University of Southern Queensland
Faculty of Engineering and Surveying

PROPERTY RIGHTS, CADASTRAL BOUNDARIES & COASTAL EROSION IN NEW SOUTH WALES

A dissertation submitted by

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Abstract

The aim of this project is to investigate the effects of coastal erosion on coastal boundaries and to determine the rights, obligations and limitations attached to that land with respect to both the private land owner and the general public.

The effects of coastal erosion along urbanised foreshores has seen the loss of land to private property by title as well as physical loss of land to the ocean, while public land is disappearing as erosion forces its natural coastal boundaries landward towards private fixed-line boundaries. As Australia continues to urbanise along its coastline, the value of coastal land near large cities in Australia is continually increasing, further highlighting the importance of resolving issues that surround coastal property boundaries.

These issues have been demonstrated through a literature review. The collection and critical review of current legislation, case law, survey regulations as well as investigation into examples of coastal remedial works (both successful and unsuccessful) was then applied to a primary research study, located at Collaroy-Narrabeen Beach, within the local government area of Warringah, NSW.

A detail survey was conducted of the foreshore and adjoining properties along the described length of Collaroy-Narrabeen Beach, as well as boundary survey to define the cadastral boundaries between the beach reserve and private properties that it adjoins. This study revealed significant deficiencies that continue to see the loss of land along the foreshore, affecting both private land owners and public beach users.

This study has proven that there are serious and concerning issues surrounding coastal erosion, and its effect on coastal property boundaries. As Australia's stunning and iconic coastline continues to urbanise, the importance of collective and responsibly considered actions which successfully manage the delicate balance between protecting privately owned land and public interests from coastal erosion in New South Wales has never been more significant.

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I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

Student Name
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Signature

26 October 2011

Date

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Nomenclature

AHD……...Australian Height Datum
CBD……Central Business District
DECCW…….....Department of Environment, Climate Change and Water
DP……...Deposited Plan
GMR…….Greater Metropolitan Region
LEP…….…….Local Environment Plan
LPMA……...Land & Property Management Authority
MGA……...Map Grid of Australia
MHWM……Mean High Water Mark
MLWM…….Mean Low Water Mark
NSW……..New South Wales
PM……Permanent Mark
RM...…….....Reference Mark
SIX……..Spatial Information Exchange
SP……..Strata Plan
UNSW…….University of New South Wales
WLEP……....Warringah Local Environment Plan

CHAPTER 1

Introduction

> *'…on natural beaches, erosion does not endanger the beach itself. Shorelines eroded for thousands of years, yet beaches remained, because they could change their shape and position. Erosion only becomes a problem when we place stationary buildings, parking lots and roads too close to the beach.'*
>
> Don Barber, Geology Dept., Bryn Mawr College c.2004

1.0 The Problem

Over tens of thousands of years beaches and coastlines around Australia have undertaken changes due to rises in sea levels, as well as erosion and accretion. Coastal erosion and rises in sea levels has formed a consistent historical pattern over time, however these historical changes have not been highlighted as a concern until recent decades, primarily due to the increase in urbanisation of Australia's coastline.

One of Australia's uniquely defining characteristics is the permanence of our land, and, being the largest island in the world, its isolation. Australia is extremely sparse, and if our population was evenly spread out across the land, supply would be virtually unlimited, and demand would therefore be very low. Yet the majority of our population lives within our cities, most of which are located within proximity to the coast. No other country has this pattern of extreme concentration in a small number of isolated cities. This unique Australian population pattern and lack of portability of land has over time come to be seen as a desirable attribute thus making the land valuable.

The value of coastal land near large cities in Australia is highly desirable, therefore the effect of erosion and accretion on private and public land, as Australia continues to urbanise along our foreshore, is of increasing significance and requires continual evaluation.

Major storm activity and climate change has resulted in significant rises to sea levels, thus contributing to fairly sudden and major erosion along many parts of the New South Wales coast line, and in particular, to my home beach of Collaroy-Narrabeen. As the shoreline begins to encroach upon land owners' properties, it signifies that the boundaries formed between the beach reserve and the privately owned land can either change or remain, depending on its status as a natural or right-line boundary.

If the boundary is natural, gradual and imperceptible accretion or erosion can cause the boundary to shift, increasing or decreasing the area of a property by title. Alternatively, if erosion occurs within proximity of a right-line boundary, this study has determined two problems:

- The landward side of the affected area can appear to physically 'lose' land, although it does not lose area by title. The land on title could end up as part of the foreshore (ie. sandy beach) which may not be ideal for the owner. The change in landform could, in extreme circumstances, sweep away the land completely, leaving an unusable land form, such as water.

- As the right line boundary remains despite the movement of the foreshore, and the adjoining coastal reserve is gradually swallowed up into the sea, the foreshore adjacent to the affected area is reduced, and could potentially disable public access completely.

1.1 Research Aims

The aim of this project is to investigate the effects of coastal erosion on coastal boundaries and to determine the rights, obligations and limitations attached to that land with respect to both the private land owner and the general public.

Both current and future legislation, survey regulations, legal precedence and government planning procedures will be assessed to gain a greater understanding of

how coastal erosion may affect both natural coastal boundaries, as well as right-line ‘fixed’ boundaries and how to minimise the effects of erosion.

This investigation will aim to focus on both secondary research and a primary study to provide a more comprehensive and conclusive report that focuses on coastal land with personal significance. The primary component of study will focus on a section of beach front properties known locally for the effects erosion has on the area. It will identify the type of boundaries those properties have, being either ambulatory (natural) or right line boundaries, and the extent of erosion that has occurred on those properties with regards to those boundaries.

The secondary component of study will examine Local Government planning procedures, as well as State Government legislation. These legislations will be reviewed to understand and determine the rights, obligations and limitations the landward property owner has with respect to erosion, and determine the areas of legislation that do not, in practice, adequately protect the foreshore. These procedures will also be reviewed to discover the role these tiers of government have on the protection of the general publics’ interests of the foreshore with respect to access and recreational purposes.

It is the aim of this study to determine what changes to legislation, survey regulations, and planning procedures are required as well as what protective and preventative measures that can be put in place to protect both land owner rights and interests and the public use of the coastal reserve.

Figure 1 - Photo taken 23 July, 2011 days after a relatively small storm (Millard 2011)

1.2 Scope of Research

The scope of this research project is to investigate the rights, obligations and limitations attached to coastal land with respect to both the private land owner and the general public, with regards to coastal erosion.

The literature review in chapter 2 will investigate the legislation in place with regards to land within the coastal area of New South Wales. It will also assess the New South Wales State Government and local government of Warringah Council's guidelines in respect to planning and development within the coastal zone, ie. 100 metres landward of the mean high water mark (Warringah Council 2001). It will also look at emergency procedures during times of large storm activities to assist in the prevention of coastal erosion, as well as long term preventative measure to reduce the effects of erosion caused by these storms.

The research method will be determined in three parts; a detail survey will be carried out on the beach front along Collaroy-Narrabeen Beach to examine the position of

the mean high water mark, as well as the position of the grassy bank and sandy beach. Secondly, a boundary survey will be carried out to establish the position of the cadastral boundaries between the beach reserve and the privately owned residential lots. In combining both surveys, a position of the mean high water mark and the grassy bank can be determined in relation to the cadastral boundaries to establish whether any land loss has occurred. The third part of the research study will apply methods of legislation and council regulations to the subject area to understand what deficiencies have occurred.

1.3 Area of Investigation

The area of investigation is located within a portion of coastline in the suburb of Collaroy, New South Wales. Collaroy is part of Sydney's Northern Beaches and is located approximately 17km from the CBD. It is situated within the Local Government Area of Warringah, Parish of Manly Cove, and County of Cumberland (*Figure 2*).

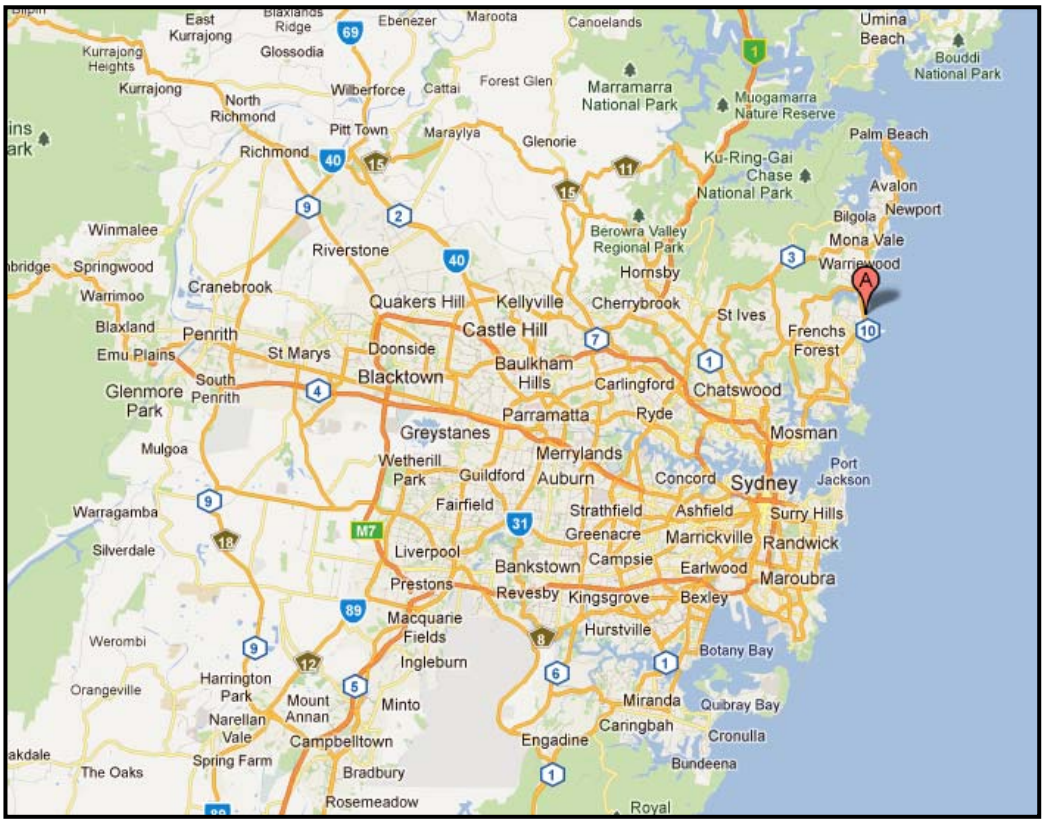

Figure 2 – Greater Sydney with Collaroy-Narrabeen Beach shown (Google Maps 2011)

The area was originally settled by Europeans during the early 1800s, with the whole of the Collaroy-Narrabeen beachfront being almost fully developed by 1941 (Warringah Council 1997). The suburb and beach of Collaroy were named after the paddle steamer *S.S. Collaroy* ran aground and was stranded on the beach in 1881 (NSW Heritage Council 2003) *(Figure 3).* Previous to this, the area was known as part of Narrabeen.

Figure 3 – S.S. Collaroy run-aground (Heritage Council Annual Report 2003)

The beach is known as Collaroy-Narrabeen Beach and stretches approximately 3.5km between the suburbs of Collaroy and Narrabeen. It is regarded by the New South Wales Government as one of the 19 'hot spots' along the coast that suffers from severe coastal erosion (Warringah Council 2011). Collaroy-Narrabeen Beach has suffered many historically large storms, in particular during the years of 1945, 1967 & 1974 (Clarke & Malone 1987). These storms have seen the destruction and loss of many houses along the beach front.

The properties and beachfront under investigation is situated South of Ramsay Street, East of Pittwater Road, North of the Collaroy Beach Carpark (North), and

West of the Pacific Ocean. The properties are known as 1102-1124 Pittwater Road, Collaroy (*Figure 4*).

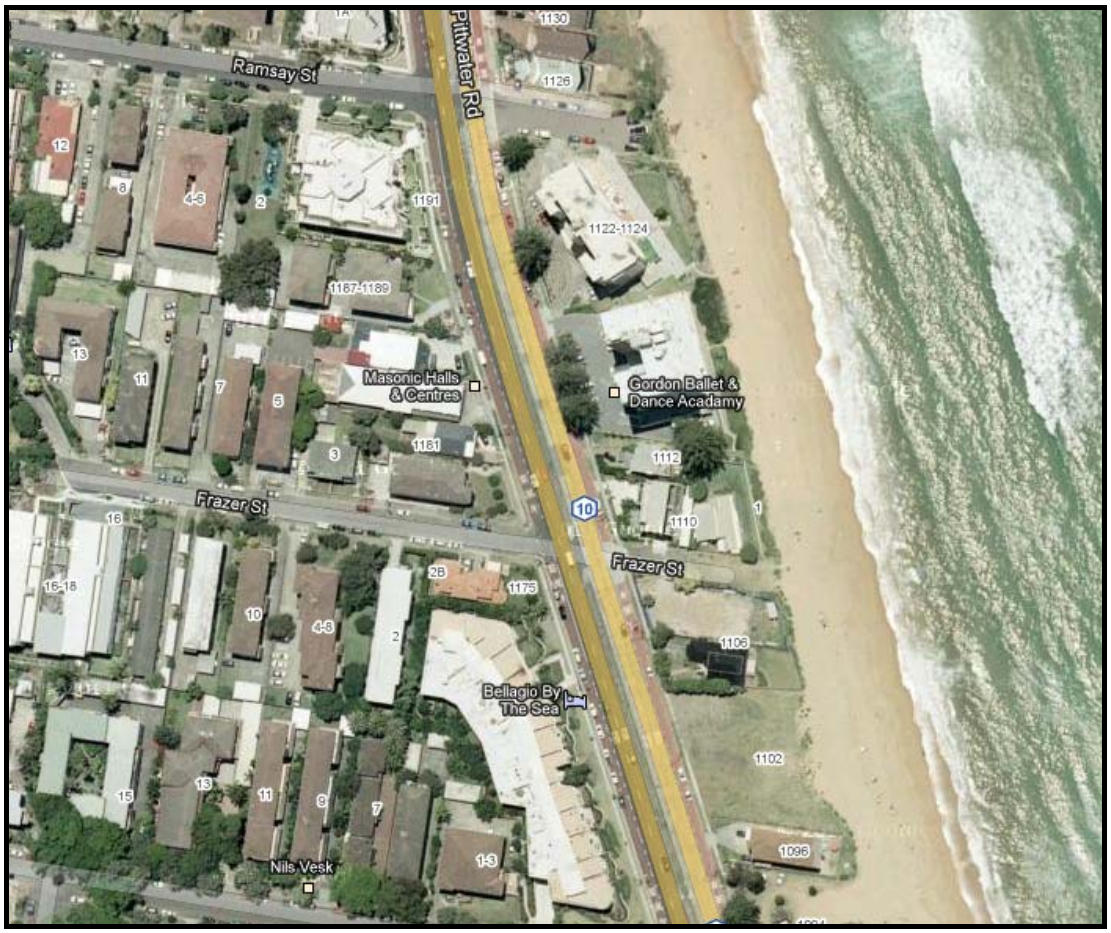

Figure 4 – Area of investigation (Google Maps 2011)

Among these properties stand four free-standing houses, three strata subdivisions, including two large multi storey apartment blocks, and an area of land that has been resumed by Warringah Council and converted to a recreational reserve. This stretch of area was chosen to provide a cross section of property types so that this study will provide a greater understanding of the effects of coastal erosion on cadastral boundaries. The two larger unit blocks, named ‘Shipmates’ and ‘Flight Deck’, located within my area of study have been the focus of much media attention throughout the years due to the effects of erosion upon the high-rise 8 and 15 storey properties respectively.

1.4 Summary of Chapter 1

Coastal erosion is a topic widely reported on, not only within New South Wales and Australia, but also throughout the rest of the world. Global warming may contribute to not only rises in sea levels, but may also be an influence on increased storm surges. These factors may contribute towards coastal erosion, and this project will look at contributing factors as well as prevention of such erosion. Property owners' rights and restrictions will be examined with regards to this erosion and government policies and legislation in place to protect private and public space.

CHAPTER 2

Background and Literature

2.0 Introduction

This chapter will serve as a review of past and present literature and will investigate the regulations, legislation and coastal protection methods set in place to protect land with respect to both public use and private ownership.

Survey regulations will be examined to assist in understanding the meaning of natural boundaries, as well as the rights of land owners with respect to these naturally changing boundaries. Local and State Government legislation will be investigated to determine what, if any, protection is offered to beach reserves to prevent or reduce the effects of coastal erosion when properties landward of the natural boundary can claim title to this accretion through the doctrine of accretion and erosion. This legislation will also be examined to determine what regulations are in place to protect the interests of private property owners landward of these coastal reserves. Finally, an investigation of various methods of physical protection from the effects of accretion and erosion will be carried out to determine the most suitable techniques to assist in the reduction of these effects to the coastal area.

2.1 Natural Boundaries

A natural boundary is a line which represents a natural division between areas of differing types, such as land and water. Along a coastline this boundary can be defined by a cliff, bank or by the mean high-water mark (MHWM) along a beach front. As these boundaries are defined by a natural line, as the environment changes

so does the boundary. Accretion and erosion can cause shifts in the shoreline over time, moving the MHWM and therefore shifting the boundary line of a parcel of land, therefore making it ambulatory.

The term ‘ambulatory’ is defined as ‘...moving from place to place’ or something that is ‘...capable of being altered.’ (Merriam Webster Dictionary 2011), which aptly describes a natural littoral boundary, as the shoreline is constantly moving. This process of the boundary line shift or alteration can only occur if the accretion or erosion takes place gradually over an extended period of time. If the erosion is caused by a sudden storm front, the boundary would remain in the position it was prior to the storm.

Clause 48 (1) of the *New South Wales Surveying and Spatial Information Regulations 2006* states ‘…if, since the date of a previous survey, there has been a change in the position of the mean high-water mark of tidal waters forming a boundary of land to be surveyed:

(a) if the change arose from natural, gradual and imperceptible accretion or erosion – the position of the mean high-water mark as it is as the result of the change is to be adopted, or

(b) if the change arose otherwise than from natural, gradual and imperceptible accretion or erosion – the position of the mean high-water mark as it was before the change is to be adopted.

It is the role of the surveyor to determine the whether the shift in the shoreline warrants a change in the cadastral boundary in line with these current guidelines and regulations.’

This clause is complicated further by the gathering of evidence. Unless records are taken after each unexpected movement of the coastline, then there is no means by which to determine if the change can be classified accurately.

On occasions, it can be difficult to establish whether a boundary is natural or right line, as in *Suntea Investments Pty Ltd v. State of New South Wales* (1995) 7 BPR 14,598; (1998, unreported, NSWCA). The owner of Lot 1 in Deposited Plan 739877, with which was part of a Crown Grant, claimed the benefit of accretion on the

northern boundary in which was bounded by the Myall River. It was found that the northern boundary was not actually bounded by the Myall River, but in fact by a right line boundary. As this was a case involving land that adjoined Crown land and the boundary adjoining the two types of land was discovered to be a right-line boundary, the ruling determined that '...any ambiguities in a grant should be resolved in favour of the Crown'.

2.2 The Doctrine of Accretion and Erosion

The process of erosion and accretion as defined by the doctrine determines that where land which adjoins the sea accumulates deposits acquired from the sea, this acquisition of land becomes part of that title. Conversely, where land which adjoins the sea is eroded away, the deposits of land which have been removed no longer form part of that title. This process must happen in a gradual and consistent manner, imperceptible over the natural course time, with imperceptible meaning day to day, but not over a considerable length of time (Hallmann 2004; *Government of the State of Penang v. Ben Hong Oon* (1972) AC 425). This was reiterated in *Hindson v. Ashby* (1896) 2 Ch 1, whereby the change in a man's natural boundary must not be seen '…day to day, week to week, month to month.' *Rex v. Yarborough* (1824) 130 ER 1023 describes 'imperceptible' as imperceptible in progress and not in result; that is to say, where the increase cannot be observed as actually going on, though a visible increase is observable every year.

Any change in natural boundaries must come about by natural means and not involve the hand of man in any way: *Trafford v. Thrower* (1929) 45 TLR 502 & *A-G and Hutt River Board v. Leighton* (1955) NZLR 750. This was not the case in *A-G v. Chambers* (1854) 43 ER 486 & *A-G of Southern Nigeria v. John Holt & Co. (Liverpool) Ltd* (1915) AC 599 whereby accretion had been caused by the landowners knowing intent. However, if accretion is found to be caused by the landowners unintentionally, the doctrine applies: *Brighton and Hove General Gas Co. v. Hove Bungalows Ltd* (1924) 1 Ch 372; *Verral v. Nott* (1939) 39 SR (NSW) 89.

'…The common law doctrine asserts that where there is an acquisition of land from the sea by gradual and imperceptible means, the accretion is held to become part of the adjoining land so as to be included in the title.' (Hallmann 2004, p.13-101).

A speech by the Minister on the doctrine of accretion and erosion states 'the doctrine can adversely affect public access to foreshore areas' (Hallmann 2004, p.13-107). Landowners are able to apply by survey to increase the area of their land on title due to gradual accretion, with implications such as public beach access being restricted or disabled completely. Conversely, the Minister comments on when erosion occurs suddenly due to a storm, the doctrine does not apply, and therefore no land is lost by title to the landward property. It is apparent that the doctrine in New South Wales 'favours the private land owner at the expense of the public domain' (Hallmann 2004, p.13-107).

The doctrine also originally asserted '…where land is eroded away or is encroached upon gradually and imperceptibly by the sea, the owner of the adjoining land loses title to that extent.' (Hallmann 1973, p.189).

While this information is relevant and generally widely accepted, it is important to examine this concept in context of additional legislation, which has recognised that more protection is necessary where public land is at risk. In a recent modification to the doctrine of accretion and erosion taken from the *Coastal Protection Act 1979 No 13*, clause 55N section (2b) states that:

> *'…A court has no jurisdiction to make a declaration concerning a water boundary that would increase the area of land to the landward side of the water boundary if as a consequence of making such a declaration, public access to a beach, headland or waterway will, or is likely to be, restricted or denied.'*

Further to this, the *Coastal Protection Amendment Act 2002* inserted into Part 1, section 3 of the Coastal Protection Act that the objects of this act are:

- to promote public pedestrian access to the coastal region and recognise the public's right to access, and
- to provide for the acquisition of land in the coastal region to promote the protection, enhancement, maintenance and restoration of the environment of the coastal region

Amendments are now in place to protect land that falls under public interest, while further investigation in this study has found the same does not apply to private property. This falls under the responsibility of the private owner.

As indicated in the Coastal Protection Act and the Coastal Protection Amendment Act, the law provides little protection to the land owner if erosion decreases the size of ones land on title, but if the land is found to have increased in size by title through accretion, and the effects of that change disrupts the existing use of adjoining public land, such as a beach or reserve, the acquired land cannot be granted by a court and therefore the existing boundary will remain.

The same concept applies in section (4b) of the Coastal Protection Act: 'The Minister administering the Crown Lands Act 1989 (or a person authorised by that Minister) has no power under Part 7 of the Surveyors (Practice) Regulation 2001 (or any regulation made by way of replacement, or in substitution, for that Regulation) to approve a determination concerning a water boundary that would increase the area of land to the landward side of the water boundary if as a consequence of making such a determination, public access to a beach, headland or waterway will, or is likely to be, restricted or denied.'

2.3 Tidal Waters

The term tidal water refers to the flowing back and forth of the tide as the water reaches the coastline before returning to the sea. Common law (Hallmann 2004) distinguishes between tidal and non-tidal waters and states that where land is bounded by tidal waters the boundary is determined by the Mean High Water Mark

(MHWM), which is measured by the average, or mean, of all the high tides including the neap and spring high tides, measured over a sufficiently long period of time (Hallmann, 2004 p.4-2; *A-G v. Chambers* (1854) 43 ER 486). Spring tide refers to the period when the sun and the moon are aligned with the earth and the tide is at its maximum range (Encyclopaedia Britannica 2011), and neap tide refers to the period when the sun and moon are at right angles to each other with respect to the earth with the tides at their minimum range (Encyclopaedia Britannica 2011)

> *'A period of 19 years is generally considered as constituting a full tidal cycle, for during this time the more important of the tidal variations will have gone through complete cycles. It is therefore customary to regard results derived from 19 years of tide observations as constituting mean values. Hence sea level derived from 19 years of observations may be taken to constitute a primary determination and as giving accurately the datum of mean sea level.'* (Broadbent 2011).

This is the standard for tidal measurements in Queensland, although tidal charts acquired through Manly Hydraulics Laboratory (1995), a division of the New South Wales Government, currently measure the Mean High Water Mark using 10 years of data and is accepted as the standard in New South Wales.

Boundaries which are defined by tidal waters are of increasing concern because of the direct affect rising sea levels has on the Mean High Water Mark (MHWM). A government report indicates that the sea level will rise by 40cm by 2050, and as much as 90cm by the year 2100 (DECCW 2009; Cherry 2009). As the Mean Sea Level (MSL) increases, this in turn alters the location of the boundary further towards the land, as well as potentially causing the zone that waves break onto the shore to also proceed inland.

2.4 100 feet Reservation

> *'Most crown grants of farm lands issued between 1830 and 1844, and many from time to time thereafter, contain reservations of all land within on hundred feet (30.48m) of high water mark, whether the grant had a tidal frontage or not, and even where the land was inland'* (Hallmann 2004, p.13-121)

Land with a tidal boundary that has been granted a 100 feet reserve has an adjacent right line boundary approximately parallel to the mean high water line. The right line boundary would not move from the position it was originally placed even if the mean high water mark did fluctuate (*McGrath v. Williams* (1912) 12 SR (NSW) 447).

In the court case of *McGrath v. Williams* (1912) 12 SR (NSW) 447, McGrath claimed that a reserve located along a section of the Shoalhaven River had in part completely eroded away. The Crown claimed the landward boundary of the 100ft reserve should be measured from the current high water mark, however the court held that the '…reservation so-called was really an exception from the grant and that the exception operated at the date of the grant' (Azimuth 2010, p.14).

Therefore the 100ft line must be related to the high water mark at the time of grant, and consequently the landward boundary is considered a defined artificial boundary. Further to this, if erosion continues past this landward boundary, the title holder of the lot landward of that boundary may in fact end up owning land under the water. Clause 55N, section 2b and 4b of the *Coastal Protection Act 1979 No 13* as described above gives protection to the public beach user if land increases in size due to accretion, but doesn't comment on whether a reserve can erode enough for the property of an owner landward of the right line boundary to eventually take ownership of that title which lies within the ocean. This erosion is based on gradual and imperceptible movement of the shore line and not erosion caused by a storm or flood. To date, this study has discovered no court case which has ever ruled on this

scenario, a landowner on the landward side of the right line boundary will still own this land by title.

In an article contained within the publication ‘Azimuth’ (No.49, Issue 2 March 2010), a comment by Booth suggests that if there is gradual and imperceptible erosion of the mean high water mark, and erosion were to affect land beyond the right line boundary, this boundary line should not move, but rather, the lot in question should reside in part under water. His reasoning is that ‘...the lot did not have original frontage to the MHWM, and that the right line boundaries defining the landward boundary are not ambulatory.’

Clause 58 of the *Survey Practice Regulation 1990* states that a landward boundary is a defined boundary. As a result, the doctrine of accretion and erosion does not apply as the defined boundary is not ambulatory. If the predicted sea level rises continue then this situation could become more significant as additional cases emerge of land being physically lost to the sea. Currently, no precedence has been set and no legislation has ruled on this issue.

2.5 The Littoral Zone

The littoral zone (*Figure 5*) is widely referred to as a section of sea or lake which is closest to the shore. The extent of the littoral zone can be measured from the mean high water mark to the areas seaward that are permanently submerged.

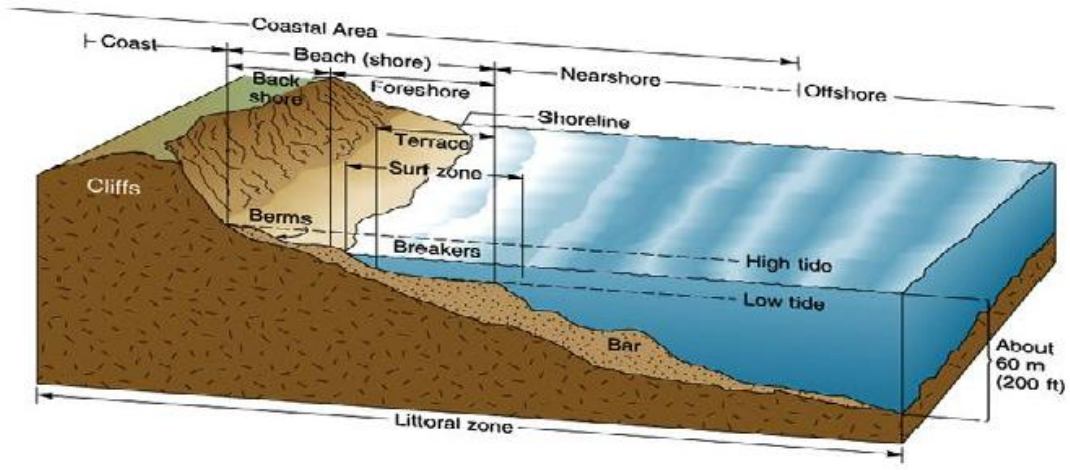

Figure 5 - Littoral Zone (U.S. Navy 2011)

The zone between the mean high water mark and the mean low water mark, known as the foreshore, as well as the land below the low water mark belong to the Crown as per common law (*Fowley Marine (Emsworth) Ltd v. Gafford* (1967) 2 All ER 472). The littoral zone refers to the shoreline where the sand sits, and is where the waves can affect or disturb the sediment. It is therefore within this zone that littoral drift can occur.

