A Map User Guide

To Reading Tactual and Low Vision Maps

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FOREWORD

Maps are a valuable source of information about the world in which we live.

This unique guide is designed to introduce maps to the visually handicapped by explaining basic map elements and by providing the skills necessary for successful map reading.

It is the result of an outstanding cooperative effort between the author, cartographers and geographers in the Division of National Mapping, organisations serving the visually handicapped, and blind and visually impaired people themselves. The text, diagrams, map symbols and sample maps were completed only after extensive testing amongst blind and visually impaired people, ranging from young high school students to mature adults.

The author, Mr Byrne Goodrick, is a cartographer of long standing international repute. Through his chairmanship of the Australian Institute of Cartographers Working Group on Tactual Mapping since its inception in 1981, he has been heavily involved in developing and promoting tactual and low vision mapping both in Australia and internationally.

Largely through the dedication and enthusiasm of Mr Goodrick, the acute need for tactual and low vision mapping has been officially recognised throughout Australia. As a result, various Commonwealth and State mapping agencies are now actively engaged in tactual and low vision mapping.

Con Veenstra
Director

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PREFACE

Even though maps have been in use since ancient times, tactual and low vision map making is a relatively new activity and therefore few blind or visually impaired people have had the opportunity to use maps.

As more tactual and low vision maps and atlases have become available, a demand has developed for aids which help people to use these new map products. This *User Guide*, through text and illustrations, is intended to assist potential users in understanding tactual and low vision maps, and to help them develop skills which are essential for map reading. Although highly recommended for use by senior secondary students, the *User Guide* will also certainly be useful for interested adults.

Annexures at the back of this publication list places and organisations where enquiries can be made about the availability of maps, where map reading aids can be purchased and where contacts can be provided for assistance with map reading difficulties. These contacts will be particularly useful for adult users who don't have access to assistance through teaching institutions.

The *User Guide* is produced in two versions, one for braille readers and the other for readers needing bold print and for parents and teachers assisting braille readers.

Low vision maps are made for readers with varying degrees of seeing difficulty. Large, bold type which occupies about the same space on maps as braille is used. In addition, the degree of generalisation and simplification of map detail necessary for efficient map reading by users with severe visual impairment is about the same as for tactual map reading. Therefore, the descriptive text and map reading exercises in the low vision version of this *User Guide* are essentially the same as in the braille version.

You should not expect instant success with reading maps. However, this *User Guide* will help you to understand maps better and, with practice, develop the skills necessary to make map reading an enjoyable and valuable experience.

SECTION 1: Introducing Maps

Maps have been in use since ancient times as a means of representing the relative positions of features on the earth's surface. Today, there are many different kinds of maps providing information for many different purposes. They include:

- topographic maps, which represent portions of the earth's surface and show relief, and natural and man-made features
- bathymetric maps, which show seabed relief
- cadastral maps, which show surveyed boundaries of land parcels or properties
- aeronautical and hydrographic charts, which are maps designed especially for air and sea navigation
- thematic maps, which illustrate a theme, for example population, climate, land use, manufacturing industry, geology, etc.
- town maps and street directories, which show roads and streets, shopping centres, public buildings and facilities

Plans are usually large scale depictions of property boundaries, development sites, etc. and are distinguishable from maps, which usually show much larger areas.

You can use maps to derive information which will assist you in finding your way about cities or the countryside. They provide you with pre-knowledge of the layout of roads and streets, and of the terrain in general.

Atlases, which are collections (usually in book form) of general reference and/or thematic maps covering a region, country or the world, are valuable sources of information on many subjects difficult to comprehend from words alone.

Maps therefore are used as sources of information by many people. Competence in map reading will make you more mobile, independent and knowledgeable. Maps can help you to understand more about your immediate surroundings and the world in general. This *User Guide* aims to develop skills in the interpretation of tactual and low vision maps to the point where you can use maps to plan a journey, move freely between places and as a source of information for educational and research purposes.

Development of map reading skills depends largely upon the understanding of certain concepts and conventions peculiar to mapping, and the development of mental and physical skills which can only be achieved with practice. Hopefully, the following sections will provide you with adequate explanations of cartographic 'concepts' while the accompanying maps and illustrations will enable you to practise various aspects of map interpretation and use.

Some of the concepts of mapping are:

- A map is a bird's-eye view shown on a plane (i.e. flat) surface
- Mapped size and distance relate to real world size and distance
- Mapped shape relates to real world shape
- Map direction relates to direction in the real world
- Map symbols usually represent real and tangible features on the earth's surface
- Lines on a map signify continuity, despite changes in direction and intersection with other symbols.

Skills which need to be developed include:

- systematic scanning and perception of map data
- use of map scale
- map and user orientation
- symbol recognition and discrimination
- shape (outline) recognition
- tracing line symbols

SECTION 2: Map Scale

One of the most important characteristics of a map is that it enables the reader to measure distances between mapped features. However, maps are necessarily smaller than the areas they represent and must state the ratio between comparable distances on the map and the ground to enable accurate measurements to be made. This ratio is known as the 'map scale'.

The map scale is therefore commonly thought of as being the ratio between a distance on the map and the corresponding distance between the same two points on the ground, with the distance on the map always expressed as one.

Effective map use is impossible without a proper understanding of scale. Map scale not only provides you with knowledge of distances between objects on the ground but it is a prime factor in assisting you to appreciate the relative position of mapped features and thus build a mental picture of a mapped area. It is this pre-knowledge of an area which enables you to move with confidence from one location to another.

Map scale can be expressed in the following ways:

- scale statement
- graphic or bar scale
- representative fraction

SCALE STATEMENT

On many maps the scale is described in words and numbers. For example 1 centimetre equals 100 kilometres or, as often found, 1 centimetre to 100 kilometres. This means that 1 centimetre on the map represents 100 kilometres on the earth's surface.

Figure 1.1 gives some examples of scale statements.

GRAPHIC OR BAR SCALE

This is a line or parallel lines placed on a map, usually near the margin, to enable distances between points on the map to be measured directly in the ground distances they represent. Such scales are subdivided into convenient units of measurement such as 10s or 100s of metres or kilometres. The left-hand end of the scale may be subdivided further so that distances can be measured more precisely.

Figure 1.2 includes some different kinds of bar scales. Note that the third bar scale is divided into major units only, with every second unit infilled for easy recognition.

REPRESENTATIVE FRACTION

Map scale is commonly expressed as a 'representative fraction' (RF for short), in which map distances are expressed as ratios of real distances, for example 1:10 000. This means that 1 mm or 1 cm on the map represents 10 000 mm or 10 000 cm respectively on the earth's surface. Stated another way, a map drawn 1000 times smaller than that part of the earth's surface it represents would have an RF scale of 1:1000.

Figure 1.3 gives some examples of RF scales.

You will find that most of the maps you wish to use will have bar scales. A ruler will help you to use a bar scale to measure the distance between two points. Place the end of the ruler on the first point and with one of your fingers mark the position of the second point on the ruler. Then, without moving the finger on the ruler bring the ruler to the bar scale and read off the distance.

Figure 1.1
Scale statement

1 centimetre equals 1250 metres

One centimetre to twelve hundred and fifty metres

1 centimetre equals 25 kilometres

1 centimetre to 300 kilometres

Figure 1.2
Graphic or bar scale

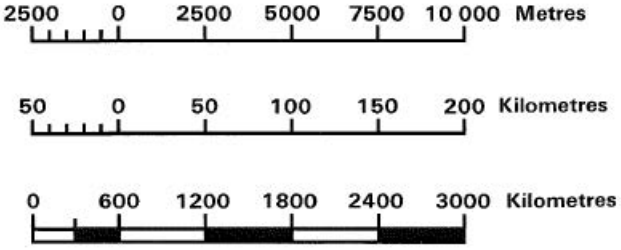


Figure 1.3
Representative fraction (R F)

1:1250 (1 unit on the map represents 1250 units on the ground)

1:25 000 (1 unit on the map represents 25 000 units on the ground)

1:30 000 000 (1 unit on the map represents 30 000 000 units on the ground)

Your thumb and forefinger can also be used to measure the distance between two points. However, both of these methods will only give approximate measurements. A more accurate measurement can be achieved by using 'dividers' to obtain the length between selected points.

Did you notice that the same three scales—1:1250, 1:25 000 and 1:30 000 000—were represented in three different ways in Figure 1?

Maps can be drawn at many different scales and the terms 'small scale' and 'large scale' are often used. One way to explain these terms is to imagine that you have two maps covering exactly the same area of the earth's surface but at different scales. The larger scale map will be larger than the small scale map. Conversely, if you have two maps of the same size but at different scales the larger scale map will cover a smaller area of the earth's surface than the smaller scale map. Examples of small scale maps found in this *User Guide* are the maps of Australia at 1:20 000 000, 1:22 000 000 and 1:30 000 000, whereas the map 'Urbanville Town Centre' at 1:1250 is a large scale map.

