3. ACQUIRING THE DATA

The collection of the data on which the scenic quality survey was based is described in this chapter. It covers the photography of the region, the classification of landscape units, the selection of scenes for the survey, and the development and implementation of the survey instrument.

3.1 PHOTOGRAPHY OF THE RIVER MURRAY REGION

(1) Approach to photography

The River Murray in South Australia is approximately 560 km in length from the Customs House on the Victorian border to Wellington. Added to this is a further 11 km to the NSW border, making a total river length of 571 km.

The terminal lakes, Lakes Alexandrina and Albert, cover 850 km². The length of their shoreline is approximately 350 km (GIS measurement; excludes Finniss River, Currency Creek, Hindmarsh Is and other islands).

The Coorong comprises two main lagoons about two to three km wide, and 140 km in total length.

Taking into account the two banks of the River Murray, the total length of shoreline (River, Lakes and Coorong) is at least 1770 km and more likely nearer 2000 km. This does not include anabranches and lagoons or Lake Bonney.

In approaching the photography of the River Murray region it would be clearly impractical to photograph every kilometre of it. Neither was this necessary. Rather a sampling of landscapes was undertaken which aimed to ensure that each type of riverine landscape was represented.

7. Due a surveying error, the South Australian/Victorian border from the sea to the River Murray was placed 3.6 km west of its correct location. This resulted in a dogleg with the South Australian/Victorian border following the River Murray for about 11 km. The location of the border in the River has not been defined although the border between Victoria and NSW is the south bank and NSW has the River.

The method used was that all accessible and navigable roads available in a region were traversed to the River, Lakes and Coorong and photographs taken. In addition, to view the land from the water, two boat trips were taken:

- **Spirit of the Coorong** This boat went from Mundoo, south past the barrages and along the Coorong to Cattle Point opposite Mark Point, a distance of 23 km.

- **Spirit of the Murray** This boat travelled from Customs House on the Victorian border down the River Murray to Wellington, a five day trip.

These trips enabled areas to be photographed from the water which was particularly important for viewing infrastructure (e.g. pumping stations, boat ramps, locks & barrages), housing developments including shacks and marinas, and reaches of the river difficult to access from land.

Photography was undertaken on a total of 31 days from mid May to early August, 2006, a 12 week period made necessary by cloudy conditions. Although it was winter, it was very dry and sunny days occurred throughout this period. The last two days of the river boat trip (Morgan to Wellington) however became increasingly overcast.

Being winter meant that the daylight hours were relatively few. In summer, photography can be conducted from about 7 - 8 am until 6 - 7 pm, up to 12 hours a day. In winter this was nearly halved to about 7 hours, from around 9 am to around 4 pm.

![Figure 3.1 Sun angle for 22 June](www.susdesign.com/sunangle)

Note: Data for 140° E, 35° S
Source: [www.susdesign.com/sunangle]

© Dr Andrew Lothian, Scenic Solutions
A further consideration was the low angle of the sun. At midday it was only 33° compared with 77° in summer (Fig 3.1). For much of the day, the sun was lower than 33° and created long shadows. Due to the low angle, photographs could not be taken into the sun because of strong back lighting and the loss of features. A further difficulty for photographs into the sun was the reflection of the sun off the water.

Being winter, the ubiquitous willows were without leaves. This resulted in them being mainly reddish-brown in colour due to the branches being visible instead of the dense green foliage of summer. Any leaves present were yellow.

The flow in the River Murray was at minimum entitlement flow and accordingly the level of the river was low – at pool level.

Despite these difficulties, over 6200 photographs were taken, both from land and from water. Nearly 9,000 km was travelled including 600 km by boat.

(2) Photographic Criteria

Photography was based on the following principles:

- Principle of representativeness – the photographs should cover the diversity of riverine landscapes and the variations within each type;
- Principle of equivalence – that similar scenes of a given type of riverine landscape, e.g. cliffs and river, should gain similar ratings; thus location was not critical but the characteristics present;
• Principle of complexity – the photographs should reflect the complexity of the riverine landscapes;
• Principle of typicality – scenes were selected which typified a particular landscape;
• Principle of simplicity – landscapes were photographed to contain a minimum of components, and complicating and distracting elements were avoided as far as possible.

Photographs were taken at 50 mm focal length, which is equivalent to that of the human eye. The composition of each photograph sought to minimise extraneous features such as people, sheep or cattle, fences, electricity poles and wires, and excavations or other eyesores. Any of these can influence preferences either positively or negatively and as many were of an ephemeral nature and not part of the scene they were excluded. However as waterbirds were common throughout the riverine environment, photographs were taken of scenes with and without wildlife to assess their contribution to scenic ratings.

Photographs were in the horizontal landscape format, not the vertical portrait format. The photographs extended where possible to the horizon, and avoided close-up confined views.

The photographs deliberately did not include the transitory effects of special atmospheric lighting such as sunsets or particularly vivid side lighting. Nor did they reflect the influence that clouds could have on a scene – heavy cloud dampens colour saturation while spectacular cloud formations enhance the scene. Sunny cloud-free conditions were sought to standardise scenes against a blue sky.

Photographs were taken so that, as far as possible, the rating reflected the quality of the scene, not the quality of the photograph. Photographic composition of a scene to frame a view or to lead the viewer into a scene can enhance its appearance and was avoided as far as possible.

A Nikon D70 SLR digital camera was used throughout. Its advantage over lesser digital cameras was that the lens could be set at the correct focal length8. Digital photographs were recorded at the normal image quality and the medium image size, producing images of 2,240 X 1,488 pixels (3.3 megapixels) which were recorded by 8 – 900 kilobytes. Only a UV filter was used on the camera.

---

8. The focal length of digital cameras is multiplied by 1.5 to equate to conventional cameras. Thus a focal length of 35 mm in the Nikon D70 equates approximately to 50 mm in a conventional camera.
Note: Waypoints were registered by GPS. At each waypoint several photographs, up to 6 were taken. On the Spirit of the Murray trip waypoints were registered at regular intervals and photographs taken between them.

Figure 3.2 Location of waypoints of photographs
waypoint recorded was a small distance from the actual photograph. The location of the waypoints was also recorded on maps.

The waypoints for each site were later transferred to the 1:50,000 digital topographic map of the region using OziExplorer™. Google Earth™ was also used to record their locations. Figure 3.2 indicates the distribution of the waypoints throughout the Project Area.

Table 3.1 Summary of photographs

<table>
<thead>
<tr>
<th>Location</th>
<th>Land</th>
<th>Water</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Border to Renmark</td>
<td>287</td>
<td>329</td>
<td>616</td>
</tr>
<tr>
<td>Renmark to Lock 3</td>
<td>548</td>
<td>666</td>
<td>1214</td>
</tr>
<tr>
<td>Lock 3 to Morgan</td>
<td>351</td>
<td>417</td>
<td>768</td>
</tr>
<tr>
<td>Morgan to Wellington</td>
<td>1538</td>
<td>911</td>
<td>2449</td>
</tr>
<tr>
<td>Lakes, Finniss River, Currency Ck, Hindmarsh Island</td>
<td>743</td>
<td>0</td>
<td>743</td>
</tr>
<tr>
<td>Coorong</td>
<td>299</td>
<td>190</td>
<td>489</td>
</tr>
<tr>
<td>Total</td>
<td>3766</td>
<td>2513</td>
<td>6279</td>
</tr>
</tbody>
</table>

Note: Lock 3 is near Overland Corner at the commencement of the trench section

Table 3.1 and Figure 3.3 summarise the photographs taken from the land and from water for each section of the Project Area.

3.2 OBSERVATIONS FROM FIELD WORK

Based on the extensive travel in the region, the following observations were made.

(1) Rubbish

Farm rubbish was often found dumped in gullies leading to the River, particularly in the trench section. In several instances, the River was in sight of the rubbish.

Shack areas were generally clean and tidy without rubbish. Many groups of shacks had sets of bins near the entrance for rubbish.

