University of Southern Queensland

Faculty of Engineering and Surveying

An Investigation into the Victorian Permanent Survey Mark Infrastructure.

A dissertation submitted by

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Courses ENG4111 and 4112 Research Project

Towards the degree of

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Abstract

This project was developed to enable the investigation and analysis of Victoria's permanent survey mark (PSM) requirements and the density and distribution of PSM's throughout the State of Victoria. With the number of organisations requiring the need for spatial information continually on the increase, requirements to have a high density and accurate network of PSM infrastructure is in high demand.

To complete the main aims of the project an investigation and evaluation of Victorian survey requirements with regard to PSM density and distribution has been completed. Case studies were also conducted on two local authorities within the survey control database in order to evaluate existing PSM density and distribution.

Results indicate that there are deficiencies within areas investigated and general guidelines have been developed to decrease these issues.

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Limitations of Use

Certification

I certify that the ideas, designs and experimental work, results, analyses and conclusions set out in this dissertation are entirely my own effort, except where otherwise indicated and acknowledged.

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

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Signature

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Date

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Nomenclature

AGD – Australian Geodetic Datum

AHD – Australian Height Datum

DCDB – Digital Cadastral Data Base

DSE – Department of Sustainability & Environment

GDA – Geocentric Datum of Australia

GIS – Geographic Information System

MGA – Map Grid of Australia

PSA – Proclaimed Survey Area

PSM – Permanent Survey Mark

SCDB – Survey Control Data Base

SCN – Survey Control Network

SSN – State Survey Network

Chapter 1

Introduction

1.1 Background

This project has been developed to address various issues raised by a large number of Victorian surveyors and the Surveyors Generals Office of Victoria. The project has been developed to investigate the current state of the Victorian Permanent Survey Mark (PSM) infrastructure. Issues have been raised with regard the PSM density and distribution with many industry representatives believing that PSM infrastructure is on the decline and present legislation and regulations are not adequate.

The Survey Control Network (SCN) in Victoria is a network that has been continually developed over the past fifty years and predominantly consists of PSM's. The continued placement and coordination of PSMs is essential to the development of the State Survey Network (SSN).

In Victoria the current requirements for the placement and connection of PSMs have been primarily aimed at improving the relationship between land parcels and the state SCN. The development of various state legislations and regulations has encouraged surveyors to connect new surveys to the state control. The connection to existing surveys creates an integrated network of survey control.

The PSMs used throughout the state are ground marks and are seen as the cornerstone of survey coordination. Victoria's PSM infrastructure can be defined in both vertical and horizontal directions that are defined by two separate datums. The horizontal datum that has been adopted is Map Grid Australia (MGA), the vertical datum is the Australian Height Datum (AHD). PSM infrastructure is to a degree being maintained and expanded, with most expansion being completed by the private sector surveyor and is achieved during the course of the undertaking of major construction or subdivision projects. Regulations in Victoria enforce the rule that cadastral surveys must connect to at least two permanent cadastral marks and for subdivision developments with 10 lots or greater the placement of new permanent marks is required.

In Victoria the SCN geodetic infrastructure totals approximately 165 000 units. This infrastructure is presently the responsibility of the Surveyor General of Victoria which presently is the primary governing body for the states PSM infrastructure (Tulloch, 2007). The positioning of new PSMs allows a network to develop and expand, this is an essential aide to the surveyor in spatial positioning. Surveyors and various government departments rely heavily on this Victorian network. The coordination of PSM infrastructure will determine the future integrity and density of the SCN. Survey legislation and regulations have been developed by the state that ensure that mark numbers are continually being increased and that survey marks are to be connected to geodetic survey control. The inception of such legislation and regulations has had an effect on the development of the state survey control.

This project was developed to enable the investigation and analysis of Victoria's PSM requirements and the density and distribution of PSMs throughout the state of Victoria.

1.2 Project Aims & Objectives

The main aim of this research project is to investigate the existing PSM infrastructure and identify if the density and distribution of PSM's within the state is adequate. It will also investigate PSM requirements placed on surveyors through reviews of various state legislations and regulations. This investigation will enable a greater understanding if the current PSM infrastructure that is in existence in Victoria meets the needs and requirements of surveying professionals who rely on its accuracy and its continual densification. It will also aim to give an indication if the states survey infrastructure is declining.

The main objectives of the project are to:

- Research the background information relating to the Victorian permanent survey mark infrastructure.

- Analyse two Local Authority areas of the Survey Control Database to evaluate the density and distribution of the permanent survey mark infrastructure in Victoria.

- Examine the current Victorian survey requirements with regards to PSMs.

- Evaluate the effectiveness Victorian survey requirements with regard to PSM density and distribution.

- Through the analysis of results propose improved guidelines for the successful development of permanent survey mark infrastructure.

1.3 Justification

This project is directed at the discovery of improvements that can be made to the Victorian SCN infrastructure. If improvements can be identified then the benefits would be measurable in both efficiency and accuracy.

Through the increased expansion and maintenance of infrastructure within the SSN it enables the organisations that rely on the system to have tasks completed at a more efficient rate while being accompanied by high degrees of accuracy. A cadastral surveyor can effortlessly connect ground surveys to high accuracy PSM, this intern allows for the improved accuracy of Digital Cadastral Databases (DCDB) such as the Vic map Database. The many organisations that use the DCDB will then have the follow on benefit.

With the number of organisations requiring the need for spatial information continually on the increase, requirements to have high density and accurate network of PSM infrastructure will continually increase. The legislation, regulations and state departments that enforce the development of this valuable infrastructure should be required to show that the states development of PSM infrastructure is not decreasing but rather increasing at a rate that is deemed acceptable.

1.5 Summary

The PSM infrastructure with regard to density and distribution in the state of Victoria is under investigation. Presently the infrastructure is known to be developed through Legislation and Regulations, but to what degree? , and is the density and distribution of these PSM's acceptable?

This chapter has seen the introduction to various issues and areas of investigation that this research project will address. The general aims and objectives of this project have been discussed and further discussion of these points will be completed in depth in later chapters.

Chapter 2

Literature Review

2.1 Introduction

This chapter seeks to give some perspective to how the PSM infrastructure in Victoria is developed. This is achieved through the review and analysis of the history of Victorian PSM's and how this infrastructure has evolved over time.

The aim of the chapter is to discuss the issues that have had an impact on PSM density and distribution. The chapter will review various legislation and regulations that relate to the connection, installation and development of PSM infrastructure. This chapter will also discuss the Survey Control Database (SCN), Proclaimed Survey Areas (PSA) and PSM maintenance. The main issues relating to density and distribution will also be reviewed.

The outcome of this chapter will be to develop a much greater understanding of various factors that have influenced the development of PSM infrastructure within the state of Victoria.

2.2 Permanent Survey Mark Overview

The PSM is used to help the development of a network of reliable survey marks and is seen as the cornerstone of survey coordination.
(Institute of Surveyors, 2002)

The PSM is a major survey mark that is placed by a surveyor to aide them in the establishment and re-establishment of land parcels. The marks are usually attributed with both horizontal and vertical attributes. These marks form part of the Victorian SCN.

There are four general specifications given for the construction of permanent marks. Each is a variation of a mark cast in situ with two being for more permanent fixture each of these marks is installed with one of five different metal tablets. These marks and tablets are defined in the Survey Coordination Regulations 2004.

2.3 Proclaimed Survey Areas

In Victoria the establishment of Proclaimed Survey Areas (PSA) began in the 1950's. The main objective of the PSA was to have a staged progression towards the achievement of state wide coordination. In Victoria there are 179 Proclaimed Survey Areas, with each of the PSA having the authority of the Survey Coordination Act 1958 (Institution of Surveyors Victoria 2002).

The development of the PSA was seen as a major step towards the increase in density and coordination of the SCN within Victoria. Before areas were proclaimed, PSMs were placed in the land and the densification of the network begun, control surveys then were conducted to provide coordinates and bearings on AMG. The concept of the PSA was introduced in the Survey Co-ordination Act 1958 and it required all surveys to connect to the Australian Map Grid (AMG) within that area (Hallyburton 2002). Since its inception Victoria has moved to adopt MGA and has updated information accordingly.

Since the inception of the PSA it has allowed for all new survey data to be moved onto a common datum. The properties associated with PSM's have also increased, with increased coordinate and level information. The PSA has undoubtedly been a major factor and a major contributor in the continued development of PSM infrastructure in the state of Victoria. It was an issue that many areas that were outside that of a PCA were not seen to be benefiting by the increased infrastructure. This will be investigated in further chapters.

2.4 The Survey Control Database (SCD)

In Victoria the Survey Control Database is a computerised dataset that is a dynamic record of the State's survey control infrastructure. The current Victorian network comprises of approximately 140 000 survey marks. These survey marks each have associated heights and positions to varying degrees of accuracy. Marks that are incorporated into the database are physical ground marks that include Permanent Survey Marks (PSM), Primary Cadastral Marks (PCM) as well as a network of GPS base stations. It is to be noted that from the 140 000 survey marks that make up the SCN and are incorporated into the SCD that 100 000 of these survey marks are estimated not to have sufficient class or order to be used for surveying purposes (Tulloch 2007).

The SCDB in Victoria is known as the Survey Marks Enquire Service (SMES). This database is the official register of survey marks within the state. It provides interactive, online access to survey mark information and contributes to the Surveyor-General's management of Victoria's survey control network (DSE 2008).

Access to the SMES system is through an online webpage and can be gained by both registered and non registered users. This access is now granted for free as the maintenance of the survey infrastructure was seen as a priority. General access gives users access to all PSM information including sketch plans. With registered users there is increased access, users are able to upload PSM data including coordinates, sketch plans and update mark status.

The database is the resource that is used to gain access to the states SCN. The SCN is the network of PSM's which provides framework to which land, boundaries, development, infrastructure, mapping and spatial information is related. Information that is essential for both geodetic and cadastral surveys can be accessed through this database and includes information relating to positional information of PSMs.

Through the investigation and history research using SMES it will help determine if changes to legislation or regulations have produced the desired results. Bell (2003) brings to attention the view that the maintenance levels performed on the network was below that of other states. From the 100 000 survey marks estimated to be of an unacceptable class to be used for survey proposes it was reported that approximately 30% of those marks were either destroyed or unable to be located. This further enforces the need to maintain the SCN and keep the SCDB updated.

2.5 Legislation & Regulations

To develop a greater understanding of what legal requirements are in place with regards to the development of PSM infrastructure a review on various legislation and regulations that relate to PSM's has been conducted.

In the state of Victoria the Survey Co-ordination Act 1958 and the Surveying Act 2004 have been developed and provide the primary legislative framework for surveyors undertaking any geodetic or cadastral surveys. These two legislations contain the major elements for all PSM requirements.

The Survey Coordination Act 1958 is the principal legislation dealing with Victoria's geodetic infrastructure. This infrastructure is also referred to as the SCN. The Act with regard to PSM infrastructure was created to establish Victoria's network of PSM's to support a national geodetic and cadastral network.

The Survey Coordination Act 1958 is based on four main principals that enable the establishment an efficient system that:

- Minimises the duplication of any survey work, thus reducing community costs.

