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DEPARTMENT OF  
FISHERIES AND WILDLIFE  
WESTERN AUSTRALIA

DUPLICATE

# REPORT NO 41

Published by the Director of Fisheries and Wildlife, Perth,  
under the authority of the Hon. Minister for Fisheries and Wildlife

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## A Survey Method for Identifying Roadside Flora Suitable for Conservation in Western Australia

BY

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PERTH  
WESTERN AUSTRALIA

1981

Department of Fisheries and Wildlife

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PERTH

R E P O R T

No. 41

A SURVEY METHOD FOR IDENTIFYING  
ROADSIDE FLORA SUITABLE FOR  
CONSERVATION IN SOUTH-WESTERN AUSTRALIA

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## A SURVEY METHOD FOR IDENTIFYING ROADSIDE FLORA SUITABLE FOR CONSERVATION IN SOUTH-WESTERN AUSTRALIA.

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### ABSTRACT

*A survey method for identifying flora suitable for conservation alongside roads in south-western Australia was derived from an examination of characteristics of road verges. Two roads, from Midland to Toodyay and from Armadale to Bunbury, were examined. Width of verge, weed cover, soil disturbance, vegetation structure, presence of public utilities, evidence of fire and the type of adjoining land were measured at one mile (1.6 km) intervals on both sides of the road. Also recorded were aesthetic qualities such as stands of beautiful trees and sites of special interest, e.g. the presence of rare plants.*

*Three variables, percentage weed cover, width of verge and vegetation structure were associated with each other and a low percentage weed cover, wide verge and more than three types of plant forms were assumed to be indicative of long term survival of native flora.*

*A survey method is given based on these three variables and consideration of special attributes and aesthetic qualities of road verges. This survey method is extended to small areas of vegetation outside the verge. The method was used on the York to Bruce Rock road and the results are given along with recommendations for flora conservation along the road.*

## I INTRODUCTION

The Western Australian Road Verge Conservation Committee (R.V.C.C.) was formed in 1969 in response to public enquiries about the destruction of roadside flora. This committee made eleven recommendations which were accepted by Government (Table 1). During the next ten years there has been some work on refining road building techniques and on the effect

Table 1. Recommendations of the 1970 report of the Road Verge Conservation Committee

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1. The Lands Department policy of creating three to ten chain road reserves in new areas should be continued.
2. Where wider reserves place an added burden on either individual farmers or the local authority in relation to vermin, noxious weed or fire control Government assistance should be considered.
3. Roadside flora areas should be provided at intervals along existing narrow road reserves. These areas should be selected in Crown land where possible, but the resumption of suitable areas of private land should be considered where necessary.
4. A specialist committee consisting of a highway engineer, a botanist and a forester should be constituted to select and recommend suitable sites for these flora areas.
5. The Commissioner of Main Roads should be vested with the control of the whole reserve on classified main roads.
6. The Main Roads Department should be encouraged to extend the techniques they have developed for the restoration of verges disturbed by construction.
7. Other road construction authorities should be informed of these techniques and encouraged in their use.
8. Public utilities should avoid road reserves wherever possible, but where such reserves are used the authority concerned should be responsible for satisfactory conservation and restoration.
9. Consideration should be given to co-ordinated planning of road verge burning operations to enable the problems of fire and conservation of native flora to be dealt with to the best advantage.
10. That a research programme be implemented to investigate -
  - (a) the effects of season, periodicity and type of burn on native flora
  - (b) the long term re-establishment of native flora on degraded road verges
  - (c) the tolerance level of native species to herbicide sprays in general use.
11. Existing legislation be examined with a view to achieving closer control of picking, sale and export of native flora.

of burning roadside vegetation but most of this work has not been published and continued research has been hampered by a lack of trained personnel.

The present membership of the R.V.C.C. is given in Table 2. The partial implementation of recommendation 10 (employment of a research team) commenced when I was employed as a Temporary Research Officer by the Department of Fisheries and Wildlife for the first half of 1980.

#### A. IMPORTANCE OF ROADSIDE FLORA

Roadside vegetation is important for the conservation of flora and fauna. This is particularly so where the verge is the last vestige of the original vegetation of a region. The linear patches of vegetation may also operate as biological pathways or as migratory routes for animals. Western Australia is renowned for its wildflowers and verges are important in displaying this rich flora to tourists. The diversity, beauty and aesthetic qualities of roadside areas have attracted visitors in the past and conservation is essential to ensure the continued presence of attractive vegetation.

#### B. DESTRUCTION OF ROADSIDE FLORA

Roadside vegetation is lost through frequent burning, invasion by weeds and effects of vermin such as rabbits, farm practices and provision and maintenance of public utilities. In some places it is necessary to clear vegetation for road safety but generally the destruction of vegetation can be avoided. However, there has been little progress in enabling the users of the verge and roadside areas to identify sites for flora conservation. This is partly due to the lack of an assessment system enabling the identification of verges suitable for conservation.

#### C. VESTING AND MANAGEMENT OF ROADSIDES

In accordance with the Main Roads Act, 1930 - 1972, the care, control and management of the road reserve is vested in the Commissioner of Main Roads. The Main Roads Department manages all Highways and Main Roads while the remaining roads are managed by Local Authorities and to a much lesser extent, the Forests Department and some statutory authorities. Services of Telecom, State Energy Commission and the Public Works Department are often accommodated in the verge. Adjoining landholders often decide the fate of verge vegetation by either total clearing, creation of firebreaks, frequent burning or fencing activities.

Roadside areas with native vegetation next to the road reserve may be either freehold or Crown land. These areas are not specifically managed for the conservation of flora and fauna unless the land is vested in the W.A. Wildlife Authority or the National Parks Authority.



Table 2. Membership of the Western Australian Road Verge Conservation Committee in 1980.

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Mr B.J. Beggs	Conservator of Forests (Chairman)
Mr B.K. Bowen	Department of Fisheries and Wildlife
Mr T.E. Coulter	State Energy Commission
Mr P.N. Hewett	Forests Department
Mr C. Keane	Westrail
Dr N.G. Marchant	Western Australian Herbarium, Department of Agriculture
Mr A.A. Mills	Invited Member (local government)
Mr B.L. O'Halloran	Department of Lands and Surveys
Mr R.E. Shaw	Main Roads Department
Mr G.W. Spencer	Department of Agriculture
Mr A.R. Tomlinson	Agricultural Protection Board
Mr R.C. Ward	Country Shire Councils Association
Mr S.A. Young	Telecom Australia
Mr J.C. Adams	Forests Department (Secretary)

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At present there is no mechanism to adequately handle management problems associated with roadside flora and usually the vegetation is destroyed before any action can be taken.

#### D. AIMS OF THIS REPORT

This report provides a means of identifying road verges and roadside areas suitable for flora conservation. Specifically the report aims to:

1. Develop a classification system of flora conservation values for roadside areas and demonstrate the use of the classification. This classification system should enable a person with minimal training to rapidly identify valuable roadside areas.
2. Outline the requirements for future research on flora in roadsides.

## II DEFINITIONS

### 1. Road verge

The road verge is the area of the road reserve between the outside edge of the top of the back slope of the table drain and/or foot of embankment and the boundary of the road reserve.

