ROUTE SURVEY OF KWARA STATE POLYTECHNIC,

(A CASE STUDY OF KWARA STATE POLYTECHNIC MINI CAMPUS)

OFF GENERAL HOSPITAL TO SAWMILL GARAGE ROAD, ILORIN

WEST LOCAL GOVERNMENT AREA, KWARA STATE.

PRESENTED BY

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DEDICATION

This project is dedicated to everyone who believed in me, supported me, and walked this path with me. I couldn't have done it without you. Thank you all.

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First and Foremost, I give all thanks to God, who from the beginning knows the end for granting me strength, wisdom and perseverance to complete this project.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Route surveying is indispensable in the planning, design, and construction of various infrastructure projects. Its applications span multiple sectors including transportation, energy, water supply, and telecommunications. In the transportation sector, route surveys are used for road and railway design. Engineers need precise data about the terrain, land cover, and existing infrastructure to plan safe and efficient routes. Road alignments must account for gradients, curvature, and drainage. Similarly, railways require careful planning of slopes and curves to ensure safe train operations. A comprehensive route survey ensures that the final design adheres to engineering standards and avoids expensive rework.

For pipelines and utility lines, route surveys help determine the most suitable paths for laying water supply, sewage, gas, and oil pipelines. Factors like topography, land ownership, environmental sensitivity, and proximity to existing infrastructure are considered. Surveyors also identify potential hazards and design mitigation strategies, such as rerouting around wetlands or constructing bridges across rivers.

Electric power transmission lines and telecommunication cables also rely heavily on route surveys. In such projects, surveyors must plan routes that minimize interference with residential areas, airports, and protected natural reserves. Accurate survey data ensures that poles, towers, and substations are placed optimally for stability and accessibility.

Another important application is in urban development and city planning. Route surveys contribute to the design of roads, pedestrian pathways, drainage systems, and other public infrastructure. Planners use survey data to optimize traffic flow, reduce congestion, and improve accessibility. These improvements lead to better quality of life and economic growth. The importance of route surveying extends beyond construction.

It also plays a role in environmental conservation. By identifying and avoiding ecologically sensitive areas, route surveys help in minimizing the environmental footprint of development projects. They also aid in preparing Environmental Impact Assessments (EIAs) and obtaining permits from regulatory bodies.

From an economic standpoint, a well-executed route survey reduces project costs by avoiding errors, delays, and costly redesigns. It ensures efficient material usage and labor deployment, thus contributing to the overall success of the project.

In conclusion, the applications and importance of route surveys are vast and far-reaching. They serve as the backbone of successful infrastructure development, enabling engineers and planners to make informed decisions based on accurate and reliable data.

1.2 AIM

The primary aim of the route survey is to identify and determine the most suitable and practical path for linear infrastructure such as roads, pipelines and railways.

1.3 OBJECTIVES

The key objectives of the route survey include:

1. Establishing Route Alignment
    - Horizontal Alignment: Selecting the most appropriate route considering terrain, obstacles and curvature.
    - Vertical Alignment: Determining elevation profiles, slopes and gradients.
2. Site Assessment and Mapping
    - Ground configuration: Mapping contours, slopes and other terrain features.

- Feature location: Identifying existing structures, vegetation, utilities, and property boundaries.
- Earthwork volume: Calculating quantities of cut and fi8ll required for construction.

3. Planning and Design
   - Right-to-way Planning: Determining land requirements and easements.
   - Construction Layout: Providing accurate data for on-site setting out of the route
   - Design consideration: Supplying data for geometric design elements such as curvature, super elevation, and gradients.

1.4 METHODOLOGY

1. Reconnaissance and Planning
   - Preliminary Investigation: Reviewing maps, aerial imagery and geological data.
   - Field Reconnaissance: On-site assessment of possible routes considering terrain, vegetation and infrastructure.
2. Detailed surveying
   - Establishing control points: Setting up benchmarks and reference points for accurate measurements.
   - Centerline and Chainage: Marking the centerline and chainages at regular intervals (e.g., every 25 meters)
3. Data Analysis and Map Production
   - Coordinate calculation: Processing field data into coordinates using measured angles and distances.
   - Map Production: Creating detailed route maps, profiles and cross sections.
   - Report writing: Documenting methodology, findings and recommendations.

4. Additional Considerations
    - Obtaining Permissions: Acquiring necessary permits from authorities
    - Utility identification: Locating underground and surface utilities to avoid conflicts.
    - Geological and soil surveys: Assessing ground suitability for construction.

