# Defining a Marine Cadastre: Legal and Institutional Aspects

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# DECLARATION

This is to certify that this thesis:

(a) Has not been submitted for a higher degree at any other University or Institution;

(b) Is approximately 30,000 words in length.

Andrew James Blackley Binns.

The following publications have resulted from this research:

Binns, A., Rajabifard, A., Collier, P. and Williamson, I.P. (2004), Developing the Concept of a Marine Cadastre: An Australian Case Study, *The Trans Tasman Surveyor*, 6 pp. 19-27.

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# ABSTRACT

This thesis aims to define the concept of a marine cadastre through an analysis of institutional and legal aspects of Australia's current marine based management system. It also aims to investigate the applicability of current legal, institutional and administrative land based spatial management arrangements, including the Australian Spatial Data Infrastructure (ASDI) and cadastre, to the administration of current spatial rights, restrictions and responsibilities in the marine environment.

The research comprises three phases. The first phase is a review and analysis of national and international efforts in the management of the marine environment. This includes an examination of domestic and international tools of governance, as well as sustainable development factors driving the need for the development of a spatial boundary management system for Australia's oceans. The relationship between legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment is also studied, with particular focus on a Victorian pilot project.

The second phase utilises research from the first phase to aid in defining the concept of a marine cadastre for Australia. A marine cadastre is defined as a spatial boundary management tool, which describes, visualises and realises legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment, allowing them to be more effectively assessed, administered and managed. A marine cadastre diagram is also created in order to aid in the visualization of this concept.

The third phase is to identify key terrestrial cadastral and Spatial Data Infrastructure (SDI) principles that may aid in the implementation of a marine cadastre. The key principles focus on policy, tenure, legal, institutional and technical aspects of Australia's terrestrial cadastral systems. The utilisation of the ASDI within the context of a marine cadastre focuses on issues of fundamental datasets, custodianship, accuracy, metadata and access to spatial data.

# TABLE OF CONTENTS

# LIST OF FIGURES AND TABLES

## FIGURES

# TABLES

# LIST OF ACRONYMS

| | |
|---|---|
| AAV | Aboriginal Affairs Victoria |
| AFMA | Australian Fisheries Management Authority |
| AHO | Australian Hydrographic Office |
| ANZLIC | Australian & New Zealand Land Information Council |
| ARC | Australian Research Council |
| ASDD | Australian Spatial Data Directory |
| ASDI | Australian Spatial Data Infrastructure |
| ASDI DN | ASDI Distribution Network |
| CSC | Coastal Services Centre |
| DCDB | Digital Cadastral Database |
| DEM | Digital Elevation Model |
| DPI | Department of Primary Industries |
| EA | Environment Australia |
| EEZ | Exclusive Economic Zone |
| EPBC | Environmental Protection and Biodiversity Conservation Act |
| FAO | Food and Agricultural Organisation of the United Nations |
| FIG | International Federation of Surveyors |
| GIS | Geographic Information System |
| GSDI | Global Spatial Data Infrastructure |
| HWM | High Water Mark |
| LAT | Lowest Astronomical Tide |
| LINZ | Land Information New Zealand |
| LWM | Low Water Mark |
| MHW | Mean High Water |
| nm | nautical mile |
| NNTT | National Native Title Tribunal |
| NOAA | National Oceanic and Atmospheric Administration |
| NOO | National Oceans Office |
| OCS | Offshore Constitutional Settlement |
| OPIS | Ocean Planning Information System |
| PSMA | Public Sector Mapping Agency |

| | |
|---|---|
| RAMSAR | Wetlands of International Importance |
| SDI | Spatial Data Infrastructure |
| SFR | Statutory Fishing Rights |
| TSB | Territorial Sea Baseline |
| UN | United Nations |
| UNCLOS | United Nations Convention on the Law of the Sea |
| VGIS | Victorian Geospatial Information Strategy |
| VSDD | Victorian Spatial Data Directory |
| VSIS | Victorian Spatial Information Strategy |

# 1.0 INTRODUCTION

## 1.1 BACKGROUND

Australia lays claim to one of the largest maritime jurisdictions in the world, covering an area 1.5 times greater than the country's land mass and extending up to 350 nautical miles from the coastline. Given the size and diversity of this area, there is an economic, social and environmental need to effectively manage it. Current policy and institutional frameworks for the governing of this ocean territory are complex, with government legislation and international conventions such as the United Nations Convention on the Law of the Sea (UNCLOS) needing to be considered.

Underpinning this legislative framework is the complex relationship and interaction between overlapping, and sometimes competing rights, restrictions and responsibilities of various stakeholders, both in the marine environment and at the land-sea interface. This is made more complicated by a deficiency in the availability of reliable and accurate spatial data for the marine environment and a lack of coordination in the management of Australia's marine resources.

On the other hand, the current system in place to manage the various freehold and state rights, restrictions and responsibilities on land is the cadastre, described by the International Federation of Surveyors (FIG) as:

> "a parcel based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities), which usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements"
>
> (FIG 1995).

Australia already has a well developed terrestrial cadastre based on the Torrens land registration system, which has evolved over the past 150 years (Dalrymple et al., 2003). The advent of the Australian Spatial Data Infrastructure (ASDI) as a tool to help coordinate access to spatial data across the country has also strengthened the management of rights, restrictions and responsibilities on land, incorporating the cadastre as one of eight fundamental datasets. The ASDI has been established to ensure a uniform approach for maximum integration and security of data, effective resource use and the development of a comprehensive land information system. According to Australia's peak spatial information body, the Australian and New Zealand Land Information Council (ANZLIC), the nation's Spatial Data Infrastructure (SDI) should form the basis for spatial data management across the country, both in the terrestrial and marine environments.

A collaborative research project between the Department of Geomatics, Geoscience Australia, the Queensland Department of Natural Resources and Mines, and Land Victoria aims to define the issues relevant to the development of a coordinated spatial management system, or "marine cadastre" for Australia's ocean territory. The project is funded by the Australian Research Council (ARC).

There are currently two schools of thought on the development of such a marine cadastre for Australia. The first of these is that it should be designed independently from the current Australian terrestrial management system, in order to overcome inherent problems in that system. This could however, alienate the land from the marine environment creating further management problems, especially in the coastal zone. This thesis will be looking at the second approach, which is to extend, use and learn from the current land based cadastral system and ASDI.

There are obvious benefits to utilising what has been learnt from the development of the terrestrial cadastre over the past 200 years. This is especially so considering the majority of marine activity occurs at the land/marine interface or coastal zone, particularly from high water mark (HWM) out to a limit of 12 nautical miles (nm). There are also planning and environmental issues which take into account land and marine areas, increasing the need for the integration of both spatial management systems. It is clear from the FIG statement on the cadastre, that there are some

aspects of the terrestrial cadastre that could be extended to facilitate the management of marine resources. The development of the ASDI framework in the marine environment may also enable more efficient and effective access to spatial data. There are also inconsistencies however between the land and marine environments that need to be resolved in the development of a marine cadastre.

## 1.2 PROBLEM STATEMENT

Whilst there are methods in place in Australia to manage the wide range of spatial rights, restrictions and responsibilities in the marine environment, they are currently 'task-specific' and lacking in coordination.

## 1.3 AIM

There are two primary aims of this thesis. The first is to define the concept of a marine cadastre through an investigation into institutional and legal aspects of Australia's current marine management regimes. The second aim is to analyse the applicability of current land based spatial management arrangements, including the Australian Spatial Data Infrastructure and cadastre, to the administration of current spatial rights, restrictions and responsibilities in the marine environment.

## 1.4 RESEARCH OBJECTIVES

In order to achieve the stated aim, the objectives of this research include:

- An examination of Australia's historical involvement in the management of its marine environment. This includes both national and international tools of governance and also an identification of the influential factors driving the need for the development of a marine cadastre for Australia.
- Identify and critically evaluate current research into the development of a marine cadastre.
- A review of existing institutional and legal aspects of Australia's marine spatial management systems, in order to help define and delineate the rights, restrictions and responsibilities of various industries and activities impacting on the creation of a marine cadastre.

- Undertake an investigation into current stakeholders and institutions in the marine environment in order to identify issues and problems that need to be considered in the creation of a marine cadastre. This includes consulting with industry and special interest groups, aiding in the development of a marine cadastre questionnaire and involvement in marine cadastre workshops.
- Define the concept of a marine cadastre in an Australian context, and develop a diagram to aid in the visualisation of that concept.
- Review the legal, administrative and technical theories and principles of the land cadastre, and their applicability to the management of rights, restrictions and responsibilities at sea.
- Evaluate the role of the Australian Spatial Data Infrastructure in the management of the marine environment.
- Participate in a marine cadastre pilot based in two geographically separate locations off the coasts of Queensland and Victoria. This will facilitate the evaluation and refinement of the theoretical reviews conducted.

## 1.5 PILOT STUDY

The implementation of a pilot study as part of the overall project will enable theoretical ideas and concepts to be tested, evaluated and refined. In the context of this thesis, the major objectives of the pilot study are:

- To investigate and understand legal issues:
  - by fully documenting all rights, restrictions and responsibilities in each area of delimitation
  - by understanding the application of legislation and other instruments of governance
- To investigate and understand user issues:
  - by evaluating the limitations and shortcomings of existing data
  - by analysing aspects of policy
  - by demonstrating the complexity of the inter-relationships between various sources of marine spatial information

- To illustrate the concept, benefits and applications of a marine cadastre
- To identify key issues for the development of a national marine cadastre
- To provide a platform for the demonstration of the benefits of a marine cadastre
- To highlight any shortcomings of the developed model and identify a pathway for future research and development leading to a comprehensive marine cadastre for Australia

In order to gain as much stakeholder and data diversity as possible, the location of the pilot study is divided into two areas. A section of the Queensland coast between Townsville and Cairns (Figure 1.1) provides one pilot study area, and was chosen due to the high level of marine activity, much of which is associated with the Great Barrier Reef Marine Park.

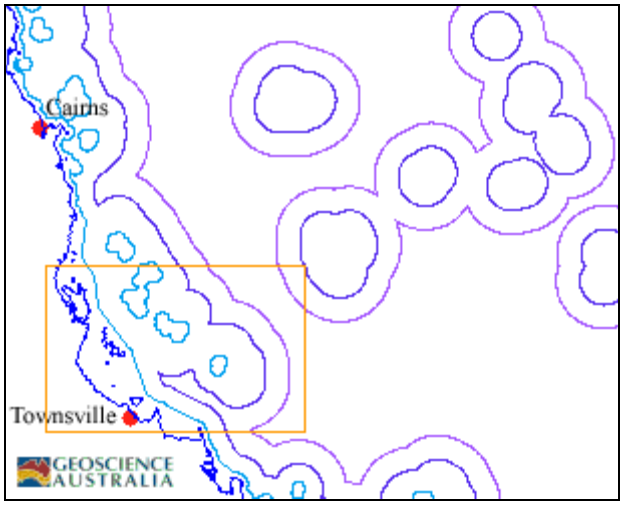



Figure 1.1 – Queensland pilot project area

The second area is centred on the Victorian coast, and runs from the west side of Port Phillip Bay through to the borders of New South Wales and Tasmania (Figure 1.2). This area was chosen primarily due to high levels of fishing, shipping and oil and gas exploration and extraction.

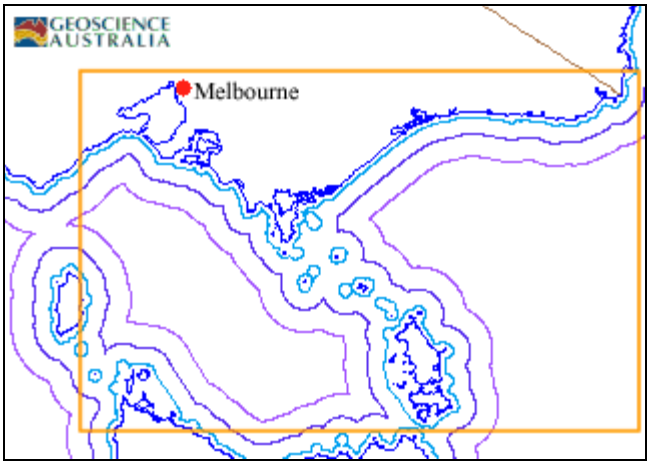



Figure 1.2 – Victorian pilot project area.

## 1.6 RESEARCH SCOPE

An understanding of current marine management systems within Australia, including the investigation of stakeholders, institutions and laws are core to this research. Due to time constraints however, not every state contribution to the marine cadastre could be studied in detail, and hence research has been focussed primarily on the pilot area centred on the coast of Victoria.

## 1.7 OUTLINE OF THESIS

This thesis is comprised of three broad phases. The first phase, covered in chapters 2, 3 & 4, is a detailed analysis of the problem that is being addressed. Chapter 2 discusses the legal regulation of the marine environment, concentrating on international and national tools of governance. It also points out the major sustainable development issues driving the development of a marine cadastre. Chapter 3 examines current marine management initiatives both internationally and nationally. This includes the development of marine cadastre initiatives in the USA, Canada and New Zealand, culminating in a review of the major activities and stakeholders within Australia's marine environment. Chapter 4 follows on with an investigation into the overarching legal, technical, institutional and spatial issues facing the development of a marine cadastre.

The second phase, covered in chapter 5, utilises research findings from chapters 2,3 & 4 to develop a tangible concept of a marine cadastre, pointing out the need to define,

visualise and realise boundaries in the marine environment. A diagram is also developed to aid in the visualization of this marine cadastre definition.

Phase three incorporates chapters 6 and 7 and identifies key terrestrial cadastral and SDI principles that may aid in the implementation of a marine cadastre. These principles are discussed within the context of both the marine and terrestrial environments.

The final chapter discusses the research findings, drawing conclusions to form a national marine cadastre perspective as well as identifying areas of future research. Figure 1.3 demonstrates the flow of the thesis.

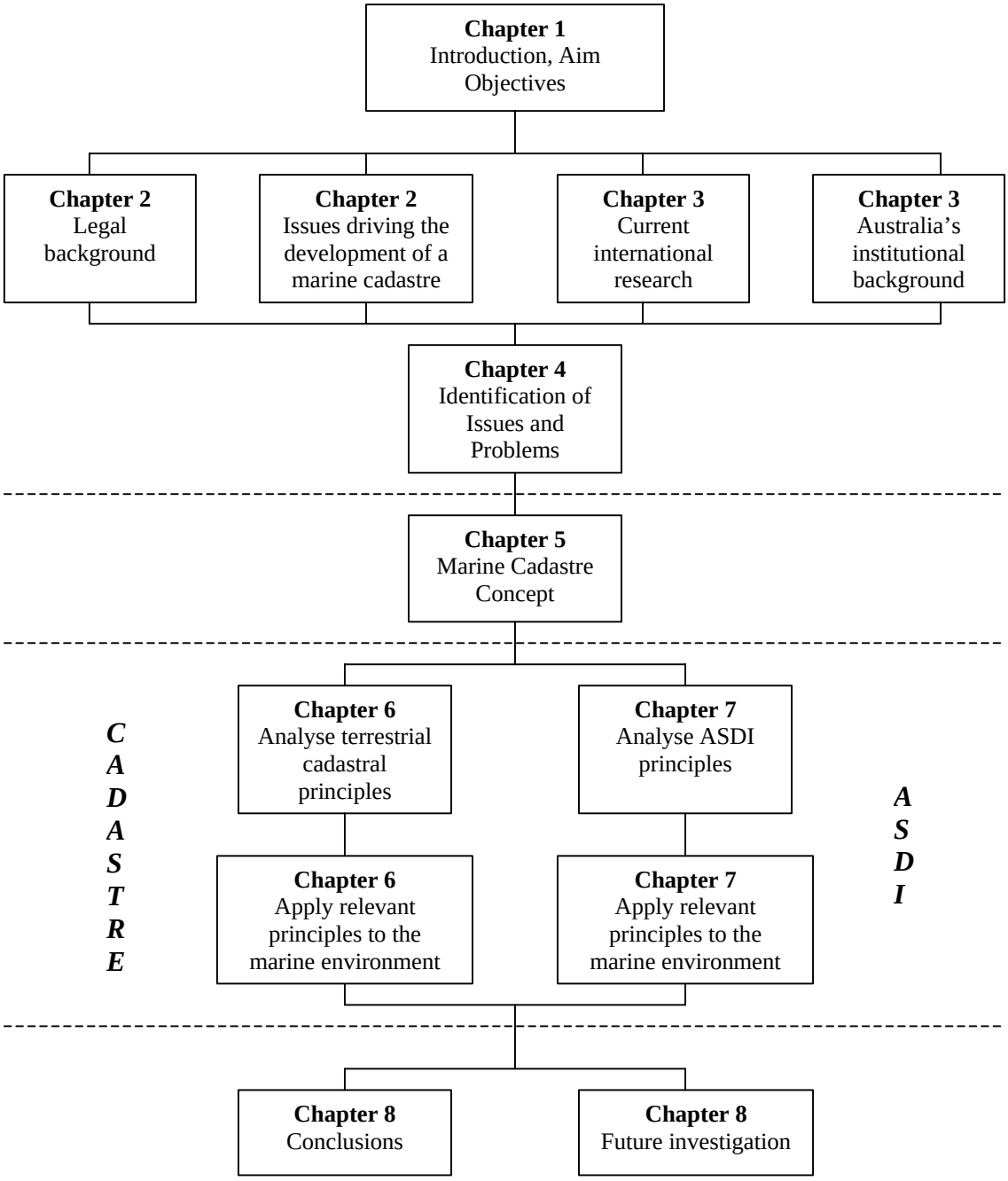



Figure 1.3 - Thesis Flow Chart

# 2.0 AUSTRALIA'S OFFSHORE REGIME

## 2.1 INTRODUCTION

In order to fully understand the challenges faced in developing a marine cadastre, it is important to examine Australia's historical involvement in the management of its marine environment. This includes not only the dynamic nature of both national and international tools of ocean governance, but also problems that need to be addressed through the development of a marine cadastre. Such issues are highlighted within section 2.2 of this chapter. The importance of this development to stakeholders in both the terrestrial and marine environments is also discussed in section 2.3, through the identification of influential factors driving the development of a marine cadastre.

## 2.2 HISTORICAL PERSPECTIVE

The world's oceans cover almost 75 percent of the earth's surface, regulating weather patterns and providing life to thousands of varieties of aquatic plants and animals, yet the oceans are the least regulated part of the earth. Humans relationship to land, along with the various rights and obligations which go along with it, have been well documented, but the same cannot be said for our relationship to the sea. According to Ting and Williamson (1999) the rights, restrictions and responsibilities that society creates in relation to land reflect the diverse meaning and significance that land has held for humankind. This can also be said for the marine environment, for which the management systems currently in place have evolved over the past 100 years, governed by a complex web of legislative arrangements.

### 2.2.1 Australian Domestic Law

Australia's interest in the marine environment stems from the Federal Council of Australia, which established a basis for fisheries legislation in 1885. This federal

power “over fisheries in Australian waters beyond territorial limits” was adopted in 1898 as the basis for section 51(X) of the Australian constitution, and is still the legal basis for legislation in the marine environment (Rothwell and Haward, 1996). Australia did not however take an active role in administering the marine environment, as in 1901, both English and Australian courts developed a doctrine of extraterritorial incompetence. Doubts were raised as to whether the Australian government had powers to legislate with respect to activities that occurred beyond its territorial boundaries, which were fixed at low-water mark. It was not until 1931 that Australia had “full powers to make laws having extraterritorial operation”, with the passing of the Statute of Westminster, enabling Australia to take a more active role in managing its offshore areas (Rothwell and Haward, 1996).

Although the Statute of Westminster left no doubt as to Australia’s ability to regulate offshore, there was confusion between the state and Commonwealth governments. In general, the states administered the offshore area out to a limit of 3nm (coastal waters), with the Commonwealth regulating from 3nm out to the continental shelf. In 1967, there was successful drilling for offshore oil in the Bass Strait, which was the catalyst for the 1967 Petroleum Agreement between the Commonwealth and states. This agreement involved the establishment of identical Commonwealth and state legislation, or ‘mirror legislation’, to govern exploration and production operations in the maritime areas adjacent to the states (Evans, 1996). This meant that there was no conflict between the states and the Commonwealth, as legislation could only be amended with the consent of both parties.

***Seas and Submerged Lands Act 1973 (Cth)***

In 1973 however, the Commonwealth Labor government introduced the *Seas and Submerged Lands Act 1973 (Cth)*, which declared and enacted that the Commonwealth had sovereignty over the territorial sea and continental shelf, thus ending the states rights to govern out to the 3nm limit. The states continued to have control of internal waters (waters within the baseline used to define the limit of the territorial sea (12nm), mostly comprising bays, estuaries and ports) but this had the potential to create administrative difficulties with sovereignty and jurisdiction of Australia’s offshore and internal waters being divided (Rothwell & Kaye, 2001). The 1973 Act was challenged in the High Court by all states, but was upheld in a decision

handed down in 1975, after the Labor government had been defeated at the elections. This forced the newly elected Liberal government, who had heavily criticized Labor over the implementation of its *Seas and Submerged Lands Act 1973 (Cth)*, to negotiate a new agreement with the state and Northern Territory governments (Rothwell and Haward, 1996). Agreement between the parties was reached in 1979, in what was termed the Offshore Constitutional Settlement (OCS). It was agreed that the states and Northern Territories' offshore jurisdiction would return to pre *Seas and Submerged Lands Act 1973 (Cth)*, ie. out to the 3nm limit.

***Offshore Constitutional Settlement***

In 1979 the state, Northern Territory and Commonwealth governments agreed to terms accommodating the sharing of both the resources and responsibility for administering the offshore area. This agreement was termed the Offshore Constitutional Settlement. Each state and the Northern Territory passed legislation requesting the Commonwealth to enact laws in agreed terms, with the Commonwealth enacting fourteen separate pieces of legislation. According to Rothwell and Kaye (2001), two pieces of legislation are key to understanding the basis of the OCS. The first is the *Coastal Waters (State Powers) Act 1980 (Cth)*, which extends the legislative jurisdiction of the states to two offshore areas. It extends legislative power to a state to make laws in respect of all matters for the "coastal waters of the state", and empowers a state to legislate in respect of areas beyond the coastal waters of the state, defined as the "adjacent area". The adjacent area for each state is defined in the *Petroleum (Submerged Lands) Act 1967 (Cth)* by a series of geographical co-ordinates. The second Act of importance is the *Coastal Waters (State Title) Act 1980 (Cth)* which vests in each state the same title to its adjacent "coastal waters" and sub-adjacent seabed as if those areas formed part of the land territory of the state. The *Coastal Waters (Northern Territory Powers) Act 1980 (Cth)* makes identical provision for the Northern Territory as the State Powers Act makes for the states.

There are also joint arrangements in place between the states, Northern Territory and the Commonwealth government, which in some cases allow the states legislative jurisdiction beyond their coastal waters. An example of this is the management of offshore mining, with the relevant Commonwealth Acts conferring day to day

administrative responsibilities to the states (Rothwell & Kaye, 2001). These types of management arrangements are discussed further in chapter 3.

### 2.2.2 International Law

Although domestic law has played an important role in regulating the management of the marine environment, international law has been the primary basis for the implementation of Australia's maritime policies and boundaries over the past century. According to Mitchell et al. (2001), although maritime law dates back to Roman times it has "traditionally been ill-defined and poorly documented". Historically, the world's oceans operated under the principle of freedom of the seas, which provides unrestricted access for activities such as navigation and fishing. The only restrictions to such freedom was a strip of ocean adjacent to a nation's coastline, under which sovereign jurisdiction was granted (defined today as the "territorial sea"). The width of the strip was undefined, but generally held to be the range of a shore-based cannon shot (Mitchell et al., 2001). Since then, the rapid improvement in technology and increasing interest in exploring the marine environment has caused the need for more modern laws governing the world's oceans.

UNCLOS establishes the jurisdictional regimes under which a coastal State can claim, manage and utilize its marine territories. As the law of the sea has evolved, so has a sovereign State's right to jurisdiction over marine areas. The four Geneva Conventions on the Law of the Sea, beginning in 1958, were the first successful attempts to codify relevant international maritime law. They recognized a coastal State's right to a territorial sea and contiguous zone, although the outer limits of these were not defined. The conventions also recognized coastal States' rights over a continental shelf, with its outer limits determined by the depth of the water column and exploitability (Rothwell and Haward, 1996). However only a minority of States were bound by the Conventions as a whole, with 56 parties to the High Seas Convention, 45 to the Convention on the Territorial Sea and Contiguous Zone, 53 to the Convention on the Continental Shelf and 35 to the Convention of the Conservation of Fisheries (O'Connell, 1982).

Issues and disputes over fishing rights and environmental degradation however became more common place and were attempted to be resolved through unilateral acts and regional agreements, rather than through an international forum. There was also a feeling that more developed nations would be able to exploit deep sea bed resources more easily then less developed ones. A proposal to consider the seabed beyond a nations jurisdiction as "the common heritage of mankind" (Friedheim, 1993) was put forward, however the developed countries were reluctant to agree to such a proposal (Mitchell et al., 2001). This forced the United Nations (UN) to play a greater role in maritime jurisdictional issues, with the implementation of the 3rd United Nations Convention on the Law of the Sea. This convention became "the largest, most complex and most difficult global negotiations ever hosted by the United Nations" (Miles, 1998).

The 3rd United Nations Convention on the Law of the Sea (UNCLOS), held from 1974-1982, negotiated the 320 articles which make up the convention, legally recognizing a number of maritime zones for the first time. As the convention was initiated by questions of access to mineral resources in the deep sea bed, it also brought to the fore the subject of the limits of the continental shelf and territorial sea. The convention was divided into three committees, "the first concerned with deep sea mining, the second with the subject of jurisdiction, and the third with a miscellany, including pollution and scientific research" (O'Connell 1982). In 1982, the convention was put to a vote, with 130 countries voting in favour, four against and 17 abstaining. The convention was then open for signatures for a period of two years, in which time 158 signatures were officially recorded. These signatures then had to be ratified, and 12 months after the deposit of the sixtieth instrument of ratification on the 16th of November 1993, the Convention entered into force. Australia ratified the Convention on the 5th of October 1994 (Mitchell et al. 2001).

One of the major achievements of the convention was the recognition of a number of maritime zones. The territorial sea (12nm limit), contiguous zone (24nm limit), Exclusive Economic Zone (EEZ) (12nm – 200nm limit) and continental shelf form the basis of a coastal State's maritime boundaries. UNCLOS also recognized the deep seabed, archipelagic waters and high seas, which are classified as international waters (O'Connell, 1984).

***Australia's Maritime Boundaries***

Australia's declaration of maritime zones as defined in UNCLOS and subsequent adoption of jurisdictional responsibilities are summarised in Figure 2.1 and Table 2.1 below. It must be noted that with the exception of the coastal waters, the definitions apply internationally (ie. UNCLOS does not define or recognize the existence of coastal waters – this is a matter for Australian legislation).

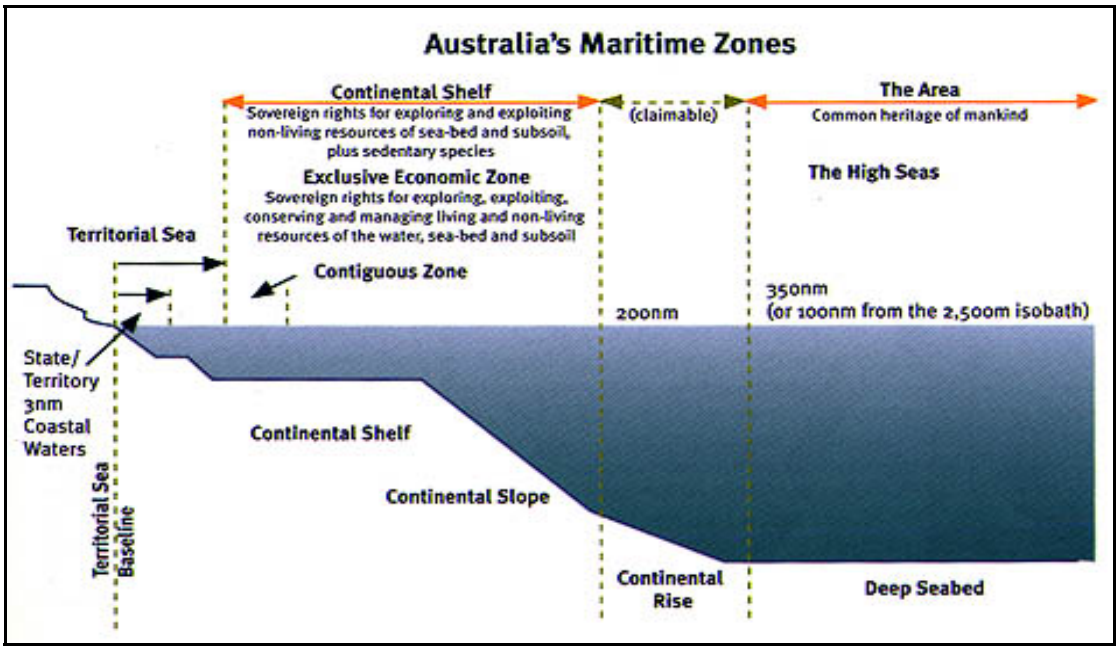


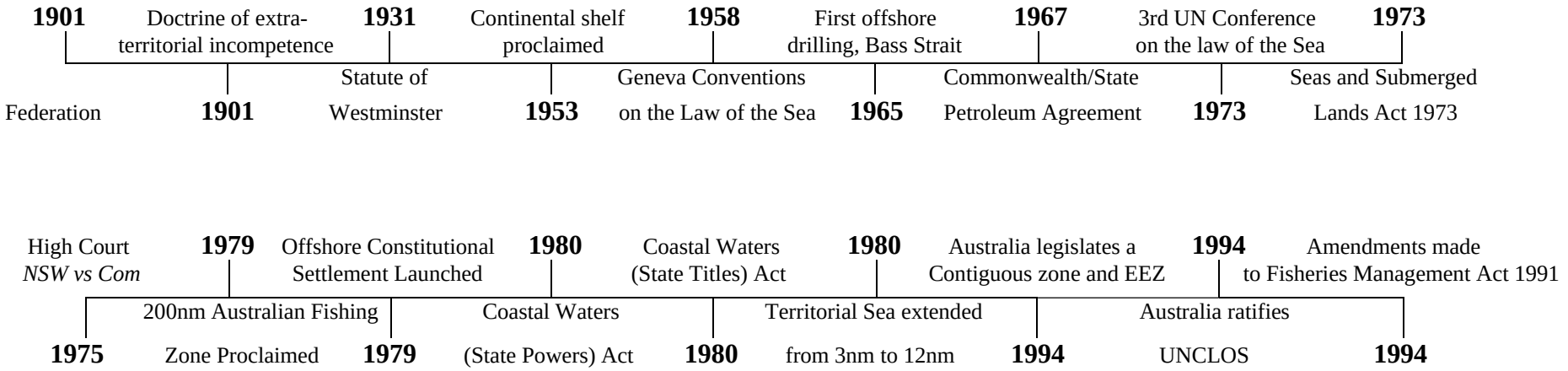

Figure 2.1 - Maritime zones (Source: CGA, 1998)

| Zone | Definition | Coastal State Jurisdiction |
|---|---|---|
| **Territorial Sea Baseline (TSB)** | The line from which the seaward limits of Australia's maritime zones are measured, theoretically the line of Lowest Astronomical Tide (LAT). | |
| **Coastal Waters** | Waters from the TSB out to a limit of three nautical miles (defined by the State) | Jurisdiction rests with the states and Northern Territory. Not defined under UNCLOS. |
| **Territorial Sea** | Band of ocean adjacent to the coastline, the outer limit of which does not exceed 12 nautical miles from the TSB. | Australia has full sovereign rights within this area, with the exception that it must allow foreign ships the right of innocent passage. |
| **Contiguous Zone** | Band of ocean adjacent to the territorial sea (12nm), with the outer limit of the contiguous zone not exceeding 24 nautical miles from the TSB. | Australia does not have sovereign jurisdiction over this area, although is does have the right to enforce its customs, fiscal, immigration and sanitary laws and regulations. |
| **Exclusive Economic Zone (EEZ)** | Area stretching from the limit of the territorial sea (12nm) out to and not exceeding 200 nautical miles from the TSB. | Australia has the right to explore and exploit the living and non-living resources of the water column, seabed and subsoil. |
| **Extended Continental Shelf** | A nation may gain rights to an extended continental shelf beyond the 200 nautical mile limit, up to 350 nautical miles from the TSB, subject to the provisions of Article 76 of UNCLOS. | Australia would gain seabed and subsoil rights to any areas of an extended continental shelf granted under UNCLOS. |
| **High Seas** | Area of ocean that falls beyond the Exclusive Economic Zone, with the exception of areas granted to nations under Article 76 of UNCLOS. | All nations have equal rights and, subject to certain provisions, enjoy freedom of navigation, overflight, fishing and scientific research. |
| **The Area** | The area is the seabed, ocean floor and subsoil thereof beyond the limits of national jurisdiction (United Nations, 1997). | All nations have equal rights to the resources of the Area. |

Table 2.1 – Australia's Coastal Zones, as defined by UNCLOS

Australia was a major contributor to UNCLOS and was generally satisfied with the outcomes of the conference, but has since been slow in implementing its maritime claims (Burmester, 1995). In fact, it was not until 1990 that Australia extended its territorial sea from 3nm to 12nm. This did not affect the division of responsibility between the Commonwealth and states/Northern Territory however, as it was expressly agreed under the OCS that the coastal waters limit of 3nm would continue to apply, even if the territorial sea was extended (Burmester, 1995). In 1991, Australia announced its decision to declare a contiguous zone and EEZ, but this was not legislated until the implementation of the *Maritime Legislation Amendment Act 1994 (Cth)*, which amended the *Seas and Submerged Lands Act 1973 (Cth)* (Rothwell & Kaye, 2001). Figure 2.2 shows the implementation of Australia's offshore regime over the past century.

# Figure 2.2 Implementation of Australia's Maritime Boundaries



## 2.3 INFLUENTIAL FACTORS DRIVING THE DEVELOPMENT OF A MARINE CADASTRE

"There is an increasing realization that the interests of a nation do not stop at the land-sea interface" (Collier et al., 2001). The economic, environmental and social impacts that this realization is having on the marine environment are just beginning to be felt, with competition for the vast array of natural resources in the marine environment increasing. Added to this is the implementation of UNCLOS. The following section outlines these impacts, enabling an understanding of what is driving the development of a marine cadastre in Australia.

