GEOG 204

LECTURE 2

1

House keeping stuff

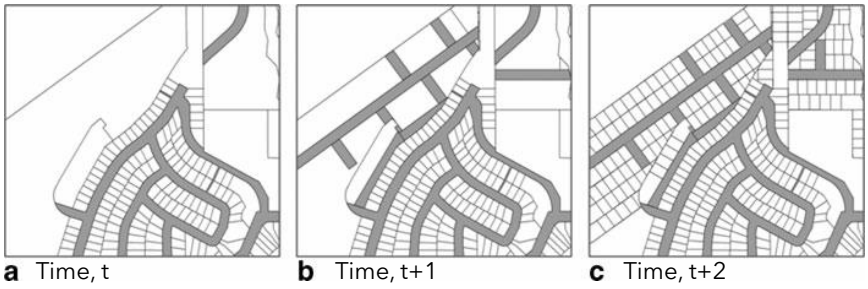
This week:

VECTOR and RASTER Data

2

The nature of geographic phenomena

- Temporal Variation



Parcel subdivision

3

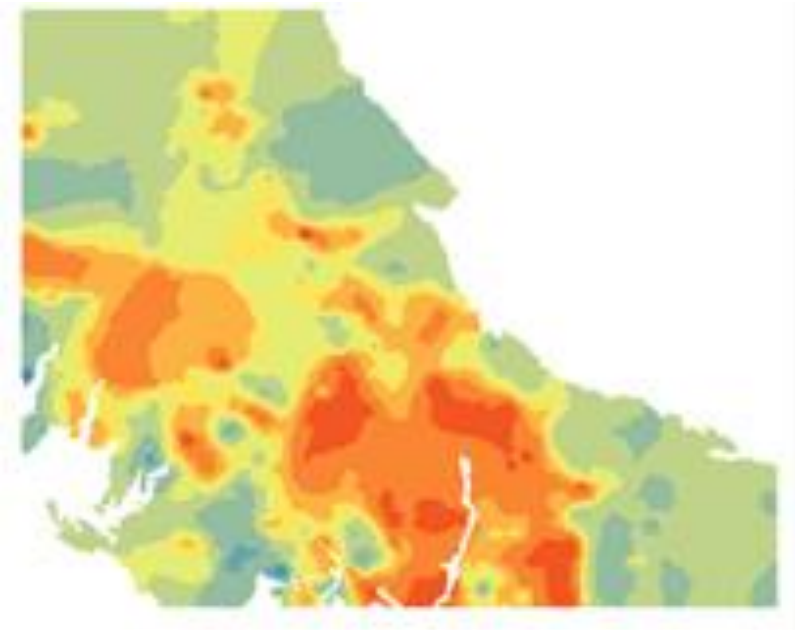
3

The nature of geographic phenomena

- Spatial Variation
  - Tobler's First Law of Geography: "everything is related to everything else, but near things are more related than distant things."
  - Implications for appropriate representation:
    - Significance of spatial autocorrelation
    - Proximity effects
    - Geographic scale (level of detail)

4

4



Soil pH Distribution

5

5

Representing geographic space

- Two basic forms: Objects and Fields
  - Objects are discrete and definite, such highways, parks, municipalities…
  - Fields are distributed continuously over a large area for example temperature, rainfall, elevation…

6

6

Representing geographic space

- The object view considers space to be populated by distinguishable, discrete, and bounded entities.
  - Objects have identity, boundaries or spatial extent and attributes
    - Points, lines, polygons
    - E.g. a representation of individual houses in a city suburb
  - Uses the Vector Data Model

7

7

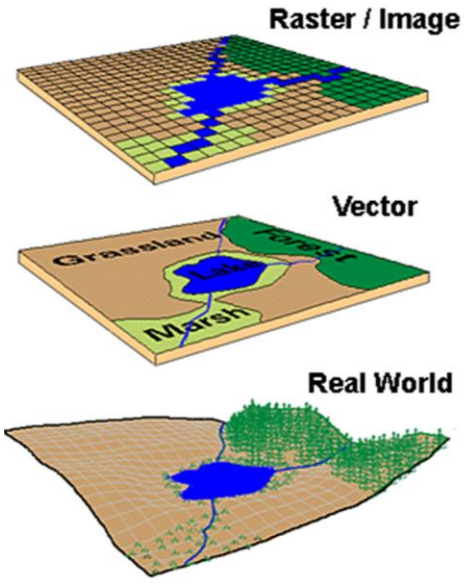
Representing geographic space

- A geographic field treats space as being populated by one or more continuous phenomena. For every point in the study area, a value can be determined.
  - E.g. River depth can be determined anywhere on a bathymetric map of the Netchako River
    - Uses the Raster Data Model

