FINAL REPORT

Assessing the Value of Coast to Victoria





Prepared for

The Victorian Coastal Council

Department of Sustainability and Environment

8 Nicholson St.
East Melbourne, 3005

August 2007

43283296

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Date: AUGUST 2007
Reference: 43283296
Status: FINAL

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ES 1.1 Background

The sandy beaches, rocky shorelines, inlets and bays of Victoria's coast are perhaps most readily associated with recreation and natural beauty. With their temperate climates and associated ecosystems, the coast also provides economic value beyond aesthetic benefit. They also support human lives and livelihoods through the provision of food and materials, protection from the elements, waste processing, and other essential goods and services, and enabling trade with other countries/regions of Australia.

The value of these ecosystem services is evident in returns to commercial activities, such as ports, fishing, tourism, agriculture, forestry, shipping and petroleum and gas production. However, many of the services are provided for "free", e.g. storm protection of coastal infrastructure. Although they are not marketed, they provide significant value to the Victorian, Australian and even global, communities. Because they are unpriced, there is a risk that the significance of the contribution of the services will not be fully appreciated in making decisions about how to use and manage the coastal areas. The risks are potentially large for those situations where there are tensions between, for example, the management strategies required for commercial activities and those needed for conservation purposes.

The Victorian Government's overall vision for coastal management is outlined in the *Victorian Coastal Strategy 2002*, prepared by the Victorian Coastal Council (VCC, 2002). The Strategy provides the framework for ecologically sustainable management of the coast. This framework recognises the importance of economic value of coastal assets - both market and non-market - as an integral aspect of coastal planning.

The *Coastal Management Act* 1995 (Act No. 8/1995) specifies a five year review period for the Victorian Coastal Strategy. It is in the context of this review that the VCC together with the Department of Sustainability and Environment (DSE) have commissioned this study. The study seeks to inform decision-makers on the nature and size of the economic benefits that the coast provides and, in order to realise those benefits, the characteristics and attributes of the coast which need to be protected and enhanced.

The study has been undertaken by URS together with Centre for International Economics (CIE). It provides an analysis of the market and non-market services and how both contribute to the economic value of the coast to Victoria. The study aims to be comprehensive, and employs a variety of data and techniques. A summary of some of the key findings arising from the Project has already been provided for use by the VCC.

ES 1.2 Objectives and scope

The key tasks or objectives for the Project are to:

1) Identify the range of commercial activities and unpriced services provided by the coast;

2) Determine the characteristics/attributes of the coast which give rise to these services and activities, and to identify changes to those characteristics/attributes since 2001; and

3) Develop quantitative estimates, where possible, of the current benefits to Victoria of the commercial activities and unpriced services.

After the commencement of the study, it was also decided to undertake a travel cost study to gain a better understanding of the value of non-market recreational services provided by the coastal region.

The coast is the interface between the sea and the land. In this study, the coast is defined as a strip either side of the high water mark: 5.5 kilometres to the state limit out in the sea, and 5 kilometres inland. This distance was deemed to be adequate to capture all the coastal ecosystems.

However, economic, social and demographic statistics are not collected on this basis. Official statistics from the Australian Bureau of Statistics (ABS) are available on a Statistical Local Area (SLA) basis that does not correspond closely with biophysical regions. Accordingly, it is not possible to get a perfect fit

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between the biophysical boundaries of the coastal region and the statistical boundaries. Furthermore, the overwhelming size of the Melbourne Metropolitan area's economy and population would distort any statistics on the coast if the coastal metropolitan SLAs were included. Thus, for most discussion and analysis involving economic, social and demographic statistics, Victoria is divided into three regions, the coastal and non-coastal (non-metropolitan) regions and Melbourne. The coastal region is defined as all SLAs that have a border on the coast excluding those in the Melbourne Statistical Division.

ES 1.3 Coastal natural assets and services

Environmental and social services of the natural assets of the coast make a significant contribution to the Victorian economy. Shoreline stabilisation and storm protection enables settlement on the coast and minimises adverse impacts on towns and infrastructure from the forces of wind and waves. Therefore, where ecosystems are degraded, high costs can be incurred. Climate regulation in general and fish nurseries in estuaries and mangroves enable a thriving agricultural and fishing sector in Victoria, which contributes directly through commercial activities.

However, social services are probably even more valuable. Visual amenities of the coast are important for inhabitants, as shown through high property prices as well as visitors. This value could not be estimated, because proper analysis has not been undertaken in the past, but some rough models of a few neighbourhoods suggests that the value is substantial, maybe even in the hundreds of millions to billions of dollars per year. One of the recommendations of this report is to examine this further. The value of the recreational services of the coast is estimated in this project. The analysis shows that **the recreational value of the coast is $1.9 billion per year**. It also shows that visitors with preferences for sport activities, nature and peace and quiet have a higher value of the recreation on the coast whereas people who enjoy recreational facilities, café's and restaurants have a lower value. This high value depends on many of the other services functioning as beautiful landscape, habitats for wildlife etc. It has implications for the future development of the coast, especially when looking at the trade-offs between development and conservation of the coast. It suggests that it is important to maintain undeveloped landscapes, peace and quiet and areas to do sports activities (e.g. surfing) to ensure a high value of coastal recreation.

The coast provides value to society by offering services that are linked to the existence of ecosystems. These services are divided into commercial, environmental and social services, adapted from the Millennium Ecosystem Assessment, a global analysis of how human well-being is influenced by ecosystems. Table ES 2-1 gives an overview of these ecosystems and the services they provide.

Coastal ecosystems face many threats and in places are degraded. This analysis shows that on one hand, most ecosystems (around 80 percent) are found on public land, which is assumed to offer protection, especially in national parks and Ramsar areas along the coast. On the other hand, one third of the area is found within 5 kilometres of built-up areas, which are known to threaten healthy ecosystems. This may partly explain why around one fourth of the area is showing some degradation. Coastal scrubs and woodlands as well as mangroves are depleted.

The costs of coastal protection are also significant. Healthy coastal landforms provide these services for free, so improvements in coastal condition could be expected to bring benefits in this area as well.

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Table ES-1 Summary of Ecosystem Services by Natural Asset Type

	All coastal ecosystems	Estuaries and salt marshes	Mangroves	Rocky shore, sandy beaches and mudflats	Dunes	Seagrass	Kelp forests	Coastal scrubs, heath and woodland	Inland ecosystems
Commercial									
Food		●		●			●		
Fibre									●
Oil and Gas	●								
Wind and wave power	●								
Market recreation		●		●	●	●	●	●	●
Environmental									
Climate regulation	●								
Storm protection		●	●	●					
Erosion control					●	●		●	
Water purification and waste assimilation		●	●						
Fish nursery		●	●			●	●		
Shoreline stabilisation				●	●	●			
Nutrient cycling		●	●			●			
Provisioning habitat		●	●	●	●	●	●	●	●
Social									
Non-market recreation		●		●	●	●	●	●	●
Visual amenity		●		●	●			●	●
Cultural heritage	●								
Health benefits	●								

ES 1.4 Coastal attributes and trends

The socio-economic profile of Victoria's coastal regions reflects the subdued economic opportunities provided by its industry structure. The coastal region of Victoria had a resident population of 325 933 at the time of the Census in 2001, seven percent of the population of Victoria. Small area 2006 Census data were not available at time of writing.

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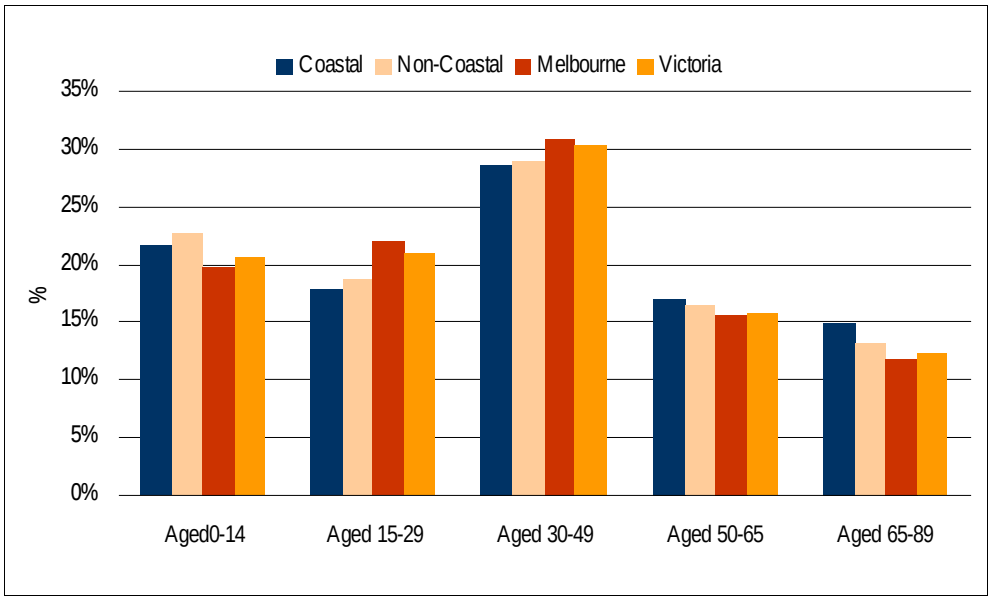
This is shown in Figure ES-1 which illustrates the percentage of the population in different age groupings.

Figure ES-1 Age by Coastal and Non-Coastal Regions of Victoria in 2001



Source: Australian Bureau of Statistics, 2001b

The population of the coastal area is older than the rest of Victoria and the non coastal regions. This has been attributed to the attractions of coastal regions for retirement on the one hand, and the departure of younger people on the other. The chart shows that the coastal region has smaller shares of younger working-age people. There is a smaller share of people in the 15-29 and 30-49 age groups in coastal regions than in other parts of Victoria and in the state at large. The age structure also represents the departure of younger people from the coast as they move elsewhere for education and employment.

These demographic changes may reflect the employment opportunities on the coast compared with the rest of Victoria. People employed in the industries predominating on the coast, such as agriculture, forestry and fishing, hospitality and retail trade tend to have lower incomes and educational attainment. Industries with higher paying jobs are relatively more scarce on the coast than in Melbourne or the state as a whole.

Household incomes in Victoria's coastal region are significantly lower than in Melbourne, the state as a whole, and even slightly lower than the non-coastal region, as shown in Figure ES-2. This reflects the slightly larger proportion of retirees, and also the employment opportunities in the region, as described above.

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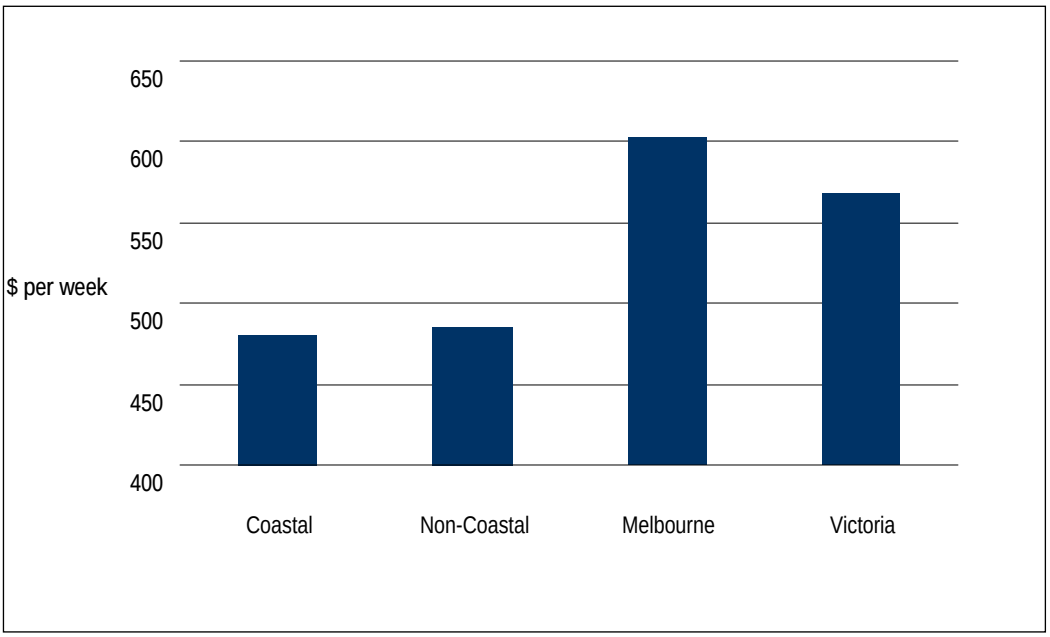
Figure ES-2 Median Weekly Income Victoria and Regions



Source: Australian Bureau of Statistics 2001b

While the past is no guarantee of the future, looking at the trends in the different industries is a first step to making predictions about their future size. The CIE has used its model of the Australian economy to forecast production and employment beyond the 2001 census year to predict changes to 2007 and beyond.

Trends in production and employment have varied among the industries on the coast, with some growing and others contracting, both in absolute and relative terms. However, available measures of output and employment show that overall commercial activity in Victoria's coastal region is more subdued than in either the non-coastal non-metropolitan region or in Melbourne. This is reflected in slower growth in both employment and production. Production on the coast also tends to be more volatile as a result of fluctuations in seasonal conditions for primary products and in petroleum and gas prices. This pattern can be seen in Figure ES-3 which shows gross product for Australia and the coastal, non-coastal and Melbourne regions 1995 – 2007, based on CIE forecasts beyond 2006.

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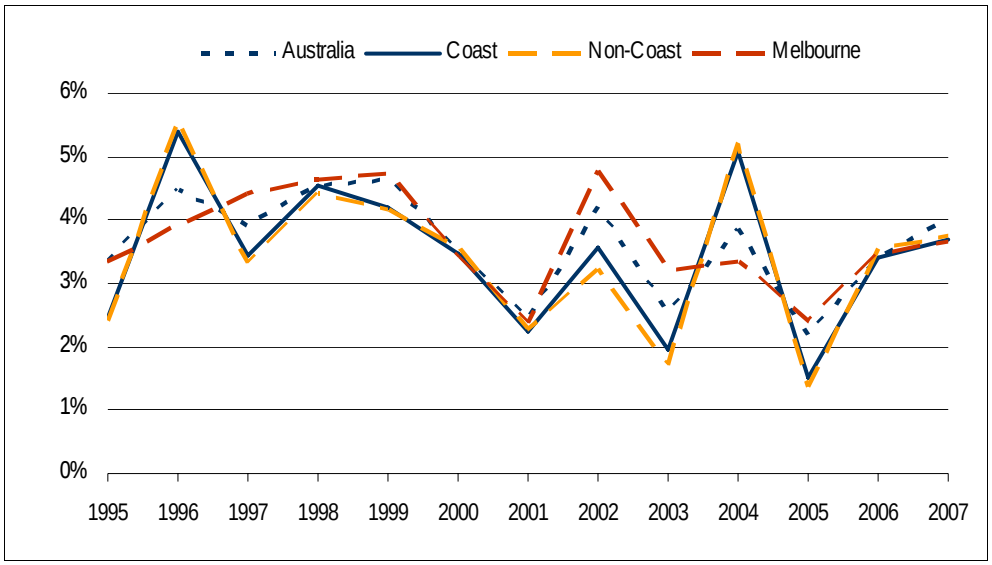
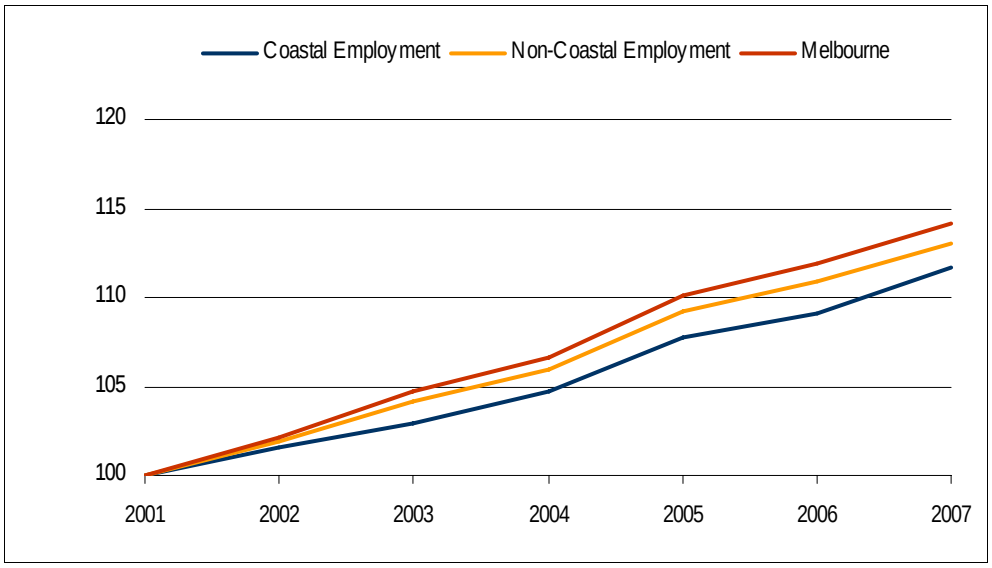
Figure ES-3 Annual Change in Gross Product, Australia and Victorian Regions 1995 - 2007, Percent



Source: CIE estimates

Employment has not been as volatile as the value of output. Total employment in coastal regions in 2001 was estimated at 128,000 people. Using the AUSM model employment for 2007 is estimated to grow by 11 percent over the period to 2007 as shown in Figure ES-4. Employment growth on the coast has been relatively steady over the period, but slower than employment growth in both the non-coastal region and Melbourne.

Figure ES-4 Index of Employment Growth by Region



Source: CIE estimates

The employment forecast also shows how employment is estimated to have changed in each industry in the coastal region from 2001 to 2007 (Figure ES-5). Most of the growth is expected in the service industries, while employment in agriculture, forestry and fishing is expected to decline by about 2000 persons.

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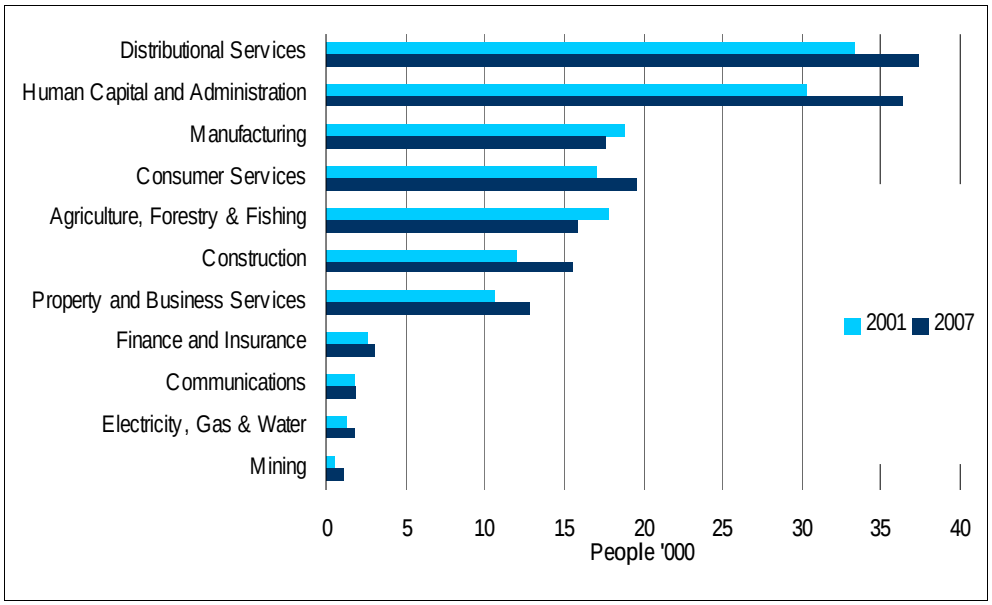
Release of the small area 2006 Census data will provide a more accurate picture of the changes in employment and population. Some recent changes in the detailed pattern of production, for example growth of the dairy industry and decline in the abalone fishery are not likely to be reflected in the modelling.

Figure ES-5 Estimated Coastal Employment Growth



Source ABS Population Census, 2001 and CIE estimates

The relative disadvantage of the coastal economy compared to the rest of the state creates pressures for both conservation and further commercial development of the region's natural assets. On the one hand, many people choose to live and work on the coast because of the natural benefits they receive, but on the other, desires to improve material standards of living create pressures for further development.

ES 1.5 Estimating benefits of coastal activities and services

There is an abundance of natural assets in Victoria's coastal zone that provide a range of goods and services to the Victorian economy. Some of these, such as fish, are valued in the marketplace, but many others are not. This study has provided a snapshot of the social and economic conditions in the coastal region, compared with the rest of Victoria, and examined the principal commercial and non-priced goods and services provided by the natural assets of the coast.

There are inherent difficulties in seeking to determine the value of the contribution of coastal resources to Victoria. Even for marketed commercial activities, there are statistical constraints, measurement problems and missing data. These are discussed in detail in the report. The difficulties that arise in relation to the non-traded goods and services are even greater because information about these contributions to human well-being is not readily available since these services are not traded in the marketplace. These difficulties mean that estimates of various contributions to well-being provided in this report should not be summed. Nonetheless, each of the sets of data can be examined separately to gain insight into their nature and relative magnitudes of value.

The GRP of Victoria's coastal region, excluding Melbourne, is estimated at about $9 billion which is 6 percent of total GSP. The value of output of the major industries outside of Melbourne that are dependent on coastal natural assets is about $1.5 billion, about 16 percent of GRP.

Table ES-2 presents a summary of the commercial values attributed to activities which are supported by the natural asset base of the Victorian coast.

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Table ES-2 Value of Output and Value Added in Selected Industries Dependent on Victoria's Coast

Industry	Value of output ($ million per year)	Value added ($ million per year)
Port Melbourne	1,338	596
Port of Geelong	170	89
Port of Hastings^	46	24
Port of Portland	44	22
Shipping	144	na
Commercial Fishing	83	na
Coastal non-metro tourism*	908	na
Wind energy	13	na
Total	2,796	731

Note: *Tourism estimates relate to non-metropolitan tourism in coastal statistical local areas. ^Port of Hastings values imputed from volumes.

Source: CIE and URS estimates, Deloitte et al 2003, Tourism Task Force Australia 2005, Price Waterhouse Cooper 2007, DPI 2007.

The largest contributor to the Victorian economy reliant on what might be considered coastal natural assets is the oil and gas extraction industry with production valued at over $3 billion. However, as the industry is based on resources largely located beyond Victoria's territorial limit offshore in Commonwealth waters, it has not been included in Table ES-2. Nevertheless, its impacts on natural values on the coast, both in the marine environment and on land, are important considerations for policy and management.

Ports and tourism are the largest industries dependent on the natural assets of Victoria's coast, followed by shipping and commercial fisheries. If the Port of Melbourne is excluded, tourism is the largest by far. This finding is supported by the results of the travel cost study for coastal recreation undertaken for this project.

The study estimated the consumer surplus[1] at $48 per visitor day, which is comparable with similar studies' findings. Aggregated over the number of visits by Victorians to the coast per annum, the total value of non-market recreation is **$1.9 billion per annum**. This represents the most significant and robust data available on non-market services. This demonstrates the importance of protecting the natural assets which support tourism and recreation.

Thus in comparing the estimates between commercial and non-market services offered by the coast, it is clear that, even when considering only one non-market service – informal recreation – this far exceeds the value of the range of coastal dependent industries considered, and even if offshore oil and gas are included, the figures for commercial industries and recreation are similar. This is an interesting comparison, especially when one considers that many of those coastal dependent activities place risks upon, or in some cases compete with, the quality of recreation.

ES 1.6 Changing social and economic pressures on the coast

The economic growth of the coast is more volatile and the employment growth is slower compared with Metropolitan Melbourne and the rest of Australia. Compared with Melbourne metropolitan area, incomes

[1] Consumer surplus is the amount of value or well-being that individuals gain through the consumption of a good or service that is in excess of what they have paid. Where services are non-priced, consumer surplus is the single measure of value.

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in the coastal region are lower and the age structure is older. This pattern is caused by the relatively low representation of younger members who have left because of the greater employment, and income earning potential, elsewhere. Together this paints a picture of a region of Victoria that is resource rich but disadvantaged.

It is against this background of relative economic disadvantage amid rich natural resources that the forces of economic and social change are applying pressure to existing use of land and other natural assets of the region. As market forces are exerted strongly, demands for preservation of natural values increase. As a result, the drivers of change are a paradoxical mix of drivers for both more intensive use of resources and conservation. They can be summarised as:

- Population shift to the coast (the 'Seachange' phenomenon), particularly with the imminent retirement of the baby boomer generation:
  - Increased population pressure;
  - Prospects of an even higher proportion of lower income retirees;
  - Urban expansion; and
  - Increased popular awareness of the impact of pressures on coastal natural resources and values.
- Expansion of resource-based industries, for example:
  - Port facilities and associated terrestrial transport and logistics infrastructure;
  - Petroleum industry;
  - Wind farms;
  - Forestry plantations;
  - Aquaculture: auction last year for sites in Port Phillip Bay and elsewhere on the coast; and
  - Geosequestration of carbon dioxide.
- Changes to agricultural industries and land use are all affecting the demand for and value of agricultural land along the coast, for example:
  - Growing demand for the region's agricultural produce, for example dairy products
  - Drought;
  - Climate change and the higher, more reliable rainfall on the coast; and
  - Demand for hobby farms associated with the 'seachange' phenomenon described above.
- Changes in social preferences, for example:
  - Increased conservation effort, including Landcare and Coastcare;
  - Reduction in logging of native forests and changes to logging practices;
  - Increase in areas of national parks and other conservation areas;
  - Creation of various types of marine protected areas;

All of these changes will be affecting the use of Victoria's coastal natural resources in the years ahead. From a commercial market perspective, pressure will be applied to lower market value uses in favour of higher value uses of resources. Thus, as the demand for renewable energy rises, the demand for sites for wind power will also increase, leading to changes in agriculture in windy areas. Similarly, as water for irrigation becomes scarcer in inland Australia, production of some crops may shift to higher rainfall agricultural areas on the coast.

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The restructuring of the forestry industry is also leading to increases in plantations in higher rainfall areas, particularly adjacent to port facilities. Thus, reductions in logging in the Otways are being accompanied by new plantings of trees in western Victoria close to the port of Portland.

The expansion of the petroleum industry illustrates some of the pressures that can affect the natural values and assets of the coast. Over the years, concerns have been expressed about potential negative impacts of the petroleum industry on other sectors of the economy such as tourism, the environment and ecosystems. While the seismic exploration program has been arranged to avoid the whale breeding season, the impacts on fish and other marine species are not well understood. The proximity of the Otway Basin to several National Parks, including the Twelve Apostles, has also required careful attention to environmental issues in the development of the gas field.

The changing socio-economic profile of the coast will have implications for commercial use of coastal resources. On the one hand, more people will be living at the coast which will increase the pressure on coastal natural assets. On the other hand, the natural assets are drawing people to the coast, leading to greater calls for protection. This tension brings the non-market value of these natural assets into sharper relief and provides a clear rationale for further development of the tools and data to inform decisions where these trade-offs are in evidence.

There are strong lifestyle values associated with the coastal regions — they are attractive areas in which to live. This attraction is a source of potential conflict between the different uses of the natural resources of the regions, especially between urban development, conservation and more traditional land uses such as agriculture and native timber forestry. In addition, conflicts emerge such as between the use of land for agriculture and plantation forestry.

Resolution of such conflicts can be helped by a better understanding of the relative contributions of different commercial services to human well-being compared with the contribution from non-market services. In many situations these respective contributions cannot be pursued concurrently, and choices have to be made.

Such measures are most appropriate if used to address location specific natural resource allocation and use decisions. This is because the decision that is to be made can be more clearly specified, and the required information attained to make that decision. Further detailed research and analysis may be required to determine the relative contributions. This report seeks to provide a guide to the techniques that are available.

Examples of decisions such monetary value data can inform are:

- decisions about the appropriate amount of investment in coastal defences, dune maintenance or recreational infrastructure;
- decisions regarding acceptable levels of risk, such as from shipping accidents that risk damaging the natural environment; and
- land-use planning decisions regarding socially acceptable levels of urban development in the buffer zones between towns or a change from one land-use provision to another (e.g. to a national park).

Non-market valuation techniques may provide either the benefit or cost side of a benefit-cost equation informing such decisions, depending upon the decision at hand. Costs may be the opportunity costs of forgone recreational opportunities or the loss of non-use values associated with a loss of habitat for current and future generations. Benefits may be the improvements in well-being of affected populations that result from improved dune maintenance (as was measured in Pitt, 1993, see Section 5.1.1), or the improvements in well-being that result from an internationally recognised asset gaining the security of management that results from national park status. These are all welfare (or well-being) changes that non-market economic valuation techniques are adept at valuing. That there is a lack of data on the values of non-market services provided by the Victorian coast is argument for further research to inform pressing decisions.

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1.1 Background

The sandy beaches, rocky shorelines, inlets and bays of Victoria's coastal areas are perhaps most readily associated with recreation and natural beauty. The areas however, with their temperate climates and ecosystems, provide economic value beyond their aesthetic benefit, supporting human lives and livelihoods through the provision of food and materials, waste processing, and other essential goods and services, and enabling trade with other countries/regions of Australia.

The value of these ecosystem services is evident in returns to commercial activities, such as fishing, tourism, agriculture, forestry, shipping and petroleum and gas production. However, many of the services are provided for "free", e.g. storm protection of coastal infrastructure. Although they are not marketed, they provide significant value to the Victorian, Australian and even global, communities. Yet, because they are unpriced, there is a risk that the significance of the contribution of the services will not be fully appreciated in making decisions about how to use and manage the coastal areas. The risks are potentially large for those situations where there are tensions between, for example, the management required for commercial activities and that needed for conservation purposes.

The Victorian Government's overall vision for coastal management is outlined in the *Victorian Coastal Strategy 2002*, prepared by the Victorian Coastal Council. The Strategy provides the framework for ecologically sustainable management of the coast. This framework recognises the importance of economic value of coastal assets - both market and non-market - as an integral aspect of coastal planning.

The *Coastal Management Act* 1995 (Act No. 8/1995) specifies a five year review period for the Victorian Coastal Strategy. It is in the context of this review that the VCC together with the Department of Sustainability and Environment (DSE) have commissioned this study. The study seeks to inform decision-makers on the nature and size of the economic benefits that the coast provides and, in order to realise those benefits, the characteristics and attributes of the coast which need to be protected and enhanced.

