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# Geography

NSW Syllabus

for the

Australian Curriculum

7 & 8

4  
Stage

Series Editor  
Kate Thompson



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**Series Editor**  
**Kate Thompson**

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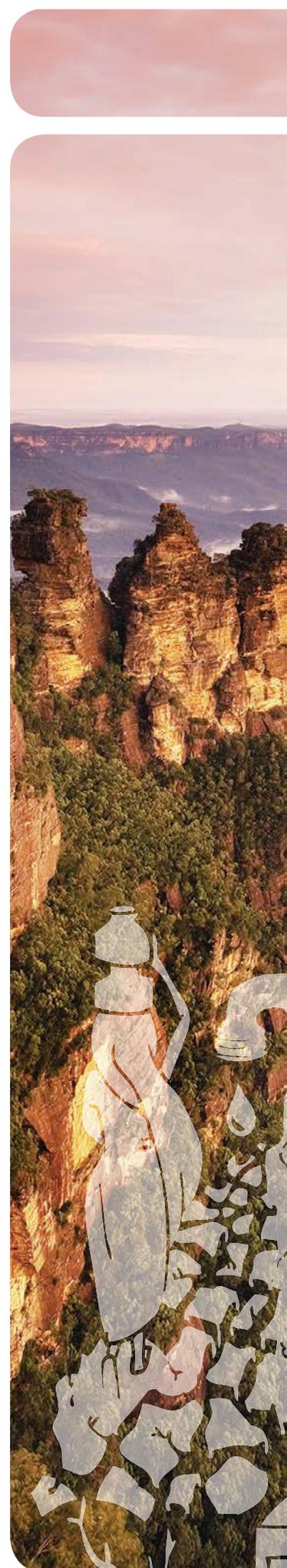
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# Contents

<i>Foreword</i>	vii
<i>About the authors</i>	viii
<i>Acknowledgements</i>	ix
<i>How to use this resource</i>	x
<b>Geographical skills toolkit</b>	<b>2</b>
0.1 Introduction	2
0.2 Geographical concepts	3
0.3 Geographical skills	9
0.4 Geographical tools	14
<b>Topic 1 Landscapes and landforms</b>	<b>22</b>
<b>Chapter 1 Landscapes and landforms</b>	<b>24</b>
1.1 Different landscapes and landforms	25
1.2 Geomorphic processes	26
1.3 Weather and climate	26
1.4 Examining a landscape and its landforms	39
<b>Chapter 2 Value of landscapes and landforms</b>	<b>44</b>
2.1 Aesthetic value of landscapes and landforms	45
2.2 Cultural and spiritual value of landscapes and landforms	48
2.3 Economic value of landscapes and landforms	52
<b>Chapter 3 Changing landscapes</b>	<b>57</b>
3.1 Ways people use and change landscapes	58
3.2 Impact of human activities on landscapes	63
3.3 Examining landscape degradation	68
<b>Chapter 4 Landscape management and protection</b>	<b>73</b>
4.1 Landscape protection across different scales	74
4.2 Examining the management and protection strategies for a landscape	78
4.3 Aboriginal and Torres Strait Islander peoples' use and management of landscapes	84
<b>Chapter 5 Investigating a contemporary geomorphic hazard</b>	<b>90</b>
5.1 Spatial distribution of the disaster	91
5.2 Geomorphic processes causing the disaster and its impacts	93
5.3 Responses to the impact	97
5.4 Management strategies to reduce the future impact of similar hazard events	98





## Topic 2 Place and liveability 106

### Chapter 6 Influences and perceptions 108

- 6.1 Place and liveability 109
- 6.2 Environmental factors that influence perceptions of liveability 111
- 6.3 Human factors that influence perceptions of liveability 120
- 6.4 Measuring the liveability of places 126
- 6.5 Personal liveability criteria 129

### Chapter 7 Access to services and facilities 134

- 7.1 Important services and facilities for people's wellbeing 135
- 7.2 Accessing services and facilities in different places 147
- 7.3 How limited access to services and facilities affects liveability 150

### Chapter 8 Environmental quality 157

- 8.1 Factors that reduce environmental quality 158
- 8.2 Comparison of the impact of environmental quality on the liveability of places 170

### Chapter 9 Community 175

- 9.1 Characteristics of places that influence community identity 176
- 9.2 Factors that enhance social connectedness 184

### Chapter 10 Enhancing liveability 192

- 10.1 Characteristics of highly liveable places 193
- 10.2 Assessing different roles in enhancing liveability 197
- 10.3 Strategies to improve the liveability of a place in Australia 200

## Topic 3 Water in the world 204

### Chapter 11 Water resources 206

- 11.1 Classification of water resources 207
- 11.2 Different forms of water 209
- 11.3 Spatial distribution patterns of water resources 213

### Chapter 12 The water cycle 222

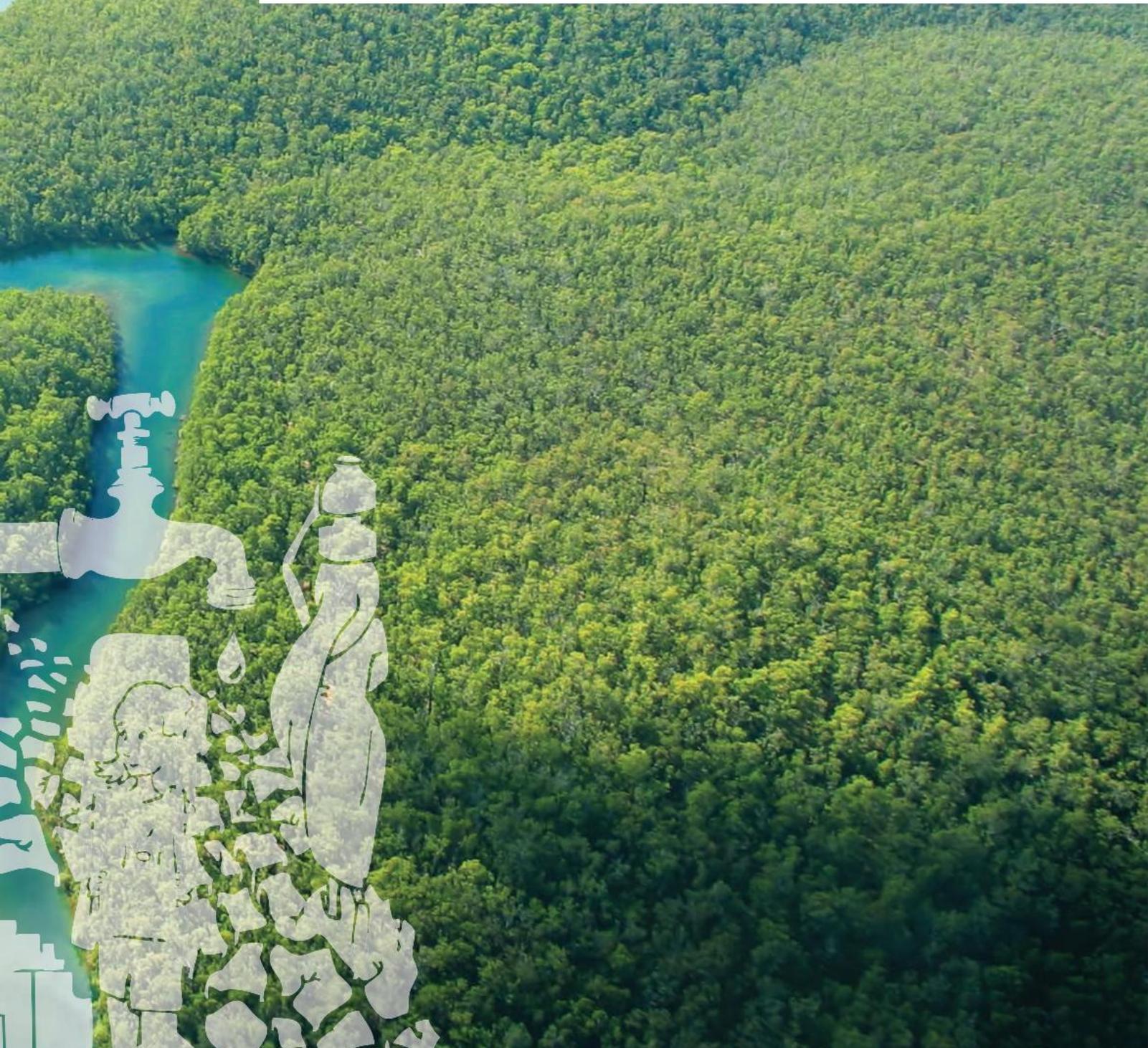
- 12.1 Water cycle processes 223
- 12.2 How water flows within a catchment area 226
- 12.3 Factors influencing water flows and the availability of water resources 228
- 12.4 How the water cycle connects people and places 237

<b>Chapter 13 Australia's water resources</b>	<b>243</b>
13.1 Spatial variations in Australia's water resources	244
13.2 Variations in freshwater availability across Australia	245
13.3 Variations in freshwater availability between continents	258
<b>Chapter 14 Water scarcity and water management</b>	<b>266</b>
14.1 Water scarcity in different countries	267
14.2 Overcoming water scarcity and the role of different groups in sustainable water management	274
14.3 Individual actions contributing to water management	280
<b>Chapter 15 The value of water</b>	<b>285</b>
15.1 Ways water is used by people	286
15.2 People's perceptions about the value of water	293
15.3 The importance of water to Aboriginal and Torres Strait Islander communities	299
<b>Chapter 16 Investigating a contemporary natural hazard</b>	<b>303</b>
16.1 Natural hazards	304
16.2 Spatial distribution and cause of disasters	309
16.3 Impact of climate change on floods	311
16.4 The impact of and responses to disasters	312
16.5 Responses to floods and management strategies for future disasters	316
<b>Topic 4 Interconnections</b>	<b>320</b>
<b>Chapter 17 Personal connections</b>	<b>322</b>
17.1 Patterns and trends in people's activities	323
17.2 Impact of people's travel on the future of places	330
17.3 Impacts of tourism on Phillip Island and Monkey Mia	333
<b>Chapter 18 Technology</b>	<b>339</b>
18.1 How transport technologies connect people to places	340
18.2 How ICT increases people's connections to other places	344
18.3 Impact of increasing global connectivity on people and places	354
<b>Chapter 19 Trade</b>	<b>358</b>
19.1 Trade connections in Australia	359
19.2 Examining a country's trade links with other countries	362
19.3 Spatial patterns of global trade	372





<b>Chapter 20 Production and consumption</b>	<b>382</b>
20.1 Impacts of production and consumption of consumer goods	383
20.2 Effect of production of goods on a place	389
20.3 Responses to minimise the effects of production and consumption	396
<i>Glossary</i>	404
<i>Index</i>	413



# Foreword

Geography is not just about academic learning from a textbook but about developing a holistic understanding of the world. Our team of authors are experts in their field; and with their input, you can be assured that you have been provided with accurate and reliable information that addresses the nuances of the NSW Geography Syllabus in fine detail.

*Geography NSW Syllabus for the Australian Curriculum Stage 4, 7 & 8* fully achieves the aims of the syllabus by fostering curiosity about places and cultivating respect for people, cultures and environments around the world. You will develop a strong geographical understanding of Australia and its neighbours through the integration of interesting case studies and examples throughout. New and contemporary insights into events, processes and places from around the world are also explored, which will enrich your geographical knowledge and understanding.

This textbook will help you develop opinions about geographical issues and concepts. Activities seek to target creative and critical thinking skills. It encourages you to immerse yourself in current issues, be aware of media reports and realise that human actions have significant consequences on the environment and for the future of the environment. In this way, the textbook also captures the essence of the cross-curriculum priority of sustainability.

We have achieved a productive balance between geographical knowledge and understanding and geographical inquiry and skills. The incorporation of fieldwork activities throughout the textbook allows you to explore your surrounding environment and to investigate the causes and effects of various human and physical geographical processes. Each activity can be tailored to suit your local area or classroom needs by focusing on developing and applying geographical inquiry methods and skills.

In Stage 4 by learning about *Landscapes and landforms* you will appreciate the complex geomorphic processes that create unique environments. *Place and liveability* focuses on contemporary life and settlements, the reason for the location and all infrastructure requirements to ensure that areas are desirable places to live. In *Water in the world* you will develop a deep understanding of water and its associated connections, uses, values and hazards. Finally, *Interconnections* allows for learning about demographic shifts, such as urbanisation, and management strategies for the future.

As geographers it is our responsibility to adopt an informed point of view, adopt a measured approach and promote environmentally sustainable practices in whatever we do. By thinking geographically, we can work together to contribute to a socially just world.