SECTION 3: Map Direction and Orientation

MAP DIRECTION

Map direction relates to direction in the real world and is usually described in terms of the four main (or 'cardinal') points of the compass—north (N), south (S), east (E) and west (W). These cardinal points divide the map into four quadrants which can be further subdivided in half by the 'intercardinal' points—north-east (NE), which is half-way between north and east, north-west (NW), south-east (SE) and south-west (SW). Figure 2.1 illustrates the eight points of the compass.

It is standard practice to have north pointing towards the top of a map. South is therefore towards the bottom, east towards the right and west towards the left. However, on rare occasions there may be a need to break this convention. In such cases the direction of north is usually indicated by an arrow called a north point, or sometimes on tactual maps by a north line at the top of the map-sheet. Figure 2.2 gives two commonly used kinds of north points.

It is very important to remember to check the direction indicator when using maps. Where direction is not marked on the map you may safely assume that north is at the top of the page.

ORIENTING A MAP

Directions between features on a map are the same as the directions between the same features on the ground only when the map is correctly oriented. In order to orient a map it must be turned so that north on the map points in its correct direction.

If you already know the true direction of a linear feature such as a street you can stand in the street and turn the map until the street on the map points in the same direction. The map is then said to be oriented.

Figure 2.1
Cardinal and intercardinal points

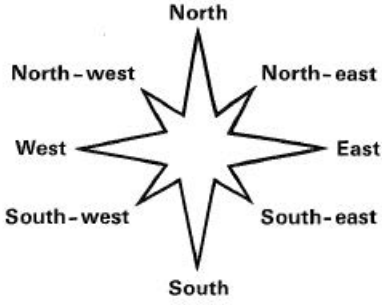
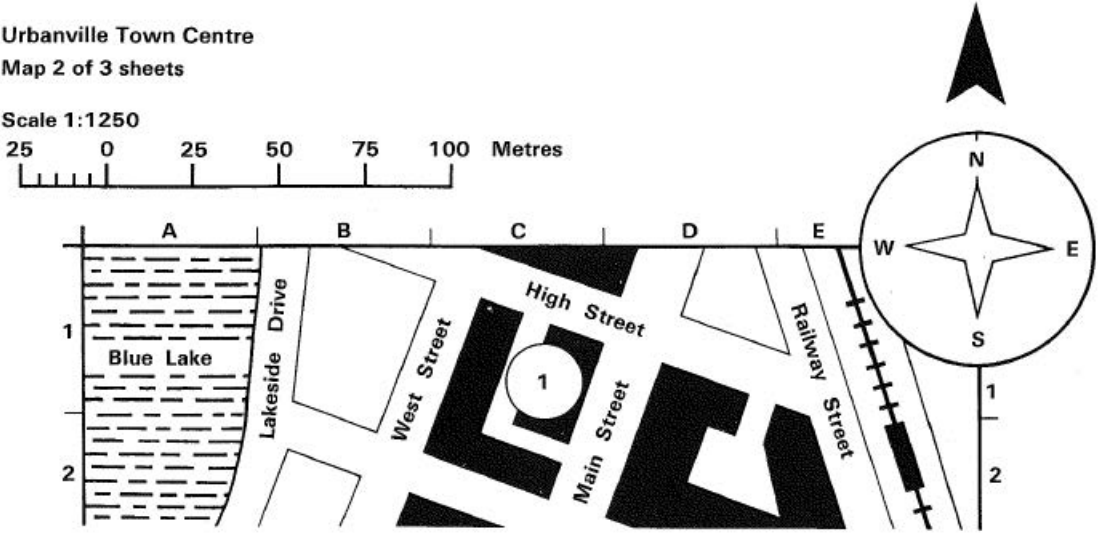


Figure 2.2
North points

Figure 2.3
Orienting a map

Urbanville Town Centre
Map 2 of 3 sheets

Scale 1:1250



More often, however, it is necessary to use a magnetic compass, which works on the principle that a pivoting magnetised needle always points towards the earth's magnetic pole. This is called 'magnetic north'.

A map can be oriented quickly by placing a compass on it and rotating the map until map north and the needle of the compass are pointing in the same direction. Refer to Figure 2.3 where a compass has been placed adjacent to the map's north point to allow alignment. The compass can of course be placed anywhere on the map; alignment of map north and compass north is what is important.

Tactual (braille) compasses are available and are very useful to both the visually impaired and the blind. On the compass dial north is usually indicated by a raised arrow; the dial can be locked in position for tactual reading.

One well-known type of braille compass uses the lid movement to lock the dial in position. To orient a map using this type of compass, place the map and compass on a level surface, with the compass adjacent to the north point on the map. Leave the compass lid closed for about 10 seconds to allow the dial to float freely and to be attracted by the earth's magnetic pole then open the lid to lock the dial in position. Now observe the direction of north on the compass and turn the map until both map north and compass north point in the same direction.

Re-check compass north by repeating the action and re-adjust the map if necessary.

For the locations of places where tactual compasses can be purchased refer to Annex 1 located at the back of this *User Guide*.

SECTION 4: Map Reference Systems

Most maps have some form of reference system to help you locate or refer to places and other features on maps.

MAP GRIDS

A grid divides the map into columns and rows so that you can search it in a logical way to find a point or area on the map.

Alphanumeric Grids

Tactual and low vision maps usually have a simple grid of letters and numbers to indicate a small area of the map in which a feature can be found. This grid is generally shown by ticks around the edge of the map dividing the map into columns which are lettered and run down the page, and rows which are numbered and run across the page. Letters and numbers start from the top left-hand corner of the grid.

Figure 3.1 provides a simple alphanumeric grid with several shapes located within it. To establish where the triangle is located trace up or down the column and find the corresponding letter, and then across the row and find the corresponding number. The triangle is in column C and row 2. Therefore, the values which specify its location (known as the 'coordinates') are C2. Remember, when working with alphanumeric grids the letter representing the column should always be stated before the number representing the row.

It may not always be easy for you to trace the columns and rows accurately with your fingers and in these cases a ruler held in one direction will help. Now see if you can find the coordinates of the remaining shapes—a circle and a cross. The answers are at the end of this section.

Figure 3.1
Alphanumeric grid

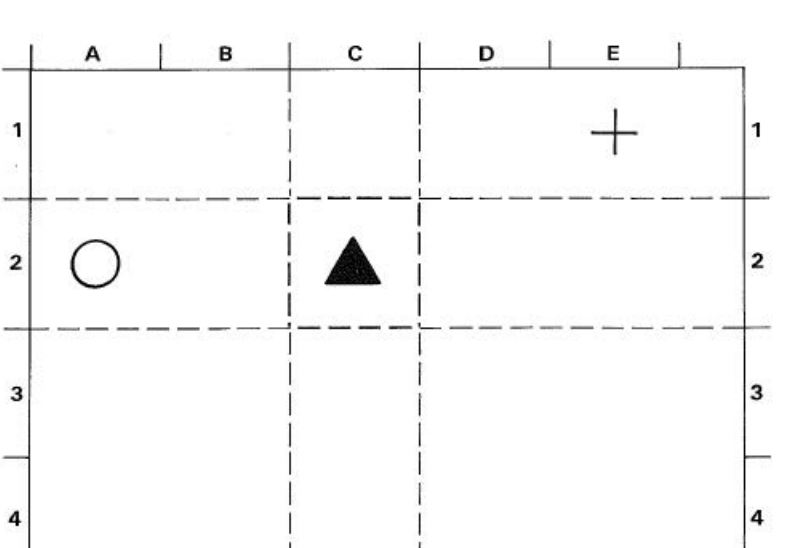


Figure 3.2

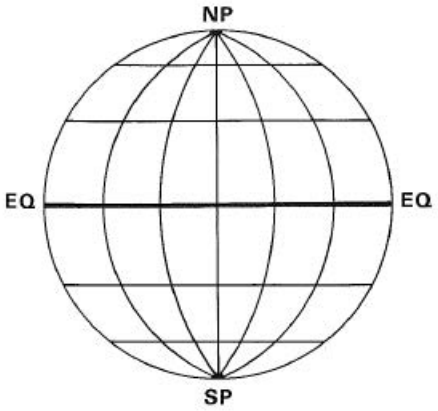
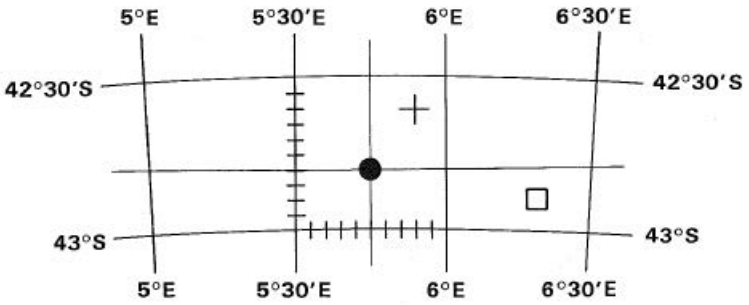


Figure 3.3
Latitude and longitude



Topographic Map Grids

Topographic maps usually have a grid of parallel N–S and E–W lines spaced at regular intervals. Map coordinates can be read from these grid lines in metres from W to E (the 'eastings') and from S to N (the 'northings'). When determining such map coordinates, the easting should always be read first.