- Provides for the lodgement of plans and surveys by departments and authorities.

- Controls survey procedures and stipulates accuracy standards required by the community and spatial industry and,

- Enables the establishment of Victoria's network of permanent survey marks to aid the development of the geodetic and cadastral networks. (Tulloch 2005)

In 2002 there was a review of the Survey Coordination Act 1958. The Act developed was seen to reflect priorities dating back to the 1940s. Survey and mapping techniques in Victoria were seen to be vastly different from those existing in the 1940s. The review was made for the examination of the legislative and regulatory framework for survey and spatial information in Victoria. On the completion of the review found underlying principles of the Act remain valid and current, particularly the principles of coordinated acquisition of survey information and the implementation of simple and effective access arrangements for survey information from a single authoritative point of access . (Land Victoria, 2003)

Regulations that have been made under the Act include the Survey Co-ordination Regulations (2004). The regulations include the objective to provide for the connection of surveys to existing surveys, standard traverses and permanent marks.

The Surveying Act 2004 was created in the mist of the review of the Survey Coordination Act 1958. The Surveying Act (2004) replaces the Surveying Act 1978. The main objectives as stated Section 1 of the Act are:

- to provide for the annual registration of licensed surveyors to perform cadastral surveying in Victoria;

- to provide for investigations into the professional conduct of licensed surveyors;

- to establish the Surveyors Registration Board of Victoria;

- to provide for the establishment of the Surveyors Registration Board of Victoria Fund;

- to repeal the Surveyors Act 1978 and make consequential amendments to other Acts;

- to provide for fees for the maintenance of the survey control network

Regulations that have been made under the Act include the Survey (Cadastral) Regulations (2004). A main objective of these regulations is to prescribe standards for cadastral surveys. The regulations prescribe that survey in a PSA must connect a cadastral survey in accordance with the requirements of the Survey Coordination Act 1958. All surveys outside a PSA are to now be connected in accordance with the Surveying Act 2004. The requirement to connect cadastral surveys to the standard traverse and required permanent marks within a PSA is replicated by similar requirements under the Surveying (Cadastral Surveys) Regulations 2005 and prior to that the Surveying (Cadastral Surveys) Regulations 1995 for all cadastral surveys within the state. With the implementation of the Surveying Act 2004 all areas of Victoria now contribute to developing state wide coordination. (Tulloch 2007)

2.5.1 Permanent Survey Mark Connection

The primary function of connecting cadastral surveys to MGA94 and collecting coordinate information for parcel corners is to provide for the updating of the States digital cadastral map base index.

Section 12(3) (a) of the Survey Coordination Act (1958) and Section 14 of the Survey Coordination Regulations (2005) state that a cadastral survey within or contiguous to a proclaimed survey area must be directly connected to at least two permanent survey marks that are on a standard or local traverse.

The Survey Coordination Regulations 2005 require the connection of cadastral surveys to MGA94 datum in the manner specified in that of the Survey Coordination Regulations 2004.

Practice directives released by the surveyor general that are designed to interpret legislation and regulations stipulate the following specific requirements for all cadastral surveys within or outside a PSA.

Subdivisions creating 10 Lots or More a surveyor must

(a) Connect to at least to known 3rd order MGA ground marks that are shown in SMES to 0.001m.

(b) Rotate the survey onto MGA94 datum

(c) Provide MGA94 coordinates for all the PSM's and PCM's connected to 0.01m.

(d) Provide MGA94 coordinates for parcel corners of the land under survey to 0.01m.

(DSE 2009)

A subdivision creating less than 10 lots must connect the same as above. However if there is only one 3rd order and one 4th order, or two 4th marks within a 500m radius or within 3 setups then this must be adopted for the MGA94 datum. If this is so then directives state that coordinates must not be provided for new PSM connections but may be provided for parcel corners. Thus cadastral surveys will only increase the accuracy of the PSM infrastructure if cadastral surveys are connected to two 3rd order PSM's.

2.5.2 Placement of Permanent Survey Marks

The placement and preservation of PSM's is one of the essential components in the development and maintenance of the state survey infrastructure. The placement of all Permanent Survey marks in Victoria is established under Survey Coordination Act 1958.

Survey Coordination Regulations (2004) Section 6 states that permanent survey marks placed under the Act must be placed where it is least likely to be subject to damage, disturbance, removal or to constitute a hazard. It also must be placed in an area able to facilitate horizontal and vertical connections to existing and future marks and must be placed in a stable location. The regulations also state that the permanent mark shall be made of a durable, permanent and stable construction material.

Section 15 of the Survey Coordination Act 1958 also states that marks can be created upon crown land. The marks can also be created upon any public street, lane or thoroughfare, upon any privately owned land (with consent of the owner) or upon any land vested in or under the care and management of any department or public authority or any committee of management or body of trustees for any public purpose.

2.5.3 Permanent Survey Mark Maintenance

To obtain and sustain PSM infrastructure continual maintenance of the physical marks is required. Tulloch (2009) believes that in principal this maintenance and development is invariably this is performed by private sector surveyors while completing large construction projects or major subdivisions.

Under the Survey Co-ordination Act 1958, responsibility for the establishment and maintenance of the permanent marks and the SCN is the joint responsibility of the Surveyor General and departments and public authorities involved in undertaking surveys.

Section 8 of the Survey Coordination Regulations 2005 gives the process for the removal, replacement or irregularity in position of permanent survey marks

2.6 Victorian Permanent Survey Mark Statistics

Operational statistics for PSM's can be found within the Annual report on the Administration of the Survey Coordination Act 1958 (2002, 2007). This document is produced under Section 20 of the Survey Coordination Act.

A comparison between 2001-2002 & 2006-2007 annual report shows the following statistics:

- The total number of PSM's in Victoria were 135 175 in the 2001-02 period. The 2006-07 period shows Victoria with 139 417. This is an increase of 4242 (3%) of PSM's in a five year period.

- The total number of PSM's (excluding those recorded as damaged, disturbed, destroyed, missing or not found) in the 2001-02 period were

102 828. In the 2006-07 periods there were a total of 107641. This is an increase of 4813(4%) in PSM's.

- The total number of PSM's with both rigorously adjusted GDA94 coordinates in the 2001-02 period was 19 836. In the 2006-07 period there was in increase to 23 077 marks, an increase of 3241 (14%) PSM's.

- The total number of PSM's with AHD 4th order or better accuracy in the 2001-02 period was 39 825. In the period of 2006-07 there were shown to be 42 979, this is an increase of 3154 (7%) PSM's.

2.7 Density

Density 'the degree to which something is filled' (Wilkes 1980).

Density in terms of PSM infrastructure as in a Report on Public Sector Agencies (Victorian Auditor General 2002), shows PSM density can be viewed in the form of both the number of marks per parcel of land and the number or marks per square kilometre.

The report shows that the total number of crown & freehold parcels within the state were 2400000 and total number of marks in the SCN was 143 800. Of the

143 800, 102 828 were existing PSM's. Information shows that the density in relation to parcels is one PSM per 23.34 parcels of land. The density per sq.km in the period 2001-02 equates to one PSM per 0.88 sq.km.

In Victoria, surveyors have indicated that the density of marks is generally reasonable in regional towns and cities but is not adequate in many rural areas and in some metropolitan areas of Melbourne.
(Victorian Auditor General 2002)

2.8 Summary

The aim of the chapter was to discuss and identify any issues that have had an impact on PSM density and distribution. The reviews of legislation and regulations and introduction to the Victorian PSM history, Survey Control Database, Proclaimed Survey Areas and PSM maintenance achieved these goals.

Chapter 3 will discuss what research techniques will be used to examine the issues relating to the density and distribution of PSM's.

Chapter 3

Research Design & Methodology

3.1 Introduction

The main research component of this project involved the thorough analyse of two local authority areas within the state of Victoria, the areas that were selected were Mildura and Bendigo.

The main aim of the investigation into the two study areas was to evaluate the density and distribution of the permanent survey mark infrastructure within the state of Victoria. It also aimed to gain an understanding if the existing PSM infrastructure in these study areas contained an acceptable level of attribute data. The level of attribute data was desired as to give an indication if the PSM's within the study areas were providing surveyors with a functional capability as well as allowing the surveyor meet various regulation requirements. The level of attribute data also gives an indication of the accuracy the SCN and SCDB through the conduction of ground surveys.

This goal was achieved through the importing of relevant Vic Map and SMES data into AutoCAD Map software and analysing results.

3.2 Study Area

To gain the knowledge that was required to determine if the PSM infrastructure achieved the general aims of the research component the investigation two case study areas were selected.

The two areas that were chosen for the study were located within the Victorian cities of Mildura and Bendigo. The general locality of the study areas can be seen in Figure 3.1. Mildura is an inland city situated in the states north-west. Mildura's study area is predominantly seen as urban however there is a small pocket of rural area included. Bendigo is situated in the centre of the state and is seen as a much larger city to that of Mildura. The Bendigo study area does not contain any rural areas and is urban.

Figure 3.1 – Study Areas (Google Earth, 2009)

3.2.1 Study Area 1 – Mildura

The first study area that was investigated was located within Mildura. Mildura is a Victorian city located in the states north-west. The study area can be viewed in Figure 3.2. Mildura currently has a population of 30 000 residents, the town is very isolated with it nearest capital city being Adelaide.

The study area is approx. 4500 hectares and is bound by the Murray River and four main arterial roads. The study area consists of approximately 80% urban development including business, industrial and residential zones. The remaining 20% of the area is rural and crown reserves.

Figure 3.2 – Study Area 1, Mildura (Google Earth, 2009)

Mildura was selected as a study area due to the large levels of development the city has seen over the past decade. It was also selected due to the fact that Mildura was not developed as a PSA. This analysis of this study areas data will hopefully give an indication if areas outside a PSA have the same issues to that of a PSA. It will also give a good comparison between the second study area under investigated as it is in a PSA.

The Mildura study area contained 200 PSM's that were seen to be in good condition. These marks were seen as existing and have not been disturbed or destroyed.

3.2.2 Study Area 2 – Bendigo

Bendigo is located in central Victoria, the city and study area are approximately 150km north of Melbourne. The study area can be viewed in Figure 3.3. Bendigo is seen as one of the fastest growing regional centres in the state of Victoria, with the population growing from 72 000 in 1991 to more than 100 000 in 2009. (City of Greater Bendigo 2009)

The study area is approx. 2700 hectares. The study area consists of primarily urban development including business, industrial and residential zones. The area covers a good spread of both new and old land parcels.

Figure 3.3 – Study Area 2, Bendigo (Google Earth, 2009)

Bendigo was chosen for a study area for a number of reasons. The main reason for its selection is that it is located in PSA No: 2 & 34, as stated in previous sections, this will give an indication if issues with PSM's within a PSA are similar to those or areas outside a PSA. The study area contains more than 900 PSM's that are seen to be in good condition. These PSM's were also used for the analysis of various attribute data.

3.3 Research Methodology

The two study areas were investigated using information provided within the SMES database. Information was analysed using the AutoCAD Map and Microsoft Excel software packages. This software was used to analyse PSM density, density of marks with various attributes, distribution of marks and the general history of those marks within the study areas.