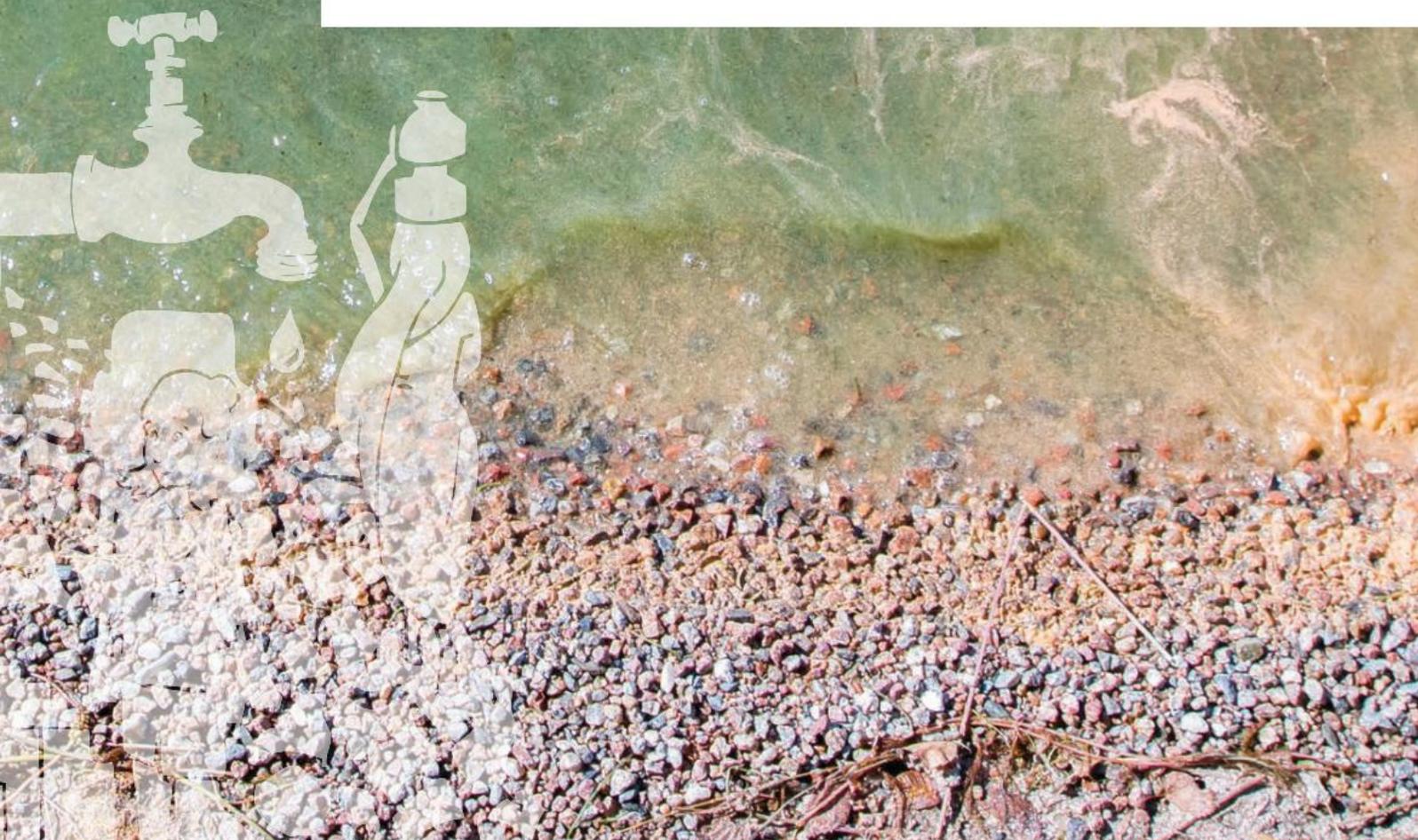
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**Kate Thompson** is the head teacher of secondary studies at Aurora College and lecturer to postgraduate students studying the Master of Teaching/Education at Australian Catholic University. Kate was awarded a New South Wales Premier's Teacher Scholarship in addition to an Outstanding Professional Service Award issued by the New South Wales Minister for Education. She holds a Bachelor of Economics (Social Sciences), Master of Teaching, Master of Industrial Relations and Human Resource Management and a Certificate in Gifted and Talented Education. She has worked in curriculum development, advisory and support roles, has developed HSC exams at the Board of Studies, Teaching and Educational Standards NSW (BOSTES) and is passionate about engaging students, using technology to support learning, differentiation and improving literacy. She is a keen geographer, having taught it for 15 years, and seeks out interesting case studies and fieldwork opportunities. She has worked with stakeholders to develop contemporary integrated units of learning and has also developed a range of online learning modules for Stage 4 and 5 Geography, utilising web 2.0 tools, to improve student outcomes and digital literacy in Geography.

For full biographies of our highly qualified author team, please see the Interactive Textbook or *Cambridge GO*.



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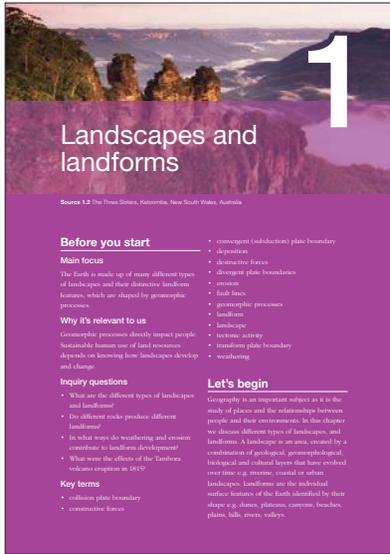
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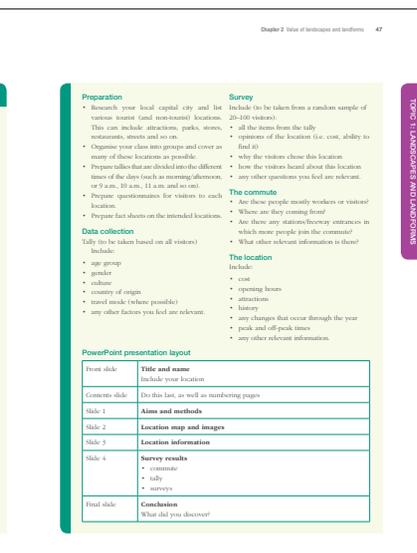
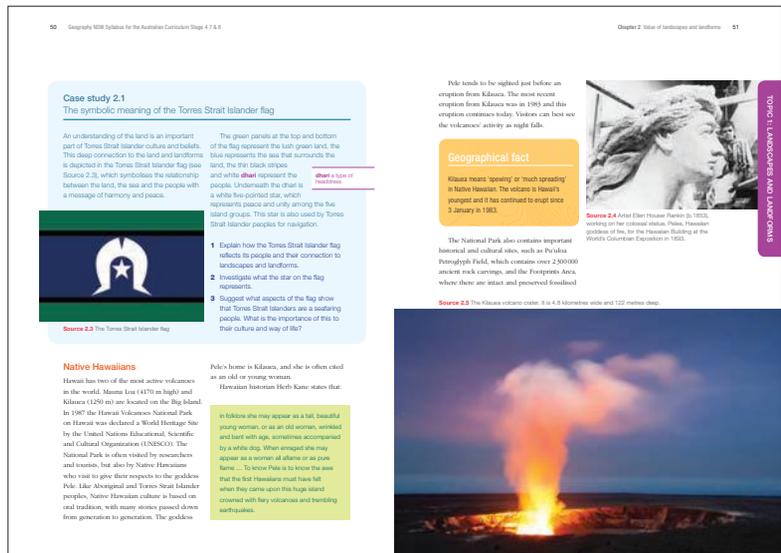


Chapter openers feature **Before you start** and **Let's begin** sections, which focus your attention on the topics being studied to prepare you for your in-depth investigations.

**Geographical facts** highlight interesting information to enrich your learning.

**Glossary terms** are bolded in the text, defined in the margins and collated at the end of the textbook for easy reference. Some terms are taken from the curriculum and are © BOSTES.

**Case studies** extend on information to add another layer to your knowledge and understanding.



**Fieldwork** activities provide step-by-step instructions on observing and recording information, enabling you to think like a geographer and utilise geographical skills outside the classroom.

A variety of **activities** and **research** tasks explore key concepts, develop skills and draw back to the general learning capabilities and cross-curriculum priorities.

**Note this down** activities recommend the use of a range of graphic organisers to help you record and revise key ideas.

These are also available as **downloadable documents**.

104 Geography NSW Syllabus for the Australian Curriculum Stage 4 7 & 8 Chapter 1 Landscapes and landforms 105

**Source 1.4** Processes of erosion and deposition have led to the formation of the turquoise lakes, famous for their azure colour. Some workers make a living from carrying produce out of the crater.

**RESEARCH 1.3**

In groups, select one of the major continental or oceanic plates and use the Internet to gather information about the size and direction of its movement. Assess what the likely outcomes of this movement will be over the next century, and share your results with the class in the form of a PowerPoint presentation.

**1.4 Examining a landscape and its landforms**

**Mountain landscapes**

Generally mountains are formed due to **collision plate boundaries**. These boundaries occur where plates are moving towards one another, resulting in the plates colliding. Even though plates are moving slowly, they often adjust quickly, causing earthquakes.

If the plates have approximately the same rock density, the collision forces part of the landscape upwards. The top of a fold is known as an **anticline**, whereas the bottom of the fold is the **syncline**, which represents the

anticline the upward-bulging of rocks caused by compression; syncline the downward-bulging of rocks caused by compression.

**Activity 1.5**

- Using the Internet, locate two maps showing:
  - the Pacific 'Ring of Fire'
  - plate movements.
- Identify the link between the types of plate boundaries around the Ring of Fire (collision, convergent (subduction), divergent or transform).
- Consider whether particular types of plate boundaries have caused the Ring of Fire.
- Investigate the career of volcanologist. How do you become a volcanologist? What do volcanologists do? And are there any famous volcanologists? Choose one and give a short summary of their career and major findings.

**Source 1.15** Tectonic plates and their boundary conditions

104 Geography NSW Syllabus for the Australian Curriculum Stage 4 7 & 8 Chapter 5 Investigating a contemporary geomorphic hazard 105

**Chapter summary**

- Geomorphology is the study of landscapes and landforms, and the processes that have made them the way they are.
- A geomorphic hazard is a danger that occurs as a result of changes to a landscape, affecting the stability of the site and resulting in devastating effects on the area and those living there. These natural disasters include earthquakes, tsunamis, volcanic eruptions, landslides and avalanches.
- Earthquakes occur when tectonic plates move, causing stress. They most commonly occur when one plate is forced under another.
- Tsunamis are giant waves that result from the displacement of a large volume of water usually caused by earthquakes, volcanic eruptions or landslides.
- Landslides are the movement of rock, debris or earth down a slope. They can be slow-moving or fast.
- The Japanese earthquake in 2011 and resulting tsunami killed nearly 160000 people and caused a meltdown at the Fukushima nuclear power plant.
- Technology is an important part of measuring and forecasting geomorphic hazards.

**End-of-chapter questions**

**Short answer**

- Compare and contrast earthquakes to another geomorphic hazard.
- Explain how a disaster can help us learn to prepare for future risks.
- Why is technology important for geomorphic hazards? Choose one type of technology and explain its contribution to our understanding of natural hazards.

**Extended response**

Investigate online the relationships between earthquakes, tsunamis and landslides and summarise your findings.

**Source 5.14** A severely damaged road at Christchurch, New Zealand, after the earthquake of 2011 which measured 6.3 on the Richter scale.

**Chapter summaries** review the main ideas of the topic to consolidate what you have learned.

**End-of-chapter questions** include short answer and extended response to test your knowledge through the reinforcement of key concepts and application of skills.

In the interactive Textbook, **video and audio** enrich the learning experience.

**Interactive maps** enable further engagement by allowing selected elements from the legend to be shown or hidden on the map.

**Interactive activities** (e.g. drag and drop questions) assist recall of facts and understanding of concepts.

All end-of-chapter content is available as **downloadable documents**.

Geography NSW Syllabus for the Australian Curriculum 7 & 8 Stage 4

Chapter 10 Australia's water resources

10.1 Spatial variations in Australia's water resources

10.2 Variations in freshwater availability across Australia

Chapter summary

End-of-chapter questions

**Cloud fronts (2 on the map)**

Have you ever experienced a cold front? If you have been outside on a sunny day, when the weather suddenly turns chilly, the wind picks up and clouds seem to appear out of nowhere, then you have experienced one. In the south-eastern region of Australia, and to an extent the south-western corner, cold fronts are common. These weather systems are basically cold air moving northward from Antarctica. As the cold air moves over land, it pushes underneath the warmer air. The warmer air is forced upwards and cools, so that it is unable to hold its moisture any longer and it falls as rain.

