

A young girl with a green headscarf and a brown headband is drinking from a green public water tap. She is looking directly at the camera with a focused expression. The background is slightly blurred, showing other water taps and pipes.

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WRITTEN TO  
THE FINAL  
AUSTRALIAN  
CURRICULUM

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# Using Oxford Big Ideas Geography

Oxford Big Ideas Geography is a brand-new series developed and written to meet the requirements of the Australian Curriculum: Geography across Years 7–10. Based on the big ideas framework, it follows an inquiry-based approach that encourages students to develop deep, transferable skills and understanding in Geography.

## Big questions

Each chapter of Oxford Big Ideas Geography is structured around key inquiry questions from the Australian Curriculum: Geography – supporting teachers and students as they implement an inquiry-based approach to Geography.

Stunning full-colour photography generates discussion and interest



## Engaging learning

Each chapter of the student book combines a range of engaging source materials – maps, photographs, timelines, data tables, satellite imagery, graphs and illustrations – all with supporting questions and activities.

The learning sequence in each chapter is clearly set out under key inquiry questions. Students are encouraged to activate their prior knowledge and make predictions at the start of each new topic.



Stunning full-colour source materials inspire a sense of wonder about the world and encourage even the most reluctant learners to engage in geographical inquiry.



# Australian Curriculum: Geography 7 — Scope and sequence

Level description and key inquiry questions	
Level description	<p>There are two units of study in Year 7: <b>Water in the world</b> and <b>Place and liveability</b></p> <p><i>Water in the world</i> focuses on water as an example of a renewable environmental resource. This unit examines the many uses of water, the ways it is perceived and valued, its different forms as a resource, the ways it connects places as it moves through the environment, its varying availability in time and across space, and its scarcity. <i>Water in the world</i> develops students' understanding of the concept of environment, including the ideas that the environment is the product of a variety of processes, that it supports and enriches human and other life, that people value the environment in different ways and that the environment has its specific hazards. Water is investigated using studies drawn from Australia, countries of the Asia region, and countries from West Asia and/or North Africa.</p> <p><i>Place and liveability</i> focuses on the concept of place through an investigation of liveability. This unit examines factors that influence liveability and how it is perceived, the idea that places provide us with the services and facilities needed to support and enhance our lives, and that spaces are planned and managed by people. It develops students' ability to evaluate the liveability of their own place and to investigate whether it can be improved through planning. The liveability of places is investigated using studies drawn from Australia and Europe.</p>
Key inquiry questions	<ul style="list-style-type: none"> <li>• How does people's reliance on places and environments influence their perception of them?</li> <li>• What effect does the uneven distribution of resources and services have on the lives of people?</li> <li>• What approaches can be used to improve the availability of resources and access to services?</li> </ul>

Geographical knowledge and understanding	
Unit 1 – Water in the world	<ul style="list-style-type: none"> <li>• The classification of environmental resources and the forms that water takes as a resource</li> <li>• The ways that flows of water connect places as they move through the environment and the way this affects places</li> <li>• The quantity and variability of Australia's water resources compared with those in other continents</li> <li>• The nature of water scarcity and ways of overcoming it, including studies drawn from Australia and West Asia and/or North Africa</li> <li>• The economic, cultural, spiritual and aesthetic value of water for people, including Aboriginal and Torres Strait Islander Peoples and peoples of the Asia region</li> <li>• The causes, impacts and responses to an atmospheric or hydrological hazard</li> </ul>
Unit 2 – Place and liveability	<ul style="list-style-type: none"> <li>• The factors that influence the decisions people make about where to live and their perceptions of the liveability of places</li> <li>• The influence of accessibility to services and facilities on the liveability of places</li> <li>• The influence of environmental quality on the liveability of places</li> <li>• The influence of social connectedness, community identity and perceptions of crime and safety on the liveability of places</li> <li>• The strategies used to enhance the liveability of places, especially for young people, including examples from Australia and Europe</li> </ul>

## Geographical inquiry and skills

Observing, questioning and planning	<ul style="list-style-type: none"> <li>• Develop geographically significant questions and plan an inquiry, using appropriate geographical methodologies and concepts</li> </ul>
Collecting, recording, evaluating and representing	<ul style="list-style-type: none"> <li>• Collect, select and record relevant geographical data and information, using ethical protocols, from appropriate primary and secondary sources</li> <li>• Evaluate sources for their reliability and usefulness and represent data in a range of appropriate forms – for example – climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies</li> <li>• Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate</li> </ul>
Interpreting, analysing and concluding	<ul style="list-style-type: none"> <li>• Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends, and infer relationships</li> <li>• Apply geographical concepts to draw conclusions based on the analysis of the data and information collected</li> </ul>
Communicating	<ul style="list-style-type: none"> <li>• Present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose, using geographical terminology and digital technologies as appropriate</li> </ul>
Reflecting and responding	<ul style="list-style-type: none"> <li>• Reflect on their learning to propose individual and collective action in response to a contemporary geographical challenge, taking account of environmental, economic and social considerations, and predict the expected outcomes of their proposal</li> </ul>

## Year 7 achievement standard

By the end of Year 7, students describe geographical processes that influence the characteristics of places and how places are perceived and valued differently. They explain interconnections between people, places and environments and describe how they change places and environments. They propose simple explanations for spatial distributions and patterns among phenomena. They describe alternative strategies to a geographical challenge and propose a response, taking into account environmental, economic and social factors.

Students identify geographically significant questions to frame an inquiry. They locate relevant information from primary and secondary sources to answer inquiry questions. They represent data and the location and distribution of geographical phenomena in a range of graphic forms, including large-scale and small-scale maps that conform to cartographic conventions. They analyse geographical data and other information to propose simple explanations for spatial patterns, trends and relationships and draw conclusions. Students present findings and arguments using relevant geographical terminology and graphic representations in a range of communication forms. They propose action in response to a geographical challenge taking account of environmental, economic and social considerations and describe the expected effects of their proposal.

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# Water in the world Place and liveability



# The geographer's toolkit

Geography is the study of the world around us. Studying geography helps us understand how the Earth works. This includes natural processes (such as volcanoes, floods and the weather) as well as human activities (such as mining, tourism and building cities).

Geographers use a range of key concepts and key skills to study the world. Each of these concepts and skills is a tool that you can use to better understand your world. As you master each of these concepts and skills you will gradually fill your toolkit with a range of useful geographical tools.

Geographers are curious. They look at the Earth's **features** and always want to know more about them. For example, when they look at Jim Jim Falls (Barrkmalam) in Kakadu National Park, Northern Territory, shown in Source GT.1, they wonder about many aspects of this natural feature. They want to know about:

- its size
- its location
- the types of rock in the area
- the types of plants and animals in the area
- its significance to Indigenous Australians
- the way it is used by people
- the way it is changing.

This curiosity and wonder gives geographers a special view of the world. You can share that view. Welcome to the wonderful world of geography!



## GT.1

Concepts for geographical understanding



**Source GT.1** A view of Jim Jim Falls in Kakadu National Park in the Northern Territory. This is known to the Aboriginal people of the region as Barrkmalam.

# GT.2

Geographical inquiry and skills

# GT.3

Fieldwork in geography

# GT.1 Concepts for geographical understanding

Geographers use seven concepts to help investigate and understand the world. At times you will use several of these at once, while at other times you may focus on just one. As you learn to use each of the key ideas you will begin to think like a geographer. The seven key concepts in geography are:

- place
- space
- environment
- interconnection
- sustainability
- scale
- change.

## Place

Places are parts of the Earth's surface that are identified and given meaning by people. Your home and your school are important places for you because they are the places where you live and spend most of your time. A place can be as small as your bedroom or as large as the entire planet!

Places play an important role in the lives of every person on Earth. Places can be natural (that is, shaped by the environment and largely unchanged by humans) or built (that is, constructed by humans).

The life of every person and animal on Earth is influenced by place. Places determine our relationships with one another. Our closest relationships are likely to be with people in the same place. The environmental and social qualities of a place all influence the way we live. Climate, landscapes, types of plants and resources, transport networks, entertainment venues and workplaces all have a major impact on the way we live.

For Indigenous Australians, place also has a deeper spiritual meaning. Their sense of identity comes from their relationship with place. Aboriginal people have lived in the Kakadu region of Northern Territory for over 50 000 years. The region contains approximately 5000 rock art sites, some of which are over 20 000 years old. They represent the longest historical records of any group in the world. This was one of the reasons Kakadu National Park was World Heritage listed. Aboriginal people refer to their place as 'Country' and believe that they have a responsibility to look after it.



**Source GT.2** An aerial view of Manhattan Island, New York City – an example of a built environment.

Geographers use the concept of **place** when conducting any geographical inquiry. For example, a geographer visiting New York City in the United States (Source GT.2) would use the concept of place to help understand why people originally settled there, how the city was built and how it has changed over time.

They would also use place to investigate the important role the city plays in the lives of New Yorkers, Americans and people all over the world.

Just as place influences people, people also influence place. The ways in which we live, and the actions we take, change the places in which we live. Geographers investigate the outcomes of these changes. For example, by investigating the way in which human actions have altered the Brazilian Rainforest, geographers can learn how to better manage and care for our natural resources.

## Space

To most people **space** means the empty universe but to a geographer it has a different meaning. Geographers investigate the way that things are arranged on the Earth's surface. They look for patterns and try to explain them. The concept of space helps them to do this. It has three main elements:

- location – where things are located on the Earth's surface
- spatial distribution – the shapes and patterns in which things are arranged on the Earth's surface
- organisation – how and why things are arranged and managed on the Earth's surface by people.

The concept of space can also be used to investigate some other important aspects of the world around us.

Geographers investigate the way that people use and change the space in which they live. They recognise that different groups of people use space in different ways and that this changes over time. They also investigate the ways that improvements in transport and communication have made links between places quicker and easier and the ways that this is changing the world.

The city of Shimabara in the south of Japan (Source GT.3) illustrates the concept of space well. The city has been built on a flat coastal area at the foot of an active volcano, Mount Unzen. Houses, schools and office buildings in Shimabara are linked by roads leading to nearby farms closer to Mount Unzen. The volcano clearly presents a danger to people living in the town. As Source GT.3 shows, the flow of superheated ash and rock from the volcano has buried part of the city as it makes its way to the sea. At first glance it may not be clear why anyone would risk living this close to a volcano, but closer analysis of the area reveals that the fertile volcanic soil in the area makes it ideal for growing crops.

The concepts of place and space can be difficult to separate, but it will help if you remember that places



**Source GT.3** An aerial photograph showing the path of the hot ash and rock that flowed to the sea from Mount Unzen, an active volcano on the island of Kyushu in Japan. Part of the city of Shimabara (shown in the foreground) has been buried by the eruption.

can be divided into spaces. For example, a small place, such as your school, has different spaces. Each of these spaces has its own purpose. There are spaces for learning (such as classrooms and computer rooms), playing (such as playgrounds and play equipment), eating (such as the cafeteria or canteen) and running the school (such as staffrooms and administration buildings).

Larger places (such as your suburb, town or city) are also organised into different spaces. There are spaces for housing (such as homes for families), businesses (such as shops and offices), industry (such as factories and warehouses), entertainment (such as concert halls and theatres) and sport and recreation (such as stadiums, parks and gardens).

Our understanding of the location, patterns and planning of spaces helps geographers to make sense of our world.

## Environment

The world in which we live is made up of many different **environments**. Some environments are natural (or physical) such as deserts, grasslands, mountains, coral reefs, forests, oceans and ice caps. In order for an environment to be considered natural, its soils, rocks, climate, plants and animals must remain largely untouched by humans. Today, there are very few truly natural environments left on Earth.

Other environments have been so altered by humans that very few natural features remain. These environments are known as built (or human) environments and include large cities, towns, suburbs and vast areas of farmland. Human environments not only affect the natural features (such as soil, plants and animals) they also affect the climate. A large city, such as New York, has its own microclimate. It will often be a few degrees hotter than the surrounding areas because concrete in the buildings traps the Sun's heat. Skyscrapers also catch and funnel the wind, increasing its speed.

Most environments on Earth are now a combination of natural and human features. For example, Antarctica,

the harshest environment on the planet, is considered a natural environment despite humans having altered some areas of it. These changes have included the building of a number of permanent research bases and the carrying out of various scientific studies both on land and sea. The McMurdo research base, for example, operated by the United States (Source GT.4), has three airfields, a harbour and more than 100 buildings. In addition to these built structures, other human influences have affected this environment. The warming of the planet has contributed to the increased melting of ice shelves and pollution of our oceans has had an impact on sea and land animals in Antarctica.

The study of different environments helps geographers to better understand and appreciate natural processes, such as how weather works, how mountains are formed and how rainforests and coral reefs grow. The concept helps geographers to analyse the changes humans make to natural environments and better appreciate their impact so that they can be managed more wisely.



**Source GT.4** A scientist looking out over McMurdo Station at Observation Hill in Antarctica. The line between the natural and built environment is clearly illustrated in this photograph.



**Source GT.5** Bangladesh is one of the countries most vulnerable to climate change because of a number of interconnected processes that are causing sea levels to rise. It is estimated that 15 million of the poorest people living in Bangladesh, like those living in this slum, will be affected by a 1-metre rise in sea levels.

## Interconnection

No place or thing on Earth exists in isolation. All environments on Earth and every living and non-living thing found within them are connected. These connections can be on a local level or a global level.

Geographers use the concept of **interconnection** to better understand the complex links between natural and human processes that shape our Earth. Places and people can be linked in many different ways that can be categorised as:

- natural processes, such as the water cycle and food chain
- human activities, such as the movement of people, the production and trade of goods and the flow of investment and money linked within and between different countries.

It helps to think of the Earth as a single living organism, much like your body. Your brain, heart, lungs, stomach, arms and legs all work together as a

single system to keep you alive and healthy. In much the same way, the Earth's living systems (such as climate, plants, animals, oceans, soils, atmosphere and energy) all function together and are interconnected. Even a slight rise in the Earth's temperature, for example, will have an effect on the oceans (such as damaging coral reefs and affecting the populations of fish and other sea creatures), the land (such as failure of crops and drought) and the polar ice caps (such as increasing sea levels and forcing millions of people to relocate their homes). Source GT.5 shows a slum in Bangladesh, the most densely populated country in the world. Bangladesh is slightly larger than England in size, but is home to 150 million people; this is three times the population of England. Its coastal zone has a very low elevation above sea level, making it one of the countries most vulnerable to climate change through rising sea levels.



**Source GT.6** A Minke whale and her one-year-old calf are being dragged on board the Japanese factory ship *Nisshin Maru*. Anti-whaling activists argue that the number of whales hunted by the Japanese each year is unsustainable.

## Sustainability

The concept of **sustainability** relates to the ongoing capacity of Earth to maintain all life. This means developing ways to ensure that all resources on Earth are used and managed responsibly so they can be maintained for future generations.

Sustainable patterns of living meet the needs of the current generation without compromising the ability of future generations to meet their own needs. Many of the world's resources (such as oil, coal and natural gas) are non-renewable. This means that if we continue to use them they will one day run out. Other resources (such as wind, forests, solar and water) are renewable. This means that they replace themselves naturally, or can be replaced to meet the needs of society. Sustainability encourages us to think more closely about these different types of resources – the ways in which they are formed and the speed at which they are being used. It also encourages us to look more closely at renewable options and take greater care of the Earth. Actions to improve sustainability can operate at a number of levels:

- **Local** – Recycling of paper and plastics by individuals, schools and households reduces the amount of trees that need to be cut down and oil that needs to be drilled to produce plastic bottles and bags.
- **National** – In Australia the government has begun to encourage sustainable use of energy through the establishment of wind farms and hydroelectric power plants and measures to promote the use of solar panels.
- **International** – Efforts to protect endangered whale species around the world have attracted media attention and focused public opinion on maintaining breeding grounds free of large whaling vessels (Source GT.6).

Sustainability is an important concept for geographers. They use it to investigate how natural and human systems work, and understand how resources can be managed in such a way that they will be sustained into the future.

## Scale

The concept of **scale** is used to guide geographical inquiries. Geographers study things that take place on many different spatial levels – meaning from small areas (such as a local park) to very large areas (such as the use of oil and coal all over the world). They use the concept of scale to look for explanations and outcomes at these different levels. A geographic inquiry of the ways in which people use parks, for example, may be carried out at a range of scales (from smallest to largest):

- local – such as an inquiry into the daily visitors to a neighbourhood skate park, the types of facilities there and whether these facilities meet the needs of visitors
- regional – such as an inquiry into the types of visitors staying at campsites and tourist parks in the Grampians region of Victoria
- national – such as an inquiry into the yearly tourist numbers visiting national parks in Australia (such as Kakadu National Park and Christmas Island National Park), including the impact these visitors have on our National Parks, the way in which these parks are managed, and on what levels Indigenous people are involved
- international – such as an inquiry into animal poaching in national parks and wild game reserves in different countries across Africa (such as South Africa, Kenya, Tanzania and Madagascar)
- global – such as an inquiry into the use of all marine parks around the world and their effectiveness in protecting different species of marine animals.



**Source GT.7** Geographical inquiries can be carried out on a number of different spatial levels: local (e.g. at a nearby skate park); regional (e.g. at a campsite in the Grampians region of Victoria); national (e.g. at national parks across Australia); international (e.g. in different countries across Africa) and global (e.g. at marine parks all over the planet).

## Change

The Earth is constantly changing. Some changes occur very rapidly and are easy to see, while others take place over millions of years and are almost undetectable to us. The concept of **change** is important in geography because it helps us to understand what is happening around us and see the world as a dynamic place. Over millions of years, the Earth has been shaped and changed by natural forces, such as climate, earthquakes, volcanoes, running water and storms to name just a few. In more recent times, humans have shaped and changed the Earth to suit their own needs, but events such as volcanic eruptions and tsunamis are a reminder that powerful natural forces continue to alter the face of the Earth, regardless of what humans do.

Changes take place on many different levels, from personal and local right through to national and global. Small local changes that happen quickly, such as a tree falling over on your street or a creek flooding, are often easy to observe and explain. Larger regional or national changes, such as an earthquake or tsunami, can happen quickly and their effects can be widespread and have devastating impacts on places and people (see Source GT.8). Changes that take place on a global scale can take much longer to occur. Global warming, for example, is a long-term change that happens slowly. Global warming has widespread effects that are not easily explained.

Observing and understanding changes that are natural and/or are made by humans and have occurred over time is an important part of any geographical inquiry. Geographers need to look at different types of changes, why they have occurred, over what time period they have occurred and what further changes may take place as a result. Sometimes changes can be positive, such as the conservation of plants and animals in national parks, while other changes can have negative consequences, such as the deforestation of native rainforests in Indonesia. Geographers play an important role in ensuring that change is managed in a sustainable way.





**Source GT.8** The changes that took place in a Japanese coastal suburb of Rikuzentakata as a result of a tsunami in March 2011 were devastating and very rapid. The top image shows the area before the tsunami and the bottom image shows the same area after it had struck.

## Check your learning GT.1

### Remember and understand

- 1 Examine the photo of Jim Jim Falls (Source GT.1). Is this a natural or built environment? Give reasons for your answer.
- 2 New York City (shown in Source GT.2) is one of the world's largest cities. List five ways in which this built environment would affect how people live and work.
- 3 Look carefully at Source GT.3. Why have people settled in this location? Describe the pattern formed by the houses in the township.

### Apply and analyse

- 4 Here are some examples of changes that may be occurring on Earth at any given time:
  - an extra bathroom is being built onto your house
  - a new freeway is being built through the city
  - the Earth's climate is warming
  - an earthquake is destroying a town in Turkey
  - a rainforest is being cleared by loggers in Indonesia.
  - a Rank these changes from the slowest to the most rapid.
  - b Which of these changes are caused by human activities and which are caused by natural processes?
  - c Identify the scale at which each of the above changes takes place; that is local, regional, national, international or global.
- 5 Using Source GT.5, explain the chain of events that would lead to flooding in this slum area of Bangladesh. Describe how and why slum dwellers would be more affected by this event than the wealthy.
- 6 List three ways in which your school or household is addressing the concept of sustainability. Which of these do you believe is most successful? Why?
- 7 Examine Source GT.6. Work with a partner to conduct research on the importance of the Southern Ocean Whale Sanctuary in conserving endangered whale species.
- 8 Study Source GT.8. Identify the major changes to the Japanese coastal suburb as a result of the tsunami. How might an understanding of the concept of change be useful in guiding the rebuilding or relocation of the suburb?
- 9 Your class is undertaking research on the Great Barrier Reef. Develop one question for each of the seven geographical concepts discussed in the text.

### Evaluate and create

- 10 Create a diagram, such as a flow chart, to show the interconnection between the natural and built environment at Antarctica's McMurdo Station (Source GT.4). Include information on such aspects as climate, landforms, wildlife and human settlement (especially waste management and change to the natural environment).
- 11 Choose one of the key concepts that has been discussed. Design a poster for your geography classroom to help you and your classmates remember this concept and use it in geography.

# GT.2 Geographical inquiry and skills

Geography has been described as the ‘why of where’. Geographers examine the world and try to explain what they see. Like a detective at the scene of a crime they follow a line of inquiry – they ask questions, collect evidence, analyse the evidence to find an answer, communicate their findings, reflect on what they have found out and, finally, decide on a course of action.

To follow a line of inquiry, geographers need a range of skills. By studying geography you will gradually master each of these skills. Some of them you will find easy to master; others may take a little longer. As you develop each new skill you will have gained another important tool for explaining the natural processes and human activities that shape our amazing planet.

Each of the skills you will learn over the course of this year is explained in this section. It might help you to think of each of these skills as individual tools in your toolkit. For some geographical inquiries you may only need to use one tool; for others, you may need to use many.

## Observing, questioning and planning

### Observe the world and its geographical characteristics

Developing an awareness and understanding of our world begins by observing the processes that are taking place in it. Geographers look at people, land, air, water, plants and animals and the connections between them to understand what is happening. They also seek to investigate where, why and how natural and built environments are formed and changed. These observations often include identifying any problems or issues that need to be investigated and resolved.

### Seeing the world through a geographer’s eyes

All good geographical inquiries begin by observing something in the natural or built world around you.



**Source GT.9** The skills needed by every geographer. Think of each of these skills as a tool in your geographer’s toolkit.

If you look out the window of your classroom you will become aware of your surroundings. Is it a sunny day? Is it windy? Can you see any buildings or trees? Are there any clouds?

Even though you may look out this window on most days and take what you see for granted, these simple questions can easily become the basis of a number of different geographical inquiries. If the sun is shining, you might like to begin an inquiry into the hours of sunlight and the pattern of temperatures in your area. If it is windy, you might like to begin an inquiry into what direction the wind is coming from, how strong it is and why. If you can see lots of trees or buildings, you might like to begin an inquiry into what type of environment you are in and the different forces that have shaped it. Once you have observed what is around you, the next stage is to develop some geographical questions to focus your inquiry.

## Develop geographical questions about the human and environmental processes shaping places

Geographers ask lots of questions. Geographical questions can be as simple as 'What is it?' and 'Where is it?' or more complex, such as 'What is the connection between these two things?' and 'How and why have things changed over time?'

As a geographer, no longer will you look at something in your world, such as Uluru, and only think of it as an interesting place to visit. Instead, you will begin to ask questions about how it was formed and came to look the way it does. You will also start to ask questions about the area in which it is located, its vegetation, how it is used and managed and its significance for Indigenous Australians.



**Source GT.10** Developing geographical questions is an important part of a geographical inquiry

### skilldrill

## Developing geographical questions

Study Source GT.10. This visitor to Uluru is asking some important geographical questions. You can learn to do this too by starting your questions with the words 'what', 'where', 'how', 'why', 'what impact' or 'what should' when thinking about a particular feature or place.

Your questions should deal with ideas such as:

- Where is it?
- How many are there?
- How big is it?
- What pattern or shape is it?
- Why is it like this? Is it like this because something else is at this location?
- How does it interact with other things in this place?
- Who interacts with it?
- Is it changing? If so, why is it changing and what will it look like in the future?
- How should people best manage this change?

The very best questions open up an exciting area for you to explore. For example, the visitor might ask a simple question, such as 'How big is Uluru?' This is a question with a relatively simple answer. A better geographical question for the visitor to ask would be 'Why is Uluru so big?' This question opens up a whole new area for her to explore.

### Apply the skill

- 1 Why would it be better to ask 'Why is Uluru so big?' than 'How big is Uluru?'
- 2 Where could you look to find answers to the question 'Why is Uluru so big?'
- 3 Examine the photograph of Jim Jim Falls at the beginning of this chapter. Work with a partner to develop geographic questions about this landscape.

## Plan and implement a simple geographical inquiry

Once you have asked a range of more general questions about a geographical feature or issue, it is time to select one question that will become the focus of your inquiry. When you have chosen this, it is useful to decide what data is needed to answer the question and how to collect the data.

### Planning a geographical inquiry about Uluru

Having chosen to investigate the key inquiry question 'Is it a good thing that so many tourists visit Uluru?', you need to decide what data is needed to answer the question and how to collect the data.

**Source GT.11** A guide for planning the direction of a geographical inquiry into Uluru

Key inquiry question	Data needed	Possible sources of data
Is it a good thing that so many tourists visit Uluru?	<ul style="list-style-type: none"><li>Information on the importance and significance of Uluru to the Anangu, who are the Indigenous people in the area</li><li>Information on the management and maintenance of the park</li></ul>	<ul style="list-style-type: none"><li>Conduct fieldwork into visitor numbers</li><li>Create surveys and questionnaires for visitors to complete</li><li>Contact Parks Australia and Uluru-Kata Tjuta National Park for information on how the park is managed</li><li>Download resources from the Parks Australia website; for example, podcasts, maps, visitor guides, geological reports, audio tours and images</li></ul>

## Check your learning GT.2

### Remember and understand

- 1 Good geographers are like detectives. Why is this?
- 2 On your way to school you notice that bulldozers are clearing an area of bushland.
  - a How could this observation form the basis of a geographical inquiry?
  - b Write five different types of questions to assist you in your geographical inquiry into the clearing of this bushland.

### Apply and analyse

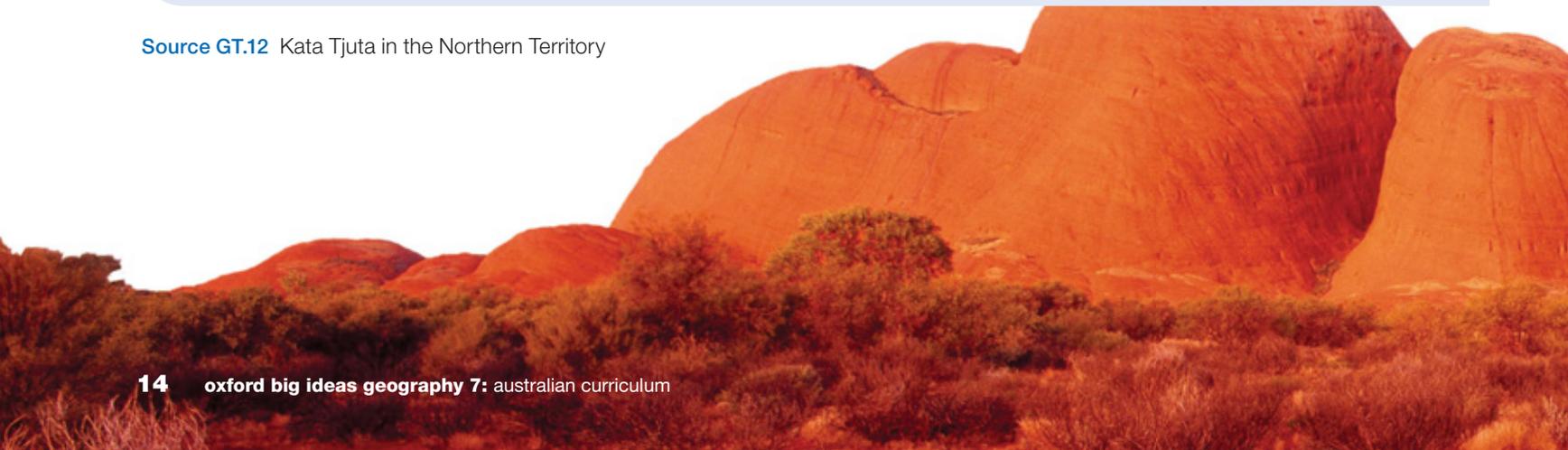
- 3 There is a proposal to build a new shopping centre.
  - a Describe how a geographer would be able to find out what local people thought about the proposal.

- b What two additional issues may be linked to this geographical inquiry into the construction of a new shopping centre? One issue should relate to the natural environment and one should relate to the built environment.

### Evaluate and create

- 4 Develop five questions that may assist a geographer in conducting an inquiry into the proposed development of a new shopping centre within their local area. Create a planning table similar to that used in the text for the inquiry into Uluru (Source GT.11).

**Source GT.12** Kata Tjuta in the Northern Territory



## Collecting, recording, evaluating and representing

### Collect, record and evaluate primary and secondary data

Good planning and preparation will ensure that your geographical inquiry will run smoothly, be relevant and give you the answers you are looking for:

- collect and record the information you think you will need to answer your key inquiry question
- evaluate this information and data to determine that it is accurate and relevant
- represent your findings in an interesting and appropriate way (such as tables, graphs, maps and sketches).

Geographers find answers to their questions in many places. They may collect information themselves by interviewing people, taking photographs, making sketches out in the field or conducting surveys and questionnaires. This kind of information will generally only be relevant to a particular inquiry and is called **primary data**.

Often a geographer collects information that supports his or her inquiry but has not been specifically collected or designed by the geographer for the inquiry. This type of information is called **secondary data**.

**Source GT.13** Examples of primary and secondary data

Some examples of primary data	Some examples of secondary data
<ul style="list-style-type: none"><li>• Hand-drawn maps and field sketches</li><li>• Photographs and images taken for the inquiry</li><li>• Questionnaires and surveys designed and created for the inquiry</li><li>• Graphs created from data (such as number of visitors, number of cars counted, and temperature and wind statistics) gathered by the geographer for the inquiry</li></ul>	<ul style="list-style-type: none"><li>• Information from textbooks, atlases, maps, graphs, reports and websites that were not created specifically for the inquiry</li><li>• Data that was collected by a government department (such as census data), the media, companies and other organisations and was not collected specifically for the inquiry</li></ul>

### Distinguish between quantitative and qualitative data

Primary and secondary data provide either **quantitative data** or **qualitative data**. Quantitative data includes anything that can be recorded as numbers (for example, Uluru is 3.6 kilometres long and 1.9 kilometres wide and has a circumference of 9.4 kilometres). Qualitative data, on the other hand, includes anything that can be recorded in words (for example, Uluru, one of Australia's best-known natural landmarks, is very large).

**Source GT.14** Examples of quantitative and qualitative data

Some examples of quantitative data	Some examples of qualitative data
<ul style="list-style-type: none"><li>• Climate and temperature statistics</li><li>• Tourist numbers</li><li>• Population figures (including birth and death rates)</li><li>• Types and amounts of food grown</li><li>• Plant and animal species and wildlife in certain areas</li><li>• Forest clearance rates</li><li>• Numbers of people killed in natural disasters</li><li>• Numbers of volcanic eruptions and earthquakes</li></ul>	<ul style="list-style-type: none"><li>• Opinions</li><li>• Points of view</li><li>• Personal stories</li><li>• Likes and dislikes</li><li>• Feelings</li></ul>

Good geographical inquiries will always be based on a combination of primary and secondary data that is both quantitative and qualitative. Even though qualitative data is an important part of any geographical inquiry, quantitative data is considered to be more valuable because it is less open to personal interpretations and can be more accurately represented in graphs and charts. Before you move to the next stage of your inquiry, it is important to check that you have recorded all your data without errors and that it is balanced and fair. Your data should not reflect your personal opinions, emotions or attitudes; instead it should present the facts in a clear and concise way.

## Create maps and other graphic representations

Geographers often present the information they gather during their inquiries in a number of different ways. They often make maps, create graphs and tables or even draw diagrams to help them look for patterns in the data they have gathered. These tools also help people who were not involved in the inquiry (such as the general public, the government or people in the media) understand the work that has been done.

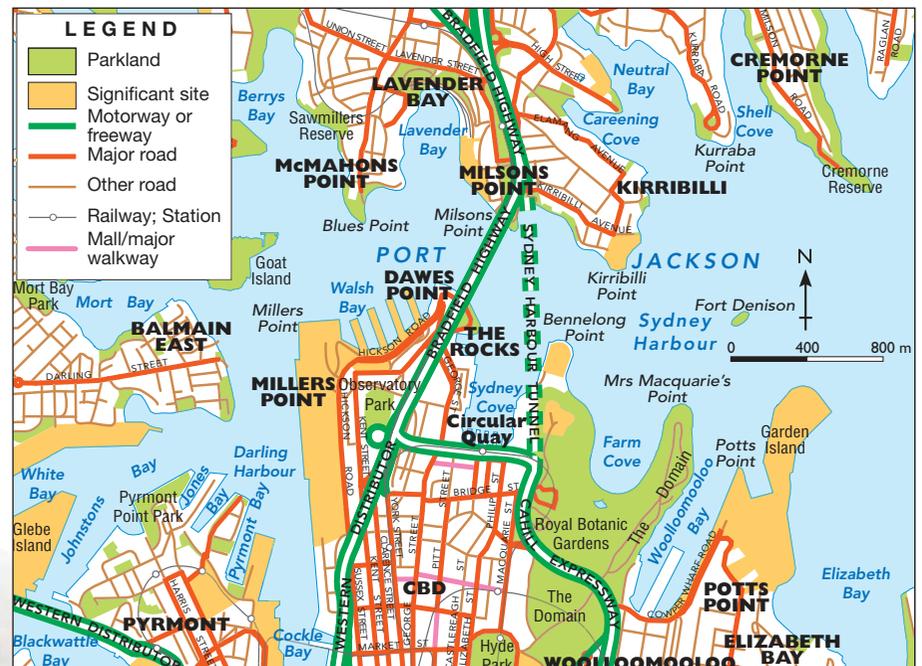
### Creating maps

One of the most useful tools that geographers use to process information is a **map**. A map is a simplified plan of an area. Maps are drawn in the **plan view** (directly from above) because this ensures the scale will be the same across the entire area. If maps were drawn from an angle, some parts of the mapped area would look distorted and so it would not be an accurate representation of the area. When properly used, maps can reveal a great deal about our planet and the ways in which we use it.



Source GT.15 An aerial photograph of Sydney Harbour and the city

### SYDNEY: HARBOUR AND CBD



Source GT.16 A map of Sydney Harbour and the city (as shown in GT.15)

Source: Oxford University Press



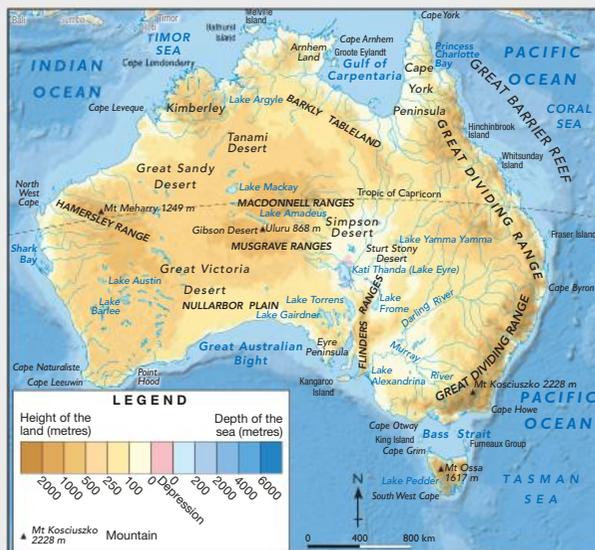
## Simple maps

Geographers use different types of maps to show a whole range of different natural and built features – and the connections between them. This year you will be learning how to create a number of different types of maps and interpreting the information that they provide. These maps include:

### Physical maps

**Physical maps** show the locations and names of natural features of the Earth. These may include deserts, mountains, rivers, plains, oceans, reefs, volcanoes and lakes.

#### PHYSICAL MAP OF AUSTRALIA SHOWING OCEANS AND MAJOR MOUNTAIN RANGES, RIVERS, LAKES AND DESERTS



Source GT.17

Source: Oxford Atlas

### Political maps

**Political maps** show the locations and names of built features of the Earth. These may include country borders, state and territory borders, cities and towns.

#### POLITICAL MAP OF AUSTRALIA SHOWING STATE AND TERRITORY BORDERS, CITIES AND TOWNS



Source GT.18

Source: Oxford Atlas

### Dot distribution maps

**Dot distribution maps** use dots (or shapes) to represent (and sometimes compare) a range of different features. The dots show the location of the chosen feature. The size and colour of the dots on the map can show different characteristics of that feature. For example, in GT.19, small towns are shown as small green dots and big cities are shown as big red squares. Other dot distribution maps show the location of a single feature, such as litter (see Source GT.51). Dot distribution maps help to show patterns and links between features – geographers refer to this as spatial distribution.

#### DOT DISTRIBUTION MAP OF AUSTRALIA SHOWING POPULATION



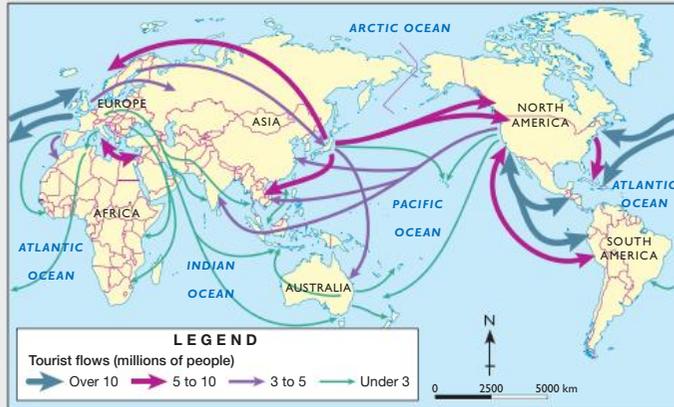
Source GT.19

Source: Oxford University Press

## Flow maps

**Flow maps** show movement from one place to another. Arrows of different thicknesses or colours are used to show where different things (such as people or goods) are moving to and from, and compare the numbers involved in the movement.

### FLOW MAP SHOWING THE FLOW OF TOURISTS WORLDWIDE



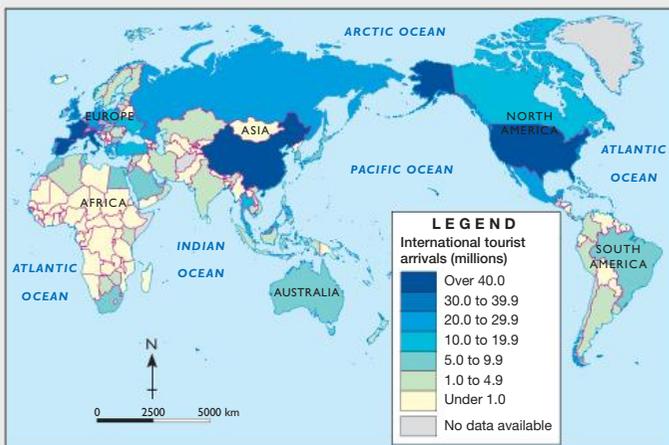
Source GT.20

Source: Oxford University Press

## Choropleth maps

**Choropleth maps** use different shades of the same colour to give a quick impression of the pattern formed by the data being shown. Darker shades show the highest values or the greatest amounts, while lighter shades show the lowest values or the least amounts.

### CHOROPLETH MAP SHOWING INTERNATIONAL TOURIST ARRIVALS WORLDWIDE

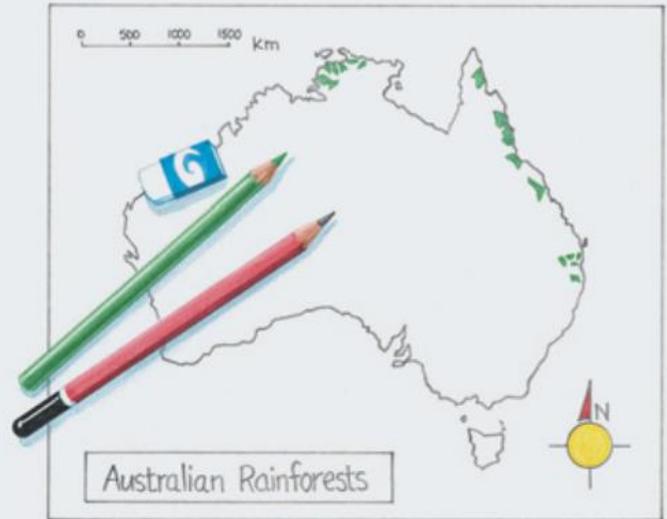


Source GT.21

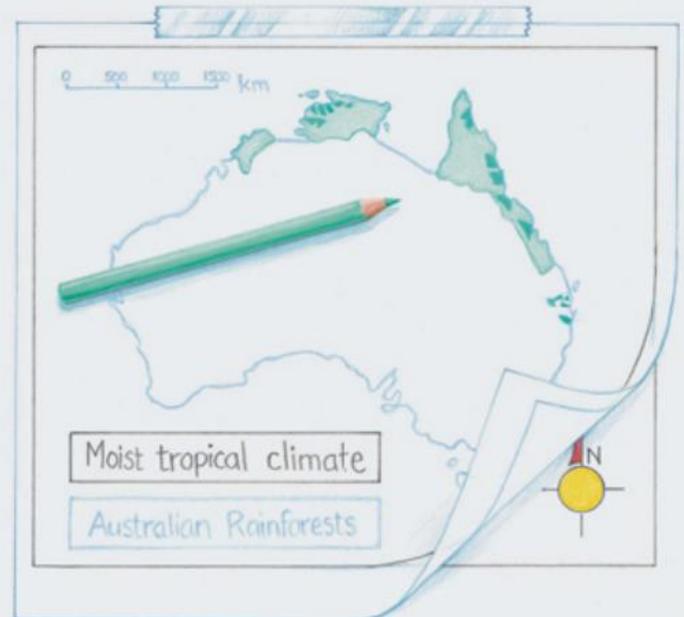
Source: Oxford Atlas

## Overlay maps

**Overlay maps** show how features on the Earth's surface may be related to each other. To create an overlay map you first need to produce a base map showing one feature (such as the location of Australian rainforests) and then place a piece of tracing paper or plastic sheet over this base map showing the other feature you are investigating (such as areas with a moist tropical climate).



From Mongabay.com



From Mongabay.com

**Source GT.22** An overlay map showing the location of Australian rainforests on a base map (top) and areas with a moist tropical climate on an overlay (bottom)

## More complex maps

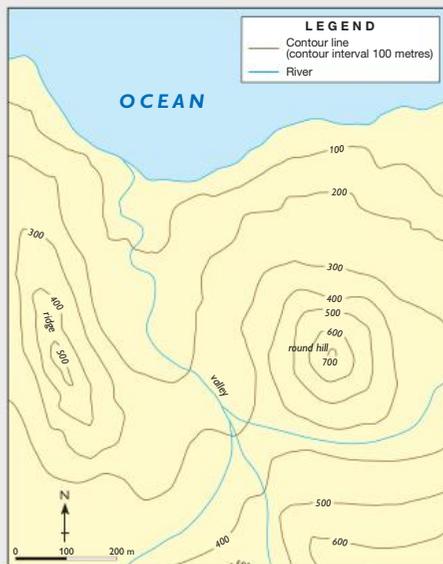
Over the course of the year you will also be working with a number of other, more complex maps. You won't necessarily be creating these maps yourself, but you will be learning how to make sense of the information they provide. These maps include:

### Topographic maps

**Topographic maps** show the shape of the land (such as the shapes formed by valleys, hills and ridges) by using **contour lines**. Numbers on some of the contour lines show the height of the land above sea level. The closer together the contour lines are, the steeper the land. Symbols and colours are also used on topographic maps to show other natural features (such as forests, rivers and lakes) and built features (such as towns, roads and mines).

The contour patterns of three common features are shown below the topographic map in Source GT.23.

TOPOGRAPHIC MAP SHOWING A ROUND HILL, A VALLEY AND A RIDGE



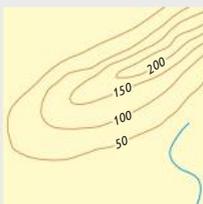
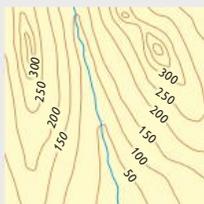
A ROUND HILL



A VALLEY



A RIDGE



Source GT.23

Source: Oxford University Press

### Weather maps

**Weather maps** show conditions in the atmosphere, such as air pressure, wind speed and wind direction. They also show the size and location of warm and cold fronts. Weather maps are also known as synoptic charts. They are most commonly seen on the nightly news.



Source GT.24 Weather maps feature in the nightly news on television

### Thematic maps

**Thematic maps** show a particular theme or topic; for example, the distribution of resources (such as coal and gas), the different types of forests around the world, access to safe drinking water, or the types of crops and animals farmed in Australia.

THEMATIC MAP OF AUSTRALIA SHOWING TYPES OF ANIMALS AND CROPS GROWN



Source GT.25

Source: Oxford University Press

## Geographic Information Systems (GIS)

**Geographic Information Systems (GIS)** are a way of creating, viewing, organising and analysing geographical information with the use of a software application. GIS is an exciting new development in the world of geography because it allows geographers to access and share an incredible amount of data and look at the world in new ways. GIS are made up of three elements:

- digital base maps
- data that is layered over the base map (such as a chart, overlay or table)
- a software application or platform that links these elements together and allows the user to interact with all of this information.

GIS combine satellite images, graphs and databases to allow you to identify patterns and trends so that you can gain a better understanding of the world around you. They allow you to turn different layers of data on and off in order to isolate exactly what you are looking for. You can even create and share your own maps, look at 3-D models of areas and record video simulations, known as flyovers.

GIS is already a part of many people's everyday life. Governments, companies and individuals all around the world use GIS. There are a number of GIS platforms available today, but one of the most commonly used and free GIS is Google Earth.

## Essential features of maps

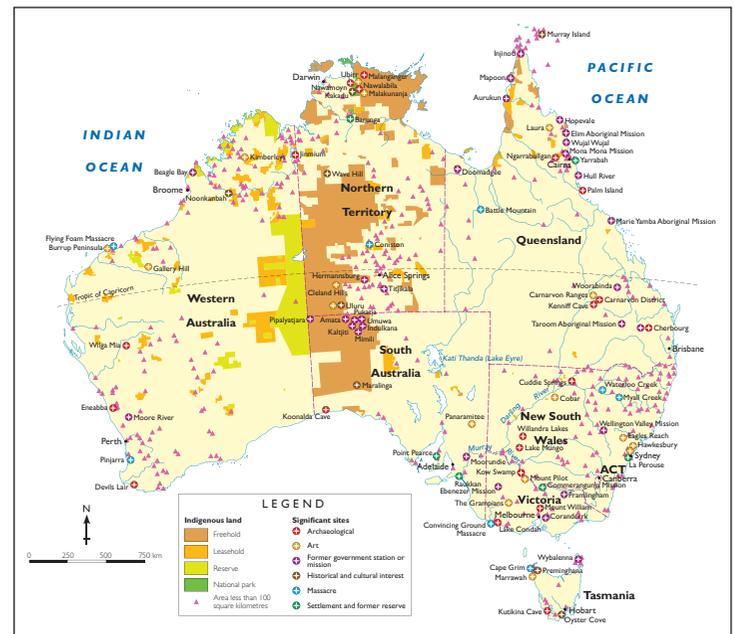
### BOLTSS

Regardless of the type of maps you are creating or interpreting, all will share some common features. There are six features that ensure every map is drawn in a clear, concise and accurate way. To help you remember these features, remember you can use a mnemonic (memory aid) that consists of the first letter of each of the features. Together, these six letters make up the word **BOLTSS**:

- B** **Border** – an outline or box drawn around the map
- O** **Orientation** – an indication of direction, usually shown with a north arrow or compass rose
- L** **Legend** – an explanation of the symbols, colours and patterns used on the map (also known as a key)
- T** **Title** – a heading that describes the map and what it is showing
- S** **Scale** – a way of indicating what distances on the map represent in the real world. Scale can be shown in three different ways: as a written scale, a line scale or a ratio. Source GT.29 shows the three ways scale can be represented on a map.
- S** **Source** – where the information used to create the map came from. If these details are not known, simply write 'Source: unknown'. If you have created the map from your own data, simply write 'Source: own map' or 'Source: [add your name]'.

Source GT.26 shows a map of Australia that is held together with BOLTSS.

### AUSTRALIA: INDIGENOUS LAND AND SITES, 2006



Source: Oxford Atlas

Source GT.26 A map of Australia showing all the features of BOLTSS

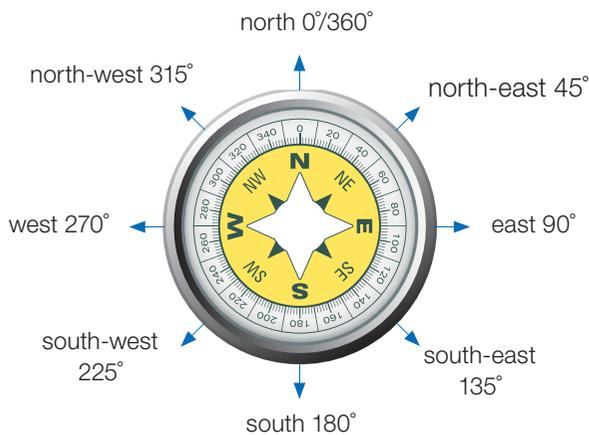
## Direction

**Direction** must always be shown on maps because it enables the user to work out the location of features shown. Direction is shown on maps by the use of compass points. A **compass** is an instrument with a magnetised needle that will always point to the Earth's magnetic field near the north pole (known as **magnetic north**). The face of a compass shows a circle made up of 360 degrees (see Source GT.27).

The four main directions on a compass are north, south, east and west. These are known as **cardinal points**. Most maps are oriented to north. Once north has been established, you can find the other points of the compass.

Using compass points is an accurate way of giving directions because the compass always points to magnetic north no matter which direction you are facing.

**Compass bearings** provide an even more precise way to give directions. A bearing is an angle that is measured clockwise from magnetic north. The bearing of magnetic north can be either 0 degrees or 360 degrees, the bearing of south is 180 degrees, the bearing of east is 90 degrees and the bearing of west is 270 degrees. These bearings are also shown in GT.27.



**Source GT.27** A compass face showing cardinal points and compass bearings

## Scale

We use **scale** to shrink or increase real world features so they will fit into a space. Model cars are scaled down in size and proportion from real cars.

The model shown in GT.28 looks like the real car, only smaller. It is a 1:35 scale model.

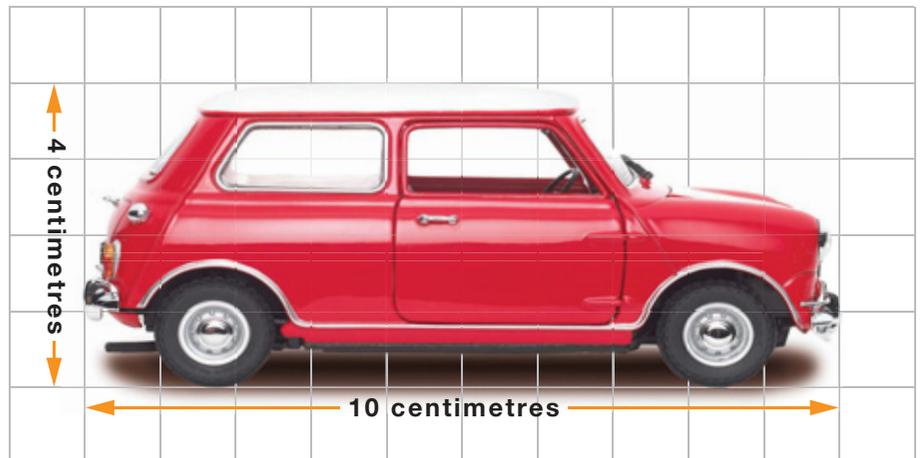
This means that 1 centimetre on the scale model is equal to 35 centimetres on the real car. If 1 centimetre represents 35 centimetres, then 10 centimetres (the total length of the model) represents a total length of 350 centimetres (or 3.5 metres) on the real car.

## Scale on maps

Maps are scaled representations of real areas. These representations have been designed to fit on a piece of paper or on a computer screen. Maps look the same as the real areas they are representing, just reduced to a size you can work with. Scale on maps allows you to work out the distances in the real world.

Look at the map of Tasmania (Source GT.29). In the bottom left-hand corner it shows the three types of scale that can be used on maps and how they work:

- **Written scale** – A written scale tells you how much a distance on the map represents on the ground. The written scale on Source GT.29 is '1 centimetre on the map measures 30 kilometres on the ground'. Using this information we can easily work out that 5 centimetres on the map would be equal to 150 kilometres on the ground, and so on.
- **Line scale** – A line scale is a numbered line that acts like a ruler. You can use it to measure distances on the map. The Source GT.29 line scale shows 1 centimetre is equal to 30 kilometres.
- **Ratio scale** – A ratio scale shows scale in numbers. The ratio scale for Source GT.29 is 1:3 000 000, so 1 unit (that is, 1 centimetre) on the map represents 3 000 000 centimetres on the ground. Of course, 3 000 000 centimetres is equal to 30 kilometres.



**Source GT.28** This model car is thirty-five times smaller than the real car. This is expressed as 1:35.

## skilldrill

### Using line scale to measure distances

Scale is a handy tool to help you study the world around you from inside your classroom. Look at Source GT.29. You will notice that all the features on the map have been shrunk by the same amount so that they fit on the page.

You can use the line scale to measure the distance between two points 'as the crow flies' (that is, in a straight line) by following these steps:

- Step 1** Place the straight edge of a sheet of paper over the points you wish to measure.
- Step 2** Mark the starting and finishing points on the paper.
- Step 3** Hold the edge of the paper against the line scale to work out the real distance between the two points.

### Apply the skill

- 1 Use Sources GT.29 and GT.30 to answer the following questions:
  - a How far is it from the peak of Cradle Mountain to the centre of Hobart as the crow flies?
  - b How far is it from Devonport in the state's north to Queenstown in the west as the crow flies?
  - c How long is Lake Gordon from north to south?
  - d How wide is the state of Tasmania at its widest point?

**Source GT.30** Measuring straight distances on a map using a sheet of paper

### TASMANIA



Source GT.29

Source: Oxford Atlas

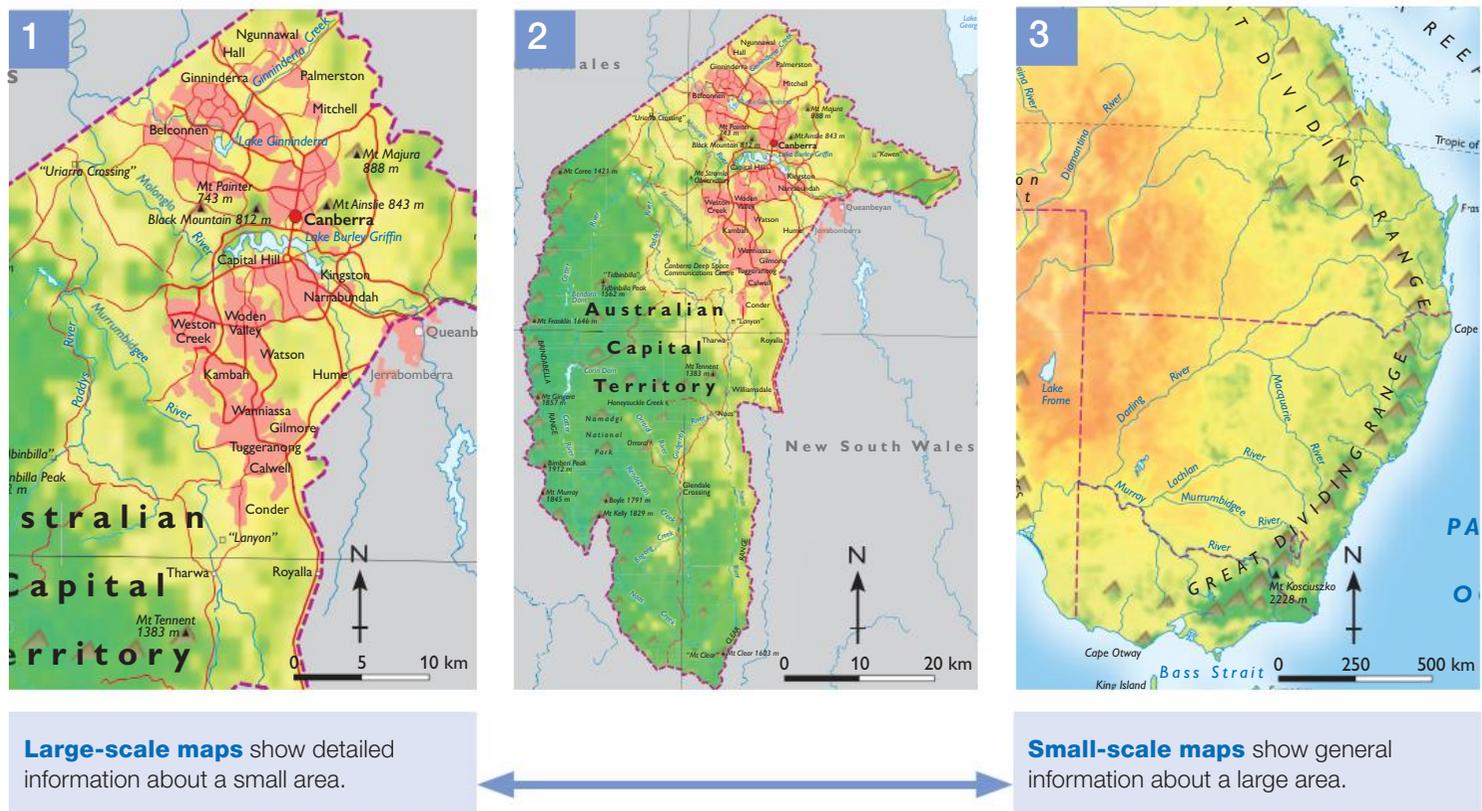


## Comparing map scales

Maps are often shown at different scales depending on the amount of detail they need to show. Source GT.31 shows three maps at different scales:

- Map 1 is a **large-scale** map. It shows a large amount of detail but only a small area. You can see the city area (in pink) and Lake Burley Griffin.
- Map 2 is a **medium-scale** map. It shows a medium amount of detail and a medium area. You can see the whole of the Australian Capital Territory (ACT).
- Map 3 is a **small-scale** map. It shows a small amount of detail but a large area. You can only just see the border of the ACT.

### ACT AND EASTERN AUSTRALIA



Source GT.31

Source: Oxford University Press

### Remember:

- Large-scale maps show a **large** amount of detail, but a **small** area.
- Small-scale maps show a **small** amount of detail, but a **large** area.

## Locating places on maps

Maps are used for many different purposes, but the most commonly used maps help us to find things we are looking for. These maps are often overlaid with a set of lines that form a grid. These gridlines divide the map into smaller areas and help us find places more easily. There are a number of ways in which you can locate things on maps and a number of methods you can use to help other people find these places. Some of these methods will give you a general idea of where something is, while others can help you pinpoint the exact location of something.

SURFERS PARADISE STREET MAP



Source GT.32

Source: *Brisway*

## Grid and area referencing

### Alphanumeric grid referencing

In maps that use alphanumeric grid referencing the spaces between gridlines are labelled with letters and numbers. The letters appear along the bottom (or top and bottom) of the map while the numbers appear down the left-hand side (or both sides) of the map. For example, in Source GT.32 the grid reference for the Paradise Centre is J6.

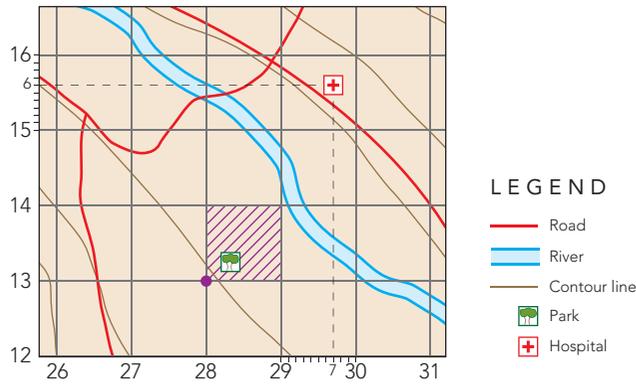
### Area referencing (AR)

The area referencing (AR) method is used on topographic maps that have gridlines. Each line is given a two-digit number. The lines that run up and down the map are known as **eastings** (because the numbers increase as you move east). The lines that run across the map are known as **northings** (because the numbers increase as you move north). A four-figure area reference will pinpoint the bottom left-hand corner of the grid square in which you will find the feature. The eastings are given first then the northings. For example, in GT.33 the park is located in AR2813.

### Six-figure grid referencing (GR)

Six-figure grid references (GR) help locate exact points on a topographic map. The area between each easting is divided into ten further parts (tenths), as is the area between each northing. This is just like adding a finer set of gridlines over the existing gridlines allowing you to be very specific about where things are within each grid square. As with area referencing, the eastings are given first then the northings. The difference is that one more figure is added to the easting and one more figure is added to the northing. This makes six figures in total. For example, in GT.33 the hospital is located at GR297156.

TOPOGRAPHIC MAP EXTRACT SHOWING AR AND GR



Source GT.33

Source: Oxford Atlas Project 3

*Latitude and longitude*

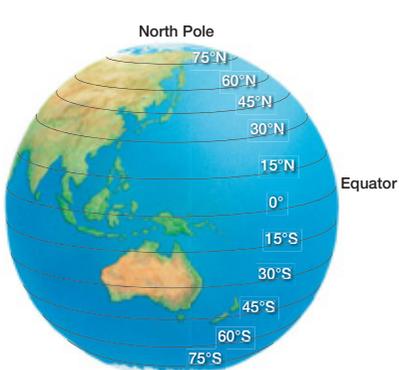
Maps that show large areas of the Earth’s surface (such as world maps) use a set of imaginary lines that form a grid. These gridlines, known as **latitude** and **longitude**, help us to locate places accurately.

Lines that run from east to west are known as lines (or parallels) of latitude. Lines that run from north to south are known as lines (or meridians) of longitude. Each of the lines is separated by degrees rather than distance because the world is round, not flat.

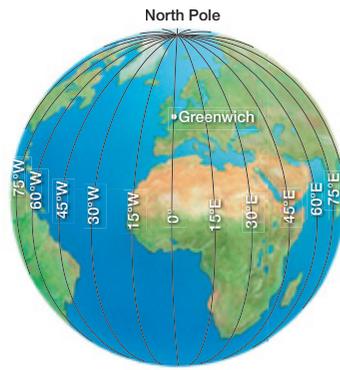
The line of latitude midway between the north pole (90 degrees north) and south pole (90 degrees south) is known as the **Equator**, which is located at 0 degrees latitude. It divides the Earth into the northern hemisphere and southern hemisphere.

Lines of latitude are measured in degrees north and south of the Equator.

Lines of longitude are measured east and west of the Greenwich meridian (also known as the Prime Meridian), which is located at 0 degrees longitude.



Source GT.34 Lines (or parallels) of latitude



Source GT.35 Lines (or meridians) of longitude

Remember:

- Latitude – think ‘lat is flat’.
- Longitude – think ‘long is long’.

Creating graphic representations

In addition to maps, geographers use a range of other visual representations to communicate information they have collected. These include:

- Tables – These allow geographers to present and compare data by organising it under different headings (see Source GT.36).
- Diagrams – These allow geographers to show the features or characteristics of some places or things much more effectively than describing them in words. Certain interesting or complex processes can also be more easily explained and demonstrated with the help of sketches, flow charts or illustrations (see Source GT.34 and Source GT.35).
- Graphs – These allow geographers to compare data and present it in an interesting and attractive way. There are a number of different types of graphs used by geographers for different purposes. The most common of these are explained on the following pages.

Source GT.36 A table showing the populations of Australian states and territories in 2011

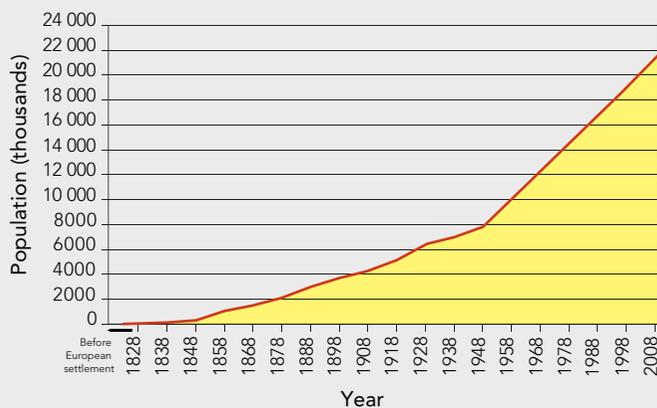
State/Territory	Population	Percentage of Australia’s population
New South Wales	7 317 500	32.3
Victoria	5 640 900	24.8
Queensland	4 599 400	20.3
Western Australia	2 366 900	10.4
South Australia	1 659 800	7.3
Tasmania	511 000	2.3
Australian Capital Territory	366 900	1.6
Northern Territory	231 200	1.0
Australia	22 693 600	100.0

## Simple graphs

Graphs are one of the most effective graphical representations when it comes to showing numerical (or quantitative) data. Some kinds of graphs are simple, while others are more complex. This year you will be learning how to create a number of different types of graphs and interpreting the information that they provide. Some of these graphs are described below.

### Line graphs

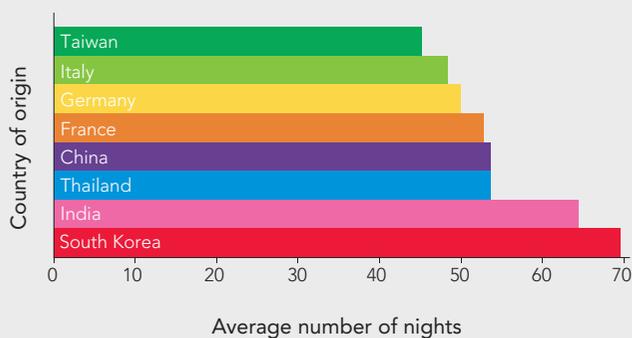
**Line graphs** show information as a series of points that are joined up to form a line. The line shows a trend or change over time. The horizontal axis (x) will usually show units of time and the vertical axis (y) will usually show amounts.



