DEVELOPING A DATABASE SYSTEM FOR CADASTRAL LAYOUT OF PART OF BWARI AREA COUNCIL ABUJA.

BY

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DECEMBER 2004.

DECLARATION

I Sincerely declare that this Thesis "Developing a database system for cadastral layout of part of Bwari area council" is my own work and has not been submitted at any institution for whatsoever reason.

Ajibola I.I. — 04/11/05

Date

CERTIFICATION

This dissertation entitled "Developing a database system for cadastral layout of part of Bwari area Council" has been conducted by Ajibola Ismaila Isola and has been prepared according to regulations governing the preparation and presentation of projects in the Federal University of Technology, Minna Post Graduate School.

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DEDICATION

This Thesis is dedicated to Almighty Allah, my Late parents, Friends and well wishers.

ACKNOWLEDGEMENT

I give thanks to Almighty Allah for giving me this opportunity. My appreciation goes to my late parents for the legacy left behind. I shall not forget the efforts of my teachers, for their roles from grass-root to date cannot be ignored. I sincerely acknowledge the efforts of Surv. Alade Adesoji, Surv. Alade Mojeed, Mr. Lawrence Alabi, brothers and sisters whose names are too numerous to be mentioned in this thesis. I am very grateful for the wonderful efforts of Mr. Hassan Ijar. Thanks for the assistant rendered. I refuse to forget the efforts of Mr. Tajudeen Ojelade, thanks for what God has used you for. I thank my supervisor and teacher, Dr. G.N Nsofor for all his efforts and encouragement. Sir, I wish you long life and prosperity. I thank Prof. D.O Adefolalu, Prof. J.M Baba, Dr. M.T Usman, Dr. A.S Abubakar, Dr. S Halilu, Dr. P.S Akinyeye, Dr. A.M Okhimamhe, Dr. (Mrs.) Odafen, Mr. Saliu and Surv. Ogundele of Federal School of Surveying, Oyo, for the parts played in making this thesis a successful one.

ABSTRACT

The process of analyzing real world entities is called spatial database. The inter-relationship are analyzed and modeled in such a way that maximum amount of data could be generated.

Our quest here is to attempt to design database system for cadastral layout. so that the problems of data standardization, data quality, inconsistency, manual archiving and the slowness in cadastral services caused by traditional methods will be somehow eliminated.

In solving these problems was the design stage, which consists of view of reality, conceptual design and database creation. Then geometric and attribute data about land parcels of the layout were obtained.

The geometric data was captured from 1 meter resolution ICONOS satellite imagery after being properly scanned and georeferenced. The layouts were designed using AutoCAD 2002 software and later overlaid on the satellite imagery. Scrip files were written and ran by using the same software (AutoCAD 2002) and the result were exported to the Arcview 3.2a software.

The attribute database was linked to the geometric database for proper analysis, which resulted to the presentation of final results in the form of tables, maps/plans and charts.

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CHAPTER ONE

1.0 INTRODUCTION

The term land subdivision plan, layout plan and cadastral layout are synonymous (Obateru, 1986).

The common understanding of cadastre is that it is a form of land information system. A land information system (LIS) gives support to land management by providing information about the land, the resources upon it and the improvements made to it. The cadastre is a subset of LIS that has been defined as a record of interest in land, encompassing both the nature and the extent of these interests. An interest in land (or property right) may be narrowly constructed as a legal right capable of ownership or more broadly interpreted to include any uniquely recognized relationship among people with regard to the acquisition and management of land (NRC 1980). The basic spatial unit of cadastre is a land parcel, on which all land tenure and land use records are compiled. Data that may appear in a cadastre include geometric data (coordinates, maps), property addresses, land use, real property information, the nature and duration of the tenure, details about the construct, of building and apartments, population, and land taxation values (CERCO, 1995).

The diversity of data brings the complexity in data management and required to be managed by using an advanced database management system (DBMS). A database may have special characteristics according to the structures of the data managed, such as spatial database, which manage the geographical data. When the time constructs are considered in a spatial database, it is called spatiotemporal database. Definition and modeling have important roles on database and processing.

The complexity of spatial data structures and the advances in geographic data management together with a wide application of G.I.S have made spatial database modeling an interesting and challenging research area. In recent years, several models have been proposed that are based on either an entity-relationship (ER) approach or an object-oriented (OO) approach. MODU-R, Geo2 and Geo0m, POLLEN and CONGO are the examples for 00 approaches in conceptual modeling. It can be seen from the previous studies that a cadastral database should be modeled using a spatial and temporal modeling technique because of its spatial and temporal data characteristic. Basic cadastral queries require information about the changes on objects, their attributes, and the relationships between these objects. This, storing historical information on cadastral objects and the relationship between them is an important necessity (Hakar, P. 1990).

It is apparently necessary to lay more emphasis on G.I.S whenever a research work is carried out on a database development. Therefore, Burrough (1986) defines such a system as one which has a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes.

1.1 STATEMENT OF PROBLEM

The Ministry of Land and Surveys (MLS) carries out Land registry and cadastral works in Nigeria. While the cadastral surveys are performed by MLS, the land rights are guaranteed by the state. Since then cadastral system has been formed by the state with several legal and organizational modification. These modifications have resulted in a lack of standardization and the inconsistency in the geometric aspects of the cadastral data, such as the cadastral maps without a coordinate system or in different coordinate systems. The problems regarding data standardization, data quality, inconsistency, digital archiving, and the slowness in cadastral services forced us to make a reform in Nigeria's cadastral tending towards a computer- based cadastral information system. Our quest here is to know whether developing a data base system for cadastral layout will help to eradicate the problems mentioned above.

1.2 AIM AND OBJECTIVES

The aim of this research work is to demonstrate on how the science of Geographical Information System can be used as a tool for tackling the problems of data standardization, data quality, inconsistency, digital archiving and the slowness in cadastral services.

1.2.1 OBJECTIVES

The objectives of this research are the following:

* To develop spatial database for cadastral layout.
* To integrate the spatial database with the attribute database.
* To assess whether these can make updating, retrieval and maintenance of information in the database easy.

1.3 SIGNIFICANCE OF THE STUDY

Closely associated with significance of study is the desire to reduce or even-eliminate much of the tedium from the demanding cartographic work, such as compilation, draughting, scribing, masking, lettering and symbol generation and placement which require highly skilled personnel who are often difficult to find. The present study results if achieved could provide basis for environmental management and decision making. Therefore, doing a research on G.I.S cadastral database means that one needs to go beyond manual retrieval of documents, cartographic and Automated methods of producing maps and begin to think of the entire geo information products. However, it becomes necessary to consider the G.I.S as a specially import tool because of its attribute data linkage capability

1.4 SCOPE OF THE STUDY

The scope of the study embraces part of Bwari area council, Abuja Federal Capital, Nigeria.

1.5 STUDY AREA

The study area comprises part of Bwari area council, Abuja. Fig 1.0 shows the administrative map of Bwari area council. The area pointed red, which is nearer to JAMB office of Bwari, is the said location area. It lies between Latitude 9° 16' 15.07" and Longitude 7° 22' 38.33".

1.6 RESEARCH HYPOTHESIS.

Generally, the output of any surveying operations are maps or plans. Though these maps can be equally produced using any other methods other than G.I.S. but G.I.S as a tool performs wonderful functions which make it to differ from either cartographic or Auto CAD system. Actually, this research study in a hypothetical direction is asking whether developing a G.I.S database for cadastral layout is much better than a conventional approach. (Cartographic, manual method).

1.7 LIMITATION

Using data got from satellite imagery (secondary data) limits the accuracy of information that may be derived from them to the accuracy of such input data. In this study, the design and implementation of a cadastral database with a spatiotemporal modeling approach was described. The system requirements were analyzed according to data types collected in the existing cadastral system. The restrictions on land rights such as mortgage, usage rights, etc. were not considered during the system requirement analysis phase.

1.8 ORGANIZATION OF THE THESIS

This thesis has been organized into five chapters.

Chapter one provides an introduction to the research work.

Charter two contains review of related literatures

Chapter three discusses on the research materials and methodology adopted.

Chapter four is about the analysis, discussion of findings and presentation of final results.

Chapter five is the summary, conclusion and recommendations.

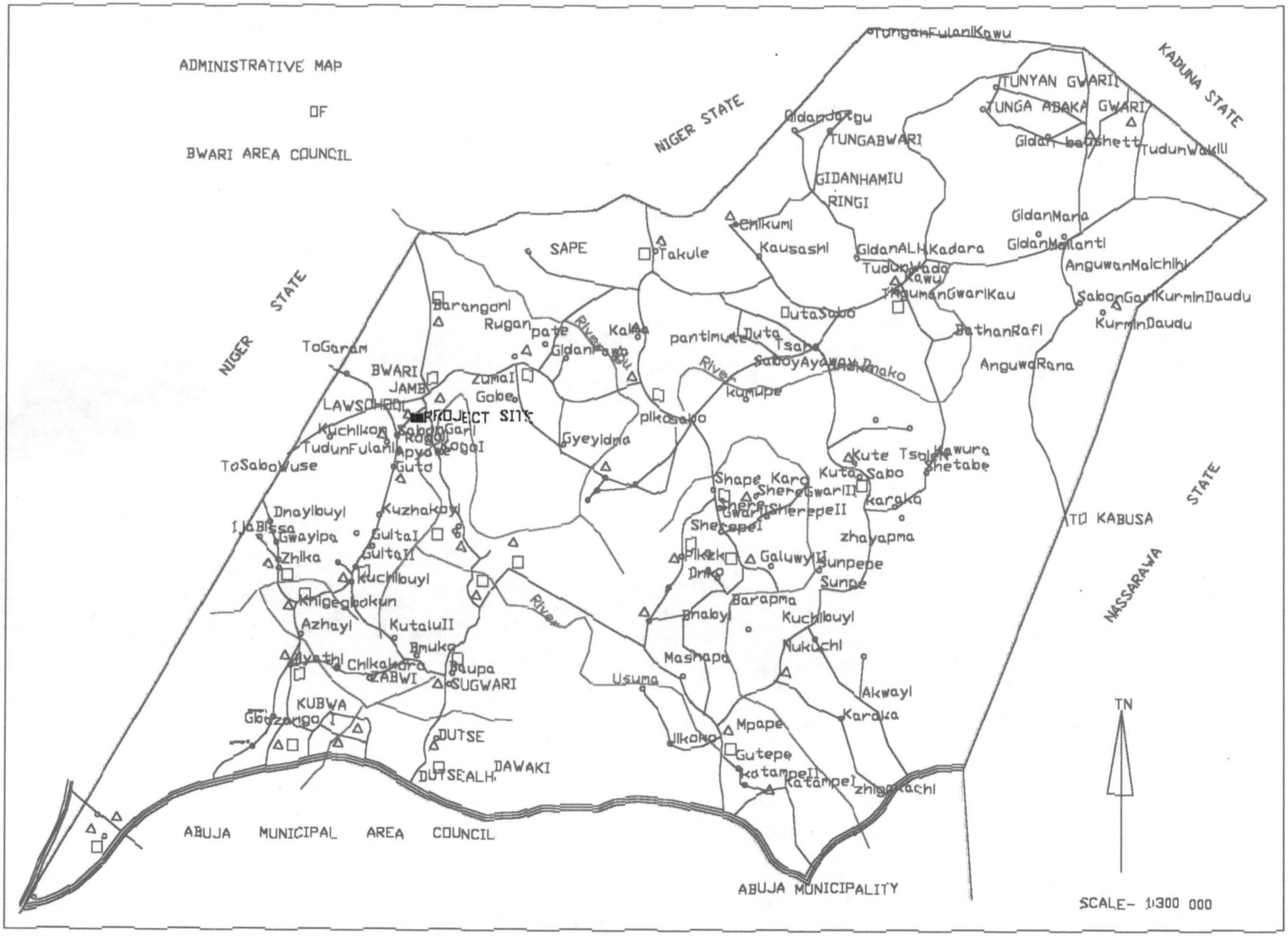

Fig.1.0;MAP SHOWING LOCATION OF BWARI AREA COUNCIL

CHAPTER TWO

LITERATURE REVIEW

2.0 BACKGROUND TO STUDY

Any observed feature or phenomena exists in space and time and therefore has a spatial (geometric) and a temporal extent. Such a feature exists in real world and can be geo-referenced, or defined by its location (Akinyede & Boroffice, 2003).

The brain has processed the optical signals received through the eyes and mind and may go further to define the attributes of the terrain features and their potentials to change with time. This explains the process of data acquisition, which can be transformed, through appropriate data processing into information, for planning and decision-making. Therefore, geospatial information and geographic information or geo-information are synonymous and exist in real world in terms of space (with location) and time (Akinyede et al, 2003).

Sabins (1996) defines remote sensing as the science of acquiring, processing, and interpreting images, and related data, obtained from aircraft or satellites that record the interaction between matter and electromagnetic radiation. Processing refers to the procedure that converts the raw data into images. Acquiring images refers to the technology employed. Interpreting the images thus becomes the most important meaningful and valuable tool for wide range of users (Abubakar & Achinivu, 2003).

ESRT (1991) defines GITS as a powerful tool for collecting, storing, retrieving, transforming, displaying and disseminating spatial information. It is a decision support system involving the integrating of spatially referenced data in a problem-solving environment. Nwilo and Osanwuta (2001) further explained that GIS supports "higher order thinking skill" through inquiry, real-world exploitation and exploration, collaboration, and constructive approaches to survey practitioners and researchers, most especially in the area of spatial concepts.

Furthermore, a GIS subsystem has a database management system at its core where spatial analysis is carried out. For example, GIS technology uses computer technology to merge remote sensing image with other data sets and produce inventory maps.

Also, Queen and Blinn (1993) defined GIS as a computerized, integrated system used to compile, store, manipulate and output mapped spatial data. GIS includes computer hardware, software and people who use the system in support of data management and analysis.

However, it can be seen as a stack set of map layers, where each layer is aligned or registered to all other layers. Typically, each layer will contain a unique geographic theme or data type. These themes might include, for example, topography, soils, land use, cadastral (land ownership) information, or infrastructure such as roads, pipelines, power lines, or sewer networks. Therefore, GIS is a fast growing technology that has applications in environmental studies.

