University of Southern Queensland
Faculty of Engineering and Surveying

THE COMMERCIAL IMPLICATIONS OF THE NZ SURVEYOR-GENERAL'S RULES FOR CADASTRAL SURVEY 2008

A dissertation submitted by

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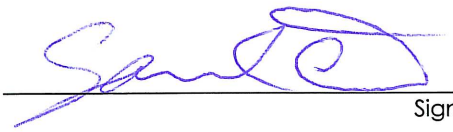

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Abstract

Deregulation is happening around the world, its aim is to promote market competition and lower compliance costs while providing a secure business environment. This dissertation examines New Zealand Government's justifications for deregulating cadastral surveying and the commercial implications on the profession. Is anyone likely to benefit from the proposed changes? Will compliance costs decrease? Are ownership rights protected? Will land trading remain safe?

Research into the background of New Zealand legislation is presented in first chapters followed by analysis of nineteen cadastral projects. These show that lack of boundary monumentation and witness mark densities will increase compliance costs.

The project also analyses costs that fall outside the example projects such as social implications and costs to the profession especially with the introduction of a new certification, which will result in the increase of public liability insurance for licensed cadastral surveyors.

Future studies could be done to design appropriate rules for cadastral surveying to ensure that there is a balance between maintaining the rights of property holders to have accurate surveys while ensuring that survey costs and compliance are not so stringent as to warrant huge costs.

Acknowledgements

I would like to thank my supervisors, Mr. Glenn Campbell and Mr. Shane Simmons (USQ) for their support and guidance throughout my project.

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Glossary of Terms

GNSS	Global Navigation Satellite System
sd	standard deviation
LOL or LandonLine	Landonline is the online service for surveyors, lawyers and other land professionals, providing access to New Zealand's only authoritative database for land title and survey information. It enables land professionals to search, and to lodge title dealings and survey data digitally.
LINZ or Land Information New Zealand	Land Information New Zealand (LINZ) is a New Zealand government department responsible for land titles, geodetic and cadastral survey systems, topographic information, hydrographic information, managing Crown property and a variety of other functions.
ESP or Eliot Sinclair and Partners Ltd	Eliot Sinclair & Partners Ltd provides services to a wide range of businesses in many sectors including land development, building and construction, local government services, utilities and port authorities and is the sponsor of this project.

Chapter

1 INTRODUCTION

Land Information New Zealand (LINZ) is responsible for providing land related services such as titles registry and the development of policies and regulations to ensure certainty of land property rights within the social and economic systems of New Zealand.

Since the late 19th century New Zealand adopted the Torrens system of land transfer and registration. The backbone of this system is survey accurate geographic information (the cadastre) that enables landowners to identify property related interests. Fast access to accurate cadastral information is an important part of New Zealand economic growth.

New Zealand like many other jurisdictions transformed a paper-based system by implementing an electronic system for land registration, survey lodgement and transaction dealings in land rights. Some parts of New Zealand Surveyor-General's Rules for Cadastral Survey 2002/2 (the current Rules) have become irrelevant and confusing (LINZ, 2007) due to the changes that occurred in the past 6 years. These changes include the introduction of Land*on*Line digital cadastre in 2002/3, requirements for 100% electronic lodgement of survey datasets in September 2007 and 100% electronic lodgement of all legal transactions by the end of 2008.

To address the irregularity of this legislation a new set of rules was proposed by the government, the New Zealand Surveyor-General's Rules for Cadastral Survey 2008 (the proposed Rules).

1.1 Background

There are two levels of regulatory intervention for cadastral surveying in New Zealand. The principal regulation is the Cadastral Survey Act 2002 (the Act) and the secondary regulation is the Surveyor-General's Rules for Cadastral Surveys 2002/2 (the current Rules). The focus of this research is the changes to the current Rules and their impact. There are no changes proposed to the Act, which outlines responsibilities of the Government, licensed cadastral surveyors and provides for the setting of standards for cadastral survey datasets and national geodetic and control systems. The current Rules describe in detail the methodology, techniques and standards for cadastral datasets.

While the cadastral regulation was aimed at facilitating digital lodgement of cadastral datasets it is largely focused on an older type of technology and fails to be flexible towards advancements in survey equipment and techniques (LINZ, 2007). Some rules are concerned with data presentation and symbology that were relevant when the paper based cadastral plans were used and is now the responsibility of the Government to provide standards and functionality within the Land*on*Line system.

The Government proposed to reduce regulatory intervention as per their 'Optimal Regulation' policy (Surveyor-General, 2006). This policy is mainly focused on "what" is important within the cadastre not "how" to achieve it. It is believed to be in the best interest of the public to deregulate cadastral surveying and let the market forces dictate "how" surveyors use new techniques and methodologies to achieve critical outcomes for the cadastre.

The need for this project arose from the lack of evidence provided by the Government that their proposed regulatory change would result in economic benefit to the country. Considering the history of failed deregulated industries such as the Electricity and Railway networks that had to be re-regulated (Business New Zealand, 2006) it is important to research the implications of major regulatory changes.

1.2 Problem

A regulatory analysis framework was developed by LINZ to identify the critical outcomes and objectives (Surveyor-General, 2006) see

Figure 1. There are four steps within this framework as defined by LINZ (Surveyor-General, 2006).

1. Identify the purpose of the cadastre by defining outcomes, objectives and sub-objectives.
2. Identify risks of not achieving these outcomes and objectives.
3. Determine the level of intervention required i.e. regulation or guidelines or education or no intervention.
4. Develop details of the intervention.

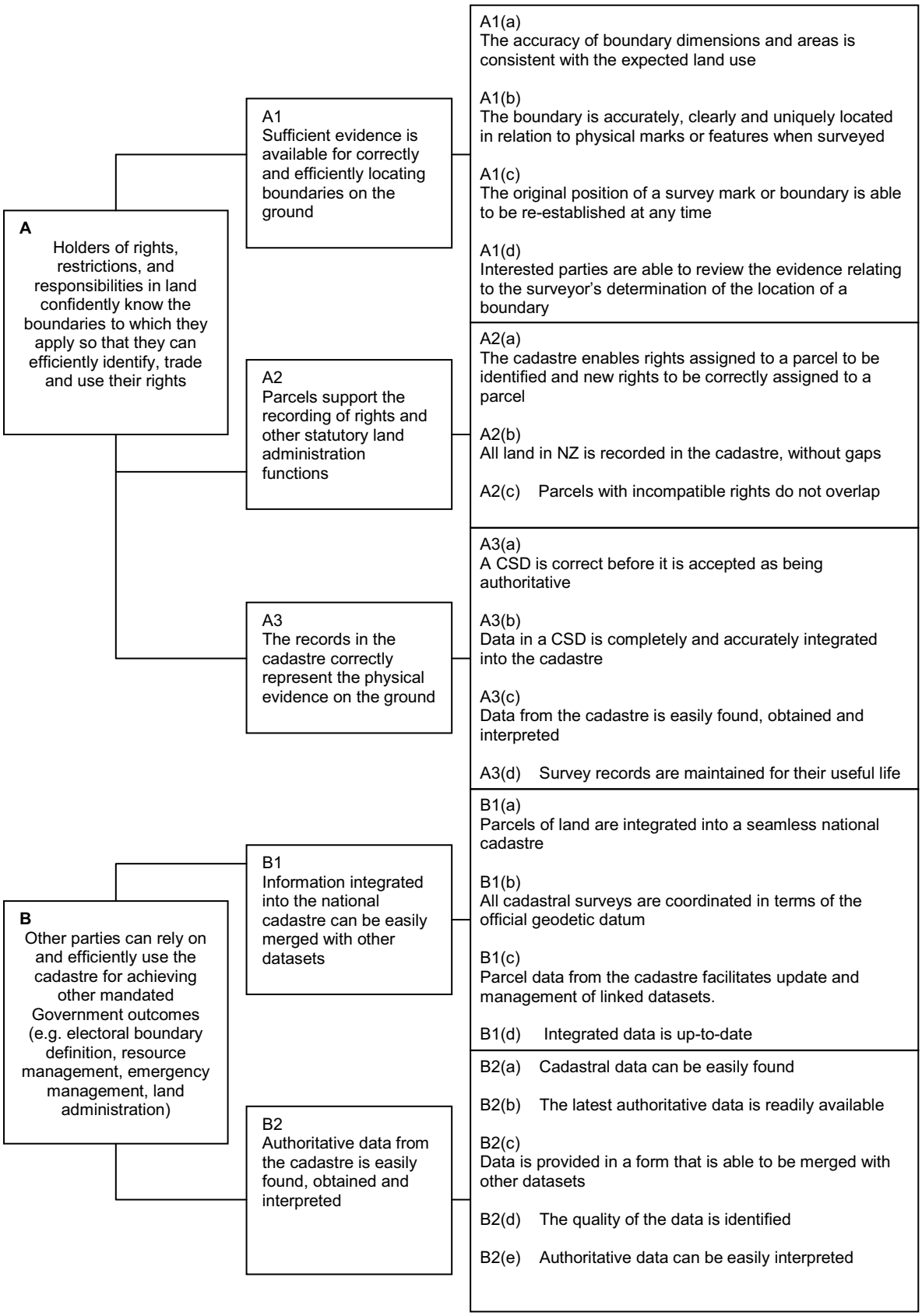

Figure 1 – LINZ, Cadastral Outcomes and Objectives

Completeness of this list directly affects the purpose of the cadastre and achievability of the main outcomes. Any errors in the risk assessment analysis will result in failure to correctly identify risks and design objectives and outcomes to mitigate such risk. Therefore it forms a part of this project to identify any rules missing or unnecessary in order to achieve the outcomes and objectives and to analyse what commercial implications of economic benefit or otherwise it may cause.

Two main outcomes are (LINZ, 2007):

A. Holders of rights, restrictions, and responsibilities in land confidently know the boundaries to which they apply so that they can efficiently identify, trade and use their rights.

B. Other parties can rely on and efficiently use the cadastre for achieving other mandated Government outcomes (e.g. electoral boundary definition, resource management, emergency management, land administration).

1.3 Project Aim

The aim of this project is to investigate the commercial implications that may arise should the proposed Rules be implemented by Land Information New Zealand in their draft form as in October 2007.

1.4 Structure

This chapter is an introduction into the background need, aim, problem and specific objectives of this research. The following chapters deliver information about literature, methodologies and analysis together with conclusions about the commercial implications of the proposed Rules.

1.5 Summary

The commercial implications could include reductions in compliance cost, changes to the costs of undertaking cadastral surveys and changes to commercial insurance cost. In addition implications on society could include a decrease in the public's trust in the cadastral system, which could impact on the integrity of the land titles system that has been in place for the past 150 years.

The proposed Rules were developed to address the Government's policy of 'Optimal Regulation'. This policy aims at decreasing bureaucracy and compliance costs and maximising the potential of the marketplace (LINZ, 2007). With this draft the Surveyor-General is promoting self-regulation of the survey profession. This project will answer the question if this can be achieved.

It is also important to analyse the completeness of the proposed Rules to ensure the interests of landowners and holders of land rights, the community, the survey profession and the Crown are protected.

CHAPTER

2 LITERATURE REVIEW

2.1 Introduction

The aim of this dissertation is to establish whether there would be any commercial implications by the proposed Rules for Cadastral Survey 2008. This chapter presents a summary of the literature and statutory documentation that was reviewed before undertaking the cost analysis of projects under the current and the proposed Rules.

The chapter starts by giving a brief description of the statutory framework that forms the foundation of the surveying profession in New Zealand and the current statutory position. It then presents a discussion of the proposed changes and a brief summary of the reaction by the profession. The chapter concludes if any literature could support the claim by the Government that deregulation and the introduction of the proposed Rules will lead to a decrease in compliance costs and a maximisation of the potential of the market place. LINZ did not publish the proposed Rules with any supporting research or study, nor has there been any such literature made available since the introduction of the proposed Rules.

2.2 The Statutory Framework

Land Information New Zealand administers the survey system primarily to provide for the accurate identification of boundaries for land tenure purposes. LINZ

maintains cadastral survey records for all tenure systems, including freehold and leasehold (Land Transfer Act 1952), Māori land and Crown land.

LINZ's functions and responsibilities in relation to the New Zealand's survey system are set out in the Cadastral Survey Act 2002.

The Surveyor-General is part of LINZ's Regulatory Group. A function of the Survey-General is to set standards for the cadastral and geodetic survey systems, and monitors and audits compliance with the standards. Under section 49(1) of the Cadastral Survey Act 2002 the Surveyor-General may make rules about the conduct of cadastral surveys including the use of survey marks and standards for cadastral survey datasets and section 49(3) states that the Surveyor-General must have regard to the following matters:

a) the extent to which the proposed standards will promote the purpose of any tenure system:
b) the costs and benefits of consistency in standards relating to more than 1 tenure system:
c) the costs and benefits of maintaining the accuracy of the cadastre:
d) the costs involved in cadastral surveys and cadastral survey datasets complying with the proposed standards:
e) maintaining public confidence in the cadastre.

The Cadastral Survey Act 2002 is the backbone of the statutory framework that administers the surveying profession. It is the enabling act for the various rules and regulations that make the profession work. This Act sets out the basic rules affecting the administration of cadastral surveying, licensing and discipline.

2.2.1.1 The Surveyor-General's Rules for Cadastral Survey

The Surveyor-General's Rules for Cadastral Survey were made under authority of the Cadastral Survey Act 2002. These rules determine how the spatial extent (including boundaries) of interests in a tenure system are defined and described.

The current Rules are set out in the Surveyor-General's Rules for Cadastral Survey 2002/2, which came into effect 29 October 2002.

Version 2002/2 is now being reviewed and is the catalyst for this dissertation.

