DETAILED MAPPING OF IYEKOGBA HOUSING ESTATE AT OREDO LOCAL GOVERNMENT AREA, BENIN CITY, EDO STATE, NIGERIA.

BY

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P.M.B 1154

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF SCIENCES {BSCGEM - B.SC. GEOMATICS} DEGREE, IN THE FACULTY OF ENVIRONMENTAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA.

APRIL 2024

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CERTIFICATION

This is to certify that this project was carried out by EJEMAI, FAITH with Matriculation Number: **ENV1810642** of the Department of Geomatics, Faculty of Environmental Sciences, University of Benin, Edo State, Nigeria.

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HEAD OF DEPARTMENT

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EXTERNAL EXAMINER Date

DEDICATION

I offer my heartfelt dedication to the almighty God, Whose unwavering protection and boundless grace have been my guiding light overtime.

Secondly, my profound appreciation continues with a special mention to my parents, Pst. Joseph .A. Ejemai and Pst. Mrs. Patience Ejemai, my elder cousin, sister Blessing, and Miss Joy. O. Obayuwana. The mentioned names have immensely contributed constant love, care and unending support that have been the pillars of my journey.

Furthermore, I extend my major dedication to my uncle, Engr. Joel Egbon whose support, encouragement and guidance have played a significant role in shaping my experiences and aspirations in this discipline.

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ABSTRACT

Urban development projects rely heavily on accurate and detailed mapping to ensure efficient planning and management of resources. This study focuses on producing a comprehensive digitized map of Iyekogba Housing Estate, situated in the Oredo Local Government Area of Edo State, Nigeria. The aim of this project is to create a detailed map that encompasses all essential features, landmarks, and amenities within the estate. Achieving this aim involves the use of advanced mapping techniques to generate precise spatial data that can support informed decision-making in urban planning and development initiatives.

The methodology employed in this project involves the use of Oscar Tersus GNSS equipment to acquire survey data (X, Y, Z coordinates) of the entire estate. Subsequently, the collected data is processed using various software applications, including AutoCAD, ArcGIS, and Microsoft Excel. These software tools enable the integration, analysis, and visualization of the survey data, leading to the creation of a detailed map that accurately represents the spatial characteristics of Iyekogba Housing Estate.

The results of the project are presented in accordance with the specified objectives. Firstly, the detailed map reveals the well-organized layout of individual plots (buildings) within the estate, indicating a planned development approach. Also a perimeter plan was created using AutoCAD to accurately define the boundary of Iyekogba Housing Estate. According to the perimeter plan analysis, the estate occupies an area of 510,538.983 square meters with a perimeter of 3,083.53 meters. Furthermore, a contour map was generated using ArcGIS to visualize the topographical characteristics of the study area. The contour map illustrates the elevation variations across the estate. In conclusion, this project successfully achieves its aim of producing a detailed map.

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INTRODUCTION

1.1 Background of Study

A detail survey is a type of survey that is used to determine and locate the features and improvements on a parcel of land. The word 'features' here means both natural and man-made structures on a piece of land, such as vegetation, types of soil, buildings, land utilities, fences and boundaries, roads, landmarks and so on.

In recent times, the prevalence of Global Navigation Satellite Systems (GNSS) in detailed surveying has surged, transforming the field and yielding remarkable advantages with respect to precision, efficacy, and output. (Kim, 2018). GNSS technology, which includes systems such as Global Positioning System (GPS), GLONASS, Galileo, and BeiDou, has transformed the way details surveying is conducted, offering new possibilities and capabilities for surveyor (Chen, & Zhang, 2017).

As a new modern technology, GPS technology has achieved good applications in multiple fields of modern social and economic development, and is constantly expanding its application scope. At the same time, it also provides strong guarantees for the quality and efficiency of work in different fields. The application of GNSS technology in detailed surveying and mapping has many advantages compared to traditional surveying and mapping techniques in the past. It does not only has high accuracy in surveying and mapping, but also has a relatively simple operation, requiring low proficiency of surveying and mapping technicians (Jiang & Zhao, 2023).

Moreover, the utilization of GNSS technology in detailed surveying has demonstrated its cost-effectiveness. It diminishes the requirement for extensive fieldwork and curtails the deployment of supplementary resources, culminating in more proficient survey operations. By simplifying the data collection process and curtailing manual labor, GNSS technology assists surveyors in optimizing their resources and enhancing project efficiency (Shah & Chawla, 2017).

1.2 Statement of problem

The availability of sufficient data is key to achieving detail environmental mapping and modelling especially where construction projects are always being carried out just as in the case of the Iyekogba Housing Estate. The housing estates lacks a detailed map to accurately depict the various amenities within the estate to facilitate navigation and planning. Additionally, due to the undulation of the lands terrain a proper study of the topography of the estate is necessary to help in future planning and decision making. To address these obstacles, a thorough survey and mapping project utilizing Global Navigation Satellite Systems (GNSS) equipment is necessary.

1.3 Aim and Objectives of the Project

This project aims to produce a detailed map of Iyekogba Housing Estate at Oredo Local government area of Edo state.

The objectives of the project are to:

i. create a detailed map of Iyekogba Housing Estate, encompassing all essential features, landmarks, and amenities.

ii. produce the perimeter plan of the study area.

iii. generate the Contour map of the study area.

1.4 Scope of the Project

The scope of this project comprised the following operations;

i. Reconnaissance (Field and Office).

ii. Data Acquisition

iii. Data Processing and analysis

iv. Data Presentation

v. Comprehensive report writing.

1.5 Justification of the Study

The detailed survey of Iyekogba Housing Estate holds immense significance, offering multifaceted benefits to both the residents of the community and the broader field of knowledge.

The creation of a detailed map for Iyekogba Housing Estate is crucial for enhancing navigation within the community. Residents and visitors alike will benefit from a comprehensive map that accurately depicts the layout of the estate, enabling efficient movement and access to various amenities. Also, a detailed survey facilitates the identification and accurate representation of amenities within the estate. Residents will have access to valuable information about nearby facilities, including schools, hospitals, recreational areas, and public services. This knowledge contributes to an improved quality of life, allowing residents to make informed decisions about their daily activities.

The study expands the existing knowledge base in the field of Geomatics by addressing the unique challenges posed by the undulating topography of Iyekogba Housing Estate. The insights gained from analyzing the estate's topography contribute to the broader understanding of how Geomatics technologies can be adapted to varying geographical conditions.

In conclusion, the detailed survey of Iyekogba Housing Estate is not only a practical necessity for the community but also a valuable contribution to the field of knowledge. It aligns with the principles of effective urban planning, sustainable development, and the advancement of geospatial technologies. The benefits derived from this study extend beyond the immediate community, serving as a model for future detailed surveys and applications of advanced Geomatics technology in diverse geographical settings.

CHAPTER TWO

LITERATURE REVIEW

2.1 General overview

Geomatics, a term sometimes used in place of surveying, has conventionally been described as the discipline encompassing the scientific, artistic and technological aspects involved in identifying the spatial relationships between points situated above, on or below Earth's surface. This includes establishing such points to enable accurate positioning (Wolf et al., 2012).

Geomatics, in its broader scope, encompasses the comprehensive discipline involved in measuring and gathering information about the physical earth and our surroundings. It involves the assessment of acquired data and the generation of diverse products catering to a wide array of clients. Surveying, an integral part of geomatics, has played a pivotal role since the early stages of human civilization. The act of measuring and demarcating property boundaries stands out as one of its earliest applications. Over time, the significance of surveying has grown significantly due to escalating demands for various maps and spatial information. Additionally, the need for establishing highly accurate benchmarks, guiding construction projects with precise line and grade, has further elevated the importance of surveying, steadily increasing its relevance over the years (Wolf et al., 2012). The primary objective of surveying is to obtain accurate and reliable data regarding the dimensions, positioning, and configuration of the terrain, along with the arrangement and orientation of constructed edifices (Kavanagh, 2010). The creation of maps, charts, and plans, derived from this precise information, forms the foundation for the design, implementation, and oversight of infrastructure projects (Schofield, 2007).

2.2 Types of Surveying

i. Geodetic Surveying: Geodetic surveying involves precise measurements over a large area, taking into account the Earth's curvature and gravitational variations. It is used for mapping large regions, establishing control networks, and determining precise global coordinates (Leick, 2004).

ii. Topographic Surveying: The emphasis in topographic surveying lies in the mapping of both natural and artificial features within a designated area. This encompasses the measurement of elevation, contours, vegetation, water bodies, and various surface details. Crucial for applications in land development, urban planning, and engineering initiatives, topographic surveys play an integral role in providing a comprehensive understanding of the terrain (Wolf & Brinker, 2009).

iii. Cadastral Surveying: Cadastral surveying is primarily concerned with delineating property boundaries, land divisions, and establishing detailed land records. This discipline ensures the accuracy of land ownership, facilitates seamless property transactions, and supports legal and administrative processes related to land management (Miguel, 2016).

iv. Construction Surveying: At the core of construction surveying is the layout and positioning of structures, roads, utilities, and other infrastructure components during the construction phase. Its primary purpose is to guarantee that construction activities align precisely with design plans and specifications, ensuring the integrity of the built environment (Kavanagh, 2010).

v. Hydrographic Surveying: Focused on mapping and measuring bodies of water, hydrographic surveying encompasses the study of lakes, rivers, and oceans. This surveying type gathers data on depth, shape, and water features, serving vital purposes in navigation, coastal engineering, and the management of marine resources (Church, 2012).

vi. Mining Surveying: In the realm of mining operations, mining surveying assumes a critical role in mapping mineral deposits, establishing boundaries, planning excavation activities, and monitoring extraction processes. It serves as a fundamental component in resource exploration and management within the mining industry (Borich, 2011).

vii. Detailed Surveying: Specializing in accurate measurement and mapping of smaller-scale elements such as buildings, roads, utilities, and additional structures, detailed surveying is crucial for applications in urban planning, infrastructure development, and architectural design.