Moreover, GIS and LIS are closely related to digital mapping and digital terrain modeling. The significant distinguishing features of GIS/LIS are the inclusion of a database management system (DBMS) to store both graphic and attribute data about individual features or areas present in the landscape and the software or tools to analyze the data held in the DBMS. According to Dashe (1987), cadastral refers to a daily-maintained record system, which contains an unambiguous description of the physical location and extent of a parcel of land, the related rights to the land, and information on the land. Aronoff (1991) identified such a record system to have three basic components viz.

- Records of the cadastral parcels i.e. the land units.
- The cadastral records- the graphic and text information describing land interest.
- The parcel index used for relating parcels and record.

Also, Fabiyi (2001) defines GIS as a unique integration of computer hardware, software, peripherals, procedural techniques, organizational structure, people and institutions for capturing, manipulating, storing, analyzing, modeling modulating and displaying of geographically referenced data for solving complex human related problems.

A cursory look at the above definitions reflects different emphases of the authors. Therefore, some terminologies used in the definitions are defined at the glossary page of this thesis.

A GIS deals with spatial data, which are always geo-referenced. The referencing of data to a location on the ground (geo-referencing) is a fundamental requirement in GIS. All projections are made to define a precise location using latitude and longitude (geographic) and geoid system. GIS are based on real world coordinates. This gives them a unique ability to place widely dispersed features in context relative to one another (Okonrokwo, 1994).

Spatial data could be conceptualized as a view of reality. According to Kufoniyi (1998) view of reality is the mental abstraction of the reality for particular application or group of applications. On the other hand, Rapper (1993) stated that reality can be visualized as points, lines, polygons (area) and volume.

Rolf et al (1999) described spatial data model as a high-level language that allows us to describe (model, specify) a number of real world phenomena; Some of which have spatial characteristics and their relationships. This description is the formal phenomena. Besides, identifying conceptual structures as the static part of those phenomena, a complete spatial data model also allows us to describe the behaviour (i.e. dynamics) of the observed phenomena to an extent that is considered necessary for the application. This complete description of structure and behaviour is called a conceptual description of those real world phenomena. It aims to describe a relevant part of our environment, not its reflection in a computer system, and it should thus be devoid of implementation considerations. The representation of the conceptualization of reality are grouped under three types:

(i) Tessellation data model: - This is when the geographical space is partitioned into regular (raster) or irregular (e.g. triangulated irregular network) (TIN) cells and each cell is characterized by the area it covers and one or several values describing non-spatial properties of the cell.

(ii) Vector type: - This involves instances where the terrain object being represented as points (OD), linear (1D), area (2D) or body (3D) objects depending on the features geometric structure. The locational data of the objects are then given by x, y or x,y,z coordinates which could be determined precisely using shapes being maintained. For this research, this method of representation of reality is adopted.

(iii) Object oriented data model treats every entity as an object. The geometric and attribute data of terrain feature are treated as properties of an object.

By considering some previous geo-spatial problems, the need for spatial database cannot be over-emphasized. Some of these application are: The use of environment GIS application in the CORINE program. The objectives were to establish an environmental database for the European Union and contained aims both to rationalize data collection and availability and to develop appropriate techniques for its storage and manipulation. The base map used was at map scales 1.1,000,000 and raster scanned. The system was implemented using the Arc info software. The information covers themes such as water resources and quality, atmospheric pollutant slopes and erosion risks, administrative units and basic socio-economic data.

The use of GIS was applied in the preparation of a GIS data for erosion assessment in the upper Ewaso Ngiro North basin, Kenya (1989). The database was also required for resource monitoring and for planning and management of projects such as soil conservation, water supply, irrigation and drainage. The methodology used to capture data was through digitizing of the thematic maps (Rainfall, Agro climate zone maps, Soils, Land use/Land cover drainage.)

In Germany and Poland, forest has been dying gradually due to air pollution. GIS and satellite remote sensing were used to obtain data of the extent of pollution damaged forest stands. The remotely sensed data were scanned with high-resolution scanners and application of GPS in geo-referencing of the satellite imagery and navigating to sample sites for ground truth. The data collected were entered into relational database management system. Arc/info software was used for the implementation to obtain output.

The use of GIS was also demonstrated in the design and creation of digital topographical database for engineers survey regiment Owode Yelwa, Ogun State, Nigeria (Kehinde, 1999). The database was required for the production of topographical maps for the Nigeria Army as it lacks a common documentation of its resources and land features in digital form. Graphic data were obtained through manual digitizing of the topographical map of the study area while attributes were obtained from the map and office records. A relational data model and raster model were adopted in designing the database and ILWIS 2.2 software was chosen for data capture, management and presentation.

The application of GIS was demonstrated in the preparation of a topographical database for a portion of Ibadan North East .The base map of Ibadan at a scale of 1.1,000 was used for the project. The database was created by the input of spatial and attributes data into computer via digitizer (calcomp A3) and keyboard. A relational data model was adopted ILWIS

2.1 software was used for the data capture, management and presentation also, the data must be structured (modeled) for representation in computer system.

This chapter will not be concluded without visiting the Hungarian's PHARE project.

In Hungary, the Ministry of Agriculture operates a national network of land offices, employing over 4200 personnel who maintain and update the property records that include both large scale (cadastral). In the immediate future they have a leading role in land consolidation or in a little broader sense in land/environmental management. However, there was open learning for land offices (OLLO) Tempus joint European project as a result of lack of developed education and training facilities within the country in the area of land registration and land/geographic information system.

A computerization of land office PHARE project aims to support the transition, providing a modernized land registration sector which will ensure safe and secure management of the land and property ownership records which consist of land administrative and legal records and cadastal maps. This PHARE project involves an estimated expenditure in excess of 12 million and involves the complete reform and modernization of the land registration sector of Hungary during the period 1992-1997.

OLLO was formed to provide the essential educational background of this PHARE project (Markus, 1996). The subject area of this project (PHARE) are listed below:

Land registration and cadastral system

Spatial information management

Land use and land valuation

Land consolidation

i. **LAND REGISTRATION AND CADASTRAL SYSTEM**

Underpinning the land registration process is an understanding of real property rights. An understanding of the benefits of land registration requires an appreciation of the different systems for the protection of interests in real property and an assessment of their comparative effectiveness. The professional operation of a land registration system requires the understanding of the different approaches to registration of title (as opposed to deeds registration) of land.

Furthermore, the professional should understand the legal basis of the various information elements that are recorded. In many countries the development of land information management has led to the formation of a multipurpose cadastre. In such a cadastral system it is usual to develop land information systems such that they are able to serve a role wider than the juridical and fiscal role for which they were originally established. This blending of the interests of differing organizations with different objectives is an essential step to realizing the advantages of a multi-purpose cadastre, such as could be achieved by the Hungarian system. It is essential to understand the nature of the integration process in legal, organizational, management, financial and professional terms. It is necessary to understand the specific obligations and responsibilities of the various organizations charged with the execution of the land registration process and to understand the public and service requirement. Therefore, there are implications and from the point of view of technical system to manage the data requirement; i.e. the information technology (IT).

Also, there are special problems confronting the transition countries such as Hungary, with large-scale land reform program and an explosion in the conveyance requirements that cannot be met by the existing traditional management techniques.

ii. SPATIAL INFORMATION MANAGEMENT

Spatial information management covers a variety of topics that impact upon any act of data processing or management, which has a spatial element. It therefore, impacts on all of the understanding of data capture processes and the understanding quality of the data captured. Spatial information management includes the professional role in the development and management of information systems.

The transition countries are introducing spatial information system to provide IT management of the very large data sets that they administer. This development is also taking place in the EU countries. In Hungary the existing large scale based mapping is urgently required to incorporate the results of the land reform program, as well as to meet the demands of the local authorities, other Ministries and professional users. Spatial information systems provide the management tools to accomplish this.

iii. LAND USE AND LAND VALUATION

The land market requires information regarding, values and use building upon the appreciation of interests in nature of land use and land value which could be generated from cadastral databases.

iv. **LAND CONSOLIDATION**

Land consolidation is the process of creating viable economic property units (of agricultural land), which is often necessary after a period of land reallocation or reform. There are technical, legal and economic aspects. It also requires the professional application of more traditional estate management skills.

Also in Turkey, the General Directorate of land registry and cadastral (TKGM) carry out land registry and cadastral works. While the cadastral surveys are performed by TKGM, the land rights are guaranteed by the state. Several past studies focused on designing a cadastral system in Turkey. Yalin (1986) and Erdi (1990) studied on an overall system design but a detailed spatial database design was not conducted. Ercan (1997) studied the design and the development of a cadastral information system for Turkey. However, he did not use a spatiotemporal database modeling approach. The modernization and the automation of the cadastral system started in 1986 with a reform project on mapping and cadastral works (HAKAR 1990) conducted by TKGM and the Turkish scientific and Technical research organization (TUBITAK). However, the project was stopped after the system analysis phase.

In 1990, the first project for developing a land registry and cadastral information system was planned and accepted as one of the national projects of the state planning organization (DPT). Unfortunately, no developments were achieved on this project either. Recently, in 2000, a new project (TAKBIS) started for developing a land registry and cadastre information system. The goal of TAKBIS is to establish countrywide cadastral application software required by end user. This project is currently under development and it is anticipated that it will be successfully finished (Hakar, 1990).

In addition, the heart of Geographic information system is the

Spatial database. This is the process by which real world entities and their inter-relationships are analyzed and modeled in such a way that maximum amount of data could be generated (Kufoniyi, 1998). Therefore, the design phase of spatial database has been identified as view of reality, conceptual design, logical design and physical design. The view of reality is the mental abstraction of the reality for a particular application or group of applications (Kufoniyi et al, 1998). Cadastral information system as an important component of Geographic information system contain both information on individual and other geo-spatially referenced information for easy identification and management.

From the foregoing, it is clear that the need for a cadastral spatial database cannot be over emphasized. Therefore, some of the benefits of digital database over the conventional maps include:

- Possibility of fast amendment and dynamic updating of data;.
- Facilitates fast capturing of data;
- Facilitates the analyses of many important spatial problems;
- Versatility in integrating data collected from various sources;
- Flexible output possibilities, and provides base for additional information with relative ease for production of maps (Adebomehin, 1996).

The merits listed above call for the need for developing a database for cadastral layout of part of Bwari area council, Abuja, Nigeria. In addition, it would provide instant information relating to certain questions involving location of particular objects, attributes of all objects within the area. This is the central focus of the study.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

Recall that the primary aim and objectives of this research is to search how the science of Geographic Information system can be used for solving problems of manual retrieval, archiving, producing etc. of cadastral services. In an attempt to achieve these, the design and implementation stages of a cadastral database must be strictly structured.

In this study, the requirements of a cadastral database were analyzed and a spatiotemporal database was designed and developed to fulfill the requirements for spatial, temporal and spatiotemporal queries for cadastral data. The study was implemented in Bwari area council, Abuja. The cadastral data and the basic cadastral queries have certain spatial and temporal characteristics on the location and shape of a land parcel, querying the ownership changes on a land parcel, etc. Therefore, a spatiotemporal database modeling technique was used to model the cadastral database. The system requirements were defined based on the land laws in Nigeria. After collecting the system requirements, a conceptual database design was performed using the spatiotemporal Entity Relationship (STER) model in combination with the Enhanced Entity Relationship (EER) model. The proposed conceptual schema was then mapped onto a logical data model in a relational design approach.

3.1 EQUIPMENT FOR THE RESEARCH

The minimum hardware and software required for the research are the following:

* Hardware (Map server)

Piii 500 MHZ, 256 MB RAM

256GB HDD, 512KB internal cache

Intel 440BX AGP set, etc

3D graphic card with 16 MB video memory.

High performance 21ii colour SVGA monitor

* Printer/Plotter

Laser printer

Hewlett packard design jet 25000 (PAO colour plotter.

* Storage media

CD- ROM

CD-ROM labeller

* Software

Auto CAD Release 2002

Arc view GIS 3. 2a

Microsoft word 98

3.2 DATABASE DESIGN, CREATION AND USE

The first step in database design is to carry out users requirement studies i.e. ascertain the application and identify the required attributes. In addition the available hardware and software are noted. Also there is need to organize the data for the following reasons:

* For speedy retrieval and updating as it is paramount in environmental management, surveying and mapping.
* To give very high accuracy and precision.

* To be able to query the database i.e. allow selection of items and analysis of many important spatial problems
* To allow sharing of data
* To serve as catalyst or stimulus for many advancements.

Furthermore, the beauty of a G.I.S is its ability of linking two or more files in real time especially the spatial data and attribute files that other softwares cannot do.

The next steps in the designing of a cadastral database system are the discussion on: -

* Reality
* Conceptual design
* Physical design.

3.2.1 REALITY

This refers to phenomena, as they exist in nature. This view of reality is the mental picture or abstraction of reality for given application (Kufoniyi, 1998).

3.2.2 CONCEPTUAL DESIGN

This design phase is also referred to as conceptual data modeling which yields the conceptual data as a product. Basically, three schemes are available which include:

- Tessellation: - Involves partitioning of geographic space into cells which can be either regular (Raster) or irregular (Triangulated Irregular Network-TIN)

- Object oriented: - In this representation, every entity is as an object and the geometric and attribute data of the objects are considered as properties of objects.
- Vector Representation: In this case, geometric structure of the feature is taken into consideration, terrain features are represented as point (0-D), line (1-D), area (2-D) or body (3-D) objects.

The choice of the vector representation was favoured in this project since geographic primitives such as points, lines, and area objects represent features in cadastral surveys.

This phase of modeling also makes it possible to identify the following:

(i) Terrain features represented by the geographic primitives as

- Nodes
- Arcs
- Area objects

(ii) The basic objects of interest relating to parcel-based system as parcel, owner, road network in layout, etc.

(iii) The existing spatial relationship among the objects

(iv) The attributes of each of the identified objects as can be seen from the **fig. 3.1 and 3.2**.