1.5 SCOPE OF THE PROJECT

The project scope covers the complete process of determining the horizontal and vertical alignment of a proposed transportation route. It includes:

- Identifying potential routes based on terrain and existing infrastructure.
- Collecting data on alignment, earthworks, intersections, and construction costs.
- Planning for right-of-way acquisition and ensuring regulatory compliance.
- Conducting detailed design based on collected data.
- Preparing for construction layout and implementation
- Performing environmental impact assessments and coordinating with utility providers.
- Carrying out geotechnical investigations to assess soil and sub-surface conditions.

1.6 PROJECT SPECIFICATIONS

The project involves:

- Route alignment: Selecting the most efficient path, considering topography and land use.
- Ground configuration: Mapping elevation, slope and natural features.
- Feature identification: Documenting both natural and man-made features
- Earthwork estimation: Determining excavation and fling requirements.

- Datum and coordinates: Using standard systems (e.g. UTM) for positioning and measurement.
- Angular and Distance Measurements: Measuring horizontal/vertical angles and distances to define the route.
- Benchmarks and Turning Points: Establishing vertical control and making route direction changes.
- Crossings: Identifying intersections with rivers, roads, or other infrastructure.
- Documentation: Producing comprehensive maps, profiles and reports.

1.7 STUDY AREA

The study area for this route survey is Adewole Road, located within Ilorin West Local Government Area, Kwara State, Ilorin.

1.8 PERSONNEL INVOLVED

- Rabiu Toheeb Morenikeji	ND/23/SGI/PT/0025
- Iyanda Tunminu Rachel	ND/23/SGI/PT/0019
- Omotosho Kabir Hassan	ND/23/SGI/PT/0022
- Popoola Emmanuel Oluwafemi	ND/23/SGI/PT/0024
- Hassan Halimah Asabi	ND/23/SGI/PT/0017
- Sanyaolu Olamilekan Emmanuel	ND/23/SGI/PT/0023

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Route surveys are essential in the preliminary stages of infrastructure development, particularly in road, railway, and pipeline projects. They help determine the most efficient, safe, and cost-effective path between two points. In 2008 study by Ogunleye et al., titled “Comparative Route Survey Analysis for Road Construction Projects in Southwestern Nigeria” the researchers investigated how different surveying techniques influenced route selection and design in challenging terrains.

2.2 METHODS USED

The 2008 study employed a combination of ground-based theodolite surveying and GPS data acquisition to establish control points along the proposed route. The researchers used Total Station equipment for angle and distance measurements, integrated with ArcGIS software for data processing and map generation. The study covered a 12km stretch of proposed road alignment through varying topographies.

2.3 RESULTS

The results showed that the integration of GPS with traditional theodolite methods improved the efficiency and accuracy of route selection. The digital elevation model (DEM) generated provided a detailed profile of the terrain, enabling engineers to adjust the alignment and avoid flood-prone and erosion-susceptible areas. The study also found that the combined method reduced survey time by 30% compared to the use of conventional methods alone.

2.4 CONCLUSION

Ogunleye et al. (2008) concluded that hybrid surveying methods using both conventional and modern tools provide a practical and reliable solution for route planning in civil engineering project. The study recommended adopting GIS and GPS technologies in future route surveys to enhance data analysis and decision-making accuracy.

CHAPTER THREE

3.0 METHODOLOGY

This involve the method and techniques used to perform particular task. The major method involved in the execution of this project are:- Reconnaissance survey which involved office and field reconnaissance survey, location of the control pillars and check selection or marking of station, test of instrument data acquisition which included: Horizontal and vertical analysis detailing by total station method, data processing and information presentation.

3.1 RECONNAISSANCE

This is the general overview of the practical site. So as to have the overall picture of the nature of the terrain and feature on the site and to make decision on proper planning and execution of the project. It is on essential aspect of planning in surveying which involve preliminary examination of the site by physical inspection. It is an operation done to the actual survey exercise.

The reconnaissance survey involve two accept namely

i. Office planning

ii. Field reconnaissance

3.1.1 OFFICE PLANNING

Office planning which could be termed as office reconaissance involved knowing the types of instrument, purpose, specification and accuracy required of the survey to be carried out these lead to the chosen of appropriate equipment and method to be employed also costing of the survey operation was done in the office.

Information related to the given project area was collected from various sources, such as project supervisors, department Ilorin. The coordinate (x,y,z) of the initial and that of the three control point used for orientation where all obtained.

TABLE 1.0: Shows the Coordinates of control point used.

STATION	NORTHING (m)	EASTING (m)	HEIGHT
PT01	946624.430	679060.142	357.133
PT02	946620.733	679038.328	357.131
PT03	946612.715	679960.109	357.135

Source: Project supervisor

3.1.2 FIELD RECCONIASSANCE

The project sit was visited by all the group member to have the true picture of the site for the better planning and excursion and to locate the control pillar for the necessary orientation of the study area, why the boundaries where marked with nails and bottle cover driving into the ground for the proper identification of this intersection points.

