GEOGRAPHIC INFORMATION SYSTEMS IN SOUTH AFRICAN LOCAL PLANNING - A CASE STUDY OF MOUNTAIN RISE, PIETERMARITZBURG

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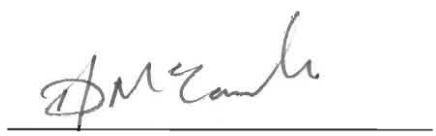
A thesis submitted to the School of Environment and Development, University of Natal, Pietermaritzburg, in partial fulfilment of the requirements for the Degree of Master of Science.

The financial assistance of the Centre for Science Development (HSRC South Africa) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the Centre for Science Development.

Pietermaritzburg, 1999

DECLARATION

I declare that this thesis is my own, unaided work. It is being submitted for the Degree of Master of Science in the University of Natal, Pietermaritzburg. It has not been submitted before in any degree or examination in any other University.



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ABSTRACT

The purpose of the study was to investigate the potential of Geographic Information Systems (GIS) in South African local planning. Planning is facing great challenges in contemporary South Africa and one of them is to consider new technologies to enable effective and efficient planning for the future.

In meeting the overall aim of the study, a number of goals were set. The first goal was to provide an overview of GIS implementation in local governments from an international perspective. This goal was achieved by reviewing literature on the subject which encompassed the technology's evolution and factors affecting implementation. Practical examples were cited to demonstrate the application of GIS in planning.

The second goal was to examine the role of GIS within the South African planning context. An investigation of the relevant legislation provided a context within which GIS could be implemented at the local level. In order to arrive at the second goal, a suitable planning process was derived from a review of applicable planning theory.

The third goal was to illustrate practically how GIS could be implemented and integrated into the planning process at the local level. This goal was achieved by carrying out a project within the Pietermaritzburg suburb of Mountain Rise. The results of the case study showed that GIS has a potentially significant role to play in planning at the local level.

ACKNOWLEDGEMENTS

I would like to acknowledge the following people who have contributed to the completion of this thesis:

- Prof. Rob Fincham, for his encouragement and support while supervising my thesis. His many words of advice and encouragement instilled a sense of belief and purpose in what I was researching, and for that I am truly grateful;
- Dr. Fethi Ahmed, who was largely responsible for me developing an increased interest and understanding of GIS while conducting the research. His constructive criticism as co-supervisor was greatly appreciated;
- Lecturers involved in the Masters Programme at the School of Environment and Development, University of Natal, Pietermaritzburg;
- Andrew Simpson (Lecturer, Department of Geography), without whose help I would not have been able to complete the case study. His expert knowledge of GIS and willingness to make his personal computer, printer, and scanner available proved invaluable in completing the case study;
- Sean Anderson (Aerial Photographic Services), for generously giving up his time to assist in 'cleaning and building' the GIS data for the case study and for the use of the digitising tablet;
- Greg Delabored (AM/FM Mapping, Pietermaritzburg-Msunduzi Transitional Local Council), for providing the digital cadastral data for the case study;
- To the many friends made during my year of study in Pietermaritzburg, in particular Tim Liversage; and
- My parents and brothers for their love and support throughout the duration of my studies.

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CHAPTER 1 INTRODUCTION

1.1. Preamble

The primary aim of the study was to investigate the potential of Geographic Information Systems (GIS) in South African local planning. This was achieved by conducting a comprehensive literature survey and carrying out a GIS project using Mountain Rise, Pietermaritzburg as a case study. This chapter provided an overview of the challenges facing planning in contemporary South Africa and explored the use of GIS in planning. Leading from this, the goals of the study were outlined and the limitations in research explained.

1.2. The Planning Challenges

Planning in general, and more specifically in developing countries, is presently facing great challenges. These countries find themselves with a range of critical socio-economic and environmental problems, such as expanding urbanisation, and its related infrastructure provision, dangerous pollution levels, ineffective waste management, inadequate health and social services, widespread poverty and ever increasing environmental crises (Department of Environmental Affairs and Tourism, 1998). The trends of urbanisation and democratisation have resulted in these countries looking for their place within the world order.

Against the above background, planning has concurrently been compromised and finds itself in a state of flux. Rapid transformation, reduction in funding, and a lack of capacity have been responsible for putting planing in the precarious position in which it finds itself. Planning in South Africa faces similar challenges.

If we argue that planning has been compromised, it is necessary that we understand what the underling purpose of planning is. This we find in the mission statement of the South African Council of Town and Regional Planners (SACTRP) (1995) which contends that planning within the South African context is concerned with the planning, development and organisation of human settlement which expands life's opportunities for people, and with the making of place. It is therefore the responsibility of planners to place before society an expanded sense of possibilities about how settlements can support life. In that endeavour, it is the obligation of planning to seek balance and sustainability: balance between human activities; and balance between those activities and the natural landscape (SACTRP, 1995).

Planning in South Africa, however, has not been successful in addressing the ills associated with developing countries. The situation is worsened by decades of Apartheid planning which practised biased development and widened the gap between the 'haves' and 'have-nots'. An example of this planning was the location of townships on the periphery of centres of employment (Physical Planning Act, 1991).

In 1994 a democratic government was installed in South Africa. At the root of this change was the principle of the potential inclusion of all people in the decision making process. Along with this change, there has been a different attitude towards the importance and use of information. In the past, this strategic resource was controlled and accessed by few. The trend is shifting towards an increased freedom of access to information. Contained within Chapter 2 of the new Constitution of the Republic of South Africa is the Bill of Rights which states that every citizen has the right of "... access to information" (Act no. 108 of 1996, p.22).

Therefore, the government's emphasis on empowering communities at the 'grass-roots' level means that a transparent and accountable local government is going to play an increasingly important role. For the first time, local government has the opportunity to embrace the above

planning ideals of the SACTRP, as well as those of the new democratic Government in South Africa. It is for this reason that the study focuses on planning at the local level.

1.3. The Role of Geographic Information Systems (GIS) in Planning

Local authorities make countless land-related decisions daily. They deal with property, development, infrastructure, and many other databases such as utilities, social facilities, and crime data that are referenced by geographic location. Individual decisions of local authorities typically have a limited scope and impact. However, as a whole, they shape the way land is used and the built environment is managed. GIS[1], says Ventura (1995, p.461), "... has tremendous potential at this level, both in allowing decision-making to be more objective and in elucidating the cumulative effect on incremental decisions". Ventura (1995) is not alone as there are many proponents of the use of GIS to assist planners in carrying out their tasks (Budic, 1994, Gilfoyle, 1991; and Ventura, 1995). They argue that GIS has become a necessary - and affordable - tool for ensuring that local government is efficient and effective in its functioning.

GIS in the South African context has a very important role to play in shaping and facilitating development and the allocation of resources. Although GIS is a new technology in South Africa, the usage and inclusion in the planning process is growing steadily. Despite the increased interest in GIS, many planners do not fully understand the capabilities and extent of this tool. These factors have contributed to the misuse and misinformation about GIS. It is therefore imperative to

[1] GIS is defined by Worrall and Bond (1997, p.366) as "... a computer-based system for capturing, storing, manipulating, analysing and visualising spatially referenced data and integrating it with other computer based information; a toolkit for the modelling and analysis of complex research, management and planning problems; and, a system to support decision makers by enabling them to structure problems and identify potential solutions for evaluation".

establish what GIS can contribute to planning and what impact it has and will have on planning as a profession and as a process in South Africa.

The planning process in South Africa, currently being shaped by new legislation, has many objectives. The most important being transparency, accountability, flexibility, and participation in the development process. The Development Facilitation Act (DFA) (Act No. 67 of 1995) and the Planning and Development Act (PDA) (Act no.5 of 1998), are examples of such legislation. GIS is a medium through which many of the aims set out in the new planning legislation can be achieved.

1.4. Goals of the Study

This potential area of research is extremely vast. The study therefore did not set out to address all of the issues involved in the adoption and use of GIS in planning. It is also acknowledged that one cannot make broad value judgements concerning the benefits reaped through the use of GIS, prior to placing it in the context of the application in which it is being used. In this light, the unit of study was confined to GIS in planning at the local level.

With the above in mind, the overriding aim of the study was to investigate the implementation and use of GIS in local planning in South Africa. Critical debates surrounding the use of GIS, notes Harris *et al* (1995), have not featured in its rapid diffusion into the private and public sectors in South Africa. This is confirmed by Maguire *et al* (1991) who points out that the set of non-technical issues being raised and debated both within and outside the GIS community, are notably absent in South Africa (Maguire, *et al.*, 1991).

It was therefore with little surprise that while researching for this study, very little literature pertaining specifically to the adoption and use of GIS

in planning in South Africa was found. A considerable amount of the literature refers to examples from the United States and the United Kingdom. While these examples are extremely valuable for providing guidelines for GIS implementation and identifying possible pitfalls, it must be realised that the South African context is unique and therefore requires unique approaches and solutions. The reason for the lack of South African examples could well be symptomatic of the fact that the uptake of GIS in planning has been somewhat disjointed and in some cases non-existent.

The first goal of the study was to investigate the current debates on the potential application of GIS to the local planning arena. This was achieved by carrying out an extensive literature survey. It served to highlight those ingredients that can influence the successful implementation of GIS in an organisation. These included organisational, managerial, political, financial, and capacity factors. Highlighting this debate was regarded as important, especially in light of the fact that South Africa has often failed to recognise the above factors when implementing GIS. It is therefore essential that individual and organisational problems in the implementation of GIS are not repeated in subsequent attempts to introduce the technology in planning.

The second goal of the study was to examine the role of GIS within the South African planning context. Firstly, it was necessary to analyse the legitimacy of the technology within the third world. Following this, the study investigated those pieces of legislation within planning that are most likely to have an impact on how and where GIS can be utilised in South Africa. Lastly, a suitable planning process for the South African context within which GIS can be integrated was derived from existing planning theories.

The third goal of the study was to illustrate practically how GIS could be implemented and integrated into the planning process at the local planning level. This goal was achieved by carrying out a project within the

Pietermaritzburg suburb of Mountain Rise. This suburb was the area of study during the coursework examination for the Masters programme in the School of Environment and Development, University of Natal during June 1998. It provided an excellent opportunity to show the usefulness of GIS when carrying out planning functions. However, while undertaking the project, many of the problems associated with using GIS in local planning, came to the fore and therefore inhibited the final output. This was in many ways not unexpected and served to emphasise those factors that need to be urgently addressed if GIS is to be successfully utilised as a tool in South African planning.

1.5. Limitations in Research

The were a number of limitations experienced while carrying out the research. These have been discussed briefly under six headings: logistical; references/bibliography; time; financial; data; environmental; and community limitations.

1.5.1. Logistical

In terms of the organisation and operation of the research, there were a number of problems encountered. Originally, the study intended to take ideas generated during the School of Environment and Development's exam process and, using GIS, communicate these ideas to the community of Mountain Rise. This was to include a large-scale public participation exercise in the form of public meetings and workshops, bringing together all interested and affected parties as well as planners from the Pietermaritzburg-Msunduzi Transitional Local Council (TLC). To accomplish such a task, extensive logistical support from lecturers in the School of Environment and Development would have been needed. While this was envisaged in initial discussions, such support was not practical given staff commitments.

Another logistical problem encountered was the unavailability of a large number of influential community members in Mountain Rise while conducting research in the field, due to their annual pilgrimage to Mecca. The final logistical obstacle was the inaccurate and out-of-date digital cadastral data that was obtained from the TLC and used for the land use and environmental condition survey. It unfortunately did not correspond with what was on the ground and therefore had to be 'ground-truthed' and corrected. This proved to be a time-intensive process.

1.5.2. References/Bibliography

Due to the fact that this is a six months coursework thesis, it was impossible to include all the literature read during the Masters programme. For this reason, those pieces of text which were not referred to in the study, but which the author feels influenced the direction of the research are included in the bibliography.

1.5.3. Time

The time limitation was probably the most important factor. It must be emphasised that this research was carried out within a coursework Masters and the time allowed for the compilation of the thesis is only six months. This limitation was compounded by the fact that this topic was finalised late into the research period of the Masters programme. The majority of the research was therefore conducted during the months of November and December. Due to many Council and community members taking annual leave, attempts to carry out interviews and surveys proved futile in many cases.

It must also be noted that due to time constraints, only a brief analysis was undertaken in establishing the current use of GIS at the TLC. However, after conducting semi-structured interviews with those in the relevant departments, the author was satisfied that it was clear that GIS was not being used to its fullest potential and that there was no formal plan of GIS implementation at the TLC. This was confirmed by Delabored

(*pers. comm.,* 1999), the person charged with overseeing the implementation of GIS at the TLC, who stated in an interview that "Pietermaritzburg-Msunduzi TLC is behind other major centres in the implementation and use of GIS". In this regard, the thesis has attempted to identify those areas of GIS implementation that require greater attention in the TLC and local governments around South Africa, with particular focus on the City Planning Department.

1.5.4. Data

Obtaining digital data in order to construct the GIS project proved to be a time and labour intensive procedure. The digital data contained within the TLC's database proved to be inaccurate in some areas and, as mentioned above, had to be adjusted and recaptured. Interchanging data between different GIS software packages and formats also proved to be time consuming.

1.5.5. Environmental

While conducting the land use and environmental condition survey and the semi-structured interviews with residents in Mountain Rise, they appeared rather hesitant in their responses. It was apparent that they were not entirely comfortable with my presence in their suburb. After explaining my reasons for conducting the survey and interviews, the environment improved somewhat. This meant that the exercise of completing the survey and interviews was time consuming and information proved difficult to solicit.

This experience served to highlight the suspicion with which the citizens view those who come into their suburbs with the intention of 'improving their quality of life'. This is especially true of the suburb of Mountain Rise, which was designated as an Indian Group Area under the Apartheid regime. The fact that they were apprehensive at first is, therefore understandable.

1.5.6. Community Participation

An attempt was made in this study to show how a greater degree of public participation can be incorporated into the planning process with the aid of GIS. However, public participation GIS is a separate topic that needs to be discussed in greater detail, which is beyond the scope of this thesis.

The limited participation included in the case study was hindered by a number of factors. Firstly, the community of Mountain Rise is divided among religious lines and business interests. During the course of the land use and environmental conditions survey, a number of semi-structured interviews were held with interested community members. An overall impression was given that the residents were generally aware of the problems facing their community and had some constructive ideas on how to solve them. However, they did point out that due to their community being fragmented, they did not foresee the problems being addressed in the near future. The problem was compounded by the fact that the Residents Association had not been functioning for the last couple of months.

The above issues serve to highlight many of the problems that planners face when attempting to involve the public in the planning process. The question of whom is the public and what is considered to be fair representation need to be answered. Generally, citizen participation is considered to be a costly and time intensive process that yields little success (Hicks, *pers. com.*, 1998). A tool such as GIS has the potential to make participation a viable and integral component of the planning process.

CHAPTER 2 OVERVIEW OF GIS IMPLEMENTATION IN LOCAL GOVERNMENT

2.1. Introduction

Discussions about the success or failure of GIS implementation in local government have been the subject of many debates amongst academics. There appears to be those on the one end of the spectrum that are unwilling to acknowledge that GIS has any positive role to play, while those on the other end believe that GIS is the answer to making local government more efficient and effective (Delabored, *pers. com.*, 1999). This debate aside, GIS and related technologies have been implemented for many purposes in local government. The trend suggests that implementation will continue at a rapid pace (Ventura, 1995). However, for technical, human, and organisational reasons, initial implementation has been typically limited to query and display applications. Ventura (1995) also notes that few applications as yet at the local level support complex analyses or ad hoc decision making.

Academics and experts alike have also differed on how best to assess the performance of GIS in local government. Increasingly, GIS implementation studies are integrating evaluations of the tangible and intangible benefits. In the past, authors have used the assessment of the benefits as an indirect measure of the success of implementing GIS (similar to a cost-benefit analysis) (Budic, 1994). Authors such as Campbell (1994), Ventura (1995), and Worrall and Bond (1997) have made use of the improvement of organisational efficiency and effectiveness (system performance) to measure the value of GIS.

With the above in mind, the aim of the chapter was to investigate the current debate on the potential use of GIS in local government, and in particular planning. This task was achieved by carrying out an extensive literature survey. The result was a discussion on the evolution of the implementation of GIS in local government and the consequent debate that has arisen amongst academics. Those factors that effect the implementation of GIS in local government were then explored in more detail. The chapter was concluded with a number of examples, both local and international, on the successful use of GIS in local government. This was considered to be important, since examples of GIS successes seem to be on the whole absent from literature reviewing the potential of GIS in local government.

2.2. Evolution of the Implementation of GIS

Results from the literature reviewed indicate that the lead-time to the development of an operative GIS is often considerable. This is due in part to the time consuming activities of customisation and data capture as well as the organisational complexities of introducing a system such as GIS. Based on a review of several reports on the implementation of GIS in local government, it would appear that the cost profile is roughly 65 percent data conversion, 30 percent hardware and software customisation, and 5 percent training (Worrall, 1994). Campbell (1994) also points out that very few local authorities already have complete data sets or their existing information in a suitable format for input into a GIS system.

Adoption, comprising at least the hardware and software components of a GIS, is readily observed (Ventura, 1995). However, it is the use of the GIS that is of most importance. It is not possible to assume from adoption of a GIS that the technology will be used for decision making. In the majority of cases, it is observed that GIS is used for mapping and

inventory tasks (Maguire *et al.*, 1991). Ventura (1995) explains that adoption of GIS usually occurs in three phases. The uptake is generally slow at first, however when the technology becomes widely known and accepted, it speeds up considerably.

Maguire *et al.* (1991) notes that the first stage of GIS implementation will generally be concerned with location and condition queries, the second stage with more complex condition and trend analysis, and the third stage with routing, pattern and modelling queries. This suggests that GIS moves form a transaction processing system to a decision support system. Crain and MacDonald (1984) also identify three stages in the evolution of GISs: inventory applications; analysis applications; and management applications (Figure 2.1.).

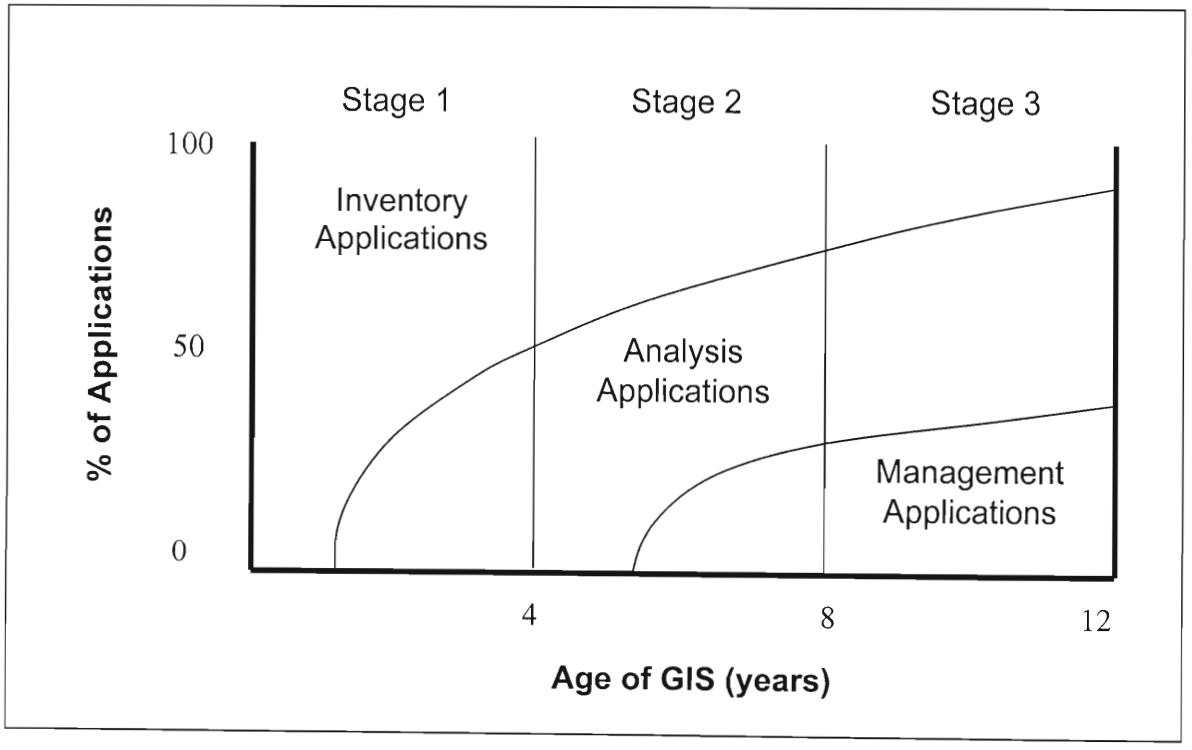

Figure 2.1. Stages in GIS development (Crain and MacDonald, 1984, p.44)

Considering the evolution of the implementation of GIS in Figure 2.1., planning could really only take full advantage of a GIS in the second stage, which concerns the more complex condition and trend analysis

(Craig and MacDonald, 1984). Crain and MacDonald (1984) suggest that the evolution of a GIS from inventory to analysis to management applications is a matter of system maturity. Because this may take four to eight years, the initial payback from a GIS is not apparent. This is particularly important in developing countries where the improvement through increased productivity is expected immediately (Ventura, 1995).

2.3. Exploring the GIS Debate

It is widely accepted in the literature that the potential of this technology to store, manipulate, and display spatial data is considerable. This point is emphasised by Budic (1994, p.244) who states that the "Collection, organisation, analysis and dissemination of information, also referred to as 'planning intelligence', is one of the major and most time-consuming planning functions". With recent developments in information technology and the plummeting costs of computing, the answer increasingly is to use GIS (Gilfoyle, 1991).

However, the introduction of GIS technology involves the complex process of managing change within environments that are typified by uncertainty, entrenched institutional procedures and individual staff members with conflicting personal motivations (Klosterman, 1997). Given these circumstances, personal, organisational, and technical factors are likely to have a profound influence on the extent to which the opportunities offered by GIS will be realised in practice (Campbell, 1992).

Local government has been identified as one of the most important groups of users of GIS (Volkwyn, 1998). More specifically, GIS has been found to have applicability in number of planning functions (Budic, 1994 and Ventura, 1995). GIS can be used in zoning, land use, transportation, economic development planning, site selection, and land suitability analysis (Budic, 1994). Sommers (1987) notes that the expectations of

GIS are not just limited to the automation of routine data handling. Instead, GIS also has the potential of assisting with managerial tasks, policy design, decision-making, and communication with the public (Sommers, 1987).

The rapid increase in the uptake of GIS, despite the cost, indicates the optimistic belief in GIS capabilities and prospective benefits. However, the task of trying to justify huge public spending on GIS in local government, believes Worrall (1994), is a complex task because local authorities are heterogeneous organisations currently facing major pressures for change, and considerable uncertainty about their future structure and role.

Arguments for and against implementing GIS amongst users, politicians, and academics have stimulated discussion in many countries (Campbell and Masser, 1992). The British Government published the 'Chorley Report" in 1987, which explored the role of GIS. In the report, GIS was seen as most probably providing policy makers and analysts with major new tools for the effective and efficient handling of spatially referenced data (Campbell and Masser, 1992). To date, argues Campbell and Masser (1992), the potential of GIS is still being promoted yet it is difficult to find, at least in Britain, an example where GIS has fully lived up to its early expectations and the considerable 'hype' that accompanied its launch in the late 1980s.

It is Worrall and Bond's (1997) opinion that GIS has been considerably 'oversold' to public sector organisations - particular local government - many of whom have failed to achieve the benefits they expected. Most authors (Campbell, 1994; Volkwyn, 1998; and Worrall and Bond, 1997) concur on the fact that use of GIS in local government is limited to 'map query'. Systems are used mainly to display the location of geographic features meeting specified criteria or report the attributes of selected geographic features. Use in decision making is restricted to automation of decisions characterised by definitive rules (Campbell, 1994). In

conclusion, Harris *et al.* (1995) notes that there is a growing international chorus which sees GIS as an unfortunate diversion in our journey towards 'truth'.

Opposed to the above standpoint, are those who feel that GIS has a constructive role to play in local government (Budic, 1994; Klosterman, 1997; Moore *et. al.*, 1995; and Ventura, 1995). While the debate about the usefulness of the technology continues, Budic (1994) is quick to point out that the optimists are prevailing in this regard. He does however admit that information about the actual performance of GIS is scarce. Worrall (1994) reiterates the point that the public sector is faced with an increasing demand that it demonstrates efficiency in the delivery of all its services. Therefore, in order for these efficiencies to be achieved without compromising effectiveness, it is vital that the public sector can exploit new techniques, toolkits, and technologies. GIS is one such technology that undoubtedly has the greatest potential (Worrall, 1994).

Volkwyn (1998), in defending the adoption of GIS in local government, considers the criticisms of the technology to be unfair and unsubstantiated. He has advocated that the primary role of GIS within the municipal environment is one of a simple information provider. If GIS is able to fulfil the functions listed below, then Volkwyn (1998) believes that GIS has more than justified its implementation in local government. Examples of these simple, but useful, queries desired by municipal officials include:

- Locating erven and highlighting it on screen;
- Presentation of basic information pertaining to the erf, via the point and click operation;
- Thematic shading of properties based on their characteristics (e.g. zoning);
- The layering of various maps or themes so as to compose a map; and
- The elementary linking of each erf (in the graphic database) to an external attribute database (Volkwyn, 1998, p.40).

Worrall (1994) believes that if the criticism of the technology is to be overcome, then it is imperative that traditional planning activities be further developed and better integrated within a GIS framework. Klosterman (1997) supports this view, but he notes that GIS needs to be integrated within a planning framework and not vice versa. If one starts with a particular technology such as GIS, and then attempts to apply it to planning, the nature of planning could be distorted. Beginning with GIS also implies that the role of advanced information technologies in planning are shaped largely by developments outside of planning and not by the particular needs of planning itself (Klosterman, 1997). By embracing GIS as a planning tool, the planning discipline should not forego its duty to remain ethical and licit. This is conceivable through upholding an apposite GIS design philosophy in which planning applications drive the design of the GIS.

2.4. Factors Affecting Implementation

If GIS is to be implemented successfully into local government, many difficulties will have to be overcome. The learning curve for GIS can be quite considerable in some instances. While time and additional training can solve many of the technical problems encountered, many of the human and organisation problems can be far more difficult to solve (Worrall and Bond, 1997). Ventura (1995) describes the technical issues involved in GIS implementation as including system components, system design, data quality, and technical expertise. Human issues include how well the staff of an organisation understands the technology and its role, as well as the support and training received. Organisational issues comprise how the organisation adapts to new sources and types of information, and factors external to an agency that influences an organisations ability to adopt or use GIS, particularly political and economic. (Ventura, 1995).

Successful use of GIS in local government depends on the ability, capacity, and willingness of organisations and individuals to absorb and use new forms and quantities of information (Campbell and Masser, 1992). Nedovic-Budic and Godschalk (1996) point out that, among the many possible adopters of GIS technology, individual users are considered the ultimate and most important adopters. Furthermore, research points to a high significance of human factors for successful development of information systems. Nedovic-Budic and Godschalk (1996, p.555) conclude that "computer system problems are traceable primarily to human factors" and that "information system failures are rarely merely of a technical nature". This point is further emphasised by Niemann and Niemann (1994) who note that "the organisational, political, and human aspects of implementing GIS are far more difficult than the technical aspects".

Therefore, if GIS is to develop into a useful component in the decision-making process, it is imperative that we begin to understand the technical, organisational, and institutional impediments to successful GIS use (Campbell and Masser, 1992). Campbell (1994) has argued that the success of GIS implementation is also related to the presence of an overall information management strategy and a commitment to and widespread participation in GIS implementation. These factors will be discussed in greater detail below.

2.4.1. Technical Factors

One of the most important factors that has led to the technology not reaching its potential is the lack of modelling functionality within many GIS packages. Some even go as far as saying that the future success of GIS technology will depend to a large extent on incorporating more powerful analytical and modelling capabilities. "It is simply not enough to use GIS to do quicker what was done before, it is essential that GIS adds value analytically" (Worrall and Bond, 1997, p.365).

There is also little incentive for developing computer tools that serve the needs of planners directly. This is largely due to the diversity of planners' analytical needs and application areas in a poorly funded public sector (Klosterman, 1997). Linked to this is the notion that the number of planning-related applications for which GIS technology is used is related to the number of maps (layers of data) incorporated in the GIS database (Budic, 1994).

GIS is more likely to achieve the benefits of its use if a comprehensive dataset is in place. Databases of the multipurpose land information systems usually contain a variety of features, because of their goal of satisfying the information needs of several agencies or departments (Budic, 1994). As a result, this extensive database encompasses more distinctive elements of an urban system and more data relevant to planning issues, and thus makes it easier to analyse those issues (Dueker in Kraemer and King, 1982).

Concerns over data quality, suitability, and access remain significant barriers to using GIS in decision making. Documentation of data quality (metadata) is often haphazard and incomplete. Many agencies would rather duplicate data already collected from outside sources to ensure a high level of accuracy (Ventura, 1995). Planners should recognise that more accurate data is likely to be more defensible, especially when decisions affect private property rights. Applications with less-stringent data quality requirements can realise immediate benefits from automation, while those for more accurate data may take many years (Ventura, 1995).

John (1993, p.113) emphasises the data quality factor when he states that "... analysis carried out on an integrated database can ultimately only be as accurate as the quality of the 'worst' data set included". Data combination is, however, necessary as the type of management objectives and decision-making problems dealt with by planning agencies

in particular, often transcend functional and organisational boundaries and may require a multitude of diverse data sets (John, 1993)

The problem of data structure, accuracy, reliability, and design of data resources severely reduces the strategic and analytical capabilities of many public sector organisations. Therefore, say Worrall and Bond (1997), significant improvements will have to be made to the statistical infrastructure in many countries if GIS is to play a more effective role in policy making and strategic analysis. Attention will also have to be paid to data collection. Often, an agency collects data to a specification required for a particular project. No consideration, however, is given to other potential uses of that same data, leading to inefficiencies, redundant efforts and resources and ultimately, inadequate social and economic planning (Grant and Li, 1995).

2.4.2. Human Factors

Ventura (1995) believes that most barriers to effective GIS use boil down to people problems. These problems are normally associated with a fear of change, difficulty in learning or accepting new methods, or struggles over authority. The reluctance of individuals to grasp new information technologies can often be traced back to a fear of computing. This fear has arisen because of the perceived job losses that accompany the introduction of computers. Individuals and organisations may also fear changes such as automation of spatial data because this can reveal weaknesses and errors in current systems (Ventura, 1995).

Ventura (1995) points out that if there has been no proper introduction to the technology or the user interface is difficult to understand, GIS implementation will not be successful. It is therefore imperative that end users obtain support from specialists to customise their GISs. According to Ventura (1995, p.463), if "... productive interaction between ...[those implementing the system] and users does not take place, users may be alienated by the process or the system, leading to personal resistance..."

Due to the complex combination of hardware, software, and database elements contained within a GIS, specialist skills are required for managing the three components so that maximum benefit can be derived from the technology. Budic (1994) emphasises that expertise in a substantive field is a prerequisite to analysing and synthesising data. Therefore, if operational and decision-making benefits are to be achieved, agencies will need to have the services of a GIS specialist on their staff. Amongst the responsibilities of this specialist will be the task of training. This area of GIS implementation is frequently overlooked and under-funded. Initial and on-going training is critical to the success of GIS. Unless someone is specifically trained in and tasked with developing new applications, says Ventura (1995), it is highly unlikely that the system will evolve into a decision-support tool.

It has been established earlier in the chapter that a GIS takes time to implement. Within the GIS implementation stage, database development is acknowledged as the most challenging and time-consuming task. Learning the technology is also seen as a time intensive activity. However, once the above obstacles have been overcome and staff have realigned their approach and attitude towards automation, a more creative approach to performing their old tasks can be taken. The longer a GIS is used, the greater the chances are that it will yield benefits (Budic, 1994).

This leads to another important factor concerning the role that the individual has to play in the success of GIS. As skills and knowledge bases are being built and as data sets are growing in complexity and coverage, increasing numbers of GIS users within public sector organisations are becoming aware of potential strategic-level applications. Many of these applications were never considered during the initial project justification phase. Those organisations with the longer track records of GIS users are now moving into a period of more mature and reflective GIS use (Worrall and Bond, 1997).

2.4.3. Organisational Factors

It is important to realise that GISs are information systems, and not just collections of hardware and software, and therefore their implementation and use must be carefully tailored to individual organisations. If organisations want to see their GIS evolve into decision-support applications, then they will need to provide incentives for innovation and plan for changes in organisational and decision-making structures (Ventura, 1995).

The structure of an organisation also affects GIS implementation in many ways. One of the main areas of concern lies in the fact that the 'group' that manages GIS exerts significant control over its use and the development of new applications. The organisational structure will also influence how GIS spreads within an organisation and the traditional decision-making procedures will be disrupted by the introduction of GIS, as some decisions are now made in different ways and by different people (Ventura, 1995).

Intergovernmental relations affect GIS operations both horizontally and vertically (Worrall and Bond, 1997). Often, local units of government have common requirements, and therefore may take advantage of co-ordinating the acquisition and management of data, equipment, or technical expertise between jurisdictions. One cost of this co-ordination is a much more protracted implementation process (Ventura, 1995). A multi-departmental or corporate approach to GIS development, however, is expected to yield greater organisational benefits, mainly by avoiding duplication of efforts in data collection and maintenance (Budic, 1994). It must be recognised that implementing a 'shared system' is more complex and realising the benefits more difficult than with single users.

Another factor that doesn't receive much attention in GIS implementation, is the 'needs assessment'. If the 'needs assessment' is not carried out properly prior to GIS implementation, argues Ventura (1995), it can lead

to the misidentification of the functional requirements of a GIS (hardware, software, and data). The flexibility to later move into advanced analyses may be constrained by solutions that meet only immediate needs (Ventura, 1995).

Organisational politics plays an important role in the adoption of GIS and can substantially influence its outcomes. It is therefore crucial that administrators and decision-makers are convinced of the potential of GIS at the needs assessment stage (Campbell, 1994). Budic (1994) also notes that political support is expected to correlate with more effective use of GIS. Long-term stable support for GIS is a prerequisite for a system to evolve and adapt to new conditions and problems. Given the continual political turnover in local government and the extended period in which benefits from a GIS accrue, such support cannot be taken for granted (Ventura, 1995).