A natural and potentially devastating effect that can occur within the littoral zone is littoral drift. Littoral drift is widely known as the transport of sediments, generally sand, along the shoreline by forces such as waves, wind and backwash. It can play a large role in the shaping and morphing of a coastline and contributes to its evolution over time. Any changes in coastal conditions such as an increase or decrease in sediment supply can affect the behaviour of littoral drift. Littoral drift is a factor that influences both accretion and erosion along a beach front.

2.6 Coastal Protection

Collaroy-Narrabeen Beach will be the subject of a three year project carried out by Warringah Council to monitor and forecast erosion (Cherry 2011). Cherry (2011) reports that '...a research team will use a variety of monitoring equipment including cameras, all-terrain vehicles, jet skis, boats and buoys to measure the height, power and impact of waves along the beach'. The project will be jointly funded by the Federal Government and local Warringah Council. Long term studies are an important process in the collection of data so that solutions can be customised to the individual site, rather then using blanket methods that may not be as effective or successful.

Methods such as sea walls, detached break walls and artificial headlands are some of the techniques used to assist in preventing or reducing littoral drift and erosion. At Collaroy-Narrabeen Beach, the use of a groyne is currently being considered by

Warringah Council as it suffers the continued effects of severe long and short term erosion, and is recognised as one the most erosion prone beaches in New South Wales. It is important to recognise that such methods can occasionally have an adverse affect on the natural movement of the coastline. With the installation of groynes and seawalls it can, in some cases, actually intensify the effects of erosion (Short 2011).

2.6.1 Government Legislation – Coastal Development

The *New South Wales Coastal Policy 1997* sets out guidelines, management policies and standards for future development within the coastal zone of NSW, a zone that extends 1 kilometre landward of the open coast high water mark (NSW Government 1997). The policy applies only to future development, and does not impact on the rights of use of current residential and other developments. It also only applies to coastal areas outside the Greater Metropolitan Region (GMR), which includes Sydney, Newcastle, Illawarra and the Central Coast. For these areas, Local Environment Plans (LEP) are produced by local councils due to the conflicts that may occur with the Coastal Policy with regards to sensitive coastal areas within these regions.

The *Coastal Protection Act 1979 No.13,* Section 55M, refers to the granting of development consent with regards to permanent coastal protection works to prevent coastal erosion and accretion. It states that protective works may not be erected if the works may limit the access to the beach reserve by the general public, or are a threat to public safety, and must not cause any ongoing effects of erosion or accretion. Therefore, private owners may erect their own coastal protective works with the approval of the consent authority, this usually being the local government.

Where possible, it is preferable that ‘soft engineered’ works be carried out for long term coastal protection which may include such processes as beach nourishment or dune rehabilitation (NSW Government 2010). ‘Hard engineered’ works such as seawalls, groynes and artificial reefs which can protect the immediate properties

from coastal hazard effects can consequently deflect wave energy and cause hazards elsewhere (NSW Government 2010).

Warringah Council sets out development guidelines for coastal development within the *Warringah Local Environment Plan 2000* and is aligned with the *Collaroy Narrabeen Coastline Management Plan (1997)* and the *New South Wales Coastal Protection Act 1979 No.13.* The aims of these guidelines as stated in schedule 13, clause 2 are to '…preserve and protect the beach as a national asset for public recreation and amenity…', as well as controlling development along the coastal zone to ensure new development takes into account the effects of current and future wave impact and coastal erosion. This illustrates a focus on protection of both public and private assets with regards to future development only.

When development applications are approved for development within the coastal zone, advice is given by the council when development applications are submitted within schedule 13, clause 5 of the Warringah Local Environment Plan, to the developer:

> *'This property is on land located in an area where there is likely to be a risk of coastal erosion and wave impact during severe storms. The risk to the property may increase with time due to long-term beach recession caused by greenhouse induced sea level rise or natural processes.'*

This statement demonstrates Council's acknowledgement of the risks involved with proposed private development, but does not clearly determine where the risk lies. It could be interpreted that by providing this information prior to development of the land it acts as a disclaimer, therefore reducing the level of responsibility of the Council should the land be impacted by natural causes. It must be recognised that land released by the Council for private development must be done so responsibly.

Development occurring near public open space within Warringah must be carried out so access to the open space is maximised for the publics use, buildings are to be constructed in such a manner that they do not appear to privatise the space and must

provide a visually appealing transition between the open space and the buildings (Warringah Local Environment Plan 2000 Part 4, Division 3, clause 52). Construction of fences is also to be avoided along boundaries between open space and private properties to assist in this visual transition (Warringah Local Environment Plan 2000 Part 4, Division 3, clause 51).

The wave impact zone is an area set out by Warringah Council along Collaroy-Narrabeen Beach with which it is referred to as a coastal hazard zone. It is a zone along the beach front that stretches from Fishermans Beach, Collaroy to Narrabeen, incorporating the entire beachfront of Collaroy-Narrabeen Beach. The zone is shown in *Figure 6* as the area to the East of the most Eastern red line, and includes most existing development along the beach front. The other two red lines shown in *Figure 6* are the Zone of Slope Adjustment line, and the Zone of Reduced Foundation Capacity line, with which new development eastward of these lines must be '…supported by piles to withstand loads which may be induced in the pile by slumping of the soil face' (Warringah Local Environment Plan 2000 Schedule 13, clause 3(b)).

Figure 6 – Wave Impact Zone (Warringah Council 2011)

This Wave Impact Zone was introduced due to major storm events which have seen the devastation of many properties along this stretch of coastline. The zone consists of planning procedures that limit the type of development allowed, as described in Schedule 13 of the *Warringah Local Environmental Plan 2000.* The guidelines prohibit major new development within the zone, but do not include engineered structures erected by a public authority for the purpose of coastal protection. Minor development such as sheds and landscape works are permitted within this zone through approval from council. All major new development is to be erected landward of this zone line.

2.6.2 Government Legislation – Emergency Coastal Protection Works

The State Government's draft Coastal Protection and Other Legislation Amendment Bill 2010 proposed to '...give beachfront home owners the rights to build temporary seawalls without having to lodge a development application or take into account the effect their seawall will have on the coastal strip' (Morcombe 2010). When the new bill was passed on 21 October 2010, there appeared to be no changes to the previous Act in this regard. Beachfront residents are, as they always were, able to erect emergency coastal protection works which can consist of sand, or fabric bags filled with sand, (other than sand taken from a beach or a sand dune adjacent to a beach), and other objects or material prescribed by the regulations (other than rocks, concrete, construction waste or other debris) as per Part 4C, Division 1 Section 55O of the *Coastal Protection and Other Legislation Amendment Act 2010 No 78.*

The current Guide to the Statutory Requirements for Emergency Coastal Protection Works (2011) produced by the Department of Environment, Climate Change and Water NSW sets out the rights of coastal property owners in regards to erecting emergency coastal works prior to a storm event. These guidelines align with the *Environmental Planning and Assessment Act 1979* and the Coastal Protection and Other Legislation Act.

Emergency coastal works must only consist of sand or geotextile fabric bags filled with sand that has not been taken from a beach or sand dune adjacent to the beach (DECCW, 2011). They may not include materials such as rocks, concrete or construction waste. These works are to be placed against the erosion escarpment on the seaward side as per *Figure 7*.

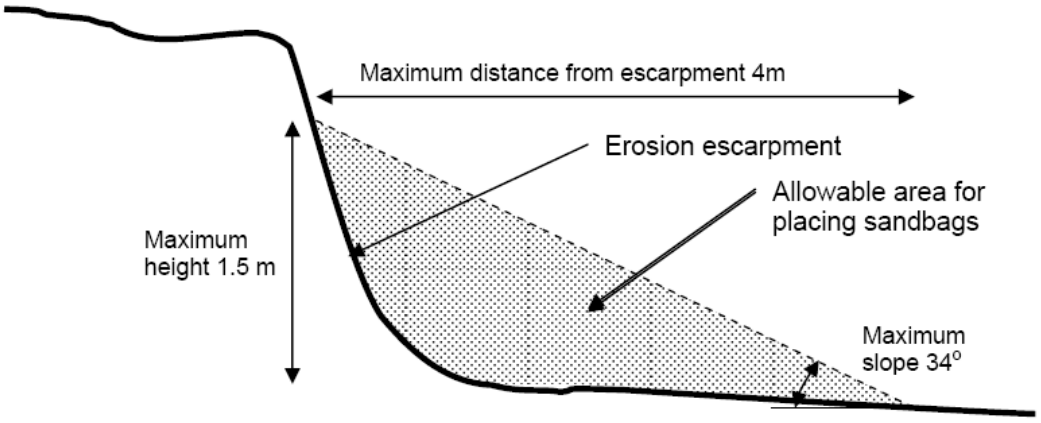

Figure 7 – Allowable Area for Placing Sand or Sandbags (DECCW 2011)

The erection of such works should not encroach upon public land wherever possible, with the exception of when this land is a reserve on a beach or sand dune, where there is no road through the reserve, or if the land is dedicated Crown land. Works may also be placed on adjacent private land if the distance from the existing building of residence under threat is equal to or within 20 metres of the erosion escarpment (*Figure 8*), with the appropriate safety precautions such as temporary fencing being placed for the protection of the public and those adjoining neighbours.

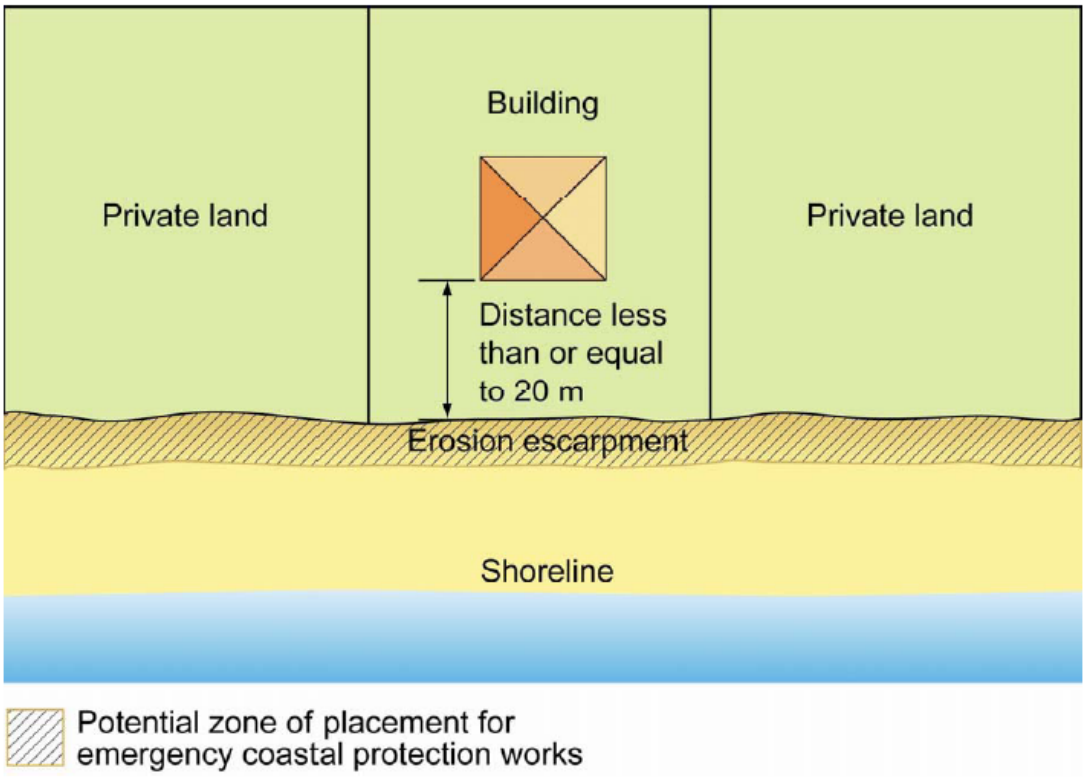

Figure 8 – Emergency Coastal Protection Works on Adjacent Private Land (DECCW 2011)

All emergency protective works must be placed in such a manner as to not limit the publics' access to the adjoining beach or headland, and must not increase the affects of erosion to the area.

2.6.3 Beach Nourishment

The concept of beach nourishment is widely known as the involvement of the replacement of sediment, usually in the form of sand, which has been lost or moved by the process of littoral drift. Beach nourishment is carried out when erosion affects a shoreline, to replace the sand eroded. It is not a preventative measure, but instead acts as a retardant to beach erosion, by prolonging its effects. Primarily, beach nourishment is carried out along Collaroy-Narrabeen Beach for two reasons (Acworth c. 2009):

- To provide protection from the effects of erosion on beach front properties
- To preserve and improve the recreational use by the public of the beach

The advantages of beach nourishment include the widening of the beach with nourishment, pleasing the users of the beach, as well as protecting properties and the structures located on these properties from the effects of erosion (Barber, D n.d.; Short 2011). Disadvantages may include marine life being disrupted due to different sand types being introduced, wave patterns being altered, also as a result of these different sand types, and increased rates of erosion. It can also be a costly process (Barber, D n.d.; Short 2011).

Sand for beach nourishment can be derived from multiple sources including local building sites, commercial sand supplier, natural nearshore locations (although scarce) and offshore mining (Cameron 2010). Development sites in Collaroy, Narrabeen and nearby Manly have been used where large developments with proposed basement car parks are excavated, and sand, after being tested and approved by Warringah Council, is used to nourish Collaroy-Narrabeen Beach (Cameron 2010).

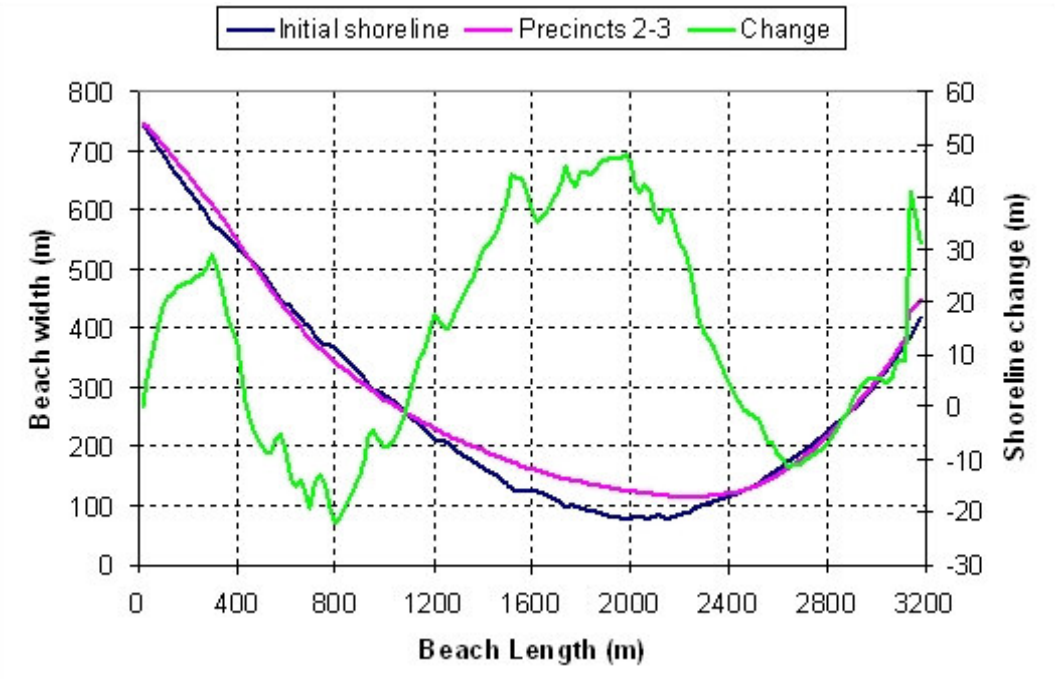

Figure 9 – Nourishment of Precincts 2-3 showing the initial and final shoreline positions and the degree of change - Collaroy Narrabeen Beach (Acworth c.2009)

2.6.4 Offshore Sand Mining

In an article from the Manly Daily (Morcombe 2010), Warringah Mayor Michael Regan suggests '...a trial of offshore sand mining for beach nourishment to save properties and infrastructure' especially along Narrabeen-Collaroy Beach. This is a costly process, and was ruled to be too expensive for the council to implement. Mayor Regan has since put the responsibility of finance back on the State and Federal Governments.

Offshore sand mining would prevent the need to find sand on shore, but could have damaging effects on marine life. The nourishing of the beach with off-shore sand could also have an affect on the Narrabeen Lagoon entrance which is at the northern end of the beach. Naturally, sand is eroded and transported north via the process of littoral drift. It settles at the mouth of Narrabeen Lagoon, eventually closing the mouth and contributing to the flooding of Narrabeen Lake and its surrounds (Morcombe 2010). The sand from around the mouth of Narrabeen lagoon is dredged every three to four years, while approximately 70,000 tonnes is replenished along Narrabeen-Collaroy from both the lagoon and other locations such as local building sites (Acworth c.2009; Cameron 2010 & Morcombe 2010). It then starts the process all over again.

2.6.5 Groynes

Groynes are artificial structures placed generally at right angles to the shoreline within the littoral zone. They can be constructed of various materials such as timber, stone or sandbags and are generally placed at regular intervals to act as a shield to littoral drift. Current legislation within the Warringah Local Environmental Plan does not permit the use of seawalls or groynes, however this legislation is currently being reviewed (Morcombe 2010).

An example of a groyne is located at Port Geographe, Busselton, Western Australia. As can be seen from aerial photographs taken (*Figures 10-12*), the area South-West of the groyne structures has actually suffered from the effects of erosion due to the

groynes. Groynes can have an affect on the downward side of littoral drift, starving it of sand or sediment, and can therefore increase the effects of erosion if not installed correctly (Short 2011). Conversely, the area to the North-East has actually thrived with the effects of accretion. The photos also show the direction of the swell moving generally in a South-West direction. In the case of Port Geographe, the groynes have been constructed at close to right angles to the coast, but also, almost exactly at right angles to the swell direction. This may be a cause of this erosion and accretion at either ends of the development.

Figure 10 – Accretion & Erosion at Port Geographe due to Groynes – 2003 (Google Earth 2011)

Figure 11 – Accretion & Erosion at Port Geographe due to Groynes – 2005 (Google Earth 2011)

Figure 12 – Accretion & Erosion at Port Geographe due to Groynes – 2010 (Google Earth 2011)

Another example of groyne construction is at Kirra Beach, Queensland. Kirra Beach is a popular surf spot and holiday area, and has suffered the effects of beach erosion over the years ever since its settlement in the late 1800s (NSW Government 2011). Historical photos (*Figures 13 & 14*) show Kirra prior to development, and shortly after a cyclone had struck in 1947. In 1972, the 'Big Groyne' was built, with the 'Little Groyne' following in 1975 (NSW Government 2011). A recent photo of Kirra Beach (*Figure 15*) from the sky shows again how a groyne could potentially plunder sand from one side, while the other replenish. Note the general direction of the swell. The accretion occurs on the upward side of the swell, while the erosion occurs on the downward side.

Figure 13 – Kirra Beach in 1910 - Wide Beach with Little Development (NSW Government 2011)

Figure 14 – Kirra Beach in 1947 Shortly After a Cyclone Stripped Beach of Sand Exposing the Sea Wall (NSW Government)

Figure 15 – Kirra Beach - Big Groyne with Little Groyne in Background (Joli n.d.)

It is important to note that both Port Geographe and Kirra Beach have suffered erosion on the upward side of their groynes during large storms. It appears the construction of a groyne is beneficial to the upward side of the swell direction, but detrimental to the downward side, and even with the construction of a groyne, it does not prevent the effects of erosion during times of large storms (Port Geographe Action Group Inc 2011; Short 2011).

A study recently completed on the effects of the groynes at Port Geographe has conceded there is a problem with the way in which the groynes have been constructed. A new model has been developed by Professor Pattiaratchi of the Faculty of Engineering, Computing and Mathematics in the School of Environmental Systems Engineering at the University of Western Australia in which a reconfiguration of the groyne layout has been proposed to allow a more natural flow of sand and seagrass along the coastline (Pattiaratchi & Wijeratne 2011). The new model places the groyne at a parallel angle to the swell direction (*Figure 16*).

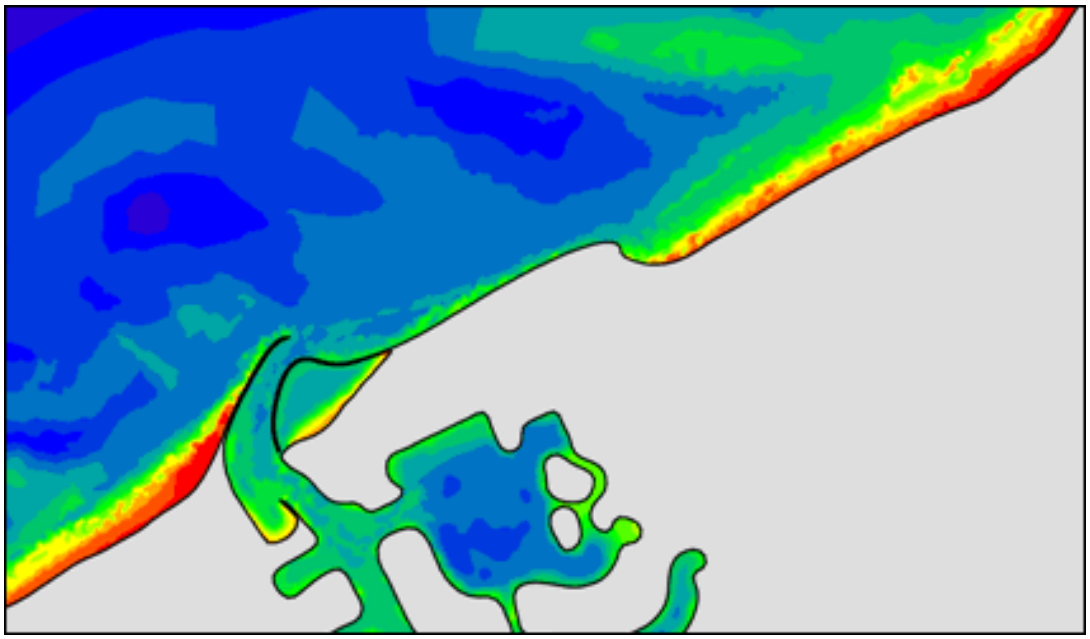

Figure 16 – Most Appropriate Re-design for Groyne at Port Geographe (Pattiaratchi & Wijeratne 2011)

This design was the most successful of 8 models, including the current configuration. It suffered a small amount of erosion to the west of the groyne, but little to no accretion or erosion around the groyne itself. It also experienced considerable accretion to the West of the area (Pattiaratchi & Wijeratne 2011). This model is currently being reviewed by the public and open to discussion.

A trial groyne which is to be constructed of geotechnical bags filled with sand, which can be easily removed by slashing the bags when the trial is complete, has been proposed by Warringah Council (Morcombe 2010). This would give those involved, including the local council and general public, a forum to consider the results and determine the success of the trial before implementing a more permanent plan. The designs of the proposed new groyne at Port Geographe should be considered by Warringah Council when planning for this trial groyne.

The groyne has been proposed and modelled at Devitt Street, Narrabeen, and is a design square to the beach. This may bring about an increase in beach sediment to the south of the groyne, but in contrast cause increased erosion to the north of the wall. This scenario also includes the continuation of beach nourishment (*Figure 17*).

The study of Port Geographe shows there may not be a need for a continuation of beach nourishment if the groyne be constructed at the correct angle.

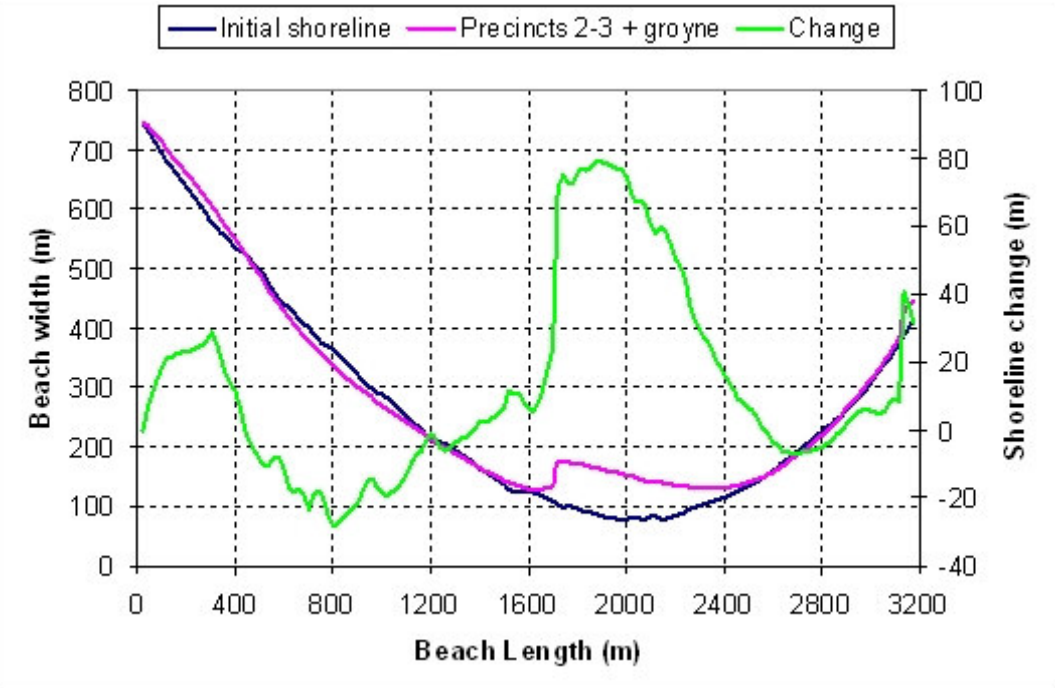

Figure 17 - Nourishment of Precincts 2-3 with a groyne at Devitt Street, Narrabeen showing the initial and final shoreline positions and the degree of change (Acworth c. 2011)

A groyne could be built not only to protect the mouth of Narrabeen Lagoon, but also to prevent some of the erosion suffered along the shoreline of Narrabeen-Collaroy Beach. It is important to also consider that while using a groyne may help resolve this issue of beach recession, apart from being a potential eyesore within the beauty of the natural landscape, it could potentially disrupt the natural surf patterns and upset local beach users. Narrabeen Beach is an especially popular surf spot, and to risk this aspect of the beach could destroy one of its major assets.

2.6.6 Artificial Reefs

Artificial reefs consist of manmade structures below the surface of the sea acting as a sanctuary for marine life or create a recreational area for divers, fisherman and swimmers. They can also be used to promote or demote wave activity, which in turn can encourage better surf, or reduce the wave impacts on beaches causing coastal

erosion. Artificial reefs are widely known to be constructed of numerous materials including disused oil rigs, ships, or even old train carriages.

Artificial reefs can be used as an alternative to beach nourishment, when this method is not suitable or economically viable for the site in question, although beach nourishment is still considered the most effective way of increasing beach stabilisation, artificial reefs have proved to work well together with beach nourishment programs such as those carried out in Florida, USA (Harris 2009).

They act as a submerged breakwater, helping to reduce the wave energy in the region of the shallow water or nearshore zone (Sawaragi, Deguchi & Park 1988). Japan has seen the construction of many artificial reefs over the past decades to help control coastal erosion. The main design used is a broad-crested submerged breakwater (*Figure 18*), although these can be expensive to build (Sawaragi, Deguchi & Park 1988; Pilarczyk 2003).

