FIG Working Week 2024
19-24 May
Accra, Ghana
Your World, Our World: Resilient Environment and Sustainable Resource Management for All

Analyzing a Section of Ahmadu Bello University's Electrical Grid Using Geometric Network Analysis and Trace Function

Adamu Bala [1′2] , **Bilal Sani** [2], **AbdulAzeez Onotu Aliyu** [2] and **Aliyu Zailani Abubakar** [2]

Presenter: **Adamu BALA**

[1′2] China University of Geosciences, Wuhan, China, P.R.

[2] Department of Geomatics, Ahmadu Bello University, Nigeria

ORGANISED BY

PLATINUM SPONSORS

PRESENTATION OUTLINE

INTRODUCTION

MATERIALS AND METHODS

RESULTS AND ANALYSES

CONCLUSION

INTRODUCTION

Electricity is the flow of electrons between two points with a potential difference, resulting in an electric current.

The electrical grid: generating plants, transmission lines, substations, transformers, distribution lines, etc

GIS can be used to manage, model and analyse electricity grids, and for the design and analysis of various networks: electricity, gas, or water

INTRODUCTION cont.

GIS can also help identify affected areas in case of power outages within the minimum time possible.

There are existing works related to this study:

- ❖Mapping and modelling an electrical power network on the web (Rajab, 2016);
- ❖Modelling of electricity distribution networks using satellite imageries and spatial data (Damilola, 2013)
- ❖implementation of utility management systems (Sree and Phani, 2016)

INTRODUCTION cont.

In the study area, the grid does get sabotaged by factors like wind, rain, etc.,

The unnecessary delays in responding to such faults caused by these factors is present also.

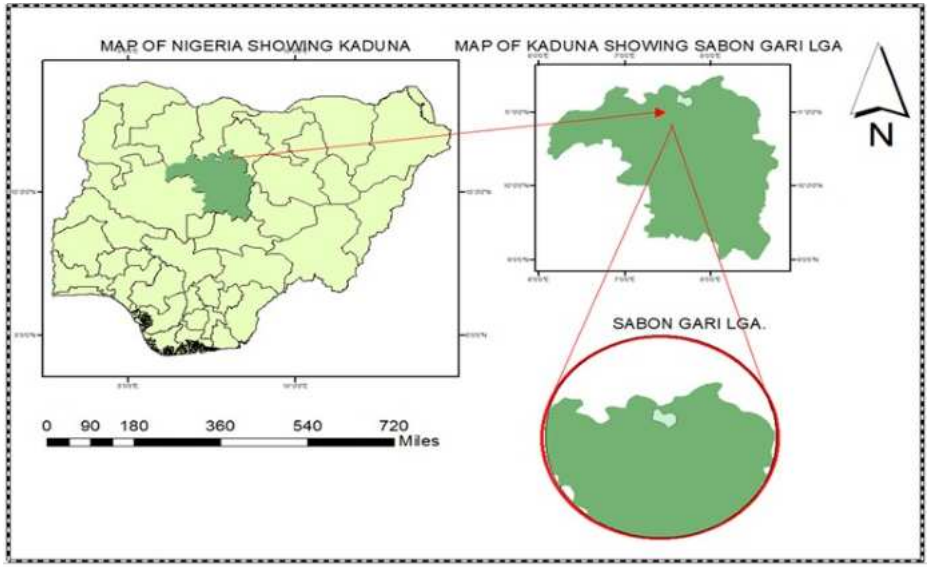
In this study, we analysed a section of Ahmadu Bello University's Electrical Grid by running a geometric network

INTRODUCTION cont.

