A PROJECT REPORT

ON

LAND INFORMATION SYSTEM OF GOVERNMENT SECONDARY SCHOOL, MARABA, ILORIN SOUTH LGA KWARA STATE.

BY

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HND/23/SGI/FT/0091

SUBMMITED TO:

THE DEPARTMENT OF SURVEYING AND GEO-INFORMATICS, INSTITUTE OF ENVIRONMENTAL STUDIES, KWARA STATE POLYTECHNIC ILORIN.

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF HIGHER NATIONAL DIPLOMA IN SURVEYING AND GEO-INFORMATICS.

JUNE, 2025

DECLARATION

I hereby certify that all the information given in this project was obtain as result of field observation and measurement made by me and that the survey was carried out in accordance with survey rules and regulation and department instructions.

NAME: FATHOYINBO THERESA

MATRIC NO: HND/23/SGI/FT/0091

DATE:

SIGNATURE:

CERTIFICATION

This is to certify that this project report was prepared and submitted by FATHOYINBO THERESA of Matric No: HND/20/SGI/FT/0091 to the Department of Surveying and Geo-Informatics, Institute of Environmental Studies Kwara State Polytechnic Ilorin, as a result of field observation and measurement using appropriate instrument and equipment to carry out the task.

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SURV. ABIMBOLA IBRAHIM ISAU DATE

Project Supervisor

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SURV. ABIMBOLA IBRAHIM ISAU DATE

Head of Department

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SURV. R.S AWOLEYE DATE

Project Coordinator

DEDICATION

This project is dedicated to Almighty Allah and to my loving parents whose continuous effort, support and encouragement made it possible for me to participate in this project.

ACKNOWLEDGEMENT

My sincere gratitude goes to all who made this project a reality. **SURV. ABIMBOLA IBRAHIM ISAU,** your guidance was invaluable. I appreciate the dedication of my Teammates and Colleagues, whose Collaborative efforts brought our project to fruition. Our institution's support was crucial in ensuring a smooth execution.

Lastly, my family, friends, and loved ones provided unwavering support and Motivation. Their belief in my abilities kept me focused on our project's objectives. Together, your collective contributions have been the driving force behind this project's success, and for that, I'm profoundly thankful.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The study of the Land Information System (LIS) at Government Secondary School, Maraba, Ilorin, Kwara State, is situated within the broader context of land administration and geospatial management in Nigeria. Land Information Systems are critical tools for managing spatial and non-spatial data related to land ownership, usage, and planning, particularly in urban and semi-urban areas experiencing rapid demographic and infrastructural changes (Yusuf & Ogunjobi, 2019).

In Ilorin, the capital of Kwara State, urbanization pressures and population growth have intensified the need for systematic land governance to address issues such as land encroachment, disputes, and inefficient land use in public institutions like schools. Government Secondary School, Maraba, as a public educational institution, represents a microcosm of these challenges, where unplanned expansion, unclear land boundaries, and inadequate documentation have historically hampered effective land management (Adeyemi & Alabi, 2020). The school's land, like many public lands in Nigeria, is governed under the Land Use Act of 1978, which vests land ownership in the state government, but implementation gaps often lead to ambiguities in tenure and administration (Olajide & Adewumi, 2018).

The conceptual framework for this study draws from interdisciplinary research on land administration systems in sub-Saharan Africa, where scholars like Enemark et al. (2016) emphasize the role of LIS in enhancing transparency, reducing conflicts, and supporting sustainable development. In Nigeria, studies by Bello and Ahmed (2020) have highlighted the inefficiencies in land record-keeping at the local government level, particularly in Kwara

State, where manual systems dominate and digital integration remains limited. For instance, a survey by the Kwara State Ministry of Lands and Housing (2017) revealed that over 60% of public institutions lack digitized land records, leading to bureaucratic delays and vulnerability to land-grabbing. At Government Secondary School, Maraba, these systemic issues are compounded by the school's historical establishment during the colonial era, with land documents often fragmented or lost due to poor archival practices (Salami & Abdulraheem, 2021). Furthermore, the absence of geospatial technologies, such as Geographic Information Systems (GIS) and Global Positioning Systems (GPS), limits the school's ability to map its boundaries accurately or monitor encroachments, a problem echoed in similar studies on Nigerian public schools by Usman et al. (2021).

The urgency of implementing an LIS at the school aligns with global trends toward smart land governance, as advocated by the United Nations' Sustainable Development Goals (SDGs), particularly Goal 11 (Sustainable Cities and Communities) and Goal 16 (Peace, Justice, and Strong Institutions) (UN-Habitat, 2020). Locally, the Kwara State Geographic Information Service (KW-GIS) has initiated efforts to digitize land records, but public schools like Maraba's Government Secondary School remain underserved due to funding constraints and prioritization of commercial land parcels (Kwara State Government, 2021). Academic research by Ibrahim et al. (2019) underscores the socio-economic implications of poor land management in schools, including reduced infrastructural development and compromised security. For example, a case study by Abdulrahman and Sule (2022) on schools in Ilorin found that unresolved land disputes diverted administrative focus from educational objectives, thereby affecting student performance. This study, therefore, seeks to bridge the gap between policy frameworks and on-ground implementation by proposing a tailored LIS model for Government Secondary School, Maraba, integrating participatory mapping, community engagement, and open-source geospatial tools, as recommended by international best practices (Williamson et al., 2010).

In conclusion, the background to this study emphasizes the intersection of legal, technological, and institutional factors shaping land management at Government Secondary School, Maraba. By synthesizing insights from Nigerian land policy literature, global LIS frameworks, and localized challenges, the research aims to contribute actionable strategies for enhancing land governance in public educational institutions. This aligns with calls by scholars like Nuhu (2023) for context-specific solutions to Nigeria's land administration crises, ensuring that schools like Maraba's can secure their land assets for future generations. The findings will also inform policymakers at the Kwara State Ministry of Education and the Nigerian Institution of Estate Surveyors and Valuers (NIESV) on the critical need for investing in LIS infrastructure as a pillar of educational and community development.

1.2 STATEMENT OF THE PROBLEM

Land administration and management in Government Secondary School Maraba continues to form critical inefficiencies, lack of coordination, and outdated systems in the study area. These problems underscore a deeper need, the urgent implementation of a digital solution that can integrate spatial data, and land use details into a unified platform.

Therefore, this project seeks to address these challenges by designing and implementing a Land Information System that is intelligent, accessible, and tailored to support effective land administration and sustainable development in Government Secondary School Maraba.

1.3 AIM AND OBJECTIVES OF THE PROJECT

1.3.1 AIM

The primary aim of this study is to design and implement a functional Land Information System (LIS) that enhances the efficiency, accuracy, and transparency of land management processes within Government Secondary School Maraba, Ilorin East Local Government, Ilorin Kwara State. The system will serve as a digital platform for organizing, storing, retrieving, and managing land-related data, with the ultimate goal of supporting effective decision-making, reducing land disputes, improving access to land records, and promoting sustainable land administration at the institutional level.

1.3.2 OBJECTIVES

The specific objectives of this study are

1. Design a user-friendly Land Information System capable of managing land and usage data in a centralized digital format.
2. Geometric and attribute data acquisition
3. Implement core features of the system including data entry, spatial mapping, search and retrieval functions, and secure access control.
4. Integrate Geographic Information System (GIS) tools to visualize and enable locationbased analysis and decision-making.
5. Evaluate the performance of the developed system in terms of accuracy, usability, responsiveness, and reliability.
6. To produce plans as graphical representation

1.4 SCOPE OF THE PROJECT

The scope of this project covers the following major phases and activities:

i. Reconnaissance Survey: Preliminary field inspection to understand the area of study, identify existing features and determine control points needed for mapping.

ii. Office Planning: Preparation of necessary materials, equipment checks, defining the workflow, and gathering existing maps or records for the project area.

iii. Data Acquisition: Collection of spatial and non-spatial data through total station.

iv. System Design and Implementation: Development of a functional Land Information System to address land management and decision making.

v. Documentation and Reporting: Compilation of project activities, methodologies, system features, and outcomes into a final technical report.

1.5 PERSONNEL

The students listed below were the members of this group who participated in the execution of the project.

NAME	MATRIC NO.
FATOYINBO THERESA	HND/23/SGI/FT/0091
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SAMSON DANIEL OLUWATOBILOBA	HND/22/SGI/FT/121

1.6 PROJECT SPECIFICATION

This project is aimed at building a Land Information System (LIS) to support effective land management. The system will combine both spatial (map-related) and nonspatial (text-based) information to help users register, retrieve, and visualize land records.

1.7 STUDY AREA

Government Day Secondary School, Maraba, is located in Ilorin South Local Government Area of Kwara State, Nigeria. The school serves as a public secondary institution providing basic and senior secondary education to students in the Maraba area and its environs. Maraba is a semi-urban area within Ilorin metropolis, characterized by moderate development, expanding residential zones, and increasing demand for educational facilities.

The choice of this school as a case study is influenced by its central location, increasing student population, and visible infrastructural expansion. The geographical coordinates of the school were established during the field survey using Total Station, and its spatial features were mapped and analyzed using GIS techniques.

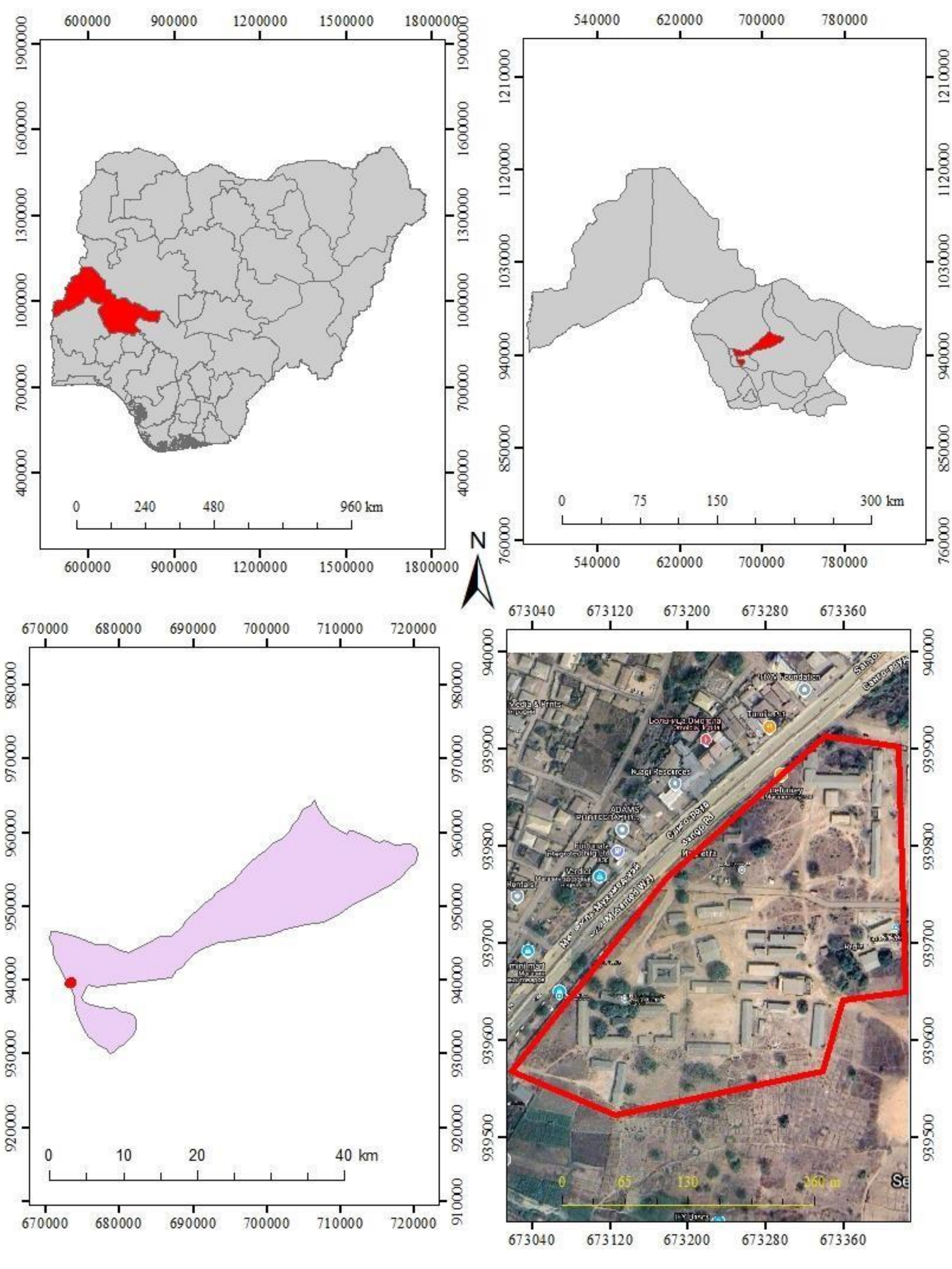


Figure 1.1: Study area Map

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The integration of Land Information Systems (LIS) into educational facilities management has become an increasingly important aspect of effective land and resource management. As schools grow in complexity and size, the ability to effectively manage land, buildings, and infrastructure through a centralized database has proven to be crucial for maintaining operational efficiency. With the rise of GIS (Geographic Information Systems) and modern data technologies, educational institutions are now exploring the potential of LIS to streamline administrative processes, enhance spatial planning, and optimize the management of physical assets such as classrooms, staff rooms, and utility systems. This chapter presents an in-depth review of literature focusing on the development and applications of LIS, particularly in secondary schools, with an emphasis on recent advancements in the field. It discusses the evolution of LIS, its components, integration with GIS and BIM (Building Information Modeling), and its impact on institutional management and planning.

2.2 CONCEPT OF LAND INFORMATION SYSTEM (LIS)

A Land Information System (LIS) is essentially a computer-based tool that allows the management of land-related information such as boundaries, property ownership, land use, and other relevant spatial data. It is designed to store, analyze, and retrieve spatial and nonspatial data. LIS integrates geographic information with attribute data to support decisionmaking in land administration and resource management. According to Williamson et al. (2010), an LIS consists of a spatial database for storing geographically referenced data, a set of applications for processing and analyzing this data, and a user interface for interacting with the system.

Dale and McLaughlin (1988) laid foundational principles in their seminal work *Land Information Management*, positioning LIS as a tool to integrate cadastral records, land tenure data, and technical mapping systems. They emphasized its role in resolving land disputes and improving governance by harmonizing legal and technical workflows.

Building on this, **Williamson and Ting (1990)** expanded the scope of LIS in their ISPRS journal article, linking it to sustainable development and urban planning. They argued that LIS could address land tenure insecurity in developing regions, a theme later echoed by organizations like the **International Federation of Surveyors (FIG)**, which formalized LIS standards in their 1995 *Statement on the Cadastre* to promote interoperability and cadastral reform globally.

By the 2000s, LIS evolved into a socio-technical system. **Enemark et al. (2005)** highlighted its role in governance and poverty reduction in a UN-FIG report, advocating for its integration with Spatial Data Infrastructures (SDIs) to support land rights and policy frameworks. Similarly, **Rajabifard et al. (2006)** emphasized multi-level data sharing and hierarchical governance models in their research, while **Zevenbergen et al. (2007)** explored LIS as a mechanism for reducing inequality through secure land registration in World Bank studies. These works underscored LIS's growing relevance in addressing global challenges like urbanization and resource management.

In the 2010s and 2020s, technological advancements reshaped LIS frameworks. **Steudler and Williamson (2017)** reimagined cadastral systems in *Cadastre 2014 and Beyond*, proposing blockchain and AI integration to enhance transparency and reduce fraud. Meanwhile, **Bennett et al. (2020)** linked LIS to climate resilience in a UNHabitat report, demonstrating its utility in tracking land degradation and disaster risks. Recent innovations by scholars like **Koeva et al. (2021)** have introduced UAVs and machine learning to automate land mapping, while **Goodchild (2022)** conceptualized LIS as part of
"digital twin" ecosystems powered by IoT and real-time analytics. Organizations like the **UN-GGIM (2023)** further advocate for global standardization through initiatives like the Integrated Geospatial Information Framework (IGIF), ensuring equitable access to land data.