GRATICULES

Latitude and longitude is the best known, and most universal system of map referencing. Lines of latitude, called 'parallels', circle the earth in an E–W direction parallel to the Equator and lines of longitude, called meridians, circle the earth in a N–S direction converging through the North and South Poles.

When shown on a map, parallels and meridians are often curved but cross each other to form a 'graticule' which can be used in the same way as a map grid to locate features or read their coordinates. Graticule values in degrees, minutes and seconds are known as geographical coordinates or simply 'geographicals' or 'coordinates'.

Latitude and longitude are measured in degrees, minutes and seconds; latitude up to 90 degrees N and S of the Equator and longitude up to 180 degrees E and W of Greenwich Observatory in England. As there are 60 minutes in a degree and 60 seconds in a minute, this form of referencing can accurately describe any point on the earth's surface.

In Figure 3.2 the earth is represented by a circle with latitude lines parallel to the Equator (**EQ**) and longitude lines converging through the North Pole (**NP**) and the South Pole (**SP**).

Figure 3.3 illustrates a small section of a latitude and longitude graticule at 30-minute intervals. The inner square is further subdivided into 3-minute intervals. The dot near the middle of this square is located at 42 degrees 48 minutes S latitude and 5 degrees 45 minutes E longitude. Try to work out the coordinates for the cross and the square. The answers can be found below.

ANSWERS TO EXERCISES IN SECTION 4

Figure 3.1 (Alphanumeric Grid)

Circle—A2

Cross—E1

Figure 3.3 (Latitude and Longitude)

Cross—42 degrees 36 minutes S, 5 degrees 54 minutes E

Square—42 degrees 54 minutes S, 6 degrees 18 minutes E

SECTION 5: Map Symbols and Legend

The main purpose of a map is to communicate data to the map user. Maps, as graphic systems of communication, use a variety of symbols to represent this data. These symbols are the language of maps.

There are three main elements which enable you to distinguish one map symbol from another. They are:

- Shape—for example, a rectangle may be used to represent a building while a triangle may represent a mine.
- Size—most commonly used to indicate the degree of importance of a feature. For example, a large circle may represent a city and a small circle may represent a town.
- Colour and texture—a limited range of strong colours can be used on low vision maps. For example, red may represent urban land, green non-urban land and blue water features. However, as tactual maps can only be read by touch, texture is used instead of colour. This texture is generated by the use of various patterns. For example, a solid raised area could represent urban land, vertical stripes represent non-urban land and small dots represent water features.

Symbols that are suitable for tactual maps have been found to be equally effective for low vision map users.

All map symbols can be divided into three types:

- point symbols
- line symbols
- area symbols

POINT SYMBOLS

Point symbols are used to represent features or data at specific locations. Dots, circles, squares and crosses are examples of point symbols. On town maps, features like traffic lights and telephone boxes are represented by point symbols. On topographic maps mountain peaks, buildings and mines are represented by point symbols, while on thematic maps a wide range of both quantitative and qualitative data is depicted by point symbols. For example, a variety of shapes may be used to represent minerals, or different size circles may depict settlements of varying sizes on a population distribution map.

Figure 4.1 gives examples of some point symbols.

LINE SYMBOLS

Lines are used on maps to show linear features such as roads, rivers, railways, boundaries and other features which have continuity. Line symbols can have many different forms: they may vary in thickness, be constructed of a series of dots or dashes, or be a combination of lines and shapes.

Figure 4.2 illustrates a variety of line symbols.

In cases where linear features cross one another, it is common for one of the line symbols to be broken, for clarity. A river, for example, may be broken where a road crosses it.

AREA SYMBOLS

Area symbols are used to depict features which cover areas too large to be mapped by point symbols. Lakes and other water features, forests, parks, plantations and reserves are examples of such features. The boundaries of area features may or may not be depicted by lines. Nevertheless, the enclosed areas are usually infilled with distinctive patterns or colours to separate the different areas mapped.

Figure 4.1
Point symbols

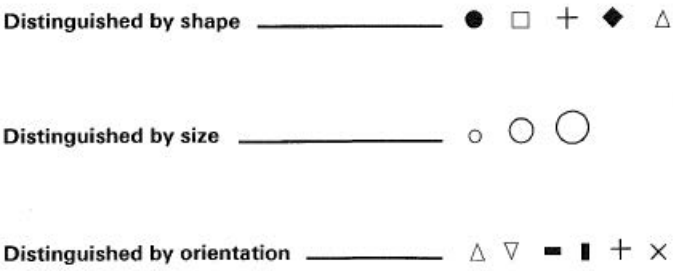


Figure 4.2
Line symbols

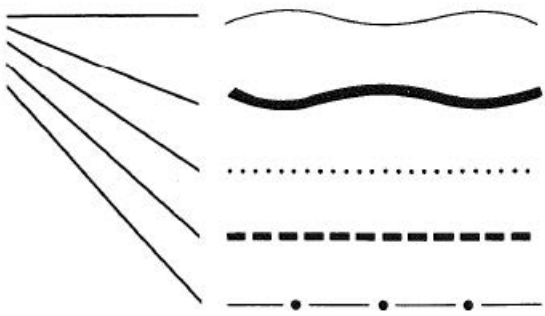


Figure 4.3
Area symbols

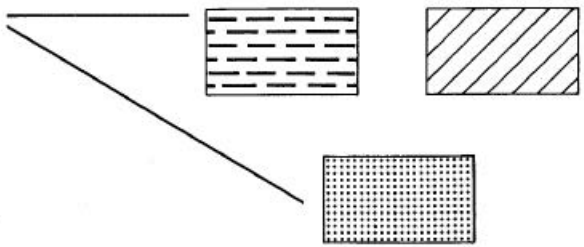


Figure 4.3 provides examples of area symbols.

MAP LEGEND

The map legend is the key to understanding what the various symbols on a map actually represent. A map legend therefore consists of a list of the symbols used on a map together with simple statements explaining what each symbol represents. It allows you to decode the map.

Most maps have their own legend, which appears on the face of the map. However, sometimes when there are a number of maps showing the same features and belonging to a series, there will be a separate standard legend for use with all of them.

SECTION 6: Contours

Contours (or, more correctly, 'isolines') are lines that join points of equal value on a map. The values may be for heights above sea-level, ocean depths, atmospheric pressure and so on. These lines have special names when they measure certain features, for example:

- contours measure height
- isotherms measure temperature
- isobars measure air pressure
- isobaths measure ocean depth
- isohyets measure rainfall
- isochrones measure time

Unlike many other map symbols which represent real objects, isolines are an abstraction used to interpret and depict data. Isoline maps can be divided into two separate types: 'isometric' maps and 'isopleth' maps. Isometric maps, such as contour maps, consist of lines drawn through points of equal value. Isopleth maps, like population density maps, consist of lines connecting areas with equal values. These values are obtained for defined areas such as towns or census districts.

Contours are probably the most common type of isoline. Contour maps show the pattern of relief of an area of land by lines which join points that are the same height above or below sea-level. The height of each contour is usually written on the contour line. The vertical distance between each of the lines (the contour interval) is constant and usually stated in the map legend.

Figure 5 explains how contours are used to depict the land surface.

Figure 5.1

Three-dimensional reprensentation of a small hill with a valley on the upper side

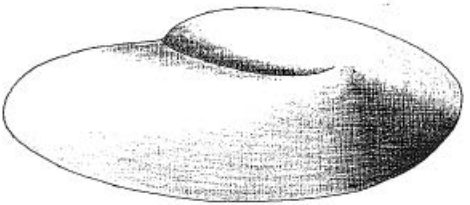


Figure 5.2

Same hill depicted by layers of equal height

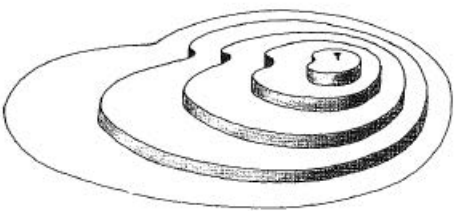


Figure 5.3

Edges of layers replaced by contour lines

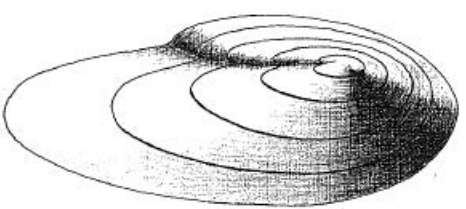


Figure 5.4

Hill depicted in two dimensions using contours

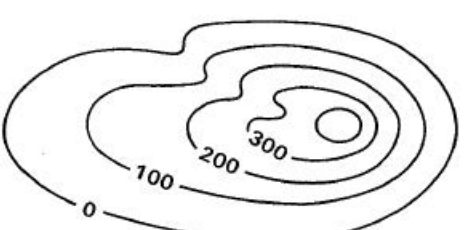


Figure 5.1 is a three-dimensional (length, width and height) drawing of a hill. The highest point is towards the right-hand or eastern side of the hill, and the slope is steeper here than on the left-hand or western side. A valley begins near the top of the hill and runs down the upper left-hand or north-western slope.

