University of Southern Queensland

Faculty of Engineering and Surveying

Historical Identification and Mapping

A dissertation submitted by

Mario de la Pena

In fulfilment of the requirements of

Courses ENG4111 and ENG4112 Research Project

Towards the degree of

Bachelor of Surveying

Submitted June 2005

ABSTRACT

This project was set out to design a method of capturing and cataloguing historical data to produce a Geographic Information System (GIS) map of a portion of the Old Ballaarat Cemetery. The research project was undertaken due to the lack of digital information on historical features in Ballarat.

The completion of the GIS map was achieved using a Total Station for survey control and data collection and a hand held Global Positioning System (GPS) unit to capture and catalogue the data in the cemetery, in addition a GIS was used to store and map the captured data. The mapped data was transferred onto a web page that is able to be updated with new information from other cemeteries for the formation of an Australia wide database in the future.

The results provides a public record of the deceased that can be accessed for use in a diversity of areas from genealogy and historical studies to the general public's interest. It was also concluded that these developments in all of the cemeteries of Australia will provide current information for many organisations.

DISCLAIMER

University of Southern Queensland

Faculty of Engineering and Surveying

ENG4111 & ENG4112 *Research Project*

Limitations of Use

The Council of the University of Southern Queensland, its Faculty of Engineering and Surveying, and the staff of the University of Southern Queensland, do not accept any responsibility for the truth, accuracy or completeness of material contained within or associated with this dissertation.

Persons using all or any part of this material do so at their own risk, and not at the risk of the Council of the University of Southern Queensland, its Faculty of Engineering and Surveying or the staff of the University of Southern Queensland.

This dissertation reports an educational exercise and has no purpose or validity beyond this exercise. The sole purpose of the course pair entitled "Research Project" is to contribute to the overall education within the student's chosen degree program. This document, the associated hardware, software, drawings, and other material set out in the associated appendices should not be used for any other purpose: if they are so used, it is entirely at the risk of the user.

Prof G Baker
Dean
Faculty of Engineering and Surveying

CERTIFICATION

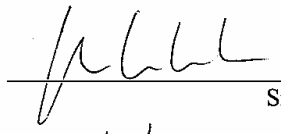
Certification

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

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

My Full Name: Mario de la Pena

Student Number: Q98229339



Signature

8/6/2005

Date

ACKNOWLEDGEMENTS

This research was carried out under the principal supervision of Associate Professor Frank Young (Head of Department) Faculty of Surveying, The University of Southern Queensland. Frank was instrumental in completing this dissertation through his guidance and knowledge in the area of GIS.

Appreciation is also due to Mr. Brian Marsh (GIS Officer, City of Ballarat) who assisted me with the process of capturing data, processing the information, analysing the results and mapping the information into the GIS system.

The City of Ballarat and Mr. David.C.Beames (Ballarat Cemetery Manager) who gave me permission to enter the cemetery along with information on the entombment's from their records.

I would also like to show gratitude to my work colleague Russell Brookes for assisting me with the traversing and secondly my cousin Marcial Cano-Perez for helping collect the grave plots using the Total Station and taking some of the digital photos of the cemetery plots.

Last of all I would like to acknowledge the support of my wife Emma and three children who helped me achieve this goal and supported me all the way. Thank you.

Without the time and effort of these individuals this project would have been impossible to complete.

TABLE OF CONTENTS

LIST OF FIGURES

PAGE

LIST OF TABLES

GLOSSARY OF TERMS

ACU – Attachable Controller Unit

AGD – Australian Geocentric Datum

AHD – Australian Height Datum

AMG – Australian Map Grid

Bluetooth – A seamless wireless short-range communication of data and voice between both mobile and stationary devices.

DOS – Direct Operating System

DXF – Drawing Exchange Format

EGNOS – European Geostationary Navigation Overlay System

EDM – Electronic Distance Measuring device

GDA – Geocentric Datum of Australia

GDOP – Geometric Dilution of Precision

GIS – Geographic Information Systems

GPS – Global Positioning Systems

GRS – Geometric Reference Spheroid

HDOP – Horizontal Dilution of Precision

HTM – Hypertext Markup

HTML – Hypertext Markup Language

JAVAscript – Object-oriented programming that is embedded in a HTML file

MapInfo – GIS software used for Mapping

PC – Personal Computer

PCMCIA – Portable Computer Memory Card International Association

PDM – Professional Data Mapper

PDOP – Positional Dilution of Precision

RMP – Reference Mark Pipe

RTK – Real Time Kinematic

SMES – Survey Mark Enquiry Service

SPSM – Standard permanent Survey Mark

SQL – Structured Query Language

SSM – Standard Survey Mark

TPS – Terrestrial Positioning Systems

TM – Trademark

UNESCO – United Nations Educational, Scientific, and Cultural Organization

UTM – Universal Transverse Mercator

USB Port – Universal Serial Bus Port

WAAS – Wide Area Augmentation System

CHAPTER 1 – INTRODUCTION

Cemeteries hold a special place in cultures, they contain concrete reminders of those who lived and shaped the landscapes which we inhabit. The headstones cemeteries contain and expose artistic styles and techniques of prior generations and inscriptions hold a great deal of historical information, allowing us to observe the health of an area, the impact of war on an area, how wealthy a region was and to trace genealogical roots of historic family properties among other uses. Cemeteries and the information they hold are some of the oldest demographic information recorded. (Boston Parks and Recreation Department, *The Boston Experience,* 1989, pp.55).

1.1 Outline and Background of Study

Identification of historical features using mapping methods can benefit many interest groups and a convenient way of archiving information for future use. This identifies the need to capture and/or catalogue historical data to create information that is in a useable format. The information can be stored in a medium such as a GIS to manipulate and use for a particular purpose.

The study chosen was to map a portion of Old Ballaarat[1] Cemetery so that there would be a permanent digital database and record of information pertaining to the people entombed in this cemetery. A web page was created to both hold the mapped information and act as a tool to be accessed by organisations or the public in a way that would benefit them.

The Old Ballaarat Cemetery was established in 1858 during the gold rush era and is one of the oldest cemeteries in Victoria. It holds approximately 35,000 entombments and is still in operation. Examples of historical figures and events which occurred in this era include Peter Lalor, leader of the Eureka Stockade Rebellion, who is entombed

[1] Note: When Ballarat was settled in the early 1850's its name was spelt 'Ballaarat', from the aboriginal words 'Balla' 'Arat' meaning 'resting place', this changed in the late 1850's to its current spelling without the double 'a', Withers (1887). Many old historical sites in Ballarat still retain this original spelling.

in this location along with many miners and soldiers that fought against each other during this time. A separate area was designated for the Chinese population who made up a large proportion of the miners. The majority of the historical interest entombment's occurred before 1885 and were made up mostly of soldiers and miner's killed during the Eureka Stockade uprising.

This cemetery is of great historical significance and way of preserving this piece of history using modern technology can only be of benefit.

1.2 Historical information

There is an abundance of information regarding historical features in places such as museums, Local Government Offices and interest group organisations but the majority of it is only archived in hard copy form. In the advent of a robbery, fire or relocation of this information, it is possible that these records could be lost. There needs to be a method of archiving this information into digital format. This would allow accurate and reliable records on cemeteries for future use that can easily be copied onto a permanent database and kept by cemetery management. In recent times there has been attempts to do this but they were unstructured and mostly isolated to one theme such as information on entombments at the Old Ballaarat Cemetery. An effort should be made to further expand this in the future to information on entombments in Australian cemeteries. This is beyond the scope of this project and will be further discussed in section 2.6. This study will attempt to start of a piece of a puzzle that will be built on over time to create an Australian registry of information on cemeteries nationally.

1.3 The Problem

Gathering cemetery data must be performed cheaply, quickly and reliably to ensure that there is useable information for the purpose of appraising historical records pertaining to the Old Ballaarat Cemetery. The output would need to contain a graphic or tabular display which could be assessed and to able the user to isolate any superfluous data thus creating a more accurate version of the cemetery site itself. The ability to complete these tasks required a non-holistic approach involving the breakdown of each objective along with a discussion on the required methodology.

1.4 Research Objectives

The project aimed at determining the best method to capture, catalogue and map grave plots in a section of the Old Ballaarat Cemetery.

Achieving this required meeting a number of steps which included determining the best method to use in capturing, cataloguing and mapping cemetery data, evaluating the most appropriate equipment to use in performing a cemetery survey, creating a source of information about entombments in a cemetery and creating a web site to be able to access the information easily.

To complete the capturing and cataloguing traditional surveying methods and a hand held GPS were employed and in addition GIS, was used to produce a digital map of the cemetery. This was assessed against any other method available to complete the same project and the benefits and limitations of these methods were discussed and evaluated. The web design needed to follow a firm criteria to produce a user friendly and informative website.

The research methodology following the literature review was broken down into five parts with several sub parts. The main headings discussed included:

- Total Station (ground coordinates and data collection);
- Hand held GPS (setting up a new project);
- Hand held GPS (capturing and cataloguing data);
- GIS (Mapping the data); and
- Web page design.

The five headings mentioned formed the basis of this research project and there practices and principles are discussed in chapter three.

1.5 Conclusion

The research aims to capture, catalogue and map data from the Old Ballarat Cemetery to use for archiving and appraising cemetery information for the purpose of having historical records and the ability for many organisations to use for their day to day activities. An example of this is a historical society determining the number of soldiers killed during the Eureka Stockade.

The outcomes are expected to demonstrate the most appropriate method of achieving the capturing, cataloguing and converting this data into useable information in a GIS system. The web design will draw all of the GIS information into one central web site to enable a user to access the cemetery information quickly and easily.

To progress with the need for this research project a literature review will establish the advantages and disadvantages of current systems used and identifying available data sources defining the best systems for an accurate and reliable information system will elucidate the best methodology for mapping this and other historical cemeteries and similar historical sites.

CHAPTER 2 – LITERATURE AND EQUIPMENT REVIEW

The literature review will provide examples of capturing, cataloguing and mapping data in a cemetery site or other historical sites and examine the methods and equipment used to achieve this.

Advantages and disadvantages of current systems used, along with possible data sources will be sought out to design and develop the methodology that will be used to complete the project.

In order to fulfil the requirements of the research project it is necessary to find methods and practices used to complete the task efficiently and to ensure the information gathered would be of benefit to the general public.

2.1 Previous cemetery surveys

In reviewing relevant literature there were numerous examples found of this type of work but they were mainly surveys that were looking for remnants of old cemeteries with maybe ten to fifty people entombed in them. Sizer (1999) had an example of this work that demonstrated it as a location survey rather than on an individual gravesite by gravesite survey and most of the other examples were for identifying family cemeteries.

In comparison there were an abundance of surveys relating to boundary definition of a cemetery for local government use and location of historical features in an area of interest such as a cemetery. The authorities of the County of Boone (1998) conducted an individual gravesites survey but weren't in depth enough and only presented a general outline of the process required to undertake this type of survey.

The general aims and processes were similar for site surveys and boundary identification although the areas covered to perform these surveys were more expansive. A site map was an essential item to estimate the area covered and it was decided that a point would be used to mark the location of each piece of data Sizer (1999), this would make it easier to define each grave plot.

Information regarding mapping cemeteries was limited although the processes involved are similar for mapping projects such as mine sites, animal habitat studies and forestry.

2.2 GPS

Attempting a project of this magnitude required the use of equipment that was quick and reliable. GPS is one such tool that enables the user to capture and catalogue information at an efficient rate.

This section will examine types of GPS' available in the market place, how two GPS models compare against each other and the errors and inaccuracies that can occur using a GPS during the capturing process.

2.2.1 GPS Options

There is a significant range of GPS' available in the market place and selecting an appropriate system depends on the accuracy and requirements needed for a project. They range from small hand held devices used for camping and orienteering to the accurate models used for geodetic work.

Grimes (1999) suggested that if it were a search for a survey of a family cemetery the best method for pin pointing would be using GPS RTK methods. This method could also be adopted to accurately define the boundaries of the site.

The cemetery project required a GPS unit that was somewhere in between Real Time Kinematic (RTK) GPS and an inexpensive GPS unit. The device needed to be small and portable but accurate to less than one metre. This narrowed the choices down to a Hand Held GPS that is commonly used for asset data collection projects, in particular the Leica GS and Trimble CE series. These two models are leaders in the market place for the acquisition of data that is quick, reliable and two a reasonable accuracy (± 400mm before post processing). Johnson (2001) identified that a hand held device such as a GPS asset data collector is ideal for this type of work and is also inexpensive to buy or hire in comparison to RTK GPS systems.

Comparing the Leica GS20 and Trimble GeoXT GPS units would determine the which model would be used for the cemetery mapping project.

2.2.2 Comparison of hand held GPS units

There are several hand held GPS units available on the market and for this exercise the comparison of two major brands were evaluated. The two brands are Trimble CE series and the Leica GS Series. The main features that are expected of the equipment are reliability, ease of use, applications for this type of project, accuracy, functionality and reliable software used for post processing.

a. Trimble

"Trimble GeoXT handheld, from the GeoExplorer series, combines sub-meter accuracy GPS with Microsoft Windows Mobile 2003 software for Pocket PCs in one rugged unit which allows you concentrate on what's important: collecting and maintaining high-quality data for your GIS", (*Trimble GeoXT datasheet available on www.trimble.com*).

The main features of the Trimble hand held GPS are;

- Sub meter accuracy with integrated Wide Area Augmentation System (WAAS)/ European geostationary navigation overlay system (EGNOS);
- Real time correction support;
- EVEREST multipath rejection technology;
- Bluetooth wireless technology;
- Rugged and water resistant design;
- TerraSync software for data capture;
- GPS Pathfinder Office for post processing; and
- Touch screen for easy data entry.

b. Leica

"Leica Geosystems GS20 PDM puts a complete field data collection and asset management system in the palm of your hand. This rugged and highly portable device delivers everything you need to collect on-the-spot data anywhere and anytime. It has unmatched accuracy Bluetooth Trade Mark(TM) for cable-free connectivity to devices

and your PC. It has a flexible configuration, user-friendly interface and ergonomic design", (*Leica GS20 datasheet available on www.lieca.com*).

The main features of the Leica hand held GPS are;

- Sub meter accuracy;
- Easy to read graphical display on the fly;
- Geo Clipboard used to cut, copy and paste features;
- Bluetooth wireless technology;
- Rugged and water resistant design;
- Powerpage software for data capture;
- Leica software used for post processing; and
- Large keypad for easy data entry.

Figure 2.1 Leica GS20 PDM & Trimble GeoXT Hand Held GPS units.

The two systems compared offer similar features and both have there own functions that make them industry leaders in this area. The Trimble GPS was chosen for availability, accuracy, user-friendliness and cost. Both systems are for a project of this nature with the capabilities they possess. The differences between each system were few and either one could have been chosen but cost and the users familiarity of the Trimble GPS were the factors used to determine the decision.

2.2.3 Errors and Inaccuracies using GPS

Cooksey (2004) defines Geometric Dilution of Precision (GDOP) as 'where the satellites are in relation to one another, and is a measure of the quality of the satellite configuration'. A GDOP less than four is desirable, if it is any higher positional errors start to play a major factor. Positional errors are caused by many factors the most

significant are Atmospheric conditions, Ephemeris errors, Selective availability and Multipath errors. This suggests that the ability to control or minimise the effects of these errors will succeed in producing more accurate results. Atmospheric conditions are related to the ionosphere and troposphere, which refract the GPS signal. This causes the speed of the GPS signal in the ionosphere and troposphere to be different from the speed of the GPS signal in space. Ephemeris errors are concerned with orbital position and about the rate of clock drift for the broadcasting satellite. Selective availability is the intentional alteration of the time and ephemeris signal by the US department of defence , USQ(1999).

An awareness that these errors and inaccuracies will always exist in GPS surveying is the first step in completing a cemetery survey. The errors that have been discussed provides information on pre-planning before the survey, which can achieve an accuracy that is to acceptable standard.

2.3 Total Station

In addition to the use of GPS for this project, a Total Station was required to collect data in the cemetery. An instrument that was easy to operate and gathered the data in an efficient and reliable mode would be selected to complete several components of this project. This section will explore the range of instruments available in the market place, compare two Total Station models and discuss their accuracy range.

2.3.1 Total Station Options

The market is currently flooded with numerous Total Station models and selecting one that will complete a project is not only complex but time consuming. Most surveyors learn to use a particular model and find moving to another instrument difficult. This leads to assessing what specific tasks the user needs the instrument to perform and its accuracy requirements.

There are six major Total Station brands that are considered market leaders, they are Leica, Trimble, TOPCON, Geodimeter, Sokkia and Nikon, all of these have websites that contain literature about the main features of each model available, USQ(1999). All models carry instruments that are capable of completing a multitude of tasks and the choice will depend on preference and availability. The functions these instruments

perform are similar for engineering surveying applications which was the task for the Total Station in this project.

2.3.2 Comparison of Total Station Options

Rather than using any available instrument, comparing two of them would be used to observe their capabilities and performance in engineering surveying. The Leica TPS1100 and Trimble 3000 series were chosen as leaders in the surveying duties that would be undertaken in this project. The focus was to assess the instruments data collecting, traversing and downloading capabilities. The choice of instrument would be determined using these parameters along with availability and cost.

a. Trimble

"Operate the 3600 Total Station with your choice of control unit including the Attachable Controller Unit (ACU). The ACU is an on-board, colour, Windows CE device equipped with a graphical touch-screen that can also be used with Trimble 5800 RTK Rovers and 5600 Total Stations. The Trimble ACU delivers one keyboard, one display, one dataset, one user interface, no cables, no hassles – truly Integrated Surveying." (*Trimble 3000 series datasheet available at www.trimble.com*)

The main features of the Trimble 3000 series are;

- Cable free operation;
- Tracklight;
- Colour touch screen;
- Bluetooth wireless technology;
- Water resistant design;
- Trimble Toolbox software;
- Millimetre accuracy; and
- Direct reflex (Electronic Distance Measuring device)EDM capability.

The Trimble 3605 uses its ACU to collect, code and download the raw information. The ACU attaches and detaches from the Total Station acting as portable data collecting and storing device. The touch screen allows the user to quickly navigate around each program. All data collected and control information is downloaded together which makes this instrument very easy to use.

b. Leica

"The Leica TPS1100 Professional Series high-end surveying instruments offer a large degree of flexibility. The easy-to-read, clear user interface and the professional programming environment invite you to configure the instrument to meet your individual requirement and personal preferences. The modular system assures a large variety of available models and options to meet varying demands and requirements." (*Leica TPS1100 datasheet available at www.lieca.com*).

The main features of the Leica TPS1100 series are;

- Millimetre accuracy;
- Rugged and water resistant design;
- Leica office software;
- Reflectorless EDM capability;
- Cable free operation;
- Automatic Target Recognition (ATR);
- Electronic Guide Light (EGL); and
- Lightweight

In addition to these basic features the Leica TC1105 has an onboard coding system that is read via a Portable Computer Memory Card International Association (PCMCIA) card. During the transferring stage the data is dragged into the Engineering software from the PCMCIA card. Traverse station information is all saved onto the card and reduction of the project includes the points collected and the station information. This instrument uses very little key strokes during data collection and control and makes it an efficient and east to use system.

Figure 2.2 Leica TC1105 and the Trimble 3605.

2.3.3 Accuracy range of Total Stations

The accuracy required for a survey such this project, defining a cemetery plot boundary, would be in the order of ± 5" for angular measurement and ± 5mm + 5ppm for distance measurement. This determined the use of these points which was a check for the points that are captured with the GPS.

