UNIVERSITY OF NATAL

APPLICATIONS OF LAND INFORMATION SYSTEMS IN LAND RE-ADJUSTMENT PROJECTS - "A LESOTHO EXPERIENCE"

2001

BOPHELO MOTHUNTS`ANE

APPLICATIONS OF LAND INFORMATION SYSTEMS IN LAND RE-ADJUSTMENT PROJECTS - "LESOTHO EXPERIENCE"

By

Bophelo Mothunts'ane

A Thesis

Submitted in Partial Fulfillment of the Academic Requirements for the Degree

Of

Master of Science in Land Surveying

In the

School of Civil Engineering, Land Surveying and Construction

Faculty of Engineering

University of Natal: Durban

2001

Abstract

Land information is a an important resource in planning, and in undertaking land administration functions such as allocation of interests to land, land adjudication, land valuation, physical planning, etc. Rapid urbanization, however, puts great pressure on personnel delegated to undertake these functions. The personnel can no longer cope with capturing, processing and disseminating land information for the increasing urban population.

Observing the failures of land information management to cope with rapid urbanization, the researcher undertook an exploration into the capabilities of LIS to manage land information for The Millennium Park Land Development Project (MPLDP) in Maseru, the Lesotho capital. The project is based on land re-adjustment principles and is of multi-stakeholdership. Such big and networked projects have been shown to be associated with land information management problems. Undertaking this research was motivated by many success stories however, world wide, in which LIS was introduced as a tool to assist in land information management.

The main themes in this project are firstly, the study of Land re-adjustment as a land management technique to meet land demand for urbanization and secondly land information system as a tool to manage land information for a land re-adjustment project. Study of LR will help understand what land information is required for such a land management project. Study of land information system will help exploring its capabilities that can be applied to manage land information for LR projects.

Furthermore, as a case study to this, the MPLDP system is analysed, examining the activities and ways in which land information is managed. This analysis is aimed at identifying the constraints that result in the observed backlogs in the project activities and recommending improvements. Many problems and constraints are identified in the MPLDP. As a land surveyor, only improvements related to technical constraints are considered in this research, with cognizance of the legal and institutional issues that need to be addressed in implementation of these improvements. The main improvement discussed is the creation of automated databases and illustrations are given on how these databases could be used to manage land information effectively for the MPLDP.

Dedication

This piece of work is chiefly dedicated to my parents Mr. Molapo Mothuntsane and Mrs 'Mabophelo Mothuntsane (RIP), you have done so much that is invaluable to me, about which I can not even elaborate further. To my parents (those relatives, family friends, colleagues, teachers, the clergy), brothers and sisters who took effort in raising a young boy to become a well-mannered young man, with inspiration towards the education they so successfully stuck in me, I love you all.

Not forgotten are all my non-believers, who pray for my down fall, thanks for the inspiration, 'its all in the mind'.

Acknowledgements

I would like to acknowledge invaluable support towards undertaking and completion of this research to the following;

- To my Lord God, The Redeemer Jesus Christ and my Guide the Holy Spirit, for the power and inspiration you so High provided me, I have always been a beneficiary and witness to, throughout this research.

- The Government of the Kingdom of Lesotho for providing me with all the financial resources that enabled my dreams of furthering my studies to come true.

- My Chief Surveyor, Mr. Q.C. Selebalo and Principal Surveyor, Mr. Mpeete who recommended me for further training in land surveying.

- My supervisor, Mr. S.M. Chilufya, for believing in me, tirelessly guiding every step of my research till the completion. Bringing a new paradigm of Land Information System in which I was just a novice. Your supervision in this research was outstanding, I acknowledge your invaluable supervision.

- Dr Clarissa Fourie, for building a concrete foundation that supports my development in land management. It was unbelievable how you created (in the blink of an eye) a suggestion that finally became a theme in this research; land re-adjustment.

- Mr Jonathan Jackson who guided the process of this research proposal with support material, advice and further warning me of difficulties inherent in some of the proposals I had initially put forward.

- All the staff in the Faculty of Engineering who made sure that all the necessary supporting education (especially Mr. Angus Forbes and Mr. Bob Hepburn) and resources (especially Mr. V. Padayachee and Mr. Carl Grossman) were efficiently provided to support my research.

- 'Me' Ramonaheng, the MPLDP manager, who tirelessly, guided and provided invaluable information during the requirement determination excursion. Thanks again to the rest of the project management team who supported, for the same reasons (especially Miss K Ntlaloe, Mr. A Offei, Mr. R Malataliana and MR L Ramahlele, Mr Matela and the rest of the LSPP staff) for your help.

- Last but not least my advisers in language Miss. S. Ts'oeu and Mrs. R. Cadman. Your help was invaluable in augmenting my expression in a second official language.

I acknowledge and certify that this is my work and that of others, that I have quoted, I have accurately indicated. I further acknowledge and certify that this thesis has not been submitted for evaluation to any other universities.

Bophelo Mothunts'ane
University of Natal: Durban
2001

Table of Contents

Chapter 6: MPLDP system analysis

Chapter 7: Improved MPLDP system

Chapter 8: Implementation and testing of the improved system

List of Acronyms

AOC	Aircraft Operating Company
ASCII	American Standard Code for Information Interchange
BNCF	Boyce/Codd Normal Form for normalization
CASE	Computer Aided Software Engineering
CD-ROM	Compact Disc read-only memory
CMDA	Cato Manor Development Association
CMDP	Cato Manor Development Project
DLSPP	Department of Lands, Survey and Physical Planning
DLHUD	Department of Lands, Housing and Urban Development
DFD	Data flow diagram
DFID	Department of International Development
DD	Data dictionary
DXF	Data Exchange Format
DBMS	Database management system
Form C	Certificate of land allocation in Lesotho
GIS	Geographic information system
GPS	Global Positioning System
JPEG	Joint Photographic Expert Group
LHLDC	Lesotho Housing and Land Development Corporation
LIS	Land information system
LR	Land re-adjustment
LTF	Land Task Force
LIMS	Land information management system
MPLDP	The Millennium Park Land Development Project
MoLG	Ministry of the Local Government
MCC	Maseru City Council
PMT	Project management team
RINEX	Receiver Independent Exchange Format
RTK	Real Time Kinematic
SQL	Structured Query Language
TIFF	Tagged interchange file format
TFW	Tagged World File, accompanying a TIFF
TSO	Trimble Survey Office
UNECA	United Nations Economic Commission for Africa
ULC	Urban Land Committee
VDC	Village Development Council
WBS	Work breakdown structure
WGS 84	World Geodetic System 84

List of figures

List of tables

Chapter 1

Introduction

1.0 Background to research

The major problem facing institutions that provide formal land delivery in the urban areas is that of meeting land demand. This demand is due to increased urbanization trends and inefficiency in managing land information.

Firstly, high urbanization trends result from rural people migrating into urban areas to look for better employment opportunities together with good social and health facilities, etc. High rates of urbanisation culminate in urban expansion, causing people to acquire land in the urban periphery. Urban-periphery settlements in most countries are associated with informal developments, as land administration weakens from urban centres outwards. This is the case of Lesotho's capital city, Maseru.

Secondly, poor land information management has meant that land allocations are being effected haphazardly. Land allocating agencies have little or no information about available land to plan and make decisions upon. Physical plans are based on outdated maps, which mostly do not correspond to the existing situation on the ground.

The combination of rapid urbanization and poor land information management causes bottlenecks in land delivery in urban areas. Governments and private developers trying to deal with this situation often initiate land management projects in order to provide formal housing and services. Land management techniques employed often include land expropriation also referred to as eminent domain, private land acquisition, land re-adjustment (LR), also known as land pooling or consolidation, etc.

In order to deal with a similar situation in The Kingdom of Lesotho (Lesotho), the Ministry of Local Government (MoLG) initiated a LR project in 1999, called The Millennium Park Land Development Project (MPLDP) in the urban periphery of Maseru. The main underlying problems that led to the initiation of this project were, lack of housing sites in the urban centre and the rapid growing rate of informal settlements in the peri-urban areas of Maseru. Apart from lack of land for housing in the Maseru urban centre, peri-urban developments are growing fast because of the adverse effect of formal land delivery governed by the cadastral system and low-cost informal land delivery in the urban peri-phery. The cadastral system, and specifically cadastral surveying component, is said to be inherent in the high survey fees charged by land surveyors. These fees are mostly out of reach of the urban poor.

The Kingdom of Lesotho, the area for this research is regionally located in Sub-Saharan Africa between 27 degrees and 30 degrees East, and between 28 degrees and 31 degrees South. The country covers an area of approximately 30 355 square kilometres with population slightly more than 2 million (Land Policy Review Commission Report, 2000: 2). The country is completely surrounded by the Republic of South Africa. Figure 1.1 on the next page shows the geographical location of Lesotho.

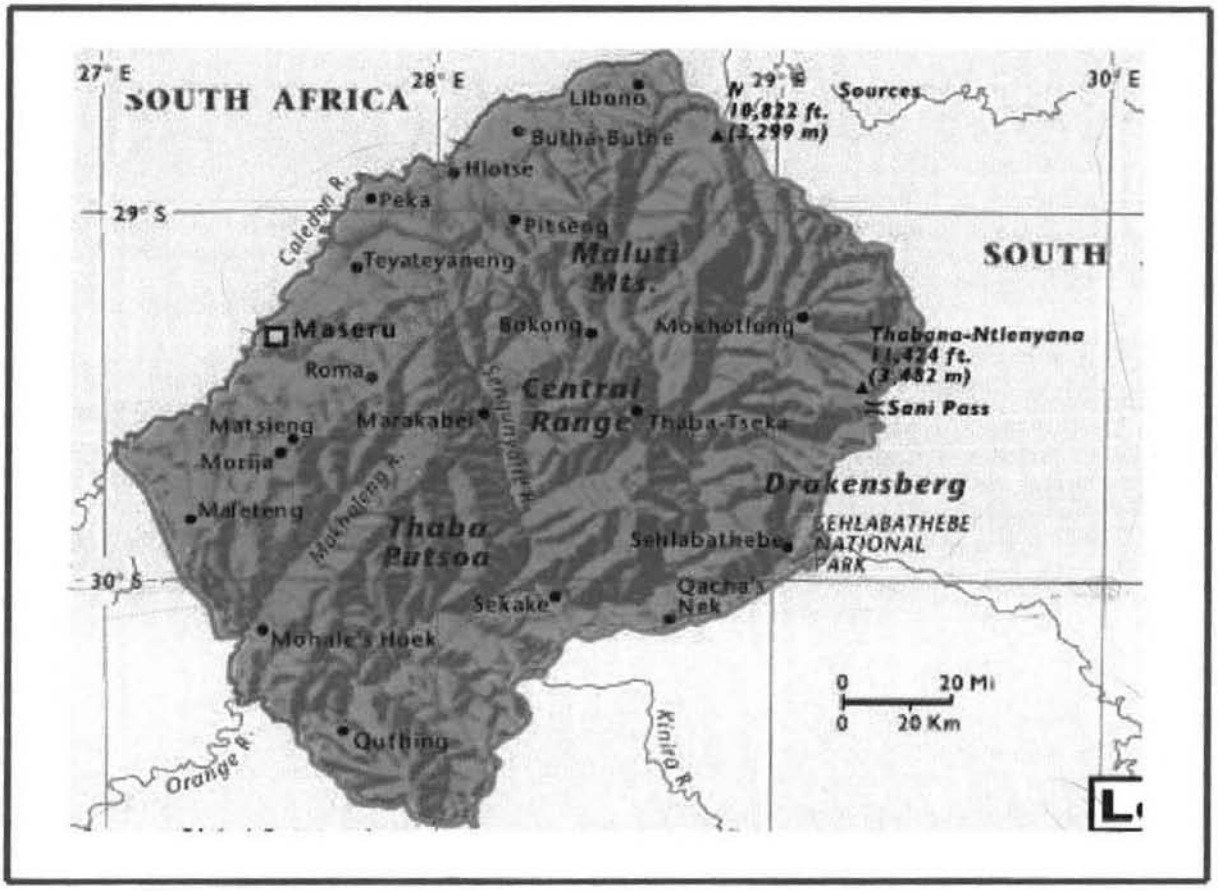


Figure 1.1 the geographical location of Lesotho with Maseru highlighted where the MPLDP is being engaged. (Source: www.allafricatravel.co.za/images/atlas/Lesotho.htm)

1.1 Research problem

The MPLDP is the first LR project undertaken in Lesotho. The government has been mainly involved in land expropriation projects. Many of these projects have failed due to among other reasons the lack of land information as basis for planning and decision-making. For example, processes of verifying ownership (land adjudication) of land acquired for the project took time as landownership records are poorly kept or non-existent. Land adjudication involves some long-term land disputes, which in part have been blamed on civil courts, which handle many cases. Thus project time overruns, causing impatience among landowners who subsequently continue with their own land developments until such land expropriation projects become no longer feasible.

This research is based on investigating an efficient land information management system (LIMS) for the MPLDP. Land information management comprises methods of collecting data, processing data into meaningful information and conveying data and information to relevant consumers. The research therefore is aimed at investigating ways in which these methods can be accomplished effectively. Effective management should ameliorate problems like the one mentioned above, where poor land information management has resulted in the failure of land management projects.

1.2 Research objectives and significance

The objective of this research is to explore the application of a computer-based land information system (LIS) or Geographical Information System (GIS) as one of the land information management systems that could be employed to manage land information for the MPLDP. The MPLDP covers 1600, hectares and is

a multi-stakeholdership project in which the community, public and private sector organisations are involved. In such a widespread network it has been noted that conveyance of information becomes inevitably a failure. This failure of communication is demonstrated by the passing of information to a group of students in succession, the last of whom presents it to the class. In most cases, versions differing from the original information result. Efficient land information management should therefore be present in such projects, to enable quality and informed planning and decision-making.

Pursuance of the research is further motivated by many success stories of the use of LIS in the implementation of large scale land management projects in Africa and elsewhere. The Cato Manor Development Project (CMDP) in Cato Manor, Durban, The Republic of South Africa, is one example of success stories in LIS applications in land management projects. Odendaal (2000: 10-11), defining GIS as "a planning and decision-support tool", shows that it has helped CMPD to co-ordinate activities between the Cato Manor Development Association (CMDA), a project management team, and other private sector organizations. Odendaal (2000: 10-12) shows that through the use of GIS, information has been well conveyed between CMDA staff and consultants on a continual basis, whilst tracking the progress of more than sixty sub-projects within the jurisdiction of the project.

The research is also significant, as the use of computerized land information systems is a new approach in the implementation of land management projects in Lesotho. The Department of Lands, Surveys and Physical Planning (DLSPP), as the main co-ordinator of the project within the broader Directorate of Lands, Housing and Urban Development (DLHUD) where the researcher is an employee, has just acquired resources necessary for implementation of LIS as an assisting tool to land information management. It is a vision of the MPLDP project manager to utilise this tool for managing the project land information. Quoting Ramonaheng (2000: 4), the project manager, referring to use of LIS in the MPLDP project maintains that "Department of Lands, Surveys and Physical Planning have awareness of the potential and have foundations of land information systems to assist with planning and development control". Thus, the research has a role in exploring the efficiency of the use of these acquired LIS resources to assist information management of the MPLDP.

1.3 Research questions

The questions to be pursued in accomplishing this research include the following:

i) What are the underlying concepts of LR?
Pursuance of this question will enable understanding of the relevant information that needs proper management in order to assist in planning and decision making. Further, the question is important, as MPLDP is the first LR project in Lesotho and studying LR in broad terms will enable identification of important areas that need careful management.

ii) What are the information requirements for the multi-stakeholdership organizations that are involved in the MPLDP?

iii) What efficient methods of data acquisition, processing, storage and dissemination can be used to speed up the project activities and reduce project expenses?

iv) What improvements are necessary to be effected to ameliorate constraints and problems that cause bottlenecks and time lags in the activities of the project?

1.4 Research methodology

The following methodology will be used to achieve the objectives of this research:

i) Relevant literature to investigate the concepts of LR and applications of LIS in land management projects.

ii) Investigation of the information requirements of the organizations involved in the MPLDP will be accomplished by requirement determination. This involves the use of various fact-finding techniques (including interviews, questionnaires, record review, observations, etc.

iii) Recommendations for improvements will be achieved by analysis of the requirement determination results. Various information analysis tools will be used in which the aim is to identify problems that cause bottlenecks and time lags because of inefficiency in land information management. In this case technical improvements will be proposed for which a pilot database of MPLD will be developed.

iv) The developed MPLDP pilot database will further be implemented and tested by performing queries to demonstrate how necessary data can be analysed, manipulated and presented in a way as to convey meaningful information for planning and decision making purposes.

1.5 Structure of the dissertation

Chapter one of this research states the rationale to undertaking the research. The main theme of the research is introduced. The statement of the research problem highlights land information management for the MPLDP and its potential to curb inefficiency and ineffectiveness in land management projects. Furthermore, the objectives and the project significance are discussed, indicating LIS as a way to achieve efficient land information management for a large, networked project like MPLDP. It is demonstrated that dissemination of information in a network usually becomes inefficient and the employment of LIS has shown successes in many large-scale land management projects. These successes provide motivation for this research. Questions that have to be pursued to undertake the research are stated. In addition, research methodology is laid out to show how answers to such questions can be found and finally, efficient ways of managing land information for the MPLDP can be derived.

Chapter 2 is a review of LR. The chapter is aimed to provide understanding of LR as a technique used for land management. Concepts that are involved in LR will be discussed. The Kukaku-Seiri LR procedure in Japan will be highlighted as guidance to LR approaches pursued to provide housing and services. Further in this chapter land administration functions will be discussed that guide the formality of activities in LR. Thus the chapter gives introduction to important LR processes and within processes activities that require land information to be undertaken efficiently.

Chapter 3 investigates specific data and information that are required for LR projects. LR processes and land administration functions discussed in chapter 2 are carefully studied to derive this required information. The chapter goes further to discuss LIS as one of the land information management systems that can be employed to manage MPLDP information. LIS is defined in terms of its backbone components. The various LIS classifications are also discussed in this chapter.

Chapter 4 provides a review of the development of LIS. Major issues in LIS development, including institutional arrangements and management issues are, discussed. The chapter goes further to discuss phases in LIS development which is shown to be as cyclic as any other system.

Chapter 5 introduces the MPLDP. In this introduction the project management framework is discussed. Within the project framework, project definition, statement of the problem and aims are described. In addition the legal, institutional and time frameworks for the project are outlined. Project activities are further discussed in which the work breakdown structure tool is used to incorporate the discussion of activities with the legal, institutional, and time frameworks of the project. The chapter gives an

understanding of the legal, institutional and time frameworks in which the developed or improved LIS to manage the project information will work. Further unpacked in this chapter is the problem of informal settlements in which the LR review does not cover. This is due to the fact that the simple application of the western and eastern LR procedures reviewed in chapter 2 does not perfectly match the third world informal settlement situation. This is important, as technical improvements are associated with changes in formality and the way organizational personnel will conduct their activities.

.

Chapter 6 focuses on the analysis of the MPLDP system. The analysis is based on identifying requirements for the system. This identification is achieved by the requirements determination, which is aimed at studying how tasks are performed, and which areas need to be improved. The process is to be achieved by a fact-finding mission, in which various fact-finding techniques are employed. The analysis further focuses on the information that is required to undertake tasks in the project. These include data flow between the MPLDP system and the external environment, and also within the MPLDP system itself. How this data is processed and disseminated and stored is also a subject of discussion. Various tools are used to model conceptually the current way in which information and data is kept and used in different activities (i.e. the conceptual functional model). This is done to understand and determine with visual tools those areas in which inefficiency, for example duplication of effort, or inefficient methods of data storage and dissemination etc., occur.

Chapter 7 discuss technical improvements to the MPLDP system. Improvements are recommended in the areas of efficient methods for spatial data collection, processing of data to information, how information and data should be stored and how easily information can be disseminated. It is shown in this chapter that technical changes have corresponding legal and institutional issues that need to be addressed. Specifications are recommended for legal and institutional changes that need to be effected for technical improvements to thrive.

In this chapter the design of an improved MPLDP system model of the database is also discussed. Various tools are used to transform the current conceptual functional model discussed above to an improved one. Areas in which data collection, storage and dissemination can be improved are depicted on this model. Further, the project data and information are carefully scrutinise to identify entities which are objects, concepts etc. that occur in many instances in the project. For example, a map will be an entity in the project as there will be many maps that are used to depict the reality of the ground situation. These entities in the MPLDP are those that require storage in the designed databases. A relational database is used to implement the database in which defining relationships between entities are required. Entity-relationship modelling tools are used to accomplish this. Further the conceptual model of the improved system is translated into logical model befitting the relational database management system. Both spatial and non-spatial models of the MPLDP data are discussed. These models are then translated into tables ready to be implemented in databases.

Chapter 8 is based on the implementation and testing of the designed database. In this chapter, the specifications of the hardware and software required for implementation are defined. Subsequently a pilot area is chosen for which test databases has bee designed and performance assessed by way of queries in order to ensure that they are capable of providing the required information. The queries make use of the data analysis, manipulation and presentation capabilities of the chosen software and hardware.

Chapter 9 concludes the research by providing the findings and recommendations. It is outlined in this chapter how the research objective was met advancing from chapter to chapter. The statement of achieving the objective has also been provided and further the shortcomings of the research, and areas for further research mentioned. Finally the concluding remarks regarding the research have been presented.

Chapter 2

Land Re-adjustment

2.0 Introduction

Land management is a "process of making and implementing decisions about how land and its resources are distributed, used and protected in a society" (Nichols, 1993: 35). Land for property development is one of the resources that needs land management. In fact, in the economist's view, land is a resource, along with capital and labour, to be exploited or conserved in order to achieve economic production and development (Dale and McLaughlin, 1988: 3).

Achievement of economic production and development regarding land is usually associated with urbanization. Hardoy and Satterthwaite (1989: 223) define urbanization as "a process by which an increasing proportion of population comes to live in urban centres". Payne (1999: 1) shows that the reason for high urbanization trends, especially for developing countries is that urban centres are a driving force behind economic development through which international and domestic investment is channelled to manufacturing, services and commerce. Thus it becomes inevitable for the rural poor to migrate to urban centres in search of opportunities and facilities associated with the above, such as jobs, better health facilities, etc., which are often scarce or absent in most rural areas.

Urbanization often impacts negatively on land management. In most cases urbanization results in urban population growth which in turn puts pressure on and defeats methods of formal land delivery. Taking the Republic of South Africa as an example, Hindson and McCarthy (1994: 2) show that in the province of KwaZulu-Natal, population growth in urban areas is three times that in rural areas. They further show that formal land delivery consequently becomes ineffective as "the growth of informal settlements far outstrips that of the formal areas". Making matters worse, informal settlement in most cases results in urban expansion in which settlements encroach informally on the urban periphery. This phenomenon, often referred to as urban sprawl, results from illegal subdivisions of agricultural land in the urban periphery or illegal occupation of state land. Urban sprawl is worsened by the fact that "the ever increasing attraction of land as a source of secure and profitable investment has intensified a commercial market system to the point where urban land in some cities is well beyond the affordability of even middle-income households" as Payne (1999: 1), posits.

In line with formal land delivery as a strategy to improve land management, lies the question of provision of services and infrastructure. Formal land delivery is not only about registering one's parcel, but also includes existence and/or provision of a variety of services, as stated in land development regulations of every country. For example emphasis is put on factors such as access to a parcel, basic services and facilities that must be inclusive in a settlement. Urbanization, however, especially in developing countries brought with it negative impacts on land management as informal settlements, developing haphazardly, do not provide easy means of service and facility provision and are often as a result ignored by the central governments. Hardoy and Satterthwaite (1989: 91) note that all kinds of informal settlements have little or no government provision of services and infrastructure and most often no government action is taken to demolish property informally developed in dangerous locations such as flood plains and hillsides prone to land slides, and other potential disaster areas.

This discussion indicates that urbanization is one of many factors that often defeat methods of formal land delivery. Blind eyes should not be turned to other factors such as inappropriate externally acquired methods of land delivery like the cadastral system form of land registration, and government bureaucracy in land delivery, especially in developing countries.

It is true that governments and other private developers have worked tirelessly to improve land management, especially in initiating and implementing formal land delivery, service, and infrastructure provision. Measures they take often come in form of land management projects. These projects involve

land acquisition, planning, servicing and later allocation of serviced land to citizens. Briefly discussed below are three land management project types aimed at providing formal land delivery, services and infrastructure;

- Eminent domain: Eminent domain involves the compulsory purchase of under- utilized land, or any land for rezoning purposes. The state can then allocate this land to private developers or develop it and later allocate it formally to subjects. Often terms like land expropriation, land banking and guided land development are associated with this land management method.

- Private land acquisition: This involves a private developer acquiring land at market prices from individual landowners, planning, servicing and allocating serviced parcels at a profitable rate.

- Land re-adjustment (LR): Land re-adjustment involves restructuring parcel and ownership structures for a well-planned settlement. Unlike the two above land management methods, land re-adjustment can occur in a situation where land is acquired without any cash exchange. Either the government or individual landowners can initiate the project. Landowners may pool their land together, plan and service it and later reallocate themselves serviced parcels equitably, according to how much they have pooled in such a project. Although methods of determining equitability are most of the time complicated, land re-adjustment provides an economic form of managing land for housing and servicing where land for property development is scarce. Usually terms such as land pooling and land consolidation are used to demonstrate land re-adjustment.

LR becomes the subject for further discussion in this chapter owing to its apparent practicability compared to the option of expropriation in fast growing urban centres where unutilized land is scarce or unavailable and or where central governments are too poor to acquire land for development through the conventional ways of land expropriation. The discussion on LR below focuses on definition, various approaches, processes and procedures.

2.1 LR defined

LR is defined as a way to adapt parcel or property structures and parcel ownership structures to suit the requirements of urbanization (Larsson 1993: 81). This idea is illustrated in figures 2.1-2.4 on pages 8-10. It involves joint land development whereby land is acquired through landowners pooling their adjoining parcels together for their unified planning and subdivision (adapting parcel structures) and later equitably reallocating themselves (adapting ownership structures) newly planned and serviced parcels. In addition it is a self-financing project in which extra parcels are produced during planning and are sold to provide for project expenditure. These processes involved are briefly discussed, with illustration in figure 2.1 on the next page.

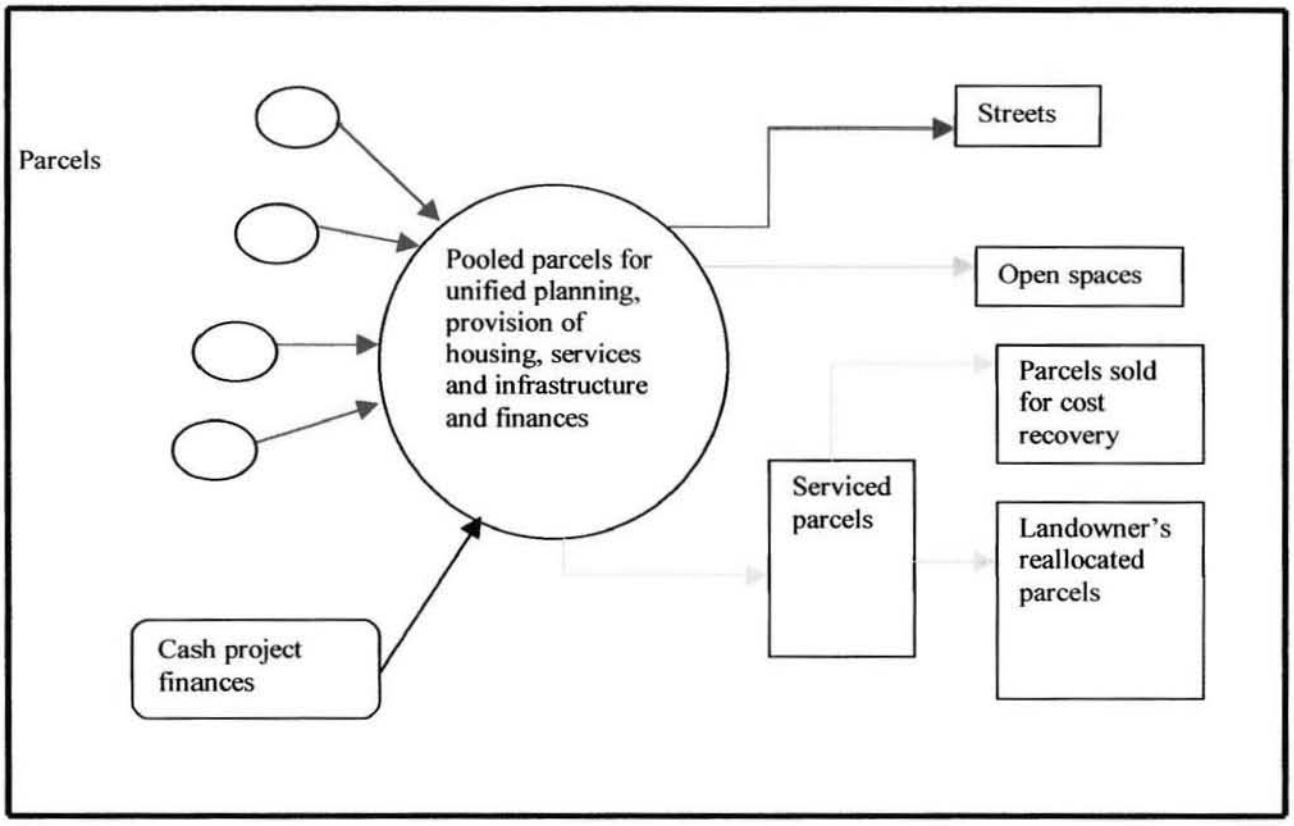


Figure 2.1 Urban land readjustment (adapted from Archer, 1999: 115)

- Land acquisition: Individual land parcels are pooled together forming a large parcel and consolidated either notionally or formally under LR agency.

- Unified planning: Land is subdivided or replotted to provide a well-planned layout of parcels with provision of space for services and infrastructure.

- Equitable reallocation of plots to landowners: The process involves reallocating landowners equitable parcels in a well layout plan, according to the value of land each had pooled in the project. It is notable that land parcels become smaller. Part of the parcel is contributed to social facilities such as roads, play grounds, etc, but the services makes such parcels appreciate value. as illustrated in figure 2.6 and 2.7 on page 11.

- Self-financing: In order to finance the project extra plots are created and sold to prospective landowners. In addition this finance provides a good opportunity for a formal land delivery process in low-cost to governments.

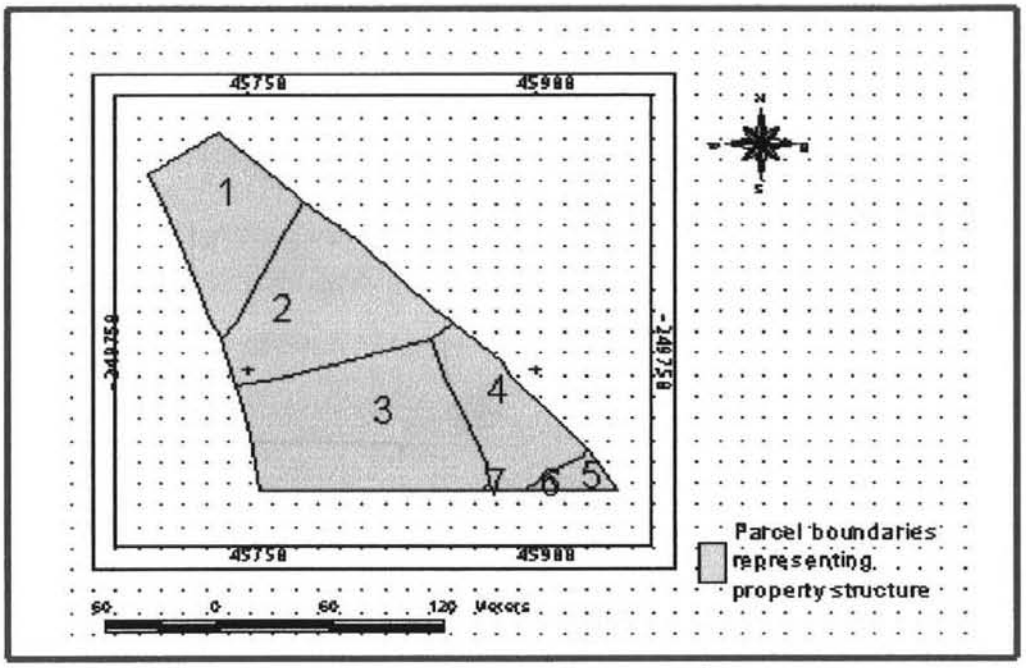


Figure 2.2 Property structures before LR

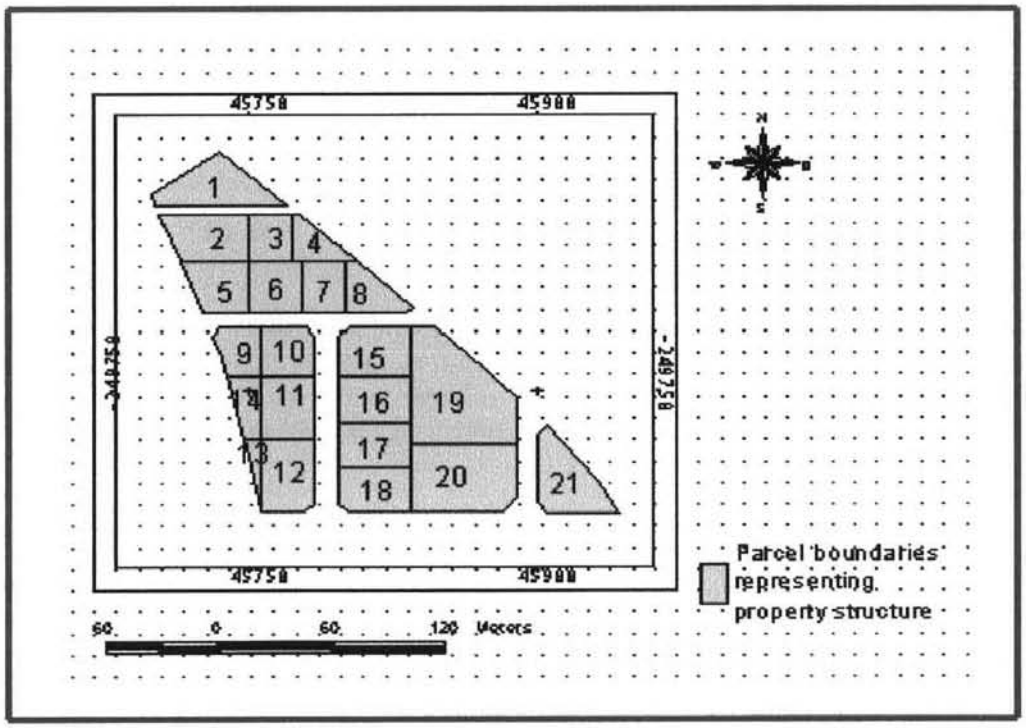


Figure 2.3 Property structures before LR

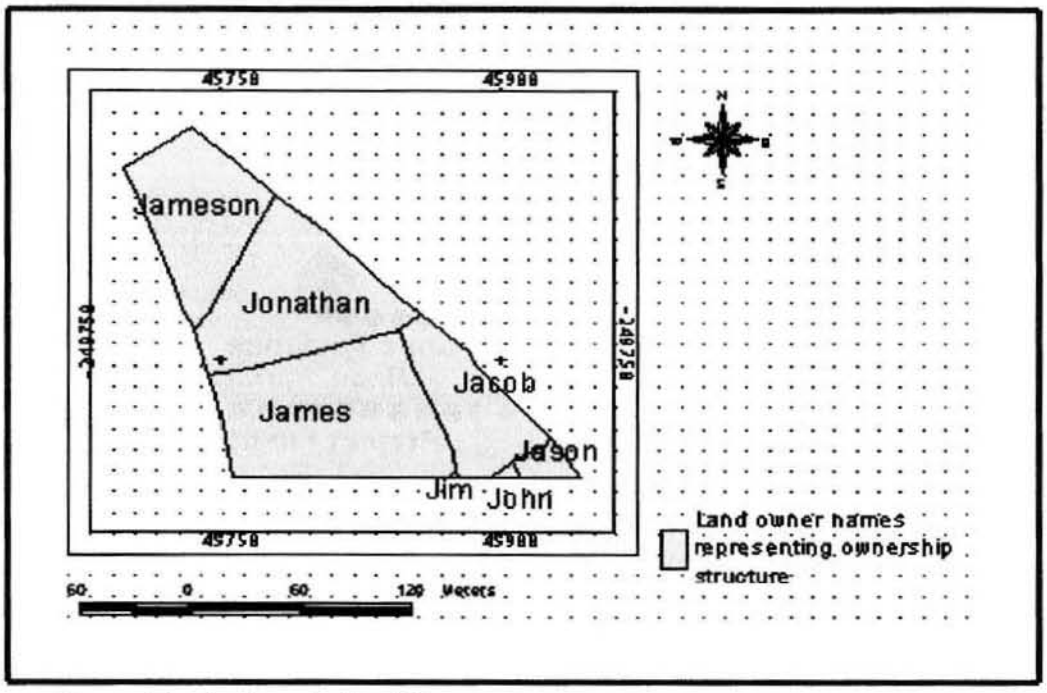


Figure 2.4 Ownership structures before LR

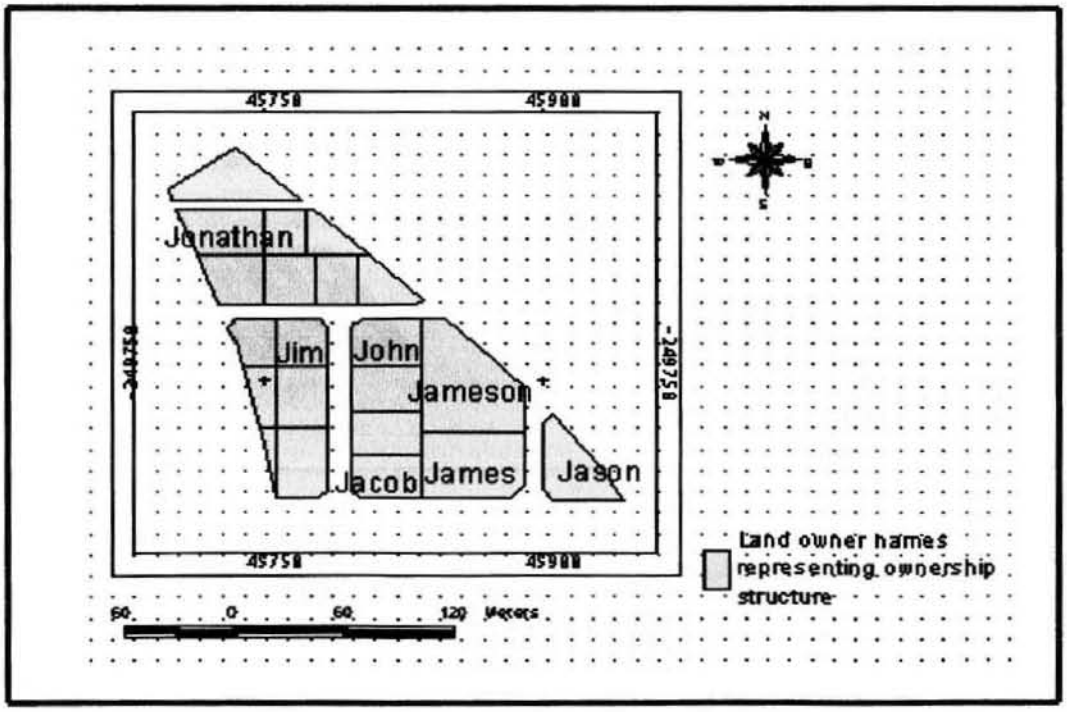


Figure 2.5 Ownership structures after LR

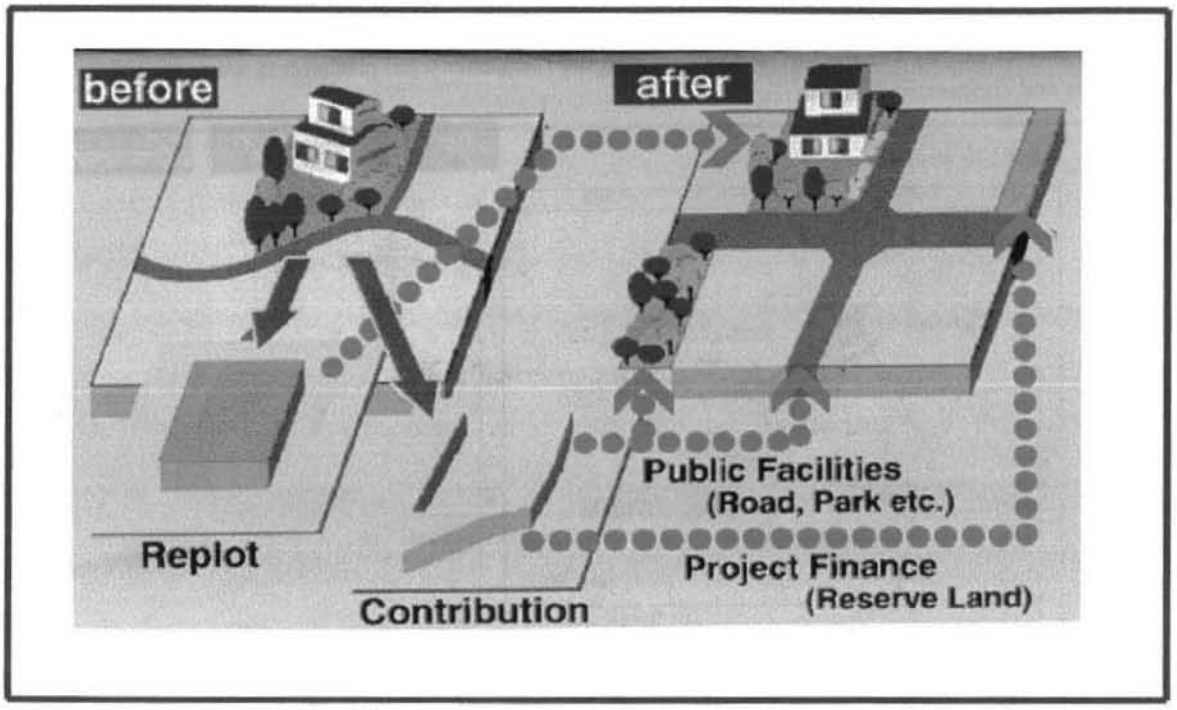


Figure 2.6 Property structure changes in developed areas. Part of parcels are provided for services (Source: www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html: 2001).

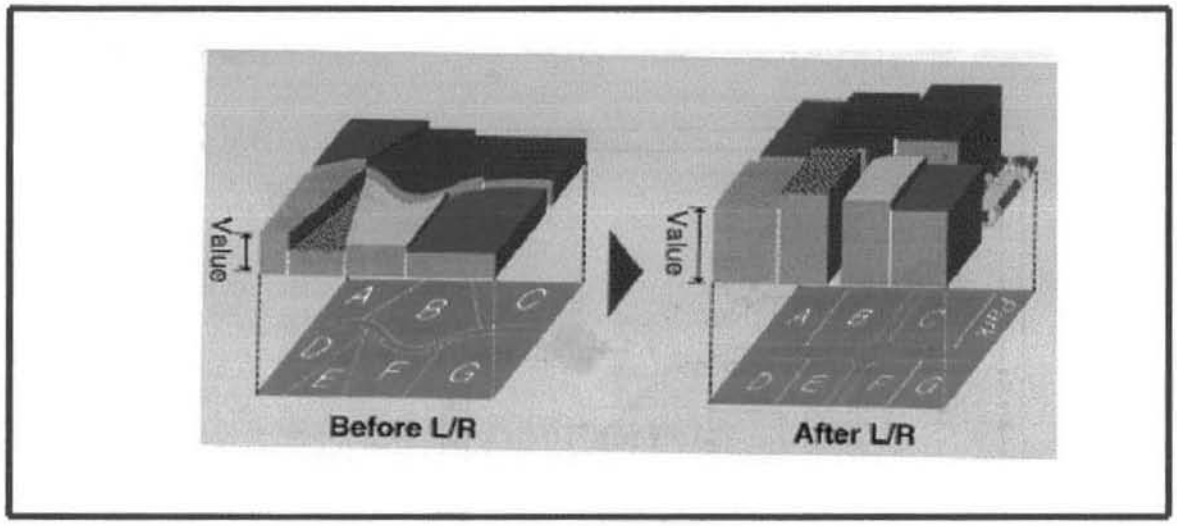


Figure 2.7 Appreciation of parcel value to newly replotted serviced parcels (Source: www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html: 2001).

2.2 *LR approaches*

Land could be re-adjusted to cater for different requirements of urbanization. The LR approaches mentioned below are as categorized by the Japanese 'Kukaku-Seiri' LR methodology and are subjectively used to show that LR could be a technique both to manage formal land delivery and the provision of housing, services and infrastructure in growing urbanizing cities of the world. LR projects could be approached in mainly two ways. These are 'building lot supply', and 'urban infrastructure development' approaches (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html.: 2001) as illustrated in figure 2.8 below.

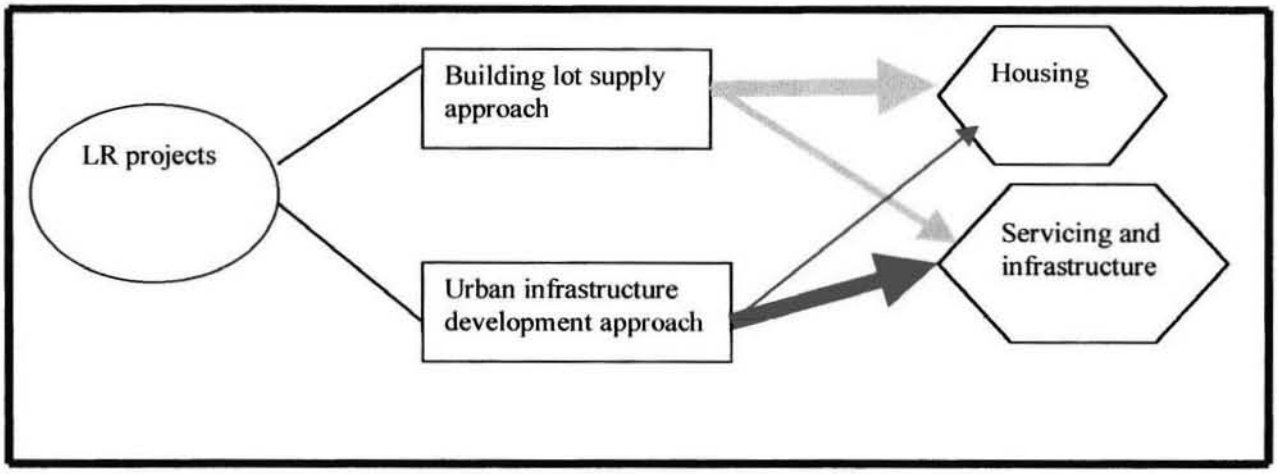


Figure 2.8 LR approaches (thickness of arrow shows the relative focus of objectives of LR approach to provision of housing and servicing and infrastructure)

2.2.1 *Building lot supply approach*

The building lot supply approach is primarily aimed at providing formal land delivery for the purposes of housing that incorporates also, but at a lesser degree, services and infrastructure. Discussing the different types of this approach as 'new town' and 'sprawl prevention' types described below will show this.

a) New town type

The new town type "is implemented in a suburban area massively and quickly in order to meet the brisk demand for housing site, especially resulting from concentration of population and industry in large cities during the period of rapid economic growth. Farmland and forestry areas are developed into building lots" (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html: 2001). Schwarzwalder (2001: 1) showing a Chinese LR as an example discusses a similar approach. In this case it is shown that such LR "involves changes in the landholding of all households within the collective; all farmland is given back to the collective landowner (usually the village) and reallocated among households so that each household receives a plot" Schwarzwalder (2001: 1). This practice is done by the collective leadership periodically (in some cases once a year), redistributing village land to reflect changes in household population size since the previous land allocation (ibid: 1).

b) Sprawl prevention type

This type involves "a comprehensive urban development carried out in the peripheral parts of urbanized areas where spotted developments are emerging and the need for planned development are urgent, in order to prevent disorderly sprawl and create urbanized areas with good environment in advance" (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html.: 2001). In fact the importance of LR in the prevention of urban sprawl is advanced by Schnidman (www.usc.edu/schools/sppd/pracinst/newsletter: 21/02/01) who points out that fragmented land ownership often creating urban sprawl and often lacking services as in most informal settlements, can be upgraded by LR's unified planning.

A practical example is the type of LR that was carried out in the United States of America, as noted by Larsson (1993: 67-68). He shows that for speculation purposes or other investment opportunities, landowners who had been allocated land in California and Florida often left their land undeveloped. The subsequent fragmented selling of parcels resulted in urban sprawl, which was inadequate, and an impediment to development and servicing. Thus, a LR project was proposed for these parcels to provide unified planning of housing and services. This was made possible as the sites allocated fragmentally had to be pooled into one parcel under the LR association, and a new layout plan, servicing and infrastructure were easy to achieve.

2.2.2 Urban infrastructure development approach

This approach to LR is "intended for development of existing built-up areas with inadequate urban infrastructure and for renewal of urban functions" (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html: 2001). Urban renewal, urban centre development and urban reconstruction types discussed below show how the LR projects can be carried out using this urban infrastructure development approach.

a) Urban renewal type

"The urban renewal is carried out in existing built-up areas by development of shopping street, station plazas, etc. with adequate urban infrastructure. As projects are implemented in existing build-up areas, it is necessary to involve complex co-ordination of land titles featuring a much longer project period and larger amount of cost" (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html.: 2001)). This type involves replotting of the existing land parcels in which landowners collectively provide a portion of their land to provide land for services and infrastructure. The whole complexity of titling in LR project will be discussed in LR processes section below.

b) Urban center development type

This type is implemented close or within the urban center. "Under this type of development, the vacant area caused by the relocation of railroad yards or large factories, etc. due to changes in the socio-economic situation is renewed with adequate development of urban infrastructure for the new land use", (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html.: 2001).

c) Urban reconstruction type

"This type of land readjustment has been used for reconstruction of damaged urban areas after wars or natural disasters" (www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html.: 2001). Larsson (1993: 19 and 33) cites the example of Germany and Japan which have used this type as a way of reconstructing damage after the world wars and natural disasters.

In an attempt to repair massive damage in Germany, inflicted during the Second World War, LR involved the community pooling land for unified planning, and the municipality incurring the costs of installing services and infrastructure. Japan used LR comprehensively in 1923 after the great earthquake that devastated large parts of Tokyo and after the Second World War. Unlike Germany where in most cases cost

of service and infrastructure is met by the municipality, in Japan servicing is mostly met by the landowners. A certain proportion of land is deducted from the landowner parcel to provide land for service and infrastructure provision. In addition extra land is deducted from each participating landowner to provide land to be sold so as to raise funds for installation of services and infrastructure (Larsson, 1993: 19 and 33).

2.3 Institutional Framework

The laws and regulations governing land development for various countries primarily guide institutional framework for LR projects. Therefore there is no ideal institutional framework for LR. Generally, Larsson (1993: 81) discusses the following as the main issues to address in relation to institutional framework for LR based on the degree of involvement between private and public participation within the LR processes discussed in the above sections:

- The roles of the private and public sectors in the project: LR has been mentioned as a form of joint land development project, involving either the community alone or the community and developers (either public and/or private). Roles played by private and public sectors in LR processes differ from country to country as regarding legal framework. For example, in countries such as the United States and Japan, the public sector role is passive and is mainly to provide guidelines for housing and installation of facilities. The private sector performs most of the implementation activities. In other countries, such as Sweden, the public sector assumes control of the whole project activities or becomes active compared to the private sector in LR processes.

- Formality of the processes: The formality depends on the extent to which the various processes are entrenched into the country's land legislation. For some countries land development regulations are provided in laws and regulations not necessarily singling out LR. Other countries like Japan have laws promulgated specifically to guide LR processes.

- Obligatory and voluntary degree in project: The degree of coercion to force landowners into the project varies from country to country. It also varies among the LR approaches. For example, on one hand, every household within the project site could be compulsorily forced by regulations to participate. On the other hand, participation could be voluntary and any dissatisfied landowner could opt to be bought out of the project and sell his/her property to the LR agency.

These are but a few of the necessary institutional issues that need to be addressed. More indulgence to these issues will be provided in the discussion of LR processes below.

2.4 LR processes

Processes in LR were briefly discussed in the LR definition section. The procedure should be undertaken in guidance of land administration to ensure that processes are performed formally. Land administration is defined by Nichols (1993: 40), as management of land tenure system. Land tenure systems are organized and established institutional arrangements in society that govern how land and its resources are allocated, used and enjoyed. Thus land administration can be seen as a way to provide formal means of managing land tenure for specific land management objectives as Nichols maintains (1993: 32).

As has been noted before, provision of housing, services and infrastructure are some of the major objectives of LR for urbanization purposes. Therefore the objectives of land administration would be to provide formal and efficient systems to allocate land formally for housing and services, to provide security for private investment in the project and to prevent and resolve any inherent disputes (Nichols, 1993: 41). She further mentions the backbone functions of land administration to achieve these objectives as parcel delimitation, allocation of interests to land, regulation, valuation and taxation, and conveyancing. These functions form part of the major discussion of this section in relation to implementation of LR projects, and stages in which their (functions) related activities in LR are undertaken are given in figure 2.9 below. The figure shows that LR projects exhibits a cyclic behaviour in which there is a possibility for reversion to

earlier stages. For example land taxation shown in figure 2.9 as being effected at the post-process, can be engaged in pre-process to raise funds for the project.

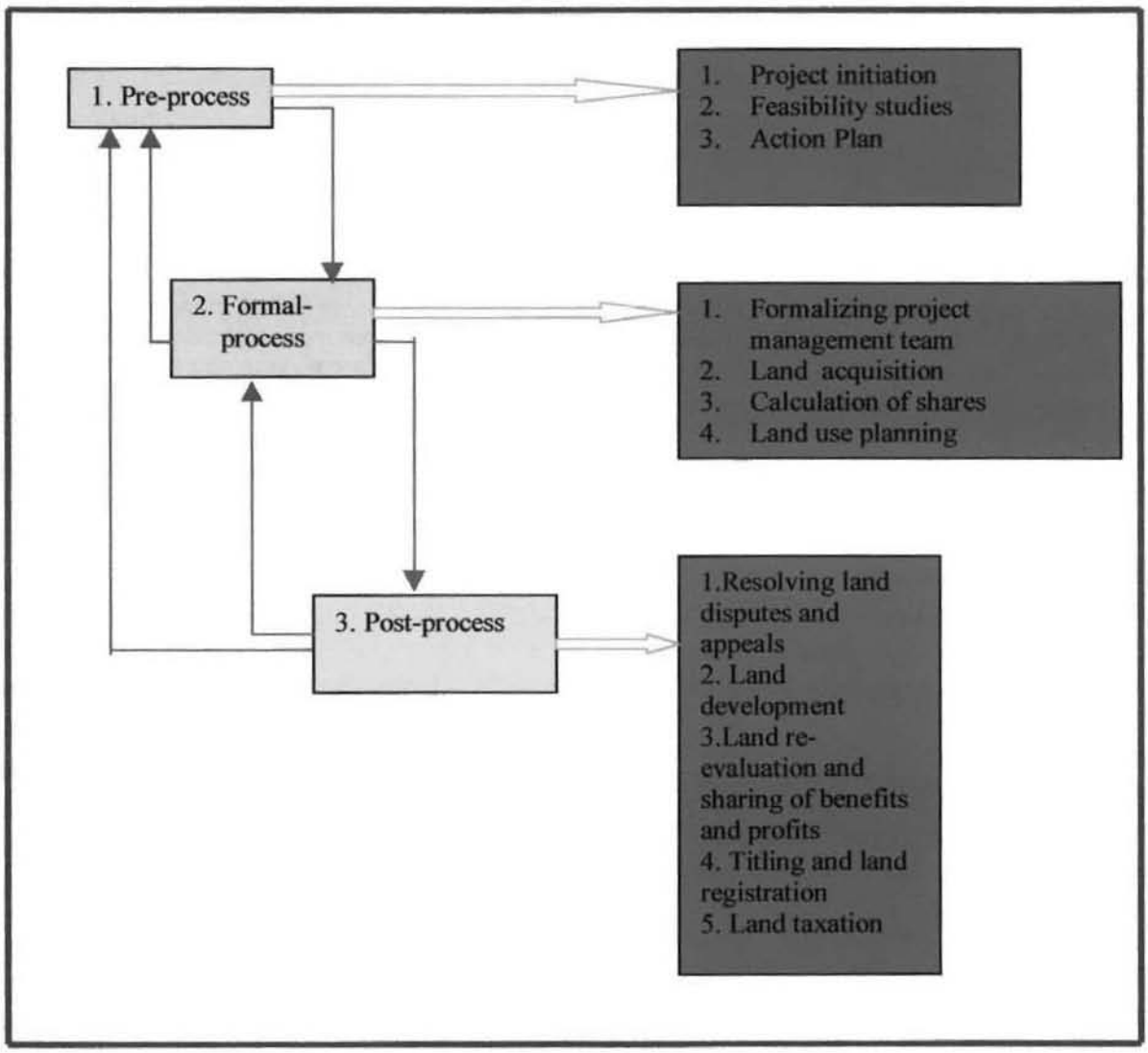


Figure 2.9 The cyclic behaviour of the LR processes. Activities related to land administration functions are noted in every process stage of LR. The cyclic behaviour allow that activities done in post-process can also be undertaken in pre-process. The dividing line is very thin.

2.4.1 Pre-process

" The purpose of pre-process is to move the project, in terms of both knowledge and opinion, from the starting point to the point of decision making, with its demands for knowledge of the consequences of entering the project" Larsson (1993: 90) notes. This process provides initial planning to administer a land tenure system for the project. This involves initiation of the project, defining project objectives and discussion of institutional issues. In addition pre-process provides initial investigations on delineating project boundaries and determining feasibility of the project to ensure that project initiators and implementers (either public or private) investment will be secure.

a) Project initiation

LR projects are initiated either by concerned communities and/or the central-local government's wish to change landownership and property structures to suit the needs of urbanization. Need, suitability, profitability and impulse drive this initiative. Initiation of LR projects by the private sector is driven by the need for and interest in building one's own home, raising the standard of the area by improving infrastructure and is further coupled with profitability of selling building parcels for housing, commercial, industrial development, and others. However, initiation from the public sector would be driven by the need and interest to create commercial, and industrial estates, low-income housing, renewal of the settlements, establishing a new infrastructure, prevention of urban sprawl, etc (Larsson, 1993: 91).

b) Feasibility studies

Feasibility studies are performed to verify the practicability of the initiated project. The purpose is to establish whether a project might be successful before committing substantial funds to it. Therefore feasibility investigations should be limited to a quick assessment of the most important
aspects of the project (Davidson and Payne, 1983: 1). In most cases, for such project objectives as provision for housing and facilities, feasibility studies are limited to issues related to social needs, economic background and such other relevant issues as will be discussed below.

- Social needs: Whether initiation is provided by the private or public sector, the objectives of the LR project must incorporate the social needs of the target community to be affected. These needs have to be investigated and prioritized. Thus it would be irrational to provide housing first to squatter settlement in which water, sanitation and other facilities are the major needs.

- Economic background: One of the distinctive characteristics of LR as opposed to eminent domain and others is that LR is supposed to be a self-financing project. That is, most of the project costs are to be met by the participants. This means drawing up a development plan to meet the needs of the targeted population, and this plan should incorporate their financial background. Practically, housing and services that are proposed should be at the level of the targeted population to meet and to maintain financially; otherwise the formal settlement would quickly regress to informal state. The economic feasibility would also help in deciding suitable methods for subsidization such as loans, or surrendering more land to cover the project costs.

- Physical studies: Physical studies are intended to provide necessary information to delineate the project boundaries, based on the suitability of the ground conditions to proposed physical tasks to be implemented. Thus the following physical studies need to be undertaken:

  i) Location of the site: Suitability of the LR site should be based on the relative position to the urban area of which the settlement to be formed will be part of;

  ii) Land use: Existing land use within the earmarked project area and surroundings should be investigated to establish the suitability of the site to be converted to meet the LR objectives. For example existence of polluting industries, flood plains, uneven topography, etc. would

reduce space for housing. In addition, provision of facilities could be prioritized in relation to what is available or not available in the nearby settlements;

iii) Site area and shape: The size of the project site provides options for planning. Small sites may be suitable for some forms of development while larger sites provide more planning options and will enable the project to cater for more LR objectives. This is also true with the shape of the project site. "In general the more regular the site is the greater will be the chance of achieving an efficient layout" (Davidson and Payne, 1983: 6);

iv) Site boundaries: Decisions on project boundaries depend on the population density for an existing settlement and on land demand for a newly developed township. Thus issues that define project boundaries like densification should take cognizance of the regulations that define settlement population density which is the allowed households per unit area.

v) Public opinion: Development is not imposed but arises from a need. The affected community in the LR project must be given a chance to scrutinize the project. The institutional framework guides the extent to which the community could scrutinize the proposed development. Larsson (1993: 100) quoting Mattsson (1985) shows that the participants have various degrees in connection to participation in planning and decision making, defined by participation right and decision-making power. The degree of participation in decision-making allows the affected community the right to be consulted, and allows for negotiations between landowners and the public sector initiators like the municipality, and limited power to decision-making. The latter entitles the affected community the right to opt out of the working plan, the right of stopping planning work, the setting of a certain percentage of landowner approval for the project to continue and full decision making powers.

- Land tenure system: Davidson and Payne (1983, 7) argue that existing land tenure determines suitability of land acquired for the project. They show that, for example, land acquisition in land held in freehold tenure could be expensive relative to land held in leasehold or customary tenure, etc. Therefore it might be totally impossible to introduce low-income housing LR project in land held at freehold. Thus, land tenure should be one of the factors to be included in feasibility studies.

c) Action plan

When the above investigations have been completed, the pre-process results are to be compiled in the form of an action plan (Larsson, 1993: 96). He further shows that the action plan should at least contain information on the following;

- A description (map included) and delimitation of the project area;
- Aims of the project and reasons for choosing the area;
- Description of present conditions as regards population, land use, streets and facilities, services, land prices, etc;
- A draft plan of future land use for the location of population and communal facilities;
- Land holdings of various categories 'before and after' LR;
- Building structures which will have to be moved or demolished;
- Schedule of activities or time plan;
- Financial calculation (income from subsidies, municipal shares of costs, sale of land, etc. and expenses entailed by the process and facilities);

- A series of maps to illustrate plans and development measures.

2.4.2 Formal process

The formal process includes the phase between the formal authorization of the LR project and the formal conclusion of the project (Larsson, 1993: 103). The formal activities at this stage of LR are to identify the LR project management team, and to formulate the LR framework by deciding on the procedures that will enable achievement of land administration processes that have been discussed in above sections. These two issues are discussed below in terms of land administration requirements.

a) Formalizing the project management team

Normally the aim is for those participating in the LR project to set up some form of LR association having legal status (Larsson, 1993: 103). In terms of land administration this association will provide guidance and hence regulation (mentioned above as one procedure) for the project. The whole project management or LR agency structure could include some of the following;

- The general assembly: The general assembly comprises all the participants in the project. In the case of large assembly, as in Japan the assembly elects an intermediary group to liase with the board described below (Larsson, 1993: 104). This intermediary group can be mandated to make decisions on behalf of the LR participants.

- The LR board: LR board comprises some individuals elected by the general assembly as project managers.

- The executor or agent: This executor or agent, however elected either as member of the board, independent or otherwise should be able to coordinate all the formal procedures that are involved in the LR project.

This project management should ensure that the following land administration procedures are done formally.

b) Land acquisition

Land acquisition for LR projects involves formal pooling of individual parcels, delimitation of the project boundaries based on the feasibility results, and official declaration of the area as the LR site. Delimitation process involves defining the location of the project boundaries, demarcation of project boundaries with appropriate monumentation, and provision of delineation description in terms of text and graphical output. In addition to formalizing project boundaries, the site may need to be formally registered under the LR agency title depending, on the institutional arrangements as mentioned in the institutional framework section. Land acquisition requires addressing the following land tenure issues:

- Amalgamating pooled land parcels needs definition of land tenure status. Archer (1999: 119) shows that there is an important legal difference involving the rights to land during land pooling and amalgamation process. He shows that in situations whereby land rights are transferred statutorily from landowners to the LR agency the process is referred to as land pooling (LP). But for LR, land rights are transferred notionally from the landowners to the agency. However legally different, in practice LP and LR are physically the same, as both constitute evolving of property and landownership structures with subsequent reallocation. The reallocation character is the dividing line between other methods like eminent domain, due to their inherent absence of reallocation. The legal difference depends on the institutional arrangements varying from country to country. In addition to statutory exchange of rights, the whole procedure of land registration should be maintained. This will involve revocation of individual landowner rights to land and registering the LR site with the LR agency. But

where the LR agency has notional rights to LR site, only exchange of title by the landowners from those of the original to those in a well-planned layout could be effected.