**Source 10.2** A cold front, warmer air is forced above the mass of moving cold air, causing rain clouds to form (BBC)

**Inland Australia (2 on the map)**

Cooler Pinery, located in inland South Australia, is one of the hottest and driest places in the country. Only 20 days a year experience rainfall on average for a total of 157 mm of rainfall per year (see Source 10.10). Cooler Pinery is sometimes referred to as the 'hottest capital of the world'. It is also famous for its underground houses, called 'logies'. Around half the town's residents live in these logies, which have a constant mid-20s temperature and provide relief from the relentless sun.

**Also available is the Interactive Textbook Teacher Edition**



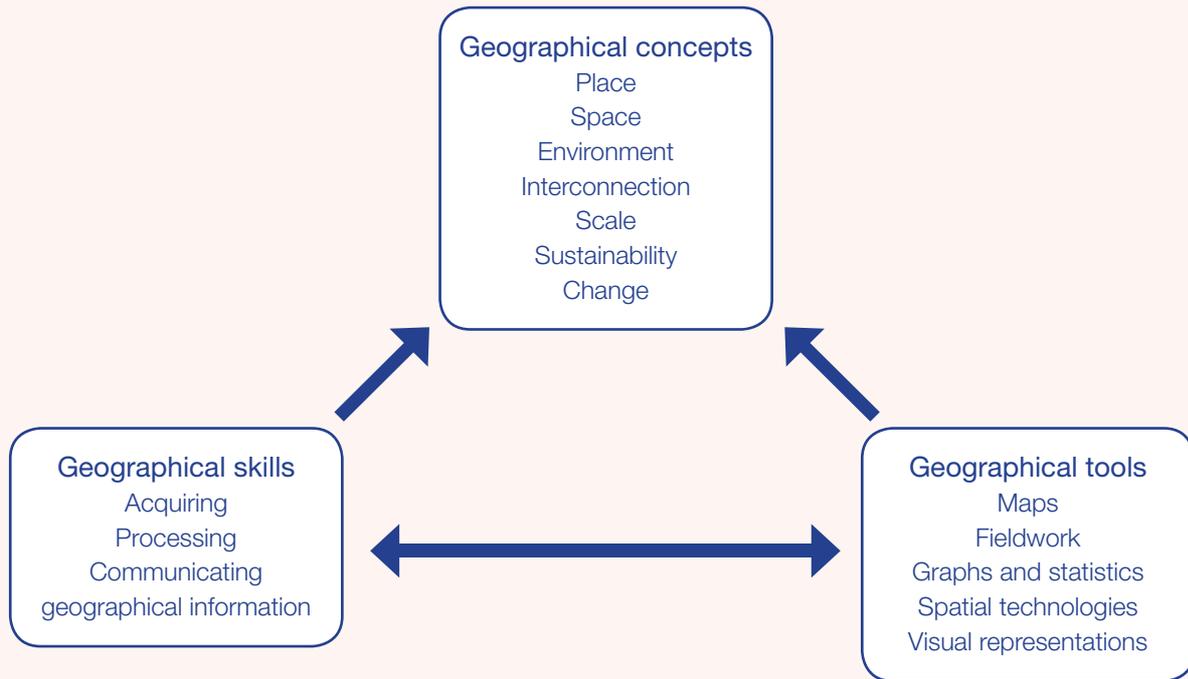
# Geographical skills toolkit

**Source 0.1** The beautiful Lake Moraine in the Banff National Park, Canada

## 0.1 Introduction

The study of geography involves posing questions, reflecting and proposing actions to enrich your understanding of Australia and the world and to shape a better future. As you investigate the places, peoples, cultures and environments that make up our world, you will develop geographical knowledge and understanding, explore key concepts and apply essential skills and tools using an inquiry framework.

This geographical skills toolkit introduces you to these concepts, skills and tools used in the study of geography. It will help you to think like a geographer as you explore landscapes and their landforms, the concept of place through liveability, water as a renewable environmental resource and the interconnections between people and places.



**Source 0.2** In the study of geography in Stage 4, concepts, skills and tools must be integrated to provide meaningful learning experiences for students.

## 0.2 Geographical concepts

It is useful to have a framework that supports and guides us in our geographic studies: a range of concepts that will allow us to target our inquiry and support our learning. The

concepts for geographical understanding (place, space, environment, interconnection, sustainability, scale and change) provide this, helping us to understand and build on the

**Source 0.3** Geographers at work: international experts discuss satellite images during work investigating tsunamis



work of others in the same field of study. In addition, a framework makes it possible for us to confidently understand the work we do and its place as valid geographic research.

## Place

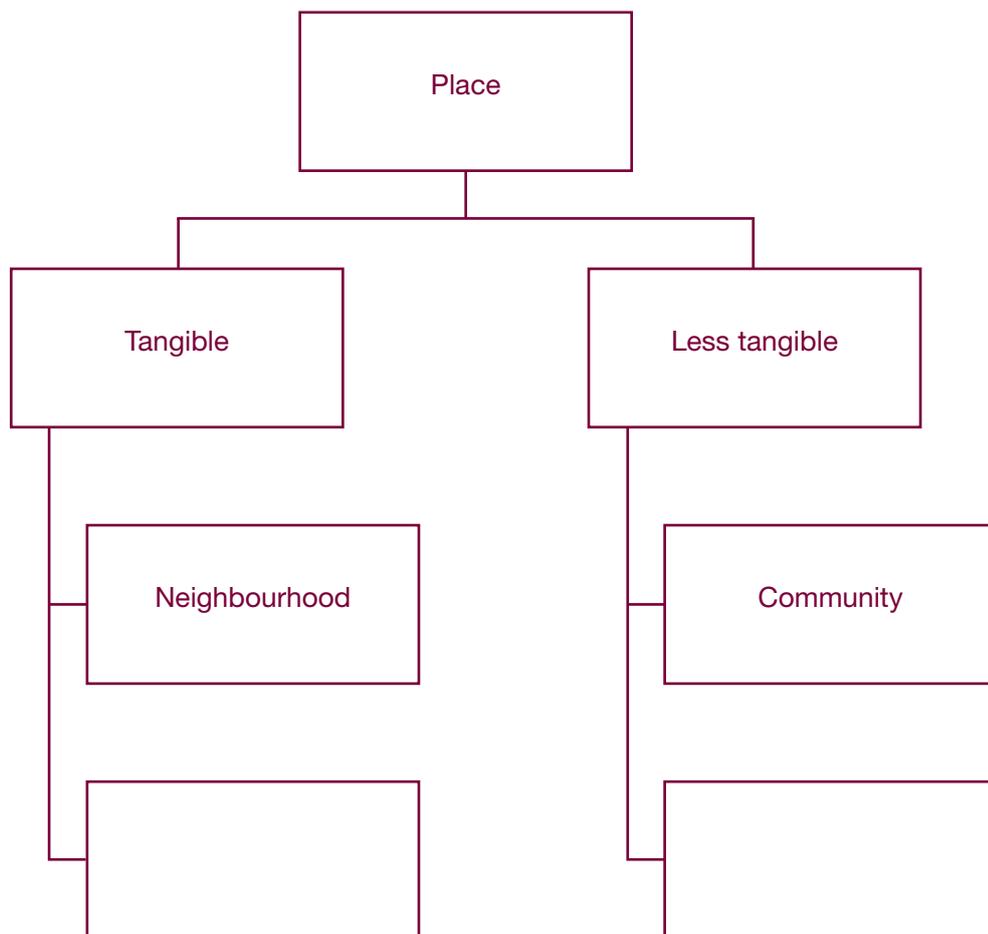
The world is made up of places that are given different meanings by people. For Aboriginal and Torres Strait Islander peoples, places can

be given spiritual meaning and can shape their culture and identity.

Places range in size from your classroom to a world region. Places are important locations for major events and social and human interaction, as well as areas that have importance in the natural environment. Places can be tangible as well as less tangible (i.e. neighbourhood versus community).

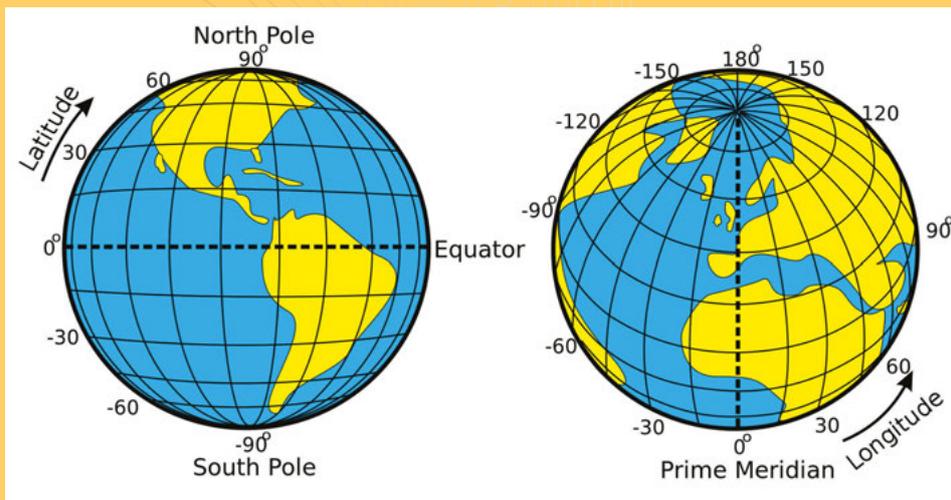
### Note this down 0.1

Copy the graphic organiser below and compare places that are tangible versus less tangible.



## Geographical fact

Where something is – its location – is very important to our studies. We can use the coordinates on a map, called **latitude** and **longitude**, to show others where something is. Latitude and longitude lines divide the world up into a grid, and when we use them, latitude is always stated first. For example, the position of Brisbane is 27.5°S, 153°E.



**latitude** distance from the equator measured in degrees north or south

**longitude** degrees east or west of Greenwich

**Source 0.4** The best-known system for locating a place is latitude and longitude. This involves an imaginary grid that covers the Earth, allowing people all over the world to use and share consistent references.

Sometimes a description can help to indicate to others where something is, or landmarks can help us to explain a place's location; for example, next door to the house with the red letterbox. Maps often have their own simple system of coordinates to help us find particular places easily. We can be directed to the northeast corner of the forest (for example, C4), allowing us to find the correct section of forest.

## Space

In geographical terms, space is the distance between things. Space refers to the organisation of an area, where things are

(location) and their distribution in it. It is about how the area is perceived, structured and managed. Patterns can be detected when examining **spatial variation**: geographical locations, data and processes. If

we examine a town, we can see patterns in the street layout or the green spaces, how far apart services like schools, churches or shopping centres are, and the patterns of human-made major transport networks such as highways and railways. In the natural world, we can see mountains in a range, the web of streams and rivers in a catchment area or the frequency of lakes in a landscape. Space refers to the distribution of items as well as their frequency and helps us to describe the patterns we see.

**spatial variation** the difference or variation in natural and human features over an area of the Earth's surface e.g. water, population, Gross Domestic Product (GDP), life expectancy



**Source 0.5** Space refers to location, spatial distribution, organisation and management, such as the changing global pattern of megacities.

## Environment

**environment** the living and non-living elements of the Earth's surface and atmosphere. Where unqualified, it includes human changes to the Earth's surface e.g. croplands, planted forests, buildings and roads

The **environment** is important in our world. It is a term that is often used and rarely defined, so what do we mean by 'environment'? It refers to the external factors that exist within an area or region – for example, air, water, minerals, plants and animals – and how they work together to form a system. The term is often used to describe natural systems like forests and oceans, but it also applies to

**anthropogenic** systems such as cities. Sometimes, environments are not as easy to classify, and we need to recognise the importance of both natural and human-altered elements (geologic/rock, atmospheric/air, hydrological/water, edaphic/soil, biotic/living and human). A natural water system such as the Murray–Darling Basin not only supports the plants and animals of the region, but the towns and human populations as well. The river is modified to provide year-round irrigation for farmers and drinking water for the city of Adelaide.

**anthropogenic** related to human activity e.g. impacts or changes in the environment

## Interconnection

Interconnection is based on the concept that nothing can be viewed on its own; everything has a relationship to other things and systems. It recognises that within an environment or space, there are real connections and influences that alter the way the space operates and is viewed. It analyses these connections

**features** the tangible elements of a place or environment

**geographical processes** the physical and human forces that work in combination to form and transform the world e.g. erosion, the water cycle, migration and urbanisation. Geographical processes can operate within and between places.

and examines the level of influence to decide the level of impact and predict future patterns. It supports looking at geographic phenomena and **features** such as urbanisation, global warming or erosion as **geographical processes** within real environments.