The study has been undertaken by URS together with Centre for International Economics (CIE). It provides an analysis of the market and non-market services and how both contribute to the economic value of the coast to Victoria. The study aims to be comprehensive, and employs a variety of data and techniques.

1.2 Rationale and objectives

1.2.1 Rationale

The Victorian Government has adopted a range of policy objectives in relation to enabling the Victorian economy to thrive, the efficient use of natural resources, the maintenance and restoration of these resources, and the protection of the environment for future generations (*Growing Victoria Together* and *Our Environment Our Future*).

Decision making on the management of the coast is based on multiple – and often conflicting- objectives, the costs and benefits have to be taken into account that are associated with commercial activities, as well as cost and benefits not captured in markets that arise from 'non-market' services. Non-market benefits include the services which the coast provides for "free", such as marshes in contributing to the purification of agricultural run-off. Non-market costs can arise from developments too close to dune systems, reducing vegetation cover and, hence, the erosion control and storm buffering services of dunes. Such outcomes could result in costs being incurred through, for example, infrastructure damage or loss, as well as reduced recreation and amenity value. Frequently, such costs are not borne directly by those who give rise to them and, hence, will not generally be taken into account.

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1.2.2 Objectives

This project aims to develop a framework for assessing the commercial and non-market values provided by the Victorian coast.

As laid out in the terms of reference, the key tasks or objectives for the Project are:

1) to identify the range of commercial activities and unpriced services provided by the coast;

2) to determine the characteristics/attributes of the coast which give rise to these services and activities, and to identify changes to those characteristics/attributes since 2001; and

3) to develop quantitative estimates, where possible, of the current benefits to Victoria of the commercial activities and unpriced services.

After the commencement of the study, it was also decided to undertake a travel cost study to gain a better understanding of the value of non-market recreational services provided by the costal region.

1.3 Defining the coast

A necessary step in estimating the economic value of the coast is to define, geographically, the area which gives rise to that value. One definition is that contained in the *Victorian Coastal Strategy* which defines the Victorian coast to include the sea and the seabed to the State limit (5.5 kilometres or 3nm) and the land and inland waters within the coastal catchment.

While this is a useful conceptual approach for certain purposes, the inclusion of the catchments extends the area well beyond the landscapes that are 'coastal' in nature and therefore beyond the scope of coastal policy and management. Also, from a biophysical point of view, it was necessary to define the coastal region more narrowly.

The *Millennium Ecosystem Assessment Report* (Alcamo *et al.,* 2003), a global analysis of how human well-being is influenced by ecosystems, included an analysis of coastal ecosystems and differentiated between the *coastal interface* and the *coastal zone*. The latter zone is defined as "a narrower band of terrestrial area dominated by ocean influences of tides and marine aerosols" (Alcamo *et al.,* 2003). The coastal interface is the area between ocean and land, extending seawards to about the middle of the continental shelf and inland to include all areas strongly influenced by the proximity to the ocean up to a distance of 100 kilometres from shore. This definition would include waters outside Victoria's territorial limit.

Therefore, for the purposes of accounting for Victoria's natural coastal ecosystems, two measures are used: on the seaside, the 5.5 kilometres band to the state limit is used and inland a boundary of 5 kilometres is applied. This distance was deemed to be adequate to capture all the coastal ecosystems through a GIS analysis Figure 1-1 shows this band both inland and seawards.

However, this biophysical definition cannot be employed when considering statistically based economic, social and demographic concepts of the coast for the following reasons:

i. Official economic, social and demographic statistics from the Australian Bureau of Statistics (ABS) are available on a Statistical Local Area basis that does not correspond closely with biophysical regions. SLAs are part of the ABS' Australian Standardised Geographic Classifications system;

ii. SLAs do not follow the coastline closely. Some coastal SLAs include substantial areas and population centres that are not close to the coast, and some non-coastal SLAs have areas quite close to the coast;

iii. The overwhelming size of the Melbourne Metropolitan area's economy and population would distort any statistics on the coast if the coastal metropolitan SLAs were included.

Accordingly, it is not possible to get a perfect fit between the biophysical boundaries of the coastal region and the statistical boundaries. The study has therefore used the best possible statistical definition, which

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is to include all SLAs that have a border on the coast excluding those in the Melbourne Statistical Division as shown in Figure 1-1. Two other regions are also defined: the non-coastal (non-metropolitan) regions and Melbourne. The few instances where this division has not been used are clearly indicated in the text.

The map shows that the difference between the biophysical boundary and the statistically based coastal region is an approximation in that it excludes some SLAs, such as Moyne – North-West and Colac-Otway – South, that have areas within them that are closer to the coast than some of the areas within the SLAs that border the coast, like Corangamite – South. However, on balance, including these contiguous but non-coastal SLAs that have a small proportion of landscapes with coastal characteristics would be more distorting. Accordingly, the statistical definition of the coastal region is an approximation.

Within this statistically defined region, the approach adopted has been to focus on those activities that are intensive users of, or are significantly dependent on, the natural assets and associated ecosystem services of the coast.

1.4 Guide to the report

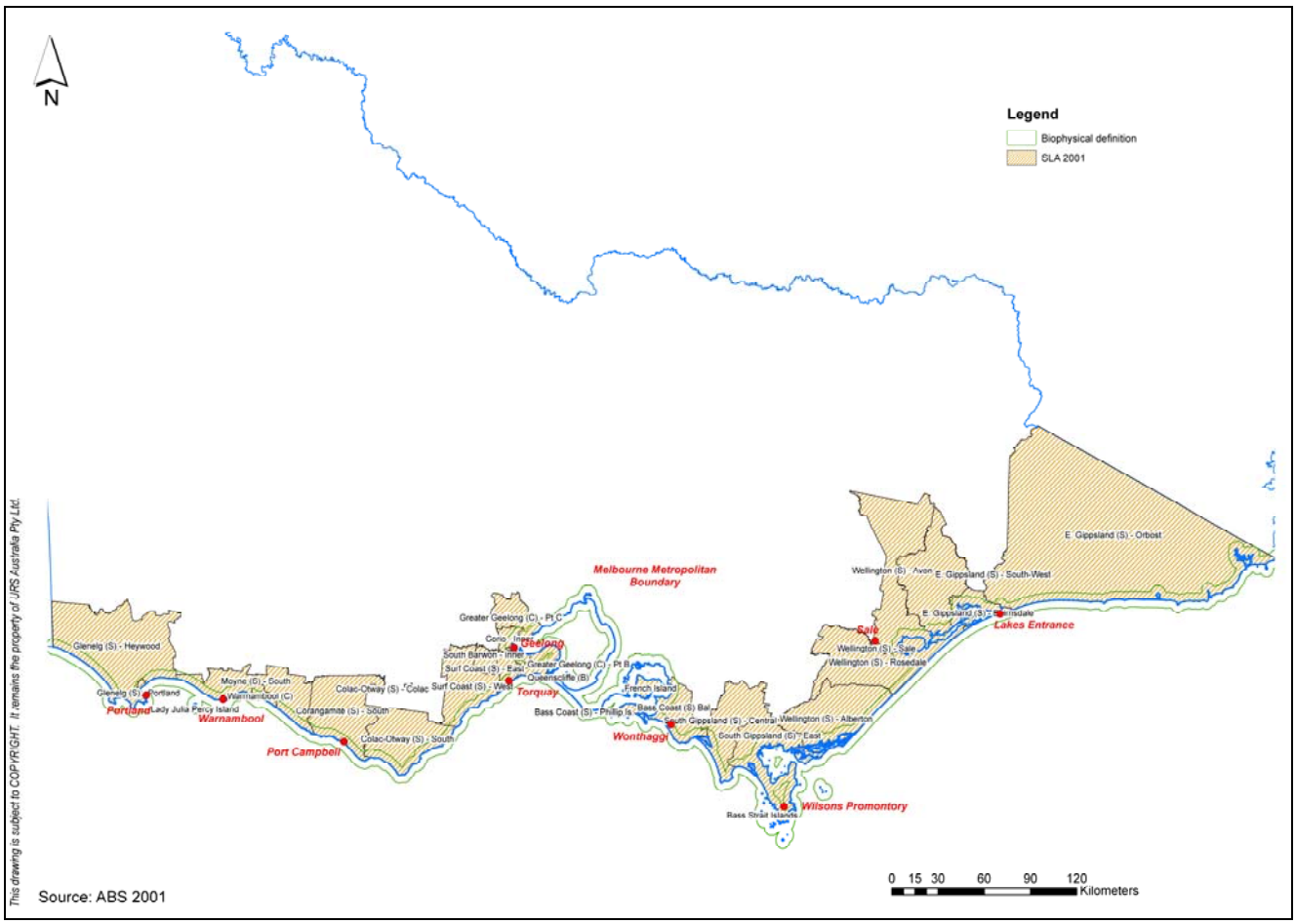
This report is organised as follows:

- **Section 2 Methodology** gives an overview of the economic concepts of value and describes the types of data and approaches used by URS and CIE to measure both commercial and non-market services of the coast.
- **Section 3 Coastal Ecosystem Services** describes the ecosystems along the coast and the services they provide. It also examines the protection and threats to these ecosystems using GIS analysis.
- **Section 4 Contribution of Commercial Services** analyses of the value of commercial activities dependent on the natural assets of the coast. This section begins with a snapshot of production and employment within the coastal area, data that is then used to estimate commercial values.
- **Section 5 Contribution of Non-market Services** reviews the Australian and international literature on the value of non-marketed coastal services and reports results of new travel cost study on the non-market values of coastal recreation undertaken by URS for this report.
- **Section 6 Socio-economic Profile of the Coast, Pressures and Drivers** provides information on the socio-economic pressures relevant to coastal management and policy.
- **Section 7 Conclusions and perspectives** summarises the main issues and findings of the report, and points the way forward to future research and the appropriate use of this type of data in decision-making.

Section 2 to 6 in the report begins with a brief summary of the results.

Section 1 Introduction

Figure 1-1 Map of the Coastal SLAs and the Coastal Zone



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Section Summary

- Natural assets provide ecosystem services and contribute to economic welfare.
- The total economic value of coastal ecosystem services includes values from market and non-market uses and non-use values.
- Economic value can be measured by consumers' willingness to pay, which includes the market value for commercial goods and services.
- Measuring value involves a number of statistical concepts and issues which are explained.
- The study has used GIS information to assess the ecosystem services of coastal assets.
- The last section describes how changes over time can be estimated and discusses the lack of data to do so.

2.1 Understanding economic value

2.1.1 Natural asset based approach

There is now recognition amongst natural resource managers of the advantages of using an asset based approach to manage natural resources. An asset based approach provides a logical framework for considering the integrated nature of natural resource management and for making investment decisions on this basis.

Figure 2-1 illustrates the asset based approach: natural assets and their ecosystem functions and processes provide flows of goods and services, which generate benefits to human populations. In economic terms these benefits are measured through consumers' surplus and market value where goods and services are traded (see 2.2.1). Where they are not traded, their value is only determined by consumers' surplus (see Section 2.2.2).

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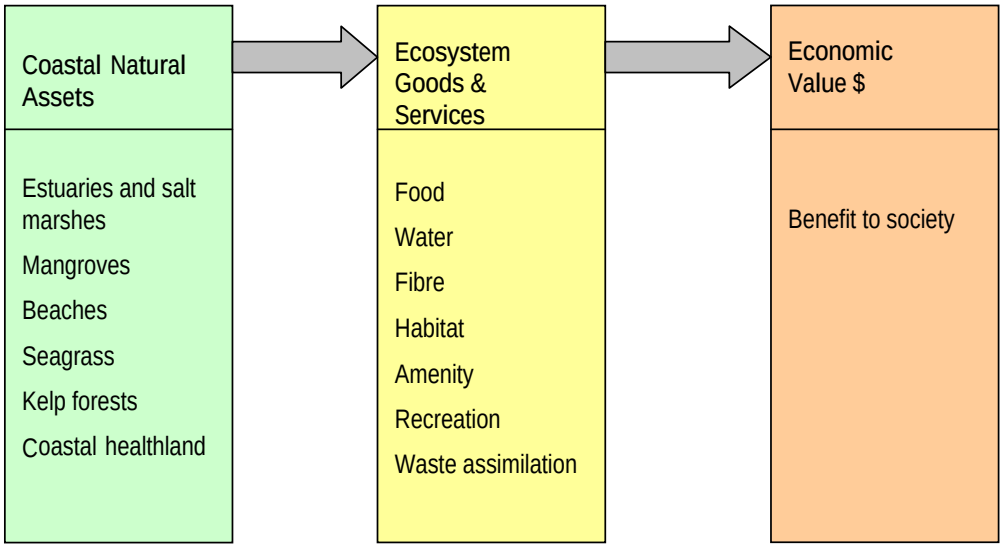
Figure 2-1 Linking Natural Assets to Economic Value



2.1.2 What is economic value?

The economic value of one unit of a good or service provided by the natural assets of the coast is determined by what consumers are willing to pay for it. Willingness to pay is a reflection of the benefit derived from the consumption of a product or service. Changes in value as the quantity consumed of the good or service changes are traced out by the demand schedule (see Figure 2-2). A demand schedule (or curve) shows the amounts of a good that would be purchased at various prices during some specified period of time (say, one year), **all other things held constant.** As consumers are usually prepared to purchase more the lower the price, demand curves generally are downward sloping.

The demand curve for a particular good or service can be used to express the value to society of any aggregate quantity of the good or service. The utility (the economic term for personal 'wellbeing') that consumers derive from consumption is represented by the area under the demand curve.

The quantity that will actually be consumed will depend on the cost. For goods and services traded in the marketplace, the market equilibrium price and quantity will be where the price at which producers are prepared to supply intersects the demand curve. Thus, in the example in Figure 2.2, at price $100 (assumed here to be the equilibrium price) consumers will purchase 10 units, for a market value of $1000.

The *market value* represents the choices that consumers and producers make among the many combinations of goods and services that they could produce and consume. While market value is the most frequently used measure of value, it underestimates total benefit because of *consumers' surplus*. Consumers' surplus arises because many members of society would be willing to pay more than they have to. The excess of what they would pay over what they have to pay is an additional benefit to these consumers.

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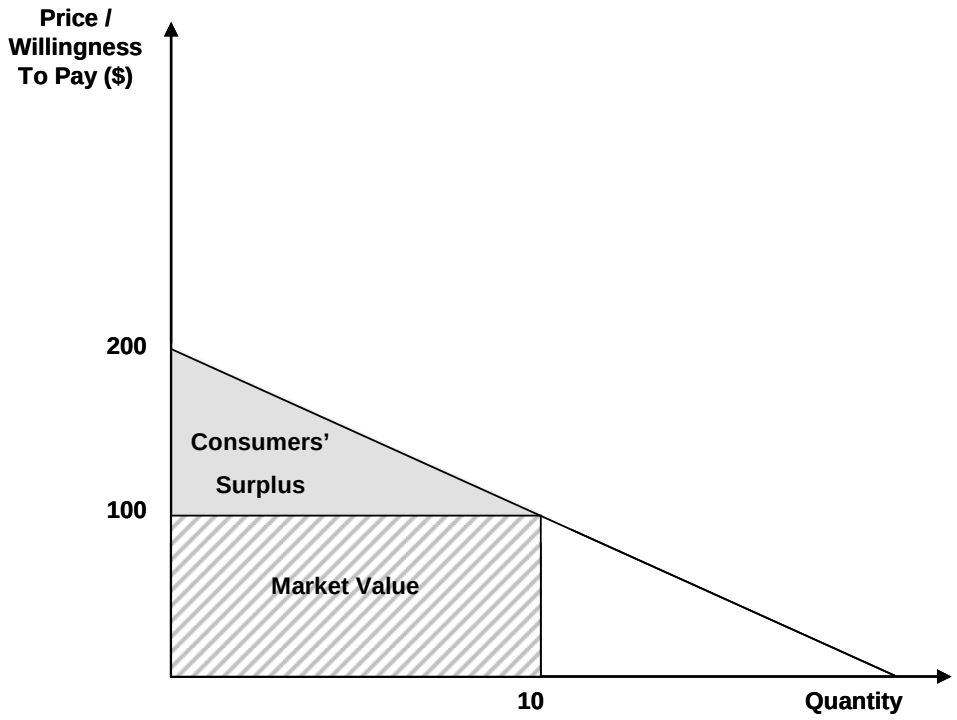
Figure 2-2 Consumers' Surplus and Market Value



However, many of the services provided by coastal natural assets are not traded in the marketplace. For these *non-market benefits*, where the price is zero, the entire value is made up by consumer surplus.

2.1.3 Total economic value framework

Environmental and cultural assets, such as those that make up the Victorian coast, are generally acknowledged to contribute value not only to those who use the resource, but also to non-users or passive users, who may value those resources for the mere reason that they can be used by others or for the knowledge that it will continue to exist. For example, even if one never expects to visit the Croajingolong National Park along the Eastern stretch of Victoria's coast, one might feel a significant loss of value should the ecosystem it harbours be damaged or destroyed.

These different types of value can be described in what economists refer to as total economic value (TEV) framework:

Total economic value = Use value + Non-use value.

Use value involves some interaction with the resource, either directly or indirectly:

Direct use value: where individuals make actual, present day use of a natural asset, which can be consumptive (e.g. commercial uses or recreational fishing) or, to varying degree, non-consumptive (e.g. hiking).

Indirect use value: where individuals benefit from services supported by a natural asset rather than directly using it (e.g. storm protection).

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Option value: an individual derives benefit from ensuring that natural assets will be available for his or her own *use in the future*. In this sense it is a form of use value, although it can be regarded as a form of insurance to provide for possible future use (often associated with the potential of genetic information inherent in biodiversity to be used for research (e.g. pharmaceuticals).

Non-use value is associated with benefits derived simply from the knowledge that the natural asset is maintained. By definition, it is not associated with any use of the asset or tangible benefit derived from it, although users of a natural asset might also attribute non-use value to it. It can be split into three basic components:

Existence value: derived simply from the satisfaction of knowing that the natural assets that make up the coast will continue to exist, whether or not this might also benefit oneself or others (also associated with 'intrinsic value').

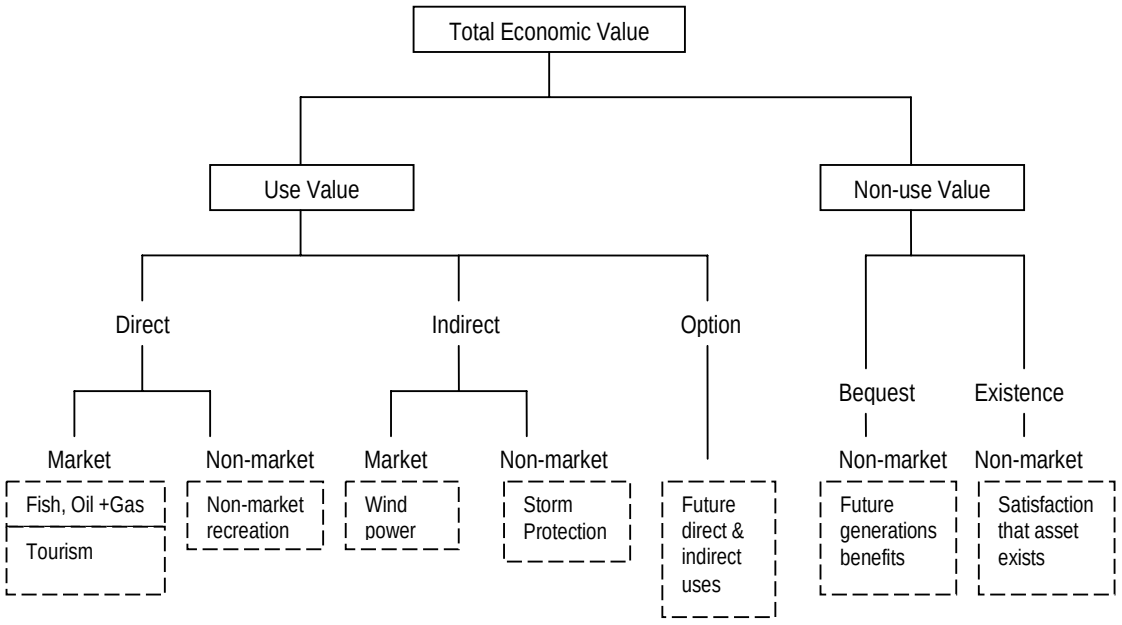
Bequest value: associated with the knowledge that the natural assets and their services will be passed on to future generations.

Altruistic value: derived from knowing that contemporaries can enjoy the services that natural assets provide.

Figure 2-3 illustrates the TEV framework and provides some examples. The figure introduces an important distinction between market and non-market measures of value. For example an estuary can generate both market goods and services such as fish and non-market goods and services such as storm protection.

The total economic value framework is a utilitarian (anthropocentric) concept of value, which means natural assets and the services they provide have value to human societies because people derive utility from their use, because they expect to use it in the future, or simply because the existence of the natural asset adds to their utility.

Figure 2-3 Total Economic Value Chart



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2.2 Measuring and demonstrating value

The coast provides both market and non-market benefits, which together provide value to the Victorian economy and community. In this section the approach taken to valuing both commercial and non-market services is presented.

2.2.1 Economic value of commercial services

The value of the commercial services provided by the coast is the market value and the consumers' surplus of the production and consumption activities that depend upon coastal natural assets. Coast-dependent industries can be distinguished from other industries because their production is intensive in use of coastal natural resources such as the sea, seabed, seawater, estuaries, sand, wind, coastal land, forests and so forth. The market value of such coast-dependent commercial production is measured by the prices and quantities of goods and services traded. As mentioned in the previous section, the consumers' surplus that ideally should be measured to find the total economic value is normally not available for commercial services.

This study has examined the value of productive activity in coastal regions, compared with the levels and trends in other regions of Victoria and the state as a whole. It has also compared data available about coast-dependent industries and other economic, social and demographic indicators in the coastal region with similar activities in the rest of regional Victoria, Melbourne and the State as a whole. Together this information provides an interesting picture of the value of commercial activities on Victoria's coast and the commercial pressures on coastal natural assets.

- **Value of commercial goods and services supported by coastal natural assets:** The value of production of commercial services can be determined by the measured contribution of coast-dependent industries to Victoria's Gross State Product (GSP). Such activities include fishing, ports and tourism. The concept of value in Gross State Product is value added by an industry, as it is important for production of individual industries or regions to add to the total without double counting. Thus, the ABS statistics for value of coast-dependent industries is value added (value of output minus the value of inputs).
- Other ABS demographic and economic measures, such as population and employment, are also important indicators of economic activity and of human pressures on coastal natural assets. Such information can be used with the national accounting data to gain insights into Victoria's coastal economy and the value of coastal natural assets.
- There are no small area data that allow the level of economic activity (Gross Regional Product) to be identified directly from ABS statistics. Instead, indirect methods must be used. One approach is to use estimates of employment from the ABS Population Census to provide the foundation for estimating the value of gross regional product for the coast, and to use for modelling that can infer the industry contributions to the value of activity. The main assumption is that output per person per industry is consistent in all regions of Australia.
- ABS data can also be supplemented by primary data from certain industries, such as the commercial fishing industry data collected by the Victorian Department of Primary Industries on the market value of production. To be consistent with the GSP/GRP data, it would be ideal to have information about industry value added. However, such information is limited, and the value of sales is often the only data available. Nevertheless, it can still help to supplement the highly aggregated data from the national accounts.
- Supplementary information is also available from economic studies of particular industries such as ports. Economic impact studies have been done for several commercial ports in Victoria (Melbourne, Geelong and Portland). Estimates of the value of production and value added from these studies have been used in this report. These studies were undertaken also to analyse the linkages between the port and the wider economy in terms of indirect flow-on benefits to the local community and the State. Regional Input-Output analysis was used to estimate regional multipliers to demonstrate the indirect production, income and employment created in other industries by the ports. Such indirect

benefits relate to other industries (for example retail sales to port workers and truck transport to the port). They are quite different in nature from the direct value of production and are not comparable with any of the other figures for value of coastal goods and services. Where available, they are mentioned for the sake of completeness.

- **Comparison of market and non-market values:** The value of commercial activities can be compared to the value of non-market services also provided by coastal natural assets with which these commercial activities may often compete. However, it is important to stress that a direct comparison is difficult due to the different techniques and should always be done with an understanding of each technique's limitations.
- **Comparison of Coastal and Non-Coastal Regions:** This study is interested in those industries that are connected to the coast through their intensive use of coastal natural assets. It is therefore useful to compare the industrial composition of Victoria's coastal region with that of the rest of the state. It is useful to examine the extent to which variables such as population, employment, economic activity and income in the coastal region are different from the rest of Victoria. The industrial composition across Australia is relatively homogeneous. It is dominated by service industries that follow the population and are essentially mobile– they tend to be provided wherever people live and work.

Available data and measurement issues

The ABS national accounts measure Gross Domestic Product (GDP), which measures the value of production in the Australian economy. ABS disaggregates the national GDP figure to obtain values for production in each state and territory. This is known as Gross State Product (GSP) (9ABS13/11/2006, 5220.0 - Australian National Accounts: State Accounts, 2005-06 Reissue).

GDP and GSP can be measured in terms of expenditure on goods and services within the economy or in terms of basic prices. Both concepts are used in this report, but for different purposes. Expenditure based estimates are relatively quick to compile. Released quarterly, the expenditure based national accounts receive intense media attention and are familiar to many newspaper readers. GDP at basic prices is income based. As it takes longer to compile, it is done annually; the latest estimates available are for 2005-06 (ABS 01/11/2006, 5204.0 - Australian System of National Accounts, 2005-06). These estimates are derived from industry-specific (among other) sources and are available on an industry-by-industry basis. This is the basic information that is used to assess the value of coast-dependent industrial production in Victoria. Further information about the national accounts is available from the ABS in the publications cited above.

Population and employment data at the SLA level can be used to apportion the state-wide level GSP data to obtain estimates of the value of production for the coastal SLAs. This is referred to as Gross Regional Product. Population and employment data are available from the Population Census. This is discussed further in Section 4.

The latest Census information disaggregated to the SLA level is from the 2001 Census. Additional analysis presented in Section 6.2 use the CIE's AUSM model of the Australian economy to augment the data from the 2001 census to 2007 to gain an insight into the economic drivers along the coast. It also helps to overcome the lags in the statistics by modelling likely changes in important macroeconomic variables, although it does not take the place of the new data that will become available.

2.2.2 Economic value of non-market environmental and social services

The coast provides a range of non-market goods and services, which are quite different from each other. Many benefits are not captured in the conventional market environment — yet they still represent economic benefits. They are not traded in conventional markets because many of the benefits which are derived, for example through environmental amenity, have 'public good' characteristics which distinguish them from conventional 'private' goods:

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- Consumption by one person does not reduce the amount of the good available for the next person. An example of this is the scenic view provided by a river which is not changed by the number of individuals who have previously looked at the river.
- Users cannot be prevented from consuming the good. For example, it would be difficult to charge tourists to see the river because of the large number of entry points to the area.

These non-market values cannot be observed through the normal market information about prices, quantities and costs. Therefore, it is necessary to estimate the value using other techniques. A number of well-established economic valuation techniques exist to measure the contributions of non-market services. The advantage of many of these techniques over the use of market prices is that they typically seek to isolate the value of the environmental good or service from any other inputs such as labour or capital, or any other influencing factor.

These techniques fit broadly into two categories:

- 'Pricing' techniques, or
- 'Valuation' techniques.

Pricing techniques use available market data to estimate the value of related non-market services. They are not measuring consumers' willingness to pay directly and are therefore not a reliable measure of value but rather an indication of value.

Pricing techniques are discussed in more detail in Appendix B and include the:

- *production function technique*, which seeks to measure the contribution of an environmental service in the production of commercial goods and services;
- *cost of alternatives technique*, which seeks to measure the value of an ecosystem function by the costs that would be incurred to replace it, such as the costs of constructing and operating a water treatment plant to replace the natural filtration function (that is, the opportunity cost of destroying this function); and
- *shadow project cost technique*, which seeks to measure the value of a non-market service by the costs that would be incurred to provide a similar benefit or service elsewhere, such as the costs of securing a 'biodiversity offset' (that is, the opportunity cost of destroying the initial biodiversity asset).

Valuation techniques measure consumers' willingness to pay for the non-market goods and services. Two types of valuation techniques, which are also discussed in Appendix B, are commonly used:

- *revealed preference techniques*, which use market data to reveal how much people are willing to pay for non-market services. The travel cost method is an example which uses information about how much people have spent to travel to and from a particular location to estimate the contribution of that location to their well-being. Revealed preference techniques are often criticized for their limited scopes, because they can only value services that are linked to a traded good, and for some econometric problems in the estimation; and
- *stated preference techniques*, such as choice modelling, which employ sophisticated survey methods to elicit how much people are willing to pay for non-market services. Stated preference methods base the valuation on hypothetical scenarios and people are not forced to pay their stated willingness to pay. The technique is often criticized for being too hypothetical and therefore leading to overestimates. There have, however, been huge developments in the design of the stated preference technique in recent years to try to solve this problem by increasing the realism of the scenarios.

The estimated values for non-market goods and services derived from the last two techniques are often used to impute the value for such services in other, similar, situations. Known as benefits transfer, this approach is discussed further in Appendix B.

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Available data and measurement issues

To estimate the value of non-market services of the coast, the best option would be to design valuation studies to value each service. This has been done for the non-market value of coastal recreation for this study using the travel cost method. Travel costs provide an indication of the costs that consumers are prepared to incur in order to utilise coastal recreational services, and are a useful substitute for a market price.

The travel cost method, which was used to estimate the recreational values of the coast to Victorians, is one of the revealed preference valuation methods and uses information on visitation numbers and the costs incurred by people to visit an area (e.g. the coast) to estimate the value of recreation. This is an advantage of the revealed preference methods in general compared with the stated preference methods, which relies on surveying people's preferences rather than observing them in a market situation. The disadvantage of revealed preference studies (including travel cost studies) are that they can only value existing goods and services, and therefore cannot be use to evaluate management changes or new policies. Also it is only possible to value goods and services that can be linked to market goods such as accommodation or petrol. The results of the valuation study are presented in Section 5.2.4; further details on the method, data and results are presented in Appendix C.

Other techniques must therefore be employed to estimate the non-market values of other coastal goods and services. A review of the existing literature was undertaken to identify any previous research that estimates these values. Where available and appropriate, such estimates have been used as a guide for the value of the non-market services of the coastal region. The estimation of the value of non-market services is discussed further in Section 5.