### 2. Roadside flora areas

These are areas of land with native vegetation suitable for conservation and adjoining the road reserve. Although the R.V.C.C. recognises that acquisition of freehold land may be desirable in some cases (recommendation 3, Table 1), initial emphasis should be on Crown land. At present these Crown lands have many different vestings and purposes.

## III METHODS

### A. RATIONALE

I attempted to measure as many variables as possible in the road verge with the aim of:-

1. identifying those variables which may be indicative of the long term survival of the flora,
2. identifying the minimum number of variables which could be used to rapidly classify road verges suitable for conservation.

To judge long term survival of native flora I attempted to identify vegetation in a natural condition. To minimise the

number of variables, I looked for associations and ease of measurement. The measurements were restricted to the road verge and the results extrapolated to the roadside flora areas.

## B. MEASUREMENTS MADE ON THE ROAD VERGE

Samples were taken on two roads, the Midland to Toodyay road and the Armadale to Bunbury road during February and March, 1980. The Midland to Toodyay road was sampled from 0.0 straight line kilometer (S.L.K.) at Midland to 64.0 S.L.K. at Toodyay. The Armadale to Bunbury road was sampled from 0.0 S.L.K. at Armadale to 78.0 S.L.K. just north of Waroona. These roads provided a contrast between areas of long agricultural practice and native bush. Verges were selected for sampling by stopping at one mile intervals (car odometer in miles) along the road. The verges on both sides of the road were separately sampled. The midpoint of the length of verge in the sample was taken to be where the car stopped and 50 m lengths of road verge was used as sampling units. If the curvature of the road meant moving to a safe parking spot then I walked back to the selected location. Where a townsite was included in a sample stop, I moved on another mile. The following variables were measured:

### 1. Width of verge

- (i) The distance from the sealed surface to the edge of the road reserve.
- (ii) The road verge measured to the fenceline or fire-break. The verge was not measured where the boundary could not be readily determined.

### 2. Weed cover

Weeds are defined as plants growing where they are not wanted. This essentially means all introduced exotic plants on the road verge. The recognition of a weed is difficult, even to an experienced botanist, as at least 10% of the approximately 7 000 species listed for W.A. are exotic (G. Perry pers. comm.). However, all pasture and cultivated land can be said to be covered with weeds in contrast with natural bush and the identity and extent of cover of weeds on a verge can be assessed by direct comparison with adjoining farmland. Percentage cover was used as a measure of the presence of weeds. This was assessed visually for five categories, (0 - 20%; 20-40%; 40 - 60%; 60 - 80%; and 80 - 100% weed cover) in an area of 10 m x verge width.

### 3. Soil disturbance

Road building, firebreaks, vehicles, etc. may cause disturbance to the soil. This disruption was measured as percentage cover in the same way as weed cover.

#### 4. Vegetation structure

Vegetation can be roughly divided into six structural categories:- trees, mallees, shrubs, grasses or herbs, sedges or rushes, and mosses or mat plants. I used the method of Muir (1977), which is designed for W.A. conditions and enables accurate identification of vegetation structural types. A 50 m length x the width of the verge was chosen as the sample area for each verge.

#### 5. Public utilities

The presence and identity of public utilities such as telephone lines, etc. were noted.

#### 6. Fire

Only evidence of fire in the previous year was recorded.

#### 7. Adjoining land

Cadastral maps of the Department of Lands and Surveys were used to identify freehold or Crown land. Both were assessed for each verge as being either cleared or undisturbed.

A subjective but necessary part of any road verge survey is the assessment of the aesthetic qualities of the verge. Sites with particularly attractive features such as rows of beautiful trees and attractive landscapes were recorded, along with the reasons for selection.

Special sites along the road were determined by the presence of any of the following attributes:

##### 1. Rare plants.

These may be gazetted under the Wildlife Conservation Act, 1950 - 1979. Also species may be added to or subtracted from the list by ministerial notice in the Government Gazette.

##### 2. Rare or unusual landforms.

These include the following areas which may have unusual flora:- wetlands, laterite outcrops (in some districts), river beds, granite outcrops and sand patches in laterite areas. These landforms would be expected to have some native vegetation cover.

##### 3. Spectacular floral displays.

These may be areas of verge with one or more species which produce a spectacular display of flowers, or a verge with majestic stands of trees. There may be some overlap with aesthetic sites but usually the special sites will be more important, for example, places where

tourist buses stop so people can admire plants.

#### 4. Locally endemic species.

This category is similar to rare plants but the species may be locally abundant. Because some endemic species are restricted in distribution they require more conservation effort.

### C. STATISTICAL ANALYSES

Tests of association between variables were made by Chi squared tests of association or Fisher exact probability test (Seigel 1956). Comparison of measurements were made by t-tests or Kolmogorov-Smirnov two sample tests (Seigel 1956).

## IV RESULTS

A comparison of measurements for the two sets of road verges is given in Tables 3 and 4. Although the verge size was similar, the Armadale to Bunbury road had more adjoining cleared land, greater weed and soil disturbance cover and fewer forms of plant. The medium value of the verge width frequency was approximately 7.0 m and this provided a convenient separation between small and large verges for conventional 1 or 2 chain roads. For later analyses I lumped the 20 - 100% categories for weed and soil disturbance cover.

### A. MIDLAND TO TOODYAY ROAD

From tests of association between variables, large road verges (>7.0 m) and verges with uncleared adjoining land had less weeds, less disturbed soil and more forms of plant (Tables 5, 6 and 7). The width of the verge and adjoining land use may have an impact on the other variables which in turn may interact among themselves. The results of the analysis of these types of interactions are summarized as follows:

1. The amount of weed cover was independent of the soil disturbance (Table 8).
2. The fewer plant forms present on a verge, the greater the weed cover, particularly if the verge was next to cleared land (Table 9).
3. The number of plant forms was independent of soil disturbance (Table 10).

### B. ARMADALE TO BUNBURY ROAD

None of the road verges were free from weeds (Table 4) while most of the adjoining land is cleared and farmed. Consequently, fewer tests of association between variables were possible and none of these which were made were different from the results for the Midland to Toodyay road.

Table 3. Size of road verge measured along the Midland to Toodyay and the Armadale to Bunbury roads.

Measurement	Midland to Toodyay	Armadale to Bunbury	T-test on means
Number of verges examined	82	100	
Number of verges measured	63	84	
$\bar{x} \pm$ S.E. width (m) from sealed surface to road reserve boundary	11.9 $\pm$ 0.85	12.9 $\pm$ 0.97	t = 0.78 p N.S.
$\bar{x} \pm$ S.E. width (m) of road verge	8.2 $\pm$ 0.83	7.1 $\pm$ 0.77	t = 0.97 p N.S.

Table 4. A statistical comparison of several verge attributes between the Midland to Toodyay (N = 82 road verges) and Armadale to Bunbury roads (N = 92 road verges).