2.2 Detailed Survey

Detailed surveying is a specialized field that encompasses the precise measurement and mapping of features on a smaller scale, such as buildings, roads, utilities, and other structures (Kavanagh, 2010).

This discipline plays a crucial role in various industries, providing essential information for urban planning, construction projects, land development, and resource management (Kavanagh, 2010).

Accurate details surveying is essential for ensuring the proper design, layout, and maintenance of infrastructure and buildings (Kavanagh, 2010).

According to the American Society of Civil Engineers (ASCE), details surveying is a fundamental component of civil engineering and plays a significant role in the planning and execution of various projects (ASCE, 2018). The accurate measurement and mapping of features provide the necessary groundwork for effective decision-making in urban planning, construction, and land development. In urban planning, details surveying allows professionals to gather precise data about existing features within a specific area. This data is crucial for understanding the current state of a city or town and assists in making informed decisions about its future development. Urban planners rely on details surveying to assess the suitability of different locations for new infrastructure, identify areas in need of improvement, and establish zoning regulations (Owen, 2017). In the construction industry, accurate details surveying is paramount to ensure that new structures align properly with the existing environment. By capturing precise measurements and mapping the surrounding features, architects,

engineers, and construction teams can design and implement projects that seamlessly integrate with the existing infrastructure (Carter, 2018). This minimizes the risk of errors, conflicts, and costly rework during the construction process.

For land development, details surveying provides crucial information for assessing the viability and potential of a site. It helps professionals determine the suitability of the land for various purposes, such as residential, commercial, or industrial development (Reid, 2019). Detailed surveys also aid in establishing accurate property boundaries and land ownership information, which is essential for legal purposes and avoiding disputes. Resource management relies on accurate details surveying to effectively utilize and preserve natural resources. By

precisely mapping features such as water bodies, forests, and other natural resources, professionals can develop sustainable management strategies (Reid, 2019). This information assists in making informed decisions about resource utilization, conservation, and minimizing environmental
impact.

2.2.1 Types of detailed survey

Detailed surveying involves the precise measurement and mapping of features on a smaller scale. While there are no specific types of surveying referred to as "detailed surveying," various surveying methods and techniques can be employed to achieve detailed surveys. These methods may include:

i. Building Surveys: Building surveys focus on capturing detailed information about the interior and exterior of structures. This includes measurements of dimensions, floor plans, elevations, and identifying any structural or architectural features.

ii. Road Surveys: Road surveys involve collecting detailed data about roadways, including their alignment, cross-sections, gradients, and pavement conditions. This information is essential for road design, maintenance, and improvement projects.

iii. Land Surveys: Land surveys encompass detailed measurements of land parcels, including boundaries, property lines, and topographic features. They provide precise information about the terrain, vegetation, and other elements on the land, supporting land development, land registration, and property management.

iv. Environmental Surveys: Environmental surveys involve gathering detailed information about the natural environment, including vegetation, water bodies, and ecological features. These surveys aid in environmental impact assessments, conservation planning, and resource management.

It is important to note that these are general categories of detailed surveying, and specific methodologies and techniques may vary depending on the project requirements.

2.2.2 Historical Background of Detailed Survey

The practice of detailed surveying has a long historical background that can be traced back to ancient civilizations. The need for precise measurement and mapping of features on a smaller scale has been recognized for centuries, evolving alongside advancements in technology and human knowledge.

One of the earliest recorded instances of surveying can be found in ancient Egypt, where surveyors played a crucial role in the construction of monumental structures such as the pyramids. The Egyptians developed sophisticated techniques to ensure accurate measurements and alignment of their architectural wonders (Turner, 2016). They used basic tools like ropes, plumb bobs, and sighting instruments to establish boundaries, lay out construction sites, and create precise maps of the surrounding land (Shaw, 2010).

The Greeks also made significant contributions to the field of surveying. The mathematician and engineer, Euclid, wrote about the principles of surveying in his work "Elements" around 300 BCE. His treatise included concepts such as measuring angles, calculating distances, and determining areas, forming the basis for geometric surveying (Greenway, 2010).

During the Roman Empire, surveying played a vital role in land division and the planning of cities and infrastructure. The Romans developed advanced techniques for measuring distances and creating accurate maps, including the use of the groma, a surveying instrument that allowed for precise alignments and right angles (Sullivan, 2013). The legacy of Roman surveying can still be seen in the layout of many cities and roads that were meticulously planned and constructed.

The Renaissance period witnessed significant advancements in surveying techniques. The introduction of more sophisticated instruments, such as the theodolite and improved triangulation methods, enabled surveyors to achieve higher levels of accuracy (Crone, 2018).

In the modern era, the Industrial Revolution brought about further advancements in surveying technology. The introduction of new instruments like the total station and later, GPS (Global Positioning System), revolutionized the field, allowing for more efficient and precise measurements (Mikhail, 2001). Today, surveying technology continues to evolve with the advent of remote sensing techniques, Light Detection and Ranging (LIDAR) and aerial surveying, further enhancing the capabilities of detailed surveying.

2.3 Global Navigation Satellite Systems (GNSS)

GNSS, which stands for Global Navigation Satellite System, is a constellation of satellites that enables precise positioning and navigation on Earth's surface. Currently, there are four main global navigation satellite system in operation or in development: the US global positioning system (GPS), the Russian global orbiting navigation satellite system (GLONASS), the European union Galileo, and the Chinese BeiDou (Liu et al., 2017).

The Global Positioning System (GPS) was developed and is maintained by the U.S. Department of Defense. It consists of a network of satellites orbiting the Earth, transmitting precise timing signals and positioning data to GPS receivers on the ground. These signals are received and processed by GPS receivers, which use the information from multiple satellites to calculate the user's precise position, velocity, and time (Kaplan and Hegarty, 2006). GPS has become an essential tool for a wide range of applications, including navigation, surveying, mapping, aviation, transportation, and outdoor recreational activities.

GLONASS, developed by Russia, is another major GNSS system. It operates a constellation of satellites that provide global positioning and timing services. GLONASS works in a similar manner to GPS, with receivers using signals from multiple satellites to determine accurate positions (Hofmann Wellenhof et al., 2008). The combination of GPS and GLONASS signals can enhance positioning accuracy, particularly in challenging environments with limited satellite visibility, such as urban canyons or dense foliage.

Galileo is the European Union's GNSS system, developed and operated by the European Space Agency (ESA) and the European Global Navigation Satellite Systems Agency (GSA). Galileo aims to provide highly accurate, reliable, and autonomous positioning and timing services to users worldwide (Giles & Rincon, 2019). With its constellation of satellites, Galileo offers increased positioning accuracy and availability, as well as improved integrity and robustness for critical applications. BeiDou, developed by China, is another prominent GNSS system. Initially regional, BeiDou has expanded to provide global coverage with its constellation of satellites. BeiDou offers positioning, navigation, and timing services with a focus on the Asia-Pacific region (Wu et al., 2018).

The system aims to enhance navigation capabilities, support various sectors including transportation and disaster relief, and contribute to the economic and social development of China and neighboring countries.

The collaboration and interoperability among these GNSS systems allow users to benefit from a broader range of satellites, leading to improved positioning accuracy, availability, and reliability (Kaplan & Hegarty, 2006). The combination of multiple constellations can mitigate the effects of signal blockage, multipath interference, and ionospheric disturbances, enhancing navigation performance in challenging environments.

2.3.1 GNSS Technology in Detail Surveying

GNSS receivers utilize the signals from multiple satellites to calculate accurate positions through a process called trilateration. Trilateration involves measuring the distance between the receiver and each satellite by calculating the time it takes for the signals to travel from the satellites to the receiver.

By combining the distance measurements from multiple satellites, the receiver can determine its precise location coordinates (Kaplan & Hegarty, 2006). This process ensures that the survey points obtained during detailed surveying are accurately positioned on the Earth's surface.

The data collected by GNSS receivers during detailed surveying can be further processed and analyzed using specialized software. This software takes the raw GNSS data and applies sophisticated algorithms to calculate more precise positions, filter out errors, and improve the overall accuracy of the survey

measurements (Hofmann-Wellenhof et al., 2008). Additionally, the software allows for the integration of other survey data, such as measurements from total stations or laser scanners, to create
comprehensive and detailed survey representations.

With the aid of specialized software, the collected GNSS data can be used to create detailed maps, digital terrain models, and 3D representations of the surveyed areas. These representations provide valuable information for various applications, including urban planning, infrastructure design, environmental assessment, and construction projects. Detailed maps derived from GNSS data offer accurate depictions of surveyed features, such as buildings, roads, and utilities, enabling urban planners and engineers to make informed decisions about land development and infrastructure design (Ginige et al., 2013). Digital terrain models created from GNSS data provide elevation information, helping in the analysis of slopes, drainage patterns, and terrain characteristics for engineering and environmental purposes.

The combination of GNSS technology and specialized software in detailed surveying enhances the accuracy, efficiency, and productivity of the surveying process. It enables surveyors to capture precise location coordinates, analyze survey data, and create detailed representations of the surveyed areas with greater ease and accuracy.