**Source GT.37** A line graph showing the increase in Australia's population, 1828–2011

### Bar graphs

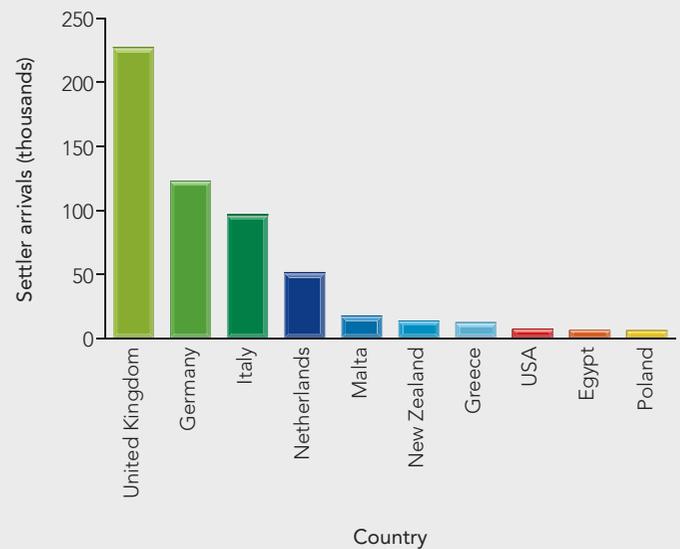
**Bar graphs** show information as a series of bars that run in a horizontal direction and are stacked one on top of the other. They are usually used to compare quantities.



**Source GT.38** A bar graph showing average number of nights spent in Australia by tourists from different countries, 2009

### Column graphs

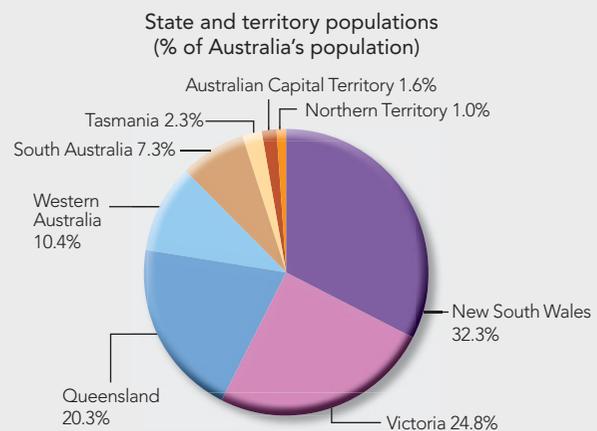
**Column graphs** are similar to bar graphs, but they show information as a series of vertical columns that are arranged side by side. They are also usually used to compare quantities.



**Source GT.39** A column graph showing top ten countries of settler arrivals in Australia, 2010–11

### Pie graphs

**Pie graphs** are shaped like a circle and are divided up so that the information being shown represents the slices of a pie. The circle of 360 degrees represents 100 per cent and each of the slices is a percentage of that. The slices of the pie are organised from largest to smallest in a clockwise direction starting from 12 o'clock.



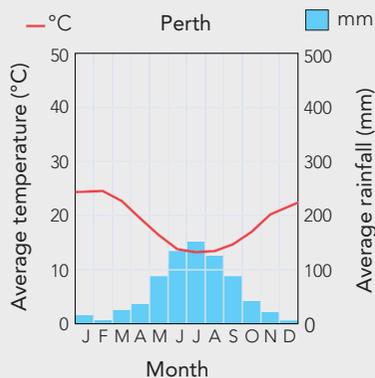
**Source GT.40** A pie graph showing state and territory populations as a percentage of Australia's total population, 2011

## More complex graphs

Over the course of the year you will also be working with a number of other, more complex graphs. You won't necessarily be creating these yourself, but you will be learning how to make sense of the information they provide. Some of these graphs are described below.

### Climate graphs

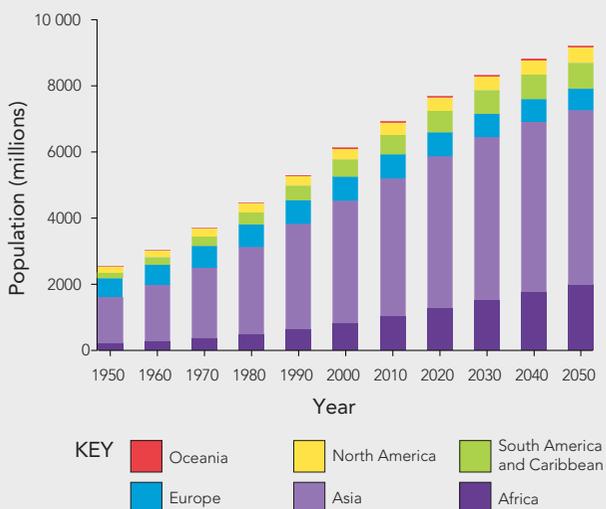
**Climate graphs** show the average monthly temperature and rainfall for a place over a year. Climate graphs combine line and column graphs. Temperature is recorded as a line graph and rainfall is recorded as a column graph.



**Source GT.41** A climate graph showing the average monthly temperature and rainfall in Perth

### Compound column graphs

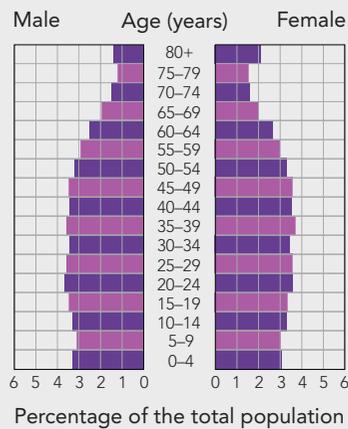
**Compound column graphs** are a more complex type of column graph in which each column is split into sections so results can be more easily compared.



**Source GT.42** A compound column graph showing the increase in world population by region, 1950–2050

### Population pyramids

**Population pyramids** are bar graphs that show the percentage of males and females in different age groups in a population. They help geographers identify trends in population growth in a country. Population pyramids are organised so that younger age groups are at the bottom and older age groups are at the top. Percentages of males are placed on the left-hand side and percentages of females are placed on the right-hand side.



**Source GT.43** A population pyramid for Australia in 2009. From it you can see, for example, that there are more females than males over the age of 80

## Check your learning GT.3

### Remember and understand

- 1 Give two examples of primary data and two examples of secondary data. What is the main difference between these two types of data?
- 2 What is a map?
- 3 What does BOLTSS stand for?

### Apply and analyse

- 4 Look carefully at Source GT.29 and answer the following questions:
  - a What is the scale of the map? Give your answer in the form of a ratio.
  - b If you were flying from Marrawah to Port Arthur in which direction would you be travelling?

### Evaluate and create

- 5 On a piece of graph paper, draw a simple map of your bedroom. Be sure to include all the furniture (for example, your bed and desk) in the correct location and to the correct scale. Make sure it has BOLTSS.
- 6 Look at Source GT.36 and construct a bar or column graph to represent this data graphically.

## Interpreting, analysing and concluding

### Use methods to identify trends, patterns and relationships in geographical data and draw conclusions

Once you have collected, recorded, evaluated and represented your data, it is time to identify any trends, patterns or relationships in the information. You will have used questionnaires and surveys to gather visitor statistics, drawn sketches and diagrams, created graphs and tables and taken photographs (all of which are primary data). You will also have collected information from various other sources, such as textbooks, websites, GIS and atlases (all of which are secondary data). Now it is time to look at this information, identify any possible links and relationships and draw conclusions.

There are a number of methods that geographers use to help them during this stage of their inquiries. These include the:

- PQE method
- SHEEPT method.

#### Using the PQE method

PQE is a tool used by geographers to analyse the data they have gathered (such as maps, tables, graphs and diagrams) and reach conclusions. The letters PQE stand for pattern, quantify and exceptions.

##### *Pattern (P)*

*In this step, you need to give a general overview of any patterns you may identify.*

When looking at any form of data, look for things that stand out or form patterns. A pattern may be a group of similar features on a diagram, a concentration of a particular colour or feature on a map, or a particular shape that is created by data on a column graph. For example, when looking at a physical map of Australia (see Source GT.44) you might say, 'Most mountains run along the coast in the east.'

##### *Quantify (Q)*

*In this step, you need to add specific and accurate information to define and explain the patterns.*

Quantifying involves using statistics, amounts, sizes and locations to give specific details. For example, rather than just saying 'Most mountains run along the coast in the east,' you would need to quantify this statement. You might instead say 'A mountain range known as the Great Dividing Range extends more than 3500 kilometres along the eastern coast of Australia from Queensland to Victoria. It is the third longest mountain range in the world.'

##### *Exceptions (E)*

*In this step, you need to identify anything that does not fit your patterns.*

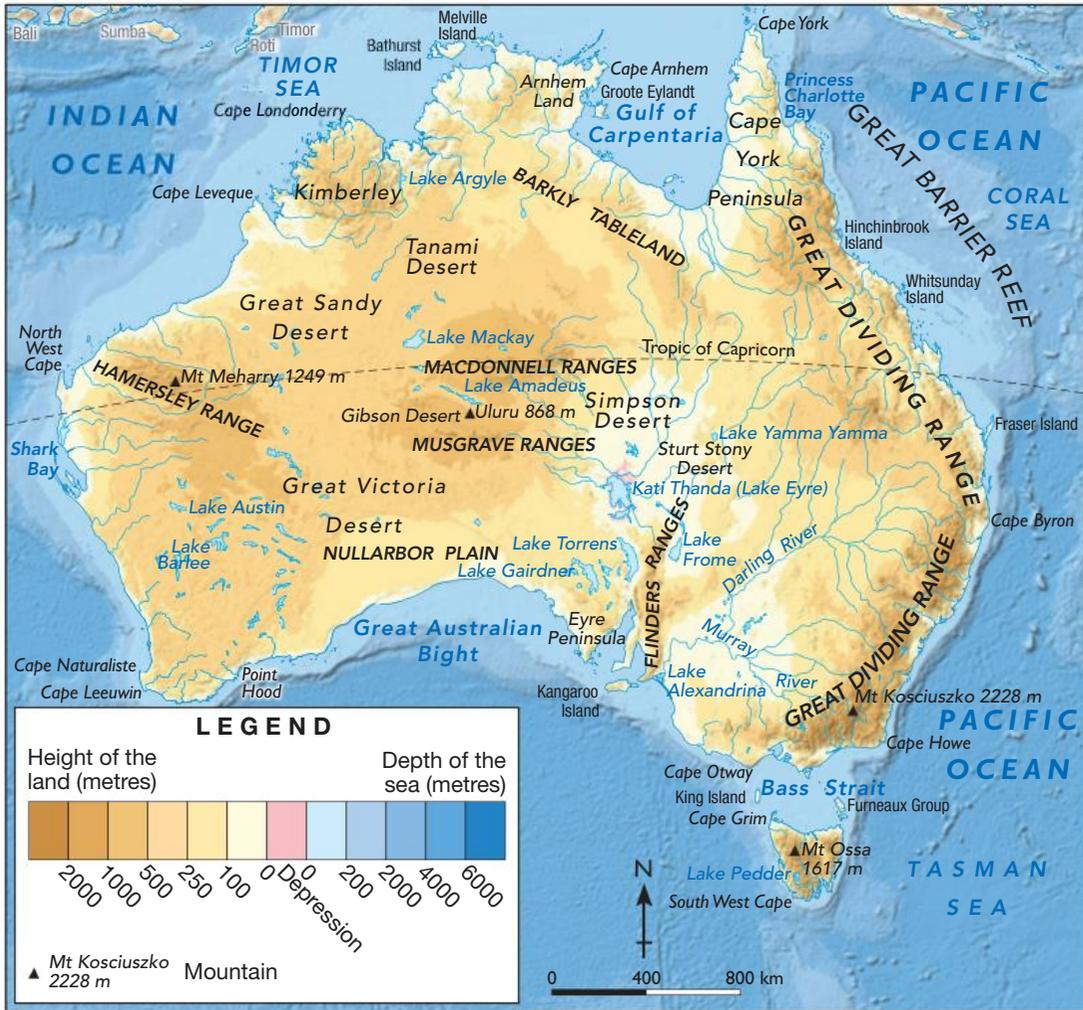
Often you may find that there are things in your data that do not fit into a pattern you have identified. These are called exceptions. They also need to be identified and quantified. For example, you might say 'There are a number of other mountain ranges that are not on the east coast. These include the Flinders Ranges in South Australia and the MacDonnell Ranges in the Northern Territory.'

#### Using the SHEEPT method

SHEEPT is a tool used by geographers to help them consider the many factors that may contribute to the patterns identified in their data. When you are examining issues related to your inquiry, it is useful to think about them in terms of these six factors and rank them in order of importance. This will help you reach your conclusions. The letters SHEEPT stand for:

- social (S) – factors relating to culture and people
- historical (H) – factors relating to past events
- environmental (E) – factors relating to the natural environment (including climate, landforms and vegetation)
- economic (E) – factors relating to the earning or spending of money (including income earned from industry and tourism and the cost of building a dam or highway)
- political (P) – factors relating to governments (including laws, regulations and policies)
- technological (T) – factors relating to the availability and use of different types of technology (including the development of greener technologies, alternative energy sources and GIS).

PHYSICAL MAP OF AUSTRALIA SHOWING OCEANS AND MAJOR MOUNTAIN RANGES, RIVERS, LAKES AND DESERTS



Source GT.44

Source: Oxford Atlas

## Check your learning GT.4

### Remember and understand

- 1 What do the letters PQE stand for?
- 2 What do the letters in SHEEPT stand for?
- 3 How can the PQE and SHEEPT methods assist us to identify trends, patterns and relationships in geographical data and draw conclusions?

### Apply and analyse

- 4 Look at Source GT.44. Use the PQE method to think about Australia's lakes.
  - a Can you identify a pattern?
  - b Can you quantify this pattern?
  - c Are there any exceptions to this pattern?

### Evaluate and create

- 5 Conduct your own Internet research on the way in which Uluru is managed and use the SHEEPT method to think more closely about the factors that impact on Uluru.
  - a List at least one point for each of the SHEEPT factors.
  - b What conclusion(s) can you make about the way in which Uluru is managed?
- 6 Create a colourful and informative pictogram (by adding an image or picture to each of the letters in the word SHEEPT) to help you and your classmates remember what each of the letters in SHEEPT stands for.

## Communicating

### Present conclusions using a range of communication forms and digital technologies

Geographers use a wide range of methods to inform other people about what they have found over the course of a geographical inquiry. After carefully considering their audience and the purpose of the inquiry they may choose to communicate their conclusions in a number of different ways. Some of the methods that geographers use to communicate their findings include:

- written methods, such as essays or reports
- oral forms, such as oral reports, presentations, discussions and debates
- graphic forms, such as maps, graphs, and diagrams
- visual forms, such as **annotated visual displays (AVDs)**, photographs, sketches, satellite images and posters
- digital forms, such as Wikis, Geographic Information Systems (GIS), databases, 3-D models and simulations, and multimedia presentations.

## skilldrill

### Creating an annotated visual display (AVD)

One of the most popular ways of presenting and communicating the findings of a geographical inquiry is to construct an annotated visual display (AVD). An AVD combines written text with visual images (such as photographs) and other graphic representations (such as maps, graphs, tables, sketches and diagrams).

To create a successful AVD there are a few steps to follow:

#### Step 1 *Gather your data*

Make sure that you have collected all the pieces of information and data that you have found and/or created throughout your inquiry. Print your photographs, tidy up your sketches and process any data that you have collected. Tables of raw data are usually much more effective when they are made into graphs (for example, bar graphs or pie graphs). Ensure that all your maps, including sketch maps, have BOLTSS. Each resource (such as a graph, map, sketch, photograph, cross-section or written explanation) must also have a title and, in the case of photographs, a caption.

#### Step 2 *Organise your results*

On a large sheet of poster paper, lay out all your information and data. All written descriptions and answers should be typed, or neatly printed, on separate sheets of white paper, not written directly onto the poster paper. This will allow you to arrange them on the poster paper in the most logical and relevant way before you glue them down. The key inquiry question that began your geographical inquiry may guide your final layout. In the following example, the focus question, 'Is it a good thing that so many tourists visit Uluru?', suggests that there will be three main parts to the AVD:

- information about Uluru and its physical features
- tourist statistics and other data that show the effects that visitors are having on Uluru and its surroundings
- an analysis of the data. A conclusion that answers the key inquiry question.

#### Step 3 *Present your results*

When you are happy with your layout, design a main heading and other smaller headings. Don't forget to write your name in small, neat letters next to the heading or at the bottom of the AVD. Use glue to stick your resources onto your AVD. You may like to draw borders around some information.

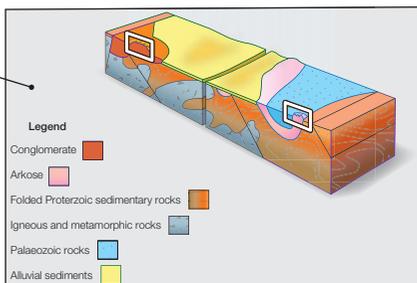
#### Step 4 *Acknowledge your sources*

If you have used books or other resources (such as websites) these need to be acknowledged in a bibliography or list of references. This can be stuck on the back of your AVD.

All diagrams, sketches, photographs and graphs must have a heading and a caption

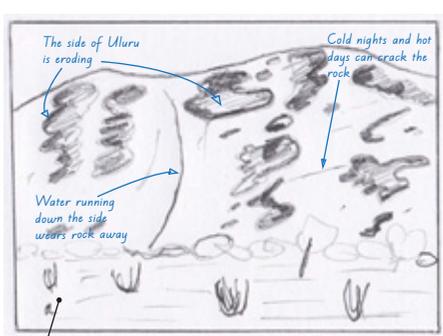
# Is it a good thing that so many tourists visit Uluru?

NATURAL PROCESSES



- Legend**
- Conglomerate
  - Arkose
  - Folded Proterozoic sedimentary rocks
  - Igneous and metamorphic rocks
  - Palaeozoic rocks
  - Alluvial sediments

EROSION OF ULURU

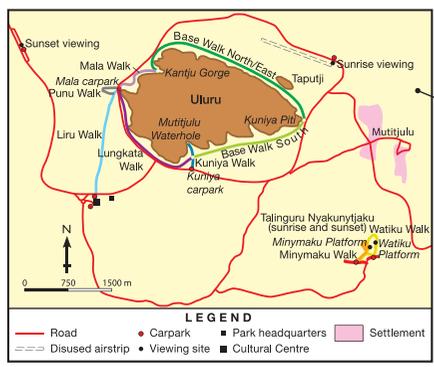


- TOURISM AT ULURU**
- \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_

EROSION



LOCATION MAP



Name: \_\_\_\_\_

Make the heading stand out

Always include a location map; remember BOLTSS

A simple sketch can break up lots of writing

Lists may be better than long paragraphs

**Source GT.45** An annotated visual display (AVD)  
 Natural processes illustration © Director of National Parks (Parks Australia) www.parksaustralia.gov.au

## Apply the skill

- 1 Imagine that your class is exploring the Great Barrier Reef as a geographic inquiry with a particular focus on the impact of tourism on this natural environment.
  - a Discuss with a partner some geographic questions about this place.
  - b Select one of these questions that could be used to complete an AVD.
  - c Gather some data in response to this question. There is no need to explore this topic in great depth, but just to practice your communication skills. Your data could be sourced from the Internet, books, magazines or from your own personal experience. You should try to find about three or four images and some writing, such as a newspaper article.
  - d Work with your partner to design your AVD on a piece of A3-sized paper.
  - e Complete your AVD by following steps 3 and 4 of the skill drill.
  - f Display your AVD on the classroom wall and compare it with those of your classmates.

## Use correct geographical terminology

Just like scientists, geographers share a common language. They use geographical terminology to clarify what they are talking about and to share their findings.

Source GT.46 lists and defines some commonly used geographical terms; additional geographical terms can also be found in the glossary at the end of this book.

**Source GT.46** Some useful geographical terms

Term	Definition
<b>BOLTSS</b>	The six essential features that should be included on every map: border, orientation, legend, title, scale and source
<b>direction</b>	A way of orienting a map, usually shown by the use of compass points, such as north
<b>distance</b>	The amount of space between two objects or places, generally measured by using the scale on a map
<b>distribution</b>	The way in which things are arranged on the Earth's surface; the pattern formed by the way objects or places are distributed across a space
<b>exception</b>	A feature that falls outside a usual pattern or does not follow an observed pattern
<b>geographical inquiry</b>	The stages that geographers follow to guide their investigations
<b>key inquiry question</b>	A question that helps geographers to plan and focus their geographical inquiries
<b>primary data</b>	Data collected for a geographical inquiry by a person conducting an inquiry, such as survey data, hand-drawn maps or photographs
<b>region</b>	An area of the Earth's surface with a feature that makes it different from surrounding areas
<b>scale</b>	A line that indicates the distances on a map as represented in the real world
<b>secondary data</b>	Data collected for a geographical inquiry from another source, such as textbooks, atlases and government websites
<b>spatial pattern</b>	The distribution of features on the Earth's surface that may form particular patterns, such as linear (in lines), clustered or radial (like spokes on a wheel)
<b>trend</b>	A general direction in which something is developing or changing (e.g. the trend in population in Australia is positive because the population is growing)

### Check your learning GT.5

#### Remember and understand

- 1 What do the letters AVD stand for?
- 2 Make a list of the things you need to gather before creating an AVD.
- 3 Why is it important to spend time on the layout of the written and visual information that will be shown on your AVD?

#### Apply and analyse

- 4 Do you think an AVD is an effective way to communicate the findings of a geographical inquiry? Why or why not?
- 5 As part of a geographical inquiry looking at the key question 'Is it a good thing that so many tourists visit Uluru?' your teacher has asked you to take part in a class debate. List three points for the affirmative and three points for the negative. Which side would you rather be on? Why?

- 6 Which form (such as written, oral, graphic, visual or digital) do you think would be most appropriate for presenting the findings of a geographical inquiry into tourism at Uluru? Why?

#### Evaluate and create

- 7 Your geography class has been asked by the principal to complete a geographical inquiry into the issue of recycling at your school. The principal hopes that by raising awareness of recycling, the school community may be willing to change their behaviour and make the school more sustainable. Conduct a class discussion on the most effective way to conduct the inquiry. At the end of your discussion, make a decision about the best way in which your findings could be presented to the whole school in order to convince them to participate.

## Reflecting and responding

### Reflect on what you have learned

The final stage of a geographical inquiry is to reflect on what you have learned and decide whether any action needs to be taken. Reflecting involves not only looking at what you have learned but also how it has been learned. It involves asking critical questions about the way in which your geographical inquiry was conducted and your role in it. One of the best ways to reflect on your progress is to complete a self-evaluation checklist rating your performance at each stage and adding comments.



**Source GT.47** A geographical inquiry found that cigarette butts were a leading cause of litter at Uluru. One of the responses was the introduction of personal ashtrays. These ashtrays are available from the Cultural Centre and carry the logo 'Don't let the ranger see your butt'. Park authorities reduced the number of butts littering the area and believe this has also reduced the risk of bushfires.

### Justify possible methods of response

After reflecting on what you have learnt, you may discover that action is needed in order to respond to the issue you have been investigating. There are a number of different ways that geographers can take action to make a change. These include:

- creating a fact sheet or multimedia presentation about the issue to inform your class, school or community
- using social media to raise awareness and gather support
- emailing your local government representative or Member of Parliament about the issue
- inviting an expert speaker to present at your school assembly
- planning a campaign to raise money for the issue.

Our geographical inquiry into Uluru based around the key inquiry question 'Is it a good thing that so many tourists visit Uluru?' may lead us to actively campaign for tourism at Uluru to be managed in a more sustainable way so that this important landmark can be enjoyed by future generations. In particular, one of the negative effects discovered in the inquiry was litter, and a good example of a campaign to combat this is shown in Source GT.47.

The title of my geographical inquiry is:		
My geographical inquiry set out to investigate:		
GENERAL POINTS	My rating	Comments
I was able to complete all stages of my geographical inquiry	1 2 3 4 5	
I was able to answer all my key inquiry questions	1 2 3 4 5	
I was able to plan my inquiry effectively	1 2 3 4 5	
My maps, graphs, tables and diagrams were clear and accurate	1 2 3 4 5	
I was able to analyse my data and reach a conclusion	1 2 3 4 5	
I was able to communicate my findings in an interesting and appropriate way	1 2 3 4 5	
AREAS OF STRENGTH	Comments	
My areas of strength are:		
I'm getting much better at:		
AREAS NEEDING IMPROVEMENT	Comments	
The part I found most difficult was:		
I need the most help with:		
IMPORTANT ISSUES HIGHLIGHTED BY MY INQUIRY	Comments	
The most important thing I learned from my inquiry was:		
This issue is important to me because:		
This issue is important to my community/country/world because:		

**Source GT.48** A self-evaluation checklist

## Check your learning GT.6

### Remember and understand

- 1 Name two ways in which you could 'reflect' on what you have learnt throughout a geographical inquiry.
- 2 Give two reasons why it is important to be able to self-evaluate your work.

### Apply and analyse

- 3 Which do you think are the two most important questions to ask yourself in the self-evaluation checklist? Why?

### Evaluate and create

- 4 The completed self-evaluation checklist can look very different depending on what you are investigating. Are there any areas that you think could be improved in GT.48? What questions could be changed or added so that you could improve on the reflection process?

# GT.3 Fieldwork in geography

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## What is fieldwork?

**Fieldwork** is any geographical study that takes place outside the classroom or, as geographers say, 'in the field'. The 'field' is the source of geographical information (primary data). It can be conducted at a number of scales – in your school grounds, within your local community, in another state or even in another country. Fieldwork is an essential part of geography because the world outside the classroom is the geographer's 'laboratory'. Working in the field provides opportunities for first-hand investigation of both natural and built environments.

Fieldwork provides an opportunity to develop skills associated with observing, measuring and recording. Different forms of geographical data can be collected and then analysed to find relationships between the natural and human environments. The results of a fieldwork investigation are presented and communicated in a fieldwork report.

Fieldwork also involves identifying issues or problems and finding possible solutions. It is a way to engage with the real world and make a contribution to developing more sustainable and fair ways to manage the Earth's resources.

Fieldwork often looks at a key feature, issue or conflict. For example, many tourists visit Uluru each year with the intention of climbing 'The Rock.' In doing so, they ignore the wishes of the traditional owners of the land, the Anangu people (See Source GT.49). They also put themselves and others at risk. About thirty-five people have died while climbing Uluru and countless others have been injured or rescued. Geography students visiting Uluru may try to find out why people continue to climb it, and study the impacts of this activity on people and the natural environment.

**Source GT.49** Every tourist that climbs Uluru must pass a sign asking them not to climb the rock out of respect for the traditional owners, the Anangu.





## Different types of fieldwork

Most topics you learn about in class can also be studied during fieldwork. The types of fieldwork you conduct will differ according to your topic and the places you visit, but all these activities will help you to better understand your world. Source GT.50 provides examples of fieldwork locations and activities for a range of topics.

**Source GT.50** Examples of fieldwork locations and activities for a range of topics

Topic	Possible location	Sample fieldwork activity
Water in our environment	Local river or stream	Water sampling
Water as a resource	Water treatment plant, desalination plant or dam	Taking geographical photographs
Growing cities	Edge of a large city	Observing and describing
Changing cities	Urban renewal project	Land use mapping
Coastal landscapes	Local beach	Sketching a cross-section
Landscape hazards	Local beach	Field sketching
Global links	Shopping centre	Using a questionnaire
Communities	Local area, including houses and shops	Street surveying
Food security	Farming area	Asking questions
Endangered environments and animals	Zoo	Comparing environments

## Conducting successful fieldwork

Fieldwork is a type of geographical inquiry, so whenever you take part in fieldwork you will need to follow the stages that are outlined in this toolkit, namely:

- 1 Observing, questioning and planning
- 2 Collecting, recording, evaluating and representing
- 3 Interpreting, analysing and concluding
- 4 Communicating
- 5 Reflecting and responding.

The first stage is vital as this gives you a focus for your fieldwork. It also allows you to make a judgement about whether your fieldwork investigation has been successful.

## Stage 1: Observing, questioning and planning

Begin by looking at an issue or location and compile a set of related inquiry questions that you would like to answer. Plan what information you will need and how you will collect it.

## Stage 2: Collecting, recording, evaluating and representing

Plan your fieldwork so that you can collect the evidence and data that you will need. For example, take photos, draw sketches, conduct tests, construct questionnaires and surveys. You will then need to use this data to create graphs and maps for analysis. You may also need to consider members of the public, including Indigenous people and their beliefs and feelings about places in the landscape. If your class is planning a field trip to a natural environment, such as a forest or beach, you will need to ensure you do not damage the environment by trampling on plants or animals or by dropping litter.

## Stage 3: Interpreting, analysing and concluding

Interpret and analyse the data you have collected and look for patterns or clues that will help you to answer your key inquiry question and come to a conclusion. There are a number of different tools and methods you can use to do this, including PQE and SHEPT.

## Stage 4: Communicating

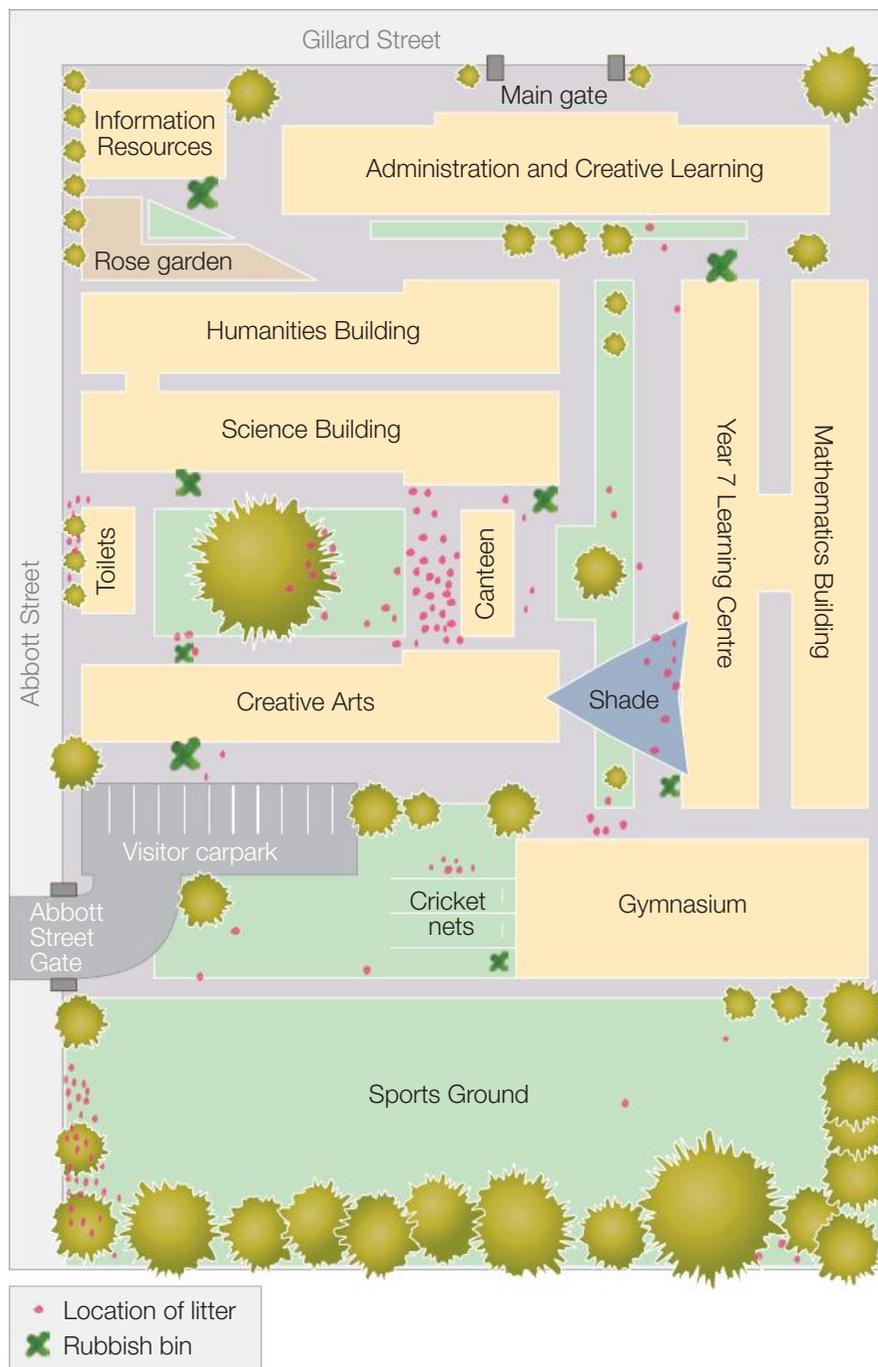
Communicate what you have found to an audience in the form of a report, a presentation or an annotated visual display (AVD).

## Stage 5: Reflecting and responding

Think about your fieldwork findings and reflect on ways to improve your investigation process. Finally, decide on a course of action, if this is appropriate.

## A fieldwork example: Gumtree College litter investigation

In the following example, a Year 7 geography class at Gumtree College (7G) decided to conduct fieldwork to explore a problem in their school – litter. As a class, they followed a process of inquiry to understand the issue and try to resolve it.



**Source GT.51** A sketch map of the schoolyard showing the locations of the bins and litter at Gumtree College



Source GT.52 A questionnaire of students in the canteen

## Stage 1: Observing, questioning and planning

During a brainstorm session, a range of investigation questions were raised by 7G. These included:

- What are the most popular foods sold in the school canteen?
- Does our school have the worst litter problem in the city?
- Does our school have enough bins in the yard?

During discussion it was decided that the first question wasn't really about litter. It was also decided that the second question was too broad and complex to answer in one fieldwork inquiry. The class agreed that the third question was the best one for the class to investigate.

The next stage was to plan what data had to be collected in order to answer the question and choose the methods used to collect this data. As geographers, 7G had to carefully consider other people and the environment when collecting data in the field. For example, they had to be careful not to disturb other classes while collecting their data.

## Stage 2: Collecting, recording, evaluating and representing

After some discussion, 7G decided to gather the information they needed to answer their inquiry question in three ways:



Source GT.53 A litter survey

- A sketch map of the schoolyard showing the locations of the bins and the litter – To complete this map, a group of students would look for rubbish at the end of every lunchtime for five days and show their findings on a dot distribution map (see Source GT.51).
- A litter survey – This would involve another group of students looking closely at the rubbish and classifying each piece of rubbish using certain headings (see Source GT.53).
- A questionnaire of students in the schoolyard – Another group of students would ask other students about litter and how they disposed of it (see Source GT.52).

### Stage 3: Interpreting, analysing and concluding

After asking questions and collecting evidence through fieldwork, 7G needed to interpret and analyse this data so that they could come to some conclusions about what they had found. Their aim was to use the evidence to answer the key question. By looking closely at their map and applying the PQE method, 7G students identified that most of the litter in their schoolyard was located close to the canteen where there were no bins. It was found that in places where bins were provided they were generally used. The results of the student questionnaire were graphed (see Source GT.54); the results confirmed that 82 per cent of students used bins if they were nearby.

### Stage 4: Communicating

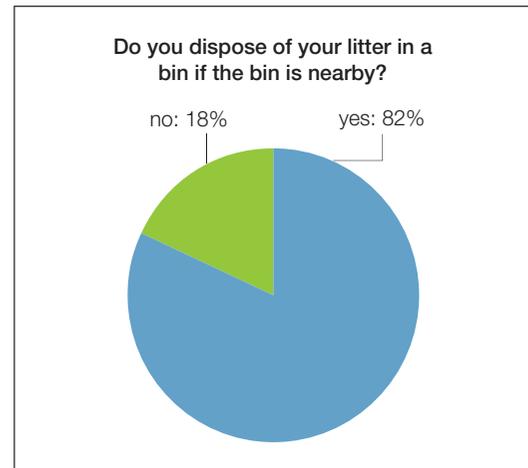
Based on the data they had collected, 7G prepared an AVD about this issue and presented it to the school council. The students argued that three new bins had to be installed in the schoolyard – two near the canteen and one next to the sports ground. This information was passed on to the school principal.

### Stage 5: Reflecting and responding

The bins were installed within a week, but 7G also decided that students at Gumtree College needed to take more responsibility for their own litter and placed some posters in the canteen to remind students why littering was bad for the school.

In the final stage of their fieldwork, the 7G students had a class discussion to reflect on the ways in which they carried out their fieldwork. Most of the students felt that the process worked well, but a few thought that the key question about bins was a little too simple.

They decided to use the same method to explore a more complex problem in the local community.



Source GT.54 A pie graph showing the results of the student questionnaire

## Check your learning GT.7

### Remember and understand

- 1 What is meant by studying geography 'in the field'?
- 2 List two ways in which the results of a fieldwork investigation may be presented.
- 3 What is the main aim of all fieldwork investigations?

### Apply and analyse

- 4 In what ways did 7G gather the information they needed to answer their fieldwork question?
- 5 Which of these methods do you think would have given them the most valuable and reliable data? Why?

### Evaluate and create

- 6 Look again at the geographical questions shown in Source GT.10. Imagine that you are on a field trip to Uluru to study the impact of visitors on the natural and cultural environment.
  - a In small groups, decide on an issue related to Uluru that you would like to investigate.
  - b Generate a set of inquiry questions and decide on the one you would most like to explore in detail.
  - c Create a set of questions for a visitor questionnaire that you think will help you get the information you need to answer your key inquiry question.
  - d Share your key inquiry question with the class and read out the questions you decided to include in your visitor questionnaire. What do your classmates think of your ideas?

A close-up photograph of a young girl with dark skin and hair, drinking water from a large, dark green gourd. She is holding the gourd with both hands, and water is pouring out from the bottom. The background is blurred, showing other people and colorful lights.

Water in  
the world

unit

1

# Water as a resource

A resource is anything we use to satisfy a need or a want. Resources we use from the natural world are called environmental resources. All life on Earth depends on these environmental resources to survive. The water we drink, the Sun we depend on for light and warmth, the soil we use to grow our crops, and the trees we rely on to produce the oxygen we breathe are all environmental resources.

As the world's population grows, we continue to place more and more pressure on these resources. The availability of many of these environmental resources (including oil, forests, and of course, fresh water) is becoming increasingly uncertain.



## 1.1

How is water an environmental resource?

- 1 Which environmental resources do we need to survive?
- 2 How are the people in the photograph using the Ganges River as a resource?

## 1.2

How does water connect and affect places?

- 1 How do you think the Ganges River connects places in India?
- 2 List three ways that water from the Ganges River might be used.



chapter

1

**Source 1.1** Hindus in India believe that bathing in the holy waters of the Ganges River gives them spiritual blessings.

# 1.3

## How much water do we have?

- 1 Water covers about 70 per cent of the Earth's surface. Why, then, do we have a shortage of water to drink and to wash in?
- 2 Where do you think the wettest and driest places in Australia might be found?

# 1.1 How is water an environmental resource?

## Environmental resources: an overview

Over thousands of years, humans have developed ways of life that depend on almost all **environmental resources** found on Earth. Water from rainfall, minerals from rocks, and food from the forests and oceans have allowed us to build homes, farms, cities and highways all over the world. We have found and used resources in almost every corner of the Earth. Oil is drilled from beneath polar **ice caps** and water is drilled from far below barren **deserts**. Deep in the rainforests we have found plants that can cure illnesses and we have even worked out how to generate electricity from the waters flowing in our rivers.

### Types of environmental resources

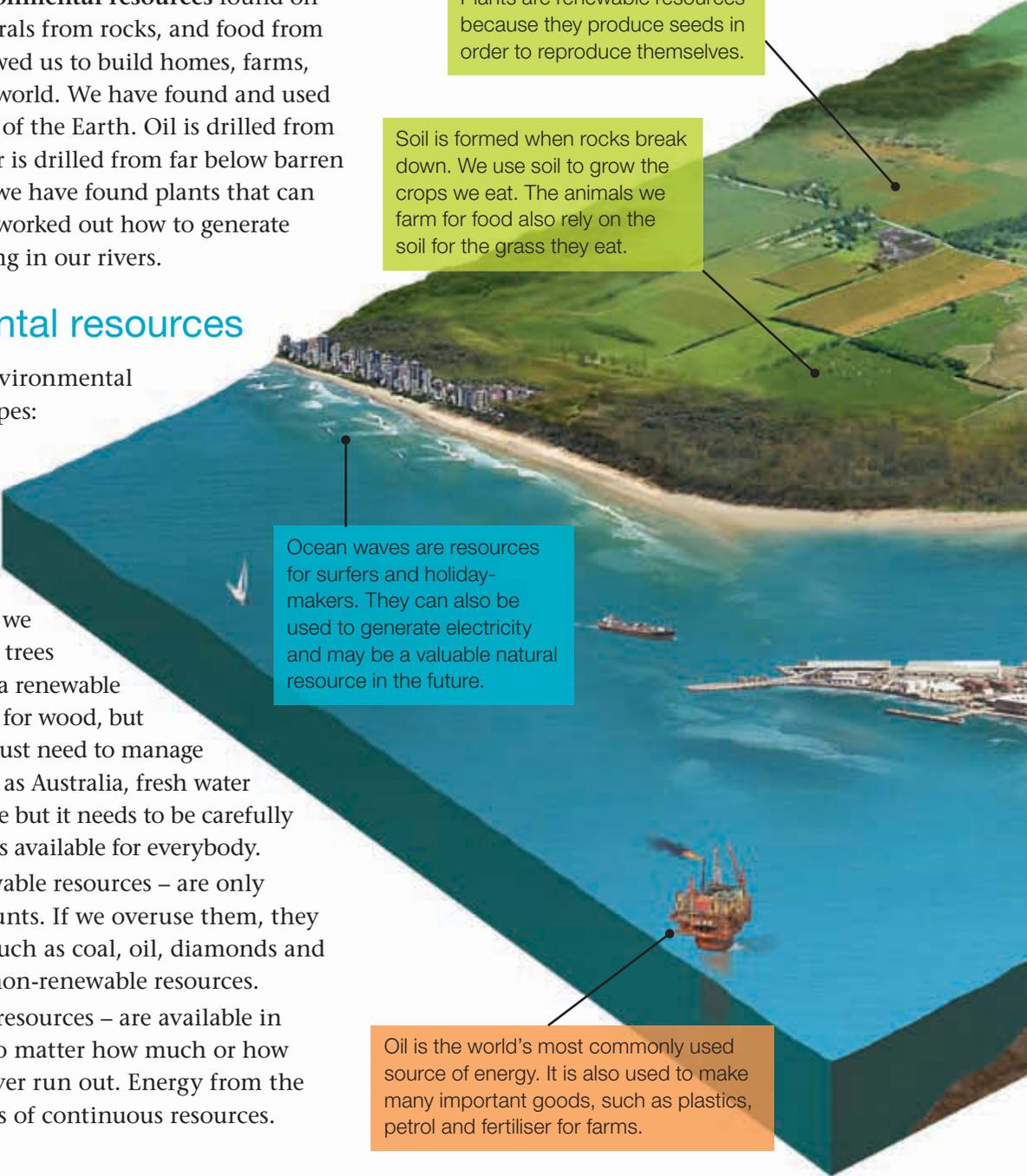
Geographers divide all of the environmental resources on Earth into three types:

- renewable resources
- non-renewable resources
- continuous resources.

The first type – renewable resources – will replenish themselves naturally over time if we do not use them too quickly. The trees in a forest are a good example of a renewable resource. We can cut them down for wood, but they will grow back in time. We just need to manage them carefully. In countries such as Australia, fresh water is considered a renewable resource but it needs to be carefully managed to ensure that enough is available for everybody.

The second type – non-renewable resources – are only available in limited (finite) amounts. If we overuse them, they will one day run out. Minerals such as coal, oil, diamonds and uranium are good examples of non-renewable resources.

The third type – continuous resources – are available in unlimited (infinite) amounts. No matter how much or how often we use them, they will never run out. Energy from the Sun and wind are both examples of continuous resources.



Plants, animals and human beings are renewable resources. Humans, however, are unique in that our use of the Earth's resources is disrupting the Earth's natural systems.

Plants are renewable resources because they produce seeds in order to reproduce themselves.

Soil is formed when rocks break down. We use soil to grow the crops we eat. The animals we farm for food also rely on the soil for the grass they eat.

Ocean waves are resources for surfers and holiday-makers. They can also be used to generate electricity and may be a valuable natural resource in the future.

Oil is the world's most commonly used source of energy. It is also used to make many important goods, such as plastics, petrol and fertiliser for farms.



**Types of environmental resources:**

- Renewable resources
- Non-renewable resources
- Continuous resources

Wind is used to power ships and windmills and to produce electricity.

The Sun provides the energy for plants and animals to grow and forms the basis of everything we eat. It also evaporates water, setting the water cycle in motion.

Even gravity is a resource. Without gravity, seeds from trees and plants would never fall to the ground and grow into plants. There would also be no rain to help them survive.

The amount of oxygen in our atmosphere stays about the same because it is constantly recycled through plants, animals and oceans.

In some parts of the world, electricity is generated from heat within the Earth. This is known as geothermal energy.

Forests are a renewable resource that is under serious threat. Most of the world's natural forest cover has been cleared or logged.

Fresh water is vital for all life forms on Earth, including plants, animals and humans.

Most of Australia's electricity comes from the burning of coal. Coal is an important energy resource in many countries.

Minerals are used as a resource in many ways. Uranium is just one of thousands of minerals mined around the world. It is being used at this nuclear power station to produce electricity.

### Check your learning 1.1

#### Remember and understand

- 1 What are the three main types of resources? Give two examples of each type.
- 2 Why is it important to look after renewable resources, such as fresh water?
- 3 Describe how you may have used a non-renewable resource in the last hour.
- 4 What problems might societies around the world face if people continue to rely heavily on non-renewable resources?

#### Apply and analyse

- 5 Collect pictures of continuous resources, non-renewable resources and renewable resources from newspapers, magazines or the Internet. Sort these pictures into groups and describe how each resource is used by humans.

#### Evaluate and create

- 6 What do you think is the most important resource shown in Source 1.2? Give some reasons for your answer and be prepared to discuss this with a partner and with the class.

**Source 1.2** An overview of the many types of environmental resources.

# Where water comes from

Water is one of our most precious environmental resources. Without it, nothing can survive. It is an essential, renewable resource that occurs naturally on Earth. It can exist as a solid (such as ice in a **glacier**), a liquid (such as water in a river) or a gas (such as steam). Fresh water is an available resource when in liquid form and a potential resource as a gas or a solid. Liquid water is constantly being recycled through the atmosphere, rivers and oceans in a natural system known as the **water cycle** (see Source 1.4).

In the water cycle, water from the oceans and lakes is heated and evaporated by the Sun. The evaporated water vapour, which is like steam, then rises until it reaches the cooler parts of the atmosphere. Cold air cannot hold as much moisture as warm air, so the water vapour turns back into liquid water in a process known as **condensation**. These drops of water then form into clouds, which may be carried on to land by winds and forced to rise. The colder air can no longer hold the condensed droplets and they fall as rain. The rainwater finds its way back to the world's lakes and oceans through rivers and streams and the process begins again.

As you can see in Source 1.4, rain falls when wet air masses are forced to rise. There are three reasons that air masses rise. Each of these will produce different types of rainfall at different places on the Earth's surface.

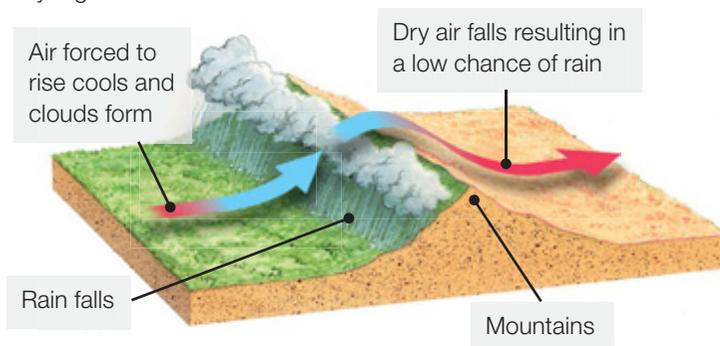
**keyconcept:** interconnection

## The water cycle

The water cycle links together large areas of the natural environment (see Source 1.4). The world's oceans, mountains, rivers and atmosphere are all important parts of this cycle. The water cycle links together the natural and human environments because water is so central to all human activities. The presence of water is key when settling new farms and cities. For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.

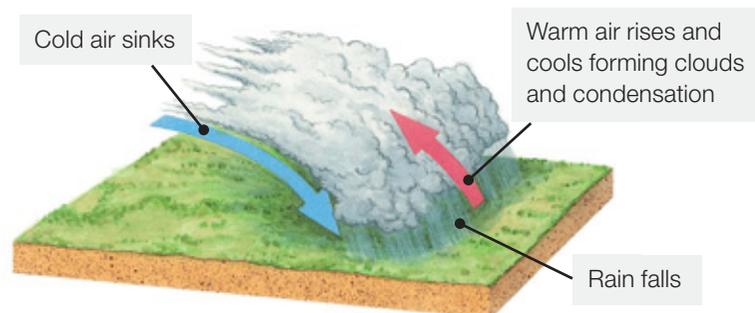
### Orographic rainfall

Air is forced to rise due to the height of landmasses, such as mountains. As the air cools, condensation forms, producing rain. As the air begins to fall from the high land, it warms up, creating dry regions.



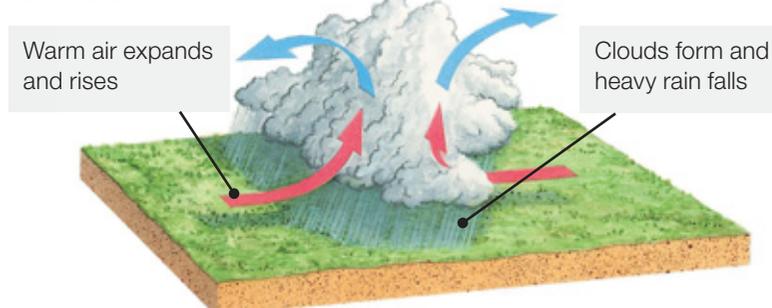
### Frontal rainfall

Two air masses meet and the cooler air mass wedges itself under the warmer air mass. This forces the warm air to rise and cool, causing condensation and rain along a distinct line.



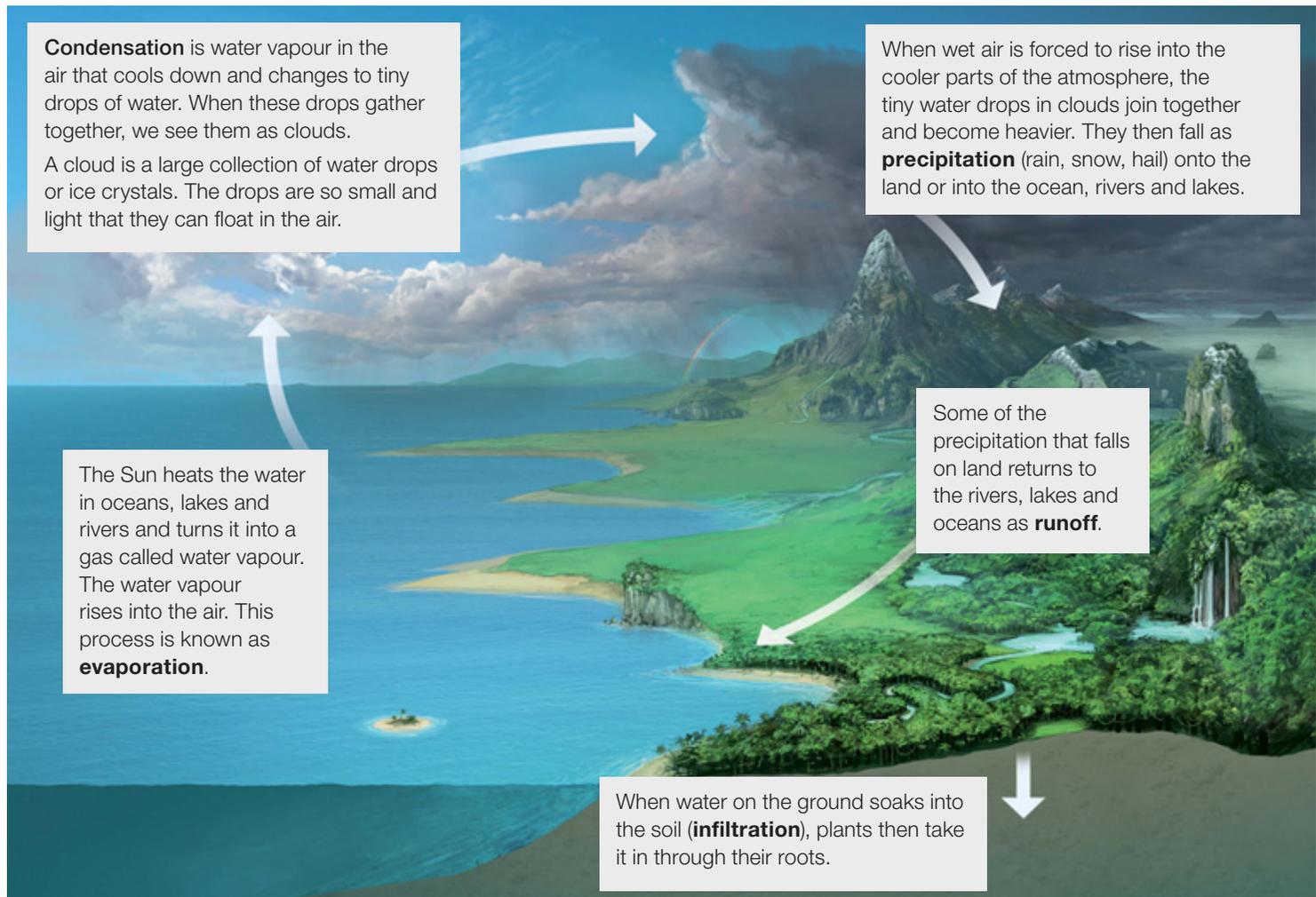
### Convective rainfall

Temperatures during the day warm the ground causing warm air to rise rapidly and condense at high altitude. This produces heavy rain and thunderstorms.



Source 1.3 Different types of rainfall

## The water cycle



Source 1.4 The stages of the water cycle

### Check your learning 1.2

#### Remember and understand

- 1 What is the water cycle?
- 2 What causes water to fall as rain?
- 3 List these words in the correct order within the water cycle: precipitation, condensation and evaporation. Now write a definition for each in your own words.

#### Apply and analyse

- 4 What is the difference between frontal rainfall and orographic rainfall? How are they similar?
- 5 Why do you think the wettest place in Australia is near Tully on the eastern slopes of the Great Dividing Range in Queensland? You might like to find Tully in an atlas to help with your answer.
- 6 The water cycle helps us to understand how water moves

in our world but it can also help us understand how rivers change the landscape. How do you think the rivers shown in Source 1.4 have changed this landscape?

- 7 What type of rainfall do you receive most often in the place where you live? Why will the answer differ for students who live in other parts of Australia?
- 8 Salt water in oceans cannot be used to drink or water crops. Is salt water an available or potential resource?

#### Evaluate and create

- 9 Imagine that you are a water droplet in a cloud. Describe your journey through the water cycle in language that a young child would find interesting. Here is a start: 'Floating along with billions of my closest friends, I thought nothing would ever change ...'

# Accessing water resources

Although the surface of the Earth is covered with water, only a tiny percentage of that water is fresh and available for consumption. Typically this is found in surface water, such as lakes and rivers. Source 1.6 shows the breakdown and availability of this water. As populations grow and more water is used, people are also using groundwater locked away in underground **aquifers**. This water supports every man, woman, child, animal and plant on Earth. This makes water our most precious resource.

To further complicate matters, the available fresh water is not evenly distributed across the planet. Some areas of the world have much more than they need, while other areas do not have enough.

Countries with large rivers, such as the Amazon River in Brazil, and those with high rainfall, such as Indonesia and Papua New Guinea, can be thought of as being 'water rich'. Other countries, including Australia, can be considered to be 'water poor'.

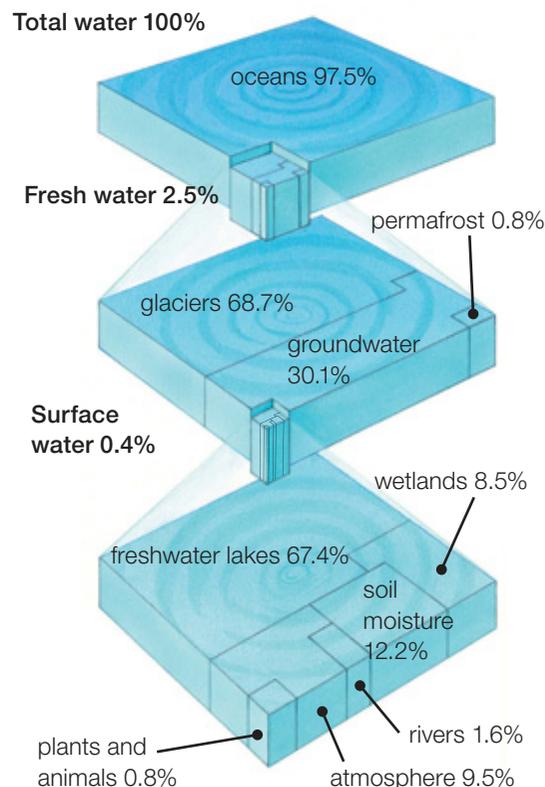
## Groundwater

When it rains, water seeps into the soil to provide moisture for plants to survive. As water passes through the spaces between soil and rock it becomes groundwater. In the saturated zone, all the spaces between soil and rock particles are filled with water. The top of this zone is referred to as the water table (see Source 1.5).

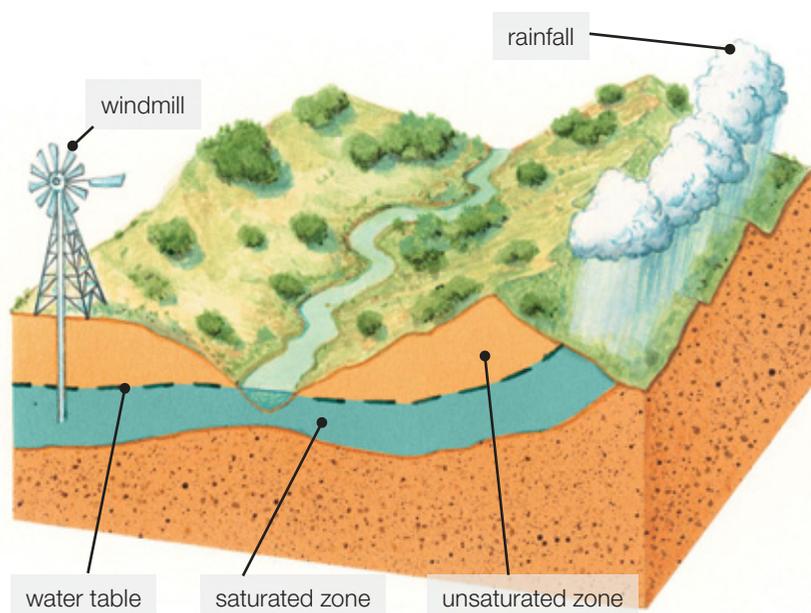
Groundwater is fed by surface water from rainfall and rivers and naturally comes to the surface at springs or at oases in dry areas. Groundwater is also drawn to the surface by **bores** drilled into the ground. Most of Perth's water is drawn from an underground aquifer, a layer of permeable rock that stores water.

## The world's freshwater resources

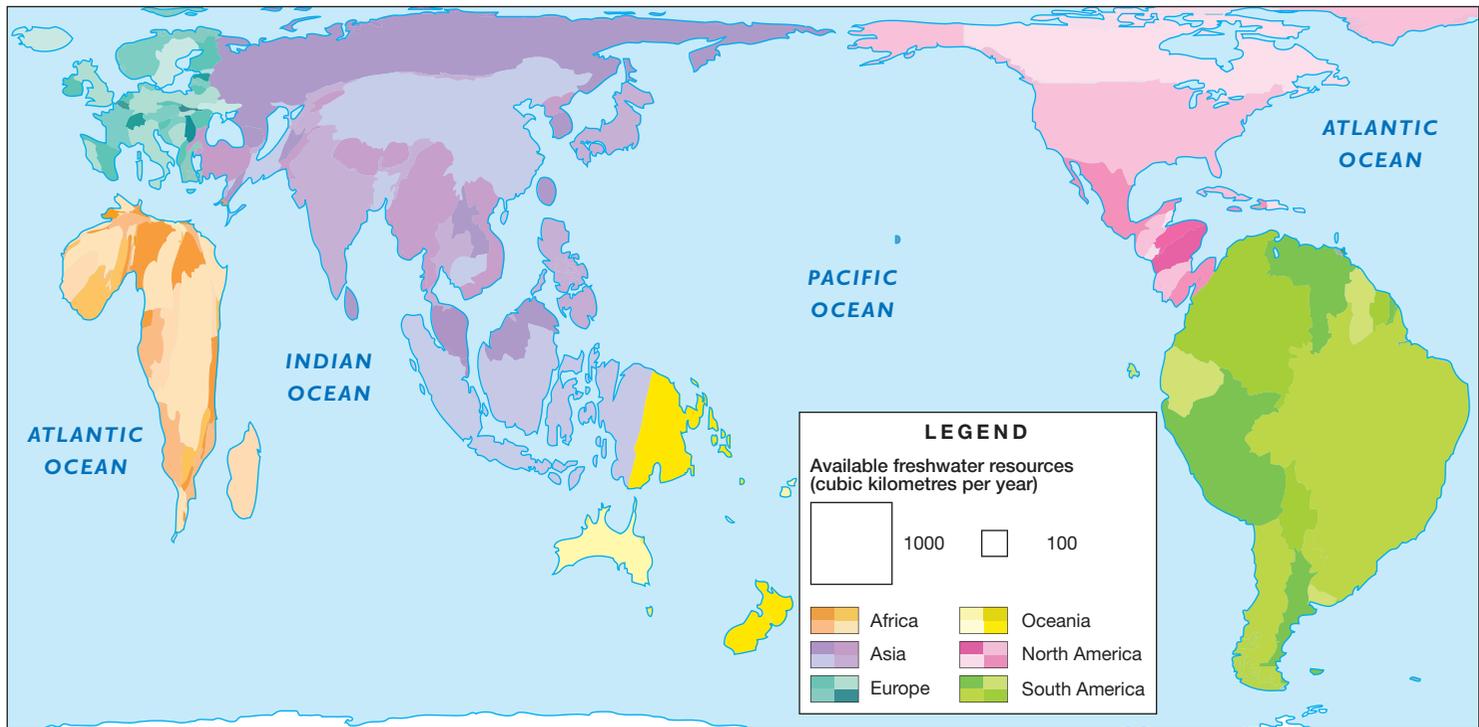
Source 1.7 is a map of the world as you have never seen it before. While each country is shown in its correct location, its size shows the proportion of the world's freshwater resources found there. Countries that appear fat are water rich; those that appear thin are water poor. Comparing the size and shape of countries in Source 1.7 with the same countries on a standard world map (like the one provided at the back of this book) will clearly show which are water rich (larger than normal) and which are water poor (smaller than normal).



Source 1.6 Distribution of the world's water



Source 1.5 Groundwater from aquifers is pumped to the surface via bores for use by humans



Source 1.7

Source: Oxford Big Ideas: Humanities 1

## skilldrill

### Using the PQE method to describe maps

The PQE method is used by geographers to identify trends and patterns in data and draw conclusions. For more information on the PQE method refer to section GT.2 of 'The geographer's toolkit'. There are three steps to follow when using the PQE (pattern, quantify, exceptions) method to describe maps:

**Step 1 Pattern:** Give a general overview of the pattern, referring to particular places. Which areas seem to have common features? (For example, 'The map of the world's freshwater resources shows that countries throughout South America have lots of fresh water'.)

**Step 2 Quantify:** Quantify your general overview using data for specific regions or countries. (For example, 'Brazil has more than 5000 km<sup>3</sup> of fresh water a year'.)

**Step 3 Exceptions:** Point out any exceptions to the pattern you have described. (For example, 'Madagascar, the island off Africa, appears to have abundant water supplies, whereas the rest of the African continent does not'.)

#### Apply the skill

- 1 Use the PQE method to describe the world's freshwater resources. Be sure to describe areas that are water rich and those that are water poor. The world map on the inside back cover will be useful.

## Check your learning 1.3

### Remember and understand

- 1 How much of the world's water is fresh water, available for our use?
- 2 Is Australia water rich or water poor? What does this mean?
- 3 Study Source 1.7.
  - a Which countries would you consider to be the most water rich? Which are the most water poor?
  - b Compare the freshwater resources of Australia, New Zealand and Papua New Guinea.

### Apply and analyse

- 4 What can countries that are water poor do to access more fresh water? Brainstorm this as a class. Think first of those methods that you already know about, perhaps those used in your local area, and then expand these into other possibilities.

# Stored water

The water cycle is the movement of water through the Earth, but most of the fresh water on Earth is in storage. Fresh water can be stored for days or weeks in a lake or for thousands of years underground or in an ice cap, such as the one that covers much of Greenland. About 97.5 per cent of the Earth's water is found in the oceans and is too salty to drink. Much of the remaining 2.5 per cent, which is safe for us to drink, is locked in the polar **ice caps** and in flowing rivers of ice, known as **glaciers**.

Antarctica contains nearly 70 per cent of the world's fresh water as ice in an ice sheet that covers large sections of bedrock (solid ground) in Antarctica. The ice sheet has an average thickness of 2500 metres and scientists have found places where the ice is thought to be twice this thickness. If this ice were to melt, sea levels around the world would rise by up to 60 metres. Because the temperature in the interior of Antarctica remains below freezing, any snow that has fallen there in the last few million years has never melted and has gradually formed into a great dome of ice. The ice is gradually moving towards the sea away from the centre of the continent. As it reaches the sea, the ice breaks off into gigantic **icebergs**.

**Source 1.8** The ice of Antarctica stores most of the world's fresh water.

## Check your learning 1.4

### Remember and understand

- 1 List three places where ice is stored.
- 2 Where is most of the world's fresh water stored?
- 3 Why doesn't the ice in Antarctica melt?

### Apply and analyse

- 4 Look carefully at the map in Source 1.9.
  - a What happens to the sea surrounding Antarctica in winter?
  - b What is the difference between an ice sheet and an ice shelf?
- 5 Look carefully at the cross-section of Antarctica in Source 1.9. This shows a view of Antarctica from the side as if it had been cut along the A–B–C line on the map.
  - a Over which part of Antarctica is the ice sheet the thickest?
  - b Describe what Antarctica would look like without its ice sheet.
  - c Why is this cross-section a better way of showing the thickness of ice in Antarctica than the map?
- 6 What would happen if all the ice in Antarctica were to melt? What conditions might cause this to happen?





