MAPPING OF GOVERNMENT INFRASTRUCTURES IN AFIKPO URBAN, EBONYI STATE

Department of Surveying and Geoinformatics, Akanu Ibiam Federal Polytechnic, Uwana, Ebonyi State, Nigeria

Dr. Felix Oseiwe Ukebho, Surveyor Moses Ayegba Emakoji

ABSTRACT

This project focuses on the mapping of government infrastructures in Afikpo Urban, Ebonyi State, using Geographic Information System (GIS) techniques. The study was motivated by the need for accurate and up-to-date spatial information on infrastructures such as schools, health centers, police stations, banks, and other public facilities, which are essential for planning, development, and decision-making. Field data were acquired using a handheld GPS receiver to capture the coordinates of identified infrastructures. The data collected were processed with the aid of computer applications including ArcGIS, Google Earth, and Microsoft Excel, while attribute information was recorded in a field notebook. A base map of the study area was prepared, georeferenced, and digitized to produce a spatially accurate representation of the infrastructures. The results of the study include a digital map showing the spatial distribution of government infrastructures in Afikpo Urban. The analysis revealed that most infrastructures are concentrated around major roads and the Eke Market axis, while some areas remain underserved. This distribution has important implications for future planning, accessibility, and equitable allocation of resources. The study demonstrates the relevance of GIS in infrastructure mapping and provides a reliable database for government agencies, planners, and researchers. It also highlights the need for regular updates to maintain accurate records of infrastructures for sustainable development.

Keywords: Mapping, Infrastructures, Attribute Data and Special Data

Author Email: topfelix2010@yahoo.com Phone No.: +2347036372387

1.1 INTRODUCTION

Development in any community largely depends on the availability, accessibility, and proper management of infrastructure provided by the government. These infrastructures include schools, hospitals, administrative offices, security posts, markets, roads, water supply facilities, and other social amenities. They serve as the backbone for economic growth, education, health services, governance, and social well-being of the people. In other words, government infrastructures directly affect the standard of living of the citizens.

In many towns and cities in Nigeria, including Afikpo, various government infrastructures are scattered across different locations. However, information about their exact positions, current state, and distribution is often incomplete or difficult to access. Some records are kept on paper, some are outdated, and others are missing. This makes it challenging for decision-makers, planners, and researchers to understand the actual situation on the ground. For example, without accurate data, it is difficult to know whether there are enough schools in a particular area, whether hospitals are evenly distributed, or whether government offices are located in accessible places for the population.

Modern technology now provides effective solutions to this challenge. Geographic Information Systems (GIS) and Global Positioning Systems (GPS) are powerful tools used worldwide for mapping, data management, and spatial analysis. These technologies allow surveyors and planners to capture the exact coordinates of infrastructures, store the data in a digital database, and display the information on maps. Such maps not only show locations but also reveal patterns, relationships, and gaps in infrastructure distribution. For instance, a GIS map of Afikpo showing schools and hospitals will immediately highlight areas with too many facilities or those lacking essential services.

The importance of mapping government infrastructures cannot be overemphasized. Firstly, it helps in urban planning and development control. Town planners can use the information to decide where new facilities should be located to serve the people better. Secondly, it improves

service delivery, as government agencies can respond quickly to community needs when they know the exact locations of their facilities. Thirdly, it supports disaster management and emergency response. For example, during health crises, knowing the location of all hospitals and health centers helps in distributing medical supplies efficiently. Fourthly, it encourages transparency and accountability in governance. Citizens and stakeholders can easily verify the existence and distribution of government projects when there is a reliable map and database.

Afikpo, the study area, is one of the major towns in Ebonyi State and the second largest urban settlement after Abakaliki, the state capital. It has a growing population, several educational institutions, health centers, and other government-owned infrastructures. However, like many urban areas in Nigeria, Afikpo faces the challenge of poor record-keeping and a lack of updated spatial data. Mapping these infrastructures will therefore provide valuable information for effective planning and future development of the town.

This project is designed to fill this gap by systematically identifying, collecting, and mapping government infrastructures in Afikpo using GPS and GIS. By doing so, it will create a reliable geospatial database that can serve the needs of planners, government agencies, researchers, and the community at large. The project will also serve as a reference for future surveys and encourage further research in other towns within Ebonyi State and beyond.

In summary, the background of this study rests on the urgent need for accurate and up-to-date spatial information on government infrastructures in Afikpo. With modern mapping technologies, this information can be collected, stored, analyzed, and presented in a way that is easy to understand and use. The outcome of the project will not only support better decision-making but will also contribute to the sustainable development of Afikpo and its people.

1.2 LOCATION OF PROJECT

The study area for this project is Afikpo, also known as Afikpo North Local Government Area (LGA), in Ebonyi State, Nigeria. Afikpo is the second largest urban settlement in

Ebonyi State after Abakaliki, the state capital. It lies within the southeastern part of Nigeria and is one of the most important towns in the state because of its historical, cultural, and educational significance.

Afikpo lies approximately between latitude 5°53′N and 6°03′N and longitude 7°55′E and 8°05′E. It is bounded by Amasiri to the north, Unwana to the south, Cross River State to the east, and Edda to the west. With a population engaged mainly in trading, farming, and civil service. The town is well known for its cultural heritage, educational institutions, and growing infrastructure.

The town has both urban and semi-urban settlements, with major communities such as Ozizza, Amuro, Itim, Ozzizza, and Ugwuegu forming the core urban area. Afikpo is well known for its vibrant markets such as Eke Market, which serve as commercial hubs not only for residents but also for traders from neighboring communities.

Topographically, Afikpo is made up of undulating land with gentle hills and valleys, which influence settlement patterns and road construction in the area. The town also lies within the humid tropical climatic zone, characterized by a rainy season (April–October) and a dry season (November–March). These climatic and physical factors play a role in how infrastructures are distributed and accessed by the population.