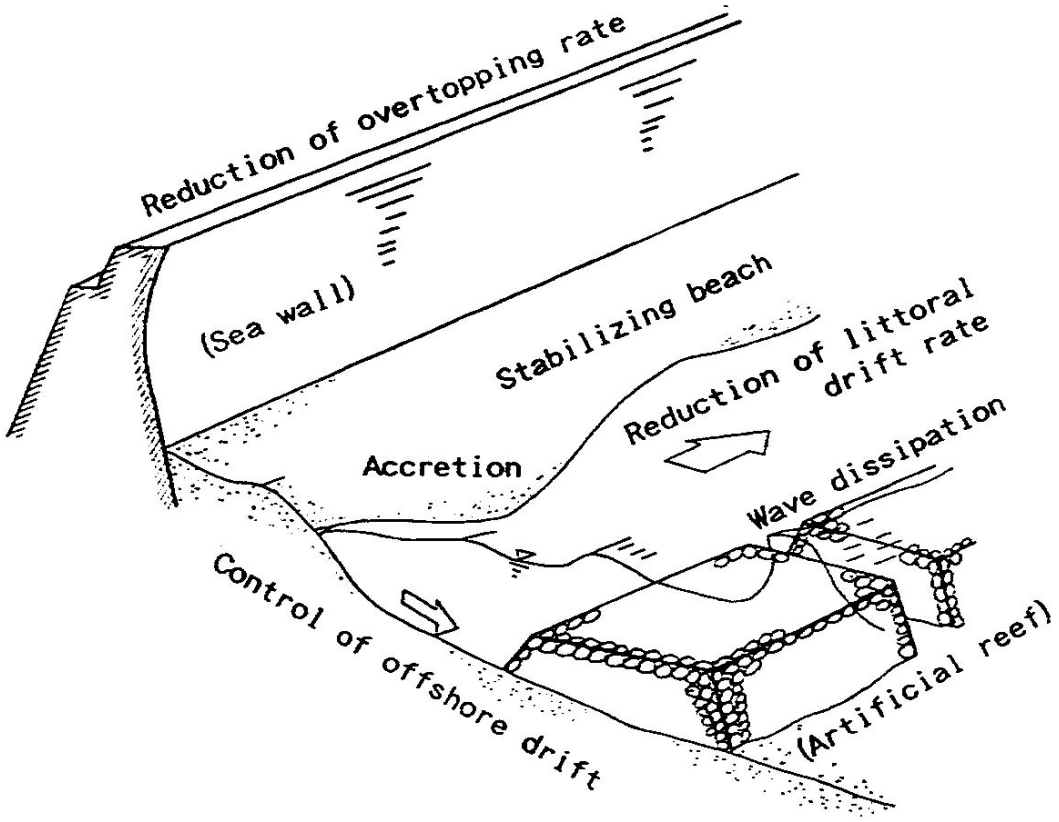

Figure 18 – Broad-Crested Submerged Breakwater (Artificial Reef) (Pilarczyk 2003)

An artificial reef could serve as an alternative to costly beach nourishment if the correct studies were carried out to model the effects of the reef. Through these studies a combination of beach nourishment and the construction of an artificial reef could be the best solution. After talking to a local surfer at Collaroy-Narrabeen Beach during my field work, he mentioned that an artificial reef could be an ideal solution, as it may not only assist in controlling beach erosion, but also serve as an excellent surf break.

2.6.7 Land Acquisition

The wave impact zone as discussed earlier includes approximately 80 properties (Warringah Council 2006), with Warringah Council having plans to purchase properties within the zone when available through developer funding known as Section 94 Developer Contributions. Currently to date, Warringah Council has '…purchased 3 properties within this zone, with enough funds to purchase another when it becomes available' (Warringah Council 2006, p. 1). The properties purchased are being converted to open space recreational areas such as parks, helping stabilise the zone which can in turn reduce the effects of coastal erosion.

2.7 Conclusion

This chapter has served as a review of past and present literature, including survey regulations, Local and State Government legislation, as well as procedures and safeguards to protect beachfront properties and the beach reserve from the effects of coastal erosion and accretion.

CHAPTER 3

Research Method

3.0 Introduction

This chapter will provide the methodology involved in carrying out the primary research portion of this project. Firstly, it will describe the site chosen for my field survey, and the procedures carried out to search and obtain Deposited Plans to establish the boundary locations. Secondly it will provide the methods involved in carrying out a field survey which will include two components:

- A detail survey of the foreshore and adjoining properties along the described length of Collaroy Narrabeen Beach;
- A boundary survey to define the cadastral boundaries between the beach reserve and private properties that adjoin the beach reserve.

In carrying out these surveys the extent of erosion that has occurred along the beach front of Collaroy-Narrabeen Beach will be determined in relation to the cadastral boundaries.

This chapter will also look at the methods involved in determining whether the affects of accretion or erosion are of gradual and imperceptible means, or due to the sudden effects of such events as storms. Finally, it will look at the responsibilities of both the private owners of beachfront properties, and the relative governments with respect to these effects of coastal accretion or erosion.

3.1 The Site

The site chosen for my field survey is a portion of Collaroy-Narrabeen Beach and adjoining beachfront properties situated South of Ramsay Street, East of Pittwater Road, North of the Collaroy Beach Carpark (North), and West of the Pacific Ocean.
As described in chapter 1, the two large apartment blocks, 'Shipmates' & 'Flight Deck', have been of much focus in the media due to the effects of severe erosion occurring directly adjacent to both sites.
Both unit blocks were built in the 1960's and were constructed despite the council's plan to resume the land following the 1945 storms. Due to poor planning, council has not only allowed initial development within a hazardous coastal zone, but also allowed massive overdevelopment within the zone (Short 2011).

The storms of 1967 undermined the 'Flight Deck' apartment block, exposing its concrete foundations *(Figure 19).*

Figure 19 – 'Flight Decks' exposed foundations after 1967 storm (Worley Parsons 2011)

3.2 Searching of Plans

Cadastral records obtained from the Land & Property Management Authority (LPMA) website via the Spatial Information Exchange (SIX) viewer are shown in *Figure 20*. It identifies each parcel of land with a unique lot and plan number. Lot 7351 in Deposited Plan 1166942 is dedicated as a Crown Reserve which forms the Collaroy-Narrabeen Beach foreshore. A search of the local reference map showed the previous plan over the beach reserve being plan MS 16009 Sy *(Figure 21)*, also known as CP16009-3000. An initial electronic search of the LPMA showed this plan was not available online. Further investigation found this plan was not held at the LPMA, and the records show that it was never lodged. *Table 1* lists the properties Lot, DP information and their address.

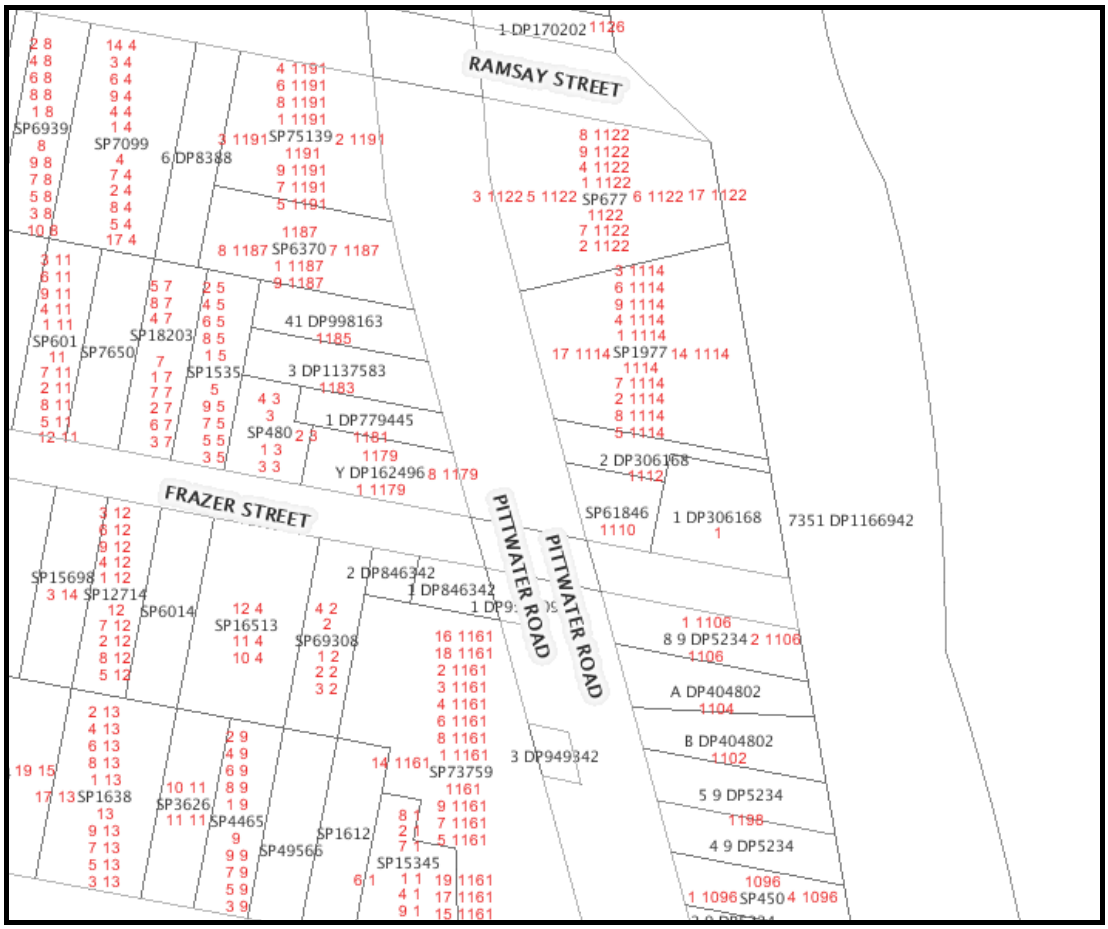

Figure 20 – Cadastral Records (LPMA 2011)

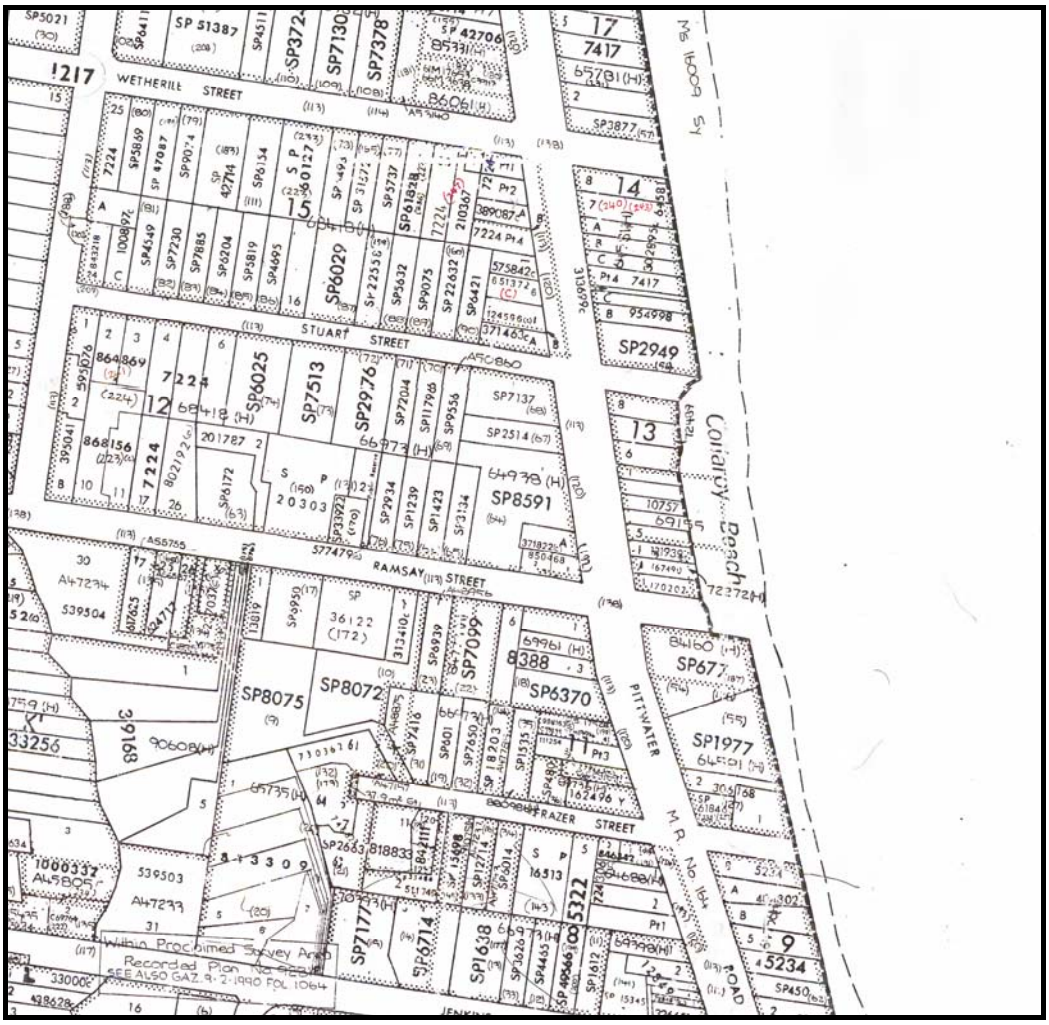

Figure 21 – Reference Plan (LPMA 2011)

Address	Certificate of Title Identifier	Type of Occupancy
1098-1102 Pittwater Road, Collaroy	4-5/9/2534, B/404802	Council Reserve (Resumed Land)
1104 Pittwater Road, Collaroy	A/404802	Private Residence
1106 Pittwater Road, Collaroy	8/9/2534	Private Residence
1 Frazer Street, Collaroy	1/306168	Private Residence
1110 Pittwater Road, Collaroy	SP61846	2 Strata Units
1112 Pittwater Road, Collaroy	2/306168	Private Residence
1114 Pittwater Road, Collaroy	SP1977	36 Strata Units
1122 Pittwater Road, Collaroy	SP677	27 Strata Units

Table 1 - Cadastral Information (LPMA 2011)

Once lot and Deposited Plan numbers are obtained, the plans are ordered from the LPMA through the appropriate online searching company. Some of the plans ordered are compilation plans which generally provide no survey information other than boundary distances and lot areas. These types of plans have been compiled from previous plans which may be either another compiled plan or a survey plan. Deposited Plans 220059 and 1009032 as well as Strata Plans 677, 1977 and 61846 contain enough survey information to carry out a boundary definition of the area to be surveyed.

3.3 Field Survey

3.3.1 Survey Equipment

The survey equipment to be used for the primary research study includes:

- A Leica TCRP 1205+ Total Station with robotic capabilities. This instrument uses Electronic Distance Measurement (EDM), a system that utilises laser technology to measure distances to an accuracy of 1mm + 1.5ppm to a single prism, up to 3 kilometres, and 2mm +- 2ppm with its reflectorless function up to a distance of 300 metres, and measures vertical and horizontal angles to an accuracy of 5 seconds (Leica Geosystems 2009). The instrument was checked and adjusted less than 6 months prior to the field survey, as well as base-lined within this time to assure its accuracy.

- A Leica RX1200 remote control unit will be used along with a Leica 360^{o} reflector prism atop a Leica Smart Pole to carry out the detail survey portion of the field survey.

- Computer aided drafting programs are required to process the data into a readable format so it can be understood and examined. The data will be downloaded from the total station in a neutral file format and processed in Civilcad 5.7. The Civilcad file will then be converted to a DWG file format to be opened in AutoCAD 2008. This program will be used to produce the final drafts of survey plans.

3.3.2 Traverse for Survey Marks and Monuments

To define the cadastral boundaries of the subject lots, a survey traverse was carried out to locate reference marks and permanent marks. These marks are shown on deposited plans with connections to boundaries through bearings and distances.

DP1009032 is a reasonably recent plan registered in 1999, and contains most marks required to get an initial orientation fix. Two permanent marks (PM3986 & PM3988) will be located from this plan to fix an azimuth, as well as reference marks and occupations to complete to boundary fix.

DP220059 was registered in 1964 and, despite the date of registration, reference marks were also found from this plan. It consisted of the original subdivision for the two unit blocks ‘Shipmates’ and ‘Flight Deck’ which also showed the partially built ‘Shipmates’ with an offset to boundary. This will also be located to assist in the boundary definition. The Strata Plans that were produced with the subdivision plan DP220059 also show offsets from walls to boundaries of the two unit blocks.

As well as marks and monuments found that are shown on registered plans, boundary marks were also discovered. A peg at the North Western corner of lot B in DP5234 will be located, as well as drill holes and nails at the boundary corners of SP677 and SP1977. The marks found and located will be enough to carry out a boundary definition of the subject lots.

3.3.3 Detail & Level Survey of the Coast Area

A height will initially be transferred from Permanent Mark 3986 which has an AHD value of 4.061m (LPMA 2011). A bench mark consisting of a nail in concrete will be placed to transfer the height from PM3986 through to a survey station near the beach front. Levels will be taken and an arbitrary value placed on the station for the initial detail survey. Heights will be calculated and transferred to AHD in post processing.

The detail survey of the subject area will be carried out in two parts. Initially a grid of spot levels will be taken across the sandy beach to determine the position of MHWM through contouring. From previous survey work, Pittwater Road has a generally known AHD value of approximately 4m. The beach had not been affected by a large storm surge recently, due to observations of the gentle gradient of the sand, so this method was deemed satisfactory to locate the MHWM initially. This decision was confirmed with Mr. Allan Gordon of NSW Maritime, who advised that this method would be satisfactory for the purpose of the survey, although if defining a MHWM boundary, real-time levelling would need to be carried out.

The second part of the detail survey, carried out on a separate day, will be used to locate the grassy bank, where erosion has also occurred. This grassy bank bounds the vegetation area and properties to the west, and the sandy beach to the east. The top and bottom of bank will be located to show the steep grade in parts of the bank.

3.4 Defining the Boundaries

From marks and monuments found, the boundaries of the subject lots can be defined. Azimuth will be taken using PM3986 and PM3988. These marks are shown on DP1009032 and form a basis for connecting marks to boundary corners. From there the boundaries will be established using the accepted hierarchy of evidence for the reinstatement of boundaries.

3.5 Survey Report on Location of Boundaries

A survey report will be produced to comment on the position of the eroded bank. As with identification surveys carried out on property boundaries in New South Wales, a survey report accompanies the survey plan to assist in the explanation of the findings of the boundary survey. This report can be found in the appendices section.

3.6 Gradual & Imperceptible Erosion

The Water Research Laboratory of the School of Civil and Environmental Engineering (UNSW) has placed 5 monitoring cameras on top of the 'Flight Deck' apartment block. These images are used to '…quantify and map shoreline variation along the embayment, and to quantify sediment movement within the embayment' (WRL 2011). Images are archived and available online for the public to view. A study of these images will assist in determining whether changes to the shoreline are gradual and imperceptible, and therefore whether the doctrine of accretion and erosion may apply.

3.7 Implications of the Crown Beach Reserve

Lot 7351 DP1166942 is dedicated as a beach reserve over Collaroy-Narrabeen Beach. As mentioned earlier in this study, the previous plan over this area was unable to be located. A study of the legislation and survey regulations will determine whether the doctrine of accretion & erosion applies over this land, and will be examined in the results of Chapter 4.

3.8 Government Responsibilities to Beach Erosion

A review of legislation and local government guidelines conducted in Chapter 2 will assist in determining what responsibilities the local and state government has in reducing and preventing the effects of beach erosion. This will apply to both emergency coastal works after a recent storm, as well long term planning for protection of the foreshore and adjacent properties. In doing so, this study can then determine what, if any, changes are required to current legislation and guidelines to protect both the adjacent landowners rights, as well as public interests in regards to beach access and utilisation of the beach reserve.

3.9 Private Landowner Rights & Responsibilities to Beach Erosion

As with Section 3.8 in this study, legislation and government guidelines will also be examined to determine the rights and obligations of the private landowner in relation to both emergency coastal works after a storm, and long term protection of their beachfront properties.

3.10 Summary of Chapter 3

This chapter has outlined the methods used to determine the position of cadastral boundaries with respect to the extent of coastal erosion upon these boundaries, government legislation and guidelines on coastal protection in regards to both public rights and interests of the beach reserve and the private landowners' rights and obligations towards the protection of their own land.

CHAPTER 4

Results

4.0 Introduction

Chapter 4 will outline the results of primary field data and secondary research data. It will aim to look at the effects erosion has on the cadastral boundaries of properties along Collaroy-Narrabeen Beach as well as the implications the Crown Beach Reserve has with regards to the doctrine of accretion and erosion.

This chapter will also summarise the methods of protection that can be put in place prior to and during a large storm event to prevent or reduce the effects of erosion, as well as the long term plans by Governments to prevent erosion to the coast.

4.1 Boundary Establishment

From marks and monuments found, the boundaries of the subject lots have been defined. Azimuth was taken using PM3986 and PM3988. In comparing a connection between these two marks via survey and MGA ground, a difference of 0.002m (2mm) over 284.052m. this produces an accuracy of 1:142000, and is well within the accepted accuracy for this type of survey. These marks are shown on DP1009032 and form a basis for connecting marks to boundary corners. From there the boundaries have been established using the accepted hierarchy of evidence for the reinstatement of boundaries.

All boundaries fit to marks from survey to original survey plans, although the offset from the North Western corner of the garage wall of the ‘Shipmates’ building on SP677 was found to be different from original survey by 0.060m. This was proved

by checking an adjacent offset from the same building to boundary, which agreed as per original survey plans. This discrepancy has been disregarded and is shown, along with all other connections used to define the boundaries on the calculation sheet contained within Appendix G.

4.2 Detail Survey of Part of Collaroy-Narrabeen Beach

A detail survey of part of Collaroy-Narrabeen Beach front was conducted on 31st July, 2011. The survey took place between numbers 1098-1124 Pittwater Road, and 1 Frazer Street, Collaroy and included the sandy beach and location of the grassy bank that runs along the property boundaries of the beach reserve and the landward properties bounding the reserve. The purpose of the survey was originally to determine the position of the mean high water mark in comparison to the cadastral boundaries of privately owned land along the strip. In carrying out the detail survey, it became apparent that the mean high water mark was not a concern for the cadastral boundaries (*Figure 22*) as it was found to be a minimum of 33.9 metres from the fixed line boundaries at the time of survey. It was apparent from the detail survey that no major storm activity had recently occurred due to observations of the gentle gradient of the beach, hence the mean high water mark being so far away from the private cadastral boundaries. Further evidence is shown when comparing the position of the surveyed MHWM line to the MHWM line shown on DP1166942 (*Figure 22*). The concern was the amount of erosion that had occurred between the private land and the beach.

Figure 22 – Position of Mean High Water Mark as per survey & DP1166942 (background image – nearmap 2011)

It was revealed from the detail survey that the sandy beach had encroached upon the private land by up to 10.94 metres measured along the adjacent boundary lines to the sand line (*Figure 23*). This poses an increasing problem of privately owned land becoming part of the sandy beach, confusing beachgoers who may trespass on private land.

Figure 23 – Position of sandy beach with offsets to cadastral boundaries (background image – nearmap 2011)

AutoCAD was used to compute the amount of physical land lost from the landward side properties to the beach caused by erosion along these fixed-line cadastral boundaries. As table 1 and graph 1 shows, up to 20.94% has been lost in the case of No.1 Frazer Street, Collaroy. This could cause some concern for beachfront land owners.

Address	Total Land Size (By Survey)	Total Land Lost to Erosion	Percentage of Physical Land Lost
1098-1102 Pittwater Road, Collaroy	2176.8	417.0	19.15%
1104 Pittwater Road, Collaroy	710.7	81.9	11.52%
1106 Pittwater Road, Collaroy	788.6	108.6	13.77%
1 Frazer Street, Collaroy	980.6	205.3	20.94%
1110 Pittwater Road, Collaroy	383.4	0.0	0.00%
1112 Pittwater Road, Collaroy	472.0	27.4	5.80%
1114 Pittwater Road, Collaroy	2884.5	423.5	14.68%
1122 Pittwater Road, Collaroy	2662.6	278.7	10.47%

Table 2 – Percentage of Physical Land Lost

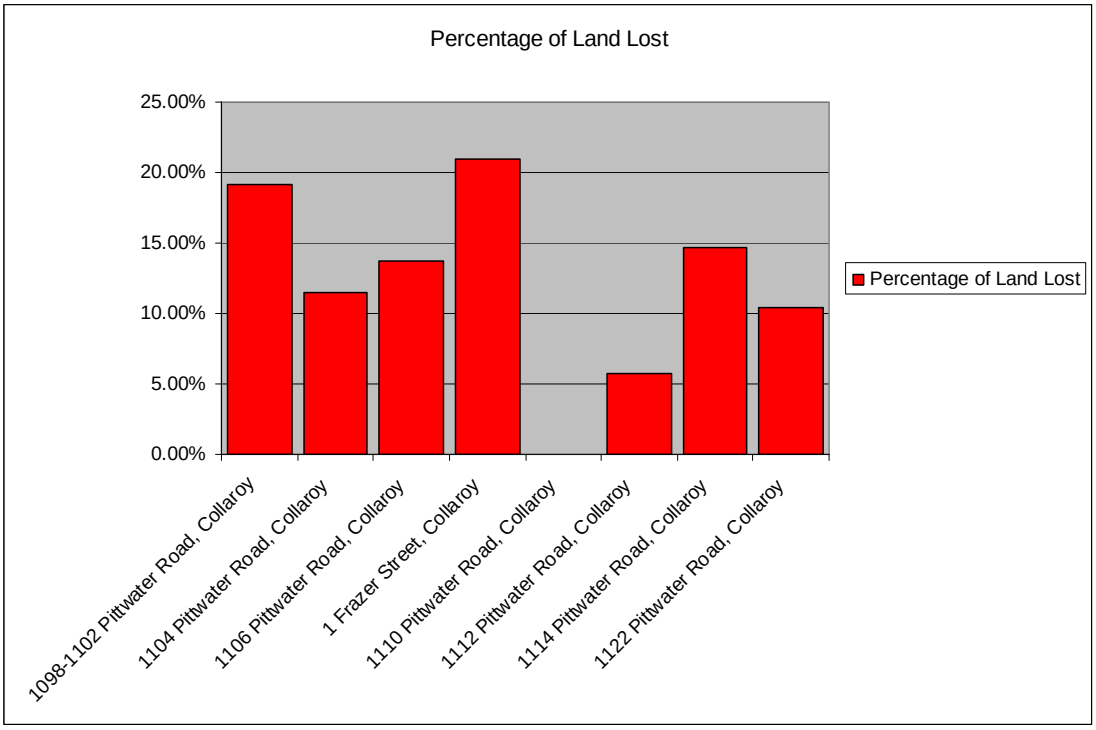

Table 3 – Percentage of Physical Land Lost

4.3 Survey Report

The purpose of the survey report is to assess any issues arising from the erosion caused along the coastal area surveyed. At the time of survey, the Mean High Water Mark had receded towards the ocean due to no large and substantial storm activity prior to the survey. It is clear from the position of the grassy bank however, that erosion is a problem along this coastal area, and after a large storm the sandy beach can be eroded up to this grassy bank, hence the mean high water mark possibly encroaching upon the private 'right line' cadastral boundary. A copy of the survey report is included within Appendix F.

4.4 Application of the Doctrine of Accretion & Erosion

The analysis of beach width data and photographic evidence has aided in determining whether the doctrine of accretion and erosion applies along the beach front of Collaroy-Narrabeen. Certain criteria must be examined to assess whether this is the case. As seen in *Table 4,* beach movement has been quite irregular in the years 2004 to 2008. The dark blue line which represents the part of the beach directly adjacent to Jenkins Street and very close to where the primary research survey was partaken. It illustrates a beach width that fluctuates in a very irregular way, from as little as 17 metres in December 2004 to as much as 51 metres wide in June 2006. As can be seen, it is evident that erosion and accretion has not been gradual and imperceptible at all, but rather hugely irregular, due mostly to large storms impacting on the beach.

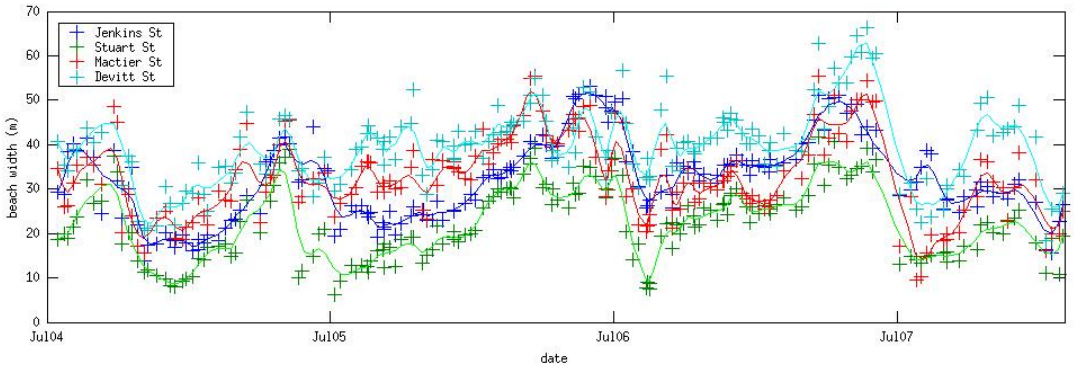

Table 4 – Fluctuations in beach width at Collaroy-Narrabeen (Water Research Laboratory – School Of Civil And Environmental Engineering 2011)

It should be noted that the beach width is not measured to the landward side cadastral boundaries of the beach reserve, but instead from water line to landward sand/vegetation line. Due to this, the actual beach width at the extreme would measure just 6 metres wide from water line to the fixed-line cadastral boundary in December 2004.

