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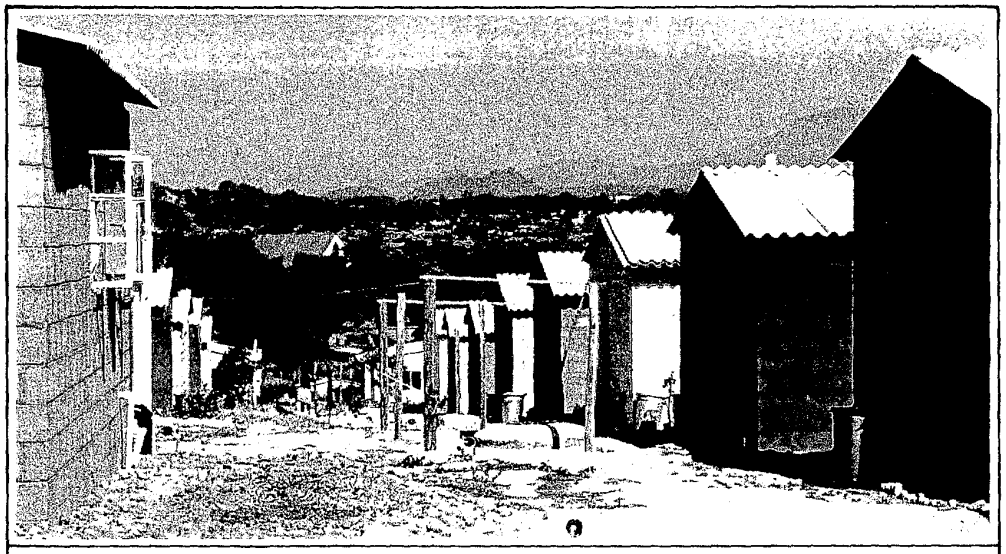
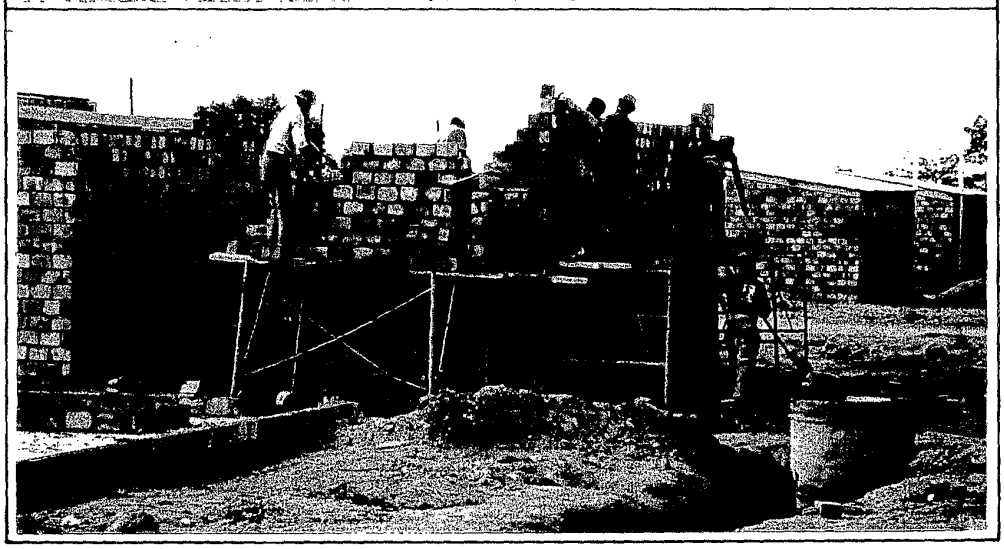
Layout Design Manual

for High-Density Residential Developments





Department of Physical Planning
Ministry of Local Government Rural and Urban Development
Government of Zimbabwe

December 1996

Layout Design Manual

for High-Density Residential Developments

prepared for

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Ministry of Local Government Rural and Urban Development
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United States Agency for International Development/Zimbabwe
Contract No. PCE-1008-1-00-6008-00, Delivery Order No. 7

prepared by

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December 1996

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Chapter 1
Introduction

This manual is dedicated to the creation of efficient and affordable layouts for high density housing. It is the result of growing concern about layout design and about the diminishing affordability of housing for low income households. The aim of the manual is to help Zimbabwean planners and local authorities establish site layouts that will:

- result in the efficient use and development of valuable urban land;
- lead to the provision of cost effective urban infrastructure and services; and
- create urban neighborhoods with social, market and ecological values that benefit their residents and the city as a whole.

1.1 Background

Zimbabwe has long been concerned with meeting the shelter needs of its low income urban population. High levels of population growth and migration to urban areas, however, have made the task of meeting the housing demand for this segment of the population increasingly difficult. Growing numbers of lodgers and evermore crowded housing conditions have been the result. The obvious solution to the problem is to improve the overall performance of the housing market and, in particular, to increase the delivery of stands and housing units affordable to low income households.

Recently revised standards have shown the potential to achieve significant improvement in the affordability of high density housing. However, only a few layouts, as yet, have been prepared using the newly defined standards. The promotion of cost efficient and affordable residential layouts based on the application of affordable standards is one of the primary reasons for the development of this manual.

1.2 Introducing Value into Layout Design

Land subdivision for residential use is the principal mechanism by which cities are developed. It is a vital part of urban growth and one of the main determinants of a city's appearance, the mixture of land uses, the location, extent and efficiency of infrastructure and the quality of the urban environment.

A major problem in attempting to achieve an efficient approach to this urbanization process is that land does not become available for residential subdivision in an orderly manner. The sale of land very rarely occurs in large continuous tracts. Each residential layout, therefore, should establish a coherent and well designed neighborhood that can be efficiently incorporated into the structure and organization of the city.

1.2.1 Identifying Layout Values

Land subdivision and layout design involve the organization of the external environment to accommodate human behavior and to support continuous improvement in the quality of life. Because the layout and subdivision of land into residential stands involves a fundamental change in the use of land (i.e. from agricultural or open space to fully developed areas), three important sets of values - social use, market and ecological - must be incorporated into successful layout design.

Social Values
Social values reflect the importance given to the layout of a site as the setting within which people carry out their daily lives. Seen from this point of view, the layout of a housing site provides the means to facilitate desired human activity. It does so through its: Urban form or design qualities, through the activity systems which it supports and through the framework it provides for community development. Layout designs should exhibit an urban form and quality that provide:

- a physical vitality through which human functions, biological requirements and inherent capabilities can be supported;
- a special sense of place through which residents can develop a clear perception of their neighborhood;
- an effective fit between spaces and the activities that occur within the neighborhood;
- an adequate degree of access to reach persons, activities, resources, services, information etc.
- a physical environment allowing residents and users to control management of the area;
- an efficiency in the relative infrastructure cost to support human activity; and
- a just distribution of environmental benefits and costs among all inhabitants.

Layout designs should promote activity systems that respond to the behavior pattern of residents and provide an acceptable fit between the physical parts of the site and the human activities that take place. Particular attention should be given to the activity patterns of women and children who spend most of their time in the neighborhood. Since the majority of low income residents are also pedestrians, careful attention must be given to the establishment of safe and efficient pedestrian ways to public facilities and other areas of activity.

Layout designs should provide a framework for community reinforcement that responds to local needs, increases citizen participation, encourages progressive physical improvements, promotes greater social interaction and instills a strong sense of community within the resident population. The layout and orientation of stands, for example, are particularly important in developing a sense of good neighborliness and community among residents. Layout design must not only reflect place-oriented social values but also provide a setting for:

- routine activities which are centred on the residence;
- informal support networks which can provide life-sustaining products and services to those households with only limited means;
- security and trust which result from being part of a social space that is seen as orderly, predictable, and protective of inhabitants;
- development of a local identity which will allow the neighborhood to compete effectively with other neighborhoods for city resources;
- agglomeration benefits which result from the overlapping of social and community activities; and
- ethnic and cultural reinforcement which is fostered by a shared style of life.

Good layouts lead to attractive neighborhoods that can adapt to a continuous pattern of change and development in the lives of their residents and provide sustainable improvements in their quality of life.

Market Values
Market values express the importance of residential land as a commodity. Market values are important to all participants in the land subdivision process because they:

- provide developers and/or local authorities with an adequate return on investment that will enable them to continue the development of high density housing operations in the future;
- provide low income households with a tangible asset that makes them genuine urban citizens and that can be used as collateral in obtaining formal sector credit;
- provide local authorities with the basis for taxation to finance the normal expansion, maintenance and operation of urban infrastructure and services;
- provide truly needy households with an opportunity to obtain unsubsidised, affordable housing through differential pricing policies and targetted cross-subsidisation.

Future market values, when based on quality layout design and freely operating housing markets, should also increase financial equity for poorer house-owning families and allow them to further improve their housing situation.

Ecological Values
Ecological values reflect the importance that is given to natural systems within the land subdivision process. They can be grouped according to three different points of view:

Environmental assets. In layout design, environmental assessts should be considered as resources to be efficiently managed for human benefit through plans, management programs, regulations and the continuous application of monitoring and feedback.

Environmental integrity. The links between environmental processes and human activity, should be protected by gauging an area's:

- *Carrying capactiy.* The carrying capacity of a site is measured by its capability to accommodate a particular level of development without experiencing irreversible ecological damage or change. Threshold limits to growth are established which are based on environmental, physical and/or psychological considerations and which depend upon the situation. A carrying capacity analysis is done by identifying the threshold limits of use that respect the capability of land and its ecology. A typical carrying capacity analysis includes the:

  - allocation of predetermined amounts of growth;
  - determination of ecological impacts from human actions;
  - identification of critical areas;
  - prediction of effects of alternatives;
  - restoration of ecosystems and renewable resources;
  - specification of performance standards for development; and
  - determination of the consequences of various levels of resource utilisation.

- *Land suitability.* This is determined by an analysis that describes the uses to which a particular parcel of land is best suited based on the characteristics of its soils, slope, vegetation and hydrology. The suitability of the site and/or specific areas within the site are determined by the use of overlay maps and the weighting of relevant criteria.

- *Sustainable development.* This is the measure of the land's ability to link and to balance environmental, economic and social functions and value. A level of development is identified that can be sustained without critical environmental change and that can meet both present and future economic and social needs.

Preservation of Nature. Preserving nature because of its inherent value is a point of view that is based on the belief that the degree of diversity within the natural world must be maintained as a matter of inter-generational equity. While seemingly at odds with the current demands for urbanisation, this point of view can be effectively incorporated into a more conservation-oriented approach to planning, layout design and the subdivision of land.

1.2.2 Maintaining a Balance Among Values

The successful implementation of local government responsibility in the management of land use change depends on effectively integrating the use, layout and development of land within a balanced system of values. The required balance between social use, market and ecological values can be visualised as shown in Figure 1.1. The management of land use change must maintain an equilibrium between these three sets of values in order to achieve sustainable development. Each of the three sets of values must be fully considered, equally emphasised and

FIGURE 1.1

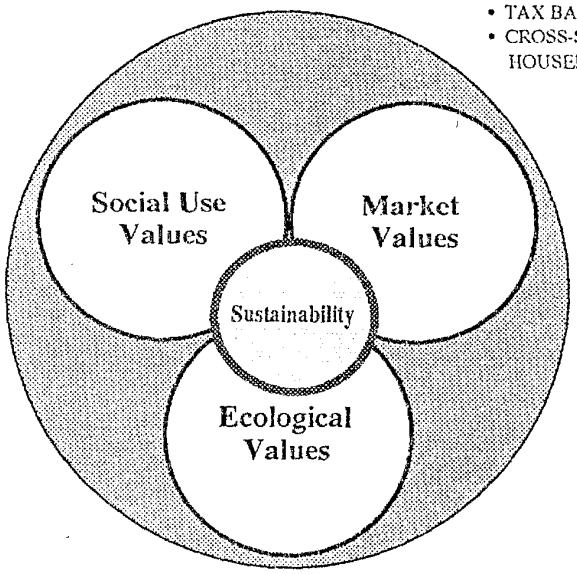
CREATING VALUE THROUGH LAYOUT DESIGN

SOCIAL USE VALUES INCLUDE:

- URBAN FORM AND QUALITY
  - PHYSICAL VITALITY
  - SENSE OF PLACE
  - FIT BETWEEN SPACES AND ACTIVITIES
  - ACCESS
  - MANAGEMENT OF THE AREA
  - COST EFFICIENCY OF INFRASTRUCTURE
  - DISTRIBUTION OF BENEFITS
- ACTIVITY SYSTEMS
  - WOMEN AND CHILDREN
  - PEDESTRIANS
- COMMUNITY REINFORCEMENT
  - SUPPORT NETWORKS
  - ORDERLY, PREDICTABLE AND PROTECTIVE SPACE
  - LOCAL NEIGHBORHOOD IDENTITY
  - AGGLOMERATION BENEFITS
  - CULTURAL REINFORCEMENT

MARKET VALUES INCLUDE:

- FINANCIAL INCENTIVES TO DEVELOPERS
- ASSETS AND COLLATERAL TO BENEFICIARIES
- TAX BASE FOR LOCAL AUTHORITIES
- CROSS-SUBSIDIES TO LOWEST INCOME HOUSEHOLDS



ECOLOGICAL VALUES INCLUDE:

- PROTECTION AND ENHANCEMENT OF ENVIRONMENTAL ASSETS
- MAINTENANCE OF ENVIRONMENTAL INTEGRETY
  - CARRYING CAPACITY
  - LAND SUITABLITY
  - ECOLOGICALLY SUSTAINABLE DEVELOPMENT
- PRESERVATION OF NATURE

properly related. Without the integration and balance of these varying sets of values, it would be impossible to resolve the conflicting claims which result from the dramatic land use changes that occur due to urbanisation. Active consensus building between government, land developers and residents is required in order to promote sustainable development and keep the necessary linkages in place.

1.3 Basic Planning Process

Formal land subdivision and layout design provides the basic means to manage the urbanization process. It culminates in the art of arranging structures on the land and in shaping the character of the spaces between them. Layout design is a complex task that requires a considerable degree of sensitivity to and knowledge about architecture, engineering, landscape architecture, and urban planning. It is a process that involves the inventory, analysis and synthesis of a wide range of information and the development of consensus between the public and private sectors.

The process of layout design involves a logical sequence of tasks beginning with a clear definition of the problem and ending with the integration of monitoring and feedback results into the formulation of new projects. The actual sequence of these tasks can be organised in a number of ways. One attempt to outline and organise their basic sequence is presented in Figure 1.2. It can be briefly summarized as follows:

Inventory and Analysis - which include:

- a clear definition of the problem based on a review of housing needs, housing deficits and waiting lists, urban growth requirements, economic and demographic conditions, current construction costs etc.;

- a rational outline of project goals and objectives based on an understanding of the existing institutional framework for residential land development and an appreciation of the capabilities and programmes of public and private sector participants; and

- a thorough analysis of the existing situation based on an inventory and analysis of potential sites, market conditions, financial opportunities and constraints, operative regulations and procedures, etc.

Programming - which includes :

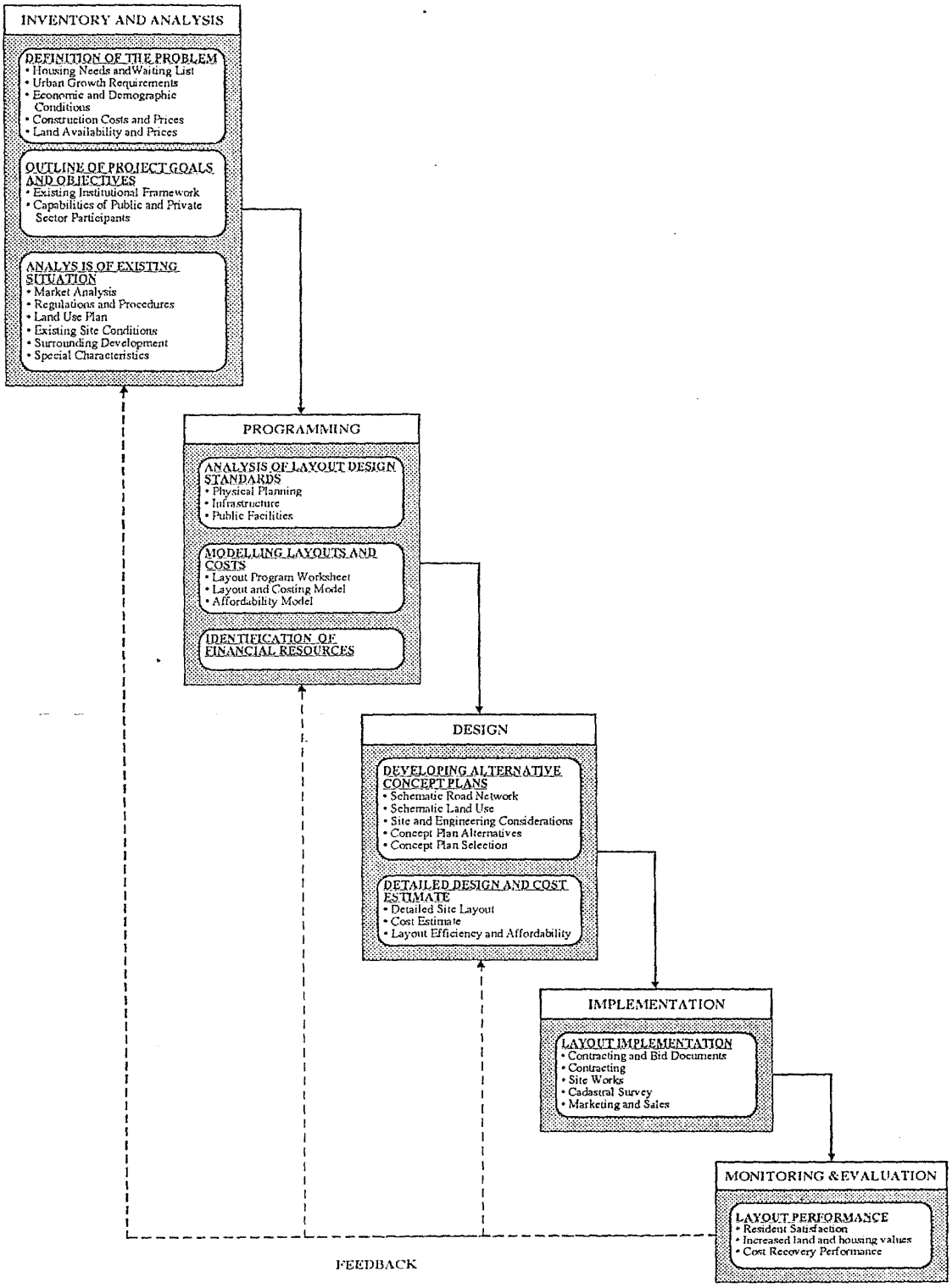
- the establishment of a layout plan programme based on the investigation of land use and infrastructure standards for different types of housing, the identification of financial resources and a more detailed knowledge of the target group population;

Design - which includes:

- the development of alternative concept plans based on a detailed knowledge and understanding of urban planning, zoning and actual site conditions, an evaluation of the impact of current regulations, standards and road requirements, etc.

FIGURE 1.2

BASIC SEQUENCE OF TASKS IN LAYOUT DESIGN AND IMPLEMENTATION



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- the design of alternative concept plans and preliminary cost estimates based on various standards and approaches to site design;

- the evaluation of potential consequences of alternative layouts for the community, beneficiaries and developer based on the efficiency, affordability and financial feasibility of the various alternatives;

- selection of the preferred alternative based on the results of efficiency analysis and market study considerations;

- the detailed design and cost estimate based on knowledge and insights about local conditions and market requirements to create a detailed layout plan which meets existing regulations and corresponds to the proposed programme;

Implementation -which includes:

- the actual implementation of the layout based on the carrying out of the cadastral survey, preparation of contract drawings and bid documents, contracting of site works, construction, marketing and sales of stands, etc.

Monitoring and feedback - which includes:

- the continual monitoring and feedback of outcomes based on surveys and investigations concerning the use and performance of the layout plan, resident satisfaction, land and housing value increases in the area and cost recovery performance.

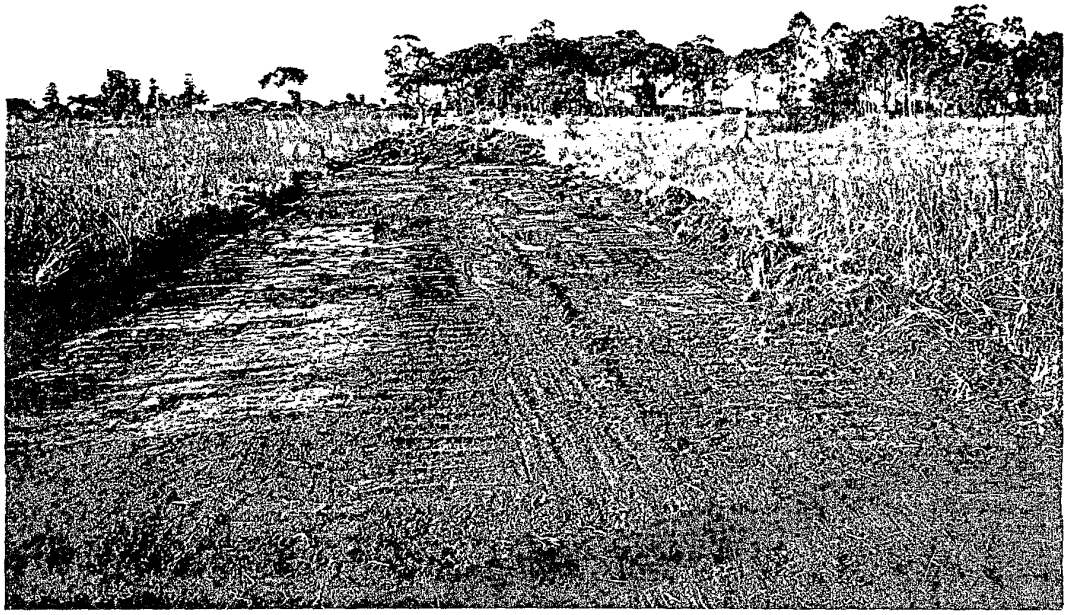
1.4 Purpose and Organization of the Manual

The purpose of this manual is to provide housing layout designers and local officials with an understandable and easy-to-use planning guide for the design and review of high density residential layout plans. The information contained in the manual is organized in a way that corresponds to the step by step process of layout design so that it can be used on a daily basis. The basic intention is to create well designed and efficient layouts that are affordable to low income households.

The manual is not intended to provide the final word on layout design but rather to serve as a starting point and stimulus to Zimbabwean professionals in continuing to improve the residential layouts they produce. While it may never be possible to produce the perfect layout, it is almost always possible to improve the plan on which one is working. This manual and the computer models which accompany it will contribute to making these improvements.

The manual should also serve as a supplement to existing reference books on layout design and engineering. It is equally intended to provide a framework for cooperation among professionals by providing them with a practical approach to and the basic guidelines for efficient layout design. The manual should prove to be particularly useful during the programmatic stages of layout design and in evaluating the efficiency of proposed layouts.

The substantive part of the manual is divided into five chapters which correspond to the major groups of tasks in project design and implementation. They include: inventory and analysis; programming; design; implementation; and monitoring and feedback. Three annexes are also attached to the manual which describe the computer models used in this approach, the results of case studies undertaken as part of a planning workshop in Harare during the week of November 25th to 29th 1996 and the new standards which have recently been adopted.



A sound personal knowledge of the site is indispensable to successful layout design

Chapter 2
Inventory and Analysis

A careful inventory and analysis of a project site and the environment within which it will be developed is an extremely important component of layout design. This chapter describes some of the basic data required to carry out a successful layout design and the ways in which this data can be obtained and analyzed. Inventory and analysis efforts should focus on obtaining data concerning the: current housing market, land use requirements, physical conditions of the site, surrounding environment, environmental concerns, and special character of the area. Detailed site analysis should result in a series of composite maps which show the suitability of development for various uses.

2.1 Conducting a Simple Market Analysis

The current approach to high density housing in Zimbabwe operates under the "production oriented" assumption that virtually all of the housing units produced will be easily sold. This assumption will not remain valid if housing supply is increased to more closely meet demand. Many developing countries that have embraced a similar long term production oriented approach have suddenly been confronted with a poorly focussed housing delivery system, distorted housing markets and overbuilt housing types.

Because housing must be consumed where it is built, the property market, unlike other business markets, is very location dependent. This and the many other unknowns in the property market decision making process have made market analysis a very useful and essential tool in the provision of housing and is one the very first steps in the project planning process. Market analysis should occur at two distinct stages in project development. A general, city wide market study should be carried out prior to site selection, while a more detailed, site specific study should be included as an integral part of the analysis and programming stage of a particular project.

Market studies essentially attempt to predict the demand for various types of property services and the influence that current and planned supply will have on this demand. In order to keep the market analysis both simple and manageable, the demand side of the analysis generally limits its focus to population growth, community income and employment trends. These elements, when properly analysed, can provide a clear distinction between the need or desire for housing services and effective demand. The supply side of the analysis is also simplified by focussing on the existing competitive environment and planned supply. The data which are developed from the market study provide the basic information for subsequent decisions about of the project's financial feasibility and physical design.

There are many types of market studies which range from the very general to the very specific. A general market study is one that determines the overall community demand for housing but does not relate this demand to any specific location or type of project. A more detailed market analysis is used to assess the supply and demand relationships for a predetermined type of housing on a particular site. It should be kept in mind that property market analyses are not

based on fixed routines or procedures, nor do they produce foolproof answers or even standardised products. Results are limited by the accuracy of statistical data and derivations, the reliability of the estimates which are developed, the competency of the individuals whose judgements must be incorporated into the analytical process, and the inherent uncertainties of projections related to future economic conditions. Nevertheless, a good comprehensive market analysis for housing will basically concern the:

Impact of regulations and indirect economic conditions
The constraints imposed by various regulations to protect the community (e.g. zoning laws, building by-laws, licensing requirements, and various permits and approvals) must be well understood in terms of their potential impact on a proposed project. Physical factors or characteristics of the land which may also impose limitations on the nature of the project need to be identified and analysed along with linkages to the rest of the community. All of these considerations should be clearly outlined in the market analysis report.

Size of the future market and percentage which can be attracted to the project
An analysis of demand factors must be made in order to estimate the percentage of future demand that can be expected to seek housing in the proposed development. This segment of demand must also be related to distinct periods of time (i.e by month or year). The estimate of realistic demand over a specified time period is critical to the projection of gross revenues; to the establishment of cash flow variables; and the estimation of market value. In many cases, these financial considerations will determined whether or not the project will proceed.

Range of market-determined prices
The market analysis must also determine the effective demand and price range for the sale or rental of the proposed units. This can be achieved by a thorough analysis of the estimates of future population and the distribution of community income. An analysis of the existing supply and the competitive environment are also crucial factors in this calculation.

Types of sizes of stands and units that respond to market demand
The market analysis should recommend the broad categories of stands and/or housing units to be provided by the project based on the estimated percentage of market demand that can be captured by the project. A project with a mix of different types of stands and/or housing units is likely to attract a greater share of the market and to have a higher absorption rate and consequently lower risk than one with only limited types of stands and/or units. In addition, a good market analysis should indicate the specific types, styles or patterns of ownership to be provided by the project. It must also provide the developer with an idea of the cost parameters for the general types of stands or housing units that will have the broadest market appeal.

Amenities to be provided
An investigation of the amenities provided in similar housing projects will help to increase the competitiveness and marketability of the proposed layout.

2.1.1 Basic Content of a Market Study

The content of a typical market study involves the analysis of both indirect and direct economic factors.

Indirect Economic Factors

Indirect economic factors will establish the basic project constraints, any one of which could create an insurmountable obstacle or at least a very strong adverse effect on project feasibility. A good market analysis will attempt to assess the importance and potential impact of these forces on the anticipated project. Indirect factors to be considered include:

- *Zoning.* Existing zoning regulations will establish a number of initial development constraints for land use and allowable densities. Simply building to the maximum allowable limits however, will not always respond to effective demand. All local authority planning offices should be consulted when studying these zoning constraints;

- *Soil Conditions and Topography.* The importance of these factors will increase with the size of the project. They are particularly important for sewer lines, grading requirements and road configurations. A determination of the area of a prospective site that cannot be developed due to natural constraints must be made at the very outset of the project.

- *Utilities.* Potential problems regarding existing utilities and any physical, political or financial obstacles that may be encountered in their provision should be identified. Analysis should begin with interviews of local planning staff and utility services for electricity, water and sewerage, telephone, etc.;

- *Transportation Linkages and Traffic Requirements.* Public and private transportation linkages to the city centre, sub-centres and employment areas need to be identified and evaluated. The amount of time and distance required to reach major sources of employment, commercial activities, schools, health and recreational facilities should be plotted and compared with the conditions for competitive projects that currently exist or are in the planning process. Interviews should be held with local and provincial planning authorities, bus companies, taxi associations etc.;

- *Environmental Impact.* Environmental concerns which include the project's impact on air, water and noise pollution should be anticipated and addressed in the form of checklists;

- *Impact on Urban Services.* The project's impact on essential urban services such as police, schools, health facilities and solid waste collection and removal should be considered. National averages and prevailing per capita ratios for police officers, teacher to pupil ratios, doctors and hospital beds per capita, etc. can be used as proxies in this analysis.

- *Prevailing Attitudes.* There is an obvious need to assess the potential attitudes of the local community and political leadership towards the anticipated project. The elected Councillors who represent citizens in the vicinity of the anticipated project should be interviewed and fully informed about the nature and extent of the project. The concerns and objections of influential individuals should be obtained and noted in the market study report. In summary the developer should become fully aware of the prevailing attitude of the local officials so that the layout plan process and final design can be

sensitive to their concerns. The market analysis should involve as many community leaders as possible and make a qualitative judgement about the prevailing atmosphere for the type of project being considered.

Each of the indirect economic factors should be elaborated very clearly in the market report. Apparent obstacles should be identified and potential remedies explored and proposed.

Direct Economic Factors
The analysis of direct economic factors should consider both supply and demand and the balance that exists between them. Nine basic questions should be addressed (see Figure 2.1).

Demand. Key functional relationships for demand include: population, income, employment, relative prices, taxes, interest rates, down payment requirements and future expectations. In order to reduce the complexity of the analysis, however, most market studies focus only on those elements of supply and demand that will have the most direct impact on the marketability of the project and that can be quantified most easily. On the demand side, population growth, distribution of community income and sources of employment are generally considered to be the most significant forces in determining housing demand.

- *Population Growth.* The overall objective of any housing market analysis of the population is to determine the population increase within the market area over a specific period of time, to divide this figure by the average number of persons per household and to estimate the related need for new housing. Attention should be given to the spatial distribution of population growth within the overall city. The market study should analyze the major characteristics of the population, historical growth trends, current developments and future projections. The basic forces which affect changes in population characteristics and growth within an area include the:

  - natural rate of population growth (i.e. births minus deaths)
  - population migration into or out of the area, and
  - average household size.

  Potential sources of population data which can be used include the: national population census, labour statistics, utility and telephone company waiting lists, school enrollments, bank demand deposits, vehicle registration, building plan approvals, etc. Particular attention should be given to an assessment of the numbers of current lodger households who would both want to and be able to afford to become house owners.

- *Community Income.* The major objective in analyzing income data is to determine how a community's income is distributed through the population. Since high density housing will increasingly have to deal with unsubsidized housing units, there is a growing need to distinguish between housing need and effective demand. Market analysis should establish the patterns of income within the community in order to quantify the number of households that can afford to purchase different types of stands and/or housing units. Income distribution and probable change over time must also be determined in order to establish sufficiently accurate estimates of effective demand. This can be done by income percentiles of the total population based on CSO published results (rather

Figure 2.1

MARKET ANALYSIS - KEY QUESTIONS

DEMAND FACTORS

1. What are the general population and economic trends in the market area?

2. What are the characteristics of recent homebuyers in the market area?

3. What is the annual effective demand for housing?

SUPPLY FACTORS

4. What is the composition of housing within the market area?

5. What is the current supply of stands and housing units for sale in the market area and how are they selling?

6. What projects are currently in the pipeline?

SUPPLY/DEMAND BALANCE

7. Comparing effective demand and supply, what is the market potential for stands and/or housing units?

8. What is the mix of stands and/or housing units to be supplied by type, size and amenities ?

9. What is the level of non-effective demand in the market area?

than waiting lists which are not a statistically reliable sample of the population). The affordability of basic housing types to targeted populations groups should also be carried out.

- *Employment.* An employment to population ratio must be established in order to review and analyze the trends in local employment. Market analysis should determine the number of new jobs required to maintain the current ratio and whether or not this number can be realistically achieved. The employment to population ratio is important in evaluating potential population growth and in avoiding any excessive overbuilding in the sector.

Supply. Functional relations for supply include: expectations of demand, planned supply, competitive environment, and the availability and cost of land, labor and capital. The most important forces are existing and planned supply and the competitive environment.

- *Existing and Planned Supply.* Careful attention must be given to ensure that existing and planned supply within the market area is accurately identified and quantified. This can be achieved through interviews, field surveys, review of newspaper advertisements, etc. A table of the number of different types of housing (e.g. detached, semi-detached, flats, hostels, informal settlements, etc.) can be prepared from interviews with DCHS or random field checks and the typical occupancy rates applied to each type of housing. Housing delivery over the last three to five years for all income sectors and types of developers (low, middle, high income; rental/lodger units; informal settlements; by private of public sector) should be determined.

- *Competitive Environment.* Data about competing projects are normally collected by on-site inspections of the projects and interviews with project developers. A matrix table should be constructed for each submarket and/or major type of stand or housing unit which can provide basic data about the competitive environment.

  These data would cover the distribution and sales records of various units within competitive projects, the sizes and price ranges of these units, the density of units on different high density sites, their absorption rate, the amenities provided and the number of units still on the market or planned which will be in direct competition with the anticipated project. Some of the competitive supply information which should be obtained is shown in Figure 2.2.

2.1.2 Implementing a Simple Market Study

Several basic steps should be followed in organizing, implementing and documenting a simple market study for housing. These steps would include activities to:

- *develop a work plan* that includes: a step-by-step statement and description of tasks; a schedule for starting and completing each task; staffing plan and assignments to specific individuals; logistical plan; and budget proposal;

Figure 2.2

COMPETITIVE SUPPLY INFORMATION

1 What is it?

- What is the project name?
- Who is the developer?
- What is the project size and density?
- What are the product offerings?
- What type of construction is being offered?

2 Where is it?

- How does it compare to other locations?
  - What is the distance to the city center?
  - What are the site amenities?
  - What amenities are nearby?
    (schools, open space and other community facilities)
  - What is the level of infrastructure access?
    (electricity, water, sewage, other services)
  - How is transportation access?
    What is the distance to the main road?
    How close is it to public transportation?

3 How much does it cost?

- What is the breakdown of product offerings by type, size and price?
- What sources of financing are available?

4 How is it selling?

- What is the project absorption rate (total and recent)?
- When did the project start marketing its stands or housing?
- What have been the number of sales to date by product type, size and price?

5 Who are the buyers?

- What is the range in the profile of buyers?

6 Any other comments?

- *compile generally available data on demographic and economic conditions* which would include data on: existing and forecasted population and households; existing and forecasted employment; and other characteristics that can be useful in illustrating general trends;

- *prepare an inventory of significant housing projects in the area* which have sold units over the last two or three years and obtain information about these projects through interviews with local planners and officials, building societies, etc. Information about units still in the pipeline can be obtained from newspapers and other advertisements, from windshield surveys and/or key informant interviews;

- *conduct more detailed surveys of selected housing projects* to obtain data on the size of these projects; their levels of infrastructure and amenities; the distances they are located from the city centre, areas of employment and main road; existing transportation links; marketing performance for different types of stands and/or houses; the financing options that were offered to beneficiaries; sales performance rates, etc.;

- *survey recent stand and/or house buyers* in selected projects in order to obtain more detailed information about the strength and character of housing demand as shown in Figure 2.3;

- *analyse all the accumulated data* to obtain a more definate picture of existing market conditions;

- *implement an affordability analysis* for the stands and units to be offered through the project and the anticipated financial situation of the target group population within the market area;

- *synthesise all information and draft marketing conclusions and recommendations* that will respond to the basic questions about market conditions, whether or not to

- proceed with the project, criteria for site selection and the orientation and components of the project;

- *prepare a brief market study report* that will provide essential information for the cash flow analysis and serve as a guide to programming and planning the layout.

Although a market analysis study cannot eliminate all of the uncertainties and risks related to real estate investment, it can help to reduce these concerns to a better known and manageable level. A sound market analysis and a concerted effort to understand how these analyses can benefit the decision making process is essential for creating successful housing projects and for sustaining one's operations in the housing market.

Figure 2.3

CHARACTERISTICS OF RECENT HOMEBUYERS IN THE MARKET AREA

1 Demographic Characteristics of Recent Homebuyers

- Age of head of household
- Household size
- Profession of head of households
- Place of work of head of household

2 Prior Location

- Prior residence of homebuyer
- Prior tenure of homebuyer

3 Characteristics of the Purchase

- Price
- House and stand size in square meters
- Number of rooms
- Other indications

4 Financial Aspects

- Amount of downpayment and source
- Means of financing the unit
- Conditions of any loans and/or mortgages

5 Reasons for Purchasing the Unit

6 Timing Issues (for stands)

- Land transactions and anticipated length of time to complete unit
- Financing of land and unit

2.2 Selecting a Development Site

In deciding the best use for a site, one tries to answer two basic questions:

- How appropriate or suited is the particular site to the proposed use as defined by the developer[1] and the market analysis that has been carried out?

- What are the features of the site itself that need to be protected to ensure its long-term viability or sustainability, as built development almost always has a measurable impact on the natural environment?

At present, many of the planning briefs in use are simply dictated by the amount of money available for expenditure on low income housing to the local authority or developer in any particular year. A rough calculation is made of the area of land that can be serviced by the amount of money that is available. This then is matched to a block of undeveloped land that is available in any suitably zoned part of the city.

The difficulty with a supply-driven approach is that it does not always allow for the optimum use of a site. Nor does it take into account how the site may be integrated with other functions or land uses and transportation routes in the town or city as a whole. It can result in the *ad hoc* planning and construction of off-site infrastructure which adds to both capital and operation/maintenance costs.

As discussed in Section 1.3 the starting point of any design is for the planner to draw up a clear and concise inventory and analysis of the proposed project and then to obtain consensus on the analysis from key stakeholders of the development team, notably the client/developer, the potential residents of the programme project (or by proxy sample), the chief planner, the engineer and the financial officer.

2.2.1 Assessing Site Suitability

Assess in broad terms the suitability of the site selected by the developer (or select one site from a number of alternative available sites) taking into account the following:

- land ownership and land cost

- amount of raw land available for development

- zoning of site in terms of an operative Master or Local Plan. If a Master or Local Plan has not been prepared, then a conceptual strategic land use plan may be necessary before a particular site is selected (particularly for large developments, i.e. 200 stands or more)

- Extent and nature of existing development on the site

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[1] Throughout the Manual, "developer" is taken to mean either a private sector developer or a local authority or central government ministry as the case may be.

- Extent and nature of existing or planned development adjacent to the site
- Availability and capacity of off-site infrastructure to service the site
- Availability and capacity of community facilities in adjacent areas which might be used by the residents (in particular shopping centres, schools and clinics, sports fields)
- A broad estimate of the developer's total budget and phased cash flow to develop the site
- Demand or market analysis (see section 2.1)

2.2.2 Criteria for Site Selection

On the basis of both the broad physical assessment of the site as well as the developer's financial resources, the most suitable site should be selected and the boundary of the plan be established. This process gives physical or spatial effect to the development programme drawn up (see Chapter 3).

The process involves a broad screening process -- blocking off on a map of the town or of an area of the city, parcels of land that are not suitable (in light of the objectives), because of small size, other existing development, lack of access or off-site infrastructure, excessively steep slopes, and similar.

Physical Criteria
Select the development site if it meets the following physical criteria:

- the site is appropriately zoned for the proposed development;
- the site is large enough to cater for the size of the proposed development at the densities indicated by the demand analysis and, if necessary, for any future anticipated phases of the development;
- servicing of the site would not be constrained by the lack of off-site infrastructure (which is generally financed from different sources than the on-site infrastructure)
- the environmental integrity of the site would not be unduly compromised by the development or else appropriate mitigatory measures have been identified and an estimate of the cost for the measures can be made (for example the canalisation of a stream, planting vegetation to stabilize steeply cut slopes, and similar) (see section 2.5).

Financial Criteria
The developer's financial objectives should be clearly formulated in quantifiable terms. For example, "To achieve a financial break-even point, XXX number of plots for Z$YYY income level and ZZZ number of plots for Z$AAA income level are to be developed. The development will need to be phased in three steps to roll over the financial costs." (See Chapter 3). The financial objectives should be assessed against the broadbrush market analysis that has

been undertaken and reviewed as may be appropriate.

2.3 Ascertaining Existing Conditions

Having established the broad plan boundary and an understanding of the circulation networks and land uses surrounding the site through the site selection process, the next step is to form a comprehensive understanding of the main characteristics of the site itself and how these will affect the proposed development.

There are two considerations which are indispensable to successfully preparing a layout plan: using an accurate base map which shows, to scale, as much information of the site as possible; and having a sound personal knowledge of the site.

2.3.1 Base Map

The first key to a successful plan and the servicing and development of the site is the base map on which the plan is to be prepared. In all cases requiring subdivision approval (either Section 40 or Section 43 of the Regional, Town and Country Planning Act, Revised Edition 1996 in the case of private or public developers respectively), the approved plan may only be varied by up to five percent by the land surveyor when he/she places the survey beacons on the ground. The costs and time delays in the surveyor having to return a layout to the planner for amendments and then reapproval, more than justify the initial expenditure to prepare an accurate base map on which the plan is to be prepared.

In some cases an aerial photograph is used as a base map. An air photo is useful in site planning but it is not accurate enough to be used for the base map. Because aerial photographs are central projections, there is increasing distortion towards the edges of the photographs. In addition, shrinkage or expansion of the photograph itself, can result in inaccuracies well in excess of changes that the land surveyor is allowed to make. For example, a plan drawn up on an air photo may show a road going around a rock outcrop but when set out to scale on the ground the road might run right through the rock outcrop. The plan then will have to be returned for amendments (which can take many months) or the developer will have to blast through the rock at additional cost.