Rubbish above Purnong Lagoon, River Murray

Car wreck opposite Swan Reach
(2) Holiday housing and floods

Most of the shacks were located on the floodplain and were therefore subject to flood risk. Due to the freeholding of Crown land shacks, many of the former dwellings have been replaced by substantial houses, often two storey. The bottom floor was often enclosed whereas an open structure would pose less risk from floods.

In 1974, the author witnessed the damage that a fast moving flood carrying trees and other debris could do to shacks, essentially ripping apart galvanized steel and fibreboard cladding, undermining foundations, and destroying toilets, fences and other objects in its path. Considerable amounts of building materials were deposited in the River. Although the total number of shacks has not changed greatly, the investment they represent has vastly increased over the 30 year period and accordingly the cost of a major flood, when it occurs, will be much greater.
Flood marks on tree, opposite Devlins Pound

Flood levels at Morgan

Flood levels on windmill superstructure, Good Hope Landing

Flood levels at Swan Reach
Houseboat moorings occupied significant lengths of the river bank, generally near towns where the need for public access to the waterfront was greatest. The creation of marinas for the houseboats, as at Kia Marina near Mannum, Long Island at Murray Bridge, and Riverglen south of Murray Bridge, moved the houseboats off the riverfront.

Not only were houseboats available for hire, they were also sold as an alternative to land-based housing. In future, it might be expected that many older houseboats will be sold upon reaching the end of their hire lives.
(4) Dead trees

Signs of stress of the trees through lack of water were evident along the length of the River Murray, though generally in pockets rather than widespread. As the last flood which covered the floodplain was in 1993, many of the trees were suffering from lack of water.

(5) Access

Sections of the river valley could not be visited by land as many access roads were restricted. Indeed, access was found to be much more restricted by locked gates and the ubiquitous signs “Trespassers Prosecuted” than when the author was involved in planning and environmental work on the River in the 1970s and 1980s.

(6) Facilities

Most of the river recreation areas near the towns were characterised by spacious lawns and suitable facilities. Some toilets, such as those illustrated, were poorly located in a highly visible area but these were comparatively rare.

(7) Subdivision

The extensive freeholding of former Crown Land shack sites may have reduced the pressure for further subdivision along the River Murray, at least for the time being. Along the Coorong, however, where shack sites were fewer, subdivisions were occurring.
Landscape units are areas of similar physical characteristics which provided the basis for sampling the riverine landscapes. Photographs in the survey were selected to represent the characteristics of each of the landscape units.

This section summarises the geomorphological classifications of the study area which various authorities have developed to describe its characteristics. It then describes findings from past studies of this study’s author relevant to the delineation of landscape units. Finally the derivation of landscape units for the study area is described. These form the basis for the scenic quality survey.

(1) Existing geomorphological classifications

C.R. Twidale (1976), a geomorphologist, described the River Murray in South Australia thus:

The River Murray partly flows through a narrow, moderately deep trench eroded through calcareous sandstones of Miocene age … Intrenched meanders are well developed, and there are good examples of undercut bluffs and slip-off slopes.

The valley sidewalls display both faceted and graded slopes, as well as all gradations between the two extreme types…

The steepest slopes are found where the river is actively and vigorously eroding the base of the slope and that, conversely, the smoothest and most gentle slopes are found where the river is furthest removed from the slope…

The location of the intense attack must change in time as the river curves migrate downstream.

In 1974, the South Australian State Planning Authority carried out the first planning study of the Murray Valley, which was led by the author. The study (State Planning Authority, 1978) classified the region into three major physiographic units: the broad valley (Border to Overland Corner), Trench (Overland Corner to Wellington) and the Lakes and Coorong.

Figure 3.4 summarises the key geological, geomorphological and vegetation influences on each unit. These are depicted in ecological terms, showing the relationship between the inter-relating influences.
Figure 3.4 (a) Broad Valley Section (Border to Overland Corner)

Figure 3.4 (b) Trench Section (Overland Corner to Wellington)
In her MA thesis on the geomorphology of the Murray Valley (1975), Robyn Thomson summarised the land forms:

Intrenchment has produced a variety of valley-side slopes related directly or indirectly to fluvial processes acting upon the combined effects of Pleistocene to Tertiary stratigraphy and jointing. Processes of sub-aerial weathering, erosion and deposition subsequently modified the primary slopes.

The morphology of the intrenched valley is locally variable due to structural differences rather than to changes in discharge through the evolution of the river...

There are two types of river channel pattern: a meandering pattern occurs upstream of Overland Corner whereas the river has an ‘angular meandering’ form downstream from this locality. This difference in pattern suggests that the Murray River in its lower reaches is still in a period of adjustment to the lateral surface, as it flows across a deep floodplain.

The geomorphic units of the Murray valley in South Australia are chiefly the product of intrenchment, and minor baselevel changes. However, some of the present-day landforms are being modified by, or may be the result of, (1) chemical weathering, (2) mass movements, (2) normal fluvial processes, (4) Aeolian processes, and (5) anthropogenically induced processes.

Thomson mapped the valleysides, the floodplain, lakes, lagoons, clay pans and gypsum lakes, and the river channel covering the area from the Border to Lake Alexandrina. Appendix 2 presents her nine geomorphological maps of the Murray Valley from the Border to Wellington.

These maps classified the geomorphological features present in the river valley including the river and anabranches, cliffs, lakes & lagoons, and the floodplain.
The valley slopes are a distinctive landscape feature as they enclose the river valley for much of its length. However as the form of the valley slopes vary by location from high sheer cliffs through to low gently sloping cliffs, their visual quality is likely to vary also.

Thomson surveyed the valley slopes in detail, using both field work and desk top analysis of aerial photographs. She classified the valley slopes thus:

<table>
<thead>
<tr>
<th>Vertical profile</th>
<th>Number of zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments – relative length</td>
<td>Elements – uniform, convex, concave</td>
</tr>
</tbody>
</table>

| Lateral profile | The degree of uniformity of the slope either side of the vertical profile |

Thomson provided detailed analyses of thirteen valley sections including cross sections. Seven of these sections showing cliffs are included as Figure 3.5.

**Figure 3.5 Murray Valley cliff cross-sections**

- Ittledoo (south of Morgan)
- Roonka east bank
- Roonka west bank
- Pike Creek
- Teal Flat
- Woolpunda
- Tailem Bend

Source: Thomson, 1975
These cross sections indicate some of the variations apparent in the cliffs which line particularly the trench section of the Murray Valley. They show a range of heights, of steepness of the cliffs, and of the surface slope of the land surface at the top of the cliffs. Each of these factors was considered likely to influence their scenic quality.

In 1977, the CSIRO Division of Land Use Research carried out a major mapping and classification of South Australia based on similarities in climate, land forms, soils, vegetation, water and land use (Laut et al.). A hierarchical classification of areal units was adopted, the largest area being the province, followed by region, association and unit at the micro level.

The River Murray, Lakes and Coorong were all located within the Murray Mallee Province which comprised four environmental regions:

- Murray Lakes including the Coorong
- Northern calcarenite ridges and plains – located inland of the Coorong
- South east Mallee heathlands which included the lower Murray
- Upper Murray lands covering the remainder of the Murray Valley

Table 3.2 summarises the descriptions of the environmental associations defined by this comprehensive assessment.

The River Murray Catchment Water Management Board identified five distinctive regions within the Murray Darling Basin in South Australia. These were:

- **Upper Murray**, from the border to Blanchetown and including the northern mallee plains and the south Olary plains extending north towards the Broken Hill road. The region was defined as being above Lock 1 and including the major irrigated wine and citrus producing areas. It also included extensive wetlands and floodplain vegetation, much of it significantly degraded.

- **Lower Murray**, from Blanchetown to Wellington along the well-defined valley and including the reclaimed swamps used for dairying.

