University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

Re-Establishment of the State Border between New South Wales and Victoria.

A dissertation submitted by

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ABSTRACT

The boundary between land and water is one of the most difficult of all boundaries to re-define. The changing nature of watercourse systems poses major problems and surveyors across the country currently have limited knowledge and guidelines to assist in the process of selecting an appropriate survey method and procedures to use for a boundary alignment.

This project has been undertaken to address uncertainty in regard to non-tidal boundaries and I have chosen the state border between New South Wales and Victoria to investigate this process.

The River Murray dissects the two states, and has done since 1850. The state border between the two colonies has always been a topic of great debate, with the wider community knowing that the river belongs to New South Wales but not being aware as to the correct position of the state border.

The boundary between land and non-tidal water is defined by the term – bed and banks. The methods adopted by surveyors in determining the state border have been drawn upon using their experience alone rather than a combination of experience and theoretical knowledge in solving this problem.

At present there are very few guidelines and practical examples in place to assist the surveyor in the re-establishment process of the state border and an improved guideline structure and set surveying methods would greatly improve the process for all surveyors. This would potentially address the deficiency that currently exists in the system thereby satisfying the greater community.

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Chapter 1

1.0 Introduction

1.1 Project Aim

This project aims to investigate the methods of re-establishing the state border between New South Wales and Victoria. This will involve research of existing literature, historical records, administrative requirements and guidelines.

The project will establish three study sites of differing physical characteristics and investigate alternative surveying methods to re-establish the border. Best practice methods will be determined, which could be adopted by other surveyors around the two states.

1.2 Background

In 1850 the Separation Act saw New South Wales and Victoria officially separated into different colonies. As a result, The Murray River was made the boundary between the two colonies from Lake Hume downstream to the South Australian Border.

In the *Separation Act 1850*, it was decreed that the State Border was the top of the bank of that channel, which in 1850 had the greater flow, and the top of the bank of the 1850 course was considered to be the freehold boundary with the rule of gradual and imperceptible erosion and accretion applying (Knights 1996).

In the High Court decision *Ward v The Queen 1980,* it was deemed that the border line between the States runs along the top of the southern or left bank of the Murray River.

These are deemed to be the most important factors, when considering the re-establishment of the State Border (Kernebone 1991).

Over the past 150 years many different surveying methods have been used in order to attempt to re-establish the state border. This project sets out to test alternative methods of the re-establishment process in order to not just simplify it, but identify the most reliable, efficient and correct method of re-establishment.

Currently there is no prescribed method of performing the re-establishment itself, only guidelines in place which the surveyor should follow.

The surveyor must also consult representatives of the Surveyor General of both states before and during the survey process. It is not the intention of the Surveyor General to impede the determination process, but rather to lend weight to a consistent and defensible determination of the border. (Kernebone 1991).

1.3 Critical Objectives

Addressing shortfalls in the important aspects of the riparian boundary re-establishment process and state border location will allow a better understanding of the process that is involved.

Bed and bank descriptions, research into precedents set such as legislations and court judgements, and the physical characteristics of the riparian areas themselves will play important roles in achieving the best results.

1.3.1 Analysis of Precedents

Critical analysis of precedents set were vital in the investigation into the state border re-establishment, current legislations and Australian High Court

Judgements on non-tidal boundary definition is required to determine if any deficiencies lay in the current system.

The current legislations are described in *The Separation Act (1850)* and the *New South Wales Constitution Act (1855).*

Investigation will be made into the Australian High Court Judgement of the *Ward v The Queen (1980)* case.

The Precedents will be discussed in detail in Chapters 2 and 4.

1.3.2 Analysis of Physical Characteristics

The Physical Characteristics of riparian areas are largely dependent on the theory behind the doctrine of accretion and erosion. Just as riparian boundaries change over time by accretion and erosion, so to have the rights individuals hold in the land they occupy. These changes have historically been difficult for surveyors to deal with and at present the same issues still remain today.

The impact of this is that ever-changing environmental features have not been documented as frequently as necessary to substantiate the doctrine. To assume that accretion and erosion has taken place is irrelevant if the boundary of the watercourse has been misidentified on prior occasions.

To enable informed decisions in this process, the characteristics of riparian zones and in particular the state border location need to be taken into account. For the state border alignment to be determined there are a number of natural features, which could be used in the process. Vegetation, actions of water over time, soil, trees, and bank profiles must be considered when determining the location of the State Border.

As limited direction has been given through regulation and legislation in the past, this project seeks to investigate how these natural features along with suitable surveying methods can best aid a surveyor in the determination of the state border between New South Wales and Victoria.

1.4 Summary: Chapter 1

Limited direction has been given to surveyors to define the state border or any non-tidal riparian boundary. Surveyors have found it difficult to identify appropriate natural features to adopt, precedents to follow and the necessary documentation to assist them in the re-establishment process.

This project is important as surveyors across South Australia, Victoria, and New South Wales have for many years now been unclear as to the requirements of the state border survey, and have not known the best practice methods of how to actually carry one out.

This is becoming more critical today with environmental changes, water usages and riverfront developments are becoming more prevalent in today's landscape.

This project topic has therefore been chosen to find an alternative method in an attempt to bring some standardisation to the process to assist surveyors in future re-establishment surveys.

Chapter 2

2.0 Literature Review

2.1 Introduction

This chapter outlines the available literature for surveyors to determine a non-tidal boundary, and in particular the state border between New South Wales and Victoria.

There is little published literature on defining riparian jurisdictional boundaries. Very few state border re-establishments have actually been carried out to date. Non-tidal boundaries like the state border should be reinstated in the same professionalism and clear manner as any straight-lined boundary would be. The same surveying rules and standards should apply to all boundaries being surveyed.

Research into publications (Kernebone 1991), and (Williams 1993), show that many surveyors in the industry are unclear on the exact requirements of how to undertake a re-establishment survey of the state border. The records indicate that there was very little research information and actual surveys carried out on the re-establishment of the New South Wales and Victorian border until the last 20 years. This confirms that there is limited literature available in this area.

2.2 Current Legislation

In relation to the state border between Victoria and New South Wales the following legislation is available.

The Separation Act 1850

The boundary between New South Wales and Victoria was originally defined as:

'A straight line from Cape How to the nearest source of the River Murray and hence by the course of that River to the Eastern Boundary of the Colony of South Australia.'

http://www.foundingdocs.gov.au/resources/transcripts/vic3_doc_1851.pdf

NSW Constitution Statute 1855

Due to jurisdictional problems in relation to navigation and trade, the original definition was modified in 1855 so that:

'The whole watercourse of the said River Murray from its source therein described to the eastern boundary of the colony of South Australia, is and shall be within the territory of New South Wales.'

http://www.foundingdocs.gov.au/resources/transcripts/nsw9ii_doc_1855.pdf

2.3 Available Literature

Literature on non-tidal riparian boundaries regarding the state border between New South Wales and Victoria is limited. The following is a list of Literature that is available to assist surveyors with the reinstatement process;

(Kernebone 1991) 'Guidelines for the determination of the State Border between New South Wales and Victoria'.

(Williams 1993) 'Crown Boundaries along Rivers and Shorelines'.

Thomson, L (1994) *'Determination of Ordinary Winter Level of the River Murray at Merbein'*.

(Knights 1996) 'Rivers and their impact on Cadastral Boundaries'.

(Thomson 2001) 'Definition of Three Chain Permanent Reserve Upstream of the Mildura Wharf '.

Williams, P. (2001) '*Victoria – NSW Border, Murray River Section'* Office of Surveyor General.

(Lawless 2006) 'Defining Non-Tidal Riparian Boundaries'.

2.4 History

Re-defining the boundaries between land and water is one of the most difficult of all boundaries to survey.

As early as 1851 a united states court case highlighted that the identification of the bank at any particular point along a river must be a question very largely of the fact to be decided in each particular case by reference to the size and habit of the river, the geological composition of the land, and the level of the land as compared with the river, and other circumstances (Howard v Ingersoll: USA Supreme Court: 1851 December term pp. 542-574, 13H381).

This is important as this remains true not just in the United States and Australia but for all rivers around the world.

There is a long history behind the lack of information available to the current surveyor. Australian Law was introduced by the English upon settlement and thus reflected the situation in England. Over time, the extreme Australian climate became apparent, which differed greatly from that of England and this had to be taken into account when legislations were created (Lawless 2006.)

Kernebone states that the 1850 boundary represented a compromise between the disires of two opposing groups. The Port Phillip Separation movement in Melbourne and the Sydney based settlers. However this had to be clarified in 1855 due to controversy over colonial entitlements to collect customs duties on goods transported by paddle steamers along the Murray from South Australia. This still did not alleviate the problem of the actual border position and it was not until the Ward Case of 1980 that the border was more accurately clarified as the top of the original high bank on the Victorian side. (Kernebone 1991).

This ruling of the border lying on the bank on the Victorian side was to make it easier for surveyors and other professionals to find the border without the worry of the river's water rising. Therefore it was determined that the whole watercourse of the Murray River was within the colony of New South Wales (Kernebone 1991).

The determination of the state border between New South Wales and Victoria is a process that is complex and involves many parties working together including property owners, surveyors, solicitors and Crown land administrators (Kernebone 1991).

The adaptation of the determination of the border between New South Wales and Victoria is to be agreed upon by the Surveyors General of both states. Surveyors undertaking the re-establishment survey need to have confirmation from the Surveyors General through a written agreement that the survey can proceed, and the actual positioning of the border must be approved by the Surveyors General for both states.

2.3 Guidelines

In the readings by Kernebone there were a number of guidelines that were implemented to help in the determination of the border between New South Wales and Victoria. An important guideline was that the whole watercourse of the Murray River is within New South Wales and the relevant

watercourse is the main channel of 1850, that is the channel in which the greater flow occurred in 1850.

'The whole watercourse means the area between the extremities of the banks of the river. Such banks determine the course of the river' (Kernebone 1991.)

This quote from a paper by senior surveyor Mr R.A. Kernebone highlights the importance of the Murray River itself in the determining of the border between New South Wales and Victoria.

The development of a new channel after 1850 by sudden avulsion would not alter the location of the state border. So therefore, the ruling of gradual erosion would apply and the border would not be affected.

This guideline has taken into account the natural features of the environment that surrounds the border between New South Wales and Victoria and how they may change overtime.

Any investigation and examination of the watercourse should take place when the river is low so the natural features of the riparian zone itself can be appreciated by the eye (Kernebone 1991).

This is an important guideline implemented to help surveyors in the field, however the river will rise and fall due to environmental influences making this particularly hard for the surveyor to adhere by.

Mr R.A. Kernebone also stated in his paper's guidelines that the state border does not follow any particular water level. Due to the rise and fall of the water levels of the Murray River over the years it cannot be possible for the border to be determined by water levels; the bank is a more concise location for the border to be determined as its structure is less likely to be environmentally affected.

2.4 Survey Methods

In order to gain an appreciation of which survey methods should be investigated, it was important to discover some of the surveying methods and techniques that have been used previously in the re-establishment of the state border.

The following is a list of case studies that highlight some of the previous methods used.

'*I re-established the normal pool level and the average winter level from Barry Breen's 1881 river bank survey that was carried out in this region. This survey is deemed to be the earliest known survey of the high bank of the Murray River in the Mildura area, this greatly assisted me in determining the original position of the high bank that contained the natural water flow at that time'* Thomson, L. (2009, April).

'I located natural surface features from the top of the high bank into the water and created contour information, I believe this to be the best way to obtain data to determine where the original high bank position may be' Craig, A. (2009, April).

'*It can be very difficult to define the state border. This is due to the many changes to the natural conditions that have occurred over the years. This makes the decision process very interesting for us surveyors. Often there can be more than one solution and the surveyor must use all his practical experiences to come up with a practical outcome.*

In my experiences I have tried to obtain water level information where ever possible, whether that from Water Authorities or carrying out survey work over a period of time to determine average winter levels and normal pool heights of the area that I am surveying. This assists me in establishing the water level that contains the natural water flow of the river' Pitt, J. (2009, May).

'*I believe that obtaining contour information using that to develop cross section levels are imperative to the re-establishment process, as many*

natural conditions may have varied over the years. Under water levels are also required in the survey to assist in identifying the original high bank, as lochs and weirs affect your water levels in the Mildura area and there is a good chance the original high bank position may be under the current water level. I also believe a good set of guidelines for surveyors to adhere to are important so that future surveyors had a clear direction of what is required when carrying out a survey for the state border' Peter Williams (2009, May).

As there is minimal literature available, communications with professional surveyors with experience in the re-establishment of the state border process is invaluable as there is little else available.

2.5 Summary: Chapter 2

Research into the re-establishment of the state border between New South Wales and Victoria has uncovered a limited number of texts available and the definition of where the boundary is situated is unclear.

Information within the texts provides some basic guidelines but gives no set procedures or methods for the surveyor to follow. They do not provide any recommendations of changes or improvements to the current system.

A much clearer form of guidelines and survey methods are required for the surveyor to clearly understand what is required of him or her when carrying out a survey to establish the state border.