Ideally, the base map should be prepared as either an orthophoto (a "flattened" air photo with calculated ground checks of contours and cadastral boundaries) or as a topocadastral survey carried out by field survey. It should be prepared at a scale of 1: 2 500 (engineers prefer to show the design of infrastructure at a scale of 1: 1 000, but the size of the site may not warrant the spreading of the plan over three or more sheets). The base map should show:

- the cadastral boundary of the site (if it has been surveyed) and of adjacent properties or properties within the site
- contours at two metre intervals
- surface water courses, rock outcrops, depressions and large trees which should be protected

- existing buildings, fences, boreholes, etc on the site

- existing public infrastructure in the vicinity of the site or running through it (roads, water pipelines, sewers, servitudes, etc)

2.3.2 Sound Personal Knowledge of the Site

The planner should pay a number of personal visits to the site. On the first visit one orientates himself/herself to the site's general landform, adjacent uses, natural qualities, and similar. A second visit is used to check specific details that need to be incorporated into the plan, for example the position of large trees to be protected, the distance from a main road and the impact on proposed uses, the aspect of certain slopes requiring special positioning or orientation of stands. Finally a site visit is made once the draft layout plan is finalized to check the details of the plan on the ground.

Site planning is not and should not be regarded as a desk exercise. Although the preparation of an accurate base map and a number of site visits might require initial expenditure, their costs are minuscule in comparison to overall site development costs and are more than justified.

2.4 Site Analysis Procedures

Once a suitable site has been established and a broad inventory and analysis has been prepared, the planner undertakes a detailed site analysis. The sieve-technique, using overlays of different characteristics, is a useful and comprehensive way of carrying out the analysis. A series of overlays are drawn freehand on clear film or tracing paper, to build up an image of different site characteristics.

Layer 1 : Off-Site Links
The first level of analysis is to assess development surrounding the site -- in particular the surrounding circulation system (roads, bicycle tracks and footpaths), neighbouring land uses and settlement patterns and densities as well as the proximity to off-site infrastructure and the capacity of the infrastructure to service the proposed development. See Figure 2.4.

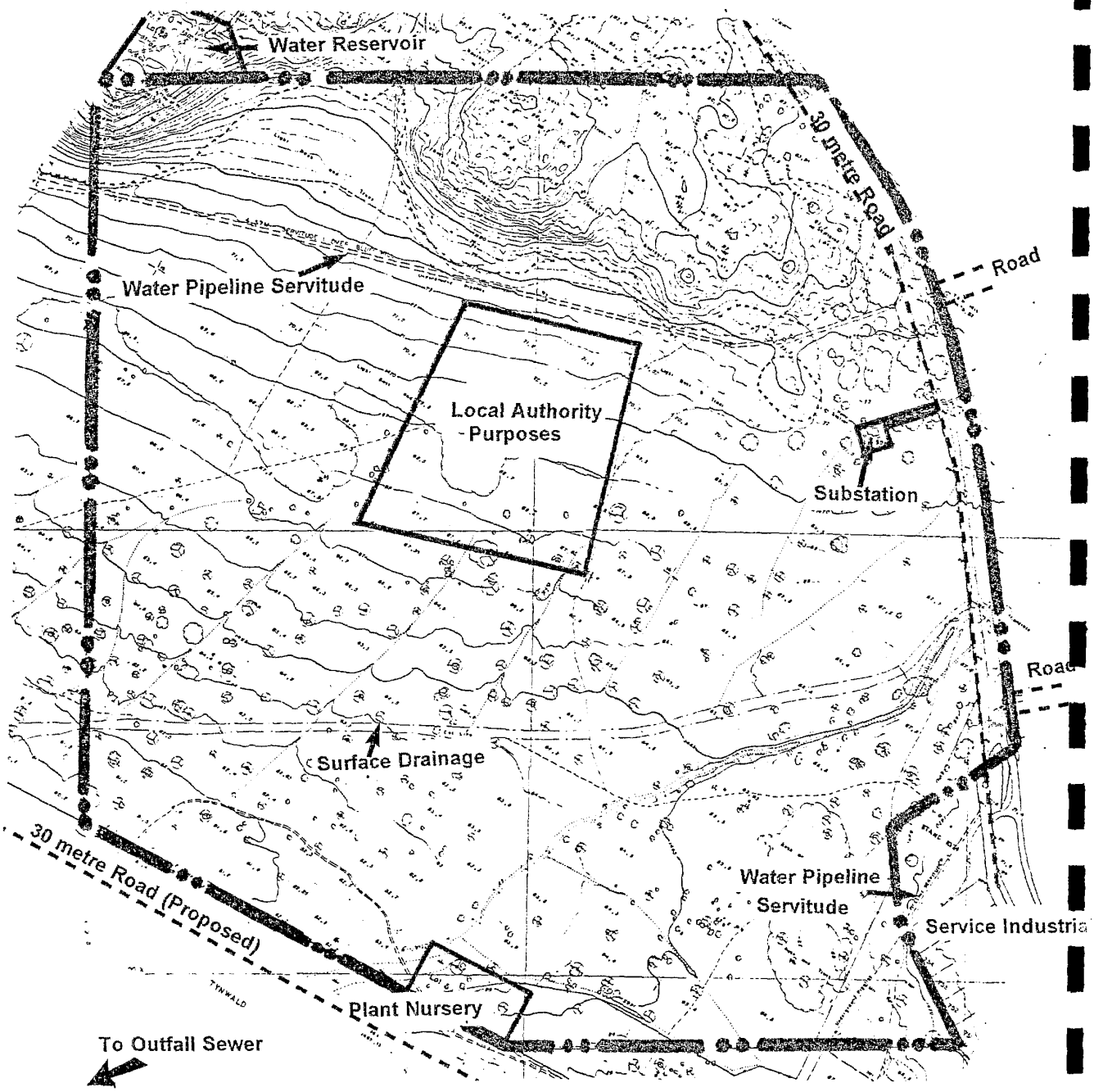
The design solution within the site often depends on and should explicitly try to establish outside links so that the site becomes part of the larger urban fabric. Integrating elements which can be used include:

- the main circulation pattern which will be extended through the site,
- the convenience to shopping and other community facilities,
- negative influences against which buffers may be needed,
- similar adjacent land uses which may be integrated into the site proposals.

The most important characteristics to be mapped are:

- relevant zoning provisions set down in any operative Master Plan, Local Plan or Town Planning Scheme;

Figure 2.4
Off-Site Links



- distributor roads through or in close proximity to the site
- adjacent land uses and settlement densities
- cadastral boundaries of the perimeter of the site, within the site and adjacent properties, and if relevant, land ownership information
- utility servitudes passing through the site or along its perimeter (e.g. ZESA wayleaves, pipeline servitudes, rights of way, etc.)
- location and capacity of off-site infrastructure, in particular water and sewerage.

Layer 2 : Topographical Features
Topography fundamentally affects the way in which a site may be used. The most important element in understanding the topography is the slope of the site, which warrants a layer analysis of its own (see Layer 3 below). Other important characteristics to be mapped are shown in Figure 2.5 and are listed below:

- The main streams and surface watercourses (hydrology of the site) and scaling off the 30m stream bank protection reservation (protected against development)
- Vleis or wetlands which are particularly sensitive natural eco-systems and act as natural filters to runoff water
- Information on the water table. A high water table causes unstable foundations and stagnant surface water is frequently a breeding ground for mosquitoes. A high water table can be detected by inspection of existing wells or cuttings, by seepages and springs, mottled soils and by certain plants, for example poplar trees, water grass and reeds and *Makute* trees. A simple method for detecting if a water table is likely to be high enough to cause difficulties for ordinary residential development is to dig a two metre deep inspection pit at the end of the rainy season (February or March) and observe the depth to water table or signs of seepage.
- Ridgelines which provide a 3-dimensional visual quality to the site and are useful later on in the planning process to inform decisions to be made such as the directions of flow for sewer lines, orientation of stands to minimize the number of east/west facing houses which tend to be hot in summer and cold in winter, the way in which circulation routes may be restricted, and so on.
- Rock outcrops which will need to be incorporated into the future design of the site and depressions or quarries which are poorly drained and may require infill before the land can be used.

Layer 3 : Slope Analysis
The degree of differentiation to which the slope analysis is carried out depends to some extent on the steepness of the site. Generally four main categories of differentiation (see Figure 2.6) will provide an adequate picture of site conditions:

Figure 2.5
Topographical Features

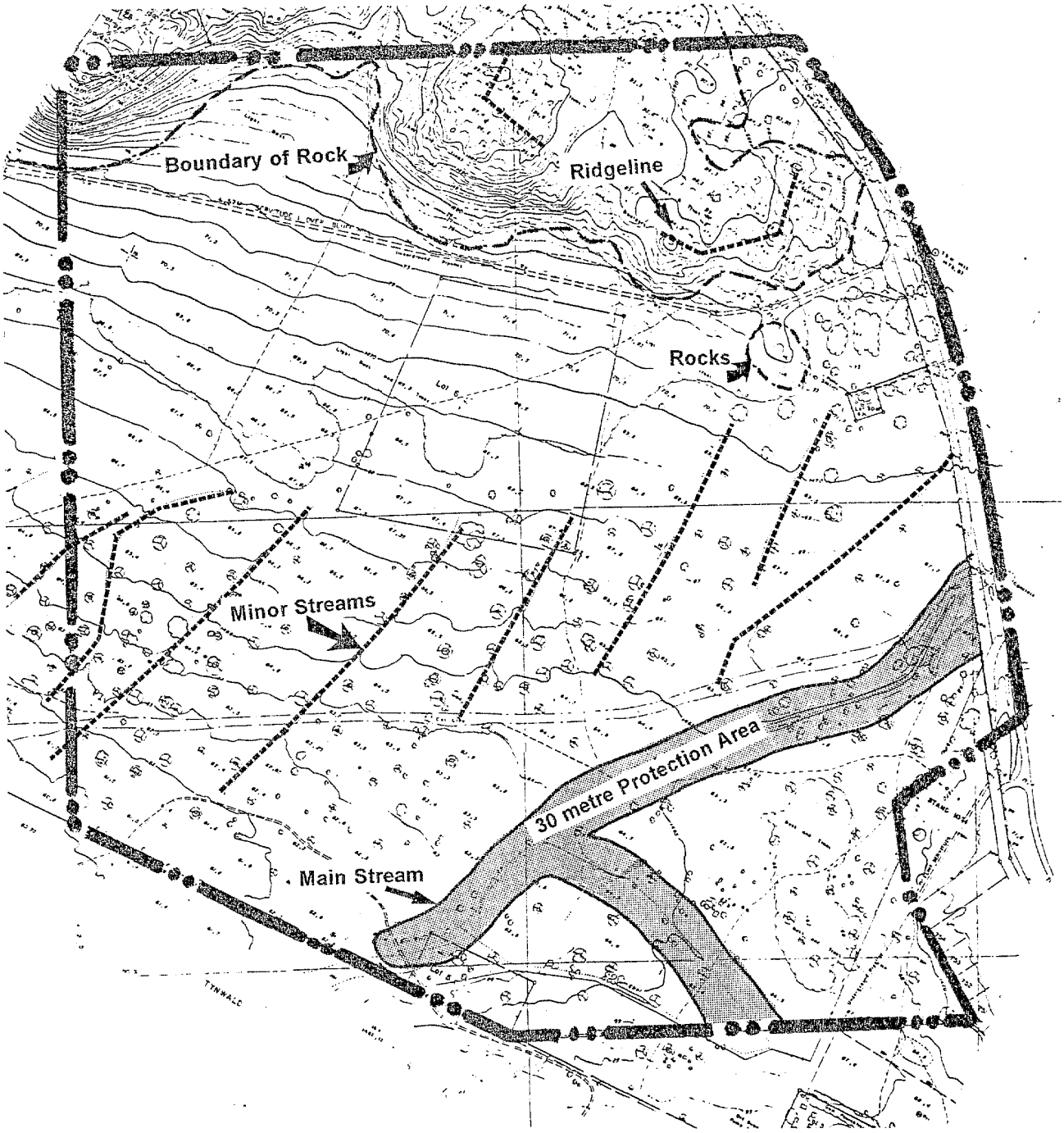
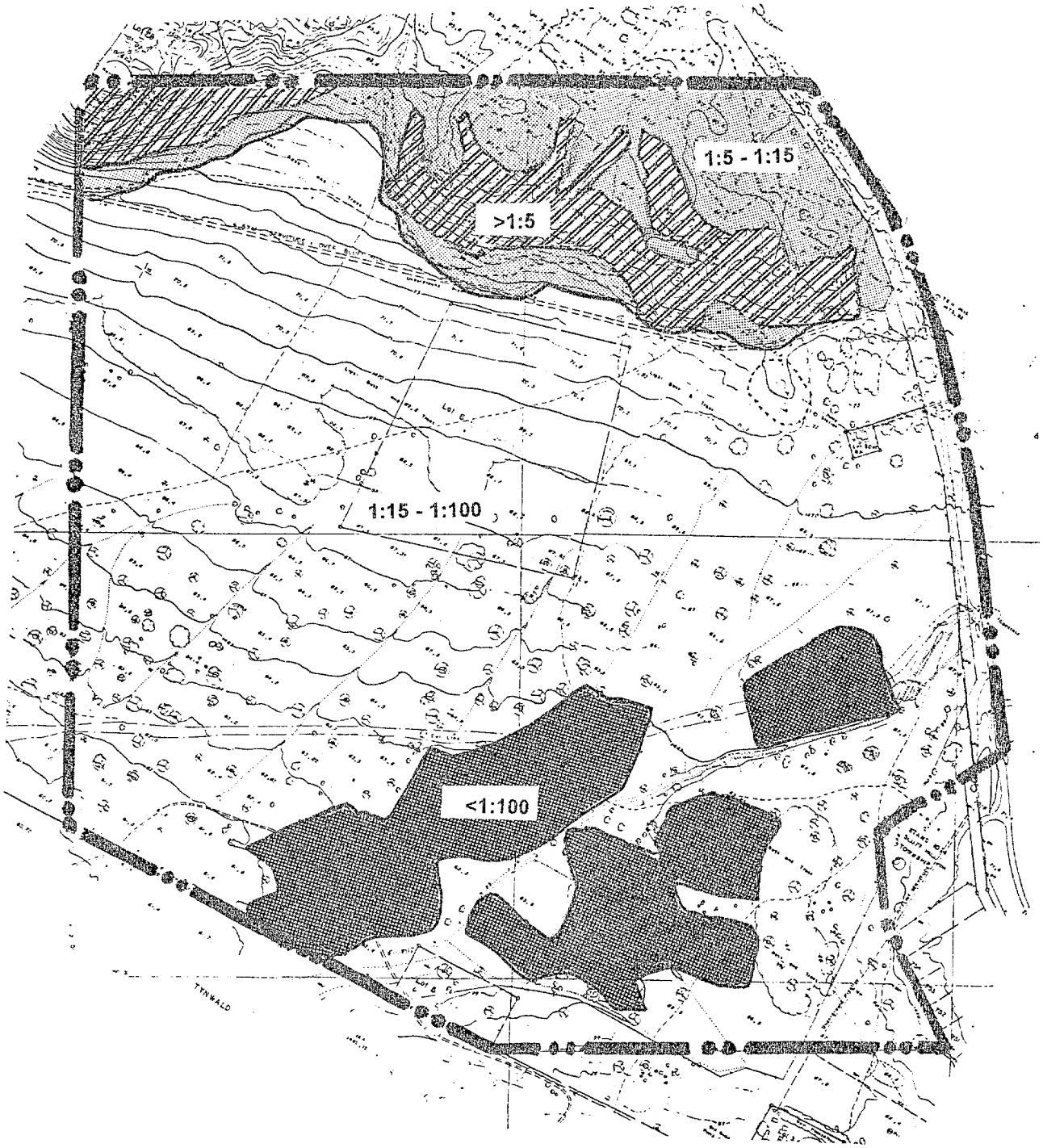


Figure 2.6
Slope Analysis



- slopes which are steeper than 1:5 which are expensive to build on and their use would result in strongly negative environmental impacts

- slopes which are between 1:5 and 1:15 which although steep (and therefore more expensive to build on), can be developed but may require fairly wide frontages for access

- slopes which are between 1:15 and 1:100 which are suitable for intensive use

- slopes which are flatter than 1:100 which have poor drainage qualities and will need special drainage and sewerage provisions (at additional financial and environmental costs) if the land is to be used for built development.

Layer 4 : Soils Analysis

It is possible through practice, to make a rough identification of soils in the field suitable for the siting of light structures such as single-storey houses. However professional analysis is strongly recommended. The engineering classification of soils is based on the exact composition of soil specimens extracted at different depths (the soil profile), and is best determined by professional soils engineers using specialized laboratory techniques. Soils analysis is used to determine the bearing capacity of different soils (for foundations and roads), the percolation rates if on-site sewage disposal methods are to be used; and similar.

Soils can be divided broadly into ten classes which each have different siting implications:

- *Clean gravels* (standard symbols GW/GP). The dominant constituent is gravel with less than 5 to 10 percent being clay.

- *Silty and clayey gravels* (GM/GC). Mostly gravel but with more than 10 to 12 percent silt (GM) or clay (GC).

- *Clean sands* (SW/SP). Mostly sand, less than 5 to 10 percent silt or clay.

- *Siltey and clayey sands* (SM/SC). Mostly sand but with more than 10 to 12 percent silt (SM) or clay (SC).

- *Nonplastic silts* (ML). Inorganic silts or very fine sands with a liquid limit of less than 50 (i.e. begins to flow like a liquid when containing less than 50 percent of water).

- *Plastic silts* (MH). Inorganic silts with a liquid limit over 50.

- *Organic silts* (OL). Silts with substantial organic matter and a liquid limit under 50.

- *Nonplastic clays* (CL). Inorganic clays with a liquid limit under 50.

- *Plastic and organic clays* (CH/OH). Either predominantly inorganic clay (CH) or a silt or a clay with substantial organic matter (OH) and liquid limit over 50.

- *Peat and muck* (Pt). Predominantly organic material whether plant remains are visible (peat) or invisible (muck)

Figure 2.7 evaluates soil types for various uses. In general, gravel is a well-drained, stable material and bears heavy loads if it is well graded. Sand is also well drained and makes a good foundation if well graded but must be confined at the sides. Loose sands and gravels may settle initially under a load.

Fine sands and sand-silt mixtures may become "quick" (unstable) when saturated. Silt is stable when dry or damp, although it will compress under a load. It is extremely unstable (heaving and swelling) when wet and buildings and roads will require extremely deep foundations. Silt also erodes easily. Clay is plastic (impervious and tends to slip or swell) when wet and is stiff and cohesive when dry. Peat and other organic soils are very poor engineering material. It is inelastic, weak and has little cohesion. Land with peat must either be left undeveloped or it must be removed from the site and replaced by better material.

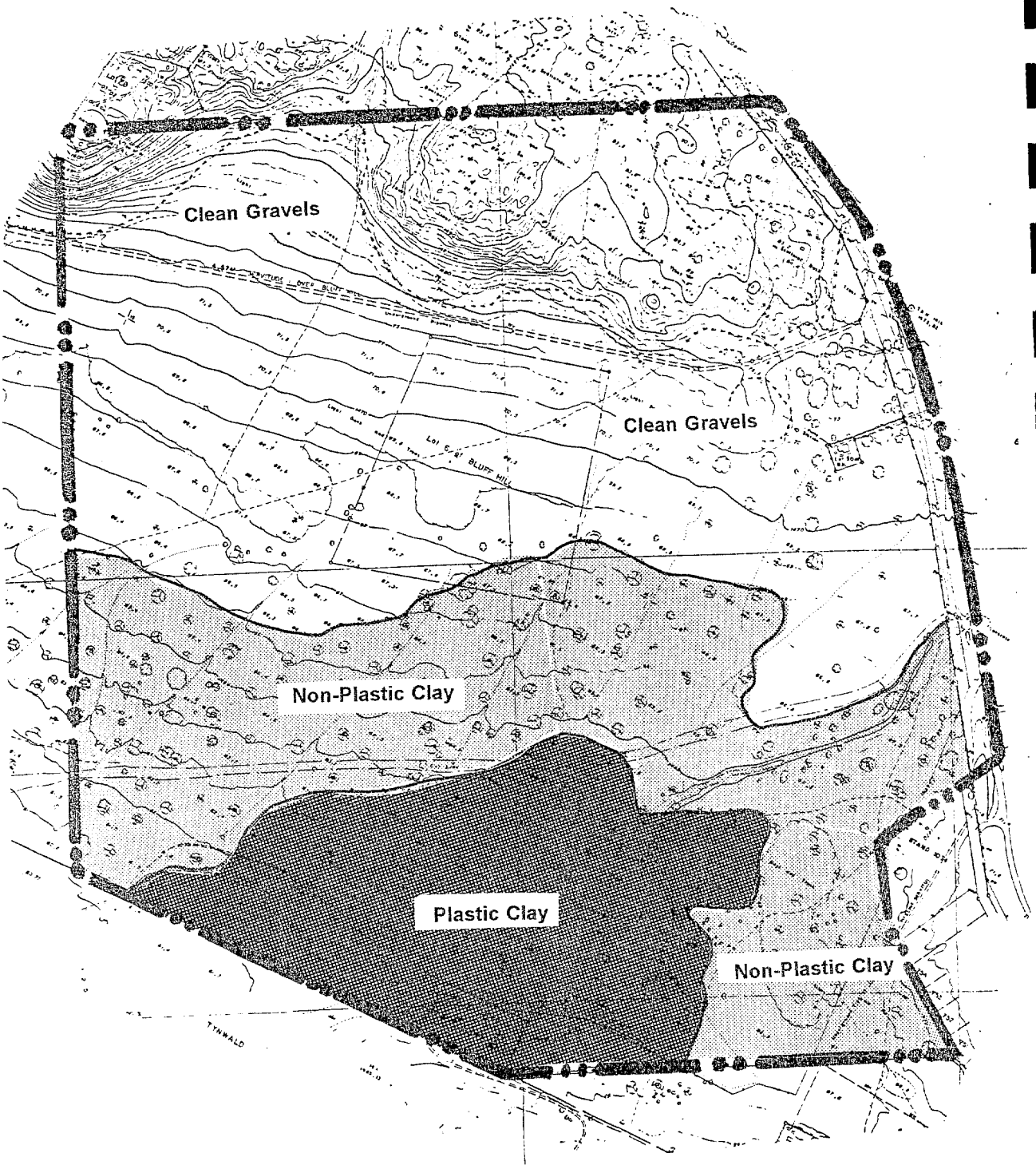
In summary, the various sands and gravels are generally suitable for foundations for light roads and buildings and some of the nonplastic silts and clays can be used. However clays will swell, silts tend to heave and organic soils compress under loads. Peat is completely unusable.

Evidence in the field of subsurface problems, for example a high water table; evidence of organic soils or of soft plastic clays, or loose silt; rock lying close to the surface; land previously used as a dump with new or unconsolidated fill, or any evidence of either floods or subsidence, all call for in-depth, specialized investigation. Figure 2.8 is an example of a map showing soil characteristics of a site.

Figure 2.7
Evaluation of Soil Types

Soil Class	Stability when loaded	Drainage	Bearing for foundations or roads	Base course for sealed roads	Material for light roads if stabilized	House construction
GW/GP	Excellent	Excellent	Excel.-Good	Good-Fair	Good	Very Poor
GM/GC	Good	Very Poor	Good	Poor-Good	Good	Good
SW/SP	Excellent	Excellent	Fair-Good	Pr.-Very Pr.	Good	Very Good
SM/SC	Fair-Good	Very Poor	Fair-Good	Poor	Good	Good
ML	Fair-Good	Poor-Fair	Poor-Fair	Very Poor	Fair	Good
MH	Poor	Poor-Fair	Poor	Very Poor	Poor	Very Poor
OL	Poor-Fair	Poor	Poor	Very Poor	Very Poor	Very Poor
CL	Fair	Very Poor	Poor-Fair	Very Poor	Poor	Fair
CH/OH	Poor	Very Poor	Very Pr.-Pr.	Very Poor	Very Poor	Very Poor
PT	Very Poor	Poor-Fair	Very Poor	Very Poor	Very Poor	Very Poor

Figure 2.8
Soil Characteristics



Layer 5 : Vegetation Analysis
The plant cover of the site can be used to assist in understanding the soil, hydrology and subsurface conditions (for example a high water table, leached soils, etc). Plants also play an important role in the micro-climate of any site. For example large trees can provide both direct shade as well as a sense of place within a neighborhood. Thickets of trees or shrubs act as wind-breaks and also as noise barriers.

An analysis of the vegetative cover of the site is best done by initial use of an air photo followed by field inspection. Factors to be mapped (see Figure 2.9) include:

- Large indigenous or exotic trees or clumps of trees that add visual interest and protect smaller shrubs and birds which should be protected within the layout
- Vegetation indicative of a high water table that may affect built development (for example a clump of eucalyptus trees, *Mukute* trees, water grass, etc)
- Vegetation which acts as a natural barrier to the wind, pollution or noise
- Vegetation indicative of natural eco-systems requiring protection (vleis or wetlands)
- Vegetation which has been protected in the past as marking a site of cultural significance (a meeting place, grave sides, etc)

Layer 6 : Infrastructure Analysis
In consultation with the responsible engineer for the project, highlight those areas (see Figure 2.10) of the site :

- to which water cannot be reticulated;
- which cannot be sewered without pumping;
- which should be red-flagged as having especial engineering difficulties associated with them.

2.5 Composite Site Analysis

The physical characteristics of a site affect its feasibility for development. Various characteristics differ in degree of importance and affect various kinds of development in different ways. The overlay process results in a comprehensive understanding of different parts of the site's development suitability. By overlapping two or more characteristics from different base maps, a composite map indicating varying degrees of suitability for one intended use is derived. This information can then be used to resolve conflicting physical demands for the site, within the limits of the site.

Figure 2.9
Vegetative Cover

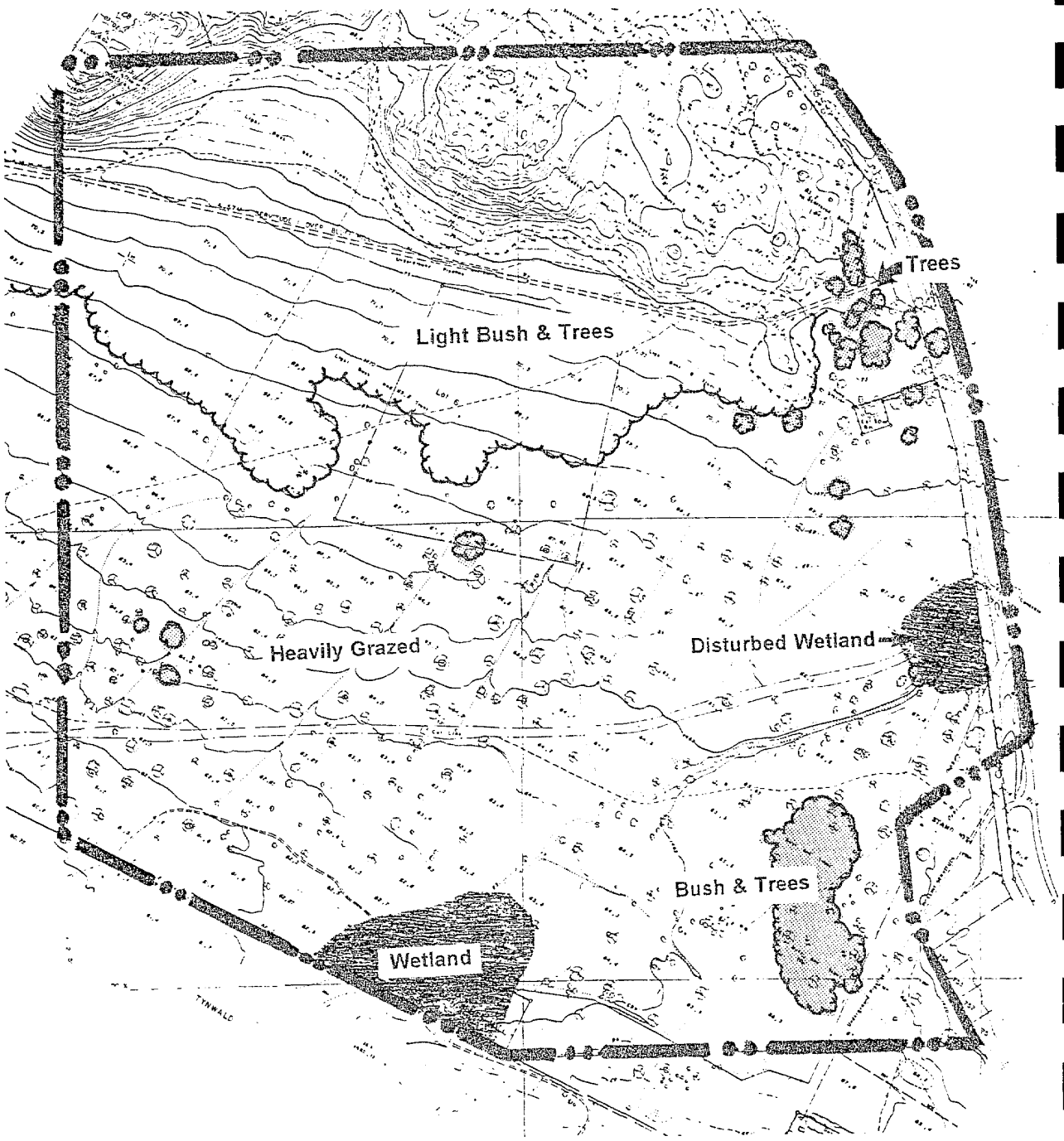


Figure 2.10
Infrastructure Analysis

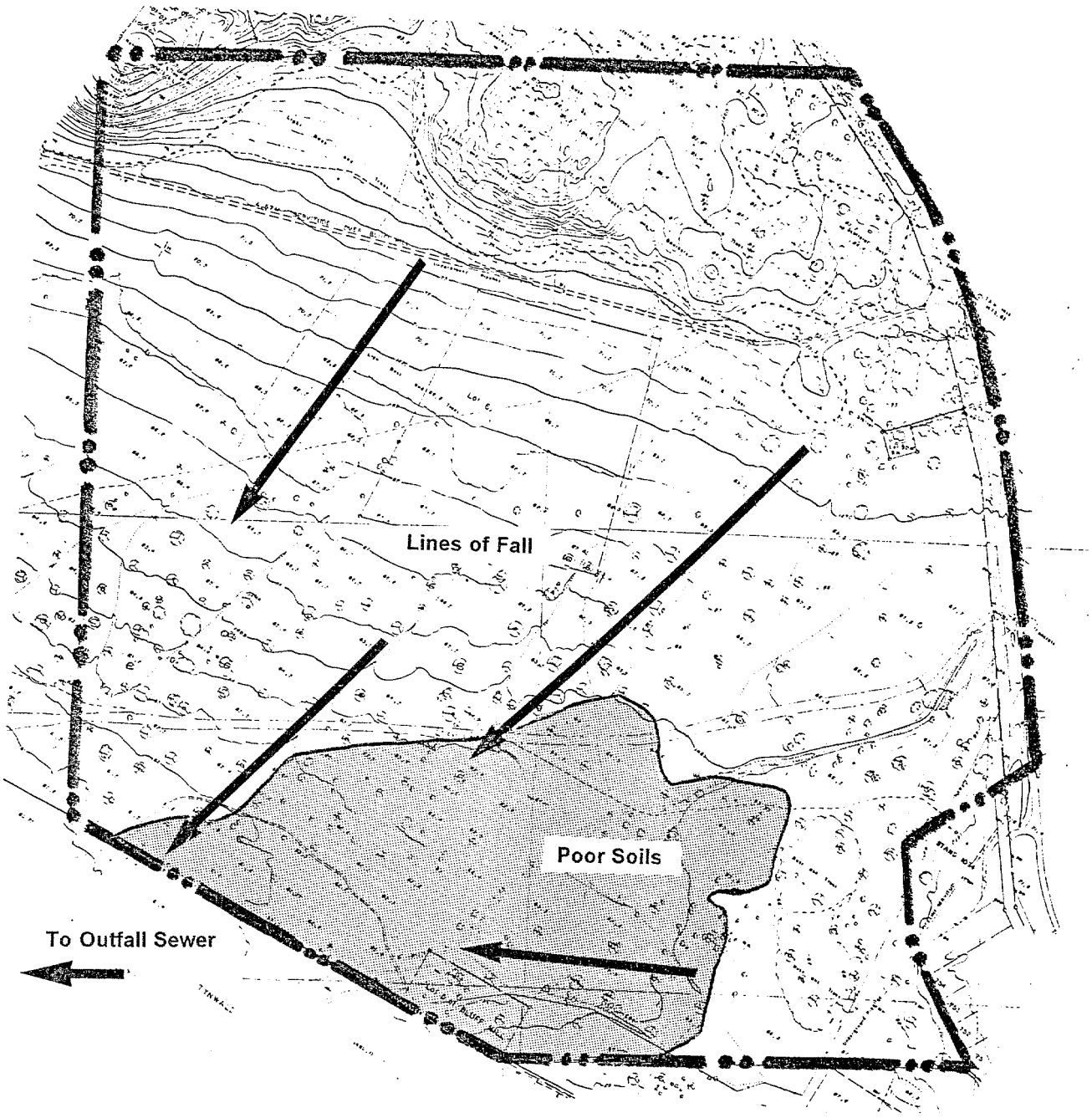


Figure 2.11 shows the resultant suitability development composite for a typical high density housing development. In summary, the sieve overlays used were:

Layer 1 : Off-Site Links
Layer 2 : Topographical Features
Layer 3 : Slope Analysis
Layer 4 : Soils Analysis
Layer 5 : Vegetation Analysis
Layer 6 : Infrastructure Analysis
Layer 7 : Development Suitability Composite

Figure 2.12 shows the process by which the Development Suitability Composite Map has been derived.

When all of these characteristics are overlaid and the specific positive and negative characteristics are isolated, a single map can be produced which indicates:

- areas which are most suitable for development
- areas moderately suitable for development and should only be developed with guidelines
- areas with severe limitations for development which should not be developed.

The development suitability map (composite analysis map) with assigned intensity of use must be completed in the early stages of plan formulation to form a sound basis for the next plan formulation steps.

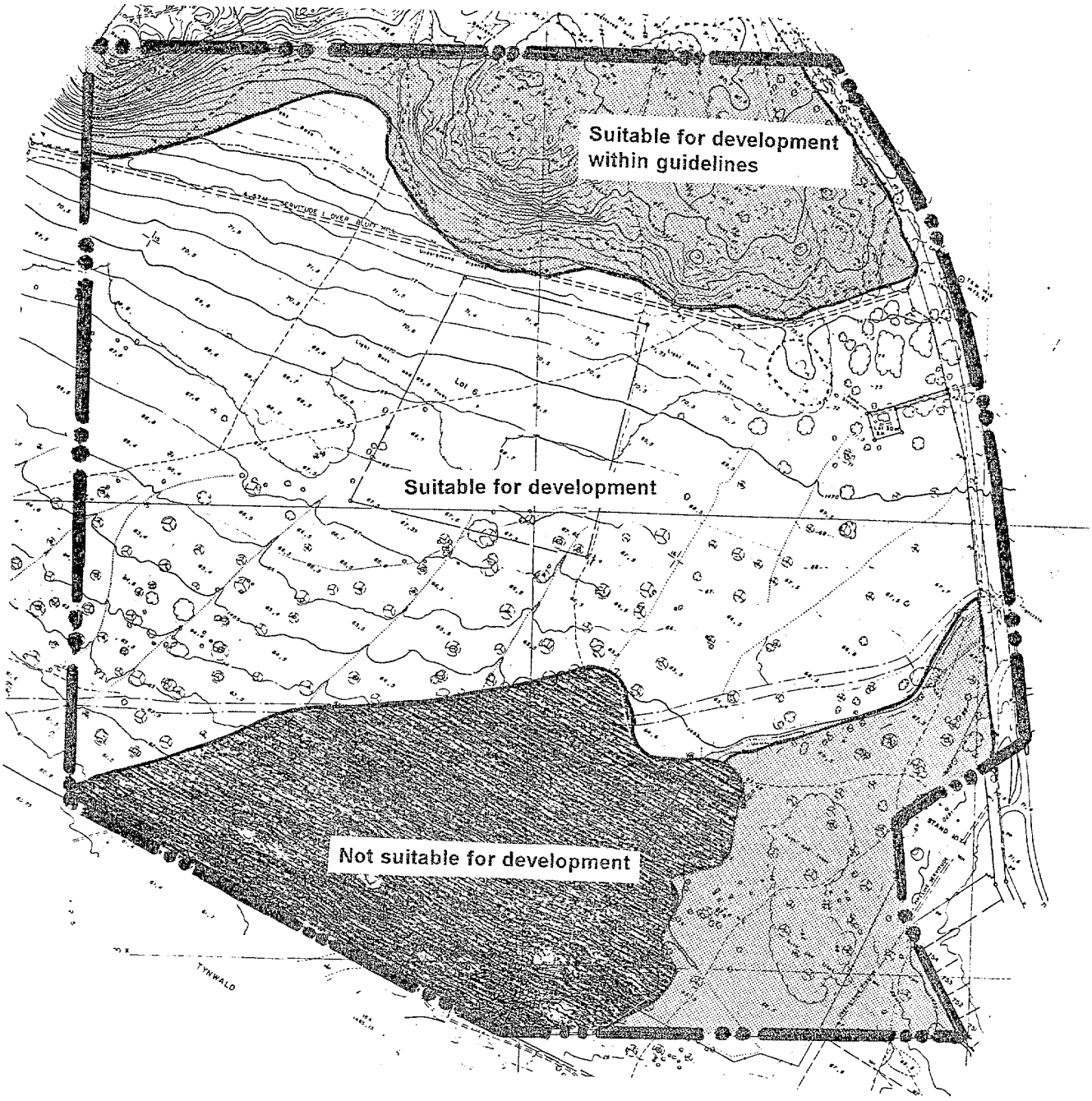
2.6 Evaluating Environmental Conditions

A variety of environmental issues affect human life in Zimbabwe -- deforestation, soil erosion, loss of biodiversity, and air and water pollution to name but a few. Protection of the natural environment is not only a desirable goal in community development but has recently been introduced as a national policy requirement in the country. The development of new national environmental management legislation will take time to enact but in the interim, an Environmental Impact Assessment Policy was adopted in July 1994 and is being implemented by the Ministry of Environment and Tourism. The aim of the policy is to minimize confusion and uncertainty for both project developers and government regarding the impact on the environment of development projects.

The goals for Environmental Impact Assessment in Zimbabwe as set out in the MET policy document are as follows:

- Environmentally-responsible investment and development in Zimbabwe must be encouraged through transparent, predictable, equitable and effectively administered environmental assessment policy.

Figure 2.11
Site Suitability Composite Map



- The long-term ability of the natural resources to support human, plant and animal life must be maintained.

- A broad diversity of plants, animals and ecosystems must be conserved.

- Natural processes such as recycling of air, water and soil nutrients must be preserved.

- Irreversible environmental damage must be avoided and any environmental damage must be minimized.

- The basic needs of the people affected or likely to be affected by a proposal for food, water, shelter, health and sanitation must be met.

- Social, historical and cultural values of people and their communities must be conserved.

Table 3 of the EIA Policy 1994, prescribes activities in terms of type, not size, for which new activities and substantial additions or expansions to existing conditions should be submitted to the Minister for a determination as to whether or not an EIA Report is needed. Housing developments and new towns or townships are prescribed activities.

In order to maintain a harmonious relationship between the natural environment and our use of it, the locations, design and construction of all buildings, roads and infrastructure must be based on the proper management of the environment. The impact of all new developments on natural systems should be assessed, and appropriate changes made in the concept plan. Three basic guidelines to help establish whether or not an EIA report might be called for are:

- Is the project in or near an area that is considered to be environmentally sensitive or aesthetically pleasing?

- Is the project likely to have disruptive effects, such as generating substantial traffic and noise?

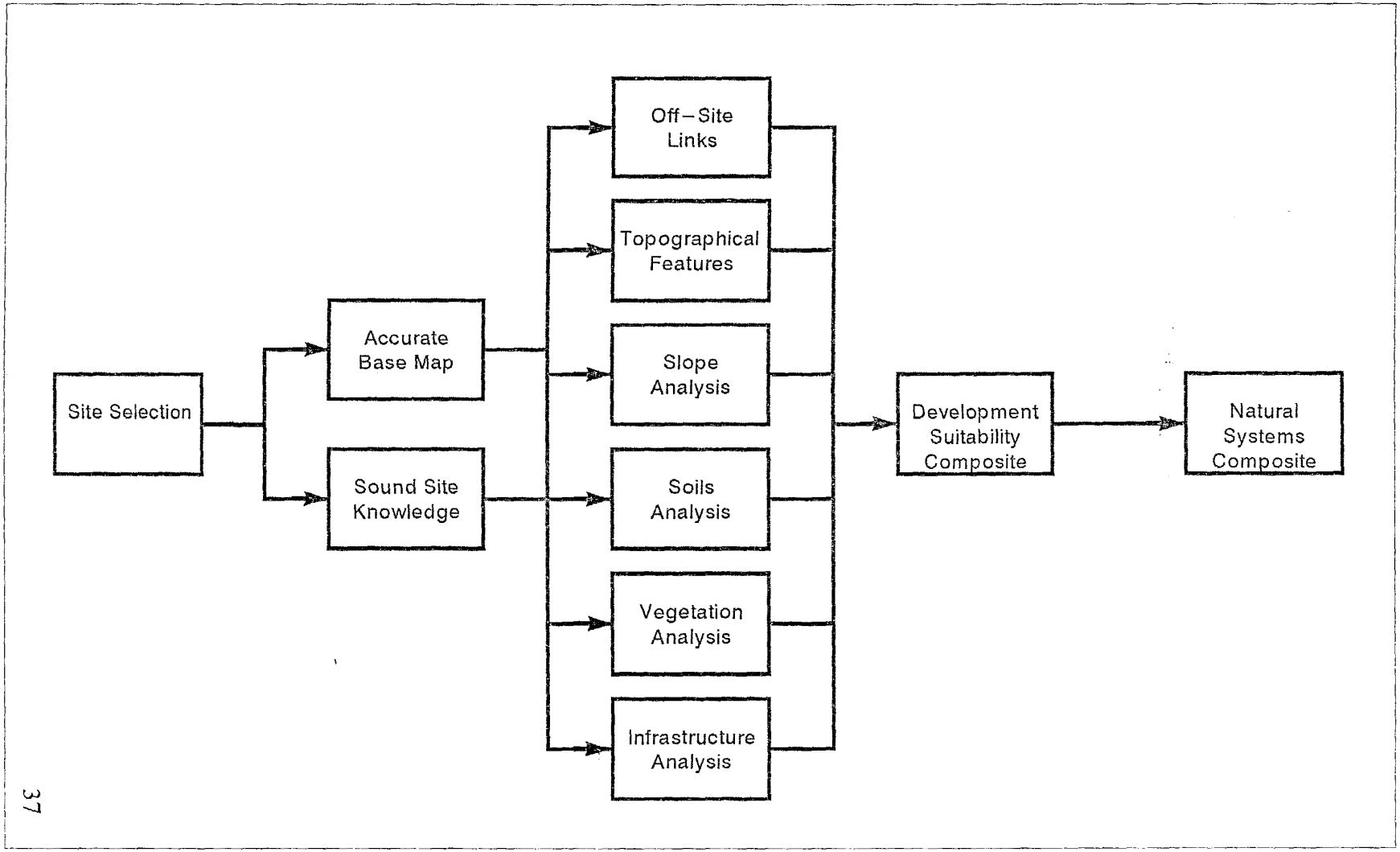
- Is there public question or controversy regarding the effects of the proposed project?