- Land acquisition also differs in terms of proportion of the landowner's land being contributed into the project. Mostly the LR objectives determine this. For existing settlement where LR objective is installation of communal services and infrastructure, a percentage of landowner's parcel could be acquired to meet the project objectives. For example to introduce line services in an existing settlement, like water, sewerage or telecommunication networks, etc. only a proportion of the landowner's parcel would be acquired and the replotted parcel would be reallocated to the landowner. In an approach such as large scale rezoning or the building supply approach discussed in the LR approaches above, the whole of landowner's parcel could be acquired.

- After the land acquisition procedure is finalized, the landowner's development activities are restricted unless with consent from the LR agency or the land administration authorities. This is because these activities could disruptively affect project activities (Larsson, 1993: 105) notes. For example, in cases where certain property has to be demolished to pave way for intended developments, speculative landowners may improve their property in order to claim higher compensation. This can have a negative impact on project finances. In addition, it is at this stage that recalcitrant landowners could be bought out of the project with equitable compensation.

c) Calculation of shares

Calculation of shares provides a measure of ensuring the security of investment for every shareholder in a joint development and determining the share of inherent profits. There are different ways in which participants contribute to project costs and share benefits. Shares in LR project could be contributed in form of land, money, services, and other inputs. Again even the benefits could be in terms of land as in reallocation of serviced parcels, which have appreciated value, as illustrated in figure 2.5 on page 7, and further benefits could be in terms of money. In addition this calculation helps to determine the compensation to be issued to recalcitrant landowners (Larsson, 1993: 107).

Usually various methods of valuation are used to calculate shares in terms of the land contribution in a joint venture involving land. The value of land depends on its intrinsic and extrinsic factors. Intrinsic factors include topography, nature of soil, design and condition of immovable property, etc. Extrinsic factors include factors relating to the location of the parcel, like proximity to other land resources, availability of services and type of land tenure (i.e. land held in freehold tenure would have more value than leasehold). Based on these factors, and others, land valuers devise methods in which to determine the value of land. Using these factors land market rates are defined. Land market rate is defined as land value per unit area. Then, depending on the quality of these factors inherent in a parcel, valuers value land as a product of land market rate and area. Methods that can be used to value property for LR purposes include the following, as discussed by Dale and McLaughlin (1988: 51-52):

- Comparative method: This method is based on comparing the price of similar property that has been sold recently. This method provides an adjustment in value if there exists a structural change in the properties compared. For example if one of similar property compared did not have a structure like a garage, the value of the current valued parcel should be adjusted in order to incorporate the value of such a structure. The problem with this method is for the valuation professionals to decide on what could be referred to as recent in relation to the selling price.

- Income method: This method is based on the comparative theory. The method recognizes that "market value of an interest in land is equal to the present value of the net income that should in future come from the land. The net income is the gross income less the cost of overheads, such as depreciation of the building stock and its maintenance and upkeep. It is equivalent to the notional rent and must be discounted at an appropriate rate. The valuer's problem is to determine the net benefits that should come from the land by comparison with similar properties; and then to determine the market discount rate by analyzing recent sales of similar assets" (Dale and McLaughlin, 1988: 51).

- Cost method: This method "assumes that the costs of replacement, less appropriate depreciation, are equal to the value of the land" (Dale and McLaughlin, 1988: 51). As commonly known as the contractor or the quantity surveyor's method, the associated problem of this method is to assemble suitable cost data, including the cost of the site, and to estimate depreciation rates.

- The residual method: "This method is the combination of the three methods listed above. The value of the site is assessed as if it had been developed. The method may be applied either to the land itself or to the improvements upon it" (Dale and McLaughlin, 1988: 51). This method is based on the full benefit potential of the site.

d) Land use planning

Land use planning for LR involves defining formal ways for implementing anticipated land uses based on the feasibility study results. This involves finalizing zoning of the project area according to proposed land uses, and drawing formal land subdivision plans to be implemented on the ground.

Drawing of the land subdivision plan will differ in situations of existing settlement from unoccupied land. On existing settlement, where objectives of LR would be improving settlement planning and installation of services and infrastructure, the land subdivision plan should incorporate the structure of the existing settlement. Spatial land information acquired from feasibility studies should be used to base planning on, in such a way as to avoid excessive property demolition. Undeveloped land provides fewer planning restrictions (Davidson and Payne1983: 26) argue. Moreover, drawing of the subdivision plan should take cognizance of the resulting land values in such a way that landowners should not incur deficit in the project.

2.4.3 Post-Process

"Boundary between formal process and post-process is rather indeterminate, and it varies from one country to another" (Larsson, 1993: 114). The land administration activities involved at this stage include attending to land disputes and appeals by recalcitrant landowners, guiding land development, and reallocation including land registration and sharing of project benefits and land taxation. As mentioned above, these processes could be performed even iteratively between formal-process and post-process stage, depending on the legislation or need. Below is a review of these activities.

a) Resolving land disputes and appeals

At this stage land disputes, cases about discontent landowners with subdivision plan and compensation cases could be entertained by the LR agency. Varying from the institutional arrangements of different countries, either administrative and/or judicial legal machinery could be resorted to. For example, in Japan, most of the appeals are normally administrative, either to the LR agencies or the provincial governors concerned, and finally to the minister responsible. Appeals regarding compensation could, however, constitute civil proceedings. Another example is given for Sweden where on the first attempt the property court hears cases, which is administrative, and further, the appeal court and later the Supreme Court, which are judicial (Larsson, 1993: 115). In addition the LR agency could instigate court proceeding against landowners that fail to adhere to regulations passed in declaring an area a LR site. This may include continuation of development by landowners without necessary permission from the relevant authorities.

b) Land development

Land development involves construction of the proposed housing, services and infrastructure according to the planned objectives of the LR undertaken. Below is a review of the activities that are involved in land development.

- Implementation supervision and finance: All the construction work has to go through proper guidelines as laid down in the formal-process. The project management needs also to oversee that the construction

work adheres to other laws and regulations of town planning and zoning. In addition the LR agency is required to arrange finances for implementation activities and works (Archer, 1999:115);

- Implementation of layout plans: This activity involves the surveying profession demarcating the proposed subdivision plan on the ground, and putting monumentation to mark formally spaces for housing, services and infrastructure.

- Housing: The project management is to ensure that housing is effective as one of the important objectives of LR. Davidson and Payne (1983: 76) mention the three types of management approaches that could be introduced for housing projects. These are owner-managed, assistance-to-owner and agency buildings and these are discussed below.

  i) Owner-managed building: This is owner-build housing whereby the LR agency is supposed to assist with the availability of low-cost building lots, plans and building material for the low-income LR participants.

  ii) Assistance to owner-managed building: This is a housing scheme that facilitates landowners with finance, technical assistance, etc. to accomplish housing. The financial background studies performed in pre-process are important for the LR agency to plan for this building management in time.

  iii) Agency-managed building: The agency itself, if in possession of enough funding, could also be able to improve or construct houses. Detailed housing plans are necessary in the new settlement formation, while on the already developed land, only improvements may be necessary (Davidson and Payne, 1983: 77).

  iv) Installation of services and infrastructure: Institutional arrangements provide guidelines as to which party between the private and public sector is to accomplish installation of services and infrastructure. In countries like "Germany and Western Australia the local authority, as the prime mover, is responsible for the construction work" (Larsson 1993: 116). In some countries like Japan, local authorities and the participants often share the costs, and sometimes when necessary with extra help from the government subsidies (Larsson, 1993: 116).

Services are often classified into point and line services. Point services are those which are accessed in one location and include health facilities, educational centres, etc. Line services are those that are provided in terms of networks like roads, telecommunication lines, piped water, etc. Thus a whole range of these services could be installed according to the specifications drawn in the LR objectives.

c) Land re-evaluation, reallocation and sharing of project benefits and profits

Depending on the objectives of the executed LR there must be benefits accruing from the project. The following are ways in which benefits and/or profits could be enjoyed by the shareholders in the project:

- Equitable land reallocation: In cases where the LR's objective is to provide housing and services the landowners will enjoy the benefit of being reallocated sites that have gained value by the introduction of services and infrastructure. Determination of new parcel values need re-evaluation of land parcels, using one of the methods discussed above. Determination of the profit in reallocation does become a complicated procedure. Larsson (1993: 122) notes that the profit accruing from a reallocated parcel can be determined by the market value of the parcel after LR, minus the value before LR, minus the costs of measures taken.

- Selling extra building lots created during land subdivision: All the shareholders who had contributed property or money in the project for service installations are liable to cost recovery through selling extra parcels created during the drawing up of the subdivision plan. Proceeds from such selling could be shared equitably by the shareholders on the basis of contributed shares. For example, in a country

like Germany where costs of services and infrastructure are met by the municipality, the municipality claims most of the profits accruing from the project (Larsson, 1993: 123).

- Shareholdership in commercial property in LR: In LR projects in which the aim is to construct commercial property, like the urban renewal type, shareholders in the project must enjoy shareholder status in any communal development introduced. It is maintained by the www.calvertinstitute.org, (2001) that participants who contributed to the project should gain *pro-rata* shares as owner-in-common to the commercial property. The amount of shares each participant contributed will form the basis of profit sharing in such commercial property.

d) Titling and land registration

Land registration forms part of a formal land delivery process. New land parcels either being reallocated or allocated to new prospective landowners need to be registered. Different institutional arrangements for land administration allow various ways of registering land. In cases of LR, as mentioned in the land acquisition section above, reallocation of rights involves exchange of land titles from those of the old parcels to those of the new parcels. The following are forms of land registration possible in LR projects:

- Private conveyancing: In situations where land was pooled and amalgamated under LR agency, reallocation and new allocations could be done privately between the LR agency and the allottee. However most institutional arrangements require that a notary be present to witness the transfer of land tenure interests and record the dealings (i.e. a deed) which become proof of landownership in courts of law.

- Deeds registration: In terms of deeds registration all the documents or records of private dealings (for example the private conveyancing documents discussed above) regarding land transfer in LR must be deposited with the public deed registration authorities, in most cases known as the Registrar of Deeds.

- Title registration: Title registration allows the allottee to be associated with a parcel as proof of ownership of a parcel. The public land registration authorities do title registration. This can be engaged in centralized or local land records system. In cases where parcels had been pooled 'notionally' with title to LR agency, the process of title transfer may do reallocation and new allocations from the LR agency to the allottee. However in the case of land pooling approach where land rights are revoked substitute rights may be applied for.

e) Land taxation

Land tax is revenue that governments collect firstly out of the improvements and uses to which land is put, and secondly, out of the value of the parcel itself, as determined either from its improved or unimproved state. These types of taxes are property tax and land value tax respectively (Dale and McLaughlin, 1988:48) note. The objective of taxation in the LR is first to raise money for the project expenditure and secondly for maintenance of the introduced services and infrastructure. Services like those managed by the municipality need such revenue from taxation to run.

2.5 Concluding remarks

In this chapter LR is discussed as a land management technique that can be used to provide formal land delivery for urbanizing cities. To achieve formal land delivery, LR is shown to provide a chance for efficient planning for formal housing, service and infrastructure with minimum expenditure for both the authorities and the communities. This is because planning is done in holistic settlement, disregarding the existing parcel boundaries, extra parcels are made available for sale to meet project finances, and further land tax can be pursued for finance.

The process of LR was shown to involve adjusting property and ownership structures of parcels. Adjusting property structure is characterized by landowners pooling land together and entails dissolving the individual parcel boundaries, followed by planning and formation of a new large parcel. Adjusting ownership structure involves transferring land rights of individuals formally or notionally to the LR agency for joint planning and servicing purposes and further reallocating new rights to new planned parcels. It was also shown that a part of land could be incorporated if the LR project involves introduction of developments such as line services for settlement upgrade.

Further, approaches to LR were discussed and the Kukaku-Seiri, a Japanese LR methodology, was used for illustration. This methodology categorizes LR into two main approaches being 'building lot supply type' and 'urban infrastructure development'. The distinctive factor between these two was shown to be that 'building lot supply' concentrates more on land delivery for housing and 'urban infrastructure development' focuses more on development of services and infrastructure.

Moreover, mention was made that in order for LR to be engaged formally, land administration was an important consideration. Important land administration issues covered included project initiation, feasibility studies, project management structure, land acquisition, land use, appeals, calculation of shares and profits, titling and land registration and land taxation. These issues were discussed in the time framework in which they occur, being pre-process, formal-process and post-process. It was shown that how these activities are undertaken in the LR project depends on the institutional arrangements, which differ from country to country. In some countries like Japan, specific laws were shown to exist that govern LR activities like the Kukaku-Seiri methodology which is an entrenched LR principle. In other countries, common land legislation is extended to include LR. In addition it was shown that legislation further governs how the community, the public and the private sector take part in the project. In terms of the community the participation right and decision making power towards planning and decision making were mentioned. In terms of private versus public indulgence into the project, it was mentioned of active and passive involvement. Active participants who incurred most of the project expenditure were shown to enjoy equitable benefits and profits on a par with stakes contributed. Overall benefits in the project were shown to be: the public sector enjoys the benefit of formal land delivery; the community enjoys a well-planned settlement with parcels of appreciating values; and the main developers (whether community, private or public sectors) enjoy the proceeds from selling extra plots in the project area.

Chapter 3

Information requirements for LR projects

3.0 Introduction

In the previous chapter, LR was scrutinized to explore its capability as a land management technique. It was shown that to achieve the objectives of LR formally, land administration functions need proper planning, decision-making and control to ensure that regulations are adhered to. Therefore, to accomplish proper planning, decision-making and control for these land administration functions, there is need to use information. This argument is reinforced by Nichols (1993: 26), who states that information is the foundation for making, implementing, and enforcing land management decisions. Those involved in the management process, from public policy makers to private developers, require land information about the potential environmental and economic impacts of land-related activities. They also require information about land tenure because the implementation of plans and policies ultimately rests in rights to use, control and benefit from the land and its resources (Nichols, 1993: 26).

Being in possession of land information is however not an end in itself. Good land information management increases the potential for planning, decision-making and control activities. This chapter attempts to illustrate land information requirements to accomplish land administration functions. In addition, the land information management system will be discussed as a way to manage land information for LR.

3.1 Land information required for LR

It is important to understand that land and information are central to land information requirements for LR.

- Land: It is defined in legal terms by Dale and McLaughlin (1988: 3) as "a volume of space stretching notionally from the centre of the earth to the infinite in the sky, and associated with it are a variety of rights which determine what may be done with it". This idea is represented by figure 3.1 provided on the next page.

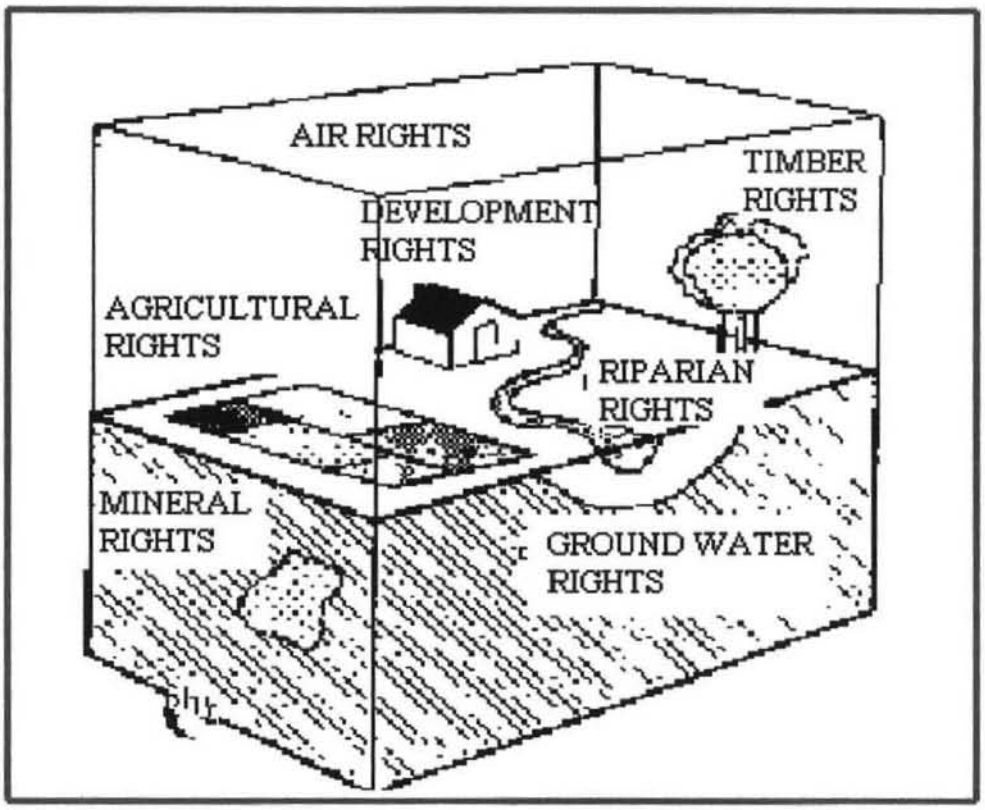


Figure 3.1 Legal definition of land (adapted from Dale and McLaughlin, 1988)

Larsson (1991: 15) defines a parcel, usually used interchangeably with land, as a continuous tract of land within which unique tenure interest are recognized. Thus in this research, these two terms will be used interchangeably with similar meaning. Land is defined subjectively however, by other professionals dealing with land, for example, in an economist's view, land is a resource together with labour and capital, as means to provide economic development (Dale and McLaughlin, 1988: 3).

- Information: Information are facts assembled to answer a specific question arising in a context of problem solving in connection with managerial and/or decision making activities (Chilufya, 1997: 7). The difference between data and information must be recognized, because these words are sometimes used interchangeably. The United Nations Economic Commission for Africa, UNECA, (1998) notes that what is information to one person might be data to another. To differentiate between the two, Dale and McLaughlin (1988: 8) maintain that data are collections of raw facts and in order to become information, raw facts must be processed to a state where they can readily be utilized by planners and decision-makers. Thus, information can be regarded as data ready for utilization in planning and decision-making process.

From these descriptions of land and information, land information requirements could be defined as a collection of raw facts about land, processed and assembled in a way required to answer a specific question arising in the context of problem solving in connection with planning, managerial and/or decision making activities. Nichols (1993: 26) mentions the following information sets as a requirement to provide solutions regarding planning and decision-making for land administration functions.

- Land tenure information is required to answer questions about parcel delimitation and allocation of interest in a parcel.

- Land value information answers those questions related to determining value of land and taxation.

- Land use information solves problems relating to planning and regulating land use, while land regulation information is concerned about authentication of all collected and processed information.

- Land regulation information is collected (e.g. existing land use in a parcel, etc.) and disseminated (e.g. subpoena, court orders etc.) to ensure that land developments are done in adherence to land regulations, and policies and parties violating regulations are notified respectively. These will be adopted as the relevant information sets for LR and are further reviewed below.

3.1.1 Land tenure information

Land tenure information comprises records relating to interests in land, ownership of interests and the status of a land parcel, which require formal recording and updating during land transfer (land acquisition and allocation) in LR. This recording is necessary because ownership and parcel status usually change during LR, as mentioned in the last chapter. To adhere to land regulations relating to land transfer, such changes require registration. The process entails an application to the responsible authority or organization that further undertakes an adjudication process to ascertain formal ownership and ensure that no other interests or restrictions in that parcel are violated by such a transfer. Summarizing from Nichols (1993: 235-239), the land transfer process, including adjudication for LR, would require land information to identify a parcel to be transferred and to verify its status. These factors are briefly discussed below:

a) Identify a parcel to be transferred

The process involves formal identification of land parcels to be transferred. This requires knowledge of the parcel's spatial location, defined by delimited parcel boundaries and unique parcel identifier on the ground and on a spatial reference frame.

- Parcel's spatial location: This is defined by delimitation of fixed or general boundaries and determining boundary coordinates on a spatial reference frame. Boundary delimitation entails definition, dermacation and delineation. Boundary definitions describe the locus of the boundary in terms of size and extent of dimensions. Demarcation is a process of placing monumentation or adopting any existing physical features marking boundaries between adjacent parcels on ground. Delineation provides description of parcel boundary location (e.g. with coordinates on a spatial reference frame) either in text or graphical form (Nichols, 1993: 62). A typical fixed boundary cadastral plan delineated is shown on figure 3.2 below. Dale and McLaughlin, (1988: 29), however posit that the monumentation on the ground takes precedence over the textual records.

  Fixed boundaries provide a precise line dividing adjacent parcels. Fixed boundaries are classified into three groups according to Barry (1999: 70), quoting Dale (1976: 35). These are:

  i) "those defined (beaconed) on the ground prior to development;

  ii) those in which the boundary is adjudicated after development and;

  iii) those which are defined by surveys to specified standards" .

  A general boundary is described by a fuzzy line, which can only be adjudicated on the ground. Boundaries are identified on the map and verified on the ground. Barry (1999: 70) quoting Dale (1976: 35) defines general boundaries into three categories as:

  i) those where ownership of the boundary feature is not established and the boundary lies

perhaps down either side of the boundary feature or perhaps the middle;

ii) those where the boundary is an indeterminate edge of a natural feature, such as seasonal marsh;

iii) those where the position of any boundary is regarded as approximate so that the register may be kept free from boundary dispute. The monument, such as a hedge, is paramount evidence and if law allows it, the de-jure boundary can be defined sufficiently flexible to coincide with the de facto position of the monument.

The spatial location of a parcel is defined graphically by a cadastral plan, which is a result of delineating the parcel's demarcated boundaries. This delineation is based on the coordinates on a reference frame as a result of fixed boundary surveys or based on the back coverage of, for example an orthophotograph, which clearly identifies parcel boundaries. A cadastral plan can then be used to update a cadastre, which is a geo-referenced record of parcels in a jurisdiction. An example is given below in figures 3.2 and 3.3 showing how the graphical component of the cadastre is updated to incorporate a fixed cadastral plan of subdivided parcel.

Unique parcel identifier: This is a parcel reference (e.g. in numeric or alpha numeric, etc) given to each parcel for unique identification. Nichols (1993: 65) argues that there should be standard parcel identification (PID) for all organizations referencing information about tenure interests or identifiers that can easily be related to one another. This information is provided on title documents and cadastral plan of a parcel. In both figures 3.2 and 3.3 the numbers in the parcel provide a unique PID for the parcels.

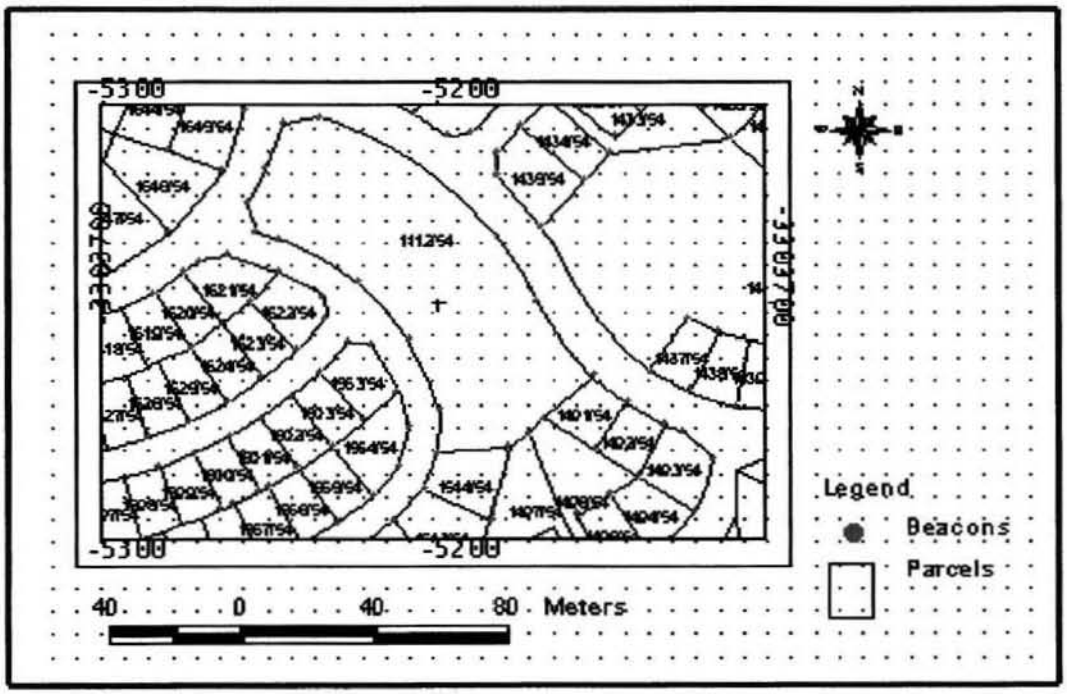


Figure 3.2 An extract from a graphical component of cadastre before being updated to include cadastral plans for a subdivided parcel number 1112/54

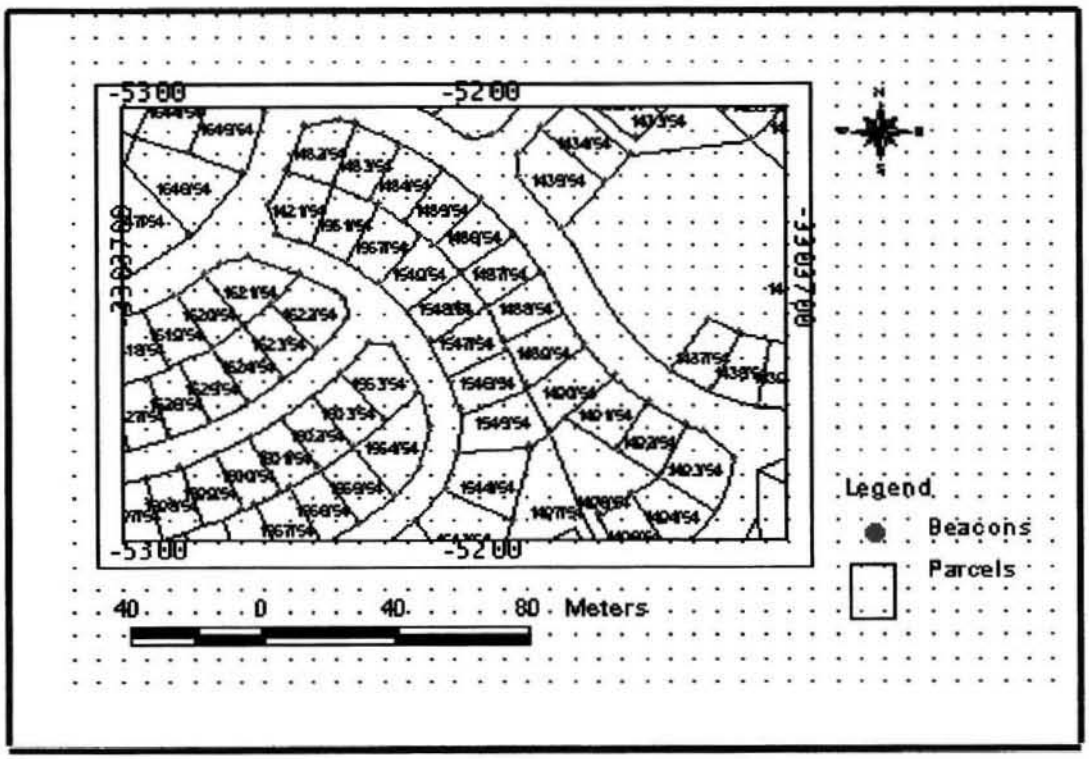


Figure 3.3 Updated graphical component of cadastre to include parcels depicting subdivisions of parcel number 1112/54

b) Verify parcel status

Verification of parcel status involves investigating the rights, ownership of rights and interests and any restrictions inherent in a parcel. In addition the process incorporates verification of the parcel location relative to other adjacent parcels and any existing servitude.

- Verification of interests, ownership of interests, and any other interests and restrictions: This ensures that changes in ownership structures are done formally. The process involves investigation on the nature and ownership of interests in a parcel so that the party transferring these interests does not violate any land regulations regarding disposal of land rights (e.g. leases, easements, etc.), responsibilities (e.g. environmental issues, etc.) and restrictions (e.g. land use restrictions, etc). Title records (e.g. land registers and title documents, etc.) are information requirements as they contain parcel records relating to the nature of registered interests and their ownership.

- Verification of the parcel boundaries and dimensions: This entails checking that a transferred parcel still maintains its original registered boundaries and dimensions. A re-survey of both the parcel to be transferred and adjoining parcels, or checking of fixed ground monumentation is necessary. This provides verification that the registered boundaries have not been tampered with resulting in changes in parcel dimensions and encroachments. In case of re-survey, both the original cadastral plan and the one produced after re-survey should check for correspondence. Any changes identified, either emanating from tampering with monumentation or improvement of accuracy of survey methods, must be attended to accordingly and if necessary the cadastre be updated.

3.1.2 Land valuation information

Land value information plays an important role in determining the participant's pooling shares, which must be equitable to the benefits to be enjoyed. In addition, land and property values are used for land and property taxation purposes, to derive project funding and government revenue. Valuation of land and property, according to Nichols (1993, 240-243) requires land information to:

- identify parcel and immovable property to be valued: this is done as mentioned under section 3.1.1 a) above. Furthermore, any immovable and registrable property in the identified parcel should be identified; and

- determine information needed for valuation: What information is pertinent depends on the method of valuation to be used. Land value regulations need to be checked to identify formal methods of land valuation. Then pertinent information required for valuation can be collected. For example, if land market rates are derived from the land valuation methods mentioned in chapter 2 and as stated in the land value regulations, land market rates can be multiplied by the area of a parcels identified from the cadastral plans and land values will then be determined. In case of 'income method' for land transfer in agricultural fields, pertinent information will lead to investigation of the yield of the fields.

3.1.3 Land use information.

Land use information is required to determine the physical and legal factors that can impede conversion of the parcel use to uses proposed for LR. Information about current physical land use (including land developments and natural physical features) is required to determine the ground suitability, possible environmental hazards to be met by the LR objectives, and environmental impacts that could be brought about by the activities of the project. In addition formal land use rights, interests and restrictions are investigated to determine any legal impedance to convert parcel use to the proposed uses to meet LR objectives. Nichols (1993: 245-250) mentions the following significance of land use information and types of information required:

- Investigation of land use rights: Land use rights are either endorsed specifically on the title records (including land registers and title documents), on land development specifications documents

(including building permits etc.) or provided in terms of the zoning regulations of an area. Zoning is arranging or partitioning a city, township etc. into zones of different land uses in recognition of likely impacts one land use can have on the other (Merrian-Webster's Collegiate Dictionary, www.yourdictionary.com : 2001).

- Determining existing land use: This involves identifying all existing natural physical features and developments on the ground that are of concern to proposed land uses to meet the objectives of LR. For example, residential use within the project area can impede planning and development objectives to the extent that houses may need to be demolished. A detailed land use plan of the project area is a requirement for the analysis of any physical features or developments on the ground that could be of impedance to planning and land development.

3.1.4 Land regulation information

All the activities in the project area must be regulated to ensure that all the policies, regulations and land tenure rights are adhered to. Therefore all the collected and processed information needs to be presented to land administrators for authentication. (Nichols, 1993: 74 -75) stipulates that the process of authentication requires information about:

- Interpreting regulations and policies: Land administrators are to interpret implications of collected and processed land information in relation to land regulations and policies. They are then to provide guidelines on how to deal with irregularities found in data and information analysis. For example, if the adjudication process identifies disputes in land ownership, land administrators must provide ways to resolve them. Thus this would require them to be in possession of land regulations and/ or land registers to verify parcel ownership.

- Examination of collected and processed information: Collected and processed information should be examined to check against irregularities such as boundary encroachments, etc.

- Notification and enforcing regulations: In cases where a party will be affected by proposed land development or has violated land regulations and policies a notification letter or subpoena should be sent to this party by the land administrators.

3.1.5 Section Summary

Land information is required to assist and regulate land administration functions associated with the LR project. In order to identify the required information a clear understanding of the activities and land regulations need to be known.

Land tenure, land valuation, land regulation and land use information are identified as major land information sets for planning, decision-making and control required in undertaking land administration functions in LR activities. Associated with these information sets are data sets that provide specific land information. A summary of the processes, activities, data sources and land information required is given in Table 3.1 below.

Table 3.1 A summary of the land information requirements for the LR as identified from the above text.

Processes	***Activities***	***Data sources***	***Land Information required***
1. Identification of parcel to be transferred	1.Parcel's spatial location 2.Parcel identifier	1.Survey diagram 2.Title documents	1.Boundary monuments and coordinates 2. PID
2.Verification of parcel status	1.Identification of tenure interests 2.Verification of parcel boundaries and dimensions	1.Title documents 2.Cadastral plans	1.Owner 2.User rights 3.Any other interests and restrictions 4.Monumentation description and coordinates
3.Valuation of land and property	1.Determining method of valuation 2.Identifying pertinent valuation data to be used	1.Valuation regulations	1.Valuation method 2.Description of data required for valuation
4.Conversion of land use to meet LR objectives	1.Investigating land use rights 2.Determining environmental impacts	1.Title documents 2.Zoning plans 3.Land use and zoning regulations 4.Land development regulations 5.Land use plans	1.Endorsed land use rights and restrictions 2.Delimited land uses in an area 3.Land zoning specifications 4.Land development specifications 5.Natural physical features and land developments
5.Regulation	1.Interpreting land regulations and policies 2.Examination 3.Notification and enforcement	1.Examined and verified land information required 2.Land tenure, land valuation and land use regulations	1.Authenticated land information required

3.2 Management of LR land information

Land information is shown above as an integral resource in undertaking land administration functions and therefore needs to be managed like any other resource. The importance of managing land information is to maximize its potential benefits (Dale and McLaughlin, (1988: 15). Nichols (1993: 126) describes land information management as concerned with the development and implementation of strategies regarding efficient methods of information collection, processing, storage, dissemination and use.

Land information management systems (LIMS) are employed today to manage land information. UNECA (1998) describes LIMS as an entity consisting of "a number of broad dimensions, such as firstly, a technological dimension (e.g. hardware and software). Secondly, it consists of a set of organizing procedures, which structure the relationship among the functional components and thirdly, an institutional element, which includes a corporate structure. Fourthly, it includes a platform or resource-base, on which data are stored and from which meaningful land information can be produced, analyzed and disseminated. Finally, it includes (explicit or implicit) policy towards users, transparency, information dissemination etc., which are often reflective of the state of the country's land policy, or lack of land policy". Land information system (LIS) is an example of LIMS that can be used to manage land information.

3.3 Land information system

LIS can be developed and used strategically to manage land information for LR projects. Before explaining how this is achieved, there is a need to understand what a system is.

A system is an inter-related set of components defined in an identifiable boundary and working together for a specified purpose (Hoffer *et al.*. (1998: 41). Nichols (1993: 40) further shows that a system has an organized set of components and relationships to meet objectives either internal to the system or defined by the external system environment.

From the above description of a system the following characteristics can be listed:

- They are composed of components (i.e. parts, elements, relationships etc.);
- The components work together for a common purpose;
- Systems have defined boundaries, and their components interact between themselves or with components of the external system;
- Interaction whether within the system or with external system is guided by defined procedures.

An integrated definition of land information system can be derived from the definition of land information provided in section 3.1 above and the discussion of a system above. Thus, LIS can be defined as a set of inter-related components in a determinate boundary, working in interaction between themselves and/or with external environment in guidance of procedures to manage land information. Larsson (1991: 2) defines LIS as a tool for legal, administrative, economic decision-making; and an aid for planning and development. LIS consists, on the one hand, of a database containing spatially referenced land-related data for a defined area, and on the other hand, of procedures and techniques for the systematic collection, updating, processing and distribution of the data.

The focus of the sections below will be on firstly, description of the components including procedures in LIS and how procedures are used to guide interaction of components within systems boundaries and/or the external environment in managing land information for LR projects. Secondly, the types of LIS that can be used to manage land tenure, land value and land use information for LR projects will be analysed.

3.3.1 Components in LIS

According to Chilufya (2000: 1) LIS consists of human, and a set of organizing procedures. Resources may be technical, financial, etc.

- Human resources: Human resources in LIS consist of " a variety of people said to have a hand in LIS establishment and usage and they include policy makers, managers, and operators (Chilufya, 2000: 2);

- Technical resources: Chilufya (2000: 2-4) states that technical resources in LIS include hardware, software and data required in running an LIS:

  i) Hardware in LIS: This includes computer platforms based on centralized or distributed processing, peripheral devices including auxiliary storage devices, and input and output devices, communication hardware devices that facilitate spatial data sharing and integration;

  ii) Software in LIS: Software used in LIS include firstly, a core package module which incorporates a variety of functionalities including; graphic processing, database management, basic cartographic etc. Secondly, geographic analysis utilities, and specialized application software which are "special programs often considered separate from the core package, but can be smoothly integrated with the core package"-"and are usually designed to fulfil a specific purpose" (Chilufya, 2000: 2);

  iii) Data in LIS: This defines its spatial aspect. Spatial data comprises locational and attribute data. Locational data, also referred to as geometrical, graphical or spatial, defines spatial data in terms of its location on a reference frame. It is usually presented in terms of either geographic (latitude and longitude) or in Cartesian (x, y) coordinates and is represented by a point, line or area. Attribute data describes the spatial aspect of the data and comprises locational and relate attributes. Locational attributes describe presentation of the spatial aspect of data (e.g. a road stretch) in terms of colour, line type line thickness, etc. Relate attributes describe the features (e.g. road width, road type, and any other related properties of the feature.

3.3.2 Procedures in LIS

Procedures in LIS are activities related to methods of acquisition, modelling, storage, retrieval, manipulation, analysis and presentation of spatial data.

a) Data acquisition

Data acquisition is a process of obtaining data in a form that can be used in LIS. This requires hardware for capturing external data into the database, and software for converting data to a structure compatible with the model of the database. Data for capture into LIS may be of two types; primary and secondary data. Primary data is captured directly from a sensor into the computer e.g. use of satellite imagery, global positioning system (GPS) or Total Station, etc. Secondary data exist in some format which requires conversion into a format recognizable to the LIS software e.g. by digitizing already existing maps.

As one of the objectives of LIM mentioned above, data in LIS must be of acceptable quality. According to Chilufya (2000: 5-6), the major parameters to check the integrity of data in LIS include:

- Accuracy: This is closeness of the estimate/measurement to the actual/true value or the difference between a recorded value (measurement/observation) and its true value in positional and attribute data;

- Lineage: This provides the data identity by defining its source, method of derivation, scale, spatial reference frame, etc.;

- Logical consistency: This refers to the permissible values or conditions of details such as intersection

at nodes, no duplicate lines, no over or under shoots and closure of polygons, etc.;

- Completeness: This is a measure of the existence of all spatial and attribute data in the database and may be expressed in percentage of all the necessary data required to be entered;
- Timeliness: This addresses the up-to-dateness of the features and their respective attributes stored in the database;
- Appropriateness: This establishes the relevance of the data stored in database with respect the required applications;

b) Data modelling.

Data modelling in LIS involves representation of real life phenomena in a database. Different models are used for representation of spatial (locational) and non-spatial data.

- Spatial data models: Representations of spatial (locational) data e.g. cadastral plans etc. may be of form vector or raster. Chilufya (2000: 6-9) elaborates further on spatial data models as thus;

  i) Vector data model: It is a spatial data model represented by three main graphic objects; point, line and area. Vector data model may be topological or spaghetti vector data models. The topological vector model makes use of nodes and links to establish relationships between spatial objects at intersections and ensures that geometric properties remain unchanged even during distortion. The spaghetti vector model consists of strings of coordinates with each string merely representing a coded or classified feature without connectivity between features at intersection;

  ii) Raster data model: The model represents spatial data using an array of regular cells, which are pixels and grid cells. A raster data model may be simple raster or hierarchical raster data models.

- Non-spatial data models: Non-spatial data can be represented in hierarchical, network, relational or object orientated data models (Hoffer *et al.*, (1999: 668).

  i) Hierarchical database model: This model exhibits files in the database being arranged in a top-down structure that resembles a tree or genealogy chart;

  ii) Network database model: In this model files in the database may be associated with an arbitrary number of files;

  iii) Object-orientated database model: Files in the database are represented by attributes and methods that operate on those attributes and these are encapsulated in structures called object classes;

  iv) Relational database model: Stored data is based on two-dimensional tables where multiple relationships between data elements can be defined and established in an ad-hoc manner, as according to Antenucci *et al.*, (1991: 287) illustrated in fig.3.4.

Access

Road_id	*Parcel_id*
1	1551/52
2	1551/98
3	1551/105

Road details

Road_id	*Road name*	*Road width*
1	Thriller Road	12 m
2	Crescent Road	15 m
3	Mkhuze Road	15 m

Figure 3.4 Two-dimensional relational table with relations established in an ad-hoc manner between separate files.

c) Data management

Data management involves storage and retrieval of data associated with map features from a database. A database is a store of inter-related data logically unified, but probably physically distributed over several sites shareable by a group of users (Chilufya, 2000: 11). Data in a database are organized in records and files. Records are collection of data describing a particular object and consisting of a key or unique identifier, which identifies the object stored and the associated attributes. A file is a collection of related records, each of which describes a single object, but can be cross-referenced to several other files logically. Therefore a record of land values before LR stored in one file, can be cross-referenced with records of land values after LR stored in another file and analysis be made to assess appreciation of value.

Database management system (DBMS) software provides a way to achieve data management. It is a software that is used to create, maintain, and provide controlled access to user databases. Using data definition language (DDL) and data manipulation language (DML) accomplishes data storage and retrieval when using DBMS (Hoffer *et al.*, 1999: 666).

- Data definition language: DDL allows the user to describe the characteristics or schema for files that contain non-graphic attributes (Antenucci *et al.*., 1991: 171). The schema holds description of the data element names, size of element fields in bytes or columns, data elements format (i.e. alpha, integer, binary, etc.) and other data required by the software to process attribute data. Data entry could then be accomplished according to DDL allowing users to keypunch data according to system prompts (Antenucci *et al.*, 1991:171).

- Data manipulation language: DBMS use DML to retrieve data by extracting data based on user-defined criteria. Information that meets the criteria is extracted from the database through a query language (Chilufya, 2000: 12). In a relational database normally used today, data retrieval is accomplished by applying a filter in form of a logical expression. For example data stored could be selected on basis of exact matching of specified attributes such as names, and classes of phenomena etc. Constructing queries can also involve retrieval of specified information. For example, queries can be performed on databases to find information about stored objects in which their data values are equal to or lie within a specified range. In addition DML could be used to update data by adding, modifying, deleting, etc. (Chilufya, 2000:12)

According to Chilufya (2000: 12-13), a DBMS has the following characteristics to meet requirements of efficient storage and retrieval of data:

- Data integrity: protecting of database from hardware and software malfunctions;

- Security: ensuring data is not used unlawfully;

- Roll-back: facilitating reversion to earlier state and re-installation of database when damaged by computer failure;

- Data independence: ensuring that data stored is independent of the query or application programs;

- Back-up procedures: providing back-up copies of files onto separate disks or tapes in a safe storage;

- Concurrency control: ensuring that part or all of the data stored is locked up while updating takes place;

- Version control: providing the ability to keep track of associated versions of the same geographical area, reflecting either real world changes or proposed changes in a specific geoinformation database.

d) Data manipulation and analysis

According to Chilufya (2000: 13), data manipulation and analysis involve operations on the data to derive meaningful information.

- Data manipulation: involves processing data prior to during or after data inputting and analysis. Data manipulation includes general utilities functions (e.g. zooming and highlighting), editing and correction, topology creation, coordinate transformation and projections, etc, (Chilufya, 2000: 13).

- Data analysis: Analysis on data involves operations associated with the study of the location of geographical entities together with their spatial dimensions. Data analyses include activities such as sorting of attribute data in report presentations or for use by other computer systems, geometric searches, arithmetic, logic and statistical operations on attribute tables. New sets of data can be compiled using geometric and attribute data based on original or geographic relationships. Operations used in data analysis include logical operations using set or Boolean algebra like equal, greater than, intersection, etc., arithmetic and relational operations, geometric operations, statistical operations, etc. It is also possible to link spatial and non-spatial data and perform integrated data analysis (Chilufya, 2000: 13).

g) Presentation of spatial analyses results

The results from data manipulation and analysis should be presented so that they convey information that can be understood by the end user. The spatial nature of land information requires the use of maps and other forms of graphic output coupled with descriptive text for presentation. These results could be presented using hard and soft copy generating devices and output in terms of text (tables, legends, lists, etc.) or graphics (maps, cartograms, 3-dimensional scenes, photographs, etc).

- Hardcopy generating devices: These devices work with presentations both of vector and raster data models. They include a variety of printers and plotters that enable production of such data models;

- Softcopy generating devices: These include a variety of video display units (VDU) made possible by the use of colour. It is also possible, due to advent of innovative media technology, to integrate images, sound and video images in VDU output.

3.4 LIS classifications

LIS can be either parcel or non-parcel based. In parcel-based LIS (PBLIS) land information is organized around a cadastral parcel while in non-parcel based LIS (NPLIS) information is organized around the extent of features that are of concern e.g. forestry types, soils types, etc. PBLIS is of concern to this research as LR involves changes in parcel and related ownership structures.

3.4.1 PBLIS

PBLIS is classified into juridical, fiscal and multipurpose cadastres. Cadastre is a systematic inventory of the parcels with reference to characteristics that are of concern to land information management. Cadastres usually include a geometric (graphical) description of parcels, which can be linked with other records describing the nature of interests, and often the value of the parcel and its improvements etc. Due to its detailed nature, cadastre is often used as a basis for land registration by many countries. Maintaining juridical, fiscal and multi-purpose cadastres could achieve management of LR land information.

a) Juridical cadastre

Juridical cadastre is concerned with managing land information about allocation of interests in a parcel. Juridical cadastre is a parcel-based and up-to-date LIS containing a record of interests in lands (e.g. rights,

restrictions and responsibilities). This cadastre can be kept by the LR agency as an efficient method of managing land tenure information.

b) Fiscal cadastre

Fiscal cadastre provides an efficient method of managing land value information for LR projects. Dale and McLaughlin (1988: 46) define fiscal cadastre as an inventory of land parcels containing information necessary to determine the value of each parcel and tax due to it.

c) Multi-purpose cadastre

Dale and McLaughlin (1988: 63) define multi-purpose cadastre as a large scale, community-orientated LIS designed to serve both public and private organizations and individual citizens. It provides information about a series of land records covering land tenure, land value, land use etc.

3.5 Concluding remarks

This chapter focussed on identifying the land information required to undertake land administration functions for LR. Land tenure, land value, land regulation and land use information were identified as the major information sets required. It was further recognized that these information sets are an integral resource that need to be managed so as to maximize their potential benefits in planning, decision-making and control in land administration processes. Land information management was discussed and LIS mentioned as one of LIMS to manage these information sets. LIS was then scrutinized to assess its capability to manage land information for LR.

PBLIS was emphasized as a way of organizing management of land information for LR. Juridical, fiscal and multi-purpose cadastres were examined as possible PBLIS that could be employed to manage land tenure, land value and land use respectively. From the discussion of PBLIS, multi-purpose cadastre can be recommended as the most efficient PBLIS to manage land information for LR projects. This choice is due to its capability of organizing various categories of land information on a large-scale map. Through overlays, multi-purpose cadastre achieves integration of these maps to extract all required information about a parcel.

Chapter 4

Land information system development

4.0 Introduction

In the previous chapter, the information requirements needed to assist in the running of LR's land administration activities were identified. In addition, LIS was discussed as a way to manage land information for LR. Development of LIS is a daunting task, as it comprises many components as has been mentioned before. There must be a method to ensure that the system is developed in a way that enables efficient implementation and maintenance.

System development methodology is a standard process followed in an organization to conduct all the steps necessary to analyze, design, implement, and maintain information systems (Hoffer *et al.* 1999: 24). The methodology provides means by which planning strategy could be applied to develop LIS in phases. This planning is similar to the development of any system, for systems follow phases or a life cycle. To implement a phased development of LIS, system development life cycle (SDLC) can be used. SDLC is a traditional methodology used to develop, maintain and replace information systems as noted by Hoffer *et al.* (1999: 24).

A phased life cycle for developing LIS is approached differently by many system developers. In this research, a methodology followed by Chilufya (1997) will be utilized to demonstrate how LIS for the LR is developed. The important phases in SDLC, as highlighted in this research, are system strategy and planning, system analysis, system design, and system realization.

Development of LIS like any other project needs institutional and management issues to be addressed. This is because the changes in procedures that it brings about, may require changes in the existing system, and may also violate the entrenched regulations and policies on land information management.

4.1 Major issues in the development of LIS

Institutional issues are those aimed at addressing the development of an economical LIS, that will focus on enhancing land administration rather than diverting resources into inappropriate development of uneconomical LIS. Not only land information should be managed, but also the LIS. Managing LIS helps to achieve the implementation of policy decisions and accomplishment of objectives in an optimum fashion, as perfect solutions never arise (Dale and McLaughlin, 1988: 207).

4.1.1 Institutional arrangements

The term institution "refers to the established laws and customs and the administrative structures needed to support them" (Dale and McLaughlin, 1988: 183). In the development of LIS, the policies on information, the social and economic environment, the role of public and private sectors, education and training, the transfer of technology, the legal and political issues and the data standards and exchange as Dale and McLaughlin (1988: 183-203) point out are issues to be considered. These issues are overviewed below.

- Policies on information: Policies on information arise from the perspective of information being a right or economic commodity. Therefore the following must be addressed:

i) Who is to manage land information (between the private and public sectors) and how is the cost to be recovered?

ii) How will the costs of information be regulated in order that both the consumers and the producers do not incur loss?

iii) Should the data be centralized or decentralized for easy access to the users?

iv) Who should have access to which data in both updating and consumption? This question arises because free consumption and updating could infringe on personal privacy; data corruption and some of the data could be security sensitive. Thus there is a need for data security.

- Social and economic environment: These issues are crucial in the development of LIS because land information development should be checked against national and international economy as well as the social dependence of people on land. Tools that are important in the development of LIS are costly and might be a burden for developing countries owing to their weak national economies and respective exchange rates. Socially, dependency of the people on land as a resource should not be compromised by the use of incompatible technologies that often benefit only the upper class of the society. These related issues must be addressed.

i) Social impact of land information: Inadequate land information leads to erroneous decision-making that impacts on the community. In addition, policies on access to and dissemination of land information management should be checked against the infringement of personal privacy.

ii) Economic impact: Costs and benefits of land information are measured in part by the revenue it generates and the costs involved in its creation. Thus, labour intensive (use of example measuring tapes or theodolites that require at least a number of labourers) and capital intensive (use of modern survey equipment such as Global Positioning Systems which are expensive and sometime requiring expensive subscriptions to service providers and requiring few professional staff) methods of data collection must be devised in order to balance with the economy of the country. It thus become logical for poor countries to have a limited number of capital intensive data capture resources and sufficient labour intensive. This is due to fact that most of this capital intensive equipment is donated and become ineffective as they cannot maintain it, while labour intensive is easily available together with labour.

- The role of the public and private sectors: There are often contrasting interests between the private and public sector in the management of land information. These interests further arise owing to the increasing rate of privatization. Some of the related issues include the following:

i) Responsibility of developing LIS: Dale and McLaughlin (1988:189) quoting United Nations Ad Hoc Group of Experts (UNAHGE) show that it is the responsibility of the governments to develop LIS as it will contribute to their own success and can be guided by legislation, both on development and modification. As juridical cadastre could be developed and maintained by the governments, the development of LIS for running land management projects either by private or public organizations is an issue that needs to be addressed.

ii) Updating of the LIS: Within the institution that runs the LR's LIS, activities related to updating LIS like data capture (cadastral surveys, etc.) need to be clearly regulated, as they could be in the interests of both the private and public sectors. The private sector could be contracted to undertake data collection and the public sector could examine all the juridical cadastre data collected by the LR agencies.

iii) Coordination of land information: Information related to land can be handled by many public and private sector organizations and in both central and decentralized offices. Thus coordination of the management of information system must be so addressed as to define data standards and the reduction of data duplication.

iv) Education and training: The establishment and efficiency of LIS require a large number of specialists with broad experience and knowledge to advise and supervise the formulation of

nationally compatible systems. Thus people who operate LIS should be qualified in ways compatible with the running and maintenance of the developed LIS.

v) Transfer of technology: Development of LIS should be in accordance with the economy of the country and level of education and training of the human resources. In addition technology must be compatible with the environmental conditions and to avoid problems like acquiring total stations in humid climates which will most of the time be out of effective use;

vi) Legal and political issues: Copyright issues in the development of LIS need to be addressed. Violation of copyright regulations on published, or hardcopy material (maps, etc) could easily be policed, however information in digital form transmitted through electronic systems and telephone lines require complicated means to enforce copyright laws. Thus the organizations that will be managing land information need to maintain a strategy to safeguard information for cost recovery purposes.

vii) Security: Some of the land information carries sensitive data about national security. Therefore land information should be classified, in order to control access to it.

viii) Database protection: The information or data stored in LIS database is often formal and need to be protected against 'hackers' and infringement of personal privacy. Therefore there is need for controlled access to databases and who should have access to them and to what extent they should have access with regards to data entry and updating.

ix) Data or information accuracy: Often the users of land information incur expense because of faulty information. The issue to be addressed is to which party will the responsibility lie between the data gatherers and those integrating data to produce information for the users. Once entered into the system, liability lies with the organizer of the system, which in most cases are the central governments. Thus, private data gathering and processing organization, for example surveyors, should be licensed and should be in possession of professional insurance to compensate the losing parties in case of incurred expenditure due to faulty information.

x) Data standards and exchange: In order to improve on the data integration and sharing there is a need to define data standards and modes of exchange between different organizations that handle land related data. This should include data transfer formats, a uniform spatial reference system, data classifications and data accuracy standards, to enable the use of compatible systems and accurate data integration.

4.1.2 Management issues

Managers have to ensure that LIS is developed and implemented effectively according to the laws and policy decisions. In addition, management should also ensure the efficiency and productivity of the developed LIS. The major issues that the management in land information handling organization must consider include the management framework, organizational factors, matters relating to land registration, survey procedures, financial matters, coordination and human factors and computerization, note Dale and McLaughlin (1988: 206-224).

- Management framework: According to Dale and McLaughlin (1988: 207), the management framework of LIS should be able to perform the following activities:

  i) Strategic planning: Effective guidelines must be formulated to decide on organization objectives, changes in these objectives, costs involved in operations and policies that will guide the LIS procedures;

ii) Management control: Issues like acquisition of resources and ensuring that they are put to effective use is the duty of the management;

iii) Operational control: Operations related to LIS should be controlled to ensure that specific LIS related tasks are carried out efficiently.

- Organizational factors: Organizational structure is an important consideration in the success of LIS. Within an organization there may be different departments that handle land information. The management should have a clear knowledge of the productivity of these departments and devise some structures that would enable the staff to work efficiently with the developed LIS.

- Matters related to land registration: Management should address matters related to land tenure. Dealings in land, both in customary and formalized tenure, should be well established and documented. These measures help in that only relevant data or information is included in the LIS databases. In addition, the land transfer procedures should also be clear in that the developed LIS should incorporate reservations for data updating and maintenance of records.

- Land surveying: Survey procedures have an impact on the efficiency of the LIS. The following survey procedural issues need to be addressed in order for the LIS to be efficient:

  i) Spatial data collecting methods: Survey standards that are too high are both costly and time consuming. Appropriate methods of data collection must be identified in order not to compromise the right to shelter for the poor;

  ii) Capital investment: As survey equipment is a capital investment, the management should ensure that the equipment is used so as to recover the costs.

  iii) Legal aspects: The legality of the survey documents should be addressed to maintain the accuracy of the data. Thus the degree of legality involved with a surveyor's field sheets and the title document must be addressed with regard to resolving land disputes (i.e. relative to this two documents which carries much weight as evidence of landownership in the courts of law).

  iv) Professional bodies: The role of professional bodies such as those of professional private surveyors needs to be checked by the management against the framework of the survey legislation in various jurisdictions. Their inherent powers and responsibilities could be critical in the pace and success of the LIS could maintain.

- Financial matters: "Land information managers should be familiar with accounting procedures and should be able to provide financial justification for all operations within the system he or she controls" (Dale and McLaughlin, 1988: 217). Thus the manager has to be aware of the parts where value is added to the LIS products and costs and strategize in cost savings accordingly. Therefore areas such as levying of transfer tax and charging of information should be managed efficiently, such that cost recovery is maintained.

- Co-ordination: Management should be in a position to know the information requirements of the LIS users. In addition to land tenure data, the management should be able to recognize information requirements in the wider land use and environmental issues. Thus data standards must be defined in such a way that different layers of information could be overlaid to produce comprehensive information to meet wider user requirements. These are important as the planners and the community could be served by the LIS.

- Human factors in computerization: Human factors, such as identification of the staff categories and training specifications, are of concern in LIS development. Management should address issues inherent

in the occupational health of the personnel working on the LIS workstations. Stress, neck, and back aches and exposure to radiation of the visual display units could increase occupational health risks.

- Factors affecting performance: The success of LIS depends on the working environment. Factors such as job insecurity, job clarity, skills, remuneration, etc. are some of the issues that the management must address.

4.2 Phases in LIS development

As mentioned in the introduction section, LIS development is a phased cyclic process. According to SDLC methodology, the phases which LIS development undergoes include system strategy and planning, system analysis, system design, and system realisation. These phases are discussed below and depicted in the figure 4.1 on the following page.

4.2.1 Phase I: System strategy and planning

System strategy and planning entail steps of identification of project, initiation and planning. These activities are reviewed below:

- Project identification: The information system requirements of the organization are identified, analyzed, prioritized and arranged (Hoffer *et al.*, 1999: 27). This phase may involve the management and the staff in identifying the need for development of a new IS or improvement of the existing one.

  One of the strategies used in the project identification is to select the work activities that add value or expenditure to the organization products. Hoffer *et al.,* (1999: 161) maintain that value chain analysis should be engaged to identify these activities and check that the information system is prioritized to manage them accordingly.

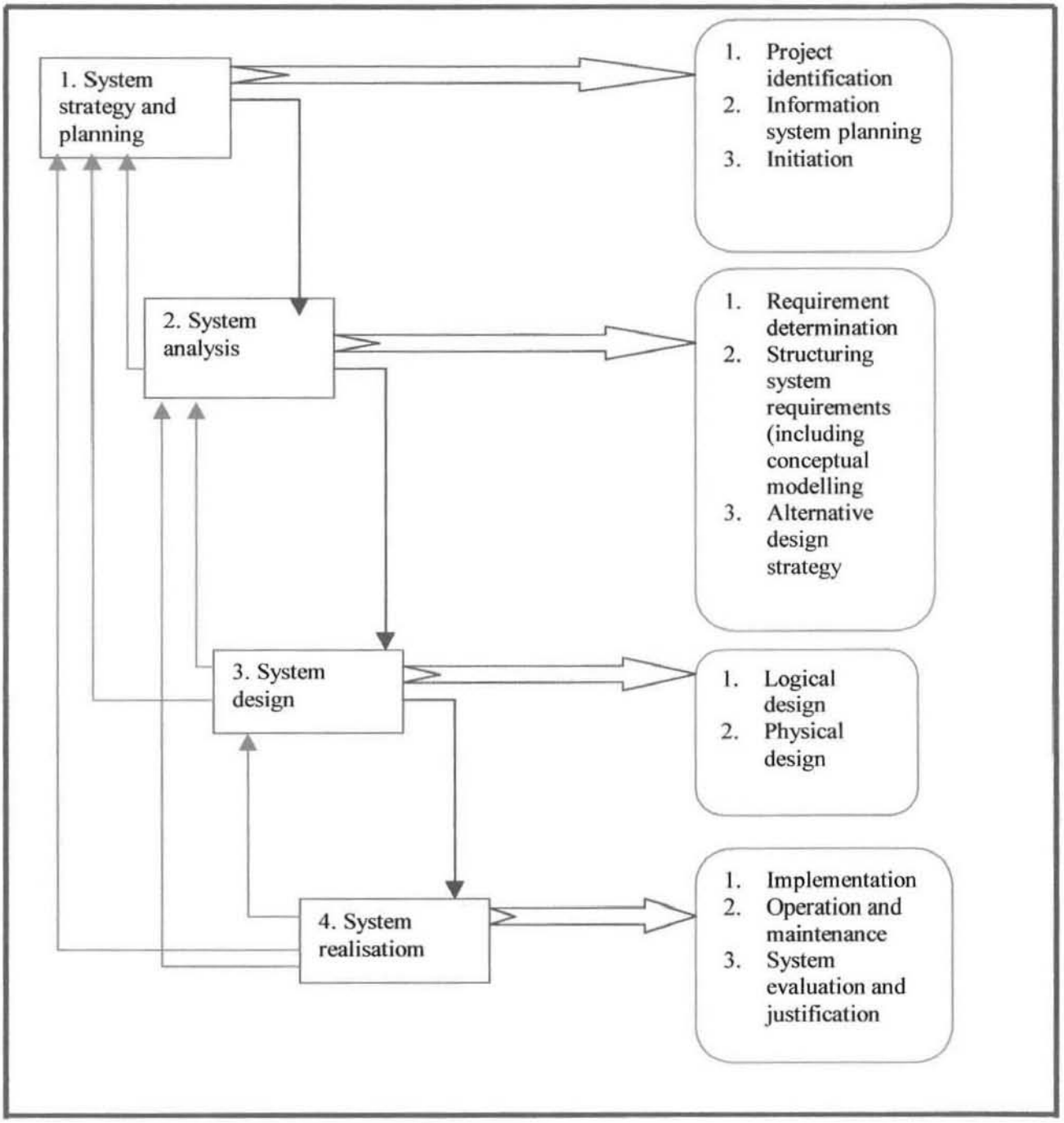


Figure 4.1 Phases in LIS development. Return arrows show that in the development some of the phases might be revisited.

- Information systems planning: Information systems planning is an "orderly means of assessing the information needs of an organization and defining the systems, databases, and technologies that will best satisfy those needs" (Hoffer *et al.*, 1998: 168). The activities involved in this step include;

  i) assessing the current IS assets such as human resources, data, processes and technologies;

  ii) developing the target future states for these assets;

  iii) developing a series of scheduled activities that will drive the current state of these assets to the desired future state.

  Information systems planning could be achieved by the use of information systems architecture. This may make use of a matrix to cross-reference various entities of business, to show the current and the desired future states. For example, the existing information systems could be cross-referenced with the current organizational processes and the future desired states decided on the same matrix as a process to plan for improvements or development of a new LIS.

- Initiation: This involves understanding the scope of LIS and feasibility on development based on the existing resources. Feasibility studies involve identifying the extent to which the LIS is practical and estimating its costs and benefits (Antenucci *et al.*, 1991: 218). The following feasibility studies need to be undertaken before introducing information system according to Hoffer *et al.*, (1998: 209-210):

  i) Economic feasibility: Economic feasibility is undertaken to identify financial benefits and costs associated with a development project. Benefits/costs associated with the development of LIS are both tangible and intangible. Tangible benefits/cost include those benefits that could be valued in monetary terms with certainty. This may include gain/loss in monetary terms in error reduction, increased organizational productivity, etc. Intangible benefits/cost include those that cannot be measured monetarily or with certainty. This may include efficient/inefficient decision-making, improved/unimproved client servicing, etc;

  ii) Technical feasibility: The aim of performing technical feasibility studies is to investigate whether the organization will be able to cope with the proposed IS regarding technical requirements. Technical issues to be investigated include hardware, software, operating environment, system size and complexity in regard to the staff's experience with a similar system;

  iii) Operational feasibility: This is the process of assessing the degree to which a proposed system or improvements to a system may solve business problems and enhance its activities;

  iv) Schedule feasibility: This is assessing that the implementation of proposed system or improvements will meet organizational deadline. Thus the constraints that could impede meeting these deadlines should be investigated;

  v) Legal and contractual feasibility: The legislation and policies towards land information must be investigated and known in such a way that procedures in which LIS would be designed should be formal. In addition the contractual ramifications due to the construction of the system need to be taken into consideration;

  vi) Political feasibility: The shareholders within the organization should make their opinions known about the proposed system or improvements.

The system strategy and planning phase is concluded by a baseline project plan. This is a report, documenting the findings of this phase. The contents often include the description of the proposed system, the feasibility assessment and the related management issues (Hoffer *et al.*, 1998:211).

4.2.2 Phase II: System analysis

The purpose of system analysis is to analyze the existing system, to determine what information and information processing services are needed to support selected objectives and functions of the organization (Chilufya, 1996: 10, Hoffer *et al.*, 1998: 235). System analysis comprises requirement determination, requirements structuring, and selection of the alternative LIS. Chilufya (1997) mentions of the following steps in which system analysis could be undertaken:

- Requirement determination: This is a process of studying the current organizational system to find out how it works and where improvements should be made (Chilufya, 2000: 66). This process is a fact-finding activity and studies of the current system could be carried out using the following techniques:

  i) Interviews: An interview is a verbal information collection method in which an analyst poses questions to system users or future users. Interviews could be carried out in an unstructured or structured ways. Unstructured interviews are those that are carried out with free-flowing atmosphere of conversation. Structured interviews follow structured prepared questions to investigate the specific application details with high reliability.

  Another form of interview could be carried out in the form of joint application design. This is a method of collecting information simultaneously from the key system users in a joint interview session. This process could be facilitated by the use of computer aided software engineering (CASE) tools. The use of prototyping in this process could facilitate the conversion of the "requirements to a working, though limited, version of desired information system" (Hoffer *et al.*, 1998: 264).

  ii) Questionnaires: These are structured questions issued to persons for fact-finding purposes. Questionnaires could be in the form of open-ended or closed questionnaires. Open-ended questionnaires give the respondents' ample opportunity to describe the reasons for their ideas. Closed-questionnaire require the respondents to be specific, without the opportunity to express their views towards the posed question;

  iii) Records review: This involves examination of the details and descriptions that are already recorded or written, about the system and the user departments. These are basically regulations and procedures that guide the organization activities and are necessary in order to understand the current state of the organization activities;

  iv) Observations: Observations give the system analysts first hand account of the business activities.