As photographic evidence from the monitoring cameras atop of 'Flight Deck' suggests (*Figure 24 & 25*), erosion of the beach and adjacent private land is not occurring gradually, day to day, week to week, month to month; instead it is happening almost instantaneously, during and immediately after a large storm. *Figure 24 & 25* are photos taken at the same time of day, just a week apart. As can be seen, a large storm that has occurred during the week has exposed rock protection works in front of beachfront properties. The erosion has also exposed the foundations of a set of steps used to access the beach, making them a hazard to the publics' use. These results, both measured and photographic, therefore illustrate that the primary study area within Collaroy-Narrabeen does not comply with the doctrine of accretion and erosion.

Figure 24 – Photo taken 8am, Friday 15th October, 2004 looking North (Water Research Laboratory – School Of Civil And Environmental Engineering 2011)

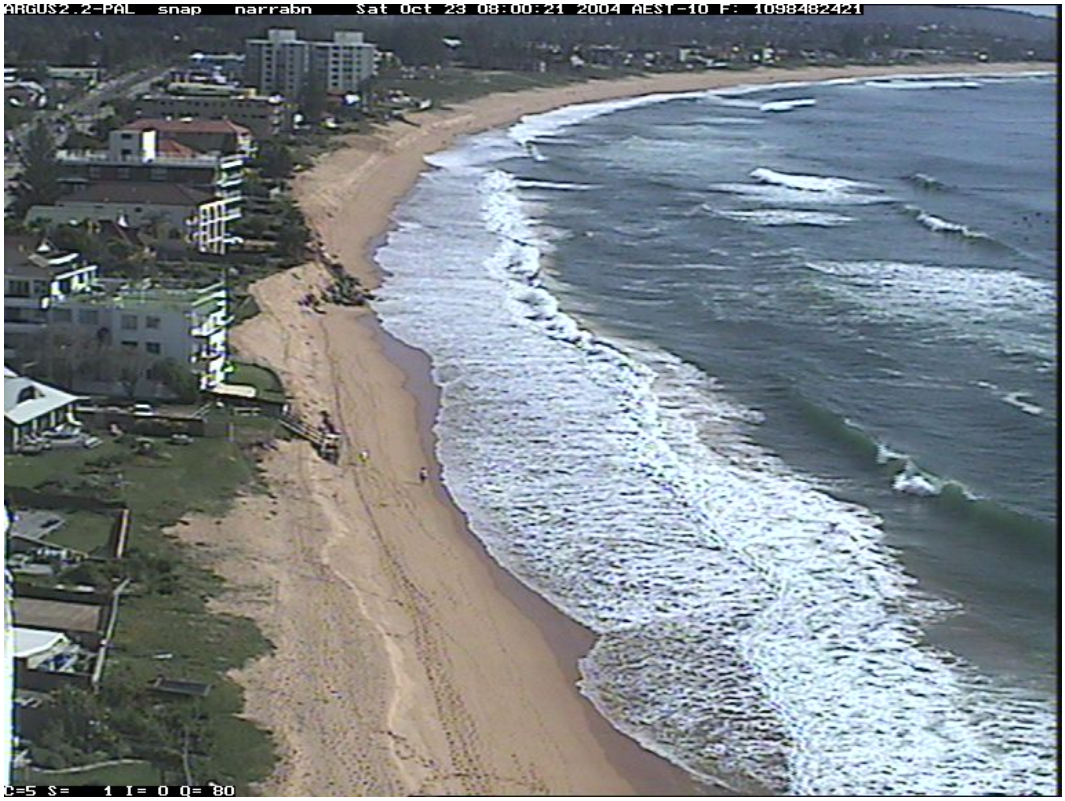

Figure 25 – Photo taken 8am, Saturday 23rd October, 2004 looking North (Water Research Laboratory – School Of Civil And Environmental Engineering 2011)

For the doctrine to apply, it states that erosion cannot be caused by the intentional hand of man. Previous to rock stabilisation protection, erosion was not caused by any man made structures, or by any deliberate act of man, therefore the doctrine of accretion and erosion may apply. Since the erection of the rock stabilisation protection, it could be said that the process of erosion may have been accelerated due to these man made structures. In this case the doctrine would not apply. The doctrine of accretion and erosion may also apply, as it could be said the processes are natural, as in they are caused by storms.

Looking at all these factors concerning the processes of accretion and erosion, it is apparent that the doctrine does not apply, as the erosion cannot be considered gradual and imperceptible.

4.5 Crown Land Conversions & the Status of the Beach Reserve

In January 2008, a Crown Lands Conversion, Valuation and Asset Data Management Program commenced, funded by the New South Wales Treasury. The aim of the project is to convert a large proportion of Crown land parcels that were formally held under the old system of titling, to the new system of Torrens Title. This allows these properties to be searched electronically online, the same as normal freehold titles can be. In doing so, this process allows the management and valuation of these Crown owned properties by Government agencies, as well as the general public having more readily available access to research these properties (LPMA 2011). These conversions are taking place across the eastern division of New South Wales, and include such parcels as beach reserves and mangrove areas.

A recently lodged plan has identified the beach reserve of Collaroy-Narrabeen between the ocean and right-line cadastral boundaries on the East and West of the foreshore respectively, and Malcolm Street, Narrabeen in the North to Birdwood Avenue, Collaroy in the South. The beach reserve is now known as Lot 7351 in Deposited Plan 1166942. The plan was prepared solely to identify the land described above, and the boundaries were not investigated by the Registrar General. Hence, it

defines no cadastral boundaries, other than that the beach reserve extends to the mean low water mark to the east.

Investigation into previous plans of this Reserve found that the previous plan was number MS 16009 Sy, also known as CP16009-3000. Investigations at the Land and Property Management Authority found they had no record of the previous plan. Further investigation at the LPMA found that they had never received a copy of this Crown Plan.

The plan shows the reserve having a boundary to the east defined by the mean low water mark. Modification of the doctrine of erosion and accretion as stated in Section 55N of the *Coastal Protection Act 1979 No. 13* states that the doctrine applies to a water boundary which is defined or otherwise determined by reference to a mean high water mark. As the eastern boundary is bounded by MLWM, this coastal Crown Reserve is not affected by the doctrine of erosion and accretion and cannot lose or gain land by title. The Crown Reserve will therefore always remain as a piece of legal land, although may not continue to remain as a piece of physical land due to the effects of erosion and sea level rise perhaps eventually putting it completely under water.

4.6 Government Responsibility to Erosion

Storms in 1945 hit Collaroy-Narrabeen Beach and destroyed many properties (Worley Parsons 2011), some of those which now form the northern end of the Collaroy Beach car park (*Figure 26*). These buildings in this area were removed, and the properties resumed by council, allowing no more development on the properties.

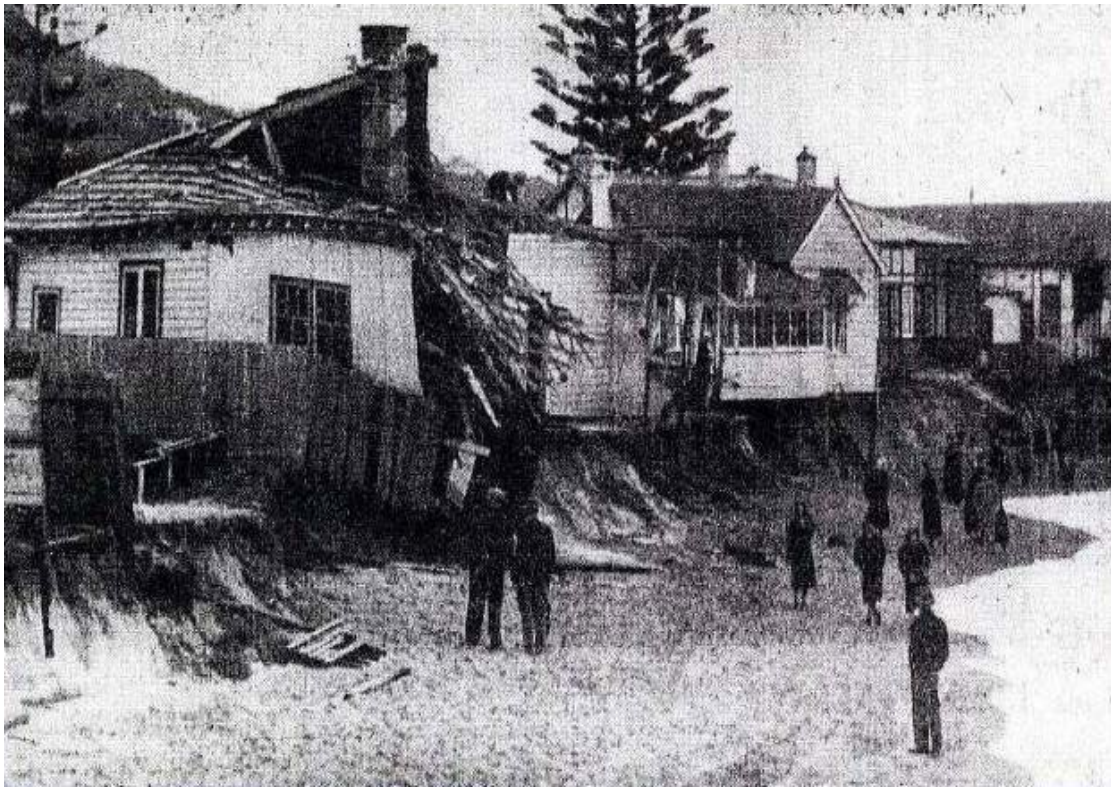

Figure 26 – Damage to houses, June 1945, resulting in them being demolished, with the land being resumed by council (Cameron 2010)

1967 saw another large storm strike the beach eroding sand to a depth of 5m along the portion of beach in front of the 'Flight Deck' unit block (Worley Parsons 2011), the area in which the primary study of this project was carried out. The erosion exposed the buildings foundations and caused serious concern for the stability of the multi storey building and its neighbouring high-rise 'Shipmates'.

In 1974, further large storms devastated the beach front, washing away dunes at North Narrabeen, and destroying part of Ocean Street, as well as washing away part of the central-northern area of the beach, threatening more homes, as well as another multi storey unit block at Narrabeen 'Marquesas' (Worley Parsons 2011).

The state and local governments have a responsibility to '…preserve and protect the Collaroy/Narrabeen Beach as a national asset for public recreation and amenity…' (Warringah Local Environment Plan 2000 schedule 13, clause 2).

These storm events show the responsibilities that must be extended by local & state governments to protect the existing private properties as well as the publics' assets. It has been through poor management and planning practices throughout the past, that has allowed the development (and in some cases, overdevelopment) of these coastal areas. Remedial works of these areas have previously been carried out by the Government in the way of rock protection and sea walls, as well as ongoing sand nourishment of Collaroy-Narrabeen Beach. Future methods of remedial work must be studied and carried out to not only protect the private property owners interests, but also the interests of the public as a whole with regards to the continual use of the beach foreshore.

4.7 Temporary Protection – Past & Present

4.7.1 Concrete Tank Traps

After the storms of 1945, huge concrete tank traps were placed in front of the Arlington Amusement Hall as emergency protection (Worley Parsons 2011). Concrete tank traps are large concrete structures, usually of square or pyramid shape, that are used in war time to prevent tanks from passing through an area (Wisegeek n.d.). These large structures helped break up the wave surges hitting the building. Although they are a very effective way of breaking up wave surges, they could only be put in place as a temporary measure as they are quite obtrusive and do not please the landscape aesthetically.

4.7.2 Rock Protection

As an emergency measure large boulders and rocks were placed along the eroded beach area (*Figure 27*) after historically large storms in 1967 to help not only break up the path of wave surges, but also to stabilise the already weakened banks and sand (Worley Parsons 2011). Much like the tank traps mentioned above, these rocks are an effective way of reducing wave surges.

Figure 27 – Emergency rock protection in front of ‘Shipmates’ & ‘Flight Deck’ c.1972 (Worley Parsons 2011)

4.7.3 Sand Bagging

As per government legislation, temporary emergency coastal works are permitted to be installed by private land owners to protect their properties. These works should be erected prior to or after a storm has commenced and can consist only of sand or geo-textile bags filled with sand. The sand must be imported from elsewhere and may not originate from the beach with which they are being laid. No other temporary emergency protection materials are permitted by law.

4.8 Long Term Protection – Present & Future

4.8.1 Rock Protection

As a result of large storms, council partook in the dumping of large sandstone rocks and rubble. After the storm of 1967, rocks and rubble were placed along the beachfront (*Figure 27*), particularly in front of ‘Flight Deck’ to increase beach stability (Worley Parsons 2011). These rocks were placed initially as an emergency

measure, but have become a long-term protection method for the beachfront properties, although do not prevent beach erosion as can be seen in *Figure 28*. This photo was taken after large storms in 2007, and as can be seen, the beach has been heavily eroded. They do, however, prevent erosion occurring past (landward from) the rock protection, therefore protecting beachfront residences and their foundations.

Figure 28 – Exposed rock walls at Collaroy-Narrabeen Beach, 28 July 2007 (Worley Parsons 2011)

4.8.2 Sea Wall

The southern end of Collaroy-Narrabeen Beach is now occupied by a seawall of stone gravity construction (Worley Parsons, 2011). The southern end of the beach is the popular position for beach-goers, and is where the flags are often placed for safe swimming. This southern end appears at most times to be plentiful of sand, and generally has quite a wide sandy beach area, although during large storms can suffer from heavy erosion which can expose rocks and also the foundations of the sea wall.
It has proven over the years however, that it has been a successful in protecting the foundations of the 'Arlington Arcade' building as well as the Collaroy Beach

Reserve, which includes the ‘Collaroy Beach Surf Life Saving Club’, located immediately to the south of this ‘Arlington Arcade’.

4.8.3 Prevention of Future Development & Planning Procedures

As stated earlier, Warringah Council is in the process of purchasing beachfront properties in order to restore the land to its more natural state by turning it into a vegetated reserve. In doing so, this will prevent any future development of the land, stabilising the area and reducing the effects of erosion and accretion on the land. Two properties have been purchased to date with Section 94 Developer Contribution funds, with enough money to purchase another when it becomes available (Warringah Council 2006).

Dune rehabilitation is an effective ‘soft engineered’ approach to combating the effects of erosion. With this form of protection it can also increase the number of ecological communities within the area, helping to maintain these dune systems (Department of Planning NSW 2010).

Along with land acquisitions, Warringah council has guidelines in place to restrict and monitor future development. Restrictions such as the Wave Impact Zone, Zone of Slope Adjustment and the Zone of Reduced Foundation Capacity lines (*Figure 6*) allow Council to restrict or even completely prohibit major development within these zones, assisting the natural process of accretion and erosion to continue as it has for thousands of years.

4.8.4 Beach Nourishment

Beach nourishment is a popular method used by Warringah Council to replenish sand lost to storm surges. Although a reactive solution rather then a preventative one, it is an immediate solution that allows the continued use of the beach reserve by the public, as well as reinstating the physical land lost to erosion on private properties, at

least until the next storm removes the replaced sand. This solution does not offer any long term or permanent resolutions.

4.9 Private Landowners Rights

As discussed in chapter 2, private landowners have the rights prior to and during storm activity to erect temporary coastal protection to prevent erosion occurring to their properties. The only temporary protection permitted is geotextile bags filled with sand, with which the sand must not be taken from the adjacent beach. Land owners are expected to be aware of any approaching storms, and should be ready with appropriate protection.

With regards to long term protection of land owner's properties, planning procedures are in place to allow the construction of protective structures, such as sea walls, through development applications and approval from the consent authority. There are strict conditions that must be adhered to for the approval of these structures, but if all conditions are met, a landowner has the rights to construct coastal protection within their property boundaries.

4.10 Summary

This chapter has outlined the results of primary field data and secondary research. It has examined the effects erosion has on the cadastral boundaries of properties along Collaroy-Narrabeen Beach as well as the implications the Crown Beach Reserve has with regards to the doctrine of accretion and erosion.

This chapter has also reviewed the methods of protection available prior to and during a large storm event to prevent or reduce the effects of erosion, as well as the long term plans by Governments to prevent erosion to the coast.

CHAPTER 5

Conclusion

'Man cannot fight Mother Nature but educated man can assist her to restore balance.'

Michele, Manly Daily, 2009

5.0 Introduction

This study has collected and reviewed both secondary research combined with a primary study to offer a cohesive report that critically reviews current legislation, case law, survey regulations and remedial coastal works, to recognise deficiencies and recommend considered solutions to the case study of Collaroy-Narrabeen Beach.

5.1 Achievement of Objectives

It was the aim of this project to investigate the effects of coastal erosion on coastal boundaries and to determine the rights, obligations and limitations attached to that land with respect to both the private land owner and the general public. This study comprehensively reviewed the above through a combination of secondary and primary research methods. The collection and critical review of current legislation, case law, survey regulations as well as investigation into examples of coastal remedial works (both successful and unsuccessful) was applied to a primary research study. This final chapter will suggest what recommendations are believed to be most effective in protecting the foreshore of Collaroy-Narrabeen.

5.2 Problems & Recommendations

Natural boundaries will continue to be more difficult to review in context, simply because they are continually moving. There can be advantages for both the landward side property owner (private) and the seaward side property owner (the Crown) whose properties includes a natural boundary, in that if accretion occurs, title is gained by the private owner, and if erosion occurs the Crown would gain land by title. This however, has changed with the modification of the doctrine of accretion and erosion through the Coastal Protection Act, which currently states that land cannot be granted to the landward owner if it restricts or denies access to the adjoining beach reserve. This modification indicates a fairer and more balanced approach to legislation with the protection of public assets, without loss to the landward owner.

To be protected under this law, conditions must comply with the doctrine of accretion and erosion, which states that such change must do so gradually and imperceptibly. When erosion occurs suddenly however, such as during a storm, although no land is lost by title, land is lost physically. Landowners have the right to place temporary protective works to protect their properties from these effects, although these works may only be placed immediately before or during a storm. If a property owner is not prepared for such storms, property damage and physical land loss can occur. Permanent protective works may be applied through a development application through local Council, although approval is not guaranteed. Permanent protective works such as sea walls may actually increase the effects of coastal erosion, and could in some cases accelerate the erosion of an entire beach width.

Although 100 foot reserves have been successful in protecting properties with right-line boundaries within the coastal zone to date, the solution has only been a temporary measure, as the natural boundaries will eventually meet the right-line boundary. Any erosion that occurs beyond the right-line boundary suffers a loss of physical land, though not by title, and the 100ft reserve becomes non-existent.

As temporary solutions such as the 100ft reserve lose their effectiveness, more time and dedication needs to be committed to the research and testing of remedial

protective works to prevent further coastal erosion. Groynes can be a successful way of reducing the effects of littoral drift if placed correctly. As discussed in chapter 2, the groynes built at Kirra Beach have been quite successful, as can be seen in *Figure 15*. These groynes have successfully allowed for the beaches upward of the littoral drift to thrive, and with strategic planning the placement of a groyne (or groynes) at Collaroy-Narrabeen Beach could be an effective way of increasing the beach width, protecting both private landowners assets, as well as the publics' use of the beach reserve. Initial testing with sandbags will be particularly useful in determining what the actual effects will be prior to committing to such a significant development. As Collaroy-Narrabeen is a popular surf spot, this testing will be instrumental in determining the effects on surf breaks also.

Along with groynes, artificial reefs could also be implemented to reduce the wave impact on the shoreline, effectively reducing coastal erosion during large storms. Artificial reefs have many benefits, along with the assistance in the reduction of coastal erosion, they can serve as a recreational diving area, a surf break, as well as a new habitat for marine life.

The wave impact zone line along Collaroy-Narrabeen Beach was implemented by Warringah Council to restrict and prohibit major development eastward of the line, and has proven to been an effective way of regenerating natural dunes along the coast. This solution, along with land acquisitions, will see continued natural dune rejuvenation, returning the coast to its natural state and in doing so the possibility of a decrease in sudden erosion due to dune stability. The wave impact zone position should be continually reviewed to determine the best setback positions for new development. This could be done with the introduction of surveys annually or bi-annually of the beachfront, similar to the survey conducted in this primary study, to determine the exact movement of the sand and grassy bank from year to year.

The importance of collective and responsibly considered action which successfully manages the delicate balance between protecting privately owned land and public use is demonstrated below in *Figure 29*, which forecasts a 'doing nothing' scenario, the results of which show the area of primary study (shown at chainage 2600) having

a shoreline change of -32m, and in doing so push the Mean High Water Mark Westward towards the right-line boundaries of the private properties.

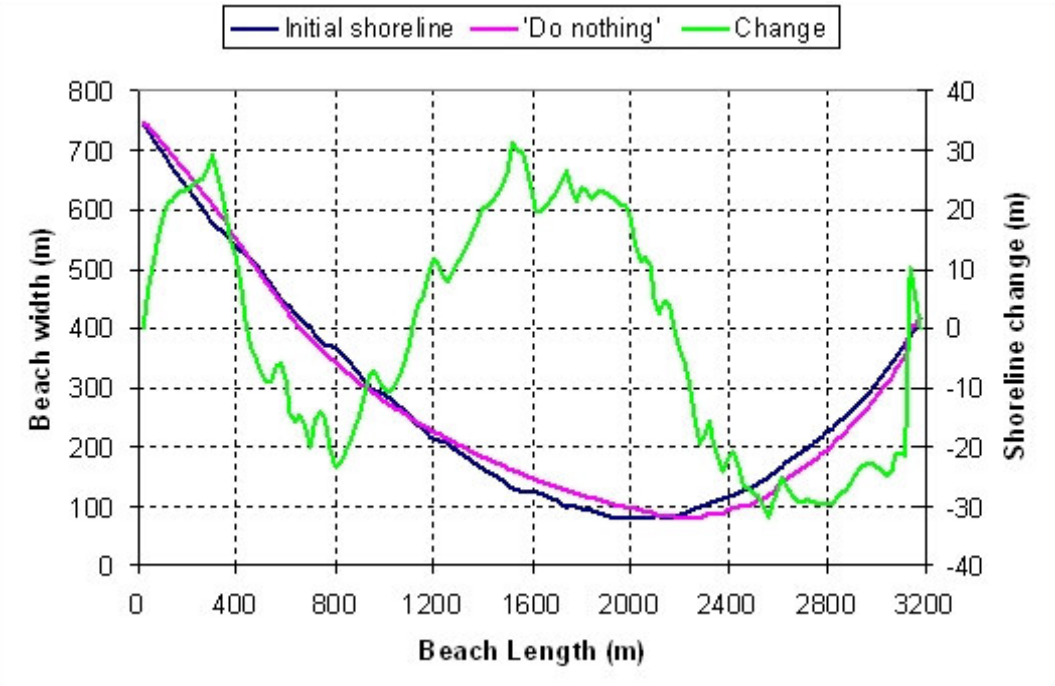

Figure 29 – The 'do nothing' scenario showing the initial and final shoreline positions and the degree of change (Acworth c. 2011)

This study has proven that there are serious and concerning issues surrounding coastal erosion, and its effect on coastal property boundaries. As Australia's stunning and iconic coastline continues to urbanise, the importance of collective and responsibly considered actions which successfully manage the delicate balance between protecting privately owned land and public interests from coastal erosion in New South Wales has never been more significant, which has been demonstrated through a primary research study complimented with secondary literature review.

APPENDIX A - PROJECT SPECIFICATIONS

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG411/4112 Research Project
PROJECT SPECIFICATION

FOR: Aaron Millard

TOPIC: Property Rights on Ambulatory Boundaries in NSW

SUPERVISOR: Shane Simmons

PROJECT AIM: To examine the rights, obligations and restrictions that attach to land with an ambulatory boundary, and the affects of rising sea levels, erosion and accretion on these boundaries in New South Wales.

PROGRAMME: Issue A, 5 April 2011)

1. Research and summarise the relevant New South Wales legislation which relates to land with ambulatory boundaries.
2. Research any guidelines the local coastal governments of Sydney have in place, in particular Warringah Council.
3. Identify parcels of land with varying topographical characteristics in regards to ambulatory boundaries
4. Identify the rights, obligations and restrictions that attach to those parcels
5. Conduct field surveys of those parcels and surrounding beach area, defining the limits of various tide heights and current boundaries and identify any areas of concern.
6. Analyse the current legislation and guidelines in regards to case studies, and identify any deficiencies and offer solutions

AGREED
(Supervisor)_____ (Student)_____
Date: / /2011 Date / /2011

Co-examiner:_____

USQ UNIVERSITY OF SOUTHERN QUEENSLAND

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Research Project Part 1

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Friday, 8 April 2011, 10:46 AM

Please save file as " **StudentNumber_StudentName_Specs_version1 (or version2, etc.)_SupervisorFamilyName**", e.g. " **0123456_ArmandoApan_Specs_Version1_Bullen** ".