Verge attribute	% of road verges		Significance	
	Midland to Toodyay	Armadale to Bunbury		
Adjoining land	cleared	80.4	96.7	$\chi^2 = 108.06^*$ $p < 0.001$
	uncleared	19.6	3.3	
Weed cover	0 - 20%	26.8	0.0	$\chi^2 = 37.82^+$ $p < 0.001$
	20 - 40%	23.2	3.3	
	40 - 60%	6.1	6.5	
	60 - 80%	3.7	4.3	
	80 - 100%	40.2	85.9	
Soil disturbance	0 - 20%	35.4	14.1	$\chi^2 = 48.17^+$ $p < 0.001$
	20 - 40%	12.2	2.2	
	40 - 60%	15.9	4.3	
	60 - 80%	11.0	1.1	
	80 - 100%	25.6	78.3	
Verge	< 7.0 m	41.5	53.3	$\chi^2 = 2.42^*$
Width	≥ 7.0 m	58.5	46.7	N.S.
	≤ 2 plant forms	29.2	67.4	$\chi^2 = 25.21^*$
	> 3 plant forms	70.8	32.4	$p < 0.001$

\* Chi squared test of independence, 1 d.f.

+ Kolmogorov - Smirnov two sample test, 2 d.f.

Table 5. Test of association between width of verge and adjoining land with the percentage of weed cover for the Midland to Toodyay road.

		Percentage of weed cover		Statistic
		0-20%	20-100%	
Width of verge	<7.0 m	3	31	$\chi^2 = 8.09$
	>7.0 m	19	29	$p < 0.01$
Adjoining land	uncleared	9	7	$\chi^2 = 7.00$
	cleared	13	53	$p < 0.01$

Table 6. Test of association between the width of the verge and the adjoining land with the percentage of soil disturbance for the Midland to Toodyay road.

		Percentage of soil disturbance		Statistic
		0-20%	20-100%	
Width of verge	<7.0 m	8	26	$\chi^2 = 2.73$
	>7.0 m	21	27	$p \text{ N.S.}$
Adjoining land	uncleared	11	5	$\chi^2 = 7.96$
	cleared	18	48	$p < 0.01$



Table 7. Test of association between the width of verge and the type of adjoining land with the number of plant life forms for the Midland to Toodyay road.

		Number of plant life forms		Statistic
		≤ 2	≥ 3	
Width of verge	<7.0 m	18	16	$\chi^2 = 3.78$ $p = 0.05$
	≥7.0 m	14	34	
Adjoining land	uncleared	0	16	$\chi^2 = 10.77$ $p < 0.01$
	cleared	32	34	

Table 8. Test of association between the degree of weediness and the percentage of soil disturbance when separated into different categories of width of verge and adjoining land for the Midland to Toodyay road.

Controlling variable	Value of controlling variable	Sample size of road verges	Percentage cover by weeds		Percentage of soil disturbance		Statistic
			0-20%	20-100%	0-20%	20-100%	
Width of verge	< 7.0 m	34	0-20%	1	2	1	Fisher exact probability test, p = 0.73
			20-100%	6	25		
	≥ 7.0 m	48	0-20%	7	12	7	$\chi^2 = 3.60$ p N.S.
			20-100%	9	20		
Type of adjoining land	uncleared	16	0-20%	1	8	1	Fisher exact probability test, p = 0.077
			20-100%	3	4		
cleared		66	0-20%	7	6	7	$\chi^2 = 1.85$ p N.S.
			20-100%	12	41		

Table 9. Test of association between the degree of weediness and the number of plant life forms when separated into different categories of width of verge and adjoining land for the Midland to Toodyay road.

Controlling variable	Value of controlling variable	Sample size of road verges	Percentage cover by weeds	Number of plant life forms		Statistic
				$\leq 2$	$\geq 3$	
Width of verge	< 7.0 m	34	0-20%	0	3	Fisher exact probability test, $p = 0.094$
			20-100%	18	13	
	$\geq 7.0$ m	48	0-20%	2	17	$\chi^2 = 3.90$ $p < 0.05$
			20-100%	12	17	
Type of adjoining land	uncleared	16	0-20%	0	9	No test necessary
			20-100%	0	7	
	cleared	66	0-20%	2	11	$\chi^2 = 5.55$ $p < 0.05$
			20-100%	30	23	

Table 10. Test of association between the percentage of soil disturbance and the number of plant life forms when separated into different categories of width of verge and adjoining land for the Midland to Toodyay road.

Controlling variable	Value of controlling variable	Sample size of road verges	Percentage cover of soil disturbance	Number of plant life forms		Statistic	
				≤ 2	≥ 3		
Width of verge	< 7.0 m	34	0-20%	2	6	Fisher exact probability test, p = 0.08	
			20-100%	16	10		
	≥ 7.0 m	48	0-20%	4	17		$\chi^2 = 1.08$
			20-100%	10	17		p N.S.
Type of adjoining land	uncleared	16	0-20%	0	11	No test necessary	
			20-100%	0	5		
	cleared	66	0-20%	6	12		$\chi^2 = 1.52$
			20-100%	26	22		p N.S.

### C. WHICH VARIABLES TO CHOOSE?

It was difficult to measure the long term effect of fire or the installation and maintenance of public utilities in a short study. Both may have beneficial or detrimental effects so I have not included them in the final classification system.

Each of the remaining variables presented difficulty in both the measurement technique and usefulness for predicting the long-term survival of flora. It was clear that a wide verge, with few weeds and at least three vegetation types, next to uncleared land, was likely to resemble the pristine condition. These qualities of the verge were also likely to occur together. For a classification system, the condition of adjoining land was not usable as its status can change rapidly and the time since clearing was likely to affect the cover of weeds. The detrimental effect of soil disturbance was also likely to depend on the closeness of a source of weeds.

Below is a short list of variables chosen for the final classification system with reasons for their choice.

#### 1. Percentage weed cover.

This variable provides both a measure of past damage to the verge and the likelihood of native plants successfully competing and reproducing if not further disturbed.

#### 2. Width of verge.

The data given above suggest that a verge greater than 7.0 m in width is likely to maintain native flora.

#### 3. Number of plant forms.

This provides a measure of the structure of the vegetation. The more structural components, the more likely the vegetation is in a natural condition. However, a number of Australian vegetation types are structurally simple, with one or two layers of plants. Such areas should be classified as special sites. The chance of misclassification of vegetation structure will be lowered if the observer is familiar with the types of vegetation of the area being investigated. This can be achieved by the study of vegetation maps and local areas already reserved for the conservation of flora.

#### 4. Other factors to be considered.

Special and aesthetic sites are self-explanatory and have to be included in any classification. The length of verge suitable for conservation presents a similar

problem to choosing an ideal width. The longer the road verge examined, the more species or species associations can be expected. I examined six, 100 m lengths of the Midland to Toodyay road and counted the number of species. I found that the species area curves not only plateaued at or before 500 m<sup>2</sup> but that there were often as many species of native plants from similar vegetation given in Figure 7.2 of Marchant and Hopkins (1979). Calculating species numbers in a survey of road verges would be unsuitable for classification purposes due to the time involved, season and possibility that many long-lived, but unsuccessfully reproducing species, can occur as individuals among a high weed cover. However, it appears that 100 m lengths of verge would not be too small a unit for flora conservation.

#### D. THE CLASSIFICATION OF ROAD VERGES

The detail of how to carry out surveys of road verges based on the above analysis of variables of the verges is given in Appendix I. I have 'weighted' some of the variables which are to be used in the survey. This is to give greater emphasis to wide road verges and verges with few weeds.

#### E. THE CLASSIFICATION OF ROADSIDE FLORA AREAS

Most of the above variables can be used for the classification of roadside flora areas. Additional factors which can be considered are the area, purpose and vesting of Crown lands. Details of survey methods are given in Appendix I.