In Figure 5.2 the same hill is represented by a series of layers of equal height. Assuming the bottom layer to be sea-level, the edges of the other layers represent lines of equal height above sea-level—they are contour lines.

In Figure 5.3 the edges of the layers in Figure 5.2 are represented by lines on the three-dimensional drawing of the same hill—they are contour lines on the ground surface of the hill.

Figure 5.4 is a plan (map) view of the contour lines in Figure 5.3. Values for the contour lines (in 100-metre intervals) have been added from sea-level up to 300 metres. The highest contour, which represents 400 metres above sea-level, is unlabelled. Note that the contours are closer together where the slope is steep on the right-hand side, and wider apart on the left-hand side where the slope is more gentle. Also, the valley on the left slope is represented by contour lines which run in one side of the valley and back out the other.

In Figure 5.4 you will notice that the three-dimensional hill has been accurately depicted on a flat plane!

Figure 5 represents only a simple relief feature. In the real world, however, the terrain is very diverse and complex and to date little research has been undertaken on the ability of blind people to interpret terrain from contours.

Nevertheless, simple contours and other isolines can be readily interpreted as you will discover in the map reading exercises which use Figure 14.

Here isolines are used to depict two common types of data—elevation (height in metres) and population density—on small scale maps of Australia. However, it is advisable that you wait until you have read the following sections before attempting to read these maps.

SECTION 7: Naming Features on a Map

The placement of feature names on tactual and low vision maps is sometimes quite difficult for the cartographer, particularly as braille and bold type take up large amounts of space. Despite this difficulty, the cartographer strives to maintain a clear relationship between the position of a feature and its name. Hence an understanding of cartographic name placement and the means used to overcome problems of space will help you in map reading.

POINT FEATURES

The names of point features are placed as close to the feature as possible. The preferred sequence for the positioning of point feature names (depending on the proximity of other features and the space available) is:

1. Horizontal and immediately to the right
2. Horizontal and immediately to the left
3. Horizontally above
4. Horizontally below

Figure 6.1 gives examples of name placement for point features.

LINE FEATURES

The names of continuous features such as roads and streams are positioned so that they follow the general shape of the feature. On conventional maps and low vision maps this often means that names will be curved. Braille, however, does not lend itself to curving so the names of line features on tactual maps are parallel to the feature regardless of direction. If a feature such as a street runs directly N–S, the name will be positioned so that you read from the bottom.

Figure 6.2 gives examples of name placement on line features.

Figure 6.1
Point features

First preference ..... ■ Name

Second preference ..... Name ■

Third preference ..... Name ■

Fourth preference ..... ■ Name

Figure 6.2
Line features

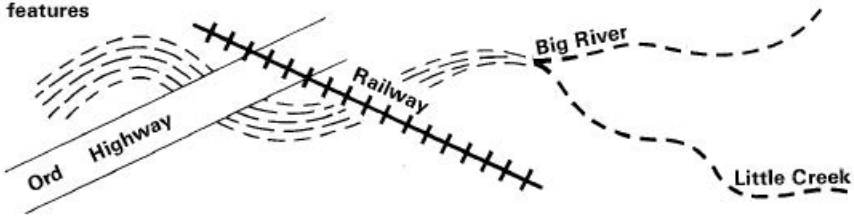


Figure 6.3
Area features

Figure 6.4
Names cutting coastlines

AREA FEATURES

Names of area features like lakes and parks are wherever possible placed in the centre of the area to which they refer. If the name is too large to fit wholly within the feature, it will usually be placed partly within the bounded area and the boundary will be broken to allow the name to extend beyond it.

Figure 6.3 gives some examples of name placement for area features.

When naming features on a map, cartographers will always try to avoid breaking line symbols. However, at times the problem of name placement will dictate that features like the coastline and boundaries be broken. For example, the name of a coastal town may have to be positioned so that it cuts the coast, or placed entirely in the sea to allow more space for features on the land. In these cases any associated patterns will be cleared to allow the names to be easily read.

Figure 6.4 gives some examples of these situations.

LETTER AND NUMBER ABBREVIATIONS

Lack of space on tactual and low vision maps will sometimes mean that feature names have to be abbreviated on the face of the map. Letters and/or numbers are often used in place of names, with an accompanying list providing the full names or descriptions. When this technique is used it will be indicated in the legend or elsewhere in the marginal information on the map.

Figure 6 gives only some samples of the many problems associated with the placement of names on tactual and low vision maps. Don't be surprised if you encounter others!

SECTION 8: Generalisation of Map Detail

Generally, the amount of detail which can be included on a map is determined by the map scale—only on very large scale plans is it possible to include every feature. The amount of detail which can be depicted decreases rapidly as the map scale becomes smaller.

Maps which contain too much information become cluttered and difficult to read, and are of little use. The cartographer must therefore use a process of simplification and selection to ensure that the map contains a maximum amount of information but at the same time remains readable. This process is known as 'generalisation'.

SIMPLIFICATION

Cartographers commonly simplify data by smoothing outlines and making shapes less complex so that they are more easily read; by aggregating data so that a number of small features are represented by a single symbol; and by grouping categories of data to reduce the number of categories shown.

SELECTION

Selection is undertaken by ranking the map data in order of importance. The least important can then be omitted or amalgamated as map scale decreases. For example, a large scale map may show all six categories of a particular road classification whereas on a smaller scale map of the same area only the two most important categories might be included, or the four most important categories may be combined into two and the lesser two categories omitted.

The size of features is also an important selection criteria; larger features are retained whereas smaller features are omitted as map scale decreases.

Other factors, such as the large amount of space required by braille and bold type, and the necessity to leave enough space between features on a map so they can be identified by touch, impose severe limitations on the amount of detail which can be shown on tactual and low vision maps.

Figure 7 gives examples of generalisation for different map scales. Figure 7.1 depicts the same section of a town map at two different scales. You will notice that the less important streets and street names have been omitted at the smaller scale and that the railway station symbol has been simplified.

Figure 7.2 depicts a series of lakes at two different scales. On the smaller scale map the two largest lakes are unaltered but the smallest lakes have been omitted and the small lakes close together have been combined into one. However, the three lakes remaining at the small scale still indicate that more than one lake in fact exists. Also the overall shape of the series of lakes has been preserved.

Figure 7.3 illustrates how toilets on maps at two different scales may be depicted. The large scale map shows the layout of the toilets with their entrance on Main Street and the individual cubicles. At the small scale a single symbol is used to show the location of a toilet facility in relation to the street.

Figure 7.4 depicts how a stream pattern has been simplified by omitting the smaller and less important streams shown at the larger scale.

Figure 7.1

Town Map — large scale ..... Town Map — small scale

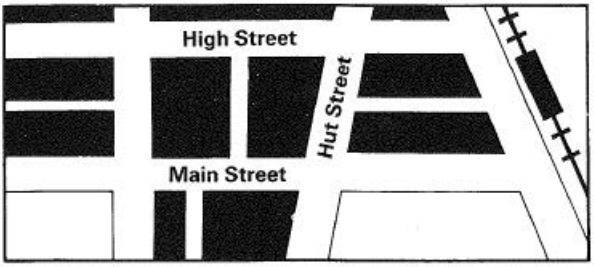


Figure 7.2

Lakes — large scale ..... Lakes — small scale

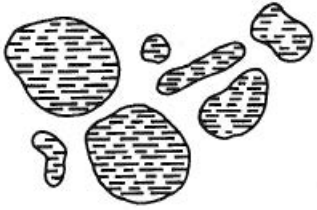


Figure 7.3

Toilets — large scale ..... Toilets — small scale

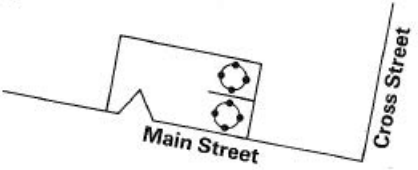


Figure 7.4

Rivers — large scale ..... Rivers — small scale

SECTION 9: Map Reading Strategies

By now you should have an understanding of the basic map elements and be ready to begin map reading.

Maps, like books, should be read systematically. This will take practice on your part but if you adopt the following general steps the task will be made easier:

1. Undertake a preliminary scan of the whole map area.
2. Locate and read the marginal information (such as the title, scale and legend).
3. Then read the map content.

SCANNING

It is very important that you do a preliminary scan of the entire map area before attempting to read the map content in any detail. It should be done slowly and systematically so as to provide you with a complete mental picture of the general layout of the map and its contents.

For braille readers, the most efficient method of scanning is to use both hands simultaneously to move in vertical strips down the map. If you use three fingers on each hand, thus giving a six-finger wide perceptual window, the whole map can be covered in relatively few scans. The use of six fingers also helps in recognising linear features and their orientation. Because you are accustomed to reading braille, it may take a little while to get used to vertical scanning, but with practice it will become easy.