An initial prospectus of the development can be prepared at little cost and as an integral part of the sieve analysis of the site by means of a Natural Systems Composite Map. Typical information in the NSC map include the vegetation analysis of the site (Layer 6), the soil analysis of the site (Layer 4) and the analysis of the surface hydrology of the site (Layer 2). The resultant NSC map highlights the following considerations:

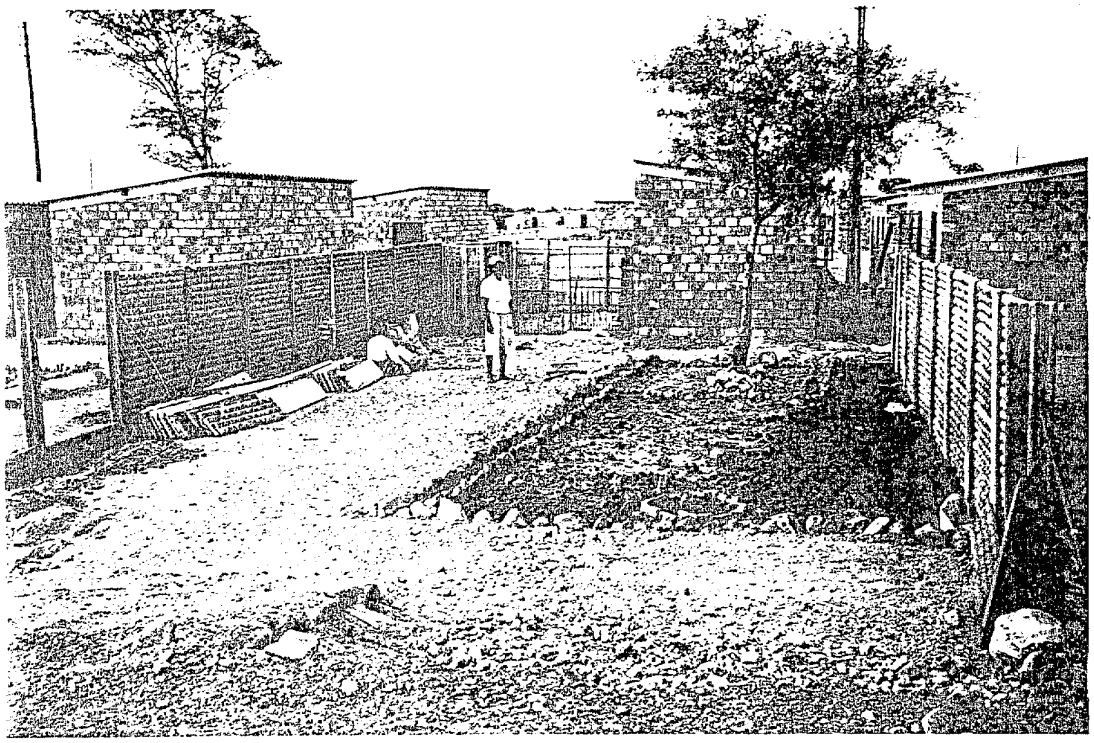
- locations which will have no impact on the natural systems

- areas where environmental management principles should be applied if development is to be undertaken

Figure 2.12 : Site Analysis Procedure



- areas in which erosion management principles should be applied to the site if development is to take place
- areas that are highly sensitive but still buildable if vegetative, soil and water management principles are applied
- areas that are most environmentally sensitive to development and should be protected or restricted against development.



Stand sizes for high density housing schemes should range from 150m² to 300m²

Chapter 3
Programming

This chapter focusses on the use of computer modelling and simulation techniques to evaluate layout design and standards in terms of their efficiency and affordability. The end result of this activity will be the achievement of a detailed site layout programme before any actual drawing of a layout has begun. The full definition and testing of this programme prior to layout design is essential to the establishment of viable residential layouts for high density areas. Without the guidelines established by this programme, the layout designer would not be able to realise the consequences of his or her decisions before a great deal of time and effort had been spent. Computer simulation models will therefore be used in order to prepare and analyse the proposed programme for layout efficiency, cost and affordability. This is an iterative process which generally requires a number of attempts to achieve a programme that will reflect the desired result. The use of simple computer models to simulate layout characteristics makes this process quick and easy to implement.

3.1 Identifying Basic Regulations and Standards

Layout plans prepared for high density housing areas require full cadastral survey, whether on state, municipal or private land. The survey (followed by title deeds to each stand) is used by financial institutions such as building societies to underwrite the loans extended to households to develop the stands and build the houses. In order for cadastral survey to be carried out, the layout plan has to be approved in terms of either Section 40 (in the case of private land) or Section 43 (in the case of state land) of the Regional, Town and Country Planning Act (Revised Edition , 1996), or approved in terms of Section 205 of the Urban Councils Act in the case of municipal land. Once approved, the plan becomes a statutory document and can only be altered or amended by formal procedure.

3.1.1 Statutes and Regulations

Not only is a layout plan itself a statutory document but it is prepared within the statutory parameters set by a number of documents. The most important are:

- *Master Plan, Local Plan or Town Planning Scheme* currently operative in the area. The Plan/Scheme sets out the permitted zoning on the site, main reservations for utilities and public lands, and provides detailed guidelines concerning minimum permitted stand sizes, building lines, coverage and height factors, and frequently sets out specifications for land uses ancillary to the housing component of an area, for example the amount of land to be set aside for public open space and the numbers of health and education facilities per thousand population.

  The parameters set down by an operative Master/Local Plan or Scheme have to be abided by and can only be altered by a rewriting of the Plan or Scheme or under other

certain circumstances, for example the rezoning of land in the national or regional interest [Section 29] or the rezoning of reserved land after appropriate public notice has been given [Section 49].

- *Section 40 (3).* If there is no operative Master/Local Plan or Town Planning Scheme, the proposed use of the land and size of the proposed subdivisions is subject to Section 40(3) of the Act. The effect of Section 40 (3) is that a land use or development which is in conflict with the title deeds of the parent property or is substantially different from the use and sizes in adjacent areas, should be placed on public exhibition for public comment and objection. If there is no guiding Master or Local Plan for an area, there is a stronger responsibility for the site planner to carry out a careful site selection process (see Section 2.2), with particular analysis of adjacent land uses and off-site servicing available.

- *Regional, Town and Country Planning (Subdivision and Consolidation) Regulations RGN No. 924 of 1976* are relevant in areas where there is no reticulated water supply or sewerage and is not particularly relevant for urban, high density housing layouts.

- *The Regional, Town and Country Planning (Use Groups) Regulations, 1994* (Statutory Instrument 216 of 1994) prescribes the use of land or building uses for the purposes of Section 22(1)(i) and Section 25(2)(c) of the Regional, Town and Country Planning Act. Part II of the Regulations allows for a variety of uses which, under stated conditions, may be freely permitted in residential areas unless expressly prohibited by a Master or Local Plan.

  Uses which may be permitted in a residential area are:

  - Convenience services of no-nuisance value where the predominant use remains residential, where the goods are not publicly displayed, where the enterprise is run by a single family and is meant to serve persons in the immediate vicinity (for example a hairdresser, tailor, typist, photographer, stone carver, etc)

  - An office for use by a single family.

  Certain other uses also may be permitted by special consent in residential areas, typically where only five to ten people are employed; where the uses are not obtrusive (such as home offices, surgeries and creches) or where an obtrusive use is limited in scale of operation and not in the public view (for example carpenter, welder, small scale car repair, and similar).

3.1.2 Policy Circulars

Policy circulars and statements that are issued from time to time by the Ministry of Local Government, Rural and Urban Development, the Ministry of Public Construction and National Housing and the Ministry of Environment and Tourism frequently have a bearing on the preparation of housing programmes.

- *Circular No. 3 of 1992.* The most recently issued circular which is germaine to the preparation of layout plans for high density housing is Circular No. 3 of 1992 "Revised Minimum Building Standards for Medium and Low Cost Housing" issued by MPCNH. The circular is aimed at reducing the costs of housing and making it more affordable for low income groups. The circular sets out "minimum building standards pertaining to planning, infrastructure and superstructure". The sections of the circular relevant to site planning are given in Figure 3.1. The full text of Circular No. 3 of 1992 is given in Annex III.

- *The Environmental Impact Assessment Policy, 1994* implemented by the Ministry of Environment and Tourism. Table 3 of the EIA Policy prescribes that new or expansions to existing housing developments and new towns or townships should not receive the required authorisations from the relevant permitting authorities unless and until the Minister of the Environment has exempted the activity from the requirements of the EIA Policy or has granted an "EIA Acceptance". EIA Acceptance is granted when the Minister determines that the environmental planning and assessment of an activity has been sufficiently thorough to identify the impacts which it is likely to cause as well as measures for managing them.

3.1.3 Standards for Supporting Use Groups

A key task in designing a residential area is to ensure that adequate reservation has been made for such community areas and facilities as schools, health care, parks, playgrounds and shopping. These areas should be accessible, adequate in size and located on land suited to their purpose. The overall site design should at the least provide a basic functional adequacy in the provision of sites for community use. However the design can go further by giving the area a positive visual character through the careful siting of public areas and intensive uses. For example community facilities, shopping areas and in particular a system of linked open spaces can be used to create focal points; and varied stand shapes and building lines can be used to create attractive building clusters rather than linear development.

There can be few hard and fast rules concerning the provision of land for community facilities as different uses in an area are a function of numerous inter-related variables. For example the appropriate floor area space for commercial uses is more a function of disposable income levels and competition from other outlets than a direct relationship to population. The requirement for healthcare and educational facilities will depend on the demographic structure of the community being planned for -- older age groups have very different needs than younger age groups. In many cases too, occupancy rates of the housing stock vary enormously[1], making set standards to provide a fixed number of facilities per XXX stands redundant.

Similarly, the amount of public open space to be provided should be based on an analysis of the density of the residential units and the private space usable by families, the topography of

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[1] For example, in Chitungwiza, the estimated average stand occupancy rate in St Mary's is 14 people whereas it is only seven people in Zengeza.

Figure 3.1
Layout Planning Standards - Circular No. 3 of 1992

Planners should aim at a mixture of stand sizes in each scheme

The minimum permitted stand size for detached houses is 150 m^2 with a frontage of 8,5 metres.

Stand sizes for high density detached housing schemes should range from 150m^2 to 300m^2. As a guideline, the stand should be mixed as:

- 40 percent should be 150m^2
- 40 percent should be 200m^2
- 20 percent should be 300m^2, (with 5m, 3m and 1m building lines from the street, back and side boundaries respectively).

The minimum stand size for semi-detached houses is 105m^2 with a stand frontage of 7 metres (with 5m, 3m and 1m building lines from the street, back and side boundaries respectively).

Stand sizes for medium density detached housing should range from 300m^2 to 500m^2.

Not more than five percent of the site should be used for active open space and not more than 30 percent of the site should be used for community facilities.

the site, the natural eco-systems present, and the financial viability of the project. Furthermore, the area being planned is part of the larger urban system and residents will frequently make use of facilities beyond the plan boundary.

Various planning standards for community facilities can be found in different reports. A summary of guidelines for supporting use groups taken from the Department of Physical Planning's draft "Design Manual for Zimbabwe", March 1996 are given in Figure 3.2. Local Plans also typically set out the number of facilities to be provided and indicate "floating reservations" for the sites. Generally, these standards should be regarded as guidelines; the provision and siting of facilities within a particular layout is best derived from a careful analysis of the site itself and surrounding development and from the design programmeme which is developed for the area.

3.2 Preparing a Preliminary Programme

When applicable regulations and standards have been identified, the next step in the layout design process is to prepare a preliminary layout programme for the selected housing project. Certain data for the programme will come from the market analysis, the characteristics of the

Figure 3.2
Guidelines for Supporting Use Groups

The following are guidelines for supporting uses in high density residential developments summarised from the Department of Physical Planning (DPP) *Design Manual for Zimbabwe*, March 1996. These are intended only as guidelines to assist the planner in establishing a programme and developing concept plan alternatives for analysis. Areas for supporting uses may require adjustment during the design process to make a project feasible. Current DPP directives limit space for community facilities to 30 percent of the site which is still higher than in many other developing countries.

Shopping Facilities

The location, orientation and design of commercial centres is important since they form the focus of a community or neighbourhood and generate both vehicular and pedestrian traffic. The minimum requirements outlined below serve as the baseline but may be modified to meet local conditions. Shopping facilities and the types of services appropriate for each level include:

Type of Shopping Facility	Population Served	Functions
Regional Shopping Centre	-	Size and functions to be determined by market study.
District/Community Shopping Centre	20 - 30,000	All the functions of a neighbourhood centre plus the following: offices, banks, cinemas, restaurants, surgeries, and bookshops. The number of functions should be limited so as to not compete with Central Business Districts (CBD) or regional shopping centres.
Neighbourhood Shopping Centre	5 - 8,000	Bus stop, market, general dealer/superette, bottlestore, petrol filling station, bakery, hairdresser's shop, beer garden.
Corner Shops	250 -300	One shop selling basic commodities and lower level goods, e.g. matches, bread, milk, sweets, etc.

Recommended planning guidelines for selected shopping functions are:

Type of Shopping Facility	Stand Size	Design Criteria
Petrol filling or service station	2,000m^2 for stations with ancillary uses - 600m^2 for filling stations only	Locate in accessible, prominent position at junction with main road.
General Dealers	180m^2 - for larger shops combine two or more stands	Locate at the core or long axis of shopping centre to serve as an anchor.
Beer Garden	5,000m^2	Locate in or adjacent to shopping centre. One facility per 20,000.
Supermarket	600m^2	Locate in prominent area of shopping centre to serve as magnet. Provide on-site parking.

Figure 3.2
Guidelines for Supporting Use Groups (continued)

Type of Shopping Facility	Stand Size	Design Criteria
Hotel	4,000m^2	Locate in accessible but quieter position.
Market	2m x 2.5m for market stall	Locate next to a bus stop or terminus. Provide space for public toilets, landscaping, and future expansion.
Bus Terminus	2,800m^2	Locate next to market.

Industrial Areas

Standards and location for industrial areas are determined by the type and nature of industrial activities and their environmental qualities, e.g. fumes, noise, odors etc. Design criteria for major industrial uses are outlined below.

Type of Industry	Stand Size	Design Criteria
Service Industry: day to day activities such as cycle repairing, tinsmith, hair saloons, shoe repair, carpentry, welding, minor car repair	120m^2	Locate in or close to shopping centres if there are minor environmental problems. Compatible uses can be mixed.
Cottage Industry: craftsman, carving, habor dashery	60m^2	Locate near a shopping area to increase passing traffic. Provide working area at rear.
General Industry & Warehousing: factories, bakeries (large scale), warehouses, wholesalling, government departments, equipment depots	300m^2 minimum to 1.5 hectares	Locate with good accessibility to transportation, on leeward side of wind direction, and ideally on the edge of the area. Consider the scale of operation and level (provincial, district or local) in determining location. Provide on-site parking.
Storage and Special Industry: abattoirs, saw mills, tanneries	+1 hectare with size determined by the nature of the industry	Locate with good accessibility to roads and close to railway siding but away from residential and commercial area and sources of water supply (present and future).
Light and Heavy Industry: cement factory, chemical factory, brick factory	Size determined by the nature of the industry - generally large area is needed	Locate in industrial park at the edges of the community and down wind from residential areas.

Special note should be taken of the changes in use groups introduced in Statutory Instrument 216 of 1994. The former light and heavy industry groups have been combined into one group. Storage and Special Industrial uses remain in a separate use group since these are for specialized functions. Some types of service industry may be permitted on residential stands by special consent.

Figure 3.2
Guidelines for Supporting Use Groups (continued)

Social Facilities

These are facilities such as schools, public parks, churches and community halls that benefit the community. These facilities are provided at the community and neighbourhood level. Design guidelines for some of the most common social services provided in high-density layout plans are outlined below.

Type of Social Facility	Stand Size	Design Criteria
Primary School[a]	3.5 hectares	Locate in accessible and central area away from shopping centres and main roads. One primary school per 500 - 700 residential units.
Secondary School[a]	5 hectares	Locate in central, accessible area adjacent to active open space (to share facilities). One secondary school for 3 - 5 primary schools.
Creche[b]	1,500 m^2 minimum	Locate in central, accessible area away from major roads. One creche per 600 residential units.
Church[c]	1,600m^2 for church building only, 2000m^2 if there are related facilities	Locate in prominent site. Churches should not be located next to each other. One to two churches per neighbourhood (5 - 8,000)
Community Hall	1,500m^2	Locate as part of the commercial centre. One community hall per neighbourhood (5 - 8,000).
Sports Club	2 hectares	Locate in accessible area.
Post Office (inclusive of an Exchange)	1,200m^2	Locate in accessible area of a community shopping centre.
Police Station	1,000m^2	Locate on prominent site on major road, accessible to residential areas.
Local Authority (administrative)	1,000m^2	Locate on prominent site with easy access from main road.
Fire Station	2,000m^2	Locate in the center of the community with easy access to main roads.
Health Clinic	2,000m^2	Locate adjacent to a shopping centre. One clinic per 10,000 residents.
Open Space	5% of planning area	Locate in area accessible to residents. Make use of land that is difficult to develop. Residual open space is not encouraged.

a The stand sizes for schools are being considered by DPP but have not been officially adopted.
b DPP number is doubled based on recommendations of *Gender Analysis of the Zimbabwe Housing Guaranty Program, 1996.*
c Stand sizes for churches are based on a 1982 study of standards for high density areas.

site and current unit costs. Other data will be the "best estimations" of standards that will result in an efficient and affordable development. The preliminary programme is the basis for the further analyses of cost and affordability using the computer models.

3.2.1 Efficient Layout Design

The Layout Programmeme Worksheet has a two-fold objective. The first is to establish layout design parameters that will result in the efficient use of valuable urban land. The second, closely related to the first, is to set the conditions for housing development that will be affordable to the target low-income families. Certain principles of efficient layout design should be kept in mind before looking at the details of a preliminary programme.

Maximize Marketable Land

The underlying principle of efficient layout design is to maximize the amount of site area that can be sold in order to recover development costs. Since circulation space (roads, pedestrian ways and parking) and open space are the main non-marketable land uses, an efficient layout design will keep these uses to a minimum acceptable level. In high-density developments, it is crucial that adequate open space, both passive and active, be provided. The best opportunity to reduce the area of non-marketable land, therefore, is to keep circulation space to a minimum by reducing the width of road reservations. This approach is particularly suited for low income, high density areas in which car ownership is low (around 5 percent). DPP guidelines set a maximum of 20 percent for circulation space. Sites for community facilities such as churches can be sold, often at the cost of development, so as not to increase the costs of the stands. Commercial land can be sold at market prices to provide a cross subsidy for the lowest income purchasers of high-density stands.

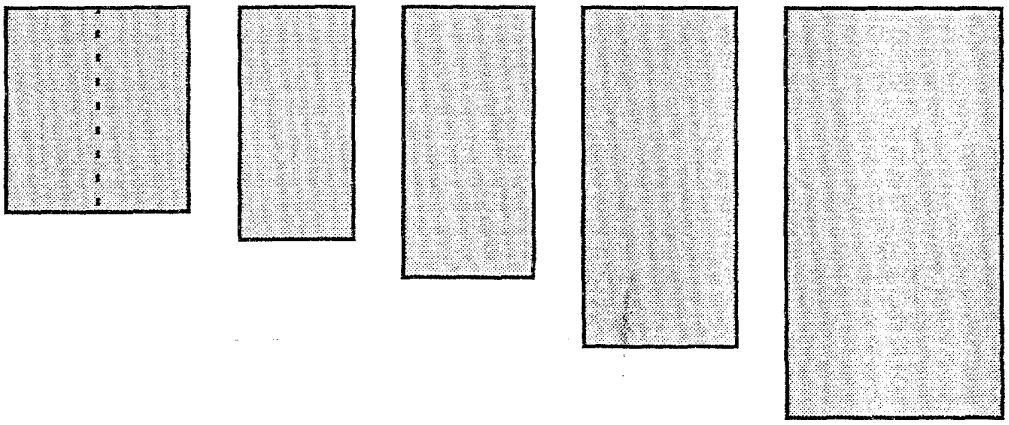
Layout of Residential Stands

There are several principles relating to the layout of residential stands that have an impact on the efficiency and affordability of the design. Planners should be aware of the following when developing a layout programme and design:

- *Stand configuration.* Stands should be rectangular with the short dimension oriented to the lower usage access street. The shorter the frontage of a stand, the shorter the length of road and infrastructure required to service it. The ratio of stand depth to frontage should be two or more if possible. Figure 3.3 shows possible configurations of common stand sizes in Zimbabwe. Care should be taken that even narrow stands provide a suitable location for housing construction and that both front and rear gardens be as useful as possible.

- *Stand size.* As stand sizes decrease and density increases, the overall cost of infrastructure also increases. The total cost per stand however, can be substantially reduced. Figure 3.3 shows estimated costs for infrastructure for different stand sizes. Although the costs are only indicative they are proportionately correct and close to reality. If stands are developed to the same level of infrastructure, the cost per m^2 will be slightly higher for the smaller stands (Z$ 33,54/m^2 for the smallest stand vs. Z$ 27,02/m^2 for the largest stand), but the cost per stand is significantly less (Z$ 3 522 for

Figure 3.3
Stand Configuration and Cost

Area(m2)	105(1/2 duplex)	150	200	300	500
Dimensions(m)	7 X 15	8.5 X 17.6	10 X 20	12 X25	15 X 33.3
Ratio (depth/frontage)	2.1	2.1	2.0	2.1	2.2
					
Cost/M2(Z$)	33.54	31.55	30.24	28.60	27.02
Stand Cost(Z$)	3,522	4,733	6,048	8,580	13,510

the smallest stand vs. Z$ 13 510 for the largest stand). The minimum sized stand is currently 150 m^2. In the future, creative arrangements that increase density may be required in order to serve low-income households.

- *Block length.* The efficiency of a layout and cost per net m^2 can be improved with careful design of the block layout. Costs are reduced as residential blocks increase in length as a result of reductions in circulation space for secondary cross streets. The blocks that are less than 100 metres can have a considerable impact on infrastructure costs per m^2. The length of blocks should not exceed 250 metres.

Differential Land Pricing

One of the options that can be used to reduce the cost of stands in high density developments is the judicious application of differential land pricing in place of charging an average cost for all residential land. As noted above, if stands are developed to the same level of services, the cost per m^2 increases for smaller stands. But this is not true if different infrastructure standards are used. Stands with differing levels of service do not cost the same amount to develop. If smaller stands are provided with lower levels of services, for example narrower access streets, their development cost will be less.

Also location within a layout will have an impact on the market value of a stand. While it has not been generally recognized in Zimbabwe, stands located on major roads, particularly at intersections, have a higher market value because of their commercial potential than those located on minor streets in the middle of a residential area which do not have such potential. In most high density neighborhoods, there are already informal shops ("tuckshops") at intersections and along major streets.

Figure 3.4 shows the differences in development costs and percentages of circulation for three stands with differing levels of service. Actual development costs vary by over 45 percent from Z$13,53 to Z$24,75 per net square metre. If the same average cost of Z$19,90 was charged for all of the stands, there would be a 19,7 percent subsidy to purchasers of bigger stands by lower-income families purchasing smaller ones. This makes it important to determine the cost of developing each type of stand.

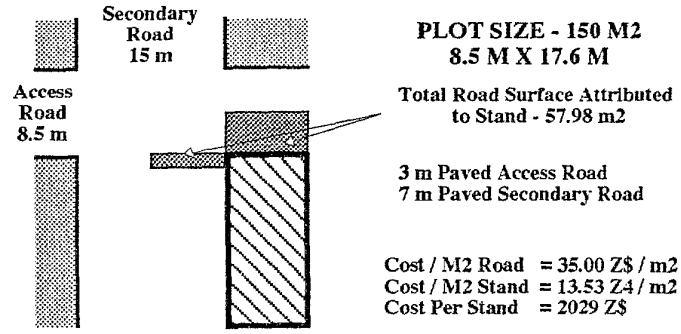
Maximization of marketable land in locations of higher market value can improve cost recovery with little or no additional expense to the project.

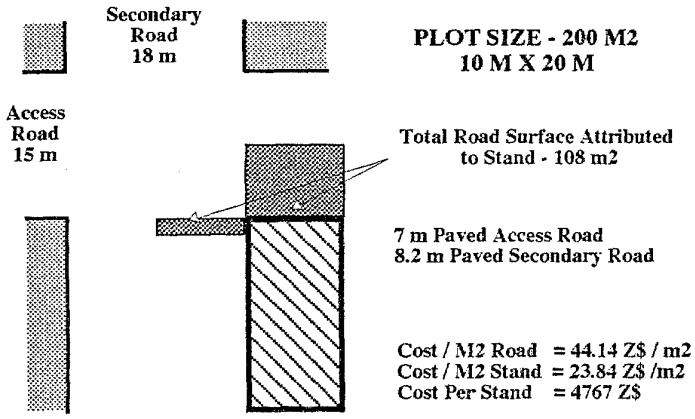
Appropriate Standards for Target Groups

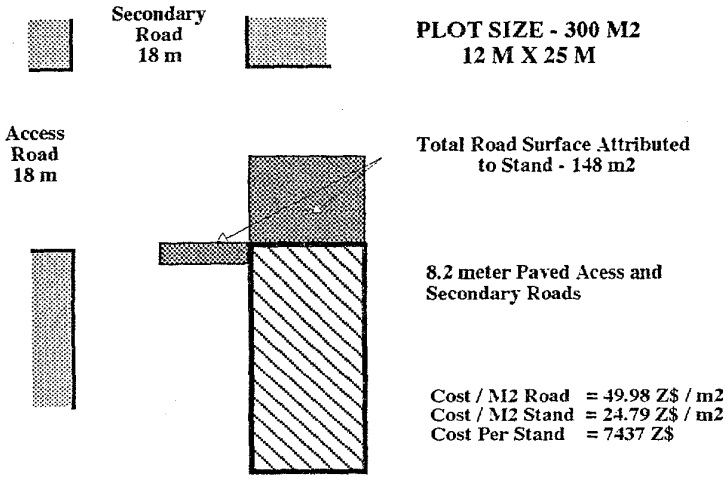
Differential land pricing is not only determined by location within the site, but also by the cost of development based on standards and levels of services provided. Standards should be largely determined by the financial resources of target populations.

- *Stand size.* This is one of the most important factors in determining the cost of a stand. Smaller stands are less attractive to higher-income families which reduces the likelihood that they will compete with low income beneficiaries for these stands even when the stands are subsidised.

Figure 3.4
Differential Land Pricing







Average road costs per m2 of stand = 19.9 Z$ / m2

There is a 19.7 % subsidy from the 150 m2 stands to 300 m2 stands when charging the average cost per stand.

- *Location within the layout.* If smaller stands are located in the centre of residential areas away from principal streets, a lower price legitimately can be charged.

- *Level of services.* If fewer services are provided to small stands the infrastructure costs will be less. Since there is limited vehicular traffic in high-density neighbourhoods, options could include access by minor residential roads with graveled surfaces and earthen drains or by footpaths and panhandles.

3.2.2 Layout Programme

To assist planners in preparing a layout programme, a computerized format has been provided for entering pertinent data that will be needed to prepare a layout plan. An example of a completed form is shown in Table 3.5. Operating instructions are given in Annex I.A. A preliminary programmeme is developed by entering data on the following characteristics:

- Total area of the site and non-developable area
- Proposed road hierarchy
- Percentage of non-marketable uses (circulation and open space)
- Number of community facilities and area
- Number of commercial facilities and area
- Percentage, area and frontage for up to eight stand types

With this data the computer calculates:

- Total areas for community and commercial facilities
- Stand depth and the ratio of depth to frontage for each stand type
- Proposed land use for the site (area and percentage of each use)

There is also space provided to compare the final layout design with the programmed land use and breakdown of stand types. This Layout Programme Worksheet can be used to initiate layout.

3.3 Modelling Layout Characteristics and Costs

The Layout and Costing Model allows a large number of alternative scenarios for land use and infrastructure standards and costs to be tested and evaluated prior to the development of any layout designs for the site. The primary use of this simulation approach is to analyse the broad implications of different physical parameters and standards of a grid type layout and to estimate their corresponding costs. The use of a computer spreadsheet programme allows this analysis to be done quickly and easily.

The actual layout which is developed and submitted for approval will undoubtedly differ from the guidelines which result from the application of this simulation approach. Nevertheless, the use of computer spreadsheet simulation enables a wide range of different layouts and standards to be evaluated that will help ensure that the eventual layout is both financially feasible and affordable to the intended beneficiaries.

Figure 3.5

	A	B	C	D	E	F	G	H	I	J
1	LAYOUT PROGRAMME WORKSHEET									
2	Developer Anywhere			Project:	Edge-of-Town			Date:	11/15/96	
3	Site Area(ha)		50.53	Non-developable area(m2)			21,500	Developable Area(m2		483,800
4	ROAD HIERARCHY			Reservation(m)		Carriage way(m)		Surfacing(materials)		
5	Foot Path (FP)			2.5		1.0		Compacted earth		
6	Stand Access (SA)			8.5		3.0		Regrading of in situ soils		
7	Local Distributor (LD)			15.0		7.0		One layer gravel		
8	District Distributor (DD)			18.0		8.2		Granular base surfaced		
9	Primary Distributor (PD)			20.0		8.7		Structural layers surfaced		
10	NON-MARKETABLE USES(% of site)									
11	Circulation(roads & foot paths)			22.0		Passive Open Space			2.0	
12	Parking Areas			0.4		Active Open Space			3.0	
13	COMMUNITY FACILITIES(m2)					SHOPPING FACILITIES(m2)				
14			Number	Area/Fac.	Area			Number	Area/Fac.	Area
15	Creche		2	1,500	3,000	Dirtrict Shopping Ctr.				0
16	Primary School		1	35,000	35,000	Neighborhood Ctr.		1	3,000	3,000
17	Secondary School		1	70,000	70,000	Corner Shops		10	300	3,000
18	Health Clinic		1	500	500	Peoples' Market		1	1,000	1,000
19	Community Center				0	Beer Garden		2	500	1,000
20	Religious		3	2,000	6,000	Service Industrial		4	400	1,600
21	Public				0	Other				0
22	Other		1	5,000	5,000	Other				0
23	Total				119,500	Total				9,600
24	STANDS AND HOUSING UNITS								% Total	100.0
25	Stand Type		Type #1	Type #2	Type #3	Type #4	Type #5	Type #6	Type #7	Type #8
26	% of Total Stands		20.0	20.0	30.0	25.0	5.0			
27	Stand Size(m2)		110	150	200	300	450			
28	Stand Frontage(m)		7.0	8.5	10.0	12.0	15.0			
29	Stand Depth(m)		15.7	17.6	20.0	25.0	30.0	0.0	0.0	0.0
30	Ratio(depth/frontage)		2.2	2.1	2.0	2.1	2.0	0.0	0.0	0.0
31	Stands/Block(1 side)		20	16	14	12	12			
32	Block Length(m)		140.0	136.0	140.0	144.0	180.0	0.0	0.0	0.0
33	Access Road Type		SA	SA	SA	LD	DD			
34	Secondary Rd. Type		SA	LD	LD	DD	LD			
35	House Size(m2)			15	15	40				
36	Target Income($/mth)		1000	1200	1600	3000	5000			
37	LAND USE ANALYSIS			Program			Layout Plan			
38				Area(m2)	Percent		Area(m2)	Percent		
39	Total Developable Area			483,800	100.0		483,800	100.0		
40	Residential			222,139	45.9		180,560	37.3		
41	Circulation & Parking			108,371	22.4		124,520	25.7		
42	Open Space			24,190	5.0		22,200	4.6		
43	Community Facilities			119,500	24.7		150,320	31.1		
44	Commercial Facilities			9,600	2.0		6,200	1.3		
45	STAND ANALYSIS									
46	Stand Type		Type #1	Type #2	Type #3	Type #4	Type #5	Type #6	Type #7	Type #8
47	Program % of Total		20.0	20.0	30.0	25.0	5.0	0.0	0.0	0.0
48	Layout Stands/Type		148	155	274	189	41			
49	Layout % of Total		18.3	19.2	34.0	23.4	5.1	0.0	0.0	0.0
50	Total Stands in Layout			807						

The Layout and Costing Model has been developed using relatively straightforward formulae that have been incorporated into a Microsoft Excel spreadsheet. Detailed operating instructions are given in Annex I.B. There are no difficult formulae or macros involved in the spreadsheet which would preclude it from being used on other spreadsheet programmes such as Lotus 1-2-3. Only very little modification to the formatting of the spreadsheet is required when changing spreadsheet programmes.

3.3.1 Organization Of The Spreadsheet Model

The model is divided into four major sections as shown in Figure 3.6. These include:

- land use quantification and analysis of non-residential activities and residential areas which include up to eight different types of stands;
- infrastructure quantification and cost estimates based on the results of the non-residential and residential land use analyses, and
- a summary of total costs according to each major infrastructure component and a comparison of these cost to acceptable minimum and maximum limits.

Figure 3.7 presents the basic logic and order by which the programme works. It also shows the data inputs to be provided by the user and the calculations which are made by the programme based on these inputs. Since the programme includes a series of formulae which have been progressively linked together in order to obtain the successive results, a change in any one of the inputs will automatically produce a series of changes in the related calculations. Because all calculations are done very rapidly by the computer, the use of this programme allows the user to introduce and test a wide range of parameters and trade-offs between standards and costs. The end result will be an overall description and programme for a simulated layout that will be very close to reality. A good indication of the cost of development based on desired infrastructure standards and estimated unit costs will also be provided. The total infrastructure cost per gross square metre of site and the overall percentages for circulation and open space which result from the use of this programme should be introduced into the Affordability Programme in order to test the affordability of the proposed standards to the intended target group.

3.3.2 Types Of Analyses That Can Be Carried Out By Programme

By changing the value of one parameter and holding those of other parameters constant, the user can determine the impact of a particular land use or cost characteristic on the efficiency and/or affordability of the layout. Figure 3.8 shows the results of one typical analysis which can be carried out. Changes in average block length can have a significant impact on the area required for circulation. This will be different for grid and loop type solutions based on the formulae shown in Figure 3.9. As shown by the results of the analysis, the increase in the number of stands resulting from changes in block length can be substantial. These types of analyses can be done very quickly and easily since they only require the introduction of a few changes in the spreadsheet numbers for each simulation.

Figure 3.6
Layout Cost Model Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	SITE/COSTS:		Developer:			Project:				Date:	
2	LAND USE CHARACTERISTICS										
3	Site area in hectares		75	Non-developable area in m2				Developable area in m2			750000
4	NON-RESIDENTIAL AREAS										
5	Type of non-residential stand			Prim. Sch	Sec. Sch.	Health	Religious	Public	Shops	Market	Beer Gar.
6	Net stand size in m2			100000	100000	10000	12000	2500	2000	1000	10000
7	Stand frontage in meters			400.00	400.00	80.00	75.00	40.00	40.00	30.00	80.00
8	R.O.W. of access street			12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
9	Vehic. street (1), footpath (2)			1	1	1	1	1	1	1	1
10	Width of pavement			7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
11	R.O.W.of secondary street			16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
12	Vehic. street (1), footpath (2)			1	1	1	1	1	1	1	1
13	Width of pavement			10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
14	Network length / land use			342.0	342.0	119.5	134.5	68.3	62.0	48.7	119.5
15	M2 footpaths / land use			0	0	0	0	0	0	0	0
16	M2 paved footpath/land use			0	0	0	0	0	0	0	0
17	M2 street / land use			8992	8992	3152	3652	1672	1472	1085	3152
18	M2 paved street / land use			5420	5420	1930	2245	1025	900	663	1930
19				M2	%					M2	%
20	Total circulation area			32169	11.36		Total non-marketable area			45669	16.13
21	Passive o.s.			12000	4.24		Total non-residential area			283169	
22	Active o.s.			1500	0.53						
23	RESIDENTIAL AREAS			%	M2		Total residential area				466831
24	Passive o.s.			2.50	11671						
25	Active o.s.		(1st est)	2.50	11671						
26	Circulation area		25.00	23.83	111261						
27	Total non-marketable area			28.83	134602.72		Total net residential area				332228
28	Residential stand type		Total	#1	#2	#3	#4	#5	#6	#7	#8
29	Percentage total stands		100.00	40.00	40.00	20.00					
30	Stand size in m2			150.00	200.00	300.00					
31	Number of stands		1661	664	664	332	0	0	0	0	0
32	Stand frontage in meters			8.50	10.00	12.50					
33	Number of stands / block			10	8	10					
34	Reservation for access street			8.00	8.00	8.00					
35	Vehic. street (1), footpath (2)			1	1	1					
36	Width of pavement			5.50	5.50	5.50					
37	Reservation for secondary street			10.00	10.00	12.00					
38	Vehic. street (1), footpath (2)			1	1	1					
39	Width of pavement			5.50	5.50	7.00					
40	Network length / stand type			5475	6437	3563	0	0	0	0	0
41	M2 footpaths / stand type			0	0	0	0	0	0	0	0
42	M2 paved footpath / type			0	0	0	0	0	0	0	0
43	M2 sec. street / stand type			14384	19934	11163	0	0	0	0	0
44	M2 acces street / stand type			22592	26578	16611	0	0	0	0	0
45	M2 paved sec. street / type			7911	10964	6512	0	0	0	0	0
46	M2 paved access / stand type			15532	18273	11420	0	0	0	0	0
47	Total m2 circulation area			111261	Percentage circulation			23.83	Nb. units/hectare		36
48	LAND USE SUMMARY			M2	%					M2	%
49	Total footpaths			0	0.00		Total green space			23671	3.16
50	Total vehicular streets			143431	19.12		Total public spaces			13171	1.76
51	Total circulation			143431	19.12		Total non-marketable area			180272	24.04

Figure 3.6
Layout Cost Model Spreadsheet (Continued)

	A	B	C	D	E	F	G	H	I	J	K
52	SITE DEVELOPMENT COSTS					Unit	Quantity	% Site	% Bidding	Cost/m2	% total
53						Cost	M2-Ml	Adjust.	Climate	site	cost
54	Site preparation					1.5	750000			1.50	8.93
55	Vehicular streets:		90144	m2 paved							
56	- subgrade					40.60	102441			5.55	33.02
57	- base course					4.64	102441			0.63	3.77
58	- gravel wearing course					5.22				0.00	0.00
59	- base 1					4.64				0.00	0.00
60	- base 2					4.64				0.00	0.00
61	- surfacing			Total ml	%	13.54				0.00	0.00
62	- sidewalks in m2			40651	10.00	22.04	4065			0.12	0.71
63	- kerbs in meters			25169	20.00	98.60	5034			0.66	3.94
64	- channel in meters			25169	20.00	365.40	5034			2.45	14.60
65	Footpaths		0	m2 paved	%						
66	- grading and base					40.60	0			0.00	0.00
67	- cement					10.44	0			0.00	0.00
68	- paving slabs 50 mm thick					98.60	0			0.00	0.00
69	- stabilized earth						0			0.00	0.00
70	Drainage network		16711	m length	%						
71	- concrete pipe 450 mm diameter				10.00	327.16	1671			0.73	4.34
72	- concrete pipe 525 mm diameter				10.00	425.56	1671			0.95	5.65
73	- concrete pipe 600 mm diameter					498.80	0			0.00	0.00
74	- pipe						0			0.00	0.00
75	- pipe						0			0.00	0.00
76	- open ditch				80.00	23.20	13369			0.41	2.46
77	- other						0			0.00	0.00
78	- culvert inlet			spacing =	110	69.60				0.01	0.06
79	- culver outlet			"	110	69.60				0.01	0.06
80	- other			"						0.00	0.00
81	Sewer network		16711	m length	%						
82	- AC Sewer Pipe 100 mm diameter					52.20	0			0.00	0.00
83	- AC Sewer Pipe 150 mm diameter					77.72	0			0.00	0.00
84	- AC Sewer Pipe 225 mm diameter					161.24	0			0.00	0.00
85	- cleanouts (rodding eye)			spacing =		986.00				0.00	0.00
86	- manhole - 900 diameter			"		1223.80				0.00	0.00
87	- manhole - 1050 diameter			"		2204.00				0.00	0.00
88	- lagoon			number =						0.00	0.00
89	Water supply		16711	m length	%						
90	- primary pipe						0			0.00	0.00
91	- pipe - 50 mm diameter				20.00	52.20	3342			0.23	1.39
92	- pipe - 75 mm diameter				20.00	75.40	3342			0.34	2.00
93	- pipe - 90 mm diameter				20.00	104.40	3342			0.47	2.77
94	- pipe - 110 mm diameter				20.00	136.88	3342			0.61	3.63
95	- pipe - 160 mm diameter				20.00	226.20	3342			1.01	6.00
96	- valve			spacing =						0.00	0.00
97	- valve			"						0.00	0.00
98	- fire hydrant			"						0.00	0.00
99	- standpipe			"						0.00	0.00
100	Electricity		16711	m length							
101	- transformer				%	50000	4			0.27	1.59
102	- overhead lines				50	30	8356			0.33	1.99
103	- streetlighting			spacing =	50	1000	19407			0.52	3.08
104											