The specifications shown in the Trimble 3605 are:

- Angular measurement standard deviation of ± 5" .
- Distance measurement ± 1mm + 1ppm using a prism over 3000m.
- EDM measuring time is 2 seconds.

(*Trimble specification datasheet for TC1105 available at www.trimble.com*)

The specifications shown in the Leica TC1105 are:

- Angular measurement standard deviation of ± 5" .
- Distance measurement ± 2mm + 2ppm using a prism over 3000m.
- EDM measuring time is 1 second.

(*Leica specification datasheet for TC1105 available at www.lieca.com*)

The specifications for both instruments are very similar so from an accuracy perspective either instrument was capable of completing the project.

The Total Stations in the market place were illustrated and out of these two a comparison was made. After considering the specifications and accuracy of both instruments it was apparent that both were more than capable of being used for the project. The choice was the a Leica TC1105 for its availability and the users familiarity with this particular Total Station.

2.4 Mapping

The methods used for mapping the data to GIS from the GPS and Engineering software vary in their method of transfer but are similar in the general process between systems. The steps involved for this particular transfer provides options of display output, tables, figures and analysis tools.

The GIS software used was MapInfo, it was available at no cost and needed little training to operate the system. The method that was be used for this project was to create a layer for the captured data, create polygons using data collected by the Total Station, moving the captured data into its correct position and attaching a photo of each grave plot to the point. This process has been explained in more detail by referring to section 3.5.1.

The mapping process is required to locate the spatial attributes of the cemetery using accurate surveying principles to ensure that the location of the line work and polygons that make up the grave plot layer are correctly located within the GIS and can be incorporated into existing GIS system. The hand held GPS was used to catalogue the data pertaining to each grave plot. This data logging component of the GPS allows the non spatial information to be collected. (I.e. name, dates, epitaph condition etc). The GPS also provides a Geospatial reference point.

The linking of the two capture processes, the hand held GPS and TPS data collection, allows the data captured by the GPS to be joined to the correct plot shapes that creates a GIS layer with linked attribute data. This is achieved by using SQL to join and analyse the data. The collected TPS information determines the shape of the plots that the user will see and requires the spatial accuracy to ensure a valid plot profile. The higher the accuracy here the better it will look on the GIS.

2.5 Analysis of collected and mapped data in a cemetery survey

Data analysis can be defined as the extraction of significant facts embodied in a dataset, Bonham-Carter (1994), this suggests that there must be some sorting of quality data from superfluous or erroneous data. This erroneous data in spatial databases can be in the form of data collection and compilation, data processing, data misuse, positional error, attribute error and final product error, Hunter & Beard(1992). Each one of these errors can be minimised by applying good analysis techniques from the initial collected data to mapped cemetery on the web page.

Fotheringham & Rogerson (1994) recommend that “it is logical to start with simple statistical, graphical and numerical methods for summarising and manipulating data, (including histograms, scatter plots, box plots, simple summary statistics and data

transformations). The potential benefits to be realised in linking these to GIS should not be ignored, particularly as all other analytical methods ultimately depend on such elementary functions".

Fotheringham & Rogerson (1994) suggest that "data analysis techniques used can vary and selecting the appropriate method should suit the type of work with several options available"(see Table 2.1). They also noted that "their is much value in being able to view simple statistical summaries and plots of data at the same time as being able to view the data geographically in the form of a map". This suggests that analysis techniques should be kept simple as over analysing could also create problems. An example graph is illustrated below to demonstrate analysing tools that can be used.

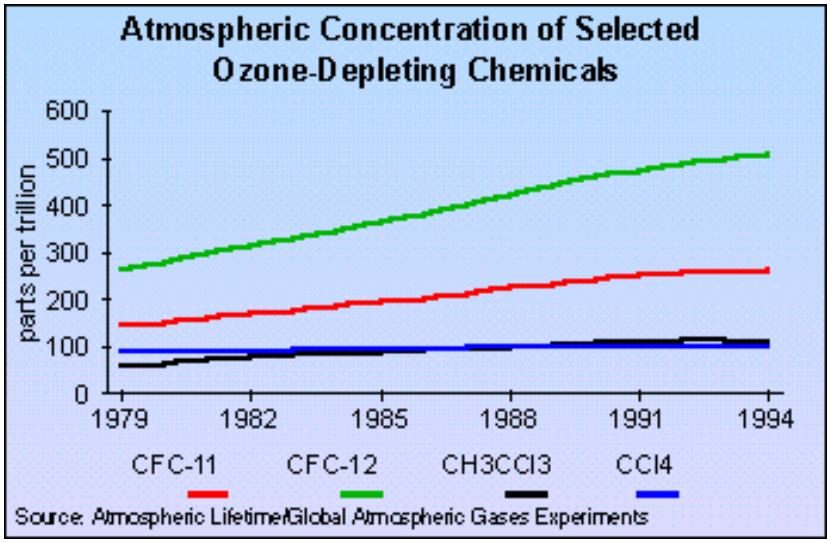


Figure 2.3 A typical line graph that can be used for analysis purposes.

Burrough(1986) suggested that "the intersection of two or more polygon nets by overlay" , would be a good way to analyse area data and "that is necessary to establish a link between database and output that will produce an answer in the form of a map, table of figures". This indicates that the use of tables and maps is vital in analysing mapped data.

DATA ANALYSIS		
Data Structure	**Dimensionality**	
	Univariate	**Multivariate**
Location Data	Nearest Neighbour Methods K-Functions	Bivariate K Functions Space Time Interactions
Attribute Data	Kernel Density Estimation Kernel Regression Bayern Smoothing - ICM	Adaptive Kernel Density Estimation Kernel Regression Bayern Smoothing - ICM
	Spatial Auto Correlation Spatial Correlograms Variograms	Multivariate Spatial Correlation
	Trend Surface Analysis Kringing	Spatial regression Co-Kringing Spatio-temporal Models
		Spatial General Linear Modelling
		Cluster Analysis Canonical Correlation Multidimensional Scaling
Interaction Data	Spatial Interaction Methods	Augmented Spatial Interaction Methods
Reproduced from Table 2.1 (Fotheringham & Rogerson, 1994, Spatial data Analysis and GIS, pp18.)		

Table 2.1 Data Analysis techniques used for certain data types.

2.6 Further research

This project, at a national level, could possibly be completed over a few years with the right resources, funding and processes. Further research must be performed to enable this project to completed in a more efficient manner. There should be no compromise in quality of information and method used to achieve the desired result but if it is possible to catalogue the data where there is less manual entry would make a huge difference and with use of RTK GPS alone would cut down time considerably. Furthermore research to investigate the availability of an approved cemetery mapping software package is needed to increase productivity.

2.7 Conclusions

The review of literature focused on methods used to capture and catalogue data using previous examples. Analysis of this captured data was discussed to present methods of achieving the best results. GPS errors was discussed to provide examples

of the difficulties and limitations encountered during a survey and the GPS used was evaluated against another system as an indication of its ability to complete the project. The outcomes of the review demonstrated the preparation needed to perform the cemetery mapping survey and the necessary steps involved in each process.

The evaluation of these tasks was necessary to establish the most appropriate method needed to perform this process. Highlighting the benefits and limitations of each task was pertinent in ascertaining if the chosen method would suffice for this project. This provided new or more suitable methods of completing the project. This method can be used to consolidate the plan to perform the cemetery survey based on the available information.

Figure 2.4 A typical grave plot in the Old Ballaarat Cemetery

CHAPTER 3 – METHODOLOGY

After reviewing the literature and equipment the best method that will complete this project is using a Total Station for control of the cemetery site and a hand held GPS to capture each plot. The cemetery data in conjunction with a GIS will form a digital cemetery map and the creation of a web page will make it possible to view the map and associated information.

This chapter will focus on developing a method of capturing, cataloguing and collecting cemetery data that is economical and easy to perform. The sections following will explore the methods used in collecting, capturing, cataloguing and mapping the cemetery data in preparation for the web page. Any relevant findings that were encountered during this process will be discussed along with the methods used which will be critically evaluated.

3.1 Study Area

The study area is in Ballarat which lies approximately 120 kilometres west of Melbourne in the state of Victoria. The cemetery site is 4 kilometres north of the city centre, to the east of Lake Wendouree and west of Black Hill lookout. The shape of the cemetery is rectangular and covers an area of approximately 7.56 hectares. See figures 3.1 & 3.2.

Figure 3.1 Aerial photo of the Study Area (Copyright The City of Ballarat 2004.)

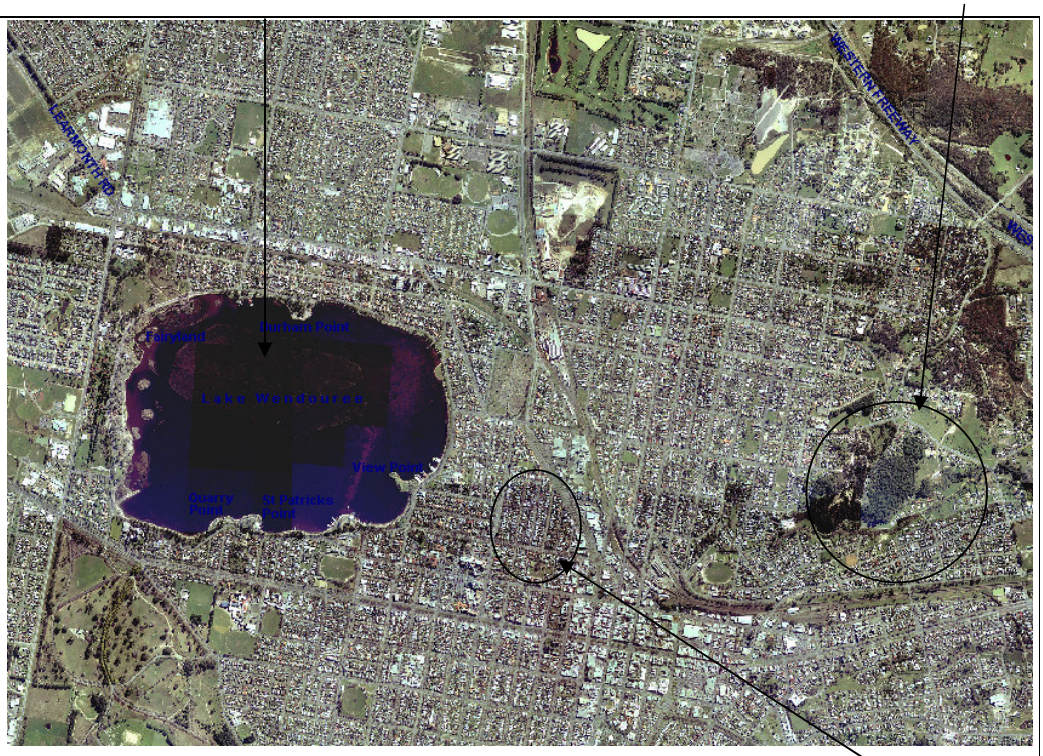


Figure 3.2 Study area including Lake Wendouree and Black Hill lookout

(Copyright The City of Ballarat 2004.)

The first task of the project was to establish ground coordinates for the cemetery map. The following section will discuss how this was achieved and in addition the investigation of existing survey marks, data collection and reduction of the grave plots and an alternative method to survey the cemetery.

3.2 Total Station (ground coordinates and data collection)

Ground coordinates were established using the Universal Transverse Mercator(UTM) projection on the Geometric Reference Spheroid 1980 (GRS80) and the study area lies within Zone 54. The datum's mostly used in Australia are Australian Geocentric Datum 1984 (AGD84) or Geocentric Datum of Australia 1994 (GDA94). Australian Map Grid 1984 (AMG84) and Map Grid Of Australia 1994 (MGA94) are grid systems derived from these datum's and were used to coordinate the newly placed points in the cemetery survey. The permanent marks in the City of Ballarat have been coordinated using AMG84 so it was deemed appropriate to use this system for the coordination of the new marks. Furthermore control was achievable from most areas in the inner and outer parts of the city. The processes involved in the control of the cemetery survey was outlined in detail to understand the reasons for these tasks and

includes the initial investigation, the traversing to new points and the reduction of the traverse. This information, from a Surveyors perspective, is common knowledge and does not need discussion but was included for evaluation and completeness.

3.2.1 Investigation of Survey marks

The process of investigation was used to determine the distance necessary to coordinate points in the cemetery. The majority of surveying firms keep maps of known permanent marks for a particular area and sketches of these marks are kept in hardcopy form or can be extracted digitally via an internet service named Survey Mark Enquiry Service(SMES). These marks are found on a digital map of Victoria which contains every known mark and its coordinates on a permanent database that is updated regularly. The information, once located, can be viewed as a digitized sketch and be printed into hardcopy form. The majority of this hardcopy information is kept by many Surveyors at their own practice and is also shared throughout the surveying community.

Sketches of the marks required were located and once copied they were kept in a file for future reference. Two existing marks were used to start the traverse and all other new points were based on this information, these initial known marks are referred to as the baseline.

The known marks likely to be used are Standard Permanent Survey Marks (SPSM's), Reference Mark Pipes (RMP's), nails, rivets, star pickets, Standard Survey Marks (SSM's) or spikes. The SPSM's make up most of the marks used in initialising a survey as they have little or no ground movement and their coordinates are very reliable. This investigation was also used to determine the length of the traverse that relates to the time taken to complete the project and ultimately the cost to perform the task.

3.2.2 Traversing and collecting data in the Cemetery Site

The method of traversing required the placement of marks in specific areas in the cemetery. The marks were placed, to view any detail from the Total Station that required collection, and to tie in the GPS points collected during data capture.

The method of traversing involved reading from one known mark, the base station, to another known backsight or reference object and then observing to an unknown

point. These known marks have coordinates and are used, in conjunction with survey observations, to transfer coordinates to newly placed marks. Bearings and distances were read to each new mark and once a new mark had been read it became the base station for the placement of the next new mark. This process was repeated until all the marks needed were placed in the cemetery site and the last mark was closed onto a known mark to complete the traverse and as a check for any errors that may have occurred during the reading of bearings and distances. In this case only two new marks were required to collect the data in the cemetery.

The points were traversed using a Terrestrial Positioning System (TPS) Leica TC1105 Total Station and were coded according to the type of mark placed in the cemetery. Only one face needs to be read using this instrument due to a compensator built into the system that allows for the horizontal circle error. The raw traverse information has been included below in Table 3.1.

CIVILCAD 5 Job ENG4111 Date 13/04/04 14:24:56
File C:\CCAD5\TEMP\ENG4111.OUT

Job details Mapping Survey at Old Ballaraat Cemetery 13/04/04

Point	-X-	-Y-	-Z-	Code	Sym	C	Layer
11	751608.833	5840221.458	452.450	NAIL/11	STN1	C	SURVEY
12	751627.554	5840328.155	453.421	NAIL/12	STN1	C	SURVEY
13	751584.418	5840112.198	450.781	SPSM/179	PSM		SURVEY
20179	751584.414	5840112.196	450.781	SPSM/179	PSM		SURVEY
20574	751557.984	5839965.270	448.671	SPSM/574	PSM		SURVEY

Pt 1	Pt 2	Bearing	Distance	Line Type	Color	Layer
20574	20179	10°11'52"	149.284	18	15	SURVEY
20179	11	12°35'52"	111.958	18	15	SURVEY
11	12	9°57'08"	108.327	18	15	SURVEY
12	13	191°17'47"	220.225	18	15	SURVEY

Table 3.1 A print out of the traverse displaying ground coordinates of nails 11 and 12

Completing the control component was followed by collecting data on each grave plot, in this case only two points at the front of each plot were taken. This method was the minimum requirement as the cemetery plots backed onto each other and as long as an extra point was collected at each end, where two cemetery plots met, the rest of the plots were able to be completed in the office using the CivilCad's editing tools. These collected points were later used to tie in the points that had been collected with the

hand held GPS and any points that fell out of a grave plot grid were adjusted accordingly.

The points were collected in what is known as 'string form' this means that each point was collected consecutively, like joining the dots on a picture, so when the information is presented graphically it is a true representation of what is in the field. Each point collected was coded with unique identifier eg. 01EDGE, to able easy editing if the points had been strung or coded incorrectly.

Another method commonly used is 'cross-sectional form', this collects multiple strings in a particular order and is mainly applied in road surveys, where this occurs. The string method was preferred over the cross-sectional method for its simplicity in collecting information in an area where there are very few strings to be coded. The cemetery plots were the only features that needed collection therefore only one code was required.

This component of the project allowed the definition of grave plot boundaries in the cemetery site and led to the next phase of data collection and traversing which was the reduction of raw information.

3.2.3 Reducing the Traverse and downloading collected data

The points collected in the field need to be processed using a method commonly known as reduction. The Engineering software is used in this instance to firstly process and adjust the traverse. Errors that are encountered, generally a misclose, are adjusted and the results are presented in the form of a report (See appendix B). The second task is to download the raw collected information and turn it into a graphical representation of what was collected in the field.

The traversed points were entered manually into the Personal Computer (PC) and processed using a misclose program. The traverse reduction was performed as separate task to compare results against the full reduction of collected and traversed points as discussed in the next section. The adjusted traverse data was transformed into AMG coordinates so that the new stations can become part of the AMG grid.

The data collected including the points traversed were reduced using an Engineering software package, CivilCad 5.72. The points were transferred into the system with the

aid of a translation program supplied by Leica that turns the raw Leica data into raw CivilCad data. The raw data is able to viewed in a Direct Operating System (DOS) editing program and all the points were checked to make certain they had been coded correctly and the station data coordinates were confirmed for correct number used and coordinates assigned to each station (mark).

The next process was the reduction phase which turned the bearings and distances from the points collected into coordinates. These points were transferred into CivilCad where they were displayed graphically onto a PC screen. The process calculates the position of each point collected, using the bearing and distance read to each point, during the data collection stage. These points were checked and edited as necessary and any obvious errors were eliminated. The finished product was a series of lines connected which represents each grave plot all joined together to show a portion of the cemetery. An example of a portion of the cemetery from CivilCad is shown below in figure 3.3.

The collected points were converted into a Drawing Exchange Format (DXF) file, this file converts the CivilCad file into a format that can be used by a variety of programs, to be used during the mapping stage as polygons around the grave plots. This process is the check to locate any erroneous data collected during the capturing stage and also aids in the ability to move the points into their correct position should they be in the wrong location.

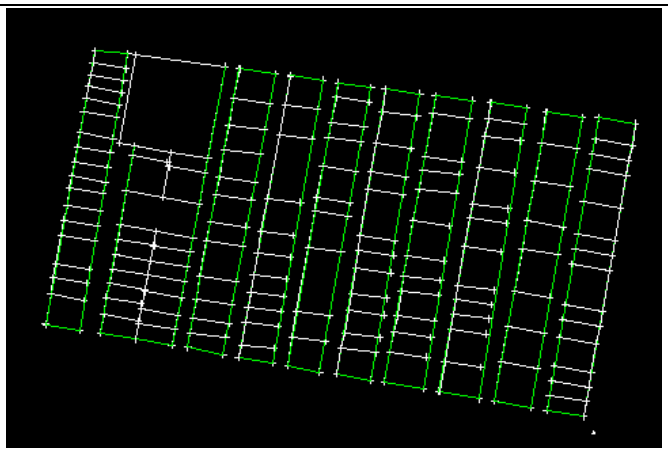


Figure 3.3 Cemetery plots collected and illustrated graphically on CivilCad 5.72.