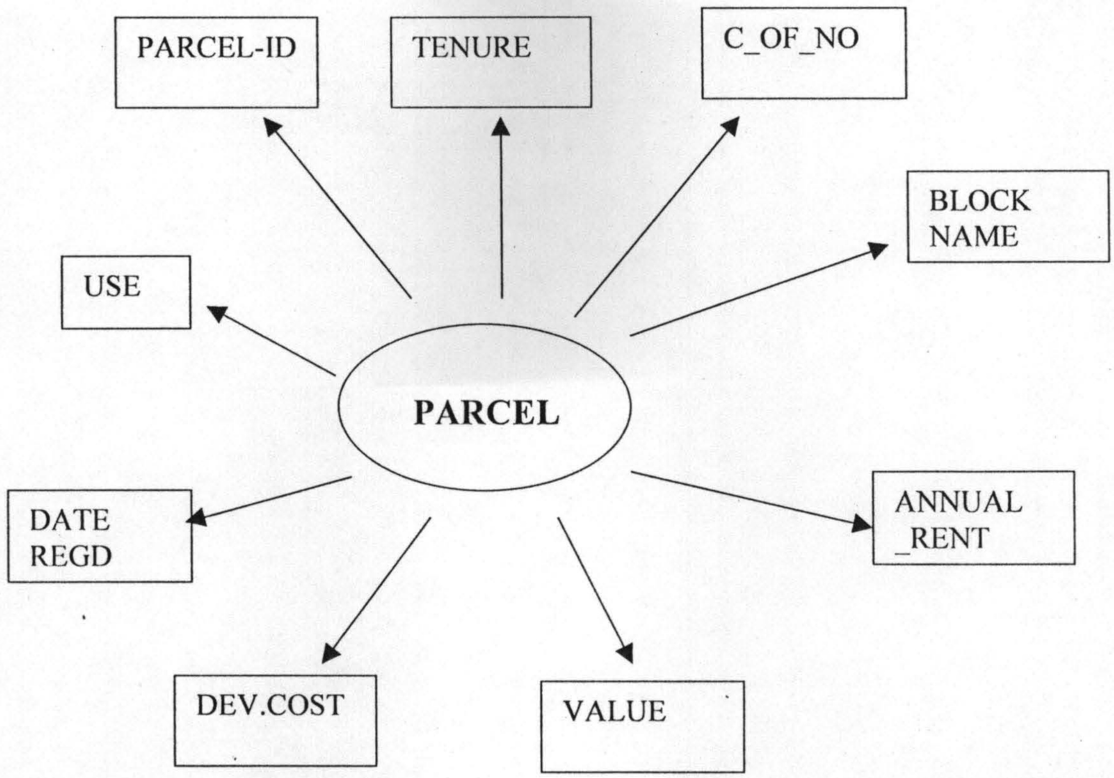

Fig 3.1 Attributes of parcel entity

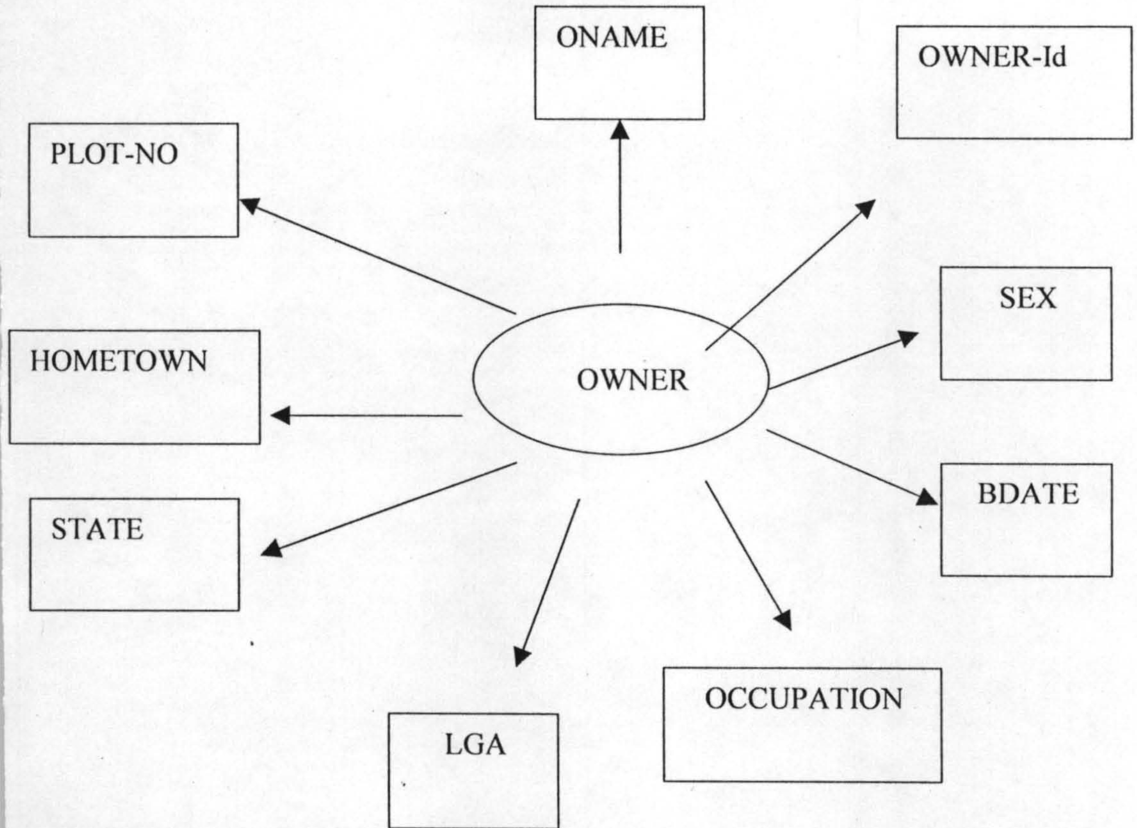

Fig 3.2 Attributes of Owner entity

(v) Constraints (Conventions)

- Two plots must not overlap
- The Government may lease parcel to an individual or corporate body.
- Road must not cross a parcel

The relationship among the entities and their attributes are translated into diagrams called the entity-relationship (ER) diagrams for the database and was expressed in the figure 3.1, 3.2, 3.3, 3.4 and table 3.1, 3.2, 3.3 and 3.4. The contents of those figures and tables are explained below:

In the fig 3.1, the flow of information to a particular parcel of land is described.

Fig 3.2 is the attributes of owner entity describing the flow of information of owner of a particular plot

Fig 3.4 gives the attributes of a particular node (point) in the form of Easting and Northing coordinates of that node.

Table 3.1 shows the easting and northing coordinates of a particular node. It is the tabular representation of the entity and its attributes.

Table 3.2 is the tabular representation of Entity relationship diagram. It depicts information about the attributes name and description.

Table 3.3 is parcel relation. It gives information about a particular parcel. Also, the table is a tabular representation of attributes of parcel entity.

Table 3.4 gives tabular information about the ownership of individual plot. Information like owner name, plot number, owner identity, sex, etc. are the contents of the table.

Broadly speaking, the figures and tables described above are the brain behind the attributes data generated for the design of cadastral database system. Detail of these will be found on the appendix page of this thesis.

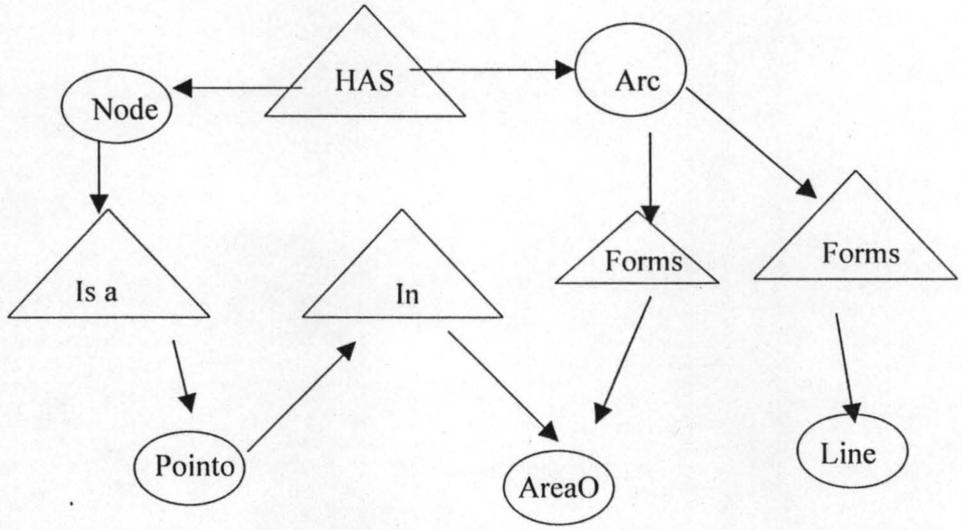

Fig 3.3 Entity relationship diagram of primary entities

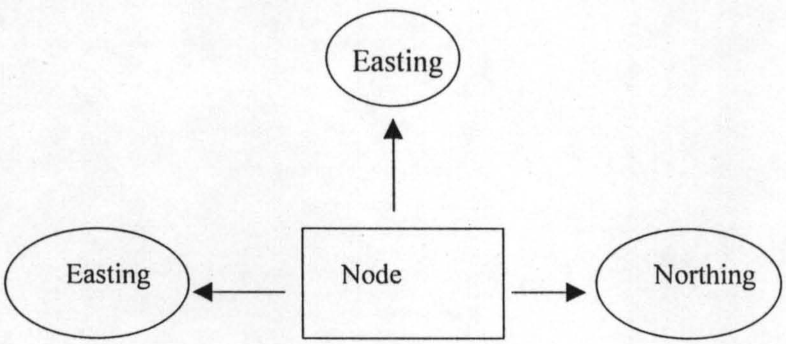

Fig 3.4 Node entity and its attributes

Table 3.1 Node Relation

Attributes name	Description
Node-ID	Node Identifier
Easting	Node coordinate
Northing	Node coordinate

Table 3.2 Arc Relation

Attributes name	Description
Arc-No	Arc Identifier
Bnode	Beginning node
Enode	End node
Rparcel	Right parcel
Lparcel	Left parcel

Table 3.3 Parcel Relation

Attributes name	Description
Parcel-id	Plot identifier
Use	Land use type
Tenure	Land ownership (e.g. Leasehold)
C-of-Onumber	Certificate of occupancy number
Reg – date	C of o registration date
Block – name	Layout block name containing the parcel
Est – Dev – cost	Estimated development cost of parcel
Value	Market value of parcel

Table 3.4 Owner Relation

Attributes name	Description
Plot – no	Owner's plot identifier
Oname	Name of the owner
Owner – id	Identifier for owner
Sex	Owner's gender
Age	Owner's age
Occupation	" occupation
LGA	Owner's LGA of origin
State	Owner's state of origin
Home – Town	Owner's Native place

3.2.3 PHYSICAL DESIGN

This is the representation of the data structure in the format of the implementation software. In order words, it refers to the representation of the data structure into the built in data types of the software in use. For this project the Microsoft access was used for the implementation of the relational data model. The physical design phase involves the actual translation of the design and the representation of the data structure in the format of the software. Several data types are available in Microsoft access such as number, text, date/currency, auto number, Yes/No etc. The appropriate data types and width were declared as shown in the tables 3.5 to 3.8.

Table 3.5 Node.mdb

Field Name	Date type/width	Description
Node _ ID	Text (10)	Beacon number
Easting	Number (long integer)	coordinate
Northing	Number (long integer)	coordinate

Table 3.6 Arc.mdb

Field Name	Date type/width	Description
Arc _ No	Number/integer	Arc number
Bnode	Number/long integer	Beginning node
Enode	Number/long integer	End node
Rparcel	Number/long integer	Right parcel
Lparcel	Number/long integer	Left parcel

Table 3.7 Arc.mdb

Field Name	Date type/width	Description
Parcel-Id	Number (long integer)	Parcel identifier
Use	Text (15)	Land use type ,
Tenure	Texts (15)	Right to land (ownership)
C_of_Onumber	Text (20)	Certificate of occupation No
Reg date	Date/Time (shortdate)	C of O registration date
Block_Name	Text (2)	Name of block
Estimated_Dev_cost	Currency (general number)	Estimated development cost
Value	Currency (general number)	Parcel market value in Naira

Table 3.8 Arc.mdb

Field Name	Date type/width	Description
Plot_No	Number (long integer)	Identifier for owner's parcel
Oname	Text (30)	Paercel owner's name
Owner_id	Texts (20)	Owner's identifier
Sex	Text (2)	Owners' gender class
Bdate	Date/Time (short date)	Owner's birth date
Occupation	Text (30)	Occupation of owner
LGA	Text (10)	Owners LGA of origin
State	Text (10)	Owner's state of origin
Hometown	Text (20)	Owner's native place

3.3 DATABASE CREATION

The database is created after the physical design phase. This involves creation and populating node, Arc, Polygon, line or object files.

The parcel table, owners table, arc and node table were all created. The parcel-id in the parcel table was selected as a primary key. This was then taken as a foreign key in the owners table thereby facilitating joining of the two table. These were finally saved into a folder and exported to Arc View. The design and construction phase of the database is shown in figure 3.5. The figure shows systematic arrangement of the components that must be structured together for the database creation.