### 2.3.1 UNCLOS

Under Article 76 of UNCLOS, "the coastal State exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources" (UN, 1997). These rights are exclusive, as no one may undertake activities without the express consent of the coastal State. If an extension of the outer limit of the continental shelf is to be granted however, the coastal State must demonstrate responsibility in defining the new area. According to Robertson et al., (1999) it is also important for the coastal State to

> …demonstrate a capability and an intent to administer these new areas in the terms of sustainable development obligations, [with] responsibilities aris[ing] from the national constitutional and legal framework and from existing international conventions.

The continental shelf of a coastal State, as listed under Part VI, Article 76 of UNCLOS, is currently set at "a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured" (UN, 1997). If however the continental shelf, comprising the submerged prolongation of the landmass of the coastal State, exists beyond the 200nm limit, coastal States can apply to the UN for an extension, where the outer limit of the continental shelf does not exceed 350nm.

Paragraph 8, Article 76, Part VI of UNCLOS describes the method by which a coastal State can apply for such an extension:

> Information on the limits of the continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured shall be submitted by the coastal State to the Commission on the Limits of the Continental Shelf set up under Annex II on the basis of equitable geographical representation. The Commission shall make recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf. The limits of the shelf established by a coastal State on the basis of these recommendations shall be final and binding (UN, 1997).

Australia is currently preparing a claim to the UN for an extension to its continental shelf, an area of approximately 4.6 million square kilometers, with the exact location of its maritime boundaries being crucial to the success of the claim (Kaye, 1995). The need to visualize such boundaries, along with the ability to effectively manage environmental, social and economic factors arising from such a claim are also important issues which a marine cadastre may aid in addressing.

### 2.3.2 Sustainable Development

***Environmental Movement***

One of the main drivers in implementing a marine cadastre comes from the environmental movement and the effect it has had on politics and society. Issues of pollution, depleted marine resources and increased threat by man to the health of the marine environment are forcing governments to implement sustainable management measures. According to the Australian Fisheries Management Authority (AFMA) (2000), 70% of all marine pollution comes from land based activities, and many of Australia's fishing zones have been over-fished, leaving stock numbers dangerously low. Conservation groups all over Australia are closely scrutinizing these practices, and it is these groups which are managing to bring about change in governments, due to public pressure.

> Indications [are] that electorally established parties will come to rely heavily on the distribution of preferences from minor parties like the Democrats and various Greens candidates as well as the endorsement given by some environmentalists (Papadakis, 1993).

This has already been seen at the last federal and state elections, with the amount of votes gained by the Greens party tripling in some areas, due mainly to conservation efforts associated with land based practices. This is starting to filter through to issues concerning the conservation of Australia's marine environment.

Another environmental impact is the current crisis in international fisheries, with "nine of the world's 17 fisheries in serious decline with four depleted commercially", according to the Food and Agricultural Organisation (FAO) (PANOS, 1995). Australian fisheries have also been over-fished, with declining catch numbers effecting not only the environment, but also the commercial viability of the fishing industry.

There is also international pressure to implement legal and institutional mechanisms to support sustainable development, with Australia participating in programs such as the United Nations World Heritage Convention and Agenda 21 and being party to a number of global and regional conventions.

***Agenda 21***

Agenda 21 is the UN response to the world summit on sustainable development, held in Rio De Janeiro in 1992. It aims to provide governments with a basis from which sustainable development initiatives may be developed and implemented, and is the first document recognizing the role of civil society in an attempt to address social, environmental and development efforts on an international stage. In terms of the marine environment, chapter 17 of the Agenda, sets out guidelines for the

> protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources (UN, 1992).

For this to be achieved, new approaches to marine and coastal area management and development are required, especially at the national level. The Agenda sets out seven program areas for the achievement of its aims, of which three could be addressed through the development of a marine cadastre, including:

1. Integrated management and sustainable development of coastal areas, including exclusive economic zones;
2. Marine environmental protection;

3. Sustainable use and conservation of marine living resources under national jurisdiction.

***Australia's Oceans Policy***

Over the past few decades, knowledge of the physical and biological components of marine ecosystems has improved rapidly. In 1990, a Commonwealth discussion paper defined ecologically sustainable development as:

> Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future can be increased (CGA, 1990).

The international community has found that the constant commercial use of the marine area has given rise to large-scale resource and environmental problems. Australia is relatively well placed compared to other countries, given that its marine industries are relatively new, and according to the National Oceans Office (NOO),

> we have an opportunity to develop ways of managing our ecosystems to detect signals of undesirable change and modify our practices in time to avoid long-term damage (NOO, 2002c).

In order to develop such management systems, the Commonwealth Government, in conjunction with the NOO, has developed a National Oceans Policy which "sets in place the framework for integrated and ecosystem based planning and management" (CGA, 1998). Regional marine plans will be developed, which will assess the pressures, resources and planning and management options for each area, and develop provisions for long term security to all ocean users. The development of a marine cadastre would aid in achieving the goals of the Oceans Policy, by providing the fundamental spatial boundary layer in any regional marine plan.

## 2.3.3 Economic

UNCLOS has given coastal States such as Australia the ability to increase the area of ocean territory under their control and with this comes increased areas to exploit and explore. Oil and natural gas explorations are just one of the major sources of revenue for both government and private industry, with competition increasing for control over marine areas that are rich in such natural resources. This makes the effective management and delimitation of Australia's coastal area increasingly important.

An example of the consequences of such an issue comes from the U.S. Supreme Court case of *United States of America v. State of Alaska (1975)*. According to Treml et al., (1999) at issue was whether a small formation off the coast of Alaska qualified as an island, with baselines from which a 3nm mile Submerged Lands Act Grant would belong to the state. Oil and gas reserves worth $1.6 billion were found nearby, and a 17-year court case followed, as both the state of Alaska and the US Federal Government fought over who had the rights to the oil and gas reserves. To avoid such issues occurring within Australia, spatial knowledge of legally defined boundaries needs to be available to both government and private users of the marine environment.

### 2.3.4 Native Title Rights

In recent times there has been growing pressure to recognise the rights of indigenous people throughout the world. Conventions such as the *International Covenant on Civil and Political Rights* (entered into force in 1976) and the World Council of Indigenous Peoples in 1975 were some of the first key initiatives, along with the Working Group on Indigenous Peoples, which in 1991 drafted a Universal Declaration on the Rights of Indigenous Peoples to be tabled before the UN General Assembly. An important aspect of this draft, as described by Robinson and Mercer (2000), is the opening of Part III:

> Indigenous peoples have the right to maintain their distinctive and profound relationship with their lands, territories and resources, which include the total environment of the land, waters, air and sea, which they have traditionally occupied or otherwise used.

International initiatives and court rulings have also given increased focus to the indigenous peoples movement, with "global and domestic attention…focusing increasingly on the recognition of indigenous people's rights and interests in coastal and marine areas" (Robinson and Mercer, 2000). This increased pressure has forced Governments, including the Australian federal government, to change the way in which land and ocean territories are governed.

***Mabo v. the State of Queensland***

Sovereignty over Australia was claimed by the British between 1788 and 1879, giving them *Radical Title*, or ownership and sovereign power over all land. This however was clearly not the case, with Australia being in the possession of its indigenous people, but property and rights were still taken away by the Government in Australia and it was not until the High Court's 1992 decision in *Mabo vs the State of Queensland (1992, 175 CLR 1)*, that it was judged to have been done "wrongfully, without compensation and contrary to the spirit of British property law" (Reynolds, 2000).

The Mabo case was a significant source of influence on society's approach to land management, and the rights, restrictions and responsibilities that go along with it. The Mabo decision overturned the traditional legal norm that described Australia as *terra nullius*, or vacant land, at the time of settlement by the English in 1788. It forced the government at the time to address indigenous people's rights to land in legislation, with the passing of the *Native Title Act 1993 (Cth)* by the then Labor government.

> The Act provided legal and administrative mechanisms for the recognition and protection of native title wherever it could be demonstrated to still exist in Australia in the 1990s (Robinson and Mercer, 2000).

The High Court's decision while giving indigenous people access to land also created an air of uncertainty.

> Mabo has created an area of great uncertainty and complexity especially in relation to land held under "other forms of title" such as leases, licenses and mining tenements (Reynolds, 2000).

From the outset of the Mabo case, the Meriam people argued that their homeland territories were not just confined to land, but to the "surrounding seas, sea-beds, fringing reefs and adjacent islets" as well. They agreed however to concentrate the legal fight around the land issues only, as they recognised that western law is much more comfortable with the concept of private rights in land, rather than at sea (Robinson and Mercer, 2000).

This uncertainty in relation to land held under “other forms of title” spread to areas such as fishing rights and rights to the sea coast with the Deputy Premier of Queensland going as far as saying that:

> Mabo may well affect the whole future of the fishing industry because there may be an un-extinguished right of Indigenous People to the resources of the sea (cited in Robinson and Mercer, 2000).

An example of a case involving traditional fishing rights, which went as high as the Supreme Court, occurred in Canada. A Native American man was charged with illegal fishing in a river in Vancouver, British Columbia. He informed the court that he had traditional rights to fish there, but the Crown argued that since the fishing industry had been regulated for over 100 years, the right of native people to fish had been extinguished. The Court however found that the Crown had “confused regulation with extinguishment” and that at no point had the crown said "In legislation we hereby extinguish the traditional rights to fish". Therefore, the man had a continuing right to fish, as that right had never been legally extinguished (Reynolds, 2000).

### *Croker Island Case*

The first native title claim over the sea and sea-bed in Australia was the Croker Seas case, lodged in 1994 and covering an area of some 2000km$^2$ around Croker Island, Northern Territory (Figure 2.3).

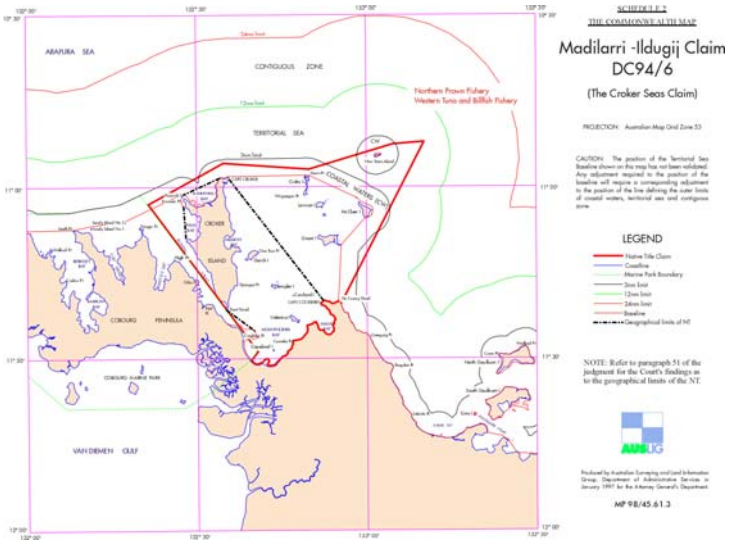



Figure 2.3 - Map of Claim Area (Source: Bowen, 2002)

According to indigenous people, “the land and the sea country are one, [with] sacred sites and dreaming tracks in and under the sea, just as there are on the land” (Yarmirr, 1999). This view supported their claim for exclusive possession of the area. According to Robinson and Mercer (2000), exclusive possession of offshore waters is not unknown in English law. Justice Howard Olney of the Federal Court however found that only non-exclusive native title existed in the offshore region of the Croker island. Both sides appealed the decision to the High Court (the Croker Island people on the basis of a claim for exclusive possession and the federal government on the basis that no form of native title existed), but both cases were dismissed on 11th October, 2001.

Although this ruling enabled indigenous people access to the sea, the decision was limiting, as native title rights were characterized as ‘non-exclusive’ and ‘non-commercial’ and included:

- rights to travel through or within the determined area,
- rights to fish, hunt and gather for the purpose of satisfying their personal, domestic or non-commercial communal needs, including the purpose of observing traditional, cultural, ritual and spiritual laws and customs,
- rights to visit and protect places which are of cultural and spiritual importance,
- rights to safeguard their cultural and spiritual knowledge.

(Bowen, 2002)

This means that non-aboriginal people and commercial fisherman can enter native title areas without asking permission and without negotiating compensation about fishing, pearling or other developments (Robertson, 2002). The existence of ‘non-exclusive’ rights makes it difficult to effectively manage these areas, as indigenous rights must be balanced with other rights such as fishing and navigation.

Amendments to the Native Title Act in 1998 have seen a watering down of indigenous native title rights, although claims to offshore areas are still allowed. Activities such as hunting, fishing and cultural activities all prevail over government regulations in the exercising of native title rights, as long as such activities are for personal, non-commercial, or domestic use. Native title rights to areas of land are only now being effectively introduced into Australia’s terrestrial cadastral system.

The ‘Croker Island’ case has introduced the need to include native title rights to the sea and sea-bed as well, increasing the complexity of the marine environment and the implementation of a marine cadastre to manage such rights.

## 2.4 CONCLUSIONS

Australia’s offshore legal regime has evolved over the past 100 years, dealing with domestic issues as they arise, and mirroring the development of international law. The solution to these issues has not always been quick and easy, with complex legislation, as seen in the creation of the Offshore Constitutional Settlement, being required to settle jurisdictional problems between the Commonwealth and the states and Northern Territory in the marine area. Australia has also been slow in declaring maritime boundaries in line with UNCLOS.

Whilst the ability of a coastal State to claim an extension to the area of its continental shelf has mobilized the need for more accurate and up-to-date maritime information, there has also been a global recognition of the importance of issues such as sustainable development and indigenous rights to the marine environment. This has led to greater research into methods employed in the creation of marine cadastral or related systems throughout the international community. If such a system is to be created for Australia however, it is clear that current institutional and administrative frameworks for marine spatial management must also be reviewed, along with the legal tools of governance.

# 3.0 MARINE MANAGEMENT SYSTEMS

## 3.1 INTRODUCTION

The previous chapter introduced Australia's offshore legal regime, providing a guide to the changes that have occurred over the past century. It is this regime that is shaping the rights, restrictions and responsibilities of the various stakeholders in the marine environment. The current environmental, economic and social issues driving the development of a marine cadastre were also discussed. These included indigenous rights to the sea, the global environmental movement including aspects of Agenda 21, and the degradation of the marine environment due to pollution and over-fishing.

This chapter aims to identify and critically analyse current international research into methods employed in the creation of marine cadastral or related systems around the world, such as those being developed in the USA, Canada and New Zealand. There is also a need to critically evaluate the current methods used by government and private sector agencies in managing Australia's maritime industries. Section 3.4 discusses these management methods examining the legal and institutional frameworks for each of the major industries and activities within the marine environment including fisheries, conservation, oil and gas exploration and shipping. The legal rights, restrictions and responsibilities of stakeholders within each activity are also explored.

## 3.2 INTERNATIONAL MARINE CADASTRE INITIATIVES

The development of cadastral systems for the sustainable management of marine resources is evident in a range of countries such as Canada, the United States of America and New Zealand.

### 3.2.1 United States – Ocean Planning Information System (OPIS)

In the USA, coastal states have control of the sea floor and marine resources from mean high water mark out to the state's seaward boundary, generally 3nm. Historically, a territorial sea extended out to 3nm, with this limit only changing in 1988 when the USA claimed a 12nm territorial sea (Treml et al., 1999). This did not alter the jurisdictional area of the states however, which remained at 3nm. This parallels with the state/Commonwealth jurisdictional relationship in Australia. A parallel can also be drawn between the two countries' existing ocean resource management methods, with the current US system being described as "fragmented, complex, and poorly understood" (Neely et al., 1998). In order to address this problem, the Coastal Services Center (CSC) of the National Oceanic and Atmospheric Administration (NOAA) in conjunction with various industry, government and academic collaborators have developed a prototype marine information system, or Ocean Planning Information System (OPIS).

#### *Ocean Planning Information System*

OPIS is one of the first applications which applies cadastral data toward integrated ocean planning. Developed in 1998, the system covers the states of North Carolina, South Carolina, Georgia and Florida (Figure 3.1). The main tasks of the system are to examine existing boundaries, their spatial accuracy and how these boundaries are used in offshore regulations (Fowler and Treml, 2001).

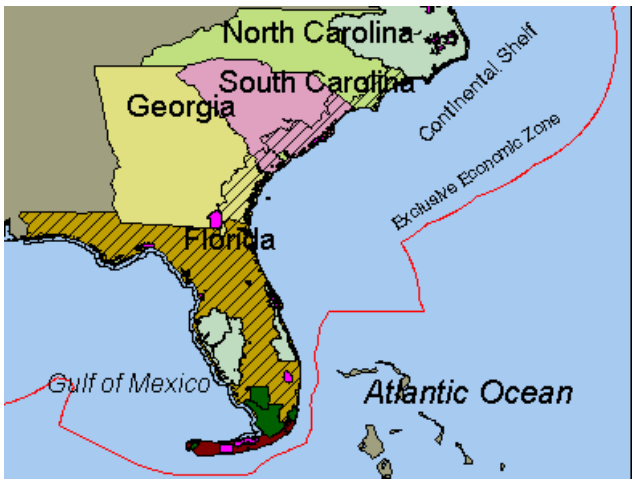



Figure 3.1 – OPIS area of operation (Source: NOAA, 1998)

The overall goal of OPIS "is to provide easy access to comprehensive ocean-related data and information that will enhance regional, integrated approaches to coastal and ocean resource management" (NOAA, 1998).

The project identified and attempted to deal with a number of issues which are of corresponding importance to the current initiatives in Australia and have been summarised by Collier et al., (2001):

- The diverse range of players that have a role in the marine environment.
- The numerous amounts of legislation and regulation relating to the marine environment.
- The need to consider the requirements of all stakeholders (ie. industry, government and community).
- The complex spatial and temporal interactions.
- The importance of accurate and well defined spatial boundaries.
- The associated problems when dealing with an ambulatory reference for boundary.

Expanding on the final issue listed above, a normal baseline comprises of a series of points along the line of intersection between water and coast but as evidenced by Treml et al., (1999)

> because coastlines vary from smooth to deeply indented and are interrupted by bays and river mouths, and because the designation of offshore boundaries may confer significant economic rights, establishment of baselines is often complicated and contentious.

This is no different to trying to interpret the baselines from which Australia's maritime boundaries are computed.

OPIS was developed as a web-based regional tool, with both federal and state policy frameworks considered. A link between the policy and the geography was created through the creation of what Treml et al., (1999) call a marine cadastre.

> The marine cadastre, similar to its land equivalent, describes the property interests or the geographic extent of the past, current and future rights and interests in the ocean. This includes the delineation of private, state, national and international rights.

The marine cadastre is described as being similar to its land-based counterpart, but with more complications, for example the inability to include physical boundary markers such as bench marks, stakes or fences which are commonly used on land.

The authors also highlight the problems caused by overlapping authorities and jurisdictions within the marine area. Examples include the Environmental Protection Agency, Minerals Management Service, Army Corps of Engineers, Fish and Wildlife Service, Coast Guard and NOAA. According to Treml et al., (1999), such overlapping authorities and jurisdictions in the management of ocean resources often results in redundant efforts, inefficiency, ineffectiveness, and lack of coordination among agencies with tangled, overlapping jurisdictions.

The development of OPIS is attempting to facilitate a shift from fragmented management of individual ocean resources to a more integrated, region-wide management approach. The systems major features include:

- an interactive mapping application;
- marine and coastal spatial data download tools;
- associated metadata; and
- legal summary pages.

All of this enables the ocean resource manager to examine the issues and data of a particular region in conjunction with the supporting text that describes the laws.

> Each applicable data layer contains an attribute link to the appropriate legislation. This allows the user to click on the map area and be presented with the legislation or agency information associated with that particular point. [Using] the flexibility of internet mapping, the user is [also] able to "drill down" to the level of detail needed to satisfy analysis (Treml et al., 1999).

OPIS draws together spatial components which can provide an important mechanism in balancing the conflicting use of resources that is occurring in the ocean. However it must be remembered that the marine environment is dynamic, and hence the system must do much more than simply describe generic legislation and boundary information at a particular snapshot in time. Fowler and Treml (2001) state that as new data becomes available, updates will be made to the digital files behind the OPIS interface. It is important to make sure that there are actual mechanisms in place to facilitate quick and effective updates and make sure that they are done as more accurate data becomes available. It is also interesting to note that OPIS is classified as a Geographic Information System (GIS) under the Coastal Services Center web page. Ultimately, if the system is to be effective, it needs to be more than just a GIS.

The system needs to become a virtual register of interests in the marine environment. This will then facilitate access to marine spatial information for use in a range of decision support systems and allow it to be integrated with other national initiatives.

### 3.2.2 Canada

The main focus of research in Canada is on identifying marine limits and boundaries, which would aid in the good governance of Canada's oceans (Nichols et al., 2000). Good governance has been described as

> knowing what resources (living and non-living) there are to govern; who holds the rights and responsibilities for their safe and orderly conservation, distribution and exploitation; and the spatial limits (boundaries) of those rights and responsibilities (Ng'ang'a et al., 2001b).

A Canadian project, initiated in 2001 within the Department of Geodesy and Geomatic Engineering at the University of New Brunswick focuses on the demarcation of ocean territory to the limit of the continental shelf, as well as the definition and maintenance of existing and future rights. The objectives of the Canadian project include:

- Identifying and evaluating boundary information requirements for good ocean governance.
- Investigating spatial data uncertainty and its impact on data integration and boundary delimitation.
- Developing and enhancing prototype visualisation tools for marine boundary delimitation.

(Ng'ang'a et al., 2001a)

To achieve these objectives, the project has established three pilot study areas, each with a slightly different scope:

A proposed marine protected area in Musquach:

- to investigate potential problems and solutions in delimiting boundaries associated with marine protected areas, fisheries limits and the coastal zone.

The New Brunswick marine administration boundary:

- to investigate problems in delimiting provincial limits and extending county boundaries in New Brunswick.

A proportion of Canada's continental shelf boundary:

- to investigate problems and alternatives in delimiting the outer limits of Canadian jurisdiction.

From the information gathered on the various boundaries described within each of the three pilot areas, a conceptual framework for the boundary information required for "good" ocean governance will be developed. According to Ng'ang'a et al., (2001a) other biological, economic and environmental information could be linked to such a framework to give the cadastre a multipurpose function. The Canadian project is also a stepping-stone for the preparation of a partial claim to the UN for an extension of Canada's continental shelf.

The problems faced by Canada in trying to manage its offshore environment are similar to those encountered by Australia. There are multiple and unclear jurisdictional boundaries, co-management arrangements for the management of fisheries and oil and gas exploration, numerous agencies managing offshore rights and boundaries, indigenous title rights, and an enormous maritime area to manage (Nichols and Monahan, 1999). There are also data integration issues and other such global problems that every coastal State faces. The ability to integrate and solve these problems and issues will be of enormous value to the development of a marine cadastral system within Australia.

### 3.2.3 New Zealand

Research in New Zealand gives weight to the argument that the terrestrial cadastral systems in place throughout the developed world can be used as building blocks to the development of marine cadastral systems. In the article 'Re-engineering New Zealand's Cadastre', Hoogsteden and Robertson (1999) discuss the strategic issues in building an Onland-Offshore cadastre for New Zealand and describe three models that New Zealand could use to implement such a cadastre.

The first of these is the 'incremental' model which implements the cadastre on a demand only basis, making it isolated and task-specific, something which is of no value to countries with large maritime jurisdictions, such as New Zealand and Australia. The 'sectoral' model implements larger sections of the cadastre for industry as the need arises, but this would still not enable multi-purpose use or wide-spread or long-term cost sharing. The final model is a 'seamless cadastral' model, described as:

> The seamless cadastral model requires a skeletal core infrastructure, enabling consistency and multiple use of all land and sea to be realised. The long-term goal is a full facility for efficient allocation transfer and operation of property rights on land and at sea (Hoogsteden and Robertson, 1999).

For this model to come to fruition however, the institutional and administrative governmental arrangements would need to be linked together, perhaps under the one banner.

Land Information New Zealand (LINZ) also initiated an investigation into a seabed cadastre in 1999 with goals being to:

- provide information and advice to enable the government to decide how future rights to the seabed will be defined and held;
- provide seabed information that will enable New Zealand to maximize its continental shelf claim under UNCLOS; and
- provide a national spatial referencing system that meets New Zealand's core land and seabed information needs.

(Bevin, 1999)

So far, LINZ has developed a set of guidelines or principles that need to be followed in order to develop New Zealand's seabed cadastre. These include:

- Design: flexible enough to manage the spatial definition of marine rights.
- Spatial Extent: determining the limits of the cadastral boundary ie. the exclusive economic zone or extended continental shelf boundary.
- Land-sea Boundary: allow for overlaps between land and marine cadastre
- Boundary Point definition: the survey options for representation of boundaries within a seabed cadastre.
- Boundary Lines: the nature of boundary lines between defined points needs to be specified along with the reference ellipsoid.
- Geodetic Datum: all datums should be supported in the cadastre and should allow for three-dimensional definitions.
- Regulatory Environment: there must be a regulatory authority to reduce the likelihood of conflict between ambiguously defined rights.

The principles described above are broad, meaning they could be used to aid in developing an Australian marine cadastre, facilitating greater cooperation between the two countries in offshore jurisdictional management.

## 3.3 AUSTRALIA'S MARINE MANAGEMENT SYSTEM

Although the marine cadastre initiatives throughout the world are a good guide to current problems and issues relating to the design and implementation of a marine cadastre, it is not possible to simply adopt these models to the Australian environment. This demands a solution that is unique, but also takes advantage of current international research into the marine cadastre.

As discussed in chapter 2, the management of Australia's offshore area is shared between the states and Northern Territory, which have jurisdiction within coastal waters (as defined in Table 2.1), and the Commonwealth, which has jurisdictional responsibility from 3nm out to the limit of the EEZ. The following sections outline the institutional and legal arrangements in place within the major sectors of Australia's marine environment. This is done through an analsysis of Commonwealth and Victorian state jurisdictional arrangements, before finally focussing on activities that occur within the Victorian pilot project. Section 3.3 also looks at the availability and use of current spatial data to aid in the management of Australia's ocean activities. This analysis includes defining and delineating the rights, restrictions and responsibilities attached to legally defined boundaries and activities that impinge on the creation of a marine cadastre. The relationship between such boundaries and current Commonwealth and Victorian institutional and legal arrangements has also been investigated through the use of flow diagrams.

### 3.3.1 Oil & Gas Sector

***Regulatory Framework - Legal and Institutional Arrangements***

Following the 1979 OCS, responsibility for oil and gas exploration is shared between the states, the Northern Territory and Commonwealth governments. The OCS put into place 'mirror' legislation, meaning that the state and Northern Territory legislation has the same provisions, or 'mirrors' that of the Commonwealth's *Petroleum (Submerged Lands) Act 1967 (Cth)*, which is the principle legislation governing offshore oil and gas activity.

The *Petroleum (Submerged Lands) Act 1967* (Cth) sets out subordinate legislation that extends the state and Northern Territory legal systems offshore, in so far as they do not conflict with Commonwealth legislation. This ensures that there is a seamless transition from land to sea. An example of this is in the conveying of petroleum from an oil field in the contiguous zone to land in the state of Victoria. The pipeline is firstly administered under the Commonwealths *Petroleum (Submerged Lands) Act 1967 (Cth),* until it reaches coastal waters, where the Victorian *Petroleum (Submerged Lands) Act 1982 (Vic)* takes over administration. Victoria currently administers offshore oil and gas approvals adjacent to the coast of Victoria, outside of coastal waters, under the relevant Commonwealth legislation on behalf of the Commonwealth. This is done through the approval of a 'Joint Authority', made up of a Commonwealth and state minister with the minister representing Victoria being the 'Designated Authority' (DPI, 2003a). Table 3.1 below summarises the current legal framework for oil and gas exploration.

| ***REGULATORY FRAMEWORK FOR OIL & GAS EXPLORATION*** |
|---|
| **Submarine Cables and Pipelines Protection Act 1963 (Cth)** |
| This act fulfills Australia's obligations under UNCLOS and applies to cables and pipelines beneath the EEZ and high seas. |
| **Petroleum (Submerged Lands) Act 1967 (Cth)** |
| Administration of Commonwealth maritime areas (seaward of the three nautical mile boundary) shared between the Commonwealth and states. Establishes the licensing regime that applies to exploration. This includes permits, licenses and leases:<br>***Exploration Permit:*** granted for initial term of 6 years, with 5-year renewals available. Permit can be sold.<br>***Retention Lease:*** allows title to a discovery that is not yet commercially viable, but likely to become so. Granted for 5 years and is tradeable.<br>***Production License:*** grants exclusive rights to recover petroleum from the area, and is tradeable. Granted for indefinite term.<br>***Infrastructure License:*** authorises the license holder to construct and operate infrastructure facilities. Granted indefinitely. |
| **Petroleum (Submerged Lands) Act 1982 (Vic)** |
| Administers state marine areas within 'Coastal Waters'. Has broadly consistent provisions with the Petroleum (Seas and Submerged Lands) Act 1967 (Cth). Administered by Department of Primary Industries. |

Table 3.1 - Regulatory Framework for Oil & Gas Exploration (NOO, 2002a)

***Legally defined boundaries and associated rights, restrictions and responsibilities***

The major legal and administrative boundaries within the oil and gas industry are those that relate to exploration acreage in the marine environment, with new areas released every year by the Commonwealth government. Competitive bidding by prospective explorers takes place, with permits awarded to those applicants who undertake the fullest assessment of the areas' potential in accordance with resource management principles (CGA, 2003). It is also important to map the spatial location of pipelines (section 3.3.9), which carry the oil and gas from these acreages to handling and processing facilities both onshore and offshore. The institutional framework for oil and gas exploration and its relationship to legally defined boundaries is shown in Figure 3.3.

Major areas of exploration are centred off the North West and South East coasts of Australia. The spatial extent of current acreages within the Victorian pilot project is shown in Figure 3.2.

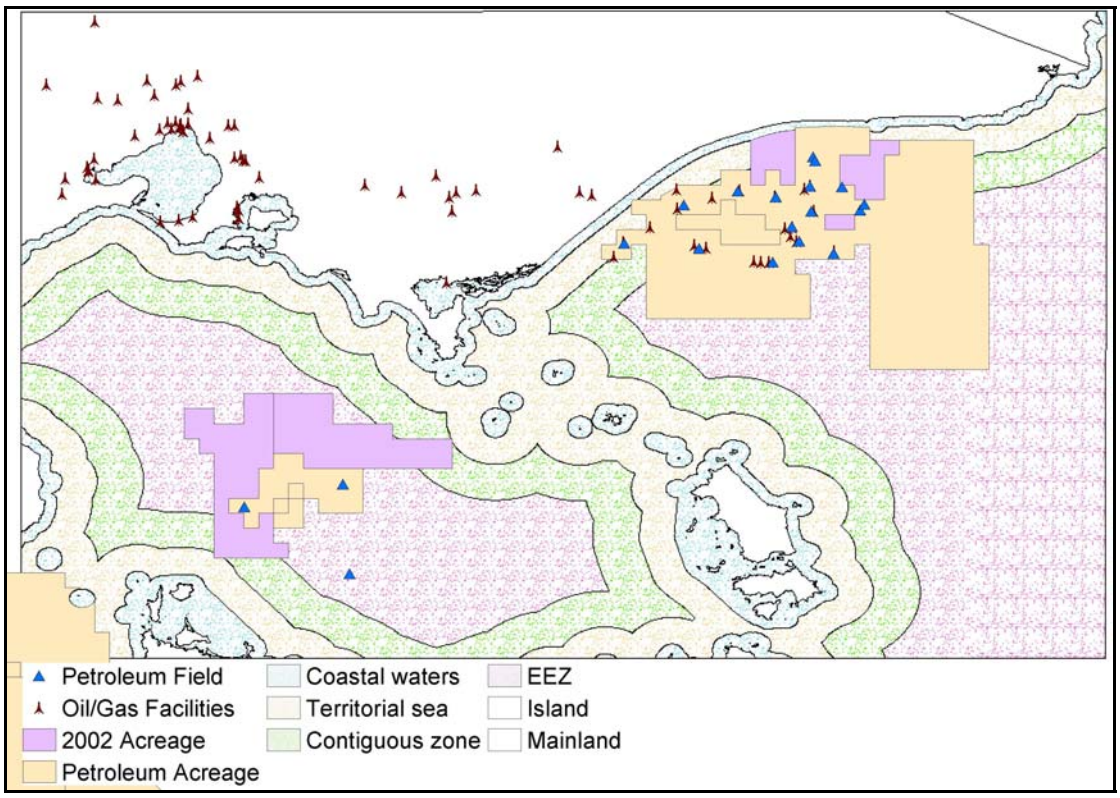



Figure 3.2 - Current acreages within the Victorian pilot project

The oil and gas industry currently has it own spatial management system to administer permits and lease areas. The system is based on parcels with relevant data such as permit holders and permit numbers attached to each parcel. This means that the rights, restrictions and responsibilities of those with exploration licenses are well documented. Within the lease and exploration areas of the oil and gas sector however, there are also other rights that occur which are also of concern. In a presentation by Yardley, (2002) at the Melbourne ARC Marine Cadastre Workshop, it was recognised that oil and gas companies need information concerning almost every major activity in the marine environment in order to effectively address their own needs. This includes shipping, native title areas, waste sites, heritage areas, fisheries etc. Such data needs to be found and integrated with existing oil and gas data before it can be used to maximum capacity.