For bold print readers, scanning by eye is an effective means of covering the map. You can scan in strips up and down or across the map. The width of each scan will depend on your area of vision. Another, less systematic form of scanning is to trace in turn the major features like the coastline, rivers, roads, railways, etc.

You may find it necessary to repeat the scan several times before you are able to gain a mental picture of the whole map.

MARGINAL INFORMATION

The first pieces of map information which should be read are usually found in the map margin. You will of course have already located them during the preliminary scan. They are:

- map title
- map scale
- map legend

and should be read in this sequence.

Map Title

A map title is a concise statement about the intended purpose of the map. It often consists of two parts:

- A primary title that identifies the mapped area
- A secondary title that states the contents of the map

For example, a map titled 'Sydney: Local Government Areas' tells you that the map covers the whole of metropolitan Sydney with the main feature mapped being local government areas (boundaries and names). Similarly, a map titled 'Civic Centre: Sheet 1 of 3 Sheets' tells you that three maps are needed to cover the whole of Civic Centre. Other titles like 'Australia: Population Density' are more self-explanatory and give specific information.

Map Scale

As you already know, map scale is the ratio between a distance on the map and the corresponding distance between the same two points on the ground. Section 2 explains map scale in some detail.

The scale is included in the marginal information on the face of the map except where the map is one of a series, in which case the scale will often be shown on a separate legend sheet—see below under 'Map Legend'.

Map Legend

As we discussed previously a map legend consists of a list of the symbols used on a map together with simple statements explaining what each symbol represents.

On most maps, like those found in thematic atlases and topographic map series, a separate legend will appear on the face of each map. However, where a braille map is one of a series using a standard set of symbols, a separate single legend sheet is likely to be provided for all maps in the series.

Locating the legend and familiarisation with the symbols used on the map are essential before you can successfully read the map content.

Other Marginal Information

Amongst the marginal information you may also find additional notes relating to map content. To conserve space, for example, braille or bold print feature names may be replaced on the map with letters or numbers and in such cases a list which identifies the abbreviations will appear in the margin or on a separate sheet.

Now that you have a mental image of the general layout of the map and know something about its content and the way in which the data are represented, you can begin a more detailed study of the map content.

MAP CONTENT

Perception of a whole map can only be achieved by exploring small parts of the map and fitting them all together into a coherent whole.

The following hints will be helpful when you are reading map content:

- Maps which depict point data, for example maps portraying urban centres, mineral deposits, etc. may best be explored State by State by relating individual locations to State borders and/or the coastline.
- Maps which depict data such as roads or railways by lines may best be explored by tracing the length of individual features and relating them to State borders and/or the coastline.
- Area data such as soil types and rainfall distribution may best be explored category by category, again using the familiar shapes of the coast and other known features.

As map detail comes in many forms, different maps are often suited to different reading strategies. The exercises in the next section include examples of strategies suited to different types of maps and will give you the opportunity to use many of the skills you have learnt in the previous sections.

SECTION 10: Map Reading Exercises

The following maps and explanations are designed to provide you with experience in reading different types of maps. They will enable you to apply the knowledge you have gained in earlier sections to use map scales, measure distances, read map coordinates and interpret map data.

READING A TOWN MAP

Complete a preliminary scan of the town map at Figure 8. Repeat the scan until you have gained a general idea of the layout of the map.

Next, the marginal information should be studied. Firstly read the map title to find the purpose of the map and the area it covers. Note that this map is one of three which make up a series.

The scale information is located on the top left of the sheet—a representative fraction (RF) and then a graphic scale. The RF tells us that 1 unit on the map represents 1250 units on the ground. The line scale is divided into 25 metre intervals labelled every 50 metres. To the left of '0' the scale is divided into 5 metre intervals to allow more accurate measurement. This is a large scale map compared to the other maps in this *User Guide*.

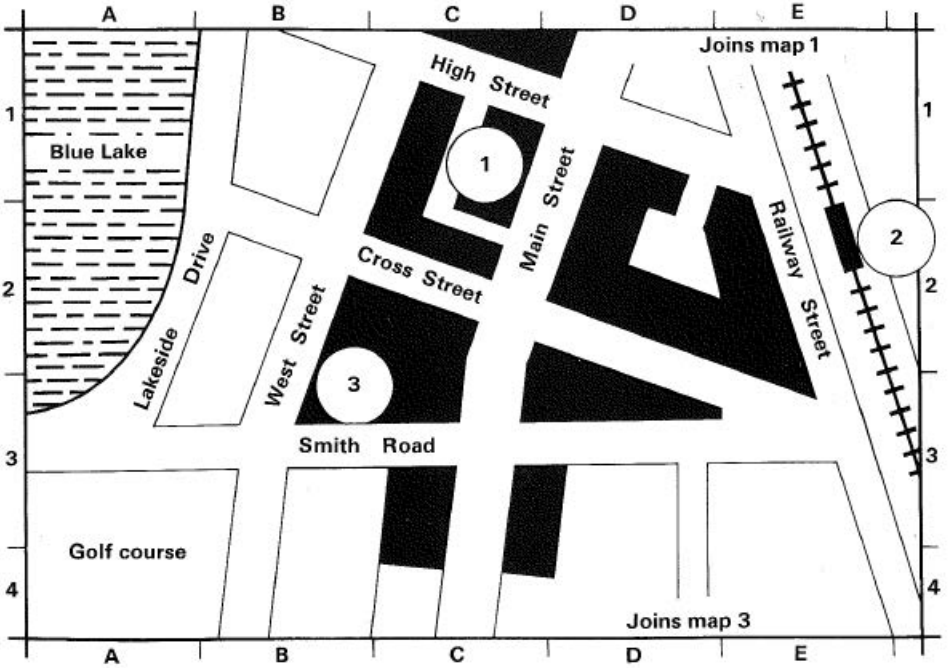
To the lower right of the map is a note indicating that the legend for this map is located on a separate page at Figure 9. To the left is a list of the features (with their alphanumeric references) which are located on the map. It is also worth noting that to the top right of the map is a north point, indicating that north is to the top of the page.

FIGURE 8 URBANVILLE TOWN CENTRE

Map 2 of 3 sheets

Scale 1:1250

25 0 50 100 Metres



List of features

1 Town hall C1
2 Railway station E2
3 Bus terminal B3

Refer to the following page for map legend

FIGURE 9 URBANVILLE TOWN CENTRE — MAP LEGEND

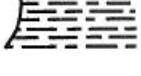
Street defined by buildings .....

Street not defined by buildings .....

Building or city block identification number .....

Water area with shoreline (sea, lake etc.) .....

Open area, car park, golf course (labelled as appropriate) .....



Railway .....

Railway station .....

North point .....

After your initial scan of the town map, exploration of the marginal information and study of the legend, you will have a general idea of the main types of features shown on the map. As the street pattern is the major feature of this map, familiarise yourself with individual streets by tracing each of them from end to end. Are the streets in a regular pattern? Does the pattern trend in a particular direction? Where is the main thoroughfare? Once you have a mental picture of the street pattern you can establish the location of the main features in relation to the streets.

Complete the following exercises using Figures 8 and 9. The answers can be found at the end of this section.

1. In what direction does Smith Road run?
2. Locate the features listed to the lower left of the map by using the alphanumeric references provided. Now, as an exercise using map scale, determine the distance between each of the following pairs of points:
   - railway station and town hall
   - railway station and bus terminal
   - town hall and bus terminal

MAKING A JOURNEY

Whether the journey is a walk in the country or to visit a friend in the city, it is best to first study a map.

Make sure that you have all the available maps. To get to a particular building or business, it may be necessary to consult a street map as well as an even larger scale map of just a city block to find the exact location of the place you wish to visit. It will also usually be helpful if you consult an overall city map to get an idea of the general location of your destination in relation to where you will be commencing your journey.

Procedure

Begin planning your journey by using a compass to correctly orient the map.

Next, use the map to identify your destination. If, for example, it is the house of a friend, find the street in which he or she lives.

You will have already found the most convenient means of travel, that is bus, train, etc. from other sources.

Locate the railway station or bus stop nearest to your destination on the map and then determine (and note) the streets along which you will need to walk to reach your destination.

Trace the route again, noting the streets which you will cross and the turns you will have to make. Also, note any features such as bridges or railway crossings which will help you to identify your position along the way.

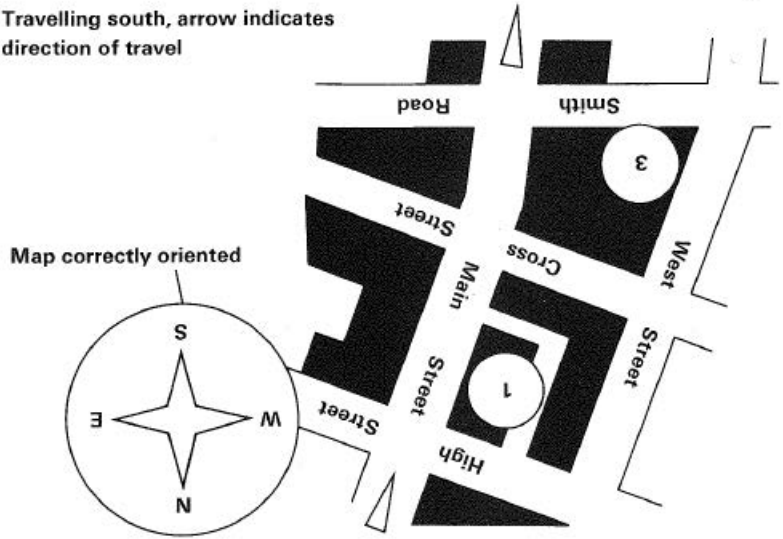
When you are satisfied that you have a mental picture of the route, and only then, undertake your journey. It is a good idea to carry your map and compass with you.