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Available from: Friday, 18 March 2011, 03:40 PM
Due date: Tuesday, 22 March 2011, 03:40 PM

Submission feedback

Shane Simmons
Monday, 11 April 2011, 10:10 AM

Aaron, Spec's okay, although there is a typo. error in the title - you forgot the Y in property. Kind regards, Shane

Submission draft

0050028561_Aaron_MillardSpecs_Version1_Simmons.doc

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Notes

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Edit

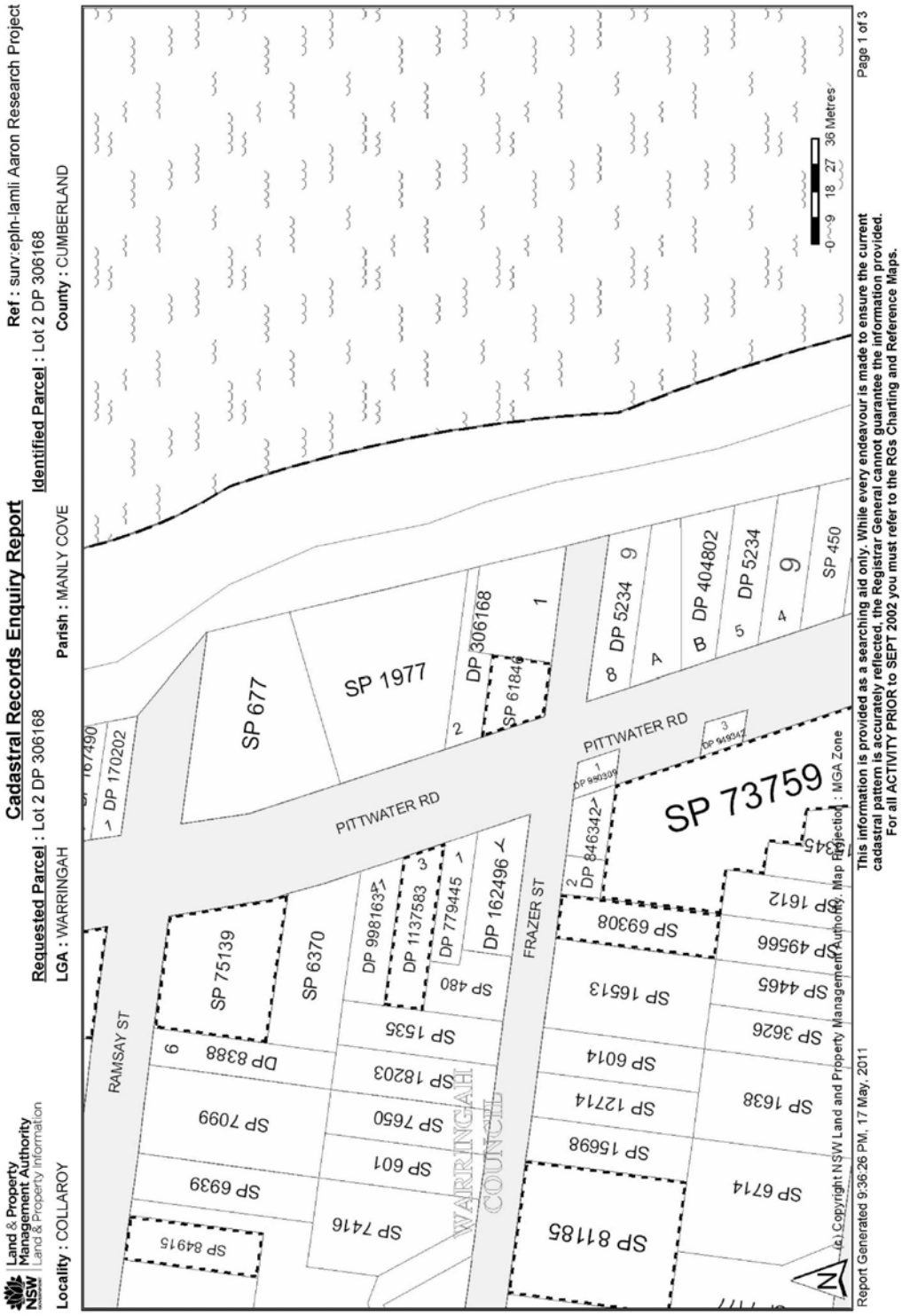
Final submission for assignment marking

Send for marking

You are logged in as Aaron Millard (Logout)

ENG4111_2011_1

APPENDIX B - CADASTRAL RECORD ENQUIRY SEARCH



	Status	Surv/Comp	Purpose
DP1137583			
Lot(s): 3			
CA111654 - LOT 3 IN DP1137583			
SP61846			
DP306168	HISTORICAL	SURVEY	UNRESEARCHED
DP1009032	REGISTERED	SURVEY	REDEFINITION
SP69308			
DP5322	HISTORICAL	SURVEY	UNRESEARCHED
DP1047281	REGISTERED	SURVEY	REDEFINITION
SP73759			
DP12849	HISTORICAL	SURVEY	UNRESEARCHED
DP326651	HISTORICAL	COMPILATION	UNRESEARCHED
DP798481	HISTORICAL	COMPILATION	DEPARTMENTAL
DP1074816	REGISTERED	SURVEY	CONSOLIDATION
SP75139			
DP8388	HISTORICAL	SURVEY	UNRESEARCHED
DP1083966	REGISTERED	SURVEY	CONSOLIDATION
SP75173			
DP850468	HISTORICAL	SURVEY	SUBDIVISION
DP1073384	REGISTERED	SURVEY	CONSOLIDATION
SP81185			
DP511749	HISTORICAL	SURVEY	SUBDIVISION
DP818833	HISTORICAL	SURVEY	SUBDIVISION
DP842111	HISTORICAL	SURVEY	SUBDIVISION
DP1130528	REGISTERED	SURVEY	CONSOLIDATION
SP84915			
DP313410	HISTORICAL	COMPILATION	UNRESEARCHED
DP1160989	REGISTERED	SURVEY	REDEFINITION

Plan	Surv/Comp	Purpose
DP5234	SURVEY	UNRESEARCHED
DP8388	SURVEY	UNRESEARCHED
DP162496	SURVEY	UNRESEARCHED
DP167490	COMPILATION	UNRESEARCHED
DP170202	COMPILATION	UNRESEARCHED
DP306168	SURVEY	UNRESEARCHED
DP404802	COMPILATION	UNRESEARCHED
DP730362	SURVEY	SUBDIVISION
DP779445	COMPILATION	DEPARTMENTAL
DP846342	SURVEY	SUBDIVISION
DP949342	COMPILATION	UNRESEARCHED
DP950309	COMPILATION	UNRESEARCHED
DP998163	COMPILATION	DEPARTMENTAL
DP1137583	COMPILATION	LIMITED FOLIO CREATION
SP450	COMPILATION	STRATA PLAN
SP480	COMPILATION	STRATA PLAN
SP601	COMPILATION	STRATA PLAN
SP677	COMPILATION	STRATA PLAN
SP1535	COMPILATION	STRATA PLAN
SP1612	COMPILATION	STRATA PLAN
SP1638	COMPILATION	STRATA PLAN
SP1977	COMPILATION	STRATA PLAN
SP2663	COMPILATION	STRATA PLAN
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SP8075	COMPILATION	STRATA PLAN
SP12714	COMPILATION	STRATA PLAN
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SP15698	COMPILATION	STRATA PLAN
SP16513	COMPILATION	STRATA PLAN
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SP69308	COMPILATION	STRATA PLAN
SP73759	COMPILATION	STRATA PLAN
SP75139	COMPILATION	STRATA PLAN
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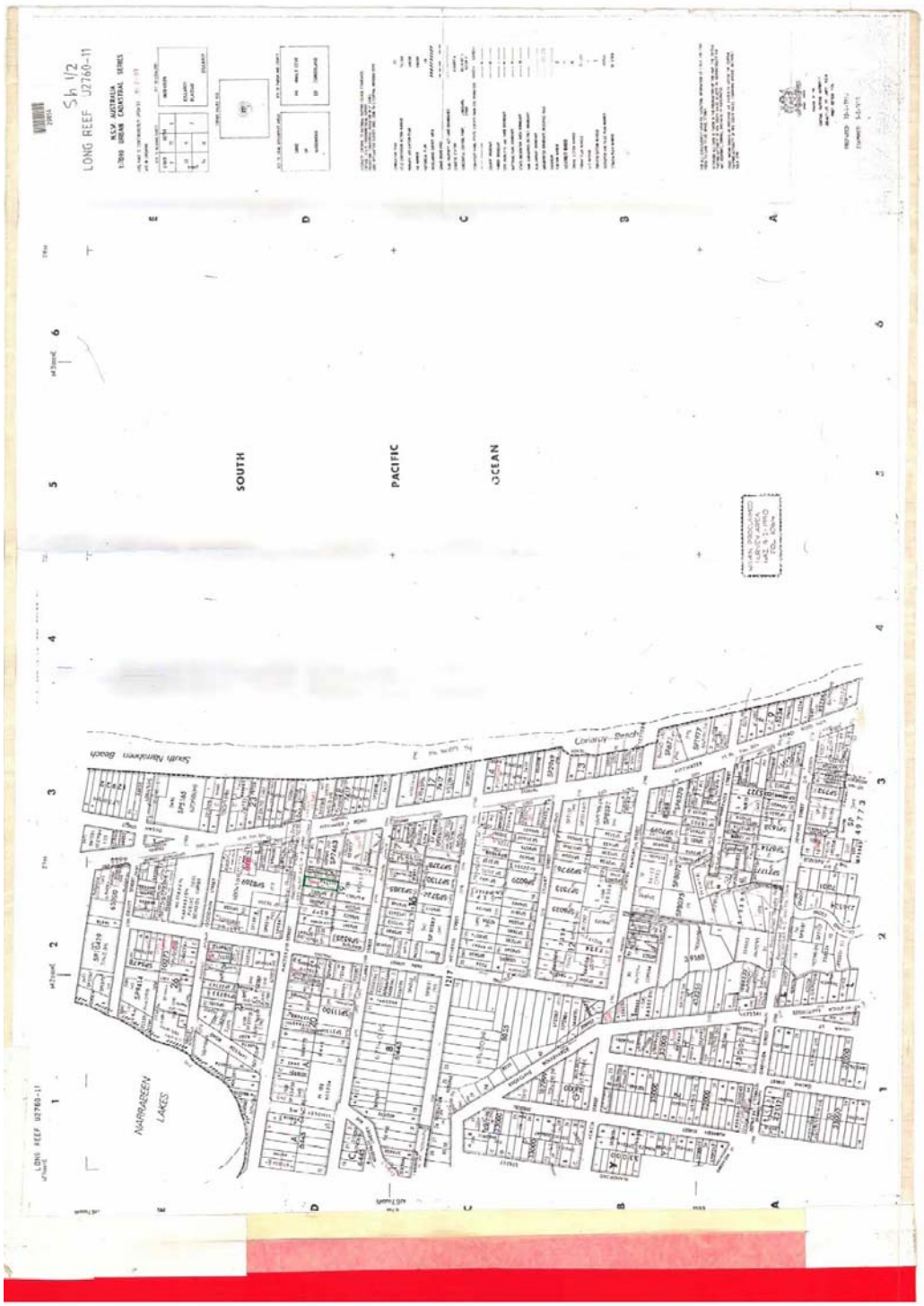
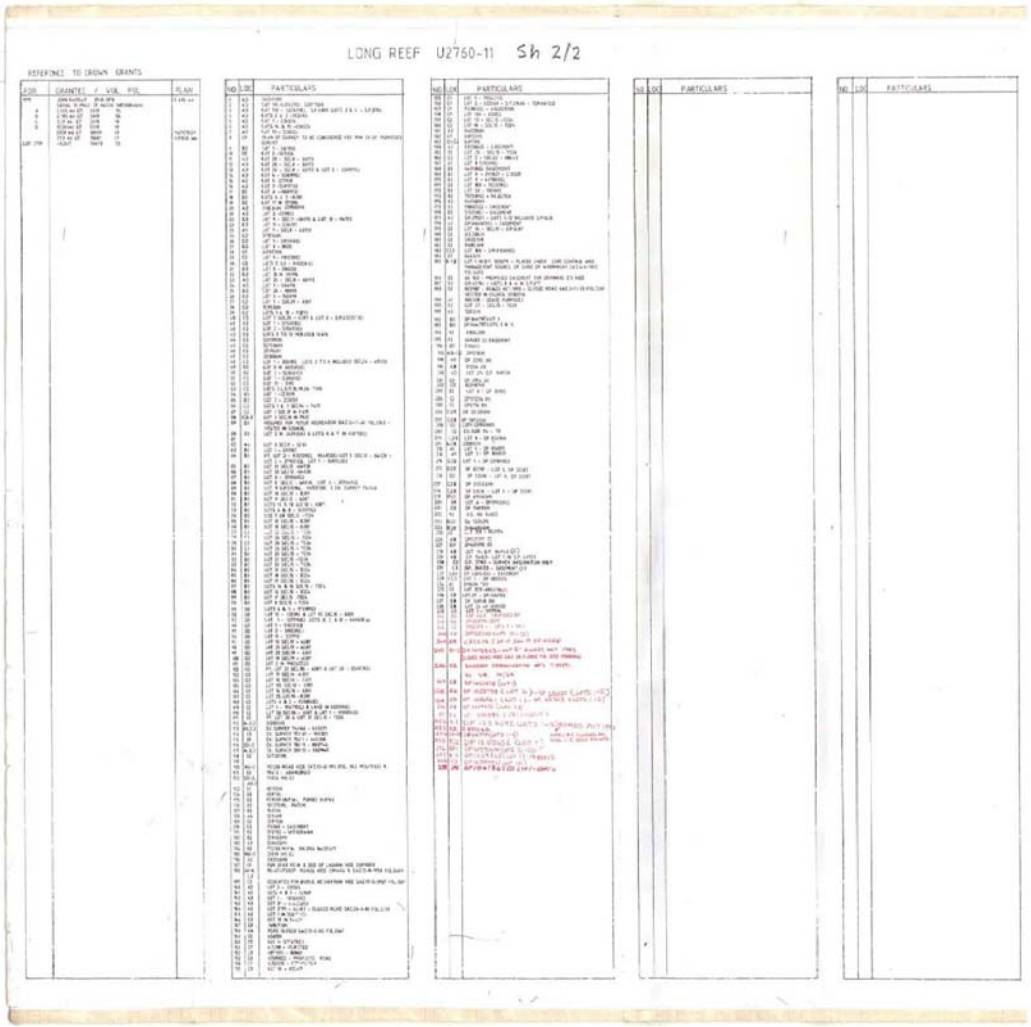
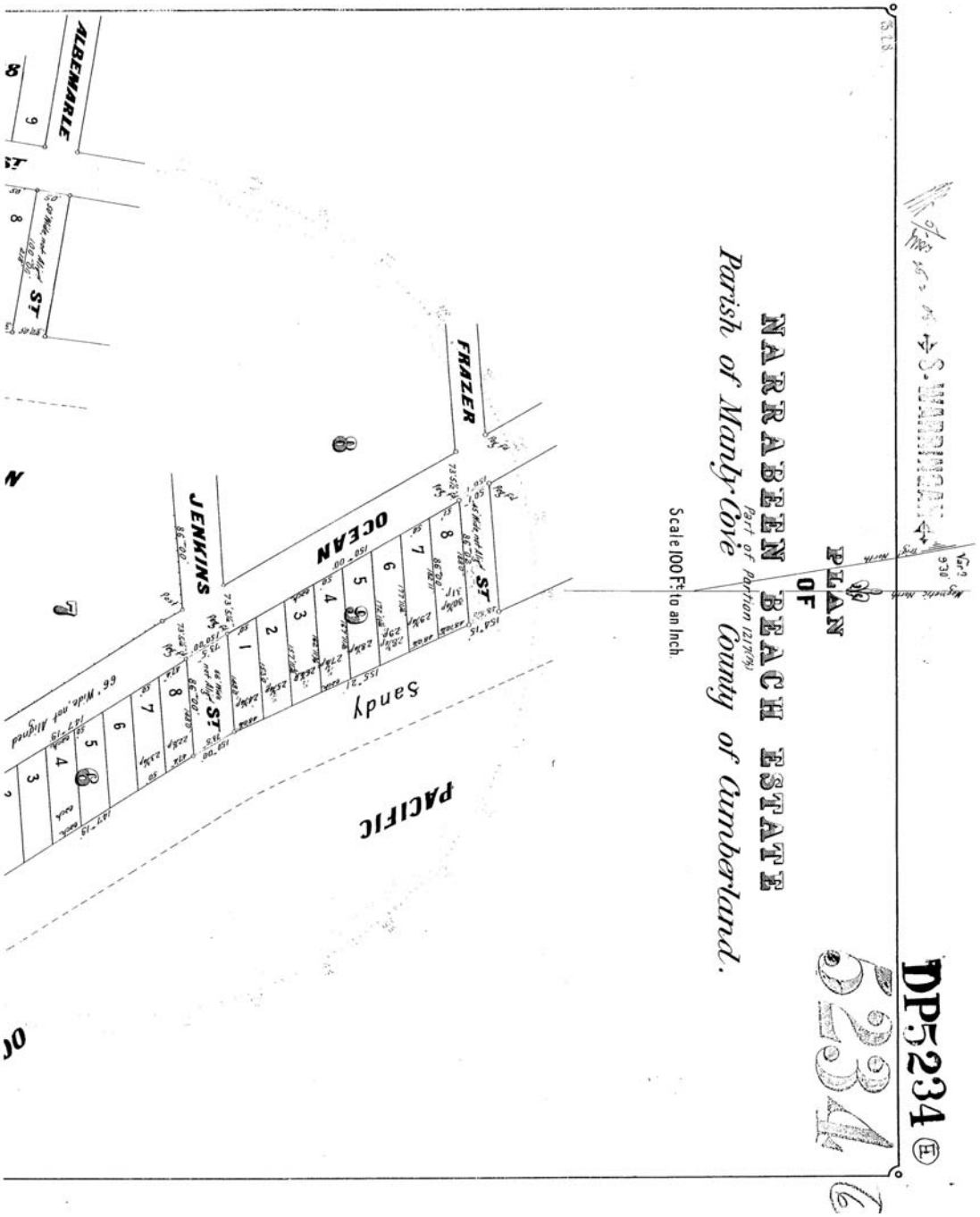
SP81185	COMPILATION	STRATA PLAN
SP84915	COMPILATION	STRATA PLAN