2.2.2 Surveyor-General's Rules for Cadastral Survey 2002/2

The main purpose of Version 2002/2 was to make provision for digital lodgement of cadastral survey datasets (CSD) into Land*on*Line (LOL), enabling electronic transactions and electronic plan production (LINZ, 2007). According to Grand (2006) these rules failed to deliver flexibility for use of future technologies and methods. Based on the 1998 regulations these rules focus on traditional survey equipment and techniques leaving little room for implementation of new technologies such as GNSS using virtual reference station.

Since the introduction of compulsory electronic lodgement via LOL eSurvey some of the 2002 rules became irrelevant. The LOL electronic lodgement means all surveys are processed electronically via a secured Internet connection using Land*on*Line website (eSurvey software). This system relies on observed vector data, bearings and distances, which are adjusted and incorporated into the national network. Survey plans and parcel diagrams are also produced electronically online. Therefore, no hard copies of observation adjustments or

traverse calculations are necessary. This removes the need for large number of rules relating to conventional hard copy lodgement.

The above are the two main reasons for changing the regulation. The Government is also trying to empower the profession by lowering government intervention and would like to see the profession take responsibility through self-regulation and producing its own best practice guidelines (Surveyor-General, 2006). The aim is to lower compliance costs and maximise the potential of the market place.

2.2.2.1 Surveying professional bodies

In New Zealand there are two organisations involved in cadastral surveying, the New Zealand Institute of Surveyors and the Institute of Cadastral Surveying. Institutes monitor professional and ethical conduct of their members. However, membership to these institutes is voluntary. Surveyors licensed by the Cadastral Surveyors Licensing Board (the Board) are not required to be members of a professional body. The Board is only concerned with setting standards, disciplining and issuing licenses to carry out cadastral surveys. Self-regulation by the cadastral survey profession would be hard to achieve without compulsory membership within a single professional body.

2.2.3 The Proposed Changes

The proposed Rules were designed to satisfy the Government's Optimal Regulation policy. Their aim is to promote minimal government intervention, lowering compliance costs and increasing the potential of the marketplace (LINZ, 2007). The risk-based approach allows identification of Cadastral Objectives and

End Outcomes necessary to satisfy requirements under the Cadastral Survey Act 2002 and protecting public interests within the cadastral system.

The proposed Rules are aimed to assist and instruct cadastral surveyors when carrying out cadastral surveys and lodging documentation with LINZ.

2.2.3.1 Cadastral Outcomes and Objectives

The two End Outcomes relate to the use, trade and identification of boundaries of rights and restrictions by affected parties and the use of cadastral information by other parties. It is therefore important to compare the proposed Rules to the table of objectives and outcomes and analyse if these can be achieved and will they result in desired economic benefits.

This research is focused on the end outcome A in particular intermediate outcome A1 and its objectives and sub-objectives. For the complete table of the End Outcomes and Objectives see Appendix B.

2.2.3.2 Rules of interest

The rules that are most likely to have commercial implications relate to accuracy tolerances, placement of survey and boundary marks, documentation and certification compliance.

It is reasonable to assume that licensed cadastral surveyors will employ methods and technologies based on the accuracy standards required. Relaxed accuracy tolerances could have cost saving benefits for the surveyor and may be passed on to clients and rights holders. Accuracy tolerances are specified within Rule 2. These include the positional accuracy between any two-survey marks, the

positional accuracy between a witness and a boundary mark as well as the positional accuracy between two boundary marks and area accuracy of parcels. Rule 2.3 is set out in full in Appendix C.

Placement of a survey or a boundary mark requires fieldwork that utilises multiple staff and equipment. Reduction of number of marks placed during a survey should have a direct cost saving benefit for the client or first registered proprietor (*Rule 6*). However, long-term effects could include boundary disputes where right holders are unable to identify their boundaries or increases of cost to subsequent surveys due to lack of old survey marks being detrimental to hierarchy of evidence for location boundaries.

Rule 6 would make it difficult to achieve Sub-Objective A1(a)5, which states that the accuracy of boundary dimensions is able to be increased as land use intensifies. The concepts of accurate boundary dimensions on the one hand and removing the necessity of survey marks are difficult to reconcile. The higher the land use intensities the greater the importance of maintaining boundary accuracy by retaining the practice of 'from whole to part' and mandatory placement of survey marks.

The rules also widen the certification required by surveyors. Rule 12 requires licensed surveyors to undertake that a survey has been carried out not only in accordance with the Cadastral Survey Act 2002 and subordinate legislation such as the proposed Rules but also all other relevant enactments and rules of law (LINZ, 2008). This wording could increase the liability of cadastral surveyors in tort and common law and increase the costs of cadastral survey should surveyors require protection in the form of public liability insurance. This rule may be in breach of the section 49(1) of the Cadastral Survey Act 2002 as it is extending the

jurisdiction of this act beyond its intended purpose. No evidence could be found during this project to suggest that similar certifications are in use in New Zealand or Australia. It is possible that courts would have to decide on the enforceability and practicality of this rule.

2.2.4 The Response to the Rules

The profession responded by lodging submissions, many of which expressed concerns regarding the impact that the proposed Rules would have on the profession (LINZ, 2008).

Of significance are the following issues:

- *Boundary Marking*

  Submissions highlighted that the relaxed monumentation requirements may not achieve the intermediate outcome A1 and significantly affecting the hierarchy of evidence for locating boundaries.

- *Accuracy Tolerances*

  Many of the submissions agreed that relaxing accuracy standards to the proposed level would have serious effects on the cadastre network, boundary definition and title area with some expressing concern in respect to the possible negative effect on public trust in the cadastre.

- *Witnessing of boundary points*

  There were both support and opposition to the proposed changes to the witnessing distances of boundary points. It has to be noted that increasing witnessing distances could result in decrease of survey witness mark density within the network and as a result could have an impact on future surveys where extra field work may be required to connect surveys to distant marks.

- *Certification*

  One third of the submissions opposed the changes to the certification by licensed cadastral surveyors (LINZ, 2008). As set out above the changes would require a certification that the CSD and survey were in accordance with all other enactments and rules of law. Submitters raised questions about the validity of such certification and possible market implications of increased insurance costs and legal liability of licensed surveyors.

- *General comments*

  The response from the profession and the general public highlights the public interest in this issue. LINZ received submissions from 16 individuals and 42 groups including survey and legal professionals, groups of surveyors associated with the survey professional bodies, local government, the University of Otago and survey supply firms (LINZ, 2008(3)). All submissions show a great interest and some offer solutions to the issues presented by the proposed Rules.

2.2.5 The Surveyor-General's Interim Decisions

According to the process of public consultation the Surveyor-General and an expert committee reviewed the submissions. Thereafter, all submitters were given the interim decision made on parts of the Rules deemed 'matters of greatest concern to the submitters' (LINZ, 2008(2)) including Boundary marking, Boundary marks, Accuracy tolerances, Water boundary accuracy, Area accuracy, Orientation, Geodetic connection, Witness mark and permanent reference marks, Monumentation CSD and CSD plans.

These decisions are general statements of intent as exact wording of the rules is not yet available. In general, these address the greatest concerns of accuracy and reliability of the cadastre. Decisions made by the expert committee will have an effect on the commercial implications of these Rules. As such these will be compared to analyse the nature and significance of the changes proposed.

CHAPTER

3 METHODOLOGY

3.1 Introduction

This chapter describes methods used to analyse selected cadastral survey datasets. Firstly presenting a comparison of the major changes to the Rules and defining factors for the analyses of data. Followed by secondary or consequential factors that maintain a realistic nature for the analyses. Finally providing a comparison between selected datasets and their changes in accordance with the proposed Rules and the factors described in this chapter.

3.2 Current vs. Proposed Rules

Primary changes that may affect the cost of cadastral surveys are:

a) Accuracy Tolerances
b) Witness Mark Density - maximum allowable witnessing distance
c) Boundary Monumentation - marking of boundary corners
d) Redefinition Survey Plans

3.2.1 Accuracy tolerances

Relaxing accuracy tolerances should decrease compliance costs allowing the profession to choose the most appropriate methodology and increase productivity. The level of accuracy must achieve the cadastral objective A that Holders of rights, restrictions, and responsibilities in land confidently know the boundaries to which they apply so that they can efficiently identify, trade and use their rights

(LINZ, 2007). The proposed root sum square standard is $\sqrt{0.03^2 + (D \times 0.0002)^2}$ in meters or 1 meter where *D* is the distance between the points in metres. The comparison to the current standard of 0.02 meters plus 0.01 meters per 100 meters of distance between the points is shown in Figure 2 below.

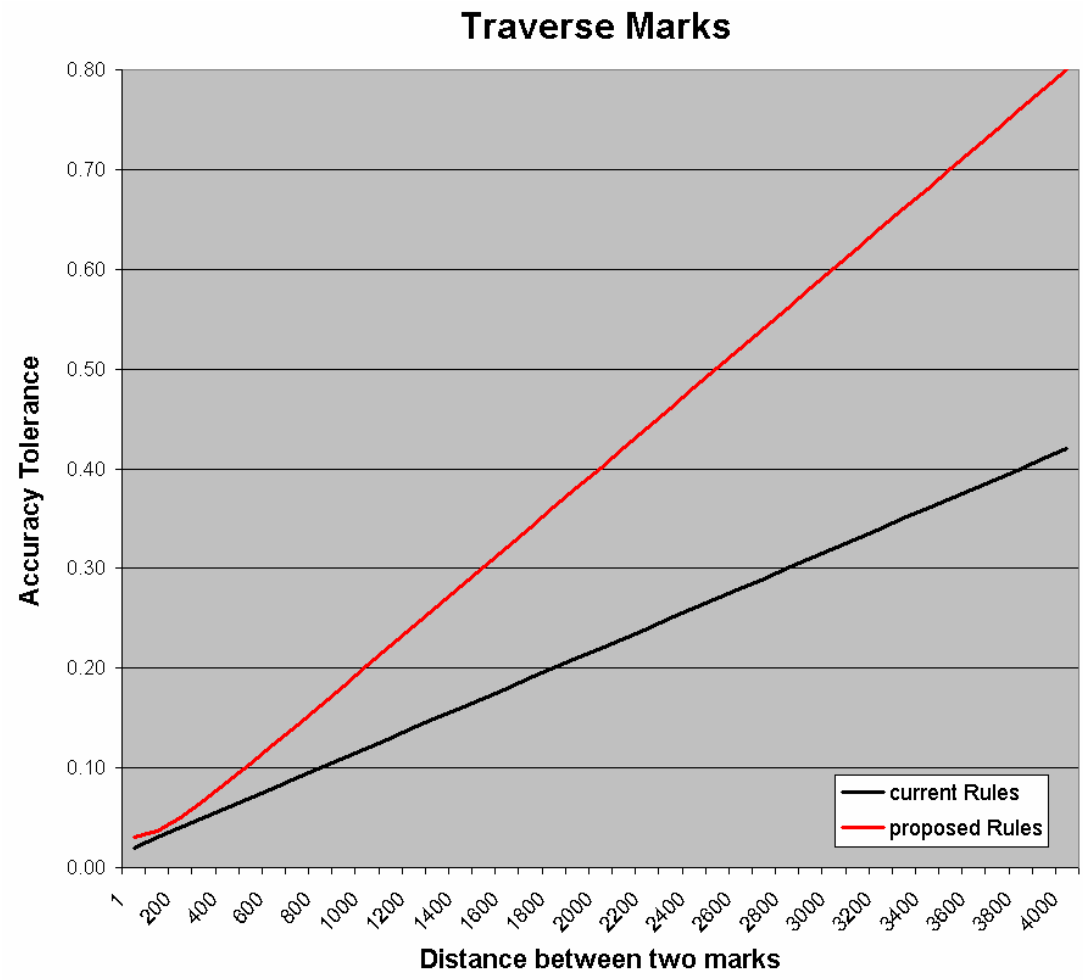

Figure 2 – Accuracy Tolerances (all shown in meters)

The purpose of these rules is to allow flexibility of technology and techniques when conducting a cadastral survey. The above accuracy tolerances aim to accommodate this and fail to safeguard boundary accuracy. LINZ only analysed the effects of this rule for the first 200 meters (LINZ, 2007) of distance in which they failed to identify the significant tolerance increase at higher distances easily

achievable by GNSS or such that can be expected from future technologies. The argument presented by LINZ in justification for decreased accuracy is that GNSS is less accurate over shorter distance but more accurate over long distances (LINZ, 2007). The Figure 2 above clearly shows the proposed new accuracy standard only accommodates use of GNSS for the shorter distances. At four kilometres the accuracy tolerance is almost double the present standard despite GNSS being more accurate at and above this distance. This is an unnecessary lowering of accuracy with inadequate justification.

3.2.2 Witness Mark Density - maximum allowable witnessing distances

Changes to this rule may have a direct impact on the number of survey marks used during a cadastral survey and time required to connect or establish these marks. Long-term effects could include changes to witness mark densities and cost implications for future surveys where lack of existing marks may require extensive fieldwork when connecting to the available marks. The following table shows the comparison between the current and the proposed Rules witnessing distance.

Table 1 – Witnessing Distances (meters)

Survey Class	Current Rules	Proposed Rules	Decision by S-G July 2008
Class A (I)	125	250	150
Class B (II)	250	500	500 (1000 rural)

3.2.3 Boundary Monumentation - marking of boundary corners

It is a compulsory requirement of the current Rules to mark all boundary corners/positions where practical. The proposed Rules only require placing boundary marks on corners that are in dispute with the cadastre or where the

owners request them. Monumentation of boundary corners adds to the hierarchy of evidence for locating rights associated with land. Monumentation is the backbone of New Zealand cadastre minimising boundary disputes. Surveyor-General in his interim decision stated that boundary monumentation would be required in the final document. Monumentation along long boundary lines may no longer be required under the proposed Rules.