3.2.4 Alternative methods of traversing and data collection

Apart from collecting data using traditional methods, with a Total Station, RTK GPS was the other option. The process of collecting of data would have been similar and eliminated traversing requirements.

RTK GPS would be more efficient and involve less field time. In addition a one man operation would have benefited the process of completing the cemetery survey along with the convenience of less equipment to carry around the site. Comparing the two methods and displaying them graphically could be a task that is used in further research of this project. This questioned the need to use a Total Station for this project and its reasoning was that the equipment was available at no cost and the time taken for an experienced person to perform the traversing and data collection was minimal compared with RTK GPS although this system would have been the preferred option.

Control of the site served two purposes in this project, the first was to verify that the boundaries of cemetery sections are in their correct position and secondly to able to check that the points captured are not outside the grave plot boundaries.

The fundamentals of traversing were discussed and illustrated standard methods of this process in addition to the reduction process which will vary in different Engineering software packages. Exploring other possible methods provided an alternative to using a Total Station and illustrated their benefits and limitations. The underlying point was that this was a necessary process to be able to perform a cemetery survey and to detail the steps if future research is undertaken on this project.

The next section will focus on the GPS component of the project particularly the beginning a new project including the attribute table and testing the Hand Held GPS.

Figure 3.4 Collecting data around the grave plots using the Leica TC1105 (TPS).

3.3 Hand held GPS (planning a new project)

Hand Held GPS units have come a long way since its introduction into the market place. Initially its purpose was for navigation, particularly from an orienteering perspective. The asset-collecting component in the current range of Hand Held GPS units have many added features that make it very adaptable to a cemetery or similar surveys.

The background work necessary to prepare the Hand Held GPS ready for a survey is performed in the office with the aid of a software program. A file created in the software program is saved into the Hand Held GPS and selected when setting up a new project. A more detailed explanation is necessary to understand the steps involved and will include setting up the attribute table, setting up a new job and testing the equipment before performing the survey.

3.3.1 Setting up the attribute table

The process of setting up an attribute table commences on the PC using the GPS's Pathfinder software. This software has been developed by Trimble and works in conjunction with the Hand held GPS's (Trimble GeoXT's, TerraSync program).

A filename must be chosen for the project, in this case 'Cemetery' was used to able easy location of the file at a later date. Following the file name selection a feature name must be allocated for the attributes, 'graveplot' was used for this task. In this case nine attributes were created and could either have been a point, a line or polygon with text,

numeric, date, time, filename or menu entry (see table 3.2). This project used point, numeric and menu which covered all the attribute data collected during cataloguing. Adding as much information as possible in the menu lists was essential in reducing field time describing certain aspects of the grave plot.

After the attribute table was completed it was transferred as the cemetery file from the GPS Pathfinder software to the Trimble GeoXT hand held GPS via a Universal Serial Bus Port (USB) connection. The attribute table becomes an entity of the GPS system and remains there until deleted, it is also used in setting up the unit for data collection. To retrieve the attribute file is a matter of choosing it from a list that includes previously created tables and is part of the initial set up in the creation of a new project outlined in the next section.

Attribute Table		
Attribute	**Type**	**Entry or Choices**
Surname	Data	Alpha
Other Names	Data	Alpha
Religion	Menu	Catholic, Protestant, Anglican etc…
Birth	Data	Numeric
Death	Data	Numeric
Headstone	Menu	Yes or No
Material	Menu	Concrete, Grass, Fenced, Bluestone
Photo Number	Data	Numeric
Epitaph	Data	Alpha
Condition	Menu	Good, Fair or Poor
Point ID	Data	Numeric

Table 3.2 Attribute table used to catalogue the captured data.

3.3.2 Preparing for a new project

The Trimble GeoXT Hand Held GPS is a user-friendly device that operates much like a PC and works together with a program named TerraSync. This data collection software has a process that automatically allocates a default filename that includes the current date and time, an example of this would be R050809A. This particular filename indicates that it is the 8th of May at 9.00am. The filename may be changed but for all intensive purposes this file is adequate as it is a record for the user of when they performed the survey.

The system prompts the user for the attribute type and this stage is the 'cemetery' attribute table is selected from the systems data dictionary. At the same time the GPS is searching for satellites and as soon as 5 or more are found the system is ready to log data. The user can now proceed to log data about an individual grave plot into the Hand Held GPS which will be discussed later in section 3.4.1.

3.3.3 Testing the Hand Held GPS data collector

Before commencing a new project the equipment must be tested for any problems or faults that may occur in the field. A common method is to use a location that is in close proximity to the office so that the results can be viewed and checked quickly.

A small test job is the common approach to fulfilling this task and requires a number of random points to be collected including some known points as a check. This process will also test for any bugs that may appear and help to verify the accuracy of the equipment. This process will also give the user an indication of the time that will be required to capture a certain number of points and the time needed to log each piece of data into the GPS.

Preparing the Hand Held GPS for data collection is one of the processes required to perform the project and is vital in estimating time and quantity of data to be captured. The importance of this stage is evident from the initial set up of attributes through to testing the equipment. Many hours may be wasted if this preparation is not performed properly and the overall quality of the project may be degraded.

The second part of the GPS component of the project is the capturing and cataloguing of data in the cemetery the next section will discuss these issues.

3.4 Hand held GPS (capturing and cataloguing data)

Capturing and cataloguing the data is the process of collecting each individual grave plot in the cemetery. These two processes are performed simultaneously, the capturing is automatic and the cataloguing is performed by the user. The two will be discussed in detail and include the method and limitations of the hand held GPS.

3.4.1 Capturing the data

The methods that can be employed for a cemetery survey depend on its application. Grimes (1999) suggested that if it were a search for a survey of a family cemetery the best method for pin pointing it is using GPS RTK methods. This method could also be adopted to accurately define the boundaries of the site.

In contrast the method used for pin pointing a particular gravesite such as in this research project requires more rigorous coordinates as the area in question has already been mapped and we are only adding another layer to the GIS. Johnson (2001) identified that a hand held device such as a GPS asset data collector is ideal for this type of work and is also inexpensive to buy or hire in comparison to RTK GPS systems.

The process of capturing the data is initialised during the set up of a new job (refer 3.3.2). Once the system has been step up the GPS starts to locate satellites and if enough are found, five is preferable, it begins to log data about the point that is to be captured. Once the user believes enough data has been logged, in the order of one to two minutes is required, the point is captured by pressing the 'capture' button with the touch pen. It is during this process that the user catalogues the data. At this point it is vital that the user remains still and only moves very slightly or the results may not be very accurate even after post processing. It is at this time the GPS is resolving ambiguities and any sudden movement will not allow the device to correctly calculate its position relative to the satellites and beacon it uses to retrieve its coordinate information.

During this project their were three sessions used to complete the portion of the cemetery, these sessions would be used during the analysis stage. At the start of session two and three previously captured points were recaptured as a check for errors or inaccuracies. This process was purposely executed in case a mass error was encountered in a session.

Figure 3.5 Capturing and cataloguing data using the Trimble GeoXT hand held GPS.

3.4.2 Cataloguing the data

Cataloguing the data is the process in which the user enters information pertaining to each grave plot. It can be a time consuming exercise as one grave plot may contain up to eight entombments. The time taken to enter each piece of information is generally enough for the GPS to have logged enough data to be able to collect the point. The cataloguing requires the user to choose a number of attributes and is included in Table 3.1. This process will need to be repeated if there are multiple entombments in one plot.

The information entered on each grave plot must be accurate and can be cross-referenced using the cemeteries records. It was found that some grave plots were unmarked but they were included for location and further research would be necessary to locate the attributes of the person/s entombed in these grave plots.

Completing this task required a steady hand as the interface between user and GPS is via a touch screen. The screen is also quite small and inaccuracies occurred during the cataloguing. This time consuming exercise though cumbersome allowed the GPS time to log data and created a situation where waiting for ambiguities to be resolved was almost eliminated.

The process of capturing and cataloguing the data was one of the main tasks involved in the project and its process was time consuming but not difficult. It was important to explain the steps involved in these tasks for further research that may take

place in the future. A method that involves less field time to capture and catalogue more grave plots is essential so that it is more economically viable for local government authorities or cemetery trusts to have this information mapped.

The information now in a raw format needs to be converted, along with the data collected, into a GIS to view in a useable format. This process will involve gathering all spatial attributes and merging them to have completed cemetery map.

3.5 GIS (Mapping the data)

The mapping element of the project required the data captured by the GPS and the data collected by the TPS to be combined and transferred into a GIS mapping software package, in this project MapInfo was used.

The collected data produced a digital map of a portion of the cemetery that clearly defined each grave plot as a polygon. The plots were also tagged with a point(s) containing information about an individual(s) entombed in the plot. These points in their raw format were assessed to determine whether their location was suitable in terms of accuracy. The points that did not fall within the plot region were relocated and will be discussed further in this section. The final task was to link a photo to each plot so a record of information along with a visual identity of the grave plot could be viewed.

The techniques used for this mapping process are particular to MapInfo but the fundamental processes used to extract information are similar between GIS systems. This information is included as a one method to map a cemetery survey project. In addition the theory behind the data capturing process and the cadastre used to verify the accuracy of the collected and captured will be discussed.

3.5.1 Mapping the data into a GIS

The first objective in the mapping process was to relate the data collected with the Total Station from CivilCad, the software used to store the data, to MapInfo. The user creates a DXF file in CivilCad that MapInfo converts to a recognisable file in the form of a TAB file. This becomes the first layer of the map displaying lines in the form of polygon shapes that define each of the grave plots.

The next layer included was the data captured by the hand held GPS. This data is an RDB file in Trimble's TerraSync Program and has been formatted to be recognised by most GIS's. The new layer is introduced in MapInfo by having the first layer, the cemetery plots, active. The steps to add a layer are, using the layer function on the toolbar in MapInfo, to choose the required file and accept it. The result is the collected, captured and catalogued data combined as shown in figure 3.6. The data displayed is in a raw format and requires manipulation to bring up to an acceptable level ready to transfer in to the web page.

Figure 3.6 Raw captured data overlayed onto collected grave plots.

The manipulation of this information can be achieved by using two methods the first is to post process the points and the second is two manually move the points into their correct grave plot. The latter method was chosen because it easier and the plots are accurate and show the true boundaries, all that is required is a point(s) in each plot.

To move each individual point the 'Layer Control' function in MapInfo is used. This requires the user to tick the information box that places the surname on each point captured and to tick the draw box which allows the moving and editing of each point. Care must be taken when editing any points in case the information is degraded by accidentally deleting attribute information. This task takes some time but the results, as shown on figure 3.7, illustrate each point(s) in a particular grave plot. This project is

now ready for the next phase in the completion of the cemetery map the inclusion of digital photos.

Figure 3.7 Captured data aligned with collected grave plots

The final layer comprised of attaching a photo of each grave plot to each point captured in the cemetery survey. The method used to introduce this information required adding an attribute 'HotLink' to the grave plot points and copying the link to its location to this attribute. The user enquires on a point using the HotLink function icon in MapInfo and by selecting a grave plot can view the grave plot photo (see Appendix G).

To complete the cemetery map colours can be added to enhance the effect of the map. The polygons were cross hatched with purple to stand out and the crosses on each grave plot corner collected with the Total Station were reduced in size to make the completed map more presentable.(See Appendix E).

The processes involved in transferring the data into MapInfo, from the GPS and TPS was discussed and illustrated graphically. The photo component was deemed necessary to complete the mapped cemetery and to allow the user to absorb all of the available information on each grave plot. The next section will discuss the cadastre process to verify the accuracy of the information introduced into the GIS, metadata for the project and polygonisation techniques used to enhance the final map.

3.5.2 Cadastre, Metadata and Polygonisation

A cadastre is defined is defined by the United Nations Educational, Scientific, and Cultural Organization(UNESCO) in 1983 as: 'an official up-to-date public record usually recording ownership, the value and quantity of land in a jurisdiction, state or country, recorded in fiscal or legal land parcel units.' USQ(2001). In this case the cadastre of the cemetery area was used to verify that the points collected in the field were true and to an acceptable accuracy. The City of Ballarat cadastre was overlayed on the captured and collected lines and points and the results were detailed in section 4.4.1. The cadastre and the cemetery map were overlayed to assess if they matched and once this was satisfied became a verification that the cemetery plots collected by the Total Station were in the correct location.

All the data collected and captured in the field should have metadata detailing the accuracy of the line work, time of capture and the person responsible for it. This serves the purpose of enabling a person who might be performing research on a similar topic the opportunity to see where the data has come from and whether or not it suitable for their requirements. Part of this information is included in Appendix D and features the accuracy of each point including when and what time it was captured. The person who collected, captured and catalogued the data is the author of the research project and the location is The Old Ballaarat Cemetery.

Polygonisation is the process of connecting and closing lines and points together to form polygons. Polygonisation of the line work was achieved by using the lines to create a polygon that represents the shape of the plot. This was later used to determine whether the captured points need relocating as described in section 3.5.1. Figure 3.8 illustrates the completed polygonisation process that also enhances the effect of the line work by minimising the size of the points. There are several techniques that can be used to polygonise lines, the technique used in this project was to use a function in MapInfo that allows the user to choose the lines or arcs in the desired polygon shape and by selecting the lines in order creates a polygon. These steps are repeated until all polygons are completed. The advantage of having polygons rather than lines without nodes is that these shapes can be manipulated by colour and shading to produce a more visually appealing end product.

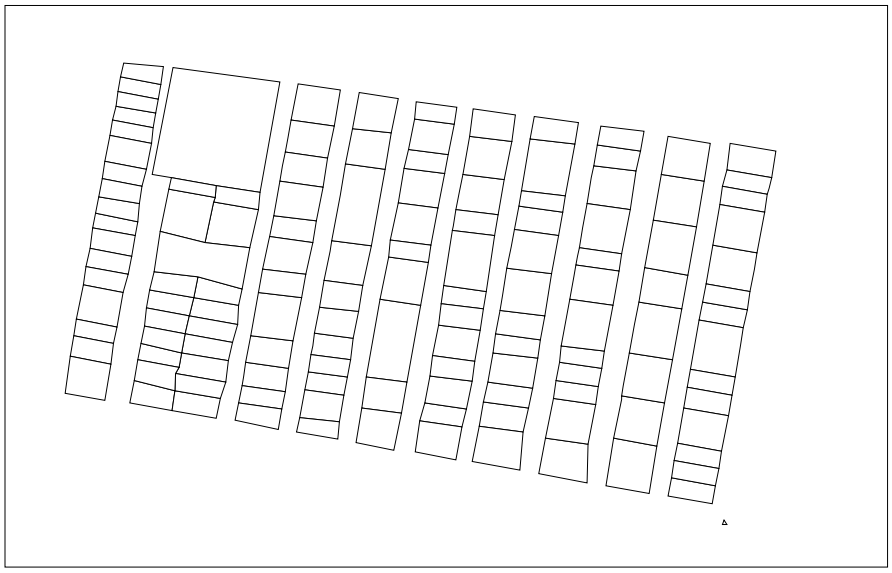


Figure 3.8 Collected data that has been transferred to MapInfo and polygonised

Collecting the grave plots in the field to create a map and check the data captured was more accurate than using the digital map, although this verified that the information was in the proximity of that portion of the cemetery. This ultimately led to an extra step in the process of collecting data using a Total Station but the end result was a more accurate picture of what was captured in the field.

The method of mapping the data was discussed and determined that layers would need to be combined for a complete picture of the cemetery plots and its boundaries. The relocating of points was performed manually although time consuming but the end product has achieved the desired result.

The cadastre process was discussed along with the metadata required and polygonisation techniques, these topics were introduced to have an overall picture of the mapping procedure. The creation of layers to form the map is only part of the as discussed in section 3.5.1 are only one part of the process.

The next step entails the mapped data in its current format to be further manipulated to reach a larger audience. Creating a web page to hold the cemetery map and its attribute information was the next logical step.

3.6 Web Page Design

The mapped cemetery information, at this stage, could not be used as a shared application so a medium was sought after that could hold this amount of information and could be accessed anywhere and at anytime. The world wide web was one such medium that would able this information to reach a larger audience and was considered the obvious choice. The problem would be the design requirements necessary to able a user to obtain information from the web site, what it would contain and to find the a suitable language to create such a web site.

3.6.1 Design requirements and contents

In preparing the web site a specific criteria was required to suit the needs of the user. The parameters for the website were that the site had to be easy to use, needed links to other related sites, required a search option to be able to find specific grave plots and had the ability to expand when further mapping was completed at the cemetery. The site would have a menu containing headings such as a history, grave plot search, further work, a cemetery map, related links and contact person for further information.

The site would contain a home page with a brief history of the cemetery including all relevant information on any significant people entombed in there. The grave plot search would require the input of a surname or previous name and looking through its database would find that person if they were located in the cemetery otherwise a ‘no matching records’ would be displayed. A ‘further work’ heading would be used by interested people who wanted to know what the next step was in completing the cemetery map or how they could contribute to the project. A general cemetery map would allow a user to view the cemetery site in relation to the Ballarat township and also give some perspective of its size. All related links such as historical societies, genealogical sites and any other related web sites would be included in the final design. In addition a contact area would be available for further information on the cemetery mapping project.

3.6.2 Language used to create a web page

As a novice, when looking for a particular language to use, it was necessary to choose one that was easy to write, easy to edit and would pin point and display errors. There are a few standard languages available such as Hypertext Markup Language

(HTML), Hypertext Markup (HTM) and JAVAScript. HTML is widely recognised, Microsoft based and is easy to learn. The other two are better used for experienced programmers and web designers and require more extensive training.

HTML uses a simple web language that shows errors and only requires typing the information that will be contained in the web site. All the coding language is displayed as shortcuts on top of the programming page, (HTML Lite), and requires the user to click on the necessary code to complete a section of the website. Any photos can be added to the web site by simply referring to the filename and its drive location. All links are added by supplying the address and will automatically link to the site and can be accessed by clicking on the particular web address. Any errors are checked using a validation section in the menu, this shows the user which line is wrong and the remedies to fix the problem.

3.6.3 Creating the web page

Creating a good web page involves a logical structure of coding that will create the main home page a user will see when they visit the site. Coding in HTML is relatively fast when the user is familiar with the basic codes but the actual typing of information contained in the web page can be laborious if there is a lot of content.

The main heading is the first item that is required and from this the content in the home page comes together very quickly. It is much easier to type the text component of the page and introducing the photos at a later stage. There is a tool, external viewer, that allows switching between the code page and the home page as it is developed. This allows aligning the text size and spacing correctly and the ability to fit graphical items. The code also allows you to link to other pages, other websites and sends you to the home page at any stage.

The web page was an additional task used to make the project more understandable for a layman in this field. The project in its GIS form would be difficult for a user to operate without using the web as a resource. The development of the web page was demanding , rewarding and demonstrated in real terms what was achieved and how it can be expanded in the future.

The methods used to complete the project was developed using a number of parameters. Availability and cost of using the equipment played a major part in completing the project along with the reason for approaching the problem in this manner, which evolved over the duration of the survey. Findings such as the maps accuracy and the difficulty of the touch pen during cataloguing culminated in the finished design used.

If the project was to be redone more resources would have been sought such as RTK GPS and additional manpower to complete the whole cemetery site. In regard to the project as it was completed, it was adequate for a portion of the cemetery and using another method would have meant over sourcing.

The field and office work now completed will require analysis to see if the results obtained was to a level of accuracy that was desired and that correct processes towards the completion of the project had been performed.