### Table 3.2 Summary of Environmental Associations (Laut et al, 1977)

<table>
<thead>
<tr>
<th>Association</th>
<th>Area</th>
<th>Km²</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murray Lakes Environmental Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goolwa</td>
<td></td>
<td>70</td>
<td>Low undulating plain on calcreted sands with numerous small depressions.</td>
</tr>
<tr>
<td>Lake Alexandrina</td>
<td></td>
<td>1380</td>
<td>Extensive lacustrine plain fringed with swamps &amp; salt flats, and low rises &amp;</td>
</tr>
<tr>
<td>Nurrung</td>
<td></td>
<td>260</td>
<td>Undulating plain on calcrite with some large areas of salt flats &amp; dunes.</td>
</tr>
<tr>
<td>Mt Misery</td>
<td></td>
<td>220</td>
<td>Undulating calcite plain rising prominently from the lake shores and overland</td>
</tr>
<tr>
<td>Coorong</td>
<td></td>
<td>300</td>
<td>Complex of active high dunes, beaches &amp; small mudflats. Heath lands on stabi</td>
</tr>
<tr>
<td>South-East Mallee Heathlands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleasdale</td>
<td></td>
<td>70</td>
<td>Gently undulating calcrite plain with some dunes &amp; alluvial flats. Vines &amp;</td>
</tr>
<tr>
<td>Lower Murray</td>
<td></td>
<td>220</td>
<td>Floodplain incised into calcrite plains. Intensive pastures &amp; swamplands.</td>
</tr>
<tr>
<td>Upper Murray Lands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Punthari</td>
<td></td>
<td>710</td>
<td>Undulating calcite plain with isolated dunes &amp; incised narrow valleys. Open</td>
</tr>
<tr>
<td>Blanchetown</td>
<td></td>
<td>2310</td>
<td>Gently undulating calcite plain veneered with sand &amp; with occasional low dunes. Mallee woodland, open parkland.</td>
</tr>
<tr>
<td>Renmark</td>
<td></td>
<td>1650</td>
<td>Incised ancestral floodplain. Woodlands, shrublands, orchards &amp; vineyards.</td>
</tr>
</tbody>
</table>

Note: Some of these environmental associations extended well outside the river valley so the areas should not be taken as referring solely to the river valley.
Coorong and Lower Lakes covering the Lakes Alexandrina and Albert and associated highlands, Hindmarsh Island and the Coorong.

Two areas were also defined covering the Eastern Mount Lofty Ranges and the Murray Mallee, both of which lie within the Murray-Darling Basin but fall outside the study area of this project.

De Mooy (1959) charted the geomorphic history of the Lakes Alexandrina and Albert. He described the region:

“The River Murray and several smaller rivers (i.e. Bremer, Finniss, Currency Creek) discharge into the lakes and flow through the Murray Mouth to the ocean. Waterlain deposits around the present lakes therefore have a lacustrine as well as a tidal and estuarine character. Changing sea levels in combination with negative tectonic movement, and changing climatic conditions have influenced this landscape.”

(2) Findings from past landscape studies

The studies undertaken by the author of the present study have provided many insights and much under-standing about scenic quality, the relative scenic quality of different areas, and the characteristics and features which generate scenic quality. This understanding assisted in defining the landscape units in the riverine environment.

Table 3.3 Ranking of influences on scenic quality

<table>
<thead>
<tr>
<th>Landscape factors</th>
<th>S.A. Landscape Lothian 2000</th>
<th>Coastal Viewscapes Lothian 2005a</th>
<th>Barossa Region Lothian 2005b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>1</td>
<td>1</td>
<td>na</td>
</tr>
<tr>
<td>Naturalness</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Trees</td>
<td>5</td>
<td>na</td>
<td>2</td>
</tr>
<tr>
<td>Landform</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Tranquility-Awe</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Note: Trees – tree present, height, number; Landforms – steepness, height

Table 3.3 summarises the factors which most strongly influenced scenic quality in three studies. Diversity, naturalness, trees, landforms and water were found to be the key factors.

Diversity is the busyness of a scene – the totality of its land forms, land uses, land cover, water etc. It is thus a holistic quality, derived from the totality of the scene. The combination of water, cliffs, tall trees and irrigated horticulture add to the diversity of the study area.

Naturalness is the natural appearance of the landscape without human presence apparent. An area may be ecologically degraded or influenced by humans but it is the perceived naturalness which is relevant, not necessarily its ecological naturalness.

For much of their length and area, the River Murray, Lakes and Coorong exhibit a high degree of naturalness, although affected in some reaches by extensive shack development and elsewhere by dairy flats, horticulture and stock. The frequency of pumping stations adjacent to the River and Lakes also detracts from the perception of naturalness. A particular issue of interest was the extent to which dead or dying trees on the floodplain affected scenic quality.

Trees play a vital role in creating a natural appearance and contribute substantially and positively to the landscape quality of an area. Indigenous vegetation is preferred over introduced trees.

In the study of Tree Amenity (Lothian 2004), the factors which influenced scenic quality were: tree spacing (denser the better), health of trees (healthier the better), number of trees (more the better), and height of trees (higher the better).

The stately Red Gums (*Eucalyptus camaldulensis*) which lined the River together with the gnarled River Box (*Eucalyptus largiflorens*) on the floodplain contributed to the area’s scenic quality.

Land form is the topography. Scenic quality increases with the steepness and height of the terrain. The cliffs lining the River Murray are a distinctive land form which is likely to enhance scenic quality. The extent of their influence is likely to depend on their height and steepness.

The presence of water generally enhances landscape quality except where the water is polluted and discoloured.

The presence of water in the River, its anabranches and lagoons, as well as in

9. The Red Gum and River Box are henceforth non-capitalised, i.e. red gum and river box.
extensive Lakes and the Coorong is a key scenic resource for the region.

(3) **Derivation of landscape units**

Based on the past studies, generic scenic quality ratings were derived for certain types of landscapes. These landscape types were based entirely on South Australian scenes and therefore are not necessarily applicable to scenes elsewhere in Australia, although they would provide a reasonable indication for landscapes of similar characteristics.

The simplest landscapes for which generic ratings can be derived are rural scenes. These can be differentiated by land form and land cover:

- Land form: flat, moderate slope, steep slope
- Land cover: barren, scattered trees, native vegetation

<table>
<thead>
<tr>
<th>Land cover</th>
<th>Land form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flat</td>
</tr>
<tr>
<td>Barren</td>
<td>4.0</td>
</tr>
<tr>
<td>Scattered trees</td>
<td>5.3</td>
</tr>
<tr>
<td>Native vegetation</td>
<td>6.3</td>
</tr>
</tbody>
</table>

The generic ratings indicated that land cover has a stronger influence than land form (Table 3.4): ratings rise 1.4 over the grades of land form but rise 2.3 over the grades of land cover. The influence of land cover is evident by observing that the rating of steep barren land (5.4) is the same as that for scattered trees on moderate land (5.4).

In addition, agricultural scenes with a sea view are 1.4 higher than the ratings already discussed, e.g. a landscape of scattered trees on a moderate slope which rated 5.4 would rate 6.8 with a sea view.

The generic ratings are applied in mapping scenic quality in the region (Chapter 5).

(3) **Definition of landscape units**

The three physiographic regions – River Murray valley, Lakes and Coorong are addressed separately.

**River Murray Valley**

Figure 3.6 provides a simple illustration of the river valley, an entrenched depression meandering across the flat mallee plains. Depending on the valley depth, the valley sides can be low or high, and the valley slopes can range from sheer through to gentle.