2.3.2 Advantages of GNSS in Details Surveying

GNSS (Global Navigation Satellite System) offers several advantages in detailed surveying, making it an essential tool for precise positioning and data collection. Some of the key advantages of GNSS in detailed surveying include:

i. High Accuracy: GNSS receivers provide high accuracy positioning, allowing surveyors to obtain precise location coordinates of survey points. The use of multiple satellites and advanced algorithms in GNSS receivers improves the accuracy of measurements, enabling surveyors to achieve sub-meter or even centimeter-level positioning (Li et al., 2015). This high accuracy is crucial in detailed surveying, where precise measurements are required for accurate mapping, infrastructure design, and construction projects

ii. Global Coverage: GNSS systems, such as GPS, GLONASS, Galileo, and BeiDou, provide global coverage, offering positioning and navigation capabilities worldwide. This global coverage makes GNSS suitable for detailed surveying projects that span large areas or involve multiple locations across different regions or countries. Surveyors can rely on GNSS to obtain accurate positioning data regardless of their geographical location (El-Rabbany, 2019).

iii. Time Efficiency: GNSS significantly improves the time efficiency of detailed surveying compared to traditional surveying methods. With GNSS, surveyors can quickly and easily collect positioning data, reducing the time required for fieldwork. The ability to obtain accurate measurements efficiently allows surveyors to increase productivity, cover larger areas in less time, and streamline the surveying process (Ginige et al., 2013).

iv. Flexibility and Mobility: GNSS receivers are portable and lightweight, providing surveyors with the flexibility and mobility to move around the survey area. This portability allows surveyors to easily access difficult-to-reach or remote locations, enabling comprehensive data collection across various terrains and environments. The flexibility and mobility of GNSS receivers contribute to their practicality and effectiveness in detailed surveying projects (O'Keeffe, 2016).

v. Integration with Other Technologies: GNSS can be seamlessly integrated with other surveying technologies, such as total stations and laser scanners, to enhance the capabilities of detailed surveying. Combining GNSS with other measurement methods enables surveyors to collect a broader range of data and create comprehensive representations of surveyed areas. This integration facilitates the creation of accurate and detailed maps, models, and digital representations (Ginige et al., 2013).

These advantages of GNSS in detailed surveying make it an indispensable tool for precise positioning and data collection in various applications, including urban planning, construction, land development, and resource management.

2.3.3 Challenges and Limitations of GNSS in detail survey

Despite the significant advantages of GNSS technology in detailed surveying, there are indeed challenges and limitations that need to be considered. These challenges can affect the accuracy and reliability of GNSS measurements. Some of the key challenges and limitations include:

i. Atmospheric Conditions: GNSS signals can be impacted by atmospheric conditions, such as ionospheric delays, multipath reflections, and signal attenuation. These factors can introduce errors in the positioning measurements, particularly in areas with adverse weather conditions or dense vegetation (Kaplan & Hegarty, 2006). Surveyors need to account for atmospheric effects and apply appropriate corrections to minimize their impact on the accuracy of GNSS measurements.

ii. Satellite Availability and Geometry: The accuracy of GNSS positioning relies on the availability and geometry of the satellites in view of the receiver. In certain locations or circumstances, satellite signals may be obstructed or limited, leading to reduced accuracy or even signal loss. Factors like tall buildings, dense urban environments, or natural obstacles can affect the visibility and availability of satellites (El-Rabbany, 2019). Surveyors must carefully consider the satellite constellation status and ensure an optimal satellite configuration for accurate positioning.

iii. Signal Obstructions: Physical obstructions, such as buildings, trees, or mountains, can obstruct GNSS signals and result in signal blockage or multipath effects. Multipath refers to the phenomenon where signals bounce off surfaces before reaching the receiver, leading to erroneous position calculations (Hofmann-Wellenhof et al., 2008). Surveyors need to assess the survey environment and choose appropriate locations or employ techniques to mitigate signal obstructions and minimize multipath effects.

iv. Equipment Limitations: The accuracy and performance of GNSS measurements can vary depending on the quality and capabilities of the GNSS receiver used. High-precision GNSS equipment may require proper calibration, regular maintenance, and expertise in operation and data processing (Li et al., 2015). Surveyors need to ensure that they are using reliable and properly calibrated equipment and possess the necessary skills to achieve accurate data collection and processing.

v. Human Factors: The accuracy of GNSS measurements also depends on the expertise and training of the surveyors. Incorrect setup, inadequate data collection techniques, or improper data processing can introduce errors in the survey results. Surveyors must have a good understanding of GNSS principles, best practices, and error sources to minimize human induced errors and ensure reliable and accurate data collection (Ginige et al., 2013).

To overcome these challenges and limitations, surveyors can employ various techniques and strategies. This includes using advanced GNSS receivers with multiple frequencies, applying differential correction techniques, utilizing real-time kinematic (RTK) positioning, or integrating GNSS with other surveying methods (El-Rabbany, 2019). By implementing appropriate techniques and considering the limitations of GNSS technology, surveyors can improve the accuracy and reliability of their detailed
surveying results.

2.3.4 Detail Surveying Procedures

To ensure precision in detail surveying with GNSS (Global Navigation Satellite System), it is imperative that surveyors observe best practices and implement specific measures. By adhering to these guidelines, surveyors can augment the accuracy of their measurements and guarantee dependable survey findings. The following are some essential factors to consider:

I. Equipment Selection: Choosing the right GNSS equipment is essential for achieving accuracy in detailed surveying. Surveyors should consider factors such as receiver quality, signal tracking capabilities, and the availability of multiple frequencies. High-precision GNSS receivers with advanced features and robust signal reception capabilities can contribute to more accurate positioning measurements (O'Keeffe, 2016).

II. Survey Planning and Design: Proper planning and survey design are crucial for accuracy. This includes establishing control points with known coordinates to provide reference for the survey. Control points should be carefully selected and distributed throughout the survey area to ensure accurate georeferencing and alignment of the survey data (Ginige et al., 2013). Adequate ground control and network adjustment techniques should be employed to minimize errors.

III. Calibration and Quality Control: Regular calibration of GNSS equipment is important to maintain accuracy. Surveyors should follow manufacturer guidelines for equipment calibration and ensure that the equipment is calibrated periodically or when significant changes occur. Quality control checks, such as comparing GNSS measurements with independent measurements or redundant observations, can help identify potential errors or inconsistencies in the data (El-Rabbany, 2019).

IV. Data Post-processing: post-processing of collected GNSS data can further improve accuracy. Surveyors can employ differential correction techniques, such as Real-Time Kinematic (RTK) or post-processing differential correction, to enhance the accuracy of GNSS measurements. Post-processing software and algorithms can be used to refine the positioning data, reduce errors, and achieve more precise results (Li et al., 2015).

V. Continual Professional Development: Staying updated with advancements in GNSS technology and surveying techniques is crucial for maintaining accuracy. Surveyors should engage in continual professional development, attend training programs, and stay informed about industry best practices. This ensures that they have the necessary knowledge and skills to effectively operate GNSS equipment and apply appropriate survey methodologies (Ginige et al., 2013).

2.3.5 GNSS Equipment and Tools

A variety of GNSS equipment and tools are available to support detailed surveying tasks, providing surveyors with the means to collect accurate positioning data. The selection of appropriate equipment depends on factors such as the required accuracy, survey conditions, and budget considerations. Here are some commonly used GNSS equipment and tools:

I. Hand-held GNSS Receivers: Hand-held GNSS receivers are compact and portable devices designed for field data collection. They offer real-time positioning capabilities and are suitable for applications where sub-meter to decimetre-level accuracy is sufficient. Hand-held receivers are commonly used in tasks such as asset mapping, forestry, and GIS data collection.

II. Survey-Grade GNSS Receivers: Survey-grade GNSS receivers are professional-grade instruments that provide high-precision positioning for detailed surveying applications. These receivers offer centimeter-level accuracy and advanced features such as multiple frequencies, carrier-phase measurements, and on-board data logging. Survey-grade receivers are used in applications where precise measurements are critical, such as construction layout, cadastral surveys, and topographic mapping.

III. GNSS Antennas: GNSS antennas are crucial components of the GNSS system, responsible for receiving satellite signals. Antennas come in various designs and types, including choke ring antennas, geodetic antennas, and survey-grade antennas. The selection of the antenna depends on factors such as the required accuracy, survey environment, and compatibility with the GNSS receiver.

IV. Data Loggers: Data loggers are devices used to store and record GNSS data collected in the field. These devices can be integrated with GNSS receivers to enable continuous data logging over extended periods. Data loggers are particularly useful when conducting static or kinematic GNSS surveys where long-duration observations are required.

V. Field Software: Field software applications are used for data collection and real-time positioning using GNSS receivers. These software applications run on hand-held devices, such as smartphones or tablets, and provide intuitive interfaces for surveyors to collect, manage, and validate GNSS data in the field. Field software often includes features such as waypoint navigation, data quality checks, and real-time differential correction. When selecting GNSS equipment and tools, it is important to consider factors such as the required accuracy, compatibility with other surveying equipment, durability, and ease of use. Choosing reliable and compatible equipment ensures optimal performance and data quality in detailed surveying projects

2.3.6 Optimal Techniques for Effective Detailing Assessment

To ensure successful detailed surveying using GNSS (Global Navigation Satellite System), surveyors should follow several best practices. By implementing these practices, surveyors can enhance the accuracy and reliability of their survey results. Here are some key best practices:

I. Research and Planning: Conduct thorough research and planning before starting a survey. Familiarize yourself with the survey area, including any potential obstructions or challenging conditions that may affect GNSS measurements. Plan the survey layout, establish control points, and determine the appropriate surveying techniques and equipment needed for the project (Ginige et al., 2013).

II. Training and Proficiency: Obtain proper training and develop proficiency in GNSS technology. Understand the principles of GNSS positioning, data collection, and processing techniques. Stay updated with the latest advancements in GNSS technology and surveying practices. Regularly participate in professional development activities to enhance your knowledge and skills in using GNSS equipment effectively (El-Rabbany, 2019).

III. Equipment Maintenance and Calibration: Regularly maintain and calibrate your GNSS equipment to ensure accurate measurements. Follow the manufacturer's guidelines for equipment maintenance and calibration. Regularly check and update the firmware and software of the GNSS receiver to ensure optimal performance. Properly store and transport the equipment to prevent damage (Ginige et al., 2013).

