



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF NATURAL RESOURCES AND SPATIAL SCIENCES

DEPARTMENT OF GEO-SPATIAL SCIENCES AND TECHNOLOGY

QUALIFICATION: DIPLOMA IN GEOMATICS, DIPLOMA IN LAND ADMINISTRATION, DIPLOMA IN PROPERTY STUDIES, BACHELOR OF GEOMATICS, BACHELOR OF GEOINFORMATION TECHNOLOGY, BACHELOR OF TOWN AND REGIONAL PLANNING, BACHELOR OF REGIONAL & RURAL DEVELOPMENT, BACHELOR OF LAND ADMINISTRATION, BACHELOR OF PROPERTY STUDIES	
QUALIFICATION CODE: 06DGEM, 06DLAD, 06DPRS, 07BGEM, 07GITB, 07BTAR, 07BRAR, 07BLAD 08BPRS	LEVEL: 5
COURSE CODE: GES512S	COURSE NAME: GEOGRAPHIC INFORMATION SYSTEMS 1
SESSION: NOVEMBER 2019	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER	Mr. Erich Naoseb
MODERATOR:	Mr. Miguel Vallejo

INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions.2. Write clearly and neatly.3. Number the answers clearly.

PERMISSIBLE MATERIALS

PERMISSIBLE MATERIALS

1. Examination paper.
2. Examination script.
3. Calculator, ruler, pencil, eraser.

THIS QUESTION PAPER CONSISTS OF 6 PAGES (Including this front page)

Question 1: State if the following statements are **True** or **False**.

- 1.1. In a raster data model, the rows function as a y-coordinate and columns as a x-coordinate. (1)
- 1.2. A spatial selection uses two or more layers and one spatial condition. (1)
- 1.3. In the location selection method, the features of the layer being selected are not compared spatially with the features of the second layer to see which ones meet the criteria, and features meeting the criteria are selected. (1)
- 1.4. The prime meridian and the equator serve as the baselines of the geographic coordinate system. (1)
- 1.5. A GIS operation that combines the geometries and attributes of the input layers to create the output is known as erase. (1)
- 1.6. Data processing is not regarded as one of the functions of an Information Systems. (1)
- 1.7. The context-diagram is used to isolate the data objects and to define the relationship between them. (1)
- 1.8. A phenomenon that populates the study area is known as a geographic object. (1)
- 1.9. In a normal projection, the main orientation of the projection surface is parallel to the earth's axis. (1)
- 1.10. The position to be selected of the geographical area does not always determine the aspect of a projection to be selected. (1)

[10]

Question 2

- 2.1 Define the following terms and provide one example of each:
- a) Scale (2)
 - b) A geographic information system (GIS) (2)
 - c) Developable surface (2)
 - d) A Geographical datum (2)
 - e) Geographical Features (2)
- 2.2. Explain hardware and people as components of GIS. (4)
- 2.3. Name three reasons why system analysis techniques are used. (3)
- 2.4. The library building of the Namibia University of Science and Technology (NUST) can be considered a geographic phenomenon. Explain why it can be considered as such. (3)
- 2.5. Explain how the vector data model differs from the raster data model in representing spatial features and provide one suitable example of what each can represent. (4)
- 2.6. Describe the three types of map projections by the projection or developable surface. (6)
- 2.7. Briefly explain how a UTM zone is defined in terms of its central meridian, standard meridian and scale factor. (5)
- 2.8. Define buffering and provide an application example. (2)
- 2.9. Suppose you need to create a map showing 4G LTE coverage in Namibia. You have downloaded a shapefile from the Digital Namibia: Namibia-NSA website that shows 4G LTE coverage in every region in Namibia. What kind of operation will you use on the 4G LTE coverage layer so that you can show only the 4G LTE coverage of the region you need? Motivate your answer. (2)

[39]

Question 3

- 3.1. There are many ways to classify the analytical functions of a GIS, describe what can you achieve using the below functions with clear examples: (2)
- a) Classification (2)
 - b) Retrieval functions (2)
 - c) Measurement (2)
- 3.2. Name four methods of vector data creation. (4)
- 3.3. Write a valid SQL expression to select "Cities" with people between 1,000 and 10,000 using a field called POP2000 from Citizens layer. (3)
- 3.4. Identify and explain the two labels in **Figure 1**. (4)