There are insufficient studies available to allow all of the non-market services to be valued. Where it seemed reasonable, examples of studies undertaken overseas have been presented, mostly to demonstrate the technique, rather than to give any indication of value.

2.2.3 Geographical analysis

To assist with the identification and analysis of market and non-market services, a range of geographic data, presented as Geographic Information System (GIS) information, were employed. Such information enables the characteristics of natural assets along the coast to be identified. It also illustrates the location of natural assets relative to built assets and population centres and, hence, provides an insight into the uses of natural assets and magnitude of their contribution to human well-being. The major layers used are described in Table 2-1.

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Table 2-1 GIS Data Layers for Describing Coastal Attributes

Assets/ attributes	GIS layer	Description	Year
Natural assets	Ecological Vegetation Classes (EVC) layer	Types of ecosystems such as wetland, mangrove, reef system, dune system, or beach.	2002-04
	Victorian Bioregions	Biogeographic areas that capture the patterns of ecological characteristics in the landscape or seascape, and which provide a natural framework for recognising and responding to biodiversity values.	2002
	Bioregional Conservation Status	Conservation status assigned on the basis of unique Bioregion EVC units	2002-04
Built assets	Built-up areas	Describes the extent of built-up areas from a geographical cluster analysis of roads.	2006
Land management	Public Land Management	Layer presents primary management details (National Parks, State Forest, Conservation Reserves etc.) and overlay management (Reference Areas, Wilderness Zones, Remote Natural Areas etc.).	Actively managed (2007)
	Land Use Layer	Describes the different types of agricultural land use including plantations.	1991

2.2.4 Changes in value over time

One of the objectives of this report is to measure the changes in value of coastal assets and services over time. This can be done by applying a number of different techniques and data. Changes can be biophysical (changes in ecosystems and natural resources) or social and economic (such as changes in population, preferences and prices).

Social and demographic changes can be captured by comparing the ABS population census over time. This is done in section 6, by comparing the 2001 and the 1996 census data directly, and by using the AUSM model to forecast demographic changes in 2007. The 2006 census is not yet available in sufficient detail to be used in this report.

Biophysical changes can be measured through GIS by comparing data sets of for example ecosystem coverage over time. This can then be linked to values through the use of non-market valuation techniques. It has not been possible to do this due to the lack of information over time. This wider use of GIS data is reasonably new and time series do not exist to an extent that would facilitate a comparison over time for the coast of Victoria. The datasets used in this report are not often updated apart from direct property information (as found in the public land management data set).

Changes in preferences can be captured in valuation techniques themselves. These are, however, often context specific and it would therefore be necessary to repeat the surveys to get measures that were directly comparable and therefore enabled an analysis of change over time. In general, non-market valuation studies are done infrequently and few have been undertaken on a consistent basis to enable analysis over time. This means that it has not been possible to evaluate changes in preferences over time.

Section 3 Coastal Ecosystem Services

Section summary

- This section provides an overview of the ecosystems along the coast and the commercial, environmental and social services they provide.
- The geographical analysis shows that there is a total of 435,000 ha of ecosystems along the coast, divided into 125,000 hectares of coastal ecosystems and 310,000hectares of inland ecosystems.
- The threats and protection of ecosystems are analysed as well as the degradation of the ecosystems. It shows that:
  - Most ecosystems (around 80 percent) are found on public land, which provides some protection and conservation
  - One third of the area is found within 5 km of built-up areas, which is known to threaten healthy ecosystems.
  - One fourth of the area is showing some degradation of the ecosystem.
  - The conclusion is that even though most areas are protected, serious pressures exist to ecosystem health from proximity to built-up areas. This may explain the low conservation status of some of the coastal ecosystems.

3.1 Overview of ecosystem services

The coast provides value to society by offering services that are linked to the existence of natural assets or ecosystems. People build ports and settle in or visit the coastal area because these services have a positive impact on our wellbeing and economic prosperity. In the following the coast is described by identifying the services that it provides and linking these to the existing ecosystems or natural assets found in coastal Victoria. This approach is adapted from the Millennium Ecosystem Assessment, a global analysis of how human well-being is influenced by ecosystems and especially changes in ecosystems (Alcamo *et al.,* 2003). The work included an analysis of coastal ecosystems and provides a good framework for this report. Ecosystems are not only the plants and animals living in a particular location; they also encompass the physical, biological and climatic environment (Alcamo *et al.,* 2003).

Table 3-1 provides a list of the services that the coast provides, under the general headings of commercial, environmental and social services; the environmental and social services are non-market services. All of these services provide economic value to Victoria, which is demonstrated either through indicators such as employment, industry activity, or through the contribution of services to the welfare of individual citizens.

Section 3 Coastal Ecosystem Services

Table 3-1 Commercial, Environmental and Social Services

Market	Non-market	
Commercial	**Environmental**	**Social**
Products or commercially exploitable services obtained from ecosystems	*Benefits obtained from regulation of ecosystem processes and supporting services necessary for the production of all other services*	*Nonmaterial cultural and amenity benefits obtained from ecosystems*
Examples: • Food (commercial fishing and agriculture) • Fibre (forestry) • Oil and gas extraction • Wind energy • Marketed recreation (tourism)	Examples: • Climate regulation • Storm protection • Erosion control • Water purification • Waste assimilation • Fish nursery • Shoreline stabilisation • Nutrient cycling • Provision of habitat	Examples: • Non-market recreation (fishing, hiking, swimming, canoeing) • Visual amenity • Cultural heritage • Health benefits

3.1.1 Commercial services

The coast offers a number of services that give rise to products which are bought and sold in markets. The existence of natural resources such as oil and gas are the most important provisioning services on Victoria's coast that are utilised commercially. Provision of food from fisheries and aquaculture and wood and pulp from forestry are also important services.

Wind energy is starting to play a bigger role in the ecosystem services provided by the coast of Victoria today. However, the potential is still not utilised fully, wind energy is therefore an example of an *option* value, i.e. a resource that is not used today but is valuable because of future possible use.

Commercial services have *direct use values*, as they contribute to the economy though direct use of natural resources.

3.1.2 Environmental services

The coast also offers a number of benefits from its ability to regulate ecosystem processes and the existence of the ecosystems that provide all other services. The stabilisation of the shoreline from the continued erosion by sea currents and the protection of hinterlands from storm and floods are important services in protecting man-made assets, such as infrastructure, agricultural production and built-up areas. Another important group of environmental services is the ability of estuaries, marshes, mangroves and other coastal ecosystems to filter water to absorb nutrients and pollutants and decompose organic matter entering the coastal area, for example from agriculture, stormwater and waste water.

Section 3 Coastal Ecosystem Services

Climate regulation along the coast is an important service that benefits industries such as forestry and agriculture due to the relatively higher proportion of rainfall and the more moderate climate that the land/ocean interface generates.

Another aspect of environmental services is the ability to provide well-functioning ecosystems, which ensure that all other services can be produced. This includes providing habitats for wildlife and biodiversity, recycling nutrients and primary production of flora and fauna in the ecosystem.

Environmental services provide *indirect use values* because people benefit from the ecosystem service without actively using it, for example the storm protection service secures towns and rural areas, which benefit the people living there. It also provides *non-use values* such as the existence value of ecosystems.

3.1.3 Social services

Social services such as recreation, cultural heritage or visual amenity are foremost in people's minds when thinking of the Victorian coast. These services are the benefits people obtain from the coast through direct use of the ecosystems or from intangible benefits. Recreation is the predominant service provided by the coast as a high number of people visit the coast yearly for that purpose

Social services are most often *direct use values* because people have to visit the coast to benefit from the services. However, some services as cultural heritage have important non-use *bequest value* and *existence value* to people, who benefit from knowing that the site is there and that it is protected and conserved for the future.

3.2 Ecosystems services by natural asset types

3.2.1 Ecosystems along the coast

Within the coastal area defined in section 1.3, there are a range of ecosystems, which have been grouped into coastal ecosystems and inland ecosystems. *Coastal ecosystems* are those directly influenced by salt from the sea via salt sprays or tides and *inland ecosystems* are situated close to the coastline without being directly influenced by salt. Table 3-2 shows the range of ecosystems.

Table 3-2 Ecosystem Types along the Coast

Coastal ecosystems	Inland ecosystems
Estuaries and saltwater marshes	Forests and woodlands
Mangrove forests	Freshwater wetlands, lakes and other water bodies
Rocky shores and sandy beaches	Inland grassland, heath and shrubs
Dunes	Plantations (a managed ecosystem)
Coastal scrub, heath and woodland	
Kelp forests*	
Seagrass beds*	

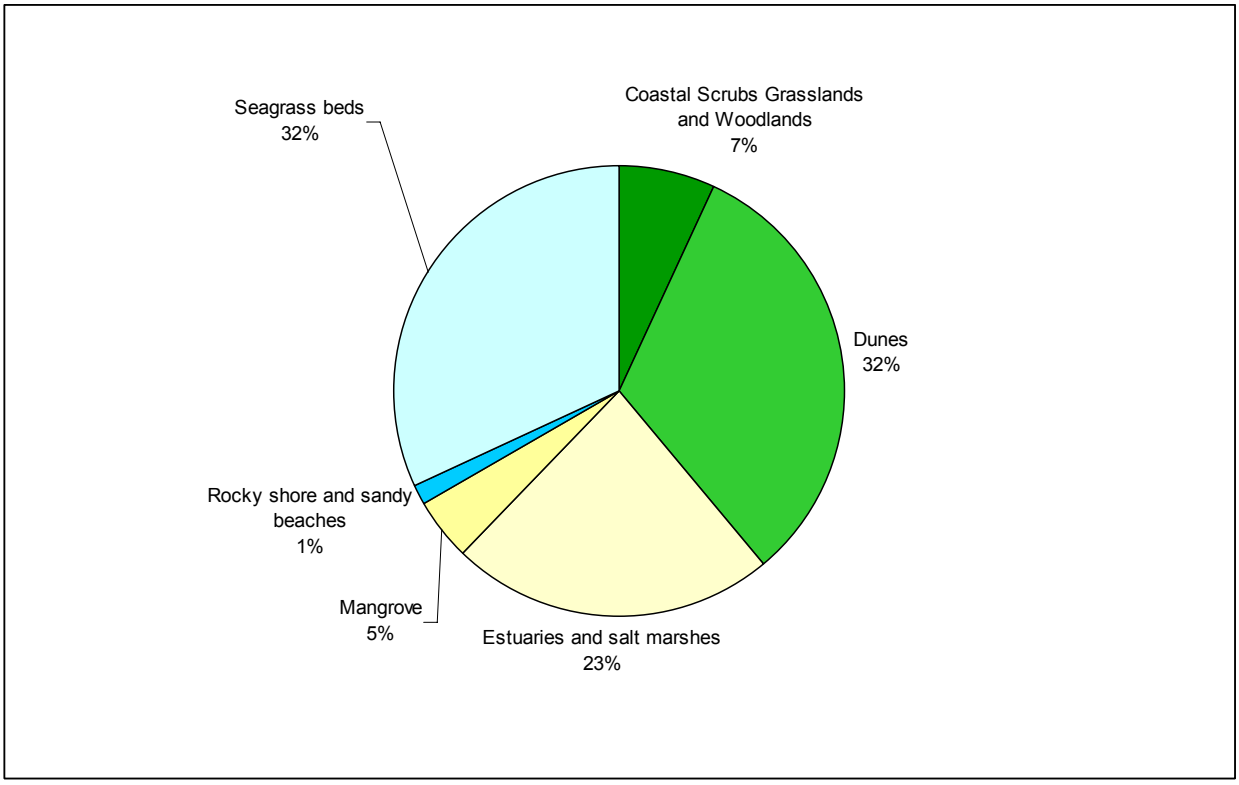
** Kelp forests and seagrass beds are not included in the ecological vegetation classes mentioned below.*

Section 3 Coastal Ecosystem Services

The Department of Sustainability and Environment has developed an ecosystem framework that is applied in this project (DSE, 2007). It divides Victoria into 27 bioregions, eleven of these are found along the coast. A *bioregion* is a broad scale mapping unit that captures the patterns and ecological characteristics in the landscape. Within each bioregion the ecosystems are classified according to ecological vegetation classes (EVC's) which are a classification of native vegetation types. To facilitate analysis the EVC groups are used and for some categories, some EVC are regrouped to fit with the idea of coastal ecosystems and the framework from the Millennium Ecosystems Assessment (Alcamo *et al.* 2003). Kelp forests and seagrass beds are generally not included in this categorisation, because the EVC categorisation does not cover the marine ecosystems.

Figure 3-1 shows the 125,000 ha of *coastal ecosystems,* the kelp forest area was not possible to estimate due to lack of marine data. The ecosystem type with the highest coverage is dunes (32 percent), seagrass beds (32 percent) and estuaries and salt marshes (23 percent). Mangroves, sandy beaches, rocky shores, coastal scrubs, grassland and woodlands and coastal heath land cover a smaller area along the coast.

Figure 3-1 Coastal Ecosystems



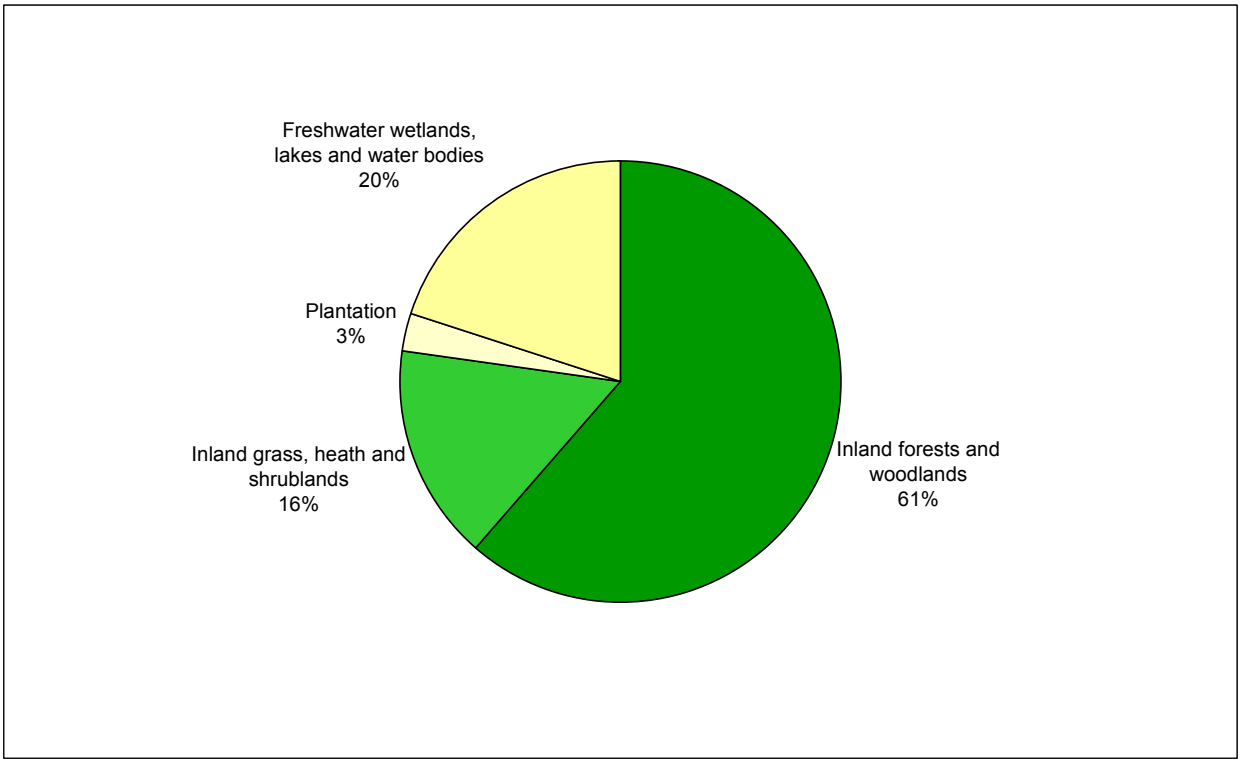
Note: The chart does not include the area of kelp forest because it is not estimated.

Source: Two GIS layers (EVC_BCS100) covering Ecological Vegetation Classes (EVC) and (VBIOREG100) covering bioregions. Both collected in 2002-04 and are available on www.dse.vic.gov.au. URS estimates of the seagrass area (see below).

The *inland ecosystems* cover a total of 310,000 ha and most of that consists of forest and woodlands (61 percent) (see Figure 3-2). Twenty percent is freshwater wetlands, lakes and water bodies and 16 percent is inland grass, heath and shrubs. Another 3 percent is covered by plantations, which are managed ecosystems, often with few native species.

Section 3 Coastal Ecosystem Services

Figure 3-2 Inland Ecosystems



Source: Two GIS layers (EVC_BCS100) covering Ecological Vegetation Classes (EVC) and (VBIOREG100) covering bioregions. Both collected in 2002-04 and are available on www.dse.vic.gov.au

This gives a total ecosystem area of 435,000 ha (plus an unknown area of kelp forests) on the coast of Victoria. They provide a range of services contributing to the extent to which the natural assets that make up the coast provide each of the services in Section 3.1.

Estuaries and saltwater marsh

Estuaries and saltwater marsh ecosystems occur where freshwater from rivers and land meet the salt water from the ocean. The natural habitats are more sheltered because water movements created by tides, wind and ocean currents are much weaker than in the open sea. Nevertheless, the areas are frequently flooded by high tides, or buffeted by strong winds and the salt content changes over time.

Sediments from rivers and the ocean accumulate in the interface and give rise to highly productive and dynamic ecosystems which provide significant habitat for plants and animals. They are important nursery areas for fish, thereby providing services to sustain both commercial fishing and recreational fishing that attribute to both market and non-market recreation. Some fish are dependent on the estuaries for their survival (estuary dependent fisheries), in Victoria the only commercially important species is prawns. Other species spend part of their lifecycle in the estuaries but could also use marine waters. Based on this, Victoria's estuary opportunistic fish species include bream, carp, eel, Australian salmon, King George whiting, pilchards, perch, snapper and garfish (LWA, 2002).

The calm waters and sheltered areas of estuaries mean that they are often used for harbours and for urban development (Underwood and Chapman, 1995). The Victorian coastline provides many examples for example the Port of Geelong and Port of Hastings, both situated within the sheltering environment of large estuaries. Melbourne was established in the sheltering environment of Port Phillip Bay and Port of

Section 3 Coastal Ecosystem Services

Melbourne was established in the estuary of Yarra River because of the environmental services that it provide.

Large estuaries, such as the Gippsland Lakes, play an important role in water purification, as well as protecting the hinterlands from storms and flooding. They also attract a high number of visitors who enjoy the vicinity to, but protection from, the ocean.

The area of estuarine and saltwater marsh ecosystem on the coast of Victoria is 29,000 ha. The greatest area (90 percent) is in the Gippsland Plains bioregion and in this region the conservation status is generally good. In the East Gippsland Lowlands bioregion (5 percent), most of the estuaries and salt marshes are depleted and around one third are classed as endangered.

A total of 20,000 ha of the registered estuaries and salt marshes, or more than two thirds of the total area, are located on public land, most of it in marine and coastal parks and reserves and wildlife reserves.

Mangrove forest

Mangroves are trees and shrubs found in the intertidal zone on sheltered coastline and estuarine margins that have adapted to living in saline water either continually or during high tides (Underwood and Chapman, 1995). They are found where silt accumulates and waves are not too strong. Mangrove forests are more frequent in warmer climates and are not widespread on the coast of Victoria.

In Australia mangrove forests are not used for timber on a large scale (Underwood and Chapman, 1995). In areas where they are abundant, they play an important role as fish nurseries and habitats for other flora and fauna. In Victoria, most of the mangrove forests are found inside estuaries and provide a number of environmental services including storm protection and water purification (Hassan *et al.,* 2005).

There are a total of 6,000 hectares of mangrove forests, two thirds of it in the Gippsland Plain bioregion: the conservation status of these is good. Smaller areas are found in the Otways Plain and Wilson's Promontory bioregions, where the conservation status is mostly endangered. Ninety two percent of the mangrove forest grows on public land, most in marine and coastal reserves and parks, but there is also a significant area in wildlife reserves.

Rocky shores and sandy beaches

The intertidal area covers the narrow strip between high tide and low tide and is often not vegetated. Along the coast of Victoria there are three groups: rocky shores, sandy beaches and mud flats; each providing specific ecosystems services (Hassan *et al.* 2005). Most of Victoria's 2000 kilometres long coastline (DSE, 2006) is alternating sandy beaches and rocky shores, whereas mud flats are not very abundant and restricted to bays, inlets and estuaries[2].

Rocky shores are abundant in the Wilson's Promontory bioregion, where they cover an area of 300 hectares. It is the only bioregion where rocky shores are identified. They provide habitats for a number of species, such as molluscs, crabs and sea urchins that were traditionally collected for food, the collection of which is now prohibited in national parks (Underwood and Chapman, 1995). The shores often constitute dramatic landscapes that underpin market and non-market recreation.

Sandy beaches are characterised by the accumulation of sand/gravel deposited by waves. Sandy beaches are a harsh environment for flora and fauna. But they provide one of the favourite recreational

[2] The GIS data analysis is incomplete for this category. First of all sandy beaches and rocky shores are only registered for a few bioregions, even though they would have to be present to some extent in all for the bioregions adjacent to the sea. Secondly, unvegetated mud flats are not registered as a category at all and can therefore not be accounted for. This has to do with the fact that the EVCs are a mapping of vegetation classes and therefore the focus on unvegetated areas is sparse.

sites, by far the most significant service provided by beaches. There are a total of 1,000 hectares of sandy beach registered in the bioregions of Gippsland Plains and Wilson's Promontory; again there is no clear data for assessing the length of sandy, accessible beach along the coast.

Mud flats develop where the finer sediments silt, clay and organic material are deposited in the intertidal zone (Underwood and Chapman, 1995). This is only possible in areas, such as estuaries and bays, protected from strong waves. They provide very diverse and productive ecosystems and important habitats for migrating birds, with bird-watching often being an important recreational activity.

Dunes

Dune systems occur inland of the intertidal zone, most often in connection with sandy beaches. Dunes can be very dynamic and mobile. They pose a threat to neighbouring areas if not vegetated, and can destroy other ecosystems and man made assets. At the same time they play an important role in shore stabilisation and erosion control, if removed, can necessitate major public works such as seawalls and sand renourishment (Hassan *et al.,* 2005).

Dunes are an important feature of the coastal area and offer recreational services. At the same time they are also fragile and vulnerable to wear from recreation. Dunes are not species rich in general but are important habitat for specific plant groups (Hassan *et al.,* 2005).

In terms of area, they are the largest of the coastal ecosystems, a total of 40,000 ha of which 38,000 are vegetated. They occur mainly in the bioregions of Gippsland Plains (17,000 ha), Bridgewater (10,000 ha) East Gippsland Lowlands (9,000) and Otway Plains (2,000 ha). The conservation status of the Bridgewater and East Gippsland Lowlands bioregions is good, Gippsland Plains mostly depleted or vulnerable, and likewise for the Otway Plains. The latter bioregion has the highest pressure from recreation uses.

Seagrass beds

Seagrass beds colonize soft-bottom areas of the oceans and estuaries and are typically found in water depths of 2-12 metres, where there is sufficient sunlight intensity to promote seagrass growth (Blake and Ball, 2001). Seagrass is a very dynamic and ecologically significant habitat that provides a range of services. It serves as a fish nursery and is an important habitat for algal and small animals, which in turn provide significant food sources for other organisms, including commercial species. The western rock lobster, for example, is dependent on near-shore seagrass (Zann, 1995). The high concentration of fish in seagrass beds also makes them a popular recreational fishing spot, giving rise to market and non-market recreational services.

In addition, the seagrass canopy acts to reduce wave and current velocities, thereby reducing erosion and enhancing sedimentation on the sea bed which stabilises the shoreline. Cut off seagrass that is transported to the beach is an important source of nutrients in coastal ecosystems, which supports species and habitats through nutrient cycling.

Data on the area and health of seagrass beds along the coast is limited; the beds are currently not registered as a unique Ecological Vegetation Class. Some information is available from the series of studies undertaken by the Marine and Fresh Water Institute during the late 1990's. The studies focussed on the seagrass beds in bays, estuaries and inlets along the coast, which are the most important habitats for seagrass, and sought to determine the extent of seagrass beds and the change over time. The results of the studies are presented in Table 3-3, which shows that the recorded area of seagrass in these habitats to be approximately 40,000 hectares. This is likely to be a conservative estimate because the studies did not cover the total marine coastline. With reference to old aerial photography, the studies also concluded that, overall, there was no clear evidence that the area of seagrass in the bays, estuaries and inlets had declined over the past decade.

Section 3 Coastal Ecosystem Services

Table 3-3 Seagrass Area in Victoria

Location	Area (hectares)
Port Phillip Bay	6,799
Western Port	12,965
Gippsland Lakes and Lake Tyers	3,111
Corner Inlet and Nooramunga	14,892
Minor inlets (Anderson, Shallow, Sydenham, Tamboon, Wingan and Mallacoota Inlets)	2,177
Total area	**39,914**

Source: Blake and Ball (2001), Blake et al.t (2000), Blake et al. (2001), Roob and Ball (1997), Roob et al. (1998).

Kelp forest

Kelp forests are typically found in waters between 1 and 24 meters below the low tide mark; the tops are often partially exposed on very low spring tides, with the tops of the kelp sticking 20 to 30 cm out of the water. Water clarity is a key factor determining the depth of water a kelp forest can thrive in, as sufficient light must reach the depth where kelp are anchored to the sea floor and first start to grow. Data were not available on the total area of kelp, and other habitat forming algal, along the Victorian coastline.

The value of the ecosystem arises because they provide important nurseries for fish species and habitats for a number of other sea vertebrates, such as seals and sea otters. In Asia and USA kelp is harvested for food and other purposes (Underwood and Chapman, 1995), an activity which is currently not pursued in Victoria. (Underwood and Chapman,1995; and Zann, 1995). They are also an excellent diving spot, thereby providing market and non-market recreation services to divers.

Coastal scrubs, heath and woodland

In the most exposed areas of the coast, where wind and salt shape the landscape, coastal scrubland is found and further inland, shrubs, heath and woodland can be found. Dunes are singled out due to their distinctive features, even though it could be argued that they fit in this category as well.

The total of this ecosystem is 9,000 ha. Almost one third is found in the Warrnambool Plains bioregion where the conservation status is vulnerable. Another 20 percent is located in the Gippsland Plains bioregion and 16 percent in the Otway Plains bioregion. In both of these bioregions, the conservation status of the ecosystems is depleted. The majority of coastal scrubs, grass and woodlands (82 percent) is found on public land.

A major influence on the conservation status of these ecosystems is the influence of urban development — they are preferred as a place to live (Underwood and Chapman, 1995). However, the ecosystems have their own natural flora and fauna, and provide important services for other market and non-market activities as recreation and visual amenity. Healthy coastal scrubs, heath and woodland are often found on sandy soils, where they are preventing erosion.

Inland ecosystems

Coastal hinterlands are found further inland and include a range of different types of forest, lakes, wetlands, scrubs, shrubs, heaths and grassland. Forests and woodlands are the most dominant, followed by freshwater wetlands, and inland grass, heath and scrub.

The most important commercial activities are forestry, both for native forests and plantations. Plantations are an increasing land use for three main features: relative high rainfall, the flat plains and access to

ports. The same reasons also make these ecosystems area suitable for agricultural production and therefore, agricultural land is abundant along the coast.

For non-market services recreation activities are the most significant and include the services provided by Wilson's Promontory National Park, the Otway National Park and other important natural assets long the coast.

3.2.2 Summary of ecosystem services

Table 3-4 gives an overview of the types of services each ecosystem provide. Some services are not provided by one specific ecosystem but by the coast as a whole, e.g. wind power and cultural heritage. They are specified in the 'overall' category.

Table 3-4 Summary of Ecosystem Services by Natural Asset Type

	All coastal ecosystems	Estuaries and salt marshes	Mangroves	Rocky shore, sandy beaches and mudflats	Dunes	Seagrass	Kelp forests	Coastal scrubs, heath and woodland	Inland ecosystems
Commercial									
Food		●		●			●		
Fibre									●
Oil and Gas	●								
Wind and wave power	●								
Market recreation		●		●	●	●	●	●	●
Environmental									
Climate regulation	●								
Storm protection		●	●	●					
Erosion control					●	●		●	
Water purification and waste assimilation		●	●						
Fish nursery		●	●			●	●		
Shoreline stabilisation				●	●	●			
Nutrient cycling		●	●			●			
Provisioning habitat		●	●	●	●	●	●	●	●

Section 3 Coastal Ecosystem Services

	All coastal ecosystems	Estuaries and salt marshes	Mangroves	Rocky shore, sandy beaches and mudflats	Dunes	Seagrass	Kelp forests	Coastal scrubs, heath and woodland	Inland ecosystems
Social									
Non-market recreation		●		●	●	●	●	●	●
Visual amenity		●		●	●			●	●
Cultural heritage	●								
Health benefits	●								

Section 3 Coastal Ecosystem Services

Attributes of the coast which describe value

While the natural asset characteristics of a coastal area will be the first major determinant of both the non-market services and commercial activities it allows (as described in the previous section), the extent to which these services add value to human welfare and the economy will also depend on the:

- land management provisions that govern the use of that asset;
- proximity of a natural asset to built-up areas, which reflects both
  - pressures that those areas put on natural resources, and
  - the access to the natural asset by users of the resource;
- quality of the assets (e.g. the extent to which they are degraded or endangered).