Delabored (*pers. com.,* 1999), a GIS specialist from the Pietermaritzburg-Msunduzi TLC, stressed that it is important to integrate GIS within existing information management systems and information technology strategies at the local government level. He points out that there are numerous problems associated with this task. Many service managers tend to take a 'vertical' view of their own application system 'smokestack', whereas the policy analyst needs to take a 'horizontal' view of data in an organisation (Delabored, *pers. com.,* 1999). It will therefore be critical to "integrate GIS into the organisation's information system strategies and into the business planning functions of the organisation" (Worrall and Bond, 1997, p.374).

Development of a functional GIS and the subsequent introduction of more accurate and current information, can lead to increased public policy conflicts by revealing issues previously hidden from view and fuelling policy debates based on conflicting interests and values. Hicks *(pers. com.*, 1998), a professional land surveyor from the Pietermaritzburg-Msunduzi TLC, expressed his concern about the amount of information

that one makes available to the community. In his experience, too much information leads to conflict. The author does not support the view that information should be withheld from the community, but rather that dissemination of information should be carried out with a degree of responsibility and caution.

Many government agencies are also reluctant to make freely available data in certain databases, especially when that data is sensitive in nature or has incurred great cost. In South Africa there is no clear national policy on this issue, although some public agencies around the world have started charging monetary fees for those requesting GIS data. Many see this as an infringement of their constitutional rights (Ventura, 1995). Those against data being withheld, argue that since government databases were created with public money, the public should have access to them.

Linked to the above issue, is the question of data liability, especially with the increased use of GIS databases by all levels of government in the decision-making processes. The debate over whether a public official(s) can be held responsible for damages caused by 'errors' in GIS information is unresolved. As a result of this position, "... government entities will be caught in the dilemma of trying to be open to the public, while at the same time employing as much expert knowledge as possible behind closed doors" (Padgett, 1993, p.516).

2.5. Practical Examples of GIS in Planning

Statements about the potential applications and value of GIS technology, however, do not supply enough reason to undertake its use in planning. Planners first need to observe the benefits of the technology, and also to find GIS technology advantageous when compared to current practices, and the effort of changing to be worthwhile. One way to evaluate GIS

technology is by observing it in use. Another way is through summarising and sharing the experience of many users of GIS technology, both the successful and the less successful (Budic, 1994 and Ventura, 1995). The examples that follow will show that the implementation of GIS provides the public sector with a significant opportunity to improve the effectiveness of its policy and the efficiency of its programmes.

2.5.1. Example 1 - GIS in Community Development

A customised GIS, called ViewMap, was developed by the Human Sciences Research Council (HSRC) in South Africa for a pilot project in Atteridgeville, a township just outside Pretoria. The aim of project was to establish what the potential GIS was in disseminating information and empowering the disadvantaged. The ViewMap GIS was therefore designed to provide a community, made up of literate and illiterate residents, with easy access to a wide range of mapped information specific to the particular community (Kuiters, 1998, p.31). An interesting facet of the system is its ability to operate in any of the 11 official languages in South Africa. This facility, Kuiters (1998) argues, will help increase the numbers of community residents that can utilise the GIS. The ability of vital information, such as the location of schools, hospitals, police station, medical practitioners, sports facilities, and so on, to be communicated to residents who normally would not have had access to such information proves the success of this pilot study (Kuiters, 1998).

2.5.2. Example 2 - GIS in Resource Allocation

The task of making resource allocation decisions is a central feature globally of the public sector and one that has increased in importance over the last few years. It is important that the public sector organisations learn to make better use of data locked in their operational systems to continually assess needs and to monitor the impact of policies and programmes. Strathclyde Regional Council, in the United Kingdom, provides an example of how GIS has been used to support a social strategy (Worrall and Bond, 1997). The Regional Council has a policy of

postcoding all client record systems. This data, in conjunction with the Census and extensive local survey material, has been used to define what are known as APTs (Areas for Priority Treatment). The process has been driven by the Council's policy that resources should be allocated on the basis of need. GIS has therefore been used as a catalyst to make decision-makers more aware of the geographic location and geographic intensity of the problems (Worrall and Bond, 1997). The application of this example to the South African context is evident in meeting basic needs.

2.5.3. Example 3 - GIS in Environmental Strategy

In the late 1980s, Lancashire County Council in the United Kingdom, undertook a GIS environmental audit of the country with the aim of assembling a comprehensive overview of the 'state of health' of the environment as a basis of generating the knowledge that would assist the Council to identify how and where environmental improvements could be made. The GIS project managed to achieve many objectives, some of which included the evaluation of a complex set of environmental indicators against legal standards; providing a baseline for the monitoring of change and assessing the environmental impact of development; identifying gaps in the availability of information; and assembling a body of data capable of supporting the creation of a county-wide environmental strategy. This example proved that GIS is an effective data integration device and that it can contribute significantly to the development, analysis, and implementation of public policy (Worrall and Bond, 1997).

2.5.4. Example 4 - GIS in Provision of Basic Services

A study was carried out to measure the accessibility of medical practices in the Wirral Health Authority, United Kingdom. Data on the road networks and location of medical surgeries was loaded into a GIS. Seven categories of road were defined and their respective mean travel speed times were developed. A contour map of accessibility was generated and subsequently translated into a map showing how the accessibility to medical practices varies within the region. The contribution of GIS

analysis to policy development was significant. Firstly, the analysis showed that areas with short 'as the crow flies' distances from medical practices could score highly on inaccessibility given the nature of the road network. Secondly, the ability to link the output of the accessibility analysis to the Census allowed the local council to identify the social and economic characteristics of the population in those areas that have poor access to medical practices (Worrall and Bond, 1997). This example of modelling would be invaluable for the South African context. Delivery of basic services needs to be implemented in strategic areas, which could be identified using the above method.

2.5.5. Example 5 - GIS and Integrated Information Technology

The Cape Metro Council (CMC) in South Africa has recently established a GIS that will allow local authorities, officials, politicians and ratepayers rapid access to an integrated, up-to-date database of spatial and nonspatial information to enhance service delivery, act as an aid to decision-making and promote transparent government. "Rapid access to integrated data will assist the CMC to achieve its stated goals of completely addressing poverty and homelessness, assist in the achievement of social harmony and civic responsibility, further develop local government, boost enhancement of the environment and position of the Western Cape in the global economy," says Milne (1998, p.14), head of the CMC's Information Services. Milne (1998) explains that the Information Services Division is now able to begin meeting the rapidly increasing demand for information. He points out that before, the lack of an integrated, manageable database, coupled with a shortage of staff precluded the rapid dissemination of relevant information.

2.5.6. Example 6 - GIS in Urban Rezoning

GIS was used as an analytical tool in a complex rezoning project in Columbus, Ohio in the United States. It was employed to provide decision-makers with the information required to select zoning categories

and to determine where zoning boundaries should be. To achieve this aim, a computer aided drafted (CAD) footprint map was superimposed on a scanned aerial photograph of the area. Corresponding points between the CAD map and aerial photograph were selected and corresponding point pairs input. The GIS then warped the scanned aerial photograph non-linearly to fit the footprint map. The database was augmented manually to include the Franklin County parcel number for each parcel of land on the map. The GIS then produced maps to reflect the attributes in the database. The result was a valuable rezoning map showing land use on a parcel-by-parcel basis. The map allowed planners to determine the prevailing land use in different areas within the rezoning region. Finally, the GIS was used to construct a map of the final proposed rezoning. City planners noted that the GIS analysis significantly aided their decision-making process by providing essential information about land use interrelationships and substantiating planners' decisions about recommended rezonings (Moore *et al.*, 1995).

2.5.7. Example 7 - GIS and Citizen Access

Newport Beach City's Utilities Department in the United States built a multi-departmental GIS. It placed a computer terminal in the Newport Beach Central Library which allowed public access to neighbourhood maps, demographic details, land parcel information, and other data stored in the GIS. Their objective, says Corbley (1995, p.66) was to "... develop a database so city employees won't have to call us for information". The GIS staff accomplished its goal of creating a user-friendly system by building a custom graphical user interface (GUI) for each particular city department. The GUIs create a 'point-and-click' environment on the front end of the GIS in which any employee can access relevant data and perform department-specific applications. In the Public Works and Building Office, clerks once had to leaf through pages of documents to find parcel information that citizens and building contractors needed to submit a building permit application. Now the clerk simply calls up a city map on the screen, clicks in a parcel or enters the

street address, and up pops the parcel's square footage, property line boundaries, zoning information, and legal description. Plans are under way to make the information available to homes and offices through a network such as the Internet (Corbley, 1995).

2.5.8. Example 8 - GIS in Land Use Management

The City of Newton, Massachusetts in the United States, is meeting a challenge shared by municipalities all around the world - an increasing demand for services in the face of tightening budgets. The Planning Department is using GIS to research zoning and land use conditions of parcels. The department also reviews requests for new developments and is able to compare proposals to actual conditions, as well as overall City objectives. In addition, it provides regular land use and zoning reports to the board of aldermen. "GIS is a wonderful tool for land use planning - to get a picture of the City's zoning and to electronically combine different data types such as aerial photographs, basemaps, and thematic overlays for planning purposes", says MacGaffey and Grady (1996, p.31). One example of complex analysis used by the City Planing Department is the visualisation of land use patterns to help identify and protect historic housing districts. It also uses GIS to keep its open space and zoning maps current and readily available. Before GIS, several years would elapse between revised versions and the data were stored and redrafted manually. The GIS now makes it easy to keep the maps up-to-date, allowing greater responsiveness to planning requirements. "The maps generated from the GIS provide improved clarity, are easier to understand, and are better products than previous versions", said Susan Glazer, director of current planning (MacGaffey and Grady, 1996, p.31). Similar to previous examples, the Department is making use of a countertop terminal with a GUI to provide citizen access to Assessor maps. The City's GIS provides easier access to consistent and reliable data to those who need it, when they need it (MacGaffey and Grady, 1996).

2.7. Conclusion

While the GIS debate persists, this chapter has demonstrated the utility of GIS technology for many applications in local government. It was shown that in most local government GISs, initial uses are typically limited to query and display applications. Evolution into applications involving more sophisticated analysis, modelling, and prediction is constrained primarily by organisational, technical, and human factors. These can be overcome, but local governments must realise that it may involve substantial reform. This is important in the South African context as local government is currently undergoing transformation. It is therefore an opportune moment for GIS to be integrated into the organisational structures and functions of local government, and in particular planning, in South Africa. Through conducting this literature survey, the first goal of the study has been met.

CHAPTER 3 THE ROLE OF GIS IN THE SOUTH AFRICAN PLANNING CONTEXT

3.1. Introduction

The overall of goal of Chapter 3 is to examine the role of GIS in the South African planning context. This is pertinent in light of the fact that the 1990's have been a decade of change. Together with the democratisation of South Africa and the establishment of the Government of National Unity, a new era in planning philosophy has been witnessed. In order to achieve the above-mentioned goal, the chapter has a number of objectives.

Leading from the GIS debate in Chapter 2, it can be concluded that GIS has a role to play in local government, especially within the first world. A similar statement cannot be confidently made regarding the application of GIS in the third world. This issue will be discussed, and particular attention will be paid to the legitimacy and use of GIS in South Africa.

Following this, those pieces of legislation in South Africa that the author feels will influence the application of GIS in planning will be highlighted. The focus will be on legislation governing planning in KwaZulu-Natal, since the case study of Mountain Rise in Chapter 4 falls within the boundaries of the above mentioned province.

Critics of the technology in South Africa have accused the tool of being a 'top down' approach to planning and therefore reinforcing the planning practices of the past government. Researchers from San Diego State

University (GIS Research Priorities, 1999) believe that academic GIS specialists have ignored the post-structuralist and communicative theories that have recently emerged in critical planning theory, literature, and practice. Planners therefore cannot afford to focus solely on rational strategic planning theory when employing GIS in planning. The final objective of the chapter will be to derive a suitable planning process that will ensure that GIS is integrated into a planning process that promotes accountability, participation and flexibility.

3.2. GIS within a Third World Context[1]

Schumacher's (1974, p.1) "small is beautiful" concept argues that developing countries must use appropriate technology relevant to the situation and context of the community in which it is being implemented. If this is not adhered to, modernisation policies will only amplify the dualism that is already in existence in most developing countries. A community therefore has to be at a certain level of technology in order for new technology to have a positive impact. Appropriate technology, as elaborated in previous chapters, can uplift the masses - economically, socially, and politically (Schumacher, 1974). This section does not attempt to make a judgement on whether or not individual developing countries are at the correct level of technology to be able to adopt GIS, as this would require an in depth analysis. Rather, GIS applicability in general to the third world context will be examined, with specific focus on South Africa.

Due to the increasing pressure being placed on limited resources, local authorities in developing countries need to be able to identify priority social groups and neighbourhoods in order to improve the targeting and

[1] The terms 'third world' and 'developing countries' are used interchangeably in this section. They are considered, for the purpose of this study, to denote the condition of inequality between the 'haves' and the 'have-nots'.

sensitive delivery of services. In addition to this, they urgently need to develop the techniques necessary for evaluating the effectiveness and efficiency of policy, develop the mechanisms for learning from past actions, and create a strategic planning framework to act as the glue which holds these activities together (Worrall, 1994). GIS is a technology that can assist the third world in meeting the above demands. Implementation, however, of GIS technology in third world local government planning agencies is at an early stage (Budic, 1994).

A very important point made in Chapter 2, that needs to be emphasised again, is the fact that planning should not be fitted to GIS. Rather, GIS should be considered a technology that can be used as a tool to a lesser or greater extent to assist planning tasks and functions. In this regard, a GIS takes time to mature, especially in a developing country in which information and data standards are not equitable with those of first world countries. A second important point to consider when implementing GIS in a developing country, is the fact that there needs to be more than a couple of isolated technical projects. It is imperative that GIS implementation is based on long-term strategies that consider future data integration and a wide-ranging indoctrination of the value of GIS to the local and national infrastructure. Without such an approach, GIS is destined for failure (Grant and Li, 1995).

If GIS were introduced to a developing country, says Harris *et al.* (1995), it would probably be utilised by those with a formal education, that is the wealthier sector, and would contribute to even greater dualism. Therefore, a major concern amongst third world planners is that the unequal access to GIS data is likely to reinforce the political and economic status quo and to work against more equitable planning decisions. As a recent report on the use of GIS in international development comments, "It is impossible to have sustainable and equitable development without free access to reliable and accurate information" (Benmouffok in Harris *et al.*, 1995, p.202).

The above viewpoint is challenged by Naisbitt (1984) who notes that access to information, through the use of GIS has meant that ordinary people and grass roots organisations can challenge those in power who in the past were the only ones with information. The 'experts' are in his opinion no longer able to singularly make decisions, as the issues have entered the political arena. Those people who are effected are now entering the decision making process (Naisbitt, 1984).

The capability of GIS technology to store, manipulate, and display spatial data has opened up a wide range of possible applications particularly suited to the planning functions of local government. This is important for planning in both the first and third world contexts. However, it is the visual component of GIS technology which holds significant potential for application in the third world and imparting information to the masses. This function adds to the credibility of the tool as it aids professional planners in presenting planning related information. The significance of the graphic capability of GIS technology emerges from Budic's survey (1994), where he found that there was a high degree of improvement in both communication of information and confidence in data analyses performed with GIS.

The above position is supported by Kuiters (1998) who argues that by supplying information in a visually accessible way and putting the power of GIS into the hands of those who need it most, community GIS may contribute significantly to development. "By giving the communities access to current information about services, businesses, facilities, etc. within the area, the technology could help citizens understand their local environment better in terms of individual, business, and development needs" (Kuiters, 1998, p.30). This is vital in the South African context, as developing communities are the most disadvantaged in terms of access to and application of information resources. Available resources are often not geared to providing the local detail they require (Kuiters, 1998).

Lupton and Mather (1996) note that over the last five years, GIS has taken on an important role in the restructuring of the state and in the broader process of reconstruction and development in post-apartheid South Africa. The attraction of this technology to planning authorities says Lupton and Mather (1996) appears to have two main sources. The first is that GIS is seen as a natural solution to apartheid social engineering. This is confirmed by Harris *et al.* (1994, p.197) who argue that it is precisely because apartheid was a geographic project that these systems have the potential of playing a "... useful role in helping to redress South Africa's spatial organisation of production and its highly skewed distribution of resources". The second advantage of GIS use in South African planning is its perceived ability to assist in rational and objective decision-making (Lupton and Mather, 1996). A researcher from the Human Sciences Research Council (HSRC) argues that GIS provides the basis for making "... rational decisions about the allocation of resources to the development of physical and social infrastructure, services and facilities" (Kok in Lupton and Mather, 1996, p.31). This is a crucial consideration in a country where political and social divisions run so deep.

A criticism of GIS implementation in South Africa surrounds the fact that it is the urban middle class that has benefited the most up to now. This is because they have had access to the information, and have therefore been able to force certain issues into the political arena and enter into the decision making process at the expense of the disadvantaged (Harris *et al.*, 1995). Although this could enhance the dualistic nature of society, the urban middle class may, as a consequence, be able to challenge planners, resulting in the process becoming more democratic and participatory.

The advent of increased globalisation and diminishing resources means that the third world, including South Africa, cannot afford not to take full advantage of GIS. The barriers to using GIS as an efficient and effective tool are exaggerated in the third world due to financial, capacity, and

political factors. South Africa, with its mix of first and third world components, is in a far better position to implement GIS that other developing countries. Planning in the third world therefore stands to benefit substantially from the technology.

3.3. GIS and South African Planning Legislation

"Now it seems reasonable to suggest that the planning profession [in South Africa] is located in the neutral zone, looking both forward and backward. It is, in an academic parlance, currently suspended between an apartheid deconstructivist and a politically correct reconstructivist paradigm" (Muller, 1995, p.3). From this statement, it is evident that South Africa is currently entering a new era in planning, and this is evidenced particularly by the way in which land is being managed. What has not changed though is the fundamental purpose of planning in South Africa, which was established around the 'public interest' concept. The purpose was captured in the country's four provincial ordinances (Transvaal, Cape, Orange Free State and Natal), which are still applicable today. The ordinance seeks "... the co-ordinated and harmonious development of the area to which it relates in such a way as will most effectively tend to promote the health, safety, good order, amenity, convenience and general welfare of such an area as well as efficiency and economy in the process of such development" (Transvaal Ordinance, Act 15 of 1986, p.7).

In striving for the above goals, local planning agencies find themselves operating in a complex legal and administrative environment. They have to comply with and enforce regional and national policies and regulations, while maintaining the services required by their respective communities. Legislation that governs and influences planning in South Africa at the local government level is therefore numerous. An overview will be given

of those pieces of legislation which the author feels will benefit from and impact on GIS implementation and use. They are:

- Townships and Town Planning Ordinance
- The Development Facilitation Act (DFA);
- The Planning and Development Act (PDA);
- The Reconstruction and Development Programme (RDP); and
- Local Agenda 21 (LA21).

3.3.1. The Townships and Town Planning Ordinance (Act 15 of 1986)

The Ordinance is the key piece of provincial legislation providing for land use control. It provides for the drawing up, extending and amendment of town planning schemes and the approval of applications for the establishment of new townships. The town planning scheme is the instrument that controls the practical implementation of the Ordinance. The regulation of land use within the urban context of every town or city is comprehensively laid out in the scheme. In an application for approval of a new township, the applicant will apply for the zoning of the properties within the new township (Drake, 1997).

Local authorities use the zoning of a property to determine the development potential of a property and thus the value at which a property will be rated. Without such a system, local authorities would not have an objective basis on which to decide development potential and thus the rating of a property. It also provides local authorities with a mechanism through which to control development within their areas of jurisdiction. Different use zones will also have building height restrictions, requirements regarding the provision of parking, and floor-area ratio restrictions.

GIS has an extremely useful role to play in aiding the task of land use management as laid out in the Townships and Town Planning Ordinance.

Only a handful of local authorities around South Africa make use of GIS to its full potential in managing land use (Delabored, *pers. com.*, 1999). When drawing up new town planning schemes, planners can make use of GIS to research zoning and land use conditions of parcels. A GIS would also allow planners to compare proposals submitted in applications to actual conditions on the ground, as well as the Councils overall objectives. On a simpler level, GIS could be used to provide regular land use and zoning reports to the TLC and interested and affected parties. Probably the most important use of GIS in carrying out the functions of the Townships and Town Planning Ordinance would be its ability to keep council zoning maps current and readily available. Presently, several years elapse between revised versions of the town planning scheme, which are then redrafted manually. GIS would make it easy to keep the maps up-to-date, therefore allowing greater responsiveness to planning requirements.

3.3.2. Development Facilitation Act (Act 67 of 1995) (DFA)

Physical planning in South Africa descended from the increasing pressure put on non-renewable resources. Legislation was therefore needed to ensure that both Provincial and Local Authorities took cognisance of economic, social, health, and other administrative issues. The result was the Physical Planning Act of 1991 (Act No. 125 of 1991), which provided for a system of policy plans at the national, regional, and local authority level. Due to the political transition in South Africa, the preparation of the new plans according to the provisions of the Act, were never implemented. Rather than amend the Physical Planning Act, the South African cabinet decided to draw up a new act. This new act was to contain the following objectives:

- To promote orderly physical development within the Republic;
- To provide for the division of the country in regions; and
- To promote the drawing up of certain plans.

The result was the Development Facilitation Act (DFA), published in December 1995. This Act was the first coherent attempt to bring about uniformity in township establishment, land registration and planning systems. Its aim was to "... introduce extraordinary measures to facilitate and speed up the implementation of reconstruction and development programmes and projects in relation to land; and in so doing to lay down general principles governing land development throughout the Republic...; to provide for the establishment in the provinces of development tribunals which have the power to make decisions and resolve conflicts in respect of land development projects; to facilitate the formulation and implementation of land development objectives...; to provide for nationally uniform procedures for the subdivision and development of land in urban and rural areas...; and to provide for matters connected therewith." (DFA, 1995, p.2)

Regulations have been published that require local authorities to set Land Development Objectives (LDOs) dealing with a range of issues. This call has been echoed in the Local Government Transition Second Amendment Act, which requires local authorities to prepare integrated development plans. LDOs are the first step towards a system of integrated development planning at local level. They are not as rigid or specific as the present zoning schemes and relate to the objectives for development in a particular area. These LDOs have to be established in accordance with the principles as laid out in Chapter 1 in the DFA. Once they have been approved, no official or decision-making body at any tier of government may approve a land development application that is contrary to the LDOs set for that area. (DFA, 1995)

As mentioned above, the DFA calls on the local authorities to speed up the development process. In order for this be achieved, local authorities have to carry out their planning tasks and functions in a more efficient and effective manner. As discussed in detail in Chapter 2, GIS has the potential to achieve the above aim. GIS could also be utilised extensively in drawing up the land developments objectives as prescribed by the Act,

as well as providing up-to-date maps and land use information to the development tribunals, ensuring that they have 'perfect'[2] information when making development decisions and resolving land use conflicts.

3.3.4. Planning and Development Act (Act 5 of 1998) (PDA)

The DFA is an interim Act, as far as land use control is concerned, and must therefore be replaced with new legislation. In KwaZulu-Natal the DFA has been replaced by the Planning and Development Act (Act No.5 of 1998) (PDA). It does not repeal any existing legislation in the urban areas, but allows developers, whether they are the State, the private sector or the community, a choice. Developers can choose between the using the relevant Provincial Ordinances, the DFA, or the PDA when proceeding with a particular development in an area. Against the current legislative background of development planning, one could be forgiven for not fully understanding what it is that is required of one in terms of fulfilling all planning legislative requirements. The PDA therefore brings clarity to the planning arena (Figure 3.1.). The concept of Provincial, Regional, Metropolitan and Local Development Plans is introduced, all of which carry statutory status (Haselau, 1998).

All Development Plans are to contain the following elements:

- A Development Planning Perspective;
- A Policy / Strategic Framework;
- A Strategic Action Plan;
- An Implementation component;
- Land Use Management and Control;
- Monitoring and Review; and
- Environmental Management (Haselau, 1998, p.5)

Having addressed the above elements, local authorities will need to identify their policy of communicating the Development Plan to the

[2] Perfect information refers to information that is error free, accurate comprehensive, and up-to-date.

broader community, as well as the participation mechanisms that will be adopted in the formulation and implementation of the Development Plans. Whilst each component is presented independently, it is vital that all components be interrelated and co-ordinated. Support would thereby be given to the intention of a Development Plan to be an effective

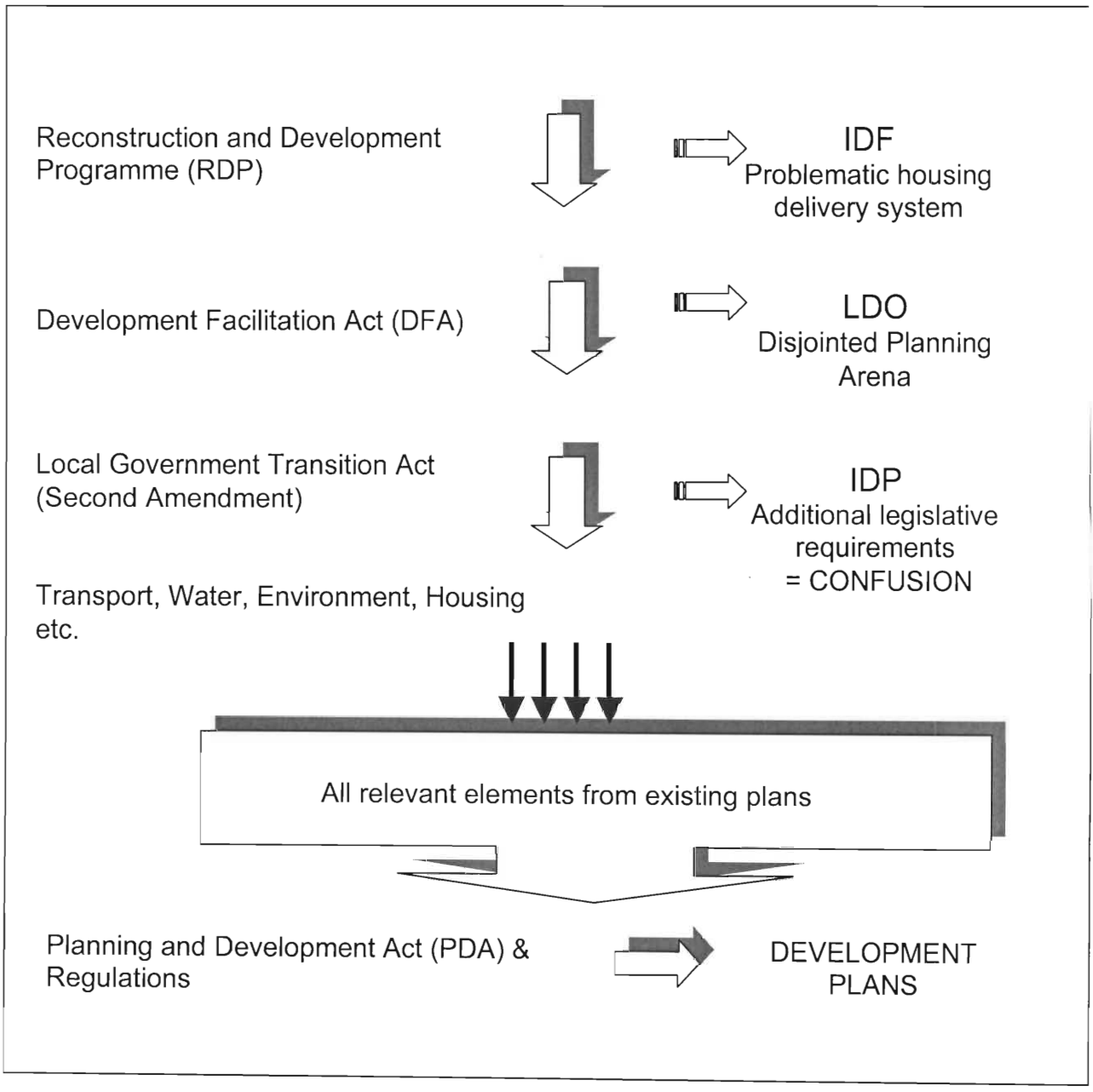

Figure 3.1. KwaZulu-Natal Planning and Development Act (Haselau, 1998,p.5)

management tool for Municipalities, throughout the development planning process.

The difficult task of constantly monitoring, evaluating and reviewing Development Plans would be greatly reduced by the use of GIS (Haselau, 1998). GIS would also be able to assist planners in communicating the plans to the community and ensuring that the public are involved in their formulation and implementation. Shuttleworth (1998) notes that GIS has been identified as one of twelve strategic elements that will enable socio-economic development in KwaZulu-Natal through the PDA. The Director-General of KwaZulu-Natal has stated that support needs to be given to 'catalytic strategic elements' of which GIS is one (Shuttleworth, 1998).

3.3.3. Reconstruction and Development Programme (RDP)

With the introduction of the Reconstruction and Development Programme (RDP) in 1994, the Government of National Unity committed itself to improve the quality of life and standard of living of all South Africans. The RDP is an integrated growth and development policy that aims to address poverty, inequality, and generate sustainable economic growth, and to transform South Africa into a democratic, non-racial and non-sexist state. The government feels that this can be achieved best by following four basic principles, namely:

- By an integrated and sustainable programme;
- By being people-driven;
- By establishing peace and security for all so that a new nation can be built through the process of reconstruction and development; and
- By striving for a truly democratic South Africa (Schwabe *et al.*, 1998).

There is no doubt that, for these aims to be achieved, information for decision-making is required, whether it be for prioritising regions for funding, for monitoring the development process or for addressing the 'skewed distribution of resources' (Harris et al, 1995). The need for

spatial information has been felt for a long time. What is also needed is a model which clearly sets out the strategies for developing information sets for the decision-making process (Schwabe *et al.*, 1998).

To make decisions on the allocation of funding for any particular development activity, one must understand the needs of the people where they are, i.e. their access to services and infrastructure at a particular spatial level, for instance: what is available where and how many people are affected by what is in place and what is not in place. More and more government officials and planners are seeing the need for spatial information in their decision-making (Harris *et al.*, 1995). This need could be met by implementing GIS.

3.3.5. Local Agenda 21 (LA21)

The United Nations Conference in Rio on Environment and Development in June 1992 was an important summit that attracted delegates from 183 countries and regions. One of the important outcomes of the conference was Agenda 21, a world-wide programme that attempts to achieve sustainable development on a global level. Part of this programme is Local Agenda 21 (LA21), an approach to planning and development which aims to achieve sustainable development of local (urban or settlement) communities. Agenda 21 recognises that sustainable development will only be achieved at the global level if it is implemented at the local level. The South African government has subsequently adopted LA21.

It is clearly evident that South Africa is still struggling to overcome the legacies of the past forms of governance and economic development which have led to one of the most unequal distributions of resources in the world (KZN Province, 1997). As a result of these practices, development has been socially, economically, and ecologically flawed. Planning in the past has therefore failed to address:

- The links between the social, economic, and ecological systems within the community;
- The long term impact of activities; and
- Ways of mobilising and building the community's human, economic, and ecological resource base.

LA21 provides local authorities with a holistic framework with which to address local problems. The issues that are addressed by LA21 include (KZN Province, 1997):

- Finding systems that can be developed which involve all stakeholders in finding solutions to local environment and development issues;
- Improving the quality of and integrating municipal services so as to address the ecological, economic, and social prospects of communities; and
- Nurturing and building social, economic, and ecological resources within the community so that future needs are addressed more effectively.

A mature GIS would be capable of addressing many of the issues that planning has failed to address in the past in South Africa. Links between the social, economic, and ecological systems within the community could be strengthened, as well long-term impacts of land use change predicted. As will be shown in the case study in Chapter 4, GIS can be effectively used to involve stakeholders in finding solutions to local environment and development issues, and making municipal services more efficient.

3.4. Impact of GIS on Planning Theory

3.4.1. The Need for a New Planning Process

Biased decision making is inherent in planning, as it operates within political institutions and on political issues. Hartman (1978), as Laburn-Peart (in Truman, 1995) notes, claims that since planning decides who

gets what, when, where, and how, it is deeply political. South Africa's planning process is proof of this, as in the past it was manipulated for political ends. However, Whitehead (1993) argues that the blatant misuse of information by decision-makers can be negated by an information system, which is an effective method of providing up-to-date, accurate and unbiased information.

The planning process in South Africa has recently witnessed a shift away from simply imposing technical-based decisions on the recipient community. There is now a need to merge both the technical knowledge of the planner and the local knowledge of the community. This should rest on the RDP's rising emphasis on the need to transfer skills, information and power to the community (Schwabe *et al.*, 1998).

Robinson (1990) argues that there are six ways in which the scope of the planning process in South Africa could be broadened. These changes could be either partially or totally achieved by implementing GIS.

(i) The planning process needs to be streamlined and the 'red-tape' reduced. A GIS could assist in streamlining the planning process, decrease 'red-tape', reducing duplication, and increasing the vertical and horizontal flow of information in local authorities.

(ii) There needs to be a greater emphasis on interdisciplinary co-ordination and management within planning agencies, therefore allowing for focused decision making and a better use of limited resources. A GIS would allow different departments and organisations to be equally informed.

(iii) The complex reality of problems needs to be reduced to manageable proportions. Policies should address problems on an incremental basis, so that action can be manageable. GIS could be used to assimilate and manage these policies.

(iv) Implementation in the planning process should receive more focus. Instead of exercising control, planners need to become more action-orientated and responsive to societies needs. Instant and precise information, supplied by a GIS, would allow planners to be

aware of future problems, and could therefore act to address potential problems.

(v) The planning process needs to provide a range of alternatives rather than one rigid solution. GIS would allow for rapid generation of alternatives.

(vi) Planners need a more positive and creative approach to development planning. The existence of a GIS could encourage involvement by all planners wanting information, forcing planning attitudes to change.

GIS is a decision making aid, and is therefore process based. Depending upon how the technology is used will determine whether or not it will have a positive or negative effect on procedural planning theory. The sections that follow therefore identify those procedural theories that allow for the best integration of GIS into the planning process. The role that planners will have to play in the face of the introduction of this technology will also be examined. The result will be a planning process that the author feels will best serve the needs of the community, while at the same time allowing GIS to infiltrate the planning process at all levels.

3.4.2. Rational Planning Process

The rational planning process has evolved to the extent that it now incorporates different forms of rationalism. The process that is generally accepted at present is a combination of among others, the rational methodology of Meyerson and Banfield (1955), the choice procedural methodology (Davidoff and Reiner, 1962), and Harris's scientific method. Meyerson and Banfield (1955) introduced the concept of rationality in planning by equating good planning with rational decision making. Rational decisions are made in the following manner (Figure 3.2.):

(i) The decision-maker considers all of the alternatives by taking into account the courses of action possible in light of the ends sought and the situation.

(ii) He/she identifies and evaluates all the consequences, which would follow from each alternative.