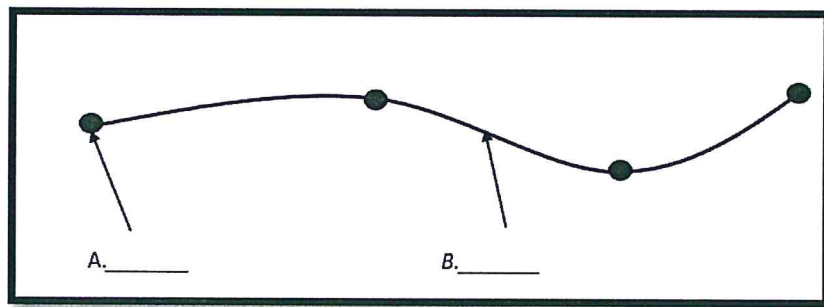


Figure 1

- 3.5. Explain the concept of utilising counts and cell value within a raster data model. (4)
- 3.6. Describe the concepts of GIS attribute tables based on **Figure 2**. (6)

FID	Shape *	name	area	designatio	year	source
0	Polygon	Ai-Ais Hotsprings Game Park	4311.9	Game Park		Map
1	Polygon	Mudumu National Park	1019	Game Park	1990	Map
2	Polygon	Mahango Game Park	241.9	Game Park		Map
3	Polygon	Khaudum Game Park	3855.2	Game Park	1989	Map
4	Polygon	Waterberg Plato Park	410.2	Game Park	1972	Map
5	Polygon	Daan Viljoen Game Park	39.9	Game Park	1968	Map
6	Polygon	Bwabwata National Park	5818.8	Game Park		Map
7	Polygon	Naute Recreation Resort	226.8	Recreation Resort	1988	Map
8	Polygon	Mamili National Park	403.1	Game Park	1990	Map
9	Polygon	Von Bach Recreation Resort	46.3	Recreation Resort	1972	Map
10	Polygon	Popa Falls Game Park	0.1	Game Park		Diagram
11	Polygon	Skeleton Coast Park	16751.2	Game Park	1971	Map
12	Polygon	Namib Naukluft Park	50658.4	Game Park	1979	Map
13	Polygon	Etosha National Park	22888.4	National Park	1907	Map
14	Polygon	Hardap Recreation Resort	242.7	Game Park	1968	Map
15	Polygon	Restricted Diamond Area	21596.1	Restricted Area		Map
16	Polygon	Gross Barmen Hot Springs	0.9	Game Park	1968	MET
17	Polygon	National West Coast Tourist Recreation Area	7380.7	Recreational Area	1973	Various

Figure 2

3.7. Name and explain the two forms of a geographic phenomenon.

(4)

[31]

Question 4

4.1 Study the map in **Figure 3** and list the map elements found in the map.

(5)