Afikpo has a growing population made up of civil servants, farmers, traders, and students, due to the presence of secondary schools, colleges, and other institutions. The increase in population has brought about higher demand for social amenities and government infrastructures such as schools, hospitals, roads, police stations, banks, and administrative offices. Mapping these infrastructures is therefore important to show how they are distributed across the town and to identify areas where more development is needed.

In this study, the focus is mainly on government infrastructures within the Afikpo urban area, including Eke Market and its surrounding environments, as this is the center of economic and administrative activities. The coordinates of infrastructures such as schools, health centers, police stations, banks, and government offices were collected using GPS devices and mobile mapping applications. These locations will be processed and displayed

in a GIS environment to produce a digital map of Afikpo's government infrastructures.

For better understanding, the project area map of Afikpo will be included in the next section to provide a visual representation of the location and boundary of the study area.

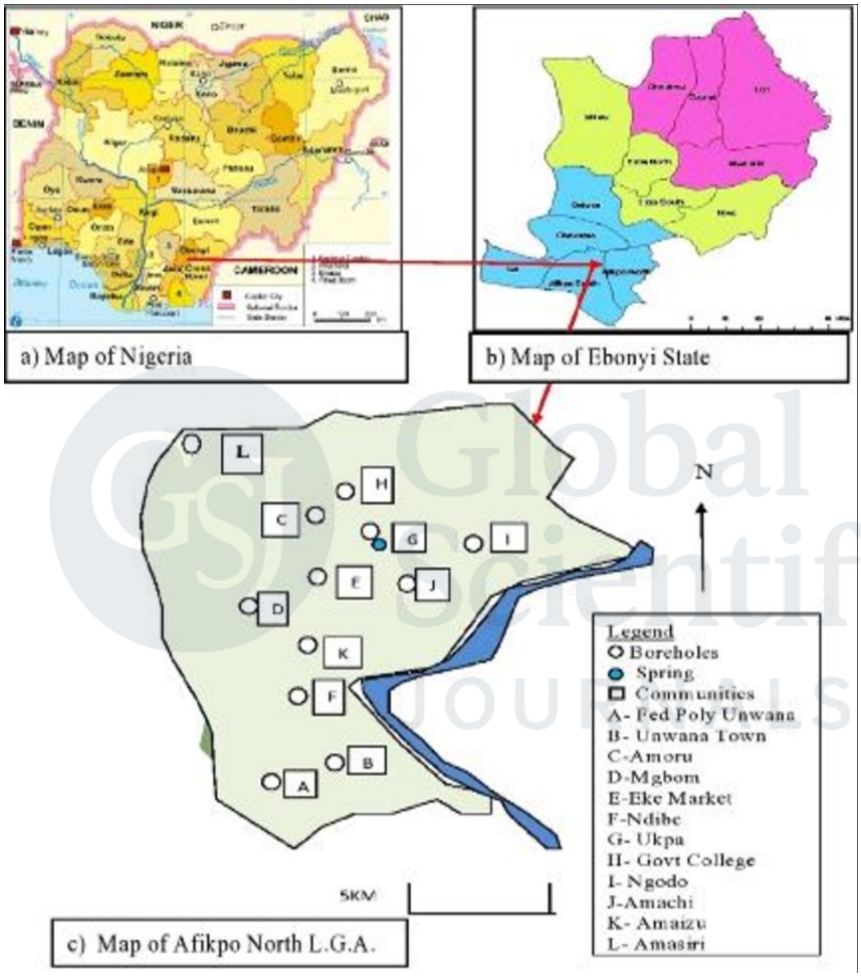

Figure 1.1: Map of Nigeria, Ebonyi State, and Afikpo North LGA showing major communities and landmarks.

Source: Modified from field survey & secondary data (2025).

Figure 1.1 illustrates the location of the study area. Afikpo North LGA is situated in the southeastern part of Nigeria, within Ebonyi State. It includes major communities such as Unwana, Amasiri, Ozizza, and Ehugbo, with prominent landmarks like Eke Market and Federal Polytechnic Unwana.

1.3 STATEMENT OF PROBLEMS

In recent years, the lack of comprehensive and up-to-date maps of government infrastructures in Afikpo North Local Government Area (LGA) has posed significant challenges to effective planning, management, and development within the region.

Most existing records are outdated, incomplete, or stored in paper form, making them difficult to access and prone to damage or loss.

This lack of accurate spatial data affects critical sectors such as education, health, security, and public utilities. For instance, government agencies often struggle to identify the exact locations of schools, health centres, and other public facilities when making decisions on resource allocation or project implementation. Similarly, emergency response and infrastructure maintenance are hindered due to insufficient geographic information.

Another challenge is the absence of modern geospatial techniques in mapping infrastructures. Traditional manual methods are time-consuming, less precise, and cannot easily be updated. As a result, there is a growing need for a reliable, digital, and georeferenced map that will serve as a vital tool for government agencies, researchers, and other stakeholders in Afikpo North LGA.

This project seeks to address these issues by generating an accurate and up-to-date map of government infrastructures in Afikpo North, using modern surveying and Geographic Information System (GIS) techniques to provide a valuable resource for development planning and decision-making.

1.4 AIM AND OBJECTIVE OF PROJECT

Aim:

The aim of this project is to produce a comprehensive digital map of government infrastructures in Afikpo North Local Government Area (LGA) to enhance planning,

management, and decision-making.

Objectives:

The specific objectives of this project are to:

1. Identify and document the various government infrastructures within Afikpo North L G A

2. Acquire the geographic coordinates of the identified infrastructures using GPS technology.

3. Process and analyze the collected data using appropriate GIS software.

4. Produce a digital map showing the spatial distribution of government infrastructures within the study area.

5. Provide an up-to-date reference material that can aid government agencies, researchers, and stakeholders in effective planning and development.