In educational contexts, LIS serves as an effective tool for managing school properties, including the mapping of building footprints, managing land tenure, and supporting future development and expansion plans. LIS can also provide real-time data on land use patterns, supporting more sustainable urban development by aiding in the planning of new educational facilities. The system helps school administrators in making informed decisions regarding land acquisition, school expansion, resource management, and infrastructure development (Osei-Tutu, 2011).

LIS has transitioned from a niche cadastral tool to a cornerstone of sustainable development, intersecting law, geomatics, and environmental science. Its applications now span climate adaptation, gender equity in land rights, and decentralized governance. Emerging trends focus on democratizing land data through open-source platforms and addressing ethical challenges in AI-driven systems. As LIS continues to evolve, its integration with universal frameworks like the UN Sustainable Development Goals (SDGs) ensures its enduring relevance in fostering equitable and resilient societies.

2.3 EVOLUTION OF LAND INFORMATION SYSTEMS

The evolution of Land Information Systems has been a gradual process, shaped by advancements in technology and the increasing complexity of land management. Initially, land records were manually maintained in paper-based systems, which were prone to errors and inefficiencies. However, with the rise of GIS in the late 20th century, the manual recording of land data became obsolete. GIS technology enabled land-related data to be digitized, analyzed, and stored in databases, drastically improving data accessibility and the speed at which spatial analyses could be performed.

Emerging in the 1980s, LIS was initially conceptualized as a tool to unify legal, administrative, and spatial land data, with pioneers like **Dale and McLaughlin (1988)** advocating for its role in resolving land disputes and enhancing transparency. By the 1990s, scholars such as **Williamson and Ting (1990)** expanded its scope, positioning LIS as a cornerstone of urban planning and sustainable development, particularly in addressing land tenure insecurity in rapidly urbanizing regions. The International Federation of Surveyors (FIG) further institutionalized LIS in 1995, promoting standardization and interoperability to support cadastral reforms worldwide. The 2000s marked a paradigm shift, as LIS evolved into a socio-technical system intertwined with Spatial Data Infrastructures (SDIs) and global policy frameworks.

Researchers like **Enemark et al. (2005)** and **Zevenbergen et al. (2007)** highlighted its potential in poverty reduction and equitable land governance, particularly in developing economies, while advancements in GIS and remote sensing enabled real-time land monitoring. The 2010s and 2020s ushered in a technological revolution, with innovations such as blockchain, AI, and UAVs redefining LIS capabilities.

Steudler and Williamson (2017) envisioned decentralized, fraud-resistant cadastres, while **Bennett et al. (2020)** linked LIS to climate resilience, emphasizing its role in tracking environmental degradation and disaster risks. Contemporary scholars like **Koeva et al. (2021)** and **Goodchild (2022)** have integrated machine learning, IoT, and "digital twin" models into LIS, enabling predictive analytics and real-time decision-making. Today, LIS is a multidisciplinary nexus of law, geospatial science, and environmental policy, underpinning global initiatives like the UN Sustainable Development Goals (SDGs) and the Integrated Geospatial Information Framework (IGIF). Its evolution reflects a relentless drive toward democratizing land data, enhancing transparency, and fostering resilience in an era of climate crises and digital transformation.

The evolution of LIS continued through the integration of more advanced tools, such as GPS (Global Positioning Systems) and Total Stations, which enabled the precise collection of geospatial data. More recently, the incorporation of blockchain technology into LIS has introduced new opportunities for enhancing the transparency and security of land records (Shahariar et al., 2023). Blockchain's decentralized nature ensures that land ownership records are tamper-proof, reducing fraudulent activities that are often associated with land transactions.

As the demands for urban development grow, there is a movement toward developing more comprehensive LIS solutions that are capable of integrating real-time data from IoT devices, sensors, and environmental monitoring systems. These modern systems provide a detailed, dynamic view of land use, infrastructure conditions, and environmental factors, which helps to improve the overall management of land and property (Mylonas et al., 2019).

2.4 COMPONENTS AND ARCHITECTURE OF LIS

The structure and design of an LIS are based on several key components that work together to provide comprehensive land management capabilities. These components include spatial data, attribute data, hardware, software, and procedures for data processing and management.

- **Spatial Data**: This refers to data that is geographically referenced, such as maps, aerial imagery, land parcels, and building footprints. GIS tools such as ArcGIS and QGIS are used to process, analyze, and visualize spatial data.
- **Attribute Data**: These are descriptive data linked to spatial data. For example, a land parcel may be linked to information about ownership, land use, zoning, and building details.
- **Hardware and Software**: Hardware components, such as GPS receivers, Total Stations, and drones, are used to collect spatial data. Software like AutoCAD, ArcGIS, and Surfer are essential for data processing, visualization, and analysis. These tools provide the interface through which users can interact with the system.
- **Procedures and Personnel**: Data collection and analysis within LIS follow standardized procedures to ensure accuracy and consistency. These procedures typically involve field data collection using surveying equipment, followed by data integration

into the LIS database. Skilled personnel, including surveyors, GIS analysts, and data managers, are necessary for the effective operation of an LIS (FIG, 1995).

The architecture of LIS often follows a client-server model, where a central server hosts the system's database, and multiple users can access and interact with the system remotely. Integration with other systems, such as financial management tools or facility maintenance software, can improve operational efficiency.

2.5 APPLICATION OF LIS IN INSTITUTIONAL MANAGEMENT

Land Information Systems (LIS) have become indispensable tools for institutional management, revolutionizing how governments, municipalities, and organizations govern land resources, streamline administrative workflows, and enhance decision-making.

By integrating cadastral, legal, and spatial data into unified digital platforms, LIS enables institutions to manage land tenure, zoning regulations, and property rights with unprecedented efficiency. For instance, municipal planning authorities leverage LIS to automate land-use planning, monitor urban sprawl, and allocate resources for infrastructure projects, ensuring alignment with sustainable development goals.

In land administration, institutions use LIS to resolve tenure conflicts, accelerate property registration, and maintain transparent land records, reducing bureaucratic delays and corruption risks. Agricultural departments rely on LIS to optimize land allocation for farming, track soil health, and implement climate-resilient practices, fostering food security and rural development. Financial institutions, such as banks, utilize LIS to assess property valuations and collateral risks, enhancing loan approval processes. Furthermore, LIS supports disaster management agencies by mapping vulnerable zones, enabling proactive risk mitigation and post-disaster recovery planning. The interoperability of LIS with other institutional systems, such as tax databases and environmental monitoring tools, ensures cohesive policy implementation.

By fostering data-driven governance, LIS empowers institutions to enhance accountability, reduce operational costs, and align land-related decisions with broader socioeconomic and environmental objectives, ultimately strengthening institutional resilience and public trust.

2.6 GIS TECHNIQUES IN BUILDING AND TOPOGRAPHICAL MAPPING

Geographic Information Systems (GIS) have revolutionized building and topographical mapping by integrating advanced spatial data collection, analysis, and visualization techniques. In **topographical mapping**, GIS leverages technologies such as **LiDAR (Light Detection and Ranging)** and **aerial photogrammetry** to generate highresolution Digital Elevation Models (DEMs) and Digital Terrain Models (DTMs). These tools capture elevation data, slope gradients, and landform features with millimeter-level precision, enabling accurate representations of natural landscapes, drainage patterns, and geological hazards. Satellite imagery and multispectral sensors further enhance these maps by incorporating land cover classification, vegetation density, and hydrological networks.

For **building mapping**, GIS employs **3D modeling** and **Building Information Modeling (BIM)** integration to create detailed structural footprints, floor plans, and façade analyses. Techniques like **terrestrial laser scanning** and **drone-based photogrammetry** capture intricate details of buildings, including height, volume, and material composition, which are critical for urban planning, heritage conservation, and disaster resilience. Attribute data linked to spatial features—such as building ownership, zoning regulations, and utility networks—are stored in geodatabases, enabling dynamic queries and scenario simulations.

GIS also facilitates **spatial analysis**, such as line-of-sight calculations for telecommunications towers, shadow impact studies for high-rise developments, and flood risk modeling for infrastructure projects. The integration of **real-time GPS** and **IoT sensors** allows for continuous updates to maps, reflecting changes in land use or structural conditions.

Furthermore, cloud-based GIS platforms enable collaborative mapping, where stakeholders across disciplines can access, edit, and analyze spatial data simultaneously. By bridging traditional cartography with cutting-edge technologies, GIS not only enhances the accuracy and efficiency of building and topographical mapping but also supports sustainable urban development, environmental management, and emergency response planning.

2.7 PREVIOUS STUDIES ON LIS DEVELOPMENT IN SCHOOLS AND INSTITUTIONS

Several studies have demonstrated the potential benefits of using LIS for school infrastructure and facility management. For example, Olaleye et al. (2012) developed an LIS for the Obafemi Awolowo University campus, which facilitated better management of property, space allocation, and infrastructure. This LIS allowed the university to track land and facilities effectively, reducing the risks of land disputes and providing the data necessary for planning further campus development.

Aina (2017) applied GIS to map educational facilities in Lagos State, Nigeria, showing how spatial information could be used for effective planning and maintenance. The results highlighted the potential of GIS in improving school infrastructure management, leading to more informed decision-making and better resource allocation.

In Ghana, the development of the Ghana Enterprise Land Information System (GELIS) has proven to be an important tool in managing land records across the country. This system has helped improve land administration and reduced the instances of land disputes, enabling better planning for infrastructure and public services (Ansah et al., 2024).

2.8 CHALLENGES IN IMPLEMENTING LIS IN INSTITUTIONAL ENVIRONMENTS

The implementation of Land Information Systems (LIS) within institutional settings is fraught with multifaceted challenges that stem from technical, organizational, and sociopolitical barriers.

One significant hurdle is **data fragmentation**, where institutions often operate with siloed, legacy systems that store land records in incompatible formats, hindering seamless data integration. This fragmentation is compounded by **interoperability issues**, as differing software standards and protocols across departments or agencies impede the creation of unified platforms. Financial constraints also pose a critical challenge, particularly for underresourced institutions, where the high costs of procuring advanced geospatial technologies, training personnel, and maintaining infrastructure compete with other budgetary priorities.

Additionally, **institutional resistance to change**—rooted in bureaucratic inertia, lack of technical literacy, or skepticism toward digitization—slows adoption and undermines stakeholder buy-in. Legal and policy ambiguities, such as outdated land tenure laws, overlapping jurisdictional mandates, or weak governance frameworks, further complicate compliance and standardization efforts. Data privacy and cybersecurity risks emerge as pressing concerns, especially when handling sensitive cadastral or ownership information, necessitating robust safeguards that many institutions lack the capacity to implement.

Finally, sustaining LIS functionality over the long term requires continuous updates, adaptive governance, and cross-sector collaboration, which are often neglected due to shifting political priorities or institutional short-termism. These challenges collectively stifle the potential of LIS to enhance transparency, efficiency, and equity in land management, demanding holistic strategies that address technological, financial, and cultural gaps in tandem.

CHAPTER THREE

3.0 METHODOLOGY

This explained the method and techniques used to pursue the objectives and to realize the aims of this project work, the execution of this project was based on the following basic principle of surveying

- Working from whole to the part.
- The principle of choosing the method of survey most appropriate to meet the desired result.
- The principle of provision for adequate checks to meet the required accuracy

3.1 PROJECT PLANNING

Effective planning is essential before initiating any survey project. This process begins with a thorough inspection of the project area, allowing the researchers to gain a clear understanding of the site prior to commencing fieldwork, known as "RECONNAISSANCE". Reconnaissance typically consists of two main components: (i) Office Planning (ii) Field Reconnaissance

Effective surveying begins with comprehensive project planning, a systematic process that establishes the foundation for accurate data collection. This preparatory stage involves:

- Thorough research on the targeted land parcel
- Clear definition of survey objectives and deliverables
- Precision assessment to determine methodology and equipment.

3.1.1 OFFICE PLANNING

Office planning which could be termed as office reconnaissance involved knowing the type of instruments, purpose, specification and accuracy require of the survey to be carried out. These led to the choosing of appropriate equipment and method to be employed, also costing of the survey operation was done in the office. Information related to the project was collected from various sources, the coordinate (x, y, and z) of the initial and that of the three choosing controls used for orientation were all obtained from survey department office (KWGIS).

3.1.2 FIELD RECONNAISSANCE

The project site was visited by all the group members to have the true picture of the site for the better planning. The recce diagram was drawn alongside the carrying out and the reasonable artificial features were fixed along and within the traverse lines, the traverse was fixed to maintain perfect indivisibility.

3.2 DATA BASE DESIGN

The design of any database involves three stages namely;

- Conceptual design
- Logical design
- Physical design

VIEWOF REALITY

In database design, there is need for reality which is referred to as the phenomenon that actually exists, including all aspects which may or may not be perceived by individuals. The view of reality however, is the mental abstraction of the reality for a particular application or group of applications.

For this application, the view of reality is made of the topography of the project. Since it is not possible to represent the real world, the only option is to conceptualize and model it in a specified manner to represent the real world. The area of interest to use in this project includes; Green Reserve, Roads, Electric poles, Trees, Water Facilities, Buildings, Football pitch, Streams.