- Structuring system requirements: This involves modelling of the current organizational state. Modelling involves graphically representing the functions, or processes which capture, manipulate, store and distribute data between components within a system. Process modelling is accomplished in the analysis phase by conceptual model. These may be facilitated by the use of data flow diagrams (DFDs) and languages that depict the flow of information and the processes that use and produce information.

- Alternative design strategy: this incorporates "a high level statement about the approach to developing an information system. It includes statements on the system's functionality, hardware and system software platform, and method of acquisition" (Hoffer *et al.*, 1998: 388).

4.2.3 Phase III: System design

"This phase refines the requirements and develops an engineering design needed to implement the system. It specifies changes to the existing programs (if there are any) and databases. It also specifies the detailed user procedures which describe how they would use the system" (Chilufya, 1996: 11). Systems design involves logical and physical design presented below.

- Logical design: Logical design involves defining and structuring improvements to data flows data storage facilities identified during the analysis phase.

- Physical design: Physical design translates the logical descriptions of data into technical specifications for implementation. The process involves designing of fields, physical records, physical files, and databases.

4.2.4 Phase IV: System realisation

According to Chilufya (1997: 11) systems realisation is aimed at accomplishing all that has been done in the previous phases. This involves three basic steps, which are implementation and installation, operation and maintenance, and evaluation and justification. These activities are briefly overviewed below (Antenucci *et al.*, 1991, Chilufya, 1996:11):

- Implementation and installation: The following activities are involved:

  i) Acquisition of IS hardware and software;

  ii) Acquisition of data and creation of the database either from primary or secondary sources as mentioned in the above sections;

  iii) System installation.

- Operation and maintenance: The following duties are undertaken in the operation and maintenance steps:

  i) Organizational staffing and training;
  ii) Preparation of organizational procedures;

  iii) Conversions to automated operations;

  iv) Applications development and system testing;

  v) Systems auditing and reviewing.

- System evaluation and justification: The system is evaluated in terms of its impact on the human resources. In addition, justification is provided for the incurred costs, benefits and the effectiveness of the system.

4.3 Concluding remarks

This chapter outlined the methodology that can be used to develop LIS for LR projects. This methodology aims at putting the components of LIS together into an efficient system. In addition, it is shown that the introduction of LIS or improvements associated with it require addressing issues related to both institutional and management frameworks.

Institutional issues related to LIS development are necessary to ensure that improved or introduced procedures in LIS will conform to the laws, regulations and policies that guide land information management. Management issues associated with development of LIS were also discussed and it was shown that the management must ensure that LIS components and resources become compatible. The management framework for LIS incorporates activities including formulating a strategic planning, and performing both management and operational control.

The SDLC as a form of system development methodology was mentioned as one way in which the LIS can be developed. The system employs phases in LIS development that are flexible and allow reversion to previous phases, iteration between phases, and the simultaneous occurrence of phases to achieve a desired and efficient system.

The descriptions that have been given for each phase demonstrated how each phase is carried out. Descriptions provide understanding of a step-by step methodology to assemble the LIS system and to show how institutional and management issues can be integrated to achieve the LIS system that matches the formal operating environment in terms of human and technical resources, and regulations that guide land information management.

Chapter 5

The Millennium Park Project Management, Legal, Institutional, and time frameworks

5.0 Introduction

It is crucial to know the project management, legal, institutional, and time frameworks for which an information system is being developed to accomplish its information management. The understanding of its system and those it interacts with culminate in initial identification of what kind of information system is required and how much resource can be expended in terms of its time of usage.

Furthermore, the understanding of the project system unpacks the similarities and contracts that had been discussed in the reviews for LR as given in chapter 2. Moreover, unpacking the project system also helps to check if the LIS concepts stemming from the discussion of LR can still hold. Deviation of LR concepts discussed in chapter 2 and African problems in land redevelopment in relation to informal settlements are considered in this chapter. This issue was not, however, thoroughly entertained in LR review as most of the LR review was taken from the western and eastern civilized nations, which apparently have fewer problems with informal settlements.

Therefore the chapter will highlight MPLDP management, legal, institutional and time frame works. This will be discussed in the comparison of similarities and contrasts with the review of LR as provided in chapter 2, addressing a problem of informal settlements in the project area.

5.1 Project Management framework

Project management encompasses strategic planning and management of resources to achieve project activities efficiently. According to www.snc.edn./socsci/chairs/333/number.html (2001), project managers should be capable of the following:

- defining the project;
- setting manageable tasks into work break down structure (WBS);
- obtaining necessary resources (including human, technical and financial, etc.) and strategically assembling them to undertake the subtasks;
- possessing skills in technical, financial, contract management and problem solving;
- adapting to changes, as planning does not attain hundred percent outputs.

The sections below will review the MPLDP based on the above arguments by discussing the project definition, legal framework, institutional framework, time framework and project WBS.

5.2 Project definition

Defining the project usually entails well-defined goals, and statements of problems, and aims to defeat problems and attain the desired goals. These issues will be discussed below with reference to the MLPDP.

5.2.1 Millennium Park site

MPLDP site is located in the southern peri-urban area of Maseru (partly covered in figure 5.1 below). The site occupies approximately 1600 hectares of land adjacent to the built up area of Maseru between Kingsway and the airport, along the route of the new Mohale by-pass. Because of its location and accessibility, the area is already coming under intense pressure for development, and a sprawl of informal settlements is visible. Most of the area is presently agricultural, though about a third consists of dongas (soil erosion caused trenches), rock outcrops, woods and the river flood plain which is unsuitable for development (Ramonaheng, 2000:1). Fig 5. 1 below illustrates the position of Maseru and figure 5.2 on the next page shows the extent of the MPLDP area in Maseru.

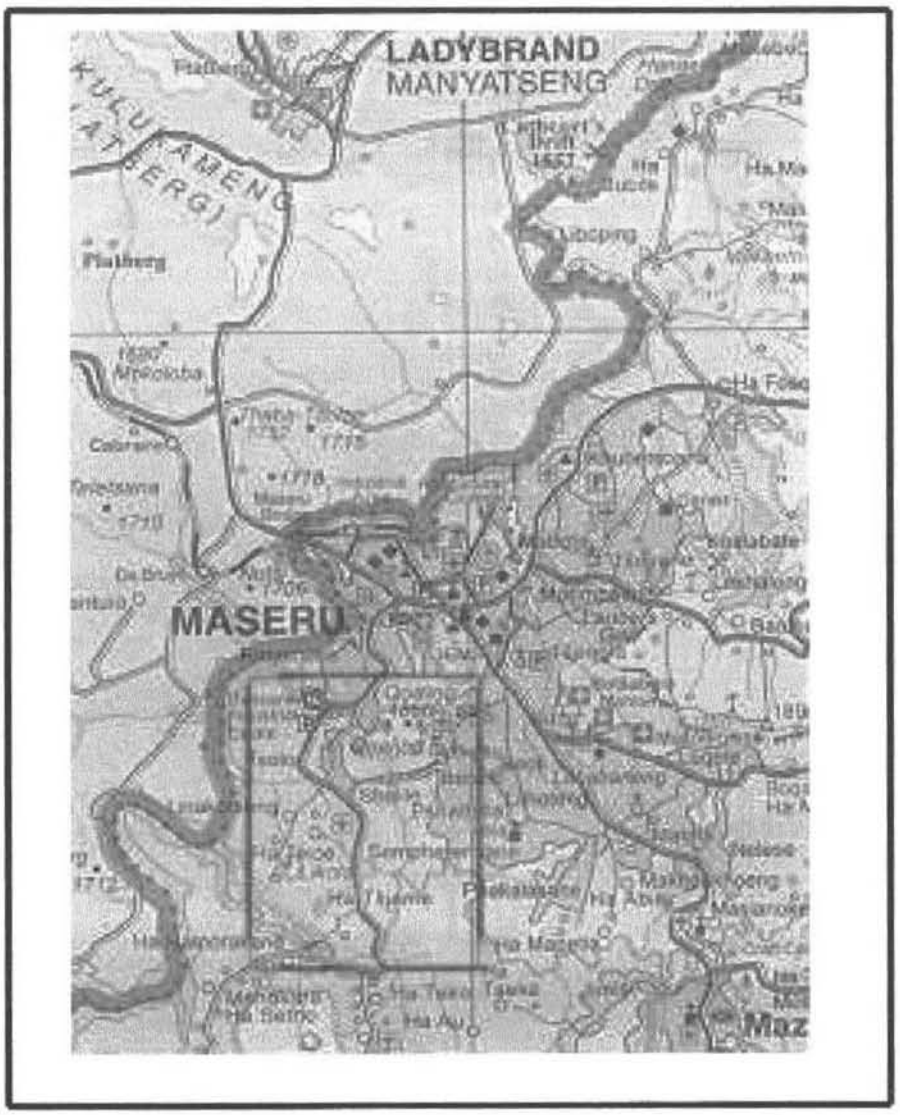


Figure 5.1 Portion of Maseru, Lesotho's capital where the MPLDP is undertaken. The green enclosure marks the approximate location of the project site. (Source: Department of Lands, Surveys and Physical Planning)

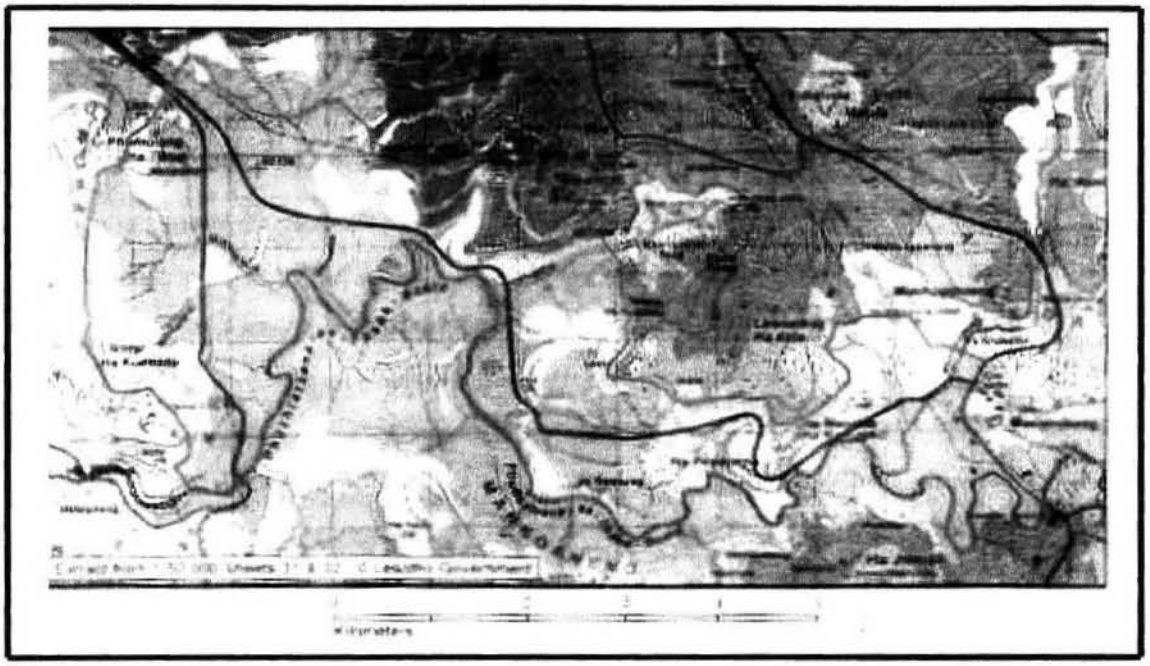


Figure 5.2 Delineated project area and surrounding settlements (source: Department of Lands, Surveys and Physical Planning, Maseru)

5.2.2 Project goals

The MPLDP is a government initiated project aimed to achieve a well-planned and serviced township in the Millennium Park area, using LR method of land management.

5.2.3 Defining the Problem

The population of Lesotho is currently growing at a rate of about 3 % per annum and shows no indication of an early reduction. The present agricultural land use is mostly subsistence farming and is unable to absorb a significant proportion of this increase. Worse, the situation of urbanization in which Maseru is presently growing at 7 % a year, doubling every ten years. This urbanization in Maseru is accelerated mostly by migration of the urban poor into Maseru to seek job opportunities (Ramonaheng, 2000:5).

Urbanization in Maseru is putting formal land delivery under enormous pressure, and informal settlements are a common problem. The project area itself is also prone to this problem of informal settlements. This has been mainly attributed to the construction of the Lesotho Highlands Water Project tarred road to the Mohale Dam, which provided good accessibility to this place (Ramonaheng, 2000:1) and the recent introduction of the industries in the vicinity of the place (mainly Chinese clothing factories, etc).

The local people and chiefs in the area are equally to blame in the perpetuation of informal settlements. Local people subdivide their agricultural land informally to allocate to prospective landowners, while chiefs assist with illegal title documents. In this situation "illegal land allocations using defunct Form C's is not considered illegal by the public" (Selebalo, 1996: 47). Some local people are taking advantage of the migrant labour problem to build flats informally in their agricultural land that are rented to these migrant labours. Selebalo (1996, 50) goes further to show that other fieldowners in fear of government expropriation projects which previously had no compensation except when crops were not yet harvested often intensify informal land subdivisions to get higher income. It should be mentioned, however, that prior to this scramble for land in the project area, some fieldowners were still subdividing land formally or

informally to their offspring or to any prospective landowners, in which initial formal settlements were informally expanding. Some subdivided their agricultural land to residential due to fact that their rural subsistent agricultural practices do not sustain them. Selebalo, (1996: 32-33 and 40) also noticed these informal settlement causes in government expropriation project in the Mabote area in the outskirts of Maseru.

Thus visible to the passer-by through the Mohale by-pass road, are pockets of densely populated settlements with a mixture of formal and informal households, and erupting sparsely populated settlements. The former settlements are mostly formal settlements coupled with subsequent informal expansion, encroaching into agricultural land. The latter is the result of the fieldowners who are informally subdividing their agricultural land to meet the recent demand for land and shelter in the project area and those fearing for government projects which have low compensation and while their own subdivisions would earn them more income.

In view of this situation the MPLDP management is of view that the situation raises the following challenges for the Lesotho government (Ramonaheng, 2000:5):

- To increase non-agricultural employment in order to raise living standards for the whole population;
- To provide formal land delivery, services and shelter for the present and future population;
- To discourage and curb unplanned urban sprawl over valuable and productive agricultural land;
- To provide high quality mixed land use development, including residential, commercial, industrial, recreational, etc;
- To protect environmentally sensitive areas.

In order to address the above listed problems the Millennium Park project management team has set out to achieve the following:

- to provide housing for projected population of 390 500 at an area of 188 hectares during the entire life of the project through:
  - i) densification, redevelopment and upgrading of existing built-up areas;
  - ii) development of green spaces as reservation for future land development;
  - iii) catering for 70 percent low, 20 percent middle and 10 percent high income groups.
- to encourage commercial sub-centres in MPLDP with 120 hectares of the project site area to:
  - i) generate employment opportunities in this areas of high potential density development;
  - ii) reduce congestion within the Maseru CBD;
  - iii) reduce travel/commuting distances and costs between residential zones and commercial areas.
- to provide industries to meet the projected industrial land requirements over the project period;
- to provide social facilities including:
  - i) education in primary, secondary and higher technical institutions;

ii) health facilities, to meet the Ministry of Health target of at least one hospital for every 33,000-115,000 catchment population and filter clinics for every 25,000-50,000 catchment population and health centres for every 5,000-15,000 people;

iii) 39 hectares for a cemetery in the project site and to meet a future projected target of 1 hectare per 10,000 people;

iv) road network that will improve on accessibility and interaction and will also take advantage of the Maseru by-pass road leading to the Mohale Highlands Water Scheme Project site.

5.3 Legal framework

LR involves changes in property ownership and structures as mentioned in chapter 2. Furthermore it was argued in chapter 2 that these changes are supposed to be effected with proper land administration procedures guided by a legal framework. The presence of informal settlements in the MPLDP project area, however, does not provide a straightforward legal procedure as has been discussed in LR review in chapter 2. As regards the law (presented in section 5.3.2 (a)) informal settlers are trespassing and are eligible to fine, imprisonment, eviction and demolition of property, however political, social and economic issues complicates the execution of statutory law and in most cases common law and rights to shelter take precedence. Below is a review of the existing property and ownership structures and how such should evolve due to changes brought about by the project. In addition the rights of informal settlers are discussed, in relation to their treatment as stakeholders in the project. Furthermore, all relevant statutes and policies that guide change in property and ownership structures are discussed.

5.3.1 Existing land tenure:

Land tenure defines the way interests are held in land. The mode of holding interests in land is defined by the land tenure systems. These systems are classified in terms of the degree of legal codification, relative emphasis on rights, restraints, and responsibilities and relative emphasis on individual, collective, or state rights (Nichols, 1993: 32). The MPLDP evolves between two types of tenure systems, namely legal (i.e. customary and statutory) and illegal or informal and the continuum between the two. These are discussed below in relation to the MPLDP.

5.3.1.1 Legal tenure systems

Legal tenure system defines a condition in which the relationship between man and land and man to man in land related matters are derived through formal authorization (Fourie, 1998: 57-58). It was a common practice as mentioned in section 5.3.2 (a) that Africans have formal customary laws governing legal tenure system. The advent of western civilization further brought about the western customs and laws of how land related matters should be governed. These brought the practice that such laws are passed through legislature and form what is known as statutory tenure. Both of these tenure systems have impact in the project area.

a) Customary tenure

Customary tenure in mostly agricultural fields prevailed prior to land acquisition for the project area. Codified by Paramount Chief Lerotholi of Lesotho in 1903, customary tenure is based on Basotho (citizens of Lesotho) traditions and custom. Relating to these traditions and custom, the Land Policy Review Commission Report (LPRCP, 2000: 23) states that land is communally owned by Basotho and thus can neither be sold nor bought. LPRCR (2000: 23) further gives an important extract of origin of this traditions and custom from Germond in Chronicles of Basutoland: -"Moshoeshoe is more explicit on the impossibility of his leasing or selling any of his territory without the consent of the whole tribe. He is not the owner of the land, but the custodian: the selling or renting of land, says he (Moshoeshoe), has been hitherto a practice wholly unknown to us (the Basotho) and I believe to all Bechuana nations. The subject has never yet been made a question for discussion or enquiry."

According to LPRCR (2000: 25-26) the following principles are inherent to customary tenure:

- A gazetted local chief is delegated right to allocate land fairly and impartially in their jurisdiction.
- Only a male elder is entitled to hold land rights. This is tradition as the Basotho culture is patriarchal.
- Land rights last for the lifetime of the allotee.
- Land rights revert to the chief at the death of an allotee.
- A male heir or dependents of the allottee are entitled to inherit the land rights of the deceased father or the guardian for subsistence as long as they dwell thereon.
- All land transactions are prohibited between an allottee and prospective landowners.

Customary land rights, however, are convertible to statutory land tenure through the current arrangements entrenched in the Land Act (1979). This is effected by appropriate application to the gazetted local chief in consultation with Village Development Council (VDC). This allocation culminates in the formal registration and issuance of 'Form C1' for non-registrable title or 'Form C2' title document for registrable title in rural areas. In the event of conversion of rural to urban townships as is the case in MPLDP, that is customary to statutory tenure the Urban Land Committee (ULC) being a land authority having jurisdiction in an area effects the change. Formal land registration results in issuance of 'Form C3'. Forms C2 and C3 are registrable and need to be converted to leases by the Commissioner of Land within a period of six months following the date of allocation, failure to which such an allocation will be deemed invalid.

b) Statutory (Leasehold) tenure

All land allocation procedures in the project area are to follow statutory tenure principles. This type of tenure is entrenched in the Land Act (1979) and became applicable by declaration of this law. Under statutory tenure, land is held under leasehold, which is an agreement between the allottee and the state. The following are some of the characteristics of a leasehold agreement under Land Act 1979:

- Village Development Councils and Urban Land Committees are leasehold land allocating authorities in rural and urban areas respectively;
- There is exclusive possession of land leased, with a duration of not less than ten years;
- Disposal of land rights, effecting other encumbrance and sub-leases, and creation of servitude, or any other transactions in land are done by consent of the Minister, except those done in terms of a will or surrender;
- At an allottee's death a written notice shall be forwarded to Commissioner of Lands in relation to inheritance to rights. If not the rights revert to the State;
- In an area marked for public development, land rights revert back to the state and are reallocated to subjects after such a development. If the developer is the private, however, such rights are allocated to the developer and further transferred to subjects after the development.

5.3.1.2 Informal tenure and continuum

Most of the informal tenure in the project area arises from the ineffectiveness in the implementation of Land Act 1979 and lack of law enforcement. For the former, local chiefs remain *de-facto* land allocating authorities (issuing Form C's) without consultation with the ULC or the VDC. Thus in pursuance of the fees of about M300, the researcher had observed from personal experience, local chiefs get from the allottees during informal subdivision of agricultural land process, informal settlements are being perpetuated. Selebalo (1996: 40) mentions of M100 charged for issue of backdated form C's by the Mabote area chiefs corrupting the allocation system. As regards the latter, ineffective law enforcement results in land allocations and the developments within the project area even after the area has been declared a public development area. The result of ineffectiveness of laws governing land tenure system is highlighted by Fourie (1998: 58) noting that "if no formal land delivery system is in place this does not mean there is a vacuum"- "on the contrary, an informal land delivery will be in all likelihood be in place".

The informal settlement situation in the project area, as discussed in the 'Definition of Problem section can be categorized into the following groups:

a) *Informal settlements in continuum of development* (*de facto* recognized informal settlements)

These are those informal households, which are within densely populated settlements and mixed with formal households, which have been in the project area for a considerable time. In such settlements it is hard to adjudicate land rights as most of the subjects (formal and informal) hold Form C (title certificates). Some of the certificates had been issued illegally by the chiefs without consultation with the VDC or the ULC and have been backdated prior to promulgation of 1979 Land Act. Evidence from the VDC and ULC is also hard to adjudicate title, as these institutions have hardly been effective LPRCR (2000: 87-88).

Further application of statute law to informal settlers (such as eviction, demolition, etc.) is not easy and straightforward due to political, social and economic reasons. Politically, the government imposing evictions to quite a large number of households in a settlement tend to loose their electorate base. To demonstrate this issue since the conception of the project 273 cases (including those informal settlers mentioned in (b) and (c) below) have been filed against informal settlers in the project area. This resulted in a mass demonstration in front of the offices of Maseru City Council and the Department of Lands, Surveys and Physical Planning by discontent informal settlers, stating that they had been allocated land formerly by the chiefs and the institutions were robbing them off their rights to land. This caused a stir in which media tabloids and opposition parties (for purpose of campaigning for supporters) severely criticized the government. This has an impact of destroying electorate base in this area and in other places where fear of eviction is high.

Such settlements seem also to exhibit a concrete social interaction as informal households expanding the settlement into agricultural land are mostly offspring and or relatives of formal settlers. Economically, formal landowners tend to go to the extent of building commercial property as their fear of eviction is much reduced than for informal settlers. In this case most of the income base of the formal settlers is from the informal settlers.

Due to practical complexity in which statutory law could act in this case sometimes a common law has been adapted to recognize the rights to a certain degree to households in a block of densely populated settlement. Selebalo (1996: 41) has met a similar blanket approval of informal land rights while studying the Mabote land expropriation project. In this situation every fieldowner who subdivided his field submitted the names of his informal allottees, and where Form C's were available they were stamped with a seal to provide *de facto* recognition of their rights and returned to the owners. Further Selebalo (1996: 25) shows that however, it has been the recommendation of the Lesotho Land Policy Review Commission to use in such situations Form CC's (made intentionally to differ with Form C's issued illegally by chiefs) that revalidates defunct Form C's. Selebalo (1996: 47) demonstrates this procedure quoting Alberts *et al.* (1995) that "finally formalizing informal settlements involves similar basic procedure, such as government recognition of an outside figure, the definition of blocks and super-blocks, issuing intermediate recognition

documents and upgrading to the formal title". Thus this is practicable in the densely populated areas in the MPLDP area in which an outside figure can be adopted. This is demonstrated in figure 5.3 (enclosed with a blue block) on page 56 showing the approximate location of the Ha Shelile village and figure 5.4 on page 57 showing how this initially formal settlement is apparently expanding informally into primary agricultural land.

b) Sparsely populated Informal settlements

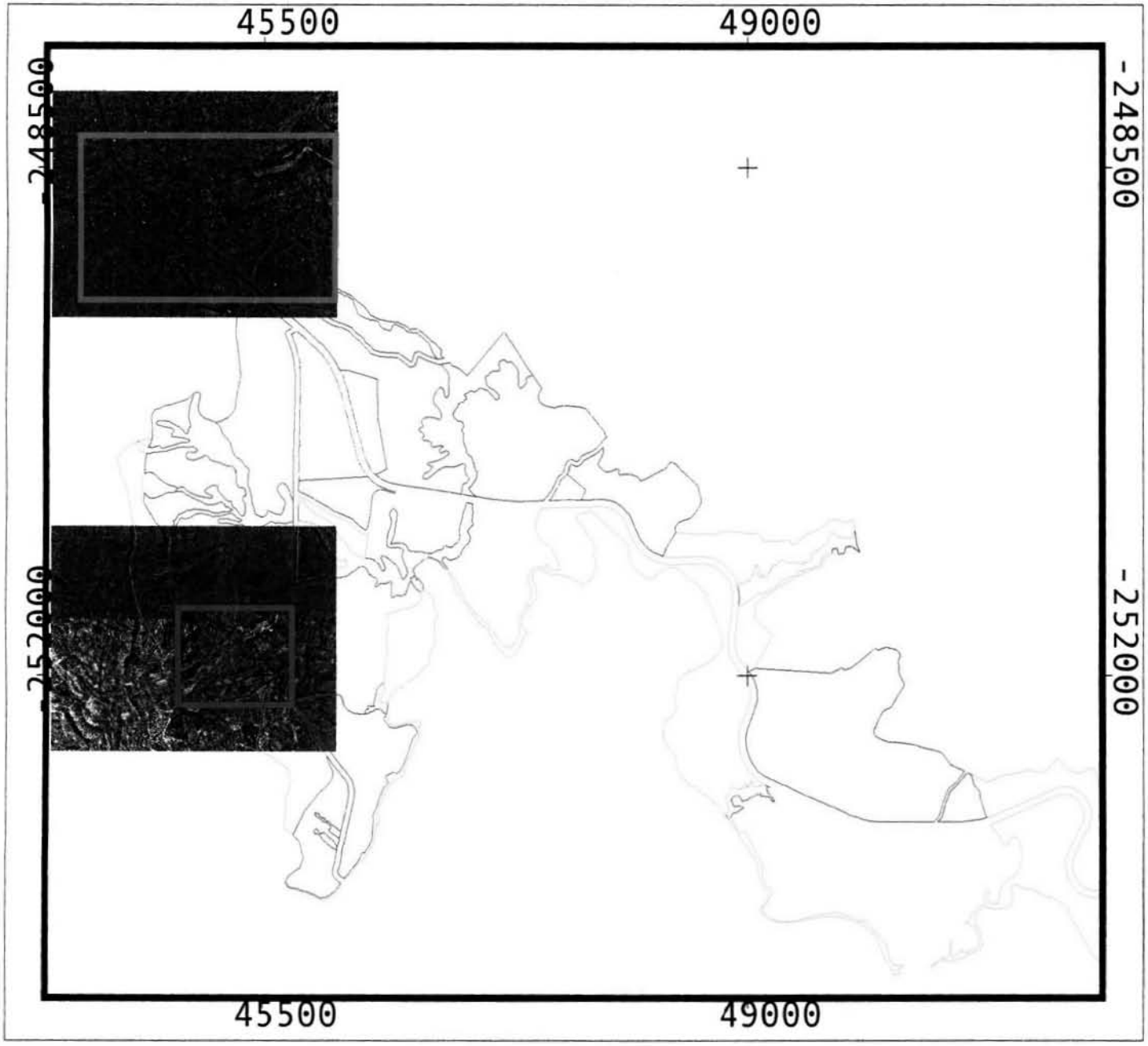
Those informal settlements sparsely populated as a result of scramble for land owing to recent developments and fear of government expropriation, which have no, or minimum compensation rates. In this settlements household owners possess certificates of title in which one way or the other should have been obtained informally.

Clearing such settlements is not such a complicated issue as in one above. The economic and social integration of these sparsely populated households is not as strong as the one discussed above. Firstly, the income base in such areas is poor and social integration is rarely there. Politically, it becomes advantageous, to deliver formerly planned and serviced land to massive population, by clearing off informally scattered settlers which are a handful to handle in cases of starting a negative social or political issues.

A similar case of eviction and demolition of informal settler property has been executed at Lepereng in the outskirts of Maseru City in the years 2000/2001. In this case a handful of subjects who were informally allocated land belonging to the Ministry of Health by the local chief were defeated in a court case (see one court order in appendix A). In close guard by the Land Task Force (see section 5.4 (f)) the Maseru City Council bulldozed their property. Even though the event sparked a few media criticism, it was quickly defused.

Furthermore as mentioned of blanket recognition of rights in (a) above it becomes difficult as for areas, which will be zoned for other land uses such as heavy industries requiring a buffer zone for health purposes. This will provide another difficulty, as blanket recognition will require an outside figure, which will cover the whole project area as these settlements of handful developments are sparsely scattered within the project area. An example is given in figure 5.5 on page 58 (see a blue enclosure in figure 5.3 on page 56 for approximate location of the example in the project area) identified by manipulating orthophotograph which covers this institutional zone. But as for those who are occupying land in sparsely fashion but in which those areas they occupy are to be zoned for residential purposes, the developers in this areas could include the informal settlers in their land subdivision plans and such settlers could be recognized *de facto* as formal. Visible from the figure are two households in the area zoned for institutional purposes and are at least 600 metres apart (see figure 5.5) showing how their social and commercial integration is weak. Thus such settlements to my point of view have to be demolished and if they have been there formally they would also rightfully claim compensation. A similar court case is given by a summon presented in appendix B.
Advantageous, however, to the politicians, to evict few informal settlers to allocate more subjects the rights of these informal settlers to shelter have to be observed, on account that a way be sought for them to tenure security within the project area or somewhere. Fortunately for them, the project management had paved their way to be allocated parcels at low cost in the Khubelu layout in close vicinity with the project area (see figure 5.12 on page 75). In addition, the fieldowners will have to compensate their informal allottees while they will be in turn compensated by the government for their acquired agricultural land

Figure 5.3 showing approximate locations quoted in figures 5.4 and 5.5



Approximate location quoted in figure 5.4

Approximate location quoted in figure 5.5

Agriculture
Commercial
Donga
Institute
Open Space
Residential

Figure 5.4 depiction of the informal settlement expansion of Ha Sheme village

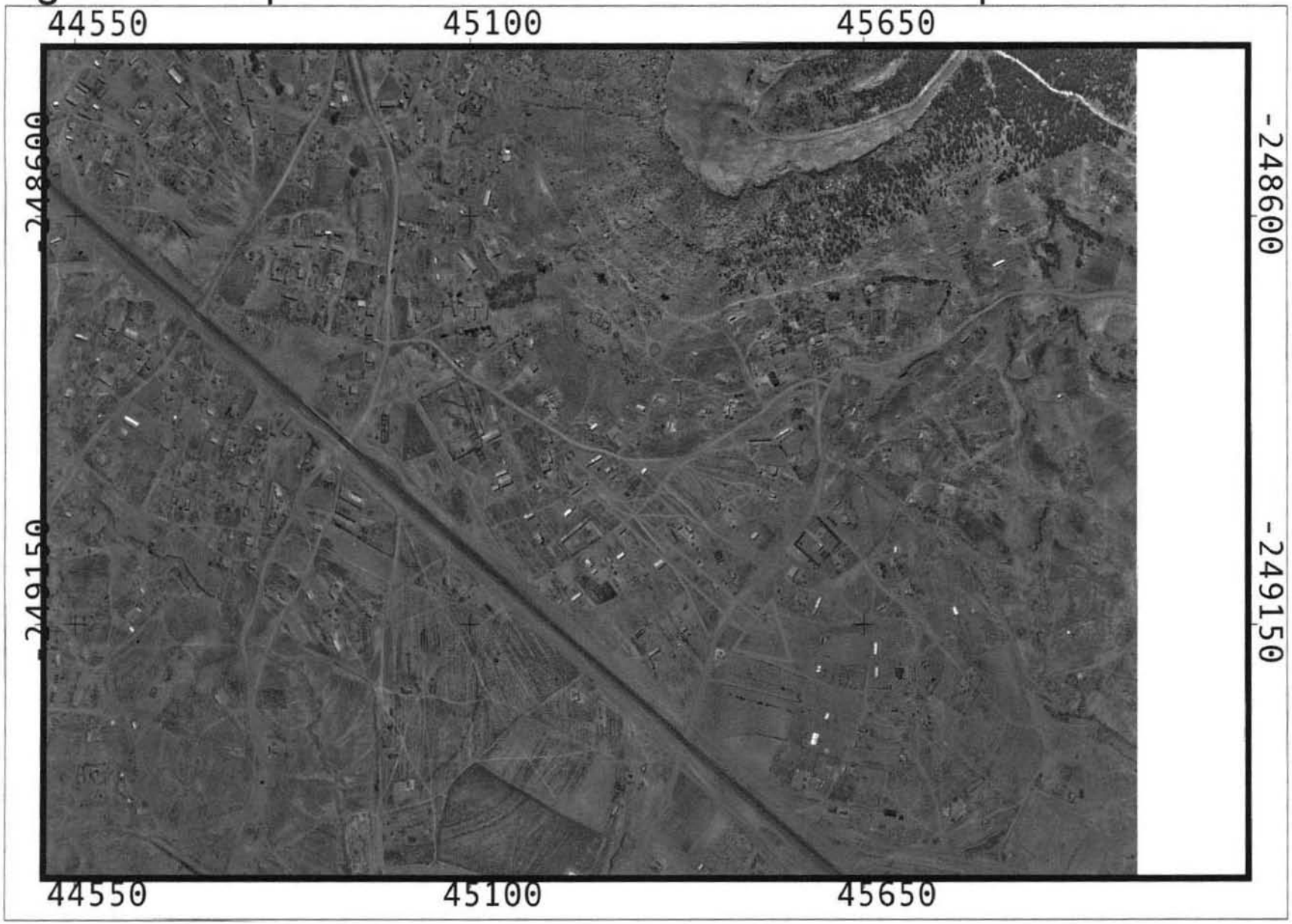
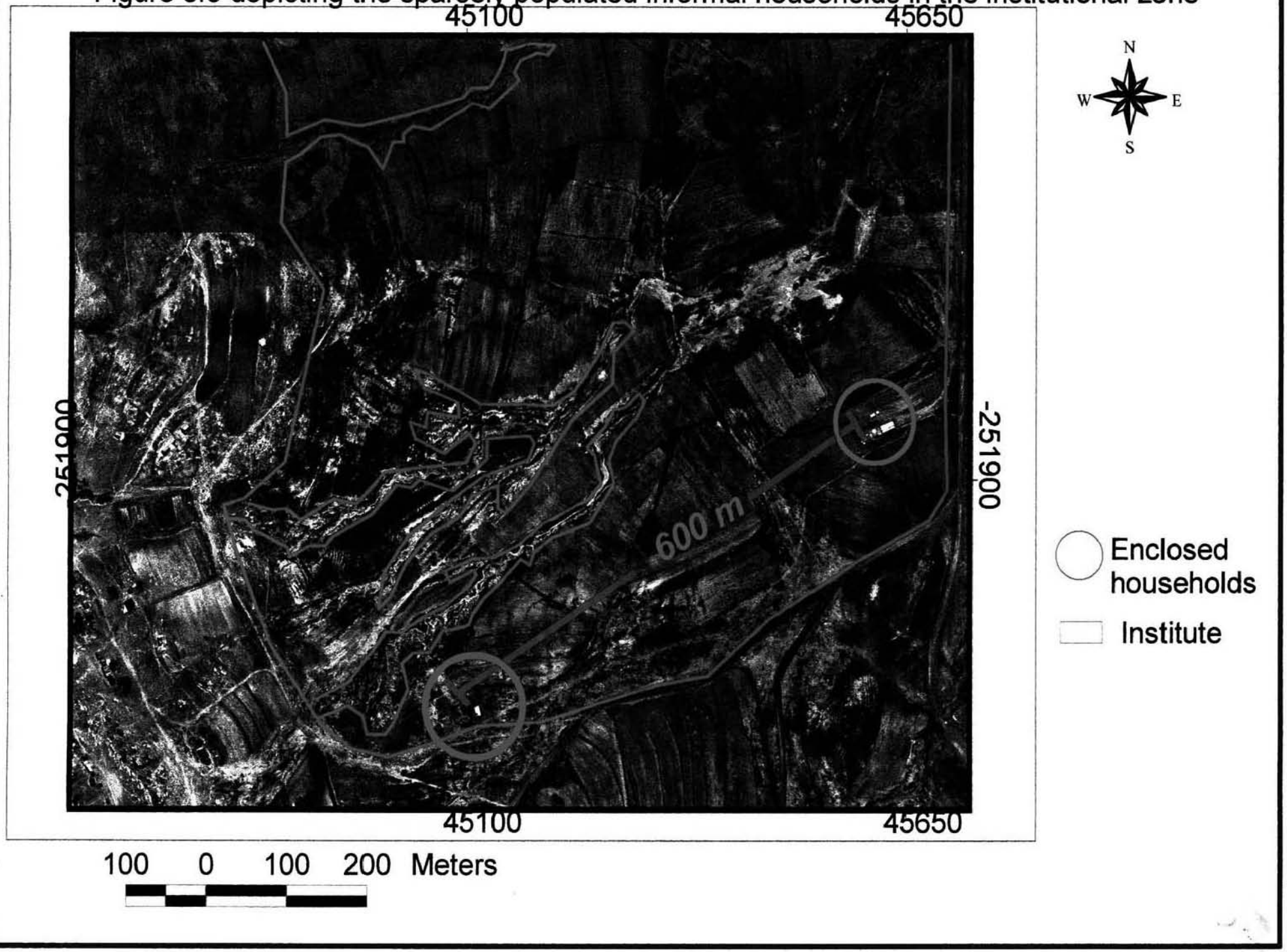


Figure 5.5 depicting the sparsely populated informal households in the institutional zone



c) Informal development

These are developments emerging after the declaration of the area a selected development area and involving both formal and informal landowners. This could be due to speculation in which a landowner, thinking that his property will be demolished during the process, will receive higher compensation. These developments had been checked by the analysis of the orthophotographs taken during the initiation of the project and the current ground situation. The developments undertaken are unlawful and are infringing the rights that had been reverted back to the state and restrictions passed that prohibit them of further developments. The households are liable to judicial procedures that can result in fines, imprisonment, eviction and property demolition. The fieldowners in this case are supposed to compensate their informal allottees for land they had informally allocated them in which in turn the government compensate formal fieldowners for agricultural land acquired. For loss of informal property demolished no compensation however is prepared.

Such cases had been noted in which households are constructed overnight. In most cases these are in the already zoned areas and demolition becomes inevitable otherwise the planned development fails. Thus as stated in chapter 2, once the project has started further unauthorized developments in the area can be disruptive. Fourie (1998: 59) building on this issue observes that "frequently, when a formal project is being undertaken the informal land delivery system intervenes at some stage"-and "becomes impossible to deliver legal serviced sites for formal housing settlement".

5.3.2 Relevant legislation

These legislation include Acts and Laws passed by the Parliament and any other regulations and policies that guide land tenure issues in Lesotho, which the project has to observe.

a) Laws of Lerotholi 1903

These laws were promulgated by the then Paramount Chief Lerotholi of Lesotho. These laws codify the Basotho traditions and customs in form of customary tenure existing in the then acquired fields in the MPLDP area. Customary tenure is discussed in the previous section. No formal rights were registered during allocation and boundaries were only adjudicated through oral traditions and on the ground. Although these rights are still in effect in rural areas of Lesotho, many laws have been passed to modernize customary tenure. The main criticisms of these laws were that they did not punish the local chiefs who did not observe fairness and impartiality in the allocation of land. Furthermore, the laws were shown to be impediment to land investment as were oriented to subsistence farming which weakens the country's foreign exchange as opposed to commercial farming, (LPRCR, 2000: 25) observes.

b) Land Act 1979

The Land Act of 1979 is the current law, which all allocation of interests in the MPLDP must fulfil. "This law was passed to consolidate and amend the law relating to land thus far" (LPRCR, 2000: 43). The law further reinstates Basotho tradition and custom. Sections 3 and 4 of this law state that land is absolutely and irrevocably vested in the Basotho nation and held under custody of the nation by the State (rectified to Head of State by Land Amendment Order No. 6 of 1992) (LPRCR, 2000: 44). The Land Act (1979) introduces the leasehold tenure system and holds the following guidelines for the MPLDP:

- Land acquisition: MPLDP is declared a Selected Development Area (SDA) under section 44 of this Act. This section revokes all existing rights to land to the Head of State, however landowners are entitled to substitute rights. Section 45-(2) states that where land acquired in a SDA consists wholly or partly of agricultural use, allottees with agricultural land use rights are entitled to compensation. Pursuing Section 46-(1) and (2) of the same Act, an allottee occupying land with land use rights other than agricultural, is entitled to reallocation within the SDA with the same land use rights in the same parcel with or without boundary amendments. In case of proposed developments deviating from such

land use the allottee is entitled to land of any one of the purposes of the development scheme or compensation.

- Land allocation: The procedure includes both new allocations and reallocation. The difference is only that reallocation cases are given first preference. The Land Act (1979) gives the following procedures relating to land allocation in the SDA in which the MPLDP is:

  i) Land rights in SDA: Rights in land shall be held in terms of a lease or licence prepared by the Commissioner of Lands;

  ii) Allocations: Allocations are guided by Part III sections 21 and 22 of Land Act (1979). Section 21 provides that all available land to be allocated shall be advertised, with full details and descriptions of position and value. Applications are to be lodged with the Urban Land Committee. Section 22 provides that in terms of land available for commercial or industrial use, the Commissioner of Lands may issue an 'Invitation to Tender Notice' (ITTN) in a Gazette and local newspapers with details as mentioned above. All grants made shall be published in local newspapers. Allottees are to be issued with 'Form C3' a copy of which is forwarded to the Commissioner of Lands to prepare a lease. The application will be lodged accordingly within six months of the allocation date. First preference to allocations in SDA is given to the original landowners in the area. Section 48 goes further to state that in cases where the value of the reallocated parcels is higher than the value of land previously held, the allottee will be entitled to a reduction equal to the value of land previously held. Moreover, if the reallocated plot is less than that previously held, the allottee cannot be forced to accept it. The allottee can claim compensation for the disparity between values of the two parcels.

  iii) Compensation: The land valuation procedure is given in terms of section 56 of the Act. Compensation shall be claimed at the expected value that could have been realized if land was sold at open market by willing seller-willing buyer arrangements. In addition, compensation can be claimed according to incidental expenses incurred from any changes in residential or commercial property owing to introduced developments.

  iv) Land development by private sector: Observing Sections 21 and 22 mentioned above, Section 47 states that in the SDA, where a development scheme is to be sponsored and operated wholly or partly by a developer other than the State or parastatal organization, the power to grant title lies with the Minister. This is done with the provision that private developer will effect a land subdivision in which former allottees in the area will be allocated interests or be paid compensation.

  v) Informal land development: Section 87-(1) cautions that occupants of land in the project area without appropriate allocation procedure are trespassing. In addition are those who are pursuing developments after the declaration of the area as SDA without the Minister's approval. Such occupants are liable to fine or imprisonment and eviction. The law further provides that informal settlers resisting court orders to vacate within specified a period will be forcefully evicted with the help of the police.

c) Deeds Registry Act 1967

This act was promulgated in 1967 by the Lesotho parliament. The objective of the Act is to provide a procedure by which an efficient and systematic method of registration of deeds can be maintained. The Act provides registration of grants or leases issued for rights to occupy land lawfully, and rights to minerals allocated by proper authorities.

d) Town and Country Planning Act 1980 (TCPA)

The Act provides a procedure for orderly development of land and promotion of efficiency and economic development (LPRCR, 2000: 54). This Act facilitated the approved Maseru Development Plan in 1990, under which jurisdiction, the MPLDP falls. Section 11-(1) provides that, subject to sub-section (5), the Planning Authority receives an application and grants permission to develop land in the MPLDP (Millennium Park Team, 2000: 2). Section (5) reads as thus; "The minister may by a development order regulate manner in which applications for permission to develop land are to be, and dealt with by, the Planning Board" (Town and Country Planning Act, 1980: 87)

e) Maseru Development Plan

The plan prepared under TCPA (1980) is concerned with developments including land uses such as housing, commerce, industry, community facilities and infrastructure. This control is aimed at retaining well-planned future growth of the city in the next twenty years, in order to curb urban sprawl onto the limited agricultural areas and the costs of infrastructure provision.

f) Development Control Code 1989

The code is aimed at controlling new developments and therefore is applicable to the MPLDP. The code provides development of compatible land uses in a wide range of environments, taking into account essential public health and other utility requirements. The code further offers guidance as to ways in which buildings should relate to parcel size and the surrounding environment.

g) Planning Standards and Guidelines 1990

The standards and guidelines to development provide specifications on how different land uses should be integrated in a development area in relation to the population and the size of the area. For example, as mentioned under the aims subsection above, "health facilities, to meet the Ministry of health target of at least one hospital for every 33,000-115,000 catchment population and filter clinics for every 25,000-50,000 catchment population and health centre for every 5,000-15,000 people" Planning Standards and Guidelines (1990: 7).

h) National Settlement Policy

The National Settlement Policy is a document produced by the DLSPP. The policy provides a framework and a programme to promote balanced settlement development and conservation of natural resources and environment affected by settlement development.

i) Land Survey Act 1980

The Land Survey Act highlights provisions for the organization of the land surveying profession and how this profession shall execute surveys for land registration purposes. The Act establishes the office of the Chief Surveyor who holds a public office and is delegated duties to:

- direct and control all public surveys;
- supervise and control other surveys,
- examine and authenticate all general and particular survey plans;
- take charge to preserve all survey records;
- prepare, certify and issue any survey records required by members of public upon payment of prescribed fees.

In terms of the organization of the survey profession, the Land Survey Act (1980) maintains that there shall be a Land Surveyor's Board, consisting of the Chief Surveyor, as the chairman, and three other persons (if practicable, surveyors) appointed by the relevant Minister. The primary aim of the board is to grant duly qualified persons licences to conduct surveys in Lesotho. In addition, it defines surveyors' professionalism and undertakes any disputes against surveyors and clients and takes disciplinary action against those surveyors who breach codes of professional conduct.

j) Land Survey Regulations 1982

The Regulations provide guidelines on the issues that the Chief Surveyor's jurisdictions should include when formulating directions to surveyors. It covers issues such as directing how to conduct surveys, authorization of survey technicians, maintenance of the national geodetic network, checking quality of surveying instruments, deciding the coordinate systems to be used, etc.

5.4 Institutional framework

The institutional framework dictates all the necessary institutional structures in which changes in property and ownership structures of land rights will be effected. It is envisaged that most of these institutions will be directly involved in this multi-stakeholdership project.

a) Directorate of Lands, Housing and Urban Development (DLHUD)

DLHUD, under the Ministry of Local Government (MoLG) was formed by the amalgamation of two public organizations, the Department of Lands, Surveys and Physical Planning (DLSPP) and Department of Housing and Urban Development respectively. Understanding the roles of this joint Directorate necessitates scanning the activities of each of the organizations.

- DLSPP: The Department comprises Lands, Surveys and Physical Planning divisions. The Lands division, headed by the Chief Lands Officer, prepares leases, sub-leases, servitude, licences, mortgage transfers, valuation and recording of all land transactions (i.e. juridical cadastre). The Survey division under the Chief Surveyor maintains and safeguards the national mapping, and undertakes and directs (to public and private land surveyors) topographic and cadastral surveys. The Physical Planning division which is managed by the Chief Physical Planner prepares overall physical development plans and advice on development proposals and creation of layout plans of sites for new grants. In addition the Department consists of the Accounting section which is entrusted with collection of land administration revenue, including property transfer tax, various fees, ground rent, etc. In addition the "consultants from Department of International Development (DFID) under the institutional link arrangements with Ordnance Survey (UK) were called to assist"(Millennium Park Development Project Report, 2000: 2). This assistance was on land management and land information system techniques training of the MPLDP personnel within the department.

- Housing and Urban Development divisions: the Housing division is headed by the Chief Housing Officer and is responsible for administration and implementation of housing policy and Government and private housing schemes. The Urban Development division under the Chief Urban Development Officer, undertakes the administration of urban sanitation. In addition the division undertakes administration of service, facilities and infrastructure development loans in Government and private housing schemes.

b) Urban Land Committees

The MPLDP is an urban development project and all the land transfer issues are supposed to be forwarded to the Urban Land Committee (ULC). In terms of Section 24 of the Land Act (1979), the ULC, a public institution appointed by the Minister, is the authority allocating land in the urban areas. Allocation is effected by the majority decision of the members. The Committee is composed of the Principal Chief and District Administrator or Town Clerk in a jurisdiction, the Commissioner of Lands, and any other three

members appointed by the Minister. Land applications in the urban areas are addressed to the ULC. In addition, when the application is considered and an allocation effected, the landowner is issued with certificate of allocation Form C3.

c) Village Development Councils

The importance of the Village Development Council (VDC) in the MPLDP is to facilitate land adjudication process by verification of existing property and ownership structures, as may be given on records and/or on ground. The VDC are delegated rights to allocate land in the rural areas, in terms of Section 12 of the Land Amendment Order No.6 of 1992. The VDC exercises the allocation rights in terms of the majority decision of its members. Applications for either commercial or industrial allocations however, are referred to the District Development Council (DDC). DCC takes decisions in consultation with representatives from the DLSPP and the Chamber of Commerce and finally the approval of the Minister.

d) Land tribunal

The Land tribunal, which is an administrative land court, was established by Section 64 of Land Act (1979). A judge or magistrate chair the tribunal and are assisted with two assessors. The tribunal is delegated rights to adjudicate on adverse land-related claims, including:

- refusal of the Commissioner of Lands to a lease issue;
- adverse claim on the title of land made available for grant;
- adverse claim in conversion of land titles, granting and creating any interest in land held;
- appeals on dissatisfaction about the value of land and improvements assessed by the Government valuer;
- appeals against conflicting claims for compensation payment for land set aside for public purposes;
- appeals against payment of ground rent;

Section 67-(1) gives a go-ahead to parties dissatisfied by the tribunal judgement to appeal to the High Court. The tribunal will then form the primary land dispute resolution machinery for the MPLDP.

e) Civil courts

These include the Magistrates Court, the High Court, and the Court of Appeal. These courts hear land-related cases: civil land disputes and criminal offences like informal occupations and developments that take place in the MPLDP after the SDA declaration.

f) The Land Task Force

The Land Task Force (LTF) is the Lesotho Police Service arm which deals with crimes related to informal occupation. The MPLDP management team works hand in hand with the LTF to clear informal settlements within the project area.

g) Deeds Registry

The Deeds Registry, headed by the Registrar of Deeds, is based under the Ministry of Law and Constitutional Affairs. It is entrusted to register all deeds in land and immovable registrable property allocated by proper authorities.

h) The Maseru City Council (MCC)

The MCC is an establishment of The Urban Government Act 1983 (Municipalities). The MCC is composed of democratically elected councillors. The MCC is delegated rights within the Maseru municipality to assume roles as a land authority. The land related tasks undertaken by the MCC include:

- directing and controlling implementation and maintenance of all the required facilities, services and infrastructure required for urban Maseru;
- assuming roles of rating including valuation;
- facilitating and engaging in duties and responsibilities as land authorities (e.g. field inspections before allocations and adjudication, etc.);
- engaging in planning functions in the Maseru municipality;

i) Land use planning

The land use planning is placed under the Ministry of Agriculture. It deals with planning of the agricultural areas.

j) Licensed private surveyors

Licensed private surveyors undertake cadastral surveys for titling purposes. Their involvement in the MPLDP will be in the form of contracts from private developers, for any works but specifically implementation of land subdivision plans.

k) Finance Ministry, commercial banks and financial institutions

The Ministry of Finance is supposed to fund the project management activities. Commercial banks and financial institutions will be approached for project funding. These institutions maintain servicing of all credit facilities (e.g. loans, mortgages and collateral to ensure security of their investment). Donor organizations could provide donations for the project.

l) Lesotho Housing and Land Development Corporation (LHLDC)

This is a government parastatal mostly involved in land expropriation and land and housing development schemes. This institution has shown interest to acquire land for development in the MPLDP area.

m) Public Private housing, facilities and property developers

Creditable private housing and property developers are important organizations which undertake provision and installation of housing, facilities, services and infrastructure in the MPLDP.

n) Community

The community must be included in the project as they are liable to benefits in the success of the project or being victims if it fails. Their stakeholdership is crucial in understanding what their main problems are, in such a way that programmes are prioritized according to their crucial needs. In the MPLDP the community has only a participatory role through its membership in the MPLDP Steering Committee but no decision-making role in the running of project.

o) Other Ministries and organizations

Various Ministries and private organizations are concerned and consulted during allocation of interests in rights in which they are directly involved. These include the following:

1) Trade, Industry and Marketing Ministry and related organizations

These organizations have interest in allocating land rights relating to commercial and industrial uses.

2) Public Works and Transport Ministry and other organizations

They undertake consultancies in allocations, construction and regular inspections on the public facilities installations and road networks.

3) Natural Resources Ministry and other organizations

Liaison is maintained between the project management regarding issues related to allocation of interests in natural resources such as water, minerals etc.

4) Tourism, Sports and Culture Ministry and other organizations

These organizations are concerned in consultation with allocating interests related to tourism establishments (e.g. national parks, game reserves, etc.), cultural venues (e.g. archives, museums, national monuments, etc.) and sports facilities, including sports fields.

5) Environmental Ministry and other organizations

This Ministry and its subsidiaries provide the guidelines for allocation, planning and development against hazards to environment.

5.5 Project Time framework

According to the Commissioner of Lands (N.D.: 3) the MPLDP is to take place in two phases, within which several stages are defined. The project is currently at stage 5 of phase 1. The phases with their accompanying stages are briefly discussed below with a Gantt chart in figure 5.6 on page 66, illustrating the timeframe in which project activities are envisaged to be accomplished.

a) Phase I

- Stage 1: This stage was envisaged to take a month. Activities in this stage include local public awareness about the project, election of representatives of locals to the MPLDP Steering Committee (SC) and appointment of the project manager. It should be noted however that locals as stakeholders in the project are represented in the SC to communicate their concerns and ideas, but can not in any way stop government decisions as mentioned in chapter 2 section 2.4.1.b (v) about the decision-making right in the project matters. During this stage, the SC will elect technical committees, which will undertake feasibility studies and other technical tasks for the project as will be mentioned in the next sections. For the feasibility studies, technical committees have to produce a project plan of action, which will be assessed by the SC.

- Stage 2: This stage involves assessment of the feasibility studies by the SC and selection of options for the development of the MPLDP site. The stage is anticipated to take two months.

- Stage 3: In two weeks the SC was to present the development options to the community and the relevant authorities for approval.

- Stage 4: This stage involves preparation of the detailed plan and land subdivision plan and was to take a month;
- Stage 5: This stage marks the implementation of phase I. Project activities in this stage include the preparation and drawing of contracts, through requests for proposal (RFP) process. Undertaking the site works, reallocation and allocation of new parcels and installation of services, facilities and infrastructure, are to be done at this stage. Furthermore, during this stage detailed proposals and land subdivision plans will be prepared for phase II of the project. The anticipated duration of this stage is six to eight months.

Phase 1	***One month***	***Two months***	***Two weeks***	***One month***	***To project closure***
1. Stage 1	1. Public awareness				
	2. Elections of SC				
	3. Feasibility studies				
2. Stage 2		1. Assessment of			
		feasibility studies			
		2. Formulating			
		development plan			
3. Stage 3			1.Community		
			and authorities approval		
5. Stage 4				1. Preparation of	
				detailed plans and	
				land subdivision plans	
4. Stage 5					1. Implementation
					2. Preparation of
					phase 2

Figure 5.6 Showing schedule of project activities on Gantt chart

b) Phase II

This phase will carry on from stage 5 till the project ends. The stages involved in this phase were not yet clear during the undertaking of this research. It is envisaged to cover the release of other development areas with different land uses, for allocation till the end of the project.

5.6 Project work breakdown structure

Work breakdown structure (WBS) is a tool to planning and scheduling a project. It entails breaking down project tasks to subtasks appropriate to be accomplished effectively with the available resources in a reference time framework, as noted in www.snc.edn./socsci/chairs/333/number.html (2001). The upper level of the structure provides the goals to be achieved and sets out the sequence of the succeeding level tasks and subtasks in which such goals are to be achieved. Project activities employing WBS and incorporating legal, institutional frameworks in a time framework (i.e. in pre-process, formal-process and post-process) are discussed below. The overall WBS of the MPLDP in a processes time framework is illustrated in figure 5.7 below in which lower levels are not included.

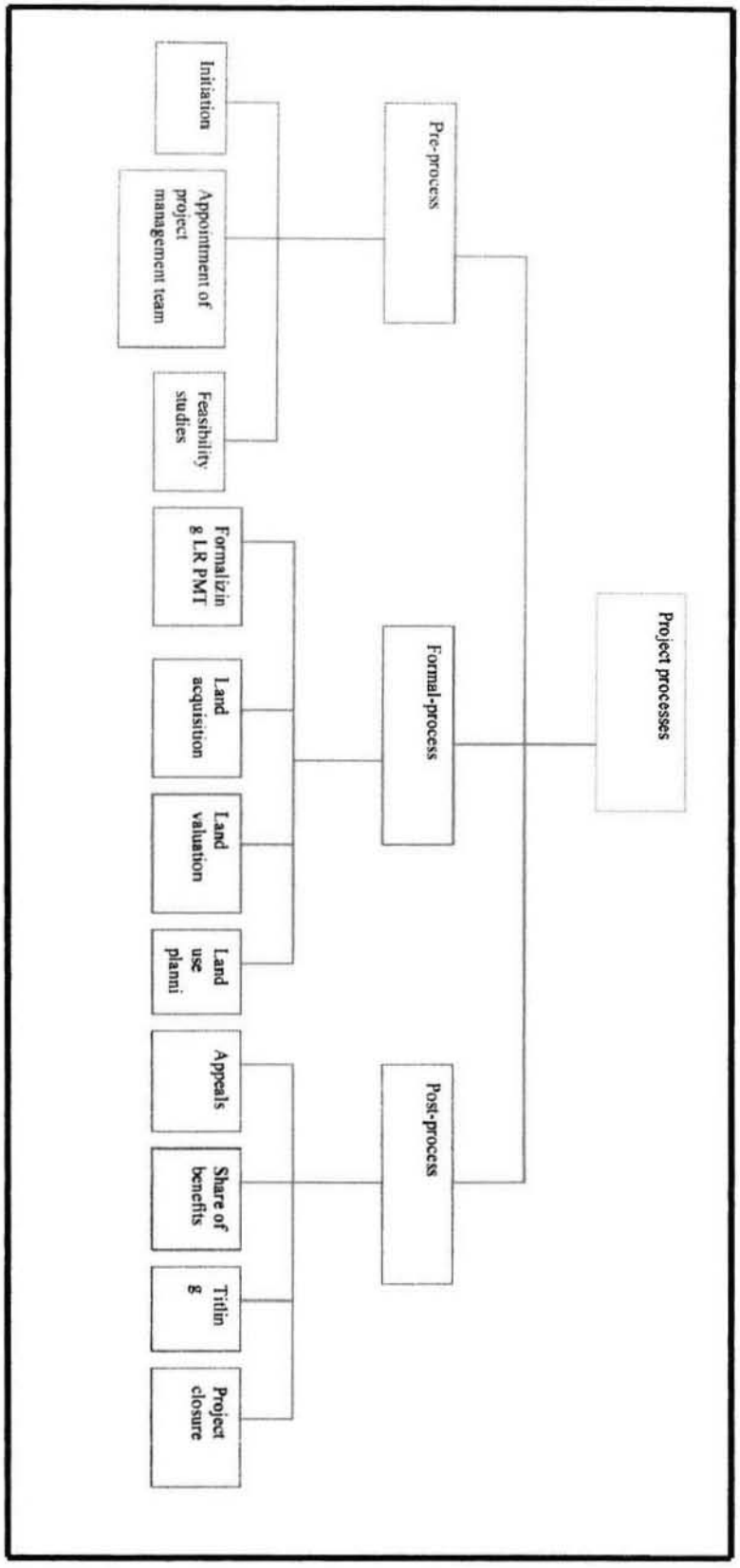


Figure 5.7 WBS of the MPLDP

5.6.1 Pre-process

The activities in the pre-process are mainly those mentioned in stages 1, 2 and 3 in the time framework.. These activities in the pre-process of LR have been shown in chapter 2 to include project initiation, including the appointment of the initial project management team, and feasibility studies as shown in figure 5.8 below.

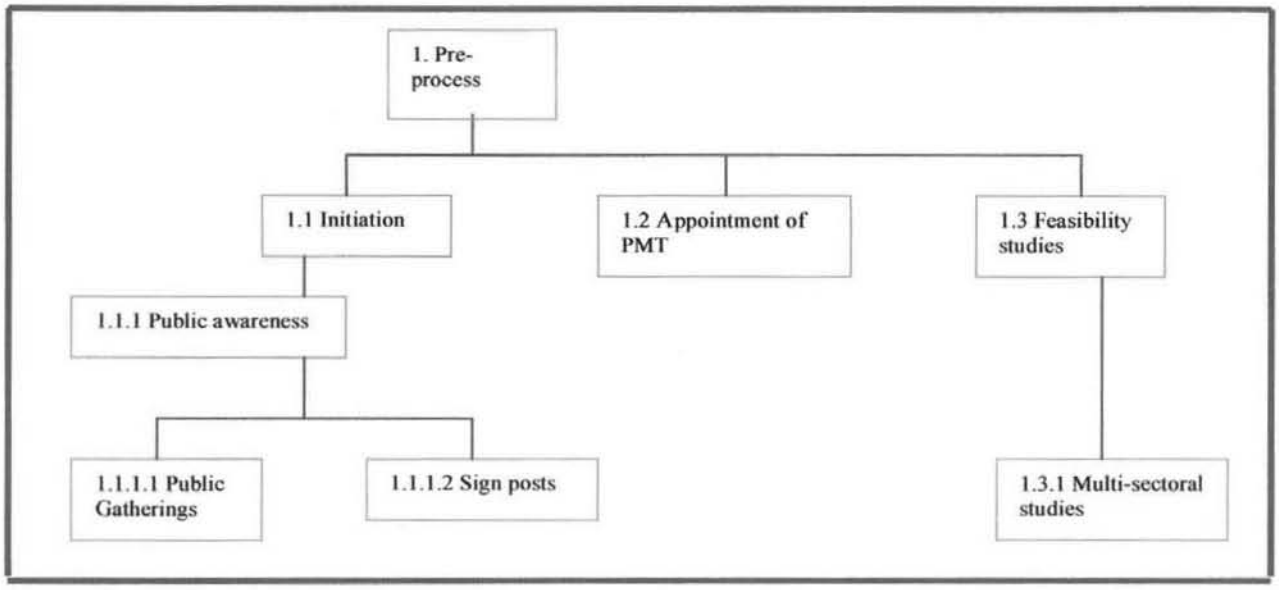


Figure 5.8 WBS for the pre-process

5.6.1.1 Project initiation

The MPLDP is a land management project initiated by the Lesotho Government through the Ministry of Local Government (MoLG) with interest to deal with formal land demand and to curb informal urban sprawl, by providing formal housing and facilities. The project management team made people aware of the project by conducting public gatherings and putting signposts. The project organizational framework presented in figure 5.9 was adopted:

5.6.1.2 PMT

This comprises the project manager, the administrative and the technical management staff appointed mainly from the DLSPP and the MCC. The PMT structure is discussed below.

a) Administrative team

The administrative team is termed the Steering Committee (SC) and is envisaged to include as many of the stakeholders who are mentioned under the institutional framework section as possible. This will include the fieldowners, local community, public sector agencies, the private sector investors and developers etc.