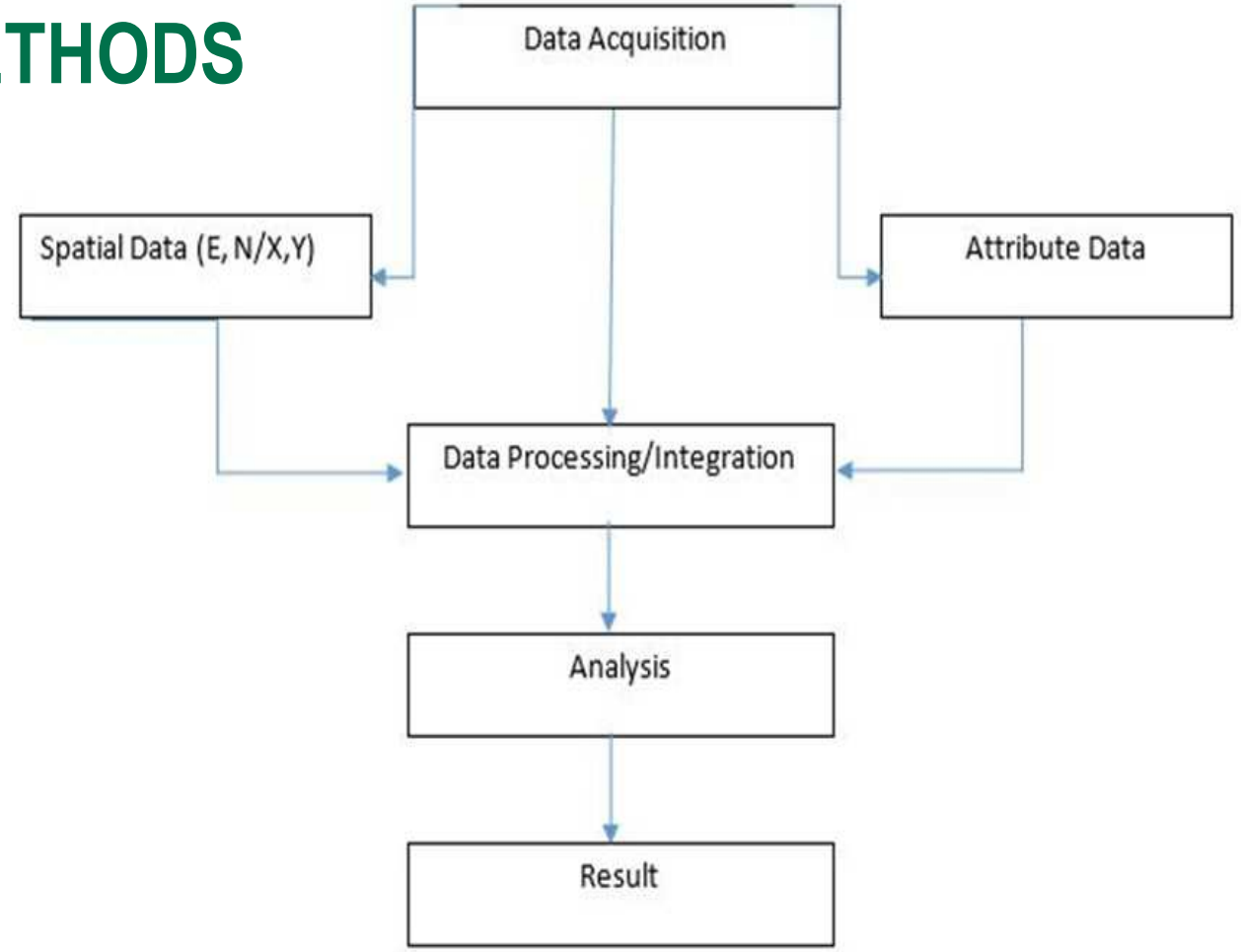
The study area covered about 9.50 km in perimeter;

it spans 11° 8'59.47"N, 7°39'55.50"E; 11° 8'14.32"N, 7°38'50.25"E and 11°10'2.35"N, 7°37'58.39"E .

it was divided into two parts, the staff quarters and the main campus.



MATERIALS AND METHODS



MATERIALS AND METHODS

- **Data acquisition**

Table 1: Datasets

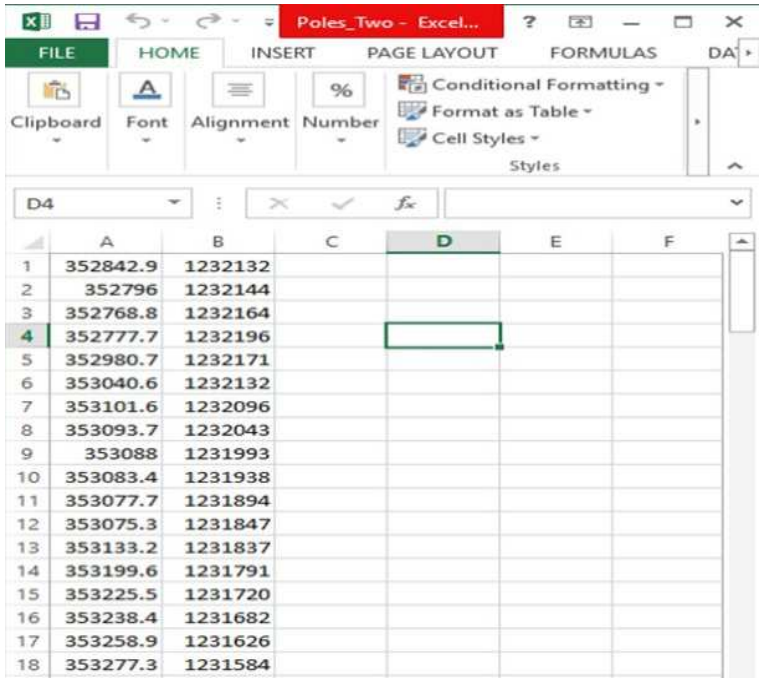
S/n	Data type	Data name	Data date	Source	Purpose	Description
i.	Secondary	Area Extent	2019	Google Earth	Determining the nature and extent of the study area.	Satellite imagery and perimeter coordinates
ii.	Primary	Spatial Data (E, N)	2019	Garmin ETrex20 GPS	To create a geodatabase of the features in the network	Coordinates of the features in the network.