In conclusion, research into the topic of the Re-establishment of the state border between New South Wales and Victoria is warranted and this report highlights the limited published documentation on the topic and the need for further study to be undertaken in this area.

Chapter 3

3.0 Methodology

3.1 Introduction

At present the principals and standards of reinstating the state border boundary are limited and therefore so is the understanding from not just other professionals but society in general.

The objectives are to research all existing records that can be found in relation to the state border. This includes all existing literature, current guidelines that are in place and how they are implemented, historical records including any previous re-establishment surveys along the Murray River, and most importantly any previous surveys and methods that have been used in the particular areas that I propose to base my study areas on. Although the guidelines themselves are quite clear, there are no fixed techniques in place for the re-establishment process. Therefore, it is an objective of this project to research the previous techniques and ascertain which should be used and which should not be in the re-establishment of the state border.

3.2 Identification of the Need.

To identify the need for an investigation into the re-establishment of the state border we firstly must identify the issues with the system currently in place.

These include the implementation of the guidelines, the surveying methods used in the re-establishment process, changes in the boundary definition and the effect this has on society.

Land surveyors working in the states of New South Wales and Victoria have little knowledge when it comes to the re-establishment of the state border. Most surveyors do not even know of any guidelines that are in place, or of any recommended surveying methods and would have no idea on how to implement these in the field. Therefore, it is necessary to further educate surveyors with the existing process and come up with some recommended improvements.

The need for identifying the state border is more common than ever before and this will continue to be the case in the future. Precise location of the border is critical to allow for future developments of riverfront land, the determination of ownership rights and the Victorian government's increased eagerness to know the location of the three chain reserve land that abuts the River Murray.

My research will address all these important issues, and will assist surveyors to understand what is involved in the re-establishment process of the State Border, and highlight the importance of the border location to the general public.

3.3 Testing and Methodology

The point of this project is to investigate the previous methods used to re-establish the state border, compare them, carry out surveys of my own using my own chosen survey methods and establish what are the best practice methods for this process.

I have chosen to concentrate my re-establishment process around three areas, all of slightly different physical characteristics. This is to demonstrate that the re-establishment itself may vary depending on the natural features themselves in relation to the fixing of the original position.

The selection of the three different study sites to examine will be an important factor in the methods used to re-establish the state border.

All sites were surveyed using a Set 3 Sokkia 3030R Total Station and MGA coordinates and AHD levels were transferred to the survey areas using a Trimble 5700 RTK GPS.

I will analyse any re-establishment surveys carried out by other industry professionals and investigate their effectiveness. Further to this, I will carry out my own surveys implementing my own techniques, to see if they are more reliable, efficient and practical than those used previously.

I will analyse different surveying techniques and endeavour to prove why my chosen methods could be used in future state border re-establishments.

The survey methods I will use will result in surveying 300 metre sections of the river and its banks in a series of cross sections spread about 30 to 40 metres apart. Level data will be located from 25-30 metres into the water itself to approximately 25-30 metres past the top of the high bank. This will show a complete cross section and assist in re-creating conditions of 100 to 150 years ago as best as physically possible. This data could also be added to any previous survey information in the area.

The data will then be downloaded to a computer where digital plans of the survey data will be produced using Trimble and AutoCad software and reduced and analysed to assist in re-creating the state border.

By carrying out the survey work itself, it will enable me to directly compare results and findings of previous re-establishments. This will allow me to make a comparison of the techniques used and the results will be evaluated against the time the survey takes, the equipment required and the simplicity of the survey.

The survey methods I chose and have implemented for my study areas were based around lengthy discussions with my surveying peers including members of the Surveyor Generals Office, Department Of Sustainability And Environment and other industry professionals.

I determined that this would provide me with accurate and reliable survey information to assist me to re-establish the state border.

As a secondary method I will also briefly investigate aerial photography techniques and depth sounding methods under the water where necessary to create contours of the physical characteristics themselves. The data produced will be used to create the state border based on the current information and information from previous studies and surveys carried out in the area.

This method could be aided by the loch and weir being removed and therefore creating a more natural river flow. Although this method will be investigated, no actual survey work will be carried out due to the anticipated costs involved in the survey.

The three survey study sites were all located in the Mildura city region as depicted below;

Figure 3.1 shows the three locations of the surveyed sites in relation to the central business district of Mildura. All sites were within three kilometres of the centre of town, and were situated in some of Mildura's prime riverfront estate areas.

Site 1, (See figure 3.2 and figure 3.3), was chosen as the site itself remains very much untouched by human intervention and is still a very natural environment. The site has a very high natural bank, approximately 17 metres above the natural water level. The current conditions are believed to be very similar to that of 150 years ago, apart from some natural erosion.

Figure 3.2 is an overhead picture of the first survey site. It shows the Winery, which has been constructed at the top of the seventeen metre high hill.

Figure 3.3 shows a side-on view of the bank in question. This gives a visual appreciation of the size of the bank that was surveyed.

Site 1 was the most difficult of the three chosen areas to survey. The main reason for this was the difficulty in accessing the very high bank. Four survey stations were required. One was placed in a very similar position to where the photo was taken for figure 3.3. This station located levels below the normal pool level. A boat and an extension prism pole were required for this as the natural land below the water dropped away rapidly. Levels were also located from the water level to the top of the high bank. Three stations were required at the top of the high bank, as level data was hard to locate due to this being heavily treed.

Site 2, (See figure 3.4 and figure 3.5), was chosen as the site contains land that is both natural, in that the land in close to its condition of years gone by, and also contains land that has been changed over the years due to man-made intervention, which has seen it alter from its original condition.

Figure 3.4, is an overhead picture of the second survey site. It shows the tennis courts adjacent to the survey area. House boats are also shown parked along the river bank.

Figure 3.5, shows the bank that was surveyed for Site 2. The bank in the foreground has been altered by man-made constructions, while the bank further down stream remains largely unaltered.

Site 2 was the easiest of the three areas to survey. Just the two survey stations were required; one on the Victorian side of the river, and the other on the New South Wales side. This was because the survey data was much easier to locate from the opposite side of the river. The same method of surveying was used with a Total Station to locate the data from beyond the high bank down into the water. A boat and a five metre extension pole were also used to assist in locating levels under the water.

Site 3, (See figure 3.6 and figure 3.7), was chosen as the site contains land that has been affected by humans over the past 50 years. All land in this area has had changes to its natural appearance and therefore it is vastly different to how it would have been around 150 years ago.

Figure 3.6, is an overhead picture of the third survey site. It shows the rowing club lawns and buildings adjacent to the survey area. The Mildura wharf is located at the upstream end of the surveyed area.

Figure 3.7, shows the bank which was surveyed for Site 3. As can be seen, the bank itself has been changed dramatically from its natural condition. Concrete retaining walls have been constructed and new buildings erected.

Site 3 was surveyed using the same methods as the other surveyed areas. Like the second site, two survey stations were used, one on either side of the river, with the level data being located with a Total Station and prism pole from beyond the high bank, down into the water. All data was located from the New South Wales side of the river to improve survey siting. Once again a boat and a five metre extension prism pole were used to locate the underwater levels.

3.4 Summary: Chapter 3

My chosen study sites provided me with areas of different physical characteristics in which to carry out my re-establishment surveys.

This allowed me to show that the same surveying methods could be used to create the required data for establishing the state border regardless of the land's appearance.

By choosing land that has been affected in all different manners, I will be able to demonstrate why cross sections levels are required to establish the state border, and why it is necessary to locate level information from beyond the high bank all the way to well below the normal pool level.

Chapter 4

4.0 Principles and Standards

4.1 Introduction

Riparian boundaries, and in particular the state border between New South Wales and Victoria is of great importance to society as these boundaries form a natural division not just between land and water, but between states.

There are some key aspects and elements that will affect how we determine the state border and it is critical that we are aware of them before undertaking this project.

Factors to take into consideration consist of environmental and human impact, and what effect these may have on the riparian zone;

- The determination of the watercourse itself, and how it is defined;
- The Doctrine of Accretion and Erosion and how it is applied;
- And finally investigations into previous standards and practices used to assist me with my own surveying methods.

4.2 Environmental and Human Impact

Over the past 150 years, poor management of riparian areas led to substantial degradation and alteration of many of our watercourses. The Murray River system is one of these.

The removal of vegetation cover combined with changed flow regimes has increased the incidence of bank erosion, which can result in the loss of valuable land usage. As a result, the alignment of the boundary itself can change due to the erosion. Surveyors must be fully aware of this as it will be

up to them and their discretion to nominate the process and declare whether it is accretion, erosion or more dramatically, avulsion.

There is one more very important aspect of the riparian zone. These areas have become corridors connecting plants and animals together, not just to create an ecosystem for themselves, but it connects them to other areas of the system.

When carrying out any survey work in these areas, the Murray River and its natural environment must remain as close to its original condition as possible. Care should be taken to ensure the environment is not impacted negatively from any survey work that is carried out.

4.3 Determination of a Watercourse

A watercourse essentially means, '*a stream of water, a river or brook, also as artificial channel for the conveyance of water*' (Knights 1996).

The beds and banks of a watercourse are and always have been the property of the crown.

From 1905 to 1989, the Water Act contained a definition of "bed and bank" which related to that Act. In 1989 the definition was redefined and transferred to the Land Act. This definition reads;

"Bed and Banks", in relation to a watercourse (a) includes the land over which the water in the watercourse normally flows and the land is normally covered by water; (b) does not include land abutting on or adjacent to the bed and banks that is from time to time temporarily covered by floodwaters from the watercourse (Knights 1996).

It should be made clear that the definition of "bed and banks" only refers to land that is bounded in whole or part by a watercourse and should only be used when defining a boundary.

Another description of a watercourse is by Tronc. Tronc lists three important elements, which summarises the watercourse as a bed, a bank and

water. These are Normal Flow, Frequency of Flow and Gradual and Imperceptible.

The Normal Flow of water is best described to be *'regular, annual, predictable behaviour of the creek/river'* (Tronc 1999). He also describes the term, normal, to be the areas that are covered whenever a usual or normal flow occurs, but not over time.

Frequency of Flow in watercourses that form a riparian boundary like the Murray River, at times may not contain a lot of water. Within these systems the frequency of the flow of water is therefore difficult to ascertain. To determine the boundary of a watercourse, ascertainment of the presence, the frequency and the regularity of the flow of water is essential.

The term 'Gradual and Imperceptible' is based on the movement or change in the location of a riparian boundary through the actions of accretion and erosion. Gradual is defined as *'taking place by degrees, slowly progressive, not rapid, steep or abrupt'* (Tronc, 1999), while the definition of imperceptible is *'that cannot be perceived, very slightly, gradual, or subtle'* (Tronc, 1999).

Riparian boundaries are prone to movement, and the Murray River system is no exception. The degree of movement is determined by the use of the word 'significant'. The term refers to the degree of total movement and also the measure of the amount of movement over time (Tronc, 1999).

4.3.1 The Doctrine of Accretion and Erosion

Riparian boundaries have and always will have the potential to move, and therefore, so to do the rights attached to it. The movement of this boundary has a fundamental right attached to it. The doctrine has its roots in Roman law and as a result is complex and difficult to apply. The basic concept though is relatively simple. Riparian boundaries have actions applied to them by the withdrawal and intrusion of water at varying times.

Accretion is the process by which waterborne material is deposited over time to the banks of a watercourse, gradually building up and expanding the area of riparian land.

Erosion is the reverse of accretion and is the process through the actions of water. The soil is removed from the banks of a watercourse to reduce the area of riparian land.

Avulsion has the same actions as erosion but the process is sudden rather than gradual.

4.3.2 Support of the Doctrine

There are a number of terms to support the doctrine. They include:

- Historical justification – the ancient term of 'de minimis non curat lex' – 'the law is not concerned with small or petty things' (Tronc, 1999).
- Productivity and Efficiency Theory – making the best use of the land available (Tronc, 1999).

Justification for the doctrine relates to the compensation or equity theory. This was described as; *'since a riparian owner is subject to losing land by erosion beyond his control, he should benefit from any additions to his lands by the accretions there to which are equal beyond his control'* (Tronc, 1999).

4.3.3 Application of the Doctrine

The doctrine can be applied using one of two scenarios:

- A rule construction – fixed as per the original survey alignment and would ignore the processes of accretion and erosion;
- A rule of law – the boundary was adopted as a riparian boundary and not a fixed boundary. The nature that the boundary is not fixed and subject to change (accretion and erosion) allows the boundary to move within the riparian zone (Tronc, 1999).

4.3.4 Applying the Doctrine

To apply the doctrine of accretion and erosion there are a number of factors, all of which need special consideration on individual merit. The relationship between natural actions within the watercourse can differ from from one region to another due to the diverse nature of our climate. They include:

- Rate of Movement – the rate of riparian boundary change over time;
- Contiguity – the actions of accretion and erosion can only affect land that bounds a watercourse;
- Permanence – acceptance that riparian boundaries are ambulatory and the actions of accretion and erosion apply;
- Method of Proof – complex and involving factual evidence supporting the movement of a watercourse boundary (Tronc, 1999).

4.4 The Ward Case

Until 1980, the position of the State Border along the River Murray was still very much unknown, as no need for its clarification had been required until then.