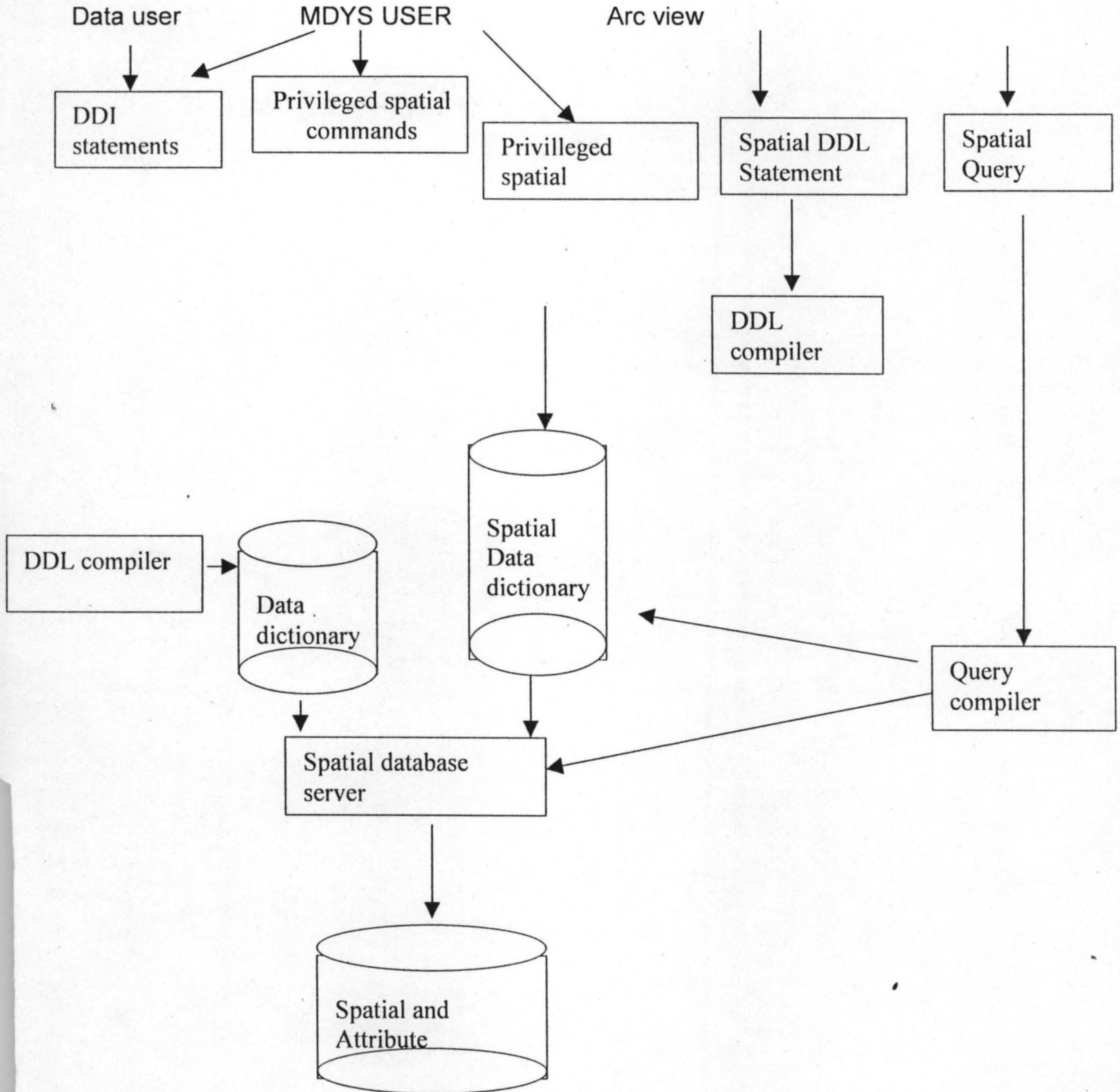

Fig 3.5: components of the designed cadastral database.

3.4 DATA SETS/SOURCE

Data sets required for the research includes the geometric and attribute data of land parcels of Bwari area council, Abuja. This was obtained from the ICONOS Satellite Imagery, received from land Office at Bwari, Abuja.

The attribute data was equally obtained from the same office.

3.5 CARTOGRAPHIC MODELING

Cartographic modeling is the process of linking or organizing the basic analytical operations in a logical sequence such that the output from one serves as input to the next. Cartographic model is the graphic representation of the data and analytical procedures used in a study. A flow chart is assumptions and relation between variables.

The basic requirements in cartographic modeling are identified as:

- The objective
- Required data
- Available data

The cartographic model evolved for the project is shown in figure 3.6.

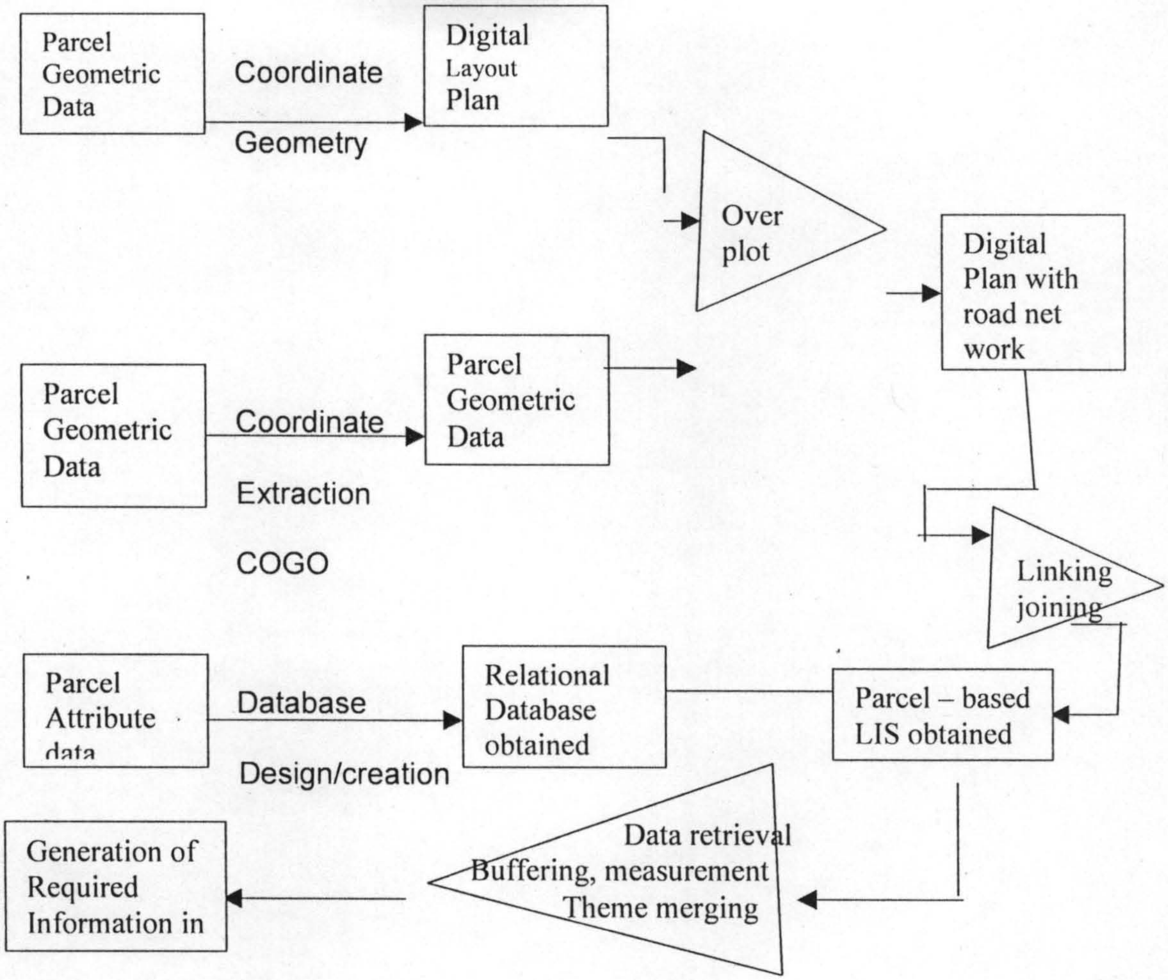

Fig 3.6 Cartographic model

CHAPTER FOUR

4.0 ANALYSIS AND PRESENTATION OF RESULT

INTRODUCTION

This chapter is dedicated to design database system for cadastral layout. Analysis of the data used and discussion of results are the consequences of the adopted methodology. Therefore the success of this thesis is vested on the output of the query analysis performed.

The tables on the appendix page are called attribute data. These data were integrated with the spatial database to design database system. A brief description of the tables is the following:

- Owner table: - This consists of information pertaining to the ownership of the plots. It should be noted that fictitious names were used, therefore, those names are not the names of the true owners of the plots.
- Parcel table: - Bears information about each plot of the layout.
- Arc table; - Information like beginning node (B. node) end node (E. node) right parcel (R. Parcel) and the left parcel (L.P) were contained in the arc table.
- Node table: - Another important table is node table. It consists of easting and northing coordinates of any given plan.

These analyses were performed on the evolved parcel-based land information system (owner table, parcel table, arc table and node table) of the Bwari area council Abuja. The required information to be generated determines the type of analysis carried out. Issues under consideration among others, basically includes inter-software data export (data migration). Types of analysis and product generatiòn in form of table charts, maps/plans both in hard and soft copies.

4.1 INTER-SOFTWARE DATA EXPORT/IMPORT

In this research, attribute and geometric data transfer was made from the minor software to the major software to the analytical software. Geometric data about the features of interest were captured using cartographic data sources. Script files were written for the coordinates defining parcels, in the research area. The scrip files were run in Auto CAD keeping in different layers. The AutoCAD drawings were saved in DWG format and Arc View using the CAD reader extension support to produce the graphics. Also the attribute of the various relational tables was exported from the software using Ms Access SQL connection.

The external database was then linked/joined to the Arc View Attribute tables after conversion to dbase format (dsbf) before the analysis.

4.1.1 TYPES OF ANALYSIS PERFORMED

Analyses performed include data retrieval, buffering, overlay by intersection theme merging, measurement and statistical functions.

4.1.2 DATA RETRIEVAL

This tool was used to answer questions like what is where and where is what?

4.1.3 QUERY BY ATTRIBUTES

This was used to retrieve record from the Information system developed.

Query 1

Fig 4.1 was the result of the query performed to determine parcels allocated to civil servants who are from Irewole local government area of Osun state.

Procedure:

* From the theme, click properties; click definition in the query builder dialogue box that is open.
* The attribute criteria was defined thus using the query definition syntax as follows:

(Occupation ="Civil servant'} and ILGA"}

The result of the query gives all parcels that meet the set criteria and every other associated attribute information with the parcels.

Query 2

Fig 4.2 shows the plots holding by female.

Procedure:

To retrieve all female plots, the database was queried following the syntax using the query builder dialogue box.

{Use =" Sex"} = "F"

The result of the query gives all the vacant plots both as graphics and the other associated attributed information about the plots.

4.2 QUERY BY LOCATION/NAME

This operation makes use of the identity icon to bring out attribute records of features on the graphics on screen. The identity icon is clicked and at any subsequent clicking of any part of the graphics, the database gives an automatic response by displaying plot holding for example by Musa Haruna. The identity result for parcel 153 (Musa Haruna) is shown in fig 4.3.a, 4.3.b and 4.3.c in different formats. The format of fig 4.3.c is digital layout of the study area showing a selected plot owned by Musa Haruna. This plot could be printed out as required by the owner. The information assigned to the plot can be updated before retrieving the plan.

4.3.1 Measurement/Statistical analysis

Measurement function was used in the calculation of area and perimeter of parcel polygons. The analysis of the result is shown in fig 4.4. The result of the query gives all parcels that meet the set criteria. The syntax used for area and perimeter calculation function is stated thus:

Area = (Shape Return Area)

Perimeter = (Shape Return Length)

The determination of annual rent payable to the

Government can be accomplished using the table calculation function. The annual rent depends on parameters like location and area. The area only was taken into consideration during the research since the parcels fall within the same cadastral zone. Therefore, query builder, which was opened in the query builder dialogue box was clicked. The attribute criteria was defined using the query builder as follows:

[(Area m^2) < = 704]

The result of the query gives all parcels that meet the set criteria and is shown in fig 4.5.