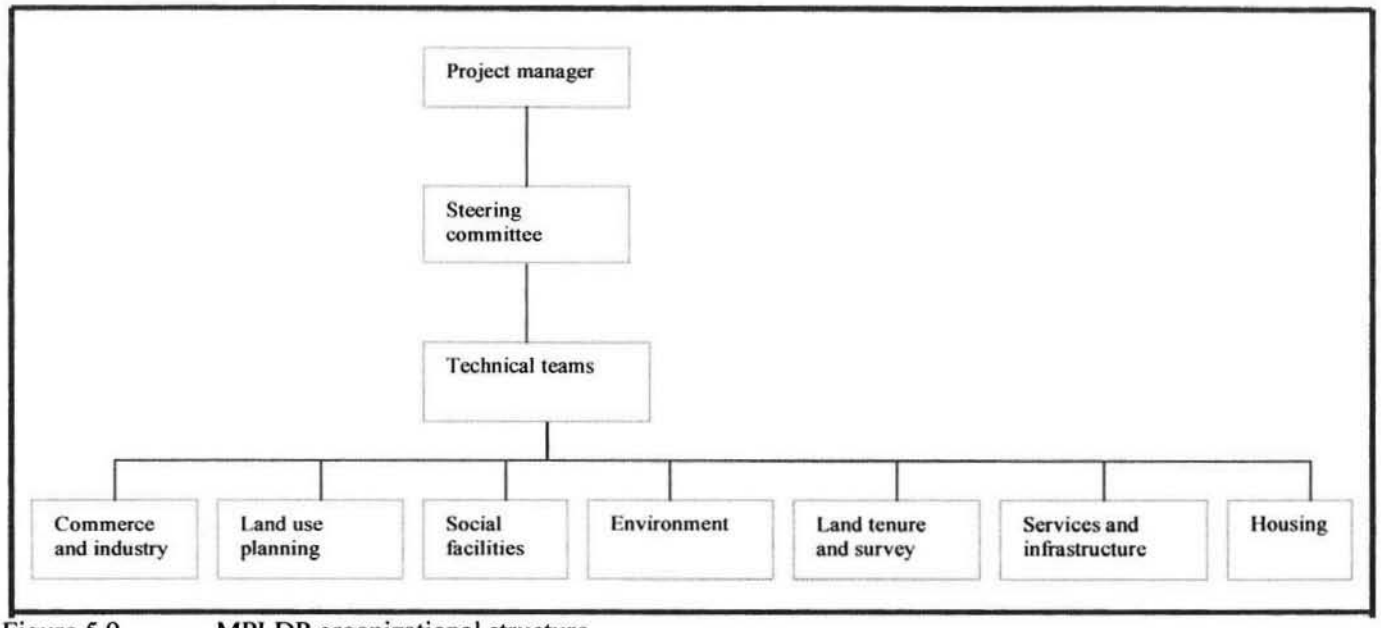


Figure 5.9 MPLDP organizational structure

b) Project Manager

The SC elects the project manager and he/she is the overall administrator and coordinator of the project.

c) Technical team

The technical team is appointed by the SC on the grounds of capacity and relevance to undertake the above subtasks mentioned in the work breakdown structure. The technical team comprises members from relevant institutions and set up the following sectoral committees:

- Commerce and industry;
- Environment;
- Housing;
- Services and infrastructure;
- Land tenure and survey;
- Land use planning;
- Social facilities.

5.6.1.3 Feasibility studies

According to Ramonaheng (2000: annex c) the PMT's technical committees are to undertake the following multi-sectoral feasibility studies:

a) Commerce and Industry Committee

The committee of Commerce and Industry has to perform feasibility studies based on the estimates of the following factors:

i) Existing and potential investment in commercial and industrial development in Maseru;
ii) Types of commercial and industrial development proposed by the potential investors in Maseru;
iii) Rental levels per square metre for prime and secondary commercial and industrial units by type;

iv) Existing and potential level of investment in commercial and industrial development in the project area;
v) Types of commercial and industrial development proposed by potential investors in the project area;
vi) Rental levels per square metre for prime and secondary commercial and industrial units by type in the project area;
vii) Potential level of local employment that commercial and industrial development could generate in the project area.

b) Environment Committee

This committee's tasks are:

i) Identification of areas within the project area, which are unsuitable for development (e.g. dongas, steep slopes, or areas of outstanding landscape, etc.);
ii) Identification of any environmental constraints to the development of other parts of the project area (e.g. topography, geology, ground cover, etc.);
iii) Assessment of environmental implications for the provision of water supply and installation of public sewers within the project areas.

c) Housing Committee

This committee's responsibilities include:

i) Assessment of housing needs for Maseru for the next five years;
ii) Estimating the proportion of total needs required for high, medium and low-income households;
iii) Assessment of the appropriate numbers and types of housing for the project area annually for the next five years;
iv) Estimating the total land area required annually in the project area for the proposed housing targets;
v) Considering alternative plot sizes and shapes, based on variations in the cost of servicing land at different density levels;
vi) Considering options for relating land costs to plot size and shape based on the variations in the costs of servicing land at different density levels;
vii) Considering options for developments by residents;
viii) Considering options for housing finance and credit appropriate to the needs of low-income households;
ix) Estimating the possible surplus which could be generated from residential development for middle and higher income for cross-subsidies to low-income households.

d) Services and infrastructure

The committee will:

i) Identify sources for water supply and capacity in the project area;
ii) Identify the sanitation options (e.g. public sewerage, pit latrines, septic tanks) for the project area;
iii) Identify any constraints on the supply of electricity within the project area;
iv) Estimate the economic costs of installing individual plot water connections at different residential density levels (assuming plot sizes of 900, 600, 350 and 250 square metres) for individual plot connections to public sewers;
v) Estimate the costs of roads for residential levels at existing standards for construction and rights of way (i.e. total reservation widths);
vi) Consider options for reducing road costs (e.g. land area required/widths of road reservations and levels of initial construction);

vii) Consider options for reducing total infrastructure costs by coordinating proposals between water, sanitation and road layouts;
viii) Consider options for incremental infrastructure development (e.g. provision of water connections and public sewers, etc.).

e) Social facilities Committee

This committee will:

i) Identify the standard population catchment size for primary and secondary schools in the new residential areas of Maseru;
ii) Specify the land areas required for both primary and secondary schools and any locational criteria. Indicate if school buildings and recreational open and can be used for community purposes;
iii) Identify the standard population catchment sizes for primary health centres/clinics in the new residential Maseru;
iv) Specify the standard population catchment sizes for public recreational spaces in the new residential areas of Maseru;
v) Specify the land areas required for primary health care centres/clinics and any locational criteria;
vi) Specify the standard population catchment sizes for public recreational spaces in the new residential areas of Maseru;
vii) Specify the standard population catchment sizes for churches in the new residential areas of Maseru;
viii) Specify the land required for churches and any locational criteria;
ix) Identify any major social, sports or other recreational facilities (e.g. public recreational grounds, cinemas, theatres, tennis courts/clubs, golf courses, social clubs, etc) required within Maseru, which would be appropriate to locate within Maseru, and which would be appropriate to locate within the project area;
x) Indicate the total area for each specified activity.

f) Land Tenure, Survey and Valuation Committee

The committee has to undertake the adjudication process and value all individual landowner's formal land and other immovable property in the project area by:

i) Identifying all the existing land holdings/fields in the project area;
ii) Determining the land market prices to estimate the values of all agricultural fields in the project area;
iii) Estimating the land market prices of the plots to be serviced in the project area.

g) Land Use Planning Committee

This committee will:

i) Identify the types of development preferred by the local residents in the project area;
ii) Identify options for efficient land use in the project areas (e.g. mixed land use, more compact urban development patterns, efficient road layouts, location and layout of social/commercial centres, etc.);
iii) Explore options for reducing land development costs (e.g. reduced road reservations, incremental services, etc.);
iv) Explore options for introducing a range of plot sizes and levels of servicing for all levels of housing demand (low, medium and high cost);
v) Assess the potential benefits of introducing smaller plots, say of 250 square metres, to reduce costs for low-income households.

According to Ramonaheng (2000: 2) the results of the feasibility studies are supposed to be compiled in an 'action plan' as the final document to be submitted to the authorities for approval of the project. The action plan must contain a draft scheme, which includes

i) Map of land parcels in the project site to show existing use;
ii) Landowner inventory;
iii) Proposal for dealing with and coordinating action against illegal occupation;
iv) Plans showing proposed land uses, including housing, commercial, road, drain, water, sewerage and electricity line networks;
v) Proposed project boundaries;
vi) Reallocation cases and reallocation plan;
vii) Calculation of budget for compensation;
viii) Distribution plan for compensation;
ix) Advice on implementation programme;
x) Development brief;
xi) A statement of approval of the majority of landowners.

5.6.2 Formal process

The formal process involves formalizing LR agency, land acquisition for the project, land valuation, and land use planning as shown in figure 5.10 below.

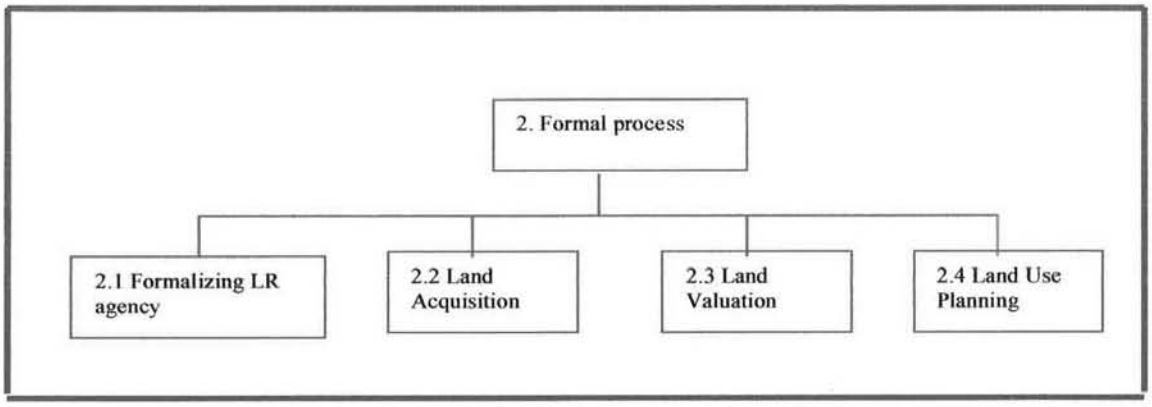


Figure 5.10 WBS for formal-process

5.6.2.1 Formalizing the MPLDP LR agency

This process involves reinstatement and/or introduction of members from relevant organizations, which are deemed to be important stakeholders in the project. The process is continuous as the PMT evaluates its goals and adopts changes.

5.6.2.2 Land acquisition

The activities of land acquisition for the project take the form of figure 5.11 on the next page. The procedure involves formal authentication of adjudication information as gathered during the feasibility studies. This is followed by delimitation project boundaries. All the parcels within the project boundaries are compulsorily pooled by the declaration of the area as the SDA, through Section 44 of Land Act (1979). Individual landowner rights are revoked and the project site is registered under the Head of State. Lawful landowners are, however, entitled to substitution rights after the project within it, or elsewhere, or to compensation. The Act further provides that any allocations and land developments undertaken without the Minister's consent in this area after this declaration are informal (Millennium Park Team, 2000: 2).

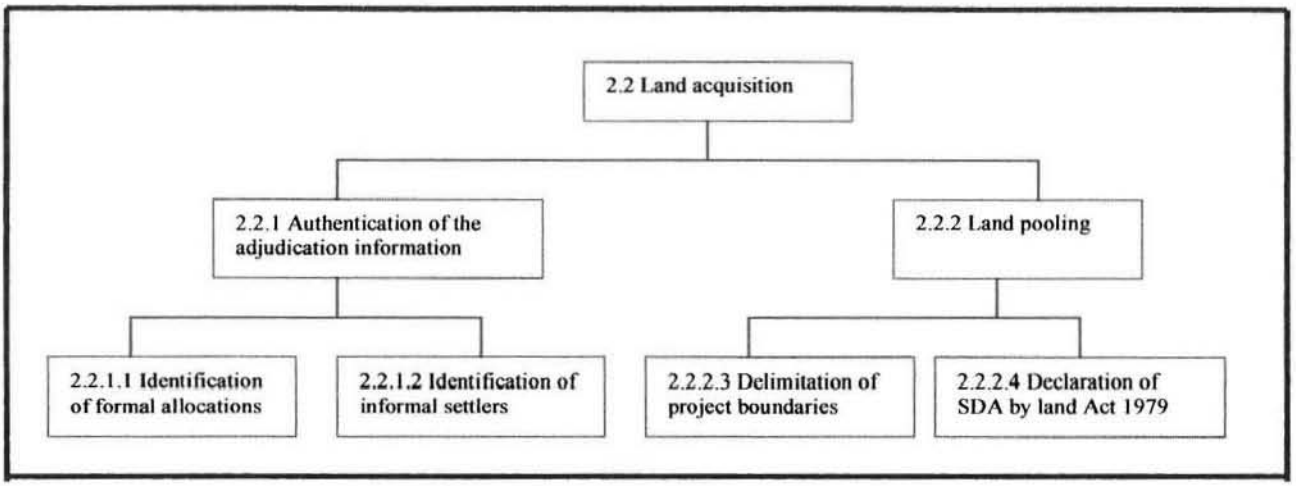


Figure 5.11 WBS for land acquisition procedure as extended from figure 5.7

In addition informal settlers identified during the feasibility studies are cleared to pave way for developments. Informal settlers are defined by Land Act (1979) section 87-(1) as mentioned above. A distinction is made however for those settlements in which are in continuum of development. These settlements are given a right to be upgraded to a level of formality. Furthermore subjects pursuing land developments after the declaration of the project area, as the SDA will be served with court orders to vacate (i.e. for those implementing new developments after the declaration of the project area as SDA) or stop developments in the case of already developed parcels. If the subjects do not abide by the law, the former face fine, imprisonment, eviction and demolition of property executed by the MCC in the help of the LTF, while the latter are fined or imprisoned.

In the cases whereby eviction of informal settlers seems inevitable for project purposes, the PMT has facilitated relocation to a nearby planned township of Khubelu given in figure 5.12 above, by requesting DLHUD to give them first preference and low cost in allocation of sites in this area.

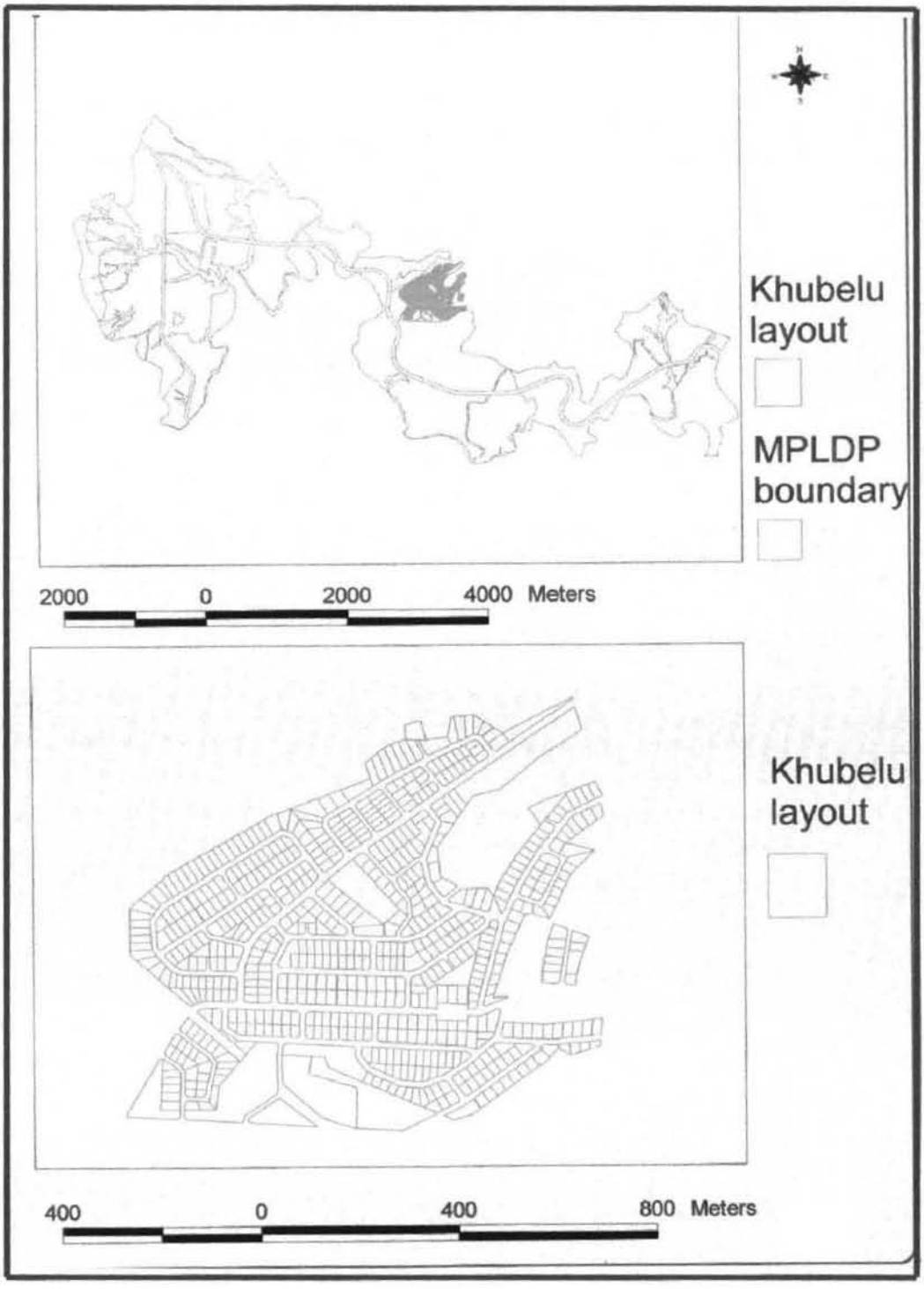


Figure 5.12 Khubelu layout relative to the MPLDP

5.6.2.3 Land valuation and calculation of shares

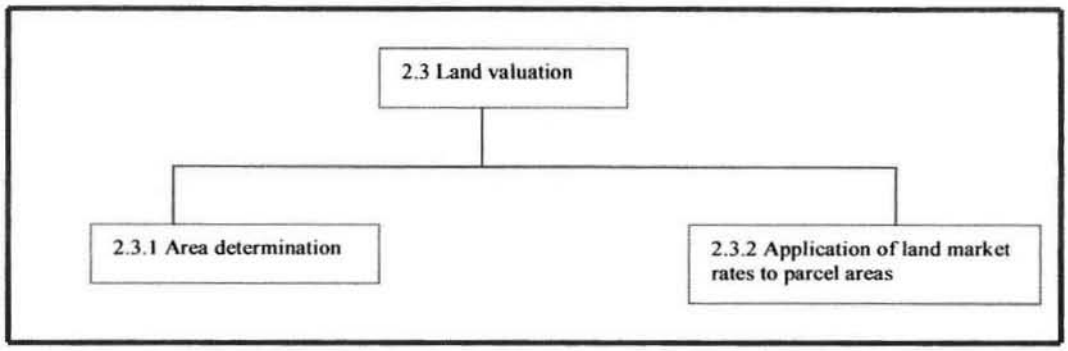


Figure 5.13 WBS for calculation of shares in the project

The 'land market rates' method mentioned in chapter 2 is adopted to determine the land values in the project. The process involves determining the areas of the fields from the survey diagram of fields produced in the action plan, and applying land market rates as shown in figure 5.13 above. Landowners contribute land to the project while all parcel developments are to be financed by the developers. Existing property values are also accounted for on willing buyer/willing seller price in cases of formal and *de facto* recognized informal settlers.

5.6.2.4 Land use planning

Land use planning in the MPLDP is aimed at achieving a planned settlement capable of accommodating housing, services and facilities. This should be done observing the above mentioned land use planning laws. The process includes delineation of project boundaries, zones, development areas and land subdivision plans as shown on figure 5.14 below.

- Delineation of project boundaries: A land use plan prepared during the feasibility studies was adopted as basis for deciding on the project boundaries.

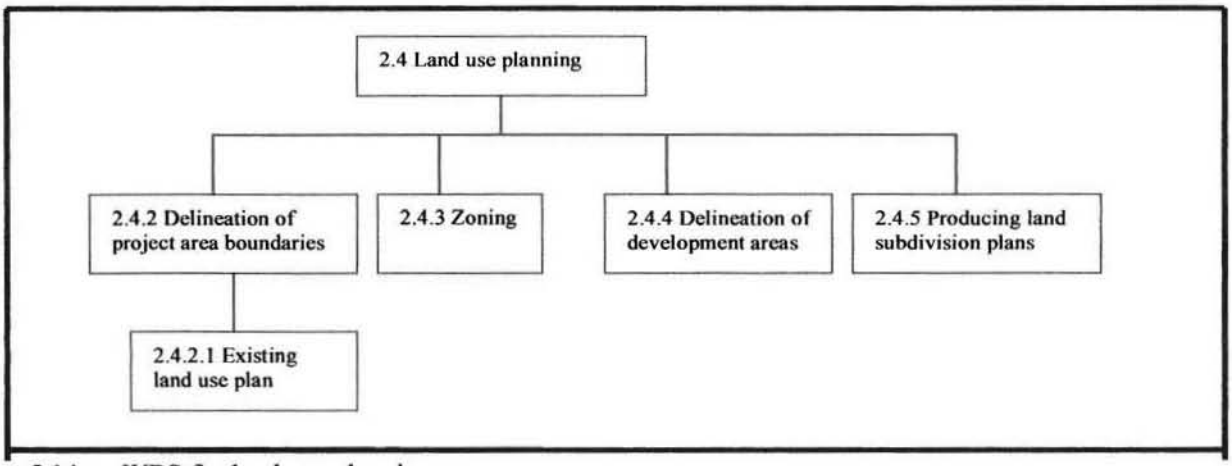


Figure 5.14 WBS for land use planning process

- Zoning: This involves partitioning the project area into areas of specific land use. The project area is currently zoned into residential, commercial, industrial, agricultural, institutional and open spaces. Integration of these land uses is supposed to follow planning regulations and environmental guidelines so that land uses do not intrude informally into each other. The Maseru Development Plan is the relevant guideline followed in zoning the area.

- Development areas: These are sizeable land subdivisions within zones and are delimited and allocated to developers. This delineation should follow Planning Standards and Guidelines of 1990 in such a way that development areas have sizes that relate land use to the population anticipated in the MPLDP. For example, institutional development areas should be in accordance with the terms of this regulation with relation to size of population.

- Land subdivision: These are land subdivisions within development areas delimited by developers and ready to be reallocated or allocated to fieldowners or prospective landowners respectively. Land subdivision plans should follow the Development Control Code 1989, as stated in the legal framework section above. A comparison to the examples in the LR review given in chapter 2 will be in places that are categorized as 'in continuum of development' (section 5.3.1.2 (a)). In this case the developer allocated such areas should incorporate the existing households in the land subdivision plan as much as possible. In this case a joint development occurs in which formal and informal settlers are in stakeholdership with the developer.

5.6.3 Post-process

The post-process of the MPLDP includes dispute resolutions, land developments, share of benefits and ultimate closure of the project as given in figure 5.15 below.

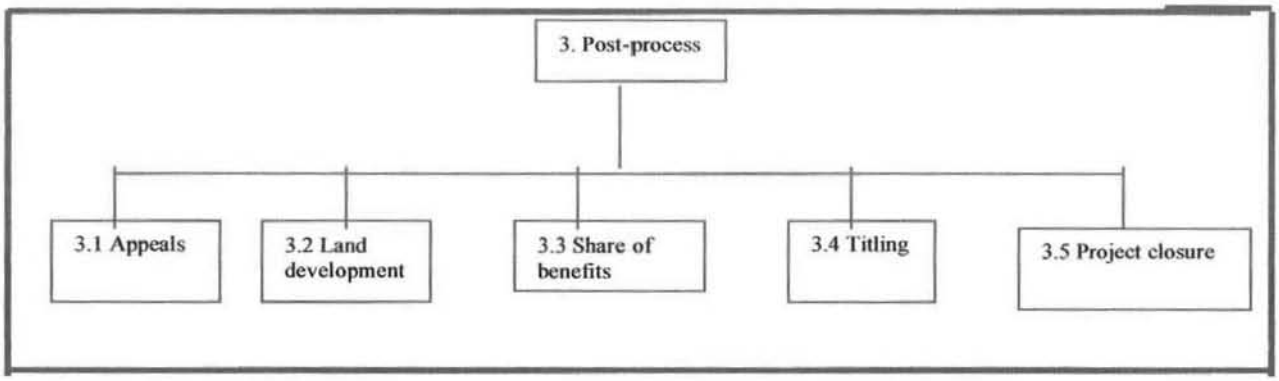


Figure 5.15 WBS for post-process

5.6.3.1 Appeals

As shown in figure 5.13 below the appeals activity involves legal action against illegal settlers (mainly those categorized under section 5.3.1.2 (b) and (c)), attending to land disputes and any other appeals related to dissatisfied fieldowners and any parties pursuing land developments after the declaration of the project area as the SDA. The PMT has no internal administrative land dispute or criminal resolution mechanism, however it may facilitates any legal actions involved in the project to relevant courts. In case of illegal land developments, the PMT hands in a report to the LTF to instigate legal action in the relevant courts and further execute court decisions such as evictions, attending to property demolition, etc. Other appeals are directed to the Land Tribunal, the Magistrate Courts, the High Court and the Appeal Courts of Lesotho as codified in the Land Act (1979) discussed in the institutional framework above. The dispute resolution machinery for the MPLDP is illustrated in figure 5.16 below. Until end of year 2000 273 dockets had been issued against informal settlers mostly of categories 5.3.2.1 (b) and (c) (Millennium Park Land Development Project, 2001: 4).

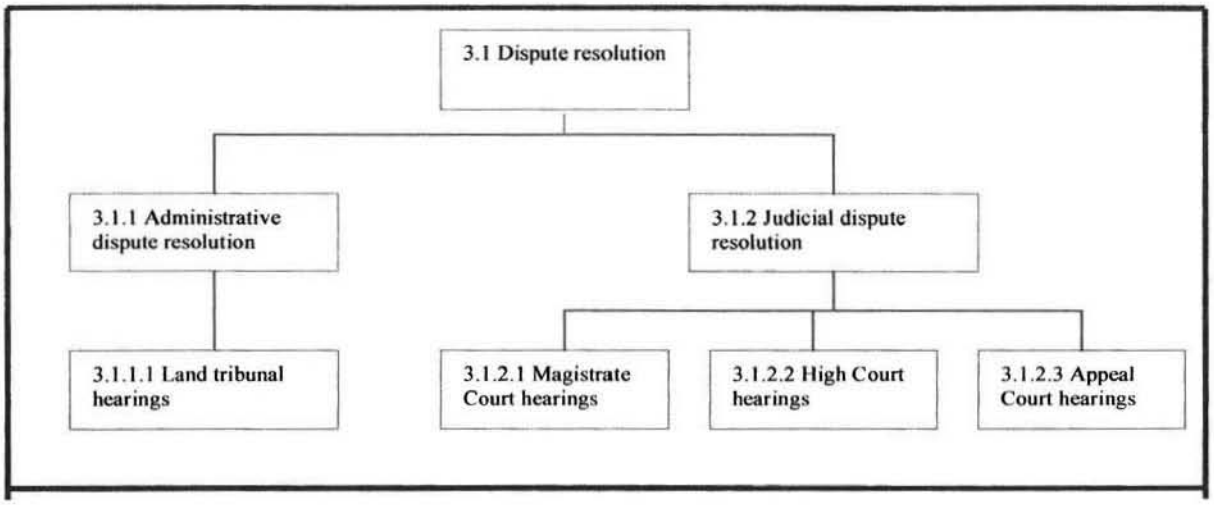


Figure 5.16 Land dispute resolution WBS

5.6.3.2 Land development

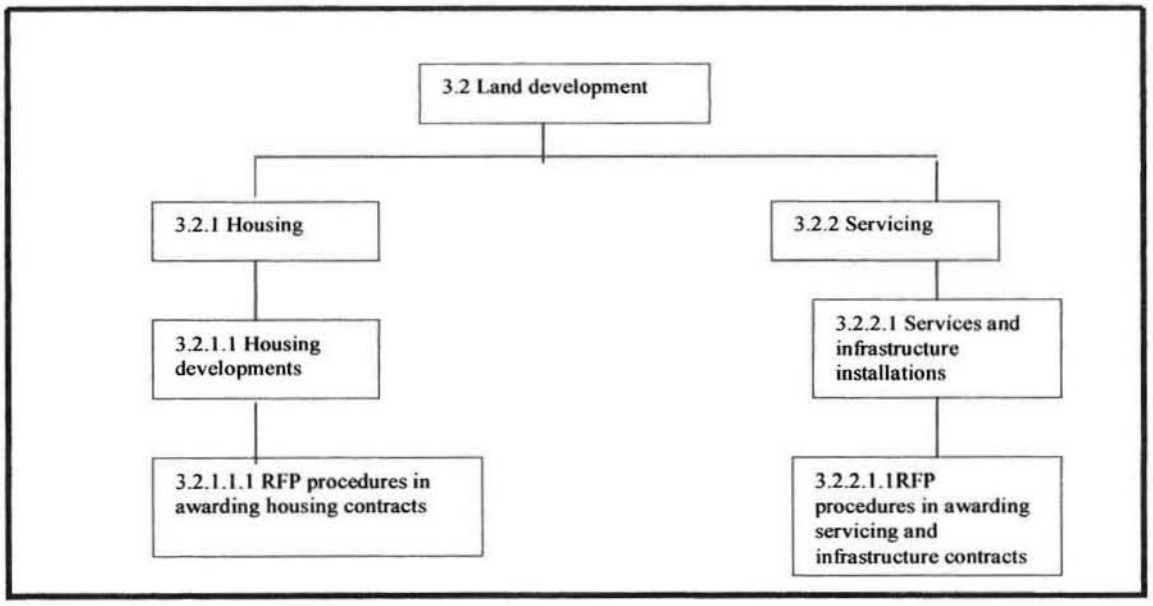


Figure 5.17 WBS for the land development procedure

Land development in the MPLDP is to be entirely guided by the PMT, ensuring that developments are in accordance with the planning regulations mentioned above. The PMT contracts credible private and public developers in the RFP procedure to undertake housing and servicing tasks in the project area as shown in figure 5.17. Land developments include, among others, housing schemes and installation of various infrastructures, facilities and services as mentioned in the project aims. Developers are formally allocated development areas with full title documents, as Section 47 of Land Act (1979) provides, in terms of housing developments. In cases of network services such as roads etc, servitude is registered where necessary with the service provider. The outline of RFP procedure is given below.

The PMT is to announce 'Request for Proposals' (RFP) shown in appendix C in cognizance of Section 22 of Land Act (1979) mentioned above to interested developers to tender for the development of each delimited development area or the installation of infrastructure and services in the project site. According to the Millennium Park Team, (2000: 20) developers are supposed to include in their tenders the following:

i) Mandatory performance standards;

ii) General and special conditions or terms under which the developer will operate;

iii) A time frame for construction;

iv) A land subdivision plan that will accommodate the landowners in the development area in the project site. Accommodating landowners may include equitable land reallocation within the developer's land subdivision plan. In cases where the developer is allocated area of other land use than residential the developer could provide options of equitable land reallocation outside the allocated development area or equitable compensation;

v) An environment impact assessment document that ensures that the developer will protect the public interest in achieving predetermined social and environmental benefits.

The developers are supposed to engage in the following project construction works with their own project funding as specified by Ramonaheng (2000: 5):

- All specified site works in the development areas;
- Allocation of new parcels and leases to all affected households and prospective landowners. The parcels must include high, medium and low-income categories in the proportion as mentioned in section 5.1 above;
- Completion of the installation of all agreed infrastructures.

5.6.3.3 Sharing of benefits

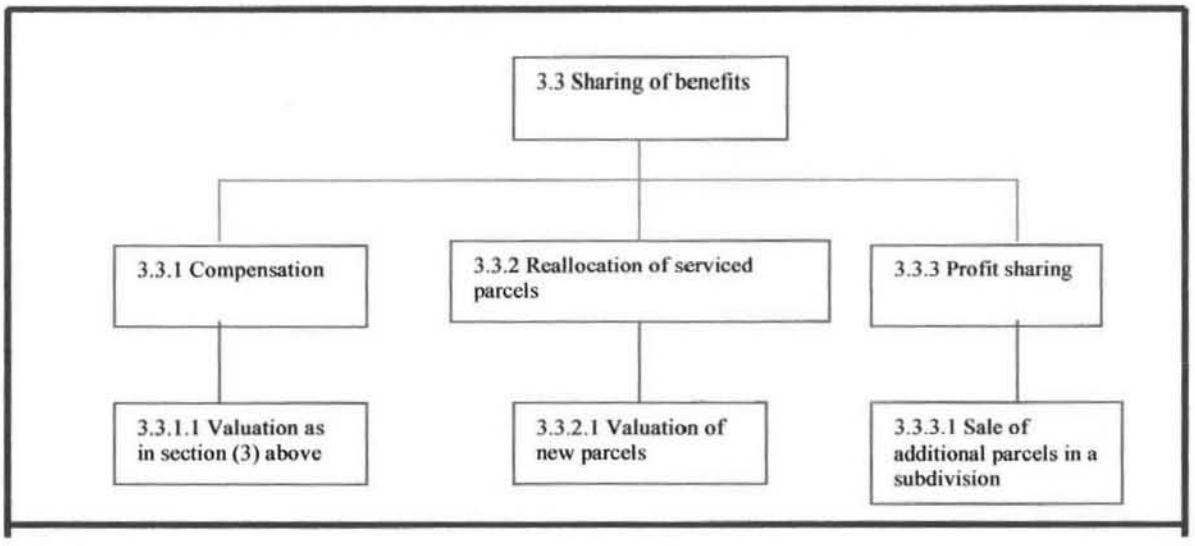


Figure 5.18 WBS of sharing of benefits

These activities are indicated in figure 5.18 above and a brief discussion of each is given below:

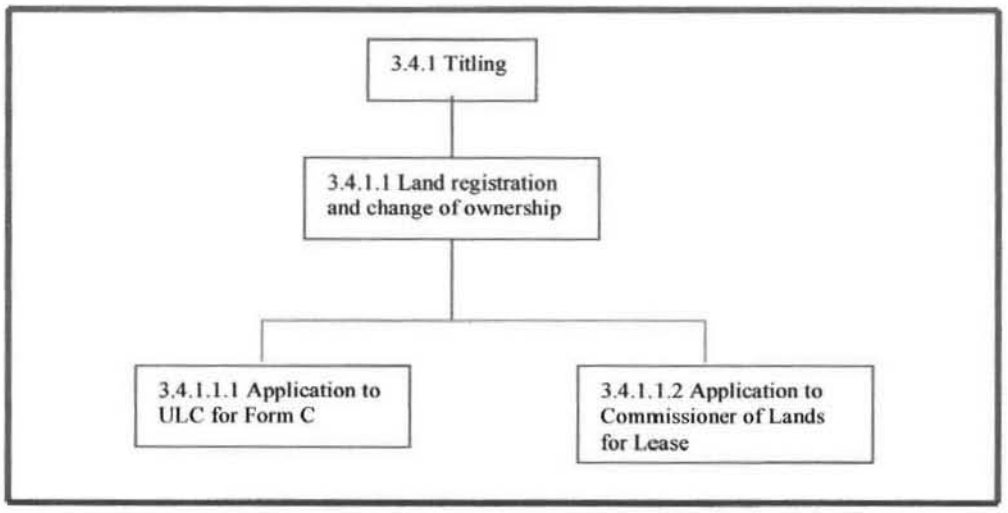


Figure 5.19 WBS for titling activity

5.6.3.5 Project closure

The project will be closed and all other land related matters such as land taxation would have to be handed to the relevant authorities.

5.7 Concluding remarks

In this chapter the MPLDP project management, legal, institutional and time framework structure is discussed. The importance of studying the project management structure lies in the understanding of the environment that LIS will work within. Project goals, problems and aims were discussed. It was shown that provision of housing and services are the goals of the project, that is, to cater for urbanization and to curb urban sprawl. The ways in which these goals are to be achieved are highlighted. Furthermore, the legal and institutional frameworks in which the project is supposed to run are discussed. Legally, the main land tenure and land use planning statutes were considered. These focussed more on allocation of land rights and land use planning in urban areas. Discussion of these statutes is again in cognizance of the fact that the area in question is located in the urban periphery and it is evolving into an urban township as a result of the project. The main evolution is progressing from the existing customary tenure and informal tenure into statutory tenure systems.

The aspect of informal settlements in the project area as a deviation from the LR review given in chapter 2 was highlighted. It was shown that those simpler model approaches discussed cannot be easily implemented without attention to problems of informal settlements predominant in third world countries. Thus this aspect was touched in every applicable section in this chapter and ways used by the PMT and arguments supported by literature were provided in which the complexities these informal settlements pose to LR procedures can be overcome.
Furthermore, all the necessary institutions in which project activities were of interest are mentioned. It is shown that the institutional framework contributes strongly towards the part these institutions play in the project activities. The project time framework is discussed. WBS is then employed to unpack the project activities and these activities are broken down into time framework, integrated with the legal and institutional issues as regarding the subtasks involved in the project.

In concluding this chapter it is also necessary to give a brief comparison of the MPLDP with the LR review given in chapter 2.

- LR approach: The MPLDP exhibits 'building supply type' with a mixture of 'new town type', 'sprawl prevention type'. 'New town type' applies in conditions where most of the land is undeveloped and rezoning applies at massive scale to accommodate more land prospective subjects and a variety of land uses. This massive rezoning to allocate land to a vast majority of people is highlighted in the case of China in chapter 2

  'Sprawl prevention type' is applicable in curbing eruption of sparsely populated settlements, in predominantly agricultural land resulting from informal scramble of land due to recent opportunities introduced within and around the project area. A comparable situation was highlighted in chapter 2 about how urban sprawl of sparsely developed settlements in California and Florida in the United States, which became an impediment to a later development were unified and redeveloped with the use of LR. . In this instance demolition of informal property and eviction will be inevitable in places rezoned for other land uses such as industrial, institutional etc and to provide a planning that can cater for a larger number of people.

  'Sprawl prevention type' also holds as a model in the areas of continuum of development where upgrades will be implemented to curb informal expansion of initially formal settlements into primary agricultural land. In MPLDP as also shown for the Mabote project case, is the fact that statutory law fails to address informal settlement question due to apparent political, economic and social issues. In this case common law is applicable in which informal settlements are given *de facto* recognition of rights. This is a case not highlighted in the review of LR in chapter 2.

- Project initiation: the Government of Lesotho initiates The MPLDP project and therefore a public sector concept. In this capacity the government further undertakes preliminary feasibility studies through elected multi-sectoral technical team. Thus the need, preliminary suitability, interest and impulse to initiate MPLDP project are a government concern. In terms of preliminary project feasibility the government as initiators take the task, as they need to see the project succeed from its initial stages. Developers undertake the site-specific suitability studies aiming at improved efficiency in construction works to minimize costs and maximize their profits. The profitability, however is of the private sector, which is awarded the development rights, and the subjects involved in the project. This is comparable to LR initiated by governments such as a mention of Japan in chapter 2.

- Decision-making power: Decision-making powers are invested in the Government and the community has only participation rights in the MPLDP. This is similar to LR projects undertaken in Germany and Western Australia in which governments are initiators and the decision-making powers of the involved subjects are very weak. It is in this case where the governments are entrusted to take meaningful decisions for public interest.

- Organizational structure: The organizational structure can be described along these lines. The project manager is the executor or the agent, the SC is the general assembly of all the stakeholders and the technical team being the LR board which is appointed by the SC to undertake specified tasks on behalf of the SC. The executor and general assembly are terms discussed in chapter 2.

- Land acquisition: The land acquisition procedure in the MPLDP is statutory and follows land pooling. It also encompasses the acquisition in whole of the landowner's parcel. LR in Lesotho is undertaken under ordinary land laws, rather than one singling out LR specifically, as it has been shown in chapter 2, for countries like South Korea, Japan or Germany.

- Dispute resolution mechanisms: The administrative Land Tribunal undertakes all appeals in the project first, and further appeals are forwarded to the judicial or civil courts. This is similar to the Swedish procedure as was discussed in chapter 2.

Important to note in this case is the fact that although dispute resolution in terms of informal settlers both common law and statutory law apply as mentioned in section 5.3.1.2. As opposed to the western and eastern examples given in LR review in chapter 2 the MPLDP exhibits typical third world country characteristic in which change from customary to statutory tenure became inefficient. During time of inefficiency, informal tenure system remained *de-facto* and at larger scale in which application of statutory law tends to upset the current political, social and economic structures of the government and the society. Thus it becomes inevitable to apply common law (in form of *de facto* recognition of informal settlements) in a way in which when such upsets become apparent common law be used to resolve disputes such as in those settlements which are in continuum of development.

- Land developments: Site works in the project area are a PMT role through RFP's or contracts to private and public developers. The PMT further oversees that activities are done as agreed and formally. This approach is similar to that adopted in Germany and Western Australia where the public sectors are responsible for all the developments, often through necessary issuance of contracts to private sector;

- Sharing benefits: In terms of sharing project benefits and profits, private developers, as the prime developers, enjoy all the profits accruing (including proceeds of allocating extra parcels) from the project while landowners enjoy equitable serviced parcels. This is also the case in Germany where local authorities as the prime developers in development enjoy all the profits.

  Mentioned in chapter 2 was that in LR projects no party in the stakeholdership is to suffer loss. Regrettable, to loose however in the project is those informal settlers who disrupt the project by developing their sites after the declaration of the area as SDA. In this case their ignorance to law will unfortunately cost them eviction, demolition of property, fine and or imprisonment. Thus strict monitoring of land developments in settlements manifested with high rate of informal land delivery is important because LR is mentioned in chapter 2 to benefit every stakeholder in the project.

Thus the MPLDP exhibits most of the characteristics of LR projects run by public sector organizations.

Chapter 6

MPLDP system analysis

6.0 Introduction

System analysis stems from the assumption (which most of the time is apparent) that a system is not performing efficiently. In order to identify the inefficiency of the system one looks first at the system input and anticipated system output in the timeframe. If there is inefficiency in a system, usually backlogs, and bottlenecks in the system deliveries. System analysis is therefore employed to find the problems and the constraint that cause bottlenecks and backlogs. Investigation of such problems and constraints follow a structured systems analysis methodology as was mentioned in chapter 4. Such a methodology includes requirements determination and structuring of the requirements which is the focus of this chapter.

This chapter presents MPLDP system analysis. This analysis arose from the apparent backlogs and therefore bottlenecks in the activities of this project. The first stage in this system analysis was to investigate the requirements of the system. A requirement determination fact-finding mission was conducted, in which the major focus was on how the project activities are executed and how information was management. In addition, information including project publications, legislation documents guiding the project activities and other miscellaneous information (political background, and resources including human and technical) was compiled. This investigation formed the basis on which to identify the cause of the bottlenecks and any constraints that make the system ineffective.

The information flow in the system were further analyzed using various tools. Data flow diagrams (DFD) and data dictionaries (DD) were employed. DFD is used to depict how data and information flow between processes, and how such data is processed, stored and retrieved. DD provides description of data, data storages and processes. From this analysis using DFD and DD, a visual representation can be accomplished so as to determine where constraints and problems might occur. A structured approach is further pursued to assemble MPLDP requirements in such a way as to recommend improvements. Tools such as information architecture are used for this purpose.

6.1 The MPLDP PMT composition, functions and information management

As mentioned in chapter 5, the PMT is the main coordinator and administrator of the project activities. It was also mentioned that the PMT consists of various committees that are allocated different tasks to perform in order to achieve the objectives of the MPLDP. Below is an overview of the structure and functions of each of the committees constituting the PMT as deduced from the analysis. It was mentioned in the last chapter that, during the time of undertaking this research the project was at its fifth stage and the activities engaged in so far and the anticipated will be discussed below going through each committee.

6.1.1 Land tenure, survey and valuation committee

a) Structure

The Chief Surveyor heads the committee on secondment from the DLSPP. The committee further includes members from other relevant private and public organizations.

b) Functions

The committee undertakes the administration of land allocation, including adjudication prior to land acquisition, demarcation of project and development area boundaries, and land valuation. In addition the committee oversees compensation and reallocation issues in the project. The committee keeps land records including landowner inventory and accompanying graphical cadastre and land value records. Further the

committee has been tasked to incorporate into their graphical cadastre land subdivision cadastral plans which are received from the developers and associated land values. Below is an overview of the functions of this committee.

1) Adjudication process

The adjudication process involves identification of the rights and interests in parcel, ownership of rights and interests and parcel status, prior to land transfer. In order to carry out adjudication as reviewed in chapter 3 the committee undertook the following:

- Determination of the spatial location and status of the acquired parcels: The spatial location of parcels is necessary to identify parcels to be transferred. The status of parcels is necessary to ascertain that no boundary conditions have been tampered with to allow fraudulent claims of compensation, land disputes or encroachments. Most of the parcels in the project area were allocated in customary tenure and informal tenure where in most cases formal records are not kept.

  For parcel identification and further record keeping, The Aircraft Operating Company (AOC) of South Africa was engaged to map the project area, employing aerial photography. The product orthophotograph was a series of (geo-referenced and rectified in Lesotho geodetic system) digital images of the project area supplied on CD-ROM in standard TIFF format at 1:2500 scale with accompanying TFW world files. From this orthophotograph the Land Tenure and Survey Committee undertook a general boundary survey of the parcels within the project area. Barry (1999: 141) quoting (Kraus, 1993: 233-236, Barry and Mason, 1997) maintains that well-defined point features such as houses and fence corners at such scales of aerial photography can yield planimetric accuracy in the order of 10 to 20 centimetres. This accuracy is good enough for the adjudication process.

  The general boundary survey was done in adherence to section 10 and 14 of the Chief Surveyor's directions and authenticated as such by the Chief Surveyor in his capacity as head of the Land Tenure and Survey Committee. The Chief Surveyor's directions (N.D.: 21) state that every plan or overlay at scale 1: 2500 will be allowed as a base to undertake general boundary surveys. Section 10 of the directions further provides that general boundary surveys must provide information sufficient to identify without reasonable doubt the properly maintained boundaries of a parcel formally allocated. In addition such information should include fair measure of the area for purposes of valuation for calculating ground rent, etc. Section 14-(a) also provides that features such as precisely defined walls, fences are allowed to mark general boundaries only if they are properly maintained, to leave in no doubt the extent of the parcel concerned.

  For this survey the seasonal marsh mentioned in chapter 3 was adopted as the general boundaries of the fields and was both identifiable from the orthophotograph and verified on the ground (Check this seasonal marsh at boundaries of fields on figures 5.4 and 5.5 on pages 57 and 58. But for those areas in which the field boundaries had been destroyed due to high rates of households property developments (areas of *de facto* recognition of rights of informal settlements), property boundaries were identified on the orthophotographs and further verified on the ground. In both these cases where boundaries were not identifiable on the orthophotographs Global Positioning System (GPS) was used for data capture. Printed hardcopy of the orthophotograph was used initially to draft general boundary surveys diagrams. The boundaries captured by GPS were further used to update the delineation on the orthophotograph. Verification from site visits culminated in the corrections of some of the boundaries and later on-screen digitizing of these cadastral plans (using Arcview) of the field boundaries, which were further examined and adopted as *de jure* field boundaries. Furthermore field areas were calculated automatically using '*[Shape].ReturnArea*' function in Arcview. The Committee is in possession of the hardcopy cadastral plans and a digitized copy in Arcview shapefile format as shown in figure 6.1 on the next page.

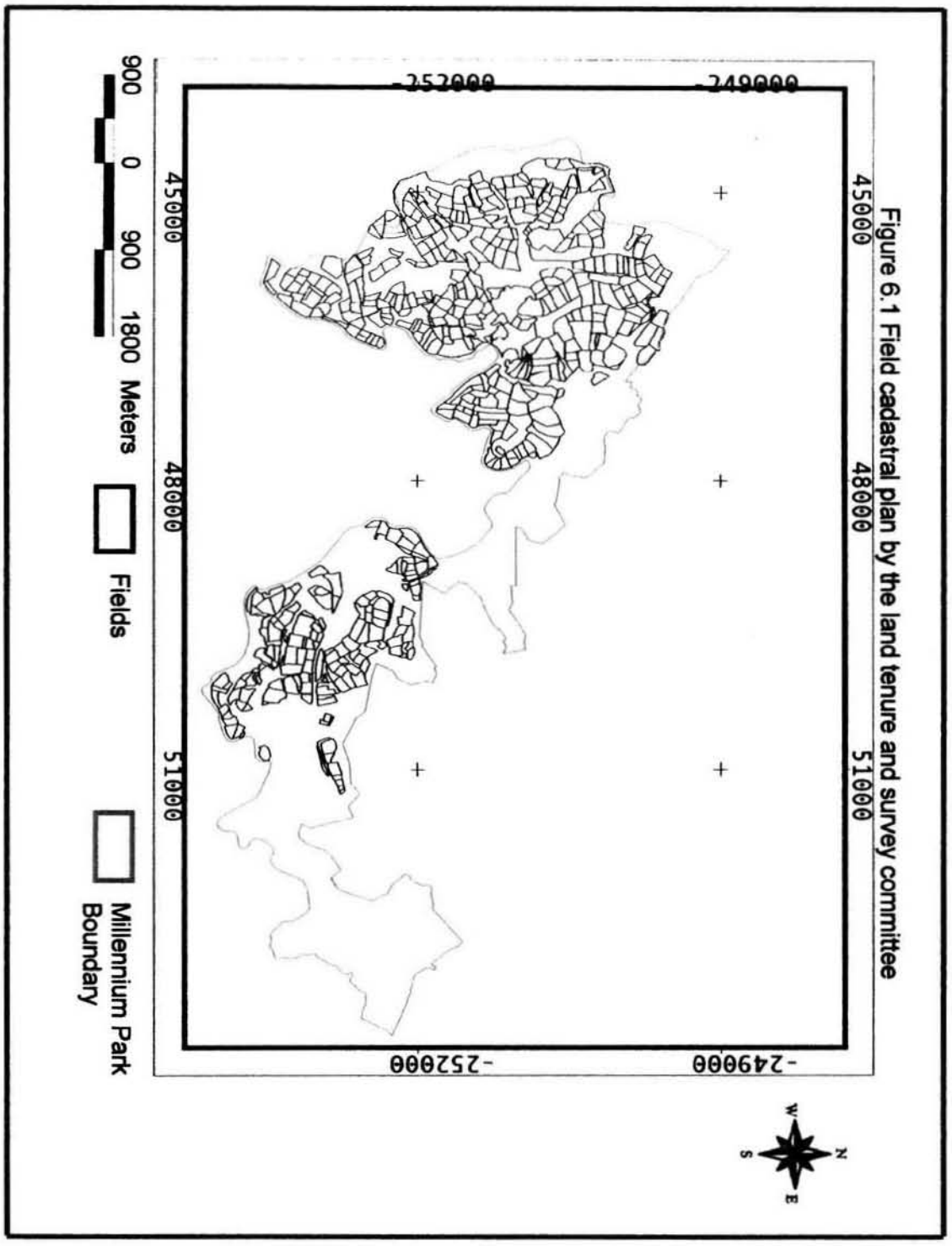


Figure 6.1 Field cadastral plan kept by the Land Tenure and Survey Committee in Arcview.

- Identification of the rights, interest and ownership: A site visit was organized at which each field or property owner or person having registrable interest in land was called forward to pinpoint his/her parcel of interest. In addition 'Form C' which is a certificate of allocation in the then rural area was a requirement to ascertain land ownership (a specimen of 'Form C' is provided in appendix D). Local chiefs and VDC verified landownership information. These resulted in compilation of landownership inventory, which included landowner details and title status cross-referenced to a parcel which were then delineated on the hardcopy orthophotograph. At this stage any apparent deviations from the delineated orthophotograph with the ground situation were corrected. Figure 6.2 is an extract from the Feature Attribute Table of the fields mentioned above, in which, the committee keeps the digital version of the landownership records. There are cases however, where landownership was disputed. Accordingly, parties that disputed ownership to land were noted and forwarded to appropriate dispute resolution machinery.

Shape	Entity	Area	Field_no	Surname	First_na
Polygon	Line String	10092	116		
Polygon	Complex Shape	18047	134		
Polygon	Complex Shape	6418	135		
Polygon	Complex Shape	14413	133		
Polygon	Complex Shape	9423	132		
Polygon	Complex Shape	7199	130		

Figure 6.2 Presents how the committee keeps its automated landownership records in Arcview as part of feature attribute table (FAT) of the field general boundary surveys. Names had been intentionally omitted for privacy.

- Identification of informal settlers: The categories of informal settlements discussed in chapter 5 (presented in section 5.3.1.2) hold in the identification and further treatment of informal settlers in the project area. But to make the procedure in which it was possible to unpack and gauge the informal settlement problem as relating to statutory land law, the following were informal settler issues investigated.

  i) Those whose households encroached informally into agricultural fields.

  ii) Those without possession of allocation certificates (Form C) and whose allocation could not be verified by local chiefs or VDC.

  iii) Those in possession of Form C but who could not have reached the required age for land allocation prior to promulgation of the Land Act 1979 when the land allocation rights were stripped off from the chiefs. This showed situations whereby such allocations were done post 1979 and chiefs as *de facto* land authorities had deliberately backdated allocation certificates to corrupt allocation procedures.

  iv) Those pursuing land developments after declaration of the project area SDA.

2) Project boundary demarcation

The committee performed dermacation of the project area boundaries by fixed boundary survey method. Trimble Global Positioning System (GPS) was used in differential, real-time kinematic (RTK) mode for this purpose. Carrier phase was observable and the GPS was operating at dual frequency (L1 and L2).

The Land Tenure and Survey Committee were shown the project boundaries by the Land Use Planning Committee on the site, to which the committee members placed standard pegs and surveyed them as *de jure*

boundary beacons of the project area. The beacons were surveyed using GPS 'stop-and-go' real-time in differential mode as mentioned above, in which an accuracy of 0.001m in horizontal positioning was pre-set, and the occupation time at each monument was determined by attaining this accuracy. Krynski (1997: 186) describes 'stop and go' as a GPS semi-kinematic survey in which a large number of boundary points can be rapidly surveyed within a short period of time. Two to four epochs can be collected to get a fix (coordinates of boundary monument on reference frame).

Data was downloaded from the GPS receiver into the TSO software in Rinex file format written in ASCII text file format. A survey file of the project boundary including a print out of the cadastral plan together with survey computations are sent to DLSPP for examination. When the survey passed, the graphical component of the project boundary from the TSO was converted into Data eXchange format (DXF) format and migrated into Microstation where the other relevant project's graphical cadastre was stored. Later after the acquisition of Arcview software, there was another migration of graphical cadastre component from Microstation into Arcview. Arcview is compatible with Microstation DGN format or a conversion to DXF format can be done if necessary, but for editing purposes, the DGN or DXF formats had to be converted into Arcview shapefile format. It is envisaged that the committee will update its cadastre in Arcview with examined land subdivision cadastral plans from private surveyors hired by developers.

Although the GPS surveys are not codified in the Chief Surveyor's directions, this method was allowed by invoking Land Survey Act (1980) Section 3-(1) providing that the Chief Surveyor can direct and control all public surveys. Thus with this section the GPS survey of the project boundary was allowed by the Chief Surveyor. According to the Chief Surveyor's directions (N.D.: 12) the dimensions of cadastral plans require depiction in metres and hectares as units of length and area respectively. All the mappings are required to be in the National Grid. The National Grid is based on national network, which is "Gauss Conformal Projection Two-degree Belts (Lo 27 degrees and Lo 29 degrees) for Lesotho using the Clark 1880 (modified) spheroid" (Chief Surveyor's directions, N.D.: 12). The Chief Surveyor's directions provides that where national geodetic control does not exist, arbitrary local grid can be adopted and be noted for its usage in production of cadastral plans. Therefore necessary transformation was done to move from the GPS WGS 84 ellipsoidal project boundary beacon coordinates to the required national grid system.

3) Valuation

Fixed land market rates were used to value fields in the MPLDP. Identification of the fields to be valued was accomplished by reference to the general boundary cadastral plans produced as described above. Appropriate land market rates were applied to the parcel area and the product of both maintained as recorded as the formal value of the fields and property in the project area. In addition the property of formal and *de facto* recognized informal settlers were valued according to the willing buyer willing seller price and kept as formal property values.

At the time of this research, parcel values were determined automatically by multiplying parcel areas as depicted on the analogue examined cadastral plans with land market rates in spread sheet programs including MS Excel as provided in appendix E. Committee members use computer printouts of these records to perform their assigned tasks.

4) Administering reallocation and compensation

Reference is made to landownership and land value records to verify equitable reallocation and compensation. Land values and property values of the original parcels and property respectively are matched with those of reallocated parcels and/or compensation and discrepancies noted. Further recommendations are made to resolve discrepancies as provided by the law. Moreover, the allocation process is monitored to ensure that formal land transfer procedures are followed. This procedure is recorded in landownership records.

5) Dispute resolution

The committee has responsibility to facilitate appeals arising from informal settlements, land disputes allocations and compensation. An inventory of appeals in form of legal records is kept in which all the data regarding the above appeals are recorded. The inventory of appeals is first compiled manually and committee members further make their own automated copies in various Microsoft programs. A brief description of how appeals are handled in the project is given below:

- Dealing with informal settlers: An extract from inventory of informal settlers is handed over to the LTF with an accompanying location map from the orthophotograph printout. The LTF instigates legal action against informal settlers and further serves them with summons, court orders for eviction, restrictions and/or demolition of property on pursuing developments (see appendices A and B for these documents). The committee receives copies of the court orders from LTF and updates its appeal records.

- Land disputes: The committee facilitates land disputes by ensuring that dispute applications are forwarded in time to the Land Tribunal and other courts. Speeding up land disputes is crucial in order that reallocation be concluded and compensations paid promptly to legal landowners. The committee records verdicts and where necessary (if the verdict results in new landownership as opposed to the one recorded) the landownership records are updated according to the verdict.

- Reallocation and compensation disputes: Landownership and land value records are used to verify equitable reallocation and/or compensation effected by developers to the landowners. In cases of discrepancies, disputing parties are made aware of the law in which further disputes are forwarded to civil courts and verdicts are received in order to update the appeal, compensation and landownership records.

6.1.2 Land Use Planning committee

a) Structure

The Chief Physical Planner seconded from the DLSPP heads the committee and is assisted by subsidiary staff drawn from DLHUD, MCC, Land Use Planning, etc.

b) Functions, data processing and information storage

The committee is tasked to prepare, produce and direct overall physical land use plans for the project. To accomplish this, the committee undertakes the following tasks for the project:

- Determining existing land uses: An orthophotograph was used to analyze the existing land uses in the project area. A detailed land use plan was delineated on a printed copy of the supplied digital orthophotograph. Features delineated included topographic and natural features such as dongas (natural trenches arising from soil erosion), property developments, and political boundaries. These land uses were further verified on site and delineated on the digital orthophotograph.

- Determining project boundaries and delineation: The project boundary layout plan is produced by drafting on a hardcopy printout of the digital orthophotograph. The layout plans were then later stored digitally in Microstation. These were further migrated into Arcview. A copy of a digital version of the project layout plan is given in figure 6.3 below on the next page.

- Zoning: A layout plan of the project area was partitioned into large parcels defining zones of different land uses. The process involved drafting zoning plan on hardcopy and later on-screen digitizing in Arcview. Care was taken that all the laws, acts, regulations and policies related to land use planning as mentioned in chapter 5 are observed. This was to avoid informal encroachment of land uses that can

result in environmental hazards. The project area is zoned into residential, commercial, institutional, agricultural and open spaces as shown on figure 6.4 on page 91.

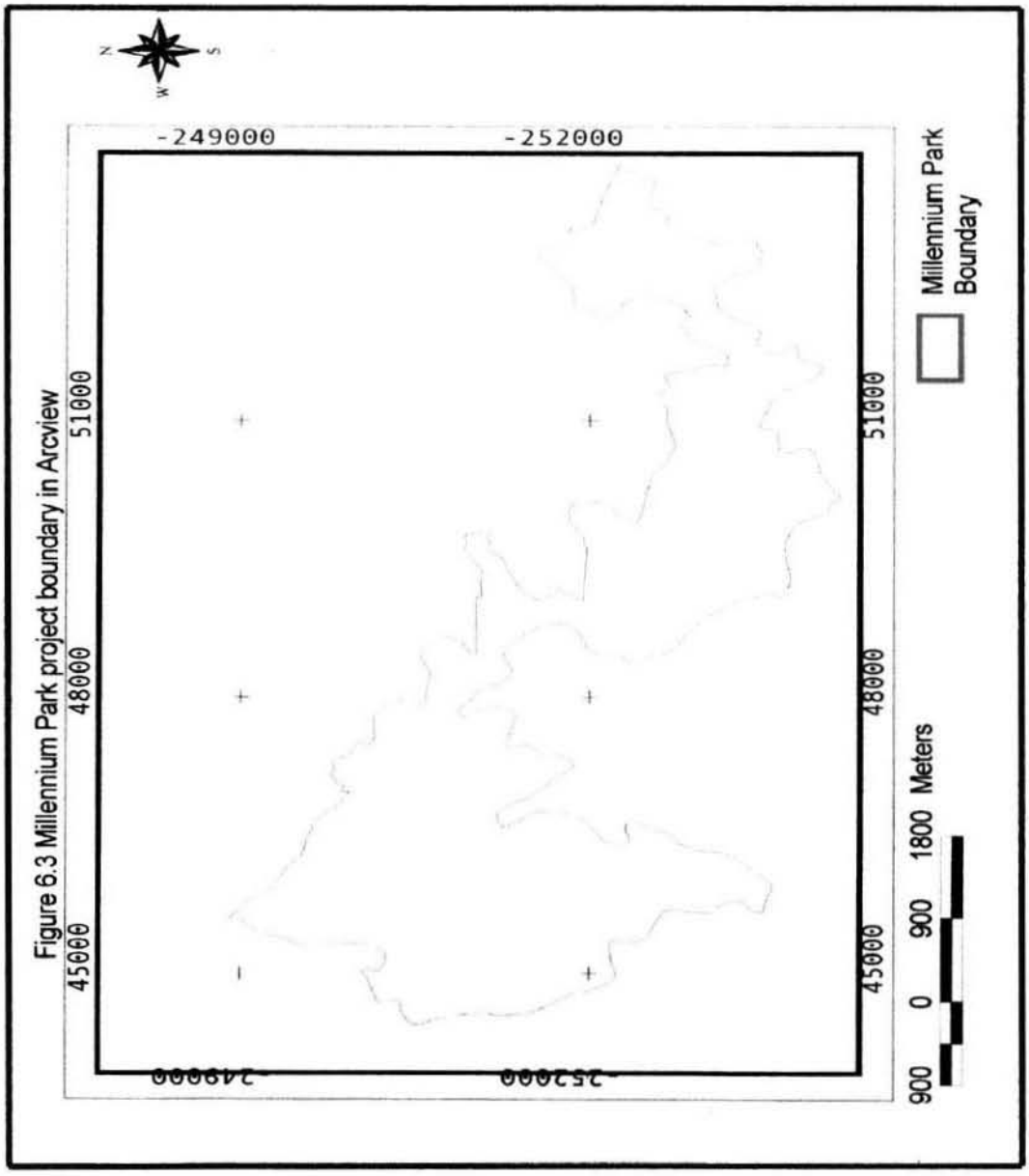


Figure 6.3 MPLDP boundary layout plan

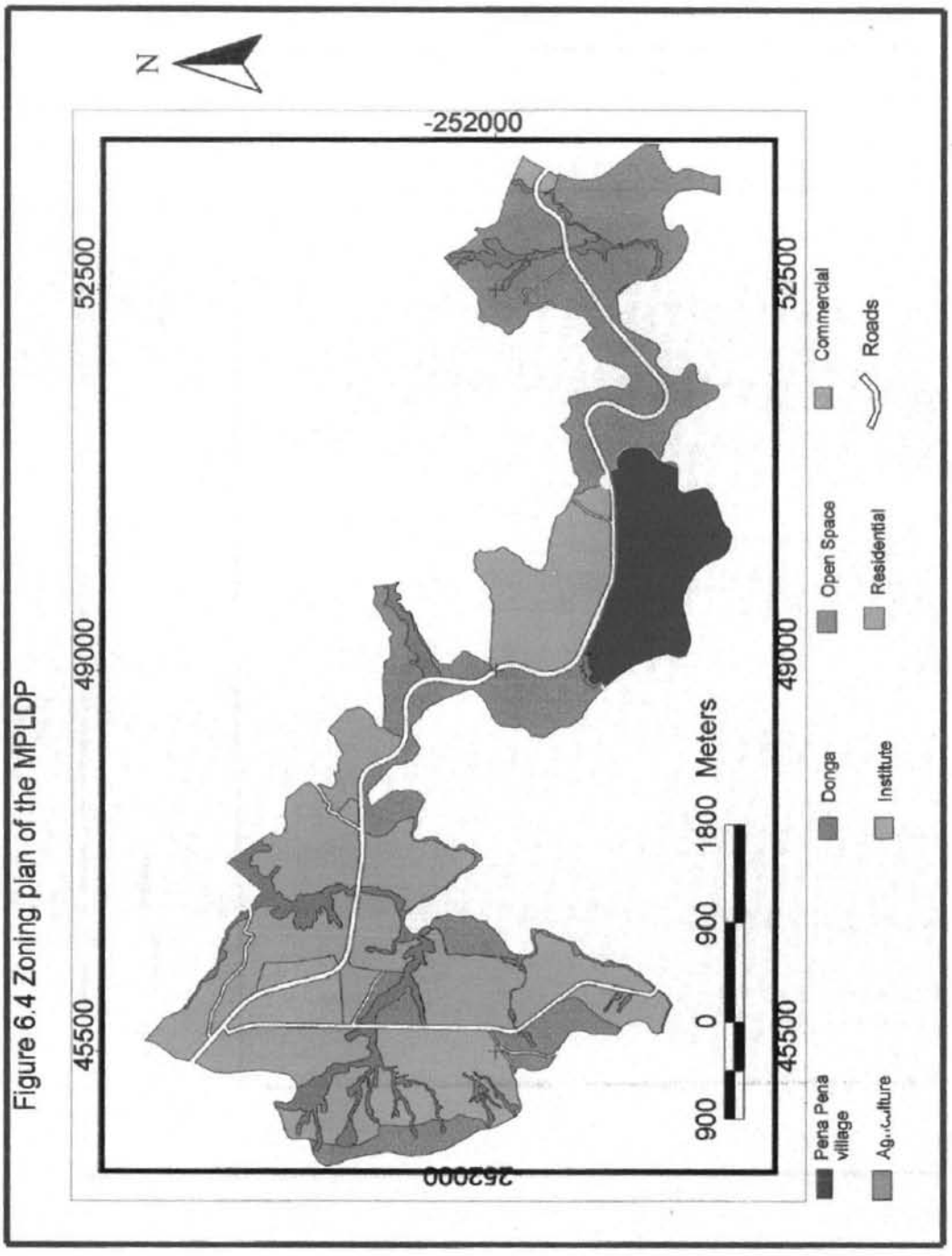
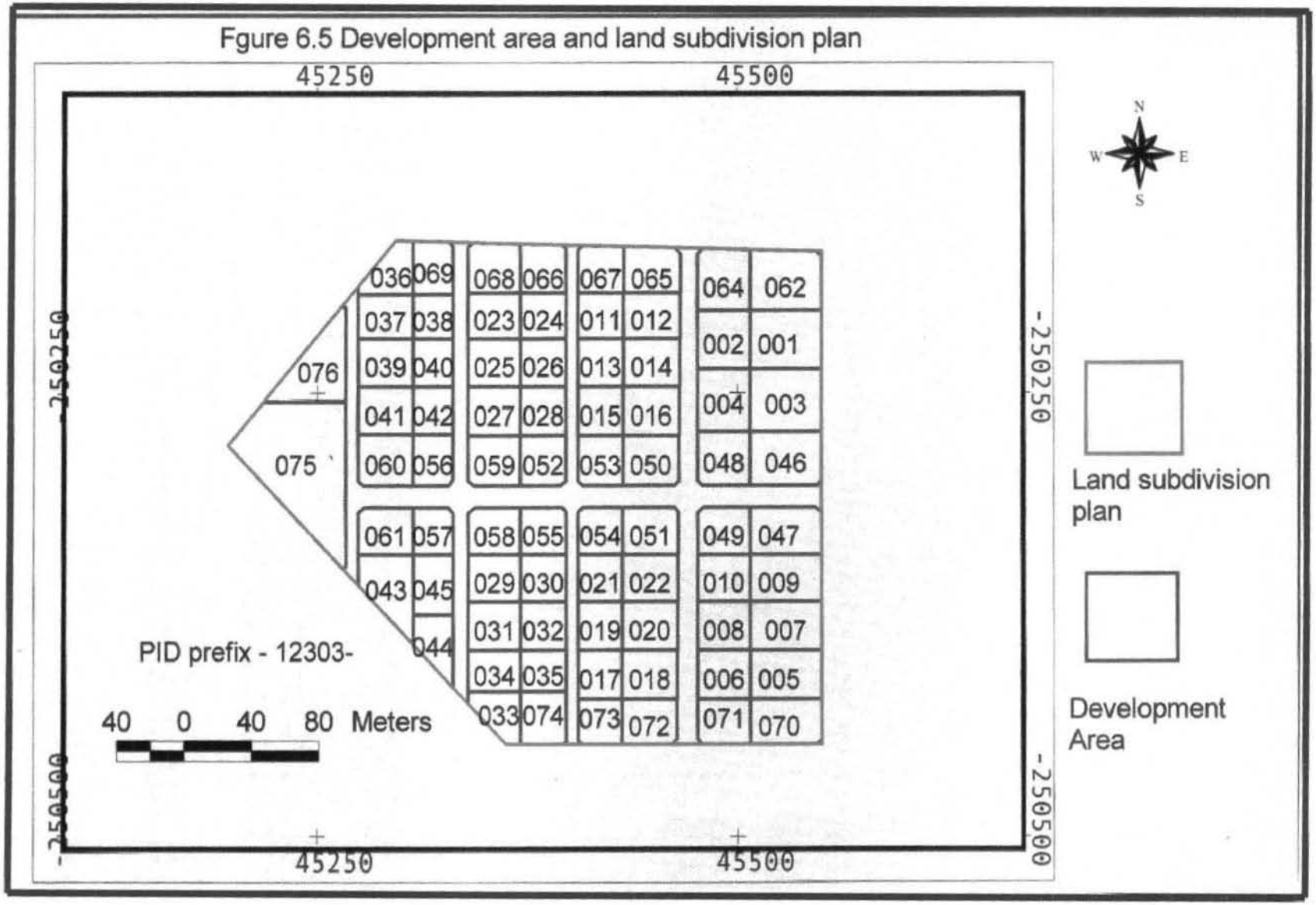


Figure 6.4 Zoning plan of the MPLDP

- Defining development areas: Development areas will be delineated on manual hard copy zoning plans, and after being examined they will be digitized and stored in Arcview in shapefiles. An example of development area created in this research is given in figure 6.5 on the next page.