Imagine yourself to be making a journey by bus. You have studied the maps and know that your destination is S and W of your bus stop. What you do not know is the exact route the bus takes and, as a consequence, on which side of the road you will alight.

On alighting from the bus, you can use your compass to determine the street direction and decide which way to go in order to reach your destination.

Use your map to check your progress by holding it so that the street in which you are walking and the street on the map point in the same direction. This will allow you to count the street crossings and make the turns you planned.

FIGURE 10 ORIENTING A MAP



When travelling S with a properly oriented map (refer to Figure 10) braille or roman lettering will appear upside down and this can sometimes be confusing. However, directions will be correct, i.e. streets or features which should be to the left or to the right will indeed be that way. This is the purpose of orientation. Experience will develop your ability to maintain orientation of a mental image, and frequent checking using the map will reinforce the correctness of orientation.

Bridges, railway crossings or other features you identified on the map when planning your journey will enable you to verify your position as you reach them. Along the way you may notice other features or phenomena which, if you make a note of them, will assist you to check your progress on the return journey.

READING GENERAL REFERENCE AND THEMATIC MAPS

When making thematic maps cartographers position and depict thematic data on a 'base map' which consists of selected topographic detail. A small scale base map of Australia for instance may include the coastline, State boundaries, major rivers, capital cities and perhaps some other populated places, and selected roads and railways.

These base maps when used as maps in their own right—as in Figures 11 and 12—serve as 'general reference' maps.

READING BASE/GENERAL REFERENCE MAPS

The map 'Australia—General Reference' (Figure 11) will help you to become familiar with the shape of Australia and its States, and the locations of its capital cities. You will learn that each State has a number of distinctive features which, once you are familiar with them, will enable you to easily recognise which part of Australia you are studying. For example, N Queensland can be

recognised by the shape of Cape York Peninsula; Victoria by the indentation of Port Phillip Bay and the distinctive shape of the Murray River, its northern boundary; and SE South Australia by the indentations of Spencer Gulf and Gulf St Vincent.

Tactual and low vision map users who are familiar with the major features of a base or general reference map will find that they have a valuable source of locational information when they progress to reading thematic maps.

Use Figure 11 to complete the following exercises. Compass directions are used to guide you around the coast, step by step, identifying coastal features. For the purpose of this exericse, remember that N is towards the top of the page, S to the bottom, E to the right and W to the left.

Read the map in the following sequence:

Step 1: Scan the whole map in vertical strips (by eye or by using both hands).

Step 2: Locate and read the map title.

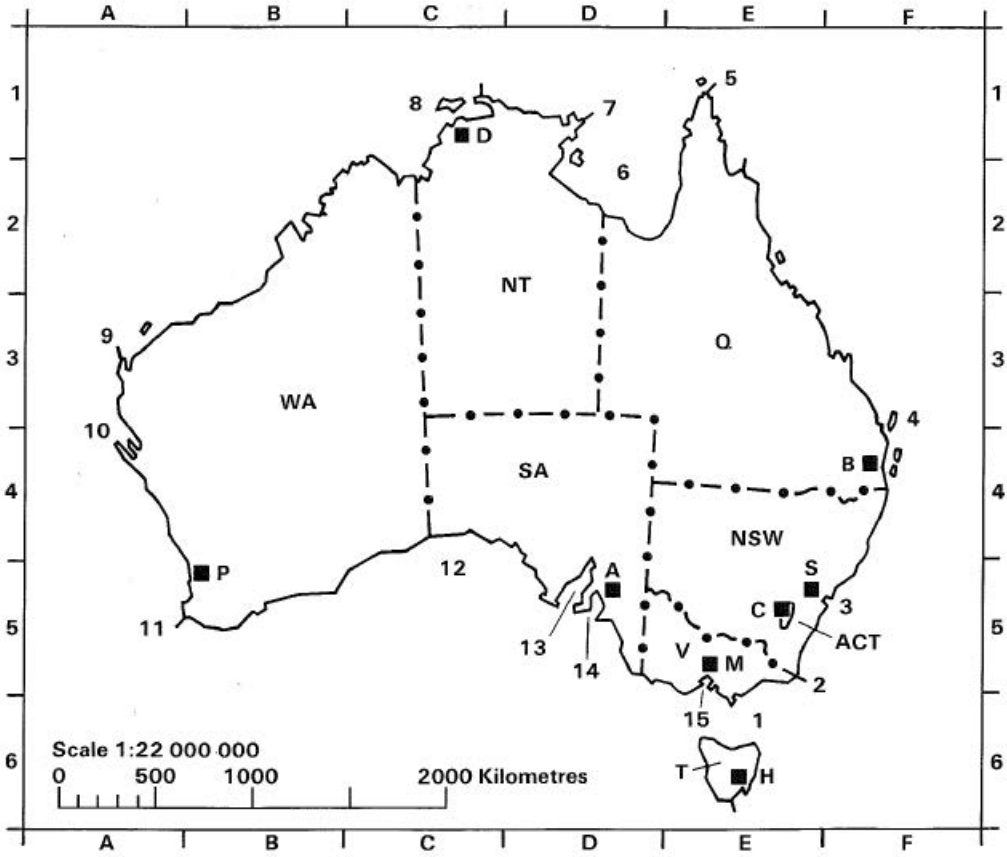
Step 3: Locate and read the map scale: find out what distances the scale subdivisions represent.

Step 4: Locate and read the map legend: become familiar with the symbols used on the map and what each represents.

Step 5: Locate the island and State of Tasmania in the extreme SE of the map and trace its coastline.

Then, beginning at the NE tip of Tasmania, move N across Bass Strait (**1**) and locate Cape Howe (**2**) on the SE coast of the Australian mainland. Trace the SE coast N and locate Port Jackson (**3**). Follow the coast northwards and locate Fraser Island (**4**), off the Queensland coast.

FIGURE 11 AUSTRALIA — GENERAL REFERENCE



Legend

Coastline .....

State border .....

Capital city .....

See text for list of abbreviations

Continue to follow the coast N to the tip of Cape York (**5**), the most northerly point of the Australian mainland. From here the coast turns SW then NW and N around the Gulf of Carpentaria (**6**) to Gove Peninsula (**7**). Follow the coast W to Melville Island (**8**), off the Northern Territory coast and then generally SW to North West Cape (**9**). Follow the coast of Western Australia S to Shark Bay (**10**) and on to Cape Leeuwin (**11**).

Now follow the coast E to the Great Australian Bight (**12**) and further E to the indentations of Spencer Gulf (**13**) and Gulf St Vincent (**14**). To the SE then locate Port Phillip Bay (**15**), on the Victorian coast, and continue back to Cape Howe (**2**). Tasmania, which was your starting point, is now close by to the S.

Step 6: Beginning where any State border intersects with the coast, trace the border and coastline of each of the States and Territories, and locate the following abbreviation for each:

Q —Queensland

NSW—New South Wales

V —Victoria

T —Tasmania—the 'T' for Tasmania is located to the W and connected to the island by a leadline due to lack of space.

SA —South Australia

WA —Western Australia

NT —Northern Territory

ACT —Australian Capital Territory—located in southern NSW but with its abbreviation placed in the sea to the SE and connected by a leadline.

Step 7: Now locate the capital cities within each State and Territory using the following alphanumeric grid references. Note their location in relation to the coastline and/or State border.