Figure 3.9 The Old Ballaarat Cemetery, Information Sign

CHAPTER 4 – DATA ANALYSIS

4.1 Analysis of Traversed and Collected Data

The traversed data can be processed in several ways depending on the size of the traverse and the application of its information. This research project required a traverse that was accurate to at least third order, meaning that the bearings and distances read to each new point was read to the second for bearing and to the millimetre for distance. The traverse was closed back to the base station to check for any possible errors and adjusted using a Compass adjustment (standard CivilCad adjustment).

The total length of the traverse was short so it was decided to test whether or not the coordinated points would vary significantly if the traverse was reduced with the collected data and unadjusted or adjusted first then reduced with the collected data.

The results illustrated that the difference was minimal although the desired method of closing and applying an adjustment is the correct procedure for reducing a traverse. A comparison table has been compiled to demonstrate the small differences found between the two methods.

COMPARISON OF READ COORDINATES OF NEWLY PLACED POINTS INTO CEMETERY			
STATION	**UNADJUSTED COORDINATES**	**ADJUSTED COORDINATED**	**DIFFERENCE**
11	751608.833E , 5840221.458N	751608.832E, 5840221.458N	-.001E, 0.000N
12	751627.554E, 5840328.155N	751627.552E, 5840328.155N	-.002E, 0.000N

Table 4.1 Comparison of unadjusted and adjusted coordinates.

This demonstrates that the two methods result in coordinates that are comparatively the same over a short distance but this will increase considerably over a greater distance. Third order traversing has an acceptable error of 1:10000, Surveyors Board of Victoria (1992). After applying a Compass adjustment on the traverse the accuracy stated was 1:99843 which is well inside these parameters. See Appendix B for both traverse and the Compass adjustment.

The subsequent analysis will discuss the data captured and the method in which it will be assessed for accuracy.

4.2 Analysis of Captured Data

The data captured by the hand held GPS requires analysis after it has been transferred into the MapInfo software. The method used to the analyse included using the MapInfo tools to move the points into their correct location. Another analysis would be to tabulate or graph the GPS inaccuracies mainly Positional Dilution of Precision (PDOP), Horizontal Dilution of Precision (HDOP) and Horizontal Precision and assess the points which were considered to be outliers.

The analysis techniques included comparing the points captured against the points taken around each grave plot. This process produced a table showing the differences and allowed the movement of the points captured into their correct position. The difficulty with this method is that their was no common error in their position therefore moving the points into position needed to be performed manually and one by one. Figure 3.6 illustrates the points in their raw form before the points were relocated. Figure 3.7 illustrates the points that after the were relocated to their correct location.

The other option was to use a post processing technique that uses coordinated points around the site. These points are fixed and a best fit method is used to move the points captured into a location relative to the fixed points. The benefits of using this method are that they can be moved together and can produce very good results if the error is common to a series of point. The capture was completed in three sessions so the data would have to be post processed for each session. A tabulated version of this produces a before and after scenario and again these moved points can be compared against the points taken around each grave plot. The limitations using this system are the availability of known points evenly spread around the site for accuracy when the captured points are moved.

Although the points were moved into their correct location manually and did not require post processing, it was decided to set up a table to illustrate the three attributes the Hand Held GPS used to display its accuracy. The three attributes were the PDOP, the HDOP and the Horizontal Precision. This would identify any wayward points and also compare the data accuracy over the three sessions.

The first step was to create a graph of each session displaying the maximum PDOP at each grave plot and calculate the average of each session, this is illustrated with a

yellow line in figures 4.1, 4.2 and 4.3. The averages for the PDOP were 2.89, 2.80 and 2.79. It was apparent that in all three sessions a PDOP of above 4 should be considered an outlier and figure 3.6 suggest that these are points not located near the grave plots. These outlying points were caused as a result of moving before the point was captured, not having a good satellite constellation, not enough satellites or not logging enough data on a particular point.

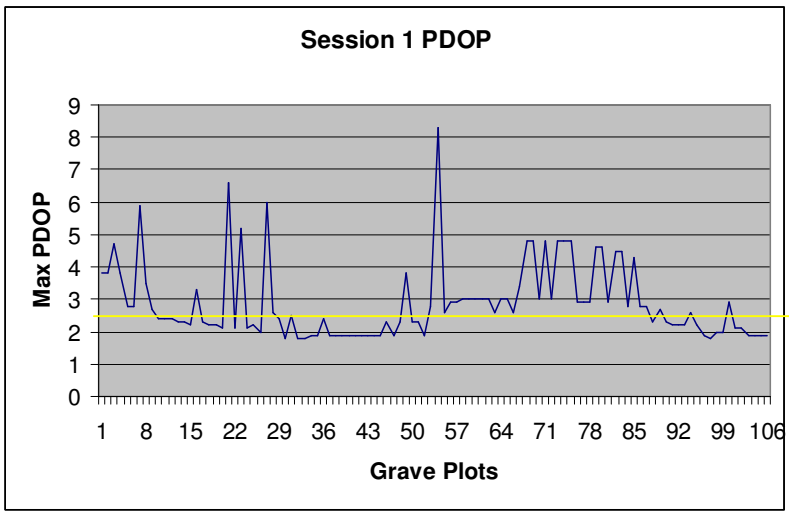


Figure 4.1 Session 1 displaying maximum PDOP of grave plots (8/5/2004).

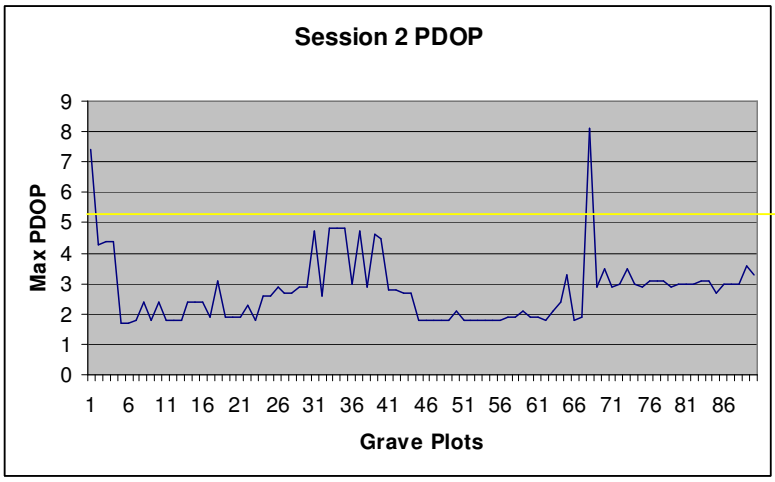


Figure 4.2 Session 2 displaying maximum PDOP of grave plots (15/5/2004).

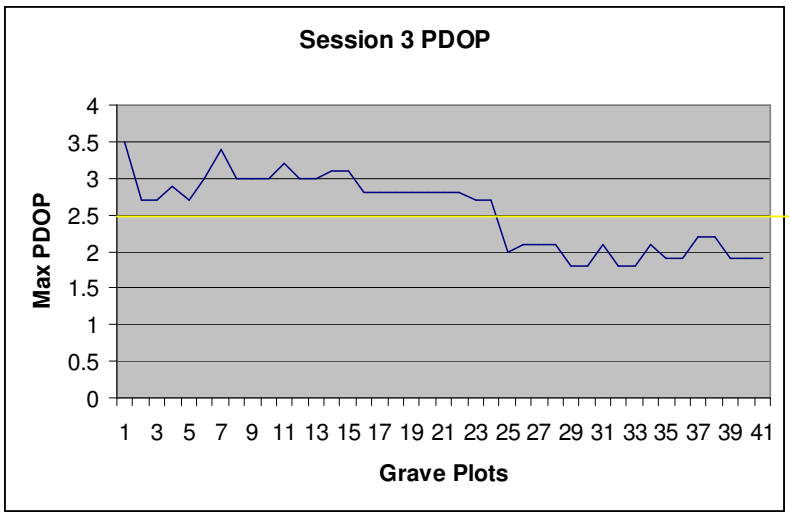


Figure 4.3 Session 3 displaying maximum PDOP of grave plots (16/5/2004).

The second task was to create a graph to assess the HDOP of each grave plot captured and analyse them over the three sessions. Their average was calculated then displayed as a yellow line on the graph as shown on figures 4.4, 4.5 and 4.6. The averages for the HDOP were 1.54, 1.48 and 1.15. The three graphs suggest that a HDOP over 3 is definitely an outlier and if these points were viewed on figure 3.6 they would be illustrated as points well away from their grave plots. Again the causes for these errors occurred as was discussed with the PDOP.

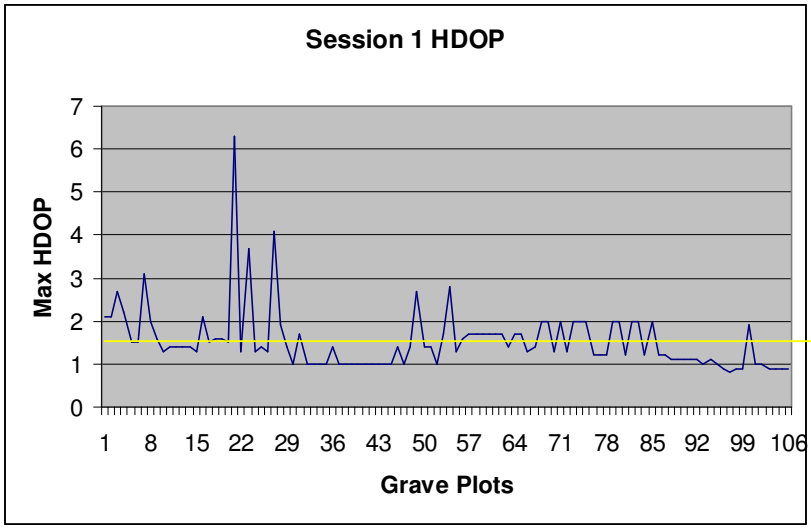


Figure 4.4 Session 1 displaying maximum HDOP of grave plots (8/5/2004).

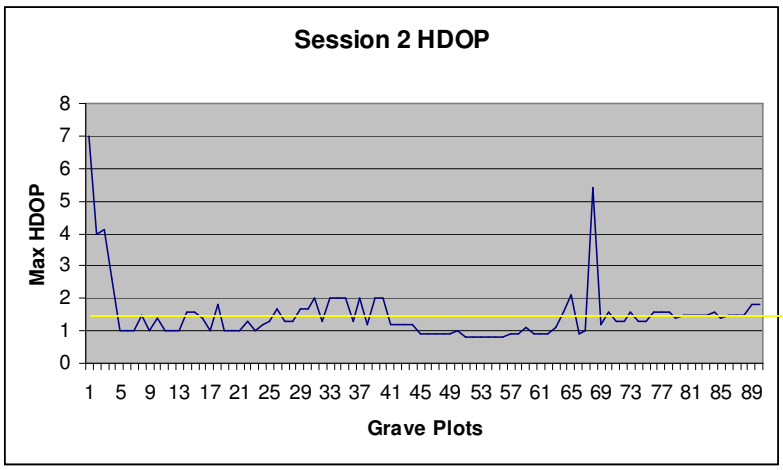


Figure 4.5 Session 2 displaying maximum HDOP of grave plots (15/5/2004).

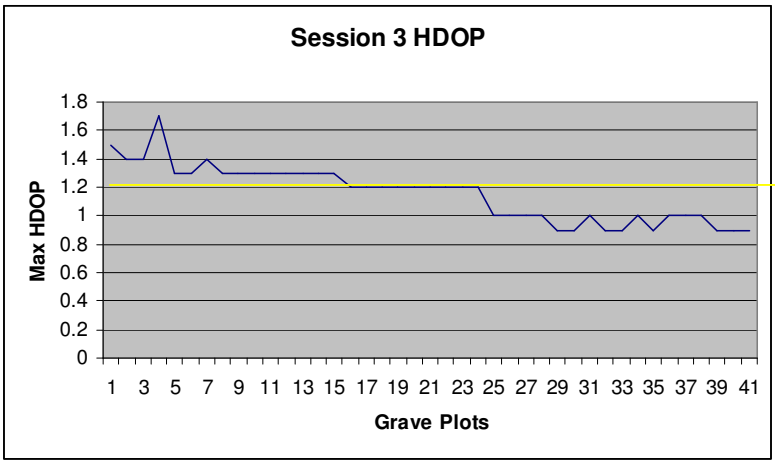


Figure 4.6 Session 3 displaying maximum HDOP of grave plots (16/5/2004).

The final task was to create a graph to assess the Horizontal Precision of the captured data. Each grave plot was analysed and assessed in three sessions. Their average was calculated then displayed as a yellow line on the graph as shown on figures 4.7, 4.8 and 4.9. The averages for the horizontal precision were 5.78, 5.79 and 5.72. The three graphs suggest that a Horizontal Precision between 5 and 7 is a good result and anything above or below these would be considered an outlier. To view these points on figure 3.6 would illustrate the points well away from their grave plots. Again the causes for these errors occurred as was discussed with the PDOP.

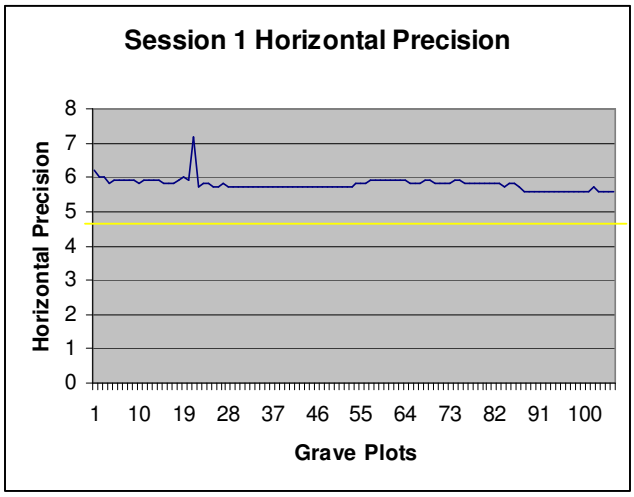


Figure 4.7 Session 1 displaying maximum Horizontal Precision of grave plots (8/5/2004).

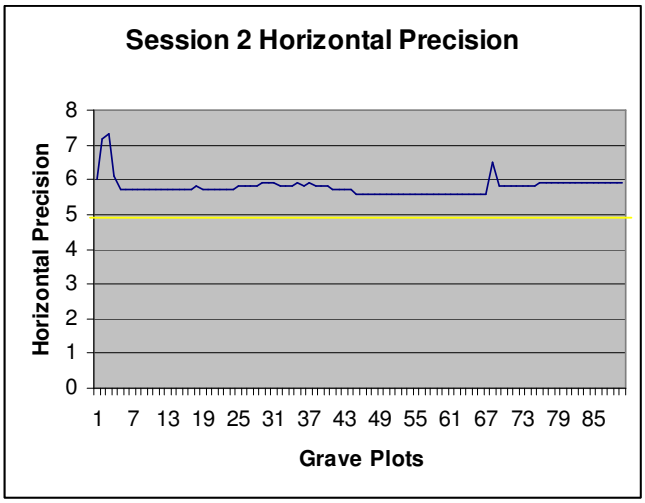


Figure 4.8 Session 2 displaying maximum Horizontal Precision of grave plots (15/5/2004).

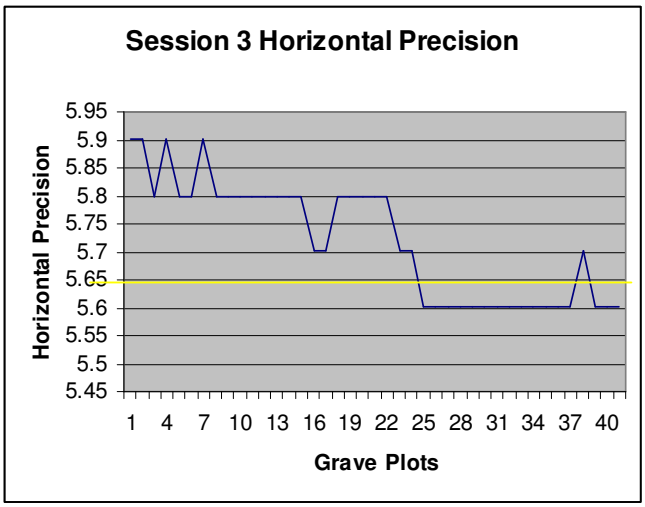


Figure 4.9 Session 3 displaying maximum Horizontal Precision of grave plots (16/5/2004).

These analysis techniques used were used to evaluate the accuracy of the captured data and resulted in various captured points becoming outliers. This was overcome by the method chosen to move the points and reflected the accuracy of the final location of each point, which was within the confines of its correct grave plot as shown on figure 3.7. There were other techniques that could have been adopted but moving the points manually was selected because of the way in which the GPS survey using the Hand Held GPS and data collection using the Total Station was performed.

The next analysis focuses on the catalogued data and the results of using a particular method to log and edit the attribute data.

4.3 Analysis of Catalogued Data

The data that was logged into the hand held GPS needed to be an accurate representation of what was written on the each grave plot on site so the that records were accurate and reliable. Errors can occur during the logging stage and may be overlooked so checking for these is a vital process. The methods used varied with the requirements needed for each piece of data and are discussed in detail.

The method of logging each piece of data (see 3.4.2) required a lot of manual typing and it was accepted that the occasional word would be misspelt due to the use of the touch screen and pen used. It was decided that the method used to analyse the data would be to print out a spreadsheet of the grave plots and check them line by line. This solved two problems, the first was to eliminate any spelling errors and the second was to check for any missing data. The photographs also provided a method of checking for missed information and spelling errors in some cases. As a last resort revisiting the site was the only other option as the wording on some photos was illegible. The time taken to complete this task was minimal and provided an accurate description of each grave plot. Incorporating a mixture of these options efficiently completed this part of the project.

The analysis of catalogued data was a minor part of the project but important in presenting accurate and reliable information on each grave plot. The method used was not technical but achieved the desired result. It was noted that the logging of data was difficult using a touch screen but with more experience using the equipment would have minimised errors.

The next analysis will focus on the mapped data in the GIS. Two focuses will include looking at the cadastre that was used to check the data and the attributes attached to each point.

4.4 Analysis of Mapped Data

Mapping the data into the GIS requires further work than simply accepting that the data is accurate and that all of the points are mapped into their correct position. Two aspects must be analysed in order to satisfy that the mapped data is in a format that can be presented and used to gather information to be appraised. The first is the cadastre itself to be compared with the actual points captured and the second is the attribute data to verify the location of data on the map. This analysis must be performed to complete the project and have an end product that is in a useable and accurate format.

4.4.1 Cadastre Analysis

The analysis used here was to compare the generated cadastre against the established GIS layers to ensure that they overlay to within an accepted level of accuracy. In addition is that they fit within a current layer to ensure that the distance calculated between a series of points within the GIS is within a level of accuracy when compared to real measurements. The resultant measurements were very close to that of the GIS and small errors were caused by the difference between the measured distances compared to AMG distances. These slight variations are not apparent over short distances but increase by distance in the order of 0.3m per 1000m. This was calculated using the average scale factor of the Ballarat area which is approximately 1.0003.

There are two prime layers that were used for this project, the Vic Map property cadastre and City of Ballarat's aerial Photography. These two layers have been integrated and result in a reasonably accurate mapped area of the City of Ballarat precinct. What it does not show accurately is the grave plots themselves these are a little blurry in appearance on the aerial map. The attributing factor is the photography used which is 0.4m pixels with an established accuracy of +/- 0.6 m. This alone has forced the collection of data using traditional surveying methods to show the boundary around each grave plot.