- Formulating guidelines and examining land subdivision plans: Developers allocated development areas will be issued planning specifications included in RFP and thereafter their layout plans, shown in figure 6.5 below as an example, are examined accordingly and kept by the committee. The researcher created figure 6.5 on the next page.


Fgure 6.5 Development area and land subdivision plan
45250
45500
-250250
-250500
N
W
E
S
036 069 068 066 067 065 064 062
037 038 023 024 011 012 002 001
039 040 025 026 013 014 004 003
041 042 027 028 015 016
060 056 059 052 053 050 048 046
076
075
061 057 058 055 054 051 049 047
043 045 029 030 021 022 010 009
031 032 019 020 008 007
044
034 035 017 018 006 005
033 074 073 072 071 070
PID prefix - 12303-
40 0 40 80 Meters
Land subdivision plan
Development Area

6.1.3 Environmental committee

a) Structure

The committee includes membership from the Ministry of Health, DLHUD, MCC, National Environmental Secretariat (NES), Water and Sewerage (WASA) and the District Secretariat (DS).

b) Functions, data processing and information storage

The committee provided a report of all areas that are environmentally unsuitable for land uses proposed for the project. Based on the report, the committee provides environmental specifications for planning and development to ensure that environmental hazards that are to be met and those to be brought about by the developments are avoided. To ensure that environmental specifications are met, environmental impact assessment (EIA) documents, cadastral plans and layout plans are examined with all further site inspections. Overall, the committee performs the following tasks:

- Updating the existing zoning plan: The zoning plan is updated to delineate areas that are unsuitable for development due to anticipated environmental hazards. Delineating such areas on the analogue zoning plan does this, and later on the digital land use plan. For example the donga land use depicted on figure 6.4 above is a non-development area and was delineated by this committee.

- Provision of environmental specifications and examination: The committee gives specifications related to planning and development. This includes among others buffer zones between land uses. Buffer zones are reserved areas given in distance from a specific land use within which other land uses are not supposed to encroach for example 'way leaves' and 'road reserves' etc. Examination to ensure that specifications are met will involve scrutinizing the submitted EIA documents from developers and further site inspections to validate them.

6.1.4 Housing committee

a) Structure

The committee headed by the Chief Housing Officer from DLHUD, is composed of members appointed from among the local chiefs, community representatives, DLHUD, MCC, estate agents, Lesotho Housing and Land Development Corporation (LHLDC) and the Department of Statistics.

b) Functions

- Housing demand: Land applications, urbanization and current states of the informal settlements in Maseru are factors of influence determining housing demand. The committee undertook research on housing demand for the project life and provided results to land use planning to provide planning that will take housing demand into consideration. Housing demand was analyzed from land applications from the Lands division of DLHUD while the overall urbanization was analyzed from the Department of Statistics. From this a comprehensive housing demand data is compiled and stored manually and in computer files;

- Identifying methods for housing subsidy: The committee has to evaluate, formulate and identify sources of housing finance, and subsidies and credits that will suit low-income housing. These are meant for 'owner-managed' and 'assistance to owner-managed' housing. Data for these housing types are analyzed from the housing tender strategies provided by developers. Records for subsidies are kept manually. It is primarily the developer's duty to provide for housing finance.

- Specifications on housing and supervision: Housing specifications will be provided on the RFP issued to the private housing developers. These may include required housing units, proportions of mixed housing and basic housing services to be provided by the developer like water, sewerage etc. In

addition the developer's tender documents will be examined accordingly. Developers are to be furnished with a layout of the development area to be allocated, a list of the fieldowners and a plan of fields (with accompanying field values for equitable compensation) that existed in that development area.

- Advertising available allocation sites: In accordance with the Land Act (1979), sections 21 and 22 (as mentioned in chapter 5) provide for the committee to place advertisements in local newspapers of available residential sites for grant, with cadastral plan of the parcels and their area and values.

6.1.5 Infrastructure committee

a) Structure

The proposed structure of the committee includes members from the DLHUD, Lesotho Electricity Cooperation, MCC, Roads Branch, and WASA.

b) Functions, data processing and information storage

The committee plans and is further tasked to supervise installation and construction of all the necessary facilities to meet the LR objectives has responsibility for the following activities:

- Feasibility studies and planning: This committee plans the preliminary identification of sources and connection points of all the line services (roads, telephone, electricity, sewerage, water, etc) for introduction in the project area.

- Contracting service installations: The committee will advertise any contracts for installation of infrastructure in the project area in newspapers and ITTN gazettes. The committee provides types and specifications for installation of services and infrastructure and this will be attached on the RFP. Developer tenders will be scrutinized and contracts awarded to the most convincing developer. The committee will also undertake site inspections to check that specifications are adhered to.

6.1.6 Social facilities committee

a) Structure

The committee includes members from the DLHUD, MCC, Ministry of Education, Ministry of Health, Ministry of Tourism, Recreation and Culture, and the Sports Council.

b) Functions, data processing and storage

The committee plans the introduction of social facilities for the MPLDP. Planning requires that every facility should be introduced based on the population to be accommodated in the area according to the Planning Standards and Guidelines (1990). Therefore the committee needs data of future household numbers. The committee will further announce contracts for construction of social facilities including schools, health centres, etc. in local newspapers, ITTN gazettes and RFP. RFP will be accompanied by a list of original fieldowners and land values to be used by developers for compensation.

6.1.7 Commerce and industry

a) Structure

The committee is made up of members from the Basotho Enterprise Development Cooperation (BEDCO), the Estate agents, the Lesotho Chamber of Commerce and Industry (LCCI), the Lesotho National Development Cooperation (LNDC), MCC, Ministry of Tourism, Recreation and Culture, Ministry of Trade and Industry.

b) Functions, data processing and storage

The committee plans introduction of commercial and industrial developments. Data for future households forms the basis for planning for commercial services, as provided by the Planning Standards and Guidelines (1990). Planned commercial and industrial uses are contracted to developers through RFP procedures. Accordingly the committee examines developer tenders and awards contracts.

6.2 Systems requirement determination methodology

The methodology utilized in this research was a mixture of structured and unstructured interviews and a further questionnaire. The intention was to have first a one to one interview with each available stakeholder who will use or be served by the system and furthermore administer a questionnaire in which some of the crucial facts can be cross-checked. This was planned bearing in mind that a group interview would have also been much helpful in which most stakeholders in the use of the envisaged LIS are present such as in joint application design. But this seemed impracticable as most of the stakeholders were working part-time in the project while they also had important commitments somewhere. Lastly, I later observed in some cases how the PMT were undertaking their duties and mostly in offices and important observations noted.

a) Interviews

Due to time factor in most cases appointments were not even prepared and most interviews were a surprise move on stakeholders and especially the PMT. Most people whom I was acquainted with agreed to be interviewed on the first visit, however those whom I was a stranger to, booked for other appointments.

During the interview session the initial questions were structured and later a free flowing atmosphere of conversation where time was available to do so. Furthermore, other project publications and related hard and soft copy were requested, which in most cases were easily available except for those not ready at the time like the layouts and cadastral plans of the development areas and land subdivision plans.

b) Questionnaires

Structured questionnaires were prepared (see appendices F and G). This was done to ensure that only relevant information was collected and facts of the interviews are cross-checked. The questionnaire method did not materialize well as on the set date to collect them the interviewee was not around or had forgotten either deliberately or unintentionally. As the project had sensitive political issues mostly on informal settlements, land acquisition and compensation some did not want to involve themselves in the fear that I would tarnish their reputation in the public, especially in the eyes of the MPLDP community.

Thus from the results of the requirement determination methods the activities of each committee are highlighted as above and in cognizance of the management, legal, institutional frameworks, the information requirements of the system are provided in table 6.1 on the next page.

Table 5.1 A summary of the land information requirements for the MPLDP system

Committee	*Input data*	*Data Source*	*Process on Data*	*Data produced*
1. Land Tenure and Survey Committee	DigitalOrthophotograph Survey regulations Landowner details Local land records Land register records Land market rates Court orders Verdicts Examined survey diagrams Compensation receipts Allocations data	AOC DLHUD Landowners VDC and local LTF Developers	General boundary surveys Recording landownership Identifying informal settlers Valuing land Updating legal records Monitoring compensation Monitoring reallocation Monitoring formal allocation	Examined Survey diagrams Landownership records Informal settler records Legal records Land value records Compensation records Allocation records
2. Land use Planning Committee	Land use planning regulations Land subdivision plans	DLHUD Developers	Planning for project land uses Examination of land subdivision plans	Land use plan Project boundary layout plan Zoning plan Land subdivision plans records
3. Housing Committee	Housing regulations Census data Land applications Subsidy details Housing tenders	DLHUD Department of Statistics Financial institutions Developers	Planning for housing Planning subsidy for low cost housing Contracting for housing	Proposed housing records Subsidy data Housing contracting records
4. Environment Committee	Environmental regulations	Ministry of Environment	Formulating environmental guidelines Updating land use plan	Environmetal guidelines
5. Social facilities Committee	Planning regulations ITTN gazzettes Social facilities tenders	DLHUD Government printing Developers	Planning for social facilities Advertizing for sited grant for social facilities Examination of tenders	Social facilitiy data Social facilities contracting records
6. Infrastructure and Services Committee	Planning regulations ITTN gazzettes Infrastructure and services tenders	DLHUD Government printing Developers	Planning for infrastructure and services installations Advertizing for sited grant for infrastructure and and services installations Examination of tenders	Proposed Infrastructure and services data Infrastructure and services contracting records
7. Commerce and industry Committee	Planning regulations ITTN gazzettes Commercial andl industrial tenders	DLHUD Government printing Developers	Planning for commercial and industrial development Advertizing for sited grant for commercial and and industrial development Examination of tenders	Proposed commercial and and industry data Commercial and industrial contracting records

6.3 Structuring system requirements

Structuring systems requirements uses visual tools to present information collected during systems requirements. In addition, the visual tools facilitate structuring the requirements in such a way as to allow the analyst to restructure information flow further in order to identify weaknesses, and to improve and optimize, information management. Such tools include DFD, E-R diagrams, relational matrices, etc.

6.3.1 Information planning

Information planning provides a way to restructure information for a system. According to Chilufya (1997: 43) and Hoffer *et al.*, (1999: 168) information planning entails:

- orderly means of assessing the information needs of an organization;
- defining subsystems of closely related activities within a system to accomplish an effective flow of information;
- defining interfaces between subsystems so that they can interact as part of a larger system;
- planning efficient databases and technologies that will best satisfy the needs of an organization.

Typical information planning can be achieved by the use of "Business System Planning (BSP), a structured approach designed by International Business Machines (IBM) to help organizations establish information plans that satisfy near and long term information needs" (Chilufya, 1997: 43) posits. Information Architecture can be employed for these purposes as described below.

6.3.2 Information Architecture

Information systems architecture is a tool for re-structuring information requirements. It involves diagrammatically mapping processes and data classes in a relational matrix (Chilufya, 1997: 43). According to the type of analysis, such mapping could also involve mappings of 'location to process' location to unit', 'process to data entity' etc. (Hoffer *et al.*, 1999: 173-174) maintain. The logic for employing this matrix is to find a common information flow in a system with subsequent re-structuring of the system into subsystems as provided in appendices H, I, J, K. It was not possible to formulate information architecture for MPLDP owing to the unavailability of the appropriate computer-aided software engineering (CASE) tool such as the relationship matrix.

An example of how such an Information Architecture can be formulated is provided in appendix H. The matrix construction is such that at the 'intersection of every process row and data class column, a cell is formed where an action code 'c', 'u' or both is inserted depending on whether a concerned process 'creates', 'uses' or 'creates and uses' a corresponding data class respectively" (Chilufya, 1997: 43) clarifies. The stages of the Information Architecture formulation are achieved by:

- determining process groups through clustering, using the action code 'c' (appendix H);
- delineation into information subsystem with action codes removed (appendix I);
- substituting clusters with arrows (appendix J);
- re-arranged data flows between subsystems indicated with arrows (appendix K);

After formulating Information Architecture, it is possible to delineate boundary of the system that should be developed. In the event of insufficient resources a subsystem within such a system can be developed in such a way that there would be no problem of integration with other subsystems when they later get

delivered. After a system or subsystems has been identified it can then be subjected to further information analysis with the help of analysis tools such as DFD supported by DD.

6.3.3 Information analysis

Information analysis for MPLDP was carried out as a way of presenting data flow of the organization to the lowest activity of project processes. The aim is to scrutinize simultaneously process with data flow and their storage to determine how each could be improved, still maintaining the product. DFD are usually employed to implement information analysis. They are supported by DD providing description of processes, data flows and storage depicted on the DFD. DFD make use of four components.

- External entities: These are organizations, concepts and object outside the system with which the MPLDP system interacts in more than one instance. In this case organizations interacting MPLDP and data and information that flow in and out of the system.

- Processes: These form the machinery in which inputs into the MPLDP system are transformed to outputs that are anticipated to accomplish assigned tasks. For example, drawing a layout plan is a process in which certain inputs are needed. With these inputs layout plans are drawn and the end product is a layout plan.

- Data flow: This is data in motion. In a DFD, a data flow is depicted by an arrow from a source to destination.

- Data store: A database containing a variety of data (whether records, which are a collection of data, related to an object or files which are a collection of records).

The DFDs below shown in figure 6.7 and 6.8 on pages 101 and 102 are implemented using a System Development Workbench (SDW) 'function analysis' module, which is a CASE tool. The module allows analysis starting from the highest level to the bottom most or atomic with data flows and stores being transferable vertically to the subsequent levels. Included in this section are figures 6.7 and 6.8 illustrated which represent the 'context diagram' and the 'top level diagram' respectively. The lower levels of the processes are included in appendix L with examples of DDs for processes, data flows and data stores in appendix M. Cognizance should be given to the fact that at the 'context diagram' level nouns are allowable in terminators and the system itself, but subsequent levels require the use of adverbs for describing processes.

In the DD the following symbols in figure 6.6 are used to represent data flows, external entities and data stores:

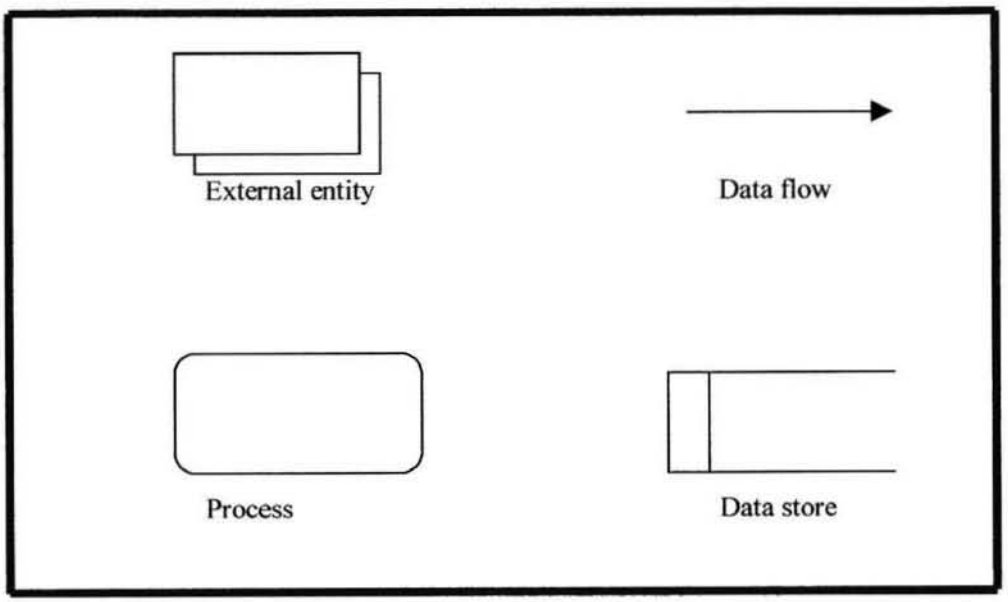


Figure 6.6 Representation of DFD components

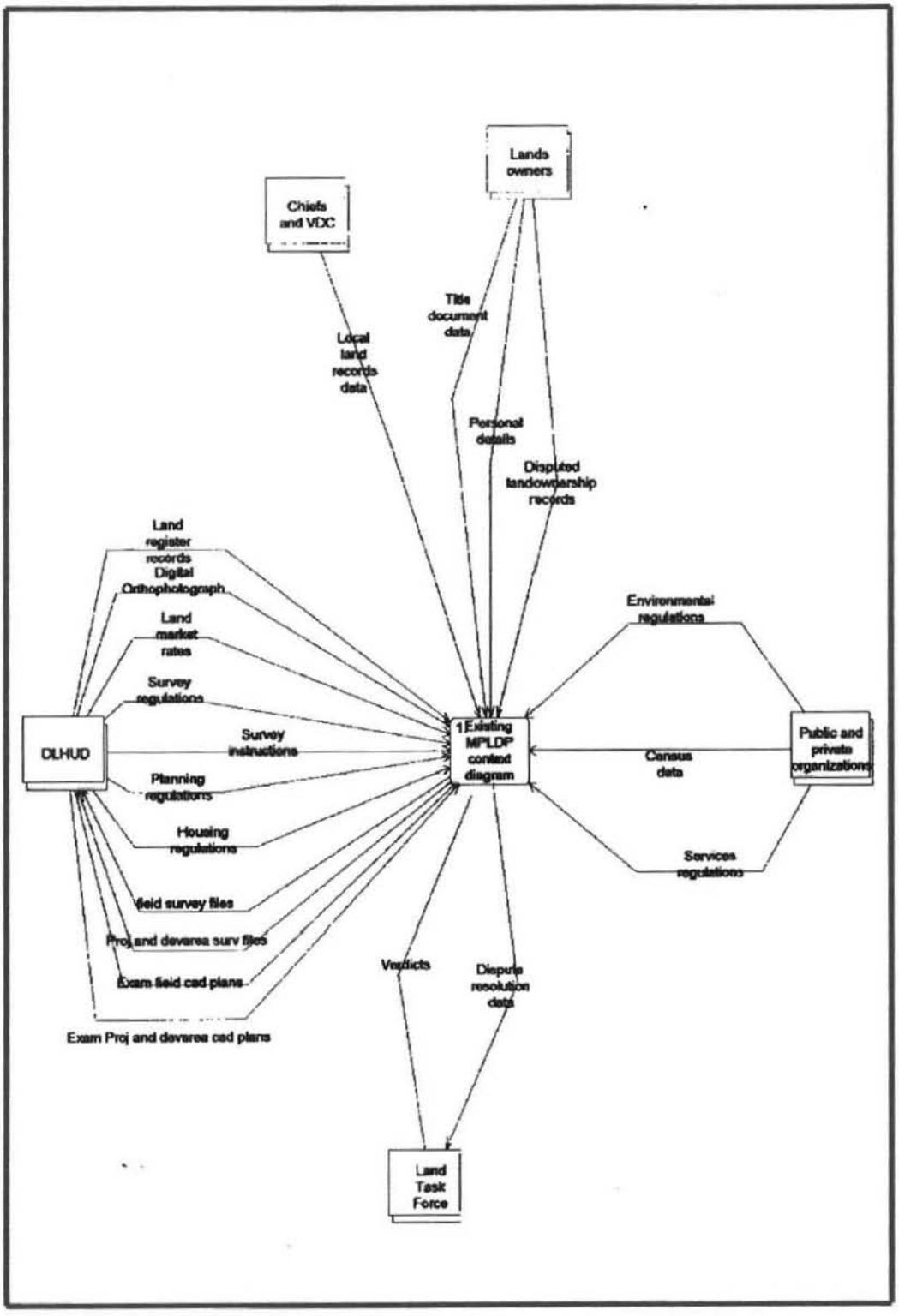


Figure 6.7 The context functional model for the existing MPLDP system

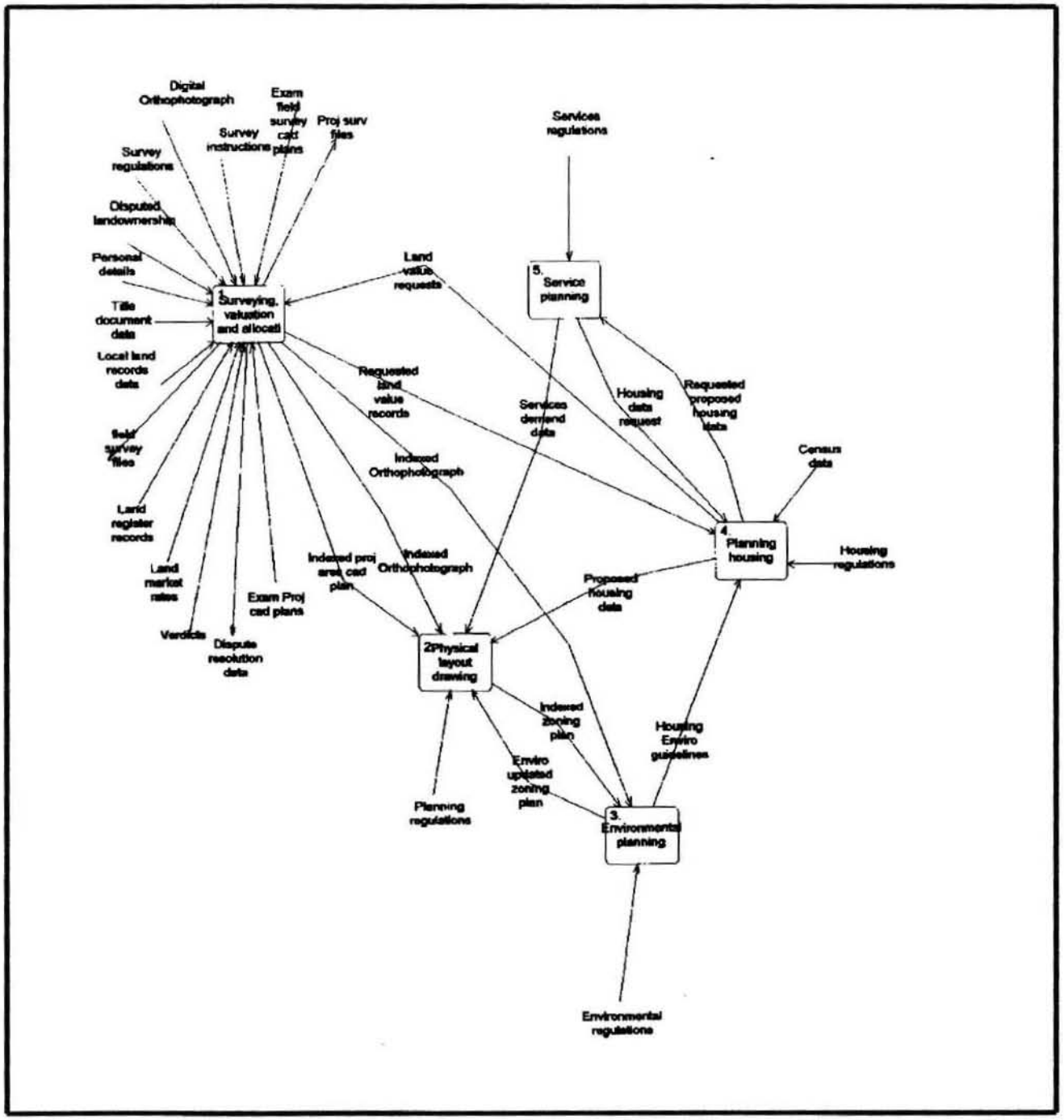


Figure 6.8 Top level diagram of the existing MPLDP system

6.4 Systems constraints

The system is associated with a number of problems with the most notable ones being the following:

- Non-permanency of the PMT staff: This factor causes bottlenecks in the system. Most members are seconded from their organizations in which they still carry out their day to day tasks hence project tasks are not a priority. Thus time lags in the project tasks become inevitable.

- Social, legal, economic and political issues of informal settlements: The project management has to devise some ways in which all the community in the project area could benefit. However, the problems associated with the high rate of informal developments have a negative impact in the project. Applications of the statutory law seem to upset the political, social and economic situation as mentioned in chapter 5. Again implementation of common law discriminate some of the informal settlers as some will be recognized *de facto* while others will have to be evicted and or their properties get demolished in the area. Attendance to these issues by the management tends to track the project activities slowly as the PMT often find difficulty to adjudicate land rights to undertake formal land acquisition and to facilitate compensations due to absence of land records which is a problem in informal settlements.

- Dissociation of PMT staff and deficiency in information and data exchange and dissemination: The fact that PMT members are based in different organization impacts on the interaction and data flow. As seen from the DFDs above there are a lot of data exchanges between processes in which flow of data becomes crucial in engaging in project tasks. Most of this data or information flow is done manually through surface mails such as requests or 'savingram', an example of which is given in appendix N. Such methods of data exchange take time and in the mean time bottlenecks occur in project activities. Thus inefficiency in information exchange and dissemination brings bottlenecks in the project activities.

  Furthermore, observed was that the dissociation of PMT members results in the individual committee members working alone in some project tasks. Data I had requested during requirements determination exercise mostly came in bits and pieces from individuals at different places and some of it was never found.

- Lack of expertise in the current automated technologies: Most of the work carried out by PMT committee members is still manual, although basic automating resources are available. From the description of committee functions given above, it becomes clear that most of the processes are done manually and later converted to digital format, resulting in duplication of effort and data storage and adding to the bottlenecks in the project activities. Some processes may need to go via such steps but for example drafting layout plans on analogue maps and later digitizing is unnecessary. Arcview software, which is in use, can be employed fully for drafting, editing and finalizing such layout plans. Moreover most of the spatial and spatial data are not linked. Spatial data is mostly in analogue and digital form while non-spatial is in spreadsheets and paper files. A linkage is not maintained and querying on both is a very tedious process.

From the above discussion it is clear that the existing information system for the project is not efficient and there is a need for improvement.

6.5 Concluding remarks

This chapter concentrated on the analysis on the structure of individual committees and how the PMT members actually execute delegated tasks in the project. The analysis went further to discuss the kinds of data classes that are handled by the members and where these data classes have a role in the process planning or decision-making. The base of this knowledge was accomplished by a requirements determination fact-finding mission undertaken in Maseru where the MPLDP PMT is based. Several fact-finding techniques were used in this mission. In this respect the questionnaire method seemed less effective.

Certain approaches and tools were then used to put the findings in perspective. Information planning was discussed so as to structure processes and data classes to further restructure the system into subsystems with efficient methods of interaction and data storage. Information Architecture was given as a tool to achieve this. Further information analysis was discussed. DFD and DD examples were used to represent data flow with associated processes within the project and between itself and the external environment. This discussion formed the basis of identification of constraints and bottlenecks in how processes are being executed and how data is being exchanged and stored.

Miscellaneous constraints and bottlenecks arising from the institutional arrangements were discussed. The fact that the project includes multi-stakeholdership without permanent members causes a major constraint to the project because, for some PMT members, project activities are not a priority. Furthermore, members are located in different organizations so that teamwork depreciates. This inflicts damage on the project information management as each individual has private data store in which data is not readily available on request. In addition, technology is not used to full capacity as most of the work, even that which can be handled in an automated environment in which resources are available, is still being done manually with subsequent manual and analogue data stores. Addressing social, political and economic issues related to informal settlements seemed also to derail project activities. From the above discussion it can be concluded that MPLDP LIS is not efficient and there is a need to recommend improvements. These improvements are the subject of the next chapter.

Chapter 7

Improved MPLDP system

7.0 Introduction

The current system could be improved by an attempt to alleviate constraints that result in bottlenecks and backlogs, observed in the system during the analysis. In the previous chapter, constraints observed which related to organizational, political, economical, legislative, and technical issues. Below is a discussion related to eliminating constraints arising from technical reasons. Improvements can be made by the automation of data acquisition, data flow, processing and storage. Caution needs to be taken, however those technical improvements are linked to legal, political, economic and legislative frameworks. For example automation requires boosting of the project's finance to acquire more computers. Therefore, there is need to address necessary adjustments in the frameworks in which technical improvements can formally and efficiently thrive. Furthermore the chapter addresses a possible database that can be designed to anchor automation in the MPLDP.

7.1 Technical improvements

Technical specifications aim to describe how processes should be undertaken to avoid the observed constraints. Automation is proposed as relevant procedure by which most of the technical problems may be improved. Areas of improvements are also discussed.

7.1.1 Automation

The core utility of automation is to convert and use data in digital form. Storing such data in digital databases will enable data integration including both graphic and non-spatial data. This integration will enable minimization of constraints to project data acquisition, storage, processing, data exchange, dissemination, etc. However the nature of some activities and the lack of technical resources will still require some of the activities to be performed manually. A good use of automation has been made as was mentioned in the previous chapter, by determining field areas in Arcview and use of GPS. Below is a discussion on the proposed automation, in activities associated with surveying and mapping, data storage, physical planning, data integration, data exchange, data retrieval, and dissemination.

a) Surveying, mapping

Surveying and mapping provides most of the spatial data for the project planning and decision-making activities. The following is suggested as an improved way to undertake surveys and mapping.

- Aerial photography surveys: Aerial photography surveys providing a digital orthophotograph should be engaged in identification of settlement pattern and providing a backdrop for general boundary surveys. In addition the aerial photography can be used to monitor developments in the project area periodically, may be after two to three years. This would help, as further planning would be based on what exist on the ground.

  The aerial orthophotograph at its current TIFF format does, however, consume a large disk space, which is inherent to slow processing. To remedy this, TIFF files can be translated and compressed into JPEG file format, resulting in reduced file size with virtually no loss of visual quality.

- GPS surveys: The GPS surveys in RTK mode should be engaged in all the title surveys in the project area including those for services servitude. The project area is free from cover that can obscure the GPS signals to the GPS receivers. In addition the geodetic control exists in and around the project

area. Within the project area itself, there are three reference control marks fixed in Lesotho geodetic network system as mentioned in chapter 6.

The use of GPS would further enhance data processing and transfer to Arcview data store. This could be accomplished by transferring cadastral plans produced in TSO, GPS's processing software in DXF format into Arcview. There is a sample script in Arcview that can be compiled and run to convert DXF polylines into polygon shapefiles. An alternative also in Arcview provides sample scripts that can be compiled and run to convert ASCII GPS output files into shapefiles. The rest would be to edit the attribute data to suit the user criteria. The Environmental Systems Research Institute (ESRI) web site at (www.gis.esri.com/arcscripts/scripts.cfm) provides many alternative Arcscripts that can be download or run shared on the site to perform data conversion to suitable Arcview line, point or polygon shapefiles from other software into Arcview.

b) Drawing of physical layout plans

Drafting of layout plans on hardcopy and further digitizing on Arcview does involve duplication of effort. To improve this activity, only Arcview can be used to digitize layout plans on the backdrop of an orthophotograph. This can even speed-up the survey activities, as the coordinates of the layout can be transferred from Arcview to the GPS software faster as it is illustrated in the next chapter.

c) Data storage

Computer databases should be used as ultimate stores for spatial and non-spatial data. Data, like analogue layout plans, and landownership records in analogue form, currently kept in heaps in management staff offices, and liable to misplacement can be safely stored in computer databases. In addition to safe keeping, computer database provides the advantage of reduced storage space. Thus there is a need to convert all the existing analogue data into digital either by scanning or digitizing for graphic data and keyboard entry for non-graphic data.

d) Data integration

Automation makes it easy to develop a system in which digital graphical and/or non-spatial data can be linked. To accomplish this graphical data must be in similar or compatible data exchange formats, and geo-reference frame to facilitate overlaying. This should be maintained in the Lesotho geodetic network system according to the Chief surveyor, directions. Non-spatial data entities should maintain common unique identifiers (e.g. pid for parcels) or field values (e.g. parcel number 12303-005 should maintain the same identification between the PMT committees) that would enable cross-referencing between non-spatial records and further to spatial objects. A relational database is then proposed to achieve this data integration.

e) Data retrieval and dissemination

Digital data allows prompt retrieval of data and information from many digital data stores through the electronic media. This enables a quick production of required project documents by automation as it is just a matter of a computer print out. This speeding up will greatly enhance production of project documentation and automated inclusion of graphical data, such as cadastral plans for sites available for grant in newspaper advertisements, dispute resolution data etc. which require integrated presentation in graphic and non-spatial information.

f) Data exchange

Automated data exchange would be an improvement for data sharing that has been done through manual requests. Distributed data exchange with a client/server setting described in chapter 4 would be ideal for PMT members based in different organizations. Economically, telephone network modems can be used in computer network to access information from distributed databases (Antenucci *et al.*, 1991: 187). A detailed account of such a data communication system is beyond the scope of this research.

The Wide Area Network (WAN) concept can be extended to Internet technology, which has been an issue raised by the project manager (Ramonaheng, 2000: 5) to use a web site to place project publications including advertisements, etc. The Lesotho government website could be used in which the project's web page could be constructed to post any information relevant to the public and especially advertisements of sites and requests for proposals for contracting developers in the project area, etc. Construction of such a web site is subject to further research.

7.2 Legal specification

Legislation should be adjusted to allow full transition from manual operations to automation. Based on the technical improvements proposed above, the following areas are in need of adjustment:

- The Chief Surveyor's directions should be amended to include full codification, including guidelines to GPS surveys and relevant transformation from WGS 84 to Lesotho geodetic coordinate system;

- The Chief Physical Planner should lay down guidelines that would enable automated production of layout plans. This would eradicate duplication of effort in manual and later digitizing of these manually compiled plans. This improvement will bring further efficiency in speeding up surveys, which will be a matter of uploading coordinates into surveying equipment as mentioned above.

- Through legislation local chiefs should be in one way or the other be brought back in the village level land allocation procedures to assist with the availability of non-spatial land attribute data due to the following factors. Firstly they are administrators and are mostly conversant with land related issues (such as property boundaries, landownership, etc.) as they had allocated before and often solve land disputes at the most basic village level. Secondly, they are the most effective land allocating authority, though *de facto,* as compared to statutory VDC's or ULC's. And lastly due to the fact that to the ordinary citizens chiefs are still seen as *de jure* (though not) land-allocating authorities and the very first person a prospective citizen approaches during land transaction is the local chief.

- Applications of the common law should be harmonized with the statutory law in such a way that no subjective *de facto* recognition of informal settlers rights be made that will appear unfair treatment to others and cause social disruptions. Thus practices such as *de facto* recognition of informal settlers should be addressed by the legislative body and further land law be amended accordingly to cater for this.

7.3 Organizational and institutional specifications

Institutional specifications are divided into two namely the in the PMT specifications and the informal settlement land records specifications.

a) PMT specifications

The structure of the committees is prone to repetition of data flows. This was observed in mainly the service administering committees (i.e. the Social Facilities, Commerce and Industry and Infrastructure and Services committees). For example cadastral plans, layout plans, etc. are exchanged through repeated requests, retrievals and dissemination that clutter data flow. The proposed-shared or distributed database will eradicate such manual flow of data. Arrangements should be made to define access (i.e. 'use only' and 'use and update') rights to databases. It would be logical for the Land Use Planning Committee to have 'use and update' rights to layout plans in a digital database while other committee members be allowed 'use only' rights to this data. In addition PMT members should undergo training both in-service and formal to acquire the necessary skills in LIS that would enable the proposed automation.

b) Informal settlement land records specifications

The current land information data capture methods (i.e. use of aerial photography and GPS) seems to be effective but the problem of unavailability of non-spatial attribute data (mainly of landownership) becomes the problem. This is related mainly to the ineffectiveness of the VDC's as mentioned by the LPRC (2000: 52-53). Thus for a smooth integration of gathered spatial data with non-spatial data I argue that, based on Fourie (1996: 59), an easier way to ameliorate informal settlements problem lack of information is to have local level land administrator in the project.

This official should be appointed or elected and should be a permanent and paid public servant with basic land administration (including land surveying, physical planning, legal and record keeping) skills. He/she should be in charge of registering all the land transactions in this area whether formal or informal and furthermore, oversee that land is registered with the VDC's. In the present form the VDC's are very, very ineffective as (LPRCR, 2000: 52-53) notes, and most of the land transactions are unaccounted for, which in most cases delay land adjudication process and further perpetuate informal settlement problem. These councils seldom if ever question any form of informal settlement they observe in a settlement. This is due to corrupt practices on their part, and bureaucracy in electing these councils (either in political lines, etc.). In addition, their unpaid state of affairs (no allowances) in which most of the time the members have no resources to perform their work. Frequent resignations for better employment result in councils often being short of quorum to attend to land transactions, reducing their efficiency (LPRCR, 2000: 53).

The local chiefs, which in most cases are empathetic with their subjects, having a broader knowledge of property boundaries as they have been dealing with land disputes at local level for long, are preferred candidates. In addition they pose a more economic advantage as they are already on the government payroll. This should not however upset the democratic arrangement of VDC's (as elected members of the community) but should be in arrangement with the chief keeping alternative land records. The powers to issue Form CC's that revalidate defunct Form C's or valid Form C's should rest with the VDC's quorum. This will, I argue, limit chiefs from allocating land informally while again the chiefs will be recording land transactions in ineffectiveness of the VDC's. This will always provide a cross-check in which liaison between the chiefs and the VDC's on periodic bases is maintained to cross-check their records and discuss the discrepancies. This in my point of view will try to ameliorate the problem and bring a better land administration at local level. This will help again when adjudication process is underway. Concrete land information can be provided and cross checked on who owns what where, how long and how much.

Presently the chiefs have been removed from the VDC's as *ex-officio* members (LPRCR, 2000: 52) as was the initial arrangements in the Land Act 1979. Disregarding the powerful influence of the local chiefs in the land allocation procedures is ignoring the possibility of easier and effective ways to tackle the problems associated with lack of land records and perpetuation of informal settlements. This is because until present, as noted in chapter 5 section 5.2.3 locals do not know and even consider the defunct Form C's issued by chiefs as illegal. My suggestion, may seem a good opportunity for the local chiefs to perpetuate further unfair land allocation practices that brought about the introduction of VDC's. But I further argue that this should be an intermediate and temporary arrangement while ways are sort to strengthen the effectiveness of the elected VDC's as VDC's present ineffectiveness have been much criticized by the LPRCR (2000: 52-53).

7.4 Improved system model

Modelling is an approach pursued in the presentation of real world phenomena in the design of the improved system, because real objects cannot be input into databases. Various tools are employed in modelling, but in this research only functional and data modelling tools will be discussed as representation of improvements to the systems processes, data flows, and data stores and database design, respectively.

7.4.1 Conceptual functional modelling (improved MPLDP system)

The discussion below presents proposal of how processes, data flows and data storage should be improved. This is based on identifying areas of bottlenecks and constraints depicted on the DFDs used during the

analysis, as presented in the previous chapter and further introducing DFDs that depict an improved system. These DFDs are provided in appendix O and only the context and the top-level diagram DFDs are provided on the next pages in figures 7.1 and 7.2. Digital data stores and automated activities depicted on the improved MPLDP top level diagram are very helpful to information and data exchange as also shown in figures 7.2 and comparisons with the existing MPLDP system given in figures 7.3 and 7.4 on the succeeding pages. Unless of the *'Proj EIA documents'* data store on the improved top level diagram the rest of the data stores are proposed to be digital. This does not mean that the documents are impossible to be digitized but their volume could be too numerous for the current resources for data capture and the personnel to undertake easily.

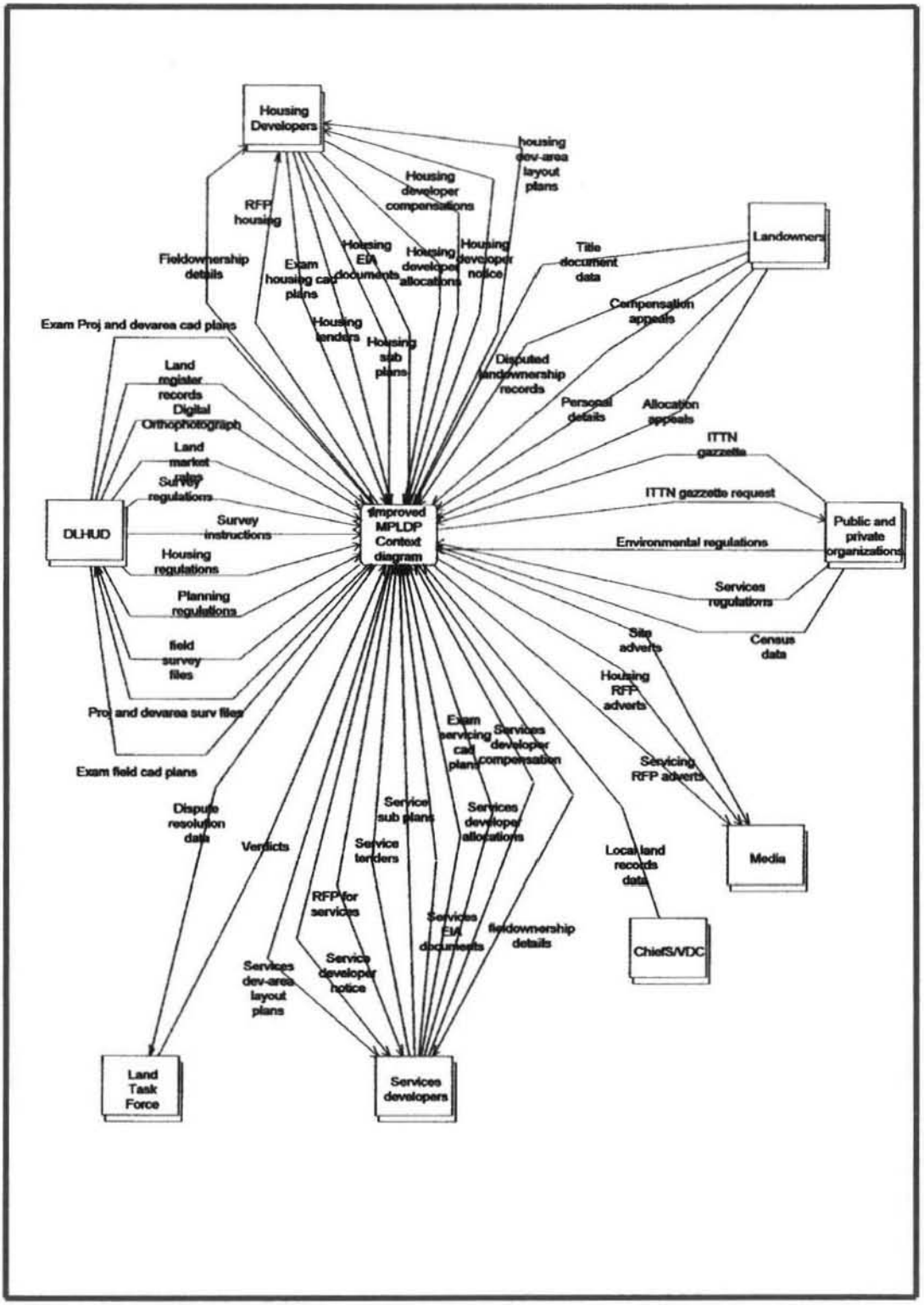


Fig 7.1 Context diagram of the improved MPLDP system

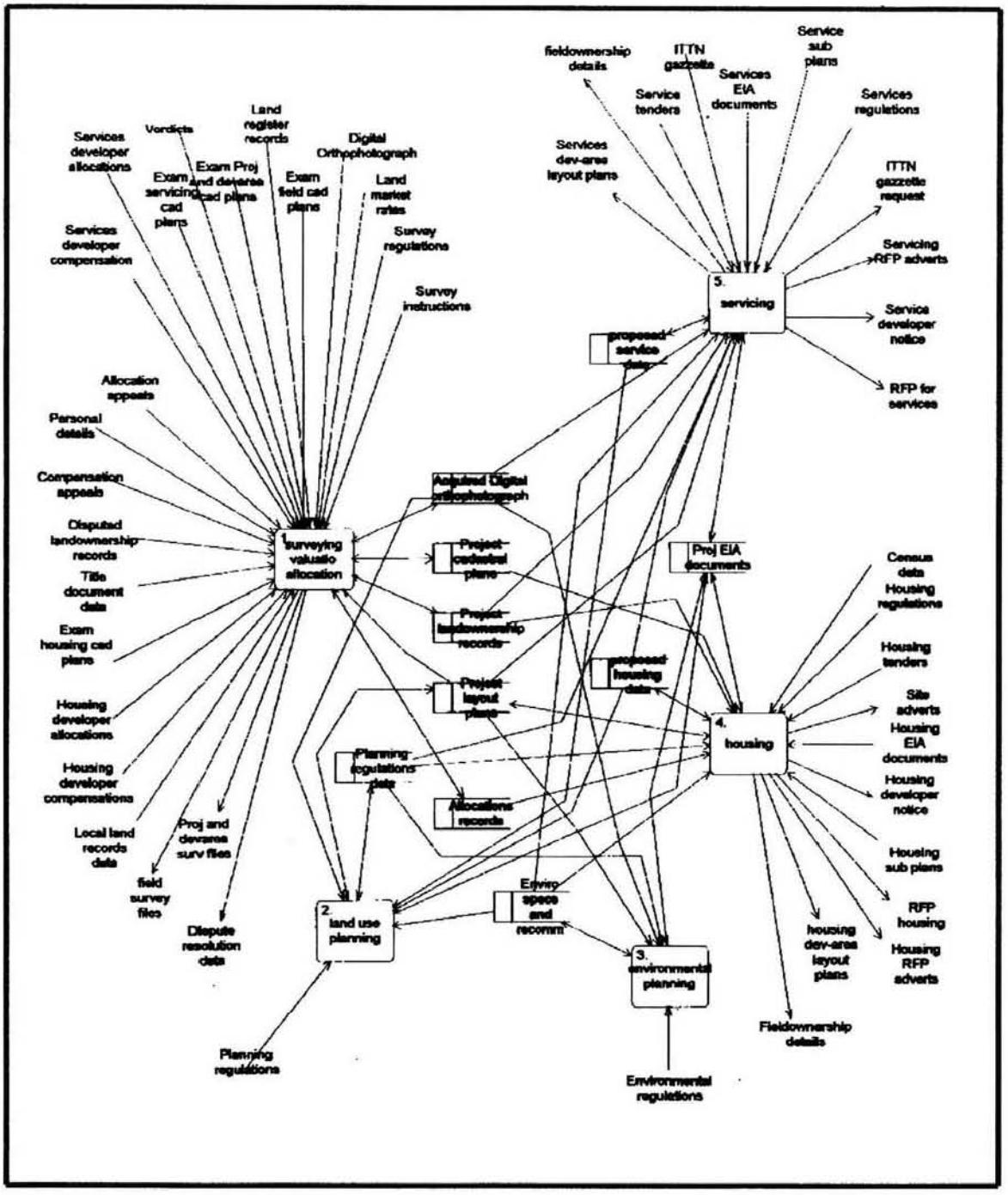


Figure 7.2 The improved MPLDP top level diagram

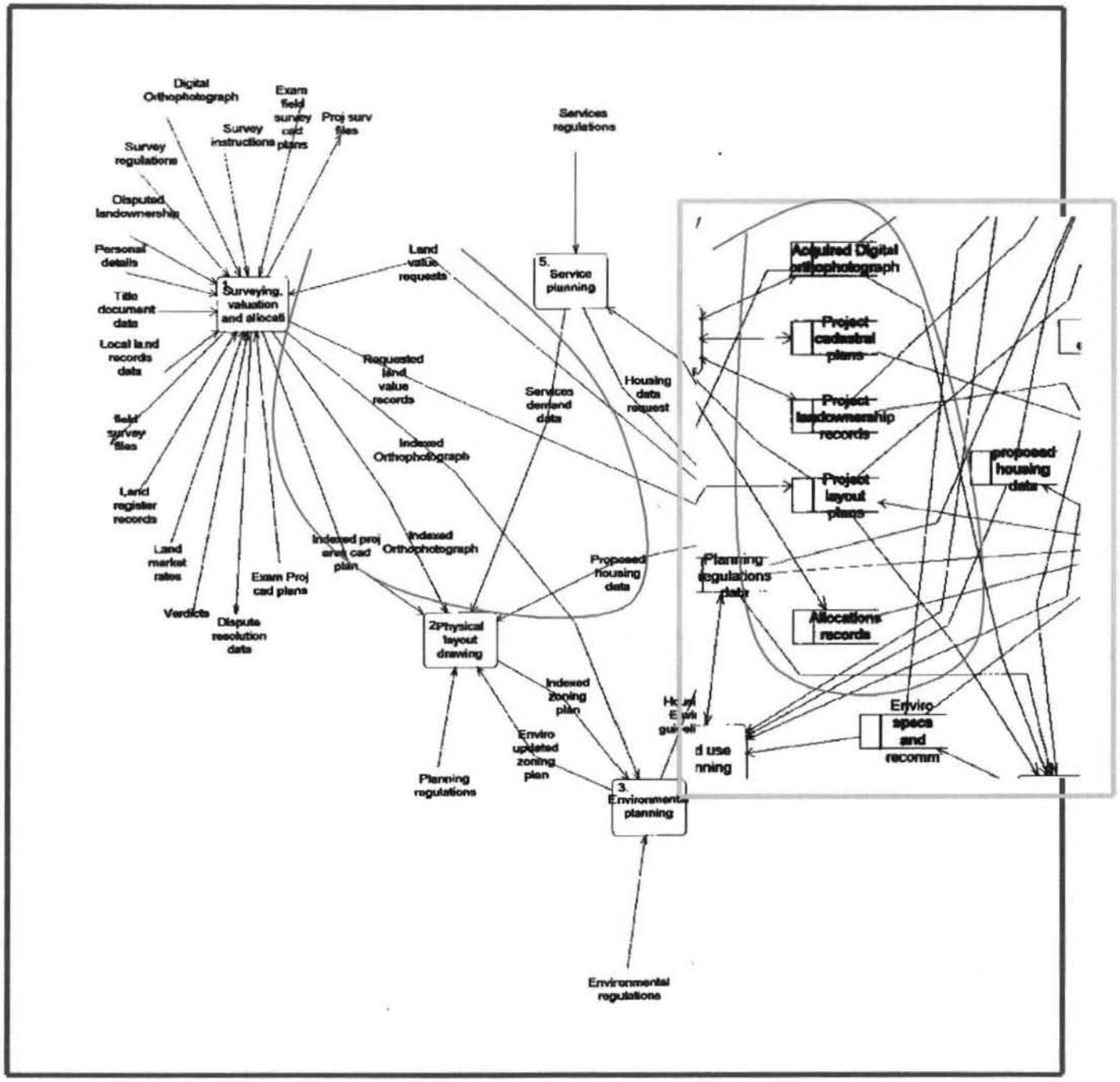


Figure 7.3 Comparison of the existing and improved (in orange caption) top level diagrams. The improvements that could be achieved with distributed network data exchange. Each activity can be undertaken through retrieving data from the digital data stores as shown from the caption than through requests shown on the main picture (existing MPLDP system)

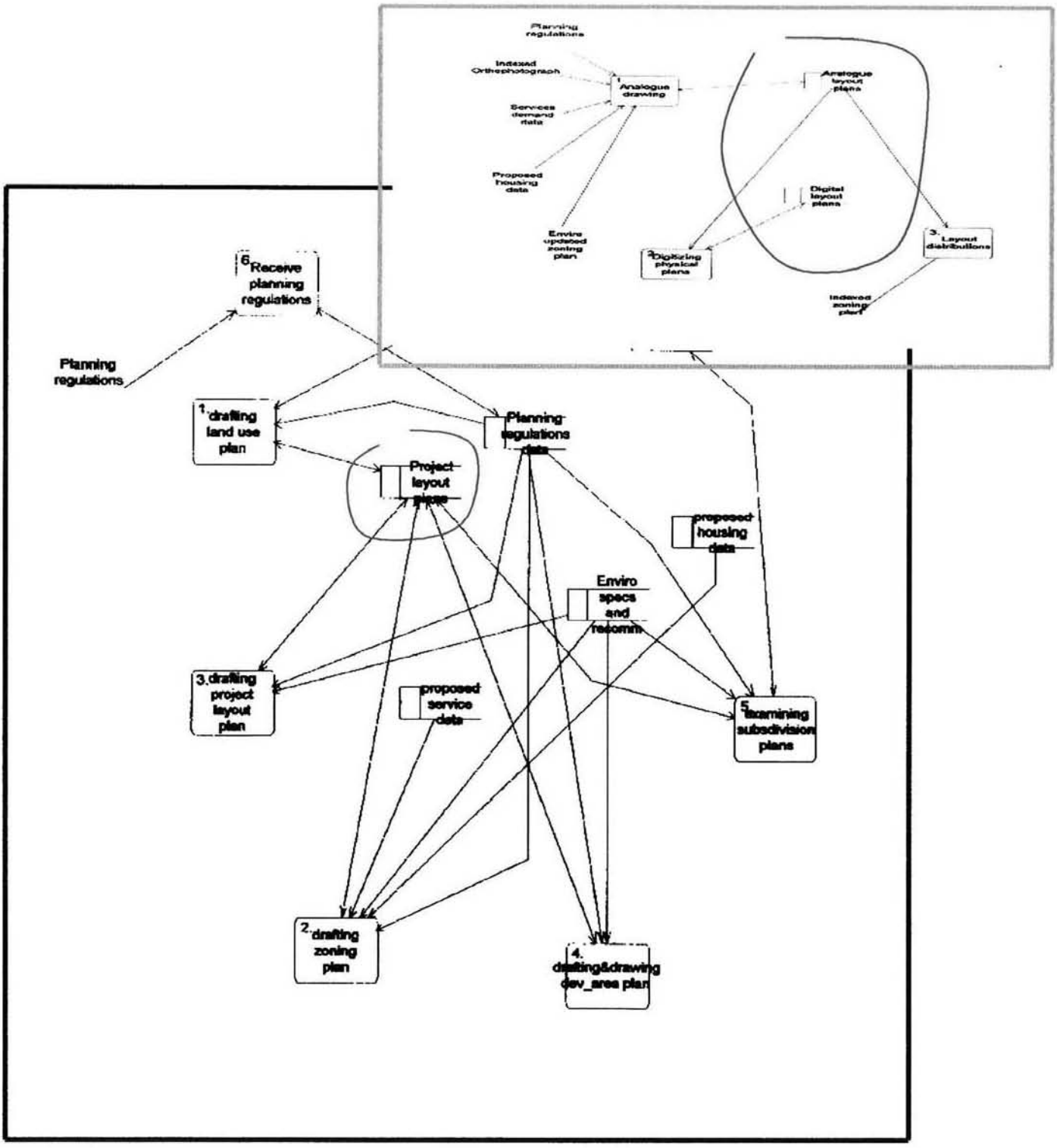


Figure 7.4 Automated physical plans drawing. From the figure the duplication of effort shown on the caption representing the existing MPLDP can be improved by the automated drawing of layout plans as shown on the main picture representing the improved system.

7.4.2 The MPLDP Conceptual data model

The conceptual data model provides the relationships between data entities without reference to any DBMS. To derive a conceptual data model of the designed or improved database, the relationship of the entities of the data kept needs to be understood. In this research, the Entity-Relationship (E-R) modelling approach was adopted. This modelling approach makes use of a number of components to describe the system's data. These include entities, relationships (including their degree and participation), enterprise rules, attributes and tables (skeleton and fully normalized). These components of E-R modelling are discussed below and where necessary these components are illustrated in figure 7.5 on page 116.

- Entities: "An entity is a thing (object, concept, etc.), which is recognized as being capable of independent existence and can be uniquely identified" (Chilufya, 1997: 53). Entities are determined by capturing the overall structure of the organization data.

- Relationships in data: Relationships in the data are defined in terms of relationship degrees or cardinality and optionality, as expressed in the enterprise rules that govern the relationship between entities, leading to eventual representation in a database.

  Relationships express ways in which entities participate in a relationship. Relationship between entities can either be obligatory (mandatory) or non-obligatory (optional). Relationships between entities may be of any of the following types: recursive multiple, exclusive or. An exclusive relationship is observed where same entities relate in only one way. Multiple relationships exist where entities can relate in more than one different ways. A recursive relationship occurs where entities do have relationships with themselves. Relationships are also characterized by the relationship degree. These relationship degrees are briefly discussed below.

  i) 1:1 (read as one-to-one): This degree defines occurrence whereby an entity in the relation is associated with just one occurrence of the other;

  ii) 1:M (read as one-to-many): The degree defines an instance "where one occurrence of an entity in the relation can be associated with more than one occurrence of the other. This relationship may include 1:1 also" (Chilufya, 1996: 54);

  iii) M:N (read as many-to-many): This holds when the occurrence of either entity in the relationship may be associated with one or more occurrence of the other. This relationship may include both 1:1 and 1:M too.

The way relationships degree are represented on the DFD are highlighted in figure 7.5 on page 116.

- Attributes: Attributes are details that qualify, identify and classify, quantify or express the state of an entity. Attributes that uniquely identify an entity are known as identifiers or key identifiers. In cases whereby an entity can be uniquely identified by more than one key identifier, such identifiers are referred to as candidate identifiers.

- Enterprise rules for the MPLDP system: "Enterprise rules are the underlying rules which govern how different data in an organization work together" (Chilufya, 1997: 54). The MPLDP data was carefully studied to identify entities and their relationships, including cardinality and optionality. Based on this study the following enterprise rules were then formulated:

1) An orthophotograph must show at least one parcel
A parcel may appear on one or more orthophotographs

2) A cadastral plan must be associated with at least one parcel
A parcel may be associated with only one cadastral plan

3) A parcel must at least be bound by three beacons
A beacon must bind one or more parcels

4) A layout plan must be associated with at least one parcel
A parcel may appear on one layout plan only

5) A parcel may have at least one utility
A utility may be associated with one or more parcels

6) A parcel may be associated with at least one subject (includes formal and informal settlers)
A subject may have one or more parcels

7) A parcel must be associated with at least one allocation type (includes formal and informal allocations in one parcel)
An allocation type must be associated with one or more parcels

8) A subject may be associated with at least one allocation type
An allocation type may be associated with one or more subjects

9) A zone may have at least one development area
A development area must belong to one zone only

10) A parcel may be categorized into one income group only
Income group may be associated with one or more parcels
(Parcels in new subdivision layouts will assigned for low, medium and high income)

11) A parcel may be associated with at least one appeal
An appeal must be associated with one parcel only

12) A verdict must be associated with one appeal only
An appeal must be associated with one verdict only

13) Compensation must be paid to one subject only
A subject may receive one or more compensation

14) A request for proposals must be associated with at least one development area
A development area may be associated with one or more request for proposal
(includes a scenario whereby a developer can be contracted to undertake road construction in one or more development areas)

15) A development area must be associated with at least one parcel
A parcel may be associated with one or more development areas

16) Compensation paid must be associated one parcel only
A parcel may be associated with one or more compensations

17) A land use must be associated with at least one zone
A zone must be associated with one land use only

18) An appeal must be associated with at least two subjects

A subject may be associated with one or more appeals

19) A developer may be associated with at least one development area
A development area may be associated with one or more developers

20) An informal development my be associated with at least one subject
A subject may be associated with one or more informal development

21) A parcel may be associated with at least one informal development type
An informal development type may be associated with one or more parcels

- E-R diagram for the MPLDP's conceptual model: E-R diagramming involves using Data modelling tools to visually represent relationship between data. Based on the above enterprise rules, the E-R diagram shown in figure 7.6 was developed to represent the conceptual model for the MPLDP Different symbols are used in DD to represent relationships. In this research the following symbols will be used

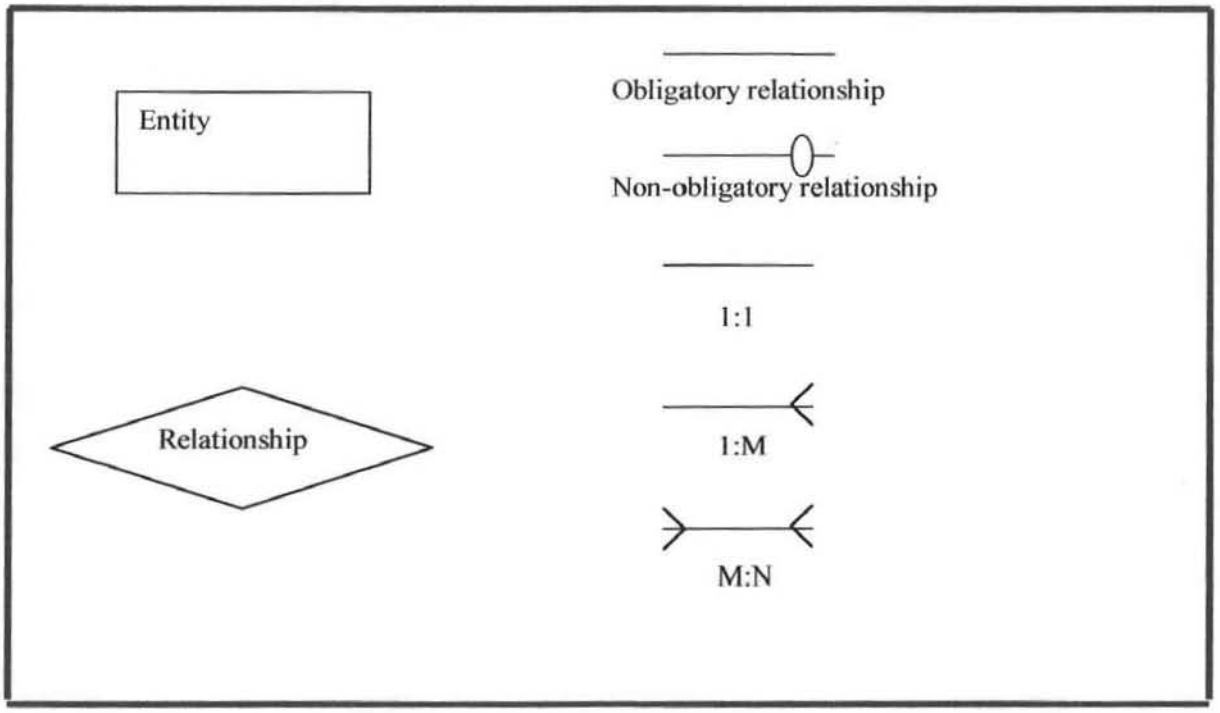


Figure 7.5 description of symbols to be used in the DFD for conceptual and logical data models.

