2019

Paper GIS - Somerset West

esri South Africa
THE SCIENCE OF WHERE™

| International Business Gateway, 113 Elizabeth Rd, Midridge Park, Midrand, 1685

Contents

Section A. The Geographic Inquiry Process

There is a certain sequence of steps that need to be followed when GIS is used to solve a problem. This is called the Geographic Inquiry process illustrated in Figure 1 below:

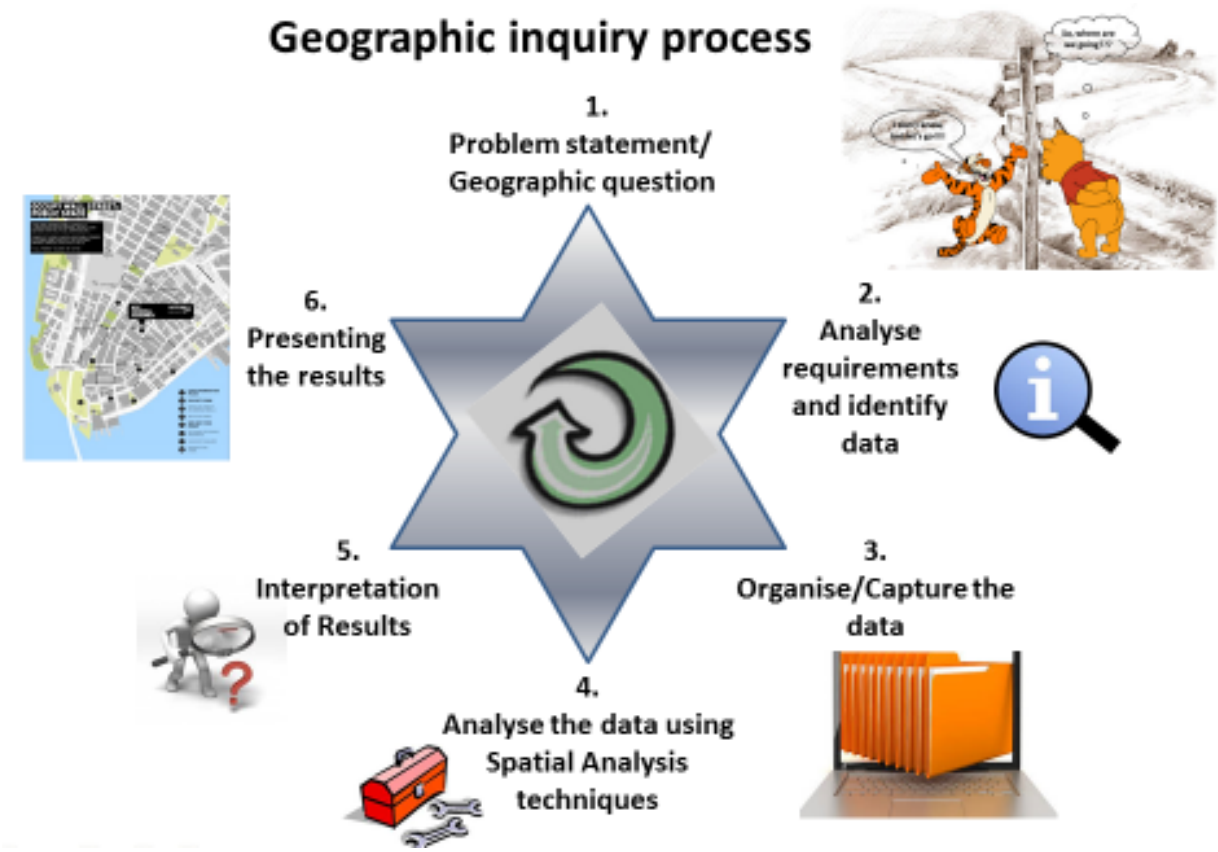


Figure 1: The Geographic Inquiry Process

Step 1: Problem Statement or Geographic Question

We apply GIS by stating a geographic problem. If I do not have a specific objective or a problem to solve, it will be very difficult to use GIS. Therefore, the GIS user needs to be able to convert their investigation into a question such as:

- Where is the best place to build a new school?
- If I place a new KFC store at this position, how many potential customers are near this location?
- What would be the impact on the traffic flow if I were to build a new road in this area?
- What crops can be produced in this area?
- Which power lines will be affected if lightning strikes a particular line?

Step 2: Identify requirements and data needed (data capturing)

In this step, the user identifies the spatial and non-spatial data that will be needed, based on the requirements to solve the problem. The study area will also be defined.