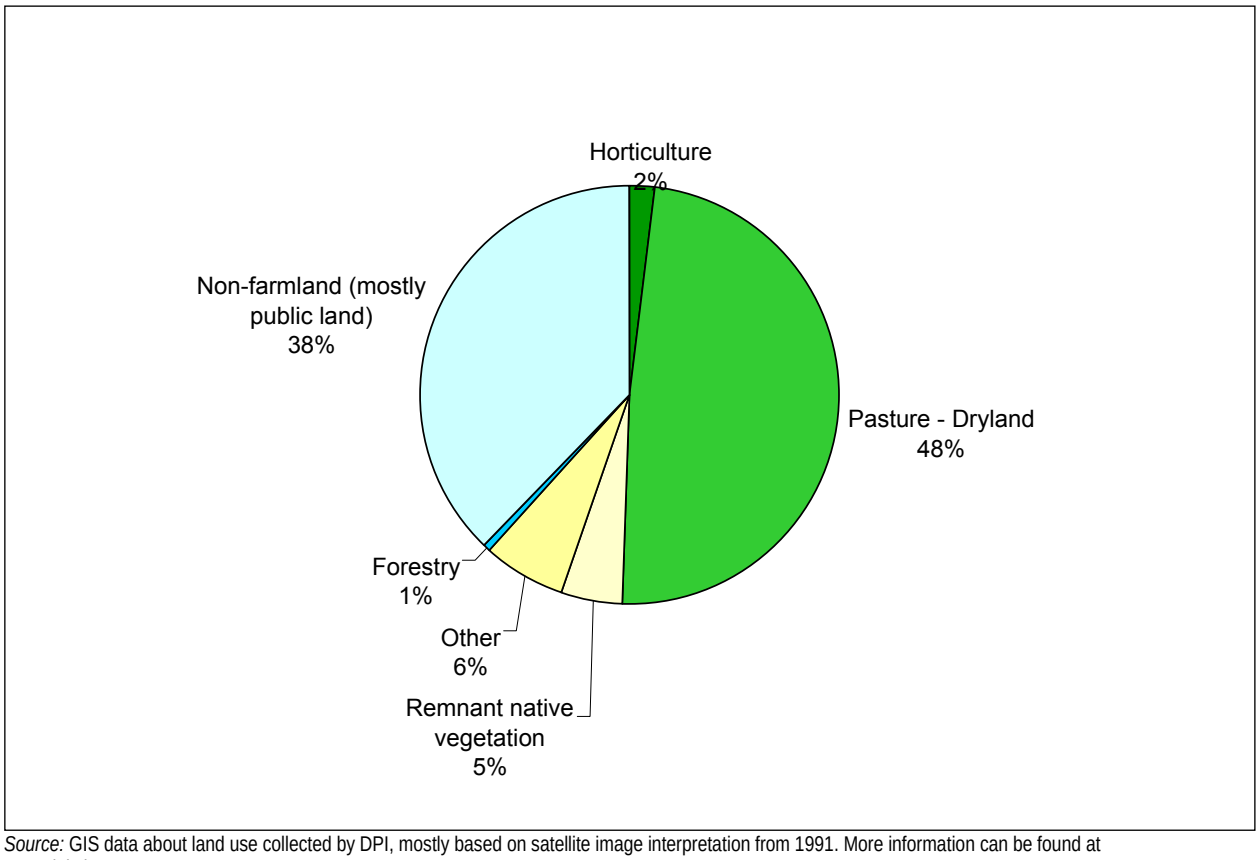
The remainder of this section provides an overview of the GIS data collected under each of these categories and provides insight into how, through analysis of this data, the understanding of the economic significance of the Victorian coast can be improved.

3.2.3 Coastal land use

A key insight to the value of a natural asset, such as the coast, is provided by current land use and management practices. Figure 3-3 shows the breakdown of non-urban land-use along the coast, where most of the land is either pasture dryland (48 percent) or non-farmed land that is mostly public land (38 percent). This is different from further inland, where dryland farming and irrigated pastures prevail. This is due to the climate regulation service of the coast that provides higher rainfall and more constant climate compared with inland agricultural areas.

Section 3 Coastal Ecosystem Services

Figure 3-3 Land-Use along the Coast



Source: GIS data about land use collected by DPI, mostly based on satellite image interpretation from 1991. More information can be found at www.dpi.vic.gov.au

The amount of public land along the coast is only slightly higher than the Victorian average of 34 percent. Figure 3-4 presents the breakdown of public land by land category status. National parks and reserves are created to provide protection to ecosystems within their boundaries. This protection is greater than that for other types of public land, which increases the potential contribution of the non-market services of these ecosystems to human well-being. Recently, marine national parks have been designated along the coast, which expands the protection of national parks into marine waters.

Ramsar site designation is another significant category as this reflects the value that the international community places on the services provided by coastal ecosystems. Five Ramsar sites are located on the Victorian coast.

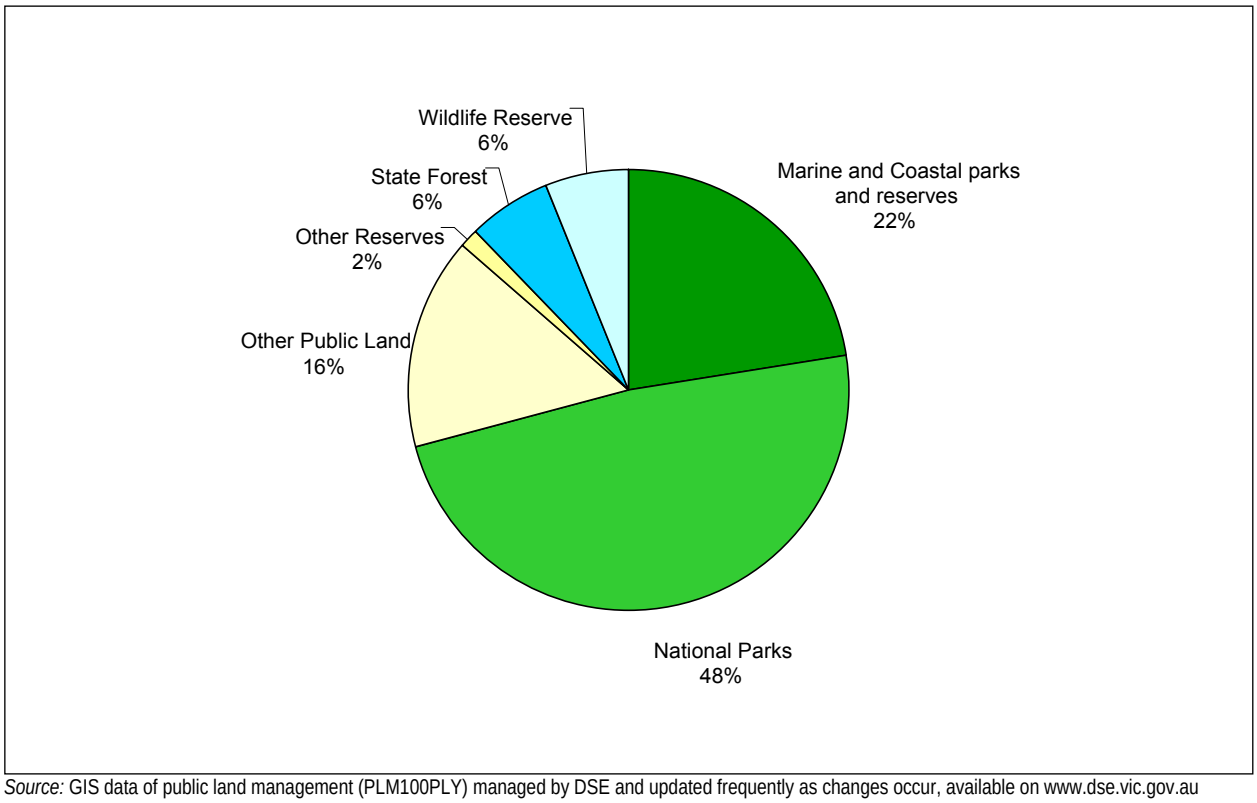
Table 3-5 Ramsar sites along the coast of Victoria

Ramsar site names	Area (hectares)
13. Corner Inlet	67,186
18. Port Phillip Bay (Western Shoreline) and Bellarine Peninsula	22,897
19. Western Port	59,297
21. Gippsland Lakes	60,015
57. Edithvale-Seaford Wetlands	261

Source: GIS data (RAMSAR100) covering all Ramsar areas in Victoria. More information available on www.dse.vic.gov.au

Section 3 Coastal Ecosystem Services

Figure 3-4 Public Land Composition along the Coast

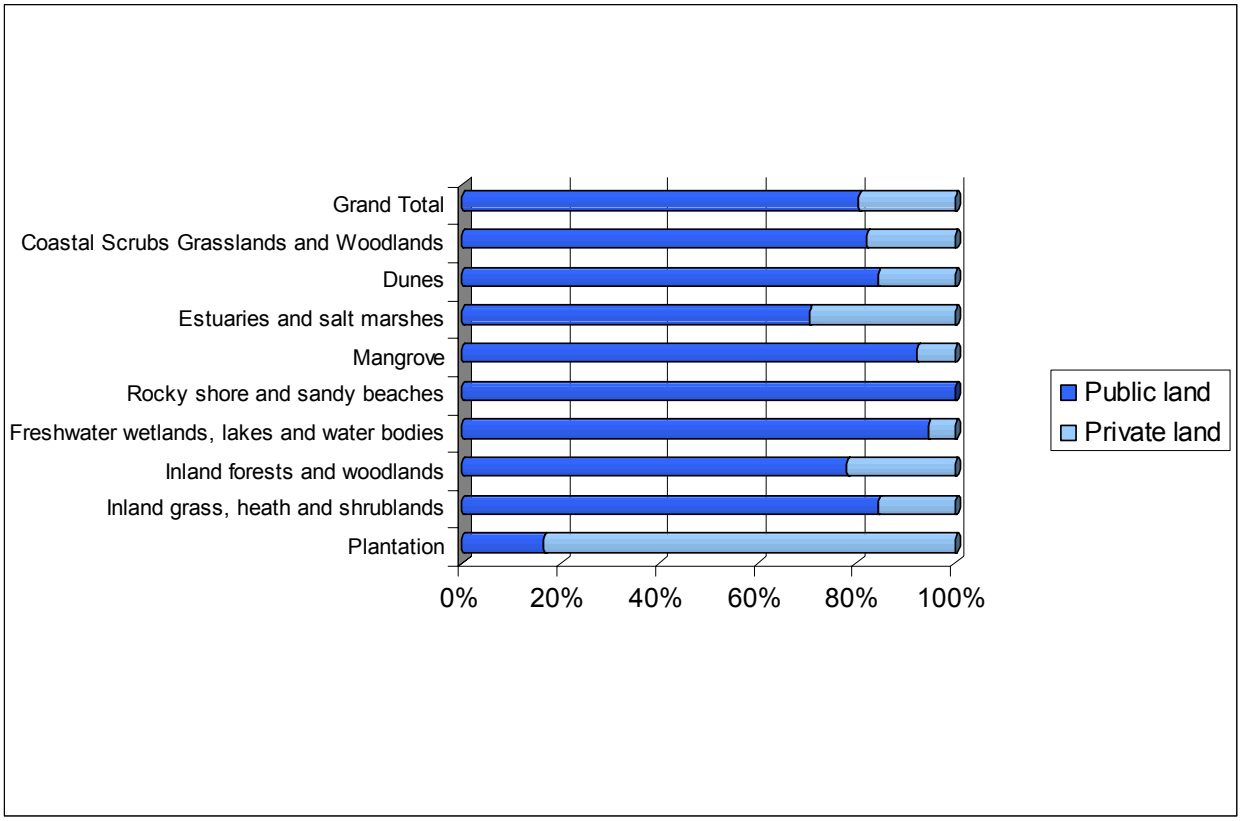


Source: GIS data of public land management (PLM100PLY) managed by DSE and updated frequently as changes occur, available on www.dse.vic.gov.au

The analysis of ecosystems of public land can be expanded to look at individual ecosystem types and how they are protected. Figure 3-5 shows this analysis by giving the percent of each ecosystem type located on public land versus other types of land. For most of the ecosystem types, the vast majority is on public land with responsibility for maintaining these areas. This indicates that the protection of existing ecosystems is good along the coast, but also that on non-public land, the cover of natural ecosystems is low, probably due to the extensive competing uses as agriculture and built-up areas.

Section 3 Coastal Ecosystem Services

Figure 3-5 Percent of Coastal Ecosystems Located on Public Land



Source: The information is produced from combining the following GIS data: (EVC_BCS100) covering Ecological Vegetation Classes (EVC) collected between 2002 and 2004, (VBIOREG100) covering bioregions, collected between 2002 and 2004, (PLM100PLY) covering public land management, which is updated continuously and GIS data about land use collected by DPI. More information about each GIS layer can be found on www.dse.vic.gov.au or www.dpi.vic.gov.au.

Conservation status

In evaluating ecosystems in Victoria different systems are afforded a conservation status according to the following categories:

- Presumed extinct in the bioregion
- Endangered
- Vulnerable
- Depleted
- Rare
- Least concern

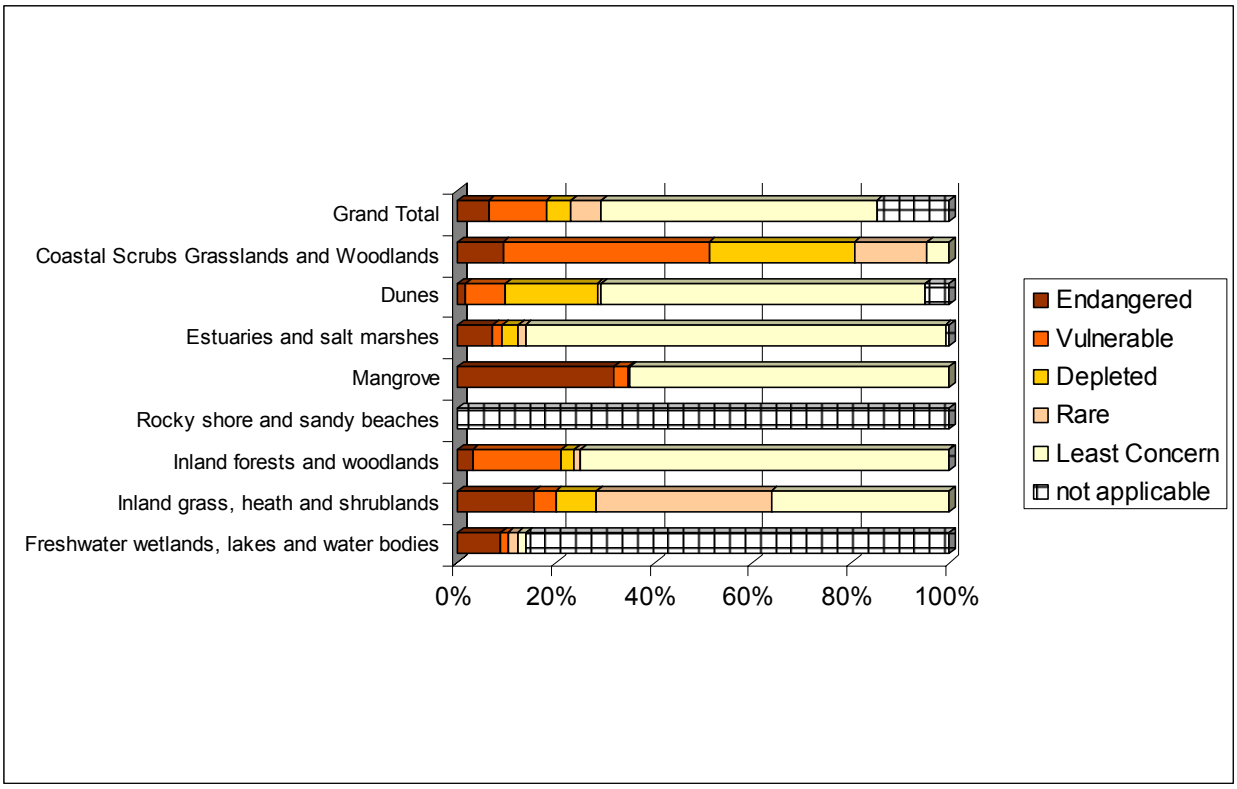
The conservation status is evaluated based on how much of the original extent of the ecosystem is left (compared to pre-European levels) and how degraded the remaining area is (see DSE, 2002 for details).

Figure 3-6 provides an overview of the conservation status of different coastal ecosystems. Mangroves are in the worst condition with 30 percent registered as endangered. The status of coastal scrubs and grasslands and woodlands is also poor, with major pressures arising from land-use change associated

with agriculture and housing as well as the pressures from tourism. In contrast, the overall status of estuaries and salt marshes is better.

The contribution to human well-being from the non-market services of the remaining vulnerable and depleted natural assets is limited due to their limited ability to function in the landscape. However, at the margin, the scarcity of such assets adds to their unit value and provides greater rationale for preserving them.

Figure 3-6 Conservation Status of Coastal Ecosystems



Source: GIS data (EVC_BCS100) covering Ecological Vegetation Classes (EVC), collected in 2002 to 2004, available on www.dse.vic.gov.au

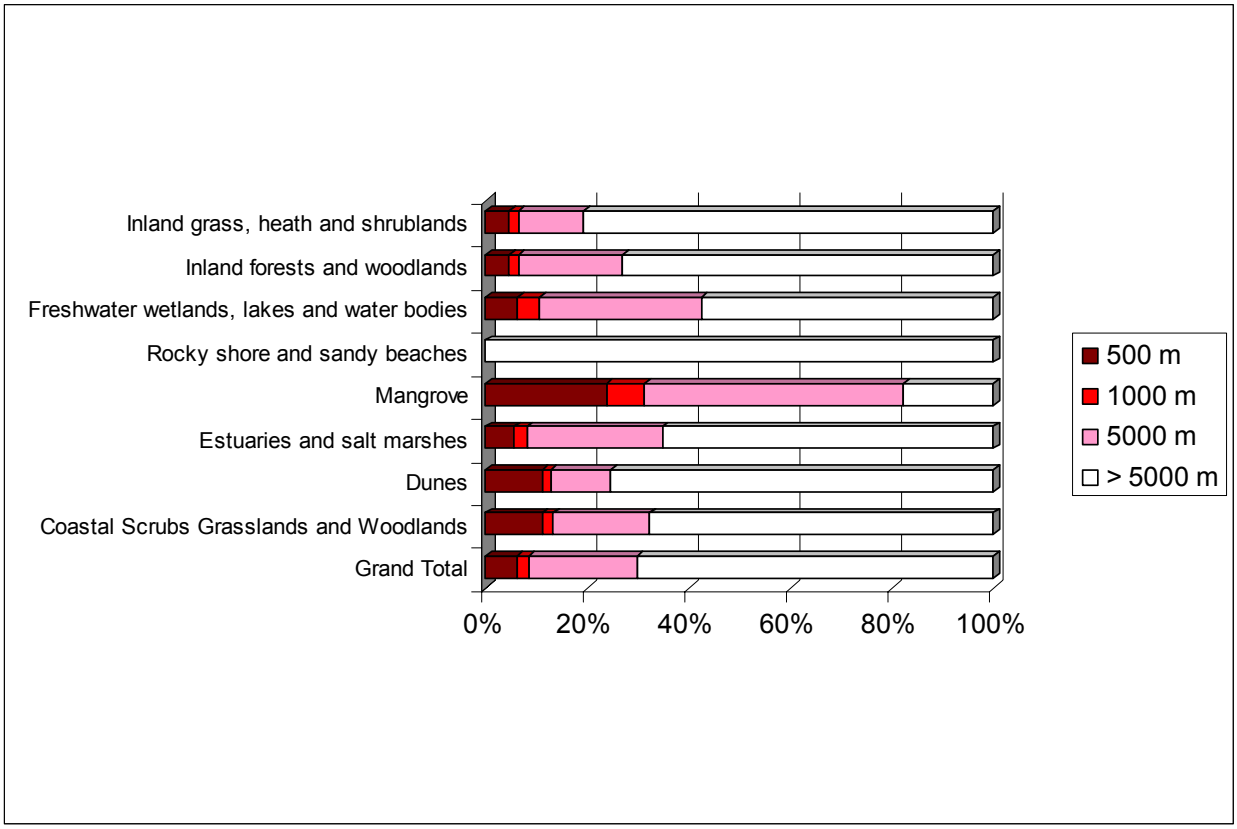
Location near built-up areas

Figure 3-7 shows the percent of each ecosystem type that is located within 500m to 5kilometres from built-up areas. The built-up areas have been identified using the GIS data based on areas with high concentrations of roads and buildings. This analysis provides an indicator of both the level of stress placed on ecosystems by the presence of human activity, as well as the extent to which different services are offered. For example estuaries and marshes located close to built-up areas will be performing greater services of waste assimilation and water purification due to storm-water run-off. The figure illustrates that mangroves are especially close to built-up areas, which threaten their ability to provide, for example, services such as nursery grounds for fish.

When combined with Figure 3-4 that shows the amount of ecosystems situated on public land, it suggests that even though they are well protected, they are also influenced by the pressures on non-market services found in built-up areas, which can be a source of tension about future land use and consequential impact on the contribution to well-being from these services.

Section 3 Coastal Ecosystem Services

Figure 3-7 Location of Coastal Ecosystems near Built-Up Areas



Source: GIS data (EVC_BCS100) covering Ecological Vegetation Classes (EVC) combined with a data set on built-up areas in Victoria based on aerial photo, which is produced in 2006 by URS.

All in all, the geographical analysis paints a picture of the ecosystems along the coast as being largely situated on public land, which suggests that, on one hand, they are well protected especially in the half of the public land that is national parks and the five Ramsar areas along the coast. On the other hand, one third of the area is found within 5 km of built-up areas, which is known to threaten healthy ecosystems. This may partly explain why around one fourth of the area is showing some degradation; coastal scrubs and woodlands are especially depleted, as well as mangroves. This influences the services they provide e.g. recreation or storm protection and therefore also the value of the coast.

Section 4 Contribution of commercial services

Section Summary

- The Gross Regional Product of Victoria's non-metropolitan coastal region is about $9 billion.
- The industries that are most dependent on Victoria's coastal natural assets are ports, tourism, shipping, fishing and wind powered electricity generation, whose value of output is about $2.8 billion.

4.1 The natural resource base of Victoria's coastal economy

Commercial industrial use of coastal natural resources is dominated by the petroleum and gas, agriculture, forestry and fishing, tourism and hospitality, and ports and shipping industries. They are relatively large contributors to both the value of regional commercial productive activity (gross regional product) and to employment, although not necessarily in the same proportions. Significant natural resource-based Victorian coastal commercial activities include:

- Ports: Ports are the interface between land and sea transport. Coastal topographical features such as deep water and protection from the elements are the natural assets on which ports and shipping depend. They are key location choice factors for port facilities for all marine activities (shipping, fishing, boat-based tourism and off-shore petroleum and gas extraction). Ports are often found in estuaries and bays, where they are protected against the forces of the sea.
- Shipping: Shipping as a mode of transport is naturally dependent on the sea and the availability of good port and land transport facilities. Most shipping that traverses Victoria's coast is international, with some limited Australian coastal shipping, for example interstate freight services, Tasmanian passenger, vehicular and freight services and ferries within bays and estuaries.
- Fishing and marine aquaculture: Abundant fish and shellfish have also stimulated a significant fishing sector along Victoria's coast. Both commercial and recreational fishing take place in the marine and estuarine environments. Coastal aquaculture in Victoria mainly involves the production of molluscs such as mussels and abalone in bays and inlets and inshore on the ocean. Fishing uses several ecosystems on the coast. Estuaries, mangroves, seagrass meadows and kelp forests all provide either fish nurseries or feeding grounds / habitats for fish and shellfish.
- Coastal tourism: Significant tourism and recreation opportunities are provided by coastal environmental assets including beaches, rivers, fish, flora and fauna and attractive landscapes. The coastal regions reflect a larger reliance upon the accommodation, cafes and restaurants sector than non-coastal regions and Melbourne. While most Victorian tourism is land-based, boat-based activities such as whale watching and charter fishing are increasingly popular. Habitats, wildlife, visual amenities and cultural heritage are all services along the coast that facilitate extensive tourism activities.
- Agriculture: Arable land and greater or more reliable rainfall are salient factors in shaping the location of agricultural activity. The Agriculture, Forestry and Fishing industry sector is much larger proportionately on the coast than in the rest of Victoria, accounting for 10 percent of employment in the coastal region but only 3 percent in non-coastal regions and Victoria as a whole. There is particularly high agricultural, forestry and fisheries production in three coastal Statistical Local Areas (SLAs)[3], Corangamite South, Moyne South and South Gippsland Central. Moyne has a relatively

[3] The coastal region in this chapter is defined as all the Statistical Local Areas (SLAs) with a border on the coast, except those in the Melbourne statistical division. The data will be compared to state level data for Victoria to contrast any differences or unique features of coastal regions.

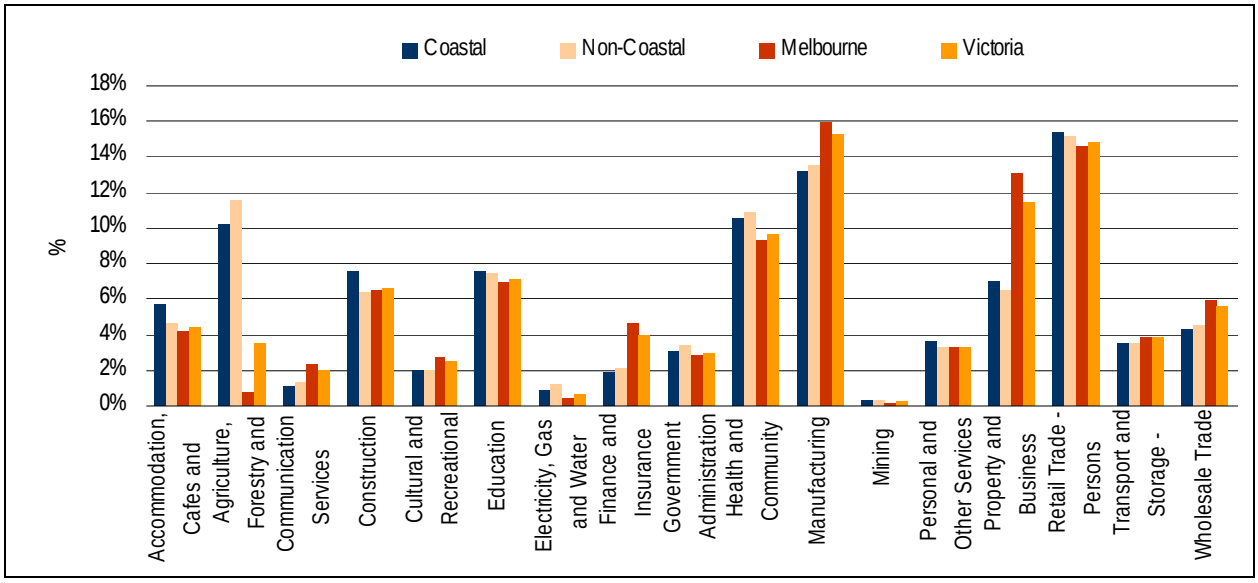
large dairy industry and produces lamb and wool. Corangamite and Gippsland have large livestock and dairy industries. The agricultural activities along the coast depend heavily on the climate regulation that the coast provides in form of higher rainfall and more stable temperatures.

- Seawater: Seawater has been used as a resource for the production of salt for many years. In the future, seawater will also be used as a substitute for fresh water for industrial and drinking water in coastal urban areas.
- Wind power generation: The strong winds in parts of Victoria's coast are increasingly being harnessed for electricity generation using wind turbines.
- Petroleum and natural gas extraction: major petroleum and natural gas reserves available to Victoria are largely to be found off shore, although some Otway Basin gas wells are located on shore. Although most of the offshore wells are located outside the state 5.5 kilometres limit in Commonwealth waters, the oil and gas is piped ashore for refining and distribution.

4.2 Snapshot of production and employment of coastal industries

The ABS Population Census is a fundamental building block to develop a snapshot of the value of Victoria's production for the coastal and other regions. The census records the number of persons employed by industry at the SLA level. This information can then be used to scale state-wide level data to develop estimates of coastal gross regional product (GRP).

Figure 4-1 Share of Employment by Industry



Source: Australian Bureau of Statistics, 2001a

Figure 4-1 shows the proportion of employment by industry for the coastal, non-coastal and Melbourne regions and for Victoria as a whole. The significance of natural resources to the economy of coastal Victoria is highlighted by the relatively large share of employment accounted for by the agriculture, forestry and fishing sector. The chart shows that on the coast, the proportion of people employed in agriculture, forestry and fishing is about three times the proportion for the state as a whole (10 percent on the coast compared with 3.5 percent for Victoria as a whole).

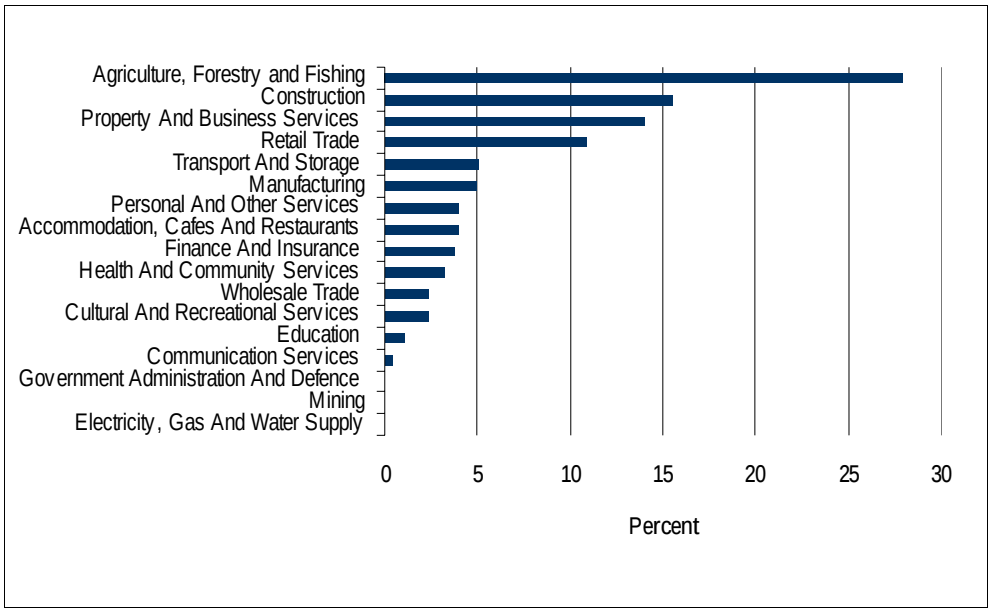
The hospitality and construction industries are also slightly larger proportionately on the coast than for the state as a whole, reflecting the importance of tourism and urban development. The coastal areas have a

Section 4 Contribution of commercial services

different pattern of employment compared to the rest of regional Victoria. Recreation and tourism (as an industry) rely on amenity and access to beaches and other natural areas, which are quintessential to the coast. Therefore, the coastal region has a high concentration of people working in accommodation, cafes and restaurants – 6 percent work in that sector compared to 4 percent for Victoria as a whole. The coastal regions of Victoria have relatively smaller shares of employment in some industries, notably the finance sector, property and business services, manufacturing and wholesale trade.

