>	-	-	-	-	+	-	-	-
* <i>Phalaris aquatica</i>	-	-	-	-	++	-	-	-
* <i>Polypogon monospeliensis</i>	-	-	-	-	++	-	-	-
* <i>Lotus suaveolens</i>	-	-	-	-	++	+	-	-
* <i>Hordeum leporinum</i>	-	-	-	-	++	-	-	-
<i>Bolboschoenus caldwellii</i>	-	-	-	-	+	-	-	-
* <i>Rumex crispus</i>	-	-	-	-	+	-	-	-
<i>Juncus pallidus</i>	-	-	-	-	+	-	-	-
* <i>Trifolium repens</i>	-	-	-	-	+	-	-	-
* <i>Isolepis prolifer</i>	-	-	-	-	+	-	-	-
<i>Lobelia alata</i>	-	-	-	-	+	-	-	-
* <i>Sonchus oleraceus</i>	-	-	-	-	+	-	-	-
* <i>Centaurium</i> ? <i>erythraea</i>	-	-	-	-	+	-	-	-
* <i>Juncus articulatus</i>	-	-	-	-	+	-	-	-
* <i>Dittrichia graveolens</i>	-	-	-	-	-	+	+	-

Note: ++ = Dominant Species
 + = Associated Species
 - = Absent
 * = Introduced Species

- Plot 4: Variable plot ranging from an open-woodland of Melaleuca raphiophylla, to open water devoid of vascular plant species to a fringing low open-woodland of Melaleuca raphiophylla. This plot extends from the open area of water in the south-eastern section of McCarley's Swamp to the embankment to the west of the area of open water (on the property of Bentley). The depth of water present in July 1987 was variable (ranging from 40 - 130+ centimetres in the lake to pools on the fringes of the lake) and was deeper than in January, 1987 (10-100 cm).
- Plot 5: Open-woodland of Eucalyptus rudis with an occasional shrub of Paperbarks and Wattles. This plot occurs on the embankment east of the open water area in the south-eastern section of McCarley's Swamp, and at the time of monitoring in July 1987 included pockets and pools of water (0-25 cm).
- Plot 6: Low woodland of Melaleuca raphiophylla with occasional Melaleuca hamulosa and Melaleuca lateritia. This plot occurs in a lower lying area on the south-western section of McCarley's Swamp (on the property of Bentley). At the time of monitoring in July 1987, the plot was covered with pools of water up to a depth of 60 cm, which is slightly deeper than in January 1987 (up to 30 cm).
- Plot 7: Open-woodland of Melaleuca raphiophylla, with a general lack of understorey species (except for the occasional plant growing from the forks of trees, above the water-line, including Astartea aff. fascicularis). The plot was inundated by approximately 100 to 130 cm of water in and July 1987 (which is slightly deeper than the 80-100 cm in January, 1987).
- Plot 8: Open-scrub of Melaleuca hamulosa with herbaceous ground cover. This plot was covered by 5 to 10 cm of water at the time of the monitoring in January 1987 and some 10 to 35 cm of water in July 1987.

In summary, the main plant communities on the wetlands at McCarley's Swamp are:

- . The stands of Melaleuca raphiophylla, which vary in height, age and density (Plots 2, 4 and 7).
- . The mixed stands of Paperbarks; Melaleuca raphiophylla and varying proportions of Melaleuca hamulosa and Melaleuca lateritia (e.g. Melaleuca hamulosa is dominant in Plot 3, while Melaleuca lateritia is dominant in Plots 3 and 6).
- . The open-scrub of Melaleuca hamulosa forms a fringing plant community that extends around the wetlands on the lower slopes (Plot 8 and in part Plot 3).
- . The last of the plots (Plot 5), supports a open-woodland of Eucalyptus rudis with a variable understorey.

As expected in response to the autumn and winter rains, the water levels in the swamp were higher.

5.3 Plot Data

The vegetation data collected in the plots is summarized in the following text by plant species, condition of plant species and diameter size classes for each plant species. The locations of the tagged trees and shrubs in each plot are summarized in Appendix B (note Plots 6 and 8 are 10m x 10m, the other plots are 20m x 20m). The results for each species in each plot are summarized in Appendix C. Several minor editing corrections were made to the January 1987 Appendix C summaries and hence comparative results in the following sections are based on the revised totals.

5.3.1 Condition of Stems

The condition of the plant species varied a great deal between the vegetation plots and through the wetlands. The results are summarized by individual tree or shrub in Appendix C and by plot in the following text and tables, see Tables 3A, 3B, 3C, 3D, 4A, 4B, 4C and 4D.

TABLE 3A : SUMMARY OF CONDITION OF EUCALYPTUS RUDIS STEMS IN THE MONITORING PLOTS AT MCCARLEY'S SWAMP IN JULY 1987.

Plot No.	No. Trees	No. Stems	Condition of Stems					
			H	Sl.St	St	V.St	Rd	D
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	1	4	-	-	4	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-
Total	1	4	-	-	4	-	-	-
% of Total Stems		100	-	-	100	-	-	-

TABLE 3B : SUMMARY OF CONDITION OF MELALEUCA HAMULOSA STEMS IN THE MONITORING PLOTS AT MCCARLEY'S SWAMP IN JULY 1987.

Plot No.	No. Shrubs	No. Stems	Condition of Stems					
			H	Sl.St	St	V.St	Rd	D
1	1	1	-	-	-	-	-	1
2	-	-	-	-	-	-	-	-
3	5	9	-	-	4	-	-	5
4	-	-	-	-	-	-	-	-
5	2	57	57*	-	-	-	-	-
6	6	6	-	-	-	-	-	6
7	-	-	-	-	-	-	-	-
8	55	120	22	1	13	-	6	78
Total	69	193	79	1	17	-	6	90
% of Total Stems		100	41	0.5	9	-	3	46.5

(Note: * Some stems broken in July 1987)

TABLE 3C : SUMMARY OF CONDITION OF MELALEUCA LATERITIA STEMS IN THE MONITORING PLOTS AT McCARLEY'S SWAMP IN JULY 1987.

Plot No.	No. Shrubs	No. Stems	Condition of Stems						Below Breast Height
			H	Sl.St	St	V.St	Rd	D	
1	9	11	-	-	-	1	2	7(1)	-
2	1	1	-	-	-	-	-	1	-
3	47	73	8	4	17	4	11	27(2)	33
4	-	-	-	-	-	-	-	-	-
5	1	6	6	-	-	-	-	-	-
6	322	322	-	-	-	1	-	321	180
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
Total	380	413	14	4	17	6	13	359	213
% of Total									
Stems		100	3	1	4	1	3	88	N.A.

(Note: No.in () after Dead No. denotes the No. of Fallen Dead Stems)

TABLE 3D : SUMMARY OF CONDITION OF MELALEUCA RHAPHIOPHYLLA STEMS IN THE MONITORING PLOTS AT McCARLEY'S SWAMP IN JULY 1987.

Plot No.	No. Trees	No. Stems	Condition of Stems					
			H	Sl.St	St	V.St	Rd	D
1	21	60	12	10	8	17	4	8(1)
2	32	188	-	-	5	37	37	99(10)
3	59	176	20	32	67	23	2	28(4)
4	15	175	-	4	25	3	94	49
5	-	-	-	-	-	-	-	-
6	37	113	1	-	5	11	34	59(3)
7	45	216	-	-	1	15	97	94(9)
8	1	1	-	1	-	-	-	-
Total	209	929	33	47	111	106	268	337(27)
% of								
Total Stems		100	4	5	12	11	29	39

(Note: No.in () after Dead No. denotes the No. of Fallen Dead Stems)

TABLE 4A: COMPARISON OF PERCENTAGE STEM CONDITIONS IN JANUARY 1987 AND JULY 1987 FOR EUCALYPTUS RUDIS

Plot No.	No. of Stems	Percentage of Stems									
		H.		Sl. St.		St.		V. St.		D.	
		Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87
5	4	-	-	-	-	100	100	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-
Total Stems	4	-	-	-	-	4	4	-	-	-	-
% Stems	100	-	-	-	-	100	100	-	-	-	-

TABLE 4B: COMPARISON OF PERCENTAGE STEM CONDITIONS IN JANUARY 1987 AND JULY 1987 FOR MELALEUCA HAMULOSA

Plot No.	No. of Stems	Percentage of Stems									
		H.		Sl. St.		St.		V. St.		D.	
		Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87
1	1	-	-	-	-	-	-	-	-	100	100
2	-	-	-	-	-	-	-	-	-	-	-
3	9	-	-	-	-	11	44	33	-	56	56
4	-	-	-	-	-	-	-	-	-	-	-
5	57	100	100	-	-	-	-	-	-	-	-
6	6	-	-	-	-	-	-	-	-	100	100
7	-	-	-	-	-	-	-	-	-	-	-
8	120	22	18	-	1	13	11	-	-	65	70
Total Stems	193	83	79	-	1	17	17	3	-	90	96
% Stems	100	43	41	-	0.5	9	9	1.5	-	46.5	49.5

