AMENITY VALUE OF NATIVE VEGETATION

Report to the South Australian Native Vegetation Authority
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February, 2000

1. Introduction

The purpose of this report is to inform the Native Vegetation Authority about findings of a study on landscape quality in South Australia which are of relevance to its deliberations on the amenity value of clearance applications. It is understood that the main concern of the Authority lies with applications which involve scattered trees rather than broadacre tracts of vegetation.

Amenity refers to the pleasantness of places [Shorter Oxford] and while this clearly covers more than the visual environment [eg odour, noise] it is taken here as referring essentially to landscape quality. Landscape quality, or scenic quality, is the relative quality of the scene as determined by people viewing the scene. Thus it is a subjective quality but nevertheless can be measured and analysed objectively.

2. Assessment of Landscape Quality

The study has been undertaken as part of PhD studies at University of Adelaide (*Landscape Quality Assessment of South Australia*. 2000) It has:

- photographed landscapes across South Australia; plus slides from collections
- developed a map of landscape character for South Australia
- selected 160 representative slides covering the areas of varying landscape character
- held sessions with 319 adult respondents from a variety of groups who rated the slides on a 1 – 10 scale
- analysed the results

The analysis of the results has examined the influence of land form, land cover, land use, water and other factors on the preferences.

The slides are a surrogate of the scene and many studies have indicated that providing certain criteria are met they provide a very satisfactory basis for assessing landscape quality comparable with on-site assessments. The scenes need to be in colour, should provide lateral and foreground context, and not be artistic in their composition. Photographs tend to provide a more objective response while site assessments tend to provide a more subjective response influenced by a range of site factors unrelated to landscape quality [eg wind, temperature, smell]. Black and white photographs tend to produce more extreme responses and emphasise the formalist qualities of the picture. In practical terms slides overcome the obvious logistical difficulties in gaining responses from over 300 respondents to 160 widely scattered scenes.

The 1 - 10 scale provides a convenient instrument to measure respondents' assessment of landscape quality but it needs to be emphasised that it is a surrogate of preferences. This is not a "3" scene and that a "7" scene, rather the individual viewing a scene condenses all that they see into an appraisal of its landscape worth and expresses this in the form of a number. Respondents quickly settled into a process of assessing scenes and rating them and none indicated difficulty with the scaling instrument.

The assessments are of the *perception* of landscape quality, not landscape quality *per se*. Although care has been taken to best ensure that the measurement of the perceptions reflects the physical landscape, it remains a perception by humans of the landscape that is being measured.

3. State-wide findings

The overall mean rating of the 155 scenes for South Australia was 5.83 [SD 0.93]. Table 1 and Figure 1 summarise the average ratings for scenes per landscape region.

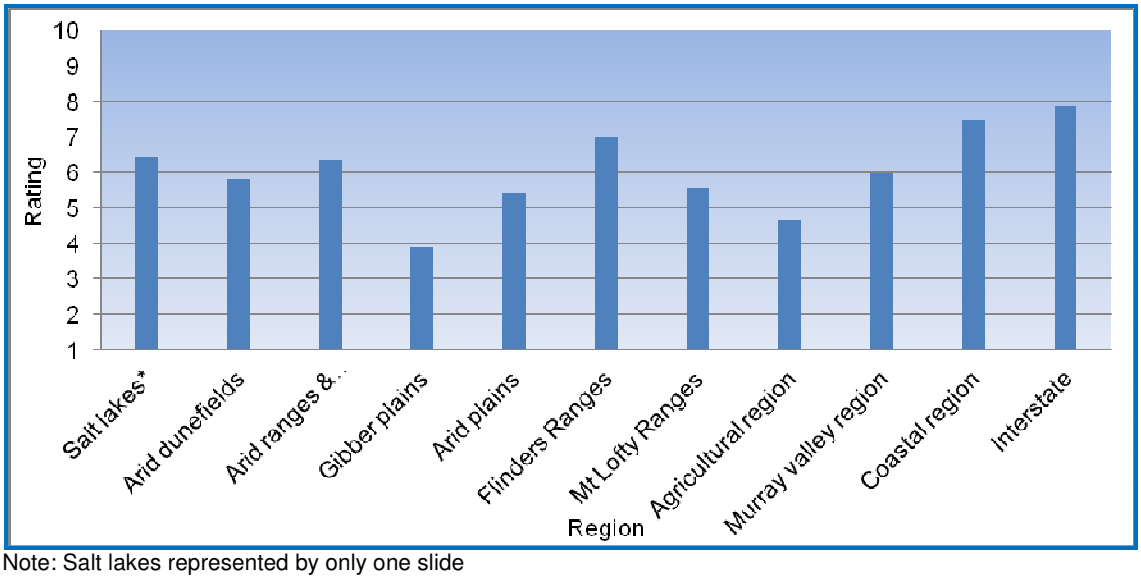
Table 1 Average Ratings by Landscape Region