MATERIALS AND METHODS

Data Processing

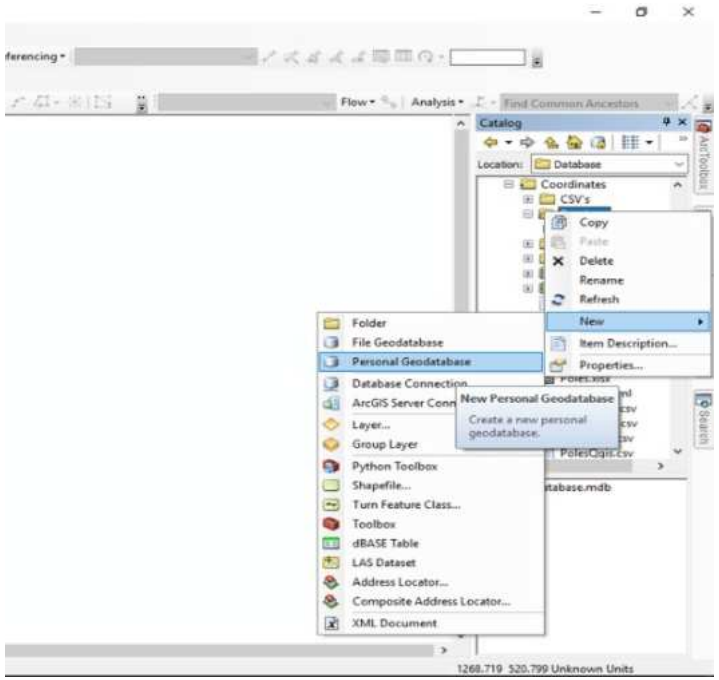
Categorisation and Cataloguing

Processing in ArcMap



	A	B	C	D	E	F
1	352842.9	1232132				
2	352796	1232144				
3	352768.8	1232164				
4	352777.7	1232196				
5	352980.7	1232171				
6	353040.6	1232132				
7	353101.6	1232096				
8	353093.7	1232043				
9	353088	1231993				
10	353083.4	1231938				
11	353077.7	1231894				
12	353075.3	1231847				
13	353133.2	1231837				
14	353199.6	1231791				
15	353225.5	1231720				
16	353238.4	1231682				
17	353258.9	1231626				
18	353277.3	1231584				

The catalogued data (in Excel)



Creating a Geodatabase in ArcCatalogue

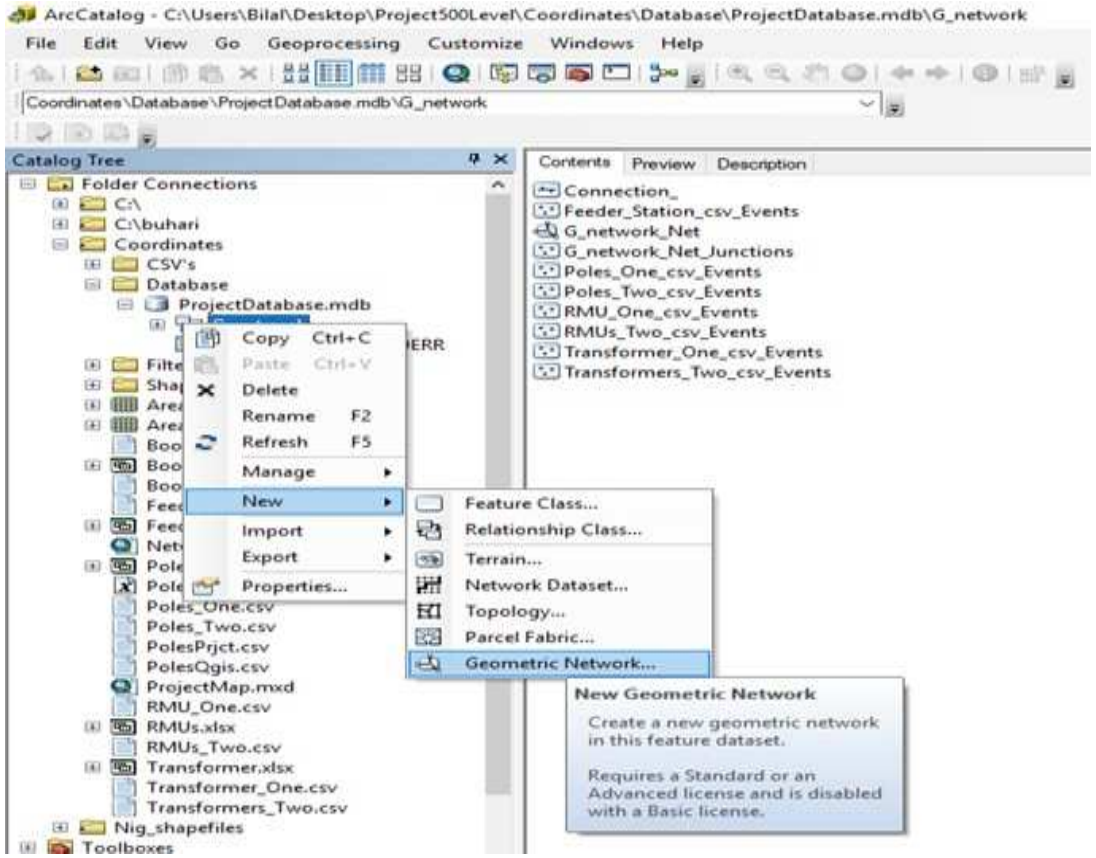
MATERIALS AND METHODS

The Geometric Network

Datasets;