TABLE 4C: COMPARISON OF PERCENTAGE STEM CONDITIONS IN JANUARY 1987 AND JULY 1987 FOR MELALEUCA LATERITIA

Plot No.	No. of Stems	Percentage of Stems									
		H.		Sl. St.		St.		V. St.		D.	
		Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87
1	11	-	-	9	-	-	-	18	9	73	91
2	1	-	-	-	-	-	-	-	-	100	100
3	73	32	11.5	5	5.5	22	23	1	5	40	55
4	-	-	-	-	-	-	-	-	-	-	-
5	6	100	100	-	-	-	-	-	-	-	-
6	322	-	-	-	-	-	-	0.3	-	99.7	100
7	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-
Total Stems	413	29	14	5	4	16	17	4	5	359	373
% Stems	100	7	3.5	1	1	4	4	1	1	87	90.5

TABLE 4D: COMPARISON OF PERCENTAGE STEM CONDITIONS IN JANUARY 1987 AND JULY 1987 FOR MELALEUCA RHAPHIOPHYLLA

Plot No.	No. of Stems	Percentage of Stems									
		H.		Sl. St.		St.		V. St.		D.	
		Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87
1	60	33	20	10	17	28	13	12	28	17	22
2	188	-	-	1	-	13	3	24	19.5	62	77.5
3	176	16	11.5	19	18	38	38	7	13	20	19.5
4	175	6	-	6	2	35.5	14	30	2	22.5	82
5	-	-	-	-	-	-	-	-	-	-	-
6	113	3	1	-	-	23	4	20	10	54	85
7	216	-	-	-	-	20	0.5	30	7	50	92.5
8	1	100	-	-	100	-	-	-	-	-	-
Total Stems	929	62	33	52	47	241	111	206	106	368	632
% Stems	100	7	3.5	5.5	5	26	12	22	11.5	39.5	68

The results reflect the dominance of the three Paperbarks in the wetlands, Melaleuca raphiophylla, Melaleuca hamulosa and Melaleuca lateritia.

Eucalyptus rudis was restricted to the fringing woodlands near the area of open water in the south-eastern section of McCarley's Swamp on Plot 5 (Table 3A). All stems were stressed in January and July 1987, although the cause appeared to relate to insect damage (Table 4A).

Melaleuca hamulosa occurred on a range of sites, although its dominance in Plot 8 is obvious from a comparison of the number of shrubs (particularly as Plot 8 was on a reduced area of 10m x 10m), see Table 3B. There appeared to be a slight improvement in condition of some of the shrubs on Plot 3 (Table 4B). The high percentage of dead stems in all plots (46.6% and 49.5% in January and July 1987 respectively) is of concern (Table 4B).

Melaleuca lateritia occurred in a range of plots, although it was most vigorous in the plots on the fringes of the wetter areas (namely Plots 3 and 5), see Table 3C. The high number of dead shrubs and stems (including the 213 dead stems below breast height) resulted in a low percentage of living stems (9.5%) for this species (Table 4C). Results in July 1987 reflected a decrease in vigour and increase in death on Plots 1,3 and 6. This result appears to reflect the inability of this species to tolerate inundation. The appearance of healthier shrubs on the fringes of the wetlands supports this concept of inundation causing death. In addition, the dead shrubs in the wetlands support the concept that the lower lying areas have been drier in the past.

Melaleuca raphiophylla occurred in the majority of the plots (with the exception of Plot 5), see Table 3D. In most plots the numbers of dead and stressed stems increased markedly (Table 4D). The marked deterioration was evident in all plots, although the number of deaths was particularly obvious in Plots 1,2,4,6 and 7. Plot 3, which occurs on the fringes of the inundated areas showed generally decreased vigour (although some stems showed signs of improvement on Plot 3), but insignificant changes in the percentage of dead stems.

The cause of this stress appears to be variable, but may relate to a variety of factors (age, period of inundation, bird damage). Although it is still too early to provide distinct causes of the deterioration in condition, it is obvious from the aerial photos that the degree of stress has increased since 1983 and that it is concentrated in the wetter areas of McCarley's Swamp. This may relate to the increased periods of inundation in the lower lying areas, or possibly an indirect aspect like the greater utilization of these wetter areas by the bird populations for nesting (with the resulting direct and indirect effects).

To re-assess the effects of inundation the depth of water at the time of monitoring in January 1987 and July 1987 are compared with the percentage of healthy, stressed and dead stems of Melaleuca raphiophylla in the respective plots, Table 5.

The depth of inundation appears to have affected the condition of the Melaleuca raphiophylla. The higher percentage of dead stems in Plots 2, 4, 6 and 7, which were all subjected to deeper water reflects this likely correlation. The findings may also reflect the length of inundation (which would be higher in these same areas). It is of interest that less changes were observed in Plot 3, which occurs on the fringes of the previously inundated swamp areas. Although slight changes were observed in vigour, the results for this plot did not reflect the massive collapse observed in other areas. Of interest, were a range of stems for the Paperbarks which increased in vigour:

Melaleuca hamulosa - in Plot 3 (Very stressed to stressed).

Melaleuca lateritia - in Plot 3 (Stressed to Slightly stressed)

Melaleuca raphiophylla - in Plot 3 (14 stems which improved in vigour, including a "Dead" stem which produced shoots by July 1987) and in Plot 7 (Very Stressed to Stressed).

It is of interest that the majority of these stems which increased in vigour occurred on Plot 3, which was located on the fringes of the inundated areas of the swamp. The latter

TABLE 5: COMPARISON OF WATER LEVELS IN JANUARY 1987 AND JULY 1987 WITH PERCENTAGE OF VARYING STEM CONDITIONS FOR MELALEUCA RHAPHIOPHYLLA

Plot No.	Depth of Water (cm)		Percentage of Stems									
	Jan.87	July 87	H.		Sl. St.		St.		V. St.		D.	
			Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87	Jan.87	July 87
5	-	0-25	-	-	-	-	-	-	-	-	-	-
8	5-10	10-35	100	-	-	100	-	-	-	-	-	-
1	10-20	30-50	33	20	10	17	28	13	12	28	17	22
3	10-20	30-50	16	11.5	19	18	38	38	7	13	20	19.5
6	10-30	40-60	3	1	-	-	23	4	20	10	54	85
4	10-100	40-130+	6	-	6	2	35.5	14	30	2	22.5	82
2	80-100	100-130	-	-	1	-	13	3	24	19	62	77.5
7	80-100	100-130	-	-	-	-	20	0.5	30	7	50	92.5

combined with the results summarized in Table 5 appear to support the concept that the degree and length of inundation may have affected the vigour and condition of the Paperbarks. Further monitoring may clarify the significance of the deaths and the trends in Plot 3.

In assessing the condition of the stems for each species the presence of adventitious and epicormic growths were recorded. In some instances it appeared that these growths were reflecting a last effort to regain vigour, while in some instances they reflected a change from "dead" stems (lacking leaves) in January to "very stressed" in July. Only time will tell if the latter regrowth is reflective of sustained regeneration. The following results are extracted from Appendix C:

Eucalyptus rudis - no adventitious or epicormic growth.

Melaleuca hamulosa - no adventitious or epicormic growth.

Melaleuca lateritia -

Adventitious growth - January 1987 (1), July 1987 (4).

Epicormic growth - January 1987 (2), July 1987 (-).

Melaleuca raphiophylla -

Adventitious growth - January 1987 (43), July 1987 (31).

Epicormic growth - January 1987 (326), July 1987 (167).

The significant changes in numbers of adventitious and epicormic growths in Melaleuca raphiophylla appear to support the earlier failure of many stems to maintain leaves or growth in plots which occur in the deeper areas of the swamp.

5.3.3 Review of Bird Damage to Stems

The direct effect of the birds resting and nesting on the upper stems and branches is evident from results summarized in the previous report (E.M. Mattiske & Associates, 1987).

Findings indicated that the direct effects of the birds were most obvious on the upper stems, where apparent wing damage had resulted in the loss of leaves (defoliation) and

broken upper branches and twigs. The degree of bird activity in the south-western section of McCarley's Swamp was evident from the concentration of damaged trees in Plot 6.

No further evidence of bird damage was apparent in July, 1987, although some species were resting on the upper branches at the time of the survey. If the loss of leaves is reflective of the death of the trees (see earlier regrowth from apparently dead stems), then the stems may become more susceptible to breakage from the birds resting and nesting. Future monitoring may also expand on the effects of the decrease in vigour and loss of leaves on the nesting activities of the respective bird species.

5.4 Nesting Activity

Previous nesting activities are summarized in E.M. Mattiske & Associates (1987). At the time of the monitoring in July 1987, five pairs of Swans were observed to be nesting, mainly on the western section of the swamp. The nests were located in and near Plots 2 (Tree 2-27), 6 (nearby) and 7 (Tree 7-32).

The importance of healthy vegetation to the bird species may be clarified as monitoring of the Swamp continues.