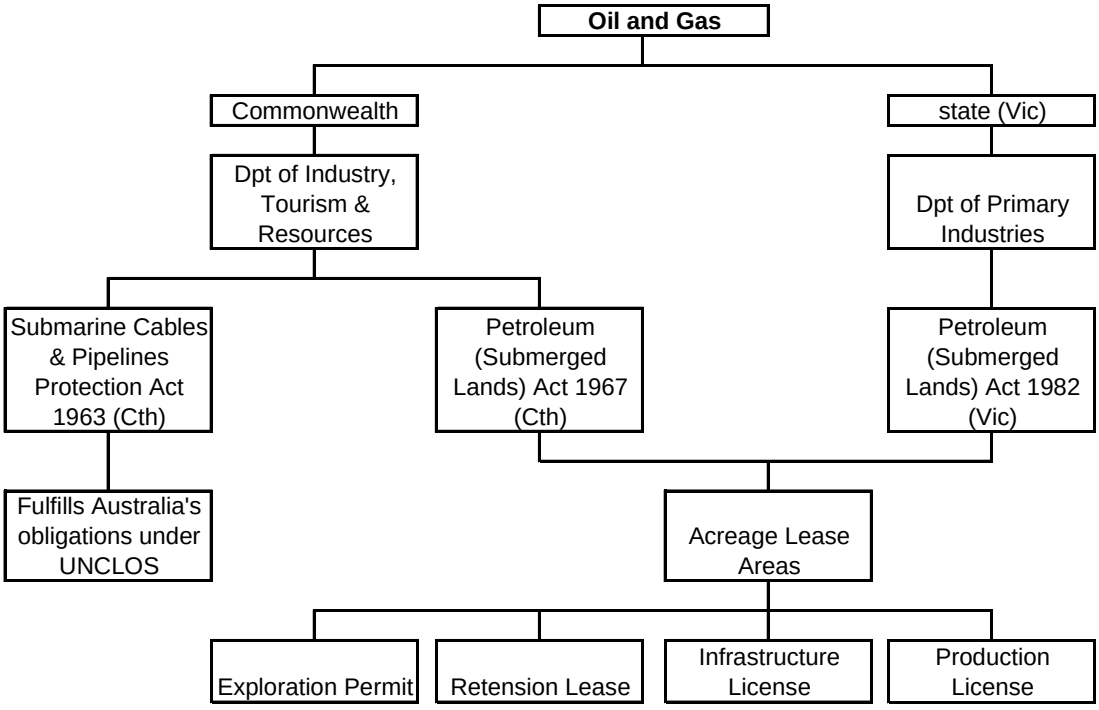



Figure 3.3 - Oil & gas management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

## 3.3.2 Fisheries

***Regulatory Framework - Legal and Institutional Arrangements***

As discussed in section 3.3.1, the OCS governs how Australia's ocean territory is divided up jurisdictionally. In terms of the fishing industry however, it provides for specific arrangements to vary this rule, such as fisheries located in state waters to be governed by the Commonwealth and vice versa. The OCS also enables fisheries to be co-managed.

The principle pieces of legislation for the management of Commonwealth fisheries are the *Fisheries Management Act 1991 (Cth)* and the *Fisheries Administration Act 1991 (Cth)* (described in Table 3.2 below). The Administration Act has created a statutory authority for fisheries management, whereby the day-to-day management of fisheries is carried out by the Australian Fisheries Management Authority (AFMA).

In Victoria, the Department of Primary Industries (DPI) is responsible for the administration of the *Fisheries Act 1995 (Vic)*, the major piece of legislation governing fisheries in the state. Such state regulation also applies to recreational fishing not just within the 3nm zone but also within the EEZ.

| *REGULATORY MANAGEMENT FOR FISHERIES* |
|---|
| **Offshore Constitutional Settlement** |
| ***State Management***<br>Where a fishery is located off one coast, it is managed under that state's law. |
| ***Commonwealth Management***<br>Where a fishery is located off more than one state, the fishery can, by agreement between all parties, be managed by the Commonwealth. |
| ***Joint Authority Management***<br>Where the Commonwealth and one or more states form a single legal entity which manages a fishery under a single law, be it Commonwealth or state. |
| **Fisheries Administration Act 1991 (Cth)** |
| Establishes the institutional and administrative aspects of managing Commonwealth fisheries.<br>***AFMA:*** The Act sets up the Australian Fisheries Management Authority (AFMA) which claims day-to-day responsibility for the management of Commonwealth fisheries. |
| **Fisheries Management Act 1991 (Cth)** |
| Governs the management of all Commonwealth fisheries within Australia by setting out appropriate management tools such as regulations, concessions and management plans in accordance with the Act. |
| **Department of Agriculture, Fisheries and Forestry Australia (AFFA)**<br>Government department representing Australia's fishing interests both domestically and internationally. |
| **Fisheries Act 1995 (Vic)** |
| Major piece of legislation governing fisheries within Victoria, providing for the development, control and management of fisheries, aquaculture industries and associated aquatic biological resources. |
| **Fisheries Regulations 1998 (Vic)** |
| Define the boundaries of the various fisheries operating in Victoria's Coastal waters. |

Table 3.2 - Regulatory Framework for Fisheries (NOO, 2002a)

### *Legally defined boundaries and associated rights, restrictions and responsibilities*

Management plans which specify the nature of the rights held by fishers within a fishery are the main form of regulation of fisheries under Commonwealth jurisdiction (NOO, 2002a). Under the *Fisheries Management Act 1991 (Cth)*, there are two main forms of access rights to fish that can be granted, including statutory fishing rights (SFR) and fishing permits. SFRs are only provided under a management plan and are granted for the period of the plan, enabling SFR boundaries to be spatially defined. The granting of an SFR gives the right to fish for a resource and permits maximum allowable catches to be changed. Unlike SFRs, fishing permits do not formally convey the right to fish, they only specify conditions which must be met in order for the permit holder to retain their permit. Such permits also specify the area of

operation for the permit, and are usually granted and renewed on a yearly basis (NOO, 2002a).

The two types of rights (SFR's and fishing permits) are freely tradable, as long as the current holders have paid all outstanding fees and met conditions of their use. The SFR however, gives a greater amount of security, as the holder has rights similar to that of private property, with holders able to borrow against an SFR (NOO, 2002a). Fish receiver permits, scientific permits and foreign fishing licences may also be granted, but these are used to a much lesser extent than SFR and fishing permits. AFMA may also direct that no fishing, or that a particular kind of fishing is to take place within a fishery (or part of a fishery) for a specified period of time. Such directives add a fourth dimension to the spatial management of fisheries. The relationship of such spatially defined boundaries to the fisheries institutional framework is shown in Figure 3.5 below.

The spatial extent to which fishing occurs within the Commonwealth jurisdiction is defined by 17 fisheries within Australia's EEZ and is important information for all users of the marine environment. The fisheries are shown in Figure 3.4.

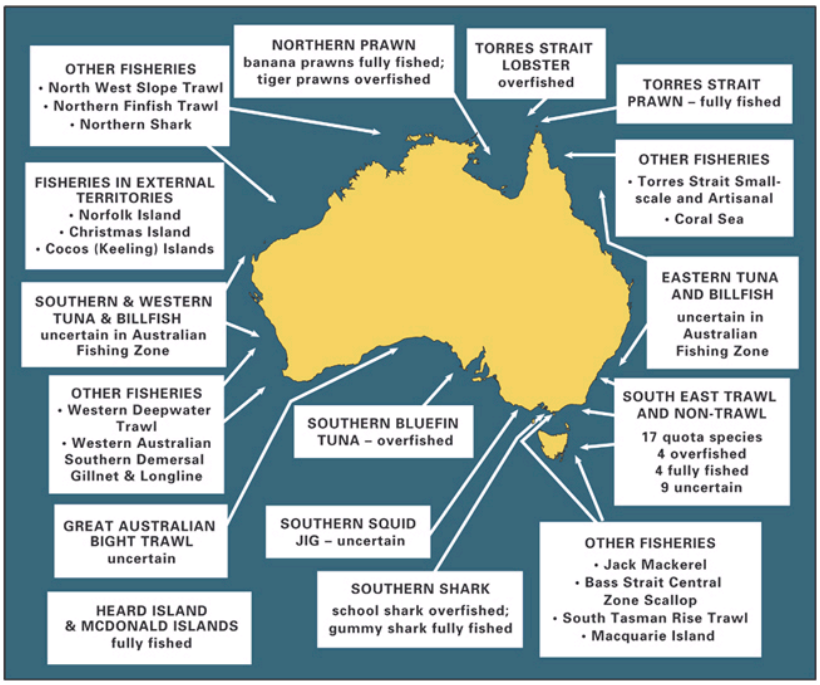



Figure 3.4 - Status and location of Commonwealth-managed fisheries

(Source: Caton, 2001)

There are also eight state managed fisheries that fall within the spectrum of the Victorian pilot project (Table 3.3). There are currently no co-managed fisheries in the pilot study area.

| State Managed Fisheries | Commonwealth Managed Fisheries |
|---|---|
| Abalone Fishery | Bass Strait Central Zone Scallop Fishery |
| Arrow Squid Fishery | South East Trawl Fishery |
| Eel Fishery | South East Non-trawl Fishery |
| Rock Lobster Fishery | Southern Shark Fishery |
| Scallop Fishery | Southern Squid Jig Fishery |
| Southern Shark Fishery | Jack Mackerel Fishery |
| Trawl Fishery | Eastern Tuna and Billfish Fishery |
| Victorian Abalone Fishery Management Plan | |

Table 3.3 - State (Vic) and Commonwealth managed fisheries falling within the jurisdiction of the Victorian pilot project.

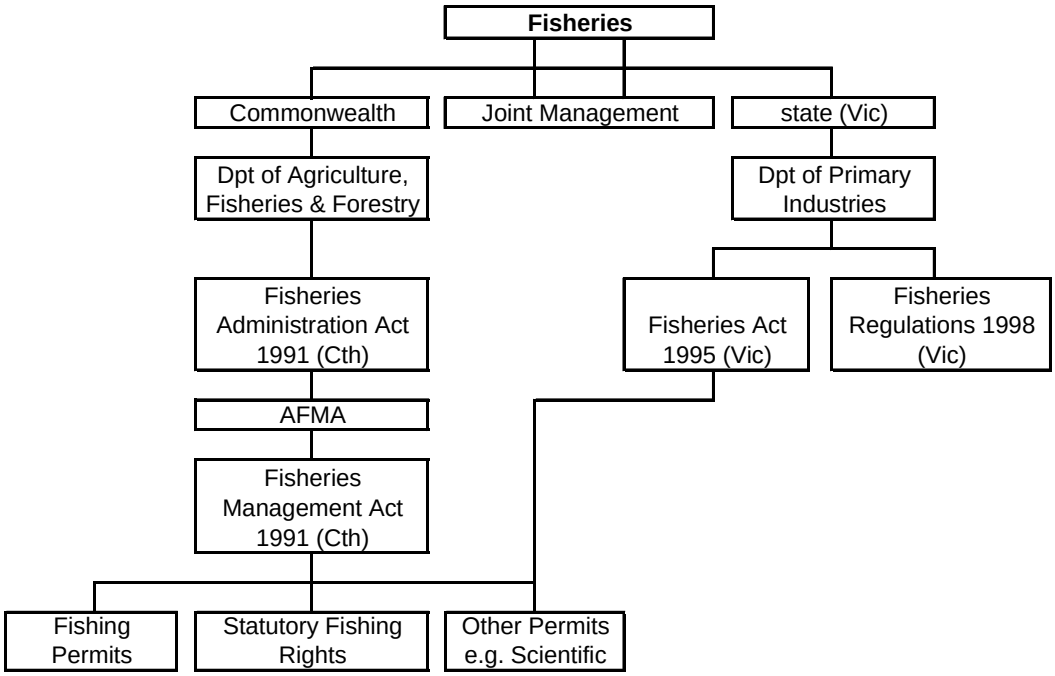



Figure 3.5 - Fisheries management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

## 3.3.3 Aquaculture

***Regulatory Framework - Legal and Institutional Arrangements***

The management of aquaculture in Australia rests with the states and Northern Territory, which generally put in place aquaculture and coastal development plans. Under such plans, licences for marine farms are granted with the inclusion of environmental standards and conditions. In Victoria, DPI (within the Fisheries management division) administers aquaculture licences under section 43 of the *Fisheries Act 1995 (Vic)*. The regulatory framework for aquaculture is shown within Table 3.4 below.

| ***THE REGULATORY FRAMEWROK FOR AQUACULTURE*** |
|---|
| Management of aquaculture within Australian waters rests solely with the states and Northern Territory Governments. |
| **Fisheries Management Act 1995 (Vic)**<br>Aquaculture is managed under section 43 of the Fisheries Act 1995 (Vic). Under the Act, two types of licenses relating to the conduct of aquaculture activities can be granted and include:<br>Aquaculture (Crown Land) License<br>Aquaculture (Crown Land) License - Type A License |

Table 3.4 - Regulatory Framework for Aquaculture

***Legally defined boundaries and associated rights, restrictions and responsibilities***

There are currently two major types of licences that are of relevance to the management of aquaculture areas within the Victorian pilot area, an Aquaculture (Crown Land) Licence and an Aquaculture (Crown Land) Licence – Type A Licence. The spatial locations of such licences are shown in Figure 3.6. Both licences authorise the holder to conduct aquaculture activities on crown waters, such as lakes, rivers and marine areas. The difference between the two is that an Aquaculture (Crown Land) Licence is granted for the harvesting of non-human consumption and a Type A Licence for human consumption. The framework for aquaculture management is shown in Figure 3.7.

The areas of such licences are spatially defined on maps and those wholly within the marine environment could be easily integrated within a marine cadastre.

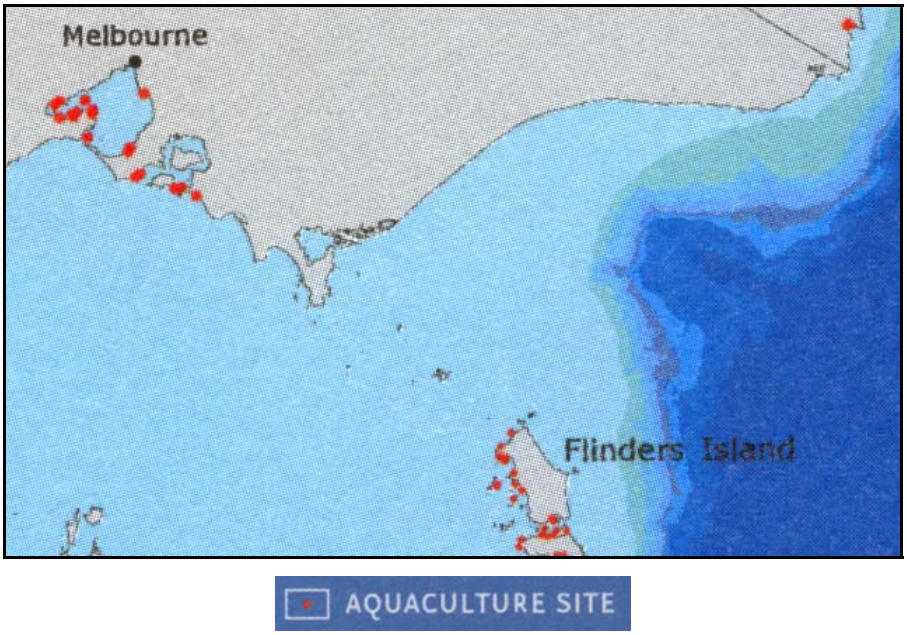



Figure 3.6 – Major Aquaculture sites within the Victorian pilot project
(Source: NOO, 2002d)

There are some aquaculture leases that straddle the land-sea boundary and unless there is a link between the marine and terrestrial environments, these areas would be hard to spatially define and manage effectively.

The state government has recently added nine new aquaculture zones within Victoria, and these have been declared as fisheries reserves, under section 88(2)(iii) of the *Fisheries Act 1995 (Vic)*. The zones may be areas of land, water or land and water and are listed below (DPI, 2003b):

- Grassy point Aquaculture Zone
- Clifton Springs Aquaculture Zone
- Bates Point Aquaculture Zone
- Kirk Point-Werribee Aquaculture Zone
- Beaumaris Aquaculture Zone
- Mount Martha Aquaculture Zone
- Dromana Aquaculture Zone
- Pinnace Channel Aquaculture Zone
- Flinders Aquaculture Zone

The development of such zones within Victorian waters will create almost freehold style rights giving rise to the need for accurately defined maritime boundaries.

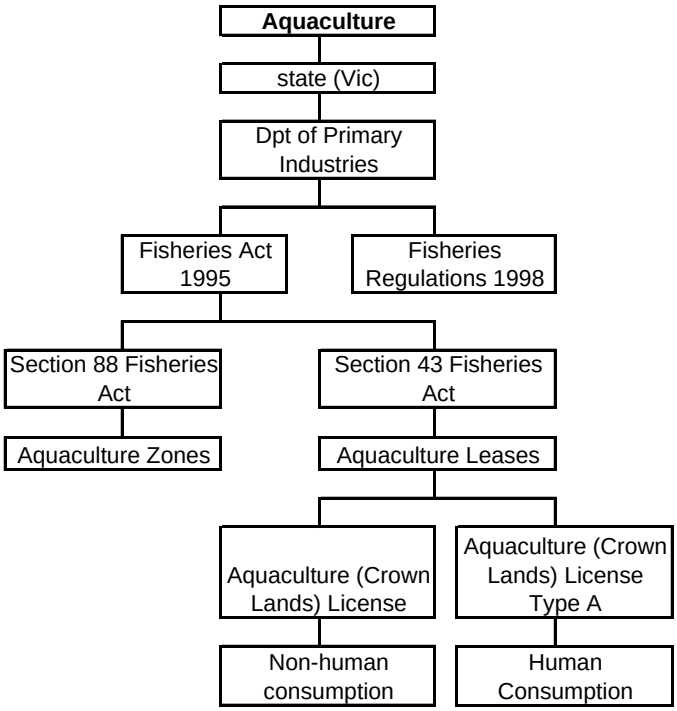



Figure 3.7 - Aquaculture management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

## 3.3.4 Shipping

***Regulatory Framework - Legal and Institutional Arrangements***

As a country surrounded by water with a coastline of approximately 37,000 km, shipping is fundamental to Australia's way of life. Australia is the fifth largest user in the world of shipping services in terms of tonnes per kilometre. Around 99% of trade is carried by ship (NOO, 2002b). Such services can be divided into cargo and passenger shipping, with jurisdiction for each being separated between the Commonwealth and the states and Northern Territory under the OCS.

> The agreement provides for sharing of powers based on the voyage being undertaken rather than a ship's location at any particular time or whether or not it is engaged in commerce (NOO, 2002a).

Trading ships on an overseas or interstate voyage, Australian fishing vessels on overseas voyages and fishing fleet support vessels on overseas voyages are governed by the Commonwealth, yet vessels such as pleasure crafts are not.

The *Navigation Act 1912 (Cth)* provides the legislative framework for the Commonwealths responsibilities on maritime issues, including both cargo and passenger shipping. The Department of Transport and Regional Services is responsible for the administering of the *Navigation Act 1912 (Cth).* Within Victoria, the *Marine Act 1998 (Vic)* provides the regulatory framework for the efficient and safe operation of ships. The regulatory framework for shipping is described in more detail in Table 3.5 below.

| ***THE REGULATORY FRAMEWORK FOR SHIPPING*** |
|---|
| **The Offshore Constitutional Settlement** |
| The division of responsibility between the states and the Commonwealth is governed by the navigation agreement under the OCS. The nature of the voyage (e.g. overseas, interstate, within internal waters) determins which jurisdiction governs it. |
| **Navigation Act 1912 (Cth)** |
| The Navigation Act provides the legislative basis for many of the Commonwealth's responsibilities with respect to maritime matters including ship safety, the coasting trade, employment of seafarers and shipboard aspects of the protection of the marine environment. |
| **Australian Maritime Safety Act 1990 (Cth)** |
| Established the ***Australian Maritime Safety Authority:*** Main objective is to promote maritime safety and combat pollution of the marine environment. |
| **Marine Act 1988 (Vic)** |
| Relate primarily to providing efficient and safe operation of vessels on state waters. |
| **Department of Transport and Regional Servises** |
| Federal Government Department responsible for the Navigation Act and also provides policy advice, research, analysis and safety investigations and provides safety information. |
| **Australian Hydrographic Service** |
| Commonwealth Government Agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating Australian waters. |
| **International Maritime Organisation (IMO)** |
| Specialist agency of the UN dealing with matters relating to ship safety and marine environment protection. |

Table 3.5 - The Regulatory Framework for Shipping (NOO, 2002a)

***Legally defined boundaries and associated rights, restrictions and responsibilities***

The Australian Hydrographic Office (AHO) is the Commonwealth government agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating Australian waters (see Table 3.5). Such publications serve a wide variety of users and are often used as a spatial background for other non-shipping related activities. According to the *Navigation Act 1912 (Cth)* such publications also need to be adequate, kept up-to-date and freely available to the shipping community.

According to Murray, (2002) there is also a lack of shoreline data, including in-shore bathymetry which is used to aid in shipping search and rescue operations and in the monitoring of environmental disasters such as oil spills. The data that is currently collected is done so in a project based way, with data collected differently within each state. This makes the creation of seamless data layers extremely difficult.

Shipping is a major activity within the pilot project area which contains Victoria's three major ports (Melbourne, Geelong, Westernport). Each port is controlled by the relevant port authority which governs rights within the designated port area. Within Port Phillip, the Melbourne Port Authority, through the Victorian Channels Authority, is responsible for planning and supervision of services and facilities. This includes the provision and maintenance of all navigation aids, emergency response, the control of commercial ships and the surveying of port waters (DSE, 2003). There are also major shipping passages running both East-West and North-South through Bass Strait which include international coastal cargo trade, passenger services and cargo and vehicular ferry services. Figure 3.8 below shows the amount of traffic that flows through the pilot area, with some shipping passages having over 1000 vessels each year. The management framework relating to such shipping passages, as well as their relationship to legally defined boundaries is also shown in Figure 3.9.

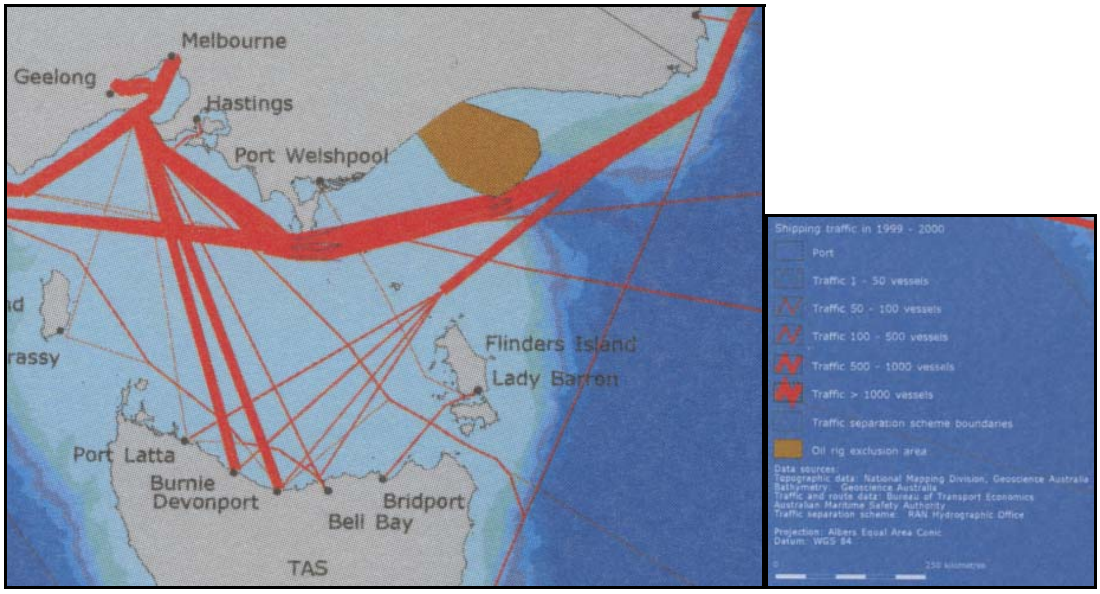



Figure 3.8 - Traffic flow through the Victorian pilot project area

(Source: NOO, 2002d)

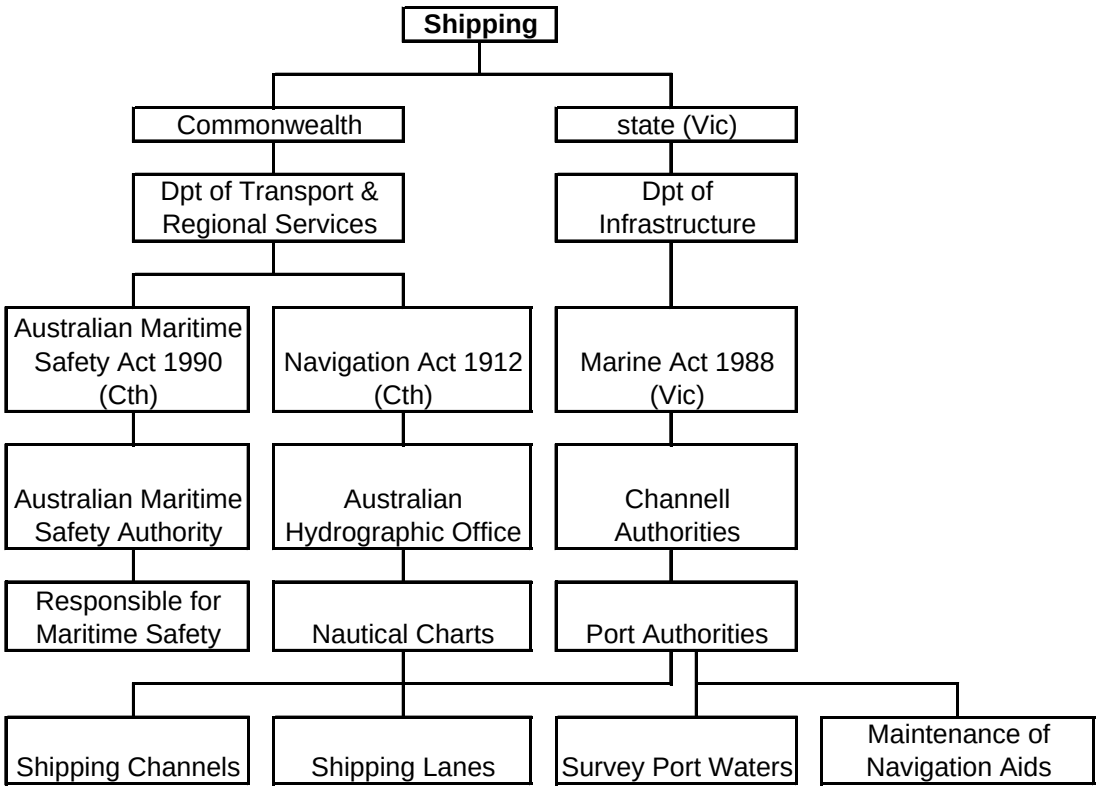



Figure 3.9 - Shipping management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

### 3.3.5 Conservation

***Regulatory Framework – Legal and Institutional Arrangements***

*The Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC) is the principle Commonwealth legislation relating to environmental matters. The Act consolidates much of Australia's environmental law and gives direct effect to Australia's international environmental obligations. The Act identifies six matters of environmental importance including:

1. World Heritage Sites;
2. Wetlands of international importance (RAMSAR);
3. National threatened species and ecological communities;
4. Listed migratory species;
5. Commonwealth marine areas;
6. Nuclear projects, including uranium mining.

All of these have relevance to the marine environment with the public needing spatial knowledge of areas such as world heritage sites, RAMSAR and marine protected areas in order for legislation governing these areas to work effectively. Users cannot adhere to spatially defined rights in legislation if the area concerned is not clearly delineated and publicised.

*Marine Parks & Sanctuaries*

Marine Parks and Sanctuaries "have been recognised nationally and internationally as being important for marine conservation and management since the early 1960's" (Kriwoken & Côté, 1996), but according to Cresswell and Thomas (1997) have not been used widely enough:

> While the oceans comprise 70% of the earth's surface, less than 1% of the marine environment is within protected areas, compared with 9% of the land surface.

Cresswell and Thomas (1997) claim that this worldwide lack of marine protected areas is reflected in Australia, with approximately 7.6% of terrestrial area protected and only about 3.5% of the marine environment.

Australia's coastal waters and oceans contain one of the greatest arrays of marine biodiversity in the world. The area includes more than 4000 fish varieties and tens of

thousands of species of invertebrates, plants and micro-organisms, with around 80% of southern marine species occurring nowhere else in the world (DSE, 2003). Such diversity needs to be protected and conserved, with both the Commonwealth and state governments implementing marine protected areas for just such a purpose. These areas are dedicated to the protection and maintenance of biodiversity and cultural resources, and are managed through legal means.

The EPBC Act is the key Commonwealth legislation in relation to Marine Parks and Sanctuaries. In terms of Victorian legislation, the *National Parks (Marine National Parks and Marine Sanctuaries) Act 2002 (Vic), Fisheries Act 1995 (Vic), Fisheries Regulations 1998 (Vic), Marine Act 1998 (Vic), Marine Regulations 1999 (Vic), Heritage Act 1995 (Vic)* and *Heritage (Historic Shipwrecks*) *Regulations 1996 (Vic)* all play a role in regulating marine parks and sanctuaries.

*Sea Dumping*

The regulation of deliberate loading, dumping and incinerating of waste at sea is also part of conservation administered by the Commonwealth under the *Environment Protection (Sea Dumping) Act 1981 (Cth)* and the *Environment Protection (Sea Dumping) Amendment Act 1986 (Cth).* A permit must be granted from Environment Australia (EA) for all sea dumping, with about 30 permits a year currently being issued for:

- Ammunition Dumps
- Chemical Dumps
- Unexploded Depth Charges
- Jarosite Dumps
- Scuttled Vessels
- Official Vessel Dumps
- Miscellaneous Dumps

(EA, 2003)

| *THE REGULATORY FRAMEWORK FOR CONSERVATION* |
|---|
| **Offshore Constitutional Settlement**<br>Included environmental regulations to address aspects of coordination for environmental management of marine parks, shipwrecks and offshore instalations. |
| **Environmental Protection and Biodiversity Conservation Act 1999 (Cth)**<br>Identifies and assess' activities having a significant impact on matters of national environmental significance, including Commonwealth marine protected areas, world heritage sites, RAMSAR wetlands, migratory species, national threatened species and ecological communities.<br>The Act applies to Commonwealth, state and territory marine waters. |
| **National Parks (Marine National Parks and Marine Sanctuaries) Act 2002 (Vic)**<br>Governs the restrictions of seabed use, mineral disposal, fishing and development rights that apply within a marine park or marine sanctuary within Victorian waters. Navigational, air space and water column rights remain unchanged by this act and continue to be governed by other relevant Acts. |
| **1996 Protocol to the London Convention**<br>Lists seven categories of waste or other matter which may be considered for dumping at sea which a permit may be granted for. |
| **Environmental Protection (Sea Dumping) Act 1981 (Cth)**<br>Prohibits dumping of waste from all ships, aircraft and platforms without a permit. |

Table 3.6 - Regulatory Framework for Conservation (NOO, 2002a)

***Legally defined boundaries and associated rights, restrictions and responsibilities***

*Marine Parks & Sanctuaries*

Public knowledge of the spatial extent of conservation areas such as marine parks and sanctuaries is of great importance in aiding the protection of biodiversity within the parks. There are also conditions on the use of marine parks that need to be attached to their spatial extent. These conditions are described in legislation and prohibit acts which affect native species and heritage, ban commercial activity, and in some cases allow almost no human activity, including recreational fishing. There can also be seasonal adjustments to shipping routes to reduce the impact on marine species such as migrating whales. In some cases, there are adjoining marine and land parks which, when managed together, can reduce the effects of land based pollution in the marine environment.

A list of the marine parks and sanctuaries which are located within the Victorian pilot study area are shown in Table 3.7 below:

| Marine National Parks | Marine Sanctuaries |
|---|---|
| Bunurong National Park | Barwon Bluff Marine Sanctuary |
| Cape Howe National Park | Beware Reef Marine Sanctuary |
| Churchill Island National Park | Jawbone Marine Sanctuary |
| Corner Inlet National Park | Mushroom Reef Marine Sanctuary |
| Discovery Bay National Park | Point Cooke Marine Sanctuary |
| French Island National Park | Ricketts Point Marine Sanctuary |
| Ninety Mile Beach National Park | |
| Point Addis National Park (Not in Pilot Project Area) | |
| Point Hicks National Park | |
| Pot Phillip Heads National Park | |
| Twelve Apostles Naitonal Park (Not in Pilot Project Area) | |
| Wilsons Promontory Naitonal Park | |
| Yaringa National Park | |

Table 3.7 - Marine National Parks and Sanctuaries within Vic pilot project

*Sea Dumping*

The ability to successfully manage waste and dump sites needs careful spatial planning in order to avoid unnecessary disturbance or disruption of waste within the marine environment. Such management also needs knowledge of other activities such as shipping routes and the location of marine parks, enabling permits to be granted for the most appropriate areas. This will minimise disturbance to other marine stakeholders as well as the marine ecosystem as a whole. There are numerous sea dumping sites within the Victorian pilot project area, as can be seen from Figure 3.10 below.

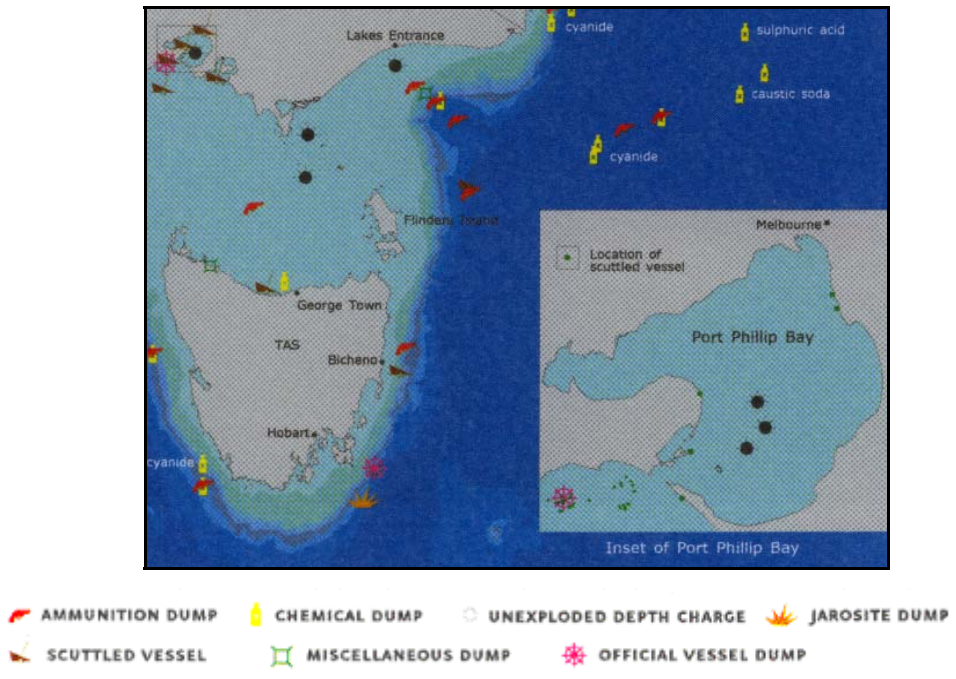



Figure 3.10 – Sea dumping sites within the Victorian pilot project

(Source: NOO, 2002d)

The relationship between the various aspects of conservation and the legally defined boundaries that underpin their management are described in Figure 3.11 below.

