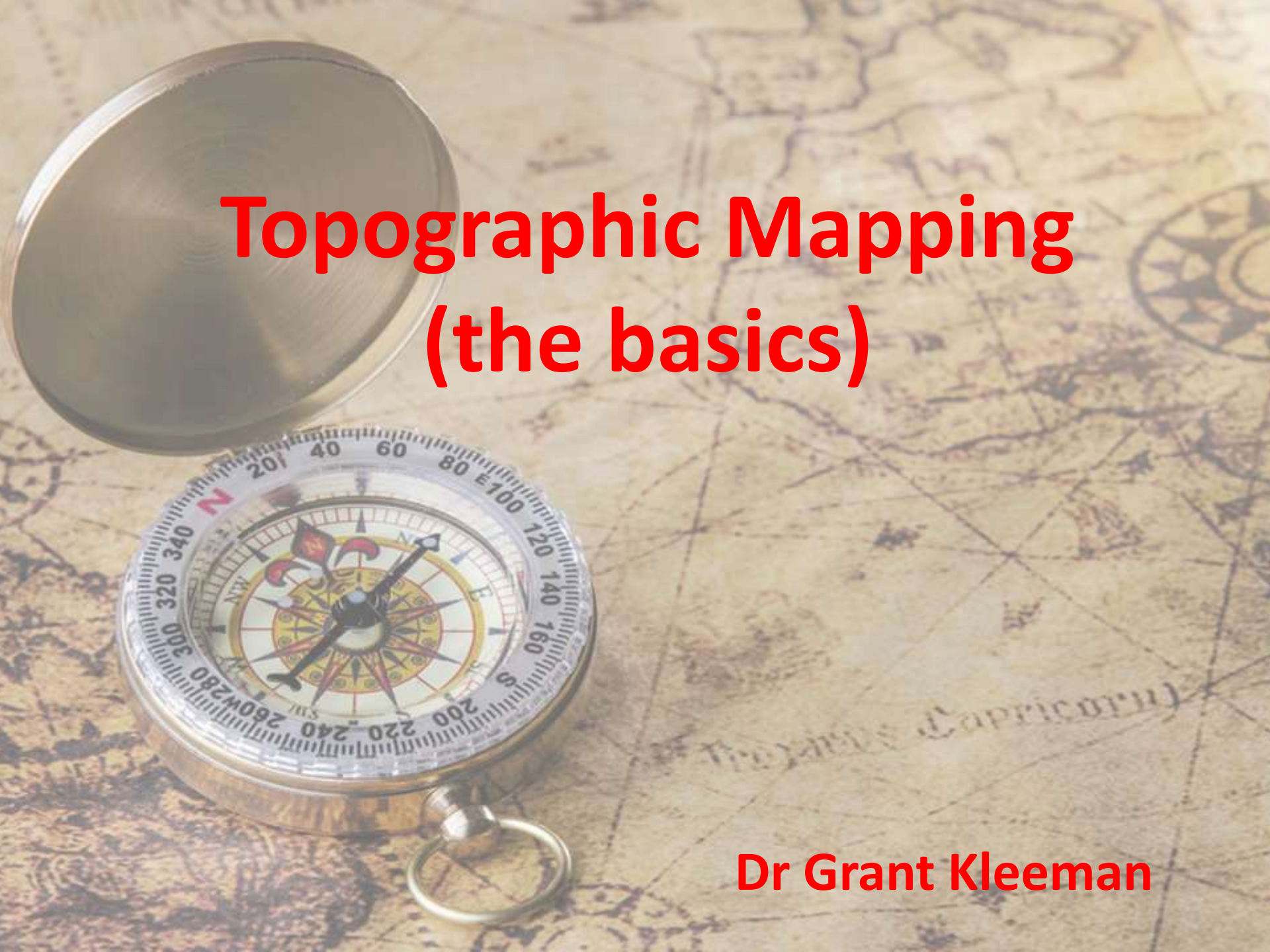
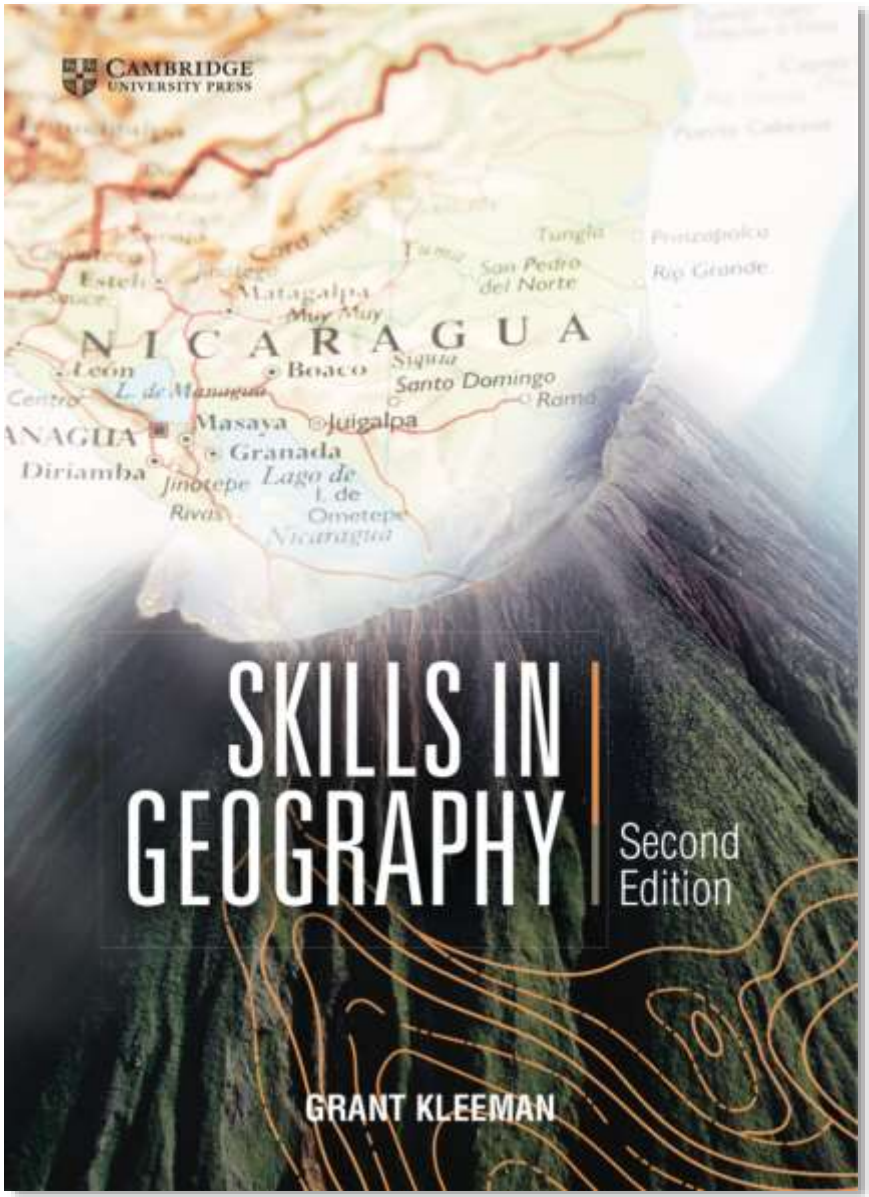


Topographic Mapping (the basics)

Dr Grant Kleeman

Types of maps

- Atlas maps (physical & political)
- **Topographic maps**
- Thematic maps
- Weather maps
- Flowline maps
- Choropleth maps



Working with topographic maps

Elements of maps

Title

Topographic Map of Blue Lake

Direction indicator

Scale

Mt Brown
Lat. 36˚46'S
Long. 148˚26'E

Latitude and longitude

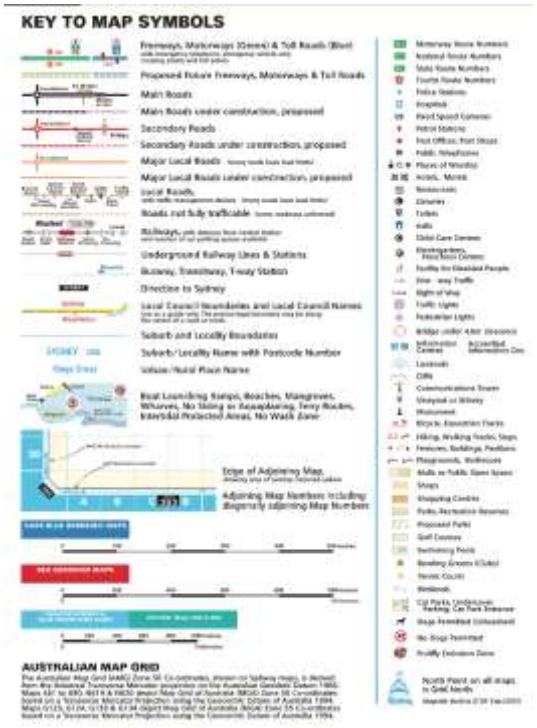
Grid

Legend

Sea cliff
Sandy beach
Road
Open eucalypt forest
Pine plantation
Sand dunes
Wetland
Mangroves
Bridge
Camping ground
Walking trail