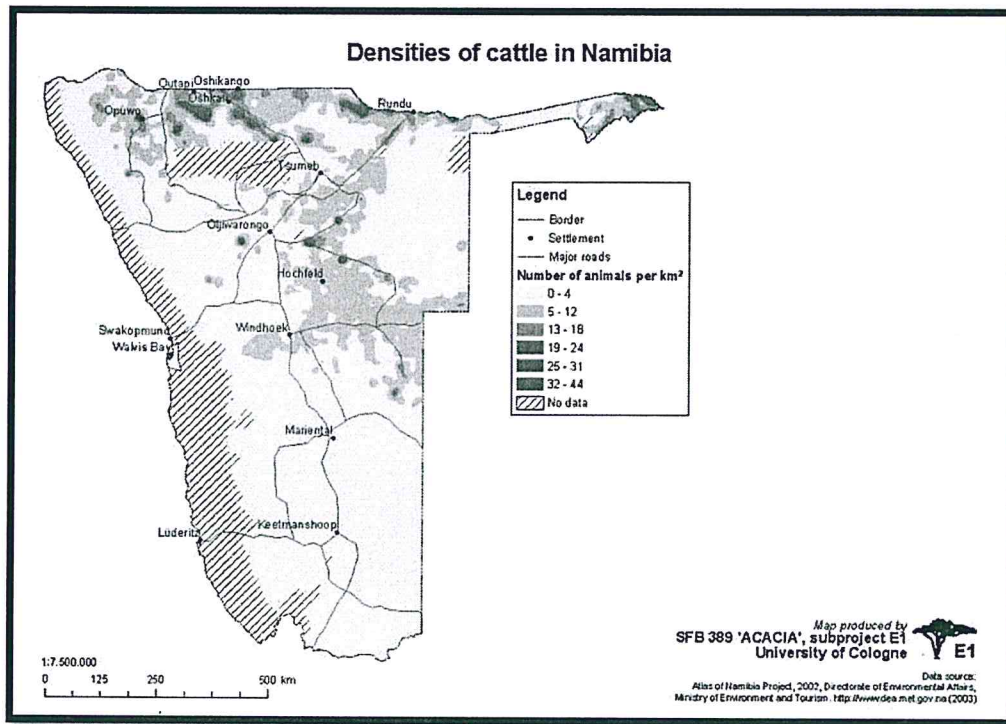


Figure 3

- 4.2. Identify the data type used to indicate the number of animals in the map legend of **Figure 3**. (1)
- 4.3. Name four (4) rules that must be followed to classify the data type used in the map to indicate the number of animals in **Figure 3**. (4)
- 4.4. During the map production process what does the main classification decisions refer to? (3)
- 4.5. Under which map category would you classify the map in **Figure 3**? Motivate your answer. (3)
- 4.6. Data accuracy is a statement of how closely a bit of data represents the real world. Name any indicator aspects which can be used to describe accuracy. (4)

[20]



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FIRST OPPORTUNITY MEMORANDUM	
EXAMINER	Mr. Erich Naoseb
MODERATOR:	Mr. Miguel Vallejo

THIS MEMORANDUM CONSISTS OF 8 PAGES
(Excluding this front page)

INSTRUCTIONS

The model answers are used as guidelines only. The information provided by the students will be evaluated on merit

Question 1 State if the following statements are True or False.

- 1.1. In a raster data model, the rows function as a y-coordinate and columns as a x-coordinate. *T ✓* (1)
- 1.2. A spatial selection uses two or more layers and one spatial condition. *T ✓* (1)
- 1.3. In the location selection method, the features of the layer being selected are not compared spatially with the features of the second layer to see which ones meet the criteria, and features meeting the criteria are selected. *F ✓* (1)
- 1.4. The prime meridian and the equator serve as the baselines of the geographic coordinate system. *T ✓* (1)
- 1.5. A GIS operation that combines the geometries and attributes of the input layers to create the output is known as erase. *F ✓ (Overlay)* (1)
- 1.6. Data processing is not regarded as one of the functions of an Information Systems. *F ✓ it is one of the functions of an IS.* (1)
- 1.7. The context-diagram is used to isolate the data objects and to define the relationship between them. *F ✓ (E-R diagram)* (1)
- 1.8. A phenomenon that populates the study area is known as a geographic object. *T ✓* (1)
- 1.9. In a normal projection, the main orientation of the projection surface is parallel to the earth's axis. (1)
- 1.10. The position to be selected of the geographical area does not always determine the aspect of a projection to be selected. *F ✓* (1)

[10]

Question 2

2.1 Define the following terms and provide one example of each:

a) Scale is the ratio between a distance or area on a map (or image) and the corresponding distance or area on the ground \checkmark (i.e. 1/10.000). \checkmark (2)

b) A geographic information system (GIS) is a computer system for capturing, storing, querying, analyzing, and displaying geospatial data. \checkmark (ArcGIS for Desktop \checkmark or QGIS \checkmark) (2)

c) Developable surface: A surface that can be cut and flattened. \checkmark A cone \checkmark , cylinder \checkmark or a planar \checkmark surface. (2)

d) A datum is a mathematical model of the Earth, which serves as the reference or base for calculating the geographic coordinates \checkmark in the case of a horizontal datum \checkmark and for calculating elevations in the case of a vertical datum \checkmark (2)

e) Geographical Features: Trees \checkmark , buildings \checkmark , streets \checkmark , and lakes are examples of real world objects. When using a GIS, these objects are referred. \checkmark (2)

Allocate maximum two marks for defined term with an example.