## 1.1 bigideas: broadsheet

# Perth's water supply

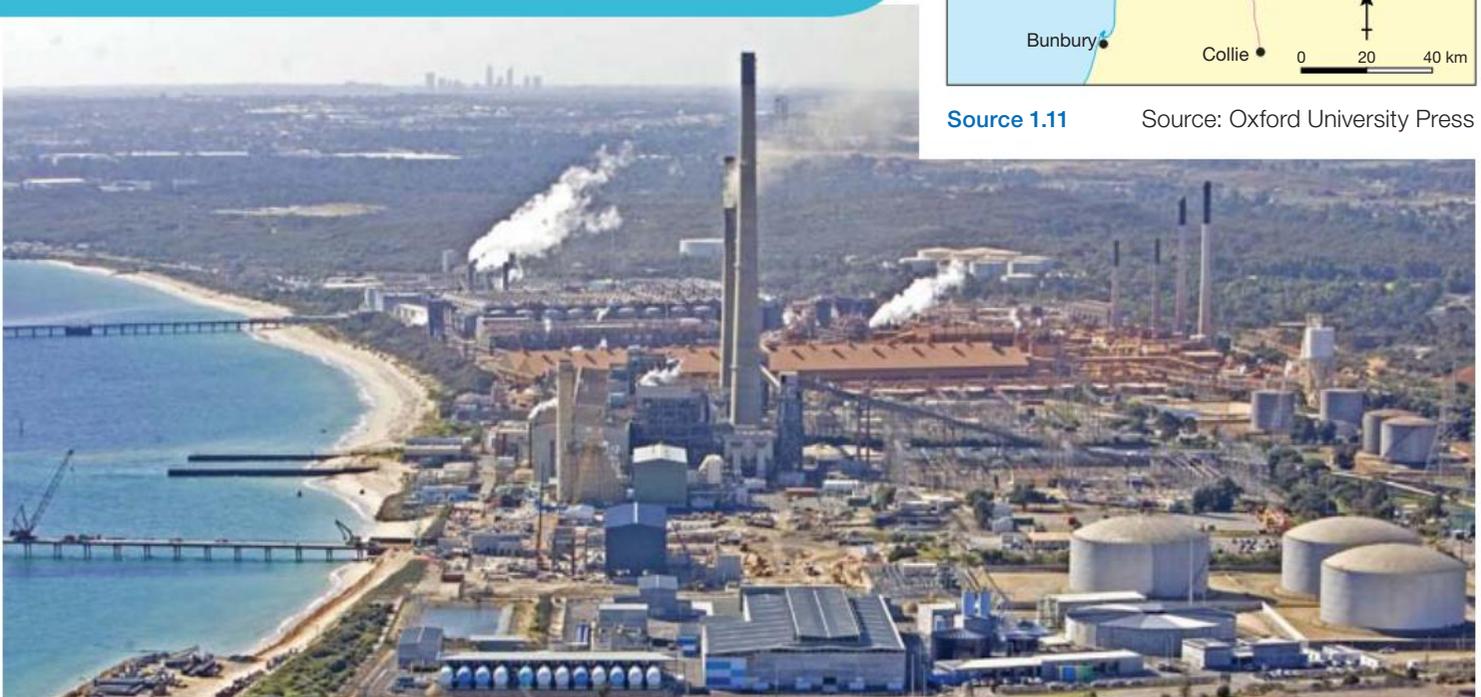
Like many Australian cities and towns, Perth faces many challenges in supplying its population with enough fresh water. A decline in its rainfall over the last 100 years has meant that the people of this rapidly growing city can no longer rely on rivers, lakes and dams to supply all their water needs. About half of Perth's water now comes out of the ground. North of the city are large aquifers which have collected rainwater for thousands of years and stored it within sand or limestone layers. Wells are dug to access the water which is treated, mixed with rainwater and used by Perth residents in their homes, farms and gardens. Up to 20 per cent of Perth's water comes from two large desalination plants. The city was one of the first in Australia to use desalination plants to provide fresh water. The Western Australian state government hopes that expansion of these plants will help to 'drought-proof' Perth.

PERTH: WATER RESOURCES

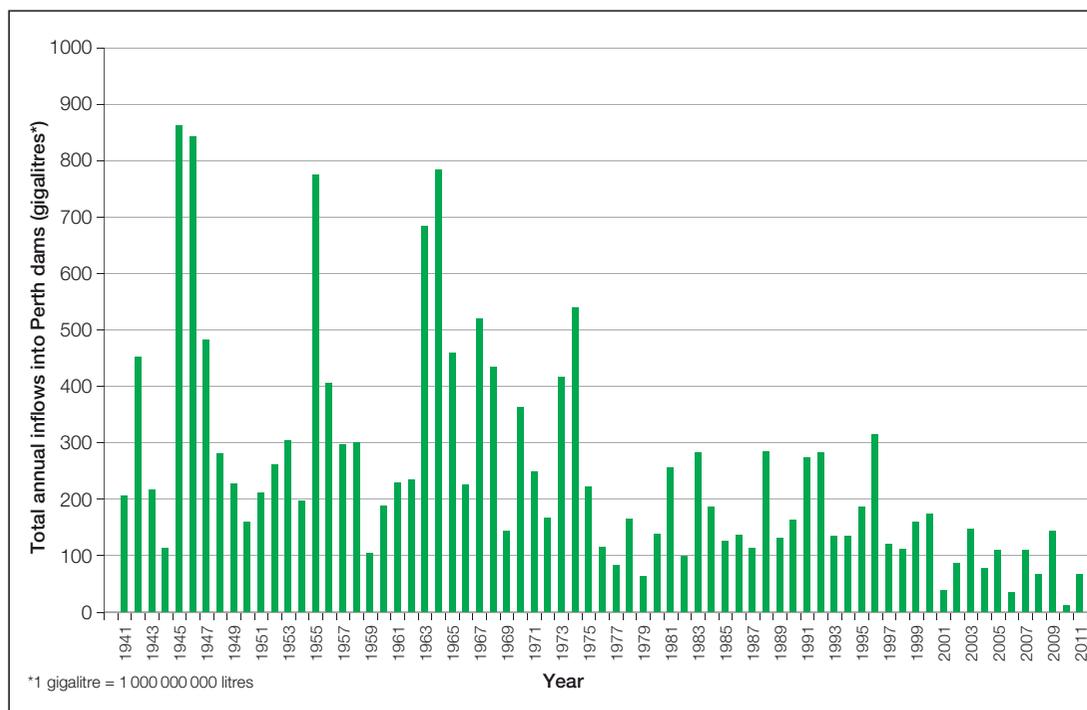


Source 1.11

Source: Oxford University Press



Source 1.10 One of Perth's desalination plants. The Perth Seawater Plant removes the salt from sea water to produce fresh water.



Source 1.12 Water flowing in to Perth's dams 1941–2011

## skilldrill

### Using a map legend

In order to show the features on maps clearly, various symbols and colours are used. To help us unlock the information on the map these symbols are explained in a legend (or key). There are three main types of map symbols:

- **point symbols** – show features in one particular place (such as a railway station or desalination plant)
- **line symbols** – show features that connect places on the map (such as roads and rivers)
- **area symbols** – use colours or patterns to represent large areas (such as lakes and cities).

### Apply the skill

- 1 Study Source 1.11.
  - a What symbol has been used for desalination plants on this map?
  - b Give an example of an area symbol used on this map.
  - c How many groundwater treatment plants supply water to Perth?
  - d What do you notice about the location of the dams on this map?

## Extend your understanding

- 1 Look carefully at Source 1.12.
  - a Compare the annual flow of water into Perth's dams before and after 1975. What difference can you see?
  - b List the four years with the smallest annual inflows of water. What do you notice from this pattern?
  - c Why do you think the annual inflow of water changes so greatly between years?
- 2 What two other sources of water does Perth use to access water other than dams fed by rain?
- 3 Do you think it is possible to drought-proof a city? Give some reasons for your answer.
- 4 What do you think will happen to the water in an aquifer if water continues to be pumped out of it for use in a city such as Perth?
- 5 Why does Perth need more water now than it did 100 years ago?
- 6 What are some of the strategies being tried to address water problems in other parts of Australia?

# 1.2 How does water connect and affect places?

## Water connects places

Because people rely on water to survive, easy access to water influences where people choose to live. Cities, towns and villages are often located near fresh water sources such as rivers, lakes and underground water reserves. Water sources also directly influence the way people live; for example, the crops they grow or the transport they use. As human settlements tend to cluster around the same types of water sources, these water sources need to be shared by the communities. Because of this, many places around the world are connected with each other through these water sources. Generally, three main factors relating to water influence where people settle. These factors are discussed below and shown in Source 1.13.

### Historical and environmental factors

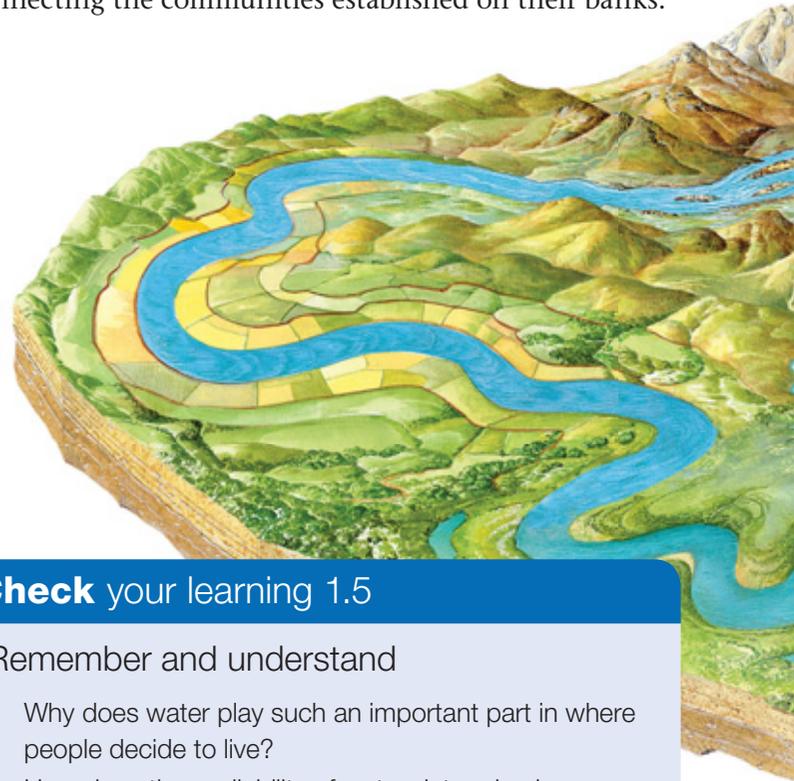
Historically, towns and cities have developed along rivers and near lakes and other fresh water sources. People will settle anywhere there is water, adapting their way of life to the local environmental features. Communities in the Hindu Kush region of the Himalayas in Pakistan and Afghanistan depend on the seasonal melting of the snow and glaciers to provide them with fresh water. This melt also feeds the great rivers in the region, the Indus River and the Ganges River, that supply water to the many cities and communities that have been established along their banks – around 1.5 billion people.

### Agriculture

Communities also rely on fresh water to grow crops and farm animals. The availability of fresh water will determine the sorts of crops grown. In places where water is limited, crops that need little **irrigation**, such as corn, will be grown. Crops that rely heavily on water, such as rice, are grown on **floodplains** where water is plentiful. These floodplains and **deltas**, located on flat land where rivers meet the sea, have particularly rich soil due to the deposits of silt that has travelled down the river from the mountains.

### Trade and transport

Rivers move water across the Earth's surface, carrying water great distances to the sea. Rivers, lakes and oceans also act as transport networks, allowing products and people to move easily from one place to another, connecting the communities established on their banks.



### Check your learning 1.5

#### Remember and understand

- 1 Why does water play such an important part in where people decide to live?
- 2 How does the availability of water determine how people in different places live?
- 3 Name three factors relating to water that influence where people choose to settle. In your own words, describe each of these factors briefly.

#### Apply and analyse

- 4 Describe how water flowing along a river can connect people living at different points along it.
- 5 How has the choice of crops being grown in Source 1.16 been determined by the environment? By contrast, what types of crops do you think would be grown in the location shown in Source 1.14?

## How rivers connect people and places



**Source 1.14** Communities in the Himalayas (a mountain range in Asia) depend on annual glacial melts to replenish their water supplies. Once replenished, excess water flows into rivers, connecting these communities with others downstream.



**Source 1.15** Large cities and towns around the world are connected by rivers. River waters allow people to travel and goods to be transported and traded. This barge on the Rhine river is carrying coal from the city of Cologne south to Switzerland.



**Source 1.16** Farming communities along the Mekong Delta in Vietnam plant their rice crops in the rich soil of the floodplains.

**Source 1.13** The water that flows through the river systems around the world connects people and places in many ways.

# Water affects places

As well as connecting different people and places, water can also affect them – in both positive and negative ways. On the positive side, water from the rain and rivers is used to irrigate the crops and farm the livestock that we eat. This water has a positive effect on the places in which we live. Without it, no life could exist. On the negative side, water in all its states – whether as a liquid (water), a solid (snow and ice) or a gas (fog) – can cause serious problems and damage in different places. Snow storms can shut down cities for days, heavy fog can disrupt air travel and cripple airports, and heavy rainfalls can cause widespread flooding.

A good way of understanding how water affects places is to look at some case studies relating to rivers. Rivers are interesting to study because if there is a problem upstream (such as a flood or pollution) this problem will quickly travel downstream, affecting the people who live there. Flooded rivers can affect many settlements along their banks, collecting and carrying debris, such as trees and cars, as they go. If pollution or toxic chemicals enter the water at one location on the river, they quickly affect other parts of the river downstream, as well as the people who use it.

## Case study: Tisza River pollution, 2000

In 2000, a storage pond used by a gold mine in Romania burst its banks. Around 100 000 cubic metres of water containing poisonous cyanide spilt into a local river that flowed into the Tisza River in nearby Hungary.

The cyanide spill killed much of the fish and plant life for several 100 kilometres downstream. Drinking water was polluted in four different countries: Romania, Hungary, Serbia and Bulgaria.

**Source 1.17** A Hungarian fisherman pulls out toxic fish from Lake Tisza on the Tisza River 12 days after a serious chemical spill upstream in Romania on 30 January 2000.

## Case study: Thailand floods, 2011

In 2011, the people of Thailand experienced some of the worst flooding they had seen for decades. Areas of Thailand are prone to flooding as the annual monsoon brings heavy rain, particularly in the north of Thailand. In early 2011, a tropical cyclone combined with the monsoon to more than triple the amount of rain falling on northern Thailand. As heavy rains continued for several months, rivers burst their banks in the mountainous north, resulting in flash flooding and at least 13 deaths.

Flooding continued downstream in many large towns built beside rivers. Soon the country's capital, Bangkok, became the area of greatest concern. Located on a low floodplain at the mouth of the Chao Phraya and Tha Chin Rivers, Bangkok is very prone to flooding and, despite an intricate system of flood walls and canals, much of the city flooded. By the time the floodwaters receded, they left more than 500 people dead and a damage bill of more than US\$45 billion.





**Source 1.18** Floodwaters in the main street of Ayutthaya during the floods in Thailand in 2011 shut down the city and resulted in many deaths

## Check your learning 1.6

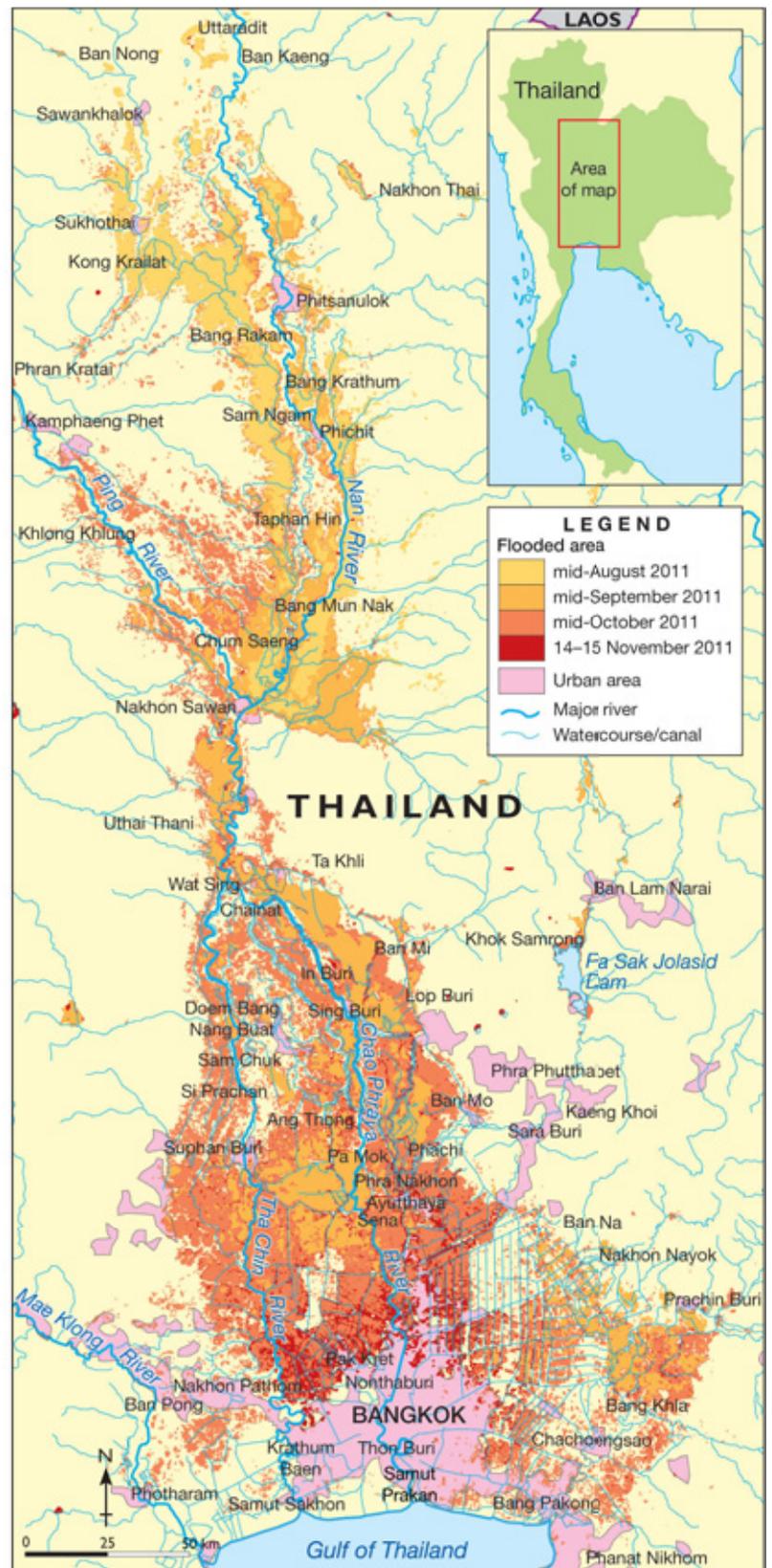
### Remember and understand

- 1 Give examples to show how water affects places in its gas, liquid and solid states.
- 2 What problems did the gold mine in Romania cause downstream?

### Apply and analyse

- 3 Look carefully at Source 1.19.
  - a When did floodwaters reach Bangkok?
  - b How far had some of the floodwater travelled? (Use the scale provided to calculate the distance.)
- 4 Decide whether each of the following facts makes flooding in Bangkok more likely or more dangerous. Justify your answer for each one.
  - a Between June and October Thailand experiences its wet season with heavy monsoon rains.
  - b Bangkok has been built on the Chao Phraya River delta.
  - c Between 1985 and 2010 Thailand's population increased by more than 10 million people.
  - d The land on which Bangkok is built is sinking by 30 millimetres a year.

**THAILAND: TIME LAPSE MAP SHOWING THE SPREAD OF FLOODWATERS, MID-AUGUST 2011 TO 15 NOVEMBER 2011**



**Source 1.19**

Source: Oxford University Press

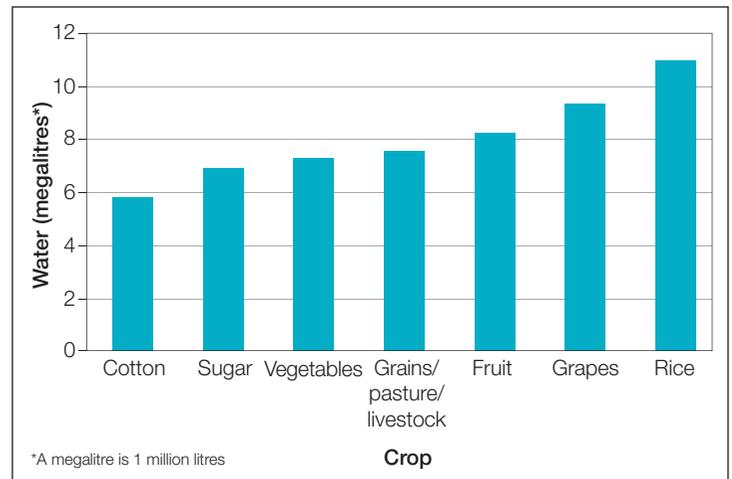
# Water for food

Farmers are by far the biggest users of water in Australia. About 70 per cent of the fresh water used each year in Australia is used in agriculture. This water is used to produce an enormous range of products, many of which you consume every day (see Source 1.20).

You may not realise it, but a lot of water was needed to produce your breakfast. Many everyday products use even more water. For example, it takes up to 50000 litres of water to produce 1 kilogram of beef, and 685 000 litres to produce enough wool to make one suit. The amount of water needed to produce an item of food, such as a steak, or a piece of clothing, such as a suit, is known as **virtual water**.

In Australia, many crops are grown in the Murray–Darling Basin in south-eastern Australia (see Source 1.23). While a lot of the water used in this region falls on the farms as rain, much of it is taken from the rivers. Movement and control of water has a large economic impact in this region.

In the past, the rivers in this region had a normal cycle of flood and drought. Farmers needed a more reliable flow of water and so a system of dams and weirs was built along the river. These collect water during wet times and release it gradually during dry times, thereby controlling the flow of the river.



**Source 1.21** Water used per hectare (10000 square metres) to grow selected crops

Farmers are allowed to use a certain amount of water each year and are charged for the amount of water they use. Because they have to pay for their water, farmers in this region use it very carefully. Another reason for farmers to use water as efficiently as possible is the scarcity of water in many parts of Australia. In the early years of the twenty-first century, a widespread and severe drought turned the Darling River and many others into a series of pools separated by kilometres of dry river bed. Because of these factors, many farmers and farming industries have developed more water-efficient methods of farming.



## Apricots

Apricots are grown and processed in northern Victoria and southern New South Wales. They are processed in various plants centred around Shepparton, Victoria.

*Estimated water needed to produce 1 kilogram of apricots: 1391 litres*



## Bread

The main ingredient in bread is wheat. New South Wales produces the most wheat in Australia, most of this in the east of the Murray–Darling Basin.

*Estimated water needed to produce 1 kilogram of wheat: 750 litres*



## Milk and butter

More than 60 per cent of Australia's milk and milk products comes from Victoria. Leongatha in Victoria is home to a huge dairy factory.

*Estimated water needed to produce 1 glass of milk: 200 litres*  
*Estimated water needed to produce 1 kilogram of butter: 18 070 litres*



## Raspberry jam

The main ingredient in raspberry jam is sugar. Virtually all of Australia's sugar is grown in Queensland. Raspberries grown in the Goulburn Valley make up 40 per cent of the jam.

*Estimated water needed to produce 1 kilogram of sugar: 173 litres*  
*Estimated amount of water needed to produce 1 kilogram of raspberries: 713 litres*



## Rice Bubbles

Rice Bubbles are made from 89 per cent whole white rice, which is grown in the Murrumbidgee Irrigation Area (part of the Murray–Darling Basin). Much of the rice industry is centred around Deniliquin in southern New South Wales.

*Estimated water needed to produce 1 kilogram of rice: 1550 litres*

**Source 1.20** Water requirements to produce typical breakfast foods



Source 1.22 An irrigation channel in the Murray–Darling Basin

## Murray River irrigation

Lake Hume is an artificial lake formed by the Hume Weir near Albury–Wodonga on the Murray River. Completed in 1936, it is one of a series of dams and weirs built to control the flow of water in the Murray River. Its main purpose is to trap water during periods when there is a large amount of water in the Murray River and release it gradually to keep the flow of the river relatively constant.

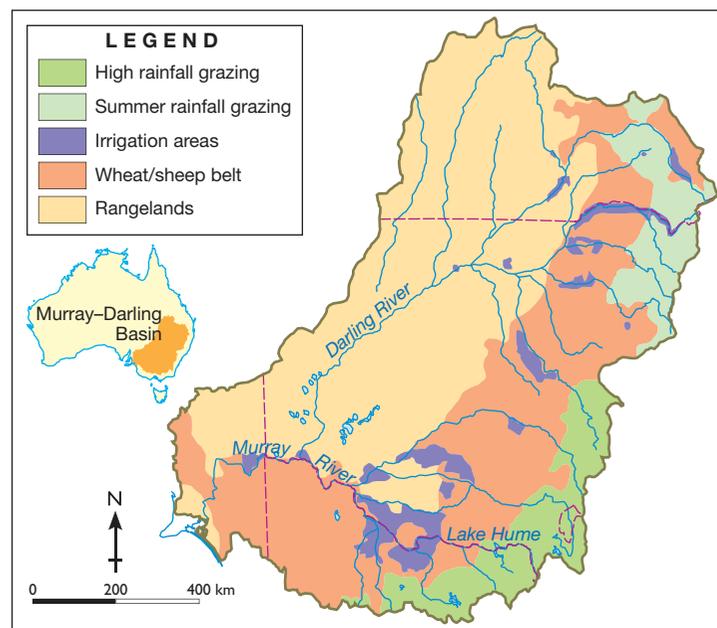
A network of irrigation pipes and open channels carries the water from the Murray River hundreds of kilometres to individual farms. Open channels are generally less efficient than pipes as water is lost to evaporation and water seeping into the soil. However, they are much cheaper to build than pipes.

When the water reaches the farms it flows through gravity or is pumped onto the crops or pastures. A common method of irrigation is the use of a pivot spray. A giant arm with sprayers attached moves around a central pivot point, creating distinctive circles of green.

Source 1.24 Pivot spray irrigation



## MURRAY–DARLING BASIN: LAND USE



Source 1.23

Source: *Oxford Atlas*

## Check your learning 1.7

### Remember and understand

- 1 How much of Australia's fresh water is used on farms?
- 2 How does water for irrigation of crops and pastures reach the farms?
- 3 Rank the breakfast foods shown in Source 1.20 in order from greatest water need to least water need.

### Apply and analyse

- 4 Can farmers use as much water as they want?
- 5 Look at Source 1.21.
  - a Which crop uses the most water?
  - b Which crop uses the least water?
- 6 Why do you think it takes so much water to produce 1 kilogram of rice?
- 7 In what ways is the Murray–Darling Basin one of Australia's most important resources?
- 8 Look closely at the map (Source 1.23).
  - a What relationship do you notice between irrigation areas and rivers?
  - b Explain the nature of this relationship.

### Evaluate and create

- 9 Draw a labelled diagram to clearly show how pivot spray irrigation works. Use Source 1.24 to help you.

# Water for energy

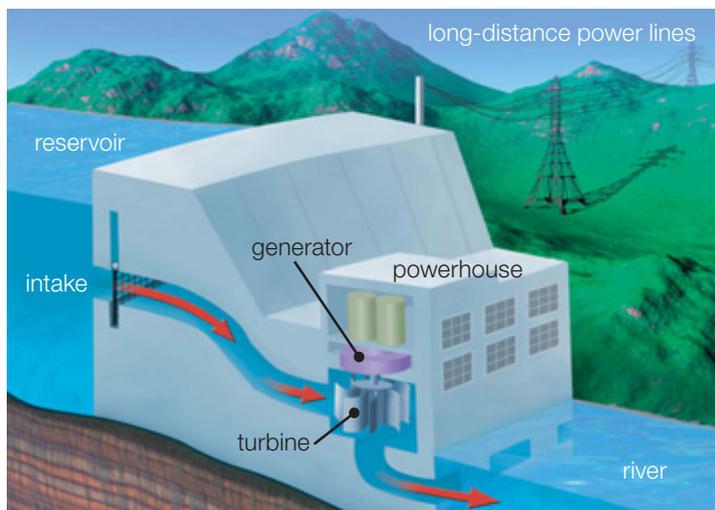
Moving water has been used as a source of power since 240 BCE, with the invention of the water-driven wheel. Watermills use the force of the flowing water to drive the blades of a large wheel or turbine. This, in turn, rotates an axle to drive the machinery inside the mill.

## Hydroelectricity

Hydroelectric power is generated in the same way that early watermills operated. A dam is built across a river, creating a large reservoir of water. This water is then released through turbines, causing them to turn. The spinning turbine rotates giant magnets around a huge coil of copper wire to create electricity. The faster the water flows, the more electricity is created.

Australia's largest plant is the Snowy Mountains Hydroelectric Scheme. More than 100 000 people from over thirty countries constructed the huge tunnels, dams and power stations. Electricity generated by the scheme is used in the Australian Capital Territory, New South Wales and Victoria.

Hydroelectricity is the largest source of renewable, non-polluting energy in the world. The main negative impact of building a hydroelectric plant is that the natural flow of the river is stopped and the land behind the dam is flooded. The flooding of valleys behind the dam can destroy natural habitats and human features, such as houses, fences and roads.



**Source 1.25** How a hydroelectric power station works

## Case study: Three Gorges Dam, China

China's Three Gorges Dam is not only the world's largest dam, it is also the largest power station ever built. More than 2 kilometres long and 180 metres high, the dam has turned the Yangtze River into a lake 660 kilometre long. As well as producing electricity, the dam has increased the Yangtze River's shipping capacity, and has reduced the flooding hazard downstream. The building of the Three Gorges Dam stirred protests around the world, as it involved displacing 1.25 million people and flooding more than 600 square kilometres of land; that is about 30 000 times the size of the Melbourne Cricket Ground.



**Source 1.26** An oblique aerial view of the Three Gorges Dam on the Yangtze River in China. Water flows through the open sluice gates. The hydroelectric power station is to the left of the sluice gates.

## Check your learning 1.8

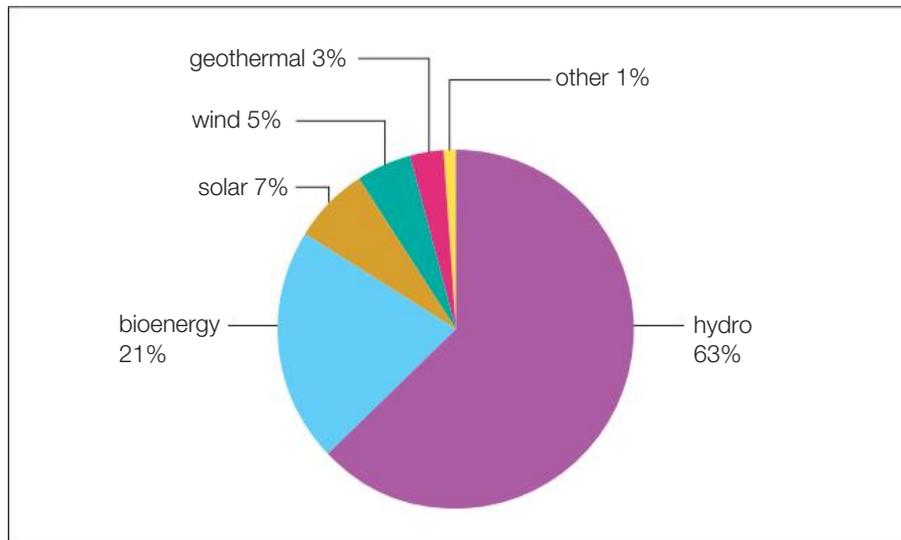
### Remember and understand

- 1 How is water used to create electricity?
- 2 What is the main source of renewable energy in the world?
- 3 What advantages and disadvantages does the building of dams bring?
- 4 How can you stop a river flowing to enable a dam wall to be built?

### Apply and analyse

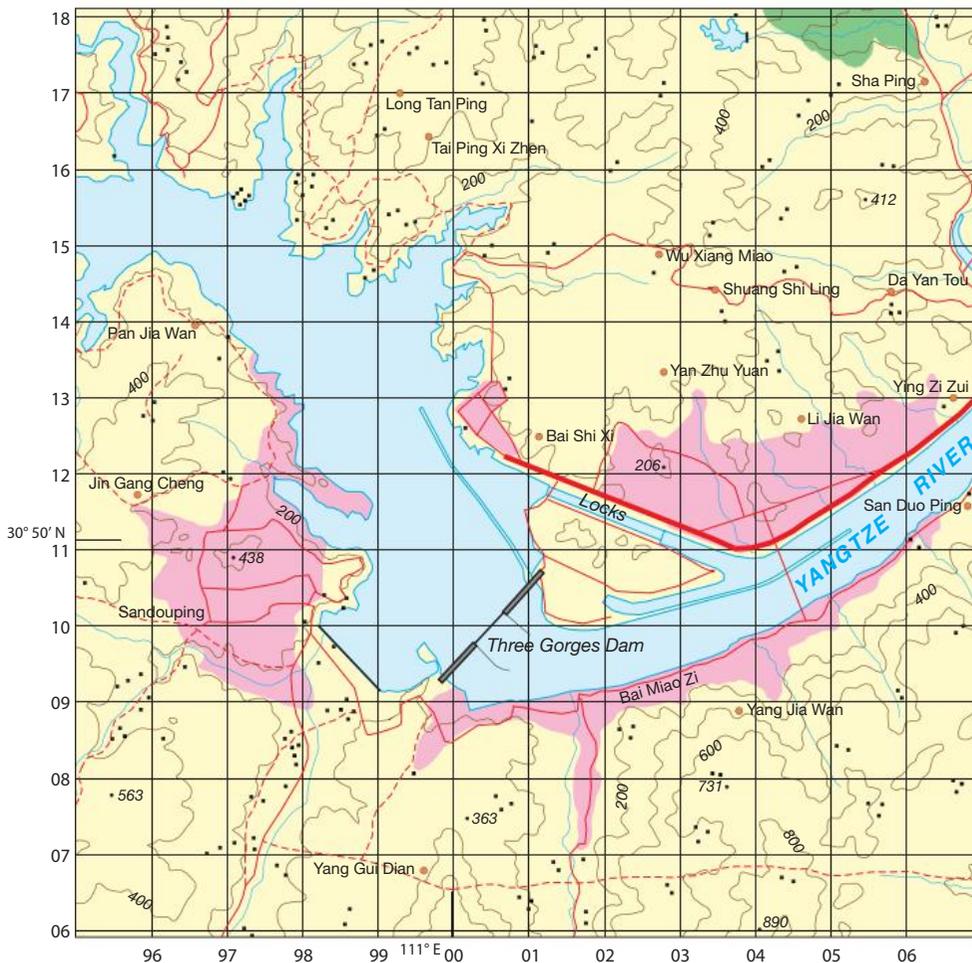
- 5 Look carefully at Source 1.26. Oblique aerial images are taken from an angle and show a foreground and a background. Is the dam wall in the foreground or the background?
- 6 Draw a sketch of the oblique aerial image (Source 1.26) and label the following:
  - Three Gorges Dam
  - Yangtze River
  - hydroelectricity plant
  - flooded valley.

Mark in where you think the original course of the river flowed.
- 7 What happened to the towns, villages and farms upstream of the Three Gorges Dam on the Yangtze River?



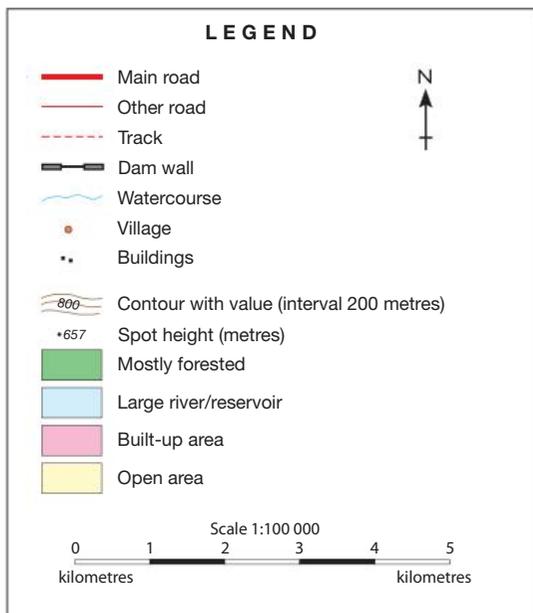
**Source 1.27** Energy from renewable and continuous sources. Hydroelectric power accounts for most of the total energy produced from these sources around the world.

### CHINA: THREE GORGES DAM



**Source 1.28**

Source: Oxford University Press



## 1.2 bigideas: broadsheet

# The Ok Tedi mine

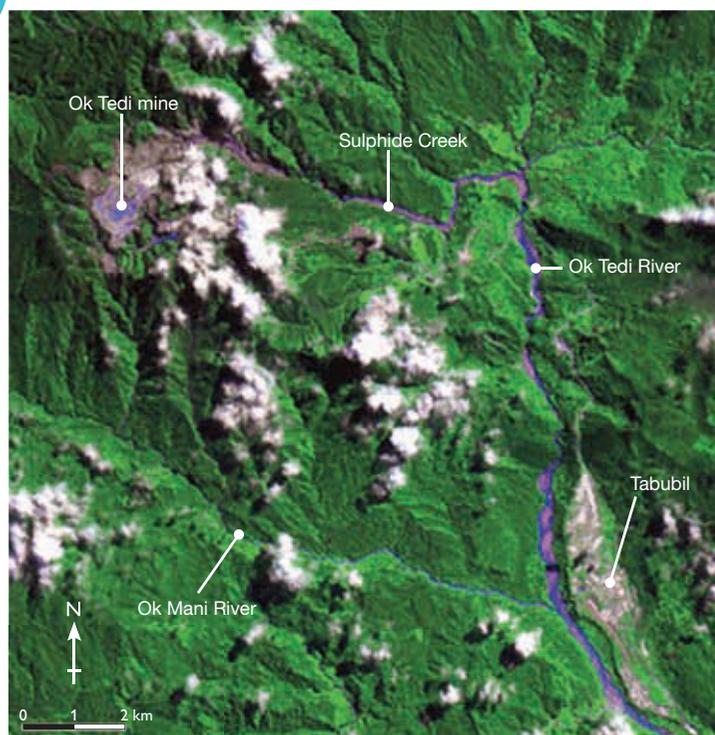
The Ok Tedi copper and gold mine is located at the headwaters of the Ok Tedi River, a tributary of the Fly River, in Papua New Guinea. During mining operations large amounts of chemicals are used to separate the precious minerals from other rocks. These chemicals, along with the residue of rocks and ore (known as **tailings**), need to be disposed of. In order to do this, the mine owners (BHP) built a dam known as the tailings dam. The tailings dam allowed heavy metals and solid waste from the mine to settle. Cleaner water would then be released into the river system.

Unfortunately, an earthquake in 1984 collapsed the tailings dam. BHP argued it was too expensive to rebuild it.

Since 1984 the mine has discharged 70 million tonnes of tailings into the river system each year. Chemicals from these tailings destroyed wildlife, particularly fish, in the river, and the materials dumped into the river changed a deep and slow river into a shallow river with rapids. Transport up and down the river became more difficult. The change in the river bed led to frequent floods that spread contaminated mud onto 1300 square kilometres of farms by the Fly River. The discharge from the Ok Tedi mine caused great harm to the 50 000 Indigenous people who live in the 120 villages downstream of the mine. Millions of dollars in compensation was paid to those affected by the misuse of the river system.



Source 1.29 Ok Tedi mine



Source 1.30 Satellite image of Ok Tedi mine, 5 June 1990



## skilldrill

### Identifying change over time

By carefully examining photographs, satellite images or maps from different times we can see the changes that occur at a location. When studying the same area at two different times:

- Step 1** Find a key feature, such as a river or main road, as a reference point on both sources.
- Step 2** Note the areas of the image where there has been little or no change.
- Step 3** List the differences in the later image where there has been change.
- Step 4** Look for other information on the image that shows what might have contributed to the change.
- Step 5** Describe the type of change – permanent change or seasonal change (such as different stages of crop production or plant growth).

### Apply the skill

- 1 Study Sources 1.30 and 1.31.
  - a In what two years were the satellite images taken?
  - b Were the images taken at different times of the year?
  - c What changes to the rivers occurred between the two years when these images were taken?
  - d Why did these changes occur?
  - e Are these changes permanent or seasonal?
  - f Draw a sketch map of the area in 2004, using a key and labels to outline the changes that have occurred since 1990.



Source 1.31 Satellite image of Ok Tedi mine, 26 May 2004

### Extend your understanding

- 1 What competing uses were there for the Ok Tedi and Fly Rivers?
- 2 What problem did BHP have managing the polluted water in their tailings dam?
- 3 What environmental impact did the tailings have on the rest of the river?
- 4 What social impact did the actions of BHP at the Ok Tedi mine have on the Indigenous users of the river?
- 5 Give another example where change in water use in one part of a river has impacted on water users downstream.

# 1.3 How much water do we have?

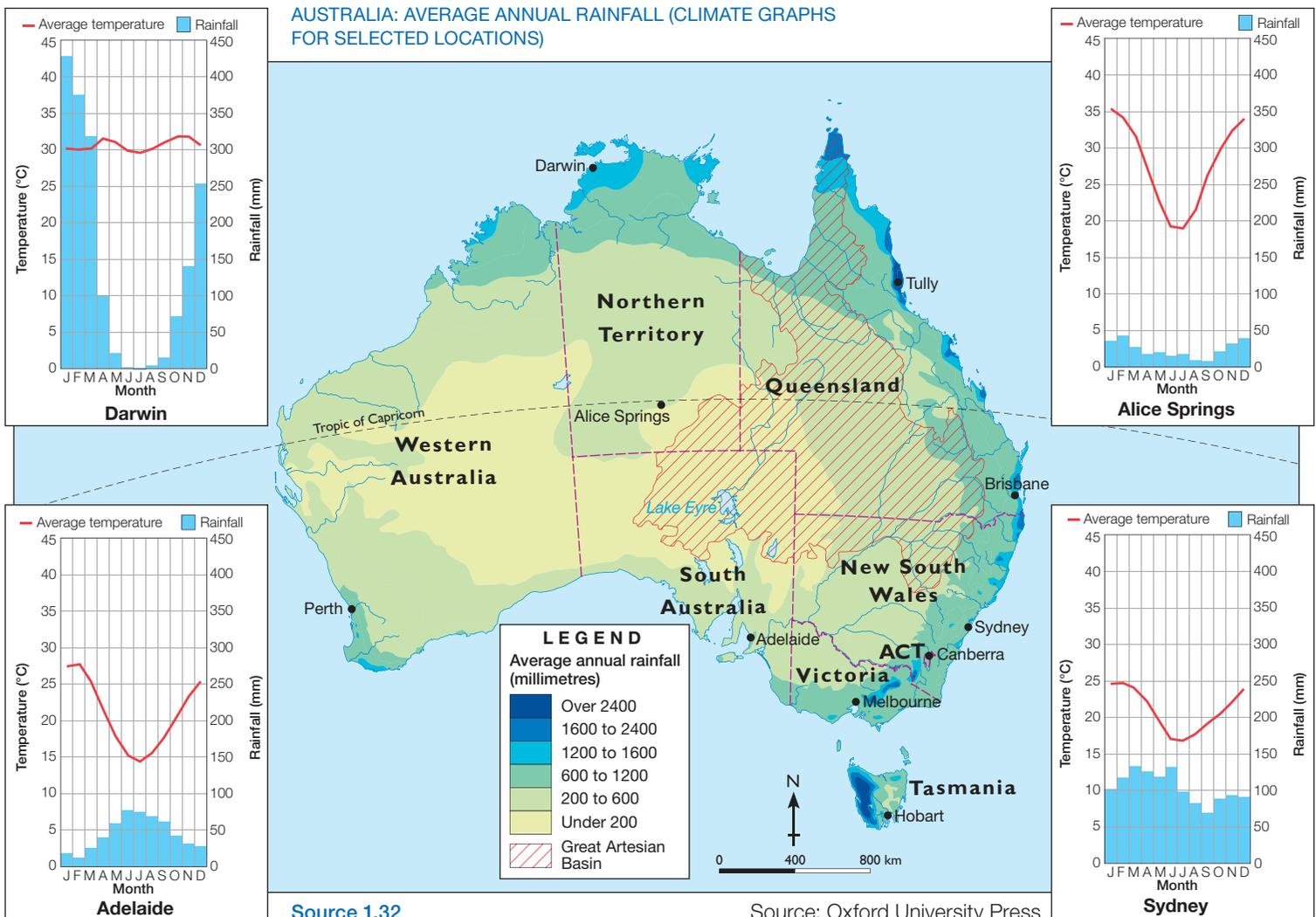
## Water in Australia

Australia has the lowest volume of water in rivers and the smallest number of permanent wetlands of any continent except Antarctica. Australia's water supplies are not evenly distributed. The northern third of the continent lies in the **tropics** and receives heavy rainfall with **monsoons** in the summer. It is a water-rich area. By comparison, vast areas of the interior receive very little rain.

Virtually all of Australia's large cities and towns are positioned on the coast, especially in the east and south-east. While most of these areas receive good, reliable rainfall, pressure from a large number of water users has put great strain on water resources in these areas.

### Rainfall distribution in Australia

Much of the Australian continent is dry. It is only the northern, eastern and south-western coastal regions that receive good annual rainfall. The climate of the eastern half of Australia is influenced by the Great Dividing Range. It extends 3500 kilometres from the northern tip of Cape York to southern Victoria. Moisture-rich winds from the south-east push warm, moist air over the land. Forced to rise and cool, the water droplets fall onto the east coast as rain, but as the air descends to the west, it becomes warmer and drier.





**Source 1.33** Australia's heaviest rainfall makes Tully the white-water rafting capital of Australia.

Being such a large country, Australia has a great deal of variation in rainfall. It is common for one part of the country to have floods while another has a long drought. The wettest place in Australia is Tully, near Innisfail in north Queensland, which averages 4204 millimetres of rainfall a year. Tully receives so much rain because of its location within the tropics on the north-eastern facing slopes of the Great Dividing Range.

The driest place in Australia is on the shores of Kati Thanda (Lake Eyre) in South Australia, which receives little more than 100 millimetres per year. Kati Thanda receives so little rain because it lies far from any supply of moisture. Air masses reaching the interior of the country have generally dropped their rain on to the south-eastern corner of Western Australia, and so they are dry by the time they arrive at Kati Thanda.

Many communities in the interior of Australia rely on underground water as well as the little rain that falls. Lying beneath much of eastern Australia is the world's largest underground water supply, the Great Artesian Basin (see Source 1.32). It is over 1.7 million square kilometres in size and covers approximately 22 per cent of Australia. The water is trapped underground in a sandstone layer covered by sedimentary rock, creating an aquifer. Farmers and communities access this water by drilling a well and pumping water to the surface with a windmill.

## Australia's river resources

Rivers are a vital source of fresh water for many people. Australia, though, has the lowest volume of water in rivers of any inhabited continent on Earth. On average, just 12 per cent of Australia's rainfall is collected in rivers; this is referred to as the river discharge. The remaining 88 per cent of rainfall is used by plants, held in natural water storages (such as lakes, wetlands and aquifers) or returned to the atmosphere through evaporation. The Darling River, part of Australia's largest river basin (the Murray–Darling Basin), loses enough water every year through evaporation to fill Sydney Harbour four times.

### Check your learning 1.9

#### Remember and understand

- 1 Why do many Australians live on the southern and eastern coast?
- 2 Where are the wettest regions of Australia? Where are the driest regions of Australia?
- 3 How do many farmers and communities in inland Australia access more water?
- 4 Use the map in Source 1.32 to estimate how much rainfall is received every year on average where you live.

#### Apply and analyse

- 5 Use the PQE method outlined on page 47 to describe the distribution of Australia's rainfall.
- 6 Four climate graphs are shown in Source 1.32. Each of these gives us two important pieces of information about the climate at a particular place. Rainfall is shown as a series of blue bars while average temperatures are shown with a red line. The trickiest part of reading a climate graph is reading the correct scales. Temperature is shown on the left-hand side, rainfall is shown on the right-hand side, and months along the bottom. For more information on reading a climate graph refer to section GT.2 of 'The geographer's toolkit'.
  - a Which is the most water poor of the four places shown? Why is this?
  - b Which has the most even or reliable rainfall throughout the year? Why is this?
  - c Which has the most seasonal rainfall?

# Variations in Australia's water supply

Water is particularly difficult to manage in Australia, the driest inhabited continent on Earth. Australia has the lowest amount of water in rivers and the smallest areas of permanent wetlands in the world. Australia's water supplies are not evenly distributed. The northern third of the continent is water rich, while vast areas of the interior receive very little rain. Variable rainfall patterns make it quite common for one part of the country to experience major flooding while others experience extended periods of drought.

## The Darling River

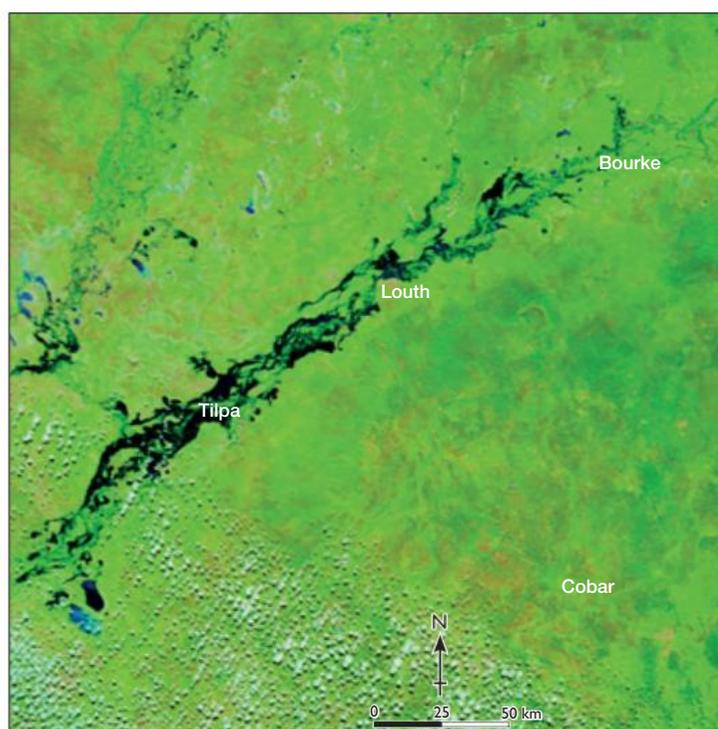
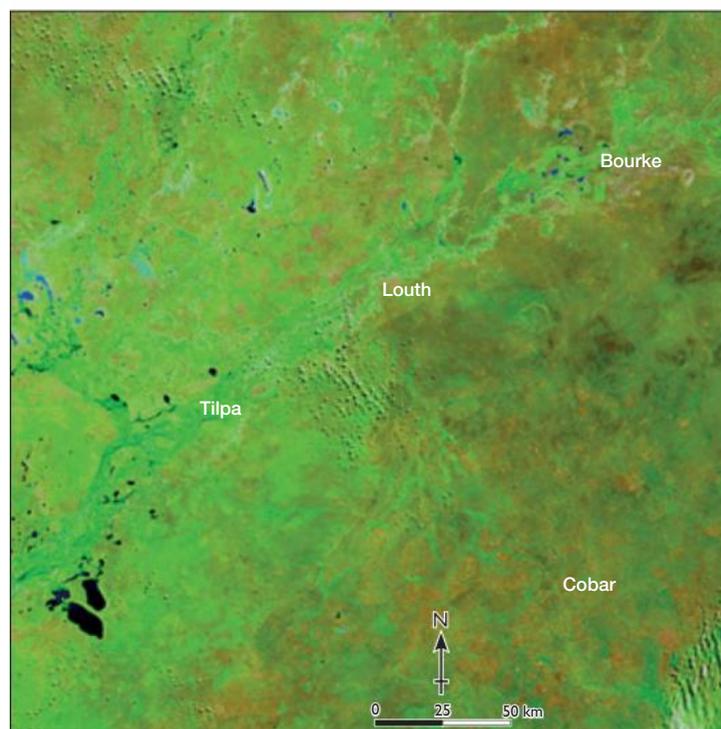
The Darling is Australia's third-longest river, flowing 1390 kilometres from Brewarrina until it joins the Murray River at the town of Wentworth. The Murray and Darling are the main rivers in the Murray–Darling River Basin, where 40 per cent of Australia's food is produced.

The flow of water in the Darling River varies greatly

due to drought and water that is taken to supply farms for irrigation. The Darling can be a small trickle or a raging torrent – it can even dry up completely. The Darling River stopped flowing at the town of Menindee, near Broken Hill in New South Wales, 48 times between 1885 and 1960.

## Climate change

Australians have come to see drought as part of the natural cycle of rainfall patterns, but a new threat now faces us – and it is one we do not fully understand. For years scientists have been warning us about the possibility that our climate is changing. While the vast majority of the world's scientific community now accepts that the planet is warming due to the effects of greenhouse gases, these experts are much less sure how this will affect specific places and specific climates. It appears that climate change will mean less water for many Australians in the future, putting even greater pressure on our current supplies.



**Source 1.34** These satellite images of the Darling River show the river affected by drought in 2011 (left), and flooded in March 2012 (right). These images use a photographic technique to help geographers distinguish between water and land. The colours used in the image are blue for water, bright green for vegetation, and an earth-tone for bare ground.

Much of Australia's fresh water comes from water collected in rivers, lakes and dams. This water will evaporate more quickly in the future, meaning that there will be less available for use in cities and rural areas. Source 1.37 shows the trends in annual rainfall over the last four decades. The green areas have had an increase in rainfall while the yellow and brown areas have had a decrease.

**Source 1.35** Part of the poem 'My Country' by Dorothea Mackellar (1908)

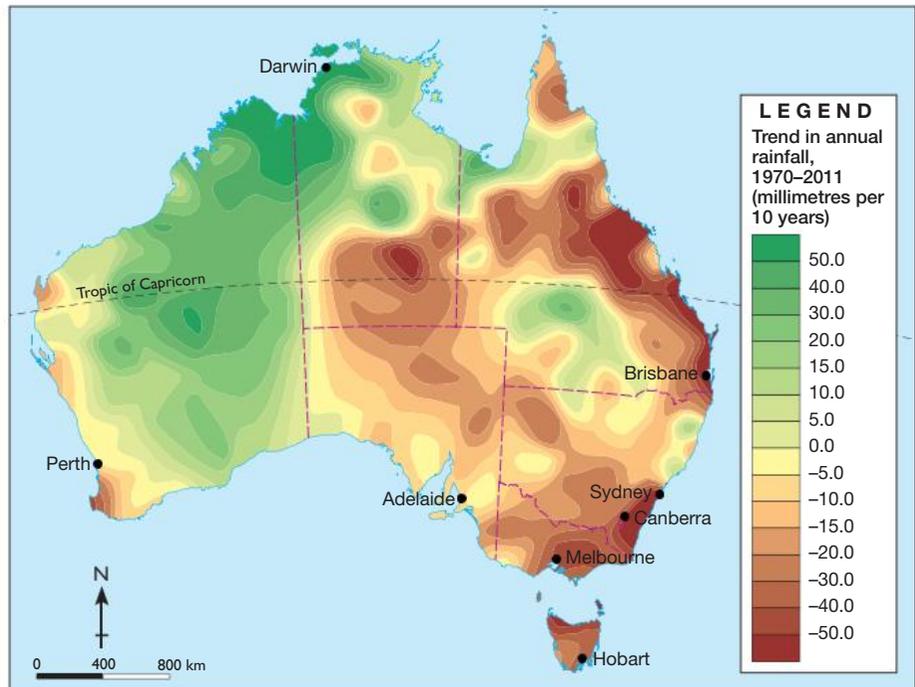
I love a sunburnt country,  
A land of sweeping plains,  
Of ragged mountain ranges,  
Of droughts and flooding rains,  
I love her far horizons,  
I love her jewel-sea,  
Her beauty and her terror –  
The wide brown land for me! ...

Core of my heart, my country!  
Her pitiless blue sky,  
When sick at heart, around us,  
We see the cattle die –  
But then the grey clouds gather,  
And we can bless again  
The drumming of an army,  
The steady, soaking rain...

**Source 1.36** A young girl from Wentworth in New South Wales jumps over the Darling River in 2006 (top) and swims in it during a flood in 2008 (bottom).



AUSTRALIA: RAINFALL TRENDS, 1970–2011



Source 1.37

Source: Oxford University Press

## Check your learning 1.10

### Remember and understand

- 1 Which part of Australia is the most water poor?
- 2 Read the poem 'My Country' in Source 1.35.
  - a Decide if you think the poem accurately describes the part of Australia you live in.
  - b Which line in the poem best sums up Australia's variable water supply?
- 3 Why might a warmer future lead to less water being available in Australia?
- 4 Look at Source 1.34. How and why did the flow of water along the Darling River change between 2011 and March 2012?

### Apply and analyse

- 5 Look carefully at Source 1.37.
  - a Between 1970 and 2011, which parts of Australia experienced significant decreases in annual rainfall?
  - b Which capital cities have been most affected?
  - c How has the Murray–Darling River Basin been affected?

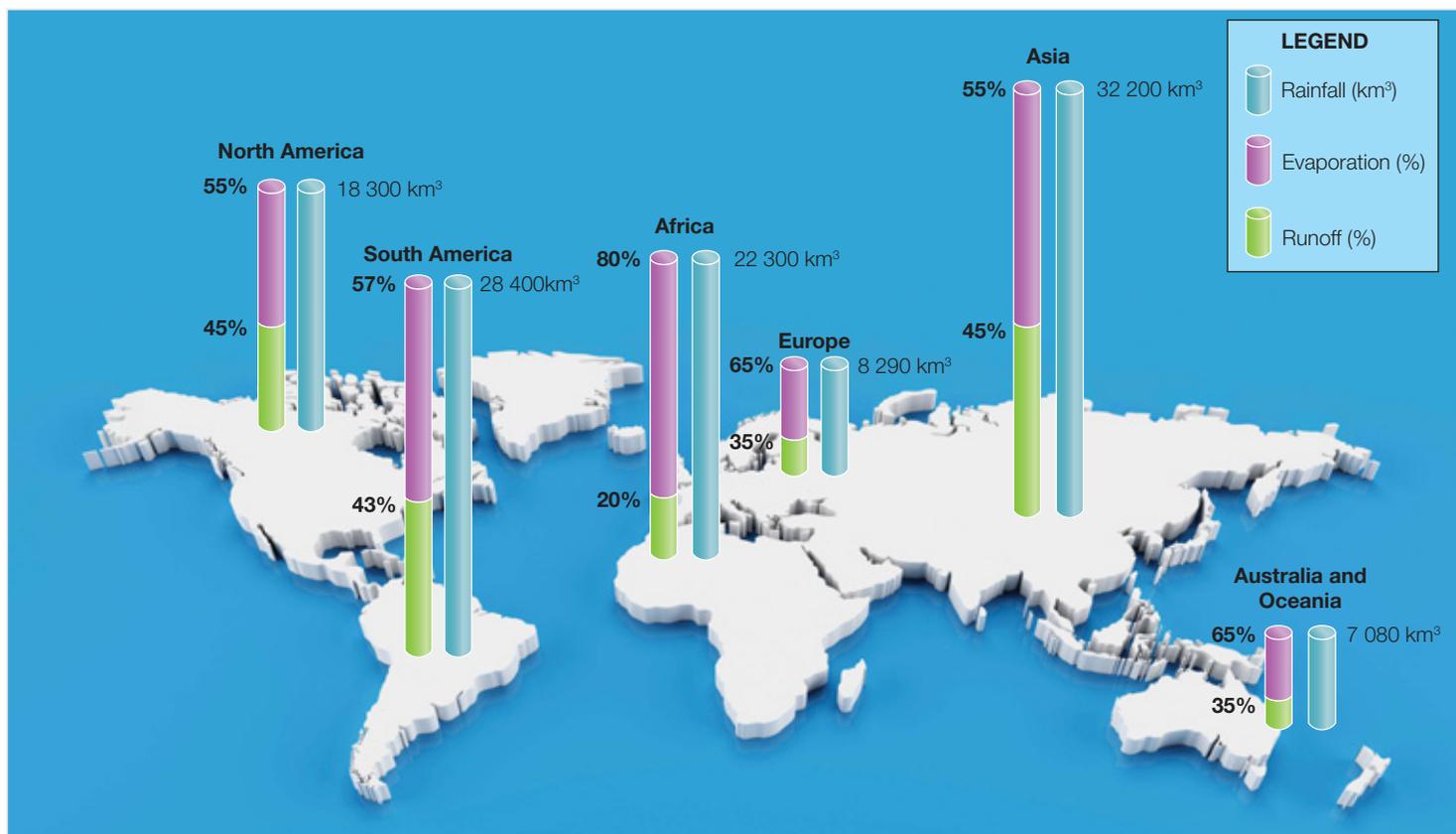
# Water in the world

In an average year, 577 000 km<sup>3</sup> of rain falls on Earth. Of this, 458 000 km<sup>3</sup> fall, on the oceans and 119 000 km<sup>3</sup> on land.

When water falls to earth as rain, most of it **evaporates** back into the atmosphere. Of the annual rainfall that falls on land 74 000 km<sup>3</sup> (or 62 per cent) evaporates. In Australia, around 65 per cent of our total rainfall each year evaporates. The remaining 35 per cent runs off the land, and of this, only about 12 per cent ends up in our rivers. Only Africa has a higher

evaporation rate than Australia.

The amount of water in Australian rivers is the smallest of all inhabited continents, with South America experiencing the highest volumes of water in its rivers. For example, the Amazon River (the second-longest river in the world) carries more water than any other river on Earth with an average discharge (volume of water flowing through it) greater than the next seven largest rivers combined. Nearly 20 per cent of all the fresh water entering the oceans comes from the Amazon River.

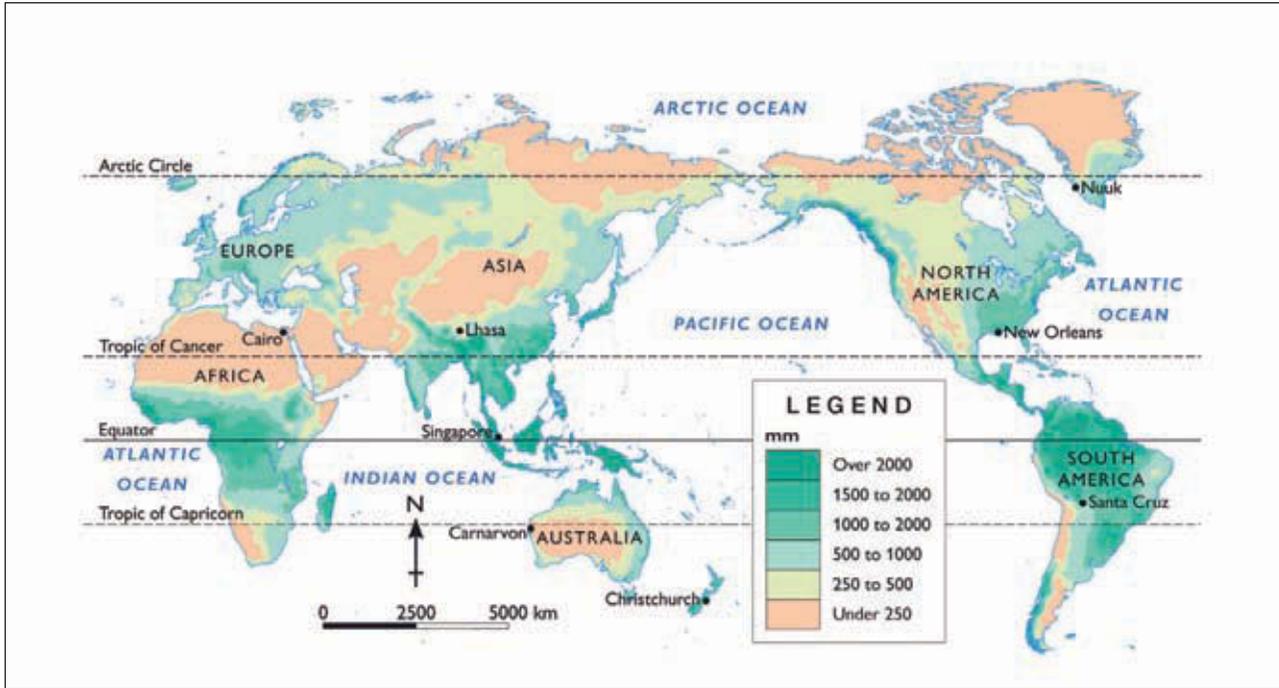


Source 1.38 Average volume of yearly rainfall (km<sup>3</sup>), evaporation and runoff by world region

Source: FAO Aquastat

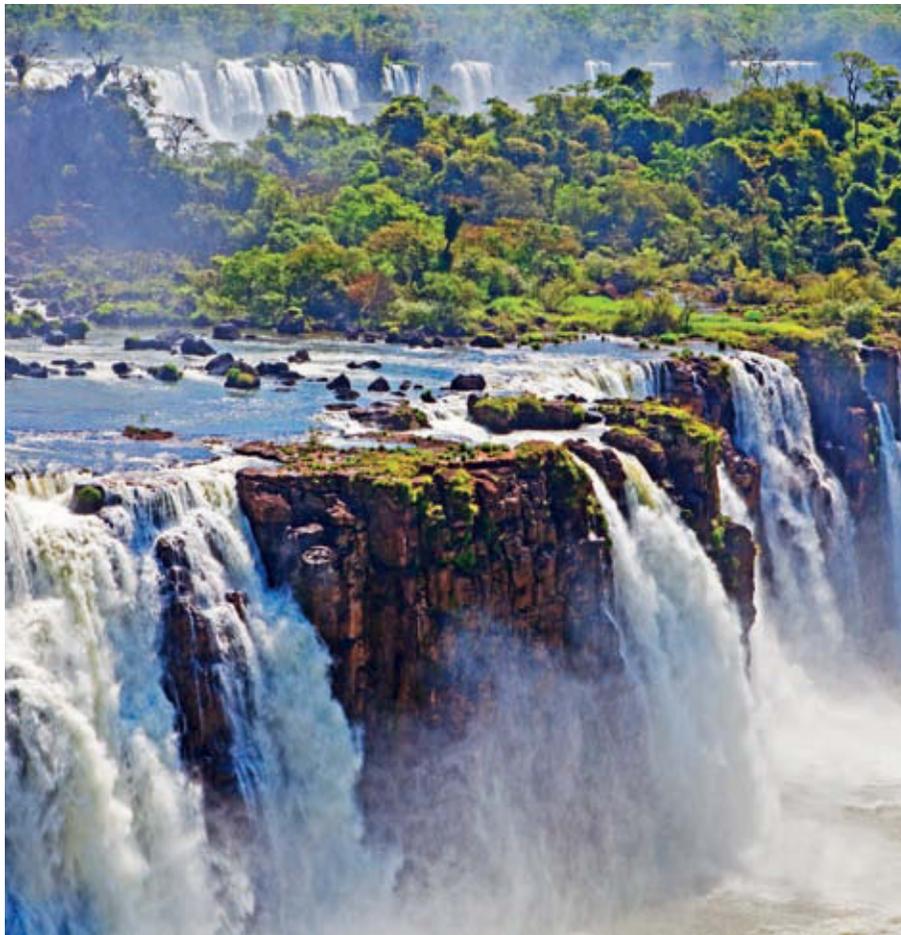
Source 1.39 Some of Australia's driest regions are in the desert.