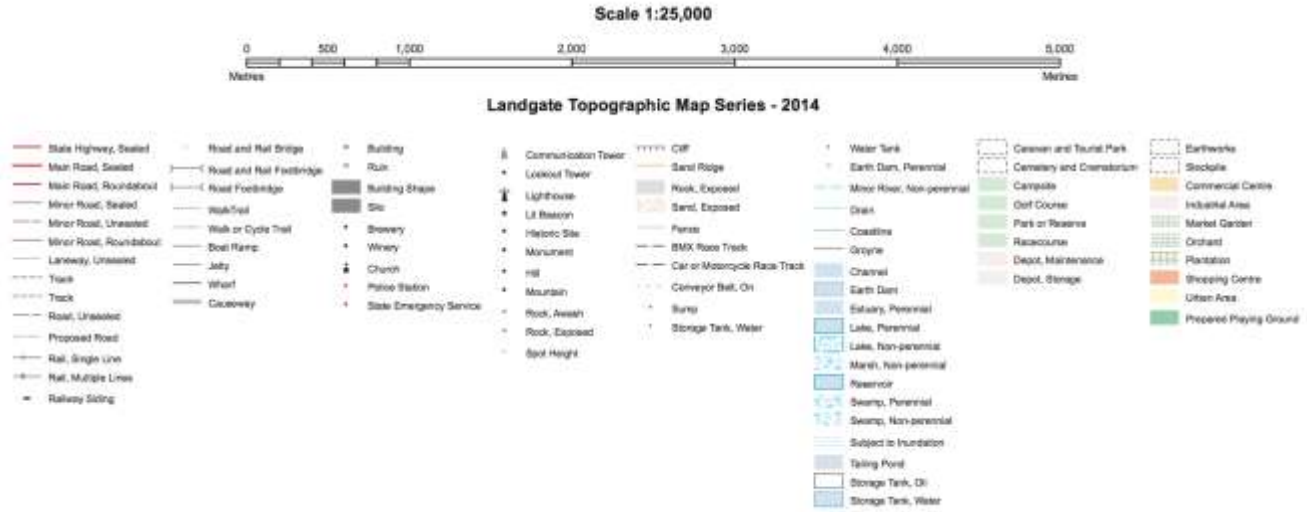
Map symbols

NSW Maps

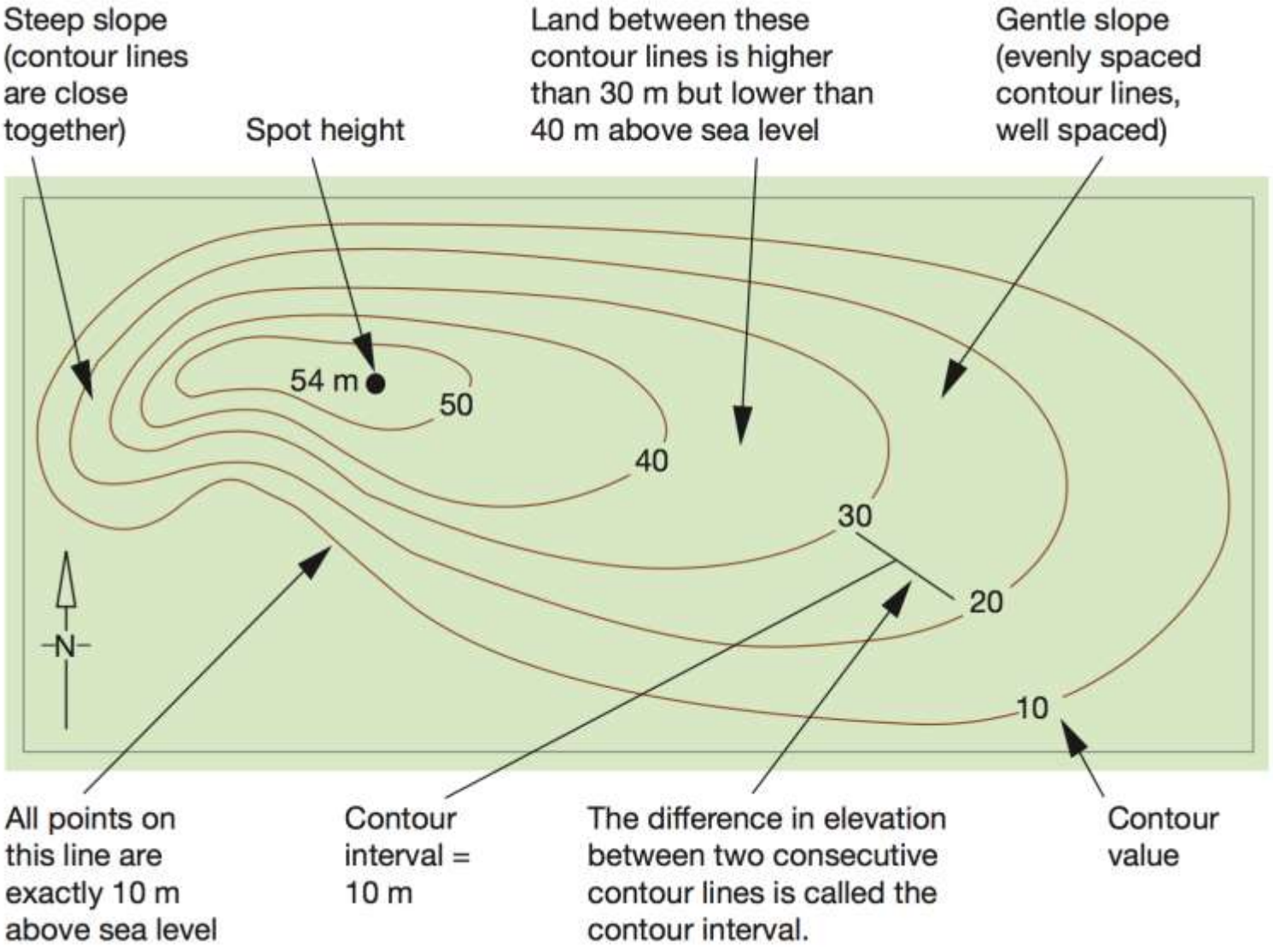


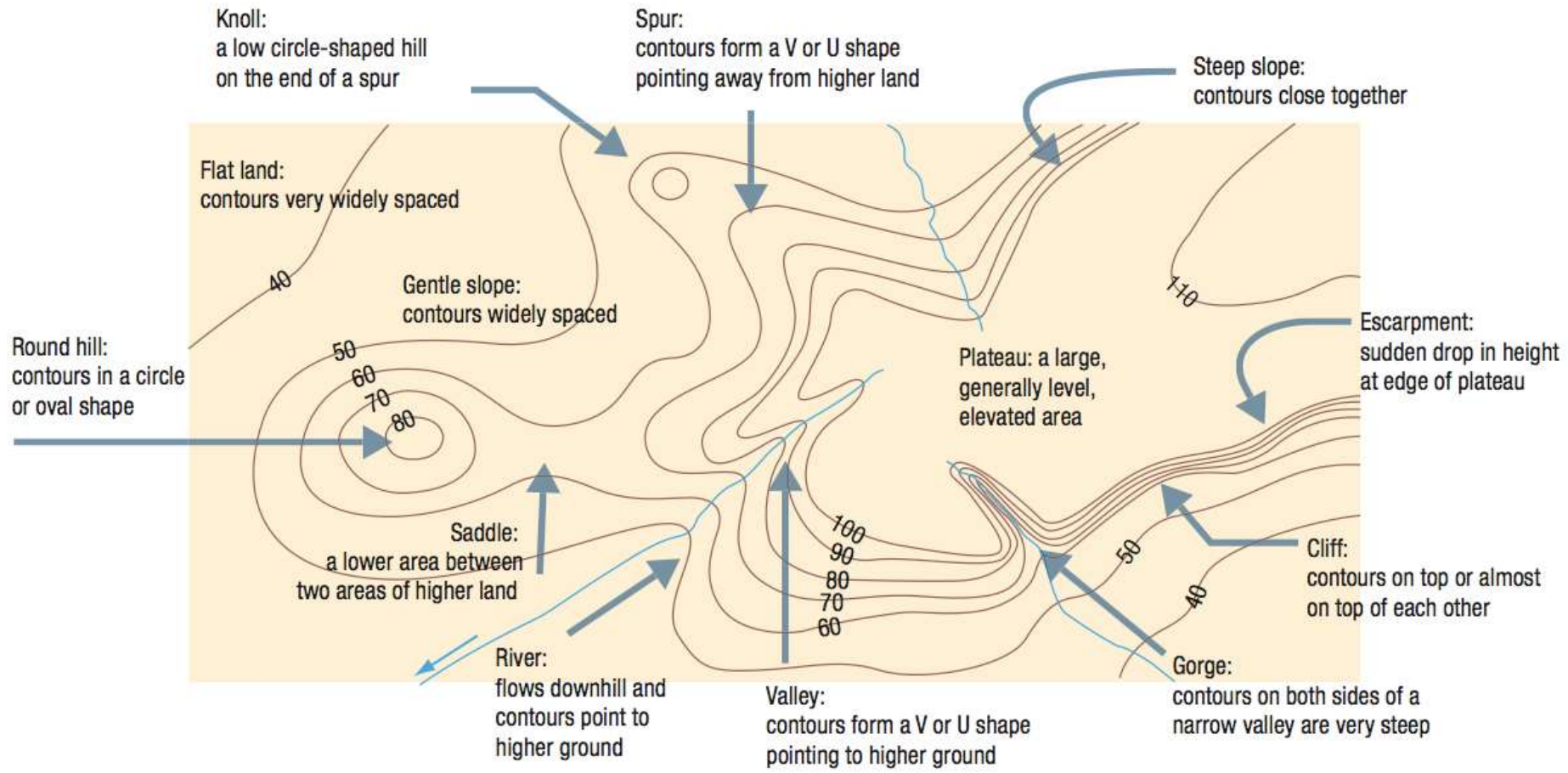
Street directory

WA maps



Contour lines




Knoll:
a low circle-shaped hill
on the end of a spur
Spur:
contours form a V or U shape
pointing away from higher land
Steep slope:
contours close together
Flat land:
contours very widely spaced
40
Gentle slope:
contours widely spaced
110
Round hill:
contours in a circle
or oval shape
50
60
70
80
Plateau: a large,
generally level,
elevated area
Escarpment:
sudden drop in height
at edge of plateau
Saddle:
a lower area between
two areas of higher land
100
90
80
70
60
50
40
Cliff:
contours on top or almost
on top of each other
River:
flows downhill and
contours point to
higher ground
Valley:
contours form a V or U shape
pointing to higher ground
Gorge:
contours on both sides of a
narrow valley are very steep

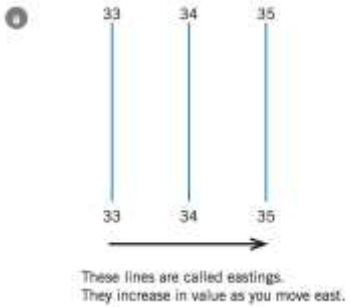
Grid and area references (1)

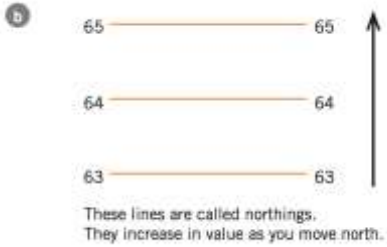
Grid references

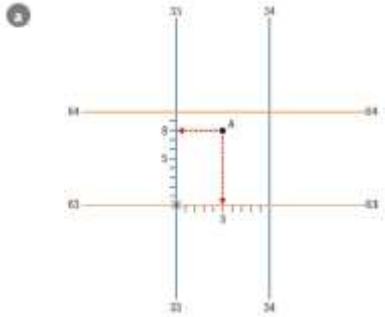
You can locate features on maps by using a six-figure grid reference (GR). The first three digits refer to the eastings and the last three digits refer to the northings. Each set of three digits is referred to as a coordinate. The first two digits of each coordinate refer to the eastings and northings that surround the map. The third digit needed to complete each coordinate is obtained by dividing each easting and each northing into tenths.

Area references

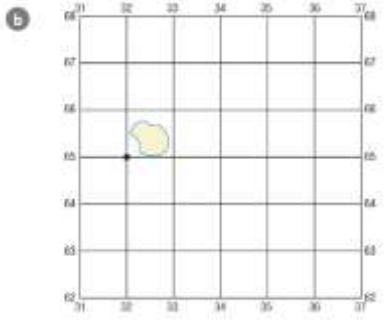
Features such as a small lake, quarry or village are usually located by means of a four-figure area reference (AR). To find the AR of a feature, use the coordinates of the lower left-hand corner of the grid square in which the feature is located. As in grid references, eastings come before northings in area references.





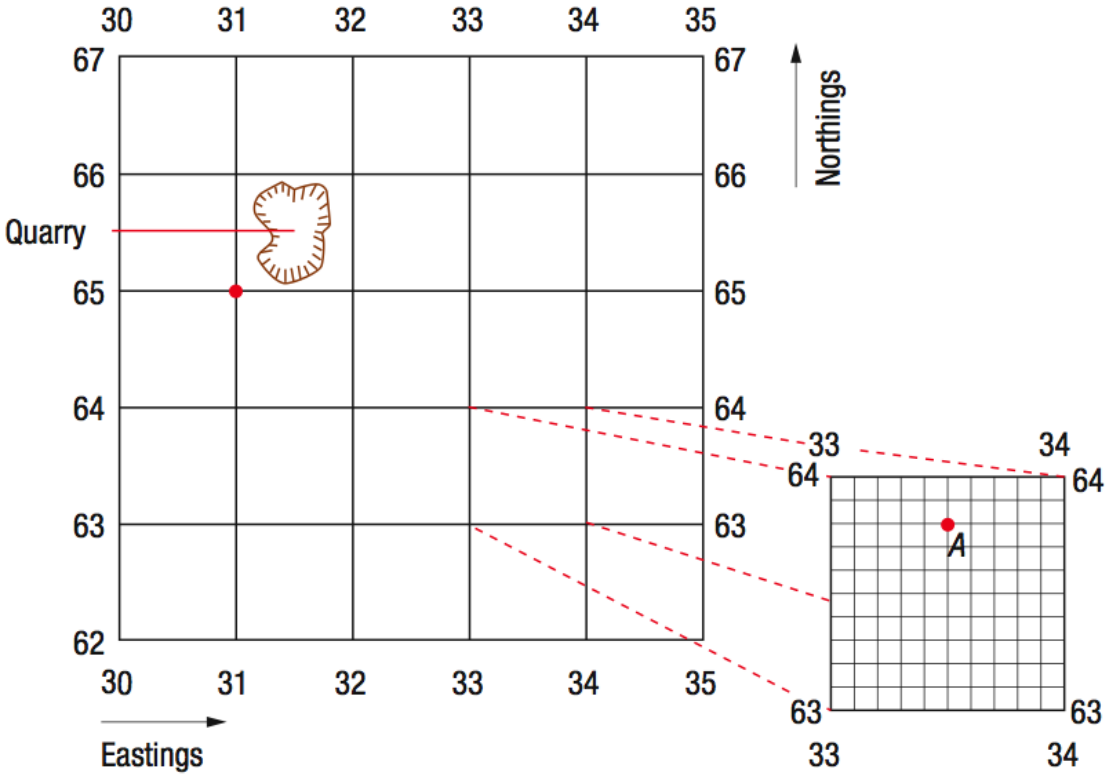


Point A is located at GR 335638.

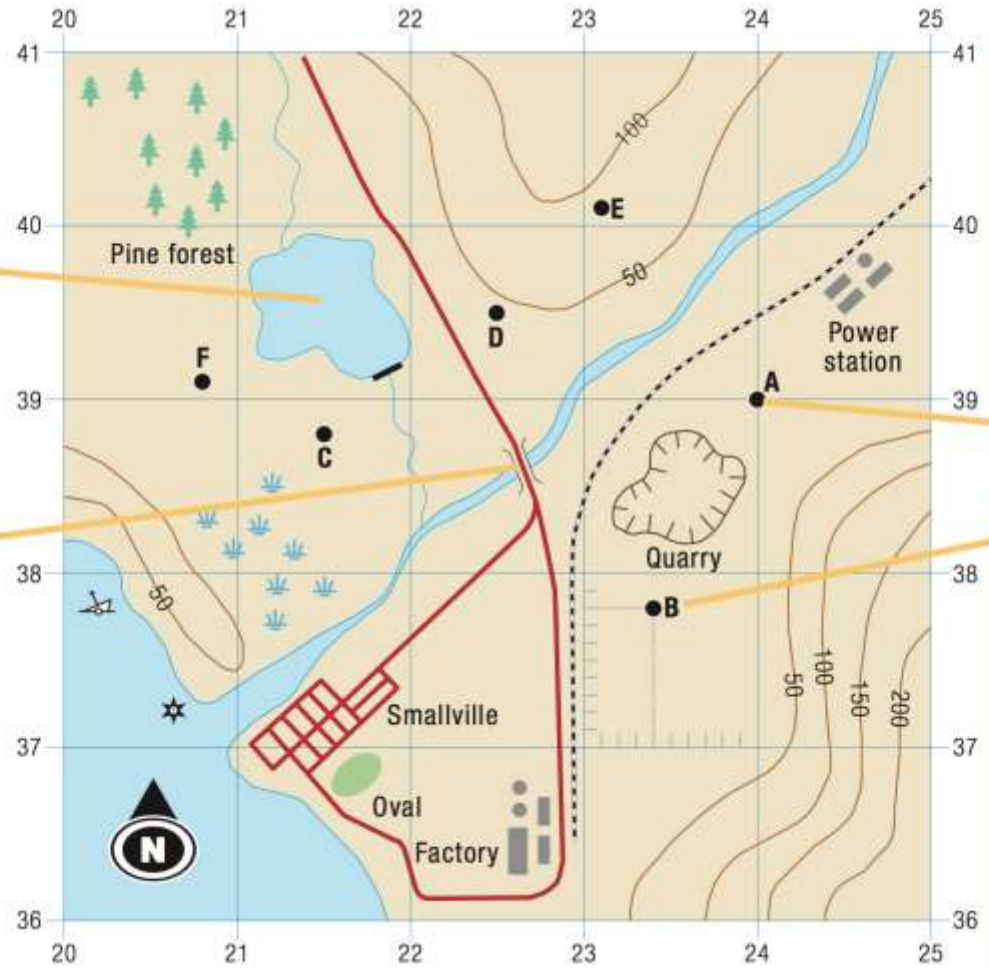


The quarry is located in AR 3265.

Grid and area references (1)



Grid and area references (2)



EXAMPLE 1
Find the grid reference (GR) for point A. Point A is located exactly on the intersection of easting 24 and northing 39. The easting is, therefore, 240 (24 and no tenths towards 25). The northing is 390 (39 and no tenths towards 40). The GR of point A is expressed as 240390.

EXAMPLE 2
Find the grid reference (GR) of point B. Point B is located four-tenths of the way between eastings 23 and 24. The easting is, therefore, 234 (23 and 4 tenths towards 24). The northing is approximately eight-tenths of the way between northings 37 and 38; therefore it is 378. The GR of point B is expressed as 234378.

EXAMPLE 3
Find the area reference (AR) of the dam. The AR of the dam is 2139.

EXAMPLE 4
Find the area reference (AR) of the road bridge. The AR of the road bridge is 2238.