3.2.4 Redefinition Survey Plans

The current Rules define Redefinition survey as:

> *a survey undertaken for the purpose only of reinstating 1 or more parcel boundaries. (LINZ, 2002)*

The information required to be lodged under the current Rules include all observations and measurements as per any other survey purpose. The proposed Rules reduce the documentation requirement to that of boundary mark types and names where no observation data is required or necessary. The licensed surveyor is solely responsible for the accuracy and placement of these marks when certifying lodgement of a monumentation dataset. This rule is designed to decrease the cost of completing redefinition surveys where no new allotments are created.

3.3 Consideration of factors

Information collated for this project was made available by Eliot Sinclair and Partners Ltd (ESP) of Christchurch, New Zealand. Survey datasets represent sample of cadastral plans completed and lodged by ESP between 2003 and 2008 under the current Rules 2002/2.

Analysed data is presented as time and cost shown as hours and percentages representing increase or decrease of cost.

Many aspects are present in professional practice and have an impact on budgets of cadastral projects. The scenario for testing commercial implications of changes to regulation must take into account all those factors that arise from the regulatory change and consequent factors or secondary factors. Traverse or pegging distances for example may only be as long as the environment allows and not necessarily take advantage of any increase in allowable distances. Survey technologies and equipment in use today may allow for more unconventional approach increasing productivity and accuracy.

Consideration must also be given to the total cost of the cadastral project to demonstrate the significance of any compliance cost savings as advertised by the government.

3.3.1 Placement of survey and boundary marks

Every boundary point defined or marked during a cadastral survey must be witnessed by a survey mark within a specified horizontal distance. Prior to the current Rules this was a directly measured line with a theodolite between the boundary mark and its witness. These lines are referred to as pegging ties. The 2002 regulation no longer requires for a witness mark to be directly connected to the boundary point it witnessed. This is primarily to enable new technologies such as GNSS to be used for cadastral surveys. Witnessing distance is now described "as the crow flies" (LINZ, 2006) with focus on stability and performance rather than convenience or compliance. This approach has its disadvantages as well when connections between marks may not be intervisible. The proposed

Rules increased this witnessing distance from 125 metres to 200 meters. This was strongly opposed by the profession when LINZ received submissions that rule 6.3 should be reworded and witnessing distance decreased. The primary concern being lack of witness marks used during a cadastral survey could have a detrimental effect on the future of cadastral surveying effecting survey mark density in the national network and hierarchy of evidence for reinstatement of boundary positions. Surveyor-General made a decision to decrease witnessing distances to 150 metres with exemptions for rural surveys where witnessing distance will be increased to 1000 metres. This is to provide for adequate but not unreasonable density of witness marks (LINZ, 2008(2)). Commercial implications arising from decreased density of witness marks will include increased costs of locating existing marks and cost savings where lower number of new witness marks is required for example during a rural surveys.

To assess the commercial implications of the above factor each test survey will be analysed to determine if any number of witness marks or control stations could be omitted from the survey. Total time of the fieldwork is divided between all station as per the equipment used and number of survey and boundary marks placed.

3.3.2 The criteria for use of a monumentation CSD

LINZ (2007) note that in spite of the current regulation requirements for lodgement of redefinition datasets many surveyors do not submit any information when marking an existing boundary. The monumentation CSD is proposed to replace the current redefinition survey plans where no new parcels are created. This type of dataset must include information about old witness marks, boundary marks and new boundary marks placed in position of previously approved boundary monuments. Requirements for such dataset have been reduced to a simple

diagram showing boundary marks placed, parcel identifiers for adjoining parcels and witness marks found and used to witness each new mark. There is no requirement for dimensions to be shown as the Licensed Cadastral surveyor must certify that survey complies with all relevant rules. This should result in lower compliance costs for redefinition surveys.

3.3.3 Best survey practice

Analyses of test survey datasets have to consider best survey practices recommended by the Surveyor-General and LINZ. Until 2004 LINZ maintained Cadastral Survey Guidelines document describing the best survey practice and their interpretation of the Cadastral Survey Rules. It is now expected that the survey profession will develop the best survey practice guidelines as part of self-regulation. For the purpose of this research design of survey geometry follows the Cadastral Survey Guidelines 2004:

- placing marks where they are not like to be disturbed,
- easily accessible creating strong geometric shapes and avoiding hanging vectors,
- sufficient number of old marks must be located or other evidence such that supports definition of the parcel being subdivided.

3.3.4 Survey technologies including GNSS and Robotic Total Stations

New technologies available to cadastral surveyors can be utilised to increase productivity and accuracy. It is one of LINZ' reasons for changing the regulation to enable wider use of modern digital equipment such as GNSS and Robotic Total Stations. The use of this equipment makes traditional field note recording of cadastral surveys impossible. Surveyors will have to develop new techniques for collection, reduction and adjustment of traverse information. Quality control

techniques from other survey disciplines can be modified to suit cadastral surveying with attention to appropriate use of new technologies that make it possible to reinstate boundary points in the future. Intervisibility between marks is an important issue and while one surveyor has access to GNSS another may not. According to LINZ (2007) the completion of a redefinition survey or the proposed monumentation CSD should be inexpensive task and surveyors are required to provide under the proposed Rules reasonable hierarchy of evidence for boundary monuments. As part of the following analysis no marks will be placed in a position where it would be considered unreasonable and or not intervisible with at least one other mark in that survey.

3.3.5 Environmental factors

While the environment is identical for both surveys under the current and proposed Rules it may have a different effect on traditional and new technologies. Where the use of a theodolite or a total station is dependant on line of sight GNSS equipment does not but the effect of dense vegetation is much greater on GNSS. To ascertain such effects aerial photographs were used to determine what equipment would be most efficient given the environmental factors. This may result in the use of the same conventional equipment or warrant introduction of modern equipment. Analyses of the absolute extreme case without consideration of the environment would provide unrealistic results where placing of marks could be impossible or impractical. Site-specific obstructions such as buildings, trees and dense vegetation must be considered when estimating number of control station required or equipment used.

3.4 Relationship of costs and activities

Cadastral projects encompass many activities not all of which are under the jurisdiction of Cadastral Survey Act 2002. The total cost of a cadastral project may include sourcing subdivision or resource consent, administrative costs, travel to the site and meetings and discussions with client not all of which will change due to the new regulation. Some costs are fixed or unrelated to the physical part of cadastral surveying. Therefore, these activities were identified and excluded from the analyses. Time records for each test surveys were divided into five categories:

a) Fixed costs – such as administrative costs and obtaining of consents, instruction, discussion and correspondence.
b) Travel costs – this is most likely to be fixed cost for smaller jobs as any reduction in field work is not likely to be as long as a day field trip, however, on larger projects this could be significant.
c) Office calculation costs – the amount of time necessary to prepare definition calculations, field reductions and adjustments is relative to the complexity and size of the survey and fieldwork. Changes of the time for fieldwork will be proportioned into office calculations.
d) Field work costs –field work time will be allocated to control station depending on used equipment and number of boundary marks placed from each station, cost of the survey can be estimated based on number of control marks necessary to complete that survey according to the proposed Rules.
e) Drafting – time required for drafting of survey plans is relative to the complexity and geometry of the survey and number of extra diagram sheets used. This can be related to the number of control stations and boundary marks required for the survey.

The above categories will be analysed individually and results collated into a single spreadsheet showing total job cost comparison and individual categories.

3.5 Conclusion

This chapter described the approach to the analyses. While each test survey is different in its nature results should be comparable as percentages of the total cost of each job. The use of an electronic spreadsheet to produce tables and graphs of the results will support the final conclusion of what commercial implications in particular financial cost can be expected from the proposed Rules.

CHAPTER

4 ANALYSIS AND RESULTS

4.1 Introduction

This chapter analyses and presents results for nineteen cadastral surveys selected for this study of commercial implications. Data was sourced from ESP's accounting software package AccPack and cadastral records. This data was used to estimate financial saving for test surveys. The results show a general trend in decrease of costs.

4.2 Collected Data

The financial data about each project was divided into categories according to the activity that took place. The five categories include fixed costs, travel costs, office calculations, fieldwork and drafting. These are shown in the following chart:

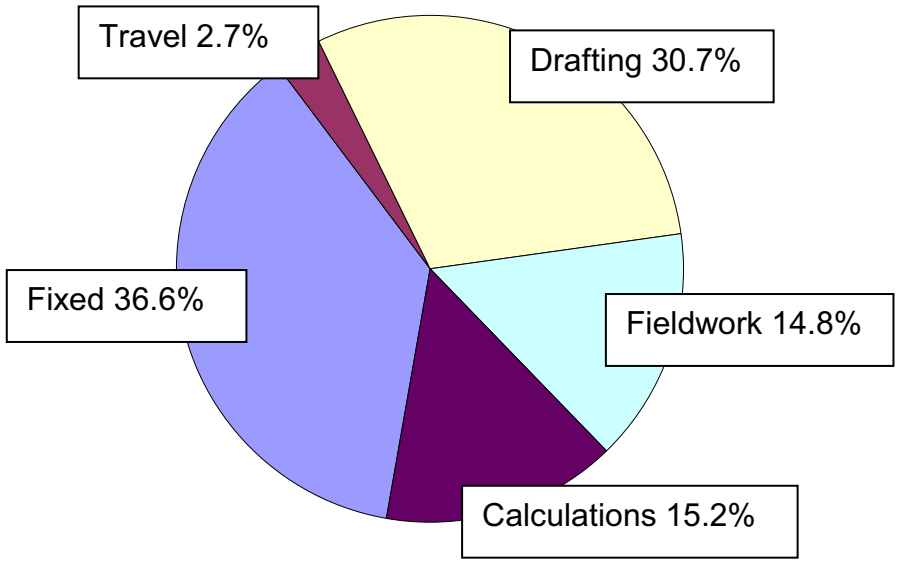

Figure 3 - Per activity average costs as percentage of the total cost

Only three of the above categories have a potential for savings. This is due to the fact that the fixed costs are considered to be constant in regard to the proposed regulatory changes. The Figure 3 above shows that the travel costs are smallest of all costs and any reduction in travel costs can be considered insignificant. Therefore, this study concentrates only on Calculation, Drafting and Fieldwork costs. Following Figure 4 shows cost distributions per each one of the plans studied.

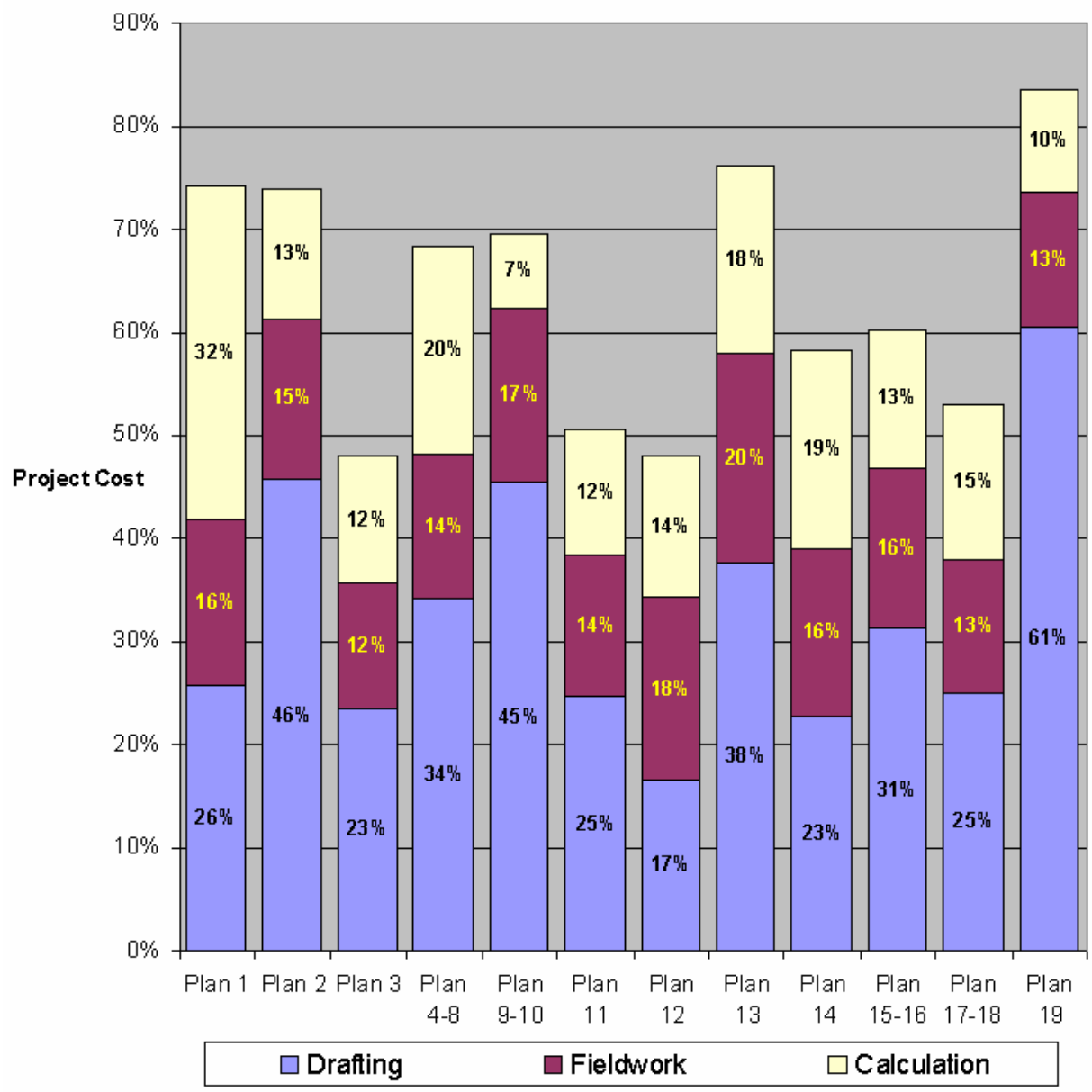

Figure 4 - Activity costs per project

4.3 Analysis

Three major changes were selected for this analysis.

- boundary monumentation,
- witness mark density and
- accuracy tolerances.