Adelaide (**A**)—D5
Brisbane (**B**)—F4
Canberra (**C**)—E5
Darwin (**D**)—C1
Hobart (**H**)—E6
Melbourne (**M**)—E5
Perth (**P**)—B5
Sydney (**S**)—E5

Step 8: Using the graphic scale at the top left of the map, measure the distance between the following capital cities:

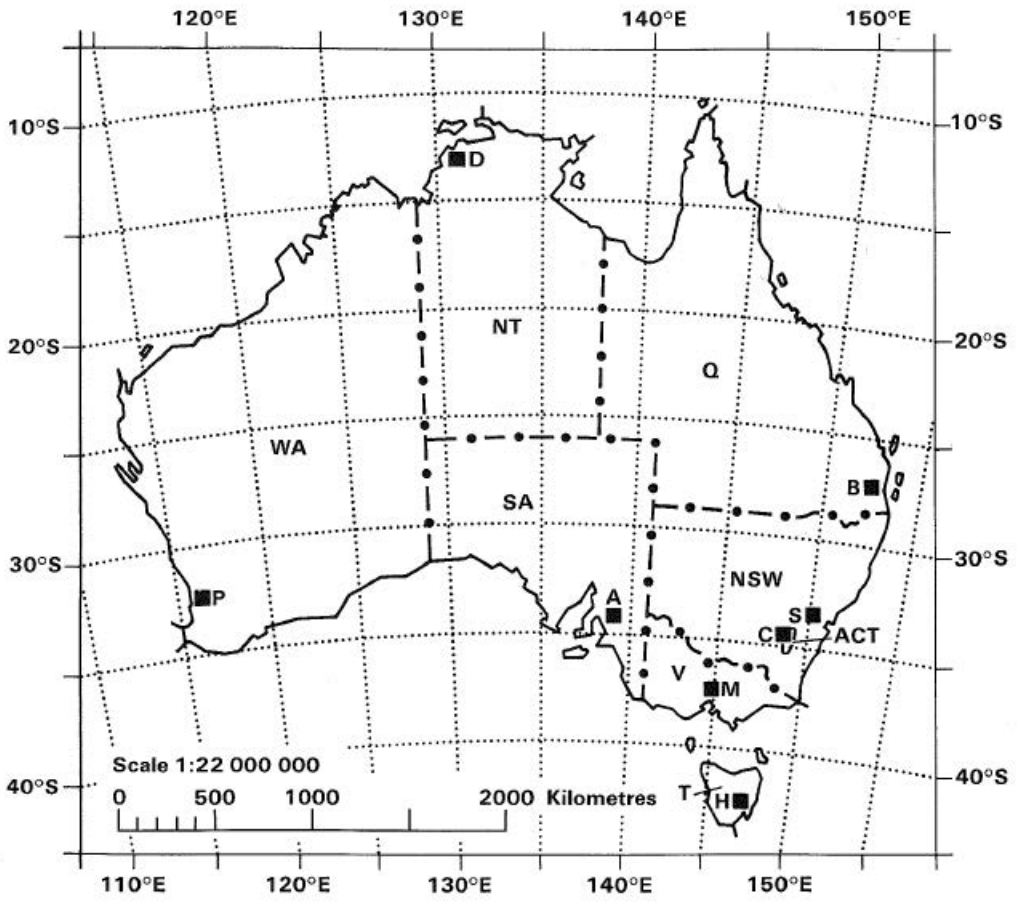
Brisbane and Sydney
Adelaide and Melbourne
Adelaide and Perth
Darwin and Adelaide
Melbourne and Sydney

The answers can be found at the end of this section.

READING LATITUDE AND LONGITUDE

The object of the map at Figure 12 is to provide you with an understanding of latitude and longitude. As you should remember from Section 4, latitude and longitude is the best known and most universal geographic reference system. Lines of latitude (parallels) are measured in degrees N and S of the Equator and lines of longitude (meridians) are measured in degrees E and W of Greenwich Observatory in England.

FIGURE 12 AUSTRALIA — LATITUDE AND LONGITUDE



The same base data is shown on Figure 12 as on Figure 11 but a graticule (lines of latitude and longitude) at 5 degree intervals has been added. Note that only every second graticule line has been labelled. You can now work out that Australia extends in a N–S direction from approximately 10 degrees S to 43 degrees S latitude and in an E–W direction from 153 degrees E to 113 degrees E longitude.

Now using your knowledge of the location of the capital cities which you acquired from the previous exercise, find the latitude and longitude of each of the capital cities. Here is an example:

Perth—32 degrees S latitude, 116 degrees E longitude

The answers can be found at the end of this section.

READING THEMATIC MAPS

Now that you are familiar with the shape of Australia's coastline, its State and Territory borders and the location of its capital cities, you can use this knowledge to explore new types of maps. Figure 13, 'Australia—Uplands and Deserts', has been included as an exercise in reading thematic maps and at the same time to learn something about the basic physical geography of Australia.

Let's investigate Figure 13 by undertaking the following steps:

Step 1: Complete a preliminary scan of the entire map area, noting that information on this map is represented by distinctive patterns.

Step 2: Locate and read the map title.

Step 3: Locate and read the scale information.

Step 4: Locate and read the map legend so you become familiar with the symbols used on the map.

Step 5: Take each category in turn from the legend and locate its distribution on the map, noting its position in relation to the coastline and the other categories of data.

It will help braille readers to recognise patterns if one hand is used to feel sample patterns in the legend while the other is used to identify patterns on the map.

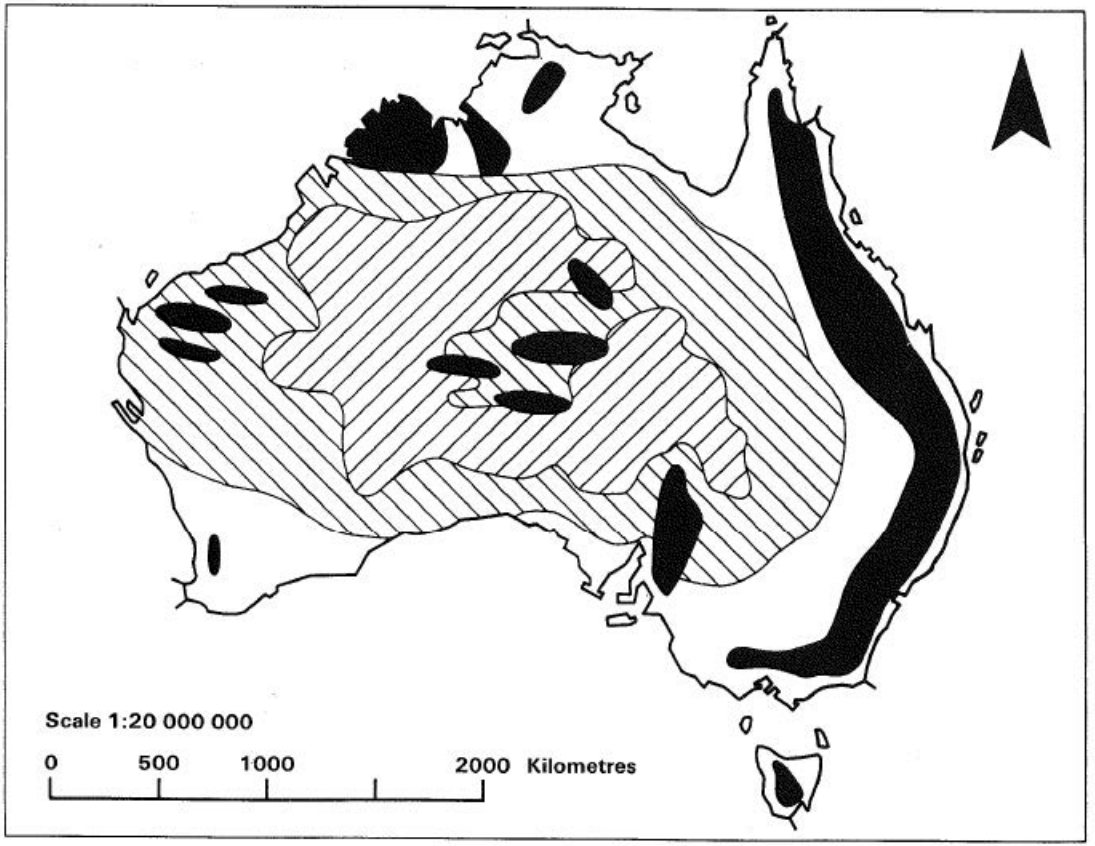
Did you notice that much of Australia consists of desert or other arid land and that there is a large continuous strip of uplands along the E coast of the continent?

The eastern uplands, which include the Great Dividing Range, extend from Cape York Peninsula in N Q to central V. Smaller upland areas occur in near-coastal areas in the SW and NW of WA and in the NT, in central Australia, N of Adelaide in SA, and in central T.

A large part of Australia, including much of WA, NT and SA and some of Q and NSW, is arid land. The central core of this area is mainly very arid sandy desert, which is largely unused and uninhabited.

The remainder, comprising mainly a very thin strip along the E coast and a band surroundig the arid land in the N, E, SE and SW (the areas without any patterns on Figure 13), is characterised by gentle slopes and reasonable rainfall, making it generally more suitable for agriculture and settlement. In fact, nearly 97 per cent of Australia's population lives in this area.

FIGURE 13 AUSTRALIA — UPLANDS AND DESERTS



Legend

Coastline .....

Uplands .....

Desert land .....

Other arid land .....