#### F. TIME TAKEN TO CARRY OUT SURVEYS

Appendix II gives an example of a survey of the York to Bruce Rock road. The survey was carried out using the classification which resulted from the above analyses. From this survey I estimate that one day is needed to examine a 100 km length of road. Another two to three days are required to examine records in the Department of Lands and Surveys and to locate other data on the flora of the area. The road would probably need to be examined again to complete work on roadside flora areas. Thus, approximately five man days are needed to examine 100 km.

### V DISCUSSION

I have presented a classification which will enable a person with minimal training to rapidly identify valuable roadside areas. However, the real test of such a system of classification is the long term survival of the selected areas. This can only be ascertained by long term research some of which I outline below.

#### 1. Percentage weed cover

Experiments are needed on the interaction between weeds and

native flora to answer the following questions.

- (i) With what percentage weed cover or number of weed species can native plants continue to survive and successfully reproduce?
- (ii) What effect do herbicides have on native flora?
- (iii) What weed control measures are necessary to ensure the long term survival of native flora?

## 2. Width and length of verge

Small verges and roadside areas are expected to lose some species and research is needed to determine how many and which species can be expected to disappear. Further sampling along more roads is needed to confirm that seven metres is a desirable minimum width of verge.

## 3. Vegetation structure

Trees may be important for the survival of the understorey and selective replanting may enable the rehabilitation of certain areas.

## A. OTHER RESEARCH NEEDS ON ROADSIDE FLORA

### 1. Burning

Although there does not appear to be any published data on the interaction of fire and weeds in Western Australia, it is likely that an increased fire frequency leads to abundant weed cover hence perpetuating a cycle of frequent burning. Research is needed on this topic to determine what would be an acceptable frequency of burning in various vegetation types.

### 2. Control of vermin and weeds

Control of vermin and weeds is often made difficult by the presence of vegetation in the road verge. In the past the solution was often to clear the verge of vegetation. However, an exact opposite approach may provide the answer to weed and vermin control. A verge with natural vegetation provides less places for weeds to occur. This is a solution to be aimed at but requires further research. Vermin, particularly rabbits, will always be a problem in road verges but economical and effective control should be possible in adjoining land rather than on the verge. Again, further research is needed on this topic.

### 3. Pollutants

Lead, cadmium and other by-products of vehicle use have received considerable attention overseas. Bottomley and

Bougos (1975) and Hosie *et al.* (1978) have measured lead and cadmium levels at Heirisson Island, within the Perth metropolitan area, and found levels lower than examples from U.S.A. No study has been made of rural areas and such research would be useful for determining baseline data. Excessive water run off, salt encroachment and chemicals used in agriculture such as herbicides and fertilizers are other pollutants which may warrant attention.

#### 4. Road construction and maintenance

Pedersen and Walden (1973) detail techniques which are practised by the Main Roads Department for conservation and regeneration of road verges in Western Australia. In some cases soil disturbance is beneficial for regenerating native flora and further research on this could reveal methods of enhancing regrowth of native plants.

#### 5. Rare plants

Hopper (1979) outlines the factors endangering rare species in Western Australia. As roadside areas are often the last vestige of natural vegetation containing rare plants, a systematic survey and monitoring is needed as well as research into the specific needs of certain rare plants.

### B. EDUCATIONAL NEEDS

For conservation to be effective, the public must be aware of the role they play and the result of actions they take. An aware public also acts as a 'conscience' for the public services. Following are some areas where better communication is needed or has been achieved.

#### 1. Firebreaks in the road reserve

The R.V.C.C. has discussed firebreaks with local government and partial agreement reached that firebreaks are not to be placed in the road reserve where there are alternative locations for them.

#### 2. Recognizing flora worthy of conservation

At present this is generally not feasible for persons actively managing the road verge. However, if areas of high flora conservation value were marked in on work plans of the Main Roads Department then protection could be achieved. If Shire Councils had surveys of their road verges, they likewise could manage special areas for conservation of flora. To achieve this at least one person with a knowledge of road building techniques and flora surveying would be needed to liaise between work teams and any botanical research team.



### 3. Adjoining landholders

There is an urgent need to educate adjoining landholders about conservation of native flora. A publicity campaign would be useful. This could include a booklet on roadside flora, to be distributed to country Shires.

### C. ROADSIDE FLORA AREAS

Often the whole road reserve is needed for road construction, particularly on one chain (20 m) roads. Small areas of Crown land, which are usually alongside roads, often become the only natural bushland in cleared and farmed landscapes. Despite an often small size, these areas can be important in providing migration routes for native flora and fauna as well as adding to the attraction of roadsides.

Often roadside areas of Crown land which are covered with natural bush are required for numerous purposes. If an area is not required for its original purpose then the purpose should be changed to conservation of flora. If the area is small then a road verge survey team could carry out a complete survey. If the area is large, then the survey team should recommend a separate survey be carried out. If a separate survey finds against conserving a large area for roadside flora conservation then consideration should be given to reserving a minimum width of at least 100 m alongside the road for the purpose of flora conservation.

Areas required for purposes of conservation of flora and fauna should be vested in the W.A. Wildlife Authority. Managing such reserves would then become a W.A.W.A. responsibility. Areas which are required for other purposes which are compatible with flora and fauna conservation should retain their present purpose plus conservation of flora and fauna. Management of flora and fauna should be arranged through the vesting body and W.A.W.A.

Roads often pass through undeveloped townsites or townsites with few blocks in use. Such mostly uncleared areas are suitable as roadside flora conservation areas but a survey needs to be made. A recommendation for a biological survey of townsites, particularly those of the wheatbelt was also made in the Conservation Through Reserves Committee (1974) report on system 4.

### D. WHICH ROADS TO SURVEY FIRST?

Roads known to have verges with rare species or rare vegetation should be surveyed first. Then Shire by Shire surveys could be made starting with those that have the most cleared land. This means the South West in general, and wheatbelt and coastal plain areas in particular.

## VI ACKNOWLEDGEMENTS

I would like to thank the Department of Fisheries and Wildlife for financing the project, the Western Australian Herbarium for providing laboratory space and the R.V.C.C. subcommittee, consisting of Mr P.N. Hewett (Forests Department), Dr S.D. Hopper (Western Australian Wildlife Research Centre), Dr N.G. Marchant (Western Australian Herbarium) and Mr R.E. Shaw (Main Roads Department) for help and advice. I also thank Dr A.A. Burbidge, Western Australian Wildlife Research Centre, for his comments on the manuscript.

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## APPENDIX I.

### HOW TO CARRY OUT SURVEYS OF FLORA ALONGSIDE ROADS

Because of different management and vestings, the flora alongside roads can be divided into two areas:-

1. the road verge, that part of the road reserve between the top back slope of the table drain and/or the foot of the embankment and the boundary of the road reserve (or fence-line);
2. roadside areas, Crown or freehold land alongside the road which has not been cleared for farming or other purposes.

#### BEFORE EXAMINING THE ROADSIDE FLORA

1. Acquire a map of the road. This should be in sufficient detail to allow another person to relocate designated sites. 1:25 000 or 1:50 000 scale maps are adequate and should show cadastral details.
2. Consult lists of rare plants<sup>\*</sup> and botanists to establish the likely presence of rare plants. Examine records and specimens of rare plants in the W.A. Herbarium to find accurate locality data if such plants occur alongside the road.
3. Examine vegetation maps and vegetation descriptions of the area. This will aid in the identification of natural vegetation types and their relative rarity. Use soil maps if vegetation maps are absent, the assumption being that different soils will have different vegetation.