8

8

- Continuous field
  - A value can be determined for every point on the surface
- Discrete object
  - The space between them is potentially 'empty' or undetermined

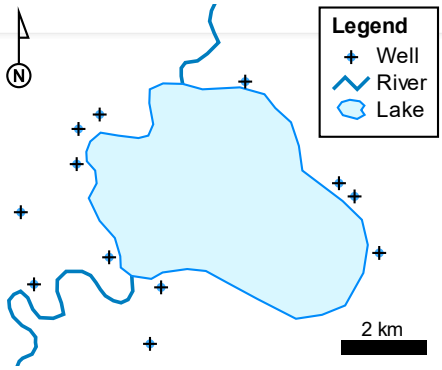


9

Vector data model

Three types of geometry

- Points:
  - dimensionless (no width, length, or height)
  - A pair of coordinates
- Lines:
  - One dimension
  - have length
  - At least two coordinate pairs (vertices)
  - Terms: Line, polyline, linestring
- Polygons:
  - Two dimension
  - closed vertices
  - Minimum vertices for a triangle?
  - Terms: polygon, multipolygon



Source: Wikimedia

10

Vector data model

Formats

- Shapefile
  - Developed by ESRI as a data interchange format
  - Open specification, regulated by ESRI
  - A collection of multiple files
    - shp, .shx, .dbf, .prj, …
  - A shapefile can represent one geometry type

Other formats?

- GeoJSON

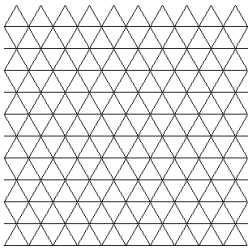
```
{
  "type": "Feature",
  "geometry": {
    "type": "Point",
    "coordinates": [-122.8155, 53.8922]
  },
  "properties": {
    "name": "UNBC"
  }
}
```

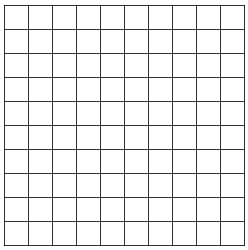
11

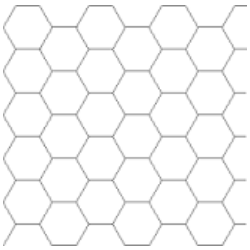
11

Raster data model

- Phenomena is continuous over a large area
- Regular tessellation of space
  - Triangles, squares, hexagons



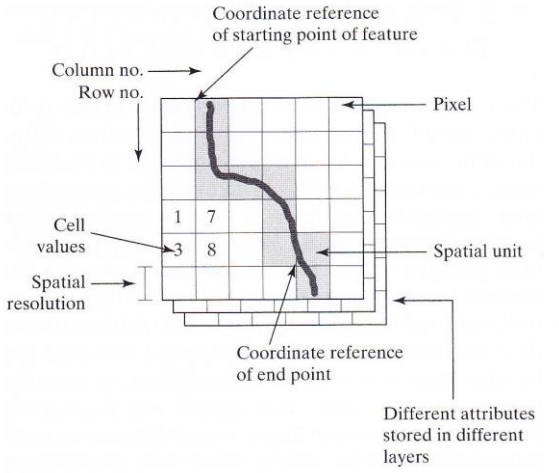




12

12

Raster data model



Characteristics of raster data

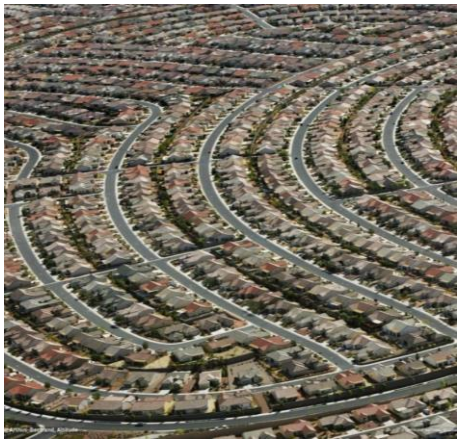
Source: Lo and Yeung 2007. Concepts and technics of Geographic information Systems. Pearson Prentice Hall