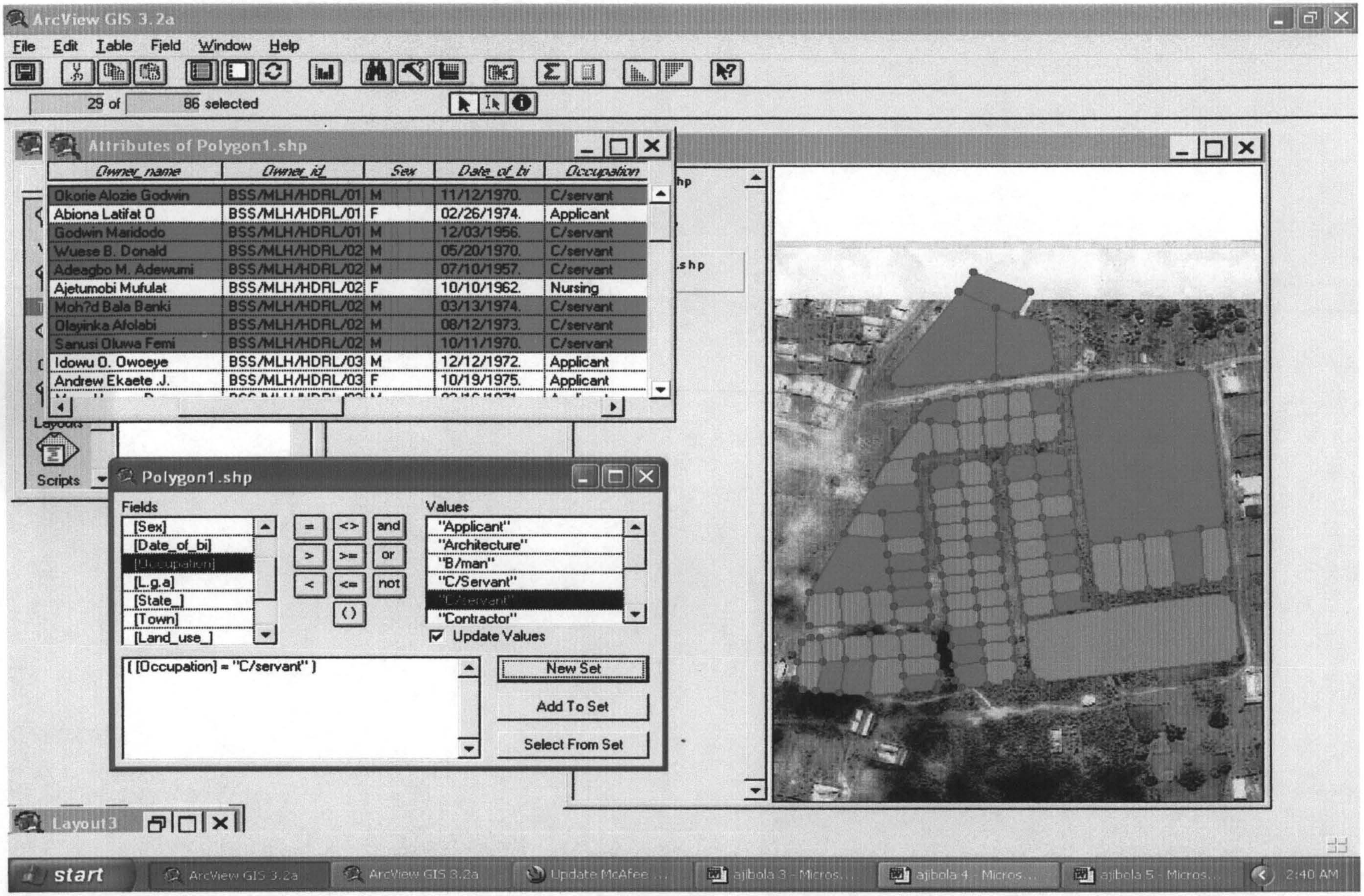

FIG 4.2: LOGIC QUERY BY CIVIL SERVANTS

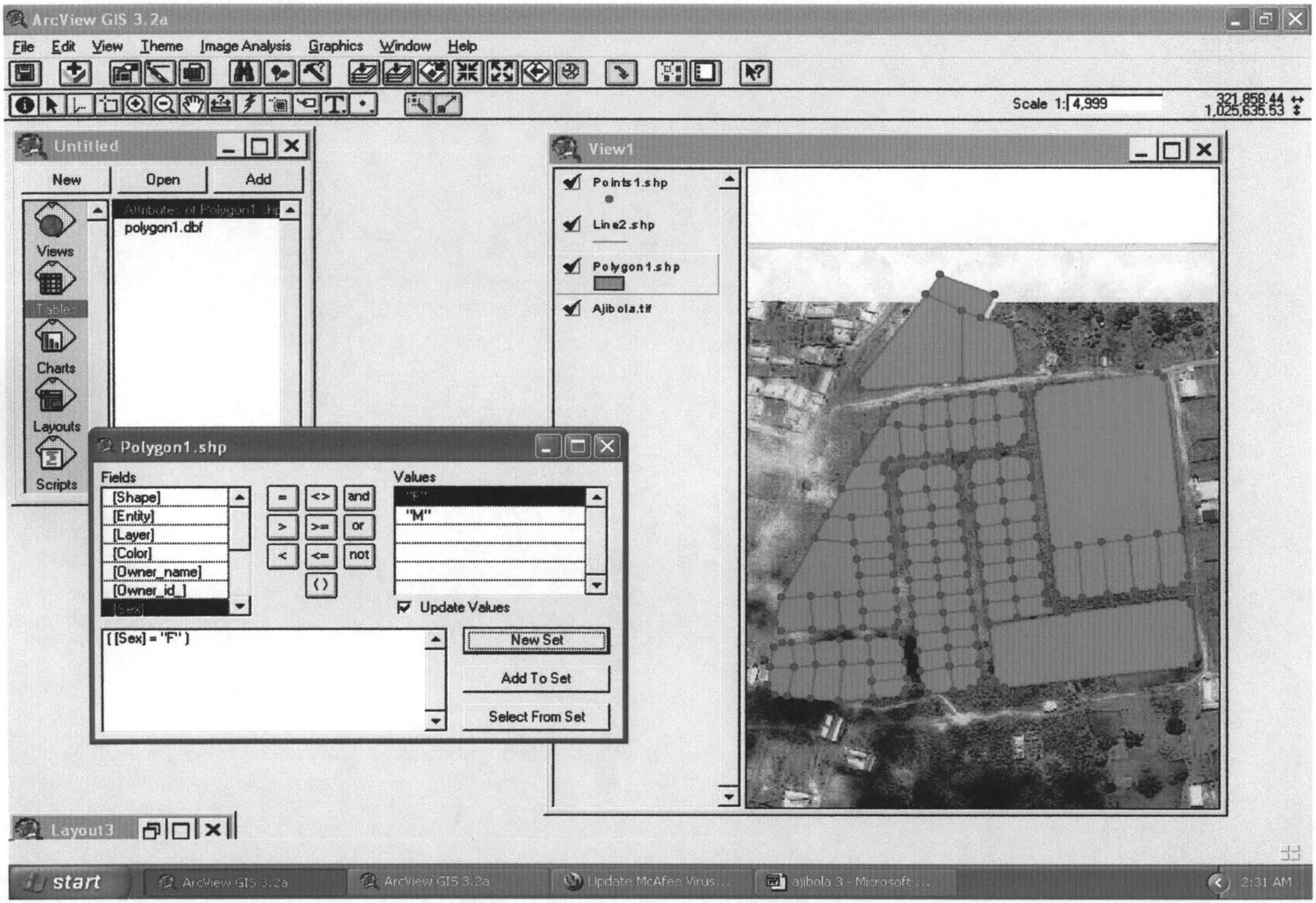

FIG 4.2: LOGIC QUERY BY SEX

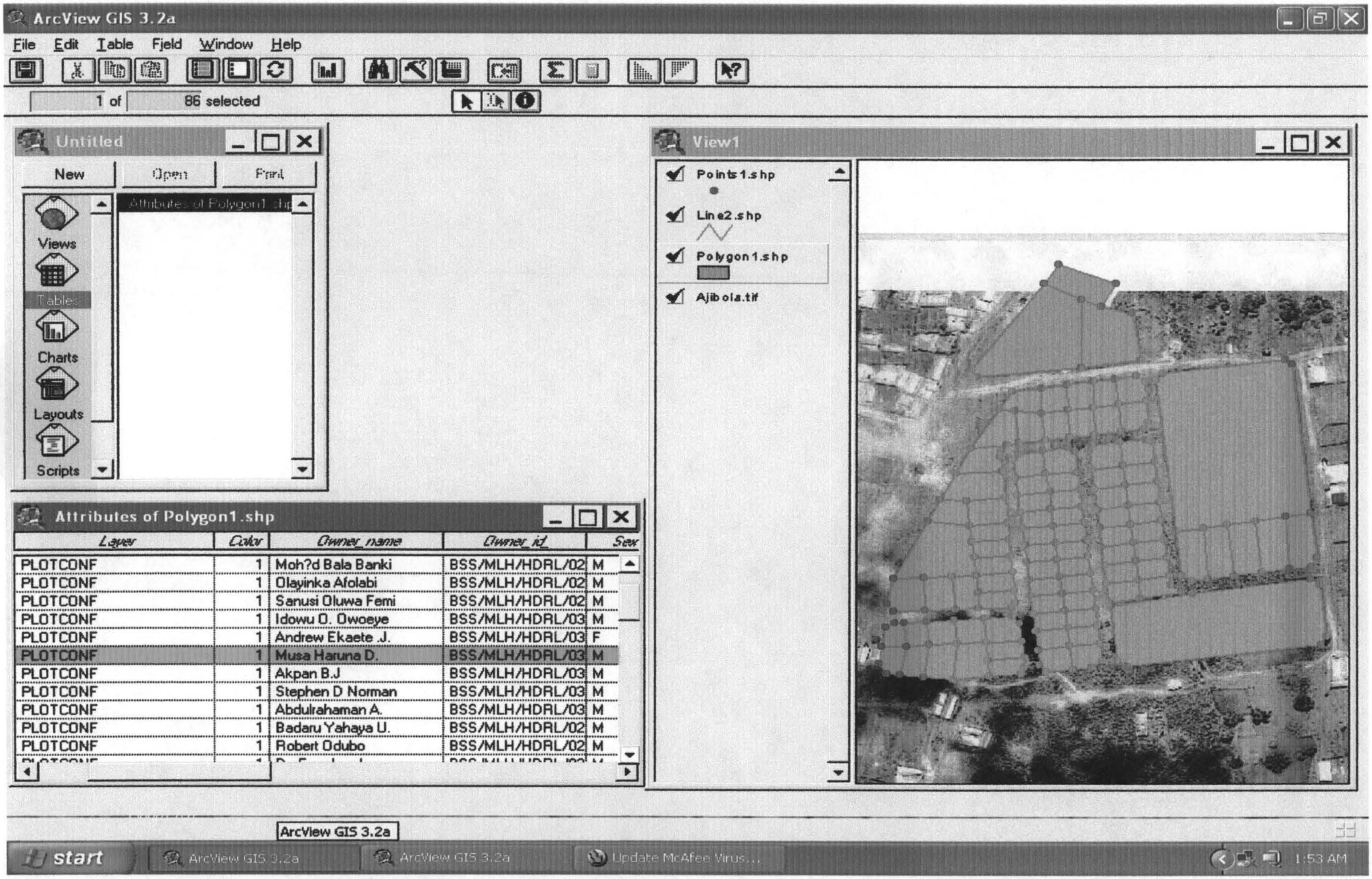

FIG 4.3a: LOGIC QUERY BY LOCATION

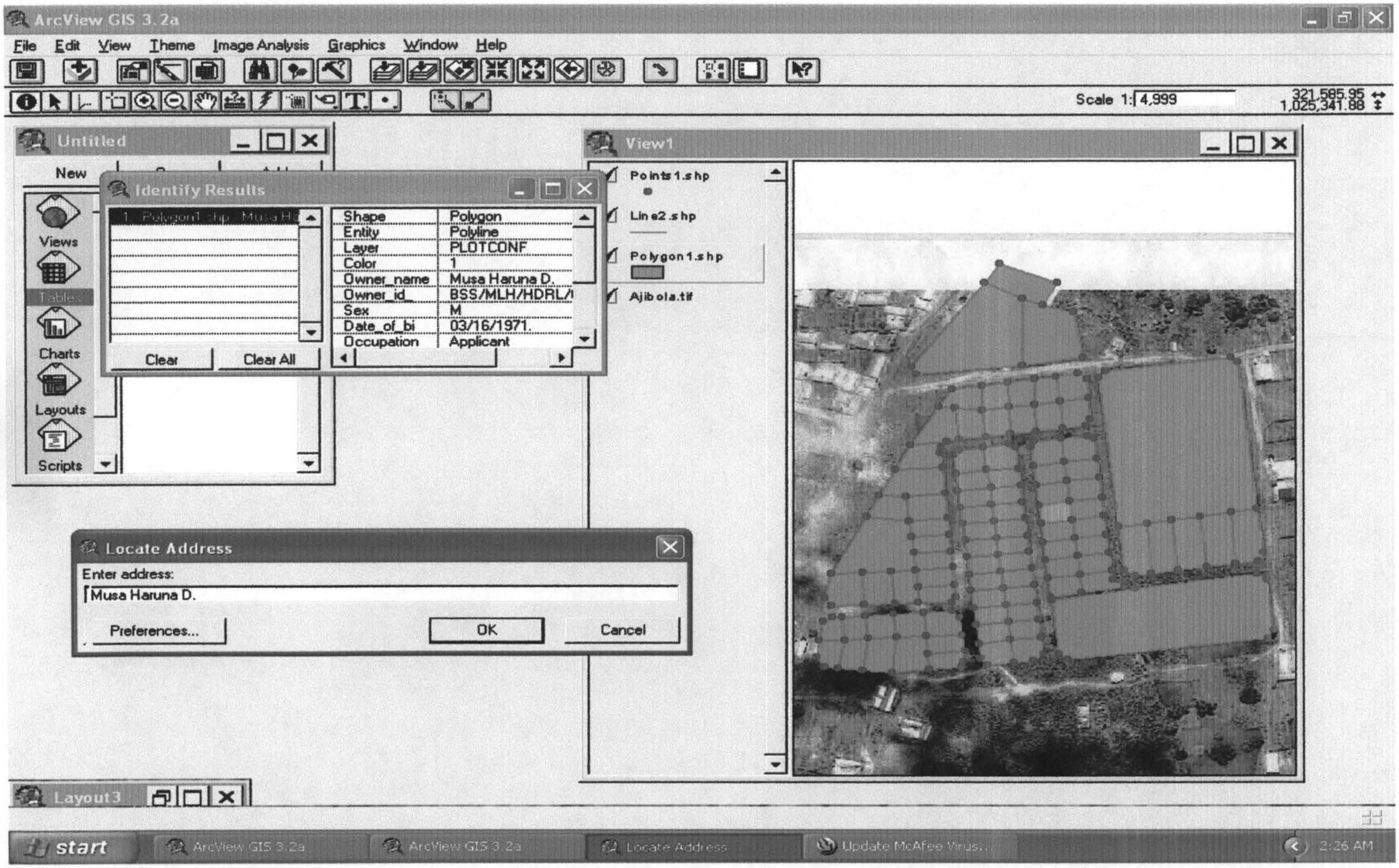

FIG 4.3b: LOGIC QUERY BY LOCATION

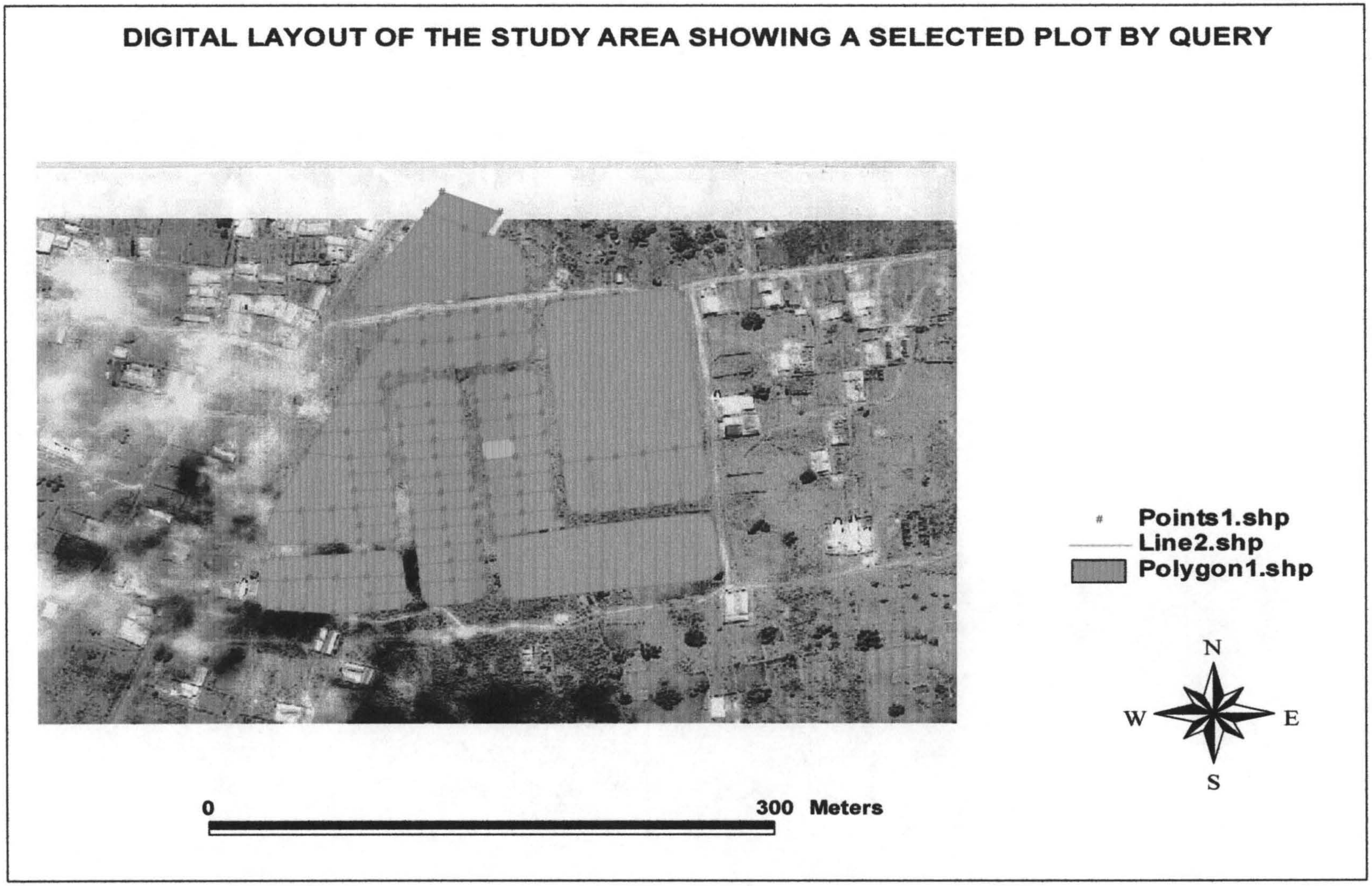

FIG 4.3c: ŁOGI+C QUERY BY LOCATION

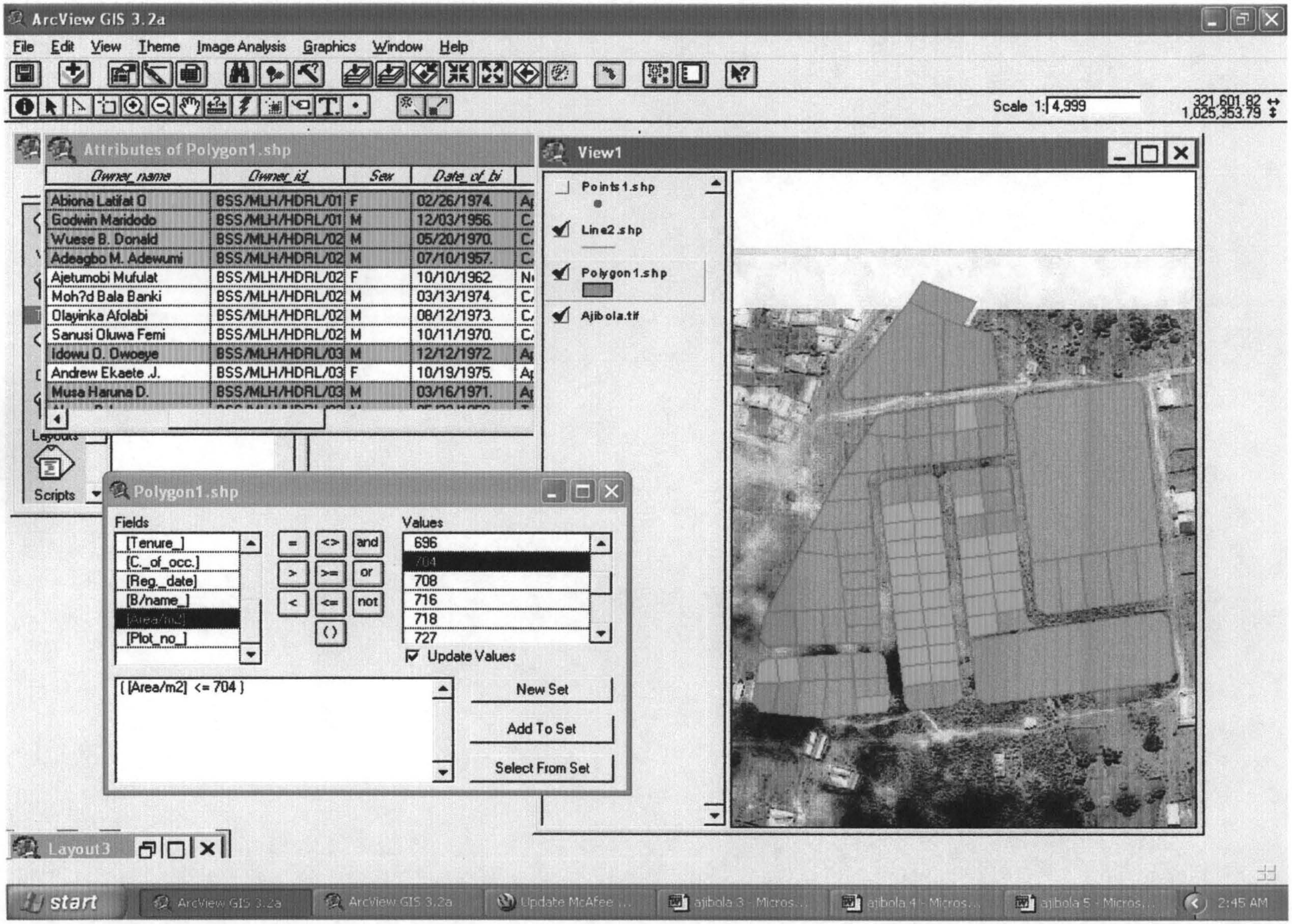

FIG 4.4: LOGIC QUERY BY AREA

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter is the summary of the whole thesis.

5.2 SUMMARY

The thesis was aimed at developing a database system for cadastral layout of part of Bwari area council, Abuja. This was commenced by considering what should constitute the said information system and where such can be obtained. Therefore, the task of data sources/types and data required for the research were completely solved. The targeted information system was envisaged to be made up of geometric and attribute data about land parcels of the layout. The geometric and attribute data were collected from Land office, and land department of Bwari area council respectively. The representation scheme was chosen as vector due to the nature of the data as made up of points, lines and area objects.

The various phases of design of the database for the information system were observed: the conceptual, logical and physical phases. The conceptual phase otherwise known as the conceptual modeling involved the representation of the view of reality, identification of the entities involved to be represented and their relationships independent of implementation details. The logical phase involved the structuring of the data in a computer environment. Physical phase involved the data declaration to make it compatible with the data type of the implementation software.

Lastly, the database was created after the physical design by populating the various tables (relations) identified and designed in the thesis. These include the Arc, Node, Owner, and parcel tables respectively.

The geometric data was captured from ICONOS satellite imagery after being properly scanned, and georeferenced. Also, the layouts were designed using Auto CAD 2002 software and later overlaid on the satellite imagery. The scrip files were written and run by using the same software (Auto CAD 2002) and the results were exported to Arc view 3.2a software. The attribute database was then joined/linked to the geometric database for analysis. Certain GIS analyses were performed which included spatial search (data retrieval), buffering, overlay by intersection, merging, measurement functions, and statistical analysis. The results of these analyses were presented in form of tables, maps/plans, and charts. The forms of the analysis performed on the evolved parcel-based information system were determined by the required information to be generated.

5.3 CONCLUSION

In this study, the design and implementation of a cadastral data base were described. The system requirements analysis for a cadastral database was carried out in Nigeria's context. The system requirements were analysed according to data types collected in the existing cadastral system. The restrictions on land rights such as, mortgage, usage rights, etc., were not considered during the system requirements analysis phase. The basic cadastral queries showed that a cadastral database should store historical information on land parcels and related objects. A spatial and temporal database modeling approach is inevitable to design and implement a cadastral database. The integrated analysis of land registry and cadastral data, which are stored separately, is another important feature required from a cadastral database.

5.4 RECOMMENDATION

From the fore going, it will be in the interest of this country to support a massive departure from the analogue to digital operations.

Therefore, recommendations to be drawn from the studies are as follows:

- Development of databases for reasonable extent of land based on the results and products of the areas, along with existing and historical data.
- Updating the databases using GIS and remote sensing (RS) systematically (every 5 years for example) to detect the new changes, which depend mainly on the frequency and occurrence of urban changes and the socio-economic development of the cities.
- Further developments are still needed in terms of soil type, land use change detection and modeling for future research.

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GLOSSARY

Below are definitions of some terminologies used in the thesis;