This picture is also reflected in the number of enterprises in the various industries. The largest industry sector in terms of number of enterprises in the coastal region is agriculture, forestry and fishing, which accounts for almost 30 percent of coastal enterprises, almost twice the proportion of the next largest sector, construction. The proportions of enterprises by industry are shown in Figure 4-2. These proportions also reflect the preponderance of small businesses in these sectors.

Figure 4-2 Coastal Enterprises by Industry



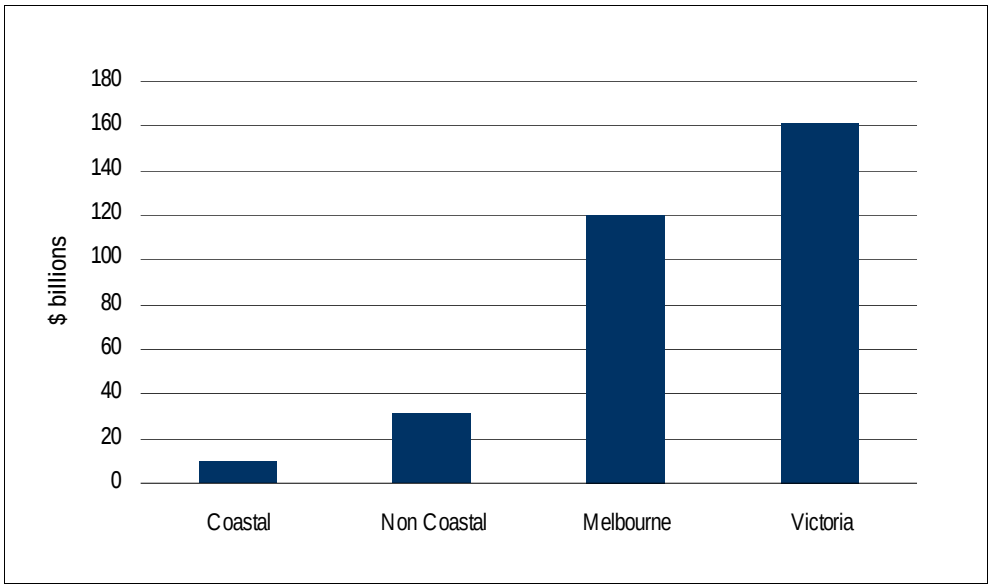
Source: Australian Bureau of Statistics, 2001b

Despite the coastal region's abundant natural resources, the commercial value of production as measured by gross regional product (GRP) is relatively subdued. The coastal region's GRP is estimated to have been $9 billion in 2001.[4] This equates to around 6 percent of the gross state product (GSP) of Victoria, 8 percent of Melbourne's GRP, and about a third of the GRP of the non-coastal region (see Figure). On a per capita basis, coastal gross regional product is about 11 percent of Melbourne's GRP per capita. This reflects the fact that the coastal population contains a larger proportion of people of non-working age (children and retired). However, the large disparity also indicates that the value of production of measured and marketed goods and services on the coast is low relative to Melbourne. These socio-economic issues are discussed further in Section 6.

[4] The most recent and reliable small area economic data available is from the Australian Bureau of Statistics (ABS) 2001 population census for SLAs.

Section 4 Contribution of commercial services

Figure 4-3 Gross Regional Product of Victoria and its Regions in 2001



Source: Australian Bureau of Statistics 2001a, CIE estimates

4.3 Estimating commercial values of coast-dependent industries

The level of industry aggregation of the national accounts and census data is quite high. For this study, it would be useful to be able to separately measure those activities that are highly coastal dependent from others. For example, it would be useful to be able to separate commercial fishing from the category agriculture, forestry and fishing. Another solution is to get information from other sources about the market value of production, and in some cases, value added, where possible.

Table 4.1 gives an overview of the results from the following section. It shows that while ports form the largest industry by value, if the Port of Melbourne is excluded, tourism is by far the largest industry dependent on the natural assets of the Victorian coast. The table shows that the estimated value of production of certain of the coastal-dependant industries is about $2.8 billion, excluding the value of agriculture and forestry. The values include the Melbourne area when relevant, such as for ports, shipping and fishing, but exclude Melbourne from the coastal tourism estimates, because it would otherwise distort the value with most of the central metropolitan tourism activities, because it is situated less than 5 km from the coast. Details about each of the estimates are provided below.

Ports are the largest industry dependent on Victoria's coastal natural assets. The value of the output of commercial ports of Victoria is $1.6 billion; Melbourne is largest, accounting for half of the value of output of the selected industries identified here. The Port of Melbourne adds significant value to the economy as Australia's largest container port, contributing $1.3 billion to the value of production, and almost $600 million in value added.

Coastal tourism is the second biggest industry that depends on Victoria's natural coastal assets. When combined with industries that provide services to it, the tourism industry provides 13,250 jobs and contributes $908 million to the Victorian economy.

Shipping's value of production of $144 million makes it the next largest coast-dependent industry, followed by commercial fishing at $83 million.

The value of production of wind energy in 2006-07 is estimated at $13 million. Wind energy has the potential to grow as an economic activity on the coast, where environmental and social factors permit, but is currently the smallest of the industries identified as dependent on coastal natural assets..

Section 4 Contribution of commercial services

Table 4-1 Value of Output and Value Added in Selected Industries Dependent on Victoria's Coast

Industry	Value of output ($ million per year)	Value added ($ million per year)
Port Melbourne	1,338	596
Port of Geelong	170	89
Port of Hastings^	46	24
Port of Portland	44	22
Shipping	144	na
Commercial Fishing	83	na
Coastal non-metro tourism*	908	na
Wind energy	13	na
Total	2,796	731

Note: * Tourism estimates relate to non-metropolitan tourism in coastal statistical local areas. ^Port of Hastings values imputed from volumes.

Source: CIE and URS estimates, Deloitte et al 2003, Tourism Task Force Australia 2005, Price Waterhouse Cooper 2007, DPI 2007.

The largest contributor to the Victorian economy reliant on what might be considered coastal natural assets is the oil and gas extraction industry with production valued at over $3 billion. However, as the industry is based on resources largely located beyond Victoria's territorial limit offshore in Commonwealth waters, it has not been included in Table 4.1. Nevertheless, its impacts on natural values on the coast, both in the marine environment and on land, are important considerations for policy and management.

These *direct economic values* flow on to the rest of the economy with linkages both forward and back in the production and consumption chain. For example, commercial fishing provides products for fish packing and processing, and the boat building and repair sectors. Fishing boats use fuel. The fishing industry provides fish for wholesale and retail sale and restaurants. Those employed in the fishing industry, like the rest of the community, spend their incomes on other goods and services that have little or nothing to do specifically with the coast, such as housing, groceries, cars, hairdressing, health, education and the like. Such *flow-on effects* (or *indirect effects*) can be estimated using regional input-output analysis. Such analysis has been undertaken for the commercial ports, and is discussed further below. However, such figures for indirect effects have not been included in the table because GRP as used above provide a better estimate of the level of general economic activity in the coastal region.

4.3.1 Ports

Victoria has a network of four commercial and 14 local ports. The commercial ports provide services for exports and imports of products from large container ships, where as the local ports role is to provide a port for commercial fishing vessels and visiting yachts of a smaller size.

Commercial ports

The four commercial ports in Victoria consist of the port corporations and a number of companies that operate port services such as the stevedores. The four ports are:

- Port of Melbourne;
- Port of Geelong;
- Port of Hastings; and
- Port of Portland.

Section 4 Contribution of commercial services

Port of Melbourne is the largest of these ports and is owned by the State-owned Port of Melbourne Corporation, with the private sector providing port services such as stevedoring and tugs. Thus, the size and value of port operations is much larger than the activities of the Port of Melbourne Corporation itself. In 2005/06 the Melbourne port handled almost 28 million tonnes (Port of Melbourne Corporation, 2006). 70 percent of this was in the form of container throughput and the port handled 1.93 million twenty-foot equivalent units (TEU). A recent study (Price Waterhouse Coopers 2007) estimated that **the value of production and value added by the Port of Melbourne were $1,338 billion and $596 million per year** respectively.

The study was part of the Channel Deepening project and was concerned with the wider impact on the economy of the port, as much as with the value of the port's production itself. It modelled the flow-on indirect as well as direct effects on output and employment. The gross impact of the port (the combined impact from the direct and indirect effects of the port) on the Victorian economy is valued at $5.4 billion. Total direct and indirect value added was estimated at approximately $900 million, generating approximately 7,600 full time equivalent jobs at the port. The average gross annual income of those employed in port-related activity is $55,000. Applying this to the estimated employment numbers means that the Port of Melbourne adds a further $418 million to household income.

The Port of Geelong is Victoria's second largest port. An assessment of the economic impact of the Port of Geelong undertaken in 2005 estimated that **the value of production and value added by the Port of Geelong in 2004/05 were $170 and $89 million per year** respectively (Econsearch 2005).

The study looked at both the direct and indirect impact of the port to the Barwon region as well as the state-wide impact on the state of Victoria (Econsearch, 2005). The direct impacts include the output and value added from the port-related activities as well as the household income from the port-related employment. The assessment found that the total direct and indirect value of output of the Port of Geelong was $290 million to the Barwon region and $328 million to the state.

The two smaller ports are Port of Hastings and Port of Portland. **Port of Hastings** handled 3.28 million tonnes of cargo in 2005/6 and deals mainly in steel, petroleum products and liquefied petroleum gas. Although no separate analysis has been done for the Port of Hastings, an estimate can be obtained by applying the figures from Geelong. The port of Geelong generates $25 in direct value from every one ton of cargo shipped through the port. Applying this value to the port of Hastings implies that **the value of production and value added by the Port of Hastings would be about $46 and $24 million per year** respectively.

The Port of Portland services Victoria as well as South Australia and transports aluminium and its inputs, woodchips and logs from plantations in Victoria and South Australia, fertilisers, sheep, cattle, construction materials and fuels among other things. An economic impact study of the Port of Portland (Meyrick *et al.*, 2006) estimated that **the value of outout of port-related activity in 2004/05 was $44 million, and that the value added was $22 million per year**. This activity was generated by the employment of 160 full-time equivalent workers, contributing nearly $10 million in household income.

Local ports

In 2003, an analysis of the economic impact of the 14 local ports in Victoria was conducted (Deloitte, Touche and Tohmatsu, 2003). These ports are Ports of Port Fairy, Warrnambool, Port Campbell, Apollo Bay, Lorne, Barwon Heads, Port Phillip Bay, Queenscliff, Western Port Bay, Anderson Inlet, Corner Inlet and Port Albert, Gippsland Lakes, Snowy River and Mallacoota. The study estimated the value of production of $190 million per annum by these ports from the value of the services using them, mainly from commercial fishing, recreational boating, government funded maintenance and tourism activities. As fishing and tourism activities are covered elsewhere in this report, this estimate has not been included in the table as it would be double counting. It is not appropriate to include government subsidies as part of the value of production.

Section 4 Contribution of commercial services

4.3.2 Shipping

The value of shipping in Victoria can be calculated by looking at the estimated number of employees in the shipping industry. This can be done by looking at the number of people employed in the four digit ANZSIC groups related to shipping as shown in Table 4-2. This was done using GDP and employment numbers from the ABS.

Table 4-2 Estimated Value of the Shipping Industry

Category	Estimated employment	Industry value added ($ million per year)
International sea transport	1,131	109
Coastal water transport	199	19
Water transport undefined	171	16
Total	1,501	144

Source: ABS 2001a and ABS 2001b, CIE estimations.

The table shows that **the value added of the shipping industry is estimated at $144 million per year**.

4.3.3 Commercial fishing and marine aquaculture

The value of the fishing industry in Victoria can be estimated by using the value of the fish caught in Victorian managed fisheries and produced by Victorian marine aquaculture licensees. This estimate excludes the value of fish landed from other jurisdictions, such as Tasmania, Commonwealth managed fisheries, or international fisheries.

Table 4-3 Value of the Victorian Fishing Industry, 2005 – 06 *

Fish type	Value of catch ($ thousands per year)
Marine scale fish	7,785
Molluscs and echinoderms	51,600
Crustaceans,	15,737
Marine aquaculture	7,450
Total	82,572

** Value of catch from Victorian State managed fisheries; does not include value of fish from other jurisdictions landed in Victoria. Source: Department of Primary Industries (2007) Fisheries Victoria Commercial Fish Production Information Bulletin, November 2006.*

Sixty percent of the value of production of Victoria's fishing industry comes from the catch of abalone, while the next highest value fishery, rock lobster, accounts for about 18 percent. The health of the abalone fishery is therefore a significant factor in the value of Victorian fisheries. It is notable that the annual value of production fell by almost $10 million from 2004-05 to 2005-06 as a result of a decline in the abalone catch (DPI, 2007). **The value of catch of the Victorian fishing industry is estimated as $83 million per year.**

Marine and coastal aquaculture in Victoria consists mainly of mussels and abalone. Victoria does not possess sheltered deep-water coastal sites suitable for aquaculture of cold water scale fish such as Atlantic salmon.

The value of fish caught by recreational fishers could be estimated as the implicit commercial value of the recreational catch. However, many studies have shown that this gives a substantial underestimate of the value of recreational fishing. Other techniques are more appropriate for analysing the value of

recreational fishing, and these are considered in later sections of this report dealing with non-market services.

4.3.4 Tourism

The state and regional tourism organisations of Victoria have defined twenty one tourism regions and eleven campaign regions for the purposes of marketing and promotion. These tourism regions are aligned to groups of SLAs. This regional framework can be used to compare tourism in coastal and non-coastal regions. The tourism regions can be broken down further into SLAs. The SLAs can be divided into coastal and non coastal according to the same framework used previously. Table 4-4 shows the employment in tourism in different areas of Victoria in 1997 and 2003 plus the change over time. It can be seen that the growth in tourism employment has been higher in the coastal area compared to the rest of Victoria.

Table 4-4 Tourism Employment in Victoria by SLA

Area	Employment 1997	Employment 2003	Change (%)
Coastal SLAs	10,829	13,250	18
Non-Coastal SLAs	30,717	34,022	10
Coastal Melbourne SLAs	34,849	38,818	10
Non-coastal Melbourne SLAs	34,214	35,267	3
Victoria	110,609	121,357	9

Source: ABS 2001b, Tourism Task Force 2005 and CIE calculations.

The estimates for coastal tourism shown in Table 4-4 combine elements of direct and indirect effects as the employment figures contain both those employed directly in the tourism industry and those employed in industries which provide services to the tourism industry. The estimates are conservative as employment alone cannot capture the entire value of tourism.

To estimate the output of the tourism industry, the CIE took the figure for coastal employment of 13,250 jobs from the Tourism task force employment atlas 2005. The CIE then calculated an estimate of output per worker in the tourism industry. This was done using GDP and employment numbers from the ABS. Gross domestic product is divided by employment to get a measure of output per employee in the Australian economy. This measure is then weighted according to the industries that tourism employees work in as shown in the tourism task force employment atlas 2005.

The CIE estimated that output per worker in the tourism industry was around $68,000 per worker. Assuming that there are 13,250 workers as estimated in the TTF employment atlas, this results in ad estimated **value of output of $908 million per year on the coast for the tourism industry**.

4.3.5 Wind energy

Victoria's coast holds considerable potential for the development of wind farms, given high wind speeds in some areas (greater than 7m/s). The economic value of wind energy potential depends on a number of factors, such as wind speed, access to electricity grid connection, amenity impacts on surrounding communities and the opportunity cost of using land for wind farms in favour of other uses. Wind speed is the most significant factor on wind energy potential, as the energy output is a function of the cube (power of 3) of the wind speed.

Future improvements in wind turbine technologies, such as larger, higher output turbines, may improve the viability of wind farms in Victoria. Policy changes, such as higher energy prices under the proposed National Emissions Trading Scheme, will also improve the business case for investment in wind farms.

Section 4 Contribution of commercial services

URS estimates that **the value of production of wind generated electricity in Victoria in 2006-07 was $13 million**. This estimate includes the following windfarms:

- Breamlea
- Aurora (Brunswick)
- Yambuk
- Toora
- Wonthaggi
- Codrington

The only operating windfarm not included is Challicum Hills, which is further inland than all the other windfarms. It has not been possible to estimate value added. The estimated value was arrived at by working out the megawatt hours of electricity produced per megawatt of installed wind capacity, and multiplying that by the total number of megawatts of Victorian capacity (coastal wind farms only), then multiplying by the wholesale price of electricity in Victoria in 06/07 (Sources Pacific Hydro, Australian Wind Energy Association (2005), NEMMCO (2006).

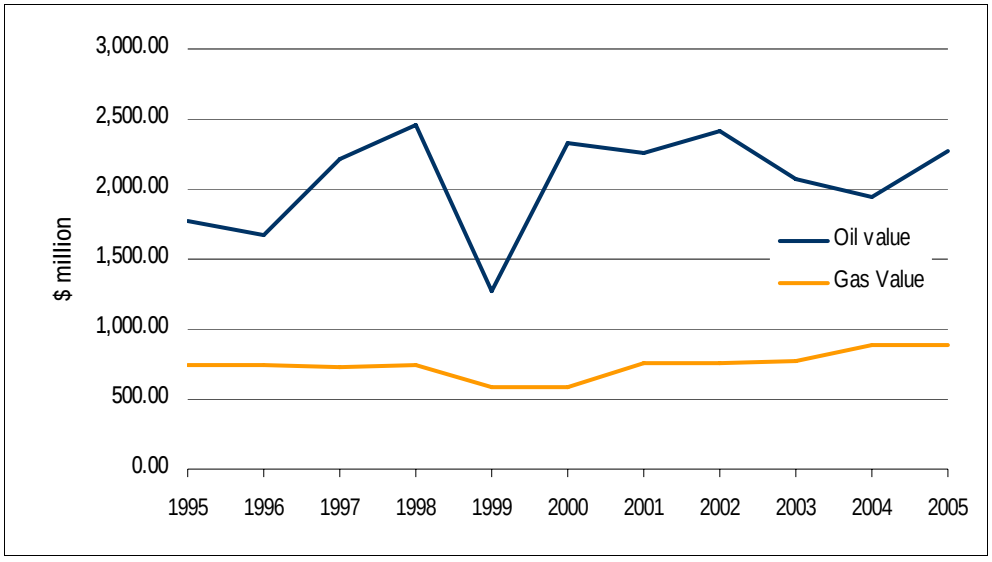
4.3.6 Petroleum

Victoria's petroleum industry produces crude oil, liquefied petroleum gas/condensate, natural gas and commercial carbon dioxide. Most of the industry is centred offshore in Commonwealth waters in the Gippsland Basin, although the Otway Basin gas field is now producing. There is some onshore gas production from the Otway Basin, but Gippsland currently accounts for 95 percent of Victoria's gas.

The production of crude oil and condensate are declining in Victoria as major fields are reaching advanced stages of maturity. Natural gas production however is on an increasing trend in line with increasing demand.

The sales value of oil and gas production in the Gippsland basin was $3,157.2 million in 2005 (DPI, 2006). The value of production for the last decade is shown on Table 4-4.

Figure 4-4 Value of Oil and Gas Production from Offshore Gippsland



Source: Department of Primary Industries, 2006.

Section 4 Contribution of commercial services

In addition, gas has been produced from the Otway basin onshore. In 2005, this accounted for 5 percent of total gas production. Thus, the value of total gas production would be about $929 million, of which about $47 million would be from the Otway Basin.

However, the value of the resource to the economy also includes the value of exploration activity. Exploration activities are volatile, depending on such factors as oil and gas prices and relative prospectively of competing resource areas. Expenditure on exploration activities in Victoria in 2005, most of which was on the coast in both Victorian water and offshore, was $226 million, more than double the annual average for the previous decade.

Thus the total value of production and exploration for the coastal oil and gas industry in 2005 is estimated at about $3.4 billion. However, as the resources for most of this production are located beyond Victoria's coastal boundary, these values have not been included in Table 4-1 above. However, the value of the production is so great that the industry can have a significant bearing on coastal land use and development.

Section 5 Contribution of non-market services

Section summary

- This section analyses the contribution of non-market services
- The knowledge is very limited for most ecosystem services.
- The special survey of the non-market recreational use of the coast show a value of $1.9 billion per year, making it a significant contributor to the value of the coast
- The value of other services cannot be estimated, which does not mean that they are not highly valuable to Victoria. The following ecosystem services are assessed as being very important contributors:
  - The visual amenity values of properties
  - The value of shoreline stabilisation and storm protection of properties and infrastructure

5.1 Environmental

5.1.1 Climate regulation

The climate along the coast is notably different from the climate further inland in Victoria. Industries such as forestry and agriculture benefit due to the relatively higher proportion of rainfall and the more moderate climate that the land/ocean interface generates.

How to capture this value

This value is expressed through market mechanisms, because the major goods are all traded on a market: water, food and wood. The value can be estimated from differences in land prices, compared with inland areas, as the price of land basically reflects the profit potential of the area. It can be done by using hedonic pricing to value the impact (see appendix B). This revealed preference technique utilize the theory that the value of land is a function of a range of biophysical and economic characteristics, which changes from estate to estate, including a difference in rainfall. The component of the land value that is due to differences in rainfall can then be isolated and used to estimate the total value of this service. The challenge is to collect enough information on other variables for example soil type and infrastructure to ensure that the impact of rainfall could be estimated correctly.

5.1.2 Shoreline stabilisation and erosion control

Erosion can be a problem along the coast, where wind and waves are constantly eroding the ecosystems, changing shorelines and moving sand, thereby damaging infrastructure and other man-made assets. Healthy ecosystems provide important protection against the forces of nature and reduce weather-related costs for society. There are few studies available on the value of shoreline stabilisation and erosion control provided by dunes, sandy beaches, seagrass and coastal scrubs.

A study in New South Wales by Pitt (1993) is of interest: it gives an estimate of how much inhabitants in a coastal town are willing to pay to protect and maintain dune and beach vegetation along their shoreline. The environmental services provided are primarily shoreline stabilisation and erosion control including stabilisation of dunes that minimise the sand drifting and movements of dunes, which could threaten the town and lead to high costs for the local community. Other services included would be biodiversity and visual amenities, but these are probably less important for the local inhabitants' willingness to pay. Pitt (1993) used the contingent valuation method (see Appendix B) to estimate a willingness to pay of $17 per person per annum for local inhabitants [corresponding to $24 per person per annum in $A 2006]. This

was then converted to $20,000 per kilometres of beach per year in 1993 [corresponding to $28,700 per person per annum in $A 2006].

How to capture this value

The value of shoreline stabilisation and erosion control could be captured using a similar technique as in Pitt (1993) that is based on inhabitants' willingness to pay to maintain the benefits of the environmental service. Another option is to look at the cost of alternatives to the service for example sea walls in areas where the built-up area has been extended all the way to the coastline or the increased infrastructure costs in areas where people have failed to protect the ecosystems.

5.1.3 Storm protection

Coastal wetlands and dunes provide protection from severe weather events to inland ecosystems, coastal towns and infrastructure. Storm surges are more common in the Australian tropics and subtropics compared with temperate Victoria. Still, even in Victoria, storm surges are a problem. The existence of coastal wetlands and other ecosystems protect the towns and infrastructure inland. If these are damaged due to human development, the impact and related costs can be higher. The service is primarily provided by ecosystems which are close to built-up area, because the avoided damage is related to them. There can also be damage to inland ecosystems, which are not salt tolerant.

The coast of Victoria is in general well protected by the band of Crown land running along the majority of the coast. This has two positive impacts: protecting the narrow band of coastal ecosystems against development and protecting built-up areas further inland from storms and flooding. In section 3.2.1 the location of coastal wetlands close to built-up areas was discussed. It showed that 35 percent of all estuaries and saltmarshes are located within 5 kilometres from built-up areas. In many places along the Victorian coast where built-up areas and infrastructure are placed close to the ocean, it is necessary to invest in coastal protection works as rock wall or concrete reventment.

This can be compared with a study from the US, which estimated the value of storm protection in relation to four hurricane events in Louisiana (Farber, 1987). The study sought to estimate the costs of increased wind damage to properties associated with the loss of a one mile wide band of coastal wetlands along the Gulf of Mexico coast of Louisiana. Hurricane damage per property was modelled as a function of the wind speed of the storm at landfall, the distance of the county in which the property was located from the nearest coastline, the distance of the county in which the property was located from the storm path, and the inland distance of the county in which the property was located inland times the wetland area traversed by the storm. The net present value of wind storm protection of wetlands was US$64,000 million in USD1980 [corresponding to $197,000 in AUD 2006] for the loss of a one mile wide band of coastal wetland. This shows that coastal ecosystems can play an important role in storm protection, and even though there are no hurricanes on the Victorian coast, the value of coastal ecosystems is likely to be high.

Woodward and Wui (2001) undertook a meta-study of wetland values including a wide range of studies from around the world, which can be used to give a more general sense of the value. They found that the average value of storm protection was $237 USD 1990 per acre [corresponding to $1134 per hectare in AUD 2006] within a range from $11 to $5142 USD 1990 per acre [corresponding to $53 per hectare to $24605 per hectare in AUD 2006] for wetlands, where storm protection is the only service. The reason for the wide range is that the valuations are conducted under very different conditions and a benefit transfer based on this result should be used with care.

Both these examples relate to wetlands. However, sandy beaches and rocky shores also play an important role in the protection against storm surges. The value of protection from storms by beaches and rocky shores can be estimated using the replacement cost method by examining the total cost of coastal defence investments, such as rock walls and so on, that would be required to replace natural defences. It could also be estimated by determining the cost of increased storm damage for coastal towns where the beaches and rocky shores no longer exists. There is unfortunately no local information available for this service.

Section 5 Contribution of non-market services

How to capture this value

The value of storm protection could be captured using different techniques:

- A valuation technique similar to the one used in Pitt (1993) that is based on inhabitants' willingness to pay to maintain the benefits of the environmental service would estimate the direct consumer surplus of the perceived benefits of existing storm protection.
- Another solution is outlined in the study from Louisiana, where they looked at the increased cost of storm damage in areas where the ecosystems had been destroyed. This technique is not estimating the consumer surplus, but still gives a good indicator of the minimum value of the natural storm protection. It is only possible to use this technique if there exists areas along the coast of Victoria that are unprotected due to development of land that has destroyed existing protection.
- The last option is to look at the cost of alternatives to the service for example seawalls in areas where the built-up area has been extended all the way to the coastline. This can be used to estimate the cost if additional coastal ecosystems were destroyed. Again, even though the technique is not estimating consumer surplus, it at least gives a good indicator on the costs of alternative protection.

5.1.4 Water purification and waste disposal

Coastal wetlands, estuaries and mangroves perform the essential function of waste assimilation and water purification by removing nitrogen, phosphorous and other pollutants from agricultural or urban runoff. However, the ecosystems ability to purify water is limited and if the input is too high, it leads to eutrophication of coastal lakes and shallow coastal waters, which adversely affects the ecosystems ability to support human activities and health, and damage biodiversity. An example of this is algal blooms in the Gippsland Lakes, which have been estimated to have costed A$7.4 million per annum in lost tourism revenues [corresponding to $8.8 million *in 2006*] (URS, 2004a and URS, 2004b) at the current levels of nutrient discharged into the lakes and tourism activities.

In order to estimate the value of water purification and waste disposal, information would be required on the avoided costs to human health and the environment, and on society's willingness to pay these costs (or willingness to accept the damage). Presented in Table 5-1 is a Swedish study on the costs and willingness to pay for either building a sewage treatment plant, reducing the nitrogen output from agriculture or restoring wetlands to reduce the impacts of nitrogen eutrophication. They did not only look at costs but also at the other social and environmental benefits of restoring wetlands, and it came out as the most valuable option.

Section 5 Contribution of non-market services

Table 5-1 The Value of Investing in Wetlands for Nitrogen Abatement (Gren, 1995)

Methodology	Summary of results
An input-output model, using a mix of pricing techniques and contingent valuation, was used to calculate the value of marginal investment in wetlands for nitrogen purification in Gotland, Sweden, compared with the current situation. Three nitrogen reducing policies are modelled: (i) investment in sewage treatment plants, (ii) investment reducing nitrogen pollution from agriculture and (iii) investment in wetland restoration. Nitrogen abatement capacity of restored wetlands is assumed to be 215kgN per ha in the first year, rising to 500kgN/ha after ten years.	Wetlands restoration is found to be four-times more valuable than investing in sewage treatment works, and over 100 times more valuable than reducing nitrate pollution from agriculture.

This shows the importance of restoring and maintaining wetlands in order to benefits from the environmental services that they provide. When draining or seriously disturbing coastal wetlands, high costs of handling waste assimilation and water purification through other means such as sewage treatment or to change agricultural operations can be the result. Given the extensiveness of coastal wetlands and proximity to built-up areas, the contribution of waste assimilation services is expected to be significant.

How to capture this value

Both the study of tourism income in the Gippsland Lakes and the Swedish study of costs and benefits of different options to reduce eutrophication show pathways to capture the value of the environmental service of waste assimilation and water purification that coastal ecosystems provide. The environmental service is reducing costs of agriculture and sewage treatment and its value can therefore be captured by the following techniques:

- Studies of alternative costs of sewage treatment or changes in agricultural production.
- Studies of loss of profit in industries affected by for example eutrophication or other types of loss of coastal and marine water quality.
- Choice modelling studies of the population's willingness to pay to avoid the loss in welfare incurred due to eutrophication or other types of loss of coastal and marine water quality.
- Travel cost studies or hedonic pricing studies revealing users' loss in welfare due to eutrophication or other types of loss of coastal and marine water quality.

5.1.5 Fish nursery

Estuaries with their mangroves and seagrass and the shallow marine environment with seagrass and kelp forests are offering the important environmental service of fish nurseries for a range of species. The value of nurseries is captured through the value of commercial fisheries and recreational fishing, but it is not possible to isolate the effect of fish nurseries from these numbers.