The three control pillars where founded within the study area the end product of this field reconnaissance is the sketch or recci diagram which are show below.

3.2 EQUIPMENTS USED/SYSTEM SELECTION/SOFTWARES

The instrument used for execution of the project are listed below

- **EQUIPMENTS USED**
- Total station
- Reflector
- Ranging pole
- Steel tape
- Wooden pegs
- Nails
- Field book
- **SYSTEM SELECTION**
  - Laptop Hp
  - Printer

- **SOFTWARE**
  - Civil cad 2014
  - Micro soft Excel 2015
  - Micro soft word 2015
  - Note pad 2015
  - Mts downloading software

3.3 INSTRUMENT TEST

Having collected the instrument to be used, the following test were carried out on total station instrument to ascertain the proper working of condition of the instrument test.

- **TEST OF TOTAL STATION AND CONFIGURATION**

The total station (South 1205R) used was tested to ensure that is line of sent was perpendicular to trunion axis, this test is called collimation test. The test was set on a point and the temporary adjustment i.e centering leveling, focusing after this target was equally set on another point and leveled the target was bisected on above face left and face right on the instrument why both the horizontal and vertical reading on each faces where read and booked respectively.

TABLE 1.1 Shows The Result of Instrument Test.

STN	SIGHT	FACE	HORIZONTAL	VERTICAL	DIFFERENCE	DIST(m)
A	B	L	$116^0$17”40”	49^0 00’ 20”		
	B	R	$296^0$18”00”	$268^0$52’ 20”	$180^0$00”20”	50

Horizontal collimation error = $180^0$00’ 20” - $180^0$00’ 20”

Difference = $00^0$00”20” -2

= $00^0$00”20”

Vertical collimation error = $360^0$00”00” - $359^0$59”40”

= $00^0$00”20” ÷ 2

Difference = $00^0$00”10”

i.e misclosure = 30^0

Where N = 1

Hence the allowable misclosure = 00^{0}00’ 30”

3.4 CONTROL CHECK

The excess of carry out this operation was to ascertain the reliability of all the control to be used for the project because these will go along the toward determining the accurate of the project, the checked involved base Northing, Easting and height the instrument was set up on control 1

i. (KWPT02) and all the necessary temporary adjustment performed on it. The target at back station (KWPT01) was bisected and reading was obtained.

The telescope was pointed to face station (KWPT03) and bisected the reading also recorded.

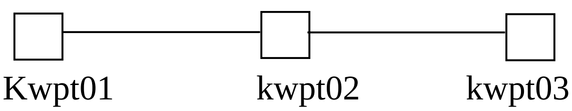

TABLE 1.2: Control check (control 1)

STATION	NORTHING	EASTING	HEIGHT	REMARK
KWPT01	946624.430	679060.142	357.133	OBSERVED
KWPT01	946624.400	679060.138	357.131	ORIGINAL
DISCREPANCY	ΔN=0.030m	ΔE=0.004m	ΔH=0.002m	

TABLE 1.3: Control check (control 2)

STATION	NORTHING	EASTING	HEIGHT	REMARK
KWPT02	946620.733	679038.328	357.140	OBSERVED
KWPT02	946620.723	679038.320	357.135	ORIGINAL
DISCREPANCY	DN=0.010m	DE=0.008m	ΔH =0.005	

TABLE 1.4: Control check (control 3)

STATION	NORTHING	EASTING	HEIGHT	REMARK
KWPT03	946612.715	679960.109	357.135	OBSERVED
KWPT03	946612.707	679960.102	357.133	ORIGINAL
DISCREPANCY	DN=0.008m	DE=0.007m	ΔH =0.002	

3.5 DATA ACQUISITION

Data acquisition begins with the physical phenomenon or physical property to be measured. Example of this include temperature light intensity, distance from one point to another etc. regardless of the type of physical to be measured must first be transformed into a unified form that can be sampled by a data acquisition system.

A data acquisition system is a collection of software and hardware that let y measure or control physical characteristics of something in the real world.

3.5.1 GEOMETRIC DATA

These started at chainage 0+000. Three existing control point where used KWPT01, KWPT02, KWPT03 and there where establish side the road.

The job commercial by setting up the instrument (South 205R) on KWPT 01 and all temporary adjustment where performed and instrument was oriented by the following procedures:-

- Setting up (centering, levelling, elimination of parallax).
- The instrument was powered on.
- “MENU” was pressed (The following was set on the instrument).
- “JOB” was click
- File folder was click
- Automatic data was set by the instrument
- Data capture was click (the first coordinate was input then the height instrument was measured with a steel tape and was also input on the instrument)
- Save
- Esc was pressed in order to go back to the back sight to check the control point.

On the back sight input was clicked and the reflector was mounted on the back sight KWPT02 and observation is taken.