6.0 DISCUSSION

The vegetation monitoring programme established in January 1987 was re-assessed in July 1987.

Observations from this second monitoring period indicated that McCarley's Swamp is deteriorating in condition. In fact most of the communities within the centre of the swamp had deteriorated significantly, so that many of the trees had lost all leaves (and therefore it is assumed that these trees have died) since January 1987.

Possible causes for changes in the plant communities present in McCarley's Swamp appear to include the following:

- . Increased water levels (may explain the stress and deaths in Melaleuca lateritia and Melaleuca raphiophylla), particularly as the deterioration in vigour and deaths were concentrated in the centre of the swamp in the lower lying and inundated areas. Further the slight increase in vigour of some stems on Plot 3 (which occurs on the fringes of the swamp) supports this concept.
- . Increased periods of inundation (may explain the stress and deaths in Melaleuca lateritia and Melaleuca raphiophylla).
- . Altered water quality levels (increased sampling at regular intervals may clarify these relationships, particularly if nearby "Control" areas are also sampled for water quality).
- . Bird damage (defoliation and broken upper branches).
- . Insect damage (largely on the Flooded Gums - Eucalyptus rudis).
- . Lack of factors which may be a pre-requisite for seasonal growth and sustained healthy growth.

If monitoring is maintained on a regular basis, it should assist in assessing the management option adopted to return McCarley's Swamp to a seasonally inundated wetland.

7. RECOMMENDATIONS

The following recommendations are based on the results presented and discussions with other researchers.

7.1 Monitoring Recommendations

- . Regular inspections by Wildlife Officers to assess bird activities and the condition of the plant communities. These inspections should be carried out at monthly intervals to follow seasonal water levels, to collect water samples from both the centre of the Swamp and near

the inflow channels and to monitor bird activities.

- . Yearly monitoring of the vegetation plots should be undertaken by the Department of Conservation and Land Management. If possible, the option of expanding the programme into nearby "Control" wetlands should be reviewed and incorporated into the programme.

7.2 Management Recommendations

A range of management options were discussed with various researchers in the State. These included:

Option 1: No action.

In view of the historical data and the apparent evidence that inundation (depth and length of inundation) may have led to the loss of vigour and deaths, this option was not considered.

Option 2: Summer Pumping.

This option, although it raised some conflicting arguments, appears to be the only short term means of creating a seasonally dry swamp. In the longer term it is hoped that the planted seedlings to the east of the swamp may reduce the inflow of water from the adjacent mining operations. Other discussions were also held on the timing of the pumping, i.e. the length and commencement options for pumping. Generally there is little to base such decisions on, other than comparing this swamp with other nearby seasonally inundated swamps. The latter supports the earlier recommendation to review similar nearby swamps, which are not affected by the close proximity of the mining operations.

This option assumes that the evidence of increased vigour on some stems in Plot 3 and the healthier trees on the less inundated fringes of the swamp are significant in reflecting the needs of the Paperbarks in relation to the depth and length of inundation.

One reservation expressed by Dr Neville Marchant was the risk of the spread of Typha into the swamp if the level of inundation was lowered too far for significant lengths of time (Typha or Bullrush occurs in nearby dam sites). The latter point requires monitoring and review.

Option 3: Summer Pumping and Planting of Paperbarks.

This option, although similar to Option 2, assumes that the process of regeneration may need some encouragement in the short term. Several suggestions were made regarding planting Melaleuca raphiophylla and/or Melaleuca teretifolia in the areas where deaths had occurred to increase evapotranspiration within the swamp and to replace the lost shrubs and trees. At this point in time it was considered to be a possible option, although the conservative approach (Option 2) was thought to be more appropriate in the immediate future. The latter was considered as a possible alternative if the Paperbarks did not show further signs of regrowth following the proposed pumping in the summer months.

Option 4: Control Burning following Pumping.

This option appeared to work in the past (see regrowth in the areas on previously cleared sections of the swamp which were burnt some 25 years ago). However, this option appears a little too drastic at this point in time, particularly as it is doubtful with the continued inflow of water from the adjacent mining operations that it would even be a possible option in the short term.

Therefore it is recommended that Option 2 be continued (with the mining company's cooperation), with a re-assessment to be undertaken in the latter part of 1988.

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Miss C.D.M. Keating

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APPENDIX A : FLORA LIST - McCARLEY'S SWAMP

APPENDIX A : FLORA LIST - MCCARLEY'S SWAMP

<u>FAMILY</u>	<u>GENERA</u>	<u>SPECIES</u>
TYPHACEAE	* Typha	orientalis
POACEAE	* Briza	maxima
	* Briza	minor
	* Cynodon	dactylon
	* Eragrostis	curvula
	* Hordeum	leporinum
	* Paspalum	dilatatum
	* Phalaris	aquatica
	* Polypogon	monospeliensis
CYPERACEAE	Baumea	arthrophylla
	Baumea	juncea
	Bolboschoenus	caldwellii
	Chorizandra	enodis
	Cyperus	polystachyos
	Gahnia	trifida
	Isolepis	cernua
	* Isolepis	prolifer
ARACEAE	* Zantedeschia	aethiopica
RESTIONACEAE	Leptocarpus	coangustatus
JUNCACEAE	* Juncus	articulatus
	Juncus	holoschoenus
	Juncus	kraussii
	Juncus	pallidus
PROTEACEAE	Banksia	littoralis
	Hakea	varia
POLYGONACEAE	* Rumex	crispus
	* Rumex	pulcher
CHENOPODIACEAE	* Chenopodium	? macrospermum
AMARANTHACEAE	Alternanthera	nodiflora

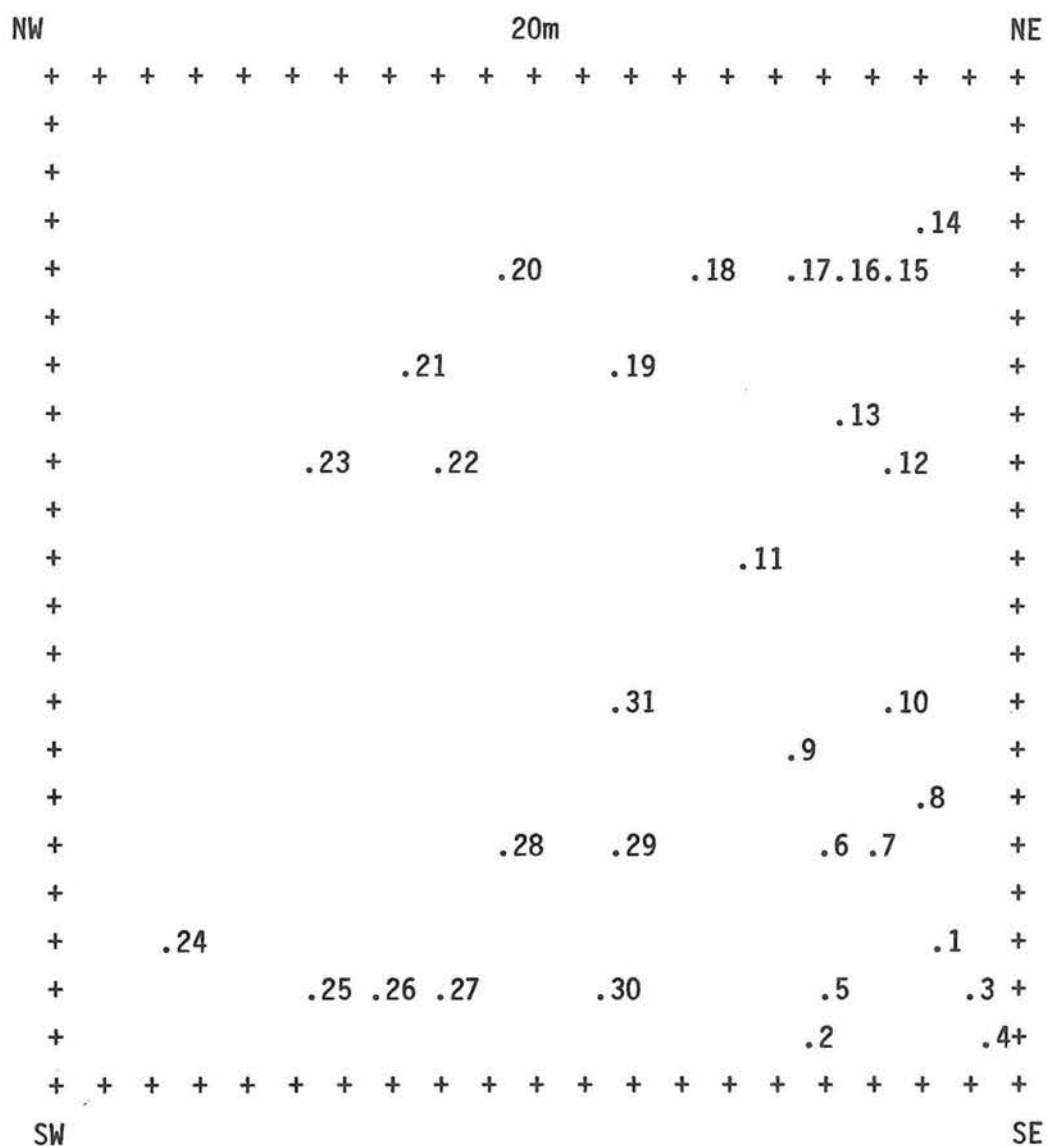
APPENDIX A : FLORA LIST - MCCARLEY'S SWAMP (Cont.)