In May 1980 the High Court of Australia clarified the situation in relation to the position of the border in a trial known as 'The Ward Case' (Kernebone 1991).

The Story

A murder was committed by shotgun on the banks of the River Murray and the victim was left with his feet in the river and head angled up the bank.

The assailant, Ward was captured shortly after and sent to trial in The Supreme Court (Victoria) in December 1978, and found guilty

During trial, the question as to the location of the border was raised and justice Marks directed the jury that the banks not covered by water on the Victorian side were within Victoria.

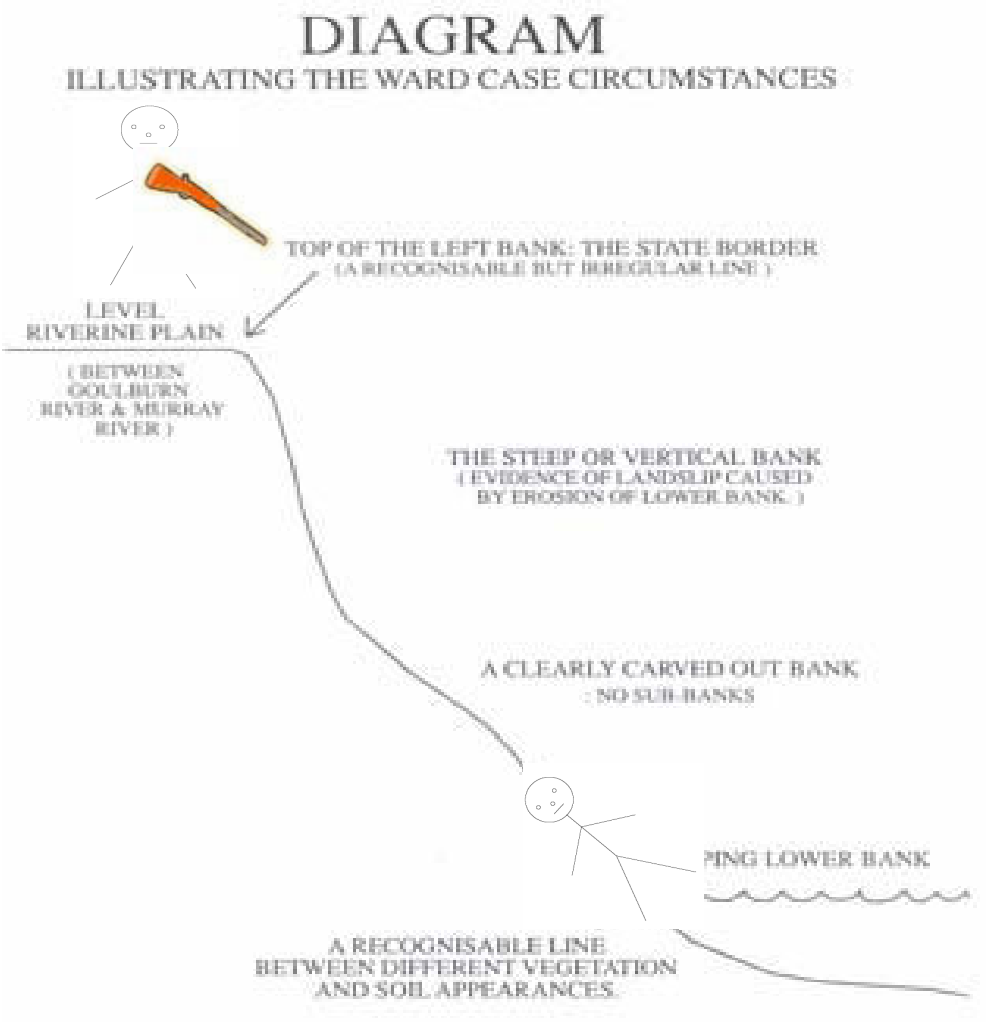
Ward then appealed to the Full Court of the Supreme Court who reached the same conclusion.

In taking his next appeal to the High Court, Justice Stephen ruled that the boundary to be adopted was the top of the southern (left) bank and therefore it followed that Reed was murdered in NSW not Victoria. His appeal was upheld and the conviction quashed. He was then tried in NSW, found guilty and sentenced to life imprisonment.

The reason for the many appeals was not to prove his innocence, but to take advantage of NSW system allowed for a defence of diminished responsibility (Kernebone 1991).

Figure 4.1, depicts a re-enactment of what took place at Echuca in 1978).

It shows Ward standing at the top of the bank, and the victim lying at the waters edge.



What was critical about this case was not the outcome of the trial itself, but the clarification of the state border position as put down by Justice Stephen.

The High court ruling did not alter the location of the border. It merely clarified what the border had been since its separation.

Some very important factors in relation to the state border location came out of this trail. These were:

- The northern boundary of Victoria is the top of the southern (or left) bank of the River Murray;
- The banks of the river are those elevations of land, which confine the water when they rise out of the bed;
- The Common Law doctrines of accretion and erosion apply in determining the current position of the boundary;
- The state border requires a recognisable and certain boundary to separate the two independent jurisdictions.

4.5 Case Studies

Echo Point Case Study

Figure 4.2, shows a google picture depicting the location of Echo Point

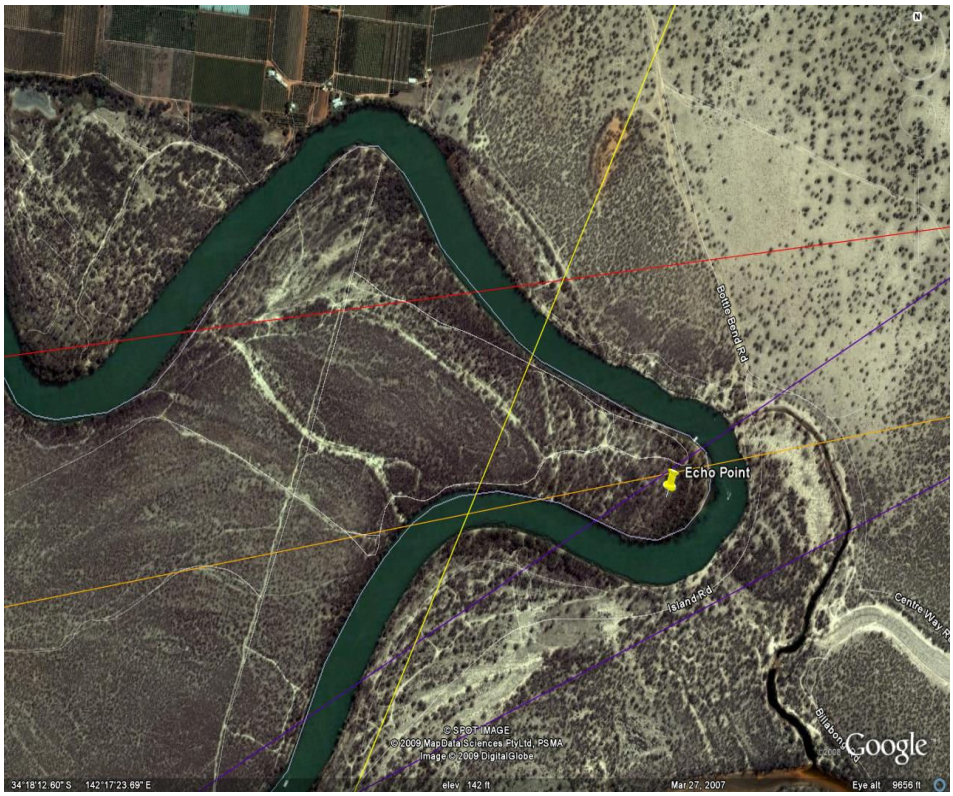
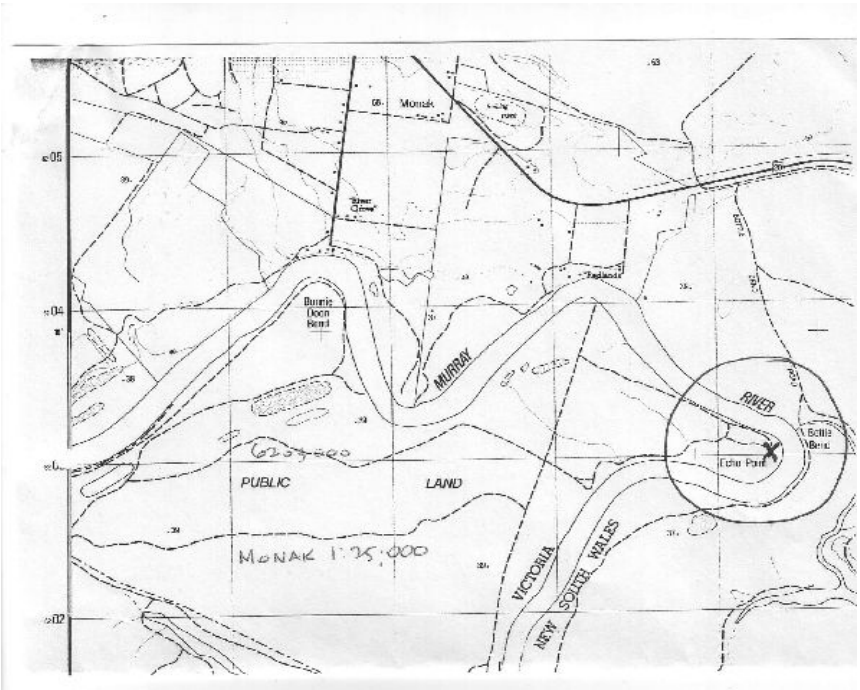


Figure 4.3, is a map of the Monak area, showing the location of Echo Point.



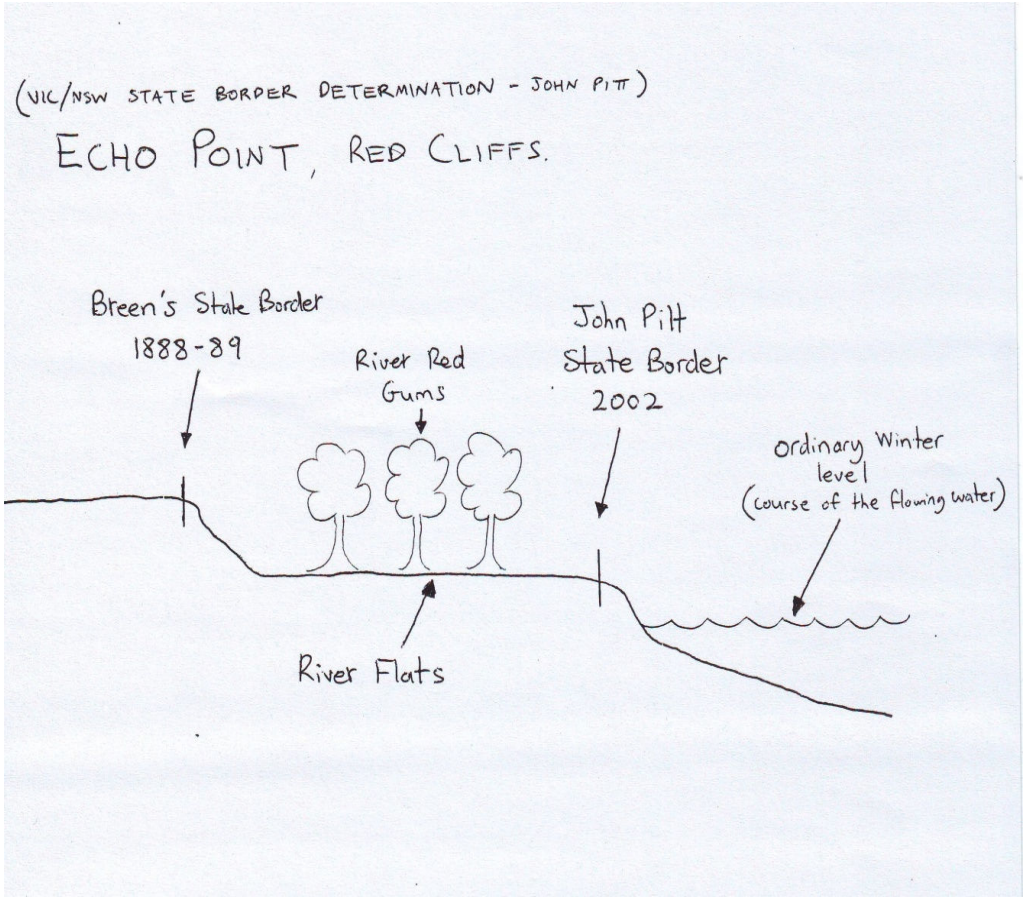
Echo Point is located just out of Red Cliffs about 35 kilometres south of Mildura. John Pitt, a licensed surveyor with the DSE was required to survey and locate the state border as an incident had occurred on the river flats of that area and it was unknown whether it had taken place in Victoria or in New South Wales.

Firstly, John spoke with local residents about any local knowledge they had about the area in question and especially about the water flows in that area. John was also able to obtain some river height data for the area in question, which had been compiled over the previous 12 years. This proved valuable to John as it resulted in him being able to use that data to determine the ordinary winter level of the water flows in that area.