Raster data model

- Formats
  - GeoTIFF
  - ESRI Grid
  - Pix

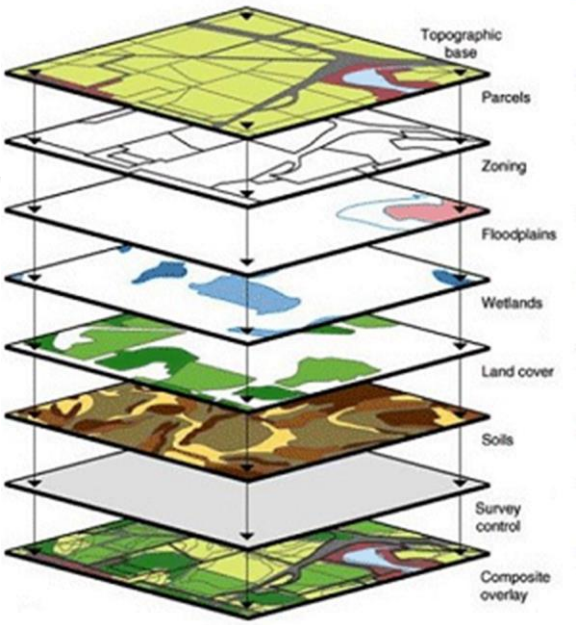
Objects or Fields?

It is not a debate



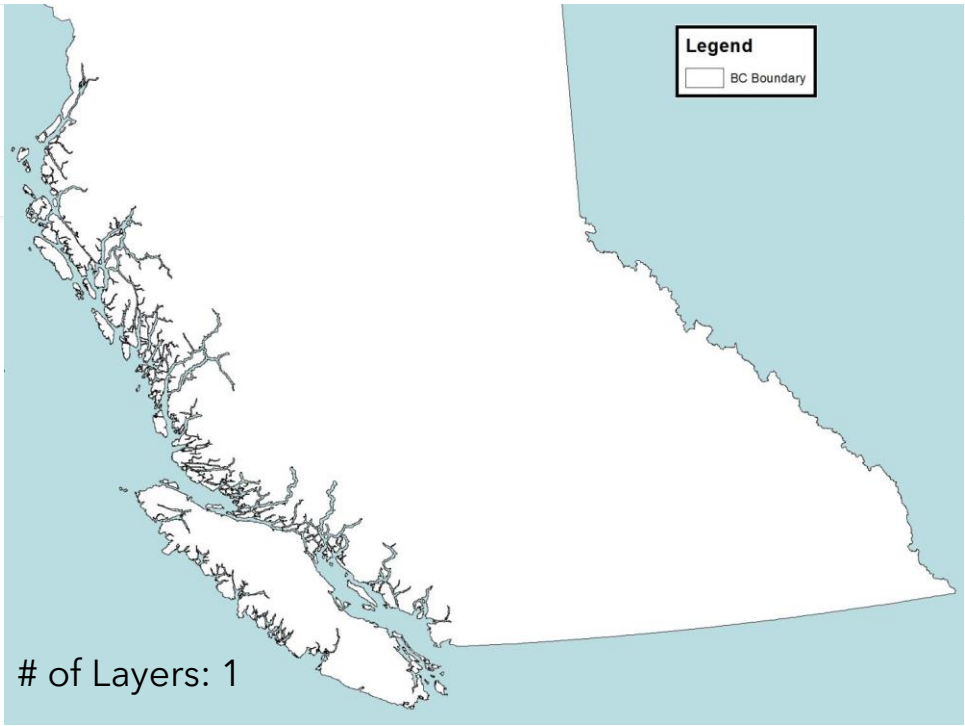

15

- **Spatial data are grouped by themes**
  - Layers
- **The concept of layering is key in GIS and computer aided design (CAD)**