<u>FAMILY</u>	<u>GENERA</u>	<u>SPECIES</u>
LAURACEAE	Cassytha	racemosa
MIMOSACEAE	Acacia	pulchella var. galberrima
	Acacia	saligna
PAPILIONACEAE	* Lotus	suaveolens
	* Trifolium	repens
	Viminaria	junceae
THYMELIACEAE	Pimelea	ciliata
LYTHRACEAE	* Lythrum	hyssopifolia
MYRTACEAE	Astartea	aff. fascicularis
	Eucalyptus	rudis
	Melaleuca	hamulosa
	Melaleuca	lateritia
	Melaleuca	rhaphiophylla
	Melaleuca	teretifolia
ONAGRACEAE	Epilobium	billardierianum ssp. cinereum
GENTIANACEAE	* Centaurium	? erythraea
SOLANACEAE	* Solanum	nigrum
LOBELIACEAE	Lobelia	alata
GOODENIACEAE	Goodenia	filiformis
ASTERACEAE	Cotula	coronopifolia
	* Dittrichia	graveolens
	* Hypochoeris	radicata
	* Pseudognaphalium	luteo-album
	* Sonchus	oleraceus

APPENDIX B : LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

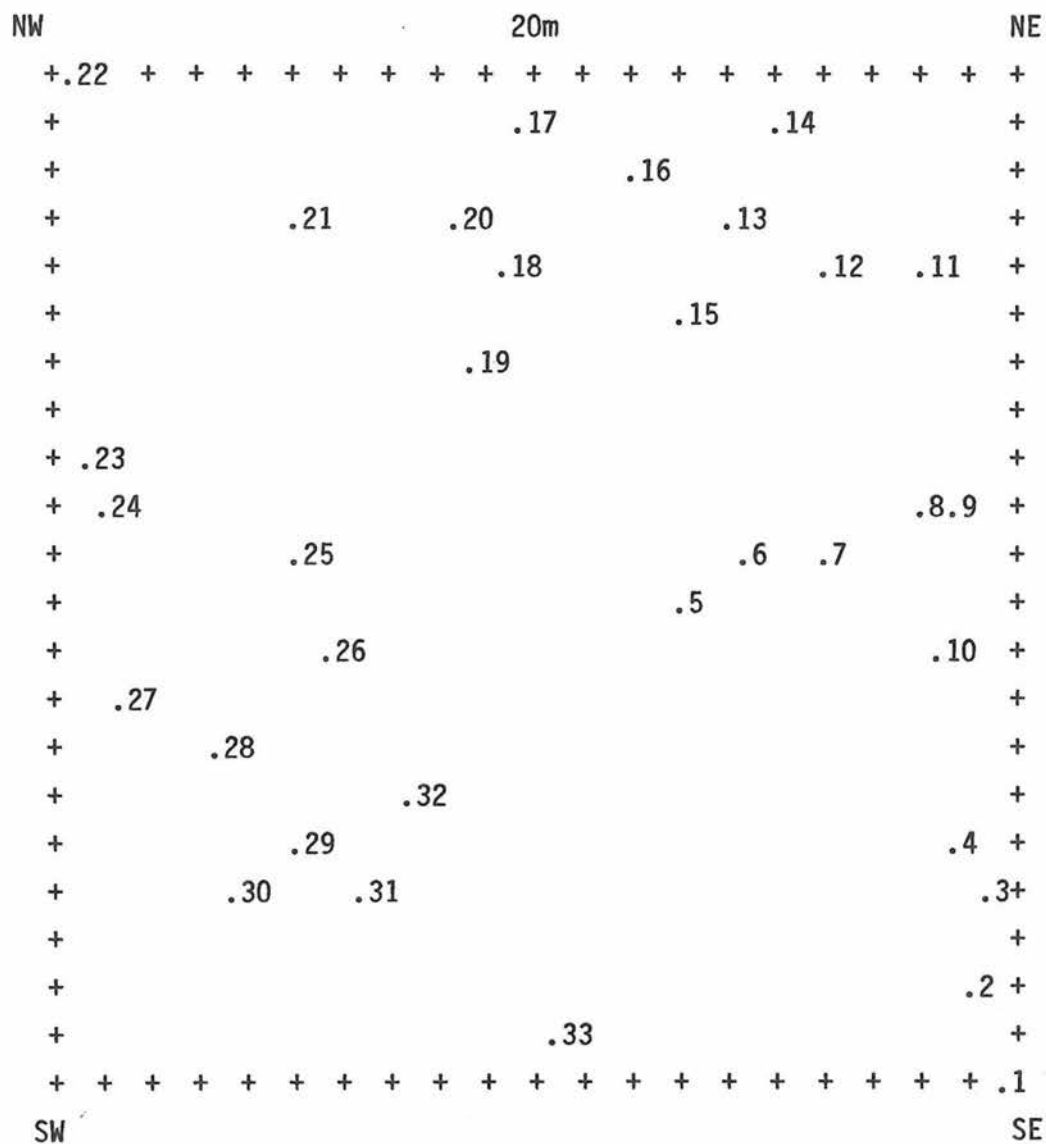
Plot No: 1 (Location of plants is approximate).



Note: Plot 1 is located some 18m north of central fenceline dividing two properties; and some 60 metres west of eastern edge of open water.

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

Plot No: 2 (Location of plants is approximate).



Note: Plot 2 is located some 100m north of Plot 1.

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

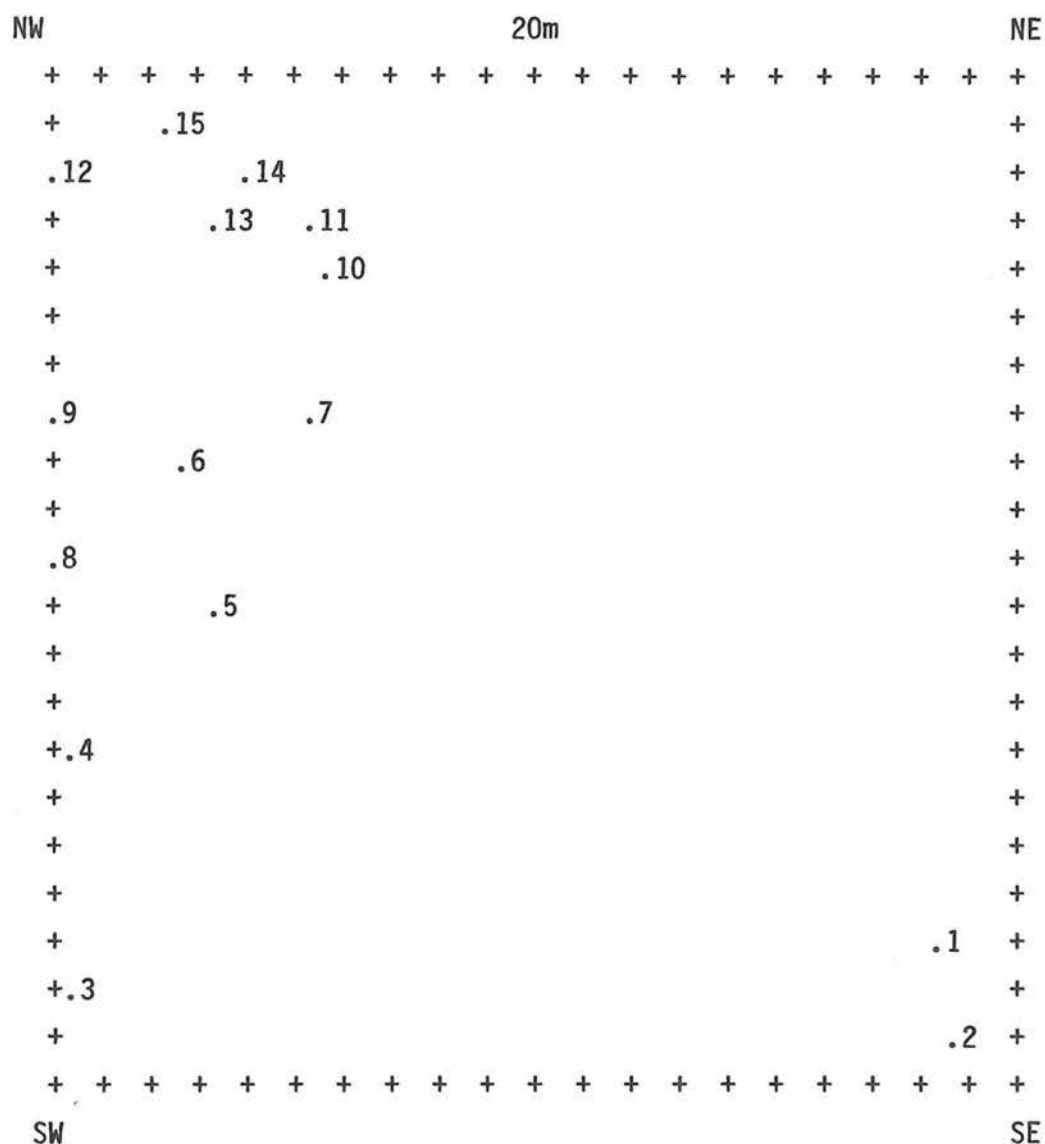
Plot No: 3 (Location of plants is approximate).