Interconnections can be very detailed, and can lead us to look at spaces or environments as a whole system, rather than viewing each element separately.

## Scale

The main focus of this geographic concept is to see things at different levels, from the personal to the local, national and global. How we view an issue or the types of solutions we can put forward will change as we move through these different scales. Collecting water for personal use is at a low scale and very controllable, with variables such as chemicals and additives being our own responsibility. Water harvesting on a national or global scale is very different, with a supply chain that includes governments and other organisations on many levels.

We also need to understand that choices and management plans at one level can influence the situation at another level. This occurs when the federal government passes legislation that impacts on how the individual is able to operate or changes processes on a local level – for example, the introduction of the Murray–Darling Basin Plan.

**Source 0.6** The Murray–Darling Basin Plan impacted on individual farmers, small towns and major cities, and was produced by the Australian federal government.



## Sustainability

Sustainability refers to the ability to achieve long-term balance, often in the environment, and refers to things that are not harmful, and are able to continue far into the future.

Sustainability is not a concept with which

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**environmentalist** a person who acts to preserve the quality of the natural environment

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only **environmentalists** would concern themselves, it is increasingly being used to describe any system (natural or human-made) that is in

a healthy state of balance. It helps to direct people to accept their responsibility for their environment and to formulate plans to protect it for the future.

## Change

Change refers to both space and time. It is a concept that covers the impact of movement and history, with human-altered and natural environments both being affected. When we look specifically at our local area, it is clear that it is dynamic. Homes are built, roads are upgraded, gardens are rejuvenated – and this is just the beginning. In fact, there is so much change over time in our local neighbourhoods that it would seem very unusual if it all stopped.

Change can be gradual or catastrophic. Gradual changes take place slowly; for example, climate change or urban sprawl.

**Source 0.7** The concept of sustainability helps us to question the current state of a space and to pose management solutions to issues and challenges that we are able to identify. Wind power is considered a sustainable source of energy.



Other changes can be drastic and immediate, such as during natural hazards. Both the natural and human environments are

constantly changing. Therefore planning and developing management strategies are extremely important in geography.



### Activity 0.1

- 1 In your own words, outline the concepts required for geographical understanding.
- 2 List one example for each of the concepts you have outlined.
- 3 Explain how latitude and longitude are used by geographers. What is their link to world time zones?

## 0.3 Geographical skills

What sets the geographer apart from others interested in the world are the methods we use to investigate. Geographers are not truly happy until they have collected geographical data in the field, and developed a series of **hypotheses** to test their own work and investigation methods. Geographers enjoy working together in teams to share and discuss ideas. They know that the world is their laboratory, and that inquiry-based research is highly effective.

**hypothesis** a proposition made on the basis of limited evidence, used as the starting point for further investigation

As a geography student, you will be using the methods of the professional geographer, although on a smaller scale. You will follow an inquiry approach by working through stages that represent a complete investigation:

- acquiring geographical information by observing, questioning and planning as well as collecting, recording, evaluating and representing
- processing geographical information by interpreting, analysing and concluding
- communicating geographical information as well as reflecting and responding.

Depending on the type of inquiry, you may only need to focus on one particular skill. Your work becomes part of the complex web of data collected and analysed to ensure that our global footprint treads lightly on the planet, encouraging environmental sustainability and responsible human activities.

### Acquiring geographical information

The geographer begins an inquiry by observing issues or problems and developing significant **geographical questions**. Information is collected and recorded from various sources, evaluated for reliability and represented in different forms.

**geographical questions** questions that inquire into the spatial and environmental dimensions of places and environments

Observing, questioning and planning Geographically significant questions are questions that are worth investigating. The inquiry questions at the beginning of each chapter form a model for geographical study, demonstrating the method used to construct a framework of questioning and learning. They prepare you for the learning to come, and allow you time and readiness to prepare

for the material that lies ahead. However, these questions are not intended to limit your learning so that at the end of the chapter you are only able to respond to them; rather, they are a scaffold that supports you to build your learning a level at a time, adding your own inquiry questions as appropriate.

These questions become the language of our

study, moving us beyond the known and into discussions and debates where there may be no right or wrong answer, just many options and **geographical challenges** to be explored as an integral part of our understanding.

**geographical challenges** issues and problems arising from interactions between people, places and environments that threaten sustainability e.g. biodiversity loss, food insecurity, inequality

### Inquiry questions

- What are the different types of landscapes and landforms?
- Do different rocks produce different landforms?
- In what ways do weathering and erosion contribute to landform development?
- What were the effects of the Tambora volcano eruption in 1815?

**Source 0.8** Examining the questions from Chapter 1, it is clear in what direction the study will develop.

**Source 0.9** A lot of exploration is currently undertaken in Antarctica as geographers, scientists and other researchers study different features of this amazing region.



Collecting, recording, evaluating and representing

How do we collect and record information? How do we evaluate and represent this information? The geographer uses a range of tools to gather information, and needs to be aware of the source of that information in order to use it effectively.

*Primary data and secondary information sources*

Information gathered in the field or directly connected to our research is called **primary**

**data**. Primary data is essential to valid scientific inquiry. It is targeted and specific to the task. We understand how the information has been collected, the methodology used in the process and whether there

were any elements that may have given unexpected results.

Information collected by others – perhaps people not directly involved in our research –

is called a secondary source.

**Secondary information**

**sources** can also be valuable, and can even reduce the work we need to do directly.

For example, the Australian Bureau of Statistics conducts the Census every 5 years, collecting demographic (population) information for the country.

Where do people live? How far do they travel each day to work or school, and what transport do they use regularly? This is information that would

be difficult for us to collect on our own on such a large scale, but it can be very useful.

When collecting information, we also need to be aware of **ethical protocols** including confidentiality, informed consent, citation and integrity of data.

**secondary information sources**

sources of information that have been collected, processed, interpreted and published by others e.g. census data, newspaper articles, and images or information in a published report

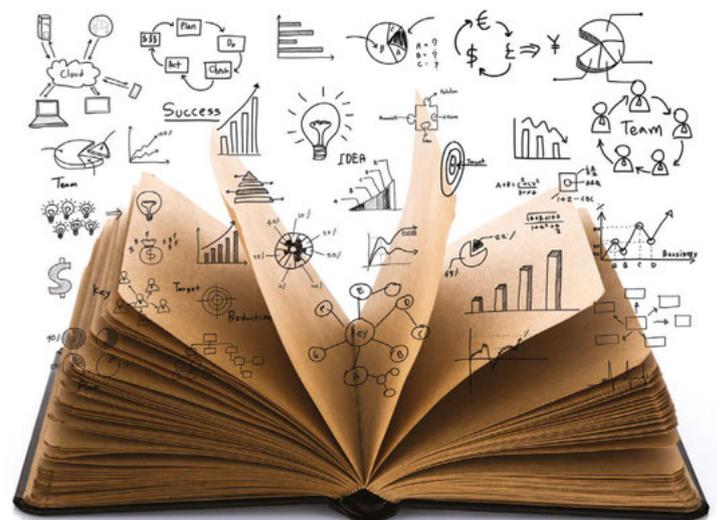
**ethical protocols**

the application of fundamental ethical principles when undertaking research and collecting information e.g. confidentiality, informed consent, citation and integrity of data

**primary data** original materials collected by someone e.g. field notes, measurements, responses to a survey or questionnaire



**Source 0.10** Fieldwork is an example of primary data whereas books or websites would be viewed as secondary information sources.



## **Note this down 0.2**

Copy the graphic organiser below and summarise what you have learned about primary data and secondary information sources.

Sources	Definition	Examples
Primary data		Field notes
Secondary information		Census data

### Processing geographical information

The next stage of the inquiry involves making sense of the information, analysing and reaching conclusions.

#### Interpreting

Setting a series of inquiry questions and gathering information to try to answer those questions is important, but how you interpret the information is vital to any geographic study. As a geography student, you need to be able to identify and propose explanations for

spatial distributions, patterns and trends, and infer relationships. What is it that the data are showing? Do they point to further questions that require investigation in order for your work to be considered complete? If the initial inquiry questions are clear and detailed, and if the research was appropriately targeted, then you have the information required to make informed conclusions. Let's take a closer look at what that means.

- Was your inquiry specific and measurable?
- Did your research include data collection?

**Source 0.11** Researchers ski along a plateau in Antarctica



- Did you also check your data with another research tool such as an encyclopaedia?

If you can confidently answer 'yes' to all these questions, then you are ready to begin analysing your data and reaching logical conclusions.

### Analysing

Start by answering your inquiry questions, not with a yes or no, but by explaining why/how you are sure of your response. What data back up your answer? Do the data clearly show that you have an answer, or is there a qualifying statement to be made? For example, 'The survey data from our visit to the city, where we took responses from 250 people over a 1-hour period, show that 83% of those people would prefer ...' and 'from this, we can say that the local council should seriously consider ... as a part of their management plan for the area'.

### Concluding

It is important not only to analyse your information, but also to decide what it is telling you. Are you able to make any reasonable and logical statements based on your data? Are

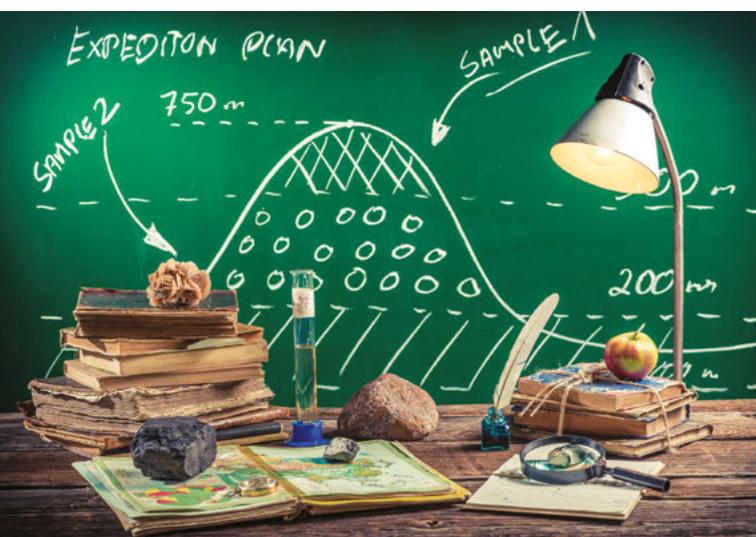
some aspects of the data unclear? Sometimes, you need to be honest enough to say that your research may not have covered all angles, and you need to investigate further before you can really be sure about what is going on. Acknowledging a weakness in your initial inquiry or data collection shows your ability to reflect upon your work and identify areas or directions for further work.

## Communicating geographical information

This final stage of the inquiry involves communicating information, reflecting on what has been learned and responding by proposing actions.

### Communicating

There are many ways to communicate the results of investigations. These include but are not limited to written, oral, audio, graphical, visual and mapping. When deciding on which method to use to present findings, arguments and explanations, we need to consider the subject matter, purpose and audience. It is also important to use relevant geographical



**Source 0.12** Communicating information is an important part of geography.



terminology and digital technologies where appropriate.

### *Written*

The most common method to convey research results is the written report. Other methods include essays and extended responses. Ensure that written pieces are easy to understand, logically organised and fluent, and that they use the correct conventions for spelling, punctuation and grammar. It is always a good idea to use a plan that keeps the work on track – especially if there is more than one writer.

### *Oral*

It is just as important to have a plan when you make an oral presentation as it is when you produce a written report. The aim is to present your findings to an audience, so there is a need to make sure the audience can access your information. When using computer tools to create visual displays or presentations, be aware of the strengths and weaknesses of the program you are using. Make sure you use a font that is easy to read and a background that doesn't make it more difficult to see the information. Always keep the amount of text onscreen to a minimum, saving the space for visuals and allowing your presenter to reveal the information while speaking.

### Reflecting and responding

We should always reflect on the information we have, looking critically to understand what it shows and to see what work still needs to be done to make it more useful. This also applies to data, whether we collected them or whether they are being presented to us by others. Can the information be checked through another source, or do we trust it because of a known collection method? What is the information showing us? How can we respond to it?

How can we use it? These are the crucial questions that must be asked if we are to make effective use of the information rather than allow the data to exist without analysis or response. Thinking about the material allows us to absorb and bring together the key ideas, leading us to a point where we can put forward solutions to challenges in the world. When putting forward solutions, it is important that we take into account environmental, economic and social considerations. The purpose of our inquiry is to understand the current situation and to propose thoughtful options for the future.