Source 1.40

Source: Oxford Atlas



**Source 1.41** South America's high rainfall has contributed to the creation of the Iguazu Falls, which is 80 metres high and 3 kilometres wide.

## Check your learning 1.11

### Remember and understand

- 1 Use Source 1.38 to rank the six inhabited continents from the continent with the most runoff to the continent with the least.
- 2 Which river carries the most water and how does it compare to other rivers?

### Apply and analyse

- 3 Look carefully at Source 1.40.
  - a Which region of the world is the wettest? Why do you think this is the case?
  - b Which part of Africa experiences the lowest rainfall? What type of landscape would you expect to find here?
  - c Which part of Asia is the wettest? What are some of the advantages and disadvantages of high rainfall?
  - d Does the region north of the Arctic Circle have low or high rainfall? How might much of the water in this region be stored?

# The world's drinking water

Drinking water, sometimes called potable water, is water that is safe to drink and use for cooking and washing. In Australia, most water undergoes some form of treatment to make it safe to drink. Water treatment removes sediments, pollutants and microorganisms that can make us sick. Australians are among the world's biggest water users, using almost 500 litres of water per person per day. This figure is for all water use, including water used in agriculture and industry. While this amount has declined in recent years, it still ranks among the highest in the world. Experts estimate that each Australian will need to use 12 per cent less water by 2030 in order to stay within the limits imposed by our rainfall. Some households have started to use a number of strategies to save water, while many others continue to waste large amounts.

## Access to safe drinking water

In Australia, we take for granted that we have flush toilets, running water from taps and clean, safe drinking water. However, millions of people around the world get sick or die each year from drinking contaminated water. The United Nations estimates that half the world's population has problems caused by lack of access to clean water. More than 1 billion people do not have access to a reliable freshwater supply, and 2.6 billion do not have basic sanitation, such as running water to clean their hands or flush their toilets.

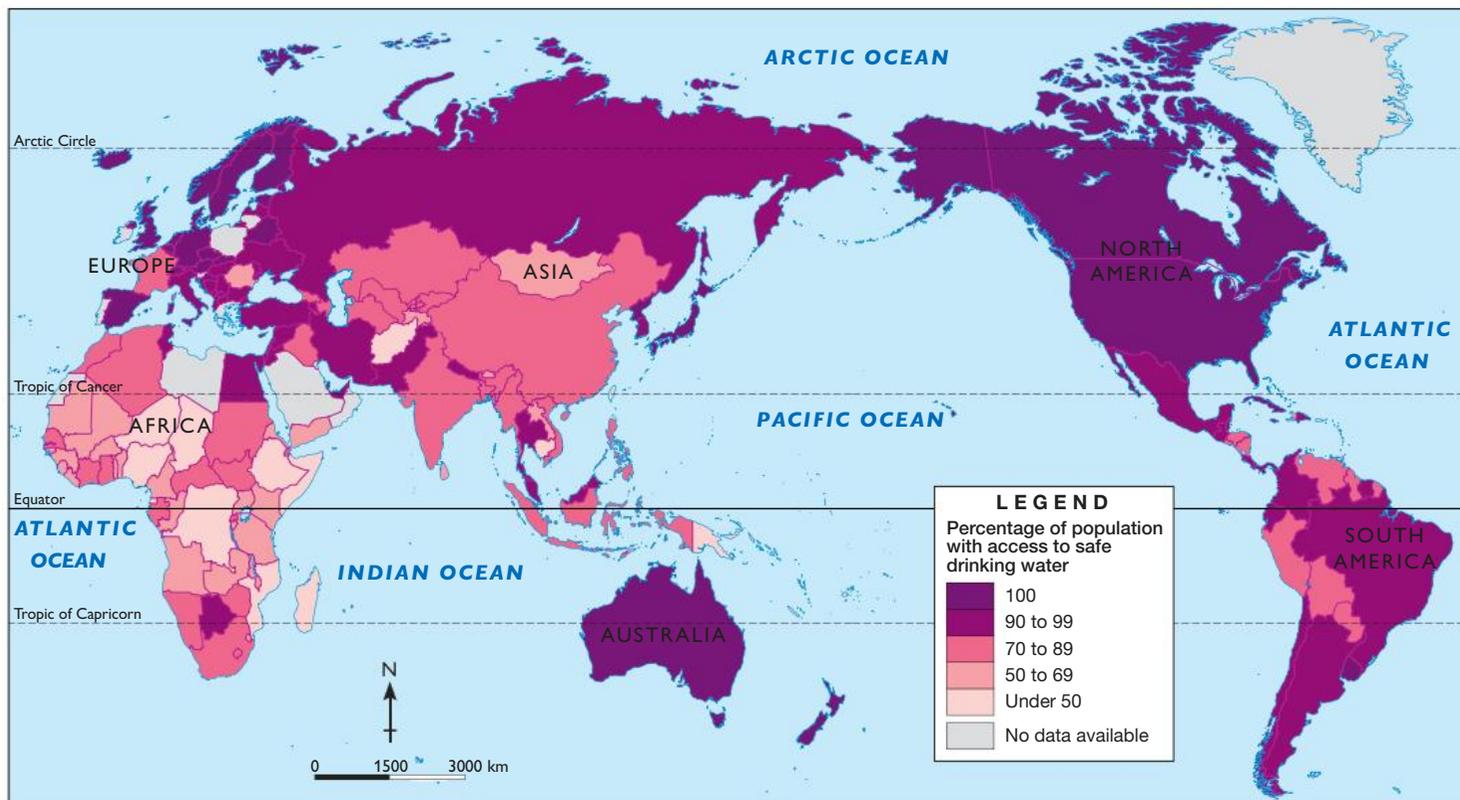
It is estimated that, at any one time, almost half the people in poorer countries are suffering from health problems due to a lack of safe water. Each year, millions of people die from diseases carried in their water. Millions of women and children around the world, particularly in Africa, spend several hours a day collecting and carrying enough water to keep their families alive for another day.



**Source 1.42** Water use per person per day. Mozambique has the lowest daily water use per capita while the United States has the highest. Source: United Nations 2006

**Source 1.43** In Chad, as in many African countries, each day begins with a walk to the village well.





Source 1.44

Source: *Oxford Atlas*

**keyconcept:** environment

### Serah's story

Serah and her six children live in Ethiopia in Africa. The scarcest resource in her region is water. Before dawn, she makes her first journey to the village pump. Once there were three wells, but the 8-metre well has dried up. The 9-metre well has a little salty water at the bottom. The flow from the pump of the 25-metre well has slowed to a painful trickle. There is just barely enough for everyone to drink.

While it takes her 25 minutes to walk down the hill to the pump, it will take her 40 minutes to make the return journey with the 10-litre jar balanced on her head. She makes this trip at least twice a day. She tends not to drink as much as the others as she believes she should look after her children before herself. This means that she cannot produce enough milk for her baby, so he is often ill. The water contains parasites that make her other children sick, but Serah has little choice.

For more information on the key concept of environment, refer to section GT.1 of 'The geographer's toolkit'.

### Check your learning 1.12

#### Remember and understand

- 1 What is potable water?
- 2 How many people in the world do not have access to a reliable supply of fresh water?
- 3 Describe the differences in the drinking water available in most Australian homes and in Serah's village.

#### Apply and analyse

- 4 Using Source 1.44 and the world map on the inside front cover of this book, identify two countries with excellent access to safe water and two countries with poor access to safe water. Which continent has the worst access to safe water?
- 5 Read Serah's story.
  - a How much water will Serah collect in two trips to the pump?
  - b How many people depend on her trips to the pump?
  - c How much will each person receive?
  - d The average toilet in Australia uses 8 litres per flush. Write a statement about the way water is used in Australia compared to Ethiopia.

## 1.3 bigideas: broadsheet

# Windhoek, Namibia

Namibia is the driest country in Africa south of the Sahara Desert. Its capital, Windhoek, receives about 360 millimetres of rainfall a year and its 250 000 people rely on three dams for most of their water. These dams, however, are built on rivers that do not always flow and are therefore unreliable for city water use.

In 1969 the government decided to mix water from traditional sources, such as dams and wells, with recycled water from the city's sewage-treatment plant in order to supplement Windhoek's fresh water. As the city's population continued to grow rapidly, in the 1990s it was decided to build another treatment plant to convert sewage into drinking water. This was completed in 2002. Now more than one-third of Windhoek's drinking water comes from this unlikely source, making the city the world leader in turning waste-water into drinking water.



**Source 1.45** Water is a scarce and precious resource in Namibia.

**Source 1.46** Climate data: Windhoek, monthly averages

Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	76	74	79	41	8	0	0	0	3	10	23	48
Temperature (°C)	29	28	27	25	22	20	20	23	25	29	29	30

### skilldrill

## Drawing climate graphs

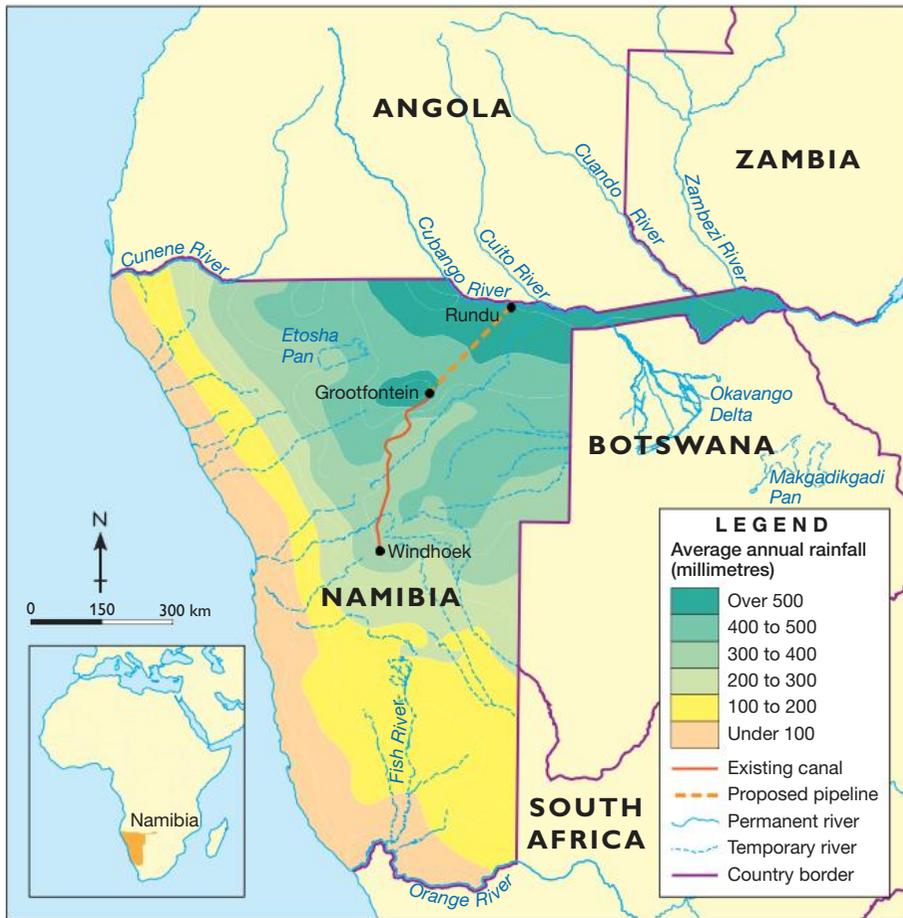
Climate graphs combine column graphs and line graphs to help us interpret the climate in a specific location. In order to draw a climate graph, geographers gather climate data – the monthly average rainfall and temperature – for the location they are investigating.

- Step 1** Look carefully at the climate data to find the lowest and highest temperature figures that you will need to show on your graph. In this example, Windhoek's temperature varies from 20 to 30 degrees Celsius. Decide on a scale that shows this range of data, then place it on the left-hand axis of your climate graph.
- Step 2** Using graph paper, plot the temperature data on your graph by placing a small, neat dot in the centre of each month at the correct height. Join the dots with a smooth red line and continue the line to the edges of the graph.
- Step 3** Look carefully at the climate data to find the lowest and highest rainfall figures that you will need to show on your graph. In this example, Windhoek's rainfall varies from 0 to 79 millimetres a month. Decide on a scale that shows this range of data, then place it on the right-hand axis of your climate graph.
- Step 4** Plot the rainfall on your graph by drawing a blue column to the correct height for each month. You may like to very lightly shade the bars with a blue pencil.
- Step 5** Complete your graph with a suitable title and a label for each of the three axes.

### Apply the skill

- 1** Using the steps shown above and the data in Source 1.46 and referring to the Alice Springs climate graph (Source 1.32), construct a climate graph for Windhoek.

NAMIBIA: AVERAGE ANNUAL RAINFALL



Source 1.47

Source: Oxford University Press

Source 1.48 Many Namibian rivers are only temporary, meaning they are dry for most of the year.

Extend your understanding

- 1 Describe the annual pattern of rainfall in Windhoek.
- 2 Explain how this annual pattern makes dams and reservoirs an unreliable water resource.
- 3 Describe the annual pattern of temperature and explain the impact of these temperatures on the evaporation of water held in dams.
- 4 Compare the climates of Windhoek and Alice Springs (Source 1.32).
- 5 Examine the map of Namibia. Identify three water resources on this map.
- 6 a What have the people of Windhoek done to make their water supply more sustainable and safe?  
b What problems does lack of access to safe water cause?
- 7 Use the information on the map (Source 1.47) to explain why a pipeline is proposed to be built from the Cubango River to Grootfontein.
- 8 Why would the people of Botswana be concerned about this proposed pipeline?



An aerial photograph of a desert landscape. The terrain is rugged and brown, with a winding road and a small settlement. In the foreground, a lush green golf course is visible, contrasting sharply with the arid surroundings. The sky is clear and blue.

# Valuing and managing water

People value water for many different reasons. It has economic, cultural, spiritual and even aesthetic (appreciated for its beauty) value. As populations grow, the demand for water increases, yet its supply is limited. People all over the world need to examine how they use water, and put in place measures to conserve and manage it. On the other hand, when rainfall is high, communities in low-lying areas close to rivers need to put in place measures to deal with the opposite problem – floods.

## 2.1

In what ways do we value and manage water?

- 1 Considering that only 2.5 per cent of all water on Earth is fresh water, do you think that the Cascata Golf Club's use of water (see Source 2.1) is responsible?
- 2 Why might water have a higher economic value in the Nevada Desert?

## 2.2

How can we overcome water scarcity?

- 1 What could the managers of the Cascata Golf Club do to use less water?
- 2 Make a list of strategies that you, personally, could put in place to use less water.



chapter

# 2

**Source 2.1** The Cascata Golf Club in the Nevada Desert uses 5 000 000 litres of water per day to irrigate its fairways and greens.

## 2.3

### How do we respond to floods?

- 1 The Nevada Desert suffers from permanent drought conditions. Other parts of the world are frequently flooded. What factors do you think might make an area prone to flooding?
- 2 Suggest two ways that communities in flood-prone areas might plan for floods.

# 2.1

In what ways do we value and manage water?

## The importance of water

Since the beginning of human history, we have relied on water. We drink it in order to survive; we wash, cook and clean with it; and we use it to grow our food and produce electricity. In this way, water is arguably our most precious resource. Life on Earth without it would be impossible. One of the challenges facing Australia today is that we use too much of this environmental resource.

Only 12 per cent of the water consumed in Australia is used in our homes and gardens, whereas 70 per cent is used to irrigate farms. This **irrigation** provides us with much of the food we eat, so it must be included when we think about how much water each of us personally consumes. When you add this water to the amount used to make other products we use every day, such as shampoo and toothpaste, every Australian is responsible for using over 1 million litres of water per year! Source 2.2 outlines the various ways in which we all use water.

### Spiritual uses

Water holds a special significance for almost all world religions. It often plays a key part in religious ceremonies.

### Firefighting

Firefighters around the world rely heavily on a constant supply of water in order to carry out their work.

### Domestic uses

The average Australian household uses over 350 litres of water a day for drinking, preparing food, washing, cleaning, flushing toilets, cleaning cars, and watering lawns and gardens. Toilets and bathrooms account for about 40 per cent of this **domestic** water use.

### Irrigation of parks, gardens and sporting grounds

Many parks, gardens and sporting grounds, including football ovals, rely heavily on water in order to survive. In dry areas, water is often taken from drinking storages to keep them green and healthy.

### Environmental needs

As well as being used for human consumption, fresh water is a vital part of the natural environment. Taking too much water from a river can cause many environmental problems, such as weed growth, fish deaths and salt build-up.

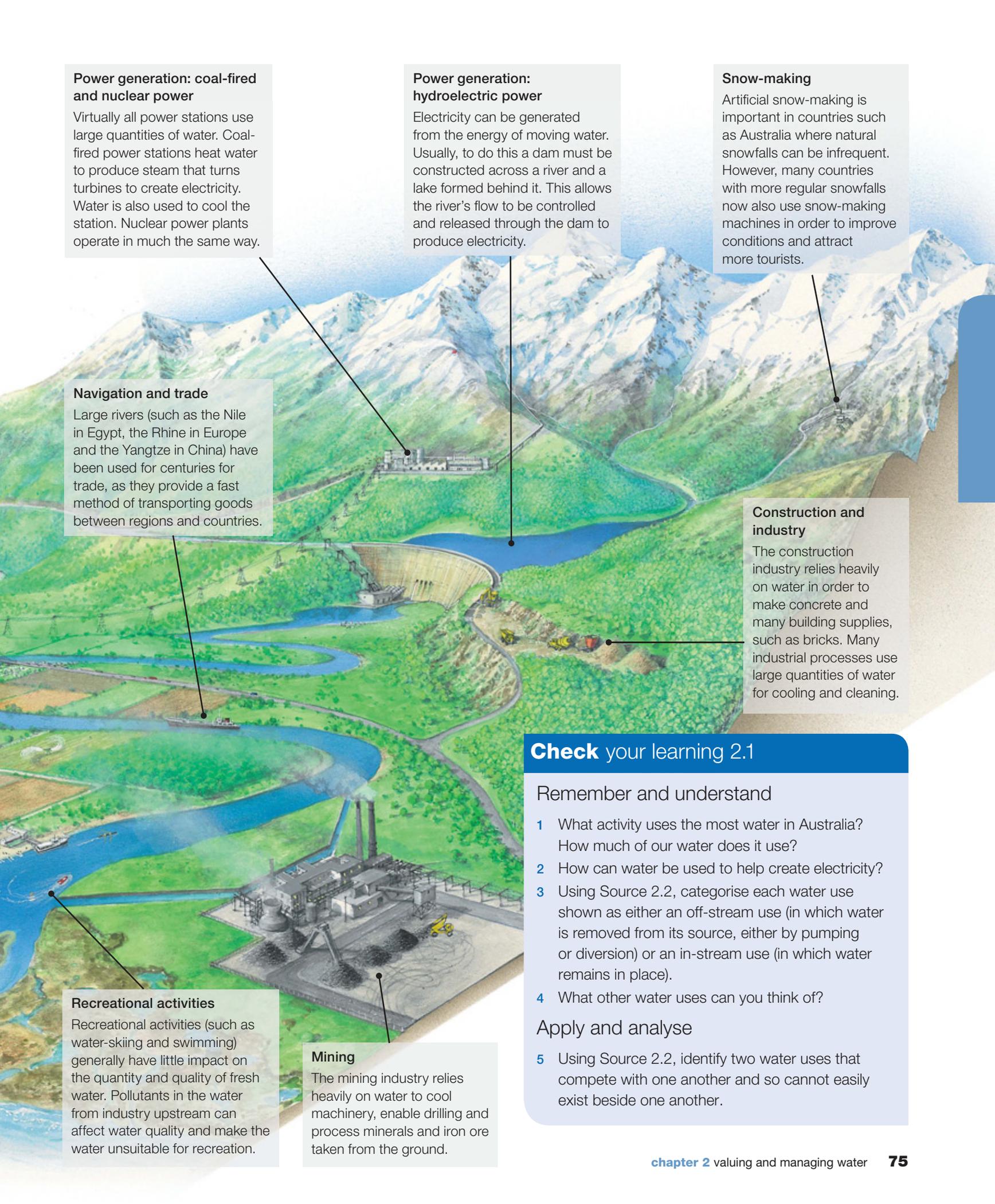
### Irrigation of crops and pastures

Irrigation accounts for most of the world's water use. In some arid areas, including many parts of Australia, irrigation is used to grow crops. So water provides us with our food as well as our drink.

### Fishing

Commercial and recreational fishing depends on clean oceans, rivers and lakes.

**Source 2.2** In Australia we use large amounts of water in many different ways.



### Power generation: coal-fired and nuclear power

Virtually all power stations use large quantities of water. Coal-fired power stations heat water to produce steam that turns turbines to create electricity. Water is also used to cool the station. Nuclear power plants operate in much the same way.

### Power generation: hydroelectric power

Electricity can be generated from the energy of moving water. Usually, to do this a dam must be constructed across a river and a lake formed behind it. This allows the river's flow to be controlled and released through the dam to produce electricity.

### Snow-making

Artificial snow-making is important in countries such as Australia where natural snowfalls can be infrequent. However, many countries with more regular snowfalls now also use snow-making machines in order to improve conditions and attract more tourists.

### Navigation and trade

Large rivers (such as the Nile in Egypt, the Rhine in Europe and the Yangtze in China) have been used for centuries for trade, as they provide a fast method of transporting goods between regions and countries.

### Construction and industry

The construction industry relies heavily on water in order to make concrete and many building supplies, such as bricks. Many industrial processes use large quantities of water for cooling and cleaning.

### Recreational activities

Recreational activities (such as water-skiing and swimming) generally have little impact on the quantity and quality of fresh water. Pollutants in the water from industry upstream can affect water quality and make the water unsuitable for recreation.

### Mining

The mining industry relies heavily on water to cool machinery, enable drilling and process minerals and iron ore taken from the ground.

## Check your learning 2.1

### Remember and understand

- 1 What activity uses the most water in Australia? How much of our water does it use?
- 2 How can water be used to help create electricity?
- 3 Using Source 2.2, categorise each water use shown as either an off-stream use (in which water is removed from its source, either by pumping or diversion) or an in-stream use (in which water remains in place).
- 4 What other water uses can you think of?

### Apply and analyse

- 5 Using Source 2.2, identify two water uses that compete with one another and so cannot easily exist beside one another.

# Growing the world's grain

Rice is the world's most important food crop and is the main food source for over half of the world's population. Rice production is heavily dependent on water. A semi-aquatic plant, rice is grown in flooded fields. For this reason, rice-growing communities tend to be located in regions of the world with high rainfall. About 90 per cent of the world's rice is grown in Asia, with India and China being the largest producers of rice. Outside of Asia, the USA and Brazil are the biggest producers of rice.



**Source 2.3** Rice seedlings being placed in the rice paddy for planting, Mekong Delta, Vietnam

## Rice farming in Vietnam

Vietnam is home to some of the world's richest agricultural regions. It is the fifth-biggest producer, the second-largest exporter and the seventh-largest consumer of rice. In Vietnam, 75 per cent of people's daily calorie needs are met by rice.

The Mekong Delta is called the 'rice bowl' of Vietnam, with over half of the country's rice produced there. The delta is formed by sediment (small particles of rock and dirt) deposited by the Mekong River and provides rich soil for farming. The Mekong Delta region is also flood prone, making it perfect for rice production. The rice is grown in flooded fields known as paddies.

Of the 17 million people in the delta region, 80 per cent are employed in rice cultivation. The rice farmers live in



## MEKONG DELTA: RICE-GROWING REGIONS



**Source 2.5** Source: Oxford University Press

**Source 2.4** Satellite image of the Mekong Delta in Vietnam. Farming here is dependent on the rich soils and plentiful water of the region.

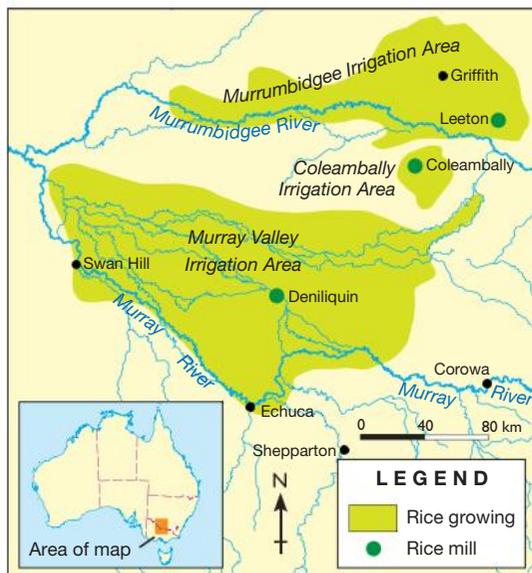
houses built on stilts and the roads in the region are located on raised embankments to provide protection from flooding.

Most of the rice produced in Vietnam and other parts of southern Asia is a variety known as Indica rice. Indica rice is a long grain rice that grows well in hot, tropical climates. In recent times, faster growing rice plants have been developed. These new strains of rice mature in 110 days instead of 160, meaning farmers can grow three crops a year instead of two.

## Rice farming in Australia

In Australia, a variety known as Japonica rice is more commonly grown. This variety of rice grows well in the Australian climate. In a dry country such as Australia, rice farmers have to be very efficient in their use of water (see Source 2.7). Australian rice growers use 50 per cent less water than the world average to grow one kilogram of rice. To ensure water is not wasted, the soil of Australian rice farms needs to be checked and approved to ensure that it can hold water and not allow it to escape below.

### AUSTRALIA: RICE-GROWING REGIONS



Source 2.6 Source: Oxford University Press



Source 2.7 Australian farmers carefully plough their fields to minimise water wastage. They even use lasers to ensure rice fields are as close to level as possible. Raised levees divide large fields into individual bays to allow farmers to carefully control the flow of irrigation water.

Australia's rice-growing regions include the Murrumbidgee and Murray Valley in south-western New South Wales (see Source 2.6). These regions are suitable for rice cultivation as they have available water, irrigation infrastructure, large areas of flat land, and suitable soils. Storage and milling facilities for rice have also been established in these areas. The rice industry has been a major contributor to the economic and social wellbeing of people in the towns of these regions.

## Check your learning 2.2

### Remember and understand

- 1 What economic value does rice have?
- 2 How have farmers reduced their water use in rice-growing regions across Australia?

### Apply and analyse

- 3 Compare rice-growing techniques in Australia and Vietnam. How are they similar? How are they different?

### Evaluate and create

- 4 Draw a sketch map of Source 2.4 to show the location of rice paddies on the Mekong Delta. Mark in the South China Sea and rice paddies (most of the green area on the image).

# Competition for water supplies

Fresh water from rivers is used by people in cities, farms and factories. Competition for this precious economic resource has seen the introduction of dams all over the world to store the water flowing down rivers and ensure a constant supply of water to the people nearby. Because people living along the entire length of rivers depend on them for water, competition also exists between upstream and downstream users. The flow and quality of water available to downstream users depends on how the river is used upstream.

## Case study: the Murray River

The Murray River provides an excellent example of what happens when demand for river water threatens to outpace supply. Water from the Murray River has many competing uses, including irrigation, domestic urban water supply, industrial water supply, maintaining the natural environment, recreation, navigation, hydroelectricity and water storage. There are three major water storage dams on the Murray River. There are also 10 weirs (another type of dam) built across the river to slow the river flow and allow towns to access the water. Locks have been built where the water level can be raised and lowered to allow boats to travel from one side of the weir to the other.

A series of pumps and pipes carries some of the water from the Murray River to water users in towns, cities and farms many kilometres from the river (see Source 2.8). One of these pipes carries water from the town of Mannum to Adelaide, 60 kilometres away. The amount of water pumped from the river to Adelaide varies from year to year but can be as high as 90 per cent of Adelaide's water needs in some years.

The agriculture sector is by far the largest user of water from the Murray River. On average, 3780 gigalitres (3780 billion litres) is diverted each year to irrigate farmland to grow crops and raise livestock. Clearing of native vegetation in the river valley has enabled irrigated crops and

MURRAY RIVER AND SOUTH AUSTRALIAN WATER PIPELINES



Source 2.8

Source: Oxford University Press

Source 2.9 Oblique aerial photograph of the Murray River at Mannum, South Australia



pastures to be grown, but also forced salty groundwater to the surface and into the river. Along with pesticides and fertilisers, the salty water causes problems for users downstream. Near the South Australian town of Waikerie a system of pumps intercepts some of the salty water before it reaches the Murray River. It is carried in pipes to a 400-hectare lake. It is estimated that this scheme prevents more than 100 tonnes of salt a day reaching the river. Most of the water not used for irrigation is diverted to homes and industries throughout South Australia through six major pipelines (see Source 2.8). The average amount of water that flows from the Murray River into the ocean near Adelaide is now just 25 per cent of the total natural flow. This is because around 75 per cent of this water is taken out of the river upstream.



**Source 2.10** This image was taken in 1981 when the mouth of the Murray River completely closed, creating changed conditions for wildlife and plants in the region.

## keyconcept: scale

### The changing scales of water management

The water in the Murray River is one of Australia's most precious resources but is very difficult to manage. This is mainly because there is so much competition for the water. The water is used by thousands of farmers to produce food and other products for millions of people. Many towns and cities in three different states use the river to supply residents with water for their homes and businesses.

In the past, many upstream water users have only considered their own water needs when taking water from the river. They have not considered how this would impact on people and places downstream. We now know that this local-scale approach to water use damages the health of the river. Water must be managed at the regional scale, considering the needs of all water users and the environment in the entire river basin. For more information on the key concept of scale, refer to section GT.1 of 'The geographer's toolkit'.

## Check your learning 2.3

### Remember and understand

- 1 What competition is there for Murray River water?
- 2 What are the two major uses of Murray River water?
- 3 How have the competing water uses of boating and water storage in weirs been catered for along the Murray?
- 4 What problems have been caused downstream by upstream usage of the Murray River water?

### Apply and analyse

- 5 Why is it difficult to manage the water resources of the Murray River?
- 6 In the foreground on the left of the Mannum oblique aerial photograph (Source 2.9) you can see a small

marina and a residential development. Are these developments at a local or regional scale?

- 7 Examine Source 2.8.
  - a How many pipelines are shown that access water from the river?
  - b Use the scale to estimate the distance water travels from Swan Reach to Edithburgh.

### Evaluate and create

- 8 Draw a map of Source 2.9. Use a legend to show the following features: the Murray River, irrigated farmland, irrigated golf course and sporting ground, a marina for houseboats and the town of Mannum.

# The challenges of managing water

Water is an essential environmental resource that is important for the health of humans and the health of the environment. Different values are often placed on water; for example, water used for economic purposes can also have great spiritual and cultural importance for a community. Competition for water use needs careful management. It is often not easy to come up with solutions. Water management is difficult because:

- it is an essential resource needed by every person on the planet
- it moves through the environment quickly so it is difficult to capture and store
- its availability is not constant – it changes over time and in different locations
- it is a shared resource with many competing uses.

Over the past 50 years the world's population has doubled, and the output from farms and industries has surged to meet increasing demands. The growth in demand and competition for water has put a much greater strain on global water supplies. We need to make good decisions to fairly share the use of water and minimise the impact our water use has on the natural environment.

**Source 2.11** Sewage spills into the Ganges River in the city of Varanasi



## Case study: Ganges River, India

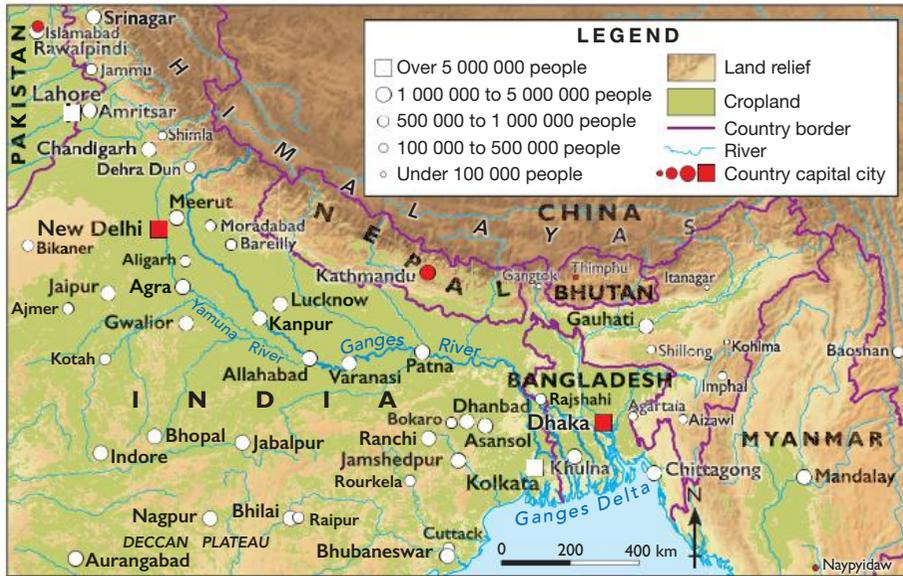
The Ganges River begins high in the Himalayan mountains, and travels across India before flowing east into Bangladesh and into the Bay of Bengal. In total, the river is 2525 kilometres long. The Ganges is worshipped by Hindus, who believe bathing and praying in the river purifies them. This sacred river is also used by millions of Indians who live along its banks and depend on it for their daily needs.

In the last 30 years, India's population has grown to nearly 1.2 billion people; one-third of these people live along the banks of the Ganges. Huge increases in the size of cities, factories and agriculture have put enormous pressure on the river. Irrigation canals siphon off large amounts of water to grow food for the country's increasing population. Untreated **waste-water** is dumped into the river from cities and towns that lack proper sewage-treatment facilities. Around 25 per cent of India's population work in manufacturing and industry. The waste-water and **effluent** from these industries often contain hazardous chemicals. The Ganges is now one of the most polluted rivers in the world.

Overuse and lack of management have meant that India's most sacred river is gradually dying. In Varanasi, a city on the banks of the Ganges in north-eastern India, the bacterial count in the water is 3000 times higher than the safe levels established by the World Health Organization. Polluted water is the main cause of skin problems, disabilities and infant deaths, but many Hindus refuse to accept that the Ganges (or Mother Ganga as they call her) is the source of these problems. 'People have so much faith in this water that when they bathe in it or sip it, they believe it is the nectar of God [and] they will go to heaven,' says a scientist at the Central Pollution Control Board in India.

In 2011, Indian officials signed an agreement with the World Bank for a \$1 billion loan to finance a government project that aims to stop the flow of untreated waste-water into the Ganges by 2020.

## COURSE OF GANGES RIVER



Source 2.12

Source: Oxford University Press

**Source 2.13** Tens of thousands of Hindu devotees gather on the banks of the holy Ganges River to bathe and offer prayers during Karthik Purnima festival in Patna, India.



## Check your learning 2.4

### Remember and understand

- 1 Why is water difficult to manage?
- 2 List three reasons why water resources are under threat.
- 3 Look carefully at Source 2.13.
  - a Why have all of these people gathered at the Ganges River?
  - b What dangers do they face?
- 4 List as many competing uses of the Ganges as you can.
- 5 Why is the Ganges River so difficult to manage?

### Apply and analyse

- 6 Look at Source 2.12. Why is the pollution of the Ganges a much greater problem in Kolkata than in Kanpur in northern India?
- 7 How do you think the pollution of the Ganges affects the natural environment around the river?

# Water and Indigenous Australians

Water is a vital resource valued by both Indigenous and non-Indigenous Australians. Non-Indigenous Australians generally consider water as a natural resource with great economic and aesthetic value. Indigenous Australians on the other hand generally value water for cultural and spiritual reasons. They regard the rivers and waterholes as an inseparable part of their land. Land and water management is a key part of the culture of Aboriginal and Torres Strait Islander peoples.

## A spiritual connection with water

Prior to European settlement, most Aboriginal peoples lived in the well-watered coastal areas and along the rivers of the Murray–Darling Basin. Aboriginal people in the arid areas of Australia studied the habits of wildlife to detect water supplies. They mapped the location of water in their artwork. In these maps, spirals identified the location of pools and wells while wavy lines showed the location of running water (see Source 2.15).



**Source 2.15** In the past, Indigenous Australians communicated the location of water resources through symbols on maps (like this one) and through spoken instructions and stories.



Aboriginal people also passed on their knowledge of water resources through stories. The Worrorra people live in the Prince Regent River region of the Kimberley. Their Dreaming (or Lalai) stories tell of the formation of the Prince Regent River.

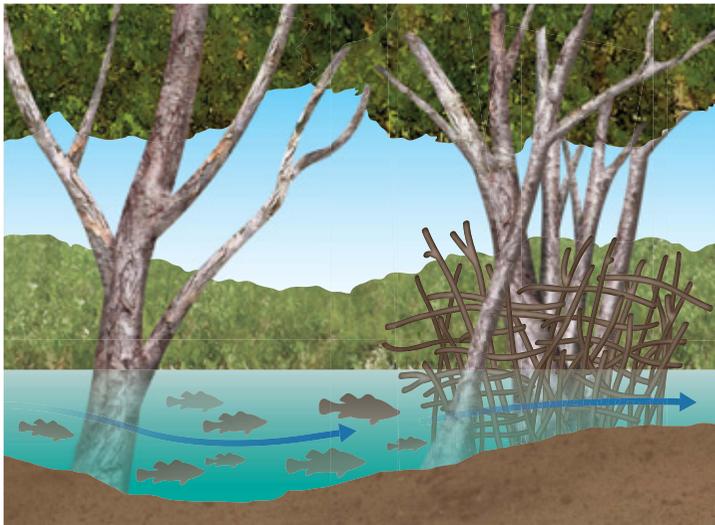
The stories tell of how the Wunggurr snake (a creator) dug a path where the Prince Regent River now flows by travelling from far inland to the sea. Other creator beings called Wandjina then took the animal forms of Rock Cod and Melo (a large sea snail), and created Malandum (the Prince Regent River) by swimming upstream along this path. At what is now called King Cascade Falls, Rock Cod was forced to stop abruptly by the Lalai Bowerbird and thrust herself against the soft mud, where she created a step-like cliff. Today, a waterfall flows over these rocks from the stream above where the Bowerbird lives (see Source 2.17).

**Source 2.14** Aboriginal links to water in the Kimberley region go back thousands of years. These scenes were created by the Worrorra people on a cave ceiling about 8000 years ago. The scene is said to depict a 'great fish chase', showing figures representing both Rock Cod and Dugong and their Wandjina captors.

## Indigenous water management

Traditionally, Aboriginal peoples in drier areas of Australia depended on their knowledge of water sources to survive. They accessed water trapped in waterholes, rocks and tree hollows. They watched the flight paths of birds, such as the zebra finch, to help uncover wells and springs. The long roots of eucalypt trees were followed to find underground water, and water was collected from the morning dew on plants. Indigenous Australians would also enlarge rock holes and chip channels through rocks to divert water into specific holes to increase their access to water. To catch fish, dams were built across narrow creeks using rocks or woven branches (see Source 2.16).

In modern Australian society, Indigenous Australians have been largely left out of the decision-making process when it comes to managing their traditional water sources. In some remote areas of Australia, many traditional water sources have become unreliable or unusable because station owners have given their cattle access to these important areas without consulting the Aboriginal peoples.



**Source 2.16** An Aboriginal dam made of woven branches designed to catch fish.

Urlampe in the Northern Territory, 1330 kilometres south-southeast of Darwin, is home to one of Australia's most remote Aboriginal communities. Allan Rankine of the Urlampe Aboriginal Corporation is responsible for managing the water supply for the community. Allan decides what water the community pumps from the bore and how it will be distributed. Traditionally, Aboriginal land and water management plans are clearly defined and everyone understands and respects them.



**Source 2.17** King Cascade on the Prince Regent River is now a popular tourist destination.

However, Allan and the traditional owners of the area do not have control over all important water resources in the region. The permanent spring that Allan visited as a child has been polluted by cattle. This once valuable water resource is now undrinkable.

### Check your learning 2.5

#### Remember and understand

- 1 Where did most Aboriginal peoples live in Australia before Europeans arrived in 1788?
- 2 Give examples of traditional and modern Aboriginal water management.
- 3 How are Indigenous and non-Indigenous views of water resources different?
- 4 Both Aboriginal peoples and Europeans built dams along the Murray River. What impact did each have?

#### Apply and analyse

- 5 Look carefully at Source 2.17.
  - a What is the spiritual value of this place to the local Indigenous people?
  - b What value might this site have to a tourist?
- 6 Look carefully at Source 2.15
  - a Sketch the symbols you think represent water holes and running water.
  - b Why were maps such as these important to Aboriginal communities?
  - c Why do you think maps like these are still being produced by Indigenous Australians?

## 2.1 bigideas: broadsheet

# The Aral Sea

The Aral Sea is located on the border of Kazakhstan and Uzbekistan. In the early 1960s, the two rivers that channelled water to the Aral Sea, the Amu River and the Syr River, were diverted to irrigate areas of the surrounding desert to grow rice, melons, cereals and cotton. From 1960 to 1998, the size of the Aral Sea shrank by 60 per cent, and its volume was reduced by 80 per cent. In 1960, the Aral Sea was the fourth-largest lake in the world. Today, it is the thirty-first largest. Over the same period of time, the lake has also become five times saltier.

The Kara Desert covers about 70 per cent of the land area in Turkmenistan. It is crossed by the 1375-kilometre Karakumski Canal, the second largest irrigation canal in the world. The canal brought a water supply to the town of Ashkhabad and allowed farming to take place in the desert, particularly cotton growing. Leakages from the canal allowed 50 per cent of the water to escape.

### skilldrill

## Interpreting satellite images

Satellite images help geographers view large areas of the Earth's surface. Special cameras in orbiting satellites 700 kilometres above the ground record variations in the light reflected on the Earth's surface. Satellite images can show different features on the Earth's surface through colour variations on the image. Sometimes this colour variation is natural but it can also be added by computer to highlight specific features. The natural colour satellite images of the Aral Sea in Source 2.18 accurately record the shrinking size of the lake from 2000 to 2011.



**Source 2.18** Satellite images of the Aral Sea in 2000 (top) and 2011 (bottom)

## Apply the skill

- 1 Study Source 2.18.
  - a Describe how the Aral Sea has changed between 2000 and 2011.
  - b What colour represents deep water on these satellite images?
  - c What is the shallowest part of the lake in 2000?
  - d What type of land surrounds the Aral Sea in 2000 and 2011?
  - e Use the scale to estimate the length of the longest remaining part of the Aral Sea in 2011.

## ARAL SEA BASIN: WATER RESOURCES



Source 2.19

Source: Oxford University Press

### Extend your understanding

- 1 Look carefully at Source 2.19.
  - a What is the name of the longest river that feeds the Aral Sea?
  - b Where does this river begin?
  - c Into which canal is most of the water from the Amu River diverted?
  - d What is this water used for?
- 2 Look carefully at Sources 2.18 and 2.19.
  - a What was water once used for in this region?
  - b How has the Karakumski Canal changed this region?
- 3 The management of the water resources in this region is made more complex because more than one country is involved. Name the countries involved and the ways in which they use water resources in this region.

**Source 2.20** The shore lines of the Aral Sea have receded by 60 to 80 kilometres, leaving behind rusting fishing trawlers that used to fish in its waters. All 20 known Aral Sea fish species are now extinct, unable to survive in the salty water that remains.



# 2.2 How can we overcome water scarcity?

## Managing water scarcity

Water is most difficult to manage when there is not enough to go around. Water becomes scarce when the demand for clean water exceeds the available supply. It is one of the biggest issues facing Africa, the second driest inhabited continent in the world after Australia. Whereas all Australians have access to clean water, millions of Africans face water shortages. Of the 800 million people who live in Africa, more than 300 million live in water-scarce areas.

The main reasons for water scarcity in Africa are:

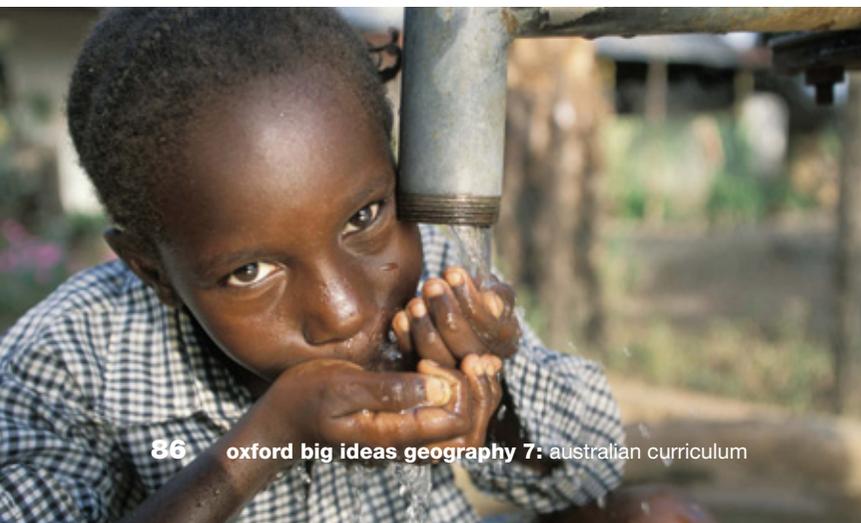
- a large and fast-growing population
- large areas with low and variable rainfall
- poor water quality
- lack of water infrastructure, such as pipelines.

Water scarcity contributes to the deaths of many African children. Local water sources may contain harmful bacteria that cause diseases, such as typhoid and dysentery. These diseases are spread by drinking and washing in contaminated water.

### Delivering safe water

The most common solution to water scarcity in African villages is digging a well. A water well is created by digging or boring into the ground in order to reach

**Source 2.21** A young girl in Guinea-Bissau enjoys clean water from a new well that has been sponsored by the World Vision aid agency.

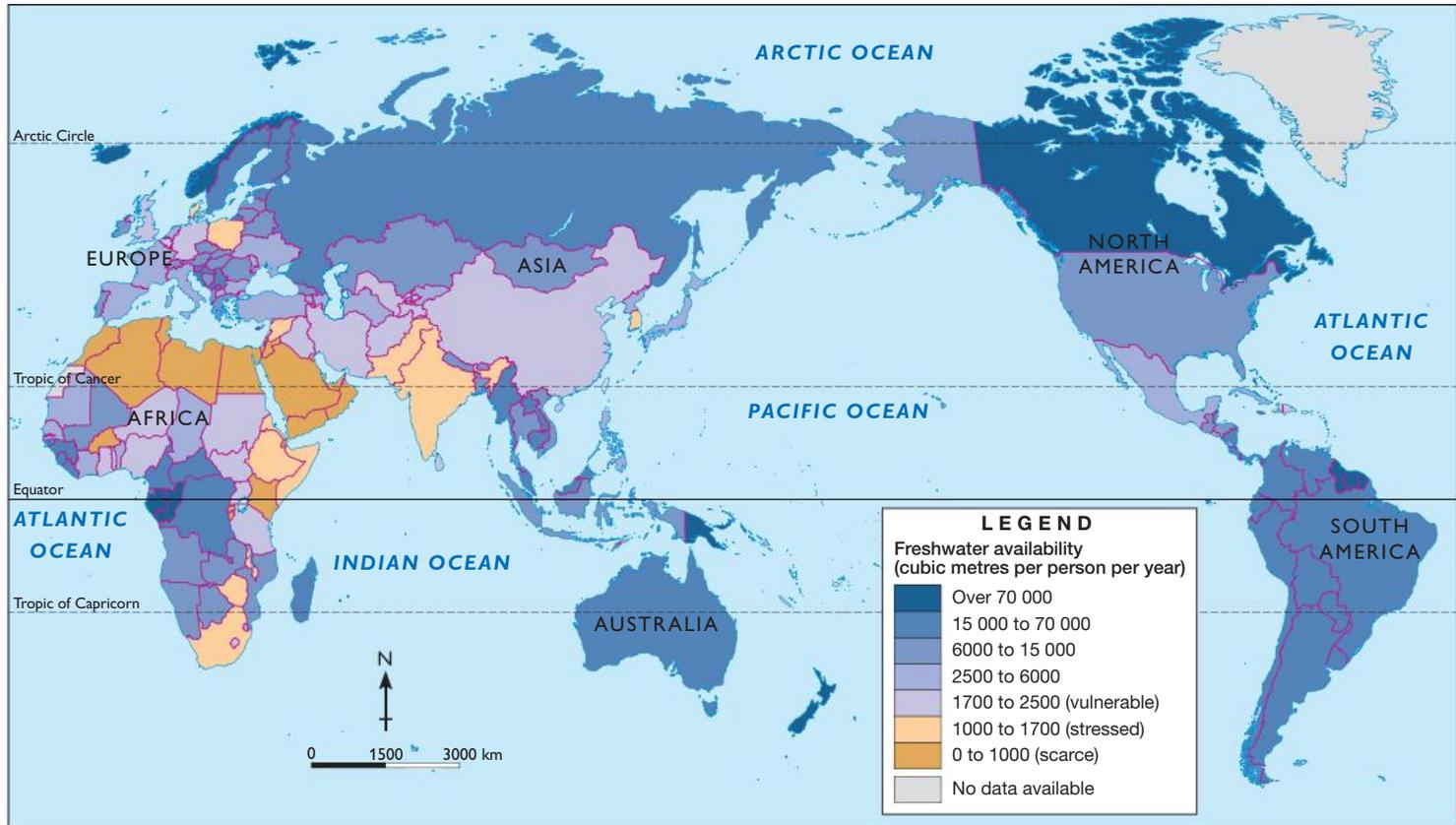


groundwater in underground aquifers. Clean water from a well stops people catching any water-borne diseases. Providing clean and drinkable water for communities across Africa is a high priority for many of its **developing countries** and international relief agencies, such as World Vision and AusAID.



**Source 2.22** This woman in Zambia is collecting water from a dried-up river bed half a kilometre from her house. She uses a saucepan to fill the large container, which she will carry on her head or shoulder back to her home.





Source 2.23

Source: Oxford University Press

**Source 2.24** A woman fills a water container from a well in the desert in Niger. In most African societies, women are the collectors and managers of the family water supply. African women can spend up to 60 per cent of their day collecting water, especially where water sources are far from the village.



## Check your learning 2.6

### Remember and understand

- 1 What is water scarcity?
- 2 Why is water scarcity such a problem in Africa?
- 3 What problems does water scarcity cause, especially for women and young children?

### Apply and analyse

- 4 Look carefully at Source 2.23.
  - a Describe the area of Africa that suffers most from water scarcity.
  - b Australia is the driest inhabited continent on Earth. Does it have a water scarcity problem? Why or why not?
  - c Compare freshwater availability in Australia and New Zealand. Which country has access to more fresh water? Why do you think this might be the case?

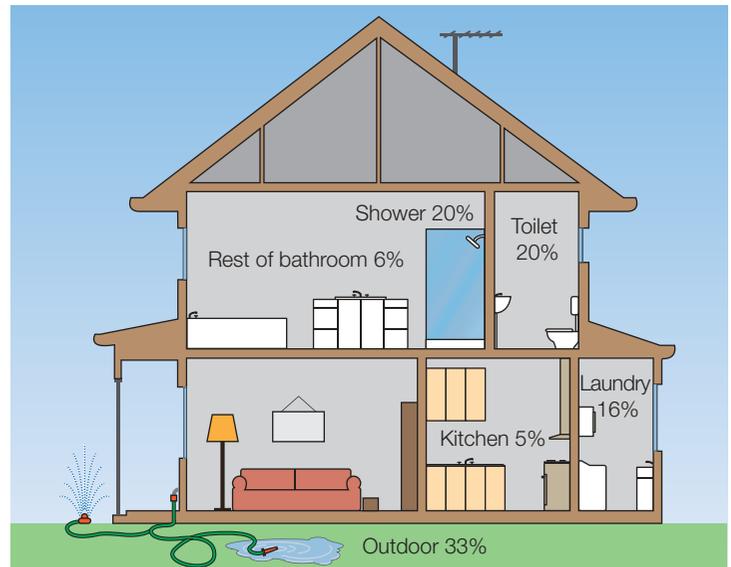
### Evaluate and create

- 5 Create a poster or PowerPoint presentation highlighting the problems of water scarcity in Africa and how it affects people's lives.

# Managing water at home

The easiest way for us to become involved in water management is to understand how we can be more water wise at home. A resource management plan takes into account the range of uses of the resource, the amount of the resource required and the impact of resource use on the environment. Decisions are then made about what is the best and most **sustainable** way to use the resource. Sustainability is an important concept in geography. In order for a resource to be used sustainably there must not be so much used that it affects the ability of the resource to replace itself naturally. Domestic users of water are under more pressure than ever before to manage their water use properly as our water resources become more stressed.

As you have learned, Australians are among the highest users of water in the world. Nearly half of the domestic water usage occurs in the bathroom. To improve water management in the home we need to select water-saving appliances, capture and recycle water and attempt to use less water. To ensure we have a sustainable supply of water into the future, think about some of the water-saving ideas shown in Source 2.25.



Source 2.26 Water use in the home

## Bathroom

Take shorter showers and install new water-efficient showerheads that use no more than 9 litres of water per minute (compared with old-style showerheads that use 20 litres per minute). This can save up to 20 000 litres of water per person per year.

## Laundry

Only use the washing machine when you have a full load. Redirect the waste water from the washing machine into a collection bin and use it on the garden, but make sure you use detergents that will not kill your plants.

## Outside

Don't use the hose to clean hard surfaces outside; use a broom. Install a plastic pool cover to reduce water lost to evaporation. Install a rainwater tank to use the water that falls on your roof. It can be used to flush toilets, wash clothes and water the garden. Top up the pool with water from the tank.



## Kitchen

Don't rinse dishes under a running tap. Ensure the dishwasher is full before turning it on.

## Garden

Plant native gardens using local plants that are accustomed to the climate and soil conditions in your area. Use drippers to deliver water directly to the base of the plants where they need it. Avoid sprinklers, which allow water to be blown away and evaporated.

Source 2.25 A range of simple water-saving ideas

## keyconcept: sustainability

### The air shower

Despite living in one of the world's driest places, Australians are among the world's biggest water users. Many scientists believe that our use of water is not sustainable and have looked for ways to increase our water supply or decrease the amount of water we use.

#### AIR SHOWER SET TO CUT WATER USE BY 30 PER CENT

As Australians become increasingly alert to the importance of using water wisely in the home, CSIRO researchers have found a way to use a third less water when you shower – by adding air.

The scientists have developed a simple 'air shower' device which, when fitted into existing showerheads, fills the water droplets with a tiny bubble of air. The result is the shower feels just as wet and just as strong as before, but now uses much less water.

The researchers, from CSIRO Manufacturing Materials Technology in Melbourne, say the device increases the volume of the shower stream while reducing the amount of water used by about 30 per cent.

Given the average Australian household uses about 200 000 litres of water a year, and showers account for nearly a third of this, the 'air shower' could help the average household save about 15 000–20 000 litres a year. If you extend this across the population, that is an annual saving of more than 45 000 Olympic-sized swimming pools ...

CSIRO website

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



Source 2.27 This cartoon was first published in 2007 during a period of severe drought.

### Check your learning 2.7

#### Remember and understand

- 1 What does a management plan need to take into account?
- 2 Which room in the house uses the most water?
- 3 What is the easiest way of reducing the amount of water and energy used in the shower?
- 4 Suggest three ways that water can be gathered and reused around the home.
- 5 Give two examples of how technology can be used to help save water.

#### Apply and analyse

- 6 Look carefully at the news article.
  - a What have researchers at CSIRO developed to help save water in the home?
  - b What water savings do they hope to make?
  - c Apply your understanding of the air shower to develop a new water-saving product idea to clean dishes.
- 7 Look carefully at Source 2.27.
  - a What is the cartoonist suggesting about our management of water in the future?
  - b When was the cartoon drawn and what influence might this have had on the cartoonist?

#### Evaluate and create

- 8 Create your own water-saving reminder for display in one of the rooms of your house.

# Managing water in Australia's biggest cities

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In order to ensure that reliable supplies of safe water are available for use now and into the future, we all need to use water more **sustainably**. Careful management of our existing supplies and reductions in our consumption will help to achieve this. We also need to remember that people are not the only living creatures on the planet. The interests of all living organisms need to be considered if the natural environment is to be protected for the future.

**Source 2.28** The Warragamba Dam near Sydney is one of the largest domestic water supply dams in the world. It supplies 80 per cent of Sydney's water.



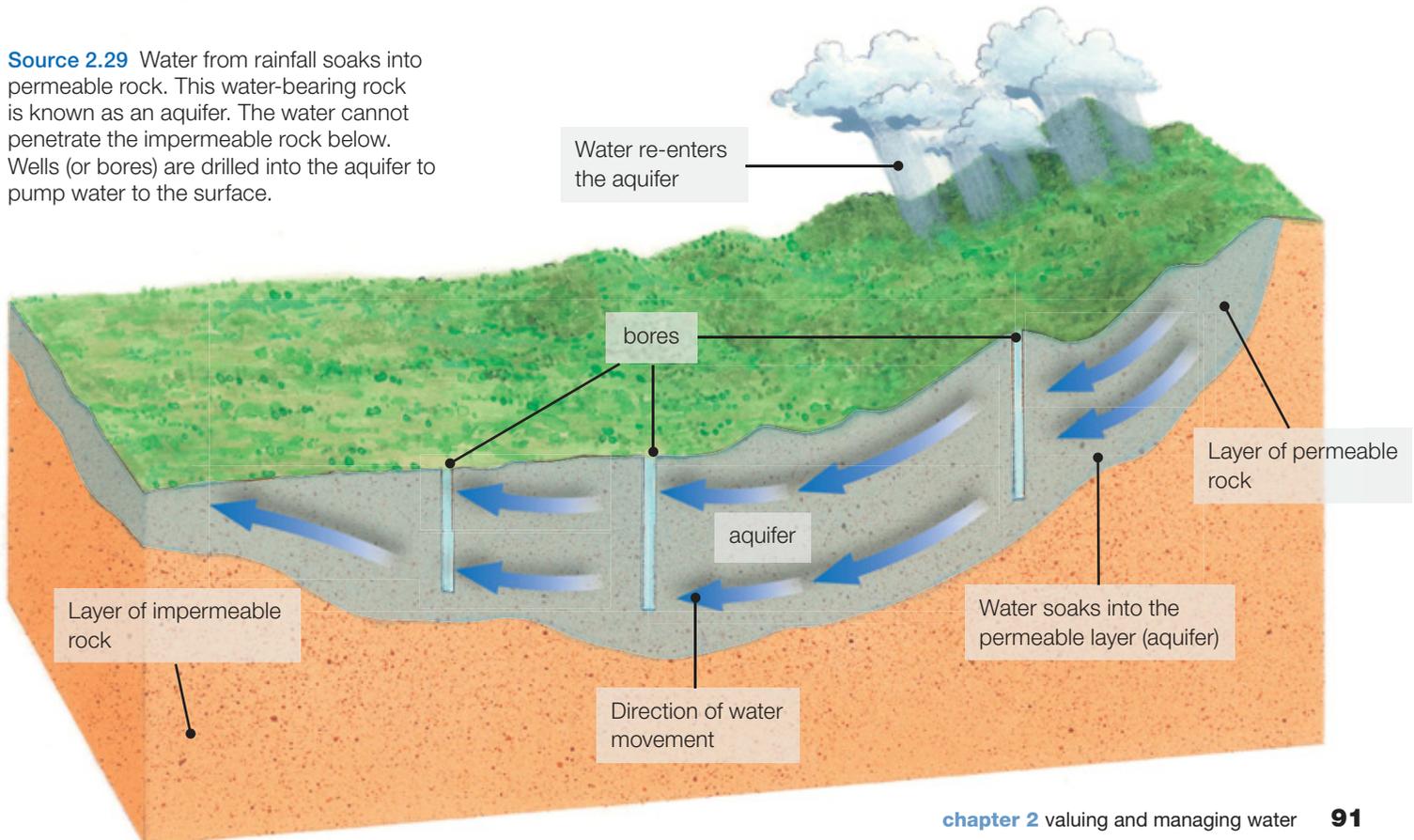
## Ensuring reliable water supplies in Australian cities

Over 60 per cent of Australia's population lives in one of our five largest cities – Adelaide, Brisbane, Melbourne, Perth and Sydney – all of which are home to more than a million people. The sites of these cities were chosen in large part because of their reliable rainfall and access to fresh water from neighbouring rivers. However, all of these cities have now outgrown their original water supplies. Large dams have been built to provide a permanent water supply for large towns and cities, but population growth and drought have put enormous pressure on these reserves. As a result, many Australian cities are now looking at a number of strategies to reduce their water usage and ensure they have access to reliable supplies into the future. Some of these options are discussed here.

### Option 1: Build more dams

Across Australia, governments are thinking about building more dams to create a reliable water supply for our growing population. Dams can also be used to create hydroelectric power when water let through the dam wall turns a turbine to create electricity.

**Source 2.29** Water from rainfall soaks into permeable rock. This water-bearing rock is known as an aquifer. The water cannot penetrate the impermeable rock below. Wells (or bores) are drilled into the aquifer to pump water to the surface.



### Option 2: Use underground water reserves

Drilling water **bores** is a common method used on Australian farms for supplying water for irrigation and animals. Many Australian cities have started to use this method to add to their freshwater supplies. Deep holes, called bores, are drilled down into a layer of rock under the ground that holds water. This layer of rock is called an **aquifer**. The water is then pumped to the surface (see Source 2.29). It is also possible to replace the water in the aquifers during wet periods by pumping the water back underground. In this way, aquifers operate as underground dams. In Western Australia scientists are trialling a method of treating storm water (rainwater that falls on the hard surfaces of a city, such as roofs and roads) and using it to recharge the aquifers that supply much of Perth's water.

There are large aquifers in many areas of Australia, including beneath Melbourne. Often this water has a high mineral content and must be treated before it can be used for drinking and other household uses. This water could be used for industrial purposes, such as to clean machinery and irrigate crops. This would allow drinking water, currently used for these other purposes, to be added to the city's water supplies. This idea of using lower-quality water for non-domestic purposes has been considered in many Australian cities.

### Option 3: Build desalination plants

**Desalination** plants treat sea water to remove from it the salt and other impurities (see Source 2.30). This process, known as reverse osmosis, turns sea water into fresh water for drinking. As Australia has easy access to a vast supply of sea water, desalination plants are an attractive option for many cities.

There are three main reasons why there are not more of them already:

- Desalination plants cost a lot of money, making the water they produce expensive. The Perth desalination plant, opened in 2006, cost \$387 million to build and adds about \$44 a year to every consumer's water bills.
- Desalination plants use a lot of electricity and can damage the environment. It has been estimated that the Sydney desalination plant uses as much electricity as 120 000 households. A new power plant had to be built to run it, adding to the cost.
- Desalination plants can damage the environment. They release highly concentrated salt water (brine) back into the ocean, which can harm marine animals.

### Option 4: Build water pipelines

Perhaps the simplest method of ensuring a reliable water supply is to move water from areas that have a surplus. This already happens in most Australian cities. Rainwater is collected in catchments in the hills and forests close to cities and piped to treatment plants and then to water users.

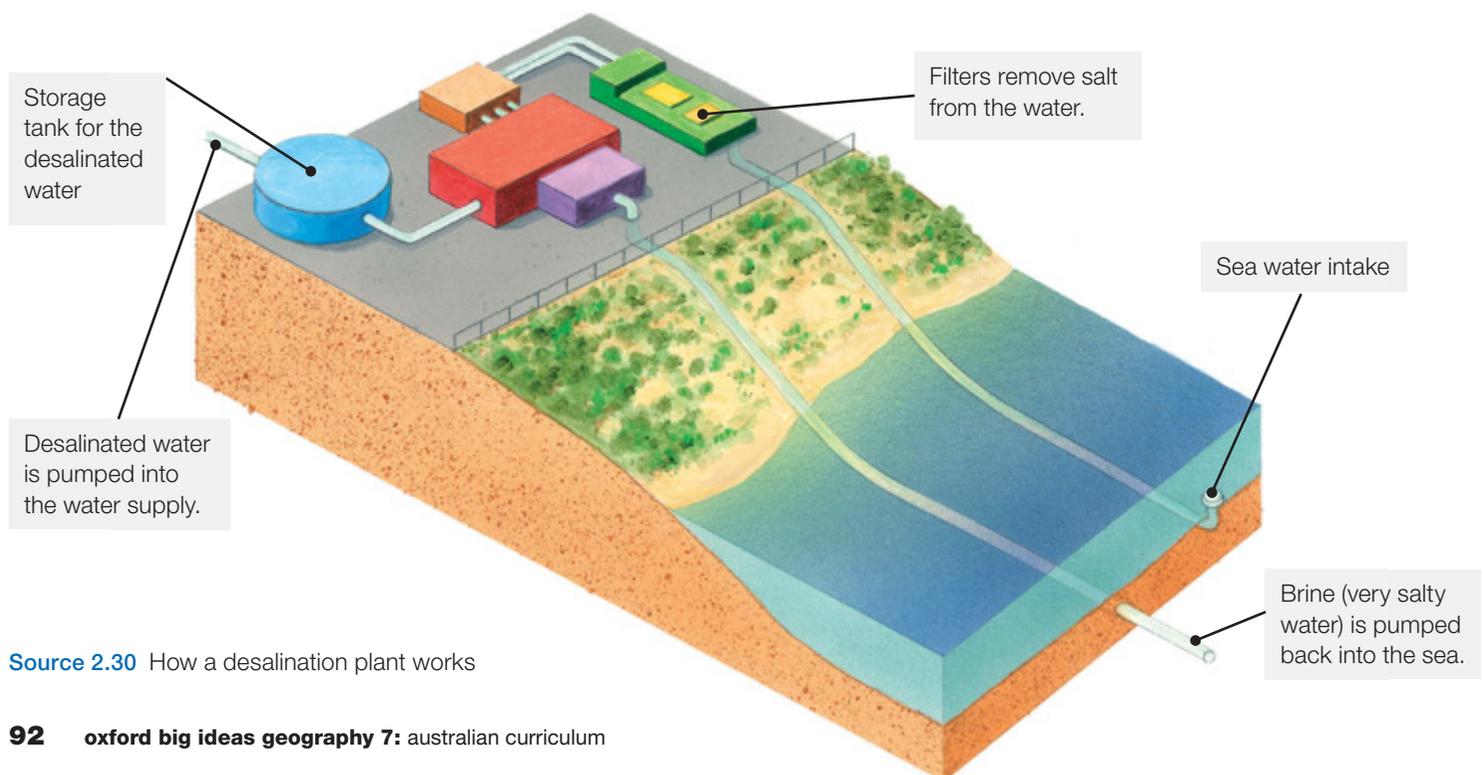


**Source 2.31** Huge pipes carry water beneath our city streets. Here, pipes are being laid in Brisbane.

One proposal currently involves piping water not just hundreds of kilometres but thousands. For many years, there has been an idea to pipe water from the Fitzroy River in the Kimberley region in north-western Western Australia to the city of Perth. This pipeline would need to be 3700 kilometres long. The cost of transporting water this far through steel pipes is much greater than other options, such as desalination plants, and so this method is unlikely to be used in the near future. It will also cause environmental problems at the source of the water and would require large amounts of energy to build and operate.