Having perfectly done the telescope was turn bisect the reflector on the center line of the road which 25meter to the occupied station (KWPT01) measured was clicked the reflector was moved to the left edge of the road and observation was taken and also to the right edge of road and measured was taken.

3.5.2 TRAVERSING

Traversing may be defined sequence of connected straight lines whose direction and distance was been measured that is, it involved the determination of the bearing and distance of series of connected straight line from know coordinated point so as to obtain the coordinate of the newly established station. This includes the following.

3.5.3 SPOT HIGHTING

The total station was used in conjunction with reflector stand to execute this task. The procedure is as follows

- The total station was set up on a point (point A) with a known coordinate (Northing, Easting and Height).

  All the necessary temporary adjustment were out on the instrument the height of instrument was measured using steel tape and recorded. The telescope was directed to the target and bisect on point B for orientation. The telescope was turned clockwise to the target which has been placed at every 5meter to the edge or the road both left and right of edge road.

3.5.4 DETAILING

These is refer to as the man-made (artificial and natural feature on the ground) within the project site which are determine and obtain by using a total station and finally represented with a suitable scale on plan. The position of details with the project area was fixed using total station. The reflector man move the reflector to the edge of interest details. Such as (building, electrical pole, trees) and the telescope was directed to the reflector were the three edges of the building were picked and recorded and the position of details like electric pole were field.

3.5.5 ATTRIBUTE DATA

These are the name given to a particular building block, street or road of a the study area i.e

Below shows the lost of the attribute collect from the site.

BID	-	Building
EP	-	Electric pole
DR	-	Drainage
LF	-	Left side of the road
RT	-	Right side of the road
ACC.RD	-	Access Road Name.

3.6 DATA DOWNLOADING AND EDITING

After the completion of all earth works. Data were downloading with aid of total station SD card, the data were downloaded into the computer via SD card using the South-TS software inserted into computer and go to CD card and downloading, copy and data from CD card down to system (computer) and was later saved in excel for further editing.

3.6.1 EDITING

Excel is used in data editing, NOTEPAD is also part of software used in editing data.

The following procedure were followed

- Highlight the column A
- Go data and select the data
- Click on comer and click on select
- The data was now selected.
- Copy and paste and editing NOTEPAD
- Go to format and click on replace
- And save on NOTEPAD
- Then go to CIVILCAD

- Go to format and set the unit. Then the data was put in to load from text file: EXP and click on paste.
- Select on open
- Click on refresh
- Click on Z enter
- Click on E enter
- And data was displayed

3.7 DATA PROCESSING AND REPORT ANALYSIS

After the downloading of the acquired data from the field through cable then software civil 2012 and AUTOCAD 2007 was used to plot the horizontal alignment and longitudinal profile and where prepared in a proper and acceptable way here, the project area was visualized using sketched obtained after plotting to guide against omission of feature representing by data.

3.8 PROCESSING OF DATA BASE MANAGEMENT

The input data are proceed via data base management system (DBMS) which comprise of a set of program which manipulation and maintenance data in the data base.

3.8.1 DATA SECURITY

For a data to be move and easily secured if the user supposed to have and knows his/her password.

The computer room must be out of bound to authority's user by copying the data base file and program file and program files into compact disk.

3.8.2 DATA INTEGRITY

Integrity of the data base most be ensured at all times and care must be taken while inserting data and updating the data base.

3.8.3 DATA MAINTANCE

The quality of data base depend, on its currency and fitness for us as a decision support system and most therefore be kept to data the integrity must be maintained.

CHAPTER FOUR

4.0 ANALYSIS AND INFORMATION PRESENTATION

From the results of observation and computation the information was presented in digital form, the digital plan produced using the coordinate computed. The plotting was done by using coordinate.

After plotting the control coordinate the coordinate of details and spot high were also plotted in rectangular system and all feature were seen to appear in their appropriate relationship.

The digital plan showing all details and that showing the spot height and contour were produced by AUTOCAD and SURFER.

Preparing script file with note pad (Bold)

i. Launch notepad

ii. Tape P line and press enter

iii. Enter co-ordinate of all point on different line

iv. Repeat the first coordinate of lose boundary.

v. Click file menu

vi. Click on save as.

Running the script in AUTOCAD

i. Launch AUTOCAD

ii. Click format, click unit in the unite dialogue box, select desired option such as precision, direction, unit etc and then click Ok.

iii. Add layer by selecting the layer, repeat for all other and click Ok.

iv. Select tools menu

v. Select run scripts

vi. In the run scripts dialog box, search for your script file and click Ok.

vii. Press escape, type 2 and press enter (200m)

viii. Type E and press enter key (extend) the polygon is displayed.