The Vic Map database is provided on MGA coordinates, drawing data for each of the study areas was used as a base map within the GIS software. The information relating to PSM's within the study areas was obtained from the SMES database. This data was then overlayed and then separated into various categories that related to different PSM attributes. The analysis of these categories was then completed and results obtained.

In order to perform the investigation into the density and distribution of marks and also include the investigation into attribute information, attribute data for all PSM's was obtained through the SMES database.

Searches within the SMES database were done based on a radius in excess of the defined study areas, this was completed to obtain all relevant PSM information. Information that was gained through these searches included the

PSM identification, MGA easting's, northing's, level information (AHD) and the order of coordinates and levels.

Information was presented in tabular format within the SMES database search. This data was then imported into Microsoft Excel. When the import of data was completed for each of the study areas, PSM data was then broken into the different categories that would be later analysed. These categories can be viewed in table 3.1.

Table 3.1

Category 1	Category 2	Category 3	Category 4	Category 5
PSM GOOD CONDITION	PSM GOOD COORDS	PSM GOOD LEVEL	PSM GOOD COORDS	PSM DESTROYED
			PSM GOOD LEVELS	

Good Condition = PSM not disturbed, not destroyed, found.

Good Coordinates = MGA coordinates of 4th order or better.

Good Level = AHD level 4th order or better.

On completion of the categorisation for each of the study areas, data was then ready to be imported into the AutoCAD Map software.

Information was exported into a .CSV file. This file contained all the desired and relevant attribute information. The AutoCAD Map software was then used to analyse this data. Each category was imported one at a time into the software program. The data was then placed into unique layers and group based on categories. Information was now able be viewed overlayed with the Vic Map study area parcel boundaries.

While viewing the overlay there where marks discovered that were outside the study area. This occurred due to the initial radial search being in excess of the study area. These marks outside the study areas were then deleted. The point groups and layers where then updated. This was completed for each case study. The analysis was then able to be completed.

Information was then exported from each group into a .CSV file. This was kept as a record for all PSM's within the study area. The names of the PSM's were then able to be searched in SMES to gain the marks history. Information relating to the installation date of each mark was documented.

To gain an understanding of density & distribution an analysis within the AutoCAD Map program was completed for each category. This analysis involved the calculation of the distance each PSM is in relation to its nearest neighbour. This was to be completed for each of the study areas.

A function was used inside the AutoCAD Map software that allowed for the increase in radius of a node that was representing each PSM. The node radius was increased at a rate of 5m. When the PSM's for each category overlapped to that of its nearest neighbour they altered in appearance, the distance (within 5m) of when each PSM overlapped to that of its nearest neighbour was then documented. The nodes were thus increased in radius at a rate of 5m until all PSM's were accounted for. Information relating to the density & distribution was then obtained. This is able to be presented in graph format in later chapters.

Practice directives released by the Surveyor General of Victoria give requirement of when completing a subdivision of less than 10 lots the minimum requirements to place coordinates on parcel corners to increase the accuracy of the DCDB is a surveyor must connect to two 4^{th} order PSM's on the MGA datum that are within 500m or three setups. If marks are outside this range then the survey is exempt from the requirements.

For the development of the project I then accepted that 500m was an acceptable distance between PSM's to reach my aim of discovering if PSM's within the study areas were providing surveyors with a functional capability. I was also able to see if the surveyor was meeting various regulation requirements that help increase accuracy the SCN and SCDB through the conduction of ground surveys.

Plans for each of the study areas were then completed. These were completed for Categories 1, 2 & 3. PSM's on the plans were surrounded by a buffer of 500m. The PSM's on the plan would overlap if they were within 250m to that of another mark. This gives a visual representation to the density& distribution of PSM's in the study areas. The plans were also able to give an indication of areas within the study areas that either required increased density or the density was seen as acceptable. These plans are presented in later chapters.

3.3.1 Result Assessment

The results that were obtained following the investigation of both the Mildura and Bendigo study areas gave a good indication into the density & distribution of PSM infrastructure in relation to various attributes that the PSM's exhibit. The results obtained enabled research aims to be met.

The overall results obtained from the study areas will be discussed in the following chapter. This chapter will also include a discussion and statistical analysis of the obtained results. Information that relates to results are displayed in plan and graphical format, all the results that have been obtained through research are explained in detail.

3.4 Summary

This chapter has discussed the main aspects of the research involved in regard the two study areas, Mildura & Bendigo. The research aspect was introduced to meet the general aims of the research project as discussed in previous chapters.

This chapter discusses the research approach that was undertaken and identified the study areas that were to be investigated. The approach into the analysis of the study areas was also explained. The research analysis mainly concerned itself with issues relating to the history, density, distribution, attributes and conditions of PSM's within the study. The analysis also provided results relating to the general usefulness of existing PSM infrastructure to surveyors.

Chapter 4

Results & Discussion

4.1 Introduction

This chapter will contain all the investigation results obtained from the two study areas in regard to PSM's. The results will be discussed and analysed in detail throughout this chapter.

The results of all findings for both study areas will then be reviewed. There will then be a discussion on the results obtained regarding the state of Victorian PSM infrastructure and if it seen to meet the requirements of surveyors. There will also be discussion on any improvements that can be through the definition of guidelines that enable the increase of PSM infrastructure within the state.

4.2 Case Study

Information was analysed using the AutoCAD Map and Microsoft Excel software packages. This software was used to analyse the PSM density & distribution, density of marks with various attributes and the general history of those marks within the study areas of Mildura & Bendigo.

To analyse the relative density & distribution of PSM's within the study areas results were gained in five different categories. Category 1 included PSM,s in good condition, category 2 included PSM's with good coordinates, category 3 PSM's with good levels, category 4 includes PSM's both good levels & good coordinates and category 5 includes PSM's that have been destroyed.

Plans were also completed in order to give an indication if PSM's within the study areas either required increased density or the density was seen as acceptable. The PSM's shown on plans are surround by a buffer of 250m. These plans have been conducted for categories 1, 2 & 3.

In order to obtain an indication if there have been any regulations that have had a positive or negative effect in the development of PSM infrastructure an analysis was conducted on the various installation dates of PSM's for each of the study areas.

4.2.1 Results Case Study 1 – Mildura

The Mildura study area contained a total of 200 PSM's in good condition. The study covered an area of 4500ha. This equates to 1 PSM per 0.23sq.km.

Condition 1 – PSM's in Good Condition

The study area contained 200 PSM's in good condition. Results for distribution calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.1.

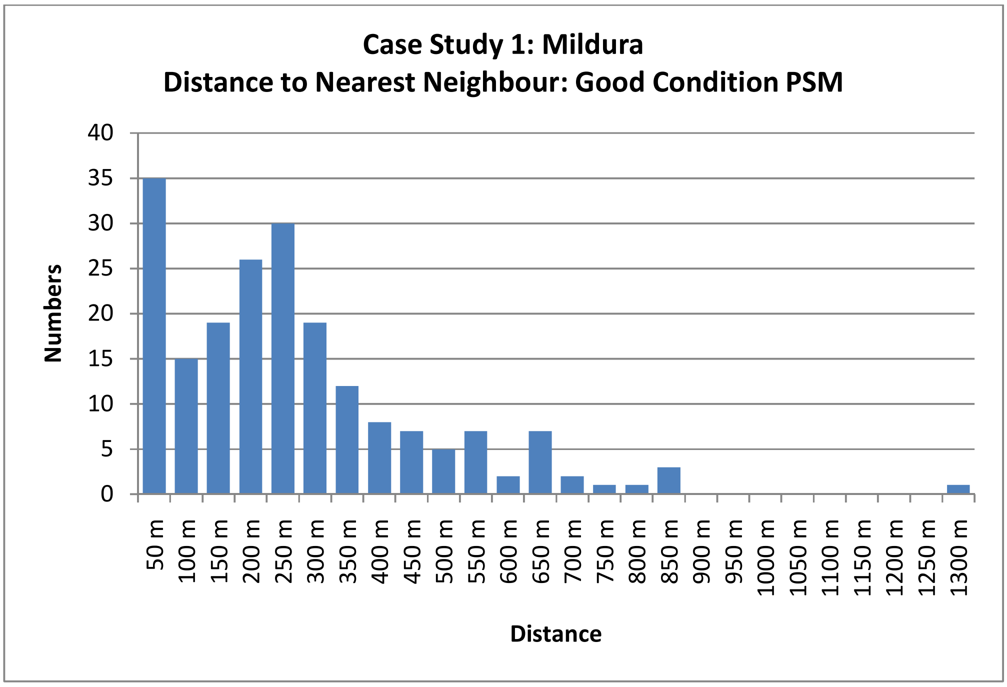

Figure 4.1

The analysis revealed results that showed the minimum distance between PSM's in good condition was 3m. The maximum distance between PSM's was 1320m with the median distance being 210m. Results also have revealed that 176 of the PSM's are within 500m of its nearest neighbour. This indicates a good level of distribution within certain areas.

Figure 4.2 was developed in order to give an indication if PSM's in good condition within the study area required increased density. The plan represents PSM's buffered at 250m. The plan gives an indication to PSM's that are more than 500m apart by being able to view the map base. This plan shows that the north-west seems to have adequate density, however toward the south-west in newly developed areas the density of PSM's seems inadequate and further densification may be required.

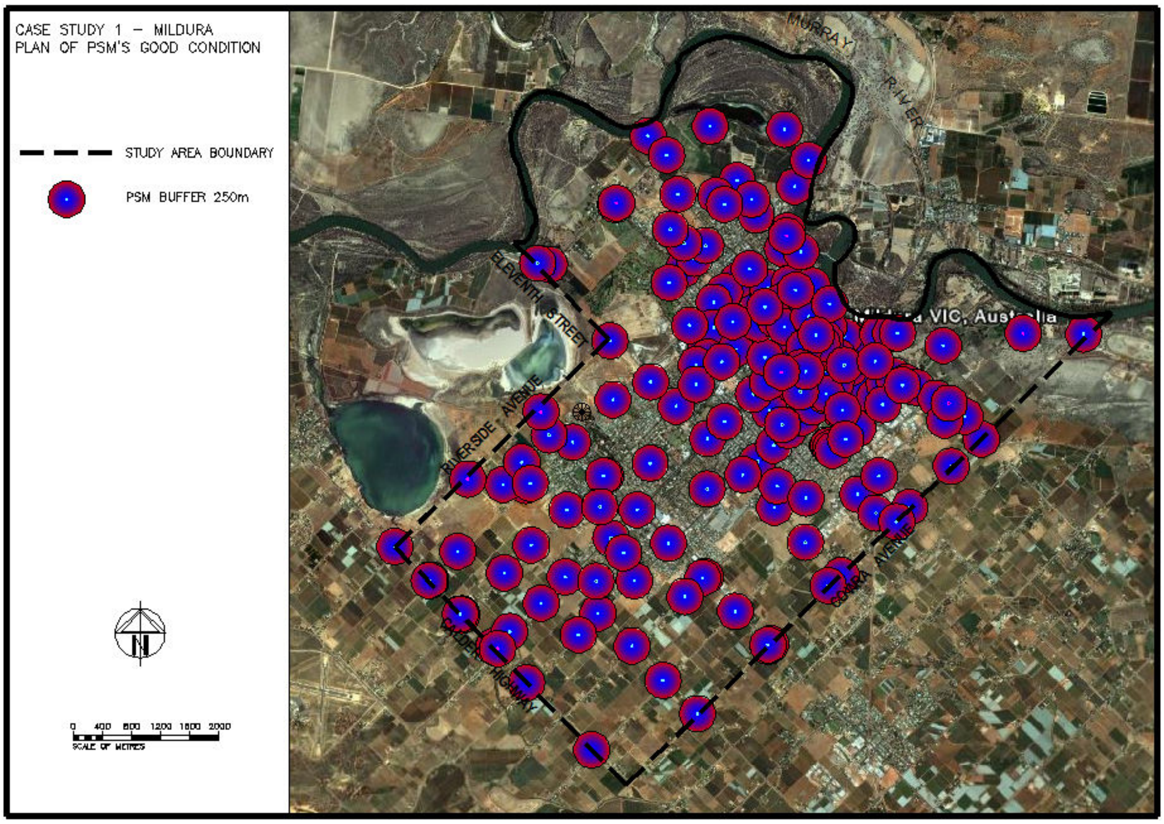

Figure 4.2

Condition 2 – PSM's With Good Coordinates (4th order or better)

The study area contained 78 PSM's that contained coordinates that were 4th order or better. This number of marks represents 39% of the marks within the study area and equates to 1 PSM per 0.23sq.km. Results obtained for distribution calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.3.