The cadastre in the area around the cemetery has been derived from 1:1000 plans. The level of accuracy that could be accepted by this project was at least 1:1000 as the points are visible on the digital map and the plots can be seen on the aerial map clearly, along with the boundary of each grave plot.

4.4.2 Attribute Analysis

Checking the data against the points was the prime analysis in this instance. In addition that the points were within the grave plots, the points were in the right grave plot, points where they were not within the grave plot, grave plots that had no GPS points within them and grave plots with multiple points within where the surname differed.

The level of accuracy of the point was checked but because it only has to within the grave plot was not a necessary process. The graphs were shown for completeness and further research that may require this task. The points themselves as discussed earlier were only checked for correct data and position. The accuracy of the data was relatively good, however there were a few points outside the polygons and some plots without points. It would be assumed that the GPS device moving before the data was accepted caused this. This is a common problem and care must be taken to remain still until the device prompts the user that the point has been captured correctly. The sounding of a chime is the way of establishing that a point has been captured using this Hand Held GPS device.

The analysis of web page is discussed in the following section. It will analyse if the criteria to build the web page was met, how relevant the content was and how well a user can navigate around the web page.

4.5 Analysis of Web Page Design

The web page design was analysed once implemented to assess whether or not it met the criteria set out in its design. This incorporated the layout of the web page, the content of information and the user friendliness of the system.

The general layout as discussed in section 3.6 was designed to follow a set of prompts that a user could manipulate for there particular purpose. It encouraged the use

of web links and a search tool to navigate through to the available information in the system. The content itself comprised of the cemetery plots and the information on each plot. In addition the history of the site was also examined to give the user an understanding of the area in the this era. The web page was kept as simple as possible with the aid of web links and short cut keys so that a novice user could navigate around the system.

The limitations of the system was that research was not performed for a user, with an interest in completing the whole cemetery, to be able to input new information. It would have made the project more appealing to an interested person knowing this tool was available.

The last analysis will be of the data sets used. In this section a discussion on the importance of this information and how well it shaped the cemetery map.

4.6 Data Sets used

The research project was completed with an array of data sets that made up the cemetery survey. Each piece of data can be linked in such a way that creates the information in the final design placed in the web site. The data types were examined to illustrate there importance towards the project and how they all fit together in the completed map.

The data sets used in the collection of data and the ground coordinates were in alpha-numeric format. Each piece of data represented one part of the cemetery information and consisted of a point number, coordinates, bearings, distances, vertical angles and codes. The culmination of this data resulted in points displayed in grid format (AMG84) that had attributes linked to each point. These point were connected by lines and produced an outline of each grave plot in the portion of the cemetery surveyed.

The data collected with the hand held GPS was also in alpha-numeric format and included positional data in addition to the attribute data collected on each grave plot. The positional data included coordinates, Australian Height datum (AHD) Levels, accuracy information, time and date of capture and was also given a point number. The

data in this case once processed displayed a layout of each grave plot, with the use of a star symbol, with attached attribute information.

The GIS processed the various data sets from the data collected, captured and catalogued and produced layers of information. The cadastre used in the GIS also has its own data sets that built the map of the city area including positional data (pits, signs, survey marks etc..), attribute data (descriptions of survey marks, sign information and pits pipe sizes etc..), polygon information (boundaries, waterways etc.) and land parcel information.

The method in which this data was manipulated determined the accuracy and reliability of the information presented in the final product. An awareness of the data sets used is necessary in formatting the mapped cemetery in order to piece the data together to create useable information.

The analysis in general illustrated each process and discussed the results and possible improvements that may have made the completion of the research project more efficient and effective in all facets of each task.

The traversed data, when analysed, produced results that proved two methods can equate to a similar outcome although traditional methods should always be used. Analysing the mapped data achieved the result of having accurate and reliable data that would be in a useable format. It also verified that the accuracy met an acceptable standard and its reasons. The analysis of the web page concentrated on the end product and how it met the needs of a user. As discussed it had its own limitations but overall met the criteria set out in the design.

Without the analysis it would have meant the traversed, mapped data and web design was accepted and not checked for inaccuracies, errors or layout of design. The finished product would have been an unfinished and possibly a poor quality map of the cemetery.

The final chapter will examine the outcomes of the analysis and draw conclusions regarding the tasks performed in completing the project. It will also discuss the public

perception on this project and a general view of the overall achievements of the project.

CHAPTER 5 – CONCLUSIONS, DISCUSSIONS AND IMPLICATIONS.

5.1 Conclusions

The results of the analysis have suggested that the methodology used to complete the project achieved an accurate and true representation of the portion of the cemetery including a map and information on each grave plot that can be viewed on a web page. This is one method that could have been used another was discussed in section 3.2.4. In addition the cost was kept to a minimum by utilising equipment from my place of work and time efficiencies were made by the employer allowing some field work to be completed in work hours.

This chapter will draw conclusions to the steps in each facet of the project and discuss the outcomes of each task. The final section will include any implications the project incurred and the method used to overcome these problems.

5.1.1 Control and data collection

Control of the site was a function deemed necessary to verify the boundaries of the portion of cemetery mapped and observe that the points captured were in the right area.

The traversing, including the adjustment, was illustrated as a process required to place marks around the cemetery and detailed for completeness along with the reduction of raw information collected in the field. These steps were discussed in detail to understand the principles and tasks involved to complete a cemetery survey.

5.1.2 Capturing and Cataloguing

The capture process was not as accurate as expected although this problem was alleviated by collecting the grave plots with the Total Station as verification of the plot boundaries. The speed at which the information was captured was excellent but was offset by the cataloguing which took more time than expected. Economically the Hand Held GPS is ideal, it is also easy to use and also light weight. There are no cables to worry about and battery lasts for up to 6 hours which allows for a days work out of the GPS.

The cataloguing of information was a laborious task and was made simpler by adding a menu list to choose from. Setting up the attribute table was also straight forward and needed very little training. The choice of equipment for this part of the project was critical from a time perspective and proved to be the factor that determined the number of grave plots collected. Hence, using the Hand Held GPS and capturing the points as described section 3.4.1 and 3.4.2 was determined to be the best available choice.

From a statistical point of view, the number of points captured was 237 and out of these, 126 grave plots were in this portion. Approximately half of the plots had multiple entombments in them, some up to eight.

5.1.3 Mapping

Mapping the data resulted in the information captured to be verified for accuracy in location. It also proved that the digital map and aerial photo were not accurate enough to display each grave plot and created the extra step of collecting data using a Total Station but the end result was a more accurate picture of what was captured in the field.

The cadastre map used was reliable enough to present the final product in a digitally mapped form that was true and reliable for use by any interested persons or organisations.

5.1.4 Web Page

The web page proved to be the obvious way of completing the project, not only was it able to store all of the cemetery information into one database but it is in useable format to be accessed by the general public anywhere on the globe, if it was permanently on the world wide web.

The links to other websites also aided in understanding the purpose of the project and also to allow a visitor to have there own input into further research if they had an interest in the project.

5.1.5 General

The completed project of the mapped grave plots in the cemetery with the attributes and photos attached demonstrated that there was a benefit in undertaking this survey

using GPS and GIS. The result of a permanent record of information for users to be able access from a web site or the cemetery manager is invaluable as this information does not exist nationally at present. In addition the amount of data capable of being stored on a GIS is quite large and with further work a national cemetery register is definitely achievable.

The next section is for general discussion on the tasks involved in piecing together the project. Included is the project in general, , GPS data Capture, mapping the data into a GIS and the benefits and limitations of the research work.

5.2 Discussion

5.2.1 Evolution of Project

The project was challenging due to the original methodology, which was not presented in this paper, changing as new research information surfaced in the early stages of the project. The plan was to capture the cemetery plots with a Hand Held GPS; map the data into a GIS; and create a website to view the information. As the project evolved it was apparent that further work was required to achieve the desired accuracy in the form of a feature survey. This was used to define the grave plots more accurately as the captured data was not as reliable as it could have been due to the GPS unit used. The field survey proved to achieve a better outcome for presentation and accuracy although it required an extra day of survey. If RTK GPS was used this step would have been eliminated as discussed in section 3.2.4.

The amount of plots collected was less than expected due to the number of entombments per grave plot. It was expected that one or two would be the maximum number of deceased people in each grave plot but some contained up to eight which slowed the capture process down considerably and resulted in a smaller portion of the cemetery mapped.

5.2.2 Capturing and Cataloguing

The capturing process was kept uncomplicated by setting up the GPS unit to suit the requirements of the cemetery survey. The ability to have a device that can be used by

one person with no leads and enough battery life for a days work made this a very useful and appropriate piece of equipment to use for this specific project.

The cataloguing on the other hand was a harder task but was made easier with a list of menus and fields. An alternative method would not have saved a lot of time as typing was required for many parts of the grave plot information.

5.2.3 Mapping

The mapping side of the project was one of the most demanding parts of the process. This section took a lot of time to learn and the analysis was a major step in the final output of the project. Not being familiar with MapInfo and its principles made performing the task to produce the end result a lot more satisfying. This tied all of the steps from traversing to mapping together and made a lot more sense than in the early stages of this project.

5.2.4 Benefits and Limitations

The potential benefits of carrying out a cemetery survey, I believe, are enormous and the groups or organisations that can use this type of information are endless. Genealogists, historians, governments, museums, and the census bureau are but a few areas where this information, assuming it is useful to these organisations, could be accessed and used. An example could be for governments to inject funding to refurbish the grave plots to their original state as many of them are dilapidated. It is important from a historical perspective to archive this information so that future generations have access to a multitude of facts and figures to use in appraising and collating the data.

The fact that this information can be preserved in digital format is another incentive that should make a national register on cemeteries a high priority and government funding should be allocated to enable the completion of this work.

The limitations of this work was the amount of data capture and cataloguing required just for one cemetery. It would take many months to complete a full cemetery, using this method. At this stage the ability to combine the features of RTK GPS and the TerraSync program has not been explored but would dramatically reduce the time

needed to complete this project in full with the accuracy and cataloguing benefits working together.

The last section focuses on explaining the implications of such research project and analyses the possible repercussions if the public are made aware of the project.

5.3 Implications

5.3.1 Public perception

Although anyone is able to visit the cemetery, a question is posed in collecting information on each person and displaying it on a website that can be accessed by anyone. Some families of the deceased may view this as invasion of privacy even though the cemetery manager has given permission to complete the project . Would it be a reasonable to request their permission also? It is a public area after all so what is the difference in displaying this on a website or being able to view a grave plot in person at a cemetery? At present from the research performed for this project these questions have not been asked but must be considered. It is also the responsibility of the person undertaking the project to firstly seek permission to complete the task and to be sure that none of the grave plots are disturbed or damaged.

The Cemetery Map now complete and in the Web page is able to be used for its intended purpose of locating historical information on an entombed person in the Old Ballaarat Cemetery. This information in the future should be used to complete the whole cemetery and ownership should be made to the Cemetery Manager for use by other organisations.

REFERENCES

Bonham–Carter, G.F., 1994, *Geographic Information Systems for Geoscientists: Modelling with GIS,* Permagon, New York.

Boston Parks and Recreation Department, 1989, The Boston Experience: *A Manual for Historic Burying Grounds Preservation.*

Burrough, P.A, 1986, 'Methods of data analysis and spatial modelling', *Principles of Geographic Information Systems for Land Resource Assessment,* Clarendon Press, Oxford.

Cooksey.D, Understanding the Global Positioning System (GPS), Department of Land Resources and Environmental Sciences, Montana State University-Bozeman, 2004, (http://www.montana.edu/places/gps/understd.html#Geometric_Dilution_of_Precision_(GDOP): accessed 15/04/2004).

County of Boone, Boone County Missouri Cemetery Project, 1998, (http://www.bocomo.org/cemmain.htm : accessed 19/04/2004).

Fotheringham & Rogerson, 1994, Spatial Analysis and GIS, *Review of Statistical Spatial Analysis in GIS*, Burgess Science Press, Basingstoke.

Grimes.J, How to Conduct a Cemetery Survey, 1999, (http://www.bjhughes.org/cemhow.html : accessed 19/04/2004).

Hunter, G & Beard, K, 1992, 'Understanding error in spatial databases', T*he Australian Surveyor*, vol. 37, no.2, pp.110-111.

Johnson. S.P, Using a GPS Device, 2001, (http://www.interment.net/column/records/gps/ : accessed 19/04/2004).

Sizer.S.M, Locating and Mapping Cemetery's in Loudon County, Virginia, 1999, (http://kitkat.wvu.edu:8080/files/623.1.etd.PDF : accessed 30/03/2004).

Surveyors Board 2004, Surveying using GNSS, (http://www.surveyorsboard.vic.gov.au/documents/SurveyingusingGNSS.pdf: accessed 25/9/2004.)

Surveyors Board of Victoria,1992, Survey Coordination (Survey) Regulations 1992.

University of Southern Queensland, 1999, Department of Engineering and Surveying, *E4006 Automated Surveying Systems*.

University of Southern Queensland, 2000, Department of Engineering and Surveying, *E4020 Cadastral Surveying*.

University of Southern Queensland, 1999, Department of Engineering and Surveying, *E4019 Geodetic Surveying A*.

Withers.W.B, 1887, History of Ballarat, *From First Pastrol Settlement to the Present Time,* F.W.Niven & Co., Ballarat.

Worboys.M.F, 1994, Innovations in GIS 1, Burgess Science Press, Basingstoke.

LIST OF APPENDICES

Appendix A

Appendix A – Project Specification

THE UNIVERSITY OF SOUTHERN QUEENSLAND
FACULTY OF ENGINEERING AND SURVEYING

ENG 4111 & 4112 Research Project 2004

PROJECT SPECIFICATION

FOR:	**Mario de la Pena**
TOPIC:	Historical Identification and Mapping
SUPERVISORS:	Dr. Frank Young, Faculty of Engineering Surveying USQ Mr. Brian Marsh, City Of Ballarat
PROJECT AIM:	This project is aimed at determining the methods of capturing and cataloguing information of a portion of the Old Ballarat Cemetery and to map this into a GIS system to be later used as a web based service.
SPONSORSHIP:	City of Ballarat
PROGRAMME:	**Issue A, 09 March 2004**

1. Research information on methods of capturing and cataloguing data on historical information using GIS.
2. Critically evaluate the current methods for capturing and cataloguing data and evaluate the methods of mapping the data captured into a GIS software program.
3. Design a method of capturing and cataloguing the data and design a method for mapping data into a GIS software program.
4. Capture and catalogue data: Analyse the results of the data capture and cataloguing for errors and/or inaccuracies.
5. Analyse the results of the mapped data and provide a demonstration of the finished product.

<u>As time permits:</u>

6. Design a website for the public to use the information.

AGREED: _____ (Student) _____ (Supervisors)

8/6/05 8/6/05 __/__/__

iii

Appendix B

Appendix B – Traverse Information after compass adjustment

TRAVERSE REDUCTION

JOB TRAVAMG
FILE C:\CCAD5\TEMP\ENG.DAT

From	Bearing	Distance	to	Easting	Northing	Point
Start				751584.414	5840112.196	20179
****	12°35'52"	111.958		751608.833	5840221.459	11
11	9°57'08"	108.327		751627.554	5840328.156	12
12	191°17'45"	220.224		751584.418	5840112.198	13
Closing to				751584.414	5840112.196	20179

Misclose Bearing 69°41'16" Distance 0.004
Accuracy 1:99843.
Traverse length 440.509

ADJUSTED TRAVERSE

JOB TRAVAMG
FILE C:\CCAD5\TEMP\ENG.DAT

Adjustment COMPASS

From	Bearing	Distance	to	Easting	Northing	Point
Start				751584.414	5840112.196	20179
****	12°35'50"	111.957		751608.832	5840221.458	11
11	9°57'06"	108.326		751627.552	5840328.155	12
12	191°17'47"	220.225		751584.414	5840112.196	20179

Traverse length 440.509
Enclosed area 279.898

Appendix C

Appendix C – Part of raw data from feature survey

#VERSION-1.0 NEUTRAL FILE

NOTE TRANSLATOR: LEICA TPS vers 3.21

UNIT UL=M,UA=S

AMODE HM=B,VM=Z

SCALE 1.000000

EDMTYPE ET=0, EO=0.000, EP=0.000

JOB ENG4111

INST TC1105 s/n:624898

DATE 3.5.04 17:25

NAME MDEL

ATMOS T=, P=

STN ID=20179, HI=1.780, CO=SPSM/574

XYZ ID=20179, E=751584.414, N=5840112.196, RL=450.781, CO=SPSM/179

SS ID=20574, HA=190.11520, VA=89.05220, SD=149.303, HT=1.830, CO=SPSM/574

SS ID=11, HA=12.35520, VA=89.07140, SD=111.971, HT=1.675, CO=NAIL/11

JOB ENG4111

INST TC1105 s/n:624898

DATE 3.5.04 17:35

NAME MDEL

ATMOS T=, P=

STN ID=11, HI=1.655, CO=NAIL/11

XYZ ID=11, E=751608.835,N=5840221.471,H=452.450

BKB ID=20179, HA=192.35510

SS ID=12, HA=9.57070, VA=89.30250, SD=108.331, HT=1.694, CO=NAIL/12

SS ID=101, HA=327.27180, VA=94.56130, SD=1.569, HT=1.600, CO=01EDGE/PLOT

SS ID=102, HA=281.11290, VA=90.04290, SD=45.969, HT=1.600, CO=01EDGE

SS ID=103, HA=307.28110, VA=89.20530, SD=51.772, HT=1.600, CO=01EDGE

SS ID=104, HA=7.46110, VA=89.06020, SD=25.691, HT=1.600, CO=01EDGE*C/PLOT

SS ID=105, HA=13.49040, VA=89.01280, SD=25.918, HT=1.600, CO=02EDGE/PLOT

SS ID=106, HA=68.13500, VA=92.46140, SD=2.258, HT=1.600, CO=02EDGE

SS ID=107, HA=97.47280, VA=91.25470, SD=38.127, HT=1.600, CO=02EDGE

SS ID=108, HA=64.50340, VA=90.36550, SD=47.316, HT=1.600, CO=02EDGE*C/PLOT

SS ID=109, HA=62.59510, VA=90.40440, SD=48.380, HT=1.600, CO=03EDGE/PLOT

SS ID=110, HA=44.12400, VA=90.13390, SD=69.691, HT=1.600, CO=03EDGE

SS ID=111, HA=11.34560, VA=88.59460, SD=57.193, HT=1.600, CO=03EDGE

SS ID=112, HA=13.36300, VA=89.05400, SD=27.549, HT=1.600, CO=03EDGE*C/PLOT

SS ID=113, HA=7.52200, VA=89.07040, SD=27.411, HT=1.600, CO=04EDGE/PLOT

Appendix D

Appendix D – Spreadsheet listing attributes of each Grave Plot.