Fixing details

i. Select spot height layer or details layer on the object properties bar.

ii. Select format unit

iii. Select direction other-pick angle

iv. Select P line tools

4.1 LONGITUDINAL SECTION

These are section which follow some particular line of defining a part of a new construction and are usually run along the centre lines of a proposed work such as new roads, pipelines railways etc. the particular line may consist of a straight line connected by curves this longitudinal section was done for this project so as produce on paper the existing was done for this project so as produce on paper the existing ground profile along a particular line.

4.2 VERTICAL SECTION

Vertical sections are straight up and down or 90^0 from horizontal. There are two shot taken at the same distance or station when a vertical section is taken.

4.3 APPLICATION OF PRODUCT

Horizontal Alignment of the road

Used to determine and calculating horizontal curve that is the corner of road/

Vertical section

- Elevation along the centerline of the road that is profiling
- It is used determine the volume of cut and field
- It is used to determine the introduction of grade (slope).

1. The product generated can be use to cost the construction fee for the job by the users.
2. The horizontal and vertical curves can be determine through the product.
3. The volume of earth-work can be easily determine through the product, which enable the engineers to determine the type and source of material such as borrow-pit.

CHAPTER FIVE:

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary

The route survey project undertaken in [Insert Study Area] aimed at identifying the most suitable and sustainable alignment for a proposed road that will enhance connectivity and socio-economic activities within the region. The project incorporated several phases, beginning with a comprehensive understanding of the study area, followed by reconnaissance, field data collection, control point establishment, data analysis, and final alignment selection. Each phase was critical in ensuring the accuracy and reliability of the survey results and the practicality of the selected route.

In Chapter One, the groundwork was laid by introducing the topic, stating the aim and objectives, and discussing the scope and significance of the project. The study highlighted the crucial role that route surveys play in infrastructure development, particularly in planning roads and other linear structures. The personnel involved and the geographical extent of the project were also presented, giving the study a well-defined context.

Chapter Two presented a detailed literature review, exploring the theoretical and historical perspectives of route surveying. It examined existing works on surveying techniques, technologies used in route surveys (such as Total Stations, GPS, and GIS), and the application of survey data in route design. This chapter helped establish a strong academic foundation for the methodology and decisions taken in the later parts of the project.

Chapter Three detailed the methodology, including the instruments used (like dumpy levels, GPS devices, ranging rods, and Total Stations), the procedures for reconnaissance, control point establishment, leveling, and traversing. It also discussed data processing using AutoCAD and other software to produce alignment drawings, profiles, and cross-sections. The methods were selected based on best practices in the field and the specific conditions of the study area.

Chapter Four focused on the results and analysis, where data collected during the field survey was presented in charts, maps, and tables. Profiles of the proposed alignment, contour maps, and other outputs were analyzed to evaluate the feasibility of the route. Several factors such as slope, elevation differences, existing physical features, and land use patterns were considered before finalizing the proposed alignment. This chapter demonstrated how the integration of field observations and technical analysis leads to informed decision-making.

Overall, the project successfully achieved its aim of identifying an efficient, cost-effective, and sustainable road alignment through a structured and methodical approach. The project not only applied theoretical knowledge to a real-world problem but also demonstrated the importance of integrating technical data, environmental factors, and socio-economic considerations in route planning. The skills and techniques applied in the course of this project can be replicated or adapted for similar surveys elsewhere.

5.2 Conclusion

The route survey conducted for the proposed road in [Insert Study Area] provides a comprehensive example of how geospatial and engineering principles can be effectively applied to address infrastructural development needs. Through a combination of fieldwork, data analysis, and route design, the project has identified a viable alignment that balances technical, environmental, and economic factors. The process involved careful planning, precise measurement, and critical evaluation, all of which are hallmarks of professional surveying practice.

The project began with the recognition of the need for improved transportation infrastructure in the area. The lack of accessible and well-maintained roads has long hindered economic activities and reduced the quality of life for local residents. In addressing this need, the route survey aimed to determine a path that minimizes earthworks, avoids unnecessary environmental damage, and connects key points in the most efficient manner.

The implementation of modern surveying instruments and techniques played a significant role in enhancing the accuracy and efficiency of the project. Tools such as GPS and Total Stations enabled the survey team to capture high-precision data that were crucial for mapping terrain features and elevations. These tools ensured that the selected route was not only feasible on paper but also practical on the ground. The use of AutoCAD and GIS software further added value by providing detailed visual representations of the proposed route and facilitating easier interpretation of the data.

An important conclusion that emerges from this project is the central role of preliminary investigations and data collection in successful infrastructure development. Without accurate surveys and thoughtful route alignment, road construction projects are likely to suffer from cost overruns, structural failures, and negative social or environmental consequences. Hence, the route survey serves not just as a technical requirement but as a strategic planning tool.