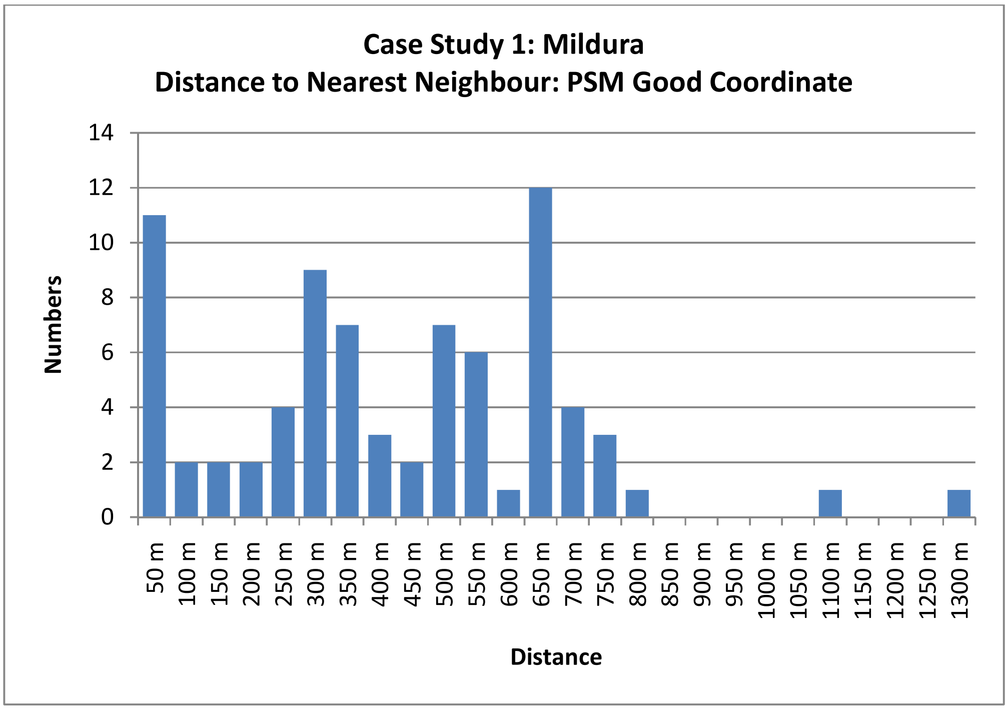

Figure 4.3

The analysis results that were obtained showed that the minimum distance between PSM's with good coordinates was 3m. The maximum distance between PSM's was 1320m with the median distance being 400m. Results also have revealed that 49 of the PSM's are within 500m of its nearest neighbour.

Figure 4.4 gives an indication if PSM's with good coordinates within the study areas require increased density. This plan reveals that the entire study area has a density issue that is required to be addressed. Through the analysis of the plan it can be seen that there are a very small number of areas where the PSM's buffer areas is in overlap, this indicates that there are density issues for PSM's within the study area that contain good coordinate attributes.

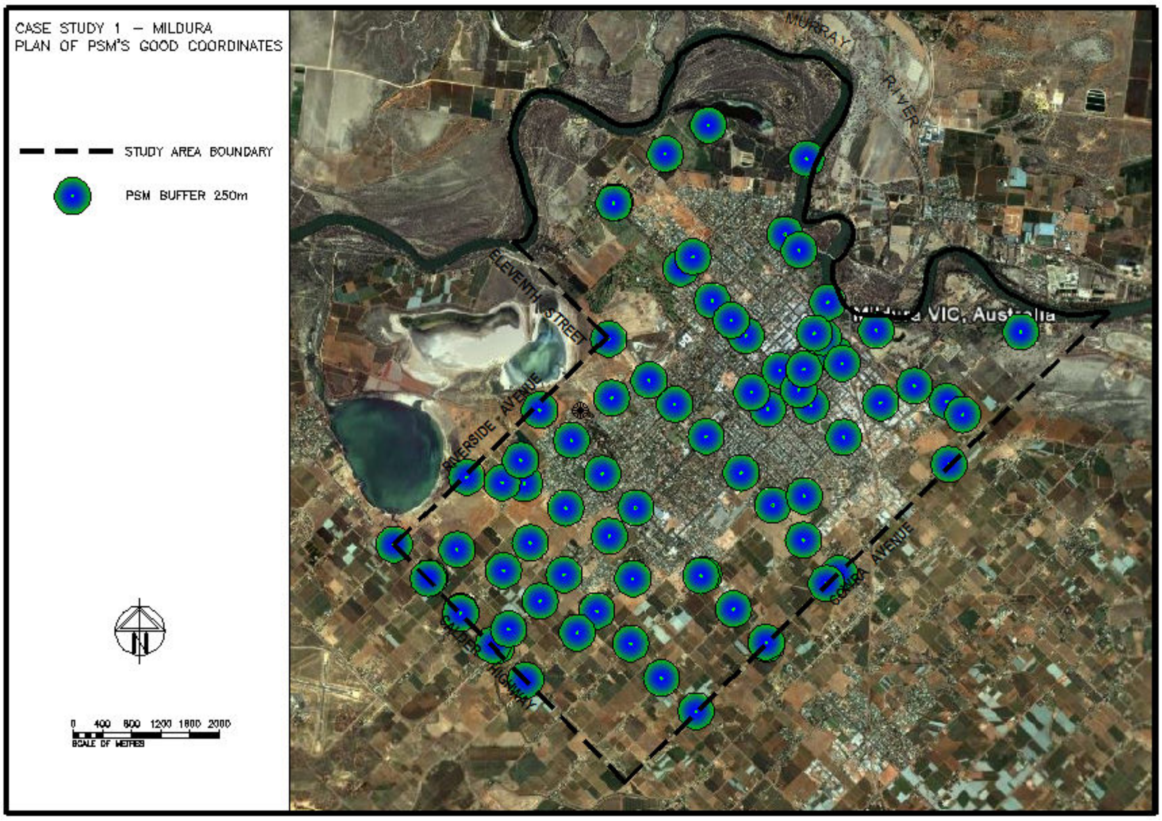

Figure 4.4

Condition 3 – PSM's With Good Levels (4th order or better)

The study area contained 17 PSM's that contained levels that were 4th order or better. The 17 PSM's represents 9% of the marks within the study area and equates to 1 PSM per 2.65sq.km. Results for distribution calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.5.

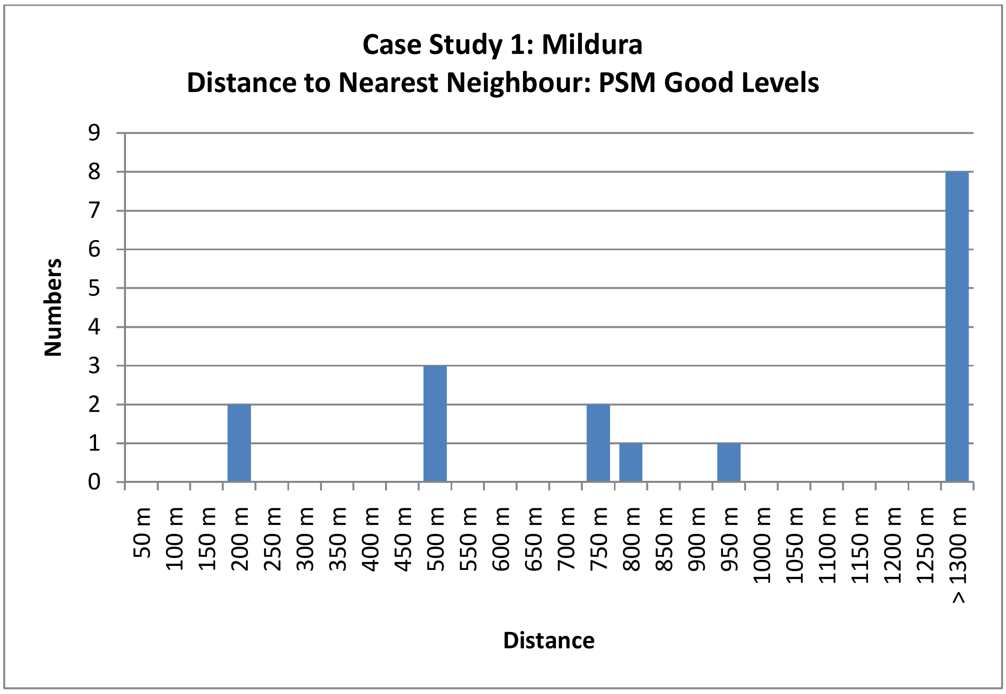

Figure 4.5

The analysis revealed results that showed the minimum distance between PSM's with good levels was 190m. The maximum distance between PSM's was 1440m with the median distance being 950m. Results also have revealed that only 5 of the PSM's are within 500m of its nearest neighbour.

Information displayed within Figure 4.6 gives an indication that PSM's with good levels within the study area require increased density. This plan shows that the entire study area has a density issue that is also required to be addressed. The plan shows that there is very limited level information placed on the PSM's within the study area. The density in regard to PSM level information is seen as being inadequate.