METHODOLOGY

2.1 OFFICE PLANNING

Before the commencement of fieldwork, proper office planning was carried out to ensure the success of the project. This stage involved all preliminary preparations required to organize and execute the mapping of government infrastructures within Afikpo North Local Government Area efficiently.

The planning process began with defining the objectives of the project and determining the necessary resources, such as maps, equipment, and personnel.

Essential materials such as base maps of Afikpo North LGA, writing materials, and software for data processing (like SW Maps and QGIS) were identified. Additionally, the office planning stage included preparing field forms for data collection, checking the availability and condition of survey instruments, and ensuring all members of the team were familiar with the methods of data acquisition to be used.

This planning phase ensured that all possible challenges were anticipated and provided a

structured approach to achieve the project objectives effectively.

2.2 DATA SEARCH

Data search involved gathering all relevant information required for the execution of the project. This stage ensured that sufficient background knowledge and reference materials were obtained before going to the field.

The process began with reviewing existing maps of Afikpo North LGA to understand the general layout of the area. Information on the location of key infrastructures such as schools, health centers, government offices, police stations, and banks was sourced

from local online resources.

Topographic data, satellite imagery, and coordinate references were also obtained using online mapping platforms such as Google Earth. This provided a preliminary understanding of the terrain, road network, and accessibility of the study area.

By conducting this data search, the team ensured that the fieldwork would be accurate, efficient, and free from unnecessary delays caused by inadequate background information.

2.3 RECONNAISSANCE SURVEY

The reconnaissance survey was conducted to gain a practical understanding of the project area before detailed data collection. This initial visit to Afikpo North LGA, with focus on the Eke Market area, allowed the team to assess the general layout, terrain, and condition of the site. Key activities carried out during the reconnaissance included:

- Identifying the locations of major infrastructures to be captured.
- Assessing road accessibility and determining the best routes for data collection.
- Locating potential reference points for coordinate measurements.

Nothing possible challenges such as poor network coverage, obstructions, or restricted areas.

The information gathered during this stage was crucial for proper planning, ensuring that fieldwork would be efficient, accurate, and free from avoidable setbacks.

2.4 INSTRUMENTATION

The instruments and tools used for the successful execution of this project included both hardware and software resources:

1. Handheld GPS: Used to obtain accurate geographic coordinates (latitude and longitude) of each government infrastructure within the study area.
2. Field Book and Pen: Utilized to record field observations, coordinates, and other relevant details during data collection.
3. Computer System: Employed for data storage, processing, map creation, and final report preparation.
4. Software Applications: Google Earth: For preliminary location identification and visualization of the study area. ArGIS: For plotting captured coordinates and producing the final digital map.

   Microsoft Excel/WPS Office: For organizing data, performing basic analysis, and preparing the project report. These instruments and applications collectively ensured precise data collection, effective processing, and high quality final output.

2.5 INSTRUMENT TEST

Before the commencement of field data collection, the instruments to be used for this project were tested to ensure their accuracy and reliability. The handheld GPS receiver was powered on and initialized to confirm proper satellite reception and coordinate display. Several known locations within the study area (with previously established coordinates) were visited, and the recorded coordinates from the GPS were compared with the known values. The differences observed were minimal and within the acceptable tolerance for third-order survey work.

Additionally, the field notebook and pen were checked for usability, while the computer system and GIS software (ArcGIS, Google Earth, and Microsoft Excel) were tested to ensure they were functioning properly and capable of handling the required data.

This preliminary testing assured that the instruments and software applications were in good

working condition and suitable for the successful execution of the project.

2.6 DATA ACQUISITION

Data acquisition for this project involved the collection of both primary and secondary data.

(a) Primary Data: Primary data refers to information obtained directly from the field. For this project, primary data included:

Geographic coordinates of government infrastructures such as schools, hospitals, police stations, and banks. Road network coordinates linking the infrastructures. Field observations recorded i n the field book.

(b) Secondary Data: Secondary data refers to information sourced from existing materials. These included:

A base map of Afikpo North Local Government Area.

- Satellite imagery from Google Earth for cross-checking coordinates.
- Literature review on mapping techniques and related projects.

The combination of these data sources ensured the accuracy and reliability of the final map.

2.7 BASE MAP

The base map served as the foundational framework upon which all field data were plotted. It provided the geographical boundaries and layout of Afikpo North Local Government Area, enabling accurate positioning of the collected data.

The base map was obtained from:

- Google Earth imagery, which provided a satellite view of the project area.
- Existing cartographic data, which ensured proper scaling and orientation.

The base map was imported into the mapping software (ArcGIS) and served as a reference for plotting the coordinates of the identified infrastructures and road networks.