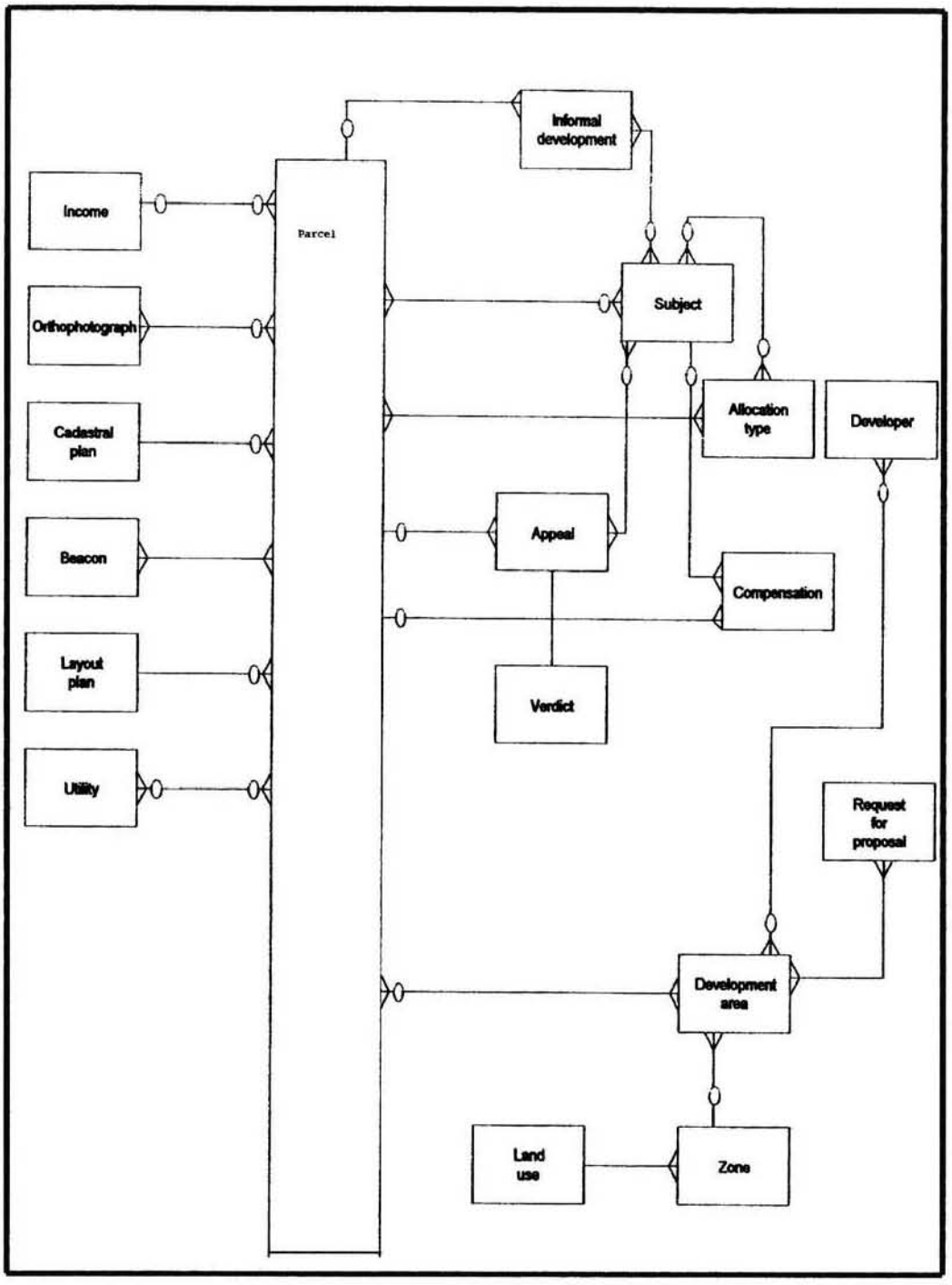


Figure 7.6 The E-R diagram for the MPLDP conceptual data model

7.5 Logical data modelling

The conceptual data model of the MPLDP discussed above could be converted to a format that is acceptable to the DBMS through logical data modelling design. The approach followed in this model is to provide for both the non-spatial and spatial logical data models.

7.5.1 Non-spatial logical data model

Non-spatial logical data modelling "involves the structuring of non-spatial data in such a way that the non-spatial component of the conceptual model can be mapped onto relations (tables)" Chilufya (1997: 61). In this process, key identifiers and other attributes are assigned to every entity and the normalization procedures are used to remove redundancies and functional dependencies amongst the non-spatial data sets. Normalized logical data model with fully normalized tables results. The process of normalization involves the following:

i) Identification of key and other attributes of entities. In cases where an entity has more than one possible key attributes such are referred to as candidate identifiers. The case holds "except where the same entity occurrence is connected by more than one occurrence of the same relationship in which case at least one additional attribute is required to make the identifier unique" (Chilufya, 1997: 61).

ii) Avoiding repetition by ensuring that relations have simple or atomic values;

iii) Ensuring that all relations have identifiers;

iv) Ensuring that all non-key attributes are functionally dependent on the whole of each relation key;

v) Maintaining that no dependencies exist between non-key attributes;
each relation key;

In this modelling approach the process of modelling is accomplished through the creation of well normalized skeleton tables and fully normalized tables.

Creation of skeleton tables: Skeleton tables are part representations of entities or relationships in a relational model, created through transforming entities and relations into tables (relations), and designating a name and an identifier to each table. Once identifiers have been selected, the tables are subjected to the process of partial normalization to obtain well-normalized skeleton tables. This process involves observing the following, in relation to degrees and optionality in entity relationships.

- If relation is 1:1 and membership is:

  i) obligatory for both entities, the attributes of both are put into a single table;

  ii) obligatory for only one entity, two tables should be constructed one for each entity. In addition the identifier of the non-obligatory entity should be posted into the obligatory entity table;

  iii) non-obligatory for both entities, three tables should be defined one table for each entity and another one for the relationship. The identifiers of the entities become the identifiers of the relationship table.

- If relationship is 1:M and membership is:

  i) non-obligatory both sides, three table are constructed, one for each entity and one for the relationship. In addition, both entities become identifiers of the relationship table;

ii) non-obligatory on the '1' entity and obligatory on the 'M' entity, two tables should be constructed for each entity. The identifier of the '1' entity is posted into the 'M' entity table;

iii) obligatory both sides, two tables should be defined in which the identifier of the '1' entity is posted into 'M' entity table;

iv) obligatory on the '1' entity and non-obligatory on the 'M' entity, three tables should be defined one for each entity and one for the relationship. In addition, the identifiers of both entities become identifiers for the relationship table.

- If the relationship is M: N, then three tables should be defined one each entity and for the relationship regardless of the membership class. Identifiers of both entities become a composite identifier for the relationship table.

Fully normalized tables: Chilufya (1997: 62-63) further illustrates that the next step in normalization is to derive fully normalized tables in which additional attributes are assigned to the tables showing identifiers and posted identifiers as depicted on the skeleton tables. This step should take cognizance of the following;

- "For 1:1 and 1:M relationships, the row identifier of the relationship table is not the same as the relationship identifier. A relationship identifier is needed to construct a skeleton table, but it is the row identifier which matters when the first normalisation rule, BCNF is used to check that the table remains well normalized after additional attributes have been assigned to the skeleton tables;

- "The candidate identifiers for the skeleton tables once defined need not be redefined without affecting other skeleton tables. Changing an identifier alters the meaning of the corresponding entity class and in turn affects the specifications of the skeleton tables. Thus attributes should not be assigned to a skeleton table if so doing alter the tables identifier;

- "Assignment of an attribute will be ambiguous if there is more than one skeleton table whose identifier is a determinant of the concerned attribute. Such ambiguities can only be resolved by ensuring that null values are avoided;

- "Fully normalized tables must not contain repeating groups,

- If in trying to find a home for an attribute, it turns out that no suitable skeleton table exists, it may be best to redefine some of the existing entities and relationships. However, quite often it is required that an E-R model is extended by adding further entities and/or relationships" (Chilufya, 1996: 62-63).

Thus, by application of these rules the following figure 7.7 on page 121 was obtained as a logical E-R diagramming for the MPLDP data model together with fully normalized table for the designed MPLDP database. Identifiers for each relational table to be created are underlined while posted identifiers are in italics.

Fully normalized tables

1. Parcel (Pid, par_area, par_value,)
2. Orthophotograph (Serial_nr, surveyor_id)
3. Par_ortho (serial_nr, pid)
4. Cadastral plan (Cadid, surv_date, *surveyor_id*)
5. Cad_par (pid, cadid)
6. Beacon (Beac_id, beac_desc, surv_date, *surveyor_id*)
7. Par_beacon (beac_id, pid)
8. Utility (Utility_id, utility type)
9. Par_utility (pid, utility_id)
10. Layout plan (Lplan_nr, plan_date, plan_descr, planner_id)

11. Par_lplan (pid, lplan_nr)
12. Land use (Luse_id, luse)
13. Zone (Zone_nr, zone_area, *luse_id*)
14. Devarea (Devarea_id, dev_specification, devarea_area, *zone_nr*)
15. Encroaching fields (pid, devarea_id, encr_area, encr_value)
16. Appeal (Appl_nr, appl_date, appeal_descr, verd_nr, verd_descr, verd_date, pid)
17. Compensation (Receipt_nr, comp_value, comp_date, *devarea_id, pid, subj_id*)
18. Appellent (Appellent_id, appl_nr)
19. Defendant (Def_id, appl_nr)
20. Subject (Subj_id, subj_name, subj_surname, subj_address)
21. Info_subj (info_id, subj_id, infosettler_id)
22. Allocation type (Alloc_id, alloc_type, cert_type)
23. Formal Allocation (alloc_id, pid, subj_id)
24. Informal development (Info_id, info_type)
25. Info_par (info_id, pid)
26. Income (Inco_id, inco_type)
27. Par_income (pid, inco_id)
28. Developer (Dev_id, dev_specifications)
29. Developer_devarea (dev_id, devarea_id)
30. Request for proposals (Req_nr, ITTN_nr, issue_date, dev_specification)
31. Req_devarea (req_nr, devarea_id)

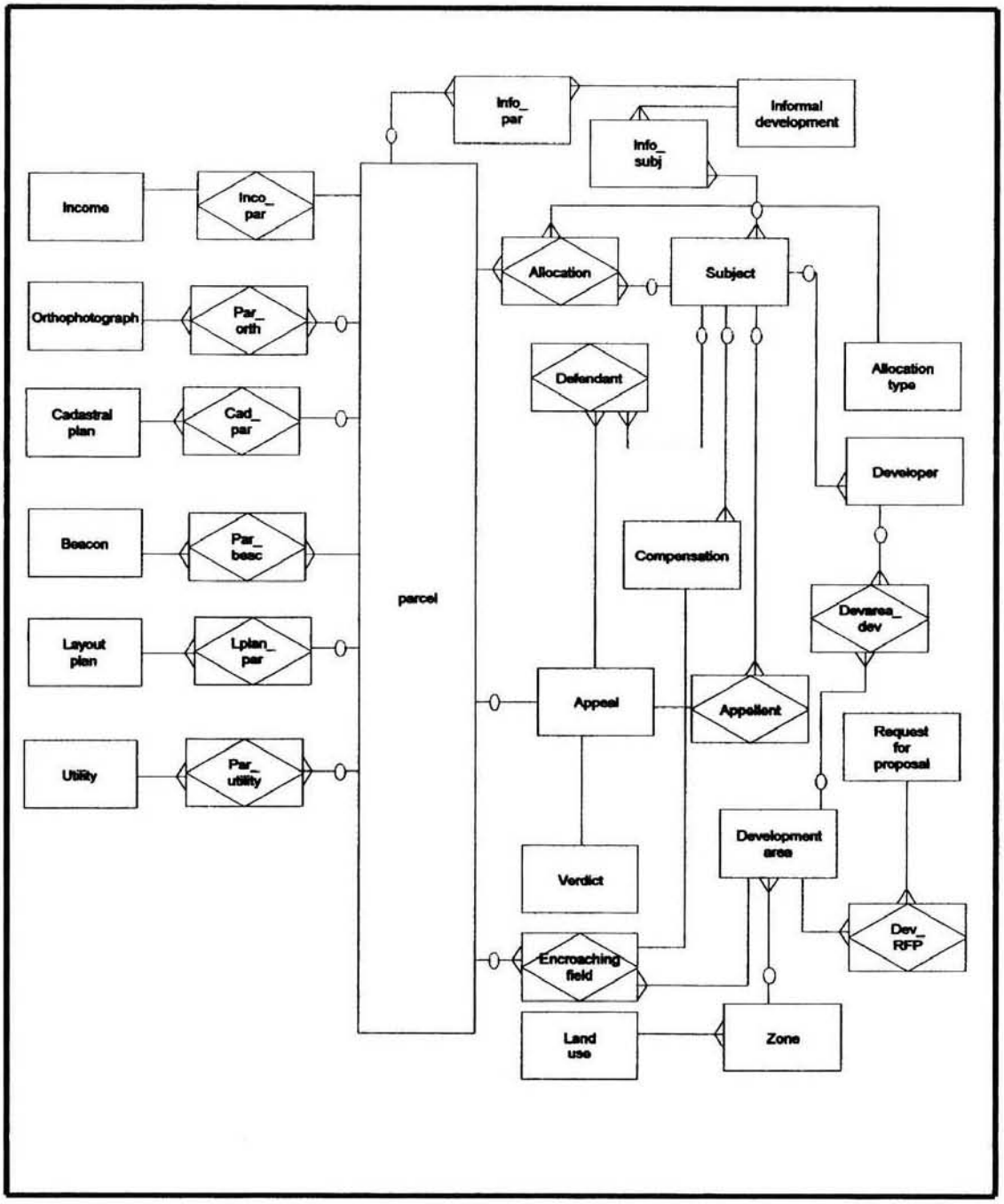


Figure 7.7 The E-R diagram for the MPLDP logical data model

7.5.2 Spatial Logical data model

The spatial logical data model involves structuring spatial data in such a way as to integrate it easily with the conceptual model of the non-spatial data into a GIS graphic data model. Although GIS packages maintain various data structures, the following are some similar issues that need to be considered in defining a spatial logical model:

- Coordinate system: "The coordinate system for the spatial database needs to be uniform and in appropriate units that represent the geographical features in their true shape and relative sizes" (Chilufya, 1997: 67). In the MPLDP, the maps that are used for reference are mostly from the DLSPP and are according to the Lesotho geodetic coordinate system defined in the Chief Surveyor's directions, as mentioned in chapter 6.

- Parcel reference system: The current parcel reference system is based on the serial number of the cadastral sheets available in the DLSPP. For example, a parcel on the cadastral sheet number 12222 will have a parcel number 12222-001 and so on. This system ensures that no two parcels share the same parcel identification number.

- Classification and coding of spatial features: Spatial features need to be classified to facilitate their entry into the database and their unique identification. The following is the representation of features that are presented on the existing project's spatial data;

  i) Parcel boundaries, buildings and beacons: On the project graphical maps, imaginary lines that run along the seasonal marsh marking boundaries between parcels represent field boundaries. Accordingly, as provided by the Chief surveyor's directions, imaginary lines between beacons on the cadastral plans of new layout mark the boundaries between parcels. This includes boundaries of other service servitude. Blocks inside cadastral plans represent buildings. In addition beacons are represented by dots on the cadastral plans.

  ii) Natural features: Natural features are included on layout plans. These are marked by real lines depicting linear topographical features for example banks, donga and river courses etc.

  iii) Service servitude: Line symbols are provided to mark line services such as telecommunication, electricity networks or roads, etc.

7.6 Concluding remarks

In this chapter some improvements to the MPLDP system were discussed in relation to the technical constraints discussed in the previous chapter. Furthermore, necessary changes to the institutional, legal and organization frameworks were discussed that would enable formality and efficiency of the technical improvements and performing of . This was necessary as issues such as codification of activities in legislation, level of technical training and the organizational structure have impact on formality and efficiency to change.

Automation was shown to be a relevant cure for most of the information management problems technically. It was shown that constraints associated with data acquisition, data processing, data integration, data exchange, dissemination and data storage could be ameliorated through conversion of analogue data to digital format. In terms of spatial data acquisition, aerial photography and GPS were found to be among the quickest methods that could cope with the project timeframes within the resources of the project.

Automated processing was discussed as a technical improvement to the system. It was proposed that spatial data captured in GPS equipment should be processed in the TSO software to produce cadastral plans. Orthophotographs should be engaged in carrying out general boundary surveys, assisting in drawing layout plans on its backdrop and monitoring of developments in the project area.

The improvements were further represented in terms of improved MPLDP functional model using DFDs. In this model it is illustrated how automated environment could reduce the number of functions still maintaining the desired outputs, reduce data stores by introducing digital databases, and reduce data traffic by use of the distributed network.

The model of the non-spatial database that could be designed and implemented to handle data for the MPLDP was discussed. The conceptual data model was discussed and it was mentioned that the model does not make use of any specific DBMS. E-R modelling was used to derive this model. E-R modelling was shown to involve defining relationships between data entities. The enterprise rules govern the relationships between entities and these were given for the MPLDP. Guided by the MPLDP enterprise rules E-R diagramming was then used to depict the MPLDP conceptual data model.

Further the MPLDP conceptual data model was converted to a non-spatial and spatial MPLDP logical data models which would be acceptable to a relational DBMS. The creation of the non-spatial logical data model involved assigning unique identifiers to the data entities and it was shown that this process culminates in production of skeleton tables. Further through the process of partial normalization skeleton tables are transformed into well-normalized skeleton tables with identifiers of entity tables posted to another depending on the relationship degrees and optionality. The process advances to creation of the fully normalized tables in which unnecessary duplicates in data are removed and additional attributes are assigned to the tables. The non-spatial logical data model was then accomplished by employing E-R diagramming. The spatial logical data model was also discussed. This involved defining data structure to entities, in which they could be represented in the GIS database.

Chapter 8

Implementation and testing of the improved system

8.0 Introduction

Implementation is the part of system realisation in which the improvements proposed in the previous chapter are effected. This chapter focuses on implementation of technical improvements. During this stage specific hardware and software are chosen and further processes are translated into computer programs and/or manual procedures. In addition, the logical data model discussed in the previous chapter is translated into a compatible working module database, capable of linking spatial and non-spatial data.

Testing of the database is also done during the implementation in order to assess the capability of the system to handle routine queries. Accordingly, the chapter discusses the testing of the implemented improved system to find out if it can provide solutions to the typical management problems that arise from planning and decision-making processes.

8.1 Hardware and software

Choice of the implementation hardware and software depends on one hand on the benefits/costs analysis and, on the other hand, the capabilities. The hardware and software available for this research is discussed below. Fortunately these hardware and software are also available for the MPLDP PMT, and the implementation using these hardware and software can easily be transformed to a working module for the project.

- Hardware: The hardware used for this research is Fugitech systems computer, 256 set coloured monitor with Micro-Soft Windows 95 operating system with 32 MB RAM, 260 MB Hard Disk free space and Pentium-S CPU with a frequency of 100MHz.

- Software: The software used for implementation include Windows-based Microsoft Access 97 (MS Access) DBMS and Environmental Systems Research Institute (ESRI) PC ARC/INFO and Arcview 3.2a.

8.2 Database creation

Because the MPLDP data is in both spatial and non-spatial forms both these databases were implemented as discussed in the sections below.

8.2.1 Spatial database

The spatial database was created using the existing project spatial data, which are in Arcview shapefiles and Micro-station DGN/DXF files. Owing to the fact that I had recommended the use of Arcview for spatial database, it was necessary to convert the existing Micro-station DGN/DXF files into Arcview shapefiles.

In the following sections, the nature of the existing spatial data of the project will be discussed. In addition, the procedure that was followed using Arcview and PC ARC/INFO to structure this data to conform to the non-spatial fully normalized tables mentioned in chapter 7 will be discussed.

8.2.1.1 MPLDP spatial data used to create spatial database

The MPLDP spatial data consists of a series of digital orthophotographs covering the project area and vector spatial layers (themes) in Arcview *'shapefile'* format (including 'project *boundary'*, *'fields'*, and

'zone'). One area of concern to the MPLDP is the Khubelu layout, which as was mentioned, the informal settlers in the project area were to be allocated land at first preference. This Khubelu layout currently exists in the spatial data of the project in Micro-station DGN files. The fields in the project area were shown in figure 6.1 on page 86, the project boundary was also shown in figure 6.3 on page 90, the zone plan in figure 6.4 on page, 91. Further the Khubelu layout was shown in figure 5.12 on page 75. From the existing spatial data mentioned above, the following were done to create a pilot database for the project

- The pilot area was chosen and project *'boundary'*; *'fields'* and *'zone'* shapefiles were clipped in the pilot area as shown in figure 8.1 on the next page.

- On the existing *'field'*, and *'zone'* shape feature attribute table (FAT) some of the field identifiers were re-structured in order to conform with the logical model of the non-spatial databases. Additional identifiers and attributes identified as necessary during the requirement determination process were added. Later their values were populated into these tables. Comparison of the original and the re-structured FAT are given in figure 8.2 and 8.3, for the 'zone' theme and figures 8.4 and 8.5 for the 'field' theme.

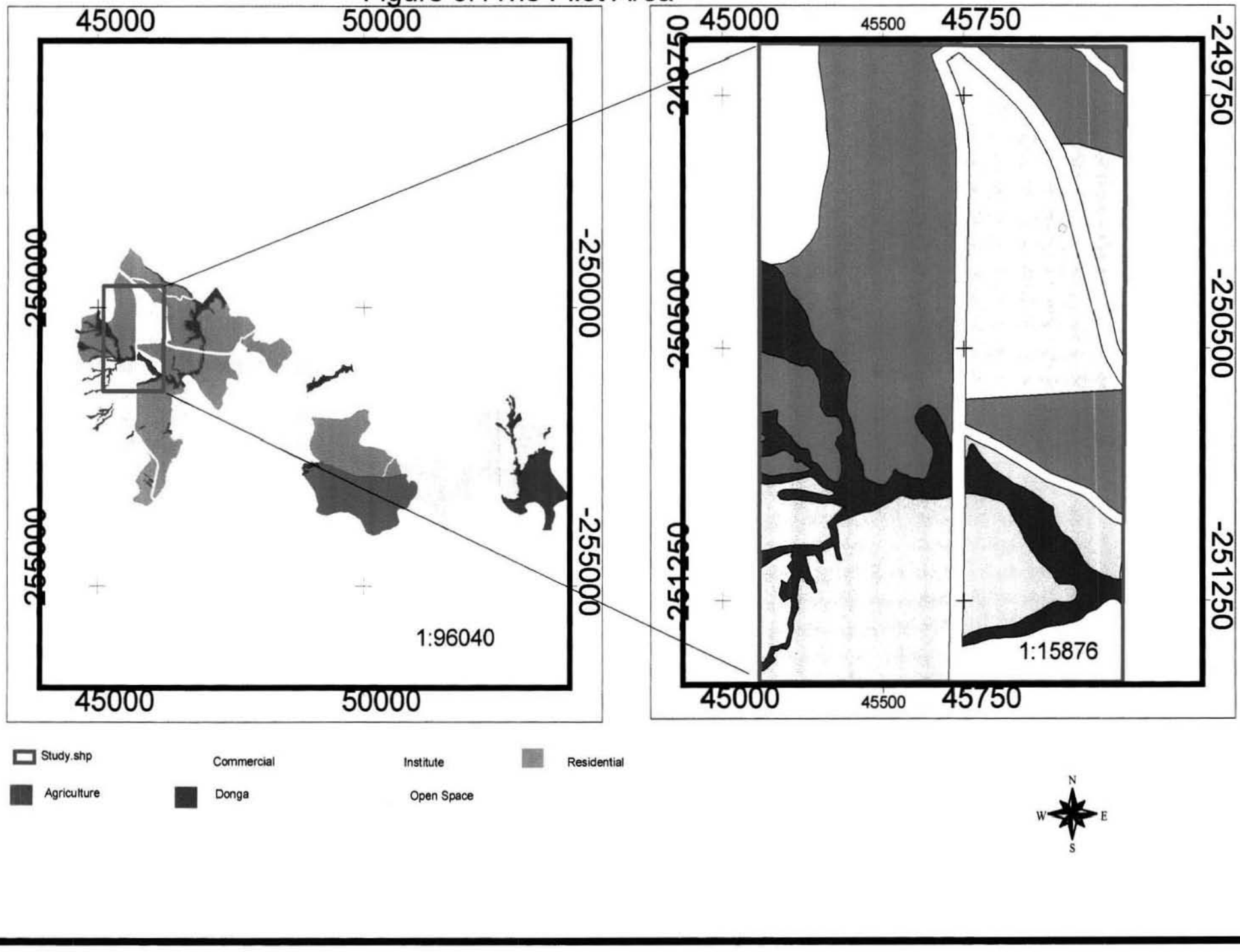
Shape	Level	Count	Use
Polygon	10	28	Donga
Polygon	11	4	Commercial
Polygon	12	45	Open Space
Polygon	13	15	Residential
Polygon	14	6	Institute
Polygon	15	10	
Polygon	19	1	Agriculture

Figure 8.2 Original attributes of the *'zone'* Arcview shapefile theme

Shape	Zone_nr	Zone_area	Luse
Polygon	1	80606	Donga
Polygon	2	151417	Donga
Polygon	3	303141	Commercial
Polygon	4	59202	Commercial
Polygon	5	86901	Open Space
Polygon	6	49972	Open Space
Polygon	7	81077	Residential

Figure 8.3 Re-structured attributes of the 'zone' Arcview shapefiles theme

Figure 8.1The Pilot Area



Shape	Entity	Field_no	Area	Surname	First_name
Polygon	Line String	116	10092		
Polygon	Complex Shape	134	18047		
Polygon	Complex Shape	135	6418		
Polygon	Complex Shape	133	14413		
Polygon	Complex Shape	132	9423		
Polygon	Complex Shape	130	7199		
Polygon	Complex Shape	131	8937		

Figure 8.4 Original attributes of *'fields'* theme

Shape	Pid	Par_area	Par_value
Polygon	3	1887	2831
Polygon	4	8880	13320
Polygon	5	15134	22701
Polygon	6	10009	15014
Polygon	7	11321	16982
Polygon	8	14225	21338
Polygon	9	9842	14763

Figure 8.5 Re-structured attributes of 'fields' theme

8.2.2.2 Layout plans and cadastral plans databases

Layout plans and cadastral plans are the major graphical component of the spatial data of the project. At the time of undertaking this research, development area layouts plans were not yet finalized, no layout subdivision plans prepared or land subdivision cadastral plans, except those of the project area boundaries. The PMT have since been busy on the process of drawing development area plans and preparing *'Requests for Proposals'*. It was attempted here however to produce typical layout plans and accompanying cadastral plans the way they may be managed stemming from the discussion with the project manager during the requirements determination. It has been the project manager's vision to see that most of the graphical data is stored and processed digitally (Ramonaheng, 2000: 4). To serve as an example of how these major graphical components (layout plans and cadastral plans) should be managed, the following methodology would be followed.

- Creation of the layout plans in Arcview environment using the orthophotograph as a backdrop;
- Creation of cadastral plans by deriving coordinates of the layout plan using Arcview to input into GPS software and later uploading into the GPS controller for surveying purposes. In addition the process involves downloading the surveyed coordinates from the GPS controller into GPS software and later input of the GPS software processed data into Arcview for management.

The created layout and the associated cadastral plans will be added to update the existing graphical cadastre and layout plans of the pilot study area.

a) Creation of layout plan database

The zoning plan is the only layout plan that exists in the pilot project area. Below is an attempt to show how layout database can be updated to include *'development areas'* and *'land subdivision layout'* plans using Arcview.

An orthophotograph is loaded and added into the *'View'* window where it could be zoomed to identify the suitable environmental conditions e.g. natural features or vegetation. Site inspection should however, not be neglected. After a suitable place has been identified, a new polygon theme is created and on–screen digitizing can be engaged according to the specifications e.g. parcel dimensions, area, etc. The on-screen digitizing in Arcview allows the user to view these dimensions during the process. The development area and associated subdivisions shown in figure 8.6 below were created using this method. The FATs of the layout plans were then assigned appropriate attributes and populated accordingly.

Figure 8.6 layout plan created in ArcView with other themes

Land subdivision Plan

Donga

Residential Zone

Development Area

60 0 60 120 Meters

b) Creation of the cadastral plan database

The creation of the cadastral plan database of the pilot study area was achieved by clipping the existing cadastral plans of the project area boundary and the fields as shown in figure 8.1. The cadastre of the pilot project was updated by the inclusion of the *'development area'* and *'land subdivision layout'* cadastral plans from the above development area and land subdivision layout plans. The inclusion of the development area cadastral plan and later the land subdivision plan was carried using the following methodology:

- Derivation of the layout coordinates in Arcview: A sample script that enables conversion of shapefiles to ARC/INFO format was compiled and run for both the *'development area'* and the *'land subdivision layout'* plan. Below in figure 8.7 is the result from the conversion of the development area layout coordinates to ARC/INFO format in Arcview.

```
1 AUTO
45296.699333, -250163.261532
45549.804026, -250169.511031
45549.804026, -250447.613718
45362.319068, -250447.613718
45196.707355, -250278.877256
45296.699333, -250163.261532
END
END
```

Figure 8.7 The resulting ARC/INFO format of the *'development area'* deflection point coordinates copied from Micro-soft Word Pad after conversion in Arcview engaging sample scripts

In this figure it should be noted that the first and the last coordinates are the same as the coordinate structure defines a closed polygon. These coordinates can then be import into GPS software and later uploaded in the GPS controller to undertake GPS survey. Depending on the software of the GPS, these coordinates could be structured to allow input in the software.

- Updating the project cadastre in Arcview using the surveyed coordinates: It was mentioned in chapter 6 that, it is necessary to further survey the staked out beacons after they are being fixed on the ground using 'stop and go' method. The resulting beacon coordinates can be downloaded into the GPS software. The cadastral plan can be processed in GPS software and later be transferred to Arcview in DXF format in beacon and parcel layers.

  The other alternative attempted in this research was to use a sample script in Arcview, which is capable of converting ASCII GPS output to a shapefile. Here it was assumed, as is the case that coordinates from GPS could be in a point form, as regards the surveyed beacons. Then to simulate a cadastral plan, the above given layout coordinates were structured to conform to the point format as shown in figure 8.8 below. From this point format structure, the script can produce point, line or polygon shape files. For this research the point (for beacons) and the polygon (for parcel) shapefiles were produced.

```
1, 45296.699333, -250163.261532
2, 45549.804026, -250169.511031
3, 45549.804026, -250447.613718
4, 45362.319068, -250447.613718
5, 45196.707355, -250278.877256
END
```

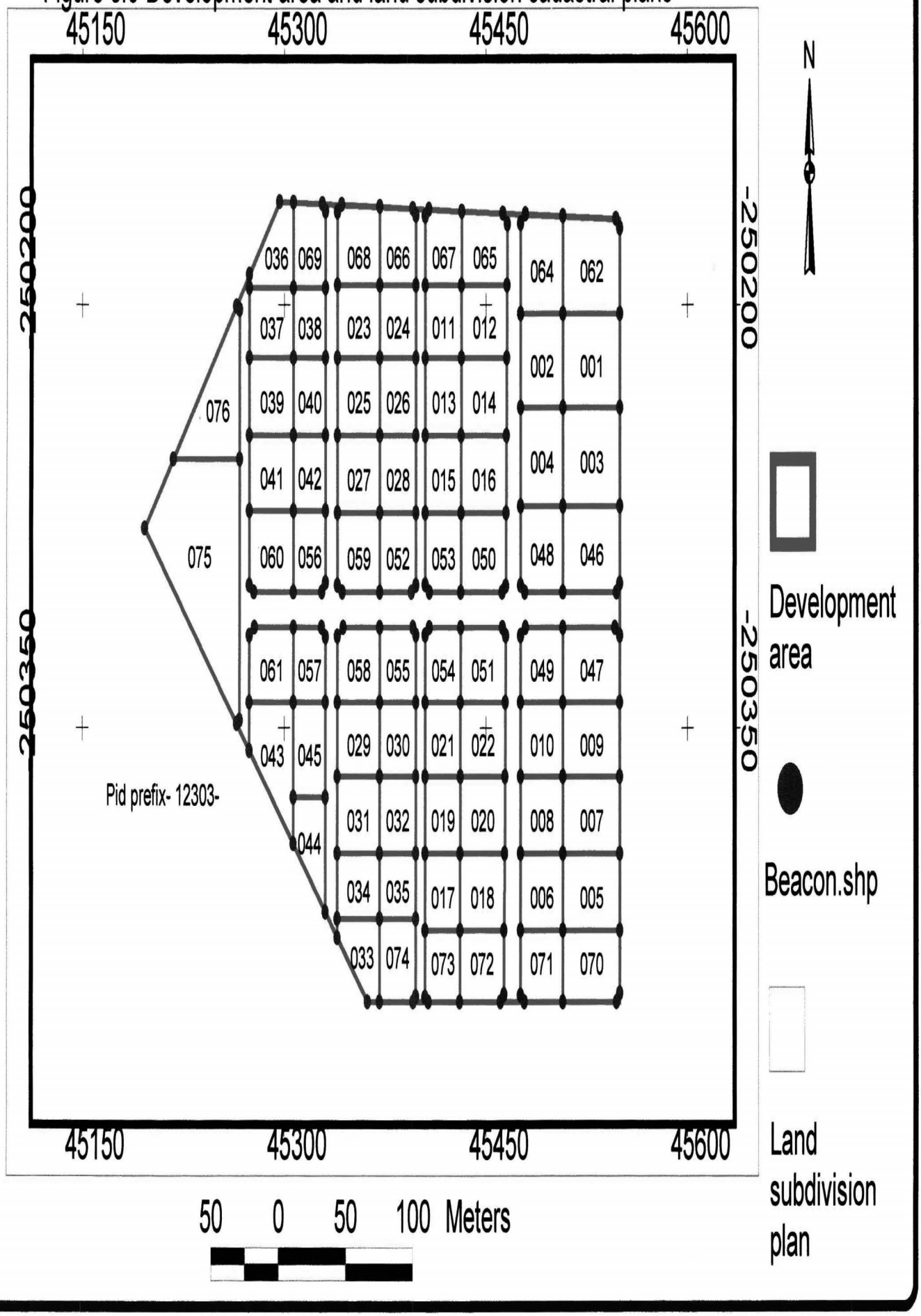
Figure 8.8 Structured development area layout plan coordinates from polygon to point format used to simulate an ASCII GPS output to be converted to a polygon (parcel) and point (beacon) shapefiles in Arcview by compiling and running a sample script to create the *'development area cadastral'* plan.

The same procedure can be followed to create the *'land subdivision cadastral'* plan from the *'land subdivision layout'* plan discussed in the above section, with the corresponding simulated, and structured to point form ASCII GPS output equivalent file. But for the 'land subdivision cadastral', owing to its many coordinates to be structured, the manual approach can be tedious. Programs need to be engaged like the ones found at www.gis.esri.com/arcscripts/scripts.cfm for such conversions from numerous ASCII GPS output in point form to Arcview polygon shapefiles. Then for both the development area the cadastral plan and the land subdivision cadastral plan two spatial layers were created for the parcel and for the beacons as shown in figure 8.9 on the next page.

The creation of the cadastral database advanced to defining attributes to the feature attribute tables and populating them accordingly. For the parcel layer *'[Shape].ReturnArea'* function was used to calculate the areas of the parcels automatically. The beacon coordinates for the *'development area cadastral'* and *'land subdivision cadastral'* plans were derived by compiling and running a sample script in Arcview that adds the x and y (Cartesian) coordinates of the beacons to the feature attribute tables.

From this example shown of the simulation of GPS data it shows that any other ASCII GPS output in the same format could actually be used to update the cadastral plan database of the project. Mostly it would be important for the Land Tenure and Survey Committee to update their cadastre in the same manner.

Figure 8.9 Development area and land subdivision cadastral plans



8.3 Non-spatial database creation

Creation of the non-spatial database involved implementing fully normalized tables in Micro-soft Access. The procedure involved the following:

- Entering entity attributes: This involved the creation of fully normalized tables and entering of attributes of entities. The key identifiers including candidate, were assigned keys accordingly. Tables that were implemented are given in the appendix P.

- Selection of field properties: When entering attributes, a choice is provided that defines the structure of data (i.e. size, format, to allow duplicates, etc.). For the key identifiers for all relationship degree including candidate in 1:1 relationship, *'Yes (No Duplicates)'* property was used in such a way as not to allow duplication of key attribute values. However *'Yes (Duplicates OK)'* property is used to define posted identifiers of the relation table for the 1:M and for M:N relationships.

- Populating fields with attribute values: The tables were populated with values in the attribute fields as determined from the existing records. The tables were then saved with entity names.

8.4 Linking of databases

The capability of databases to be able to integrate data is a crucial requirement in data analysis and manipulation. To achieve full data integration, there is a need to find ways in which graphic, spatial attribute and non-spatial data can be linked between themselves and each other. The discussion on the data linkages is presented on the basis of MS Access and Arcview, as the main types of software used to implement non-spatial and spatial data respectively.

a) Integration of non-spatial database using queries

Non-spatial to non-spatial data integration was achieved in MS Access. One of the ways employed was creation of queries. Query tables are done in MS Access to join tables that have related key attributes. The logic is to integrate and extend information relating to one entity kept in two or more tables in one table. When queries are created a new table from all or part of the data from multiple tables is linked as required.

b) Spatial to spatial data and/or non-spatial integration and queries

These forms of integration can be engaged in Arcview and MS Access. This could be in the form of a FAT of the spatial layer to that of the other spatial layer or FAT to a relate attribute table resident in an external database such as MS Access. This integration should take place in Arcview using the commands discussed below. Once a 'View' in Arcview is opened with relevant layers displayed various functions can be used for integration and querying. These functions are discussed below.

1) *Adding tables on 'View'*

- *'SQL CONNECT'* function: This function establishes a connection between spatial and non-spatial databases in the external database in which SQL query is created to retrieve records from MS Access into Arcview. Further integration of the non-spatial to spatial data once accessed in Arcview can be achieved using *'LINK'*, *'JOIN'*, etc. functions discussed below.

- *'ADD'* function: The function enables to bring FAT from spatial attribute database to be integrated with others opened on a *'View'*.

2) *Integrating databases in Arcview 'View'*

The following are some of the common functions that are used to integrate data in Arcview. Geoprocessing (including *'CLIP'*) has some of the function for data integration and more which are not discussed below.

- *'LINK'* function: *'LINK'* function is used to integrate a source table with a destination table (either a FAT or non-spatial from MS Access can be interchanged as source or destination). *'LINK'* function requires that both tables one field with common attribute values and the same data type (strings, numbers, etc.). In addition linking requires that the tables with the fields required for linking are already activated, and the destination table should be activated at the time the *'LINK'* operation is being done. Following the *'LINK'*, selection of records on the destination table will automatically highlight such on the source table. A 1:M relationship between destination and source table is well supported by *'LINK'* function, in which selection of one record in destination table can correspond to many on the source table.

- *'JOIN'* function: *'JOIN'* establishes a 1:1 or M:1 relationship in which usually the source table (in which the use of FAT is ideal compared to external relate table, because FAT provides a link to the spatial layer displayed) is joined to the destination table when fields having same attribute values are active. This results in the destination table being active and corresponding information from the source table is integrated into the destination table.

- Multiple *'View'* themes overlay: This is engaged in graphical to graphical shapefiles themes opened in one *'View'*. Multiple themes are displayed in terms of overlays in the order they appear on the *'View'* legend.

3) *Performing queries in Arcview*

- *'QUERY BUILDER'*: *'QUERY BUILDER'* is used to select a specified value in a field of attributes. Selection can be based on logical expressions (including =, >, <, and, or, etc.) to a specified value the result of which are selected on the FAT of the queried theme and on the graphics.

- *'SELECT'*: The function works in both spatial attribute (*'POINTER'*) and graphical (*'SELECT FEATURE'*) and (*'SELECT BY THEME'*). Clicking with a *'POINTER'* on the record on FAT would automatically select the corresponding graphic feature on the *'View'*. Clicking with a *'SELECT FEATURE'* on the graphical feature of the active themes allows selection of the accompanying record on the FAT. *'SELECT BY THEME'* allows integrating graphical data in which situations of intersection, complete containment, etc. can be selected between active themes on *'View'*.

- *'BUFFER'*: Buffer creates a theme of specified distance around other active themes.

- *'IDENTIFY'*: Allows the display of attribute records in tabular form for the graphical features on the *'View'* selected by *'IDENTIFY'* function on graphics.

- *'FIND'*: *'FIND'* identifies any required attribute textual value in the fields of the FAT of active theme by input of the required attribute value. The identified value is then related to attribute records and further highlighted on the graphics.

- *'CLIP'*: Helps to incorporate part of one graphical data into the other.

8.5 Database testing

Testing is based on employing the created database to derive information required to solve some of the planning and decision-making problems. An attempt was made below to formulate typical questions that are relevant to some of the activities undertaken for planning and decision-making process for the project.

Problems and solutions:

(N.B. all the tables highlighted in Italics are given in appendix P)

1) **What is the total value of all the fields acquired for the project?**

Solution: The *'allocation'*, *'parcel'* and *'allocation type'* tables as given in figure 8.10 below were used to solve the problem. The *'allocation table'* provides information about the allocation status of a parcel. The *'allocation type'* provides reference on allocation types and the *'parcel table'* provides information about the parcel values. These tables in italics will however be provided in this problem for clarity, otherwise they are listed in appendix P

pid	subj_id	alloc_id
10	7	5
11	8	5
12	9	5
12303-	87	2
12303-	88	2
12303-	89	2
12303-		6
12303-	23	4
12303-	21	4
12303-		6
12303-		6

alloc_id	all_type
1	illegal allocation
2	new allocation
3	relocation
4	reallocation
5	acquired
6	not yet allocated

pid	par_valu	par_ar
10	25410	1694
11	11940	796
12	14006	933
12303-	21390	142
12303-	20985	139
12303-	22035	146
12303-	19350	129
12303-	14445	96
12303-	16470	109
12303-	15675	104
12303-	16380	109

Figure 8.10 Tables that enable to solve the problem 1. The first table is the *'allocation table'*, followed by *'allocation type'* and lastly *'parcel table'*. These tables are provided in appendix P.

These tables were joined to form query 1 shown in figure 8.11 below in which information about the parcel number, the status of allocation and its value can be derived. The expression 'acquired' in the figure refers to those fields that had been acquired for the project.

pid	par_value	all_type
284	50	acquired
12303-053	1110	new allocation
253	1626	acquired
53	1869	acquired
3	2831	acquired
267	3020	acquired
40	3279	acquired
41	3333	acquired
33	4407	acquired
248	4695	acquired
997	4869	acquired
56	5355	acquired
57	6141	acquired
999	6479	acquired
245	7454	acquired
64	7553	acquired
241	7856	acquired
12303-030	8880	new allocation
34	9143	acquired
72	9144	acquired
12303-040	9405	not yet allocated
12303-052	9420	not yet allocated
12303-032	9480	new allocation
12303-031	9780	new allocation
12303-060	9840	not yet allocated
12303-050	10095	not yet allocated
208	10140	acquired
12303-042	10275	not yet allocated
12303-033	10290	new allocation
12303-017	10335	not yet allocated
12303-056	10395	new allocation
12303-057	10395	new allocation
12303-020	10425	new allocation
45	10586	acquired
12303-059	10620	new allocation
209	10662	acquired

Figure 8.11 Part of QUERY 1

QUERY 1 was connected into Arcview and *'QUERY BUILDER'* was used to choose from QUERY 1 all the parcels acquired for the project. *'STATISTICS'* operation was then engaged to find the sum of all the acquired parcel values. The result is given in figure 8.10 below. The result shows that, the acquired parcels for the project have a combined value of M 1698413 (M for Maloti, the Lesotho currency)

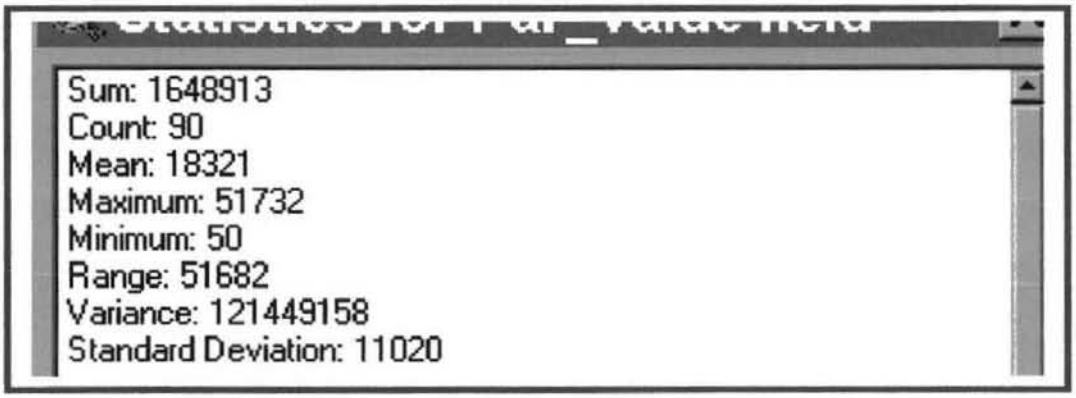


Figure 8.12 The result of performing the query to find the sum of all the parcels acquired for the project using the statistics operation.

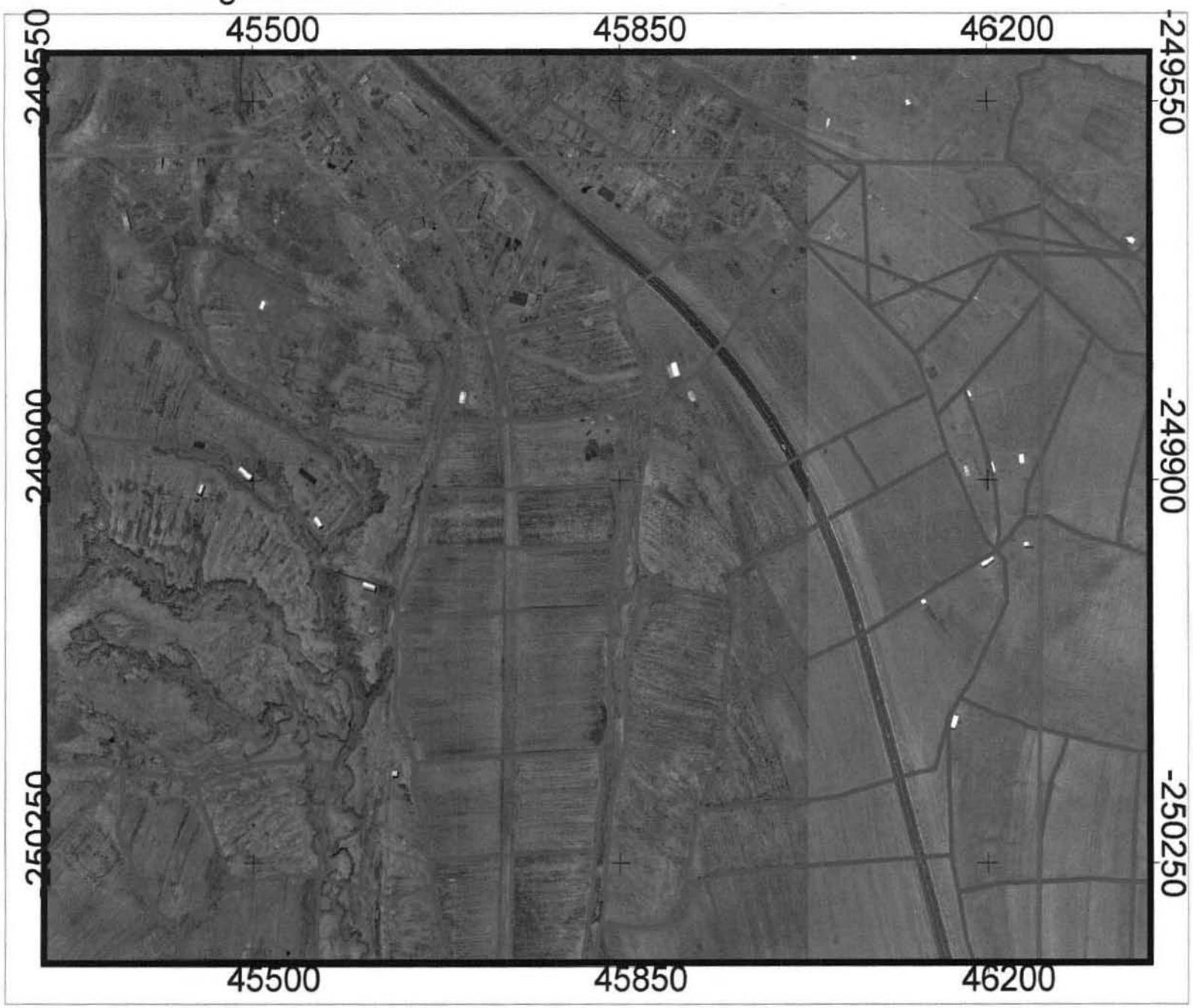
2) **Which fields in the project area are harbouring informal settlers? and who own the fields these informal settlers subsist on? This report is required by the project manager to hand in the presentation to the Land Task Force to deal with landowners who subdivide their land illegally.**

- Solution 2: A query was performed joining the non-spatial *'informal development'* and *'allocation' and 'Info_subj'*, and results are given as QUERY 2 in figure 8.13 below (only an extract given). The query provides the owners of the informally developed parcels, and their parcel identifiers and the kind of informal development the parcel is engage. The informal settlement problem is shown in figure 8.14 below.

pid	subj_id	subj_surname	subj_name	info_type
11	8			informal occupation
13	10			informal occupation
17	14			informal occupation
226	56			informal occupation
239	68			informal occupation
240	70			informal occupation
245	68			informal occupation
246	76			informal occupation
247	77			informal occupation
248	78			informal occupation
255	81			informal occupation
259	265			informal occupation
266	8			informal occupation
284	81			informal occupation
4	2			informal occupation
44	70			informal occupation
5	3			informal occupation
6	2			informal occupation
7	4			informal occupation
997	999999			informal occupation
999	221			informal occupation
99993	267			informal occupation
99997	268	Mothuntsane	Bophelo	informal occupation

Figure 8.13 QUERY 2 extract. The names of the fieldowners are deleted intentionally for privacy purposes, however the subject identity (subj_id) can be used to identify the names in the subject table.

To get the spatial part of the problem, the digitized informal development and parcel themes were added and displayed on *'View'* window. *'SELECT BY THEME'* function was used to highlight all the parcels that contained informal developments. The result is given in figure 8.15 on page 140.


45500
45850
46200
-249550
-249900
-250250
N
W
E
S
Pilot Area
Fields.
60 0 60 120 Meters

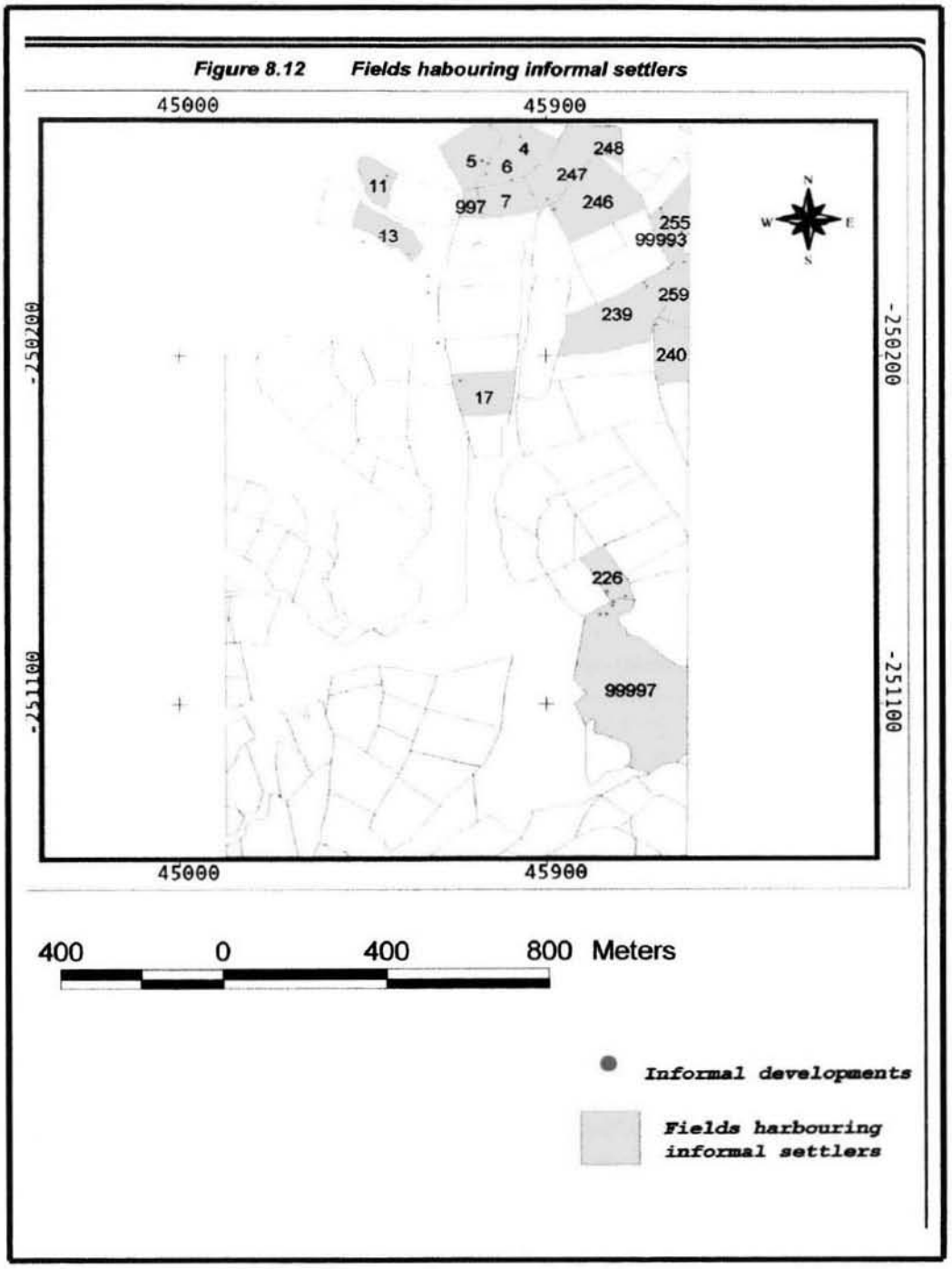


Figure 8.15 Fields that are harbouring informal settlements

3) **What are the values of the fields in development area 1 in which an allocated developer has to reallocate or compensate the fieldowners equitably, and who are the owners? The Housing Committee had just awarded a developer to develop development area 1 and requires this information both in spatial and non-spatial forms.**

- Solution 3: Solving this problem was met with another problem because fields encroach in development area 1 in whole and others in parts as shown in figure 8.16 on the next page.

To get the true representation of the area of the fields encroaching into development areas, *'CLIP'* function was used to get only the encroaching part of the fields as shown in figure 8.17 on page 143. The areas of the fields required to calculate parcel value were derived using *'[Shape].ReturnArea'*. function. Further a table was constructed in MS Access that represent the encroachment scenario named *'encroaching fields'*. This table provides the values of the encroaching parts of the field in development area 1. This table is given on the integrated presentation in figure 8.17on page 143. This table was connected into Arcview using 'SQL' connect function and *'QUERY BUILDER'* was used to select parcels associated with development area 1.

Fields in the pilot study area and some encroaching into the development area

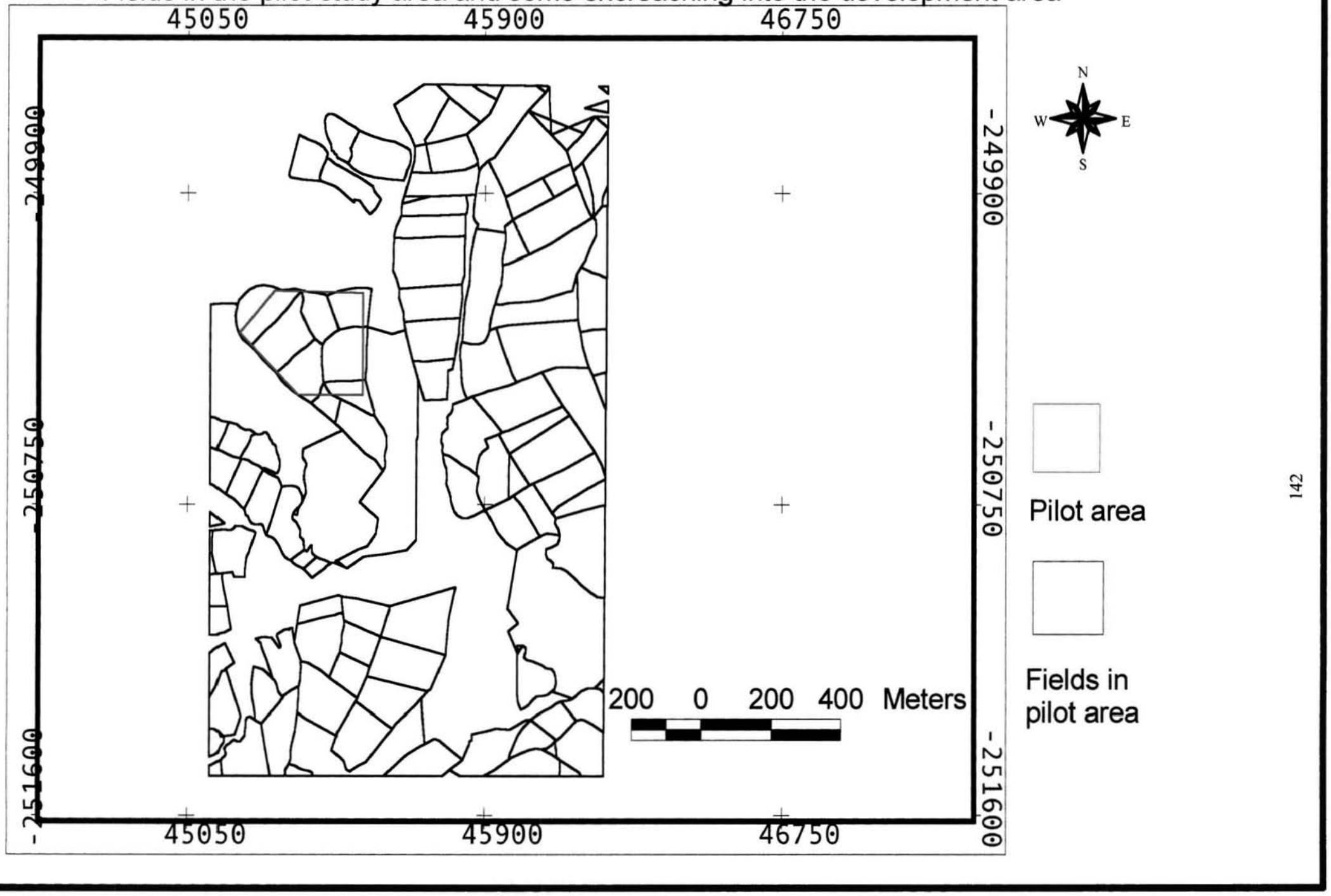
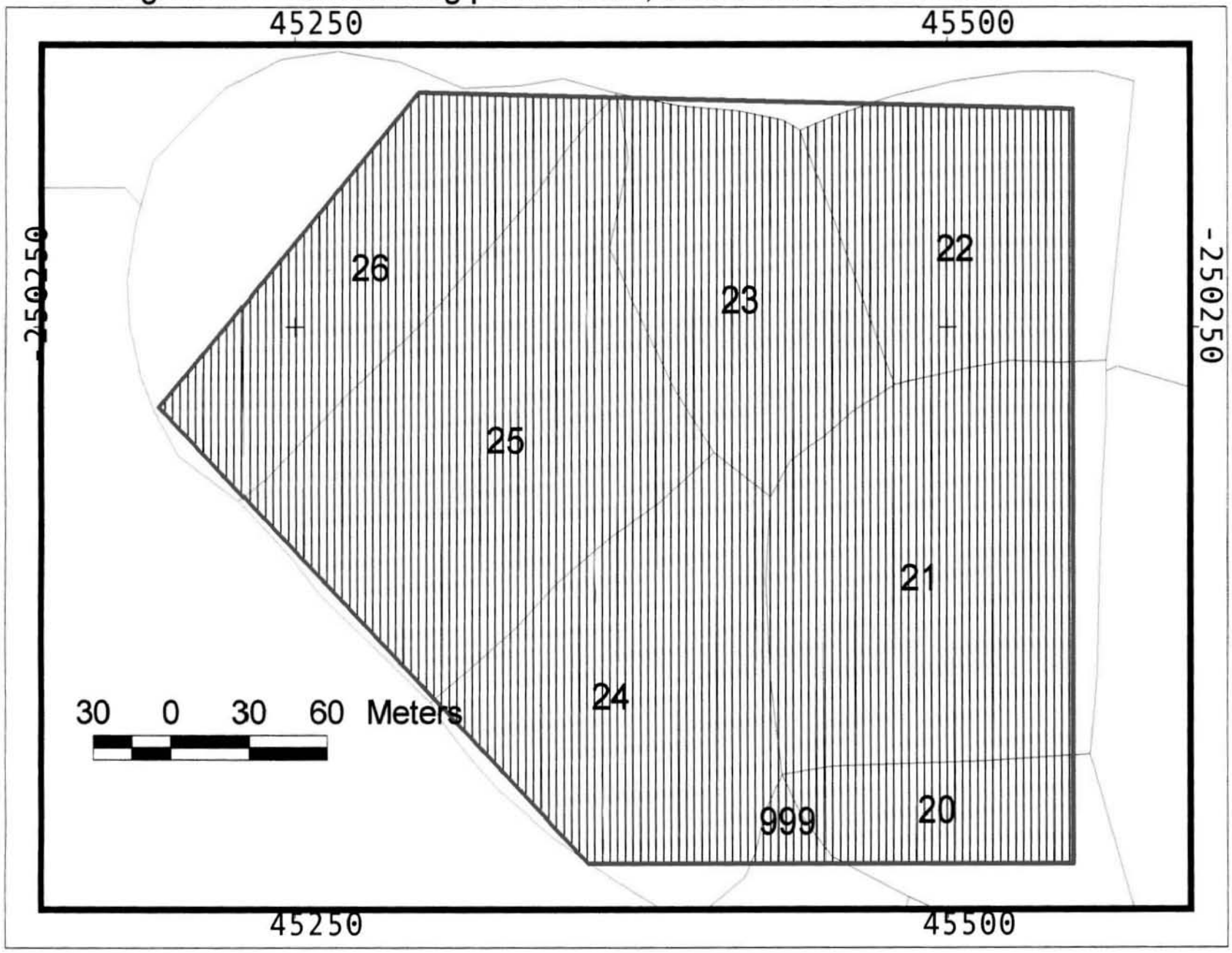


Figure 8.17 Encroaching part of fields, their owners and values



Subj_id	pid	Encro_value
23	26	14612
21	24	19272
19	22	12824
20	23	15119
18	21	24017
22	25	26859
221	999	788
17	20	5736
221	999	

development area

Fields

Encroachment parts

143

4) **Which of the parcels that has not been allocated in development area 1 that can be reallocated equitably, to subject 12 whose acquired parcel had value of M 14006? A spatial representation is required**

- **Solution 4:** The following was followed to solve the problem;

In order to identify a possible parcel not yet allocated in development area 1 that can be reallocated to subject 12 the following Query 1 (figure 8.11) given in problem one was used. In this figure parcels that have not been allocated are expressed with 'not yet allocated'.