IV. Standard Operating Procedures: Adhere to standard operating procedures to maintain consistency and reliability in your surveying practices. Establish clear protocols for data collection, field procedures, and quality control checks. Follow standardized methods for data processing and analysis. Document your survey procedures to ensure repeatability and traceability (Li et al., 2015).

V. Quality Control Checks: Perform regular quality control checks to verify the accuracy and reliability of your survey measurements. Use redundant observations or independent checks to validate the results. Compare GNSS measurements with control points or reference data to identify any potential errors or inconsistencies. Apply appropriate data validation techniques to ensure the quality of the collected data (El-Rabbany, 2019).

2.4 Geographic Information Systems (GIS)

Geographic Information Systems is a powerful technology that allows for the collection, storage, analysis, and visualization of geospatial data. It integrates various types of data, including geographic, demographic, environmental, and socioeconomic information, to provide a comprehensive understanding of spatial relationships and patterns. GIS is widely used in fields such as urban planning, natural resource management, transportation, public health, and many others.

2.4.1 Definition and Components of GIS

GIS is a system that enables the capture, storage, manipulation, analysis, and presentation of geospatial data. It consists of several key components. The hardware component includes computers, scanners, GPS receivers, and printers, which are used to acquire and process data. The software component provides tools and applications for data management, analysis, and visualization.

Examples of GIS software include ArcGIS by Esri, QGIS, and GRASS GIS. Geospatial data, such as maps, satellite imagery, and survey data, form the foundation of GIS. Skilled personnel, including GIS analysts and technicians, are essential for the effective utilization of GIS technology.

2.4.2 Data Capture and Sources

GIS relies on the acquisition of accurate geospatial data. Data can be obtained from various sources, including remote sensing, surveying, and existing maps and databases. Remote sensing techniques involve the use of satellite imagery, aerial photography, and LiDAR to capture data from a distance.

Surveying techniques, such as GPS (Global Positioning System) and total stations, are used to collect precise spatial data on the ground. Existing maps, aerial photographs, and other sources can also be digitized or scanned to create digital datasets. The quality and reliability of data greatly influence the accuracy and usefulness of GIS analysis.

2.4.3 Data Storage and Management

GIS utilizes databases to store and manage geospatial data efficiently. Data is organized into layers or feature classes, each representing a specific geographic theme, e.g., roads, buildings, land use, etc. GIS databases can be relational databases or file-based formats. Proper data management practices include data validation, metadata creation, and version control to ensure data integrity and accessibility.

Database management systems, such as PostgreSQL with Post GIS, are commonly used for GIS data storage and retrieval.

2.4.4 Spatial Analysis and Modelling

GIS enables various spatial analysis and modelling techniques to extract meaningful insights from geospatial data. Analysis functions include overlay, proximity analysis, network analysis, spatial interpolation, and spatial statistics. These tools allow users to explore spatial patterns, relationships, and trends, and make informed decisions based on the analysis results. GIS modelling allows for the simulation and prediction of real-world phenomena based on spatial relationships and attributes. This helps in decision-making and planning processes, such as predicting the spread of diseases, assessing environmental impacts, and optimizing transportation routes.

2.5 AutoCAD

AutoCAD, developed by Autodesk Inc., is a powerful computer-aided design (CAD) software application that has played a pivotal role in shaping the fields of architecture, engineering, construction, manufacturing, and many others. With its user-friendly interface and comprehensive toolset, AutoCAD has been an indispensable tool for professionals in various industries for several decades.

2.5.1 Key Features of AutoCAD

i. 2D Drafting and Detailing: AutoCAD is renowned for its robust 2D drafting capabilities. It provides a wide range of drawing and editing tools, making it ideal for creating precise technical drawings, schematics, and plans. Engineers, architects, and drafters rely on AutoCAD for tasks such as creating floor plans, electrical layouts, and mechanical drawings.3D Modeling and Visualization: AutoCAD offers powerful 3D modeling tools, allowing users to create three-dimensional objects and structures. This feature is particularly valuable in architectural design, where it enables the creation of 3D models for presentations and visualization. Customization: AutoCAD's flexibility is a standout feature. Users can customize the software using AutoLISP, a scripting language, and develop custom commands, routines, and plugins. This customization capability allows professionals to tailor AutoCAD to their specific work-flows and requirements.

ii. Parametric Design: AutoCAD supports parametric design through constraints and parameters. Designers can establish relationships and constraints between objects in their drawings, enabling dynamic changes and updates as design parameters are modified. This enhances design flexibility and efficiency.

iii. Collaboration and Cloud Integration: AutoCAD provides collaboration tools that facilitate teamwork. Users can share their designs with others, work on files collaboratively in real-time, and store projects in the cloud for easy access and sharing. This is particularly valuable in project management and collaboration across dispersed teams.

iv. Industry-Specific Toolsets: Autodesk offers industry-specific versions of AutoCAD known as AutoCAD tool-sets. These tool-sets are tailored to specific fields, such as architecture, electrical, and mechanical design. They include specialized features, libraries, and workflows that cater to the unique needs of professionals in those industries.

v. Rendering and Visualization: AutoCAD includes rendering capabilities that allow users to create realistic visualizations of their 3D models. This is crucial for architects and designers who need to present their designs in a compelling and realistic manner to clients and stakeholders.

2.5.2 Applications of AutoCAD

AutoCAD finds applications in a wide range of industries and professions, including:

i. Architectural Design: Architects use AutoCAD to create building plans, elevations, sections, and 3D models. It aids in the visualization of design concepts and facilitates communication with clients and contractors.

ii. Engineering: Engineers use AutoCAD for tasks such as designing mechanical components, electrical circuits, and civil engineering projects. It aids in precision and accuracy in engineering drawings.

iii. Construction: AutoCAD is employed in construction for creating detailed construction plans, site layouts, and structural drawings. It assists in project planning and coordination.

iv. Manufacturing: Manufacturers use AutoCAD to design and document products, machinery, and production processes. It helps streamline manufacturing workflows and ensure product quality.

v. Interior Design: Interior designers use AutoCAD to create layouts, floor plans, and 3D models of interior spaces. It assists in visualizing and presenting design concepts to clients.

vi. Urban Planning: Urban planners use AutoCAD for city planning, zoning, and land use mapping. It aids in creating sustainable and efficient urban environments.

CHAPTER THREE

METHODOLOGY

3.1 THE STUDY AREA

The project site is Located at Iyekogba Housing Estate which is located at Oredo Local Government Area of Edo State. With boundary coordinates of 786110.00mE, 694572.00mN; 785589.00mE, 694678.00mN; 785174.00mE, 693990.00mN; 785667.00 m E, 693625.00mN. The study area map is shown in figure 3.1.

Figure 3.1 Satellite Imagery of the Study Area

3.2 OFFICE PLANNING AND FIELD RECONNAISSANCE

3.2.1 Office Planning

Office reconnaissance, which is also regarded as desk study, commenced with gathering of all relevant information and records that could aid in executing the Project. This is the process of acquiring or searching for available data and information pertaining to the project site. This was done to see the available infrastructures or already established features within the project boundary and to better organize the survey crew accordingly. Some of the process carried out during office reconnaissance include;

3.2.2 Field Reconnaissance

Office reconnaissance, which is also regarded as desk study, commenced with gathering of all relevant information and records that could aid in executing the Project. This is the process of acquiring or searching for available data and information pertaining to the project site.

This was done to see the available infrastructures or already established features within the project boundary and to better organize the survey crew accordingly.

3.3 INSTRUMENT AND SOFTWARE SELECTION

After the reconnaissance survey and gone through the project specifications, the equipment listed below were chosen to achieve the desired result

i. Trimble R8 GNSS receiver and it's accessories

ii. Microsoft Excel

iii. ARCGIS

iv. Google Earth

v. Global Mapper.

3.4 In-situ Check

In-situ check is surveying also known as verification of controls carried out on control point to connect job. This was done in the process using UB100, UB101 and UB 102 control station. It was carried out by comparing the original co-ordinate value obtain from data search to that which was obtain by on field check observation, with the GNSS instrument with a coordinate system of UTM Zone 31. Table 3.1 shows the coordinates obtained from In-situ check.

Table 3.1. In-situ check on GNSS Instrument.

PILLAR NO.	KNOWN			OBSERVED			DIFFERENCE		
	N (m)	E (m)	Z (m)	N (m)	E (m)	Z (m)	dN	dE	dH
UB100	708605.325	790196.019	114.733	708605.289	790196.007	114.727	0.036	0.012	0.006
UB101	708599.165	790309.969	112.990	708599.126	790309.951	112.982	0.039	0.018	0.008
UB102	708509.201	790714.857	110.820	708509.168	790714.835	110.809	0.033	0.022	0.011

3.5 Data Acquisition

To carry out data acquisition in a detailed survey using Trimble GNSS there are several steps and considerations to keep in mind. Trimble GNSS technology provides high-precision positioning capabilities, allowing surveyors to collect accurate spatial data in the field. Here is an extensive guide on how to conduct data acquisition using Trimble GNSS:

i. Equipment Setup

Begin by setting up the Trimble GNSS equipment properly. This includes assembling the receiver, attaching the antenna, and ensuring the device is securely mounted on a surveying pole or tripod. Follow the manufacturer's instructions and guidelines for equipment setup to ensure reliable and accurate data collection.

ii. Establish Control Points

Before starting data acquisition, it is crucial to establish control points in the survey area. Control points are known, accurately positioned reference points that serve as a reference for subsequent measurements. These points should be established using conventional surveying techniques or using GNSS equipment with known coordinates. Control points should be spread across the survey area to ensure adequate coverage.

iii. GNSS Data Collection

Trimble GNSS receivers use satellite signals to determine precise positions. Follow these steps for GNSS data collection:

a. Power on the Trimble GNSS receiver and allow it to initialize. The receiver will start searching for satellite signals.