Figure 3.6
Layout Cost Model Spreadsheet (Continued)

	A	B	C	D	E	F	G	H	I	J	K
105	SITE COST SUMMARY			Cost/	Cost X	% Total		Comparison with anticipated costs			
106				m2 dev.	1000 $	cost		min.	max.	Z$/m2	% dif.
107	Site preparation			1.50	1125.0	8.93				0.00	0.00
108	Vehicular streets			9.41	7059.7	56.05				0.00	0.00
109	Footpaths			0.00	0.0	0.00				0.00	0.00
110	Drainage network			2.11	1583.4	12.57				0.00	0.00
111	Waste water network			0.00	0.0	0.00				0.00	0.00
112	Drinking water supply			2.65	1988.9	15.79				0.00	0.00
113	Electricity network			1.12	838.8	6.66				0.00	0.00
114	On-site costs w/o prep.			15.29	11470.8	91.07				0.00	0.00
115	Total site development			16.79	12595.8	100.00				0.00	0.00

Figure 3.7

FLOW OF INPUTS AND OUTPUTS IN THE LAYOUT COSTING MODEL

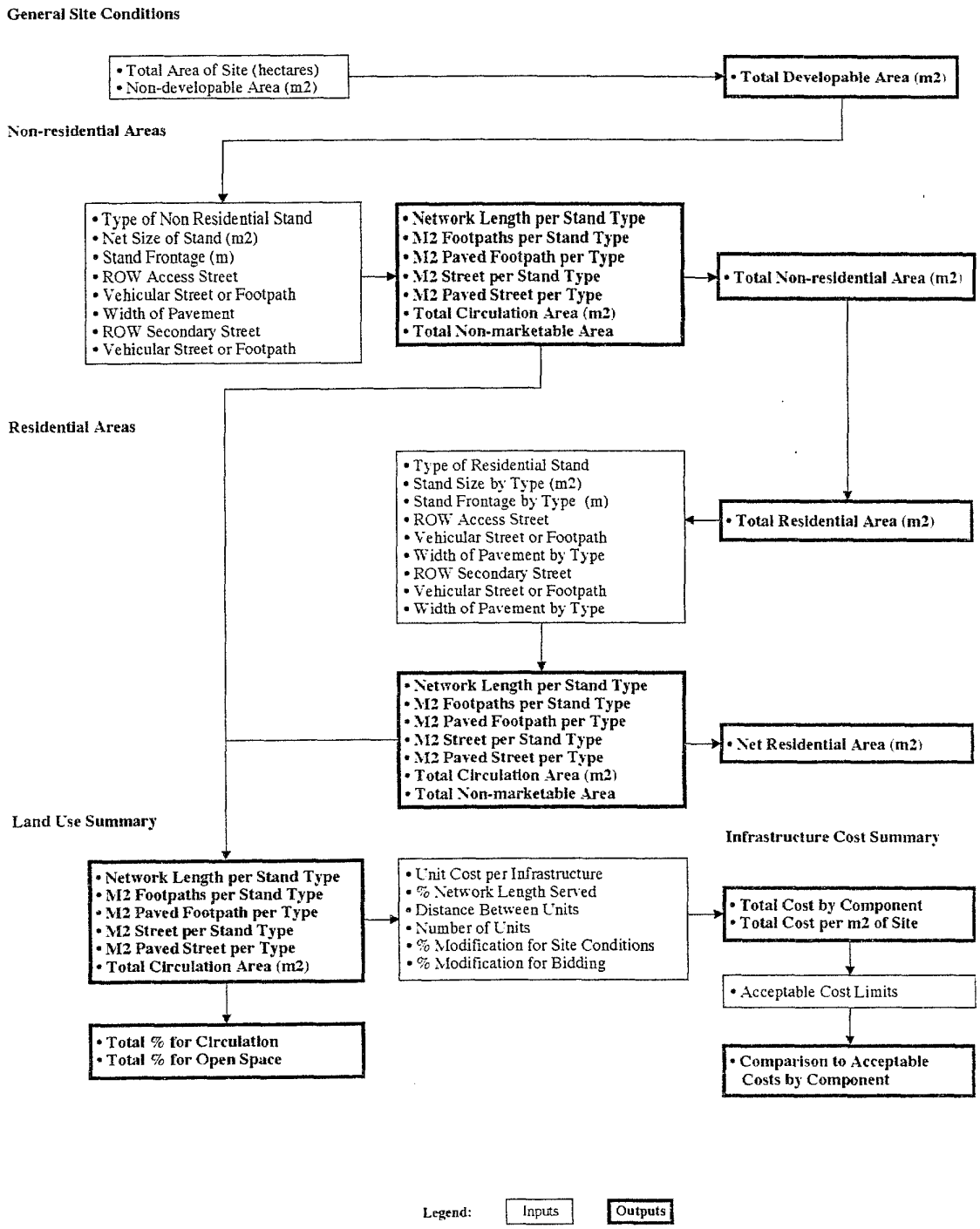
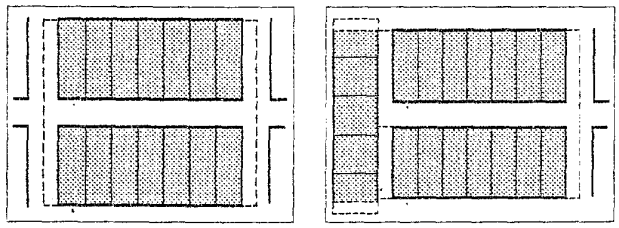


Figure 3.8

EFFICIENCY ANALYSIS OF GRID AND LOOP TYPE MODULES

High Density Stands	
Stand size 1 (m2)	150
% of Stands	40
Stand Size 2 (m2)	200
% of Stands	40
Stand Size 3 (m2)	300
% of Stands	20
Average Stand	200



Characteristics	Grid Layout	Loop Layout
Average Stand size in m2	200	200
Stand frontage in meters	10.00	10.00
Number of stands in the main block	18	15.7
Reservation for access street	8.00	8.00
Reservation for secondary street	10.00	10.00
Reservation for pedestrian path	0.00	0.00
Total area of basic module in m2	**9120**	**9120**
Number of stands	**36**	**36**
M2 of access street	**1440**	**1480**
M2 of secondary street	**480**	**240**
M2 of pedestrian path	**0**	**0**
Total circulation area	**1920**	**1720**
% Circulation	**21.1**	**18.9**

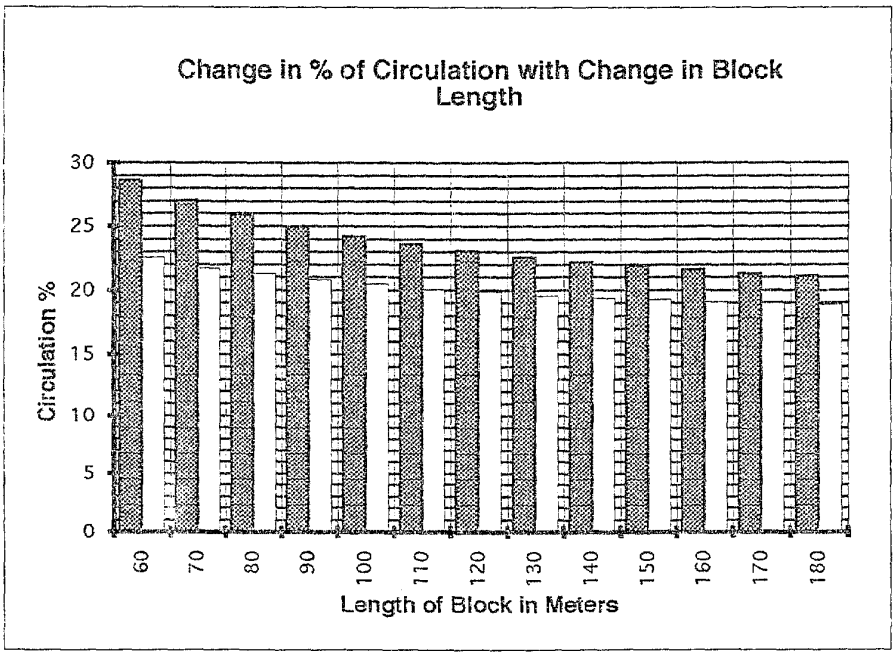


Figure 3.9

Calculations of Block and Circulation Areas for Typical Grid and Loop Type Layouts

Stand Characteristics

Inputs

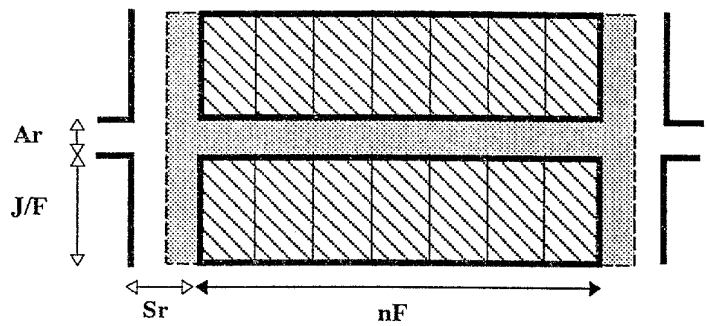
F = Stand Frontage
Sr = Secondary Road Reservation
J = Stand Area
Ar = Stand Access Road Reservation
n = Number of Plots Along One Side of a Block

Grid Layout

Calculations:

Total Block area = (nF+2X 1/2 Sr) X ((2 X J/F) + (2 X 1/2 Ar))

Circulation area = (nF X Ar) + (((2 X J/F) + Ar) X Sr)

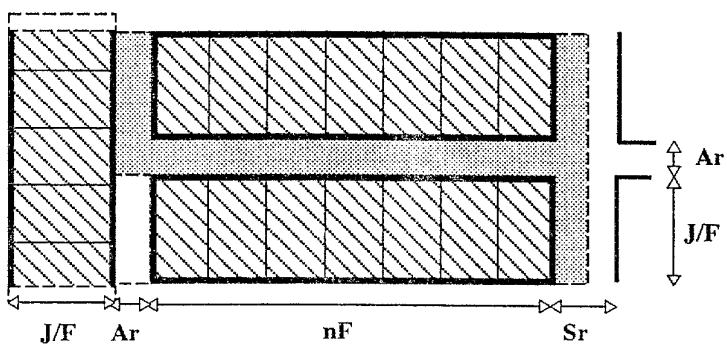


Loop Layout

Calculations:

Total Block area = (J/F+Ar+nF+(1/2 X Sr)) X ((2 X J/F) + Ar)

Circulation area = (1/2 X Sr) X ((2 X J/F) + Ar) + (Ar X (nF+Ar)) + (Ar X J/F) X 2



3.4 Analyzing Affordability

Once the main physical characteristics and costs of an acceptable layout simulated by the computer have been determined, the affordability of this proposed layout can then be analysed. This process is also an iterative one that may require the evaluation of a number of simulations and alternatives before an acceptable solution can be achieved. In this way, the three computer models provided with this manual are effectively linked.

3.4.1 Affordability Model

The Affordability Model, like the Layout and Costing Model, is built upon a simple spreadsheet programme. The Excel version of the model is recorded on a computer disk which has been included with this manual. Instructions for using the Model are provided in Annex I.C. This section of the manual will simply focus on describing the components of the model and the outputs which can be achieved.

Inputs and Outputs
Figure 3.10 is a printout of the Affordability Model spreadsheet. The logic and flow of calculations within the Model along with inputs and outputs are shown in Figure 3.11.

- *Land Use Characteristics.* Data on the proposed land use for the project are recorded in the first section of the programme. Inputs include the area and sales price for public and commercial facilities as well as the area of non-marketable land. Outputs are the area of residential and non-residential land. Net residential land is the total area of stands.

- *Land and Infrastructure Costs.* Inputs include the estimated costs of land, site preparation, and on- and off-site infrastructure. Outputs are the development costs per gross and net square metre of the site.

- *Stand Sizes and Housing Unit Construction.* Data on the number and size of up to eight different stand types can be analysed by the model. Additional inputs include the size and unit costs for housing units. Outputs include the total cost per unit and the sales price per unit.

- *Project Costs and Revenues.* This section summarises the costs and revenues of the project and the developer's profit or loss. With the input of the estimated percentage of expenditures and revenues over a period of up to four years, the internal rate of return will be calculated.

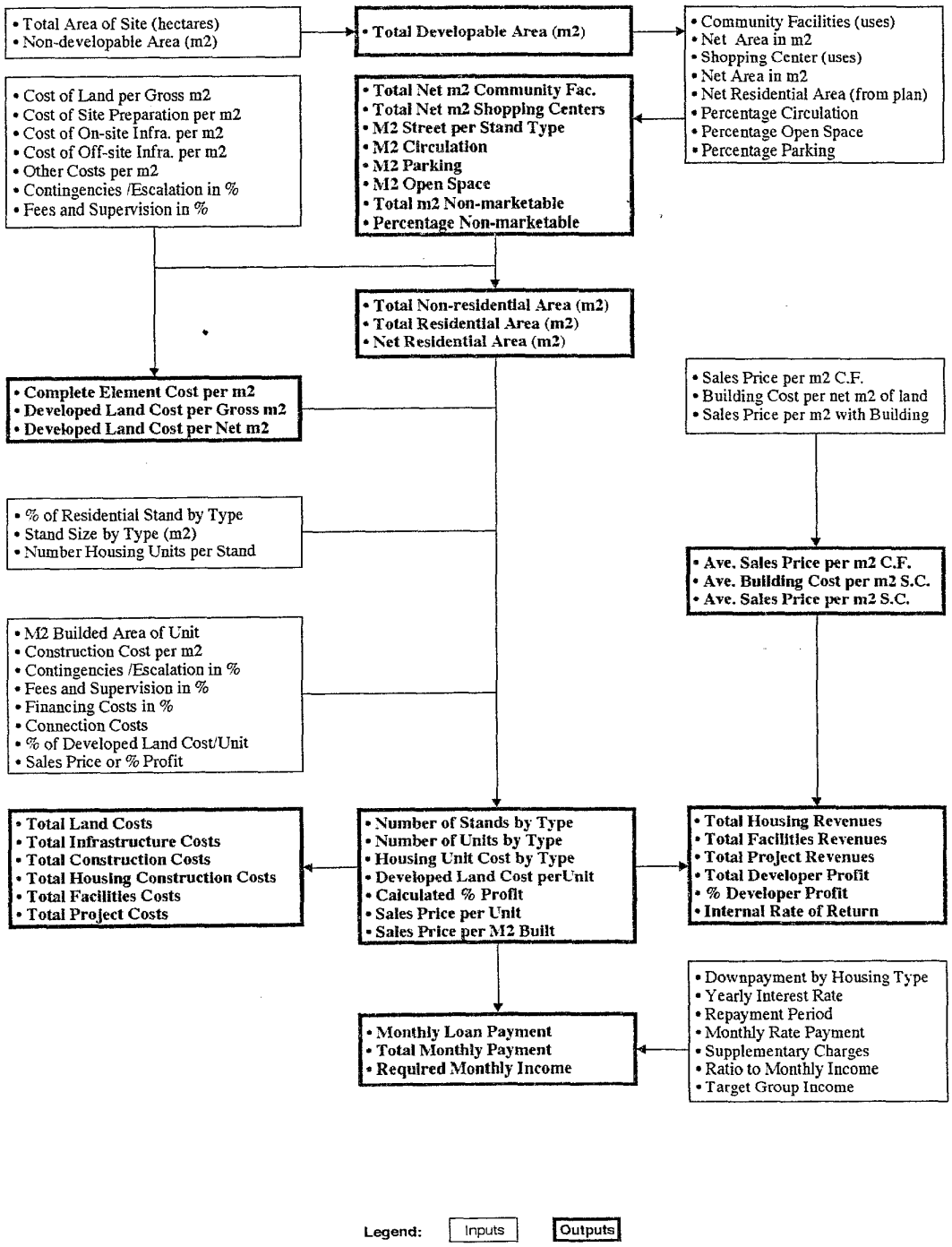
- *Affordability.* The last section looks at the affordability of up to eight different stand types by calculating the monthly payment and required monthly income for their purchase.

Figure 3.10
Affordability Model Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	AFFORDABILITY		Developer:				Project:	Glaudina		Date:	11/27/96
2	LAND USE CHARACTERISTICS										
3	Site area (ha)		260.95	Non-developable area (m2)			7500	Developable area(m2)			2602000
4	Cmty.	Net area	Sales	Shopping	Net area	Building	Sales	Net residential area in m2			
5	facilities	in m2	price/m2	facilities	in m2	Cost/m2	price/m2	from program or measured from plans			
6	Prim. Sch.	150000		Shops	20000	500	2000.0	Non-marketable land %			m2
7	Sec. Sch.	90000		Market				Circulation areas		11.29	293766
8	Health	2000		Beer Gardn.	1400	500		Parking areas			0
9	Religious	4500	1800.0	Service Ind.				Passive o.s.			0
10	Creche	2400	1800.0	Other				Active o.s.		1.57	40851
11	Total	248900	49.9	Total	21400	10700	1869.2	Total		12.86	334617
12	M2 Non-resid.land		310190	M2 total residential land			2291810	M2 net residential land			1997083
13	LAND AND INFRASTRUCTURE COSTS					Land	Site	On-site	Off-site	Other	
14						price	prep.	infrastr.	infrastr.	costs	
15	Basic development costs					25	1	20			
16	Contingencies and escalation (%)					12	12	15			
17	Fees and supervision (%)					1		4			
18	Financing costs (%)										
19	Complete item cost/gross m2 of site					28.28	1.12	23.92	0.00	0.00	
20	Total developed land cost/gross m2 of site					53.32	Developed land cost/net m2 of site				68.73
21	PLOT SIZES AND HOUSING UNIT CONSTRUCTION										
22	Housing unit type		Total	Type #1	Type #2	Type #3	Type #4	Type #5	Type#6	Type#7	Type#8
23	% of total stands/type		100.00	40.00	35.00	15.00	5.00	5.00			
24	Stand size in m2			150.00	200.00	300.00	105.00	800.00			
25	Nb.of stands/type		9067	3627	3174	1360	453	453	0	0	0
26	Nb.housing units/stand			1	1	1	1	1			
27	Nb.units/type		9067	3627	3174	1360	453	453	0	0	0
28	Nb. stands/ha.		40	Persons /Household		7	Density (per/ha)		277	Pop.	63471
29	M2 building area			40.00	40.00	80.00	40.00	35.00			
30	Construction cost/m2			500.00	500.00	500.00	500.00	400.00			
31	Contingencies (%)			10	10	10	10	10			
32	Financing costs (%)			13	13	13	13	13			
33	Connection Costs			2000	2000	2000	1000	500			
34	House Costs			26860	26860	51720	25860	17902	0	0	0
35	% developed land cost/unit			90	100	100	90	120			
36	Developed land cost/unit			9279	13747	20620	6495	65985	0	0	0
37	Total cost/unit			36139	40607	72340	32355	83887	0	0	0
38	Sales price or % profit			15	15	15	15	15			
39	Calculated % profit			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	Sales price/unit			41560	46698	83191	37209	96470	0	0	0
41	Sales price/m2 built			1039	1167	1040	930	2756	0	0	0
42	PROJECT COSTS		X1000 Z$	%	REVENUES		X1000 Z$	%	RATE OF RETURN		
43	Land		73797	17.46	Housing units		472688	90.02	Year	% Exp.	% Rev.
44	Infrastructure		65342	15.46	Facilities		52420	9.98	1	25	10
45	Construction		283546	67.08	Total project		525108	100.00	2	45	25
46	Housing	272846							3	20	30
47	Facilities	10700							4	10	35
48	Total project		422685	100.00	Developer profit		102423	24.23		% IRR	35.49
49	AFFORDABILITY			Type #1	Type#2	Type#3	Type#4	Type#5	Type#6	Type#7	Type#8
50	Downpayment			10	3000	15	15	6000			
51	Yearly interest rate			14.00	14.00	18.50	14.00	14.00			
52	Repayment period			25	25	25	25	25			
53	Monthly loan payment			450	526	1101	381	1089	0	0	0
54	Monthly rate										
55	Supplementary charges			48	48	48					
56	Total monthly payment			498	574	1149	381	1089	0	0	0
57	Ratio to monthly income			28	28	28	28	28			
58	Required monthly income			1637	1913	4005	1384	3960	0	0	0
59	Target group monthly income			1200	1200	5000	1200	1200			

Figure 3.11

FLOW OF INPUTS AND OUTPUTS IN AFFORDABILITY MODEL



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3.4.2 Data Sources

Since the Affordability Model can be used during all phases of the design process, the sources of data will vary. Some data will be taken from the topographic plan and site analysis, including the total area of the site and those parts of it which cannot be developed. In the initial programmeming stage, some data will be available from the Layout and Costing Model including:

Area of non-residential uses
Percentages of non-marketable land
Site preparation cost/m^2
On-site infrastructure cost/m^2
Percent of total stands/type
Area of stands
Percentage of circulation

Other data will come from regulations, policies and experiences of the agencies involved with projects. These include such data as:

Contingencies, fees and financing costs
Number of housing units per stand
Percent of developed land cost attributed to a unit
Percent profit
Financial terms of loans
Ratio of monthly payment to monthly income

The Affordability Model can also be used to conduct continuous affordability evaluations of layout plans both during and after their preparation. At this stage data relating to land use and stands can be calculated directly from the plan. Cost data for site preparation and on- and off-site infrastructure costs can be taken from preliminary estimates and bills of quantity prepared by the design engineers. It is useful to conduct this form of continuous assessment of preliminary layout plans in order to make sure that they basically conform to the parameters of the layout programmeme and are affordable to the target populations.

3.5 Finalizing a Layout Design Programme

It may take several iterations of the Layout/Costing and Affordability Models to arrive at an acceptable Layout Design Programme. This programme should define a layout that uses urban land efficiently and is affordable to target populations. Once this has been done, the planner will have entered into the Programme Worksheet the basic parameters of the proposed layout plan. These will include information on: percentages of non-marketable land, number and area for community and shopping facilities, percentages and sizes of stands, block lengths, and a summary of proposed land use for the site

The spreadsheet should be saved so that it can be used again to analyse the layout plan once it has been completed. The next step will be to translate this programme into a well-designed, efficient, and affordable residential layout plan.

Chapter 4
Design

After the site inventory, analysis and programming have been completed, the next step is to design the layout plan. All of the data assembled and analyses done in the earlier steps will be used. The steps of the design process presented in this chapter are:

Developing alternative concept plans
Incorporating engineering considerations
Developing a detailed layout plan

A number of alternative concept plans should be evaluated in order to find the solutions that best respond to site conditions and best achieve the objectives of the layout programme. Once the detailed layout plan has been completed, the process is not over. It is important to verify that the detailed plan adequately reflects the parameters established in the layout programme to keep the project feasible and affordable. This chapter not only sets out the layout design process but also includes steps to evaluate resulting layout plans by assessing their efficiency and affordability to the target populations.

4.1 Developing Alternative Concept Plans

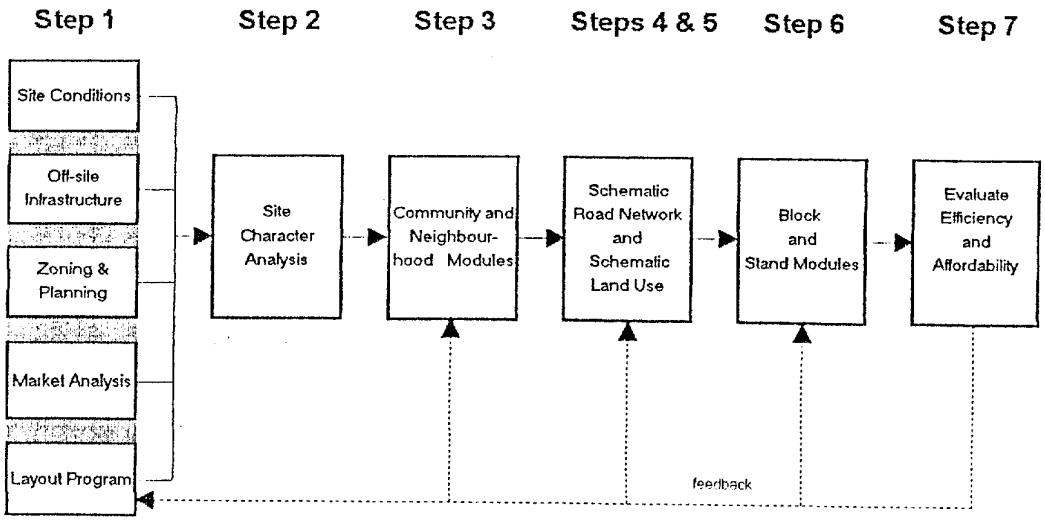
This is the point where all the information that has been assembled thus far should be brought together to determine how the constraints and opportunities that have been identified for a particular site should be incorporated into a concept plan. It is important that concept plan alternatives do not become too detailed but that they focus on establishing broad outlines for planning. This is when the "magic" of design can rationalise the many demands of the site and its future residents into a vital urban community. A number of concept plan alternatives should be articulated to explore the potential social, market and ecological values (see Chapter 1) of the developed neighborhoods. The design process should increase its focus on detail with each step. Steps for preparation of alternative concept plans are outlined below and illustrated in Figure 4.1.

4.1.1 Step 1: Assemble Project Information

Before preparing concept plan alternatives, all information on the project must be adequately synthesised for decision making. Much of the information needed to prepare a concept plan has been obtained through the site analysis and development of the layout programme. The principle sources of information are:

Site Analysis
The composite site analysis identified non-developable land, best locations for development and special features of the site (such as streams, mature trees, hills, views, etc.) that should be incorporated into the underlying layout concept. The concept plan should exclude non-developable land from uses other than open space or land within school reservations.

Figure 4.1
Layout Design Process



The topography of the site will also be important in determining the organisation of uses. Generally high density housing should be located on the more level sections of the site with good soil conditions. Open space and larger institutional uses can be located in those areas with greater slopes. Topography will also impact on road layout and drainage patterns.

Off-site Conditions and Infrastructure
A concept plan must not be designed in isolation from surrounding development. The planner should be aware of existing uses and planned developments in the immediate vicinity so that the concept plan will reflect a practical integration of the project. It is particularly important that off-site infrastructure be determined. The main elements identified in the site analysis are roads (existing or planned), sewer mains, water supply and drainage patterns.

Zoning and Planning Regulations
All sites will be impacted by planning and zoning regulations that will limit certain land uses and specify the locations of others. The site analysis and layout programme will have identified public facilities to be located in the project in accordance with existing planning regulations. Master plans may propose community facilities that are intended to serve a population larger than the project area that should be included in the concept plan. This may also be true for the circulation system, with sections of district or primary distributors located within the project site.

Market Analysis
Information from the market analysis can help to make the layout plan more responsive to the demands of the local market. Useful data from this study will include:

Size of the future market and percentage that can be attracted to the project
Range of market determined prices
Types and sizes of stands and units responding to market demand
Amenities to be provided

Layout Programme
The layout programme will contain additional information that can be used in developing a concept plan. It will play a pivotal role in the design process since it delineates the main parameters of a project. Evaluation of alternative concept plans will be done by comparing the results with the guidelines of the layout programme.

4.1.2 Step 2: Prepare a Site Character Analysis Plan

A character analysis plan (see Figure 4.2) will combine information on the project site and programme, and then subdivide the site into relatively homogeneous zones. Descriptions of the character and possible utilisation of each zone will support this division. This exercise is based to a large degree on professional experience and can be very important in forming the foundation for building concept plan alternatives. The character analysis is a useful tool in justifying the location of different land uses in specific areas of the site.

4.1.3 Step 3: Develop Community and Neighbourhood Modules

Urban areas can be broken down into discrete modules that form a community. These modules are defined by population size, public facility requirements and geographical area. The hierarchy of the four basic modules within a community is shown in Figure 4.3. Information on general organisation, natural environment and physical components of community, neighborhood, and block modules are given in Figure 4.4.

At this stage the planner should develop a conceptual diagram for a community. When a community module is larger than a proposed site, careful consideration should be given to how the project site is to be incorporated within the larger community. The module should also relate closely to the approved master plan for the city. A community module will normally include two or more neighborhood modules. A layout of a community and neighbourhood modules is shown in Figure 4.5.

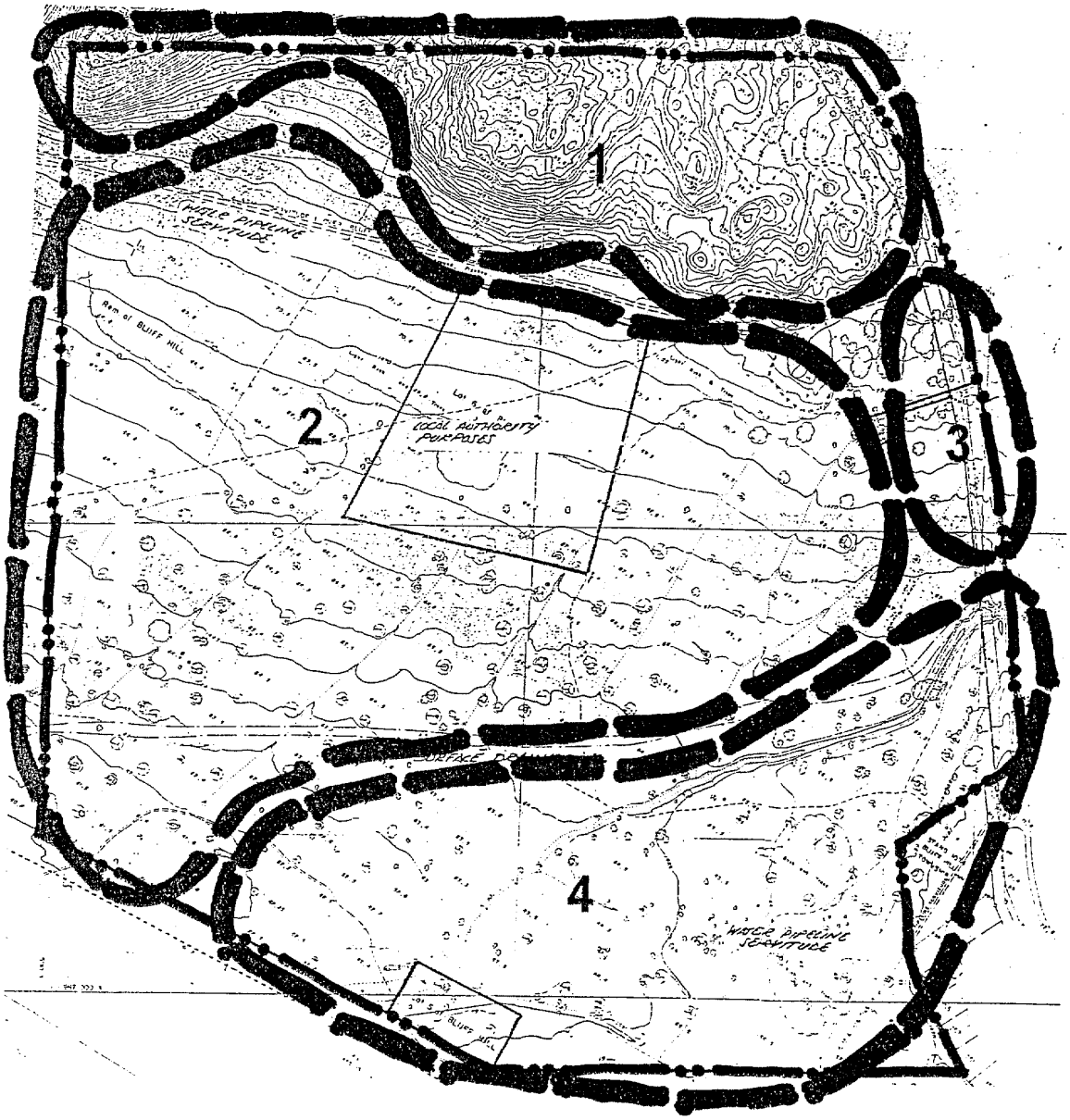
Figure 4.3
Layout Development Modules

Module	Population Size	School Requirements	Geographical Area(ha)
Community	20 - 30,000	2 Secondary	50 - 150
Neighborhood	5 - 8,000	2 Primary	15 - 30
Block	250 - 300		0.5 - 5
Stand	4 - 8		104 - 500 m^2

Figure 4.2
Site Character Analysis Plan

1 Ridge Land
Steep slopes
Good views from top
Rock outcroppings
Low density residential development

3 Road Impacted Land
Fronting on to district distributor
Noise and traffic congestion
Visibility from road - image
Non-residential uses



2 Central Open Land
Moderate slope
Grass land with scattered trees
"Good" soils for development
Medium & high density residential development

4 Low Land
Flat land
Stream bed & flood plain
"Poor" soils for development
Parks and open space

Figure 4.4
Description of Layout Development Modules

Community Module

A community module is defined as a grouping of neighborhoods proximate to each other, under the same local authorty structure and of sufficient size to warrant large-scale common facilities serving daily and weekly needs. Principles relating to the design of community modules are outlined below. They should be considered as suggestions and as a checklist of points to be considered when planning a project. Since conditions and needs will not be the same for any two projects, the application of these principles will also be different in each case.

Overall Organization. The following should be considered when designing community modules:

- Layout should be the servant of the people and place - by failing to respond to the topography, a rectangular grid on an undulating, gully-crossed site generates extra costs for roads and services.
- The road and footpath pattern should reflect the need to move directly between clusters of stands and community and shopping facilities.
- Circulation networks should reinforce the focal points of the layout such as community and commercial facilities.
- A diminishing hierarchy of access should be planned to restrict through traffic in residential areas.
- Since access to many of the non-residential components within the community module is often by vehicle, it is recommended that they be oriented to local or district distributors - exceptions include schools and open space.
- Walking distances within the community should not exceed comfortable limits - pedestrian paths should be planned to connect community facilities and focal points.
- Circulation and infrastructure networks should correspond to both existing and planned off-site networks.

Natural Environment. The following points should be considered in response to the natural environment.

- Steeply sloped (more than 1 in 5) sites should be left intact as passive open space.
- Unique natural features (rock formations, mature trees or streams) should be left untouched.

Physical Components. The following list of physical components should normally be provided only at the community module level or higher:

Health facility for both outpatient and inpatient care
Secondary schools including classrooms and active open space
Major commercial facilities for weekly shopping
Market with rental stalls and open market space
Post office, fire and police stations
Entertainment facilities such as cinemas, clubs, etc.
Active and passive open space
Electricity transformer stations, water storage tanks, and pumping stations

Figure 4.4
Description of Layout Development Modules (continued)

Neighbourhood Module

A neighbourhood module is defined as a grouping of blocks bounded by natural, social, or administrative boundaries, containing sufficient population to warrant common facilities serving daily needs. A neighbourhood module is a good scale for high-density housing projects since it can be designed as a self-contained unit. Basic design principles of neighbourhood modules are:

Overall Organization. The following points should be considered in the overall organization of a neighbourhood module:

- Through circulation should border the neighbourhood unit as a corridor to one side or as a loop road.
- Grouping non-residential components together on a spine or in a centre creates a focus for the neighbourhood.
- Vehicular and service access provided on streets should be designed to present a discontinuous pattern to avoid through traffic.
- Schools and open spaces should have a direct and proximate relationship to residential areas.
- Public transportation stops should be located on the periphery of the neighbourhood, near non-residential uses if possible.
- Walking distances should be minimised through the use of direct walkways in a concentric rather than linear layout.

Natural Environment. The following should be considered in response to the natural environment:

- Street and footpath layout should be planned to channel surface runoff water with natural slopes, away from buildings, and into natural or existing lines of drainage.
- For sites with a steep slope, a rectangular grid is not appropriate - street patterns should run parallel to contours.
- To facilitate the implementation process, land that is easiest to build on (least slope or fewest drainage problems) should be reserved for high-density residential land use.

Physical Components. The following physical components and services should normally be provided at the neighbourhood level or higher:

Primary school and creches
Local commercial facilities for daily shopping
Peoples' Market for daily needs
Neighbourhood park
Local religious facilities
Public transportation stops
Multi-use community centre

Figure 4.4
Description of Layout Development Modules (continued)

Block Module

A block module is defined as a group of individual stands bounded and served by public roads and foot paths. It is the basic component of all residential layouts. Block dimensions are traditionally derived from the need to provide for pedestrian circulation and for limited use of low-speed vehicles. Basic design principles for block modules are:

Overall organization. The following should be considered when designing block modules:

- Longitudinal axis of a block should be laid out perpendicular to the major roads of the neighbourhood.
- Contrary to current practice, in blocks adjacent to major roads, end stands should be oriented to the major road, thus increasing their commercial potential and land value. Traffic management can still be affected through the use of turning lanes and slip roads.
- Intervals between secondary roads should be sufficiently long so as to minimize circulation space - at least 100 metres but not more than 200 metres. Foot paths should be considered for the middle of blocks approaching the maximum length.
- Access to stands must be sufficiently wide to permit passage of ambulances and other emergency and service vehicles.
- Active open space, playgrounds and other community facilities should be located within view of residents for better supervision.
- Generally only one access point should be provided to each stand, thus negating the idea of alleys or blocks with streets on both sides.

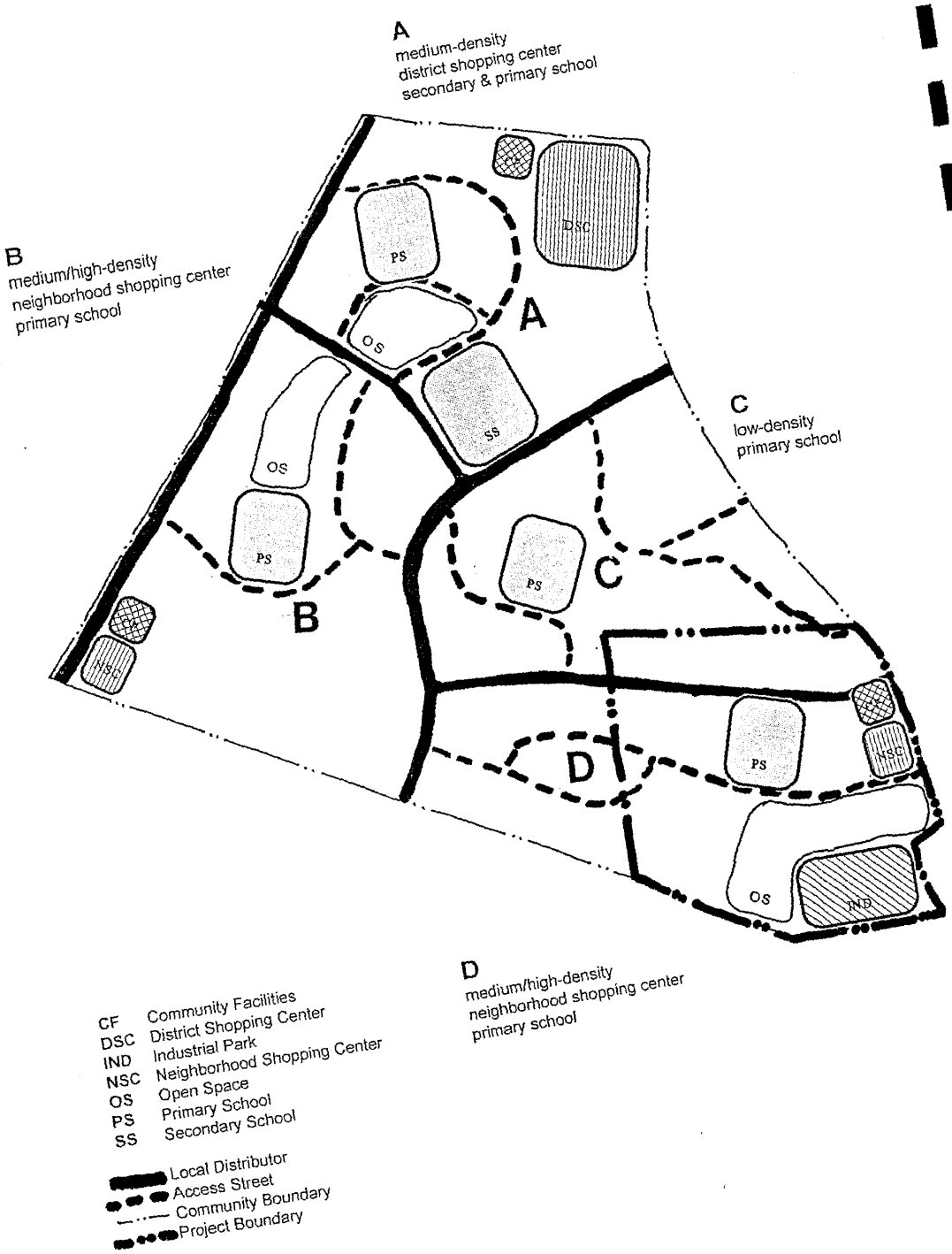
Natural Environment. The following points should be considered in response to the natural environment.

- For steep sites, the longitudinal axis of a block should be laid out parallel to the contours of the site thus making the stand more usable and facilitating stand drainage.
- Where feasible, the longitudinal axis of blocks should be laid out perpendicular to the direction of prevailing winds thus providing each plot with the cooling effects of wind.

Physical Components. The following physical components are normally provided at the level of the block:

Through and access circulation
Street lighting
Open space and playgrounds

Figure 4.5
Community and Neighbourhood Modules



4.1.4 Step 4: Design a Schematic Road Network

The basic component of the concept plan is the road network. The hierarchy of roads to be incorporated into the project layout should have been identified in the layout programme. The locations of each type of road should be determined by community module and by site conditions. The main points to be considered in designing the road network are:

- Existing access points such as access to main roads, the city center and adjacent settlements.
- Trunkline infrastructure connection points for water, sewers, drainage and electricity.
- Location of primary roads proposed by the city master plan.
- Preferential direction for streets and networks in each of the topographical zones of the site.

A schematic road network can be evolved from the above information. It should show the approximate location of roads and their basic characteristics. More detail is given on principles of road design in section 4.2 on engineering considerations.

4.1.5 Step 5: Determine A Schematic Land Use Plan

Within the framework of the road network, a schematic land use plan can be developed that corresponds to the layout programme. This should be done as a "bubble diagram" but with land uses drawn to the approximate size proposed in the programme.