Activities:

Grid reference questions

1. Identify the feature of the physical environment located at:

a. GR 132647

b. GR 155673

c. GR 133637

d. GR 286653

2. Identify the feature of the human or built environment located at:

a. GR 162644

b. GR 298655

c. GR 149653

d. GR 229732

3. What is the grid reference of Mount Townsend?

Area reference questions

4. Name the type of physical feature found in AR 1869?

5. Name the type of vegetation found in AR 2563?

6. Name the type of landuse found in AR 2670?

7. What creek flows into the Snowy River at GR 210710?

8. Name the tributary that joins the Thredbo River at AR 2966.

Activities:

Grid reference questions

1. Identify the feature of the physical environment located at:

a. GR 132647 Mount Kosciuszko

b. GR 155673 Mount Clarke

c. GR 133637 Lake Cootapatamba

d. GR 286653 Muzzlewood Wetlands

2. Identify the feature of the human or built environment located at:

a. GR 162644 Australian Alps Walking Track

b. GR 298655 Golf Course

c. GR 149653 Seamans Hut

d. GR 229732 Dam Wall

3. What is the grid reference of Mount Townsend? 128684

Area reference questions

4. Name the type of physical feature found in AR 1869? Hedley Tarn

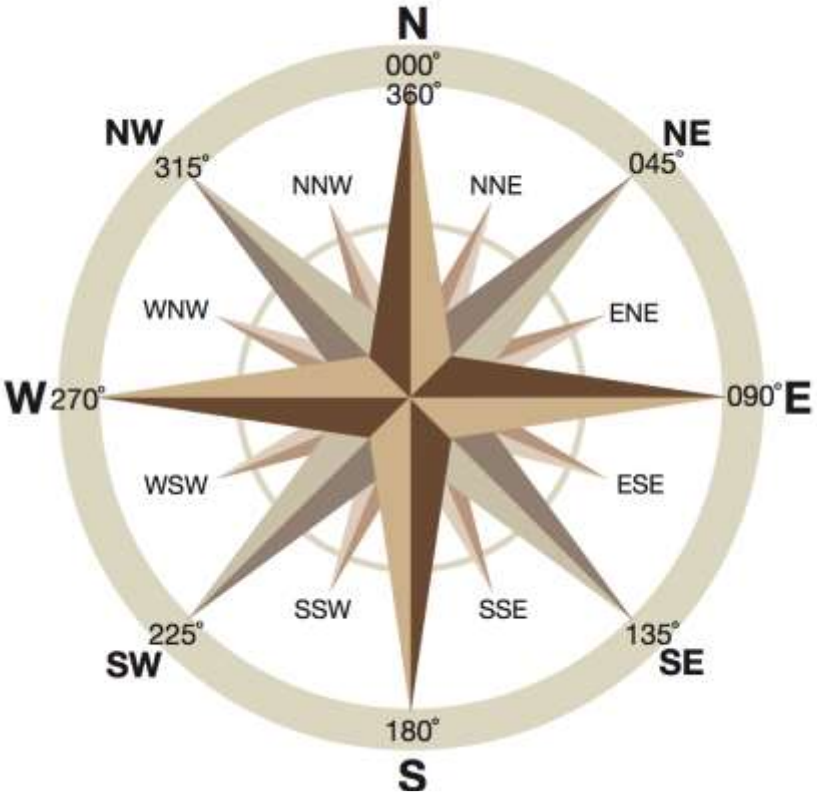
5. Name the type of vegetation found in AR 2563? Closed forest

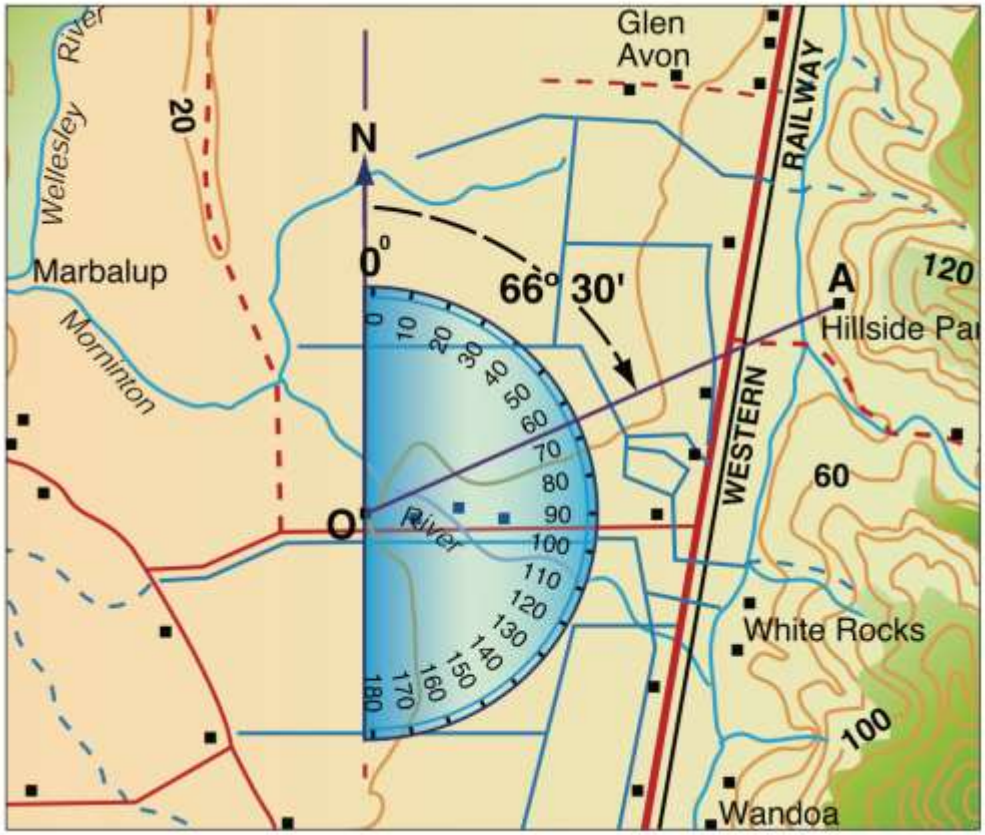
6. Name the type of landuse found in AR 2670? Ski resort (perisher) built up area.

7. What creek flows into the Snowy River at GR 210710? Spencers Creek

8. Name the tributary that joins the Thredbo River at AR 2966. Little Thredbo River

Direction & bearings

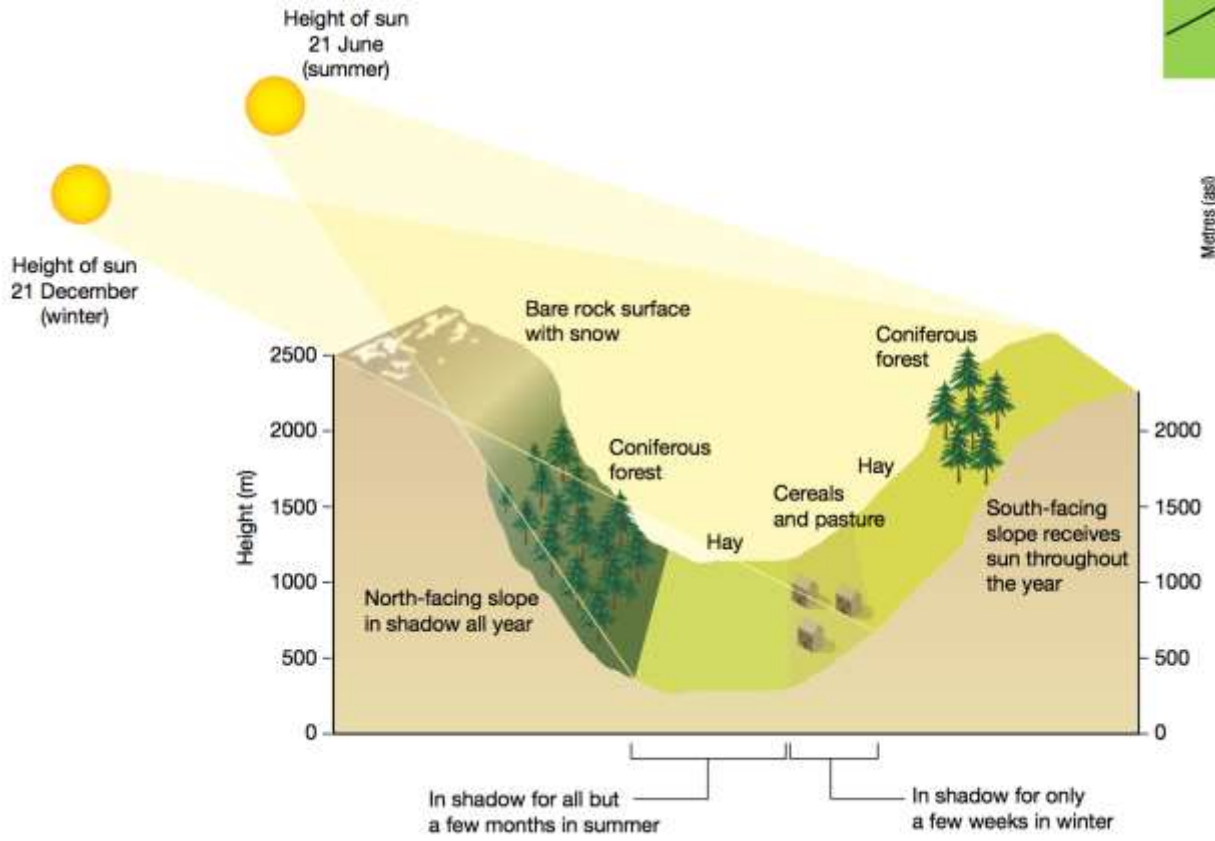


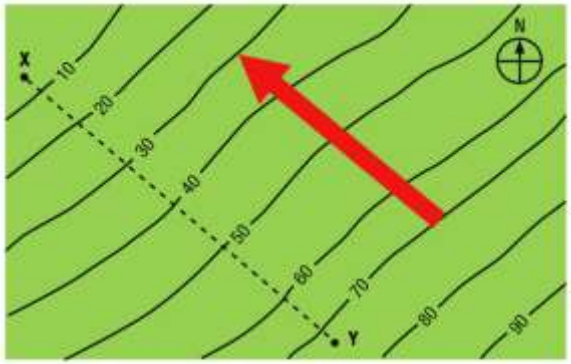


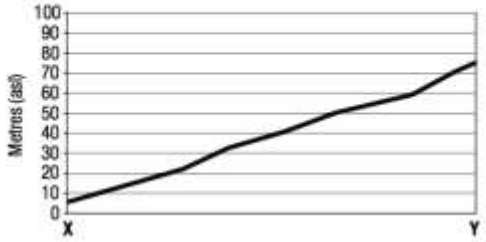
Bearing O–A: 65˚

Aspect

Northern Hemisphere





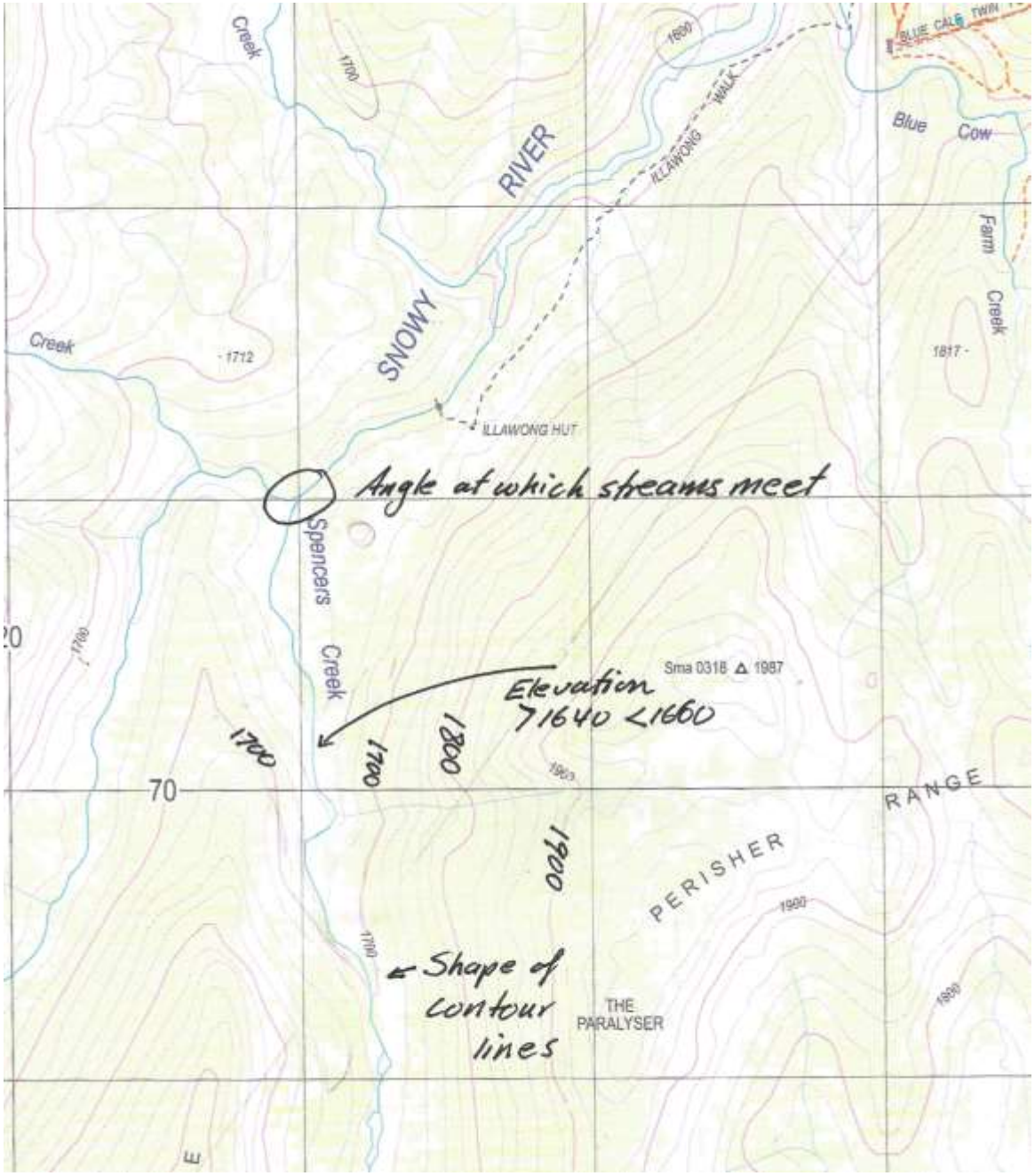


North-west aspect

Direction of flow

- Reading contour lines
  - changes in elevation
  - shape of contour lines

- Angle at which tributaries join larger streams


Creek
1700
1690
BLUE CAL
TWIN
RIVER
ILLAWONG WALK
Blue Cow
Farm Creek
SNOWY
Creek
1712
1817
ILLAWONG HUT
Angle at which streams meet
Spencers Creek
Sma 0318 △ 1987
Elevation
71640 <1660
1700
1800
1900
70
RANGE
PERISHER
1900
1700
Shape of contour lines
THE PARALYSER

Activities:

Direction

9. What is the direction of the Charlotte Pass ski resort (GR 195670) from Guthega ski resort (AR 2372)?

10. In what direction is Spencers Creek flowing in AR 2169?

11. What is the bearing of Mount Townsend (AR 1268) from Carruthers Peak (AR 1569)?

Aspect

12. What is the aspect of the slope in AR 2060?

Activities:

Direction

9. What is the direction of the Charlotte Pass ski resort (GR 195670) from Guthega ski resort (AR 2372)? SW

10. In what direction is Spencers Creek flowing in AR 2169? North

11. What is the bearing of Mount Townsend (AR 1268) from Carruthers Peak (AR 1569)? 244˚-246˚

Aspect

12. What is the aspect of the slope in AR 2060? NW

Scale

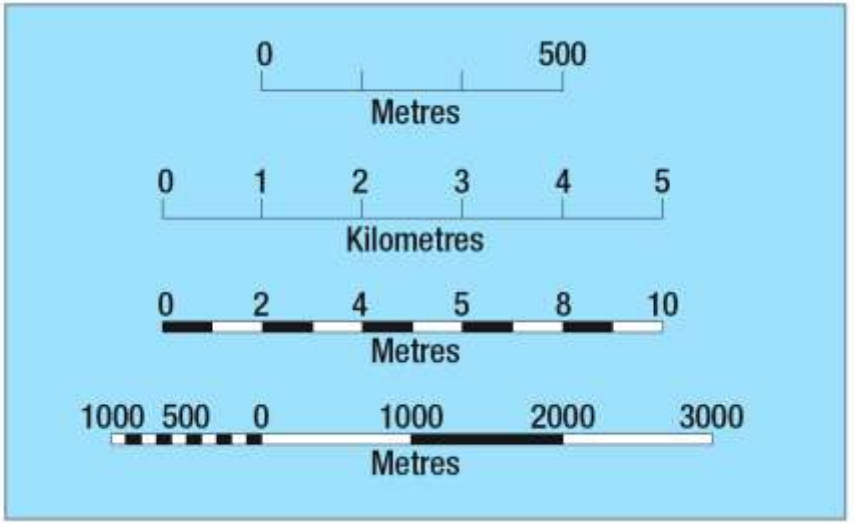
To draw a map of any part of the Earth's surface, the area must be reduced in size, or scaled down, so that it can fit on a sheet of paper. There is, therefore, a direct relationship between the size of features on a map and their actual size on the ground. In other words, maps are actually a scaled- down representation of part of the Earth's surface. To determine how large the real area is, it is always necessary for the map to indicate the scale at which it has been drawn. Scale is expressed as the ratio of distances on the map to distances on the ground.