b. Select the appropriate surveying mode based on the requirements of the survey. Trimble GNSS receivers typically offer options such as static, real-time kinematic (RTK), or post-processing kinematic (PPK) modes.

c. Set up the survey parameters such as measurement interval, observation time, and data logging options. These settings may vary depending on the specific Trimble GNSS receiver model and software being used.

d. Once the receiver has established a sufficient number of satellite signals, initiate the data collection process by recording observations at each survey point. This typically involves occupying each control point, waiting for a stable position fix, and recording the position data.

iv. Data Quality Control

During data collection, it is essential to monitor the quality of the collected data. Trimble GNSS receivers provide real-time information about the number of satellites being tracked, signal strength, and positional accuracy. Monitor these indicators to ensure that sufficient satellite coverage is maintained and that the accuracy requirements of the survey are met.

v. Post-Processing and Adjustment

Depending on the survey requirements, post-processing of GNSS data may be necessary. Trimble provides software tools like Trimble Business Centre (TBC) that allow for post-processing of GNSS data. This step involves applying correction data, such as precise ephemeris and differential corrections, to improve the accuracy of the collected data. Post-processing can help achieve higher precision, especially in static or PPK surveys.

vi. Data Integration and Analysis

After the data has been collected and processed, it can be integrated with other geospatial data sets for further analysis. This may involve importing the GNSS data into a Geographic Information System (GIS) or other software platforms for spatial analysis, mapping, or generating reports.

vii. Quality Assurance and Quality Control

Finally, conduct thorough quality assurance and quality control checks on the collected data. This involves reviewing the accuracy and consistency of the survey data, cross-checking against control points, and ensuring that the data meets the required standards and specifications.

3.6 Perimeter Map with Auto CAD

Creating a perimeter map using AutoCAD involves outlining the boundaries of the area of interest and labelling it appropriately. Here are the general steps to produce a perimeter map in AutoCAD:

Step 1: Open AutoCAD and Set Up Your Drawing

1. Launch AutoCAD and create a new drawing (File > New or Ctrl + N).
2. Set up your drawing units, scale, and drawing area based on your project requirements.

Step 2: Import or Create a Base Map (Optional)

If you have a base map or existing drawing of the area, you can insert it as a reference:

1. Go to the "Insert" tab or type "INSERT" in the command line.
2. Select your base map file (e.g., a DWG or image file).
3. Adjust the insertion scale and rotation as needed and insert the base map.

Step 3: Draw the Perimeter

Now, you'll create the perimeter boundary:

1. Use the "Polyline" command (type "PL" or "PLine" in the command line).
2. Start clicking points along the boundary of the area you want to outline. You can use existing points or coordinates for precision.
3. Continue clicking to trace the entire perimeter. To close the polyline, either press "C" in the command line or click the starting point.
4. Press "Enter" to finish the polyline.

Step 4: Label the Perimeter

To label the perimeter, you can use the "Text" command:

1. Type "TEXT" in the command line.

2. Specify an insertion point for the label (usually near the perimeter line).

3. Enter the label text (e.g., "Perimeter Boundary").

4. Adjust the text height and style as needed.

5. Click where you want to place the text.

Step 5: Save Your Drawing

Make sure to save your AutoCAD drawing regularly (File > Save or Ctrl + S).

Step 6: Export or Plot Your Map

To share or print your perimeter map:

1. Go to the "Output" tab or type "PLOT" in the command line.

2. Select a plotter/printer and set the plot scale, paper size, and other settings.

3. Click "OK" to plot the drawing to a file or send it to a printer.

Step 7: Review and Finalize

Review the final map for accuracy and completeness, making any necessary adjustments or additions.

CHAPTER FOUR

RESULT AND DISCUSSION

This Chapter presents the results obtained from the detailed mapping project of Iyekogba Housing Estate, Oredo Local Government Area, Edo State. The project aimed to address the challenges associated with the lack of a comprehensive map for the estate. As outlined , this chapter would consist of the following sections.

i. A detailed map encompassing all essential features, landmarks, and amenities within Iyekogba Housing Estate.
ii. A perimeter plan and map that accurately defines the boundaries of the estate as well as the route map.
iii. A contour map to illustrate the topographical variations across the estate.

The following sections will discuss the creation process, key features, and significance of each map in detail.

4.1. Detailed Map Of Iyekogba Housing Estate

The detailed map of Iyekogba Housing Estate generated using ArcGIS software, provides a comprehensive overview of the Estate layout and characteristics. The data used for this map originated from site surveys, capturing X, Y, and Z coordinates, representing Easting, Northing, and elevation, respectively. The analysis reveals the following key features and the detailed map is shown in figure 4.1.

i. **Organized Residential Plots:** The map depicts individual plots within the estate, likely representing residential buildings. These plots appear well-organized, which shows a planned development pattern.

ii. **Extensive Road Network**: A well-developed road network is clearly visible on the map, potentially categorized by different classifications (major roads, minor roads, etc.). This extensive network indicates good internal connectivity within the estate.

iii. **Green Spaces:** Areas of vegetation are captured on the map, which depicts the presence of green spaces throughout the estate. These green spaces can contribute to a more aesthetically pleasing environment and potentially offer recreational benefits for residents.

iv. **Natural Drainage:** An interesting feature revealed by the map is the presence of a river located at the end of the estate. This information is crucial for understanding the natural drainage patterns within the estate and can be a vital consideration for future development or infrastructure planning.

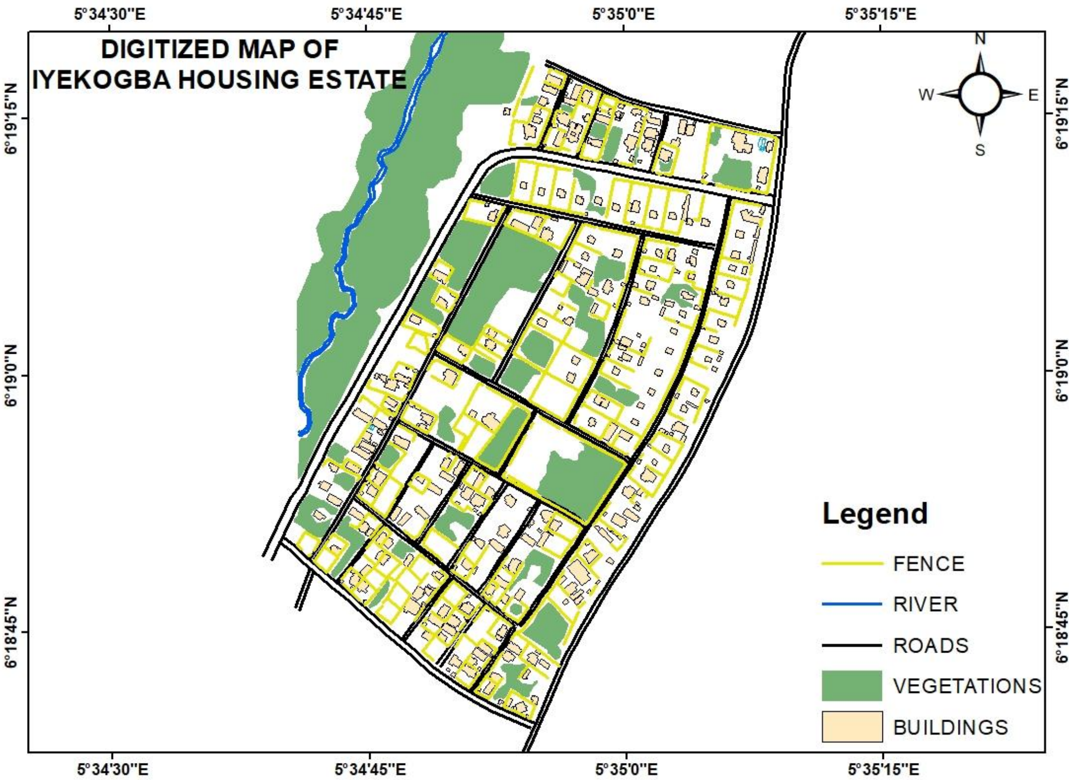

Figure 4.1. Detailed Map of Iyekogba Housing Estate

4.2. Perimeter Map of Iyekogba Housing Estate.

The satellite imagery of Iyekogba Housing Estate provides valuable insights into the land cover within the estate. Analyzing the imagery reveals:

i. **Residential Buildings:** As expected for a residential estate, the dominant land cover is comprised of buildings, likely representing individual houses.

ii. **Vegetation**: While the focus is on residential development, the presence of vegetation is also evident on the satellite imagery. This suggests the existence of green spaces within the estate, which can contribute to a more aesthetically pleasing environment and offer potential recreational benefits for residents.

iii. **Well-Accessible Roads:** The satellite imagery clearly depicts a network of roads throughout the estate. This indicates good accessibility within Iyekogba Housing Estate, facilitating movement for residents and essential services.