By now you should have an overall idea of the distribution of upland and desert areas in Australia so try to answer the following questions by referring to Figure 13:

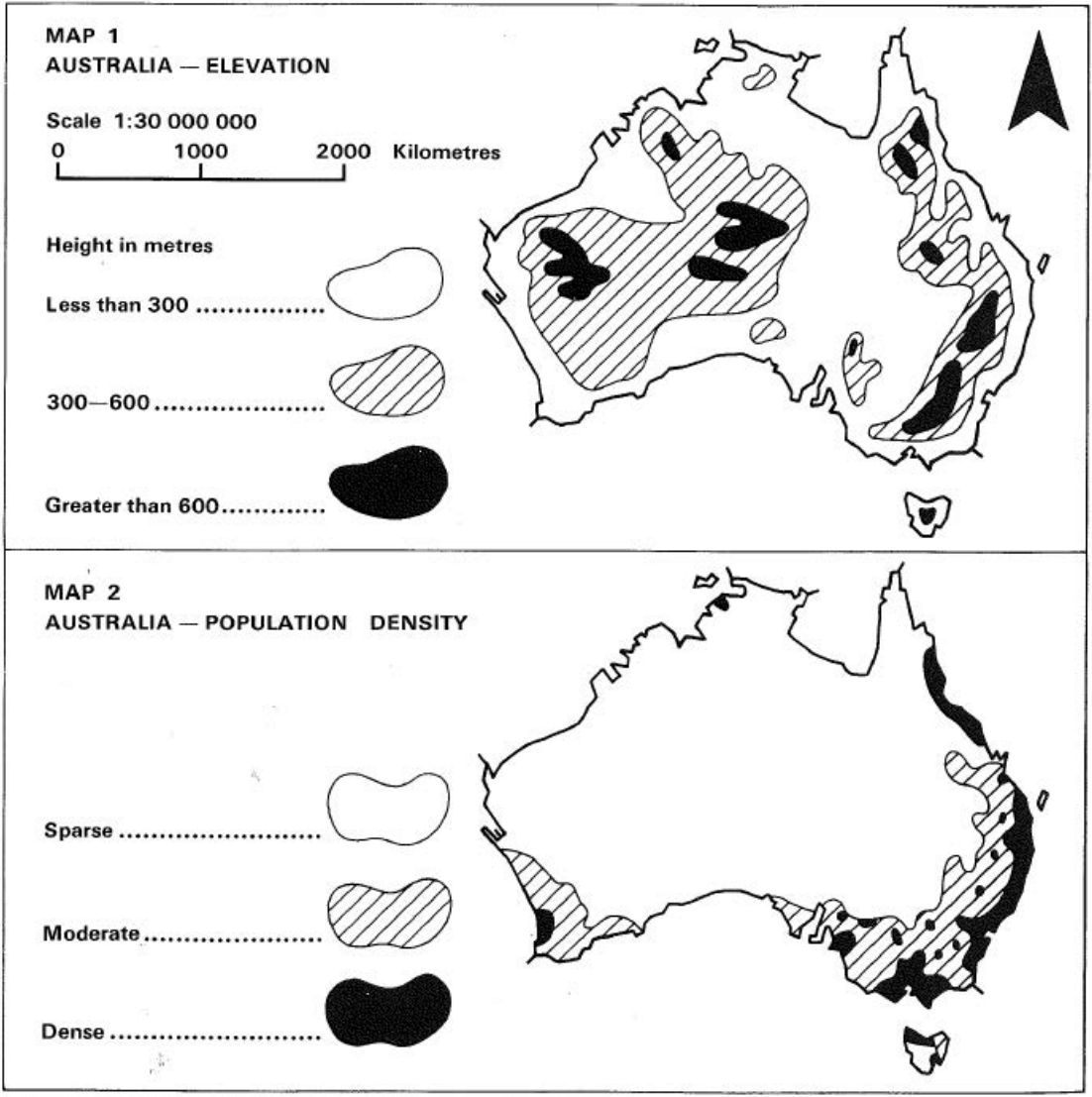
1. How far do the eastern uplands extend?
2. Roughly what proportion of Australia is desert?

The answers can be found at the end of this section.

When reading thematic maps the relationships between data are often significant, for instance a country's economic and social resources are to a large extent dictated by its geography. In Australia, for instance, you are unlikely to find very much economic or social data depicted in the vast central and western desert areas. In the E of the continent and in the SW corner of WA, on the other hand, terrain, climate and soils combine to create conditions conducive to settlement and rural development. It is in these areas that concentrations of people, transport, agriculture, manufacturing and other such resources are to be found.

Large lakes and rugged mountain ranges also affect the distribution of resources. For example, dots showing population will not appear in water areas. Physical resources such as geology, soils, landforms and climate, however, are much less affected in this way. Such basic knowledge of the physical geography of an area or country will greatly help you in understanding the distribution of its socio-economic resources.

As you will remember from Section 6, isolines are lines that join places of equal value on a map. Figure 14 includes two isoline maps of Australia. Map 1 depicts elevation (height in metres) whereas Map 2 depicts population density. Data on both of these maps is represented by distinctive patterns bounded by isolines.


MAP 1
AUSTRALIA — ELEVATION
Scale 1:30 000 000
0
1000
2000 Kilometres
Height in metres
Less than 300 .....
300—600 .....
Greater than 600.....
MAP 2
AUSTRALIA — POPULATION DENSITY
Sparse .....
Moderate.....
Dense .....

Scan each map separately then go ahead and read the marginal information, paying particular attention to the legend on each map before attempting to read the map content. Trace the outline of each class of data and relate its position to the coastline and the next class of data.

Elevation

No doubt you discovered that Australia is mainly low and flat, with much of its area lying less than 300 metres above sea-level. Nethertheless, two major elevated areas of over 300 metres do stand out on the map. The first, along the eastern coast, includes the Great Dividing Range. The second, covering a large part of WA and extending into the NT and SA, is a broad elevated block linking the upland areas of the Pilbara, the Kimberleys and central Australia. Almost all of the limited areas of over 600 metres occur as isolated patches within the much larger areas of over 300 metres, and include Australia's major mountain ranges.

Population Density

Australia, with its dry, forbidding interior which severely restricts human occupation, is the world's most sparsely settled continent (after Antarctica). Only the SW, the SE and the eastern coastal strip have at least a moderate population density. These areas correspond to the major farming zones, where rural and urban population concentrations are associated with agricultural development. The limited areas with a dense population are confined mainly to around the capital cities and along the eastern coast.

Having now become familiar with Australia's elevation and population density, here are two exercises for you to complete:

1. How many separate areas of over 600 metres are depicted on the elevation map?
2. Where is the largest single area of dense population on the population density map?

The answers are given at the end of this section.

ANSWERS TO EXERCISES IN SECTION 10

Figure 8 (Urbanville Town Centre)

An E–W direction

Railway station and town hall —125 metres

Railway station and bus terminal—165 metres

Town hall and bus terminal — 75 metres

Figure 11 (Australia—General Reference)

Brisbane and Sydney — 750 kilometres

Adelaide and Melbourne— 700 kilometres

Adelaide and Perth —2150 kilometres

Darwin and Adelaide —2500 kilometres

Melbourne and Sydney — 700 kilometres

Figure 12 (Australia—Latitude and Longitude)

Canberra —35 degrees S, 131 degrees E
Brisbane —27 degrees S, 153 degrees E
Sydney —34 degrees S, 151 degrees E
Melbourne—38 degrees S, 151 degrees E
Hobart —43 degrees S, 147 degrees E
Adelaide —34 degrees S, 139 degrees E
Darwin —12 degrees S, 131 degrees E

Figure 13 (Australia—Uplands and Deserts)

About 3500 kilometres

Approximately one-third

Figure 14 (Map 1. Australia—Elevation)

Eleven separate areas

Figure 14 (Map 2. Australia—Population Density)

In a continuous strip along the SE coast from N of Brisbane to near the NSW–V border.

SECTION 11: Map Maker and Map User Communication

Skill in map reading, and the benefit and enjoyment which can be gained from it, will depend to a large extent on your ability to select the right reading strategy. Hints given in this book are only a starting point and a general guide. With practice and experience you will find out which methods best suit your needs and with continued experimentation you will develop even greater expertise in map reading.

It should be remembered that much remains to be discovered about tactual and low vision perception and cartographers still have much to learn about making tactual and low vision maps. User experience can contribute enormously to making maps more effective and map producers welcome comments. If you encounter map reading difficulties or have suggestions which may improve a map or maps, you should contact the relevant map production agency. The mapping organisations listed in Annex 2 will welcome such user feedback as a way in which cartographers can improve their product.

Map reading is an acquired skill and if you are blind or visually impaired you face difficulties which will require patience and concentration to overcome. Hopefully, this book will encourage you to become an effective map reader and thus increase your mobility and give you access to a new source of knowledge. The ability to read maps can lead to many enjoyable experiences, make you more independent and open up ways to a better understanding of the world in which we live.

Annex 1: Distributors of tactual aids for map reading

Braille compasses, scales, etc. can be purchased from the following organisations:

New South Wales

Royal Blind Society of New South Wales
4 Mitchell Street
Enfield N.S.W. 2136
Telephone: (02) 747 6622

Victoria

Association for the Blind
7 Mair Street
Brighton Beach Vic. 3188
Telephone: (03) 598 8555

Royal Victorian Institute for the Blind
507 St Kilda Road
Melbourne Vic. 3004
Telephone (03) 51 1381

South Australia

Blind Welfare Association
84 Archer Street
North Adelaide S.A. 5006

Map users in States other than those listed above should contact their local agency.