**Cliffs**

Thomson’s analysis of the cliffs (Figure 3.5) indicated some of the variations present among the cliffs. However she concentrated on the geology and the geomorphological differences rather than their relative heights and steepness.
The cliffs lining the River can reach a height of 44 m (Table 3.5) and were classed as:

- low <20 m
- moderate 20 – 30 m
- high 30 – 45 m

Table 3.5 Height of mallee plain above River Murray (m)

<table>
<thead>
<tr>
<th>Location</th>
<th>River</th>
<th>Plain</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellington</td>
<td>0.75</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Tailem Bend</td>
<td>0.75</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Caloote</td>
<td>0.75</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>Teal Flat</td>
<td>0.75</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>Big Bend</td>
<td>0.75</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>Blanchetown</td>
<td>3</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>Morgan</td>
<td>3</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>Waikerie</td>
<td>6</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>Overland Corner</td>
<td>6</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>Loxton</td>
<td>10</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Paringa</td>
<td>16</td>
<td>50</td>
<td>34</td>
</tr>
<tr>
<td>Chowilla</td>
<td>19</td>
<td>60</td>
<td>41</td>
</tr>
</tbody>
</table>

Source: Height of mallee plain measured off 1:50,000 Riverland map. Heights rounded.

It is the variations in the cliffs, trees, the location of the river on the floodplain and the presence of backwaters which create the ever-changing character of the River valley which is popular with visitors.

Valley width
The width of the valley floor – the floodplain – varies. It extends up to 10 km across the Chowilla area, the Pike River, Gurra Gurra Lakes, and Lake Bonney – Cobdogla – Moorook, then narrows to 1 - 3 km throughout the trench section between Overland Corner and Wellington.

Natural Vegetation
The major natural vegetation in the river valley comprises:

- River Red Gum *Eucalyptus camaldulensis*
- River box *Eucalyptus largiflorens*
- Lignum *Muehlenbeckia cunninghamii*
- Fleshy chenopods *Bassia spp.*, *Anthrocnemum spp.*
- Common reed *Phragmites australis*
- Bull rush *Typha augustifolia*
- Introduced willow *Salix babylonica*

Combinations of components
Within each physiographic component (e.g. cliffs, riverbank) distinct combinations of land form, land cover and land use occur along the River valley, Lakes and Coorong. These were derived from inspection of several thousand photographs covering the river valley. Table 3.6 summarises the combinations of components that occur along the River Murray valley from the Border to Wellington.

Renmark Caravan Park
Devlin Pound
View over Bookmark from Murtho Forest
View from near Sab Aruma, north of Walker Flat
### Table 3.6 Combinations of components in River Murray valley – Border to Wellington

<table>
<thead>
<tr>
<th>Land forms</th>
<th>Plain</th>
<th>Cliffs - sheer</th>
<th>Cliffs - slope</th>
<th>River</th>
<th>Bank</th>
<th>Floodplain</th>
<th>Backwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>Vertical</td>
<td>Sloping - extensive</td>
<td>Width</td>
<td>Natural bank</td>
<td>Flats</td>
<td>Anabranch</td>
<td></td>
</tr>
<tr>
<td>Undulating</td>
<td>Partly vertical &amp; sloping</td>
<td>Sloping - narrow</td>
<td>Islands</td>
<td>Levee</td>
<td>Terraces</td>
<td>Lagoon, ox-bow lakes</td>
<td></td>
</tr>
<tr>
<td>Sand dunes</td>
<td>High height</td>
<td>High height</td>
<td>Cliffs on one side, floodplain on other side</td>
<td>Sandbars &amp; artificial beach</td>
<td>Salt pans Clay pans</td>
<td>Large lake (Lake Bonney)</td>
<td></td>
</tr>
<tr>
<td>Moderate height</td>
<td>Moderate height</td>
<td>Floodplain on both sides</td>
<td>Anabranch or tributary entry/exit</td>
<td>Salt scalded land</td>
<td>Dry lagoons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low height</td>
<td>Low height</td>
<td>Anabranch or tributary entry/exit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land cover</th>
<th>Mallee</th>
<th>Trees at base of cliffs</th>
<th>Mallee</th>
<th>Drowned red gums</th>
<th>Red gum</th>
<th>Red gum</th>
<th>Red gum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue bush</td>
<td>Barren cliffs</td>
<td>Blue bush</td>
<td>Blue bush</td>
<td>Reeds &amp; bull rushes</td>
<td>Willow</td>
<td>River box</td>
<td>Willow</td>
</tr>
<tr>
<td>Native pine</td>
<td>Native pine</td>
<td>Logs &amp; snags</td>
<td>Reeds &amp; bull rushes</td>
<td>Lignum</td>
<td>Reeds &amp; bull rushes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bullock bush</td>
<td>Other vegetation</td>
<td>Other vegetation</td>
<td>Other vegetation</td>
<td>Samphire</td>
<td>Other vegetation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grasses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other vegetation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stressed trees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead trees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land uses</th>
<th>Horticulture</th>
<th>Pump pipes</th>
<th>Pump pipes</th>
<th>Grazing</th>
<th>Grazing</th>
<th>Conservation</th>
<th>Conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropping</td>
<td>Lookouts</td>
<td>Horticulture</td>
<td>Shacks &amp; houses</td>
<td>Shacks &amp; houses</td>
<td>Recreation areas</td>
<td>Recreation areas</td>
<td></td>
</tr>
<tr>
<td>Grazing</td>
<td>Quarries</td>
<td>Cropping</td>
<td>Pipes &amp; pumps</td>
<td>Horticulture</td>
<td>Shacks &amp; houses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerlines</td>
<td>Irrigation seepages</td>
<td>Grazing</td>
<td>Marina</td>
<td>Marina</td>
<td>Townships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quarries</td>
<td>Powerlines</td>
<td>Quarries</td>
<td>Conservation</td>
<td>Conservation</td>
<td>Canal housing developments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubbish dump</td>
<td>Recreation</td>
<td>Recreation areas</td>
<td></td>
<td>Caravan parks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation seepages</td>
<td>Jetties</td>
<td>Lawns</td>
<td></td>
<td>Camping areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Houses</td>
<td>Moorings</td>
<td>Jetties</td>
<td>Horticulture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheds</td>
<td>Ferries</td>
<td>Wharves</td>
<td>Grazing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial developments</td>
<td>Locks</td>
<td>Walls</td>
<td>Cropping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerlines</td>
<td>Bridges</td>
<td>Ferry infrastructure</td>
<td>Lock infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumping stations, pipes</td>
<td></td>
<td>Lock infrastructure</td>
<td>Commercial developments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boat ramps</td>
<td>Powerlines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerlines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Other

| Birdlife | Birdlife | Birdlife | Birdlife | Birdlife | Birdlife |
| Stock | Stock | Stock | Stock |
| Side lighting | |
Table 3.7 Combinations of components

<table>
<thead>
<tr>
<th>Component</th>
<th>Land forms</th>
<th>Land cover</th>
<th>Land use</th>
<th>Other</th>
<th>Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plains</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>240</td>
</tr>
<tr>
<td>Sheer cliffs</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>96</td>
</tr>
<tr>
<td>Sloping cliffs</td>
<td>5</td>
<td>4</td>
<td>12</td>
<td>2</td>
<td>480</td>
</tr>
<tr>
<td>River</td>
<td>6</td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>216</td>
</tr>
<tr>
<td>Bank</td>
<td>4</td>
<td>8</td>
<td>14</td>
<td>2</td>
<td>896</td>
</tr>
<tr>
<td>Floodplain</td>
<td>4</td>
<td>6</td>
<td>13</td>
<td>2</td>
<td>624</td>
</tr>
<tr>
<td>Backwater</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2600</td>
</tr>
</tbody>
</table>

Table 3.8 Summary of combinations of components

<table>
<thead>
<tr>
<th>Plain</th>
<th>Cliffs</th>
<th>Cliffs</th>
<th>River</th>
<th>Bank</th>
<th>Floodplain</th>
<th>Backwater</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>13</td>
<td>23</td>
<td>22</td>
<td>28</td>
<td>25</td>
<td>13</td>
<td>1,077,476,400</td>
</tr>
</tbody>
</table>

For example, under the Plain component covering the land which extends back from the River valley, there are three land forms (flat, undulating, sand dunes) each of which occurs adjacent to the river valley, eight forms of land cover (mallee, etc), five land uses and two other possibilities (i.e. birdlife and stock). For this component there are therefore 240 possible combinations.