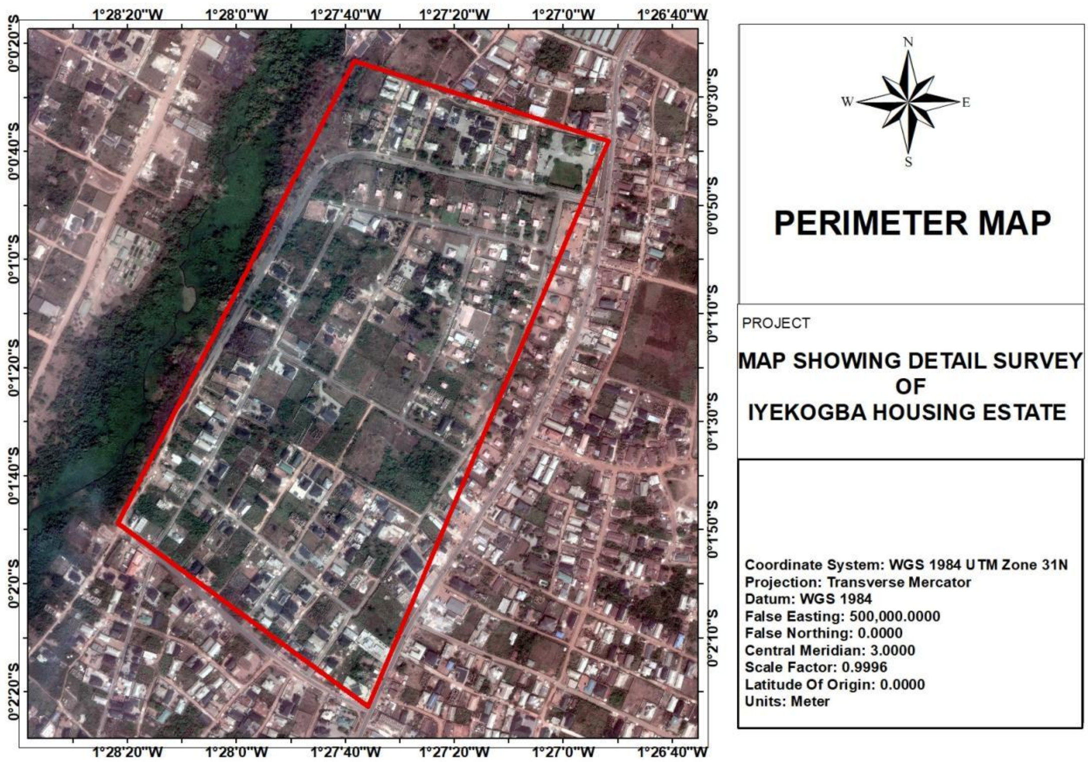

Figure 4.2. Satellite imagery of Iyekogba Housing Estate

4.3. Perimeter Plan Of Iyekogba Housing Estate.

A perimeter survey, also known as a boundary survey, plays a crucial role in accurately establishing the legal boundaries of a piece of land. This process involves precisely measuring and mapping the perimeter of the property. Utilizing the field data collection methods, the boundary coordinates of Iyekogba Housing Estate were successfully acquired. These coordinates were then employed to generate the perimeter plan using AutoCAD software.

The perimeter plan as shown in Figure 4.2 helps in developmental Planning as understanding the precise boundaries is essential for any future development or construction projects within the estate. Also for land Management, the perimeter plan serves as a valuable tool for estate management, enabling them to effectively manage the land within the estate's boundaries.

A clear and accurate perimeter plan which was produced would help to prevent or resolve disputes with neighboring landowners regarding property boundaries. The perimeter plan analysis reveals that the total area of Iyekogba Housing Estate encompasses 510,538.983 square meters. Additionally, the calculated perimeter distance of the estate is 3,083.54 meters.

The plan which was generated using the AutoCAD Software is Shown in Figure 4.3.

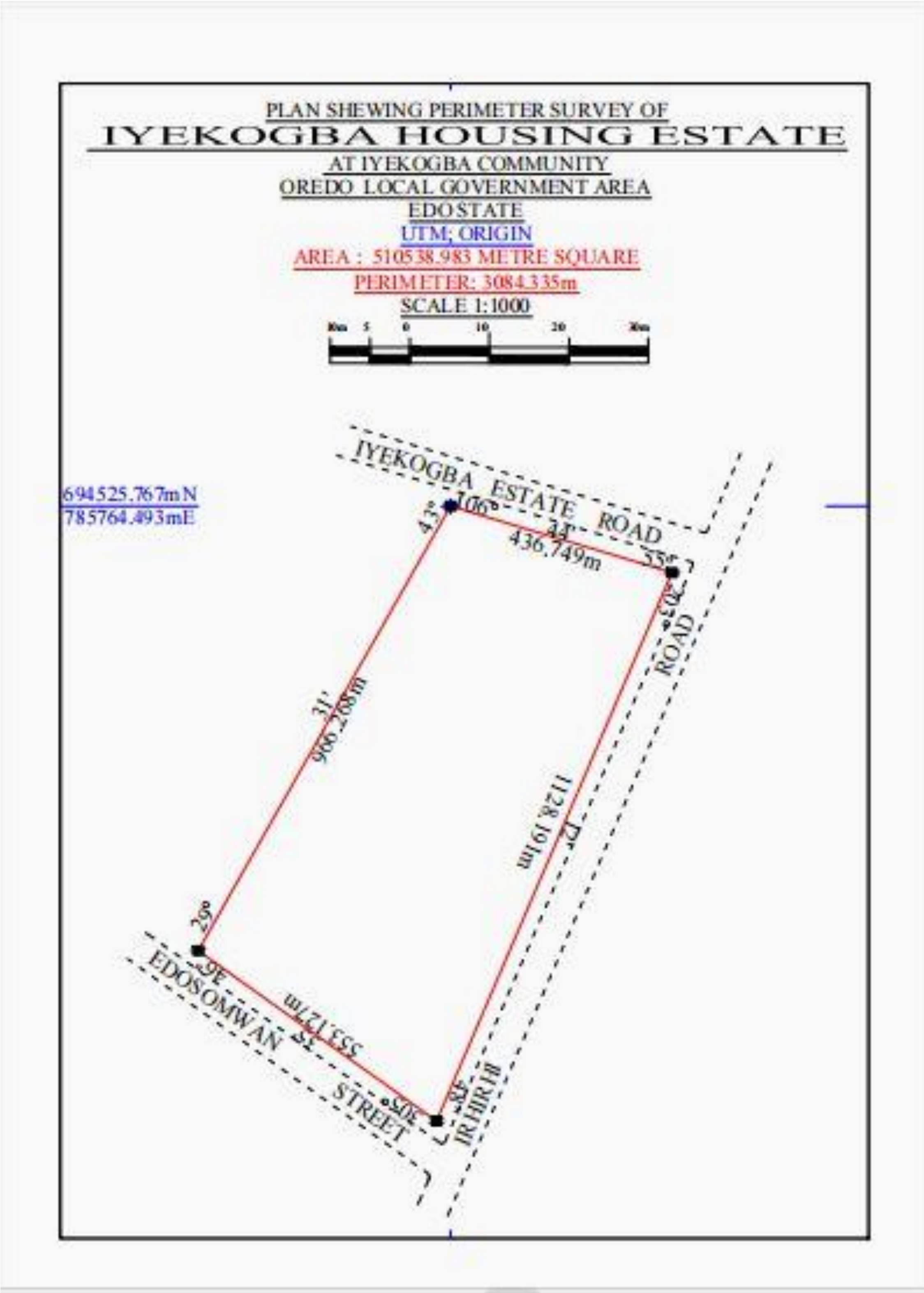

Figure 4.3. Perimeter Plan of Iyekogba Housing Estate.

4.4. Contour Map Of The Study Area

The contour map analysis provides valuable insights into the topography and elevation variations within Iyekogba Housing Estate. By visualizing the terrain in three dimensions, the contour map aids in understanding the landscape's characteristics and potential implications for urban planning and development.

The (.csv) file was added to ArcGIS, and the XYZ data were displayed. The points were converted to Raster using a special Arc tool "Kriging". After kriging was done, contour line was then applied to it, and the contour lines were labeled. Figure 4.4 shows the contour of the study area.

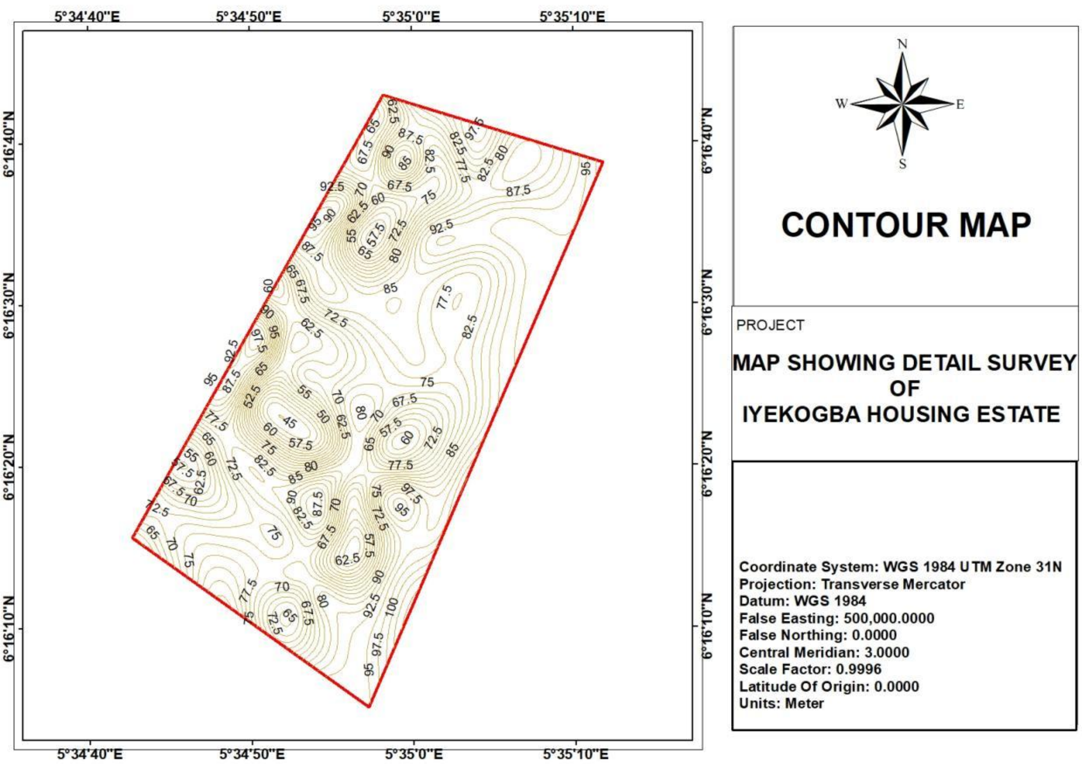

Figure 4.4. Contour map of iyekogba housing estate.