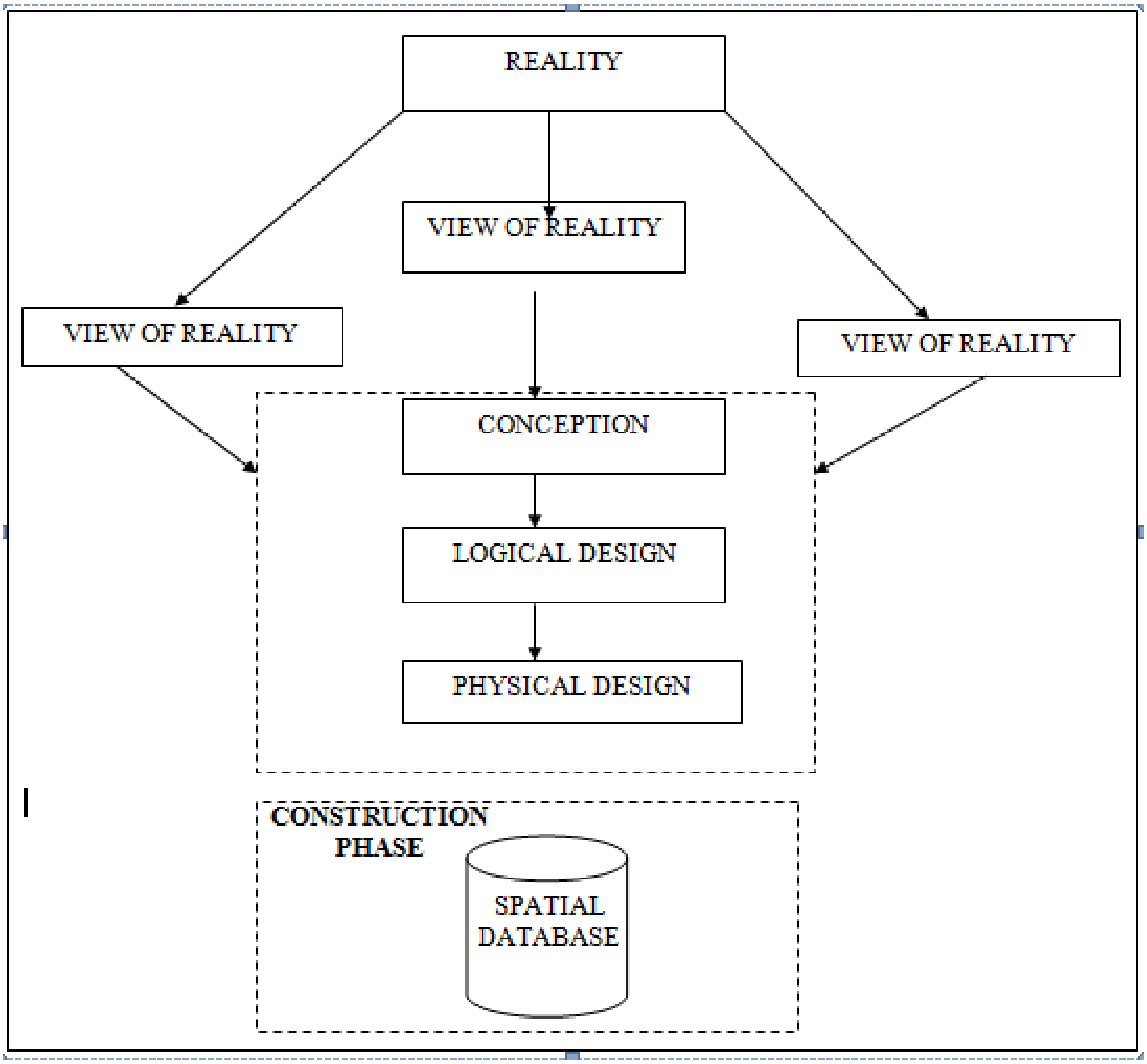


Fig.3.1Design and Construction Phases in Spatial Database (R Sobh, C Perry,. 2006)

3.1.1 LOGICAL DESIGN

This is the design aspect of the database refers to the process of creating a conceptual framework or model that represents the structure and organization of spatial data within the system. It involves defining the data element, their relationship, and the rules for data manipulation and analysis. In this phase, the entities, their attributes and their relationships are represented in a single uniform manner in form of relation in such a way that would be no information loss and at the same time no unnecessary duplication of data. In this study, the logical database design is employed to generate a geo-relation database structure. Each entity has unique identifier in bold type. An attribute type or combination of attribute types that serves to identify an entity type is termed an identifier.

i Building (B_ID,B_Area, B_Name, B_Easting, B_Northing)

ii Roads (R_ID,R_Width, R_Type, R-Condition, R_Easting, R_Northing)

iii Vegetation (V_ID,GR_Area,)

iv Tree (TR_ID,TR_spp,TR_Importance,TR_Easting,TR_Northing)

v Electric Pole (EP_No,EP_Type,EP_Height,EP_Easting,EP_Northing)

vi Football Pitch FP_ID, FP_Area,FP_Status)

3.3 EQUIPMENT USED

3.3.1 HARD WARE

- Total Station (South
- Reflector Pole
- Hand-held GPS
- Steel tape
- Nails and bottle cover
- Field book
- 1 cutlass

3.3.2 SOFTWARE

- AutoCAD 2007
- Arc-GIS 10.2
- Google Earth
- Note pad
- Excel

3.4 INSTRUMENT TEST

To ensure data quality, the Total Station used for this project was tested for both vertical index and horizontal collimation errors. It was also to ascertain the efficiency and reliability of the instrument. The procedure used is described below.

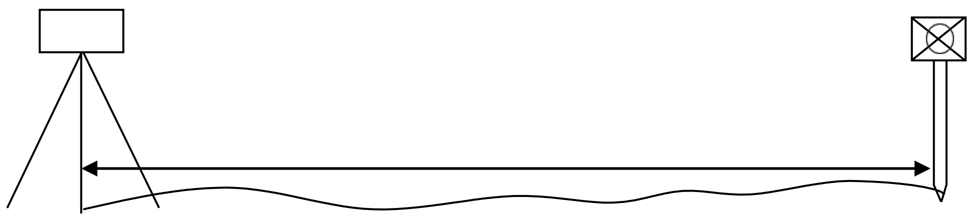
3.4.1 HORIZONTAL COLLIMATION TEST

This test was conducted to ensure that the line of sight was perpendicular to the trunnion axis. The Total Station was positioned over a specific point, and initial adjustments were made to ensure proper alignment, leveling, and focus (to eliminate parallax in the telescope). A vertical target was placed at a distance of 100 meters from the Total Station. To access the configuration menu of the Total Station, the menu key was pressed and held for approximately 2 seconds. From the

main menu, the calibration sub-menu was selected, and within that, the horizontal collimation test option was chosen. The target was then observed and divided into two halves, with horizontal readings recorded for Face left and Face right. The readings are shown in Table 3.4.1 below.

Total Station Reflector

(Target)



Station A Fairly Level Ground Station B

Fig3.4.1.1; Horizontal Collimation and Vertical Index error test

Table3.4.1.1: Horizontal Collimation Data

Station	Target	Face	Horz. Reading	Difference	Error
A	B	L	025° 32‘‘ 32”		
		R	205° 32‘‘ 35”	180° 00’ 03”	00° 00’ 03”

3.4.2 VERTICAL INDEX ERROR TEST

This test was conducted to verify the accuracy of the vertical reading when the line of sight is horizontal. The desired measurement for this test is exactly ninety degrees (90˚), any deviation from this value is referred to as the vertical index error.

The Total Station was positioned over a specific point, and necessary temporary adjustments were made to ensure proper alignment and functionality. A target was placed approximately100 meters away from the Total Station, and the instrument

was aimed at the target. The target was bisected by aligning the instrument on the face left, and the corresponding reading was recorded. Similarly, the target was then bisected on the face right and the respective reading were also recorded. The recorded readings are provided below:

Table3.4.2.1: Vertical Index Data

Instrument Station	Target Station	Face	Vertical	Sum	Error
A	B	L	95° 00‘‘ 00”		
		R	275° 00‘‘ 02”	360° 00‘‘ 02”	02”

3.4.3 ANALYSIS OF COLLIMATION AND VERTICAL INDEX DATA

The readings obtained during calibration were reduced to obtain new collimation and vertical errors.

Horizontal collimation = {(FR–FL) –180} /2 ={(00˚00‘‘03”} /2 =1.5”

Vertical collimation = {(FL+FR) –360} = (95˚00‟00” + 275˚00‟02”) -360} = 02” The result shows that the instrument is still in good working condition.

3.5 CONTROL CHECK

3.5.1 Control Check Procedure Using Total Station

To ensure the accuracy and reliability of the Total Station observations used for spatial data acquisition, control checks were carried out before and during the main survey. The procedure involved setting up the instrument over a known control point, performing temporary adjustments, executing angular and distance observations (back sight and foresight), and validating the computed coordinates against known values.

Step 1: Instrument Setup and Centering.

The Total Station was mounted securely on a tripod placed directly over the first known control point.

Centering was done using the built-in optical plummet to align the vertical axis of the instrument precisely over the ground mark.

Fine adjustments were made by shifting the tripod legs or using the sliding base plate to achieve perfect alignment.

Step 2: Temporary Adjustments (Leveling and Elimination of Instrumental Error)

Leveling: The circular bubble was first centered using the tripod legs. Then, the tubular (or electronic) level was used with the foot screws to achieve fine leveling in two perpendicular directions.

Collimation Check: An internal calibration (collimation) check was performed using the instrument's self-diagnosis function to ensure the vertical and horizontal axes were perpendicular.

The horizontal circle was then set to zero after selecting the backsight direction.

Step 3: Back sight Observation

The telescope was rotated to face a second known control point (backsight).

The instrument was focused accurately on the backsight prism, and both horizontal and vertical coordinates (XYZ) were measured.

Step 4: Foresight Observation and Coordinate Validation

The telescope was then turned to observe a third point (foresight). The horizontal and vertical coordinates (XYZ) were measured. The observed coordinates were then compared to the known coordinates of the foresight control point already established.

Coordinate difference (ΔX, ΔY, ΔZ) was calculated to assess positional accuracy. The difference was within the allowable tolerance (typically ±2cm for X/Y and ±3cm for Z), the instrument was considered properly calibrated.

Step 5: Repeat Check at another Station

The same procedure was repeated for every station setup across the site to ensure uniform accuracy across the network.

All three control stations showed closure errors and coordinate differences well within the accepted tolerance for third-order survey work. This control check procedure ensured that the Total Station data used for plotting school boundaries, buildings, and topography in the Land Information System were precise and trustworthy.

Once the control points were verified and validated, they were used as reference locations for the detailed survey of the sc

ordinate of the observed and the original values of K654AD

PILLAR	NORTHING	EASTING	STATUS	REMARKS
SC/KW K654AD	939792.896	673354.040		ORIGINAL
SC/KW K654AD	939792.886	673354.020	FIXED	OBSERVED
DISCREPANCY	0.010	0.020		

Table 3.4.2: Coordinate of the observed and the original values of K656AD

PILLAR	NORTHING(m)	EASTING(m)	STATUS	REMARKS
SC/KW K656AD	939837.818	673334.688		ORIGINAL
SC/KW K656AD	939837.797	673334.666	FIXED	OBSERVED
DISCREPANCY	0.021	0.022		

Table 3.4.3: Coordinate of the observed and the original values of K657AD

PILLAR	NORTHING(m)	EASTING(m)	STATUS	REMARKS
SC/KW K657AD	939803.143	673366.311		ORIGINAL
SC/KW K657AD	939803.132	673366.291	FIXED	OBSERVED
DISCREPANCY	0.011	0.020		

3.7 GEOMETRIC DATA ACQUISITION

The total station instrument was set carefully on control point SC/KW K6546AD back sight taken to K SC/KW K654AD after necessary station adjustments has been carried out on it. The adjustments include; centering, leveling and focusing. The following procedures were then followed to determine the position of the next point (NL1) and the same procedure were repeated until all we come close to the site. The method used in acquiring data on site was radiation method where two or more points are coordinated from one instrument station.

i. Having setup the instrument and temporary adjustment carried out, the instrument was powered „on‟ and a job file was created under job menu in the internal memory of the instrument. The job file created was named GSSGR4C.

ii. On the job, the coordinates of the three (3) control points were keyed in to the memory of the instrument and some codes were also saved. The codes include „RD‟ for road, SP‟ for spot height, BD for buildings, etc.

iii. The height of the instrument was measured and saved on the memory of the instrument as well as their reflector height.

iv. On coordinate menu, orientation was set by inputting the coordinates of the instrument station and back sight. The reflector at the back station was perfectly bisected before the orientation was confirmed by clicking yes.

Having done the orientation, the reflector at the next station was bisected and observe option was clicked. The three-dimensional coordinate of the point (E N, H) were displayed on the display unit of the instrument and record button was clicked to save the data into the memory of the instrument. For subsequent observation after this, all options were used instead of pressing observation ("obs") and pressing record later.

v. It was ensured that the center of the prism of the reflector was bisected and that it was set perfectly on the tripod in order to minimize the error on height determination.

vi. The instrument is been shifted to another station after all details, spot height and boundary point visible from the instrument station have been picked, The instrument was set over new station and temporary adjustments carried out.

However, the above operations were repeated until all the boundary points with heights were coordinated.

In this project all spot height were not in grid intervals but randomly acquired. At the end of data acquisition process all details were observed and properly recorded to be shown in their respective positions on the plan.

Detailed Survey:

The detailed survey focused on mapping the internal structures and facilities within the school, including:

- Classrooms
- Staff rooms and administrative offices
- Laboratories and libraries
- Playgrounds and sports fields
- Roads, parking lots, and walkways

Geometric data for every feature were acquired using Total Station, and the collected spatial data were stored in a structured format. Screenshots of the Total Station data interface were captured to illustrate the data collection process. The observations were carried out systematically to ensure complete coverage of all features within the project area.

Non-Spatial Data Collection

In addition to spatial data, non-spatial data (attribute data) were collected to provide descriptive information about each observed feature. These data were gathered through field observations, school administrative records, and structured interviews with key personnel.

Types of Non-Spatial Data Collected

- Building Information: Name, number of floors, year of construction, type of usage (classroom, staff office, laboratory, etc.).
- Staff Room and Office Details: Departmental functions, number of staff, office occupants.
- Infrastructure Information: Type of roads (paved or unpaved), water supply, power supply.

A field book was used to record the collected data, ensuring uniformity and easy integration into the LIS database. The completed forms were reviewed for accuracy before entering the data into a spreadsheet for GIS processing. Screenshots of the attribute data collection forms were taken and included in the documentation.

3.3.4 Data Download and Storage

Once the field surveyed was completed, all collected data were transferred to a computer system for further processing and storage. The following steps were taken to ensure proper data management:

1. Downloading Total Station Data: The surveyed X, Y, Z coordinates were extracted from the Total Station's internal memory using instrument software. The data were saved in a CSV (comma-separated values) file format for compatibility with GIS and AutoCAD software.

2. Organizing Non-Spatial Data: The collected attribute data were entered into an Excel spreadsheet, ensuring proper formatting for easy integration with spatial data. The file structure was reviewed to ensure consistency and completeness.

3. Data Backup: Copies of all data files were stored in an external flash drive to prevent data loss. File versions were properly labelled to maintain organization.

The downloaded spatial and non-spatial datasets were prepared for further processing and integration into the LIS.

3.3.5 Data Validation and Accuracy Assessment

To ensure the accuracy and reliability of the collected data, a rigorous validation process was conducted. This involved cross-checking the surveyed coordinates, attribute data, and instrument readings to identify and correct any errors.

Validation of Spatial Data

- Coordinate Cross-Check: The surveyed points were compared with known control points to verify accuracy.
- Boundary Accuracy Check: The surveyed boundary was overlaid on an existing satellite image in Arc=GIS to detect any misalignment.

Figure 3.3: Satellite Imagery of the study area

Validation of Non-Spatial Data

- Attribute Consistency Check: The recorded building and facility details were compared with official school records.
- Correction of Data Entry Errors: Any discrepancies or incorrect attribute entries were identified and corrected before finalizing the dataset.

3.4 DATA PROCESSING AND INTEGRATION

The data processing and integration phase is a critical step in transforming the raw data collected from the field survey into a structured Land Information System (LIS). This stage involves cleaning, organizing, and integrating both spatial and non-spatial data into a geodatabase, ensuring seamless access, analysis, and visualization.

The processing workflow consists of multiple steps, including spatial data processing in AutoCAD and Surfer, non-spatial data structuring in Excel, geodatabase creation in ArcGIS, and data integration for LIS development. The structured integration of these datasets enables effective querying, mapping, and decision-making for the secondary school management system.

3.4.1 Spatial Data Processing in AutoCAD

AutoCAD was used to plot the observed coordinates, (Geometric data) ensuring accurate representation of school facilities such as classrooms, staff rooms, administrative offices, roads, and playgrounds. The following steps were carried out:

1. Importing Surveyed Points:
    - The CSV file containing surveyed coordinates was imported into AutoCAD.
    - The points were plotted based on their real-world X and Y coordinates, while the Z values were retained for elevation analysis.
2. Plotting of Boundaries and Features:
    - The boundary points were connected using polyline tools, forming a closed polygon to define the extent of the school premises.
    - Each school building was mapped as a separate layer, and unique identifiers were assigned to distinguish classrooms, staff rooms, laboratories, and other structures.