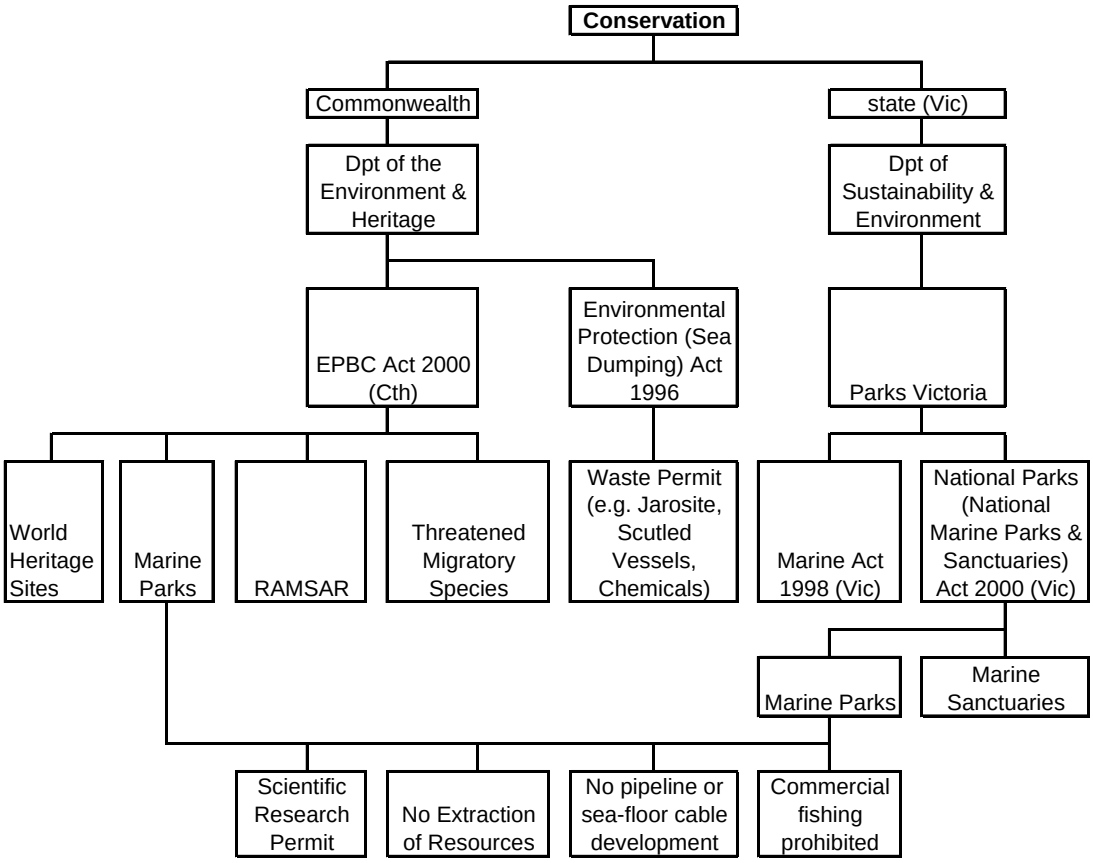



Figure 3.11 - Conservation management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

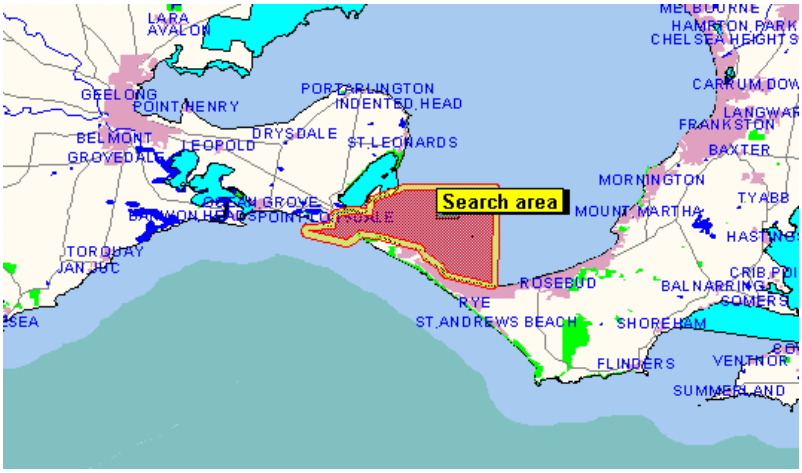
*EPBC Act – Interactive Database*

An interactive database has been designed to aid members of the public in knowing and understanding what their rights, obligations and requirements are under the EPBC Act. The database holds mapped areas of World Heritage sites, RAMSAR wetlands, threatened and migratory species, threatened ecological communities and protected areas (EA, 2002). The database can be used to:

- Map an area of interest or development project area
- Overlay maps, conservation reserves and places of national environmental significance onto stakeholder maps
- Run queries to find out where nationally threatened migratory species occur.

An interactive map and coordinate search allow users to produce a report on potential matters of national environmental significance in any nominated area. This flows on to knowledge of whether approval for an activity is needed under the EPBC Act.

An example can be seen in Figure 3.12 below. A search of the entrance to Port Phillip Bay was undertaken, and the subsequent report and map produced.




**Nominal scale**


**Legend**

- Builtup Areas
- Ramsar Sites
- Water Bodies
- World Heritage
- Roads
- Reserves
- Cwealth Areas
- Land

**Threatened ecological communities** **0 communities**

**Threatened species:** **28 species**

**Migratory species:** **33 species**

**Marine protected species:** **35 species**

**World Heritage Areas**: Nonefound

**Ramsar sites:** Within 10km of Port Phillip Bay (Western Shoreline) and Bellarine

Within Catchment Area of Port Phillip Bay (Western Shoreline

**Conservation reserves:**

Unnamed Natural Features Reserve

Point Cook Marine Reserve

Harold Holt Complex (Mud Islands) Marine Reserve

Harold Holt Complex (Popes Eye Annulus) Marine Reserve

Figure 3.12 – EPBC interactive database search (Source: EA, 2002)

The report generated provides a list of the species and threatened communities that may occur in the nominated area, along with RAMSAR wetland sites and World Heritage listed areas. These lists are then linked to other web sites that give a greater amount of detailed information regarding each particular species or protected area. This type of information system gives a good indication of how valuable spatial knowledge of legislation is. There are however a large number of Acts which help to regulate conservation in the marine environment and a spatial knowledge of these other aspects such as sea dumping are just as important.

The EPBC interactive database is primarily a decision support tool for use within the environmental sphere. There are a number of such databases on the web, each providing a unique decision making service. The ability to make informed decisions also relies on the capability of the system to take into account all relevant information to a specific spatial area. This is only possible if an underlying foundation such as an SDI is in place to provide the decision support system with access to any and all relevant spatial data.

## 3.3.6 Marine Heritage

***Regulatory Framework – Legal and Institutional Arrangements***

Marine heritage in Australia takes into account both places and objects of cultural and natural significance and can include coastlines, islands, reefs, shipwrecks, lighthouses and coastal fortifications amongst other things (NOO, 2002b). Such archaeological and historical objects are regulated through both Commonwealth and state legislation, which is guided by international treaties and UNCLOS. Marine heritage is under constant threat from accidental damage from boat anchors, theft, vandalism, pressure from development (eg. gas pipelines) and environmental factors such as erosion. These threats need to be managed and mitigated with spatial information being one of the best tools for the job.

*Heritage Protection Legislation*

There are two main areas of Commonwealth legislation pertaining to marine heritage, with the first being places of National heritage significance. Heritage protection laws were recognised under the *Australian Heritage Commission Act 1975 (Cth),* which established the Australian Heritage Commission, an independent body set up to advise the Commonwealth government on heritage matters. The acts major role was to:

- Identify places to be included in the National Estate and maintain a register.
- Conserve, improve and present the National Estate.
- Grant financial or other assistance by the Commonwealth for the above.

The National Estate can be described as a register of natural or cultural places within Australia which have aesthetic, historic, scientific or social significance. The register extends from the terrestrial environment out to the limit of Australia's continental shelf and protects sites by limiting the actions that can occur there (NOO 2002a).

This system of governance of Australia's heritage areas has undergone a change recently, with the passing of the *Australian Heritage Council (Consequential and Transitional Provisions) Bill 2000 (Cth).* This Bill has created a National Heritage List and a Commonwealth Heritage List which replace the National Estate, with these operating under the scope of the EPBC Act. The main advantage to this change is

that the EPBC Act would impose legal obligations on the management of places on the lists, something which did not occur under the National Estate (NOO, 2002a).

*Historic Shipwrecks*

The second area of legislative control relates to historic shipwrecks. There are over 6000 documented shipwrecks in Australian waters, ranging from wooden sailing ships to passenger and fishing vessels, and all are protected to some degree under the *Historic Shipwrecks Act 1976 (Cth)*. The Act provides immediate protection for shipwrecks once they are more than 75 years old whilst also allowing the Commonwealth Environment and Heritage Minister to declare younger wrecks protected. Such protection prohibits actions that would damage, destroy, interfere with, dispose of, or remove a declared historic wreck or relic from Australian waters (Historic Shipwrecks Act, 1976 (Cth), s 13).

In Victoria, the *Heritage Act 1995 (Vic)* provides the legislative framework for the protection of heritage places. In terms of shipwrecks, each state in Australia has complimentary legislation to the Commonwealth in place. However due to the closeness of the majority of shipwrecks to the Australian coastline, the day-to-day management of most historic shipwrecks is the responsibility of the states. The *Heritage Act 1995 (Vic)* and the Commonwealths *Historic Shipwrecks Act 1976 (Vic)* are both administered by Heritage Victoria for shipwrecks found within the state's coastal waters. Relics connected to such historic shipwrecks are also protected under legislation.

| *THE REGULATORY FRAMEWORK FOR MARINE HERITAGE* |
|---|
| **Australian Heritage Commission Act 1975 (Cth)**<br>Established the Australian Heritage Commission whos major role was to identify places to be included in the National Estate Register. |
| **Australian Heritage Council (Consequential and Transitional Provisions) Bill 2000 (Cth)**<br>Creates a National Heritage List and a Commonwealth Heritage List, replacing the National Estate Register. |
| **Historic Shipwrecks Act 1976 (Cth)**<br>Provides a framework for protecting shipwrecks, providing blanket protection for those more than 75 years old. It also provides for the protection of relics associated with shipwrecks. Day-to-day management of most shipwrecks under the Act is the responsibility of the states (due to proximity of wrecks to the shore) |
| **Heritage Act 1995 (Vic)**<br>Provides the legislative framework for the protection of heritage places within Victoria and provides complimentary legislation to the Commonwealth in terms of the management of shipwrecks. Also protects associated relicts. |
| **Environmental Protection Heritage Council**<br>Created to deal with historic shipwrecks and other heritage issues in the marine environment at a Commonwealth level. |
| **Heritage Victoria**<br>Administer the Heritage Act (Vic) and Historic Shipwrecks Act 1976 (Cth) for ships found within the states Coastal Waters. |

Table 3.8 - Regulatory Framework for Marine Heritage (NOO, 2002a)

### *Legally Defined Boundaries & Associated Rights, Restrictions and Responsibilities*

The major technique used to protect shipwrecks from damage is the proclaiming of a protected zone of up to 800m in radius around shipwrecks more than 75 years old. This is in line with Australia's obligations under the Convention on the Protection of Underwater Cultural Heritage, adopted in November 2001. Such zones prohibit all entry in the absence of a permit, which includes no diving, trawling or mooring of ships. There is also the option of proclaiming protected zones around shipwrecks younger than 75 years if they are of national or cultural significance. There are currently 13 protected zones within Australian waters, with seven such zones located in Port Phillip Bay. The locations of such wrecks are kept in a national shipwrecks database, which includes nodes from each state of Australia. The relationship of the regulatory framework to legally defined boundaries and associated rights, restrictions and responsibilities in shown in Figure 3.13.

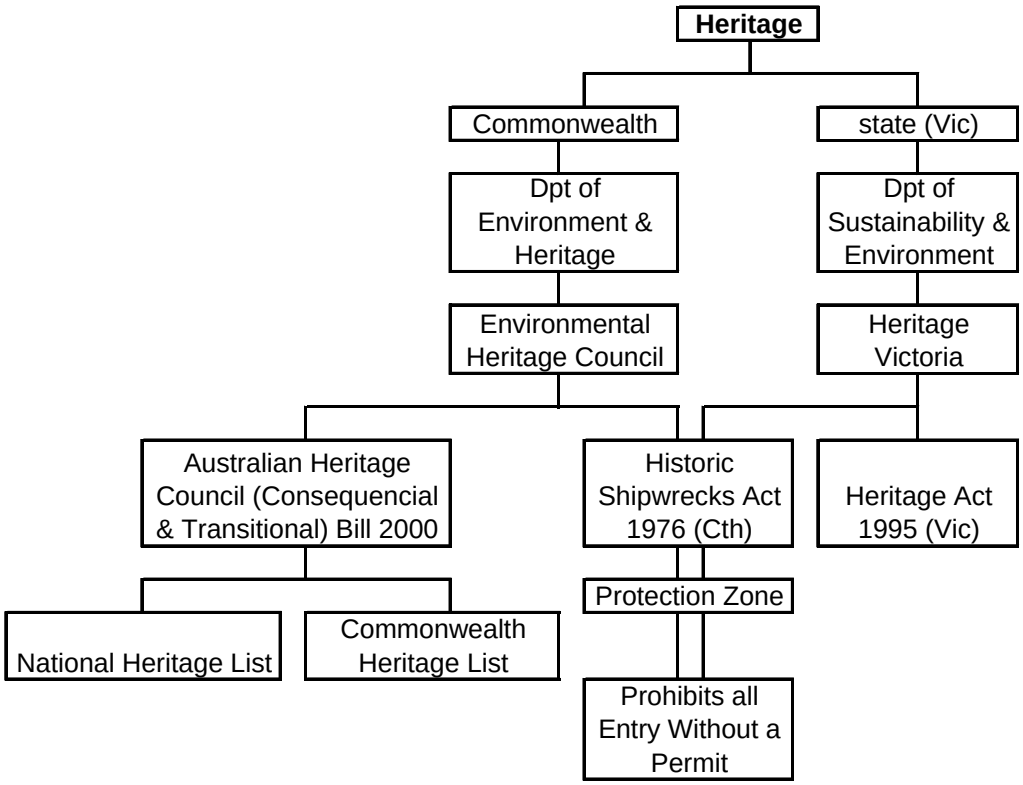



Figure 3.13 - Heritage management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

## 3.3.7 Native Title and Indigenous Heritage

***Regulatory Framework – Legal and Institutional Arrangements***

The *Native Title Act 1993 (Cth)* provides the framework for the recognition and regulation of native title rights within Australia. For such rights to be granted, it must be shown that the relevant rights and interests have been and still are possessed under the traditional laws and customs of indigenous Australians. This shows that the people concerned have a connection with the land, and hence their rights are recognised under common law.

In terms of the marine environment, the *Native Title Act 1993 (Cth)* merely contemplated that native title may exist offshore, depending on the operation of the common law to afford such recognition (Native Title Act 1993 (Cth), s 223(1)(c). In the past decade, Australian courts have attempted to address indigenous or native title rights in marine areas, culminating in the High Court's decision in the Croker Island Case (section 2.3.4). This decision established the existence of native title in the

territorial sea. As mentioned in section 2.3 however, only non-exclusive native title rights were granted in the Croker Island Case. This is due to the fact that the right of innocent passage under international law and the public right to navigate and fish under domestic law needed to be upheld (Yarmirr 1999). There are also a number of claims over the sea and sea-bed which are still to be determined and those within the Victorian pilot project are shown in Figure 3.14. Australia wide, there are:

- 104 Registered Applications with sea
- 39 Unregistered applications with sea
- 6 Indigenous land use agreements with sea

(Bowen, 2002)

The National Native Title Tribunal (NNTT) and Aboriginal Affairs Victoria (AAV) are the managing agencies for native title claims in the marine environment for the Commonwealth and Victorian governments respectively.

There is also legislation in place - *The Aboriginal and Torres Strait Island Heritage Protection Act 1984 (Cth)* - to protect and preserve areas or objects that are of significance to Aboriginals within Australia and Australian waters. The regulatory framework for indigenous rights and the protection of their cultural heritage is summarised in Table 3.9.

| ***THE REGULATORY FRAMEWORK FOR INDIGENOUS RIGHTS AND CULTURAL HERITAGE*** |
|---|
| **Native Title Act 1993 (Cth)**<br>Provides the framework for the recognition and protection of native title and seeks to regulate transactions that impact on native title. The High Court has affirmed that where an inconsistency arises between native title and another interest, the non-native title interest prevails. |
| **Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)**<br>Preserves and protects areas or objects that are of significance to aboriginals in accordance with tradition, from injury or destruction. The act applies to the territorial sea, the EEZ and the continental shelf. |
| **National Native Title Tribunal**<br>Manage native title claims to the marine environment within the Commonwealth. |
| **Aboriginal Affairs Victoria**<br>Manage native title claims to the marine environment within Victoria. |

Table 3.9 - Regulatory framework for indigenous rights and cultural heritage (NOO, 2002a)

***Legally Defined Boundaries & Associated Rights, Restrictions and Responsibilities***

In order for indigenous Australians to claim native title to the marine environment, the areas concerned must be spatially defined. Such boundaries then become legally binding, determining areas that are of cultural, spiritual or recreational (hunting and fishing) significance. The availability of such boundary information to the wider community will aid in the management of native title areas, encouraging co-existence. This is also the case when dealing with declarations over maritime zones for the protection of aboriginal areas and objects of significance. Current legislation also enables emergency declarations to be made if an area is under serious and immediate threat of desecration, highlighting the need for spatial information to be accurate as well as up-to-date. The native title and indigenous heritage management framework is shown in Figure 3.15 below.

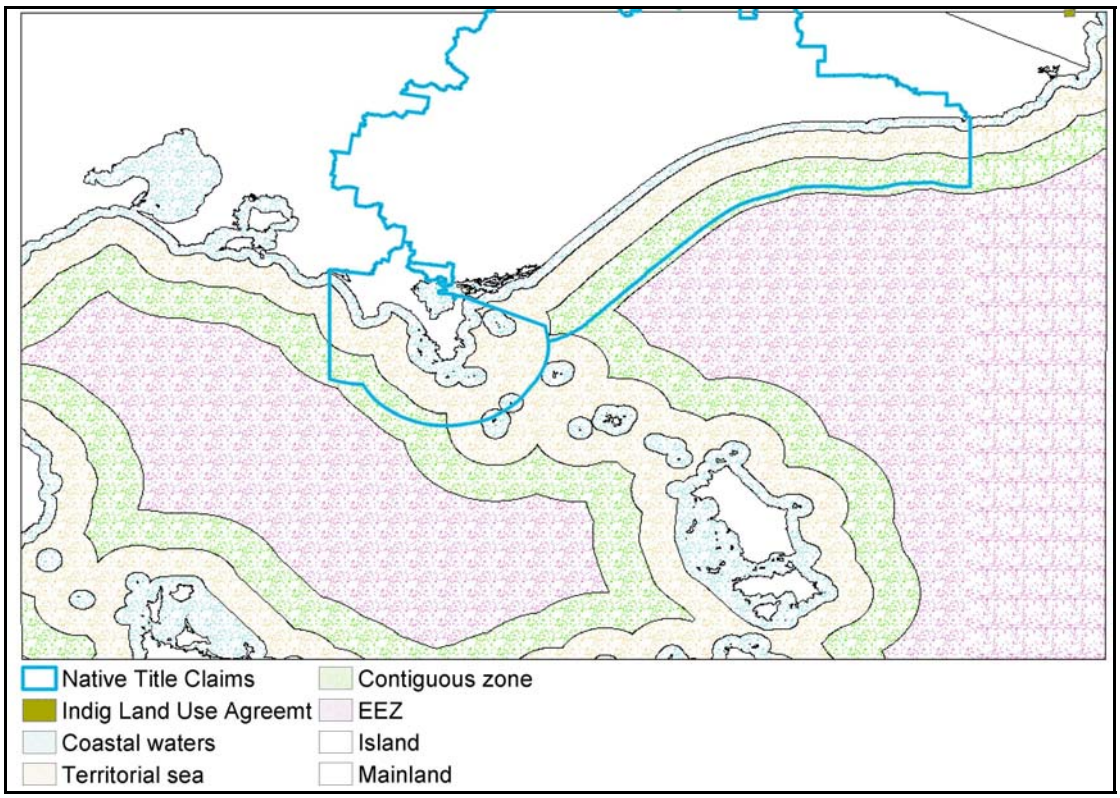



Figure 3.14 – Native title claims over areas of sea within the Victorian pilot project.

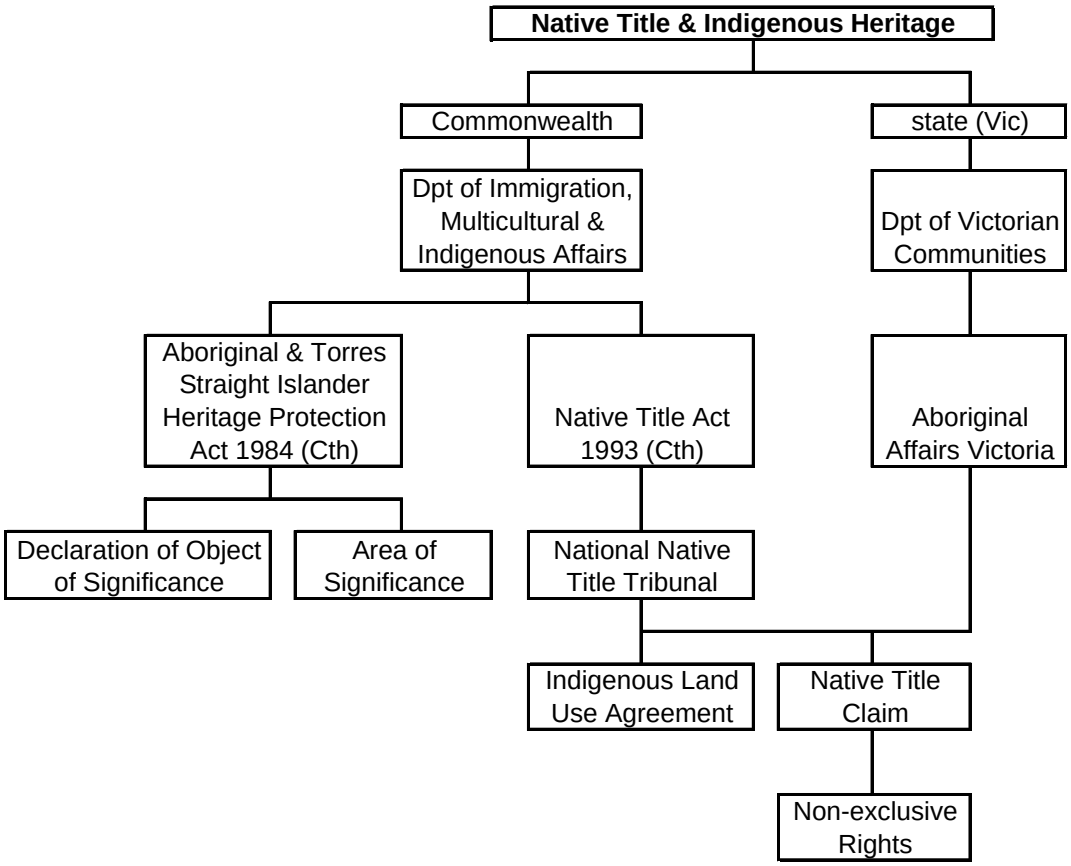



Figure 3.15 - Native title and indigenous heritage management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

## 3.3.8 Cables & Pipelines

***Regulatory Framework – Legal and Institutional Arrangements***

The Commonwealth government regulates pipeline leases under the *Petroleum (Submerged Lands) Act 1967 (Cth)* and the *Petroleum (Submerged Lands) (Pipelines) Regulations 2001 (Cth)*, through pipeline and infrastructure licenses. Once the pipelines reach the Victorian coastal waters, they are managed under the *Petroleum (Submerged Lands) Act 1982 (Vic)*, which mirrors the Commonwealths Submerged Lands Act to maintain, as far as practicable, common principles, rules and practices in the regulation of petroleum resources in state, Northern Territory and Commonwealth territorial waters (DPI, 2003a). The *Petroleum (Submerged Lands) Regulations 2001 (Vic)* are also used to manage pipeline licenses. As mentioned in section 3.3.1,

Victoria issues approvals and administers the Commonwealth Act for oil and gas exploration, and this is no different in terms of pipeline licenses.

The *Telecommunications Act 1997 (Cth)* regulates telecommunication carriers through a licensing system, with the Act extending to those services which use submarine cables. The Act is administered by the Department of Communications, giving the Australian Communications Authority the role of setting technical standards and ensuring compliance with the Act. The installation and maintenance of telecommunications cables is also affected by several other Acts, demonstrating the multiple use issues that are found in the use of the seabed and subsoil. These Acts include:

- *The Environment Protection (Sea Dumping) Act 1981 (Cth)*
- *The Environmental Protection and Biodiversity Conservation Act 1999 (Cth)*
- *The Petroleum (Submerged Lands) Act 1967 (Cth)*
- *The Offshore Mineral Act 1994 (Cth)*
- *Fisheries Management Act 1991 (Cth)*
- *Submarine Cables and Pipelines Protection Act 1963 (Cth)*
- *Crimes Act 1914 (Cth)*
- *Defence Act 1903 (Cth)*
- *Native Title Act 1993 (Cth)*
- *Historic Shipwrecks Act 1976 (Cth)*

(NOO, 2002a)

The *Submarine Cables and Pipelines Protection Act 1963 (Cth)* fulfils Australia's obligations under UNCLOS and is administered by the Commonwealth Department of Transport and Regional Services. The Act makes it an offence to break or damage a submarine telegraph or telephone cable, pipeline, or submarine high-voltage power cable, with those who do bearing the repair costs. The Act only applies to cables and pipelines beneath the high seas and EEZ.

| *THE REGULATORY FRAMEWORK FOR CABLES AND PIPELINES* |
|---|
| **Petroleum (Submerged Lands) Act 1967 (Cth) & Petroleum (Submerged Lands) (Pipelines) Regulations 2001 (Cth)**<br>Establishes the licensing regime that applies to exploration within the marine environment.<br>**Pipeline License**: Granted indefinitely, creating an easement over the area required to construct a pipeline and associated facilities. |
| **Petroleum (Submerged Lands) Act 1982 (Vic) & Petroleum (Submerged Lands) Regulations 2001 (Vic)**<br>State legislation governing pipeline licenses and exploration activity within the marine environment. |
| **Submarine Cables and Pipelines Protection Act 1963 (Cth)**<br>Fulfils Australia's obligations under UNCLOS by making it an offence to break or damage a submarine telegraph or telephone cable, pipeline or submarine high-voltage power cable within the high seas and EEZ. |
| **Commonwealth Department of Transport and Regional Services**<br>Administers the Submarine Cables and Pipelines Protection Act 1963 |
| **Telecommunications Act 1997 (Cth)**<br>Regulates telecommunications services which use submarine cables through a licensing system. |

Table 3.10 - Regulatory framework for cables and pipelines (NOO, 2002a)

***Legally Defined Boundaries & Associated Rights, Restrictions & Responsibilities***

The ability to construct and lay pipelines and cables is managed through cable, pipeline and infrastructure licenses. These licenses allow for “rights of way” to be granted along the sea floor, in much the same way as easements are granted on land for the creation of infrastructure such as water pipes and electricity cables. Infrastructure and rights of way within the Victorian pilot project are shown in Figure 3.16. The relationship between these rights, restrictions and responsibilities and legislation is shown in Figure 3.17.

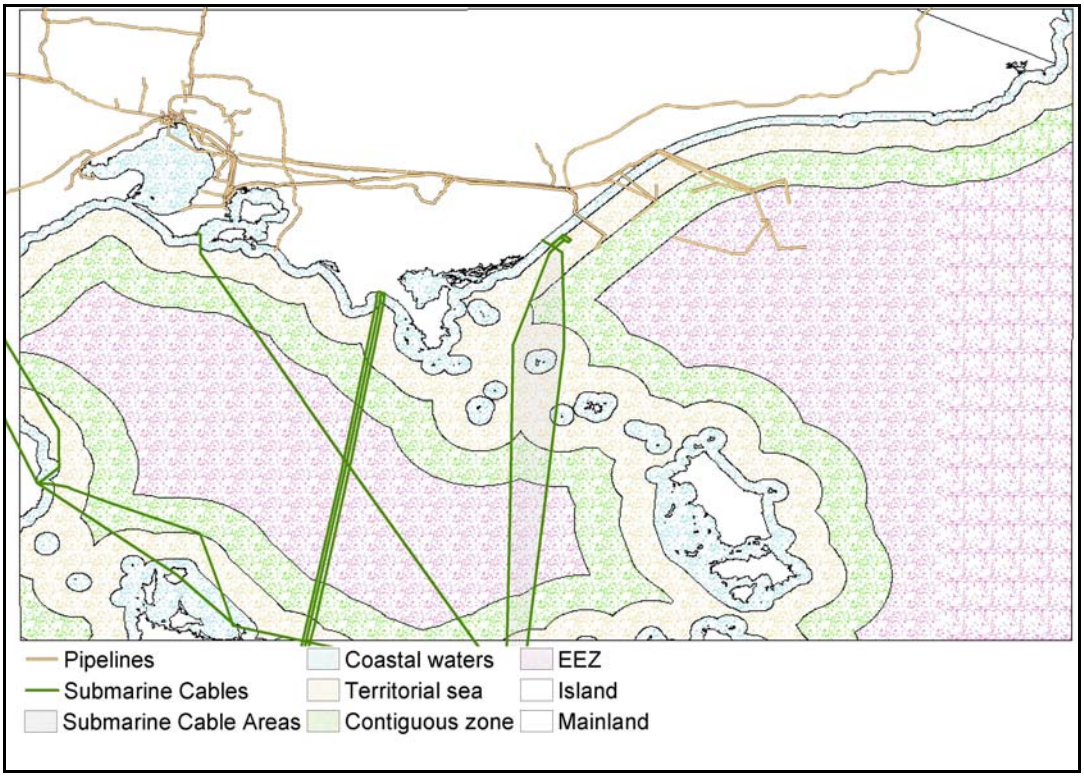



Figure 3.16 – Pipelines and cables within the Victorian pilot project.

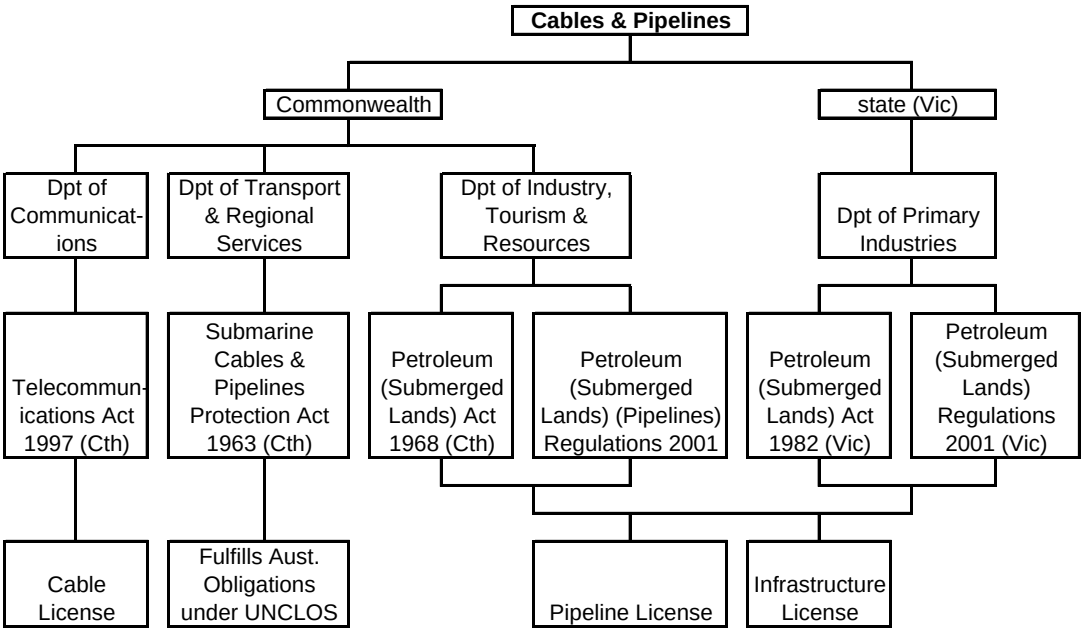



Figure 3.17 - Pipeline and cable management framework and the relationship to legally defined boundaries and associated rights, restrictions and responsibilities.

### 3.3.9 Coastal Zone

The addition of both land and ocean within Australia's coastal zone makes it one of the most difficult areas to effectively manage. Almost all of the legislation described within section 3.3 applies to the coastal zone in some form. Added to this are local government planning regulations for areas of foreshore, various marine zones enabling access to the ocean and state and Northern Territory based land legislation. Current regulatory methods for the management of the coastal zone separate it into land and sea, with the use of spatial information for this area also remaining separated. This separation hinders the development of solutions to issues which straddle the land-sea interface, such as the pollution of the marine environment from land based sources. For this to come about, the integration of management techniques and spatial data within the coastal zone needs to occur.

## 3.4 CONCLUSION

The concept of a marine cadastre is still in its infancy, with various opinions on the makeup and development of the cadastre. As seen from the review of international initiatives however, there are common themes between all of the spatial boundary management regimes currently being put in place. Some of the main issues that have been raised include:

- the ambulatory nature of the coastline;
- the size of the marine area to be managed;
- the numerous amounts of legislation and regulation relating to the marine environment;
- the complex spatial and temporal interaction;
- the need for mechanisms to facilitate quick and effective updates of data;
- the need for a virtual register of interests in the marine environment to support decision support systems; and
- the range and nature of marine activities and stakeholders.