As discussed in the previous chapter boundary corners must be monumented only if in dispute with the cadastre. To test for the maximum benefit it is assumed that the owner will not require any extra monuments to be placed. This assumes the best-case scenario in terms of the cost benefit on the project. Relaxation of the witness mark density in the Proposed Rules was used to identify minimum required number of marks for each test plan. Each plan was analysed individually and time/cost was allocated to monumentation tasks based on the ESP records. Following example plan shows monuments not required resulting in savings.

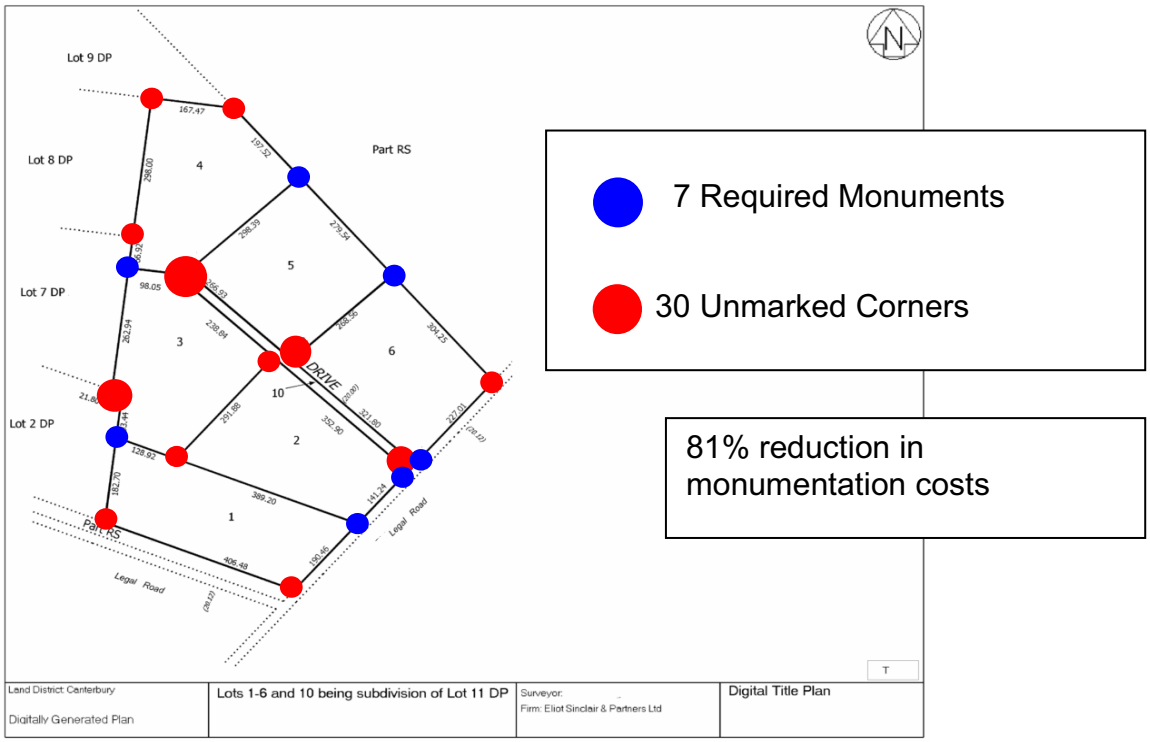

Figure 5 - Example Title plan

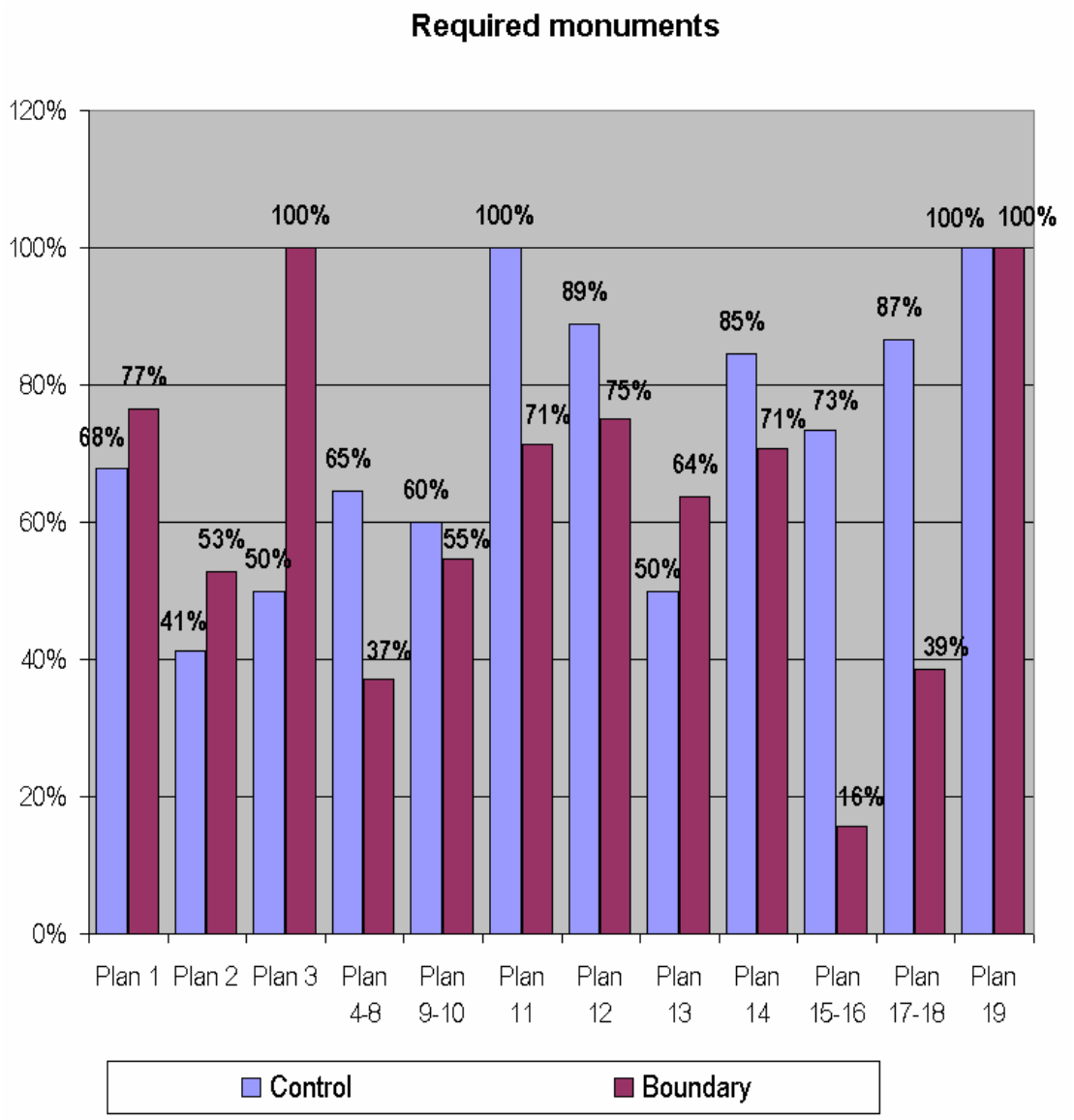

Figure 6 - Required Control and Boundary Marks

The figure above shows percentages of control and boundary marks required under the proposed Rules for each of the test plans. The average reduction of control marks is 70% with a standard deviation of 20% and the average reduction of boundary marks is 63% with a standard deviation of 25%. The cost of establishing control marks and boundary marks is estimated based on the ESP time records to be two to one respectively. The following figure shows amount of savings relative to the original plan activity costs expressed in percentages.

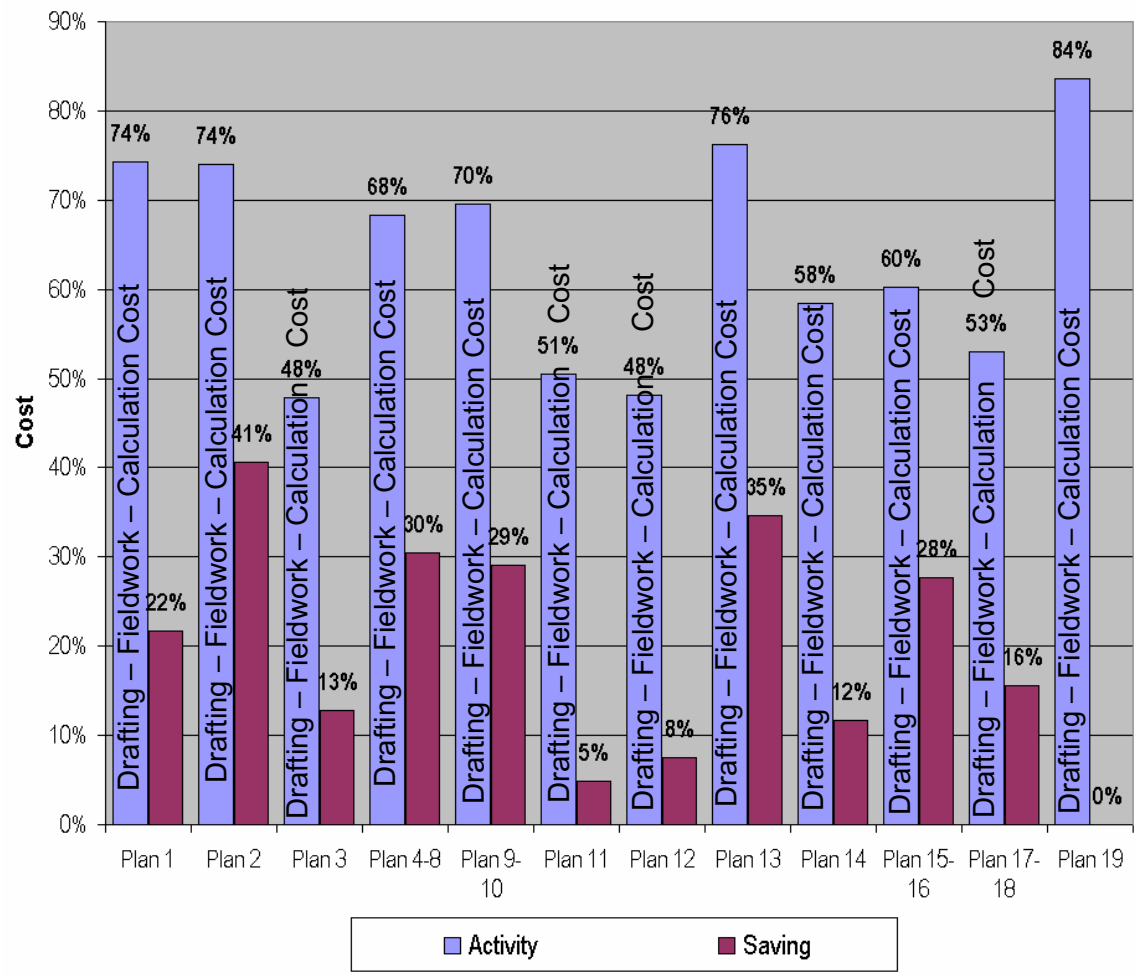

Figure 7 - Cost reductions per plan

The average cost reduction is 20% with a standard deviation of 13%. The minimum saving is 0% and maximum saving is 41% of the original project cost.

4.3.1 *Project Size breakdown*

The above Figure 7 can be reorganized in terms of the project size to analyse if this has an effect on the average cost reductions. Following figure shows cost reductions for large size projects costing over $100,000:

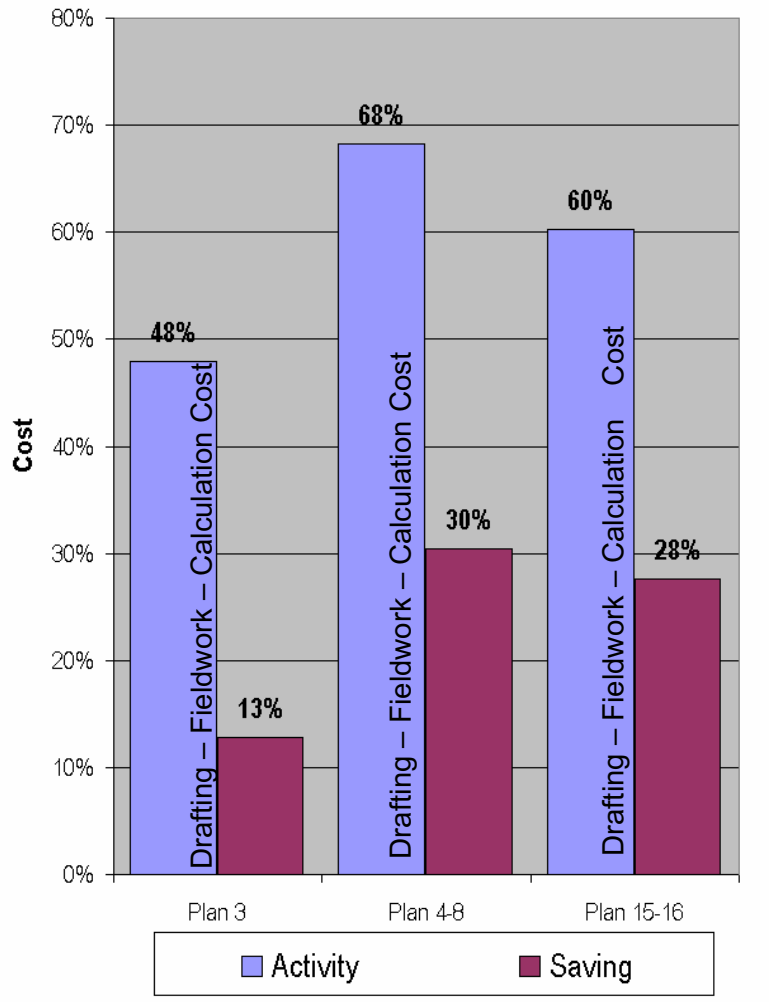

Figure 8 - Large Projects savings

The average cost reduction for eight large size projects tested is 24% with a standard deviation of 9% of the total project cost. Following figure shows cost reductions for medium size projects costing over $40,000:

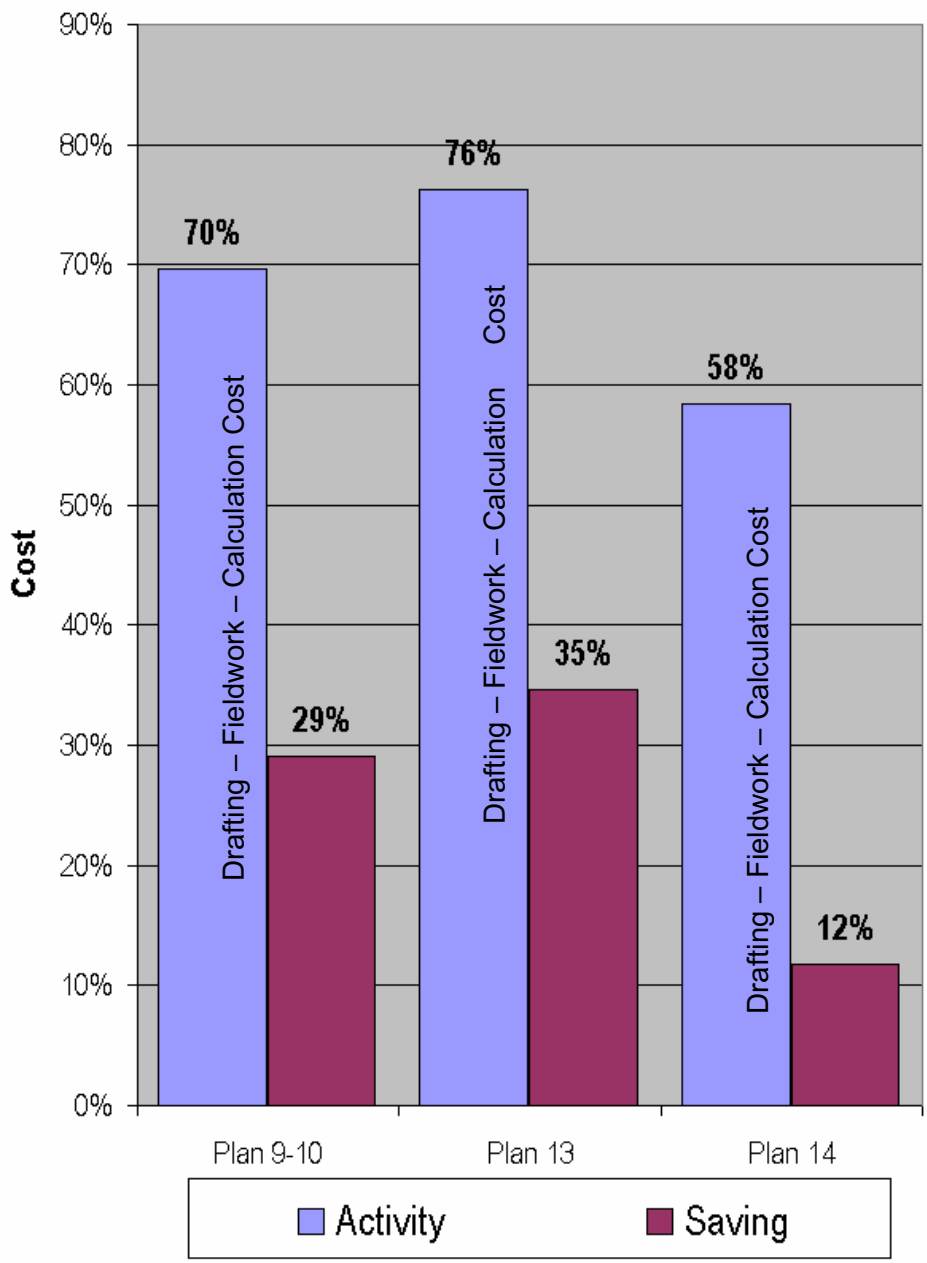

Figure 9 - Medium Projects savings

The average cost reduction for four medium size projects tested is 25% with a standard deviation of 12% of the total project cost. Following figure shows cost reductions for small size projects costing less than $40,000:

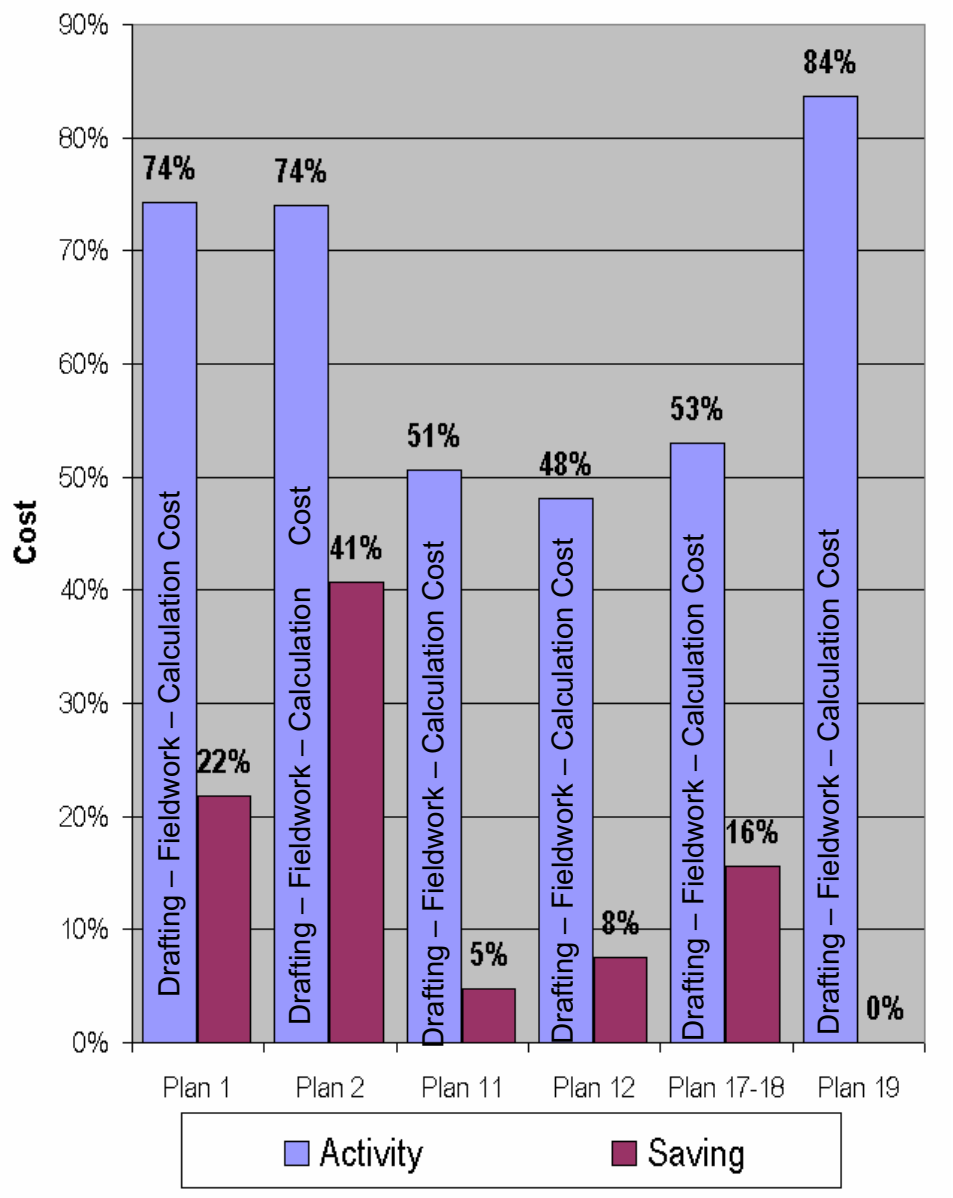

Figure 10 - Small Projects savings

The average cost reduction for seven small size projects tested is 15% with a standard deviation of 15% of the total project cost.

4.3.2 Accuracy Tolerances

From discussions with licensed surveyors at ESP it can be assumed that the relaxation of accuracy tolerances by the proposed Rules may have an effect on the cost of cadastral projects. However, this cost is difficult to estimate. There is a potential for decrease of costs while placing monuments in the field and also potential for increase in costs when locating old marks or proving reliability of old monuments. Using correct field techniques should result in every survey being compliant with the proposed Rules accuracy tolerances. LINZ (2008) noted that this part of the proposed Rules will be rewarded and accuracy tolerances will be similar to those of the current Rules. Therefore, it is assumed there will be no reduction or increase in cost associated with this original change.

4.4 Preliminary Results

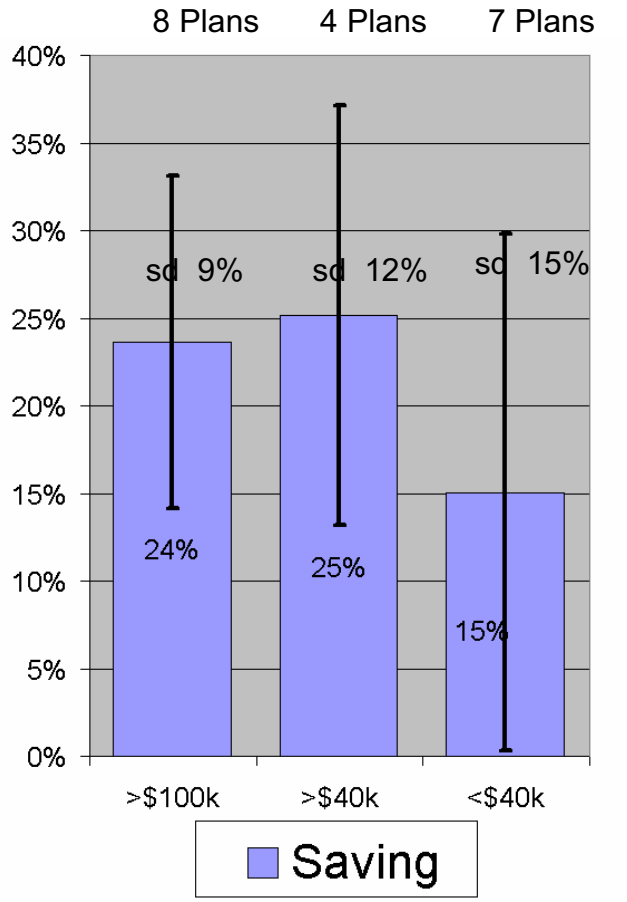

Figure 11 – Preliminary Results – cost savings

The results presented in the figure above indicate that the cost of most projects would decrease. Some projects may not benefit from any cost reductions due to their size. If the two highest and the two lowest results were considered to be outliers and were removed and all these categories were combined the average saving would be 21% with a standard deviation of 8%. This is a large amount potentially welcomed by any land developer. However, the effect on the land usability must be considered prior to any conclusion.

4.4.1 The effect on land usability

The product of a residential subdivision survey is an allotment that can be easily identified, enjoyed and traded on the open market. The proposed Rules as shown above will decrease the density of witness marks and boundary monuments. Local Authorities under the Building (2004) and Local Government (2002) Acts may require further surveys where there is insufficient evidence that structures are being erected in the correct place. It is currently a common condition of a building consent where owners must present evidence that the framework is located correctly relative to the cadastral boundaries. Locating of the physical evidence (boundary monuments) or an identification survey by a Licensed Cadastral surveyor may be required as part of the evidence. Due to the lack of witness and boundary monuments as a result of the proposed Rules it is assumed that all future building consents will require identification surveys and building location certificates to be issued resulting in increased cost of future developments. The cost of these surveys is analysed below and will show that initial savings are negated by the cost of future surveys. Appropriate methodology and assumptions are discussed below followed by retesting of the datasets and presenting adjusted cost benefit results.

4.4.1.1 Revised methodology

The following information is based on hypothesis derived from discussions with Licensed Cadastral surveyors at ESP. The scenario tested assumes that Local Authorities will require boundary identification surveys to be undertaken prior allowing buildings to be erected. It is possible that identification surveys could be required prior fencing by contractors limiting their public liability or by new landowners wanting to identify their allotment.

4.4.1.2 Assumptions

Identification surveys are usually completed at low cost or fixed cost to the client, as the work involved is generally limited to locating old marks and proving reliability of existing boundary monuments. The average cost of such survey is around 8 hours including administration and travel costs. The original scenario above considered absolute minimum of boundary monuments and witness marks is place during a cadastral survey to achieve the highest possible cost savings. This is repeated here with the assumption that placement of control and boundary marks will be necessary in the future, as boundaries are not monumented during the original survey as per the original scenario. To estimate the cost of cadastral surveys Plan 15-16 was selected for analysis. This plan features over 200 allotments being representative of a large sample for identification surveys. Allotments were divided into four categories representing level of complexity and time necessary to complete their identification surveys. Those categories are:

- A – complex surveys 16+ hours
- B – intermediate surveys 12+ hours
- C – simple surveys 8+ hours
- D – not surveyed, defined by default (A,B,C above)

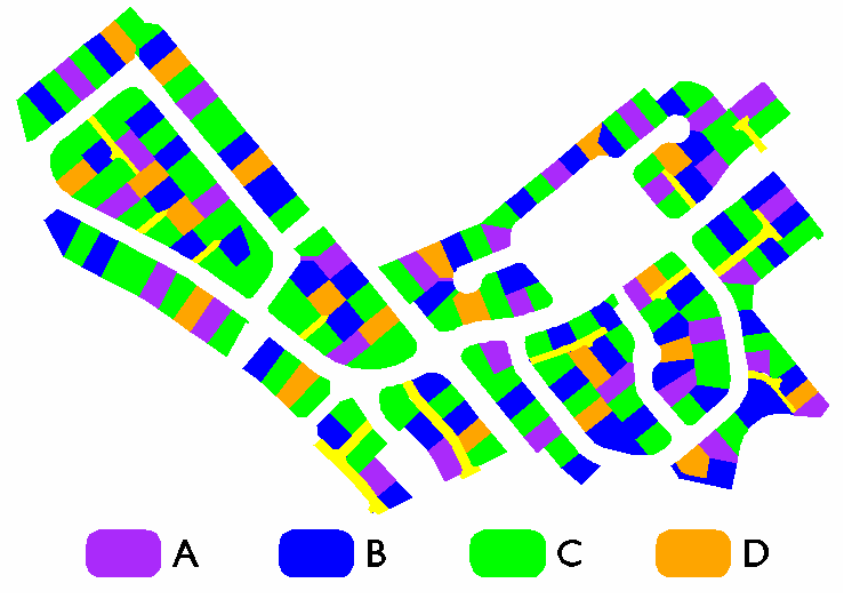

Figure 12 - Plan 15-16 Identification surveys

Allotments allocated for each category are shown in Figure 12 above. Category A comprises of approximately 10% of the lots, category B comprises of 10% and category C comprises of 50% leaving 30% of allotments not needing to be defined as they are enclosed by other defined allotments. Once these surveys are completed this will result in the same level of boundary monumentation as that of example Plan 15-16 enabling building developments to take place.