NW	20m																NE
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+									.36				23:24.22.16				+
+													.18.17				+
+							.35						.20 .21				+
+						.33	.34		.25				.19				+
+	.38						.32						.15				+
+	.37						.30 .31						.14				+
+		.39				.29 .27			.26						.13 11	+	+
+												68. .67 .65 .12 .10				+	+
+												.66			.9	+	+
+									.28					.7	.8	+	+
+		.40										.69 .70					+
+												.71 .72 .6				+	+
+		.41				.42			.64			.75 74..73				+	+
+									.63.62			.77 .5				+	+
+					.43				61..60 98..97			.76			.4		+
+					.44				102.101..100 79..78 .85 .3								+
+					.45				59.103..104.99			.80.81.83				+	+
+									.108			.86.82.84+					+
+		.47 .48-53.54						.56.58.57.107.105 88.89..87.							.2		+
+	.46					.55			.106 95..96 90..91							+	+
+	+	+	+	+	+	+	+	+	+	+	.109+	+	.110. .93	+	.92.1		+
SW													94				SE

Note: Plot 3 is located some 100m north of Plot 2 and then some 30m east, on edge of wetland.

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

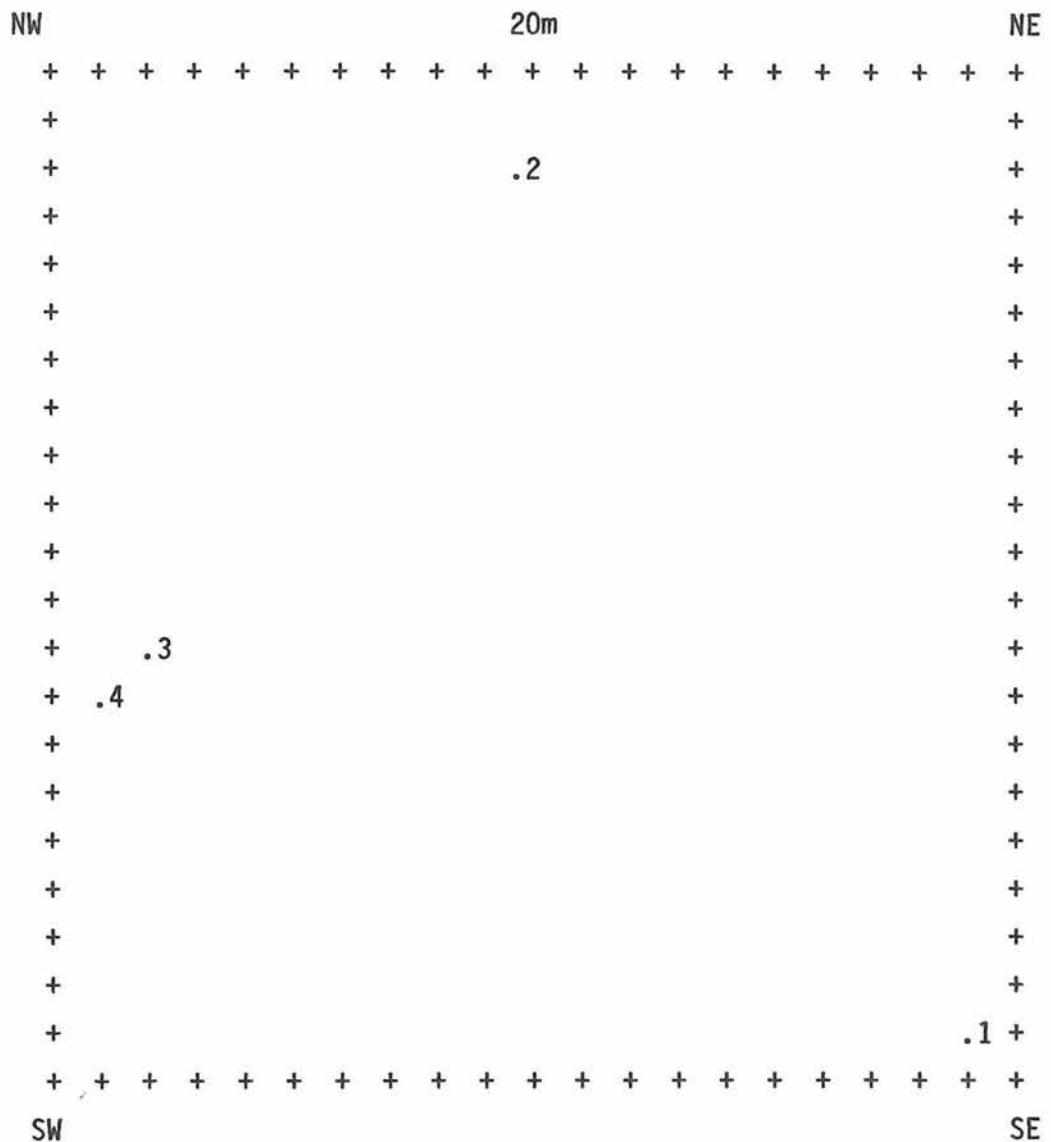
Plot No: 4 (Location of plants is approximate).



Note: Plot 4 is located in open water in south-eastern section of McCarley's Swamp, note trees 1 and 2 in open water at the time of monitoring in January 1987.

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

Plot No: 5 (Location of plants is approximate).



Note: Plot 5 is located on the eastern edge of the open water in the south-eastern section of McCarley's Swamp.

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

Plot No: 6 (Location of plants is approximate).

NW	10m																NE
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+	.44			.40		.39							.30	.29	+	+	+
+		.43													.28		+
+															.27		.24
+					.38			.37			.32						+
+			.42														+
+								.36	.34	.33				.26	.25	+	
+																	+
+																	.23
+				.41				.35									+
+																	+
+															.21	.22	+
+	.14			.15													+
+						.16		.17								.20	+
+	.13																+
+			.12							.18							.19
+																	+
+	.11																+
+								.5									+
+	.10					.7					.4		.3				+
+	.9						.6										+
+	.8														.2	.1	+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
SW																	SE

Note: Plot 6 is located in the south-western section of McCarley's Swamp. The plot is also subdivided into sections (see coding) for data presented in Appendix C.

(NW) (NE)

5E 4E 3E 2E 1E

5D 4D 3D 2D 1D

5C 4C 3C 2C 1C

5B 4B 3B 2B 1B

5A 4A 3A 2A 1A

(SW) (SE)

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

Plot No: 7 (Location of plants is approximate).

NW	20m																NE
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+	.45	.43					.13	.12									+
+	.44																+
+		.41	.42				.15	.14					.10				+
+																	+
+	.40							.16									+
+													.11				+
+.39																	+
+	.37															.9	+
+.38																	+
+	.36												.8				+
+							.18	.17									+
+																.7	+
+	.34	.35					.19					.6					+
+.33								.20									+
+	.30						.21		.5								+
+.31	.29	.28						.4									+
+				.27	.22							.2					+
+									.3								+
+								.23		.1							+
+.32	.26		.25														+
+	+	+	+	+	+	+	+	+	.24	+	+	+	+	+	+	+	+
SW																	SE

Note: Plot 7 is located north of the boundary fenceline in the north-western section of McCarley's Swamp.

APPENDIX B: LOCATION OF TAGGED PLANTS IN VEGETATION PLOTS

Plot No: 8 (Location of plants is approximate).

NW	10m																NE
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+				+				+				+					+
+				+	No. 24			+	Nos.20-23	+					+	No. 19	+
+				+				+				+					+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+				+				+				+					+
+	Nos.27-28	+		+	No. 26	+		+	No. 25	+					+		+
+				+				+				+					+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+				+				+				+					+
+	Nos. 29-30	+						+	No. 31	+	Nos. 16-18	+	Nos. 10-15	+			+
+				+				+				+					+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+				+				+				+					+
+	No. 38	+	Nos. 36-37	+				+	Nos. 32-35	+					+	Nos. 7-9	+
+				+				+				+					+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
+				+				+				+					+
+				+				+				+	Nos. 2-6	+	No. 1		+
+				+				+				+					+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
SW																	SE

Note: Plot 8 is located on the eastern edge of the wetland in the north-eastern section of McCarley's Swamp, just north of the boundary fenceline. The plot is also subdivided into sections (see coding) for data presented in Appendix C.