Designing a Geodatabase Topology;

The Network



Creating geometric network

MATERIALS AND METHODS

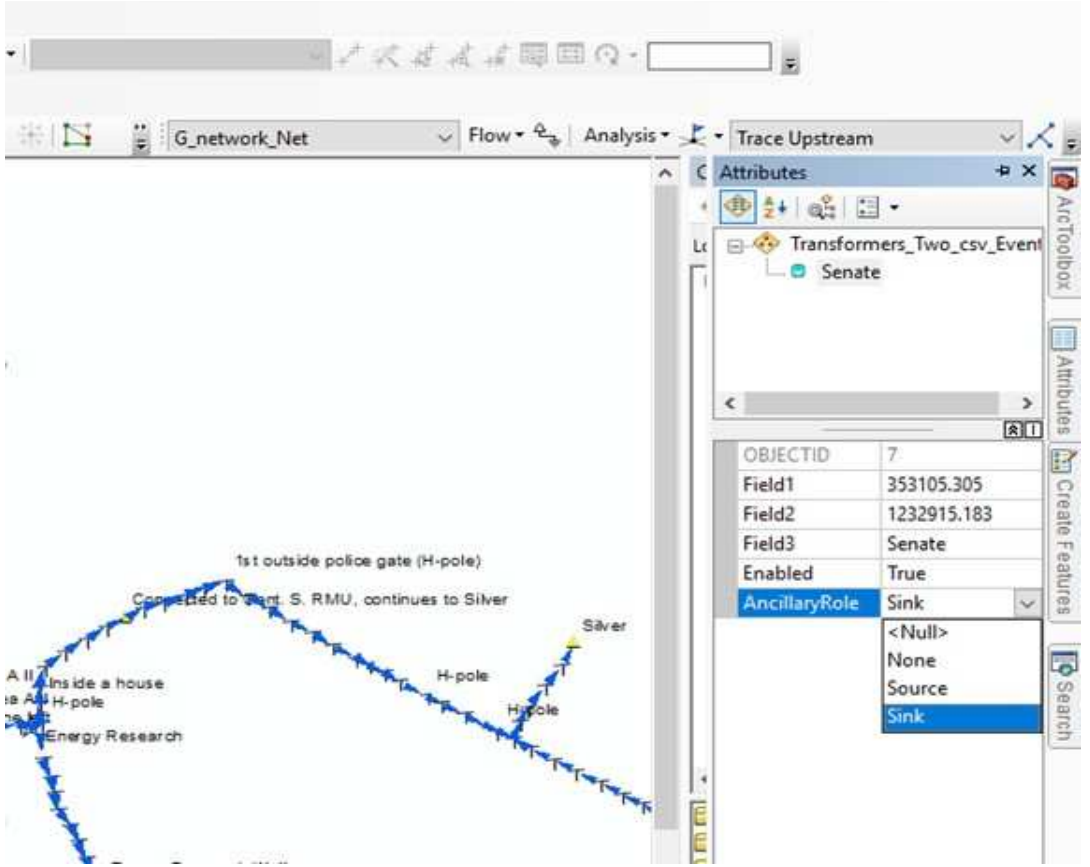
The Geometric Network

The thresholds set for the geometric network wizard:

i. RMUs were set "sources";

ii. Transformers were set as "sinks"

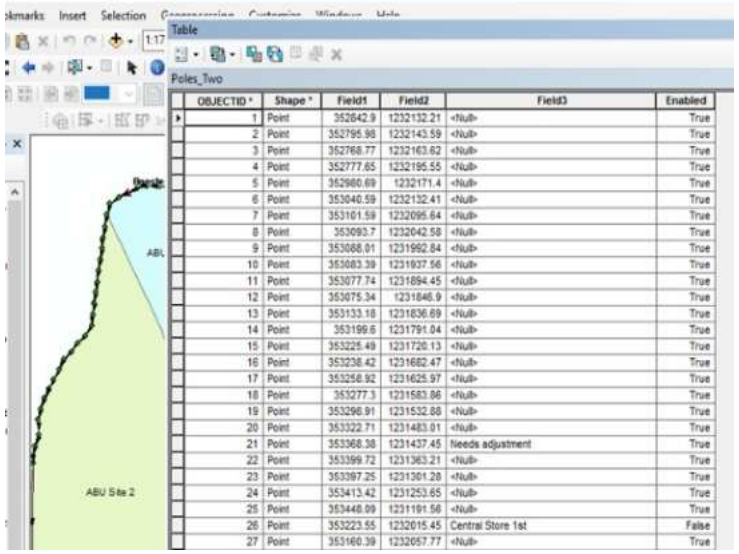
iii. Edges were set as complex edges.