Table 3.7 summarises the number of combinations for each component. The total number of combinations possible with all of these components is 2600.

However these only take account of combinations within each component. When viewing the River valley, one does not just see the cliffs or the River but the cliffs and the River in combination with other components. The view from above the river commonly includes the cliffs, River, bank, floodplain, lagoons and anabranches, and slopes on the other side leading to the plains beyond. From within the River valley the view is somewhat more restricted but generally the cliffs, River, bank and floodplain are seen. A similar range of components are seen from the River itself.

Multiplying the combinations together yielded a total number of possibilities which exceeded one billion! (Table 3.8). Obviously it was not practical to sample 2600 possibilities, much less one billion. These are theoretical maxima, and do not provide a practical basis for sampling the riverine landscapes.

Key components
The distinctive components in terms of their visual significance were the cliffs, the trees, the floodplain, and the water bodies.

As Thomson’s work demonstrated (Figure 3.5), the form of the cliffs varied widely. In respect of landscape quality and based on previous studies, the following significant variations are expected:

- **Height**
  - Low
  - Moderate
  - High

- **Steepness**
  - Vertical
  - Steep
  - Sloping

- **Trees**
  - Barren
  - Few trees
  - Abundant vegetation

- **Water**
  - Cliffs line river or lagoon
  - Cliffs adjacent to floodplain

Each of these variations occurred in combination; e.g. high, steep cliffs lining the river with a few trees.

The variations in the appearance of the floodplain were:

- **Water**
  - River
  - Anabranch or tributary
  - Small or large lagoon
  - Lake (Lake Bonney)

- **Riverbank**
  - Redgums, reeds/rushes
  - Redgums, no reeds/rushes
  - Redgums, bare ground
  - Town recreational areas

- **Floodplain**
  - Thick vegetation – trees, lignum
• Isolated trees, bare ground
• Bare areas – salt pans, clay pans

Trees
• Red gums
• River box & other trees
• Lignum
• Willows
• Unhealthy (dying) trees
• Dead trees
• Drowned trees

Again, many of these features occurred in combination; e.g. a view of the riverbank with the River, red gums, lignum, some unhealthy trees, and an occasional willow. Cliffs were often present in the background.

A further variation was the location of the view:
• From the River
• From the bank or floodplain
• From above the River valley looking down, i.e. from cliffs

Views from within the River valley, whether from the River, bank or floodplain, were more restricted in the range of components visible compared with views looking across the River valley from above.

The presence of birdlife in the landscape was another variation. Birdlife is such a ubiquitous element of the riverine environment that it is difficult to imagine the River without them. It had been established from other studies that the presence of wildlife tends to have a small but positive influence on ratings (Hull & McCarthy, 1988, Nassauer & Benner, 1984, Schroeder, 1991). Wildlife has its greatest influence on enhancing less attractive scenes. The influence of birdlife in the landscape was therefore included.

The colour of the sheer cliffs in the early morning or late afternoon with strong side lighting is a well known feature of the River Murray. Only in South Australia is the River Murray lined by such extensive cliffs. The effect of the side lighting on the cliffs was included.

Lakes Alexandrina & Albert

In contrast with the River valley, which has a strong vertical element provided by the cliffs, the Lakes are characterised by the general flatness and barrenness of the surrounding land.

The Lakes comprise several distinct physiographic areas:

Lake Alexandrina A very large lake, roughly oval in shape with grazing, some irrigated, around its shores. The Tolderol Game Reserve and Mosquito Point Sanctuary are located on its northern shore. The River Murray enters the Lake south of Wellington. The shoreline has few indentations. There are few islands in the Lake, although in some locations the shoreline comprises reed beds which extend well into the Lake. On the east, low land extends nearly to Cooke Plains and is occasionally flooded. The highest points are at Point Sturt (20 m ASL) and at Raukkan (Point McLeay) (44 m ASL) opposite, both abrupt headlands.

Lake Albert About one third the size of Lake Alexandrina, Lake Albert is roughly rectangular in shape with indentations along the southern shore and a large peninsula on its western side. The northern shore rises to a low range about 80 m ASL. Through the Narrows, Lake Albert is linked with Lake Alexandrina. The Narrows are a 1 – 2 km wide stretch of extensive reeds with the Narrung ferry at narrowest point between the Lakes. To the northwest, low land extends inland and is occasionally flooded. Extensive irrigated grazing occurs all around the Lake.
Western area South west of the Lakes, the Lower River Murray skirts around the north of Hindmarsh Island, past Goolwa and terminates at the Goolwa Barrage. It is joined by two significant tributaries, the Finniss River and Currency Creek, along which are extensive areas of wetlands.

East of Hindmarsh Island are low lying islands including Mundoo, Tawitchere and Reedy Islands. Extensive grazing, some irrigated, occurs on Hindmarsh Island and the other islands and on the Sturt Peninsula. Linear housing development stretches north of Goolwa and along the northwest coast of Hindmarsh Island. The Hindmarsh Marina is located on the south-western end of Hindmarsh Island and a further marina is proposed at Naru on its north coast. An east-west ridge on Hindmarsh Island rises to 30 m ASL, the remainder of the island being generally flat and low lying.

Extensive tree planting on Hindmarsh Island and also on Sturt Peninsula will in the future modify their generally barren appearance.

From inspection of photographs of the Lakes, the key types of views present in the area are:

- **Inland**
  - Grazing
  - Cropping
  - Scattered red gums
  - Dead trees (Finniss R.)
  - Samphires
  - Small lakes
  - Dry salt scalds/clay pans
  - Vines
  - Creeks
  - Waterways

- **Shore & water**
  - Beach
  - Barren of trees
  - Reeds & bull rushes
  - Offshore areas of reeds & bull rushes
**Estuary**
- Willows
- Recreation areas
- Low cliffs

**Development**
- Pumps
- Jetties
- Marina
- Boat moorings

**Towns**
- Holiday houses
- Shacks
- Caravan parks
- Canal housing developments

**Other**
- Stock
- Birdlife

**Coorong**

The Coorong is the narrow stretch of water lying between Youngusband Peninsula and the land to the east. The Murray Mouth is located at the northern end. North of the Mouth lies Sir Richard Peninsula. The northern boundary of the Coorong is taken here to be the Goolwa and other barrages.

On Youngusband Peninsula the sand dunes are generally about 20 metres ASL rising to 40 m in some localities. There are dunes which are well vegetated and other dunes which are largely barren. The barren dunes are in constant motion, pushed by the westerlies towards the Coorong.

The Coorong is nearly divided into two separate lagoons by a peninsula at Hells Gate. The northern lagoon is narrower, between 1 – 3 km. The southern lagoon of the Coorong is wider, about 3 – 4 km, narrowing to 1 km at its southern end at about 42 Mile Crossing. South of the Crossing, the Coorong terminates in a series of separate lagoons, stretching south towards Kingston.

Salinity levels are much higher in the southern lagoon, well above the salinity of seawater. The declining volume of freshwater down the River Murray has increased salinity in the Coorong and this is affecting its ecology.

The entire Coorong together with Youngusband Peninsula constitutes a National Park and the area had been declared a “Wetland of International Importance especially as Waterfowl Habitat” under the Ramsar Convention 1985. The National Park extends to the Goolwa Barrage but excludes the Sir Richard Peninsula north of the Murray Mouth.

The landward side of the Coorong has a narrow shoreline and a narrow belt of native vegetation for part of its length. Beyond this the land is used for grazing and cropping.
From inspection of photographs of the Coorong, the key types of views present in the area are:

- Ocean beach
- Beach and dunes
- Sir Richard/ Younghusband Peninsula
- Murray Mouth
- Well vegetated dunes
- Largely barren dunes
- Interdune swales – vegetated
- Interdune swales – barren
- Midden areas

- Shore & water
- Sand
- Reeds & bull rushes
- Samphires
- Dunes
- Mudflats
- Rocky shore

- Landward side of Coorong
- Grazing
- Samphires
- Flat barren land
- Trees

- Development
- Fishing settlements
- Barrages
- Jetties
- Caravans
- Shacks

- Other
- Stock
- Birdlife

3.4 MAPPING OF LANDSCAPE UNITS

GIS data bases potentially suitable for mapping the riverine landscape units were investigated. The GIS section of the Department of Water, Land and Biodiversity Conservation prepared the mapping.