(NW)	(NE)
5E 4E 3E 2E 1E	
5D 4D 3D 2D 1D	
5C 4C 3C 2C 1C	
5B 4B 3B 2B 1B	
5A 4A 3A 2A 1A	
(SW)	(SE)

APPENDIX C : SUMMARY OF PLOT DATA

H	=	Healthy
Sl.St	=	Slightly Stressed
St	=	Stressed
V.St	=	Very Stressed
Rd	=	Recently Dead
D	=	Dead
Fd	=	Fallen Dead
Adv	=	Adventitious Shoots
E	-	Epicormic Shoots
<BH	=	Below Breast Height

APPENDIX C1 : SUMMARY OF PLOT DATA - EUCALYPTUS RUDIS - JULY, 1987

PLOT NO. 5.

Tree No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
5/1	4	-	-	4	-	-	-	-	-	-	-
Total	4	-	-	4	-	-	-	-	-	-	-

APPENDIX C2 : SUMMARY OF PLOT DATA - MELALEUCA HAMULOSA - JULY, 1987

PLOT NO. 1.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
1/18	1	-	-	-	-	-	1	-	-	-	-
Total	1	-	-	-	-	-	1	-	-	-	-

PLOT NO. 3.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
3/ 1	1	-	-	-	-	-	1	-	-	-	-
3/ 8	3	-	-	3	-	-	-	-	-	-	-
3/ 9	3	-	-	-	-	-	3	-	-	-	-
3/10	1	-	-	-	-	-	1	-	-	-	-
3/11	1	-	-	1	-	-	-	-	-	-	-
Total	9	-	-	4	-	-	5	-	-	-	-

APPENDIX C2 : SUMMARY OF PLOT DATA - MELALEUCA HAMULOSA
- JULY, 1987 (Continued)

PLOT NO. 5.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
5/ 2	32	32*	-	-	-	-	-	-	-	-	-
5/ 3	25	25*	-	-	-	-	-	-	-	-	-
Total	57	57	-	-	-	-	-	-	-	-	-

* Note: 5 stems broken on 5/2, and 1 stem on 5/3 broken.

PLOT NO. 6.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
6/10	1	-	-	-	-	-	1	-	-	-	-
6/29	1	-	-	-	-	-	1	-	-	-	-
6/33	1	-	-	-	-	-	1	-	-	-	-
6/35	1	-	-	-	-	-	1	-	-	-	-
6/36	1	-	-	-	-	-	1	-	-	-	-
6/42	1	-	-	-	-	-	1	-	-	-	-
Total	6	-	-	-	-	-	6	-	-	-	-

APPENDIX C2 : SUMMARY OF PLOT DATA - MELALEUCA HAMULOSA
- JULY, 1987 (Continued)

PLOT NO. 8.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
Quadrat 8A1											
8/ 1	2	2	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	5	-	-	-	-
Quadrat 8A2											
8/ 2	1	1	-	-	-	-	-	-	-	-	-
8/ 3	1	1	-	-	-	-	-	-	-	-	-
8/ 4	1	-	-	-	-	1	-	-	-	-	-
8/ 5	1	1	-	-	-	-	-	-	-	-	-
8/ 6	1	1	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	4	-	-	-	-
Quadrat 8B1											
8/ 7	1	1	-	-	-	-	-	-	-	-	-
8/ 8	1	1	-	-	-	-	-	-	-	-	-
8/ 9	1	1	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	5	-	-	-	-
Quadrat 8B2											
	5	-	-	-	-	-	5	-	-	-	-
Quadrat 8B3											
8/32	2	-	-	2	-	-	-	-	-	-	-
8/33	1	1	-	-	-	-	-	-	-	-	-
8/34	1	1	-	-	-	-	-	-	-	-	-
8/35	1	1	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	4	-	-	-	-
Quadrat 8B4											
8/36	1	-	-	1	-	-	-	-	-	-	-
8/37	2	-	-	1	-	-	1	-	-	-	-
Quadrat 8B5											
8/38	1	-	-	1	-	-	-	-	-	-	-
Quadrat 8C1											
8/10	1	1	-	-	-	-	-	-	-	-	-
8/11	1	1	-	-	-	-	-	-	-	-	-
8/12	1	1	-	-	-	-	-	-	-	-	-
8/13	1	1	-	-	-	-	-	-	-	-	-
8/14	1	1	-	-	-	-	-	-	-	-	-
8/15	1	1	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	1	-	-	-	-
Quadrat 8C2											
8/16	1	-	-	1	-	-	-	-	-	-	-
8/17	1	-	-	-	-	1	-	-	-	-	-
8/18	1	-	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	2	-	-	-	-

APPENDIX C2 : SUMMARY OF PLOT DATA - MELALEUCA HAMULOSA
- JULY, 1987 (Continued)

PLOT NO. 8. (Continued)

Shrub No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl. St	St	V. St	Rd	D	Fd	<BH	Adv	E
Quadrat 8C3											
8/31	2	2	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	5	-	-	-	-
Quadrat 8C4											
	10	-	-	-	-	-	10	-	-	-	-
Quadrat 8C5											
8/29	1	1	-	-	-	-	-	-	-	-	-
8/30	1	-	-	1	-	-	-	-	-	-	-
	1	-	-	-	-	-	1	-	-	-	-
Quadrat 8D1											
	2	-	-	-	-	-	2	-	-	-	-
Quadrat 8D3											
8/25	1	-	-	1	-	-	-	-	-	-	-
	1	-	-	-	-	-	1	-	-	-	-
Quadrat 8D4											
8/26	1	-	-	1	-	-	-	-	-	-	-
	7	-	-	-	-	-	7	-	-	-	-
Quadrat 8D5											
8/27	1	-	-	1	-	-	-	-	-	-	-
8/28	1	-	-	1	-	-	-	-	-	-	-
	12	-	-	-	-	-	12	-	-	-	-
Quadrat 8E1											
8/19	1	-	-	1	-	-	-	-	-	-	-
	1	-	-	-	-	-	1	-	-	-	-
Quadrat 8E3											
8/20	1	-	-	-	-	1	-	-	-	-	-
8/21	1	-	-	1	-	-	-	-	-	-	-
8/22	3	-	-	-	-	3	-	-	-	-	-
	7	-	-	-	-	-	7	-	-	-	-
Quadrat 8E4											
8/24	1	1	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	3	-	-	-	-
Quadrat 8E5											
	2	-	-	-	-	-	2	-	-	-	-
Total	120	22	1	13	-	6	78	-	-	-	-

APPENDIX C3 : SUMMARY OF PLOT DATA - MELALEUCA LATERITIA - JULY, 1987

PLOT NO. 1.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
1/ 3	1	-	-	-	-	-	1	-	-	-	-
1/ 4	1	-	-	-	-	-	1	-	-	-	-
1/ 5	3	-	-	-	-	-	3	-	-	-	-
1/ 6	1	-	-	-	-	-	1	-	-	-	-
1/ 7	1	-	-	-	-	-	-	1	-	-	-
1/ 9	1	-	-	-	-	1	-	-	-	-	-
1/24	1	-	-	-	-	-	1	-	-	-	-
1/25	1	-	-	-	-	1	-	-	-	-	-
1/31	1	-	-	-	1	-	-	-	-	1	-
Total	11	-	-	-	1	2	7	1	-	1	-

PLOT NO. 2.

Shrub No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
2/25	1	-	-	-	-	-	1	-	-	-	-
Total	1	-	-	-	-	-	1	-	-	-	-

APPENDIX C3 : SUMMARY OF PLOT DATA - MELALEUCA LATERITIA
- JULY, 1987 (Continued)

PLOT NO. 3.

Shrub No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
3/16	3	3	-	-	-	-	-	-	-	-	-
3/17	2	-	2	-	-	-	-	-	-	-	-
3/18	7	-	-	6	-	-	1	-	-	-	-
3/19	3	-	-	3	-	-	-	-	-	-	-
3/20	3	1	-	1	-	1	-	-	-	-	-
3/21	1	-	-	-	1	-	-	-	-	-	-
3/22	1	1	-	-	-	-	-	-	-	-	-
3/24	2	-	-	2	-	-	-	-	-	-	-
3/28	3	-	-	1	1	1	-	-	3	-	-
3/29	5	-	-	1	-	4	-	-	4	1	-
3/30	3	-	-	2	-	-	1	-	-	2	-
3/31	1	-	-	1	-	-	-	-	1	-	-
3/32	1	-	-	-	-	-	1	-	1	-	-
3/33	2	1	-	-	-	-	1	-	-	-	-
3/34	1	1	-	-	-	-	-	-	-	-	-
3/35	1	-	-	-	-	-	1	-	1	-	-
3/37	1	-	-	-	-	-	-	1	1	-	-
3/40	1	-	-	-	1	-	-	-	1	-	-
3/44	1	-	-	-	-	-	1	-	1	-	-
3/45	1	-	-	-	-	-	1	-	1	-	-
3/47	1	-	-	-	-	-	1	-	-	-	-
3/48-3/53	6	-	-	-	-	-	6	-	6	-	-
3/54	1	-	-	-	-	-	1	-	-	-	-
3/55	1	-	-	-	-	-	1	-	-	-	-
3/56	2	-	-	-	-	2	-	-	-	-	-
3/57	3	-	-	-	-	3	-	-	-	-	-
3/58	1	-	-	-	-	-	1	-	-	-	-
3/60	1	-	-	-	1	-	-	-	-	-	-
3/61	1	-	-	-	-	-	1	-	1	-	-
3/62	1	-	-	-	-	-	1	-	1	-	-
3/63	1	-	-	-	-	-	1	-	1	-	-
3/69	1	-	1	-	-	-	-	-	1	-	-
3/82	1	-	1	-	-	-	-	-	1	-	-
3/83	1	-	-	-	-	-	1	-	1	-	-
3/84	1	-	-	-	-	-	1	-	1	-	-

[illegible]

APPENDIX C3 : SUMMARY OF PLOT DATA - MELALEUCA LATERITIA
- JULY, 1987 (Continued)

PLOT NO. 6.