Region	Area [sq km]	Mean	Stnd Dev
1. Salt lakes	30380	6.43	-
2. Arid dunefields	438660	5.82	0.81
3. Arid ranges & uplands	88720	6.36	1.14
4. Gibber plains	40230	3.90	1.30
5. Arid plains	208735	5.43	1.26
6. Flinders Ranges	28150	7.01	0.96
7. Mt Lofty Ranges	5170	5.57	0.81
8. Agricultural region	140885	4.66	0.83
9. Murray valley region	4030	5.98	0.83
10. Coastal region	2860*	7.49	1.09

* Includes only units within the coastal region; most of this region is contained within the agricultural, Mt Lofty Ranges and Murray Valley [ie Coorong] regions.

Table 2 Ranking of Landscape Regions

Region	Mean Rating
Coast	7.49
Flinders Ranges	7.01
Arid ranges	6.36
Murray Valley	5.98
Arid dunefields	5.82
Mt Lofty Ranges	5.57
Arid plains	5.43
Agricultural region	4.66
Gibber plains	3.90



Note: Salt lakes represented by only one slide

Figure 1 Mean Ratings of Landscape Regions

Based on the distribution of scenes analysed on a regional basis, the coast was rated the highest followed by the Flinders Ranges and the arid ranges [ie Musgraves, Mann Ranges]. The order of regional rankings is summarised by Table 2.

The order of these suggests a strong influence of naturalism and elevation in the ratings. The low rating of agricultural regions suggests the converse of naturalism and the influence of generally flat agricultural land in depressing preferences. This ranking indicates the overall amenity ranking of the agricultural area and Mt Lofty Ranges relative to the other regions. It is noteworthy that these regions are not only in the lower half of rankings but their mean rating is below the average for the state as a whole [5.83]. The relatively low rating of the Mt Lofty Ranges [5.57] is particularly surprising given its popularity for sightseeing.

The agricultural and Mt Lofty Ranges regions were particularly well represented in the survey by 41 and 31 slides respectively, nearly half the total of 160 slides.

4. Significance of Trees in the Landscape

An assessment was undertaken of the significance of the trees in scenes. This identified scenes which contained trees, ie vegetation with a tree form, and included low sparse trees in arid areas through to tall, thick eucalypts and pines in wetter areas. It included many scenes in agricultural regions and the Mt Lofty Ranges with scattered trees and clumps of trees. It contained a few scenes of extensive tracts of vegetation. There were a total of 111 scenes which contained trees. The significance of the trees in the scenes was assessed on a 1 - 5 scale, 1 being insignificant and 5 being very significant.

Table 3 summarises the average ratings. Figure 2 indicates the scores of significance of trees vs the ratings of the scenes in the five classes, and Figure 3 provides a boxplot[1] of the ratings.