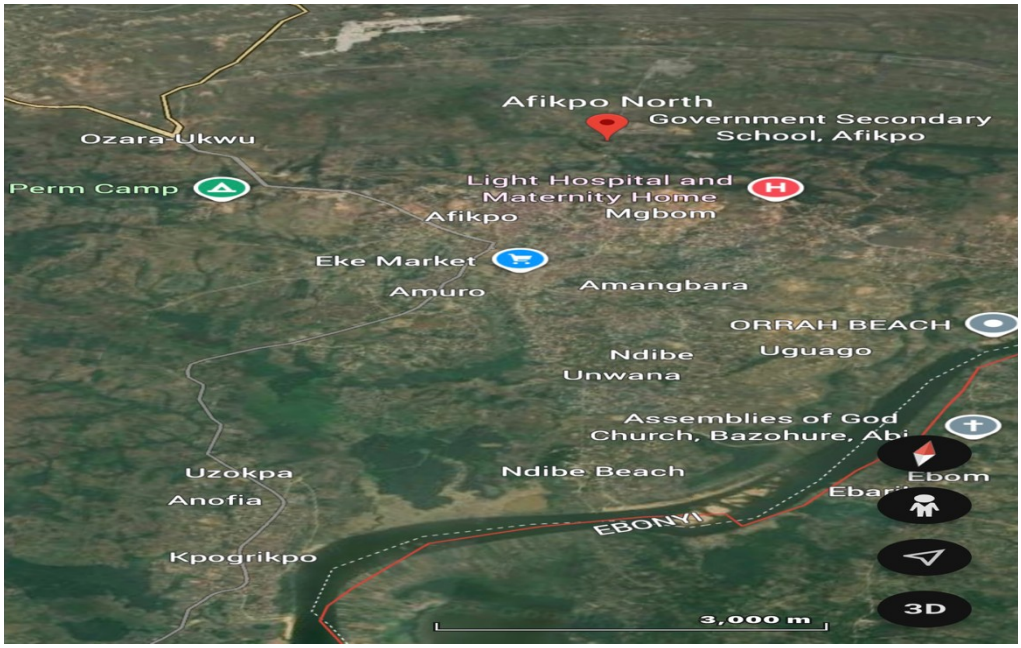

Fig 2.1 Sample view of Afikpo Map obtained from Google Maps which was used during planning and orientation for the fieldwork.

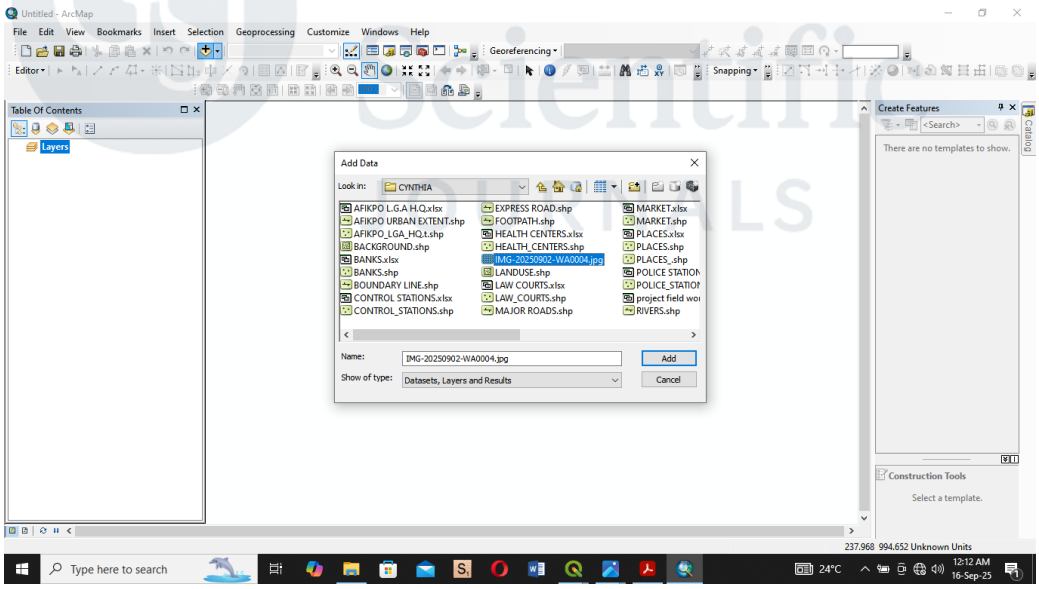

Fig 2.2 Adding the scanned map of Afikpo into ArcGis

2.8 CONTROL POINTS FOR GEO-REFERENCING

Control points were established to ensure accurate geo-referencing of the mapped features.

These points were selected at easily identifiable and permanent locations such as road intersections, town halls, markets, and other public infrastructures within Afikpo.

The coordinates of each control point were obtained using a handheld GPS receiver with adequate satellite coverage to ensure positional accuracy. These control points were later used in ArcGIS to align the base map to real-world coordinates, ensuring spatial accuracy of all plotted features.

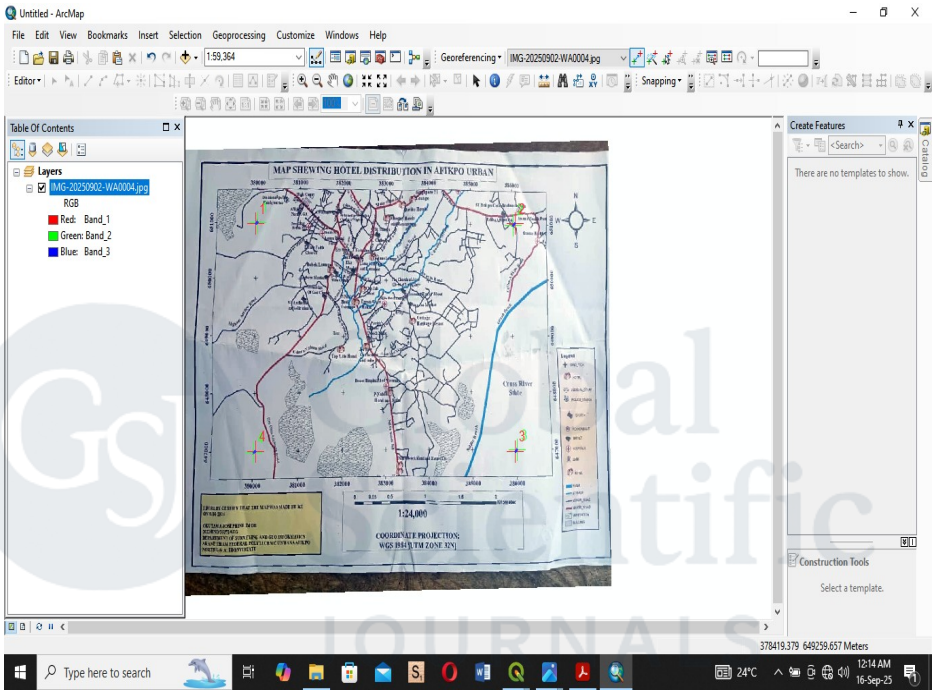

Fig 2.3 Georeferencing the map with four control points in ArcGis

Table 2.1 Showing the three control points chosen

POINT ID	EASTING(m)	NORTHING(m)
OZIZA ROAD	384643.935	651321.106
IBIAM GIRLS	381431.694	649328.217
NDIBE BEACH	383478.839	645949.614