During this step, data from other systems is identified, converted and translated in order to be integrated into one system. The available data is also checked for its suitability, such as whether the projection is correct and if all the required attributes were captured correctly. If the data, you require is not available you may have to capture it

Step 3: Organise the data (Data Standardization)

The third step is to create a project database in which the data can be organised. This is the phase when all the data that you have identified to solve your problem is integrated into one workspace and you will decide on the projection that will be used.

Organising the data into a project database is the most critical and time consuming part of any GIS project. The completeness and accuracy of the data one uses in the analysis determines the accuracy of the results – garbage in, garbage out!

In order to conduct any analysis one needs to have the best possible data in the most appropriate format – raster data or vector data.

Step 4: Analyse the data using Spatial Analysis techniques

The fourth step is to analyse the data. As you will see later in Chapter 4, analysing data using a GIS ranges from simple mapping to complex spatial techniques. With a GIS you can quickly perform analysis that would be extremely time-consuming if done by hand.

Step 5: Interpretation of the results

It is in this phase of a GIS project where the results are critically evaluated for applicability and usability by the GIS personnel. Additional information is usually noticed in this step. After interpretation is done and the results seem to be informative and useful, then the GIS personnel can decide to present the data.

Step 6: Present the results (Data output)

The sixth step is to present the results of your analysis also called data output. This is where the results of the project are communicated to an audience in the form of maps, graphs, figures and reports. In most cases the results of a GIS analysis are best shown on a map. Charts, graphs and reports of selected data are other ways of presenting ones' results. Often a combination of maps and reports are used. Decision makers can base their decisions on the information presented.

Section B. Paper GIS Activity

Objective
In this activity, we are going to imitate GIS functionality such as digitise, zoom, identify, query and find which play an integral part in understanding GIS technology. We will use these functions to solve a geographic question. The overall aim is to complete a GIS project without using a computer. During this activity, keep in mind the GIS inquiry process.

Tasks to complete

- Ask a geographic question
- Capture spatial data – 'digitise' or trace five point features (points of interest), line features (a river and roads) and polygon features (residential and industrial areas)
- Label and symbolise the captured features
- Update attribute tables
- Perform basic spatial/data analysis
- Buffer
- Identify
- Answer the geographic question

What you need

- 3418BB Somerset Topographic map, and 3418 BB 7 Somerset West Orthophoto map
- A4 Tracing paper – to digitise each layer individually
- Crayons/Colored Pencils – to digitise and symbolise thematic layers
- Ruler
- Prestik/Tape
- Sissors

Topic 1: Understanding Latitude and Longitude

Latitude and longitude are imaginary lines forming a grid-like structure over the surface of the Earth. They used to find the precise location of any feature or place on Earth. This topic seeks to explore the concept of latitude and longitude.

Lines of latitude are imaginary horizontal lines around the Earth each of which is an equal distance from the other. Lines of longitude are also known as parallels. The longest line of latitude is the Equator at 0°. The Equator separates the planet into a Northern and Southern Hemisphere. The Earth is widest at the Equator, with a circumference of 40,075 kilometres. At the poles, i.e. 90° North and 90° South, the latitudes are shown as points. Specific lines of latitude represent crossovers between areas of different climates. The average temperature decreases as you move away from the Equator, which receives the highest intensity of sunlight due to the angle at which the sun's rays strike the area.

Lines of longitude are imaginary vertical lines of equal length, which run from north to south and converge at the poles. Lines of longitude are also known as meridians. Lines of longitude are important as the system of time is based on the position of these lines. Time increases in hourly intervals between consecutive 15° lines of latitude as the Earth rotates in an east to west direction. Therefore, knowing the longitudinal position of a place enables us to know the time for that place, relative to the time where one is located. The intersection of a line of latitude or longitude across a place gives us the position of that place on the earth.

How to read coordinates, using degrees, minutes and seconds, on a topographical map
Step 1: First we look for the line of latitude, which is always given first by reading the latitude reference on the side margin of the map going downwards (south).

Step 2: Then count the minutes on the side "bars" of the map which are divided into one minute per "bar". Look at the partitioned line that runs along the sides next to the degrees that represent minutes.

Step 3: To find the exact latitude we divide each minute into 60 seconds; then read off the approximate seconds of our feature.

Step 4: Next we read off the line of longitude from the top left of the map on the horizontal margin (going east).

Step 5: Then count the minutes. Look at the partitioned line that runs along the sides next to the degrees that represent minutes vertically.

Step 6: Lastly, divide the minute into 60 seconds. Then read off the approximate seconds of our feature.

Step 7: The degrees, minutes, seconds of latitude and degrees, minutes, seconds of longitude are the exact coordinates.

Q1-Q3. Please answer the questions on the Practical 3 Answer Sheet.