#### CATEGORIES FOR LISTING DURING THE SURVEY

The roadside flora should be examined for the occurrence of any of the following five categories:-

1. road verge
  - i. special sites,
  - ii. aesthetic sites,
  - iii. flora conservation sites
2. roadside areas
  - i. special sites,
  - ii. flora conservation sites.

#### METHOD FOR EXAMINING ROAD VERGES

##### Special sites

A special site on the road verge may have any of the following attributes:

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\* e.g. Hartley and Leigh (1979), Marchant and Keighery (1979).

### 1. Rare plants

These are gazetted under the Wildlife Conservation Act, 1950-1979. Additional species may be added to this list by Ministerial Notice.

### 2. Rare or unusual landforms

These include the following areas which may have unusual floras:- wetlands, laterite outcrops (in some districts), river beds, granite outcrops and sand patches in laterite areas. These landforms would be expected to have native vegetation.

### 3. Spectacular floral displays

These are areas of verge with one or more species which produce a spectacular display of flowers or a verge with majestic stands of trees. There may be some overlap with aesthetic sites but usually flora display sites will be more important, for example, places where tourist buses stop so people can admire plants.

### 4. Locally endemic species

This category is similar to 'rare plants' but the species could be locally abundant. Because locally endemic species are restricted in distribution they require a greater conservation effort than widespread species.

Having located the road verge with a special site, measure its length along the road, assess weediness, width and floral structural diversity by the methods given for flora conservation areas. Count the number of rare plants and make observations on destructive influences such as firebreaks, rubbish dumping and human interference such as seed collecting. Include comments on the likely effect of fire on the species and the long term survival and general ecology.

#### Aesthetic sites

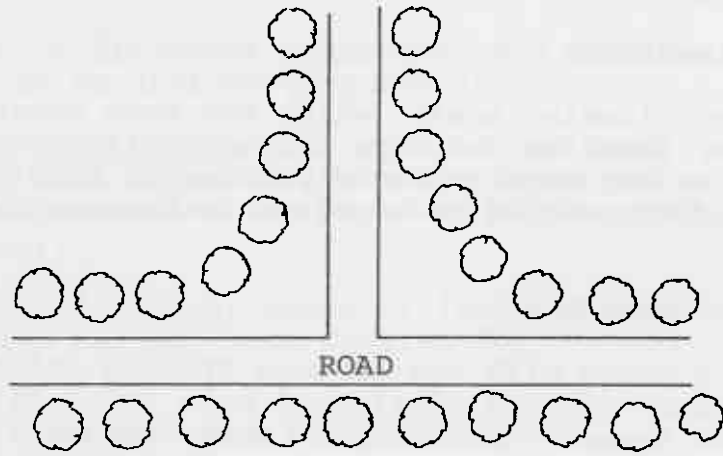
Examine both sides of the road and record the start, finish and reason for the classification of an aesthetic site. What is an aesthetic site? This is difficult to answer precisely as beauty may mean different things to different people. Stands of trees are generally regarded as things of beauty and Figure 1a gives examples of useful attributes of trees in the road verge. Figure 1b gives an example of an aesthetic use of trees. Other examples are rows of mature trees on one side of the road, good stands of a species of shrub and plantations of local native trees or shrubs.

#### Flora conservation areas

Drive slowly (about 60 km/h) along the road, examining both sides for vegetation with mostly native plants or three

FIGURE 1a. EXAMPLES OF THE USE OF TREES IN ROAD VERGES

Demarcation of road - T junctions



Demarcation of road - curves and crests

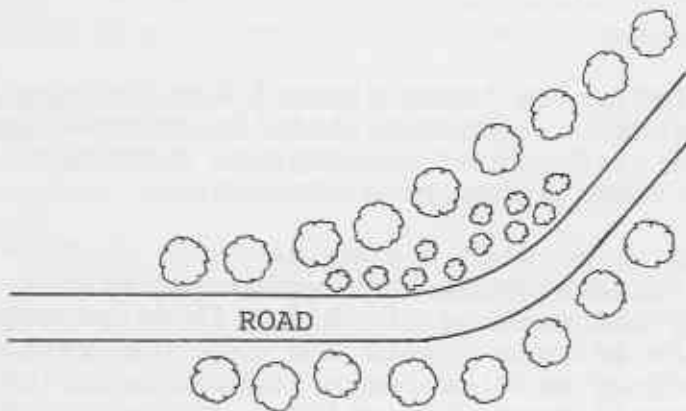
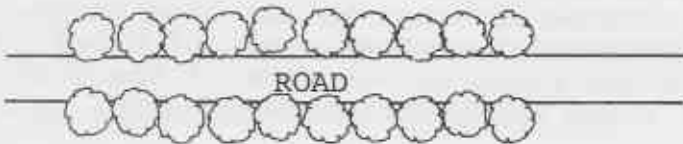


FIGURE 1b. AVENUE OF TREES



- ⊙ = small shrub
- = tree

structural types of plant. A form for the assessment of particular road verges is given in Figure 2, and further explanations of the measurements are given below.

#### 1. Length

This can be measured either with a tape measure or car odometer.

#### 2. Weediness

Compare the verge with a neighbouring cleared and pastured paddock. The verge will either look:-

- i. similar, which implies that it is covered with exotic plants,
- ii. different, i.e. greener in summer, have lots of plants that are not grass-like, which implies that the vegetation is native.

#### 3. Types of vegetation

Compare the structure of plants in the verge with an area of natural bush. Types of plant that can be seen are:-

- i. trees - plants with trunks, e.g. gums,
- ii. mallees
- iii. shrubs - any woody plant, that is not a tree,
- iv. grasses or herbs,
- v. sedges or rushes,
- vi. mosses and ferns.

Three points to remember:-

- i. natural bush may not have any trees,
- ii. shrubs may be very small,
- iii. the bottom of a valley will have different plants, compared with the tops of hills.

#### 4. Width

A wide verge is over seven metres in width even for one chain (20 m) roads. The verge should be measured from the top back slope of the outside edge of the table drain and/or the foot of the embankment to the edge of the road reserve (or fence-line).

#### METHOD FOR EXAMINING ROADSIDE AREAS

Only examine the 100 m closest to the road reserve for areas greater than 10 ha. Such large areas should be recommended to be given separate surveys of flora and fauna if containing natural vegetation. Areas less than 10 ha should be included in the roadside flora survey.

FIGURE 2

ASSESSMENT OF NATIVE FLORA IN ROAD VERGES

ROAD NAME OR NUMBER

OBSERVER

DATE

S.L.K. (or km to Town - state which)

OTHER LOCALITY DATA

SCORE

LENGTH                    m

Less than 100 m = 1; More than 100 m = 2

WEEDINESS

No native plants = 0; Mostly weeds = 1

Mostly bush = 4; Natural bush = 5

PLANT TYPES

Score number of plant types. Types are  
Trees; Mallees; Shrubs; Grasses or herbs;  
Sedges or rushes; Mosses or ferns.  
Total will range from 1 to 6.