(iii) He/she selects the alternative whose likely consequences would fit the most valued ends.

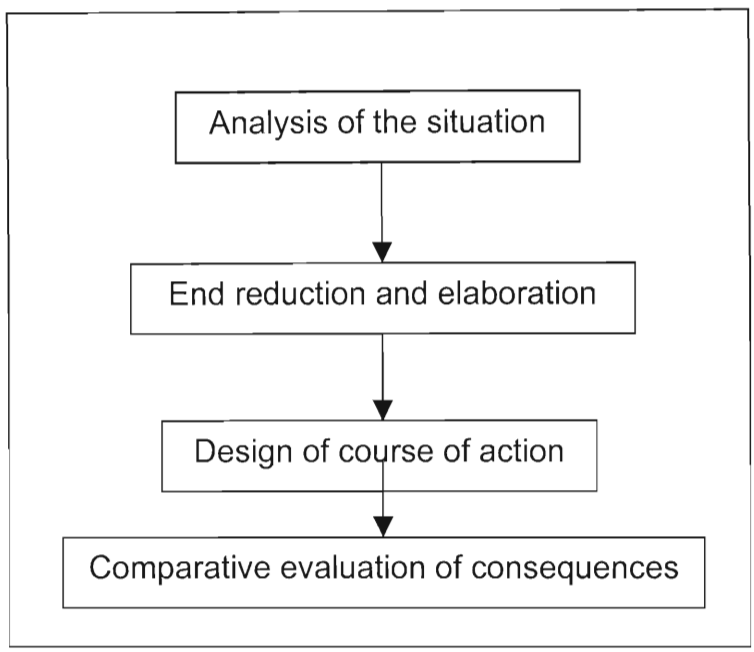

Figure 3.2. Rational Approach (Meyerson and Banfield, 1995)

Drake (1991) notes that the four-stage model begins with analysis of the situation, which requires large amounts of data collection, and analysis. To consider all the alternatives and all the consequences, there needs to be comprehensive data available. These limitations were addressed by what Waterson (1965) called bounded rationality, which suggested 'satisficing'. This involved choosing the first alternative that meets the criteria, instead of the optimum one. The main criticism of this model is that it assumes that there is always perfect information, and it is therefore not prepared to change its course of action when new information is obtained.

The rational comprehensive method is not an ideal planning process to use in South Africa by itself. It does however contain elements which, when combined with other planning approaches, could ensure a democratic, flexible, and responsive planning process. GIS would play a vital role in collecting and storing the required data and providing system models that could describe the present and project the future. GIS would also allow for rapid alternative generation, which would result in a greater number of alternatives being put forward. By changing only specific factors, different groups of alternatives could easily be generated. As a result, the extent of information and alternatives will cause an increase in comprehensiveness. A planner will no longer need to 'satisfice', but will be able to optimise, thus widening the boundaries of rationality.

Klosterman (1997) points out that GIS would be able to assist in unambiguously identifying the best plan from the range of available alternatives generated in the rational approach. A GIS would also enable greater access to the planning process for communities. This would be achieved through wider access to databases through a GIS. However, there would have to be an extensive community education programme, such as in Example 1 in section 2.5.1. If more people are included in the process, greater comprehensiveness is likely to be achieved. It must be realised that the communities will at first use the GIS to gain information - it may take a long time for the community to start using it directly to make alternatives that suit their needs and goals. A possible framework for moving a community from purely visualising the information to actually using it for decision support is put forward in the case study in Chapter 4.

In advocating for use of the rational comprehensive method, it must be noted that there are certain assumptions that are made. These are: that information is value-free and a politically neutral resource; more information is always better; the planner's most important role is providing more and better information that can inform and improve the policy-making process; and a clear distinction can be made between the

'objective' facts stored in a computer and the 'subjective' opinions and values of individuals and groups.

3.4.3. Participation Theory

Participation theory, a modified form of the rational comprehensive method, arose out of the increasing demand for participation in the planning process. The 'transactive' style of planning (Friedman, 1973) was one of the influences on participation theory, as it emphasised person centred communication, which 'leads to a life of dialogue and mutual self-discovery' (Loew, 1979). It incorporated the need for the planner and the community to be involved in some form of joint learning process. Loew (1979) outlined a process based on a rational comprehensive model, which included analysis, goals, objectives, alternatives, and implementation (Figure 3.3.). It also included a monitoring and feedback component. It is recognised that in general, participation is difficult because it seeks consensus from a conflict situation. There is also the problem of diverse groups who have different aims and agendas. Opponents to public participation argue that citizen involvement often slows the decision-making process and ultimately costs taxpayers' money. On the other side of the fence, there are those who argue that it is every citizen's right to fully participate in environmental decisions (Padgett, 1993). The 'top-down' planning approach adopted by South Africa planners during the Apartheid years has meant that public participation will be an essential element in any planning process adopted.

As a result of the community education and access inherent in participation theory, GIS could have a positive effect. GIS can be used in a process of community education as it allows end users to be a part of the planning process. The educational method could start with an explanation of the planing and decision making process, and where community involvement fits in. The next step may be to introduce the computerisation of information with which decisions are made, and then

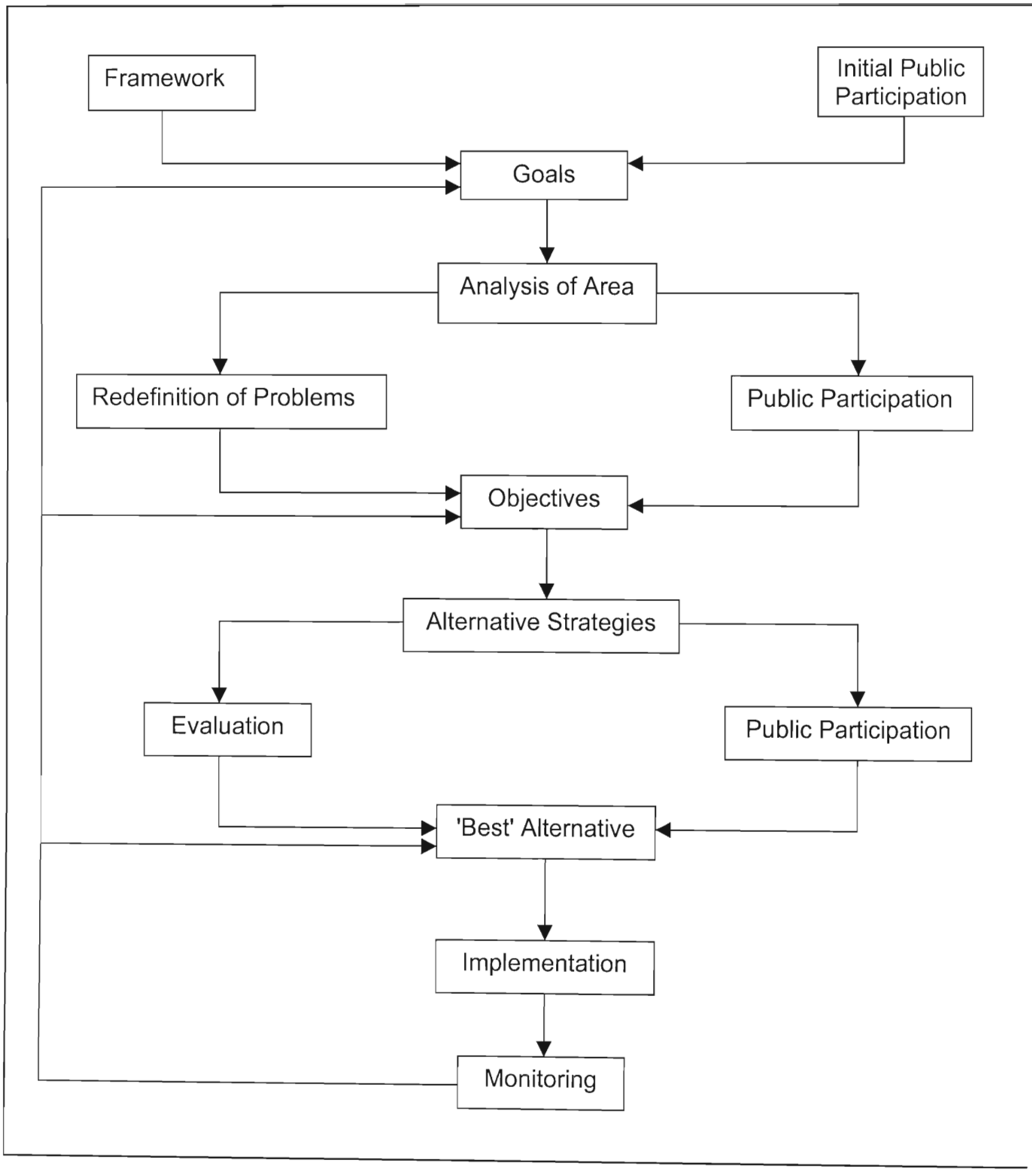

Figure 3.3. The Participation Process (Loew, 1979)

how that information is manipulated through a GIS. Education can be equated to the step of 'informing' on Arnstein's (1969) ladder of participation. Although this could be considered as tokenism, it is the introduction to the process that is important. Planners and the community can start with a joint learning process, and as the community gain power, so too will their demands for partnerships and delegated power. GIS could therefore be an important part of community education (Truman, 1995).

A key concept that is pivotal to the participation theory is the degree of access to information. As noted above, the learning process will introduce this access. However, as the community becomes more empowered, their access to information will increase incrementally. GIS will be able to aid in this access, as it enables greater information manipulation. The planner could use GIS in a participatory process in a positive manner if he/she were committed to the recognition of communities and goals. This would have to manifest itself in a continual process of mutual learning. The planner would learn what the community wants from the planning process, and the community would begin to see how the technology can help them be part of the planning process.

3.4.4. Strategic Choice

Decker and Mastop (1979) developed the strategic choice theory. The method continually takes information from the environment and acts upon that information. To achieve this aim it has constant feedback and feed-forward mechanism inherent in the process. Strategic choice also allows users to test those (strategic) decisions that they think will reach certain preferable ends. This is pertinent to the third world situation in which action sometimes occurs before planning, according to what information is available at the time.

Strategic choice theory would benefit from using GIS as information could be easily captured, stored and manipulated on a continual basis. The

flexibility of GIS would allow the information to be continually updated. The GIS user would, after analysing of the new information, be in a position to suggest new alternatives or consider new models. GIS could also play a proactive role in mitigating the effects of action before planning. The feedback and feed-forward mechanisms would also be easily accommodated by a GIS, which is flexible to changing information needs.

3.4.5. Advocacy Planning Role

Advocacy planning rose out of the Civil Rights movement that gained momentum in the United States during the 1960's. As a result of the dualism in society, and the lack of power and access of disadvantaged communities to the planning system, Davidoff (1965) suggested advocacy as a role for the planner. He implied that the planner should not try to identify and utilise the aims that he/she thinks are important, but rather should try to find out first hand from the community what their needs are. The planner must then advocate for that particular group and represent them in the planning process. By advocating for a group, there would be more than one alternative. However, a criticism of advocacy is that it is paternalistic and may lead to greater dualism as the communities may be forced to rely heavily on the planner. The question also needs to be asked about who the planner should represent, as even small neighbourhoods, as will be shown in Chapter 4, are often divided. Advocacy also downplays scientific analysis, as decisions are made purely on whom has the greatest power to get their plan implemented.

Advocacy is important in the South African context as large sections of the population have been disadvantaged and excluded from the development process. The need for the planner to advocate on their behalf is great. The process should not however result in the communities becoming dependent on the planner, but rather there should be a process of mutual learning. The community would become familiar with the planning process and the planner would learn what the needs and

aspirations of the community are. Information could be transferred to community members through read only access to a GIS located at libraries or schools such as in Example 7 in section 2.5.7. The community would then be empowered with the same information as the planner. The negative impact of advocacy could be the ability of the planner to manipulate information contained within a GIS.

3.4.6. Promotive Planning Role

Promotive planning requires the planner to take on the role of the catalyst. Planning cannot create democracy, merely promote it, and this is the concern of promotive planning. Muller (1980, p.10) notes that the community has "... a right to exercise and express preference, to make decisions and make mistakes, to explore and to experiment, to play a productive part in the development of their living environment". The community will perceive their priorities, even though this might be at odds to a rational deduction. The planner does not represent the community, but helps the community to represent itself. It will be dependent on the planner to withdraw from the process when the community has reached a sufficient level of independence.

Therefore, as in advocacy, promotive planning involves the community and the planner being part of a joint learning process. It is up to the planner to choose whether or not to utilise or withhold knowledge and access to a technology such as GIS. GIS would give the communities a medium through which to express themselves and their needs. This would be extremely important when drawing up development plans under the Planning and Development Act for example.

3.5. Conclusion

The objectives of the second goal of the study have been met. Firstly, the role and legitimacy of GIS within the third world, and in particular South

Africa, was outlined. It was shown that developing countries cannot afford to pass up the opportunities provided by implementing GIS. However, questions were raised about individual developing countries having the resources and capacity to utilise such a technology. Following this discussion, the chapter examined those pieces of legislation that are likely to have the greatest impact on GIS implementation in South Africa, and in particular KwaZulu-Natal. Finally, a 'best' planning process was derived from existing procedural planning theories.

While GIS automatically lends itself to the rational planning approach, it was shown that it is imperative that both the participatory and strategic choice theories are also incorporated so as to ensure an accountable, transparent and flexible planning process. The role of the planner in the planner process that includes the use of GIS will be one of advocacy and promotive planning. Planners have an important role to play in the South African context since many disadvantaged communities do not have the capacity or skills to participate in development planning. By using GIS in the planning process, communities will be empowered, planning authorities will become more efficient in carrying out their tasks and functions, and the whole development process will become more accountable, comprehensive, and democratic.

CHAPTER 4 CASE STUDY: MOUNTAIN RISE, PIETERMARITZBURG

4.1. Introduction

The previous chapters have undertaken a comprehensive theoretical look at GIS in local planning. Chapter 4 now takes the important step of illustrating how GIS can be practically integrated into the planning process to ensure that planning functions are carried out in a more effective and efficient mode. In this regard, the chapter is attempting to address the third goal of the study. This task was achieved by undertaking a project in the suburb of Mountain Rise, Pietermaritzburg (Figure 4.1.). Mountain Rise is both a residential area with fascinating cultural, religious and architectural features and the scene of seemingly intractable problems arising from its apartheid past. The suburb was the area of study during the June 1998 coursework examination for the Masters programme in the School of Environment and Development, University of Natal.

4.2. Mountain Rise - An Overview

Mountain Rise is a residential suburb located to the north of the City of Pietermaritzburg. It is bounded by the old and new Greytown Roads in the west, Ohrtmann Road in the north-east and south-east, and by Willowton Road to the south-west. It is raised on a spur, which is part of the lower Hogsback escarpment. A councillor for the ward of Mountain

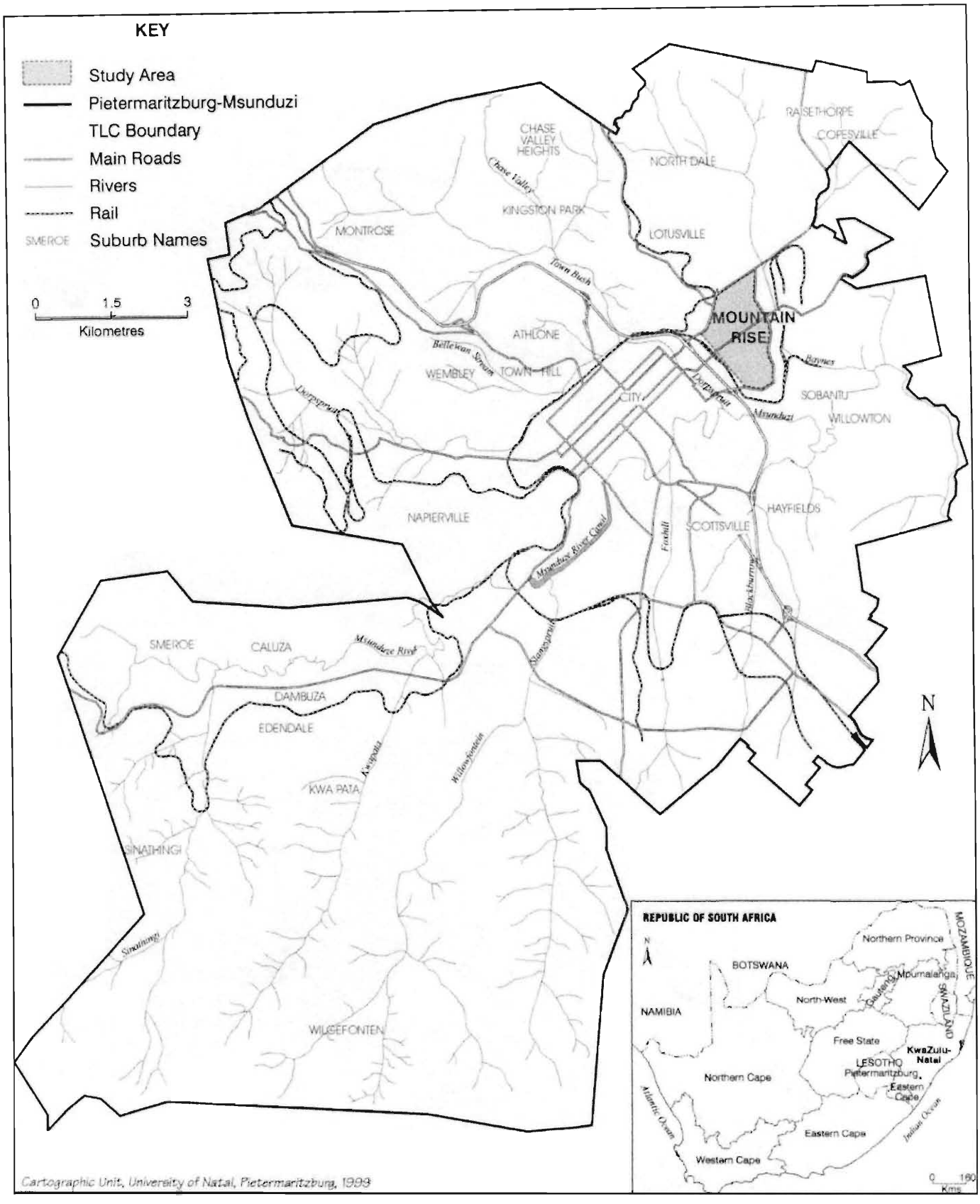

Figure 4.1. Context Map of Mountain Rise, Pietermaritzburg (Cartographic Unit, 1999)

Rise once described it as the healthiest place in the city, citing the fresh complexions and the rosy cheeks of the local children as evidence of the good clean air (Coan, 1998). That was almost 75 years ago. The suburb has undergone radical changes since then due to a number of factors. These will be discussed briefly below.

The suburb of Mountain Rise, as described by historian Paul Thompson (1998), a lecturer at the University of Natal, Pietermaritzburg, was originally a European residential area located on the periphery of the city and was occupied by a small community of professional and thus well-to-do citizens. The area had a country ambience. However, the council took a decision in the early 1950s that the city of Pietermaritzburg should no longer just be an administrative, educational, and farming centre but should also industrialise. As a result of this decision, the areas of Willowton and Rosedale were identified as industrial development nodes. This change in land use policy coincided with the Nationalist government's implementation of apartheid. The city's attempts to delay implementing the Groups Areas Act of 1951 proved futile when, in 1964, Mountain Rise was proclaimed an Indian group area. Between 1964 and 1966 the Europeans had moved out and groups of Indian communities who had been scattered around the town living as market gardeners along the banks of the Umsinduzi and as traders in the city centre, were forced to move into the newly established Indian suburb (Thompson, 1998).

These changes had a profound impact on the way in which Mountain Rise developed. The area experienced rapid residential growth, which placed increasing pressure on the land. At the same time, rapid industrial development was taking place in the adjacent Willowton industrial area. The lack of housing, together with the City of Pietermaritzburg encouraging the view that Mountain Rise was *the* elite Indian suburb, created an artificial shortage of land which drove the property prices upwards (Wills, 1988). After the properties were re-rated to the same level as the European areas in 1989, protests broke out. The Rate Payers

Association of Mountain Rise argued that apartheid has distorted values. The City gave in and provided rebates on the resident's property rates. While this provided temporary relief, the community still wanted the rates further reduced to a level similar to that of other areas sited next to the industrial areas (Thompson, 1998).

High property values and pollution from industry are not the only problems faced by the residents of Mountain Rise today. The many vacant lots scattered throughout the suburb have been appealing sites for illegal dumping and squatter settlements. While most squatters have been removed in recent years, there are still a number who remain behind. Linked to this problem, is the steady increase in the crime rate over the last year. Despite all these difficulties, Mountain Rise is regarded as an elite area amongst its citizens (Dhoda, *pers. com.*, 1998).

4.3. Exam Process

The June 1998 coursework examination for the Masters programme in the School of Environment and Development, University of Natal comprised two sections (Appendix A). Section A firstly involved analysing the major biophysical, structural, and historical changes that have taken place in Mountain Rise between the years 1944 -1989. Secondly, the brief requested that the pollution problem be examined, followed by an assessment of the land ownership patterns and valuation thereof. Section B of the exam required students to devise a development plan for Mountain Rise, as well as a strategy for the implementation of the plan for the period 1999-2001. The development plan was to address existing problems, while simultaneously integrating the suburb into the fabric of the City. Finally, the development plan was to serve as a model for local development within the framework of Local Agenda 21 (LA21).

The examination ran over a period of one week, during which students were given an opportunity to tour the area. Here they met the local residents, as well as councillors, and council officials from the Pietermaritzburg-Msunduzi Transitional Local Authority (TLC). Geographers, historians and other experts on the area also provided additional information.

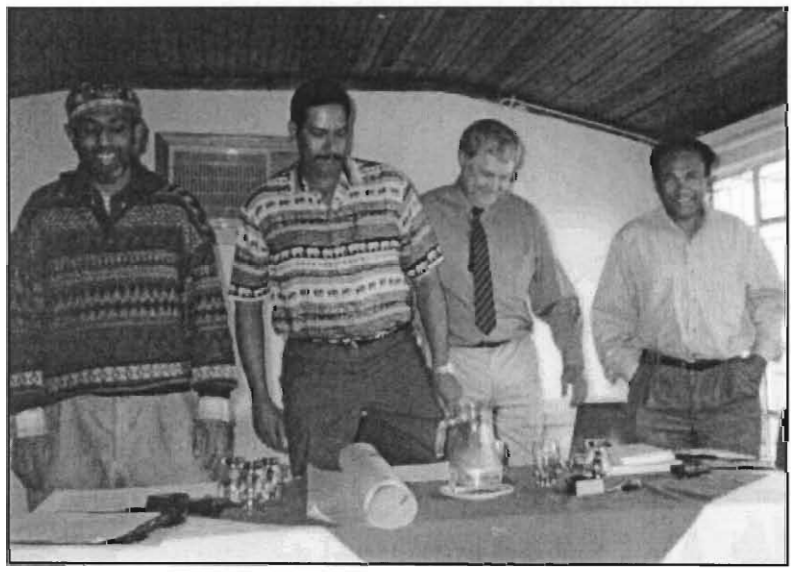

Plate 4.1. Community meeting with a representative from the Rate Payers Association of Mountain Rise, a Councillor for Mountain Rise, and representatives from the Pietermaritzburg-Msunduzi TLC.

4.4. Methodology

The GIS project focused on section B of the brief, which called for the creation of a Development Plan for Mountain Rise. This was achieved within the legislative arena as described in Chapter 3, section 3.3. The planning process adopted from the analysis of procedural planning theory in Chapter 3 was a combination of the rational and participatory planning theories, with elements of the strategic choice theory inherent in the process (Figure 4.2.).

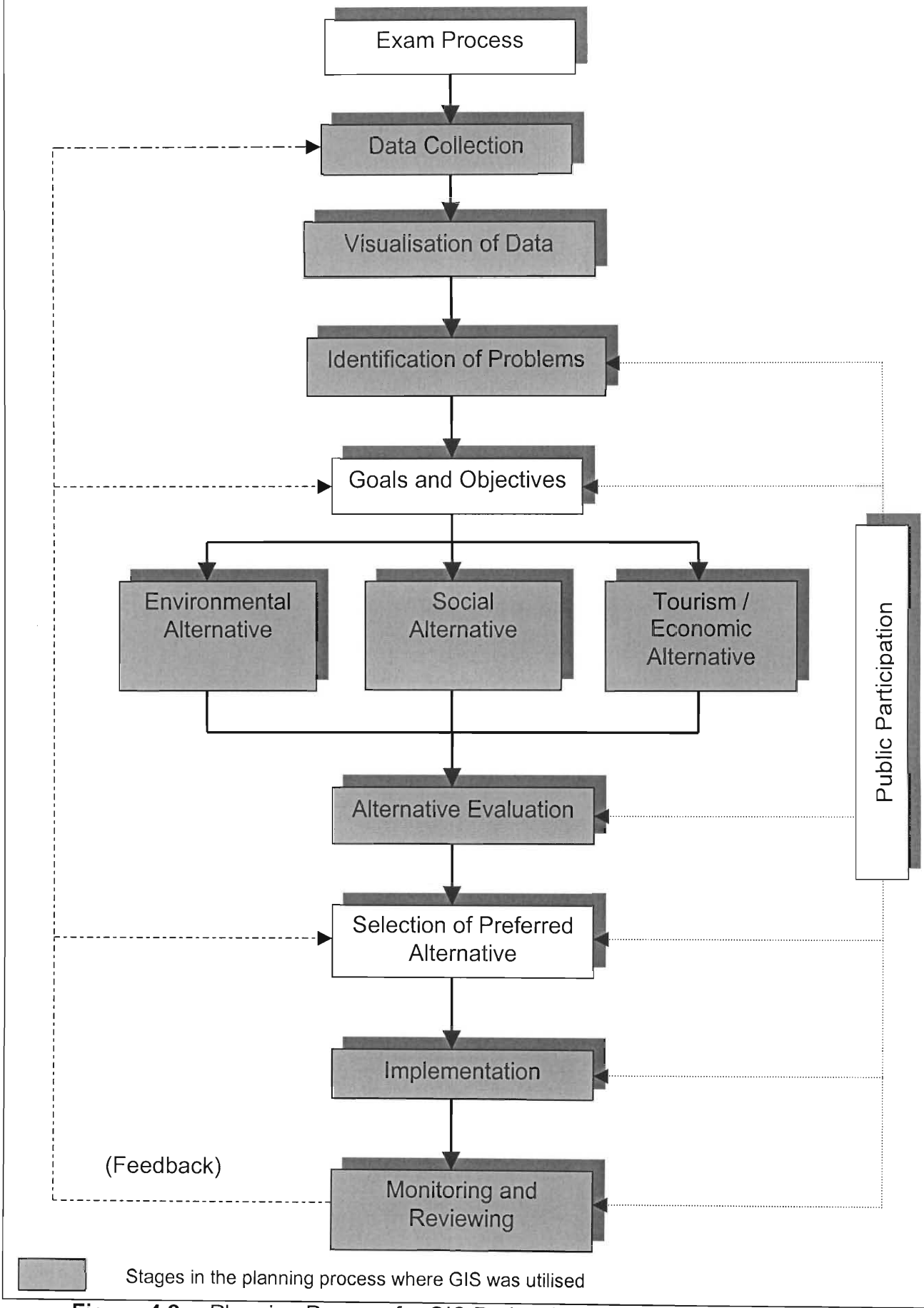

Figure 4.2. Planning Process for GIS Project in Mountain Rise, Pietermaritzburg.

4.4.1. Data Collection

Before any analysis could be undertaken, certain base data was needed for the study. A data collection exercise was carried out in Mountain Rise using a 'Land Use and Environmental Conditions Survey' (Appendix B). This survey was conducted in the field, over a period of one week. Cadastral data for Mountain Rise was obtained from AM/FM Mapping, Pietermaritzburg-Msunduzi TLC, in digital format. The survey was completed by 'walking' the suburb and conducting a visual survey of the land use and environmental conditions. Informal interviews were conducted while in the field. These were used to solicit community opinions on perceived problems. Discussions focused on the level of facilities, crime and pollution problems, and community involvement in the planning process in Mountain Rise. Portions of the data set were out-of-date and in some areas inaccurate. The data was therefore cleaned, updated and "ground-truthed" in AutoCad (Autodesk, 1996) software using a 1997 aerial photograph of Mountain Rise and the 'Land Use and Environmental Survey'. The result was a cadastral map of Mountain Rise accurately representing the conditions as they appeared on the 'ground'.

Due to the many vacant properties in Mountain Rise, ownership of this land needed to be established (either private, council, state or unregistered). This proved to be a labour intensive process. It involved accessing the Valuation Departments computer database at the TLC and entering the relevant property numbers into the information system individually to determine ownership. The collected survey data and ownership of vacant land was entered into a database using Excel (Microsoft Corporation, 1996) software (Appendix C).

The next step in the project required the 'Land Use and Environmental Conditions' database to be linked digitally to the cadastral data. To achieve this aim, the digital cadastral data was manipulated in AutoMap (Autodesk, 1996) software to build the typology. The typology was then

imported into ArcView GIS (ESRI, 1996) software as a 'shapefile'[1]. The survey database was imported into ArcView GIS software from Excel. The database was linked manually to the individual erven in the cadastral data. 'Coverages' or 'themes' were generated using ArcView's query function.

4.4.2. Visualisation of Data

4.4.2.1. Thematic Mapping

A number of thematic maps[2] were generated from the database. The first map that was produced was the town planning scheme of Mountain Rise (Appendix D(1)). The zoning categories were obtained from the City Planning Department at the TLC. The different zonings had to be manually copied off a wall map in the department's offices. The map was extremely old, and did not appear as though it had been updated in several years. It was important to produce this map, as it was the author's intention to compare the town planning scheme to the actual land use on the ground. In this way, any illegal land uses could be identified. However, this proved futile since the town planning scheme at the TLC had not been updated and therefore many land uses on the ground did not correspond with the zoning. Maintaining an up-to-date town planning scheme has many benefits, as mentioned in Chapter 3, section 3.3.1. The problem mentioned earlier about keeping the scheme up-to-date is just one example of where GIS can make local planning more effective and efficient.

A land use map (Appendix D(2)) was generated from the database for Mountain Rise. The purpose of this map was to allow one to get a general picture of the land use patterns on the ground. It is very detailed in that it differentiates between ten categories of land use and each individual property is described. In addition to the land use map, an alternative land

[1] A 'shapefile' is a specific name for a file type in ESRI's ArcView GIS software.

[2] A thematic map is map that communicates a single theme or subject.

use map was also produced (Appendix D(3)). This map indicates those properties which have a secondary land use. This includes, for example, a residential stand which also has a 'tuck shop' on the property. This map becomes extremely useful for planners and valuators since residential properties, which also operate businesses from their premises, are liable to pay higher rates. However, planners and valuators at the Pietermaritzburg-Msunduzi TLC have no method of keeping abreast of these emerging businesses as they do not have the information readily available. Thus valuable income is lost and the urban fabric is affected.

As mentioned above, data on the ownership of vacant properties in Mountain Rise was obtained from the Valuation Department at the Pietermaritzburg-Msunduzi TLC. A map showing the distribution of vacant land was created (Appendix D(4)). This was a very simple procedure once the information had been entered into the GIS database. Initially, when a request for information on vacant properties in Mountain Rise was made to the TLC, the process proved to be time intensive. A request such as this would take a GIS only a couple of minutes to process, whereas the TLC needed several hours to produce the same information. The vacant land map provides the planner with vital information about spatially where the vacant lots are located and whether they are privately, council, or state owned or whether they are unregistered.

Additional maps that were generated from the GIS database included a map showing the number of dwelling units (Appendix D(5)) and the number of structures (Appendix D(6)) on each individual property. This data would be used to provide the planner with information regarding patterns of density in Mountain Rise. It would also serve to highlight those properties that had additional structures on their properties other than dwelling units. This would then suggest that these residents are running some form of business from their properties. Linked to the above maps was a map displaying the structural conditions of the houses (Appendix D(7)). The condition of the structures were determined by site observation, and then placed into one of three categories: 'sound';

'deteriorating'; and 'dilapidated'. The criteria used for assigning a structure to a particular category was based on the outer appearance. As an example a property which was generally 'run-down' (overgrown lawn, peeling paint, broken windows, gutters and fences, etc.) and/or vacant would be classified as dilapidated. This provides valuable information to inspectors from the TLC, as they can locate and visit citizens whose houses are deteriorating or dilapidated. This will ensure that the TLC plays a proactive role in maintaining the suburb's integrity.

The minimum plot size map (Appendix D(8)) was generated from data obtained from the City Planning Department at the TLC. This information represents a policy of the TLC to restrict the sizes of properties. In other words, they are preventing parcels of land from being sub-divided into smaller sections and sold. If they did not manage this, the density in Mountain Rise could increase to such an extent that the existing infrastructural services would be unable to cope. A map showing the areas of individual plots (Appendix D(9)) was created from the GIS database, as a means of comparison to the TLC's policy on minimum plot size. The result was interesting since several properties in Mountain Rise are below the specified minimum plot size (Appendix D(10). This could be due the properties already being sub-divided when the policy was introduced, or that the TLC is unaware of the fact that these properties have been sub-divided. The latter alternative is plausible since the TLC is severely understaffed and cannot enforce its policies.

The next set of data that were visualised from the database are related to the environmental conditions of the individual properties. They display properties which have overgrown sidewalks and are full of weeds (Appendix D(11)), properties which are strewn with litter (Appendix D(12)) and junk (Appendix D(13)), and properties where extensive illegal dumping has taken place (Appendix D(14)). From the maps it is clearly evident that the problems of overgrown pavements and properties, litter, and illegal dumping are widespread throughout the suburb. A query could be performed on the GIS database, and addresses obtained which would

then be handed over to TLC inspectors so that they could enforce the local bylaws.

4.4.2.2. GIS Query

The above visualisation of data is using GIS in what Crain and MacDonald (1984, p.44) refer to as "Stage 1: Inventory applications". The next set of maps progress to Stage 2 in Crain and MacDonald's GIS development (1984, p.44), namely 'analysis applications'. Using the 'query builder' in ArcView GIS, a map was generated showing the social and religious facilities in Mountain Rise (Appendix E(1)). This was achieved by constructing a query that requested the GIS to label all properties containing a social or religious facility. Another example of a GIS query is shown in Appendix E(2). This form of query was initiated by selecting two individual properties on the map from which information was required. The example shows clearly that one is able to obtain information about a particular property by simply 'clicking' on the map, as the map is linked to the database as well as to a photographic library of the suburb.