Setting Ancillary Role

RESULTS AND ANALYSES

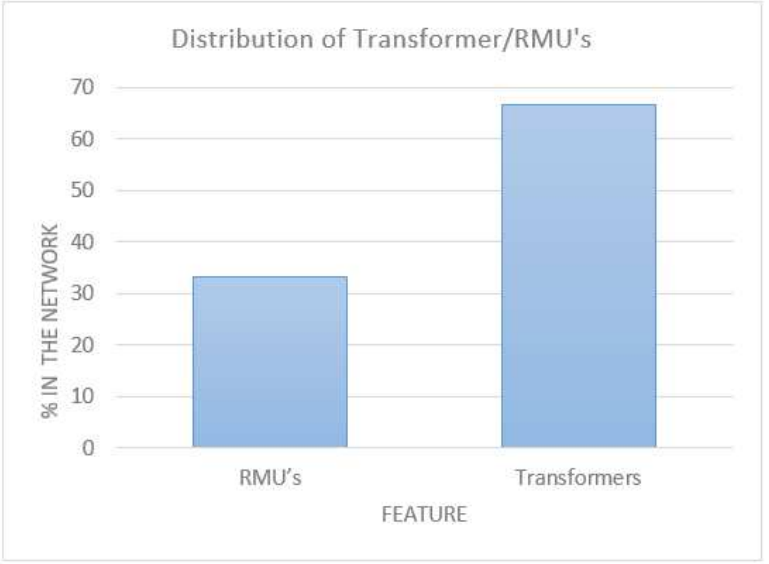
The geodatabase of the spatial attribute of the features/facilities



Geodatabase in ArcMap.

Table 2: Features involved in the network

S/n	Feature	Quantity	%
i.	Poles	201	88.16
ii.	Ring Main Units (RMU)	9	3.49
iii	Transformers	18	6.98



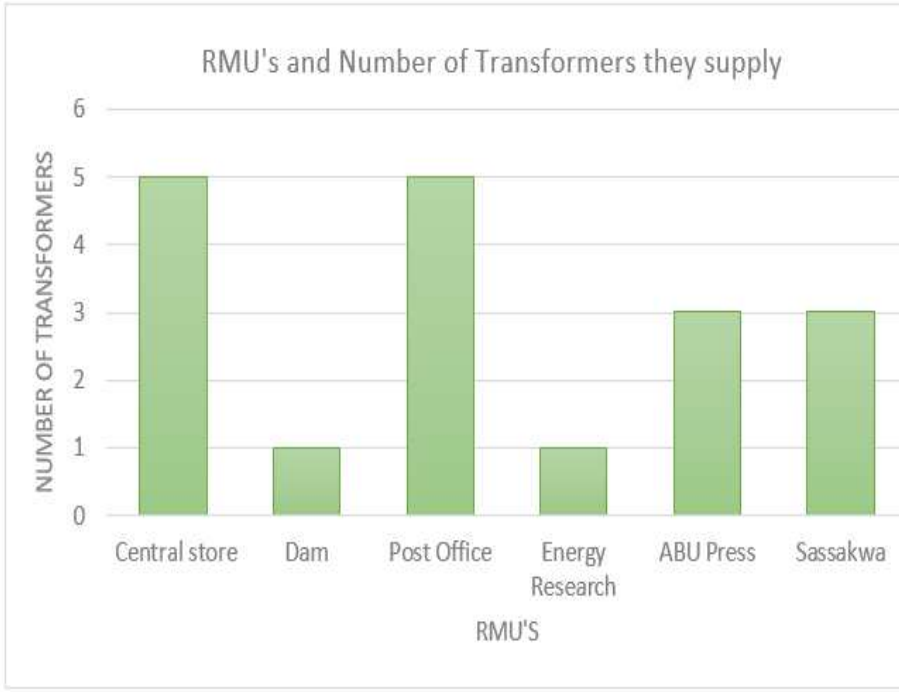
Transformers and RMUs Features (%)

RESULTS AND ANALYSES

The geodatabase of the spatial attribute of the features/facilities

Table 3: RMUs in the network and transformers they feed.