Table 3 Statistics of Significance of Trees in Scenes

	Score			
	1 - 1.99	2 - 2.99	3 - 3.99	4 - 4.99
Mean	4.89	5.71	6.15	6.09
SD	1.07	0.98	0.99	1.10

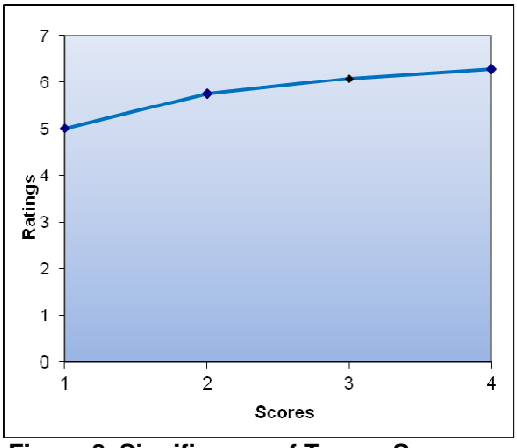


Figure 2 Significance of Trees - Scores vs Ratings

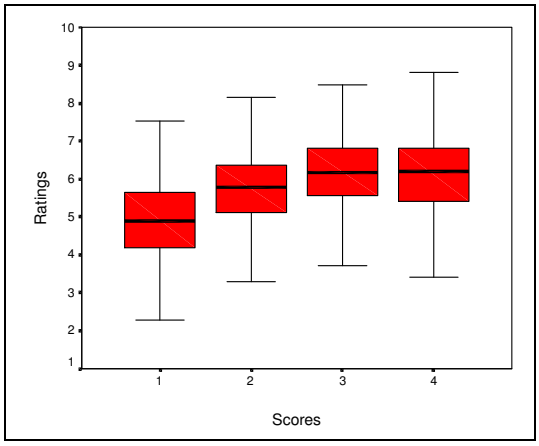


Figure 3 Boxplot of Scoring of Significance of Trees

The ratings clearly increase with the scoring of the significance of trees as described by the following algorithm: $y = 0.40x + 4.70$; $r^2 = 0.81$. The algorithm indicates that scenes with highly significant trees [score 5] rated 31% higher than scenes with insignificant tree cover [score 1]. These results indicate that the clearance of trees can have a significant impact on landscape quality.

These figures cover all scenes. The significance of trees in scenes of crops and pastures and of scenes in the Mt Lofty Ranges is shown by the following algorithms [including all scenes for comparison]:

Trees in all scenes
$y = 0.40x + 4.70$ $r^2 = 0.81$
31% increase in ratings

Trees in crops & pasture scenes
$y = 0.27x + 3.93$ $r^2 = 0.99$
22% increase in ratings

Trees in Mt Lofty Ranges [hills & pastures, mixed uses and vines]
$y = 0.41x + 4.34$ $r^2 = 0.99$
32% increase in ratings

All of these indicate that trees have a positive influence on preferences and, particularly in scenes containing a variety of land forms and land uses, the effect of

1. Boxplots show the distribution of ratings for each of the scores. The box covers the 25% - 75% of ratings, ie 50%, while the lines indicate the extremities of the distribution. The line across the box is the median.

the trees is quite substantial. Using the algorithm for all scenes, Table 4 indicates the loss in landscape quality which would result from clearance [to score 1] at each score level. For example, if vegetation which scored 4 was cleared there would be a 24% reduction in landscape quality.

Table 4 Reduction in Landscape Quality by Vegetation Clearance

Score	Average Rating*	% Change in Rating
1	5.10	
2	5.50	8%
3	5.90	16%
4	6.30	24%
5	6.70	31%

* based on algorithm $y = 0.40x + 4.70$; $r^2 = 0.99$

5. Vegetation Height and Density

To seek further explanation of the role that vegetation plays in influencing preferences, all scenes were analysed regarding the height and density of vegetation. This covered all forms of vegetation, not just trees, so included low coastal and chenopod vegetation along with tall eucalypts and pines. The height and density of vegetation were each assessed on a 1 - 5 scale, with 1 being low height/very scattered vegetation through to 5 being very high/dense vegetation.