This final point is illustrated in Figure 3.18 below, which shows the spatial extent of the various uses and activities that occur within the Victorian section of the ARC pilot project.

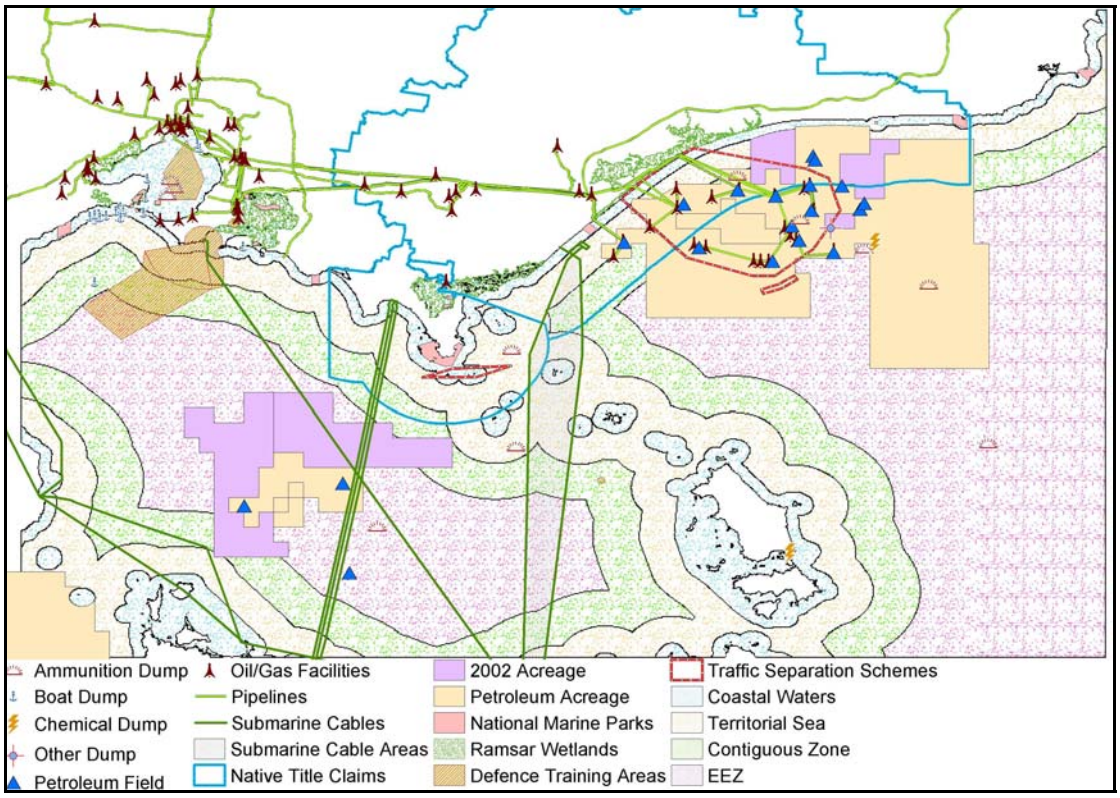



Figure 3.18 – Activities and uses within the Victorian pilot project.

Section 3.3 discussed the legal and institutional aspects of the major activities occurring within Australia's marine environment. The legislation which constitutes the cornerstone of ocean governance was identified along with the key institutions and agencies responsible for implementing such legislation. The description of the current arrangements in place to manage Australia's offshore environment demonstrates the complex inter-jurisdictional relationship between users and stakeholders of the marine environment. What was also discovered was a complex regime of geographically overlapping jurisdictions and activities, which were managed in a task-specific manner. This often results in redundant effort, inefficiency, ineffectiveness and a lack of coordination amongst agencies (Neely et al., 1998).

The ability to map and spatially define such jurisdictions would be an essential component for a more efficient and effective management regime, "balancing the rights and responsibilities of multiple users of seabed and subsoil areas, and ensuring that other activities that are permitted under relevant legislation can take place" (NOO, 2002a). The creation of a marine cadastre aims to extend this management

philosophy to all activities in the marine environment, to ensure that Australia's oceans are utilised effectively.

# 4.0 ISSUES TO BE CONSIDERED IN THE DEVELOPMENT OF A MARINE CADASTRE

## 4.1 INTRODUCTION

The previous chapter explored the current marine based cadastral initiatives that are at the forefront of marine management throughout the world, including those in the USA, Canada and New Zealand. Australia's current marine management arrangements were also discussed in section 3.3, expanding on the problem outlined in chapter 1. Section 3.3 included an assessment of the current legislative arrangements in place within the major maritime activities including shipping, maritime conservation, oil and gas exploration and cables and pipelines. Administrative and legal boundaries and associated rights, restrictions and responsibilities were also identified.

This chapter follows on from these areas by giving a broad overview of the issues and problems identified through research and consultation with the marine community. Section 4.2 introduces and discusses findings from a broad spatial information based questionnaire conducted as part of the ARC marine cadastre project. Two marine cadastre workshops have also been held within the course of this thesis, with participation from industry, government and academia. Relevant issues which were addressed within these workshops are discussed in section 4.3. Private consultation with stakeholders in the marine environment was also conducted, which concentrated on legal, institutional and technical aspects of marine management. The subsequent findings and other relevant issues stemming from the consultations, questionnaire and workshops are presented in section 4.4

## 4.2 QUESTIONNAIRE

Spatial data plays an important role in aiding planning and management decisions in both the terrestrial and marine environments. The issues of access to and requirements of such data are well documented on land, but not so in the marine environment. As part of the ARC marine cadastre project, a questionnaire (Appendix A) was formulated as a tool to evaluate the usage and requirements for spatial data in the marine environment. The results of this questionnaire will aid in the design of features and capabilities of a future marine cadastre for Australia.

The questionnaire was made available to the public on-line from September 2002, with over 110 responses received over the following four months. The main objectives of the questionnaire were to:

- Identify major users, suppliers and producers of marine spatial data.
- Identify the main categories of marine spatial data.
- Understand the ways in which marine spatial data is being used.
- Identify the limitations and short comings of currently available marine spatial data.
- Identify the ways in which marine spatial data can better serve the needs of users.

(Forse and Collier, 2003)

The most relevant results from the questionnaire have been split into three areas (spatial/institutional, legal and technical) and are summarised below.

***Spatial / Institutional***

- There were four core marine business areas identified by the questionnaire (see Fig. 4.1), including environmental issues, scientific research, administration and management, and commercial industry.

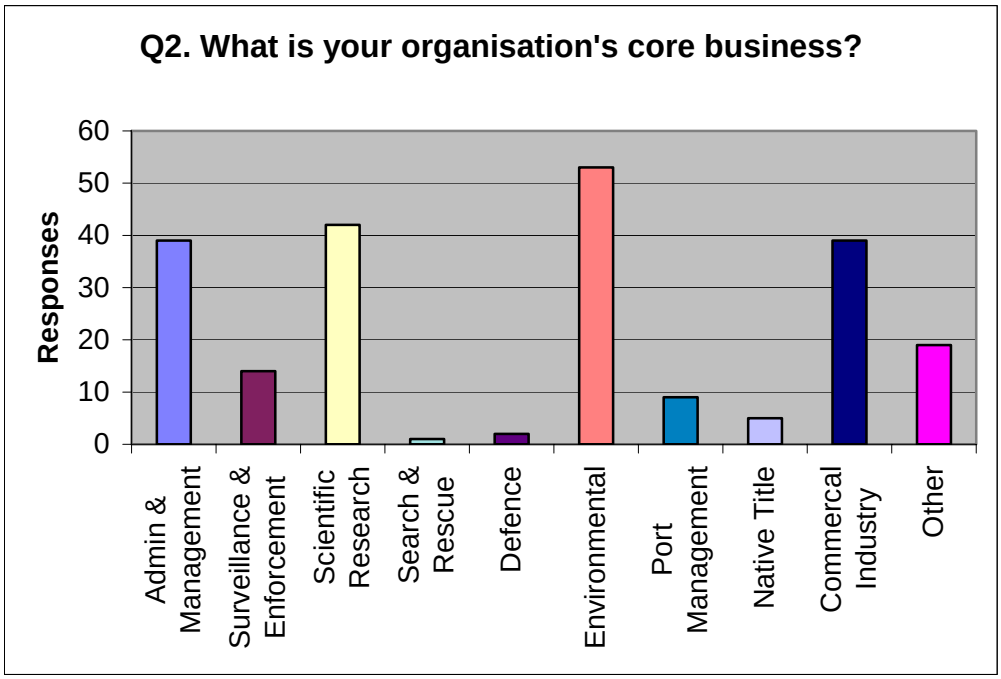



Figure 4.1 – Question 2

- The importance of spatial information as perceived by respondents is overwhelming with 94% claiming that it is an essential or important part of their business operations (see Fig. 4.2).

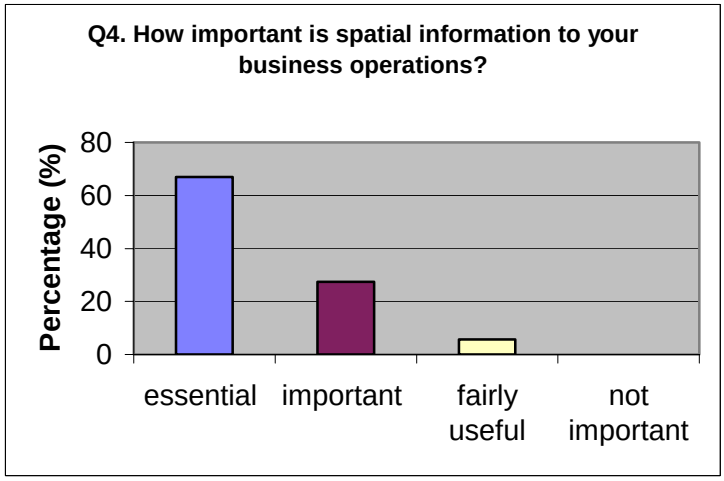



Figure 4.2 – Question 4

- The majority of respondents require 3 and 4 dimensional spatial information in the marine environment to adequately address their needs (see Fig. 4.3). This includes variations in time, for example a seasonal fishing area.

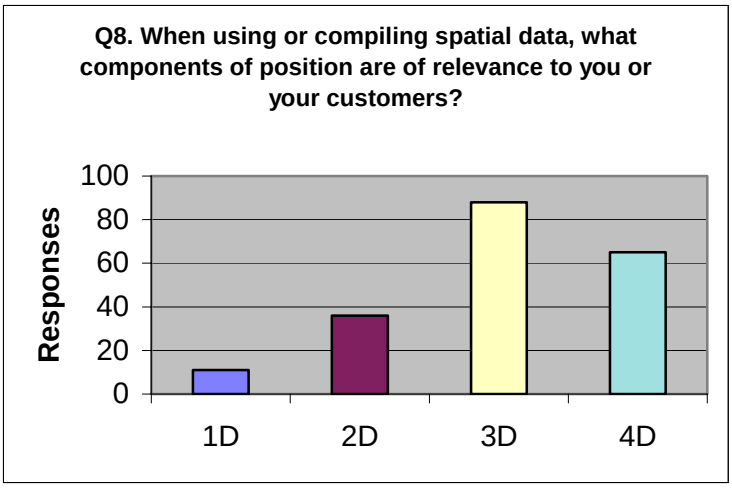



Figure 4.3 – Question 8

- Users of offshore data are also very dependent on the data being up-to-date, reflecting recent changes in the marine environment, with no respondents claiming that it was not important at all (see Fig. 4.4).

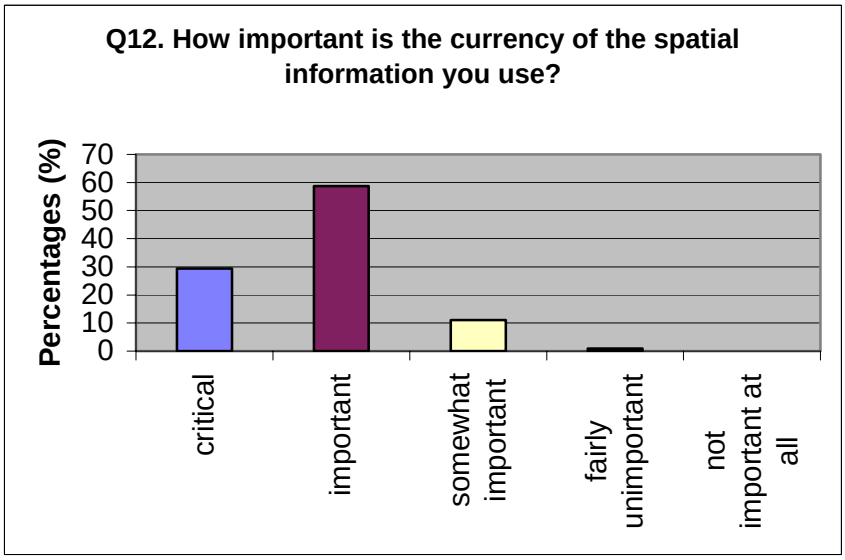



Figure 4.4 – Question 12

- Metadata (data that provides information or documentation of other data) is also very important to respondents, with over 30% citing it as critical to their needs (see Fig 4.5).

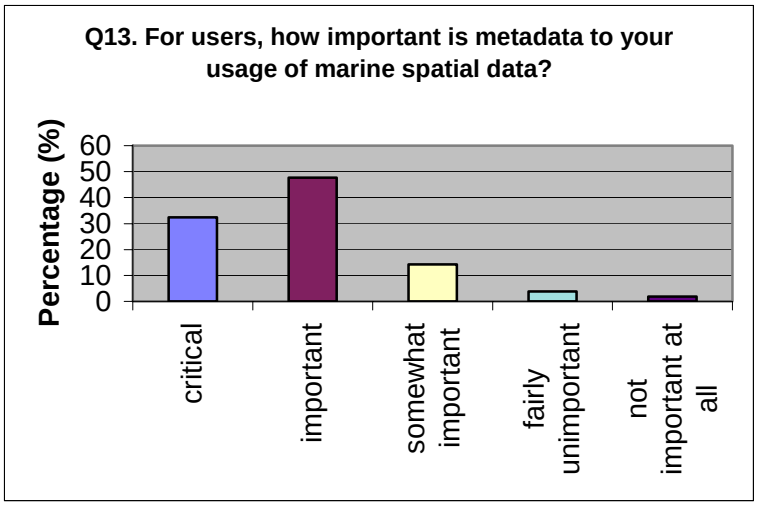



Figure 4.5 – Question 13

- Despite the importance of metadata, the producers of data do not always supply such information to marine stakeholders (see Fig. 4.6). Some producers are even unsure if they do or do not provide metadata.

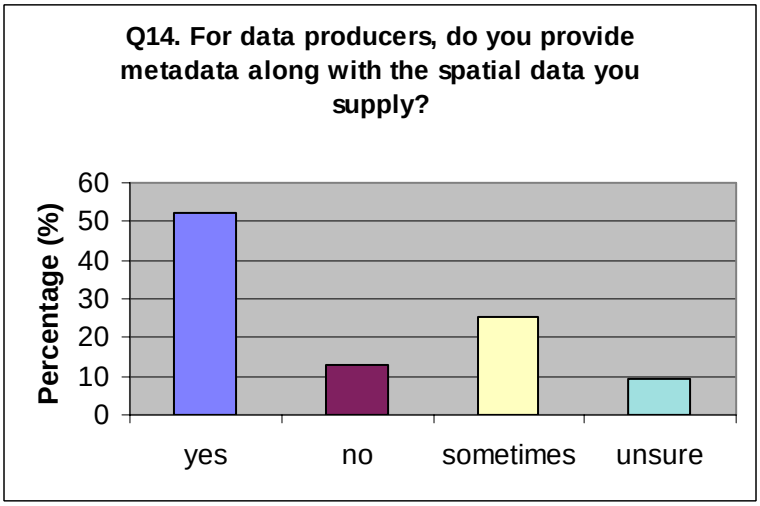



Figure 4.6 – Question 14

- Question 22 asked respondents how the spatial data used could be improved to better serve their purposes. The top four responses were to make data more accessible, for it to provide more information, for it to be more accurate and also more current (see Fig. 4.7).

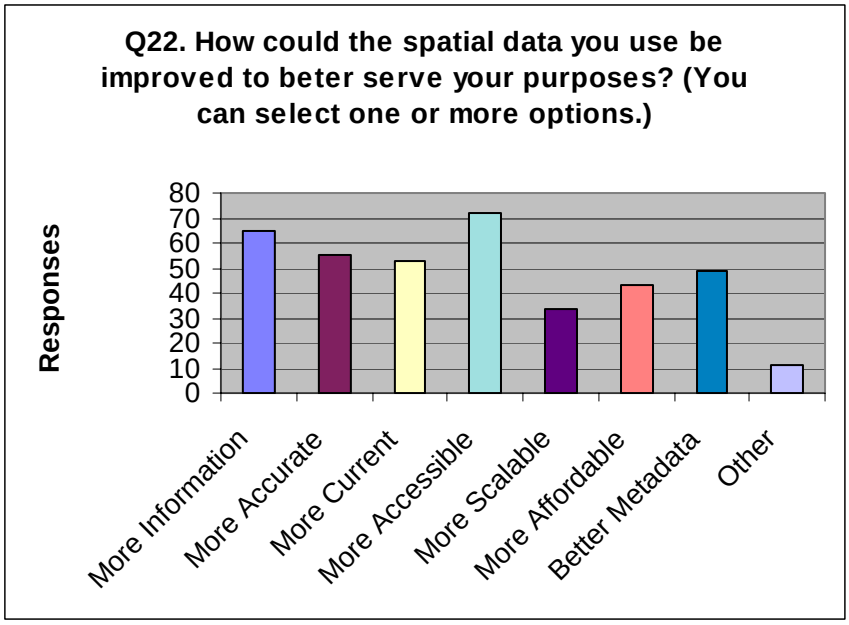



Figure 4.7 – Question 22

- Half of the respondents indicated that they have trouble accessing the spatial data that they need (see Fig. 4.8).

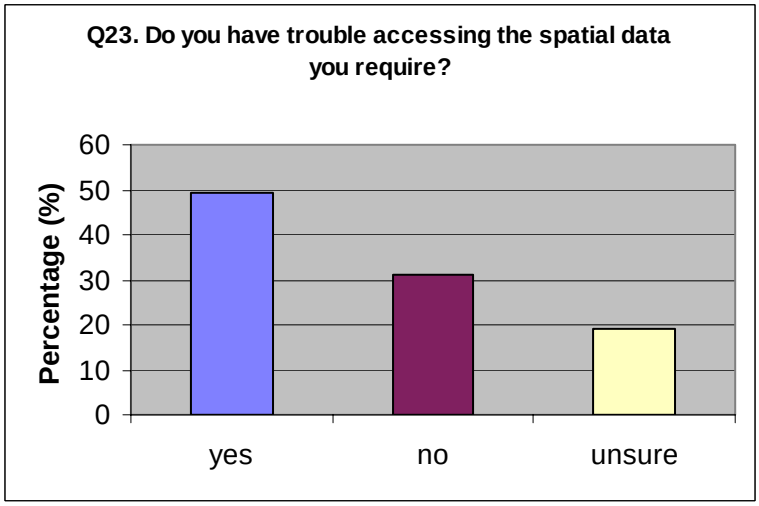



Figure 4.8 – Question 23

- Those surveyed stated that the main impediments to accessing data were finding it and the cost of the data. Format and licensing are also seen as major issues (see Fig 4.9).

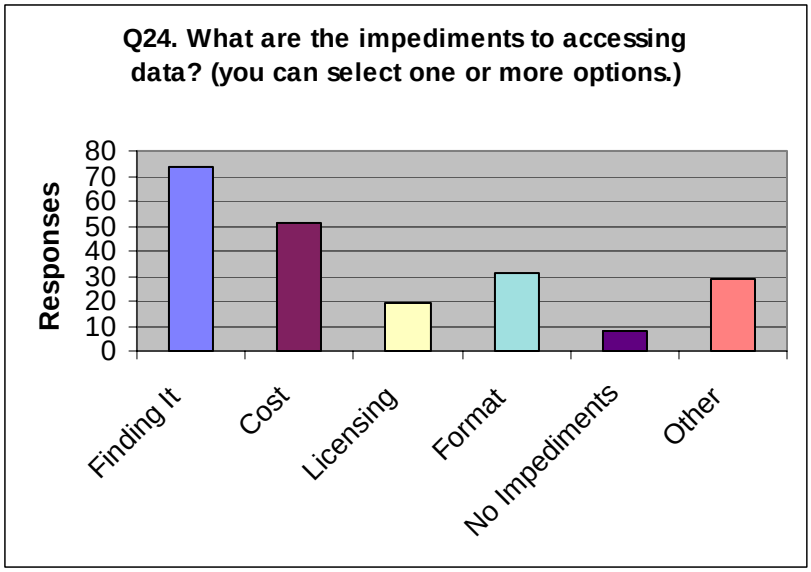



Figure 4.9 – Question 24

- Respondents indicated that a greater amount of detail in the spatial data which they access would be of an advantage. The main areas of additional detail included bathymetry, ecological information, marine parks, boundaries, links to law and fishing areas (see Fig. 4.10). There were over 580 responses to this question, which averages out to each stakeholder requesting over five different areas of data where more detail would aid in their particular operation.

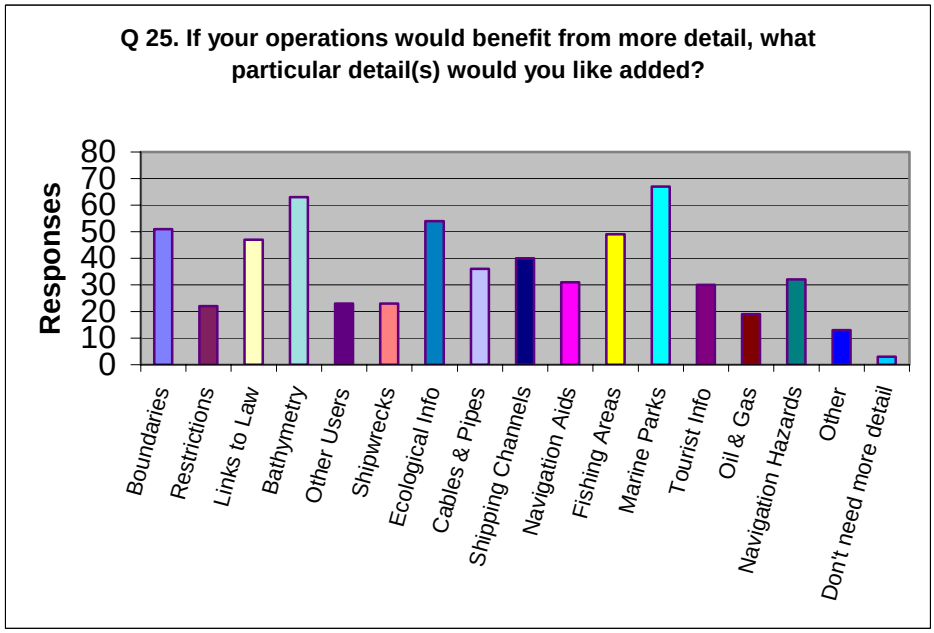



Figure 4.10 – Question 25

The major spatial/institutional issue that the questionnaire highlights is the need for respondents to gain access to accurate and up-to-date spatial information.

Stakeholders are concerned not only with information relating to their particular activity, but also information about other stakeholders that impacts on their activities. This demonstrates the nature of overlapping interests within the marine environment. The only way that such areas can be effectively managed is with spatial knowledge detailing where each individual activity occurs, so that conflicts of interest can be minimised.

***Legal***

The major legal area of concern highlighted by the questionnaire is the lack of stakeholder knowledge of the instruments of governance under which they operate in the offshore environment. Question 20 asked respondents to identify the legislative controls under which they operate. The response rate to this question was extremely low. This could be due to the amount of legislation that governs the marine environment, with international treaties, conventions and federal and state legislation all needing to be considered. The ability of respondents to identify the legislation which effects their activities in the marine environment needs to be improved in order to facilitate more effective marine management.

***Technical***

In terms of technical issues, Question 17 asked respondents if their work in the marine environment was affected by the intersection of a tidal plane with the land. As can be seen from Figure 4.11 below, almost 70% of respondents indicated that they were in some way dependent on tidal plane definitions. When asked to say which tidal plane they used however, the response rate was poor. This could indicate that respondents were unsure of exactly which one their work related to. This also relates back to respondents' inability to identify tools of governance in the marine environment, as definitions of which tidal plane is used and for what purpose are often embedded within legislation.

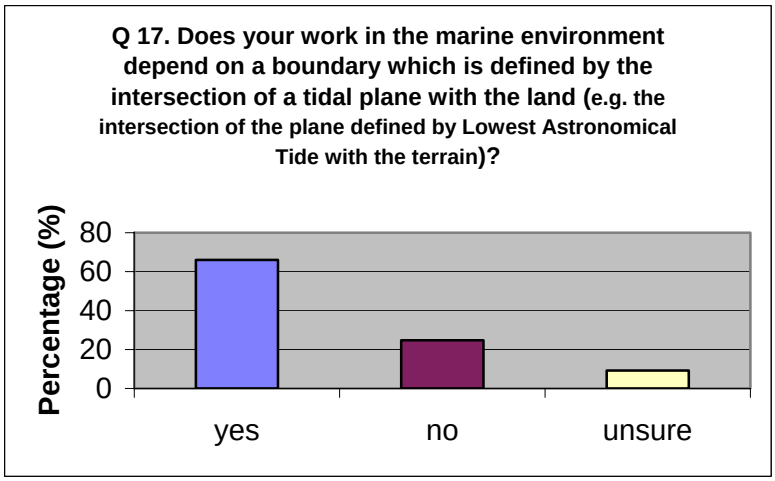



Figure 4.11 – Question 17

Results from the marine cadastre questionnaire highlight the important role that spatial information plays in aiding organisations to manage the range of rights, restrictions and responsibilities in the marine environment. The resolving of issues arising from the questionnaire such as where, how accurate and how up-to-date marine spatial information is, would go a long way to resolving many current problems facing marine stakeholders.

## 4.3 ARC WORKSHOPS

Following on from the marine cadastre questionnaire, two workshops were held as part of the ARC marine cadastre project. The first was held in August 2002 in Townsville and marked the launch of the Queensland section of the pilot project. The second was held in Melbourne in November 2002, building on and complimenting the Townsville workshop. The aim of the workshops was "to provide a forum for the presentation and discussion of issues and ideas by those who work or have an interest in the marine environment and for whom spatial data is a key element in the fulfilment of that role" (Collier, 2002). This section describes the key issues that were discussed in the workshops, helping to create a greater understanding of the requirements of industry in the creation of a marine cadastre for Australia.

### 4.3.1 Townsville

The Townsville Workshop was held with the intention of documenting the business requirements of a marine cadastre for members of both the public and private sector, with a particular interest in marine boundaries. It aimed to provide an opportunity for registrants to contribute to the design of a marine cadastre by voicing their own business needs.

One of the major issues raised at the workshop was the perceived danger in waiting for a marine cadastre to simply 'evolve' out of the current range of management systems in place. The idea of designing a unique marine cadastre for the marine environment was put forward at the workshop, as a means of overcoming this danger. The needs of marine data users would feed in to the development of a maintenance environment, which concentrates on the updating and upgrading of data, not the actual creation of the datasets themselves. The custodians of datasets would continue to gather data, which would then feed in to the maintenance environment (Todd, 2002). Users of maritime data could then access the most accurate and up-to-date spatial data from the one location. Attendees also decided that compatibility between the marine and terrestrial environments was important, and that land cadastre principles may have an important role to play in the marine environment. This meant that while the development of such a maintenance environment would be advantageous, it should aim to be compatible with its land-based counterpart.

The Queensland component of the pilot project was also launched at the Townsville workshop and focused on solving Queensland issues in the context of a national infrastructure. This is being implemented through a collaborative strategy based on commitment expressed by those involved in a partnering charter. The pilot is concentrating on the analysis of legal and spatial entities and the means of maintaining and delivering them to marine stakeholders. This includes sovereign, jurisdictional, administrative and tenure boundaries. The pilot is also addressing issues involved with the approximation of tidal planes and some limited aspects of the visualization of maritime data (Todd, 2002).

### 4.3.2 Melbourne

The attendees of the Melbourne Workshop represented a wide range of maritime activities, including government agencies, private industry, not-for-profit organisations, special interest groups, and scientific and research institutions. The main objectives of the workshop were to:

- Raise awareness of the concept of the marine cadastre.
- Consult with those using or producing marine spatial data.
- Identify issues in the use of spatial data offshore.
- Collaborate with users in the design testing and refinement of a marine cadastre.
- Develop a vision for a future marine cadastre.

(Collier, 2002)

There were a range of issues raised by attendees of the workshop, and these have been separated into two categories and summarized in tables 4.1 and 4.2 below.

| **Institutional & Legal issues identified** |
|---|
| Need a system to link all the different data providers. |
| Metadata needs to be provided with marine data. |
| Fundamental marine data should be provided free of charge. |
| How will marine data be transferred to and from stakeholders and custodians? |
| Will there be standard symbology? |
| What will be the legal status of the marine cadastre? |
| Who is the intended audience of the marine cadastre? |
| What is the geographical extent of the marine cadastre? |
| Will the marine cadastre show the real thing at scale? |
| Where does the ASDI and current marine data custodians fit in? |
| Lack of lead agency in marine environment. |
| Need clarity over jurisdictional status along the coastline at high and low tide. |
| Methods of boundary descriptions in legislation are ambiguous. |
| Need clear jurisdictional boundaries within the marine environment. |
| Marine cadastre must follow nationally agreed standards. |
| Need standard datum and format across agencies. |
| Need overlap of the terrestrial and marine cadastres. |
| Who is responsible for the operation and maintenance of a national marine cadastre? |
| What will happen to marine operations which straddle the land-sea boundary? |
| Increased community participation and education is needed. |

Table 4.1 - Institutional and legal issues identified

| Spatial data issues identified |
|---|
| There are currently many separate data providers which require separate license agreements. |
| What marine data currently exists and where can it be found? |
| There is no standard format across marine data. |
| There is no standard scale across marine data. |
| How can data be accessed? |
| There is no interoperability between current data systems within the marine environment. |
| There is no standard spatial data management system across marine jurisdications? |
| The cost of data. |
| What is the legal accuracy across datasets within the marine cadastre? |
| Data needs to be current and up-to-date. |
| Three dimensional data is needed in the marine environment. |
| Data relevant to time is needed by some marine stakeholders (4D). |
| Need to measure environmental change within the marine environment. |
| Will there be a data dictionary within the marine cadastre? |
| How is marine boundary uncertainty dealt with in a marine cadastre? |

Table 4.2 - Spatial data issues identified.

The range of issues discussed at the Melbourne workshop follow a similar trend to those that became apparent through analyzing the results of the questionnaire. One of the main advantages of holding the workshop was that the concept of a marine cadastre was able to be discussed amongst the broad cross section of maritime stakeholders who attended. The major trend that emerged was the need for a strong link to be made between the terrestrial and marine cadastres through the use of the ASDI. It was also noted that research should first look to the terrestrial cadastre for guidance in developing the marine cadastre, which is discussed further in chapters 6 and 7.

## 4.4 MARINE MANAGEMENT ISSUES

The feedback gained from the questionnaire and workshops has created a broad picture of the issues and problems effecting users and managers of the marine environment. Industry consultation has also been undertaken with a variety of stakeholders in both the government and private sectors. The major issues and impediments to the effective management of maritime boundaries and associated rights, restrictions and responsibilities have been divided into three main categories (legal, institutional and technical) and are discussed below.

### 4.4.1 Legal

As discussed in chapter 2 of this thesis, Australia's marine environment is not governed by a single legislative framework, with various pieces of legislation evolving over the past century, ranging from fisheries regulation through to the protection of aboriginal cultural heritage. UNCLOS is the overarching international statute, however state, Northern Territory and Commonwealth legislation must take into account at least 50 other international treaties and conventions that deal with marine related matters to which Australia is a party. Domestically, Australia also has in place the OCS (see section 2.2.1), which allows the state, Northern Territory and federal governments to jointly manage particular coastal jurisdictions.

Another impediment to effective management of Australia's marine environment is the volume and complexity of legislation. According to the National Oceans Office there are roughly 600 pieces of state, Territory and Commonwealth legislation which currently manage ocean use and ecosystem health in Australian waters (NOO, 2002a). More than 100 pieces of Commonwealth legislation apply to marine and ecosystem health in the South-east marine region of Australia, in which the Victorian section of the ARC pilot project is located. Research has also identified over 50 pieces of Victorian legislation which would apply to more local activities and stakeholders utilising a marine cadastre. Greater detail on the most relevant Acts which need to be taken into account in the process of creating a marine cadastre can be found in section 3.3.

The way in which legislation is written can also be misleading. Most of the older legislation pertaining to individual marine matters was written in isolation, without taking into account the activities and requirements of other stakeholders in the marine environment. This has recently been changing, with new legislation such as the EPBC Act taking into account the diverse nature of the ocean and its use. This act pulls together the various environmental rights, restrictions and responsibilities which must be adhered to if the nation's oceans are to remain environmentally sustainable. This includes the impact that international treaties have on Australia's environmental management.

The issue of legislation being created in isolation is also cause for a degree of ambiguity within legislation. For example tidal datums are used to demarcate the natural boundaries between land and sea. There is a need to have a clear and consistent definition of each tidal datum. While such definitions exist within relevant legislation, they vary between pieces of legislation, creating considerable confusion. Table 4.3 below shows the definition of Mean High Water (MHW) as given by various acts. This boundary marks the outer edge of rights to freehold title and is also the outer edge of council planning zones.

| State | Department | HWM | Legislation | Definition |
|---|---|---|---|---|
| QLD | Department of Primary Industries | **high water** | FISHERIES ACT 1994 - SECT 4 | **"high water"** means the mean height of the **highest high water at spring tide**. |
| QLD | Department of Primary Industries | **high water** | MARINE PARKS (CAIRNS ZONING PLAN) ORDER 1992 - SECT 2 Interpretation | **"high water**" means the mean height of the **higher tide at spring tides**; |
| QLD | Environmental Protection Agency | **high water mark** | COASTAL PROTECTION AND MANAGEMENT ACT 1995 - SCHEDULE 2 | **"high water mark"** means the ordinary **high water mark at spring tides**. |
| QLD | Department of Primary Industries | **high water** | MARINE PARKS (WOONGARRA ZONING PLAN) ORDER 1991 - SCHEDULE 1 | **"high water"** means the **Mean High Water Spring (MHWS) tide level**; |

Table 4.3 - Definitions of high water – (Finney, 2002)

The definitions of high water contained in Table 4.3 are from various Queensland Acts yet are all slightly different. There are a number of interpretations that can be made from the definitions which would vary the physical location of MHW.