WIDTH                    m

Less than 7.0 metres = 1

More than 7.0 metres = 3

LIST OF MAJOR PLANTS (IF KNOWN)

TOTAL SCORE

SCORE INTERPRETATION

3	4	5	6	7	8	9	10	11	12	13	14	15	16
Low conservation value					Inter-mediate			High conservation value					

### Special sites

These are recognised in the same way as special sites on the road verge.

### Flora conservation areas

Again the method is similar to that of road verges and an assessment form is given in Figure 3. Some of the Crown land alongside roads will have already been examined for the conservation of flora. Sources of this information are:

1. Conservation Through Reserves Committee (1974). Conservation reserves in Western Australia. Report of the Conservation Through Reserves Committee to the Environmental Protection Authority.
2. Environmental Protection Authority (1976). Conservation reserves for Western Australia as recommended by the Environmental Protection Authority.
3. Kitchener, D.J. (1976). Preface to the biological survey of the Western Australian wheatbelt. Records of the Western Australian Museum Supplement Number 2 : 3-10 (and subsequent papers).
4. W.A. Department of Fisheries and Wildlife Reports and Bulletins.

To discover for what purpose the Crown land is intended, consult the Roads and Reserves section of the Department of Lands and Surveys. They will give the current purpose and vesting of the land. At present, freehold land is not being considered for conservation of flora by the Road Verge Conservation Committee except in special cases.

### REPORTING ON THE SURVEY

1. Briefly state which road and a summary of vegetation types the road passes through.
2. State who carried out the survey and when.
3. List for the whole road the road verges and roadside areas suitable for conservation with reasons. Clearly show these on the map with the distance of road or area involved.
4. Submit report to the Road Verge Conservation Committee for consideration.



FIGURE 3

ASSESSMENT OF NATIVE FLORA IN AREAS ADJOINING THE ROAD RESERVE

ROAD NAME OR NUMBER

OBSERVER

RESERVE NUMBER

LOT OR LOCATION NUMBER (IF FREEHOLD)

S.K.L. (or km to nearest Town - state which)

OTHER LOCALITY DATA

SCORE

LENGTH                    ha

Less than 1 ha = 0; Between 1 and 10 ha = 1

Greater than 10 ha = 2

WEEDINESS

No native plants = 0; Mostly weeds = 1

Mostly bush = 4; Natural bush = 5

PLANT TYPES

Score number of plant types. Types are  
Trees, Mallees, Shrubs, Grasses or herbs,  
sedges or rushes, Mosses or ferns.

Total will range from 1 to 6.

LIST OF MAJOR PLANTS (IF KNOWN)

TOTAL    SCORE

SCORE INTERPRETATION

1	2	3	4	5	6	7	8	9	10	11	12	13
Low conservation value						Inter-mediate			High conservation value			

## APPENDIX II

### A SURVEY OF FLORA ON AND ADJACENT TO THE YORK TO BRUCE ROCK ROAD VERGE

#### LOCATION

The York to Bruce Rock classified main road is part of the York - Bruce Rock - Merredin road (number 1015) and stretches from the Town of York to the Town of Bruce Rock (Figure 4). The road passes through Quairading as well as a number of rail sidings and through the shires of York, Beverley, Quairading and Bruce Rock. The road is 144 km in length and crosses mostly cleared freehold farmland and a small number of Crown reserves.

#### PHYSICAL FEATURES

The road is entirely within the W.A. wheatbelt. This area of wheatbelt is part of the Yilgarn Block, of Precambrian origin which has weathered into a peneplain of laterites, silica sands and sandy loams and is part of the Swan - Avon River drainage system (Beard 1973) with an annual rainfall variation of 400 to 600 mm.

#### PRESENT MANAGEMENT OF THE VERGE

In accordance with the Main Roads Act, the care, control and management of the road reserve is vested in the Commissioner of Main Roads. Telecom, State Energy Commission (S.E.C.) and water supply services are accommodated in parts of the road verge.

#### VEGETATION ASSOCIATION ALONGSIDE THE ROAD

Beard (1980) and Erickson *et al.* (1979) divide the area into woodland, shrublands, heaths and halophytes on saline soils. Woodlands are either comprised of York Gum (*Eucalyptus loxophleba*), Wandoo (*E. wandoo*) mixed with Jam (*Acacia acuminata*), or Salmon Gum (*E. salmonophloia*) mixed with Gimlet (*E. salubris*). Shrublands may be wodjil (*Acacia* spp.) or tamma (*Casuarina campestris*). Another shrub type occurs on laterite hilltops, mainly dominated by *Dryandra* spp. Heaths commonly occur on sandplains and are dominated by species of Proteaceae, Myrtaceae and Epacridaceae. Other associations between soil and vegetation types for the area are noted in Mulcahy and Hingston (1961).

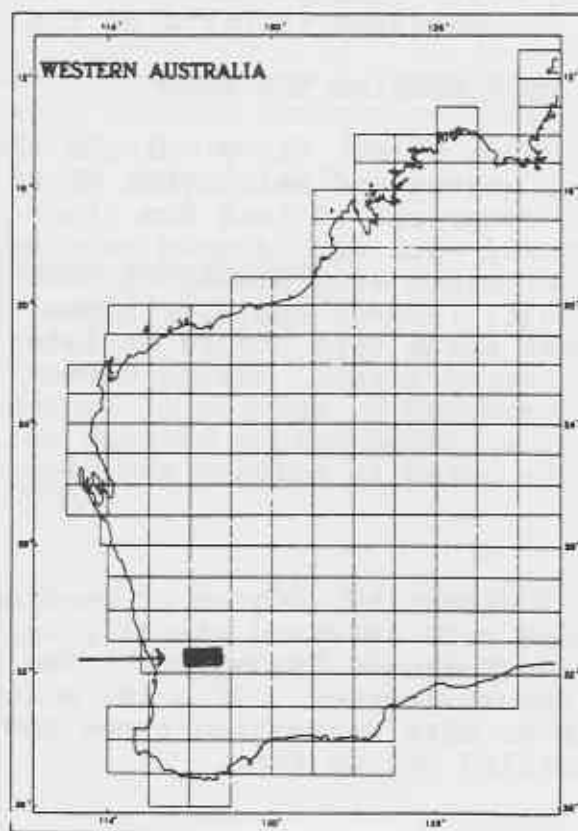
#### METHOD OF SURVEY

The floral structural diversity, degree of weediness, and width of verge on both sides were assessed visually by driving slowly (50 - 60 km/h) between York and Bruce Rock. The classification was checked on the return journey. If a 100 m length of verge had a score of three or more vegetation types and few weeds, a visual survey was carried out on foot.

Figure 4a. Map of York to Bruce Rock road.



Figure 4b. Location within Western Australia of map.



All Crown land was examined on foot for areas near the road and assessed by the methods given in Appendix I. Purpose and vesting of Crown lands was confirmed by examination of records of the Department of Lands and Surveys.

#### SIZE OF VERGE

Except for few locations, the verge varied between two and six metres in width. In places where the verge was greater than seven metres there was either little natural vegetation (if the area was a truncation caused by road re-alignment) or good natural vegetation worthy of conservation.

#### ARTIFICIAL REVEGETATION OF THE VERGE

Extensive revegetation by tree planting has occurred in the road verge, along the entire length of the road. The trees were mostly *Eucalyptus* spp.