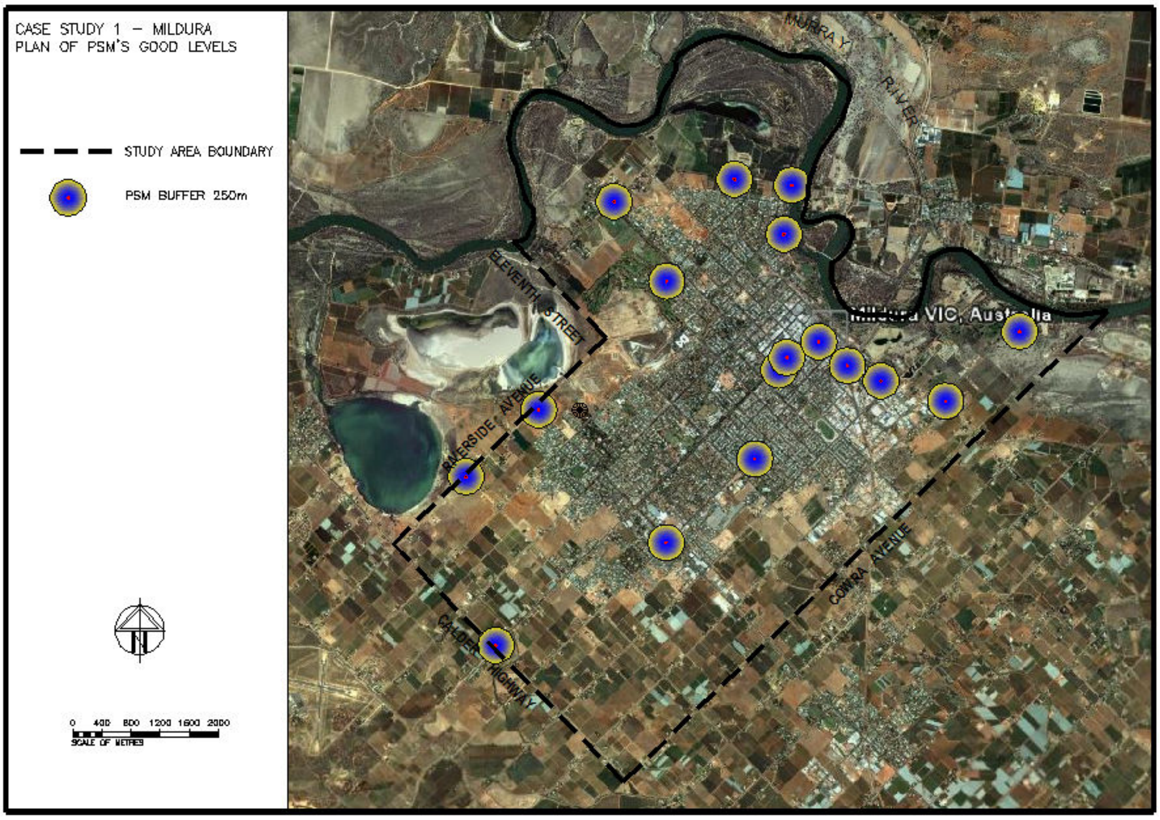

Figure 4.6

Condition 4 – PSM's with Good Levels & Coordinates

(4th order or better)

The study area contained 7 PSM's that contained both levels & coordinates that were 4th order or better. Theses marks represent a mere 3.5% of the marks within the study area and equates to 1 PSM per 7sq.km. Results for distribution calculations were that small a graph has not been produced. The analysis did however reveal the minimum distance between PSM's with good levels & good coordinates was 1370m. The maximum distance between PSM's was 2390m with the median distance being 1850m. Results also have revealed that PSM's are within 500m of its nearest neighbour.

PSM Installation Dates

The analysis results also revealed the installation period for each of the 200 PSM's. The analysis results can be viewed in Figure 4.7. The information shows that more than 35% precent of marks were placed with 1960-70. During this period Mildura was being considered as a PSA, however due to a lack of coordinate information it did not eventuate. Installation numbers have been consistent since 1970 with the exception of the 1990-2000 periods. Low installation numbers during this period have been attributed to low development in the study area.

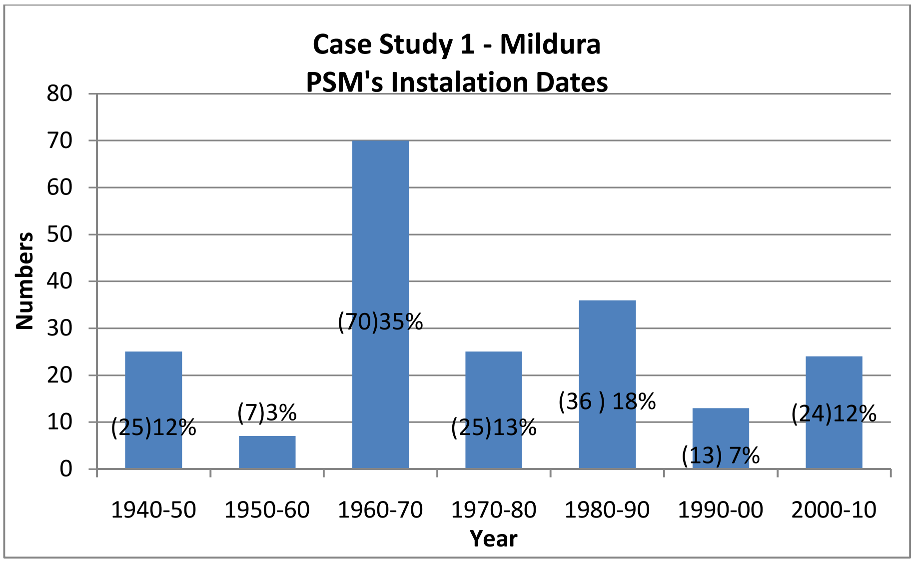

Figure 4.7

PSM's Destroyed

The results also revealed that there were PSM's within the study area that have been recorded on the SMES database as being classified as not found or destroyed. In the Mildura area there were only 5 PSM's registered as being in either of these categories during the period 1940-2009. This represents around 3% of the total marks. PSM information can be found in Appendix 'B'.

4.2.2 Results Case Study 2 – Bendigo

The Bendigo study area contained a total of 928 PSM's in good condition. The study covered an area of 2700ha. This equates to 1 PSM per 0.03sq.km.

Condition 1 – PSM's in Good Condition

The study area contained 928 PSM's in good condition. Results for distribution calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.8.

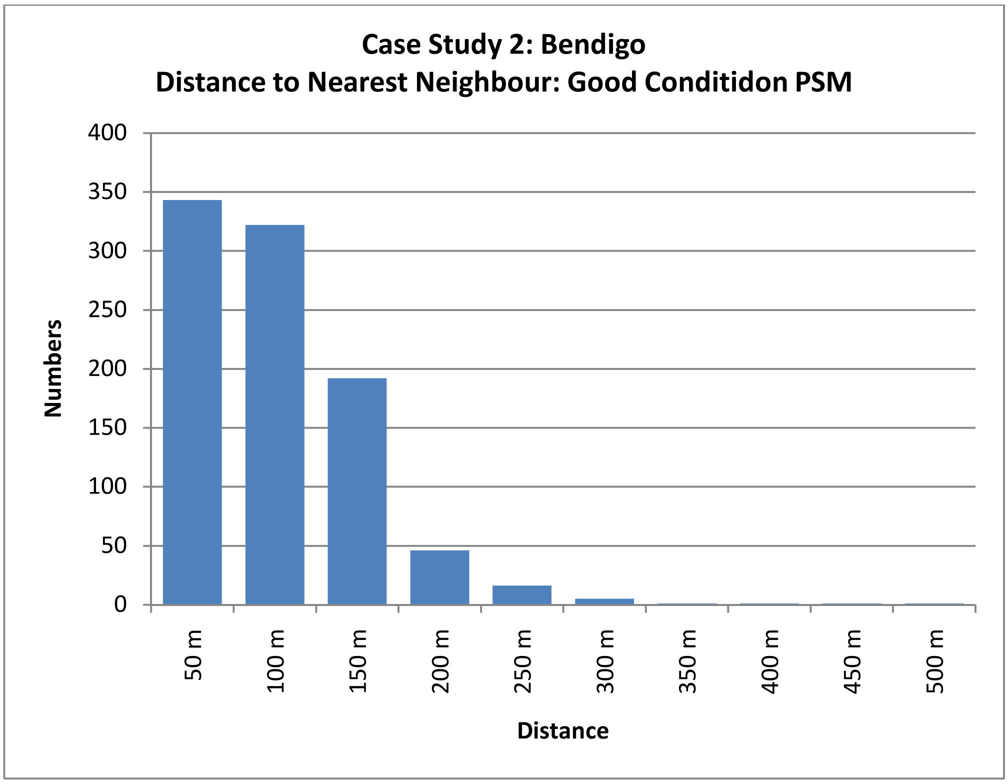

Figure 4.8

The analysis revealed results that showed the minimum distance between PSM's in good condition was 1.3m. The maximum distance between PSM's was 494m with the median distance being only 69m. These results have found that all 928 PSM's within the study area are within 500m of its nearest neighbour.

Figure 4.9 was developed to give an indication if PSM's in good condition within the study areas required increased density. The plan represents PSM's buffered at 250m. The plan gives an indication of a density issue by being able to view the map base if PSM's are more than 500m apart. This plan reveals that the density of the PSM's within the study area are more than adequate and much higher density in comparison to study area 1.

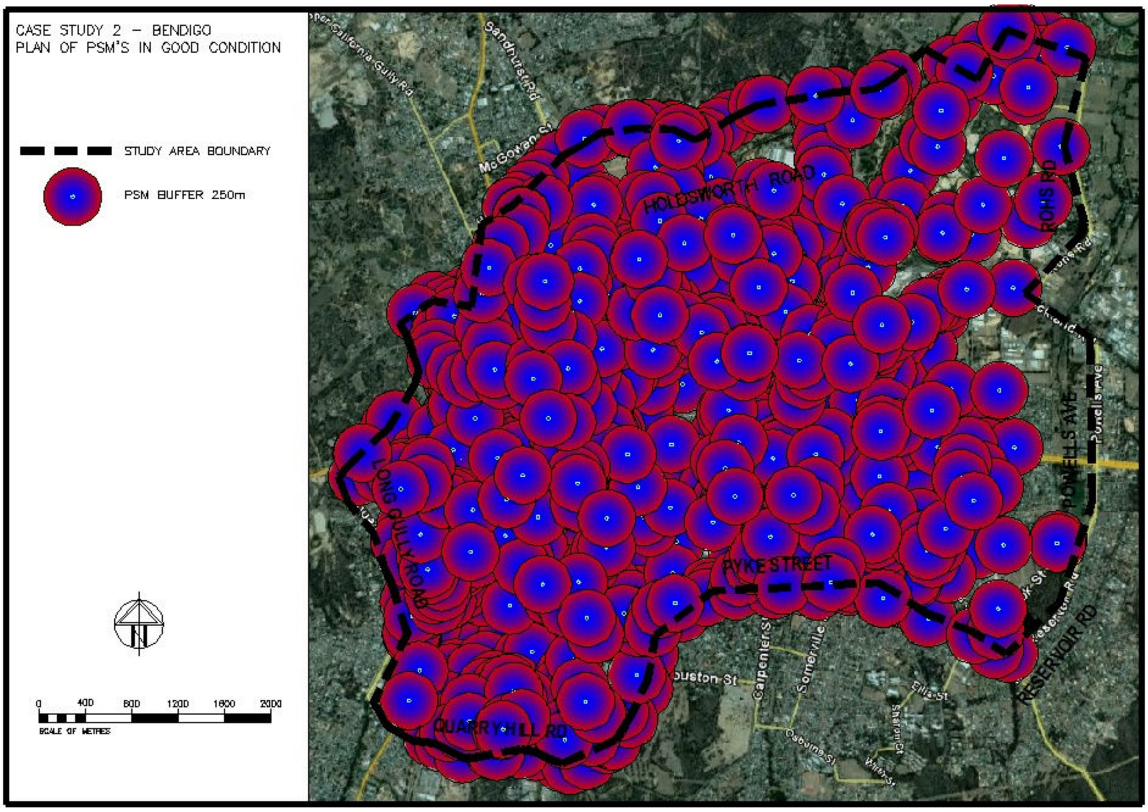

Figure 4.9

Condition 2 – PSM's With Good Coordinates (4th order or better)

The study area contained 327 PSM's that contained coordinates that were 4th order or better. This number of marks represents 35% of the marks within the study area and equates to 1 PSM per 0.08sq.km. Results for distribution calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.10.