Topic 2: Understanding Digitising

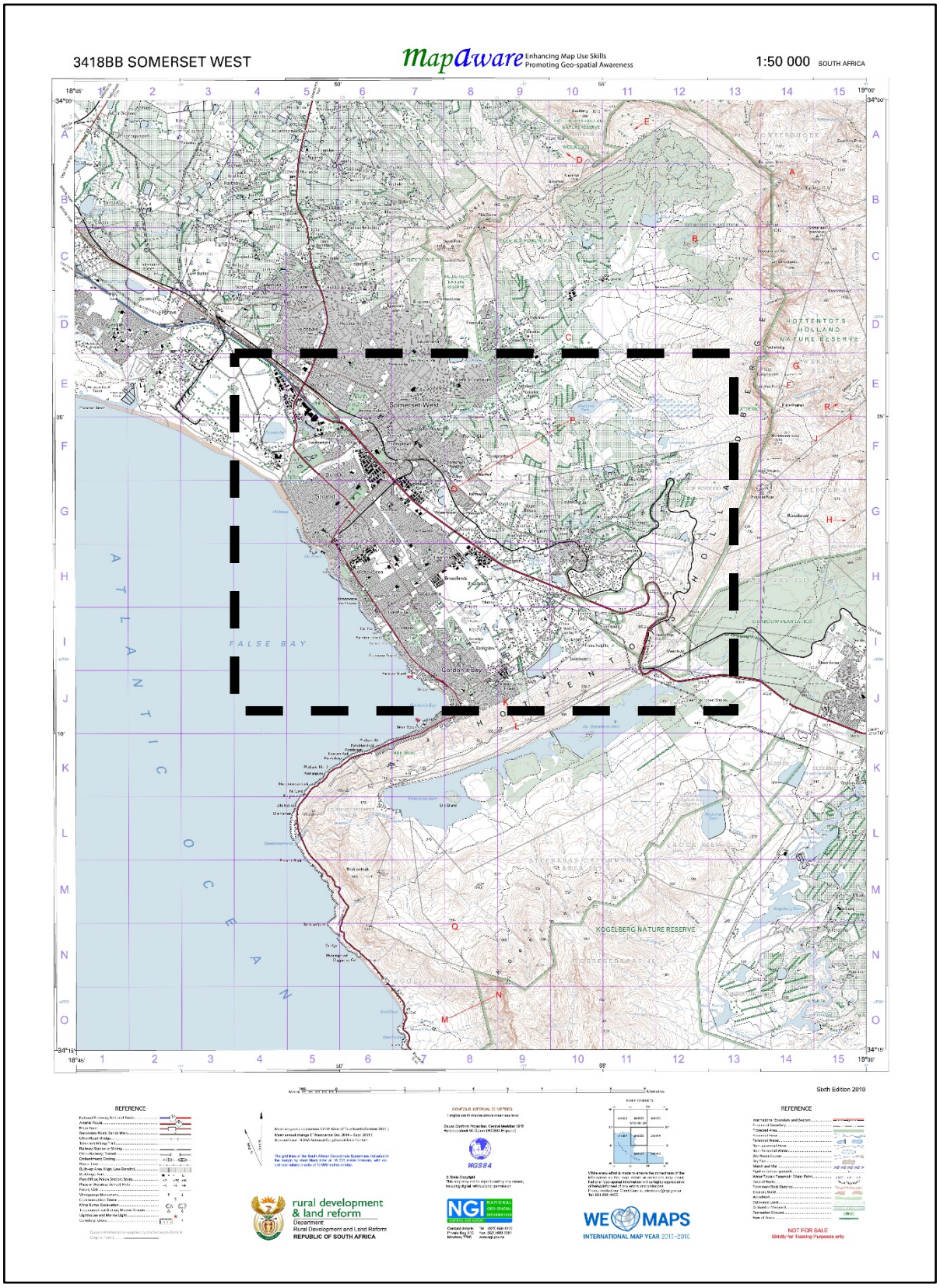
The process of converting the geographic features on a paper map into a digital format using a digitizing tablet, or digitizer, which is connected to a computer or GIS system. Features on a paper map are traced with a digitizer puck, a device similar to a mouse, and the x,y coordinates of these features are automatically recorded and stored as spatial data.

Step 1: Locate the coordinates of the different Points of Interest (PoI).

1. Line up the top left corner of your tracing paper with the following coordinates: **34˚04'00"S and 18˚48'00"E.**

2. Use the prestik or tape provided to hold the tracing paper in place as illustrated in the picture below.

Note: You will use this method for each layer you digitise.



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Step 2: Digitise point features

Below are copies of the pictures that you are going to use to illustrate the Points of Interest.