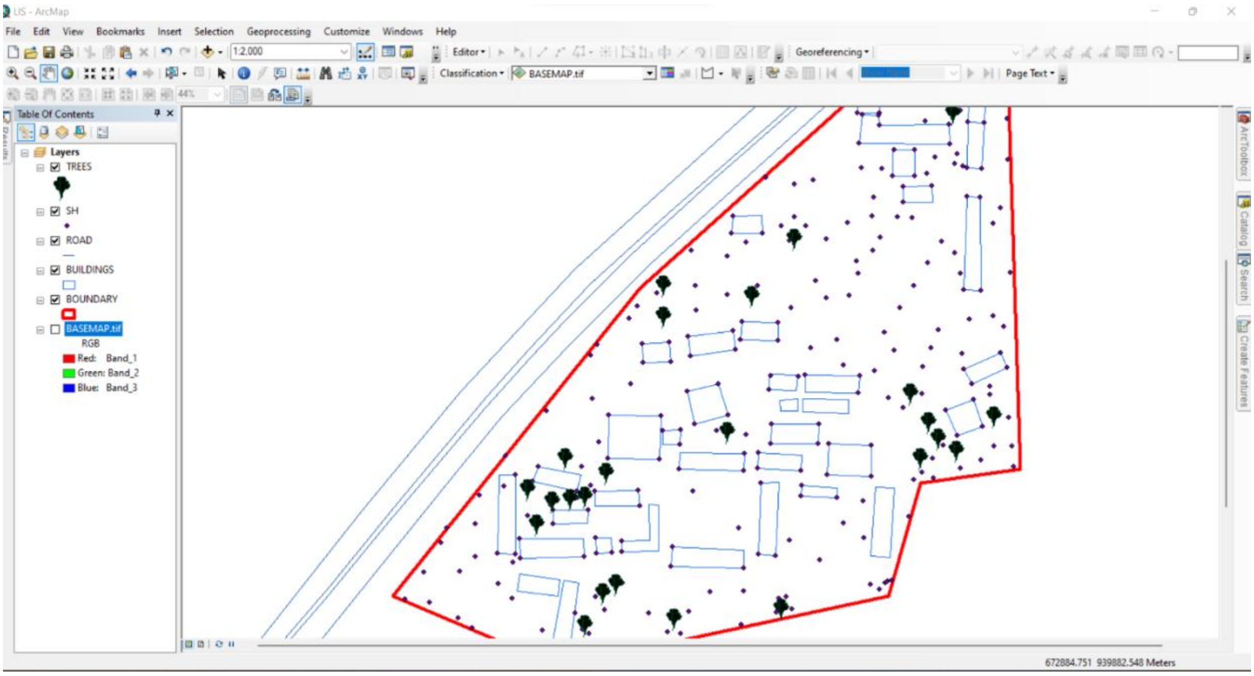


Figure 3.5 Screenshot of boundary digitization and features

3.4.2 TOPOGRAPHIC DATA PROCESSING IN SURFER

Surfer software was used for topographic analysis and terrain modelling based on the surveyed elevation data (Z values). The following procedures were followed:

1. Importing Surveyed Data:

    - The X, Y, and Z coordinates were loaded into Surfer as a point dataset.

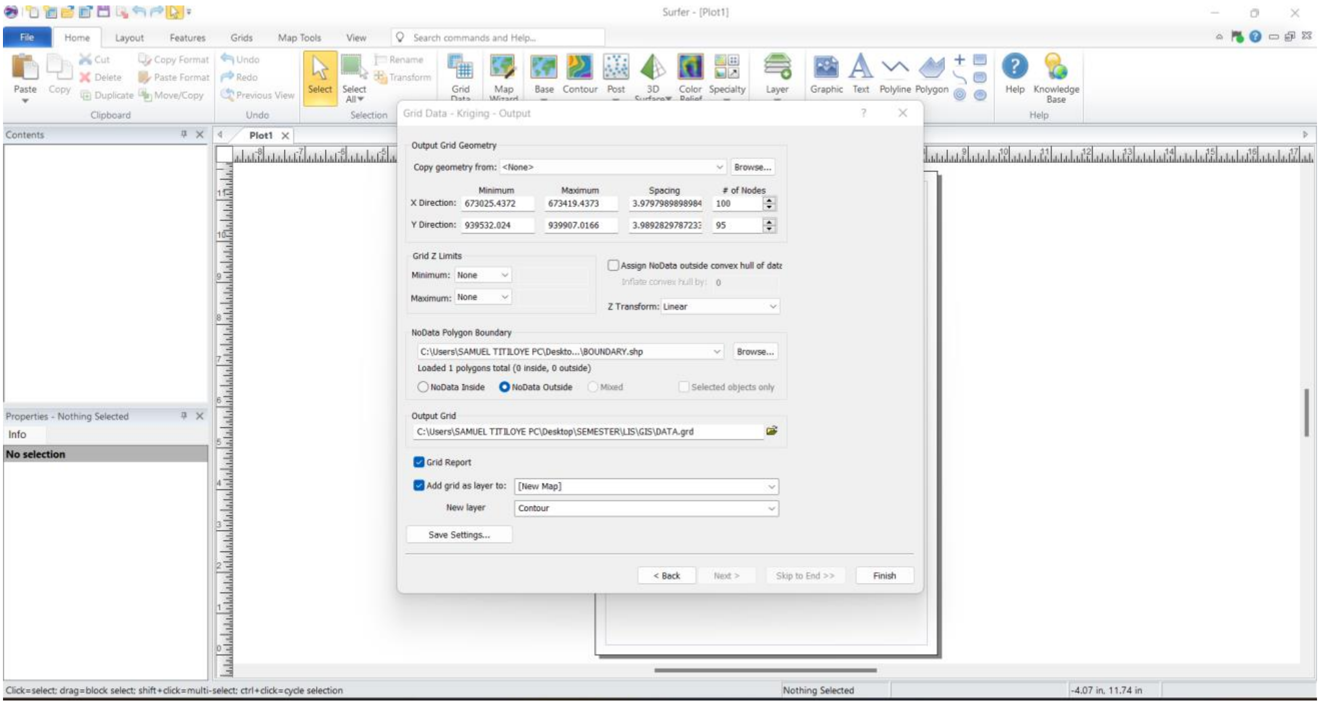


Figure 3.6: Screenshot of the imported dataset.

2. Generation of Digital Elevation Model (DEM):

- A grid-based interpolation technique was applied to generate a Digital Elevation Model (DEM) of the school area.
- The DEM provided insight into the elevation variations across the school premises, assisting in drainage and flood risk assessment.

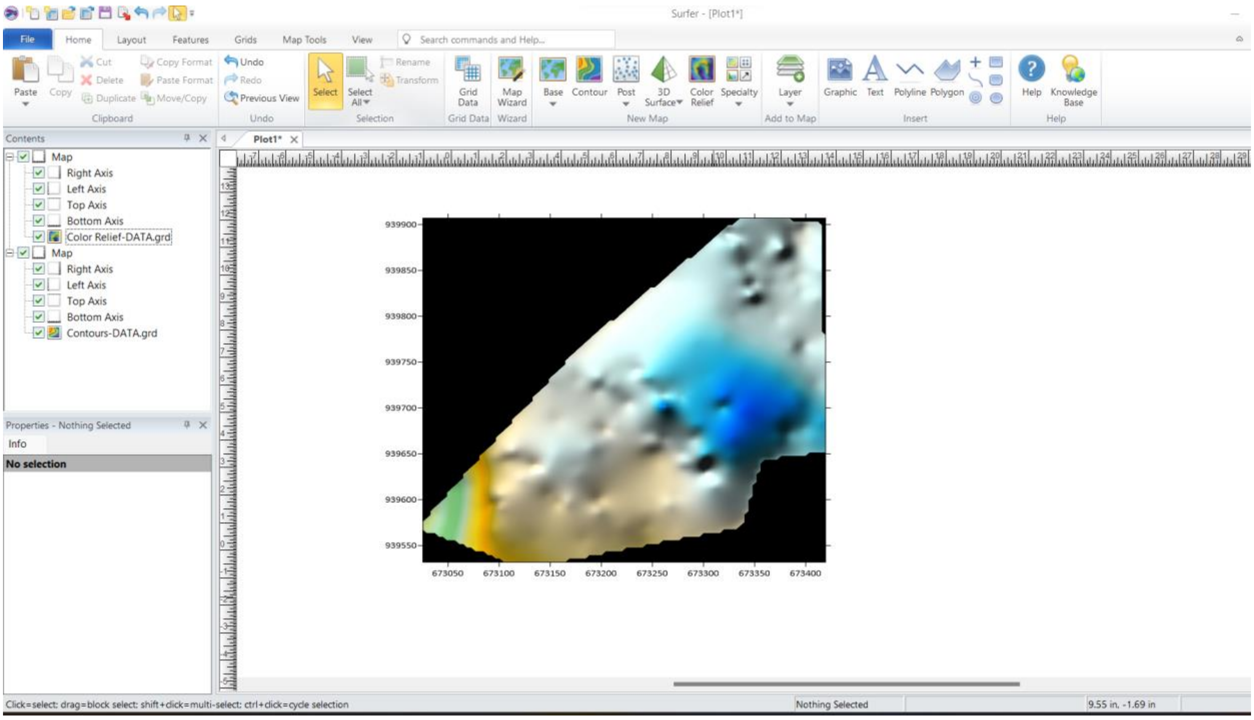


Figure 3.7: Screenshot of the generated DEM.

3. Creation of Contour Maps:

- Contour lines were generated at specific intervals to visualize terrain variations.
- The contour map was exported in Geo-TIFF format for integration into Arc-GIS.

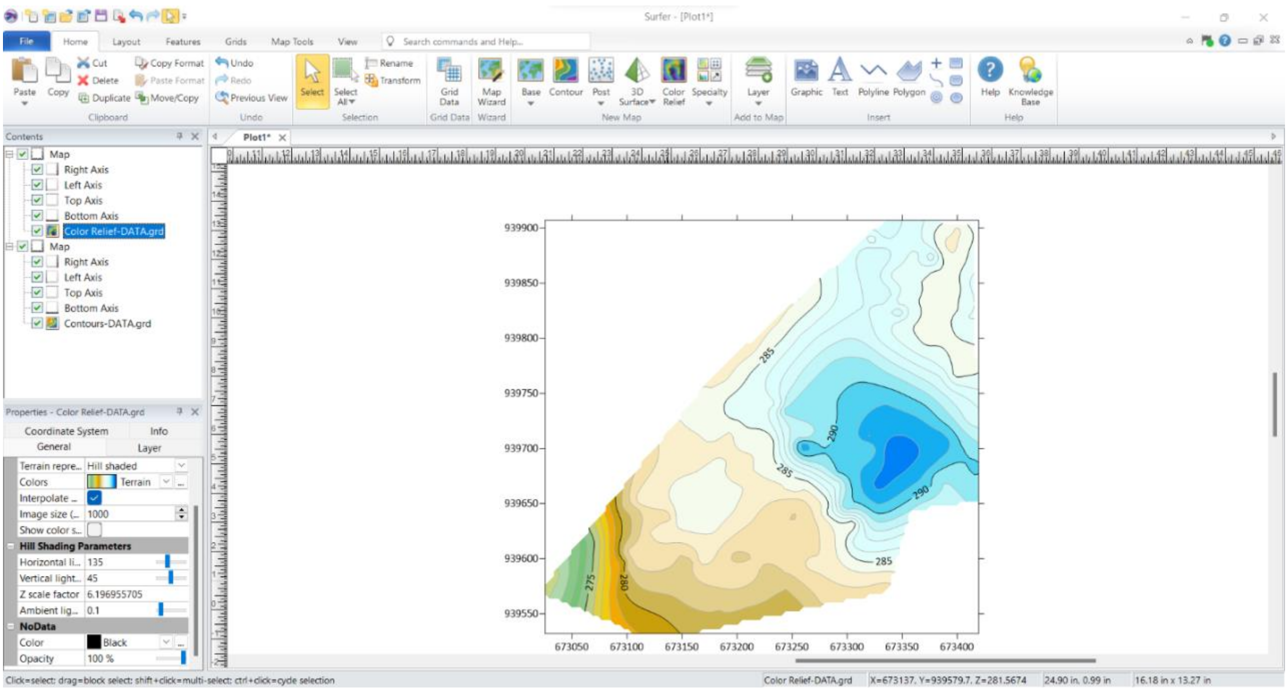


Figure 3.8: Screenshots of the contour generation process.

3.4.3 NON-SPATIAL DATA PROCESSING IN EXCEL

Non-spatial data collected through field observations and school administrative records were structured and formatted in Excel to ensure consistency and ease of integration into Arc-GIS.

1. Data Entry and Formatting:

   - Each facility was assigned a unique ID corresponding to its spatial location.
   - Attributes such as building type, year of construction, and available amenities were recorded.

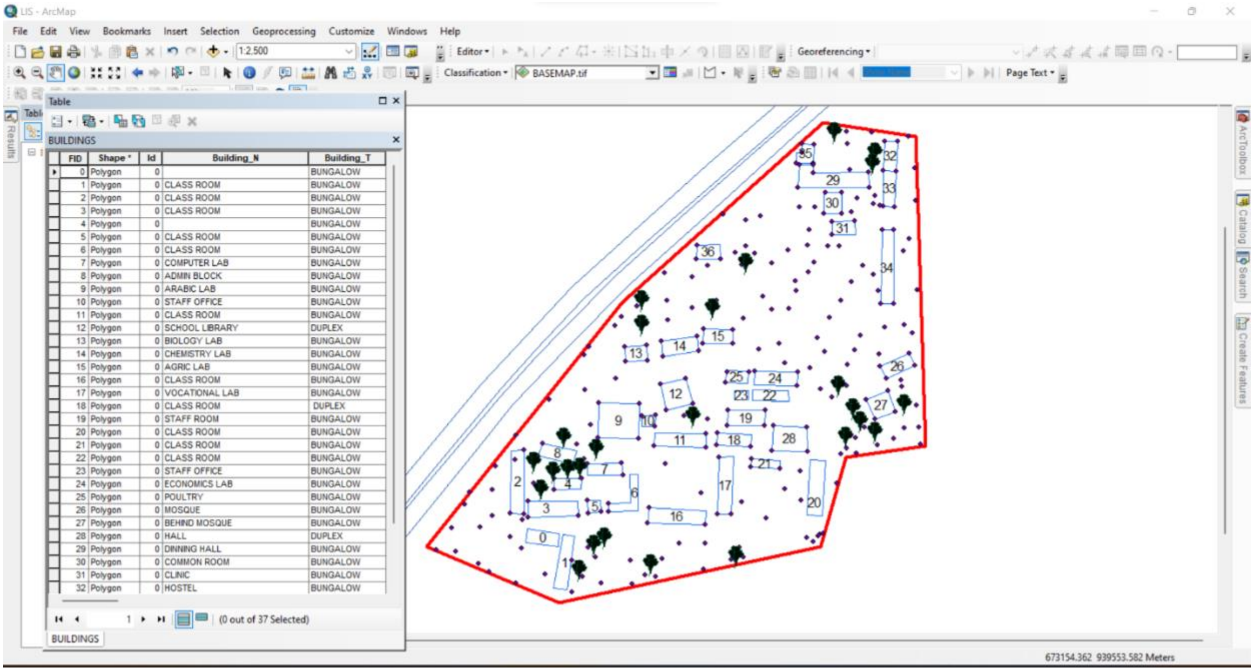


Figure 3.9: Screenshot of the structured attribute table.

3.4.4 GEO-DATABASE CREATION IN ARC-GIS

A geo-database was created in Arc-GIS to integrate both spatial and non-spatial data, allowing efficient storage, retrieval, and analysis of school infrastructure data. The following steps were taken:

1. Creating a New Geo-database:
   - A file geo-database was created in Arc-GIS to store all spatial data layers and attribute tables.
2. Importing Spatial Data:
   - The DXF file from Auto-CAD (containing school boundaries and building layouts) was imported into Arc-GIS.

- The Geo TIFF file from Surfer (containing the DEM and contour data) was also loaded.

3. Defining Feature Classes:

    - Separate feature classes were created for classrooms, staff rooms, offices, laboratories, roads, and other infrastructure.
    - Each feature class was assigned relevant spatial properties (e.g., polygon for buildings, polyline for roads).