- Land information system: A computerized land information system is a computer database of spatially referenced land-related data. Within the database, graphical information of topographic mapping and spatially referenced textual information are held in a carefully structured form (Kennie & Petrie 1994).
- Database management system (DBMS). Database management system is an essential feature of GIS which distinguishes it from other systems (Ayeni 1999b).

tabular file which are related simultaneously, to associate attibutes, (ESRI1991).

- Quatree: A spatial index that breaks a spatial database into homogenous cells of regularly decreasing size. Each decrease in size is 2/4 the area of the previous cell. The entire map is partitioned, (Kessler 1992).
- Network DBMS: An extension of hierarchical structure for storing data in which explicit connections and relations are defined by links or pointer of many-to- many types where a child's record can have more than one parent unlike HDBMS, (Kessler 1992).
- Metadata: Data describing data. It is a description of the features of a data set to facilitate access to and application of the data. Metadata for Geoinformation provides information about data source, extent, quality, spatial reference, distribution (Ayeni, Kufoniyi, and Akinyede 2003).
- Data manipulation language: A computer program or software for editing, sorting, merging and analysing input data (Ayeni et al 1999b).
- Data model: An abstraction of the world includes only those properties through to be relevant to the application at hand. The data model defines specific groups of entities, their attributes and relationships among them (Ayeni et al 1999b).
- Data Modeling: The act or process of representing the real would taking into consideration specific groups of entities of interest, their attributes, and relationships among them (Ayeni et al 1999b).
- Data transfer: the import of data from one system to another using various data exchange formats (Kufoniyi et al 1998).

- Data base: An organized, integrated collection of data stored for use by relevant applications (Dale and Mclaughlin, 1999).
- Data base development: creation or establishment of a database (Ayeni 1999b).
- Data base management system (DBMS): A collection of software designed for creating, updating, retrieving and managing information in a computer database (Ayeni et al 1999b).
- Database Model: A representation of the database showing data logic design and data structure (Ayeni et al 1999b).
- Database Query: structure query language (SQL) commands which helps in the selection of various combinations of variables and retrieval of information stored in the database (Ayeni et al 1999b).

APPENDIX I

OWNER TABLE

Owner name	Owner id	Sex	B date	Occupation	LGA	State	Home
Okorie Alozie Godwin	BSS/MLH/H DRL/01	M	11/12/1970	C/servant	Ogbia	Delta	Otuopoti
Abiona Latifat O	BSS/MLH/H DRL/01	F	2/26/1974	Applicant	ILGA	Osun	Ikire
Godwin Maridodo	BSS/MLH/H DRL/01	M	12/3/1956	C/servant	KLGA	Kadun a	Kajuru
Wuese B. Donald	BSS/MLH/H DRL/02	M	5/20/1970	C/servant	PATANI	Delta	Patani
Adeagbo M. Adewumi	BSS/MLH/H DRL/02	M	7/10/1957	C/servant	ILGA	Osun	Ikire
Ajetumobi Mufulat	BSS/MLH/H DRL/02	F	10/10/1962	Nursing	ILGA	Osun	Ikire
Moh'd Bala Banki	BSS/MLH/H DRL/02	M	3/13/1974	C/servant	BLGA	Bida	Bida
Olayinka Afolabi	BSS/MLH/H DRL/02	M	8/12/1973	C/servant	ILGA	Oyo	Ibadan
Sanusi Oluwa Femi	BSS/MLH/H DRL/02	M	10/11/1070	C/servant	OLGA	Oyo	Saki
Idowu O. Owoeye	BSS/MLH/H DRL/03	M	12/12/1972	Applicant	ELGA	Ekiti	Ikole
Andrew Ekaete .J.	BSS/MLH/H DRL/03	F	10/19/1975	Applicant	ILGA	A/Ibom	Ikono
Musa Haruna D.	BSS/MLH/H DRL/03	M	3/16/1971	Applicant	KLGA	Kadun a	Kajuru
Akpan B.J	BSS/MLH/H DRL/03	M	5/22/1950	Teaching	ELGA	A/Ibom	Eket
Stephen D Norman	BSS/MLH/H DRL/03	M	11/6/1970	Force	C/K	Kadun a	Kaduna
Abdulrahaman A.	BSS/MLH/H DRL/03	M	12/3/1971	Teaching	BLGA	Niger	Minna
Badaru Yahaya U.	BSS/MLH/H DRL/02	M	01/6/1960	Force	KLGA	Kwara	Omuran
Robert Odubo	BSS/MLH/H DRL/02	M	11/23/1954	Contractor	SILGA	Bayels a	Eniwari
Dr. Freedom J.	BSS/MLH/H DRL/02	M	3/18/1956	M/practitioner	KOLGA	Bayels a	Sabagari a
Hrn. NS Oranzi	BSS/MLH/H DRL/03	M	9/1/1959	P/Ruler	OGBIA	Bayels a	Otueke
Sir Nelson .A.	BSS/MLH/H DRL/03	M	8/20/1962	Teaching	YELGA	Bayels a	Ogbolom a
Tarila Bunas	BSS/MLH/H DRL/03	M	11/11/1971	B/man	AKOLG A	Rivers	Kula
Chief Ni Igwelle	BSS/MLH/H DRL/03	M	2/8/1961	P/Ruler	SILGA	Bayels a	Opuama
Pension H. Dino	BSS/MLH/H DRL/03	M	9/18/1969	Contractor	C/KANU	Bayels a	Lobia
Bala Usman Moh'd	BSS/MLH/H DRL/03	M	2/12/1971	C/servant	PEGEM A	Kano	Kano
Moses A. I.	BSS/MLH/H DRL/03	M	4/11/1960	Force		Rivers	Degema
Moh'd Sada Danmusa	BSS/MLH/H DRL/03	M	7/7/1975	Applicant	KLGA	Katsina	Katsina
Ojo Kayode Ayodami	BSS/MLH/H DRL/03	M	10/12/1974	Teaching	KLGA	Oyo	Ibadan