There is also uncertainty and ambiguity in terms of identifying the spatial limits of boundaries described in legislation. This is due to two factors. The first is that older legislation was not written with modern mapping technology in mind. The legal description may not adequately describe the geography or it may be extremely complicated to develop a mapping solution to the area. A system of bearings and distances is used in older legislation to describe legally defined boundaries, with such descriptions often not accurate enough to undertake boundary delimitation. The second fact is that people who write legislation generally do not have a spatial background. Even when legislation is updated, the spatial data community is not

asked to comment on how to accurately describe boundaries. Both of these factors can result in ambiguous spatial definitions of geographic areas or boundaries in legislation. Three examples are shown below.

Example 1: This is the most common form of boundary definition within legislation

> The area the boundary of which commences at a point that is the intersection of the coastline at mean low water by the boundary between the States of New South Wales and Victoria and runs thence south-easterly along the geodesic to a point of Latitude 37º 35´ South, Longitude 150º 10´ East, thence south-easterly along the geodesic to a point of Latitude 40º 40´ South, Longitude 158º 53´ East, thence south-westerly along the geodesic to a point of Latitude 41º 30´ South etc…(describing the adjacent area in respect to Victoria).
>
> (Petroleum (Submerged Lands) Act 1967 (Cth), section 2A)

Example 2: Within the extract below, the term "generally south" is used to describe the boundary of part of the Australian fishing zone. This term introduces an element of uncertainty to the description. There is also reference to the "shore" which is ambulatory in nature and likewise ill-defined.

> DANISH SEINE AREAS PART 1-EASTERN SECTOR That part of the Australian fishing zone that is within the area bounded by a line:
>
> (a) commencing at the intersection of the eastern shore of Australia with the parallel of Latitude 33¼ 35' South;
>
> (b) then running east along that parallel to its intersection with the outer limit of the Australian fishing zone;
>
> (c) then **generally south** along that outermost limit to its intersection with the parallel of Latitude 40¼ 00' South;
>
> (Fishing Management (South East Trawl Fishery) Regulations 1998 (Cth), schedule 3)

Example 3: This example is one of the most ambiguous, with geographical features rather than coordinates used to define boundary extents.

> to a point on the **coast** approximately 1.9 kilometres north-east of Lorne, thence generally south-westerly along the **coast** to the southern most point on Cape Otway, thence west-north-westerly by a line to Thunder Point on Lady Julia Percy Island,

> thence generally north-westerly by the shore of that island to West Cape, thence north-westerly by a line to where the boundary between the Shire of Heywood (formerly Portland) and the Shire of Belfast intersects the **coast**, thus completing the boundary, (describing an Aboriginal Trust)
>
> (Aboriginal and Torres Strait Islander Heritage Protection Regulations 1984 (Cth), schedule 4)

This final example also highlights the importance of geographically registering place names. The legislation describes a boundary that runs "west-north-westerly by a line to Thunder Point on Lady Julia Percy Island". The geographic extent of both Thunder Point and Lady Julia Percy Island must be known in order to accurately define such a boundary.

If the regulatory framework for the oceans is to be effective, then the spatial component of such a framework must be accurate and unambiguous. For this to occur, legislation must be geo-referenced, highlighting the need to engage other disciplines, such as the legal profession, in the development of a regulatory framework for Australian marine environment.

### 4.4.2 Institutional

Australia's interest in the marine environment has arisen historically from sectoral planning, with fisheries agencies managing fisheries and environmental agencies managing the environment, in much the same way as there is no one legislative framework for Australia's marine environment, previously described in chapter 3. There is also a large variety and number of stakeholders. The task of efficiently and effectively managing all stakeholders is complicated by the fact that their rights can often overlap, creating competing rights, restrictions and responsibilities. This gives rise to the need for cooperation between agencies, something which can be difficult to achieve. Often, agencies function in isolation from one another and hence stakeholders such as commercial fisherman may only have clear spatial certainty of what rights other fisherman have within prescribed fisheries. This does not meet users needs adequately as there may also be shipping channels or a newly prescribed native title area within the fishery that they may have no knowledge of.

The problem of a lack of knowledge about what rights exist within the marine environment is further compounded by an inability to access up-to-date and accurate spatial information relating to maritime boundaries and activities. This limits the ability to make quick and well-informed decisions. Generally, each agency collects and disseminates its own spatial data which can be timely and expensive, and often the same type of data is collected by various agencies at various accuracies due to a lack of cooperation between them. Figure 4.12 below demonstrates this point showing pipeline data collected by two different agencies (pipelines 1 and 2) within the Victorian pilot project.

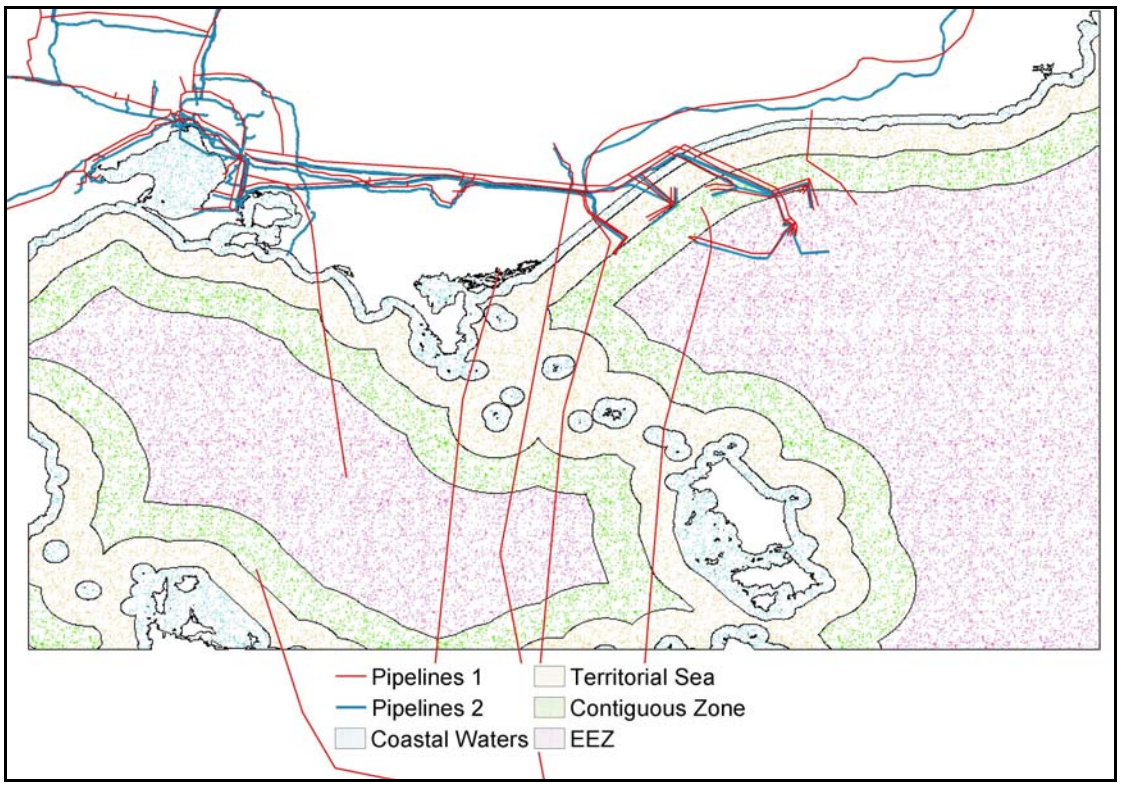



Figure 4.12 – Pipeline data from two different sources within the Victorian pilot project.

There are also major issues in the management of Australia's coastal zone. Within the state of Victoria, for example, local councils have jurisdiction out to MHW. As stated in table 1 (section 2.2.1), the state and Northern Territory governments jurisdiction over the 3nm zone begins at the Territorial Sea Baseline (TSB) (also, the point of Lowest Astronomical Tide - LAT). This leaves a strip of coastal area between MHW and LAT that does not come under any direct management

jurisdiction. This gap between the terrestrial and marine environments needs to be bridged in order to aid in coastal environmental and planning issues such as:

- Urban, industrial and tourism planning and development;
- Public health and safety issues including oil companies, fisheries and environmental organizations;
- Pollution and waste control from farms, coastal industrial development and coastal residents, including nutrient run-off and the positioning of outlets into the ocean;
- Commercial and recreational fishing activities within and around marine parks; and
- Commercial harvesting of living and non-living natural resources within the coastal zone.

(Widodo, 2003)

The key to bridging this gap is compatible spatial information spanning the coastal zone. For this to occur however, there is a need for a lead agency to be created for the marine environment. This agency would be responsible for facilitating an overarching framework for Australia's oceans, providing guidance on access to spatial information and addressing issues of national importance.

### 4.4.3 Technical

The discontinuity between the land and marine environments is compounded by the inability to accurately define tidal datums such as Low Water Mark (LWM), which are used to determine the boundaries between international, national, state and private rights. The ambulatory nature of the coastline is a problem which all nations face and the ability to take this into account would greatly aid in coastal zone and marine management.

One of the major technical issues that came out of the questionnaire and workshops was that the nature of the marine environment is three dimensional, with different activities occurring on the surface of the ocean, across the water column and beneath the sea-bed. There are also instances in which a fourth dimension is introduced. An example can be seen in the techniques used to regulate fisheries, with some regulated seasonally, adding the advent of time over a three dimensional space. The modelling

of such three and four dimensional spatial characteristics is a major hurdle to the development of a truly spatial representation of the rights, restrictions and responsibilities in the marine environment.

Research into technical issues such as those discussed above is currently being undertaken within the broader context of the ARC marine cadastre project, but not specifically within this thesis.

## 4.5 CONCLUSION

The development of a questionnaire, industry consultation and the running of two workshops within the two pilot project jurisdictions has enabled the identification of a broad range of institutional, legal and technical issues affecting the management of Australia's marine environment. The major issues identified include:

- the complex nature of ocean governance;
- the need to identify not only what legislation applies to the marine environment, but also where it applies, including identifying the spatial limits of boundaries described within legislation;
- providing greater access to up-to-date and accurate marine spatial data;
- more effective and efficient management of the coastal zone;
- 3 and 4 dimensional nature of maritime activities;
- overlapping nature of activities within the marine environment; and
- the need for greater cooperation between agencies and stakeholders in the marine environment.

In order for such issues to be overcome, a whole-of-government approach to the management of Australia's marine environment is needed. This includes identifying organizations that have a mandate to manage marine datasets, overcoming laws and regulations that promote conflicts in marine spaces, and defining ambiguous terminology and spatial definitions within legislation. The main aim must be to facilitate greater cooperation between stakeholders and users of the marine environment.

# 5.0 MARINE CADASTRE CONCEPT

## 5.1 INTRODUCTION

The previous chapters have identified and analysed the current legal and institutional aspects of marine management in relation to Australia as a whole (chapter 2) and also in relation to the 'task-specific' management of industries (chapter 3). This chapter attempts to define the concept of a marine cadastre by building on current marine cadastre knowledge and research. A diagram has been developed to aid in visualising the marine cadastre concept.

## 5.2 MARINE CADASTRE DEFINITION AND CONCEPT DIAGRAM

The concept of a marine cadastre is being considered by a number of countries, (as seen in section 3.3) in order to address the issues and problems identified within the previous chapters of this thesis. Due to the complex and changing nature of the marine environment, there are currently several different definitions for a marine cadastre. Robertson et al., (1999) describe the marine cadastre as:

> A system to enable the boundaries of maritime rights and interests to be recorded, spatially managed and physically defined in relationship to the boundaries of other neighbouring or underlying rights and interests.

Nichols et al., (2000) have a slightly varied understanding of the marine cadastre, introducing concepts of ownership and the need to record rights and responsibilities in addition to the recording of boundaries. They describe the marine cadastre as:

> A marine information system, encompassing both the nature and spatial extent of the interests and property rights, with respect to ownership, various rights and responsibilities in the marine jurisdiction.

In order to illustrate the relationship and interaction between marine rights and responsibilities, Sutherland (2000) at the University of New Brunswick has developed a conceptual diagram of the complex set of rights and controls offshore, showing the overlapping nature of relationships between stakeholders and the 3 dimensional nature of the ocean (Figure. 5.1).

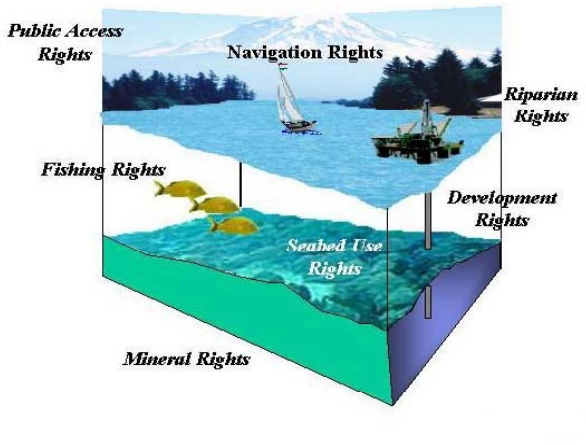



Figure 5.1 – The Marine Parcel (Source: Sutherland, 2000)

What this diagram fails to show however is the interaction that the marine environment has with the terrestrial environment. As mentioned in section 2.3.2, issues such as pollution and coastal zone planning and management do not stop at the land-sea boundary, and hence the two environments cannot be treated in isolation. The cadastre developed to govern rights in the marine environment must be compatible with its land based counterpart.

The ARC marine cadastre group at the University of Melbourne have used the University of New Brunswick marine cadastre diagram and previously stated definitions of a marine cadastre as the starting point for the development of an alternate marine cadastre concept diagram, Figure 5.3.

The first aim of this diagram is to demonstrate the fact that for the marine cadastre to be effective, it must not be developed in isolation from the terrestrial environment. As discussed in section 4.4.2, most of the maritime activity occurs in and around the coastal zone or tidal interface. This area straddles both land and sea and is the public access point to the marine environment. The linking of the marine and terrestrial

cadastres will enable the seamless integration of spatial data at the land-sea interface, facilitating a more integrated and effective approach to coastal zone management.

The diagram also shows the range of stakeholders and activities that occur within the marine environment. As can be seen from the summary below (Table 5.1), there is a large diversity of interests, ranging from tourism and recreational activities such as diving and swimming, to the disposal of waste such as jarosite and chemical dumps. It is not the actual activities that the marine cadastre must take into account, but the administrative and legal boundaries which govern where and when such activities occur. The rights and restrictions that go along with such boundaries must also be recorded. For example, marine protected areas have defined boundaries for the purpose of excluding or restricting the rights of other stakeholders within such an area. Knowledge of these rights and restrictions needs to be attached to the boundaries in order for them to be effective. In essence, the marine cadastre would provide the means for delineating, managing and administering such legally definable offshore boundaries.

| Activity | Includes: | Activity | Includes: |
|---|---|---|---|
| ***Tourism & Recreation*** | Diving<br>Boating<br>Fishing<br>Swimming | ***Aquaculture Leases*** | Mussle Farms<br>Abalone Farms<br>Spat Gathering Areas<br>Oyster Farms |
| ***Marine Protected Areas*** | Marine National Parks<br>Marine Sanctuaries | ***Mineral and Evergy*** | Mineral Exploration<br>Oil and Gas Exploration<br>Resource Extration |
| ***Shipping*** | Commercial Shipping<br>Freight Haulage<br>Passenger Ferries | ***Native Title*** | Non-exclusive access to the sea and sea-bed. |
| ***Heritage*** | Shipwrecks<br>Indigenous Artifacts | ***Ocean Waste Disposal*** | Ammunition Dumps<br>Chemical Dumps<br>Jarosite Dumps<br>Scuttled Vessels<br>Land-based sources |
| ***Cables and Pipelines*** | Oil and Gas pipelines<br>Telecommunications<br>Electricity Cables | | |

Table 5.1 - Activities in Australia's marine environment

The marine cadastre must also take into account activities that occur within different sections of the ocean, including on the surface, on and beneath the sea-bed and through the water column. This three dimensional nature makes it difficult to generate a spatial boundary management model such as a marine cadastre, as each and

every jurisdictional right, restriction and responsibility has to be taken into account in order to avoid conflict between different stakeholders.

Another factor which a marine cadastre needs to address is that the wide range of interests in the marine environment are currently managed by a number of organisations or agencies in 'silos', with each responsible for the collection, collation and updating of spatial data relating to their own interests. As can be seen from Figures 5.1 and 5.3, these interests overlap, which can create conflict and inefficiency within current management systems. The ability to provide consistent and accurate spatial information on all activities and issues to all marine users would overcome this inefficiency, as well as reducing time and cost constraints. For this to be achieved, the ASDI must be in place in the marine environment to underpin the availability and reliability of spatial data. This would also provide the basis for the integration of spatial data from the marine and terrestrial environments, helping to facilitate sustainable management objectives across Australia's entire jurisdiction, as demonstrated in Figure 5.2 below.

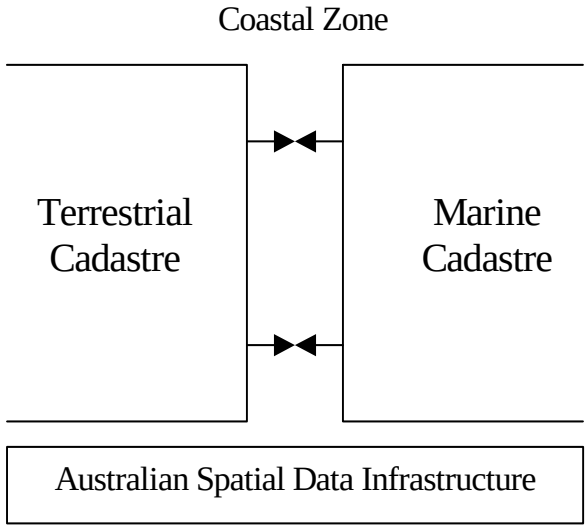



Figure 5.2 – Integration of the terrestrial and marine environments

(Source: Binns et al., 2003)

The review of Australia's legal and institutional governance of the marine environment, along with the identification of marine issues through research and consultation, has enabled the concept of a marine cadastre to be defined.

***Marine Cadastre Concept***

A marine cadastre is a spatial boundary management tool, which describes, visualises and realises legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment, allowing them to be more effectively assessed, administered and managed.

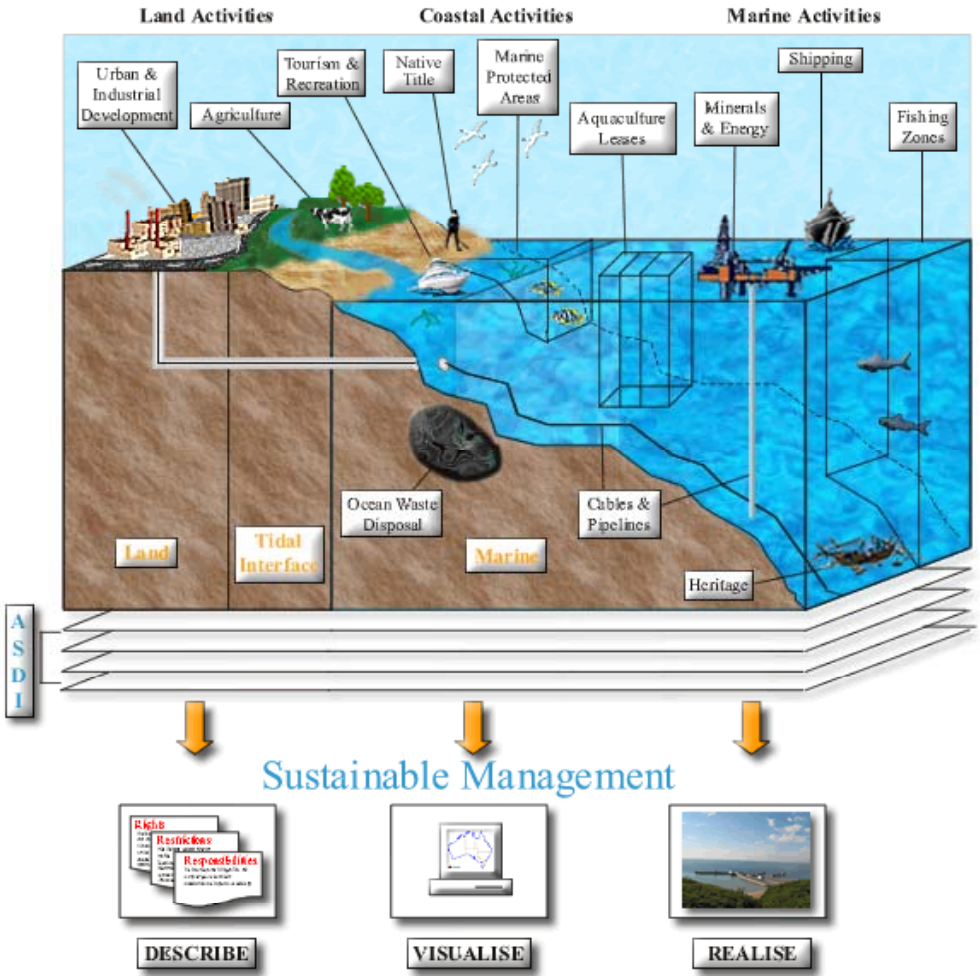



Figure 5.3 - Marine Cadastre Concept Diagram (Source: Binns et al., 2003)

As illustrated in Figure 5.3, the tangible outcome of the marine cadastre is the ability for users and stakeholders to "*describe*, *visualise* and *realise*" spatial information in the marine environment (Todd, 2001). The marine cadastre will *describe* the location and spatial extent of rights, restrictions and responsibilities in the marine environment, including management boundaries, coastal planning guidelines, ocean parcels and legal definition. Such spatial extents should then be able to be *visualised*

through the continual updating and maintenance of accurate and comprehensive digital spatial data. This ability to describe and visualize maritime boundaries will enable users to *realise* them physically at sea. This physical realisation would aid in activities such as managing and creating new fisheries or aquaculture leases, policing marine protected areas, exploration, and the laying of cables and pipelines, enabling an integrated and practical approach to the management of Australia's maritime extent.

## 5.3 CONCLUSION

This concept of a marine cadastre has been proposed and developed in order to aid in the management of Australia's marine environment, thereby addressing the issues identified within chapter 4. The concept diagram shown in Figure 5.3 presents the view of a marine cadastre as a spatial boundary management tool which describes, visualises and realises legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment.

The task now is to develop the tools which will facilitate the implementation of such a concept. As stated in chapter 1, there are currently two schools of thought on how to go about this. This thesis is looking at the second view - using the terrestrial cadastre as a guide to the implementation of the marine cadastre. The terrestrial cadastre enables efficient management of the rights, restrictions and responsibilities on land. The underlying principles which facilitate such management need to be identified in order to see if they are applicable to the marine cadastre. Although experts such as Fowler and Treml (2001) have stated that most of the principles of the terrestrial cadastre are seen to be compatible with the marine environment, an investigation into this has never actually been undertaken in Australia, which has a unique cadastral system. An investigation into the ability of the ASDI to create an underlying framework for the distribution of spatial data in the marine environment also needs to be undertaken. These issues are investigated in chapters 6 and 7 respectively.

# 6.0 APPLICABILITY OF FUNDAMENTAL CADASTRAL PRINCIPLES TO THE MARINE ENVIRONMENT

## 6.1 INTRODUCTION

The previous chapter outlined the concept of a marine cadastre for Australia. At the heart of the concept is the ability of the marine cadastre to describe, visualise and realise spatial boundaries and associated rights, restrictions and responsibilities in the marine environment. The concept also stresses the need to create a framework that is compatible with its land-based counterpart and built upon the principles of the ASDI.

This chapter analyses Australia's current land based cadastral systems (concentrating on Victoria), which contain tools used in managing boundaries in the terrestrial environment. Section 6.2 gives a brief outline of the current trends and initiatives occurring within land administration both nationally and internationally, including the FIG statement on the cadastre and Cadastre 2014, the FIG blueprint for cadastres of the future. Section 6.3 identifies and analyses the fundamental cadastral principles that allow the recording of rights, restrictions and responsibilities in Australia's terrestrial environment and compares and contrasts the ability of such principles to aid in the management of boundaries in the marine environment. By developing an understanding of Australia's terrestrial management system, parallels can be drawn with the management of our oceans, ensuring that we do not 're-invent the wheel'.

## 6.2 LAND ADMINISTRATION - TRENDS AND INITIATIVES

The concept of land means different things to different people, depending on how it is used. Economists view land as a resource, lawyers as legally defined space, and

physical geographers as landscape. These perceptions mean that there are a range of humankind-to-land relationships that must be taken into account when managing and administering land. Such diverse relationships also apply to the marine environment, for example, the different relationship that a fisherman and a marine scientist have in terms of how they view the oceans and their natural resources.

### *Land Administration*

The process of managing the different humankind to land relationships is called 'Land Administration', described by Dale and McLaughlin (1999) as:

> the process of regulating land and property development and the use and conservation of land, the gathering of revenues from the land through sales, leasing and taxation, and the resolving of conflicts concerning the ownership and use of land.

The functions of such a system may be divided into four components:

- Juridical component; places emphasis on the holding and registration of rights in land.
- Regulatory component; concerned with the development and use of land through zoning mechanisms, and the designation of special areas of interest such as historic districts and fragile ecosystems.
- Fiscal component; focuses on the economic utility of land, including revenue collection.
- Information management; integral to the three other components.

(Dale and McLaughlin, 1999)

The UNECE (1996) describes land administration as:

> the process of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies. It is considered to include land registration, cadastral surveying and mapping, fiscal, legal and multi-purpose cadastres and parcel based land information systems, and in many systems information supporting land use planning and valuation/land taxation systems.

The importance of land and property, and its management, is fundamental to economic development and environmental sustainability, however "rarely have the institutional arrangements been put in place to integrate the ways in which land is managed" (Dale and McLaughlin, 1999). For this to occur, land administration must

not be treated in isolation from other activities as the only way in which to develop and administer land. Valuation, planning, and land markets all play a vital role in a land administration system if it is to function properly, but it is the cadastre which this thesis will focus on.

### *The Cadastre*

As discussed by Kaufmann (1999), land management needs reliable information about the existing land and its resources and about the legal situation of these items. Cadastres provide the 'book-keeping' for this information within the wider land administration and land management systems, and hence the major component of any land administration system is the cadastre.

> Cadastral systems are the foundation and an integral component of parcel-based land information systems,…[which] are a central component of the land administration and land management systems in a state or jurisdiction. (Ting and Williamson, 1999).

Although Australian cadastral systems were designed specifically to support the operation of a land market and not as part of a wider land administration system, they have increasingly developed such a role (Williamson, 1996a).

Over time, the cadastre has evolved, mirroring the ever-changing relationship between humankind to land. According to Ting and Williamson (2000), this relationship will always be dynamic, changing as societal pressures and priorities change, as shown in Figure 6.1 below.

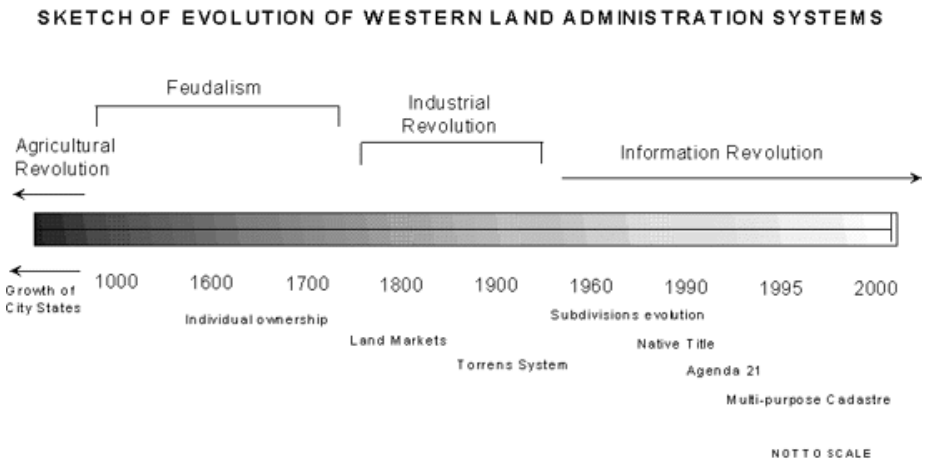



Figure 6.1 – Evolution of western land administration systems (Source: Ting and Williamson, 2000)

According to the National Library of Australia, the cadastre derives from the French *cadastre* and originally from the Greek *Katastikhon* and defines the extent, value and ownership of land for taxation purposes. The modern interpretation of the cadastre derives from the French Napoleonic cadastre introduced in 1808. The National Research Council (NRC, 1983) defines a cadastre as a parcel-based record of interests in land encompassing both the nature and extent of these interests.

In order to address planning and sustainable development objectives, the trend has been to develop multi-purpose cadastres which has been evident in a range of countries including Australia, Denmark, New Zealand and the USA (Williamson, 1996b; Enemark, 1999; Robertson, 1996; NRC, 1983). Such cadastres link other relevant information regarding the physical and biological natures of the environment to the cadastre, giving it its multi-purpose function. The concept of the multi-purpose cadastre is based upon the three-dimensional nature of a spatial unit, or land parcel, representing unique, homogenous, continual interests (McLaughlin, 1975 cited in NRC, 1983).

Over the last decade "there has been a greater recognition…of the importance of cadastral systems in the economic development and environmental management of countries" (Williamson 1996a). This has seen the development of Australia's cadastral system influenced by a variety of international institutions, particularly the International Federation of Surveyors, the lead organisation which guides the direction of surveyors and other professionals within the spatial information industry.

### 6.2.1 International Federation of Surveyors

The International Federation of Surveyors (FIG) is divided into nine working commissions and, in alliance with the World Bank and the UN, initiates projects targeted towards land reform and the administration and management of land-based resources. Commission VII concentrates its activities on the cadastre, with the FIG recently setting up a joint working group on the marine cadastre under commissions VII and IV. FIG has released several publications concerning the role of the cadastre in the land administration process, hence impacting on the creation of a marine

cadastre, which include the "Statement on the Cadastre" (FIG, 1995) and "Cadastre 2014" (Kaufmann and Steudler, 1998).

### *Statement on the Cadastre*

FIG produced a statement on the cadastre in 1995. The statement highlights the importance of the cadastre as a land information system for social and economic development, as well as pointing out the dynamic nature of cadastral systems:

> A Cadastre is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements.

This statement highlights the important role that the cadastre plays in aiding land management and its related issues and goes on to discuss the process of managing the use and development of land resources, including such critical objectives as:

- Improving the efficiency of land resource use to support a rapidly growing population.
- Protecting the natural environment from degradation.
- Providing equitable and efficient access to the economic benefits of land.
- Supporting government services through taxation and fees related to land.

The key to meeting these objectives is "having effective access to information about land, including information about land resource capacity, land tenure and land use" (FIG, 1995). These objectives can also be related to the marine environment, demonstrating the importance of research and development into a marine cadastre.

### *Cadastre 2014*

The most recent initiative has been the development of Cadastre 2014 by Commission VII of the FIG. Most of the current cadastral systems throughout the world have been created in order to facilitate the management of private rights to land. There are however a range of other tenures and humankind to land relationships which occur such as customary rights to land and public land. In order to accommodate all of these tenures,

cadastres must be re-engineered, with the FIG producing Cadastre 2014, a document which aims to set guidelines for countries to follow in this process.

Parallels can be drawn between the implementation of this cadastral concept with the marine environment. As discussed in section 3.2, one cannot have freehold title to sections of the ocean, with the majority of the area open to the public. There are exceptions to this (including exploration and aquaculture leases) but in terms of managing the oceans, it will be these public areas which will be the most complicated to administer. Cadastre 2014 aims to address such issues on land.

The concept of Cadastre 2014 provides for the complete documentation of public and private rights and restrictions for land owners.

> Cadastre 2014 is a methodically arranged public inventory of data concerning all legal land objects in a certain country or district, based on a survey of their boundaries. Such legal land objects are systematically identified by means of some separate designation. They are defined either by private or by public law. (Kaufmann and Steudler, 1998)

A parallel can be drawn between Cadastre 2014 and the marine cadastre concept identified in chapter 5. Both rely on data concerning legally defined boundaries in order to identify public and private objects. The application of Cadastre 2014 to Australia's current cadastral system and the ability for these generic principles to be applied to the development of a marine cadastre makes Cadastre 2014 an important component in the creation of a seamless cadastre for Australia's entire jurisdiction.

## 6.3 THE AUSTRALIAN CADASTRAL SYSTEM AND ITS APPLICABILITY TO THE MARINE ENVIRONMENT

The following outlines the development of the Australian cadastral system, focussing on the state of Victoria. Components of cadastral theory are discussed in section 6.3.1, before the fundamental principles used in recording rights, restrictions and responsibilities in land are presented. The applicability of such principles to the recording of boundaries in the marine environment is also discussed.

### *Introduction*

In 1901 Australia became a federation of states, over which the federal government has jurisdiction in relation to defence, foreign affairs, trade and commerce, taxation, customs and immigration services. Other powers are the responsibility of state and territory governments, such as health, education, town planning and land administration, including cadastral systems and land registration. This division of responsibilities concerning the administration of land has resulted in differences and complexities between states concerning land law and cadastral systems (Dalrymple, et al., 2003).

There is also generally a division in the availability of cadastral information relating to freehold land and crown land. Within the state of Victoria the two are segregated into different cadastral databases, and are currently undergoing amalgamation.