2.9 ATTRIBUTE DATA AND SPATIAL DATA OF GOVERNMENT

INFRASTRUCTURE

The data collected consisted of both spatial and attribute components:

- **Spatial Data:** This included the geographic coordinates (latitude and longitude) of each government infrastructure within the study area, captured using a handheld GPS device. These infrastructures included schools, markets, hospitals, town halls, police stations, and other public facilities.
- **Attribute Data**: Attribute information was recorded in a field book and later entered into Microsoft Excel/WPS Office. The attributes captured for each infrastructure included:
- Name of the facility
- Type of infrastructure (e.g., school, hospital, market)
- Location description (e.g., nearby roads or landmarks)

Current condition/status (functional, under construction, abandoned, etc.)

Both datasets were integrated in ArcGIS to produce a comprehensive map showing the spatial distribution and descriptive information of government infrastructures in Afikpo.

Table 3.2: Shows the spatial and attribute data of the study area.

S/N	FEATURE NAME	FEATURE TYPE	EASTING (m)	NORTHING(m)	OWNERSHIP
1	IBIAM GIRLS SEC. SCHOOL	SCHOOL	381431.694	649328.217	GOVERNMENTAL
2	AMURO-MGBOM PRIMARY SCHOOL	SCHOOL	381767.203	649586.055	GOVERNMENTAL
3	FIRST BANK AFIKPO	BANK	382313.137	650385.061	NON-GOVERNMENTAL

See appendix 1 for comprehensive details.

2.11 DIGITALIZING

Digitizing is the process of changing a paper map or scanned image into a digital format using GIS software like ArcGIS. It involves tracing important features such as roads, buildings, and boundaries on the computer to create accurate digital maps.

This process is very important because it:

- Saves information from old paper maps.
- Makes the data more accurate and easy to update.
- Allows easy analysis and combination with other data.
- Produces clear, professional maps for presentation and decision-making.

Steps Taken to Digitize the Map

1. Setting up the Project:
    - A geodatabase (data storage folder) was created in ArcCatalog to keep all project data organized.
2. Creating Feature Classes:
    - Separate feature classes were created for infrastructures such as buildings, roads, and boundaries.
3. Georeferencing the Map:
    - The scanned base map was linked to real-world coordinates using control points collected during fieldwork.
4. Tracing Features:
    - Using the Editor toolbar in ArcMap, each feature was traced by clicking on Create Features.
5. Adding Coordinates:
    - Field coordinates were entered using the GO TO XY tool to place each feature in the right position.
6. Adding Attribute Information:

- Names and details of each infrastructure were typed into the attribute table.

7. Designing the Map Layout:

- The map was switched to Layout View where the title, legend, scale bar, north arrow, and grid were added.

8. Exporting the Map:

- The final map was saved as a PDF file for use in the project report and presentation.

Through this process, the paper base map and field data were transformed into a usable digital map of Afikpo North L.G.A. This digital map became the main source for analysis and decision-making in the project.