12	Ajibola Muideen	BSS/MLH/H DRL/03	M	12/3/1974	Applicant	ILGA	Osun	Ikire
13a	Hellen Aggrey	BSS/MLH/H DRL/03	F	10/10/1970	Nursing	KOLGA	Bayels a	Kaiama
13	Grace Peregba	BSS/MLH/H DRL/03	F	5/30/1965	C/Servant	SILGA	Bayels a	Ikebiri
14	Kingsway Zalah	BSS/MLH/H DRL/03	M	1/31/1974	Trading	EKERE MOR	Bayels a	Peretoru
15	Udieme Okpogiaha	BSS/MLH/H DRL/04	F	12/3/1971	Teaching	OKIRIK A	Rivers	Ogu
16	Lambart Ototo	BSS/MLH/H DRL/04	M	1/19/1968	Mechanic	SALGA	Bayels a	Ukonbiri
17	Tesini Samuel	BSS/MLH/H DRL/04	M	9/28/1950	Politician	SALGA	Bayels a	Angalabir i
8	Alade Mojeed A.	BSS/MLH/H DRL/04	M	12/27/1972	Surveyor	ALGA	Osun	Kuta
9	Alongie P. Abiodu	BSS/MLH/H DRL/04	M	11/13/1973	Surveyor	OLGA	Osun	Odo Otin
0	Ajibola Musbau O.	BSS/MLH/H DRL/04	M	11/14/1973	Driving	ILGA	Osun	Ikire
1	Oyeyemi K. Nike	BSS/MLH/H DRL/04	F	11/14/1957	Teaching	ILGA	Osun	Ikire
2	Asma'u A. Buhari	BSS/MLH/H DRL/04	F	6/20/1970	C/servant	KLGA	Katsina	Katsina
3	Oworu O. Oyesola	BSS/MLH/H DRL/00	M	10/14/1976	C/servant	ELGA	Ogun	Igbsa
4	Amusuk D. J	BSS/MLH/H DRL/00	M	11/12/1976	C/servant	SALGA	Bayels a	Angalabir i
5	Salau Dauda	BSS/MLH/H DRL/00	M	3/15/1964	Teaching	KWARA	Kwara	Omuaran
6	Shitti Lateef Y.	BSS/MLH/H DRL/00	M	5/27/1958	Teaching	OFFA	Kwara	Offa
7	Haruna Sim	BSS/MLH/H DRL/00	F	8/10/1960	C/servant	KUJE	Kadun a	Kuje
8	Ajibola I. Isola	BSS/MLH/H DRL/01	M	12/10/1974	Teaching	ILGA	Osun	Ikire
9	Bitrus A. Dang	BSS/MLH/H DRL/01	M	11/11/1966	C/servant	BLGA	Borno	Boronu
9A	Ayuba Markus K	BSS/MLH/H DRL/01	M	19/22/1967	C/servant	SLGA	Zaria	Zaria
9B	Arieol Vianana	BSS/MLH/H DRL/01	M	7/6/1965	Tailoring	AKLGA	Rivers	Degema
0	Ombrai Oguoko	BSS/MLH/H DRL/01	M	9/19/1974	Driving	KOLGA	Bayels a	Odi
0A	Collins N/ Odu	BSS/MLH/H DRL/01 BSS/MLH/H DRL/01	M	10/22/1971	Welding	NEMBE	Bayels a	Bassnbir
0B	Ebiere E. Bietoru	BSS/MLH/H DRL/02	F	5/13/1972	Trading	SILGA	Bayels a	Lobia
1	Isoun William	BSS/MLH/H DRL/02	M	8/14/1975	Driving	KOLGA	Bayels a	Odi
32	Isong M.A	BSS/MLH/H DRL/02	M	6/25/1945	Teaching	ILGA	A/Ibom	Ikono
32A	Oykunle Kazeem	BSS/MLH/H DRL/02	M	6/101969	Architecture	ILGA	Osun	Ikire
33	Walta Mutok	BSS/MLH/H DRL/02	M	10/18/1968	Force	AKOLG	Rivers	Kula
34	Dania Ebenezer	BSS/MLH/H DRL/00	M	03/03/1950	Teaching	KLGA	Kadun a	Kaduru
35	Yahanasu Aliyu	BSS/MLH/H	F	12/5/1978	C/servant	BLGA	Abuja	Bwuari

		DRL/00						
36	Usman Balarabe	BSS/MLH/H DRL/00	M	06/10/1965	C/servant	BLGA	Niger	
37	Hassan Sulaiman	BSS/MLH/H DRL/00	M	07/11/1970	C/servant	KUJE	Kaduna	Kaduna
38	Jubril K.N	BSS/MLH/H DRL/00	M	10/20/1971	Force	SOKOTO	Sokoto	Sokoto
39	Liman M. Hadiza	BSS/MLH/H DRL/03	F	5/5/1970	C/servant	MLGA	Niger	Minna
39A	Adeniji Sunday A.	BSS/MLH/H DRL/03	M	2/22/1968	C/servant	ILGA	Osun	Ikire
39B	Olajide Salami	BSS/MLH/H DRL/03	M	10/291975	Applicant	ILGA	Osun	Ikire
39C	Oyekunle Bariu	BSS/MLH/H DRL/03	M	4/10/1972	C/servant	ILGA	Osun	Ikire
1A	Alabai Lawrence	BSS/MLH/H DRL/04	M	3/13/1971	Trading	ONLGA	Oyo	Ogbomoso
1	Oyedemisola	BSS/MLH/H DRL/04	M	5/27/1975	Applicant	ELGA	Osun	Ede
2	Adedeji K. Tela	BSS/MLH/H DRL/04	M	9/14/2972	Teaching	ELGA	Osun	Ejigbo
3	Osunrayi Babtope	BSS/MLH/H DRL/04	M	12/12/1970	Surveying	ELGA	Ekiti	Ikole
4	Adebimpe Kamarudeen	BSS/MLH/H DRL/00	M	10/11/1972	Surveying	LLGA	Oyo	Ibadan
5	Ramoni Sakirat B.	BSS/MLH/H DRL/00	F	10/11/1976	Teaching	ILGA	Oyo	Ibadan
6	Alimi Oluwakemi	BSS/MLH/H DRL/00	F	2/20/1973	C/servant	KLGA	Oyo	Ibadan
7	Ajibola Fatai	BSS/MLH/H DRL/02	M	4/10/1960	Teaching	ILGA	Osun	Ikire
8	Dotun Obaju	BSS/MLH/H DRL/02	M	10/10/1973	Surveyor	LLGA	Oyo	Ibadan
9a	Hayatudeen Atiku	BSS/MLH/H DRL/02	M	12/12/1959	C/servant	KATSINA	Katsina	Katsina
9	Alh. Moh'd Moh'd	BSS/MLH/H DRL/02	M	10/261948	Applicant	BLGA	Niger	Bida
0	Akande Kazeem A.	BSS/MLH/	M	7/12/1971	C/servant	ILGA	Osun	Ikire
1	Akhidenor S. Otaifo	BSS/MLH/H DRL/03	M	10/5/1970	C/servant	PATANI	Delta	Patani
2	Okoroafor Ukamaka	BSS/MLH/H DRL/03	M	3/13/1972	C/servant	PATANI	Delta	Patani
38a	Chinyere Chukwueke	BSS/MLH/H DRL/03	F	1/10/1968	C/servant	SILGA	Bayelsa	Ikebiri
3a	Debbie Akpatakpa	BSS/MLH/H DRL/02	M	3/19/1970	Applicant	OGBIA	Delta	Otuokpoti
3b	Ajibola Waliyatu A.	BSS/MLH/H DRL/02	F	10/23/1963	Trading	ILGA	Osun	Apomu
3c	Amaina Tekerebo	BSS/MLH/H DRL/02	M	9/28/1970	Applicant	OGBIA	Delta	Otoukpoti
3d	Izibefien Atun	BSS/MLH/H DRL/02	M	8/19/1961	C/servant	SILGA	Bayelsa	Eni wari
3e	Lambart	BSS/MLH/H DRL/02	M	9/28/1950	Politician	SALGA	Beyelsa	Angarabir
480	Chief Philemon S.	BSS/MLH/H DRL/02	M	8/19/1952	P/Ruler	DEGAMA	Rivers	Degema

APPENDIX II

PARCEL TABLE

/ID	Use	Tenure	c. of Occ. Number	Reg. date	B/name	Area/M²
1	Residential	Lease hold	No 8 of page 2 volume 5	9/4/2001	B	
2	Residential	Lease hold	No 9 of page 2 volume 5	9/4/2001	B	
3	Residential	Lease hold	No 10 of page 2 volume 5	9/4/2001	B	
4	Residential	Lease hold	No 1 of page 3 volume 5	4/30/2002	B	
5	Residential	Lease hold	No 2 of page 3 volume 5	4/30/2002	B	
6	Residential	Lease hold	No 3 of page 3 volume 5	4/30/2002	B	
7	Residential	Lease hold	No 4 of page 3 volume 5	4/30/2002	B	
	Residential	Lease hold	No 5 of page 3 volume 5	4/30/2002	B	
	Residential	Lease hold	No 6 of page 3 volume 5	4/30/2002	B	
	Residential	Lease hold	No 7 of page 3 volume 5	4/30/2002	B	
	Residential	Lease hold	No 8 of page 3 volume 5	4/30/2002	B	
	Commercial	Lease hold	No 9 of page 3 volume 5	4/30/2002	B	
	Commercial	Lease hold	No 10 of page 3 volume 5	4/30/2002	B	
	Commercial	Lease hold	No 1 of page 4 volume 5	4/30/2002	B	
	Commercial	Lease hold	No 2 of page 4 volume 5	4/30/2002	B	
	Commercial	Lease hold	No 3 of page 4 volume 5	4/30/2002	B	
1	Commercial	Lease hold	No 4 of page 4 volume 5	4/30/2002	B	
2	Commercial	Lease hold	No 5 of page 4 volume 5	4/30/2002	B	
3	Commercial	Lease hold	No 6 of page 4 volume 5	6/6/2002	A	
4	Residential	Lease hold	No 7 of page 4 volume 5	6/6/2002	A	
5	Residential	Lease hold	No 7 of page 4 volume 5	6/6/2002	A	
6	Residential	Lease hold	No 8 of page 4 volume 5	6/6/2002	A	
7	Residential	Lease hold	No 9 of page 4 volume 5	6/6/2002	A	
8	Residential	Lease hold	No 10 of page 4 volume 5	6/6/2002	A	
9	Residential	Lease hold	No 10 of page 5 volume 5	6/6/2002	A	
0	Residential	Lease hold	No 2 of page 5 volume 5	6/6/2002	A	
1	Residential	Lease hold	No 3 of page 5 volume 5	6/6/2002	A	
2	Residential	Lease hold	No 4 of page 5 volume 5	6/6/2002	A	
3a	Residential	Lease hold	No 5 of page 5 volume 5	6/6/2002	A	
3	Residential	Lease hold	No 6 of page 5 volume 5	6/6/2002	A	
4	Residential	Lease hold	No 7 of page 5 volume 5	6/6/2002	A	
5	Residential	Lease hold	No 8 of page 5 volume 5	6/6/2002	A	
6	Residential	Lease hold	No 9 of page 5 volume 5	6/6/2002	A	
7	Residential	Lease hold	No 10 of page 5 volume 5	6/6/2002	A	
8	Commercial	Lease hold	No 1 of page 1 volume 5	7/15/2002	B	
19	Commercial	Lease hold	No 2 of page 1 volume 5	7/15/2002	B	
20	Commercial	Lease hold	No 3 of page 1 volume 5	7/15/2002	B	
21	Commercial	Lease hold	No 4 of page 1 volume 5	7/15/2002	B	
22	Commercial	Lease hold	No 5 of page 1 volume 5	7/15/2002	B	
23	Commercial	Lease hold	No 6 of page 1 volume 5	7/15/2002	B	
24	Commercial	Lease hold	No 7 of page 1 volume 5	7/15/2002	B	
25	Commercial	Lease hold	No 8 of page 1 volume 5	7/15/2002	B	
26	Commercial	Lease hold	No 9 of page 1 volume 5	7/15/2002	B	
27	Commercial	Lease hold	No 10 of page 1 volume 5	7/15/2002	B	
28	Commercial	Lease hold	No 1 of page 2 volume 5	12/3/2002	B	
129	Commercial	Lease hold	No 2 of page 2 volume 5	12/3/2002	B	
129A	Residential	Lease hold	No 3 of page 2 volume 5	12/3/2002	B	
129B	Residential	Lease hold	No 4 of page 2 volume 5	12/3/2002	B	
130	Residential	Lease hold	No 5 of page 2 volume 5	12/3/2002	B	