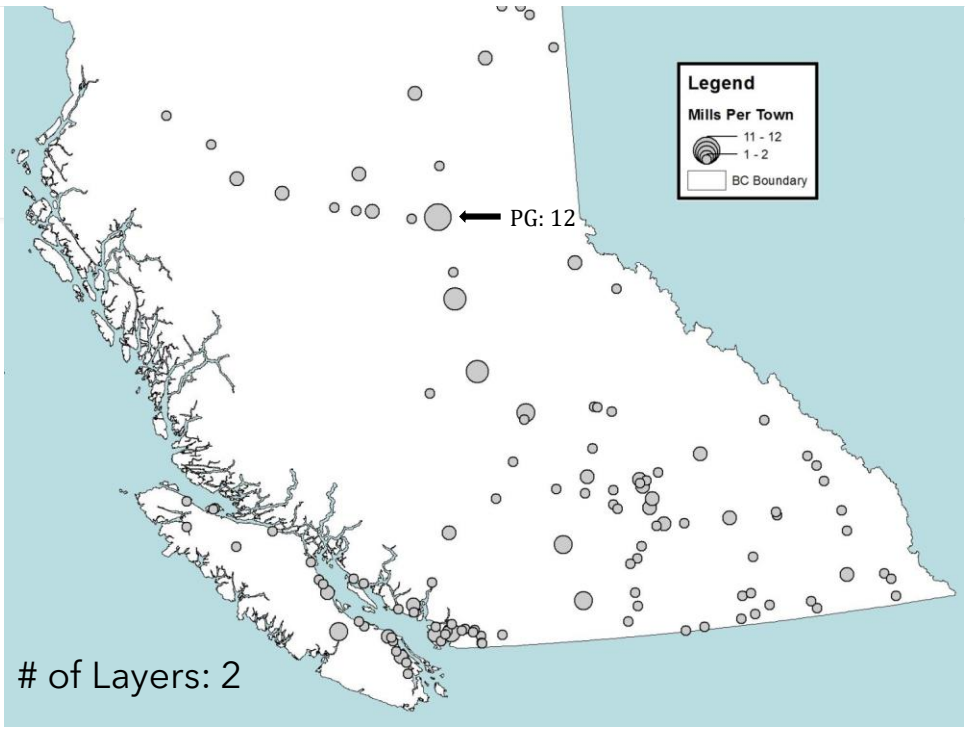


16

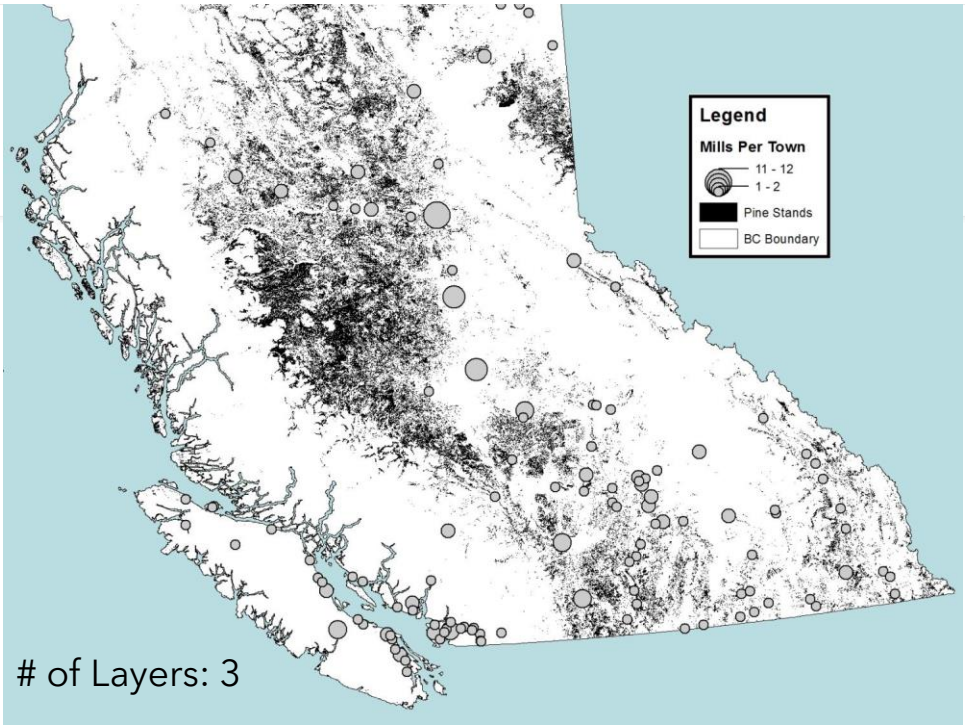
16


Legend
BC Boundary
# of Layers: 1

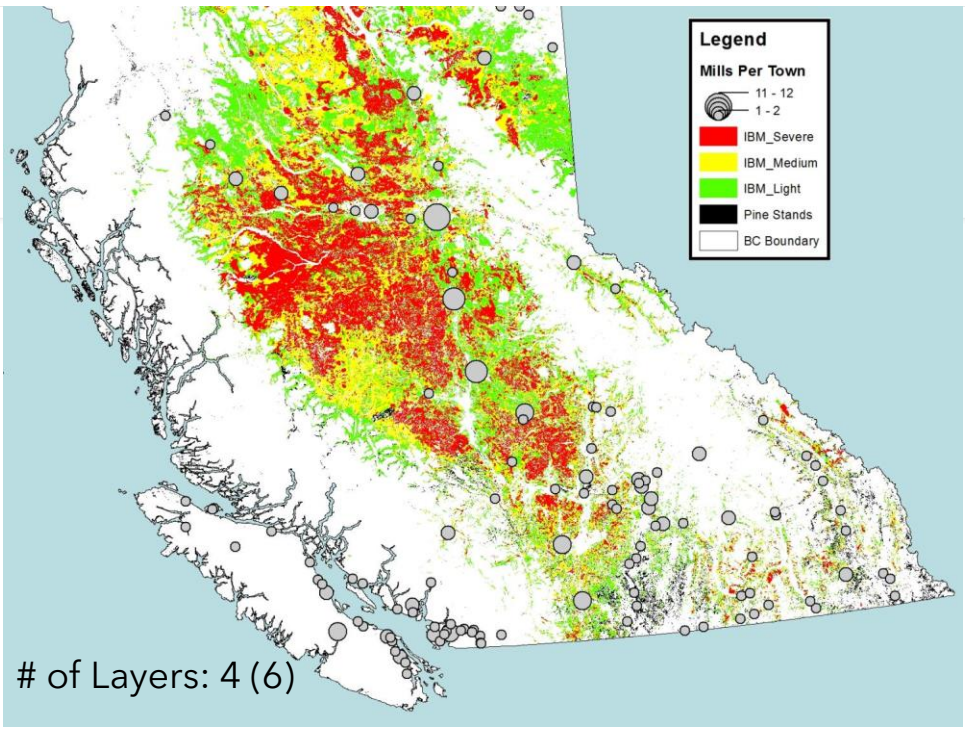
17


Legend
Mills Per Town
11 - 12
1 - 2
BC Boundary
PG: 12
# of Layers: 2

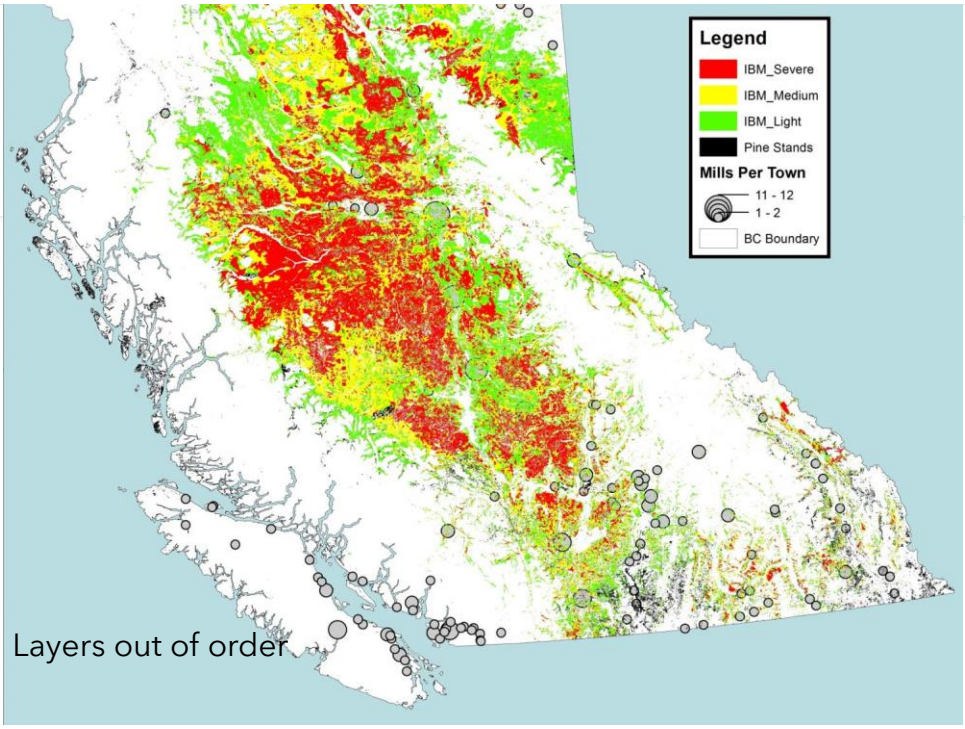
18


Legend
Mills Per Town
11 - 12
1 - 2
Pine Stands
BC Boundary
# of Layers: 3

19


Legend
Mills Per Town
11 - 12
1 - 2
IBM_Severe
IBM_Medium
IBM_Light
Pine Stands
BC Boundary
# of Layers: 4 (6)

20