Survey levels were taken in the field using RTK GPS and from this data Pitt was able to determine the high bank that would contain the ordinary water flow and therefore the location of the state border.

There was an interesting outcome to Mr Pitt's survey. The location of the high bank was now located in a different position to that of a previous survey carried out in the Echo Point area some 110 years earlier.

Figure 4.4, depicts the differences between the high bank containing the ordinary water flows in 1888, to the bank that contains them in 2002.



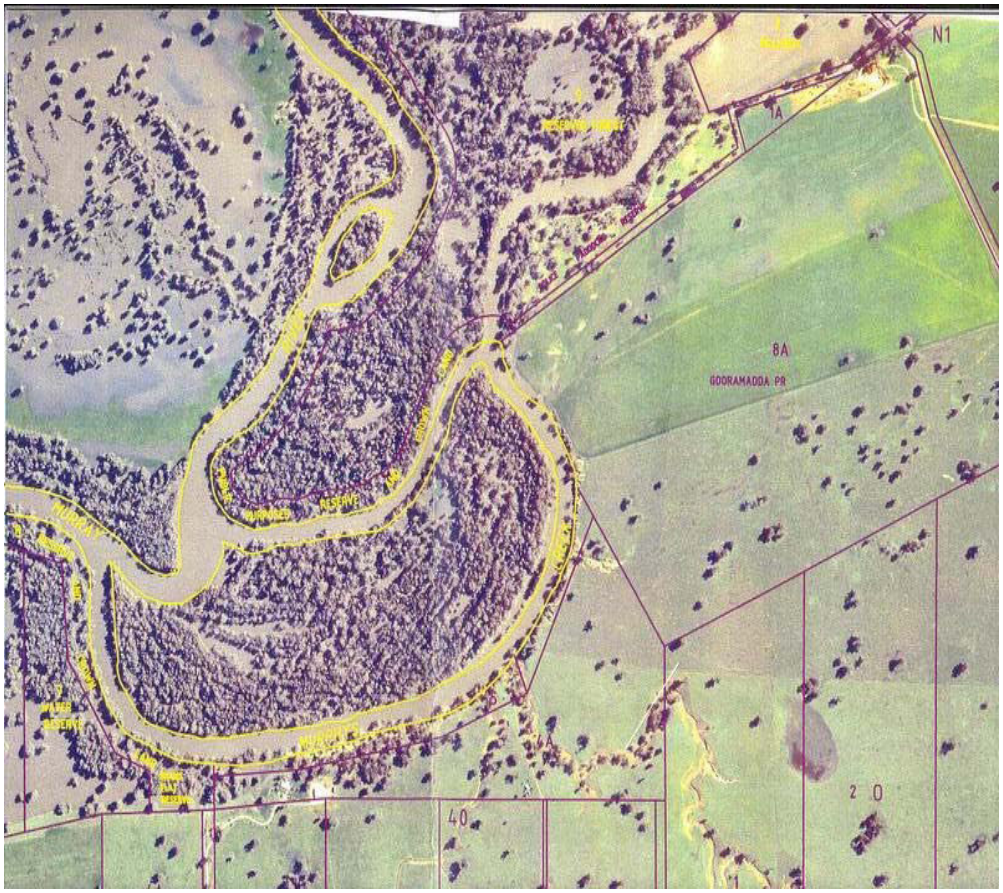
M.D. Breen surveyed the Murray River in 1888-89. His survey located the Murray river and its banks from Merbein to Carwarp.

Pitt's level information shows a high bank very close to the ordinary winter level that he adopted. A further high bank was located some 60 metres away with river flats and some river dead red gums in between. The fact that the river gums are now dead suggests that at one time the bases of their trunks were not constantly submerged.

Pitt states that the situation presents as a case of 'slow and imperceptible accretion', and that the state border should now be fixed at the lower of the banks as this was now the bank that contains the ordinary river flows.

The Gooramadda Study case

Figure 4.5, shows the Murray River and Murphy's Creek, which was the course of the river at separation.



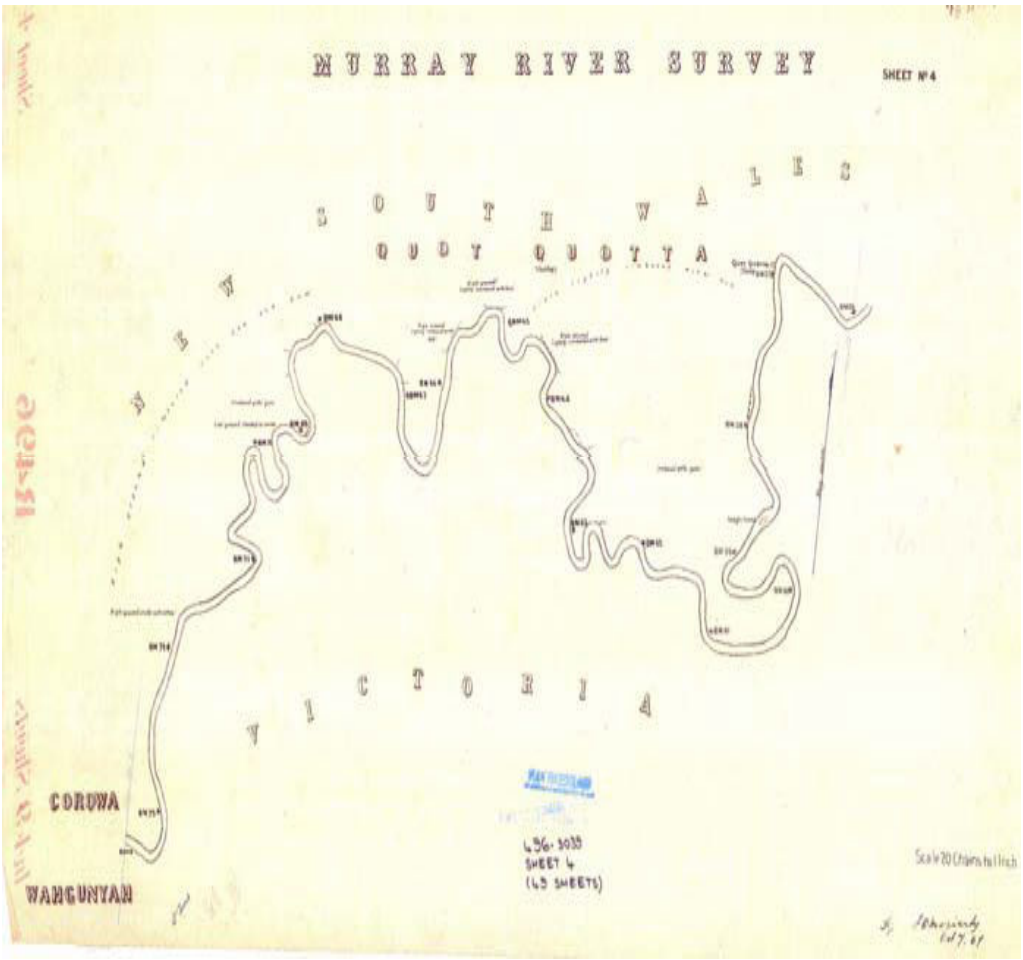
This is a recent example of a state border determination where land was granted prior to 23 May, 1881. The Gooramadda Pre-Emptive Right (1855) was bounded in part by the Murray River.

The current abuttal is to Murphy's Creek which is the course of the river at time of separation, but broke through some time after 1870, as illustrated in the 1869/70 survey plan. Although the Murray now flows in a different channel, the border remains unaltered as the change in course was not due to gradual and imperceptible movement but rather a sudden break-through. This refers back to the Doctrine of Accretion.

It is a classic case demonstrating the differences between gradual and imperceptible movement, which moves the location of the state border, and one of a sudden break-through, which does not alter from its original position.

The original course of the Murray River can be clearly shown on the 1869/70 Murray River Survey Plan below.

Figure 4.6, is an 1869/70 map showing the original position of the Murray River at the time of separation. This depicts were the sudden break-through in the river occurred.



The Swan Hill Caravan Park Survey

The site in question is located at Swan Hill adjacent to the local caravan park. The surveyor in this case was required to survey the area near the caravan park to determine the position of the state border and around the location of Goat Island and the Little Murray entrance.

There was some confusion as to which side of Goat Island the state border was located on.

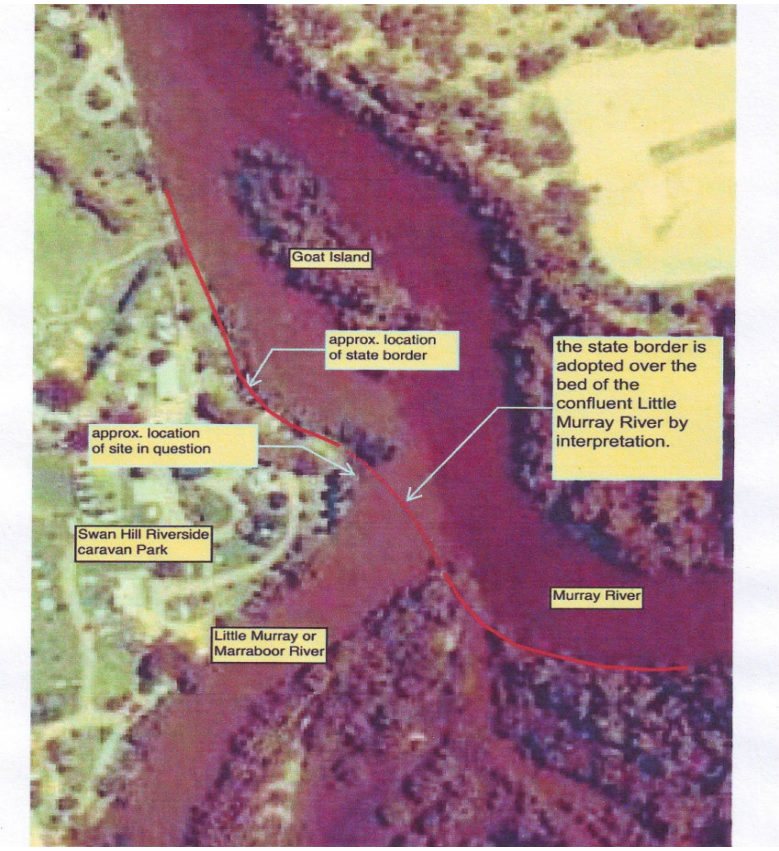
Figure 4.7, is a google map showing the site in question in relation to the Swan Hill town centre.

Before the surveyor carried out any survey work he first researched the area for any previous information and unfortunately was informed by two well-known locals with very different stories. One said he believed the border was on the north side of Goat Island and the other said it was to the south.

The surveyor come in contact with a member of DSE who informed him of the recently found plans from the 1869/70 River Murray survey that was carried out by the Harbours and Rivers Branch of the NSW Public Works Department. This enabled him to confirm that the island did in fact exist in 1870 and therefore the border would be to the south of Goat island.

In this case the surveyor used a Total Station and located natural surface levels either side of the Little Murray Entrance, then created contours to assist in determining the high bank and therefore the location of the state border. He deemed this to be the high bank he located just above the average water level.

Figure 4.8, shows the approximate location of the adopted state border in relation to Goat Island and the Little Murray entrance.



The Bethanga Bridge Survey

Figure 4.9, shows the bridge crossing over Lake Hume.

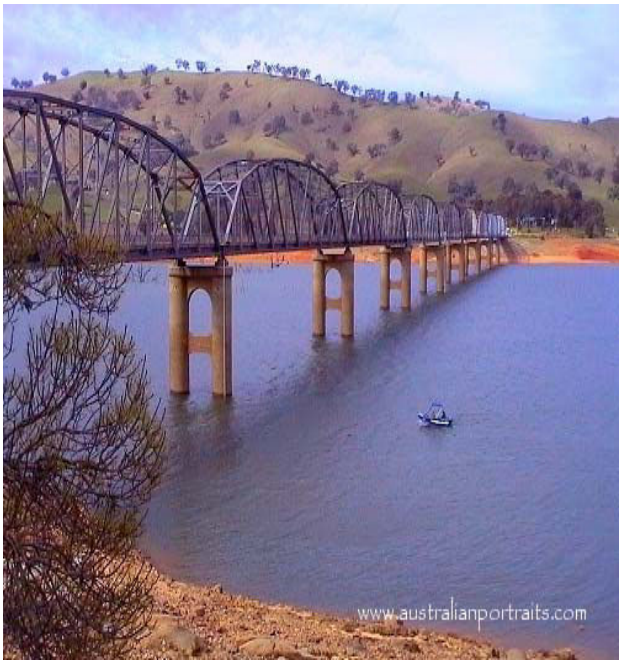
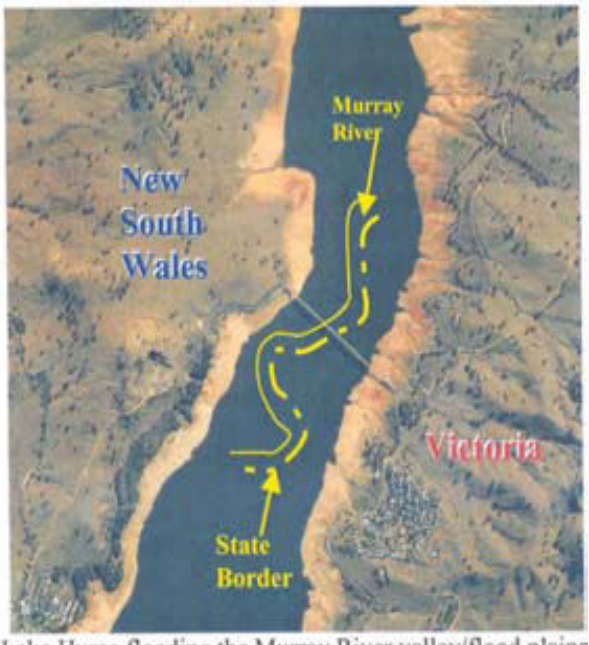


Figure 4.10, depicts the location of the river channel and the state border within the Lake Hume watercourse.