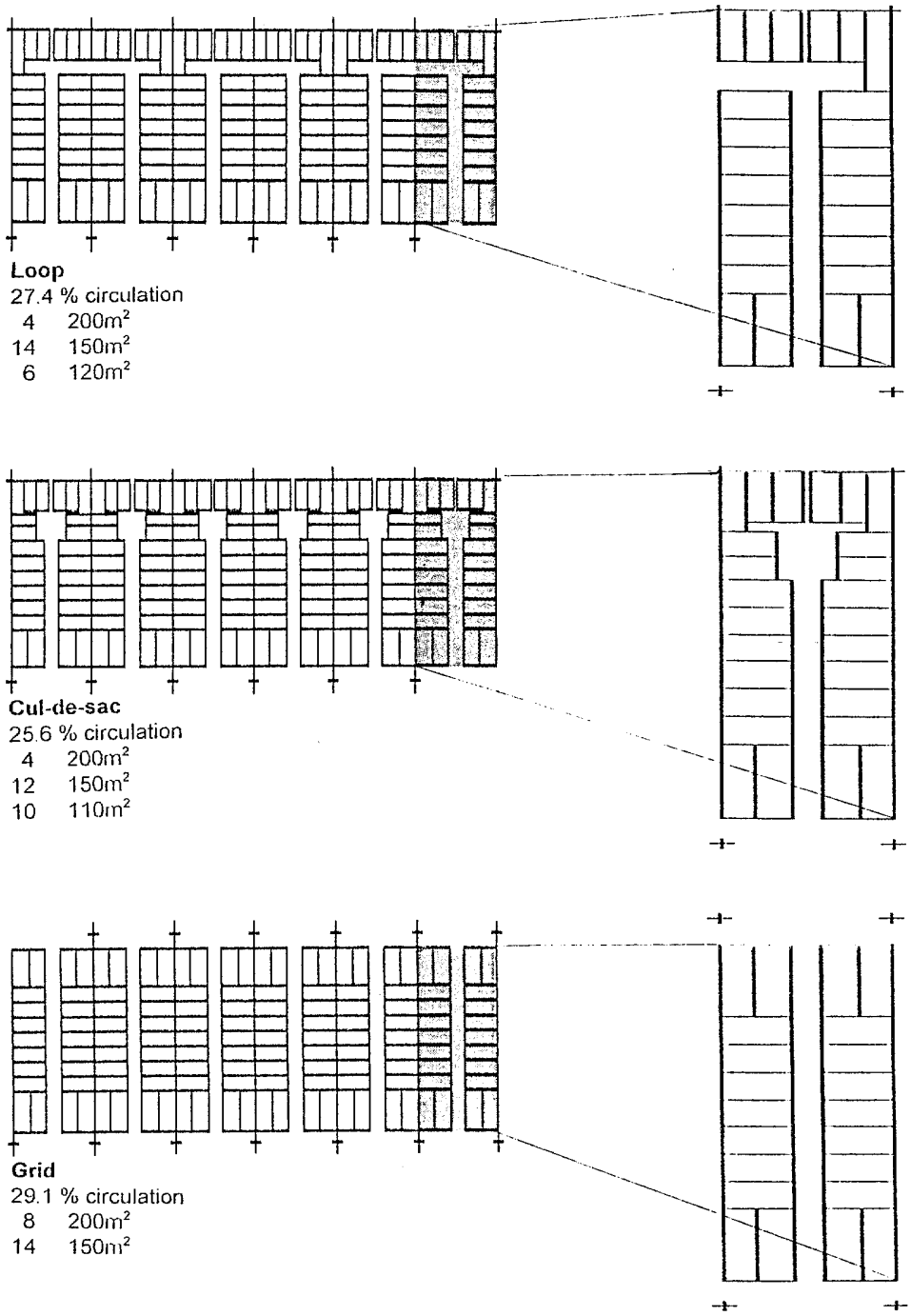
The community and neighbourhood frameworks and road network can serve as guides in structuring the location of community and shopping facilities. It is important that non-residential uses, particularly open spaces, be located to give structure and a sense of place to the community and not be treated as simply "left over" spaces.

4.1.6 Step 6: Develop Block and Stand Modules

For the areas of the site designated for residential use, the planner can now establish the basic block modules that will efficiently accommodate the target populations defined in the layout programme. Details of a block including length, width of access streets, type of circulation (grid, cul-de-sac, loop) can be investigated. Selected block modules can be repeated to give structure and a sense of order to residential areas. A few examples of block modules are shown in Figure 4.6. The circulation for individual blocks is higher than the 20 percent recommended by DPP since larger areas such as schools and shopping centres are not included in the calculation. The cul-de-sac is the most efficient of the three modules shown.

The size, configuration and utilization of stand types can also be investigated at this stage. For smaller stands (100 to 150 m^2) it is particularly important to study the potential location of a house within the stand in order to allow for expansion and to maximize usable outdoor space.

Figure 4.6
Block Modules



The block and plot modules are the last components of a concept plan. When these are fully incorporated with the road network and non-residential land uses, the concept plan is essentially finished. An example of a completed concept plan is shown in Figure 4.7.

4.1.7 Step 7: Evaluating Concept Plan Alternatives

The design process is an iterative one. Concept plan alternatives can be evaluated at any stage of the process and should be fully evaluated before going on to detailed design. The procedures outlined in the manual provide opportunities for evaluation early in the process before there is extensive commitment of time and resources to a particular layout plan that is difficult to change. The time to explore different alternatives for the layout of the site is during the concept phase.

Once alternative concept plans have been developed, they can be evaluated to select the plan that best responds to the unique characteristics of the site and to the requirements of the layout programme. It should be remembered that there are no perfect plans but only better solutions. Plans should be evaluated as to how well they respond to programme goals, planning regulations and site conditions. One alternative may meet the programme goals but not relate well to site conditions. The evaluation objective is to identify the combination of elements that comes closest to satisfying the various demands of the project. A close approximation of land use of each alternative can be calculated from plans and compared with the land use proposed by the layout programmeme.

After the planner has made his own evaluation of alternatives, they should be reviewed by the planning staff and client. The iterative process should enable the return of several options for the layout concept plan before a final concept plan is selected. The next step after finalising the concept plan will be to review the plan with engineers in order to minimise any potential engineering design problems.

4.2 Incorporating Engineering Considerations

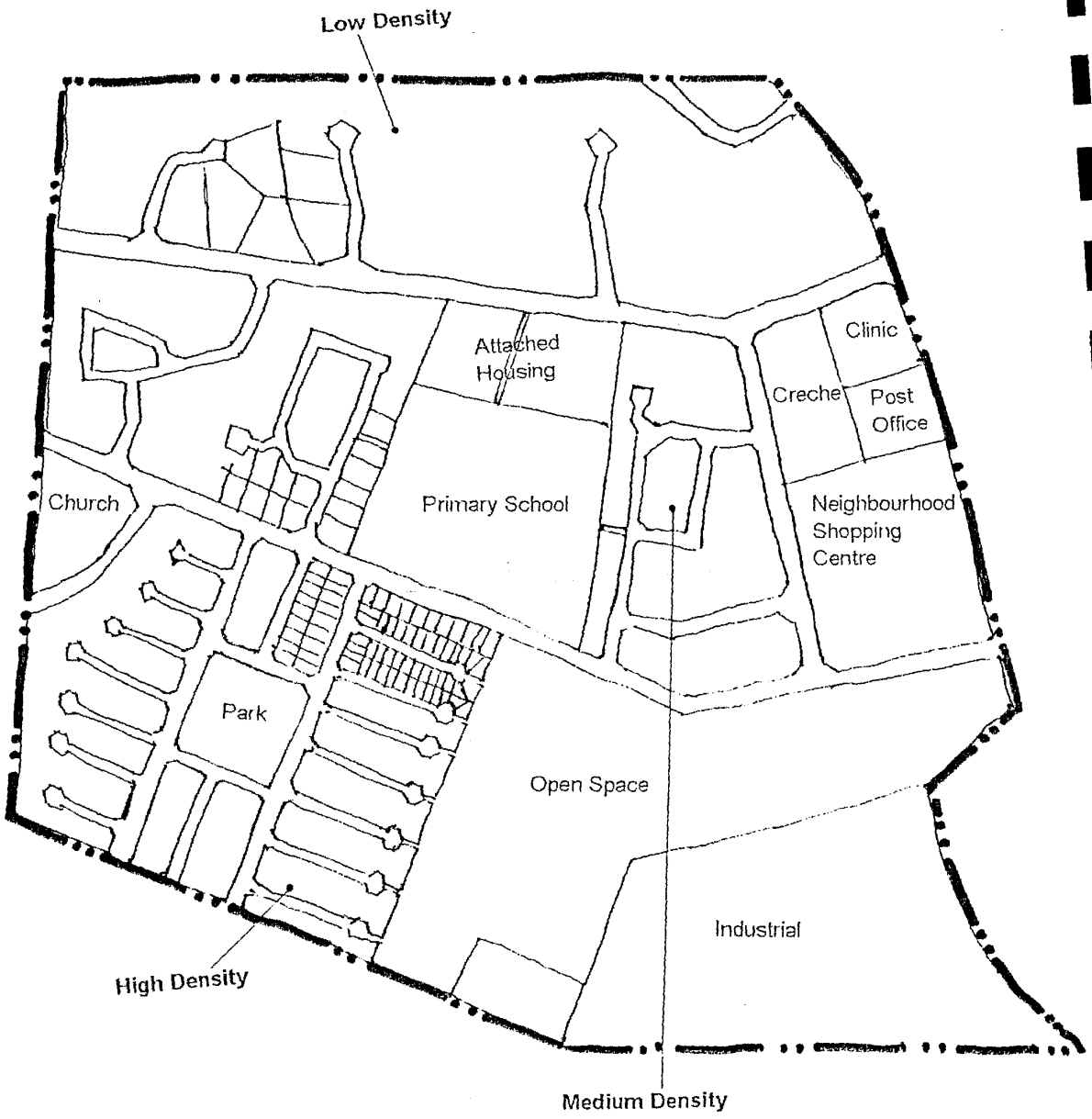
Engineering considerations are a significant component of the cost of providing serviced land to low-income households. These costs are very dependant on the planning layout. Standards for infrastructure and engineering outlined in this section can help planners to design efficient and cost effective layouts for low-income households.

There are a number of important engineering considerations related to the site, most notably topography and soil properties, that have already been discussed in Chapter 2. When reviewing concept plans the following engineering guidelines should be applied.

4.2.1 Guidelines for Roads

The road network for a residential development is designed as a hierarchy. At the top end of the hierarchy are the largest roads which carry large volumes of traffic at high speed. At the bottom end are the local stand access streets, the function of which is to give access to individual stands and to cater for pedestrian movement. They form an important space component of a housing environment.

Figure 4.7
Concept Plan



The development of a functional road hierarchy and appropriate design criteria is guided by objectives and principles which are based on the need to separate distributive movement by destination and journey length. (See Figure 4.8).

Design Principles for the Layout of the Residential Road Hierarchy
This section details traffic considerations in road layout design. Each of the design principles is applicable to different densities, housing types and topography. They are also pertinent to the development of a hierarchy which will determine the most appropriate network given the environmental circumstances.

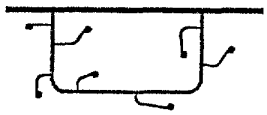
- The layout should exclude external traffic, particularly heavy vehicles.

Figure 4.8
Road Hierarchy Options

Road Type	Function	Recommended Road Reserve (metres)	Recommended spacing (metres)	Options for road construction standards
Primary Distributor	Major regional transport route	+ 20	-	Structural layers necessary, surfaced
District Distributor	Bounds neighborhoods provides for general urban vehicular circulation and through traffic. Commuter and bus route.	+18	400 - 1000	Granular subbase and base, surfaced
Local Distributor	Provides plot accesses and vehicular circulation within the development	+ 15	80 - 200	One layer gravel wearing course only.
Access Streets	Provides direct access to stands and circulation between blocks. Pedestrians predominate.	+ 8.5		Minimal regrading of in situ soil to provide drainage
Footpaths	Pedestrian traffic/cycle tracks.	+ 2.0		Compacted earth.

- There should be a continuous gradation in function from one level of the hierarchy to the next, avoiding the possibility of intersection between high and low order roads.

YES



NO

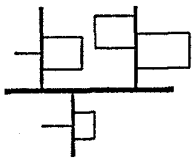
- Higher order roads which carry larger volumes of traffic and heavier axle loads cost significantly more than lower order roads which makes it imperative to minimise the number of larger and more expensive roads in a low cost development.

- The following proportions of road length of district distributor, local distributor and local access streets are recommended for maximum cost saving on road network.

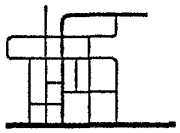
District distributor	5%
Local distributor	25%
Local access streets	preferably 70% or more.

- Roads should intersect only with other roads one level above or below in the hierarchy.

YES

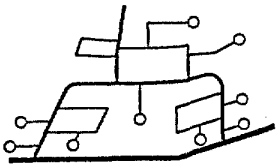


NO



- The layout should seek to minimize the number of intersections especially the number of intersections on higher order roads.

YES



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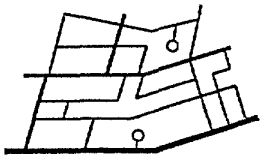
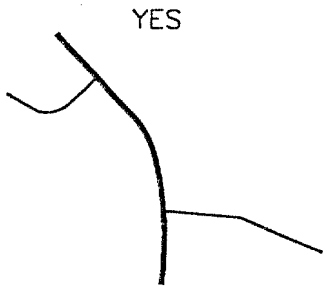
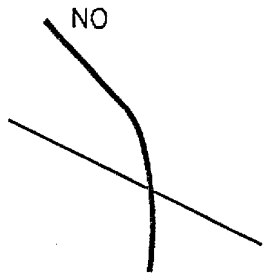
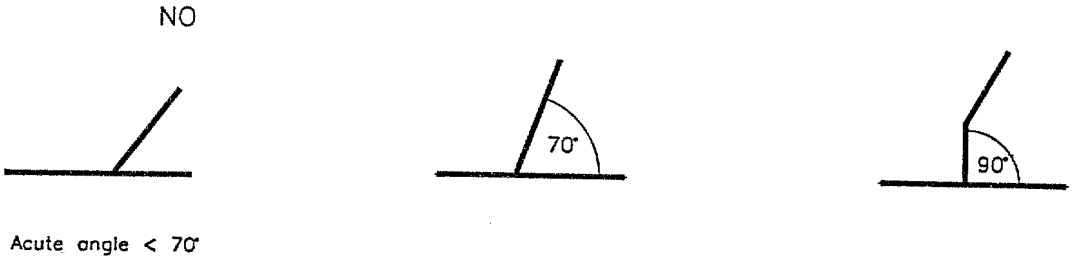


- Crossroads should generally be avoided in higher order roads unless traffic volumes and turning movements warrant the installation of traffic signals or a roundabout. The preferred intersection is a T - junction, with the lower order road joining the higher order road at right angles.





- Intersections should be as near to a right angle as possible (70° maximum permissible off-set). Acute angles are dangerous.



- Intersections on a bend are permissible provided sight lines and vehicle stopping distances are adequate. Intersections on a bend should never be on the inside of a curve where sight lines are poor, but on the outside of the curve.

- Land uses which affect the volume and direction of travel should be located so as to minimize internal vehicular travel. Vehicular traffic from the more intensive vehicular traffic generators (e g flats, shops, schools) should not have to pass less intensive

generators on the way to higher order roads.

- Bus routes and land uses which attract pedestrians should be placed so as to minimize walking distance and to avoid at grade crossings of busy higher order roads.

4.2.2 Guidelines for Sewer Reticulation

Sewerage reticulation is a gravity service, depending upon natural topography for efficacious operation. Once the planner is aware of the techniques of sewering a layout, then he/she is able to make significant economies in the detailed layout design. The objective of sewerage reticulation design is to ensure adequate flows through sewers in order to avoid blockages.

Manholes

Manholes are normally provided to access the pipeline and clear blockages. Manholes have a significant impact on the cost of the overall infrastructure. It is important that they should only be provided where absolutely essential such as: changes in direction, changes in gradient, where two or more sewers meet, and other intermediate locations to facilitate sewer maintenance. The following are recommendations to minimize the number of manholes:

- The optimum spacing of manholes is about 75 - 80 m.

- Every effort should be made to ensure that a bend in a block will roughly occur where a manhole is required.

- Where sewers cross from one block to another, stand boundaries should be correctly aligned at the end of a block run.

- At the head of a block use should be made of a rodding way pipe and a rodding eye.

Reducing Evacuation costs

Overall costs for a sewer system could be minimised by judiciously designing the housing layout and its sewer system to minimise the depth of excavation. Sewers are usually located 1,0m offset from the mid - block boundary on the lower side of the block. The planner should ensure that the orientation of the block is at an angle to the contours so that the sewer line does not impose additional excavation costs in achieving design gradients. On steep grades block orientation should be parallel with contours.

Sewer design parameters shown in Figure 4.9 are given as a guide. Engineering designs will need to be carried out to assess self cleansing velocities and sewer carrying capacities at the detailed design stage.

Figure 4.9
Sewer Design Parameters

Pipe Diameter	Average Depth	Optimum Sewer Length	Minimum Desirable Gradient	No. of Stands Served (maximum)
100 mm	0,5	30 m	1:60	6
150 mm	0,75	80 m	1:120	<700
225 mm	<1,5	90 m	1:200	>700

4.2.3 Guidelines for Water Reticulation

The layout designer should have an appreciation of the basic requirements for a water reticulated system so that due allowance is given in the layout plan. The detailed water reticulation layout is normally undertaken by an engineer in order to design for adequate flows and pressures.

Figure 4.10 gives indicative figures of water demand per stand per day based on an average family of 9 in the case of high density housing. It must be noted that with the present acute housing shortage, cases where up to 15 people occupy a stand are now fairly common with a consequent dramatic increase in consumption of water per stand. The following are recommendations for water supply and reticulation:

- Check the static head level of the supply to the area against the levels of the highest point in the area to ascertain whether pressures will be high or too low. A range of 15 m to 60 m would be indicative of adequate pressures. If static head is less than 15 m, ground at suitable elevation should be earmarked for service reservoirs at the planning stage.

- Reticulation pipes to be designed in a loop network (except for short branches).

- Use 75 mm and 50 mm reticulation pipes for distribution.

- Lay distribution pipes in mid block about 1,0 m offset on the higher side of the mid block boundary.

- Fire hydrants to be located adjacent to schools, clinics, commercial ccentersand other medium to high fire risk developments.

A looped 50 mm pipe, subject to adequate pressures, should be able to serve up to 160 high density stands or 80 pairs of stands back to back. A looped 75 mm pipe should be able to serve up to 320 high density stands.

Figure 4.10
Water Demand by Housing Types

Type of Houses	Average Water Demand/Stand
High Density	600 litres
Medium Density	1400 litres
Low Density	1800 litres

Note: For individual supplies where sanitation is not waterborne, demand is assessed at 420 l/stand for a yard tap and for a communal standpipe at 280 litres/stand.

4.2.4 Guidelines for Electricity Reticulation

Power is distributed to houses by overhead cables along the mid block boundary. The layout plan should take cognisance of the following with regard to pylon stays.

- No stays are required where pylons serve housing on both sides.
- Where housing is on one side only a 5 m stay is required from each pole and at corners.
- Corner stands must be designed to allow the stay to lie along the stand boundary.
- Where tower lighting is used for security lighting at least 250 m spacing should be allowed for between towers.

If a review of the concept plan for engineering considerations finds major problems, modification to the concept plan or even the preparation of a new concept plan should be carried out to reflect the required engineering considerations. It is better to do so at this stage than after the detailed layout plan has been prepared.

4.3 Developing the Detailed Layout Plan

Once an acceptable concept plan has been designed and approved, the next step in the planning process is to prepare the detailed layout plan. Since this is a refinement of the concept plan, the task will be much easier if the concept plan has been well conceived and organised. The detailed layout plan will be a more accurate representation of the proposed project based on applicable regulations and standards. The accuracy of the detailed layout plan will be important since it becomes a legal document that cannot be changed without going through the government approval process again. While all components of the plan will be integrated, the main elements of the detailed plan are summarized below.

- *Road Network.* The road network should be carefully laid out to show width of reserves, curve and turning radii, intersection details, etc.

- *Land Use.* Parcels of non-residential land as shown in the concept plan should be located within the road network and their exact boundaries delineated. The areas of non-residential parcels should be calculated in order to evaluate their actual areas.

- *Stand Layouts.* Residential areas of the site should be divided into stands based on the modules developed in the concept plan. The number of each type of stand and their area should be calculated from the plan.

An example of a detailed layout plan is shown in Figure 4.11. Once the detailed layout plan has been completed, it should be carefully reviewed by the staff of the planning department before being submitted for review or transmitted to engineers for final infrastructure design.

4.4 Assessing Efficiency and Affordability

The detailed layout plan can be assessed using the Programme Worksheet and the Layout Cost and Affordability Models discussed in the previous chapter. The layout designer will have to manipulate some of the information from the detailed layout plan in order to make it work in the three models. Despite the small amount of effort to get this information into the necessary format for use in the models. The assessment of the detailed plan to be certain that objectives established in the layout programme have been met and that the layout is still affordable to target populations is well worth the effort. This analysis can be done at two different times for the detailed layout plan.

4.4.1 Evaluating the detailed layout plan

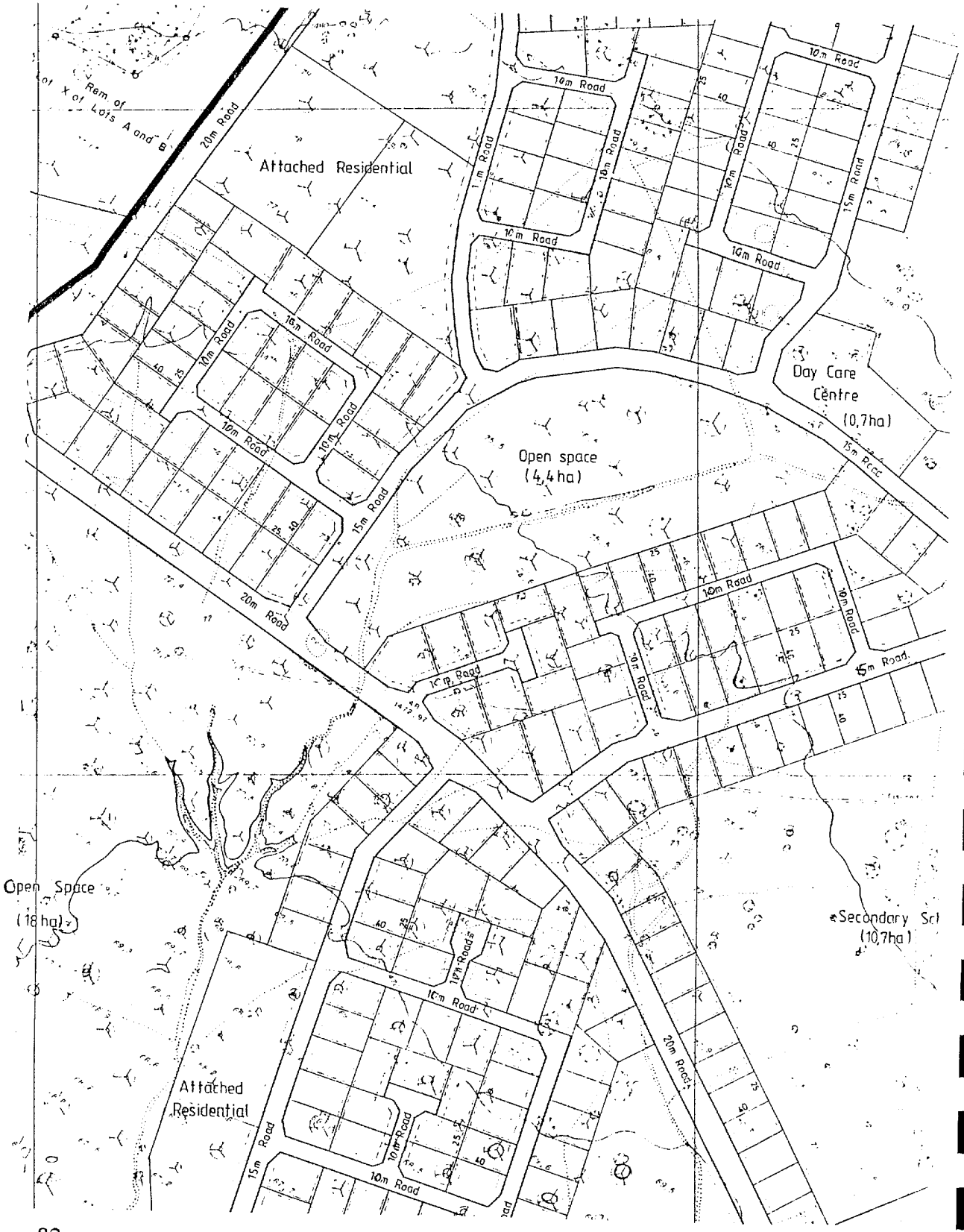
The planner can make his or her own analysis of the detailed layout plan before the engineering designs are done and before the plan is submitted for government approval. The plan can be assessed for the following:

- *Layout efficiency.* At this stage the land use of the site can be calculated and entered into the Programme Worksheet to see how closely the layout plan meets the programme objectives. The area for residential, community facilities, commercial facilities, and open space should be calculated from the plan. The circulation space will be calculated by the computer as a residual area. There is space under the Land Use Analysis section of the Programme Worksheet to enter this information.

- *Stands.* A tabulation of the number of each type of stand can be entered into the Programme Worksheet to see how the percentage breakdown of stands compares with the original target.

- *Affordability.* Information on land use and stands can be entered into the Layout Cost Model to calculate preliminary costs for the detailed layout plan. These costs as well as stand sizes and percentages taken from the plan can be entered into the Affordability Model to verify that stands are still affordable to the target populations.

Figure 4.11
Detailed Layout Plan



If there are problems with either efficiency or affordability, it will be possible to modify the detailed layout plan before it has been submitted for engineering design or approval which would make it more difficult and expensive to modify.

4.4.2 Evaluating Affordability

With cost estimates based on final engineering designs for the infrastructure, a final check can be made concerning the affordability of the project. The updated cost data can be compared with preliminary estimates and also entered into the Affordability Model to make certain that the different stand types are affordable to the target population. Should there be a major discrepancy between preliminary estimates and final costs which make the stands too expensive for the target population, the client will need to make a decision on what actions to be taken. Options are:

Change some of the target population to higher income groups
Subsidise the sale price of units for lower income families
Change the financial conditions by which to obtain stands.
Redesign part of the layout plan

To change a layout plan at this stage of the design process would be both time consuming and costly. That is why this manual has attempted to provide tools to assess and programme a site during the entire design process. The planner should make use of these tools at any time during the process that he/she feels it would be useful. It is much better to make corrections as one goes along than to wait until the end and have to make major modifications. If the procedures outlined above are carried out by the planner, it is likely that the final detailed layout plan will be efficient and affordable.

Chapter 5
Implementation

Once built, the layout plan becomes a permanent feature within the city or town. The roads lay down a movement pattern for people and vehicles through and around the site; the community facilities and open space set a visual quality for the neighbourhood; and the housing and commercial activities provide social and economic cohesion for the residents.

A layout plan for a housing estate carries additional professional responsibilities for the designer. A home provides far more than mere physical shelter against the elements. It provides:

- privacy for a household -- a form of shelter from the social pressures of the outside world. It provides a family with privacy to carry out daily basic functions -- sleeping, eating and preparing food

- linkages for the family with the wider neighbourhood -- to places of employment, community facilities, shops, recreation areas and neighbours for social interaction

- environmental amenity (or lack of it) through the provision of potable water, access roads, sewage and garbage collection and disposal and the surrounding natural landscape

- financial security, social identity and social mobility -- the purchase or construction of a home is often the single most important and largest investment that a household makes in its lifetime, requiring an large initial investment and ongoing substantial financial commitments every month for as much as 25 years.

5.1 Final Checks on the Layout Plan

The planner should be fully satisfied that his/her design is appropriate and supportive of the many different functions for which it is intended. Before forwarding the plan for final adoption by the Council and approval by the appropriate authority, a number of final checks should be made:

- Conceptually travel through the entire layout plan, checking the adequacy of the circulation system in terms of flow, ratio of the total site, social communication, technical standards for horizontal and vertical alignment, intersections, block lengths, and so on. The circulation system should also provide for future roads and connections

- Draw the building lines on all stands. Then site a typical building on every stand, making sure that every stand has at least one location for the main building(s). Stands which are nearly rectangular in shape are easiest to develop; avoid acute angled corners (tapered triangular pieces of land) which are unusable on the ground

- Check that adequate reservation has been made for community facilities such as pre-schools, schools, parks, churches and shopping

- Run the Affordability Model spreadsheet one final time to evaluate the layout and check that it is still affordable to the target population.

Once the planner is satisfied with these final checks, the final layout plan, together with supporting plans and a supporting brief written report are collated for Council review and adoption.

5.2 Final Documentation

The layout plan is now finalised and ready for submission to the appropriate Council planning committee for discussion and adoption and from there for formal statutory approval. To ensure that the approval process is not unnecessarily delayed, the submission must be both complete, accurate and be supported by relevant documentation. The following set of documents should be provided for a large layout (50 stands or more):

5.2.1 The Layout Plan

A sepia and the required number of plan prints which have been colourwashed to show different land uses within the layout (the number of prints required varies between different authorities).

Once approved, the layout plan forms the basis for cadastral survey and should therefore be accurately and precisely draughted, with notations on various stands stipulating the stand dimensions (or areas in the case of larger community facility stands and open space), road reservation widths and widths and purpose of servitudes.

The plan should have a clear heading indicating that it is a "Proposed Subdivision of [Cadastral Property Description]". As discussed in Section 2.3.1 of the Manual, the layout plan is prepared on a detailed and accurate base map which would indicate the plan area boundary, scale, north point, main topographic features and adjacent property descriptions. An approval box (which varies from authority to authority) together with the planner's signature certifying that the information given on the plan is, to the best of his/her knowledge correct, is also provided.

In the case of large layouts, it is useful to provide a land use analysis table to the one side of the plan, summarising the percentage of the site dedicated to various different uses and different residential stand types/sizes.

5.2.2 Supporting Plans

It is useful to provide a "Land Inspection Map" of the site which is essentially the final Site Analysis Composite Map developed in Chapter 2 of this Manual. It highlights all salient features of the site and adjacent land uses. Depending on the size of the layout and the detail on the base map, it may be useful to provide the Natural Systems Composite Map (topographic features, soils, slope analysis, hydrology and vegetative cover) and to provide a separate composite map detailing the off-site links, existing development and infrastructure .

5.2.3 Supporting Written Report

A concise written report should be prepared to accompany the layout plan. The report would set out:

- the purpose of the layout plan
- a brief written description of the site analysis undertaken
- a brief description of the alternative concept plans prepared and the justification for selecting the one
- copies of the three completed computer spreadsheet analyses prepared for the site (the Layout Programme Worksheet, the Layout Costing Model and the Affordability Model) together with a summarised conclusion of the analysis.
- In the case of privately owned land, a signed and completed TPSC1 form together with a copy of the title deeds to the property.

Chapter 6
Monitoring and Feedback

This chapter briefly presents some basic ideas on the use of monitoring and feedback to improve future layout design. It is intended to stimulate the layout designer to learn from previous projects and experience by highlighting some of the more obvious and easy ways to monitor existing projects. The monitoring of the performance of existing high density layouts is important and useful to the layout design process. Information obtained from the careful evaluation of existing high density layouts can provide valuable insights and knowledge about the:

- use and performance of these layouts;
- value added to individual stands and housing units due to good layout design; and
- levels of resident satisfaction and willingness to pay for the costs of residential development.

Much of the above information can be incorporated into market analysis studies and/or used as additional guidelines to improve future layout design. A regular system of monitoring and feedback that reviews implemented layouts two or three times over a ten year period will provide very useful information and a good understanding of the most important lessons to be learned. The resulting feedback can then be used to create future layouts that will have greater long term value.

6.1 Layout Use and Performance

Simple and effective survey and analysis techniques can be combined in order to develop a better understanding of the ways in which layouts are used by their inhabitants and the degree to which they fulfill the assumptions which governed their design. Among others, these survey techniques can include:

- direct observation through on-site field survey;
- informant interviews with local representatives, leader and/or community organizations;
- meetings with neighborhood focus groups; and
- analysis of existing written information and records about the area.

The techniques which are the easiest and least costly to implement are on-site analysis, key informant interviews and neighborhood focus groups.

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6.1.1.Simple Field Surveys

Very simple field (or windshield) surveys can provide a considerable amount of useful and cost effective information about the performance of particular layout plans and the ways in which these layouts either enhance or detract from social use, market and ecological values. An annotated plan of the implemented layout, which will be very similar in nature to the character analysis of the site that was done at the start of the project, will be the outcome of this survey.

Social Use Values
In terms of social use values, typical notations to be made on the map will focus on:

- visually interesting spaces that have developed a special vitality, character and sense of place, as well as those areas where the opposite is true due to poor layout design;
- specific areas within the layout where there is positive interaction among residents, as well as those areas where inhabitants perceive a real absence of security due to poor layout design;
- pedestrian linkages between schools, jobs, commercial activities, social facilities and recreational areas, as well as areas of conflict between vehicular and pedestrian circulation;
- activity patterns for people of different gender and age groups (i.e. children, women, men, elderly etc.) throughout the site;
- particular household and income generating uses of front and rear yards within stands of different sizes and dimensions;
- character and use of community facilities and the degree to which they respond to the behavior patterns of the residents; and
- areas of environmental impact on social use values.

The user can obviously add other types of annotations to the map based on his or her own knowledge of the area and the specific concerns which exist in future high density layout design.

Market Values
Typical notations related to market values will focus on:

- housing consolidation, expansion and improvements throughout the site as well as any stands or housing units that have not been developed or improved;
- stands that contain different types of income generating activities and/or are being used primarily for non-residential activities;

- development of planned commercial areas within the site and the locations and nature of unplanned commercial activities; and
- stands that have been sold, rented or changed to non-residential uses and the approximate sales prices or rents that have been obtained.

Other market values can also be monitored based on local conditions and concerns.

Ecological Values
Typical notations related to ecological values will focus on:

- use and maintenance of passive and active open space;
- areas of recurring problems or breakdowns in the provision of infrastructure and services due to poor design or conditions that should have been anticipated;
- areas of small scale pollution and/or dumping of waste throughout the site;
- areas of poor drainage and/or standing water; and
- areas of excessive dust or noise pollution due to characteristics of the layout design.

Once again, other ecological values to be evaluated can be added to this list based on the needs of the designer.

The resulting annotated map should be a composite of social, market and ecological values that accurately reflects the degree of balance between them. Future layout designs can be improved by making a greater effort to balance these values.

6.1.2. Informant Interviews and Focus Groups

Once the initial evaluation map has been completed and a number of specific problem areas identified, key informant interviews and meetings with neighborhood focus groups can be used to pursue a better understanding of the potential causes, impacts and resolution of these problems.

Key informant interviews and focus groups can be arranged very easily and do not require a great deal of preparation or costly scientific analysis. They can, however, provide considerable insight and depth into the evaluation of how a layout and neighborhood actually perform and what the local residents think of them.

Based on the results of these analyses, a catalogue of typical problems related to layout design and different site conditions can be established and included as part of a continually updated manual for layout design. Difficulties in project implementation, delays in housing consolidation and recurring maintenance needs, are all indications of problems that most likely

began with project programming and the design layout of the site. The eventual use of GIS (geographic information systems) and/or multi-media techniques, can provide a very effective and exciting way of storing, analyzing and presenting these evaluation data.

6.2 Resident Satisfaction and Value Added

Resident satisfaction is another important consideration to investigate in high density housing areas. A good part of this information can be obtained through neighborhood focus groups, case studies and, if necessary, through very carefully defined and limited household surveys. Household surveys and case studies have the advantage of being able to relate the satisfaction of the resident to the conditions of his or her stand and to the character and quality of the surrounding layout. Focus groups can provide broad and insightful discussions of neighborhood issues but may be dominated by the opinions of a few outspoken people unless they are carefully managed.

Information on the changing market values of stands and housing units within the neighborhood can be obtained from local real estate brokers working in the area or from local authority data on the payment of rates and/or supplemental charges. The general, though not always guaranteed, advantage of home ownership is that the stand and housing unit become recognized financial assets that can serve as collateral to access additional credit for economic opportunities. Household case studies should determine the extent to which resident financial situations have improved by following the progress of a number of households over the proposed ten year period of evaluation.

Housing consolidation, expansion and improvement are some of the signs of resident confidence in the value and soundness of their neighborhood.The degree to which small scale enterprises and service companies have been set up within the neighborhood is also a good indication of its economic health and resident willingness to invest in its future. A large part of this information can be determined by direct observation and also recorded on the annotated map of the layout and stands described above. Neighborhood improvements, maintenance and general upkeep of the area are additional signs of resident pride and satisfaction with their neighborhood.

Another indication of satisfaction with the layout and the location of the project is the speed at which the original stands and/or housing units have been sold. This information should be available from the developer of the project and/or local authority. It is also normally included in the market analysis.

6.3 Cost Recovery Performance

The recovery of site development costs has already become a very important consideration in the design and implementation of high density housing areas. Cost recovery for public sector projects must reach almost 80%,while that for private sector projects must include a reasonable profit for the developer. It is important therefore to review the ongoing experiences of both local authorities and private developers with the sales of their stands and/or housing units and the ways in which they recover their different costs. Resident performance in paying the

imposed rates and other property related charges should also be investigated. Neighborhood financing of local improvements should be investigated with the location, nature and extent of these improvements indicated on the annotated map of the layout.

It is equally important to identify any cost recovery or sales problems that can be attributed to poor layout design or implementation. Because the cost of construction is rising much faster than incomes it is becoming increasingly important to consider the use of cross-subsidies in high density housing projects that can benefit low income households without de-capitalizing the agency or developer responsible for the project. The validity of pre-project assumptions concerning resident affordability and the performance of building society loans should be reviewed.

Annex I.A
Layout Programming Worksheet

I.A.1 Basic Description and Objectives

This simple spreadsheet provides a format for assembling data needed to analyze a proposed layout for costs and affordability using the computer models included with the manual and to prepare a layout design. The objective of the worksheet is to assist in assembling information needed to prepare a layout plan. Using some of the data provided by the planner, the worksheet calculates additional information and tabulates proposed land use. The worksheet can also be used to evaluate site plans to see how closely they come to meeting the proposed programme.

I.A.2 Organization of the Worksheet

The spreadsheet is divided into several sections for the input of information on both residential and non-residential land uses. See Figure I.A.1 for an example of the worksheet. The information sections are:

General information and site area
Road hierarchy
Non-marketable uses
Community facilities
Commercial facilities
Stands and housing units

The final two sections of the spreadsheet are for analysis of land use and stand types.

I.A.3 Description of Inputs and Outputs

The following is a brief description of inputs and resulting outputs of the worksheet. It should be noted that cells for data input are shaded. Cells without shading are outputs of the worksheet. Output cells have been protected so that the formulas cannot be accidentally erased. The name of the computer program on the diskette is "LAYOUTPR.XLS".

General

Inputs
Site Area (cell C3) is expressed in hectares and includes the total area of land within the boundaries of the site for which the cost of land is to be recovered.

Non-developable area (cell G3) is expressed in square meters and includes all of the area within the site that cannot be developed. These areas can result from physical or environmental constraints (e.g. wetlands, flood plains, major rock outcrops, etc.), urban planning restrictions (e.g. special road reservations and other servitudes, water treatment and supply installations, electricity supply, etc.) and the land use needs of major public facilities (e.g. major sports facilities, colleges, city parks, etc.).

Figure I.A.1

	A	B	C	D	E	F	G	H	I	J
1	LAYOUT PROGRAMME WORKSHEET									
2	Developer Anywhere			Project:	Edge-of-Town			Date:	11/15/96	
3	Site Area(ha)		50.53	Non-developable area(m2)			21,500	Developable Area(m2		483,800
4	ROAD HIERARCHY			Reservation(m)		Carriage way(m)		Surfacing(materials)		
5	Foot Path (FP)			2.5		1.0		Compacted earth		
6	Stand Access (SA)			8.5		3.0		Regrading of in situ soils		
7	Local Distributor (LD)			15.0		7.0		One layer gravel		
8	District Distributor (DD)			18.0		8.2		Granular base surfaced		
9	Primary Distributor (PD)			20.0		8.7		Structural layers surfaced		
10	NON-MARKETABLE USES(% of site)									
11	Circulation(roads & foot paths)			22.0		Passive Open Space			2.0	
12	Parking Areas			0.4		Active Open Space			3.0	
13	COMMUNITY FACILITIES(m2)					SHOPPING FACILITIES(m2)				
14			Number	Area/Fac.	Area			Number	Area/Fac.	Area
15	Creche		2	1,500	3,000	Dirtrict Shopping Ctr.				0
16	Primary School		1	35,000	35,000	Neighborhood Ctr.		1	3,000	3,000
17	Secondary School		1	70,000	70,000	Corner Shops		10	300	3,000
18	Health Clinic		1	500	500	Peoples' Market		1	1,000	1,000
19	Community Center				0	Beer Garden		2	500	1,000
20	Religious		3	2,000	6,000	Service Industrial		4	400	1,600
21	Public				0	Other				0
22	Other		1	5,000	5,000	Other				0
23	Total				119,500	Total				9,600
24	STANDS AND HOUSING UNITS								% Total	100.0
25	Stand Type		Type #1	Type #2	Type #3	Type #4	Type #5	Type #6	Type #7	Type #8
26	% of Total Stands		20.0	20.0	30.0	25.0	5.0			
27	Stand Size(m2)		110	150	200	300	450			
28	Stand Frontage(m)		7.0	8.5	10.0	12.0	15.0			
29	Stand Depth(m)		15.7	17.6	20.0	25.0	30.0	0.0	0.0	0.0
30	Ratio(depth/frontage)		2.2	2.1	2.0	2.1	2.0	0.0	0.0	0.0
31	Stands/Block(1 side)		20	16	14	12	12			
32	Block Length(m)		140.0	136.0	140.0	144.0	180.0	0.0	0.0	0.0
33	Access Road Type		SA	SA	SA	LD	DD			
34	Secondary Rd. Type		SA	LD	LD	DD	LD			
35	House Size(m2)			15	15	40				
36	Target Income($/mth)		1000	1200	1600	3000	5000			
37	LAND USE ANALYSIS			Program			Layout Plan			
38				Area(m2)	Percent		Area(m2)	Percent		
39	Total Developable Area			483,800	100.0		483,800	100.0		
40	Residential			222,139	45.9		180,560	37.3		
41	Circulation & Parking			108,371	22.4		124,520	25.7		
42	Open Space			24,190	5.0		22,200	4.6		
43	Community Facilities			119,500	24.7		150,320	31.1		
44	Commercial Facilities			9,600	2.0		6,200	1.3		
45	STAND ANALYSIS									
46	Stand Type		Type #1	Type #2	Type #3	Type #4	Type #5	Type #6	Type #7	Type #8
47	Program % of Total		20.0	20.0	30.0	25.0	5.0	0.0	0.0	0.0
48	Layout Stands/Type		148	155	274	189	41			
49	Layout % of Total		18.3	19.2	34.0	23.4	5.1	0.0	0.0	0.0
50	Total Stands in Layout			807						

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Outputs
Developable Area (cell J3) of the project is calculated in square meters.