Furthermore, the project highlights the importance of considering socio-environmental impacts in engineering design. The alignment process consciously avoided sensitive areas such as farmlands, wetlands, and densely populated regions. This approach demonstrates a commitment to sustainable development, ensuring that road construction does not come at the expense of community well-being or environmental integrity.

In conclusion, this project has successfully demonstrated the importance and application of route surveying in civil engineering. It has delivered a technically sound and socially responsible outcome that can serve as the basis for detailed engineering design and eventual construction. The knowledge and experience gained from this project are valuable assets for future endeavors in both academic and professional contexts.

5.3 Recommendations

Based on the findings and experiences obtained during the execution of this route survey project, several recommendations are offered to guide future route survey projects and infrastructure planning processes:

1. Integration of Advanced Technology: Future surveys should incorporate more advanced technologies such as drone-based aerial photogrammetry and LiDAR. These tools provide high-resolution topographic data over large areas quickly and with minimal human error. The integration of such tools will improve accuracy, reduce labor, and enhance decision-making.

2. Comprehensive Stakeholder Engagement: It is recommended that local stakeholders, including community leaders and landowners, be involved in the route selection process. Their local knowledge can help identify potential issues early, such as land ownership conflicts or cultural sites, which might not be visible during physical surveys.

3. Periodic Training for Survey Personnel: Continuous professional development is crucial for survey teams. Training on the latest equipment, software, and data interpretation methods ensures high-quality output. Institutions and companies should invest in regular workshops and certification programs for their personnel.

4. Environmental and Social Impact Assessment (ESIA): While this survey focused on technical alignment, future projects should be complemented with detailed

environmental and social assessments. This ensures that road construction does not negatively affect ecosystems or displace communities without compensation or planning.

5. Development of a Centralized Geospatial Database: Establishing a geospatial database that stores previous and ongoing survey data can be very beneficial. Such a database will reduce redundancy in data collection and serve as a planning tool for future infrastructure projects.

6. Route Design Optimization: It is advisable to analyze multiple alignment alternatives before selecting a final route. This includes comparing alignments based on distance, construction cost, ease of access, and environmental impact. Decision-making should be supported with multi-criteria analysis.

7. Monitoring and Updating Survey Data: In areas where development is rapid or where natural features change due to erosion or urbanization, survey data should be updated periodically. Keeping data current ensures that subsequent design and construction works are based on reliable information.

8. Policy Implementation and Enforcement: Government agencies responsible for infrastructure should enforce policies that mandate thorough surveys before project approval. This will enhance project sustainability, reduce budget overruns, and improve public satisfaction.

In conclusion, while this route survey has achieved its goals, the recommendations provided here are aimed at improving future projects. A combination of technological, institutional, and environmental best practices will ensure that route surveys contribute meaningfully to sustainable development and national progress.

ID	EASTINGS	NORTHINGS	Elevation
C1	679964	946753.1	357.368
C2	679963.5	946724.6	357.962
C3	679957.2	946709.7	358.567
C4	679948.3	946699.7	358.819
C5	679938.3	946686.4	358.654
C6	679941.1	946665.7	356.633
C7	679947.2	946658.3	355.579
C8	679959.8	946641.6	353.871
C9	679958.5	946624.2	352.777
C10	679959.5	946603.2	352.517
C11	679971.3	946600.7	352.13
C12	679974.7	946624.4	352.261
C13	679977.8	946645.9	353.655
C14	679987.2	946660.3	354.464
C15	680004.8	946671.8	354.676
C16	680025.2	946674.8	353.942
C17	680051.3	946672.4	353.826
C18	680057	946680.6	353.722
C19	680011.5	946683	354.636
C20	679998.1	946689.7	355.487
C21	679985.9	946703.5	356.333
C22	679976.4	946718.7	356.948
C23	679972.8	946730.6	357.154
C24	679972.7	946752.5	357.073
C25	679929.8	946682.3	358.972
C26	679870.7	946685.2	358.228
C27	679781.2	946688.4	349.667
C28	679708.4	946689.8	355.523
C29	679639.3	946691.9	353.779
C30	679585.6	946695.6	355.247
C31	679491.5	946699.9	357.036
C32	679394.2	946701.1	359.694
C33	679333.2	946702.1	359.467
C34	679273.5	946705.1	361.621
C35	679231.6	946706.6	360.463
C36	679203.2	946706.5	359.894
C37	679169.7	946707.7	360.433
C38	679137.9	946709.1	359.982
C39	679077.8	946713.8	360.103
C40	679037.9	946712.3	358.725
C41	678999.7	946713.7	357.113
C42	678963	946715.1	358.92
C43	678943.5	946714	360.007
C44	678923	946713.9	359.344