30A	Residential	Lease hold	No 6 of page 2 volume 5	12/3/2002	B	
30B	Residential	Lease hold	No 7 of page 2 volume 5	12/3/2002	A	
31	Residential	Lease hold	No 8 of page 2 volume 5	12/3/2002	A	
32	Residential	Lease hold	No 9 of page 2 volume 5	12/3/2002	A	
32A	Residential	Lease hold	No 10 of page 2 volume 5	12/3/2002	A	
33	Residential	Lease hold	No 1 of page 3 volume 5	12/3/2002	A	
34	Residential	Lease hold	No 2 of page 3 volume 5	12/3/2002	A	
5	Residential	Lease hold	No 3 of page 3 volume 5	12/3/2002	A	
6	Residential	Lease hold	No 4 of page 3 volume 5	12/3/2002	A	
7	Residential	Lease hold	No 5 of page 3 volume 5	12/3/2002	A	
8	Residential	Lease hold	No 6 of page 3 volume 5	12/3/2002	A	
9	Residential	Lease hold	No 7 of page 3 volume 5	9/4/2002	A	
9A	Residential	Lease hold	No 8 of page 4 volume 5	9/4/2002	A	
9B	Residential	Lease hold	No 9 of page 4 volume 5	9/4/2002	A	
9C	Residential	Lease hold	No 10 of page 4 volume 5	9/4/2002	A	
1A	Residential	Lease hold	No 1 of page 4 volume 5	9/4/2002	A	
1	Residential	Lease hold	No 2 of page 4 volume 5	9/4/2002	A	
2	Residential	Lease hold	No 3 of page 4 volume 5	9/4/2002	A	
3	Residential	Lease hold	No 4 of page 4 volume 5	9/4/2002	A	
4	Residential	Lease hold	No 5 of page 4 volume 5	9/4/2002	A	
5	Residential	Lease hold	No 6 of page 4 volume 5	9/4/2002	A	
6	Residential	Lease hold	No 7 of page 4 volume 5	9/4/2002	A	
7	Residential	Lease hold	No 8 of page 4 volume 5	9/4/2002	A	
8	Residential	Lease hold	No 9 of page 4 volume 5	9/4/2002	A	
9a	Commercial	Lease hold	No 10 of page 4 volume 5	9/4/2002	A	
9	Commercial	Lease hold	No 1 of page 5 volume 5	9/4/2002	A	
0	Commercial	Lease hold	No 2 of page 5 volume 5	9/4/2002	A	
1	Institutional	Lease hold	No 3 of page 5 volume 5	9/4/2002	A	
2	Residential	Lease hold	No 4 of page 5 volume 5	9/4/2002	B	
8a	Institutional	Lease hold	No 5 of page 5 volume 5	9/4/2002	B	
3a	Residential	Lease hold	No 6 of page 5 volume 5	9/4/2002	B	
3b	Residential	Lease hold	No 7 of page 5 volume 5	9/4/2002	B	
3c	Residential	Lease hold	No 8 of page 5 volume 5	9/4/2002	B	
3d	Residential	Lease hold	No 9 of page 5 volume 5	9/4/2002	B	
3e	Residential	Lease hold	No 10 of page 5 volume 5	9/4/2002	B	
30	Institutional	Lease hold	No 1 of page 5 volume 5	9/4/2002	B	

APPENDIX III

ARC

Arc No	B Node	E Node	R parcel	L parcel
1	3632	3950	88	89
2	3949	3950	0	87
3	3948	3949	0	86
4	3947	3948	0	85
5	3946	3947	0	8f4
6	3945	3946	0	83
7	3944	3945	0	82
8	3959	3944	81	96
9	3961	3959	96	0
10	3962	3961	95	0
11	3963	3962	94	0
12	3964	3963	93	0
13	3965	3964	92	0
14	3966	3965	91	0
15	3630	3966	90	0
16	3632	3630	88	89
17	3976	3973	112	113
18	3972	3973	0	111
19	3971	3972	0	110
20	3970	3971	0	109
21	3969	3970	0	108
22	3968	3969	0	107
23	3967	3968	0	106
24	3875	3967	0	105
25	3864	3875	0	104
26	3869	3864	0	103
27	3862	3869	0	102
28	3839	3868	101	124
29	3861A	3839	124	0
30	3172A	3861A	123	0
31	3171A	3172A	122	0
32	3971B	3171A	121	0
33	3984	3971B	120	0
34	3985	3984	119	0
35	3986	3985	118	0
36	3987	3986	117	0
37	3988A	3987	116	0
38	3988	3988A	115	0
39	3989	3988	114	0
40	3976	3989	112	113

41	3861B	3863A	125	131
42	3865A	3863A	0	126
43	3844	3865A	127	128
44	3846	3844	128	129
45	3847	3846	129	129A
46	3848	3847	129A	129B
47	3851	3848	129B	0
48	3854	3851	130A	130B
49	3857	3854	130	130A
50	3858	3857	131	130
51	3861B	3858	125	131
52	3378	3907A	146	147
53	3905	3907A	145	144
54	3904	3905	144	143
55	3903	3904	143	142
56	3902	3903	142	141
57	3900	3902	141	141A
58	3895	3900	0	113A
59	3892	3895	0	139A
60	3891	3892	0	139
61	3896A	3891	0	138
62	3897A	3896A	0	137
63	3893A	3897A	0	136
64	3891B	3893A	0	135
65	3890	3891B	0	134
66	3880	3890	134	133
67	3881	3880	133	132
68	3882	3881	132	132A
69	2885	3882	132a	0
70	3898	3885	139C	0
71	3899	3898	139A	0
72	3893	3899	113A	0
73	3894	3893	141A	0
74	3815	3894	149A	0
75	3917	3815	149	149A
76	3911	3917	148	149
77	3380	3911	147	148
78	3920	3993	150	151
79	3996	3920	0	152
80	3992	3993	150	151
81	3927	3940	0	1938000
82	3930	3927	3130E	3130D
83	3933	3930	3130D	3130C

84	3934	3933	3130C	3130B
85	3937	3934	3130B	3130A
86	3940	3937	3130A	0
87	3936	3940	3130B	3130A
88	3935	3936	3130C	3130B
89	3932	3935	3130D	3130C
90	2931	3932	3130E	3130D
91	3927	3931	0	3130E
92	3957	3950	87	88
93	3657	3630	90	89
94	3953	3949	86	87
95	3953	3966	91	90
96	3954	3948	85	86
97	3954	3965	92	91
98	3955	3947	84	85
99	3955	3964	93	92
100	3956	3946	83	84
101	3956	3963	94	93
102	3957	3945	82	83
103	3957	3962	95	94
104	3958	3944	81	82
105	3958	3961	96	95
106	3977	3973	111	112
107	3977	3989	114	113
108	3978	3972	110	111
109	3978	3988	115	114
110	3979	3971	109	110
111	3979	3988A	116	115
112	3980	3970	108	109
113	3980	3987	117	116
114	3981	3969	107	108
115	3981	3986	118	117
116	3982	3968	106	107
117	3982	3985	119	118
118	3983	3967	105	106
119	3983	3984	120	117
120	3876	3875	104	105
121	3876	3971B	121	120
122	3873	3864	103	104
123	3873	3171A	122	121
124	3870	3869	102	103
125	3870	3172A	123	122
126	3861	3868	101	102

127	3861	3861A	124	123
128	3845	3865A	127	126
129	3860	3863A	126	125
130	3860	3859	128	131
131	3856	3855	129A	130A
132	3855	3851	129B	130B
133	3888	3890	134	135
134	3889	3891B	135	136
135	3889	3887	133	139C
136	3886	3887	132	139C
137	3886	3885	132A	139C
138	3890B	3893A	136	137
139	3877A	3897A	137	138
140	3877	3896A	138	139
141	3877	3898	139C	139B
142	3890A	3891	139	139A
143	3890A	3899	139B	139A
144	3877	3907A	145	146
145	3377	3902A	144	147
146	3901	3902A	143	148
147	3901	3913	142	149
148	3814	3913	141	149A
149	3814	3815	141A	149A

Node Table

APPENDIX IV

Nodeid	Easting	Northing
3171A	1025109.063	321752.750
3172A	1025089.250	321754.969
3832	1025143.438	322038.938
3833	1025149.500	322028.750
3834	1025117.875	321828.938
3835	1025054.563	321836.219
3837	1025055.188	321821.344
3838	1025046.313	321811.094
3839	1025044.375	321792.188
3840	1025041.813	321766.313
3841	1025049.375	321759.313
3842	1025046.000	321743.500
3843	1025039.250	321740.125
3844	1025036.250	321708.594
3845	1025055.000	321707.656
3846	1025032.875	321673.188
3847	1025035.375	321643.656
3848	1025037.438	321620.188
3849	1025038.563	321607.156
3850	1025050.313	321599.000
3851	1025071.375	321602.031
3852	1025092.625	321605.156
3853	1025098.563	321614.688
3854	1025099.125	321624.875
3855	1025071.000	321627.031
3856	1025073.875	321650.031
3857	1025100.250	321647.344
3858	1025102.000	321674.594
3859	1025074.125	321676.781
3860	1025075.375	321705.969
386102	1025104.125	321703.813
3862	1025106.375	321731.219
3863	1025099.000	321739.031
3863A	1025077.500	321741.844
3864	1025115.750	321814.188
3865A	1025058.500	321744.969
3868	1025075.125	321818.969
3869	1025096.000	321816.563
3870	1025092.813	321786.406
3873	1025112.813	321784.125
3875	1025136.563	321811.875
3876	1025132.938	321781.781
3876A	1025122.250	321736.000
3877	1025212.125	321689.781
3877A	1025194.063	321691.594
3879	1025116.313	321731.469
3880	1025115.250	321698.563
3881	1025114.438	321676.063
3882	1025113.250	321645.719
3883	1025112.313	321614.281
3884	1025121.500	321607.219
3885	1025150.125	321614.156
3886	1025151.688	321643.875
3887	1025152.750	321671.719
3888	1025134.313	321697.750
3889	1025154.375	321695.750
3960	1025122.250	321828.063

Node Table

Node_id	Easting	Northing
3961	1025144.688	321825.563
3962	1025166.125	321823.156
3963	1025187.375	321820.688
3964	1025209.313	321818.156
3965	1025231.063	321815.813
3966	1025254.500	321813.438
3630	1025277.250	321810.563
3631	1025300.000	321808.000
3049	1025305.625	321810.250
3632	1025309.688	321838.125
3657	1025281.750	321841.313
3953	1025259.250	321843.844
3954	1025235.375	321846.469
3955	1025213.625	321848.906
3956	1025191.938	321851.375
3957	1025170.625	321854.000
3958	1025149.313	321856.563
3959	1025127.500	321857.906
3941	1025134.250	321900.063
3943	1025143.688	321888.500
3944	1025153.563	321887.438
3945	1025174.938	321885.063
3946	1025196.375	321882.656
3947	1025218.188	321880.250
3948	1025240.063	321877.844
3949	1025263.750	321875.250
3950	1025286.250	321872.750
3951	1025310.188	321870.094
3952	1025313.188	321863.250
3834	1025117.875	321828.938
3942	1025132.250	321910.594
3833	1025149.500	322028.750
3832	1025143.438	322038.938
3928A	1025083.000	322045.125
3929A	1025073.000	322039.000
3938A	1025047.813	321844.969
3928	1025174.813	322036.000
3929	1025164.438	322029.781
3930	1025161.375	322008.375
3933	1025157.375	321979.906
3934	1025153.438	321951.906
3937	1025149.688	321925.906
3938	1025147.375	321909.719
3939	1025153.625	321900.000
3940	1025205.563	321894.156
3936	1025209.813	321922.000
3935	1025213.500	321946.156
3932	1025217.625	321972.875
3931	1025222.188	322003.281
3927	1025226.125	322029.094
3926	1025400.063	322010.000
3925	1025406.000	322004.469
3923	1025389.938	321881.313
3924	1025381.938	321874.813
3976	1025299.477	321761.926
3975A	1025302.915	321787.025
3974	1025299.182	321793.176

Node Table

Node id	Easthing	Northing
3973	1025274.450	321795.838
3972	1025254.217	321798.352
3971	1025234.531	321800.581
3970	1025215.651	321802.787
3969	1025195.653	321805.084
3968	1025176.120	321807.365
3967	1025156.114	321809.650
3975	1025136.554	321811.880
3861	1025071.580	321788.515
3983	1025152.725	321779.328
3982	1025172.800	321777.007
3981	1025192.643	321774.588
3980	1025212.625	321772.269
3979	1025232.548	321769.861
3978	1025252.403	321769.461
3977	1025273.068	321765.142
3991	1025296.130	321738.089
3989	1025268.419	321735.236
3988	1025248.550	321737.402
3988A	1025228.495	321739.686
3987	1025209.142	321741.931
3986	1025189.162	321744.063
3985	1025170.242	321746.185
3984	1025149.355	321748.431
3971B	1025129.860	321750.570
3971A	1025109.039	321752.764
3861A	1025067.150	321757.380
3990	1025290.065	321732.677
3890	1025136.330	321734.630
3890B	1025174.650	321693.760
3893A	1025176.800	321730.370
3897A	1025196.230	321728.210
3896A	1025216.209	321727.192
3890A	1025241.868	321686.819
3891	1025245.575	321724.391
3892	1025276.041	321721.588
3893	1025273.466	321675.912
3899	1025242.035	321660.146
3894	1025301.913	321690.107
3897	1025292.999	321720.139
3896	1025300.025	321720.683
3895	1025306.651	321726.170
3900	1025308.233	321738.093
3902	1025311.759	321764.056
3903	1025314.952	321788.682
3904	1025318.358	321813.459
3905	1025322.006	321839.994
3906	1025325.091	321862.433
3907	1025332.126	321865.954
3907A	1025357.152	321864.436
3377	1025353.386	321836.795
3902B	1025350.021	321812.023
3901	1025346.554	321786.501
3913	1025343.047	321760.927
3814	1025345.427	321734.749
3815	1025347.287	321718.507
3916	1025368.833	321732.015

Node Table

Node id	Easthing	Northing
3917	1025372.770	321760.008
3911	1025376.464	321785.915
3380	1025380.030	321811.632
3378	1025383.176	321832.989
3910	1025386.226	321854.219
3909	1025380.235	321863.271
3921	1025405.500	321860.000
3920	1025396.021	321800.151
3918	1025384.965	321696.366
3918A	1025394.140	321692.103
3993	1025494.486	321763.140
3992	1025476.003	321800.002
3996	1025468.000	321819.850
3922	1025460.000	321851.051
3995	1025494.002	321834.026
3994	1025515.960	321778.342
3891B	1025157.744	321732.640
3898	1025217.888	321648.132