Road Hierarchy

Inputs
Reservation (cells D5 to D9) width is given in meters. Standards in effect as of November 1996 have been entered but can be changed by the planner according to local conditions.

Carriage way (cells F5 to F9) width is given in meters. Current standards have been entered but can be changed.

Surfacing (cells H5 to H9) give a description of the road surfacing materials proposed to be used in the project.

Non-marketable Uses

Inputs
Types of Non-marketable Land Uses (cells D11 & 12 and I11 & 12) as a percent of the total area of developable land.

Community Facilities

Inputs
Number of Community Facilities (cells C15 to C22) proposed for the project.

Area for each Community Facility (cells C15 to D22) to in the project expressed in square meters.

Outputs
Total Area for each type of Community Facility (cells E15 to E22) expressed in square meters.

Total Area for Community Facilities (cell E23) expressed in square meters.

Shopping Facilities

Inputs
Number of Shopping Facilities (cells H15 toH22) proposed for the project.

Area for each Shopping Facility (cells I15 to I22) to in the project expressed in square meters.

Outputs
Total Area for each type of Shopping Facility (cells J15 to J22) expressed in square meters.

Total Area for Shopping Facilities (cell J23) expressed in square meters.

Stands and Housing Types

In this section information can be entered for up to eight different types of stands and housing units. If there are fewer types than eight proposed, leave spaces for that type blank.

Inputs
% of Total Stands (cells C26 to J26) for each stand type.

Stand Size (cells C27 to J27) in square meters for each stand type.

Stand Frontage (cells C28 to J28) is the distance of the side of the stand facing the street expressed in meters.

Stands per Block (cells C31 to J31) is the number of stands on one side of the block that determine the length of the block.

Access Road Type (cells C33 to J33) indicates the type of road (from the road hierarchy) to be used in front of stands.

Secondary Road Type (cells C34 to J34) shows the type of road to be used at the end of blocks.

House Size (cells C35 to J35) gives the area in square meters of the proposed housing unit to be constructed on the stands.

Target Income (cells C36 to J36) shows the monthly income in Z$ for the target group for each stand type.

Outputs
% Total (cell J24) is the sum of the percentages for each stand type. This number should always be 100.

Stand Depth (cells C29 to J29) gives the depth of the stand in meters.

Ratio of Depth to Frontage (cells C30 to J30) is the number resulting when the depth of the stand is divided by the street frontage.

Block Length (cells C32 to J32) gives the length of a block in meters for each of the stand types.

Land Use Analysis

This section gives a summary of land use based on the information entered in the other sections of the spreadsheet. This section can also be used to analyze a layout plan to see if the proposed programme has be achieved.

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Inputs (from layout plan)
Residential Land (cell G40) in square meters as calculated from a layout plan.

Open Space (cell G42), both passive and active, in square meters measured from a layout plan.

Land for Community Facilities (cell G43) in square meters measured from a layout plan.

Land for Commercial Facilities (cell G44) in square meters from a layout plan.

Outputs
Area of Programmed Land Use (cells D39 to D44) in square meters for the proposed layout programme.

% of Programmed Land Use (cells E39 to E44) in square meters for the proposed layout.

Land for Circulation and Parking (cell G41) in square meters for a layout plan. This is calculated by subtracting all other uses from the total developable area of the site.

% for Land Uses (cells H39 to H44) for a layout plan.

Stand Analysis

Inputs
Number of Stands by Type from layout (cells C48 to J48) taken from the a layout plan.

Outputs
% of Total for Layout Stands (cells C49 to J49) is calculated by the model for comparison with the proposed breakdown of stand types.

Total Number of Stands in layout (cell D50) for the project layout plan.

Annex I.B
Layout and Infrastructure Costing Model

I.B.1 Basic Description and Objectives

This spreadsheet model concerns the simulation of basic land use characteristics and infrastructure costs for a simple grid type layout. The primary purpose of this program and simulation technique is to be able to analyze the implications of different physical parameters and standards of a potential layout and to estimate their corresponding costs. The use of a computer spreadsheet model allows this to be done quickly and easily.

The actual layout which is developed and ultimately submitted for approval will undoubtedly differ from the guidelines which result from the application of this simulation approach. Nevertheless, the use of this computer simulation will enable the evaluation of a wide range of layout conditions and standards that will help ensure that the eventual layout is both financially feasible and affordable to the intended beneficiaries. Results from this simulation should be incorporated into the Affordability Model in order to test the feasibility and affordability of the proposed development.

The Layout and Costing Model has been developed using relatively straightforward and simple formulas which have been incorporated into a Microsoft Excel spreadsheet. There are no difficult formulas or macros involved in the spreadsheet which would preclude it from being used on other spreadsheet programs such as Lotus 1-2-3. Only very little modification to the formatting of the spreadsheet is required.

I.B.2. Organization of the Model

As shown in Figure A.I.B.1., the spreadsheet model is divided into four major sections:

- land use quantification and analysis of non-residential activities
- land use quantification and analysis of residential areas which include up to eight different types of stands;
- infrastructure quantification and cost estimates based on the results of the non-residential and residential land use analyses, and
- a summary of total costs according to each major infrastructure component and a comparison of these cost to acceptable minimum and maximum figures.

Figure A.I.B.2. presents the basic logic and order by which the program works. It also shows the data inputs to be provided by the user and the simple calculations that are made by the program based on these inputs. Since the model includes a series of formulas which have been progressively linked together in order to obtain the final results, a change in any one of the inputs will automatically produce corresponding changes in the related calculations. Because all calculations are done very rapidly by the computer, the use of this model allows the user to introduce and test a wide range of parameters and trade-offs concerning standards and costs. The end result will be an overall description and program for a hypothetical layout and a valuable indication of the cost of development which needs to be achieved in order to keep the layout affordable to the desired population target group.

The total infrastructure cost per gross square meter of the site and the overall percentages for circulation and open space which result from the use of this model should be introduced into the Affordability Model in order to test the affordability of the proposed standards to the intended target group.

Figure A.I.B.1
Layout Cost Model Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	SITE/COSTS:		Developer:			Project:				Date:	
2	LAND USE CHARACTERISTICS										
3	Site area in hectares		75	Non-developable area in m2				Developable area in m2			750000
4	NON-RESIDENTIAL AREAS										
5	Type of non-residential stand			Prim. Sch	Sec. Sch.	Health	Religious	Public	Shops	Market	Beer Gar.
6	Net stand size in m2			100000	100000	10000	12000	2500	2000	1000	10000
7	Stand frontage in meters			400.00	400.00	80.00	75.00	40.00	40.00	30.00	80.00
8	R.O.W. of access street			12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
9	Vehic. street (1), footpath (2)			1	1	1	1	1	1	1	1
10	Width of pavement			7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
11	R.O.W.of secondary street			18.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
12	Vehic. street (1), footpath (2)			1	1	1	1	1	1	1	1
13	Width of pavement			10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
14	**Network length / land use**			342.0	342.0	119.5	134.5	68.3	62.0	48.7	119.5
15	**M2 footpaths / land use**			0	0	0	0	0	0	0	0
16	**M2 paved footpath/land use**			0	0	0	0	0	0	0	0
17	**M2 street / land use**			8992	8992	3152	3652	1672	1472	1085	3152
18	**M2 paved street / land use**			5420	5420	1930	2245	1025	900	663	1930
19				M2	%					M2	%
20	**Total circulation area**			32169	11.36		Total non-marketable area			45669	16.13
21	Passive o.s.			12000	4.24		Total non-residential area			283169	
22	Active o.s.			1500	0.53						
23	RESIDENTIAL AREAS			%	M2		Total residential area				466831
24	Passive o.s.			2.50	11671						
25	Active o.s.		(1st est)	2.50	11671						
26	Circulation area		25.00	23.83	111261						
27	**Total non-marketable area**			28.83	134602.72		Total net residential area				332228
28	Residential stand type		Total	#1	#2	#3	#4	#5	#6	#7	#8
29	Percentage total stands		100.00	40.00	40.00	20.00					
30	Stand size in m2			150.00	200.00	300.00					
31	**Number of stands**		1661	664	664	332	0	0	0	0	0
32	Stand frontage in meters			8.50	10.00	12.50					
33	Number of stands / block			10	8	10					
34	Reservation for access street			8.00	8.00	8.00					
35	Vehic. street (1), footpath (2)			1	1	1					
36	Width of pavement			5.50	5.50	5.50					
37	Reservation for secondary street			10.00	10.00	12.00					
38	Vehic. street (1), footpath (2)			1	1	1					
39	Width of pavement			5.50	5.50	7.00					
40	**Network length / stand type**			5475	6437	3563	0	0	0	0	0
41	**M2 footpaths / stand type**			0	0	0	0	0	0	0	0
42	**M2 paved footpath / type**			0	0	0	0	0	0	0	0
43	**M2 sec. street / stand type**			14384	19934	11163	0	0	0	0	0
44	**M2 acces street / stand type**			22592	26578	16611	0	0	0	0	0
45	**M2 paved sec. street / type**			7911	10964	6512	0	0	0	0	0
46	**M2 paved access / stand type**			15532	18273	11420	0	0	0	0	0
47	Total m2 circulation area			111261	Percentage circulation			23.83	Nb. units/hectare		36
48	LAND USE SUMMARY			M2	%					M2	%
49	Total footpaths			0	0.00		Total green space			23671	3.16
50	Total vehicular streets			143431	19.12		Total public spaces			13171	1.76
51	Total circulation			143431	19.12		Total non-marketable area			180272	24.04

100

Figure A.I.B.1
Layout Cost Model Spreadsheet (continued)

	A	B	C	D	E	F	G	H	I	J	K
52	SITE DEVELOPMENT COSTS					Unit	Quantity	% Site	% Bidding	Cost/m2	% total
53						Cost	M2-Ml	Adjust.	Climate	site	cost
54	Site preparation					1.5	750000			1.50	8.93
55	Vehicular streets:		90144	m2 paved							
56	- subgrade					40.60	102441			5.55	33.02
57	- base course					4.64	102441			0.63	3.77
58	- gravel wearing course					5.22				0.00	0.00
59	- base 1					4.64				0.00	0.00
60	- base 2					4.64				0.00	0.00
61	- surfacing			Total ml	%	13.54				0.00	0.00
62	- sidewalks in m2			40651	10.00	22.04	4065			0.12	0.71
63	- kerbs in meters			25169	20.00	98.60	5034			0.66	3.94
64	- channel in meters			25169	20.00	365.40	5034			2.45	14.60
65	Footpaths		0	m2 paved	%						
66	- grading and base					40.60	0			0.00	0.00
67	- cement					10.44	0			0.00	0.00
68	- paving slabs 50 mm thick					98.60	0			0.00	0.00
69	- stabilized earth						0			0.00	0.00
70	Drainage network		16711	m length	%						
71	- concrete pipe 450 mm diameter				10.00	327.16	1671			0.73	4.34
72	- concrete pipe 525 mm diameter				10.00	425.56	1671			0.95	5.65
73	- concrete pipe 600 mm diameter					498.80	0			0.00	0.00
74	- pipe						0			0.00	0.00
75	- pipe						0			0.00	0.00
76	- open ditch				80.00	23.20	13369			0.41	2.46
77	- other						0			0.00	0.00
78	- culvert inlet			spacing =	110	69.60				0.01	0.06
79	- culver outlet			"	110	69.60				0.01	0.06
80	- other			"						0.00	0.00
81	Sewer network		16711	m length	%						
82	- AC Sewer Pipe 100 mm diameter					52.20	0			0.00	0.00
83	- AC Sewer Pipe 150 mm diameter					77.72	0			0.00	0.00
84	- AC Sewer Pipe 225 mm diameter					161.24	0			0.00	0.00
85	- cleanouts (rodding eye)			spacing =		986.00				0.00	0.00
86	- manhole - 900 diameter			"		1223.80				0.00	0.00
87	- manhole - 1050 diameter			"		2204.00				0.00	0.00
88	- lagoon			number =						0.00	0.00
89	Water supply		16711	m length	%						
90	- primary pipe						0			0.00	0.00
91	- pipe - 50 mm diameter				20.00	52.20	3342			0.23	1.39
92	- pipe - 75 mm diameter				20.00	75.40	3342			0.34	2.00
93	- pipe - 90 mm diameter				20.00	104.40	3342			0.47	2.77
94	- pipe - 110 mm diameter				20.00	136.88	3342			0.61	3.63
95	- pipe - 160 mm diameter				20.00	226.20	3342			1.01	6.00
96	- valve			spacing =						0.00	0.00
97	- valve			"						0.00	0.00
98	- fire hydrant			"						0.00	0.00
99	- standpipe			"						0.00	0.00
100	Electricity		16711	m length							
101	- transformer				%	50000	4			0.27	1.59
102	- overhead lines				50	30	8356			0.33	1.99
103	- streetlighting			spacing =	50	1000	19407			0.52	3.08
104											

101

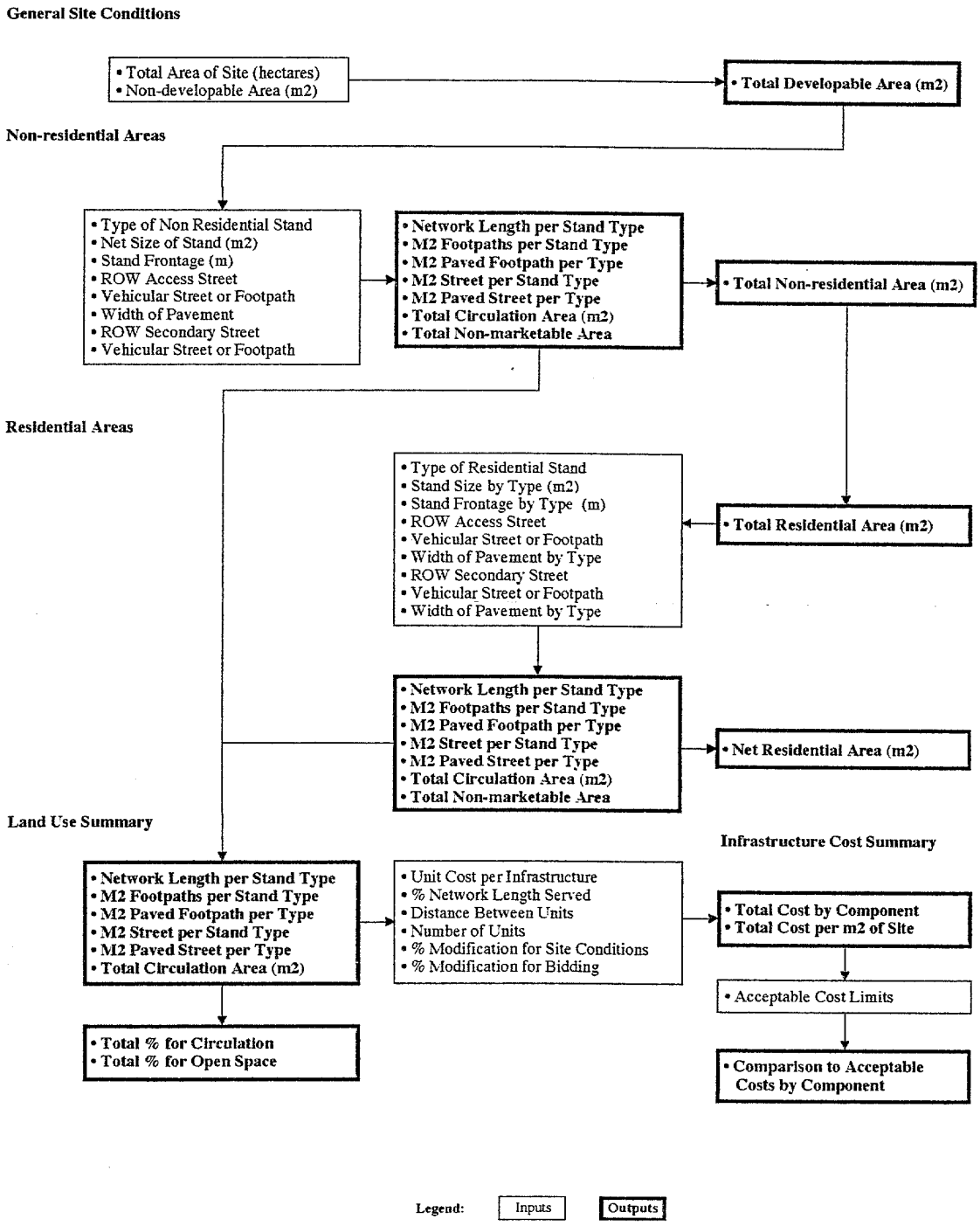
Figure A.I.B.1
Layout Cost Model Spreadsheet (continued)

	A	B	C	D	E	F	G	H	I	J	K
105	SITE COST SUMMARY			Cost/	Cost X	% Total		Comparison with anticipated costs			
106				m2 dev.	1000 $	cost		min.	max.	Z$/m2	% dif.
107	Site preparation			1.50	1125.0	8.93				0.00	0.00
108	Vehicular streets			9.41	7059.7	56.05				0.00	0.00
109	Footpaths			0.00	0.0	0.00				0.00	0.00
110	Drainage network			2.11	1583.4	12.57				0.00	0.00
111	Waste water network			0.00	0.0	0.00				0.00	0.00
112	Drinking water supply			2.65	1988.9	15.79				0.00	0.00
113	Electricity network			1.12	838.8	6.66				0.00	0.00
114	On-site costs w/o prep.			15.29	11470.8	91.07				0.00	0.00
115	Total site development			16.79	12595.8	100.00				0.00	0.00

102

Figure A.I.B.2

FLOW OF INPUTS AND OUTPUTS IN THE LAYOUT COSTING MODEL



I.B.3. Description of Program Inputs and Outputs

The following is a basic description of the inputs used in the model and the resulting outputs. Much of the information used for inputs is available from the printout of the Layout Programming Model.

General Land Use

Inputs

Total Site Area, (cell C3) is expressed in hectares and includes the total area of land within the boundaries of the site for which the cost of purchasing the land is to be recovered.

Non-developable Site Area (cell G3) is expressed in square meters and includes all of the area within the boundary of the site that cannot be developed. Non-developable areas can result from physical or environmental constraints (e.g. wetlands, flood plains, major rock outcrops, bad soil conditions etc.), urban planning restrictions (e.g. special land reservations for high tension lines, etc.) and the land use needs for major city wide facilities (e.g. sports grounds, colleges, city parks etc.)

Output

Total Developable Area of the Site (cell K3) is calculated in square meters by subtracting the non-developable area from the total area of the site.

Non-Residential Land Use

Inputs

Types of Non-residential Land Uses (cells D5 to K5) include up to eight areas for major non-residential uses that can include primary and secondary schools, health and community centers, public buildings, religious facilities, shops, markets, services, beer gardens etc. Non-residential activities can also be combined and entered into the program as "Block 1" , "Block 2", etc. depending on how they will be arranged on the site. The user can define or combine different land uses as desired.

Net Stand Size by Type of Non-residential Land Use (cells D6 to K6) is presented in square meters for each type of non-residential land use or block.

Stand Width by Type or Block (cells D7 to K7) is the meter length of the side of the stand fronting the access street.

Reservations for Access and Secondary Roads (cells D8 to K8 and D11 to K11) are the meter widths of reservations for access and secondary roads around each of the included non-residential uses or blocks. The basic procedures for determining how to enter these widths into the program are shown in Figure A.I.B.3.

Designation of Vehicular Roads and Pedestrian Paths for Access and Secondary Roads (cells D9 to K9 and D12 to K12) are determined by the user. The number "1" is introduced for vehicular roads and the number "2" for pedestrian paths.

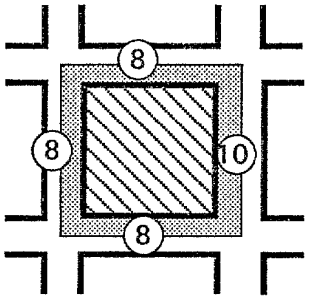
Pavement Widths for Access and Secondary Roads (cells D10 to K10 and D13 to K13) are the meter widths of pavement for these roads around each of the non-residential land uses or blocks to be included in the project. Once again, the basic procedures for determining how to enter these widths into the program are shown in Figure A.I.B.3.

Figure A.I.B.3

METHOD OF INTRODUCING ROAD RESERVATIONS

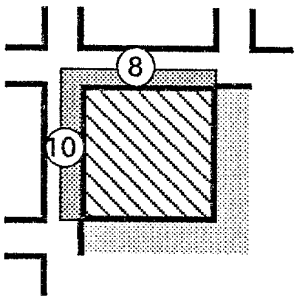
NON- RESIDENTIAL BLOCKS

Two Different Secondary Road Reservations



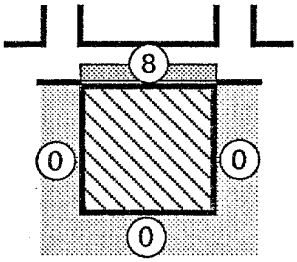
The road reservation to enter for the secondary road is 9 (1/2 of 8 meters + 10 meters) and for the access road 8 (1/2 of 8 meters + 8 meters)

Access and Secondary Roads on Only One Side



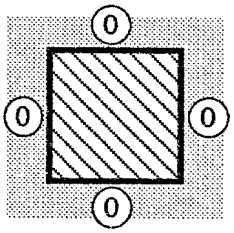
The road reservation to enter for the secondary road is 5 (1/2 of 10 meters + 0 meters) and fo the access road 4 (1/2 of 8 meters + 0 meters)

Access Road on One Side



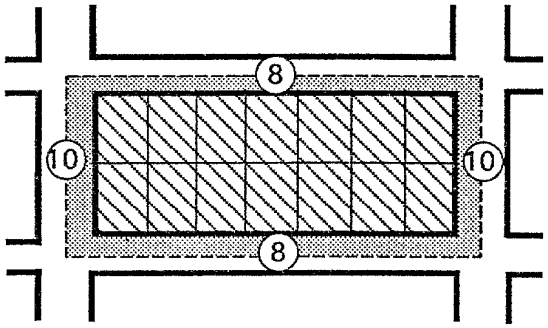
The road reservation to enter for the secondary road is 0 (1/2 of 0 meters) and for the access road 1/2 of 8 meters (4 meters)

No Vehicular Access



The road reservation to enter for the secondary road is 0 (0 meters + 0 meters) and for the access road also 0 (0 meters + 0 meters)

RESIDENTIAL BLOCK



The road reservation to enter for the secondary road is half of each side of the block (5 meters + 5 meters)

The road reservation to enter for the access road is half of each side of the block (4 meters + 4 meters)

Active and Passive Open Space in Non-residential Areas (cells D21 and D22) are entered into the program in terms of square meters. The program calculates the percentage of the total non-residential area covered by these land uses.

Outputs

Network Lengths per Non-residential Land Use (cells D14 to K14) are essentially calculated for each type of non-residential use by determining the length of the network along the access and secondary roads (when they exist) and then dividing these lengths in half in order to share the infrastructure costs with the facing stands.

Square Meters of Footpaths per Non-residential Land Use (cells D15 to K15) are calculated for each type of non-residential use based on the designation for footpaths, the width of the corresponding reservations using a grid type layout and the dimensions of the stands .

Square Meters of Footpath Pavement per Non-residential Land Use (cells D16 to K16) are calculated based on the paved widths of footpaths, the reservations for access and secondary roads/footpaths and the dimensions of the stands.

Square Meters of Road Reservation per Non-residential Land Use (cells D17 to K17) are calculated for each type of non-residential use based on the designation for vehicular roads, the width of the corresponding reservations using a grid type layout and the dimensions of the stands .

Square Meters of Paved Roads per Non-residential Land Use (cells D18 to K18) are calculated based on the paved widths of roads, the reservations for access and secondary roads/footpaths and the dimensions of the stands.

Total Non-residential Circulation Area in Square Meters and Percentage of Gross Non-residential Area (cells D20 and E20) are calculated by adding together all of the calculated road and pedestrian areas for the different non-residential land uses and then dividing the total by the total gross non-residential area in order to obtain the percentage.

Total Passive and Active Open Spaces in Percentages of Gross Non-residential Area (cells E21 and E22) are calculated by dividing the square meter areas entered into the model for these uses by the total non-residential area.

Total Non-marketable Non-residential Area in Square Meters and Percentage of Gross Non-residential Area (cells J20 and K20) are calculated by adding the square meter areas for circulation, passive open space and active open space and then dividing the total by the total non-residential area.

Total Non-residential Area in Square Meters (cell J21) is calculated by adding the total non-marketable area for non-residential uses to the total net area of the non-residential stands.

Total (Gross) Residential Area in Square Meters (cell K23) is calculated by subtracting the total (gross) area for non-residential use from the total developable area of the site.

Residential Land Use

Inputs

Active and Passive Open Space in Residential Areas (cells D24 and D25) are entered into the program as percentages of the total (gross) residential area.

First Percentage Estimate for Circulation Area must be entered into cell C26 in order for the program to begin the iterative process of determining the actual percentage for circulation. A relatively small number of iterations automatically determines the correct percentage based on the inputs for stands and roads which follow.

Percentages of Stands by Type (cells D29 to K29) are determined by the user and entered into the program for each type of stand to be included in the project.

Size of Stands in Square Meters (cells D30 to K30) are entered for each type of stand.

Frontage or Width of Stands in Meters (cells D32 to K32) are entered for each type of stand.

Average Number of Stands in a Block (cells D33 to K33) are entered for each type of stand.

Reservations for Access and Secondary Roads (cells D34 to K34 and D37 to K37) are the meter widths of reservations for access and secondary roads for each of the types of stands.

Designation of Vehicular Roads and Pedestrian Paths (cells D35 to K35 and D38 to K38) are determined by the user. The number "1" is introduced for vehicular roads and number "2" for pedestrian paths

Pavement Widths for Access and Secondary Roads (cells D36 to K36 and D39 to K39) are the meter widths of pavement for access and secondary roads for each of the types of stands.

Outputs

M2 o f Passive and Active Open Space in M2 (cells E24 and E25) are determined by multiplying the gross residential area by the percentages entered for each of these uses.

Circulation Area in % and M2 (cells D26 and E26) are obtained by the computer through a number of iterations using the initial estimated percentage of circulation area in cell C26 to start the process and then calculating the actual percentage using the physical planning data for stands, block lengths and roads that follow in the program; once the percentage is obtained it is multiplied by the gross residential area to obtain the square meter area for circulation.

Total Non-marketable Residential Area in Percentage and in M2 (cells D27 and E27) are found by adding the percentages for passive and active open space to that for circulation and multiplying the total by the gross residential area.

Total Net Residential Area (cell K27) is found by subtracting the total non-marketable residential area from the total gross residential area.

Total Percentage of Stands (cell C29) is the sum of the percentages for each of the types of stand. This number should always be 100.

Total Number of Stands and by Type of Stand (cells C31 and D31 to K31) are found by first multiplying the percentage per type of stand by the size in m2 and adding all the results to obtain the average sized stand, then dividing the total net residential area in m2 by the average sized stand in order to obtain the total number of stands and finally multiplying the total number of stands by the percentage for each type to obtain the number of stands by type.

Total Network Length per Type of Stand (cells D40 to K40) are calculated for each type of stand by determining the average block length and the length of network along the access and secondary roads (when they exist). The lengths of networks that are located at the rear of the stand or go down the middle of the access street will be very similar. These network lengths are used for water, sewers and electricity supply.

Total Square Meters of Footpaths per Type of Residential Stand (cells D41 to K41) are calculated for each type of residential stand based on the designation for footpaths, the width of the reservations and the length of the block based on a grid type layout and the dimensions of the stands .

Total Square Meters of Footpath Pavement per Type of Residential Stand (cells D42 to K42) are calculated based on the paved widths of footpaths, the reservations for access and secondary roads/footpaths and the dimensions of the stands.

Total Square Meters of Road Reservation for Secondary Roads per Type of Residential Stand (cells D43 to K43) are calculated for each type of stand based on the designation for vehicular secondary roads (or roads along the depth of the blocks), the width of the corresponding reservations using a grid type layout and the dimensions of the stands .

Total Square Meters of Road Reservation for Access Roads per Type of Residential Stand (cells D44 to K44) are calculated for each type of stand based on the designation for vehicular access roads (or roads running along the fronts of the stands), the width of the corresponding reservations using a grid type layout and the dimensions of the stands .

Square Meters of Paved Secondary Roads per Type of Residential Stand (cells D45 to K45) are calculated based on the paved widths of vehicular secondary roads and the dimensions of the blocks of stands.

Square Meters of Paved Access Roads per Type of Residential Stand (cells D46 to K46) are calculated based on the paved widths of vehicular access roads and the dimensions of the blocks of stands.

Total Residential Circulation Area in Square Meters and Percentage of Gross Residential Area (cells D47 and H47) are calculated by adding together all of the calculated road and pedestrian areas for the different types of stands and then dividing the total by the total gross residential area in square meters in order to obtain a percentage figure.

Number of Units per Hectare (cell K47) is found by dividing the total developable area of the site by the total number of stands.

Total Footpaths and Percentage for the Entire Site (cells D49 and E49) are found by adding the square meter area of footpaths from both the non-residential and residential areas and dividing the resulting square meters by the total developable area of the site to obtain the percentage.

Total Vehicular Streets and Percentage for the Entire Site (cells D50 and E50) are found by adding the total square meter area of footpaths from both the non-residential and residential areas and then dividing the resulting square meter total by the total developable area of the site to obtain the percentage.

Total Circulation and Percentage for the Entire Site (cells D51 and E51) are found by adding the total square meter area of footpaths and streets and dividing the resulting square meter total by the total developable area of the site to obtain the percentage.

Total Green Space (Passive Open Space) and Percentage (cells J49 and K49) are found by adding the square meters of passive open space from both the non-residential and residential areas and dividing the resulting m2 by the total developable area of the site to obtain the percentage.

Total Public Space (Active Open Space) and Percentage (cells J50 and K50 are found by adding the square meters of active open space from both the non-residential and residential areas and dividing the resulting square meters by the total developable area of the site to obtain the percentage figure.

Total Non-marketable Area and Percentage (cells J51 and K51) are found by adding the m2 of non-marketable area from both the non-residential and residential areas and dividing the resulting m2 by the total developable area of the site to obtain the percentage.

Infrastructure Costs

Inputs

Unit Costs (cells F54 to F104) are the current unit costs for the infrastructure items indicated in the program list. These costs should include both labor and materials.

Certain Infrastructure Quantities to be Expressed in Square Meters, Linear Meters or Numbers (cells G56 to G61 for roads; and E101 to E103 for electricity and street lighting)

Percentages of Total Amounts for Certain Infrastructure Elements (cells E62 to E64 for the percentages of the total vehicular road network with sidewalks, kerbs or channels; E66 to E69 for the percentages of the total footpath network with different types of surfacing: E71 to E77 for the percentages of different sized drainage pipes within the overall network; E82 to E84 for the percentage of different sized sewer pipes within the overall network; E90 to E95 for the percentage of different sized water pipes within the overall network; and E102 for the percentage of the total electricity network served by overhead lines) are entered into the model as necessary based on experience and/or from working with physical planning data developed by using the model. Familiarity and experience in using the model will improve the precision of these estimates.

The area for sidewalks shown by the model in cell E62 is simply the difference in area between the road reservation and the paved areas for vehicular streets. Consequently, the unit cost for sidewalks should reflect the typical treatment of these areas (paving, planting etc.) and the resulting cost per square meter.

The total kerb and channel lengths shown in cells E63 and E64 are automatically calculated by the model by simply dividing the total paved area of vehicular streets by the width of the pavement for secondary and access roads for each type of stand. The user must refer back to the proposed standards for each type of stand and perhaps, execute a few simply side calculations, in order to determine the percentage of the total road network that will have kerbs or channels.

Other Infrastructure Related Inputs (cells E78 to E80 for drainage culverts and other elements; cells E85 to E88 for cleanouts, manholes and lagoons; cells E96 to E99 for valves, fire hydrants and standpipes; cells E101 and E103 for transformers and streetlighting) refer to distinct elements within the infrastructure networks that are calculated on a unit basis.

The number of culvert inlets or outlets are determined by either entering the length of the networks involved in cells G78, G79 and/or G80 and the corresponding spacing of these elements in cells E78, E79 and/or E80. If the number of culverts can be estimated, for example, directly from a concept plan, then cells G78, G79 and/or G80 are left blank and the number of culverts or other drainage element are entered directly into cells E78, E79 and/or E80. The model will assume this to be the case if cells G78, G79 and/or G80 are left blank.

Clean outs and manholes for the sewer network (lines 85, 86 and 87) are calculated in the same way. One can either enter the length of the concerned network in cells G85, G86 and/or G87 and the anticipated or required spacing in cells E85, E86 and/or E87 or, alternatively, leave the cells for the network lengths blank and enter the estimated number of different types of cleanouts and manholes directly into the necessary cells between E85 and E87. The number of lagoons is entered directly into G88.

The procedures work in exactly the same way for valves, hydrants and standpipes related to water supply (lines 96 to 99) and for streetlighting (line 103). The number of transformers within a site is entered directly into cell G101.

Percentage Modification for Site Conditions (cells H54 to H103) enable the user to adjust unit costs based on the nature of site conditions or other criteria and to test certain cost assumptions without having to continually change the unit costs.

Percentage Modifications for Market Conditions (cells I54 to I103) allow the user to make a further adjustment in consideration of the bidding climate and/or impending changes in the prices of specific infrastructure components. This percentage adjustment will allow the user to further "test" assumptions about potential market conditions without having the change or restore the current unit costs each time.

Minimum and Maximum Acceptable Costs (cells H107 to H115 and I107 to I115) are entered for each of the major infrastructure categories and allow the user to compare the results of each infrastructure element within the simulation with the generally accepted range of costs. Minimum and maximum costs are based on experience and should be kept up to date.

Outputs

Costs per M2 of Site by Infrastructure Element (cells J54 to J103) are determined by multiplying the quantity of the infrastructure element by (1) their unit cost, (2) the percentage adjustment for site conditions and (3) the percentage adjustment for market conditions and then dividing the resulting total by the developable area of the site.

Percentages of the Total Cost by Infrastructure Element (cells K54 to K103) are determined by dividing the cost per m2 of developable land for each infrastructure element by the total cost per m2 of developable and multiplying the result by 100 to obtain a percentage figure.

Costs per M2 of Developable Land by Major Category (cells D107 to D114) are calculated by adding up the cost per m2 of developable land for all of the elements in that category.

Total Cost per Major Category of Infrastructure (cells E107 to E114) are calculated by multiplying the total cost per m2 of developable land per category by the total m2 area of developable land. The total costs are expressed in thousands to allow them to fit inside the spreadsheet column.

Percentage of Total Cost by Category (cells F107 to F114) are calculated by taking the cost of each category dividing it by the total cost and multiplying the result by 100 in order to obtain percentage figure.

Total Site Development Costs (cells D115, E115 and F115) are obtained by adding up the respective costs and percentages for each of the categories. The total cost per m2 of developable land in cell D115 should be entered into the Affordability Model once the desired results of the layout and costing simulation have been achieved.

Differences from Accepted Costs (cells J107 to J115) are calculated by comparing the cost results for each of the different infrastructure categories with accepted norms and then indicating whether this amount is higher or lower than normal. If a result is shown in these cells there is a problem that needs to be reviewed, either in the inputs to the model or with the project itself.

Percentages Between Simulated and Anticipated Costs (cells K107 to K115) are calculated by taking the difference and dividing it by the maximum or minimum costs according to the situation and then multiplying the result by 100 in order to obtain a percentage figure.

Annex I.C
Affordability Model

I.C.1 Basic Description and Objectives

This spreadsheet model concerns the simulation of project characteristics, costs and revenues and an analysis of the affordability of the proposed stand and housing types to the intended beneficiaries or target groups. The primary purpose of this program and simulation technique is to be able to determine whether a particular project has the potential to be profitable and affordable. The use of a computer spreadsheet model allows this assessment to be done quickly and easily and to consider a wide range of trade-offs and possibilities.

The characteristics of an actual project will no doubt differ from the information obtained through simulation. Nevertheless, the results of the simulations should be accurate enough to help ensure that the eventual layout and/or project is both financially feasible and affordable.

The Affordability Model has been developed using relatively straightforward and simple formulas which have been incorporated into a Microsoft Excel spreadsheet. There are no difficult formulas or macros involved in the spreadsheet which would preclude it from being used on other spreadsheet programs such as Lotus 1-2-3. Only very little modification to the formatting of the spreadsheet is required.

I.C.2. Organization of the Model

As shown in Figure A.I.C.1., the spreadsheet model is divided into five major sections that include:

- land use characteristics;
- land and infrastructure costs;
- stand sizes and housing unit construction;
- project costs and revenues; and
- affordability.

Figure A.I.C.2. presents the basic logic and order by which the program works. It also shows the data inputs to be provided by the user and the basic calculations which are made by the model using these inputs. Since the model includes a series of formulas that have been progressively linked together in order to obtain the final results, a change in any one of the inputs will automatically produce a series of changes in the related calculations. Because all calculations are done very rapidly by the computer, the use of this model allows the user to introduce and test a wide range of parameters and trade-offs between standards and costs. The end result will be an overall description and program for a hypothetical project and an indication of the cost of development which needs to be achieved in order to keep the layout affordable to the desired population target group.