4. Importing Non-Spatial Data and Linking to Spatial Features:

    - The CSV file containing attribute data was imported into ArcGIS.
    - A one-to-one relationship was established between the spatial features and their corresponding attribute records using the unique ID field.

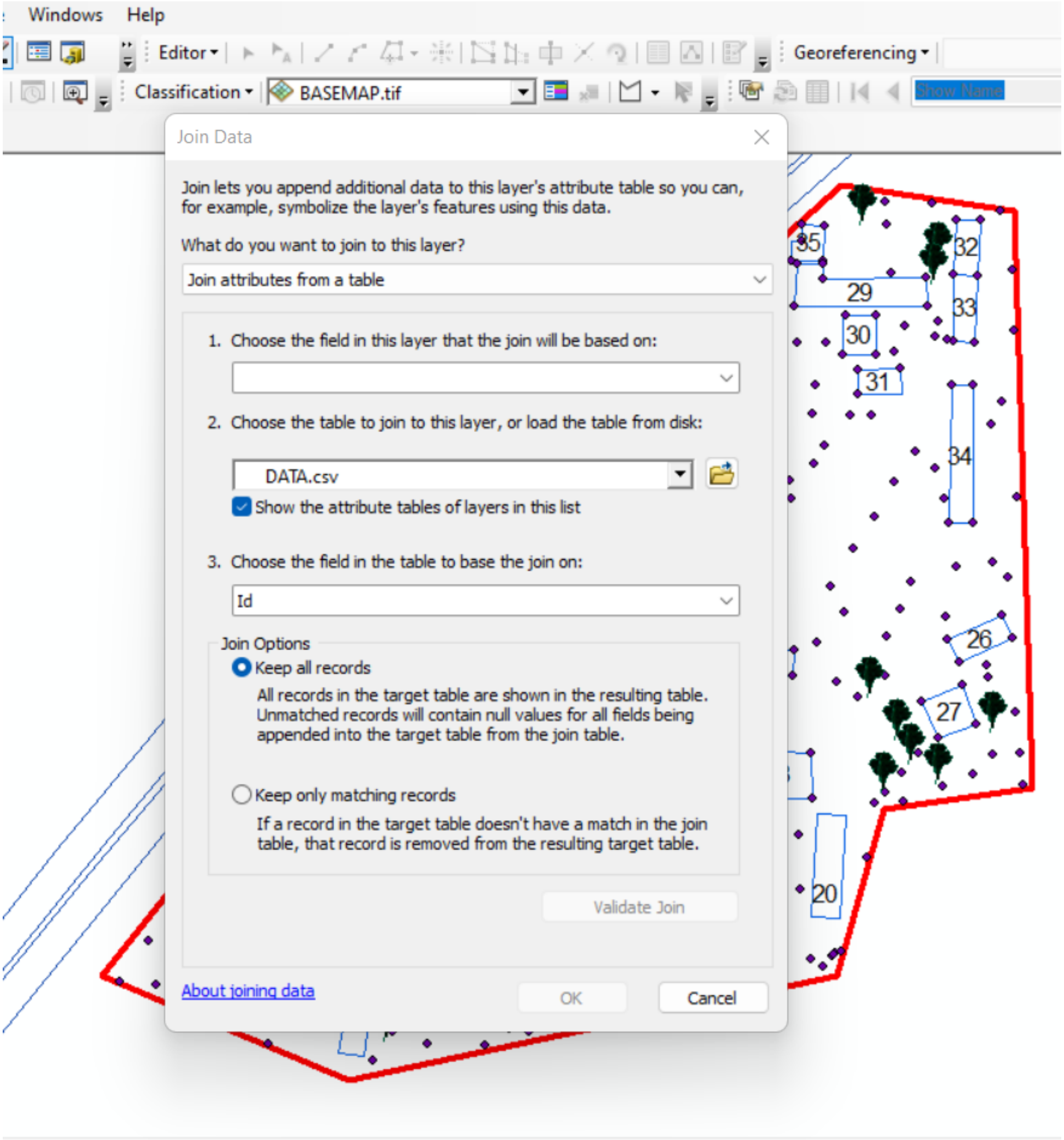


Figure 3.11: Screenshot of the data join process.

3.4.5 DATA INTEGRATION AND FINALIZATION FOR LIS

The final stage involved ensuring seamless integration between spatial and non-spatial data within the LIS environment.

1. Verification of Data Integrity

- The attribute data were cross-checked to ensure they matched their respective spatial locations.
- Any mis-linked records were corrected, and missing attributes were updated.

2. Symbolization and Visualization:

- Each feature class was assigned unique symbols and colors for better visualization in Arc-GIS.
- Thematic maps were created to represent building categories, classroom capacities, and road networks.

3.7.1 Perimeter Plan of the Project Area

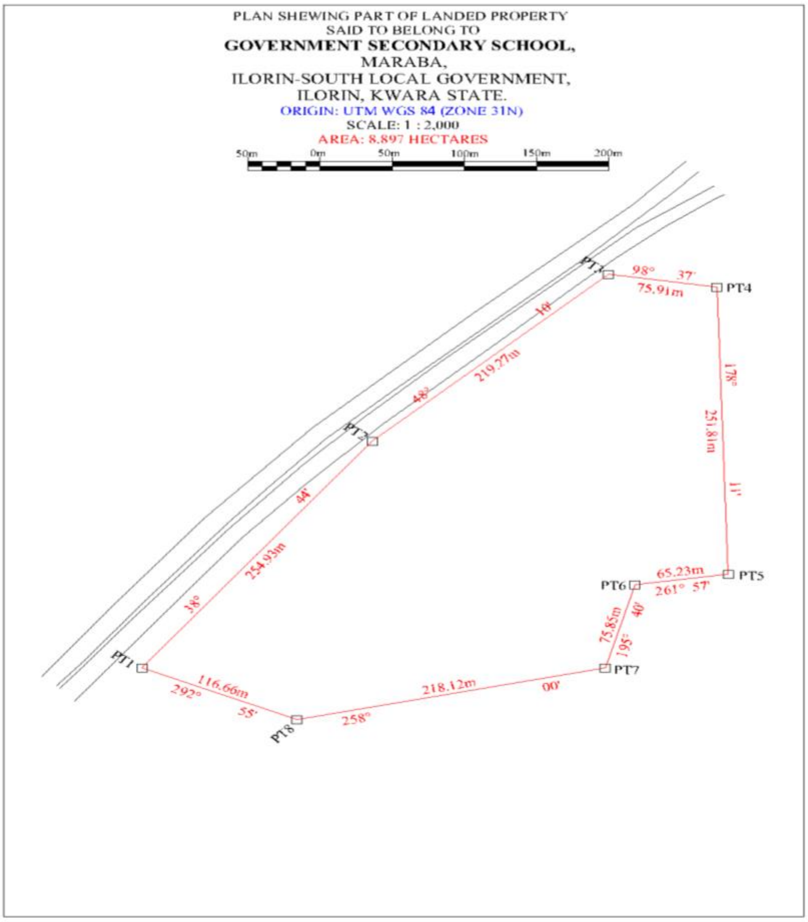


Figure 3.7.1: A screenshot of the boundary in AutoCAD.

3. Boundary Digitization and Feature Mapping:

- The boundary points were connected using polyline tools, forming a closed polygon to define the extent of the school premises.
- Each school building was mapped as a separate layer, and unique identifiers were assigned to distinguish classrooms, staff rooms, laboratories, and other structures

3.7.2 Detailing

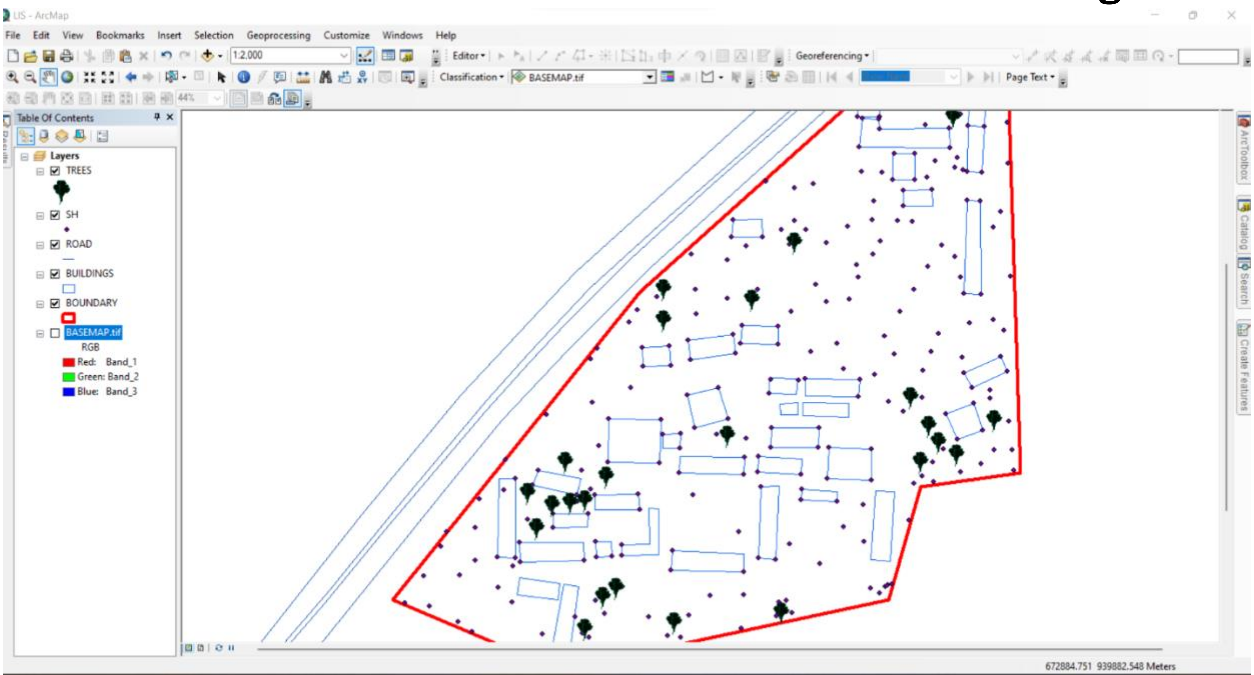


Figure 3.7.2 Screenshot showing the digitization process and layer management.

3.7.2 Topographic Data Processing in Surfer

Surfer software was used for topographic analysis and terrain modelling based on the surveyed elevation data (Z values). The following procedures were followed:

4. Importing Surveyed Data:

    - The X, Y, and Z coordinates were loaded into Surfer as a point dataset.

3.7.3 ATTRIBUTE DATA ACQUISITION

Attribute data is information about spatial features. They provide the characteristics, description and nomenclature about spatial objects. Thus, the attributes data acquired includes names of buildings and their uses such as classrooms, roads, water facilities and prominent natural features Likes River and trees found and vegetation were properly identified within and around the

3.8 DATABASE CREATION / IMPLEMENTATION

This is the database creation phase. Having completed the three stages of design phase (i.e Reality, Conceptual and Logical design), the data base was created using ArcGIS10.2 software. It involves the combination and storage of acquired graphic data and attributes data in creating the database for the purpose of spatial analysis and query.

Database is an organized integrated collection of data stored so as to be capable of use by revenant application with data being accessed by different logical part. After the Attribute table was populated via the keyboard, some attributes such as areas of settlements were automatically displayed by special command in the ArcGIS 10.2 version. The ArcGIS software was used to link the graphic data and table for query generation.

3.8.1 DATABASE MANAGEMENT SYSTEM (DBMS)

Data base management is a collection of software for creating, storing, manipulating, updating, organizing and querying of information in a database (Kufoniyi, 1998). It is a software package whose function is to manipulate a data base on behalf of the user.

A good DBMS must provide the following functions:

a. Storage and retrieval of data.

b. Access to by several users at a time.

c. A standardized interface between data base and application programmed.

d. Standardized access to data and separation of data storage and retrieval functions from the program using the data.

e. Maintenance of data security and integrity.

3.8.2 Data Quality

Having created the database, proper maintenance practice was made to meet its stated objectives. The ability to include more data and remove irrelevant data was possible by way of maintenance. There is every need for the data to be updated regularly because of the physical changes that may occur on the landscape with time. Both security and integrity were also exercised to ensure maintenance and to meet its stated objectives.

Proper observance, updating and management of database ensure its currency and quality to stand a profound chance in Spatial Decision Support System (SDSS). The quality of any database depends on the currency and fitness for use as a decision support system (SDSS). The quality of database depends on its ability to generally fit and use as a decision system(DSS). The storage media should be from time to time justified if otherwise could necessitate data inaccessibility or physical deterioration of the storage media. Also, care must be taken during populating any database system, as a database is only good as the data supplied. In archiving stable media should be used. Examples of these are

- Computer compatible tape reader
- Magnetic tape

- Optical disc and compact disc.

CHAPTER FOUR

ANALYSIS AND RESULTS

4.1 Introduction

This chapter presents the results obtained from the data acquisition, processing, and integration procedures described in the previous chapter. The findings provide a comprehensive spatial and non-spatial representation of the school environment, including the layout of buildings, topographical features, and attribute information related to school facilities. The results are structured to demonstrate how the Land Information System (LIS) can enhance school management by providing accurate, well-organized, and easily accessible data.

The results are categorized into different sections for clarity. The spatial data results include mapped school boundaries, building footprints, and access networks, all of which were digitized using GIS tools. The topographical results analyze elevation variations using Digital Elevation Models (DEM) and contour maps, which are crucial for site planning and infrastructure development. The non-spatial data results contain attribute information such as classroom capacity, staff room assignments, and building conditions, all integrated into the LIS database. The data integration and query results demonstrate how the LIS functions as an interactive tool for retrieving, analyzing, and visualizing school-related data.

This chapter also includes analyses that reveal important insights into building distribution, infrastructure conditions, environmental constraints, and potential areas for school expansion. The results are presented using maps, tables, and screenshots from GIS and related software to illustrate how data were processed and visualized. The goal of this chapter is to demonstrate the practical application of an LIS in school facility management and to highlight the benefits of integrating spatial and non-spatial data for decision-making.

4.2 SPATIAL DATA RESULTS

The spatial data results provide a detailed representation of the school's geographical layout, including its boundaries, buildings, access roads, and pathways. These results were derived from Total Station survey data, processed in AutoCAD and ArcGIS to create an accurate Land Information System (LIS) for the school. This section highlights the steps taken to map the school boundary, digitize building footprints, and visualize access routes.

The spatial data results are essential for effective school management, as they provide a georeferenced framework that helps in planning expansions, monitoring infrastructure, and optimizing resource allocation. The outputs presented in this section form the foundation for further topographical, non-spatial, and LIS-based analysis discussed in subsequent sections.

4.2.1 School Boundary and Building Layout

The school boundary and building layout were mapped using surveyed coordinates (X, Y, Z) collected with the Total Station. The acquired data were processed in AutoCAD to generate a structured boundary map and building footprints, which were then imported into ArcGIS for further spatial analysis and integration into the LIS database.

Figure 4.2.1: As built Plan of Government Secondary School Maraba, Ilorin South East Local Government. using GIS software

Visualization of Spatial Data Results

The final processed spatial data were visualized in ArcGIS, where the school boundary, building footprints, and access roads were symbolized appropriately to enhance readability.