The above category proportions can be applied to all test projects. The cost of identification surveys is adjusted for each projects hourly rate and presented as percentage of the original cost of each project in the following Figure 13.

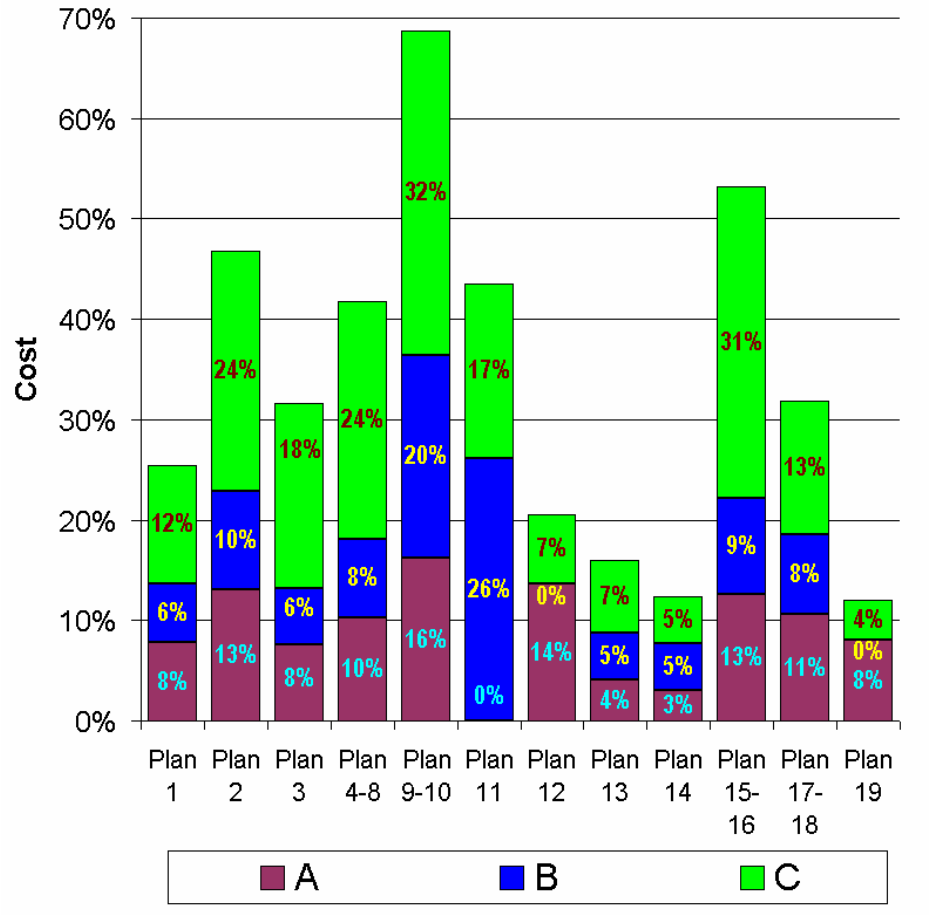

Figure 13 - Identification surveys results

4.4.2 *Revised Results per Project Size*

Reorganized data in terms of the project size is shown in the following figure. Shows cost implications for large size projects costing over $100,000:

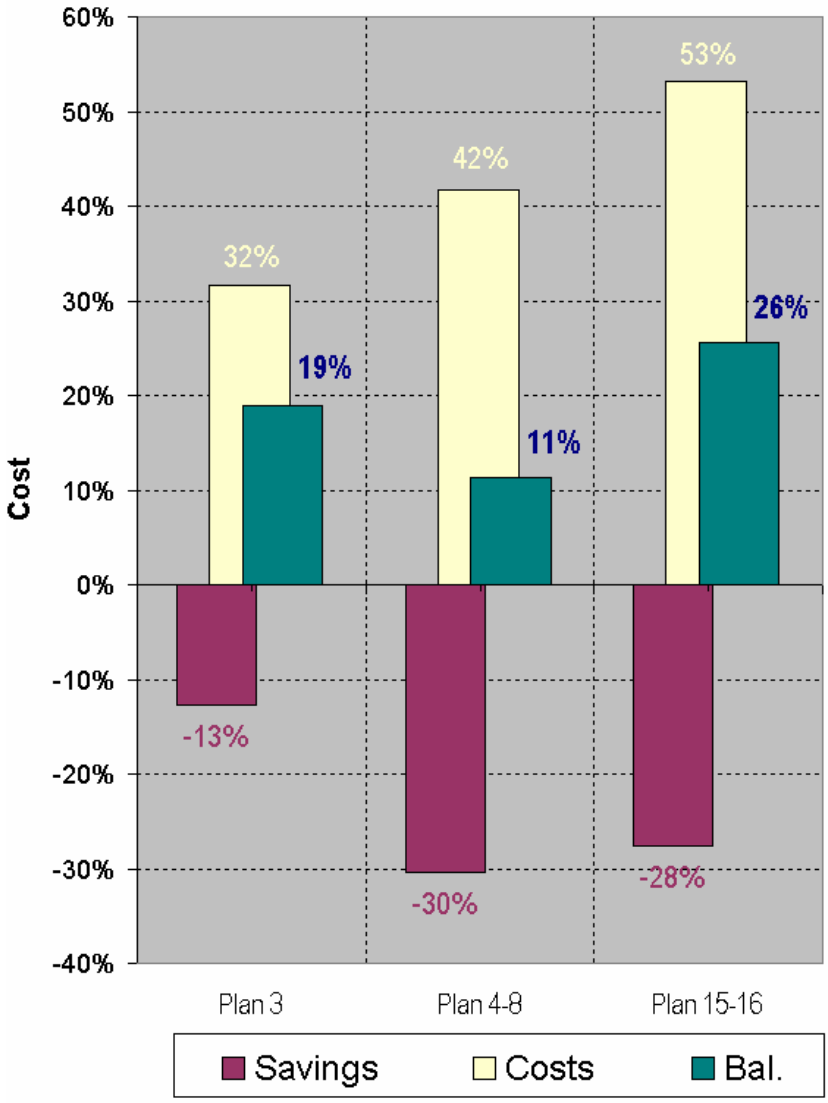

Figure 14 - Large Projects results

The above figure shows the initial savings, costs of monumentation survey and overall balance/cost implication on the project. The cost implication is a cost increase of 19% with a standard deviation of 7% of the total project cost. Following figure shows cost implications for medium size projects costing over $40,000:

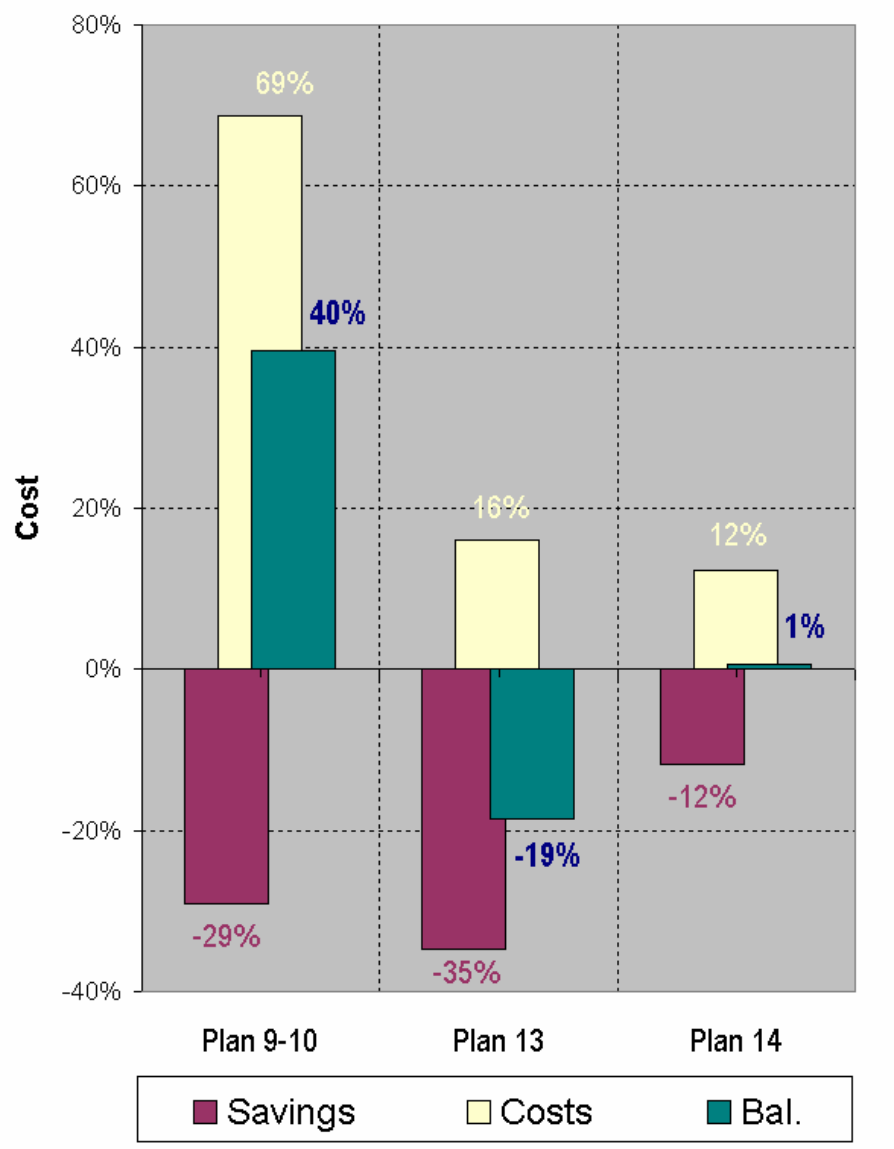

Figure 15 - Medium Projects results

The above figure shows the initial savings, costs of monumentation survey and overall balance/cost implication on the project. The cost implication is a cost increase of 7% with a standard deviation of 30% of the total project cost. The cost increase for Plan 13 was much smaller than the savings. This is likely due to the secondary purpose of that plan, which had to deal with a balanced parcel with Limited as to Parcels definition requiring extra fieldwork. Since this is the only plan showing cost decrease it could be considered to be an outlier for the purpose of this research. Following figure shows cost implications for small size projects costing less than $40,000:

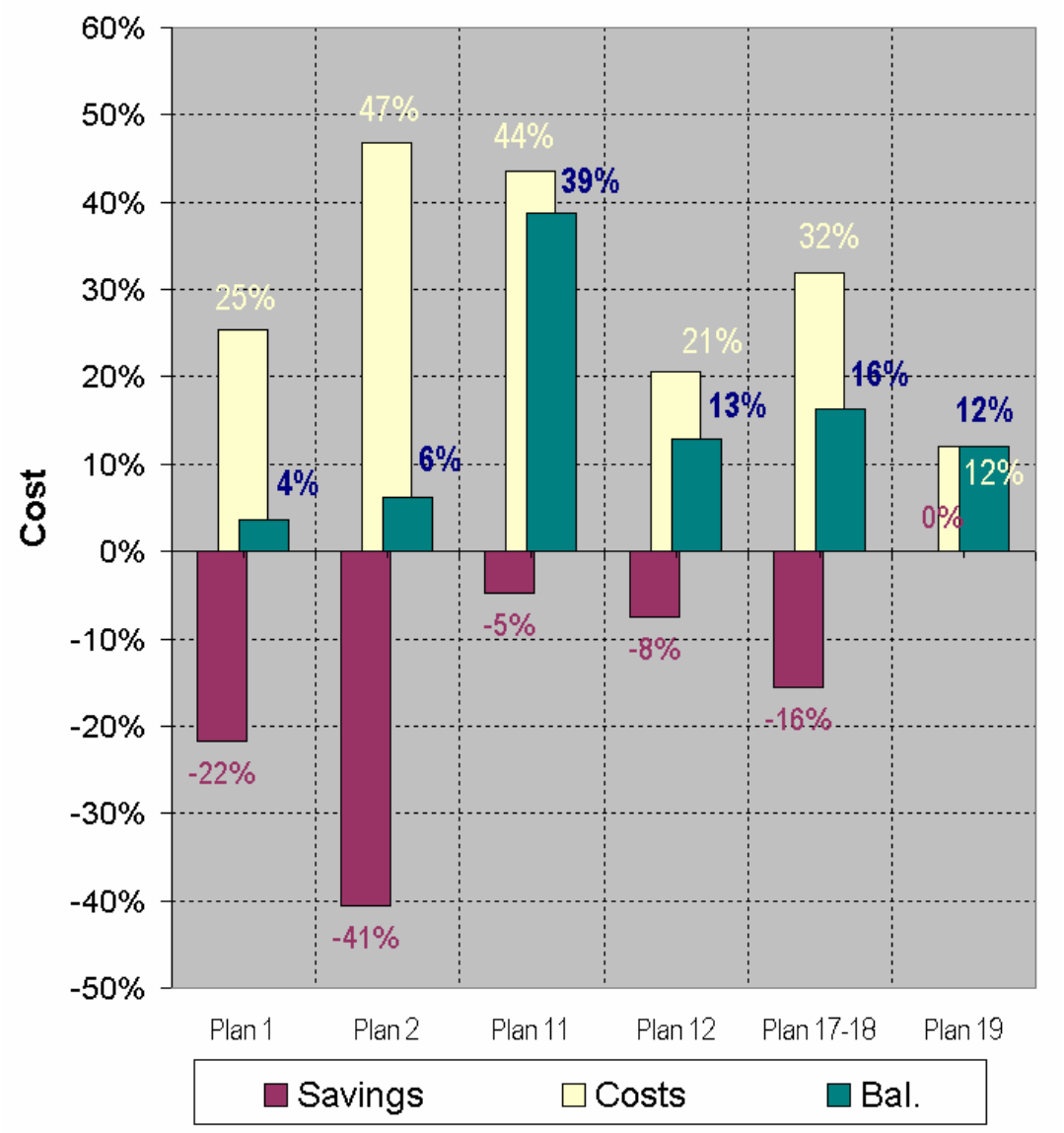

Figure 16 - Small Projects results

The above figure shows the initial savings, costs of monumentation survey and overall balance/cost implication on the project. The cost implication is a cost increase of 15% with a standard deviation of 13% of the total project cost.