QUERY 1 was connected to Arcview using *'SQL CONNECT'* function. In Arcview, QUERY 1was joined using *'LINK'* function to FAT of *'land subdivision cadastral plan'* (see page 132 and figure 8.9) theme. The *'QUERY BUILDER'* was then used to select the parcels in development area 1 without owners ('not yet allocated'). From the selected set of records showing the parcels in development area 1without owners, *'QUERY BUILDER'* again was used to select parcels with values close to M 14006 by employing logical expressions (> <) operations. The resulting possible parcels were selected and are shown in figure 8.18 below. From the figure parcel 12303-013 could be the most possible parcel to be reallocate to subject 21.

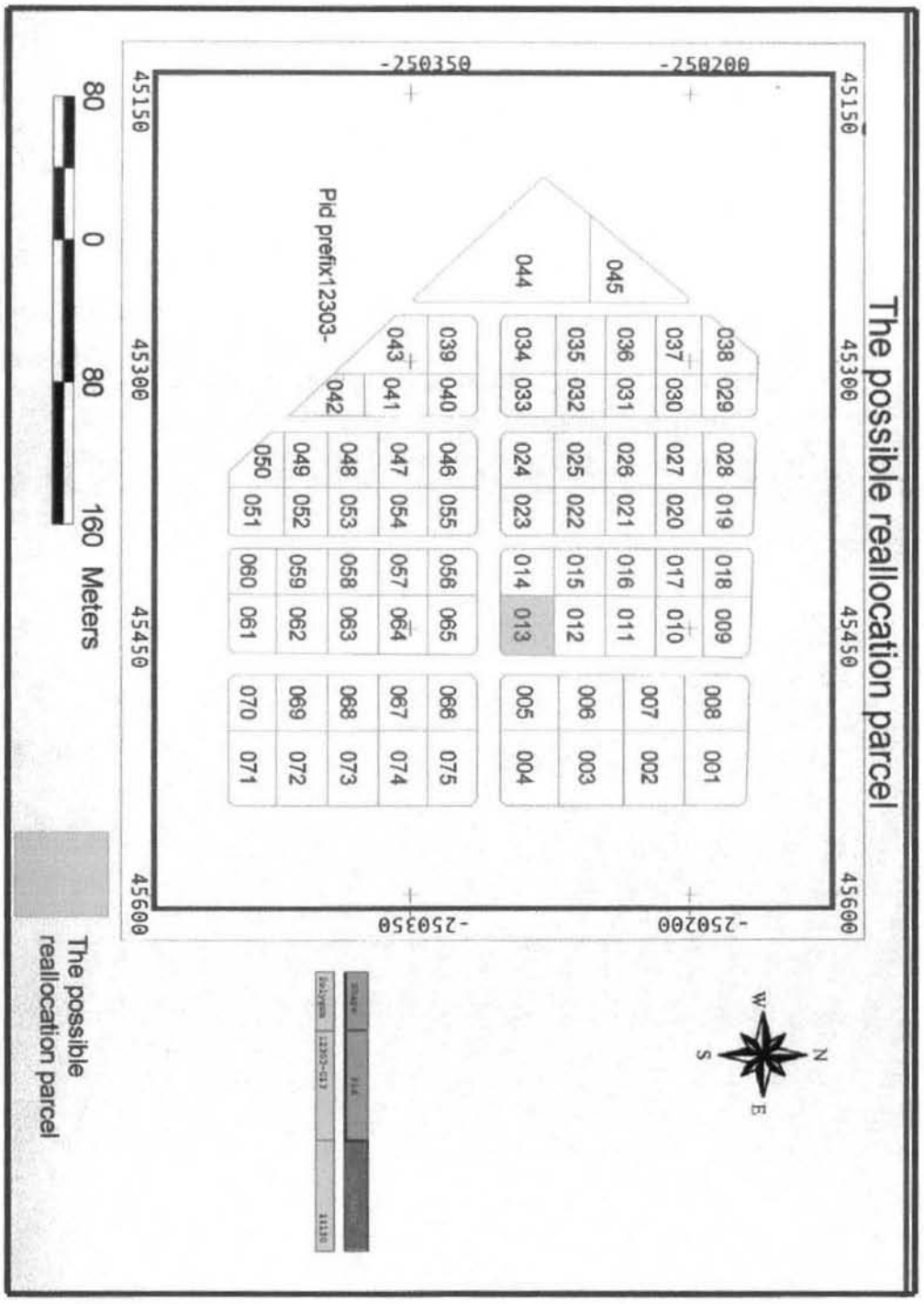


Figure 8.18 The possible reallocation parcel

5) **The layout inspection team from the Environment Committee is on a site visit at development area 1 and suspects that some of the parcels fall in the buffer zone within which development is not allowed. Verify this.**

- **Solution 5**: The problem was solved by creating a buffer zone of 50 metres away from the donga as specified in environmental guidelines to developers. This buffer was then overlaid on the *'subdivision cadastral plan'* of the parcels in *'development area 1'*. A *'select by theme'* function was used to select all the parcels that intersect with the buffer. The result of the informally developed parcels is given on figure 8.19 below.

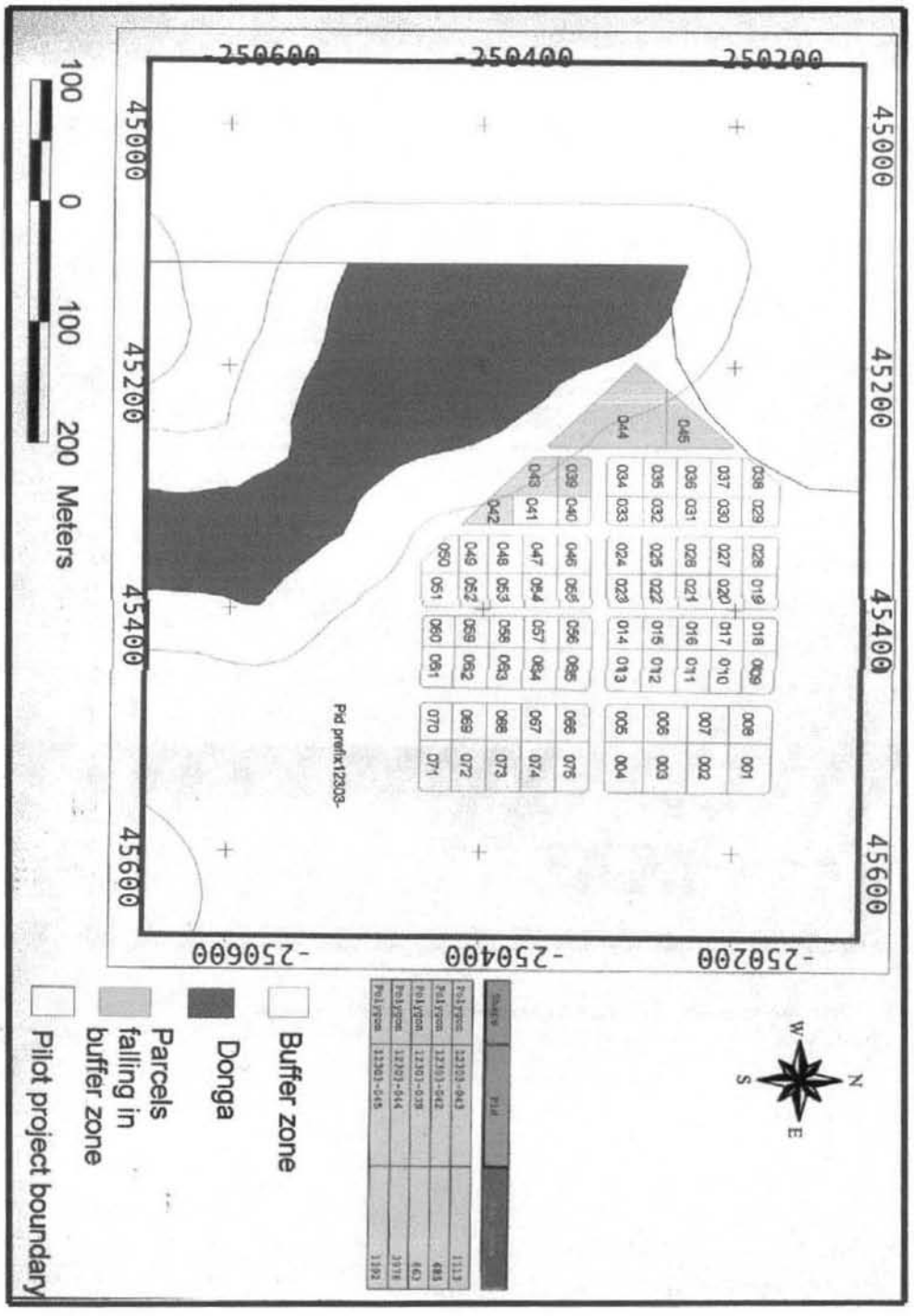


Figure 8.19 Parcels that fall within the buffer zone

8.5 System installation strategy

A single location installation as discussed by Hoffer *et al.* (1999: 777-778) is the strategy recommended for this improved functional and databases system implementation. This strategy is based on running an improved LIS on one location first, in which when it succeeds it can be installed in the other location as illustrated in figure 8.18 below. The strategy could be important to convince the management and to help the personnel to be conversant with the procedures.

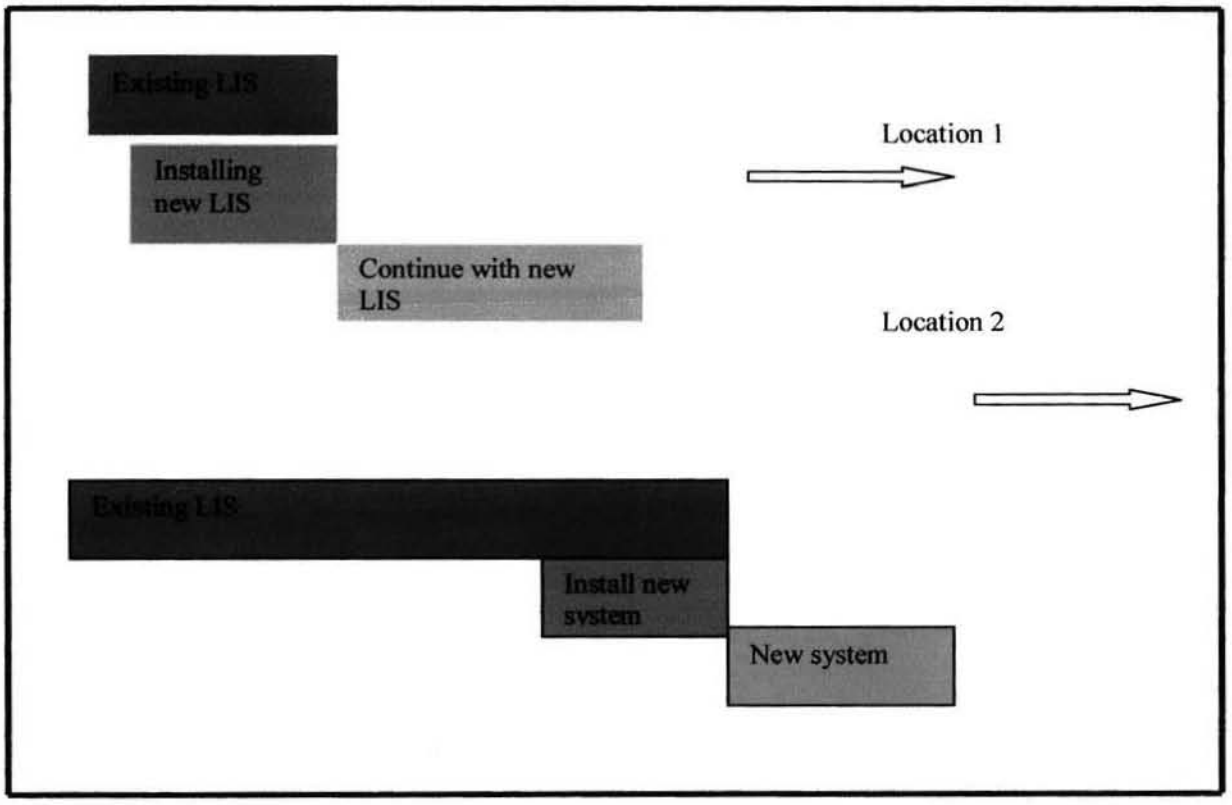


Figure 8.20 Recommended single location installation strategy (adapted from Hoffer *et al*, 1999)

8.6 Concluding remarks

In this chapter the implementation of technical improvements discussed in the previous chapter were described. This included defining software and hardware that were used for implementation. The fully normalized tables and the graphical database were implemented. Only a small pilot area was chosen for database creation.

A constraint encountered in database creation was that the major spatial data, such as the layout subdivision plans and their accompanying cadastral plans (forming the cadastral), were not available at the time of research. Examples were, however, given in which typical physical layout plan and cadastral plan production could be achieved. It was shown that really it was not necessary to undertake layout drawing in two phases as shown in the previous chapter using analogue orthophotograph and later digitizing in Arcview. Automated layout production was shown to be sufficient by itself. In addition it was shown that GPS and its TSO data processing software TSO were also compatible with the use of Arcview. It was shown that it was easy task to migrate GPS data into Arcview or vise-versa through conversions on ASCII files by compiling and running scripts in Arcview. An example then was given which illustrated the process of drawing layout plans using orthophotograph, transferring coordinates of the deflection points on the layout plans to GPS, staking out the coordinates on the ground and producing cadastral plans in TSO, and eventually migrating the cadastral plan of the layout to Arcview for storage and further processing.

The created pilot non-spatial and spatial databases were then tested to assess their capability to provide data analysis, manipulation and presentation that conveyed meaningful information for planning and decision-making processes. Data integration was mentioned as the main capability to be examined. Functions to achieve data integration both in non-spatial spatial were discussed and some utilized in running the tests on databases. Engaging in solving simulated management questions using the improved database tested the integrity of the created database. Although a few problems had been entertained in this research for testing, the researcher cannot foresee any reasons why the created databases should not be able to manage project data for the created pilot project study. SDLC is however a cyclic project which allows maintenance of the created database in case of any difficulties met. As mentioned in chapter 4, the SDLC methodology allows back reference maintenance of the system. A single location installation strategy is recommended for this improved system as it allows testing to pass criticism and allows time for confidence in LIS handling personnel, without risk of loosing data if the old system is being switched off, at introduction of the improved system.

Chapter 9

Conclusion and recommendations

9.0 Introduction

This research focussed on exploring the capabilities of LIS to facilitate managing land information for the MPLDP, a LR project initiated by the Lesotho government. In pursuance of this, the research further looked into how functions and land information are being currently managed in the MPLDP, and where constraints were noted, recommendations were made for improvements.

The first step was to understand what LR and LIS were. In this research LR was understood as a land management technique associated with changes in property and property ownership structures to meet the requirements of urbanization. The changes are effected through land pooling, unified planning, and reallocation of well-planned and serviced parcels. This provided understanding the underlying concepts of LR's in which the capabilities of LIS have been investigated. This was followed by a review in which land information required to undertake LR was investigated.

Also in this first step the capabilities of LIS to manage the land information required for LR were reviewed. This involved analysis of its types and components and how the components could work together to achieve efficient management of land information. Furthermore, major considerations in the development of LIS associated with management and institutional issues were noted and discussed.

The second step in this research involved understanding the MPLDP system in terms of how functions and land information were managed. This was aimed at analysis of any bottlenecks and backlogs in the functioning of the project and further, investigating areas where there were any constraints that were associated with these bottlenecks and backlogs. This process was undertaken in terms of requirement determination in which several fact-finding techniques were used. Furthermore, the second step recommended improvements in certain LIS procedures. The improvements discussed were mainly technical while the legal and institutional issues that were necessary in introduction of technical procedures were also highlighted. The improvements included how spatial data could be collected, processed, stored, exchanged and disseminated efficiently and effectively. Moreover, the technical recommendations were implemented and a test using the databases was performed in which experimental typical land management, and administration problems were solved, using the implemented databases.

As a result of these activities I was able to conclude that the aim of the research in which the capabilities of LIS were explored for the management of MPLDP land information has been achieved. In order to review the activities and achievements of the research, a discussion of the summary of each of the chapters, observations and conclusions have been presented below.

9.1 Chapter 1

In chapter one the background to the research was provided. In addition the problem that led to the research, the objective, the questions that would be pursued towards the achievement of the objective, the methodology which the exploration would follow, and finally how the dissertation would be structured were discussed.

Elaborating on these further, it was noted that the problem leading to this research was the poor land information management that contributes to the failure of land management projects in Lesotho. An example was given in which land disputes owing to lack of efficient land information management, results in overrunning the initial stages of projects like land adjudication process.

I noted the objective of the research as exploring LIS as a possible tool to facilitate management of land information for the MPLDP. In this project of multi-stakeholdership, many problems of information management arise. Success stories of LIS as a powerful tool in managing land information for big projects served as motivation to undertake this research. An example was mentioned of the neighbouring country to Lesotho, The Republic of South Africa, in which a massive project The Cato Manor Land Development Project managing simultaneously more than sixty sub-projects, had introduced LIS successively as a tool to manage its land information. Another motivation was the recent acquisition of the resources capable of assembling LIS in the Department of Lands, Survey and Physical Planning which is the Head Quarters of the project and where the researcher is an employee. It was again the wish of the MPLDP manager to see such tools being employed in the project.

In order to guide this research to accomplish the desired objective, some important questions were formulated which were pursued. Firstly, it was deemed necessary to investigate the underlying concepts of LR to overview the types of information sets required. Secondly, it was seen as a matter of importance to identify efficient methods of data collection, processing, storage and dissemination to speed up the project activities. This was envisaged to be undertaken by analyzing how these activities were currently done and proposing more efficient methods. These questions provided the base on which the methodology was formulated to undertake this research. The rest of chapter 1 presented an overview of the research structure highlighting the areas each subsequent chapter would focus on.

9.2 Chapter 2

In chapter 2, LR was discussed as a land management technique to provide for formal land delivery for housing and services. LR was defined and shown that it encompasses changes in property and property ownership structures to meet the requirements of urbanization. In addition LR was shown to be a multi-stakeholdership project in which the community the public and private sector are involved with projects costs and benefits equitably distributed. To understand LR's underlying concepts, some international literature was reviewed based on the various countries that are conversant and experienced with the technique. These countries included Japan, Germany, Sweden, the United States of America, etc. Among these countries Japan's Kukaku-Seiri, methodology to LR was used to demonstrate LR's underlying concepts. The methodology was subjectively used for basis of LR discussion as it was clearly outlined from the literature I got. A clear distinction was provided in which LR could be approached which are the 'Building Lot Supply' and 'Urban Infrastructure Development' approaches. Within these approaches sub-types were also discussed.

This chapter further touched on the important institutional framework in which LR is undertaken. It was shown that as a multi-stakeholdership project the community, the private and the private sector engage in different roles. The degree to which these stakeholders are involved in the technique is determined by institutional arrangements varying country to country. The activities engaged in LR were then discussed in terms of land administration functions as mentioned to be parcel delimitation, allocation of interests to land, land regulation, land valuation and taxation. These functions were discussed in the timeframe (being pre-process, formal process and post process) they normally occur in the project but bearing in mind that the project is cyclic and there is possible reversion to earlier phases if need arises. These functions were each scrutinized within the process time frames (i.e. pre-process, formal-process and post-process. This provided an initial step to understand how the functions can be undertaken in the processes and identifying possible supporting information required in planning and making decision.

9.2 Chapter 3

Chapter three focussed on identifying relevant land information sets that would assist in the land administration functions discussed in chapter 2. To understand land information, land and information were discussed as individual entities. An integrated definition based on the discussion of land and information was then derived. Other terms usually used interchangeable with land and information were discussed including parcel and data used interchangeably for 'land' and 'information' respectively.

Further, relevant land information sets required for LR were identified to be land tenure information to assist in allocation of interests; land valuation information to assist in equitable sharing of project costs and benefits; land use information to solve problems of planning for various land uses; and land regulation information to provide control and law enforcement in observance of laws guiding developments in land and adherence to these laws. I then noted some important specific activities in LR to which these information sets serve as resource to planning and decision making. In summary, a set of these specific activities and their associated land information requirements were compiled in the form of a table.

The chapter went further to explore how these information sets are managed employing LIS tools. LIS was discussed and shown to comprise various components including resources (human, technical and finance), and procedures, including those involved in data acquisition, data modelling, data management, data manipulation and analysis, and presentation of spatial analyses results. All of these work together, to achieve an efficient land information management goal. These components were further scrutinized to explore their capabilities. It was shown that LIS may employ parcel as a spatial unit of records in which juridical and fiscal cadastre can be engaged to manage land tenure and land value. Multi-purpose cadastre was further discussed, in which management of land information is accomplished by overlaying various information sets, including land tenure, land values, land use, etc. based on a parcel as a spatial unit in a uniform geo-reference frame.

In this chapter, then, the identification of the relevant information required for LR and how LIS can be employed as a tool to manage this information stemming from investigation of its capabilities were established.

9.4 Chapter 4

In chapter 4 the development of LIS was reviewed. This development was based on a systematic procedure in which LIS components can be assembled to avoid deficiency in a developed information system. In this attempt it was shown that there are management and institutional issues which need to be addressed before LIS is developed. These issues were further discussed and their significance in the development of LIS highlighted. The chapter went on to discuss SDLC as a relevant systematic approach to develop LIS because it takes into consideration the development of a system as cyclical and phased, enabling reversion to previous stages for maintenance. It was then illustrated how the methodology can be used to assemble LIS components. Activities engaged in each phase of development were discussed, which were isolated as system strategy and planning, system analysis, system design, and system realisation.

9.5 Chapter 5

Chapter 5 introduced a discussion of the MPLDP project management framework in which a practical exploration of LIS capabilities to manage land information was to be engaged. The MPLDP was defined in terms of its location, goals, definition of problem, aims and objectives to address the problems stated. Highlighted as deviation from the LR review in chapter 2 which was based on the western and eastern countries was the problem of informal settlements in the third world countries including Lesotho. This was shown to have complicated social, economic and political issues that rendered common law to overweigh statutory law. The chapter continued to discuss the legal, institutional and time frameworks in which the project was to run. Important legislations and policies that needed observance in carrying out project activities were mentioned. Those institutions that are consulted in the running of the project, whether as a matter of formality or need, were also mentioned. In addition the time framework of the project was discussed. It was shown that the project would be undertaken in two phases. At the time of this research the project was in stage five of the first phase, which is preparation of contracts to implement envisaged land developments.

The approach outlined in chapter 2 was followed to discuss specific project activities and associated land administration functions involved. A work break down structure was used in which process structure (pre-process, formal-process and post-process) was used. This provided a comfortable platform to disintegrate land administration functions into sub- functions within which the associated legal, institutional and time frameworks would be integrated in the discussion. For example land administration function like allocation

of interests was disintegrated into land acquisition and titling, which occurred at different time frames, under specific legal frameworks and involved with specific institutions.

9.6 Chapter 6

Chapter 6 focussed on the analysis of the MPLDP to identify areas, which manifested constraints, resulting in backlogs and bottlenecks in project activities. To achieve this, the structure of each committee, its functions, data acquisition, data processing, data storage, data exchange and information dissemination for each committee were analyzed. Requirement determination excursion was necessary to identify the above factors, and involved several trips to visit the various institutions that housed the PMT members. To gather information for analysis, various fact-finding techniques, including questionnaires, observations, study of the project publications and relevant regulations governing project activities were used.

In this mission I identified that most of the data that was needed for analysis was not available at the time. This was due to the stage at which the project was, in which significant spatial data, like land subdivision layout plans and accompanying cadastral plans that would form the largest part of the project's cadastral information was not available. However, the existing land information and how the other aspects were envisaged to be managed, and how problems in planning and decision-making in the future were to be solved were discussed with some members of the project management team through interviews and further information was extracted from the project publications. These sources were to be sufficient for my analysis.

The information gathered during this stage was further compiled into land information system requirements, relating each committee to input data, data source, the processes in which data were involved and the outputs. Land information requirements were then structured using various CASE tools for further analysis. Information planning and architecture tools were discussed. Information analysis was further employed in which data flow diagrams were used to depict information or data flow visually, functions in which this data or information was used and converted to required outputs and in addition how such information was stored.

Although this research is not a professional systems analyis, what was achieved in this chapter was firstly, understanding how functions are undertaken and how information is managed in the MPLDP system. Areas where bottlenecks and backlogs occurred were identified, and constraints causing these were determined. This was first achieved by scrutinizing the project structure, functions and ways in which information is managed. Secondly, the areas that were involved in potential constraints causing bottlenecks and backlogs were investigated, employing methods of structuring information requirements using information analysis. Finally, the results of the analysis were discussed. It was found that the system had many problems. Those which caused inefficiency to land information management were discussed. These included dissociation of the PMT members who are located at various institutions, lack of valid non-spatial information caused by high intensity of informal settlement and inefficient methods of data exchange. In addition lack of expertise in automation was identified in which relevant technical tools were used ineffectively, like information processing being done manually and further digitized which culminated in duplication of effort and time wasting. Further this inefficiency was noted by committee members using various Microsoft Windows spread sheet programs and Arcview databases without introduction of integrated databases that could enhance the efficient supply of information with queries that could provide spatial and non-spatial information simultaneously.

9.7 Chapter 7

In this chapter technical improvements to the MPLDP were discussed. The improvements mentioned were not intended to overhaul the current system but to ameliorate the weaknesses identified in chapter 6. Only technical improvements were attended to, and some suggestions to how non-spatial attribute data could be managed in the settlement to be in par with the capturing of spatial data which seems to be effective for the project. Any other constraints were a matter beyond which, as a land surveyor, I could handle. Technical improvements discussed in this chapter are mostly based on automated data acquisition, processing, exchange and dissemination.

Orthophotograph was proposed to be used for identification of the settlement pattern, the adjudication process and as the backdrop to drawing layout plans. Again the TIFF, the format for current orthophotograph is in was shown to consume a lot of disk space culminating in slow processing. A way to ameliorate this was for conversion of the orthophotograph into JPEG format. GPS was proposed to be used in engaging in fixing boundary surveys in the project area.

It was further noted that digital data storage was a necessity to assist automation. The current digital data of the project was proposed to be converted into digital form, captured either by scanning and digitizing for graphic data, and, by key entry for non-spatial data. This was shown to be capable of reducing data storage requirements and misplacement of data as observed during the requirement determination mission. Furthermore it was shown that such automated processing and digital data storages would enhance methods of data exchange and dissemination proposed. For data exchange, a distributed system WAN and even Internet technology suggested by the project manager was proposed, in which electronic data exchange would be more efficiently managed. It was also shown that data dissemination would be enhanced also by computer print outs to enable an efficient integration of spatial and non-spatial data.

It was further noted under technical improvements that institutional and legal issues need to be addressed in order for the improvements to be effected formally and effectively. Among others it was noted that the use of GPS should be codified under Chief Surveyor's Directions, and the Chief Planner should amend planning procedures in such a way that full automation of layout plans would be permitted. In addition it is noted that the PMT members need to undergo either formal or in-service training in order to engage in the proposed automation, as it was observed that necessary resources are present, but are not used to full effect.

In this chapter, the improvements to the system functions and database were visually presented, using various CASE tools. Improved conceptual functional model DFDs were used to illustrate improvements proposed to the existing project functions as were noted on the conceptual function model DFD of the existing system in chapter 6. The important factors depicted on this improved DFD were the use of automated processing and digital data storages and the data exchange and dissemination that were possible through distributed and shared database and computer print out.

The improvements to databases were presented by the conceptual data model of the system employing E-R diagramming tools. This E-R modelling was used to map the relationship between data entities derived from the MPLDP data. The relationships between these entities were defined by the existing enterprise rules. The conceptual model was later transformed into a logical data model through the process of normalization, employing also the E-R diagramming tools. The logical data model was undertaken to prepare data entry into a specific DBMS for a relational database; Micro-soft Access DBMS was selected. In addition the logical model of spatial data was discussed in which specific graphical data structures were described that are compatible with the Arcview database. Further identified were necessary legal and institutional issues that needed to be addressed to implement these improvements.

9.8 Chapter 8

Chapter 8 focussed on the implementation of the technical improvements proposed in chapter 7. In this chapter specific hardware and software were highlighted for implementation. These included personal computer and MS Access and Arcview and for non-spatial and spatial database respectively.

Creation of the database was based on the existing and collected MPLDP data. Further simulation was done to provide an example of how data, that was not available at time of research, but of significance to the project, like the layout plans and cadastral plans could be managed. The creation of databases was based on a pilot area within the MPLDP. On the existing data, like the zoning plan of the project, the attribute fields were re-structured to correspond with the created fully normalized tables produced in chapter 7.

To illustrate how proposed automated data processing would occur an example was given of how physical layouts can be produced in Arcview. Furthermore illustrated was how coordinates data from layout plans could be transferred into GPS TSO software for uploading into GPS controllers; and also how data

captured in GPS can finally be stored in Arcview for editing and further analysis, manipulation and presentation.

The possible ways in which data in MS Access and Arcview can be integrated, manipulated, queried and analysed were mentioned. This discussion was based on the functionalities that are provided by these software. The databases created were tested in order to assess if they could provide the required information for planning and decision making. This was done in the form of formulating questions, which portrayed the kind of information could be required from the created databases. In order to answer these questions, queries, data manipulation and analysis were undertaken, and the results finally presented in spatial and/or non-spatial format where necessary.

In MS Access query tables were used to present non-spatial results. The Layout function in Arcview was used for presentation of graphical information and where necessary integrated with spatial and non-spatial attribute information. The Layout function enables presentation of data in a geo-reference frame, which could enable accurate integration of many themes, which maintain a similar reference frame. In this case, the local coordinate system defined by the Chief Surveyor's directions should be maintained. To achieve this it was shown that there is a need to transform GPS WGS 84 coordinates to this system.

As these resources are present in the Department of Lands, Surveys and Physical Planning at the MPLDP Head Quarters, I see the introduction of LIS such as the system described in this research, in which its capabilities were assessed and tested, a more efficient way of managing land information for the MPLDP. To provide space for criticism for such implementation, a single location installation strategy is proposed, employing a pilot area in which the capabilities of these improvements can be further tested by the MPLDP management. This strategy avoids risk of losing data by the automatic switch off of the existing system.

9.9 Statement of achieving the objective

What was achieved in this research was to show how LIS could be employed as a tool in the management of MPLDP land information, to assist in the effective provision of information to support planning and decision-making processes. Technically, improved methods of data capture, data processing, storage and dissemination were assessed with practical examples and were found a success. Furthermore employment of an improved and implemented database to solve typical management problems and success observed could be concluded as successful in this project. Thus, I can conclude that LIS tools employing MS Access, Arcview and PC ARC/INFO can be employed in the management of the land information for the MPLDP.

9.9 Shortcomings in the research

The shortcomings in this research were that most of the data required for analysis, such as the subdivision plans and accompanying cadastral plans were not yet available due to the stage the project was in at the time of undertaking this research. Therefore I needed to structure interviews and questionnaires to focus directly on how these data were envisaged to be managed. As a land surveyor trainee in the Department of Lands, Surveys and Physical Planning also the Head Quarters of the MPLDP, and likely to be involved in the later stages of the project if called upon, I was chiefly interested in analysis and improvements focussing on spatial data acquisition and management for the MPLDP. Furthermore, in pursuance to get more information I was sent a 'Request for Proposal' document given in appendix 5 at the time I was winding up my research in which I could not get the graphical part mentioned on page 3 of the document. This should have been development area not yet subdivided in which I could have used in the implementation chapter. Last but not least was the shortcoming in the literature of land re-adjustment for third world countries and in which in LR review mostly the examples were taken from the west and eastern civilized societies. This fact however, made me indulge further into the informal settlement situation of Lesotho and to integrate this fact in the analysis, design and testing of the improved MPLDP system.

9.11 Areas for further research

Areas for further research for this dissertation include getting a detailed plan for implementing a distributed network that would function as envisaged in this research. Furthermore it would be of interest if such a

system were extended to the whole project area, to assess its data management capabilities further and provide necessary maintenance. This would be of no difficulty as the SDLC methodology employed in designing the improved databases allows reverting to earlier stages for maintenance. This could be achieved by improving the conceptual functional and data models discussed in this research augmented by further undertaking analysis of the system at that stage.

9.12 Concluding remarks

LIS technical resources including hardware, software and data are associated with a variety of functionalities and models in which specialists can achieve their most effective use. I recognize that there may be, simpler ways in which the implementation and testing of the designed functional model and databases could have been done to achieve the same results as I have attempted in this research. As a student, and to be a researcher in LIS technology, I recognize the need to take this research in practice and to identify further more simpler and efficient ways of managing land information for land management projects and other land information resource based activities in Lesotho, as technology is evolving every day for the better.

References

Antenucci J.C, Brown K, Croswell P.L, Kevany M.J, 1991, Geographic Information Systems: A Guide to Technology, Van Nostrand Reinhold, New York

Archer R. W, 1999, The potential of land pooling/readjustment to provide land for low-cost housing in developing countries, in Making Common Ground: Public-private partnerships in land for housing, G. Payne (eds.), Intermediate Technology Publications, Southampton Row, London, p 113-133

Barry M. B, 1999, Evaluating Cadastral Systems in Periods of Uncertainty: A Study of Cape Town's Xhosa-speaking Communities, Ph.D. dissertation, Department of Surveying and Mapping, University of Natal, Durban

Dale P. F and McLaughlin J. D, 1988, Land Information Management: An introduction with special reference to cadastral problems in Third World countries, Clarendon Press, Oxford

Davidson F and Payne G. (Editors), 1993, Urban Projects Manual. Liverpool University Press, Liverpool

Chilufya M. S, 1997, From Manual to Integrated Cadastral and Land Registration Information System: A Zambian New Legal Challenge, International Institute for Aerospace Survey and Earth Sciences, Enschede

Chilufya M. S, 2000, GIS Notes, University of Natal, Durban

Commissioner of Lands, 2000, Proposed Phomolong SDA/Tikoe Participatory Pilot Project, DLHUD, Lesotho Government Printers

Fourie C, 1998, The role of local land administrators: an African perspective, in Land Use Policy, Pergamon (eds), Elsevier Science Limited, Great Britain pp. 55-66

Hardoy J. E and Satterthwaite D, 1989, Squatter Citizen: Life in the Urban Third World. Earthscan Publications, London

Hindson D and McCarthy J, 1994, Here to Stay: Informal Settlements in KwaZulu-Natal. Indicator Press, Durban

Hoffer A H and George J F and Valacich J S, 1999, Modern Systems Analysis and Design, Addison-Wesley, Massachusetts

Land Act. 1979, Land Act of 1979. Lesotho Government Printer, Maseru

Land Policy Review Commission. 2000. Land Policy Review Report. Government Printer, Maseru

Land Survey Act.1980, Land Survey Act 1980. Lesotho Government Printer, Maseru

Larsson G, 1983, Land Readjustment, Avebury, Aldershot

Merrian-Webster's Collegiate Dictionary, 2001, www.yourdictinary.com/cgi-bin/mw.cgi

Millenium Park Team, 2000, First Draft: Development Brief For Millenium Park Project, DLHUD, Maseru

Nichols S E, 1993, Land Registration: Managing Land Information for Land Administration, Ph.D. dissertation, Department of Surveying Engineering Technical Report No.168, University of New Brunswick, Fredericton, Canada

Odendaal N, 2000, GIS As a Planning Decision-Support Tool on The Cato Manor Development Project, in Monitor, Town and Regional Planning Commission, (eds.), Province of KwaZulu-Natal, vol 25, p 10-13

Payne G, 1999, Introduction, in Making Common Ground: Public-private partnerships in land for housing, G Payne (eds.), Intermediate Technology Publications, Southampton Row, London, p 1-16

Ramonaheng M, 2000, Final Report: Millenium Park Land Development Project, DLHUD, Maseru.

Schwarzwalder B, 2001, 'China's Farmers need Long Term Land Tenure Security, Not Land Readjustment' www.worldbank.org (21/02/01)

Selebalo Q.C, 1996, Proposal for Land Registration System which Recognizes Informal Settlements in Lesotho, Masters research project, Department of Surveying and mapping, University of Natal

Sumpter CW and Asher G.W, UNECA, 1998, (www.odyssey.maine.edu/gisweb/spatdb/acsm/ac94105.html: 2001)

UNECA, 1998, An Integrated Geo-information (GIS) with emphasis on Cadastre and Land Information Systems (LIS) for decision -makers in Africa, Working Document for a meeting of Group Experts at UNECA, Addis Ababa, 23-26 November 1998

www.calvertinstitute.org.issue/0005/lib0005b.html#3d (20/02/01)

www.gis.esri.com/arcscripts/scripts.cfm

www.moc.go.jp/city/sigaiti/kukaku-e/what/chap1.html (21/02/01)

www.snc.edn./socsi/chairs/333/number.html (10/8/01)

www.usc.edu/schools/sppd/pracinst/newsletter (21/02/01)

Appendices

Appendix A -A court order of eviction and demolition of property at Lepereng at the outskirts of Maseru.

IN THE MAGISTRATE COURT FOR THE DISTRICT OF MASERU

HELD AT MASERU **CR 492\00**

In the matter between

REX

And

1. [redacted]
2. [redacted]

COURT ORDER

Whereas on the 12th December 2000 accused 1 was ordered to vacate the site she occupies at Lepereng in terms of Section 87(1)(3) of the Land Act, but had not done so , I hereby order that the said accused be evicted from the said site with the assistance of the police forthwith. Any structure on the premises should also be demolished.

2001 -02- 0 5

L.S. Mapetla
Chief Magistrate 5th February 2001

Appendix B - A summon calling upon an informal settler to court in case of occupying, aiding or abetting unlawful occupation of land.

LESOTHO

SUMMONS IN CRIMINAL CASE

IN THE SUBORDINATE COURT OF THE MAGISTRATE/ 1st CLASS

FOR THE DISTRICT OF MASERU HELD AT MASERU

To the Messenger of the Court,

You are hereby required and directed in His Majesty's name on the sight hereof to summon* [illegible] Mosotho

female aged about 35 years

hereinafter called the "accused"

of Semonkong presently staying at Ha-Shelile under Him Stanly Motsoso

that he appear personally before this Court at MASERU MAGISTRATE

on the 16th day of March 2001

next, at 8.30 o'clock in the forenoon, to answer and abide the judgment of the Court upon the complaint and information of

The Public Prosecutor for the said District (who prosecutes in the name and on behalf of His Majesty); who presents and informs the Court that the said accused did commit the crime of C/S 83 of The Land Act 1979 as ammended

in that on or about the — day of — 2000 last

and at Ha - Shelile

in the district of MASERU the said accused did wrongfully, unlawfully and maliciously occupy said [illegible] in the unlawful occupation of land

TLDM 1: [illegible] ha u na [illegible]

* Describe him particularly.

Appendix C - A Request for Proposal (RFP) document

Ministry of Local Government
Department of Lands, Housing and Urban Development
P. O. Box 876
Maseru 100
LESOTHO

RE: REQUEST FOR PROPOSALS (RFP) FOR THE DESIGN AND IMPLEMENTATION OF SERVICED LOW-INCOME HOUSING. PROJECT, MASOWE.

We wish to inform you that the Government of Lesotho's Ministry of Local Government intends to use the services of consultants/developers for the detailed design and construction of serviced low-income housing . MASOWE.

This Request For Proposal is comprised of this covering letter or letter of invitation and the following documents:-

- Section 1: Terms of Reference
- Section II: Instruction to Developers/Consultants
- Section III: Annex (Project Location Plan)

In the event of any queries for clarification on this RFP, these should be directed to:

Project Co-ordination Unit
Department of Lands, Surveys and Physical Planning
P. O. Box 876
Maseru 100

Any information given to a prospective developer concerning this RFP will be furnished to other developers as an amendment to this RFP.

Should you decide to submit a proposal, please follow instruction to developers (Section II) and deliver your proposals, not later than **12 noon on Tuesday, 9th October, 2001**, in sealed envelopes to the Central Tender Board (3rd Floor, Government Complex Phase 3), Box 395, Maseru 100. The envelopes should be marked: ***DESIGN AND CONSTRUCTION OF LOW-INCOME HOUSING,MASOWE.***

Tenders will be opened at the Central Tender Board on **Tuesday, 9th October, 2001 at 2:30pm** in the presence of bidders or their representatives who choose to attend.

Prior to your submission, you are expected to attend a compulsory site visit on **Tuesday, 25th September, 2001 at 10:30am** in Maputsoe. All interested persons are requested to meet outside the Town Clerk's Office, Maputsoe at the same time.

Yours faithfully,

M. BUTI
COMMISSIONER OF LANDS

SECTION 1

TERMS OF REFERENCE

SECTION 1: TERMS OF REFERENCE

1. INTRODUCTION (DISCUSS MILLENIUM PROJECT)

The Department of Lands, Surveys and Physical Planning has been mandated to promote effective and sustainable management of land, housing and urban development in Lesotho as provided for under relevant legislations and policies.

In pursuit of the implementation of the millennium project, Ministry of Local Government intends to undertake a project of developing the Maseru South West (MASOWE) for the development of Low-income residential uses (1000 low-income housing), road network, open spaces, community facilities. The project has the following objectives:

a) To address housing deficit within the Maseru Urban area and also relief congestion within the already existing settlements.
b) To facilitate provision of affordable housing for low-income since they are usually marginalized within the community.
c) To facilitate provision of properly planned and serviced settlements in the peri-urban areas of Maseru.
d) To pre-actively respond to anticipated housing demand for the industrial workers which will be created by the New additional firms at Ha Tikoe.

2. PROJECT AREA 'A'AND 'B'

The Project is located within the Millennium Park project at the south west of the LNDC proposed industrial area .The distance between the two are 4.6 to 5.4 kilometres apart from each other. The total area is approximately 61hectares. **See location plan in annex 1.**

3. SCOPE OF DESIGN AND IMPLEMENTATION

3.1 The developer is expected to carry out the design and implementation of 1,000 housing units and the provision of infrastructure (roads, water, etc)

3.2 The developer will be required to carry out detailed design, preparation of tenders and contract documents and evaluation of tenders, assist with contract award and supervision of the contract, as per attached development brief.

3.3 The developer in preparation of this design for the project shall use the Government of Lesotho Standard Design for Roads and Bridges, building standards and regulations of the Government of Lesotho and the private sector involved in development.

3.4 The developer is expected to finance the project with full cost recovery from the beneficiaries.

3.5 The minimum of 1 room and maximum of 3 rooms both with services; yard tap, VIP ,gravel roads with drainage.

3.6
- *50% should be used for residential.
- *15% should be used public for uses
- *5% should be used for local shopping
- *13% should be used for playground
- *17% should be used for roads parking

SECTION II: INSTRUCTIONS TO DEVELOPERS

The developer should follow the instructions contained herein and supply all required information. Failure to comply with these instructions may serve to disqualify the proposal. Developers must provide full, accurate and complete information as required by this RFP.

1. Period of Validity of Proposals

Proposals should be valid for 90 days from the closing day for receipt of proposals by the Government.

2. Preparation and Submission of Proposal

The proposals must be prepared in two parts: Technical and Financial Proposals must be made for the complete scope of services as outlined in the Terms of Reference, Section 1. Proposals for only a part of services will be rejected. Proposals should be prepared and submitted on or before the date and time specified in 2.3 below, in original and five (5) copies, and in two separate and sealed envelopes. The first containing the original and five copies of the Technical Proposals and labelled 'Technical Proposal' and the second containing the original and five copies of the Financial Proposal and marked 'Financial Proposal'. The two envelopes should bear the name of the firm making the proposal. The two envelopes should be put inside one large envelope which should be labelled. The cost for implementing the project should be clearly shown.

'CONFIDENTIAL'
'PROPOSALS FOR DESIGN AND CONSTRUCTION OF LOW-INCOME HOUSING MASOWE.'

The envelope should carry no identification of the name or mark of the proposer nor any other means of identification.

2.1 Technical Proposal

This proposal should at a minimum, contain:

a) Developer's analysis and understanding of the TORs.
b) Technical approach and methodology for providing the required services.
c) Proposed staffing and management structure of the proposed project team and details of how this team will be managed and supervised.
d) Detailed estimates of total required manpower for the project expressed in terms of man-months, broken down by individual team member, area or technical speciality, etc.
e) A detailed work plan showing proposed schedule for accomplishment of the major tasks required to complete the project.
f) Detailed curriculum vitae for personnel proposed for the project.
g) Three alternative sketches of plans for housing units

2.2 Financial Proposal

This proposal should at a minimum, contain:

a) A data sheet, for each staff member, reflecting a billing rate comprised of salary, social costs and company overheads.
b) Detailed listing of indirect costs (disbursements).
c) Detailed cost estimate for the implementation of the project.
d) Detailed information on how the tenderer will finance the project.

Developer must include sufficient backup information to enable the Government to determine the basis of their cost estimate.

2.3 Delivery of Proposals

Proposals shall be delivered to:
Secretary of Tender Board
Ministry of Finance
Government Complex III (3rd Floor)
Room 3016/17
P. O. Box 395
Maseru 100

Delivery must be made **on or before 12 noon on Tuesday 9th October, 2001** and they will be opened on the same day at 2:30pm. Proposals received after this specified time will not be considered for evaluation.

3. Evaluation Proposal

After the closing date for submission of proposals, **before 12 noon on Tuesday 9th October, 2001** the proposals will be evaluated by the Ministry of Local Government. The evaluation process will be as detailed below:

a)Technical Evaluation

Technical proposals will be opened first and evaluated on the basis of the following weighted criteria.

CRITERIA	WEIGHT
i) Overall quality of proposal (Completeness, thoroughness, responsiveness quality of workplan proposed ,technical approach)	**35**
ii) Company profile with emphasis on experience of design And supervision of development	**5**
iii) Understanding of terms of reference	**10**
iv) Qualification and experience of proposed project team	**40**
v)Contribution and use of qualified and experienced Basotho experts	**10**
TOTAL	**100**

Proposals with a score of less than 65 will be rejected.

b) Financial proposal

Financial proposals will be opened immediately after the technical evaluation has been completed. Only financial proposals of the firms whose technical proposals have scored 65 or more will be evaluated. The lowest tender price of the proposal which scored 65 or more will be considered for further evaluation.

4. Contract Negotiations

Developers are requested to provide the name, telephone/cell number, fax, e-mail numbers of the contact person with whom the Ministry of Local Government, if necessary, may discuss proposals submitted in response to this RFP.

4. REPORTING

The developer shall prepare and submit progress reports as follows:

a) Project Inception Report
b) Preliminary Design Report
c) Final Design Report
d) Tender Document
e) Tender Evaluation Report
f) Minutes of Site Meetings and Progress Reports during supervision of construction work.

The original copy and five (5) copies of each report will be required.

5. Withdrawal of Proposals

Proposal may be modified or withdrawn at any time prior to the last date of receipt of proposals. Notification for modifications and withdrawals must be delivered to the office designated for the receipt of proposals.

6. Award of Contract

Only one fixed revenue price contract will be awarded as a result of this RFP. The firm which receives the award shall not automatically be excluded from competing for follow-on or related projects.
The Government reserves the right to reject any or all offers and to waive informalities and minor irregularities in the offers received.
If negotiations are conducted on an offer received, they shall not constitute a rejection or counter offer on the part of the Government.

Appendix D - Form C (adapted from Lesotho Land Act 1979)

THIRD SCHEDULE
(Section 17)

FORM "C1"

Certificate of allocation

(Non-registrable title-Rural Area)
* delete where appropriate

1 This is to certify that ..... Name of allottee
.....

Address of allottee — of .....
has been granted an allocation of land which allows the allottee with effect from the date of this certificate to use or to

Enter period of years if applicable — use and occupy for ..... years. The land known as

Describe the land — .....

Enter situation of land — and situated at .....

Approximate area — with an area of about .....

Enter purpose i.e. the approved use — for the purpose of .....

2 A sketch plan or map of the boundaries of this * land is/is not attached and the land's dimensions measure as follows:— .....

Attempt to measure the boundaries — .....

3 This allocation of land cannot be transferred, sold, given away or leased to any other person and on the death of the allottee, * his/her lawful spouse may continue to use and occupy this land until * his/her own death.

Date Stamp

Signature of Chairman

Insert name of witness — Witnessed by .....
.....

Signature of member of Land Committee

Appendix E - An example of how the Land Tenure, Survey and Valuation Committee manage their records

Field_no	Surname	First_name	Changed name/number	Area (sqm)	LHLDC Area (sqm)	Difference in area
17				4597	5828	1231
18				2487	2620	133
19				14325	7290	7035
20				7556	6305	1251
21				17510	15748	1762
22				803	9486	8683
23				5664	5500	164
24				13956	12600	1356
25				17486	15290	2196
26				14729	11123	3606
27				10818	7250	3568
28				37100	32194	4906
29				4159	4159	0
30				4181	570	3611
31				10301	6674	3627
32				9553	2028	7525
33				8518	6275	2243
34				6095	4554	1541
35				7739	6090	1649
40				2186	13332	11146
41				2222	12442	10220
42				13363	18347	4984
43				10540	7316	3224
44				7765	6300	1465
45				14803	10266	4537
46				9606	6328	3278
47				5368	3196	2172
48				8093	7420	673
49				16507	14496	2011
50				12499	4664	7835
51				12669	12023	646
52				9362	8410	952
53				2910	2837	73

Page 1 of 3 01/04/10 09:31 AM

Appendix F - Questionnaire to system users

1. What are the aims of the MPLDP?
2. How long is the project envisaged to run?
3. Who are the stakeholders in the project and what are their participation characteristics regarding planning and decision making?
4. Describe the functions that your committee is involved in?
5. Has the project so far experienced major problems?
6. What are the major problems you have observed so far?
7. How do you think the problems might be solved?
8. Is the any problems regarding land information management and project functions, specify?
9. Which areas do you think are hard hit in the land information management and the project function activities?
10. What type of information is mainly necessary to undertake which activities?
11. Is this information ready at request, if not specify why, if any idea?
12. What is the future envisaged activities that your committee is supposed to undertake?
13. What kind of information do you think will be needed and why?
14. Do you think this information will be readily available and why?
15. What kind of information is disseminated, to whom and for what reason?
16. Could you please list below in the table on the next page what kind of information you are currently using and what functions is this information supporting? If possible can you supply any specimen data or information you are using.
17. Also in the table you can fill in the information that you need to carryout the future coming functions of the project.
18. Write any other information about the current management of the project, which you think, is necessary for public consumption?

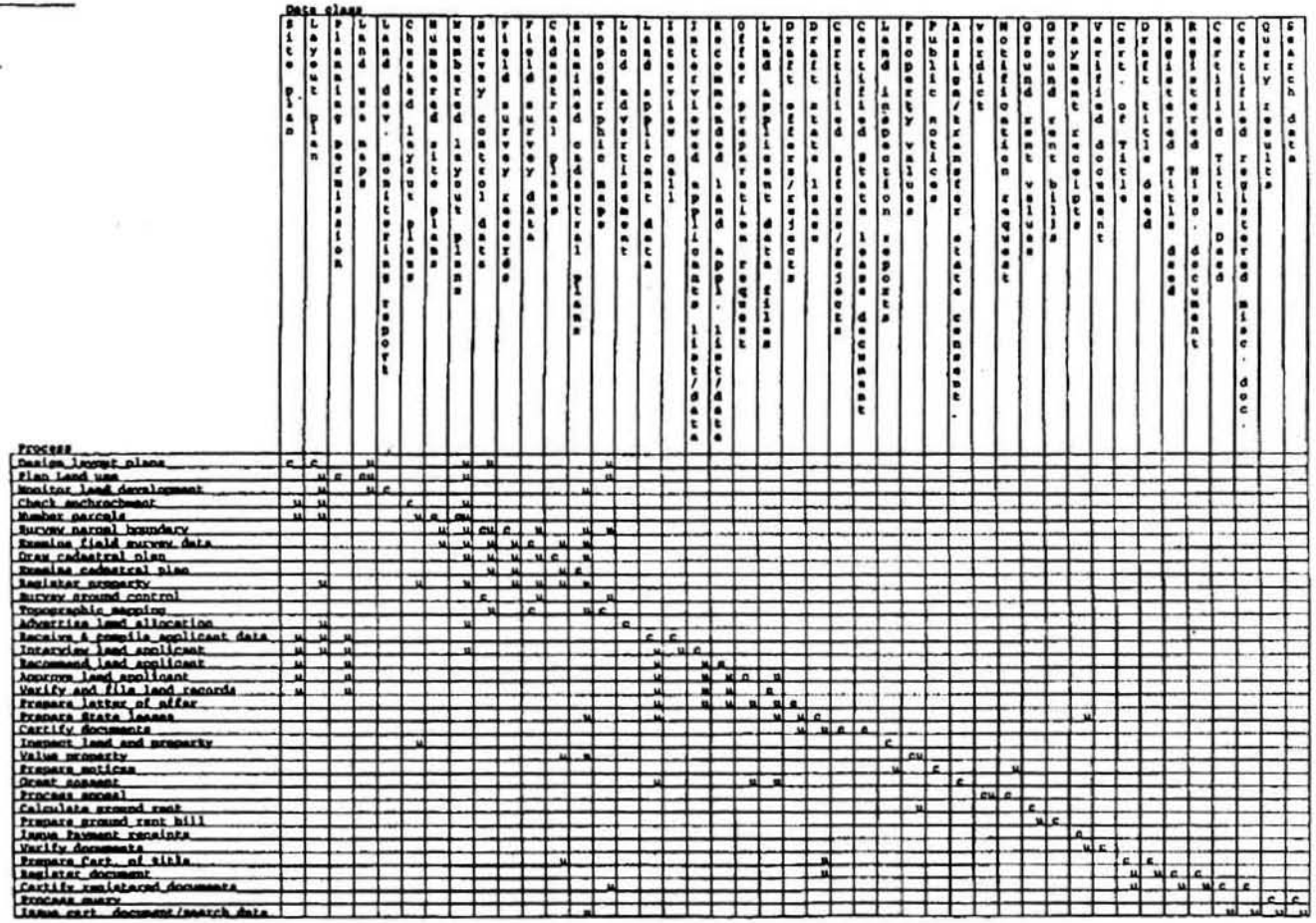
Committee	***input data***	***source***	***function***	***output***	***bottlenecks***

Appendix G -

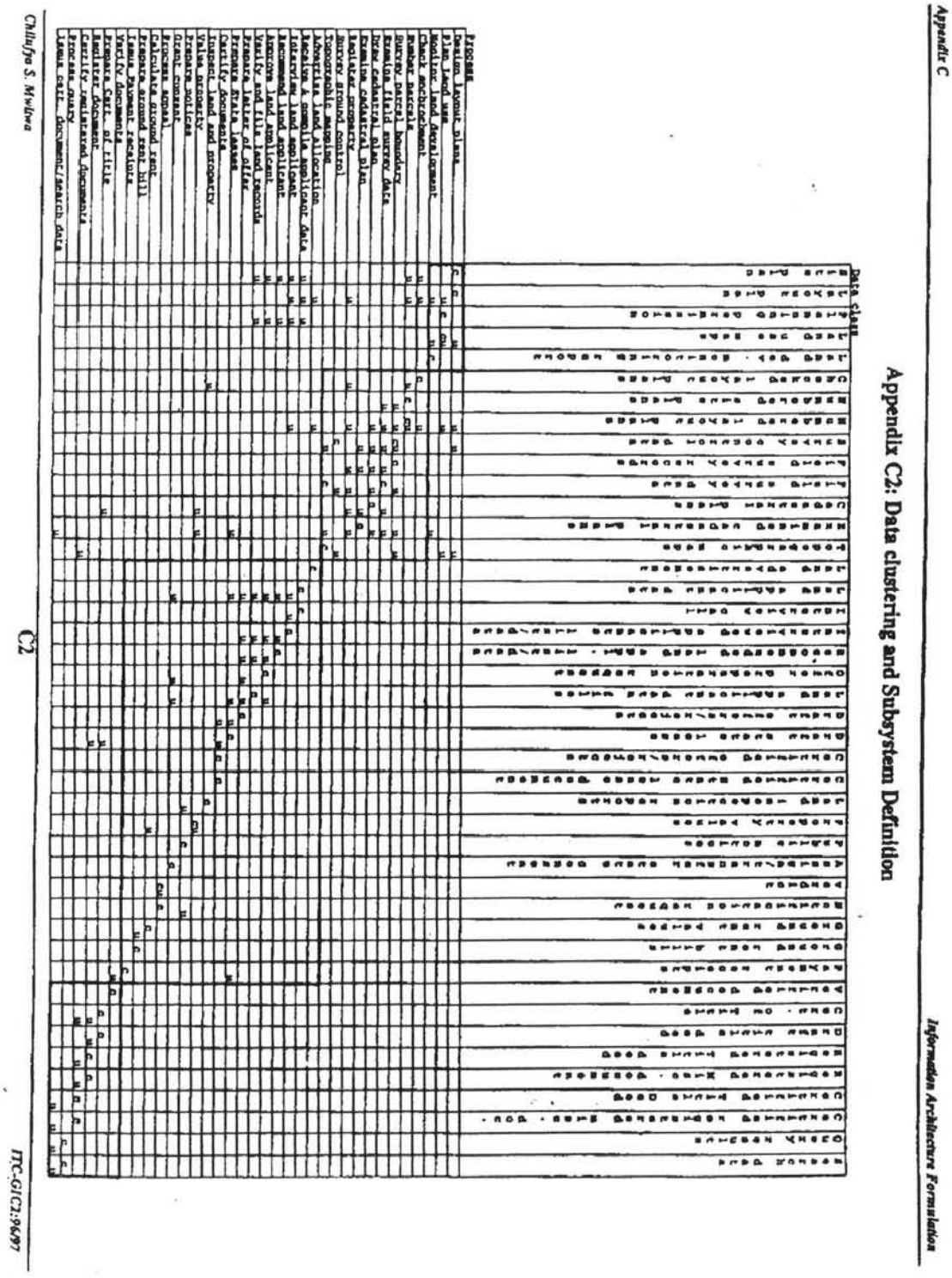
Questionnaire to MPLDP information consumers

1. What part do you play in the MPLDP?
2. Who are your frequent contacts within the MPLDP project management (PMT)?
3. What kind of information do you require from the PMT?
4. What information do the PMT require from you?
5. What are media and documents involved in this information exchange?
6. Which areas are prone to:
   i) Effective flow of information?
   ii) Ineffective flow of information?
7. In case of inefficiency what do you think could be done to remedy this problem?
8. What information you envisage requiring from the PMT in the future?
9. What information you envisage issuing to the PMT in the future?
10. How do you like the information exchange between you and the PMT look like for effective land information management?