## 0.4 Geographical tools

In geography, we collect data. Once we have collected our data, we need to present them in the most appropriate form using tools. Tools include maps, graphs and statistics. Some information easily fits into a written discussion, while numerical or quantitative data may work better in a visual representation, such as a graph or diagram. Other data can work well in an annotated photograph, a sketch or a map. Geographers not only analyse the data they have, but also view them critically to decide what the best format will be for sharing that information.

### Maps

Maps are probably the best-known geographic tool. A **map** is a diagrammatic or symbolic representation of particular features of a place, such as landforms, usually drawn on a flat surface. The same river can be viewed from different perspectives on a map, with

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**map** a diagrammatic representation of particular features of a place, usually drawn on a flat surface

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## Geographical fact

There are a range of different map types which we will refer to in this book, including:

- **pictorial** – a map using illustrations to represent information on a map
- **sketch** – a labelled drawing outlining the main geographical features of a place
- **flowline** – map showing the flows of people, goods, information or ideas between places
- **relief** – a three-dimensional map showing the shape of the land and distinctive landforms (terrain) or a two-dimensional map representing 3D terrain
- **thematic** – a map portraying a specific type of information e.g. rainfall, transport routes, climatic zones or population distribution
- **synoptic charts** – a map showing atmospheric conditions at the Earth's surface at a point in time e.g. air pressure, winds, precipitation. Also known as a weather map.
- **small-scale** – a map showing a large area of the Earth's surface with little detail e.g. world map where 1 cm on the map scale represents a large distance on the land
- **large-scale** – a map that shows a small area of the Earth's surface in large detail e.g. a suburb where each centimetre on the map scale represents a small distance on the land
- **political** – a map showing governance boundaries e.g. country or state borders



**Source 0.13** Maps are probably the best-known geographic tool.

information adding to our understanding of the system. We can see how steep the river

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**cartographic conventions** accepted practices associated with constructing and interpreting maps e.g. using a border, orientation or compass point, legend or key, title, scale, giving latitude readings before longitude etc.

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valley is, the direction in which it flows and the type of landscape through which it flows. All of this information allows us to predict the impact of changes to the river if the surrounding environment changes. Maps also have various conventions, known as **cartographic conventions**,

that help us to construct and interpret them, including symbols, colour-coding, orientation and scale presentations. They allow us to present and analyse data in a visual format, giving us the ability to understand the information spatially, as separate parts of the environment.

## Fieldwork

Fieldwork is at the heart of geographic inquiry. It is any activity conducted outside the classroom, whether in your local area or in a more distant location. It forms the framework for valid scientific research, and supports the development of inquiry questions that make sure we are able to consider a range of strategic solutions and management plans to maintain sustainable environments. In this textbook, you will find several fieldwork activities that provide step-by-step instructions on observing and recording information. There are a number of ways to communicate your observations and data, including **field sketches** for example, in the

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**field sketches** annotated line drawings created to record features of an environment during fieldwork activities

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form of a fieldwork report. This method is used in the textbook and explained below.

Front page	<p><b>Title and name</b></p> <p>Ensure you have your own name (or names of group members) clearly identified.</p> <p>The front page should also contain a clear title indicating what your research was focused on.</p>
Contents page	Do this last, as well as numbering pages
Page 1	<p><b>Aims and methods</b></p> <p>What was your intention when you started the research? List your inquiry questions here, and if you are able to predict what you might find, do that here too. Describe the way you collected data to test your questions and hypothesis.</p>
Page 2	<p><b>Location map</b></p> <p>One of the key tools for the geographer is mapping. Make sure your map is clear, easy to read and follows the mapping conventions of BOLTSS and uses the recognised symbols and colours of maps, such as blue for water.</p> <p><b>BOLTSS:</b></p> <p><b>Border</b> – the border should surround your map and everything that is a part of the map (title, scale, legend, etc.). It encloses the information and shows that it all relates to the map.</p>

Page 2 (continued)	<p><b>Orientation</b> – show where north is using one of the conventional symbols, for example, an arrow or full compass.</p> <p><b>Legend</b> – the legend or key shows what all the symbols and colours you have used on your map mean.</p> <p><b>Title</b> – make sure your map has an accurate title that explains what the map is showing, for example <i>Shopping Centre Traffic Flow, 1 – 3 pm, Sunday 26th December, 2016</i>.</p> <p><b>Scale</b> – the map’s scale shows how big the area shown on the map is in the real world.</p> <p><b>Source</b> – indicate where you obtained the information for the map. This could include your own measurements, a search engine, <b>GPS</b> mapping system or the local council offices.</p>
Page 3	<p><b>Introduction</b> Give a brief description of the study sites and any noteworthy features.</p>
Pages 4–5	<p><b>Description of uses and photos</b> What is the area currently used for? A written description accompanied by photographic evidence is good practice.</p>
Page 6	<p><b>Table of usage</b> Effects of current use (positive or negative, short-term or long-term). A table is an excellent way to display this information. Keep your points simple and refer to any photographs or other data in your fieldwork report that support this information.</p>
Pages 7–8	<p><b>Description of effects of use, sketches and/or photos</b> This section needs to be quite detailed and show that you understand the area your fieldwork is based on. Annotate any field sketches or photographs you use to highlight and explain the space.</p>
Page 9	<p><b>Association between use and effects of use</b> Make the links between how the space is used and the impact of those uses on the space. It might seem obvious, but you need to be explicit and openly state what is going on.</p>
Page 10	<p><b>Table or written description of management strategies</b> What are the current management strategies being used in this space? Depending on how many applicable strategies there are, you may choose to organise them in a chart or table to separate them and make it easier to discuss them later.</p>
Page 11	<p><b>Photos or sketches of management strategies</b> Do not underestimate the impact of images in your work. It is often easier to show how a management strategy is working than to explain in words, and this could be more interesting for the reader. Make sure your photos or sketches are clearly labelled or annotated.</p>

**global positioning systems (GPS)**  
navigation systems that provide location and time information anywhere there is a line of sight to GPS satellites

Page 12	<p><b>Evaluation of these strategies</b></p> <p>How well are the current management strategies working? Are there any parts of them that are supporting the space well? Perhaps other sections of the plan need re-thinking? What would you change if you had the chance? Evaluate, do not just describe. Make sure you are giving clear and balanced feedback on the current strategies.</p>
Page 13	<p><b>Appendix, bibliography, glossary</b></p> <p>An appendix is the section at the end of the book that provides additional information that supports the main work. You should include an appendix to add meaning to your work. If you undertook a survey as a part of your fieldwork, the results could be included here.</p> <p>The bibliography is an important piece of any research. Make sure you list all information sources, websites and people who informed your work. Here's one method – Author/s. [surname first, then initials] (publication year in brackets). <i>Title in italics</i>. City location of publisher: Publisher's name. For example: Thompson, C. et al. (2016). <i>Geography NSW Syllabus for the Australian Curriculum Stage 4 Year 7 &amp; 8</i>. Melbourne: Cambridge University Press.</p> <p>A glossary is a mini dictionary for your work. You should include any words in the glossary that your reader needs to know in order to understand your usage of them.</p>

## Graphs and statistics

To assist with interpreting, analysing and developing conclusions, geographers use quantitative and **qualitative methods** to gather

**qualitative methods**  
explanatory and interpretive methods e.g. participant observation, focus group discussion or interviews, which are used to gather qualitative data

**quantitative methods**  
statistical and other methods used to analyse quantitative data

data. If we examine a nature reserve, we can talk to people who currently use the area so that we gain an understanding of how and when they use it, giving us qualitative methods for collecting information, while **quantitative methods** could include the numbers of animal populations sighted or the numbers of plant species found there. This information may be gathered using measures that give numerical results. Both types of methods are important for the geographer to be able to present a complete picture of the landscape.

Graphs and statistics are both quantitative **geographical data**.

Statistics can include averages, proportion or percentages, total number (such as total number

of animals observed in a region) and so on.

Statistics are very descriptive, and informative particularly if they are collected in a systematic manner. It is important, therefore, to be able to trust the data we use in our research.

We need to know that the ways in which they were collected were appropriate and consistent.

It is important that the ways in which our data were gathered are reliable, but

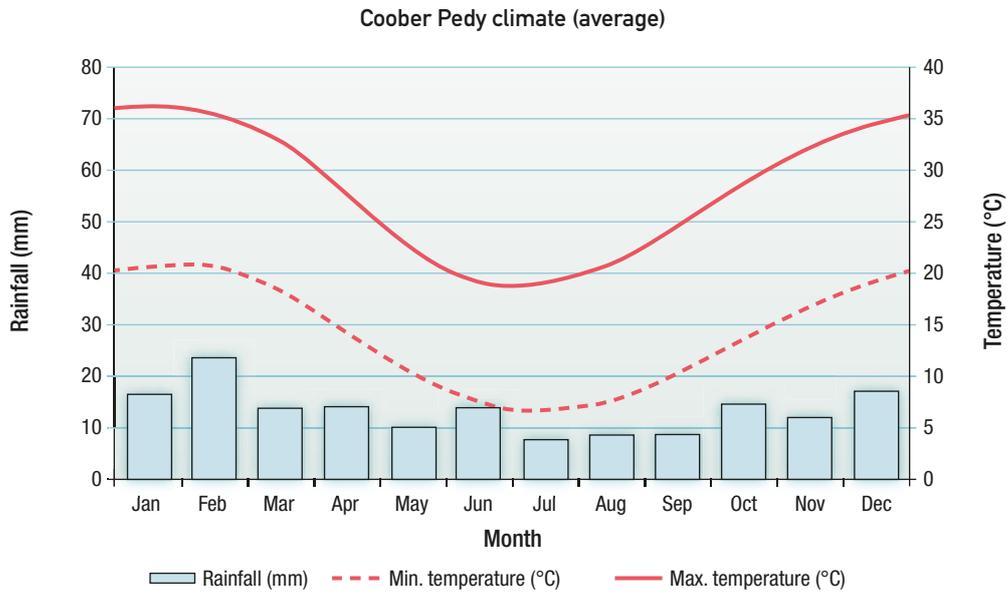
also that we are aware of any

**bias** in the collection of the information that may make us review its value.

Some data are better presented visually, through graphs and diagrams, rather than in

**geographical data**  
quantitative or qualitative information about people, places and environments

**bias** a particular interest or view that limits one's ability to make a fair judgement



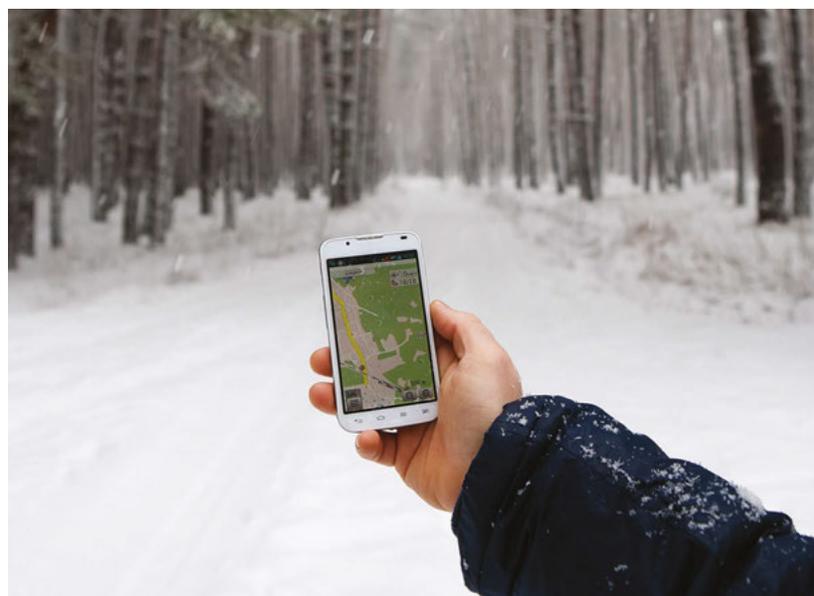
**Source 0.14** Data can be represented in a range of appropriate forms including climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams.

words. If you are using a graph in a written report, always refer to it and discuss what it shows, ensuring that it is an important part of the report, not just a pretty image designed to fill some space. If it is worth using, it is showing something important and deserves to be discussed.

### Spatial technologies

The use of spatial technologies in geography is becoming increasingly important, both in geographic work and in the wider community. Not only is this an employment growth area, but also digital information has become a part of everyday life for many people. A range of

**Source 0.15** We easily often view satellite maps and weather radar on smartphones from anywhere in the world without thinking about the technology that makes it all possible.



digital communication technologies such as blogs and wikis, electronic surveys and social media applications can also be used effectively to gather data and share results. The trick is to make sure we use them when they are the best tools available for the specific task at hand.