4.4.2.3. Digital Elevation Model (DEM)

The digital elevation model (DEM)[3] is regarded as an important visual aid in carrying out planning functions. It gives one a better appreciation of scale and helps one understand the relationship between places and spaces. Often, only skilled professionals can interpret a 2D map. This means that an ordinary citizen could be excluded from the planning process because of his or her failure to interpret maps. This is extremely important in South Africa, were the majority of those who are likely to be affected by development planning, are illiterate. A DEM is therefore a valuable tool that can be used to communicate complex spatial concepts and solutions, and ensure that every citizen has a role to play in the planning process.

[3] A digital elevation model (DEM) or terrain model is defined as a data model used to represent a topographic surface, often based on a grid with a height value for each cell, or on a set of irregular triangles (The essential guide to GIS - Jargon Buster, undated).

The process of creating the DEM for Mountain Rise was extremely quick. Firstly, a 1:10 000 ortho-photograph of Pietermaritzburg (Ref. 2930 CB 8/9) was obtained from the Geography Department, University of Natal. The five metre contours were manually digitised using AutoCad software and a digitising tablet. Each digitised contour was assigned its respective elevation. The drawing containing the digitised contours was exported from AutoCad and imported into ArcView software. The DEM was generated in ArcView using a software extension package called 3D-Analyst. A vertical exaggeration of five was applied to the image to illustrate the typology more clearly.

Using the DEM, a '3D model' of Mountain Rise (Appendix E(3)). This was accomplished by 'draping' or 'overlaying' the town planning scheme map (Appendix D(1)) over the DEM, once again using the 3D-Analyst extension in ArcView GIS. Each individual land use was assigned an average elevation (e.g. residential - 4 metres, industry - 12 metres, and so forth) to approximate the respective heights in real life. A vertical exaggeration of two was applied to the land use surface. The effect was visually impressive and the relationship between the different land uses was clearly evident.

Once the 3D model has been created, there are number of functions for which it can be used. Appendix E(4) is an example combining the DEM with photographs of the suburb. This example provides a useful technique for allowing people to gain a better understanding visually of the suburb and in achieving a 'sense of place'. The second example (Appendix E(5)) provides views of the 3D model from the North, South, West, and East. One is able to gain a better understanding of the typography of the land, as well the relationships between the different land uses. This is aptly illustrated in Appendix E(6) where the cross section 3D model clearly shows that the height of the smokestacks in the industrial belt are at same height as the residential homes in Mountain Rise. The pollutants expelled are therefore deposited and breathed in by

residents. Had GIS been available and used by planners before industrial applications had been approved, this current situation could have been avoided.

There are many other analyses that can be carried out once a DEM has been created. For example, images could have been produced showing line-of-sights from different elevations, contours, slope and aspect, shaded relief, and drainage networks and basins. These and many other analytical capabilities have important application in planning, especially in areas such as landscape design, aesthetics, and infrastructure provision.

4.4.2.4. Aerial Photograph

Aerial photography is another useful tool that can be used to assist planners in carrying out their functions. For the purpose of this project, the digital cadastral data was overlayed on the aerial photograph of Mountain Rise (Appendix E(7)). The aerial photograph was obtained from the Land Surveying Department, Pietermaritzburg-Msunduzi TLC. In order to carry out the overlay function, the aerial photograph was scanned into digital format using a desktop scanner. Both images (the cadastral data and aerial photograph) were opened in AutoMap software. Because the aerial photograph was 'uncorrected', the two sets of data had to be 'rubber sheeted'. This process involves selecting corresponding point pairs on both sets of data. The software was then able to 'warp' the scanned aerial photograph to fit the digital cadastral map. Once again, the output is a very effective visualisation tool in the planning process. The aerial photograph can be used to illustrate various ideas and concepts, as shown in Appendix E(8) which has integrated photographs of the social and religious facilities with the aerial photograph.

4.4.3. Identification of Problems

To arrive at the problems facing Mountain Rise, both qualitative and quantitative data was used. Analysis of the GIS database, together with the DEM and aerial photograph allowed certain problems to be identified.

Other problems were established using a questionnaire which was given to six members of the community (Appendix F). More questionnaires and therefore participation could not be included due to time constraints. When selecting members to answer the questionnaire, an attempt was made to ensure that the candidates were representative of the whole community. Semi-structured interviews were also held with officials from the City Planning and Land Survey Departments, and the head of AM/FM Mapping at the Pietermaritzburg-Msunduzi TLC. Informal interviews were conducted with interested residents while undertaking the land use and environmental survey. For the purpose of this study, the questionnaires and interviews proved to be adequate in establishing what the most pressing problems in Mountain Rise were.

A summary of the problems facing Mountain Rise are:

- High pollution levels caused by Willowton industrial belt;
- Inflated rates on property;
- Traffic congestion, especially the amount of taxis using the suburb as a thoroughfare;
- The amount of vacant land in the suburb which is under constant threat by squatters;
- Arising from the above, the crime rate has risen due to increased petty theft by squatters;
- A general lack of social facilities (such as an old age home and high school); and
- Large scale illegal dumping on vacant lots;

4.4.4. Deriving Goals and Objectives

Goals and objectives were then drawn up based on the problems identified. Normally, interested and affected parties would have been consulted and involved in drawing up of goals and objectives. A workshop in which members of the community, councillors, planners, and other stakeholders could meet to discuss addressing the problems was planned as part of this study. Time constraints made this impossible.

Goals and objectives were therefore drawn up by the author to address the problems identified by the community and the GIS analysis.

Three broad goals were identified for the suburb of Mountain Rise. The objectives for achieving each of the goals are discussed briefly under each goal. They goals included the:

- **Improvement of the environmental quality of the residential suburb**
  - The Willowton industrial belt should be rezoned to a non-polluting land use;
  - A green belt (tree planting and burns) should be constructed at the interface between industry and residential areas;
  - Tree planting should be undertaken along main roads in the suburb to minimise noise pollution and absorb pollutants from motor vehicles and industry;
  - Sidewalks should be cut regularly and illegal dumping cleared and stopped; and
  - Owners of vacant land should be forced to maintain and fence off their properties.
- **Provision and improvement of social facilities**
  - Middle and low cost housing should be established on state and council owned vacant land;
  - The existing shopping centre along Rosedale Road should be upgraded and extended;
  - An additional community park should be established on council or state owned land;
  - An old age home should be constructed on council or state owned vacant land;
  - A crèche and pre-primary school should be constructed on council or state owned vacant land;
  - A high school should be constructed on council or state owned vacant land; and

- A public transport route should be established along a major access route to allow for greater integration of Mountain Rise with the City of Pietermaritzburg.

- **Development of economic opportunities and tourism**
  - Rezoning and development of an office park on the vacant land in the Willowton industrial belt;
  - Rezoning and development of state owned vacant land along Ohrtmann Road for cultural centre;
  - Rezoning of privately owned vacant land along Royston Road for bed and breakfasts;
  - Establishment of cultural tour along Royston Road which will includes places of interest (religious, architectural, and cultural); and
  - Rezoning and construction of activity corridors along Rosedale and Ohrtmann Roads.

4.4.5. Generation of Alternatives

Based on the goals and objectives described above, three alternatives were generated in ArcView GIS and a graphics software programme. The alternatives set out to address each of the three goals. The alternatives were:

- **Environmental Alternative** (Appendix G(1) and Appendix G(2))
- **Social Alternative** (Appendix G(3))
- **Tourism / Economic Alternative** (Appendix G(4))

There was no need to elaborate on each of the alternatives since the purpose of the exercise was to show the potential of GIS in assisting with planning functions. Here it was shown how GIS could be used to visualise alternatives generated from the goals and objectives. GIS affords the planner with the tools to quickly generate alternatives, and if necessary, make changes to or generate additional alternatives with very little effort.

4.4.6. Completion of Planning Process

It was at this point in the planning process that the study ended. If the project had been seen through to completion, the stages involving evaluating the alternatives, selecting the preferred alternatives, implementation, and finally monitoring and reviewing would have needed to be addressed.

In order to evaluate the alternatives, it was planned that they would be presented to the community of Mountain Rise at a workshop. This stage would have been achieved by firstly ranking the goals and objectives, and then applying a weighting. The alternatives would then have been evaluated against the ranked and weighted goals and objectives of the community using the 'Goal-Achievements Matrix' method[4]. The outcome of this process would have been the selection of a preferred alternative, which could comprise a single alternative or a combination of alternatives.

The final two steps of the planning process, namely implementation and monitoring and reviewing of the development plan, move into stage three of Crain and MacDonald's (1984) stages of GIS development. The GIS would have been used at these stages as a management tool. This is supported by Haselau (1998) who stated that the task of constantly evaluating, monitoring, and reviewing development plans would be greatly reduced by using GIS.

4.5. Conclusion

Harris *et al* (1995, p.205) asked, "How can this advanced technology (GIS) be incorporated into a community-based participatory planning

[4] An alternative method that could have been used to evaluate the alternatives is the analytic hierarchy process (AHP). This process is a "... comprehensive, logical and structural framework, which ... improves the understanding of complex decisions by decomposing the problem in a hierarchical structure (Information and Discussion Forum on Priority Setting in Agriculture Research, undated). The AHP method explicitly recognises and incorporates the knowledge of the public.

process where the local knowledge is incorporated and analysed interactively?" The case study of Mountain Rise, Pietermaritzburg provided a very practical answer to the above question. It illustrated how GIS was able to address the difficulty commonly experienced in communicating complex spatial concepts related to planning, as well as significantly aiding the decision-making process by providing essential information about land use relationships. GIS and the planning process adopted ensured that the principles contained within the legislation reviewed in Chapter 3 were met. Overall, GIS was successfully integrated and utilised in the planning process at the local level. The fact that the planning process was left uncompleted did not detract from the third and final goal of the study being met.

CHAPTER 5 CONCLUSIONS

The study acknowledged that planning is facing many challenges, particularly in developing countries. If these challenges are to be met in a context of dwindling resources, reduction in funding, lack of trained personnel, and political transformation, then new and innovative technologies will have to be adopted. GIS was identified by the study as one such technology which has the potential to aid planning at the local government level.

A detailed literature survey, which sought to investigate those factors which have a bearing on the implementation of GIS at local government level, was carried out. This was concluded with a number of examples from around the world showing the usefulness of GIS at the local government level, and therefore achieving the first goal of the study.

The second component of the literature survey attempted to examine the role of GIS in the South African planning context. The study found that GIS, as a technology, has legitimacy in the third world context. The argument put forward by the study was that despite the high set-up costs involved in implementing GIS, developing countries could not afford to miss the opportunities afforded by the technology. The study also highlighted and discussed those pieces of legislation that are likely to have an impact on GIS implementation at the local planning level.

The literature survey was completed with an analysis of the planning theory, which allowed for a suitable planning process to be identified which would facilitate the adoption and use of GIS in the South African context. The adopted planning process was a combination of the Rational, Participatory, and Strategic Choice planning theories. The second goal of the study was therefore achieved in Chapter 3.

Chapter 4 of the study illustrated practically how GIS could be implemented and integrated into the planning process at the local government level. The third and probably most important goal of the study was achieved by carrying out a practical project within the Pietermaritzburg suburb of Mountain Rise. The benefits of implementing and using GIS to assist planners in the planning process was clearly illustrated by the case study. It also showed how easily GIS use could progress from simple inventory applications to perform more complex analytical and managerial tasks. The adoption of GIS in the planning process resulted in an improvement in the quality and quantity of planning-related data and facilitation of planning-related decision making. The fact that the study was unable to complete the planning exercise did not detract from the third goal of the study being met. GIS was shown to make the planning process more efficient and effective, while allowing for greater participation, comprehensiveness, and flexibility.

The author hopes that the study has gone someway in highlighting the important role that GIS has to play in South African local planning. If the potential of GIS is to be realised by the Pietermaritzburg-Msunduzi TLC and other planning departments around South Africa, its implementation will have to be managed very carefully so that resources are not wasted and results not forthcoming. As a starting point, all local governments should have a implementation plan or guide in place when adopting GIS. Disappointingly this is not the case, as evidenced at the Pietermaritzburg-Msunduzi TLC. An example of such an implementation guide for parcel-based GIS, adopted from the Minnesota Local Government, is given in Appendix H.

In conclusion, the study has attempted to provide a thorough investigation of the implementation and use of GIS in South Africa. The case study of Mountain Rise, Pietermaritzburg, was effective in showing practically how GIS could be implemented and integrated into the planning process. Overall, the study has a potentially valuable contribution to make to the City Planning Department of the Pietermaritzburg-Msunduzi TLC, and to

other local planning departments around the country. The sooner that GIS ceases to be regarded as 'special' and is seen as a integral part of local government operational planning and strategic management that real progress will be made in local planning in South Africa.

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APPENDICES

BRIEF FOR SCHOOL OF ENVIRONMENT AND DEVELOPMENT MASTERS EXAMINATION, JUNE 1998

Section A

1. Using the aerial photographs of Mountain Rise (1944-1989) as a basis, analyse and explain the major biophysical, structural and historical changes that have taken place.
2. Describe and analyse the pollution problems affecting Mountain Rise as the consequence of the cheek-by-jowl location of residential and industrial areas.
3. Describe and assess the land and property ownership and occupancy patterns, as well as the valuations thereof, in Mountain Rise. What are the implications of these patterns?

Section B

Mountain Rise is both a residential area with fascinating cultural, religious and architectural features and the scene of seemingly intractable problems arising from its apartheid past. The Pietermaritzburg local authority has commissioned you to devise a development plan for the area and a strategy for the implementation of the plan for the period 1999-2001. The plan should:

1. Provide solutions for existing problems as far as practicable;
2. Integrate Mountain Rise more effectively into the fabric of the city; and
3. Serve as a model for local development within the framework of Local Agenda 21.

The development plan must be accompanied by a realistic budget, indicating what costs might be involved in implementing the plan.

LAND USE, HOUSING, ENVIRONMENTAL CONDITIONS SURVEY OF MOUNTAIN RISE, PIETERMARITZBURG

Land Use

Vacant Land
1 Private
2 Council
3 State
4 Unregistered

Residential
11 Single Family
12 Duplex
13 Multi Family
14 Flats/Townhouses

Retail
21 Formal
22 Informal

Industrial
31 Craft
32 Light
33 Heavy
41 Transport, communications, utilities (name)
5 Institutional (name)
6 Churches, mosque, temple (name)

Open Space / Undeveloped
71 Yard
72 Gardens
73 Park
74 Sports field
8 Other (name)
10 Community hall

Block: _____

Date: _____

Time
Begin: _____

End: _____

Structural Condition
1 sound
2 deteriorating
3 dilapidated

Environmental Conditions

1 Uncontrolled weeds
2 Overgrown sidewalks
3 Litter
4 Junk (cars, appliances, etc.)
10 Roadside dump
13 Incompatible land use (specify)
15 Other

Parcel	Street #	Street Name	Use 1	Use 2	# Struc	# DU	Structural Condition	Env Neg	Env Pos	Comments/Name of Institution

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
1	82/38	Rosedale Road	41		1	1	0	1						Telkom - Mountain Rise Exchange
2	82/2/7	Rosedale Road	11		1	1	1	1						
3	82/7/20	Rosedale Road	11		1	1	1	1						
4	82/2/8	Rosedale Road	11		1	1	1	1					15	Broken storm water drain
5	82/8/21	Rosedale Road	11		1	1	1	1						
6	82/14/REM	Rosedale Road	13		1	2	2	1						
7	82/14/34	-	1		1	0	0	0						
8	82/14/33	-	1		1	0	0	0						
9	82/14/32	-	1		1	0	0	0						
10	82/14/31	-	1		1	0	0	0						
11	82/14/30	-	1		1	0	0	0						
12	82/14/29	-	1		1	0	0	0						Fenced
13	82/14/28	Woodstock Road	8		1	0	0	0	1	1				Servitude
14	82/2/10	Rosedale Road	21		4	1	0	2					15	Dump - rubble and earth
15	82/2/11	Rosedale Road	21		4	1	0	2					15	
16	82/2/12	Rosedale Road	1		1	0	0	0					15	
17	82/2/13	Rosedale Road	1		1	0	0	0						Walled
18	75/7/111	Rosedale Road	11	21	1	1	1	1						Retail/Residential
19	75/7/112	Rosedale Road	11		1	1	1	2					15	Chicken coup, crops, vegetable garden
20	75/6/127	Rosedale Road	4		1	0	0	0	1	1		1		
21	75/7/113	Woodstock Road	4		1	0	0	2	1	1				
22	75/7/115	Woodstock Road	4		1	0	0	0	1	1				
23	75/7/114	Woodstock Road	4		1	0	0	0	1	1				
25	75/7/116	Woodstock Road	1		1	0	0	0	1	1				
26	75/7/117	Claremont Road	1		1	0	0	0						Fenced
27	75/7/118	Claremont Road	1		1	0	0	0	1					Fenced
28	75/7/119	Claremont Road	1		1	0	0	0	1					Fenced
29	75/7/120	Claremont Road	1		1	0	0	0	1					Fenced
30	75/6/REM	Woodstock Road	4		1	0	0	0	1					Sub-station
32	75/6/126	Claremont Road	11		1	1	1	1						
33	75/6/125	Claremont Road	1		1	0	0	0	1	1				
34	75/6/124	Claremont Road	1		1	0	0	0	1	1		1		No dumping sign
35	75/5/REM	Woodstock Road	8		1	0	0	0	1	1				Servitude
36	75/5/18/REM	Rosedale Road	11		1	1	1	2						
37	75/18/108	Woodstock Road	11		1	1	1	1						
39	75/18/106	Woodstock Road	11		1	1	1	1						
40	75/18/105	Rosedale Road	11		1	1	1	1						
41	75/9/81	Rosedale Road	11		1	1	1	1						
42	75/9/82	Woodstock Road	11		1	1	1	1						
44	75/9/83	Woodstock Road	11		1	1	1	1						
45	75/9/84	Peter Hey Road	11		1	1	1	1						
46	75/72/95	Rosedale Road	11		1	1	1	1						
47	75/72/96	Woodstock Road	11		1	1	1	1						
49	75/72/97	Woodstock Road	11		1	1	1	1						
50	75/72/98	Peter Hey Road	11		1	1	1	1						
51	75/8/15	Rosedale Road	11		1	1	1	2						
52	75/8/2/REM	Woodstock Road	11		1	1	1	1						
53	75/8/17	Woodstock Road	11		1	1	1	1						
54	75/8/11	Rosedale Road	13		1	2	2	1						
55	75/8/1/REM	Woodstock Road	11		1	1	1	1						
56	75/8/16	Woodstock Road	1		1	0	0	0	1	1		1		
57	1614/1	Rosedale Road	13		1	3	3	1	1					
58	1614/2	Rosedale Road	11		1	1	1	1						
59	1614/3	Woodstock Road	11		1	1	1	1						
60	75/2/122	Rosedale Road	11		1	1	1	2						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
61	75/2/REM	Rosedale Road	1		1	0	0	0						
62	75/21/77	Rosedale Road	11	32	1	1	1	2						Panel beaters
63	75/21/74	Rosedale Road	4		1	0	0	0	1	1	1	1		
64	75/25/27	Rosedale Road	11		1	1	1	1						
65	75/25/27	Rosedale Road	11		1	1	1	1						
66	75/2/123	Woodstock Road	1		1	0	0	0	1					
67	75/2/109	Woodstock Road	13		1	2	2	1						
68	75/21/76	Woodstock Road	11		1	1	1	1						
69	75/21/75	Woodstock Road	4		1	0	0	0	1	1				Storm water drain broken
70	75/25/37	Woodstock Road	11		1	1	1	1						
71	75/25/37	Woodstock Road	1		1	0	0	0	1	1		1		
72	75/25/29	Rosedale Road	11		1	1	1	1						
73	75/25/30	Rosedale Road	11		1	1	1	1						
74	75/25/31	Rosedale Road	11		1	1	1	1						
75	75/25/32	Peyer Hey Road	11		1	1	1	1						
76	75/25/33	Peyer Hey Road	11	8	1	2	1	2				1		Tent
77	75/25/34	Peyer Hey Road	11		1	1	1	1						
78	75/25/35	Peyer Hey Road	11		1	1	1	1						
79	3050	Peyer Hey Road	2		1	0	0	0	1					Former squatter area
80	75/25/38	Woodstock Road	11		1	1	1	1						
81	75/25/39	Peyer Hey Road	11		1	1	1	1						
82	3007	Peyer Hey Road	11		1	1	1	1						Sub-station on pavement
83	75/25/44	Peyer Hey Road	13		1	2	2	1						
84	75/25/43	Peyer Hey Road	11		1	1	1	1						
85	5/25/42	Peyer Hey Road	11		1	1	1	1						
86	75/25/41	Peyer Hey Road	11		1	1	1	1						
87	75/25/40	Peyer Hey Road	11		1	1	1	1						
88	75/26/63	Peyer Hey Road	13		1	2	2	1						
89	75/26/64	Peyer Hey Road	13		1	2	2	1						
90	75/25/65	Peyer Hey Road	11		1	1	1	1						
91	75/25/66	Peyer Hey Road	11		1	1	1	1						
92	75/25/67	Peyer Hey Road	11		1	1	1	1						
93	75/26/52	Peyer Hey Road	11		1	1	1	1						
94	75/26/53	Rosedale Road	11		1	1	1	1						
95	75/54/87	Rosedale Road	11		1	1	1	1						
96					1									Part of 95
97	75/55/88	Rosedale Road	11		1	1	1	1						
98	75/26/55/REM	Ohrtmann Road	11		1	1	1	1						
99	75/26/56	Ohrtmann Road	11		1	1	1	1						
100	75/26/57	Ohrtmann Road	11		1	1	1	3	1					Sold and being renovated
101	75/26/58	Ohrtmann Road	11		1	1	1	1						
102	75/26/59	Ohrtmann Road	11	22	1	1	1	1						Photographic and Video Repairs
103	75/26/60	Ohrtmann Road	11		1	1	1	1						
104	75/26/61	Ohrtmann Road	11		1	1	1	1						
105	75/26/62	Ohrtmann Road	11		1	1	1	1						
106	75/25/49	Ohrtmann Road	11		1	1	1	1						
107	75/25/48	Ohrtmann Road	11		1	1	1	1						
108	75/25/47	Ohrtmann Road	11		1	1	1	1	1					New structure - possibly doctors rooms
109	75/25/46	Ohrtmann Road	1		1	0	0	0	1	1		1		
110	1353/1	Ohrtmann Road	11		1	1	1	1						
111	1353/2	Brook Road	11		1	1	1	1						
112	82/1/REM	Royston Road	5		6	5	0	1						Mountain Rise Police Station
113	1353/81	Royston Road	11		1	1	1	1						
114	1353/97/100/REM	Royston Road	11		1	1	1	1						
115	1353/104	Sydenham Road	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
116	1353/79/REM	Sydenham Road	11		1	1	1	1						
117	1353/78	Sydenham Road	13		1	2	2	1						
118	1353/77	Sydenham Road	11		1	1	1	1						
119	1353/76	Sydenham Road	11		1	1	1	1						
120	1353/75	Sydenham Road	11		1	1	1	1						
121	1353/74	Sydenham Road	11		1	1	1	1						
122	1353/73	Sydenham Road	13		1	2	2	1						
123	1353/47	Sydenham Road	13		1	2	2	1						
124	1353/46	Sydenham Road	11		1	1	1	1						
125	1353/44	Claremont Road	11		1	1	1	1						
126	1353/45	Sydenham Road	13		1	2	2	1						
127	1353/27	Claremont Road	11		1	1	1	1						
128	1353/26	Claremont Road	11		1	1	1	1						
129	1353/25	Rockdale Cres.	11		1	1	1	1						
130	1353/28	Peter Hey Road	11		1	1	1	1						
131	1353/24	Rockdale Cres.	13		1	2	2	1						
132	1353/29	Peter Hey Road	11		1	1	1	1						
133	1353/23	Rockdale Cres.	11		1	1	1	1						
134	1353/30	Peter Hey Road	11		1	1	1	1						
135	1353/22	Rockdale Cres.	11		1	1	1	1						
136	1353/31	Peter Hey Road	11		1	1	1	1						
137	1353/21	Rockdale Cres.	11		1	1	1	1						
138	1353/32	Peter Hey Road	11		1	1	1	1						
139	1353/20	Rockdale Cres.	13		1	2	2	1						
140	1353/33	Peter Hey Road	13		1	2	2	2					15	Vacant house
141	1353/19	Rockdale Cres.	11		1	1	1	1						
142	1353/34	Peter Hey Road	11		1	1	1	2						
143	1353/18	Rockdale Cres.	11		1	1	1	1						
144	1353/14	Rockdale Cres.	13		1	2	2	1						
145	1353/15	Rockdale Cres.	11		1	1	1	1						
146	1353/95	Rockdale Cres.	11		1	1	1	1						
147	1353/96	Rockdale Cres.	11		1	1	1	1						
148	1353/3	Rockdale Cres.	11		1	1	1	1						
149	1353/4	Brook Road	11		1	1	1	1						
150	1353/5	Brook Road	11		1	1	1	1						
151	1353/6	Brook Road	11		1	1	1	1						
152	1353/7	Brook Road	11		1	1	1	1						
153	1353/13	Rockdale Cres.	11		1	1	1	1						
154	1353/8	Ohrtmann Road	11		1	1	1	1						
155	1353/12	Rockdale Cres.	11		1	1	1	1						
156	1353/9	Ohrtmann Road	11		1	1	1	1						
157	1353/11	Rockdale Cres.	11		1	1	1	2			1			Vacant house
158	1353/10	Rockdale Cres.	11		1	1	1	1						
159	74/2/17	Ohrtmann Road	11		1	1	1	1						
160	74/2/18	Ohrtmann Road	11		1	1	1	1						
161	74/30/31	Rockdale Cres.	11		1	1	1	1						
162	74/2/19	Ohrtmann Road	11		1	1	1	2			1			
163	74/2/20	Ohrtmann Road	11		1	1	1	1						
164	74/30/REM	Rockdale Cres.	1		1	0	0	0	1			1		No dumping sign
165	74/2/21	Ohrtmann Road	11		1	1	1	1						Damaged sign post
166	74/2/22	Tors Road	11		1	1	1	1						
167	74/2/23	Tors Road	11		1	1	1	2	1					
168	1353/35	Rockdale Cres.	11		1	1	1	1						
169	74/7	Tors Road	11		1	1	1	0				1		Being built, building rubble on pavement
170	1353/36	Rockdale Cres.	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
171	74/8	Tors Road	11		1	1	1	1						
172	1353/37	Rockdale Cres.	11		1	1	1	1						
173	74/9	Tors Road	11		1	1	1	1						
174	1353/38	Rockdale Cres.	11		1	1	1	1						
175	74/10	Tors Road	1		1	0	0	0	1					
176	1353/39	Rockdale Cres.	13		1	2	2	1						
177	74/11	Tors Road	11		1	1	1	1						
178	1353/40	Rockdale Cres.	13		1	2	2	1						
179	74/12	Tors Road	11		1	1	1	1						
180	1353/43	Rockdale Cres.	11		1	1	1	1						
181	1353/42	Claremont Road	11		1	2	2	1						
182	1353/41	Claremont Road	11		1	1	1	1						
183	74/13	Tors Road	11		1	1	1	1						
184	74/14	Tors Road	11		1	1	1	1						
185	1353/67	Sydenham Road	11		1	1	1	1						
186	1353/68	Sydenham Road	11		1	1	1	1						
187	1353/69	Sydenham Road	11		1	1	1	1						
188	1353/70	Sydenham Road	11		1	1	1	1						
189	1353/71	Sydenham Road	11		1	1	1	1						
190	1353/72	Sydenham Road	11		1	1	1	1						
191	1353/48	Claremont Road	11		1	1	1	1						
192	1353/49	Claremont Road	11		1	1	1	1						
193	1353/50	Claremont Road	11		1	1	1	1	1					
194	1353/51	Claremont Road	11		1	1	1	1						
195	1353/52	Claremont Road	11		1	1	1	1						
196	74/15	Tors Road	11		1	1	1	1						
197	74/16	Tors Road	11		1	1	1	1						
198	1353/53	Tors Road	11		1	1	1	1						
199	1353/54	Tors Road	11		1	1	1	1						
200	1353/55	Tors Road	11		1	1	1	1						
201	1353/56	Tors Road	11		1	1	1	1						
202	1353/57	Shelley Cres.	11		1	1	1	1						
203	1353/66	Shelley Cres.	11		1	1	1	1						
204	1353/65	Elfin Place	11		1	1	1	1						
205	1353/64	Elfin Place	11		1	1	1	1						
206	1353/63	Elfin Place	11		1	1	1	1						
207	1353/62	Elfin Place	11		1	1	1	1						
208	1353/61	Elfin Place	11		1	1	1	1						
209	1353/60	Elfin Place	11		1	1	1	1						
210	1353/59	Elfin Place	11		1	1	1	1						
211	1353/58	Elfin Place	11		1	1	1	1						
212	1353/88	Shelley Cres.	11		1	1	1	1						
213	1353/89	Tors Road	11		1	1	1	1						
214	1353/90	Tors Road	11		1	1	1	1						
215	1353/91	Tors Road	1		1	0	0		1	1		1		
216	1353/92	Tors Road	13		1	1	2	1						
217	1353/93	Royston Road	13		1	1	1	1						
218	1291/19	Royston Road	5		3	3	0	1						Mountain Rise Primary School
219	1291/128	Mountain Rise D	11		1	1	1	1						
220	1291/121	Royston Road	11		1	1	1	1						
221	1291/127	Mountain Rise D	11		1	1	1	1						
222	1291/122	Royston Road	1		1	0	0	0	1					
223	1291/126	Mountain Rise D	13		1	1	1	1						Being constructed
224	1291/123	Royston Road	1		1	0	0	0	1					Sold, building material being stored
225	1291/125	Oaklands Road	13		1	1	1	1						Being constructed