Shrub No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
6/18 Quadrat	1	-	-	-	-	1	-	-	-	-	-
6E5	7	-	-	-	-	-	7	-	2	-	-
6E4	10	-	-	-	-	-	10	-	6	-	-
6E3	21	-	-	-	-	-	21	-	11	-	-
6E2	18	-	-	-	-	-	18	-	8	-	-
6E1	11	-	-	-	-	-	11	-	3	-	-
6D5	16	-	-	-	-	-	16	-	6	-	-
6D4	14	-	-	-	-	-	14	-	6	-	-
6D3	7	-	-	-	-	-	7	-	3	-	-
6D2	23	-	-	-	-	-	23	-	16	-	-
6D1	17	-	-	-	-	-	17	-	8	-	-
6C5	12	-	-	-	-	-	12	-	6	-	-
6C4	10	-	-	-	-	-	10	-	6	-	-
6C3	9	-	-	-	-	-	9	-	3	-	-
6C2	23	-	-	-	-	-	23	-	11	-	-
6C1	10	-	-	-	-	-	10	-	5	-	-
6B5	15	-	-	-	-	-	15	-	14	-	-
6B4	10	-	-	-	-	-	10	-	6	-	-
6B3	16	-	-	-	-	-	16	-	14	-	-
6B2	26	-	-	-	-	-	26	-	19	-	-
6B1	9	-	-	-	-	-	9	-	8	-	-
6A5	11	-	-	-	-	-	11	-	6	-	-
6A4	9	-	-	-	-	-	9	-	5	-	-
6A3	2	-	-	-	-	-	2	-	-	-	-
6A2	8	-	-	-	-	-	8	-	5	-	-
6A1	7	-	-	-	-	-	7	-	3	-	-
Total	322	-	-	-	-	1	321	-	180	-	-

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987

PLOT NO. 1.

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
1/ 1	3	-	-	-	2	-	1	-	-	-	2
1/ 2	11	-	-	1	5	1	3	1	-	-	4
1/ 8	2	-	-	-	-	-	2	-	-	-	-
1/10	7	-	3	3	1	-	-	-	-	1	5
1/11	6	-	-	-	3	2	1	-	-	-	2
1/12	1	-	-	1	-	-	-	-	-	-	1
1/13	1	-	1	-	-	-	-	-	-	1	1
1/14	1	1	-	-	-	-	-	-	-	1	-
1/15	4	2	2	-	-	-	-	-	-	2	-
1/16	1	1	-	-	-	-	-	-	-	-	1
1/17	2	2	-	-	-	-	-	-	-	2	-
1/19	3	1	2	-	-	-	-	-	-	1	2
1/20	5	1	1	2	-	-	1	-	-	2	3
1/21	2	1	1	-	-	-	-	-	-	2	1
1/22	3	3	-	-	-	-	-	-	-	1	1
1/23	1	-	-	1	-	-	-	-	-	-	-
1/26	2	-	-	-	2	-	-	-	-	-	-
1/27	1	-	-	-	1	-	-	-	-	1	1
1/28	2	-	-	-	1	1	-	-	-	-	-
1/29	1	-	-	-	1	-	-	-	-	1	1
1/30	1	-	-	-	1	-	-	-	-	-	1
Total	60	12	10	8	17	4	8	1	-	15	26

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987 (Continued)

PLOT NO. 2.

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
2/ 1	1	-	-	-	-	-	1	-	-	-	-
2/ 2	1	-	-	-	-	-	1	-	-	-	-
2/ 3	7	-	-	-	1	1	5	-	-	-	-
2/ 4	6	-	-	-	2	3	-	1	-	1	-
2/ 5	3	-	-	-	-	-	3	-	-	-	-
2/ 6	10	-	-	-	1	-	9	-	-	-	-
2/ 7	7	-	-	-	1	-	6	-	-	-	-
2/ 8	5	-	-	-	-	-	4	1	-	-	-
2/ 9	1	-	-	-	-	-	1	-	-	-	-
2/10	7	-	-	-	2	-	5	-	-	-	-
2/11	4	-	-	-	-	2	2	-	-	-	-
2/12	6	-	-	-	1	2	3	-	-	-	-
2/13	3	-	-	-	2	-	1	-	-	-	-
2/14	17	-	-	-	6	4	7	-	-	1	5
2/15	4	-	-	-	-	1	3	-	-	-	-
2/16	3	-	-	-	2	-	-	1	-	-	2
2/17	7	-	-	-	4	-	3	-	-	1	4
2/18	1	-	-	-	-	-	1	-	-	-	-
2/19	1	-	-	-	-	-	1	-	-	-	-
2/20	1	-	-	-	-	-	1	-	-	-	-
2/21	12	-	-	-	5	2	4	1	-	1	4
2/22	14	-	-	-	-	7	5	2	-	-	-
2/23	7	-	-	-	1	3	3	-	-	-	-
2/24	2	-	-	-	-	-	2	-	-	-	-
2/26	6	-	-	-	-	-	5	1	-	-	-
2/27	6	-	-	4	1	-	1	-	-	-	5
2/28	15	-	-	-	-	4	10	1	-	-	-
2/29	7	-	-	1	3	1	2	-	-	-	1
2/30	5	-	-	-	1	3	-	1	-	-	-
2/31	3	-	-	-	1	1	1	-	-	-	1
2/32	9	-	-	-	3	3	2	1	-	-	1
2/33	7	-	-	-	-	-	7	-	-	-	-
Total	188	-	-	5	37	37	99	10	-	4	23

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987 (Continued)

PLOT NO. 3.

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
3/ 2	1	1	-	-	-	-	-	-	-	-	-
3/ 3	3	2	1	-	-	-	-	-	-	3	-
3/ 4	2	-	1	1	-	-	-	-	-	-	-
3/ 5	1	-	-	1	-	-	-	-	-	-	-
3/ 6	1	-	-	1	-	-	-	-	-	-	1
3/ 7	1	-	1	-	-	-	-	-	-	-	-
3/12	1	1	-	-	-	-	-	-	-	-	-
3/13	2	2	-	-	-	-	-	-	-	-	-
3/14	9	1	8	-	-	-	-	-	-	-	8
3/15	5	5	-	-	-	-	-	-	-	-	-
3/23	20	5	-	13	-	1	-	1	-	-	5
3/25	3	1	2	-	-	-	-	-	-	-	-
3/26	8	-	-	7	-	-	1	-	-	-	7
3/27	4	-	-	2	-	-	1	1	-	-	-
3/36	9	-	2	4	-	-	3	-	-	-	-
3/38	9	-	-	9	-	-	-	-	-	3	9
3/39	9	-	-	6	-	-	2	1	-	-	6
3/41	1	-	-	-	1	-	-	-	-	-	1
3/42	10	-	-	7	-	-	3	-	-	3	4
3/43	8	-	-	3	1	1	3	-	-	-	3
3/46	1	-	-	-	1	-	-	-	-	-	1
3/59	1	-	-	-	-	-	1	-	-	-	-
3/64	1	-	-	-	1	-	-	-	-	-	1
3/65	3	-	-	-	1	-	1	1	-	-	-
3/66	3	-	3	-	-	-	-	-	-	-	1
3/67	3	-	-	1	1	-	1	-	-	-	-
3/68	1	-	-	1	-	-	-	-	-	-	-
3/70	3	-	2	-	1	-	-	-	-	-	2
3/71	1	-	-	-	1	-	-	-	-	-	1
3/72	1	-	-	-	1	-	-	-	-	-	1
3/73	1	-	-	-	-	-	1	-	-	-	-
3/74	1	-	-	-	-	-	1	-	-	-	-
3/75	2	-	-	-	2	-	-	-	-	-	2
3/76	1	-	-	-	1	-	-	-	-	-	1
3/77	3	-	-	-	3	-	-	-	-	-	3

