

Report on

# **Australian Marine Cadastre Research and Activities**

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The marine cadastre is an important topic for research both internationally, and particularly in Australia. With this in mind, Department of Geomatics at the University of Melbourne is involved in different national and international collaborative research projects. The main objectives of these activities are looking at defining the issues to be considered in the context of developing an Australian marine cadastre and facilitation for the development of a set of guidelines appropriate to the Asian and Pacific region for the design of marine cadastres.

This report aims to describe both national and international activities and involvement of the Marine Cadastral Research Group at Department of Geomatics, University of Melbourne. The report provides an overview of the incentive, objectives and principle tasks as well as the results of current research activities. These activities aims to act as an aid in designing the features and capabilities of a future marine cadastre for Australia.

## **INTRODUCTION**

Australia is a profoundly maritime nation. Encircled by the sea, the Australian coastline is almost 60,000 km in length and the area of the nation's maritime responsibility is over twice that of the Australian continental landmass (Kaye, 1995). The Australian Maritime Jurisdiction (AMJ) – the region to be covered by any future marine cadastre – is the second largest in the world and represents not only a vitally important national asset, but also a major national and international responsibility. Given the diversity and extent of Australia's ocean resources, there is a fundamental requirement to manage, explore and exploit the nation's ocean territories in a way that will maximise benefit to the nation, while at the same time protecting the delicate ocean environment (Collier *et al*, 2001).

In regard to ocean governance, Australia is bound by a number of international treaties and conventions. Furthermore, Australia is a federation of states and territories, each of which has enacted legislation governing activities in the marine environment. Such instruments of

governance operate in tandem with the sovereign rights, responsibilities and legislative controls introduced by the Commonwealth.

In recent years there has been an increasing awareness of the importance of spatial data in the marine environment and the need for a structured and consistent approach to the definition, maintenance and management of offshore legal boundaries. It is in this context that the concept of a national marine cadastre has gained increasing prominence.

The marine cadastre is now being recognised as a fundamental layer of offshore spatial data infrastructure. In essence, the marine cadastre provides a means for delineating, managing and administering legally definable offshore boundaries. Examples of such boundaries include:

- International maritime boundaries
- Internal maritime boundaries
- The federal/state boundary at the 3 nautical mile limit of coastal waters
- Administrative and jurisdictional boundaries such as those used to define marine protected areas, restricted fishing zones and other areas where operational restrictions apply
- Tenure boundaries such as those delineating mariculture or aquaculture leases, petroleum exploration and mining leases, cable and pipeline locations and areas granted under native title claims

## **STATUS OF MARINE CADASTRE RESEARCH IN AUSTRALIA**

Initial support for marine cadastre research in Australia came in late 2001 with the awarding of an ARC Linkage-Projects grant to a team comprising the University of Melbourne, GeoFix Pty Ltd, Land Victoria (LV), Geoscience Australia (GA) and the Queensland Department of Natural Resources and Mines (NR&M). Throughout the remainder of this report, this project will be referred to as the ARC marine cadastre project.

In addition to the work and contribution being made directly ARC project, a number of other initiatives have commenced:

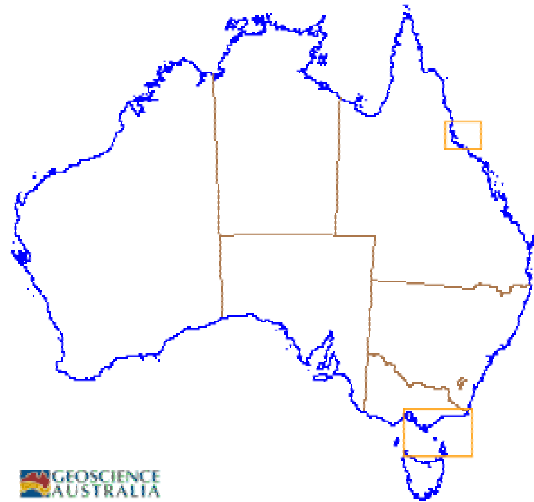
- The Intergovernmental Committee on Surveying and Mapping (ICSM) has established a Tidal Interface Working Group. The group is chaired by GA, with both LV and DNRM being active members. Because of the overlap in personnel, there is a strong link between the activities of the ICSM working group and the work being carried out under current ARC marine cadastre project.
- The Australian National Marine Data Group (ANMDG) has established a Marine Cadastre Working Group. Again, a representative from GA chairs this group. A member from DNRM sits on the ANMDG committee and acts as mentor to the marine cadastre working group, further facilitating cooperation and coordination of the national marine cadastre research effort.
- The Australian and New Zealand Land Information Council (ANZLIC) is an intergovernmental body which provides leadership in the collection, management and use of spatial information. In the past, ANZLIC's focus has been on land-related spatial information. However recently ANZLIC has publicly recognised the importance of marine related spatial information and is actively supporting efforts to

facilitate the development of an Australian marine cadastre, particularly through its role in the ANMDG.