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
226	1291/124	Oaklands Road	13		1	1	1	1				1		Building sand
227	1291/49	Mountain Rise D	11		1	1	1	1						
228	1291/21	Oaklands Road	11		1	1	1	1	1					
229	1291/50	Mountain Rise D	11		1	1	1	1						
230	1291/22	Oaklands Road	11		1	1	1	1						
231	1291/51	Mountain Rise D	11		1	1	1	1						
232	1291/23	Oaklands Road	11		1	1	1	1						
233	1291/24	Oaklands Road	11		1	1	1	1						
234	1291/52	Mountain Rise D	11		1	1	1	1						
235	1291/53	Mountain Rise D	11		1	1	1	1						
236	1291/25	Oaklands Road	11		1	1	1	1						
237	1291/54	Mountain Rise D	11		1	1	1	1						
238	1291/55	Mountain Rise D	11		1	1	1	1						
239	1291/56	Mountain Rise D	11		1	1	1	1						
240	1291/26	Oaklands Road	11		1	1	1	1						
241	1291/57	Mountain Rise D	11		1	1	1	1						
242	1291/27	Oaklands Road	11		1	1	1	1						
243	1291/58	Mountain Rise D	11		1	1	1	1						
244	1291/28	Oaklands Road	1		1	0	0	0	1			1		
245	1291/59	Mountain Rise D	11		1	1	1	1						
246	1291/60	Mountain Rise D	11		1	1	1	1						
247	1291/29	Oaklands Road	11		1	1	1	1						
248	1291/61	Mountain Rise D	13		1	2	2	1						
249	1291/30	Oaklands Road	11		1	1	1	1						
250	1291/62	Mountain Rise D	11		1	1	1	1						
251	1291/32	Oaklands Road	11		1	1	1	1						
252	1291/31	Kenilworth Road	11		1	1	1	1						
253	1291/63	Kenilworth Road	11		1	1	1	1						
254	1291/36	Oaklands Road	11		1	1	1	1						
255	1291/37	Oaklands Road	11		1	1	1	1						
256	1291/35	Oaklands Road	11		1	1	1	1						
257	1291/34	Oaklands Road	11		1	1	1	1						
258	1291/33	Kenilworth Road	11		1	1	1	1						For sale
259	1291/38	Kenilworth Road	11		1	1	1	1						
260	1291/39	Oaklands Road	1		1	0	0	0	1	1		1		
261	1291/45	Kenilworth Road	11		1	1	1	1						
262	1291/40	Oaklands Road	11		1	1	1	1						
263	1291/44	Kenilworth Road	11		1	1	1	1						
264	1291/43	Kenilworth Road	11		1	1	1	1						
265	1291/41	Burnside Road	11		1	1	1	1						
266	1291/42	Burnside Road	11		1	1	1	1						Being constructed
267	1291/64	Mountain Rise D	11		1	1	1	1						
268	1291/93	Kenilworth Road	1		1	0	0	0	1	1		1		
269	1291/65	Mountain Rise D	11		1	1	1	1						
270	1291/92	Oaklands Road	11		1	1	1	1						
271	1291/66	Mountain Rise D	11		1	1	1	1						
272	1291/67	Mountain Rise D	11		1	1	1	1						
273	1291/91	Oaklands Road	11		1	1	1	1						
274	1291/68	Mountain Rise D	11		1	1	1	1						
275	1291/90	Oaklands Road	11		1	1	1	1						
276	1291/69	Mountain Rise D	11		1	1	1	1						
277	1291/70	Mountain Rise D	11		1	1	1	1						
278	1291/71	Mountain Rise D	1		1	0	0	0	1	1		1		
279	1291/89	Oaklands Road	13		1	2	2	1						
280	1291/72	Mountain Rise D	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
281	1291/88	Oaklands Road	13		1	2	2	1						
282	1291/73	Mountain Rise D	11		1	1	1	1						
283	1291/87	Oaklands Road	11		1	1	1	1						
284	1291/74	Mountain Rise D	11		1	1	1	1						
285	1291/75	Mountain Rise D	11		1	1	1	1						
286	1291/76	Burnside Road	11		1	1	1	1						
287	1291/86	Oaklands Road	13		1	2	2	1						
288	1291/77	Burnside Road	11		1	1	1	1						
289	1291/78	Burnside Road	11		1	1	1	1						
290	1291/85	Oaklands Road	13		1	2	2	1						
291	1291/79	Burnside Road	11		1	1	1	1						
292	1291/84	Oaklands Road	11		1	1	1	1						
293	1291/80	Burnside Road	11		1	1	1	1						
294	1291/83	Oaklands Road	11		1	1	1	1						
295	1291/81	Burnside Road	11		1	1	1	1						
296	1291/82	Kenilworth Road	13		1	2	2	1						
297	1291/131	Oaklands Road	1		1	0	0	0	1	1		1		
298	1291/115	Burnside Road	11		1	1	1	1						
299	1890	Royston Road	6		1	2	0	1						Mountain Rise Methodist Church
300	1291/94	Burnside Road	11		1	1	1	1						
301	1291/105	Royston Road	1		1	0	0	0		1				
302	1291/95	Burnside Road	11		1	1	1	1						
303	1291/104	Royston Road	1		1	0	0	0		1	1			
304	1291/96	Burnside Road	11		1	1	1	1						
305	1291/103	Royston Road	11		1	1	1	1						
306	1291/97	Burnside Road	11		1	1	1	1						Being built
307	1291/102	Royston Road	1		1	0	0	0	1	1		1		
308	1291/98	Burnside Road	13		1	2	2	1						For sale
309	1291/101	Royston Road	11		1	1	1	1						
310	1291/99	Mountain Rise D	11		1	1	1	1						
311	1291/100	Mountain Rise D	11		1	1	1	1						
312	1291/110	Mountain Rise D	11		1	1	1	1						
313	1291/109	Mountain Rise D	11		1	1	1	1						
314	1291/108	Mountain Rise D	11		1	1	1	1						
315	1291/107	Mountain Rise D	13		1	2	2	1						
316	1291/106	Royston Road	1		1	0	0	0	1	1				
317	83/3/5/REM	Royston Road	11		1	1	1	1						
318	83/5/51	Tors Road	11		1	1	1	1						
319	83/5/25	Tors Road	11		1	1	1	1						
320	83/5/18/REM	Tors Road	11		1	1	1	2						Being renovated
321	83/3/6/REM	Royston Road	11		1	1	1	1						
322	83/65/66	Shelley Cres.	11		1	1	1	1						Joined with 323 and walled
323	83/6/65/REM	Shelley Cres.	71		1	0	0	0						Joined with 322 and walled
324	83/3/7/REM	Royston Road	13		1	2	2	1				1		Being constructed, bldg sand & rubble
325	83/8/12	Royston Road	11		1	1	1	2	1					
326	83/8/48	Royston Road	11		1	1	1	1						
327	83/8/43	Shelley Cres.	11		1	1	1	1						
328	83/8/42	Shelley Cres.	11		1	1	1	1						
329	83/8/50	Royston Road	5		1	3	0	1				1		Madressa Noor for the Blind
330	3/8/9/REM	Royston Road	5		1	3	0	1						Madressa Noor for the Blind
331	83/8/41	Shelley Cres.	11		1	1	1	1						
332	83/8/40	Shelley Cres.	11		1	1	1	1						
333	83/8/39	Shelley Cres.	11		1	1	1	1						
334	83/8/38	Shelley Cres.	11		1	1	1	1						
335	83/8/37	Shelley Cres.	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
336	83/15/16/REM	Tors Road	11		1	1	1	1						
337	83/8/28	Shelley Cres.	11		1	1	1	1						
338	83/16/17	Tors Road	11		1	1	1	1						
339	83/8/29	Shelley Cres.	11		1	1	1	1						
340	83/15/45	Tors Road	11		1	1	1	1						
341	83/8/30	Shelley Cres.	11		1	1	1	1						
342	83/15/46	Tors Road	1		1	0	0	0						Walled by 340
343	83/8/31	Shelley Cres.	11		1	1	1	1						
344	83/15/47	Tors Road	1		1	0	0	0						Walled by 340
345	83/8/32	Shelley Cres.	11		1	1	1	1						
346	83/10/11/REM	Tors Road	13		1	2	2	1						
347	83/8/33	Shelley Cres.	11		1	1	1	1						
348	1354/24	Tors Road	11		1	1	1	1	1					
349	1354/25	Claremont Road	11		1	1	1	1						
350	1354/26	Claremont Road	11		1	1	1	1						
351	1354/27	Claremont Road	11		1	1	1	1						
352	1354/28	Shelley Cres.	11		1	1	1	1						
353	83/8/34	Shelley Cres.	1		1	0	0	0	1	1		1		No dumping sign, walled property
354	83/8/35	Shelley Cres.	11		1	1	1	1						
355	83/8/36	Shelley Cres.	11		1	1	1	1						
356	1354/29	Claremont Road	10		1	1	0	1	1					V.V.P.S. Hall
357	1354/30	Claremont Road	11		1	1	1	1						
358	1354/31	Claremont Road	11		1	1	1	1						
359	1354/32	Claremont Road	11		1	1	1	1						
360	701/2/8	Claremont Road	11		1	1	1	1						
361	701/2/3	Royston Road	5		3			1						Arthur Blaxall School
362	1354/23	Tors Road	11		1	1	1	1	1					
363	1354/22	Claremont Road	13		1	2	2	1						
364	1354/21	Florida Cres.	11		1	1	1	1						
365	83/4/22	Tors Road	11		1	1	1	1						
366	1354/20	Florida Cres.	11		1	1	1	1						
367	83/4/23	Tors Road	11		1	1	1	1						
368	1354/19	Florida Cres.	11		1	1	1	1						
369	83/4/24	Tors Road	11		1	1	1	1						
370	1354/18	Florida Cres.	11		1	1	1	1						
371	1354/1	Tors Road	11		1	1	1	1						
372	1354/17	Florida Cres.	11		1	1	1	1						
373	1354/2	Tors Road	11		1	1	1	1						
374	1354/16	Florida Cres.	11		1	1	1	1						
375	1354/3	Tors Road	11		1	1	1	2	1					
376	83/26/53	Tors Road	12		1	1	1	2			1			
377	83/26/54	Tors Road	12		1	1	1	2			1			
378	83/26/55	Ohrtmann Road	12		1	1	1	2						
379	83/26/56	Ohrtmann Road	11		1	1	1	1						
380	1354/15	Florida Cres.	11		1	1	1	1						
381	83/26/57	Ohrtmann Road	14		1	1	1	1						
382	1354/14	Florida Cres.	11		1	1	1	1						
383	83/26/58	Ohrtmann Road	14		1	1	1	1						
384	1354/13	Florida Cres.	11		1	1	1	1						
385	83/26/59	Ohrtmann Road	14		1	1	1	1						
386	1354/12	Florida Cres.	11		1	1	1	1						
387	83/26/60	Ohrtmann Road	14		1	1	1	1						
388	1354/11	Florida Cres.	11		1	1	1	1						
389	83/26/61	Ohrtmann Road	14		1	1	1	1						
390	1354/10	Florida Cres.	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
391	1354/4	Ohrtmann Road	11		1	1	1	1						
392	1354/9	Florida Cres.	11		1	1	1	1						
393	1354/5	Ohrtmann Road	11		1	1	1	1	1	1				
394	1354/8	Cameron Cres.	11		1	1	1	1						
395	1354/7	Cameron Cres.	11		1	1	1	1						
396	1354/6	Ohrtmann Road	13		1	2	2	1						
397	1354/69	Florida Crescen	73		2	0	0	0	1	1		1		3 pieces of equipment (good condition)
398	1354/36	Hampden Road	11		1	1	1	1						
399	1354/37	Florida Cres.	11		1	1	1	1						
400	1354/38	Cameron Cres.	13		1	2	2	1						
401	1354/35	Hampden Road	13		1	2	2	1						
402	1354/39	Cameron Cres.	13		1	2	2	1						
403	1354/34	Hampden Road	11		1	1	1	1						
404	1354/40	Cameron Cres.	11		1	1	1	1						
405	1354/33	Hampden Road	11		1	1	1	1						
406	1354/41	Claremont Road	11		1	1	1	1						
407	1354/48	Cameron Cres.	1		1	0	0	0	1			1		Being built
408	1354/47	Cameron Cres.	11		1	1	1	1						
409	1354/46	Cameron Cres.	11		1	1	1	1						
410	1354/45	Cameron Cres.	13		1	2	2	1						
411	1354/44	Cameron Cres.	11		1	1	1	1						
412	1354/43	Cameron Cres.	11		1	1	1	1						
413	1354/42	Cameron Cres.	11		1	1	1	1						
414	701/40	Bonnyview Place	11		1	1	1	1						
415	701/1/2/24	Bonnyview Place	13		1	2	2	1	1					
416	701/1/15	Manning Ave. (e	11		1	1	1	2	1	1				
417	701/15/26	Manning Ave. (e	11		1	1	1	1						
418	701/26/37	Manning Ave. (e	11		1	1	1	1						
419	701/15/19	Manning Ave. (e	11	8	1	1	1	1						Play school at back
420	701/19/36	Manning Ave. (e	11		1	1	1	1						
421	1354/49	Ohrtmann Road	11		1	1	1	1						
422	1354/50	Manning Ave. (e	11		1	1	1	1						
423	701/36/52	Manning Ave. (e	8		0	0	0	0						Turning square
424	701/41/51	Cameron Cres.	11		1	1	1	1						
425	701/41/REM	Bonnyview Place	11		1	1	1	1						
426	701/1/2/REM	Manning Ave. (e	13		1	3	3	1						
427	1354/55	Cameron Cres.	11		1	1	1	1						
428	1354/56	Manning Ave. (e	13		1	2	2	1						
429	1354/54	Cameron Cres.	11		1	1	1	1						
430	1354/57	Manning Ave. (e	11		1	1	1	1						
431	1354/53	Cameron Cres.	11		1	1	1	1						
432	1354/52	Cameron Cres.	11		1	1	1	1						
433	1354/58	Manning Ave. (e	11		1	1	1	1						
434	1354/51	Cameron Cres.	11		1	1	1	1						
435	1354/60	Cameron Cres.	11		1	1	1	1						
436	1354/59	Cameron Cres.	11		1	1	1	1						
437	1354/61	Cameron Cres.	11	8	1	1	1	1						Panel Beaters, 5 cars on pavement
438	1354/62	Cameron Cres.	13		1	2	2	1						
439	1354/63	Cameron Cres.	11		1	1	1	1						
440	701/REM	Royston Road	5		3			1						New Horizon School for the Blind
441	701/16/28	Cameron Cres.	13		1	2	2	1						
442	701/16/29	Manning Ave. (e	13		1	2	2	1						
443	1354/64	Manning Ave. (e	11		1	1	1	1						
444	1354/65	Manning Ave. (e	11		1	1	1	1						
445	1354/66	Manning Ave. (e	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
446	1354/67	Manning Ave. (e	11	22	1	2	1	1						Athma's Tuck Shop
447	1354/68/REM	Royston Road	11		1	1	1	2				1		Rubbish on corner
448	1354/68/70	Manning Ave. (e	8		1	0	0	0				1		Turining square
449	153/1/7/REM	Royston Road	13		1	2	2	1	1					
450	153/1/4/REM	Royston Road	11		1	1	1	2						
451	153/1/44	Shuttle Place	11		1	1	1	1						Alterations in progress
452	153/1/43	Shuttle Place	11		1	1	1	1						
453	153/10/41	Shuttle Place	13		1	2	2	1						
454	153/1/10/REM	Crystal Place	11		1	1	1	1						
455	153/76/77	Crystal Place	1		1	0	0	0	1					
456	153/76/80	Crystal Place	1		1	0	0	0	1			1		
457	153/76/78	Crystal Place	1		1	0	0	0	1					
458	153/76/79	Crystal Place	1		1	0	0	0	1					
459	153/5/82	Crystal Place	11		1	3	3	1						Consolidated with 461,460 & 462
460	153/5/85	Crystal Place	1		1	0	0	0						
461	153/5/83	Crystal Place	11		1	1	1	1						
462	153/5/84	Crystal Place	1		1	0	0	0						
463	89/61/66	Coronet Place	11		1	1	1	1						
464	89/61/67	Coronet Place	11		1	1	1	1						
465	89/61/68	Coronet Place	11		1	1	1	1						
466	89/61/69	Coronet Place	11		1	1	1	1						
467	89/61/70	Coronet Place	11		1	1	1	1						
468	89/61/72	Coronet Place	11		1	1	1	1						
469	89/61/71	Claremont Road	11		1	1	1	1						
470	89/61/73	Coronet Place	11		1	1	1	1						
471	89/61/74	Coronet Place	11		1	1	1	1						
472	89/61/76	Coronet Place	1		1	0	0	0	1	1		1		
473	89/61/75	Coronet Place	1		1	0	0	0	1	1		1		
474	89/61/77	Coronet Place	1		1	0	0	0	1	1		1		
475	89/61/78	Coronet Place	11		1	1	1	1						Being built
476	89/61/80	Coronet Place	1		1	0	0	0	1			1		
477	89/61/79	Coronet Place	11		1	1	1	1						
478	89/61/81	Coronet Place	1		1	0	0	0	1			1		Bldg rubble in access way
479	89/61/82	Coronet Place	11		1	1	1	0						Being built
480	89/61/83	Coronet Place	11		1	1	1	1						
481	89/61/85	Coronet Place	11		1	1	1	1						
482	89/61/84	Coronet Place	11		1	1	1	1						
483	89/61/86	Coronet Place	11		1	1	1	1						
484	89/61/87	Coronet Place	1		1	0	0	0	1	1		1		
485	89/61/88	Coronet Place	1		1	0	0	0	1	1		1		
486	89/61/89	Coronet Place	1		1	0	0	0	1	1		1		
487	89/61/90	Coronet Place	1		1	0	0	0	1	1		1		
488	89/61/91	Coronet Place	11		1	1	1	1						
489	89/61/92	Coronet Place	11		1	1	1	1						
490	89/61/93	Coronet Place	1		1	0	0	0						489 storing car, caravan & trailor
491	89/61/94	Coronet Place	11		1	1	1	1						
492	89/61/95	Coronet Place	11		1	1	1	1						
493	89/61/96	Coronet Place	11		1	1	1	1						
494	89/61/97	Coronet Place	11		1	1	1	1						
495	89/61/98	Coronet Place	14		1	2	2	1	1			1		Two identical units on property
496	89/61/99	Coronet Place	1		1	0	0	0	1	1		1		
497	89/61/100	Coronet Place	1		1	0	0	0	1	1		1		
498	89/61/101	Coronet Place	1		1	0	0	0	1	1		1		
499	89/61/102	Coronet Place	1		1	0	0	0	1	1		1		
500	89/61/103	Coronet Place	1		1	0	0	0	1	1		1		

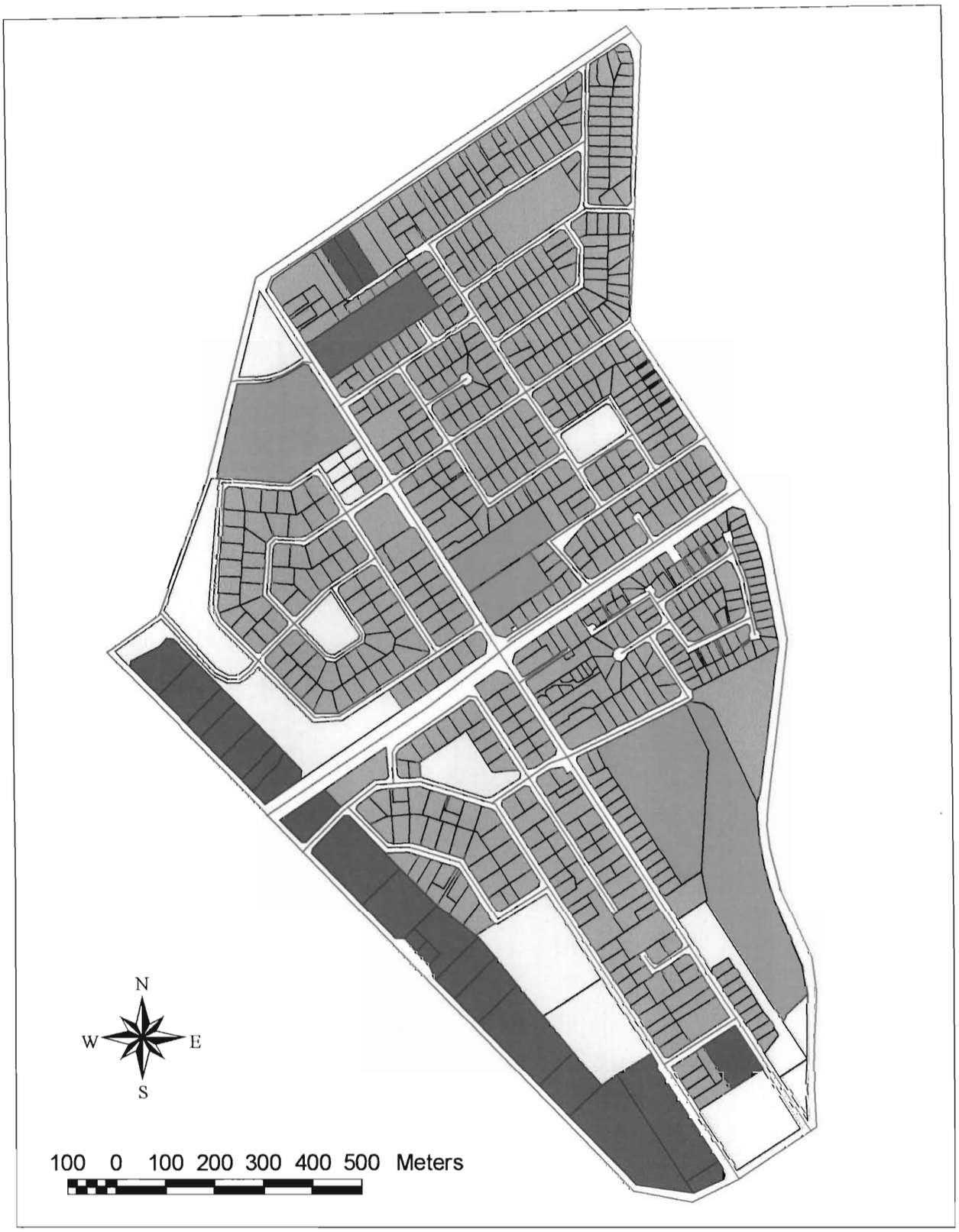
Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
501	89/61/106	Coronet Place	11		1	1	1	1						
502	89/61/104	Coronet Place	1		1	0	0	0	1	1		1		
503	89/61/107	Coronet Place	11		1	1	1	1						
504	89/61/105	Coronet Place	1		1	0	0	0	1	1		1		
505	89/61/108	Coronet Place	11		1	1	1	1						
506	89/61/109	Coronet Place	1		1	0	0	0	1	1				For sale
507	89/61/111	Coronet Place	11		1	1	1	1						
508	89/61/110	Coronet Place	1		1	0	0	0	1	1				For sale
509	89/61/112	Coronet Place	1		1	0	0	0		1				
510	89/61/113	Coronet Place	1		1	0	0	0		1				
511	89/61/115	Coronet Place	11		1	1	1	1						
512	89/61/114	Coronet Place	1		1	0	0	0		1		1		Piles of bricks and sand
513	89/61/116	Sterculia Cres.	11		1	1	1	1						
514	89/61/117	Sterculia Cres.	11		1	1	1	1						
515	89/61/118	Sterculia Cres.	11		1	1	1	1						
516	89/61/119	Sterculia Cres.	11		1	1	1	1						
517	89/61/120	Sterculia Cres.	1		1	0	0	0	1	1	1			Fenced
518	89/61/121	Sterculia Cres.	1		1	0	0	0	1	1	1			Fenced
519	89/61/122	Sterculia Cres.	1		1	0	0	0	1	1	1			Fenced
520	89/61/142	Coronet Place	1		1	0	0	0	1	1				
521	89/61/143	Coronet Place	11		1	1	1	1						
522	89/61/144	Coronet Place	11		1	1	1	1						
523	89/61/123	Coronet Place	11		1	1	1	1						
524	89/61/124	Coronet Place	11		1	1	1	1						
525	89/61/125	Coronet Place	11		1	1	1	1						
526	89/61/126	Coronet Place	11		1	1	1	1						
527	89/61/127	Coronet Place	11		1	1	1	1						
528	89/61/128	Coronet Place	11		1	1	1	1						
529	89/61/129	Coronet Place	11		1	1	1	1						
530	89/151	Coronet Place	11		1	1	1	1						
531	89/61/133	Coronet Place	11		1	1	1	1						
532	89/61/134	Coronet Place	11		1	1	1	1						
533	89/61/135	Coronet Place	11		1	1	1	1						
534	89/61/136	Coronet Place	11		1	1	1	1						
535	89/61/138	Coronet Place	11		1	1	1	1						
536	89/61/137	Coronet Place	11		1	1	1	1						
537	89/150	Coronet Place	11		1	1	1	1						
538	153/2/REM	Royston Road	11		1	1	1	1						
539	153/2/75	Shuttle Place	8		1	0	0	0	1	1				Turning square
540	89/61/64	Coronet Place	11		1	1	1	1						
541	89/61/63	Coronet Place	11		1	1	1	1						
542	89/61/62	Coronet Place	1		1	0	0	0	1					
543	153/25/38	Sterculia Cres.	13		1	2	2	1						
544	153/25/37	Sterculia Cres.	11		1	1	1	1						
545	153/25/36	Sterculia Cres.	11		1	1	1	1						
546	153/25/35	Sterculia Cres.	11		1	1	1	1						
547	153/25/34	Sterculia Cres.	11		1	1	1	1						
548	153/25/33	Sterculia Cres.	13		1	2	2	1						
549	153/25/32	Sterculia Cres.	11		1	1	1	1						
550	153/25/31	Sterculia Cres.	13		1	2	2	1						
551	153/25/30	Sterculia Cres.	11		1	1	1	1						
552	153/25/29	Sterculia Cres.	13		1	2	2	1						
553	153/25/28	Sterculia Cres.	11		1	1	1	1						
554	153/25/27	Sterculia Cres.	11		1	1	1	1						
555	153/25/26	Sterculia Cres.	13		1	2	2	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
556	153/18	Noodsberg Road	11		1	1	1	1						
557	153/17	Noodsberg Road	11		1	1	1	1						
558	153/16	Noodsberg Road	13		1	2	2	1						
559	153/15	Noodsberg Road	13	22	1	3	2	1						Mimis Tuck Shop & General Dealer
560	153/14	Noodsberg Road	13		1	2	2	1						
561	153/13	Noodsberg Road	11		1	1	1	1						
562	153/42	Noodsberg Road	13		1	2	2	1						
563	153/21	Royston Road	1		1	1	0	2						Walled
564	153/22	Royston Road	11		1	1	1	1						Consolidated with 565
565	153/23	Royston Road	11		1	1	1	1						Consolidated with 564
566	153/3/50	Royston Road	11		1	1	1	1						Part of same property
567	153/3/51	-	11		1			1						Part of same property
568	153/3/52	-	11		1			1						Part of same property
569	153/3/54	-	11		1			1						Part of same property
570	153/3/55	-	11		1			1						Part of same property
571	153/2/56	-	11		1			1						Part of same property
572	153/3/57	-	11		1			1						Part of same property
573	153/3/58	-	11		1			1						Part of same property
574	122/3/69	Royston Road	11		1	1	1	1						
575	122/3/50	Royston Road	11		1	1	1	1						
576	122/3/51	Royston Road	11		1	1	1	1						
577	122/3/52	Royston Road	11		1	1	1	1						Shree Radha Krishna Mandir
578	122/81	Royston Road	11		1	1	1	1						
579	122/3/REM	Royston Road	2		2	0	0	0	1	1		1		
580	122/3/53	Royston Road	11		1	1	1	1						
581	122/3/54	Royston Road	11		1	1	1	1						
582	122/3/55	Royston Road	11		1	1	1	1						
583	122/3/56	Royston Road	11		1	1	1	1						
584	122/3/57	Royston Road	11		1	1	1	1						
585	122/3/58	Royston Road	11		1	1	1	1						
586	122/3/59	Royston Road	11		1	1	1	1						
587	122/3/60	Royston Road	13		1	2	2	1						
589	122/3/61	Royston Road	11		1	1	1	1						
590	122/84	Noodsberg Road	3		3	0	0	0						Large scale dumping of top soil
591	122/100	Ohrtmann Road	3		3	0	0	0	1	1		1		Open land with squatters
592	1539/9	Royston Road	6		1	1	0	1						Parking & bldg, consolidated with 593/4
593	1539/10	Apollo Road	8		1	0	0	0						Parking
594	1539/8	Royston Road	6		1	1	0	1						Surti Sunni Mosque
595	1539/11	Apollo Road	11		1	1	1	1						
596	1539/7	Royston Road	11		1	1	1	1						
597	1539/12	Apollo Road	11		1	1	1	1						
598	1539/6	Royston Road	11		1	1	1	1						
599	1539/13	Apollo Road	11		1	1	1	1						
600	1539/5	Royston Road	11		1	1	1	1						
601	1539/14	Apollo Road	11		1	1	1	1						
602	1539/4	Royston Road	11		1	1	1	1						
603	1539/15	Tucker Road	11		1	1	1	1						
604	1539/3	Royston Road	11		1	1	1	1						
605	1539/28/63	Tucker Road	11		1	1	1	1						Consolidated with 606
606	1539/28/REM	Tucker Road	11		1	1	1	1						Consolidated with 605
607	1539/27	Apollo Road	11		1	1	1	1						
608	1539/26	Apollo Road	11		1	1	1	1						
609	1539/25	Apollo Road	11		1	1	1	1						
610	1539/24	Apollo Road	11		1	1	1	1						
611	1539/23	Apollo Road	11		1	1	1	1						

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
612	1539/22	Apollo Road	14		1	1	4	1						Four units
613	1539/21	Apollo Road	11		1	1	1	1						
614	1539/20	Apollo Road	11		1	1	1	1						
615	1539/19	Apollo Road	11		1	1	1	1						
616	1539/18	Tucker Road	11		1	1	1	1						
617	1539/57	Tucker Road	73		2	0	0	0	1	1		1		
618	1539/17	Tucker Road	11		1	1	1	1						
619	1539/16	Tucker Road	11		1	1	1	1						
620	1813	Dartnell Road	11		1	1	1	1						
621	1783/22	Dartnell Road	11		1	1	1	2						
622	1783/13	Apollo Road	11		1	1	1	1						
623	1783/21	Dartnell Road	11		1	1	1	1						
624	1783/14	Apollo Road	1		1	0	0	0	1					
625	1783/20	Dartnell Road	11		1	1	1	1						
626	1783/15	Apollo Road	1		1	0	0	0	1					
627	1783/19	Dartnell Road	1		1	0	0	0	1	1		1		
628	1783/18	Dartnell Road	11		1	1	1	1						
629	1783/16	Apollo Road	1		1	0	0	0	1			1		
630	1814	Dartnell Road	11		1	1	1	1						
631	572/1/8	Dartnell Road	11		1	1	1	1						
632	572/1/REM	Dartnell Road	13		1	2	2	1						
633	572/3/4	Dartnell Road	11		1	1	1	1						
634	1539/2	Tucker Road	13		1	2	2	1						
635	1539/1	Royston Road	11		1	1	1	1						
636	1783/1/24	Royston Road	6		1	1	0	1						Guru Rambaranji's Ashram
637	1783/1/REM	Royston Road	11		1	1	1	1						
638	1783/2	Royston Road	11		1	2	1	2						
639	1783/11	Apollo Road	11		1	2	2	2						
640	1783/3	Royston Road	11		1	1	1	1						
641	1783/10	Apollo Road	1		1	0	0	0	1					
642	1783/4	Royston Road	1		1	0	0	0	1			1		
643	1783/9	Apollo Road	1		1	0	0	0	1					
644	1783/5	Royston Road	11		1	1	1	1						
645	1783/6	Royston Road	1		1	0	0	0	1			1		
646	1783/8	Apollo Road	1		1	0	0	0	1			1		
647	1783/7	Royston Road	11		1	1	1	1						
648	572/3/5	Royston Road	11		1	1	1	1						
649	572/3/6	Royston Road	11		1	1	1	1						
650	572/3/REM	Royston Road	11		1	1	1	1						
651	572/3/7	Royston Road	11		1	1	1	1						
652	574/1	Royston Road	11	32	1	2	1	1						Construction
653	1784/11	Dartnell Road	1		1	0	0	0	1					
654	1784/10	Dartnell Road	1		1	0	0	0	1					
655	1784/9	Dartnell Road	1		1	0	0	0	1					
656	1784/6	Apollo Road	1		1	0	0	0	1	1				
657	1784/8	Dartnell Road	1		1	0	0	0	1					
658	1784/7	Apollo Road	1		1	0	0	0	1					
659	1784/3	Apollo Road	1		1	0	0	0	1	1				
660	1784/1	Apollo Road	1		1	0	0	0	1	1				
661	609/2	Dartnell Road	11		1	1	1	1						
662	609/REM	Dartnell Road	11		1	1	1	1						
663	1784/5	Apollo Road	11		1	1	1	2	1					
664	1784/4	Apollo Road	1		1	0	0	0	1					Consolidated with 663
665	1784/2	Royston Road	1		1	0	0	0	1					Consolidated with 663
666	609/1/3	Royston Road	5		1	1	1	1						Rainbow Nation Creche and Pre School

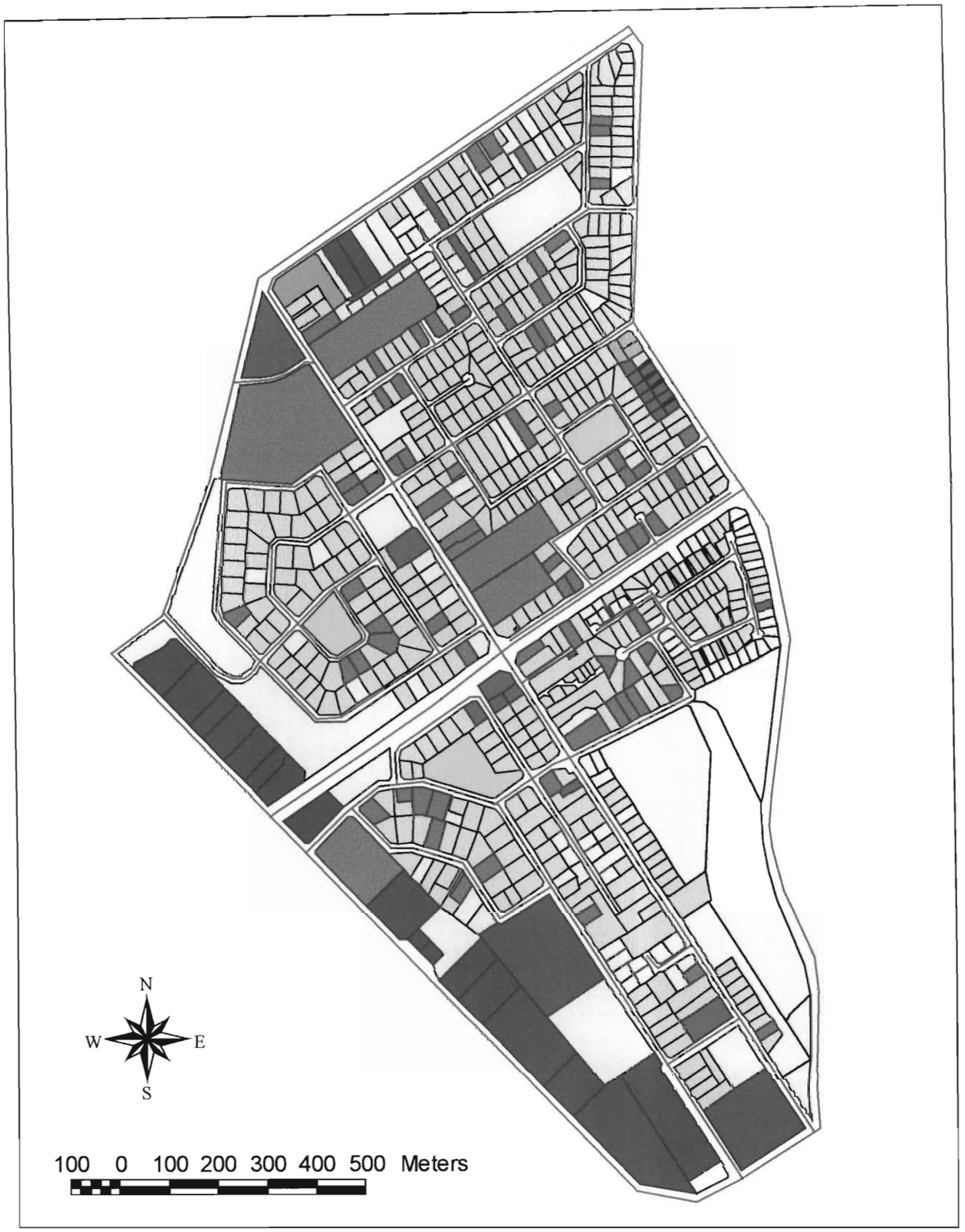
Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
667	610/1/REM	Dartnell Road	11		1	1	1	1						
668	610/2	Royston Road	11		1	1	1	1						
669	610/1/3	Dartnell Road	11		1	1	1	1						
670	610/REM	Royston Road	11		1	1	1	1						
671	611/1/2	Dartnell Road	11		1	1	1	1						
672	611/1/REM	Dartnell Road	11		1	1	1	1						
673	611/REM	Royston Road	14		1	16	16	1						Gani Apartments
674	1133/1	Dartnell Road	11		1	3	3	2						
675	1133/2	Dartnell Road	11		1	1	1	1						
676	1133/REM	Dartnell Road	11		1	1	1	1						
677	613/1/2	Dartnell Road	11		1	1	1	1						
678	1539/29	Eagle Road	13		1	2	2	1						
679	1539/30	Tucker Road	11		1	1	1	1	1					
680	1539/31/REM	Tucker Road	13		1	2	2	1	1					
681	1539/31/62	Tucker Road	11		1	1	1	1						Consolidated with 680
682	1539/32	Tucker Road	13		1	2	2	1						
683	1539/33	Tucker Road	13		1	2	2	1						
684	1539/34/REM	Tucker Road	11		1	1	1	1						
685	1539/34/64	Tucker Road	1		1	0	0	0						Used by 684
686	1539/35	Tucker Road	11		1	1	1	1						
687	1539/36	Dartnell Road	11		1	1	1	1						
688	1539/37	Dartnell Road	11		1	1	1	1						
689	1539/38	Dartnell Road	11		1	1	1	1						
690	1539/39	Dartnell Road	11	22	1	2	1	1						Tuck Shop
691	1539/40	Eagle Road	11		1	1	1	1						
692	1539/41/61	Eagle Road	11		1	1	1	1						
693	1539/41/REM	Eagle Road	11		1	1	1	1						
694	1539/42	Eagle Road	11		1	1	1	1						
695	1539/43	Eagle Road	13		1	2	2	1						
696	1539/44	Eagle Road	11		1	1	1	1						
697	1539/45	Eagle Road	11		1	1	1	1						
698	1539/46	Eagle Road	11		1	1	1	1						
699	1539/47	Eagle Road	13		1	2	2	1						
700	1539/48	Eagle Road	11		1	1	1	1						
701	1539/49	Eagle Road	11		1	1	1	1				1		Being built
702	1539/50	Eagle Road	11		1	1	1	1						Vacant, just built
703	1539/65	Eagle Road	11		1	1	1	1						
704	1539/66	Eagle Road	1		1	0	0	0	1	1		1		For sale
705	1539/67	Eagle Road	11		1	1	1	1						
706	1539/53/60	Eagle Road	11		1	1	1	1						
707	1539/53/REM	Eagle Road	11		1	1	1	1						
708	1539/54/59	Eagle Road	11		1	1	1	1						
709	1539/54/REM	Eagle Road	13		1	2	2	1						
710	1539/55	Eagle Road	1		1	0	0	0	1	1		1		No dumping sign
711	1539/56	Eagle Road	1		1	0	0	0	1	1		1		Pressure Die Castings
712	1291/12	Willowton Road	32		7		0	1	1	1		1		MG Shoes
713	1291/14	Willowton Road	32		7		0	1						Anderson Eng., Food & Chem. Equip
714	1291/15	Willowton Road	32		7		0	1						Refrigeration Engineers
715	1291/46	Willowton Road	32		7		0	1						
716	1291/20	Willowton Road	32		7		0	1						Hardware Assemblies
717	1291/9/130	Willowton Road	32		7		0	1						Midlands Paper
718	1291/9/REM	Willowton Road	32		7		0	1						Jen Group, Corrugated Containers
719	1291/18	Willowton Road	32		7		0	1						KLN Bagging and Distribution, EPOL
720	1291/16	Willowton Road	5		7		0	1						Post Office, PMB Hub
721	1495	Willowton Road	32		7		0	1	1					Freewell, For sale