Lake Hume flooding the Murray River valley/flood plains

The bridge passes over the channel of the Murray River, which is now submerged under the lake. In this particular case, the surveyors were required to define the state border in the vicinity of the bridge. Normally this would have required the surveyors to survey levels across the entire lake in order to determine the original Murray River channel position. However, in this particular case the surveyors were able to take advantage of the lake being in drought. Therefore, the main channel that contained the average winter flow was now visible to the surveyors, making the re-establishment of the border a more practical process.

This could also be done when any of the lochs or weirs along the Murray are removed and drained for maintenance purposes. Obviously this is not usually practical, but if it can be arranged it recedes the water level back to its average winter level, making the state border re-establishment easier to survey.

Figure 4.11 was taken during the drought in 2004 when much of Lake Hume receded back into the channel of the Murray, which clearly shows the location of the left bank (on the right side of the photo) and therefore, the position of the state border.

4.6 Summary: Chapter 4

It is important to gain a complete understanding of what is involved when dealing with the re-establishment of the state border.

As a professional surveyor it is vital to research all available resources before undertaking survey work to re-establish a riparian boundary. Any previous maps, aerial photographs, topographic maps and local knowledge of the survey site can prove invaluable.

The surveyor must take local conditions, society's needs and the environment into consideration. They must have a clear understanding of the definition of the watercourse and how the average water flow is re-established and contained in the bed and banks of the river; and finally, the doctrine of erosion and accretion, and how it is interpreted and implemented.

These will form the basis of a surveyor's decision-making in the re-establishment, and will form the backbone for the survey practices I will use in my own surveys of the state border.

Chapter 5

5.0 Results

5.1 Introduction

To date the methods used to survey the Murray River and banks have been quite similar, however, no set principles have actually been in place to assist the surveyor in what methods they should be using. It has more been up to the surveyor to contact others for advice or just make their own judgements.

I have set up a set survey method and practices and applied them to my chosen survey sites to see what results could be achieved.

The following chapter shows some of my results from my own survey work.

5.2 Surveyed Sites

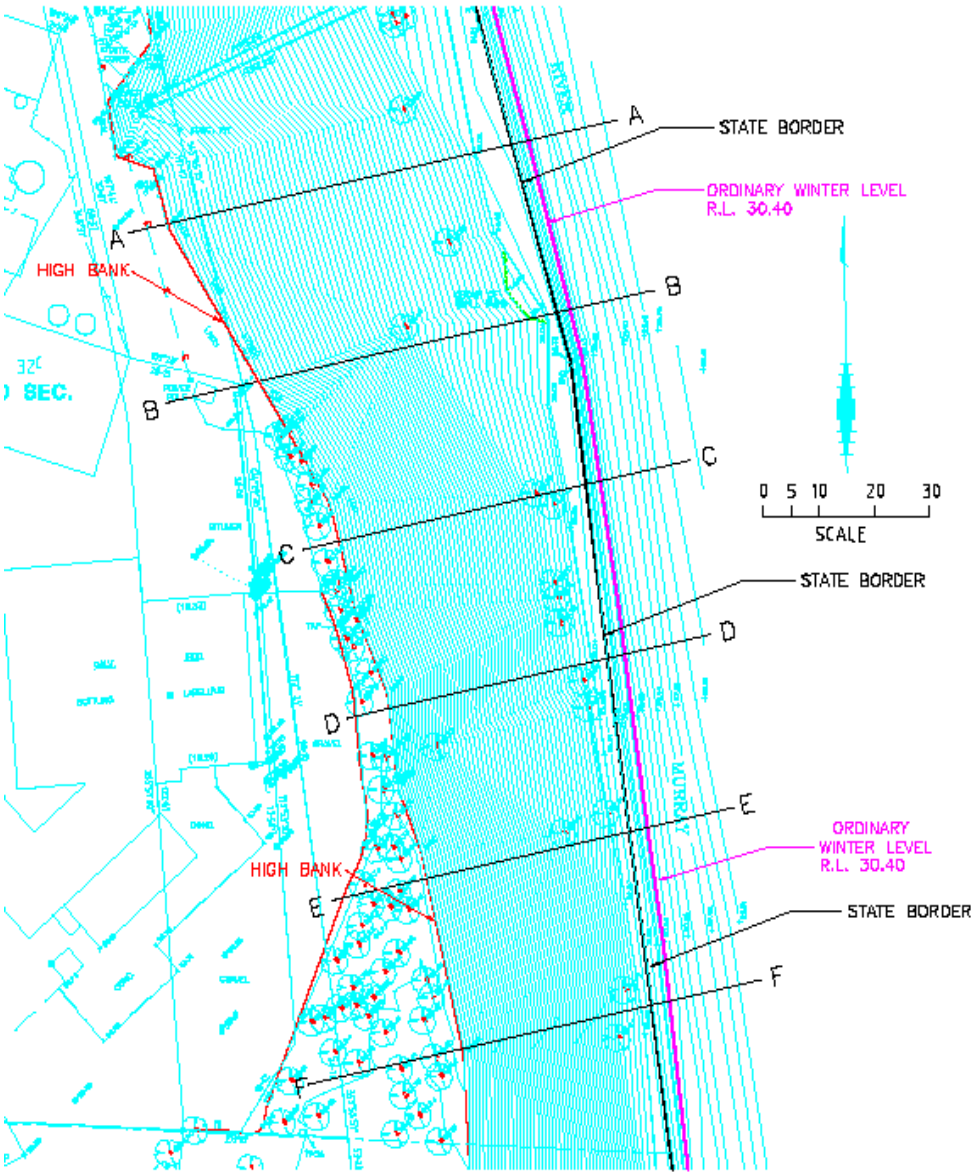
5.2.1 Site 1

The contours and cross sections of Site 1 show that although there is a steep 17 metre high bank, the bank that contains the normal channel of water flow is what the state border is re-established on, making the border very close to the natural water level or ordinary winter level as can be seen on Figure 5.1.

Figure 5.1 shows the contour plan for Site 1.

Cross sections are labelled on the plan as is the adopted state border location and the ordinary winter level.

(Cross section plans of Site 1 can be seen in the Appendices).



The cross section levels located at Site 1 produced results very similar to what I had expected. The high bank located just above the fixing of the ordinary winter level is of a similar offset distance along the entire 300 metre survey area.

The most important aspect of this site was that it was not the very high bank that contained the average water level of the normal flow, but the bank that was located some 15 metres lower.

While these results were what was expected it, the general opinion from the locals was that they assumed that the very high bank would be the border, and the results have created much interest with the knowledge now that the majority of the large bank is it fact in Victoria, not New South Wales. This has proved the survey work to be a very worthwhile exercise.

5.2.2 Site 2

The contours and cross sections of Site 2 show that the original high bank that contained the natural flow actually seems to vary quite a lot from the current conditions that exist. While at the northern and southern ends of the surveyed area, the state border is fixed very close to the normal pool level, though the middle section of the site the border would be fixed by the high bank that was located between the average winter level and the normal pool level. This made re-establishing this particular section more complex than the other two sites.

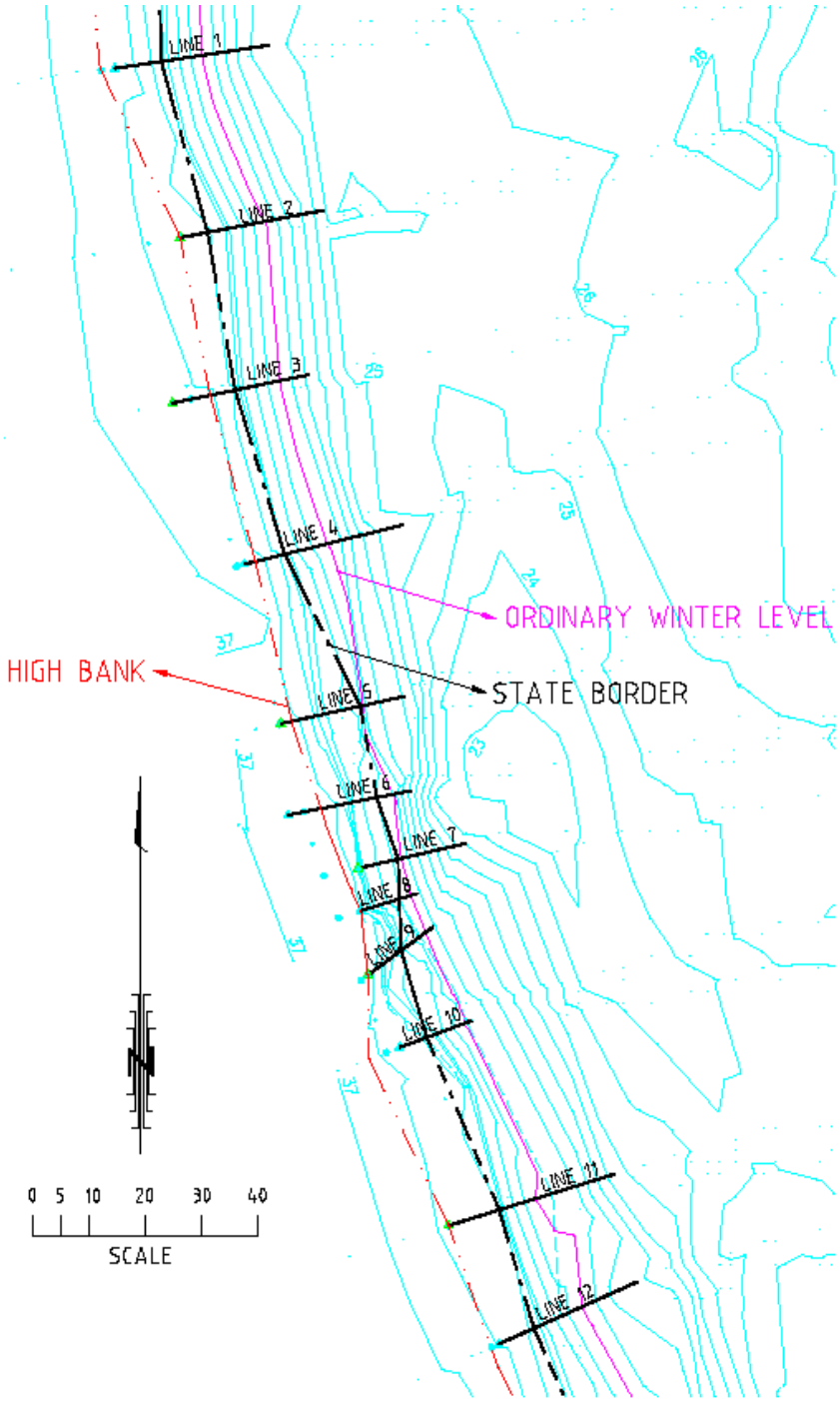
There are a large number of houseboats that continually use this area. It was thought that they may have had some affect on the natural banks. However, after studying the contours and cross section plans it was my opinion that due to the loch and weir being in place, the houseboat activities have had little or no affect on the original high bank. The bank movement in the middle section of the site has been caused by natural erosion and accretion over a long period of time. There were some dead river gums located in this area, which are consistent with the average winter level water flows being contained within my adopted state border.

Some extra cross section level data was taken in this particular area to assist in confirmation of my findings.

Figure 5.2 shows the contour plan for Site 2.

Cross sections are labelled on the plan, and numbered as is the adopted State Border location, the ordinary winter level and the top of the bank.

(Cross section plans of Site 2 can be seen in the Appendices.)



5.2.3 Site 3

The contours and cross sections of Site 3 show that although their has been much man made activity that has occurred on and around the banks of the river, most of this has taken place above the normal pool water level when the loch and weir are in place. The original channel of water flow or the ordinary winter level, is contained by the submerged high bank that has been located by this survey. It appears to be still very natural and untouched. It can be seen most evidently on Figures 5.4 and 5.5 on Pages 59 and 60.

This result was consistent over the entire 300 metre section of the surveyed area with my re-established border position remaining in a similar location throughout the site.

The state border is clearly lying at the high bank position in between the location of the ordinary winter level and the normal pool level, as seen on Figure 5.3.