Scale can be expressed in three ways:

1. As a statement for examples '1 cm represents 100 000 cm' or '1 cm represents 1 km'.
2. As a ratio or representative fraction; for example, 1:100 000 or $\frac{1}{100\,000}$

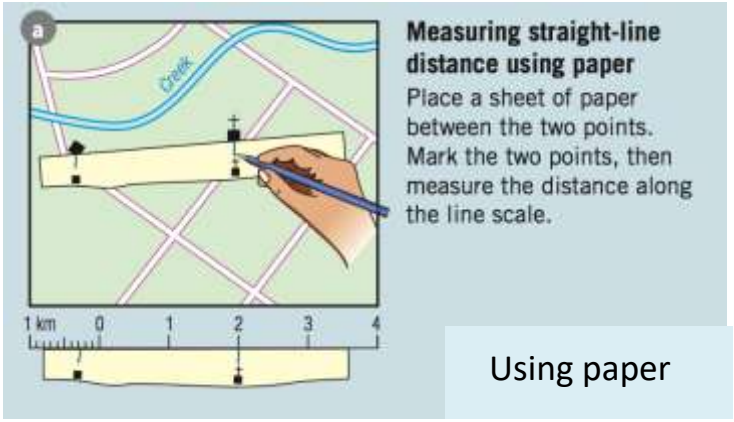
3. As a linear scale.

	Scale	Distance on the ground shown by 1 cm on the map
Larger-scale ↑	1:10 000	100 m
	1:25 000	250 m
	1:50 000	500 m
	1:100 000	1 km
Smaller-scale ↓	1:250 000	2.5 km
	1:1 000 000	10 km
	1:5 000 000	50 km



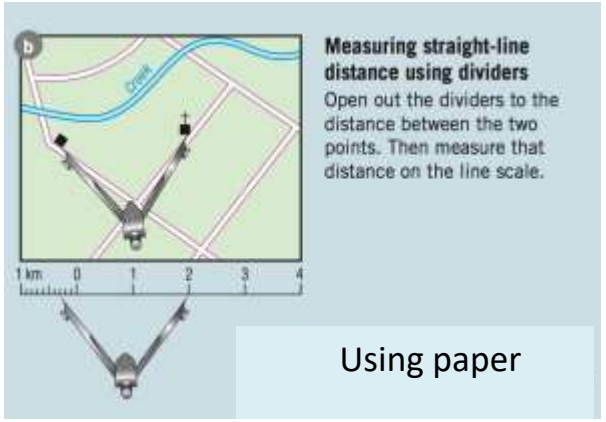
Measuring distances on a map

Straight-line distances



Measuring straight-line distance using paper
Place a sheet of paper between the two points. Mark the two points, then measure the distance along the line scale.

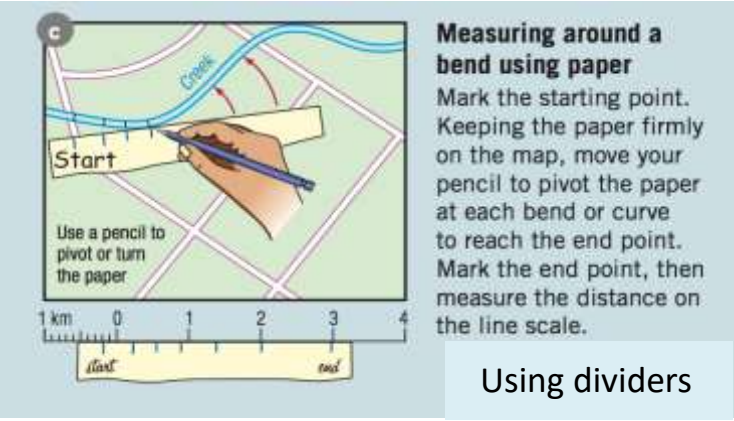
Using paper



Measuring straight-line distance using dividers
Open out the dividers to the distance between the two points. Then measure that distance on the line scale.

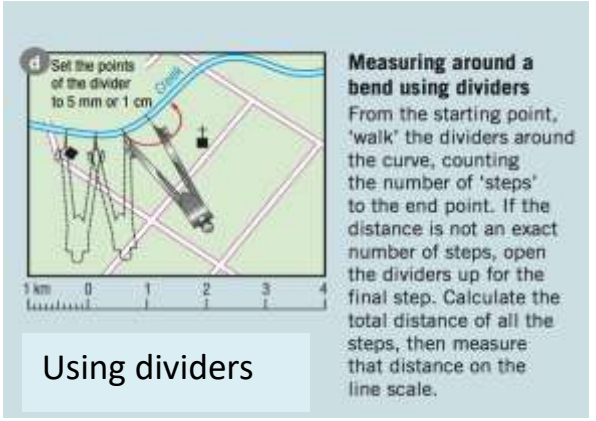
Using paper

Distances along a curve



Measuring around a bend using paper
Mark the starting point. Keeping the paper firmly on the map, move your pencil to pivot the paper at each bend or curve to reach the end point. Mark the end point, then measure the distance on the line scale.

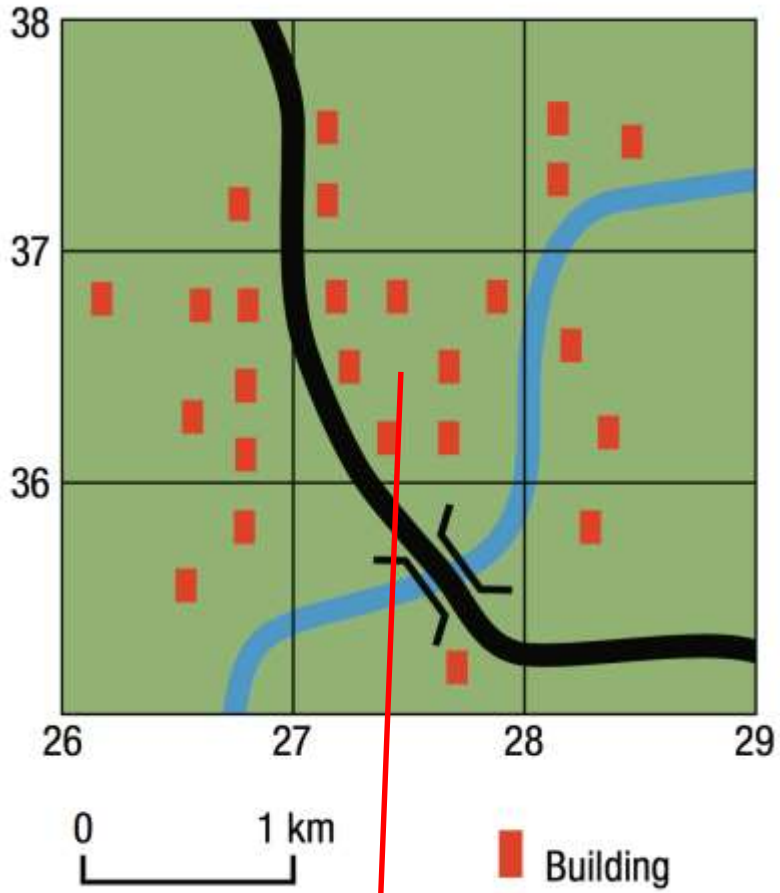
Using dividers



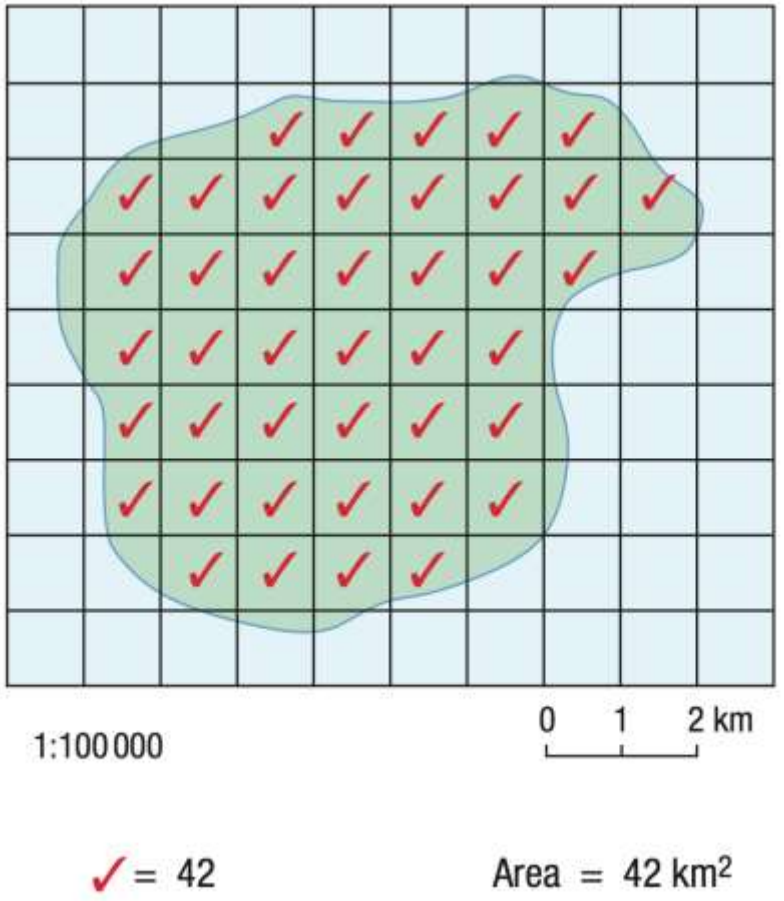
Using dividers

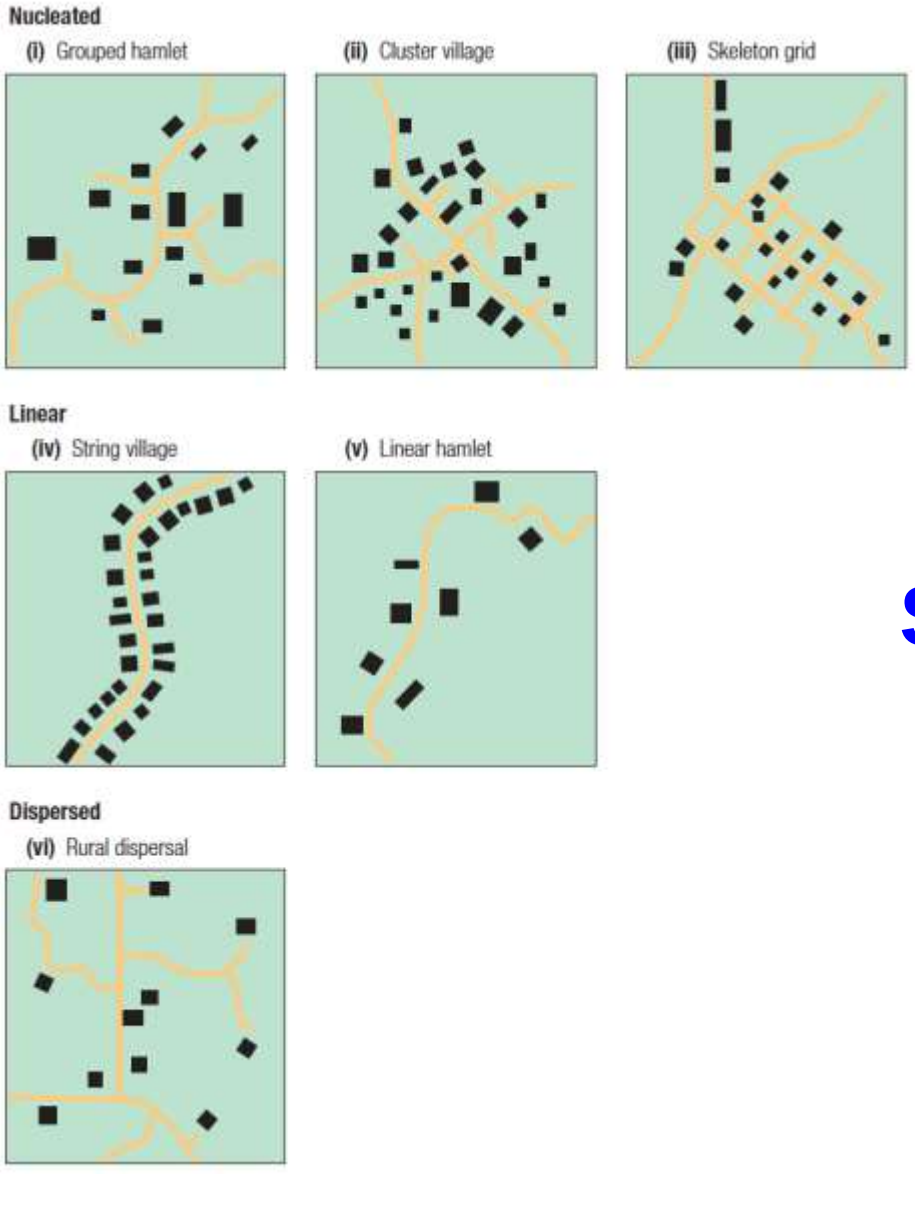
Measuring around a bend using dividers
From the starting point, 'walk' the dividers around the curve, counting the number of 'steps' to the end point. If the distance is not an exact number of steps, open the dividers up for the final step. Calculate the total distance of all the steps, then measure that distance on the line scale.

Density & Area



7 per square kilometre





Settlement patterns

Activities:

Scale

13. Estimate the straight-line distance between the summit of Mount Townsend (AR 1268) and Carruthers Peak (AR 1569).

14. Estimate the distance from the top of the Kosciuszko Express chair lift in AR 1560 to the summit of Mt Kosciuszko walking track.