In analysing the scenes, height and density were assessed independently of each other and the vegetation with the highest height and the greatest density were used as the basis of the scoring. The scoring ignored grass cover and crop cover. The analysis in this paper also excluded coastal scenes and several scenes with pines, willows and dead trees.

Table 5 summarises the ratings for the scores of vegetation height and density and the mean ratings are illustrated by Figure 4. The earlier illustrations of scenes included their height and density scores.

Table 5 Ratings of Vegetation Height and Density

	Scores			
	1	**2**	**3**	**4**
Height - mean	4.98	5.35	6.01	6.38
- SD	1.10	0.99	1.01	1.02
Density - mean	5.10	5.37	5.91	6.09
- SD	1.11	0.99	0.96	1.13

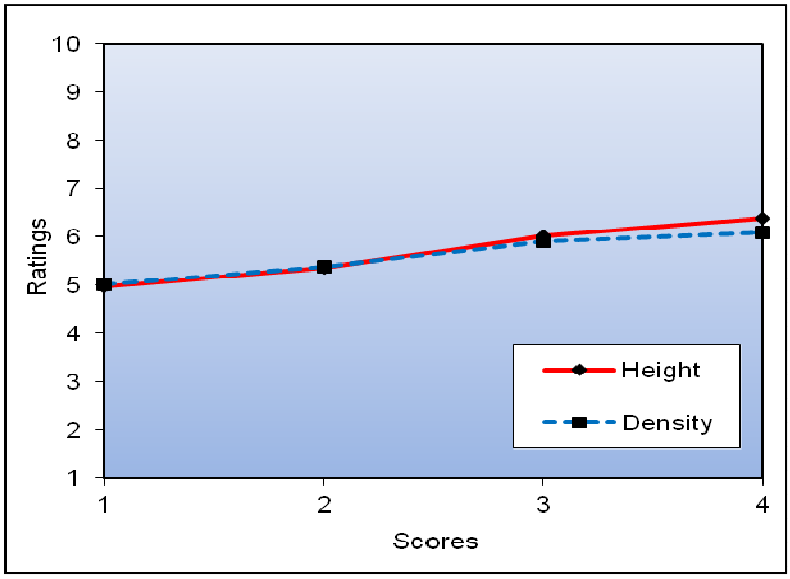


Figure 4 Vegetation Height & Density

The algorithms for the vegetation height and density are shown below:

Height	$y = 0.49x + 4.47$; $r^2 = 0.99$
Density	$y = 0.38x + 4.65$; $r^2 = 0.97$

These figures indicate that both height and density have a substantial influence on landscape quality ratings; clearance of high dense vegetation will have a greater impact on landscape quality than clearance of high vegetation of low density.

Tables 6 and 7 indicate the effect of clearance of vegetation of varying heights and densities. These are comparable with the earlier assessment based on the significance of the vegetation and indicate that clearance can have a substantial effect on landscape quality.

Table 6 Vegetation Height - Effect of Clearance

Score	Average Rating*	% Change in Rating
1	4.96	
2	5.45	10%
3	5.94	20%
4	6.43	30%
5	6.92	40%

* based on algorithm $y = 0.49x + 4.47$; $r^2 = 0.99$

Table 7 Vegetation Density - Effect of Clearance

Score	Average Rating*	% Change in Rating
1	5.03	
2	5.41	7.6%
3	5.79	15%
4	6.17	23%
5	6.55	30%

* based on algorithm $y = 0.38x + 4.65$; $r^2 = 0.97$

6. Types of Vegetation

The types of vegetation present in the scenes were analysed to assess their influence on preferences. The types of vegetation were grouped and average ratings derived. These are summarised by Table 8.