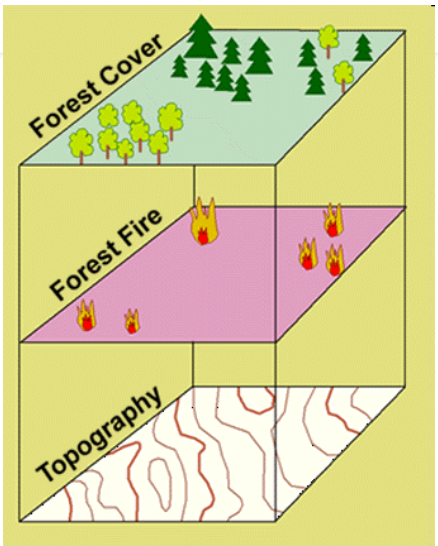
21

Properties of GIS data

- *Spatial (x,y location)*
  = 'where is it ?'

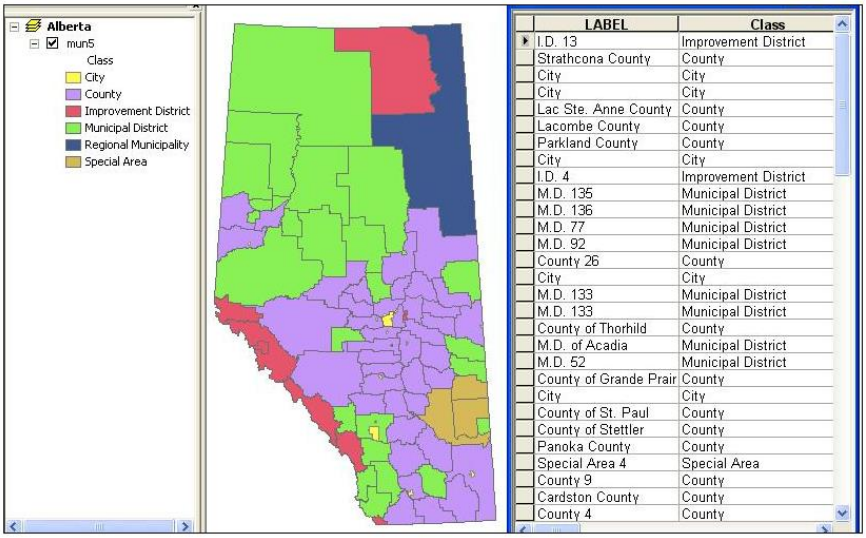
- *Attributes (multiple)*
  = 'what is it' ?

- *[Pattern]*
  = 'how are they related' ?
- *Other questions?*



22

Location and Attributes



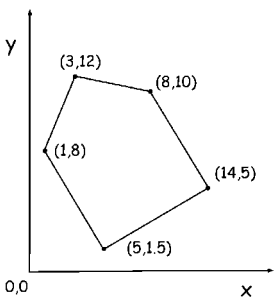
LABEL	Class
I.D. 13	Improvement District
Strathcona County	County
City	City
City	City
Lac Ste. Anne County	County
Lacombe County	County
Parkland County	County
City	City
I.D. 4	Improvement District
M.D. 135	Municipal District
M.D. 136	Municipal District
M.D. 77	Municipal District
M.D. 92	Municipal District
County 26	County
City	City
M.D. 133	Municipal District
M.D. 133	Municipal District
County of Thorhild	County
M.D. of Acadia	Municipal District
M.D. 52	Municipal District
County of Grande Prair	County
City	City
County of St. Paul	County
County of Stettler	County
Panoka County	County
Special Area 4	Special Area
County 9	County
Cardston County	County
County 4	County