Being a narrow linear feature, the River Murray posed considerable difficulties in mapping. For example, in mapping cliffs, the data base interrogated the data to determine the height difference and the slope. The mapping focused on cliffs, vegetation and wetlands.

The results were used in mapping scenic quality which is described in Chapter 5.

3.5 PREPARATION OF LANDSCAPE QUALITY SURVEY

(1) Two Surveys

The project required separate surveys of scenic quality and of development on the River Murray. Separating these aspects into two surveys ensured that an adequate number of photographs could be included in the first survey to fully cover its features. It also minimised the risk of development scenes affecting ratings of non-development scenes.\(^\text{10}\)

(2) South Australian scenes

The Internet survey comprised 150 scenes. Of these, 20% (30 photographs) were scenes from elsewhere in South Australia to benchmark the scenes from the River Murray, Lakes and Coorong and ensure that their ratings were from a State-wide perspective.

The State-wide ratings found in earlier studies (Lothian, 2004, 2005a & b) ranged from 2 to 8, a span of 6. Ratings within the River valley, Lakes and Coorong, however were found from an earlier study (Lothian, 2000) to range from 4.9 to 7.3, a span of only 2.4. Without the inclusion of the South Australian scenes, the ratings of the riverine environment were likely to be based on the narrow range of ratings from within the region and thus not reflect a state-wide perspective.

(3) Landscape Quality Survey

Inclusion of the 30 benchmark South Australian scenes left 120 scenes to be distributed between the three regions.

Approximately 15 scenes were allocated to each of the Lakes and Coorong. These areas are more uniform than the River valley, lacking its diversity of landforms, land cover and water bodies. This left around 90 scenes to be allocated to the River valley.

Given that a considerable body of data already existed for the scenic quality of various land uses and of native vegetation found on the surrounding plains, it was considered unnecessary to further survey these. Ratings could be derived quite effectively from

\(^{10}\) Some comments received on these surveys from participants complained about the lack of development scenes in the scenic survey, and of natural scenes of the River in the development survey.
previous studies. This allowed allocation of more scenes to cover the riverine environment.

(4) **Selection of photographs**

In identifying suitable scenes for inclusion in the survey, photographs were reviewed and if suitable, grouped with others for closer inspection. For example, in examining cliffs, several hundred suitable scenes were identified. From these, a selection was made.

For the Coorong, photographs were selected covering the following characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunes</td>
<td>6</td>
</tr>
<tr>
<td>Shore</td>
<td>7</td>
</tr>
<tr>
<td>Murray Mouth</td>
<td>1</td>
</tr>
<tr>
<td>Open water</td>
<td>1</td>
</tr>
<tr>
<td>Wildlife</td>
<td>1</td>
</tr>
<tr>
<td>Samphires</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

For the Lakes, photographs were selected covering the following characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hindmarsh Island</td>
<td>6</td>
</tr>
<tr>
<td>Shore</td>
<td>8</td>
</tr>
<tr>
<td>Open water</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

Together, the scenes of the Coorong and Lakes totalled 32.

For the River valley, photographs were selected to cover:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panoramas</td>
<td>9</td>
</tr>
<tr>
<td>Cliffs</td>
<td>23</td>
</tr>
<tr>
<td>Floodplain</td>
<td>30</td>
</tr>
<tr>
<td>Trees</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>89</strong></td>
</tr>
</tbody>
</table>

The nine panoramas were selected as scenes which included all of the elements – cliffs, river, bank, floodplain, and backwaters in the riverine environment. The panoramas were selected carefully to cover the differing types of landscapes from the Border to Wellington.

The key characteristics of the cliffs, floodplain and trees were represented:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cliffs</td>
<td></td>
</tr>
<tr>
<td>High, sheer, bare</td>
<td>7</td>
</tr>
<tr>
<td>Moderate, sheer, bare</td>
<td>2</td>
</tr>
<tr>
<td>Low, sheer, bare</td>
<td>0</td>
</tr>
<tr>
<td>High, sheer, trees</td>
<td>2</td>
</tr>
<tr>
<td>Moderate, sheer, trees</td>
<td>4</td>
</tr>
<tr>
<td>Low, shear, trees</td>
<td>1</td>
</tr>
<tr>
<td>High, sloping</td>
<td>4</td>
</tr>
<tr>
<td>Moderate, sloping</td>
<td>1</td>
</tr>
<tr>
<td>Low, sloping</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total cliffs</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floodplain</td>
<td></td>
</tr>
<tr>
<td>Anabranches</td>
<td>2</td>
</tr>
<tr>
<td>Dairy Flats</td>
<td>3</td>
</tr>
<tr>
<td>Islands</td>
<td>1</td>
</tr>
<tr>
<td>River</td>
<td>2</td>
</tr>
<tr>
<td>Lagoons</td>
<td>9</td>
</tr>
<tr>
<td>Lakes</td>
<td>4</td>
</tr>
<tr>
<td>Recreation frontage</td>
<td>1</td>
</tr>
<tr>
<td>Reeds &amp; rushes</td>
<td>3</td>
</tr>
<tr>
<td>Scalds &amp; bare areas</td>
<td>3</td>
</tr>
<tr>
<td>Wildlife</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total floodplain</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td></td>
</tr>
<tr>
<td>Willows</td>
<td>2</td>
</tr>
<tr>
<td>Dead trees</td>
<td>3</td>
</tr>
<tr>
<td>Unhealthy trees</td>
<td>1</td>
</tr>
<tr>
<td>Drowned trees</td>
<td>2</td>
</tr>
<tr>
<td>River box</td>
<td>2</td>
</tr>
<tr>
<td>Other trees</td>
<td>1</td>
</tr>
<tr>
<td>Lignum</td>
<td>2</td>
</tr>
<tr>
<td>Tall dense red gums</td>
<td>6</td>
</tr>
<tr>
<td>Tall open red gums</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total trees</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

The photographs were categorised to ensure that each of their characteristics was included in the survey. However many other photographs in the survey included these characteristics as well, for example, photographs of lagoons and anabranches included trees and some of the panoramas included cliffs and trees. Nevertheless the categories served their purpose of ensuring inclusion of key characteristics.

Overall the survey comprised 150 scenes as follows:

<table>
<thead>
<tr>
<th>Photographs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Australia</td>
<td>30</td>
</tr>
<tr>
<td>Coorong</td>
<td>17</td>
</tr>
<tr>
<td>Lakes</td>
<td>15</td>
</tr>
<tr>
<td>Panoramas</td>
<td>9</td>
</tr>
<tr>
<td>Cliffs</td>
<td>23</td>
</tr>
<tr>
<td>Floodplain</td>
<td>30</td>
</tr>
<tr>
<td>Trees</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
</tr>
</tbody>
</table>
Figure 3.7 Location of scenic survey photographs
Appendix 3 contains the photographs used in the survey, arranged by category. Appendix 4 contains the photographs by number. Appendix 5 describes the location of the photographs used in the survey. Figure 3.7 maps the photographs used in the survey.

3.6 CONDUCT OF LANDSCAPE SURVEY

(1) Design of Internet Survey

Previous experience had shown the efficiency of using the Internet to conduct surveys. To achieve rapid and cost efficient results the Internet was relied upon exclusively for the surveys.

In 2004/05, 56% of Australian households had home internet access, a significant increase over the 30% in the year 2000 (ABS, 2005). In addition, in 2004/05, 29% of adults used the internet at work. Overall the ABS estimated that 63% of adults accessed the Internet. These figures suggested that reliance on the Internet should not significantly restrict participation in the survey.