Parcel	Erf No.	Street name	USE 1	Use 2	Zoning	No. Struc	No. DU's	Struc condit	Overgrown	Litter	Junk	Dumping	Other	Comments
722	1445	Willowton Road	32		4		0	1	1					Total, Petrol Station
723	1413	Willowton Road	32		4		0	1	1					Total, Petrol Station
724	1481	Willowton Road	32		7		0	2	1	1				Austin Shoes (Pty) Ltd (appears vacant)
725	1487/1	Willowton Road	32		7		0	1						Natal Rubber Compounds (Pty) Ltd
726	3043/REM	Willowton Road	32		7		0	2						Vacant
727	3043/1	Willowton Road	32		7		0	1						Mini Factories (tyres, eng, clothing, etc.)
728	1412/REM	Willowton Road	32		7		0	1						The Natal Witness
729	1412/1	Dartnell Road	32		7		0	1						Scapa Scandia
730	1291/11	Mountain Rise D	1		1	0	0	0	1			1		Fenced at back
731	1291/12	Mountain Rise D	11		1	1	1	1						
732	1539/58	Tucker Road	2		1	0	0	0		1		1		No dumping sign, VIP toilet
733	82/3/16	Royston Road	11		1	1	1	1						
734	82/3/15	Sydenham Road	11		1	1	1	1						
735	1353/82	Sydenham Road	13		1	2	2	1						
736	1353/83	Sydenham Road	11		1	1	1	1						
737	1353/84	Sydenham Road	13		1	2	2	1						
738	1353/85	Royston Road	1		1	0	0	0	1	1		1		
739	1353/86	Shelley Cres.	11		1	1	1	1						
740	1353/87	Shelley Cres.	11		1	1	1	1						
741	13	Royston Road	11		1	1	1	1						Auto repairs
742	1353/94	Royston Road	11		1	1	1	1						
743	10	Cameron Cres.	11		1	1	1	1						
744	12	Shelley Cres.	1		1	0	0	0	1	1		1		
745	122/3/39	Royston Road	1		1	0	0	0	1			1		
746	122/3/40	Noodsberg Road	1		1	0	0	0	1			1		
747	122/3/41	Royston Road	1		1	0	0	0	1			1		
748	122/3/42	Royston Road	11		1	1	1	1						
749	122/3/43	Royston Road	11		1	1	1	1						
750	122/3/44	Royston Road	11		1	1	1	1						
751	122/3/45	Royston Road	1		1	0	0	0	1					
752	122/3/46	Royston Road	11		1	1	1	1						
753	122/3/47	Royston Road	11		1	1	1	1						
754	122/3/48	Royston Road	11		1	1	1	1						
755	122/3/49	Royston Road	11		1	1	1	1						
756	1133/4	Wolhuter Road	11		1	1	1	1						
757	3046	Royston Road	1		4	0	0	0	1	1		1		
758	1	Old Greytown Ro	8		2	0	0	0						Road island, well maintained grass
759	2	Old Greytown Ro	2		2	1	0	0				1		Open space, large trees, guard hut
760	3	Manning Ave./Mo	2		2	0	0	0	1	1		1		
761	4	Dartnell Road	74		2	2	0	1						Eddels Sports and Social Club
762	5	Dartnell Road	2		2	0	0	0	1	1		1		Open space, severe dumping on roadside
763	6	Ohrtmann Road	74		2	1	0	1						Clover SA Ohrtmann Road Sports Facility
764	7	Ohrtmann Road	3		2	0	0	0	1	1		1		
765	7	Ohrtmann Road	3		2	0	0	0	1	1		1		
766	9	Oaklands Road/K	73		2	0	0	0	1			1		Park equipment deterioratin
767	122/REM	Ohrtmann Road	2		1	0	0	0						ASG (developers) 429786/728
768	82/9/22	Rosedale Road	2		1	0	0	0						Servitude
769	75/8/REM	Rosedale Road	2		1	0	0	0						Servitude
770	11	Willowton Road	1		1	0	0	0						Open land, walled with barbwire
771	14	Ohrtmann Road	14		1	1	1	1						
772	15	Ohrtmann Road	14		1	1	1	1						
773	16	Ohrtmann Road	14		1	1	1	1						
774	17	Ohrtmann Road	14		1	1	1	1						
775	18	Ohrtmann Road	14		1	1	1	1						
776	19	Ohrtmann Road	14		1	1	1	1						



Mountain Rise - Town Planning Scheme

Residential
Industrial
Government
Limited business
Educational
Open space



Mountain Rise - Land Use Map (Survey)

- Yard
- Vacant land
- Retail - formal
- Park
- Other
- Institutional
- Sports Facility
- Communications
- Church/mosque/temple
- Industry - light
- Community Hall
- Residential - multi family
- Residential - flats/townhouses
- Residential - duplex
- Residential - single family