Figure 5.3 shows the contour plan for Site 3.

Cross sections are labelled on the plan, and numbered as is the adopted State Border location, the ordinary winter level and the top of the bank.

(Cross section plans of Site 3 can be seen in the Appendices.)

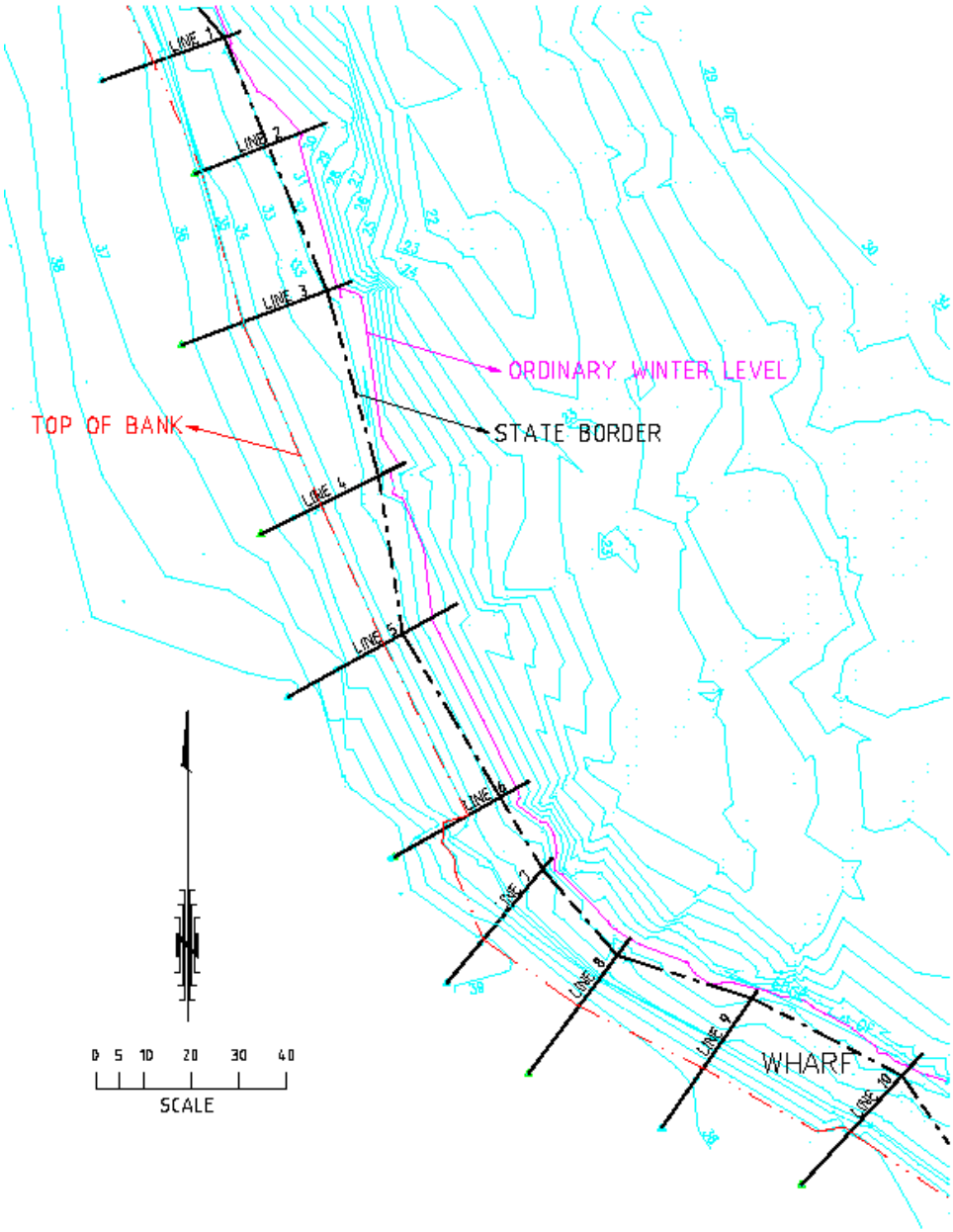


Figure 5.4

This picture of Site 3 was taken in 2001, when the loch and weir had been removed for maintenance. It shows the concrete retaining wall in the background that usually contains the normal pool level, and the top of the bank that contains the average winter level is now holding the current water flow.

Figure 5.5

This figure of Site 3 was taken in relatively the same position as that in figure 5.4 except two days later. The water level has now receded well below the high bank that contains the natural flow.

Like the previous figure, it shows the concrete retaining wall in the background and the high bank that contains the average winter water flow is now very obvious.

5.3 Summary: Chapter 5

The results of the surveys carried out on my three study sites show that the methods and practices I used were very successful.

I implemented my methods, by researching previous plans, maps, photos and survey data, and studied previous water level information to obtain my ordinary winter flows. I put my survey practices to the test by completing my own survey work, over sites all of which had different physical characteristics to ensure they would suitable for all conditions.

All data captured was able to be shown in contour plans and cross section plans as expected, and the important features of the plans such as the State Border, ordinary winter level and top of bank were able to be located clearly.

The results produced from my State Border surveys show that the methods and procedures I used were highly successful in order to re-establish the border and I believe they could be used by future surveyors for the same purpose.

Chapter 6

6.0 Conclusions, Limitations and Recommendations

6.1 Introduction

The project itself was not intended to re-create existing surveying methods, procedures or any existing guidelines that are in place. It was intended to make recommendations and suggested improvements to what is currently in place.

Throughout this project, it was found that some guidelines did exist, and that there were previous re-establishment surveys carried out that had used effective and appropriate survey methods. This project provides some alternative methods and procedures that could potentially improve the way re-establishment surveys of the state border are carried out in the future.

6.2 Alternative Solutions

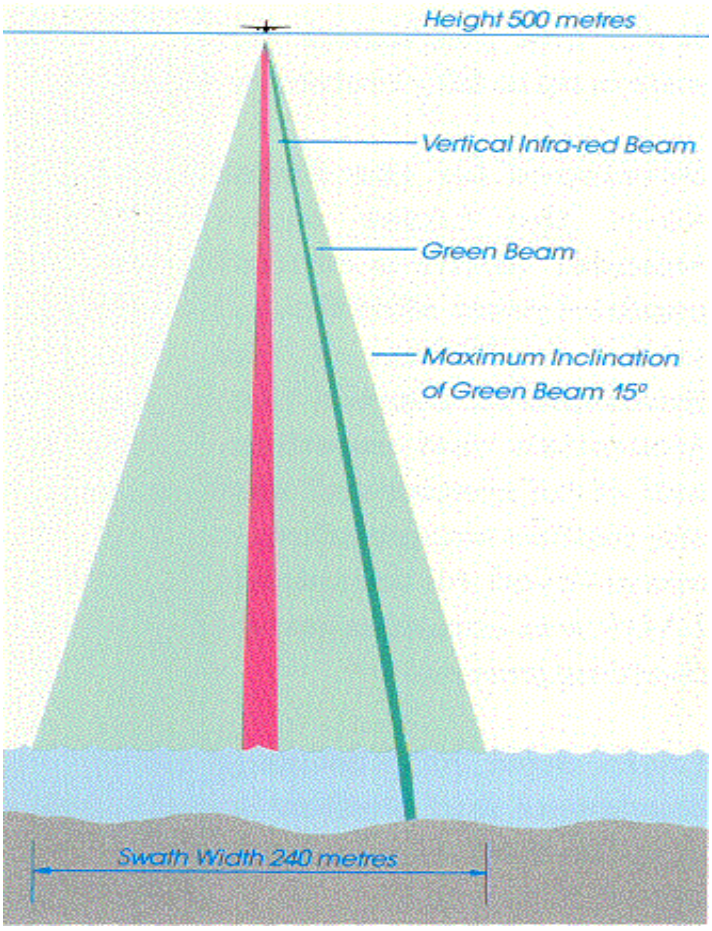
There are some alternative surveying methods that could be used in order to accurately re-establish the state border. One of these methods is by using LIDAR laser scanning. One such type of LIDAR that could be used to survey the entire Murray River System is a Laser Airborne Depth Sounder (LADS). These systems have the capability of using kinematic GPS with 'on the fly' ambiguity resolution, which allows topographic mapping over land in conjunction with the underwater mapping.

The LADS system can survey accurately to a depth of over 50 metres in clear water, and about 10 metres in murky or dirty waters. The LADS has a vertical accuracy at these depths of approximately 20cm. This type of

accuracy would be efficient for the requirements of surveying for the state border.

Figure 6.1

This figure shows how the red beam scans from the plane to the water, while the green beam penetrates the water to bounce off the bottom of the river below the surface.



Combining the 1869/70 digital plans surveyed by the Harbours and Rivers Branch of the NSW Public Works Department, which fixed the original location of the bank along the River Murray, with the Laser Scanned

information, would create digital co-ordinated and levelled data for the entire Vic-NSW state border.

This may enable the surveyor to create a more reliable and efficient re-establishment of the border.

This method of surveying does have some negatives. Using a system such as LADS is fairly costly. In my research I was advised by a Land Air company that to survey my three chosen study sites to the required accuracy would cost approximately $50,000.00. This would be up to three times the cost of my traditional methods. This indicates that in order for the LADS methods to be cost effective the whole of the River Murray system would need to be surveyed.

The river and its banks are constantly subject to change therefore the river system would be required to be surveyed approximately every five years. This would also be a costly process. I do believe this to be the way of the future and further study should be made into this surveying method.

6.3 More Information

There are a number of important points to make in relation to re-establishing the state border between New South Wales and Victoria.

Little or nothing was achieved in almost 130 years in the re-establishment process.

Some progress had been made in guidelines and methods in the past 20 years, however, there is still a lack of information available to the surveyor.

More information is required to fully inform surveyors of the methods and procedures that are required to carry out a state border re-establishment.

6.4 Further Investigation

There are a number of areas that could be further investigated in relation to the state border re-establishment. Further investigation could be made into alternative methods with field feature and location work.

Plan methods in regards to plan presentation formats, and finally further investigating methods such as research into the effectiveness of Laser Scanning of the River Murray system, and what effects it could have on the re-establishment process.

6.5 Achievement of the Topic

The main aim of this topic was to improve the guidelines currently in place and to develop a set of surveying methods and procedures that could be used to re-establish the state border.

Not only was the aim achieved but future direction for others wishing to undertake research into non-tidal boundaries or the re-establishment process of the state border has been put in place.

Further direction leans towards improving the methods used for the re-establishment itself and developing an even more practical, efficient and cost effective method.

6.6 Conclusion

The research and survey work carried out in this project is aimed at providing an educational supplement for surveyors when having to carry out re-establishment surveys of the state border between New South Wales and Victoria.

It is hoped the methods and procedures recommended in this paper will play an important role in assisting professional surveyors in the re-establishment process.

APPENDICIES

Appendix A (Copy of Research Project Specification)

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG4111/4112 Research Project
PROJECT SPECIFICATION

FOR: **BRAD BLABY**

TOPIC: RE-ESTABLISHMENT OF THE STATE BORDER BETWEEN NEW SOUTH WALES AND VICTORIA.

SUPERVISOR: Glenn Campbell

ENROLMENT: ENG 4111 – S1, 2009.
ENG 4112 – S2, 2009.

PROJECT AIM: Establish the best practice guidelines for reinstating the riparian border between Victoria and New South Wales.

SPONSORSHIP: Thomson & Blaby Pty.Ltd.

PROGRAMME: Issue A, 18th March 2009.

1. Research existing literature relating to the NSW – VIC border.
2. Research administrative requirements for the re-establishment of the state border.
3. Research historical re-establishments of the State Border to find out how they were surveyed and presented.
4. Establish three study sites of differing physical characteristics covering an area of approximately 300 metres each in length.
5. Investigate other possible methods of re-establishing the state border and apply two different methods to each of the study sites.
6. Analyse my results and findings, and compare between possible methods and recommendations as to what is the most reliable, efficient, practical and legally valid method.
7. Submit an academic dissertation on the research.