A sub-consultant, David Whiterod, prepared the survey instrument using the Internet. Mr Whiterod had undertaken similar work previously for the author (Lothian, 2003; 2004, 2005). He provided the following technical description of the Internet survey.

The use of the Internet to deliver the survey introduced a number of challenges and required certain assumptions to be made about respondents, their web browsers, screen configurations and Internet connection speeds. The survey website was developed to cater for as large an audience as possible (slightly erring on the conservative side when making assumptions about respondents' Internet speed and screen size).

The site and survey application was developed using Macromedia's ColdFusion™ Application Server. The landscape assessment survey was an image-intensive process; the cumulative file sizes of the scene images were quite large. This was not generally a problem for respondents with broadband (or faster) connections.

To cater for people with slower Internet connection speeds (such as those with dial-up Internet connections), two sets of scene images were created. Both sets of images were identical in all respects except the level of JPEG compression used. A set (with a compression level of 80) was developed for use by broadband users while another set (compression level 60) was developed for dial-up users. The total file size of the dial-up images was around 60% of that of the broadband images.

The image compression settings were a trade-off between compression and image detail. As the level of JPEG compression increased the general quality of an image decreased. If images were compressed too much this would affect the ability for respondents to see fine details in an image and would result in "blockier" images. The trade-off was that high quality scenes were slower to download.

Each image set was resized to 585x390 pixels. This size fitted well into a screen size near 800 pixels by 600 pixels. The page layout also performed well at larger screen resolutions.

A Microsoft SQL Server was used to record both the demographic details as well as the ratings of each scene.

The survey website was designed to be as self-contained as possible. The front page included details of the survey process, background and contact information. If the respondent chose to proceed to the survey they were prompted to enter some general demographic information. This information was recorded in the database and a unique survey identifier generated for each respondent. This initiated the survey session. The respondent's session identifier was used to record scene ratings with the correct demographic details. As the participant rated each scene, their rating was automatically recorded in the database.

The respondent characteristics used were the categories of the Australian Bureau of Statistics and were included to compare the respondents with the community.

As part of the demographic collection stage, respondents were asked to indicate their Internet connection speed: either dial-up or broadband. This information was used to reduce the download requirements for dial-up users as they were shown a more compressed set of scene images.
Following an introduction of four sample scenes, the 150 scenes were shown, each for as long as the respondent required (up to 30 minutes). The order of these scenes changed for each participant, a new random order being generated automatically as the participant moved from scene to scene. Each time a new scene was to be shown the survey application chose a scene at random from the list of scenes that the participant had yet to rate.

Randomising the sequence of scenes overcame an bias which can occur with a fixed order of scenes in which attention wanes towards the end of the survey, thereby affecting the results of the later scenes. Randomising the sequence also neutralises the effect of a scene being affected by the previous scene.

On selection of the rating on the 1 to 10 scale, which was displayed at the top of the screen, the next scene automatically appeared. This allowed respondents to move through the images at their own pace and not be anxious about completing their rating before the survey moved to the next scene, or alternatively, being frustrated by waiting for the scene to change after they had rated it.

Respondents could temporarily leave the session if interrupted and return to continue it. However there was a cut off time of 30 minutes at which point the survey terminated.

A respondent could exit the survey at any point. They could also leave comments, either at the end of the survey or, if they chose to leave the survey before completion, before rating all scenes.

On completion of the survey the participant was thanked and provided with an opportunity to comment on the survey. They could then either exit or go back to the first page.

The Internet survey is shown in Section 3.8.

(2) Implementation of survey

The survey was launched publicly on Wednesday 13 September, 2006 and ran until Friday 13 October. Figure 3.8 indicates the daily growth in participants.

Invitations to participate were emailed to over 150 organisations including councils, local action planning groups and land management groups, commercial organizations, conservation and community bodies and schools. Follow-up invitations were issued around a fortnight after the initial invitations.

In addition, on 27 September the Minister for the River Murray, Hon Karlene Maywald MP, participation and providing the website address (Figure 3.9).

It was not possible to ascertain the participation of members of each organisation, making it difficult to follow up individual groups to encourage participation. The Minister’s invitation in the media was therefore critical to gaining further participation.

In addition, the invitation to participate was issued through the Government’s Intranet. This was staggered over four days to avoid the bottlenecks which had occurred in previous surveys due to thousands of participants trying to access the site.

When the survey ended on 13 October, 2138 had participated in it.
News: Online survey rates River Murray landscapes

Hon KARLENE MAYWALD MP
Minister for the River Murray
Minister for Regional Development
Minister for Small Business
Minister for Science and Information Economy
Minister Assisting the Minister for Industry and Trade

September 27, 2006

A new online survey that asks participants to rate landscape scenes will provide valuable data to improve management of River Murray resources.

The online Landscape Assessment Study will identify qualities people like to see in a landscape by asking them to rate 150 photographs of the River Murray region from one to 10 for scenic quality and landscape value.

Minister for the River Murray Karlene Maywald encouraged people to complete the survey, which will be used to inform better planning and management of the region’s natural resources in future.

"Anyone can go to the website and participate in this survey, and it is important that as many people as possible participate so that we can harness the opinions of a wide cross-section of South Australia," she said.

“The consideration, protection and enhancement of landscape value is an important component in the sustainable management of the River Murray environment.

“Scenic quality is a significant environmental and community resource, and its measurement and mapping is fundamental for management and enhancement, and in addressing the impact of development.”

The survey will contribute to the development of a Landscape and Amenity Policy as part of achieving objectives for a healthy River Murray. The project is funded by the Department of Water, Land and Biodiversity Conservation and the South Australian Murray-Darling NRM Board.

The survey can be found online at www.scenicsolutions.com.au/murraysurvey/ and will be open until Friday, October 13.

Figure 3.9 Media Release by the Minister for the River Murray

3.7 IDENTIFICATION AND SCORING OF LANDSCAPE FACTORS

(1) Nature and use of landscape factors

The scenic quality of scenes derives from their content and the particular features they contained that trigger responses in participants. The presence of water for example almost invariably enhances scenic quality as also does the naturalness of the scene, the presence of trees, and high, steep landforms such as cliffs. Such features are termed landscape factors.

The identification of landscape factors allows the analysis of the ratings to proceed beyond the mere description of the ratings to understand why scenes gain the ratings they do.
Multiple regression analysis allowed these landscape factors (which are the independent variables) to be compared with the ratings (the dependent variable) and to both identify and quantify which landscape factors contributed to the ratings and their relative importance. Depending on the selection of landscape factors, the models which are derived could explain a large proportion (say 75%) of the variance of the data.

In an earlier study of the amenity value of trees (Lothian, 2004) it was found that the spacing and number of trees, their health and their height were the most important factors. In the study of coastal scenic quality (Lothian, 2005a), the sense of tranquillity or awe, the quality of the beach, the degree of naturalness, the height of landforms and the diversity in the scene were all found to be important contributors. In the Barossa study, naturalness, presence of trees and the terrain were the main positive factors. The study found that scenic quality decreased with the presence of vines but increased with the presence of trees, due to the lack of trees amidst vineyards (Lothian, 2005b).

Scoring the landscape factors thus provides insights into what affects scenic quality both positively and negatively.

The landscape factors were scored on a 1 (low) to 5 (high) scale to differentiate the scores from the 1 – 10 scale landscape quality ratings.

(2) Selection of landscape factors

Based on experience from earlier surveys and through examining the scenes used in this survey, the following landscape factors were identified as likely to contribute to the scenic quality of the River Murray region. Most of these were scored on the basis of the significance of each feature in the scene.

**Trees**

Previous studies had indicated the positive contribution that trees in the landscape can make to scenic quality. The large red gums along the River Murray are a distinctive feature. The significance of trees in the scenes was scored.

**Tree health**

The gradual degradation of the River Murray is evident in the health of some of its red gums. These are an indicator species of the state of the system. The health of the trees in the scenes was scored.