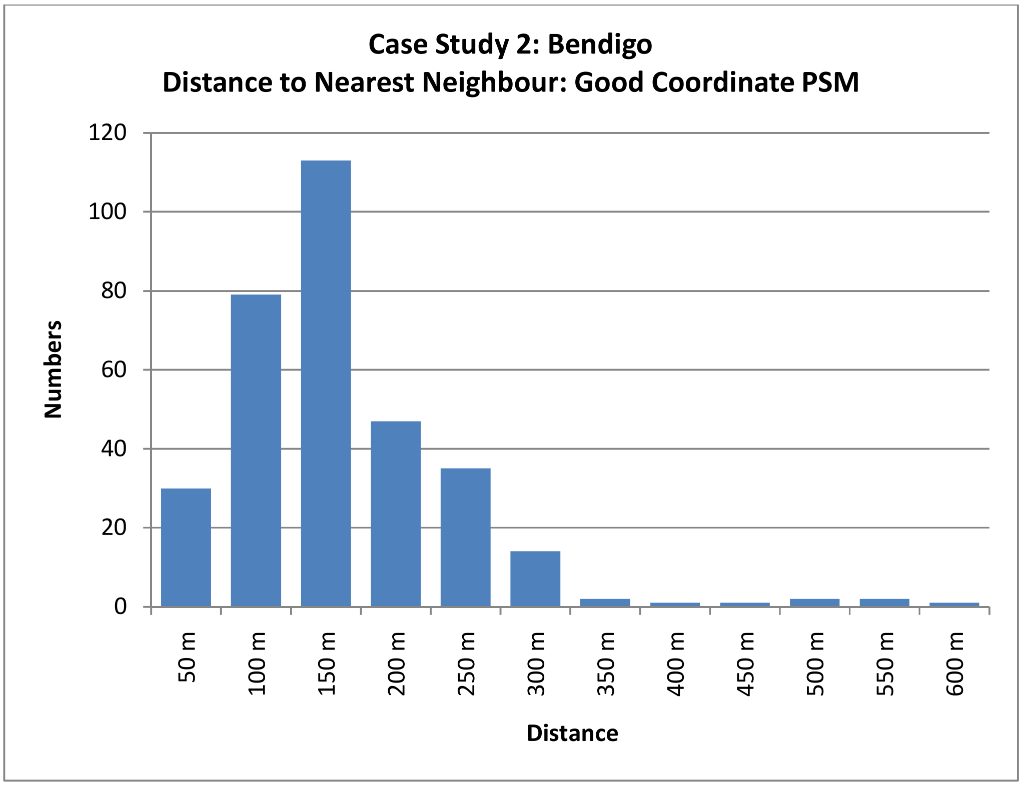

Figure 4.10

The analysis results obtained showed that the minimum distance between PSM's with good coordinates was 17m. The maximum distance between PSM's was 581m with the median distance being 124m. Results also have revealed that 324 of the 327 PSM's are within 500m of its nearest neighbour.

Information displayed within Figure 4.11 gives an indication that the density of PSM's with good coordinates within the study area is of an adequate density. This plan reveals that the only area that exists where improvement can occur is to the study areas east side. All other areas within the study zone are predominately covered by the 250m PSM buffer.

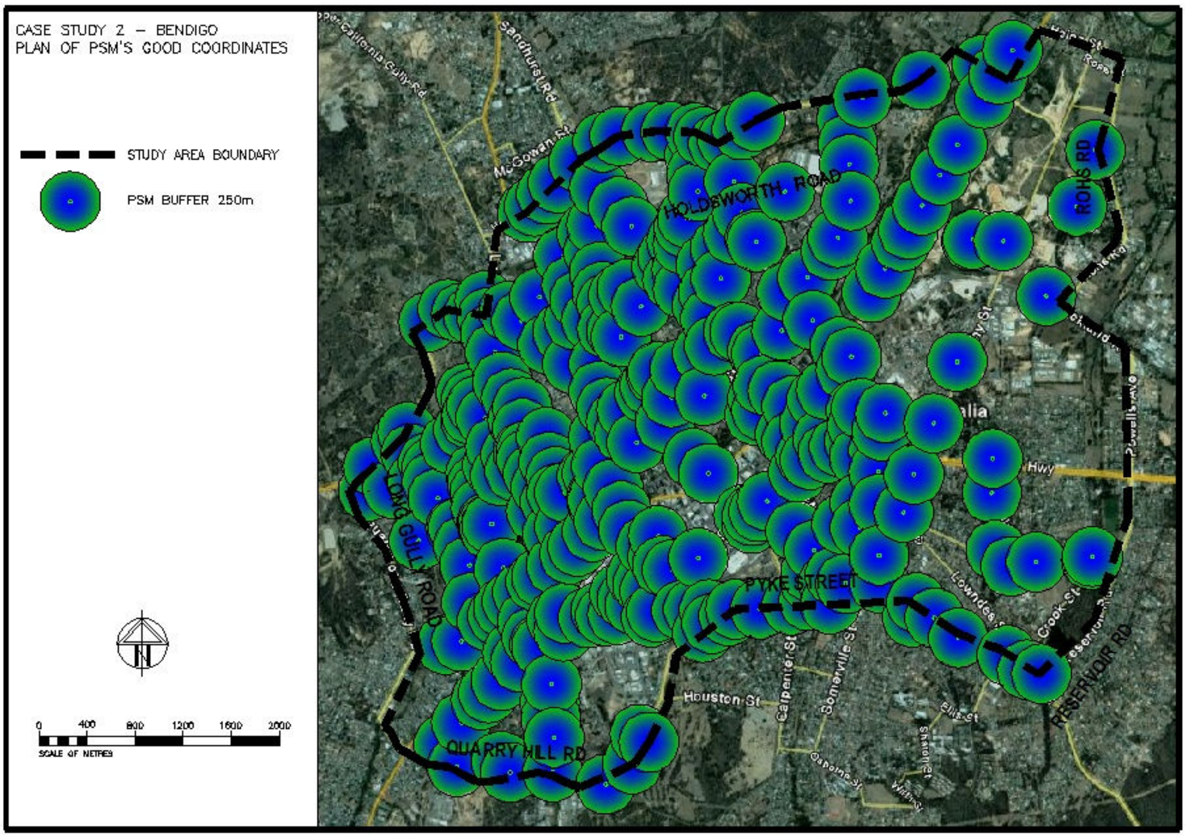

Figure 4.11

Condition 3 – PSM's With Good Levels (4th order or better)

The study area of Bendigo contained 454 PSM's that contained levels that were 4th order or better, representing 49% of the total PSM's located within the study area and equates to 1 PSM per 0.06sq.km.. Results for distribution calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.12.

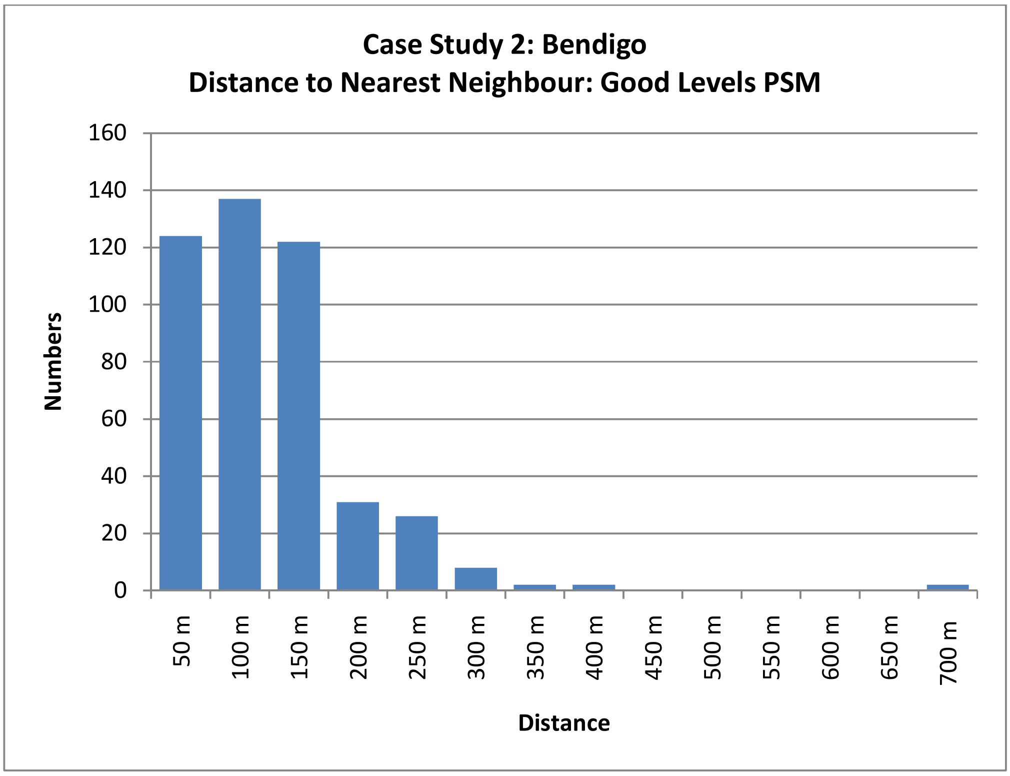

Figure 4.12

Analysis results obtained revealed that the minimum distance between PSM's with good levels was 10m. The maximum distance between PSM's was 681m with the median distance being 138m. Results show that 452 of 454 PSM's are located within 500m to that of its nearest neighbour.

Figure 4.13 gives an indication that the density of PSM's with good level information within the study area is at an acceptable level. This plan reveals similar information to that discovered on the PSM's with good coordinates.

The only area that can be identified as requiring to have more marks with level information is located to the east of the study area. The plan shows that in general the level information found is adequate for surveyors.