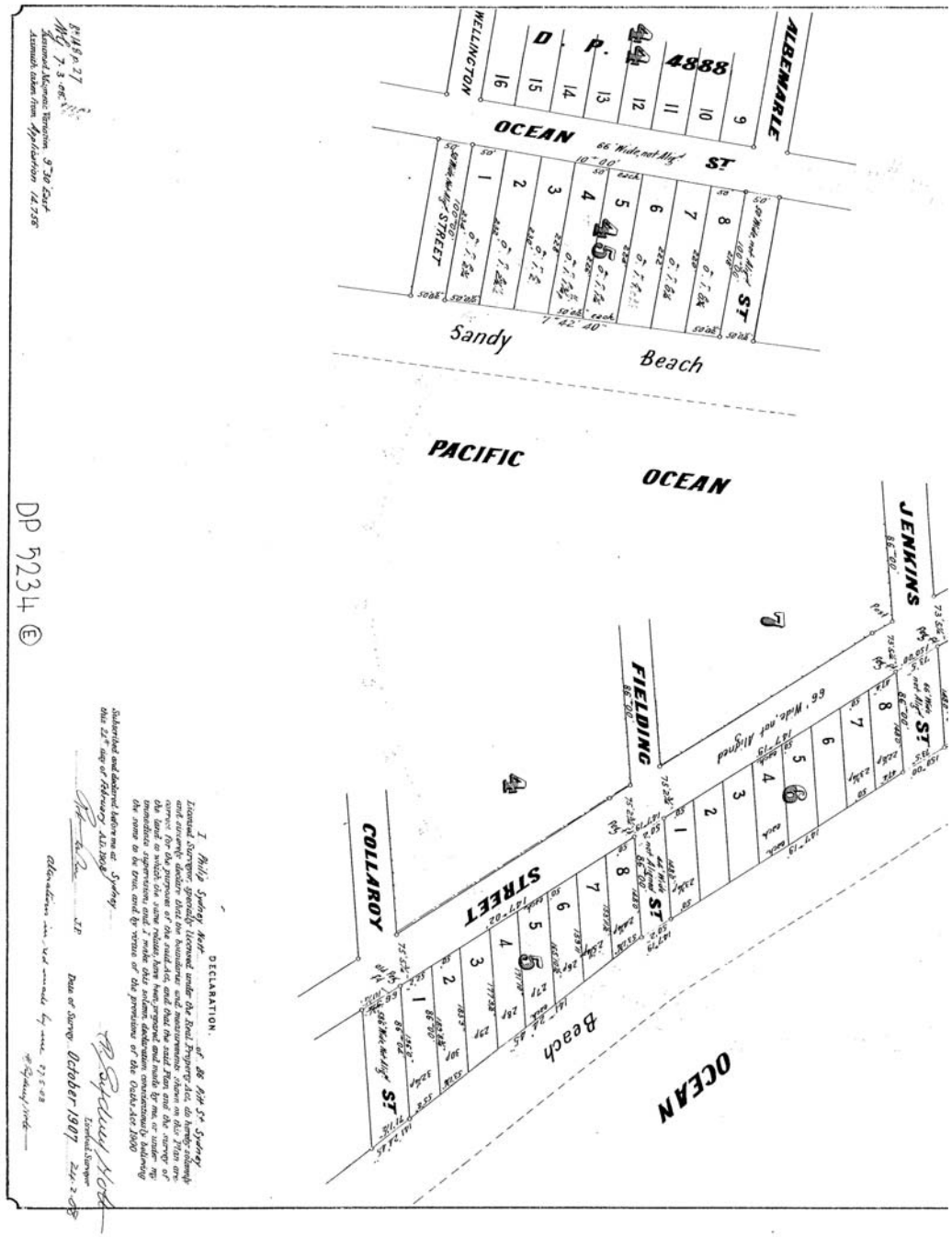
APPENDIX C – REFERENCE MAP



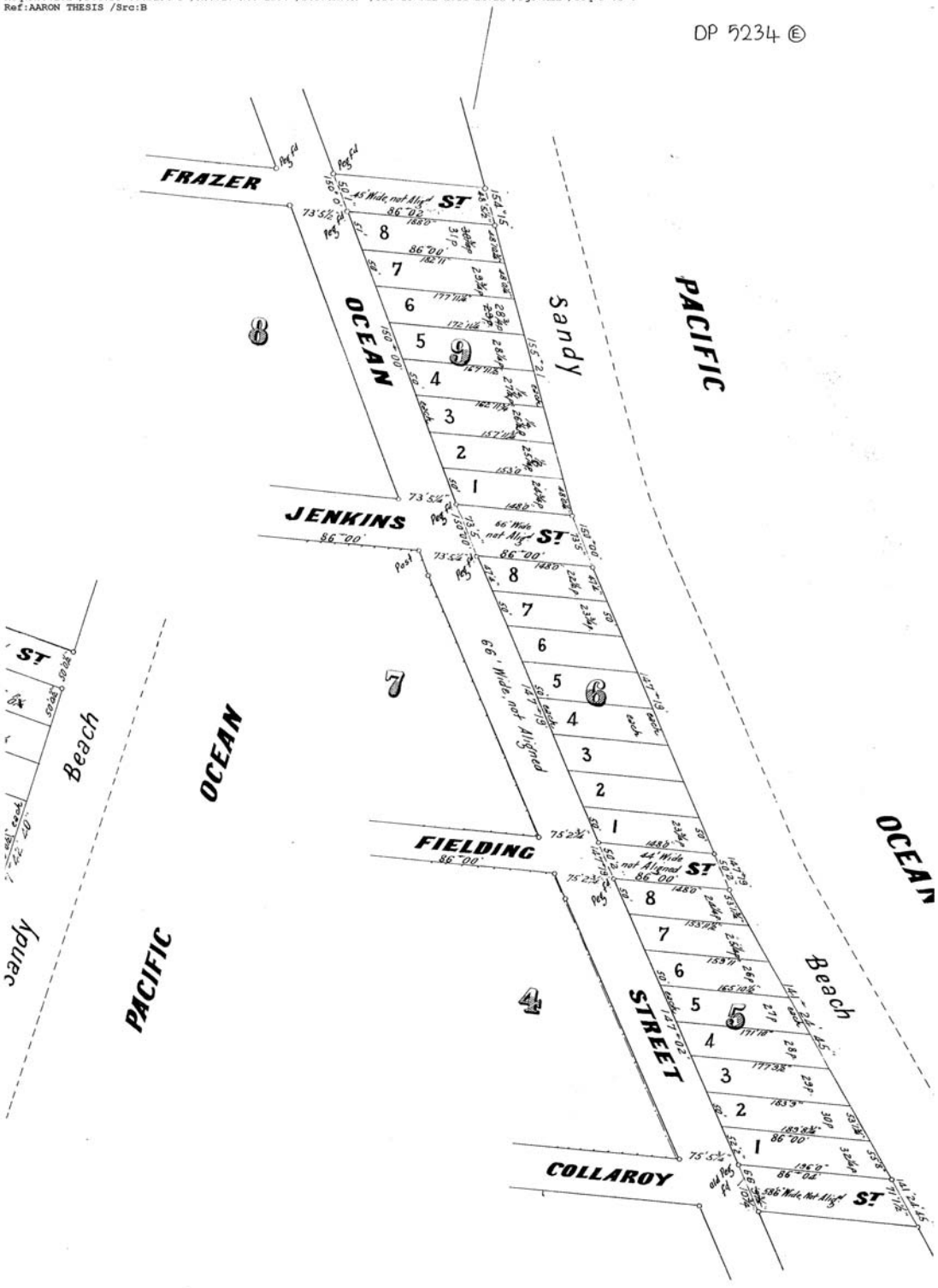

LONG REEF U2760-11 Sh 2/2
REFERENCE TO CROWN GRANTS
PARTICULARS
PARTICULARS
PARTICULARS

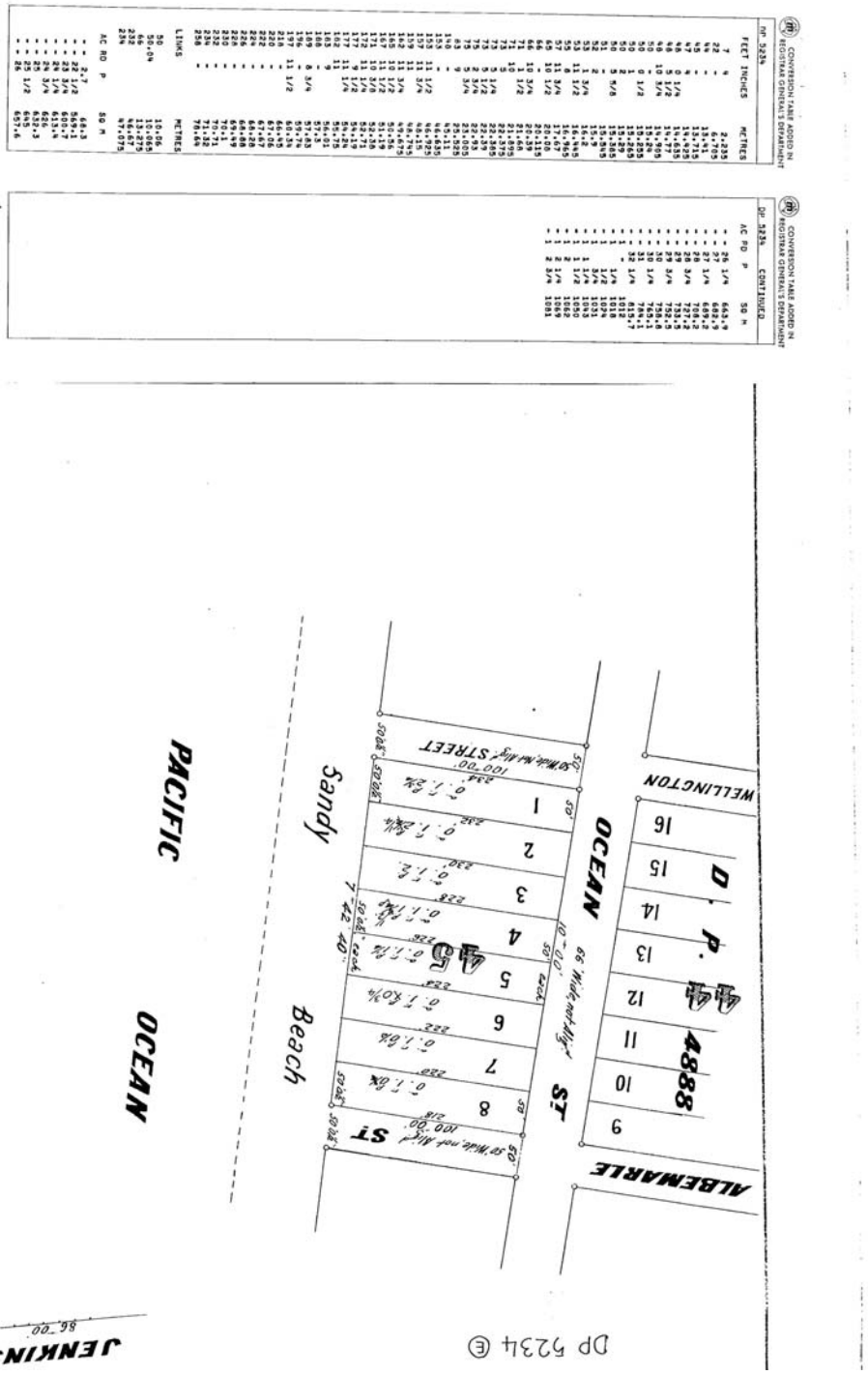
APPENDIX D - DEPOSITED & STRATA PLANS





DP 5234 E





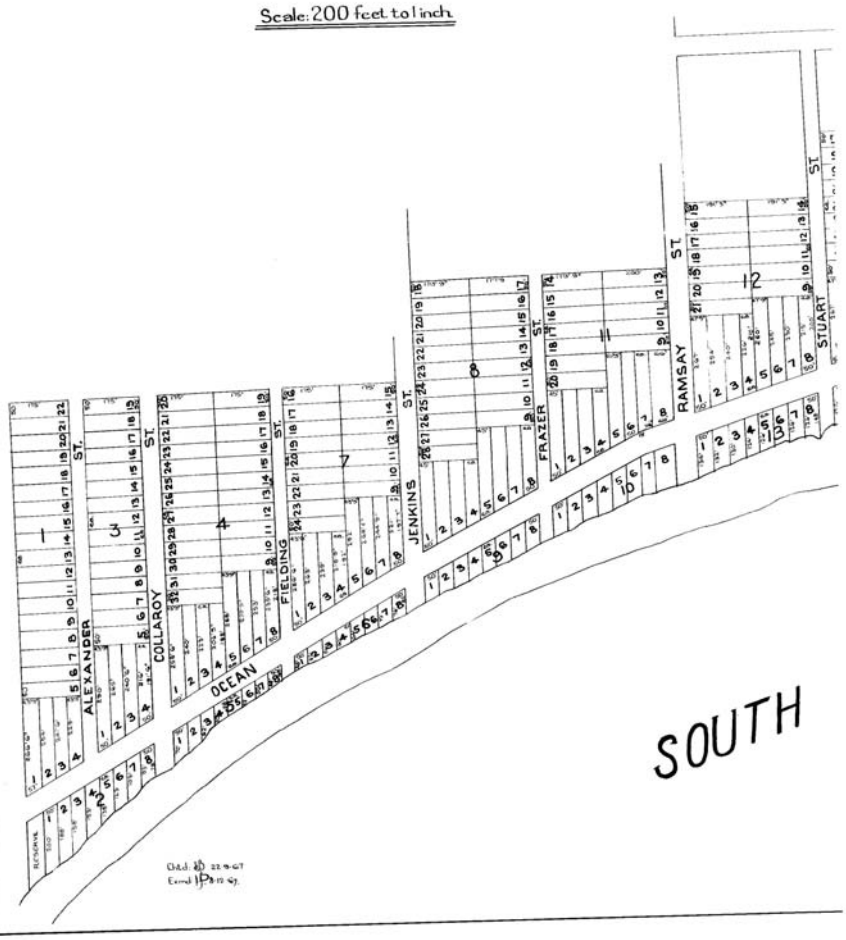
F.P. 111254

MOUNT RAMSAY ESTATE

NARRABEEN

Parish of Manly Cove. County of Cumberland

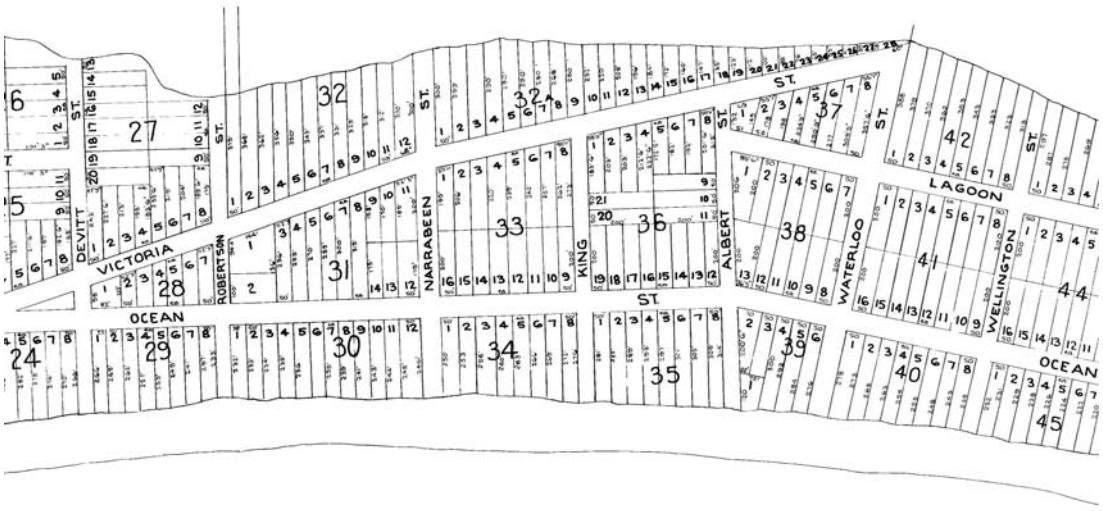
Scale: 200 feet to 1 inch



F.P 111254

PLAN F.P. 111254

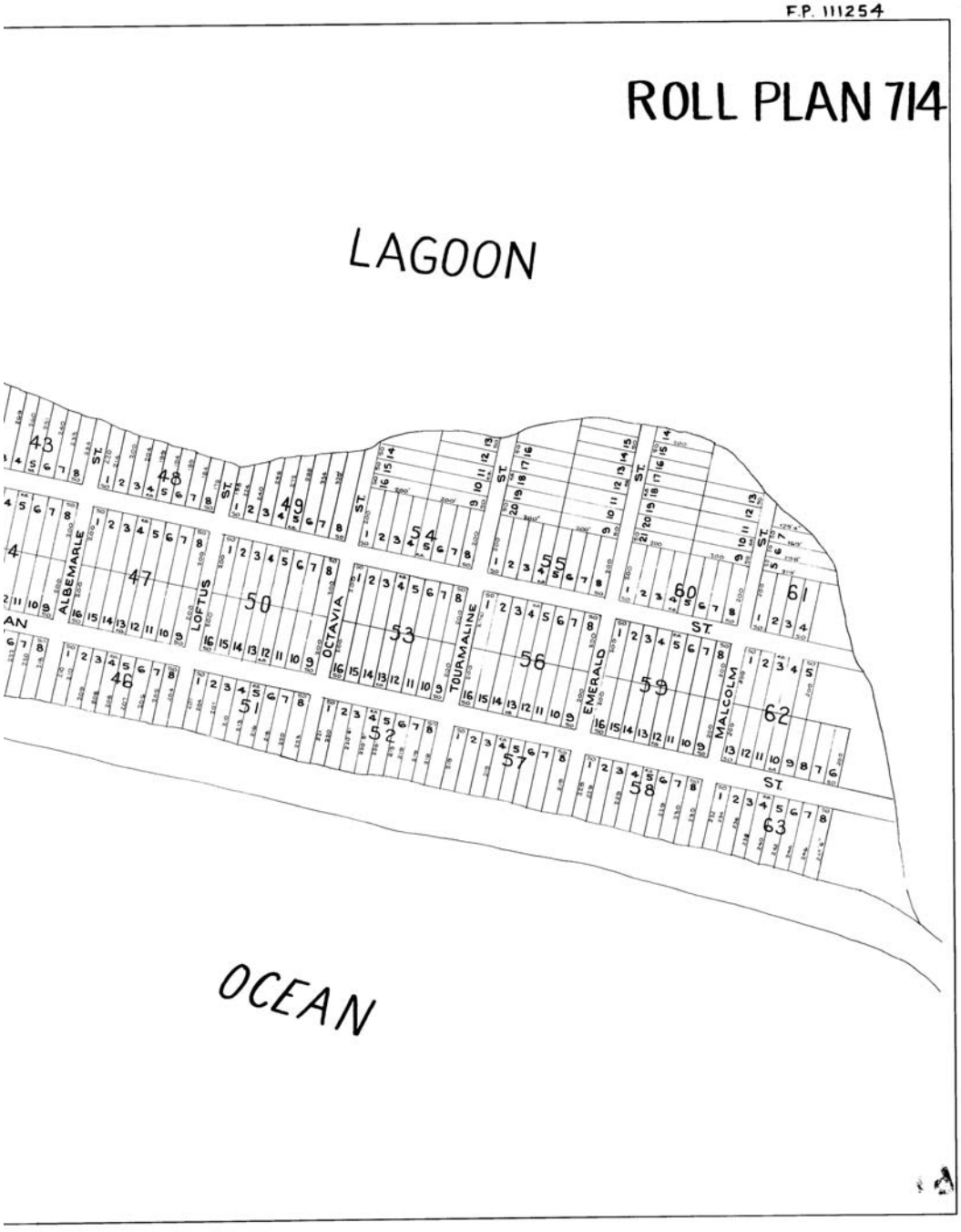
NARRABEEN

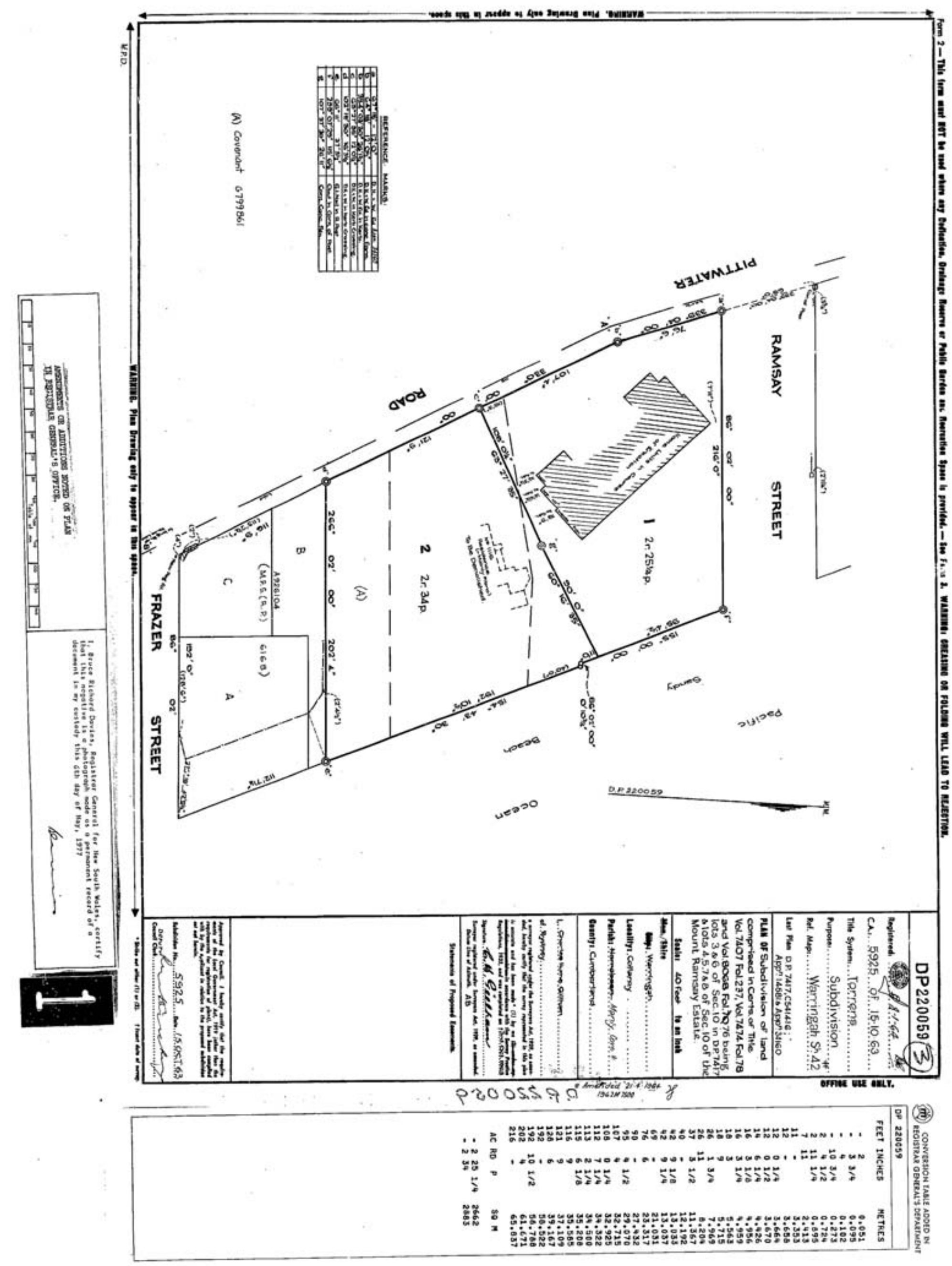


PACIFIC

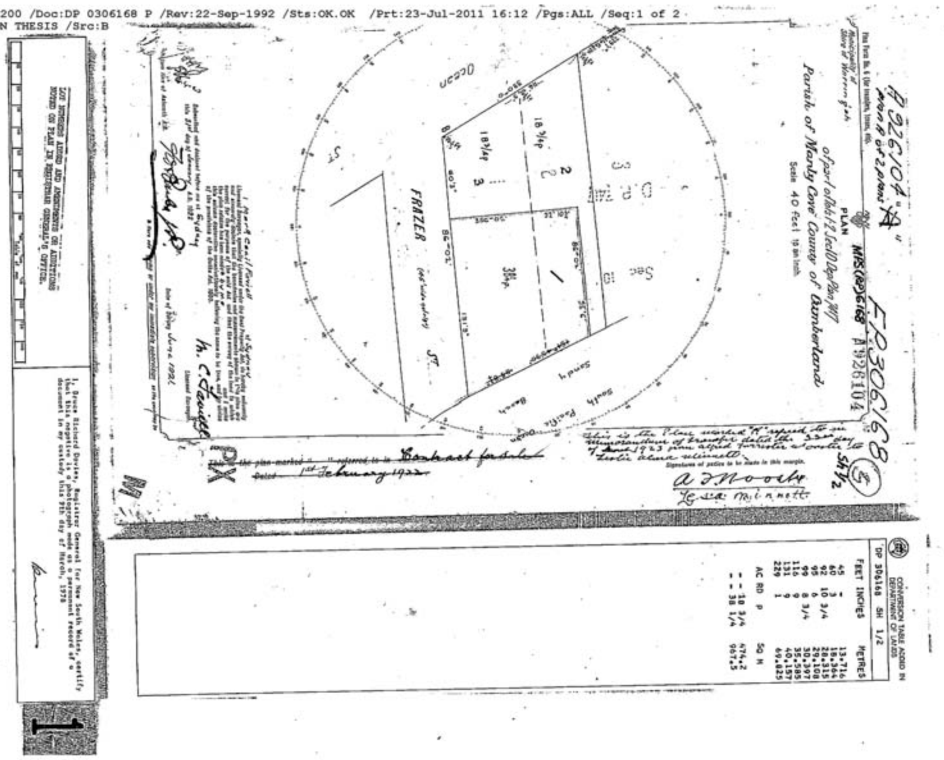
F.P. 111254

ROLL PLAN 714

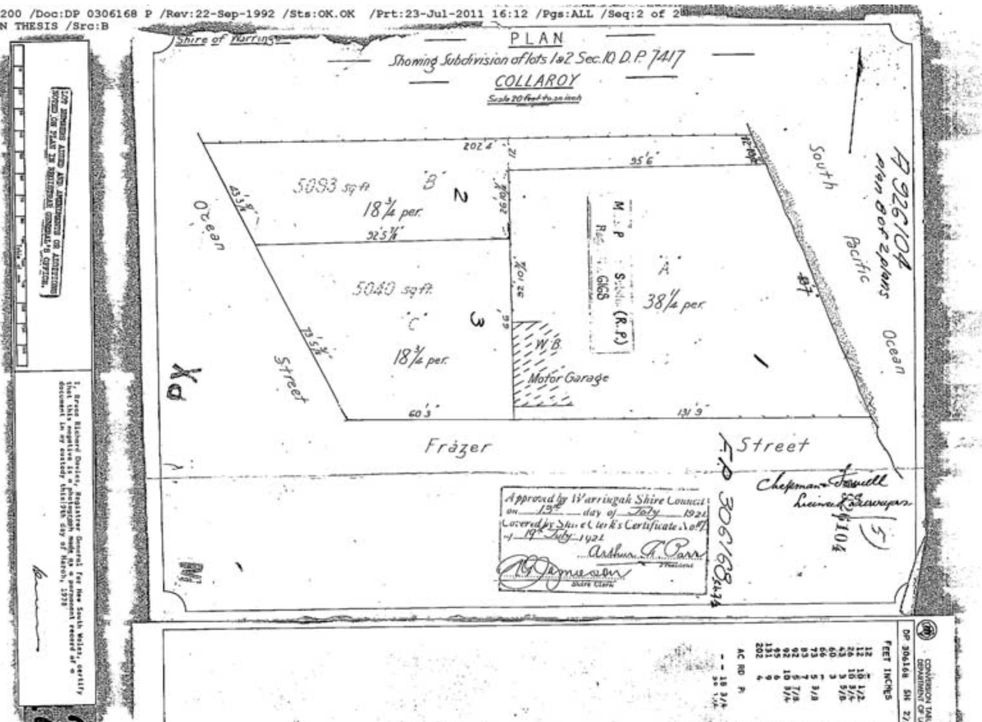



PITTWATER ROAD
RAMSAY STREET
FRAZER STREET
Pacific Ocean
Sandy Beach
DP220059
OFFICE USE ONLY.
CONVERSION TABLE ADDED IN REGISTRAR GENERAL'S DEPARTMENT

Req:R508200 /Doc:DP 0306168 P /Rev:22-Sep-1992 /Sts:OK.OK /Prt:23-Jul-2011 16:12 /Pgs:ALL /Seq:1 of 2
Ref:AARON THESIS /Src:B



Req:R508200 /Doc:DP 0306168 P /Rev:22-Sep-1992 /Sts:OK.OK /Prt:23-Jul-2011 16:12 /Pgs:ALL /Seq:2 of 2
Ref:AARON THESIS /Src:B



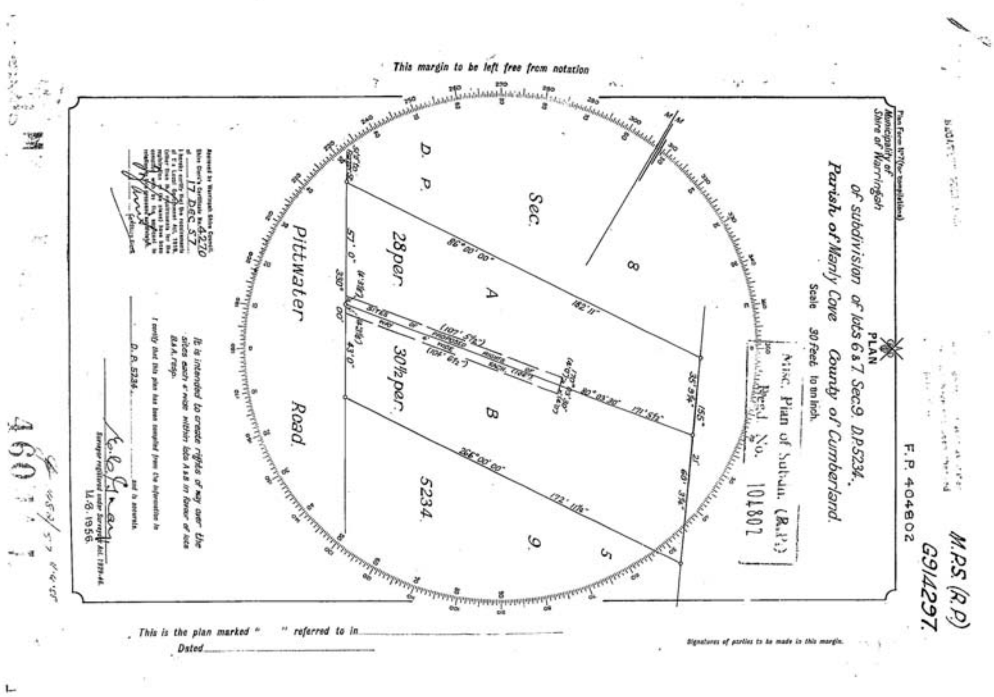
I, Bruce Richard Davies, Registrar General for New South Wales, certify that this negative is a photograph made as a permanent record of a document in my custody this 28th day of March, 1990

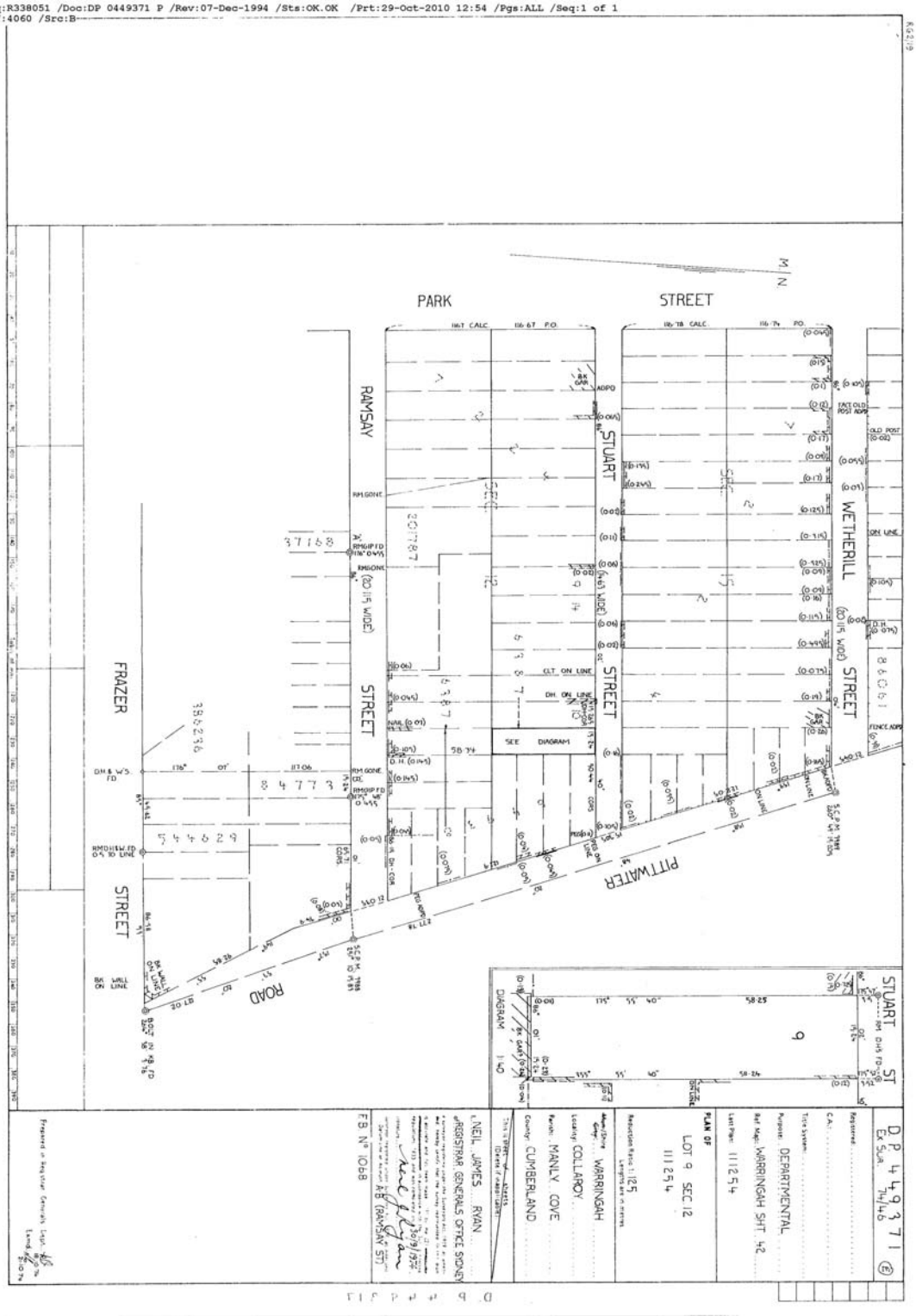
CONVERSION TABLE ADDED IN DEPARTMENT OF LANDS

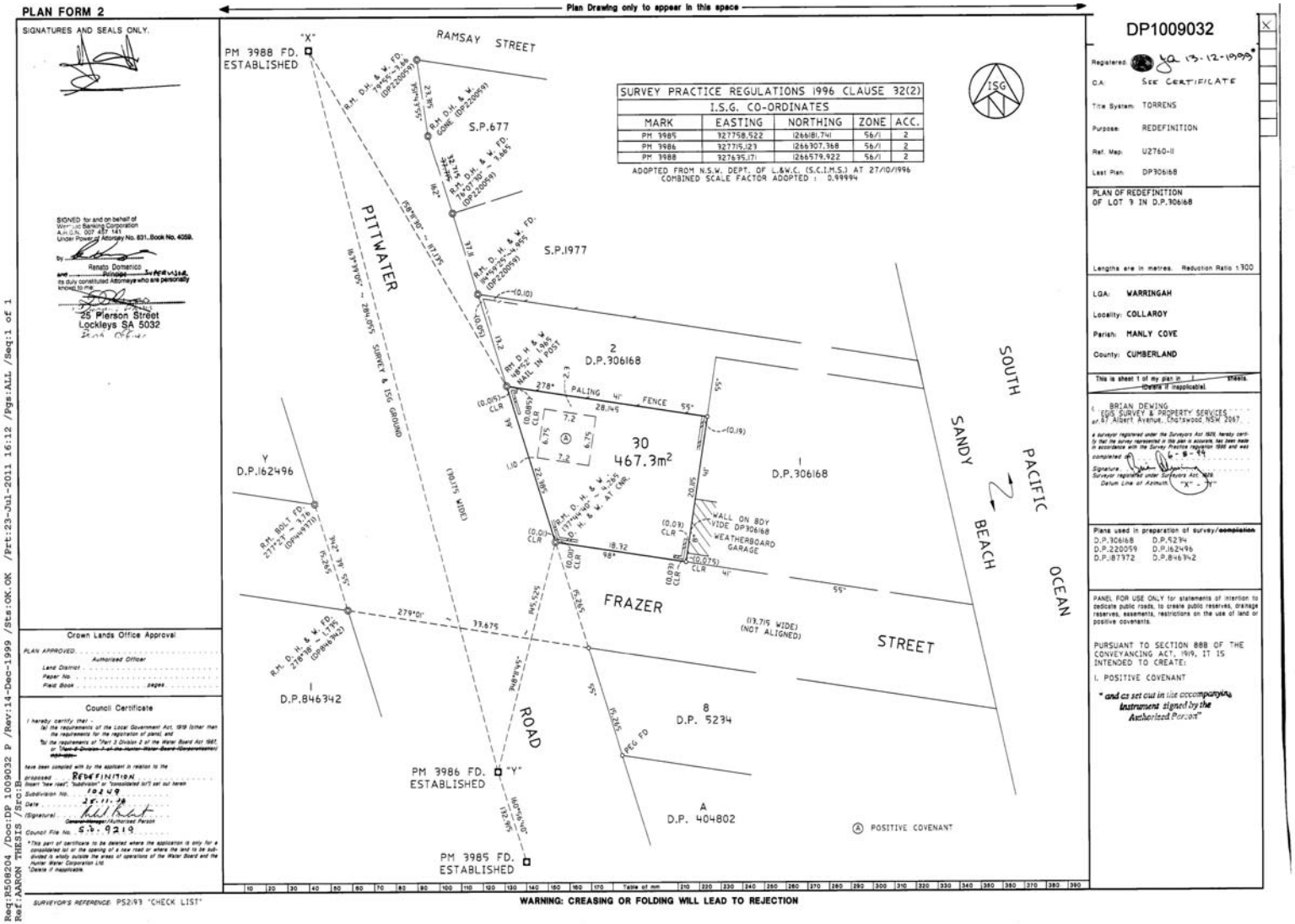
DP 404802

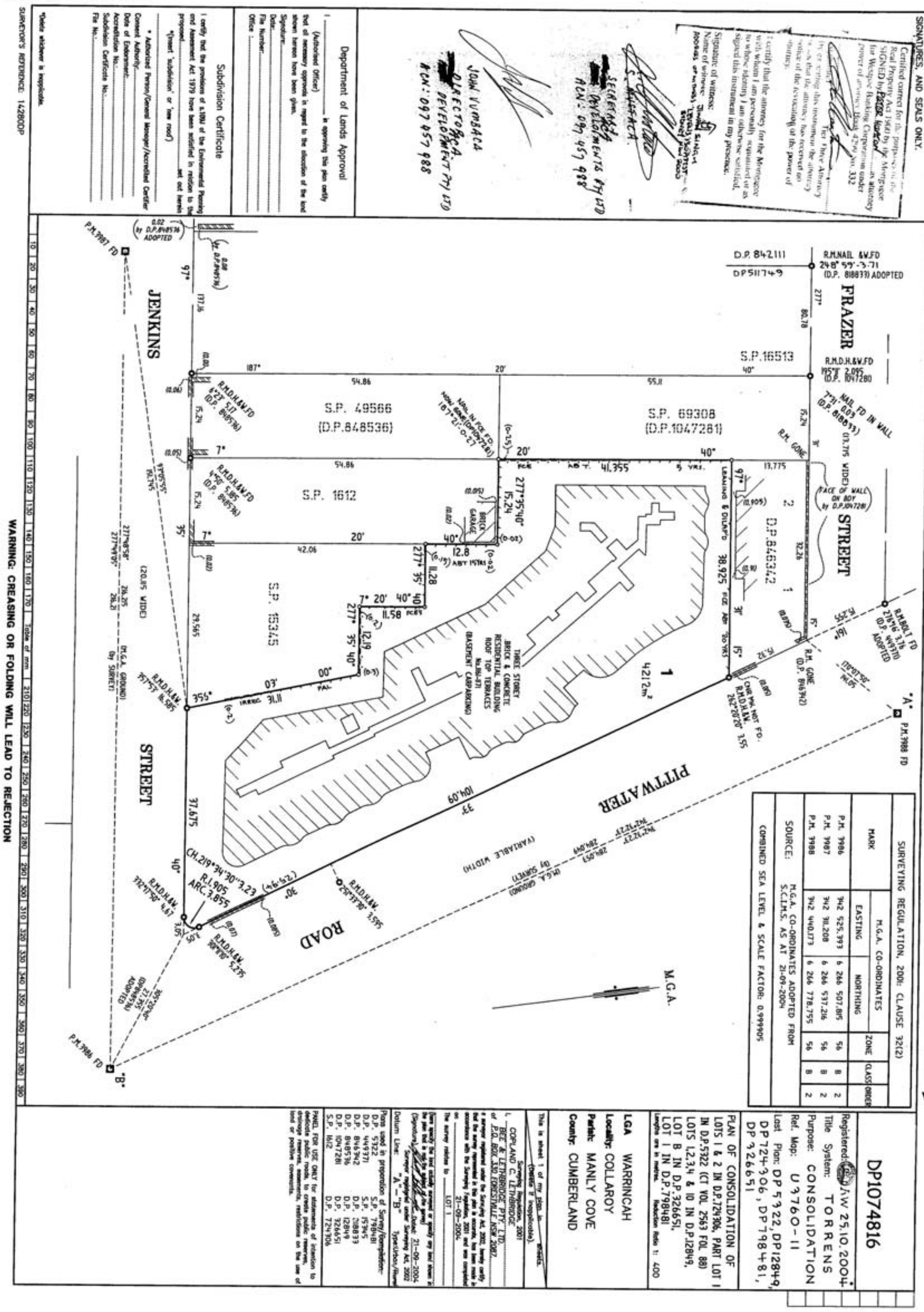
FEET	INCHES	METRES
4	-	1.219
4	3 1/8	1.299
35	9 1/4	10.903
43	-	13.106
51	-	15.545
57	-	17.374
60	3 1/4	18.371
104	6 1/2	31.864
106	-	32.309
107	5 1/2	32.753
171	5 1/2	52.261
172	11 1/4	52.711
182	11	55.753