The total infrastructure cost per gross square meter of the site and the overall percentages for circulation are two key characteristics which link the Affordability Model to the Layout Costing Model. Figure A.I.C.3. shows how the core calculations of the Affordability Model work. As shown by the curves in part A of the figure, the average plot size and the percentage of net or marketable residential area within a site determine the number of stands per hectare within a site. If, for example, 65% or 6500 square meters per hectare can be developed into residential stands, then an average stand size of 200 square meters will result in a density of 32.5 stands per hectare. If the net residential area is increased through a reduction in circulation area or other non-marketable areas, then the number of stands per hectare would increase. The density

Figure A.I.C.1
Affordability Model Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	MASTER:	Developer:								Date:	
2	LAND USE CHARACTERISTICS										
3	Site area in hectares		75	Non-developable area in m2				Developable area in m2			750000
4	Cmty.	Net area	Sales	Shopping	Net area	Building	Sales	Net residential area in m2			
5	facilities	in m2	price/m2	centre	in m2	Cost/m2	price/m2	from program or measured from plans			
6	Prim. Sch.	100000		Shops	1000			Non-marketable land		%	m2
7	Sec. Sch.	100000		Peoples Mkt	1000			Circulation areas		20.00	150000
8	Health	10000		Beer Garden	10000			Parking areas		0.20	1500
9	Religious	12000		Service Ind.	500			Passive o.s.		2.50	18750
10	Public	2500		Other	500			Active o.s.		2.50	18750
11	Total	224500	0	Total	13000	0	0	Total		25.20	189000
12	M2 Non-resid.land		317513	M2 total residential land			432487	M2 net residential land			323500
13	LAND AND INFRASTRUCTURE COSTS					Land	Site	On-site	Off-site	Other	
14						price	prep.	infrastr.	infrastr.	costs	
15	Basic development costs					10	3	20			
16	Contingencies and escalation (%)					9	10	10			
17	Fees and supervision (%)					5		5			
18	Financing costs (%)										
19	Complete item cost/gross m2 of site					11.45	3.30	23.10	0.00	0.00	
20	Total developed land cost/gross m2 of site					37.85	Developed land cost/net m2 of site				84.35
21	PLOT SIZES AND HOUSING UNIT CONSTRUCTION										
22	Housing unit type		Total	Type #1	Type #2	Type #3	Type #4	Type #5	Type#6	Type#7	Type#8
23	% of total stands/type		100.00	40.00	40.00	20.00					
24	Stand size in m2			150.00	200.00	300.00					
25	Nb.of stands/type		1618	647	647	324	0	0	0	0	0
26	Nb.housing units/stand			1	1	1					
27	Nb.units/type		1618	647	647	324	0	0	0	0	0
28	Nb. stands/ha.		37	Persons /Household		7	Density (per/ha)		262	Pop.	11323
29	M2 builded area			14.50	14.50	50.00					
30	Construction cost/m2			1300.00	1300.00	1100.00					
31	Contingencies (%)			10	10	10					
32	Financing costs (%)			7	7	7					
33	Connection Costs			600	600	600					
34	House Costs			22786	22786	65335	0	0	0	0	0
35	% developed land cost/unit			100	100	100					
36	Developed land cost/unit			12652	16870	25305	0	0	0	0	0
37	Total cost/unit			35439	39656	90640	0	0	0	0	0
38	Sales price or % profit			15	15	15					
39	Calculated % profit			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	Sales price/unit			40755	45605	104236	0	0	0	0	0
41	Sales price/m2 built			2811	3145	2085	0	0	0	0	0
42	PROJECT COSTS		X1000 Z$	%	REVENUES		X1000 Z$	%	RATE OF RETURN		
43	Land		8584	10.86	Housing units		89595	100.00	Year	% Exp.	% Rev.
44	Infrastructure		19800	25.06	Facilities		0	0.00	1	25	10
45	Construction		50622	64.07	Total project		89595	100.00	2	45	25
46	Housing	50622							3	20	30
47	Facilities	0							4	10	35
48	Total project		79005	100.00	Developer profit		10590	13.40		% IRR	18.74
49	AFFORDABILITY			Type #1	Type#2	Type#3	Type#4	Type#5	Type#6	Type#7	Type#8
50	Downpayment			5.00	5.00	10.00					
51	Yearly interest rate			14.00	14.00	18.50					
52	Repayment period			25	25	25					
53	Monthly loan payment			466	522	1461	0	0	0	0	0
54	Monthly rate										
55	Supplementary charges			48	48	48					
56	Total monthly payment			514	570	1509	0	0	0	0	0
57	Ratio to monthly income			28	28	28					
58	Required monthly income			1695	1896	5313	0	0	0	0	0
59	Target group monthly income			1200	1200	5000					

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Figure A.I.C.2

FLOW OF INPUTS AND OUTPUTS IN THE AFFORDABILITY MODEL

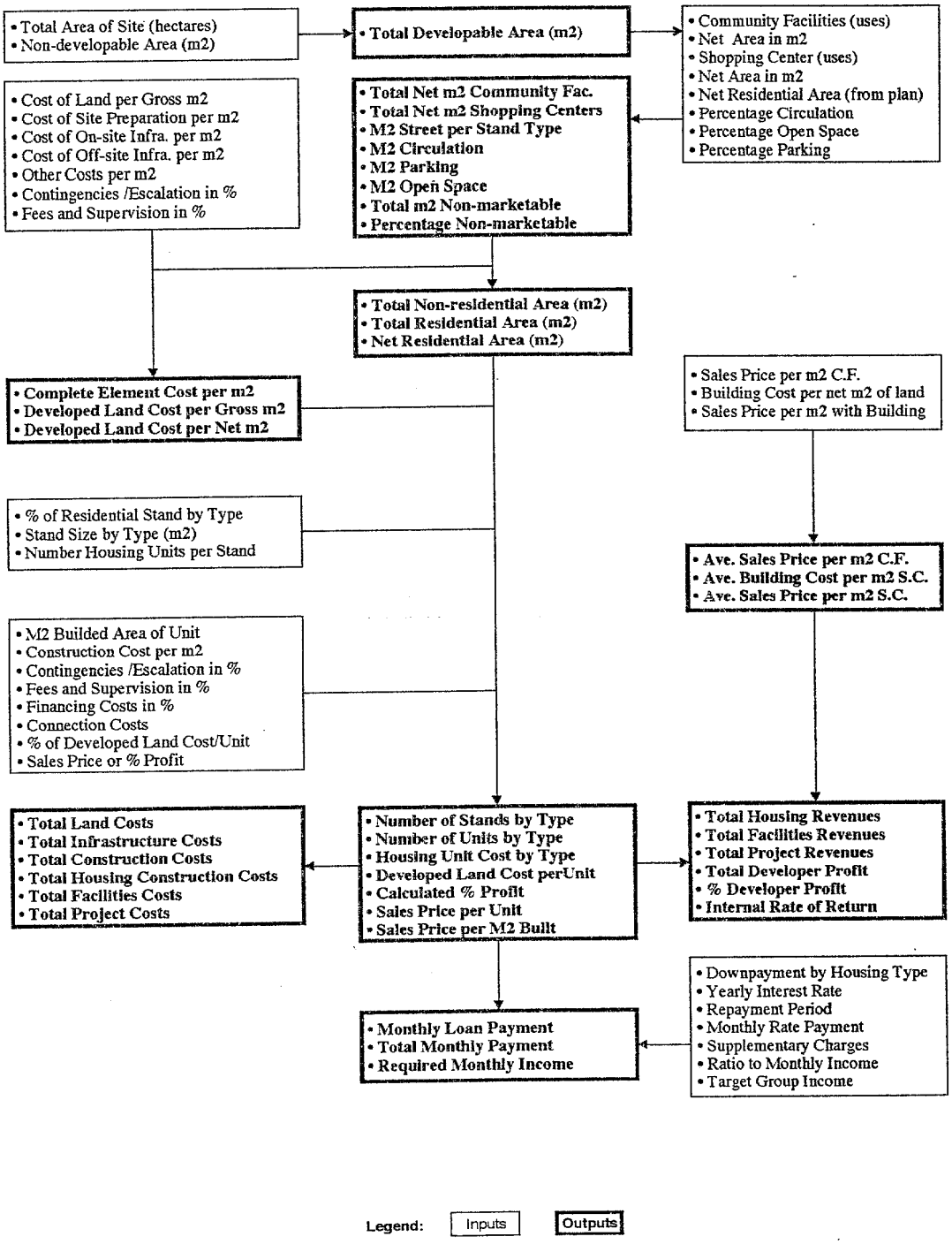

Figure A.I.C.3A

RELATION BETWEEN AVERAGE STAND SIZE, NET RESIDENTIAL AREA AND DENSITY

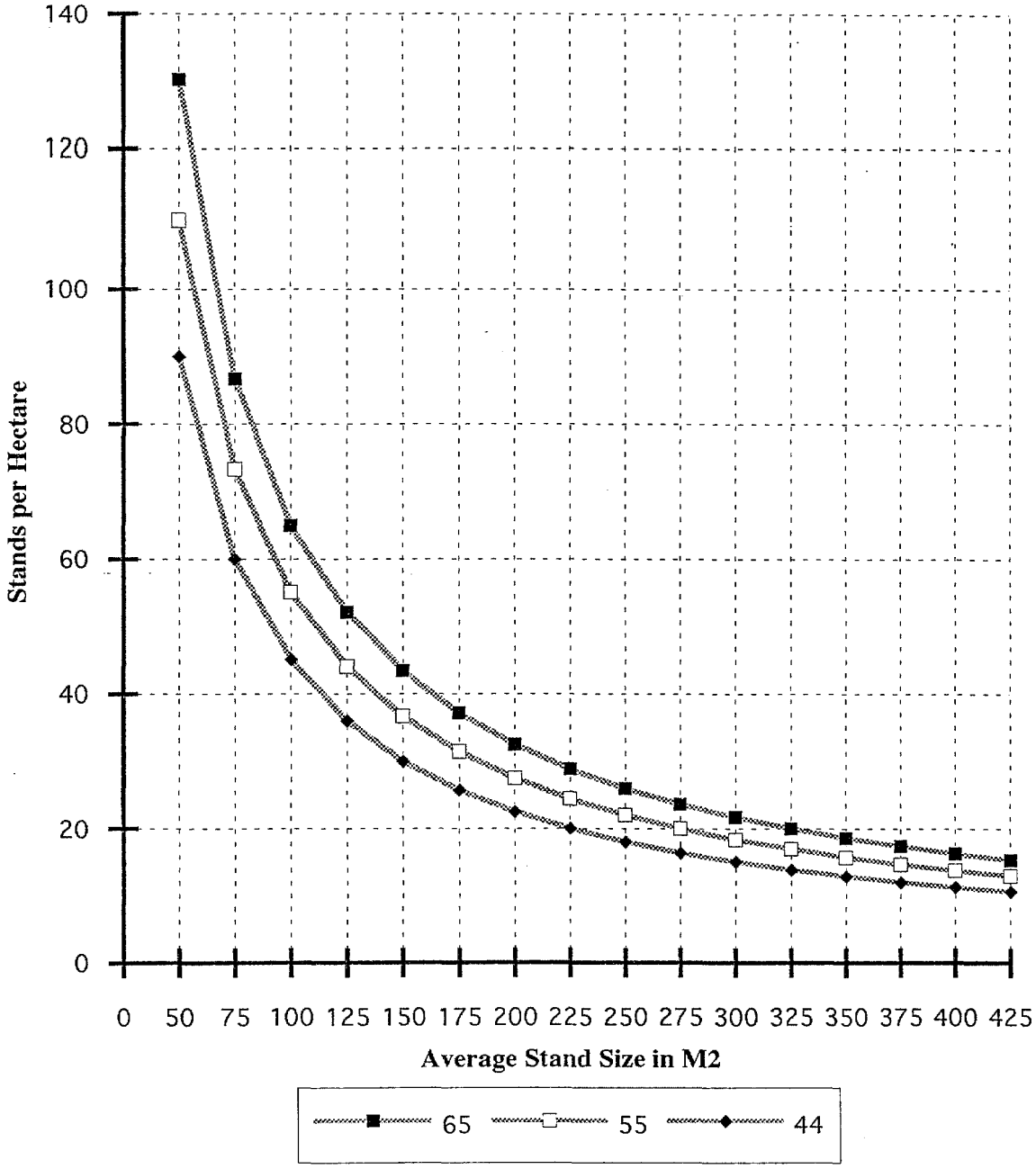

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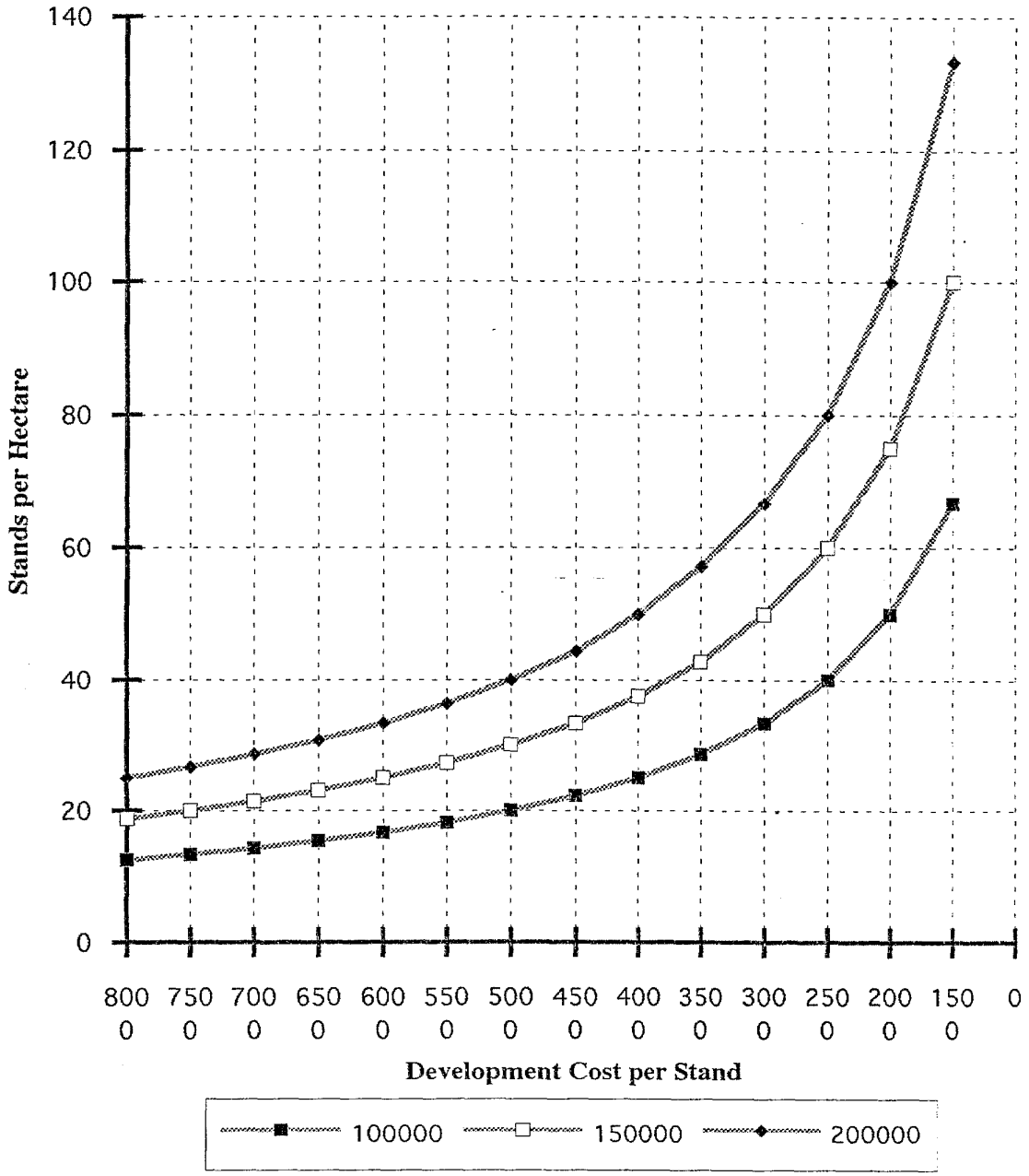
Figure A.I.C.3B

RELATION BETWEEN OVERALL COST OF DEVELOPMENT, COST PER STAND AND DENSITY



of stands is important because it relates directly to the cost of a stand based on a certain level of development as shown by part B of the figure. If the cost of developing a hectare, for example, is considered to be ZD$ 150,000, then the cost per stand at a density of stands per hectare of 40 would be ZD$ 3750 . If the density of stands for the same level of development dropped to only 20 per hectare then the cost per stand for the same level of development would increase to ZD$ 7,000. One can use both of the curves in Figure A.I.C.3. to quickly review the consequences of a number of possibilities.

I.C.3. Description of Program Inputs and Outputs

The following is a basic description of the inputs used in the model and the resulting outputs. Much of the information used for inputs is available from the printout of the Layout Programming Model.

Land Use Characteristics

Inputs

Total Site Area in Hectares, (cell C3) includes the total area of land within the boundaries of the site for which the cost of purchasing the land is to be recovered.

Non-developable Site Area (cell G3) is expressed in square meters and includes all of the area within the boundary of the site that cannot be developed. Non-developable areas can result from physical or environmental constraints (e.g. wetlands, flood plains, major rock outcrops, bad soil conditions etc.), urban planning restrictions (e.g. special land reservations for high tension lines, etc.) and the land use needs for major city wide facilities (e.g. sports grounds, colleges, city parks etc.)

Net Square Meter Areas for Community Facilities in the Project (cells B6 to B10) include up to five different types of areas. These can be primary and secondary schools, health and community centers, public buildings, religious facilities and public buildings as indicated, or the user can change the names to correspond to the community facilities that will actually be provided in the project.

Sales Prices per Net Square Meter of Community Facility (cells C6 to C9) are entered for each type of community facility in the project. In some cases, areas for schools etc. are provided by the developer without any cost to the government user. The policy in other cases is to charge the actual cost of developing the land per net square meter of site as indicated in cell K20. If this is in fact the policy, then the user should enter "=K20" in each of the cells between C6 and C9 where there is a community facility in the project.

Net Square Meter Areas for Shopping Center Facilities (cells B6 to B10) can include up to five different types of areas which have been indicated as shops, markets, services, beer gardens and other. The user can change these names as necessary or even combine certain activities that are likely to be sold at the same land price.

Building Cost per Net Square Meter of Land for Shopping Center Facilities (cells F6 to F11) is determined by dividing the estimated cost of constructing facilities by the net square meter area of the land on which they will be built.

Sales Prices per Net Square Meter of Shopping Center Facilities (cells C6 to C9) are entered for each type of facility in the project. These can be cost or market prices and can provide the developer with the opportunity to generate a profit or to cross-subsidize some of the stands for lower income families. If the developer is also building some of the facilities, the corresponding sales prices should include the building costs indicated in cells F6 to F11.

Net Residential Area in Square Meters (cell K4) is only used when this parameter is already known, either through measurement of an existing or completed layout or through the final list of stands. It makes it possible to use the model to evaluate the final design of a project based on its detailed characteristics.

Percentage of the Developable Area Dedicated to Circulation (cell J7) can be estimated by the user based on experience or obtained from the Layout Costing Model.

Percentage of the Developable Area Dedicated to Parking Areas (cell J8) is generally based on current standards and requirements for additional public parking areas.

Percentage of the Developable Area Dedicated to Passive Open Space (cell J9) is based on current planning standards and requirements.

Percentage of the Developable Area Dedicated to Active Open Space (cell J10) is based on current planning standards and requirements.

Outputs

Total Developable Area of the Site (cell K3) is calculated in square meters by subtracting the non-developable area from the total area of the site.

Total Net Square Meter Area of Community Facilities (cell B11) is the sum of the net square meter areas for each of the community facilities.

Average Sales Price per Square Meter of Community Facilities (cell C11) is calculated based on the net square meter areas and sales prices for the community facilities.

Total Net Square Meter Area of Shopping Facilities (cell F11) is the sum of the net square meter areas for each of the shopping facilities.

Average Sales Price per Square Meter of Shopping Facilities (cell G11) is calculated based on the net square meter areas and sales prices for the shopping facilities.

Total Percentage of Non-Marketable Area (cell J11) is obtained by adding together the percentages for circulation, parking areas, passive open space and active open space.

Square Meter Area for Circulation (cell K7) is obtained by multiplying the percentage for circulation with the total developable area of the site.

Square Meter Area for Parking Areas (cell K8) is obtained by multiplying the percentage for parking areas with the total developable area of the site.

Square Meter Area for Passive Open Space (cell K9) is obtained by multiplying the percentage for passive open space with the total developable area of the site.

Square Meter Area for Active Open Space (cell K10) is obtained by multiplying the percentage for active open space with the total developable area of the site.

Total Area in Square Meters of Non-Marketable Area (cell K11) is obtained by adding the areas for circulation, parking space, passive open space and active open space.

Square Meter Total of Non-residential Land (Gross Area) (cell C12) is obtained by adding the total net square meter area for non-residential use with a proportional area for non-marketable are based on the overall percentage of non-marketable area in cell J11.
Total Square Meters of Residential Land (Gross Area) (cell G12) is obtained by subtracting the total non-residential area from the total developable area of the site.

Total Square Meters of Residential Stands (Net Area) (cell K12) is obtained by subtracting a proportional amount of non-marketable area from the total residential area based on the percentage figure in cell J11.

Land and Infrastructure Characteristics

Inputs

Basic Price of Land (cell F15) is equal to the total cost paid for the land divided by the total area of the site.

Basic Development Costs for Site Preparation, On-site Infrastructure, Off-site Infrastructure and Other Costs (cells G15, H15, I15 and J15) are entered for the developable area of the site.

% Adjustments in Basic Prices for Contingencies and Escalation (cells F16, G16, H16, I16 and J16) are entered into the model based on experience. Different percentages can be entered to test a range of real-life possibilities. There are no problems with the calculations if these cells are left blank.

% Adjustments in Prices for Fees and Supervision (cells F17, G17, H17, I17 and J17) are usually based on standard practices and relatively easy to determine. There are no problems with the calculations if these cells are left blank.

% Adjustment in Prices for Financing Costs (cells F18, G18, H18, I18 and J18) can be determined from experience or from assumptions about the financing of the project. There are no problems with the calculations if these cells are left blank.

Outputs

Complete Cost for Land, Site Preparation, Off and On-site Infrastructure and Other Costs by Square Meter of Total Developable Area (cells F19, G19, H19, I19 and J19) are obtained by multiplying the base costs and the percentage adjustments for contingencies, fees and supervision and financing.

Total Developed Land Cost per Square Meter of Total Developable Area (cell F20) is obtained by adding together the complete costs for land, site preparation, off and on-site infrastructure and other costs.

Total Develop Land Cost per Square Meter of Marketable Area (cell K20) is obtained by multiplying the total developed land cost by total developable area of the site and dividing the result by the marketable area of the site.

Stand Sizes and Housing Unit Construction

Inputs

Percentages of Stands by Type (cells D23 to K23) are determined by the user and entered into the program for each type of stand to be included in the project. It is not necessary to use all eight types.

Size of Stands in Square Meters (cells D24 to K24) are entered for each type of stand based on existing standards or decisions by the user.

Numbers of Housing Units per Stand (cells D26 to K26) are entered by the user. One or more units must be entered into these cells.

Average Number of Persons per Household (cell F28) is entered by the user based on population data and/or experience. The user may also enter the average number of persons per stand in order to obtain a more accurate estimate of density. Usually, however, new developments will begin with only one household per stand or unit.

Square Meter Areas of Construction per Unit for Each Stand Type (cells D29 to K29) are entered by the user. These cells can be left blank if no construction is involved.

Construction Costs Per Square Meter (cells D30 to K30) are entered for each type of stand. In many cases, these costs will be much the same.

% Adjustment for Fees and Contingencies (cells D31 to K31) are entered into the model by stand typed based on experience. Different percentages can be entered to test a range of real-life possibilities. There are no problems with the calculations of the model if cells are left blank.

% Adjustment in Prices for Financing Costs (cells D32 to K32) can be determined from experience or from assumptions about the financing of the project. There are no problems with the calculations of the model if cells are left blank.

Connection Costs for Utilities (cells D33 to K33) are the total amounts that a household must pay to connect to utilities (eg. water supply, electricity etc.). These cells can also be used to enter other lump sum costs that households must pay that are not dependent on the area of marketable land.

% of Developed Land Cost Charged per Unit (cells D35 to K35) are determined by the user. In the case of only one house per plot and no subsidies attached to the land this figure would be 100%. In the case of cross-subsidies, the user can enter an amount that exceeds 100% for the stands sold at market prices.

Sales Price or % Profit (cells D38 to K38) can be entered as a % less than 50% or an amount that exceeds 50. The model will do the calculations differently based on this criteria.

Outputs

Total Percentage of Stands (cell C29) is the sum of the percentages for each of the types of stand. This number should always be 100.

Total Number of Stands and by Type (cells C31 and D31 to K31) are found by first multiplying the percentage per type of stand by the size in square meters and adding all the results to obtain the average sized stand, then dividing the total net residential area in square meters by the average sized stand in order to obtain the total number of stands and finally multiplying the total number of stands by the percentage for each type to obtain the number of stands by type.

Total Number of Units by Type of Stand (cells D25 to K25) are calculated by multiplying the number of stands by the number of units per stand for each type of stand.

Number of Stands per Hectare (cell K45) is found by dividing the total developable area of the site by the total number of stands.

Density in Terms of Persons Per Hectare (cell I28) is obtained by multiplying the number of stands per hectare by the average household size.

Total Population (cell K28) is obtained by multiplying the per hectare density by the total number of hectares of developable area of site.

Housing Unit Costs (cells D34 to K34) are obtained by adding the construction cost (i.e. cost per square meter times the number of square meters in the unit plus the adjustments for fees, contingencies and financing) to the cost of connections.

Developed Land Costs per Unit (cells D36 to K36) are obtained by multiplying the developed square meter cost of land by the area of the stand in order to obtain the full developed land cost per stand and then multiplying this amount by the percentage of the cost to be recovered per unit.

Total Costs per Unit (cells D37 to K37) are obtained by adding together the housing unit costs and developed land cost per unit for each type of stand.

Calculated Percentages of Profit (cells D39 to K39) are obtained when the user enters a desired sales price into cells D38 to K38. The total costs per unit are subtracted from the sales price in order to obtain the amounts of profit which are then divided by the total cost per unit in order to obtain the percentage of profit per type of stand. The percentage of profit can be negative for those types of stands which are sold at prices below cost and are subsidized by the sales of other stands.

Sales Prices per Unit (cells D40 to K40) are obtained by multiplying the anticipated profit in cells D38 to K38 by the total costs of the unit. The user can manipulate and test various sales prices for different beneficiary groups in order to develop a project which has an attractive marketing mix of stands.

Sales Prices per Square Meter of Construction (cells D41 to K41) are determined by dividing the sales prices by the square meters of construction for each type of stands.

Project Costs and Revenues

Inputs

% of Project Expenditures in Years 1,2,3 and 4 (cells J44 to J47) are estimated by the user based on previous project experience and expectations

% of Project Revenues in Years 1,2,3 and 4 (cells K44 to K47) are estimated by the user based on previous project experience and expectations

Outputs

Total Land Cost and Percentage of Total Project Cost (cells C43 and D43) is calculated by multiplying the total area of the site by the complete land cost. The result is then divided by the total project cost and multiplied by 100 to obtain the percentage figure.

Total Infrastructure Cost and Percentage of Total Project Cost (cell C44) is calculated by multiplying the total developalbe area of the site by the sum of the complete costs for site preparation, off and on-site infrastructure and other costs. The resulting total is then divided the by the total project cost and multiplied by 100 to obtain the percentage figure.

Total Construction Cost and Percentage of Total Project Cost (cell C45) is calculated by multiplying the housing unit cost per type of stand by the number of units in each type and then adding the total cost of facility construction. The resulting total is divided by the total project cost and multiplied by 100 in order to obtain the percentage figure.

Total Housing Construction Cost (cell B46) is obtained by multiplying the total housing construction cost per each type of stand by the total number of housing units in each stand and then adding up all the results.

Total Facilities Construction Cost (cell B47) is obtained by multiplying the building costs per net square meter of stand with the size of the stands for all of the shopping center activities which have building construction.

Total Project Cost and Percentage Check (cells C48 and D48) is obtained by adding together the total land, infrastructure and construction costs for the project. The percentage in cell D48 should be 100.

Total Housing Unit Revenues and Percentage of Total Revenues (cells G43 and H43) are obtained by multiplying the sales price for each type of stand by the number of housing units in that stand and then adding the results together. The result is then divided by the total project revenues and multiplied by 100 to obtain a percentage figure.

Total Facilities Revenues and Percentage of Total Revenues (cells G44 and H44) are obtained by multiplying the net square meter area for commercial or shopping areas by the sales price per square meter.The result is then divided by the total project revenues and multiplied by 100 to obtain a percentage figure.

Total Project Revenue and Percentage Check (cells G45 and H45) is obtained by adding togher the total revenue from the sale of stands or housing units and the revenue obtained from facilities. The percentage figure should be 100.

Total Developer Profit and Percentage (cells G48 and H48) is obtained by subtracting the total cost of the project from the total revenue. The result is then divided by the total cost of the project and multiplied by 100 to obtain a percentage figure. The potential total amount of profit in a project will be one of the deciding factors for a private sector developer to go ahead with a project. It is possible however, that both the total amount and the percentage will be negative. For local authorities, this could indicate the level of subsidy required to do the project.

Internal Rate of Return (cell K48) will be calculated automatically by the computer based on the simple cash flow introduced by the user and the standard calculation for the internal rate or return.

Affordability

Inputs

Down payments (cells D50 to K50) can be entered either as a percentage or a lump sum, the model will calculate the results differently. If the amount entered is greater than 75 it will be considered as a lump sum payment and not a percentage. These will be determined by the user based on local knowledge and experience or according to the requirements of different types of loans.

Yearly Interest Rates (cells D51 to K51) are determined by the financial institutions and can differ by income group.

Repayment Periods (cells D52 to K52) are essentially outlined within the housing programs of building societies and other financial institutions making loans for housing. Many beneficiaries take loans for less than the maximum permissible repayment period.

Monthly Rates (cells D54 to K54) are based on the value of a property and are mainly charged to low and medium density areas. They could apply to certain areas of a high density layout with larger sized stands for moderate income families. These cells can also be used to introduce other monthly costs into the model, such as additional transportation costs, which would result from the remoteness of certain sites and be an added cost to beneficiaries as a result of their housing.

Supplementary Charges (cells D55 to K55) are flat monthly charges which are generally applied to high density areas. They are paid on a monthly basis.

Ratio of Housing Payments to Monthly Income (cells D57 to K57) is the percentage of monthly income that households can and are willing to make for housing. The ratio that is used in affordability analysis is normally around 25%.

Target Group Monthly Incomes (cells D59 to K59) are the monthly incomes of the intended target groups for which the project was designed. They can be compared to the required incomes based on the standards and costs of the project.

Outputs

Monthly Loan Payments (cells D53 to K53) are determined for each type of stand based on standard mortgage calculations that take into account the downpayment, interest rate of the loan and length of repayment period.

Total Monthly Payments (cells D56 to K56) are calculated by adding the monthly loan payment to the monthly rates and supplementary charges.

Required Monthly Incomes (cells D58 to K58) are determined for each type of stand by dividing the total monthly payment by the percentage ratio of housing payments to monthly incomes.

Annex II
Case Studies

A workshop on layout design for high density residential development was held on November 25 - 29, 1996 in Harare. The programme for the workshop followed the process outlined in this manual. Workshop participants were divided into six teams that carried out assignments relating to two different sites, Kuwadzana IV and Glaudina. The outputs from workshop activities are summarised in this annex.

II.1 Visual Preference Survey

The first activity of the workshop was a Visual Preference Survey[tm]. Participants were shown fifteen slides of scenes from high density neighbourhoods in Harare and asked to give their impressions in a scale of +10 to -10. A summary of the scores of the six groups is given in Figure II.1. As can be noted, there was considerable variation in the scores given to the photos attached at the end of this Annex.

Five of the photos receive an average score of over 30 points. The main reasons for the higher scores was that houses and streets shown were clean and maintained. Photos #9 and #10 which had the highest scores are of individual houses with well maintained lawns and gardens. The lowest average score (-23) was for a photo #8 of a street with a pile of garbage. Photos 6, 14 and 15 are of informal commercial activities. It is interesting to note that commerce from road sides received negative scores while a corner shop (not legally approved) received an average score of 23.

Figure II.1
Scores of Visual Preference Survey

Photo #	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Average
1	4	16	15	13	18	7	12.3
2	-13	-8	6	8	-7	-9	-3.5
3	-2	6	1	11	8	-15	2.0
4	22	29	21	19	24	35	25.7
5	34	33	26	26	27	36	31.2
6	-7	-15	-8	-5	-14	2	-6.8
7	23	12	21	15	15	14	17.8
8	-45	-29	-21	-16	-24	-15	-23.7
9	43	41	37	32	38	36	39.3
10	42	38	33	30	22	36	35.2
11	37	31	21	32	25	42	33.2
12	46	22	29	31	30	30	33.3
13	32	20	25	19	9	36	25.7
14	-10	6	1	1	-5	-12	-0.8
15	5	24	24	31	5	36	23.3

II.2 Field Trip

Participants were taken on a field trip to visit Kuwadzana IV and Glaudina on Tuesday morning and asked to evaluate the sites. To help direct their observations, they were given the handout shown in Figure II.2. Photographs of the sites are shown in Figure II.3.

The Kuwadzana site is partially developed giving the opportunity for discussion on the advantages and disadvantages of features of the layout plan. The utilization of the 150m^2 stands was of particular interest. Participants were concerned that the design and placement of the units on small stands limited opportunities for expansion. The impact of building lines on the usable area of smaller stands was well illustrated. The layout and services to the site where also of interest. There was considerable discussion about the placement of sewer and water lines in the same trench. Participants were concerned about the safety of this cost-saving practice.

Since the Glaudina site is not developed the participants concentrate on the natural features of the site including the topography, soils, vegetation and surrounding environment. Participants walked over a large section of the site. They identifies black cotton soil in a drainage area, sections with groves of trees, flat areas and a prominent hill.

II.3 Site Analysis

Following the site visit, participants carried out site analysis of Kuwadzana IV and Glaudina. Each site was assigned to three teams. The process of sieve overlays used were:

Layer 1 : Off-Site Links
Layer 2 : Topographical Features
Layer 3 : Slope Analysis
Layer 4 : Soils Analysis
Layer 5 : Vegetation Analysis
Layer 6 : Infrastructure Analysis
Layer 7 : Development Suitability Composite

Examples of the results of the analysis on each site are given in Figures II.4 and II.5. Of particular interest was the soils analysis which identified areas of "black cotton" soil that will be expensive to develop as high density housing. Slopes in only one area of the Kuwadzana site were too steep for development. Off site infrastructure that will serve the sites was identified.

II.4 Programming

Participants were encouraged to prepare a program for a site before preparing a site plan. To help in preparing a programme, principles for efficient layout design should be considered. The main concepts are: maximising marketable land, designing efficient stand sizes and configuration, using differential land pricing within a project, and establishing appropriate standards for the target group.

Figure II.2
Hand Out for Field Trip

Kuwadzana IV

A partially developed site. Part of the group will be expected to prepare a new layout plan for this site. Since a layout plan is being implemented, you should look at the urban environment that is being created and decide what you think works and what doesn't work - what you like and what you do not like. Some points you may want to consider:

- *Topography.* What is the topography of the site? How well does the layout plan relate to the topography? Are there any indications of drainage problems or erosion?
- *Urban form.* What is the concept of the layout plan? Does it have a sense of neighborhood? How does the layout respond to social, market and ecological values. What do you think the area will look like in 50 years? Would you like to live there?
- *Roads.* What do you think of the circulation network? Are the roads too narrow or too wide? Do you see any traffic problems?
- *Community and shopping facilities.* What do you think of the placement of land for community facilities? What services would you locate in the neighborhood? Do you see any informal "corner shops"? Should they be planned?
- *Stands.* What do you think of the stand sizes - of the stand proportions? How are stands used? What improvements have residents made to their stands? Do they appear to meet needs of residents?
- *Houses.* What do you think of the houses? Have any houses been expanded? Would you like to live in a house in Kuwadzana. What do you think of the flats?

Glaudina

This is an open site that has been planned but construction will not start until next year. Some of the group will prepare a layout plan for this site. Assume that you have been hired to design a layout plan and that this is your first visit to the site. These are some observations you might want to make:

- *Topography.* What is the topography of the site? Are there any steep slopes or flat areas? Are there any special topographical features that should be preserved in the layout?
- *Soils.* What types of soils are there in the site? Is there any expansive soil that may cause development problems? Where are the best locations for high density housing?
- *Vegetation.* What kind of vegetation is there on the site? Are there trees that should be saved as open space? Are there any unique habitats that should be preserved?
- *Access.* What roads are located around the site? What will be the best access points. How should the roads relate to the site topography?
- *Infrastructure.* Where are the trunk lines for water and sewer that will serve the site? Are there going to be long runs to connect? Are there sections of the site that will be difficult to sewer?
- *Surrounding environment.* Are there other factors about the surrounding environment that will impact the layout plan? How can the new development relate to that which is surrounding? Should it relate?

Figure II.3
Photographs of Kuwadzana and Glaudina Sites

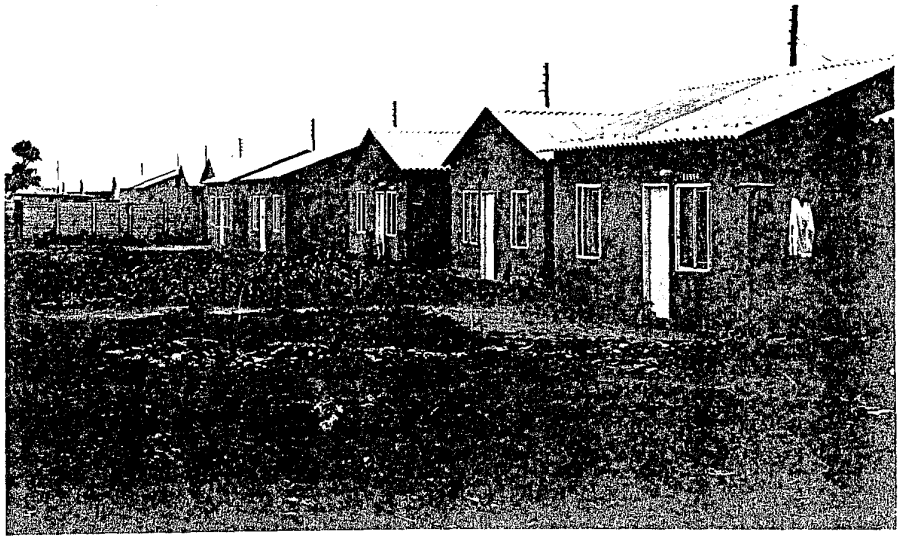


Figure II.4
Site Analysis - Kuwadzana IV

Topography:

1. Hill with rocky steep slopes is high point of the site
2. Most of site slopes gently to low points along water course the traverses site and to east of site

Soils:

1. Towards stream - black cotton soil - need for special foundations
2. As we move away from the stream we have clayey-loams requiring relatively deeper foundations
3. As we move further away we have sandy-loamy soils - good for high density

Vegetation:

1. Site is "devoid" of trees - sparsely distributed grasses

Infrastructure:

1. Trunk sewer to the east of the site
2. Sewer ponds - south of the site
3. Water reservoir - with in site
4. Bulawayo-Harare road - to the north of the site, Heany road - to the south
5. 132kv power line - to the east of the site, ZESA substation - to the north east

Location:

1. Site is within reach of existing Kuwadzana - interaction between the two communities
2. Site is at the far edge of city thus having economic implications - especially transport to and from work, shopping trips to city centre

Figure II.5
Site Analysis - Glaudina

Slope:

* Generally its a gentle slope with portions of steep slopes
* A water courses cuts almost across the site
* 3 steep areas do not hinder development

Drainage:

* Land drains towards the water course (which dissects the site into two portions at the centre)

Soils:

* Two major soil types
  - Dark clay soils (plastic & organic soils)
  - Red Gravel soils
* Non-plastic Reddish-grey (i.e. a mixture between the above two)

Topography:

* Two major high points (i.e. north & south)
* North high point with watershed
* South high point with ant hills
* Between two high points is a low-lying area

Vegetation:

* Southern end is relatively covered with Masasa & Mzanje trees
* Other areas are sparsely covered with trees

Infrastructure:

* Main trunk sewer (off-site) to the east of the site
* Existing tank near Dzivarasekwa to be used
* Gazetted road running across the site to be developed as proposed
* Harare-Bulawayo road forms the boundary of the site to the south (to be major access point to site)

Computer models were introduced that will help to evaluate the costs and affordability of the proposed utilization of the site. Layout design decisions such as sizes of stands, width of reserves, and levels of infrastructure should be based on affordability to the target population. Computer tools for determining affordability taught to the participants were:

- Layout Programming Worksheet: A spreadsheet to record information on utilization of the site. The Worksheet permits evaluation of layout plans to see if the priorities of the progamme have been met.

- Layout Costing Model: By imputing data from the Programming Worksheet and unit cost data, the Model gives information on the efficiency of the layout and costs of development.

- Affordability Model: With information from the Worksheet and Layout Costing Model the planner can determine the affordability of the proposed programme to low-income households.

Thus the objectives and parametres of a layout plan can be determined before actually drawing the plan. The objective of the training was to show participants that they could make many of the design decisions without making the time commitment to draw a plan - that this is, in fact, the most efficient process of layout design.

Participants worked on computers to familiarise themselves with the Models and to prepare a programme for a layout plan of Kuwadzana and Glaudina. Figures II.6 and II.7 are examples of the output of the Affordability model by two of the groups. The breakdown of stand types followed the recommendations of DPP with 40 percent 150 m^2, 40 percent 200 m^2, and 20 percent 300 m^2. It can be noted that the income required to purchase a stand and house is affordable by the target group (lines 58 and 59) with the developer making a small profit (cell H48). The Programme developed through this process was then used to develop concept plans.

II.5 Layout Concept Plans

While the time was too short to carry out the full concept design process, the teams were asked to prepare a overall concept plan for the site and a more detailed plan for a first phase of development. In order to have different alternatives, the teams for each site were assigned to do their plans with an emphasis on creating social, market or ecological value. The steps for developing concept layout plans presented to the participants are:

- Step 1: Assemble Project Information. Data from the site analysis, off-site conditions and infrastructure, zoning regulations, market analysis and layout programme should be assimilated into concept plans.

- Step 2: Prepare a Site Character Analysis Plan. The site should be divided into homogeneous zone with a description of each zone. An example of a Site Character Analysis Plan for Kuwadzana IV is shown in Figure II.8.