### Visual representations

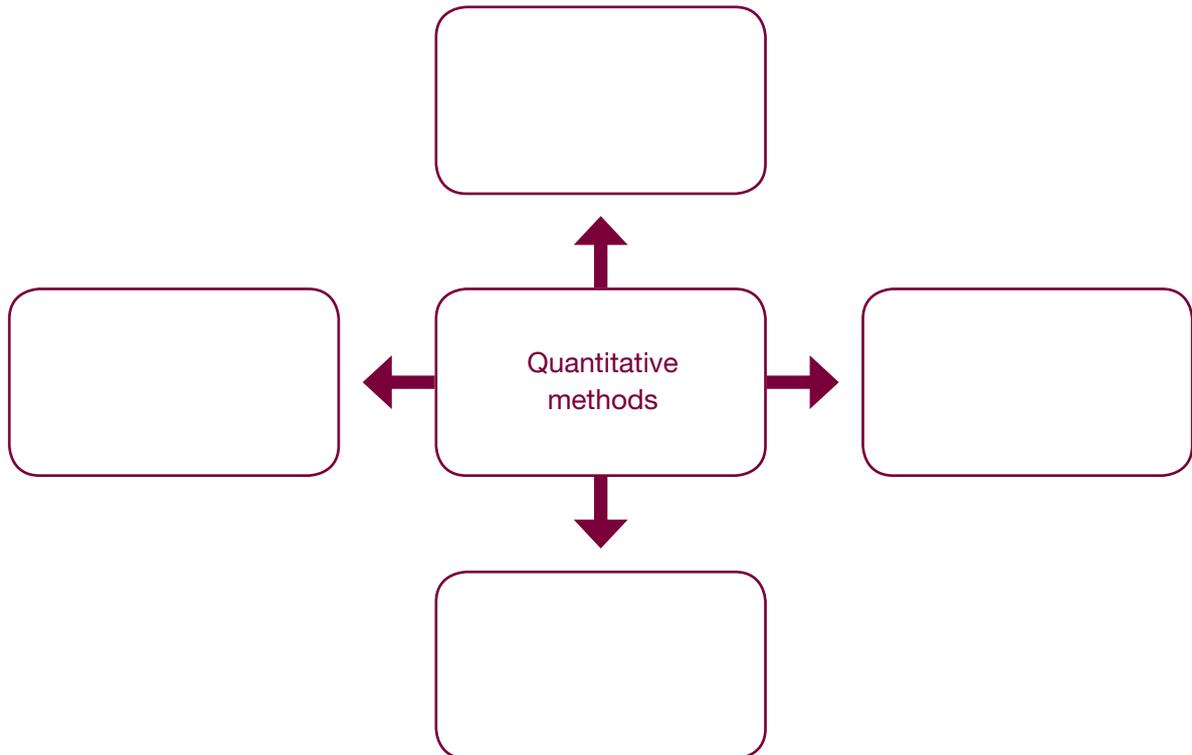
Other visual items add interest and understanding to your work, allowing your audience to clearly see what your work is

about and how you have gone about your research. Make sure that all images are clearly labelled with a title and also have a purpose for being included in your work.

Annotation (notes added to the picture) for field sketches you have taken or other images is useful in a report so you can easily highlight and refer to important sections. You should always acknowledge the source of an image if you did not take it yourself, in the same way as you list information sources in a bibliography.

### Note this down 0.3

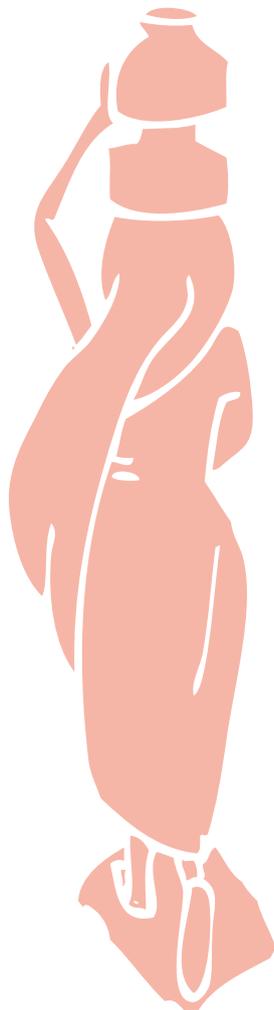
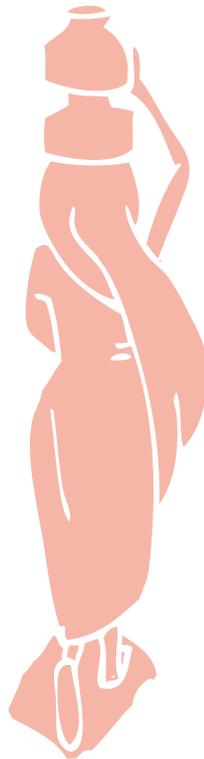
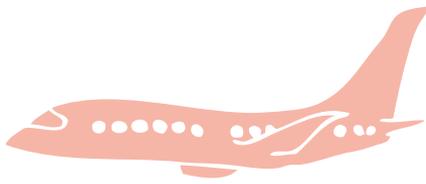
Copy the graphic organiser below and summarise some examples of quantitative methods. Use the same organiser to summarise examples of qualitative methods.

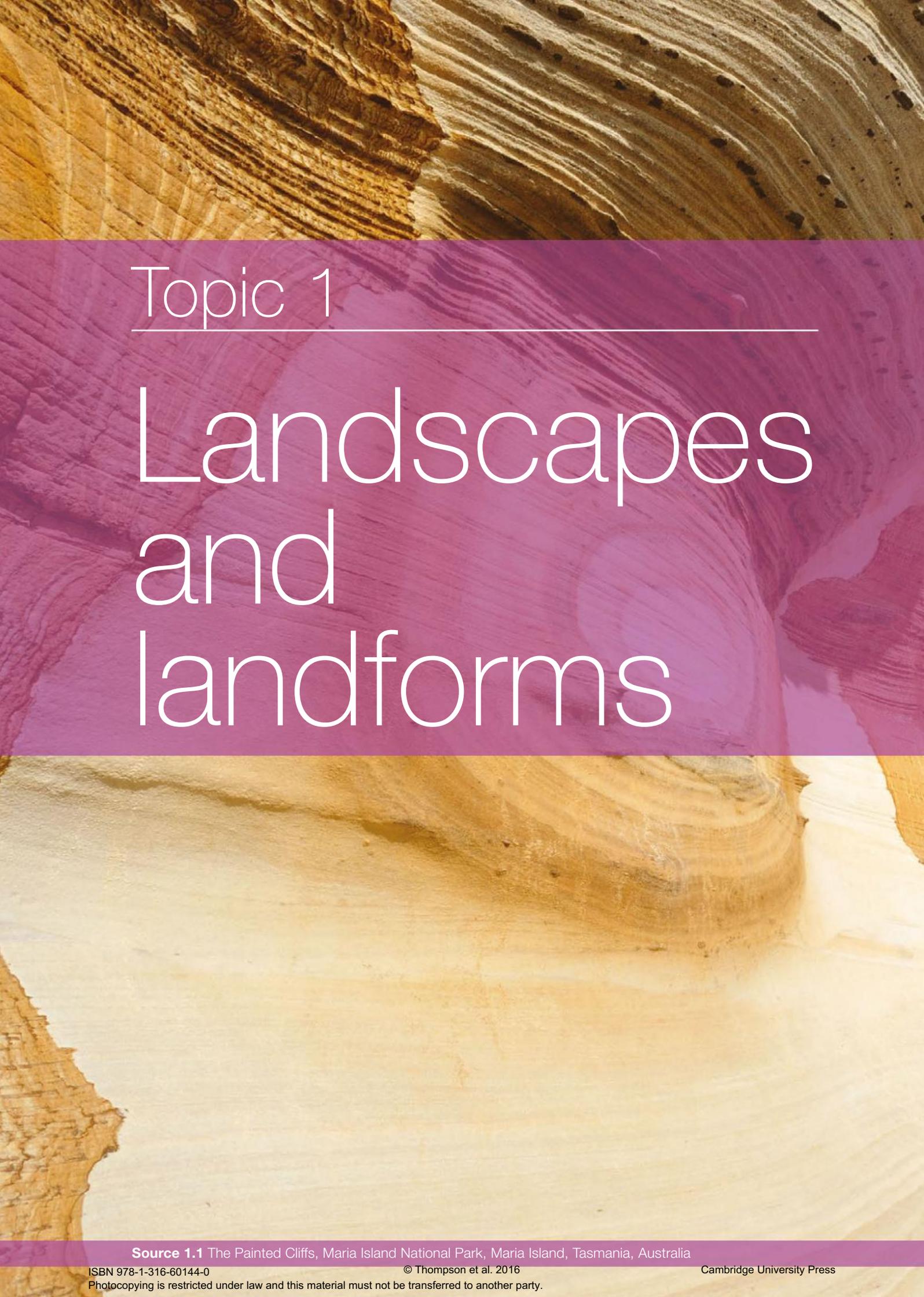




## Activity 0.2

- 1 List five spatial technologies and different ways you could use each one in developing an inquiry.
- 2 Justify the use of standard geographic conventions when creating a map.
- 3 Discuss the importance of inquiry questions.





Topic 1

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# Landscapes and landforms

**Source 1.1** The Painted Cliffs, Maria Island National Park, Maria Island, Tasmania, Australia

ISBN 978-1-316-60144-0

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Cambridge University Press

Photocopying is restricted under law and this material must not be transferred to another party.



# Landscapes and landforms

**Source 1.2** The Three Sisters, Katoomba, New South Wales, Australia

## Before you start

### Main focus

The Earth is made up of many different types of landscapes and their distinctive landform features, which are shaped by geomorphic processes.

### Why it's relevant to us

Geomorphic processes directly impact people. Sustainable human use of land resources depends on knowing how landscapes develop and change.

### Inquiry questions

- What are the different types of landscapes and landforms?
- Do different rocks produce different landforms?
- In what ways do weathering and erosion contribute to landform development?
- What were the effects of the Tambora volcano eruption in 1815?

### Key terms

- collision plate boundary
- constructive forces

- convergent (subduction) plate boundary
- deposition
- destructive forces
- divergent plate boundaries
- erosion
- fault lines
- geomorphic processes
- landform
- landscape
- tectonic activity
- transform plate boundary
- weathering

## Let's begin

Geography is an important subject as it is the study of places and the relationships between people and their environments. In this chapter we discuss different types of landscapes, and landforms. A landscape is an area, created by a combination of geological, geomorphological, biological and cultural layers that have evolved over time e.g. riverine, coastal or urban landscapes. Landforms are the individual surface features of the Earth identified by their shape e.g. dunes, plateaus, canyons, beaches, plains, hills, rivers, valleys.

## 1.1 Different landscapes and landforms

**landform** the individual surface features of the Earth identified by their shape e.g. dunes, plateaus, canyons, beaches, plains, hills, rivers, valleys

**landscape** a landscape is an area, created by a combination of geological, geomorphological, biological and cultural layers that have evolved overtime e.g. riverine, coastal or urban landscapes

**topographic map** a detailed, large-scale map of part of the Earth's surface which illustrates the shape of the land and selected natural and human features from the surrounding environment

**Landforms** of varying sizes and shapes, when taken together, are referred to as a **landscape**.

Landscapes can be seen and studied on **topographic maps**.

There are many different types of landscapes, including but not limited to:

- coastal landscapes
- **riverine** landscapes
- **arid** landscapes
- mountain landscapes
- karst landscapes.

Landforms within each landscape have distinctive features. In downstream riverine landscapes, for

example, landforms will include a **channel**, possibly a **levee**, and a **flood plain** or **terrace**.

Some landforms, like the arid zone dunes found in the Arabian Peninsula or central Australia, are very large and can extend for hundreds of kilometres. Other landforms, like individual pedestal rocks shaped like an anvil or mushroom, are generally small and reach only a metre or so in height. Geographers and others try to explain these differences in size, shape and grouping of landforms.

**riverine** associated with rivers

**arid** dry or parched, refers to regions such as deserts

**channel** the hollowed-out path formed by a river or stream

**levee** a sediment embankment bordering a channel

**flood plain** low-lying ground that is subject to flooding from a nearby river

**terrace** a 'platform' of fairly flat land, often a former flood plain that has become stranded by later down-cutting by the river

**Source 1.3** An example of a coastal landscape at Rottnest Island, Western Australia





### Activity 1.1

- 1 Distinguish between a landform and a landscape.
- 2 List the types of landforms found in riverine landscapes.
- 3 Select another type of landscape (for example, a coastal or arid landscape) and list the types of landforms you may find.