AC	RD	P	SQ M
-	-	28	708.2
-	-	30 1/2	771.4

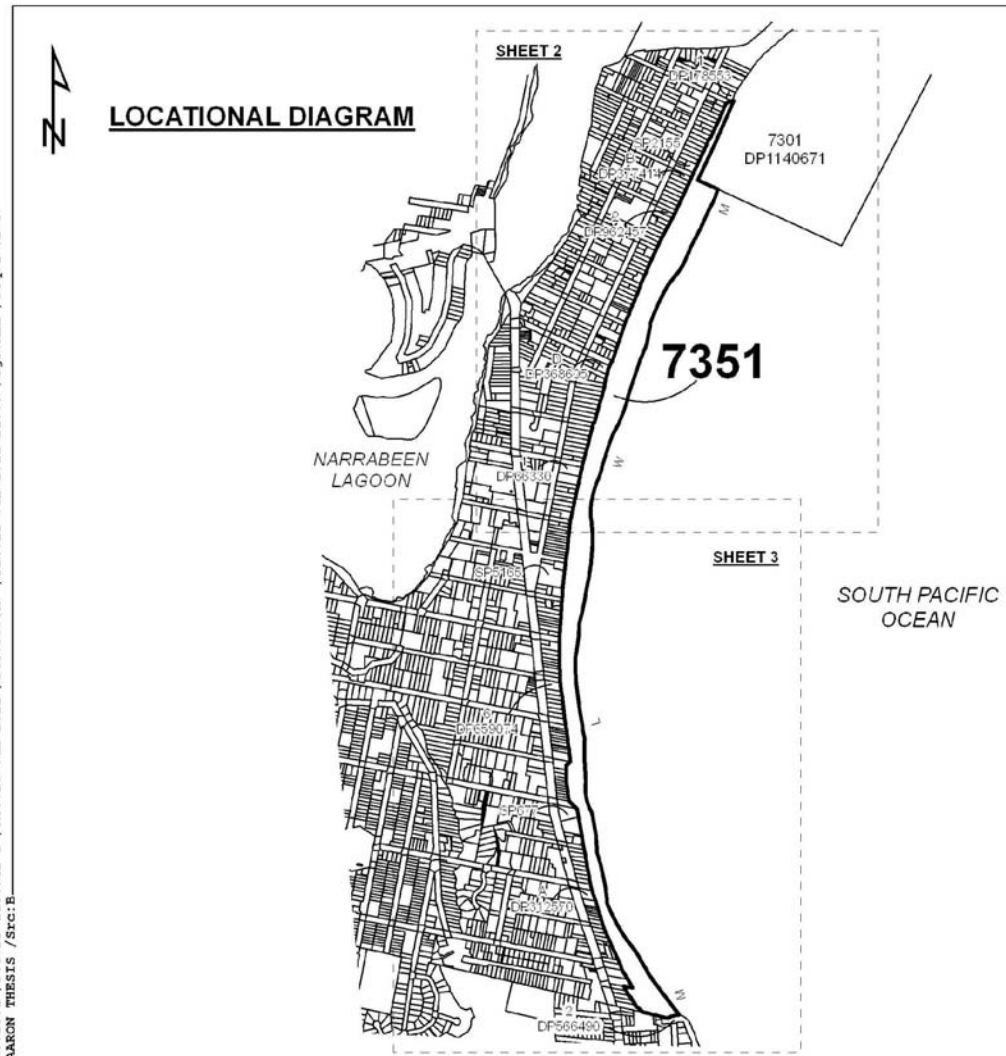







PLAN FORM 2 (APPROVED FORM 3)
SIGNATURES, AND SEALS ONLY.
Department of Lands Approval
Subdivision Certificate
JENKINS
STREET
FRAZER
STREET
PITTWATER
ROAD
S.P. 49566
S.P. 69308
S.P. 1612
S.P. 15345
D.P. 846342
1
4212m²
M.G.A.
SURVEYING REGULATION, 2001: CLAUSE 32(2)
WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION
DP1074816
Title System: TORRENS
Purpose: CONSOLIDATION
LGA WARRINGAH
Locality: COLLAROY
Parish: MANLY COVE
County: CUMBERLAND

e-departmental



DP 1166942

Registered : 27-6-2011

Title System : CROWN LAND

Purpose : CROWN LAND CONVERSION

Reference Map: U2760-11, U2760-13, U2767-71, U2767-73

Last Plan: ———

DP752038_UP119833_7351_1 CA159575

PLAN OF CROWN LAND BEING RESERVE

Lengths are in metres. Reduction Ratio - NTS

Sheet 1 of 3 sheets

LGA: WARRINGAH

LOCALITY : COLLAROY AND NARRABEEN

PARISH : MANLY COVE

COUNTY : CUMBERLAND

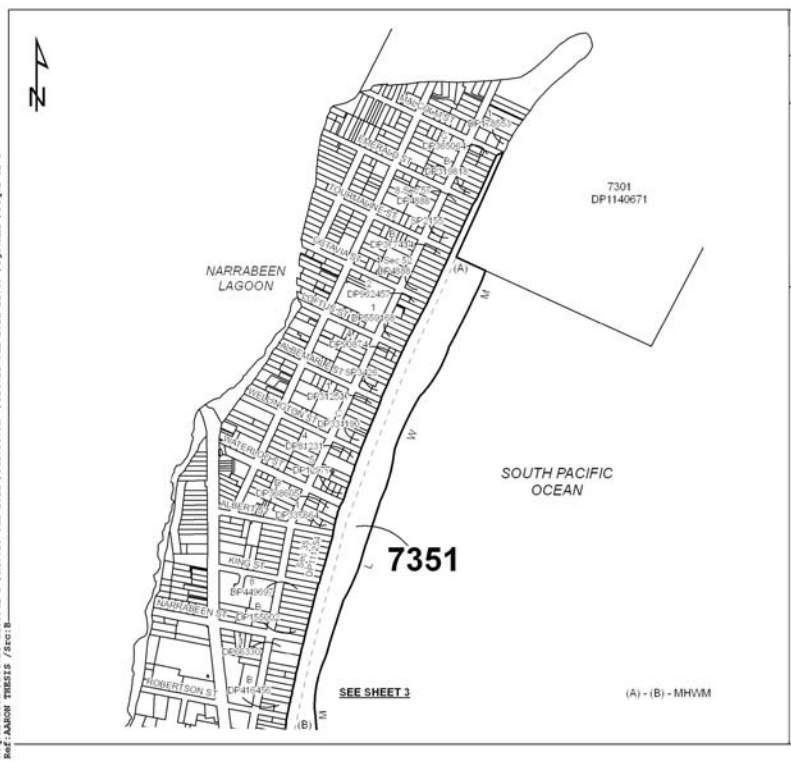
THIS PLAN WAS PREPARED SOLELY TO IDENTIFY THE LAND ABOVE AND THE BOUNDARIES HAVE NOT BEEN INVESTIGATED BY THE REGISTRAR GENERAL

THIS PLAN IS NOT A CURRENT PLAN IN TERMS OF S.7A CONVEYANCING ACT 1919

Drawn By: AJ
Signed Off: RW
Office: Head Office, Crown Lands Division, Newcastle

Req:R502381 /Doc:DP 1166942 P /Rev:28-Jun-2011 /Sts:SC.OK /Prt:21-Jul-2011 21:09 /Pgs:ALL /Seq:1 of 3
Ref:AARON THESIS /Src:E

e-departmental



DP 1166942

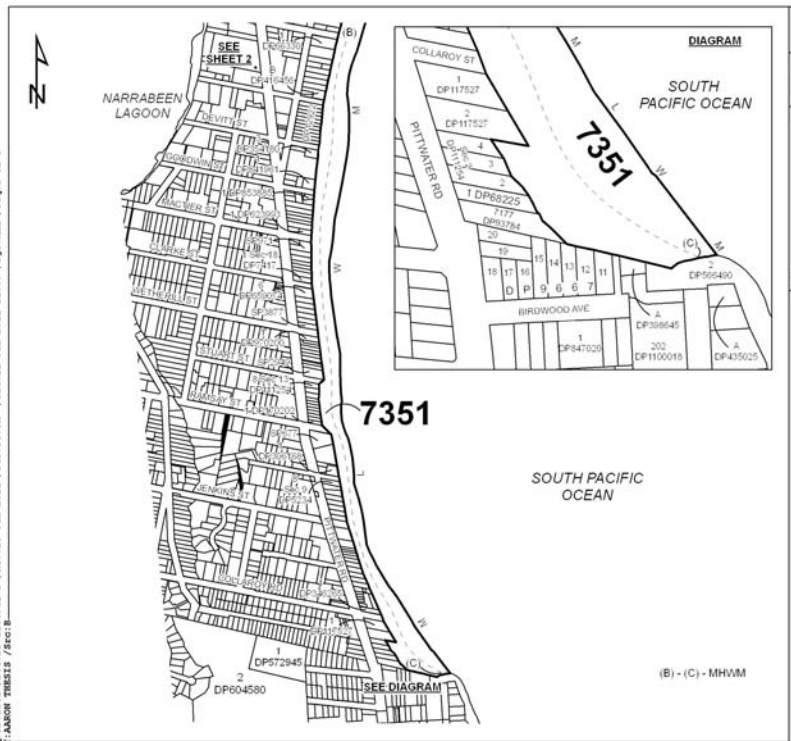
Registered : 27-6-2011

DP752038_UP119833_7352_2

Sheet 2 of 3 sheets

Req:R502381 /Doc:DP 1166942 P /Rev:28-Jun-2011 /Sts:SC.OK /Prt:21-Jul-2011 21:09 /Pgs:ALL /Seq:2 of 3
Ref:ABOOM TRB515 /Src:B

e-departmental



DP 1166942

Registered : 27-6-2011

DP752038_UP119834_7353_3

Sheet 3 of 3 sheets

Req:R502381 /Doc:DP 1166942 P /Rev:28-Jun-2011 /Sts:SC.OK /Prt:21-Jul-2011 21:09 /Pgs:ALL /Seq:3 of 3
Ref:ABOOM TRB515 /Src:B

STRATA PLAN

(3)

Shire of Warringah
Locality Collaroy
Reference to Title C.T. Vol: 9616 F: 138.
Parcel comprises whole of Lot 1, D.P. 220059

(E)

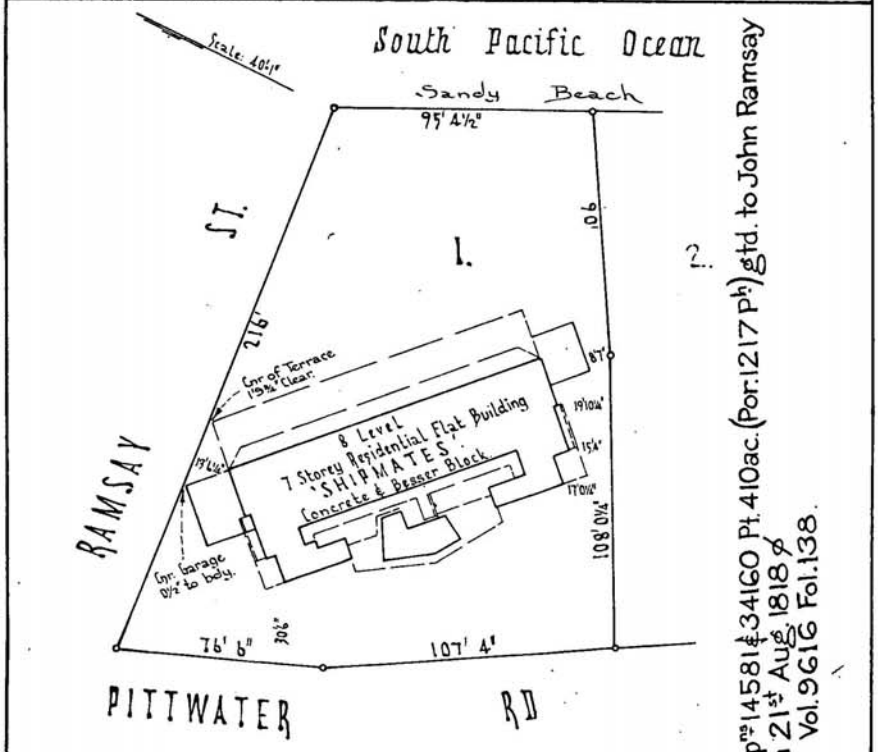
STRATA PLAN 677

(E)

Registered 13-3-1964
C.A. 33/64 of 11-3-1964
Ref. Map Warringah Sh. 42
Last Plan D.P. 220059

Parish Manly Cove County Cumberland

The address for service of notices on the body corporate is:- The Proprietors, Strata Plan No 677
1120 / 1122 Pittwater Rd, Collaroy



Schedule of Unit Entitlement

(See Sheet 2)

I, Richard Stephen Lovegrove
of 43 Prince Charles Rd Frenchs Forest
a surveyor registered under the 'Surveyors Act, 1929, as amended, hereby certify that:
the building erected on the parcel described above is within the external boundaries of the parcel.

Dated 12. 3. 64
Signature

Approved by the Council for the purposes of the Conveyancing (Strata Titles) Act, 1961.
Date 11. 3. 1964
Subdivision No. 33/64
Council Clerk

MPD

a) State if whole or part.

b) Refer to number of Lot, Allotment, or Portion and to the Deposited Plan, Town, or as the case may be.

Parcel comprises[a] whole of[b] lot 2, D.P. 220059

Reference to Title Vol. 9616 Fol. 139

~~Mun./Shire/City~~ Warringah

Locality Collaroy

Parish Manly Cove County Cumberland

Scale: 40 feet to an inch.

STRATA PLAN 1977 (E)

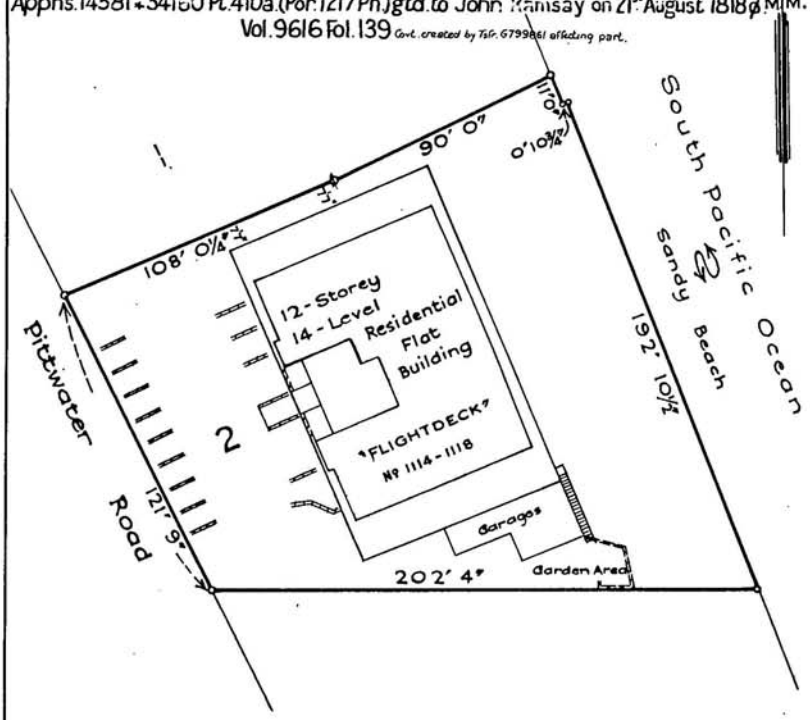
Registered: 2.2.66

C.A.: 149/65 of 27·1·1966

Ref Map: Warringah Sh.42

Last Plan: D.P. 220059

Appns. 14581 & 34160 Pt. 410a. (Por. 1217 Ph.) gtd. to John Ramsay on 21st August 1818 & M.M. Vol. 9616 Fol. 139 Cert. created by Tsfr. G799861 affecting part.



External surface boundaries of the parcel and location of the building in relation thereto to be delineated in space opposite.

(c) Additional lots should be shown in an annexure.

(d) Delete if inappropriate.

Schedule of Unit Entitlement[c]		OFFICE USE ONLY Current C's of T.	
Lot No.	Unit Entitlement	Vol.	Fol.
	Sheet		
car			
AGGREGATE			

I, Richard Stephen Lovegrove of 43 Prince Charles Rd Frenchs Forest a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that:

(1) the building erected on the parcel described above is within the external boundaries of the parcel[d] ~~subject to clause (2) of this certificate;~~

[d](2) eaves or guttering of the building project beyond such external boundaries and an appropriate easement has been granted as an appurtenance of ~~the parcel by registered Transfer No.~~

Dated 17·1·66.

Signature

Approved by the Council for the purposes of the Conveyancing (Strata Titles) Act, 1961.

Date 27.1.1966

Subdivision No. 1119/65

Council Clerk

The address for service of notices on the body corporate is:— The Proprietors, STRATA PLAN Nº 1977 'Flightdeck' Nº 1114-1118 Pittwater Rd, Collaroy

4445 4.65 K1212 V. C. N. Blight, Government Printer

M.P.D.

Surveyor's Reference: 935.

SP1

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

COUNCIL'S CERTIFICATE

WARRINGAH COUNCIL (Name of Council) having satisfied itself that the requirements of the
* Strata Schemes (Freehold Development) Act, 1973
or * Strata Schemes (Leasehold Development) Act, 1986
have been complied with, approves of the proposed:
* strata plan
* ~~strata plan of subdivision~~

illustrated in the annexure to this certificate.

* ~~The strata plan/strata plan of subdivision is part of a development scheme. The council is satisfied that the plan is consistent with any conditions of any development consent and that the plan gives effect to the stage of the strata development contract to which it relates.~~
* ~~The Council does not object to the encroachment of the building beyong the alignment of . . . .~~
* ~~This approval is given on the condition that the use of lot (s) . . . . (being utility lot / s designed to be used primarily for the storage or accommodation of boats, motor vehicles or goods and not for human occupation as a residence, office, shop or the like) is restricted to the proprietor or occupier of a lot or proposed lot (not being such a utility lot) the subject of the strata scheme concerned, as referred to in * Section 39 Strata Schemes (Freehold Development) Act 1973 or * Section 68 of the Strata Schemes (Leasehold Development) Act, 1986.~~

Date. 22·11·99
Subdivision No. 1631/99

Denis Smith
General Manager/~~Authorised Person~~

*Complete, or delete if inapplicable.

SURVEYOR'S CERTIFICATE

I, BRIAN DEWING
EGIS SURVEY & PROPERTY SERVICES
of 67 Albert Avenue, Chatswood NSW 2067
a surveyor registered under the Surveyors Act, 1929, hereby certify that:

(1) each applicable requirement of
* Schedule 1A to the Strata Schemes (Freehold Development) Act, 1973
* Schedule 1A to the Strata Schemes (Leasehold Development) Act 1986 has been met;

(2) * (a) the building encroaches on a public place:
* (b) the building encroaches on land (other than a public place), in respect of which encroachment an appropriate easement:
  * has been created by registered. . . . .
  * is to be created under Section 88B of the Conveyancing Act, 1919

(3) the survey information recorded in the accompanying location plan is accurate.

Signature:
Date: 6·8·99

*Delete if inapplicable.
*State whether dealing or plan, and quote registered number.

This is sheet 1 of my plan in 4 sheets.

PLAN OF OF LOT 30 IN DP1009032

LGA: **WARRINGAH**

Locality : **COLLAROY**

Parish : **MANLY COVE**

County : **CUMBERLAND**

Reduction Ratio 1:200

Lengths are in metres.

SP61846

Registered: 13·12·1999

C.A. SEE CERTIFICATE

Title System: TORRENS

Purpose: STRATA PLAN

Ref. Map: U2760-II

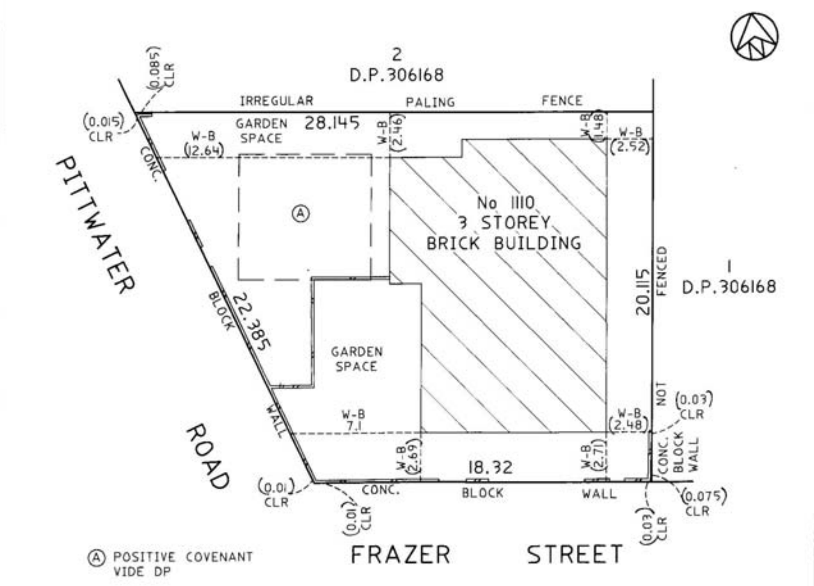
Last Plan: DP1009032

Name of, and *address for service of notices on, the owners corporation
*Address required on orginal strata plan only.

THE OWNERS OF STRATA PLAN N° 61846
1110 PITTWATER ROAD
COLLAROY NSW 2097

Signatures, seals and statements of intention to create easements, restrictions on the use of land or positive covenants.

SIGNED for and on behalf of
Westpac Banking Corporation
A.R.B.N. 007 457 141
Under Power of Attorney No. 831 Book No. 4059.
by ....
Renato Domenico
and ....Principe SUPERVISOR
its duly constituted Attorneys who are personally known to me:
25 Pierson Street
Lockleys SA 5032
Bank Officer



RESIDENTIAL
* (Insert type being adopted) Model By-laws adopted for this scheme
~~Garbage Disposal: Option A/B~~ Keeping of Animals: Option A/B/C
~~Schedule of By-laws in sheets filed with plan.~~
~~No By-Laws apply.~~
*Strike out whichever is inapplicable

Table of mm	10	20	30	40	50	60	100	110	120	130	140	150	160

SURVEYOR'S REFERENCE: PS2193-SP4735 "CHECKLIST"

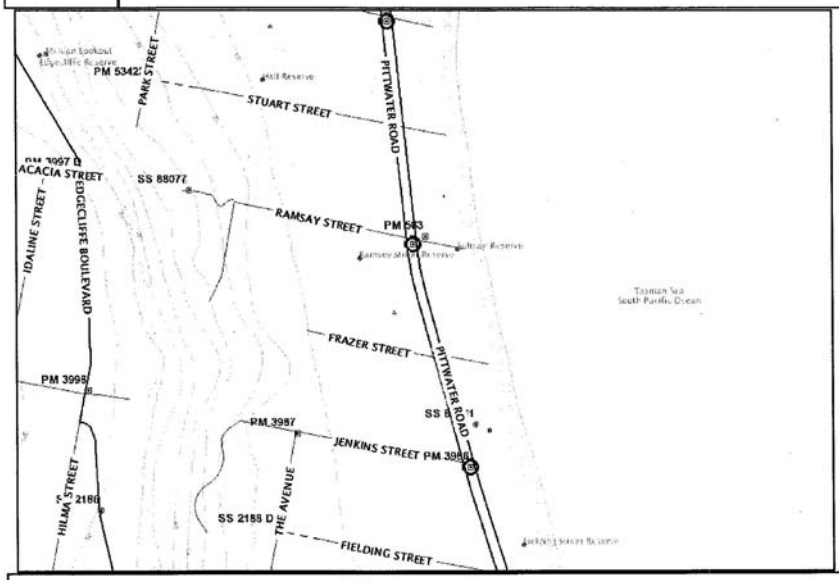
Plan Drawing only to appear in this space

APPENDIX E -
SURVEY CONTROL INFORMATION MANAGEMENT SYSTEM (SCIMS) SEARCH

SCIMS SURVEY MARK REPORT AS AT: 29-JUN-2011

Your Reference: 4060 Search Number: 9441

MARK NAME STATUS	COORDINATES AND HEIGHTS			CLASS	ORDER	PU	CSF CONVERGENCE AUSGEOID09	SOURCE
PM 3986	MGA	342525.393	6266507.815 56	B	2	n/a	0.999901	228927
	GDA94	-33° 43' 47.19902"	151° 18' 00.81597"				-0° 56' 38.54"	
	AHD71	4.061		LB	L2	n/a	23.177	201345
PM 3988	MGA	342440.173	6266778.755 56	B	2	n/a	0.999901	228927
	GDA94	-33° 43' 38.36000"	151° 17' 57.67925"				-0° 56' 40.06"	
	AHD71	5.085		LB	L2	n/a	23.188	201345
PM 3989	MGA	342394.069	6267052.670 56	B	2	n/a	0.999901	228927
	GDA94	-33° 43' 29.44536"	151° 17' 56.06389"				-0° 56' 40.74"	
	AHD71	6.082		LB	L2	n/a	23.199	201345



Map Legend

SCIMS Mark Types (Colour codes refer to the assigned accuracy "Class")

SS	PM	TS	CR	MM	CP	GB	
◉	▣	▲	⚑	✚	✪	★	Established GDA & Accurate AHD
◉	▣	▲	⚑	✚	✪	★	Established GDA Only
◉	▣	▲	⚑	✚	✪	★	Accurate AHD Only
◉	▣	▲	⚑	✚	✪	★	Unknown of Less Accurate GDA & AHD

Established GDA coordinates are assigned accuracy class 2A, A, B or C
Accurate AHD heights are assigned accuracy class L2A, LA, LB, LC, LD, 2A, A or B

Mark Status *

F Found Intact
N Not Found
D Destroyed
S Subsidence Area
U Uncertain

* Where available, the Mark Status is appended to the Mark Number in the map

Wednesday 29 June 2011 15:18:00 NSW Land & Property Management Authority Page 1 of 2

APPENDIX F – SURVEY REPORT

SURVEY REPORT

Date: 1 August 2011

Our Ref: 0050028561

RE: PROPERTIES – 1098-1122 PITTWATER ROAD & 1 FRAZER STREET, COLLAROY

LAND at Collaroy in the Local Government Area of Warringah, Parish of Manly Cove, County of Cumberland having frontages to the Pacific Ocean, Pittwater Road, Ramsay Street and Frazer Street being:

- Strata Plan 677
- Strata Plan 1977
- Lot 1 & 2 in Deposited Plan 306168
- Strata Plan 61846
- Lots 4, 5 & 8, Section 9 in Deposited Plan 5234
- Lots A & B in Deposited Plan 404802

Red edging delineates the boundaries of the subject land on the accompanying sketch.

FOLLOWING your instruction we have surveyed the above described land for identification purposes of the grassy bank and sandy beach only, noting that if any additional structure is to be erected on the subject land the boundaries should be marked for that purpose.

IT HAS BEEN FOUND the sandy beach to have encroached upon the landward properties by up to 10.94 metres within the property known as Strata Plan 677. The Mean High Water Mark line was also investigated, and at the time of survey was found to be a minimum distance of 33.9 metres East of the property boundaries under investigation. The position of the Mean High Water Mark is shown on the accompanying sketch.

IN MY OPINION the position of the Mean High Water Mark has the potential to proceed Westward of the most Easterly boundaries of the subject properties during a period of large storm activity due to the position of the grassy bank with respect to the subject properties Eastern boundaries. For any changes to title dimensions to apply however, this process of erosion must occur gradually and imperceptibly as the doctrine of accretion and erosion states within the *Coastal Protection Act 1979 No 13*.

FURTHER DETAILS are shown on the accompanying sketch, including sufficient information to identify the properties.