Section 5 Contribution of non-market services

To capture the value it is necessary to either examine changes over time or compare areas that have lost fish nurseries with areas that have not. For example, KPMG (1997) examined the effects of a loss in seagrass habitat on the commercial fishing industry in Port Phillip Bay. The study estimated that the 70 percent loss in seagrass since 1970 had caused a 40 percent drop in annual fish catch. This was valued at $4.2 million per year in 1997 value for the period 1974/5 to 1996/7 in Port Phillip Bay [corresponding to $5.4 million per year in 2006 value]. For this value to be correct there has to be a one-on-one effect between the loss of seagrass area and the drop in fish catch. In the same period, there have been significant changes in a range of factors that also have an impact on fish catch for example fishing technologies, increased fishing effort and other changes in marine environment, which is known to have impact on fish stock and fish catch. When these factors are not taken into account, the impact of seagrass is largely unknown.

How to capture this value

To capture the value of fish nurseries, it is necessary to have information about all the factors that influence fish catch and to be able to isolate the effect of loss in seagrass area. If this largely ecological information was available, the economic impacts could be determined, as the relation between fish catch and economic value is well known.

5.1.6 Nutrient cycling

The cycling of nutrients within and between ecosystems is a basic environmental service that ensures the basic functions of ecosystems are maintained. Most notably, cut off seagrass and kelp is transported to the beach under stormy weather are important sources of nutrients. Seaspray has the same effect and can affect ecosystems further inland as coastal scrubs and heath. However, there is no nutrient cycling further inland and it does therefore not affect agricultural production or other land-uses

How to capture this value

The value of nutrient cycling is an intricate part of the coastal functions that mainly affect the way that coastal ecosystems function and provide adequate nutrients to maintain habitats and biodiversity. The value is therefore captured in valuation of biodiversity (see below). It would be difficult to isolate the value of nutrient cycling from the general value of well functioning ecosystems and the value is probably low compared to many of the other services provided by the coast.

5.1.7 Supporting services/ Provision of habitat for wildlife and biodiversity

Supporting services of ecosystems are those services that allow all other values, market and non-market, to be realised e.g. provision of habitat. Thus, an indication of their contribution can be gained from the value of these services. However, the non-use values of ecosystems are not covered by many of the commercial, environmental and social services mentioned in this chapter. The non-use values are expressed as a willingness to pay for the existence of an ecosystem, when there is no expectation of ever using the services provided by the ecosystem. These values can be captured in stated preference studies of the ecosystems, which always estimate a combined use and non-use value of the ecosystem. For example, a survey on wetlands in NSW showed that people value the protection of wetlands, including coastal wetlands, for their intrinsic value and the benefits they would bring to future generations. This study estimated that households were willing to pay $38 million per annum in 1998 to conserve wetlands in NSW [corresponding to $48 million per annum in 2006] (Streever *et al.,* 1998). Even though they were asked for the non-use value, there will be elements of use-values in it, because people more easily relates to use-value. This means that people using wetlands (e.g. for recreational fishing) will have a tendency to add this value to their willingness to pay estimate, even when they are asked not to. Another issue is that the survey used an unspecified wetland to avoid use values to influence the results. This

increases the a well-known bias of this type of studies, created by the fact that people are asked their willingness to pay for something that they cannot buy in real life and would never be forced to pay for regardless of their answer. To avoid this bias, it is normally recommended that the scenarios are made as realistic and concrete as possible, which is not the case in this study. Still, it shows that there is some willingness to pay for non-use value of wetlands, one of the important coastal ecosystems.

How to capture this value

Part of the value of supporting services is expressed throughout the report. The remaining non-use value is difficult to estimate for the entire coast. Stated preference methods are assumed to be more reliable for 1) small changes in quality of the ecosystem rather then the existence of the system, 2) small areas with well specified characteristics and 3) in close-to-real-life scenarios for example in the context of a proposed new property development on the coast rather than hypothetical scenarios. The exercise of estimating the non-use values of the entire coast of Victoria does not have any of the three characteristics and the result of a large scale valuation study would be questionable.

5.2 Social services

As already discussed, coastal ecosystems provide a range of services that contribute to human well-being through a range of social services. They include cultural, heritage, indigenous and spiritual values and health, educational and recreation benefits.

5.2.1 Cultural heritage

The Victorian coastline is associated with high cultural heritage values related to its archaeological, historical and anthropological importance and contains significant tourist attractions.

Amongst the indigenous cultural heritage in coastal environments is the existence of shell middens. These middens contain the historical remains of shellfish eaten by Aboriginal people. The oldest known Aboriginal shell midden site on the Victorian coast is nearly 12,000 years old. Coastal shell middens provide Aboriginal people today with an important link to their culture and their past. Shell middens which contain burials are particularly significant (Aboriginal Affairs Victoria, 2001).

Sites of European cultural heritage include bathing boxes, lighthouses, customs houses and fortifications. Victoria's estimated 700 shipwrecks provide links to our seafaring past (DSE, 2005).

The values that people hold for heritage sites may be for accessing or preserving sites. While we have not identified any studies that attempt to estimate these values directly, it is clear that both use and non-use values are important components of overall value. The use-values such as shipwreck diving or visiting lighthouses are closely tied to recreation and tourism and are therefore captured in the value of these two services. However, there is no knowledge of the value of knowing that this cultural heritage exists and is protected.

How to capture this value

- The use-values of coastal cultural heritage can be divided into the value of tourism and the value of non-market recreation.
  - To estimate the value of tourism, it is necessary to be able to isolate the economic activity created by tourism connected to cultural heritage from the general value of tourism. This could only be done through detailed surveys of the tourism industry to determine how much of the activities that are due to the cultural heritage.
  - The other use component of the value of cultural heritage on the coast is the non-market recreational use. This value could be captured by travel cost studies of the visits to cultural heritage sites on the coast. This technique has the benefit that it is based on people's actual visits

and is sometimes seen as more defendable than the stated preference techniques mentioned below.

- The non-use value can be captured using a stated preference technique such as contingent valuation, which would uncover the population's willingness to pay for the protection of the sites. This could be done through a series of contingent valuation studies to avoid the problems of large area bias (see section 5.1.7). The willingness to pay would depend on both their use and non-use valuation of the cultural heritage and it would therefore be important to try to isolate the non-use values through the survey design. Alternatively, if the interest is to get a total non-market value, the stated preference study can be done in isolation, covering both use and non-use non-market values. However, as the use-values are already captured in this study – even though they are not isolated from general tourism and recreation – the knowledge of the non-use component is probably the most beneficial to attain if additional work should be done.

5.2.2 Visual amenity

The aesthetic value of the coast is provided not by a single ecosystem, but by the landscapes of the coast in general. In the following we are going to divide it into two categories when:

- Visual amenity adds to the value of recreational use and health benefits
- Visual amenity adds to the amenity value of people's residence

In the first case, the value of visual amenity is an intricate part of another service, adding to the welfare that people get from the service. In recreational use, it plays an obvious role in choice of destinations, when people are going e.g. hiking or driving along the coast. The same is the case for health benefits, as the quality of these are improved by beautiful coastal landscapes. The value of visual amenity in this context is dealt with in subsequent sections.

The second type of value is directly related to where people live. The aesthetic value of coastal landscapes and how they attribute to the welfare of people living along the coast is an important part of the non-use values of the coast. It has long been verified by property prices that living in beautiful landscapes is something that add substantially to residents' welfare, since the prices are much higher for coastal property compared to inland. This is due to two factors: the pure aesthetic value and a better access to the recreational services of the coast.

How much more people are willing to pay to for ocean views and proximity to the coast can be analysed by looking at differences in house prices. There are three basic ways to do this:

- To ask property valuers how much ocean views and distance to the coast means for house values. This technique has the advantage that valuers are pricing experts, often with a substantial local knowledge, who may be able to distinguish between the price premium paid for a larger and better house compared to the premium paid for location. It has the disadvantage that there are no hard data in form of house price data to back up expert opinion.
- To use average house price data to look at differences between inland and coastal locations. KPMG (1997) conducted a study which used this technique to estimate residential amenity values in Port Phillip Bay for six suburbs along the bay, again including Melbourne (Maher, 1997 as reported in KPMG, 1997). It estimated the difference between residential properties situated along Port Phillip Bay with the average property prices for that suburb and found that the total premium for bayside residential properties in the six suburbs to be at least $262 million in 1996 value [corresponding to $338 million in 2006] or an annual value of $18 million in 1997 [corresponding to $24 million in 2006]. Another example is SGS (2000), who looked at all suburbs and towns along the coast including Melbourne's suburbs. They found that the total premium paid to live along the coast was $3.95 billion in 1999 value [corresponding to $4.96 billion in 2006]. This is a total value, which corresponds to an annual value of $287 million in 1999 value based on a 30 year period and six percent discount rate [corresponding to $360 million in 2006]. However, there are serious flaws in this approach; the most

important one is that it does not acknowledge other differences between neighbourhoods, which are known to have a high influence on house prices. An example is that houses along the coast can be larger and of higher quality compared to inland properties and high premiums can be paid to live in "the right" neighbourhoods. All these factors suggests that coastal properties are priced higher than inland ones for reasons that are not relating to the coastal aesthetic services, which leads to an overestimation of the value.

- To use a hedonic pricing technique (also known as the house pricing technique) based on individual property prices. This technique uses sophisticated models, which includes a whole range of information about individual houses and their location to analyse the impacts that ocean views or proximity to the coast have on the house prices. This value reflects individuals' willingness to pay because it reflects the individual decision to buy a house at a certain price. An Australian example of this technique is the study of coastal properties in Adelaide cited by Burgan (2003). In this Adelaide study, originally undertaken in 1993, Burgan sought to determine the effect of beach proximity on land values and isolate the effect on property value of: 1) having direct access to a beach, 2) being in walking distance of a beach, and 3) having water views. The base value of a house is $71.5 per square metre and increases by $53.9 per square metre if the property has direct beach access, $68.1 per square metre for water views and $14.2 per square metre for walking distance, all in 1993 values. Only the water views are directly an aesthetic value, whereas the others suggest recreational access also adds significantly to property prices. All three values was translated into an amenity value of an urban beach per kilometres was estimated at A$1.51 million for houses (36 homes per kilometres on average) with direct access [corresponding to $2.13 million in 2006] and $2.54 million per kilometres for houses in walking distance (231 homes per kilometres on average) [corresponding to $3.58 million in 2006]. Taken the same approach as above, the annual value is $110,000 per kilometres per year in 1993 [corresponding to $155,000 per kilometres per year in 2006].

How to capture this value

The same technique as described by Burgan (2003) can be applied for the Victorian coastline. This would provide information about the value of ocean views and access to the coast. This would allow for the purely non-market value to be isolated from other variables such as location and house size as well as a distinction between the aesthetic and the recreational use values reflected in house prices. The current Victorian studies show that the non-market value is potentially very high.

5.2.3 Health

There are considerable evidence, that having access to a natural environment has a positive impact on health, through reducing stress, boosting immunity and promoting healing (Maller *et al.,* 2002). People like to visit the coast because it offers a clean healthy environment (IPSOS, 2007). The aesthetic services provided by the coast also attribute to health benefits. These factors suggest that the value of the health services provided by the coast could be substantial. Part of the value is already captured in tourism and non-market recreational services, for which it has been possible to estimate a value, but it is unknown how much of this value that can be attributed to health benefits. It is also partly captured in the amenity values of living in coastal communities, which can be expressed in property values on the coast. However, there currently does not exist studies that can give an idea of these benefits.

How to capture this value

The value of health services provided by the coast is probably the most difficult to estimate of all the non-market services. First of all, because people's health depends on a huge range of different factors including genetics and life style factors, the general health benefits of the coast would be difficult to isolate unless very large groups of people were examined carefully over time (as is sometime done in long time series analysis of specific individuals). Secondly, the monetary value that society puts on human health is greatly disputed.

Section 5 Contribution of non-market services

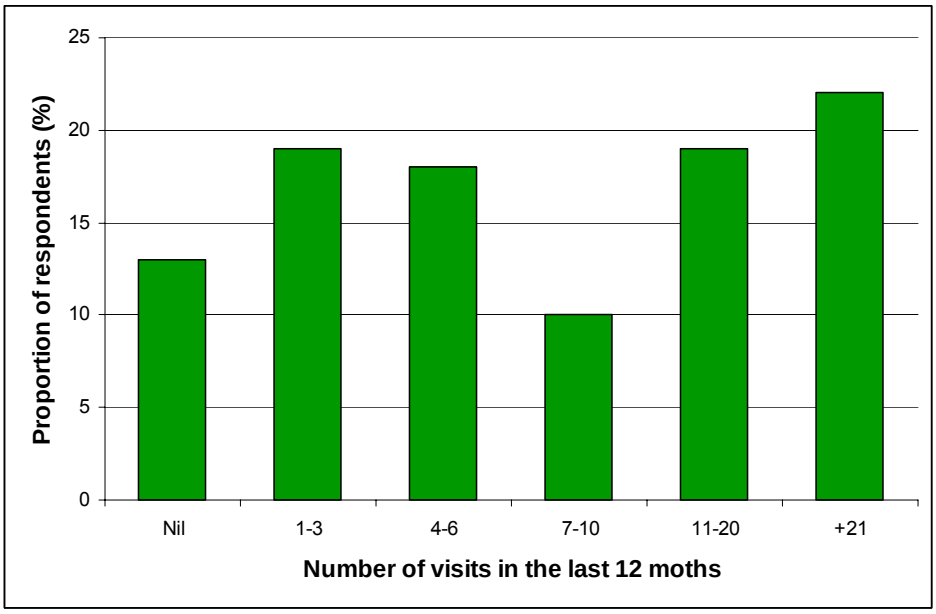
5.2.4 Recreational services

Recreational use

Recreational use of the coast is an important service and probably one of the benefits of the coast that is foremost in people's minds when thinking of their own personal gains from the coast. In connection with the previous coastal strategy, TQA (2000) undertook a survey on people's use of the coast and they found that an average person visits the coast 15 times a year, which equate to 70 million visits per annum in total. Such a large number of visits shows that people place great emphasis on the recreational service that the coast provides.

As part of Victorian Coastal Council's new coastal strategy, this study was updated by IPSOS to reflect the changes in use in the last 7 years (IPSOS, 2007). They found that the overall recreational use of the coast has increased in the period. In 2000, 80 percent of the population had visited the coast on a trip lasting more that 2 hours within the last 12 months. This number had increased to 83 percent in 2007. If people that only visit the coast on trips less than 2 hours long are included, 87 percent of the population had visited the coast in the last 12 months. Figure 5-1 shows the number of visits to the coast in the last 12 months divided into groups. The average number of trips in the last year is 26 and people living close to the coast visit more often than people living further away. This high visitation rate can partly be explained by the fact that people felt the coast had an increasing value to them as a clean healthy environment where they visit to escape from their busy life. The increasing number of visits may also reflect that many inland rivers and lake are drying out due to the on-going drought.

Figure 5-1 Number of Visits to the Coast



Source: IPSOS, 2007

Another reason for the frequent visits to the coast is the wide range of activities that the coast offers. The IPSOS survey asked what type of activities the respondents had undertaken in the last 12 months. The most frequent activities are short walks along the coast (93 percent), just relaxing on the beach (86 percent), spending time with the family (85 percent) and visiting seaside cafes and restaurants (80 percent). The more active uses are less frequent: swimming is the most frequent (70 percent) then surfing (37 percent) and land based fishing (23 percent) and boat-based fishing (17 percent). See IPSOS (2007) for the full list of activities undertaken.

Section 5 Contribution of non-market services

The value of recreational use

The frequent visits to the coast and the wide range of activities that the population of Victoria engage in show that the recreational use of the coast is very valuable to Victoria. The value of this recreation depends on a range of factors for example aesthetic and health services provided by the coast, the existences of cafés and walking trails. The question is then: *how* valuable is it?

To answer this question, URS collaborated with IPSOS and the University of Central Queensland to undertake further research. IPSOS had already been charged with surveying the public for the current review of the *Victorian Coastal Strategy* and this provided the opportunity for URS to integrate a travel cost study within the existing survey. The methodology and results of this study are presented in Box 5-1 and the details are found in appendix C.

Box 5-1 Overview of URS Travel Cost Study

Travel cost method briefly described

The basic premise of the travel cost method is that people's time and travel cost expenses of visiting a site represents the "price" of access to the coast. This means that people's willingness to pay to visit the coast can be estimated from the number of trips they make and the distance they travel. The characteristics of the coast can also be included together with information about age, number of children and income (Ward and Beal, 2000). The result of this travel cost calculation is an estimate of individual *consumer surplus* (CS) of the recreational use of the coast. The consumer surplus is defined as the difference between what a person are willing to pay for a certain amount of good (here number of trips to the coast) and what they are actually paying. This means that the consumer surplus estimate can be interpreted as the personal value from the recreational use of the coast of Victoria above what he or she had to pay given as a monetary measure.

What people were asked:

A total of 601 people were interviewed and 434 were asked the travel cost questions. Of the rest we know that 100 persons or 17 percent did not visit the coast at all within the last 12 months (as seen in the IPSOS results). The rest only went on short trips to the coast and they were not included in the travel cost study due to data limitation. It is assumed in the model that people who were not asked the travel cost question did not visit the coast in the last 12 months. This is a conservative assumption, which is necessary because there is not enough information available for the rest.

They were asked to describe their last trip to the coast, first of all about *how far* they went and *how long* that took them, their choice of *transportation* and if they travelled together with friends and family or alone and if the coast was the *only destination* on their trip. This is used to estimate the travel cost of the trip.

They were also asked about *the number of similar trips* they had taken within the last year. This gives information about their demand for that trip. This was done because the travel cost study had to concentrate on one type of trip out of the potentially many destinations that a persons has visited in the last year to be able to estimate travel time and cost of that trip. If all their different trips should be estimated, then it would be necessary to ask a range of question for each type of trip.

Last they were asked about the factors that were important for their enjoyment of the trip included:

- Sporting activities
- Nature and wildlife
- Quiet and uncrowded
- Undeveloped landscapes

- Cafes and restaurants
- Cultural heritage

Results

The results from the IPSOS study show that there exist a wide range of uses and frequency of use in the population of Victoria: some people visits the coast very often, some only once a year. When people live close to the coast, they visit it very often, maybe even daily. The same is true for people owning holiday property on the coast, even though they may have to travel far to get there. Other people visit the coast less often and it is expected that they have a lower value of the recreational use of the coast.

On average, people:

- Made 6.4 trips within the last 12 months of the type described in the survey out of the mean of 26 trips found in the IPSOS study. The trips were in general longer on average: a distance of 154 kilometres and 1.7 overnight stays. This is expected, because people that only went on short trips were excluded from the survey;
- Were 51 years old and lived 62 kilometres from the coast; and
- Two out of three were married or living together, the rest were singles, divorced, separated or widowed. Also one out of three had children under 18.

The value of coastal recreation (CS) was estimated as:

- $154 per trip for the average individual [with a 95 percent confidence interval of $139-172]
- $48 per visitor day [with a 95 percent confidence interval of $43-54]
- The model also showed that older people travel less frequently than younger people, and people with higher income have more frequent trips to the coast than people with lower income. Also, couples visit the coast more frequently as do people living within 15 kilometres of the coast. People living in Melbourne visit less frequently, probably because substitutes are easily available and maybe because city dwellers have different preferences.

If we compare this with an older travel cost study surveying the recreational use of national parks (Read and Sturgess 1999), the consumer surplus per visitor day corresponds with the upper end of the estimates for the regional national parks, which is $10-59 per visitor day in 2006 [corresponding to $8-46 per visitor day in 1999 value] but gives a higher value than the urban parks, the peri-urban national parks and the piers, which show $1-11 per visitor day in 2006 values [corresponding to $0.6-9 per visitor day in 1999 value]. This fits very well with the distance information from the interviews, as people are travelling 200 kilometres on average and have two overnight stays, which means that they are not just visiting the neighbouring urban park.

The travel cost survey also included questions about a number of factors contributing to the enjoyment of the coast as mentioned above. These were analysed for different types of visitors, based on what they enjoyed. Three of them are included in the model:

- Sport: The respondents found that sporting activities were crucial for their enjoyment of the trip
- Nature: The respondents found that the existence of wildlife, that is quiet and uncrowded and the existence of undeveloped landscape were crucial or important for their enjoyment
- Recreation: The respondents found that recreational facilities and cafes and restaurant important or crucial for their enjoyment.

The result is that sport activities have a large positive impact on the value of coastal recreation, which means that people were valuing the ability to do sport activities (e.g. surfing) highly. The impact of the nature variable was also positive, but smaller than the sport variable, which means that people who find wildlife and peace important have higher than average value of the coastal recreation per day. The

Section 5 Contribution of non-market services

recreation dummy showed a negative value, meaning that people with preference for recreational facilities and cafés and restaurants had a lower than average value of coastal recreation. This may be explained by the many substitutes that exist and that the coast itself maybe plays a secondary role in the enjoyment compared to e.g. barbequing or the service of the restaurant. The result has implications for the future development of the coast, especially when looking at the trade-offs between development and conservation of the coast.

We know from the interviews that the average number of trips within the last 12 months was 6.4 trips of the type described in the model. This can be combined with the value per recreation day given above to calculate an aggregate consumer surplus for the population of Victoria:

- Total number of households in Victoria is 1.9 million (ABS, 2001a).
- With an average of 6.4 visits to the coast and the number of households given above, the total number of trips for this calculation is 12.2 million trips or 21 million visitor days. This is lower than what is found by IPSOS (2007) because it is not including all trips, as mentioned above.
- Total recreation use value of the coast **$1.9 billion per annum** (confidence interval of $1.7-2.1 billion per annum, at 95 percent confidence levels)

Recreational fishing

The value found in the travel cost study covers all types of recreational uses of the coast, but does not break down the value of specific uses e.g. surfing or boating. Recreational fishing is considered as an important recreational user of the coast and there exists more economic and social information about this user group compared with most other users. Therefore, the next section describes this information and compares the result with the travel cost study presented above.

Fishing days

The most comprehensive survey of recreation fishing was undertaken in 2001 by the Australian Department of Agriculture, Fisheries and Forestry (Henry and Lyle, 2003). They found that Victoria had 550,000 recreational fishers (12.7 percent of the population) and that the total fishing effort in Victoria by all recreational fishers was 2.8 million fishing days (corresponding to the visitor days used in the travel costs study above).

To estimate the number of fishing days on the coast, some estimate of the *proportion of fishing days for different types of water bodies* is necessary. Henry and Lyle (2003) found that 1 percent of all fishing events were offshore, 14 percent were in coastal waters, and 42 percent were in estuaries including Westernport Bay and Port Phillip Bay. This gives a total of 57 percent or 1.6 million fishing days.

This is only one of the possible estimates for the number of fishing days. The recreational fishing survey that Fisheries Victoria undertook in 1997 (Unkles, 1997) provides an alternative set of data. The survey found that 71 percent of all recreational fishing days were spent in coastal or marine waters, and 55 percent of all recreational fishing days were spent in Port Phillip Bay and Westernport Bay. The two surveys are very different, however; Henry and Lyle (2003) is a sample of the general population with a sample size of over 9,000 Victorian households, while Unkles (1997) is an on-site survey with 1,000 recreational fishers. Because of the different nature of the surveys it is difficult to place more confidence in one than the other.

A third source is the national and international tourism survey (Tourism Research Australia, 2007a and Tourism Research Australia, 2007b), which found 5.7 million recreation days in 2006 included fishing as an activity, excluding non-coastal tourism regions, but including 2.9 million fishing days in Melbourne. There is however, no indication on what type of water body that people have fished.

Section 5 Contribution of non-market services

A low estimate of total fishing days can be estimated by applying the low number of total days (2.8 million) and the low estimate of percentage of coastal fishing (57 percent), which are both from Henry and Lyle (2003). This gives 1.6 million fishing days in coastal Victoria per year. A high estimate can be found by applying the high estimate of total fishing days (5.7 million) from Tourism Research Australia, 2007 and the high estimate from Unkles (1997) (71 percent) from Tourism Research Australia (2007). This gives 4.0 million fishing days.

The mid-point estimate is **2.8 million fishing days per year**, which is the best available estimate for coastal recreational fishing in Victoria. The low and the high estimates can be used as lower and upper bounds of this estimate. This estimate is not high compared to the recreational use of the coast reported by IPSOS (2007).

The value of recreational fishing

Relatively few studies have attempted to assess the non-market value of recreational fishing. Both Henry and Lyle (2003) and Unkles (1997) examined the expenditure of recreational fishing, but did not extend the analysis to examine consumer surplus of the non-market services.

The most applicable study available is a travel cost study of recreation on the Ovens and King Rivers in Victoria (Sinden, 1990). The inland river study estimated the consumer surplus per specialist angler to be $1,000 per year for 15 visits or $65 per fishing day (A$, 1990), [equivalent to A$104 in 2006]. However, this result is for specialist anglers, defined in the study as those recreationists who visit a river with the sole intention of fishing. Specialist anglers would therefore differ from the 35 percent of recreationists who fished as part of a visit to a site (i.e. more occasional fishers). The results presented in Rolfe and Prayaga (2006) below suggest that the consumer surplus for occasional fishers would be higher than for frequent, specialist fishers. As the results demonstrate there are decreasing returns to utility as more trips are taken in a year.

Another Australian travel cost study comes from Queensland (Rolfe and Prayaga, 2006). This study estimated the recreational fishing at three inland dams. The researchers found that the consumer surplus was $60 – $900 per person per fishing day (A$, 2006) for occasional fishers and $220-$440 per person per fishing day for frequent fishers (A$, 2006).

It is useful to consider results from outside Australia, given the limited number of Australian studies and the broad range of results provided by the above two studies. Walsh *et al.* (1992), in an extensive review of the consumer surplus values of a range of recreational activities in the United States, conducted a meta-analysis of 17 studies of salt water fishing studies. The characteristics of the net economic values ($US, 1987) estimated in these studies are USD $19-220 per fishing day with a mean of USD $72 per fishing day [equal to $41 to 483 per fishing day with a mean of $160 per fishing day in $A, 2006]. The usefulness of this study is mainly due to the fact it is an analysis of 17 studies, which gives greater confidence to the results. However, we don't know how many fishing days US fishers in these studies take per year. If it is much higher than the Australian or Victorian average then one would expect the value per fishing day to be lower.

Table 5-2 presents the results from the literature.

Section 5 Contribution of non-market services

Table 5-2 Non-market values for recreational fishing

Reference	Context	Location	Method	Measure	Range ($A, 2006)	Mean ($A, 2006)
Sinden (1990)	specialist anglers at the Kings and Ovens Rivers	VIC	Travel cost	CS per fishing day	104	104
Rolfe and Prayaga (2006)	recreational fishing at three inland dams	QLD	Travel cost	CS per fishing day - occasional fishers	60 – 900	480
				CS per fishing day - frequent fishers	220 - 440	330
Walsh *et al.* (1992),	17 salt water fishing studies	USA	Travel cost	CS per fishing day	41 - 483	159

These results can be compared with the coastal travel costs study that is presented above, which shows a value of $48 per visitor day. Recreational fishing is an activity that is more organised and requires some equipment, which in itself suggests that the value per day is higher due to the larger effort compared to just going for a stroll on the local pier.

Section 6 Socio-economic profile of the coast, pressures and drivers

Section Summary

- The non-metropolitan coastal region of Victoria had a resident population of 325,933 at the time of the Census in 2001, 7 percent of the population of Victoria.
- Household incomes in Victoria's coastal region are significantly lower than in Melbourne and employment has been growing more slowly than in the rest of the State.
- The coastal population has a higher proportion of children and retired people; many people of prime working age have moved to Melbourne.
- The coastal population and housing stock have been growing at much the same rate as for Victoria as a whole.

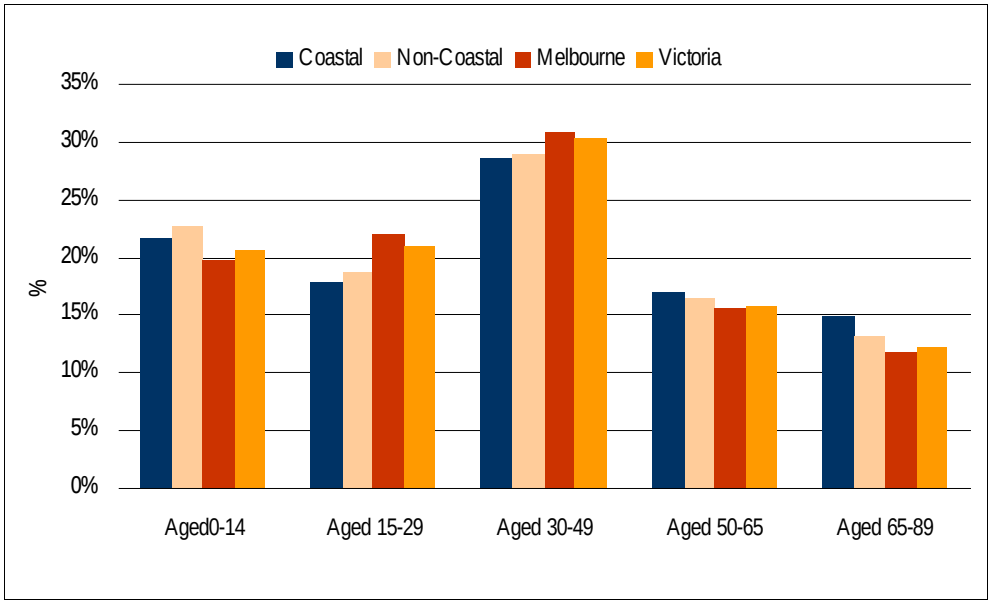
6.1 Current Socio-economic profile

The socio-economic profile of Victoria's coastal regions reflects the subdued economic opportunities provided by its industry structure as reflected in the 2001 Census. Small area 2006 Census data were not available at time of writing.

6.1.1 Population

The coastal region of Victoria had a resident population of 325,933 at the time of the Census in 2001, 7 percent of the population of Victoria. This is shown in Figure 6-1 which illustrates the percentage of the population in different age groupings.