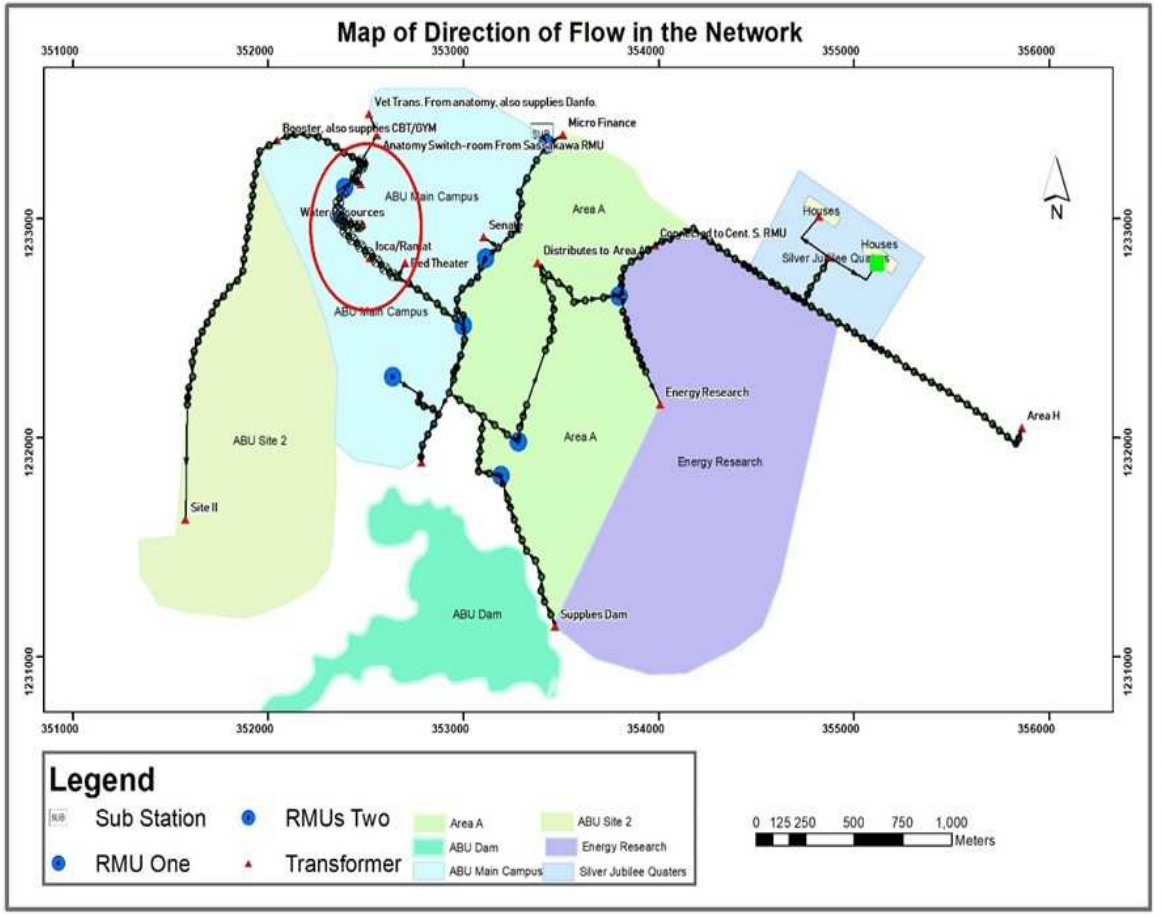
S/n	Central store	Dam	Post Office	Energy Research	ABU Press	Sassakwa
i.	Area A Part 1	DAM	Micro Finance	Energy Research	Water Resources	Anatomy
ii.	Area A Part 2		Senate building		Sassakwa	Vet. Medicine
iii.	Energy Research		Demonstration		ABU Press	ABU Site II
iv.	Silver Jubilee Quarters		Centre of excellence			
v.	Area H		PG School			



RESULTS AND ANALYSES

✓**Flow Analysis**

- The map shows where each RMU (Source) is sending its supply to
- And where each transformer (Sink) is getting its supply from.
- The flow can be either determinant, indeterminate, or uninitialized.



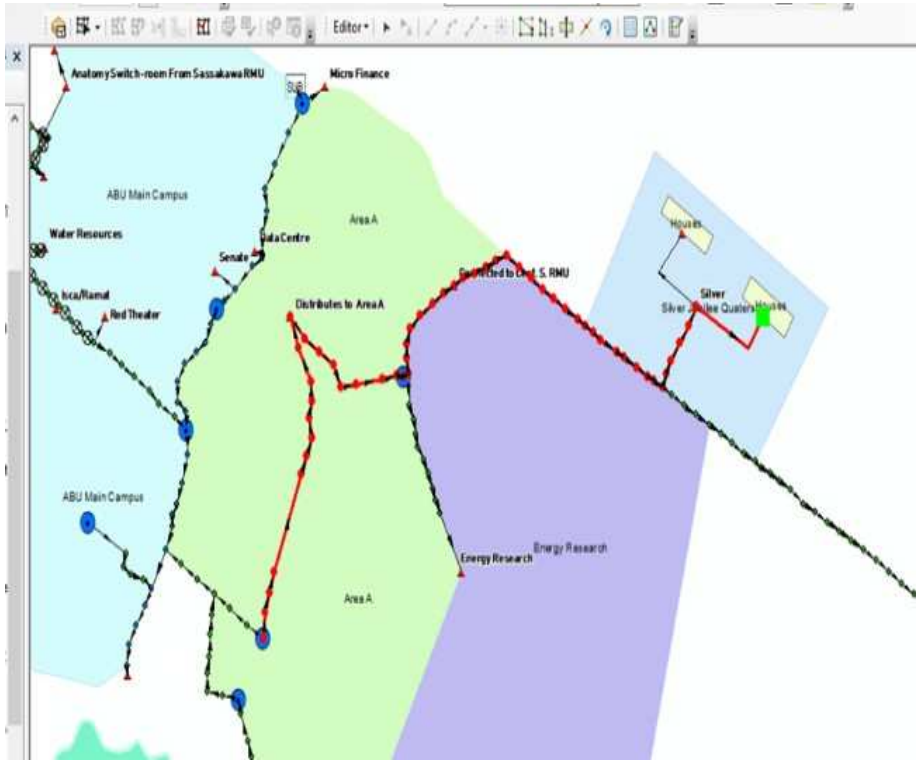
Flow of power

RESULTS AND ANALYSES

The Trace analysis

- The flow analysis will let you trace each sink to its source and vice versa following the direction of the arrow alone, but it doesn't allow for isolated traces.