4.4.3 *Revised Results*

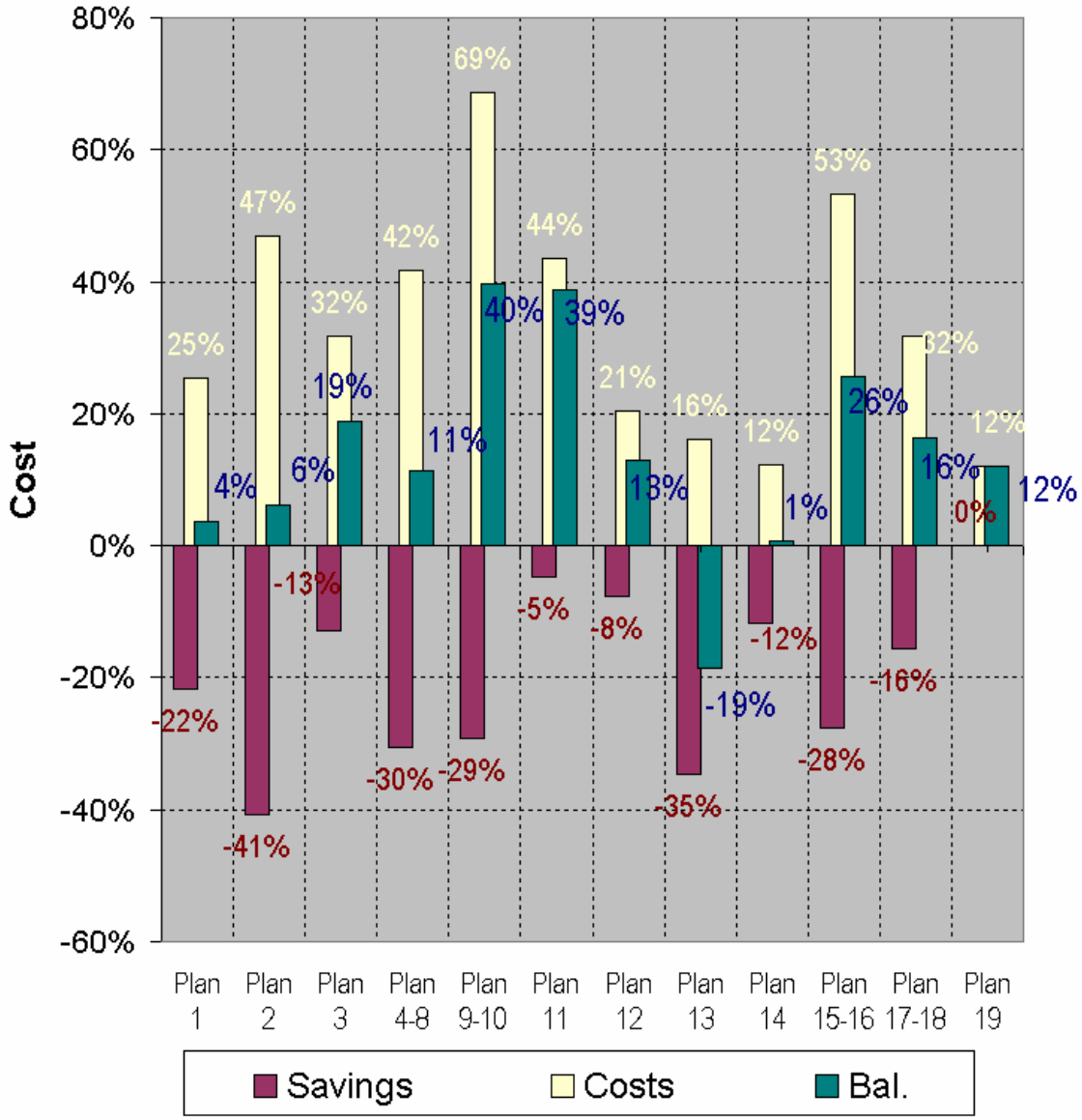

Figure 17 - costs vs. savings

The above Figure 17 combines figures 14, 15 and 16 to present total project cost implications. The resulting averages are:

Table 2 - Final cost savings/increases

COST	Average	Standard deviation
savings	14%	16%
increase	34%	18%

The results presented in the figure below indicate that the cost of most projects would increase given the extra identification surveys required to achieve the same level of boundary monumentation.

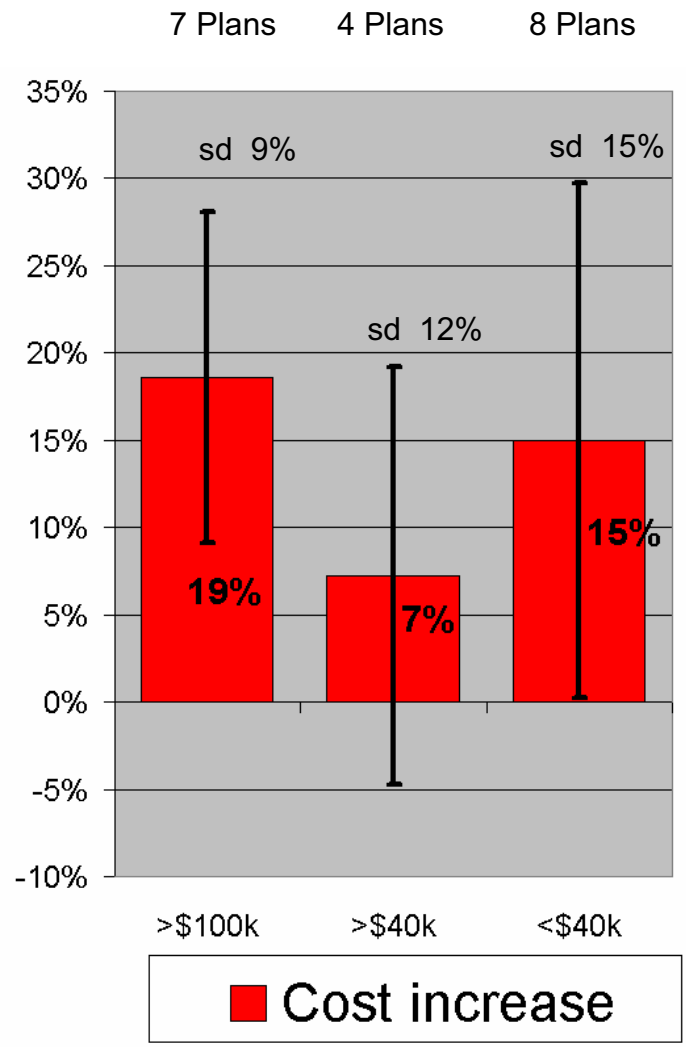

Figure 18 – Preliminary Results – cost savings

If the two highest and the two lowest results in Figure 17 above were considered to be outliers and were removed and all these categories were combined the average cost increase would be 15% with a standard deviation of 6%.

4.5 Final Results

Following figure shows the final cost implications per project relative to its' original project cost.

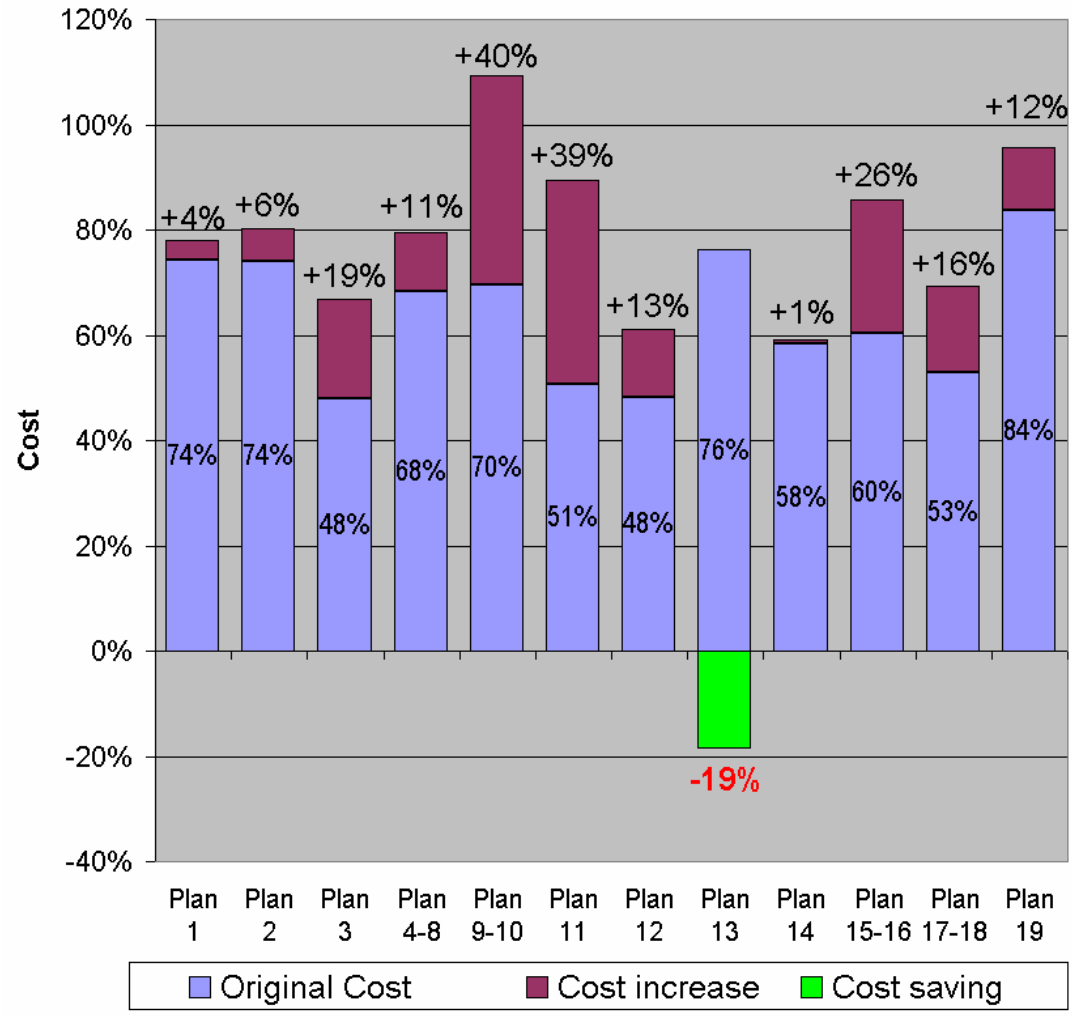

Figure 19 – Final cost implications

CHAPTER

5 DISCUSSION AND CONCLUSION

5.1 Summary

The aim of this project as defined above was to investigate the commercial implications caused by the proposed Rules. This chapter presents discussion about the results and a conclusion followed by a statement of achievement and description of accuracy of results and concludes with a statement of possible future work.

5.2 Commercial Implications Conclusion

While the analysis shows a preliminary trend in the decrease of costs, further analysis shows an increase in compliance costs to achieve identical results as under the current Rules.

5.2.1 Cost Results

Based on the collected data and analysis, the proposed Rules will increase the cost of cadastral subdivision surveys. The level of cost increase will vary depending on the complexity, size and other conditions of the site. The results of analysis show an initial decrease of compliance cost of around 20% due to modelled decrease in ground marking of boundaries. However, to achieve the same level of boundary monumentation as that under the current Rules further cadastral surveys will be required. The further surveys will on average cost 34% of the original project cost and result in overall increase of the development costs by 14%. The average cost increase adjusted for outliers is 15% with standard deviation of 6%.

5.2.2 Society Implications

The lack of physical boundary monuments will result in difficulties in identifying property related rights on land. It is possible that boundary monumentation will take place during the initial subdivision survey; however, in situations where this is not the case cadastral surveyors could be engaged to undertake identification surveys to locate property boundaries. This will result in increased compliance costs as analysed above. Some developer may choose to provide monumentation as part of the subdivision survey, however, others may choose to save money and exclude it. This will generate an inconsistency on the property market where general public will have to become aware of monumentation costs. Saving on monumentation costs could be a false economy of savings when consumers are obliged under other enactments such as the Building Act 2004, to prove prior to building that the foundations will be located within the boundary of the lot.