## 1.2 Geomorphic processes

**geomorphic processes** natural processes that transform the lithosphere to create distinctive landscapes and landforms e.g. erosion, weathering, tectonic activity

**constructive forces** those that build new landforms or add to those already there

**destructive forces** those that wear down and degrade landforms, infrastructure and property

**weathering** the breakdown of rocks and sediments into smaller particles or a solution

**erosion** the wearing away of the surface of the Earth by the action of wind and water

**deposition** the process of eroded material being deposited

**tectonic activity** movement of layers of the Earth's crust known as plates that move and float

The **geomorphic processes** that produce landforms are both large and small in scale. The Earth's entire surface, whether exposed as landmasses or lying beneath the ocean, is constantly being changed by a combination of **constructive** and **destructive forces** acting at different rates; it is affected by **weathering, erosion, deposition** and **tectonic activity**.

Large-scale plate movements, tectonic uplift and volcanic eruptions contribute to new or higher areas of ground. At the same time, these surfaces are continuously being worn down by weathering and erosion, and the products of these processes accumulate as sediments in lower parts of continents and oceans. Both constructive and destructive forces are operating, but

with different intensities and effectiveness at different times and in different places. When we look at landforms, we are seeing features

that have evolved over time in response to different forces acting on them.

## 1.3 Weather and climate

People often use the terms 'weather' and 'climate' interchangeably, believing they mean the same thing. They certainly are related, but their meaning is quite different.

**Weather** refers to the short-term conditions in a certain location. Our weather comes from the layer of the atmosphere closest to the earth's surface, called the *troposphere*, and is largely driven by air pressure. Day-to-day weather conditions vary in terms of:

- temperature
- wind speed and direction
- cloud cover
- **precipitation** (rain, hail, snow)
- humidity.

**Climate**, on the other hand, refers to long-term patterns in a region. Meteorologists collect weather data over time and can determine trends such as seasonal ranges in temperature and average annual rainfall. For example, Darwin is classified as

**weather** the condition of the atmosphere at a point in time e.g. temperature, humidity

**precipitation** forms of water falling from the atmosphere to the Earth's surface e.g. rain, hail, snow, sleet

**climate** the average types of weather, including seasonal variations, experienced by a place or region over a long period of time

having a tropical climate based upon long-term data collected (over months and years). In comparison, Sydney's climate is described as 'temperate'. This means that the city tends to experience warm days in summer and cool days in winter.

Weather is more immediate and short term, whereas climate refers to the long-term patterns. You could also describe climate as being the 'average' of all the weather for a particular region.

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**biophysical processes**  
interconnected  
sequences that form  
and transform natural  
environments in a cause-  
and-effect relationship  
e.g. erosion, deposition,  
soil formation, nutrient  
cycling

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## Weathering and erosion

Weathering and erosion are closely linked **biophysical processes**, sometimes being so connected that it can be difficult to separate them.

For example, the transportation of already-detached **quartz** grains by wind can cause these grains to then **abrade** against a rock and detach additional particles. On a windy day at the beach, sand grains will impact against bare legs and do the same to any rocks exposed nearby. Loose grains on rock surfaces will then be removed and transported by the wind. If local topography is sloping and water erosion is active, weathered materials will be transported away from their original site and moved further downslope. Sometimes sediments will be transferred directly into **drainage networks**, but more usually sediment transport on hill slopes is a 'stop-start'

---

**quartz** rock composed of silicon dioxide; a hard mineral that resists weathering

**abrade** to wear down by rubbing against something

**drainage network** pattern of gullies, streams, rivers and lakes in a drainage basin that allows water to flow to the lowest point

---

**Source 1.4** A landscape produced through soil erosion around Lake Bogoria, Kenya



**depressions** sunken places or hollow surfaces

operation, with temporary storage points in small **depressions** or flatter areas. Sediment that enters drainage lines following heavy rainfall will make

the water **turbid**; this water becomes visible in **estuaries** and in any rivers entering the sea.

**turbid** cloudy or muddy  
**estuary** a body of water formed where fresh water from rivers and streams flows into the ocean, mixing with the seawater

**Activity 1.2**

- 1 Identify sites in your local area that have been affected by weathering and erosion.
- 2 Outline how weathering and erosion alter the Earth's surface.
- 3 Research via the internet and then list some iconic landforms and landscapes that have been affected by weathering and erosion.

## Deposition

In coastal landscapes

Coastal landscapes are formed by weathering, erosion and deposition. Ocean currents and tides play large roles in these processes.

For most people, the coast means the beach. Beaches can be composed of quartz sands, calcareous sands (broken pieces of shells), volcanic (black) sands

or boulders. The material making up beaches comes from a combination of rock weathering along the coastline, through **hydraulic action** moving sediments from the continental shelf to the beach, and rivers depositing their load in the ocean. Sand or other sediment can be moved along a coastline by ocean currents

(**longshore drift**) and be shifted from one end of a beach to the other.

Ocean currents are large-scale, uninterrupted flows of seawater that follow a definite path. Currents can be either mainly

at the surface or in ocean depths. At the surface, the ocean currents are mainly driven by winds. At depths of more than 400 metres the movement of seawater is controlled by temperature and salinity differences.

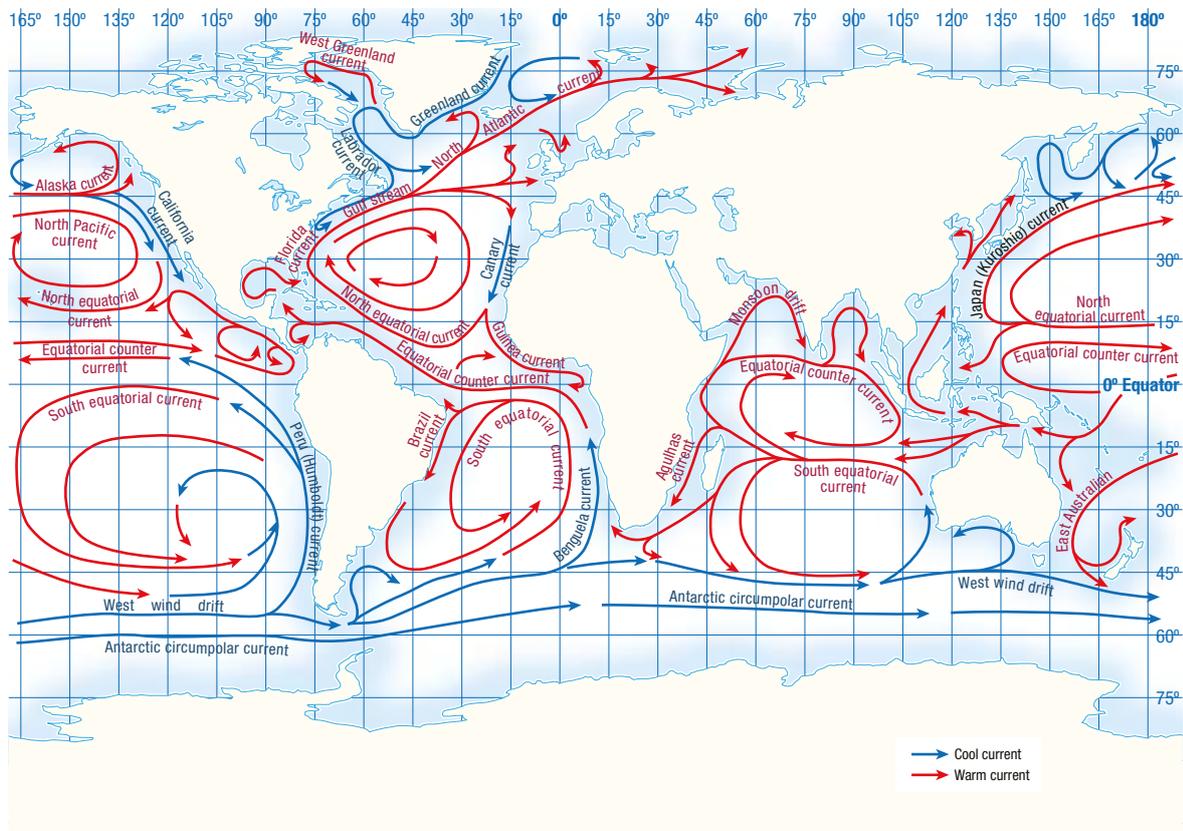
Each of the major oceans has its own system of currents due to continents interrupting oceanic flows. As there are no continents to obstruct currents flowing around

**hydraulic action** the process of waves compressing air within gaps in the rock, and this air being explosively released when the waves retreat

**longshore drift** the movement of sediment, usually sand, shingle or mud, along a coastline driven by the direction of the prevailing wind



**Source 1.5** The Disney character Nemo, a clownfish like this one here, used the Eastern Australian Current (EAC) on his journey in the cartoon film *Finding Nemo*.

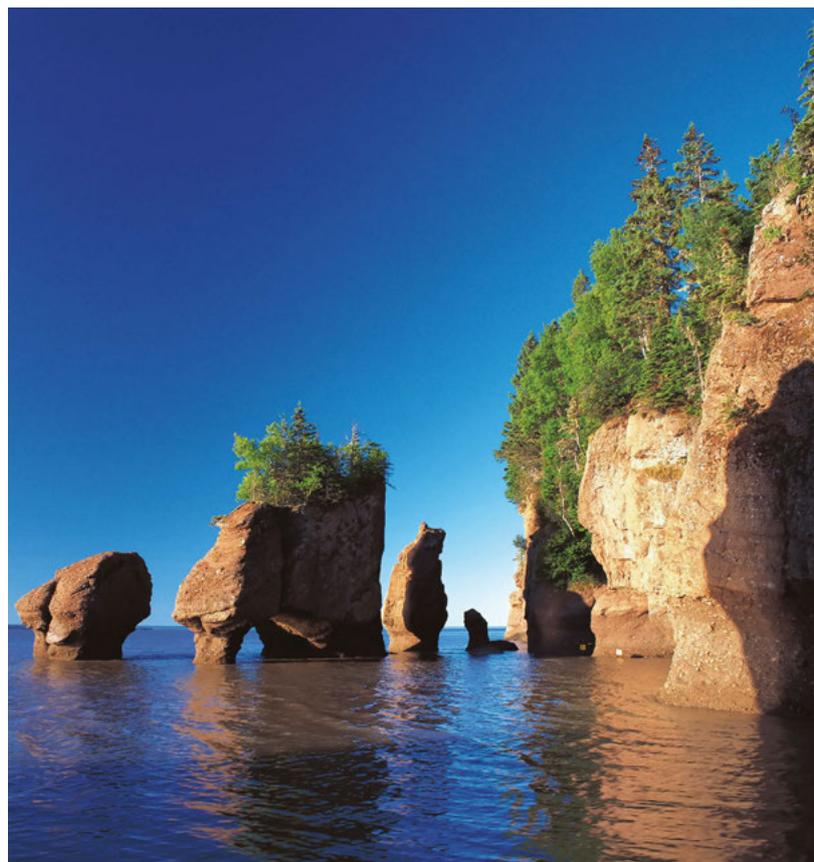


Source 1.6 World map of ocean currents

Antarctica, the west wind drift is the only uninterrupted global current.

Tides are caused mainly by the gravitational pull of the moon. A high tide will happen when the moon and sun are aligned, and the largest tides during the year are recorded when the Earth is closest to the sun. When **tidal ranges** are very large, there are usually local topographic and seabed features that contribute.

**tidal range** difference in height between low tide and high tide



Source 1.7 The Hopewell Rocks at the Bay of Fundy, in New Brunswick, Canada. The Bay of Fundy has the largest tidal range (15 metres) in the world.

## Note this down 1.1

Copy the graphic organiser below and complete the following tasks.

- 1 Select one place from each of the following two lists. Locate each place on a map.
- 2 State why tidal ranges are different at these two locations, using descriptions of the locations found on the internet.
- 3 Explain why it is important for humans to be aware of tidal ranges.

List 1 (select one)	Location (country and description)	Tidal range (m)	List 2 (select one)	Location (country and description)	Tidal range (m)
Broome			Newcastle		
Avonmouth			Athens		
Bay of Fundy			New Orleans		

### RESEARCH 1.1 //

Choose two places on the coast in Australia, one in northern Australia and one in southern Australia.

- Describe the coastal landforms in each area.
- Identify any differences in landforms between the two areas.
- Explain why coastal landforms may not all be the same in northern and southern Australia.

#### In riverine landscapes

Both deposition and erosion are processes that occur in rivers. Large-scale deposition usually happens in the downstream or slow-moving sections of rivers, while major erosion tends to

be concentrated in the upper reaches.