As time permits:

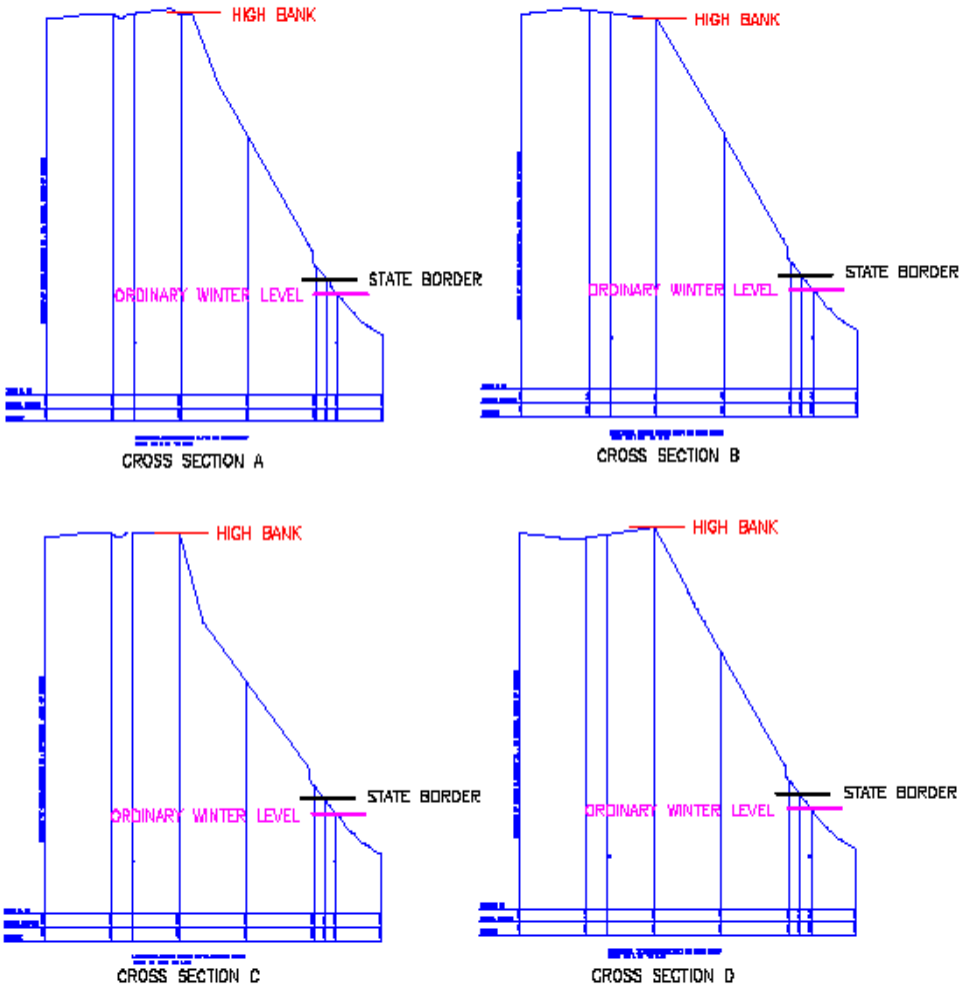
8. Finalise all plans and documents.

AGREED:

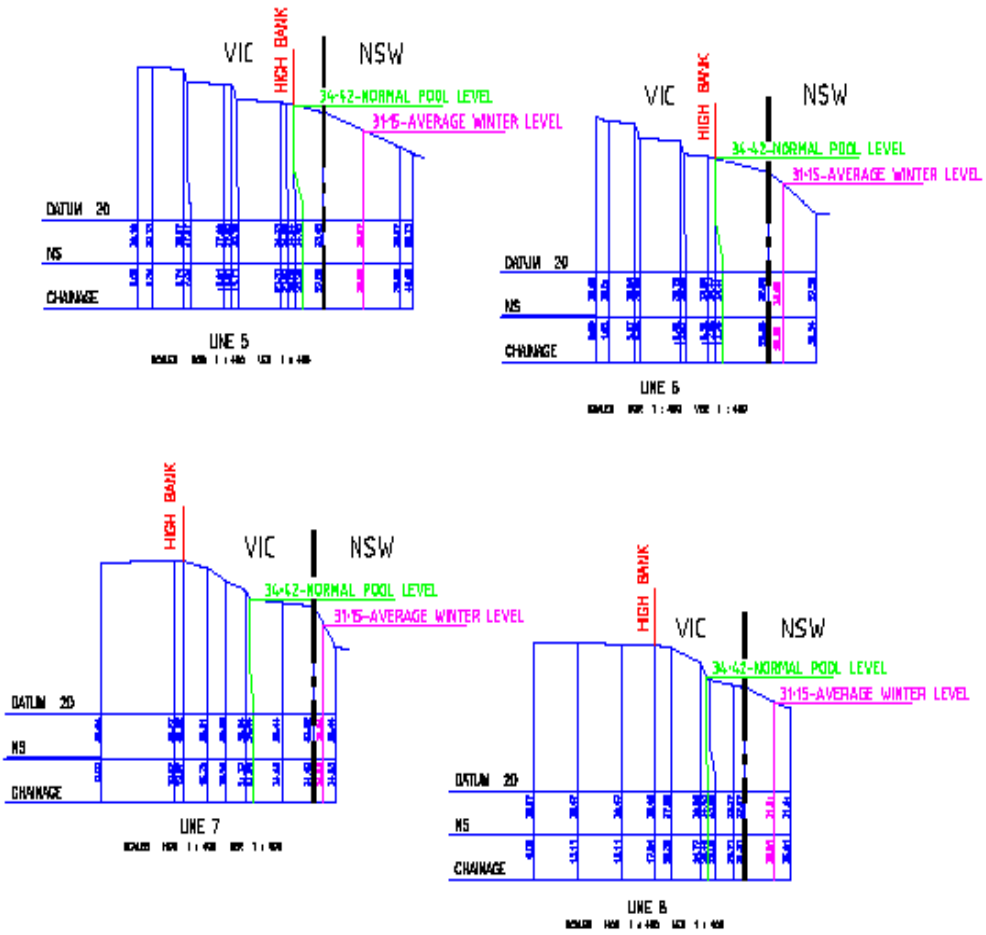
..... (student) ..... (supervisor)
Date / / 2009 Date / / 2009

Examiner/Co-examiner.....

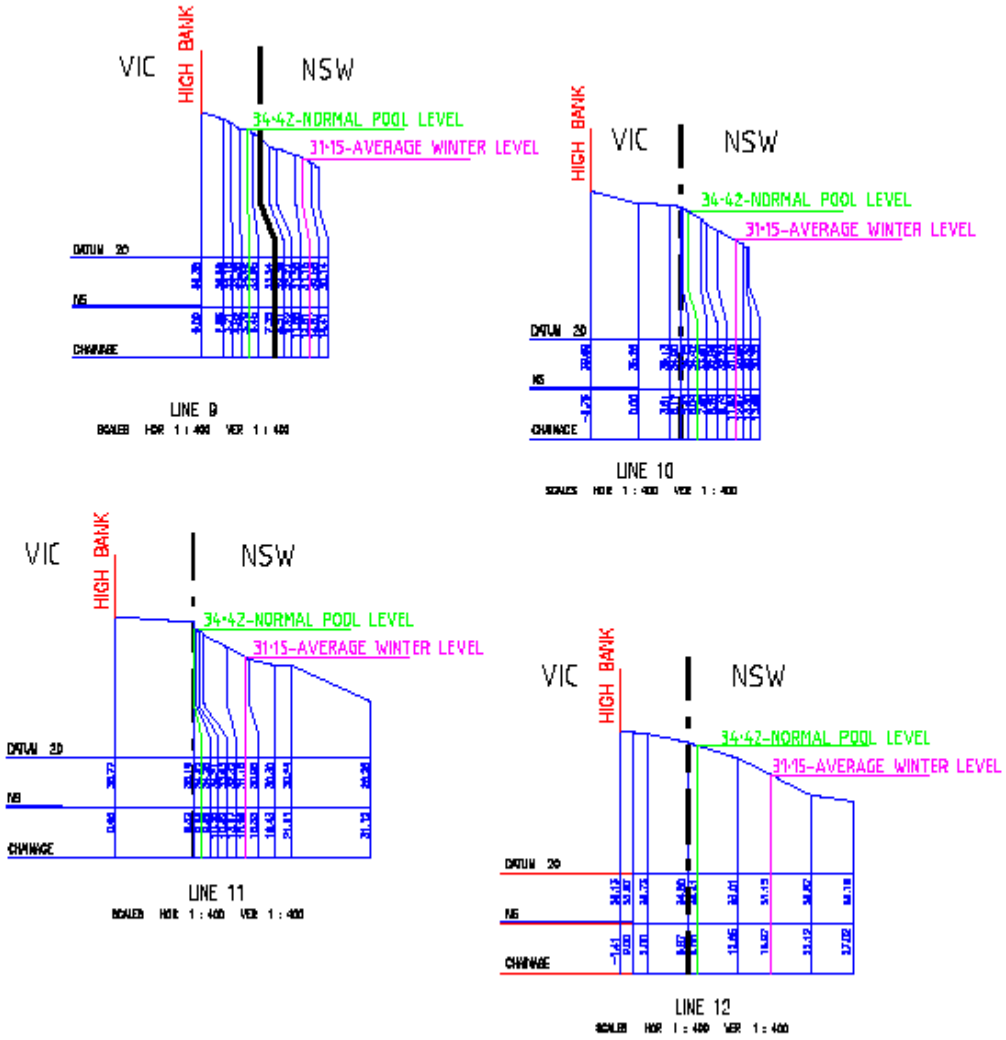
Appendix B (Cross sections of the chosen survey sites - Site 1)



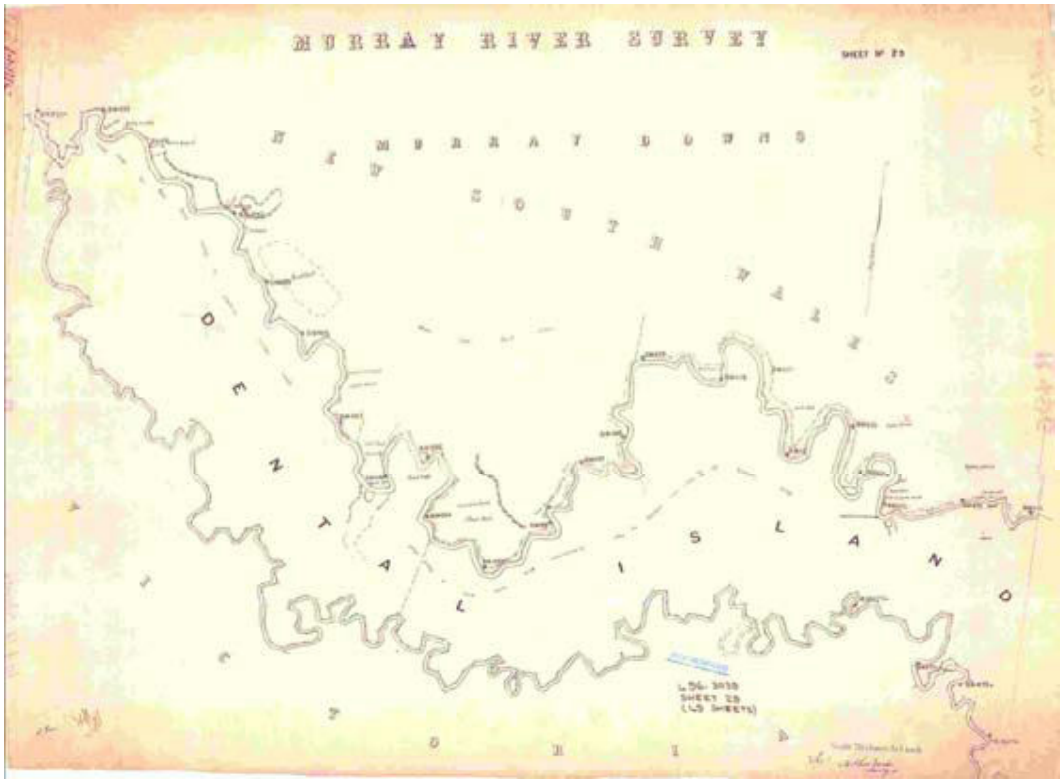
Appendix C (Cross sections of the chosen survey sites - Site 2)

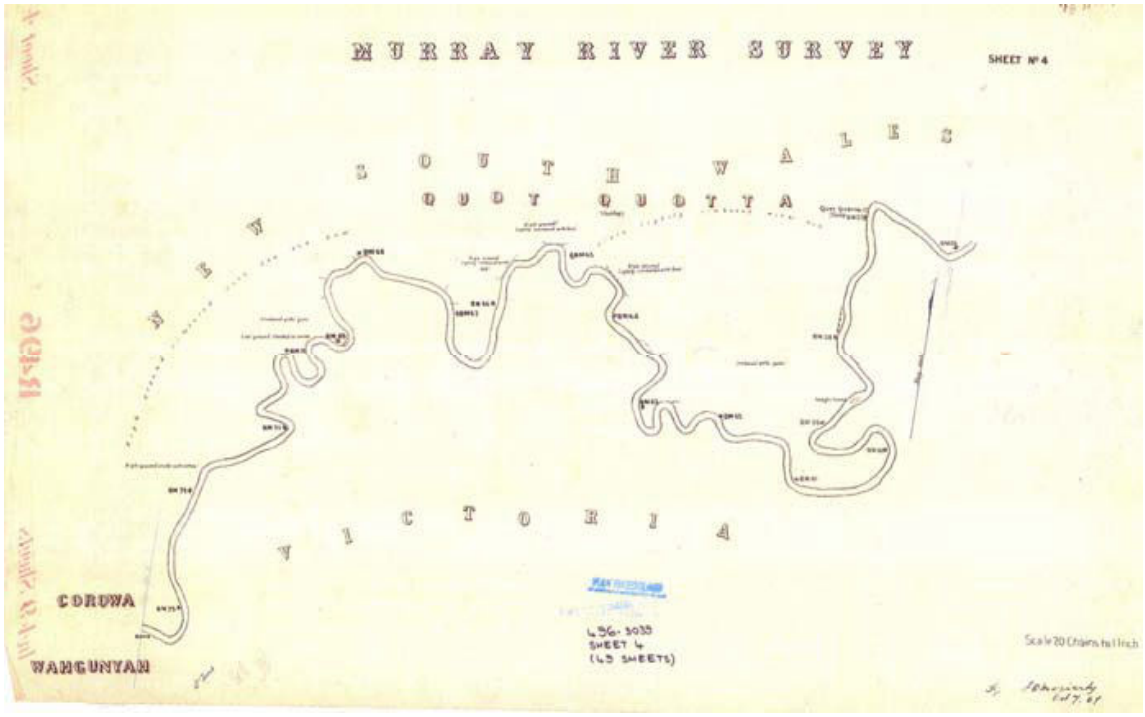


Appendix D (Cross sections of the chosen survey sites - Site 3)