Thus marine cadastre research in Australia has gained strong government support. Healthy coordination of the research effort is being maintained through the nurturing of close collaborative links between the government and academic sectors.

As a collaborative initiative through ARC marine cadastre project, two pilot project areas have been adopted to support the development and testing of research hypotheses and to demonstrate the concept and complexities of a future marine cadastre. The first area is located off Townsville on the Queensland coast, the second area includes Port Phillip Bay and extends eastward along the Victorian coast to the New South Wales border. The two pilot project areas are shown in Figure 1. More details can be found at

<http://www.geom.unimelb.edu.au/maritime/index.htm>.



**Figure 1** – Location of pilot project areas (Queensland and Victoria)

## **Progress on the ARC Marine Cadastre Project**

### ***Objectives***

The ARC funded marine cadastre project formally commenced in June 2002, with the awarding of two postgraduate scholarships and the appointment of a full-time research assistant. The project will run for two years and has as its principle objective the definition of issues currently hindering the development of an Australian marine cadastre and, in that context, the establishment of a direction for future research.

### ***Research focus***

Current research is focussed on two main areas. The first is a consideration of the similarities and differences between the existing land cadastre and a future marine cadastre and the suitability and extension of the Australian Spatial Data Infrastructure (ASDI) to the marine environment. The second research area focuses on issues of 3D and 4D parcel definition, the application of uncertainty in maritime boundary delimitation and coastline definition, and the integration of uncertainty within a multi-dimensional cadastral object model.

In parallel with these detailed areas of research, work is also being conducted to gain a broader understanding of the requirements of those individuals and organisations who use, manage and administer maritime spaces and marine spatial data. This is being achieved through the running of workshops, the conducting of a broadly based national questionnaire and the execution of detailed industry consultation.

### ***Workshops***

To date two workshops have been conducted and a third is planned for early in 2004, toward the end of the project. The first workshop was held in Townsville on 5-6 August 2002. The objective was to bring together stakeholders with an interest in the marine environment and thereby gain cooperation and support for the Queensland component of the pilot project. To this end, the workshop was very successful, with more than a dozen organisations agreeing to be partners in the pilot project including fundamental players such as the Australian Hydrographic Office, the National Oceans Office, the Australian Institute of Marine Sciences and the Great Barrier Reef Marine Park Authority. Presentations from the workshop are available on CD from NR&M.

The second workshop was held at the Geomatics Department of the University of Melbourne on 14-15 November 2002. The objective of this workshop was to explore and identify key issues in relation to the development and application of a marine cadastre from a diverse range of perspectives. An idea of the broad level of interest in the marine cadastre concept and the issues that must be considered as implementation of the marine cadastre progresses can be seen from the workshop presentations available at

<http://www.geom.unimelb.edu.au/maritime/workshop.htm>.

### ***Questionnaire-design, objectives and key results***

The national questionnaire was intended to raise the issue of the marine cadastre with a broad audience and to gain feedback to enable a general picture to be formed on how spatial data is being used in the marine environment and what limitations are currently being faced in this context.

The questionnaire was made available on-line in September 2002. Once the questionnaire was placed on the Web, over 260 emails were sent out to potential respondents with the request that the questionnaire be distributed as widely as possible. In the months that followed, a total of 110 responses were received, allowing the objectives of the questionnaire to be largely satisfied.

The aim of the questionnaire was to target as broad an audience as possible in order 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

Based on these objectives and analysis of results of the questionnaire, some key outcomes have been pointed out which can be found in Attachment 1.

### ***Industry consultation***

While some preliminary discussions with key players have been carried out, a concerted process of industry consultation is yet to be undertaken. The questionnaire responses and the workshops have provided a broad overview of issues and a picture of how spatial data is being used offshore. However it remains necessary to get to a higher level of detail in order to fully understand the issues surrounding the implementation and operation of a marine

cadastre from a user perspective. Thus in the coming months, a number of organisations will be selected for interview.