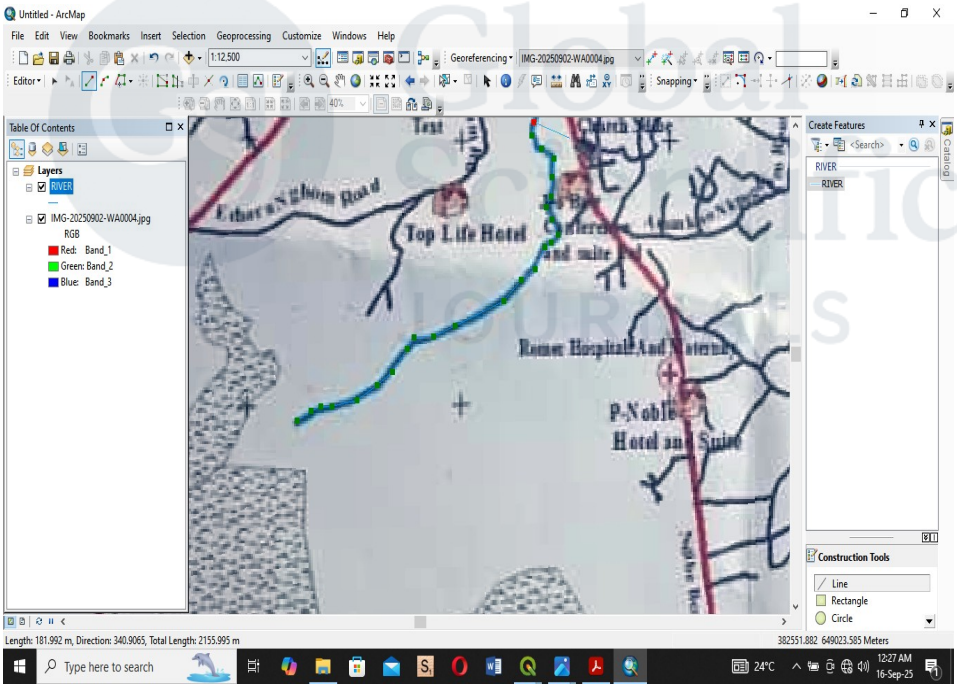

Fig 2.11 Digitalizing the map

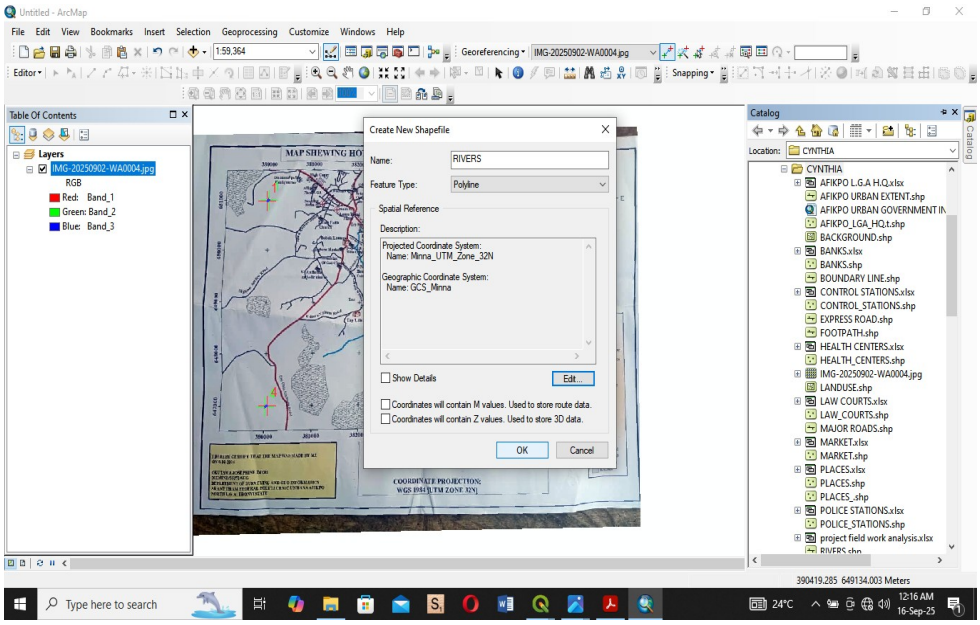

Figure 2.6: Creating a shapefile in ArcGIS for digitizing features

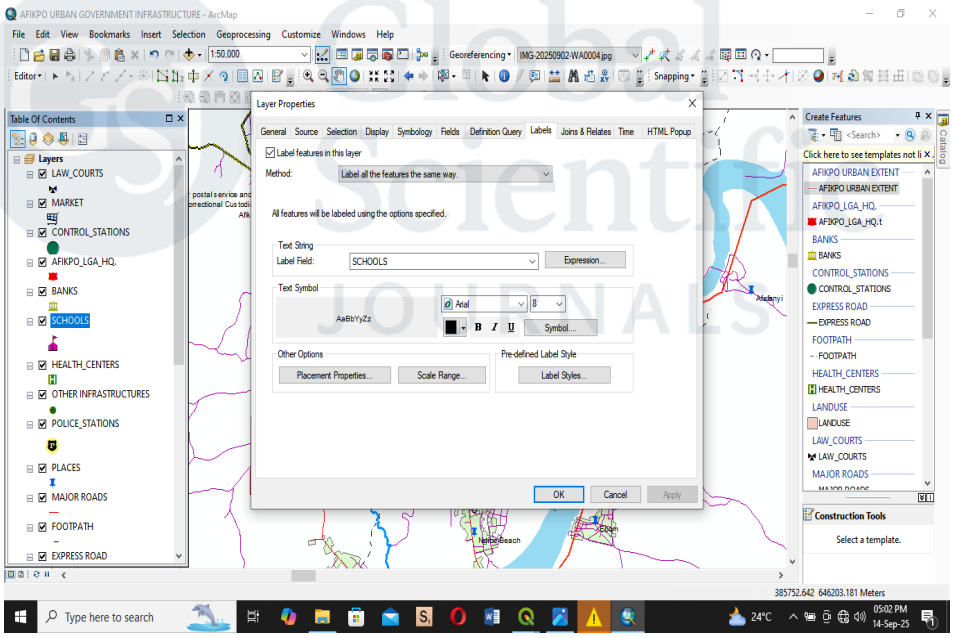

Figure 2.8: Labeling features after digitization for clarity

2.12 MAP REVISION/EDITING

Map revision, also known as map editing, is the process of updating an existing map to ensure it reflects accurate and current information. It involves correcting errors, adding new data, and improving the overall quality of the map. In this project, the revision of the digital

map of government infrastructures in Afikpo North was necessary to ensure that all features were accurate and complete. The process began by identifying the changes that needed to be made, such as the addition of new infrastructures and the correction of attribute errors discovered during fieldwork and digitizing. Updated information was then collected from reliable sources, including field observations and government records.

The map was edited using GIS software by adding new features, correcting existing ones, and updating attribute information as required. After these changes were applied, the map was carefully reviewed and validated to ensure accuracy. Topological checks were conducted to eliminate gaps, overlaps, and other errors that might affect the reliability of the map. Once the map was confirmed to be correct, the metadata was updated to include the date of revision, data sources used, and methods applied. Finally, the revised map was finalized with appropriate labels, symbols, and layout adjustments, then exported as a PDF for presentation. This process ensured that the map produced was up-to-date, reliable, and ready for use in planning and decision-making.