23

Location and Attributes

x (easting), y (northing) [z-elevation] coordinates

e.g. latitude / longitude (degrees, minutes, seconds)



Coordinates: 1,8
3,12
8,10
14,5
5,1.5
1,8

Attributes:
Lot # :1347
Street: Willow Lane
Town: Hopkins

Attributes of latlong_data2

OID	X	Y
0	-79.235444	43.207055
1	-79.261247	43.191196
2	-79.205194	43.149254
3	-79.207431	43.147622
4	-79.215648	43.15465
5	-79.250881	43.164771
6	-79.253802	43.170664
7	-79.267453	43.155617
8	-79.2638	43.16129
9	-79.21237	43.139409
10	-79.244187	43.12796
11	-79.196958	43.134143
12	-79.212195	43.132831
13	-79.279129	43.170963

24

Location and Attributes

Attribute data: allows us to ask the question … "what is it ?"

> Every layer has an associated table

> These are linked to spatial location by a code number

➢Attributes are stored in columns as *items*

➢Rows display the attributes for each feature = *records*

➢Entries may be text strings, integers, float (decimal) or dates

Item (Description)

Record (place) ->

POLYGON	ESA_1	SPC1	PCT1	SPC2	PCT2	AGE_CL	HT_CL_IN	SITE_IDX	CRNCL_CL	SitePrep	Dist	YearDist	Regen	STTEND
67		HW	40	S	40	2	1	16.6	8	B	R	1985	1999	F
133			0		0	0	0	0	0			0	0	
199		HM	40	HW	30	9	3	7.2	5		L	1980	0	
353		HW	90	BA	10	9	4	11.6	1	B	L	1980	1999	F
229		HW	70	HM	20	9	3	9.5	5	B	L	1980	1999	F
264		HM	50	HW	30	9	3	7.5	5	H	L	1980	1999	F
162			0		0	0	0	0	0			0	0	
393		HW	60	HM	20	9	3	8.5	5	H	L	1980	1999	R
165		HM	80	BL	20	9	3	7	4	H	L	1980	1999	R

25

Types of questions a GIS can answer – resulting from spatial location, attributes and patterns

a. Location: WHAT exists here
"What is at this location ?" e.g. Dig safe?

b. Condition: WHERE are specific conditions
Where are all the pine dominated stands ?

c. Trends: WHAT HAS CHANGED (over time)
How far has the riverbank receded in the past 10 years ?

d. Patterns: HOW are features related
"How does proximity to salmon streams affect the number of bear attacks";

e. Modelling: WHAT IF ..?
What if the climate warmed by 2 degrees? (e.g. effect on habitats)

26

Scale

- Map Scale: The ratio or relationship between a distance on a map and the corresponding distance the ground.
- Map details depend on the scale of the data
  - The larger the scale, the more the detail
    - Large scale is synonymous with fine scale (fine granularity)
  - The smaller the scale, the less the detail
    - Small scale is synonymous with course scale (course granularity)
  - With generalisation and simplification one can create a map with a course grained scale from large scale data

27

27

Usage of "Scale"

- Cartographic Scale
  - 1:1000000 (1 cm = 10 km)
  - Crucial in paper based maps
  - Has importance in the digital medium
- Spatial Scale
  - Resolution: the size of your pixel (raster)
  - Extent: the size of your study area
    - "small-scale" operation covers a small area
    - "large-scale" operation covers a large area
- Scale Bar
  - Provides a visual indication of the size and distance a map.
  - Use appropriate (intuitive/simple) scale bar units

28

28

Scale

- Note:
  - Zooming in on a small scale map does not increase the quality of the map
  - Match the appropriate scale to the level of detail required in the project or the scale of the date.
  - A detailed map ≠ accurate map

29

29

Scale

- Know the scale of your spatial data.
  - Can you resolve what you want to see?
  - Temporal scale – frequency for data collection
  - Ecological scale – scale and spatial resolution should match the scale of the ecological phenomena
  - Caution when comparing analyses from maps/data of different scales
- Spatial data are intended for a specific scale or a range of scales

30

30

Working with data

- Know the metadata:
  - Metadata "is data about data"
    - E.g. who collected it, for what purpose, what does it show, when was it collected, scale
- Clean data
- Appropriate file name and folder structure