2.2. Explain hardware and people as components of GIS. (4)

People GIS professionals define the purpose and objectives for using GIS and interpret and present the results. \checkmark

Hardware GIS hardware includes computers for data processing, data storage, and input/output; printers \checkmark and plotters for reports and hard-copy maps; digitizers and scanners for digitization of spatial data; and GPS \checkmark and mobile devices for fieldwork.

Allocate maximum two marks for each

2.3. Name three reasons why system analysis techniques are used. (3)

- To help build an understanding of the current system, \checkmark
- To help understanding the business needs \checkmark
- To help understanding the potential solutions to meet that business needs. \checkmark

2.4. The library building of the Namibia University of Science and Technology (NUST) can be considered a geographic phenomenon. Explain why it can be considered as such. (3)

The library building can be named or described \checkmark , georeferenced \checkmark and assigned a temporal aspect. \checkmark

- 2.5. Explain how the vector data model differs from the raster data model in representing spatial features and provide one suitable example of what each can represent. (4)

*The vector data model uses lines, points, and polygons to represent spatial features with a clear spatial location and boundary v such as streams, land parcels, and vegetation stands. v
The raster data model uses a grid and grid cells to represent a spatial feature such as streams, land parcels, and vegetation stands vsuch as vegetation and air pollution. v*

- 2.6. Describe the three types of map projections by the projection or developable surface. (6)

- *Azimuthal projection: vOne type of map projection that retains certain accurate directions. v
Azimuthal also refers to one type of map projection that uses a plane as the projection surface. v*
- *Conic projection: v One type of map projection that uses a cone as the projection surface. v*
- *Cylindrical projection: vOne type of map projection that uses a cylinder as the projection surface. v*

Allocate maximum six marks

- 2.7. Briefly explain how a UTM zone is defined in terms of its central meridian, standard meridian, and scale factor. (5)

Each UTM zone is mapped onto a secant case Transverse Mercator projectionv, with a scale factor of 0.9996v at the central meridian vand the equator as the latitude of origin. vThe standard meridian are 180 kilometres to the east and the west of the central meridianv

- 2.8. Define buffering and provide an application example. (2)

Buffering: A GIS operation that creates zones consisting of areas within a specified distance of select features. v

Create a buffer around a road to determine safe distance for future road extensions. v

Create a buffer around a school to identify all shebeens operating within the buffer zone. v

Allocate maximum two marks

- 2.9. Suppose you need a map showing 4G LTE coverage in Namibia. You have downloaded a shapefile from the Digital Namibia: Namibia-NSA website that shows 4G LTE coverage in every region in Namibia. What kind of operation will you use on the 4G LTE coverage layer so that you can get only the region you need? Motivate your answer. (2)

Select by attribute, v this operation selects features based on their attribute valuesv

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Question 3

- 3.1. There are many ways to classify the analytical functions of a GIS, describe what can you achieve using the below functions with clear examples:
- a) Classification: *Allows the assignment of features to a class on the basis of attribute values or Attribute ranges. √ Classify the erven in Khomasdal on the price range. √* (2)
 - b) Retrieval functions: *Allow to selective search of data. √ To retrieve all the vacant erven in Khomasdal with size greater than 400m². √* (2)
 - c) Measurement: *Allows calculation of distances, lengths or areas. √ Calculate the area covered by the administrative regions of Namibia. √* (2)
- 3.2. Name four methods of vector data creation. (4)
- Digitising √
 - GPS Data Collection √
 - Direct x,y data entry to a GIS √
 - Geocoding √
 - Vectorisation of raster data √
- Award maximum four marks*
- 3.3. Write a valid SQL expression to select "Cities" with people between 1000 and 10,000 using a field called POP2000 from Citizens layer. (3)
- ```
SELECT * FROM Cities
WHERE POP2000 >= 1000 AND <= 10 000 √√
```
- Provide full marks ONLY if the whole SQL statement is correct.*
- 3.4. Identify and explain the two labels in **Figure 1**. (4)
- a) Node: *The beginning or end point of an edge. √*
  - b) Arc: *A directed line with two end points, also called edge √*