- the tracing flag (the green square) was set at a house in Silver Jubilee quarters and traced down to its source RMU

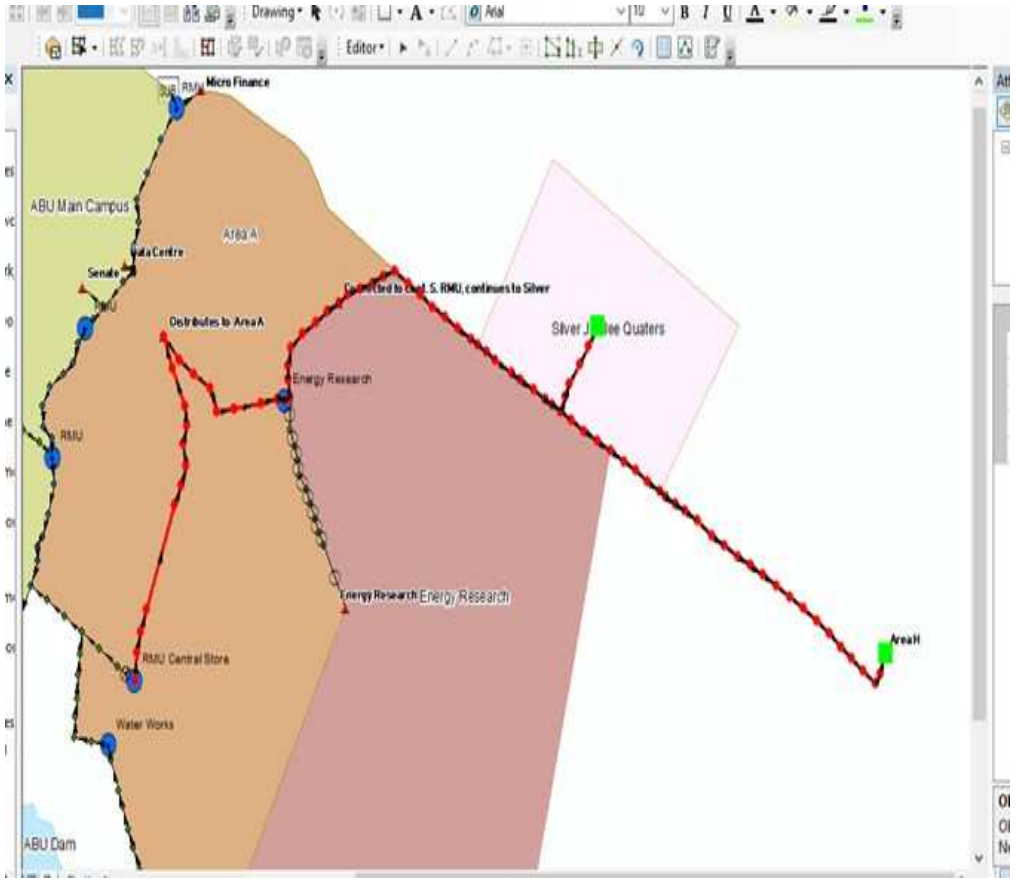


Tracing a house in Silver to its RMU

RESULTS AND ANALYSES

The Trace analysis

- the flag was set in Area H transformer and Silver Jubilee Transformer and traced down to their source RMU



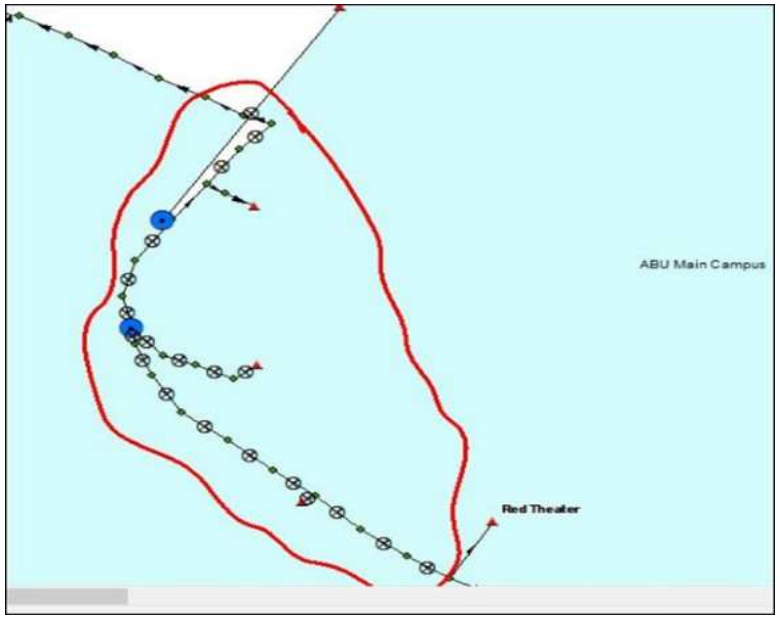
Trace from Area H transformer to its RMU