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
-JULY, 1987 (Continued)

PLOT NO. 3. (Continued)

Tree No.	No.of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
3/78	1	-	-	-	1	-	-	-	-	-	1
3/79	1	-	-	-	1	-	-	-	-	-	1
3/80	1	-	-	-	1	-	-	-	-	-	1
3/81	1	-	1	-	-	-	-	-	-	-	-
3/85	1	-	-	1	-	-	-	-	-	-	-
3/86	1	-	-	-	1	-	-	-	-	-	1
3/87	2	1	-	-	-	-	1	-	-	-	1
3/88	1	-	1	-	-	-	-	-	-	-	1
3/90	1	-	-	1	-	-	-	-	-	-	1
3/91	1	-	-	-	-	-	1	-	-	-	-
3/92	2	-	2	-	-	-	-	-	-	-	-
3/94	1	1	-	-	-	-	-	-	-	-	1
3/97	2	-	1	-	1	-	-	-	-	1	-
3/98	1	-	-	-	1	-	-	-	-	-	1
3/99	1	-	1	-	-	-	-	-	-	-	-
3/100	1	-	-	-	-	-	1	-	-	-	-
3/101	2	-	-	-	-	-	2	-	-	-	-
3/102	5	-	-	2	1	-	2	-	-	1	1
3/103	6	-	-	5	-	-	1	-	-	-	3
3/105	3	-	1	-	-	-	2	-	-	-	-
3/108	5	-	3	1	1	-	-	-	-	-	2
3/109	1	-	-	1	-	-	-	-	-	-	1
3/110	2	-	2	-	-	-	-	-	-	-	1
Total	176	20	32	67	23	2	28	4	-	11	74

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987 (Continued)

PLOT NO. 4.

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
4/ 1	17	-	-	-	-	12	5	-	-	-	-
4/ 2	25	-	-	-	-	15	10	-	-	-	-
4/ 3	24	-	-	-	-	18	6	-	-	-	1
4/ 4	23	-	-	-	-	21	2	-	-	-	-
4/ 5	9	-	-	8	-	-	1	-	-	-	2
4/ 6	10	-	-	10	-	-	-	-	-	-	10
4/ 7	9	-	-	-	-	9	-	-	-	-	-
4/ 8	21	-	-	-	-	14	7	-	-	-	-
4/ 9	7*	-	-	-	-	1	6*	-	-	-	-
4/10	5	-	-	-	-	-	5	-	-	-	-
4/11	3	-	-	-	1	1	1	-	-	-	1
4/12	4	-	2	1	1	-	-	-	-	-	-
4/13	4	-	2	-	-	1	1	-	-	-	-
4/14	8	-	-	3	-	2	3	-	-	-	1
4/15	6	-	-	3	1	-	2	-	-	-	4
Total	175	-	4	25	3	94	49	-	-	-	19

Note: * 3 of stems on 4/9 under water.

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987 (Continued)

PLOT NO. 6.

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
6/ 1	4	-	-	-	-	3	-	1	-	-	-
6/ 2	1	-	-	-	-	-	1	-	-	-	-
6/ 3	1	-	-	-	1	-	-	-	-	-	-
6/ 4	3	-	-	-	-	3	-	-	-	-	-
6/ 5	1	-	-	1	-	-	-	-	-	-	1
6/ 6	3	-	-	-	-	-	3	-	-	-	-
6/ 7	2	-	-	-	-	2	-	-	-	-	-
6/ 8	8	-	-	-	-	4	4	-	-	-	-
6/ 9	1	-	-	-	-	-	1	-	-	-	-
6/11	2	-	-	1	-	-	1	-	-	-	1
6/12	1	-	-	-	-	-	1	-	-	-	-
6/13	1	-	-	-	-	-	1	-	-	-	-
6/14	6	-	-	-	-	-	5	1	-	-	-
6/15	2	-	-	-	-	-	2	-	-	-	-
6/16	8	-	-	-	1	-	7	-	-	-	1
6/17	1	-	-	-	1	-	-	-	-	-	1
6/19	3	-	-	-	2	-	1	-	-	-	2
6/20	1	-	-	-	1	-	-	-	-	-	1
6/21	1	-	-	-	-	1	-	-	-	-	-
6/22	9	-	-	-	-	3	6	-	-	-	-
6/23	1	-	-	-	-	-	1	-	-	-	-
6/24	1	-	-	-	-	-	1	-	-	-	-
6/25	10	-	-	2	2	3	3	-	-	-	4
6/26	6	-	-	-	-	-	6	-	-	-	-
6/27	3	1	-	1	-	-	1	-	-	-	1
6/28	1	-	-	-	-	-	1	-	-	-	-
6/30	1	-	-	-	-	1	-	-	-	-	-
6/31	1	-	-	-	-	-	-	1	-	-	-
6/32	1	-	-	-	-	-	1	-	-	-	-
6/34	1	-	-	-	-	-	1	-	-	-	-
6/37	1	-	-	-	-	-	1	-	-	-	-
6/38	1	-	-	-	-	1	-	-	-	-	-
6/39	9	-	-	-	-	6	3	-	-	-	-
6/40	1	-	-	-	-	-	1	-	-	-	-
6/41	1	-	-	-	1	-	-	-	-	-	1
6/43	14	-	-	-	1	7	6	-	-	-	1
6/44	1	-	-	-	1	-	-	-	-	-	1
Total	113	1	-	5	11	34	59	3	-	-	15

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987 (Continued)

PLOT NO. 7.

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
7/ 1	7	-	-	-	-	6	1	-	-	-	-
7/ 2	2	-	-	-	-	-	1	1	-	-	-
7/ 3	3	-	-	-	-	2	1	-	-	-	-
7/ 4	2	-	-	-	-	1	1	-	-	-	-
7/ 5	11	-	-	-	4	3	4	-	-	-	-
7/ 6	4	-	-	-	-	2	-	2	-	-	-
7/ 7	14	-	-	-	-	8	6	-	-	-	-
7/ 8	6	-	-	-	-	3	3	-	-	-	-
7/ 9	6	-	-	-	-	2	2	2	-	-	-
7/10	6	-	-	-	-	5	1	-	-	-	-
7/11	7	-	-	-	-	4	1	2	-	-	-
7/12	9	-	-	-	-	4	5	-	-	-	-
7/13	7	-	-	-	-	5	2	-	-	1	-
7/14	6	-	-	-	-	4	2	-	-	-	-
7/15	5	-	-	-	-	2	3	-	-	-	-
7/16	7	-	-	-	-	1	6	-	-	-	-
7/17	5	-	-	-	2	1	2	-	-	-	1
7/18	1	-	-	-	-	-	1	-	-	-	-
7/19	1	-	-	-	-	-	1	-	-	-	-
7/20	4	-	-	-	-	2	2	-	-	-	-
7/21	5	-	-	-	-	4	1	-	-	-	-
7/22	5	-	-	-	-	4	1	-	-	-	-
7/23	1	-	-	-	-	1	-	-	-	-	-
7/24	11	-	-	1	-	3	7	-	-	-	1
7/25	6	-	-	-	1	-	5	-	-	-	1
7/26	3	-	-	-	-	-	3	-	-	-	-
7/27	1	-	-	-	-	1	-	-	-	-	-
7/28	1	-	-	-	-	1	-	-	-	-	-
7/29	3	-	-	-	-	3	-	-	-	-	-
7/30	5	-	-	-	-	2	3	-	-	-	-
7/31	3	-	-	-	1	1	1	-	-	-	1
7/32	3	-	-	-	-	1	2	-	-	-	-
7/33	4	-	-	-	-	2	2	-	-	-	-
7/34	1	-	-	-	-	1	-	-	-	-	-
7/35	10	-	-	-	2	2	6	-	-	-	2
7/36	2	-	-	-	-	2	-	-	-	-	-

APPENDIX C4 : SUMMARY OF PLOT DATA - MELALEUCA RHAPHIOPHYLLA
- JULY, 1987 (Continued)

PLOT NO. 7. (Continued)

Tree No.	No. of Stems	Condition of Stems								Regrowth Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
7/37	3	-	-	-	1	1	1	-	-	-	-
7/38	3	-	-	-	-	-	3	-	-	-	-
7/39	1	-	-	-	-	-	1	-	-	-	-
7/40	1	-	-	-	-	-	1	-	-	-	-
7/41	6	-	-	-	-	4	1	1	-	-	-
7/42	7	-	-	-	3	-	3	1	-	-	3
7/43	10	-	-	-	1	8	1	-	-	-	1
7/44	5	-	-	-	-	1	4	-	-	-	-
7/45	3	-	-	-	-	-	3	-	-	-	-
Total	216	-	-	1	15	97	94	9	-	1	10

PLOT NO. 8.

Tree No.	No. of Stems	Condition of Stems								Status	
		H	Sl.St	St	V.St	Rd	D	Fd	<BH	Adv	E
8/23	1	-	1	-	-	-	-	-	-	-	-
Total	1	-	1	-	-	-	-	-	-	-	-