Table 8 Ratings of Vegetation Types

Vegetation Type	Scenes	Mean	SD
Coastal vegetation	9	7.60	1.32
Littoral vegetation	3	5.55	1.45
Dead trees	2	5.04	1.92
River Murray vegetation	10	6.45	1.19
Mallee	4	5.94	1.55
Pastoral	10	5.33	1.19
Hills, fields & trees[2]	16	5.09	1.23
Dense eucalyptus woodlands	8	6.59	1.12
Vegetation adjacent to other water bodies[3]	4	7.19	1.23
Introduced and cultural vegetation			
Pines	2	4.62	1.75
Willows	2	5.48	1.52
Orchards	2	5.76	1.40

Notes: 1. Mainly in Mt Lofty Ranges
2. ie other than coastal and R. Murray scenes

It is important to appreciate that the ratings derive from the entire set of attributes contained in the scenes, not just the vegetation. For example coastal scenes are the highest rated of all scenes in South Australia but this is unlikely to be due to the low ground-hugging vegetation which characterise the coast. Table 8 and Figure 5 summarise the vegetation types. These only include vegetation in the southern agricultural regions, they omit the far north area.

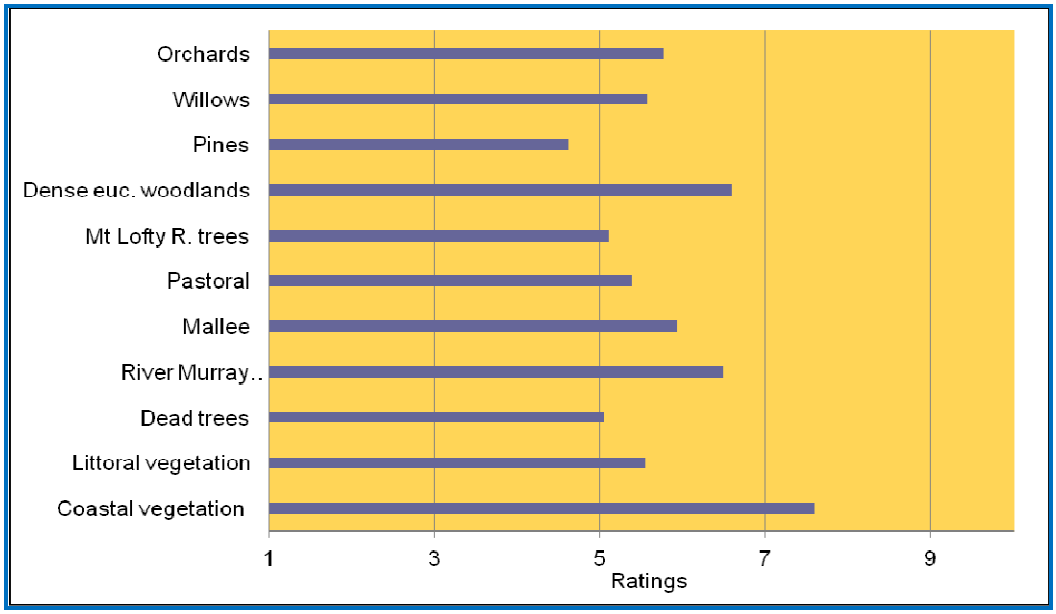


Figure 5 Ratings of Vegetation Types

The littoral vegetation refers to samphire and mangrove flats along coast and thick vegetation adjacent to the Coorong.

Dead trees refer to drowned vegetation in the River Murray. These were large red gums standing in water. It is notable that these dead trees actually rated higher [5.04] than pine plantations [4.62] which may be due to the positive influence of water on ratings.

River Murray vegetation refers to stands of red gums lining the river and on the flood plain. The high rating [6.49] probably reflects the positive effect that water has on preferences.

The mallee vegetation rated surprisingly high [5.94], however several of the scenes were relatively close-up which heightens the diversity of form and colour of individual mallee trees.

Scenes with pastoral vegetation are discussed below.

The vegetation in the Mt Lofty Ranges covers scattered trees and clumps of vegetation in the Mt Lofty Ranges and near vineyards including in the Barossa and Clare areas.