Figure 6-1 Age by Coastal and Non-Coastal Regions of Victoria in 2001



Source: Australian Bureau of Statistics,2001b

Section 6 Socio-economic profile of the coast, pressures and drivers

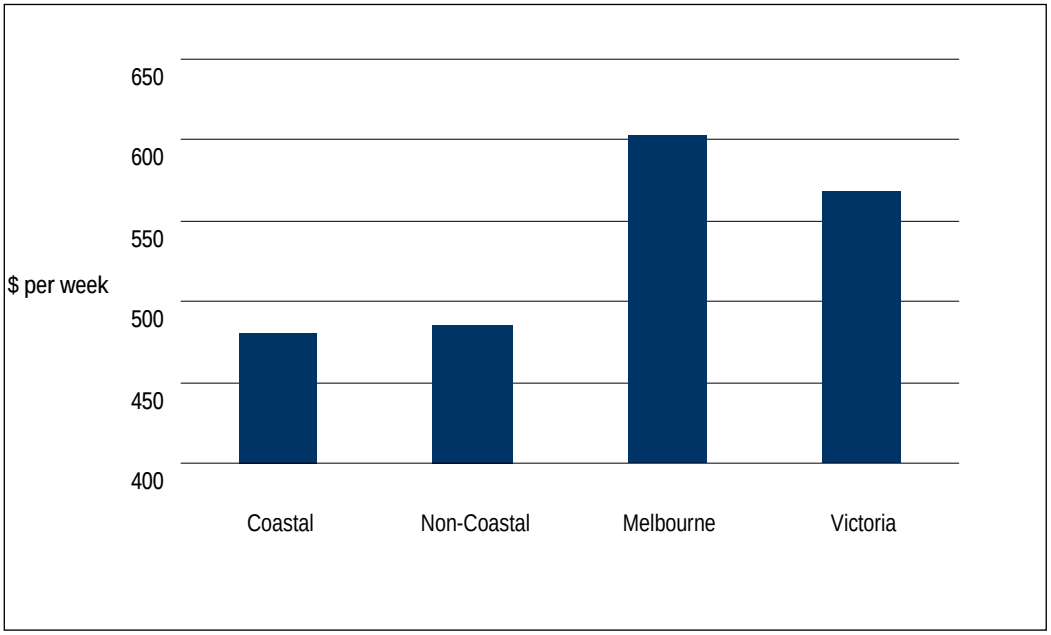
The population of the coastal area is older than the rest of Victoria and the non coastal regions. This has been attributed to the attractions of coastal regions for retirement on the one hand, and the departure of younger people on the other. The chart shows that the coastal region has smaller shares of younger working-age people. There is a smaller share of people in the 15-29 and 30-49 age groups in coastal regions than in other parts of Victoria and in the state at large. The age structure also represents the departure of younger people from the coast as they move elsewhere for education and employment.

These demographic changes may reflect the employment opportunities on the coast compared with the rest of Victoria. People employed in the industries predominating on the coast, such as agriculture, forestry and fishing, hospitality and retail trade tend to have lower incomes and educational attainment. Industries with higher paying jobs are relatively scarcer on the coast than in Melbourne or the state as a whole.

6.1.2 Income

Household incomes in Victoria's coastal region are significantly lower than in Melbourne, the state as a whole, and even slightly lower than the non-coastal region, as shown in Figure 6-2. This reflects the slightly larger proportion of retirees, but more the employment opportunities in the region, described above.

Figure 6-2 Median Weekly Income by Coastal and Non-coastal Regions



Source: Australian Bureau of Statistics 2001b

6.1.3 Housing

It is estimated that there were 1.6 million dwellings (houses, units, apartments and other dwellings such as caravans) in the coastal region at the time of the 2001 Population Census. The bulk of these dwellings are separate houses.

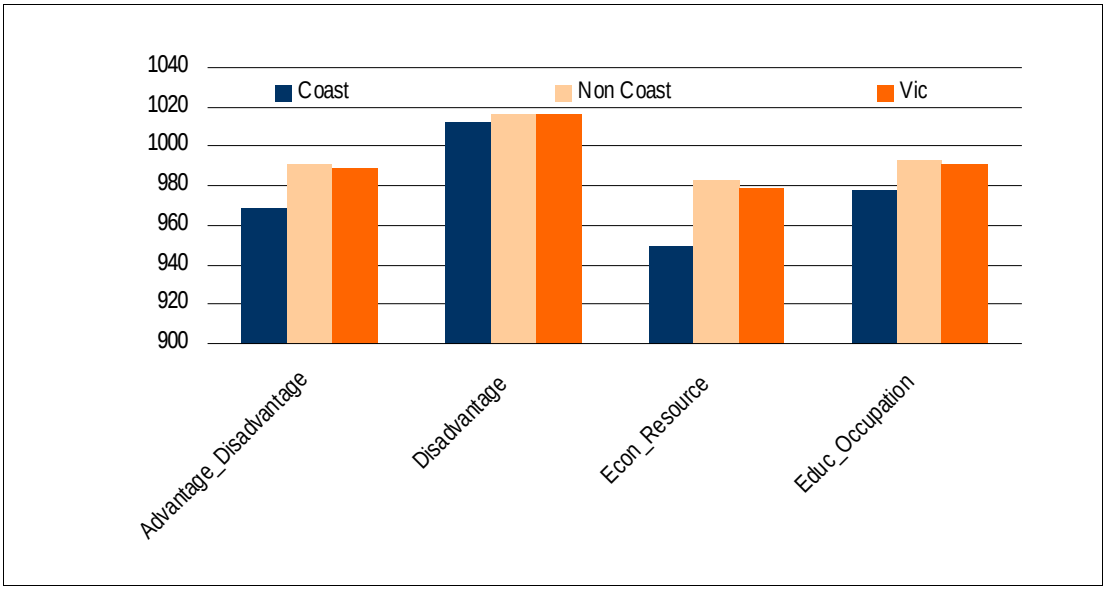
While perceptions of the "sea change" phenomenon might give an impression that housing has been booming on the coast relative to the rest of the state, in fact housing supply has been increasing at about the same rate as for the state as a whole. Over the past decade, the population census indicated the number of dwellings in Victoria has grown at 16.7 percent, while the number of coastal dwellings grew 16.5 percent. This equates to annual growth of just over 1.5 percent per annum over the ten-year period. Although this growth has not been disproportionate, the growth in coastal settlements still implies land

use change as surrounding agricultural land makes way for housing, and as native vegetation is cleared for higher density urban development.

6.1.4 Socio-economic status

Despite the rich natural assets of Victoria's coastal region, these data present a picture of a region that is poorer than Victoria as a whole. This is confirmed by the ABS' summary socio-economic indexes for areas (SEIFA) that measure different aspects of socio-economic conditions (See Box 6-1).Figure 6-3 shows the SEIFA index values for each category for the coastal and non coastal region and the average for Victoria. The indexes are constructed such that the Australian average is 1,000. Therefore a score of below 1,000 indicates a relatively disadvantaged state whereas a score above 1,000 indicates a comparatively advantaged state. The indexes are described in the box.

Figure 6-3 SEIFA Index Values by Coastal and Non-coastal Regions



Source: Australian Bureau of Statistics 2001a

The chart shows that the Victorian coastal region has the lowest score in the state for each index, indicating that it is more disadvantaged than the average for both the non-coastal region and for Victoria as a whole. The area where the coast is particularly disadvantaged is in its level of economic resources, reflecting the relatively low incomes of many coastal residents. However, Victoria as a whole and the coastal region both score higher on the national average on the disadvantage index, indicating that Victoria is a state with lower than average Australian levels of disadvantage.

Thus, from the point of view of the market economy, the people of Victoria's coastal region do not enjoy the same level of prosperity as those in the state as a whole, and particularly in Melbourne. They may welcome new economic opportunities, but some may also be vulnerable to change.

Section 6 Socio-economic profile of the coast, pressures and drivers

Box 6-1 Socio-Economic Indexes for Areas (SEIFA)

Socio-Economic Indexes for Areas (SEIFA) are produced by the ABS. The Indexes are four summary measures, derived from the 2001 Census of Population and Housing to measure different aspects of socio-economic conditions by geographic areas.

Each Index summarises a different aspect of the socio-economic conditions of an area. The Indexes have been obtained by a statistical technique called principal components analysis, which summarised the information from a variety of social and economic variables, calculating weights that will give the best summary for the underlying variables.

The four Indexes are described below.

- Index 1 — Index of Advantage/Disadvantage: This is a measure of the ratio of advantage to disadvantage in a region, a low value indicates that an area has a high proportion of individuals with low incomes, more employees in unskilled occupations and low proportion of people with high incomes or in skilled occupations.
- Index 2 — Index of Disadvantage: This index is derived from attributes such as low income, low educational attainment, high unemployment, jobs in relatively unskilled occupations and variables that reflect disadvantage. Low scores on the index occur when an area has many families of low income and people with little training and in unskilled occupations
- Index 3 — Index of Economic Resources: This index includes variables that are associated with economic resources. Variables include disposable income and house size. A low index value indicates an area with fewer economic resources.
- Index 4 — Index of Education and Occupation: This index includes factors such as educational attainment and occupational structure of a region. A low index value indicates an area with concentrations of either people with low educational attainment, people employed in unskilled occupations, or a high proportion of families with unemployed members.

All the Indexes (including the Index of Relative Socio-Economic Disadvantage) have been constructed so that relatively disadvantaged areas (for example, areas with many low-income earners) have low Index values. They are also designed so that the benchmark score for Australia at large is 1000.

Source: Australian Bureau of Statistics, 2001c

6.2 Trends in production and employment

While the past is no guarantee of the future, looking at the trends in the different industries is a first step to making predictions about their future size. The CIE has used its model of the Australian economy to forecast production and employment beyond the 2001 census year to predict changes to 2007 and beyond.

Trends in production and employment have varied among the industries on the coast, with some growing and others contracting, both in absolute and relative terms. However, available measures of output and employment show that overall commercial activity in Victoria's coastal region is more subdued than in either the non-coastal non-metropolitan region or in Melbourne. This is reflected in slower growth in both employment and production. Production on the coast also tends to be more volatile as a result of fluctuations in seasonal conditions for primary products and in petroleum and gas prices. This pattern can be seen in Figure 6-4 which shows gross product for Australia and the coastal, non-coastal and Melbourne regions 1995 – 2007, based on CIE forecasts beyond 2006.

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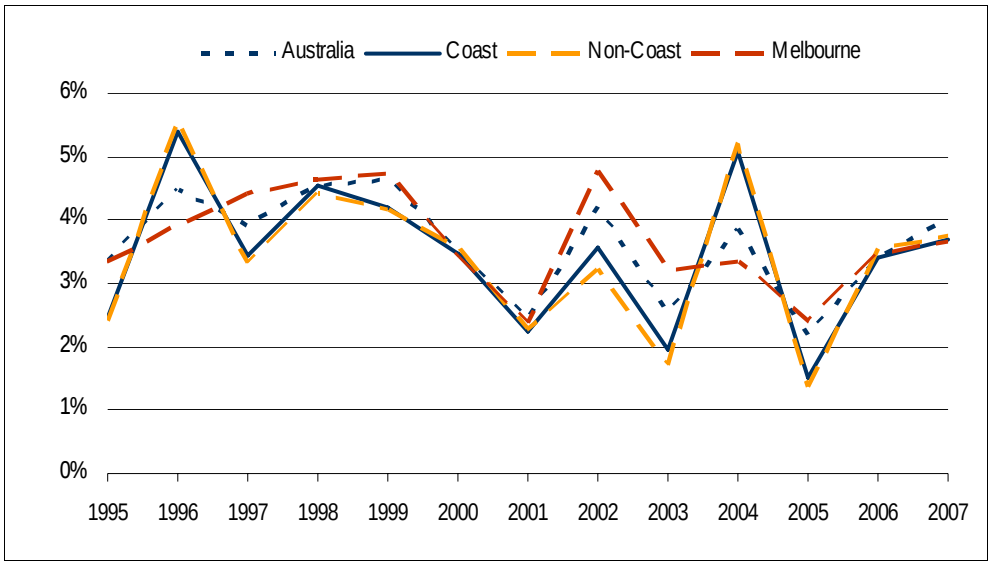
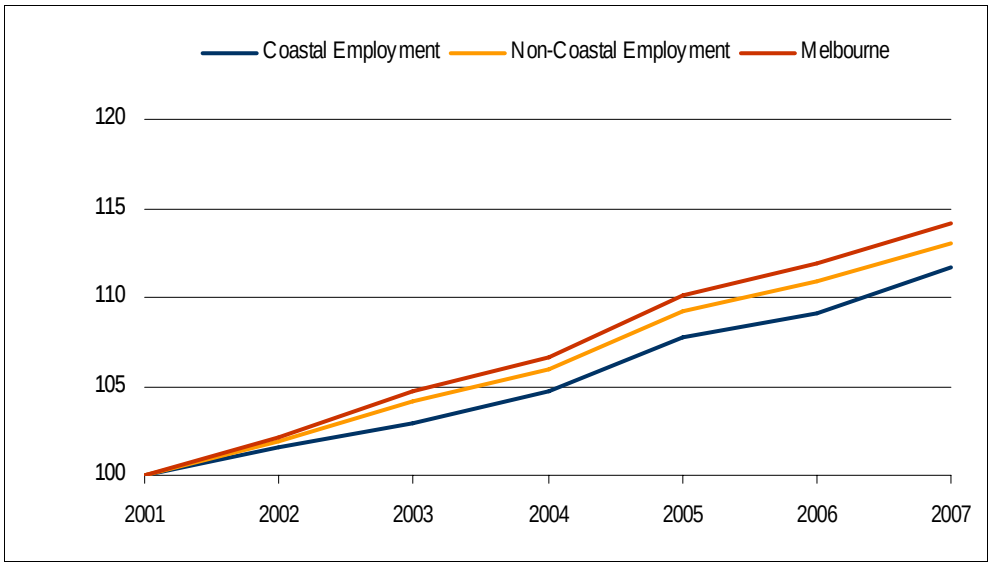
Figure 6-4 Annual Change in Gross Product, Australia and Victorian Regions 1995 – 2007, Percent



Source: CIE estimates

Employment has not been as volatile as the value of output. Total employment in coastal regions in 2001 was estimated at 128,000 people. Using the AUSM model employment for 2007 is estimated to grow by 11 percent over the period to 2007 as shown in Figure 6-5. Employment growth on the coast has been relatively steady over the period, but slower than employment growth in both the non-coastal region and Melbourne.

Figure 6-5 Index of Employment Growth by Region



Source: CIE estimates

The employment forecast also shows how employment is estimated to have changed in each industry in the coastal region from 2001 to 2007 (Figure 6-6). Most of the growth is expected in the service industries, while employment in agriculture, forestry and fishing is expected to decline by about 2000 persons.

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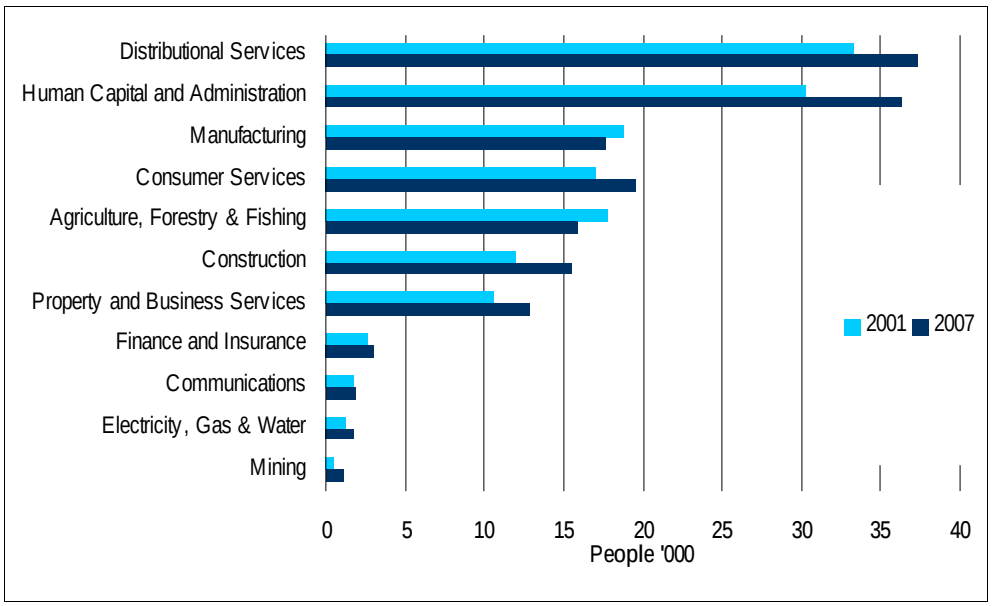
Release of the small area 2006 Census data will provide a more accurate picture of the changes in employment and population. Some recent changes in production, for example growth of the dairy industry and decline in the abalone fishery are not likely to be reflected in the modelling.

Figure 6-6 Estimated Coastal Employment Growth



Source: ABS Population Census, 2007: CIE estimates

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7.1 The Economic Value of the Coast to Victoria

Victorias coastal zone harbours an abundance of natural assets that provide a range of goods and services to the Victorian economy. Some of these, such as fish, are valued in the marketplace, but many others are not. This study has provided a snapshot of the social and economic conditions in the coastal region, compared with the rest of Victoria, and examined the principal commercial and non-market goods and services provided by the natural assets of the coast.

There are inherent difficulties in seeking to determine the value of the contribution of coast resources to Victoria. Even for marketed commercial activities, there are statistical constraints, measurement problems and missing data. The difficulties that arise in relation to the non-traded goods and services are even greater because information about these contributions to human well-being is not readily available since these services are not traded in the marketplace. These difficulties mean that estimates of various contributions to well-being provided in this report should not be summed. Nonetheless, each of the sets of data can be examined separately to gain insight into their nature and relative magnitudes of value.

The Gross Regional Product (GRP) of Victoria's coastal region, excluding Melbourne, is estimated at about $9 billion. The value of output of the major industries outside of Melbourne that are dependent on coastal natural assets is about $1.5 billion, about 16 percent of GRP.

Table 7-1 presents a summary of the commercial values attributed to activities which are supported by the natural asset base of the Victorian coast.

Table 7-1 Value of Output and Value Added in Selected Industries Dependent on Victoria's Coast

Industry	Value of output ($ million per year)	Value added ($ million per year)
Port Melbourne	1,338	596
Port of Geelong	170	89
Port of Hastings^	46	24
Port of Portland	44	22
Shipping	144	na
Commercial Fishing	83	na
Coastal non-metro tourism*	908	na
Wind energy	13	na
Total	2,796	731

Note: * Tourism estimates relate to non-metropolitan tourism in coastal statistical local areas. ^Port of Hastings values imputed from volumes.

Source: CIE and URS estimates, Deloitte et al 2003, Tourism Task Force Australia 2005, Price Waterhouse Cooper 2007, DPI 2007.

Ports and tourism are the largest industries dependent on the natural assets of Victoria's coast, followed by shipping and commercial fisheries. If the Port of Melbourne is excluded, tourism is the largest by far. This finding is supported by the results of the travel cost study for coastal recreation undertaken for this project.

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The study estimated the consumer surplus[5] at $48 per visitor day, which is comparable with similar studies' findings. Aggregated over the number of visits by Victorians to the coast per annum, the total value of non-market recreation is **$1.9 billion per annum**. This represents the most significant and robust data available on non-market services. This demonstrates the importance of protecting the natural assets which support tourism and recreation.

Thus in comparing the estimates between commercial and non-market services offered by the coast, it is clear that, even when considering only one non-market service – informal recreation – this far exceeds the value of the range of coastal dependent industries considered, and even if offshore oil and gas are included, the figures for commercial industries and recreation are similar. This is an interesting comparison, especially when one considers that many of those coastal dependent activities place risks upon, or in some cases compete with, the quality of recreation.

7.2 Changing social and economic pressures on the coast

The economic growth of the coast is more volatile and the employment growth is slower compared with Metropolitan Melbourne and the rest of Australia. Compared with Melbourne metropolitan area, incomes in the coastal region are lower and the age structure is older. This pattern is caused by the relatively low representation of younger members who have left because of the greater employment, and income earning potential, elsewhere. Together this paints a picture of a region of Victoria that is resource rich but disadvantaged.

It is against this background of relative economic disadvantage amid rich natural resources that the forces of economic and social change are applying pressure to existing use of land and other natural assets of the region. As market forces are exerted strongly, demands for preservation of natural values increase. As a result, the drivers of change are a paradoxical mix of drivers for both more intensive use of resources and conservation. They can be summarised as:

- Population shift to the coast (the 'Seachange' phenomenon), particularly with the imminent retirement of the baby boomer generation:
  - Increased population pressure;
  - Prospects of an even higher proportion of lower income retirees;
  - Urban expansion; and
  - Increased popular awareness of the impact of pressures on coastal natural resources and values.
- Expansion of resource-based industries, for example:
  - Port facilities and associated terrestrial transport and logistics infrastructure;
  - Petroleum industry;
  - Wind farms;
  - Forestry plantations;
  - Aquaculture: auction last year for sites in Port Phillip Bay and elsewhere on the coast; and
  - Geosequestration of carbon dioxide.
- Changes to agricultural industries and land use are all affecting the demand for and value of agricultural land along the coast, for example:

[5] Consumer surplus is the amount of value or well-being that individuals gain through the consumption of a good or service that is in excess of what they have paid. Where services are non-priced, consumer surplus is the single measure of value.

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  - Growing demand for the region's agricultural produce, for example dairy products
  - Growing demands for conservation areas and national parks to protect the natural assets and ensure ready access for the community and tourism.
  - Drought;
  - Climate change and the higher, more reliable rainfall on the coast; and
  - Demand for hobby farms associated with the 'seachange' phenomenon described above.
- Changes in social preferences, for example:
  - Increased conservation effort, including Landcare and Coastcare;
  - Reduction in logging of native forests and changes to logging practices;
  - Increase in areas of national parks and other conservation areas;
  - Creation of various types of marine protected areas;

All of these changes will be affecting the use of Victoria's coastal natural resources in the years ahead. From a commercial market perspective, pressure will be applied to lower market value uses in favour of higher value uses of resources. Thus, as the demand for renewable energy rises, the demand for sites for wind power will also increase, leading to changes in agriculture in windy areas. Similarly, as water for irrigation becomes scarcer in inland Australia, production of some crops may shift to higher rainfall agricultural areas on the coast.

The restructuring of the forestry industry is also leading to increases in plantations in higher rainfall areas, particularly adjacent to port facilities. Thus, reductions in logging in the Otways are being accompanied by new plantings of trees in western Victoria close to the port of Portland.

The expansion of the petroleum industry illustrates some of the pressures that can affect the natural values and assets of the coast. Over the years, concerns have been expressed about potential negative impacts of the petroleum industry on other sectors of the economy such as tourism, the environment and ecosystems. While the seismic exploration program has been arranged to avoid the whale breeding season, the impacts on fish and other marine species are not well understood. The proximity of the Otway Basin to several National Parks, including the Twelve Apostles, has also required careful attention to environmental issues in the development of the gas field.

The changing socio-economic profile of the coast will have profound implications for commercial use of coastal resources. On the one hand, more people will be living at the coast with all that urban expansion implies in terms of pressure on coastal natural assets. On the other hand the natural assets are a key draw of populations to the coast, leading to greater calls for protection. This tension brings the non-market value of these natural assets into sharper relief and provides a clear rationale for further development of the tools and data to inform decisions where these trade-offs are in evidence.

7.3 Decision-making tools

There are strong lifestyle values associated with the coastal regions — they are attractive areas in which to live. This attraction is a source of potential conflict between the different uses of the natural resources of the regions, especially between urban development, conservation and more traditional land uses such as agriculture and native timber forestry. In addition, conflicts emerge as between the use of land for agriculture and plantation forestry.

Resolution of such conflicts can be helped by a better understanding of the relative contributions of different commercial services to human well-being compared with the contribution from non-market services. In many situations these respective contributions cannot be pursued concurrently, and choices have to be made.

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Such measures are most appropriate if used to address location specific natural resource allocation and use decisions. This is because the decision that is to be made can be more clearly specified, and the required information attained to make that decision. Further detailed research and analysis may be required to determine the relative contributions. This report seeks to provide a guide to the techniques that are available.

Examples of decisions such monetary value data can inform are:

- decisions about the appropriate amount of investment in coastal defences, dune maintenance or recreational infrastructure;
- decisions regarding acceptable levels of risk, such as from shipping accidents that risk damaging the natural environment; and
- land-use planning decisions regarding socially acceptable levels of urban development in the buffer zones between towns or a change from one land-use provision to another (e.g. to a national park).

Non-market valuation techniques may provide either the benefit or cost side of a benefit-cost equation informing such decisions, depending upon the decision at hand. Costs may be the opportunity costs of forgone recreational opportunities or the loss of non-use values associated with a loss of habitat for current and future generations. Benefits may be the improvements in well-being of affected populations that result from improved dune maintenance (as was measured in Pitt, 1993, see Section 5.1.1), or the improvements in well-being that result from an internationally recognised asset gaining the security of management that results from national park status. These are all welfare (or well-being) changes that non-market economic valuation techniques are adept at valuing. That there is a lack of data on the values of non-market services of the Victorian coast is argument for further research to inform pressing decisions.

7.4 Further work

As mentioned throughout the report, there is a serious lack of information about important non-market services that has implications for the management of the coast. One of the main implications of the report is to point out the lack of this information. There are especially three services that are assessed as contributing largely to the value of the coast, but remain unknown: amenities connected to residential areas, storm protection and shoreline stabilisation.

The amenities which are connected to residential areas are discussed in sections 5.2.2, where it is also argued that the value is probably very high. Living close to the coast gives access to two important services: 1) visual amenities for properties with direct views and 2) recreational access for all properties in a certain distance to the coast. The hedonic pricing technique can be used to estimate these two important services by estimating the impact of proximity to the coast on property prices. This is equivalent to inhabitants willingness to pay for the services and is therefore a true estimate for the value of the services. It is suggested to carry out a study similar to the one from Adelaide described in section X, which looked at 1) having direct access to a beach, 2) being in walking distance of a beach, and 3) having water views. All three characteristics are important for the welfare of inhabitants and have coastal management implications for new developments. The technique can also compare different coastal areas or comparing the same area over time. This is a powerful tool, because it allows an evaluation of the impacts of public works as for example the improvement of the shoreline in Geelong, thereby showing if the public costs are comparable with the local inhabitants' willingness to pay through property price increased. The comparison between for example coastal towns could be used in the same way, if the areas where selected carefully. All in all, a hedonic pricing survey would potentially be a strong tool for justifying coastal management by increasing the knowledge of the value of the coast in residential areas.

The value of storm protection and shoreline stabilisation is another important area with limited understanding of the values. Every year, local communities and public land managers incur high costs to

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maintain and protect coastal ecosystems as e.g. the fragile vegetation on dunes. Also, there is a high pressure on some natural assets along the coast due to urban development e.g. coastal wetlands. If the value of the services these ecosystems provide in form of storm protection or shoreline stabilisation, the costs and protection would be easier to justify. Therefore, this report also recommends undertaking studies focused on these two important services, either using stated preference technique to value people's willingness to pay for the maintenance and protection, or using one or more pricing techniques as described in section 5.1.2 and 5.1.3.

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Section 9 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Victorian Coastal Council and Department of Sustainability and Environment and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated January 2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between February 2007 and August 2007 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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Appendix A Composition of coastal regions

This Appendix defines the composition of the coastal regions used in this report.

The fundamental geographical building block of the analysis is the Statistical Local Area (SLA) used by the Australian Bureau of Statistics (ABS) in its Australian Standardised Geographic Classifications (ASGC). The main purpose of the ASGC is for collecting and disseminating geographically classified statistics. The ASGC provides a common framework of statistical geography and thereby enables the production of statistics which are comparable and can be spatially integrated (see abs.gov.au).

The SLA is the smallest of the spatial units defined in the ASGC and on aggregate SLAs cover the whole of Australia without gaps or overlaps. SLAs aggregate directly to form the larger spatial units of SSDs and then the SSD aggregate into SDs.

A strength of SLAs when used in analysis of economic geography is that each SLA reflects the key elements of an economic, social and environmental community. It reflects where people live and work as well as where economic activity takes place. At this level there is a reasonable degree of congruence between factors such as the location of where economic value is added and income, where jobs are and where people live, although adjustments still have to be made for flows of labour and income between SLAs. At higher levels of disaggregation it is more likely that there is a separation between such factors. That is, people live and work in different places and economic value added and income become separated. Thus measuring and tracking such things becomes more difficult and less reliable.

In this report, the coastal region is defined as all the Coastal SLAs which have a border on the coast excluding those in the Melbourne statistical division Table A.1 shows a list of all the regions in Victoria that are coastal. The table is split into three columns according to whether the regions are Statistical divisions (SDs), Statistical sub-divisions (SSDs) or Statistical Local areas (SLAs).

Table A-1 Coastal Regions of Victoria

SD	SSD	SLA
Western District	Glenelg	Glenelg (S) – Heywood
		Glenelg (S) – Portland
	Hopkins	Moyne (S) – South
		Corangamite (S) – South
	Warmambool City	Wormambool City
Barwon	West Barwon	Colac Otway (S)
		Greater Geelong(C) – Pt C
	East Barwon	Surf Coast (S) – West
		Surf Coast (S) East
		Gtr Geelong (C) – Pt B
		Queenscliffe (B)
	Gtr Geelong City	Corio – Inner
		Geelong West
		Geelong
		Bellarine – Inner
Melbourne	Melton-Wyndham	Wyndham © – South

Appendix A Composition of coastal regions

SD	SSD	SLA
	Western Melbourne	Hobsons Bay © – Altona
		Hobsons Bay © – Williamstwon
	Inner Melbourne	Melbourne © – Remainder
		Port Phillip © – West
		Port Phillip © – St Kilda
	South Melbourne	Bayside © – Brighton
		Bayside © – South
		Kingston ©- North
		Kingston © – South
	Frankston City	Frankston © – West
	Mornington Peninsula Shire	Mornington Peninsula Shire – South
		Mornington Peninsula Shire – West
		Mornington Peninsula Shire – East
	South East Outer Melbourne	Casey © – South
		Cardinia (S) – South
Gippsland	South Gippsland	Bass Coast (S) – Phillip Island
		French Island
		Bass Coast (S) – Bal
		South Gippsland (S) - Central
		South Gippsland (S) - East
East Gippsland	Wellington Shire	Wellington (S) – Alberton
		Wellington (S) - Rosedale
	East Gippsland Shire	East Gippsland (S) – Bairnsdale
		East Gippsland (S) - Orbost

Source: ABS

Throughout the report the state of Victoria is split into' the coastal region', 'the non-coastal region' and 'Melbourne'. 'The coastal region' includes all the SLAs in the chart above apart from those under the Melbourne statistical division. Those in the Melbourne Statistical division are in the 'Melbourne' grouping. The 'non-coastal region' is all the other SLAs in Victoria not listed in the table. The sum of all three regions: 'Melbourne,' 'the coastal region' and 'the non-coastal region' makes up the whole of Victoria.