RESULTS AND ANALYSES

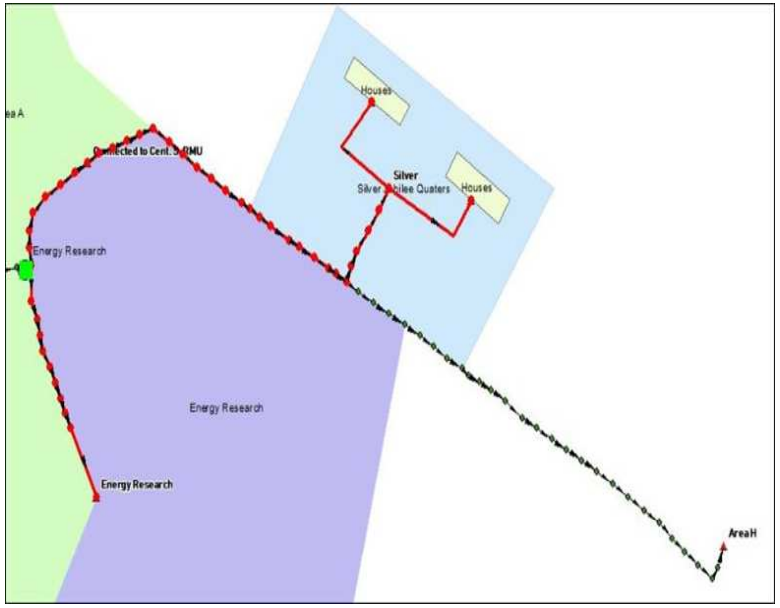
The Trace analysis

Here 2 RMUs are involved which output 7 output to 7 transformers altogether.

Geometric Networks do not allow for multi-directional flow thus, wherever there is one it will be set as an indeterminate flow.



An indeterminate flow



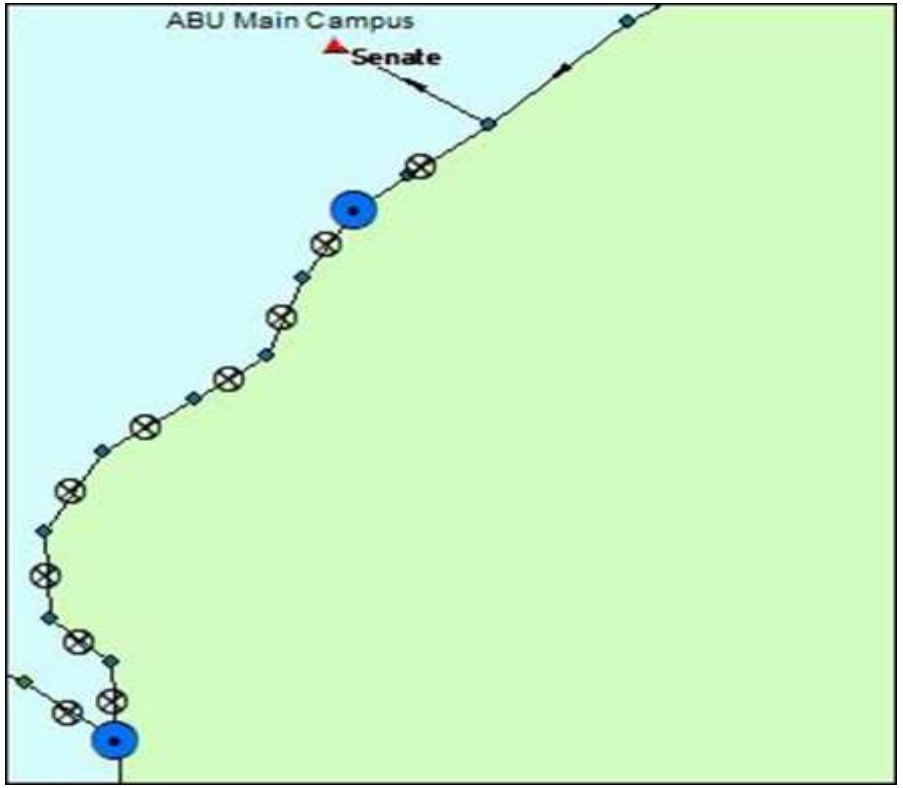
A trace error from a multi-directional flow

RESULTS AND ANALYSES

The Trace analysis

This error encountered is because an RMU feeds another RMU.

The problem here is that an RMU is a source in the network and a Geometric network does not allow for flow from one source to another source.



A clash between two RMU's (sources).

CONCLUSION

The importance of the use of GIS in the utility industry are shown in this paper.

The geometric network analyses in this study is helpful but not 100% efficient enough.

Analyses show that there are RMUs that can still take more transformers.

Network analysis should be considered because determining the shortest routes possible to a particular place is vital for utility companies.

Thank you for listening

Any ?

SUSTAINABLE DEVELOPMENT GOALS | International Federation of Surveyors supports the Sustainable Development Goals

Commission 6

Engineering Surveys

Serving Society for the Benefit of People and Planet