### Option 5: Capture and store storm water

Storm water is collected in pipes and gutters and discharged in the sea or rivers. Rainwater tanks capture this fresh water but cities have not been designed to collect this water on a large scale.



**Source 2.30** How a desalination plant works

In Adelaide, there is a plan to capture this water through existing pipes and treat it in the current water-treatment facilities. In this way, it could be added relatively easily to the city's drinking water.

### Option 6: Recycle and treat wastewater and sewage

Water that leaves our homes is generally unsuitable to be used again. In using the water to clean clothes, dishes and ourselves and to flush toilets we have polluted the water. This water (known as wastewater or sewage) is usually piped to a treatment plant where it is cleaned and purified and then released back into rivers and bays. In some places, notably Singapore and Windhoek (see Broadsheet 1.3) in Namibia, this water is added to rainwater and piped back into homes and to other water users.

#### keyconcept: sustainability

### Toowoomba says 'No' to drinking sewage

In trying to use our resources sustainably, we sometimes have to change our attitudes and behaviours. While many Australians believe that we should use less water or use water from different sources, it can be difficult to convince people to change. In 2006, for example, the people of Toowoomba were faced with a difficult decision about water.

At that time, Toowoomba's three dams had fallen to critical levels. The town council proposed a radical solution. The town would treat its sewage to a high level, store the treated sewage in a dam for three to five years and then add it to the town's freshwater supplies.

The supporters of the scheme pointed out that this is exactly the system used successfully in parts of California and Singapore, and that the technology exists to treat the sewage to a safe, clean, drinkable level. The opponents of the scheme called it 'drinking poo' and voiced concerns about the town's reputation as a tourist centre and about potential health hazards.

The campaigning was fierce for months before the vote. In the end, 62 per cent of Toowoomba's population voted 'no' to the proposal, leaving the council in the difficult position of having to find other sources of fresh water. For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



**Source 2.32** At this plant in Singapore, waste water (sewerage) is processed and then used in industry or blended with rainwater for use in homes.

## Check your learning 2.8

### Remember and understand

- 1 In your own words, describe what a sustainable resource is.
- 2 List five different ways that governments might investigate to find extra water resources for growing cities.
- 3 When a new dam is built across a river, what problems are caused for people and wildlife upstream from the dam?
- 4 How can aquifers be used to provide and to store water?
- 5 What are the advantages and disadvantages of desalination?
- 6 Where does the water that you use at home come from? Where does it go when you are finished using it?

### Apply and analyse

- 7 What plan for recycling did Toowoomba residents oppose? Do you think the recycling plan was a good idea?
- 8 Why doesn't Perth pipe water from wet places in Western Australia?

### Evaluate and create

- 9 For the capital city in your state, complete the following activities:
  - a Research the city's current water supply. Which of the water supply methods described here does it currently use?
  - b Which of these methods do you believe should be used to add to this water supply?
  - c What impacts would these new methods of water supply have on the natural environment and the cost of water?

# New ways of thinking about water

As global pressure on water resources increases, water experts are beginning to think of water in new ways. New terms for describing types of water and usage have been devised, including **virtual water**, and blue and green water. This new thinking is designed to promote a better understanding of the ways in which people use water and will help to make water usage more sustainable.

## Virtual water

The amount of water used to produce a good or service is called virtual water. This includes the water used to grow crops or raise animals as well as the water needed in processing these crops and animals into products. Experts coined the term virtual water because we cannot actually see how much water went into producing the goods and services we consume every day. For example, 15 000 litres of water are needed to produce just 1 kilogram of beef. This 15 000 litres of water is known as virtual water.

It is often impossible to move real water between water-rich countries and water-poor countries. It is, however, relatively simple to transport virtual water in the form of goods, such as meat and wheat. This helps to support water-poor countries with their water needs.

**Source 2.33** One kilogram of rice contains 1500 litres of virtual water, making it one of the world's thirstiest crops.

## Blue water and green water

Historically, water suppliers have focused on the capture and supply of blue water (that is, water in storages, such as lakes, rivers and aquifers) over green water (that is, rainwater stored in the soil as soil moisture). Green water is the water that remains in the soil to be used by plants. Farmers in dry regions, such as the interior of Australia, need to understand how to manage both their blue water resources and their green water resources. Installing a rainwater tank to collect and store water for later use is an example of blue water management. Adding a layer of mulch to slow the evaporation of water from the soil is an example of green water management.

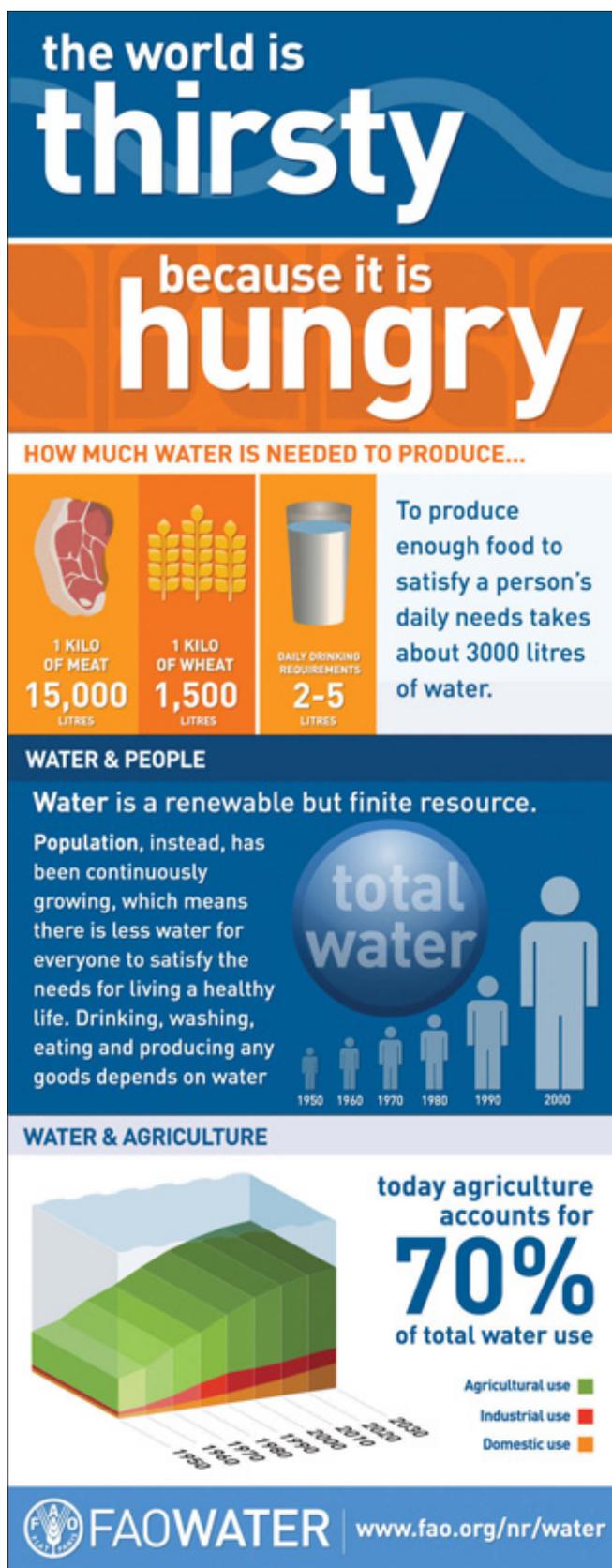
## Water footprints

The total amount of water you consume each year is known as your **water footprint**. This includes the real water you consume (by drinking, bathing and cleaning) and the virtual water you use through your consumption of goods and services. The total volume of water used by everyone who lives in a country, including the water used to produce exported goods, is the national water footprint.

The size of a country's water footprint is largely determined by the country's:

- climate, especially the amount of rainfall and evaporation





Source 2.34 A poster from the United Nations that uses the idea of virtual water to communicate a message

- farming methods, especially how efficiently water is used
- production and consumption of crops
- general consumption and production patterns.

Countries where people eat lots of beef and rice and buy many manufactured goods use more water than countries where people eat mainly vegetables and have few personal goods.

Australians are one of the world's biggest water users. It is estimated that Australia's population will increase to about 35 million by 2056 and this will place a great strain on an already stressed water-supply network. Experts believe that Australia's capital cities, for example, will need 76 per cent more water by 2056 than is currently supplied.

The good news is that Australians have embraced new water-saving measures. Despite the population of Australia increasing by 7.7 per cent between 2003 and 2009, the amount of water used by households actually fell by 12 per cent. This is due largely to water restrictions in many capital cities and the use of new technologies, such as dual-flush toilets and water-saving showerheads.

## Check your learning 2.9

### Remember and understand

- 1 What is virtual water?
- 2 What is the difference between blue water and green water?
- 3 Why is it important to understand virtual water when working out your water footprint?
- 4 How can an understanding of virtual water help water-rich countries to decide what to produce and export?

### Apply and analyse

- 5 Source 2.34 states that the world is thirsty because it is hungry.
  - a What does this mean?
  - b What evidence is presented to support this idea?
- 6 Look carefully at the image of the Chinese farmer working in his rice fields (Source 2.33).
  - a How is he using water as a resource?
  - b How is he able to control the flow on water in his fields?
  - c Explain how this makes his use of water more sustainable.

### Evaluate and create

- 7 Draw a poster to be displayed in your school canteen or tuckshop that makes students aware of the ways in which their food choices impact on water supplies in Australia.

## 2.2 bigideas: broadsheet

# The Wodaabe nomads

Communities in extreme environments develop ways of life that allow them to survive and thrive. In the south-eastern part of Niger, in Africa, live the Wodaabe people. They live in a desert region where water is often scarce and feed for their cattle is in short supply. In response to these conditions they have become **nomads** and rarely stay in one place for more than 10 days. They follow the seasonal rains across the desert as rain brings grass for the cattle; this takes them on a route they have followed for hundreds of years.



Source 2.35 Packing up the homestead to follow the rains

The seasonal migrations of the Wodaabe take them from the clay plains near Lake Chad to the sandy soils away from the lake. Over the last few decades the lake has become smaller as other communities in the area have used its water for irrigation. This has meant that the Wodaabe's have had to change annual migration routes. The reduction in the size of the lake has meant that more grass is able to grow on land that was once covered in water, but it has also meant that freshwater supplies have become less reliable.

Source 2.36 Climate data: Nguigmi, Niger

Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	1	5	11	55	100	15	1	0	0
Temperature (°C)	21	24	28	31	33	33	31	30	30	29	25	22

### skilldrill

## Understanding flow maps

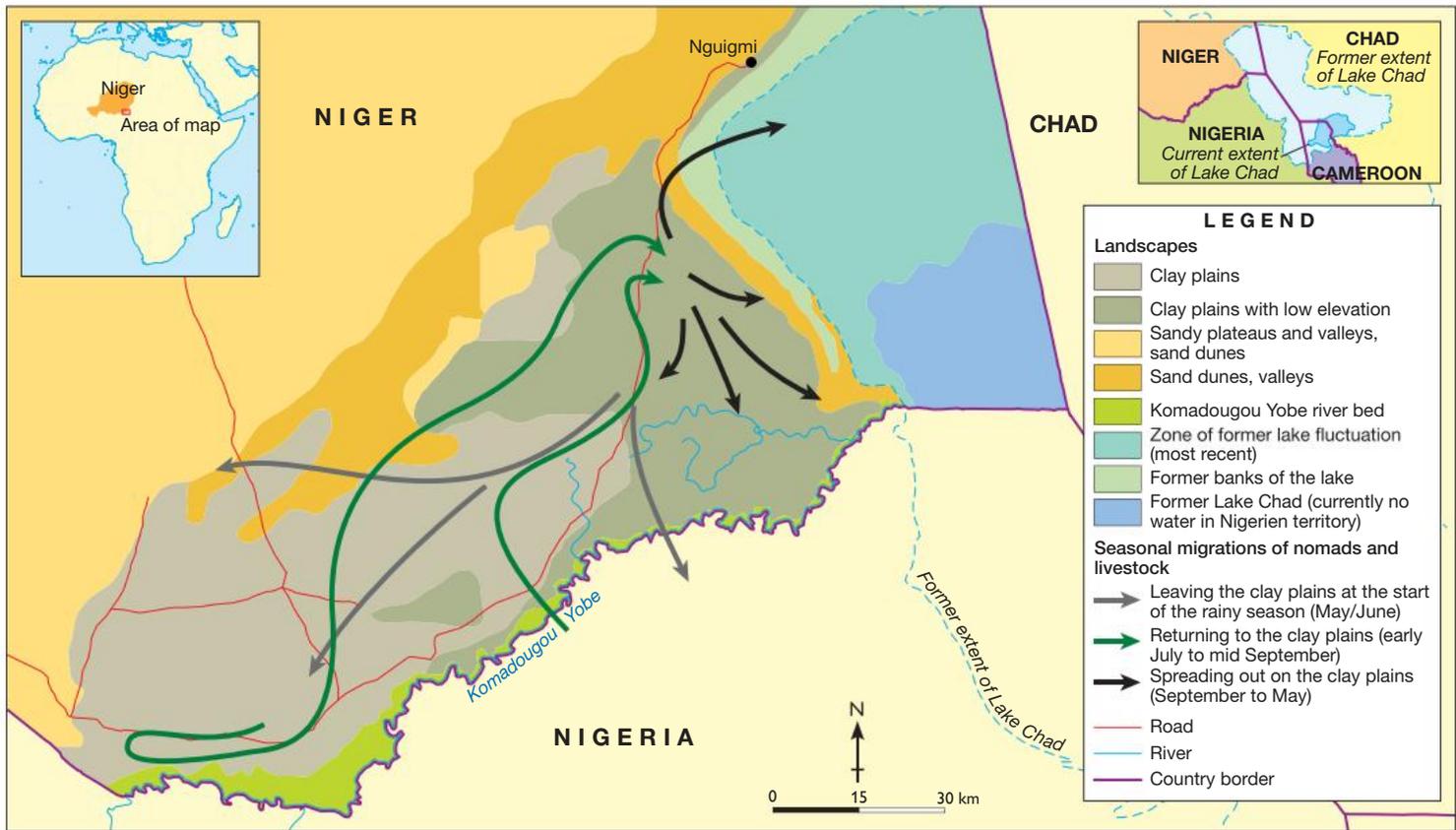
**Flow maps** show the movement of things from one place to another (for example, people or goods). Flow maps can be simple or complex. They can show the movement of one group of people around a small area or compare the movement of many different goods around the world. Depending on what they are showing, flow maps use arrows of different colours and sizes. These arrows help the person making the map show different things moving around and the numbers of these things. Here are some steps that will help you understand flow maps:

- Step 1** Read the title of the map carefully, as this will tell you exactly what is being shown.
- Step 2** Look at the legend on the map. This will tell you what the different coloured arrows on the map are showing and provide you extra information that you may need (like the time of year this movement happens).
- Step 3** Look for patterns in the movements shown on the map. Are the movements related to changes in the weather, to the time of year, to political or economic factors or all of these things?
- Step 4** Once you have identified the pattern being shown, try to explain the reasons for it.

### Apply the skill

- 1 Describe the movement of the Wodaabe during the months of May and June.
- 2 Where do the Wodaabe travel to from the beginning of July to mid September?
- 3 In your own words, explain the pattern being shown in Source 2.37.

SOUTH-EASTERN NIGER: NATURAL ENVIRONMENTS AND SEASONAL MIGRATION ROUTES OF THE WODAABE



Source 2.37

Source: Oxford University Press



Source 2.38 Young men of the Wodaabe tribe

## Extend your understanding

- Clay plains with low elevation are the best areas for the Wodaabe to graze their cattle in the dry season. Why? Describe the location of the clay plains with low elevation.
- Construct a climate graph for Nguigmi in Niger using climate data provided in Source 2.36.
  - When is the rainy season?
  - When is the dry season?
- Would you describe the Wodaabe as voluntary migrants?
- Source 2.35 shows a Wodaabe family packing their belongings, to follow the rains. Describe their possessions. How many donkeys would your family need to move?

# 2.3 How do we respond to floods?

## Why rivers flood

### Natural factors

Put simply, rivers flood because they are forced to carry more water than they can hold. This process is like filling a glass from the tap but leaving the tap dripping into the glass after it's full. Every river, like every glass, can only hold a certain amount of water. This is known as its carrying capacity. Heavy rain or a collapsed dam can cause a river to exceed its carrying capacity and force it to burst its banks. As a result, water covers the surrounding land.

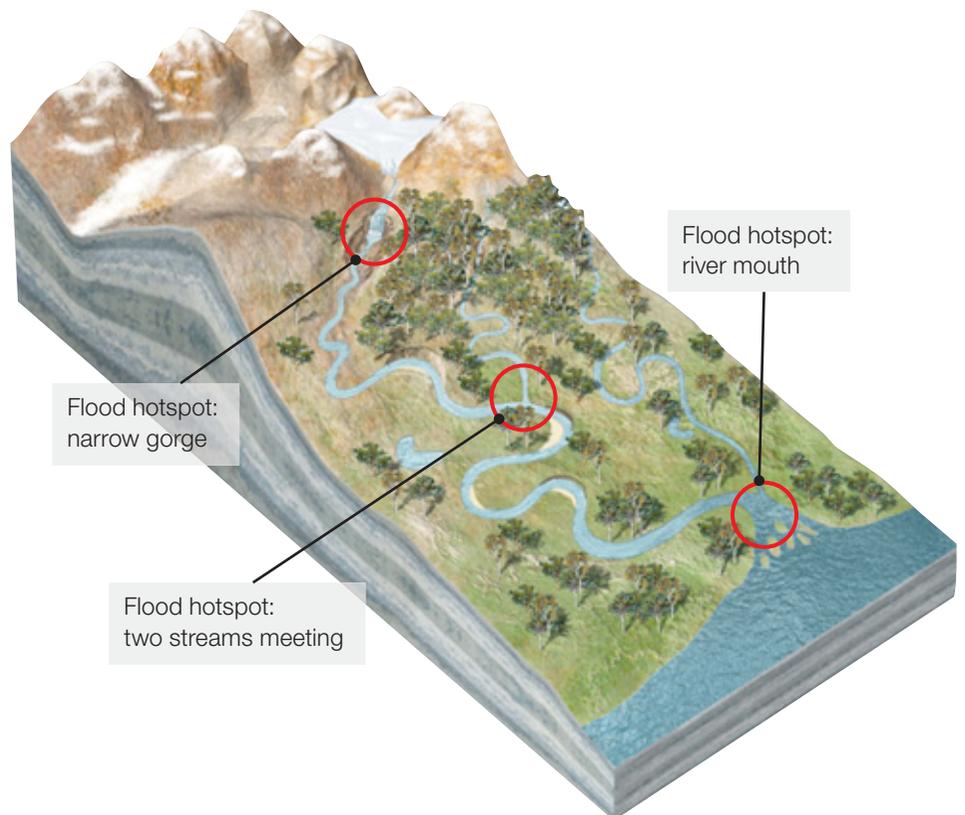
The soil carried by the river is spread across the surrounding land. Over millions of years and thousands of floods the land near the river is slowly built up and, appropriately, is called a floodplain. Billions of people around the world choose to live on these **floodplains** because of the fertile soil, flat land and ready supply of fresh water. The world's floodplains support billions of people, many of whom live with the constant threat of floods.

### Human factors

Some human activities make rivers more likely to flood, endangering both natural and human environments. Clearing the natural vegetation, such as trees and plants, growing on the sides of hills may result in more water flowing into rivers instead of being used by these trees and plants. Replacing natural environments (such as forests, grasslands, wetlands and soil) with hard surfaces (such as concrete and roads) also means that water does



**Source 2.39** A flood is a natural event, but becomes a disaster if humans are adversely affected by it.



**Source 2.40** Rivers tend to flood in particular places, shown here as hotspots.

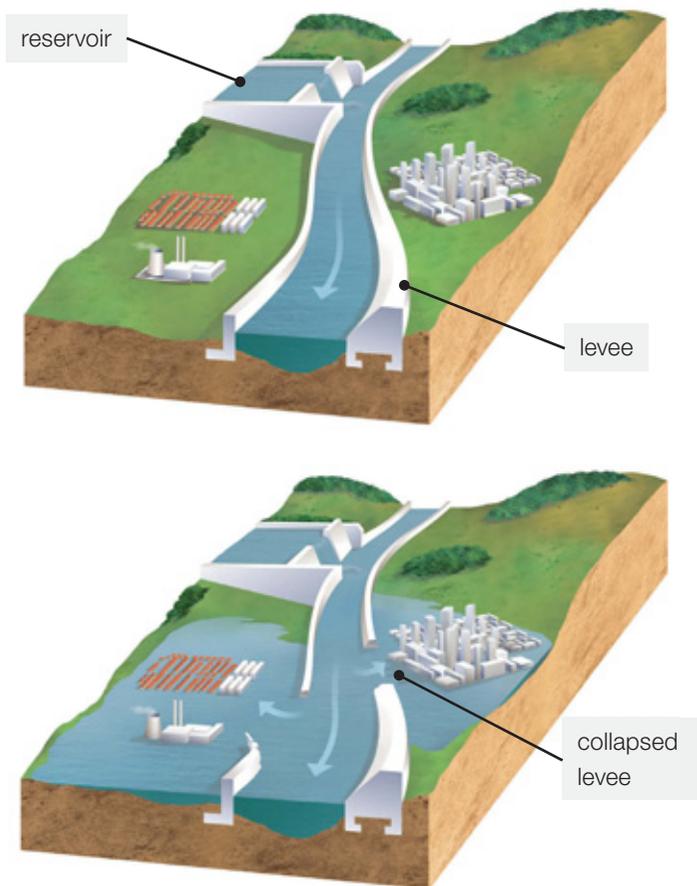
not soak into the ground; instead, it flows across it. The presence of so many communities, towns and cities also increases the flood risk. Rivers naturally flood. In areas where there are no humans this is considered a natural process, but in areas where there are lots of people, these natural events turn into potential and real disasters.

In some places, large artificial banks known as stopbanks or levees have been built to help protect communities from floods. While they help defend the community from small floods they sometimes make the effects of a large flood much worse. The river runs faster and deeper between the levees and is able to carry more water. During a major flood the water may have nowhere to go if it meets an incoming tide or storm surge at the river mouth. The water then banks up behind the levees and may spill over into surrounding areas.

If the levee collapses from the strain of holding back the floodwaters, this can result in catastrophic flooding as the water floods through a narrow gap with terrifying force. This occurred in the US city of New Orleans in 2005 when Hurricane Katrina brought torrential rain and a storm surge up to 9 metres high. Levees protecting much of the city collapsed and more than 1800 people were killed.



**Source 2.42** The first of many giant sandbags is lowered by helicopter to close a hole in a levee following Hurricane Katrina in New Orleans, USA.



**Source 2.41** A levee before and after its collapse

## Check your learning 2.10

### Remember and understand

- 1 What is a floodplain and why do so many people live on them? Do you live on a floodplain?
- 2 What is a levee and how can it reduce flooding in some areas?
- 3 List some of the human activities that may contribute to flooding. Select one of these and explain why it may lead to a flood. You may wish to use a sketch in your explanation.

### Apply and analyse

- 4 Explain why floods are more likely at each of the hotspots shown in Source 2.40.
- 5 Do you think that the attempt to repair the levee in Source 2.42 will be successful? Give some reasons for your answer.
- 6 Examine a map of Australia online or in your atlas that shows our largest cities and towns. List the Australian cities of over 1 million people that are located on flood plains at the mouth of rivers. What is the largest town or city that you can find that is *not* located in one of these hazardous places? What does this tell you about the flood threat in Australia?

### Evaluate and create

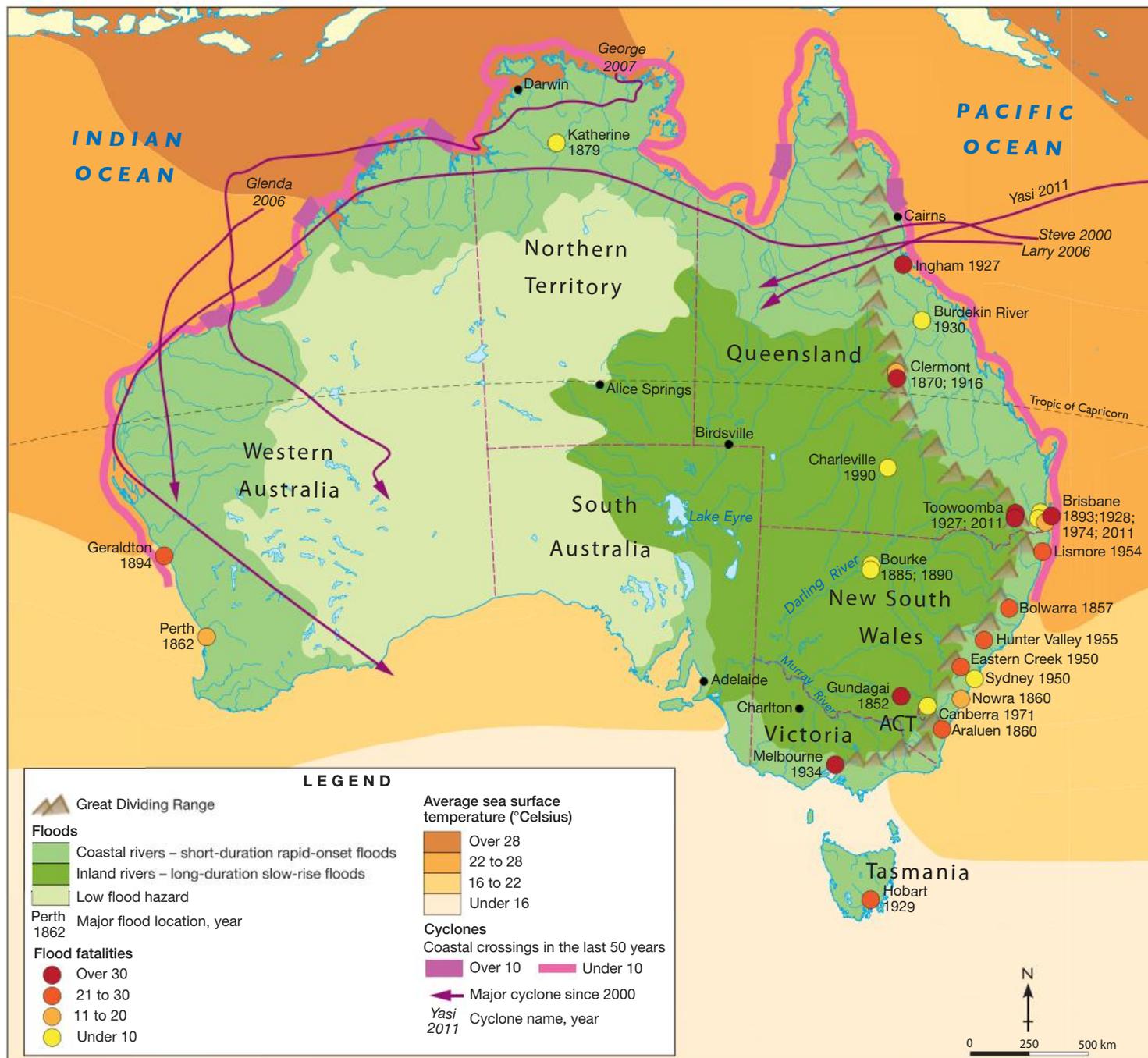
- 7 Why do levees sometimes make the effects of flooding worse? Design a flood protection system that you believe would work better than a levee. Conduct some more research to assist you in designing your system. Sketch your design and label the key features.

# Floods in Australia

Most towns and cities in Australia are located close to rivers, but some experience more floods than others. This is due to a combination of important geographical factors, particularly rainfall patterns and river geography. As you have already learned, different places experience different types of rainfall but there are also different

types of rivers. Australia is the world's flattest continent, so generally our inland rivers flow, and flood, slowly. Those that flow from the mountains to the sea, however, tend to flow and flood more quickly and this can be devastating for the people who live beside them.

## AUSTRALIA: FLOODS



Source 2.43

Source: Oxford University Press

## Inland rivers

The rain that falls on inland Australia flows into one of our many inland river systems. Some of these never reach the sea as they flow into large salt pans, such as Kati Thanda (Lake Eyre). Once a decade or so, enough rain falls in central Australia to fill Kati Thanda, creating Australia's largest lake. The rivers that flood these inland regions and fill the lake move very slowly, giving people time to prepare for them. Farming communities and towns may be isolated for weeks if roads are covered by floodwaters but few lives are lost in these slow-onset floods.

Some of our inland rivers, however, can be deadly. Much of the rain that falls in inland eastern Australia flows into the Murray–Darling river system and eventually reaches the sea near Adelaide. Some of the rivers in this system can rise quickly with little warning. The deadliest flood in Australia's history, for example, occurred when the Murrumbidgee River destroyed the small New South Wales town of Gundagai in June 1852. Swollen by torrential rain the river rose and washed away all but three of the town's houses. Eighty-nine people lost their lives, and many more were saved from the floodwaters by local Aboriginal men.

In southern New South Wales and northern Victoria, floods may be caused by summer thunderstorms or by a series of cold fronts sweeping in from the south. These fronts, created when warm air is forced above cold air, may bring heavy rain along the southern coast and into much of the southern Murray–Darling Basin.

**Source 2.44** The Diamantina River, shown here flowing past Birdsville in western Queensland, carries floodwaters to Kati Thanda several times a decade.



**Source 2.45** In early 2011 about one-quarter of Victoria was affected by major flooding. In some inland towns, such as Charlton, the floodwaters took many weeks to recede.

## Coastal rivers

Most of Australia's most devastating floods occur on our coastal rivers, particularly along the eastern coast. During summer, tropical cyclones and thunderstorms often dump heavy rain on the eastern slopes of the Great Dividing Range (see Source 2.43). This rain fills the short, fast-flowing rivers in the area to bursting point, causing rapid-onset floods. Towns and farming communities at the foot of the ranges, such as Clermont and Toowoomba, are most in danger.

### Check your learning 2.11

#### Remember and understand

- 1 Why do Australia's inland rivers flow slowly? How does this affect the types of floods that occur in the interior?
- 2 Seven Australian floods have resulted in more than 30 fatalities. Where and when did they occur?

#### Apply and analyse

- 3 Which areas of Australia are most at risk from dangerous floods? Why?
- 4 What questions could you ask to investigate the flood risk in your local area?
- 5 What do you notice about the temperature of the sea and the risk from tropical cyclones?
- 6 In what ways does the Great Dividing Range influence the flood risk in eastern Australia?
- 7 Fourteen of the fifteen most disastrous floods in Australian history occurred more than 50 years ago. Do you think this means that we are experiencing fewer floods or are there other explanations for this? Discuss this with a partner and brainstorm the possible explanations.

# How floods affect people and places

Major floods can have devastating effects on different regions all over the world. In large cities, hard concrete and asphalt surfaces mean that very little water soaks away through the soil. Instead, roads can quickly turn into rivers, with terrifying results.

In farming regions whole crops can be uprooted and washed away, along with much of the rich topsoil. Expensive farming machines and equipment can be damaged or destroyed by floodwaters and livestock can also be lost.

In some countries, floods lead to widespread famine and starvation, with large death tolls. In Pakistan in 2010, nearly 2000 people died from flooding and 17 million people were affected.



**Source 2.46** Volunteers remove flood debris from houses in the Brisbane suburb of Fairfield on 16 January 2011.



**Source 2.47** A Pakistani farmer and his family became stranded by floodwaters in 2010 and were left without food and medical supplies. The biggest challenge they faced, however, was a lack of fresh, clean water.



**Source 2.48** In flat regions, such as western Victoria, floodwaters can make farming impossible for months at a time.



**Source 2.49** This beetroot farm in the Lockyer Valley in Queensland had huge quantities of valuable topsoil washed away in 2011.



**Source 2.50** These villagers in Pakistan compete for food supplies being dropped by an army helicopter after severe flooding in 2010.

## Check your learning 2.12

### Remember and understand

- 1 What are some of the ways in which people's health can be affected during floods?
- 2 Why does it cost so much to clean up after floods?
- 3 Study Source 2.46.
  - a Who are the people in the photograph and what are they doing?
  - b Where has all the rubbish come from?

### Apply and analyse

- 4 Study Source 2.47.
  - a How can the people shown possibly be suffering from a lack of water?
  - b How might food aid reach this family?
- 5 What are some of the short-term and long-term effects of flooding?
- 6 Which of the flood effects shown on these pages do you believe will have the most lasting impact? Give some reasons for your answer.

### Evaluate and create

- 7 Study Source 2.50. Imagine you have been sent into this region to report on the effects of the flood. Write a report on the effects on the people who live in this area. Present it as a newspaper report or as a script for a television news report.

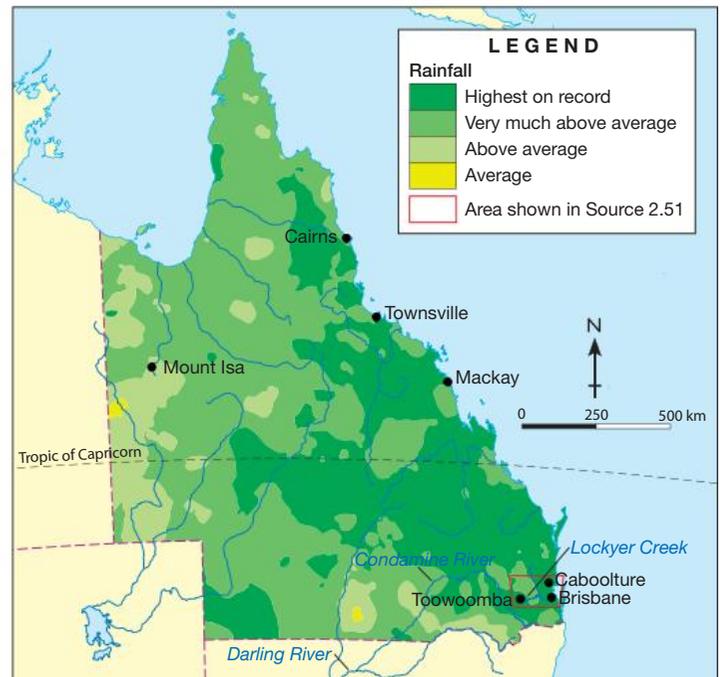
# Queensland's 'inland tsunami'

The deadliest floods in Australia in more than 70 years struck south-eastern Queensland in January 2011. In late 2010, a combination of record monsoonal rains and a tropical cyclone soaked Queensland's river catchments. The period from July to December 2010 was the wettest six months ever recorded in Australia, and December 2010 was the wettest month on record for Queensland.

By early January, many Queensland rivers were in flood. Towns had been evacuated, businesses destroyed, schools closed, farms swept away, and roads and railway lines cut. Thousands of homes were flooded, but the worst was to come.

The city of Toowoomba sits 700 metres above sea level on the Great Dividing Range. Rain that falls to the west of Toowoomba flows into the Darling River and begins a long journey of about 3000 kilometres to the sea near Adelaide (see Source 2.52). Rain that falls to the east of Toowoomba flows into the **headwaters** of the Lockyer Creek and reaches the sea at Brisbane.

QUEENSLAND: RAINFALL, OCTOBER TO DECEMBER 2010



Source 2.52

Source: Oxford University Press



Source 2.51 The appropriately named Water Street in Toowoomba's central business district became a waterway in minutes.

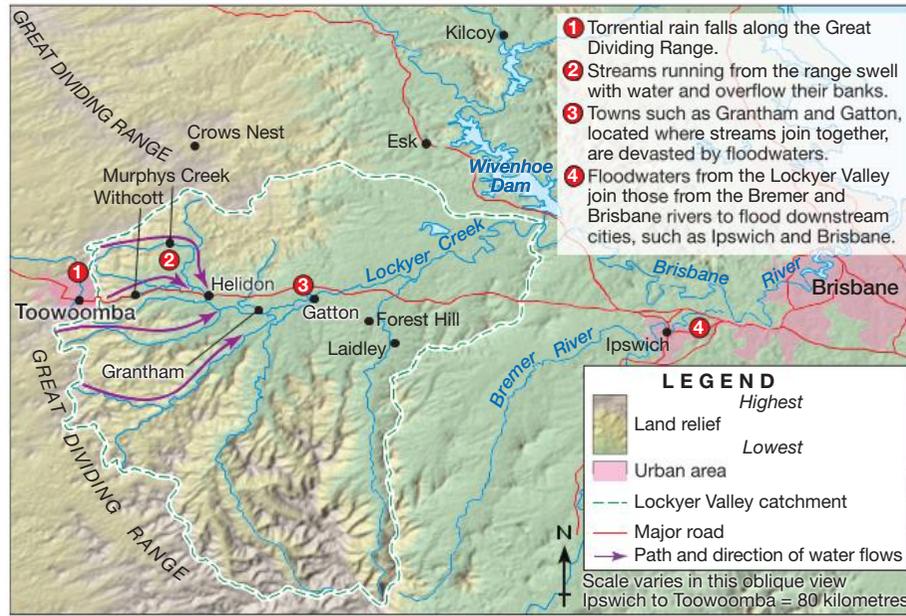
On 10 January 2011, a severe thunderstorm dumped more than 60 millimetres of rain on the town in an hour. This caused a flash flood to surge through the town, flooding the town centre and washing away cars and people. Many pedestrians and motorists had to be rescued as roads became rivers. The Queensland Police Commissioner described the flood as an 'inland instant **tsunami**'.

Between the Great Dividing Range and Brisbane sits the Lockyer Valley. As the thunderstorm that affected Toowoomba crossed the valley, it continued to dump torrential rain. When combined with the runoff from Toowoomba, the already swollen creeks could not cope. Moving down the valley with great speed and terrifying force, the floodwaters slammed into the towns of Murphys Creek, Postmans Ridge, Helidon, Grantham (see Broadsheet 2.3) and Gatton. A survivor described the flood as 'a wall of water', as creeks rose up to 15 metres above their normal level in a few minutes.

Thirty-five people died in the floods. More than 78 per cent of Queensland (an area bigger than France

and Germany combined) was declared a disaster zone, with over 2.5 million people affected. Floodwaters also affected the Bremer and Brisbane Rivers with Ipswich and some Brisbane suburbs also flooded. More than one-quarter of Queensland's rail network was destroyed and 9000 kilometres of roads were damaged. The total cost of the floods was estimated to be as high as \$20 billion.

#### LOCKYER VALLEY FLOOD, JANUARY 2011



Source 2.53

Source: Oxford University Press

## Check your learning 2.13

### Remember and understand

- 1 Why did the streams and rivers of this region overflow and flood?
- 2 What is a thunderstorm?
- 3 How did the Great Dividing Range affect the movement of floodwaters from Toowoomba?

### Apply and analyse

- 4 List the causes of this flood under two headings: natural causes and human causes. You may like to refer back to the 'Why do rivers flood?' spread earlier in this chapter to review the human activities that may lead to flooding.
- 5 On a map of Australia showing flood regions (see Source 2.43), locate the town of Toowoomba. Follow the course of rivers from Toowoomba to the Murray mouth. Do you think the flash flood caused flooding at the mouth of the Murray River? Give some reasons for your answer.
- 6 Describe the rainfall received in Queensland in the last three months of 2010. How did this rain contribute to flooding in January 2011?
- 7 Examine the map of the Lockyer Valley (Source 2.53). Why is the town of Grantham most at risk from flooding?
- 8 The Lockyer Valley is an area of rich farming land. Sometimes called 'Queensland's salad bowl', it is home to many fruit and vegetable growers. What resources in the region attract farmers to the Lockyer Valley? How do you think farmers were affected by the flood? How would this impact on other Australians?



Source 2.54 Downstream from the town of Grantham the rail bridge was covered by the debris carried by the floodwaters.

# Preparing for floods

Floods are part of the natural cycle of many rivers, so it is almost impossible to prevent them entirely. There are, however, many steps that we can take to lessen the impact of floods on people and places. These can be grouped into three categories. First, we can predict where and when there will be flooding so people have time to prepare. Second, we can ensure that people, homes and communities in flood-prone regions are prepared. Finally, when a flood does strike we can respond quickly and efficiently to save lives and make the affected area safe.

## How do we know floods are coming?

Floods in Australia are caused by heavy rain. To predict where and when heavy rain will fall, **meteorologists** use thousands of observations from radar, weather balloons, satellites and other sources. They use their observations to forecast the weather and inform the public about upcoming weather events. This includes issuing flood alerts and warnings.

The basic tool of weather prediction is a weather map. Weather maps show what is happening to the air in the atmosphere. Air rises and falls and this movement is measured with a **barometer** as air pressure. Air rises when it is heated and sinks when it is cooled. Because the Earth is spinning, the rising and sinking air also spins. We feel this spinning air as wind. Water droplets in rising air may cool and join together to create rainfall.

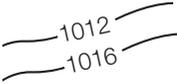
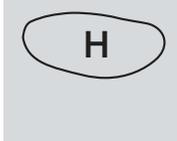
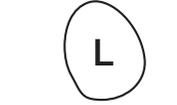
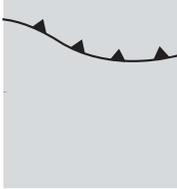
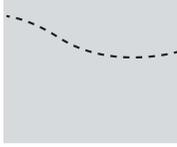
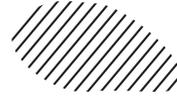
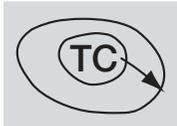
Weather maps show the air pressure as a series of

**Source 2.55** A thunderstorm rolls into Port Hedland, Western Australia.

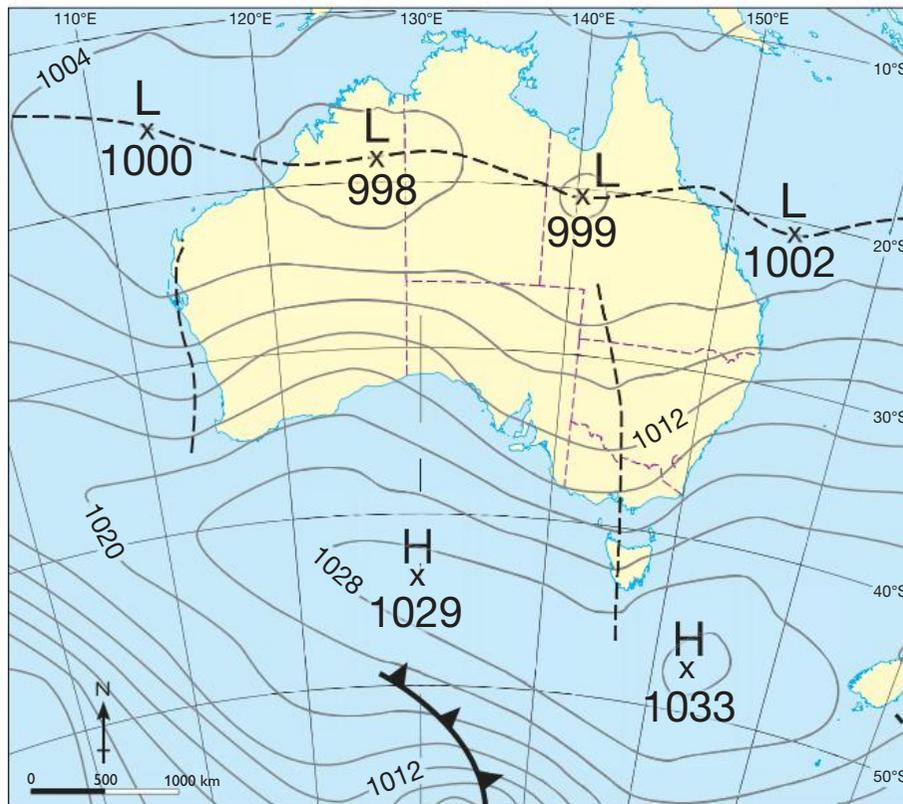


lines and help meteorologists make predictions about temperature, wind and rainfall. Although they may appear confusing at first, the symbols on a weather map are codes and, as with all codes, once you know the secret, you can read the message.

**Source 2.56** Weather map symbols

Symbol	Name	Explanation
	Isobar	A line connecting places with the same air pressure; the closer together the isobars, the stronger the wind
	High pressure cell	Air rotates anticlockwise around a sinking air mass; conditions are warm and dry
	Low pressure cell	Air rotates clockwise around a rising air mass; conditions are cool and wet
	Cold front	A line showing where cold air moves into an area and forces warm air to rise, cool and cause rain; cold fronts move in the direction of the arrowheads
	Warm front	A line showing where warm air moves into an area, rises and cools; this often produces light rain and showers
	Trough line	A long area of rising air, often bringing a line of rain and sometimes thunderstorms
	Rainfall	On some weather maps, shading is used to indicate a region where rain is likely to fall
	Tropical cyclone	Air rises rapidly and rotates clockwise with a calm centre; conditions are extremely windy and wet, and flooding is likely; cyclones move in the direction of the arrow

AUSTRALIA: WEATHER MAP, 10 JANUARY 2011



Source 2.57

Source: Bureau of Meteorology



Source 2.59 The Bureau of Meteorology issues flood warnings that are broadcast on television and other media.

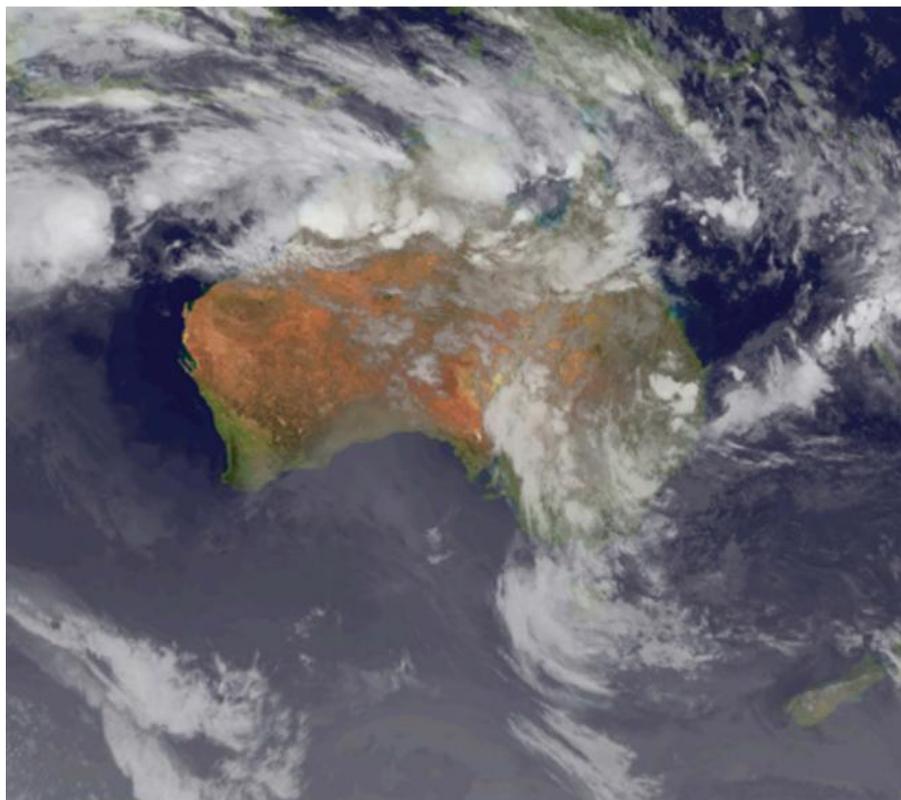
## Check your learning 2.14

### Remember and understand

- 1 What are three things that people can do to lessen the impacts of floods?
- 2 What is a cold front?
- 3 How could Source 2.57 be used to lessen the impacts of flooding?
- 4 North-eastern Victoria experienced heavy rain and major flooding on 10 January 2011. What was the cause of this rain?
- 5 On 10 January 2011 it was a windy day in Perth. From which direction did the wind blow? Do you think Hobart was windier or calmer than Perth on that day?

### Apply and analyse

- 6 What relationship do you notice between clouds and trough lines when comparing the satellite image (Source 2.58) with the weather map (Source 2.57).
- 7 Source 2.57 is a weather map that shows the situation on the day on which devastating floods hit the Lockyer Valley (see earlier in this chapter). What type of weather can this region of Queensland expect to receive in the next few days?



Source 2.58 Satellite image of Australia on 10 January 2011

# Managing floods

Individuals living in flood-prone areas should be prepared for a flood. The government department responsible for managing disasters, Australian Emergency Management, recommends following the three steps outlined in Source 2.62.

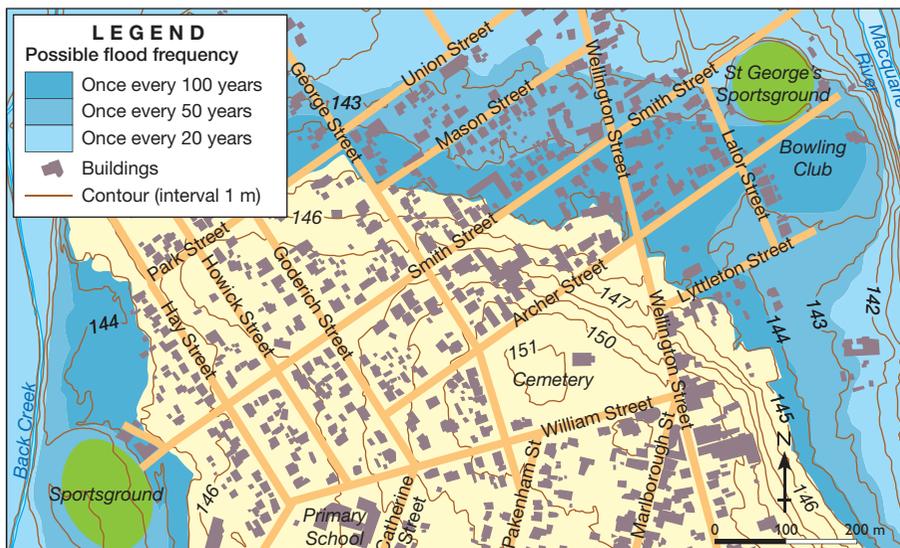
At the regional level, there are a number of ways that local communities can prepare for a flood. Some of these involve changing the physical environment to reduce the flood risk. **Flood engineers** and local councils examine the local environment and consider the impacts of previous floods when designing flood-protection strategies.

## Case study: Longford, Tasmania

The town of Longford in the north-east of Tasmania sits at the junction of two rivers (the Macquarie River and the South Esk River) on a relatively flat floodplain. Heavy rain can swell the two rivers and when they meet the waters spread across the plain. This can bring severe flooding to nearby towns, such as Longford and Perth, and to the city of Launceston, which sits at the mouth of the South Esk. In 1929, floods submerged parts of Longford under metres of water and made 4500 people homeless.

The people of Longford have responded to this flood risk. Using records of floods in the past, flood engineers have estimated the areas likely to be flooded once every 20 years, once every 50 years and once every century (see Source 2.60). This allows the local council to consider rules about building in these places, residents to prepare their flood plan, and engineers to design systems to control the flooding.

FLOODPLAIN MAP OF PART OF NORTH LONGFORD



Source 2.60

Source: Oxford University Press



Source 2.61 A temporary levee put in place during a flood in Longford, Tasmania in 2011

Source 2.62 Disaster management steps

<b>Ask</b>	Find out about floods in your local area. Have there been floods before and, if so, was your house or area affected?
<b>Learn</b>	Find out how the flood warning system works. The Bureau of Meteorology issues flood watches, flood warnings and severe weather warnings. They use terms such as minor, moderate, major, localised and flash to describe flooding. You should learn what these mean.
<b>Plan and prepare</b>	Put together a flood plan that describes what you will do in the event of a flood. Keep a list of emergency phone numbers, prepare an emergency kit (including important documents to take with you if you evacuate) and take into account people with special needs, such as the elderly or disabled.

Based on this and further investigations, a levee has been constructed beside the river junction at the northern end of the town. Made of soil and rock, the levee is 4.5 kilometres long and is designed to stop floodwaters entering the town. It has been designed to cope with the type of flood that Longford receives once a century. Large steel gates have been placed in the levee wall to allow creeks to flow to the main rivers when there are no floods. There are also temporary flood levee walls stored in Longford that can be quickly erected in a major flood.



Source 2.63 Steel gates are installed in the levee at Longford, Tasmania.

## skilldrill

### Communicating your findings

When geographers have completed an inquiry it is important that they tell other people about what they have found. For example, a geographer studying the impacts of a major flood in Longford should communicate the results of their inquiry to the local council and perhaps also to local residents.

There are a few steps to follow when communicating your results:

- Step 1** Think about the type of audience you will be communicating your findings to. Think carefully about who needs to know your results.
- Step 2** Consider the purpose of your communication. What are you trying to achieve? This may differ according to your audience. You may, for example, be trying to convince a trained flood engineer at the council to install a levee, or you may be warning a family holidaying at the local caravan park.
- Step 3** Decide on the most effective means of reaching your audience. This will differ

depending on the audience. For example, the engineer may need information such as land use maps and rainfall data, whereas the family may need a simple brochure outlining what they should do in case of a flood. Depending on the audience your report may be verbal; it may use sound, pictures or video; it may use maps; or it may be a written report.

- Step 4** Use the results of your investigation to reach your chosen audience.

### Apply the skill

- 1** Identify the different groups of people in Longford that would be interested in the findings of a geographical inquiry into flooding there.
- 2** What would be the most effective ways of communicating your findings to each of these groups? Why?
- 3** Design a brochure to be given either to campers arriving at the Longford Riverside Caravan Park or to local residents. Follow the steps provided to inform campers or residents about the flood risk in the region and the ways in which they should respond if there is a flood.

## Check your learning 2.15

### Remember and understand

- 1** Describe how a levee can help reduce flooding.
- 2** Why is Longford at risk of flooding?
- 3** How would each of these people use the floodplain map of part of Longford North in Source 2.60:
  - a flood engineer
  - a person moving to Longford and intending to build a house
  - a farmer who uses the land next to the river.

### Apply and analyse

- 4** You are listening to the radio when a flash flooding alert is issued for your local area. In teams of three, brainstorm the five most important items in a flood emergency kit. Compare your list with your classmates' lists. Were there any items that all teams named?
- 5** Examine Source 2.60.
  - a** How often are floods expected to affect the Longford Bowling Club?
  - b** Approximately how many buildings are affected once every 20 years?

## 2.3 bigideas: broadsheet

# Grantham floods, Queensland

Grantham, a small rural community in the Lockyer Valley, was devastated by the 2011 floods. Local residents described the flood that swept through the town as a wall of water that appeared with little warning. The waters swept from the Lockyer Creek across the neighbouring paddocks and into the town. Experts estimated that the floodwaters were moving at 2 to 3 metres per second and reached a depth of 2 metres within 10 to 15 minutes.

Houses were swept away in the flood and people trying to escape in their cars were also caught. Twelve people died in Grantham as a result of the flood and 130 homes were destroyed or damaged. In the year after the flood some Grantham residents moved away from the area and some built new homes on higher land near the town.

### skilldrill

## Interpreting overlay maps

Source 2.64 is an overlay map of the town of Grantham in Queensland. Overlay maps are semi-transparent maps (made of tracing paper or plastic) that sit on top of base maps of the same area. The overlay shows how different features or events happening in the same place are related to each other. For example, if a geographer is interested in exploring the links between major cities and flooding, they might create a base map of Australia showing the location of major cities and rivers. This would then be covered with an overlay map showing the extent of floods in these areas over a period of time.

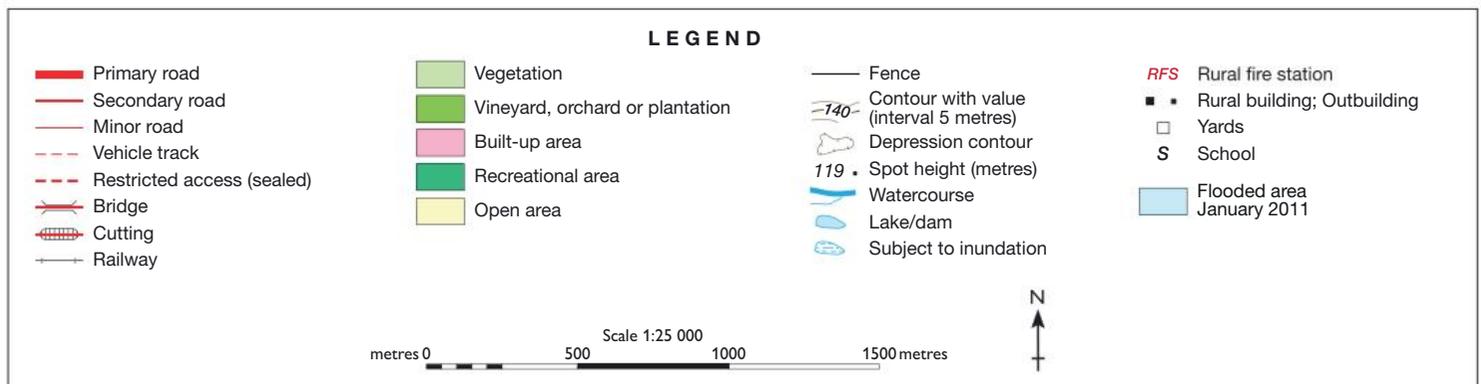
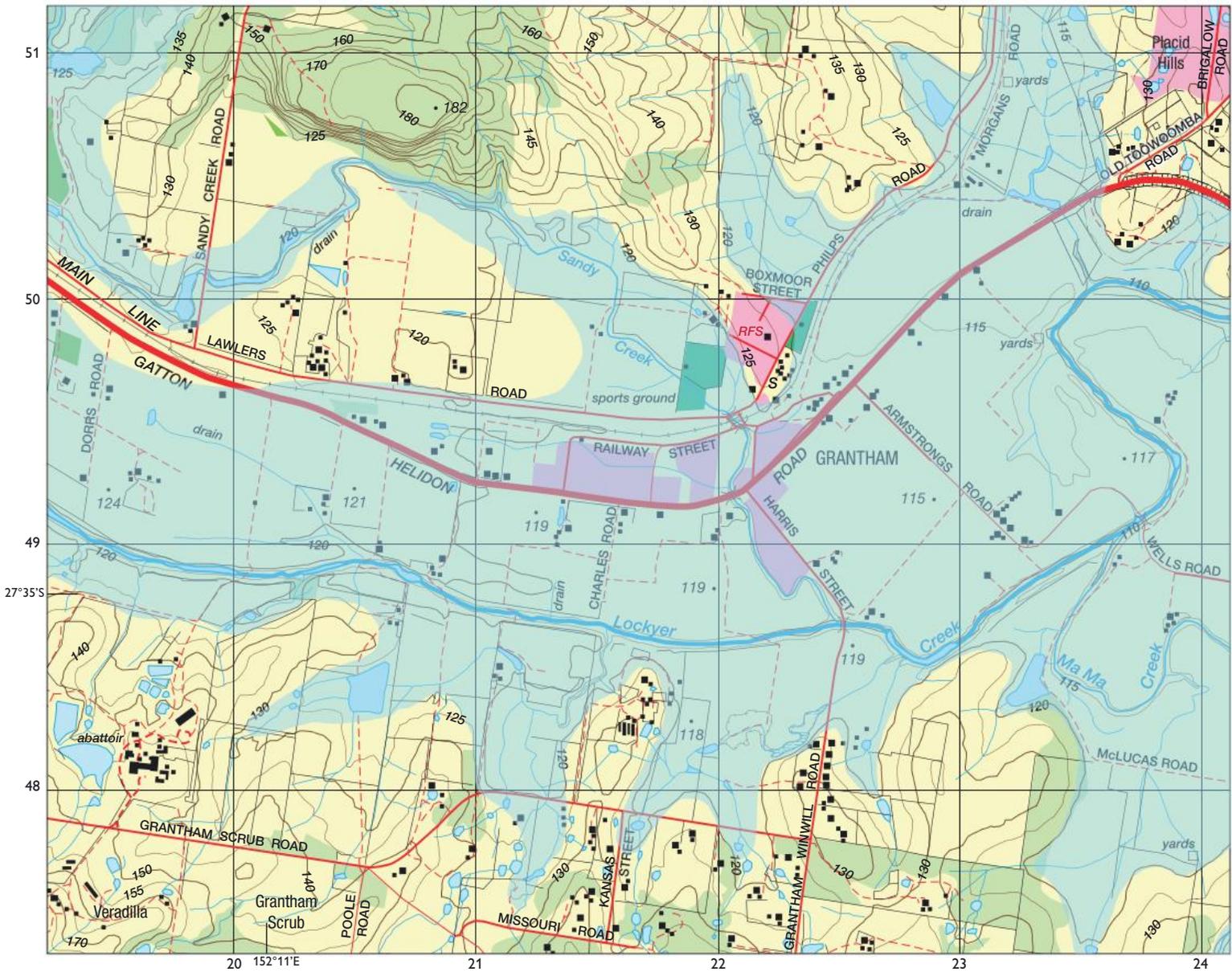
To interpret overlay maps correctly, follow these steps:

- Step 1** Look carefully at the map title and legend. Features that are shown on the overlay map will be shown in the legend. Looking at the legend on both layers will give you an idea of how the features shown are linked.
- Step 2** Look for features on the base map that help to explain what is being shown on the overlay. For example, if the overlay is showing a pattern of flooding in an area, look for rivers and streams on the base map that might have caused this.
- Step 3** Next, look for other features that might explain the pattern, such as contour lines on the base map. This will help you to identify a link between the areas that flooded and the height of the land.

## Apply the skill

- Using Source 2.64, complete the following tasks:
  - What type of map is being used for the base map?
  - What features or events is this overlay map showing the link between?
  - List three rivers or creeks that were responsible for the flooding of Grantham in 2011.
  - In which parts of the town do you think most people would have been affected by the flooding? What feature on the legend enables you to draw this conclusion?
- Using a non-permanent marker trace over the 120-metre contour line on the overlay map.
  - What relationship do you notice between this line and the pattern of the floodwaters in Grantham?
  - What recommendations could you make to the residents of Grantham to avoid flood damage to homes and properties in the future?
  - Locate two places on the map that are unlikely to flood and might be suitable sites to build a new town centre. Shade these locations on the overlay map in a different colour and add them to the legend.
  - Draw in any new roads or rail lines that would be needed to connect these areas to the rest of the town.
  - Which of the two sites you have identified would be best for a new town centre? Explain your choice.
- If you were to build a home of your own in Grantham, where would you position it? Mark this position on the overlay map and provide reasons for your location choice.

GRANTHAM TOPOGRAPHIC MAP WITH OVERLAY SHOWING 2011 FLOODWATERS



Source 2.64

Source: Oxford University Press

## skilldrill

### Showing height on maps

Maps are one of a geographer's most useful tools but most maps only allow us to see the world in two dimensions – width and length. In order to see the third dimension, height, geographers use a special map known as a topographic map. For more information on topographic maps refer to section GT.2 of 'The geographer's toolkit'. On a topographic map, such as Source 2.64, brown squiggly lines have been added to show the height of the land (you can see some of these lines clearly near the top of the map). These lines join together all places of equal height and are called contour lines.

You can work out not only the height of the land but, more importantly, the shape of the land by following these steps:

**Step 1** Some of the contour lines have a number, such as 120, written on them. This tells you that all of the places on this line are exactly 120 metres above sea level.

**Step 2** You can work out the height of the lines without numbers on them by counting down or up from the numbered ones. For example, the line that is next to the 120 metre line will either be 125 metres or 115 metres above sea level depending on whether it is uphill or downhill from the 120 metre line.

**Step 3** Find places where the contour lines are close together. This land will slope steeply. Places where the contour lines are far apart are flat or gently sloping.

#### Apply the skill

- 1 How high above sea level is the school?
- 2 In which direction does Lockyer Creek flow on this map?
- 3 Is Grantham built on flat land or hilly land?

## Extend your understanding

- 1 The rail bridge shown in Source 2.64 is located at GR 221495 on the map. On which creek is this bridge located? In which direction is this creek flowing?
- 2 Using Source 2.40, decide on which of the three flood hotspots Grantham is located.
- 3 Following the flood in 2011 many Grantham residents built new homes in the town at GR 240510. Why is this area less likely to flood than the town of Grantham?

## skilldrill

### Locating places on topographic maps

The grid that is placed on a topographic map allows you to locate places very accurately. Each line on the grid is given a two-digit number. The lines that run vertically are called **eastings** (because the numbers increase as you move east). The lines that run horizontally are called **northings** (because the numbers increase as you move north). For a detailed example of how to locate places on maps refer to section GT.2 of 'The geographer's toolkit'.

To locate points on topographic maps very accurately, geographers use a **six-figure grid reference** (GR). For example, the abattoir near Grantham is located at GR195483. The method used to work out this grid reference is:

**Step 1** Put your finger on the bottom left-hand corner of the square in which the feature you want to identify is located. The two-digit number of this easting line will give you the first two digits in the area reference.

**Step 2** Estimate the number of tenths that your feature is located between this easting line and the one to the right of it. For example, if it is half way between the lines it will be five tenths. This number (5 in this case) is the third number in the GR.

**Step 3** From the bottom left-hand corner of the square in which your chosen feature is located follow the northing line to the side of the map to find out the second two digits in the area reference.

**Step 4** Estimate the number of tenths that your feature is located between this northing line on the bottom and the one on the top. This number is the last number in the GR.

#### Apply the skill

- 1 Complete the following table:

Map feature	Six-figure grid reference
Abattoir	195483
	222498
Building at the sports ground	
Railway line crossing Sandy Creek	

# Place and liveability



unit

2

# Living in Australia

Both Indigenous Australians and early European settlers to Australia made decisions about where to live based on the available resources needed to survive – water, food and shelter. The factors that influence the **liveability** of places today are more varied and include access to services, environmental quality and safety. Connections to family, friends and places also influence where we live. Where we live can also change over time due to a range of factors, such as work and property prices. In retirement, many people opt for a sea change or tree change to enjoy a more relaxed lifestyle.



## 3.1

Where do Australians live and why?

- 1 What features shown in Source 3.1 tell you that many people live in the suburb of Bondi Beach?
- 2 Why do you think people choose to live in Bondi Beach?

## 3.2

Why are some places more liveable than others?

- 1 As a class, list the different types of places people live in Australia, such as mining towns, coastal towns and so on.
- 2 If you could live anywhere in Australia, where would it be? Make a class list of your favourite places to live in Australia and discuss the reasons for wanting to live there.



Source 3.1 An oblique aerial photograph looking south towards Bondi Beach and surrounding suburbs in Sydney

## 3.3

### How do people connect to different places?

- 1 What common interests might members of the community in Bondi Beach have?
- 2 How might the lifesavers at Bondi Beach be considered a community of their own?

# 3.1

## Where do Australians live and why?

# Why we live where we do

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The **liveability** of any place is closely linked to how suitable and enjoyable you think that place is to live in. How liveable you find a place to be depends on your own wants and needs and whether they are met. What we like about places can depend on our age, income, cultural background, lifestyle, values and beliefs. The following questions will help you to determine the features of places that make them most liveable to you.

### What do you like to do?

Access to services and facilities that allow us to do the things we enjoy has an effect on what we think of the place we live. This, in turn, increases how highly we rate its liveability.