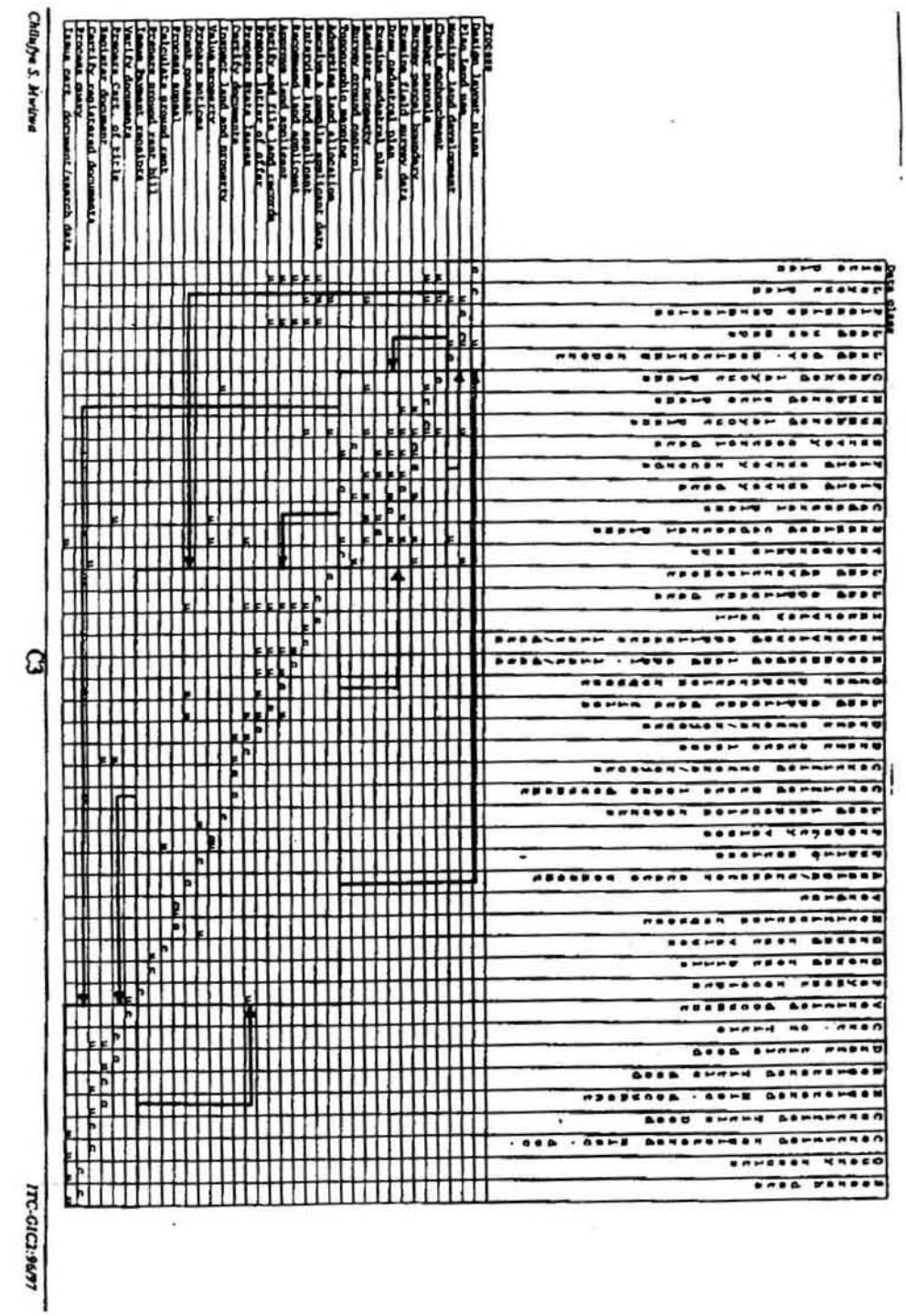
Appendix C1: Processes and Data Classes



Appendix I - Clustering and delineation of codes into information subsystems



Appendix J - Substituting clusters with arrows defining information flow



Appendix K - Resulting re-arranged data flows within subsystems

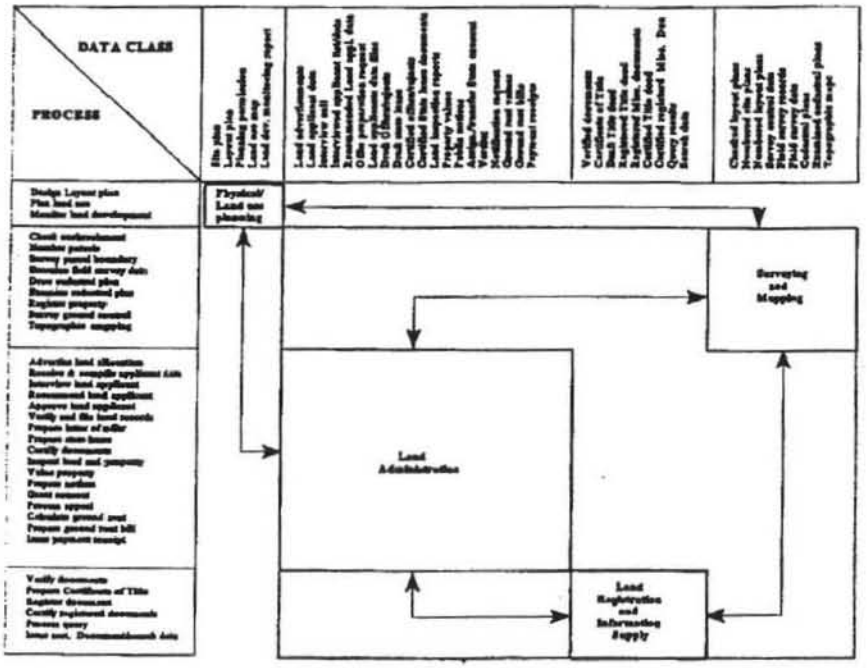
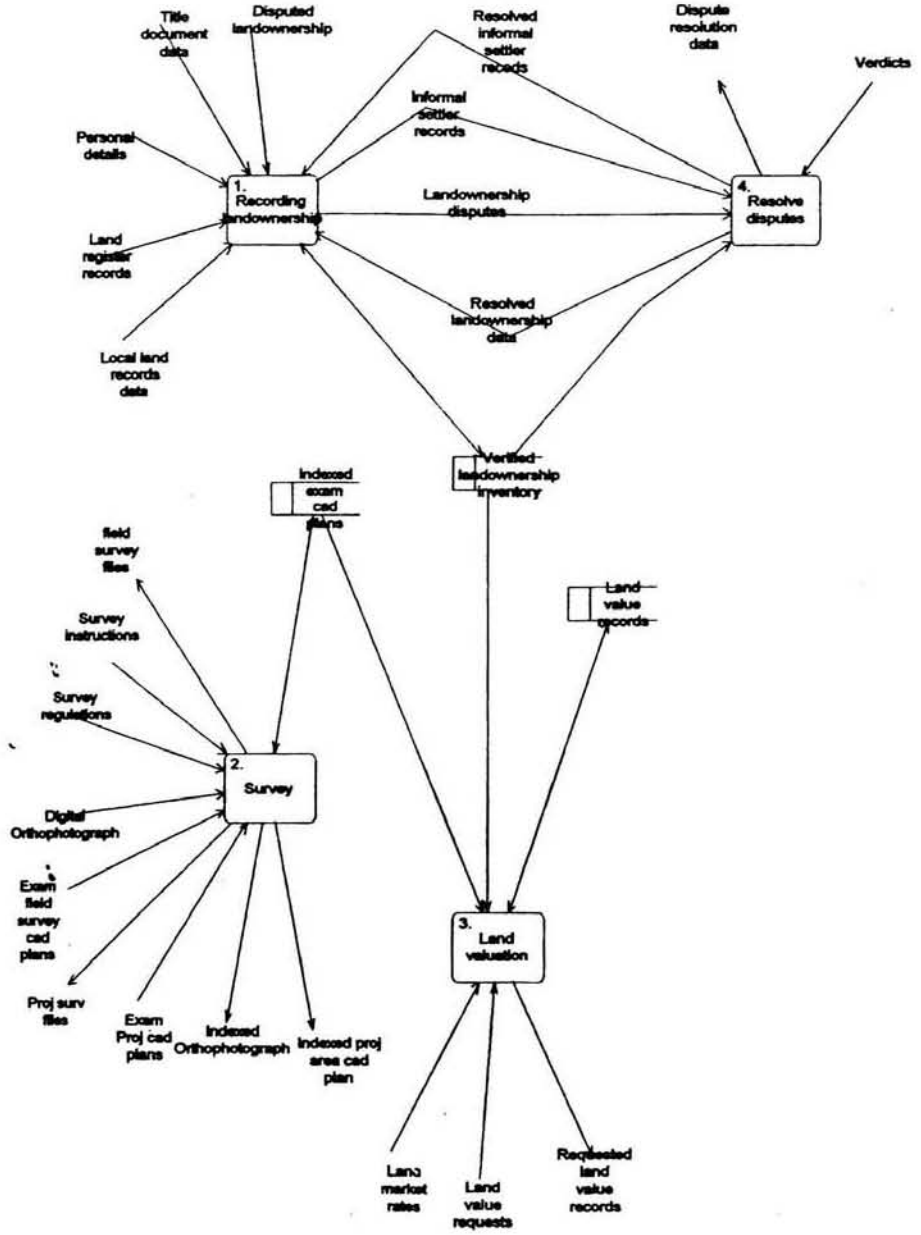


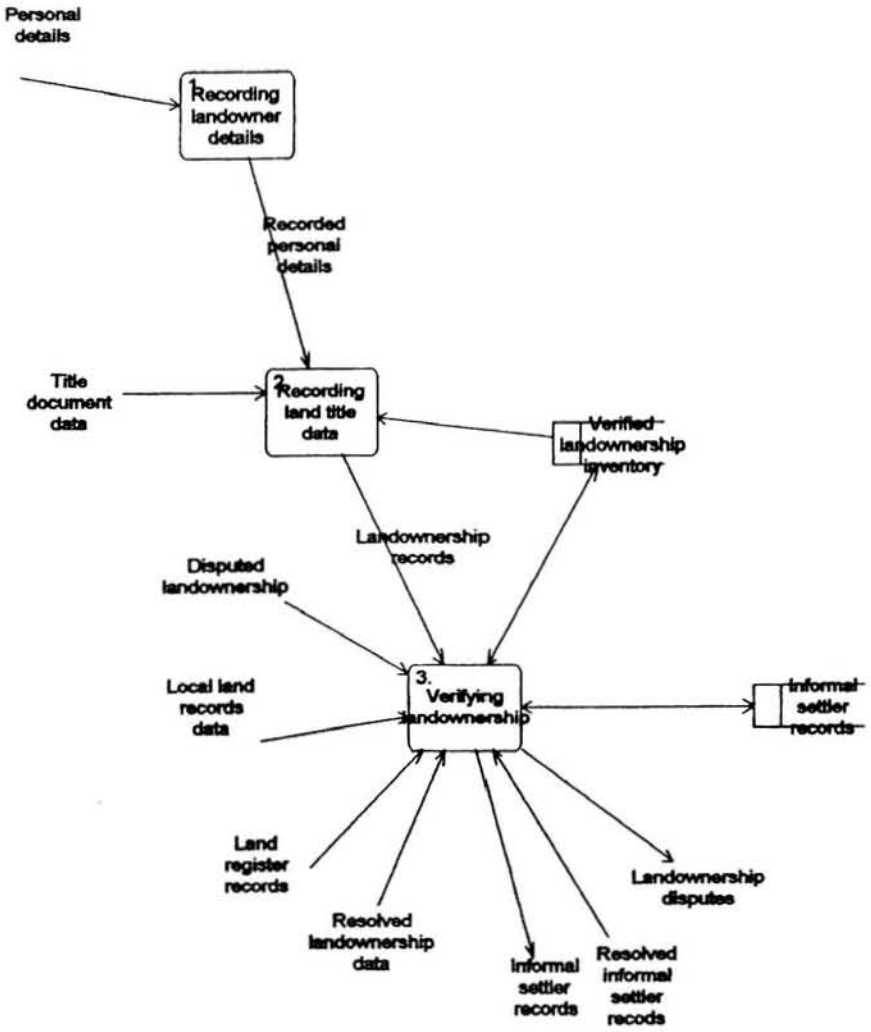
Fig. 4.3 Re-arranged Information subsystems

Appendix L - Lower levels of the DFD given in figure 6.8

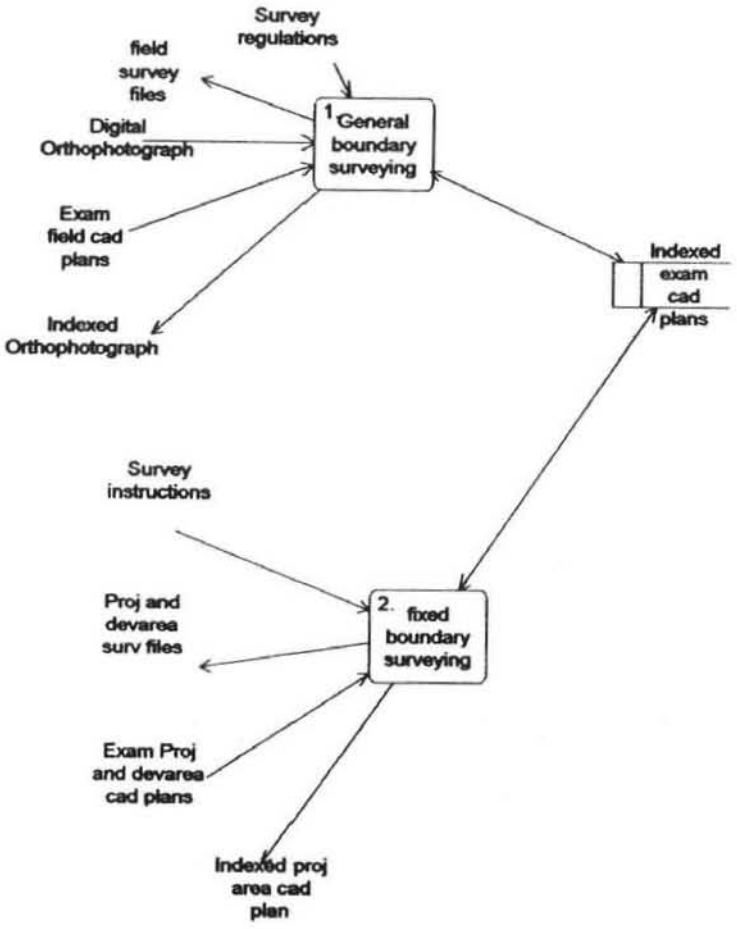
First level diagram:-1.1 Existing surveying, allocation and valuation



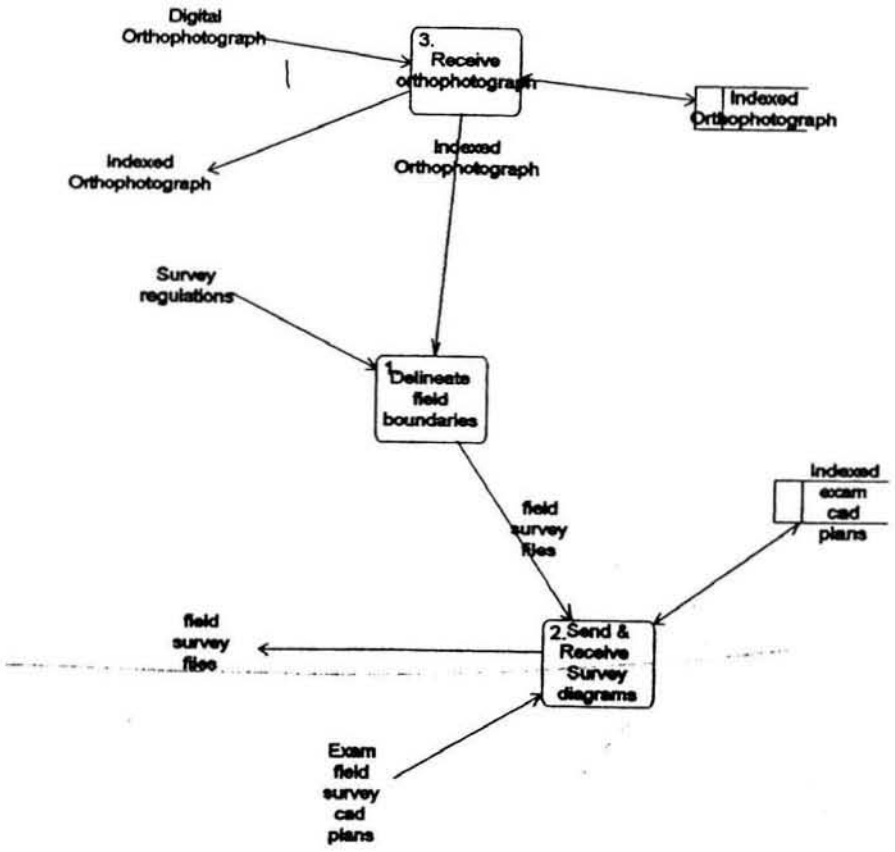
Detailed level diagram:- 1.1.1 Existing Recording landownership



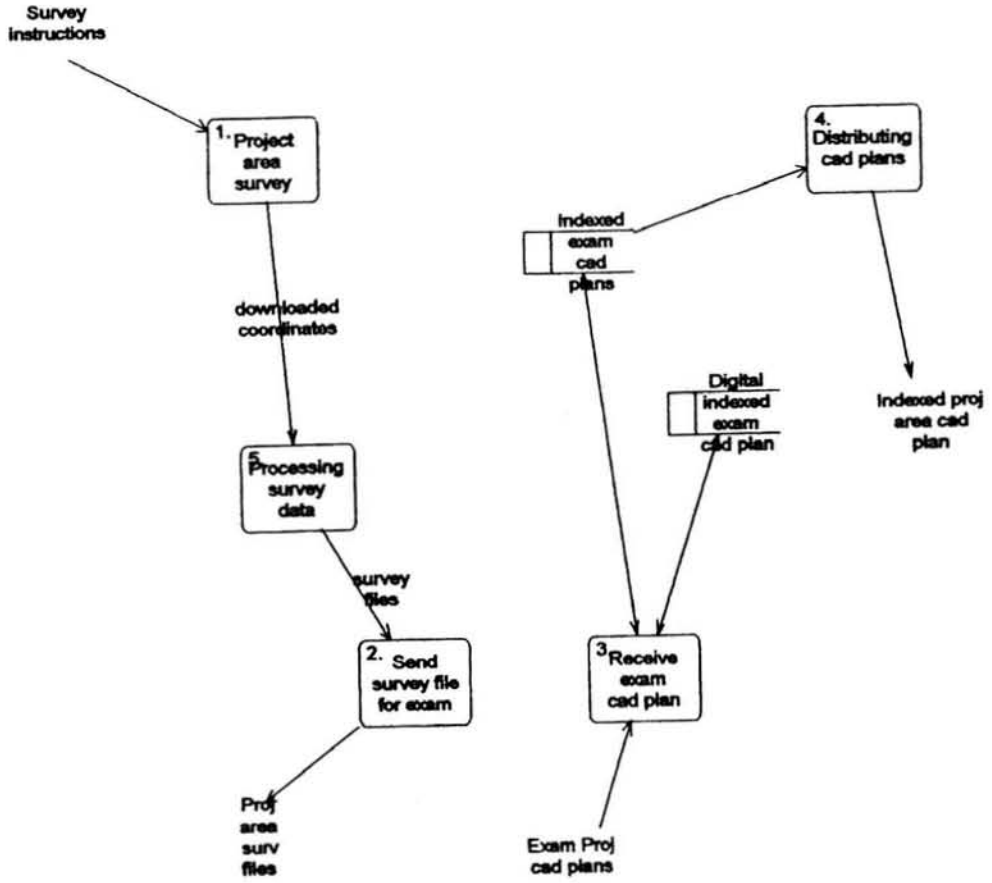
First level diagram:- Surveying



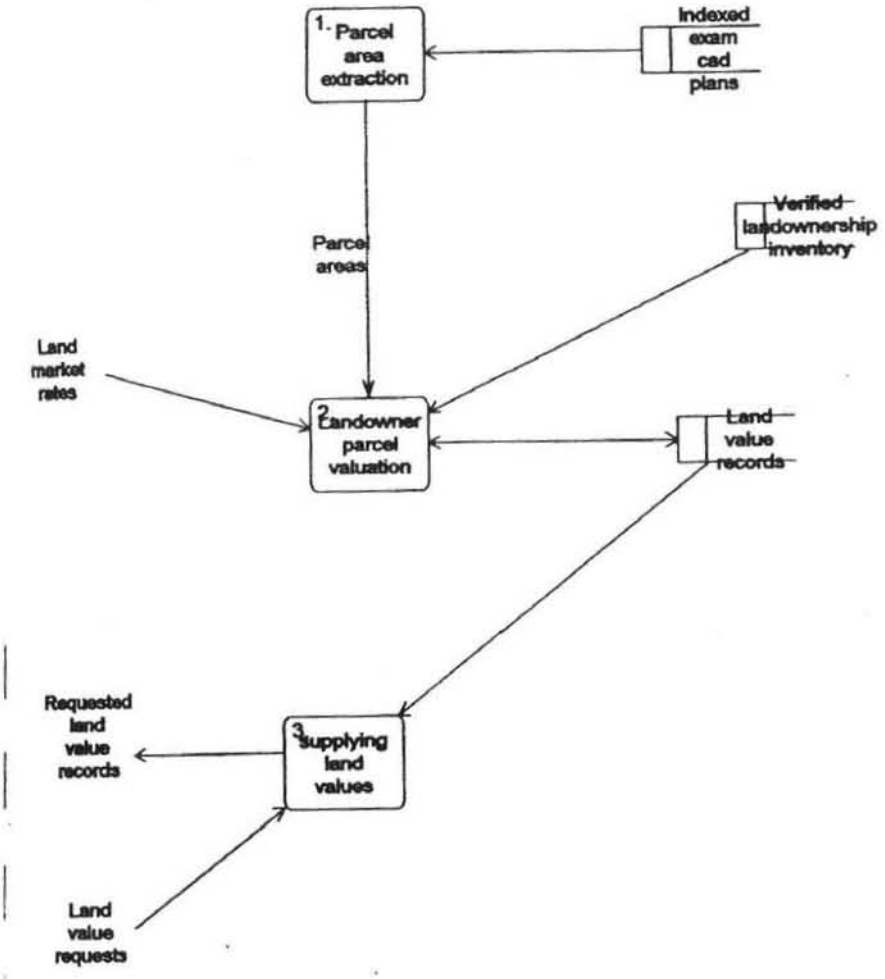
Detailed level diagram:- 1.1.2.1 General boundary survey



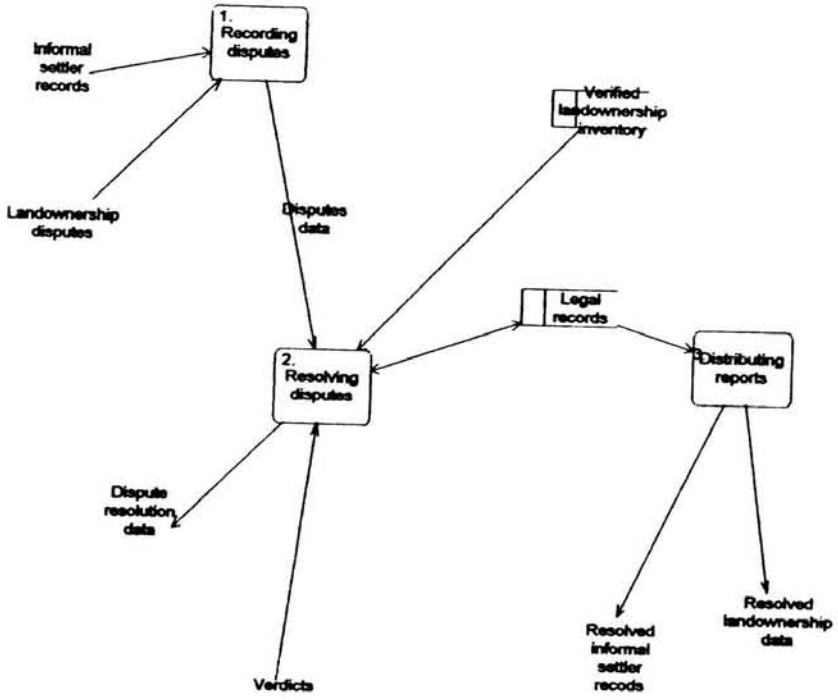
Detailed level diagram:- 1.1.2.2 Existing fixed boundary survey



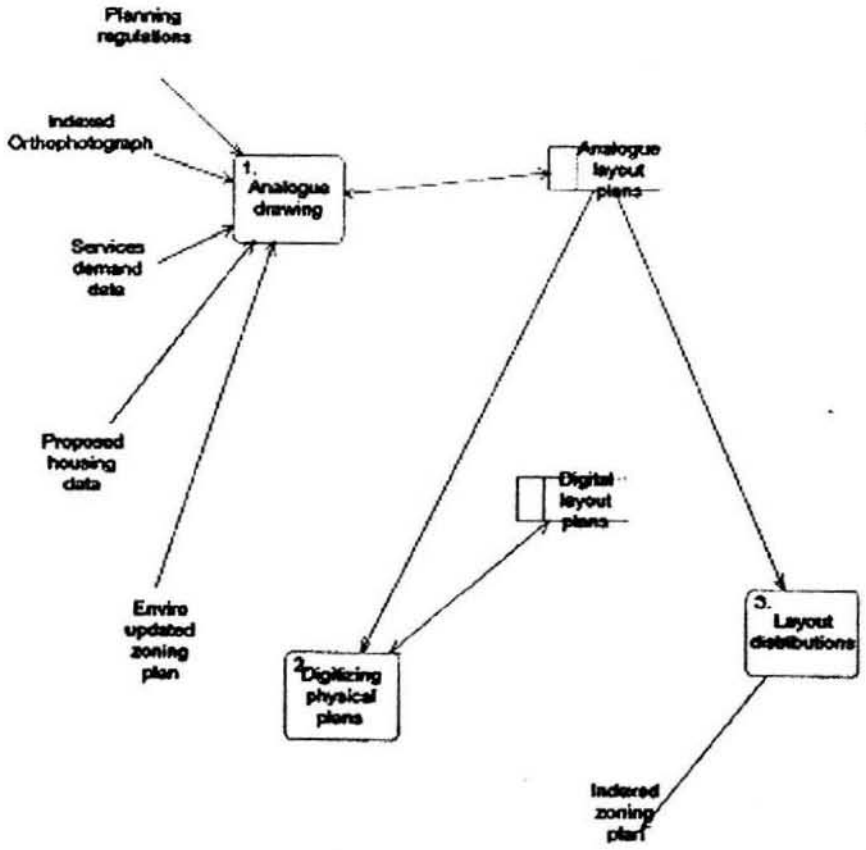
Detailed level diagram:- 1.1.3 Land valuation



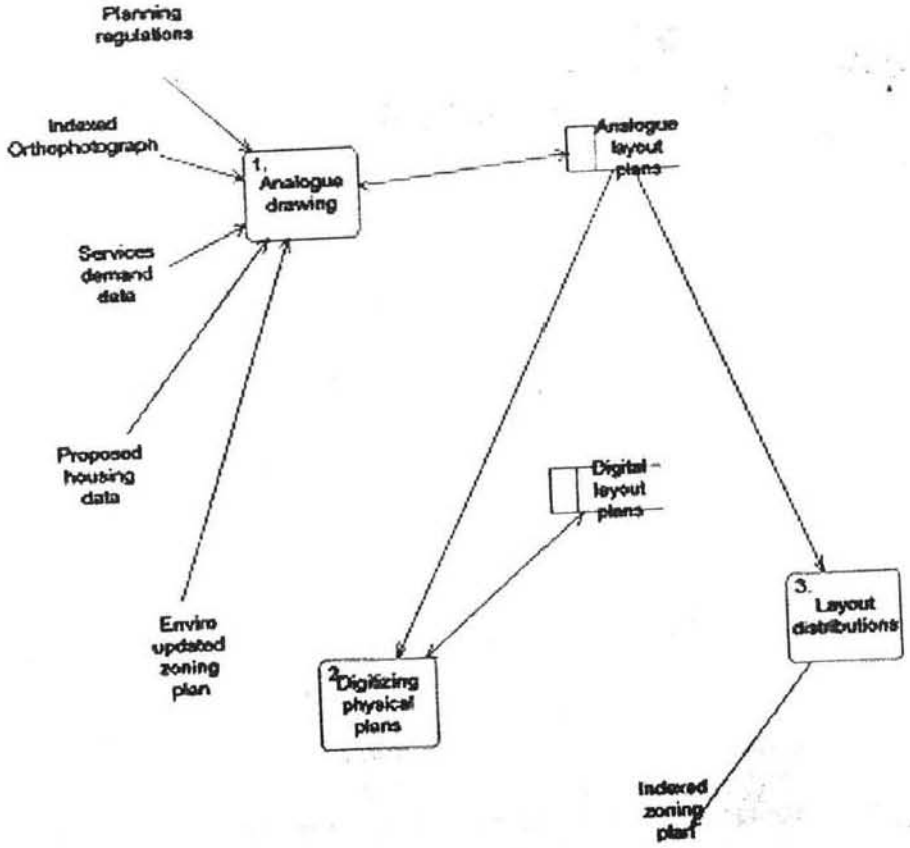
Detailed level:- 1.1.4 Dispute resolution



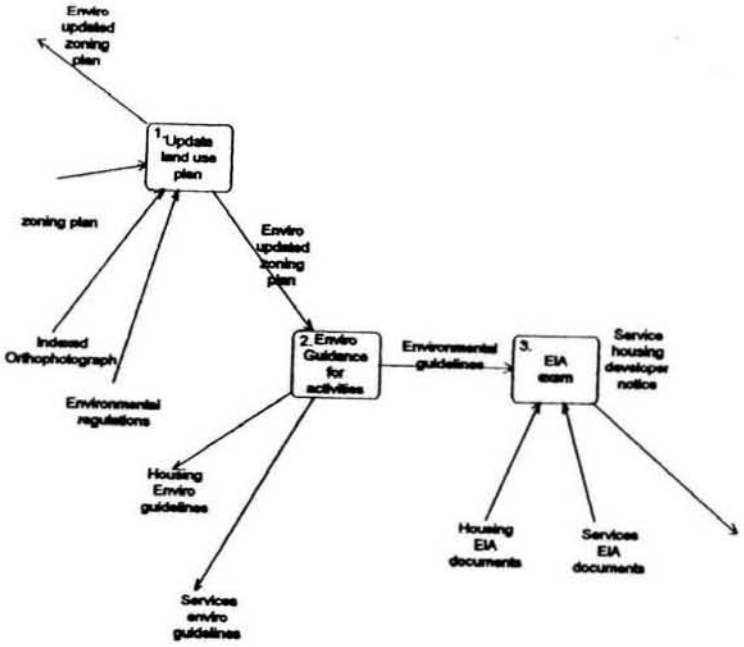
Detailed level diagram:- 1.2 Physical layout planning



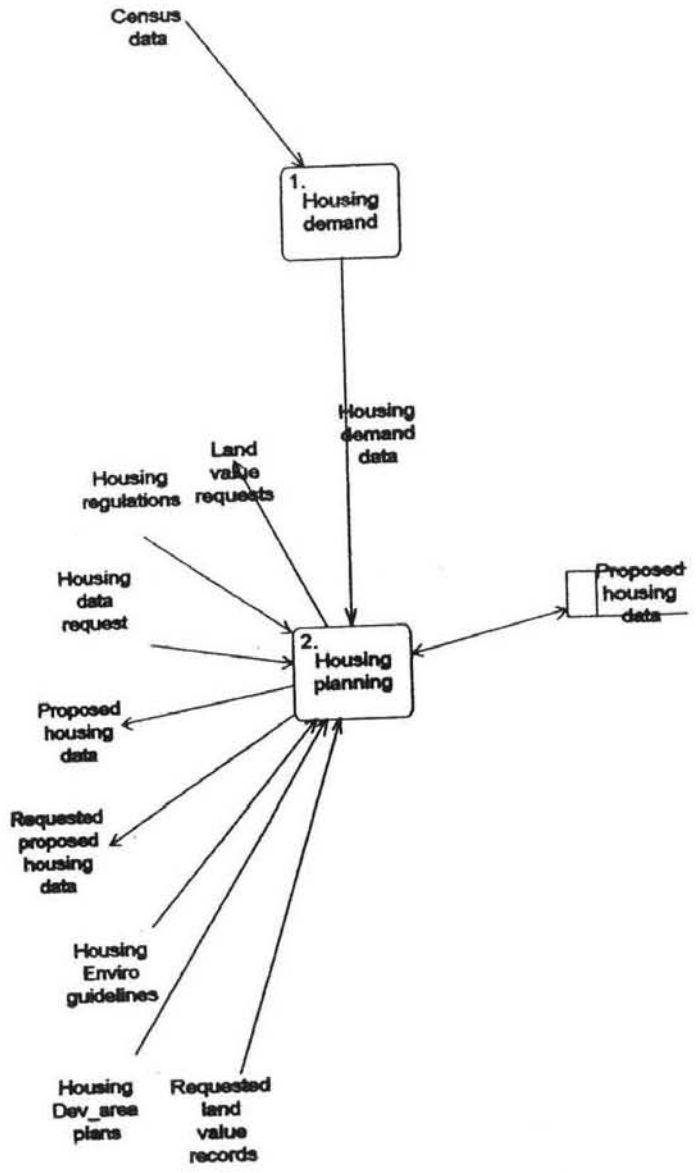
Detailed level diagram:- 1.2 Land use planning



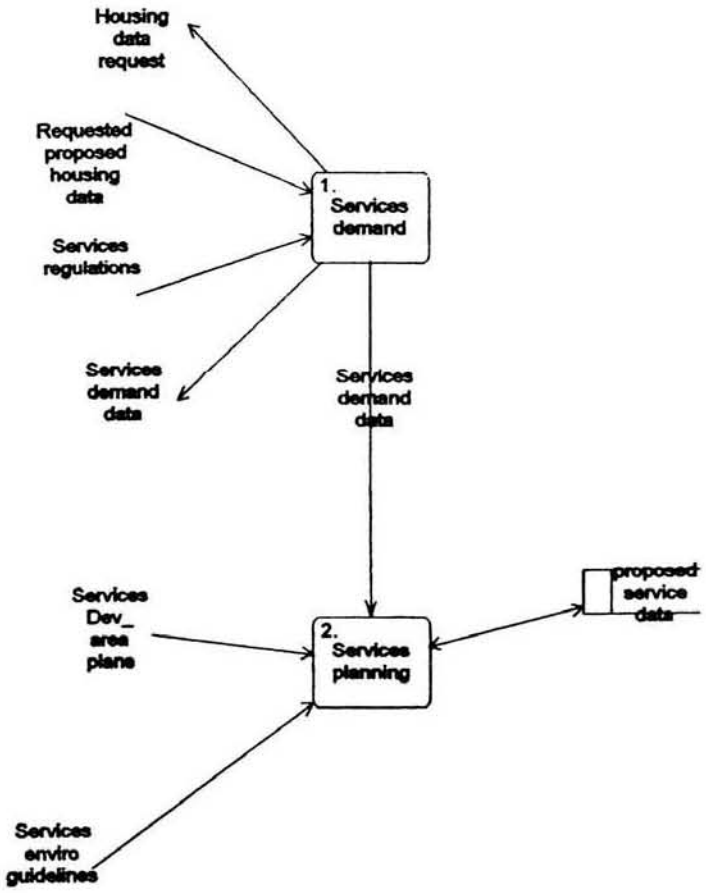
Detailed level diagram:- 1.3 Environmental planning



Detailed level diagram:- 1.4 Housing planning



Detailed level diagram:- 1.5 Services planning



AN EXAMPLE OF DICTIONARY FOR DATA FLOWS

Data flow name	Description	Source	Used by	Data structure	Volume	Quality	Bottlenecks
1.Orthophotograph	Digital orthophotograph	1.AOC (South Africa)	1.1, 1.2, 1.3,	Digital in TIFF	Bulky	Medium	1.Occupy too much
	of the project site		1.1.2, 1.1.2.1.1	format			disc space
			1.2.1, 1.2.2				2.Results in slow
			1.3, 1.3.1				processing
2.Land market rates	Price of land per square	1.DLHUD	1.1, 1.1.3	A list depicting	Small	High	
	metre			land market			
				with different			
				uses			
3.Verdicts	Results of court action	1.Land Task Force	1.1, 1.1.4	A compiled list			
	for each recorded case			with description	Medium	Medium	
				of case results and			
				their reference			
				numbers and			
				persons involved			
4.Environmental	Regulations governing	1.Ministry of	1.3, 1.3.2	Consists of Acts	Medium		
regulations	land development to	Environment		and regulations			
	conserve environment						
5.Title dicument data	Details form the	1.Landowners	1.1, 1.1.1,	Description of	High	Medium	Hapharzadly kept
	title certificate		1.1.1.2, 1.1.1.3	certificate type and			by individual comm

AN EXAMPLE OF DICTIONARY FOR PROCESSES

Committee	Process no	Process description	Input flow	outpu flow	Process	Bottlenecks
					frequency	
Land tenure and	1.1	Surveying valuation and	1.Survey instructions	1.Survey files	1.High	1.Ineffecient data storages
survey committee		allocation	2.Survey regulations	2.Requested land		2.Many land disputes
			3.Dispute appeal	values		3.Duplication of activities
			4.Title document data	3.Dispute resolution		4.Ineffective data processing
			5. Local land records	data		
			6.Land registre records	4.Indexed orthophoto		
			7.Land market rates	5.Indexed cadastral		
			8.Verdicts	plans		
			9.Orthophotograph			
			10.Personal details			
			11.Examined survey files			
2. Physical	1.2	Physical planning	1.Indexed orthophotograph	1.layout plans	1.Medium	1. Duplication in layout
Planning			2.Planning regulations			production
			3.Proposed housing data			
			4.Service demand data			
			5.Updated zoning plan			

Formulated from the Top Level Diagram of existing MPLDP functional analysis (figure 6.7)

Appendix N - A savingram

SAVINGRAM

FROM: LSPP South **RECEIVED DATE STAMP**

TO: PS Law (ICC)

REF NO. LG/LS/ 12591-287 P

SIGNED _____
(FULL SIGNATURE)

NAME: _____ **FILE NO:** _____
(TYPED) (RECEIVING MIN/DEPT.)

DATE: 06/02/2001
GPL

RE: CERTIFICATE OF USER NO: MH 001/2001

Please find hereto attached certificate of user No. ..... Relating to plot No. 12591-287 ..... intended for ..... DEVELOPMENT OF WAREHOUSE AND OFFICES

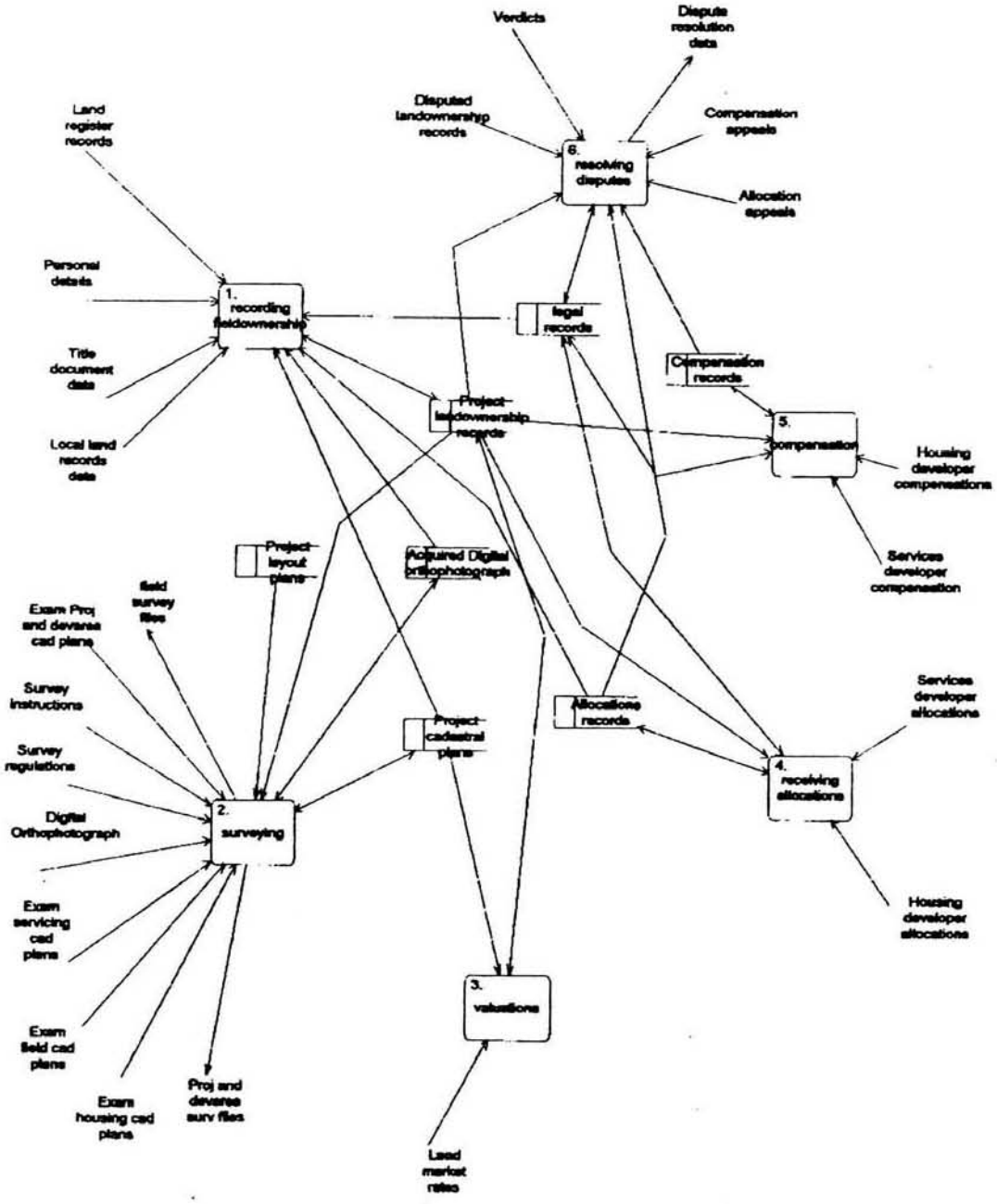
cc: Chief Surveyor

Director of Building Design Services

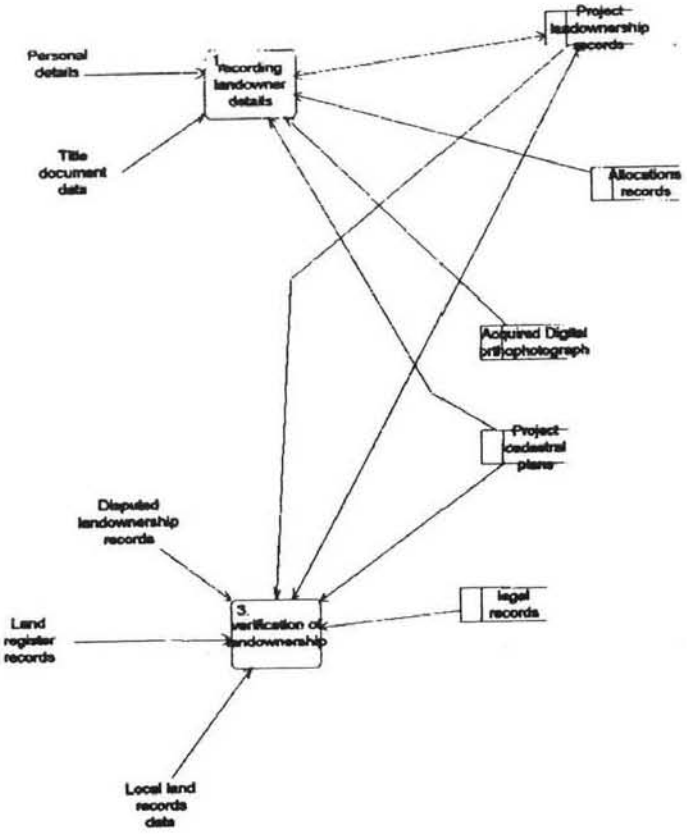
Cabinet Planning

Appendix O - The lower level diagrams (DFD's) formulated from figure 7.1

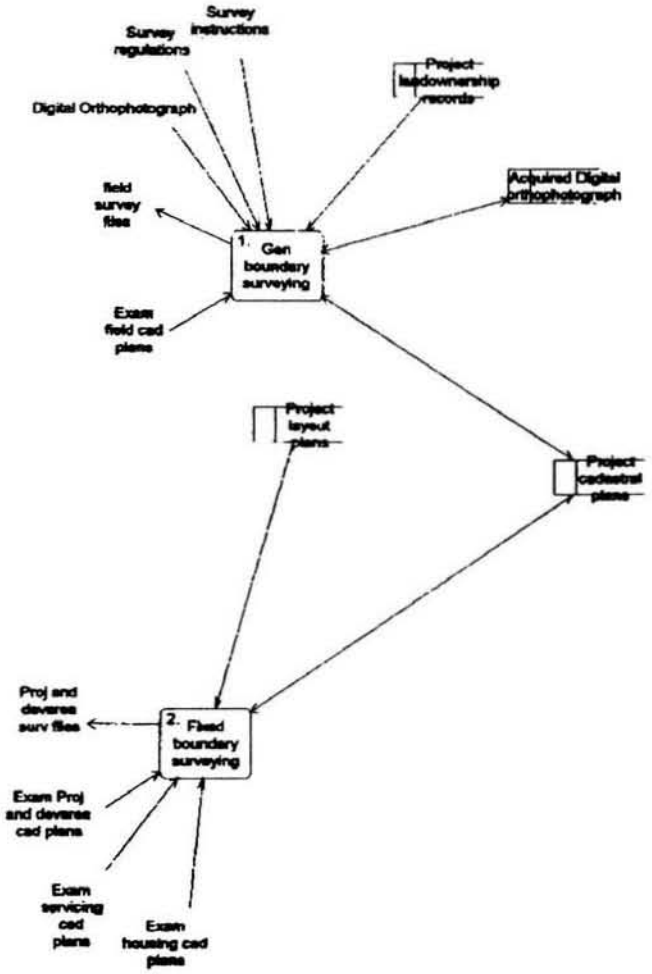
First level diagram:- 2.1.1 The improved Surveying allocation and valuation



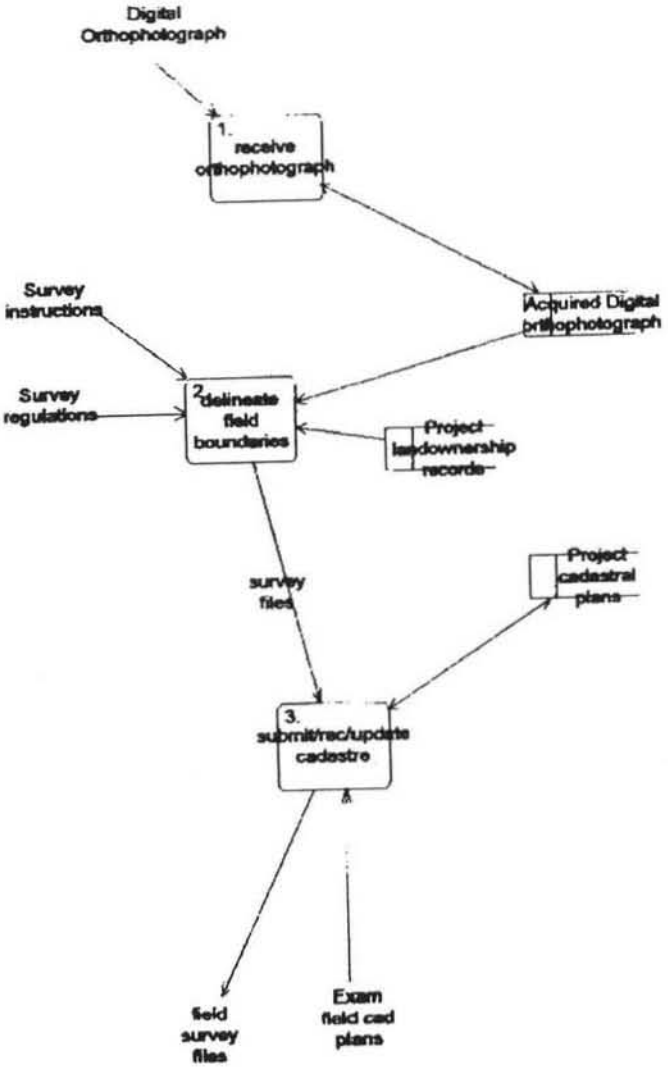
Detailed level diagram:- 2.1.1.1 Improved recording field ownership



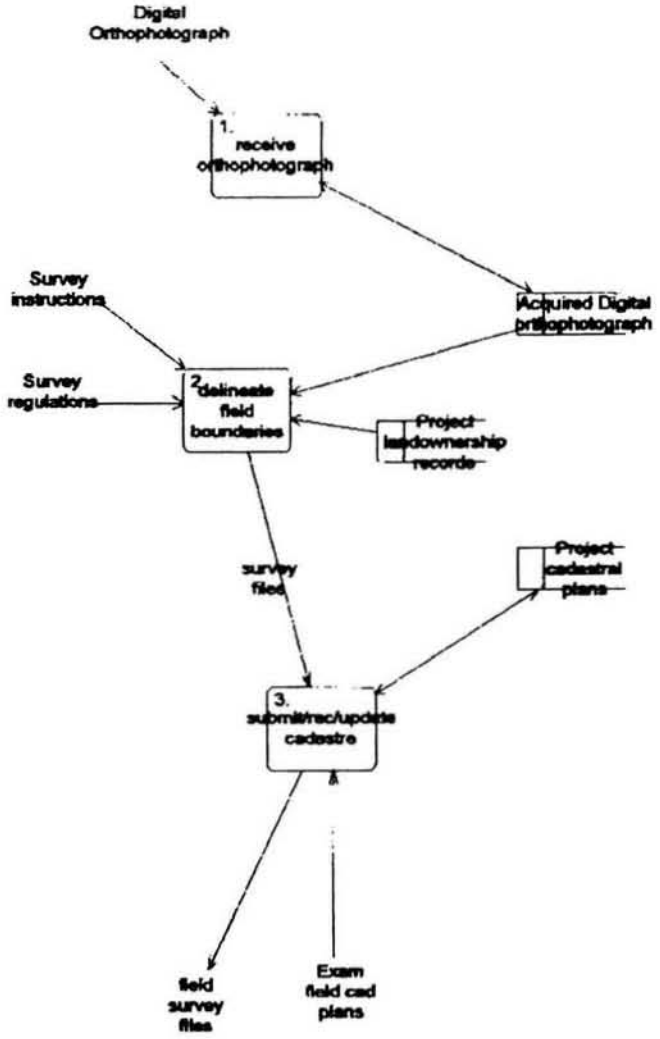
First level diagram:- 2.1.1.2 The improved surveying



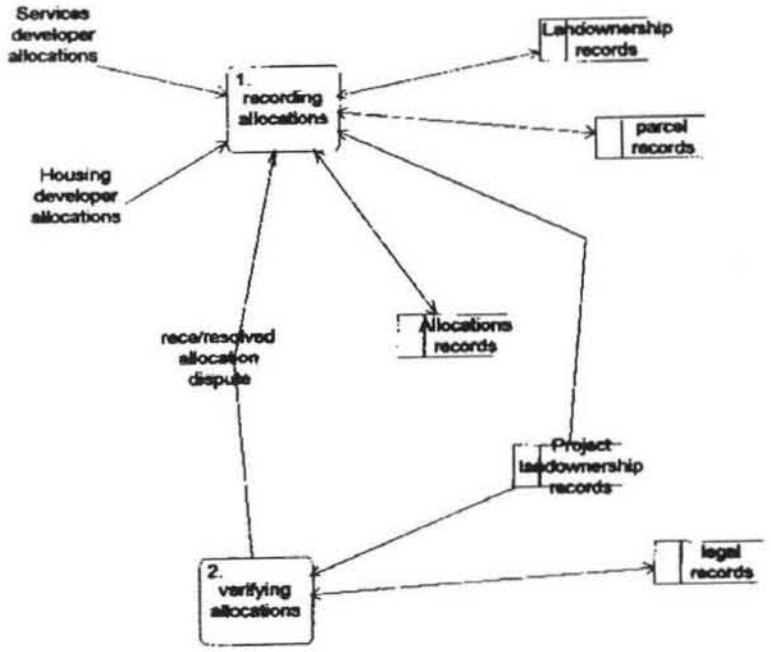
Detailed level diagram:- 2.1.1.2.1Improved general boundary surveying



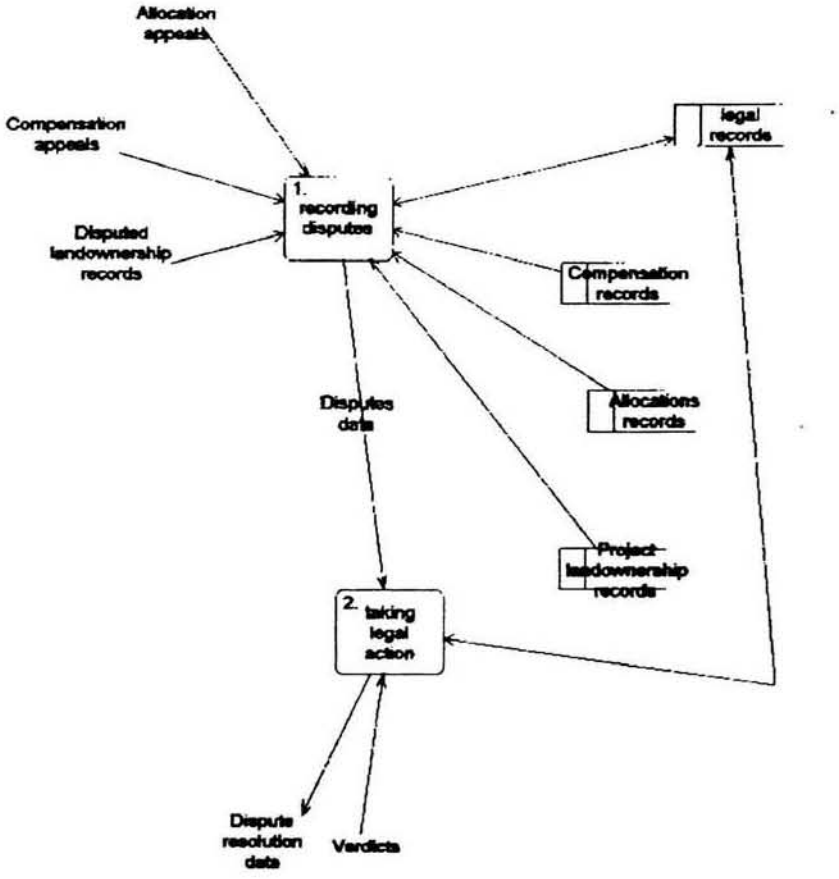
Detailed level diagram:- 2.1.1.2.2 Improved fixed boundary survey



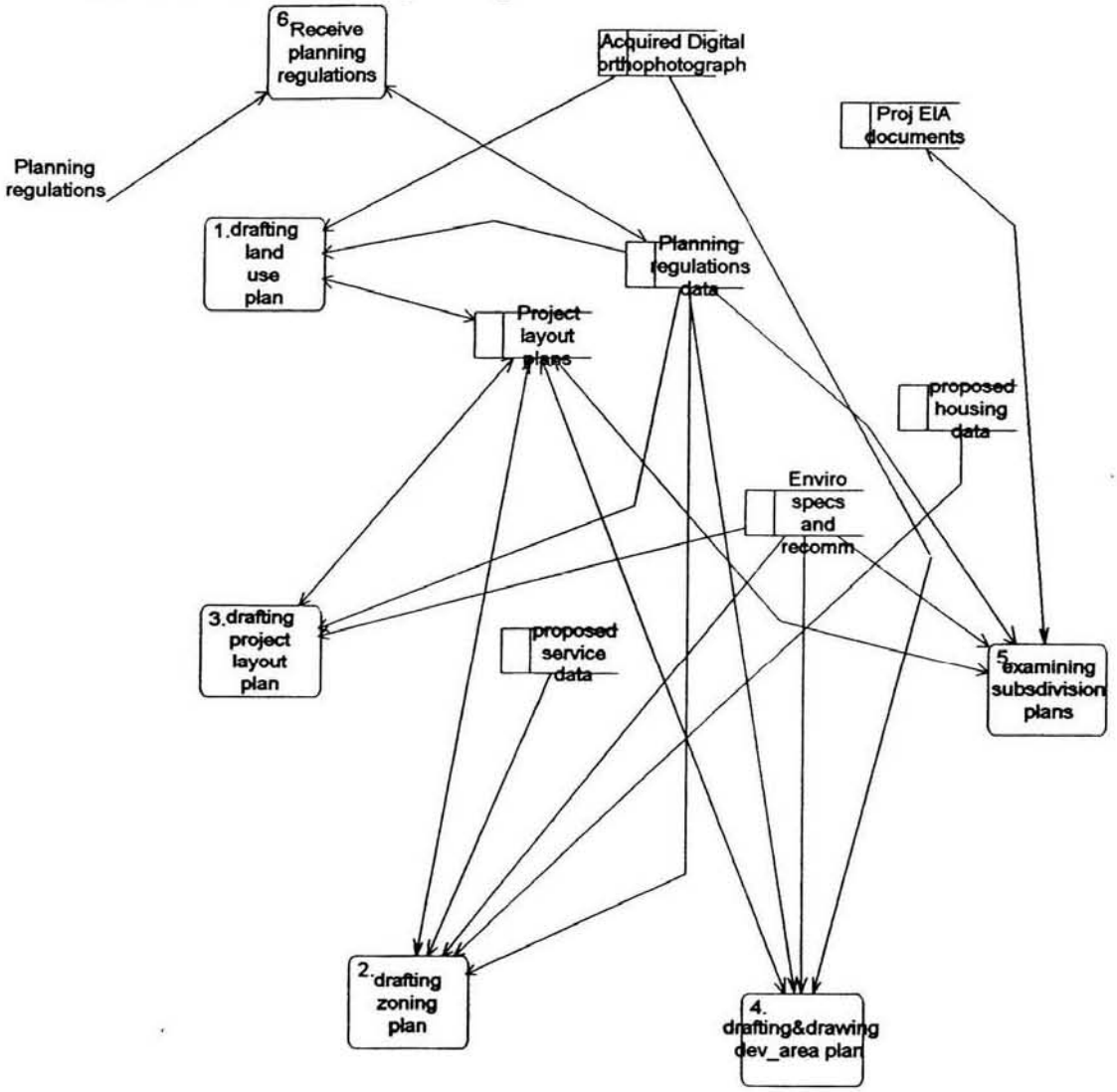
Detailed level diagram:- 2.1.1.4 Improved receiving allocations



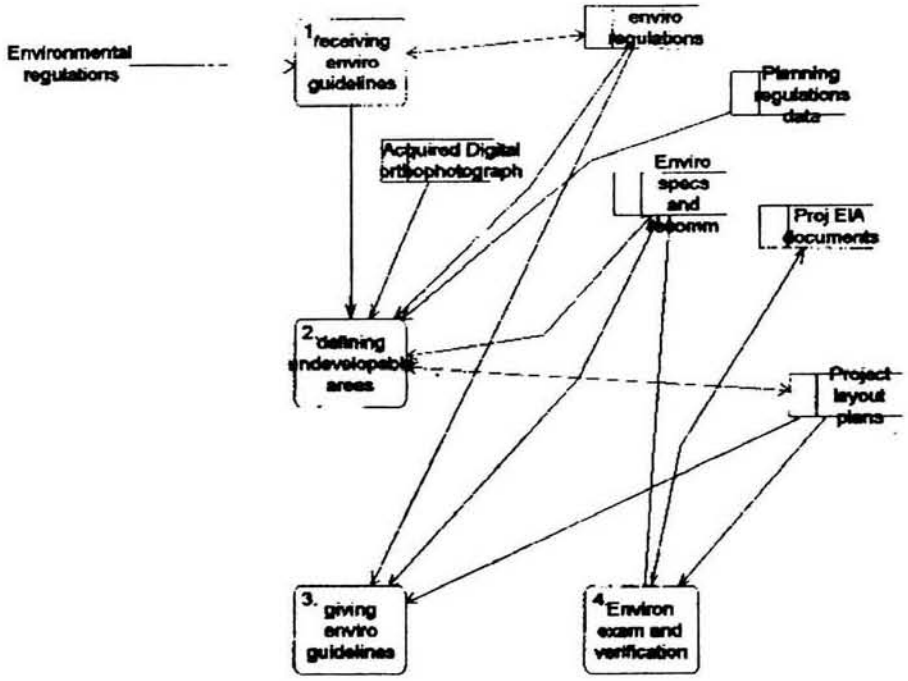
Detailed level diagram:- 2.1.1.6 Improved dispute resolution



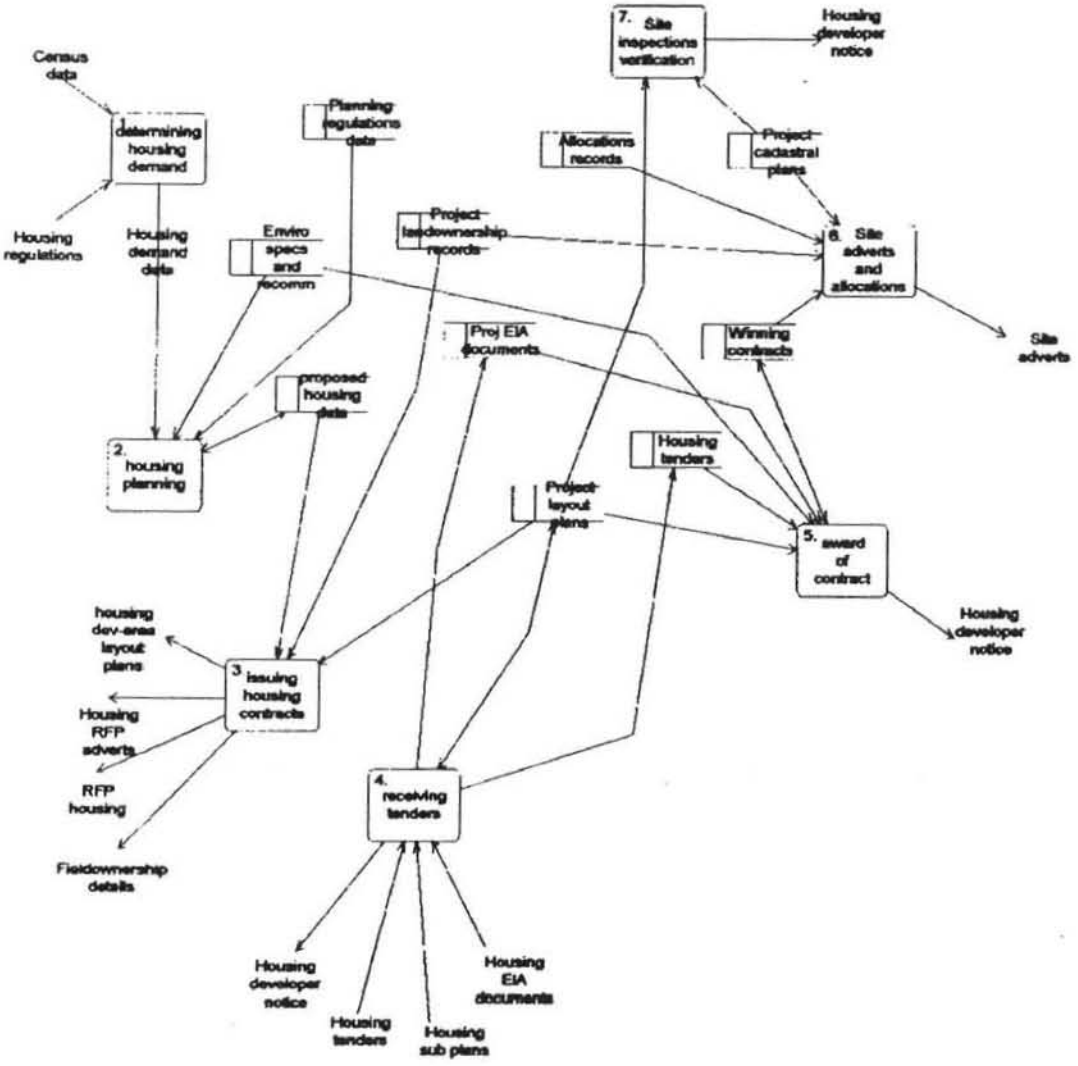
Detailed level:- Land use planning



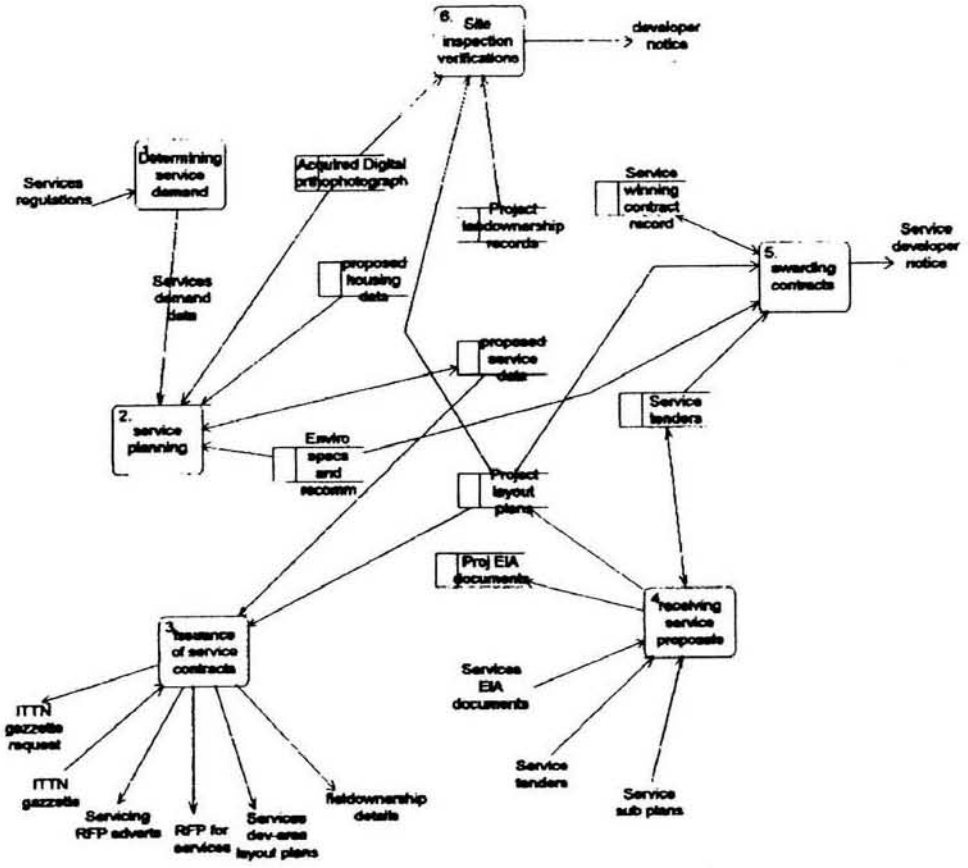
Detailed level diagram:- 2.1.3 Improved environmental planning



Detailed level diagram:- 2.1.4 Improved housing planning



Detailed level diagram:- Improved service planning



Appendix O – Fully normalized tables implemented on MS Access (some of the tables are not given fully but only extracts

pid	subj_id	alloc_id
997	999999	5
99997	268	5
99993	267	5
208	266	5
259	265	5
99998	230	5
9994	229	5
99995	225	5
999	221	5
12303-075	196	2
12303-072	193	2
12303-071	192	2
12303-068	189	2
12303-067	188	2
12303-061	182	2
12303-059	172	2
12303-057	170	2
12303-056	169	2
12303-055	168	2
12303-054	167	2
12303-053	166	2
12303-047	162	2
12303-046	161	2
12303-045	160	2
12303-044	159	2
12303-039	154	2
12303-038	153	2
12303-037	152	2
12303-034	149	2
12303-033	148	2
12303-032	147	2
12303-031	146	2
12303-030	145	2
12303-029	144	2
12303-028	143	2
12303-026	141	2
12303-025	140	2
12303-024	139	2

Allocation table

alloc_id	all_type
1	illegal
2	new allocation
3	relocation
4	reallocation
5	acquired
6	not yet

Allocation type table

PID	BUILD_NO
12303-001	6
12303-002	5
12303-003	4
12303-004	2
12303-004	3
12303-006	1
12303-007	10

Building table

pid	cadid
	0
12303-001	2
12303-002	2
12303-003	2
12303-004	2
12303-005	2
12303-006	2
12303-007	2
12303-008	2
12303-009	2
12303-010	2

Cad_par table

Cadid	surv_id	surv_d
1	12	2/02/20(
2	13	
3	0	
4	0	

Cadastral plan table

devarea_id	dev_specific	devarea_ar	zone_nr
1	Mixed	79860	12
2	Clothing	1800000	7

Development area table

dev_id	dev_specs
122	Road
123	Housing
124	Sanitation

Developer table

inco_id	inco_type
1	high
2	medium
3	low

Income table

encrfield_n	appeal_id	appeal description
12/a	0	
997/a	0	
14/a	0	
10/a	0	
8/a	0	
9/a	0	
8/b	0	
5/a	1	informal settlement
5/b	1	informal settlement
13/a	1	informal settlement
11/a	1	informal settlement
11/a	2	land dispute

Encr_appeal table

pid	encr_area	encr_value	dearea_id
20	3824	5736	1
21	16011	24017	1
22	8549	12824	1
23	10079	15119	1
24	12848	19272	1
25	17906	26859	1
26	9741	14612	1
9993	0	0	1
999999	525	788	1

Encroaching fields table

pid	info_id
11	1
13	1
13	1
17	1
226	1
226	1
239	1

Infor_pid

infosettler_	info_id	subj_id
253	1	2
250	1	2
252	1	2
251	1	3
254	1	4
2	1	8
234	1	10

Info_subj

Info_id	info_type
1	informal occupation
2	informal property

Informal development table

luse_id	luse
1	residentia
2	agricultur
3	institution
4	commerci
5	open
6	donga
7	industrial

Land use table

Lplan_nr	Lplan_desc	plan_date	planner_id
1	project area	21/03/1999	401
2	zoning plan	31/05/2001	401
3	residential	12/03/2002	500

Layout plan table

pid	Utility_id
12303-001	1
12303-001	2
12303-001	5
12303-001	6
12303-002	1
12303-002	2
12303-002	5
12303-002	6
12303-003	1
12303-003	2

Par_utility table

pid	par_area	par_valu
10	16940	25410
11	7960	11940
12	9337	14006
12303-	1426	21390
12303-	1399	20985
12303-	1469	22035
12303-	1290	19350
12303-	963	14445
12303-	1098	16470

Parcel table

subj_id	pid	all_id	cert_id	all_date	inco_id
87	12303-001	2	1	12/06/01	1
88	12303-002	2	1	30/11/00	1
89	12303-003	2	4	30/11/00	1
90	12303-004	2	1	05/06/00	1
	12303-005	8			
92	12303-006	2	4	12/02/01	1
210	12303-007	2	1	22/05/01	1

Parcel ownership table

req_nr	devarea_id
1	1

Req_devarea table

req_nr	issue_date	ITTN_nr
1	31/12/1899	

Request for proposal table

subj_id	subj_name	subj_surna	address
1			
2			
3			
4			
5			
6			
7			
8	Joshua	Lehloka	

Subject table

Utility_id	Utility_type
1	water
2	electricity
3	tarred road
4	all weather road
5	waste
6	sewerage

Utility table

zone_nr	zone_are	luse_id
1	80606	6
2	151417	6
3	303141	4
4	59202	4
5	86901	5
6	49972	5
7	21077	1

Zone table