5.2.3 Implications on cadastral profession

As a result of the increased compliance cost and lack of monumentation cadastral surveyors are likely to be exposed to more public disputes. Together with the new certification requirement this may bring an increase in the public liability or professional insurance costs that would most likely be past onto their clients. It has been difficult to quantify this statement as it is based on an opinion of licensed surveyors consulted during this research. This project was unable to obtain any data on public liability insurance, as this is confidential information held by the insurers. However, discussion with licensed cadastral surveyors implies the likelihood of increase insurance costs and this cost being passed onto clients.

The relaxation of standards will also impact on the reputation of the profession. Deregulation could lead to varying standards being utilised throughout the

profession, impacting on the profession's reputation to provide accurate and reliable data.

5.3 Achievement of Aims and Objectives

The aims of this project are specified in Appendix A and detailed in Chapter 1. Research into the background information relating to cadastral surveying is presented in Chapter 2 and analysis of available data in the following chapters. This project has achieved its objectives by setting out that there are commercial implications, the increase in compliance costs and the more difficult to quantify social and professional implications. Selection of example projects was extended from 10 to 19 surveys to improve the analysis and results. These projects were analysed for possible cost savings and increases as resulting from the proposed Rules. Other rules were selected for analysis as having possible impact on the profession, public or cadastre.

5.4 Possible improvements

As a result of this research it is concluded that changes to some of the rules are appropriate. These include:

- Monumentation should be required as a secondary objective of the cadastre and title registry. It is the monumentation that simplifies identification of rights in the field.
- Accuracy tolerances should be appropriate for the expected technologies used to ensure precise definition of boundaries and right.
- Rules related to the drafting and presentation of plans should be removed, as this is the responsibility of the electronic cadastre.
- Certification by the licensed surveyor should be changed to reflect requirements under the Cadastral Survey Act 2002 and be limited to it.

5.5 Limitations

The results presented in this dissertation show a large variation for tested datasets. The sample size of projects is too small to conclude with confidence that presented results are representative. This is further highlighted by the large standard deviation. However, the results show a general increase in cost rather than reduction as advocated by the government. While revised rules have not been published at the time of finalising this document decisions by the Surveyor-General indicate that some of the rules identified here will be changed to minimise their impact (LINZ, 2008(2)).

5.6 Future Work

Future studies could be done to design appropriate rules for cadastral surveying to ensure that there is a balance between maintaining the rights of property holders to have accurate surveys while ensuring that survey costs and compliance are not so stringent as to warrant huge costs. This could be assisted in researching appropriate systems of monumentation and accuracy standards.

BIBLIOGRAPHY

Business NZ, *Regulation Perspectives*, 12 July 2006

Cadastral Survey Act 2002 (New Zealand)

Land Transfer Act 1952 (New Zealand)

Local Government Act 2002 (New Zealand)

Land Information New Zealand, 'Surveyor-General's Rules for Cadastral Survey 2002/2', 17 October 2002

Land Information New Zealand, 'Inclusion of GPS data in Cadastral Survey Datasets', *Landwrap,* Issue 28, October 2006

Land Information New Zealand, 'Review of the Rules for Cadastral Survey', 15 October 2007

Land Information New Zealand, 'Surveyor-General's Rules for Cadastral Survey 2008', 15 October 2007(2)

Land Information New Zealand, 'Record of Public Submissions Received on the Draft Rules for Cadastral Survey (LINZS65000)', 2008

Land Information New Zealand, 'Decisions on proposed rules', 2008(2)

Land Information New Zealand, 'Thematic Summary - Public submissions received on proposed Rules for Cadastral Survey', 2008(3)

Surveyor-General, 'Cadastre 2014 Reforms in New Zealand', *1999 New Zealand Institute of Surveyors & FIG Commission VII Conference & AGM*, October 1999

Surveyor-General, 'e-Survey and Title in New Zealand-Land*online', Presented at the Joint AURISA and Institution of Surveyors Conference,* November 2002

Surveyor-General, 'Cadastral outcomes and the Surveyor-General's rules for cadastral survey', *New Zealand Surveyor*, No.296, December 2006

APPENDIX A

Project Specification

March 2008

University of Southern Queensland
FACULTY OF ENGINEERING AND SURVEYING

ENG 4111, 4112 Research Project
PROJECT SPECIFICATION

FOR: Samuel Cech

TOPIC: The commercial implications of the NZ Surveyor-General's Rules for Cadastral Survey 2008

SUPERVISOR: Glenn Campbell (USQ Supervisor)
Shane Simmons (USQ Supervisor)

PROJECT AIM: This project aims to investigate the commercial implications of the Cadastral Survey rule changes as proposed by Land Information NZ in October 2007.

SPONSORSHIP: Eliot Sinclair and Partners Ltd.

PROGRAMME: **Issue A. March 2008**

1. Research the background information relating to Cadastral Survey regulations in New Zealand and identify the reasons given by the government for changing Cadastral Rules in New Zealand.

2. Select example projects that were completed by the sponsor under the current Cadastral Rules. These will include at least two urban residential subdivisions, two rural subdivisions, two commercial subdivisions and two other projects such as re-definition surveys or pegging certificates.

3. Analyse the collected data by comparing costs and benefits of completing Cadastral Surveys under the current and proposed rules.

4. Critically evaluate each proposed rule and the commercial implications on surveyors, landowners and cadastral system as a whole.

5. Using the previous analysis evaluate the validity of reasons given by the government for changing Cadastral Rules in New Zealand.

6. Conclude what changes if any should be made to the current NZ Surveyor-General's Rules for Cadastral Survey 2002/2.

7. Submit an academic dissertation on the research.

As time permits:

8. Analyse implications of similar rules in force in Australia or other parts of the world.

9. If a new Draft is published before completion of this project analyse its implications in comparison to the first October '07 Draft.

AGREED: _____ (Student) _____, _____ (Supervisors)

Dated: 25/03/2008 __/__/__ __/__/__

APPENDIX B

Cadastral Outcomes and Objectives

Land Information New Zealand,
Review of the Rules for Cadastral Survey,
15 October 2007, Pages 34-36

APPENDIX B *Cadastral Outcomes and Objectives*

Land Information New Zealand, *Review of the Rules for Cadastral Survey*, 15 October 2007, Pages 34-36

End Outcome	Intermediate Outcome	Objective	Sub-Objectives
A. Holders of rights, restrictions, and responsibilities in land confidently know the boundaries to which they apply so that they can efficiently identify, trade and use their rights	A1 Sufficient evidence is available for correctly and efficiently locating boundaries on the ground	A1(a) The accuracy of boundary dimensions and areas is consistent with the expected land use	A1(a)1 The accuracy of horizontal boundary direction is aligned with the landowners need to derive benefit from the land
			A1(a)2 The accuracy of horizontal boundary distances is aligned with the landowners need to derive benefit from the land
			A1(a)3 The accuracy of the heighted boundaries is aligned with the landowners need to derive benefit from the land
			A1(a)4 The accuracy of parcel area is aligned with the landowners need to derive benefit from the land
			A1(a)5 The accuracy of boundary dimensions is able to be increased as land use intensifies
		A1(b) The boundary is accurately, clearly and uniquely located in relation to physical marks or features when surveyed	A1(b)1 Boundary positions are able to be readily located by reference to survey marks or physical features or by reference to other boundary positions
			A1(b)2 Marks or physical features used to demarcate boundaries are not confused with other objects in the field
			A1(b)3 Boundaries or marks are accurately positioned in relation to existing boundaries
			A1(b)4 The positions and descriptions of marks and physical features used to demarcate boundaries are correctly recorded by the surveyor
		A1(c) The original position of a survey mark or boundary is able to be re-established at any time	A1(c)1 The original position of a survey mark and/or boundary is adequately and correctly recorded in a CSD
			A1(c)2 Data from a CSD is correctly integrated into the cadastre
			A1(c)3 Sufficient information about the position of a survey mark and/or boundary is able to be retrieved from the cadastre
			A1(c)4 Sufficient original survey marks or physical evidence of boundary demarcation remains in position after survey
			A1(c)5 There is a known and sufficiently accurate relationship in the cadastre between original survey marks and boundaries, and nearby remaining survey marks
			A1(c)6 The accuracy tolerances of the survey are known
		A1(d) Interested parties are able to review the evidence relating to the surveyor's determination of the location of a boundary	A1(d)1 Adequate evidence of boundary determination is included in the CSD
			A1(d)2 The information is correctly referenced in and can be easily extracted from the cadastre

End Outcome	Intermediate Outcome	Objective	Sub-Objectives
(from above) A. Holders of rights, restrictions, and responsibilities in land confidently know the boundaries to which they apply so that they can efficiently identify, trade and use their rights	A2 Parcels support the recording of rights and other statutory land administration functions	A2(a) The cadastre enables rights assigned to a parcel to be identified and new rights to be correctly assigned to a parcel	A2(a)1 The information in a CSD meets the requirements of managers of tenure systems for the correct assignment of rights
			A2(a)2 The information in the cadastre meets the requirements of managers of tenure systems for the correct assignment of rights
			A2(a)3 The cadastre correctly reflects the rights assigned by managers of tenure systems
			A2(a)4 Statutory actions and land status are recorded against the correct parcel
			A2(a)5 The quality of parcel definition enables managers of tenure systems to judge which rights are appropriate to assign to it
		A2(b) All land in NZ is recorded in the cadastre, without gaps	A2(b)1 Surveys account for the extent of all underlying parcels
			A2(b)2 All parcels in the cadastre have a survey definition of their boundaries
			A2(b)3 Parcels abutting each other have common boundary positions
			A2(b)4 All parcels are uniquely identified in the cadastre
		A2(c) Parcels with incompatible rights do not overlap	A2(c)1 Parcels abutting each other have common boundary positions (see A2(b)2)
			A2(c)2 The relationship between new parcels and existing and other new parcels is clearly established
			A2(c)3 Parcels available for rights to be assigned are identified in a timely manner
			A2(c)4 Parcels with rights assigned or extinguished are identified in a timely manner
	A3 The records in the cadastre correctly represent the physical evidence on the ground	A3(a) A CSD is correct before it is accepted as being authoritative	A3(a)1 The content of a CSD is sufficient to enable its compliance with the standards to be determined
			A3(a)2 A CSD complies with the standards before it becomes authoritative
			A3(a)3 A CSD complies with the standards before it is submitted for integration into the cadastre
			A3(a)4 The integrated cadastre enables a CSD's compliance with the standards to be determined
		A3(b) Data in a CSD is completely and accurately integrated into the cadastre	A3(b)1 A record of all boundary marks placed is submitted for integration into the cadastre
			A3(b)2 Data in a CSD is suitable for integration into the cadastre
			A3(b)3 Data from CSDs is correctly integrated into the cadastre
		A3(c) Data from the cadastre is easily found, obtained and interpreted	A3(c)1 Data in the cadastre is easily found by users
			A3(c)2 Data is easily obtained from the cadastre by users
			A3(c)3 Data from the integrated cadastre is provided in a form that is easily interpreted by users
			A3(c)4 CSDs are submitted in a form that enables A3(c)(3) [i.e. data from the integrated cadastre to be provided in a form that is easily interpreted by users]
		A3(d) Survey records are maintained for their useful life	A3(d)1 Survey records are in a condition that enables them to be used
			A3(d)2 Survey records are retained in a format that ensures continued access and viewability

End Outcome	Intermediate Outcome	Objective	Sub-Objectives
B. Other parties can rely on and efficiently use the cadastre for achieving other mandated Government outcomes (e.g. electoral boundary definition, resource management, emergency management, land administration)	B1 Information integrated into the national cadastre can be easily merged with other datasets	B1(a) Parcels of land are integrated into a seamless national cadastre	B1(a)1 A CSD has a defined spatial relationship to existing marks or points in the integrated cadastre
			B1(a)2 Points, boundaries and parcels in a CSD are put in the correct spatial relationship to existing points, boundaries and parcels in the cadastre
			B1(a)3 The cadastre is not artificially divided
		B1(b) All cadastral surveys are coordinated in terms of the official geodetic datum	B1(b)1 All cadastral surveys are orientated in terms of an official geodetic projection
			B1(b)2 All CSDs are connected to the official geodetic datum
			B1(b)3 CSDs containing heights are connected to an official vertical datum
		B1(c) Parcel data from the cadastre facilitates update and management of linked datasets.	
		B1(d) Integrated data is up-to-date	
	B2 Authoritative data from the cadastre is easily found, obtained and interpreted	B2(a) Cadastral data can be easily found	
		B2(b) The latest authoritative data is readily available	
		B2(c) Data is provided in a form that is able to be merged with other datasets	
		B2(d) The quality of the data is identified	
		B2(e) Authoritative data can be easily interpreted	

APPENDIX C

Rule 2.3
Draft Surveyor-General's Rules for Cadastral Survey 2008

Land Information New Zealand, 2007

2.3 Accuracy of right line boundaries and arc boundaries

(a) The horizontal and vertical accuracy between any boundary point and any other boundary point must not exceed

$$\sqrt{c^2 + (D \times p)^2} \text{ metres}$$

where D is the distance between those points in metres and where the constant factor c and the proportional factor p are given in the following table:

Class of boundary point	c (metres)	p
A	0.05	0.0005
B	0.3	0.001
C	3	0.003
D	not specified	not specified

(b) Where the two points in (a) above have different applicable accuracy classes, the lower class shall apply.

(c) Notwithstanding (a) and (b) above, the relationship between a boundary and any other boundary must be determined to a sufficient level of accuracy to address the risk of boundaries overlapping where these relate to adverse rights.

2.4 Accuracy of water boundaries and irregular boundaries

(a) The difference between any position on a water boundary or an irregular boundary shown on a CSD and the true position must not exceed the following tolerances:

Class of boundary	Tolerance (metres)
A	1
B	5
C	20
D	not specified

(b) Notwithstanding (a) above, the relationship between a water boundary or an irregular boundary and any other boundary must be determined to a sufficient level of accuracy to address:

(i) the risk of boundaries overlapping, including the other side of the water body or esplanade reserve and