ID	Surname	Other_Names	Religion	Birth	Death	Headstone	Material	Photo No.	Epitaph	Plot Condition	Max_PDOP	Max_HDOP	GPS_Date	GPS_Time	GPS_Height	Horz_Prec
1	Johnson	n/a	Catholic	n/a	n/a	No	Bluestone	2953	none	Good	3.8	2.1	8/05/2004	09:54:26am	472.008	6.2
2	Turner	n/a	Catholic	n/a	n/a	No	Concrete	2954	none	Good	3.8	2.1	8/05/2004	09:55:56am	474.58	6
3	Clarke	Helen Borland	Catholic	1813	1873	Yes	Conc + Fenced	2955	Blessed are the dead who die in the Lord	Fair	4.7	2.7	8/05/2004	09:57:42am	476.494	6
4	Liddelow	Cap Audrey	Catholic	n/a	19/7/1916	Yes	Conc + Fenced	2955	Forever with the Lord	Fair	3.8	2.2	8/05/2004	10:03:01am	475.74	5.8
5	Leith	Ellen	Catholic	n/a	30/4/1948	Yes	Concrete	2956	none	Good	2.8	1.5	8/05/2004	10:09:17am	475.941	5.9
6	Leith	John Thomas	Catholic	n/a	28/8/1956	Yes	Concrete	2957	none	Good	2.8	1.5	8/05/2004	10:11:41am	474.974	5.9
7	Faulks	James	Catholic	4/1861	20/3/1864	Yes	Conc + Fenced	2958	This infants life is hid with Christ in God	Poor	5.9	3.1	8/05/2004	10:14:11am	474.103	5.9
8	Faulks	Ernest Isaac	Catholic	n/a	1/9/1876	Yes	Conc + Fenced	2959	none	Poor	3.5	2	8/05/2004	10:19:26am	473.162	5.9
9	Guthel	Emil.J.A	Catholic	1867	1917	Yes	Concrete	2960	At rest	Good	2.7	1.6	8/05/2004	10:21:22am	473.603	5.9
10	Gutheil	Frank Emil	Catholic	1914	1914	Yes	Concrete	2961	At rest	Good	2.4	1.3	8/05/2004	10:24:16am	471.976	5.8
11	Gutheil	Arthur Emil Toby	Catholic	n/a	28/5/1920	Yes	Concrete	2962	At rest	Good	2.4	1.4	8/05/2004	10:26:37am	472.187	5.9
12	Lavis	n/a	Catholic	n/a	n/a	No	Concrete	2963	none	Good	2.4	1.4	8/05/2004	10:28:21am	471.727	5.9
13	McDonald	John Gordon	Catholic	7/5/1928	15/7/1901	Yes	Concrete	2964	none	Good	2.3	1.4	8/05/2004	10:29:47am	472.138	5.9
14	McDonald	Elspeth	Catholic	1/7/1828	28/8/1898	Yes	Concrete	2965	none	Good	2.3	1.4	8/05/2004	10:31:21am	472.161	5.9
15	Cowan	n/a	Catholic	n/a	n/a	No	Conc + Fenced	2966	none	Fair	2.2	1.3	8/05/2004	10:33:21am	472.466	5.8
16	Waldie	Thomas	Catholic	1808	1884	Yes	Concrete	3180	Blessed are the dead who die in the Lord	Good	3.3	2.1	8/05/2004	10:35:11am	472.696	5.8
17	McLean	Lilly	Catholic	1816	1/4/1902	Yes	Concrete	2970	none	Good	2.3	1.5	8/05/2004	10:37:36am	473.409	5.8
18	Pattie	Eliza Charlotte	Catholic	1889	29/11/1908	Yes	Concrete	2971	Forever with the Lord	Good	2.2	1.6	8/05/2004	10:42:12am	475.191	5.9
19	Pattie	Neil Lyle	Catholic	1908	1908	Yes	Concrete	2971	Forever with the Lord	Good	2.2	1.6	8/05/2004	10:45:16am	475.522	6
20	Lumsden	n/a	Catholic	n/a	n/a	Yes	Conc + Fenced	2972	none	Fair	2.1	1.5	8/05/2004	10:48:27am	475.309	5.9
21	Rattray	John	Catholic	n/a	1863	Yes	Conc + Fenced	2973	none	Fair	6.6	6.3	8/05/2004	10:50:51am	474.912	7.2
22	Lawrence	Mary Elizabeth	Catholic	1873	24/1/1917	Yes	Concrete	2974	There is sweet rest in heaven	Good	2.1	1.3	8/05/2004	10:54:47am	475.96	5.7
23	Lawrence	Frank William	Catholic	n/a	28/3/1966	Yes	Concrete	2974	There is a sweet rest in heaven	Good	5.2	3.7	8/05/2004	10:57:57am	475.871	5.8
24	Unmarked Plot	n/a	Catholic	n/a	n/a	No	Bluestone	2975	none	Fair	2.1	1.3	8/05/2004	11:00:36am	475.525	5.8
25	Thorpe	John	Catholic	n/a	18/11/1883	Yes	Conc + Fenced	2976	none	Fair	2.2	1.4	8/05/2004	11:01:22am	475.59	5.7
26	William	Fredrick William	Catholic	n/a	24/11/1860	Yes	Conc + Fenced	2977	none	Fair	2	1.3	8/05/2004	11:04:16am	475.825	5.7
27	McFayden	Marjory	Catholic	n/a	7/11/18..	Yes	Conc + Fenced	2978	none	Poor	6	4.1	8/05/2004	11:05:46am	475.368	5.8
28	Bolton	Sarah	Catholic	n/a	19/10/1866	Yes	Conc + Fenced	2984	none	Good	2.6	1.9	8/05/2004	11:09:32am	473.992	5.7
29	Bolton	Robert Clark	Catholic	n/a	5/1856	Yes	Conc + Fenced	2984	none	Good	2.4	1.4	8/05/2004	11:13:11am	473.449	5.7
30	Bolton	Janet Eliza	Catholic	n/a	7/2/1863	Yes	Conc + Fenced	2984	none	Good	1.8	1	8/05/2004	11:14:17am	473.53	5.7
31	Bolton	Joseph	Catholic	n/a	1/9/1867	Yes	Conc + Fenced	2984	none	Good	2.5	1.7	8/05/2004	11:15:11am	473.313	5.7
32	Bolton	Hammersley Garfield	Catholic	26/3/1884	13/12/1940	Yes	Conc + Fenced	2984	none	Good	1.8	1	8/05/2004	11:16:31am	472.921	5.7
33	Bolton	Kathleen	Catholic	20/6/1895	1/3/1983	Yes	Conc + Fenced	2984	none	Good	1.8	1	8/05/2004	11:18:21am	472.435	5.7
34	Little	n/a	Catholic	n/a	n/a	Yes	Conc + Fenced	2985	none	Good	1.9	1	8/05/2004	11:19:41am	472.738	5.7
35	Tregellas	n/a	Catholic	n/a	n/a	No	Bluestone	2986	none	Fair	1.9	1	8/05/2004	11:20:21am	473.513	5.7
36	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Conc + Fenced	2987	none	Fair	2.4	1.4	8/05/2004	11:28:22am	473.185	5.7
37	Milton	n/a	Catholic	n/a	n/a	Yes	Concrete	2988	none	Poor	1.9	1	8/05/2004	11:29:16am	472.64	5.7
38	Hicks	n/a	Catholic	n/a	n/a	Yes	Concrete	2988	none	Good	1.9	1	8/05/2004	11:29:42am	472.603	5.7
39	Cummins	Margaret	Catholic	1823	8/10/1862	Yes	Conc + Fenced	2990	none	Good	1.9	1	8/05/2004	11:30:46am	472.892	5.7
40	Squire	Lorna	Catholic	1909	24/9/1909	Yes	Concrete	2994	none	Fair	1.9	1	8/05/2004	11:32:26am	472.486	5.7
41	Squire	Lloyd	Catholic	1912	13/11/1930	Yes	Concrete	2994	none	Fair	1.9	1	8/05/2004	11:33:57am	472.485	5.7
42	Squire	Puby	Catholic	1905	10/3/1931	Yes	Concrete	2994	none	Fair	1.9	1	8/05/2004	11:34:51am	472.59	5.7
43	Squire	Alexander.G	Catholic	1871	21/8/1935	Yes	Concrete	2994	none	Fair	1.9	1	8/05/2004	11:35:51am	472.538	5.7
44	Squire	Susannah Mary	Catholic	1879	2/2/1956	Yes	Concrete	2994	none	Fair	1.9	1	8/05/2004	11:37:21am	472.262	5.7
45	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Conc + Fenced	2995	none	Good	1.9	1	8/05/2004	11:39:17am	472.615	5.7
46	Named Plot not legible	n/a	Catholic	n/a	n/a	Yes	Concrete	2996	none	Poor	2.3	1.4	8/05/2004	11:39:41am	473.329	5.7
47	Clutten	n/a	Catholic	n/a	n/a	No	Bluestone	2997	none	Fair	1.9	1	8/05/2004	11:40:27am	473.555	5.7
48	Josephs	Henry	Catholic	1822	30/9/1920	Yes	Bluestone	2999	RIP	Fair	2.3	1.4	8/05/2004	11:41:27am	473.948	5.7

49	McHattie	John Blair	Catholic	1863	1866	Yes	Conc + Fenced	3000	They were lovely and pleasant in their lives	Fair	3.8	2.7	8/05/2004	11:46:32am	474.571	5.7
50	McHattie	James Anderson	Catholic	1865	17/4/1866	Yes	Conc + Fenced	3000	They were lovely and pleasant in their lives	Fair	2.3	1.4	8/05/2004	11:51:06am	474.882	5.7
51	McHattie	James	Catholic	1834	14/7/1884	Yes	Conc + Fenced	3000	They were lovely and pleasant in their lives	Fair	2.3	1.4	8/05/2004	11:52:56am	474.838	5.7
52	Fuilerton	Mary	Catholic	1828	2/4/1917	Yes	Concrete	3001	Love whilst on earth less never through come	Fair	1.9	1	8/05/2004	11:55:02am	474.427	5.7
53	Fuilerton	James	Catholic	1842	3/11/1931	Yes	Concrete	3001	Love whilst on earth less never through come	Fair	2.8	1.7	8/05/2004	11:56:21am	474.814	5.7
54	Skewes	Anne	Catholic	1827	16/5/1865	Yes	Conc + Fenced	3002	Deeply Mourned	Fair	8.3	2.8	8/05/2004	11:58:47am	475.63	5.8
55	Skewes	Mary	Catholic	1861	10/4/1865	Yes	Conc + Fenced	3002	Deeply Mourned	Fair	2.6	1.3	8/05/2004	12:02:41pm	476.803	5.8
56	Skewes	William	Catholic	1852	8/11/1931	Yes	Conc + Fenced	3002	Deeply Mourned	Fair	2.9	1.6	8/05/2004	12:04:41pm	476.881	5.8
57	Skewes	Annie	Catholic	1883	11/8/1962	Yes	Conc + Fenced	3002	Deeply Mourned	Fair	2.9	1.7	8/05/2004	12:06:21pm	476.985	5.9
58	Skewes	Phoebe Maria	Catholic	1875	31/12/1938	Yes	Conc + Fenced	3002	Deeply Mourned	Fair	3	1.7	8/05/2004	12:07:42pm	477.082	5.9
59	Skewes	Henry.I	Catholic	1877	30/3/1948	Yes	Conc + Fenced	3002	Deeply Mourned	Fair	3	1.7	8/05/2004	12:09:12pm	477.011	5.9
60	Long	Olivia	Catholic	1838	23/4/1863	Yes	Conc + Fenced	3003	none	Good	3	1.7	8/05/2004	12:12:06pm	476.841	5.9
61	Long	Olivia Eliza	Catholic	1863	29/2/1864	Yes	Conc + Fenced	3003	none	Good	3	1.7	8/05/2004	12:13:16pm	477.049	5.9
62	Long	Harriet Caroline	Catholic	1859	24/11/1886	Yes	Conc + Fenced	3003	none	Good	3	1.7	8/05/2004	12:15:52pm	474.236	5.9
63	Long	Fanny Smith	Catholic	1800	23/6/1877	Yes	Conc + Fenced	3003	none	Good	2.6	1.4	8/05/2004	12:17:12pm	474.032	5.9
64	Long	Eliza	Catholic	1800	8/6/1886	Yes	Conc + Fenced	3003	none	Good	3	1.7	8/05/2004	12:18:21pm	474.762	5.9
65	Miller	Elizabeth.M	Catholic	1864	7/12/1895	Yes	Conc + Fenced	3003	none	Good	3	1.7	8/05/2004	12:19:41pm	475.025	5.8
66	Miller	James.M and Eliza	Catholic	1895	20/2/1896	Yes	Conc + Fenced	3003	none	Good	2.6	1.3	8/05/2004	12:20:57pm	475.474	5.8
67	Long	James	Catholic	1830	3/3/1916	Yes	Conc + Fenced	3003	none	Good	3.4	1.4	8/05/2004	12:22:01pm	476.305	5.8
68	Long	Mary.J	Catholic	1842	11/12/1929	Yes	Conc + Fenced	3003	none	Good	4.8	2	8/05/2004	12:23:57pm	475.36	5.9
69	Unnamed Plot	n/a	Catholic	n/a	n/a	Yes	Concrete	3004	none	Fair	4.8	2	8/05/2004	12:25:31pm	473.888	5.9
70	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Bluestone	3005	none	Fair	3	1.3	8/05/2004	12:26:17pm	471.914	5.8
71	McLean	Margaret Miller	Catholic	1814	15/2/1870	Yes	Conc + Fenced	3006	none	Fair	4.8	2	8/05/2004	12:26:37pm	471.819	5.8
72	Fullarton	William	Catholic	1826	31/5/1863	Yes	Conc + Fenced	3006	none	Fair	3	1.3	8/05/2004	12:27:57pm	471.49	5.8
73	McLean	Isabella Kerr	Catholic	1868	27/5/1876	Yes	Conc + Fenced	3006	none	Fair	4.8	2	8/05/2004	12:29:07pm	471.981	5.8
74	McLean	Robert Fullarton	Catholic	1818	4/7/1880	Yes	Conc + Fenced	3006	none	Fair	4.8	2	8/05/2004	12:30:36pm	471.871	5.9
75	Shaw	John	Catholic	1862	1862	No	Conc + Fenced	3007	none	Good	4.8	2	8/05/2004	12:31:56pm	473.045	5.9
76	Shaw	Donald McKenzie	Catholic	1899	13/4/1900	No	Conc + Fenced	3007	none	Good	2.9	1.2	8/05/2004	12:32:52pm	471.909	5.8
77	Shaw	Christina	Catholic	1913	18/3/1914	No	Conc + Fenced	3007	none	Good	2.9	1.2	8/05/2004	12:34:16pm	471.03	5.8
78	Shaw	Alexander John	Catholic	1866	9/1/1942	No	Conc + Fenced	3007	none	Good	2.9	1.2	8/05/2004	12:35:52pm	470.321	5.8
79	Shaw	Eliza Catherine	Catholic	1870	30/6/1942	No	Conc + Fenced	3007	none	Good	4.6	2	8/05/2004	12:38:02pm	470.053	5.8
80	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Conc + Fenced	3008	none	Good	4.6	2	8/05/2004	12:40:12pm	471.21	5.8
81	Hore	Julia	Catholic	1854	18/1/1910	Yes	Bluestone	3009	Peacefully Sleeping	Good	2.9	1.2	8/05/2004	12:40:51pm	470.425	5.8
82	Hore	John	Catholic	1881	24/11/1918	Yes	Bluestone	3009	Reunited	Good	4.5	2	8/05/2004	12:42:01pm	471.454	5.8
83	Hore	Voilet	Catholic	1891	5/2/1977	Yes	Bluestone	3009	Peacefully Sleeping	Good	4.5	2	8/05/2004	12:43:17pm	471.722	5.8
84	Hore	Alfred Leslie	Catholic	1879	4/7/1980	Yes	Bluestone	3009	Peacefully Sleeping	Good	2.8	1.2	8/05/2004	12:45:11pm	474.835	5.7
85	Bloore	n/a	Catholic	n/a	n/a	No	Concrete	3010	none	Fair	4.3	2	8/05/2004	12:46:37pm	471.688	5.8
86	Strickland	Edwin Charles	Catholic	1862	9/1/1863	Yes	Conc + Fenced	3011	none	Good	2.8	1.2	8/05/2004	12:47:57pm	469.954	5.8
87	Strickland	Richard	Catholic	1808	21/3/1867	Yes	Conc + Fenced	3011	none	Good	2.8	1.2	8/05/2004	12:49:27pm	472.361	5.7
88	Strickland	Ernest Mayhew	Catholic	1869	23/5/1870	Yes	Conc + Fenced	3011	none	Good	2.3	1.1	8/05/2004	12:51:01pm	474.13	5.6
89	Skoglund	Ethel Gustafra	Catholic	1870	28/1/1873	Yes	Conc + Fenced	3011	none	Good	2.7	1.1	8/05/2004	12:52:42pm	473.508	5.6
90	Strickland	Edwin James	Catholic	8/9/1836	4/2/1902	Yes	Conc + Fenced	3011	none	Good	2.3	1.1	8/05/2004	12:54:26pm	473.181	5.6
91	Strickland	Margaret Emma	Catholic	1833	16/4/1919	Yes	Conc + Fenced	3011	none	Good	2.2	1.1	8/05/2004	12:56:06pm	472.971	5.6
92	Strickland	Harold Nicholson	Catholic	1871	16/3/1922	Yes	Conc + Fenced	3011	none	Good	2.2	1.1	8/05/2004	12:57:52pm	472.653	5.6
93	Mylrea	Edward	Catholic	1836	26/9/1905	Yes	Conc + Fenced	3182	Till the day break	Good	2.2	1	8/05/2004	12:59:22pm	473.075	5.6
94	Plier	Fredrick.E	Catholic	1845	10/5/1917	Yes	Bluestone	3183	none	Fair	2.6	1.1	8/05/2004	01:01:36pm	472.91	5.6
95	Plier	Sarah.M	Catholic	1858	11/3/1932	Yes	Bluestone	3183	none	Fair	2.2	1	8/05/2004	01:03:47pm	473.643	5.6
96	Rattray	Mary Ann	Catholic	1852	6/4/1863	Yes	Conc + Fenced	3184	none	Fair	1.9	0.9	8/05/2004	01:05:11pm	474.648	5.6
97	Rattray	Mary Ann	Catholic	1849	1876	Yes	Conc + Fenced	3184	none	Fair	1.8	0.8	8/05/2004	01:06:27pm	475.32	5.6
98	Rattray	Robert	Catholic	1812	13/4/1887	Yes	Conc + Fenced	3184	none	Fair	2	0.9	8/05/2004	01:07:17pm	475.087	5.6
99	Rattray	Robert	Catholic	1806	21/9/1894	Yes	Conc + Fenced	3184	none	Fair	2	0.9	8/05/2004	01:09:37pm	474.927	5.6
100	McKenzie	Hugh Connell	Catholic	1831	1904	Yes	Bluestone	3185	none	Fair	2.9	1.9	8/05/2004	01:11:21pm	471.62	5.6

101	McKenzie	Ursella Edwards	Catholic	1847	1921	Yes	Bluestone	3185	none	Fair	2.1	1	8/05/2004	01:12:27pm	471.927	5.6
102	McKenzie	Agnes	Catholic	1863	1911	Yes	Bluestone	3185	none	Fair	2.1	1	8/05/2004	01:13:31pm	471.372	5.7
103	Mitchell	Ethel Maude	Catholic	1865	2/3/1866	Yes	Conc + Fenced	3186	none	Fair	1.9	0.9	8/05/2004	01:14:32pm	472.227	5.6
104	Mitchell	Alfred	Catholic	1832	13/9/1891	Yes	Conc + Fenced	3186	none	Fair	1.9	0.9	8/05/2004	01:15:32pm	472.855	5.6
105	Mitchell	Lucretia Ford	Catholic	1836	8/3/1914	Yes	Conc + Fenced	3186	none	Fair	1.9	0.9	8/05/2004	01:16:32pm	473.087	5.6
106	Mitchell	Arthur Nevett	Catholic	1863	19/3/1923	Yes	Conc + Fenced	3186	none	Fair	1.9	0.9	8/05/2004	01:17:52pm	472.824	5.6