Sir Lowrey's Pass Viewpoint

Tidal Pool on False Bay

Camphor Trees Monument

1. Cut out the different pictures provided in Appendix A at the end of this document.
2. You are given 3 pictures of different Points of Interest (Features that are worth noting, visited by the public or are valuable in the community). Locate the position of each of these Points of Interest on the map. Locate one x and y coordinate point for each one of the pictures.
3. Use the Prestik/tape and stick the pictures to the east of the Point of Interest on the tracing paper. In GIS software, digital pictures can be attached to a point. This is referred to as a **Hyperlink** in a GIS.

Step 3: Adding Attribute Data

Data is a collection of raw or unorganised facts. It can consist of numbers, words or symbols. On its own, data is not very useful. An example of data may be a list of 2000 people living in an area indicating their ages and income.

For any GIS to operate, it needs data. A GIS without data is like a cell phone without contacts. The actual details we collect for our cellphone contacts are the data. The field names such as name, surname, home number, cell number, email address, birthday, home address etc., are the "attributes" of the contact.

Our world is made up of all kinds of objects or items about which we often need more information. Each object is described by a number of distinctive attributes or characteristics. **Attributes** describe data in words, numbers or pictures. Each of these attributes can be assigned a value. That value is called data. The more attributes we have for an object, the more informed we become about it. The more accurate the data associated with each of these attributes the higher our ability to make informed decisions. Having the correct data can save money and time – think about a delivery vehicle that wastes time by looking for a place when given the wrong address.

Q4. We will now additional descriptive information (attributes) to the Points of Interest (PoI) attribute table provided on the Answer Sheet.

Step 4: Symbolise

In a GIS or map, spatial data exists as points, lines, polygons or rasters. You encode meaning into these basic shapes through a process of symbolization. Symbols allow you to illustrate a unique difference between features, some difference in magnitude between features, or another characteristic. Symbolization can take on a range of functions on a map but should be clear, concise, and easily understood by the user. In many ways, symbolization can be regarded as the coding of map features to communicate meaning.

In this section, we will manipulate our symbols using different sizes and colours to make our symbols much clearer to understand.

1. Complete the symbol column in the previous attribute table by selecting the corresponding symbols in the table below.

Object ID	Name	Symbol
1	Sir Lowrey's Pass Viewpoint	red diamond ♦
2	Tidal Pool on False Bay	blue triangle ▲
3	Camphor Trees Monument	pink square ■

2. Represent the pictures on the tracing paper using the symbols as chosen in your attribute table. In a GIS technology, this symbolisation can be done for millions of records quickly.

Step 5: Labelling

In map making and cartography, text is placed on or near a map feature that describes or identifies it, making it easier to understand what you are looking at. In the case of our Points of Interest, we will label them according to their names in the attribute table.

1. Add a title to your thematic layer.

2. Label each of the three features above the attached picture.

Step 6 : Digitise a line feature- River

We will now digitise a line feature: the Lourens River or *Lourensrivier*

1. Orientate a new tracing paper sheet in the exact same position as in the previous step.

2. "Digitise" the Lourens River by tracing along the river

Object ID	Name	Symbol
1	Lourensrivier	thick blue line

3. Label your river using the Name column. The label must be placed along the river.

4. Give your tracing paper an appropriate title.

<u>Q5.</u> Complete the attribute table on the Answer Sheet.

Step 7 : Digitise a line feature- Transportation

You are going to "digitise" several roads namely:

- The N2 National Freeway
- N2 National Route
- R44
- All Main Roads
- Railroads

1. Orientate a new tracing paper sheet in the exact same position as done previously.

2. "Digitise" the roads using the topographic map symbology (legend, key).

3. Give your layer an appropriate title.

Q6. Complete the attribute table on the Answer Sheet.

Step 8: Digitise a polygon features- Land Use
You are required to "Digitise" a several areas to show different types of land use. For this layer use a new sheet of tracing paper. Orientate your tracing paper in the exact same position as done previously.

1. "Digitise" (draw polygons) and label the following areas
    - Somerset West (residential)
    - Gordon's Bay (residential)
    - Nomzamo (residential)
    - 3 large vineyards
    - Golf courses (3)

2. Symbolise your polygons using color. Select the colour palette in the table below.

Land Use	Symbol Colour
Residential	grey
Vineyard	yellow
Golf Course	green

Q7. Complete the attribute table on the Answer Sheet.

Topic 3: Orthophoto Map Interpretation

Step 9: Using the Somerset West Orthophoto map
The Orthophoto map is used in the same way as a zoom in function on the computer. It works well with the topographic map because it has a larger scale (1:10 000) than the topographic map. Orthophotos are often used as basemaps for digitizing and for studying features.

1. Using the lines of latitude and longitude on the orthophoto and topographical map, locate the coordinates of the four corner coordinates of the orthophoto on the topographic map.

Q8. Answer the questions on the Answer Sheet.

Appendix A