## **INTERNATIONAL ACTIVITIES**

The Department of Geomatics, The University of Melbourne is also involved in international collaborative research activities on marine cadastre. This project is in Asia-Pacific region, under the United Nations supported Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and the Centre for Spatial Data Infrastructures and Land Administration, Department of Geomatics, The University of Melbourne.

There is currently a general lack of transparency in the Asia-Pacific region as to what cadastral data and land administration systems exist regarding their scope, quality, and information communication technologies they utilise. Importantly all countries in the region are undertaking some form of cadastral or land administration reform with most developing countries receiving international advice or aid from countries such as the U.S., Canada, Germany, U.K., Sweden, Denmark or The Netherlands.

This is the background providing the justification to establish the United nations-Permanent Committee on GIS Infrastructure for Asia and the Pacific Working Group 3 (Cadastre) - PCGIAP-WG3. However, there was a need to document the existing cadastral systems in a standardised way to enable its collation. In order to overcome this situation, WG3 needs support to assist its effort to fulfil its tasks regarding development of Regional cadastral activities.

The Department of Geomatics, University of Melbourne, which currently has an active research group working in the field of SDIs, Land Administration and Marine Cadastre is asked to assist PCGIAP. The Department is asked to coordinate and support the PCGIAP-WG3.

### **United Nations-Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)**

Through the efforts of the United Nation Regional Cartographic Conference for the Asia-Pacific region (UNRCC-AP) and following its Thirteenth Conference in Beijing, May 1994, the national mapping agencies in the Asia-Pacific region formed the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) in 1995 (as a result of Resolution 16 of the Conference) to develop a Regional SDI for Asia and the Pacific region.

The aims of the PCGIAP are to maximise the economic, social and environmental benefits of geographic information in accordance with Agenda 21 by providing a forum for nations across the region to cooperate in the development of the Asia-Pacific Spatial Data Infrastructure (APSDI) and contribute to the development of the global infrastructure.

## Organisational Structure and Operation of PCGIAP

According to the PCGIAP, this Committee operates under the purview of the UNRCC-AP, and submits its report and recommendations to this Conference.

There are three tiers in PCGIAP organisational structure, consisting of a plenary body comprising all participating member nations, a middle tier including working groups and secretariat which facilitate and implement all decisions made by the top tier body which is empowered to make decisions on behalf of the PCGIAP as a whole on operational issues.

In addition to reporting to the UNRCC-AP, this Committee also established links with other relevant United Nations programs and international bodies such as FIG, ISO/TC 211, ISCGM, EUROGI, PCIDEA, ISPRS, IUGG, ICA.

The PCGIAP comprised of 55 nations in which member nations are represented on the Committee by directorates of national survey and mapping organisations and equivalent national agencies. Each member nation participating in the Committee has one vote, and decisions of the Committee shall be taken by a majority of the Representatives present and voting.

An Executive Board, comprising representatives from twelve member nations (President, Vice President, Secretary, and up to nine other members), coordinates the Committee's work program. The term of the Executive Board is the period between UNRCC-AP Conference, currently about three years.

The activities of and work programs of the Executive Board is supported by its Working Groups. The Working Groups are established, where required, to undertake projects in pursuit of the Permanent Committee aims and objectives. The Executive Board is currently supported by four working groups as described in Table 1. Further, the Committee's meetings are held in conjunction with the triennial UNRCC-AP meetings and also between these meetings.

**Table 1:** Working groups of the PCGIAP in the period 2000-2003

Working Group 1: <b>Regional Geodesy</b>	Responsible for the implementation of a regional, precise geodetic network and coordinating regional geodetic campaigns.
Working Group 2: <b>Regional Fundamental Data</b>	Responsible for establishing regional fundamental datasets and mechanisms for sharing these data and fostering an understanding of the benefits in using regional fundamental data.
Working Group 3: <b>Cadastral Working Group</b>	Responsible for facilitating discussion on cadastral and land administration issues, and marine cadastres.
Working Group 4: <b>Institutional Strengthening</b>	Responsible for facilitating member involvement, education, training and subregional programs.