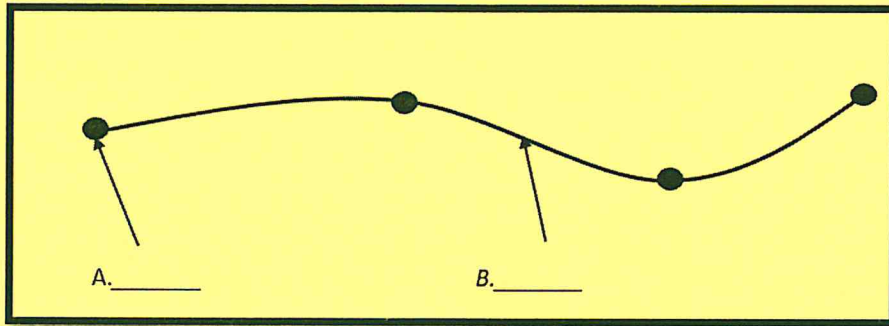


Figure 1

3.5. Explain the concept of utilising counts and cell value within a raster data model. (4)

Each cell within a raster is assigned a unique identifier which distinguish cells from one another. ✓  
 Cells that share the same characteristic are assigned the same value. ✓ The count refers to the total number of cells within a raster that share the same value. ✓  
 The value and count attributes can be used to calculate the percentage a phenomena occupies within the raster image. ✓

Allocate maximum two marks

3.6. Describe the concepts of GIS attribute tables based on Figure 2. (6)

| FID | Shape * | name                                        | area    | designatio        | year | source  |
|-----|---------|---------------------------------------------|---------|-------------------|------|---------|
| 0   | Polygon | Al-Ais Hotsprings Game Park                 | 4311.9  | Game Park         |      | Map     |
| 1   | Polygon | Mudumu National Park                        | 1019    | Game Park         | 1990 | Map     |
| 2   | Polygon | Mahango Game Park                           | 241.9   | Game Park         |      | Map     |
| 3   | Polygon | Khaudum Game Park                           | 3855.2  | Game Park         | 1989 | Map     |
| 4   | Polygon | Waterberg Plato Park                        | 410.2   | Game Park         | 1972 | Map     |
| 5   | Polygon | Daan Vlijoen Game Park                      | 39.9    | Game Park         | 1968 | Map     |
| 6   | Polygon | Bwabwata National Park                      | 5818.8  | Game Park         |      | Map     |
| 7   | Polygon | Naute Recreation Resort                     | 226.8   | Recreation Resort | 1988 | Map     |
| 8   | Polygon | Mamili National Park                        | 403.1   | Game Park         | 1990 | Map     |
| 9   | Polygon | Von Bach Recreation Resort                  | 46.3    | Recreation Resort | 1972 | Map     |
| 10  | Polygon | Popa Falls Game Park                        | 0.1     | Game Park         |      | Diagram |
| 11  | Polygon | Skeleton Coast Park                         | 16751.2 | Game Park         | 1971 | Map     |
| 12  | Polygon | Namib Naukluft Park                         | 50658.4 | Game Park         | 1979 | Map     |
| 13  | Polygon | Etosha National Park                        | 22888.4 | National Park     | 1907 | Map     |
| 14  | Polygon | Hardap Recreation Resort                    | 242.7   | Game Park         | 1968 | Map     |
| 15  | Polygon | Restricted Diamond Area                     | 21596.1 | Restricted Area   |      | Map     |
| 16  | Polygon | Gross Barmen Hot Springs                    | 0.9     | Game Park         | 1968 | MET     |
| 17  | Polygon | National West Coast Tourist Recreation Area | 7380.7  | Recreational Area | 1973 | Various |

Figure 2

Geographic features are collected and stored in an attribute table. ✓ In this attribute table



*different parks are stored together with their attributes such as the park name, area size etc. ✓*

*Attribute data in an attribute table are linked to geographic features in a GIS through a unique identifier. ✓ Each feature has a unique id which is the FID in Figure XX. By selecting Skeleton coast park will indicate the selected park in the map. ✓*

*Attribute data in a column have the same data type. ✓ Data types are not mixed in a field. The data types are text, date long/short integers etc. The field name stores only text and year field only numbers ✓*

- 3.7 Name and explain the two forms of a geographic phenomenon. (4)

*Continuous or geographic field ✓*

*This a phenomenon for which every point in the study area, a value can be determined. ✓*

*Discrete or Geographic Object ✓*

*These are phenomena that populate the study area, and are usually well-distinguished, discrete, and bounded entities. ✓*