**Cliffs**

The presence of cliffs lining the trench section as well as parts of the Riverland section of the River Murray is another distinctive feature of the river in South Australia. The significance of the cliffs derives from their height and steepness, as well as whether they are bare or have trees and other vegetation growing on them. The significance of the cliffs in the scenes was scored.

**Water**

As well as trees and cliffs, the third distinctive feature is the presence of water. The significance of water in the scene was scored. Water almost invariably enhances scenic quality, the exception being where it is discoloured or polluted. The effect on scenic quality of the presence of algae floating on some of the water, or of discoloured water was also assessed.

**Reflections**

In some scenes, the stillness of the water allowed reflections. These are an attractive feature of the River, Lakes and Coorong.

**Naturalness**

In the Coastal Viewscapes project (Lothian 2005a), naturalness was found to play a significant role in determining scenic quality. The quality measured is the perceived naturalness, not necessarily its ecological naturalness. Much of the Australian landscape has been affected by human influence such as grazing and native vegetation clearance. In many areas, housing and other developments, roads, powerlines and other infrastructure, farm structures and fences have been constructed. Their presence and that of stock, vines, pines and other artificial features all detract from the appearance of naturalness. The appearance of naturalness was scored.

**Diversity**

Diversity is a measure of the “busyness” of the scene; the variety of land forms, land uses, land cover (vegetation), water, colour and other features that were present in the scene. Together with naturalness, diversity has a strong positive influence on scenic quality. Diversity in the scenes was scored.

**Tranquil – Awe inspiring**

In the Coastal Viewscapes study, scenes were scored on whether they engendered a sense of tranquillity or awe. In scenes such as cliffs
adjacent to a rough sea, the scene scored strongly awe inspiring, whereas a calm bay with few waves scored tranquil. The same scale was applied to the riverine scenes but it was found that scenes could be both tranquil and awe-inspiring. For example, a scene of high sheer cliffs lining the smooth river would engender awe because of the cliffs, but the river beneath inspired tranquillity.

Because of this conflict, participants scoring the scenes were instructed to score tranquility either 1 or 2 and to score awe inspiring either 4 or 5. The middle score of 3 was reserved for scenes which elicited neither tranquility nor awe.

**Wildlife** Birdlife is so ubiquitous along the River, Lakes and Coorong that a small number of scenes were included with some birdlife in them.

The following six factors were scored by a group of 20 participants, drawn from Planning SA and the Department of Water, Land and Biodiversity Conservation.

- Cliffs
- Trees
- Water
- Diversity
- Naturalness
- Tranquility – Awe inspiring

The following three factors were scored by the author:

- Tree health - dead, dying or drowned
- Reflections – good or fair
- Wildlife – present or not

(3) **Review of scores**

Figure 3.10 illustrates the relationship between standard deviation (SD) and means for each of the factors. Each dot represents a scene. In the case of cliffs or of trees, only scenes with cliffs or trees were scored.
Standard deviation is a measure of the spread of scores for a given scene. A low SD indicates a high degree of agreement while a high SD indicates a wide range of opinion about the scene.

The mean score indicates the significance of the factor in the scene. A high mean score for a factor such as water indicates that this factor is very important in the scene. A low mean score indicates that it is not important.

The correlation coefficients for all categories were low (the highest being 0.11 for naturalness) due to the wide spread of the data. This means that the trend lines are merely indicative of a relationship between the SD and the means for each landscape factor.

Where the trend line slopes down from left to right, as in the water, cliffs and naturalness factors, this indicates that there is close agreement for the highly scored scenes but less agreement for the low scored scenes. For the remaining factors; trees and diversity, the opposite applied: agreement was highest for the low scored scenes and lower for the highly scored scenes.

These findings are suggestive rather than definitive. They suggest some interesting relationships which became clearer as the ratings are analysed and combined with the scores of landscape factors.

5. Linear regression (the trend line) is the line of best fit between all the data points, the line which minimises the distance between it and each point. The line enables other points along the distribution to be determined, and can be used to predict points beyond the distribution.
3.8 FORM OF RIVER MURRAY LANDSCAPE ASSESSMENT SURVEY

River Murray Landscape Assessment Survey
Welcome to the River Murray Landscape Assessment Survey

Purpose of this survey

The River Murray is one of South Australia's most popular tourist regions and is of significant environmental value. The Department of Water, Land and Biodiversity Conservation together with the South Australian Murray Darling Basin Natural Resources Management Board have commissioned a study to measure and map the region's scenic quality.

The study involves rating a series of photographs of the region for scenic quality and landscape values. Findings from the survey will be used to inform better planning and management of the region's natural resources in the future.

You are invited to participate in rating these photographs. The photographs are representative of the Region, which covers the River Murray from the Border to Wellington, Lakes Alexandrina and Albert, and the Coorong.

No qualifications or experience are required to participate and the responses will be anonymous.

Participants need to be a minimum of 18 years of age.

The survey closes on Friday, 13 October 2006.

How it works

- You will be shown a photograph of a scene and asked to rate its scenic attractiveness
- The ratings are on a scale of 1 to 10 with 1 being very low and 10 being very high
- The rating scale is located at the top of each scene's page - just click the appropriate number to register your rating for each scene
- Once a rating has been recorded you will be automatically shown the next scene.

How long will it take?

- The survey has a total of 150 scenes. How long it takes will depend on how much time you spend rating each scene: it can be completed in less than 15 minutes
- There is no time limit to rate each scene, however, your rating session will end after 30 minutes of inactivity
- Please rate all 150 scenes as this will provide a greater statistical weight to the survey
- None of the scenes for rating is repeated
- The survey includes scenes from elsewhere in South Australia to provide balance
- At the end of the survey, or if you leave before the end, you will be able to provide comments.

Hints

- Use the entire rating scale, don't just sit in the middle around 5
- Judge each scene on its merits
- Trust your initial instinct - don't try and analyse your response
- Try to ensure you have no distractions (phone, callers etc) before you start the survey
- If you feel tired or get interrupted during the survey, take a break, the survey will wait until you return (for a maximum of 30 minutes).

Contact

The project coordinator, Scott Douglas, is available if you have any questions on email Douglas.Scott@saugov.sa.gov.au or by phone on (61 8) 8463 6912.

Start Survey »

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River Murray Landscape Assessment Survey

Demographic Information

Please fill in all fields on this form. This (anonymous) information will be used to help analyse the survey results.

Age Group Please indicate your age group

Gender
- Female
- Male

Birthplace
- Born in Australia
- Not born in Australia

Education Please indicate your highest education level attained

Postcode Please indicate your home postcode (if in Australia)

Internet connection speed

This information will be used to reduce your download requirements.

- Broadband (I have a fast Internet connection)
- Dial-up (I have a slow Internet connection)

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PAGE 3

River Murray Landscape Assessment Survey

You are about to start the survey

Example Landscapes

- The survey will start with a series of 4 example landscapes. This will give you an example of the types of landscapes you will be asked to rate during the survey.
- During the example landscapes phase you can continue to the next landscape by either clicking the photograph or the rating buttons at the top of the page (these ratings are not recorded), otherwise the page will automatically progress to the next example landscape after a few seconds.

Start Survey »
Example Landscapes

Rating scale above scene: 1  2  3  4  5  6  7  8  9  10

Continue to the next example landscape by clicking the photograph or the rating buttons (above) otherwise this page will automatically progress to the next example landscape.

Example Scene 1

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Exit Survey
Scene for Rating

Rating scale above scene: 1  2  3  4  5  6  7  8  9  10

Scene 4 of 150

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River Murray Landscape Assessment Survey

Thank you for completing the survey

Please feel free to submit any comments you may have about the survey

Please note:

- The survey did not contain any repeated scenes.
- Scenes from outside the River Murray, Lakes and Coorong were included to provide a State-wide basis for the rating.

Submit

No Comments

Back to front page.

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