### *Complexities between states in cadastral systems*

Even though there is considerable commonality between the states and territories, with each utilizing the Torrens system of title registration, each still has significant individual idiosyncrasies and complexities in its land law and cadastral system (Dalrymple, et al. 2003). This is due to the fact that land laws and the laws concerning land transfer and mortgages are the responsibility of each state and territory. There is no prescribed organizational structure common to all jurisdictions within Australia with the responsibility held under a range of government organizations and departments such as Environment, Planning, Lands and Land Administration. The Public Sector Mapping Agencies (PSMA) is the closest to an overarching land administration organization for Australia. PSMA involves a consortium of all of Australia's state, territory and Commonwealth governments, enabling cadastral map products to be produced on a national scale (PSMA, 2003). There is likewise no overall governance framework for the marine environment, which is in fact even more segregated than the organizational structure on land (section 3.3).

### *Cadastral Components*

According to Dalrymple et al., (2003), although cadastral systems vary across Australia, "the integrity of each system is consistent allowing the cadastral data set in spatial data infrastructures to play a fundamental role in broader land administration

activities". The computerisation of such data establishes the cadastre as an integral tool in many areas, including:

- in a legal capacity, through the registering or ownership of land;
- in a fiscal capacity, through the valuation of land sales and taxation; and
- in a multipurpose function, aiding in land management and planning for local governments, emergency response, environmental risk assessment and business planning.

There are generally two parts to any cadastral system, being the textual and spatial components. The cadastre is created through surveying the boundaries of land parcels (spatial component) and recording the ownership of each in a land registry (textual component), as shown in Figure 6.2 below. There is generally a 1:1 relationship between these two components, with little or no overlap between parcels.

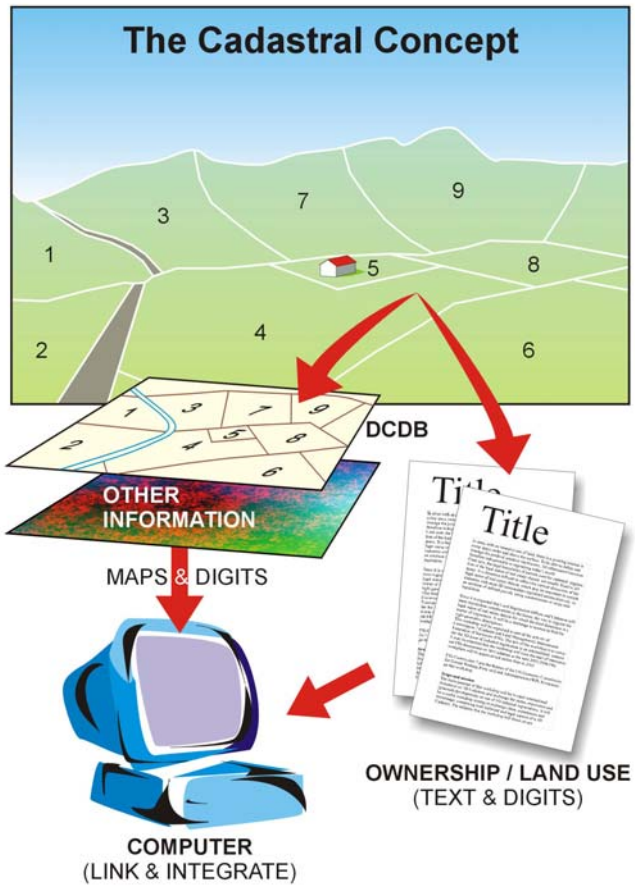



Figure 6.2 - Cadastral Concept Diagram (Source: Williamson, 2001b)

*Textual Component*

The land register forms the textual component of the cadastre. This section identifies the property parcels, concentrating on those held privately in freehold ownership. It also identifies who owns the parcel and the owners' rights, restrictions and responsibilities, including easements, mortgages etc.

*Spatial Component*

The spatial component includes the cadastral maps that show all of the surveyed land parcels that correspond to the registered title. Each parcel has a plan number and unique identifier linking it to the registered title and in the majority of Australian states and territories, the cadastral maps are only of graphical accuracy. The only exception is in the Australian Capital Territory, which has a survey accurate cadastre.

The current cadastral systems within each state and territory of Australia have proved to efficiently and effectively record the various boundaries in the terrestrial environment, and the rights, restrictions and responsibilities that go along with them. There are five fundamental principles that enable this to occur, and these are discussed below. This will enable a comparison to be made with the marine environment, in order to see if such principles are capable of managing boundaries and their associated rights, restrictions and responsibilities in Australia's oceans.

### 6.3.1 Policy Principles

According to Williamson (2001a), one of the most important aspects of any land administration system is the need for a national or state land policy. Such a policy would recognise the growing complexity of rights, restrictions and responsibilities relating to land and consequent demands on land administration infrastructures. It could also lay out the roles and responsibilities of various land related activities and agencies, facilitating a more efficient and effective land administration and cadastral system for the country. Australia however does not have such a national policy. This could be part of the reason why Australia's cadastral system is fragmented within each state and territory. According to Williamson (2001a) however, the overall land policy principle is that "land policy drives legislative reform, which in turn results in institutional reform and finally implementation with all its technical requirements".

The development of Australia's Oceans Policy in 1999 was a major step forward in providing a national policy direction for the administration of the marine environment. The policy recognized the complexity of rights, restrictions and responsibilities relating to the marine environment, setting out a vision to address natural resource management and environmental sustainability objectives. This policy will aid in the development and implementation of standards and practices to provide a common organizational structure in the development of marine plans for the sustainable management of Australia's oceans. This will help to avoid some of the complexities of Australia's state based terrestrial cadastral systems, as described above.

Terrestrial cadastral systems are currently going through a re-engineering stage, due to both the evolving nature of land management and the fact that the human-kind to land relationship (section 6.2) is dynamic. It must be remembered that it has taken 200 years for Australia to establish its current land administration infrastructure. The key to success in the marine environment is to start simple, develop a strong marine cadastre framework foundation, and allow the system to evolve and grow as future uses arise.

### 6.3.2 Tenure Principles

The ability to manage land is made more difficult by the range of tenures that exist, each requiring a different land administration response. The two main types of tenure in Australia are freehold and state owned or 'crown' land. Currently these are managed separately within the Victorian cadastral system, although the realisation that they are not in isolation is forcing the government to begin to amalgamate the two into one cadastral system.

Within Australia, customary or indigenous tenure also exists with acknowledgment of indigenous rights to land being recognized formally under the *Native Title Act 1993 (Cth)*. There are also a range of other tenures, including customary tenure, indigenous rights to land, and leasehold rights (form of freehold). The difficulty faced by Australia's land administration system is how to incorporate such diverse forms of

tenure into the formal cadastral system. In most cases, land held under customary or indigenous tenure belongs to the community as a whole. This means that the traditional system of registering and mapping the parcels concerned becomes clouded, as there are multiple stakeholders and users of the same parcel of land.

Diverse forms of tenure also exist in the marine environment, with the assumption that tenure does not exist within Australia's marine environment not being the case. The ability to effectively identify and catagorise tenure in the marine environment however is much more difficult than on land. Offshore, freehold title is said not to exist, however there is the ability to hold lease rights to areas of the ocean. According to Dalrymple et al. (2003), a lease transfers a set of rights to the leaser for a select period of time. Such rights include aspects of freehold including the right to bar access to the area under lease and the ability to borrow against the lease (e.g. aquaculture and fisheries, section 3.3.2).

Indigenous tenure also exists within the marine environment after the High Courts decision in the Croker Island Case (section 2.2). Land administrators have struggled to incorporate this type of tenure into Australian's cadastral system, due to the existence of multiple stakeholders and users of the same parcel of land. As chapter 3 demonstrates, the overlapping of interests in the marine environment is common. There is however one major difference between the marine and terrestrial cadastres that enables the incorporation of multiple uses in the marine environment to be managed more easily and efficiently than on land, as explained below.

The terrestrial cadastral systems within Australia have been created primarily to facilitate the creation of a land market, driven by private transactions. Hence when managing forms of tenure other than freehold, the solution has been to try to convert those other forms of tenure into some form of freehold, in order to create the ability to transact that land. This has not always been effective, as seen in the inability to effectively incorporate native title into Australia's cadastral systems (Brazenor, 2001).

As mentioned earlier, freehold title and hence private transactions, do not exist within the marine environment. Basically the government regulates all transactions that occur. The major advantage of this is that the government defines the boundaries to

manage access to and exploitation of various marine resources. The government also defines the rights, restrictions and responsibilities attached to such boundaries. It is up to the user to attain knowledge of these rights and abide by them, even if several sets of rights exist within the one area. The real need within the marine environment is for stakeholders to be able to have clear spatial and legal knowledge of such rights, not the ability to transfer the rights. This is the fundamental difference between the terrestrial cadastre and the formation of a marine cadastre.

### 6.3.3 Legal Principles

The differences between the land and marine cadastres are also apparent in the way in which legislation is used to govern rights, restrictions and responsibilities. The legislative framework that governs land administration processes within Australia must uphold standards related to the resolution of land ownership, including boundary definition and transactions. For example in the Victorian case, these are well documented within legislation such as the *Property Law Act 1958 (Vic), Transfer of Land Act 1958 (Vic)* and the *Subdivision Act 1988 (Vic).* In general, legislation is used to describe how a boundary should be demarcated, not the precise location of the boundary (it must be noted that this is not always the case, with boundary descriptions such as the location of national parks embedded within legislation). The 'point of truth' for boundaries is within survey plans.

In the marine environment, this is generally the reverse, with the point of truth' for the definition of boundaries lying in statutory descriptions. Conventional survey plans are still used, but are typically confined to the administration of ports and harbours as well as leasehold land below high water mark (elements of freehold tenure) (Todd, 2001). It is therefore imperative that the boundaries defined within legislation are able to be clearly visualised. This is not always easily accomplished however, as discussed in section 4.4.1.

Due to the inability to utilise monuments in the physical description of boundaries within the marine environment, the need to have *spatial* and *legal* certainty of rights is fundamental to the creation of a working marine cadastre. Hence maritime boundaries embedded within legislation need to be geo-referenced. As described in

section 3.2, the amount of legislation describing spatial boundaries and rights is large, making the task difficult. Added to this difficulty is that boundaries may be described by reference to geographical positions, meridians, parallels, geodesics, place names and geographical features. The reference to such features must also be interpreted, creating further ambiguity. There is a need for standards in the way in which boundaries are described within legislation, as seen on land within legislation such as the *Subdivision Act 1988 (Vic).*

The issue of the development of differing legislative regimes between states and territories, as seen on land, is not as apparent in the marine environment. This is due to the implementation of the OCS (section 2.2.1) and subsequent use of joint management arrangements between the states, Northern Territory and the Commonwealth and creation of 'mirror' legislation by the states and Northern Territory. This does not fully rule out complexities between states however, with various legal differences needing to be overcome as they arise.

### 6.3.4 Institutional Principles

Institutional principles put in place the governmental structures for the operation of both terrestrial and marine management systems. Within Australia's terrestrial environment, such principles are generally handled by the states and include "ministerial responsibilities, departmental structures, decentralisation/centralisation, as well as government-private sector relationships and partnerships" (Williamson, 2001a). The policy principles discussed above drive institutional change in a top down approach. This can also be seen in terms of the land tenure principles, which have resulted in Victoria bringing together not only its mapping and cadastre sections, but also valuation and land registration agencies (Williamson 2001a).

#### *Centralised Cadastral Governing Body*

The states and territories have responsibility for land administration within Australia and hence there has been no traditional national cadastral governing body. The closest is the PSMA, which develops national cadastral tools through integrating datasets from the 8 different jurisdictions. Within Victoria, the responsibility of managing the cadastre rests with Land Victoria within the government's Department of Sustainability and

Environment. This lack of an overarching body has led to the development of significant individual idiosyncrasies and complexities between Australia's state and territory based cadastral systems (section 6.3).

Within the marine environment, the Commonwealth government has created the National Oceans Office (NOO) to coordinate the development of regional marine plans. These plans are based on ecological rather than state boundaries, with the South-East regional marine plan being the first to be developed (including marine areas of Tasmania, Victoria, New South Wales, South Australia and the Commonwealth). The plan concentrates on Commonwealth aspects of the South-East marine region. However it is recognised that the majority of maritime activity occurs within Australia's coastal zone, to which the NOO does not initiate policy or management strategies. This creates separate jurisdictional areas within Australia's marine environment.

Due to Australia being a federation of states, it may not be possible to develop a marine cadastre that is free of all complexities and idiosyncrasies as seen in the development of Australia's terrestrial cadastral systems. They can be minimised through the identification of lead agencies within each state, the Northern Territory and the Commonwealth. This will foster cooperation on the development and implementation of national policy, which, as described in section 6.3.1, will drive the legislative and institutional reform needed to implement a national marine cadastre.

The implementation of governing bodies in the fashion described above will enable good central direction and coordination in the development of a national marine cadastre. This centralisation is aligned to a certain extent with the development of Australia's terrestrial cadastres.

***Public & Private Partnerships***

The cadastre is part of the basic infrastructure of a country and should therefore be the responsibility of the government (Williamson, 2001a). A key to the successful implementation of the cadastre is the establishment of partnerships within and between government agencies and industry.

Within Victoria's terrestrial cadastral system for example, the development of such partnerships has seen various tasks contracted out to the private sector. The majority of all surveying and mapping is now undertaken by the private sector, with government surveyors undertaking a quality assurance role through the inspection of plans of survey. The collection of other forms of data, and the maintenance and updating of that data, have also been contracted out to the private sector. This demonstrates the need for strong partnerships between the public and private sectors.

Within the marine environment, the development of 'task-specific' management techniques has been fuelled by a lack of partnerships between the private sector and government. As discussed in section 3.3, the various industry stakeholders collect and disseminate spatial data for their own use, creating 'data silos' making data integration and access difficult. Creating partnerships and linking stakeholders is the key to facilitating access to such data, as discussed further in chapter 7. The creation of lead agencies within each jurisdiction would also facilitate dialogue on management aspects that straddle jurisdictional borders. This is also true in developing partnerships with terrestrial cadastral agencies, as it would increase the ability to link spatial information at the land-sea interface, enabling more efficient and sustainable development of the coastal zone.

### 6.3.5 Technical Principles

***Boundary delimitation***

Boundaries mark the limit of each tract of real estate. In legal terms, a boundary is a line that divides two adjoining estates, while in common language the term denotes the physical objects by reference to which this line of division is described, for example cadastral pegs (Dale and McLaughlin, 1999). In the terrestrial environment boundaries are usually physically demarcated by a fence or hedge, neatly defining the area to which a set of rights, restrictions and responsibilities is attached. In Australia, such boundaries are 'fixed' with the precise line being accurately determined. There are however around 10% of boundaries within the terrestrial environment which are 'general' (graphical), where the precise line on the ground has not been determined. They are based on natural or artificial features, such as high water mark, or walls and buildings as found in strata subdivisions.

Such general boundaries are found within the marine environment as physical demarcation is generally not possible. As stated in section 6.3.2, the point of truth for the definition of maritime boundaries is the legal description, and to a lesser extent, conventional survey plans and physical demarcation. This means that boundaries are delimited, not demarcated, giving rise to a measure of uncertainty, given a lack of knowledge of the accuracy of a position. This is due to the process in which maritime boundaries are delimited, the realising of maritime boundaries, and ambiguity in the visualisation and realisation of the coastline and adjoining interests (Fraser et al., 2003). The ability to have clear spatial and legal certainty in regard to maritime boundaries depends on access to knowledge about the integrity of maritime boundary locations. Research into marine boundary uncertainty is being undertaken within the broader context of the ARC marine cadastre project, but not specifically within this thesis.

***Systematic v. Sporadic***

Australia's terrestrial cadastral systems were developed in a sporadic fashion, as various needs arose. Over the past 200 years, the systems have grown and evolved, utilising and implementing various tools and concepts as developed (Figure 6.1). The concepts of individual ownership and development of land markets highlighted the need for spatial information, with the majority of Australia now mapped.

The development of the marine environment is similar to land with management principles growing and evolving over the past century. The lack of a "land market" as such in the marine environment however has meant that principles developed for use in the management of the marine environment have been created in a 'task-specific' and isolated fashion. The importance of spatial data though has long been recognised, and although not mapped to the same extent as the terrestrial environment, the use of spatial data in the marine environment has enabled Australia's vast maritime area to be explored, exploited, conserved and managed to some extent.

The sporadic approach taken in developing the terrestrial cadastre is of no real advantage in implementing a marine cadastre. If implemented in sectors, the marine cadastre would not enable multi-purpose use or wide-spread and long-term cost sharing. This sporadic approach may also end up creating several marine cadastres, in much the same way as there are separate terrestrial cadastres within the states and

territories of Australia. This can be avoided through a systematic, whole-of-government approach to implementation, with the creation of a core infrastructure, enabling consistency and multiple-use between the various state, Northern Territory and Commonwealth jurisdictions.

***Digital Cadastral Database - Maintenance Environment***

The need to reduce duplication and a greater emphasis on the management of land resources have been the major driving force in the development of state-wide digital cadastral databases (DCDB) in Australia over the past 20 years (Williamson, 1996a). A DCDB shows a computerised map of cadastral boundaries within a jurisdiction such as Victoria. All cadastral surveys carried out within Victoria are incorporated into the DCDB for the state, enabling a map of all land parcels within the entire jurisdiction to be developed and maintained.

The typical technique for establishing computerised cadastral maps has been to fit the best available cadastral survey plans together onto a topographic based map using control surveys, fence lines and other physical features as control. The resulting cadastral map is then digitised and a graphically accurate DCDB established.

The main advantage in establishing a DCDB is the ability to digitally up-date the system. In Victoria, the cadastral system is centralised under the state government with the major office located in Melbourne. The plans of survey however are undertaken at a local level. The implementation of partnerships between local councils and state government has enabled digital plans to be lodged directly with the state titles office as soon as surveys are completed. The DCDB can then be updated quickly and easily.

The task specific management techniques utilised in the marine environment create difficulties in developing such a database for Australia's oceans. The delimitation and subsequent creation of spatial datasets relating to maritime boundaries is undertaken by a variety of agencies to various levels of accuracy and scale. Such data is stored in 'silos', from which integration is difficult. Boundaries in the marine environment also overlap. The ability to up-date and create a map of all boundaries within the marine environment could only be realised through the creation of

interoperable datasets that can be accessed by all users. The necessary tools which would facilitate such interoperability are discussed in detail in chapter 7.

## 6.4 CONCLUSION

The primary aim of current land based cadastral systems within Australia is to facilitate an active land market, although it has evolved to support a broad range of land administration and land management functions. Within the marine environment, the need for private transactions is limited, due to the lack of freehold rights. The major need is to have clear legal and spatial certainty of spatial boundaries and associated rights, restrictions and responsibilities that occur within the ocean. This is a major difference between the development of the terrestrial and marine cadastres.

This chapter has also identified and analysed the fundamental terrestrial cadastral principles and the ability to utilise them in the marine environment. Table 6.1 below summarises the major similarities and differences between the two environments in terms of the implementation of fundamental cadastral principles.

| *PRINCIPLES* | *TERRESTRIAL CADASTRE* | *MARINE CADASTRE* |
|---|---|---|
| **Policy Principles** | | |
| *National Policy* | No | Australia's Oceans Policy |
| *Aim of cadastre* | Creation of active land market - ability to trade rights in land. | Spatial boundary management system - ability to trade rights not an issue. |
| *Dynamic* | Yes | Yes |
| **Tenure Principles** | | |
| *Freehold tenure* | All aspects | Some aspects - there is the ability to hold lease rights |
| *Native Title* | Exclusive and non-exclusive | Non-exclusive only. |
| *State administered* | Yes - minority of land | Yes - majority of marine environment |
| **Legal Principles** | | |
| *Legislation* | Used to describe how boundaries should be demarcated. | Used to describe precise locations of boundaries. |
| *Point of truth for boundaries* | Monuments - primary. Coordinates - secondary. | Statutory regulations - primary. Conventional survey plans - secondary. |
| **Institutional Principles** | | |
| *National Governing Body* | Not traditionally - PSMA is closest. | NOO - Commonwealth governing body. |
| *State Governing Body* | Yes. | Each state needs to identify a lead agency in the marine environment. |
| *Centralised/Decentralised* | Centralised system within each state. | Centralised system within each state linked to an overarching Commonwealth system. |
| **Technical Principles** | | |
| *Boundaries* | Demarcated. | Delimited. |
| *Physically demarcated* | Yes. | No. |
| *Uncertainty* | No. | Yes. |
| *Dimensions* | 2D - there are instances where 3D is needed (e.g. strata title) but the solution has been to establish 2D on top of 2D. | 3D (aquaculture leases requiring depth) and 4D (introduction of time) boundaries needed in the marine environment. |
| *Overlapping boundaries* | Rarel | Common |
| *Systematic/Sporadic Implementation* | Sporadic. | Systematic. |

Table 6.1 - Terrestrial and Marine comparison in relation to the implementation of fundamental cadastral principles

Analysis of the fundamental cadastral principles discussed within this chapter show that their applicability to the marine environment is mainly on a large scale policy level. As table 6.1 shows, the ability and method of implementing such fundamental principles in the marine environment varies. The cadastral principles also fail to adequately address issues of interoperability and access to spatial data, two vital institutional issues identified in chapter 4.

# 7.0 THE AUSTRALIAN SPATIAL DATA INFRASTRUCTURE AND THE MARINE ENVIRONMENT

## 7.1 INTRODUCTION

The concept of Spatial Data Infrastructures as a tool to facilitate access to up-to-date spatial data is currently being developed within the context of Australia's terrestrial environment. A realization that rights, restrictions and responsibilities in time and space do not stop at the high water mark has forced ANZLIC to initiate moves to include the marine environment in the ASDI concept. This chapter aims to analyse the merit in ANZLIC's decision through a consideration of the current terrestrial based ASDI concept within the context of the marine environment. The ability of the ASDI to address the institutional and data issues identified in chapter 4 is also undertaken. This is achieved by breaking down and investigating the fundamental components of the ASDI, including data, standards, people/partnerships and access networks.

## 7.2 SPATIAL DATA INFRASTRUCTURES

Spatial data - data that can be related to a location on the Earth - plays an important role in promoting economic development, improving stewardship of natural resources and helping to protect the environment (Executive Order, 1994 cited in Rajabifard, 2002). According to Rajabifard (2002), people need spatial data and its derived information to establish the position of identified features on the surface of the Earth. The ability to locate the position of an activity or feature allows it to be linked to other types of information, whilst also allowing "distances to be calculated, maps to be made, directions

given and decisions to be made about complex, inter-related issues" (Mapping Science Committee, 1995 cited in Rajabifard, 2002).

The term 'Spatial Data Infrastructure' has been described by the Global Spatial Data Infrastructure (GSDI) Cookbook as:

> The relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides the basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general (GSDI 2001).

As a concept, an SDI is an initiative intended to create an environment that will enable users to access and retrieve complete and consistent spatial datasets in an easy and secure way. Although the concept is still evolving, internationally, "the core components of SDI are commonly viewed as policy, access networks, technical standards, people (including partnerships) and data", as seen in Figure 7.1 (Williamson 2002; Rajabifard et al., 2000). These components are seen to be the tools which enable users and producers of spatial data to interact and cooperate with each other (Chan et at 2001), reducing costs, both in terms of time and money, associated with the management and compilation of spatial data.

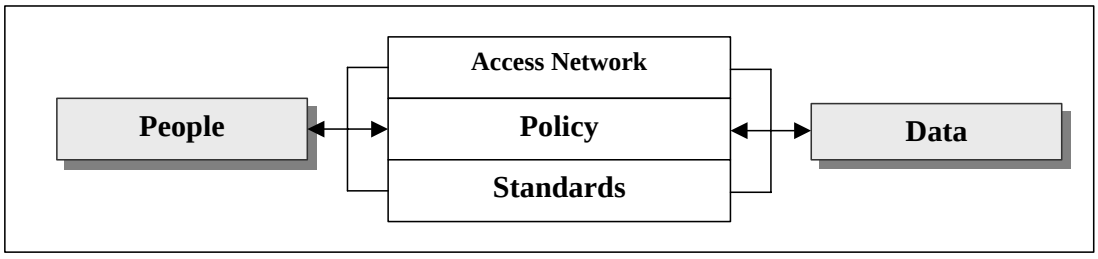



Figure 7.1 - Components of SDI (Source: Rajabifard and Williamson, 2001)

An SDI operates at various political/administrative levels including corporate, local, state, national, regional and global, as seen in Figure 7.2 below, with each subsequent level being built on the one below it. Figure 7.2 also shows the complex and dynamic inter-and intra-jurisdictional nature of SDIs (Chan et al., 2001).

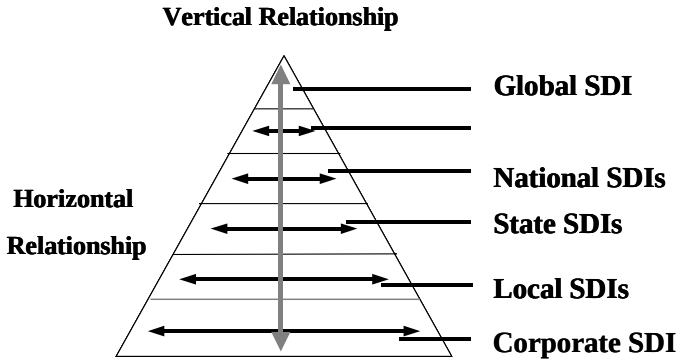



Figure 7.2 - SDI Hierarchy (Source: Rajabifard and Williamson, 2001)

The relationships that are fostered within and between each level play an important role in the development of an SDI, with political support (to provide funding and policy direction) and knowledge about types of data, their location and quality also needing to be considered. Perhaps the most important aspect is the ability to provide access to spatial datasets, as this is the key driving factor in the development of an SDI (Williamson, 2002).

## 7.3 THE AUSTRALIAN SPATIAL DATA INFRASTRUCTURE

In Australia, the facilitation of an SDI at a national level is being advanced by ANZLIC, the spatial information council, in order to "maximise the economic, social and environmental benefits from investment already being made in spatially referenced information" (ANZLIC, 2002a).

ANZLIC has recently recognised that the development of the ASDI has been mainly from a data producer perspective and hence has drafted a new user definition of the ASDI.

> The ASDI comprises the people, policies and technologies necessary to enable the use of spatially referenced data through all levels of government, the private sector, non-profit organisations and academia.
>
> (ANZLIC 2003b)

This new definition focuses on the fact that it is the users of spatial data that need to drive the implementation of the ASDI.

***Overarching SDI framework***

As mentioned above, the current ASDI model centres on the dynamic relationship between People, Data, Standards, Policy and Access mechanisms (Figure 7.1 above). The current ASDI model centres on the creation of the Australian Spatial Data Directory (ASDD), which lists metadata details (discussed further in section 7.3.4) for various datasets provided by custodians, including marine spatial data.

As discussed in section 6.3, the management of land related activities resides with the states and territories, and hence each must contribute to the creation of the ASDI. This contribution occurs through the creation of nodes within the ASDD, such as the Victorian Spatial Data Directory (VSDD). These nodes provide the mechanisms for users of spatial data to locate data which is useful to their particular needs. The ASDD also provides details on how the data can be accessed. Each state has also identified fundamental datasets (data which is fundamental to the development and operation of infrastructure) that attempt to cover the whole of the state (VGIS, 2000). These concepts are focussed on facilitating access to accurate and up-to-date spatial information in the terrestrial environment. The various aspects of the ASDI are discussed in more detail below. Included in this discussion is the ability to utilise the ASDI policies and standards within the marine environment.

## 7.3.1 Fundamental Datasets

The Victorian Geospatial Information Strategy (VGIS) (2000) has defined fundamental datasets as

> that information considered fundamental to the development and operation of Victoria's geospatial information infrastructure, in that other (business) information cannot be created or maintained without it.

ANZLIC describes a fundamental dataset in the context of its vision for a national SDI as "a dataset for which more than one government agency requires consistent national coverage in order to achieve their objectives" (ANZLIC, 1996).

The objective of the creation of such datasets is to remove duplication and the existence of multiple versions of the same data. This leads to a higher quality of data

and the ability of spatial data users to deal in the same currency, reducing costs, improving decision making ability and unlocking valuable data for general use. Such datasets must comply to a minimum degree of accuracy and quality, and are regularly updated and maintained. Within Victoria this is done through partnerships between the public and private sectors and between local and state governments.

Victoria currently has eight fundamental datasets:

- Geodetic Infrastructure
    - The most critical of the datasets, as it is the foundation layer upon which all other datasets (fundamental or other) are built.
- Vicmap Elevation
    - Digital Elevation Model (DEM), representing the statewide terrain.
- Vicmap Administrative
    - Involves the collection of data on various administrative boundaries across Victoria, including place names, electoral, locality, township and boundaries.
- Vicmap Transport
    - Representation of the transport networks across Victoria, including road, rail, tram, air (not complete) and sea (not complete).
- Vicmap Property
    - Contains the details of cadastral land parcels within Victoria (DCDB).
- Vicmap Address
    - Provides street addresses which are the main identifier of property within Victoria.
- Vicmap Hydrology
    - Provides an accurate representation of natural and man made hydrographic features.
- Vicmap Image
    - Suite of statewide satellite image mosaic products.

(VGIS, 2002c)

Each one of these datasets needs to be made available to the public at as low a cost as possible. There are development and maintenance costs associated with the data

however, and cost is still cited as one of the biggest impediments to gaining access to the data.

The objective of creating fundamental datasets is also relevant in the marine environment, however the ability to define which datasets are fundamental is difficult. As on land, the geodetic infrastructure is the foundation layer upon which all other datasets are created. The development of a DEM for the ocean (bathymetric data) is also an important tool for a number of sectors. The bulk of the other fundamental terrestrial datasets (within a Victorian context) are utilised mainly in support of a land market. For example, the Vicmap Property dataset contains all of the cadastral parcels within the state. These parcels can be for residential, commercial or industrial use, yet are still maintained through cadastral surveying and mapping techniques by the one agency (Land Victoria).

Within the marine environment the creation of a 'Vicmap Property' type dataset is fundamentally different. Each maritime industry relies on the definition of a separate set of legally defined boundaries in order to undertake their specific business needs. For example, fisheries management relies upon spatial knowledge of 17 separate fisheries zones, while the oil and gas industry rely upon lease boundaries. Due to the overlapping nature of rights within the marine environment, there is also a need for each industry to have knowledge of other spatial boundaries (see section 3.3.1). Thus it is important for a marine cadastre to contain spatial data pertaining to all legally defined boundaries. Currently such data is maintained by separate agencies at different accuracies and in various formats, creating 'data silos' from which integration is difficult and hence the development of one 'Vicmap property' style dataset is not easily achieved.

As stated in chapter 5, the aim of the marine cadastre is to create an infrastructure from which spatial data pertaining to all areas of marine management is accessible. Hence there is a need to develop each of the business needs of the various industries into a business dataset, creating many separate datasets which can be integrated through the use of a maintenance environment developed as part of the marine cadastre. This will unlock data held in 'silos' for general use, nullifying the need for

the existence of multiple datasets at various degrees of accuracy and cutting costs in terms of both time and money.

### 7.3.2 Custodianship

In general, the agencies that compile and create spatial datasets invariably manage them to a degree of quality related to their specific needs. There are often various agencies managing related datasets at varying degrees of accuracy and quality, creating duplication and decreasing the amount of time and money that can be spent on maintenance or the creation of other data sets. The role of the custodian of spatial datasets has been developed to address this problem, with the one agency or custodian responsible for managing a dataset on behalf of all other users. According to ANZLIC guidelines for custodianship (1998), this ensures accountability for the care and maintenance of information within the public sector, but this could also be true for data within the private sector. If the development of fundamental and business datasets as described above is to be managed successfully, then a custodian of that data is required.

The selection of custodians, as seen in relation to fundamental datasets in the terrestrial environment, must be done in consultation with the broader spatial information community. This ensures a level of confidence in the data by users, as the custodians have been endorsed, accepted and hence trusted by the community at large. This is also needed in the selection of custodians for fundamental and business datasets in the marine environment.

According to the Geospatial Information Custodial Guidelines for Victoria, developed as part of the Victorian Spatial Information Strategy (VSIS), custodians are expected to provide information on the description, quality, metadata, pricing, licensing and access of each dataset, answering the question “will this dataset suit my application?” They must also undertake methods to maintain the dataset to an agreed standard of accuracy and quality, the level of which must be agreed upon by the spatial information community. Within the marine environment, it would seem logical to assign relevant industry agencies as data custodians, e.g AFMA to fisheries data,

AHO to nautical charts etc. There is also the option of employing private sector agencies as custodians, as seen in the terrestrial environment.

As mentioned in section 5.4, the development of partnerships is one of the major factors in the successful implementation of the ASDI. The involvement of private sector companies as custodians of data is fostering the development of such partnerships between not only the public/private sectors, but also between private companies, creating follow-on benefits for the development of the ASDI.

### 7.3.3 Accuracy

The compilation of spatial data is done to various levels of accuracy, depending on who owns the data, how it was collected and the amount of money spent compiling it amongst other things. This variation in accuracy can cause difficulties in the use of spatial data, as well as in integrating various datasets of different accuracy. There are also times when the accuracy of the data is not known if metadata is not supplied and this can also cause problems.

> Unknown data quality leads to tentative decisions, increased liability and loss of productivity. Decisions based on data of known quality are made with greater confidence and are more easily explained and defended.
>
> (VGIS, 2000a)

Assigning custodians to specific datasets is one method whereby the quality and accuracy of data can be controlled. The main way in which custodians communicate the accuracy of spatial data to the user is through the use of metadata. An example of the need to take accuracy into account is in planning and development situations. If earth moving equipment is being used, maps and plans containing information such as the location of underground electricity and telecommunications cables is needed to ensure both the safety of operators and to reduce the chance of damage occurring. Metadata supplied with such plans may indicate that the accuracy level is no better than $\pm$1-2m. If this information is not provided, or not taken into account, workers have limited knowledge of where cables, pipelines and other important infrastructure are located and cannot safely undertake their work.

The same can be said for marine spatial data, with knowledge of how accurate a boundary is being one of the key areas for research within the broader ARC marine cadastre project. Greater accuracy of spatial data creates less ambiguity in establishing boundaries, which in turn establishes better management practices within the marine environment. As discussed in 6.5.1, the establishment of key business datasets within the framework of a marine cadastre is an important step in breaking down barriers between current data 'silos'. Making such data available to the wider marine community however is of limited use unless the accuracy to which it can be defined in the physical environment is known. The creation of metadata for spatial datasets would give stakeholders such knowledge.