The stands of dense eucalyptus woodlands occurred largely in valleys in the Mt Lofty Ranges and the high rating [6.59] is considered a reasonable reflection of the preferences for this type of vegetation.

The pines along with willows and orchards are introduced types of vegetation in contrast to the rest [including arid vegetation] which are indigenous. The average ratings for these two groups are summarised in Table 9.

Table 9 Rating of Indigenous and Introduced Vegetation Types

	Mean	Standard Deviation
Indigenous Vegetation	6.11	0.95
Introduced Vegetation	5.29	1.25

The table indicates that overall, the indigenous vegetation types are rated 15.5% higher than the introduced vegetation types reinforcing the preference for naturalism.

7. Pastoral Scenes

The pastoral scenes comprise isolated large trees with grass ground cover and scored an average of 5.38 which is surprisingly low compared with the overall state-wide mean of all scenes of 5.83. Because such vegetation is often subject to NVA consideration as clearance applications, the individual scenes used in the assessment are illustrated below together with their ratings and scores for significance, height and density.

Although some of these scenes include hilly and sloping land, overall they reflect land which might be subject to clearance applications for vines.

The relationship of ratings with the significance of the trees in the scenes is indicated by Figure 6.

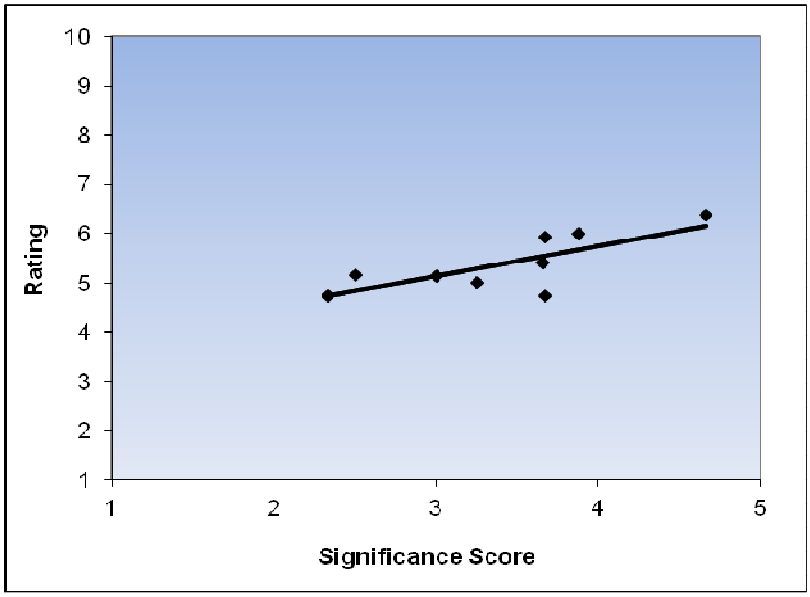


Figure 6 Pastoral Scenes – Ratings vs Significance of Trees

The algorithm for the relationship is: $y = 0.57x + 3.49$; $r^2 = 0.51$. Table 10 indicates the percentage change in rating for clearance for each significance score. It indicates for example that clearance of class 4 vegetation would result in a 42% reduction in its landscape rating, from 5.77 to 4.06.