15. What is the length of Thredbo's Gunbarrel Express chair lift?

Estimating area

16. Estimate the area of Blue Lake.

Density

17. What is the density of buildings in AR 3065?

Activities:

Scale

13. Estimate the straight-line distance between the summit of Mount Townsend (AR 1268) and Carruthers Peak (AR 1569). 3.2km

14. Estimate the distance from the top of the Kosciuszko Express chair lift in AR 1560 to the summit of Mt Kosciuszko walking track. Approx. 6km

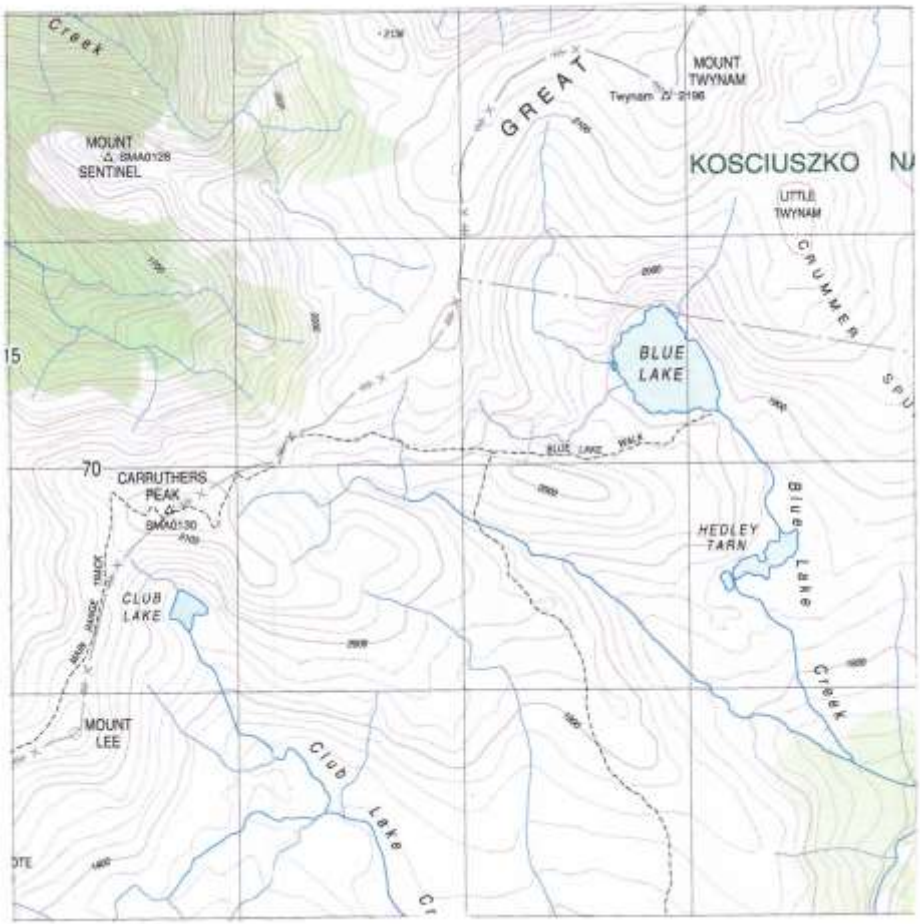
15. What is the length of Thredbo's Gunbarrel Express chair lift? 1.5km

Estimating area

16. Estimate the area of Blue Lake. 0.2km square

Density

17. What is the density of buildings in AR 3065? Approx. 14/sq.km



Area of Blue Lake:
Approx. 0.2km

Showing relief on topographic maps

Relief is a term geographers use to describe the shape of the land, including its height above sea level (asl) and the steepness of its slopes.

Because maps are usually drawn on flat sheets of paper it has been necessary for cartographers (map makers) to develop ways of showing what the landscape is like. These techniques include the use of spot heights, shading, colour layering and contour lines.

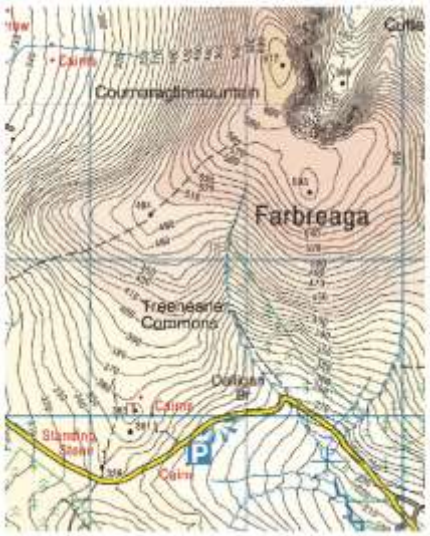
Showing relief on maps:

- **Spot heights:** A *spot height* is usually shown on a map as a black dot with the height written next to it. It gives the exact elevation (or height) above sea level of a particular location or feature.

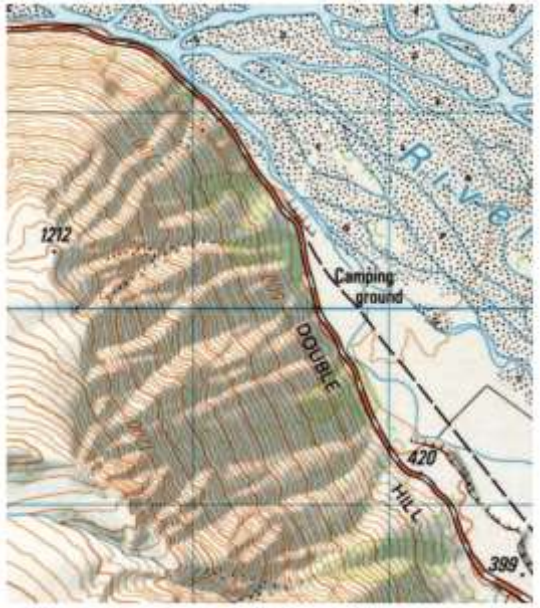
- **Shading:** Map *shading* is a very effective method of highlighting landform features. The shading makes the landform features 'stand out' from the map, creating a three-dimensional effect.

- **Colour layering:** Some cartographers use colour layering to distinguish between different elevations.

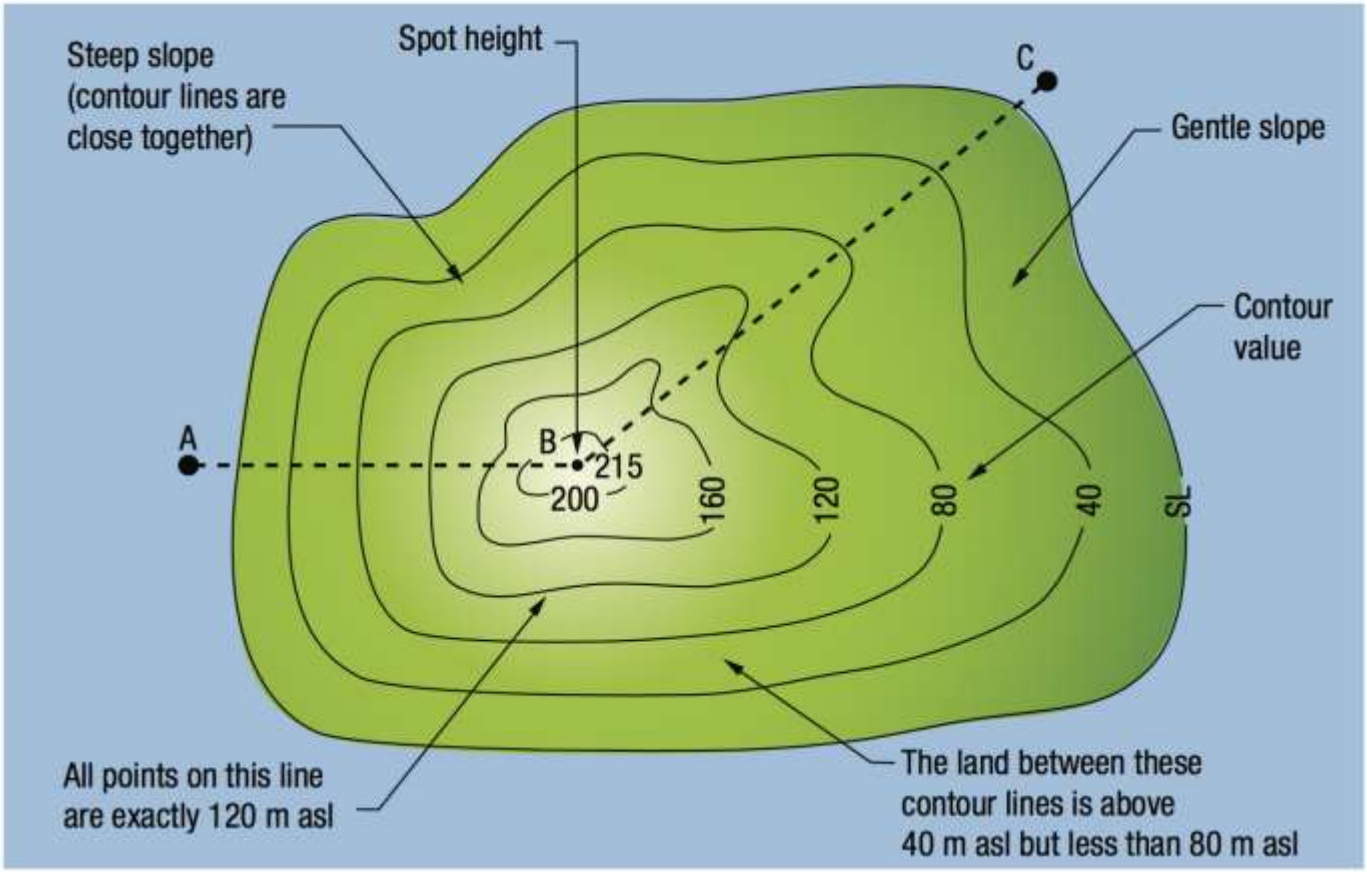
- **Contour lines:** The most effective way to show relief on a map involves the use of contour lines. *Contour lines* join places of equal height above sea level. Below sea level the lines are referred to as marine contours (or *bathytherms*). Being able to interpret contour lines provides geographers with information about the:
  - *shape* of the land
  - *slope* of the land
  - *height* of features above sea level.

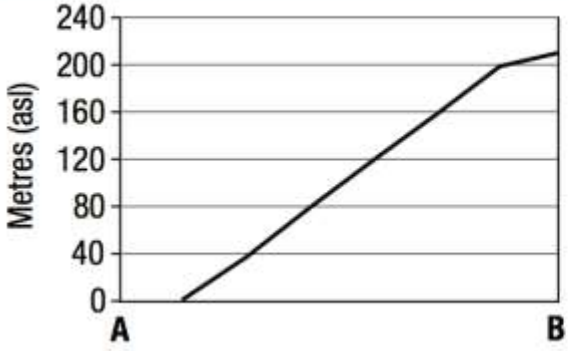


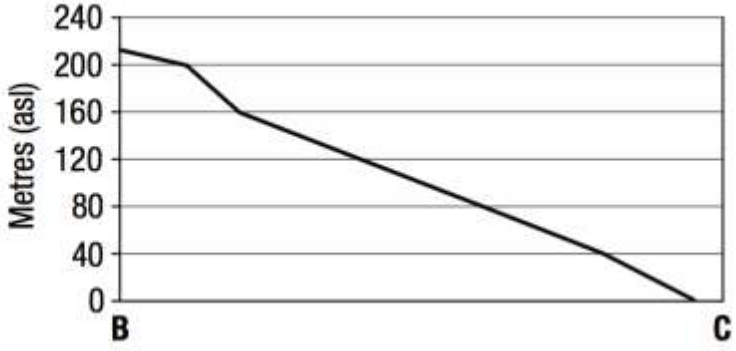
Colour layering



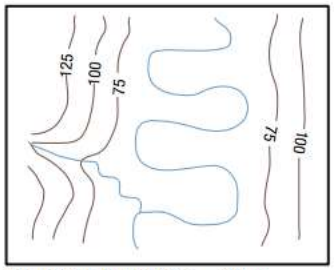
Shading


Steep slope
(contour lines are
close together)
Spot height
C
Gentle slope
Contour
value
A
B
215
200
160
120
80
40
SL
All points on this line
are exactly 120 m asl
The land between these
contour lines is above
40 m asl but less than 80 m asl