4.5. Route Map Of The Study Area

The route map illustrates the layout and extent of the road network traversing Iyekogba Housing Estate. Main thoroughfares, secondary streets, and tertiary lanes are depicted, offering a detailed portrayal of the transportation grid within the community. The visualization encompasses both vehicular arteries and pedestrian pathways, capturing the multi-modal nature of mobility within the estate.

The route map analysis provides valuable insights into the road network dynamics within Iyekogba Housing Estate, guiding transportation planning initiatives and spatial development strategies. By visualizing road connectivity, spatial distribution, and integration with land use, the route map serves as a foundational tool for enhancing mobility, accessibility, and quality of life for residents within the community. Figure 4.5 shows the route map.

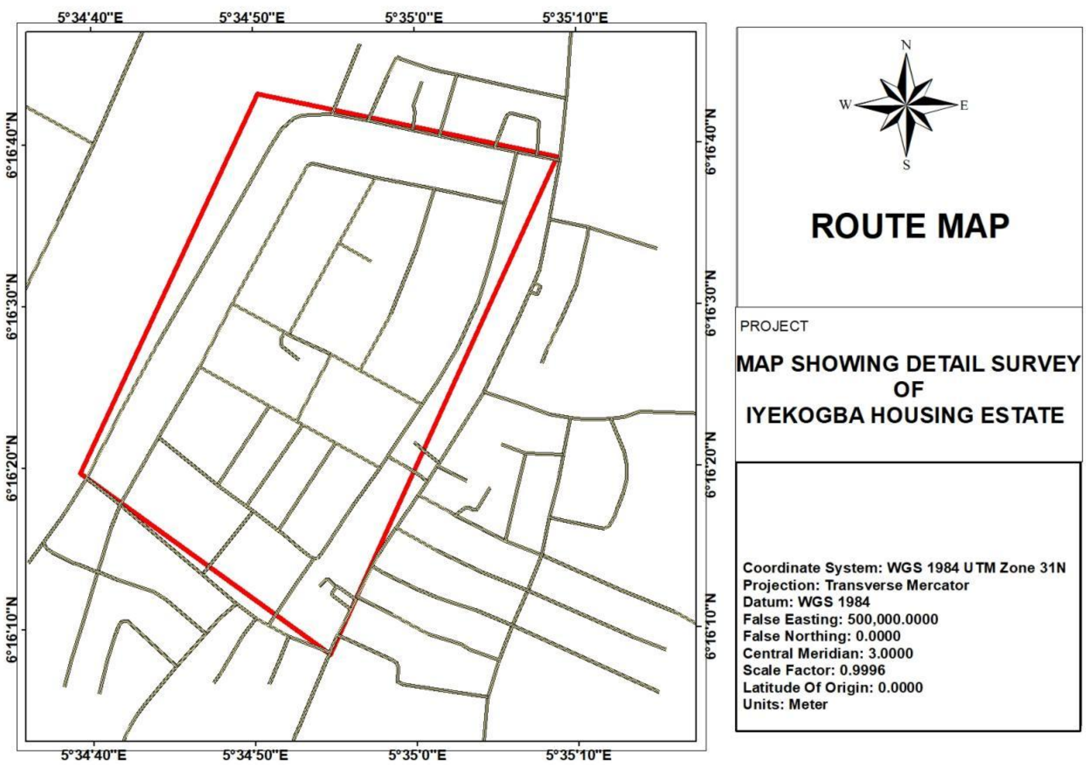

Figure 4.5. Route Map of the Study Area.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

In conclusion, the detailed mapping of Iyekogba Housing Estate has provided valuable insights into the spatial characteristics, infrastructure distribution, and topographical features of the community. Through a systematic analysis of various mapping techniques and spatial data, key findings have been unearthed, contributing to a comprehensive understanding of the estate's layout and functionality.

The mapping exercise revealed a well-organized road network, with primary, secondary, and tertiary roads facilitating inter-estate mobility and connectivity to external transportation arteries. The distribution of residential units, public amenities, and green spaces was observed to be strategically planned, promoting community well-being and livability. Furthermore, topographical analysis highlighted elevation variations and natural features, underscoring the importance of integrating topographical considerations into urban planning initiatives.

5.2. Recommendations

Building upon the findings of this study, the following recommendations are proposed to further enhance the functionality, sustainability, and resilience of Iyekogba Housing Estate:

Infrastructure Optimization: Conduct a comprehensive assessment of utility infrastructure to identify areas for optimization and enhancement. This includes upgrading water supply systems, electrical grids, and sewage networks to ensure reliability and efficiency.

Transportation Planning: Implement measures to improve transportation efficiency and alleviate traffic congestion within the estate. This may involve the introduction of traffic management strategies, expansion of public transit options, and enhancement of pedestrian and cycling infrastructure.

Environmental Conservation: Develop initiatives to preserve and enhance green spaces within the estate, including parks, playgrounds, and natural reserves. Implement landscaping strategies to promote biodiversity, mitigate urban heat island effects, and enhance aesthetic appeal.

REFERENCES

Borich, C. (2011). Mine Surveying. In Advances in High-Altitude Medicine and Physiology (pp. 209-226). Springer.

Carter, L. (2018). Basic Surveying: Theory and Practice (7th ed.). Pearson.

Chen, J., & Zhang, H. (2017). GNSS Precise Point Positioning: Basics, Algorithms, and Applications. CRC Press.

Chiu, M. L., & Huang, C. M. (2009). The effectiveness of computer-aided design (CAD) instruction in spatial geometry. Computers & Education, 53(3), 720-731. DOI: 10.1016/j.compedu.2009.04.006

Davis, B., & Foote, F. (2016). Understanding Geographic Information Systems. Esri Press.

DeMers, M. N. (2019). Fundamentals of Geographic Information Systems (5th ed.). Wiley.

El-Rabbany, A. (2002). Introduction to GPS: The Global Positioning System. Artech House.

El-Rabbany, A. (2019). Introduction to GPS: The Global Positioning System (2nd ed.).

Ghilani, C. D., & Wolf, P. R. (2017). Elementary Surveying: An Introduction to Geomatics. Pearson.

Giles, J., & Rincon, P. (2019). Galileo: Europe's global navigation satellite system. Springer.

Greenway, F. (2010). Euclid's elements and its reception. In A. Laghate, & K. Raval (Eds.), Matcom Mathematical Computing (Vol. 1, pp. 17-23). Springer.

Habib, A. F., & El-Sheimy, N. (2019). Fundamentals of GNSS. Springer.

Jensen, J. R. (2015). Remote Sensing of the Environment: An Earth Resource Perspective. Pearson.

Kaplan, E. D., & Hegarty, C. J. (2006). Understanding GPS: Principles and applications. Artech House.Wu, M., Li, B., Li, X., & Chen, G. (2018). The BeiDou navigation satellite system: An overview. Sensors, 18(6), 1794.

Kim, E. S. (2018). GNSS as an Augmentation to Inertial Navigation Systems. Inertial Technology for Surveying and Geophysics (pp. 63-80). Springer.

Kiviniemi, A., & Fischer, M. (2007). Integrating design with construction and fabrication: Increased efficiency through project-specific building products. Automation in Construction, 16(2), 298-310. DOI: 10.1016/j.autcon.2006.03.008

Li, X., Zhang, K., & Xu, G. (2015). High-precision positioning with GNSS: Theory and practice. Springer.

Lohani, B., & Jain, K. (2018). GNSS Applications and Methods. Springer.

McClements, C. (2016). Elementary Surveying: An Introduction to Geomatics (15th ed.). Pearson.

Miguel, R. C. (2016). Land Tenure, Boundary Surveys, and Cadastral Systems. CRC Press.

Owen, A. D. (2017). Urban Design and Surveying. In D. Gosling (Ed.), Urban Design (Vol. 2, pp. 267-280). Springer.

Reid, E. (2019). Land Development Handbook. McGraw Hill Professional.

Shah, P., & Chawla, S. (2017). GNSS and Inertial Fusion: A Review. Inertial Technology for Surveying and Geophysics (pp. 101-126). Springer.

Wiley Jensen, J. R. (2015). Remote Sensing of the Environment: An Earth Resource Perspective (2nd ed.). Pearson.

Wolf, P. R., & Brinker, R. C. (2009). Elementary Surveying: An Introduction to Geomatics. Pearson.