C45	678898.3	946715	357.001
C46	678851.3	946719.1	354.906
C47	678796.3	946718.3	353.422
C48	678759.8	946717.6	350.127
C49	678716.4	946718.9	348.668
C50	678662	946721	348.148
C51	678638.4	946715	346.906
C52	678621.8	946705.6	346.585
C53	678588.3	946683.9	347.166
C54	678554.5	946659.9	348.842
C55	678545	946647	349.854
C56	678510	946628.6	348.713
C57	678468.5	946603.2	348.894
C58	678433.4	946577.8	350.366
C59	678398.6	946551.7	351.422
C60	678362	946523.7	350.13
C61	678326.3	946495.8	348.907
C62	678281.8	946459.5	348.395
C63	678241.9	946414.6	348.929
C64	678217.3	946380.2	345.946
C65	678189.7	946337.7	343.072
C66	678162.3	946295.1	344.842
C67	678136.9	946260	344.621
C68	678106.8	946218.1	342.438
C69	678079.5	946190.1	341.44
C70	678047.2	946161.1	339.118
C71	678014.8	946136.8	337.645
C72	677963.6	946089.5	341.988
C73	677931.7	946063.3	340.114
C74	677889.1	946031.3	337.701
C75	677842.1	945998.5	336.041
C76	677794.2	945965.7	335.168
C77	677727.8	945921.4	330.225
C78	677655.8	945884.2	329.975
C79	677606.3	945859.4	327.096
C80	677520.4	945806.7	324.362
C81	677452	945779	322.305
C82	677369.2	945743.5	317.513
C83	677316.3	945713	314.578
C84	677233.7	945661.7	311.035
C85	677184.1	945627.7	313.347
L1	679925.8	946677.7	358.807
L2	679896.4	946679.3	359.188
L3	679861.7	946680.2	357.489
L4	679787.2	946681.7	350.436

L5	679778.3	946677	349.491
L6	679774.1	946671.7	349.173
L7	679770.1	946651.1	349.468
L8	679769.7	946635.9	349.964
L9	679760.9	946638.1	348.797
L10	679762.9	946667.6	347.723
L11	679761.9	946673.6	347.379
L12	679758.7	946677.9	347.41
L13	679755	946680.9	347.963
L14	679747.6	946682.7	349.29
L15	679731.4	946684.8	352.178
L16	679684	946685.1	355.392
L17	679667.8	946685.7	354.578
L18	679663.5	946682.3	353.995
L19	679660.3	946678.7	353.545
L20	679657.8	946671.3	352.932
L21	679652.3	946655.1	351.869
L22	679649.4	946643.2	352.017
L23	679641.5	946645	352.217
L24	679649	946675.6	353.061
L25	679649.4	946681	353.382
L26	679647.5	946684.5	353.609
L27	679644.9	946685.9	353.62
L28	679640	946687.1	353.488
L29	679629	946687.5	354.034
L30	679531.1	946692.7	356.384
L31	679457.6	946693.8	358.792
L32	679402.9	946693.1	359.27
L33	679340.9	946696.1	358.94
L34	679285.4	946699.5	360.868
L35	679268.4	946700.7	361.304
L36	679240.1	946700.9	360.395
L37	679194.8	946701.3	359.431
L38	679145.1	946703.3	359.41
L39	679082.5	946708.1	359.932
L40	679033.4	946707.8	358.329
L41	678966.6	946709.4	358.914
L42	678913.6	946709.5	358.806
L43	678891.5	946711.2	356.572
L44	678853.6	946713.5	354.941
L45	678824.4	946713.5	354.604
L46	678790.1	946713.8	352.762
L47	678731.1	946714.1	348.927
L48	678700	946715.3	349.081
L49	678681.1	946715.8	348.955

L50	678670.7	946715.6	348.717
L51	678658.6	946715.6	348.361
L52	678648.6	946712.8	347.828
L53	678632.4	946707.5	347.168
L54	678616.2	946697.1	346.745
L55	678597	946684.2	347.205
L56	678568.5	946665	348.727
L57	678549.6	946646.9	349.866
L58	678547	946642.2	350.103
L59	678540.2	946639.2	350.2
L60	678527.3	946631	349.774
L61	678517	946626.3	349.249
L62	678502.5	946619.4	348.654
L63	678484.3	946607.2	348.654
L64	678443	946579.4	350.266
L65	678386.1	946536.9	351.012
L66	678338.5	946497.1	349.352
L67	678284.2	946451.9	348.227
L68	678241.5	946406.1	348.302
L69	678219.5	946374	345.29
L70	678185	946322.2	342.873
L71	678147.8	946267.8	344.618
L72	678111.5	946216.3	342.19
L73	678093	946197.2	341.556
L74	678064.2	946170.7	340.063
L75	678028.7	946142.6	337.86
L76	678024.6	946137.7	337.742
L77	678022.3	946133.1	337.746
L78	678037.6	946121.1	339.132
L79	678046.6	946114.7	339.809
L80	678043.2	946108.2	339.81
L81	678013.5	946129.7	338.018
L82	677982.4	946100.5	341.396
L83	677938.7	946062.6	340.366
L84	677849.8	945998.4	336.039
L85	677747.8	945928.4	330.921
L86	677725.7	945911.7	330.079
L87	677716.2	945892.5	330.382
L88	677709.7	945872.7	330.964
L89	677704.6	945874.5	330.968
L90	677717.1	945906.2	330.003
L91	677712.6	945909.2	329.914
L92	677696.3	945897.8	329.729
L93	677621.3	945859	328.326
L94	677537	945810.9	325.111