240
200
160
120
80
40
0
Metres (asl)
A
B

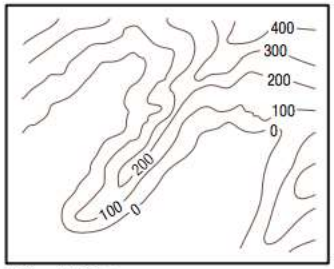

240
200
160
120
80
40
0
Metres (asl)
B
C

Floodplain

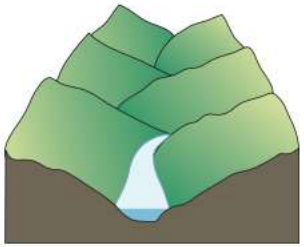


Contour interval (CI) = 25 m

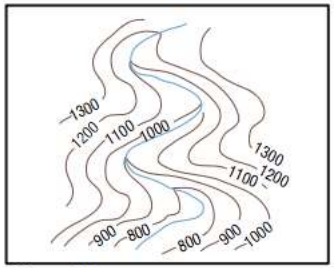
Drowned coastline



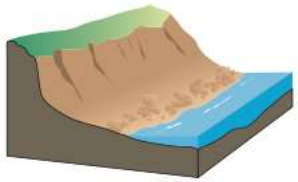
CI = 100 m



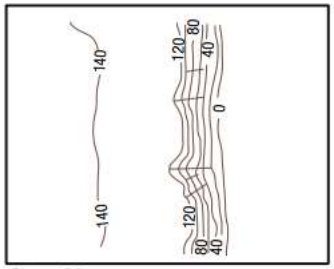
Interlocking spurs



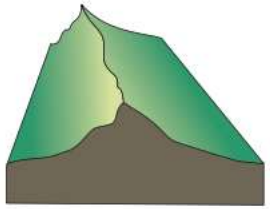
CI = 100 m



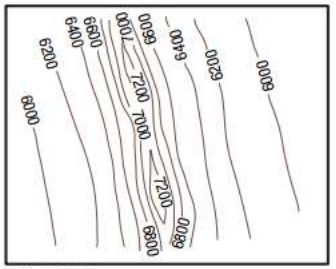
Cliffed beach



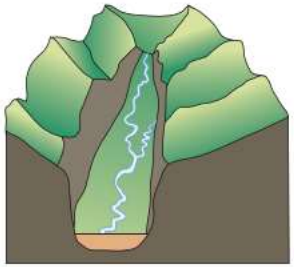
CI = 20 m



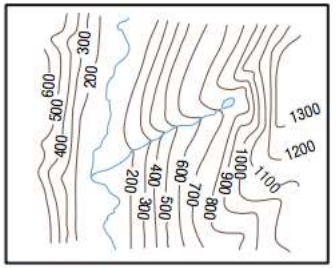
Ridge



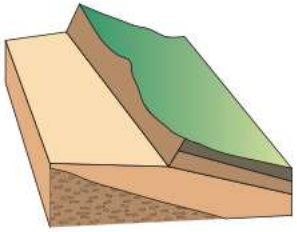
CI = 200 m



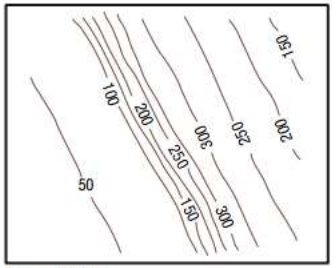
Truncated spurs



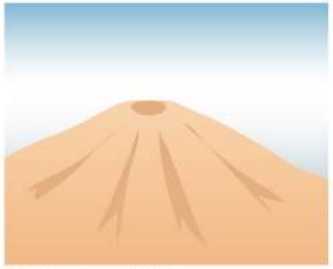
CI = 100 m



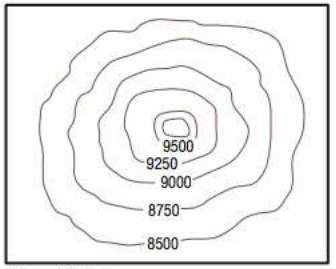
Scarp



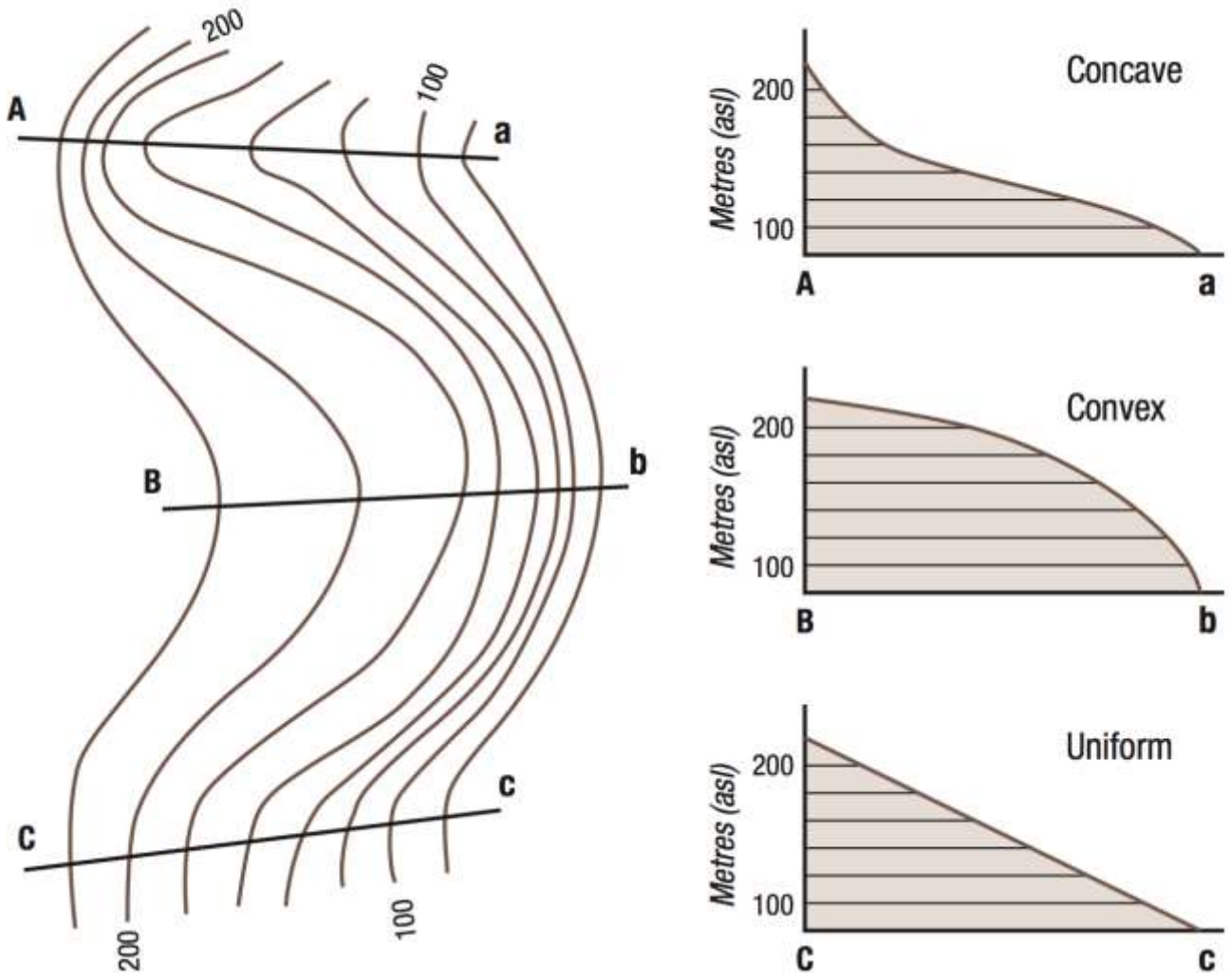
CI = 50 m



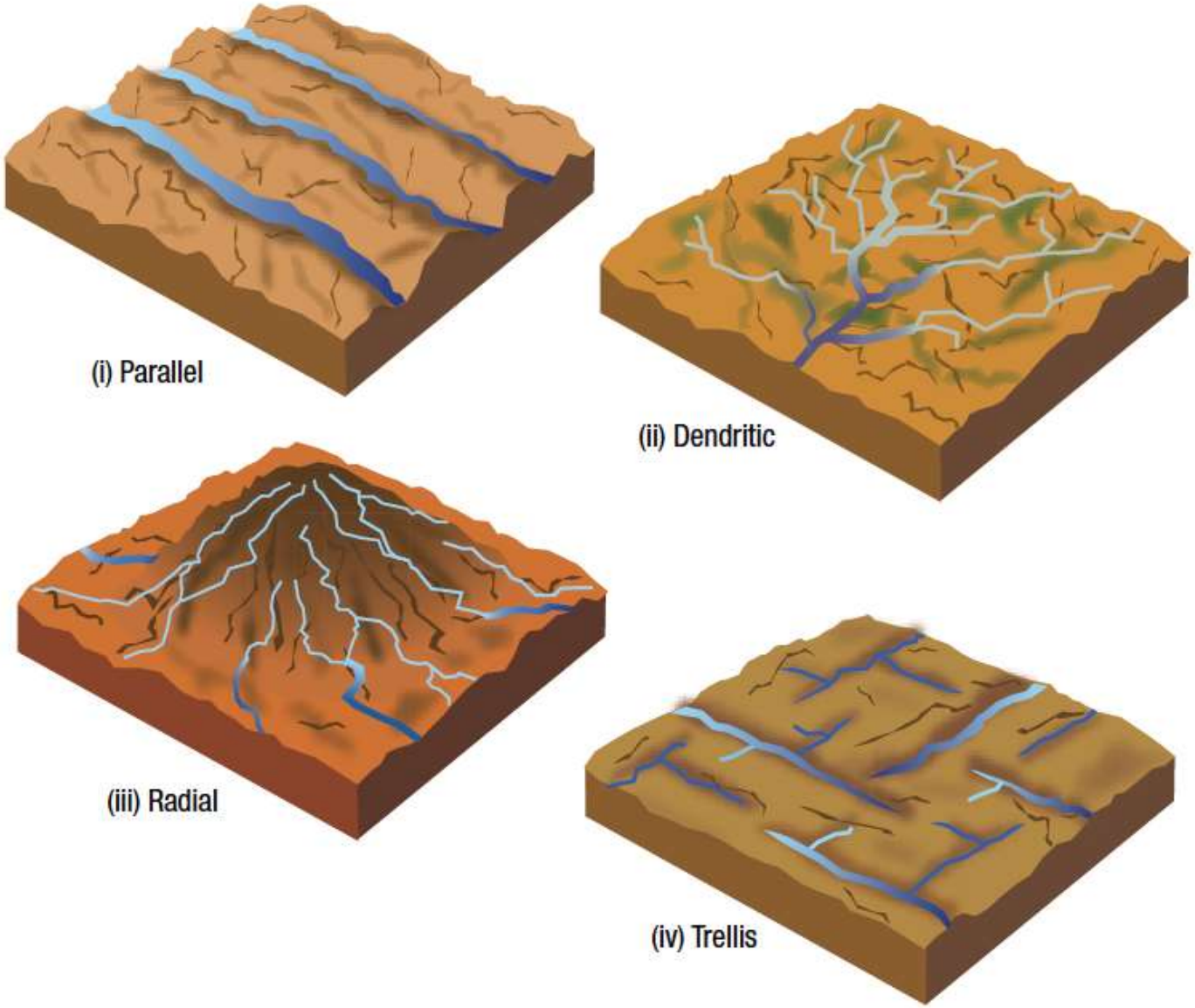
Conical mountain



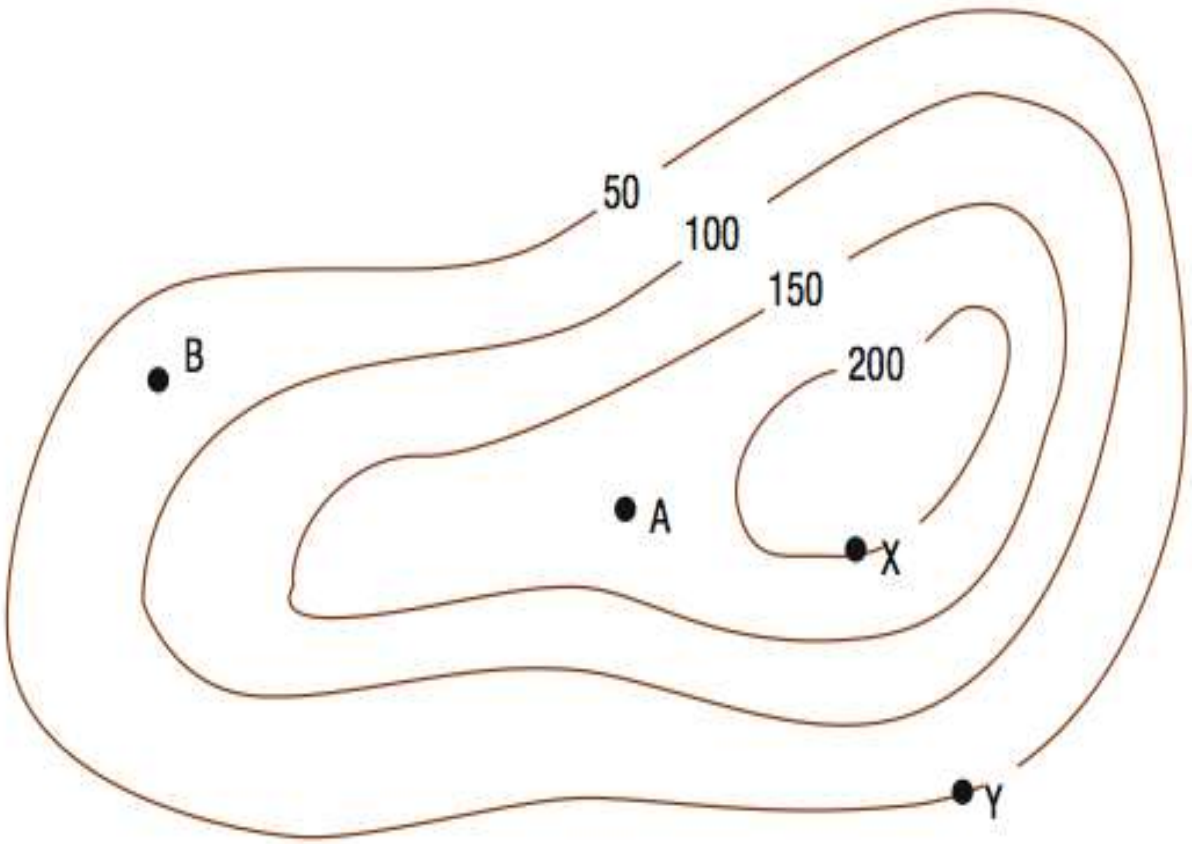
CI = 250 m


200
100
A
a
B
b
C
c
200
100
Concave
Metres (asl)
200
100
A
a
Convex
Metres (asl)
200
100
B
b
Uniform
Metres (asl)
200
100
C
c

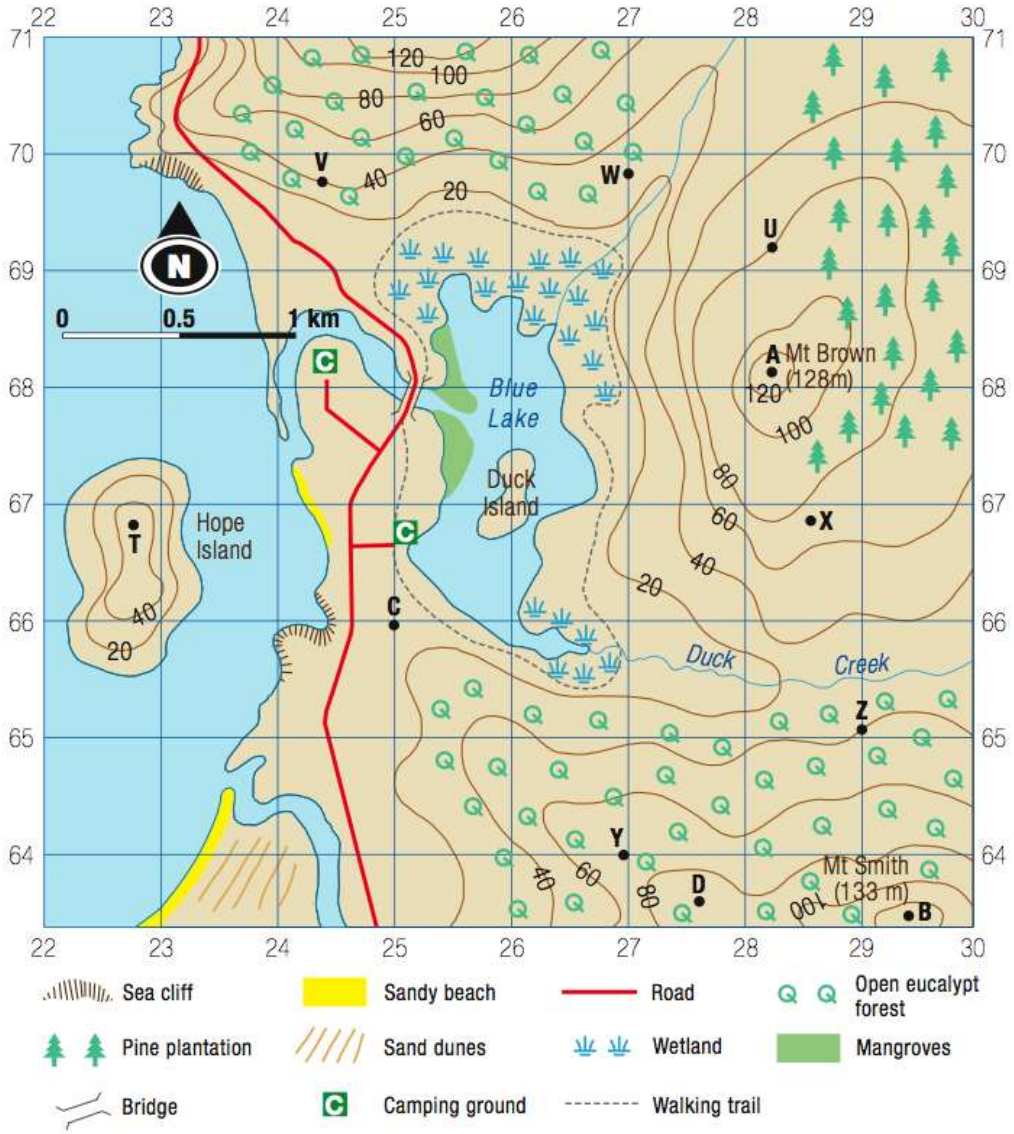
Drainage patterns



Height of landform features (1)