ID	Surname	Other_Names	Religion	Birth	Death	Headstone	Material	Photo_Number	Epitaph	Plot Condition	Max_PDOP	Max_HDOP	GPS_Date	GPS_Time	GPS_Height	Horz_Prec
1	Lugg	Edward George	Catholic	n/a	21/6/1916	Yes	Concrete	2968	none	Good	7.4	7	15/05/2004	10:18:26am	469.989	6
2	Lugg	Alice Annie	Catholic	n/a	18/7/1946	Yes	Concrete	2968	none	Good	4.3	4	15/05/2004	10:20:02am	470.436	7.2
3	Lugg	Doris Evelyn	Catholic	n/a	7/1/1958	Yes	Concrete	2968	none	Good	4.4	4.1	15/05/2004	10:21:02am	470.262	7.3
4	Rowan	n/a	Catholic	n/a	n/a	No	Concrete	3187	none	Fair	4.4	2.6	15/05/2004	10:25:51am	471.025	6.1
5	Williams	William	Catholic	1824	6/10/1891	Yes	Bluestone + Fenced	3188	Rest for the weary	Fair	1.7	1	15/05/2004	10:28:07am	470.849	5.7
6	Williams	Mary Ann	Catholic	1822	6/9/1897	Yes	Bluestone + Fenced	3188	Rest for the weary	Fair	1.7	1	15/05/2004	10:30:21am	470.969	5.7
7	Bunce	Ellen	Catholic	1778	15/4/1864	Yes	Bluestone	3189	For the Lord is good and his mercy is everlasting	Fair	1.8	1	15/05/2004	10:33:21am	471.953	5.7
8	Bunce	Richard	Catholic	n/a	29/3/1885	Yes	Bluestone	3189	For the Lord is good and his mercy is everlasting	Fair	2.4	1.5	15/05/2004	10:37:32am	471.97	5.7
9	Bunce	James	Catholic	1847	17/8/1862	Yes	Bluestone	3189	For the Lord is good and his mercy is everlasting	Fair	1.8	1	15/05/2004	10:39:02am	470.213	5.7
10	Bartelman	George	Catholic	n/a	4/1/1883	No	Bluestone + Fenced	3190	none	Good	2.4	1.4	15/05/2004	10:40:36am	470.896	5.7
11	Bartelman	Emma	Catholic	n/a	9/4/1891	No	Bluestone + Fenced	3190	none	Good	1.8	1	15/05/2004	10:42:26am	471.221	5.7
12	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Bluestone	3191	none	Fair	1.8	1	15/05/2004	10:45:02am	470.185	5.7
13	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Concrete	3192	none	Fair	1.8	1	15/05/2004	10:45:52am	470.435	5.7
14	Aldrew	Robert	Catholic	n/a	1862	Yes	Bluestone + Fenced	3193	none	Good	2.4	1.6	15/05/2004	10:47:52am	470.312	5.7
15	Briant	George	Catholic	1824	21/12/1900	Yes	Concrete + Marble	3194	At rest	Good	2.4	1.4	15/05/2004	10:52:51am	470.169	5.7
16	Briant	Emma	Catholic	1828	20/11/1910	Yes	Concrete + Marble	3194	At rest	Good	2.4	1.4	15/05/2004	10:54:51am	470.027	5.7
17	Briant	Victoria Emma	Catholic	n/a	19/4/1862	Yes	Concrete + Marble	3194	At rest	Good	1.9	1	15/05/2004	10:56:31am	469.829	5.7
18	Matthews	Lucinda	Catholic	1836	17/8/1909	Yes	Concrete + Marble	3195	none	Good	3.1	1.8	15/05/2004	11:14:07am	471.315	5.8
19	Matthews	Andrew	Catholic	1838	27/12/1928	Yes	Concrete + Marble	3195	none	Good	1.9	1	15/05/2004	11:15:27am	471.138	5.7
20	Matthews	John	Catholic	n/a	19/8/1913	Yes	Concrete + Marble	3195	none	Good	1.9	1	15/05/2004	11:16:41am	471.399	5.7
21	McGeary	Isabell	Catholic	1833	6/12/1917	Yes	Concrete + Marble	3195	none	Good	1.9	1	15/05/2004	11:18:07am	471.267	5.7
22	Hill	Bridget	Catholic	1826	7/5/1862	Yes	Bluestone	3196	I shall got to her but she shall not return to me	Fair	2.3	1.3	15/05/2004	11:21:27am	470.647	5.7
23	Thompson	n/a	Catholic	n/a	n/a	No	Bluestone	3197	none	Fair	1.8	1	15/05/2004	11:30:36am	471.846	5.7
24	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Brick	3198	none	Poor	2.6	1.2	15/05/2004	11:31:42am	470.587	5.7
25	Gibb	John Fanny	Catholic	n/a	9/4/1862	Yes	Concrete + Marble	3199	none	Good	2.6	1.3	15/05/2004	11:33:37am	470.676	5.8
26	Warburton	William	Catholic	1853	20/11/1855	Yes	Concrete + Marble	3200	none	Good	2.9	1.7	15/05/2004	11:36:57am	469.842	5.8
27	Warburton	William	Catholic	1859	8/12/1862	Yes	Concrete + Marble	3200	none	Good	2.7	1.3	15/05/2004	11:42:31am	472.3	5.8
28	Warburton	Sarah	Catholic	1863	18/5/1868	Yes	Concrete + Marble	3200	none	Good	2.7	1.3	15/05/2004	11:43:51am	471.109	5.8
29	Warburton	Thomas William	Catholic	1866	18/5/1868	Yes	Bluestone + Fenced	3200	none	Good	2.9	1.7	15/05/2004	11:45:12am	471	5.9
30	Warnburton	Charlotte Louisa	Catholic	1874	1/5/1875	Yes	Bluestone + Fenced	3200	none	Good	2.9	1.7	15/05/2004	11:46:46am	470.389	5.9
31	Warburton	Eliza	Catholic	1831	28/8/1892	Yes	Bluestone + Fenced	3200	We laid her hands down by her side and kissed her cold cold brow	Good	4.7	2	15/05/2004	11:48:16am	470.135	5.9
32	Warburton	Thomas	Catholic	n/a	18/11/1896	Yes	Bluestone + Fenced	3200	Have no mother now	Good	2.6	1.3	15/05/2004	11:52:02am	470.288	5.8
33	Smith	Archibald Vincent	Catholic	1837	28/4/1874	Yes	Concrete + Marble	3201	none	Fair	4.8	2	15/05/2004	11:54:16am	467.839	5.8
34	Smith	Caroline	Catholic	1861	21/3/1862	Yes	Concrete + Marble	3201	none	Fair	4.8	2	15/05/2004	11:58:21am	467.05	5.8

35	Smith	Albert	Catholic	n/a	8/11/1910	Yes	Concrete + Marble	3201	none	Fair	4.8	2	15/05/2004	11:59:47am	466.99	5.9
36	Smith	Harriet	Catholic	1836	12/10/1921	Yes	Concrete + Marble	3201	none	Fair	3	1.3	15/05/2004	12:01:07pm	467.042	5.8
37	Named plot not legible	n/a	Catholic	n/a	n/a	Yes	Bluestone + Fenced	3203	none	Fair	4.7	2	15/05/2004	12:05:01pm	468.431	5.9
38	Park	Margaret	Catholic	1834	16/6/1871	Yes	Bluestone + Fenced	3203	Asleep in Jesus	Good	2.9	1.2	15/05/2004	12:06:07pm	468.83	5.8
39	Park	Arthur David	Catholic	1861	24/2/1862	No	Bluestone + Fenced	3202	Asleep in Jesus	Good	4.6	2	15/05/2004	12:09:36pm	467.221	5.8
40	Randall	Fredrick	Catholic	8/7/1860	16/7/1860	Yes	Bluestone + Fenced	3204	none	Good	4.5	2	15/05/2004	12:12:22pm	467.957	5.8
41	Randall	Edward	Catholic	2/3/1862	2/3/1862	Yes	Bluestone + Fenced	3204	none	Good	2.8	1.2	15/05/2004	12:15:06pm	468.067	5.7
42	Randall	Henry	Catholic	1839	28/3/1914	Yes	Bluestone + Fenced	3204	none	Good	2.8	1.2	15/05/2004	12:16:52pm	468.774	5.7
43	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Bluestone + Fenced	3205	none	Good	2.7	1.2	15/05/2004	12:19:57pm	467.688	5.7
44	Kerr	Alfred Ernest Campbell	Catholic	1868	18/12/1939	Yes	Concrete + Marble	3206	none	Good	2.7	1.2	15/05/2004	12:22:27pm	470.929	5.7
45	Kerr	Ethel May Elllison	Catholic	1883	20/9/1953	No	Concrete + Marble	3206	none	Good	1.8	0.9	15/05/2004	12:24:07pm	472.88	5.6
46	Kerr	Catherine Campbell	Catholic	1862	10/4/1863	Yes	Bluestone + Fenced	3207	none	Good	1.8	0.9	15/05/2004	12:25:51pm	472.714	5.6
47	Kerr	Josephine Tait	Catholic	1865	24/9/1866	Yes	Bluestone + Fenced	3207	none	Good	1.8	0.9	15/05/2004	12:28:07pm	472.64	5.6
48	Kerr	Archibald Campbell	Catholic	1834	16/6/1908	Yes	Bluestone + Fenced	3207	none	Good	1.8	0.9	15/05/2004	12:29:16pm	472.576	5.6
49	Kerr	Christina	Catholic	1836	16/1/1914	Yes	Bluestone + Fenced	3207	none	Good	1.8	0.9	15/05/2004	12:30:32pm	472.309	5.6
50	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Bluestone	3208	none	Fair	2.1	1	15/05/2004	12:31:36pm	471.628	5.6
51	Guthrie	Herbert Grav	Catholic	15/12/1863	1/1869	Yes	Concrete + Marble	3209	He shall gather the lambs with his arms and carry them in his bosom	Good	1.8	0.8	15/05/2004	12:34:42pm	471.917	5.6
52	Guthrie	Percy David Grav	Catholic	13/12/1871	23/6/1876	Yes	Concrete + Marble	3209	He shall gather the lambs with his arms and carry them in his bosom	Good	1.8	0.8	15/05/2004	12:37:22pm	471.504	5.6
53	Guthrie	Gordon Hector	Catholic	13/3/1870	11/1891	Yes	Concrete + Marble	3209	He shall gather the lambs with his arms and carry them in his bosom	Good	1.8	0.8	15/05/2004	12:38:36pm	471.409	5.6
54	Guthrie	Mary Evelyn	Catholic	27/10/1875	1/7/1895	Yes	Concrete + Marble	3209	He shall gather the lambs with his arms and carry them in his bosom	Good	1.8	0.8	15/05/2004	12:40:12pm	471.784	5.6
55	Guthrie	Mary Gordon	Catholic	1845	29/3/1900	Yes	Concrete + Marble	3209	He shall gather the lambs with his arms and carry them in his bosom	Good	1.8	0.8	15/05/2004	12:41:41pm	472.04	5.6
56	Guthrie	George	Catholic	1827	14/3/1913	Yes	Concrete + Marble	3209	He shall gather the lambs with his arms and carry them in his bosom	Good	1.8	0.8	15/05/2004	12:43:57pm	470.86	5.6
57	Walker	n/a	Catholic	n/a	n/a	No	Bluestone + Fenced	3210	none	Fair	1.9	0.9	15/05/2004	12:46:07pm	471.271	5.6
58	Unnamed Plot	n/a	Catholic	n/a	n/a	No	Bluestone	3211	none	Fair	1.9	0.9	15/05/2004	12:47:07pm	470.222	5.6
59	Merson	Mary.A	Catholic	1828	4/7/1904	Yes	Bluestone + Fenced	3212	none	Good	2.1	1.1	15/05/2004	12:48:07pm	470.621	5.6
60	Merson	James	Catholic	1826	7/12/1904	Yes	Bluestone + Fenced	3212	none	Good	1.9	0.9	15/05/2004	12:50:07pm	470.693	5.6
61	Thompson	Edith	Catholic	1875	30/3/1906	Yes	Bluestone + Fenced	3212	none	Good	1.9	0.9	15/05/2004	12:51:07pm	470.256	5.6
62	Thompson	Thomas.J	Catholic	1836	8/1/1910	Yes	Bluestone + Fenced	3212	none	Good	1.8	0.9	15/05/2004	12:52:36pm	470.37	5.6
63	Carbury	Alice	Catholic	1872	25/7/1911	Yes	Bluestone	3213	none	Fair	2.1	1.1	15/05/2004	12:57:42pm	471.072	5.6
64	Carbury	Francess	Catholic	n/a	8/11/1927	Yes	Bluestone	3213	none	Fair	2.4	1.6	15/05/2004	12:59:52pm	470.636	5.6
65	Bryant	Fredrick George	Catholic	1860	27/7/1911	Yes	Concrete + Marble	3214	none	Fair	3.3	2.1	15/05/2004	01:01:42pm	471.308	5.6
66	Bryant	Mary	Catholic	1865	1/2/1963	Yes	Concrete + Marble	3214	none	Fair	1.8	0.9	15/05/2004	01:03:11pm	471.437	5.6
67	Bryant	Dorothy Merle	Catholic	1895	26/7/1971	Yes	Concrete + Marble	3214	none	Fair	1.9	1	15/05/2004	01:04:07pm	471.294	5.6
68	Biddlle	John	Catholic	1837	18/10/1911	Yes	Bluestone	3215	Peace perfect place	Fair	8.1	5.4	15/05/2004	01:27:11pm	470.328	6.5
69	Biddle	Cecelia	Catholic	1859	8/12/1937	Yes	Bluestone	3215	Peace perfect place	Fair	2.9	1.2	15/05/2004	01:28:07pm	469.398	5.8
70	McGeachen	John	Catholic	1846	1/8/1911	Yes	Bluestone	3216	none	Good	3.5	1.6	15/05/2004	01:30:21pm	469.107	5.8
71	McGeachen	Elizabeth	Catholic	1852	19/3/1925	Yes	Bluestone	3216	none	Good	2.9	1.3	15/05/2004	01:31:31pm	468.83	5.8
72	Stapp	n/a	Catholic	n/a	n/a	No	Bluestone	3217	none	Good	3	1.3	15/05/2004	01:33:31pm	469.685	5.8
73	Searle	Isabella	Catholic	1887	14/7/1911	Yes	Bluestone	3218	none	Good	3.5	1.6	15/05/2004	01:34:31pm	470.312	5.8

74	Henderson	Alexander	Catholic	1831	1910	No	Bluestone	3219	none	Good	3	1.3	15/05/2004	01:37:16pm	468.165	5.8
75	Henderson	Grace	Catholic	1834	1911	No	Bluestone	3219	At rest	Good	2.9	1.3	15/05/2004	01:38:26pm	469.193	5.8
76	Chalmers	John	Catholic	1824	20/6/1871	Yes	Bluestone + Fenced	3220	none	Fair	3.1	1.6	15/05/2004	01:41:22pm	468.139	5.9
77	Chalmers	Agnes	Catholic	n/a	19/4/1907	Yes	Bluestone + Fenced	3220	none	Fair	3.1	1.6	15/05/2004	01:42:52pm	467.3	5.9
78	Winter	Thomas	Catholic	1881	3/12/1881	Yes	Bluestone + Fenced	3221	none	Good	3.1	1.6	15/05/2004	01:45:02pm	467.655	5.9
79	Winter	Adam	Catholic	1854	21/4/1881	Yes	Bluestone + Fenced	3221	none	Good	2.9	1.4	15/05/2004	01:46:32pm	468.038	5.9
80	Winter	John	Catholic	1803	23/8/1875	Yes	Bluestone + Fenced	3221	none	Good	3	1.5	15/05/2004	01:48:41pm	468.641	5.9
81	Winter	John Irving	Catholic	1832	23/9/1877	Yes	Bluestone + Fenced	3221	none	Good	3	1.5	15/05/2004	01:49:51pm	468.485	5.9
82	Winter	Mary	Catholic	1819	27/5/1904	Yes	Bluestone + Fenced	3221	none	Good	3	1.5	15/05/2004	01:50:57pm	468.53	5.9
83	Winter	Janet Margaret Irving	Catholic	1806	2/5/1846	Yes	Bluestone + Fenced	3221	none	Good	3.1	1.5	15/05/2004	01:52:41pm	468.325	5.9
84	Dalzell	Daphne	Catholic	1891	13/9/1891	Yes	Concrete + Marble	3222	Until the break and the shadows flee away	Fair	3.1	1.6	15/05/2004	01:54:17pm	468.554	5.9
85	Dalzell	David Gerard	Catholic	1886	1/6/1892	Yes	Concrete + Marble	3222	Until the break and the shadows flee away	Fair	2.7	1.4	15/05/2004	01:58:01pm	468.827	5.9
86	Dalzell	Mary.E	Catholic	1859	8/1/1913	Yes	Concrete + Marble	3222	Until the break and the shadows flee away	Fair	3	1.5	15/05/2004	01:59:22pm	470.079	5.9
87	Dalzell	David.G	Catholic	1839	3/10/1914	Yes	Concrete + Marble	3222	Until the break and the shadows flee away	Fair	3	1.5	15/05/2004	02:00:26pm	470.345	5.9
88	Symons	George Harvie	Catholic	1841	30/4/1907	Yes	Bluestone + Fenced	3223	none	Good	3	1.5	15/05/2004	02:02:26pm	470.167	5.9
89	Symons	Mary	Catholic	1855	12/8/1902	Yes	Bluestone + Fenced	3223	none	Good	3.6	1.8	15/05/2004	02:04:16pm	469.616	5.9
90	Pyers	Cecelia King	Catholic	1820	18/6/1878	Yes	Bluestone + Fenced	3224	none	Good	3.3	1.8	15/05/2004	02:07:16pm	469.875	5.9