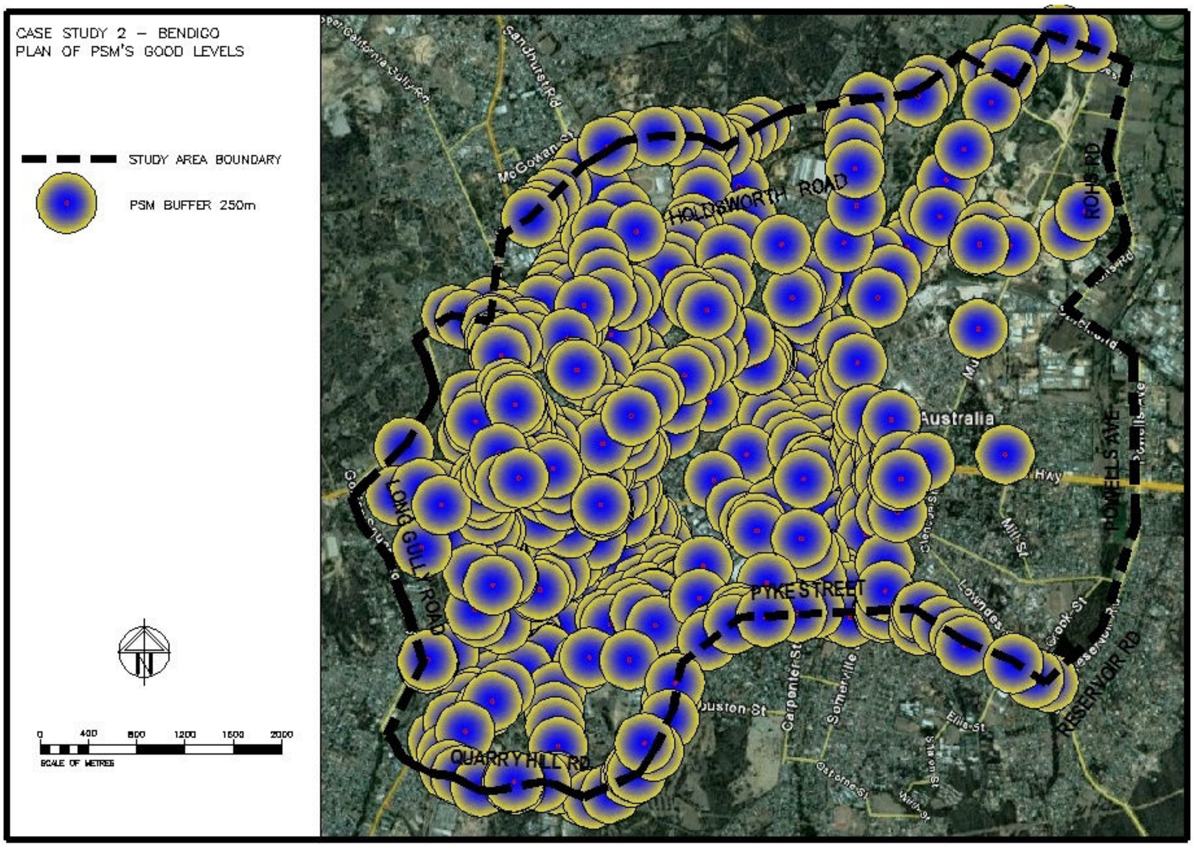

Figure 4.13

Condition 4 – PSM's with Good Levels & Coordinates

(4^{th} order or better)

The Bendigo study area contained 289 PSM's that contained both good levels & coordinates that were 4^{th} order or better. The PSM's in this section equates to

31% of the total PSM's within the survey area as well as 1 PSM per .09sq.km. Results for density calculations made for PSM's to the nearest neighbour can be viewed in Figure 4.14.

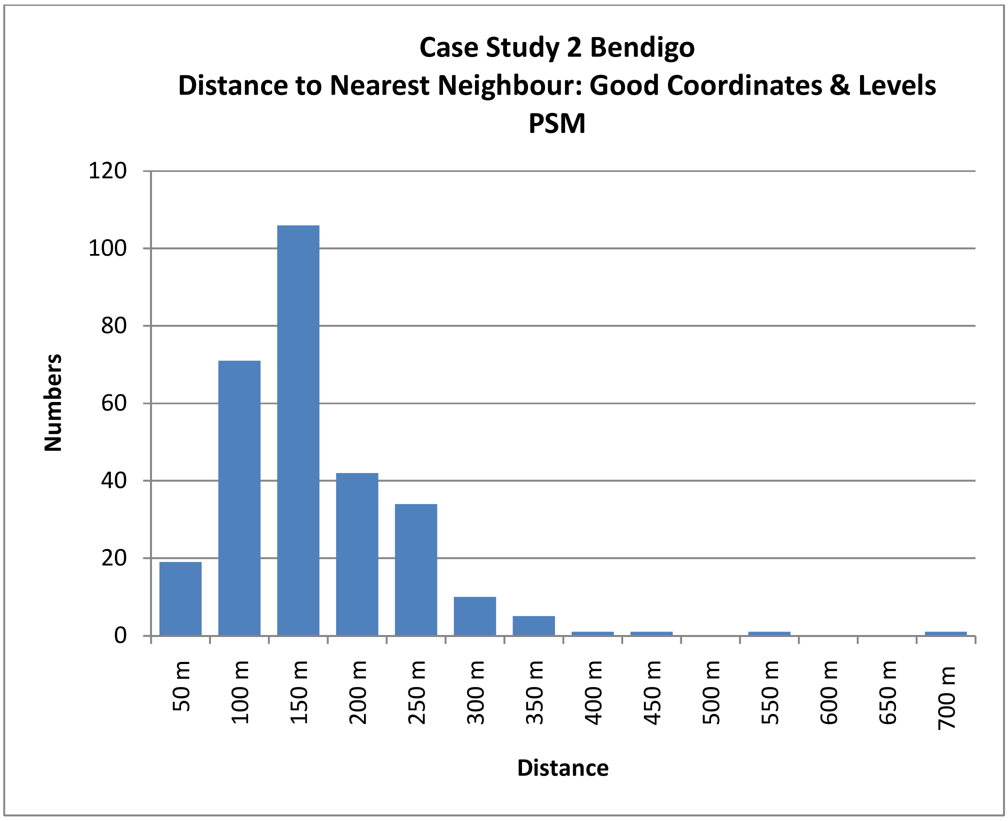

Figure 4.14

The results obtained showed that the minimum distance between PSM's with both good coordinates & levels was 17m. The maximum distance between PSM's was 679m with the median distance being 101m. Results show that 287 of the PSM's are within 500m of its nearest neighbour.

PSM Installation Dates

The investigation also revealed the installation period for each of the 928 PSM's within the Bendigo study area. These results can be viewed in Figure 4.15.

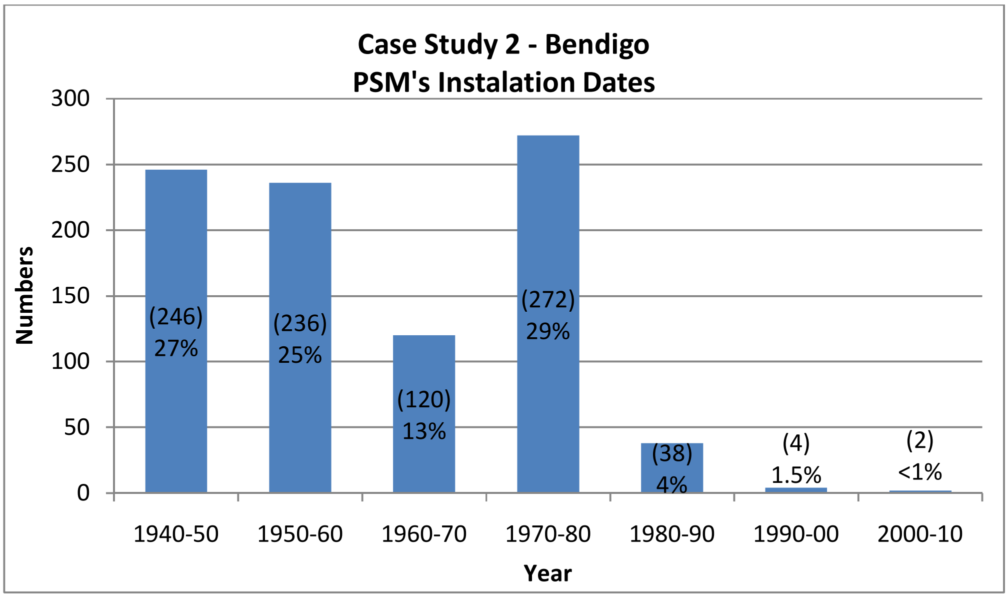

Figure 4.15

Results show that 94% of PSM's within the study area were placed during the period from 1940 to 1980. It is to be noted that the PSA's within the study area were proclaimed in 1952 & 1977. It can be seen that a major effort was conducted in the placement of PSM's leading up to these dates and an assumption can be derived that these PSM's were placed in land for the purpose of proclamation.

Prior results obtained show that the density & distribution of PSM's in good condition & containing attributes is seen as adequate within the study area. This being so, during the past 20 year period only six new PSM's have been registered. The development of the PSA in 1951 & 1977 has ensured issues relating to a lack of density are to a degree nonexistent.

PSM's Destroyed

The results of the Bendigo study area also revealed that there were again PSM's that have been recorded on the SMES database as being classified as not found or destroyed. Analysis revealed that there were 27 PSM's registered as being in either of these categories during the period 1940-2009. This value represents around 3% of the total marks. PSM information can be found in Appendix 'B'.

4.3 Density & Distribution of PSM's

Information obtained from the two case studies revealed varying differences between the two study areas. The final results with regard to general density and distribution were quite different.

Scotney (2003) explains through his research that he found the surveyors expectations with regard to an ideal density of an urban environment is 400m.

As stated prior it had been accepted that 500m was an appropriate distance between PSM's in order to reaching my aim of discovering if PSM's within the study areas were providing surveyors with a functional capability.

The analysis of case study 1 with regards to density & distribution revealed that 88% of all PSM's within the study area in good condition were within 500m to that of its nearest neighbour. The distribution of these PSM's equates to a spread of 1 PSM per every 0.23sq.km. Results for PSM's with coordinate attributes revealed that the density & distribution of marks deteriorated substantially with only 25% of the total marks that contained coordinates were located within 500m of its nearest neighbour. Results also revealed that this also depleted more in reference to PSM's with good level attributes, with only 2.5% of marks found are within the 500m range.

The buffering plans of PSM's in the Mildura area revealed that in categories 1, 2 & 3 there is the need for further control to be installed. Plans all show that the density of PSM's is inadequate within the study area.

In case study 2 the results discovered were in contrast to that of case study 1. The analysis of the Bendigo study revealed that in relation to the density & distribution of PSM's good condition that 100% of the marks were within 500m of its nearest neighbour. Review of the associated buffer plan for PSM's in good condition showed that the overall density of the marks covered an adequate amount of the study area and there is no need to increase the density of the PSM's.

The investigation also found that of the 928 PSM's within the study area that 35% of PSM's with good coordinates, 49% of PSM's with good levels and 21% of PSM's with both good coordinates and good levels were found to be within 500m of its nearest neighbour. The distribution all PSM's in good condition equates to a spread of 1 PSM per 0.03sq.km.

Plans revealing the buffering of PSM's in categories 1, 2 & 3 shows that there is generally an adequate amount of PSM infrastructure presently distributed over the study area. Attributes on marks also show that coordinate and level density of PSM's is seen to be very good and only areas located in the east of the study area require particular attribute data to be provided. There is an adequate number of PSM's in the study area to show that the density is at an acceptable level.