Sport and recreation play an important part in our lives. Team sports (such as netball, football and soccer) can be played in most places. Community facilities (such as sports stadiums and sporting parks) are provided in most communities. If your passion is surfing, you might consider a coastal town more liveable than an inland town. Horse riders might prefer to live in a rural area or on the edge of a city, close to open spaces where they can keep their horses.



**Source 3.2** Some activities, such as horse riding, require lots of space.



**Source 3.3** Busy streets in cities can make moving around difficult.

### Where do you like to go?

The places we like to go to, and how easy they are to get to, also affect the liveability of a place.

Where do you spend most of your time? Do you like to catch up with friends, go to the movies, or shop at the local shopping centre? How do you get there? Do you walk, ride a bike, or catch a bus, tram or train? Think about how easy it is for you to travel from your home to where you like to go. Is it difficult? This could make you feel negatively about where you live, decreasing its liveability. Is there another place you could live that might make it easier for you to travel to where you like to go? If so, this would increase the liveability of that place for you.

### What are your favourite places?

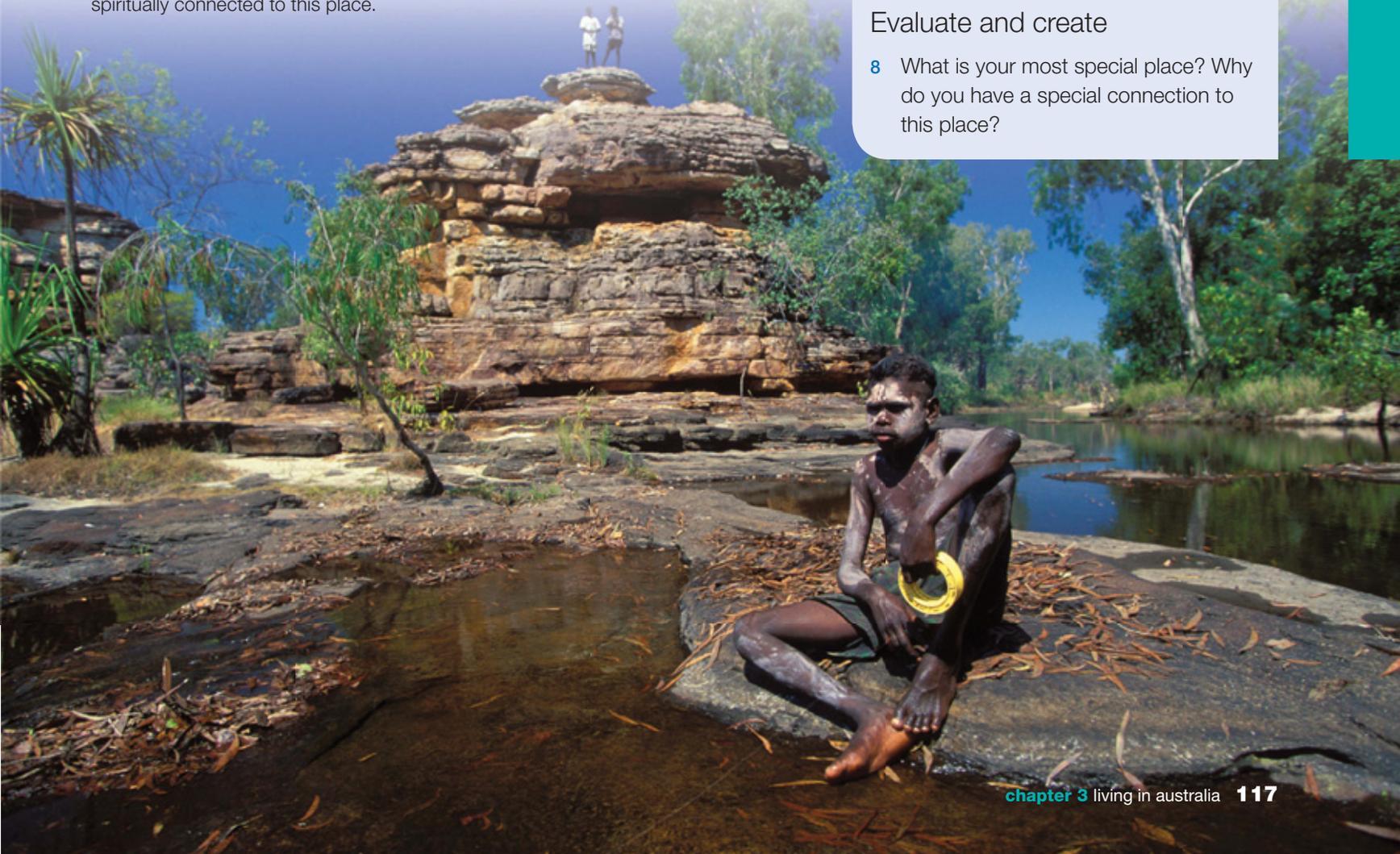
We all have places that are special to us. There are many different reasons for this. Some places appeal because of the way they look. This is known as the aesthetic

appeal. Others appeal to us because they are familiar or are attached to memories of things we have done. This is known as sentimental appeal. We may even have a spiritual connection with a particular place. Aboriginal and Torres Strait Islander peoples have developed very strong connections with their places. Places are a dominant feature of their stories and their lives. These spiritual connections can also increase the liveability of one place over another.

Every year about 5000 Australians are asked to take part in a survey about the factors that they believe make a place liveable. Their replies are often similar to the replies of people from all around the world when asked the same question. Most people agree that a liveable place:

- offers a temperate (mild) climate
- is easy to get around
- is able to offer good health care, work and education opportunities
- is safe
- is affordable
- is diverse
- is sustainable
- is attractive.

**Source 3.4** An Aboriginal boy fishing in Manbalbirriarri billabong at Djukulajarrang, Arnhem Land. This is a very special place for the Ganalbingu clan because of important rock art, burial caves and secret and sacred sites. The Ganalbingu clan feel spiritually connected to this place.



## Check your learning 3.1

### Remember and understand

- 1 What is meant by the word liveability?
- 2 What characteristics of a place attract us?
- 3 What do you like to do? Where would be a good place to live to enable you to do this?
- 4 Where do you like to go? Where would be a good place to live to enable you to do this?

### Apply and analyse

- 5 Imagine that you could live anywhere. Where would you live and why?
- 6 What are the important aspects of liveability that don't need a lot of money?
- 7 Give an example of how a person of your age and a much older person might have different ideas about the liveability of a place.

### Evaluate and create

- 8 What is your most special place? Why do you have a special connection to this place?

# Where early Indigenous Australians lived

It is impossible to work out exactly when the first people arrived in Australia, but many historians estimate it was between 40 000 and 50 000 years ago. At that time, sea levels were lower than they are today. The islands of Indonesia were part of the Asian mainland, and over time people walked and undertook short sea voyages to reach what is now northern Australia. Over thousands of years these people gradually moved south, eventually reaching the south-western and south-eastern corners of Australia. As sea levels rose, Australia became an island and the cultures and traditions of Indigenous Australians developed in isolation.

## Factors that influenced where Indigenous Australians lived

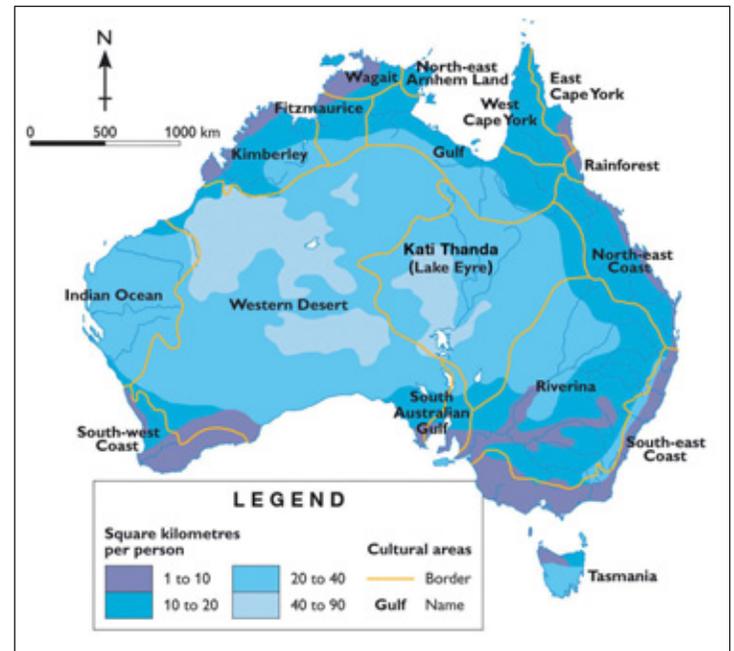
Upon reaching the Australian continent, early Indigenous Australians looked for the most liveable places – those that supplied the resources they needed to survive and prosper. Many Aboriginal peoples settled along the northern, eastern and southern coasts as well as along what we now know as the Murray River. In these places they found the resources they needed to survive, particularly fresh water and abundant food.

Indigenous Australians developed a way of life that took advantage of the natural resources available. Trees provided many important resources, including bark to make shelters, canoes and shields, and wood to make fires and spears.

They fished the rivers, in some places building elaborate stone traps to catch eels and fish, and hunted larger game such as kangaroo and wallaby. Birds and lizards living in the trees also supplied much of their food. Early tribes used virtually every part of the natural environment to support their way of life – shells, stones, plant fibres, coloured clay and bones all had their uses, however a reliable supply of fresh water, usually a river or stream, was perhaps the most important resource.

Further inland, resources were much scarcer. Aboriginal communities living here developed a different way of life suited to the limited resources. Throughout

AUSTRALIA: LOCATION AND DISTRIBUTION OF INDIGENOUS AUSTRALIANS IN 1788



Source 3.5

Source: *Oxford Atlas*

Source 3.6 Aboriginal men in northern Queensland demonstrating traditional fishing techniques using a spear





**Source 3.7** In the Western Desert, Aborigines use fire to expose the hiding places of goanna.

much of Australia, fresh water is hard to find and there are few large animals to supply food. In these desert regions, Aboriginal people lived a more nomadic way of life than the coastal and river peoples. Liveable places changed according to the season, so for most of the year they kept on the move, following natural cycles of monsoonal rains, the movement of animals or the fruiting of plants. They became superb trackers and hunters and were able to survive in some of the harshest environments on Earth. They found water in the most unlikely places, even in the roots of desert plants and the bodies of dormant (hibernating) frogs. Much of their food came from animals such as insects, grubs and reptiles, as well as from plants such as the bush tomato.

## A spiritual connection to the land

Aboriginal and Torres Strait people developed a deep connection with the land that supported them. The land formed the core of their beliefs and spirituality and an integral part of their view of themselves. They do not see themselves as separate from the natural environment but as part of it. Rather than owning land or living off the land, they believe that they live *with* the land and are responsible for looking after it. Their perception of liveability was based on the principle that the land was much more than just a resource to be used. Aboriginal people refer to their land, and their connection to it, as Country.

Part of the reason that Country is such an important concept to Indigenous Australians is because their Dreaming stories, their way of life and their ancestors are all part of their homelands. When an Indigenous Australian is in their Country, their spirits and their ancestors keep living through them. In fact, they see the Country as a living individual. Many Indigenous Australians choose to live in their traditional homelands

or dream of doing so. Like other Australians might long to see a favourite relative or return to a family home, Indigenous Australians get their sense of belonging from their Country.

## Check your learning 3.2

### Remember and understand

- 1 How did Aboriginal people first reach Australia?
- 2 Why did most Aboriginal people live near the coast or along rivers?

### Apply and analyse

- 3 Compare the ways of life of inland desert Aborigines and those who lived near rivers in south-eastern Australia. What were some of the similarities and some of the differences?
- 4 Examine Source 3.6. What resources from the natural environment are these Indigenous hunters using?
- 5 What factors influenced the liveability of places for early Indigenous Australians? Are these factors the same as those that influence your ideas on what makes a place liveable? Why/why not?

### Evaluate and create

- 6 What do you think Aboriginal people may have used each of these resources for: shells, stones, plant fibres, coloured clay and bones?
- 7 When Europeans arrived in Australia they had a different view of land ownership and use than Aboriginal people. Why did these differences cause tensions and conflicts between these two groups of people?

**Source 3.8** Many modern Aborigines are moving back to their traditional homelands to reconnect with their ancestors and their beliefs.



# Where modern Australians live

In much the same way as the early Indigenous Australians did, modern Australians also make choices about where they live based on how liveable they perceive a place to be. Today, however, many things have changed. In the distant past, people chose where to live based on whether the place gave them access to the basics necessary for survival, such as water and food. Today, modern technology and **infrastructure** make food and water available right across Australia, even in parts of the country, such as the desert, that would have previously been uninhabitable. As a result, the factors that influence where modern Australians live have changed. Today, many Australians make decisions about where to live based on a series of lifestyle factors.

## Factors that influence where modern Australians live

A person's perceptions of liveability often depend on his or her needs, wants or preferences. These needs and wants are changing all the time and are often dependent on what stage of life a person is at. Age has a big influence on what a person wants from where they live. Young adults, for example, often want access to educational opportunities and jobs, while retired people will not be so concerned about these things. The type of household a person is a part of is also significant, as families have different needs to single people.

Despite these differences, many of the factors that people take into consideration when deciding where to live remain constant. A range of these are discussed below.

### Housing

Suitable housing is a key consideration for people. On a basic level, people make decisions about where they live depending on what they can afford, and the size of house they need. Personal choice also has a big influence, whether, for example, someone wants a modern home or a traditional home, a large garden or a low-maintenance apartment.

### Access to services

People generally like to live within easy reach of the services they need. Public transport and well-maintained



**Source 3.9** Local shopping centres are an attractive feature to many people.

roads help people to get around with ease. Access to health care is also important, but even more so for people who need specialist care. Families with children often want access to good schools, childcare and playgrounds. Local shopping centres providing access to shops, banking and other professional services, as well as cafés and restaurants also play an important role in where people settle.

### Access to jobs

People often move to a place because it offers them the best opportunities for employment, and generally the bigger the place, the more jobs there are. Many young people who have grown up in small country towns end up moving to cities to find employment. Big cities, however, are not the only places to find employment. In recent years, isolated mining towns with very few facilities and services have grown rapidly because of the high-paying jobs on offer there.

### The climate and environment

Most people in Australia live along the east coast, where the climate is more moderate than other parts of the country. Personal preferences, especially when it comes



**Source 3.10** A mild climate and attractive natural features like beaches can play a key in determining where people live.

to climate, are a key factor in determining where people settle. For example, many older people follow the sun, sea and a warmer climate in their retirement by moving to the Gold Coast. Coastal places are very popular with young and old people alike, but on the other hand, someone who enjoys snow-skiing might prefer to live near the mountains.

## Cultural connections

Many people choose to live near their family and friends, and for this reason may stay in the same town or city suburb for the whole of their lives. Those moving to a new place, particularly from another country, may be attracted to a neighbourhood where others from the same cultural and language backgrounds live. This can offer a sense of security and familiarity, with local shops selling products from home, and local services offered in their native language.

## Entertainment

People also make choices about where they live based on their leisure activities; for example, whether they want easy access to the outdoors or to museums and theatres found in city centres. People of different ages often want different entertainment options. Many younger people are drawn to the variety of entertainment offered in big cities such as music venues, nightclubs, concerts, theatres, shops and big sporting arenas, whereas these facilities may be of little use to older people.

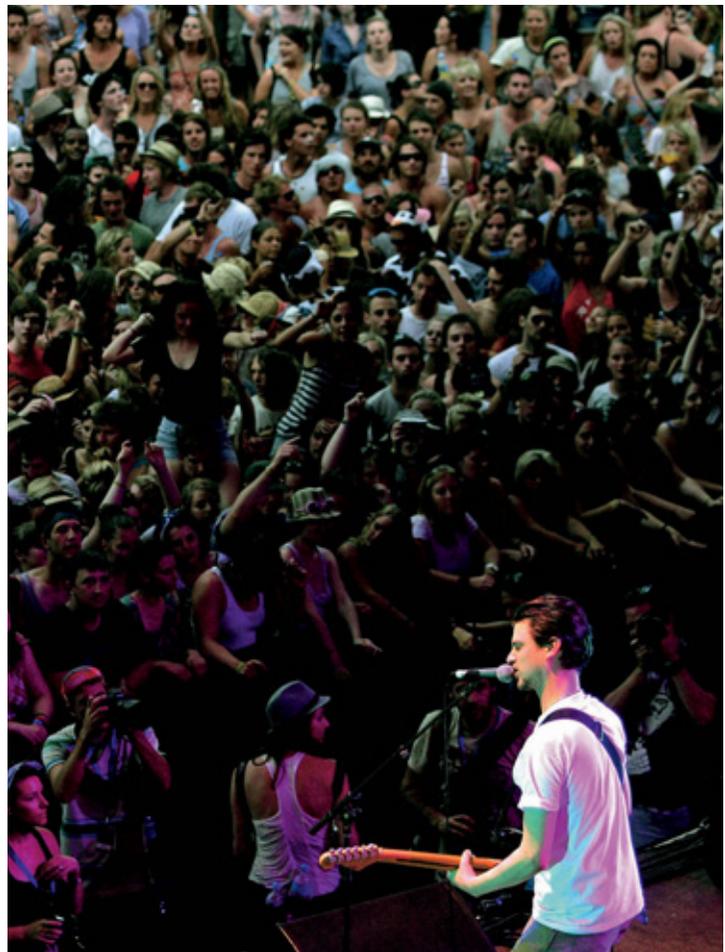
## Check your learning 3.3

### Remember and understand

- 1 What are some of the factors that modern Australians take into consideration when deciding where to live?
- 2 How important are climate and environment in influencing where people in Australia live?

### Apply and analyse

- 3 For each of the following groups, identify some of the liveability factors that would be most likely to influence where they want to live:
  - a a family with school-age children
  - b a retired couple
  - c a surfer in his 20s.
- 4 Consider the local area in which you live.
  - a What are its key liveability factors?
  - b What types/groups of people commonly live in your local area?



**Source 3.11** Large entertainment events attract big crowds of young people and play a role in where they choose to live.

## 3.1 bigideas: broadsheet

# Noosangatta

The warmer climate and stunning natural features of the south-east Queensland coastline mean this region has many high-rating liveability factors. The region, in fact, has attracted many Australians, particularly older people from New South Wales and Victoria, to make the move north. Just 50 years ago, the Gold Coast and Sunshine Coast were small holiday towns. Today, the area has seen such extensive growth and development that the towns and cities along this section of coastline may join together to form a continuous urban area known as a megalopolis. Some geographers predict that Noosa in the north and Coolangatta in the south will one day also join to form one vast urban area that some people have already nicknamed 'Noosangatta'.



The high population growth in south-east Queensland over the last few decades has led to an increasing demand for housing. As the suburban areas have spread, there has been a loss of 7500 hectares (75 km<sup>2</sup>) of bushland and farms each year. The stunning natural features and easy-going lifestyle that attracted people to move to the area in the first place are coming under threat. A victim of its own success, the area is in danger of becoming less liveable.

### skilldrill

## Reading a complex map

A map is a plan of an area of the Earth's surface drawn directly from above. Complex maps, such as the one shown in Source 3.13, can appear a little confusing at first because they show a wide range of features. As with all maps, however, it is important that you read the legend, title, source and scale carefully, so that you can learn more about the region being shown.

Follow these steps to help you read and understand a complex map:

- Step 1** Read the title carefully. Make sure that you understand what the map shows and the region that is shown in the map. If you are unsure of the location of the region, locate it in your atlas to see where it sits in relation to other regions or countries.
- Step 2** Check the source of the map so that you can assess the reliability of the information. Maps drawn by government departments and professional publishers are generally more reliable than those drawn by individuals and businesses.
- Step 3** Look carefully at the symbols and colours used in the legend and find an example of each of these on the map. Look for relationships between these symbols such as roads and urban areas.

### Apply the skill

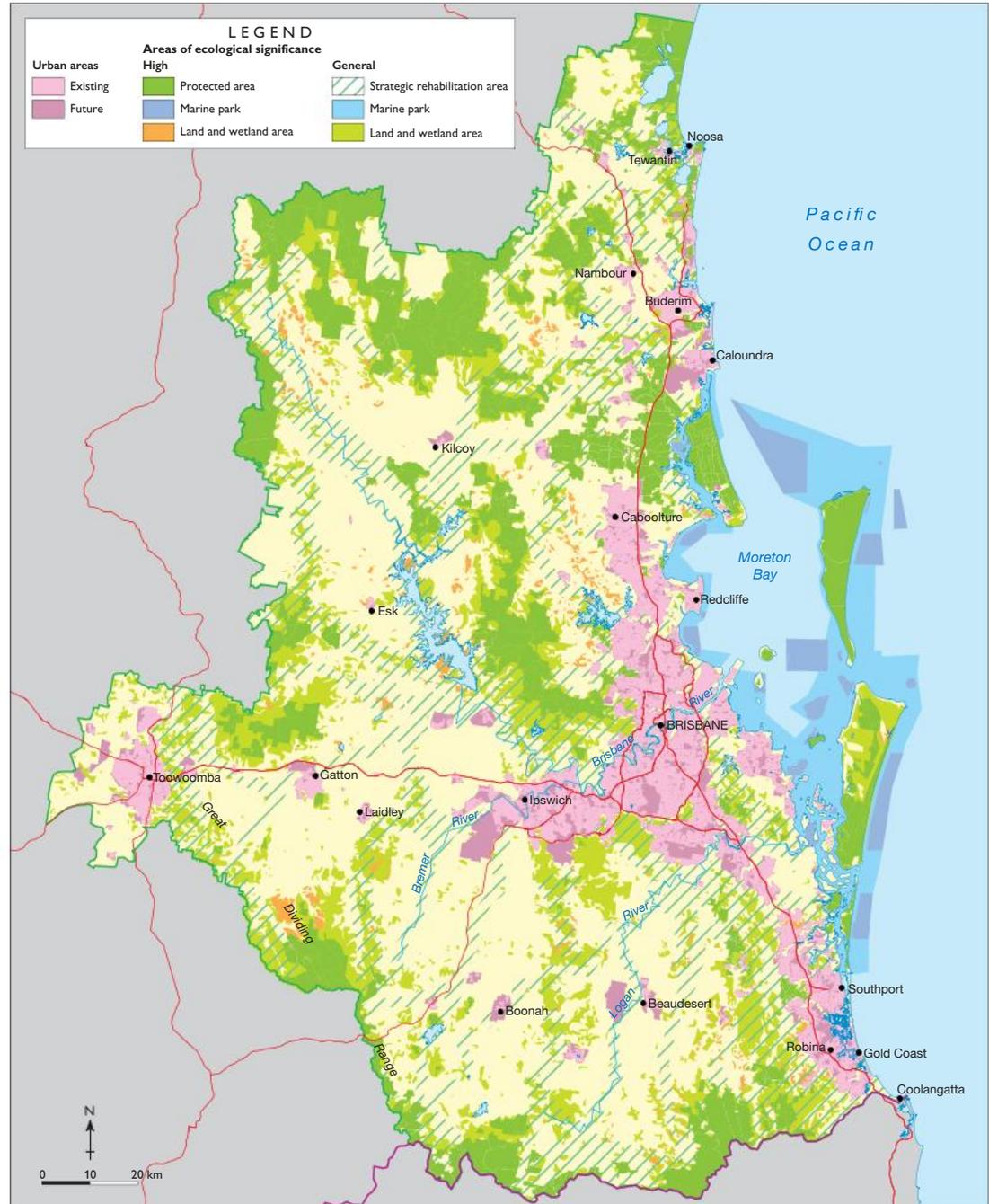
- 1 What is the source of the map shown in Source 3.13?
- 2 Is this a reliable source of information?
- 3 Use the line scale to estimate the straight line distance from:
  - Brisbane to Robina
  - Brisbane to Noosa
  - Brisbane to Toowoomba.

**Source 3.12** An oblique aerial photograph of coastal development between Noosa and Brisbane

Refer to page 22 for a guide to estimating distance.

- Describe the distribution of existing and future urban areas. Use the names of towns and cities as well as compass directions and geographic features such as the coast and rivers in your description.
- Describe the distribution of protected areas and the land and wetlands areas of high ecological significance.
- Which areas of high ecological significance are likely to be impacted most by the continued growth of urban areas in this region?

#### SOUTH-EAST QUEENSLAND: ECOLOGICAL AND URBAN AREAS



**Source 3.13** Source: South-East Queensland Regional Plan 2009–2031, Queensland Department of Infrastructure and Planning.

### Extend your understanding

- Describe the importance of natural features such as rivers, mountains and coasts in affecting the location and shape of cities. Use evidence from the map for your description.
- Is it likely that the city of Toowoomba will join the Noosangatta megalopolis? Give reasons for your answer.
- Explore the region shown in Source 3.13 on Google Earth. Use the 'Historical Imagery' tool to find examples of places that have undergone great changes in the last ten years.

# 3.2 Why are some places more liveable than others?

## Living in large cities

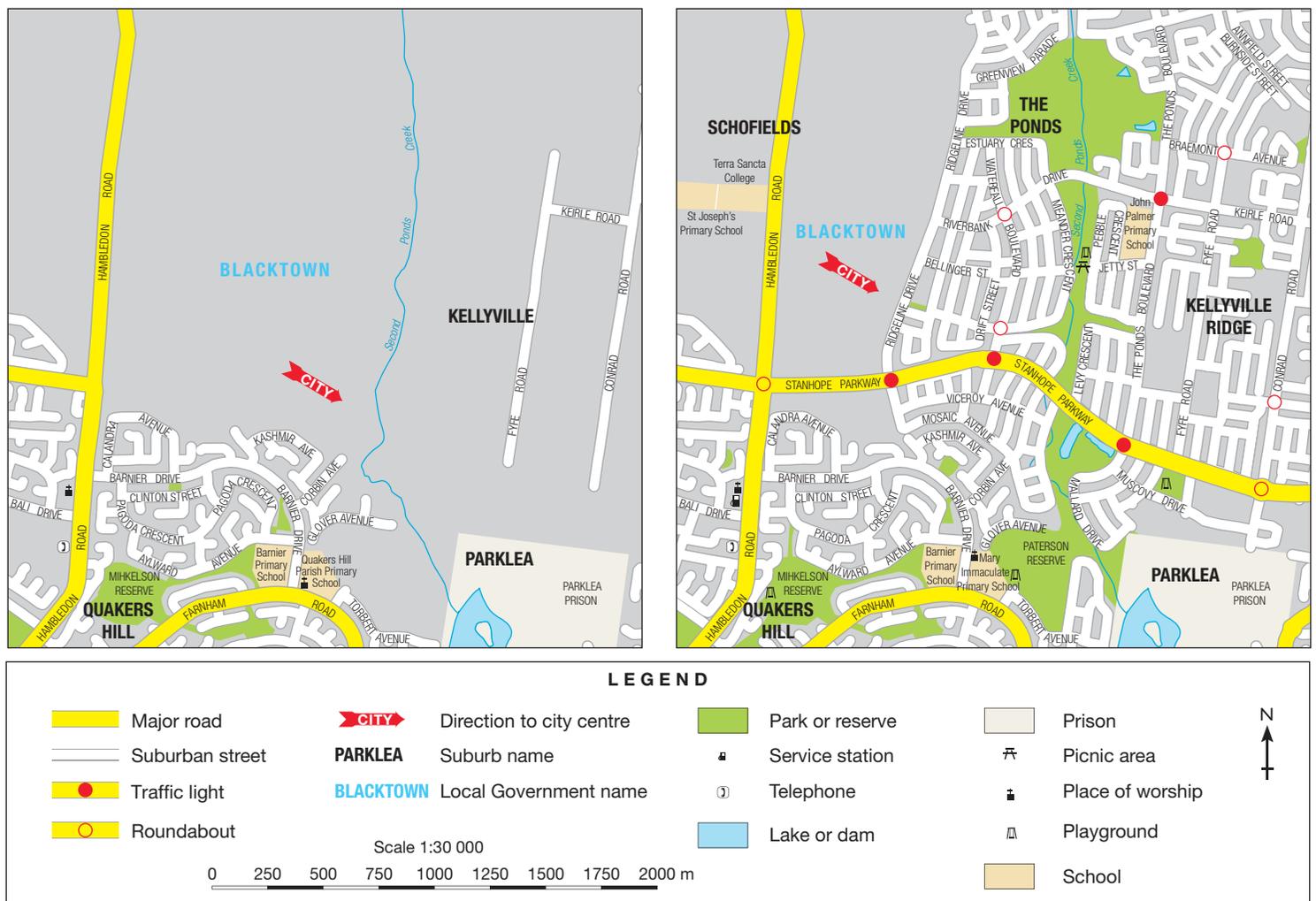
Most Australians choose to live in large capital cities. The greatest growth in capital cities usually takes place around the outer edges of metropolitan areas. New suburbs appear on what was once farmland along the **rural-urban fringe**. As new housing estates are built on the farmland or bushland adjoining the suburbs, other services are attracted to these new suburbs to service the growing population. Schools, shopping centres, medical centres and sporting facilities become established to meet

the needs of the residents. Industries are also attracted to the cheaper land and rents of the outer suburbs.

### Case study: Blacktown, New South Wales

The suburb of Blacktown is on the fringe of the metropolitan area in western Sydney. It is one of the fastest-growing areas in Australia. At the 2011 census, the

BLACKTOWN: 1997 (LEFT) AND 2012 (RIGHT)



Source 3.14

Source: Oxford University Press

area had a population of over 43 000. This population is growing rapidly and it is now one of Australia's largest suburbs. This is due to a range of factors, including the overall growth of Sydney, the relatively cheap land and the building of major roads, such as the Western Motorway, and other services. Source 3.14 shows the change in an area in the north of Blacktown between 1997 and 2012.

There are a number of schools in the region along with other amenities, such as public pools, libraries and a university. Blacktown also has numerous shopping areas, including large shopping centres, shopping strips along major roads and its own central business district (CBD). Blacktown is linked to other parts of Sydney, including its CBD, by a road and rail network. In common with other regions of Australia with a rapidly growing population, Blacktown struggles at times to meet the demands of all its residents. It can be very difficult to find rental accommodation, and some public facilities, such as hospitals, have experienced problems in dealing with a large, growing and diverse population.

Many residents of the western suburbs work closer to the centre of the city and use private vehicles to travel to and from work. This puts hundreds of thousands of cars on the road during the morning and afternoon peak periods, causing traffic jams and long delays. The road system struggles to cope with this heavy demand; at peak hour, the average speed on the freeways and tollways slows from 100 kilometres per hour to less than 30 kilometres per hour. These problems are only set to become worse in the next few decades when the population of western Sydney is expected to reach 4 million.



**Source 3.15** An oblique aerial photograph of Blacktown looking towards the Sydney CBD



**Source 3.16** Blacktown has a large population of refugees and migrants. These girls are being introduced to AFL football at Blacktown Olympic Park.

## Check your learning 3.4

### Remember and understand

- 1 Where does the greatest growth in capital cities generally occur?
- 2 What change takes place as suburbs spread to the rural–urban fringe?
- 3 Why are some industries attracted to the outer suburban areas?

### Apply and analyse

- 4 What problems do town planners in Blacktown face?

### Evaluate and create

- 5
  - a Using Source 3.14, construct a sketch map of Blacktown in 1997. Show the main roads and label the schools and prison. Shade in green the area of the map used for housing. These are the areas with the short, curving streets.
  - b On your sketch map add the changes that had occurred by 2012. Shade in red the new housing areas and label any new schools and main roads.
  - c Describe the changes that occurred in this area between 1997 and 2012.
  - d How do you think this area will change in the next 15 years?

# Living in rural areas

Many parts of Australia are used to raise animals and grow crops for food. The type of farming carried out in different areas is generally determined by climate and the availability of water. Farms vary from small properties used to grow crops, such as grapes or vegetables, to huge stations the size of European countries where cattle are raised.

Living on a farm can be very different from living in a city. It can be more difficult to access services, such as schools, shops and doctors. The population of many rural areas is declining as people move to cities for better job opportunities and a wider range of education options. There are also many advantages to living on a farm. Farms are often family-run businesses and this gives farmers the opportunity to be their own boss. There is also less air pollution, noise and traffic in rural areas. In recent years, advances in information and communication technology have reduced the disadvantages of living in a rural place.

## Case study: Western District dairy region Victoria

The largest industry in rural Victoria is dairy farming. There are more than 1 million dairy cows in the state and they produce more than 6 billion litres of milk a year. There are three main dairy farming regions in Victoria – in the north near Echuca; south-east of Melbourne; and in the Western District centred on the city of Warrnambool.

Source 3.17 is a map of the Western District dairy farming region. On the map each town is shown in the centre of a circle. The size of each circle is determined by the number of people living in the town. The bigger the population, the bigger the circle. This makes it easy to see where the larger towns and cities are located in this region and allows us to see a pattern in this distribution. These circles are called proportional circles.

Near the small town of Condah, in the western district of Victoria, lies the dairy farm of Sam and Kristy Cheetham. In common with many farms in Australia, this dairy farm is a family-run business.

The farm has grown over the years as the family has bought more land. Several workers are employed to help milk the cows twice a day and carry out other farm jobs, such as mending fences and looking after the grazing paddocks. These workers and their families also live on the Cheetham's farm.

The Cheetham's farm is located close to several small towns and some distance from larger towns and cities. The small towns of Condah and Branxholme have very few shops and the Cheethams only visit these places for basic items, such as bread. The closest supermarket is in Heywood, 24 kilometres away, as is the closest bank. Heywood has a population of 1300, which is large enough to support a wider range of retail shops and other services than the smaller towns. These include a doctor, vet and several schools.

Larger towns include Hamilton and Portland, and Warrnambool is the closest regional city. These places have a wide range of shops and other services, such as large hospitals and secondary schools. They need only visit Victoria's capital city a few times a year for major

VICTORIA: WESTERN DAIRY REGION



Source 3.17

Source: Oxford University Press

services, such as an international airport or specialised health care. They also travel to Melbourne for sport and entertainment as most large events of this type are not held in regional areas.

Towns and cities in rural areas tend to be located a certain distance apart. This is determined by the size of the population and the services available in that town or city. Large towns (such as Warrnambool, Portland and Hamilton) offer a large range of goods and services and are spaced well apart. They need to draw in people from a bigger distance to support services they offer. Small towns, such as Condah, only have a few shops and services to support the local community.



Source 3.20 Branxholme's main shopping street



Source 3.18 Heywood's main shopping street



Source 3.19 Warrnambool's main shopping street

## Check your learning 3.5

### Remember and understand

- 1 How does living in a rural area differ from living in a city?
- 2 What are Victoria's three main dairy farming regions?
- 3 What different jobs are done on the Cheetham farm?
- 4 Where would the Cheetham family go to buy each of the following?
  - a A loaf of bread
  - b A packet of breakfast cereal
  - c A pair of jeans
  - d A new television
- 5 Look at Source 3.20. What services and supplies do you think might be available in Branxholme?

### Apply and analyse

- 6 Look carefully at Source 3.17.
  - a List the three largest towns in the region.
  - b What is the approximate population of the largest town?
  - c Why do you think there are lots of small towns and only a few large towns?
  - d Why are proportional circles useful on a map?

### Evaluate and create

- 7 List one good and one service that you think would only be available in the very largest towns in the region.
- 8 List one good and one service that people in the region might need to travel to Geelong or Melbourne to purchase.

# Living in coastal areas

Eighty-five per cent of all Australians live within 50 kilometres of the coast. As a result, nine of our 10 largest cities sit on the coast. As well as huge cities such as Sydney and Melbourne, there are hundreds of smaller communities dotted along our coastline. Outside the capital cities, these coastal communities tend to be the fastest growing regions in each state. In Queensland, it's the Gold Coast and the Sunshine Coast, and in Victoria, it's the Surf Coast.

Coastal towns and cities are growing in size and population across Australia due to a range of factors. Many people decide to move to the coast because they want a more relaxed lifestyle near natural features such as beaches, bays and other landforms. Geographers refer to this trend as a 'sea change'.

## Case study: Torquay, Victoria

Torquay lies on Victoria's Surf Coast about 100 kilometres south-west of Melbourne. It has long been a popular holiday destination, particularly during the warmer



Source 3.22 The main surf beach at Torquay in Victoria

### VICTORIA: THE BELLARINE PENINSULA



Source 3.21

Source: Oxford University Press

summer months. On summer weekends, the population of the town can double, as people travel from Melbourne to take advantage of the beaches and relaxed lifestyle of this coastal town. As well as the holiday-makers, the number of permanent residents is also growing. In 2006, the town's population was about 8000. By 2025, the population of Torquay is expected to be three times that number. As with any change, there are both benefits and costs to this population increase.

Coastal towns close to large cities attract sea changers, because they offer the option of living in the coastal town and commuting to work in the city. Torquay's proximity to Melbourne makes it a popular choice for this reason and a new ring road around Geelong has reduced the journey to the Melbourne CBD from Torquay to about 90 minutes.

Torquay also attracts many retirees. In some cases, after retirement people are moving permanently into holiday homes they already own, and in other cases they are building new homes to live in. As more Australians

reach retirement age, it is expected that the demand for new homes and services such as health care, education and roads will increase dramatically in the sea-change towns like Torquay.

While real estate agents and builders welcome the new residents, not everyone feels the same way. Some people are concerned that the once small town of Torquay will become exactly the type of suburban development the sea changers are trying to escape.

Farmland, sand dunes and caravan parks are being redeveloped as retirement villages and housing estates. New businesses such as large hardware stores and food outlets are threatening the survival of smaller, well-established local businesses. Changes like this often cause conflict in the local community.



Source 3.23 A satellite image of Torquay and surrounding areas

## Check your learning 3.6

### Remember and understand

- 1 How does living in a coastal area differ from living in a city?
- 2 What has made it possible for residents in Torquay to enjoy both coastal and city life?
- 3 What is a sea change?
- 4 What is Torquay's population expected to be in 2025?

### Apply and analyse

- 5 Examine Source 3.21.
  - a What are the largest towns on the Bellarine Peninsula?
  - b Where do you think people on the Bellarine Peninsula would go to shop at department stores or purchase expensive items such as cars?
  - c How far is Torquay from Geelong?

- 6 Explain the following statement: 'Some people are concerned that the once small town of Torquay will become exactly the type of suburban development the sea changers are trying to escape.' Why might some people feel this way?

### Evaluate and create

- 7 a Draw a sketch map of Source 3.23. Shade in the area covered by housing. In a different colour, shade those areas that you think may be developed for housing in the next few years. Provide a key and title for your map.
  - b Give reasons for the land you select for new housing in part a. What type of land did you select? What type of land did you not select? Why?

Source 3.24 New homes cover the hills behind the Torquay Golf Club.



# Living in remote places

Most Australians live in large cities on the coast, with very few people living in the centre of the continent. Much of the interior of Australia is **desert** or semi-desert, with large distances between towns and settlements. Geographers refer to these areas as remote because people living in these areas have difficulty accessing some goods and services. Providing basic services (such as roads, food, water, telephone and Internet access) to remote communities can be difficult and expensive.

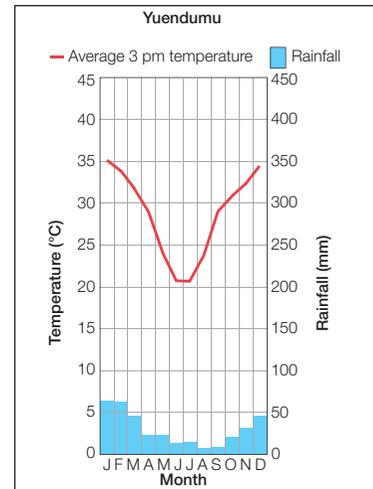
A high proportion of Indigenous Australians live in regional and remote areas – almost half of the population compared with just 13 per cent of the total population. For many Indigenous Australians this decision is based on a deep connection to the land that began thousands of years ago.

## Living in the desert

Australia is the second-driest continent in the world, after Antarctica. Seventy per cent of our continent receives less than 500 millimetres of rainfall each year. This low rainfall has produced large deserts across much of inland Australia. Deserts are some of the harshest places on Earth. The people who live in desert communities must overcome many challenges.



**Source 3.25** The Yuendumu Pool opened in 2008. Children can only swim here if they regularly go to school.



**Source 3.26** Yuendumu climate graph

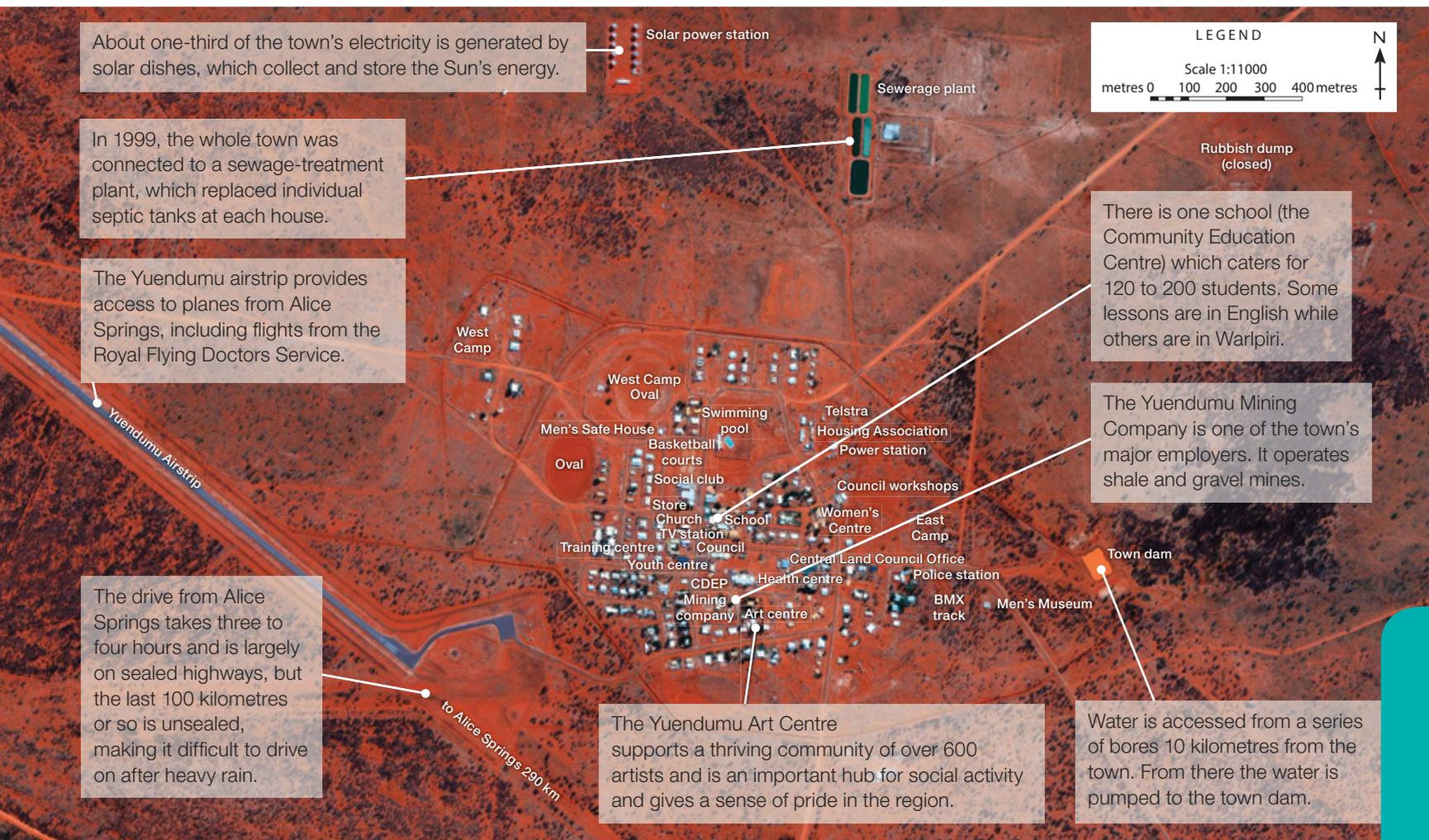
## Case study: Yuendumu

One desert community is based in the town of Yuendumu, located 290 kilometres from Alice Springs in the Northern Territory. Not only is it located in the Tanami Desert, it is also one of the most remote places in the world. It is so remote that few locals have ever seen the sea.

### The Warlpiri people

The Warlpiri people of Yuendumu do not see land as something to be owned. Instead, they believe that they belong to the land. This deep sense of connection to a particular place can be very difficult for non-Indigenous Australians to understand. In the same way, Warlpiri people find a system of land ownership difficult to understand.

The Warlpiri system of family and relationships is complex. A crucial part of any Warlpiri child's education is to learn about this system. It helps them to understand the natural and social world and a person's place within it. This system binds the Warlpiri people to each other and to the land.

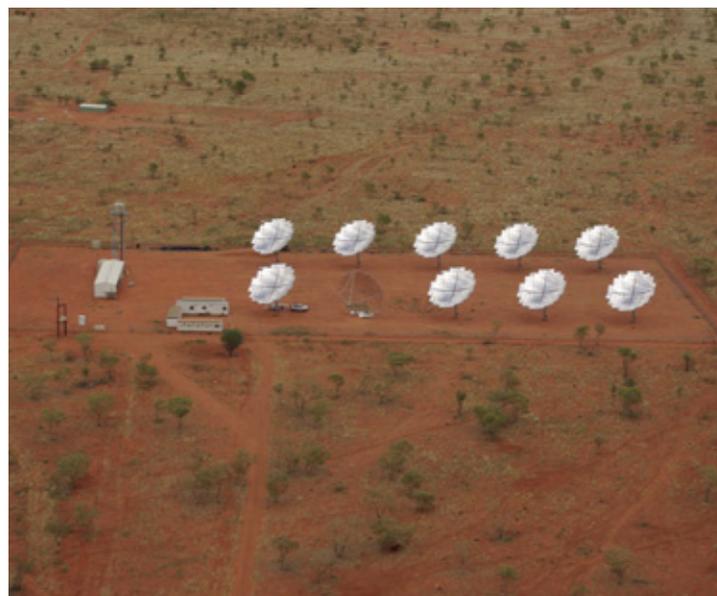


Source 3.27 Yuendumu satellite image

## Problems and challenges

Living in Yuendumu presents many challenges. The isolation from other places is the most obvious of these, however in recent years sealed roads, the airstrip, telephones, television and the Internet have helped to connect Yuendumu to the outside world. Many older people in the community, however, worry that better transport and communication will break down the customs of the Warlpiri people.

As with other remote Aboriginal communities, health problems, such as eye diseases, are common. Substance abuse among young people, particularly petrol-sniffing, was once a serious problem but a strong community response has largely brought an end to this practice. This involved providing young people with a better range of activities and making substance abuse unacceptable.



Source 3.28 The solar power station provides 50 per cent of daytime electricity needs to Yuendumu and enables significant reduction in the diesel fuel used in power generators in the community.

## Living in the Pilbara

Australia is a mineral-rich country. We have the world's largest deposits of brown coal, mineral sands, nickel, uranium, zinc and lead. We also rank in the top six in the world for reserves of other minerals, such as bauxite, black coal, diamonds, copper, gold and iron ore. Iron ore is used to produce steel, which is an important part of many industries around the world. Some of the world's largest and richest iron ore deposits are in an area of Western Australia known as the Pilbara.

Some mining workers live in towns in the Pilbara close to the mines where they work, such as Tom Price, Newman and Paraburdoo. These towns can be hard places in which to live as they tend to be very isolated. Their remote location means that some goods and services can be difficult to access. The perception of these towns as less liveable than other centres in Australia means that workers are offered very attractive salaries and conditions to come and work in the remote Pilbara region. Many miners prefer to live a FIFO ('fly in, fly out') lifestyle. This means that they live in large cities, such as Perth, for two weeks and then fly to the mines to work for two weeks. While this type of routine may suit single workers, married workers generally find that this places a strain on their families.

AUSTRALIA: MINERAL, URANIUM AND COAL RESOURCES



Source 3.29

Source: Oxford University Press

## Case study: Tom Price, Western Australia

In many ways Tom Price is a typical mining town. It is home to about 2700 people, almost all of whom are involved, directly or indirectly, in the mining industry. Of the workers in the town over the age of 15, almost 50 per cent work in the mines. Half of these workers categorise their jobs as machinery operators or drivers.

The children who attend one of the three local schools almost all have at least one parent employed at the mine. The local high school works in partnership with the international mining company that owns and operates the mine, Rio Tinto, to educate students about jobs in mining. The supermarket, milk bars, service stations, vets, chemists, doctors, hardware store and carpet cleaner all rely on the income from miners to keep their businesses running. While this is great for the town when the demand for iron ore is high, it can cause problems when demand falls. Industries and places that rely on selling one resource, such as a particular mineral, are sometimes referred to as being in a 'boom or bust' cycle.

Another problem facing the residents of Tom Price is a shortage of homes. During boom times, new workers and people looking for work at the nearby mine arrive regularly and need accommodation. This demand for housing means that house prices go up quickly, making it difficult for young adults in the town to buy a house. In the Pilbara mining town of Newman, for example, houses tripled in price between 2004 and 2008.

## skilldrill

### Understanding population pyramids

Population pyramids are bar graphs that show the percentage of males and females of different ages in a population. They help geographers compare different groups within a population and also allow them to identify trends and patterns of change (for example, in a city or country). Follow these steps in order to understand population pyramids:

**Step 1** Be sure to read the title of the population pyramid carefully. This will tell you exactly what population is being studied. Also look at the labels running along the bottom (percentage or total population) and through the middle of the pyramid (age groups).

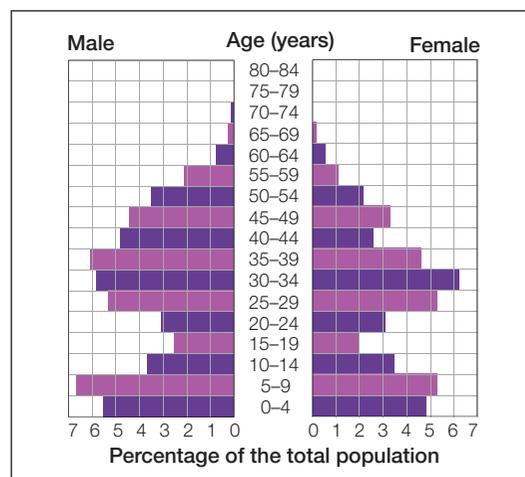
**Step 2** Population pyramids are organised so that the younger age groups are at the bottom and the older age groups are at the top. Percentages (or numbers) of men are always shown on the left-hand side and percentages (or numbers) of females are shown on the right-hand side.

**Step 3** To compare the percentage of males and females in the same age groups, read across the rows. The scale on the male side begins at zero and increases from right to left. The scale on the female side begins at zero and increases from left to right.

**Step 4** To compare the percentage of only males or females, look up and down the columns.

#### Apply the skill

- Using Source 3.31, complete the following tasks:
  - What percentage of the population in Tom Price is girls aged 10–14?
  - Are there more men or women aged 35 to 39 in Tom Price?
  - Which is the largest single group in Tom Price?
  - Is there a greater percentage of males or females in Tom Price? Why might this be the case?
  - Which group in Tom Price is the smallest? Try to estimate what percentage of the total population is made up by this group.



**Source 3.31** Population pyramid for the town of Tom Price Western Australia

### Check your learning 3.7

#### Remember and understand

- What services are difficult to supply to remote areas?
- Why don't many people live in the centre of Australia?
- Why don't the local Warlpiri people just move to a different area with more services?
- How many people live in the town of Tom Price and what work do they do?
- Why do some people choose FIFO?

#### Apply and analyse

- Use the information provided in Source 3.27 to create a table listing all of the services available in Yuendumu. List each of the services under the following headings: water and sanitation; transport; power; industry; education; and recreation.
- How does the land tie the people of Tom Price and Yuendumu to their remote locations?

## 3.2 bigideas: broadsheet

# Living on Macquarie Island

Macquarie Island is one of the most remote places on Earth. It is located in the Southern Ocean, approximately halfway between Australia and Antarctica. Macquarie Island is an Australian territory and home to about 40 scientists in summer and about 20 in winter. They live and work in the research station on the northern tip of the island. At the station there are facilities such as buildings in which to sleep and eat, a diesel power station, a greenhouse for growing vegetables, helicopter pads and even a brewery. From here the scientists explore the island and try to find out more about the island itself and the animals and birds that live there.

**Source 3.32** Oblique aerial view of the scientific base on Macquarie Island



### skilldrill

## Preparing fieldwork sketches

Fieldwork sketching helps geographers record and label important aspects of the landscapes they are investigating. It is a skill that you will need to practise before taking part in any field trips.

### Apply the skill

Imagine you are on a field trip to Macquarie Island and that the scene in Source 3.32 is in front of you. Follow these steps to create a field sketch of the scene and use the map to help you label the key features.

**Step 1** Boundaries and border: Establish the boundaries of your landscape and draw a border of the correct shape.

**Step 2** Sketch outlines: With a graphite pencil, lightly sketch the main landscape lines. If there is a horizon in the scene put this about one-third from the top of the frame.

**Step 3** Details: Keeping in mind the features on which you want to focus, add detail to your sketch. Label those parts of the scene that you consider to be most important.

**Step 4** Shade: Add shading, which helps to establish depth in your sketch and to show the shape of objects.

**Step 5** Colour: Add some colour if you wish. Do not try to copy every subtle colour of nature; just give a hint of the right colour.

**Step 6** Finishing touches: Label your sketch with the location and date.



# 3.3 How do people connect to different places?

## Connecting through communities

A community is a group of people who share something in common. It may be the place in which they live, their religion, their interests or hobbies, their **ethnicity**, their school or their language. Every person on Earth is a member of one or more communities, some by choice and some just by being who they are. To make sense of all the world's communities, geographers take into account the features that all members of a community share. One way to classify these features uses the five Ps shown in Source 3.34.

A group of people who share the same goals and objectives often join together to form communities of purpose. They are able to achieve much more if they work together than if they work as individuals. One of Australia's largest communities of purpose is Surf Life Saving Australia (SLSA), which has over 150000 members, virtually all of whom are volunteers. The shared vision of SLSA members is 'to save lives, create great Australians and build better communities'.



Source 3.34 Classifying communities



**Source 3.35** Surf lifesavers making one of the 12000 rescues carried out in 2011 – they are an example of community of purpose.

## Check your learning 3.8

### Remember and understand

- 1 What type of community is a school?

### Apply and analyse

- 2 Explain why SLSA can be considered to be a community of purpose.
- 3 Name three other communities of purpose.
- 4 Classify each of these groups under one of the five types of communities:
  - a the Labor Party
  - b employees of BHP Billiton
  - c residents of Yamba in New South Wales
  - d a Scout group
  - e your family.
- 5 The surf lifesavers in Source 3.35 are members of a community of purpose. Why is it likely that they are also members of a community of place?

## skilldrill

### Drawing a concept map

A **concept map** is a visual tool used to show the links between different ideas or pieces of information. Each idea (or piece of information) is usually represented in a circle or box and the relationship between two ideas is shown by a line or arrow connecting them. Words on the line or arrow explain the relationship between the two ideas. Concept maps can be hand drawn or prepared using computer software.

To draw a concept map, follow these steps:

**Step 1** Draw and name the focus, central idea or main problem you are trying to explore. In the example in Source 3.36, this is 'My communities'.

**Step 2** Build the concept map by adding ideas related to the central idea.

**Step 3** Add a title to help the reader quickly understand your concept map.

### Apply the skill

- 1 Construct your own concept map to show the communities you are connected to. Place your name in the centre box. Add the types of communities to the connecting lines. Choose from the five types of communities shown in Source 3.34, such as place.

### My communities



**Source 3.36** An example of a concept map

# Community identity

## Case study: Melbourne's Indian community

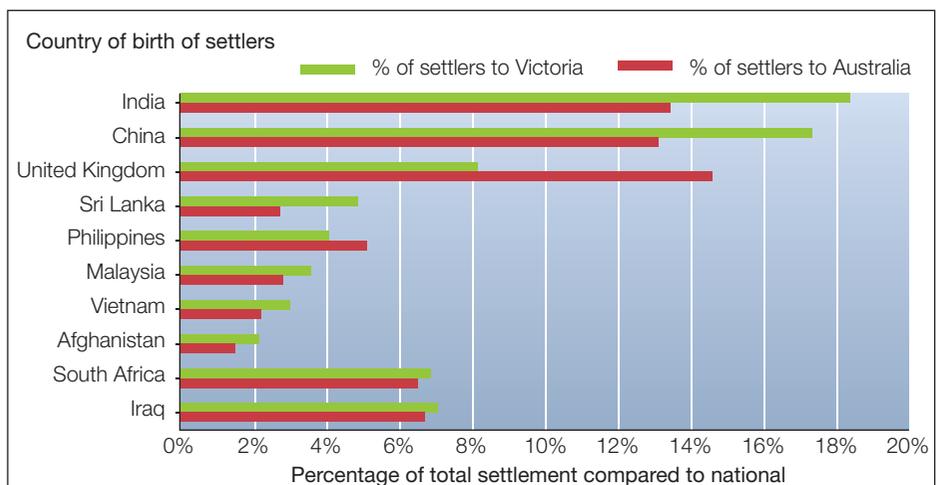
People who share similar histories (such as family, language and ethnic groups) are communities of past. Melbourne has Australia's second largest Asian population, including Australia's largest Indian and Sri Lankan communities. The Indian community has influenced the character of Melbourne by sharing its culture, clothing, festivals, beliefs, celebrations and food.

Often communities of past, such as the Indian community, share the same religious and spiritual beliefs, so they are also an example of communities of perspective. Hinduism is the world's third largest religion and one of its oldest. About 1 billion people today are Hindus and about 98 per cent of them live in India. As Indians migrate to other countries, such as Australia and New Zealand, the number of Hindus in those countries also increases. Today there are more than 40 000 Hindus in Melbourne and Hinduism has become the city's fastest growing religion.

Belonging to a religious community is a vital part of many people's identity. As a multicultural country there are a wide range of religious communities in Australia and, despite a few isolated examples of intolerance, religions here happily co-exist. This is not always the case overseas; in some countries, religion is often the basis of conflict and war.



Source 3.37 Shri Shiva Vishnu Hindu temple in Carrum Downs on the outskirts of Melbourne



Source 3.38 A bar graph comparing the percentage of overseas settlers to Victoria and Australia by country of birth (2006–2011).

## Reading compound column graphs

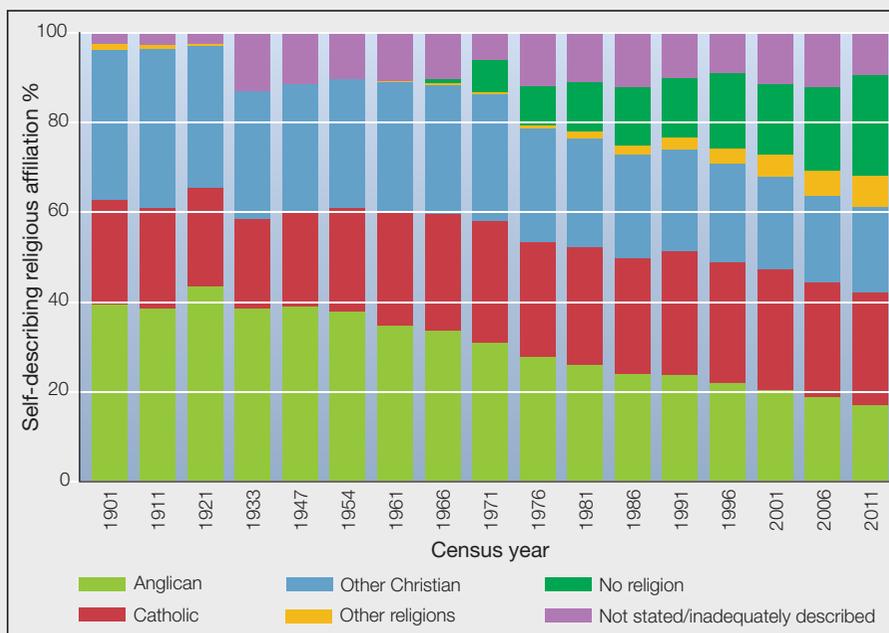
A **compound column graph** divides each column into its different parts. This allows us to easily see patterns in the information. For example, in Source 3.39 the columns show religious affiliations in selected years. The columns are divided to show the different religions, such as Anglican or Catholic.

To interpret Source 3.39 and other compound graphs follow these steps:

- Step 1** Read the title carefully so that you understand what is being shown on the graph.
- Step 2** Look closely at each scale. In this graph you will notice that the vertical axis shows percentages rather than numbers.
- Step 3** Look closely at the legend and colours so that you understand the divisions within each of the columns.
- Step 4** Look for major patterns. In this graph, there has been an obvious decline in the percentage of Australians who are Anglicans, and an increase in the percentage of people who practice no religion.

### Apply the skill

- 1 Study Source 3.39. Which of these statements are true and which are false?
  - a Most Australians are Christians.
  - b In 1921 most Australians were Anglicans.
  - c In 2011, there were more people with no religion than there were Catholics.
  - d Up to the 1970s virtually all Australians were Christians.



**Source 3.39** A compound column graph comparing the percentage of Australians following various religions (1901–2011)

## Check your learning 3.9

### Remember and understand

- 1 Look carefully at Source 3.37. Suggest two ways in which the Indian community have influenced the character of Carrum Downs.
- 2 Look at Source 3.38. What percentage of settlers in Victoria were from India? How does this compare with settlers from other countries?
- 3 Settlers from China are the next biggest group of migrants moving to Victoria. What impact would you expect this group to have on communities in Victoria?
- 4 The Hindu community of Melbourne is a community of perspective. Explain what this means.

### Apply and analyse

- 5 Carefully study the compound column graph (Source 3.39).
  - a Describe the changes over time in the religions followed by Australians.
  - b Why do you think these changes have occurred?
  - c Based on the pattern shown in the compound column graph, do you think Christianity will cease to be the dominant type of religion followed in Australia? If so, when do you think this will occur?

# Indigenous communities

Indigenous Australian communities share an ethnic background, have strong family ties and centuries of shared history and beliefs. These factors make them an example of a community of the past. Indigenous Australian communities are found throughout Australia and tend to have strong spiritual connections to the land. These factors also make them an example of a community of place.

There are two distinct groups of Indigenous Australians. The largest group are Aborigines from mainland Australia and Tasmania. The second group are native to the Torres Strait Islands, the islands between Australia and Papua New Guinea. Although they are more closely linked (in terms of ethnic origins) to the Melanesian people of Papua New Guinea than with Aboriginal Australians, Torres Strait Islanders are Australian citizens. The border between Australia and Papua New Guinea means that Thursday Island (along with many other islands in the Torres Strait) is considered part of Queensland, not part of Papua New Guinea.

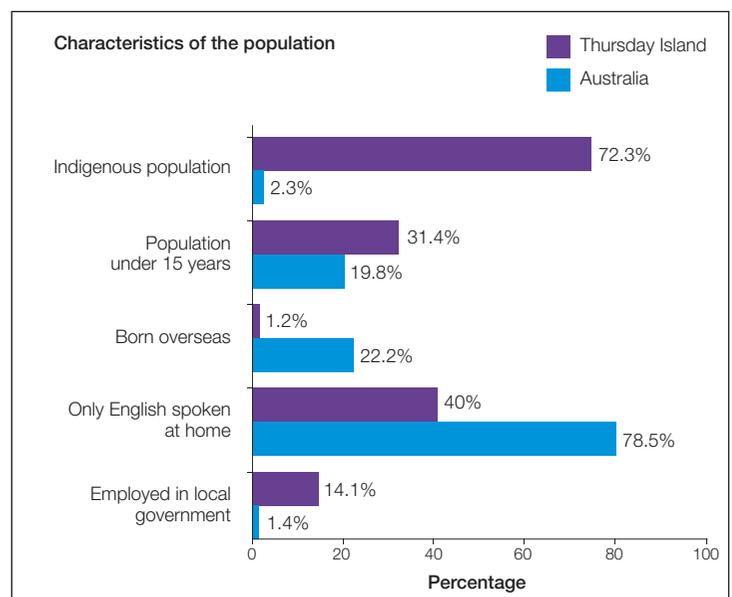


**Source 3.40** Thursday Island children play on the beach of their island home.

## Case study: Thursday Island communities

Thursday Island lies in a cluster of Islands in the Torres Strait just off Cape York, the northernmost tip of Australia. Thursday Island has the largest population of all the Torres Strait islands, and is where most of the local government functions for the islands are located. As the administrative centre, Thursday Island's 2500 people have access to excellent facilities, including several schools, a TAFE college, a hospital, a childcare centre, a library, a sports stadium with a swimming pool, parks and gardens. There is little fresh water on the island so a pipeline brings water from nearby Horn Island. Daily flights from Cairns to Horn Island and then a short ferry ride to Thursday Island reduce the isolation of life on the island.

With year-round warm temperatures and easy access to tropical reefs, the beach is the main focus of most leisure activities for children on Thursday Island. The islanders are keen fishermen and the warm waters support a great variety of marine life. Many islanders are also passionate about sports, with NRL player Sam Thaiday and basketballer Patrick Mills, both of Torres Strait Islander descent, being particular favourites.



**Source 3.41** A bar graph comparing some key population statistics on Thursday Island with mainland Australia

THURSDAY ISLAND: TOPOGRAPHICAL MAP



Source 3.42

Source: Oxford University Press



Source 3.43 An oblique aerial photograph of Thursday Island showing the Thursday Island Hospital in the foreground (left) and Hammond Island in the background.

### Check your learning 3.10

#### Remember and understand

- 1 Explain why Torres Strait Islanders have strong connections to Papua New Guinea even though they are Australian.
- 2 What community services are located on Thursday Island?

#### Apply and analyse

- 3 Examine Source 3.41.
  - a Which of these statistics do you find most surprising? Why?
  - b Explain why so many Thursday Islanders work in local government.
  - c Write a 50-word paragraph comparing key characteristics of the population on Thursday Island with the wider Australian population.
- 4 Examine Source 3.42.
  - a What are the advantages of the location of the main urban area on Thursday Island? What are the disadvantages?
  - b Where would you have chosen to build the urban centre?
  - c What is the name of the highest point on Thursday Island? How many metres above sea level is it?

# Liveability in communities

A community of place refers to a group of people with a common interest or goal. This common interest may be linked to where they live, work or spend a large part of their time. The word community can be used to describe groups like neighbourhoods, towns, workplaces, schools, sports clubs, church groups, or very large groups like members of the same religion, or citizens of the same country.

People connect with places where they feel included and safe. They connect through community services (such as schools, hospitals and libraries), job opportunities (such as the type and amount of work available) and entertainment and recreation (such as concerts, sporting events and festivals).

## Check your learning 3.11

### Remember and understand

- 1 What is a community of place?
- 2 How is the liveability of a community measured?

### Apply and analyse

- 3 Use Source 3.47 to provide a grid reference for:
  - a Recreation facility
  - b Transport hub
  - c Source of employment
  - d Education facility
- 4 Altona and Altona North are largely populated by families. What evidence can you find using Source 3.47 that the local community is made up of many families.