Figure 4.3. Example of image generated in GIS for Mountain Rise

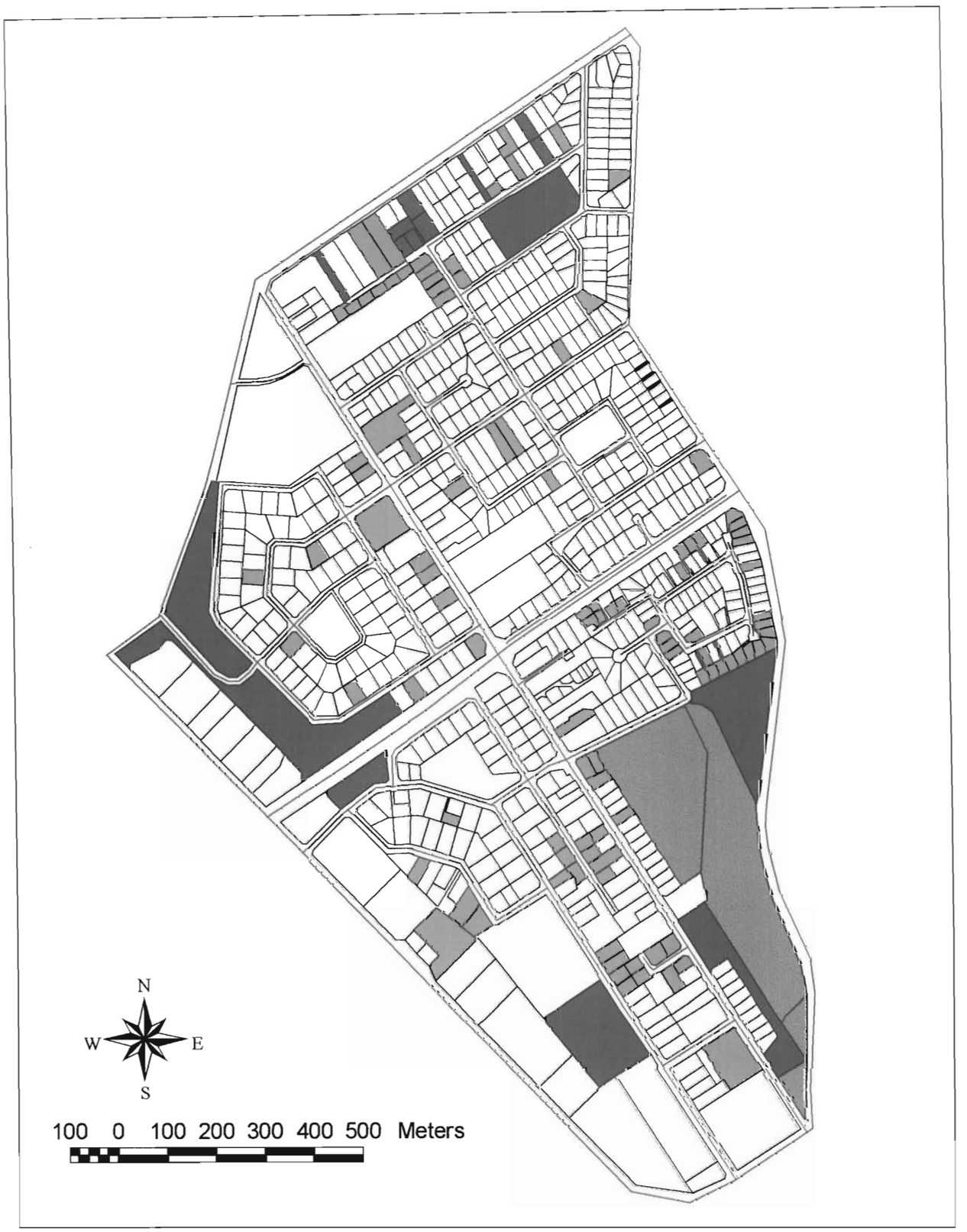
Mountain Rise - Alternative Land Uses

Formal retail

Informal retail

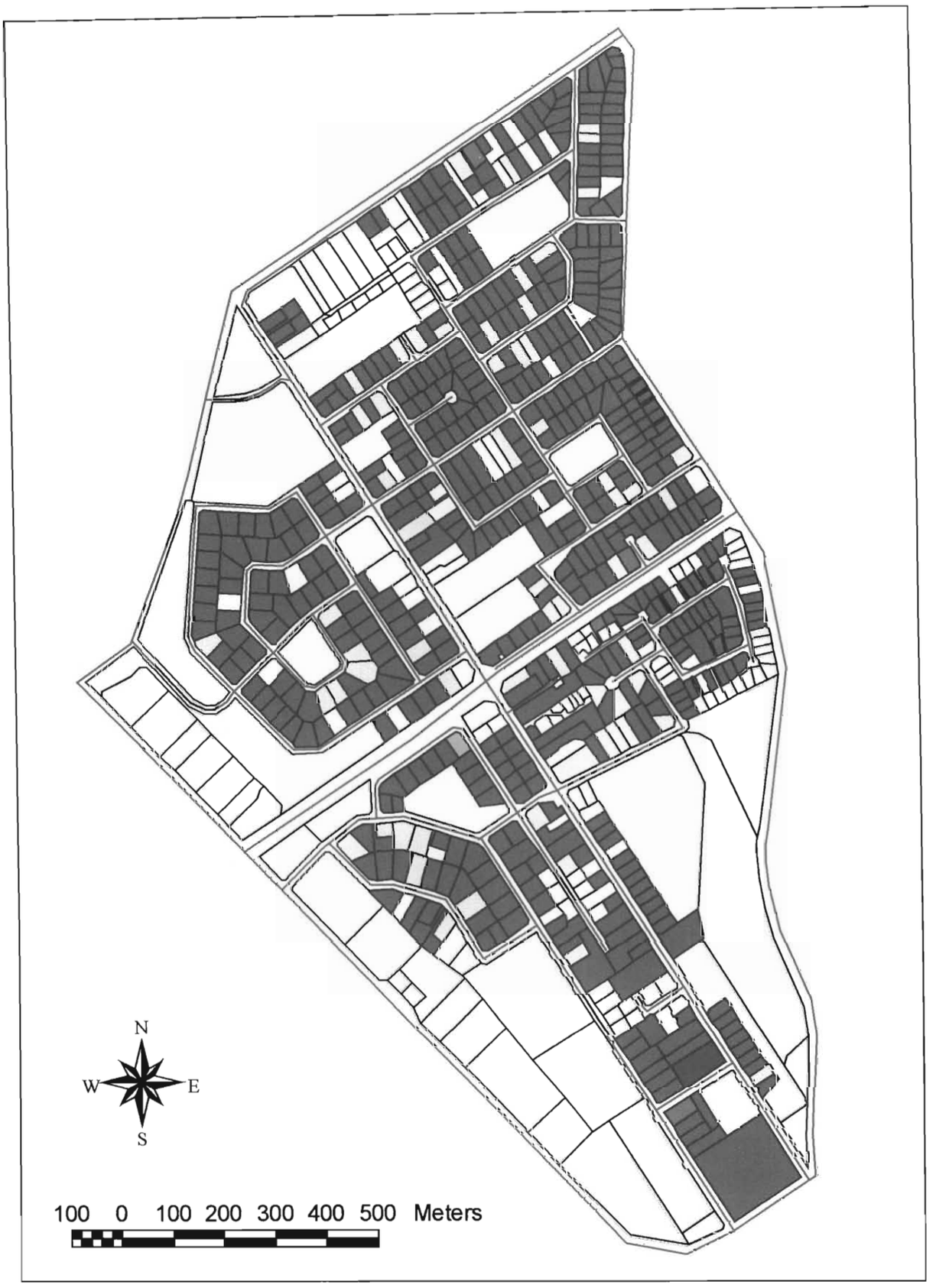
Other

Light industry



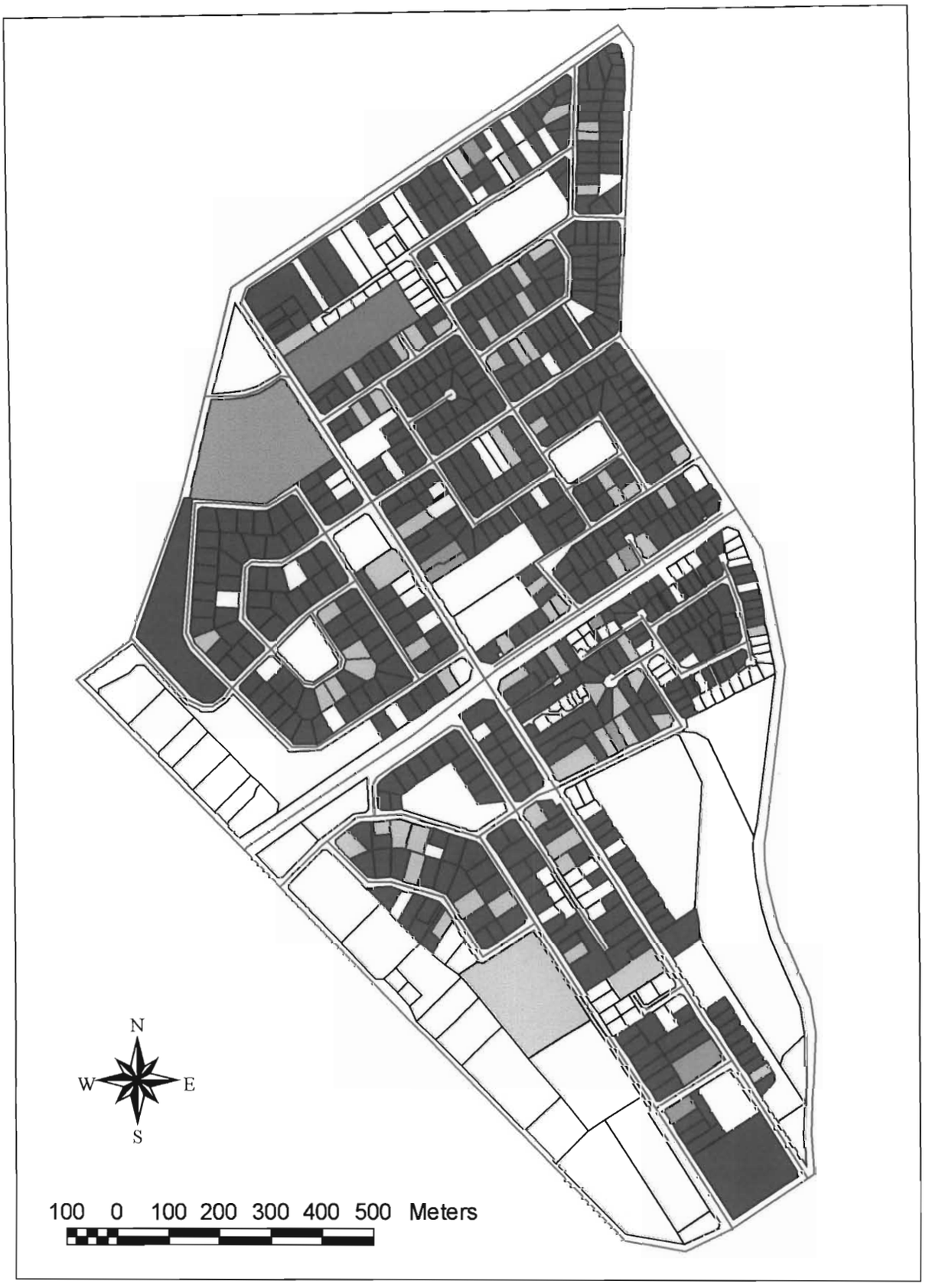
Mountain Rise - Vacant Land

- Privately owned
- Council owned
- Unregistered
- State owned



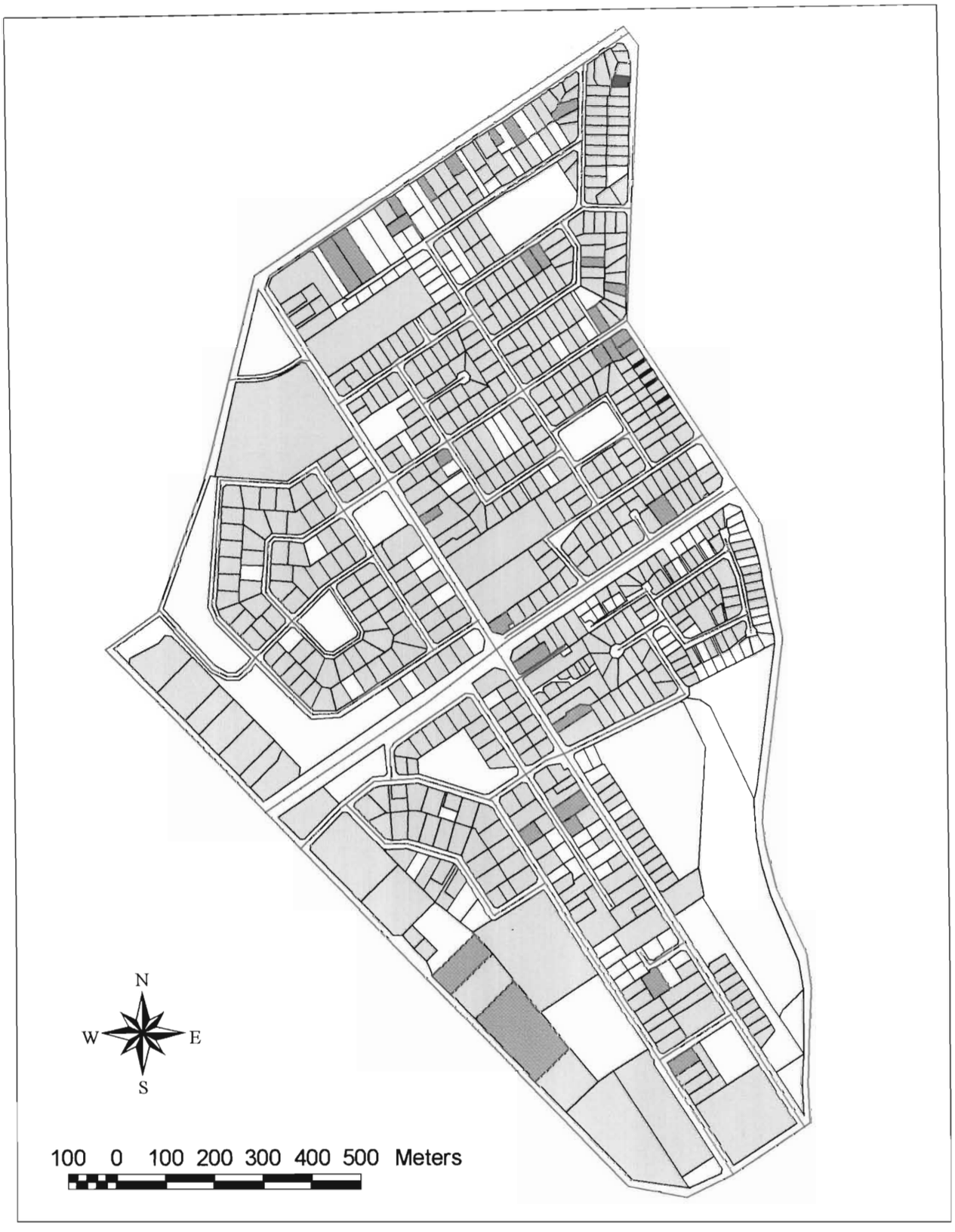
Mountain Rise - No. of Dwelling Units

One
Two
Three
Four
Sixteen



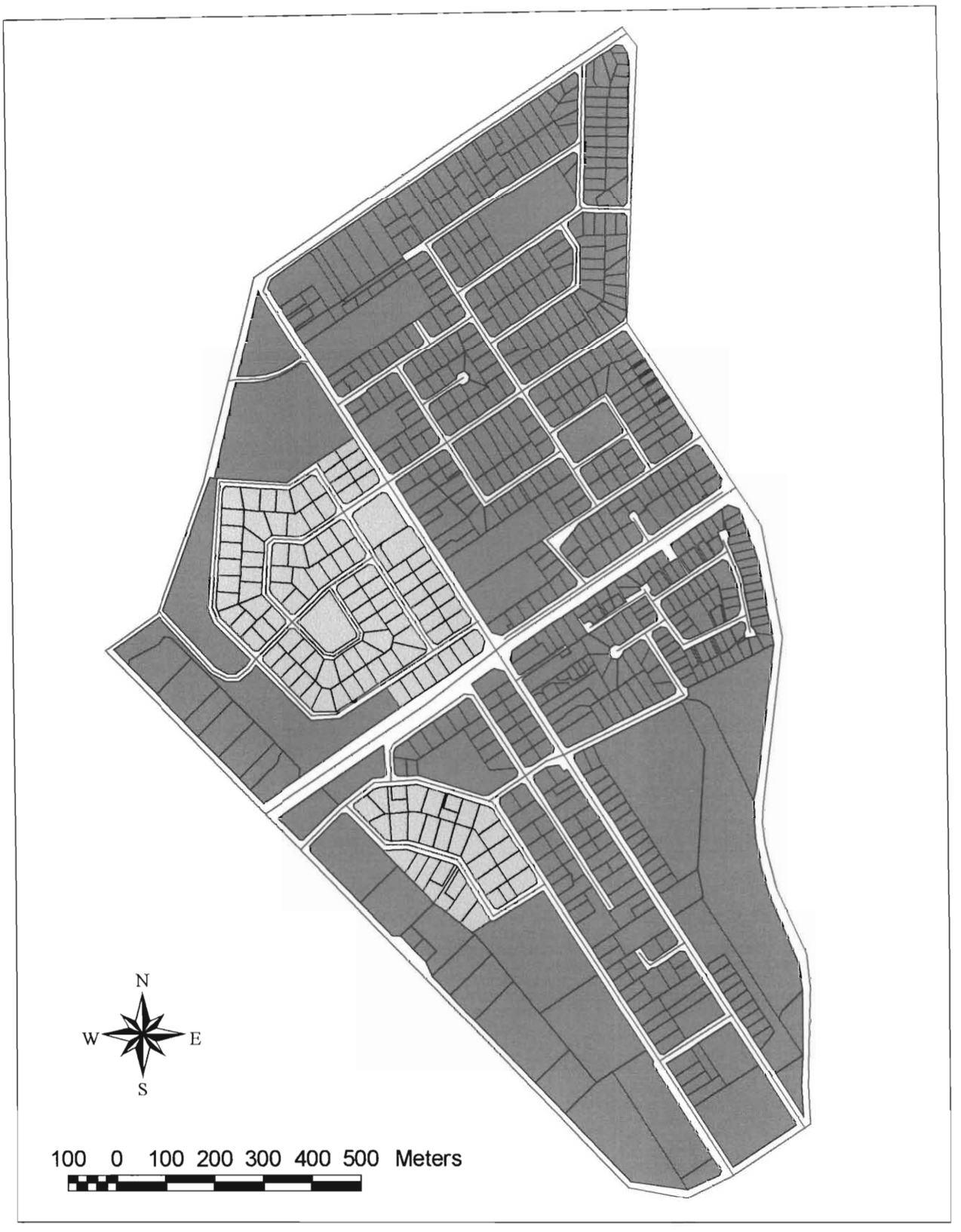
Mountain Rise - No. of Strucutures

One
Two
Three
Five
Sixteen



Mountain Rise - Structural Conditions

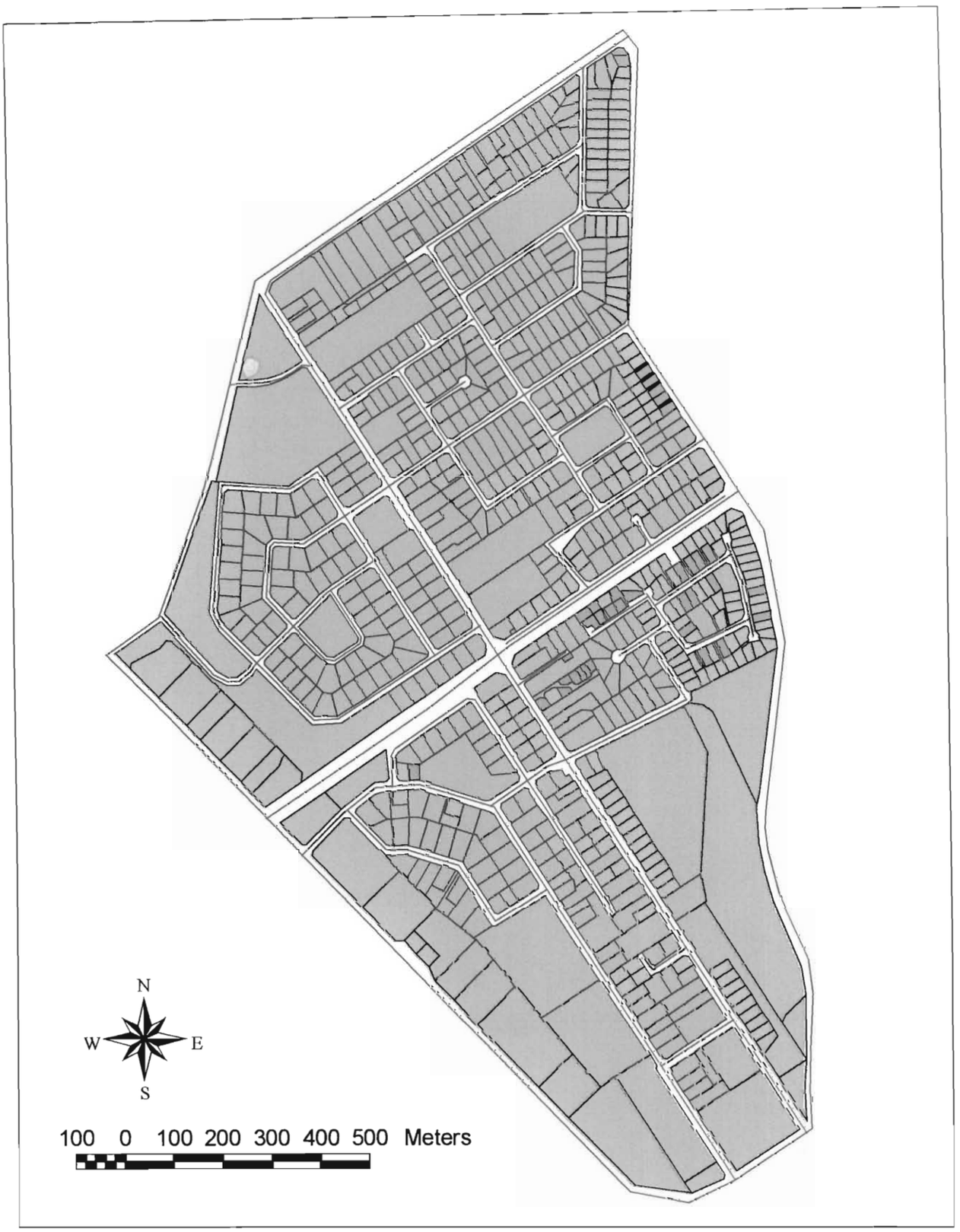
Sound Deteriorating Dilapidated



Mountain Rise - Minimum Plot Size

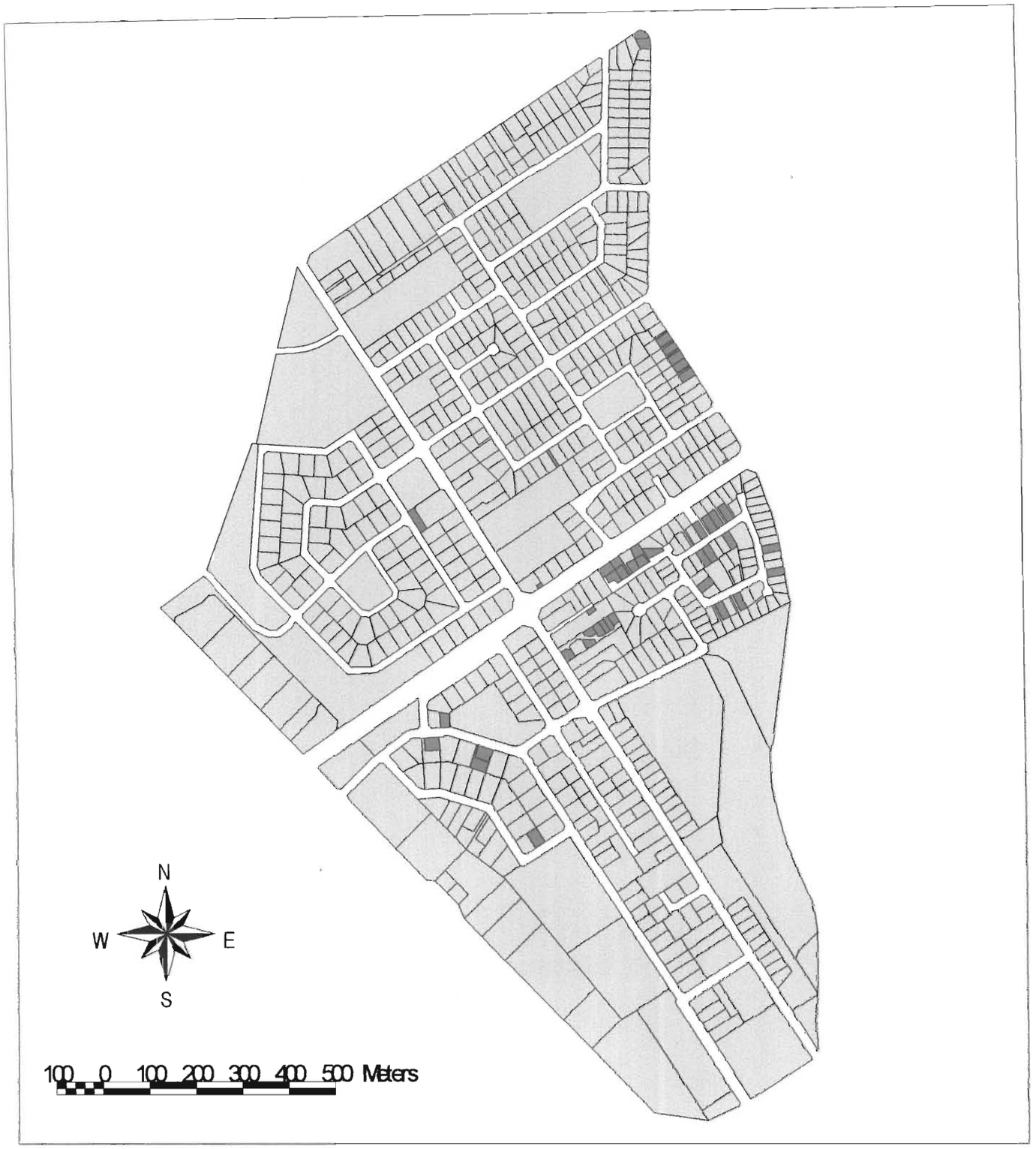
1000 m²

650 m²



Mountain Rise - Area of Plots

Plot Size < 650 m^2 | 650 m^2< Plot Size < 1000 m^2 | Plot Size > 1000 m^2

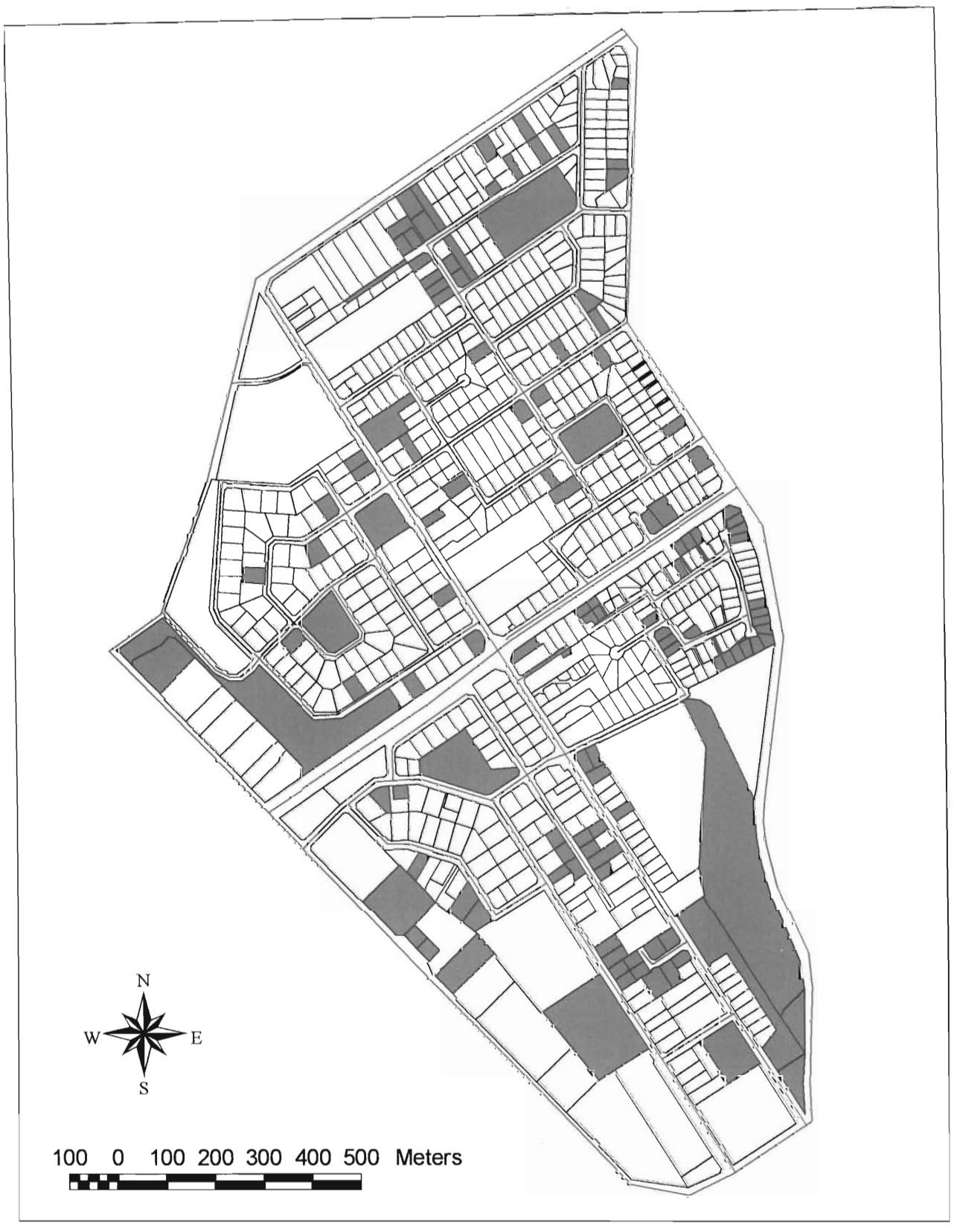


Mountain Rise – Incorrect Plot Size

Correct plot size

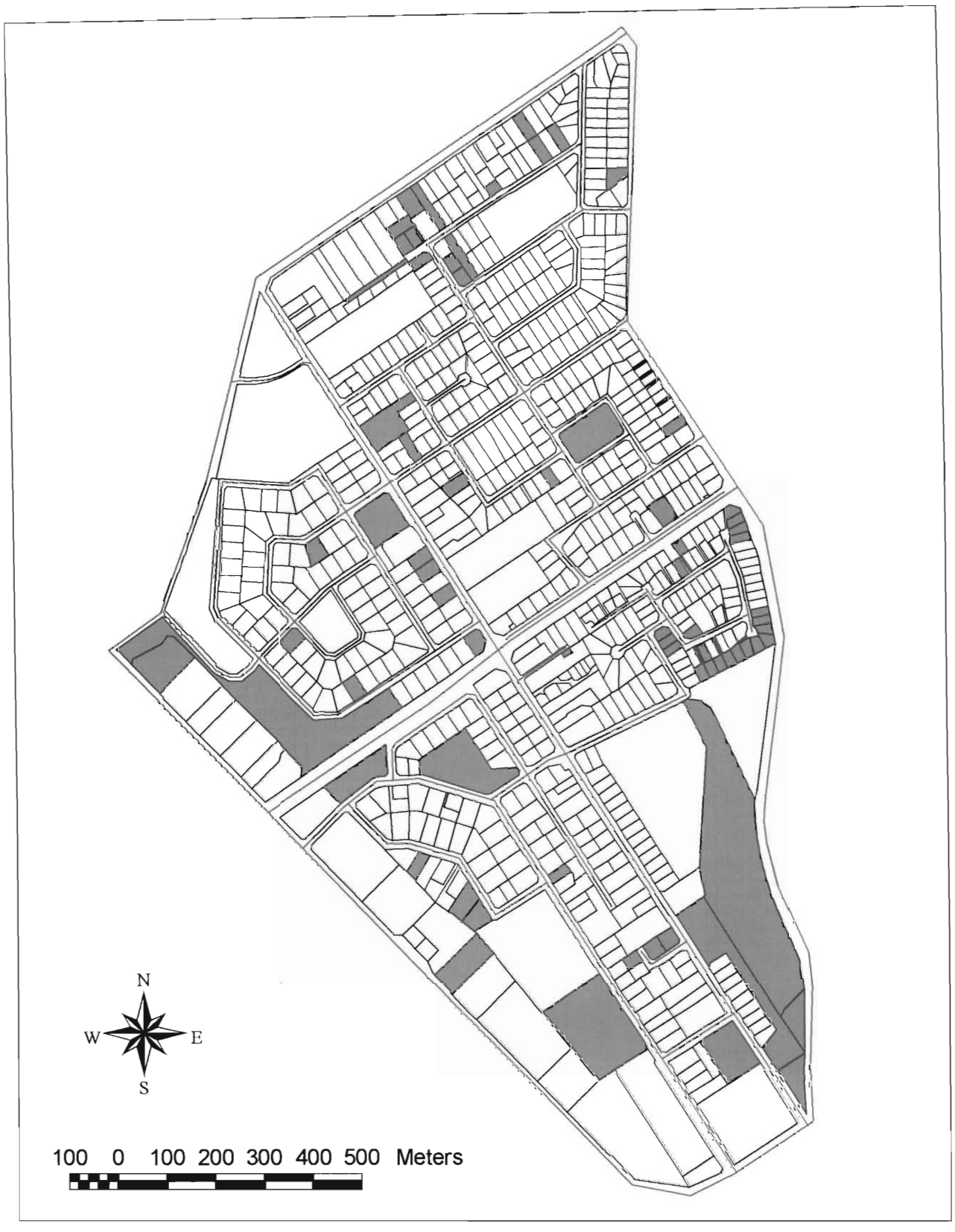
Incorrect plot size (<1000m²)

Incorrect plot size (<650m²)



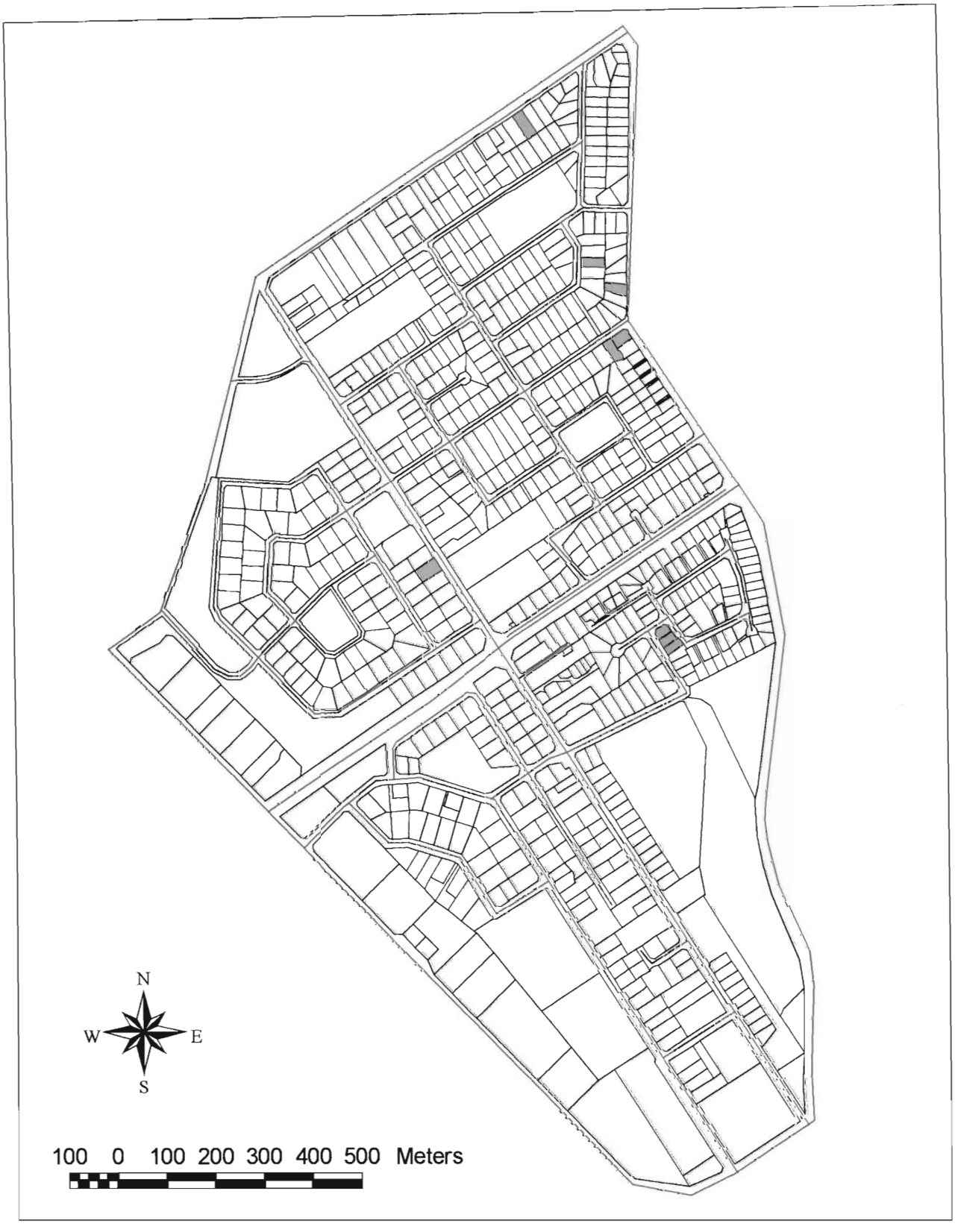
Mountain Rise - Overgrown and Weeds

Overgrown pavements and uncontrolled weeds



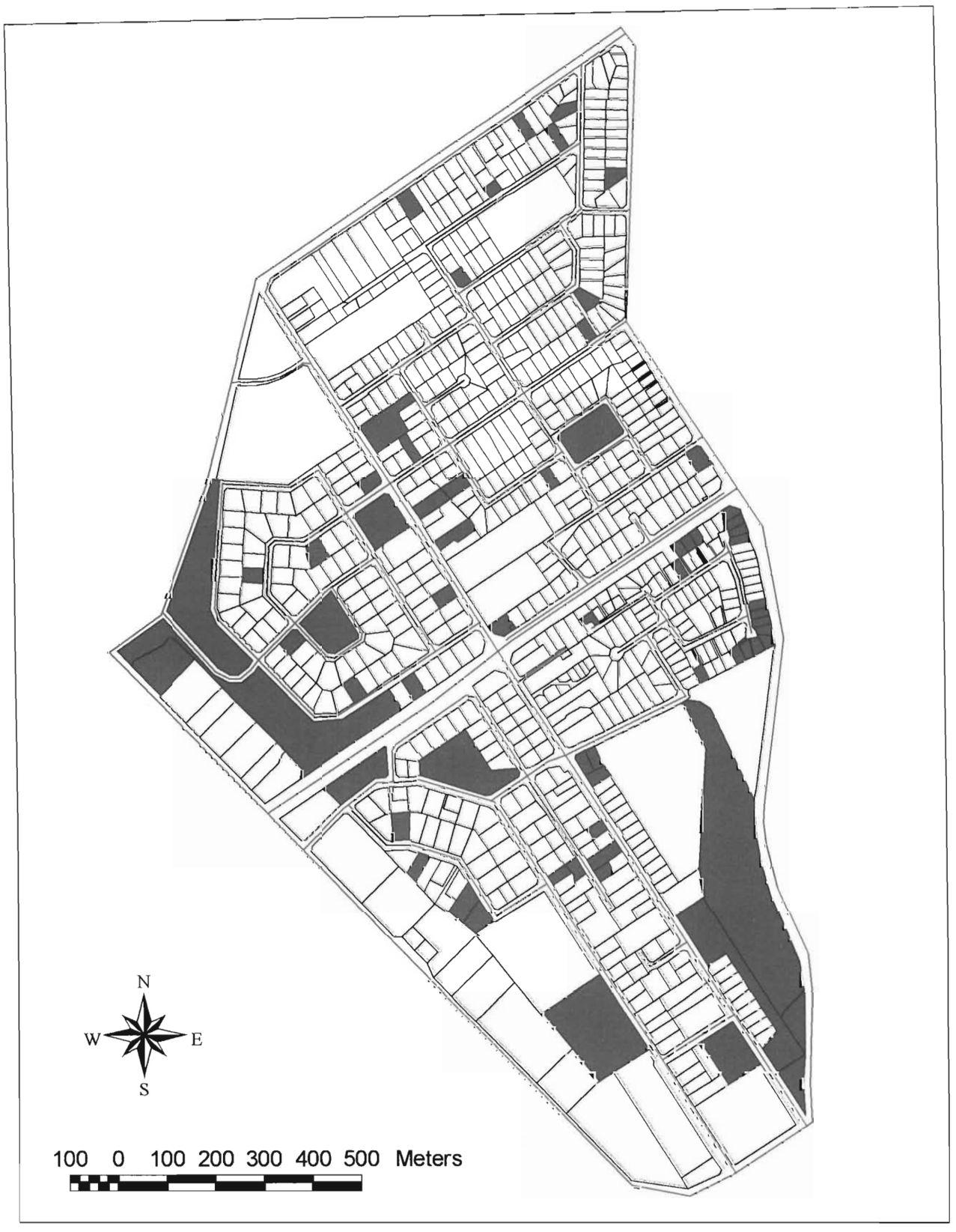
Mountain Rise - Litter

Properties with extensive litter



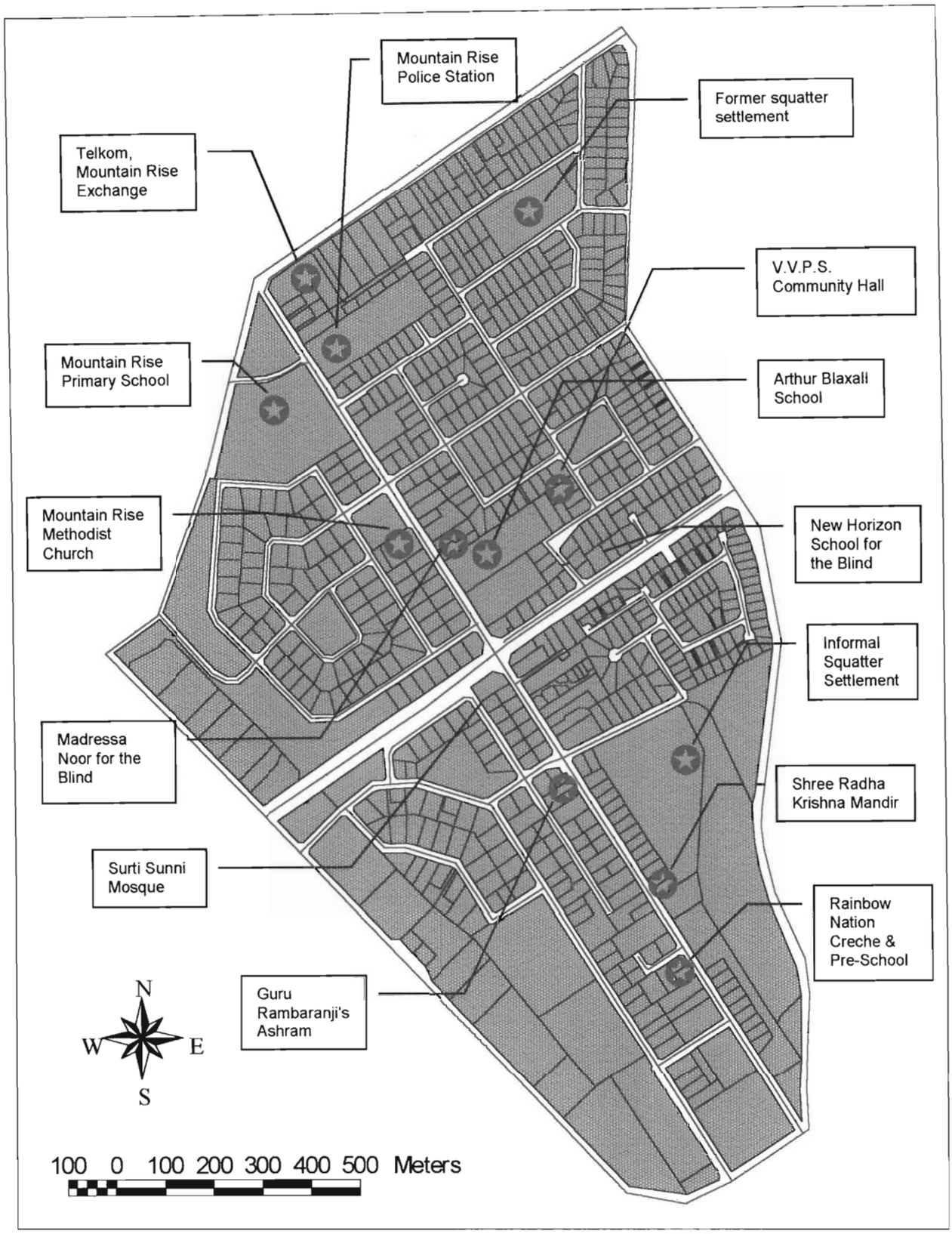
Mountain Rise - Junk

Plots containing junk (old motor vehicles, appliances, etc.)



Mountain Rise - Illegal Dumping

Plots with illegal dumping

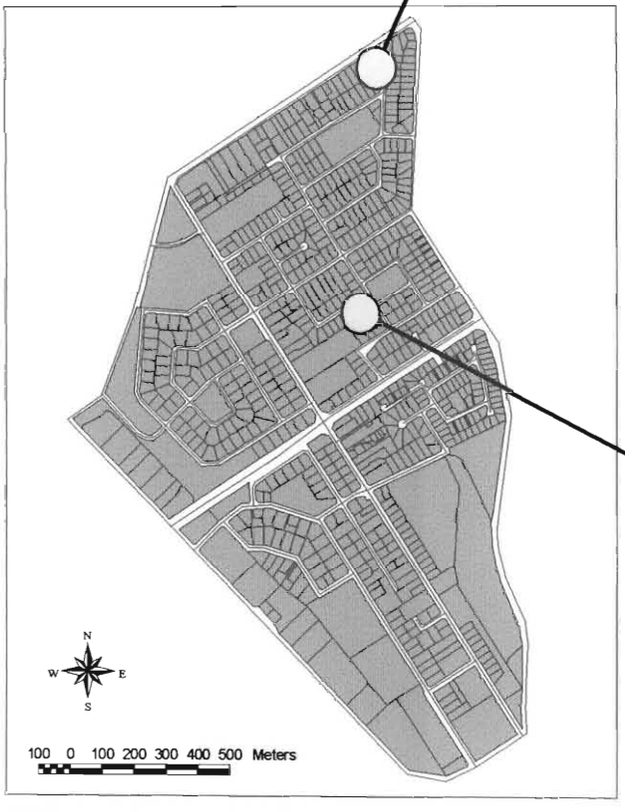


Mountain Rise - Social and Religious Facilities

Plots

Social and Religious Facilities

Parcel no.	75
Erf no.	75/25/32
Street name	Peter Hey Road
Land use 1	Single family res.
Land use 2	-
Zoning	Residential
No. of structures	1
No. of dwelling units	1
Structural condition	Good
Environmental conditions	-



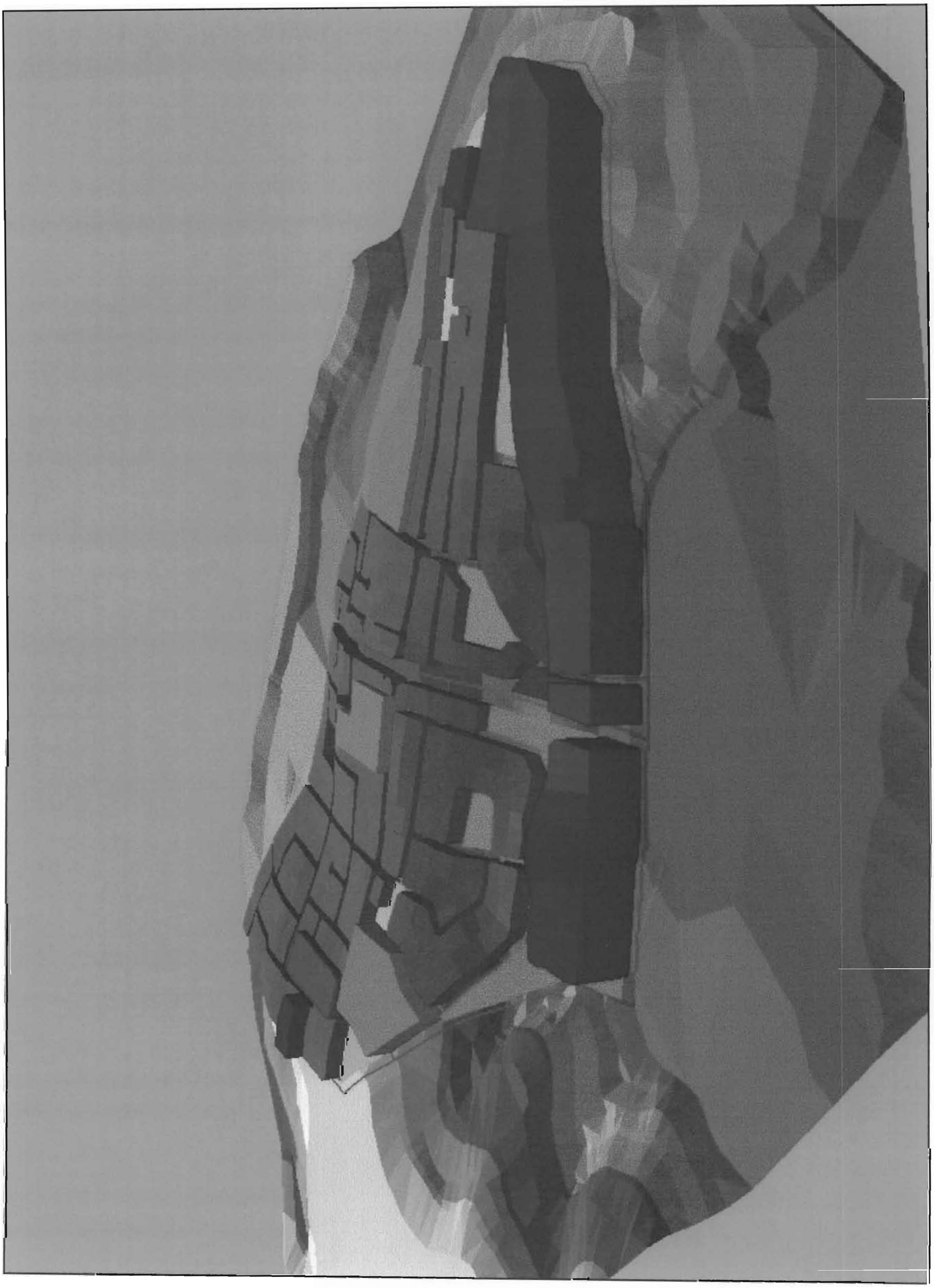
Mountain Rise Suburb, Pietermaritzburg

Plots Roads (centre line)

Parcel no.	353
Erf no.	83/8/34
Street name	Shelley Crescent
Land use 1	Vacant (private)
Land use 2	
Zoning	Residential
No. of structures	0
No. of dwelling units	0
Structural condition	-
Environmental conditions	Overgrown, litter & illegal dumping

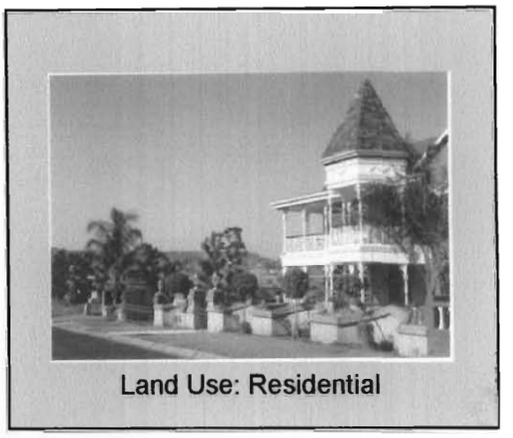
Illustration of GIS query

APPENDIX E(3)