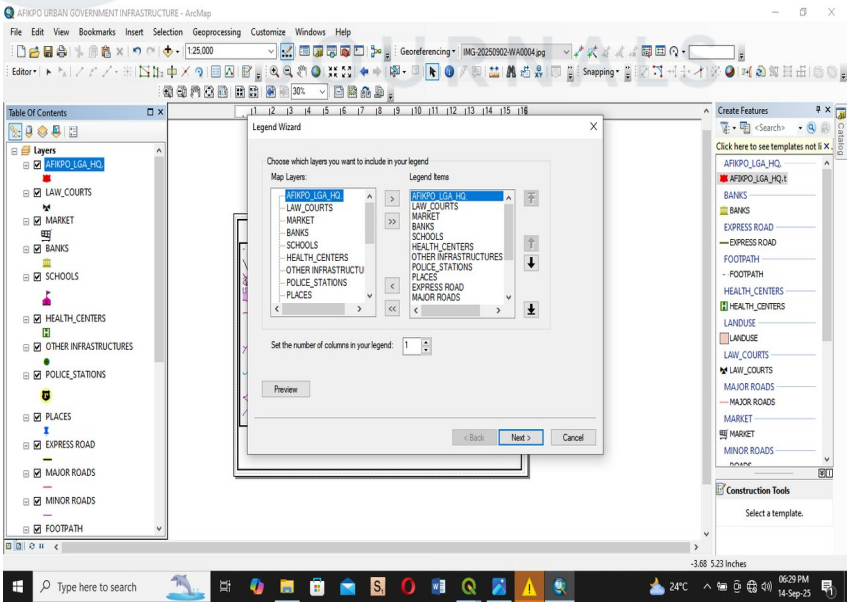

Figure 2.9: Creating the legend in ArcGIS

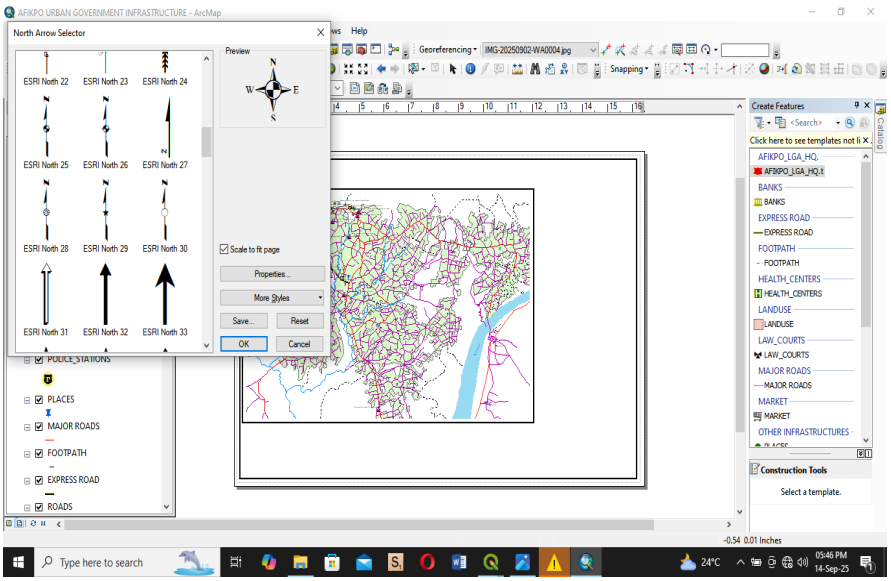

Figure 2.10: Choosing a suitable north arrow for the map

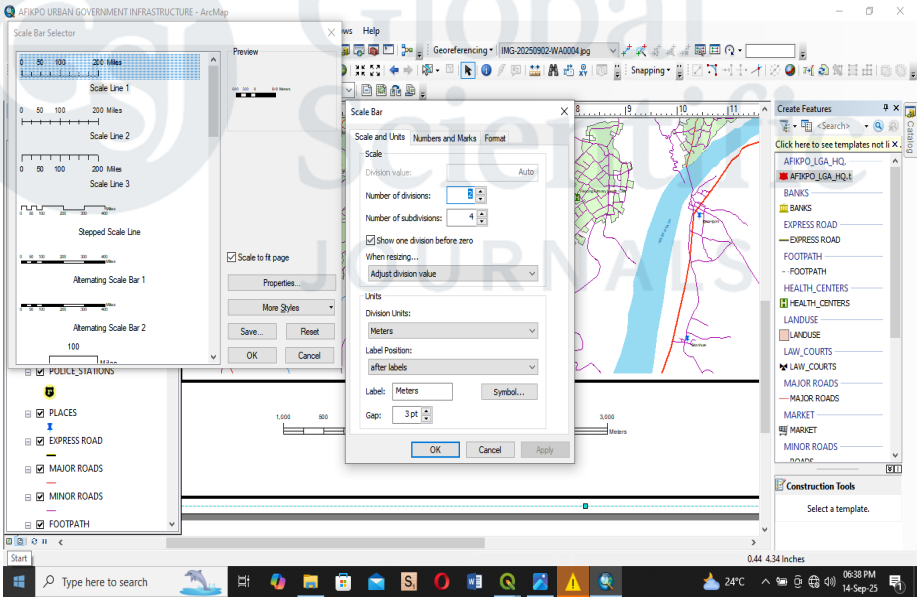

Figure 2.11: Setting the scale bar for distance measurement

2.13 DATA PRESENTATION

Data presentation is the process of displaying the results of a survey in a clear and understandable format. In this project, the data collected on government infrastructures in Afikpo North was presented using both spatial and attribute formats. The spatial data, such as

the locations of schools, health centers, and other facilities, was displayed on a digital map produced using GIS software. This map provided a visual representation of the distribution of infrastructures across the area, making it easy to identify patterns and relationships.

Attribute data, such as the names, types, and coordinates of each infrastructure, was organized in tabular form within the GIS environment. This allowed for detailed descriptions and analysis of each feature. The final map was designed with essential map elements, including a title, scale bar, north arrow, legend, and coordinate grid to enhance readability and usability. The completed map was then exported in PDF format for documentation and presentation purposes.

2.14 GROUND TRUTHING

Ground truthing is the process of verifying the accuracy of data collected and mapped during the project by physically checking the features on the ground. In this project, ground truthing was carried out to ensure that the locations of government infrastructures, such as schools, health centers, and public facilities in Afikpo North, were correctly captured and represented on the digital map.