## Community services

We are all part of a broad community based on where we live. This may be a suburb in a city, a town or a small settlement, but it can even be as big as a whole country. Governments and local councils supply a range of services to these communities, such as schools, hospitals, libraries, transport, parks and rubbish removal.

Different communities require different services. For example, a community with a younger population might require more schools and facilities such as skate parks. An older community might require greater access to health care and retirement villages.



**Source 3.44** Altona P-9 College, E9 on the map opposite

## Job opportunities

Local communities provide employment opportunities or good access to places of work, training and education. Businesses and industries, as well as providing services for the community, also provide jobs. Some examples of businesses found in many local communities include shops, hairdressers, plumbers, banks and solicitors. An industry may be a one-person operation or a large manufacturing business that employs hundreds of people. Industrial areas are usually grouped together. Industries generally require large areas of flat land and access to power, transport and parts.



**Source 3.45** The Toyota car factory in Altona North, G2 on the map opposite

## Entertainment and recreation

Leisure facilities such as basketball courts and skate parks are provided and maintained by local councils. Special areas are also set aside for recreation, such as parklands and sporting fields. These areas allow residents to socialise and exercise outdoors. In addition to these recreation areas, special conservation zones are set up by councils to ensure that native plants and wildlife are protected.



**Source 3.46** The Altona Youth Centre, G10 on the map opposite



Source 3.47 Street directory map of Altona

Source: Melway

# Building safe communities

The most liveable cities are those where people feel safe – not only for themselves, but also for their families and their property. Fear of crime can affect quality of life, reducing social interaction between people and forcing people to avoid certain places. Every year the Property Council of Australia surveys local residents across Australia about 17 different liveability factors. Each year the results clearly show that safety and security is the most important liveability factor for residents in our cities and towns.

Safety in the community is not just about crime rates, but also about how safe people feel in their community. The compound column graph in Source 3.48 shows the percentage of Australians (in all states and territories) who feel at risk from a range of different crimes and anti-social behaviours taking place in their communities. (For more information on compound column graphs refer to section GT.2 of ‘The geographer’s toolkit’.) For example, 32 per cent of people surveyed in the Northern Territory feel threatened by people hanging around in groups, whereas in the ACT, it’s only 11 per cent.

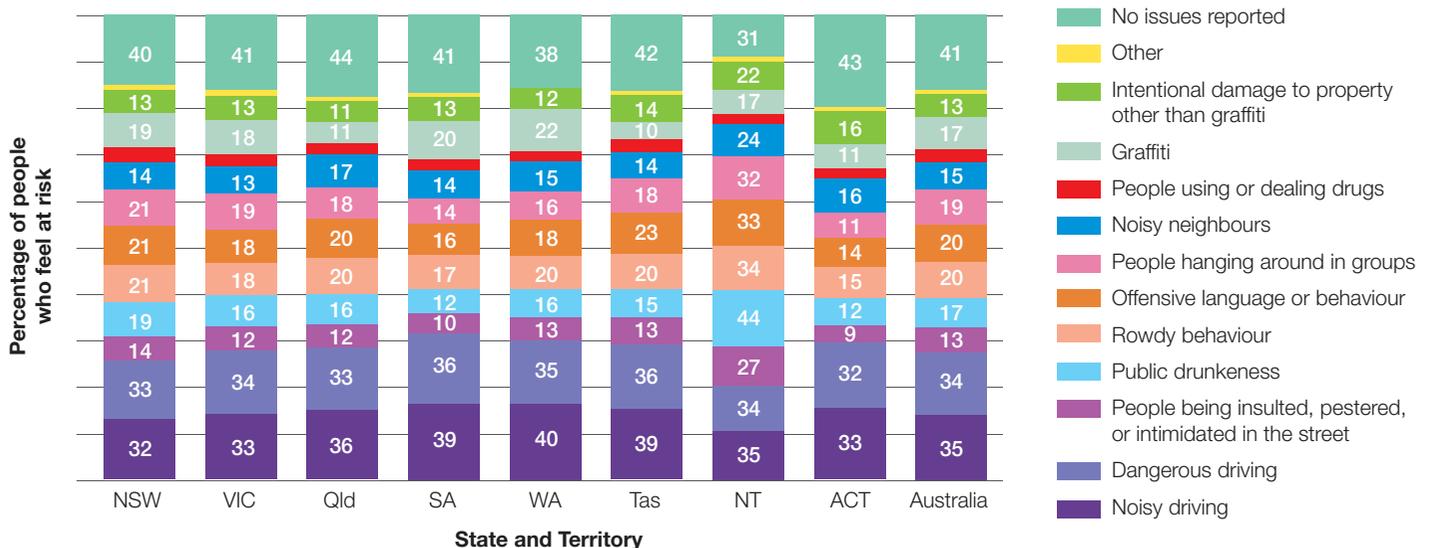
Governments and local councils are always trying to improve the design of local environments to create safer places and encourage community-based activities. Surveys of local areas assist authorities to identify the key issues and map problem areas. With this information, they can then work to find solutions to these problems.

## Safer community design

A key step towards improving local safety has been making public areas more visible. This has been achieved by different methods such as designing buildings to face public space, removing bushes to give a clear line of sight, improving lighting and introducing surveillance cameras. These strategies help reduce the numbers of crimes by making places, and therefore any criminal activity, easier to see.



Source 3.49 Dark alleyways and parks are places where crimes can go undetected. These areas are generally avoided by local residents.



Source 3.48 A compound column graph showing the percentage of people who feel at risk from crime and anti-social behaviour across Australia (by state), 2011.

Source: Australian Bureau of Statistics

## Community policing

In recent decades, the police have developed community programs to create stronger ties between the general community and the police. The goal here is to involve members of the community in keeping their own streets safe. The most successful of these programs has been Neighbourhood Watch. The police work with local communities to educate communities on safety and security issues and to encourage people to look out for, and report, any suspicious behaviour. The program also encourages community members to get to know each other, share safety concerns and support each other to stay safe.

## Helping at risk groups

Many government and not-for-profit groups work within local communities to provide outreach services for the most vulnerable members of the community. These services include things such as temporary and permanent housing, food trucks for the homeless and poor, support services for victims of domestic violence, rehabilitation programs for alcoholics and drug addicts, drop-in centres for disadvantaged youths, and home services such as Meals on Wheels for the elderly. These services help to protect and care for those in our communities who need it most.



**Source 3.50** Neighbourhood Watch (along with other community policing programs) has been used to reduce crime in local communities and create stronger ties between the police and members of their communities.



**Source 3.51** Soup kitchens and food vans provide meals for the homeless.

## Check your learning 3.12

### Remember and understand

- 1 Why do you think safety is the most important liveability factor for communities across Australia?
- 2 What example is given of police working with the community to reduce crime and increase feelings of safety?
- 3 How does increased visibility in streets and public spaces help to prevent crime? What strategies help to increase visibility?

### Apply and analyse

- 4 Look carefully at Source 3.48.
  - a What crime issues were most reported in the survey?
  - b In which categories did the Northern Territory score the highest? What strategies might police introduce to try to reduce this behaviour?
  - c In what state is graffiti considered to be the biggest problem? Why might this be the case?

### 3.3 bigideas: broadsheet

## Change in Casey

To deal with increasing populations, cities often establish new suburbs on their urban–rural fringes. Housing estates that are built on the edges of cities attract young families by offering cheaper land and affordable houses. As the population grows in a new suburb, services are attracted to the area as well. Schools, shopping centres, medical centres and sporting facilities open to meet the needs of the new community. As these services become more established, the opportunities for people to interact and feel like members of the community increase.



**Source 3.52** An aerial photograph of Narre Warren in the municipality of Casey on the outskirts of Melbourne (2007).

### skilldrill

## Drawing overlay maps from street maps

One of the best ways to show how a place has changed over time is to draw an overlay map of the area. An **overlay map** allows you to show a place at two different times so that you can see any changes that have occurred over time.

To construct an overlay map from the street maps of Narre Warren showing changes between 1985 and 2007, follow these steps:

- Step 1** Draw a base map of Narre Warren in 1985 by tracing the important features from the 1985 street map (Source 3.53). Show the two main roads and the extent of the Fountain Gate Regional Shopping Centre. Design a legend showing residential areas, recreation areas, education and vacant land and shade these areas on your map. Finish your map with BOLTSS.
- Step 2** Attach a piece of tracing paper to your base map using sticky tape along one edge like a hinge. This allows you to lift it up to easily see the map below. This top map is known as the overlay map.
- Step 3** Use the same legend on the overlay map as you used on the base map to shade in the main land uses as shown in the 2007 street map (Source 3.54). You will need to give this map a different title, but as it has the same border, orientation, legend, scale and source as the base map you do not need to repeat these on the overlay map. Make sure that your overlay title does not cover any part of the base map title.

### Apply the skill

- 1 Using the steps outlined above, construct an overlay map from the street maps of Narre Warren (Sources 3.53 and 3.54).

NARRE WARREN, 1985



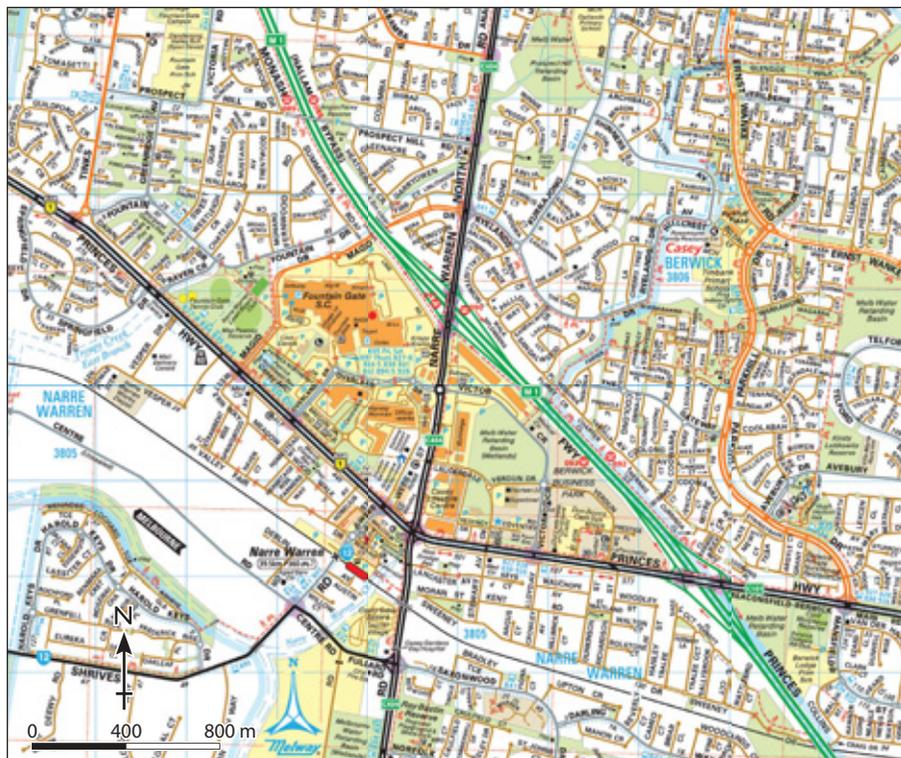
Source 3.53

Source: Melway

**Extend your understanding**

- 1 Look carefully at the street directory maps (Sources 3.53 and 3.54).
  - a What type of land use increased the most between 1985 and 2007?
  - b What land use decreased the most?
  - c What happened to the shopping centre in this time?
  - d Describe the spatial change in the area east of Narre Warren North Road between 1985 and 2007.
- 2 Find the Fountain Gate Primary School in 1985 (Source 3.53). It had recently moved here when this map was drawn.
  - a What does a new primary school suggest about families moving to the area?
  - b What new services had been added north of the school by 2007?
  - c Why do you think these new services were required?
  - d Describe the distribution of schools in Narre Warren in 2007.
- 3 Source 3.52 is a vertical aerial photograph of a place in Narre Warren.
  - a Use clues in the photograph to identify the key features.
  - b What clues suggest this photograph was taken after 2007?
- 4 What are some of the factors bringing change to this community?
- 5 Describe the changes to transport links in this community between 1985 and 2007.

NARRE WARREN, 2007



Source 3.54

Source: Melway

# Liveable cities

As we have learned, there are a range of factors that make places more or less liveable. Liveability is generally measured by factors that provide quality of life, such as access to fresh water, food, housing, transport, health care, education and a safe and stable environment. Each year, the results of a number of studies are released rating cities all over the world in order of liveability. In 2012, the capital city of Bangladesh, Dhaka, was rated as the world's least liveable city. It scored poorly in health care, public transport, crime and sanitation. Melbourne, Australia was rated the world's most liveable city.



## 4.1

### What makes a city liveable?

- 1 What does this photograph tell you about the availability of services (such as water, housing and education) in Dhaka?
- 2 In Bangladesh there is widespread poverty and government corruption. How might this make it difficult to provide services such as water and public transport?

## 4.2

### Where are the world's most and least liveable cities?

- 1 What do you think is meant by the word liveability?
- 2 Many European, North American and Australian cities tend to be rated highly in terms of liveability, whereas many Asian and African cities tend to be rated poorly. Why do you think this is the case?



**Source 4.1** A young boy living in a slum in the Bangladeshi capital, Dhaka, uses a toilet perched over a river that is also used for drinking and bathing.

## 4.3

How can we make cities more liveable?

- 1 In the 2013 survey, Melbourne was rated the world's most liveable city, but some parts of Melbourne are rated much higher in terms of liveability than others. Why do you think this is the case?
- 2 Think of a town or city you know well; what services and facilities could make this town or city more liveable?

# 4.1 What makes a city liveable?

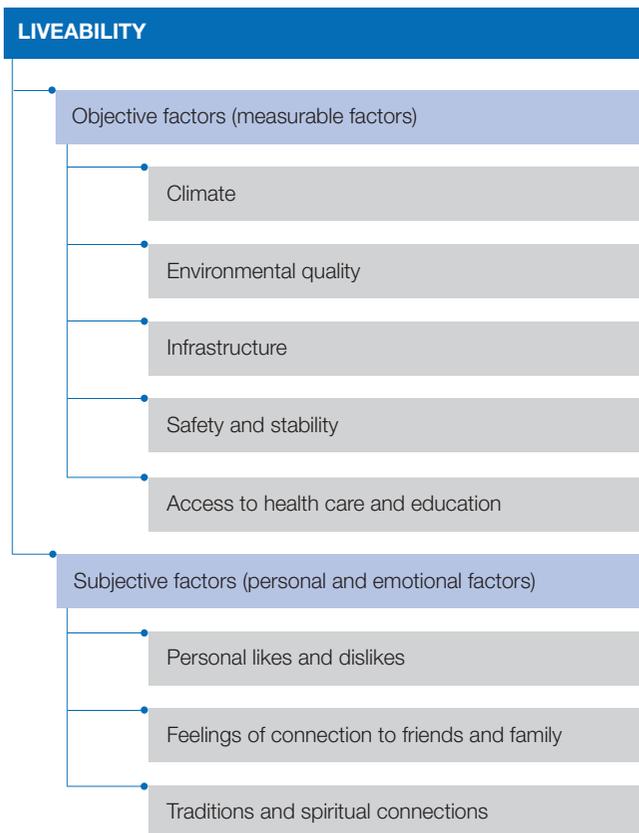
## Measuring liveability

The liveability of a place is generally measured by a number of different factors relating to quality of life. People's views about the liveability of a place can vary depending on their age, income, cultural background, lifestyle choices, values and beliefs.

The factors that influence people's ideas on liveability can be measured in two ways: by objective factors and subjective factors. Objective factors are things that can be measured and expressed as numbers, such as the cost of housing, the climate, the number of hospitals and schools, the availability of public transport, and the level of crime. Subjective factors are things that are personal, emotional and spiritual, and that cannot be easily measured or expressed as numbers. Examples of these

factors are people's spiritual connections and sentimental attachments to a place (see Source 4.2).

Each year, a number of different companies review the liveability of cities around the world in terms of their objective factors, ranking them from the most to the least liveable. The most well-known of these surveys is conducted by an organisation called the Economist Intelligence Unit (EIU), which publishes an annual list of rankings. They rank cities based on a set of criteria using objective factors. Other organisations, such as Mercer and the Organisation for Economic Cooperation and Development (OECD), also produce regular reports, with the OECD, also incorporating more subjective factors into their surveys.



Source 4.2 Liveability can be measured by objective and subjective factors

### Objective factors

There are many different objective factors that affect liveability. The most important are introduced briefly below, then covered in more detail later in this section of the chapter.

#### Climate

Climate is one of the most important factors affecting the liveability of a place. Although different people like different types of weather, most people agree that a mild climate without extremes of heat or cold is ideal. Places with mild (temperate) climates often score highly in terms of liveability. The amount of rainfall is also key when it comes to climate. Too little or too much rain has a negative effect on the liveability of a place.

#### Environmental quality

The environment is another key factor that determines how liveable a place is. Environmental quality can refer to a number of characteristics relating to the natural or built environment, such as clean water and clean air. It can also be a measure of other things such as the level of pollution, rubbish or noise in an environment.

## Infrastructure

The availability of services and facilities (such as roads, public transport, emergency services, post offices, water, sewerage treatment plants, airports, housing, sporting and entertainment facilities, electricity and communications) helps make a place more or less liveable. Together these services and facilities are referred to as **infrastructure**.

## Safety and stability

Safety and stability are two of the most important factors linked to the liveability of a place. More than most other things, people value feeling safe and stable in their homes. Australian cities are regarded as some of the most liveable places in the world for this reason. Safety and stability are measured by taking into account crime statistics and other information collected by the government. Many of the world's least liveable cities are found in war-torn countries such as Iraq and Afghanistan, where crime rates are very high and there are very few police to enforce the law. For this reason, many refugees flee to countries such as Australia in search of safety and stability.

## Assess to health care and education

In general, people living in the world's most liveable cities have access to good health care services, including doctors, public and private hospitals, specialist clinics and over-the-counter medication. They also have access to a range of schools and other education facilities, such as training centres and universities. In many of these cities, including those in Australia, a school education is not only compulsory but is also free. Cities in Canada, the USA, Australia and Western Europe generally rank highly in both health care and education. African cities are the lowest ranked in the world in terms of these services.



**Source 4.3** A young schoolgirl looks through a hole in the damaged wall of her school in Gaza City following Israeli bombings in 2012. Feeling safe is a key factor that affects the liveability of places.

## Subjective factors

Unlike objective factors, subjective factors cannot be easily measured and compared. They are linked to personal likes and dislikes, and feelings of connection to family, friends and cultural groups. They are also linked to beliefs, traditions and spiritual connections to places. Organisations such as the OECD are now conducting life-satisfaction surveys in order to take some of these subjective factors into account when rating the liveability of different places. These surveys try to take into account how happy or sad people feel, and look for the factors in their lives and environments that cause these feelings. This information is then taken into account alongside more objective measures in order to give a more complete picture of liveability.

## Check your learning 4.1

### Remember and understand

- 1 How do companies measure the liveability of places around the world?
- 2 What are the objective measures of liveability for countries? Why are these important?
- 3 What are subjective measures of liveability and how are they measured?

### Apply and analyse

- 4 Safety is a key liveability measure in all communities.
  - a What do you think are the most important safety issues for people living in large Australian cities?
  - b What do you think are the most important safety issues for people living in Gaza City (see Source 4.3).
  - c What safety issues are similar and which are different?

# Climate

The **climate** of a place has an important impact on its liveability. Different climates suit different people, but it is generally agreed that mild temperatures without extremes of heat or cold help to make a place more liveable.

Reliable rainfall, low humidity and little likelihood of weather-related disasters, such as cyclones and floods, are also seen as being desirable. These factors increase the liveability of a place

## skilldrill

### Comparing climate graphs

**Climate graphs** show the maximum and minimum temperatures as **line graphs** using the scale on the left-hand vertical axis, and rainfall as a **bar graph** using the scale on the right-hand vertical axis. The months are shown on the horizontal axis. By comparing climate graphs, geographers can better understand the differences between climates and the reasons for these differences.

**Step 1** Select climate graphs for two locations for comparison.

**Step 2** Describe the climate of one of these locations. Include the following elements of climate:

- The rainfall pattern: Mention whether rainfall is consistent throughout the year or whether there are clear wet and dry seasons. In particular, mention the highest rainfall month and any periods with little or no rainfall.
- The temperature pattern: Mention periods of warmer temperatures and colder temperatures, if these occur. If there is a more consistent, even temperature

throughout the year state this. Use temperature figures in your description of the temperature pattern.

**Step 3** Describe the climate of the other location that you have chosen for comparison using the same method.

**Step 4** Point out the obvious differences in the climates of the two locations.

**Step 5** Try to explain these differences. Some of the most likely explanations are given below:

- Places nearer to the Equator are warmer than places closer to the poles. They also tend to be wetter with rainfall occurring throughout the year.
- Places near or beside oceans have milder climates with fewer extremes than places in the centre of large land masses.
- Places at high altitude are colder than places at sea level. They are often wetter as well.

**Step 6** Point out any similarities between the two locations.

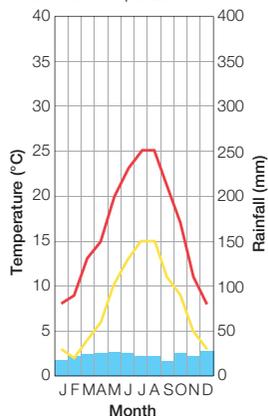
### Apply the skill

- 1 Using the steps outlined above, compare the climate of two cities shown in Source 4.4.

① Acceptable humidity and temperature:

#### Paris

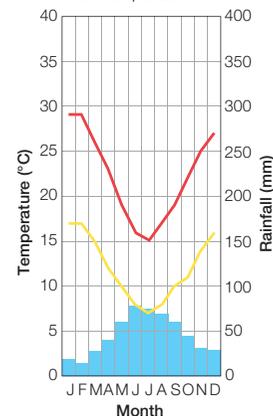
— Maximum temperature    ■ Rainfall  
— Minimum temperature



② Tolerable humidity and temperature:

#### Adelaide

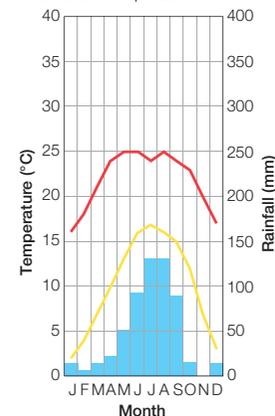
— Maximum temperature    ■ Rainfall  
— Minimum temperature



③ Uncomfortable humidity and temperature:

#### Kathmandu

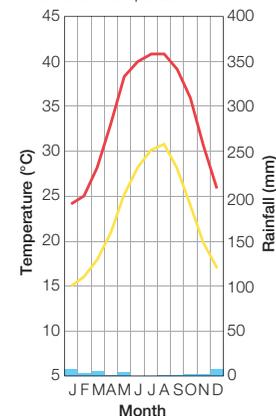
— Maximum temperature    ■ Rainfall  
— Minimum temperature



④ Undesirable humidity and temperature:

#### Dubai

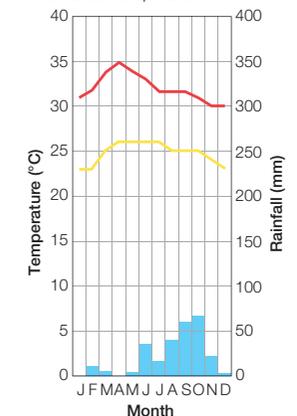
— Maximum temperature    ■ Rainfall  
— Minimum temperature

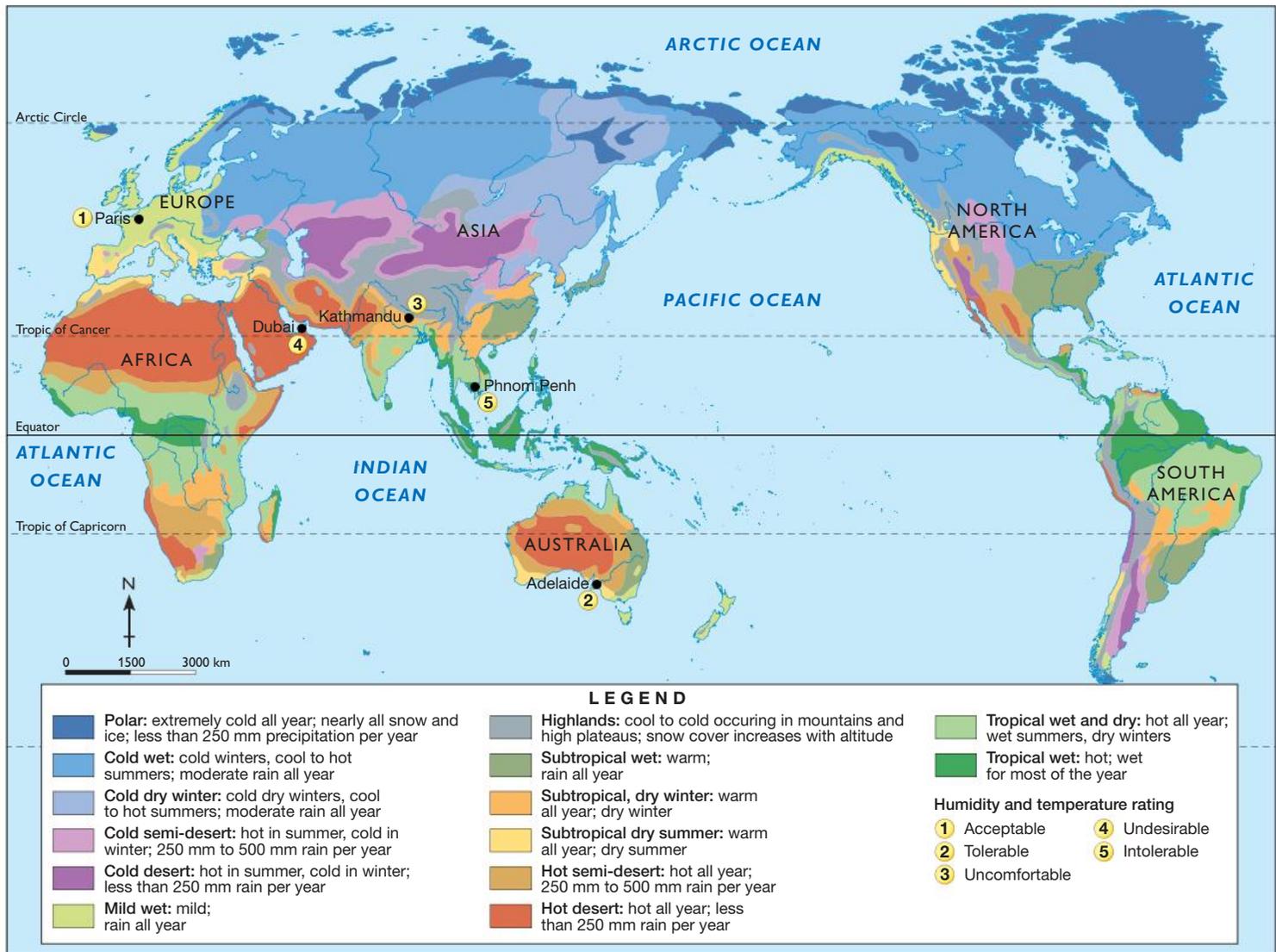


⑤ Intolerable humidity and temperature:

#### Phnom Penh

— Maximum temperature    ■ Rainfall  
— Minimum temperature





Source 4.5

Source: Oxford Atlas

## Check your learning 4.2

### Remember and understand

- 1 Name the city that is described as having acceptable temperature and humidity.
- 2 What is the connection between climate and liveability?

### Apply and analyse

- 3 Why do you think Kathmandu's climate has been described as uncomfortable?
- 4 Which city has tolerable rather than acceptable weather?
- 5 Look carefully at Sources 4.4 and 4.5.
  - a Which city has intolerable humidity and temperature?

- b What type of climate does this city experience?
- c What types of climate are experienced by the cities that have acceptable levels of humidity and temperature?

### Evaluate and create

- 6 How do people adapt to living in places with undesirable climates?
- 7 What features of the natural environment other than climate may affect a city's liveability?

# Environmental quality

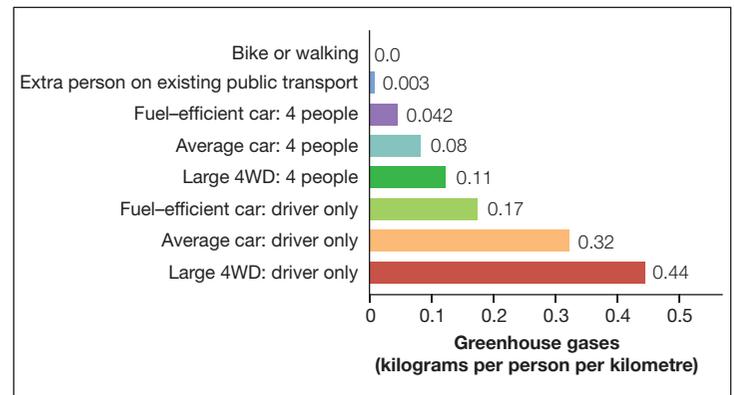
The quality of air, water and parklands in cities is an important part of liveability for both health and aesthetic reasons. Air quality, in particular, can have a big impact on health.

Air pollution tends to be worse in large cities where factories, power stations and motor vehicles spew harmful gases into the air. The polluted air can sometimes be trapped close to the Earth's surface as smog, or thrown high into the atmosphere where it may contribute to a layer of gases responsible for global warming.

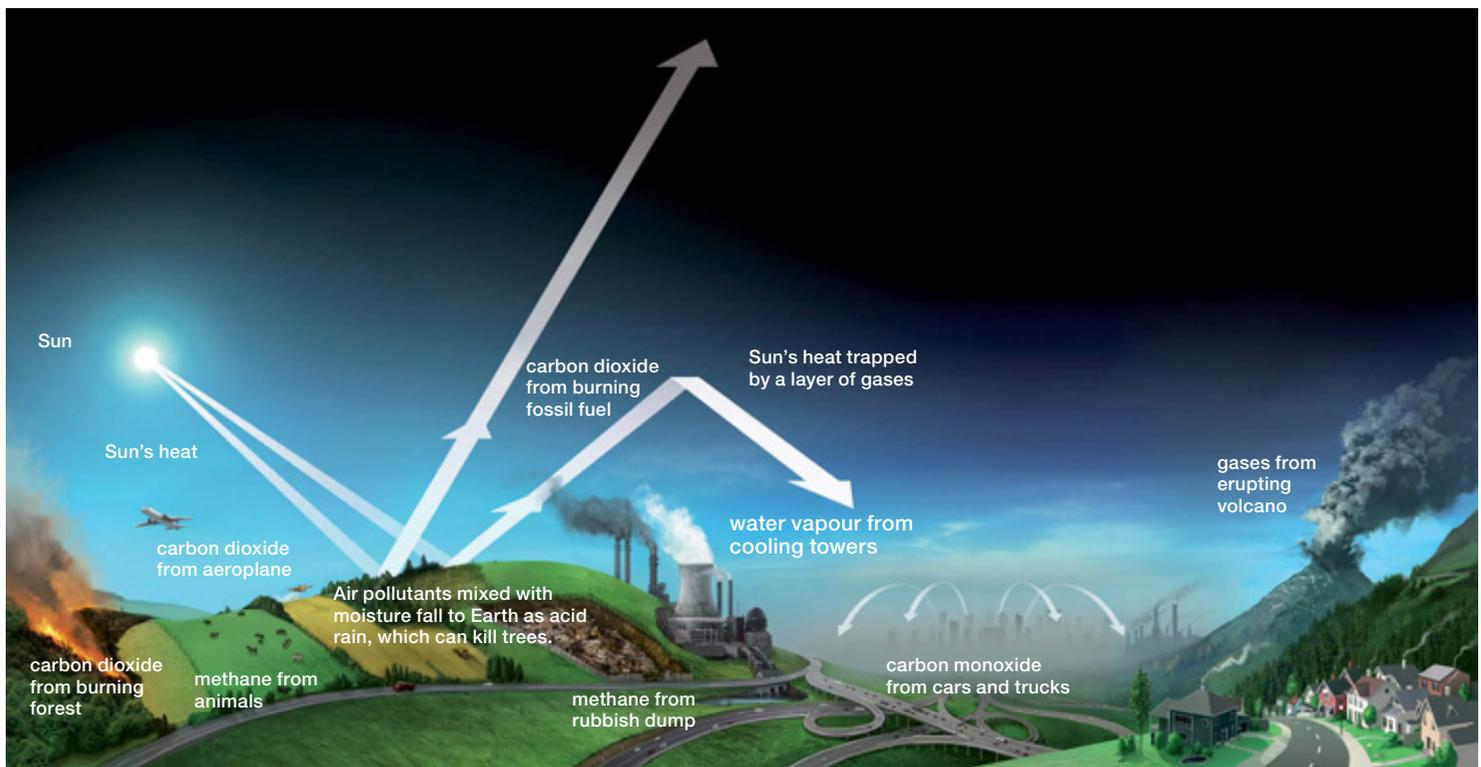
Increasing numbers of people and cars on our roads mean we need to take action to improve the quality of the air we breathe. Air quality in Australian cities is good by world standards, but can vary. In Sydney, Melbourne and Brisbane, the number of days per year where pollution exceeds the National Environment Protection Measures standard is generally less than 10. Some years it can be much higher, however, particularly when air quality is negatively affected by other events such as bushfires.

Australian governments have now introduced laws to deal with air and noise pollution, however urban air

pollution still accounts for 2.3 per cent of all deaths in Australia. Motor vehicles are the main source of air pollution. Although unleaded petrol and hybrid cars that run partly on electricity are helping to reduce pollution from motor vehicles, these have been offset by the ever increasing numbers of cars on the road. Walking, riding a bike or using public transport remain the most environmentally friendly ways to get around.

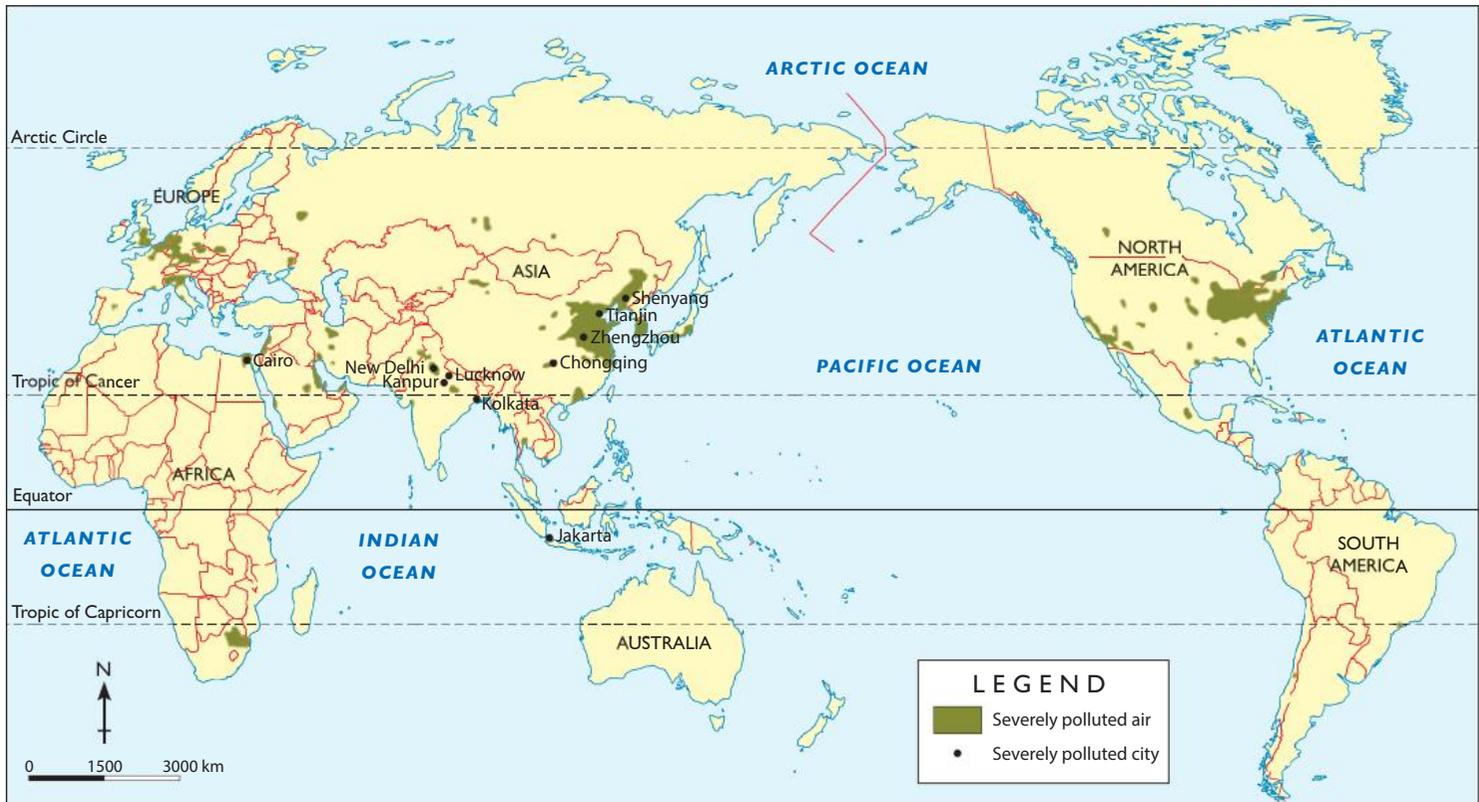


Source 4.7 Greenhouse gas emissions from different forms of transport



Source 4.6 Sources of air pollution

## WORLD: MOST POLLUTED CITIES



Source 4.8

Source: Oxford University Press

## Case study: Hong Kong

The city of Hong Kong in China is home to 7 million people. The liveability of Hong Kong is under threat from crippling pollution, three times the safe level set by the World Health Organization. Roadside pollution levels in Hong Kong are responsible for 90 000 hospital admissions and 2800 deaths each year.

In 2013, a strategy for decreasing pollution in Hong Kong was announced by electric vehicle maker BYD. The plan involves replacing Hong Kong's fleet of diesel buses and LPG taxis with fully electric vehicles that produce no exhaust fumes. Experts suggest that this strategy will reduce pollution from Hong Kong's vehicles by around 56 per cent. Replacing the 18 000 LPG taxis and 12 000 diesel buses with electric taxis and buses would lead to a reduction in emissions equivalent to more than 800 000 private cars. The plan will reduce costs, lower vehicle emissions and improve air quality.

## Check your learning 4.3

### Remember and understand

- 1 Look carefully at Source 4.6.
  - a List the causes of pollution in cities.
  - b List the causes of pollution in rural areas.
  - c Why do cities such as Sydney, Los Angeles and Mexico City suffer from smog?
- 2 Look at Source 4.8.
  - a On which continent are most of the top ten polluted cities located?
  - b Why do you think pollution is such an issue in these cities?

### Apply and analyse

- 3 Study Source 4.7.
  - a What is the difference in the amount of greenhouse gases released per person between one person driving a 4WD and four people travelling together in a 4WD?
  - b What could governments do to encourage more people to share their cars as a way of reducing air pollution?
  - c List the ways in which car sharing could potentially improve the liveability of a city.

# Infrastructure

Services and facilities (such as roads, public transport, emergency services, post offices, water, sewerage, airports, housing, electricity and communications) help make a place more or less liveable. Together these services and facilities are referred to as **infrastructure**.

## The world's best infrastructure: Singapore

Singapore is considered to have some of the best infrastructure in the world. Singapore has been recognised for its excellent roads, and for producing one of the world's busiest and most efficient ports. A first-class airport acts as a central Asian hub for tens of millions of travellers every year. Most Singaporeans live in high-rise apartment blocks in a form of public housing available to the majority of the population. These buildings are clean, modern and well serviced.

With its reliable electricity supply, Singapore has developed as a centre for advancement in technology and now boasts one of the best communication networks, with fast mobile and wireless Internet and communication services available everywhere.

Singapore also has a ready supply of fresh drinking water, a good sewerage system and, thanks to the Restroom Association of Singapore, the cleanest public toilets. Singapore can be particularly proud of its public transport with buses, taxis and two train networks covering the whole country. The use of public transport is encouraged – over 50 per cent of workers in Singapore travel to work on public transport.



**Source 4.9** Singapore's public transport system is considered one of the best in the world.



**Source 4.10** The road network in Singapore allows commuters to move around the city easily.

## The world's worst infrastructure: Dhaka

The capital of Bangladesh, Dhaka, is considered to have the worst infrastructure in the world. It rates poorly in the quality of its telecommunications, water and housing, but even worse in terms of transport. Both its road network and public transport are considered to be intolerable. This is due to a number of factors. Dhaka is a city of 16 million people and is growing at a rate of 4.2 per cent a year. This adds about 670 000 people to the city a year. By world standards, this represents rapid growth. Unlike other cities in Asia, the reason for Dhaka's growth is increased poverty not increased prosperity. Poor rural migrants flood into the city, placing the existing infrastructure under great strain. For many of the rural poor who move to Dhaka, pulling a rickshaw is their first job (see Source 4.12).

Only about one-quarter of Dhaka's population is connected to the sewerage system. The rest use open toilets in the street or slums where they live. Only two-thirds are connected to a reliable water supply. Dhaka has the highest population density of any of the world's **megacities** with about 20 000 people crammed into every square kilometre of land. This leaves little room for roads, rail lines, car parks, bus terminals and other elements of an effective transport system. There are very few forms of public transport and these are largely inefficient and poorly organised. People moving around Dhaka rely on a limited bus service and bicycle rickshaws. There is no train service within Dhaka, only trains between Dhaka and other centres in Bangladesh (see Source 4.11).



Source 4.11 The rail system in Bangladesh is rundown and chaotic.



Source 4.12 More than 80 per cent of households in Dhaka do not own a car or motorbike and instead rely on rickshaws for moving around the city.

### Check your learning 4.4

#### Remember and understand

- 1 What is meant by the word infrastructure?
- 2 How does an efficient and reliable infrastructure add to a city's liveability?

#### Apply and analyse

- 3 Compare the photographs of the road systems in Singapore and Dhaka (Source 4.10 and 4.12). What are some of the differences and some of the similarities?
- 4 What are some of the factors that have resulted in such poor infrastructure in Dhaka?
- 5 Why do you think the infrastructure in Singapore is so reliable?
- 6 Make a list of all the forms of infrastructure mentioned in this spread. Rank these forms of infrastructure from the one you consider to be the most important to the one you consider to be the least important.
- 7 Compare the infrastructure of the city or town closest to you with the infrastructure in Singapore. What are the differences and similarities?
- 8 Is it possible to live in a city and not rely on or use any of its infrastructure?

# Safety and stability

Like people everywhere, Australians want to feel safe. Even though it is tempting to believe everything that is presented in the media, if you did, you would probably think that Australian cities are in the grip of a crime wave and have become unsafe. While it is true that many crimes are committed in Australia, by world standards it is considered one of the safest places to live. Crime statistics also show that rates of some crimes, such as thefts, have actually declined in recent years.

## The world's safest and most dangerous cities

In a 2011 survey, the stability and safety of 140 world cities was compared and each received a ranking. The world's safest city was found to be Luxembourg in Europe. The world's most dangerous city was found to be Baghdad in Iraq. Most of the world's most dangerous cities were located in other war-torn countries, such as Afghanistan and Somalia. In the capital cities of these countries – Kabul and Mogadishu – the level of personal safety is classified as intolerable. United Nations aid workers who are posted to these cities often choose to live in safer neighbouring countries and drive in convoys with armed escorts to reach their place of work. Other cities that are considered very unsafe or unstable are those with very high rates of violent

crimes, such as murder. Some North American cities, such as Washington DC and New Orleans, are considered to have low rates of personal safety, as are some cities in South America and South Africa.

### ARROWS FIRED AT BOLTON POINT HOME

POLICE allegedly seized a high-powered bow when taking a man into custody after two arrows were shot into a Bolton Point home last night.

### DRUGS SEIZED BY POLICE

A VARIETY of chemicals used in the production of the drug methamphetamine were seized from an Emerald residence early yesterday morning.

The search also located a rifle in the manhole of the Yamala St property.

### BOMB FEAR DRAMA IN SEBASTOPOL

THE Victoria Police bomb squad defused a suspected explosive device at a home in Sebastopol on Saturday night during an incident which lasted more than five hours.

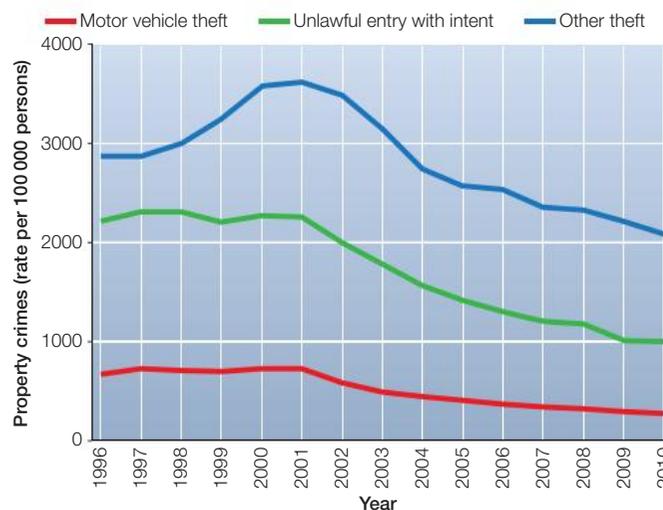
### GOONDIWINDI CRIME JUMPS 10 PER CENT

ASSAULTS in Goondiwindi have jumped more than 30 per cent in 12 months.

**Source 4.14** Local news headlines in Australia can sometimes give the impression that Australia is a dangerous place.

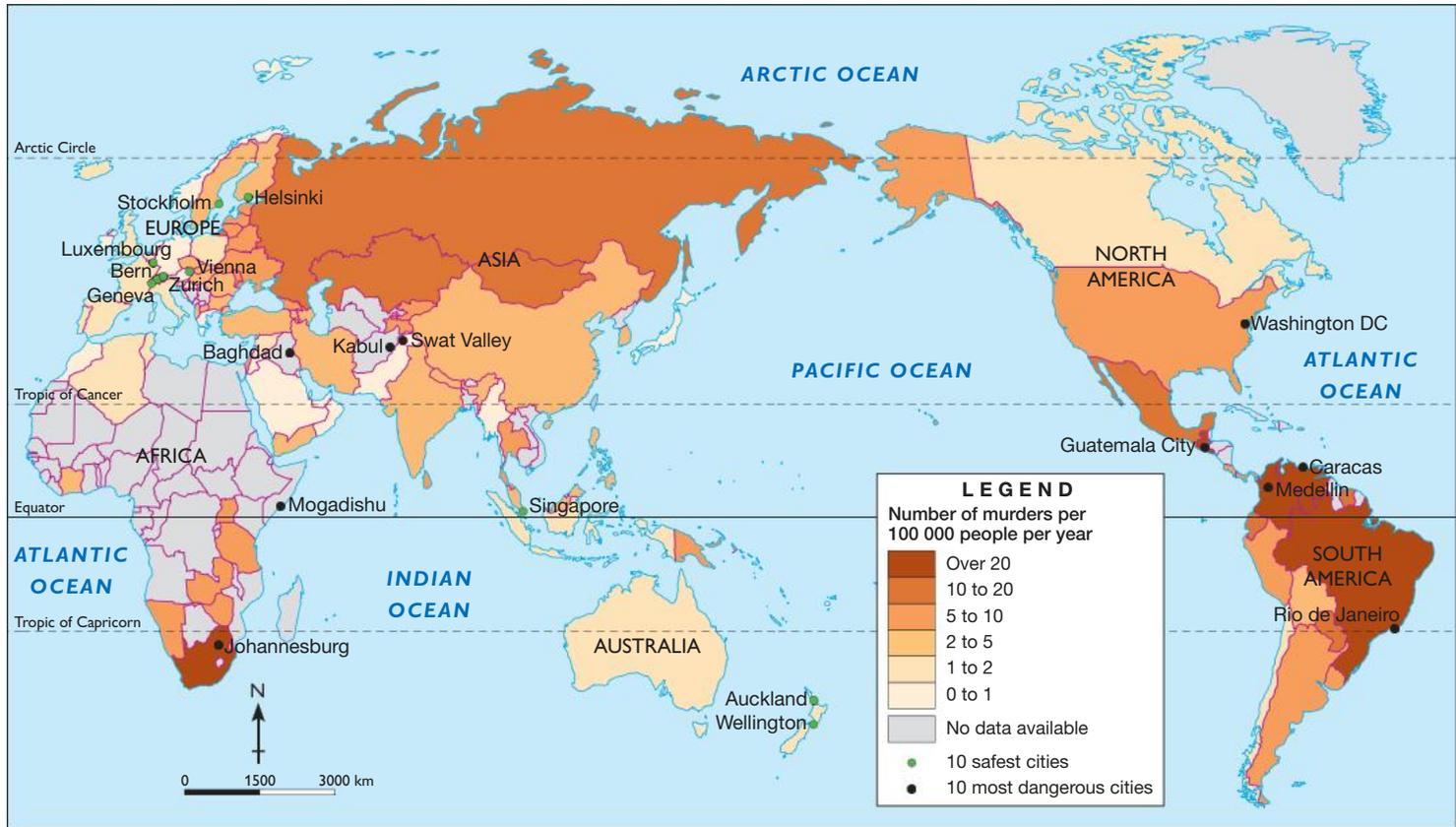


**Source 4.13** Luxembourg – the world's safest city



**Source 4.15** Property crimes in Australia, 1996–2010

WORLD: MURDER RATES AND SAFEST AND MOST DANGEROUS CITIES



Source 4.16

Source: Oxford University Press



Source 4.17 Baghdad – the world’s most dangerous city

Check your learning 4.5

Remember and understand

- 1 Why are safety and stability important factors in determining a city’s liveability?
- 2 Rank the following factors in order of what makes a place most liveable for you: safe, easy to get around, good health care, good work and education opportunities, affordable, diverse, sustainable, attractive.
- 3 In which regions of the world are the safest cities?
- 4 In which regions are the world’s least safe cities?
- 5 What makes some cities safer than others?

Apply and analyse

- 6 Collect reports of crime from your local newspaper. What impression do these reports give of safety in your community?
- 7 Use an online resource in your state or territory to research crime in your local area. For example:
  - Victoria Police – My Place (VIC)
  - Crime and Justice (QLD)
  - Crime Mapper (SA)
  - Western Australia Police (WA)
  - Hotspot Maps (NSW)

Do media reports of crimes in your community match the reality as shown in the data?

# Access to health care and education

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Citizens of the world's most liveable cities have access to good health care services, including doctors, public and private hospitals, specialist clinics and over-the-counter drugs. They also have access to a range of schools and other education facilities, such as training centres and universities. In many of these cities, including those in Australia, education is not only compulsory but is also free.

The cities in Canada, the USA, Australia and Western Europe rank highly in both health care and education, while African cities are the lowest ranked in the world in terms of these services.

## The situation in the developing world

When examining the access to health and education in developing countries it is easy to think that nothing can be done to improve the situation. Yet there have been some significant improvements in recent years.

The number of mothers who die while giving birth each year, for example, has almost halved since 1990. The main reasons are thought to be: improved care in hospitals and birth clinics; better education of girls and women; and better access to health care professionals, such as maternal nurses and doctors. Though the current rate still means that 800 women a day die while giving birth, the improvements in the last two decades give hope that this rate will decline even further.

Worldwide, 89 per cent of all primary school aged children now attend school. Although 67 million children worldwide are not at school, this is a vast improvement on 1999 when the number of children not enrolled in primary school was 106 million. The countries that have made the greatest improvements in this area are the poorest countries of sub-Saharan Africa. In many of these countries, such as Rwanda and Mali, it is believed that abolishing school fees has been the main factor behind this improvement.

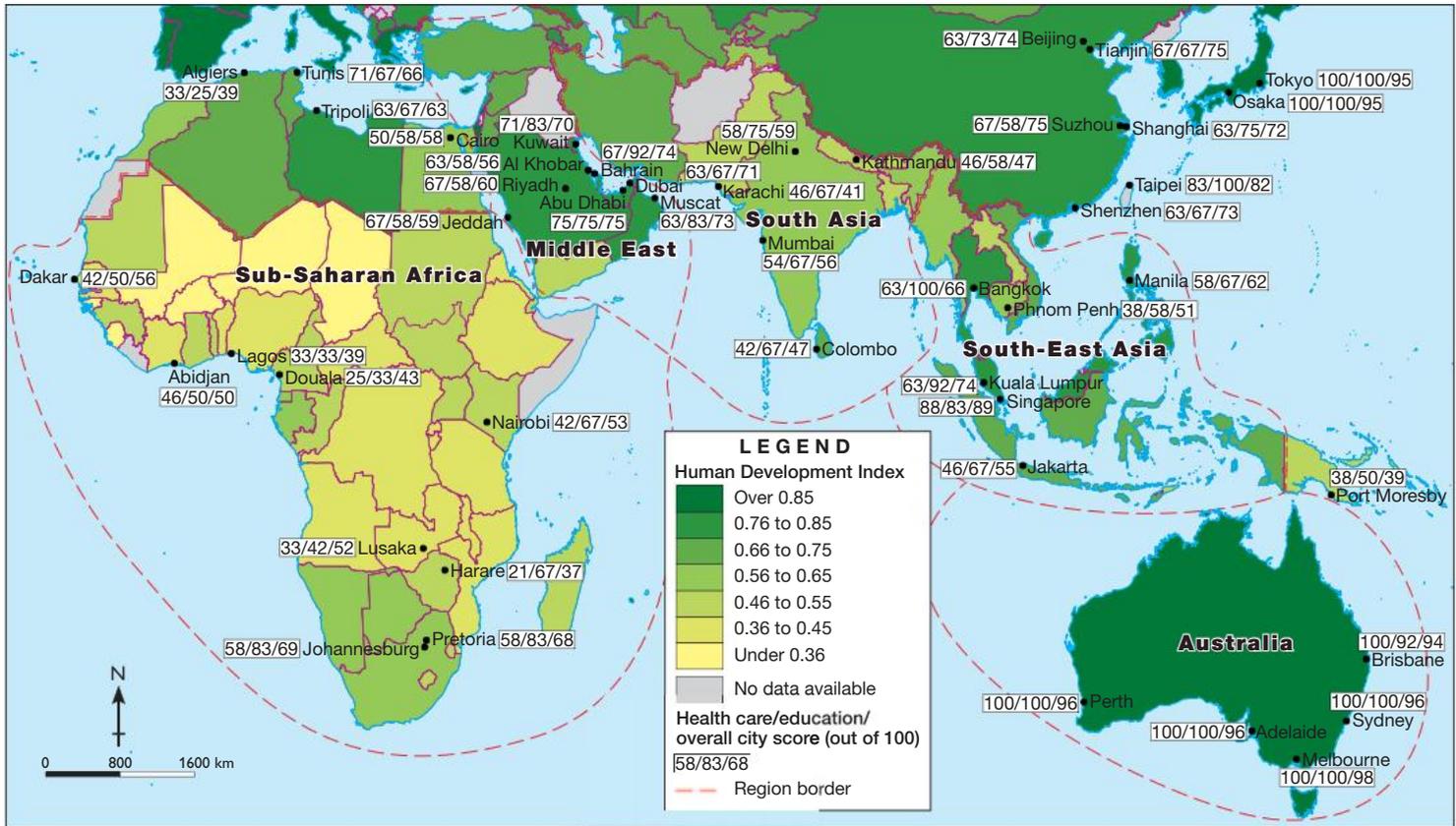


Source 4.18 A modern operating theatre at a hospital in the USA.



Source 4.19 These girls in Brazzaville, Democratic Republic of Congo, are enjoying the benefits of a free education.

AFRICA, SOUTH AND SOUTH-EAST ASIA AND AUSTRALIA: HUMAN DEVELOPMENT INDEX



Source 4.20

Source: Oxford University Press



## Check your learning 4.6

### Remember and understand

- 1 What improvements have been made in health care and education in developing countries?
- 2 What changes have led to these improvements?

### Apply and analyse

- 3 Why do you think educating girls is a key part of lowering the maternal death rate?
- 4 Examine Source 4.20. The map shows health care and education scores in selected cities in Africa, Asia and Australia. The map also shows each country shaded according to the **Human Development Index (HDI)**. This uses measures of life expectancy, literacy and **gross domestic product (GDP)** to show the living standards in each country.
  - a In which region is HDI the lowest?
  - b How do cities in this region score for health care and education?
  - c In which region is HDI the highest?
  - d How do cities in this region score for health care and education?
  - e Write a short paragraph describing the connection between living standards (as shown in the HDI), health care and education in the cities of the regions shown on the map.

## 4.1 bigideas: broadsheet

# Life on Mawson Station

Australia maintains three stations in Antarctica and one on Macquarie Island in the Southern Ocean. The oldest of these is Mawson Station, located on Horseshoe Bay in one of the few relatively ice-free places in Antarctica. The small community of scientists at Mawson Station face many challenges in the least liveable climate on Earth.

Because of its isolation from other places, it can be challenging to provide a liveable environment at Mawson Station. Electricity comes from a diesel generator and two wind turbines. Much of the electricity generated is used to provide heating, mainly to melt ice for water and to heat the water and buildings. Sewage is treated on site and scientists who are away from the station return to the station carrying all solid human waste with them where it is incinerated. Vegetables are grown in a special heated **hydroponics** room in which they can grow without soil. The station has a small operating theatre and a dentist's suite to treat most medical

conditions. There is a range of ways for people in the Mawson Station community to communicate with friends, family and colleagues in other places. Orbiting satellites provide a reliable Internet connection as well as radio and telephone connections to the ANARESAT dome.

The community lives in the Domestic Building (also known as the 'Red Shed'). When blizzard days stop fieldwork, the Red Shed provides many opportunities for expeditioners to pass the time. It has indoor climbing, a home theatre, a photographic dark room, a library and several communal sitting areas. There is a small gym, as well as sports equipment for volleyball and badminton and a range of cross-country ski equipment. A spa and sauna are also available.

### skilldrill

## Analysing a map

Understanding the information provided by maps is a key skill for every geographer. Here are some basic steps to follow each time you begin to analyse a new map:

- Step 1** Read the title carefully as this will tell you exactly what the map is showing.
- Step 2** Look carefully at the legend and map labels to identify individual features on the map.
- Step 3** Use the orientation arrow to work out in which direction the map is facing. Once you have established where north is, you will be able to work out the remaining cardinal points.

**Source 4.21** Oblique aerial view of Mawson Station, Antarctica



**Step 4** Look carefully at the map scale. This will help you estimate how far distances shown on the map are on the ground. You can then use this scale to estimate distances between places on the map.

**Step 5** If the map you are using shows a small area (i.e. a large-scale map), it may be helpful to look at another map showing a larger area (i.e. a small-scale map). This will help you locate the area shown. For more information relating to maps, refer to section GT.2 in 'The geographer's toolkit'.

### Apply the skill

- 1 Examine the map of Mawson Station in Source 4.22.
  - a Which buildings are clustered together? Why do you think they are clustered in this way?
  - b Two buildings are located away from other buildings. For each of these, estimate the distance to the nearest other building and explain why you think it is located where it is:
    - explosives hut
    - hangar (used to store aircraft)
  - c What are the two main types of transport used to bring supplies to the station?
- 2 Examine the oblique aerial image of the station. Do you think this photograph was taken in summer or winter? Give two reasons for your answer.
- 3 Compare the map with the photograph (Source 4.21).
  - a In which direction was the photographer facing when this image was taken?
  - b What is the round building on the right of the photograph?
  - c What colour is each of these buildings: domestic building, store and operations? Why do you think the buildings are different colours?
  - d What do you think is stored in the tanks with the word 'Mawson' written on them? Why do you think they are located next to the wharf?

### MAWSON STATION



Source 4.22

Source: Oxford Atlas

### Extend your understanding

- 1 Use the Internet to gather information about the climate at Mawson Station. Select the best description of the climate at Mawson Station when referring to its liveability: acceptable, tolerable, uncomfortable, undesirable, intolerable. Justify your response.
- 2 Mawson Station is essentially a scientific community. Why do you think plumbers, electricians, builders and diesel mechanics are also needed?
- 3 Rank the following factors in order of what makes Mawson Station most liveable: safety, easy to get around, good health care, good work and education opportunities, affordability, diversity, sustainability, attractiveness.
- 4 What are some challenges faced by people who live at Mawson Station? How do they overcome these challenges?
- 5 How liveable would Mawson Station be for you? What would be the advantages and disadvantages of living in this place? Discuss your answer with a classmate.

# 4.2 Where are the world's most and least liveable cities?

## The world's most liveable cities

It is difficult to compare one city to another as people who live in one city tend to favour their own city. This can make it difficult for others who are considering moving to a new location to find out what it is really like to live there. In response to this problem, a number of companies research the world's biggest cities and rank them from the most liveable to the least liveable. These companies vary in what they study and measure, and so their liveability rankings differ. For example, one company may emphasise personal safety in their study, while another may put a greater emphasis on the climate of a place. This means their scores and rankings will differ.

These liveability rankings are useful for geographers as they give us the opportunity to compare places and to consider what makes one place more liveable than another. Importantly, it also allows us to make better decisions about improving the liveability of cities around the world. The following map uses the scores from the annual survey by the Economist Intelligence Unit (EIU) of 140 of the world's cities. In its survey the EIU gives each city a score based on its: stability (such as crime and terrorism threats); health care; culture and environment (such as climate, shopping and religious freedom); education; and infrastructure (such as roads, public transport and water).

WORLD: LIVEABILITY RATING, 2012



Source 4.23

Source: Oxford University Press

## Case study: Vancouver, Canada

The Canadian city of Vancouver is usually near the top of any list of the world's most liveable cities and was placed first in one influential survey in 2011. In a 2012 survey, it was the only city in the top ten to receive a perfect score for its culture and environment. The culture and environment category included climate, levels of corruption and censorship, religious freedom, sporting and cultural facilities, and shopping. The city also received a perfect score for its health care and education.

Because cities are given a new score every year, the rankings of their liveability can change with little perceivable change to living conditions in that city. Vancouver, for example, has slipped from the most liveable city to the third most liveable and is now ranked below Melbourne and Vienna. This is largely because its infrastructure score fell as a result of increased traffic congestion in the city.



Source 4.24 Residential housing and a marina in downtown Vancouver

### Check your learning 4.7

#### Remember and understand

- 1 Why can it be difficult to compare the liveability in different cities?
- 2 Why is Vancouver considered to be less liveable in recent years?

#### Apply and analyse

- 3 Examine Source 4.23 carefully.
  - a Compare the liveability of the cities shown in Africa with those shown in Western Europe.
  - b Describe three patterns that you observe on this map.
  - c Select one of these patterns and give an explanation for it.
- 4 Of the top 10 most liveable cities virtually all had perfect scores in education and health care but only one, Vancouver, had a perfect 'culture and environment' score. Why do you think only a few cities would score perfectly for their culture and environment?

#### Evaluate and create

- 5 Some people are critical of comparing cities in this way and believe that it is unfair to the people who live there. Why do you think people would feel this way?
- 6 As well as companies looking to move employees to a new city and geographers, who else would find liveability rankings of the world's cities useful?

# Vienna: a liveable city

Vienna, the capital of Austria, usually scores highly in any survey of the world's most liveable cities. In 2011, it was rated by one agency as the second most liveable city and by another as the city with the highest quality of living in the world. It has topped this second list for three years in a row.

## Infrastructure and safety

Vienna has excellent infrastructure, which has been designed to meet the changing needs of the city while ensuring sustainability (see 'key concept: sustainability'). Vienna features particularly strongly in terms of its public transport and public housing. The city provides affordable public transport and has invested in an extensive bicycle network to keep traffic congestion in the streets low. Vienna has a large public housing system that provides high-quality housing for the majority of the Viennese population. This has kept housing affordable for everyone.

One of the features of Vienna that makes it liveable is the number of parks and other green spaces for people to enjoy. More than half the metropolitan area of Vienna is made up of these green spaces. This gives each resident of the city about 120 square metres of open space in which to socialise and exercise. (The World Health Organization suggests that at least 9 square metres of open space should be available to every city dweller.) Serious crime is rare and employment levels are high, creating a safe and stable environment for the city's residents.

## Health care and education

Vienna has a wide range of hospitals offering different types of treatment and a high level of hospital care, and every worker in Vienna has health insurance. Education through the school system is provided to every child free of charge.

**Source 4.25** Vienna is known for its shopping and safe public spaces.



## keyconcept: sustainability

### Sustainability and liveability in Vienna

Vienna is leading the world in the reduction of the **greenhouse gases** that are changing the global climate. In 1999 they began a program that encouraged companies to change the way they used energy and water and also the ways in which they disposed of their waste. The aim was to reduce gases by 2.6 million tonnes a year by 2010. The program was so successful that the target was achieved four years early and new targets have been set for 2010–20. More than 9000 individual projects have been put into place to reduce greenhouse gases since 1999. These have resulted in some impressive reductions: more than 100 000 fewer tonnes of solid waste, 42 000 fewer tonnes of greenhouse gases and more than 1 million fewer cubic metres of drinking water used. This has resulted in less water and air pollution in Vienna, making it even more liveable than before.

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



**Source 4.26** In this Viennese building, solid waste is incinerated to produce heat and electricity, which is used to power a nearby hospital.



**Source 4.27** Vienna has a well-developed public transport network that includes buses, trains and trams.



**Source 4.28** An amusement park in Prater Park near the centre of Vienna

### Check your learning 4.8

#### Remember and understand

- 1 What are some of the features of Vienna that make it very liveable?
- 2 How is Vienna becoming more liveable?

#### Apply and analyse

- 3 The exterior of the waste incinerator in Source 4.26 was designed by an artist.
  - a What does this tell you about the people of Vienna?
  - b What do you think of the exterior of this building?

- 4 In what ways do open spaces make cities more liveable?
- 5 How is open space used in your community?