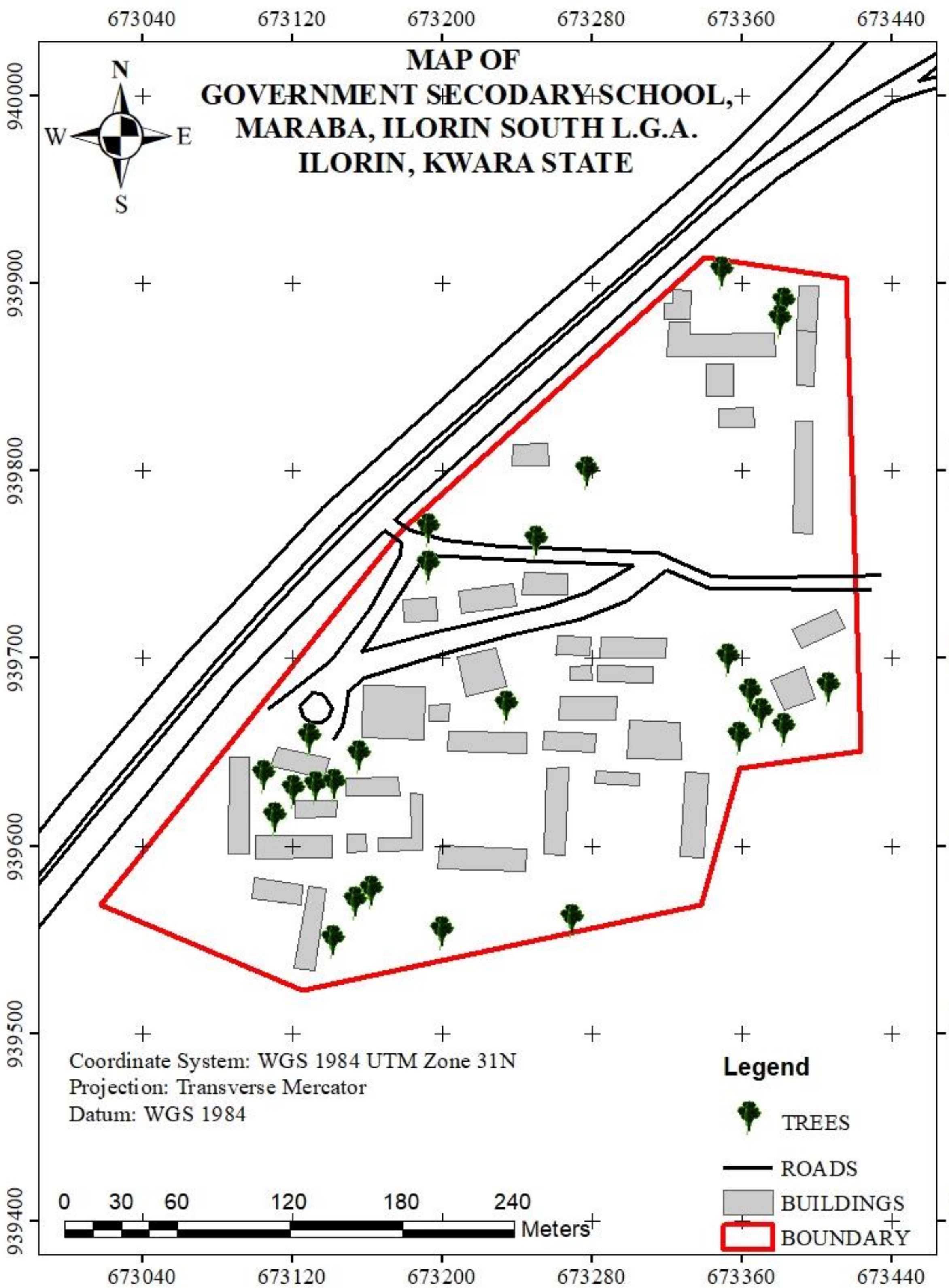


Figure 4.2.1: Mapped School Boundary and Buildings in ArcGIS

- The school boundary is represented as a bold polygon to define the outer limits of the school.
- Buildings are shown in different colors based on their usage (e.g., classrooms in blue, administrative offices in green, laboratories in red).
- Roads are displayed as lines, with roads marked in black.

This spatial data representation serves as the primary framework for the LIS database, allowing users to visualize, analyze, and manage school infrastructure efficiently.

Significance of the Spatial Data Results

The school boundary and building layout play a crucial role in:

- Infrastructure Planning: Ensuring optimal land use by identifying available spaces for future construction and expansion.
- Facility Management: Helping administrators monitor the condition, usage, and location of various school buildings.
- Navigation and Accessibility: Enhancing movement planning for students, staff, and visitors by identifying clear pathways and access points.
- Disaster Management: Providing accurate spatial information to plan for emergency exits, assembly points, and safety zones.

The spatial data results form the foundation for further analysis, including topographical evaluation, attribute data integration, and advanced GIS-based queries, which will be presented in the subsequent sections of this chapter.

4.3 TOPOGRAPHICAL ANALYSIS RESULTS

Topographical analysis provides crucial information about the elevation, slope, and terrain variations within the school environment. Understanding these features is essential for site planning, infrastructure development, drainage design, and environmental management. This section presents the results of topographical data processing and analysis, including the creation of Digital Elevation Models (DEM), contour maps, and slope analysis.

The topographical data were obtained using Total Station measurements, which captured X, Y, and Z coordinates of various points within the school premises. These data were processed in Surfer to generate elevation models and later integrated into ArcGIS for spatial analysis.

4.3.1 DIGITAL ELEVATION MODEL (DEM)

The Digital Elevation Model (DEM) was created to provide a 3D representation of the school’s terrain. Using Z-coordinates from the Total Station survey, a gridded elevation surface was generated in Surfer and later exported to ArcGIS for further analysis.

Key Features of the DEM:

- The DEM visually represents variations in land elevation within the school compound.
- Areas of higher elevation are highlighted, aiding in infrastructure planning and water drainage management.
- The DEM serves as the base for further slope, aspect, and contour analysis.

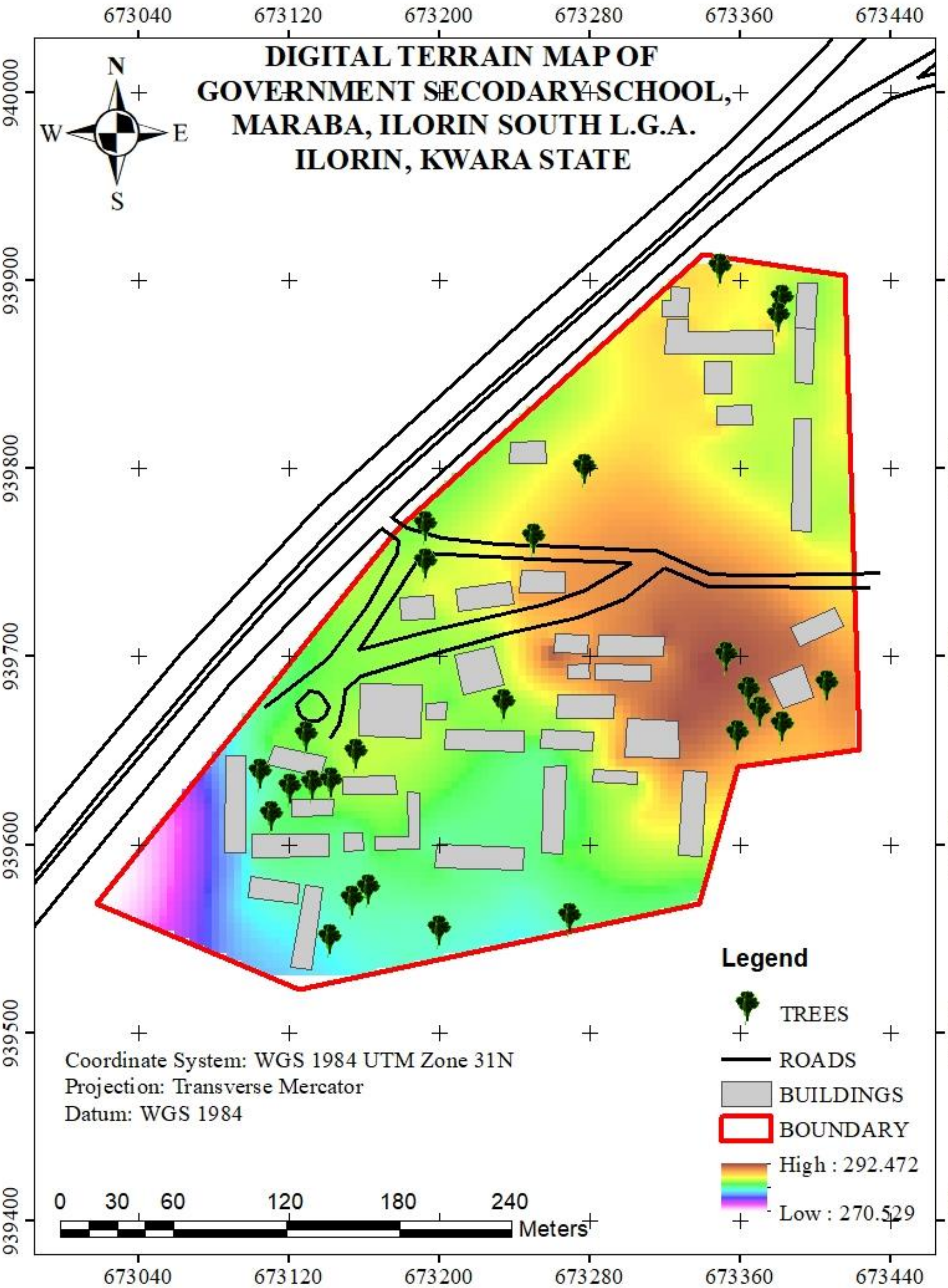


Figure 4.3.1: Digital Elevation Model (DEM) of the School Premise

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4.3.2 CONTOUR MAPPING

Contour mapping was conducted to visualize elevation changes and terrain gradients within the school environment. The surveyed elevation data were processed in Surfer to generate contour lines, which were later imported into Arc-GIS for spatial overlay and analysis.

Key Results from Contour Analysis:

- The contour interval was set based on the range of elevation variations in the study area.
- Closely spaced contour lines indicate steep slopes, while widely spaced lines represent gentler slopes.
- The contour map helps in identifying low-lying areas that may be prone to water logging or flooding.
- The results assist in drainage planning by identifying natural water flow paths.

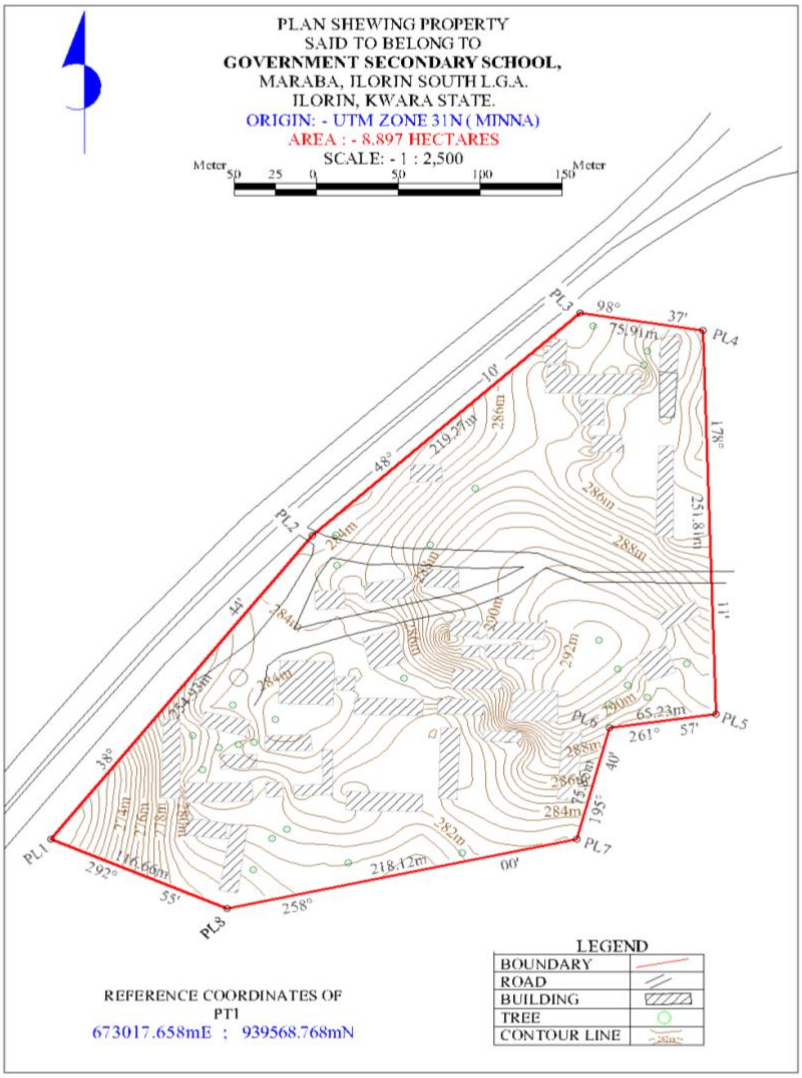

Figure 4.3.2: Contour Map of the School Premises

4.3.3 SLOPE AND TERRAIN ANALYSIS

A slope analysis was conducted to determine variations in land steepness across the school environment. The slope was computed using the DEM in

ArcGIS, with results classified into different slope categories to assess terrain usability.

Key Findings from Slope Analysis**:**

- Flat areas (0-5 degrees) are suitable for classroom blocks, play areas, and other infrastructure.
- Moderate slopes (5-15 degrees) are manageable for footpaths and minor construction projects.
- Steeper slopes (above 15 degrees) may require erosion control measures or retaining walls to prevent land degradation.

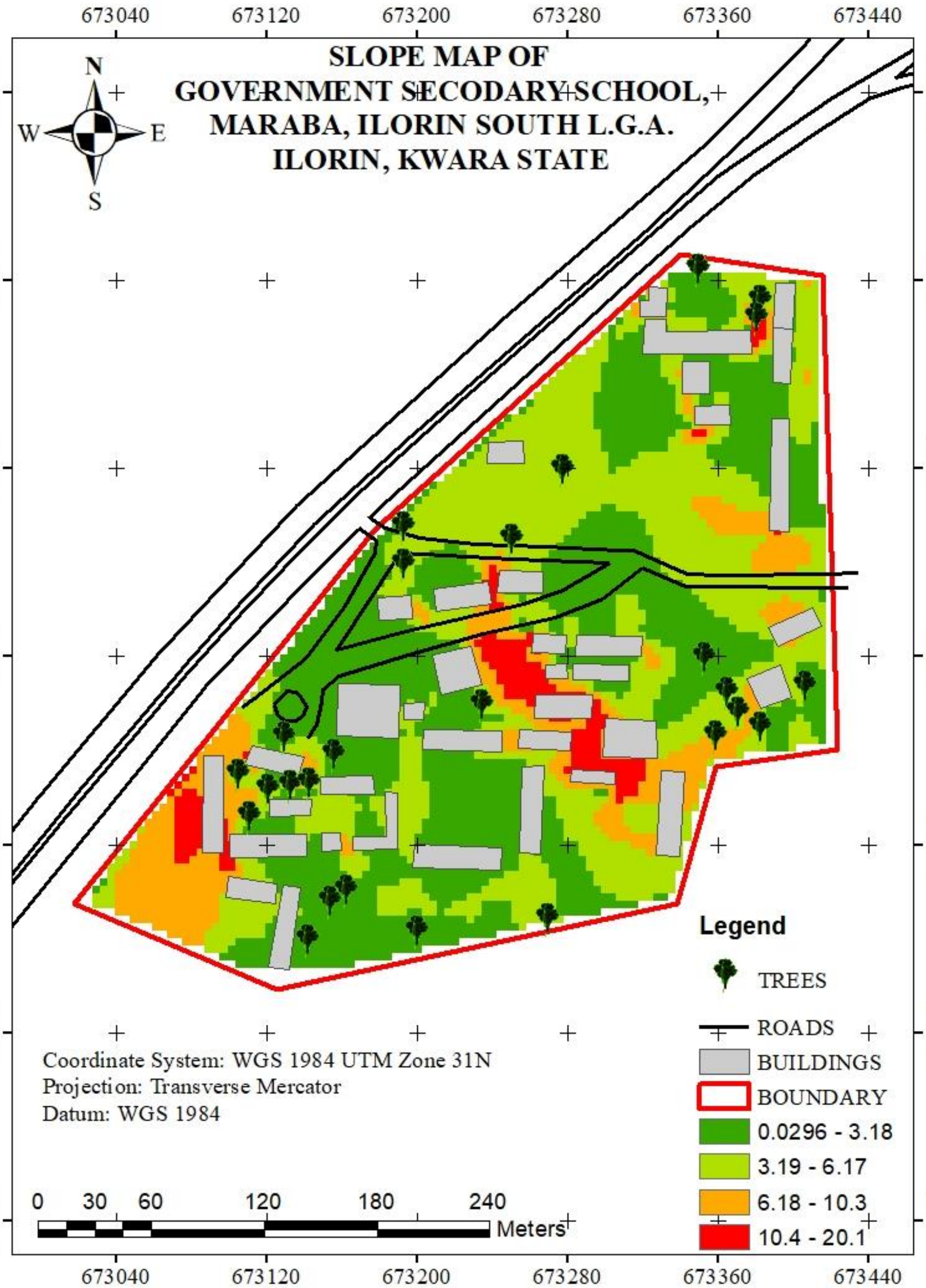

Figure 4.3.3: Slope Analysis Map of the School Premises

4.3.4 SIGNIFICANCE OF TOPOGRAPHICAL ANALYSIS RESULTS

The results of the topographical analysis provide essential insights for school management, infrastructure development, and environmental sustainability. These findings contribute to:

- Better infrastructure planning: Ensuring that new buildings and roads are constructed on stable ground.
- Improved drainage management: Reducing the risk of flooding and water stagnation within the school premises.
- Enhanced safety measures: Identifying steep areas that may require protective barriers or adjustments in land use planning.
- Sustainable land use: Helping decision-makers optimize space utilization while considering terrain constraints.