In conjunction with ANZLIC, VSIS has developed six spatial accuracy guidelines which address key areas in order to develop as greater level of accuracy as possible. These types of guidelines would also be of relevance in the marine environment.

1. Build on the common foundation of Framework (Fundamental) Information and Key Business Data.
2. Adopt industry standards.
3. Use nationally recognised datums and suitably oriented projections.
4. Include Datum, Projection and Data Quality elements in metadata.
5. Maximise analytical capability through topological structuring.
6. Establish a development plan that includes accuracy upgrades.

(VSIS, 2003)

### 7.3.4 Metadata

"Metadata is data about data; a structured summary of information that describes spatial data sets and includes, but is not restricted to content; quality; currency; access; and availability" (ANZLIC 2001). Through metadata, potential users are made aware of the assumptions and limitations in the data and are able to evaluate the data's applicability to their needs (VGIS, 2000b). A prime example of metadata is in the cataloguing of books within a library.

ANZLIC has developed metadata standards which set out the minimum requirements for metadata to be included in the ASDD. Victoria has done the same for inclusion

into the VSDD, basing their metadata standards on those developed by ANZLIC. This ensures that the inter-jurisdictional relationship between the state and Commonwealth is maintained to a high degree. These metadata standards must be applied to all data, marine and terrestrial.

The standards are produced by describing a number of "core" metadata elements that are common for all types of data and according to the ANZLIC metadata standards (2001) are used to:

> Identify what data exists, to describe its content and geographic extent, to enable potential users to assess the suitability of the data for various purposes, and to indicate where more information about the data can be obtained.

The Victorian metadata standards are implemented through a "pages" system (based on ANZLIC), where core general information is recorded at the highest level (Page 0) and organisational or jurisdictional metadata recorded at lower levels (Pages 1 and 2). Page 0 is the standard metadata provided to the VSDD and hence ASDD, with Pages 1 and 2 being used mainly by the custodians of the data to fulfil their own specific metadata needs (VGIS, 2000b). When data is accessed through any access network, agencies must include Page 0 metadata along with it. This will enable the proper and effective use of data through the ability to know how accurate and current it is, while also being aware of assumptions and limitations inherent in the data.

Due to marine data already being included within the ASDD, the metadata standards developed by ANZLIC would be applicable to fundamental and business datasets within the marine cadastre. The standards are becoming commonplace amongst custodians of terrestrial data, however the marine cadastre project questionnaire (section 4.2, Q 14) revealed that 45% of data producers in the marine environment did not always produce or supply metadata with spatial datasets. The only way in which users are able to make effective decisions is through knowledge of the accuracy and limitations of the data that they use. Metadata provides such knowledge, and would need to be provided for any dataset used within a marine cadastre. This is especially so for fundamental and business datasets, although this would be part of any custodians role.

In order to aid custodians with the development of metadata for their data, ANZLIC has developed a metadata entry tool based on Microsoft Access 97 that is freely available. It is "designed to support the capture of metadata and to ensure a consistent standards-based description of the defined core metadata elements" (ANZLIC, 2001). Such a consistent standards-based approach to the description of data also enables efficient data access mechanisms to be put in place.

### 7.3.5 Access

As stated by Williamson (2002), perhaps the most important aspect of an SDI is the ability to provide access to spatial datasets. This is ultimately what the infrastructure has been built for, with all of the other aspects described above helping to facilitate a simple and effective means of locating and obtaining accurate and up-to-date spatial information.

ANZLIC has developed a model access and management agreement, which aims to support a cooperative and consistent Australia-wide approach to data access and management. This is done through the creation of a protocol,

> "developed to define a set of consistent and workable arrangements that can be used by cross-jurisdiction partnership projects to streamline access to data and derived information products" (ANZLIC 2002b)

It also aims to ensure consistency with the development of the ASDI.

Within Victoria, the primary method of locating and obtaining spatial information is via the internet. This is in line with national initiatives, with the access infrastructure being divided into three parts (VSIS, 2003):

1. the Victorian Spatial Data Directory as part of the National Spatial Data Directory;
2. other data directories; and
3. data stores

with transparent linkages to connect them.

This type of access network allows users to 'point and click' on spatial information which is of relevance to their use through the VSDD. A review of the metadata for

that spatial information can then be undertaken to see if the data is fit for use. A satisfactory result in the metadata search leads the user on to the data store. This is where license agreements are reviewed and payment made, from which a request for data is processed. The ideal situation would then be immediate delivery of data in the format and scale requested by the user over the internet. This is currently not always possible however, and hence other delivery methods must also be utilised.

ANZLIC has recently released a draft plan for the technical architecture of an internet based framework for the ASDI Distribution Network (ASDI DN), which consists of:

> a network of distribution services, service providers and data storage facilities maintained by government agencies, private sector companies, academia, community organisations and other parts of the spatial information industry (ANZLIC, 2003c).

This framework is essentially a generic web services model, which allows communication between not only users and producers of spatial data, but also between value added providers who create services tailored to specific business needs. This would create a single online inquiry and distribution network for spatial data, and according to a Western Australian government report, the majority of users (97.4%) would adopt a single mechanism for all land administration issues (ANZLIC, 2003c).

The development of a marine cadastre aims to do more than simply allow users to locate and access spatial data. Industry consultation, as part of the ARC marine cadastre project, is to be undertaken, in which the specific business needs of users are to be discovered. These needs are based around not only access to spatial data but also the development of specific tools which utilise data, comparable to the development of the ASDI DN.

## 7.4 SDI AND THE MARINE CADASTRE

As discussed in section 3.3, there are currently a large number of agencies, stakeholders and users involved in the management of Australia's marine environment. Each operate within a set of legally defined boundaries and are responsible for the collection, collation and updating of spatial data relating to these boundaries. There are currently no standards in the marine environment for the collection of such spatial data, and hence the majority is stored within 'data silos',

with little integration between each silo. The development of a marine cadastre aims to break down the barriers between these silos, enabling all users in the marine environment access to a variety of data, irrespective of the custodian or location of datasets.

The implementation of the ASDI is enabling such access to data in the terrestrial environment and if utilised in the marine environment, as described above, would provide the platform for data access within the development of a marine cadastre. The diagram below (Figure 7.3) outlines the design concept for an Australian marine cadastre, as being developed within the Victorian section of the ARC marine cadastre project. This concept is based upon the ASDI DN described in section 6.5.5. This will facilitate the design of a system that is compatible with the terrestrial environment, taking advantage of current research so as not to 're-invent the wheel'.

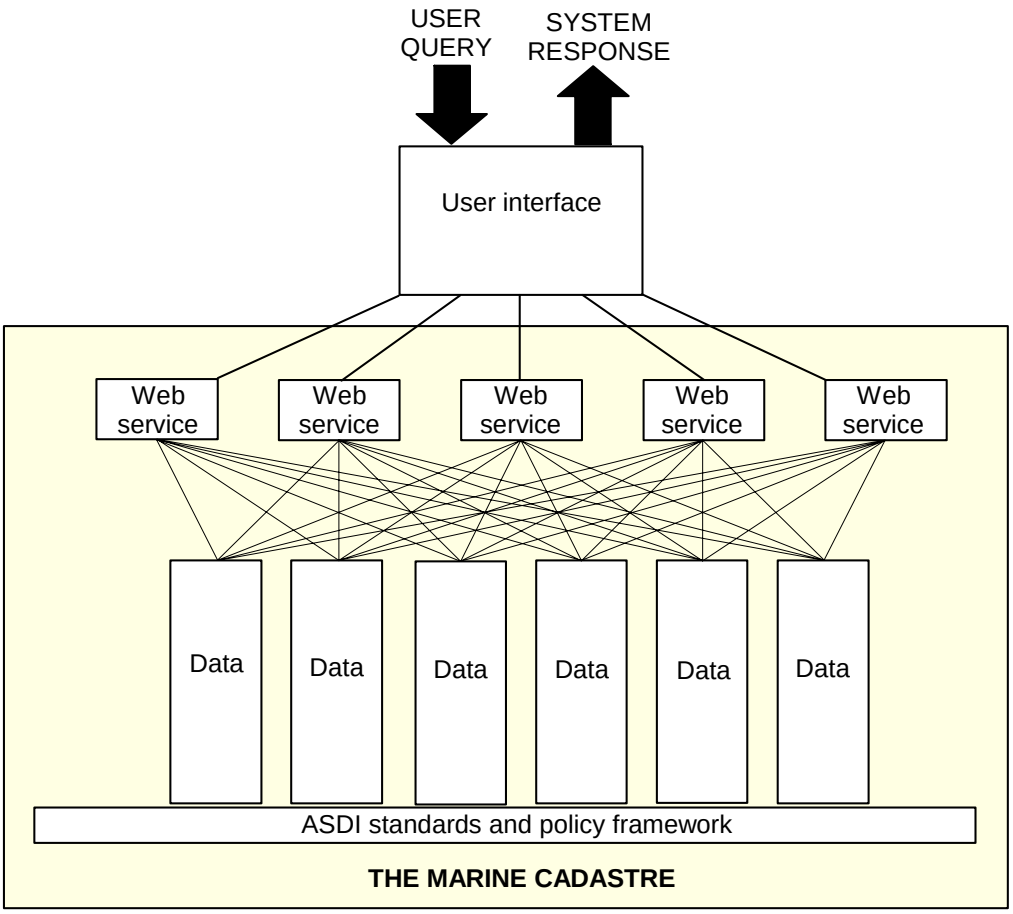



Figure 7.3 - Marine cadastre concept utilising the ASDI.

**User Interface**

The marine cadastre will be designed to be the sole access point to spatial information and tools in relation to legally defined boundaries within the marine environment. In order to achieve this, a user interface must be developed which would enable users to access and query spatial data. As discussed in section 6.5.5, access to spatial data in the terrestrial environment is to be conducted over the internet, and hence the marine user interface would be a web-site or HTML page. The design of such a site would not need to be undertaken until the last phase in the development of a marine cadastre, as it is simply an interface tool linking users to data. An example of a query that could be posed by a user is:

*based on my current location, what legislative restrictions impact on what I can do?*

**Web Services**

The ability of the marine cadastre to meet the requirements of users lies in the quality and versatility of web services that it would support. These services would be located within a maintenance environment (section 6.3.5) and can be divided into several categories.

The first of these services would enable users to search for information about data and to access the data itself. Within the ASDI DN, these have been described as *Registry Services* (ASDI DN) and may include:

- a metadata search facility with links to relevant metadata
- keyword search facility
- spatial location search facility with the ability to view location on a map
- data download mechanism to access spatial data

The second of these services would be the interrogation of various datasets through a variety of web services, described by the ASDI DN as *Shared Information Services*. These services will provide the answers to user queries. Within the example given above, a web service or variety of web services may be able to return not only a list of relevant legislation, but the section in the relevant act and links to those sections in the context to which it applies (e.g. fisheries). This ability to link legislation with spatial data would be a core web service, as management of the marine environment depends

on the ability to define, visualise and realise legally defined boundaries. The development of such a web service is being undertaken within the broader context of the ARC marine cadastre project, but is not discussed within this thesis.

There are also *Optional Services*, which would be specific to the providers, and value added services such as license agreements, payment options for the downloading and use of various data and web services and user access controls.

**Data**

The data within the marine cadastre would include all marine spatial data pertaining to legally defined boundaries, as well as that which supports the development of web services, such as state and federal legislation and international treaties. Data which would give the marine cadastre a multi-purpose function may also be included. Such datasets would be maintained and housed by various custodians (section 7.3.2). In order to create interoperability between datasets, it would be logical to expose data to users via a homogenized data form developed through the implementation of international best practice. Research into this is being undertaken in the context of the ARC marine cadastre project, but not specifically within this thesis.

## 7.5 CONCLUSION

The development of the ASDI is facilitating access to accurate and up-to-date spatial data in the terrestrial environment. Within the marine environment, immature institutional arrangements and user/provider relationships, as well as inconsistencies in the availability and quality of spatially referenced data, are hampering efforts to coordinate the management of legally defined boundaries. The utilisation of the ASDI within the context of a marine cadastre will aid in forming partnerships and providing standards from which issues of data interoperability can be addressed. As with the application of terrestrial cadastral principles to Australia's oceans, the components and concept of the ASDI apply to the marine environment at a broad conceptual level. More research will need to be undertaken to define and solve issues in relation to the implementation of the ASDI in the marine environment.

# 8.0 CONCLUSIONS

## 8.1 RESEARCH SUMMARY

The objective of this chapter is to document the major findings from this research in terms of the aims and objectives outlined in chapter 1. There were two principle aims of this thesis. The first was to define the concept of a marine cadastre through an investigation into institutional and legal aspects of Australia's current marine management regimes. The second was to analyse of the applicability of current land based spatial management arrangements, including the ASDI and cadastre, to the administration of current spatial rights, restrictions and responsibilities in the marine environment. The concept of a marine cadastre was formed as a framework to link and coordinate the spatial dimensions of such rights. In order to achieve these aims, several important objectives as described in chapter 1 needed to be fulfilled. Important observations and conclusions from these objectives have been summarised below.

## 8.2 OBSERVATIONS AND CONCLUSIONS

### 8.2.1 Australia's historical management of the marine environment

The research approach required an understanding of Australia's historical involvement in the management of the marine environment, including national and international tools of governance. A review of ocean governance in chapter 2 found this issue to be very complex due to the need to take into account state, national and international tools of governance. The state/Commonwealth jurisdictional break up of the marine environment created the need for the Offshore Constitutional Settlement (section 2.2.1). The application of the OCS, along with Australia's need to implement maritime boundaries in line with UNCLOS, have added to this complexity. There is

also a need for this legal regime to be effective in addressing current environmental, economic and social objectives, identified in section 2.3 as being the major factors driving the development of a marine cadastre.

### 8.2.2 Critical Analysis of International Marine Cadastre Research Initiatives

Chapter 3 critically reviewed international marine cadastre research initiatives, providing a guide to some of the issues and problems which countries face in attempting to implement a spatial boundary management regime such as a marine cadastre. The major issues identified include:

- the ambulatory nature of the coastline;
- the size of the marine area to be managed;
- the complex spatial and temporal interactions in the marine environment;
- the need for mechanisms to facilitate quick and effective updates of marine spatial data;
- the need for a virtual register of interests in the marine environment to support decision support systems; and
- the wide range and nature of marine activities and stakeholders which need to be taken into account.

### 8.2.3 Current Legal and Institutional Aspects of Marine Management

Chapter 3 also reviewed the legal and institutional aspects of Australia's current marine spatial management systems, focussing on major interests within the marine environment. What was discovered was a complex regime of legislation and overlapping jurisdictions, each managed separately by various agencies and stakeholders, resulting in the formation of data silos. The consequence of this was a lack of coordination in the management of spatial boundaries in the marine environment, often resulting in duplicated effort and gross inefficiency.

### 8.2.4 Legal, Institutional and Technical Issues

Research and consultation with industry and special interest groups in the marine environment enabled the identification of a number of legal, institutional and

technical issues and problems that must be taken into account in the development of a marine cadastre. These were discussed within chapter 4 and include:

- the complexity and volume of legislation governing Australia's marine environment;
- ambiguity within legislation caused by inconsistent tidal plane definitions, inadequate spatial definitions of boundaries and a lack of spatial knowledge when writing legislation;
- overlapping nature of interests within the marine environment creating competing rights, restrictions and responsibilities;
- lack of cooperation between agencies;
- need to provide greater access to up-to-date and accurate spatial boundary information;
- lack of a lead agency within the marine environment; and
- the three and four dimensional nature of interests within the marine environment.

The ability to overcome such issues requires a whole-of-government approach to the management of Australia's marine environment. There is a need to identify lead agencies within each state and the Northern Territory to facilitate greater cooperation between stakeholders. Laws and regulations that promote conflict in marine space need to be identified along with the resolution of ambiguous terminology and spatial definitions within legislation.

### 8.2.5 Marine Cadastre Concept

The investigation into the management of the marine environment within an Australian and international context has shown the complex and dynamic nature of rights which exist. As discussed in chapter 5, such rights regularly overlap, creating the need for interaction between a wide range of stakeholders and activities. In a marine context however, it is not the actual activities that a marine cadastre must take into account, but the administrative and legal boundaries which govern where and when such activities can occur. The rights, restrictions and responsibilities that are attached to these boundaries must also be recorded in order for management to be effective.

Another important point raised in chapter 5 is that the marine cadastre must not be developed in isolation from the terrestrial environment. There are a number of activities that occur in and around the coastal zone or tidal interface, which straddles areas of both land and sea. Creating a system which links the management of both environments will enable a more seamless integration of spatial data, helping to facilitate integrated and effective approaches to the management of Australia's coastal zone. The importance of creating such a continuum is shown through the fact that the marine cadastre concept diagram (Figure 8.1) shows areas of both the terrestrial and marine environments.

The ability to provide consistent and accurate spatial information on the wide range of rights, restrictions and responsibilities in the marine environment is also hampered by the fact that interests are currently managed by a number of organisations or agencies within 'silos'. The implementation of the ASDI within the marine environment would provide the basis for the integration of spatial data within the marine and terrestrial cadastres. This would aid in the development of a cadastre whereby legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment can be assessed, administered and managed.

The review of Australia's legal and institutional governance of the marine environment, along with the identification of marine issues through research and consultation, has enabled the concept of a marine cadastre to be defined. A diagram to aid in the visualisation of this concept has also been developed, as shown in Figure 8.1.

*A marine cadastre is a spatial boundary management tool, which describes, visualises and realises legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment, allowing them to be more effectively assessed, administered and managed.*

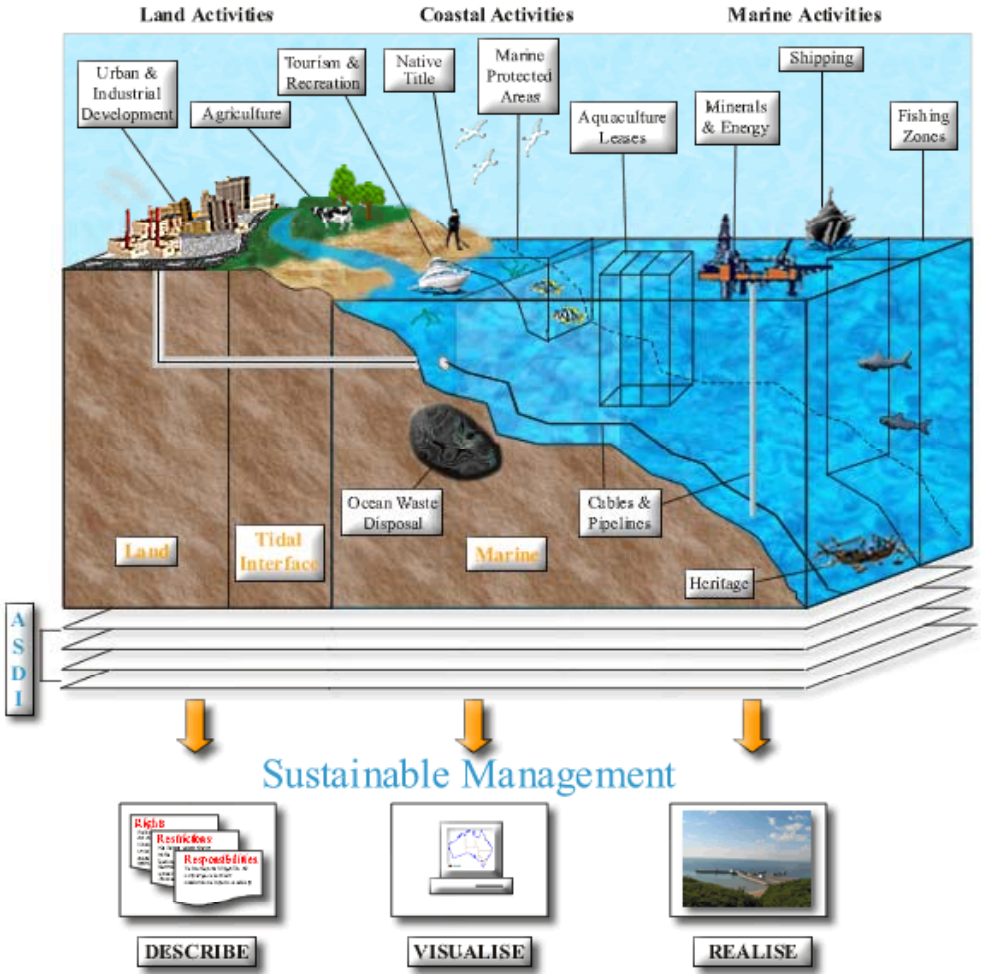



Figure 8.1 – Marine Cadastre Concept Diagram (Source: Binns et al., 2003)

*The marine cadastre will* describe *the location and spatial extent of rights, restrictions and responsibilities in the marine environment, including management boundaries, coastal planning guidelines, ocean parcels and legal definition. Such spatial extents should then be able to be* visualised *through the continual updating and maintenance of accurate and comprehensive digital spatial data. This ability to* describe *and* visualize *maritime boundaries will enable users to* realise *them physically at sea. This physical* realisation *will enable an integrated and practical approach to the management of a country's maritime extent.*

### 8.2.6 Applicability of Terrestrial Cadastral Principles to the Marine Environment

The need to create compatible terrestrial and marine spatial boundary management systems was demonstrated in chapter 5. For this to occur, an investigation into the ability of land based policy, tenure, legal, institutional and technical principles to be applied to the marine environment was undertaken in chapter 6. From this analysis, it may be concluded that policy and institutional aspects were most applicable, as the physical difference between the two environments is not a major concern when applying these principles. A number of pertinent observations were made, including:

- Creation of a national ocean's policy by the Commonwealth government is a major step forward in providing direction for the administration of the marine environment.
- Need for an overarching governing body to address marine cadastral issues, including the implementation of the marine cadastre at a national level, in similar fashion to ANZLIC implementing the ASDI.
- Must assign a lead agency at a state level to undertake the development of a marine cadastre in order to coordinate task-specific management techniques.
- Need for a centralised marine cadastre system within each state, linked to a national marine cadastre.
- The realisation that the marine environment is dynamic. The key to managing it is to start simple, develop a strong marine cadastre framework foundation, and allow the system to evolve and grow as future uses arise.

The ability to apply tenure and legal principles to the marine environment was not as straight forward. Within the marine environment, the need for private transactions is limited, due to the lack of freehold rights. This differs to land use, where the ability to transact is a primary aim of the cadastre. There is also a major difference in the description of spatial boundaries. On land, legislation is used to describe how boundaries should be demarcated, with monuments used as the primary point of truth for boundaries. In the ocean, the precise location of boundaries is generally embedded within legislation, making statutory regulations the point of truth for boundaries.

The physical nature of the marine environment also causes difficulties in applying terrestrial cadastral principles of a technical nature. Boundaries are delimited rather than demarcated, can be two, three and four dimensional as opposed to two dimensional, overlap routinely as opposed to rarely and need to be systematically defined, rather than sporadically defined as on land.

Clear legal and spatial certainty of rights, restrictions and responsibilities is needed in the marine environment. For this to occur, greater access to up-to-date spatial data is needed, a point that is not adequately addressed through the application of terrestrial cadastral principles.

### 8.2.7 Applicability of ASDI Principles to the Marine Environment

The development of SDIs as a tool to facilitate access to up-to-date spatial data is well documented in the terrestrial environment. Within the marine environment there exists immature institutional arrangements and the lack of an overarching government department to coordinate the collection and maintenance of spatial data. The utilisation of the ASDI within the context of a marine cadastre would aid in forming partnerships and providing standards from which issues of data interoperability can be addressed. It would also ensure the development of a marine cadastre was compatible with the terrestrial spatial management system.

## 8.3 FUTURE RESEARCH

Future research recommendations include:

- Reviewing the possibility of spatial boundaries defined within a marine cadastre becoming the definitive legal source of maritime boundaries. The boundaries would only change when updates to the marine cadastre occurred. This would aid in dealing with an ambulatory coastline, as well as giving both stakeholders and administrators clear legal certainty at any given moment.
- The principles that govern the recording of rights, restrictions and responsibilities in the terrestrial environment in general, have broad relevance to the development of a marine cadastre for Australia. The differences in environment between the land and ocean, such as the three and four dimensional nature of the marine environment, make it difficult to effectively utilise principles of a more technical

nature. Institutional principles such as centralisation of the system, the implementation of an overarching governing body and the creation of partnerships, which are directly related to the development of a marine cadastre should be implemented in the marine environment. An investigation into how these principles are to be implemented needs to be undertaken.

- The development of metadata protocols, data access and management guidelines and custodianship guidelines have all helped to further the development of the ASDI in the terrestrial environment. The ASDI is also the underlying fundamental infrastructure for access to data in the marine environment, and hence the protocols and guidelines have enormous relevance to the development of a marine cadastre. A review of their applicability to the marine environment needs to be undertaken, but within the context of this thesis, it is recommended that as a concept, they should be adopted for use within the development of the marine cadastre.

The need to sustainably manage Australia's oceans is an issue that is gaining recognition within both the public and government spheres of society. In defining the concept of a marine cadastre, it is hoped that this thesis will aid in successfully integrating the economic, social and environmental aspects of sustainable development.

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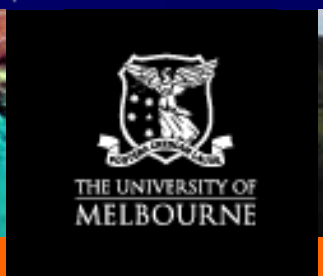
# APPENDIX A – MARINE CADASTRE QUESTIONNAIRE


# Marine Cadastre Questionnaire

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**To see a paper summarising the results of the questionnaire click here.**

## Contact details

In order to more clearly understand your role and interest in the marine environment and for the purposes of possible follow-up after the questionnaire, we would like to collect the contact details of respondents. The provision of this information is **optional**. If you choose to supply these details, we undertake not to use this information for any other purpose nor will we allow these details to be supplied to any other person or organisation.

| | |
|---|---|
| **Name** | |
| **Title** | |
| **Organisation** | |
| **Postal address** | |
| **Phone** | |
| **Fax** | |

**Email**

**Web site**

**Would you like to be kept informed of the progress of the marine cadastre project?**

○ yes ○ no

**Are you interested in attending a Marine Cadastre Workshop in Melbourne on the 14-15 November?**

○ yes ○ no

---

**1. Identify the industry sector to which your organisation belongs.**

○ Federal government ○ Non-profit organisation

○ State government ○ Academia

○ Local government ○ Private industry

○ Other (please specify)

---

**2. What is your organisation's core business? (You can select one or more options.)**

☐ Administration and management
☐ Surveillance and enforcement
☐ Marine scientific research
☐ Search and rescue
☐ Defence
☐ Environmental protection and management
☐ Port management
☐ Native title
☐ Commercial industry (You can select one or more options by using control key)

Fishing
Tourism
Shipping
Oil and gas exploration

☐ Other (please specify)

---

**3. Does your organisation use spatial information to conduct its business?**

○ yes ○ no ○ unsure

---

**4. If you answered YES to Question 3**
**How important is spatial information for your business operations?**

○ essential ○ important ○ fairly useful ○ not important

---

**5. If you answered NO to Question 3.**
**Do you think that spatial information could be used to assist or improve your operations?**

○ yes ○ no ○ unsure

---

**6. Is your organisation a user, supplier or producer of spatial data? (You can select one or more options.)**

☐ user ☐ supplier ☐ producer

---

**7. If you are a user of spatial data, in what form is the data supplied and what are the approximate**

**percentages of this supplied data? (You can select one or more options.)**

| | | |
|---|---|---|
| ☐ Paper charts and maps | | 0% |
| ☐ Digital data | | 0% |
| ☐ Other (please specify) | | 0% |

---

**8. When using or compiling spatial data, what components of position are of relevance to you or your customers? (You can select one or more options.)**

☐ Depth only (1D)

☐ Horizontal location only (2D)

☐ Both depth & horizontal location (3D)

☐ Temporal variations

---

**9. What scale(s) of mapping and charting do you use or produce? (You can select one or more options.)**

☐ Larger than 1:10,000
☐ Larger than 1:50,000
☐ Larger than 1:100,000
☐ Larger than 1:250,000
☐ Larger than 1:500,000
☐ Larger than 1:1,000,000
☐ Smaller than 1:1,000,000

---

**10. What areas does your data cover? (You can select one or more options.)**

☐ Nation-wide

☐ State-wide or territory-wide (can select more than one by using control key)

Queensland
New South Wales
Victoria

☐ Regional or local (please specify)

---

**11. What would be the ideal accuracy of the spatial information you use?**

- ○ ±1 m
- ○ ±5 m
- ○ ±10 m
- ○ ±100 m
- ○ Greater than ±100 m
- ○ Other (please specify)

---

**12. How important is the currency of the spatial information you use?**

- ○ Critical
- ○ Important
- ○ Somewhat important
- ○ Fairly unimportant
- ○ Not important at all

---

**13. For users: How important is metadata to your usage of marine spatial data?**

- ○ Critical
- ○ Important
- ○ Somewhat important
- ○ Fairly unimportant
- ○ Not important at all

---

**14. For producers: Do you provide metadata along with the spatial data you supply?**

○ yes ○ no ○ sometimes ○ unsure

---

**15. What are the sources of spatial data used by your organization and the approximate proportions of these sources? (You can select one or more options.)**

| | | |
|---|---|---|
| ☐ Satellite imagery | | 0% |
| ☐ Aerial photography | | 0% |
| ☐ Laser airborne depth sounder (LADS) | | 0% |
| ☐ Ship-borne hydrographic survey | | 0% |
| ☐ Terrestrial survey | | 0% |
| ☐ Tidal records | | 0% |
| ☐ Other (please specify) | | 0% |

---

**16. If some or all of the spatial data you use is supplied by another organisation(s), nominate the supplier(s) and the approximate percentages of the data supplied by each. (You can select one or more options.)**

| | | |
|---|---|---|
| ☐ Federal government (please specify) | | 0% |
| ☐ State or Territory government (please specify) | | 0% |
| ☐ Local government (please specify) | | 0% |
| ☐ Other (please specify) | | 0% |

---

**17. Does your work in the marine environment depend on a boundary which is defined by the intersection of a tidal plane with the land (e.g. the intersection of the plane defined by Lowest Astronomical Tide with the terrain)?**

○ yes ○ no ○ unsure

---

**18. If you answered YES to Question 17 - which tidal plane (or planes) are relevant to your operations? (You can select one or more options)**

- ☐ Highest astronomical tide
- ☐ Lowest astronomical tide
- ☐ Mean sea level
- ☐ Mean high water
- ☐ Other (please specify) [ ]
- ☐ Unsure

---

**19. In what ways does your organisation use marine spatial data? (You can select one or more options.)**

- ☐ Display purposes only
- ☐ Creating maps and charts (digital or paper)
- ☐ Management of areas of jurisdiction
- ☐ Legal purposes (e.g. law enforcement)
- ☐ Scientific investigation
- ☐ Navigation
- ☐ Exploration
- ☐ Environmental monitoring
- ☐ Native title
- ☐ Other (please specify) [ ]

---

**20. Identify the five most important *instruments of governance* which control your operations in the marine environment. In addition, indicate the jurisdiction in which each applies.**

1. [ ] Unknown
2. [ ] Unknown
3. [ ] Unknown
4. [ ] Unknown
5. [ ] Unknown
6. ☐ Unsure

---

**21. Does the spatial data you have serve your purposes adequately?**

- ○ Strongly agree
- ○ Agree
- ○ Neither agree nor disagree
- ○ Disagree
- ○ Strongly disagree

---

**22. How could the spatial data you have be improved to better serve your purposes? (You can select one or more options.)**

- ☐ By providing more information (showing information not currently available)
- ☐ By being more accurate
- ☐ By being more current
- ☐ By being more readily accessible
- ☐ By being more scalable
- ☐ By being more affordable
- ☐ By the provision of more comprehensive metadata

☐ Other (please explain)

---

**23. Do you have trouble accessing the marine spatial data you require?**

○ yes ○ no ○ unsure

---

**24. What are the impediments to accessing data? (You can select one or more options.)**

☐ Finding it ☐ Licensing

☐ Cost ☐ Format

☐ No impediments

☐ Other (please specify)

---

**25. If your operations would benefit from more detail, what particular detail(s) would you like added? (You can select one or more options.)**

☐ Boundaries (please specify)

☐ Restrictions (please specify)

☐ Links to relevant legislation and/or by-laws

☐ Bathymetry

☐ Other users

☐ Shipwrecks

☐ Ecological information

- ☐ Cables and pipelines
- ☐ Shipping channels
- ☐ Navigation aids
- ☐ Fishing areas
- ☐ Marine park boundaries
- ☐ Tourist information
- ☐ Oil and gas deposits
- ☐ Navigation hazards
- ☐ More detail is not required
- ☐ Other (please specify) _____

---

**26. Do you believe that access to a marine cadastre would assist the operations of your organisation?**

- ○ Strongly agree
- ○ Agree
- ○ Neither agree nor disagree
- ○ Disagree
- ○ Strongly disagree

---

**27. Please indicate the relative importance of the following features of a marine cadastre for your organisation?**

| Feature | Very important | Important | Neutral | Relatively Unimportant | Totally Unimportant |
|---|---|---|---|---|---|
| Accuracy | ○ | ○ | ○ | ○ | ○ |
| Currency | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| Scalability | ○ | ○ | ○ | ○ | ○ |
| Accessibility | ○ | ○ | ○ | ○ | ○ |
| Authoritativeness | ○ | ○ | ○ | ○ | ○ |
| Digital | ○ | ○ | ○ | ○ | ○ |
| Free of charge | ○ | ○ | ○ | ○ | ○ |
| National coverage | ○ | ○ | ○ | ○ | ○ |
| Other (please specify) | ○ | ○ | ○ | ○ | ○ |
| Other (please specify) | ○ | ○ | ○ | ○ | ○ |
| Other (please specify) | ○ | ○ | ○ | ○ | ○ |

---

**28. The marine cadastre project will undertake two pilot studies, one in Queensland and the other in Victoria. (http://www.geom.unimelb.edu.au/maritime/pilot.htm).**
**Would you be prepared to provide data to the pilot projects?**

○ yes ○ no ○ unsure

---

**29. Do you have any comments to add on issues not covered by the previous questions?**

Button Reset



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