L95	677506.2	945797	323.607
L96	677445.7	945770.4	321.784
L97	677383.1	945743.2	318.39
L98	677327.7	945712.3	315.254
L99	677267.4	945676.4	311.843
L100	677188.2	945624.3	313.226
R1	679924.2	946688.3	359.598
R2	679898.3	946688.1	359.595
R3	679879.6	946688.4	358.793
R4	679849.4	946688.5	356.99
R5	679817.1	946690.4	354.317
R6	679780.3	946691.6	349.578
R7	679746.1	946692.2	350.309
R8	679714.6	946693.3	355.041
R9	679693.5	946693.3	356.568
R10	679667.6	946695.2	355.777
R11	679638.3	946696.2	354.012
R12	679602.6	946697.6	354.502
R13	679574.2	946698.9	355.32
R14	679525.7	946701.3	355.843
R15	679488.3	946703.5	357.076
R16	679454.5	946704.2	359.58
R17	679406.8	946705.3	359.764
R18	679346	946705.2	359.309
R19	679321.2	946706.3	360.128
R20	679292.7	946707.2	361.131
R21	679271.4	946708	361.878
R22	679253.8	946708.7	361.351
R23	679231.6	946709.7	360.695
R24	679210.6	946709.7	360.013
R25	679187.8	946710.2	360.761
R26	679154.6	946711.1	360.282
R27	679134	946712.2	360.144
R28	679107	946714	360.158
R29	679084.5	946716	360.199
R30	679066.9	946715.8	360.069
R31	679049.9	946714.4	359.512
R32	679006.4	946715.6	357.331
R33	678972.7	946717.3	358.323
R34	678955.9	946716.7	359.202
R35	678939.7	946716.2	360.018
R36	678911.1	946717.3	357.998
R37	678892.2	946718.5	356.259
R38	678881.6	946721	355.231
R39	678855.8	946722.4	354.81

R40	678838.9	946723	354.996
R41	678813.7	946721.7	354.9
R42	678788.1	946721	352.901
R43	678770.6	946721.6	351.318
R44	678726.9	946721.2	348.728
R45	678698.4	946723.5	348.445
R46	678668.4	946724.7	347.986
R47	678648.3	946720.7	347.202
R48	678635.3	946717	346.494
R49	678622.5	946710.1	346.26
R50	678610.2	946702.4	346.093
R51	678595.6	946692.4	346.373
R52	678579.7	946681.9	347.332
R53	678567.2	946672.2	348.222
R54	678558.9	946666.7	348.401
R55	678552.1	946661.1	348.703
R56	678548.7	946656	349.08
R57	678543	946650.1	349.559
R58	678536.8	946646.1	349.853
R59	678524.8	946639.8	349.326
R60	678505.2	946629.6	348.401
R61	678479.6	946612.6	348.201
R62	678429.9	946579.7	350.239
R63	678403	946558.5	351.194
R64	678339.7	946509.8	349.195
R65	678300.8	946479.7	348.723
R66	678279.9	946465.2	348.553
R67	678259.4	946441.1	349.608
R68	678239.4	946418	349.208
R69	678218.7	946391.6	347.253
R70	678203.7	946366.5	343.926
R71	678169.3	946315.8	345.356
R72	678150	946284.9	345.809
R73	678122.4	946247.1	343.864
R74	678087.6	946205	342.244
R75	678054.5	946171.7	339.78
R76	678008.6	946136.4	337.865
R77	677972.1	946100.8	341.493
R78	677941.8	946075.2	340.658
R79	677913.7	946052.7	338.914
R80	677877.5	946025.4	337.235
R81	677840.8	946000.8	336.115
R82	677772.1	945954.4	333.427
R83	677731.2	945927.3	330.387
R84	677673.9	945896.6	329.239

R85	677589.8	945853.6	325.851
R86	677513.2	945812.1	324.367
R87	677399.7	945760.9	318.95
R88	677365.1	945747.3	317.122
R89	677291.1	945702.9	313.546
R90	677184.8	945633.5	313.132