Appendix B Valuation techniques

Economic Valuation Techniques This Appendix presents an overview of economic valuation techniques, pricing techniques, and benefits transfer.

While all techniques described in this report can be called valuation techniques, revealed and stated preference methods are generally what are referred to as economic valuation.

Stated preference methods

These methods directly elicit individuals' preferences for non-market goods, through the use of questionnaires that allow respondents to trade off goods and services against money thereby stating their preferences. These methods are the only way to gather quantitative evidence about the non-use component of TEV to be estimated. In the case of ecosystem services non-use value may be significant, particularly for irreversible impacts.

There are two types of stated preference methods:

- **Contingent Valuation (CV)** employs a questionnaire format where respondents are asked how much they would be willing to pay or willing to accept compensation for a specified gain or loss of a given good or service. Economic value estimates yielded by CV surveys are 'contingent' upon the hypothetical market situation presented to respondents and allows them to trade off gains and losses against money. WTP/WTA questions may be asked in a number of ways, including open-ended, where the respondent states their maximum WTP or minimum WTA, and dichotomous choice, where the respondent is required to answer 'yes' or 'no' to a 'bid' (e.g. are you willing to pay $x?). Typically in CV studies the attributes of the good or service are valued together as a bundle.

- **Choice modelling (CM)** approaches involve respondents making choices between goods which are described in terms of their various attributes, offered in different amounts, or levels. There are two main choice formats: contingent ranking and choice experiments. In a contingent ranking exercise, respondents rank a set of alternative scenarios of good or service provision in order of preference. In a choice experiment, exercise respondents are presented with a series of scenarios and asked to choose their most preferred. One of the attributes is always price or cost so that by ranking the alternatives or choosing their most preferred, respondents implicitly trade goods and services against money and hence their WTP or WTA can be inferred through their choices. Choice modelling is a technique borrowed from market research and typically provides more data on individuals' preferences than CV techniques for a similar sample size.

Revealed preference methods

These methods infer individuals' preferences by observing their behaviour in markets in which a given environmental good or service is indirectly purchased (e.g. recreation) or markets where the price of a man-made good is influenced by environmental goods and services (e.g. the property market).

There are two main variants of revealed preference methods:

- **The Travel Cost Method (TCM)** enables the economic value of recreational use (an element of direct use value) to be estimated. The method requires the costs incurred by individuals travelling to recreation sites to be surveyed, in terms of both travel expenses (fuel, fares etc.) and time (e.g. foregone earnings). The basic assumption is that these costs of travel serve as a proxy for the recreational value of visiting a particular site. The difference between the amounts people spend getting to different sites can also be modelled against site characteristics to estimate the value of those characteristics (e.g. landscape types or recreational facilities such as visitor centres etc).

- **Hedonic Pricing** may be applied to the valuation of environmental goods such as landscape amenity, air quality and noise. It is based on the assumption that like structural and neighbourhood characteristics, the surrounding environmental quality also affects the price of a property so that identical houses fetch higher prices in, for example, quieter areas with better air quality. The technique involves isolating the effect of these services on the demand for a marketed good. In most

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cases price data from the housing market are used. Analysis of the data estimates the implicit price which individuals are willing to pay for the relevant environmental characteristics.

Pricing techniques

The following are the set of pricing techniques, i.e. those techniques employing market data:

- **The Opportunity Cost** approach estimates the benefits that are forgone when a particular action is taken. For example, forgone revenues from timber sales and the loss of benefits from forgoing other forest products may be viewed as the opportunity cost of a forest conservation project that prevents the harvest of timber and/or other products. In the strictest sense, opportunity cost should be viewed as the next best alternative use of a particular resource.
- **Mitigation Behaviour / Preventive or Aversive Expenditure** approaches analyse the cost incurred, or prices paid, in order to defend against the negative impacts of environmental degradation (e.g. the cost of building sound-proof windows in the case of noise pollution or the cost of buying pollution masks to protect against urban air pollution).
- **The Substitute Goods / Cost of Alternatives** approaches entail estimating the cost of provision of an alternative resource that provides the function of concern. A wetland service that provides protection against flooding could, for example, be valued, at the very least, on the basis of the cost of building man-made flood defences of equal effectiveness. Another example may be the cost of fertiliser to replace the natural productivity of soils that have been eroded.
- **Shadow Project Costs** consider the cost of providing an equal alternative resource or ecosystem at an alternative location. Such an approach may also be termed as a ‘replacement cost’ approach, which measures environmental value by applying the cost of reproducing the original level of benefit. The market in wetlands in the USA is an example of such a system in practice. The regulatory system facilitates the market by allowing, say, developers to drain a wetland if they create or protect a replacement wetland elsewhere.
- **Production Function Methods** estimate the direct and indirect use value of ecosystem goods and services via their contribution to marketed outputs. An input-output approach is used, which involves measuring the change in quantity or quality of a good or service input and the resulting change in marketed output. The change in physical quantities is valued in monetary terms using the market price. This approach is most suited to ecosystem services that contribute in various ways towards economic outputs (e.g. the filtration of water is beneficial for recreation, drinking water, fisheries production and so on). Using the production function the portion of this contribution to each economic end point can be ascribed.

Benefits transfer

Benefits (or ‘value’) transfer is the process of taking information about benefits from one context (the 'study site') and applying it to another context (the 'policy site'). Essentially this means reviewing the literature of original valuation studies and selecting those results that correspond best to addressing the policy question at hand.

Appendix C Travel cost model

Theoretical framework

In this Appendix, the results of a travel cost survey of the Victorian population's recreational use value of the coast are presented. The travel cost model is mostly used to estimate the economic use value associated with recreational services provided by ecosystems and estimates the consumer surplus of either changes in environmental quality of a site or the existence of a site. For more information on travel cost models and their use, see Ward and Beal (2000).

There are two overall types of model: the zonal travel cost model and the individual travel cost model. The *zonal travel cost model* divides all individuals into zones and looks at the overall number of visits to the site made from that zone depending on average socio-economic data, distance and costs of travelling from the zone. This means that the data needs are smaller for this type of model and in the past, the zonal model has been preferred for that reason. However, it means that it is not possible to look at individual information or preferences to explain the number of trips. As an alternative, the *individual travel cost model* estimates the individual number of trips to a site depending on its travel distance, cost and preferences. This model is appropriate when there is variation in the number of visits per individual from the same zone or if there is a need to include individual preferences in the model. In the assessment of the recreational value of the coast to Victoria, there is a reason to expect a high variation in the number of times that inhabitants visit the coast regardless of where they live. There was also an aim to include information about people's preferences for a number of qualitative variables in the survey to examine what natural and man-made assets influenced the recreational value of the coast.

Therefore the individual travel cost model was chosen and for statistical reasons count data models were used, as they provide more consistent results and are more suitable to population wide surveys (Ozuna and Gomez, 1995).

Survey design and data

The survey was done as part of the general marketing survey concerning the populations' use of the coast of Victoria and their view on policy issues of coastal management. It was conducted as telephone interviews in the middle of April 2007.The sample was divided in four segments:

Table C-1 Population Sample

Residential Location	Melbourne	Rest of Victoria	Total
Within 15 km of the coast	120	120	240
More than 15 km from the coast	180	180	360
Total	300	300	600

The reason for the segmentation of the sample is that the data is collected as part of a marketing survey that was originally designed in 1996 and has been repeated in 2001 and this year. In 2001 the marketing company TQA examined the representativity and found that the sample corresponded to the distribution of the population. We are assuming that this still holds and that there is therefore not a systematic bias due to the sampling technique. For more detail on the sampling and the rest of the survey see IPSOS (2007).

For travel cost modelling, the following information was collected:

- They were asked how far away they lived from the coast.
- Then were then asked to think about their last trip to the coast and then answer a number of questions concerning that trip:
  - Where they went (possible multiple responses)
  - How far they travelled

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- How long it took them to travel there
- If they had any non-coastal destinations on the trip and if yes, how much of the trip was spent on travelling to or along the coast
- Their means of transportation and
    - If the used public transportation then to estimate the transport costs
    - If they went by car, then the number of adults in the car
- The number of overnight stays
- And finally a number of qualitative questions about the destination concerning the factors that contributed to their enjoyment of the trip. The factors were:
    - Participating in sporting activities
    - Enjoying nature and wildlife
    - The presence of recreational facilities
    - Whether the place was quiet and un-crowded
    - The presence of undeveloped coastal landscape
    - The presence of seaside town life and cafes / restaurants
    - The presence of cultural heritage

Socio-economic information was also collected about for example age, marital status, income and children.

Results

A total of 601 people were interviewed for the visitation survey made by IPSOS. Out of this group, 102 had not visited the coast in the last 12 months and therefore would have received no consumer surplus from the recreational use of the coast. Another 35 people were not presented with the travel cost questions due to a misunderstanding in the interview process. Both groups are still included in the travel cost model as non-consumers, which are technically not true for the 35 people that did visit the coast, but only made short trips of less than 2 hours. The sample of non-consumers is labelled sub-sample 2. A number of people (32), who were asked the travel cost question, had to be excluded because their answers were inconsistent (people living 200 kilometres from the coast according to post code but claiming to travel 100 kilometres) or extreme (e.g. very high cost and number of trips). This gives a total of 566 for the final sample, with two sub samples: sub-sample 1 of people that were asked the travel cost question (429) and sub-sample 2 of people who were not (137). Table C-2 shows the survey statistics of all groups. The average age, income, marital status and number of families with children correspond with the expectations based on state data and there are no statistically significant differences between sub-samples.

The table also shows statistics on the average number of trips, travel distance etc. The average person in sub-sample 1 made 8 trips within the last 12 months that were similar to the one that they described in detail. They travelled a total of 200 kilometres and spent four and a half hours doing so, which means that their travel speed averaged 45 per kilometres per hour. People had an average of 2 overnight stays at their coastal location.

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Table C-2 Survey Statistics

	Total sample		Sub-sample 1		Sub-sample 2	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Respondents	566	-	429	-	137	
Average age	51	16.9	49	16.7	57	16.1
Household income ($)	56,155	17,880	57,759	18,053	51,130	16,399
Singles, divorced or widowed (%)	35	-	34	-	38	-
Families with children under 18 (%)	30	-	32	-	23	-
Number of trips	6.4	14.2	8.5	15.8	-	-
Distance of return trip (kilometres)	154	221	204	234	-	-
Travel time	3 h 27 min	4 h 31 min	4 h 33 min	4 h 40 min	-	
Overnight stays	1.7	5.2	2.2	5.9	-	-

To be able to estimate the individual's number of trips to the coast depending on the travel cost, it is necessary to calculate the travel cost, as they are not given in the survey. There are two different approaches to the calculation of travel cost: only to look at the simple cash cost of travelling or to include the opportunity cost of time in the model. In this travel cost model the results from both approaches are presented.

To calculate the direct travel cost some information is needed on the running and operational costs of cars, information that is collected by RACV (www.RACV.com.au). The running cost of an average car is estimated to be 18.68 cents per kilometre and the operation cost is 70.65 cents per kilometre (based on a yearly use of 15,000 kilometres). Whether the running cost or the operation costs is the most appropriate measure of the true cost of travelling probably depends on the normal use of the car and the length of the trip. It is reasonable to assume that for short trips people in general will only take the running cost into account, whereas for longer trips they may consider for example wear and tear of the car. This means that the true travel cost probably lies somewhere in between the two estimates and the models are estimated using either cost assumption.

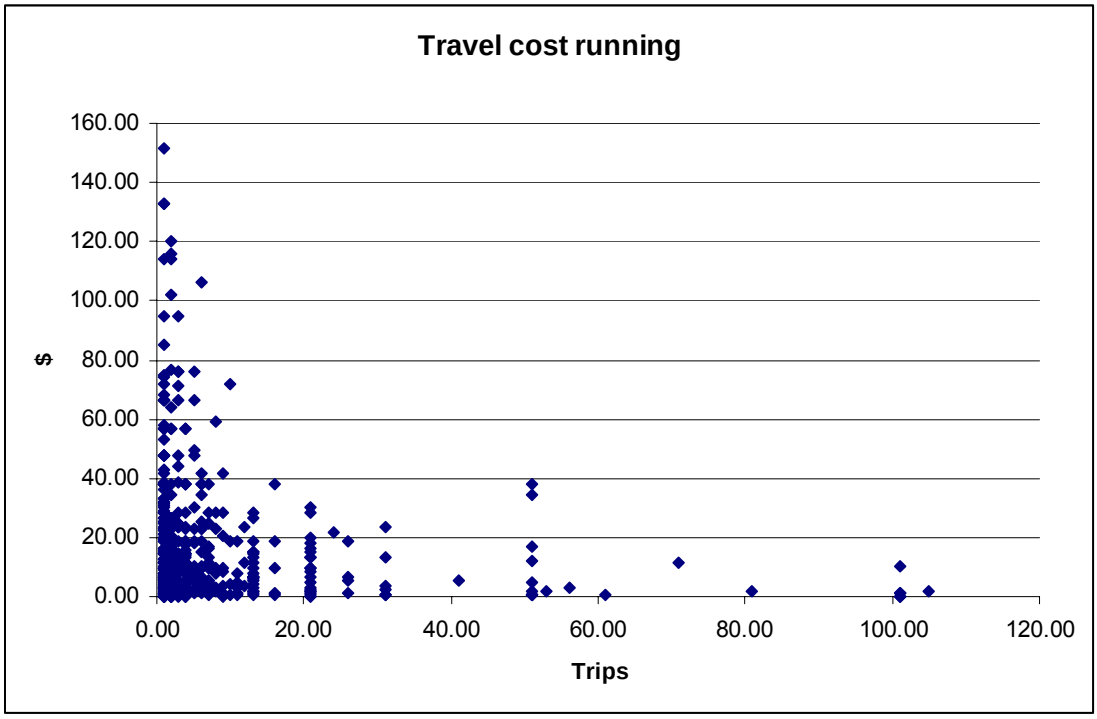
It was not possible to find reliable estimates of motor bikes running and operation costs and it was assumed that the running cost were 50 cents per kilometre. There are only 6 people that used motor bikes as means of transportation and it does therefore not have a major impact on the results.

Sixteen people used public transportation to get to their destination. They were asked about their total cost directly so no estimation was needed for them.

A graphical presentation of the data relating the number of trips and travel cost is presented in Figure C.1 for the travel cost based on running costs. The figures demonstrate the negative relationship between number of trips and travel cost: the higher the cost of the trip the fewer trips are made.

Appendix C Travel cost model

Figure C-1: Travel Cost vs. Number of Trips



The opportunity cost of travel time

The opportunity cost of travel time is one of the most debated issues in travel cost theory. The subject is not going to be further explored here, but interested readers can refer to Phaneuf and Smith (2005) for a detailed discussion. They argue that the best approach is to use one third of the wage rate as a reasonable estimate of the opportunity cost of time based on the fact that more detailed strategies for estimating the cost have not been able to find results that are significantly different from that estimate.

The low average speed that was presented in Table C-1 suggests that people stopped on their way to the coast and did other things for example visited wineries or had a meal, which provides them with additional utility (or welfare) of the trip. This should not be included in the consumer surplus calculated for the coast of Victoria because it would mean that the estimate would be exaggerated. Therefore travel time had to be calculated directly from the travel distance. The travel time was calculated in the following way: For metropolitan residents the first 20 kilometres were assumed to be city traffic with an average of 40 kilometres per hour and the rest of the trip was assumed to be travelled at 80 kilometres per hour. For non-metropolitan residents (determined from post codes), it was assumed that the average speed was 80 kilometres per hour.

To be able to compute the opportunity cost of the travelling time, it was necessary to estimate an individual wage rate from the information on household income. An income estimate is derived from the four household income categories applied in this study: i) less than $ 35,000, ii) $35,000 to $60,000, iii) $60,000 to $85,000 and iv) above $85,000. It was assumed that people in category I have a household income of $35,000 and that people in the highest category had an annual income of $85,000. It was assumed the income of people who refused to state their household income was equal to the average to allow for them to be included in the data set. Information about the average yearly working hours of men and women from the ABS 2001 census (ABS 2001a) was then used to calculate an average hourly wage. The hourly opportunity cost was computed as one third of the wage as discussed above.

For both the calculation of the opportunity cost of time and the direct travel cost, the fraction of the trip that people used on other non-coastal destinations were incorporated to ensure that there was no overestimation of the cost.

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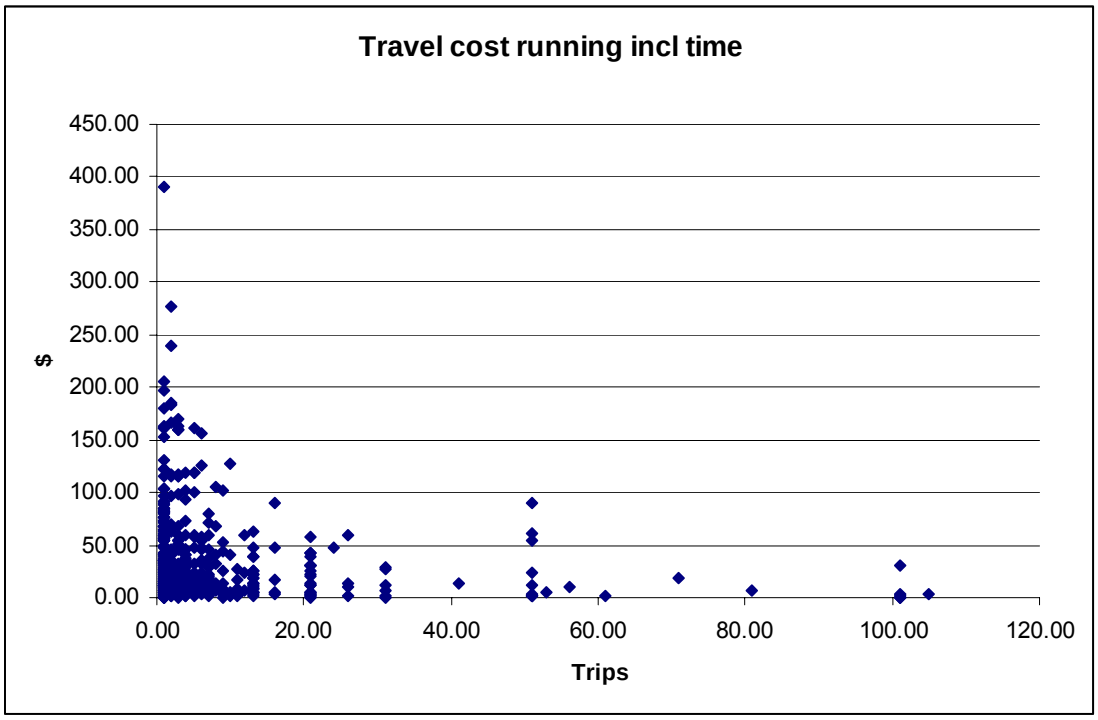
Figure C-2 shows the relation between the number of trips and travel cost including opportunity cost of time. This figure shows the same pattern as the one that only included travel cost based on running cost of cars but the cost are approximately doubled.

Figure C-2: Travel Cost (IncludingTtime) vs. Number of Trips



Qualitative variables

Part of the objective of this travel cost model is to look at how different characteristics of the coast contribute to the enjoyment of the trips to the coast and therefore to people's willingness to pay for recreation along the coast.

Figure C-3 shows the results of that question for all the travel cost interviews. It shows that the enjoyment of nature and wildlife is the factor that most people find crucial or important. This is followed by participating in sporting activities, that the site is quiet and undeveloped and the existence of undeveloped landscapes. Recreational facilities, cafes and restaurants are less important to enjoyment, but still important for a lot of people. The existence of cultural heritage is the characteristic that fewest people find important and that most people do not think is a factor at all. For most of the other characteristics apart from the existence of nature and wildlife, one in four generally does not find it as a factor of their enjoyment at all. Interestingly, only few people have found that the characteristics were not present at their destination. This may be due to a conception that people in general can find the characteristics of the coast that they are looking for.

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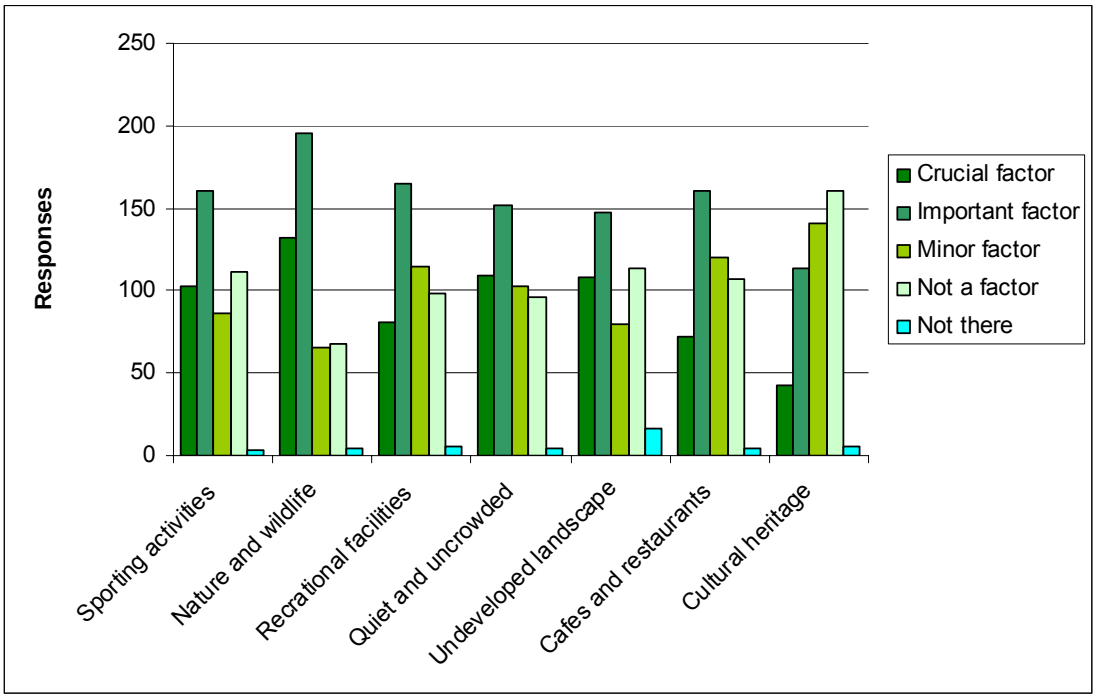
Figure C-3: Factors Contributing to the Enjoyment of the Trip



Preliminary modelling suggested that there were a number of interactions between these variables that leads to this result. To examine this, the correlations between variables were calculated, Table C-2 shows the correlation between the five qualitative characteristics of the coast and the travel distance. The grey areas are higher correlations between two variables. It is easy to see that there is correlation between the variable nature and wildlife and a number of other variables, which suggest a problem of colinearity in the model, when all the different variables are used. Colinearity means that the effect of two or more variables on the dependent variable (number of trips) cannot be separated from each other, which explains the surprising negative sign of the nature and wildlife variable. The variables are correlated because people that find the enjoyment of nature and wildlife important also find other quality variables important.

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Table C-2: Collinearity Between Variables

	Sporting activities	Nature and wildlife	Recreational facilities	Quiet and uncrowded	Undeveloped landscape	Cafes and restaurants	Cultural heritage
Sporting activities	1.00						
Nature and wildlife	**0.39**	1.00					
Recreational facilities	0.28	**0.34**	1.00				
Quiet and uncrowded	0.14	**0.36**	0.15	1.00			
Undeveloped landscape	0.17	**0.40**	0.18	**0.41**	1.00		
Cafes and restaurants	0.04	0.00	0.22	0.01	0.03	1.00	
Cultural heritage	0.12	0.25	0.31	0.14	0.20	0.18	1.00
Travel distance	0.07	0.01	0.03	0.02	-0.06	0.01	-0.03

The problem of collinearity means that it is not possible to interpret anything about the four involved without redefining the variables or excluding some of them from the model. It was therefore decided to redefine the variables in a way that would define distinct groups. It was done by analysing patterns in the data that suggested that people answered the qualitative questions in a specific way. The analysis showed that four new variables could be defined:

- Sport is defined for all interviews where people thought that Q#15a (sporting activities) was crucial for their enjoyment of the trip
- Nature is defined for all interviews where people thought that Q#15b (Wildlife) and Q#15d (quiet and uncrowded) and Q#15e (undeveloped) were crucial or important (1 and 2).
- Culture is defined for all interviews where people thought that Q#15G (cultural heritage) was crucial for their enjoyment
- Recreation is defined all interviews where people thought that Q#15C (recreational facilities) and Q#15F (cafes) was crucial or important.

The dummies are developed from an analysis of correlation and solve the problem of correlation. There are 115 of the TCM interviews that do not have a dummy assigned. They are generally people who do not find any factors really important.

These variables were included in the models together with the rest of the variables.

Models

To give an idea of the difference between the different ways of calculating costs, a number of models with different travel costs were calculated. Four different approaches to modelling travel costs were explored:

1) A model using the running cost of cars as the sole cost

2) A model using running cost and opportunity cost of time

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3) A model using operation cost of cars, which includes costs of financing, service, insurance etc.

4) A model using operation costs and opportunity cost of time

A range of variables were included in the model:

- Travel cost variables: number of trips (the dependent variable) and travel costs as defined above.
- Socio-economic variables: Income, marital status, age and whether they are living in Melbourne
- The qualitative variables defined above.

The following tables show the results for the four different models:

Model 1

	Coefficient	Standard error
Constant	1.853***	0.098
Travel cost running	-0.024***	0.001
Age	-0.010***	0.001
Income	0.000012***	0.000001
Couple	0.158***	0.043
Coast15	0.584***	0.0365
Metropolitan	-0.362***	0.035
Sports	0.651***	0.036
Nature	0.152***	0.035
Recreation	-0.730***	0.042
Number of observations		566
Log likelihood		-3487
Restricted log likelihood		-4930
Chi squared		2886

Model 2

	Coefficient	Standard error
Constant	1.825***	0.098
Travel cost running	-0.006***	0.000
Age	-0.010***	0.001
Income	0.000012***	0.000001
Couple	0.158***	0.043
Coast15	0.582***	0.036
Metropolitan	-0.387***	0.035
Sports	0.645***	0.036
Nature	0.154***	0.035
Recreation	-0.733***	0.042

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Number of observations		566
Log likelihood		-3483
Restricted log likelihood		-4930
Chi squared		2892

Model 3

	Coefficient	Standard error
Constant	1.760***	0.097
Travel cost running	-0.013***	0.001
Age	-0.010***	0.001
Income	0.000014***	0.000001
Couple	0.143***	0.043
Coast15	0.556***	0.037
Metropolitan	-0.362***	0.035
Sports	0.641***	0.036
Nature	0.158***	0.035
Recreation	-0.715***	0.042
Number of observations		566
Log likelihood		-3472
Restricted log likelihood		-4930
Chi squared		2917

Model 4

	Coefficient	Standard error
Constant	1.796***	0.098
Travel cost running	-0.005***	0.0003
Age	-0.010***	0.001
Income	0.000013***	0.000001
Couple	0.151***	0.043
Coast15	0.566***	0.035
Metropolitan	-0.380***	0.035
Sports	0.643***	0.037
Nature	0.157***	0.035
Recreation	-0.725***	0.042
Number of observations		566
Log likelihood		-3484
Restricted log likelihood		-4930
Chi squared		2892

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The models are comparable in the way that the fits are equally good in all the models. Therefore, model 2, which uses running cost of cars and includes opportunity cost of time and are seen in most travel cost models are chosen as the best possible model.

The table shows that a number of variables are significant and has varying signs. First of all, the travel cost has the expected negative sign: the higher the cost of travelling to the coast, the fewer trips. Since the model is a count data model, the cost variable is used to compute the consumer surplus per trip directly as $-1/\beta_{\text{Travel Cost}}$.

The age has the expected negative sign, because older people travel less frequently than younger people. This is also reflected in the results showed in table C-2: Sub-- sample 2 has a higher average age compared with sub-sample 1. The impact of income on the number of trips is positive, but very small (1.2E-05) as expected: people with higher income have more frequent trips to the coast. Couples visit the coast more frequently as do people living within 15 kilometres of the coast. People living in Melbourne visit the coast less frequently, probably because substitutes are easily available, and maybe because they have different preferences.

The three qualitative variables show an interesting pattern. The variables called sport and nature show positive parameter estimates, whereas the last variable (recreation) has a negative sign. The result is that sport activities has a large positive impact on the value of the coastal trip, which means that people were valuing the ability to do sport activities (e.g. surfing) highly. The impact of the nature variable was also positive, but smaller than the sport variable, which means that people that find wildlife and peace important have a higher than average value of the coastal recreation per day. The recreation dummy showed a negative value, meaning that people that think that recreational facilities as cafés and restaurants important for their coastal recreation have a lower than average value of coastal recreation. This can be explained by the many substitutes that exists and that the coast itself maybe plays a secondary role in the enjoyment compared to for example barbequing or the service of the restaurant.

Consumer surplus

The consumer surplus is by definition the difference between what a person is willing to pay for a certain amount of good or service (here number of trips to the coast) and what they are actually paying. This means that the consumer surplus estimate can be interpreted as the personal utility derived from the recreational use of the coast of Victoria given as a monetary measure.

Table C-3 shows the consumer surplus per recreation day to the coast at a 95 percent confidence interval. The interpretation of the interval is that in 95 percent of all cases, the consumer surplus would be within that interval if the survey was repeated. This gives an idea of the precision of the estimate. Because we are using count data models, the consumer surplus can be computed directly from the models given above.

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Table C-3: Consumer Surplus

	Lowest CS ($)	Average CS ($)	Upper CS ($)
Model 2	43	48	54

We know from the interviews that the average of trips within the last 12 months on average was 6.4 trips of the type described in the model. This can be combined with the value per recreation day given above to calculate an aggregate consumer surplus for the population of Victoria:

- Total number of households in Victoria is 1.9 million (ABS 2001a).
- With an average of 6.4 visits to the coast and the number of households given above, the total number of trips for this calculation is 12.2 million trips or 21 million visitor days. This is lower than what is found by IPSOS (2007) because it is not including all trips, as mentioned above.
- Total recreation use value of the coast **$1.9 billion per annum** (confidence interval of $1.7-2.1 billion per annum, at 95 percent confidence levels)