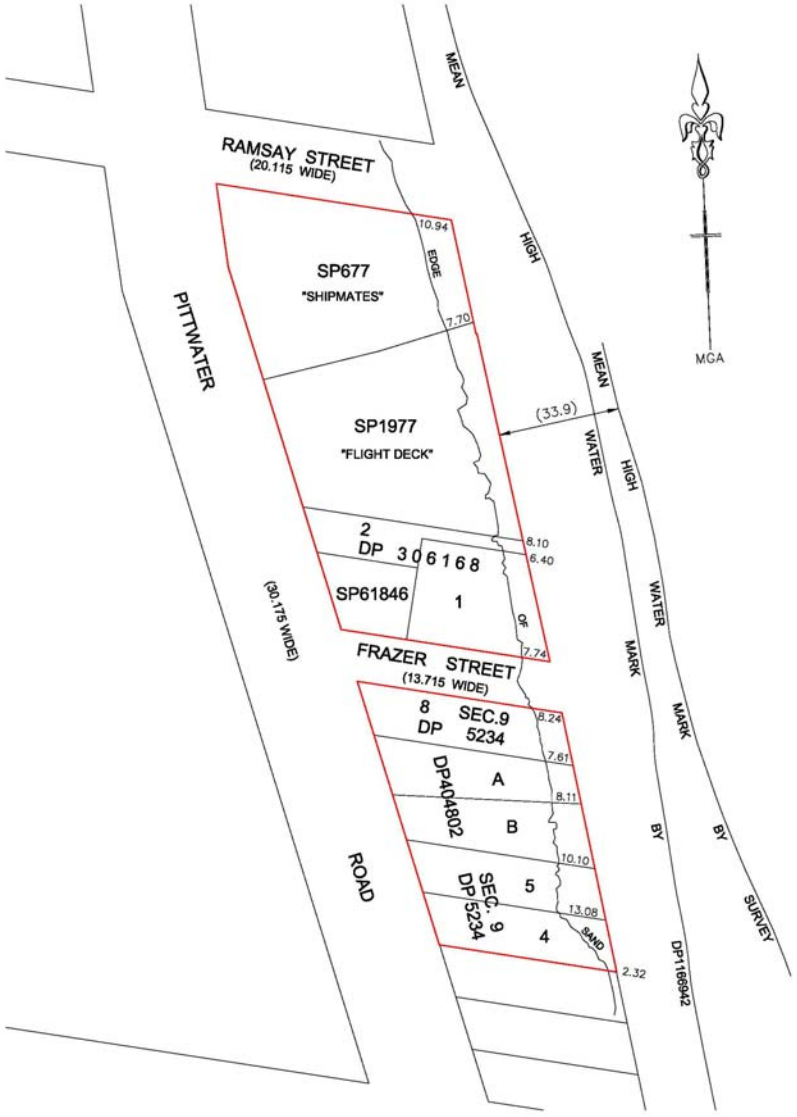
Yours faithfully

Aaron Millard
Surveyor USQ
Student Number: 0050028561

Date of Survey: 31 July, 2011
Reference: 0050028561
Not to scale

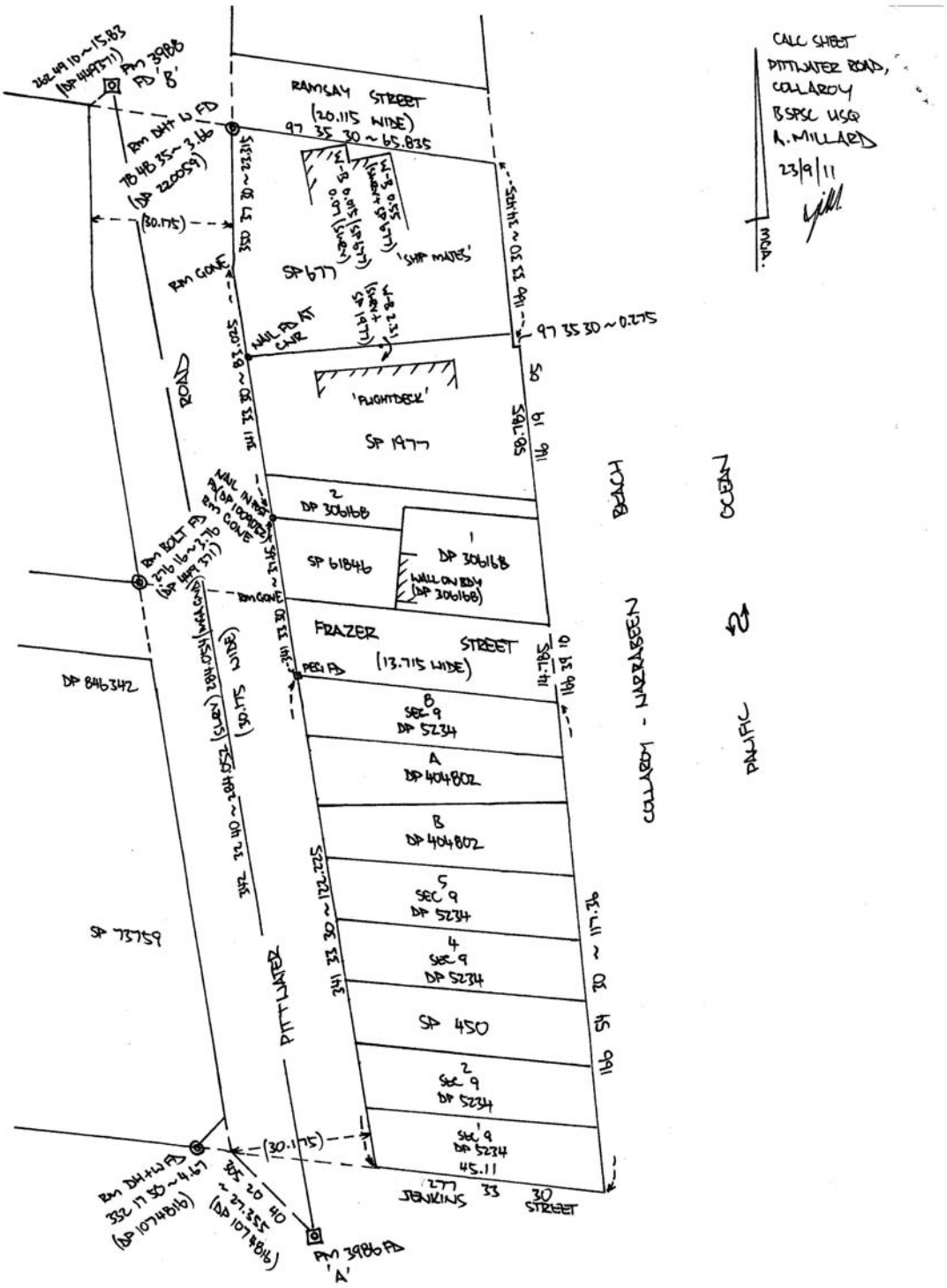
SKETCH

Page 2 of 2 pages
This is the sketch referred to in our Survey Report dated 1 August 2011



Aaron Millard
Surveyor USQ 0050028561

APPENDIX G – BOUNDARY CALCULATION SHEET



APPENDIX H – NEUTRAL FILES (ELECTRONIC FIELD NOTES)

```
                                                                THESIS
#VERSION-1.0 NEUTRAL FILE
NOTE        TRANSLATOR LEICA TPS1200 v2 10 JUNE 2005
UNIT        UL=M, UA=S
AMODE       HM=B, VM=Z
EDMTYPE     ET=0, EO=0.0000, EP=0.000,ES=1.000000
NOTE        JOB: THESIS
NOTE        OPERATOR: AM
NOTE        DATE: 31-07-2011  TIME: 12:31
INST        TCRP1205     S/N 222032
SCALE     1.000000
STN         ID=9000, HI=0.000, CO=STN, SET AZIMUTH
XYZ         ID=9000, E=500.000, N=1000.000, H=200.000
NOTE BKB          ID=9999, AZ=0.00000 , HA=0.00000
SS          ID=9999, HA=  0.00000, VA= 87.48491, SD=          , HT=0.000, CO=RO, EDM=No EDM Type, 0.004
SS          ID=9001, HA= 43.22495, VA= 90.40431, SD=  70.9146, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1000, HA=161.42288, VA= 93.00531, SD=  29.1442, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1001, HA= 49.56282, VA= 94.37524, SD=  19.0240, HT=0.000, CO=RM, EDM=Infrared Dist, 0.034
SS          ID=1002, HA=  5.35405, VA= 89.24281, SD=  32.8191, HT=0.000, CO=BLD, EDM=Infrared Dist, 0.034
SS          ID=1003, HA=  0.08573, VA= 87.30174, SD=  40.0264, HT=0.000, CO=BLD, EDM=Infrared Dist, 0.034
SS          ID=1004, HA=  0.08099, VA= 88.16064, SD=  40.0193, HT=0.000, CO=BLD, EDM=Infrared Dist, 0.034
SS          ID=1005, HA=359.59600, VA= 87.52527, SD=          , HT=0.000, CO=CHK*RO, EDM=No EDM Type, 0.034
STN         ID=9001, HI=0.000, CO=STN, KNOWN BACKSIGHT
XYZ         ID=9001, E=548.703, N=1051.538, H=199.160
NOTE BKB          ID=9000, AZ=223.22495, HA=223.22495
NOTE XYZ          E=0, N=0, H=0
NOTE        DELTA HZ=-27.16263, HD=0.000 , HT DIFF=0.838
SS          ID=9000, HA=223.22495, VA= 89.19220, SD=  70.9139, HT=0.000, CO=CHK*CHK, EDM=Infrared Dist, 0.034
SS          ID=1006, HA=163.23537, VA= 82.27321, SD=          , HT=0.000, CO=RO, EDM=No EDM Type, 0.034
SS          ID=9002, HA= 37.21109, VA= 90.35124, SD=  77.5108, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1007, HA=314.43325, VA= 88.09130, SD=  34.3675, HT=0.000, CO=BLD, EDM=Infrared Dist, 0.034
SS          ID=1008, HA=318.58185, VA= 88.16211, SD=  46.4603, HT=0.000, CO=BLD, EDM=Infrared Dist, 0.034
SS          ID=1009, HA=326.50324, VA= 85.00567, SD=  23.4228, HT=0.000, CO=BLD, EDM=Infrared Dist, 0.034
SS          ID=1010, HA= 21.11053, VA= 96.10235, SD=  10.3423, HT=0.000, CO=DH, EDM=Infrared Dist, 0.034
SS          ID=1011, HA=  2.35498, VA=102.24480, SD=   5.2187, HT=0.000, CO=NAIL, EDM=Infrared Dist, 0.034
SS          ID=1012, HA=321.39081, VA=110.15005, SD=   3.2232, HT=0.000, CO=DH, EDM=Infrared Dist, 0.034
SS          ID=1013, HA= 33.49390, VA= 90.57170, SD=  41.5555, HT=0.000, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1014, HA= 69.38134, VA= 92.04177, SD=  45.2461, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1015, HA=163.23534, VA= 82.26272, SD=          , HT=0.000, CO=CHK*RO, EDM=No EDM Type, 0.034
STN         ID=9002, HI=0.000, CO=STN, KNOWN BACKSIGHT
XYZ         ID=9002, E=595.729, N=1113.149, H=198.367
NOTE BKB          ID=9001, AZ=217.21108, HA=217.21108
NOTE XYZ          E=3, N=7, H=0
NOTE        DELTA HZ=159.36580, HD=0.000 , HT DIFF=0.789
SS          ID=9001, HA=217.21109, VA= 89.24594, SD=  77.5101, HT=0.000, CO=CHK*CHK, EDM=Infrared Dist, 0.034
SS          ID=1016, HA=171.40592, VA= 80.42369, SD=          , HT=0.000, CO=RO, EDM=No EDM Type, 0.034
SS          ID=1017, HA= 42.21414, VA= 90.22478, SD= 144.6632, HT=0.250, CO=PM, EDM=Infrared Dist, 0.034
SS          ID=9003, HA=333.15478, VA= 88.51553, SD=  47.6347, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
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                                                                THESIS
SS          ID=9004, HA= 37.13117, VA= 90.31369, SD= 116.6455, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1018, HA=292.11311, VA=117.27225, SD=   2.7897, HT=0.000, CO=WALL, EDM=Red Laser, 0.034
SS          ID=1019, HA=223.37233, VA= 90.44287, SD=  23.1436, HT=0.000, CO=NAIL, EDM=Infrared Dist, 0.034
SS          ID=1020, HA=157.40236, VA= 91.56548, SD=  28.1374, HT=0.000, CO=BOLT, EDM=Infrared Dist, 0.034
SS          ID=1021, HA= 99.10007, VA= 90.58122, SD=  31.5800, HT=0.000, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1022, HA= 99.26487, VA= 90.54450, SD=  31.5644, HT=0.000, CO=WALL, EDM=Infrared Dist, 0.034
SS          ID=1023, HA= 28.29011, VA= 93.45221, SD=  14.8408, HT=0.000, CO=PEG, EDM=Infrared Dist, 0.034
SS          ID=1024, HA= 28.38481, VA= 93.31409, SD=  15.2041, HT=0.000, CO=WALL, EDM=Infrared Dist, 0.034
SS          ID=1025, HA= 33.18467, VA= 91.34087, SD=  30.8288, HT=0.000, CO=WALL, EDM=Infrared Dist, 0.034
SS          ID=1026, HA= 33.35392, VA= 92.08584, SD=  30.8514, HT=0.000, CO=WALL, EDM=Infrared Dist, 0.034
SS          ID=1027, HA= 35.05367, VA= 91.35484, SD=  47.7322, HT=0.000, CO=WALL, EDM=Infrared Dist, 0.034
SS          ID=1028, HA=358.04191, VA= 92.17071, SD=  15.5683, HT=0.250, CO=BM, EDM=Infrared Dist, 0.034
SS          ID=1029, HA=171.40599, VA= 80.39548, SD=          , HT=0.000, CO=CHK*RO, EDM=No EDM Type, 0.034
STN         ID=9003, HI=0.000, CO=STN, KNOWN BACKSIGHT
XYZ         ID=9003, E=574.302, N=1155.682, H=199.310
NOTE BKB          ID=9002, AZ=153.15477, HA=153.15477
NOTE XYZ          E=8, N=8, H=7
NOTE        DELTA HZ=19.41508 , HD=0.000 , HT DIFF=-0.942
SS          ID=9002, HA=153.15478, VA= 91.08024, SD=  47.6344, HT=0.000, CO=CHK*CHK, EDM=Infrared Dist, 0.034
SS          ID=1030, HA=156.20025, VA= 92.45212, SD=  27.5682, HT=0.000, CO=WALL, EDM=Infrared Dist, 0.034
SS          ID=1031, HA=142.14350, VA= 92.37328, SD=  34.1702, HT=0.250, CO=BM, EDM=Infrared Dist, 0.034
SS          ID=1032, HA= 42.34135, VA= 93.41035, SD=  13.3848, HT=0.250, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1033, HA= 39.42209, VA= 91.15467, SD=  29.2140, HT=0.250, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1034, HA= 38.57527, VA= 91.05103, SD=  41.5971, HT=0.250, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1035, HA=218.54117, VA=112.24082, SD=   1.4891, HT=0.000, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1036, HA=306.46588, VA=100.53530, SD=   4.4872, HT=0.000, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1037, HA=308.54208, VA=113.12052, SD=   6.1024, HT=0.000, CO=POST, EDM=Infrared Dist, 0.034
SS          ID=1038, HA=322.12590, VA=127.53124, SD=   2.7177, HT=0.000, CO=PEG, EDM=Red Laser, 0.034
SS          ID=1039, HA=230.51514, VA= 91.02459, SD=  30.2913, HT=0.000, CO=F, EDM=Infrared Dist, 0.034
SS          ID=1040, HA=223.46172, VA= 90.57426, SD=  31.5253, HT=0.000, CO=F, EDM=Infrared Dist, 0.034
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SS          ID=1042, HA= 36.44441, VA= 89.54529, SD= 107.7026, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1043, HA= 35.13577, VA= 89.54120, SD= 107.9126, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1044, HA= 34.27538, VA= 89.55216, SD= 108.0706, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1045, HA= 33.20466, VA= 90.00014, SD= 108.1226, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS          ID=1048, HA= 29.06056, VA= 90.45475, SD= 109.2776, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1049, HA= 27.53569, VA= 90.48077, SD= 109.8327, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1050, HA= 27.11243, VA= 90.58151, SD= 110.2316, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1051, HA= 25.28051, VA= 91.17304, SD= 111.0907, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1052, HA= 23.12346, VA= 91.31510, SD= 112.2347, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1053, HA= 21.17509, VA= 91.36150, SD= 113.3637, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1054, HA= 19.39176, VA= 91.36193, SD= 114.3617, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1055, HA= 17.41299, VA= 91.40020, SD= 115.3507, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1056, HA= 15.54334, VA= 91.47364, SD= 116.5467, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1057, HA= 14.05241, VA= 91.57506, SD= 118.2137, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1068, HA= 18.37278, VA= 91.41521, SD= 100.9896, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1069, HA= 20.22482, VA= 91.43317, SD=  99.9706, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1072, HA= 24.48070, VA= 91.09291, SD=  97.7586, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1075, HA= 28.47388, VA= 90.53456, SD=  97.1546, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1079, HA= 32.19154, VA= 90.20210, SD=  96.8936, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1080, HA= 32.47434, VA= 90.07425, SD=  96.9136, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1087, HA= 38.56292, VA= 90.21389, SD=  89.1285, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1099, HA= 23.11340, VA= 91.16542, SD=  82.2184, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1100, HA= 20.56307, VA= 91.24077, SD=  82.9455, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1145, HA=344.24314, VA= 94.21132, SD=  36.0116, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1146, HA=346.00380, VA= 94.24550, SD=  34.2163, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1147, HA=346.49478, VA= 94.08040, SD=  33.4735, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1148, HA=347.28208, VA= 94.14111, SD=  32.9103, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1149, HA=347.56397, VA= 94.03174, SD=  32.5469, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1150, HA=351.39573, VA= 94.10225, SD=  29.7261, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1151, HA=356.29165, VA= 94.01235, SD=  26.8895, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1152, HA=  2.25012, VA= 94.08260, SD=  24.4592, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1153, HA= 10.01468, VA= 93.44337, SD=  22.9496, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1154, HA= 19.07404, VA= 92.08171, SD=  21.9026, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1155, HA= 23.31553, VA= 91.08019, SD=  21.3572, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1156, HA= 28.11585, VA= 90.07513, SD=  20.9522, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1157, HA= 29.27576, VA= 89.23366, SD=  20.8592, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1158, HA= 34.04495, VA= 89.39211, SD=  20.5602, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1159, HA= 40.32380, VA= 90.10218, SD=  20.2152, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1160, HA= 42.22440, VA= 90.18029, SD=       , HT=1.300, CO=SH, EDM=No EDM Type, 0.034
SS        ID=1161, HA= 53.53311, VA= 92.02207, SD=   7.6361, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1162, HA= 37.36577, VA= 93.48555, SD=   7.3426, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1163, HA= 26.45197, VA= 96.42293, SD=   7.5891, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1164, HA= 23.06127, VA= 99.49437, SD=   7.6916, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1168, HA=328.54505, VA= 97.12452, SD=  21.0172, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1170, HA=321.31393, VA= 95.39016, SD=  29.7182, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1171, HA=320.04370, VA= 95.16270, SD=  33.3063, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1172, HA=319.03426, VA= 95.03012, SD=  37.0014, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1173, HA=318.00246, VA= 95.04456, SD=  40.9333, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1174, HA=317.13072, VA= 95.14574, SD=  44.6343, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1175, HA=316.38439, VA= 95.24312, SD=  48.0613, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1176, HA=316.02154, VA= 95.33115, SD=  50.8194, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1177, HA=298.32594, VA= 95.16081, SD=  52.6055, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1178, HA=297.02018, VA= 94.57444, SD=  49.0040, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1179, HA=295.49294, VA= 94.39031, SD=  45.1164, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1180, HA=294.14154, VA= 94.16153, SD=  41.6196, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1181, HA=292.31414, VA= 93.51588, SD=  38.5793, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1182, HA=291.28135, VA= 93.17465, SD=  36.6643, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1183, HA=290.07257, VA= 93.29135, SD=  33.5096, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1184, HA=288.32149, VA= 93.59318, SD=  30.3623, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1185, HA=285.58531, VA= 94.45067, SD=  27.1070, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1186, HA=283.23180, VA= 95.31101, SD=  23.7067, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1187, HA=279.36109, VA= 96.00422, SD=  20.6443, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1188, HA=274.32504, VA= 95.53358, SD=  17.7848, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1189, HA=265.40293, VA= 96.05078, SD=  14.7416, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1190, HA=257.49513, VA= 94.10500, SD=  12.9316, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1191, HA=250.06041, VA= 91.33126, SD=  11.7998, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1192, HA=248.10254, VA= 88.45425, SD=  11.6102, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1193, HA=244.16433, VA= 88.19062, SD=  11.2723, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1194, HA=223.39049, VA= 91.59559, SD=  10.3222, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1195, HA=223.46597, VA= 91.00442, SD=  21.3182, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1196, HA=236.05284, VA= 88.57552, SD=  22.5212, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1197, HA=237.53067, VA= 90.50002, SD=  22.9007, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1198, HA=243.35183, VA= 92.43537, SD=  23.5196, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
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SS        ID=1199, HA=247.37119, VA= 93.45554, SD=  24.1802, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1200, HA=255.43166, VA= 93.45566, SD=  26.6502, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1201, HA=262.30550, VA= 93.50309, SD=  28.9381, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1202, HA=268.15386, VA= 93.48044, SD=  31.9176, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1203, HA=272.22346, VA= 93.23568, SD=  34.6904, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1204, HA=275.49004, VA= 92.58259, SD=  37.7953, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1205, HA=278.33435, VA= 92.51461, SD=  40.4759, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1206, HA=279.54145, VA= 93.20197, SD=  42.3873, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1207, HA=282.08039, VA= 93.51380, SD=  45.8823, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1208, HA=284.01347, VA= 94.16017, SD=  49.7354, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1209, HA=286.01554, VA= 94.35363, SD=  53.3429, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1210, HA=288.16023, VA= 94.57195, SD=  58.0871, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1211, HA=274.49558, VA= 94.14161, SD=  64.7494, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1212, HA=271.26536, VA= 93.47420, SD=  60.6374, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1213, HA=268.20127, VA= 93.20550, SD=  56.9598, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1214, HA=265.27478, VA= 92.57489, SD=  53.9090, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1215, HA=263.02214, VA= 92.38159, SD=  51.8204, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1216, HA=260.53151, VA= 92.22332, SD=  50.2562, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1217, HA=256.43382, VA= 92.19122, SD=  47.7931, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1218, HA=252.16299, VA= 92.21061, SD=  45.3932, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1219, HA=246.44268, VA= 92.17475, SD=  43.2193, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1220, HA=241.36168, VA= 92.15044, SD=  41.6534, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1221, HA=236.43598, VA= 92.05211, SD=  40.5937, HT=1.300, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1222, HA=233.52220, VA= 91.19454, SD=  39.8953, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1223, HA=232.20528, VA= 90.53149, SD=  39.5883, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1224, HA=231.42467, VA= 90.19102, SD=  39.6763, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1225, HA=230.41315, VA= 89.54556, SD=  39.5353, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1226, HA=229.35042, VA= 89.44405, SD=  39.3883, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1227, HA=227.31574, VA= 90.09201, SD=  39.3023, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1228, HA=223.42000, VA= 89.49484, SD=  39.2453, HT=1.600, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1229, HA=223.46311, VA= 89.31446, SD=  54.7454, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1230, HA=226.00090, VA= 89.28372, SD=  55.1844, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1231, HA=226.34302, VA= 89.49109, SD=  55.1834, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1232, HA=228.47236, VA= 90.29381, SD=  55.2404, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1233, HA=230.48484, VA= 90.53446, SD=  55.5854, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1234, HA=235.45161, VA= 90.58097, SD=  57.2784, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1235, HA=240.07208, VA= 91.06006, SD=  58.7224, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1236, HA=243.20019, VA= 91.12150, SD=  60.2254, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1237, HA=247.09485, VA= 91.13150, SD=  62.5504, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1238, HA=250.21465, VA= 91.12246, SD=  65.2454, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1239, HA=253.00132, VA= 91.18085, SD=  68.0564, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1240, HA=255.24363, VA= 91.43043, SD=  71.0945, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1241, HA=257.24432, VA= 92.11395, SD=  73.2695, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1242, HA=259.28284, VA= 92.35370, SD=  76.1955, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1243, HA=261.24568, VA= 92.55582, SD=  79.4553, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS        ID=1244, HA=254.35402, VA= 92.30076, SD=  93.1646, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
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SS          ID=1246, HA=250.09409, VA= 91.48404, SD=  90.1657, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
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SS          ID=1248, HA=246.19339, VA= 91.07250, SD=  87.5335, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1249, HA=243.20135, VA= 90.59429, SD=  85.3315, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1250, HA=240.47524, VA= 90.55025, SD=  83.8015, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1251, HA=236.31284, VA= 90.57167, SD=  81.9505, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1252, HA=232.56132, VA= 90.53565, SD=  80.6185, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1253, HA=230.47270, VA= 90.46418, SD=  79.9165, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1254, HA=228.24269, VA= 90.36169, SD=  79.3675, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1255, HA=227.03555, VA= 90.32529, SD=  78.8395, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1256, HA=225.20364, VA= 89.37494, SD=  78.3445, HT=2.150, CO=SH, EDM=Infrared Dist, 0.023
SS          ID=1257, HA=153.15383, VA= 91.08051, SD=  47.6348, HT=0.000, CO=CHK, EDM=No EDM Type, 0.034
STN         ID=9004, HI=0.000, CO=STN, KNOWN BACKSIGHT
XYZ         ID=9004, E=666.282, N=1206.032, H=197.295
NOTE BKB          ID=9002, AZ=217.13116, HA=217.13116
NOTE XYZ          E=8, N=8, H=7
NOTE        DELTA HZ=119.41358, HD=0.001 , HT DIFF=-0.208
SS          ID=9002, HA=217.13117, VA= 90.06097, SD= 116.6394, HT=0.000, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1258, HA=111.54230, VA= 90.51071, SD=  32.0821, HT=0.000, CO=RM, EDM=Infrared Dist, 0.034
SS          ID=1259, HA=217.13097, VA= 90.06065, SD= 116.6397, HT=0.000, CO=CHK, EDM=Infrared Dist, 0.034
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#VERSION-1.0 NEUTRAL FILE
NOTE        TRANSLATOR LEICA TPS1200 v2 10 JUNE 2005
UNIT        UL=M, UA=S
AMODE       HM=B, VM=Z
EDMTYPE     ET=0, EO=0.0000, EP=0.000,ES=1.000000
NOTE        JOB: THESIS1
NOTE        OPERATOR:
NOTE        DATE: 13-08-2011  TIME: 13:18
INST        TCRP1205    S/N 223005
SCALE      1.000000
STN         ID=1038, HI=1.505, CO=STN, KNOWN BACKSIGHT
XYZ         ID=1038, E=615.293, N=842.281, H=4.546
NOTE BKB          ID=1031, AZ=267.09501, HA=267.09501
NOTE XYZ          E=8, N=5, H=9
NOTE        DELTA HZ=-24.23432, HD=0.001 , HT DIFF=-0.145
SS          ID=1031, HA=267.09502, VA= 92.33264, SD=  36.3131, HT=0.030, CO=CHK*CHK, EDM=Infrared Dist, 0.034
SS          ID=9100, HA= 24.10443, VA= 91.54143, SD=  49.9543, HT=1.560, CO=STN, EDM=Infrared Dist, 0.034
SS          ID=1031, HA=267.09532, VA= 92.33252, SD=  36.3133, HT=0.030, CO=CHK*CHK, EDM=Infrared Dist, 0.034
STN         ID=9100, HI=1.560, CO=STN, KNOWN BACKSIGHT
XYZ         ID=9100, E=635.742, N=887.828, H=2.831
NOTE BKB          ID=1038, AZ=204.10443, HA=204.10443
NOTE XYZ          E=3, N=0, H=6
NOTE        DELTA HZ=171.15372, HD=-0.000, HT DIFF=1.715
SS          ID=1038, HA=204.10443, VA= 88.05432, SD=  49.9552, HT=1.505, CO=CHK*CHK, EDM=Infrared Dist, 0.034
SS          ID=2000, HA=176.43260, VA= 89.14070, SD= 144.9147, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2001, HA=176.35390, VA= 89.15063, SD= 143.5697, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2002, HA=176.34026, VA= 89.16317, SD= 142.3666, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2003, HA=176.42265, VA= 89.17439, SD= 138.6776, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2004, HA=177.12040, VA= 89.17228, SD= 132.2785, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2005, HA=177.31037, VA= 89.17593, SD= 130.3735, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2006, HA=177.40533, VA= 89.17195, SD= 129.9345, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2007, HA=178.14317, VA= 89.16581, SD= 129.3755, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2008, HA=178.31372, VA= 89.18062, SD= 127.6755, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2009, HA=178.39008, VA= 89.18138, SD= 126.9595, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2010, HA=179.03195, VA= 89.19563, SD= 126.0425, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2011, HA=179.26490, VA= 89.20052, SD= 125.8195, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2012, HA=179.33265, VA= 89.20163, SD= 124.9075, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2013, HA=180.12481, VA= 89.21415, SD= 123.7234, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2014, HA=180.38225, VA= 89.20488, SD= 121.9604, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2015, HA=181.47325, VA= 89.22400, SD= 120.3614, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2016, HA=182.25512, VA= 89.19042, SD= 118.2654, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2017, HA=183.16540, VA= 89.20246, SD= 117.7564, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2018, HA=183.22114, VA= 89.18084, SD= 116.8533, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2019, HA=183.52194, VA= 89.15395, SD= 115.9684, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2020, HA=183.55320, VA= 89.15433, SD= 115.0733, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2021, HA=183.45354, VA= 89.11533, SD= 113.6533, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
SS          ID=2022, HA=183.54228, VA= 89.04431, SD= 111.2053, HT=1.300, CO=01SAND, EDM=Infrared Dist, 0.023
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