Figure II.6
Affordability Analysis for Kuwadzana IV

	A	B	C	D	E	F	G	H	I	J	K
1	AFFORDABILITY		Developer:		Fastcash		Project:	Kuwadzana 4		Date:	11/27/96
2	LAND USE CHARACTERISTICS										
3	Site area (ha)		288.45	Non-developable area (m2)			80000	Developable area(m2)			2804500
4	Cmty.	Net area	Sales	Shopping	Net area	Building	Sales	Net residential area in m2			
5	facilities	in m2	price/m2	facilities	in m2	Cost/m2	price/m2	from program or measured from plans			
6	Prim. Sch.	400000		Shops	20450		200.0	Non-marketable land	%		m2
7	Sec. Sch.	270000		Market	1000		150.0	Circulation areas		22.41	628488
8	Health	6000		Beer Gardn.	3000		250.0	Parking areas			0
9	Religious	10000		Service Ind.				Passive o.s.		1.00	28045
10	Creche	1000		Other				Active o.s.		5.00	140225
11	Total	687000	0.0	Total	24450	0	204.1	Total		28.41	796758
12	M2 Non-resid.land		993784	M2 total residential land			1810716	M2 net residential land			1296292
13	LAND AND INFRASTRUCTURE COSTS					Land	Site	On-site	Off-site	Other	
14						price	prep.	infrastr.	infrastr.	costs	
15	Basic development costs					20	3	17.41			
16	Contingencies and escalation		(%)			15					
17	Fees and supervision		(%)			5					
18	Financing costs		(%)			25					
19	Complete item cost/gross m2 of site					30.19	3.00	17.41	0.00	0.00	
20	Total developed land cost/gross m2 of site					50.60	Developed land cost/net m2 of site				107.44
21	PLOT SIZES AND HOUSING UNIT CONSTRUCTION										
22	Housing unit type		Total	Type #1	Type #2	Type #3	Type #4	Type #5	Type#6	Type#7	Type#8
23	% of total stands/type		100.00	40.00	40.00	20.00					
24	Stand size in m2			150.00	200.00	300.00					
25	Nb.of stands/type		6481	2593	2593	1296	0	0	0	0	0
26	Nb.housing units/stand			1	1	1					
27	Nb.units/type		6481	2593	2593	1296	0	0	0	0	0
28	Nb. stands/ha.		36	Persons /Household		7	Density (per/ha)		251	Pop.	45370
29	M2 building area			14.50	30.00	36.00					
30	Construction cost/m2			1000.00	1000.00	1000.00					
31	Contingencies		(%)	10	10	10					
32	Financing costs		(%)	7	7	7					
33	Connection Costs			600	600	600					
34	House Costs			17667	35910	42972	0	0	0	0	0
35	% developed land cost/unit			70	80	110					
36	Developed land cost/unit			11281	17190	35455	0	0	0	0	0
37	Total cost/unit			28948	53100	78427	0	0	0	0	0
38	Sales price or % profit			10	10	10					
39	Calculated % profit			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	Sales price/unit			31842	58410	86270	0	0	0	0	0
41	Sales price/m2 built			2196	1947	2396	0	0	0	0	0
42	PROJECT COSTS		X1000 Z$	%	REVENUES		X1000 Z$	%	RATE OF RETURN		
43	Land		87076	25.57	Housing units		345819	98.58	Year	% Exp.	% Rev.
44	Infrastructure		58873	17.29	Facilities		4990	1.42	1	25	10
45	Construction		194606	57.14	Total project		350809	100.00	2	45	25
46	Housing	194606							3	20	30
47	Facilities	0							4	10	35
48	Total project		340554	100.00	Developer profit		10255	3.01		% IRR	4.05
49	AFFORDABILITY			Type #1	Type#2	Type#3	Type#4	Type#5	Type#6	Type#7	Type#8
50	Downpayment			10	13	15					
51	Yearly interest rate			14.00	14.00	18.50					
52	Repayment period			25	25	25					
53	Monthly loan payment			345	615	1142	0	0	0	0	0
54	Monthly rate										
55	Supplementary charges			48	48	48					
56	Total monthly payment			393	663	1190	0	0	0	0	0
57	Ratio to monthly income			28	28	28					
58	Required monthly income			1254	2237	4153	0	0	0	0	0
59	Target group monthly income			1200	2000	5000					

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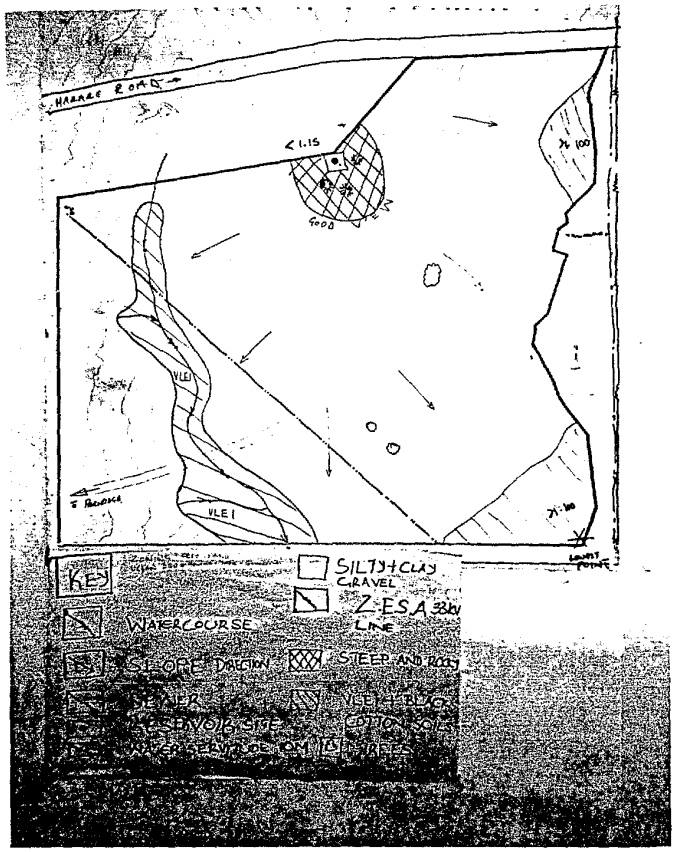
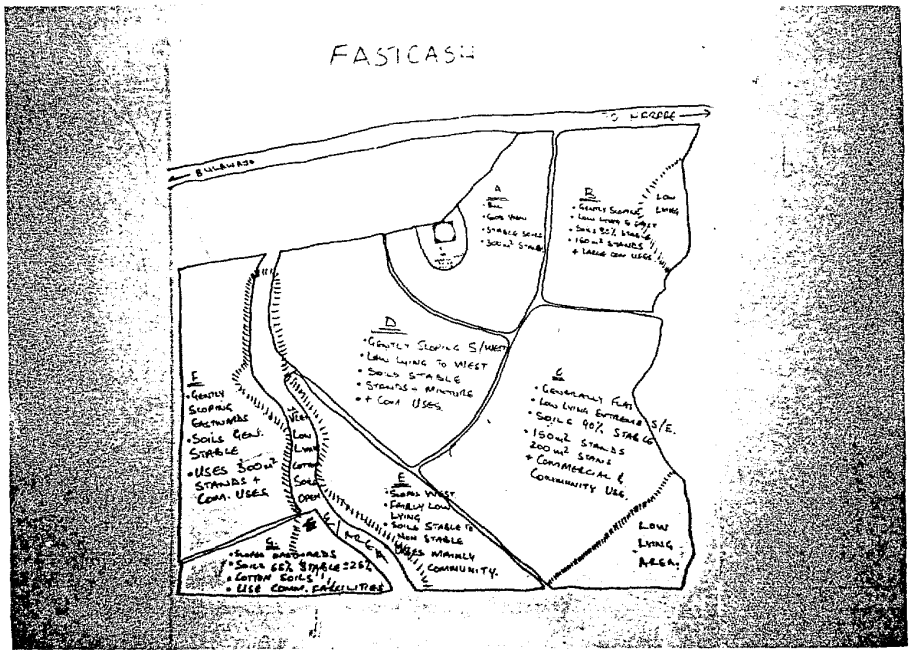
Figure II.7
Affordability Analysis for Glaudina

	A	B	C	D	E	F	G	H	I	J	K
1	AFFORDABILITY		Developer:		Harare		Project:	Glaudina		Date:	11/27/96
2	LAND USE CHARACTERISTICS										
3	Site area (ha)		260.95	Non-developable area (m2)			7500	Developable area(m2)			2602000
4	Cmty.	Net area	Sales	Shopping	Net area	Building	Sales	Net residential area in m2			
5	facilities	in m2	price/m2	facilities	in m2	Cost/m2	price/m2	from program or measured from plans			
6	Prim. Sch.	150000		Shops	20000			Non-marketable land	%		m2
7	Sec. Sch.	90000		Market				Circulation areas		20.00	520400
8	Health			Beer Gardn.	1400			Parking areas		0.20	5204
9	Religious	6000		Service Ind.				Passive o.s.		2.50	65050
10	Creche			Other				Active o.s.		2.50	65050
11	Total	246000	0.0	Total	21400	0	0.0	Total		25.20	655704
12	M2 Non-resid.land		357487	M2 total residential land			2244513	M2 net residential land			1678896
13	LAND AND INFRASTRUCTURE COSTS					Land	Site	On-site	Off-site	Other	
14						price	prep.	infrastr.	infrastr.	costs	
15	Basic development costs					20	1	18			
16	Contingencies and escalation		(%)			5	5	15			
17	Fees and supervision		(%)			5		7			
18	Financing costs		(%)					11			
19	Complete item cost/gross m2 of site					22.05	1.05	24.59	0.00	0.00	
20	Total developed land cost/gross m2 of site					47.69	Developed land cost/net m2 of site				72.97
21	PLOT SIZES AND HOUSING UNIT CONSTRUCTION										
22	Housing unit type		Total	Type #1	Type #2	Type #3	Type #4	Type #5	Type#6	Type#7	Type#8
23	% of total stands/type		100.00	40.00	40.00	20.00					
24	Stand size in m2			150.00	200.00	300.00					
25	Nb.of stands/type		8394	3358	3358	1679	0	0	0	0	0
26	Nb.housing units/stand			1	1	1					
27	Nb.units/type		8394	3358	3358	1679	0	0	0	0	0
28	Nb. stands/ha.		37	Persons /Household		7	Density (per/ha)		262	Pop.	58761
29	M2 building area			14.50	14.50	50.00					
30	Construction cost/m2			300.00	450.00	1100.00					
31	Contingencies		(%)	10	10	10					
32	Financing costs		(%)	7	7	7					
33	Connection Costs			2000	2000	2000					
34	House Costs			7120	9680	66735	0	0	0	0	0
35	% developed land cost/unit			100	100	100					
36	Developed land cost/unit			10946	14595	21892	0	0	0	0	0
37	Total cost/unit			18066	24275	88627	0	0	0	0	0
38	Sales price or % profit			15	15	15					
39	Calculated % profit			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	Sales price/unit			20776	27916	101921	0	0	0	0	0
41	Sales price/m2 built			1433	1925	2038	0	0	0	0	0
42	PROJECT COSTS		X1000 Z$	%	REVENUES		X1000 Z$	%	RATE OF RETURN		
43	Land		57539	19.65	Housing units		334612	100.00	Year	% Exp.	% Rev.
44	Infrastructure		66896	22.84	Facilities		0	0.00	1	25	10
45	Construction		168452	57.51	Total project		334612	100.00	2	45	25
46	Housing	168452							3	20	30
47	Facilities	0							4	10	35
48	Total project		292887	100.00	Developer profit		41726	14.25		% IRR	19.98
49	AFFORDABILITY			Type #1	Type#2	Type#3	Type#4	Type#5	Type#6	Type#7	Type#8
50	Downpayment			5	5	10					
51	Yearly interest rate			19.00	19.00	19.00					
52	Repayment period			25	25	25					
53	Monthly loan payment			315	424	1466	0	0	0	0	0
54	Monthly rate			120	120	120					
55	Supplementary charges			48	48	48					
56	Total monthly payment			483	592	1634	0	0	0	0	0
57	Ratio to monthly income			28	28	28					
58	Required monthly income			1147	1541	5329	0	0	0	0	0
59	Target group monthly income			1200	2000	5000					

Figure II.8
Site Character Analysis Plan for Kuwadzana IV





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- Step 3: Develop Community and Neighbourhood Modules. General concept plans for the site were developed showing the organization of the community, location of major community facilities and relationship of neighbourhoods within the site.

- Step 4: Design a Schematic Road Network. The location of roads and connection to the main Harare-Bulawayo road were determined. There was an approved road alignment within the Glaudina site that dictated part of the network for that site.

- Step 5: Determine Schematic Land Use. Plans located community, commercial and public facilities at the centre of the community and smaller neighbourhood centres at appropriate locations.

- Step 6: Develop Block and Stand Modules. Different modules of blocks were investigated to determine efficient layouts that could be used in residential sections of the site.

- Step 7: Evaluating Concept Plan Alternatives. Once an alternative has been develop, the efficiency and affordability of layouts should be evaluated. Due to lack of time all of the groups were not able to evaluate their designs using the computer models. Those doing so found that their designs had followed the programme and were still affordable.

Each group presented their concept plan and more detailed layout of residential areas on a contour model of the site as shown in Figures II.9 to II.14. The contour models were a very effective presentation technique that clearly shows the relationship of the layout to the site. The implications on infrastructure could be easily assessed. The engineer trainer was able to show participants were the design worked well and where there would be problems with storm drainage or sewers.

The participants did an excellent job in preparing their concept plans that reflected the emphasis they were assigned. A number of issues were identified from the models.

- Generally open space was located in lower areas with poor soil and possible drainage problems.

- Some streets were not properly related to the topography of the site making servicing of these areas of the site more difficult and expensive. Culs-de-sac and loop streets should be open at the lower end of the street or have reserves for drainage.

- Further review of public facilities is needed since there were considerable discrepancies in the amount of proposed space in the concept plans. Since it is important to maximise marketable land, the space for public facilities and open space should be carefully planned to keep these uses to the minimum area actually needed.

- School sites were not always located adjacent to open space. This is advisable where possible to allow multiple use of active open space.

- The use of modules is an efficient method for designing layouts for residential areas. It was observed that there was generally more discussion and input among members of groups that used modules than in those groups were layouts was drawn in the traditional manner.

Participants did an excellent job in assimilating a large amount of information into their concept plans in a limited amount of time. It is hoped that they will be able to use the tools they have learned in their work and to share them with their colleagues.

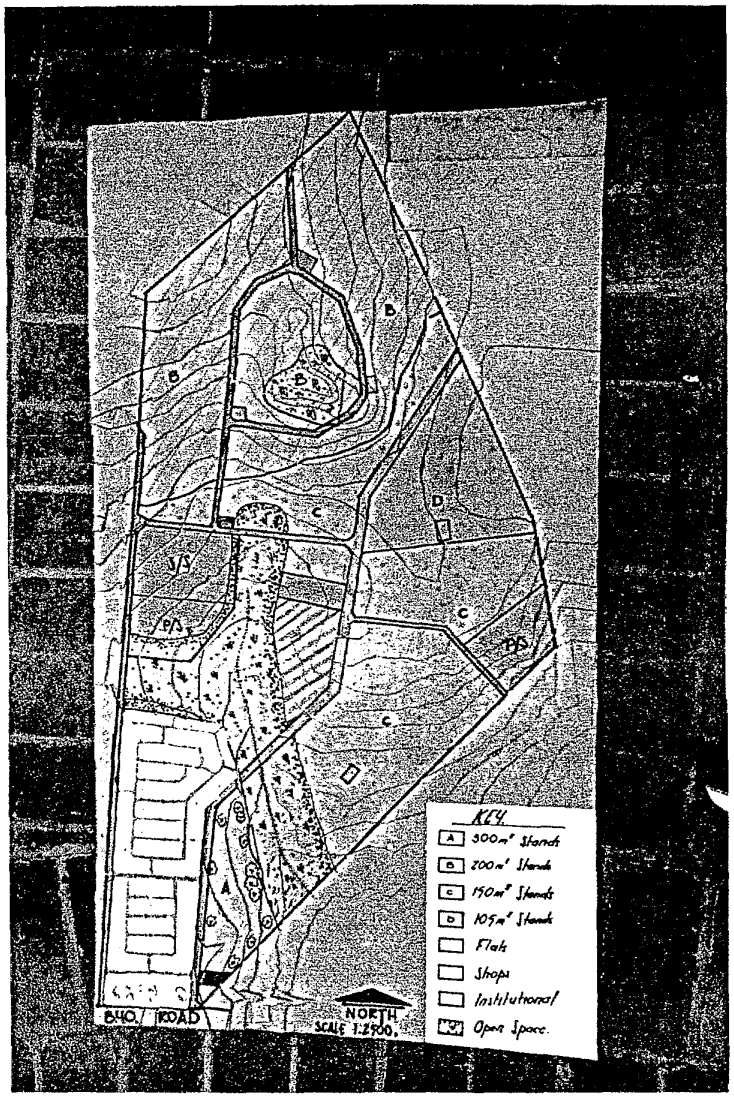

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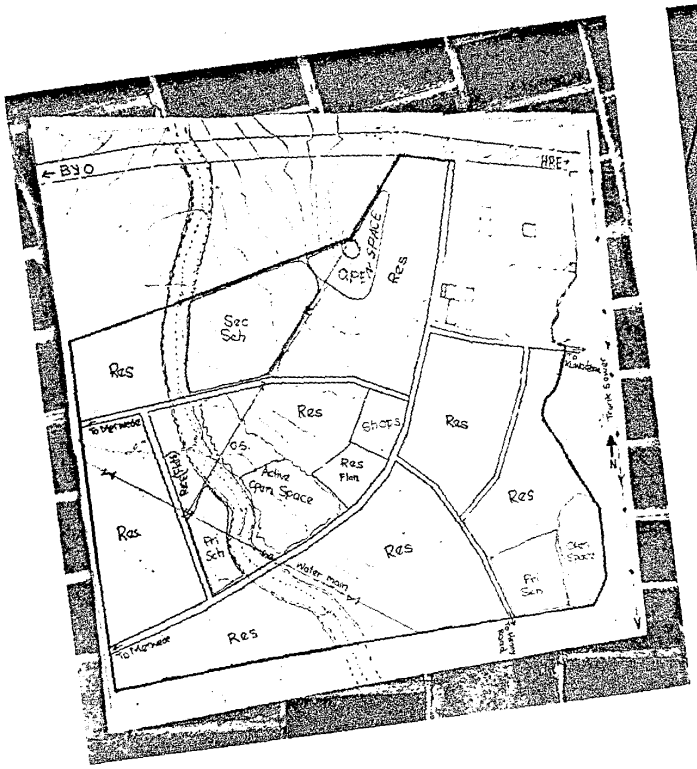
Figure II.9
Social Value Concept Plan for Kuwadzana IV



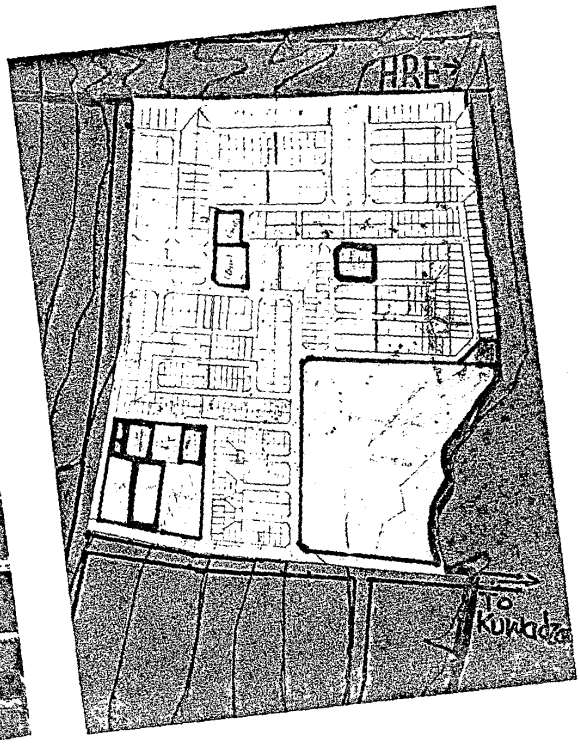


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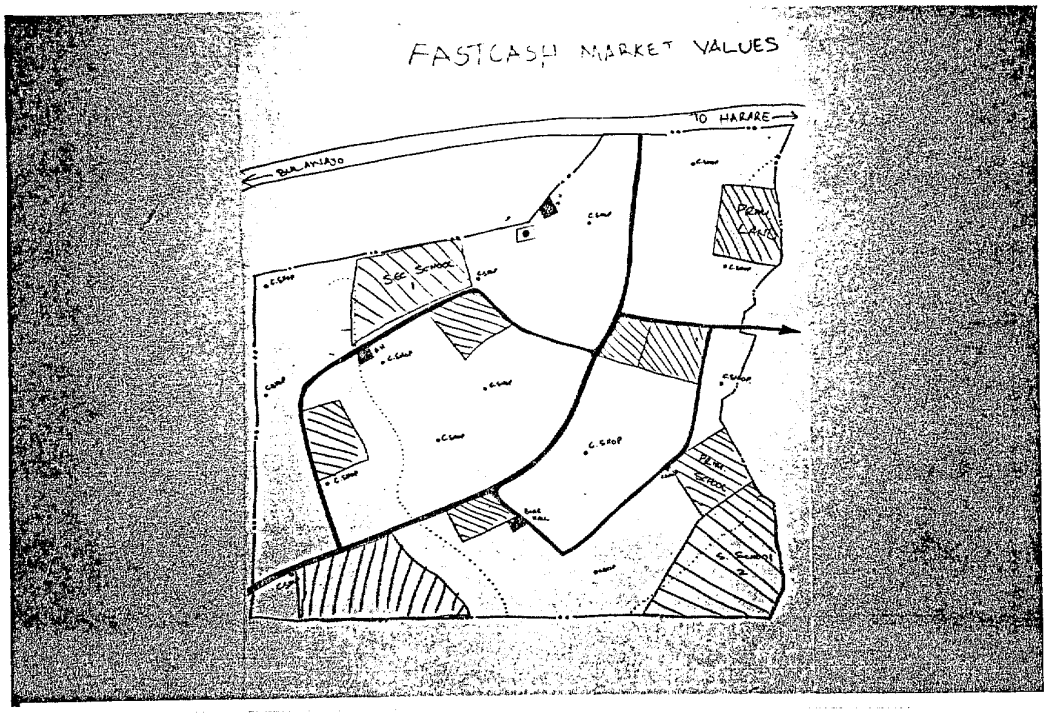
Figure II.10
Market Value Concept Plan for Kuwadzana IV



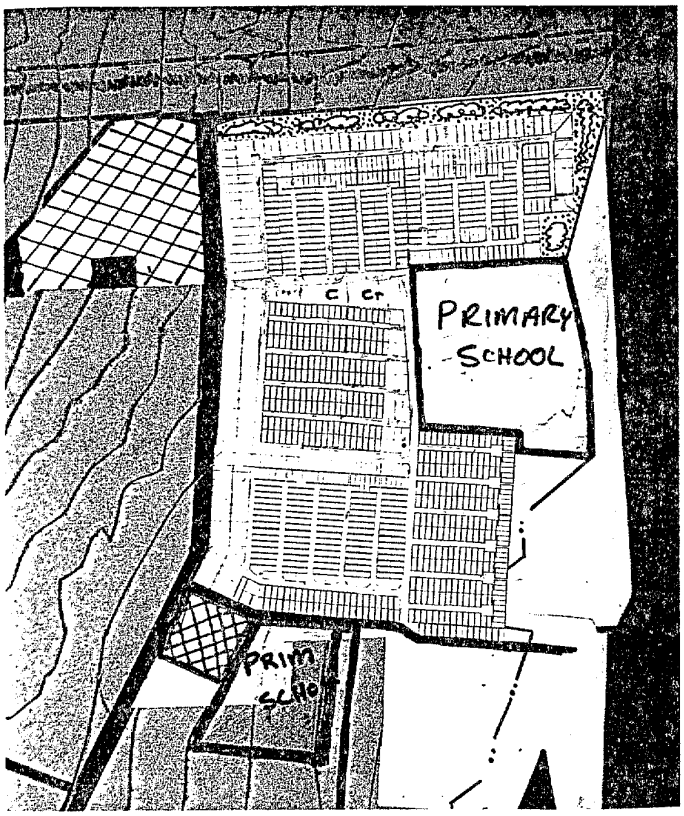


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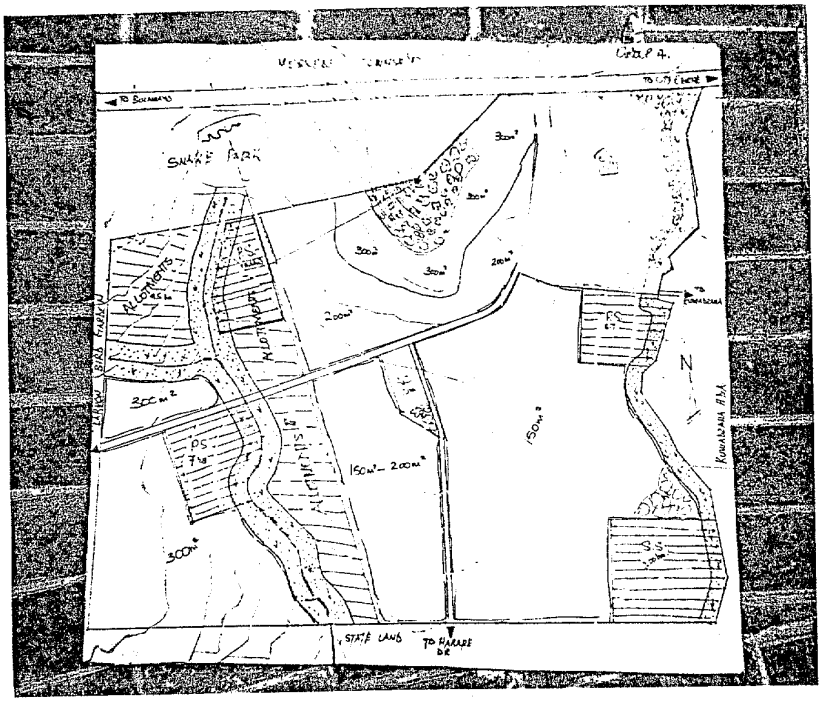
Figure II.11
Ecological Value Concept Plan for Kuwadzana IV



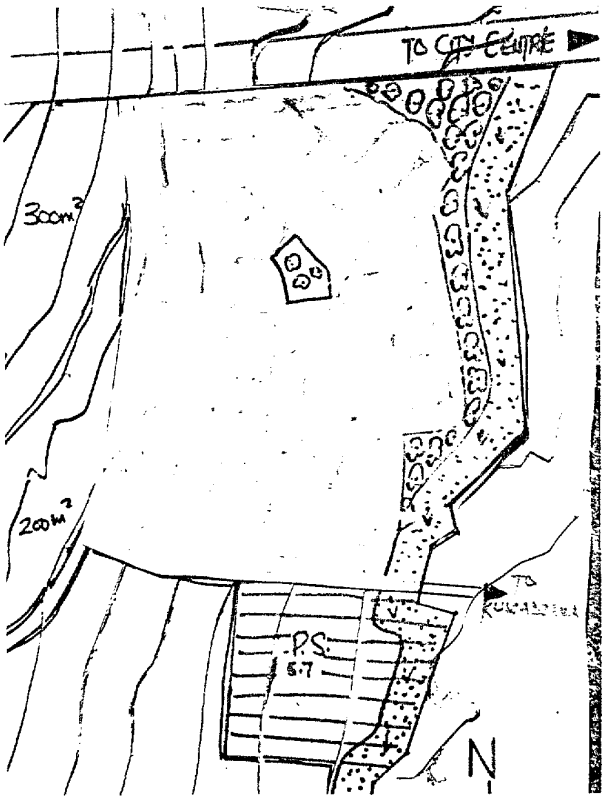


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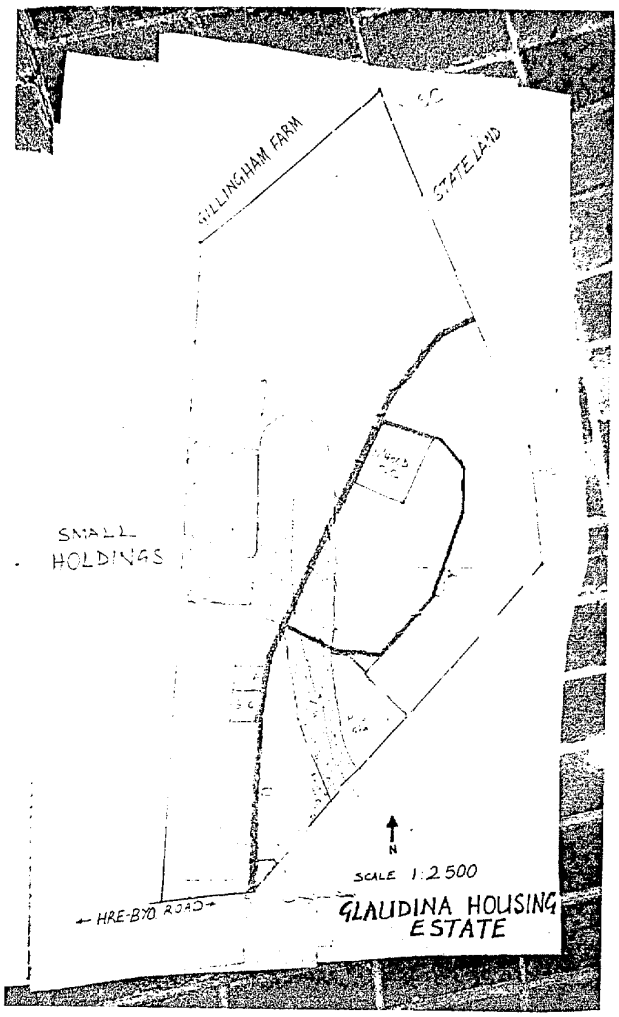
Figure II.12
Social Value Concept Plan for Glaudina



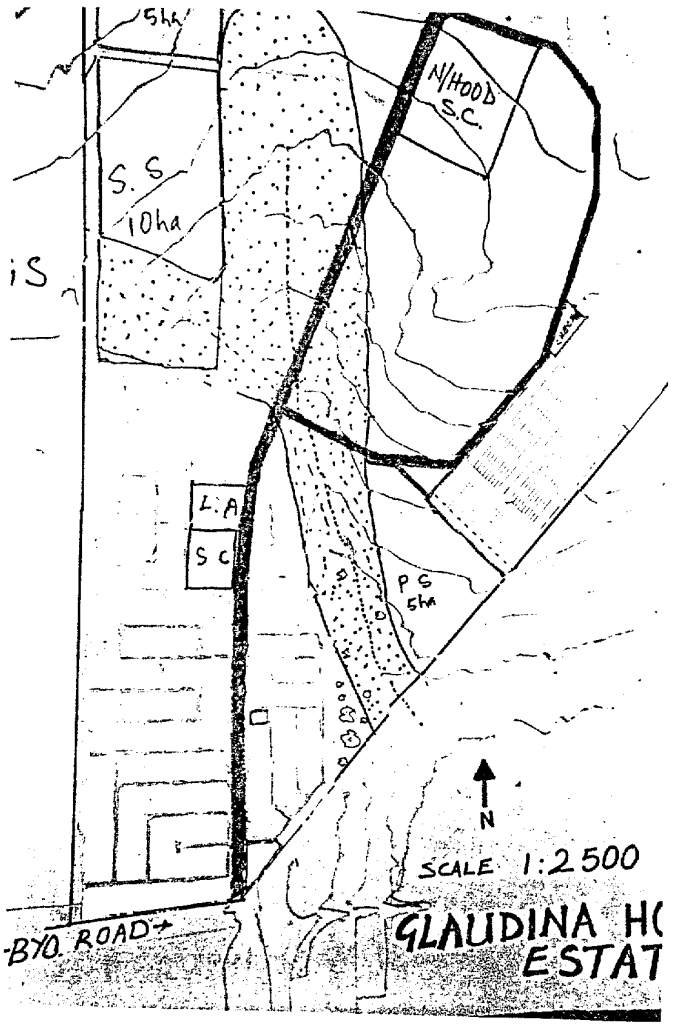


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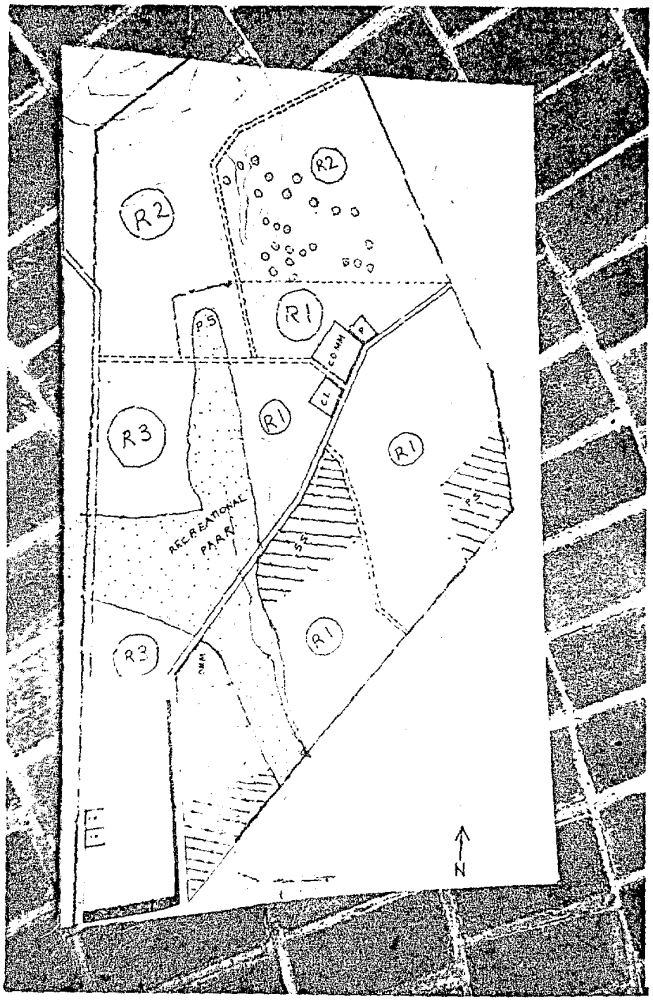
Figure II.13
Market Value Concept Plan for Glaudina



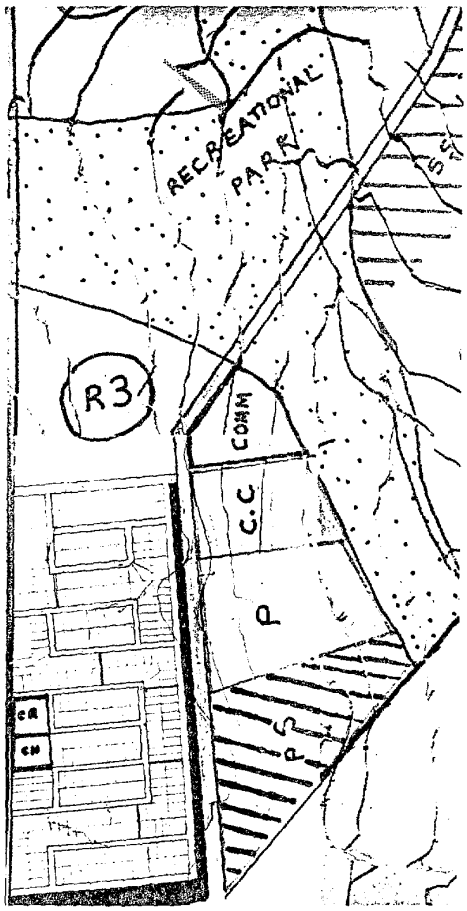
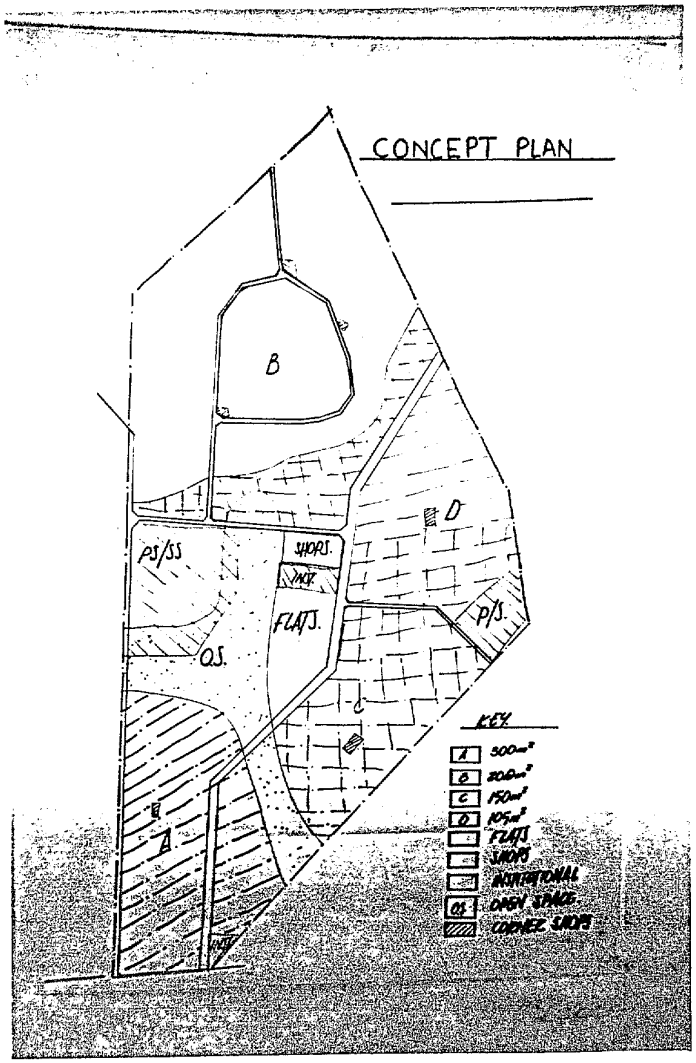
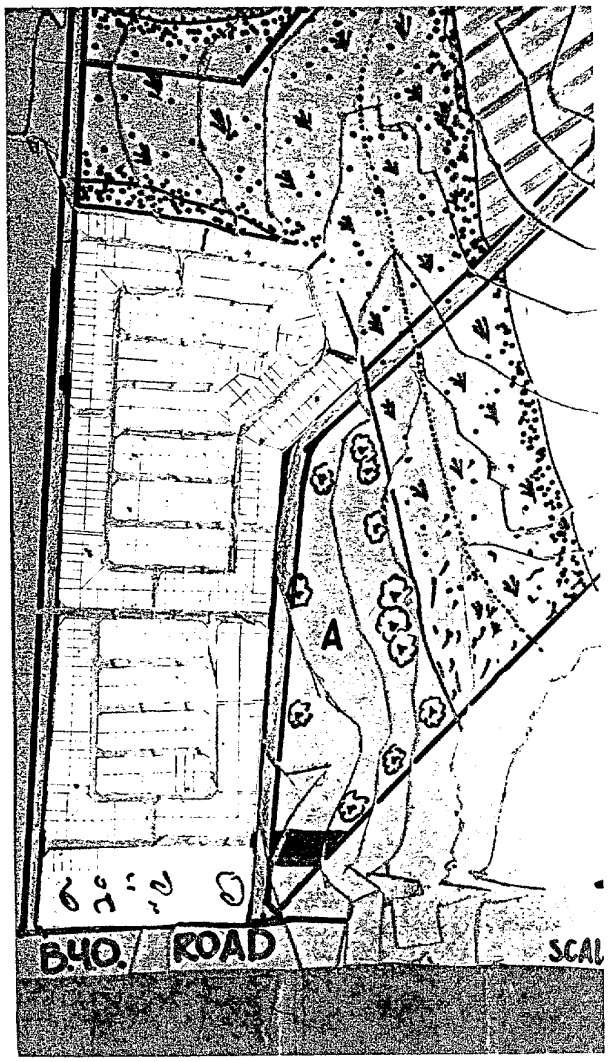


Figure II.14
Ecological Value Concept Plan for Glaudina





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Annex III

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Revised Minimum Building Standards for Medium and Low Cost Housing, Circular No. 3 of 1992

8 December 1992 Ref: 69/3

CIRCULAR NO. 3 OF 1992

TO: TOWN CLERKS
COUNCIL SECRETARIES
CHIEF EXECUTIVE OFFICERS

OF ALL LOCAL AUTHORITIES

REVISED MINIMUM BUILDING STANDARDS FOR MEDIUM AND LOW COST HOUSING

1.0 In an effort to reduce the costs of house construction and make housing more affordable, the current building standards have been revised. The following are therefore the new minimum building standards pertaining to planning, infrastructure and superstructure.

2.0 Planning

2.1 Stand Sizes

2.1.1 a) In designing residential plans, planners should aim at a mixture of stand sizes in each scheme, be cost conscious and ensure efficient layout design.

b) The minimum stand size has been reduced from 300 sqm with a frontage of 12,5m to 150 sqm with a minimum stand frontage of 8,5m for the development of detached houses. This reduction will result in a direct cost saving of over 29% per serviced plot, making the stands more affordable to a greater number of low income beneficiaries.

c) The stand sizes for high density detached housing schemes now range from 150sqm to 300sqm. As a guideline the stands should be mixed in the following proportions:

(i) 150 sq m - 40%
(ii) 200 sq m - 40%
(iii) 300 sq m - 20%

2.1.2 The minimum stand size for the development of semi-detached houses is 105 sqm with a stand frontage of 7m. The minimum building lines will be:

(a) 5m from the front boundary
(b) 3m from the back boundary
(c) 1m from the side boundary

The Ministry has adopted cluster houses (semi-detached) with a minimum of 4 rooms and a plinth area of 36 sqm per unit. With the cluster house arrangement, the estimated savings as compared to the cost of constructing a 4 roomed detached house with a minimum plinth area of 50 sqm is over 30 percent.

2.1.3 The stand sizes for medium density detached housing schemes now range from 300m^2 to 500 m^2 .

2.2 Within any given housing scheme, as much land as practicable should be used for residential development. To this end, not more than 5% of the site shall be used for active open space and not more than 30% of the site shall be used for community facilities.

3.0 Infrastructure

3.1 Roads, Water, Sewerage and Electricity

All housing estates in urban areas will continue to be serviced with running water, sewerage reticulation, electricity, access roads and stormwater drains. However, the following minimum standards will be required for roads and sewerage reticulation:

3.2 Roads

Sealing of roads should be maintained on bus routes and major connector roads. However where appropriate, use of insitu granitic materials for wearing course on low volume plot access roads should be encouraged. This will result in road cost savings of over 30 percent. Access roads servitude shall range between 8,5m and 10m wide as appropriate.

3.3 Sewerage Reticulation

a) A minimum of 100 mm diameter sewers with 0.3 metres depth of cover at the head of the sewer should be maintained. Sewer gradients of between 1:60 and 1:5 should be used for 100mm diameter. The estimated savings on existing sewer costs will be around 15 percent.

b) The number of properties to be served will depend on the requirement to attain self-cleansing velocities as specified by the design.

4.0 Superstructure

4.1 Building Lines

The following minimum building line requirements apply:

a) 5m from the front boundary
b) 3m from the back boundary
c) 1m from the side boundary

4.2 Minimum size of the house

4.2.1 Beneficiaries of aided self help schemes can now start with a minimum of a wet block and one room that is extendable. The minimum room size still remains $7m^2$ with a minimum width of 2.1m. Local authorities will constantly assess the progress to determine the seriousness of the beneficiaries.

4.2.2 Housing units that are offered ready for occupation, including shell houses, must have separate kitchens and toilets/showers.

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4.3 Building Materials

The following are the existing minimum standards for building materials:

4.3.1 Walls should be constructed of burnt clay bricks/blocks, cement bricks/blocks and stabilized soil bricks/blocks. In addition to the materials stated above, burnt farm bricks, or other approved material, and prefabricated panels of a design approved by the Ministry of Public Construction and National Housing can now be used for constructing single storey houses.

4.3.2 Floors should have grano finish; and

4.3.3 Roofs should be made of asbestos sheets, clay tiles, zinc where available, or other materials approved by the Ministry of Public Construction and National Housing.

4.3.4 The thickness of the external walls is to be a minimum of 115mm for burnt standard clay bricks, cement blocks, burnt farm bricks and stabilized soil bricks.

In all cases, structural requirements should always be taken into consideration.

4.4 Minimum Natural Lighting and Ventilation Requirements

4.4.1 The minimum natural lighting requirements for a house are outlined below.

a) A kitchen shall be provided with a window area which is not less than 12% of the area of the floor of the kitchen.

b) Any room used for dwelling shall be provided with a window area which is not less than 10% of the area of the floor of such a room of which 50% shall be capable of being open to the external air.

4.4.2 a) A window which opens from a room to a veranda or similar place shall be deemed open directly to the external air if such a room and veranda or similar place have adequate ventilation.

b) Where mechanical ventilation is provided for such a room to the satisfaction of the authority, it shall not be necessary for any of the window area of such room to be capable of being open to the external air.

5.0 This circular superceeds the following circulars:

- "Requests for Funds For Housing Construction: National Housing Fund Loans", dated 8th February, 1983;
- Circular letter No. 8 of 1983, on Aided Self Help; and
- Any other circulars and documents on minimum building standards from the Ministry of Public Construction and National Housing.

6.0 Local authorities are hereby requested to update their building bye-laws in line with the changes above. All applications for housing funds from Government should conform to the above minimum standards.

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