[31]

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#### **Question 4**

- 4.1 Study the map in **Figure 3** and list the map elements found in the map. (5)

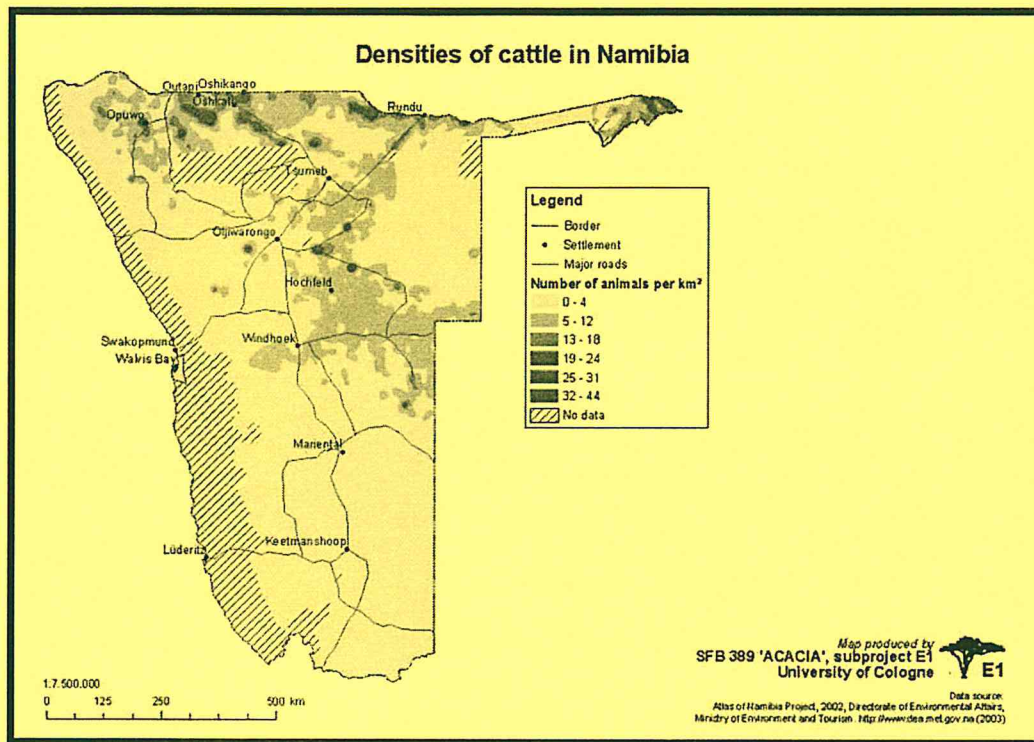


Figure 3

- Title ✓
- Legend ✓
- Scale ✓
- Map producing agency ✓
- Map body ✓

Allocate maximum 5 marks

4.2. Identify the data type used to indicate the number of animals in the map legend of **Figure 3**. (1)

*Quantitative ✓*

4.3. Name four (4) rules that must be followed to classify the data type used in the map to indicate the number of animals in Figure 3. (4)

- The classification should encompass the full range of data. ✓*
- Classes may not overlap, and empty classes are only allowed in exceptional cases. ✓*
- The accuracy of the classification may not exceed the accuracy of the original data. ✓*
- Rounded off class limits are better understood and memorised. ✓*

4.4. During the map production process what does the main classification decisions refer to? (3)

*The determination / calculation of:*

*The number of classes  $v$*

*The size of the class intervals  $v$*

*The definition of the class boundaries.  $v$*

4.5. Under which map category would you classify the map in **Figure 3**? Motivate your answer. (3)

*Choropleth map,  $v$  because visual variable value is applied to area symbols to portray relative quantities, interval data  $v$ . e.g. number of animals per  $\text{km}^2$  in Namibia.  $v$*

4.6. Data accuracy is a statement of how closely a set of data represents the real world. Name any (4) indicator aspects which can be used to describe accuracy.

- *What features have been omitted?  $\checkmark$ .*
- *What non-existent features are represented?  $\checkmark$ .*
- *How correct is their classification?  $\checkmark$ .*
- *How current is the data?  $\checkmark$ .*
- *How far away is map feature from its actual location in the world.  $\checkmark$ .*

[20]

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