Results that were obtained relating to destroyed marks revealed that only a very small level of PSM's have been destroyed in each case study and did not appear to effect the overall density and distribution in the study areas. The result was very reassuring, however these are only registered values and the results of 3%-5 are very small in comparison to the belief of Bell (2003) that approximately 30% of survey marks are either destroyed or not found. This may give an indication that not all PSM's discovered destroyed or not found are reported resulting in an incorrect assessment of the PSM infrastructure present in Victoria.

The case studies revealed different results for each of the study areas. The results of case study 1 revealed that even though a large percent of PSM's were within 500m of its nearest neighbour, not enough of the site was covered with PSM's and more PSM infrastructure and attribute information for existing PSM's was required. In contrast case study 2 contained results that revealed that 100% of PSM's within the study area were within 500m of its nearest neighbour and the site was adequately covered with PSM's. There is no need to increase the PSM infrastructure, however attribute information can be improved in the east of the study area.

4.4 Victorian Survey Legislation & Regulations

Results obtained from each of the case studies have enabled an evaluation into the effectiveness of Victorian survey requirements with regard to PSM density and distribution.

Results obtained from the density analysis revealed that survey requirements indicate that they are acceptable while development is within a PSA. Case study 2 revealed that survey requirements relating to the installation of PSM's, connection of marks to the MGA datum and level attributes all indicate that survey requirements are acceptable. The regulations enforced through the Survey Coordination Regulations 2005 have provided a good base for infrastructure development within these areas.

Results that were obtained for PSM installation dates involving case study 2 revealed that the legislation used for development of PSA's saw a large increase in numbers of PSM's during the period that sites were proclaimed.

Case study 2 contained two PSA's, each combined covered the entire study area. The PSA No: 2 was completed in 1951 and PSA No: 34 was completed in 1977. Results show that after areas were proclaimed from 1980 to 2009 only 6.5% of the 928 PSM's were installed. Analysis results also show that 93.5% of PSM's were installed during periods when areas were proclaimed. Results previously discussed had revealed that the density & distribution of marks within the study area is acceptable. With this being so the development of the PSA can be seen as positive effect for PSM infrastructure within these defined areas.

Results from the density & distribution analysis for case study 1, which was not in a PSA indicate that present survey requirements are not acceptable. Case study 1 showed that survey requirements were not acceptable in relation to the installation of PSM's, connection of marks to the MGA datum and level attributes. Survey requirements for installation of PSM's have shown that it is not achieving appropriate density in areas outside a PCA.

The installation of PSM's and placement of attributes for PSM's outside PSA's are completed under the Survey Cadastral Regulations 2005. The regulations that stipulate PSM construction installation is reciprocated for PSA's under the Survey Coordination Regulations 2004. The results suggests that the similar regulations are not improving areas outside PSA's with the results of case study 1 revealing deficiencies in all areas of investigation.

Results obtained for installation dates involving case study 1 revealed that apart from the installation of 35% of 200 PSM's in the period 1960-1970, the period of 1970-2009 revealed that installations have been relatively consistent. Results revealed an average decade increase of 24.5 PSM's.

Results discussed previously had found that the density of marks within the study area is not at an acceptable level. The past 39 years of development has seen a large increase in urban development within study area 1. The increased development involving subdivisions has seen a number of PSM's placed over the years, however knowing this and the density issues found within case study 1 results indicate that areas outside a PSA's are not able to obtain an acceptable PSM density under current survey requirements.

4.5 Guidelines

Based on the analysis of results obtained from the two case studies research has suggested that there may be deficiencies with PSM infrastructure located within areas outside a PCA. On review of these results some general guidelines have been suggested that will enable an increase in the density & distribution of PSM infrastructure within the state of Victoria.

Below are the guidelines:

(a) Develop regulations making it a requirement of a cadastral survey of any size in urban areas to connect two 3rd order coordinate PSM's even if these PSM's are outside the 500m range. A PSM should then be placed near the survey site and the assignment of 4th order coordinate placed on the new PSM. This would help maintain and increase the density and distribution of PSM's. It also would increase coordinate attributes on PSM's around the survey site.

(b) Identification of towns outside the PSA's that have very limited PSM infrastructure in regard to coordinate or level attributes. The Surveyor General then should conduct control surveys in these areas to increase the density of such attributes on existing marks. The implementation of

Guideline 'A' would then enable for the increased in the general density and distribution of PSM's in good condition when surveys are conducted.

(c) Develop regulations that deal with the replacement of PSM's that are discovered to be destroyed or not found. If any PSM is found to be in either of these conditions and there is no record of a current PSM within 500m of the destroyed marks original location, then the construction of a new PSM should be commissioned. This should be completed at the cost of the Surveyor General and will ensure that the maintaining the current level of PSM infrastructure within the survey area.

(d) Create regulations that enforce the requirement for surveyors to connect to all PSM's within a predefined limit of the survey site. This should be conducted for any subdivision survey. This will increase the surveyor's field time for those who choose to only connect to the minimum requirements, however it will provide a positive impact in ensuring that the Surveyor General will have increased access to information that will enable a more accurate representation of PSM infrastructure actually remaining in existence within Victoria.

4.6 Summary

Both case studies showed differing results in relation to PSM density and distribution. Case study one indicated that density and distribution of PSM's in all areas was seen to be inadequate. The opposite result was discovered for case study 2. This indicated that the density and distribution of PSM's in all areas was at an adequate level.

Results indicated that PSM infrastructure in a PCA contained increased density and distribution when compared to areas not within a PCA. The investigation found that survey requirements were adequate for areas only within a PCA and not for those outside. Based on these results guidelines were created to combat this issue.

Chapter 5

Conclusion

5.1 Achievement of Research Aim

The main aim of this project was to investigate the Victorian PSM infrastructure and identify if the density and distribution of PSM's within the state was adequate. It also aimed to investigate and evaluate current Victorian PSM survey requirements with regard to PSM density and distribution.

These aims have been achieved through the investigation into various aspects of PCM's. These include investigations into Victorian PSM Legislation & Regulations, the history of Victorian PSM's, PCA's, Survey Control Database and an investigation into PSM statistics.

The investigation into current density, distribution and installation periods for PSM's was conducted through the analysis of two case studies. These were completed to achieve the desired aims as outlined in Chapter 1.

5.2 Recommendations for Further Research

The analysis of results relating to the distance of PSM's in good condition to their nearest neighbour revealed results that could be investigated further.

Case study 1 presented 35 out of 200 PSM's in good condition within 50m to its nearest neighbour. Results obtained in case study 2 revealed that 343 out of 928 PSM's were within 50m to its nearest neighbour. This represents 17.5% and 37% of all PSM's respectively.

It appears that there is over densification & distribution issues within some portions of the study areas. An investigation could be conducted to discover why this problem is occurring. The identifying of what is causing this issue may lead to PSM's being placed in areas that require densification rather than in areas that don't.

5.3 Conclusion

The main aims and objectives relating to the investigation of the Victorian PSM infrastructure have been completed. Results have been obtained and analysed that relate to the density and distribution of PSM's and the examination into Victorian survey requirements in regard to PSM's has also been completed.

The information obtained has enabled the generation of suggested guidelines as discussed in Chapter 1.

The main research component of this research project involved he thorough analyse of two local authority areas within the state of Victoria. The investigation included the areas relating to density & distribution, attribute information, PSM condition and the installation periods for PSM's.

It was discovered that case study 2, that was within a PSA resulted in much higher levels of PSM infrastructure in comparison to case study 1 which was located outside a PCA.

While it is understandable that areas within a PSA should contain larger levels of PSM infrastructure, legislation and regulations that are developed to enable the PSM infrastructure to increase to an acceptable density outside PCA's are not achieving the desired result.

The Victorian PSM infrastructure is such a valuable asset to the many professions whom rely on the infrastructures accuracy and density development. Legislation and regulations implemented should be perceived to achieve a positive outcome with regard to PSM density and attribute information. The investigation involving case study 1 give an indication that density issues do exist and legislation and regulations implemented to combat these issues do not give the impression that a desired result is currently being achieved.

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Appendix A – Project Specification

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG4111/4112 Research Project
PROJECT SPECIFICATION

FOR: JOSHUA ROBERT BRICE

TOPIC: AN INVESTIGATION INTO THE VICTORIAN PERMANENT SURVEY MARK INFTASTRUCTURE.

SUPERVISOR: Glenn Campbell

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

PROJECT AIM: This project seeks to investigate the existing Permanent Survey Mark infrastructure in Victoria and analyse its effectiveness.

PROGRAMME: Issue A, 10th March 2009

1. Research exiting literature involving control network assessment.
2. Research background information relating to Victorian Permanent Survey Mark infrastructure.
3. Evaluate the present density and distribution of Permanent Survey Marks in Victoria.
4. Examine the current Victorian Permanent Survey Mark survey requirements.
5. Evaluate the effectiveness of survey requirements with regard to Permanent Survey Mark density and distribution.
6. Submit an academic dissertation on the research.

AGREED: ______________________ (Student) AGREED: ______________________ (Supervisor)

DATE: ____ /____ / ____ DATE: ____ /____ / ____

EXAMINER/CO-EXAMINER: ______________________

Appendix B – Destroyed PSM's

Datum-MGA 55

Bendigo PSM's Destroyed - Not Found			
PM	**Easting**	**Northing**	**RL**
SANDHURST PM 45	256860	5929680	
SANDHURST PM 121	257740	5929480	
SANDHURST PM 124	257830	5929400	
SANDHURST PM 125	257720	5929220	
SANDHURST PM 143	257340	5930440	
SANDHURST PM 147	256150	5929900	
SANDHURST PM 169	256441.331	5930384.799	241.414
SANDHURST PM 400	256080	5927570	
SANDHURST PM 433	256800	5929430	
SANDHURST PM 538	254710	5927860	248.523
SANDHURST PM 662	257160	5928220	
SANDHURST PM 705	256580	5928290	
SANDHURST PM 822	255840	5927080	
SANDHURST PM 827	259962.555	5929885.038	228.9
SANDHURST PM 1224	257221.311	5930100.846	230.604
SANDHURST PM 1228	257337.191	5930461.2	219.826
SANDHURST PM 1230	255240	5928310	
SANDHURST PM 1264	258290	5927300	226.638
SANDHURST PM 1450	255710	5928970	
SANDHURST PM 1508	256160	5927500	
SANDHURST PM 1693	260280	5927160	
SANDHURST PM 1694	259800	5926670	
SANDHURST PM 1761	255799.152	5927077.031	225.858
SANDHURST PM 505	259092.023	5931919.629	198.05
SANDHURST PM 1125	256436.015	5929910.669	229.826
SANDHURST PM 1269	254630.007	5926995.829	243.301

Mildura PSM's Destroyed - Not Found				
PM	**Easting**	**Northing**	**RL**	**Datum-MGA 54**
MILDURA PM 40	607390	6215140		
MILDURA PM 172	605120	6213850	50.322	
MILDURA PM 334	602800.067	6214318.938	42.6	
MILDURA PM 732	601840	6213350		
MILDURA PM 1072	603639.191	6217801.958	37	