#### REGENERATION OF ABUNDANT NATIVE SPECIES

There was no obvious regeneration of natives (except for *Casuarina* spp. and *Eucalyptus* spp.) alongside the road but this assessment is influenced by the season and duration of examination.

#### FACTORS ADVERSELY AFFECTING THE VERGE VEGETATION

1. Weed growth
2. Fires (rare)
3. Clearing under Telecom lines (rare)
4. Firebreaks (rare)

#### SITES FOR FLORA CONSERVATION ON THE VERGE

As almost the entire length of the road is adjacent to cleared farmland the few remaining verges with natural vegetation are therefore specially valuable.

- i. Special sites (reasons are set out in the survey results)
  1. Old stock route (no. 20) (for location of sites see maps)
  2. Tamma shrubland (no. 35)
  3. *Banksia* and *Xylomelum* on wide road verge (no. 44)
  4. Rare *Banksia* site (no. 29)
- ii. Sites with natural vegetation

Apart from the above special sites the verge was generally in a degraded condition. Areas of verge approaching a natural condition have been included in the aesthetic sites.

## AESTHETIC SITES

These almost entirely consist of rows of gum trees along the one side of the road and locations are given in the results section. Extensive lengths of verge have these trees and this indicates a certain wisdom in recent road construction.

## CROWN LAND ALONGSIDE THE ROAD

Information on Crown land alongside the road is summarised in Table 11. Three reserves are for conservation of flora but have other purposes (apart from fauna conservation) and are not vested. Muir (1978, 1979a,b) describes some of the Nature Reserves in the York, Quairading and Bruce Rock Shires but his survey only covers one of the reserves surveyed in this report (no. 10121). In a survey of conservation reserves of W.A. (C.T.R.C. 1974) it was pointed out the need to obtain country and railway water supply reserves and townsites for flora and fauna conservation if not needed for these purposes. This recommendation involving country and railway water supply reserves was subsequently accepted by cabinet (E.P.A. 1976).

### i. Special sites

1. Unnumbered reserve at 49 S.L.K. has the only breakaway and laterite cap, with associated flora, alongside the road (no. 21).
2. Cancelled reserve 16400 near Kwolyin Townsite, rock outcrop and associated vegetation (no. 36).

### ii. Sites with natural vegetation

These are summarised by the conservation value scores in Table 11. Values greater than or equal to 9 are worthy of conservation for flora.

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Table 11. Crown land alongside the York to Bruce Rock road. Location category gives S.L.K. (straight line kilometers); direction (N = north, S = south) and local authority (Y = York, B = Beverley, Q = Quairading, BR = Bruce Rock). N.V. = not vested.

Location	Reserve number	Purpose	Vesting	Approx. area (ha) on map	Number	Comment	Conservation value score
4.5 N Y	5498	Camping and caravan park	N.V.	7	2		5
5.3 S Y	8572	Exempt from sale or purchase	N.V.		3		5
6.0 N Y	5501	Public utility	N.V.	0.2	4		5
6.3 N Y	8570	Gravel	Cancelled	1.2	5	Cleared and farmed	-
8.0 N Y	8571	Gravel	York Shire Council	2	6		8
9.8 N Y	5502	Townsite	Cancelled	73	8	Cleared and farmed	-
10.0 N&S Y	-	Townsite			9	Mt Hardey townsite	8
15.5 N Y	2617	Gravel	York Shire Council	20.2	11		9
16.7 S Y	6074	Railway	Cancelled		12	Marley Pool (cleared and farmed)	-
23.2 S Y	2570	Public utility	N.V.	2.0	15	Cemetery and church	5
26.0 N&S Y	-	Townsite			17	Kauring townsite	8 (part) 5 (part)

cont'd....

Table 11. - cont'd....

Location	Reserve number	Purpose	Vesting	Approx area (ha)	Number on map	Comment	Conservation value score
42.5 N&S B	-	Townsite			19	Mawson townsite	9
45.0 N Q	-	Road reserve	Commissioner of Main Roads		20	Old stock route (special site)	-
49.0 S Q	-	-	N.V.		21	Special site	-
59.5 N&S Q	-	Townsite			24	Dangin townsite	4
65.0 N&S Q	16405	Water Supply and conservation of flora and fauna	Minister for Water Supply, Sewerage and Drainage	408	25		11
69.0 S Q	20494	Aerodrome	Quairading Shire	45	26	Aerodrome	9
69.0 N Q	-	Townsite			26	Quairading townsite (part)	9
77.0 N&S Q	10121	Conservation of flora and fauna	N.V.	59	28	Description in Muir (1979a)	10
87.0 N&S Q	-	Townsite			31	Yoting townsite	9
94.0 N&S	-	Townsite			33	Pantapin townsite	9
104.0 N&S BR	16400	Railway water supply	Cancelled		36		9

cont'd....



Table 11 - cont'd...

Location	Reserve number	Purpose	Vesting	Approx area (ha)	Number on map	Comment	Conservation value score
105.0 N&S BR	Townsite	Townsite			37	Kwolyn townsite	9
112.5 N BR		Townsite			40	Shackleton townsite (cleared)	-
113.8 N BR	17824	Conservation of flora	Bruce Rock Shire Council	4	41		5
115.6 N&S BR	A22131	Public recreation	Bruce Rock Shire Council	367	42	Cokine Spring	9
134.8 S BR	13503	Water	N.V.	7	46		5
136.3 S BR	20363	Gravel	Bruce Rock Shire Council	2	48		3
140.5 N&S BR	17266	Aerodrome site	Bruce Rock Shire Council	129	50	Aerodrome	9 (part)

Table 12. Recommendations for Crown land alongside the York to Bruce Rock road

Reserve number	Approx. area (ha)	Local Authority	Present purpose and vesting (N.V. = not vested)	Recommended vesting and purpose (W.A.W.A. = W.A. Wildlife Authority)
8571	2.0	York	Gravel, York Shire Council	Conservation of flora and fauna, W.A.W.A.
2617	20.7	York	Gravel, York Shire Council	Conservation of flora and fauna, W.A.W.A.
*	2.0	Quairading	None, N.V.	Conservation of flora and fauna, W.A.W.A.
16405	408.0	"	Water Supply and conservation of flora and fauna, Minister for Water Supply, Sewerage and Drainage	To remain with present purpose and vesting.
20404	45.0	"	Aerodrome, Quairading Shire Council	Aerodrome and conservation of flora and fauna, Quairading Shire Council
10121	59.0	"	Conservation of flora and fauna N.V.	Conservation of flora and fauna, W.A.W.A.
17266	129.0	"	Aerodrome site, Bruce Rock Shire Council	Aerodrome site and conservation of flora and fauna, Bruce Rock Shire Council.

\* Listed as no. 21 on map.

Table 13. Reserves and townsites alongside the York to Bruce Rock road which should be given further study. All these areas have flora suitable for conservation.