The topographical analysis results form an integral part of the Land Information System (LIS), ensuring that spatial data is not only stored but also analyzed for informed decision-making in school infrastructure management.

4.4 NON-SPATIAL DATA RESULTS

Non-spatial data results refer to the descriptive information associated with various school facilities, buildings, and infrastructure. Unlike spatial data, which provides geometric representations of features (such as school boundaries, buildings, and roads), non-spatial data includes textual and numerical attributes that help in facility management and decision-making.

The non-spatial data collected in this study were integrated into the Land Information System (LIS) to enhance school administration, infrastructure monitoring, and resource planning. The data were structured in tabular format and linked to corresponding spatial features in ArcGIS using unique identifiers.

4.4.1 ATTRIBUTE DATA FOR SCHOOL BUILDINGS

The non-spatial attributes for classrooms, staff rooms, laboratories, and administrative offices were recorded and organized in a database. Each building was assigned a unique identifier (Building ID), allowing for easy retrieval of information in GIS.

Key Attributes for Buildings:

- Building Name/ID (e.g., Classroom Block A, Staff Room 1)
- Building Type (Classroom, Laboratory, Office, Library, Hall)
- Primary Use (Teaching, Administration, Storage, Utility)

This information was stored in ArcGIS attribute tables and linked to the digitized building footprints, allowing users to perform queries such as identifying underutilized classrooms or buildings in need of maintenance.

Table

BUILDINGS

FID	Shape *	Id	Building_N	Building_T	Use
0	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
1	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
2	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
3	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
4	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
5	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
6	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
7	Polygon	0	COMPUTER LAB	BUNGALOW	Teaching
8	Polygon	0	ADMIN BLOCK	BUNGALOW	Administration
9	Polygon	0	ARABIC LAB	BUNGALOW	Teaching
10	Polygon	0	STAFF OFFICE	BUNGALOW	Adminstration
11	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
12	Polygon	0	SCHOOL LIBRARY	DUPLEX	Utility
13	Polygon	0	BIOLOGY LAB	BUNGALOW	Teaching
14	Polygon	0	CHEMISTRY LAB	BUNGALOW	Teaching
15	Polygon	0	AGRIC LAB	BUNGALOW	Teaching
16	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
17	Polygon	0	VOCATIONAL LAB	BUNGALOW	Teaching
18	Polygon	0	CLASS ROOM	DUPLEX	Teaching
19	Polygon	0	STAFF ROOM	BUNGALOW	Administration
20	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
21	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
22	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
23	Polygon	0	STAFF OFFICE	BUNGALOW	Admistration
24	Polygon	0	ECONOMICS LAB	BUNGALOW	Teaching
25	Polygon	0	POULTRY	BUNGALOW	Utility
26	Polygon	0	MOSQUE	BUNGALOW	Utility
27	Polygon	0	BEHIND MOSQUE	BUNGALOW	Storage
28	Polygon	0	HALL	DUPLEX	Utility
29	Polygon	0	DINNING HALL	BUNGALOW	Utility
30	Polygon	0	COMMON ROOM	BUNGALOW	Utility
31	Polygon	0	CLINIC	BUNGALOW	Utility
32	Polygon	0	HOSTEL	BUNGALOW	Utility
33	Polygon	0	HOSTEL	BUNGALOW	Utility
34	Polygon	0	FULANI HOUSE	BUNGALOW	Utility
35	Polygon	0	KITCHEN	BUNGALOW	Utility
36	Polygon	0	ACCOMMODATION	BUNGALOW	Utility

0 (0 out of 37 Selected)

BUILDINGS

Figure 4.4.2: Sample Attribute Table for School Buildings

4.4.3 LINKING NON-SPATIAL DATA WITH GIS

All non-spatial datasets were linked to their corresponding spatial features in ArcGIS. This integration allows for interactive queries and visual analysis of school facilities. Some of the key functionalities include:

- Clicking on a building footprint to view its attributes (e.g., building name, building type, & use).
- Running queries to find classrooms that exceed their maximum student capacity.
- Generating reports on the maintenance history of infrastructure.

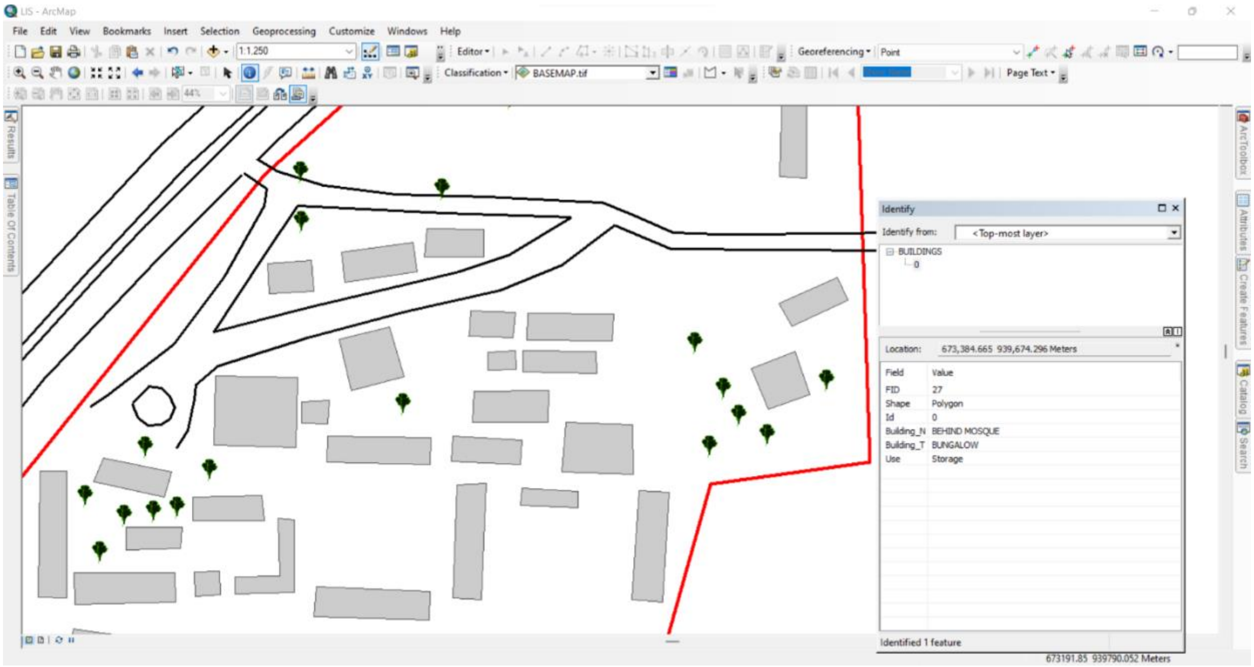

Figure 4.4.3: Linking Non-Spatial Data to Spatial Features in ArcGIS

4.4.4: SIGNIFICANCE OF NON-SPATIAL DATA IN LIS

The integration of non-spatial data into the LIS enhances decision-making by providing comprehensive attribute information for school management. These results contribute to:

- Effective Resource Allocation: Ensuring that classrooms, offices, and other facilities are optimally utilized.
- Infrastructure Maintenance Planning: Monitoring facility conditions and scheduling necessary repairs.
- Improved School Administration: Tracking staff distribution, student population trends, and room assignments.
- Emergency Preparedness: Identifying critical infrastructure that requires regular inspections and safety measures.

The non-spatial data results demonstrate how a Land Information System (LIS) can support school facility management by combining spatial visualization with detailed attribute data. This information is essential for long-term planning, policy-making, and efficient school operations.

4.5 QUERY EXECUTION AND RESULTS

With the integrated database, queries were performed in ArcGIS to extract specific information about the school environment. These queries help in analyzing building usage, staff distribution, facility conditions, and space utilization.

Example Query Results:

1. **Mapping Distribution of Staff Offices:**

   Query: "Show all staff offices"

   Result: A spatial representation of staff office locations was displayed, ensuring adequate office space allocation.

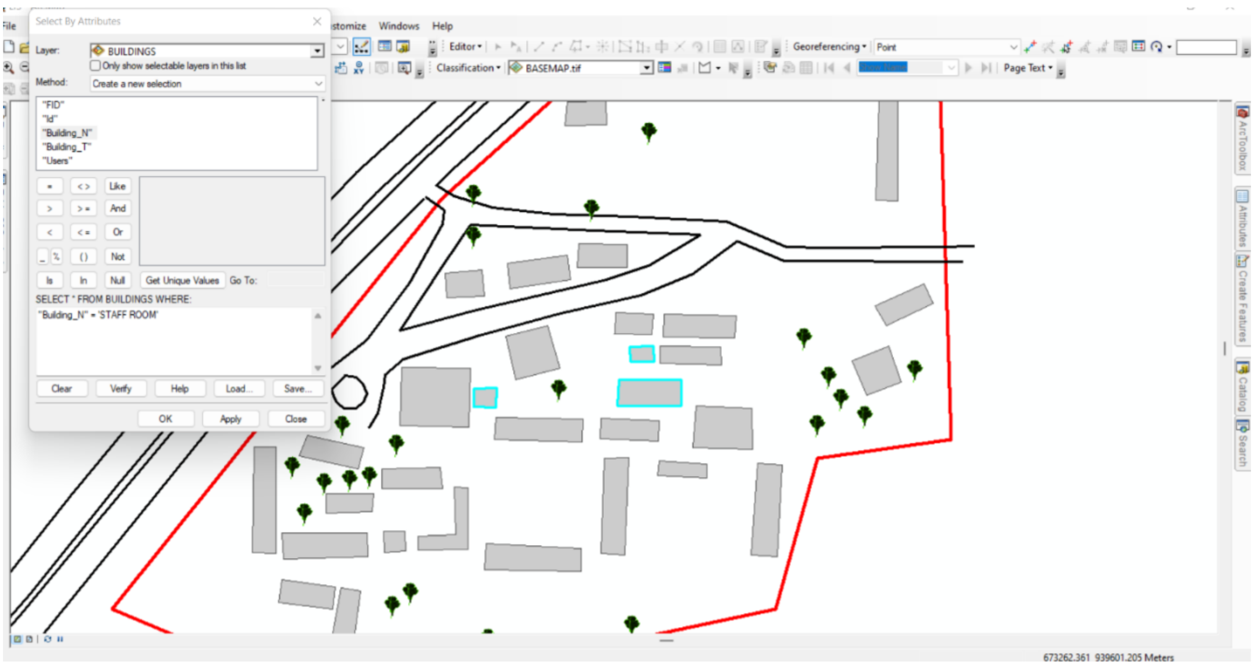

Figure 4.5.1: Sample Staff room Query Results in Arc-GIS

2. Mapping Distribution of Class rooms:

   Query: "Show all Class rooms"

   Result: A spatial representation of class room locations was displayed, ensuring adequate office space allocation.

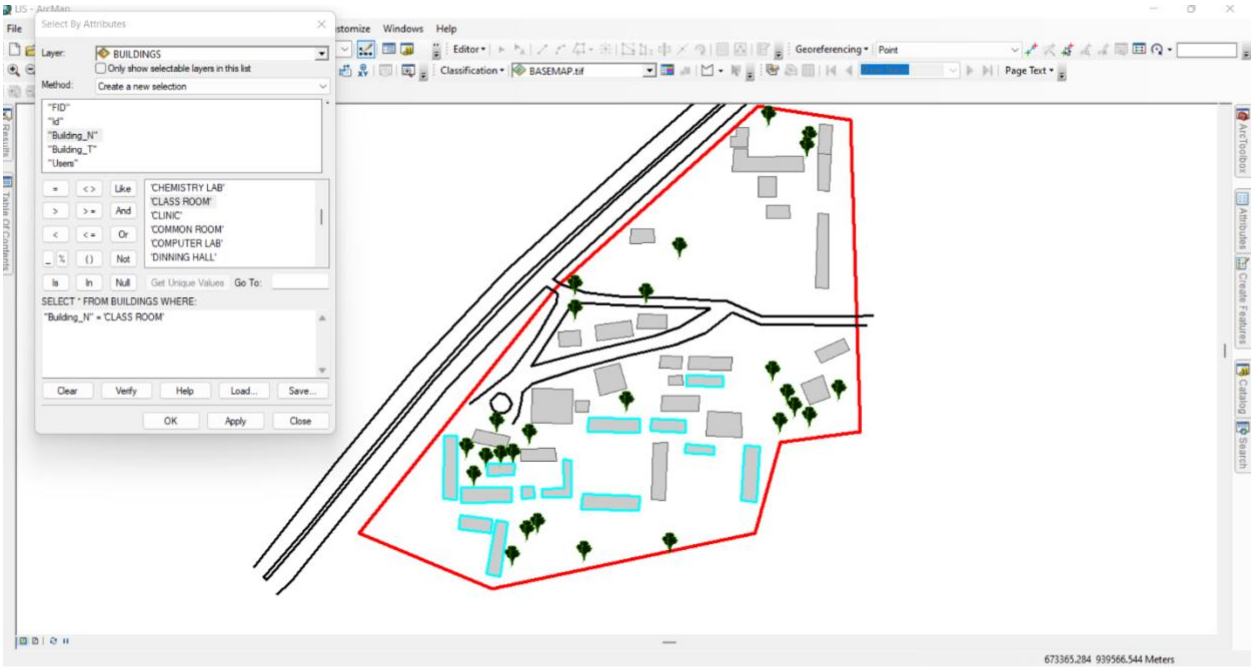

Figure 4.5.2: Sample Class room Query Results in ArcGIS

CHAPTER FIVE

5.0 COSTING, SUMMARY, PROBLEMS ENCOUNTERED, CONCLUSION AND RECOMMENDATION

5.1 COSTING

The costing of this project was done using the Nigeria Institution of Surveyor's (NIS) professional scale of fees for consultant in the construction industry. This stage shows the total cost that was spent on the project from day one to the final stage.