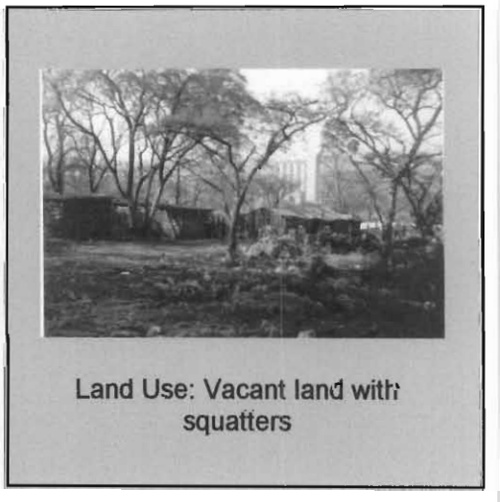


Digital Elevation Model (DEM) of Mountain Rise, Pietermaritzburg

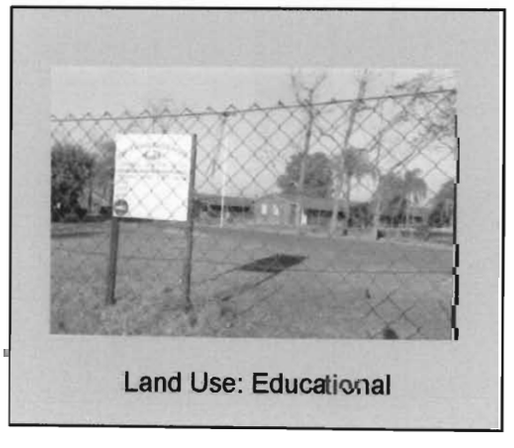
Land Use: Retail



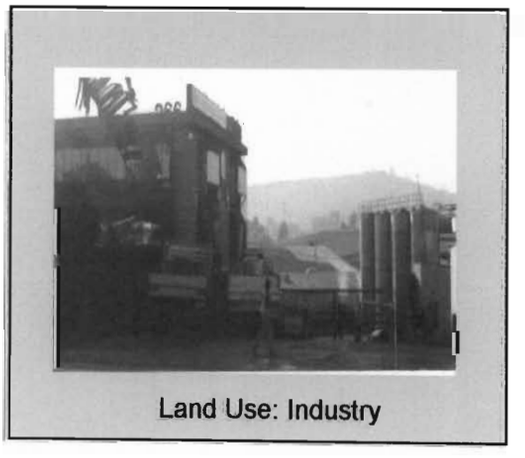
Land Use: Residential



Land Use: Vacant land with squatters

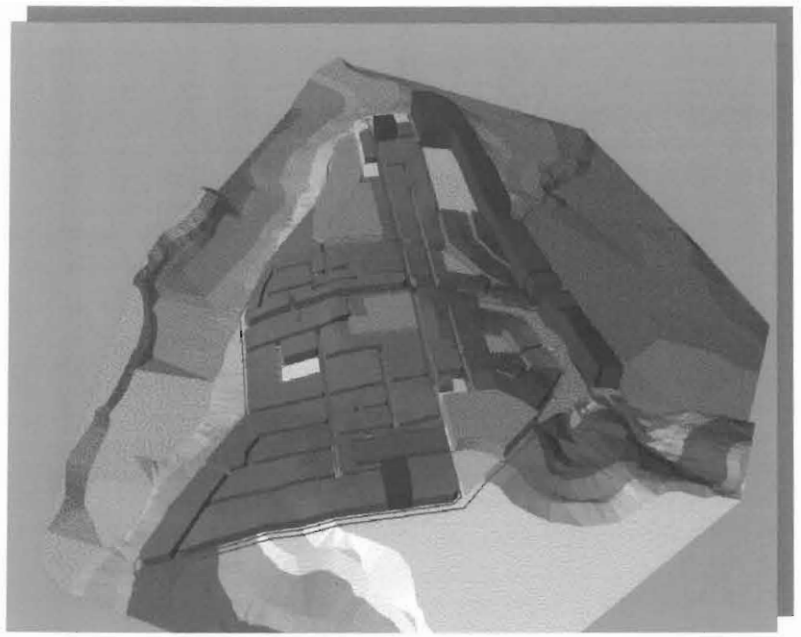


Land Use: Educational



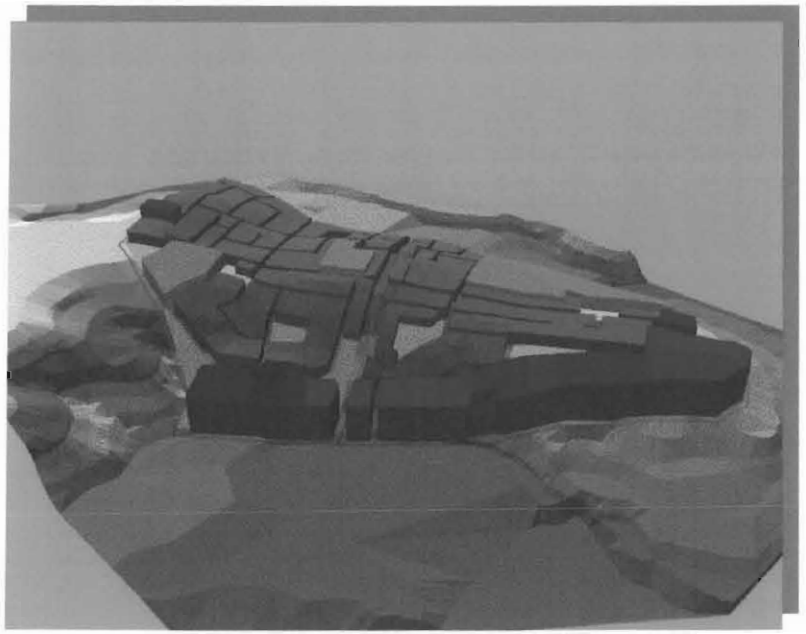
Land Use: Industry

3D View Land Use Image

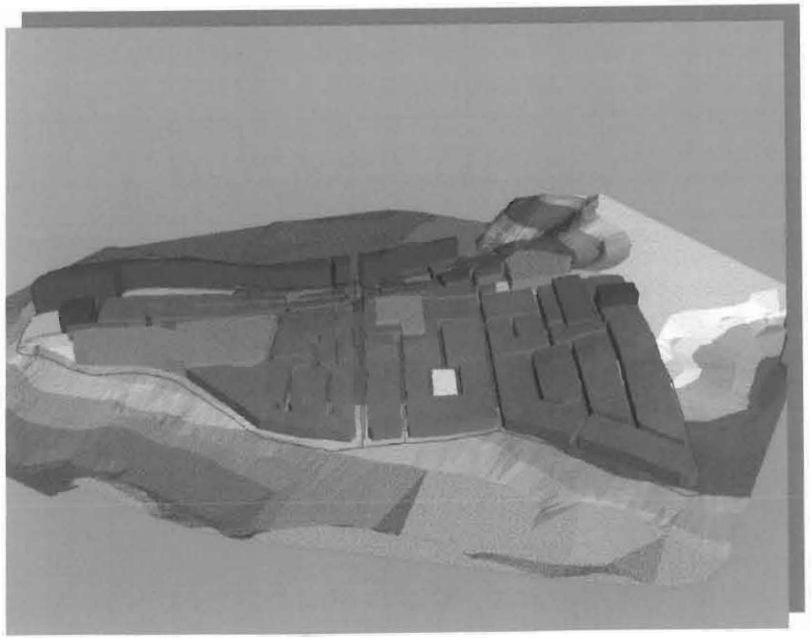


3D View from the North

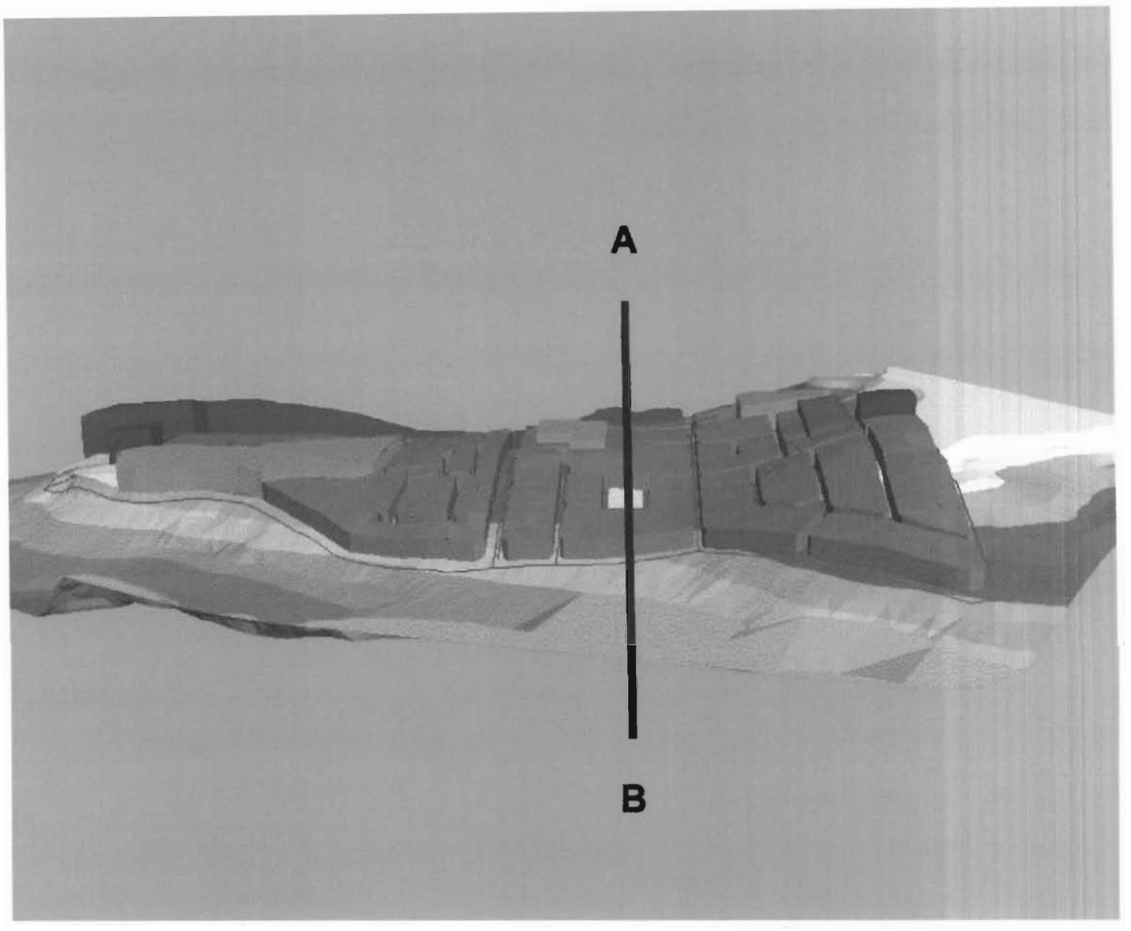
3D View from the South



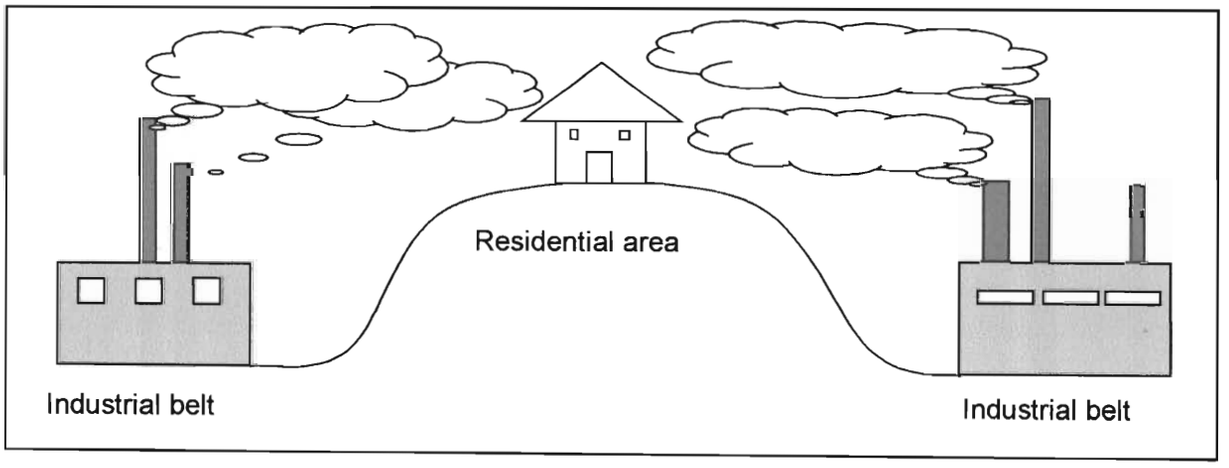
3D View from the West



3D View from the East

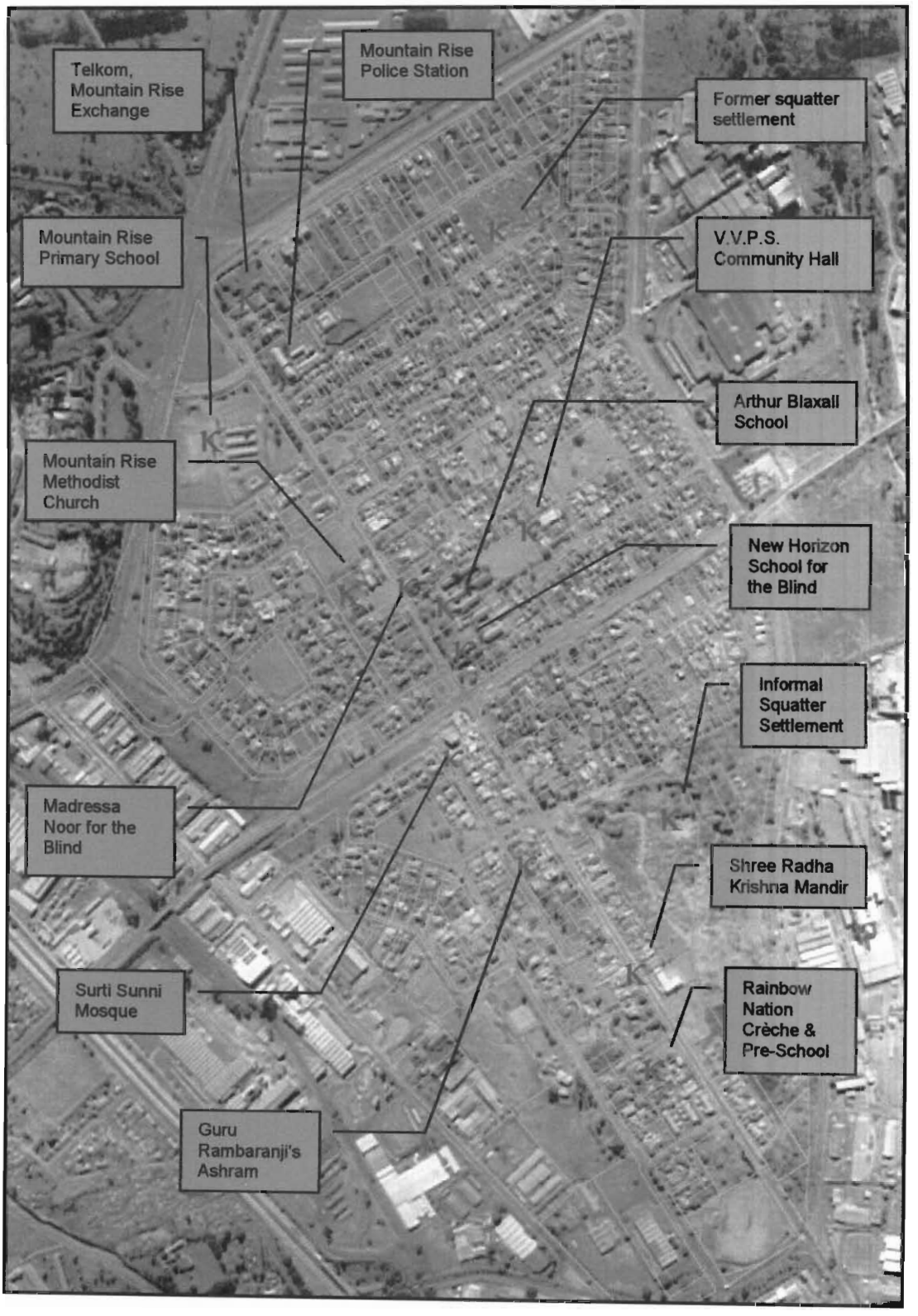


3D View from the East of Mountain Rise showing that the height of the smokestacks from the industry are at the same level as the residential homes. This is illustrated in the diagram below.



Cross Section AB

Digital cadastral data overlayed on aerial photograph of Mountain Rise



Mountain Rise - Social and Religious Facilities

Community Questionnaire

Mountain Rise Suburb

1. **Name (optional):** _____

2. **Occupation:** _____

3. **How many years have you lived in Mountain Rise?** _____

4. **Are you a member of any associations in Mountain Rise?**

   YES / NO

   If yes, please list below:

   (a)_____

   (b)_____

   (c)_____

   (d)_____

5. **What position(s) do you hold in the above association(s)?**

   (a)_____

   (b)_____

   (c)_____

   (d)_____

6. What are the responsibilities of the association to which you belong?

7. Have you had any dealings with the Pietermaritzburg Transitional Local Council (TLC)? If so, in what capacity?

8. Are you familiar with the procedures involved should you wish to make a development application to the Transitional Local Council?

YES / NO

9. Are you aware of any mechanisms, if any, that are in place to facilitate communication between the community and the Transitional Local Council? (please specify)

10. What are your views on the current living standards of the people in Mountain Rise?

11. In your opinion, does Mountain Rise have adequate access to facilities (social, health, recreational, etc.)?

12. If no, what additional facilities do you feel are needed?

(a)_____

(b)_____

(c)_____

(d)_____

(e)_____

(f)_____

(g)_____

(h)_____

(i)_____

13. In your opinion, what are the most pressing problems in Mountain Rise? (please list in order of priority)

(a)_____

(b)_____

(c)_____

(d)_____

(e)_____

(f)_____

(g)_____

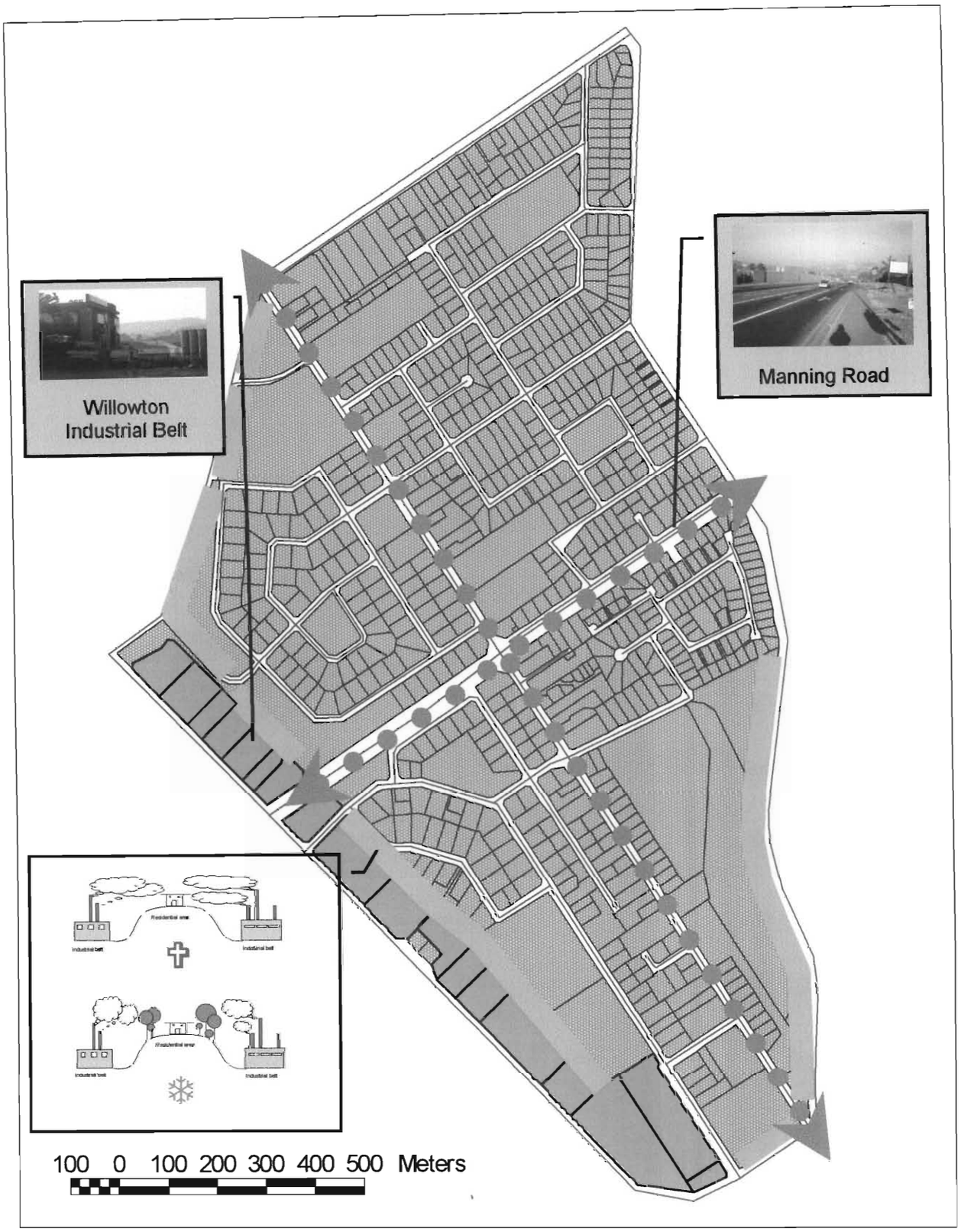
(h)_____

(i)_____

(j)_____

Thank you for taking the time to complete this questionnaire

Duncan McConnachie
School of Environment and Development
University of Natal, Pietermaritzburg
Tel. Home: (0331) 943979
University: (0331) 2605663

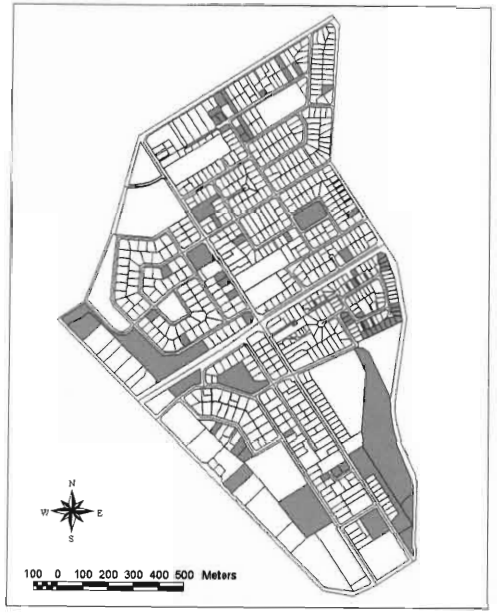


Mountain Rise - Environmental Alternative (a)

Rezoning of Willowton Industrial Belt to non-polluting land use

Tree planting along street pavements

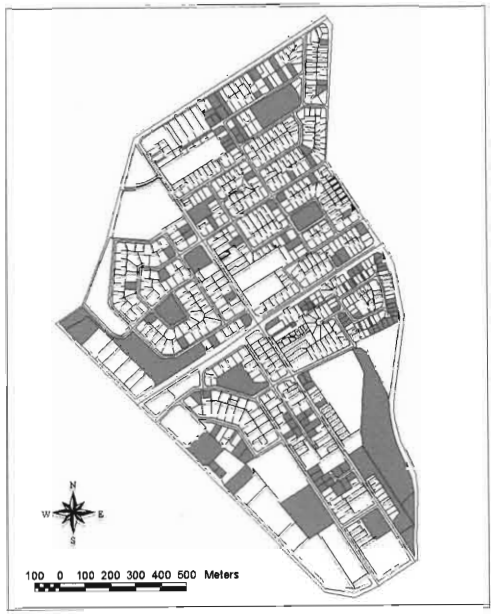
Green Belt (construction of burns & tree planting)



Mountain Rise - Litter

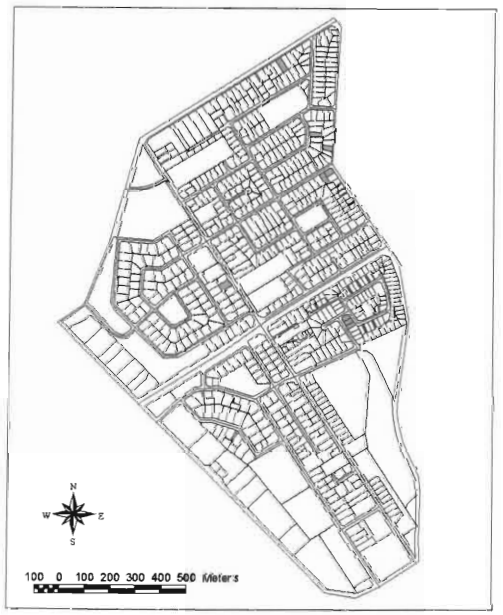
Properties with extensive litter

- The TLC should ensure that sidewalks are cut regularly and that rubbish and junk that has been illegally dumped is cleared;
- No dumping signs should be placed on all council and state owned land;
- Owners of vacant land must be fined by the TLC if they fail to maintain their properties



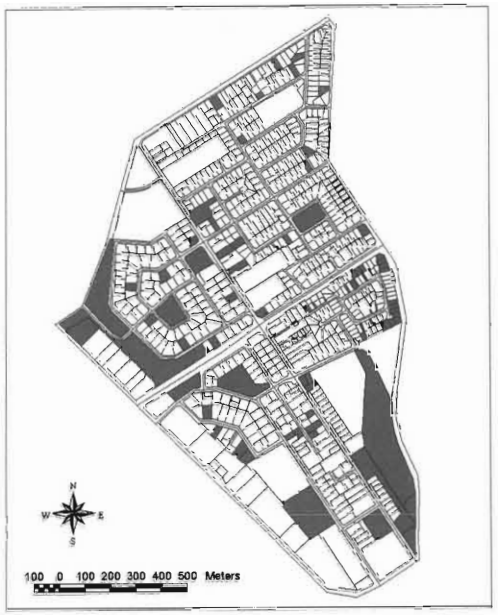
Mountain Rise - Overgrown and Weeds

Overgrown pavements and uncontrolled weeds



Mountain Rise - Junk

Plots containing junk (old motor vehicles, appliances, etc.)

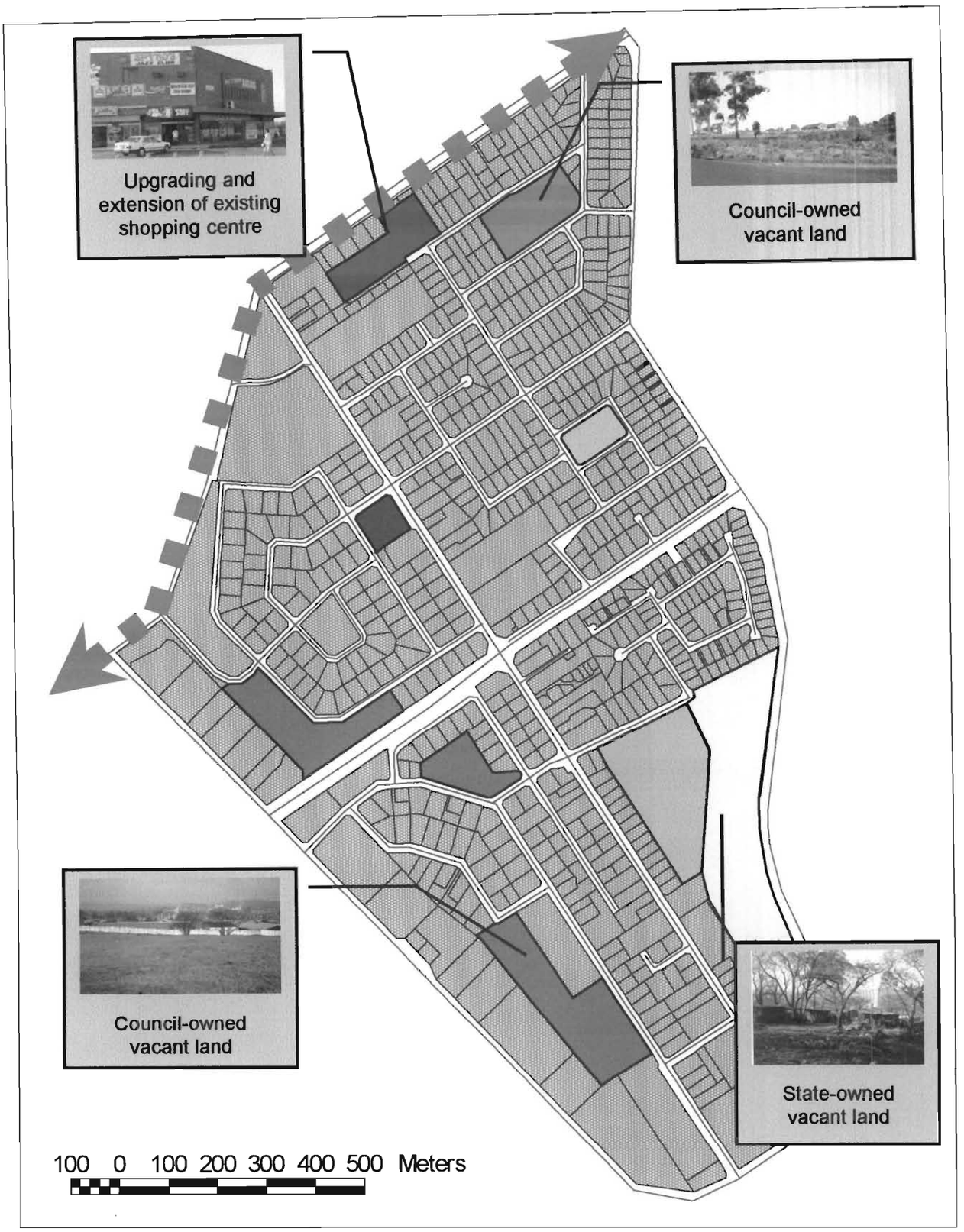


Mountain Rise - Illegal Dumping

Plots with illegal dumping

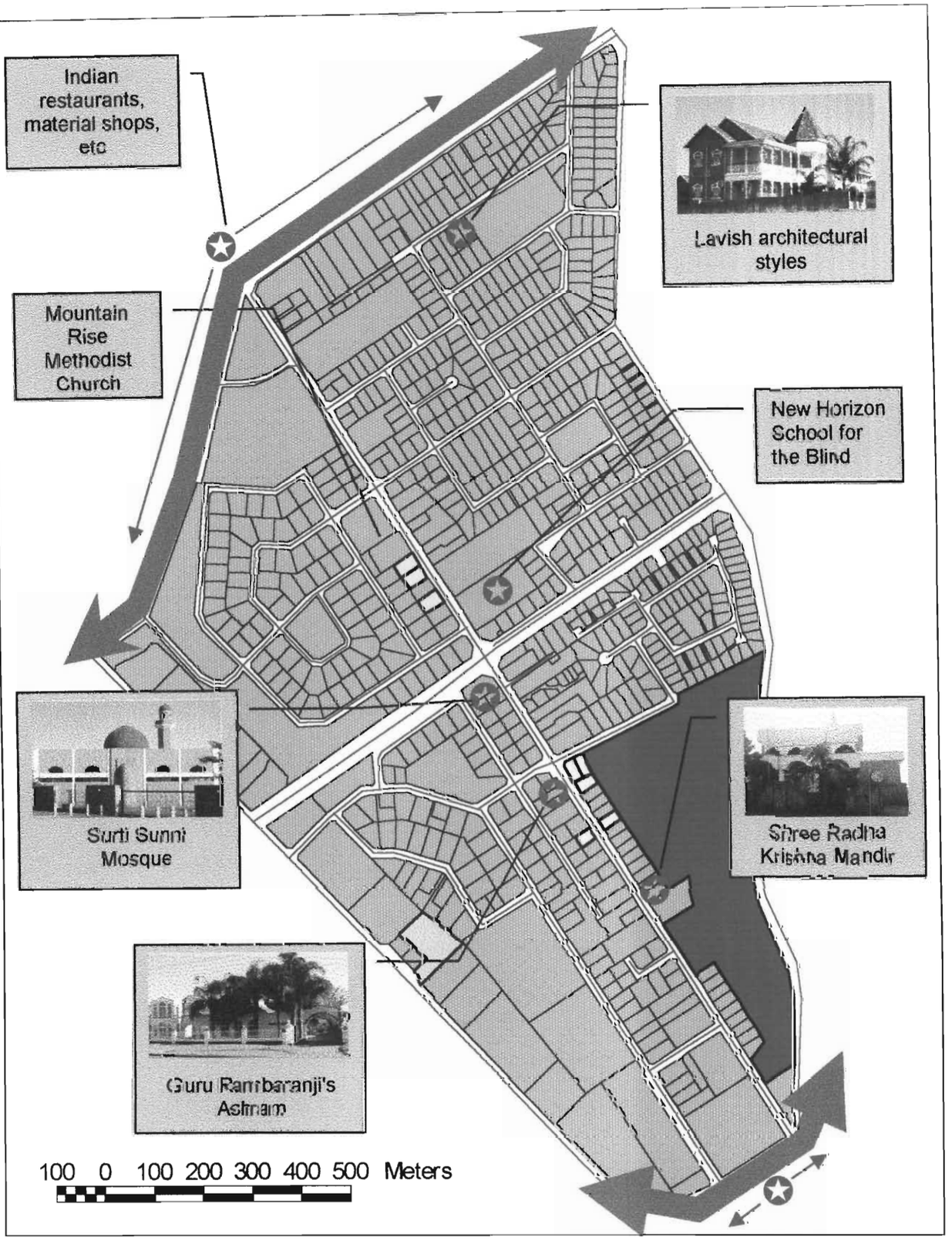
Mountain Rise - Environmental Alternative (b)

APPENDIX G(2)



Mountain Rise - Social Alternative

- Low cost housing estate
- Middle income cluster housing
- Shopping center
- Community park
- Home for the aged
- Crèche & pre-primary school
- High school
- Public transport route



Mountain Rise - Tourism / Economic Alternative

- Office park
- Possible Bed & Breakfasts
- Activity corridor (upgrade road & urban design)
- Cultural centre
- Cultural tour (places of interest)

IMPLEMENTATION GUIDE FOR PARCEL-BASED GIS IN PIETERMARITZBURG LOCAL GOVERNMENT

(Adapted from Implementation Guide for Parcel-Based GIS in Minnesota Local Government, Undated)

1. Learn about GIS

- The person who implements GIS does not necessarily have to be a GIS expert. However, he/she must be well enough informed to describe its benefits to potential users and elected officials and to make intelligent choices about standards, hardware, software, staff and consultants. It is crucial that he/she investigate other case studies of GIS implementation in similar environments to his/her own, so that any pitfalls can be avoided up front.

2. Organise for GIS investigation

- A core group must be organised that will see the GIS implementation through to completion.
- Almost every successful implementation owes its success to a relatively small group of people that includes the following:
  - An organisational 'champion' with sufficient influence or authority to get the necessary resources;
  - Technical people who made the technology produce results; and
  - A small circle of supporters and co-operators.
- This core group should be informal and cross organisational boundaries.
- The group must share a belief in the benefits to be realised from the technology and a willingness to work for these benefits.
- A formal structure should be created around this core group.
- This will provide an organisational entity for the group's activities and cause it to be recognised by the larger organisation.
- The GIS committee should work in two key areas:
  - Building organisational and political support for a parcel-based GIS; and

- Creating, then implementing, a plan for parcel-based GIS.
- The above two tasks are highly interrelated. The nature and extent of political support will determine how ambitious the plan can be. The quality of the plan and the incremental success of the implementation will add or detract from political support.

3. Set goals

- The most successful and cost effective GIS implementations are those that proceed, according to a well thought out plan, toward clear goals, while maintaining and increasing political support.
- To assist you in this regard, some goals should be included that can be achieved relatively quickly and will thus clearly demonstrate the value of your GIS efforts.
- Practical examples have shown, however, that the most successful implementations were able to achieve a balance between these short-term demands and the progress towards longer-term goals.

4. Build support

- Political support is defined as support within the various departments of the local government and support by elected officials.
- Your efforts at persuasion can be enhanced by learning the uses that departments make of spatially linked information, difficulties they encounter, and the major resources they consume.
- You should attempt to show department heads how GIS can help them in the above-identified areas, while not threatening key arrangements and relationships within the respective department.
- You should visit similar units of government that have successfully implemented GIS, as well as attending conferences and organising vendor demonstrations.
- An attempt should be made to include department heads and/or elected officials in the GIS committee.
- Get them to commit to a certain level of involvement and specific support and resources.

5. Identify needs

- Planning should begin with an assessment of needs.
- You should begin with a survey of the potential users. They should be asked at least the following questions:
  - What maps do they use, when do they use them, and why?
  - What map needs are unmet by current practices?
  - What tabular data do they use, when do they use it and why?
  - What tabular data needs are unmet by current practices?
  - What potential links to map locations currently exist in their tabular data (e.g. street addresses)? How complete and accurate are these potential links?
  - How much of this map and tabular data is currently in digital form and in what digital formats?
  - Who maintains the map and tabular data in whatever form it is in? How available is it?
  - How complete and accurate is the map and tabular information they use? How complete and accurate should it be?
  - How often must you create maps and table of information? How important is the ability to do this easily?
  - What are the main challenges the department must cope with now and in the foreseeable future? Does or can spatial information play a role in meeting these challenges?
- Once the information obtained from the above survey has been distilled, the needs can be summarised. You then need to establish which of these needs a GIS can satisfy. Once these questions have been answered, you will have the outline of your GIS needs. (This reinforces the fact that GIS should be tailored to meet the varying needs of the different departments, and not vica versa)

6. Identify resources to meet needs

- You will need access to GIS resources to accomplish your objectives. Your options include:
  - Doing all GIS processing, data conversion, and viewing and mapping in-house.

- Doing much GIS processing, data conversion, and viewing and mapping in-house and obtaining the balance from others.
- Obtaining GIS processing services and/or data from others while developing viewing and mapping capability in-house.
- Obtaining all GIS services from others.
- Contracting can be particularly useful to satisfy extraordinary or one-time needs that do not warrant an investment in hardware, software and staff.
- Contracting may also be the solution for units of government that do not have a level of need that justifies even a minimum investment in GIS processing capabilities.
- A conservative approach for many local units of government might be to begin with option three, progress to option two and then, if justified, to option one.
- Advantages of this approach include giving staff and decision makers more time to learn about the benefits and requirements of GIS, by doing useful things with it, before they must commit to developing GIS processing and data conversion capability in house.

7. Estimate costs

- The most effective way to determine the cost of implementing a GIS is to talk to other similar organisations around the country with established systems.
- With GIS providing a range of benefits and replacements for other normal activities, as well as new benefits and capabilities, it is difficult to get an agreement on what should be included in the cost calculation. Listed below are some factors to consider:
  - Software, hardware and systems;
  - Data (purchasing existing data and converting to digital data);
  - Staffing (likely to be your single biggest investment in the long run);
  - Training (GIS software)
  - Applications (customisation of the GIS software)

8. Review goals

- After estimating the costs of your plan, review and, if needed, revise the initial goals you set.
- Your goals should describe how you want the GIS to function in and contribute to your unit of government and the public that it serves.
- Once your goals (they can alternatively be called vision or mission statements) have been set, you will need to plan the means for their accomplishment.

9. Set realistic objectives

- At this point, you should have determined your GIS needs, the GIS requirements to satisfy them, and the costs of these requirements.
- Now you must reconcile the needs with the costs. In other words, the needs list has to be streamlined, rationalised, and prioritised.
- This list will then be used to formulate specific objectives for your GIS that are in balance with your resources and will realise your goals.

10. Organise for GIS implementation

- A good model to be followed for an organisational structure for GIS implementation consists of three groups: a policy team, a technical team, and a user group.
- Policy team
    - Provides policy direction and makes organisational and cost allocation recommendations.
    - It also lobbies co-operation and participation from all departments and external stakeholders.
    - It provides liaison with those outside of the governmental unit, such as other local authorities, public utilities, private industry, and regional organisations.
    - It explores the possibilities for data, staff, and cost sharing with the above organisations and among departments within the unit of government.
    - It makes arrangement for data acquisition.

    - It also plans for the allocation of GIS services among the various interested parties, determining services offered, service policies, priorities, prices, and related issues.
    - The policy team has the final say about needs and terms, selecting vendors and contractors.
    - Lastly, they need to consider the legal aspects of data sharing.
- Technical
    - This team addresses the technical aspects of the implementation.
    - It is concerned with GIS design, including hardware and software configurations, staffing, data layers, database design, data access, and data security procedures.
    - It will also consider standards of accuracy, precision, and control.
- Users
    - This team, comprising of all interested parties, identifies user issues and makes recommendations to the Policy and Technical teams.
    - It disseminates information about the GIS implementation and increases potential users' knowledge about GIS.

11. Plan for GIS implementation

- Institutional relationships
    - You must continue to establish or strengthen institutional relationships that will support the GIS effort.
    - Relationships will need to built with those organisations and departments within or outside of your unit of government that stand to benefit from the GIS and can contribute to its success.
    - Due to the likelihood of some staff members or managers resisting the new technology, establishing and solidifying institutional relationships is one of most crucial and difficult steps in the entire process.
- Service delivery
    - Thus far you have consulted potential beneficiaries of the GIS, determined their needs, refined your overall goals, and set objectives.

    - Now it is time to determine the kind, amount, and distribution of services that will be provided and who will be responsible for providing them.
- Software and hardware overview
    - Software and hardware are too often seen as the primary focus of GIS planning, in place of GIS needs and objectives.
    - The following issues should be discussed with your computer staff and software and hardware vendors: hard drive capacity; backup and data exchange; processing capacity; video display; plotters and printers, and PC versus UNIX workstation.
- Systems typology
    - A decision will have to be made whether data will be stored on individual workstations, or whether all computers will be networked and data accessed off a central server.
- Software and hardware support and upgrades
    - It is advisable that a maintenance contract is taken out for both software and hardware.
    - This will ensure that software is upgraded as new versions become available and that hardware is kept "up and running" without any costly delays.
- Revise cost estimates
    - When the GIS design has progressed to this point, you should consult GIS vendors, showing them you plans and asking them to provide detailed specifications and prices for the software and hardware.
- Funding
    - You plan should also address sources of funds for the GIS effort.
- GIS design
    - This will include: standards (co-ordinate system and projections, datum's, geodetic control, accuracy, and precision in GIS software); data layers, naming conventions, tabular data, tiling (breaking large digital maps into smaller manageable ones); parcel identification numbers (PINs); metadata ('data about the data'); data ownership, data maintenance; and security and archiving.

- Legal issues
  - The law has not kept pace with advances in technology.
  - The issues of copyright, charging for access to public records, and data liability records are very important to consider.
- Leveraging previous GIS investments
  - The value of previous attempts at GIS implementation must be preserved and should be included in the planning process as available assets.

12. GIS implementation

- Implementation schedule
  - It is important to lay out a schedule that can be met, with useful early products that can be created to help maintain and build political support.
  - The schedule should include a period for software and hardware acquisition, set up and testing, acquisition of digital data, a period of training and practice, a parcel base map pilot project to work out data conversion and design details, and a phased data conversion schedule.
  - It should also contain a timetable for the distribution of GIS data viewing capabilities within the various departments involved, and times when non-GIS specialists will receive some instruction.
- Base map creation
  - Successful base map creation for a local authority involves the following steps: ensuring adequate geodetic control; making use of the surveyor general's cadastral data; data acquisition by purchasing or exchanging, converting from hardcopies (by digitising or scanning and vectorising), obtaining data from aerial photographs.
- Pilot project
- It is advisable to begin the data conversion and GIS distribution phases of implementation with test runs or pilot projects.
- Expanding GIS use

- The most benefits of GIS will be realised when its use can be incorporated into the normal activities of the various functions within local government.
- This expanding of the use does not have to wait until all or most of the planned datasets are created. Rather, it should begin as soon as there are useful datasets to share.
- Applications
- As your GIS implementation matures you will find that you have three classes of users:
- A small number of GIS professionals and technicians whose main job is GIS processing and maintaining the datasets;
- A large number of GIS viewing and mapping software users who main jobs involve a significant and varied use of GIS data and maps; and
- The largest group, those who use GIS mostly for data query or other highly, routine applications and are likely to work with a customised version of GIS viewing and mapping software.