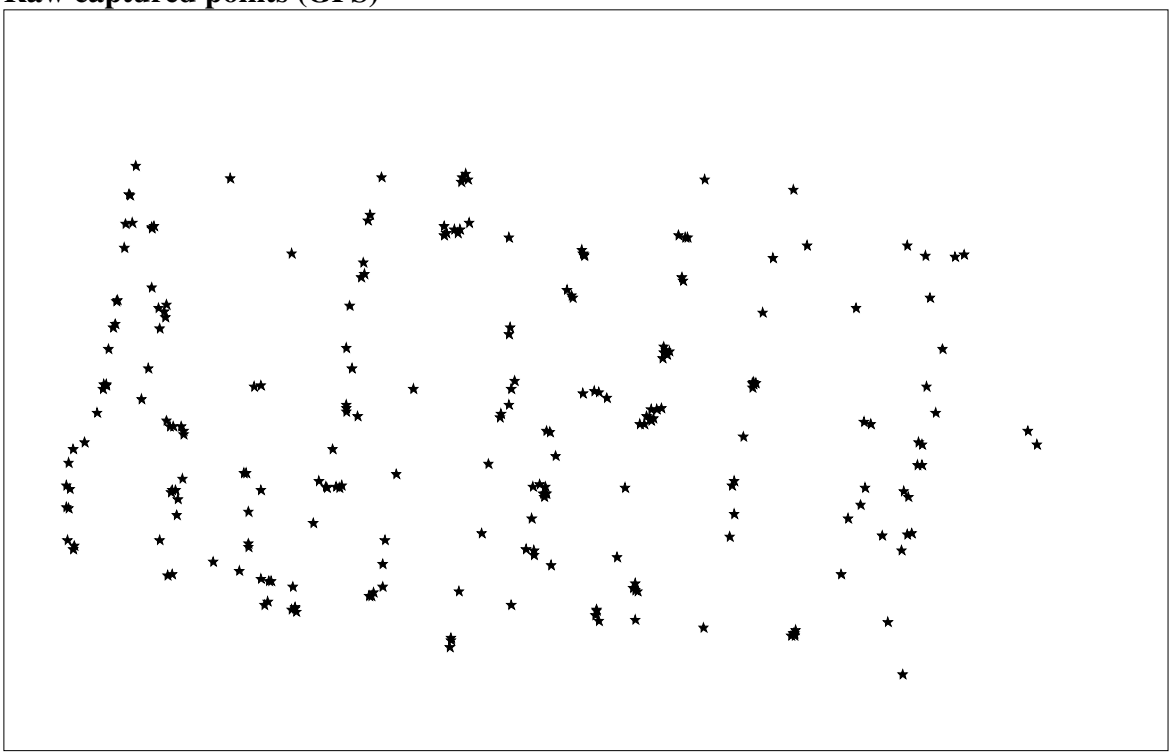
ID	Surname	Other_Names	Religion	Birth	Death	Headstone	Material	Photo_Number	Epitaph	Plot Condition	Max_PDOP	Max_HDOP	GPS_Date	GPS_Time	GPS_Height	Horz_Prec
1	Boswarrick	Eliza Ann	Catholic	1842	29/5/1911	No	Bluestone	3225	none	Good	3.5	1.5	16/05/2004	11:43:27am	471.262	5.9
2	Boswarrick	John	Catholic	1871	11/1/1898	No	Bluestone	3225	none	Good	2.7	1.4	16/05/2004	11:45:12am	471.99	5.9
3	Boswarrick	Ernest Whitelock	Catholic	1871	21/2/1875	No	Bluestone	3225	none	Good	2.7	1.4	16/05/2004	11:46:26am	471.867	5.8
4	Boswarrick	John William	Catholic	1840	1/6/1918	No	Bluestone	3225	none	Good	2.9	1.7	16/05/2004	11:47:42am	471.554	5.9
5	Boswarrick	Mabel	Catholic	1879	2/3/1953	No	Bluestone	3225	none	Good	2.7	1.3	16/05/2004	11:49:12am	471.221	5.8
6	Boswarrick	Annie Dickson	Catholic	1821	15/7/1966	No	Bluestone	3225	none	Good	3	1.3	16/05/2004	11:50:06am	470.576	5.8
7	Patten	n/a	Catholic	n/a	n/a	Yes	Concrete	3226	none	Fair	3.4	1.4	16/05/2004	11:51:46am	469.438	5.9
8	Ballhausen	Albert	Catholic	1867	22/12/1898	Yes	Bluestone + Fenced	3227	Sanft rune ihre asche	Fair	3	1.3	16/05/2004	11:52:26am	468.249	5.8
9	Ballhausen	Alfred Lewis and Charles	Catholic	n/a	n/a	Yes	Bluestone + Fenced	3227	Sanft rune ihre asche	Fair	3	1.3	16/05/2004	11:55:12am	468.404	5.8
10	Ballhausen	Augusta	Catholic	1840	21/8/1917	Yes	Bluestone + Fenced	3227	Sanft rune ihre asche	Fair	3	1.3	16/05/2004	11:56:41am	468.289	5.8
11	Ballhausen	Ernest	Catholic	1837	13/7/1931	Yes	Bluestone + Fenced	3227	Sanft rune ihre asche	Fair	3.2	1.3	16/05/2004	11:57:41am	468.101	5.8
12	Ludbrook	n/a	Catholic	n/a	n/a	Yes	Concrete	3228	none	Good	3	1.3	16/05/2004	11:58:57am	468.343	5.8
13	de Malmanche	Susan	Catholic	1877	28/7/1966	Yes	Concrete + Marble	3229	none	Good	3	1.3	16/05/2004	11:59:31am	467.362	5.8
14	Fitches	George	Catholic	1856	28/5/1929	No	Bluestone	3230	Abide with me	Good	3.1	1.3	16/05/2004	12:01:17pm	467.08	5.8
15	Fitches	Mary Ann	Catholic	1863	5/3/1931	No	Bluestone	3230	Abide with me	Good	3.1	1.3	16/05/2004	12:03:21pm	467.186	5.8
16	Acheson	William Murray	Catholic	1/12/1835	25/2/1900s	Yes	Concrete + Marble	3231	Peace perfect peace	Good	2.8	1.2	16/05/2004	12:04:57pm	467.986	5.7
17	Acheson	Mary	Catholic	28/2/1842	3/8/1923	Yes	Concrete + Marble	3231	Rest in the Lord	Good	2.8	1.2	16/05/2004	12:07:06pm	467.785	5.7
18	Acheson Must	Reginald	Catholic	24/7/1899	21/10/1973	Yes	Concrete + Marble	3231	Serva fidem	Good	2.8	1.2	16/05/2004	12:08:22pm	467.585	5.8
19	Fraser	Leonard Allen	Catholic	1864	6/2/1916	Yes	Bluestone	3232	none	Good	2.8	1.2	16/05/2004	12:09:52pm	467.219	5.8
20	Fraser	Cora Beatrice	Catholic	1872	3/8/1939	Yes	Bluestone	3232	none	Good	2.8	1.2	16/05/2004	12:11:22pm	467.148	5.8
21	Opie	John	Catholic	1862	16/6/1921	Yes	Bluestone	3233	Lead kindly light	Good	2.8	1.2	16/05/2004	12:12:42pm	466.943	5.8
22	Opie	David	Catholic	1867	9/12/1925	Yes	Bluestone	3233	Lead kindly light	Good	2.8	1.2	16/05/2004	12:14:06pm	467.38	5.8

23	Cairns	Mary Alice	Catholic	14/11/1861	9/5/1947	No	Concrete + Marble	3234	Whether we live or die for are the lord	Good	2.7	1.2	16/05/2004	12:15:12pm	467.634	5.7
24	Cairns	T.R	Catholic	19/9/1845	2/3/1913	No	Concrete + Marble	3234	Whether we live or die for are the lord	Good	2.7	1.2	16/05/2004	12:18:21pm	469.665	5.7
25	Bryant	n/a	Catholic	n/a	n/a	No	Bluestone	3235	none	Good	2	1	16/05/2004	12:19:41pm	470.803	5.6
26	Davis	n/a	Catholic	n/a	n/a	No	Bluestone	3236	none	Good	2.1	1	16/05/2004	12:20:27pm	471.741	5.6
27	Letcher	Elizabeth Jane	Catholic	1841	16/4/1916	No	Bluestone	3237	none	Good	2.1	1	16/05/2004	12:21:17pm	471.95	5.6
28	Davis	Gladys Edna	Catholic	1917	28/11/1918	No	Bluestone	3237	none	Good	2.1	1	16/05/2004	12:22:57pm	472.227	5.6
29	Davis	Fredrick Ernest Leopold	Catholic	1818	22/5/1963	No	Bluestone	3237	none	Good	1.8	0.9	16/05/2004	12:23:51pm	472.409	5.6
30	Davis	Nellie May	Catholic	1882	16/12/1971	No	Bluestone	3237	none	Good	1.8	0.9	16/05/2004	12:25:11pm	471.699	5.6
31	Barnett	n/a	Catholic	n/a	n/a	No	Bluestone	3238	none	Good	2.1	1	16/05/2004	12:26:17pm	470.971	5.6
32	Anderson	Herbet John	Catholic	3/6/1907	26/6/1913	Yes	Bluestone	3239	none	Good	1.8	0.9	16/05/2004	12:26:51pm	471.112	5.6
33	Anderson	John Austin	Catholic	1882	1/7/1916	Yes	Bluestone	3239	none	Good	1.8	0.9	16/05/2004	12:28:11pm	471.084	5.6
34	Horsfall	Henry	Catholic	1850	13/8/1912	No	Bluestone	3240	Reunited	Good	2.1	1	16/05/2004	12:29:32pm	471.064	5.6
35	Horsfall	Jane	Catholic	1852	14/12/1919	No	Bluestone	3240	Reunited	Good	1.9	0.9	16/05/2004	12:30:52pm	471.712	5.6
36	Davies	John	Catholic	1849	7/8/1913	Yes	Bluestone	3241	At rest	Good	1.9	1	16/05/2004	12:32:42pm	471.601	5.6
37	Gooch	William	Catholic	n/a	29/8/1931	No	Bluestone	3242	none	Good	2.2	1	16/05/2004	12:33:56pm	471.409	5.6
38	Gooch	Christina	Catholic	n/a	5/9/1951	No	Bluestone	3242	none	Good	2.2	1	16/05/2004	12:34:46pm	470.632	5.7
39	Symons	Walter	Catholic	11/3/1870	26/4/1949	No	Concrete	3243	none	Good	1.9	0.9	16/05/2004	12:35:36pm	470.529	5.6
40	Symons	Mary	Catholic	29/6/1874	13/8/1959	No	Concrete	3243	none	Good	1.9	0.9	16/05/2004	12:36:46pm	470.332	5.6
41	Symons	Henry William	Catholic	7/1/1862	15/4/1948	No	Concrete + Marble	3244	none	Good	1.9	0.9	16/05/2004	12:37:46pm	470.7	5.6

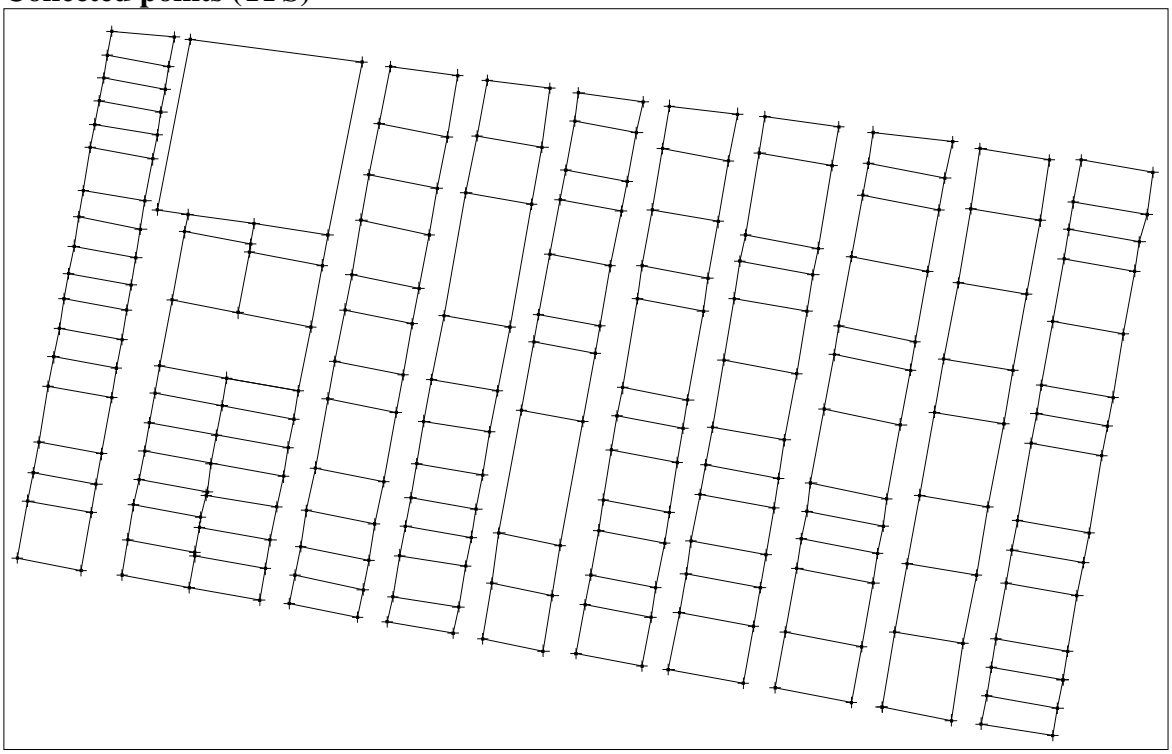
Appendix E

Appendix E – Stages of mapping data.

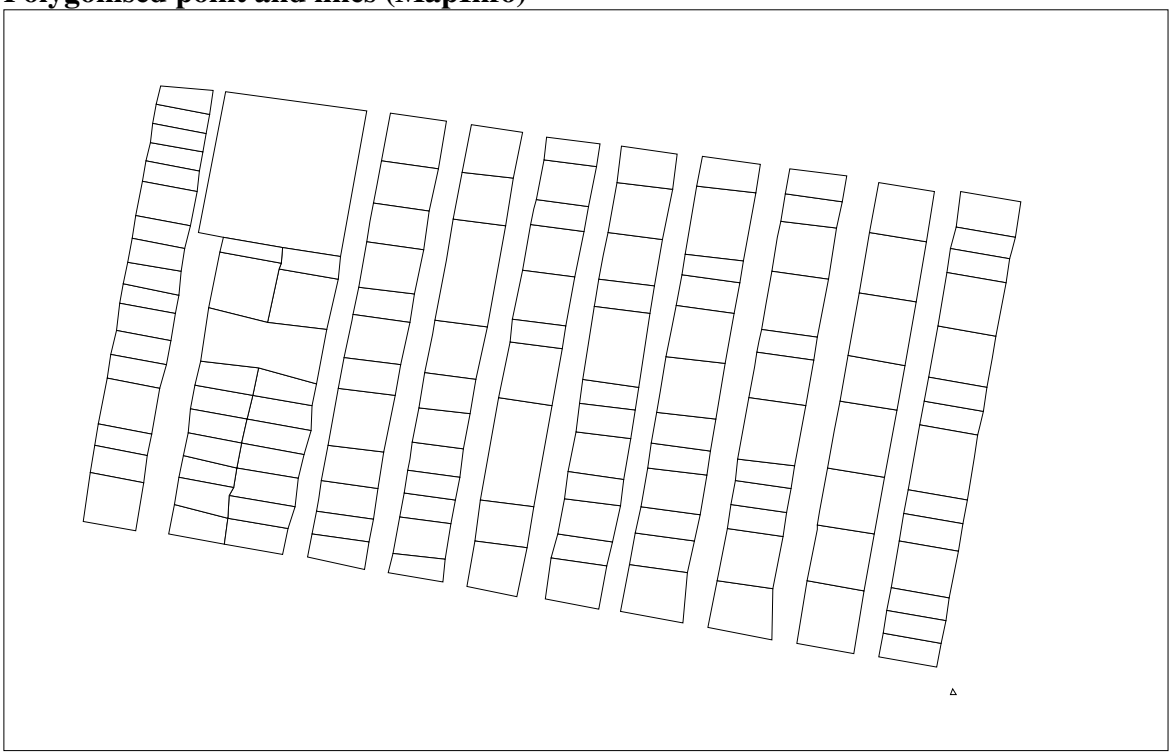
Raw captured points (GPS)



Collected points (TPS)



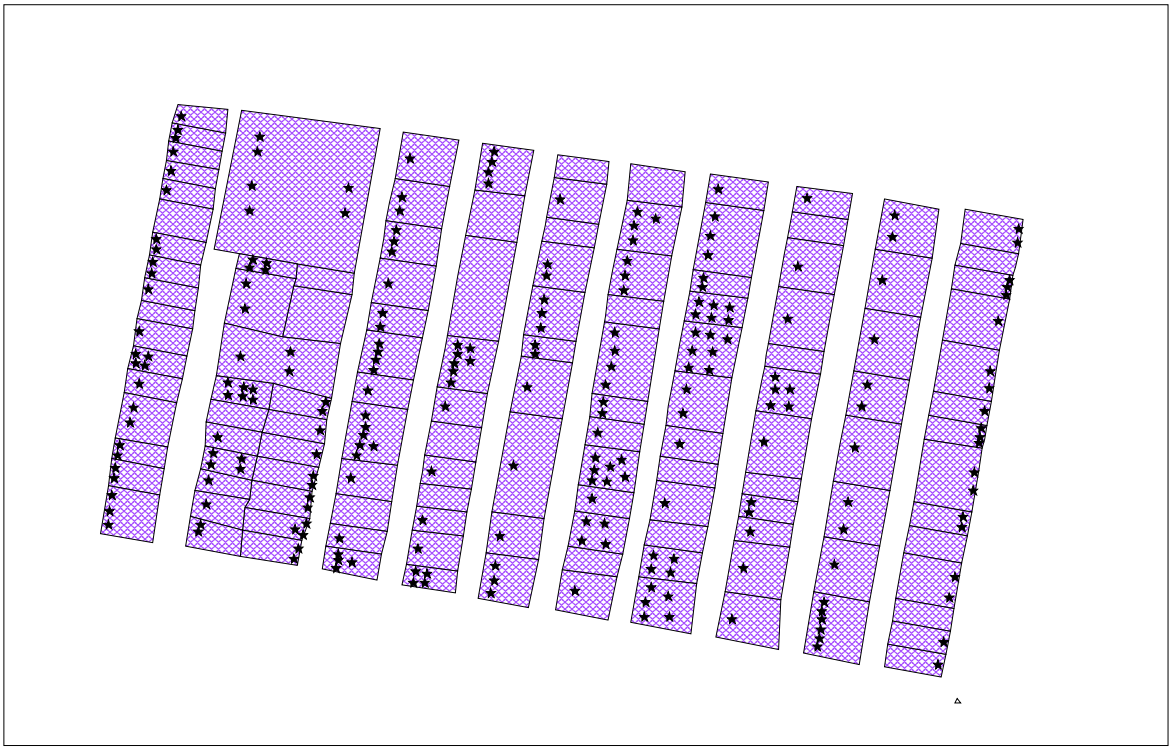
Polygonised point and lines (MapInfo)



Merged Layers Captured and Collected (GPS and TPS) unadjusted

Merged Layers Captured and Collected (GPS and TPS) adjusted

Finished map coloured



Appendix F

Appendix F – Web page for grave plot search.

The Old Ballaarat Cemetery

Grave Plot Search

PURPOSE

The purpose of this site is:

- To make interest groups and the public aware of a facility that can search for ancestors/historical figures buried in this cemetery;
- To have a permanent historical record of the Old Ballaarat Cemetery;
- To have links to similar web sites to eventually create a national site; and
- To make the genera1 community aware of the importance in preserving their history and for future generations to access.

BRIEF HISTORY OF THE SITE

- The Old Ballaarat Cemetery was established in 1858 during the gold rush era and is one of the oldest cemeteries in Victoria.
- It holds approximately 35,000 entombments and is still in operation.
- Peter Lalor who led the Eureka Stockade Rebellion is entombed here along with many miners and soldiers who fought against each other during this time.
- A separate area was designated for the Chinese population who made up a large proportion of miners.
- The majority of the entombment's occurred before 1885 and were made up mostly of soldiers and miner's killed during the Eureka Stockade uprising.

Full History

View aerial map of cemetery and surrounds

Various cemetery plots from study area

Search plot

Link for more information on cemeteries

- Australian Genealogical Society
- Geelong and District Cemeteries
- Ballarat Genealogy
- Australian Genealogy Resource List

Further work

home contact us

back to top

Old Ballaarat Cemetery

Appendix G

Appendix G – Screen shot illustrating HotLink to photo.