APPENDIX- A

DETAILED SURVEY FIELD OBSERVATION DATA

S/N	CODE	N	E	h	B	L	H
1	Pt 1	694461.9869	786192.6929	94.6227	6.277457274	5.585683242	113.9723
2	Bd1	694579.2243	786200.3856	96.9662	6.278516396	5.585757946	116.3208
3	Pt2	694472.4962	786181.0319	94.1408	6.277552766	5.585578396	113.491
4	Pt3	694471.513	786116.8421	91.2612	6.277546745	5.584998635	110.6118
5	Pt4	694426.0551	786112.8749	92.9785	6.277136123	5.58496078	112.3272
6	Pt5	694381.5405	786095.0454	94.0155	6.276734643	5.584797772	113.3624
7	Pt6	694357.6076	786096.1992	94.4156	6.276518311	5.584807126	113.7615
8	Pt7	694282.666	786063.3506	93.6144	6.275842534	5.584507121	112.9573
9	Pt8	694266.2616	786074.9789	93.5509	6.27569377	5.584611409	112.893
10	Pt9	694253.2928	786054.7065	93.3225	6.275577476	5.584427746	112.6642
11	Pt10	694165.4817	786027.7842	92.2074	6.274785133	5.584180691	111.5456
12	Pt11	694070.8188	785993.0616	90.9277	6.273931219	5.583862885	110.2621
13	Bd2	694001.3742	785935.0353	90.006	6.273306238	5.583335744	109.3379
14	Pt12	693899.7322	785867.6826	89.8872	6.272390705	5.582722941	109.2153
15	Pt13	693785.1851	785791.0205	89.8026	6.271358963	5.582025492	109.1265
16	Pt14	693705.6043	785727.7268	89.09	6.270642612	5.581450334	108.411
17	Pt15	693589.614	785650.1252	91.6325	6.269597865	5.580744341	110.9492
18	Pt16	693744.1286	785688.6501	86.2745	6.270992493	5.581099136	105.5975
19	Pt17	693764.7957	785664.2319	84.5193	6.271180347	5.580879529	103.8434
20	Pt18	693794.9361	785614.4651	81.5641	6.27145494	5.580431413	100.8899
21	Pt19	693810.1257	785610.25	80.712	6.271592395	5.580394021	100.0384
22	Pt20	693852.4056	785550.8752	76.2916	6.271977118	5.579859673	95.6203
23	Pt21	693983.7119	785468.1582	67.3506	6.273167409	5.57911847	86.6856
24	Pt22	694199.0509	785584.9107	66.7701	6.275108225	5.580182469	86.1133
25	Pt23	694455.2906	785720.4501	70.7852	6.277417816	5.58141797	90.1382

26	Pt24	694408.073	785958.2702	87.5941	6.276980514	5.583563697	106.9432
27	Pt25	694392.7944	786069.59	93.6239	6.276837478	5.584568379	112.9715
28	Pt26	694510.3121	786000.449	85.4933	6.277902562	5.583949182	104.8464
29	Pt27	694516.5626	785973.7255	83.9326	6.277960238	5.583708112	103.2862
30	Pt28	694544.3645	785841.9418	76.2447	6.278217359	5.582519169	95.6005
31	Pt29	694557.6396	785774.5585	72.9216	6.278340328	5.581911199	92.2785
32	Pt30	694344.6409	785565.2805	59.8362	6.27642479	5.580011658	79.1858
33	Pt31	693994.6403	785371.1191	58.8171	6.273270484	5.578242569	78.1534
34	Pt32	693864.3238	785305.9318	61.9395	6.272095714	5.577648055	81.2708
35	Pt33	693824.2772	785363.5809	67.9473	6.271731252	5.578166921	87.2764
36	Pt34	693681.5139	785529.206	85.317	6.270433739	5.579656379	104.6386
37	Pt35	693928.8923	785772.3505	86.6678	6.272658468	5.581863272	105.9979
38	Pt36	693976.2247	785701.0687	80.5097	6.273089383	5.581221614	99.8425
39	Pt37	694035.7667	785734.7077	79.0836	6.273625964	5.581528065	98.4186
40	Pt38	694090.6357	785766.5028	78.0843	6.274120397	5.581817656	97.4214
41	Pt39	694141.6122	785690.2534	73.2707	6.274584464	5.581131294	92.6106
42	Pt40	694175.9107	785630.1932	69.6181	6.274897092	5.580590399	88.96
43	Pt41	693542.3677	785755.702	92.2584	6.269166205	5.581695724	111.5722
44	Pt42	694705.0836	785782.1641	69.6832	6.279672433	5.581986454	89.0464
45	Pt43	694765.3996	785669.7708	91.4017	6.279136627	5.581773965	113.5193
46	Pt44	694732.578	785801.3958	93.7452	6.278834151	5.582961258	115.8678
47	Pt45	694703.8397	785894.9927	90.9198	6.27857027	5.583805285	113.038
48	Pt46	694651.0784	786024.4553	88.0402	6.278087693	5.584972156	110.1588
49	Pt47	694691.574	785600.0865	89.7575	6.278472571	5.581141331	111.8742
50	Pt48	694638.3224	785559.9799	90.7945	6.277993124	5.580776743	112.9094
51	Pt49	694569.8094	785826.7919	91.1946	6.277362083	5.583183367	113.3085
52	Pt50	694573.7866	785957.0252	90.3934	6.277392218	5.584359726	112.5043
53	Pt51	694421.0914	785950.0128	90.3299	6.276012629	5.584289589	112.44
54	Pt52	694434.3841	785869.3568	90.1015	6.276136351	5.583561751	112.2112
55	Pt53	694483.2962	785711.4648	88.9864	6.276585405	5.582137955	111.0926
56	Pt54	694527.2861	785541.8342	87.7067	6.276990498	5.58060792	109.8091
57	Pt55	694450.9124	785478.4705	86.785	6.27630313	5.580032262	108.8849
58	Bd3	694382.7553	785456.3661	86.6662	6.275688179	5.579829597	108.7623

59	Pt 56	694431.356	785563.5232	86.5816	6.276122612	5.580799532	108.6735
60	Pt57	694341.4433	785654.0118	85.869	6.275306042	5.581612763	107.958
61	Pt 58	694317.8961	785506.1267	88.4115	6.275099831	5.580276116	110.4962
62	Pt 59	694280.0468	785761.9955	83.0535	6.274746393	5.582585264	105.1445
63	Pt 60	694332.4894	785872.6917	81.2983	6.275215383	5.583587331	103.3904
64	Pt 61	694271.0945	785896.6465	78.3431	6.274659491	5.583800939	100.4369
65	Pt 62	694187.2512	785845.1937	82.144	6.273904094	5.58333252	99.5854
66	Pt 63	694151.8805	785768.4772	77.7236	6.273587868	5.582638096	95.1673
67	Pt 64	694180.2264	785680.6293	68.7826	6.273847942	5.581845978	86.2326
68	Pt 65	694234.251	785593.6214	68.2021	6.274340036	5.581062588	85.6603
69	Pt 66	694252.8495	785478.9425	72.2172	6.274513215	5.580027714	89.6852
70	Pt 67	694306.7047	785430.6145	89.0261	6.275002055	5.579593643	106.4902
71	Pt 68	694237.4494	785380.4285	95.0559	6.274378428	5.579137317	112.5185
72	Pt 69	694176.8255	785409.0558	86.9253	6.273829296	5.579393164	104.3934
73	Pt 70	694147.3433	785510.848	85.3646	6.273558336	5.58031117	102.8332
74	Pt 71	693946.7534	785530.5149	77.6767	6.271744731	5.580479867	95.1475
75	Pt 72	693857.3619	785582.7282	74.3536	6.270934577	5.580947444	91.8255
76	Pt 73	694132.4395	785537.0595	61.2682	6.273422484	5.580547231	78.7328
77	Pt 74	694041.9377	785685.8441	60.2491	6.272597997	5.581886921	77.7004
78	Pt 75	694046.2859	785779.4435	63.3715	6.272633123	5.582732436	80.8178
79	Pt 76	693952.7673	785722.7119	69.3793	6.271790524	5.582215916	86.8234
80	Pt 77	693896.8248	785674.8295	86.749	6.271287104	5.581780989	104.1856
81	Pt 78	693937.4949	785617.0908	88.0998	6.271657209	5.581261345	105.5449
82	Pt 79	694014.4323	785515.3979	81.9417	6.272357017	5.58034635	99.3895
83	Pt 80	694078.065	785462.7151	80.5156	6.27293441	5.579873386	97.9656
84	Pt 81	694123.9742	785364.063	79.5163	6.27335368	5.578984471	96.9684
85	Pt 82	694105.1197	785319.3644	74.7027	6.27318528	5.578579946	92.1576
86	Pt 83	694058.7786	785278.4767	71.0501	6.272768313	5.578208617	88.507
87	Pt 84	693989.1985	785269.0392	93.6904	6.272139936	5.578120293	111.1192
88	Pt 85	693936.2348	785361.3382	71.1152	6.271657199	5.578951518	88.5934
89	Pt 86	693826.5081	785474.3616	82.9326	6.270660572	5.579967386	97.7204
90	Pt 87	693761.5831	785625.0492	75.2447	6.270067142	5.581325396	93.3023
91	Pt 88	693797.4684	785674.223	71.9216	6.270389248	5.581771092	84.3676

92	Pt 89	693873.3937	785736.8238	58.8362	6.271072598	5.582339832	83.7953
93	Pt 90	694066.4156	785820.3461	57.8171	6.272813213	5.583102734	87.8202
94	Pt 91	694128.0076	785642.3268	60.9395	6.273377747	5.581497733	104.6252
95	Pt 92	694232.8215	785686.8306	66.9473	6.274322967	5.581904325	110.6535
96	Pt 93	694358.7072	785701.5217	84.317	6.27545994	5.582042608	102.5284
97	Pt 94	694380.8707	785848.145	85.6678	6.275653697	5.583367797	100.9682
98	Bd4	694359.7983	785922.8774	79.5097	6.275459935	5.58404179	93.2825
99	Pt 95	694528.1789	786003.2737	82.0696	6.276978	5.584775378	89.9605
100	Pt 96	694610.8185	785855.3882	81.0703	6.277731407	5.583443457	76.8678
101	Pt 97	694549.217	785699.2358	76.2567	6.277181675	5.582030446	75.8354
102	Pt 98	694552.6131	785623.0554	72.6041	6.27721576	5.581342585	78.9528
103	Pt 99	694660.2067	785685.0266	95.2444	6.278185321	5.58190706	84.9584
104	Pt 100	694715.3628	785734.4107	72.6692	6.278681564	5.582355523	102.3206
105	Pt 101	694728.024	785892.982	88.303	6.278788913	5.583788204	103.6799
106	Pt 102	694232.2226	785565.0778	89.6538	6.274322976	5.580804711	97.5245

APPENDIX B

SITE PHOTOGRAPHS