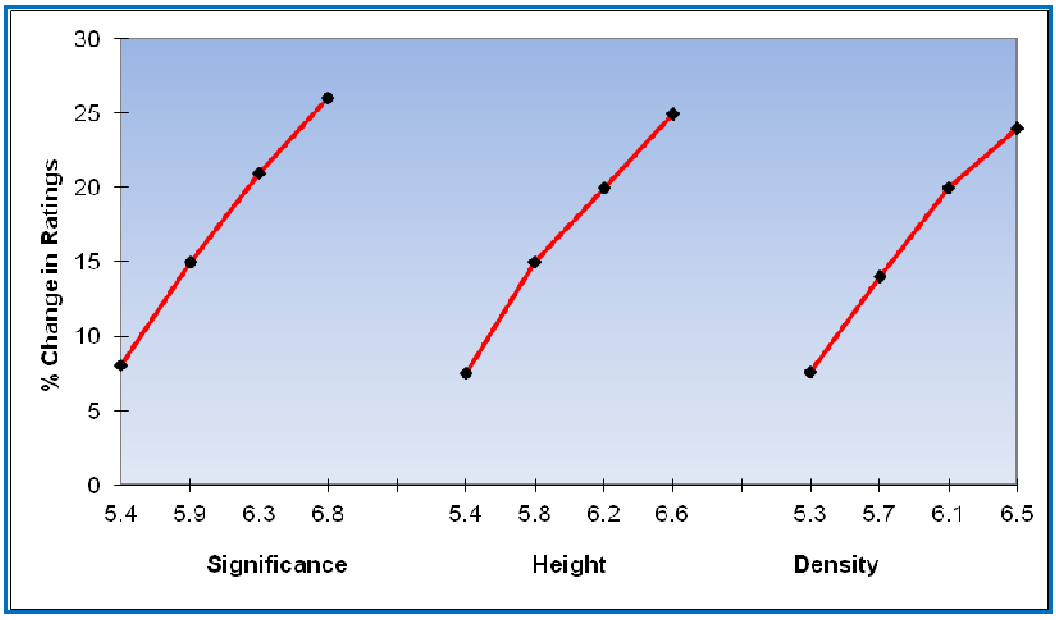


Figure 7 Effect of Clearance on Ratings

Table 10 Changes in Ratings

Significance Score	Average Rating*	% Change in Rating
1	4.06	-
2	4.63	14.0%
3	5.20	28.1%
4	5.77	42.1%
5	6.34	56.2%

* based on algorithm $y = 0.57x + 3.49$; $r^2 = 0.51$

The relationships of height and density with ratings are weak and the correlation coefficients are too low for the algorithms to be useful:

Height: $y = 0.35x + 4.11$; $r^2 = 0.27$
Density: $y = 0.35x + 4.37$; $r^2 = 0.03$

The significance score however can provide a short cut to determining the likely effect on ratings of clearance.

8. Application by Native Vegetation Authority

The foregoing results are derived from a much wider study of the South Australian landscape. However the results indicate that the methodology could provide the Authority with a robust and rigorous means for determining the likely consequences on amenity of clearance. To achieve this, the following four step process is proposed:

(1) Photograph a selection of typical landscapes of the types which are subject to clearance applications. This should cover the range of regions and vegetation types. The photographs should be in colour, provide good lateral and foreground context and avoid artistic composition. A total of 20 – 30 scenes should be included, however if there are widely differing vegetation types then there should be say 20 of each. Slides should be used.

(2) Have a range of respondents rate the scenic quality of the scenes on a 1 – 10 scale. A smaller group [say 6] should score the significance of the trees, their heights and densities. This will provide the data necessary to derive relationships between the preference ratings and the characteristics of the vegetation. The number of respondents should exceed 30 and preferably reflect the wider community – persons with botanical knowledge should not participate. Tertiary students make an ideal group as their responses are close to the average for the community.

(3) Analyse the data to provide predictive algorithms of the type shown here. Test whether scores of the significance of trees, their height or density provide the best measure. These may be used to apply to scenes in applications.

(4) Compile of set of benchmark scenes for the five scores of significance, height or density, and use these to assess the vegetation in the application. With experience the scoring of trees will be straightforward. For example, an application may have trees which are rated 4 on significance and use of the percentage change chart [as in Table 10] will indicate the likely effect that clearance would have on the landscape rating.

9, Conclusion

The results of a state-wide assessment of landscape quality provide a context and methodology for assessing the impact of clearance applications on amenity.

Providing the process is undertaken objectively and with care to avoid introducing any biases, it should provide results which the Authority could use in assessing the impact on amenity and, if necessary, backing its judgement in appeals.