### **PCGIAP-Working Group 3 (Cadastre)**

Working Group 3 (Cadastre) has been established in year 2000 based on the Resolution from the 15th United Nations Regional Cartographic Conference (UNRCC-AP) in Malaysia. Through that Resolution, it has been recommended that the United Nations within available resources, and in cooperation with the Working Group on the Cadastre under the PCGIAP, and with the expert assistance of relevant organisations such as the International Federation of Surveyors and the International Hydrographic Office, undertake the following work plan for the period 2000-2003 to:

- (a) Facilitate discussion on marine cadastres, focusing on the issues involved in the establishment of appropriate administrative infrastructures to manage marine resources in the context of the United Nations Convention on Law of the Sea;
- (b) Undertake a study of land administration issues such as the range of tenure and institutional issues, water, indigenous, mining and petroleum rights, gender, urban agglomeration, land disputes, problems and indicators, with the objective of producing a global atlas and related documentation, utilizing the vast amount of existing land administration and land tenure data existing in United Nations agencies;
- (c) Facilitate a workshop to develop an appropriate generic template for country profile analyses describing the status of cadastre and land administration, and the need for improvements, which will facilitate benchmarking and the development of performance indicators.

With this in mind, the PCGIAP, through its WG3, believes that such Facilitate discussion on marine cadastres, is essential to the:

- development of the Asia-Pacific Spatial Data Infrastructure;
- development of regional marine cadastral infrastructure;
- realisation of economic, social and environmental benefits for the region; and
- the implementation of the United Nations Conference on Environment and Development (UNCED) Agenda 21;

and that:

- data sharing avoids wasteful duplication of resources and facilitates data integration; and
- provides better data for decision making and thus expands market potential.

With this in mind, WG3 has an objective to explore the relationship between the operation of the cadastre or land administration system in each member country and the development of their spatial data infrastructures at local, state and national levels. In response to this objective, this Working Group has two major tasks. First to undertake a review of cadastral activities in the Asia and Pacific region through the use of questionnaires and the organization of a regional workshop (which was conducted in July, 2003 in Okinawa, Japan) to discuss the development of cadastral templates in order to compare systems and their role in National SDIs, and secondly to develop a set of guidelines appropriate to the

Asian and Pacific region for the design of marine cadastres which will be discussed in a regional workshop in April 2004.

### **Marine Cadastre - The Second Component of the PCGIAP-WG3 Workplan**

The second component of the PCGIAP-WG3 three year Workplan is to support research to improve understanding of Marine Cadastres in Asia and the Pacific region. The work and activity on this component of the WG3 Workplan is started since the 16th UNRCC conference in Okinawa, Japan this July. As part of this project, WG3 will host a workshop in April 2004 in Malaysia to develop both Guidelines for the establishment and maintenance of marine cadastres and a Future Action Plan for the development of marine cadastres. The project also aims to review best practice, to establish networks and to evaluate the potential for ICT expertise in establishing marine cadastres.

The research being undertaken by the Marine Cadastre Research Group (which comprises seven equivalent full-time staff and two Australian State Governments and the Federal Government as well as private sectors) is directly related to the future work plan of WG3. In particular the Marine Cadastre Research Group has done a questionnaire survey on marine cadastre which will form the basis of the PCGIAP marine cadastre questionnaire.

### **FUTURE PLAN**

The results from the questionnaire, the feedback from the two workshops held thus far and the findings from the forthcoming industry consultation process will be combined to identify fundamental design criteria for a future marine cadastre for Australia. The pilot project, with demonstration areas in Queensland and Victoria will provide a “laboratory” for testing research hypotheses and refining proposed solutions. Ultimately, the pilot project will become the means whereby the features and capabilities of an Australian marine cadastre can be illustrated and demonstrated to a wider audience. A final workshop, planned for early in 2004, will provide the forum for the presentation of results from the two year research program.

Another application for funding to the ARC has been recently submitted under the Linkage-Projects scheme, to allow marine cadastre research to continue beyond mid-2004 (when the current grant expires). The objective of this application is to allow independent collaborative research in this area to continue, by building on the findings of current research and by supporting strategic industry-academic research partnerships.