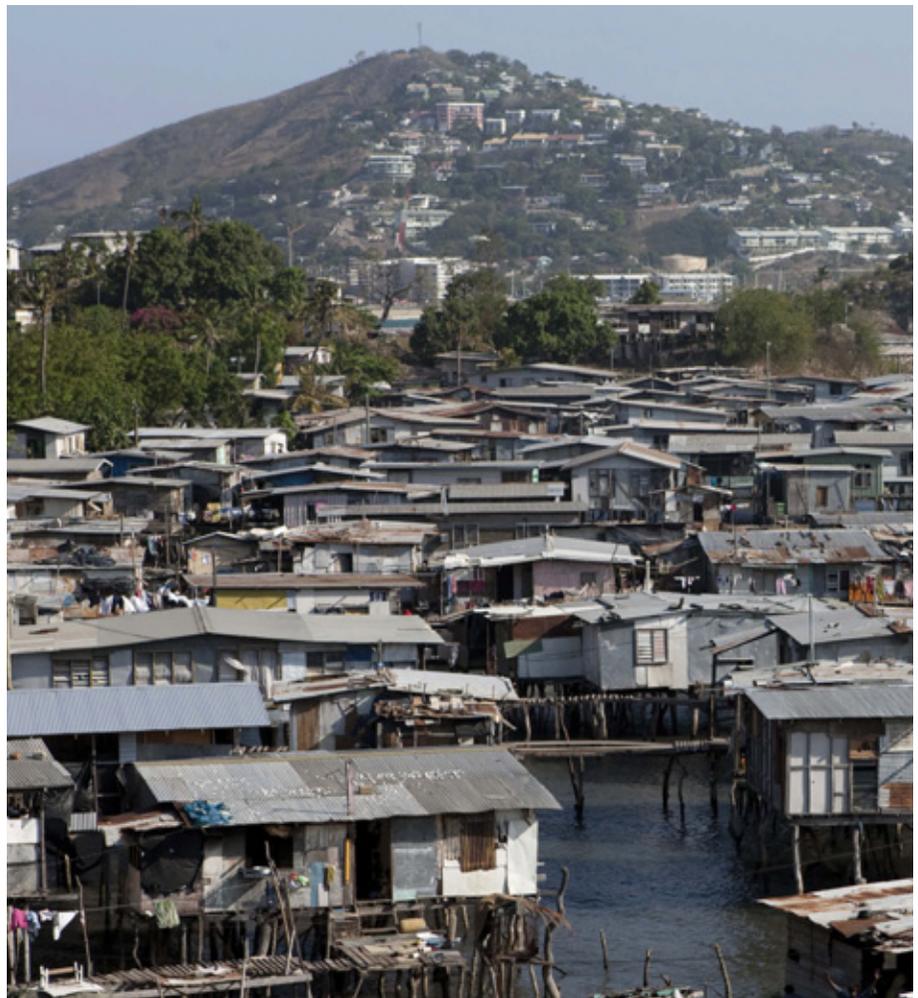
#### Evaluate and create

- 6 Imagine that you are designing a brochure advertising Vienna as the city with the world's best quality of life.
  - a Which of the photographs of Vienna would you use in the brochure and why?
  - b Which ones would you not use? Why not?

# The world's least liveable cities

While cities in Europe, Canada and Australia dominate the top of lists of the world's most liveable cities, Asian and African cities tend to dominate the bottom of these lists. It is important to remember, however, that these lists are made by companies in wealthy countries to provide their workers with a guide to lifestyles in cities around the world. The lists therefore tend to measure aspects of each city that most interest those workers rather than the experiences of the people who live there.

In 2012, one of these companies published the following list of the 10 least liveable cities. It was taken from a list of 140 cities around the world. While the same 10 cities were also ranked as the least liveable in 2011, their order and overall ratings had changed. Most notable was the improvement in Harare's score and ranking. Rated as the least liveable in 2011, improvements in stability meant that it moved above the cities of Lagos, Port Moresby and Dhaka in 2012. A city's stability is a measure of crime, terror and conflict. The world's least liveable cities tend to be the least stable and least safe.



Source 4.30 Housing area near the Port Moresby harbour

Country	City	Rank	Overall rating (100 = ideal)	Stability	Health care	Culture and environment	Education	Infrastructure
Cote d'Ivoire	Abidjan	131	45.9	30	45.8	54.2	50.0	53.6
Iran	Tehran	132	45.8	50	62.5	35.9	50.0	33.9
Cameroon	Douala	133	43.3	60	25.0	45.6	33.3	42.9
Libya	Tripoli	134	42.8	50	41.7	35.4	41.7	44.6
Pakistan	Karachi	135	40.9	20	45.8	38.7	66.7	51.8
Algeria	Algiers	136	40.9	40	45.8	42.6	50.0	30.4
Zimbabwe	Harare	137	39.4	30	20.8	55.8	66.7	35.7
Nigeria	Lagos	138	39.0	25	33.3	52.3	33.3	48.2
Papua New Guinea	Port Moresby	139	38.9	30	37.5	44.2	50.0	39.3
Bangladesh	Dhaka	140	38.7	50	29.2	43.3	41.7	26.8

Source 4.29 Liveability scores for the 10 least liveable cities

## Case study: Port Moresby, Papua New Guinea

Port Moresby, the capital of Papua New Guinea, is often ranked as one of the world's least liveable cities. This is largely due to high crime rates and a lack of safety experienced by many residents and visitors.

In many developing countries, such as Papua New Guinea, large numbers of people move from rural areas to the cities hoping for a better life. They are attracted by the possibility of a steady job or the chance for their children to attend high school. This puts a strain on the city's infrastructure and services such as hospitals, schools and the police force.

In Port Moresby, many of the young men who have arrived in the city have not been able to find jobs. They join crime gangs to survive, to earn money to buy food and to gain a sense of belonging. The most notorious of these gangs is the Raskols (from the English word rascals). Other gangs have names such as Mafia or Ook (Devils). These gangs are responsible for much of the violent crime in Port Moresby, such as robberies, car jackings, beatings, murders and rape.

Armed battles between the Raskols and the police are common, creating a dangerous environment. Many wealthier people in Port Moresby have responded to the dangers by building fences of razor wire and hiring armed security guards. The poorer people, having no access to these defences, have instead armed themselves with clubs and machetes.



**Source 4.31** A Raskol gang member guards a stockpile of food and fuel.

### Check your learning 4.9

#### Remember and understand

- 1 Why do people move to cities such as Port Moresby?
- 2 How can this movement affect a city's liveability?

#### Apply and analyse

- 3 Examine Source 4.29, showing the rankings and scores of the world's 10 least liveable cities.
  - a Why do cities move up or down this list over time?
  - b Which city is the least stable? Suggest a reason for this.
  - c Of these cities, Tehran has by far the best health care score. In what areas does it perform particularly poorly?

- 4 Refer back to Source 4.23. Locate each of the 10 least liveable cities on this map. Investigate which of these 10 cities is not in Asia or Africa.

#### Evaluate and create

- 5 Draw a geographic sketch of Source 4.30. Add these labels to your sketch: central business district, poor housing standards, lack of sewerage, lack of electricity, houses built on stilts over the water, better quality housing.
- 6 What do Sources 4.30 and 4.31 tell you about inequalities in wealth in Port Moresby?

# Harare: a least liveable city

Harare, the capital of Zimbabwe, was the fourth lowest ranked city in terms of liveability in 2012. Harare is a city of great contrasts. Many people live prosperous, healthy lives there. They have good jobs, access to good health care and their children attend some of Africa's best schools. But this is not the reality for most Harare residents, many of whom live in extreme poverty.

## Infrastructure and safety

Only 40 per cent of Harare residents have access to safe drinking water; most of the remaining 60 per cent collect their water from Lake Chivero, Harare's main water source. The lake is also the place where the city's untreated sewage is dumped as the treatment plant is unable to cope with the rapid expansion of the city's population.

Perhaps one of the greatest struggles facing many people in Harare is the struggle to find a secure home. In 2005, the country's president, Robert Mugabe, ordered the destruction of **slums** throughout the city. He claimed

it was to restore order in the city but many others believe that it was done to intimidate his political opponents. It is estimated that about 700 000 people were made homeless or lost their jobs. As well as homes, the slum clearance program destroyed schools, shops, workplaces and pharmacies. Many people are reluctant to rebuild their homes in case this happens again.

A recent report that measured the liveability of 140 of the world's cities described Harare's level of petty crime, its threat of **civil unrest** or conflict, its public health care and its quality of public transport as intolerable. It also rated very poorly in other important areas, such as the amount of violent crime, the threat of military conflict and the provision of electricity and water.

For most of Harare's 3 million residents, daily life is a series of struggles. They struggle to find enough clean water to drink and with which to wash and they struggle to find enough food. They struggle to find work to earn money and they struggle to give their children a quality education.

**Source 4.32** These boys are collecting water from a puddle in a Harare street.



## Health care and education

Harare ranked the lowest for health care of all the cities surveyed. Many struggle with disease and illness. Fourteen in every 100 adult Zimbabweans have **HIV/AIDS**, the fifth highest rate in the world. Poor **sanitation** and unsafe water supplies have led to outbreaks of cholera and typhoid in Harare, which have further strained the health services in the city and affected the ability of people to work.

A lack of government funding has made it difficult for hospitals and doctors to provide care for sick patients. The public health care system has collapsed and many common medical services are no longer available – patients cannot get prescriptions or drugs, hospitals have run out of medical supplies, and equipment has become unusable. The hospitals have had to stop performing operations and the wards are empty because the hospitals are unable to care for patients or even provide them with meals.

The only health care still available is in private clinics which only the rich can afford. Poor patients are left without care and are dying as a result.



Source 4.33 Untreated sewage flows into a Harare street from an overflowing pipe.



Source 4.34 This cholera victim is being taken to a clinic in Harare.

### Check your learning 4.10

#### Remember and understand

- 1 Why is Harare considered to be one of the least liveable cities?
- 2 Explain the link between Source 4.33 and Source 4.34.

#### Apply and analyse

- 3 The boys in Source 4.32 are collecting water from the street. Discuss with a partner some problems that these boys may face every day and use your discussion to describe a day in their lives.

#### Evaluate and create

- 4 Make a list of the problems faced by many Harare residents. Rank them from the one that is the easiest to solve to the one that is hardest. Write a few sentences explaining why you have ranked them in this way.
- 5 For the problem you considered the easiest to solve, describe a possible solution. Why do you think this problem has not been solved in Harare?

# Australia's liveable cities

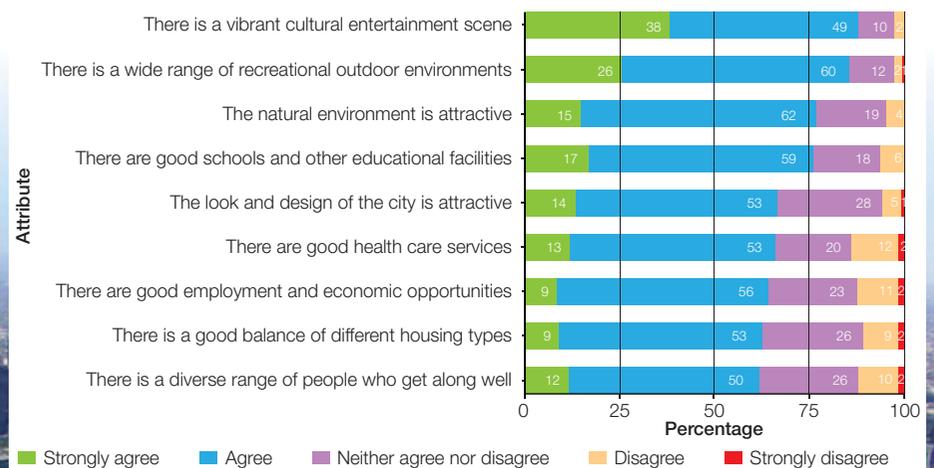
In the 2012 Global Liveability Survey, Melbourne was rated as the world's most liveable city. Adelaide (6), Sydney (7) and Perth (9) were also ranked in the top ten. Australian cities usually score well in liveability studies because they generally have open spaces for recreation, relatively low crime rates, low population densities and good education and health care. Large cities in a wealthy country, such as Australia, also have a wide range of goods and services available to the people who live there. The infrastructure in large Australian cities includes: schools and universities; efficient transport networks; clean water delivered to homes and businesses through a vast network of dams, treatment plants and pipes; and electricity supplied through a system of overhead and underground wires and cables.

**Source 4.35** The suburb of South Yarra near the Melbourne CBD – the most liveable suburb in the most liveable city in the world

## How do Melbourne's residents view their city?

In a different survey, Melbourne residents were asked about the liveability of their city. The results are shown in Source 4.36. While the city performed poorly in affordability, public transport and road network, it scored well among residents for culture, environment and education.

**Source 4.36** Results of a survey of Melburnians of the liveability of Melbourne, 2012: best performing attributes



## Check your learning 4.11

### Remember and understand

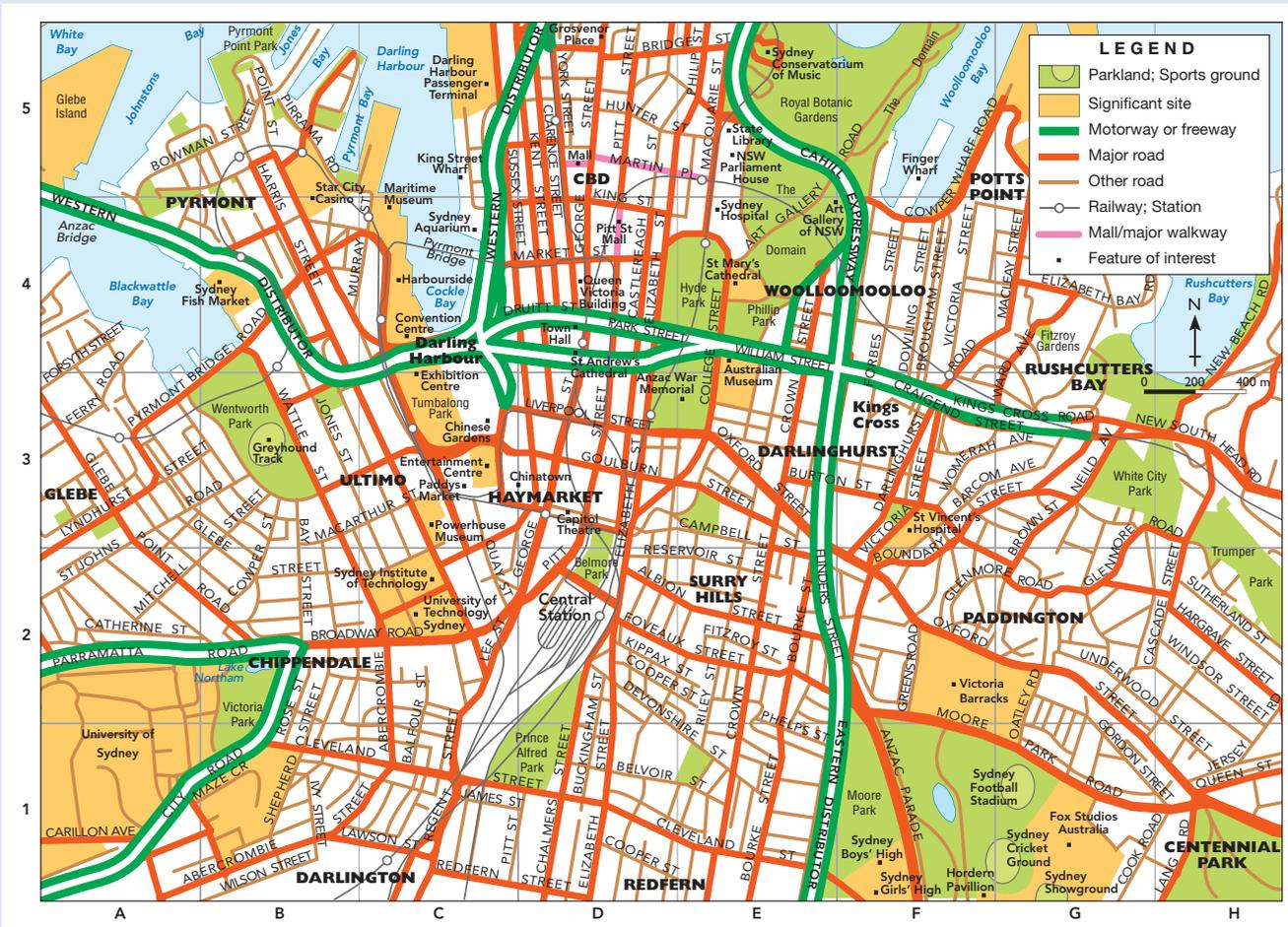
- 1 What Australian cities featured in the top 10 most liveable cities in 2012?
- 2 Why do Australian cities feature highly in these surveys?
- 3 What features of their city do Melburnians like the best? How do these features help to make the city more liveable?
- 4 What features of their city do Melburnians not like?

### Apply and analyse

- 5 Look at the oblique aerial view of Melbourne (Source 4.35). What features shown in this photograph might suggest that Melbourne is a liveable city?
- 6 Examine the map of central Sydney (Source 4.37). Then copy and complete the following table. Try to add more than one example to each category.

Liveability category	Examples from Sydney	Grid reference
Availability of public health care	St Vincent's Hospital	F3
Recreation: sports	Sydney Football Stadium	
Recreation: culture		E4
Availability of consumer goods and services	Paddys Market	
Religious freedom		E4
Availability of schools		
Availability of higher education	University of Sydney	
Quality of road network		
Quality of public transport		

### SYDNEY: CBD AND INNER SUBURBS



Source 4.37

Source: Oxford Atlas

## Liveable suburbs

In a 2011 study, each of Melbourne's 314 suburbs was rated in terms of its liveability. The study used available data, much of it from the census, to score each suburb on 14 key indicators. These included factors such as the access to shops, schools, restaurants and public transport as well as crime rates, open space and traffic congestion. The study found the inner-city suburb of South Yarra to be the most liveable suburb in the most liveable city in the world.

South Yarra scored highly because of its closeness to the city centre and the beach as well as its good public transport and shopping. Unlike many other suburbs close to city centres, it also has a large amount of open spaces. Living in South Yarra, however, has its drawbacks. The study found that residents of South Yarra have to tolerate terrible traffic jams and extremely high house prices.

The suburb of Hallam, on Melbourne's outskirts, was rated as the least liveable. A number of different factors contributed to this outcome. Although Hallam has a large number of open spaces, it lacks access to schools, cultural events, shopping and tree coverage compared to a more established suburb. It also rated poorly in terms of its distance from the city centre and the ocean.

MELBOURNE: KEY MAP SHOWING GEOGRAPHICAL FEATURES



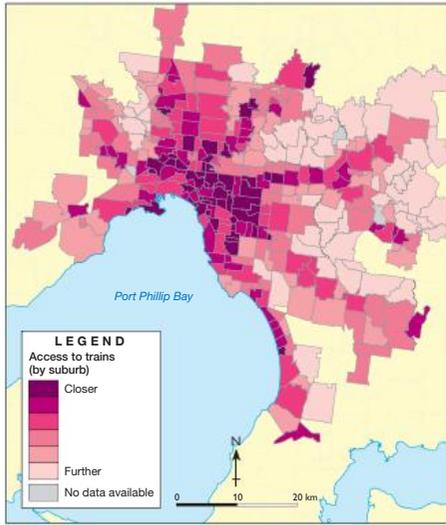
Source 4.39

Source: Oxford Atlas

Source 4.38 Hallam – Melbourne's least liveable suburb.

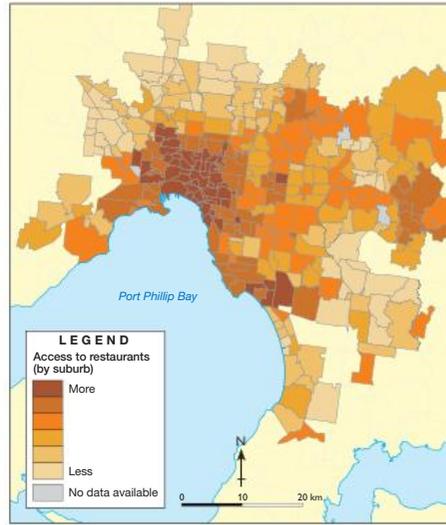


MELBOURNE: CHOROPLETH MAP SHOWING ACCESS TO TRAINS



Source 4.40  
Source: Oxford University Press

MELBOURNE: CHOROPLETH MAP SHOWING ACCESS TO RESTAURANTS



Source 4.41  
Source: Oxford University Press

## Check your learning 4.12

### Remember and understand

- 1 What pattern do you notice on the map showing access to trains (Source 4.40)? Describe this pattern using the names of specific places.
- 2 What feature on the key map (4.39) helps to explain this pattern?

### Apply and analyse

- 3 Examine Source 4.39.
  - a How has Port Phillip Bay affected the shape of Melbourne?
  - b What influence have major roads had on the shape of the outer suburbs?
- 4 These maps of Melbourne show that liveability is not the same for everyone in a city. Who would find these maps useful?

## skilldrill

### Explaining patterns on maps

Geographers look for patterns on maps such as Sources 4.40–4.42 and then try to explain the patterns they see. By following these steps you will move from describing features of a map to explaining them.

**Step 1** Look for an obvious pattern in the map you are exploring. This may be a cluster of similar features in a small region or a line of features. In the map showing the liveability of Melbourne's suburbs (Source 4.42), lighter colours (less liveable) tend to be near the fringes of the city whereas darker colours (more liveable) are nearer to the centre.

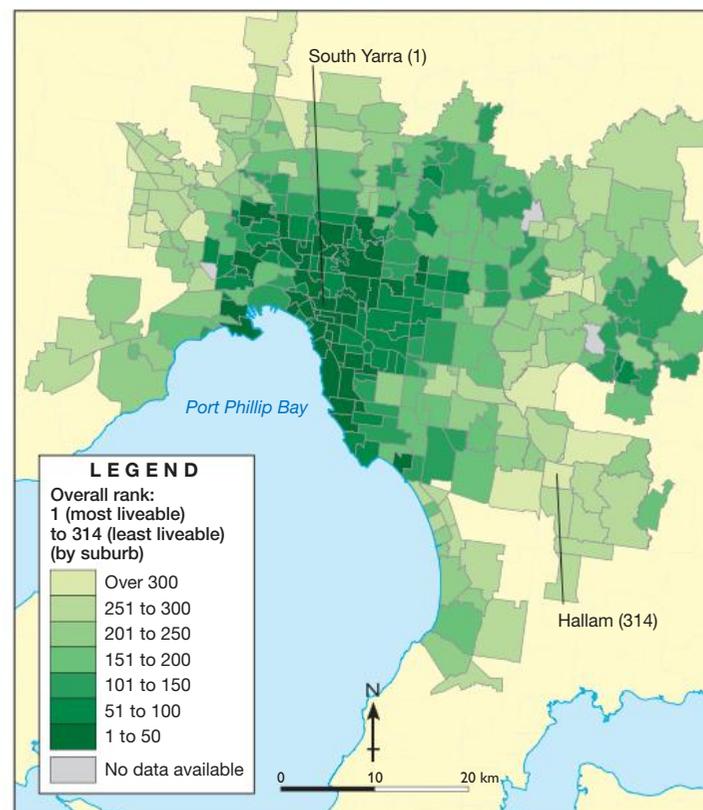
**Step 2** Describe the pattern using names of specific places in your description.

**Step 3** Look for clues that explain the pattern you have described. There may be clues in other maps or in the way the map has been drawn. In the case of the liveability map, the explanation for higher liveability in inner suburbs may be that there tends to be many restaurants, shops and train stations there. These factors were all taken into account in determining the liveability of each suburb.

### Apply the skill

- 1 Explain the pattern in Source 4.41 showing access to restaurants in Melbourne's suburbs.

MELBOURNE: CHOROPLETH MAP SCORING EACH OF THE 314 SUBURBS ON ITS LIVEABILITY



Source 4.42

Source: Oxford University Press

## 4.2 bigideas: broadsheet

# The liveability of your local area

Liveability applies not only to countries and cities but also to smaller local areas. Some areas are more liveable than others because of the infrastructure that is available or because of their culture and environment.

### skilldrill

## Completing a map survey

There are several pieces of information that you can collect to assess the liveability of your local area. The first of these is a map survey.

To complete a map survey of your local area, follow these steps:

**Step 1** Locate a map of your local area. This could be from a street directory or from a website, such as Google Maps. Decide on the limits of your local area. This could be a suburb if you live in a large city or the whole town if you live in a smaller rural town. In this example, the student lives in inner Brisbane and has chosen an area 1.5 kilometres from where she lives.

**Step 2** Mark the limit of your local area on your map.

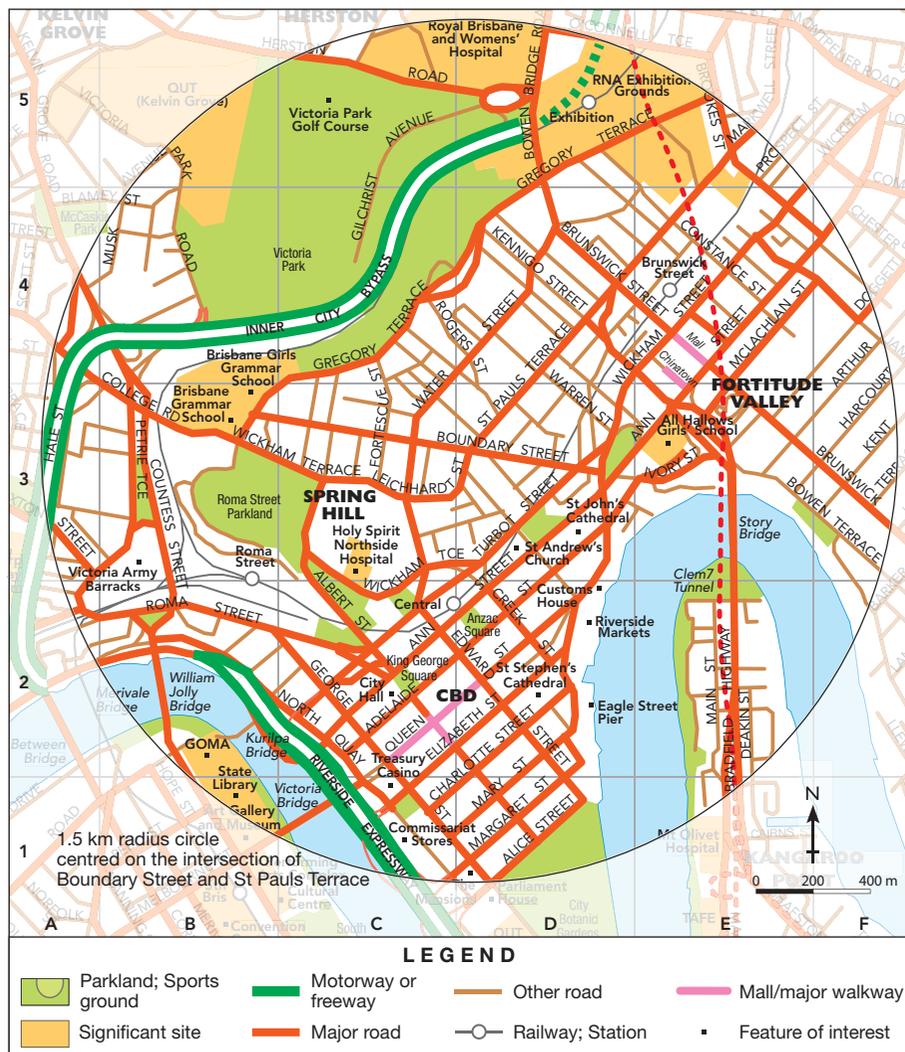
**Step 3** Examine this area closely and count each of the following pieces of infrastructure within it:

- police stations
- hospitals
- chemists
- doctors
- churches
- sporting grounds
- parks
- post offices
- schools.

### Apply the skill

- 1 Using the steps outlined above, complete a map survey of your local area.
- 2 Describe the infrastructure of this area in a carefully worded paragraph.

BRISBANE: CBD AND INNER SUBURBS



Source 4.43

Source: Oxford Atlas

## skilldrill

### Completing a street survey

Another useful way to collect information about the liveability of your local area is to undertake a street survey as part of some fieldwork. In a street survey you are assessing the quality of the housing and other features of a street or several streets.

To complete a street survey in your local area, follow these steps:

**Step 1** Choose a street with at least 30 properties and a length of at least 100 metres.

**Step 2** Use a street survey form like the one shown in Source 4.44 to score your chosen street on a scale of 0 to 3 in a range of categories.

#### Apply the skill

- Using the steps outlined above, complete a street survey in your local area.
- In what parts of the survey did the street score well? In what areas did it score poorly?
- What could be done to improve this street?

Street name: _____ Suburb: _____		SCALE				
		3	2	1	0	
<b>Traffic</b>	Free of parked vehicles Low volume of traffic Safe for children					Cluttered with parked vehicles High volume of traffic Dangerous for children
<b>Gardens</b>	Variety of plants Neatly maintained					No plants Overgrown
<b>Houses</b>	Well maintained Variety of housing styles Variety of building styles					Run down All houses the same style  All houses built from the same material
<b>Vegetation</b>	Trees shade half of road					No trees
<b>Street furniture</b> (signs, electricity poles, seats etc.)	Inconspicuous Improve the area					Conspicuous Detract from the area
<b>Street lighting</b>	Well lit					Poorly lit
<b>Litter, vandalism and graffiti</b>	No litter, vandalism or graffiti					Much litter, vandalism and graffiti
<b>Access to facilities</b>	Shops within walking distance Parks within walking distance Primary school within walking distance					Shops not within walking distance Parks not within walking distance Primary school not within walking distance
<b>Footpaths, roads and kerbing</b>	Clearly defined Good condition Maintained nature strips					Undefined Poor condition No nature strips
<b>Other land uses</b>	No offensive land uses					Offensive land uses
<b>Column score</b>						
<b>Total score</b>						



**Source 4.45** Spring Hill is an inner-city suburb of Brisbane. It contains a mix of residential and commercial land uses.

### Extend your understanding

- What health care facilities are available to residents of Spring Hill?
- What education facilities are available to residents of Spring Hill?
- As an inner-city area, Spring Hill is well served with public transport. What evidence can you find for this?
- Comment on the availability of roads in this area.
- Brisbane did not score as highly as Melbourne or Sydney in a recent survey of liveable cities. In what measures of liveability do you think it scored lower than these other cities?

**Source 4.44** Street survey

# 4.3 How can we make cities more liveable?

## Strategies for improving liveability

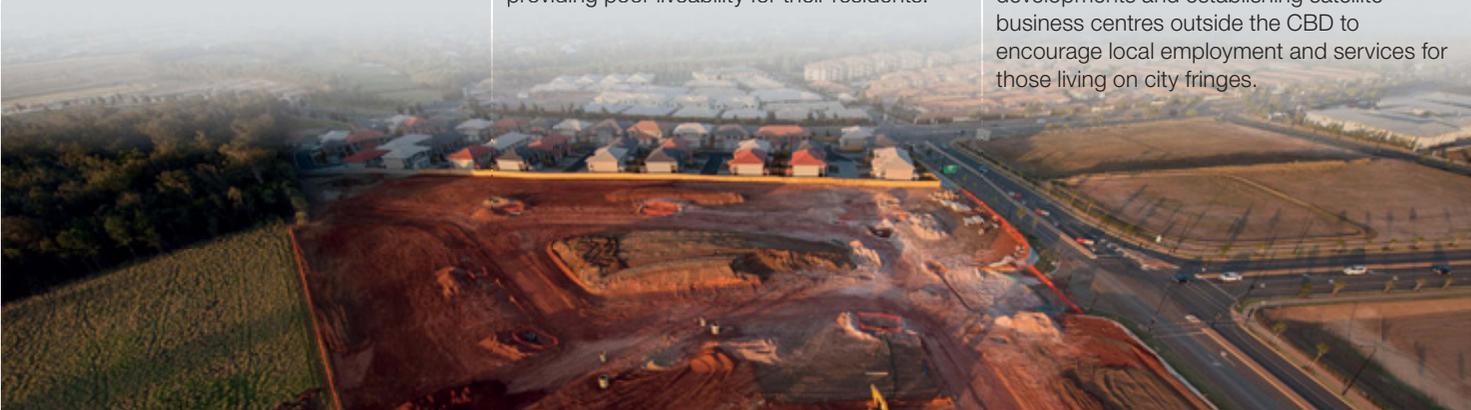
Over time, cities change and grow and the needs of people living in cities also change. To maintain and improve the liveability of a city, the services and facilities provided by governments and councils need to be regularly reviewed. Experts within government, universities, private business and community organisations, including geographers, are needed to identify problems in our cities and offer solutions.

In developing strategies to improve the liveability of our cities, planners must first identify the problems and their underlying causes, identify the impact on liveability, and then come up with strategies to try to overcome the problems. Source 4.46 shows some of the liveability issues currently facing people in Australian cities along with some of the strategies that have been suggested to cope with them.

The problem and underlying cause	The impacts on liveability	Some strategies for solving the problem
<p><b>Traffic congestion</b> As cities grow, people need to travel further to work and school. Higher rates of car ownership see more cars on the road, leaving the road network struggling to cope.</p>	<p>Traffic congestion results in people spending less time at home and more time in their cars; increases levels of air and noise pollution; increases levels of stress and frustration for drivers leading to increased incidents of road rage.</p>	<p>Strategies include building new roads which take road-users around rather than through the city; increasing public transport options to encourage people to leave their cars at home; encouraging alternative modes of transport, for example, building bike paths for cyclists.</p>
<p><b>Social inequalities</b> As cities grow, some people within the community are left without work and are unable to access services such as schools, health care and housing.</p>	<p>Social inequalities can result in homelessness, unemployment and poverty; leaves some people with a sense of alienation from the community; can have a particularly negative impact on young people.</p>	<p>Strategies include ensuring access to opportunities through good education facilities and public transport; assessing needs and providing support through community services; providing facilities for young people where they can get together and receive the help they need.</p>



The problem and underlying cause	The impacts on liveability	Some strategies for solving the problem
<p><b>Environmental issues</b> As cities grow, they have a greater impact on the environment. Water resources are used up, pollution increases and more and more energy is required to service the greater population.</p>	<p>Environmental issues include air pollution from increased energy usage, land contamination from landfill, water shortages and damaged waterways.</p>	<p>Strategies for sustainable use of the environment include recycling rubbish materials; restricting water use; developing buildings and cars to be more energy efficient; and using renewable energy sources.</p>
<p><b>Urban sprawl</b> As cities grow, more and more housing is required at an affordable price. Housing estates on the outskirts of cities push further and further outwards.</p>	<p>Urban sprawl reduces the amounts of productive farmland near cities; threatens the habitats of native plant and animal species; creates greater dependency on cars, which in turn increases levels of air pollution and traffic congestion. New housing developments can suffer from a lack of community services providing poor liveability for their residents.</p>	<p>Strategies include increasing the density of housing in established suburbs closer to the CBD with more multi-storey dwellings; protecting native habitats with bushland corridors and by planting more native trees in urban areas; ensuring public transport services are provided to all new developments and establishing satellite business centres outside the CBD to encourage local employment and services for those living on city fringes.</p>



Source 4.46 Some issues faced by modern city dwellers and some strategies for improving liveability.

## Check your learning 4.13

### Remember and understand

- 1 How does traffic congestion reduce the liveability of a city?
- 2 What is an alternative to urban sprawl when a city needs to increase its housing supply?

### Apply and analyse

- 3 Which urban issues described here affect people in the city in which you live (or in a city you know well)?
- 4 What would you describe as the biggest issue faced by people in that city?
- 5 Select one of the problems described in Source 4.46 and come up with a list of strategies of your own that you think could be used to reduce the problem and improve liveability.

# Improving transportation

Australians are among the most car-addicted people in the world. About 90 per cent of all journeys made in Australia are made by car, with trains, trams, buses and bicycles accounting for the remaining 10 per cent. As the number of people in cities grows, so too does the number of cars. Many urban roads are struggling to cope. Road congestion, particularly during morning and evening peak times, is threatening the liveability of many of our large cities.

In 2010, federal Infrastructure Minister Anthony Albanese described the problem like this: 'Urban congestion contributes to traffic delays, increased greenhouse gas emissions, higher vehicle running costs and more accidents. It is a tragedy that many parents spend more time travelling to and from work, than at home with their kids. Relieve urban congestion and we improve our quality of life.' He estimated that traffic congestion will cost Australian cities \$20 billion a year by 2020 unless the problem is addressed.



Source 4.47 Traffic on the Westgate Bridge leading to the Princes Freeway in Melbourne

## Strategies for improving transportation

Here are some solutions that planners around the world are experimenting with to improve traffic flows:

- **Change the roads**
  - Build more ring roads and bypasses that take traffic around the city centre and other busy places.
  - Change the traffic flow in the inner city by introducing a one-way system for most of the roads.
  - Make the main roads smarter by installing: overhead signs advising of variable speed limits; signs that use GPS satellites to provide drivers with traffic information; traffic lights on entry ramps; monitoring systems in the road surface to detect traffic incidents and congestion; overhead closed circuit television monitors; and traffic signals that give priority to public transport.
- **Get people off the roads**
  - Introduce a 'park and ride' system where drivers park their cars on the edge of the central business district (CBD) and then travel to the CBD by bus or train.
  - Ban cars from the CBD.
  - Charge car drivers a toll when they enter the city centre.
  - Develop a better public transport system that encourages people to get out of their cars into trams, trains, buses and ferries. The world's best public transport systems involve all these modes working together on a single ticket and with an integrated timetable rather than as individual pieces of different puzzles.
  - Encourage people to walk or cycle by building more footpaths and bike lanes and promoting the health benefits of walking and cycling.
- **Keep doing what we're doing**
  - Build more multi-storey car parks in the city centre
  - Build more roads to carry the increased traffic
  - Increase motoring taxes to pay for new roads through increases in petrol prices
  - Encourage private companies to build toll roads.



**Source 4.48** Graphic representation of the paths taken by 380 taxis in a single day in London. Bright splashes of light show paths taken by many taxis while darker areas have seen few, if any, taxis.

## Check your learning 4.14

### Remember and understand

- 1 What does the graphic representation of London taxis (Source 4.48) reveal about transport flows in large cities?
- 2 What are the causes of traffic congestion?
- 3 What problems does traffic congestion cause for people and cities?

### Apply and analyse

- 4 Here we have described many possible solutions to traffic congestion.
  - a Which do you believe are the three solutions most likely to relieve congestion? Explain your response.

- b Which solutions do you think are most likely to make congestion worse rather than better? Explain your response.

### Evaluate and create

- 5 As the planner responsible for traffic congestion in your city, you have chosen one of these solutions to put into place. Design an advertising campaign that explains this solution to drivers and the general public. Remember to explain it clearly and simply and to point out the benefits of this solution for drivers and for all the residents in the city. You may choose to create a poster, brochure, bumper sticker or short TV or radio ad explaining your campaign.

# Improving liveability for young people

When trying to improve the liveability of a town or city, planners need to take into account the varying needs of people of different ages. The needs of children and young people are obviously very different from the needs of older retired people. Each of these groups, however, benefit from having special attention paid to their particular needs. Here we will look specifically at strategies for improving the liveability of places for children and young people.

## Strategies for young people

The views of young people need to be taken into account when planning for more liveable cities. Some of the key liveability factors relevant to a younger population are:

- **Public transport**

Young people are the community group most likely to be dependent on public transport services. Public transport needs to be safe and reliable to encourage young people to use it. Public transport routes also need to be designed to meet the needs of young people with services regularly going past local schools, shops, entertainment and sports facilities.

- **An attractive and healthy natural environment**

When cities experience environmental issues such as air pollution, those often the worst affected are children, and negative impacts to their health can last a lifetime. With housing density increasing, the need for green spaces is increasing. Access to public parks and playgrounds provides healthy natural environments for children who are living in housing without gardens. These playgrounds also provide opportunities for children to develop their coordination and physical strength while enabling them to make friends and socialise.

- **Good schools and other educational facilities**

Schools need to have teaching spaces that offer the flexibility for group work and individual work and also provide good outdoor spaces. As students use more technology in the classroom, schools need to



**Source 4.49** Venues designed for young people can increase youth participation in the community.

adapt to meet the needs of this new technology by providing fast Internet and Wi-Fi.

- **A wide range of recreational environments for young people**

One of the keys to improving liveability for young people is providing good public spaces. Public spaces should be designed to cater for their specific needs and interests. These include sportsgrounds and facilities such as skate parks and skating rinks, and entertainment facilities including cafés, cinemas and music venues. Community festivals and events can also be organised to include activities specifically designed to interest young people.

- **Services for young people at risk**

Vulnerable young people who are at risk from abusive family members, homelessness or substance abuse need special attention to ensure that they are not disadvantaged by their circumstances and can reach their potential. Community services can provide support through counselling and mentoring, or by helping to arrange alternative accommodation.

## Case study: 'Our Youth – Our Future', Western Australia

In 2012, the Western Australian government released a set of goals designed to improve the lives of young people. Western Australia has Australia's fastest growing youth population. People aged between 12 and 25 years living in Western Australia make up about 20 per cent of the state's total population.

The Western Australian government is working with communities and consulting with young people to improve liveability in the areas that matter most to them. Through policies, services and community programs they aim to:

- increase young people's participation in community life through sport and recreation, culture and arts, and volunteering
- provide opportunities for young people to learn life skills and prepare for their working future
- create environments that appeal to young people and encourage healthy lifestyles.

### The Esplanade Youth Plaza

One example of a community space created specifically to appeal to young people and improve liveability is the plan for a youth plaza on Fremantle's Esplanade Reserve.

The local council and the contractor, Convic Skateparks, provided information on the various options available and collected feedback from the community through workshops and online surveys. The new youth plaza has an area designed for skateboarders and BMX riders. Other features being considered are a basketball half-court, table tennis tables, a stage area for youth concerts and children's play areas.

### Check your learning 4.15

#### Remember and understand

- 1 What are three liveability issues that affect young people?
- 2 How does a skatepark provide a more liveable community for some young people?
- 3 What facility or service would you like to see in your local community to make it more liveable for you?

#### Apply and analyse

- 4 Consider the case study from Western Australia above.
  - a What vision does the Western Australian government have for young people?
  - b Provide one example of a service or a place that you think would make a local community a more liveable place. What would be the expected outcome from your plan?



Source 4.50 Skate parks are a great way to make open spaces more appealing to young people.

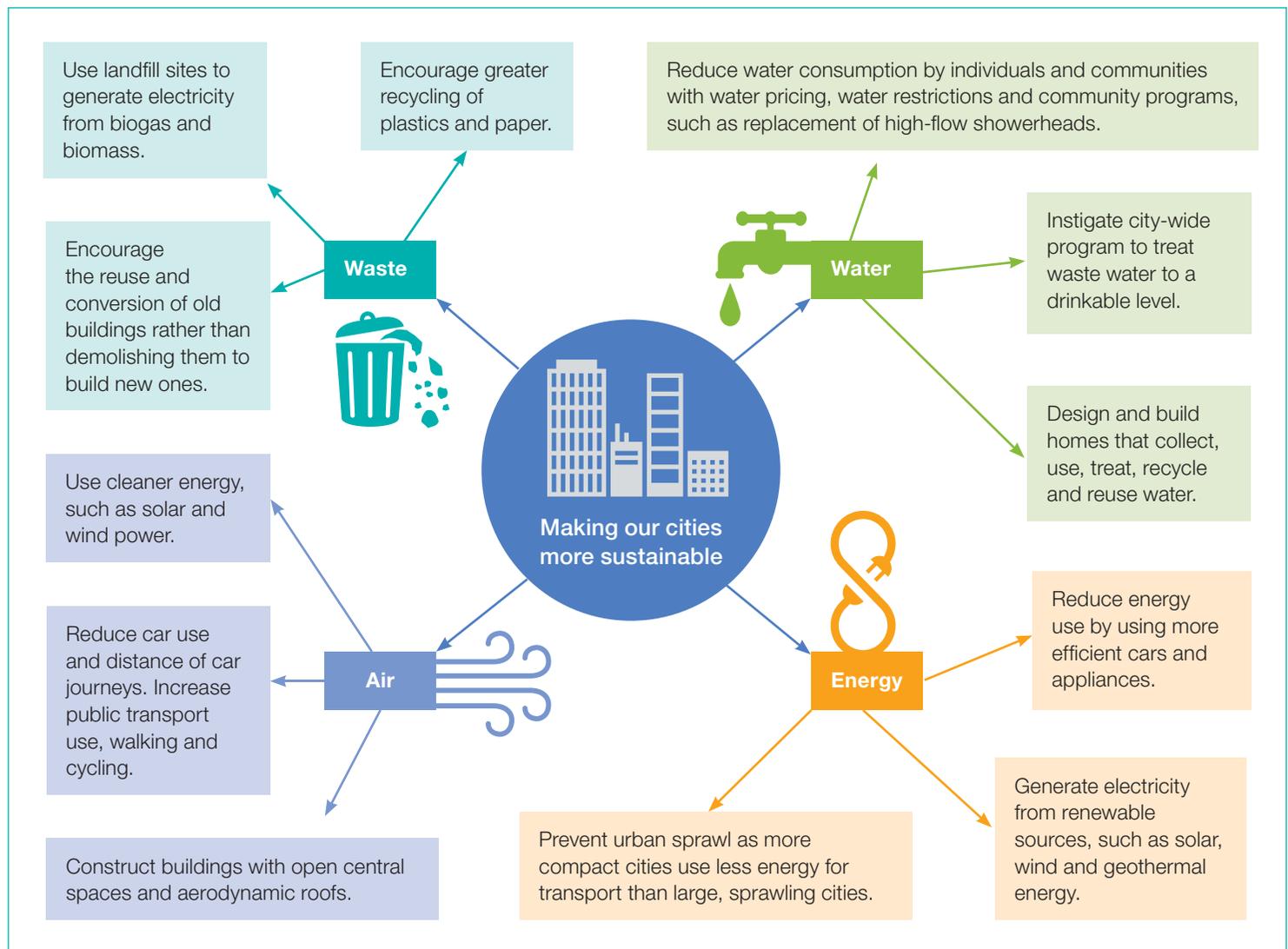
# Improving sustainability

The quality of the environment has a big effect on the liveability of a place. Cities consume large amounts of **natural resources**, such as water and energy. They also produce substances that are harmful to the environment, such as **greenhouse gases**, as well as solid waste, such as sewage and rubbish. Rapidly growing cities in developing countries are struggling to deal with these and other environmental issues.

In the last decade, Australian cities have become more sustainable by reducing their impact on the environment in many significant ways. We now use less energy, produce less rubbish, consume less water and

have cleaner air than was the case at the beginning of this century. This is largely due to new technologies in such things as power stations and the phasing out of old technologies such as less efficient cars that pollute more.

There have also been changes in behaviour that have been encouraged by governments. City dwellers, for example, now take for granted that recyclable material is not waste and should be separated out in the weekly rubbish collection. Local restrictions on the use of water in households have also helped to make our cities more sustainable. But there is still much more that can be done.



Source 4.51 Concept map showing strategies for a more sustainable city

## Clearing the air in Launceston

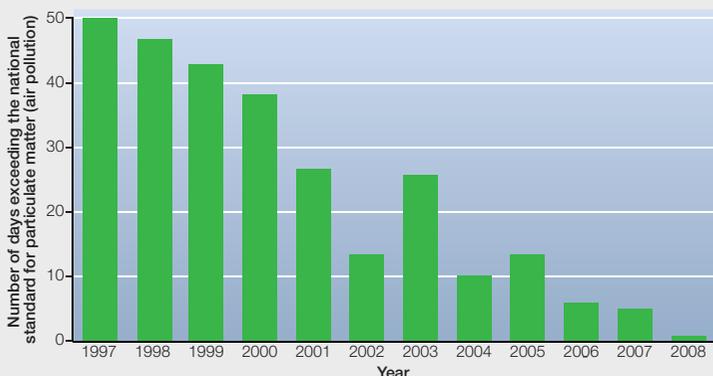
The city of Launceston in northern Tasmania was once one of Australia's most polluted cities. This was due to a combination of natural processes and human activities. About two-thirds of households in the early 1990s used wood fires to heat their homes and this produced large quantities of smoke, particularly during winter. Launceston's location in a valley meant that the smoke was trapped and people's health began to suffer. Researchers linked Launceston's smoke to high rates of asthma and lung disease and likened it to the effects of tobacco smoking.

In 1997 there were 50 days in which Launceston's air exceeded the national standard for the amount of pollution. By 2008, this had fallen to only one day a year. This was due not to wood heaters but to a nearby bushfire. This dramatic change is largely because of a government scheme where Launceston residents were given \$500 to change their home heating from wood fires to other methods, such as a gas fire or electric heater. More than 2000 residents have so far taken advantage of the scheme and thousands of others have changed their heating methods because of the publicity generated.

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



**Source 4.52** The hills that surround Launceston trapped wood smoke, making it one of the world's most polluted cities.



**Source 4.53** Air pollution in Launceston, 1997–2008

## Check your learning 4.16

### Remember and understand

- 1 Why did Launceston have such poor air quality?
- 2 How did the people of Launceston improve their air quality?

### Apply and analyse

- 3 Solutions to some of the environmental problems faced by city dwellers can be easy to find but hard to put into place. Give some examples of solutions that have been difficult to put into place.
- 4 Select one of the four environmental issues shown in Source 4.51.
  - a Explain why this is an issue in cities.
  - b Which of the three solutions given do you think has the best chance of helping to address the issue?
  - c Can you think of two more solutions? Share these with your classmates and use the discussion to describe how cities can be made more sustainable.
- 5 Examine Source 4.53.
  - a Describe the change in air pollution in Launceston from 1997 to 2008.
  - b Give a possible reason for the sudden increase in pollution in 2003.

### Evaluate and create

- 6 Cities are one of the main causes of global climate change as much of the gas that traps heat comes from burning fossil fuels in cities. In a small group discuss how cities can lead the way in reducing the emission of these gases.

# Improving spaces for wildlife

When planning to improve the liveability of places for people, it is important to also consider the impacts this has on the habitats of native wildlife. Koalas are one of Australia's most loved native animals, but despite this their future in many parts of Australia is very uncertain. As bushland on the edges of our towns and cities is cleared for farms and houses, koalas are losing their habitats. Improving the liveability of these places for people is having negative effects on the liveability of the same places for koalas.

Habitats suitable for koalas are made up of trees that serve three main functions:

- food – koalas rely on certain types of native gum trees for the food they eat; these only grow in certain parts of the country
- shelter – as well as providing food, trees provide koalas with protection from the weather and predators, such as domestic dogs
- corridors – these are spaces that link the areas of bushland where koalas live; they allow koalas to move between trees; the more small trees and shrubs there are growing in these corridors, the easier it is for koalas to move about without coming down to ground level where it is dangerous for them.

Over 80 per cent of the total habitat in Australia that was once suitable for koalas has now been cleared. Much of the remaining 20 per cent is also under threat from people. Because it is difficult to get accurate numbers of koala populations at any one time, geographers divide possible koala habitats into areas where populations are most common to least common. This gives them a good idea of where they most need to focus their efforts to conserve koala populations (see Source 4.56).

As well as losing their habitat, koalas face many dangers due to the expansion of our cities. Each year, many koalas are hit by cars as they move between sections of bushland. Many others are attacked and killed by domestic dogs. The recorded deaths of koalas in south-eastern Queensland over a 10-year period can be seen in Source 4.55.

**Source 4.54** Koalas often return to trees they consider their territory even if the tree is now in somebody's front yard.

Year	Dog attacks	Cars	Disease	Other	Total deaths
2001	114	324	303	488	1 229
2002	103	342	245	454	1 144
2003	94	342	180	558	1 174
2004	68	333	238	529	1 168
2005	60	234	262	410	966
2006	69	280	193	513	1 055
2007	68	287	179	678	1 212
2008	58	296	256	532	1 142
2009	76	248	210	738	1 272
2010	67	246	131	655	1 099
<b>Totals</b>	<b>872</b>	<b>3243</b>	<b>2647</b>	<b>5998</b>	<b>12 760</b>

**Source 4.55** Recorded deaths of koalas in south-eastern Queensland (including causes) (Source: Queensland Department of Environment and Resource Management, 2011)

## Strategies to protect koalas

There are a number of strategies that we can implement to protect koalas and their habitat, despite the expansion of urban areas. The first, and most effective, strategy is to protect key koala habitats (and corridors) from future urban development. Conservationists are constantly lobbying councils and governments in order to protect areas like this. In many cases, however, cities and suburbs have already been built over koala habitat.



In these cases, there are a number of actions that can be taken to protect koala populations in the area:

- preserve and protect existing eucalyptus trees and plant additional trees
- plant trees and shrubs (such as wattles) for koalas to use as shelter
- protect koala corridors and plant smaller trees and shrubs in these areas
- erect koala-friendly fencing that koalas can easily climb over, through or under, allowing them to move around their habitat
- erect road signs warning of koalas, and lower speed limits on roads used by koalas to cross between areas of bushland
- keep domestic dogs separated from koalas by erecting fenced enclosures (called dog runs).

#### EASTERN AUSTRALIA: KOALA HABITAT AND POPULATIONS



Source 4.56

Source: Oxford University Press



Source 4.57 A young koala hit by a car is bundled into a blanket by a member of the Moreton Bay Koala Rescue team north of Brisbane.

### Check your learning 4.17

- 1 As new homes and farms are built on the edges of our cities, how are koala habitats affected?
- 2 How much of the koala's original habitat in Australia has been destroyed?
- 3 What are the three ways in which koalas use trees and shrubs in their habitats?
- 4 List three strategies that can be used to help protect koalas and their habitats.

### Apply and analyse

- 5 Look carefully at Source 4.56.
  - a Where do koala habitats and populations tend to be?
  - b What connection is there between the capital cities on the map and koala habitats?
- 6 Using the data provided in Source 4.55 determine:
  - a the total number of koalas killed by cars in south-eastern Queensland between 2001 and 2010.
  - b What percentage is this of the total number of koalas that died over the same period?
  - c The leading cause of death among koalas is shown as 'Other'. Provide three causes of death you think would be included in this category.

### Evaluate and create

- 7 Prepare a media campaign to raise community awareness about the dangers facing koalas in Australia. You may choose to prepare a poster or a multimedia presentation warning people of the dangers facing koalas or provide some key strategies that people can implement to protect koalas living near their homes. Create a catchy slogan for people to remember your campaign.

## 4.3 bigideas: broadsheet

# Hamburg – a green city

The city of Hamburg in Germany is one of the most environmentally friendly cities in the world. Green spaces, parks, woodlands and nature reserves make up 16.7 per cent of the urban area and renewable energy accounts for 17 per cent of the city's power usage. Hamburg is one of the 20 most liveable cities in the world and, in 2011, was named European Green Capital.

Hamburg is currently building an inner-city development called HafenCity in the location of the old port warehouses. HafenCity will provide housing for 12 000 residents and jobs for around 45 000 people. It will create 10.5 kilometres of new waterfront and 26 hectares of public parks, squares and promenades. The HafenCity community will use 30 per cent less power thanks to environmentally-friendly design and materials and wind and solar-power technologies. Many rooftops will be covered in greenery to slow stormwater runoff and reduce heat from the development.

### skilldrill

#### Interpreting oblique aerial images

The photograph and illustrated plan provided are both what geographers call oblique aerial images. Oblique aerial images are taken on an angle from a high point. They can be taken looking down from a hill or mountain, or from an aircraft or hot-air balloon. Oblique aerial images are useful for geographers because they can show a much larger area than photographs taken from ground level (known as ground-level images) because the view is not interrupted by trees, houses or mountains. They are also useful because all of the features shown in them are easily recognisable. This is not always the case with images taken from directly above (known as vertical images or 'plan view' images).

When interpreting oblique aerial images, it is important to be aware of the following points:

- Oblique aerial images allow you to see the height and width of features on the ground. As a result it is possible to get an idea of the steepness of the ground or the height of a building.
- A major disadvantage of an oblique aerial image is that scale is inconsistent. This means that distances in the foreground and distances in the background cannot be calculated using the same scale. If you want to make a map or take accurate measurements of distance, you should not use oblique aerial images. Use vertical images instead that show the area in plan view.



Background

Middle Ground

Foreground

**Source 4.58** An oblique aerial photograph of the HafenCity development in Hamburg, Germany. It will be Europe's largest inner-city development project.

## Apply the skill

- 1 Examine the photograph of HafenCity shown in Source 4.58.
  - a Are the buildings in HafenCity (in the foreground) generally lower or higher than those in the background? How can you tell?
  - b Would the width of the channel behind HafenCity be easier to measure on a plan or oblique view?

## Extend your understanding

Conduct some research on the Internet to find out more about the HafenCity development in Hamburg.

- 1 In what year was the project first announced?
- 2 When do the developers estimate the project will be completed?
- 3 How many homes will HafenCity contain once the project is complete?
- 4 Find some images of the HafenCity site before it was developed and compare them with Source 4.59.
  - a In what ways has the HafenCity site changed since development began?
  - b How has the HafenCity development improved the liveability of the city of Hamburg?
  - c HafenCity has been designed to be highly sustainable – using environmentally friendly building materials and wind and solar power. Using Source 4.51, suggest three more ideas that could be introduced to improve the sustainability of HafenCity.



Source 4.59 A computer-generated plan of HafenCity from an oblique aerial view

# glossary

## A

**aerial photograph** a photograph taken at some distance above (for example, from an aeroplane)

**alphanumeric grid** a row of numbers and a row of letters on adjacent sides of a map or other image providing an easy way to locate particular features

**amenity** something that makes living someplace attractive (e.g. public transportation, good roads, a park)

**annotated visual display (AVD)** a way of presenting the final results of a research project, incorporating images, graphs, notes and explanations in a poster-style format

**aquifer** layers of rock or soil in the ground that hold water or that water can pass through

## B

**bar graph** a graph that shows information as a series of horizontal bars

**barometer** an instrument used to measure atmospheric pressure

**BOLTSS** a mnemonic (memory device) for remembering the essentials of a map: border, orientation, legend, title, scale and source

**bore** (also called an Artesian well) a drilled well that brings water up from deep in the ground

## C

**cardinal points** the four main directions shown on a compass; north, south, east and west

**change** a key concept in geography: the dynamic nature of all processes on Earth, whether slow or fast, small or large

**choropleth map** a map that shows particular data or characteristics, such as population density, by using different shades of the same colour or different colours to show variations (e.g. light green to dark green)

**civil unrest** disturbances in a city characterised by protests against the government or ruling structures

**climate** the average weather – particularly rainfall and temperature – experienced in a particular area over a period of time (usually 30 years)

**climate change** the generally accepted idea that the Earth's climate is warming and will continue to warm due to pollution and overpopulation

**climate graph** a combination column and line graph that shows the rainfall and temperature of a given place; also known as a climograph

**column graph** a graph showing information as a series of vertical columns

**compass** an instrument with a magnetic needle that points to the north; used for navigation

**compass bearings** a precise way of giving compass directions, such as 135° south-east

**compound column graph** a column graph that has subdivided columns for further comparison of groups

**concept map** a diagram or chart used to organise thoughts and ideas to show their relationship

**condensation** the process that takes place when a gas cools and forms a liquid; for example, water vapour becoming water droplets

**consumption** the use of a resource

**continuous resource** a resource, such as the Sun, that will never run out no matter how much we use it

**contour lines** lines drawn on a map that connect points at the same height to show the height and steepness of land

## D

**delta** a fertile area of land that forms at the mouth of a river

**desalination** the process of removing salt from sea water

**desert** area that receives less than 250 mm of rain every year; can be hot or cold

**developed country** an industrialised country with a well-developed economy capable of supporting its own people

**developing country** a less economically developed country that has some difficulties in supporting its own people

**direction** a way of orienting a map, usually shown by the use of compass points, such as north

**distance** the amount of space between two objects or places, generally measured by using the scale on a map

**distribution** the way in which things are arranged on the Earth's surface; the pattern formed by the way objects or places are distributed across a space

**dot distribution map** a map using dots or other shapes to show the location of a particular feature

## E

**eastings** the gridlines that run vertically on a topographical map

**effluent** contaminated water that flows out of a treatment plant, sewage system, industrial site, etc.

**environment** a key concept in geography: a specific place on Earth and all the things, both living and non-living, that are there

**Equator** an imaginary line that runs around the middle of the Earth separating the Northern Hemisphere from the Southern Hemisphere

**ethnicity** the background, nationality or culture of a person or group of people

**evaporation** the process by which a liquid (such as water) is converted to a gas

**exception** in geography, a feature that falls outside a usual pattern or does not follow an observed pattern

## F

**feature** a distinctive landform or characteristic of the landscape, either naturally occurring or made by humans

**fieldwork** geographical study that takes place outside the classroom at the site of inquiry

**FIFO** fly-in, fly-out; used to describe the lifestyle of workers who live far away from their place of employment (such as a mine)

**floodplain** low-lying land next to a river or stream that is regularly flooded by water

**flow map** a map that shows movement (such as people or goods) from one place to another

**fossil fuel** fuel made from the decomposed remains of plant and animals that lived millions of years ago (e.g. coal, oil)

## G

**geographical inquiry** the stages that geographers follow to guide their investigations

**geothermal energy** energy that comes from the internal heat of the Earth

**GIS** Geographic Information System; a software application designed to capture, store, manipulate, analyse, manage and present all kinds of geographical information

**glacier** a large frozen mass or river of ice that slowly moves down a mountain or valley in response to gravity

**greenhouse gas** a gas (e.g. carbon dioxide, methane) which is partially captured in the Earth's atmosphere preventing some of the Earth's warmth from escaping into space

**gross domestic product (GDP)** the total value of a country's goods and services

## H

**headwaters** the starting point of a river, the source

**HIV/AIDS** human immunodeficiency virus infection/acquired immunodeficiency syndrome; an illness that disrupts a person's normal immune system, making him or her susceptible to many other diseases

**Human Development Index (HDI)** a set of statistics used to indicate life expectancy, education and income

for individual countries in order to compare and rank them

**hydroponics** a method of growing plants without using soil

## I

**ice cap** a permanent layer of ice over the ground, such as found at the North and South Poles

**iceberg** a large mass of ice that has broken away from a glacier or ice sheet and is floating in open water

**infiltration** the process of water seeping through the earth

**infrastructure** the facilities and services necessary for any community, city or country to function (e.g. buildings, electricity, roads, airports and water supply)

**interconnection** a key concept in geography: the relationship between all things, both living and non-living, and all processes, both natural and human

**internally displaced person (IDP)** a person who has been forced to relocate within his or her own country

**irrigation** the watering of crops in some way other than by precipitation

## K

**key inquiry question** a question that helps geographers to plan and focus their geographical inquiries

## L

**land use map** a map that shows what segments of land are used for (e.g. residential, commercial, agricultural)

**latitude** imaginary lines running east-west around the Earth's surface, parallel to the Equator, used to work out location and direction

**legend** (also called a key) a guide to the symbols and shading used on a map or other image

**levee** a raised area between low-lying land and a body of water, built to prevent flooding

**line graph** a graph that displays data as a line

**liveability** a measure of what a place is like to live in according to particular

criteria such as access to schools and work, climate, safety, etc.

**longitude** imaginary lines running north-south around the Earth's surface, from the North Pole to the South Pole, used to work out location and direction

## M

**magnetic north** the physical place on Earth, near the North Pole, to which a magnetised needle points

**map** a simplified plan of an area shown from directly above

**megacity** a city with a population of more than 10 million people

**meteorologist** a scientist who studies the atmosphere, particularly the forecasting of weather

**metropolitan** a term used to describe a major city or urban area

**monsoon** weather or climate produced by major wind systems that change direction seasonally; in northern Australia, the north-western and south-easterly winds that produce the rainy season between December and February

## N

**natural resource** a resource that occurs in nature (e.g. water, minerals, trees, livestock)

**non-renewable resource** a resource that cannot be regenerated once it is used up (e.g. oil, coal)

**northings** the gridlines that run horizontally on a topographical map

## O

**overlay map** a map on some type of transparent paper or layer that is placed over a base map, used to show the relationship between features or events on the Earth's surface

## P

**photosynthesis** the process by which plants convert sunlight into energy for new growth

**physical map** a map that shows the locations and names of physical features of the Earth, such as mountains and rivers

**pie graph** a graphical way of presenting data; a circle is divided up into segments to represent the distribution of data

**place** a key concept in geography: a part of the Earth's surface that is identified and given meaning by people

**plan view** a way of showing something as if the viewer is looking down on it from above; a bird's-eye view

**political map** a map that shows the locations and names of built features of the Earth, such as country borders, cities, roads, dams and railways

**population density** a measurement of the number of individuals per unit area (e.g. 1500 people per square kilometre)

**population pyramid** a graph that displays the percentage of males and females in a region by age-group

**precipitation** the process of water in its various forms (rain, snow, hail, etc.) falling to the ground

**primary data** data for a geographical inquiry that was collected in the field by a geographer conducting the inquiry (e.g. survey data, hand-drawn maps or photographs)

## Q

**qualitative data** any information that can be recorded in words; for example, Uluru is very large

**quantitative data** any information that can be recorded as numbers; for example, Uluru is 3.6 kilometres long

## R

**refugee** a person who moves to another country because of a natural disaster or to avoid persecution

**region** an area on the Earth's surface that makes it different from surrounding areas

**remittances** money sent home to family by workers who are employed away from their home region

**renewable resource** a resource that can regenerate or be regrown (e.g. trees) as opposed to one that cannot be regenerated (e.g. coal)

**resource** anything human or natural that can be used by people to satisfy a need

**run-off** water that does not penetrate the ground but flows on the surface towards rivers, lakes and seas

**rural-urban fringe** the area where cities end and country or farming areas begin

## S

**sanitation** measures designed to ensure good health in a community by preventing human contact with health hazards (such as sewage)

**scale** a key concept in geography: the level at which a geographical inquiry takes place – personal, local, regional, national or global

**scale (mapping)** a system that indicates how the distances on a map as represented in the real world (e.g. written scale, line scale, ratio scale)

**secondary data** data used for a geographical inquiry that was not collected by the geographer conducting the inquiry (e.g. textbooks, atlases and government websites)

**six-figure grid reference** a system used to locate exact points on a topographic map

**slum** a settlement within a city where the inhabitants have inadequate housing and poor access to basic services

**space** a key concept in geography: the way things are arranged on the Earth's surface

**spatial pattern** the distribution of features on the Earth's surface that may form particular patterns, such as linear (in lines), clustered or radial (like spokes on a wheel)

**sustainability** a key concept in geography: the ongoing capacity of Earth to maintain all life

**sustainable** capable of being continued with minimum long-term effects on the environment

## T

**tailings** the waste material left over from commercial mining operations

**thematic map** a map that shows details about a particular topic, such as land use or the distribution of resources

**topographic map** a map that shows the shape of the land, its relief and landforms

**trend** a general direction in which something is developing or changing (e.g. the trend in population in Australia is positive)

**tropics** the area of the world between the Tropic of Capricorn and the Tropic of Cancer

**tsunami** a giant ocean wave caused by an underwater earthquake

## U

**unsustainable** not capable of being continued without long-term effects on the environment

**urban infill** the filling in of unused spaces in the centre of a city

**urban sprawl** the growth of a city onto productive farming land on the city fringes

## V

**vertical aerial photograph**

a photograph taken from directly above the landscape or feature being photographed, usually from an aeroplane or satellite, giving a **plan view**

**virtual water** the volume of fresh water used to produce the product, measured at the place where the product was actually produced

**voluntary migrant** a person who is free to choose where and when they move

## W

**waste-water** water that has been used by people in domestic or industrial settings for washing, cleaning or flushing that contains waste products

**water cycle** the continuous cycle by which water evaporates from lakes and oceans, condenses into clouds, falls on land as rain, finds its way into rivers (often after human use) and returns to the oceans

**water footprint** an indicator of the amount of water (both direct and indirect) that is used to produce the goods and services

**weather map** a map that shows conditions in the Earth's atmosphere, such as air pressure, wind speed, wind direction, and warm and cold fronts

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