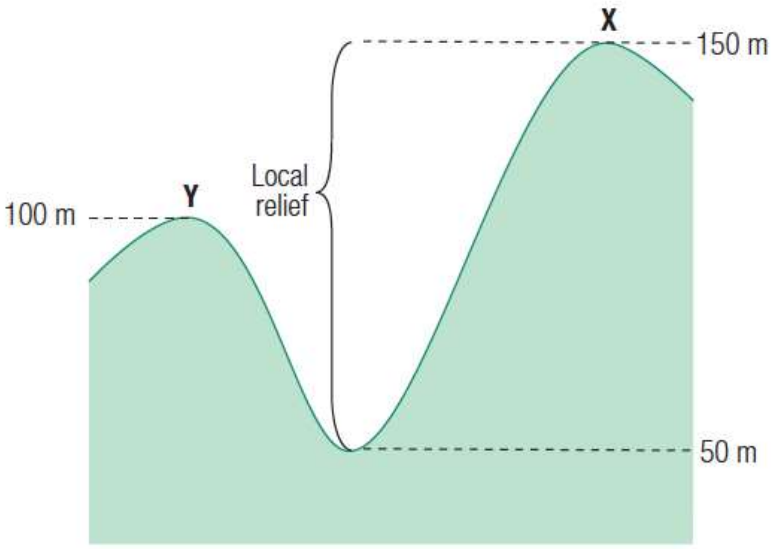


Height of landform features



A	128m
B	133m
C	<20m
D	>80m<100m
U	80m
V	40m
W	>20<40m
X	>60<80m
Y	>60<80m

Local relief



Local relief is the variation in the height over a relatively small, defined area. It is determined by calculating the difference in height between the highest and lowest points in the area.

Example: Calculate the local relief between points X and Y.

150 m – 50 m = 100 m

(highest point: X) (Lowest Point) (Local relief)

Note: Always ensure you include the appropriate unit of measurement with your answer.

Activities:

Elevation and relief

18. Estimate the height of the following landform features:

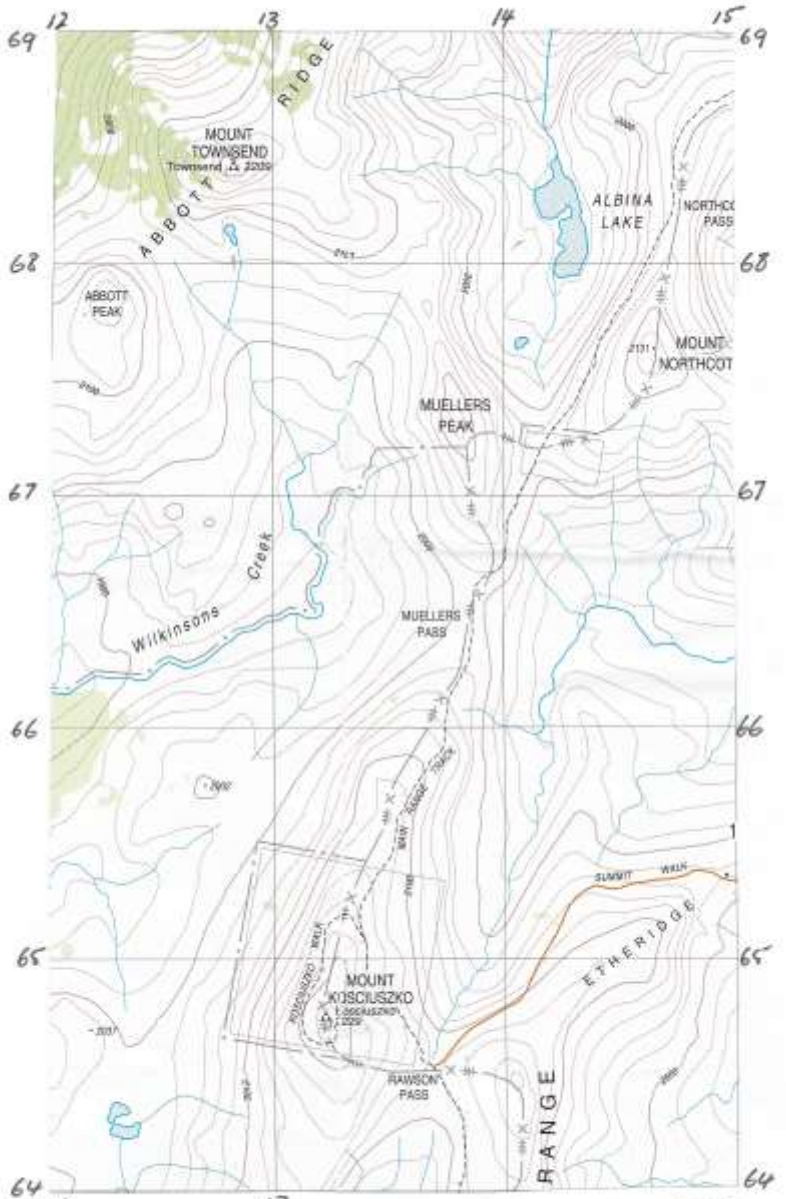
a. Knob Hill (AR 2159) >1900<1920

b. Mount Clark (AR 1567) >2100<2120

c. Abbot Peak (AR 1267) >2140<2120

d. Blue Lake >1880<1900

19. What is the difference in elevation of Mount Townsend (AR 1268) and Mount Kosciuszko (AR 1364)? Between 250 and 268m

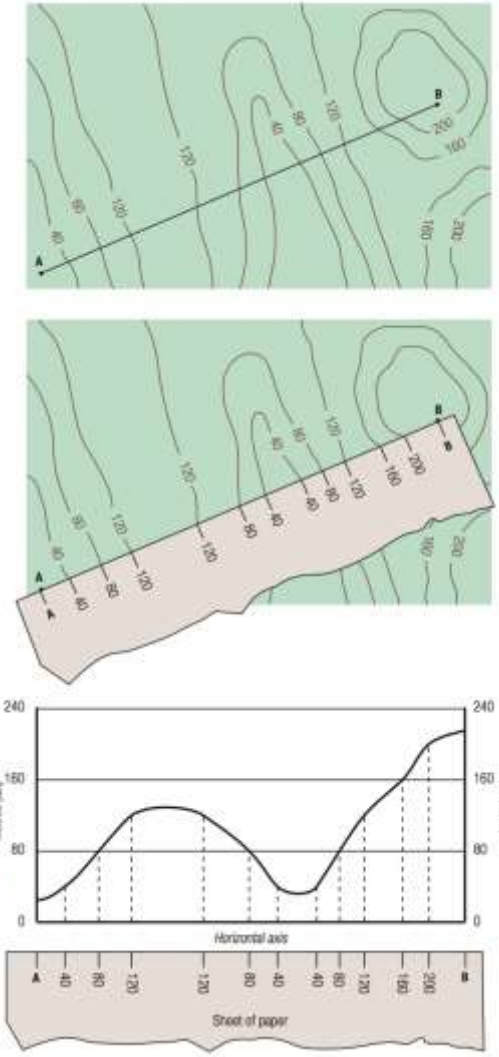


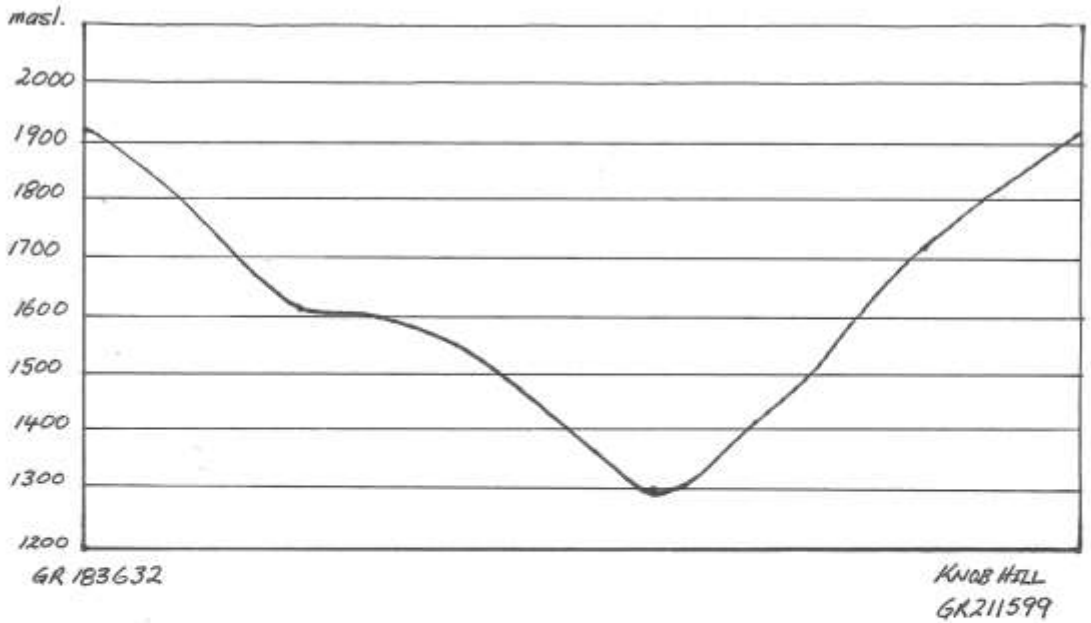
Mount Kosciuszko 2229 m
Mount Townsend 2209 m
20 m

Drawing cross-sections

Drawing a cross-section involves the following steps:

1. Place the straight edge of a sheet of paper along a line joining points A and B. Mark points A and B on your sheet of paper.
2. Starting from point A, mark the position where the edge of your sheet of paper cuts each contour line. Write the value of each contour on your sheet of paper.
3. Draw the horizontal and vertical axes for your cross-section. The length of the horizontal axis should equal the length of the line A–B. The vertical axis, showing the height of the land above sea level, should use a scale appropriate to your needs.
4. Place your sheet of paper along the horizontal axis and then plot the contour points and heights as if you were drawing a line graph.
5. Join the dots with a single smooth, curved line and then shade in the area under the line to highlight the relief.





$$VE = \frac{VS}{HS} \quad \frac{1cm = 100m}{1cm = 25{,}000\,cm} = \frac{\frac{1}{100\,m}}{\frac{1}{250\,m}}$$

$$= \frac{1}{100} \times \frac{250}{1}$$

$$= \frac{250}{100}$$

$$= 2.5 \text{ times}$$

Vertical exaggeration

When a cross-section is drawn from a topographic map, the relief (or shape) of the land is often exaggerated so that relatively small variations in the landscape are clearly visible. To accurately interpret a cross- sectional profile we need to determine how much exaggeration has occurred. To do this we measure the number of times the vertical scale of the cross-section has been exaggerated (or 'stretched') compared with the actual shape. We call this calculation *vertical exaggeration*.

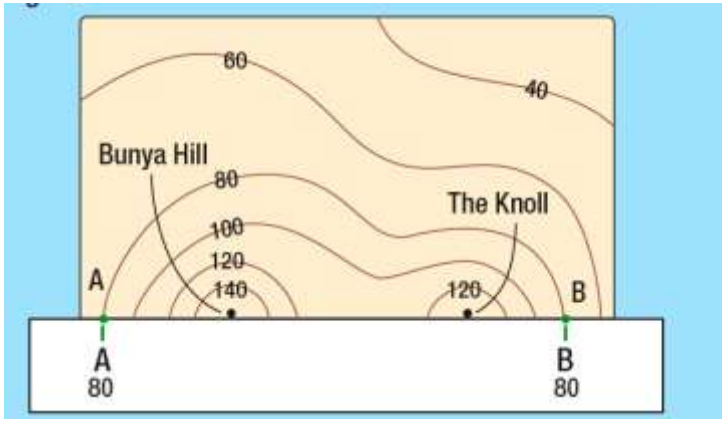
The formula used to calculate vertical exaggeration (VE) is shown below.

$$VE = \frac{\text{Vertical scale (VS)}}{\text{Horizontal scale (HS)}}$$

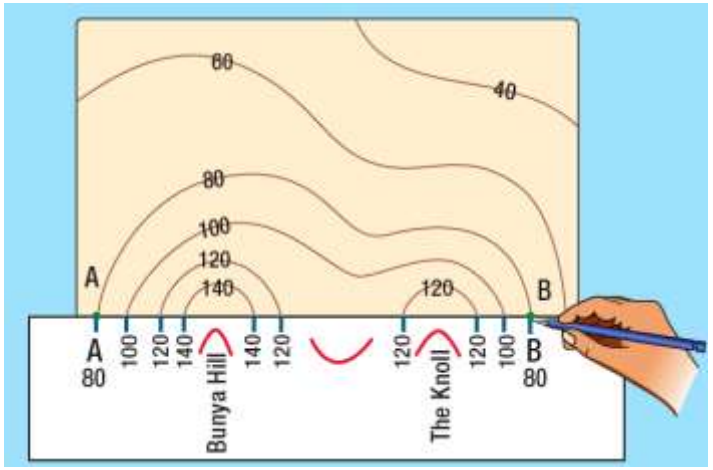
The *vertical scale* is the scale used on the vertical axis of the cross-section. The *horizontal scale* is the scale of the map from which the cross-section was drawn. The most common error students make is not converting the vertical and horizontal scales to a common unit of measurement; for example, metres. Answers must be expressed as a single number. Vertical exaggeration has no units of measurement nor is it expressed as a fraction.