RECCI

PERSONAL/ QUALITY	DAY(S)	UNITRATE(N)	TOTAL AMOUNT(₦)
1 Senior Surveyor	1	20,000.00	20,000.000
Assistant Surveyor	1	8,000.00	8,000.00
Transportation	1	7,000.00	7,000.00
Basic Equipment	1	8,000.00	7,000.00
TOTAL			#42,000.00

BEACON= 2,100 × 5

= #10,500

BEACONING

PERSONAL/ QUALITY	DAY(S)	UNITRATE(N)	TOTALAMOUNT(₦)
1Assistant Surveyor	1	8,000.00	8,000.00
Basic Equipment(6)	1	8,000.00	8,000.00
Transportation	1	7,000.00	7,000.00
TOTAL			#23,000.00

TRAVERSING

PERSONAL/QUALITY	DAY(S)	UNIT RATE(N)	TOTALAMOUNT(₦)
1 Assistant Surveyor	2	8,000.00	16,000.00
Basic Equipment	2	8,000.00	16,000.00
Transportation	2	7,000.00	14,000.00
TOTAL			#46,000.00

DOWNLOADING DATA AND PLOTTING

PERSONAL/QUALI TY	DAY(S)	UNITRATE(N)	TOTALAMOUNT (₦)
1Senior Surveyor	2	15,000.00	30,000.00
1AssistantSurveyor	2	8,000.00	16,000.00
Transportation	2	7,000.00	14,000.00
Consumables	2	7,000.00	14,000.00
TOTAL			#74,000.00

INFORMATION PRESENTATION

PERSONAL/QUALI TY	DAY(S)	UNITRATE(N)	TOTALAMOUNT (₦)
1Assistant Surveyor	1	8,000.00	8,000.00
Transportation	1	7,000.00	7,000.00
TOTAL			#15,000.00

(1) # 42,000.00

(2) # 10,500.00

(3) # 23,000.00

(4) # 46,000.00

5) #74,000.00

(6) # 15,000.00

TOTAL # 210,500.00

CONSTIGENCIES=5%

210,500.00×5%÷ 100

= #10,525.00

V. A. T = 7.5%

210,500.00×7.5%÷100

= #15,787.50

MOBILIZATION AND DEMOBILIZATION =10%

2o10, 500.00 × 10%. ÷ 100

= #21,050.00

ACCOMODATION = 1.5%

210,500.00 ×1.5%÷100

= 3,157.50

TOTAL = 210,500.00

10,525.00

15,787.50

21,050.00

3,157.50

GRAND TOTAL = 261,020.00

GRAND TOTAL

5.1 SUMMARY OF FINDINGS

This study focused on the design and implementation of a Land Information System (LIS) for Government Secondary School, Maraba, situated in Ilorin East Local Government Area of Kwara State. The objective was to develop a reliable system for managing land-related data such as parcel boundaries, structures, ownership, and land use within the school premises. The study adopted surveying techniques, GIS technologies, and database development to capture, process, and present land information digitally.

The fieldwork involved ground control surveys using GPS and total stations, acquisition of satellite imagery, data digitization, and integration into a GIS platform. The spatial database created includes detailed maps of the school buildings, open fields, access roads, drainage, and other infrastructure. Attribute data such as land use types, structure conditions, and measurement details were also embedded into the system.

The LIS produced in this study allows users to easily:

- View and query spatial data of the school property
- Retrieve detailed records of different land parcels and features
- Generate maps for administrative and planning purposes
- Monitor changes and ensure effective land management within the school

The system developed is user-friendly and can be updated over time to accommodate new developments, changes in land use, or expansion projects.

5.2 CONCLUSION

The study successfully demonstrated that Land Information Systems are essential tools for efficient and sustainable land management, even at the institutional level such as public schools. Through the integration of spatial and attribute data, the developed LIS for Government Secondary School, Maraba, provides a reliable framework for:

- Decision-making related to land use
- Infrastructure planning
- Resource allocation
- Land monitoring and documentation

By digitally capturing and organizing spatial data, the system addresses common challenges like poor record-keeping, encroachment, and land disputes. The project confirms that even smaller public institutions can benefit from LIS to enhance transparency, accountability, and long-term planning.

5.3 RECOMMENDATIONS

Based on the findings of this project, the following recommendations are made:

1. Adoption by Kwara State Ministry of Education and Urban Development

Government agencies should promote the integration of LIS in all public secondary schools to monitor and manage school lands effectively. This could prevent encroachment, mismanagement, or unauthorized use of public land assets.

2. Regular Updates and Maintenance

The LIS developed should be regularly updated to reflect any structural changes, land use modifications, or new developments within the school. A trained staff or GIS consultant should be appointed for periodic updates.

3. Capacity Building

There is a need for training of school administrators and staff on the use and benefits of LIS. Basic knowledge of how to interpret digital maps, query databases, and use the system will encourage its optimal use.

4. Integration with State-wide LIS Platforms

This project can serve as a pilot for developing a larger-scale LIS for public properties across Kwara State. The state government should integrate school land databases with platforms like KWAGIS to build a comprehensive land administration framework.

5. Security and Data Backup

To avoid data loss, the LIS should be backed up on external servers or cloud platforms. Password protection and access controls should also be implemented to ensure data security.

6. Use in Planning and Budgeting

School authorities and the Ministry of Education should use LIS outputs (maps, statistics, and reports) in future planning and budgeting for land development, classroom expansion, fencing, and infrastructure upgrades.

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APPENDIX

S/N	EASTINGS	NORTHINGS	Elevation
1	673384.7	939882.4	284.324
2	673368.3	939852.6	284.974
3	673406	939809.5	285.418
4	673328.8	939826.6	286.878
5	673277.2	939835	285.121
6	673258.7	939839.1	283.911
7	673298.3	939799.4	288.005

8	673328.2	939792.3	287.552
9	673312.6	939762.8	289.926
10	673211939791.9	283.435	
11	673176	939756.2	283.922
12	673192.6	939752.9	284.652
13	673304.7	939734.3	290.222
14	673416.3	939684.2	290.247
15	673262	939711.3	288.105
16	673150	939731.4	284.378
17	673146.7	939696.4	283.653
18	673227.3	939675.6	284.134
19	673246.1	939672.8	284.316
20	673321.7	939630.2	288.378
21	673117.2	939688.4	282.391
22	673294	939592	283.783
23	673337.8	939578.5	283.019
24	673272	939568.4	282.117
25	673104.7	939620.4	281.182
26	673073.4	939634.1	276.58
27	673071.2	939615.2	275.123
28	673242.9	939550.3	280.075
29	673203.9	939544.3	280.735
30	673148.8	939568.4	281.263

31	673052.7	939612.9	272.448
32	673140.3	939546.8	280.215
33	673159.3	939539.3	280.517
34	673136	939532	279.591
35	673114.2	939546.4	279.556
36	673037.9	939584.1	270.915
37	673025.4	939566.5	270.677
38	673037.9	939584.1	270.915
39	673048.7	939603.2	272.177
40	673145.4	939724.6	283.813
41	673170.7	939748.4	284.45
42	673188.6	939764.6	283.773
43	673320.9	939845.5	287.18
44	673362.2	939875.4	285.746
45	673385.9	939892.8	284.152
46	673372.8	939797.9	284.644
47	673363.7	939784.4	286.123
48	673354.6	939769.4	288.129
49	673345.7	939755.1	289.742
50	673090.2	939538.8	278.481
51	673341.7	939727.3	291.403
52	673417.2	939777.8	284.558
53	673403.7	939704.2	289.927

54	673373.8	939666.3	290.383
55	673366.7	939657.7	289.8
56	673359.7	939648.9	289.387
57	673354.7	939644.1	289.178
58	673322.5	939606.4	286.048
59	673144.6	939544.4	280.276
60	673154.8	939560	281.098
61	673166.3	939577	281.907
62	673335.6	939739	291.06
63	673409.7	939902.9	285.097
64	673344	939813.6	285.841
65	673333	939800.4	286.532
66	673317.5	939785.4	288.656
67	673275.5	939754.9	289.562
68	673155.4	939649.3	284.999
69	673153.1	939647.9	284.914
70	673145.9	939640.2	284.266
71	673136.9	939632	283.646
72	673095.5	939590.5	279.358
73	673085.9	939576.8	278.209
74	673068.7	939548	275.907
75	673041.6	939564.6	272.021
76	673061	939584.5	273.936

77	673071.1	939593.9	275.368
78	673171.3	939705.6	284
79	673234	939763.5	286.572
80	673274.2	939798.6	287.23
81	673284.9	939807.8	287.065
82	673360.2	939896.9	286.454
83	673379.6	939906.3	285.363
84	673415.1	939877.3	285.558
85	673385	939777	285.683
86	673370.4	939740.7	289.914
87	673366	939728.9	290.9
88	673360.4	939716.8	291.697
89	673347.6	939690.5	292.448
90	673267.4	939567.2	281.818
91	673249.8	939761.5	287.673
92	673253.6	939769.1	287.673
93	673289.4	939837.7	285.923
94	673359.1	939907	286.683
95	673309.1	939718.2	290.864
96	673386.5	939846.5	284.751
97	673381.1	939847.9	284.798
98	673311.7	939810.2	287.49
99	673214.1	939753.6	285.594

100	673151.2	939668	284.273
101	673298.3	939761.6	289.834
102	673410.6	939819.5	286.064
103	673412.8	939743.1	286.98
104	673386	939725.4	289.89
105	673338.4	939696.8	292.455
106	673094.8	939567.3	279.722
107	673060.1	939554.7	274.721
108	673308.9	939615.9	286.747
109	673367.4	939644.7	288.332
110	673384.7	939651.2	288.549
111	673397.8	939656.6	288.644
112	673418	939665.7	289.824
113	673222.9	939571.6	281.678
114	673209	939559	281.109
115	673195.2	939545.6	280.87
116	673184.7	939538.6	280.999
117	673419.4	939652.4	289.44
118	673406.3	939665.7	289.634
119	673135.8	939557.7	280.436
120	673183.4	939557.6	281.026
121	673265.8	939558.1	281.327
122	673275.6	939560.4	282.041

123	673326.7	939576.1	282.93
124	673336.1	939577.2	282.915
125	673337.2	939577.8	282.96
126	673340.2	939579.1	283.101
127	673332.5	939572.9	282.561
128	673244.5	939571.8	280.976
129	673279.8	939710.7	289.235
130	673329.3	939714.1	291.661
131	673291	939772.5	289.507
132	673213.4	939769.2	285.037
133	673363.1	939841.6	285.29
134	673415.4	939850.6	286.503
135	673382.8	939854.7	284.659
136	673268.8	939807.9	286.262
137	673381.1	939790.3	285.169
138	673404.1	939698.9	290.112
139	673359.7	939699.5	292.101
140	673211.9	939636.4	283.159
141	673241.3	939612.7	282.141
142	673274.4	939604.9	282.939
143	673119.8	939627.5	282.657
144	673089.5	939639.6	279.492
145	673351.4	939620.1	286.705

146	673139.7	939652.3	284.027
147	673090.5	939659.4	280.094
148	673288	939729.3	289.918
149	673390.6	939747.4	287.987
150	673406.2	939749.5	286.834
151	673318.7	939777.2	289.241
152	673353.4	939813.4	285.219
153	673327.9	939814.1	286.716
154	673276.9	939802.7	287.085
155	673233.8	939788.3	285.237
156	673246.2	939797.5	285.454
157	673277.4	939813.8	286.407
158	673333.9	939845	287.321
159	673121.2	939624.5	283.071
160	673121.1	939615.1	282.792
161	673143.9	939624.5	283.815
162	673100.3	939592.9	281.442
163	673085.4	939596	278.194
164	673096.8	939595.6	279.372
165	673149.2	939596.2	281.843
166	673159.5	939597	281.78
167	673141.2	939594	282.01
168	673099.8	939605.7	282.096

169	673148.7	939606.2	282.084
170	673165.5	939604.1	283.126
171	673096.8	939647.3	281.218
172	673108	939642.9	281.375
173	673136.6	939636.5	282.179
174	673111.8	939652.6	283.596
175	673148.2	939636.5	284.471
176	673176.3	939637.2	284.381
177	673177.4	939627	284.25
178	673165.5	939597.3	283.212
179	673197.6	939587.9	282.967
180	673244.4	939586.8	282.022
181	673198.4	939600.3	281.592
182	673254.1	939595.6	282.376
183	673265.5	939594.9	283.309
184	673255.8	939641.6	282.017
185	673281.4	939633.4	283.739
186	673305.1	939632.2	284.123
187	673282.1	939640.3	285.194
188	673327.4	939646	290.763
189	673298.4	939647	289.971
190	673327.1	939666.1	292.244
191	673254	939661.3	284.252

192	673281.6	939649.9	284.438
193	673244.8	939649.7	282.435
194	673253.5	939651.3	282.443
195	673245.2	939660.8	283.997
196	673262.1	939667.2	284.253
197	673262.6	939679.7	286.756
198	673292.7	939667.2	287.534
199	673156.8	939657.7	284.797
200	673190.1	939656.9	284.931
201	673190.9	939685.2	284.021
202	673207.8	939700.8	284.134
203	673212.7	939679.8	283.992
204	673234.3	939685.5	284.829
205	673157.5	939685.9	283.582
206	673203.3	939666.4	284.044
207	673192.5	939675.4	283.893
208	673203.7	939675.9	283.133
209	673202.6	939650.8	283.871
210	673228.2	939705.8	284
211	673178.7	939731.5	284.127
212	673197.5	939720.1	284
213	673179.3	939719.3	284.169
214	673208.6	939736.3	285.441

215	673210	939723.9	285.565
216	673239.3	939728.1	287.38
217	673196.5	939732.8	285.965
218	673237.7	939740.2	285.981
219	673243.3	939745.8	287.908
220	673266.6	939745.3	289.626
221	673260.8	939702.2	292.324
222	673293.1	939679.9	290.403
223	673299.9	939667.1	289.403
224	673399.1	939678.4	289.269
225	673382.5	939672.3	289.093
226	673392	939705.9	291.205
227	673375.3	939688.7	291.609
228	673393.3	939695.9	290.854
229	673414.7	939716.5	288.314
230	673386.7	939715.5	290.931
231	673410.5	939726	287.665
232	673319.6	939710.9	292.093
233	673318.9	939700.1	289.855
234	673284.5	939711.5	289.939
235	673266.6	939734.1	289.765
236	673236.8	939802.9	284.509
237	673237.8	939814.4	283.996

238	673256.7	939803.2	285.935
239	673347.6	939823.1	287.83
240	673242.5	939734.1	289.519
241	673386.9	939766.8	286.751
242	673397.8	939766.3	284.723
243	673388.8	939826.9	284.968
244	673397.5	939826.6	284.746
245	673347.6	939833.6	285.377
246	673366.2	939833.9	284.881
247	673341.1	939840.1	286.99
248	673355.4	939840.2	285.718
249	673355.4	939857.2	285.598
250	673342	939857	285.635
251	673319.4	939861.2	287.356
252	673321.1	939879.7	287.56
253	673332	939879.4	287.867
254	673332.3	939873.1	287.697
255	673377.3	939873.8	287.932
256	673378.1	939860.8	284.921
257	673332.4	939880.9	286.766
258	673332.7	939896.3	287.526
259	673389.4	939875.3	284.306
260	673400	939874.5	284.067

261	673389.1	939845.7	284.362
262	673398.5	939845.2	284.514
263	673390.4	939899.1	284.735
264	673401	939898.6	283.725
265	673318.2	939880.8	287.29
266	673323	939896.6	286.94
267	673322.9	939889.5	285.163