Though still at an early stage, real progress has already been made toward meeting the stated objective of current ARC project to identify and define fundamental problems hindering the development of an Australian marine cadastre. The new proposal thus draws on the body of knowledge and expertise flowing from current ARC project and aims at providing solutions to four fundamental research problems that have emerged. This is not to say that these four research problems are the only ones that demand attention, but taken together they represent a major impediment to the development of a future marine cadastre for Australia. These are the four key areas for future research:

- Resolving issues in the definition of the tidal interface
- The use of natural rather than artificial boundaries in a marine cadastre
- Extension and application of the ASDI to support a marine cadastre



- Marine policy, legal and security issues and the marine cadastre

Based on these areas, the new application therefore has four fundamental aims, in line with the four basic research problems that have been identified:

- To resolve scientific and technical issues in the definition and realisation of offshore boundaries that depend on a knowledge of tidal plane intersections with the land mass of the Australian continent (the tidal interface).
- To investigate and report on the use of natural rather than arbitrary boundaries to define jurisdictional limits in the marine environment.
- To extend, modify and test the principles that underlie the current Australian Spatial Data Infrastructure (ASDI) in order to support the implementation of an Australian marine cadastre.
- To analyse Australia's maritime boundaries and zones of maritime jurisdiction with a view to assessing claimed rights and responsibilities in the context of the evolving international law of the sea, current developments in Australian marine policy and enhanced concerns over maritime security.

The proposal, which seeks ARC funding for three years, brings together researchers from The University of Melbourne, The University of New South Wales and GeoFix Pty Ltd and includes four industry partners.

## **CONCLUSIONS**

The ARC marine cadastre project formally commenced in June 2002. Since that time, a considerable amount of interest and discussion has been generated about the marine cadastre concept, the definition of the marine cadastre and the benefits and applications of a future marine cadastre for Australia. Results from the marine cadastre questionnaire, presented in this report, highlight the importance of spatial information to the majority of individuals and organisations with responsibilities and interests in the marine environment. The marine cadastre will provide a means for defining, managing and administering legally definable offshore boundaries and in this context will form a fundamental component of marine spatial data and a layer in a future ASDI that covers both the terrestrial and marine environments.

## **ACKNOWLEDGMENTS**

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## **Key Outcomes of Australian National Questionnaire on**

### **Marine Cadastre**

Marine Cadastre Research Group, University of Melbourne

Most respondents came from the government sector, particularly state and territory government agencies and departments. The response from local government and the private sector was disappointing. Many respondents also played a role in commercial offshore activities. With regard to the organisational core business, most respondents indicated a role in environmental issues offshore. Scientific research was also seen to be a major activity. Administration and management were key functions.

In response to use spatial information to conduct business, it was found that the majority (97%) of respondents were users of spatial information. About 94% of responses revealed how important spatial information was (as either essential or important), and only 3% of respondents did not currently use spatial information, but all of these agreed that spatial information would improve their operations.

Nearly all respondents were users of spatial data, while roughly 70% were also producers and 60% were suppliers. Based on the information provided by organisations,

- The majority of offshore spatial data is supplied to users in digital form, though paper charts are still used by some organisations.
- Most users of spatial data require 3D information and many require knowledge of time variations as well.
- Data is generally supplied at large scale (typically 1:50,000 and 1:100,000).

With regard to the ideal accuracy of the spatial information for organisations, was the cause of much confusion amongst respondents. It seems that the term accuracy means different things to different people and is very much context or application dependent. Because of this, no clear picture could be formed from the very limited number of responses to this question. However, the users of offshore spatial information indicated that they are generally very dependent on that information being kept up to date.

Metadata is seen to be a very important part of the correct usage and interpretation of spatial information. However, not all suppliers consistently provide metadata and some are not even sure if they provide it.

With regard to the work of organisations in the marine environment and their dependency on the boundary which is defined by the intersection of a tidal plane with the land, the results demonstrated that the operations of almost 70% of respondents were in some way dependent on tidal plane definitions.

With regard to the ways that different organisations use marine spatial data, results showed that maps and charts emerge as the most prominent product from marine spatial data, though management applications, scientific research and environmental applications are once again seen as key activities.

One of the question asked respondents to identify the legislative controls (*instruments of governance*) under which they operate in the offshore environment. The poor response rate and incomplete responses to this question indicated that many were unsure about the legislation or treaties impacting on their offshore activities. Consequently no clear conclusions could be drawn from responses to this question.

There was a high degree of satisfaction amongst respondents about the adequacy of marine spatial data. However, the issue of access to data emerged as a major concern for users. Along this line, half of the respondents indicating that they do face problems in accessing the data they need. Having access to *more data* was also identified as an area where improvements could be made in regard to the suitability of currently available marine spatial data. Results indicated that the most common problem for accessing data is simply finding the data that was needed, followed by the age-old issues of cost and format incompatibilities.



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