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Reserve number	Local authority	Present purpose and vesting
-	York	Mt Hardey townsite
-	York	Kauring townsite
-	Beverley	Mawson townsite
-*	Quairading	Part of Quairading townsite
-	Quairading	Yoting townsite
-	Quairading	Pantapin townsite
-	Quairading	Kwolyin townsite
A22131	Bruce Rock	Public recreation, Bruce Rock shire

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\* Listed as no. 26 on map

RESULTS OF A SURVEY OF YORK TO BRUCE ROCK ROAD VERGE  
 (the numbers refer to the accompanying map, Figure 5)

Number	S.L.K.	
1	1.5 - 2.5	Aesthetic site, north side, trees but pipeline beneath.
2	4.5	Reserve 5498. Good cover of York Gum, <i>Casuarina</i> and Jam but ground cover mostly weeds.
3	5.0	Reserve 8572, similar to reserve 5498 but with east end partly cleared.
4	6.0	Reserve 5501, Wandoo trees with natural ground cover and abundant weeds, old road in middle of area.
5	6.3	Reserve cancelled and cleared for farming.
6	8.0	Reserve 8571, used as gravel pit and rubbish dump. York Gum, <i>Casuarina</i> and Jam with good regeneration of trees and few weeds.
7	4.0 - 10.0	Aesthetic site, both sides, trees.
8	10.0	Reserve cancelled, cleared and farmed.
9	10.0	Mt Hardey Townsite, mostly with natural vegetation but one block cleared.
10	11.8 - 14.5	Aesthetic site, both sides, trees.
11	15.5	Reserve 2617. Extensively cleared for gravel pit but now has regeneration of Wandoo and <i>Casuarina</i> . Weed growth present where there has been dumping of rubbish.
12	16.7	Reserve cancelled and cleared for farming.
13	17.0 - 18.0	Aesthetic site. North side, trees.
14	20.0 - 23.0	Aesthetic site. North side, trees.

Number	S.L.K.	
15	23.2	Reserve 2570, contains a cemetery and church. Both appear to be abandoned. This is a possible site of historical interest as well as flora conservation. Good tree cover, some shrubs and numerous weeds.
16	24.0 - 25.0	Aesthetic site, both sides, trees.
17	26.0	Kauring townsite, partly uncleared areas with mostly natural vegetation and few weeds. Parts cleared and farmed.
18	27.0 - 57.0	Aesthetic site, south side, trees.
19	42.5	Mawson townsite, uncleared with mostly natural vegetation and few weeds.
20	44.5 - 48.5	Old stock route, now included in road reserve. Natural vegetation with few weeds, some soil disturbance in places.
21	49.0	Unnumbered reserve, with natural vegetation, breakaway and laterite outcrop with associated ( <i>Dryandra</i> ) flora. One road, shown as hatched on the map is not present. Part of Lot 14978 may be included in the vegetated area.
22	49.2 - 57.0	Aesthetic site, south side, trees.
23	57.5 - 59.0	Lot 27045 on south side of road, vacant Crown land with York Gum and Jam but mostly weeds. Suitable for revegetation.
24	59.5	Dangin townsite, mostly cleared of natural vegetation.
25	63.7 - 66.0	Reserve 16405. This reserve has a large area and was only examined along the road. Has natural vegetation and few weeds.
26	69.0	North side of road, natural vegetation with few weeds within Quairading townsite, purpose of land unknown. South side of road, natural vegetation around aerodrome, within Quairading townsite.
27	75.0 - 76.0	Aesthetic site, north side, trees.

Number	S.L.K.	
28	77.0	Reserve 10121, salt flat, described in Muir (1979b) and recommended for retention of purpose (conservation of flora) and vesting in the West Australian Wildlife Authority.
29	79.0 - 80.0	<p>North and south side, rare plant and relict sandplain heath vegetation. Both sides of the verge share between 60-70 trees of the rare plant <i>Banksia</i> aff. <i>ilicifolia</i>. This as yet undescribed species (A.S. George, pers. comm.) is listed (as <i>Banksia cuneata</i>) as a plant at risk but not currently known to be endangered or vulnerable (Hartley and Leigh 1979). However, it is listed as 'rare' by the more detailed study of Marchant and Keighery (1979). W.A. Herbarium records reveal that this plant is known from three other locations and the population of plants being discussed here is the largest as well as the only one known alongside the road. However, a cursory examination of nearby reserve 23758 (277 ha reserve for the conservation of flora and fauna, vested in the W.A. Wildlife Authority), revealed only two more plants of the <i>Banksia</i>.</p> <p>A firebreak has been cleared in the north side, east end of the road verge. Also some branches have been removed from trees in what would appear to be an attempt at seed collecting. The verge is between 9.6 and 13.3 metres wide and despite abundant weeds supports a variety of sandplain heath plants. The <i>Banksia</i> trees are of variable age, appear healthy and have good follicle set (for a <i>Banksia</i>). The seed is retained in the follicle and the follicle probably requires fire to open. The absence of juvenile plants also suggests that fire is necessary for regeneration.</p>

Number	S.L.K.	
30	85.2	Small corner on north side, part of Lot 20170 with a mixture of native plants and weeds.
31	87.0	Yoting townsite, uncleared except for wheat silo. North side of road with natural vegetation and few weeds.
32	89.0 - 92.0	Aesthetic site, north side, trees.
33	94.0	Pantapin townsite, natural vegetation with few weeds.
34	96.0 - 98.0	Aesthetic site, north side, trees.
35	98.0 - 100.0	Relict vegetation, both sides of road. Sandplain heath vegetation with <i>Banksia</i> , <i>Hakea</i> , <i>Dryandra</i> , <i>Casuarina</i> and <i>Acacia</i> . Verge is about 6.0 m in width on both sides.
36	104.0	Reserve cancelled, mostly uncleared natural vegetation. Only example of monadnock and associated flora alongside the road.
37	105.0	Kwolyn townsite, partly cleared but remainder is natural vegetation.
38	107.0 - 108.0	Aesthetic site, both sides, shrubs of <i>Casuarina</i> and <i>Grevillea</i> .
39	111.5	Wide road verge, mostly weeds and some planting of trees.
40	112.5	Shackleton townsite, cleared of natural vegetation.
41	113.7	Reserve 17824. Most of the area has been used as a gravel pit and there are extensive areas of weeds near the railway line side. Although this land was set aside for flora conservation it is considerably degraded. Main shrubs are <i>Casuarina</i> spp.
42	116.0	Road crosses northern end of reserve 22131. Roadside area vegetated with samphire and dead trees, showing possible increased salination of the area.
43	118.0 - 124.0	Aesthetic site, both sides, trees and shrubs.
44	124.5 - 126.5	Wide road verge on south side, natural vegetation with <i>Xylomelum</i> and <i>Banksia</i> trees with few weeds. Clearing for Telecom line on

Number	S.L.K.	
		road edge of this verge has damaged some of the vegetation.
45	128.0 - 129.0	Aesthetic site, north side, trees.
46	134.6	Reserve 13503, Salmon gum and Gimlet woodland with some ground cover of introduced grasses. A dam is present with drains.
47	135.0 - 136.3	Aesthetic site, north side, trees.
48	136.5	Reserve 20363, gravel pit with little vegetation.
49	137.2 - 138.5	Aesthetic site, north side, trees.
50	140.5	Reserve 17266. Aerodrome site but two areas have been separated from the main reserve by roads. These two areas contain gravel pits and natural vegetation with trees of Gimlet and Salmon Gum, also <i>Hakea</i> , <i>Grevillea</i> , <i>Acacia</i> and a few weeds.



Figure 5. Map and locations on the York to Bruce Rock road.