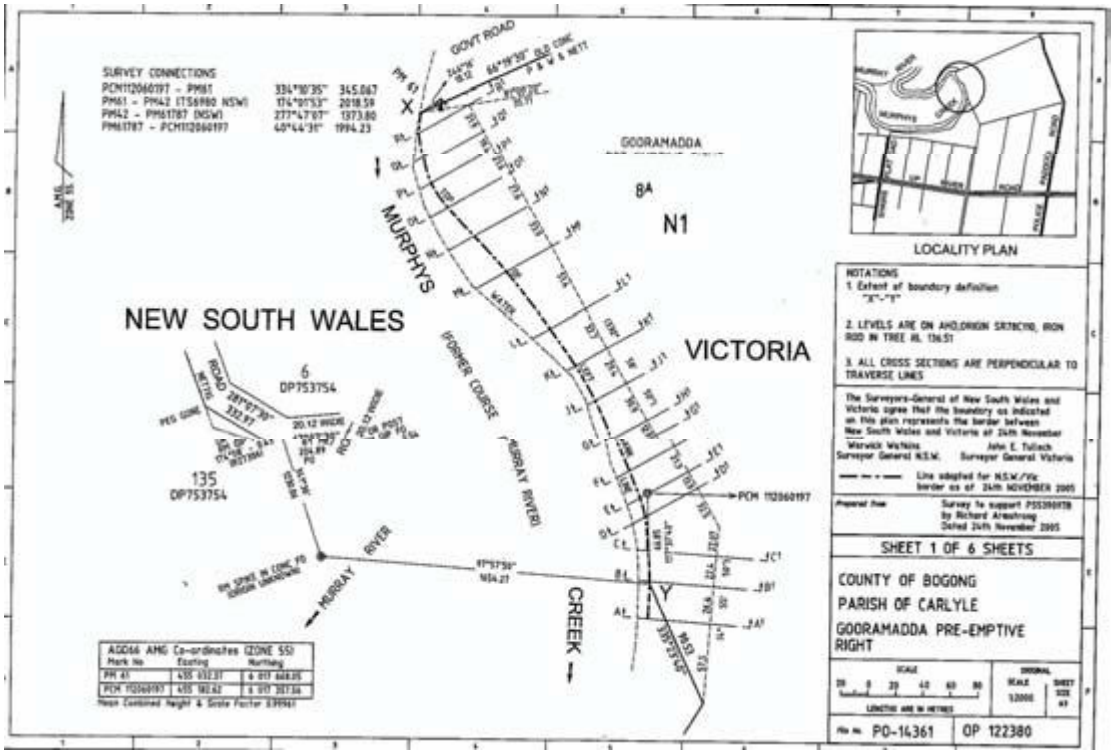


Appendix E (Examples of two sheets of the complete 49 sheet set of plans now supplied to assist surveyors in the re-establishment of the state border.)

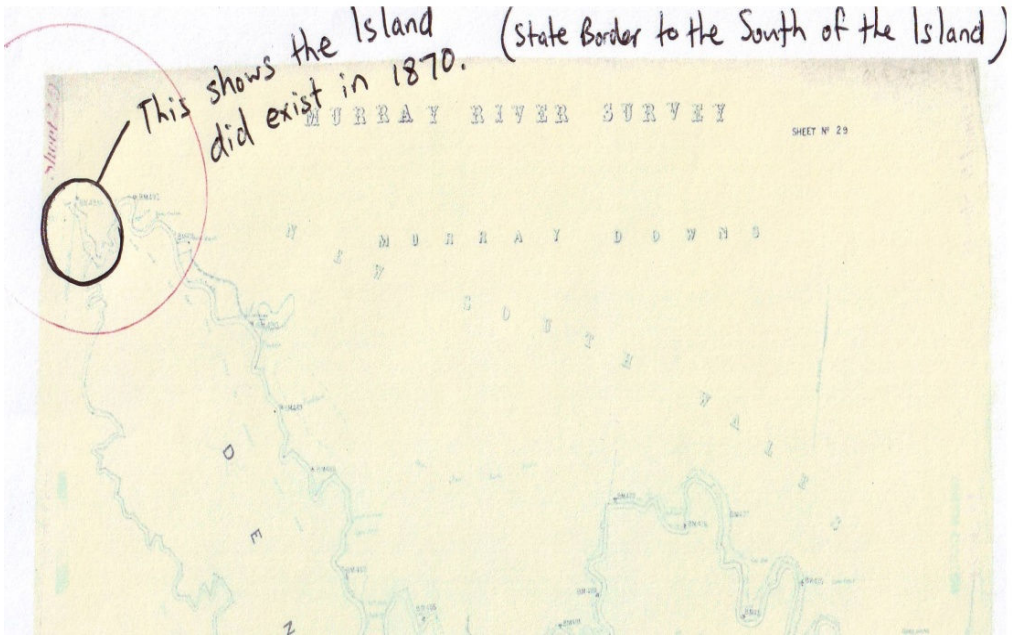




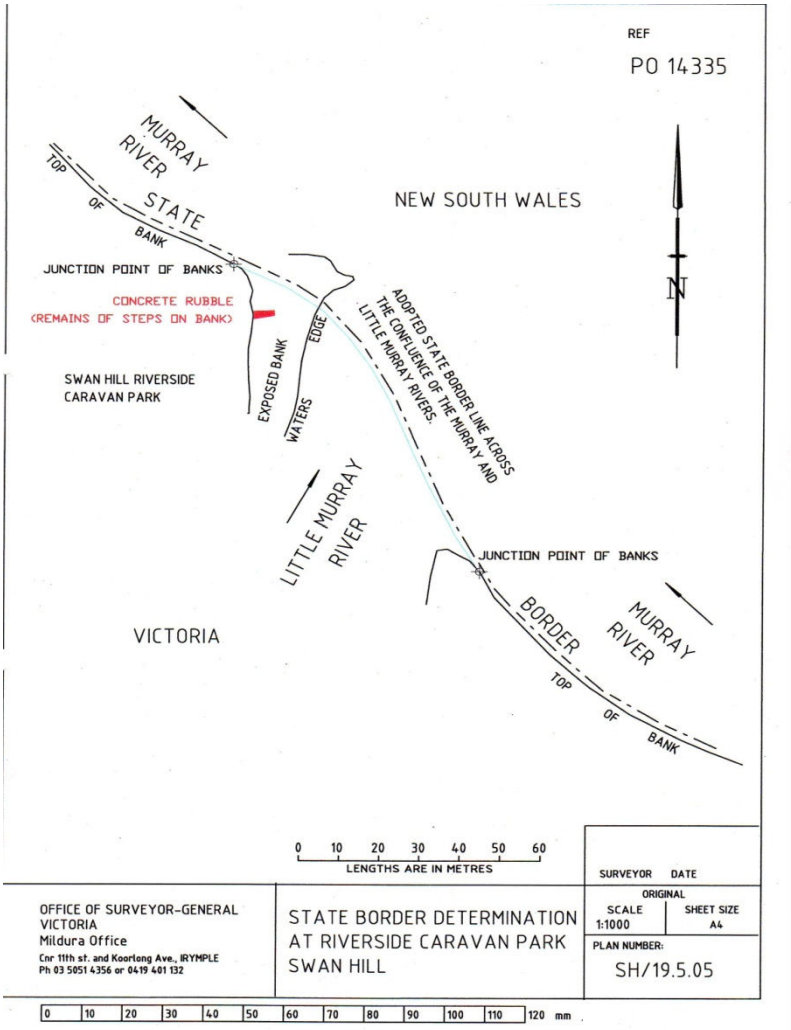
Appendix F (A standard plan format used for current state border surveys)



Appendix G (A copy of the 1870 survey plan showing the state border to the south of Goat Island in the Swan Hill Caravan Park survey)



Appendix H (A copy of the plan submitted by John Pitt for the Swan Hill Caravan Park survey)



Appendix I (A copy of some of the river height data John Pitt used to assist him in the fixing of the state border in the Echo Point case study)

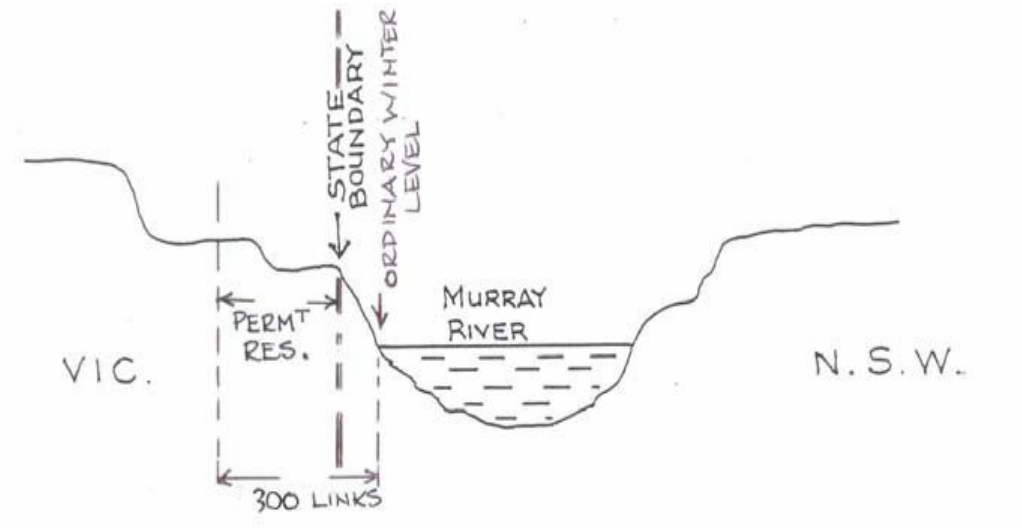
Monthly max. height of Murray River ... levels on gauge are above Australian Height Datum (AHD) and supplied by Goulburn-Murray Water (G.Sharnon).
A level of 62m +/- AHD exceeds ordinary winter level and 'low bank' at site of incident
A level of 64m +/- AHD replicates river level on date of incident.

YEAR	1988	89	90	91	92	93	94	95	96	97	98	99	00
Jan	61.29	61.65	60.44	61.04	61.24	64.44	61.85	60.86	60.59	60.41	60.66	60.10	60.89
Feb	61.13	60.16	61.25	61.18	60.97	62.30	61.64	61.07	60.41	60.64	60.57	60.58	60.68
Mar	60.78	61.60	60.40	59.96	60.13	61.24	62.06	60.04	60.34	60.00	60.59	60.64	60.73
Apr	60.96	63.06	61.71	61.32	60.45	61.74	60.79	61.00	61.20	61.24	60.82	60.69	61.01
May	62.07	63.20	61.56	61.28	61.26	61.95	61.84	62.08	60.86	61.76	60.55	60.57	60.78
Jun	62.83	64.27	61.79	60.86	61.98	62.00	60.86	64.04	60.69	60.70	60.12	61.58	60.99
Jul	63.78	64.40	63.90	62.82	61.26	63.72	61.35	64.22	63.90	59.96	60.54	61.60	61.48
Aug	64.08	64.48	64.22	62.95	62.04	63.98	60.76	64.49	64.52	61.49	61.69	61.94	61.86
Sep	64.10	64.52	64.26	64.05	64.13	64.59	61.00	64.35	64.49	62.12	60.75	63.19	64.46
Oct	63.54	64.42	64.17	64.06	64.61	64.74	61.47	60.16	64.52	60.92	62.41	60.67	63.56
Nov	61.21	63.97	63.37	63.20	64.67	64.63	61.32	61.33	64.38	60.92	62.53	60.80	64.11
Dec	62.30	62.52	61.14	61.22	64.49	64.28	60.92	61.31	63.54	60.22	60.90	60.51	64.00
Max.	64.10	64.52	64.26	64.06	64.67	64.74	62.06	64.49	64.52	62.12	62.53	63.19	64.46

Every year river level of 62 AHD was exceeded
(63 of 156 months (40%) river level was above 62 AHD)
9 of 13 years (69%) river level of 64 AHD was exceeded

TABLE 1
COMPILED BY
JOHN L. PITT L.S.

Appendix J (A diagram demonstrating how the state border, permanent reserve and the ordinary winter level can relate to the river itself)



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