Vertical exaggeration (2)

1



2



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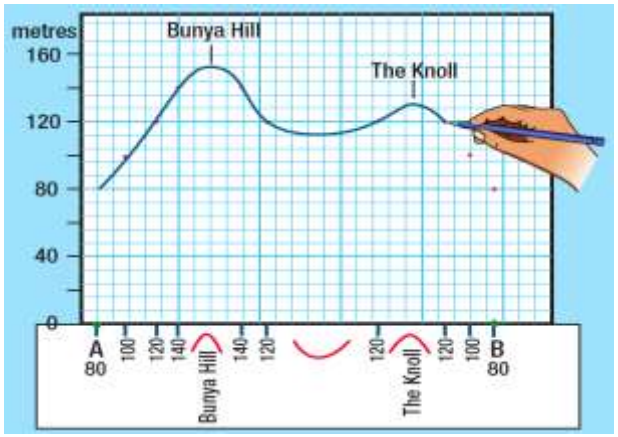
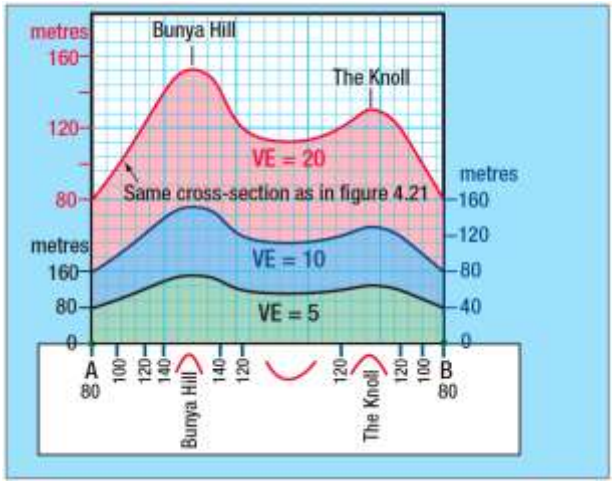


4



Activities:

Cross-sections and vertical exaggeration

20. Construct the cross-section from (GR 183632) to the summit of Knob Hill at GR 211599.

21. Calculate the vertical exaggeration of the cross-section you have constructed.

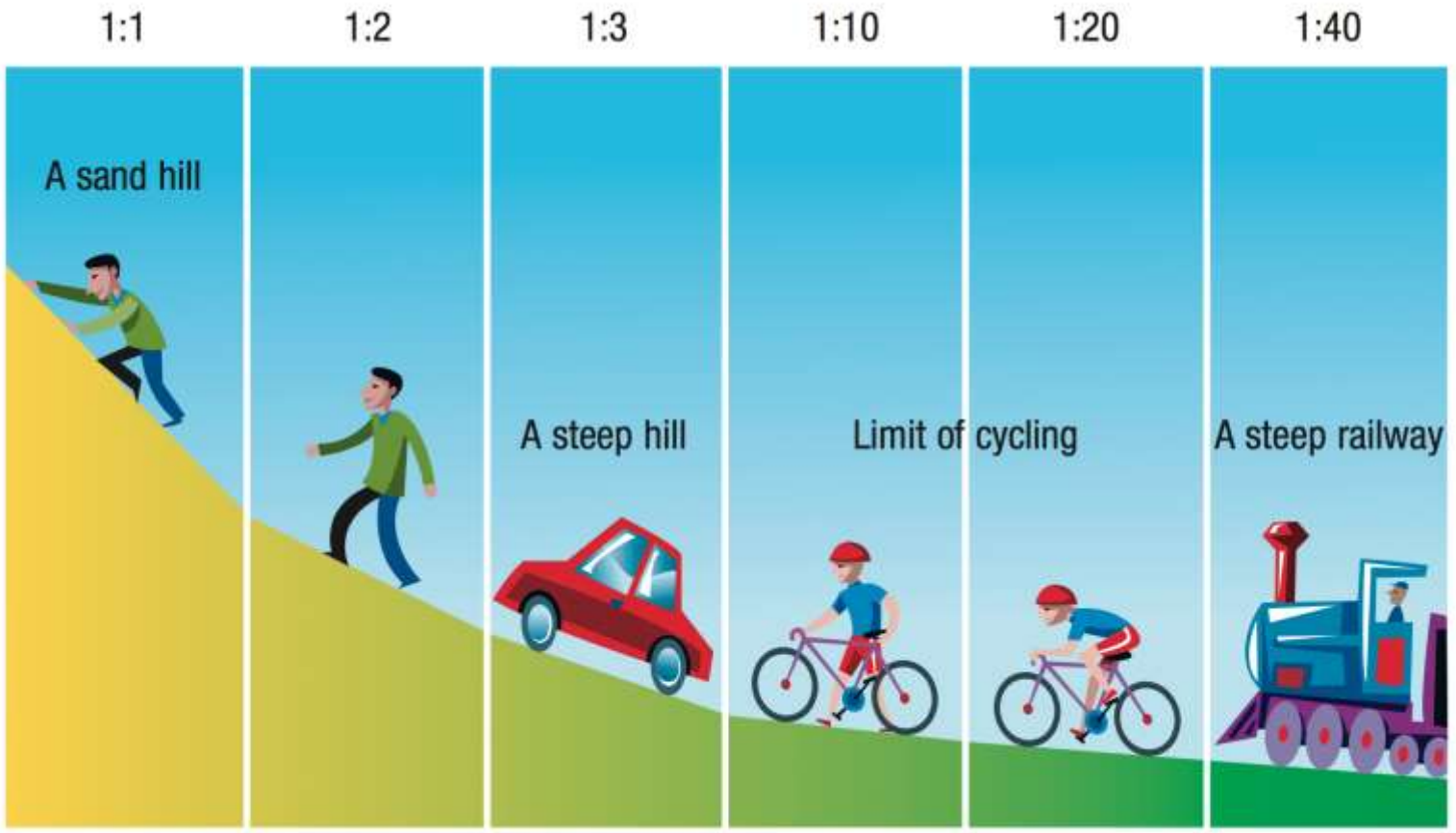
Activities:

Cross-sections and vertical exaggeration

20. Construct the cross-section from (GR 183632) to the summit of Knob Hill at GR 211599.

21. Calculate the vertical exaggeration of the cross-section you have constructed. 2.5 times

Gradient


1:1
1:2
1:3
1:10
1:20
1:40
A sand hill
A steep hill
Limit of cycling
A steep railway

Calculating gradient

Using the contour lines and scale on a map, it is possible to calculate the average gradient, or steepness, of a slope, road or river. The gradient is usually expressed as a fraction or ratio. It is calculated by dividing the difference in height (or vertical interval) between the two points by the horizontal distance between them.

Calculating the gradient between two points involves the two following steps.

STEP 1
Determine the two pieces of information required to complete the calculation.

- The first piece of information required is the difference in height between the two points. This is called the *vertical interval*, or *rise*. Find this by subtracting the lowest point from the highest point.
- The second piece of information required is the *horizontal distance* between the two points. This is sometimes referred to as the *run*. Find this by measuring the distance between the two points on the map and then using the scale to determine the actual distance.

STEP 2
To calculate the gradient of a slope use the following formula.

Gradient = Vertical interval (rise) / Horizontal distance (run)

Note: Because the gradient of a slope is expressed as a ratio, the measurements for the rise (numerator) and run (denominator) must be in the same unit of measurement; for example, metres.

Example: Gradient of the slope between X and Y.

Gradient = Vertical interval (rise) / Horizontal Distance (run)

= 70 m / 4500 m

= 7 (numerator) / 450 (denominator)

= 1 in 64 or 1:64

This means that for every 64m travelled in a horizontal direction. You go up 1 m. If you refer to the previous slide you will see that this is quite a gentle slope. The average person would be able to cycle up such a slope.

Activity

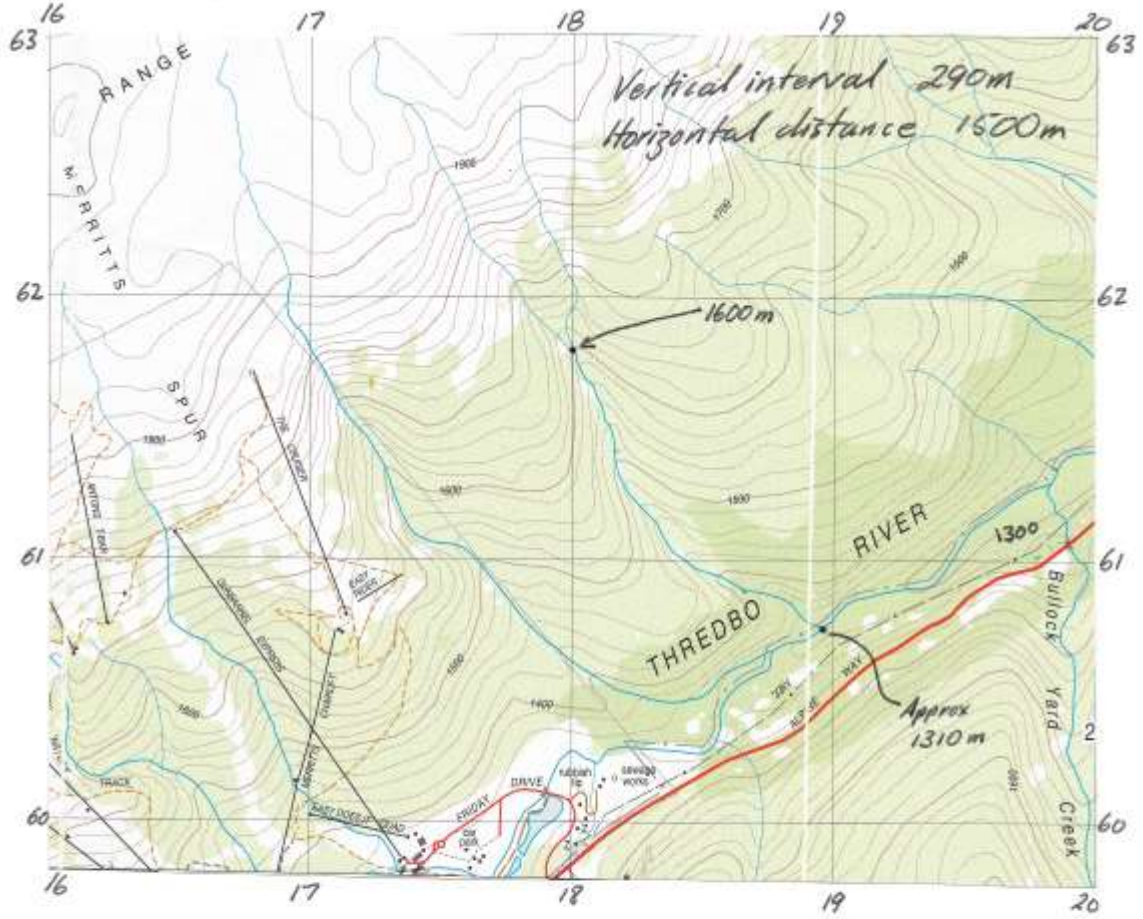
Gradient

22. What is the gradient of the creek between GR 180618 and the Thredbo River at GR 189607? 1:5

Activity

Gradient

22. What is the gradient of the creek between GR 180618 and the Thredbo River at GR 189607?

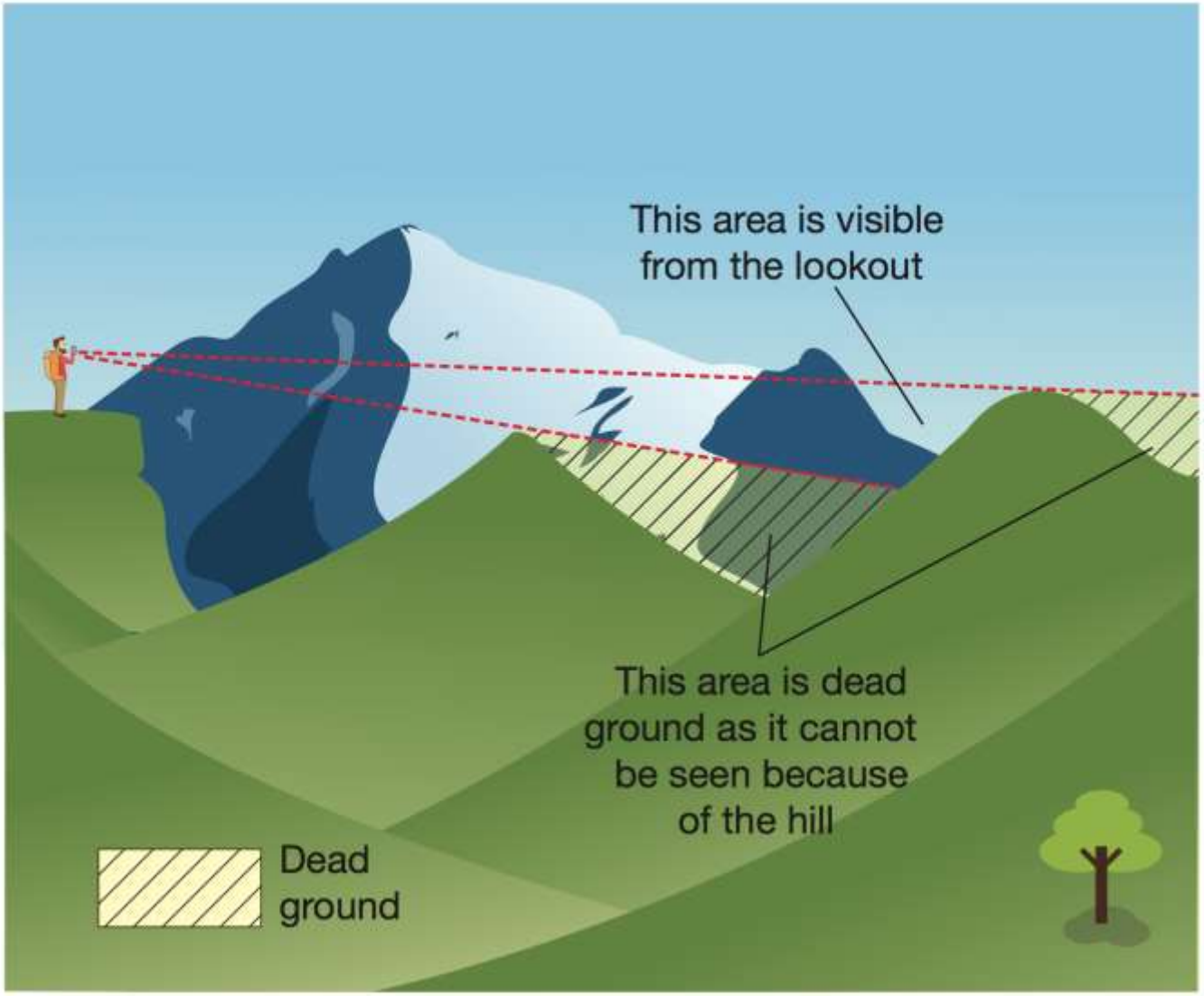


$$\text{GRADIENT} = \frac{\text{VI (Rise)}}{\text{HD (Run)}} = \frac{290\text{m}}{1500\text{m}}$$

$$= \frac{29}{150}$$

$$= 1 \text{ in } 5$$

Intervisibility (line of sight)



Activity

Intervisibility

23. Is Lake Cootapatamba (AR 1363) visible from the summit of Mount Townsend (GR 1268)?

Activity

Intervisibility

23. Is Lake Cootapatamba (AR 1363) visible from the summit of Mount Townsend (GR 1268)? No.
Mt Kosciuszko is blocking the view