During this process, the team visited selected infrastructure sites using the handheld GPS device to confirm their coordinates. Any discrepancies between the mapped data and the actual locations observed in the field were noted and corrected in the GIS database. This step was crucial in improving the reliability and accuracy of the final map, ensuring that the information produced truly reflected the real-world situation.

3.1 RESULTS

The final output of this project is a digital map of government infrastructures in Afikpo North Local Government Area. The map shows the spatial distribution of key infrastructures such as schools, health centers, administrative offices, and other government facilities. Each infrastructure was plotted using the coordinates collected during the fieldwork.

3.2 ANALYSIS

The analysis involved examining the spatial distribution of government infrastructures within Afikpo North Local Government Area using the data acquired during the fieldwork. The collected coordinates (Easting and Northing) were imported into ArcGIS, where they were used to plot the locations of the identified infrastructures such as schools, health centers, administrative buildings, and other facilities.

The base map of Afikpo North LGA was overlaid with the georeferenced data points to visualize the locations of these infrastructures. Attribute data such as the name, type, and function of each facility were linked to their spatial locations to provide more detailed information.

Through this analysis, the patterns of distribution were identified, revealing areas with high concentrations of infrastructures as well as under-served regions. The results provide insights that can guide planning, decision-making, and resource allocation within the LGA.

3.3 PROJECT EVALUATION

The evaluation of this project focused on assessing the accuracy, effectiveness, and relevance of the final output in achieving the set objectives. The primary goal was to ensure that the mapping of government infrastructures in Afikpo North LGA was accurate, comprehensive, and useful for planning and decision-making purposes.

The positional accuracy of the mapped features was verified by comparing the collected GPS coordinates with existing data sources and by ground-truthing selected locations. Attribute data were cross-checked with official records from relevant government agencies to ensure completeness and correctness.

Furthermore, the functionality of the digital map was evaluated by testing its usability within GIS software. This involved confirming that all layers were properly organized, symbology was clear, and attribute information could be easily queried. The map was found to be well-structured, visually clear, and capable of providing accurate spatial information on the

distribution of infrastructures.

Overall, the project met its objectives as it produced a reliable, user-friendly map that can aid policymakers, planners, and researchers in making informed decisions regarding infrastructure management and development in Afikpo North.

4.1 PROBLEMS ENCOUNTERED

During the course of this project, several challenges were encountered, which affected the overall workflow and progress. One of the major issues was the inaccessibility of certain government infrastructures due to restricted entry and lack of prior authorization, which limited data collection in some areas. Additionally, inaccuracies in existing base maps posed challenges during the georeferencing stage, requiring extra effort to verify and correct spatial data.

Another significant challenges include;

- Weather conditions, such as heavy rainfall, which interrupted fieldwork schedules.
- Technical limitations, including occasional malfunction of the handheld GPS and limited access to stable internet for map updates and software operations.
- Time constraints, as the project had to be completed within a short period, requiring extended working hours.
- Financial constraints in covering transportation and logistics costs for field visits
- Inaccessibility of some areas due to poor road networks and terrain, making data collection in remote parts of Afikpo North difficult.

4.2 RECOMMENDATIONS

Based on the experience gained and the challenges faced, the following recommendations are suggested:

- Improved access to accurate and updated base maps should be ensured for similar projects.
- Provision of better survey equipment, such as advanced GPS/GNSS receivers, to

improve data accuracy.

- Adequate funding should be allocated to cover transportation, logistics, and other necessary expenses.
- Capacity building and training for students and researchers in GIS software and modern mapping techniques.
- Government support in making infrastructural data readily available to ease project execution.

4.3 CONCLUSION

This project successfully mapped the government infrastructures in Afikpo North Local Government Area using GIS techniques. The process involved data acquisition through fieldwork, georeferencing of the base map, digitizing, and final map production. Despite the challenges encountered, the project achieved its objective of providing a spatially referenced digital map of government facilities. This map will serve as a vital tool for planning, development, and decision-making within the LGA

REFERENCES

Adepoju, A., Olayinka, S., & Okafor, C. (2020). Application of Geographic Information Systems in urban infrastructure management in Nigeria. Journal of Geospatial Technologies, 8(2), 45–58.

Akinyemi, F. (2018). Geospatial technologies and sustainable urban planning in Africa. African Journal of Environmental Science, 13(4), 67–79.

Anifowose, B., & Oyedele, O. (2016). Use of remote sensing and GIS in infrastructural mapping: A case study of Ondo State, Nigeria. Nigerian Journal of Surveying and Geoinformatics, 3(2), 12–27.

Ebonyi State Government. (2022). Afikpo North Local Government Area development report. Ebonyi State Ministry of Lands and Survey.

Federal Government of Nigeria. (2018). National policy on geospatial data infrastructure.

Abuja: Ministry of Science and Technology.

Hofmann-Wellenhof, B., Lichtenegger, H., & Wasle, E. (2012). GNSS – Global Navigation Satellite Systems: GPS, GLONASS, Galileo & more. Springer Science & Business Media.

International Federation of Surveyors (FIG). (2019). The importance of geospatial data in national development. FIG Publications.

Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote sensing and image interpretation (7th ed.). Wiley.

Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). Geographic information systems and science (4th ed.). Wiley.

National Population Commission (NPC). (2021). Population and infrastructure data of Ebonyi State. Abuja: NPC.

Olayinka, S., Adegboye, O., & Oduyemi, T. (2021). Challenges of geospatial data acquisition in developing countries: A Nigerian perspective. African Journal of Geoinformatics, 12(1), 23–36.

Olusola, A., & Fashina, M. (2020). The role of GIS in local government planning in Nigeria.