Large rivers can temporarily deposit sediment within their channels, usually as a result of **meandering** or when the river

flow slows down and is unable to keep moving all the sediment delivered to the stream. Large

rivers entering the sea often carry massive amounts of clay, silt and sand, and these are deposited at the river mouth in the form of a **delta**.

**delta** fan-shaped deposit of river sediments found at the mouth of a river

**meandering** a series of wide curves and loops of a river channel when viewed from above



**RESEARCH 1.2** //

Research some rivers via the internet and choose one that has slow-moving sections within it resulting in deposition.

- Describe the river and its location.
- Differentiate between pools and riffles.
- Identify reasons as to why deposition has occurred.
- Explain how a billabong (oxbow lake) forms.
- List some of the materials contained within the deposition.

 **Note this down 1.2**

Copy and complete the graphic organiser below by answering the following questions.

- 1 Select two large rivers, one in Australia and one in another country.
- 2 Using information in your table, make two lists of depositional landforms:
  - a those associated with both rivers
  - b those present on only one of the rivers.
- 3 Make two lists of erosional landforms:
  - a those associated with both rivers
  - b those present on only one of the rivers.
- 4 Discuss the similarities and differences in depositional and erosional landforms associated with the two rivers selected.

	River in Australia (name)	River in another country (name)
Rainfall distribution across the catchment (Heavier in some parts than others? The same everywhere? Approximate amounts?)		
Depositional landforms present		
1		
2		
3		
Erosional landforms present		
1		
2		
3		

### In arid landscapes

About 70% of Australia is classified as arid or semi-arid due to our low rainfall. In Australian deserts, such as the Simpson Desert, there are many dunes. Sand particles are transported

and deposited by *aeolian* (wind) processes, often forming interesting patterns such as longitudinal dunes, crescent-shaped dunes, star-shaped dunes and transverse dunes.

**Source 1.8** The Simpson Desert and its dunes





**Source 1.9** There are 10 major deserts in Australia including the Great Victoria Desert, the Simpson Desert, the Sandy and Tanami Deserts. A large proportion of this land belongs to the Aboriginal and Torres Strait Islander peoples.

↙

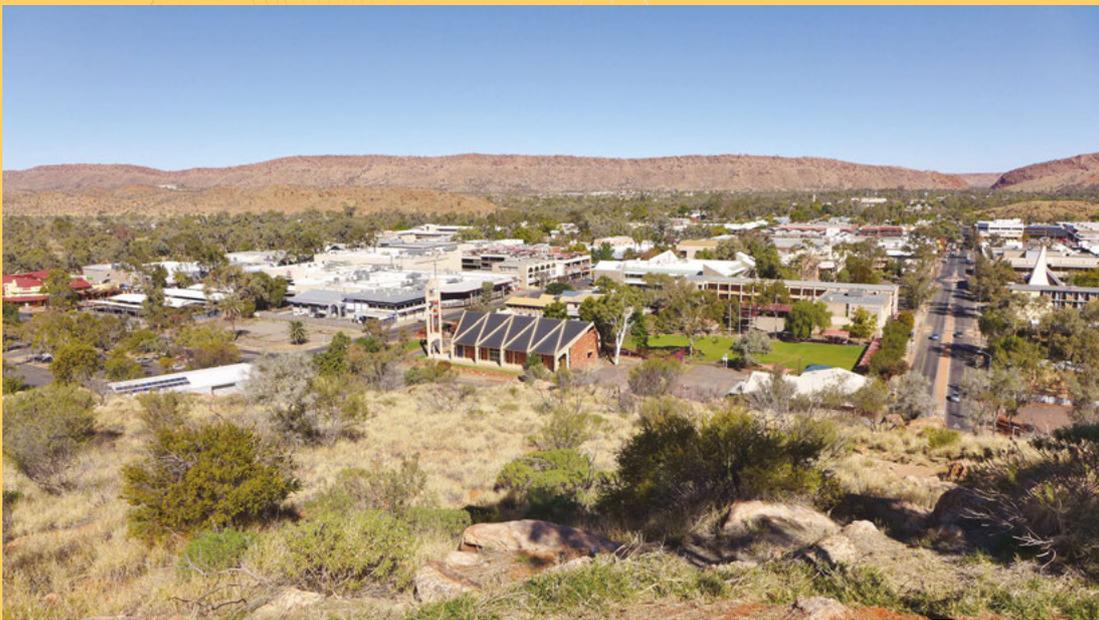
## Activity 1.3

- 1** Discuss how rivers are agents of both erosion and deposition. Refer to distinct features you might expect to see as evidence of these processes.
- 2** Identify why deserts are generally found at a **latitude** of 30° north or south of the Equator. Use the ocean currents map (page 29) to explain why deserts are mostly located on the western side of continents or inland.
- 3** Reflect on whether deserts are always hot and dry (with the exception of the Gobi Desert and Antarctica).

**latitude** distance from the Equator measured in degrees north or south

## Geographical fact

People often assume deserts are always hot and dry. Although this is mostly the case, it is also not accurate. Deserts do receive rain each year, but generally well below average. A desert is classified as a region receiving less than approximately 250 mm rainfall per year. And deserts can get cool. Light overnight frosts in winter are not unusual. In Australia, July minimum temperatures are mostly in the 3–6°C range in our arid regions. The lowest temperatures in an Australian arid area have been recorded at Alice Springs, where the temperature has fallen as low as –7.5°C.



**Source 1.10** The town of Alice Springs is classified as semi-arid, but has experienced temperatures as low as –7.5°C.

### In karst landscapes

*Karst* generally refers to the system of caves and fissures underground and their unique environments. More specifically, it refers to a situation when water infiltrates into the Earth's surface in sufficient quantities, and moves down to a zone of saturation, the upper limit of which is termed the water table. Groundwater moves more slowly than overland flow, as groundwater can only circulate through small, interconnected pore spaces within rock or sediment, but it can still contribute to the formation of landforms.

In limestone terrain, **bedding** and **joint planes** allow surface water to enter and take **calcite** into the solution, thereby widening any existing weaknesses or fractures. Over time, this may lead to the development of underground streams, which emerge either as springs or as fully fledged rivers fed by underground water. Freshwater springs appear in the ocean off the coast of

**bedding plane** surface between layers of deposited materials or sandstone that make up sedimentary rocks

**joint planes** vertical, horizontal and angled patterns of cracks in rocks

**calcite** the main mineral in limestone and marble, composed of calcium carbonate



**Source 1.11** A karst landscape. These landscapes are characterised by eroded rock formations that result in caves and sinkholes.

Montenegro in the Adriatic Sea, and offshore from Yucatán in the Gulf of Mexico.

Limestone regions and those with soluble rocks like gypsum have often developed distinctive karst topography due to the action

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**karren** small grooves or furrows in rock (usually limestone) formed by running water

---

of underground water. On the surface, small-scale features like **karren** are common. At a slightly larger scale, various other features appear: sinkholes, disappearing streams and springs. More extensive landforms, like limestone pavements,

karst or flat-bottomed valleys and tropical-region **tower karst**, also occur. When dense, compacted limestone is uplifted, gorges can be cut through the rock. Because surface water tends to disappear quickly into limestone terrain through bedding planes and joints, and then enlarge them, another **characteristic** of limestone regions is the development of extensive cave systems.

---

**tower karst** towers or pinnacles remaining after limestone has been weathered in tropical regions

---

**characteristics** the tangible and intangible elements of a place or environment

---



**Source 1.12** The Nullarbor Plain is the world’s largest limestone karst landscape. Caves are a common feature.

**Activity 1.4**

- 1 Suggest what conditions lead to the formation of a desert.
- 2 Describe how mountains are formed.
- 3 List two landforms developed in limestone by groundwater, and two developed in non-limestone areas.
- 4 Explain why groundwater is so important to landform development in limestone terrain.



### Tectonic activity

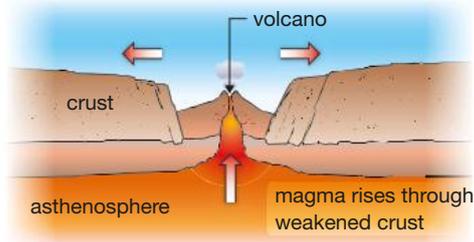
Plate tectonics movements tend to influence the formation of mountains over millions of years. Tectonic plate movements occur both on continents and on ocean floors.

#### *Tectonic activity and volcanoes*

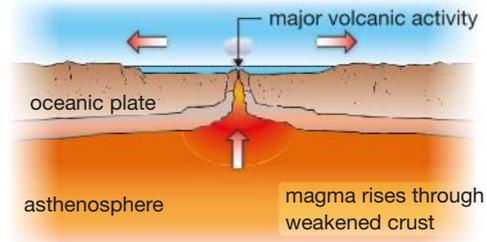
By investigating patterns of volcanic activity and the absolute amount of continental movement over a number of years, scientists have proposed that plates are moving in different pathways and at different rates. Some plate boundary locations and movements are unclear, and these are referred to as plate boundary zones. Different landforms are associated with different kinds of plate boundary, giving clues to the way plates are behaving. The main plate boundary types are described as **divergent**, **collision**, **convergent (subduction)** or **transform**.

- 
- divergent plate boundaries** the point where plates are pulled apart, allowing molten rock to emerge at the Earth’s surface
  - collision plate boundary** the point where two plates of similar strength or speed collide
  - convergent (subduction) plate boundary** the point where two plates are moving towards each other and collide, with one plate being pushed beneath the other; the lower plate is the ‘subducted’ plate
  - transform plate boundary** the point where two plates slide, grate or jerk past one another
-

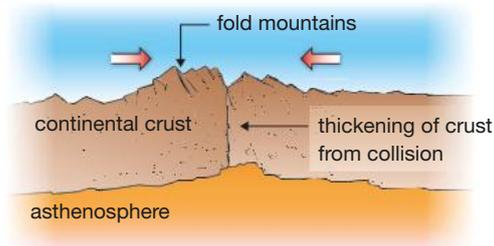
**1 Divergent (continental plates)**  
(e.g. Rift Valley, Africa)



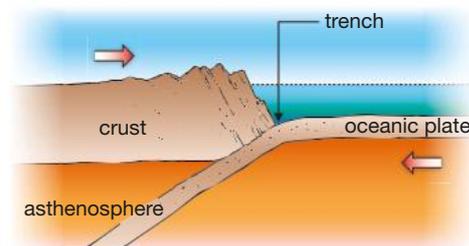
**2 Divergent (oceanic plates)**  
(e.g. Mid-Atlantic Ridge)



**3 Collision (continental plates)**  
(e.g. Andes, South America)

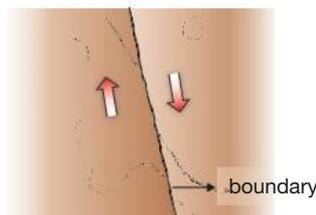


**4 Subduction (continent/ocean)**  
(e.g. Ring of Fire, Pacific Ocean)

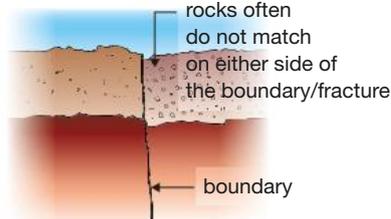


**5 Transform boundary (plates moving past each other)**  
(e.g. San Andreas fracture zone)

(a) viewed from above



(b) cross section



**Source 1.13** Divergent/collision/subducting/transform plate boundaries

Volcanic activity occurs along collision, convergent and divergent plate boundaries, both under the oceans and on landmasses, and along **fault lines**. Transform plate boundaries, where plates move past each other, generally are not associated with volcanic activity. Much of the volcanism found along convergent plate boundaries is explosive, while most volcanic activity taking place along divergent boundaries involves non-explosive outpourings of lava.

**fault lines** lines on the earth's surface that trace a break

As many convergent plate boundaries are on or near landmasses, explosive volcanism is what people generally experience. The 'Ring of Fire' around the Pacific Ocean represents more than 1000 volcanoes that have appeared on convergent plate boundaries. Of those volcanoes that have erupted during historical time, the highest is in the Andes in northern Chile, at an elevation of nearly 7000 metres. There is evidence of submarine volcanism having taken place over the last 150 years at depths of about 5300 metres in the Mid-Atlantic Ridge (divergent plate boundary).



**Source 1.14** Indonesia still has active volcanoes such as Ijen in Java. Ijen has the world’s largest acidic crater lake, famous for its striking azure colour. Some workers make a living from carrying sulfur out of the crater.

### Note this down 1.3

Copy the graphic organiser below and give an example of each boundary type and associated landforms.

Nature of plate boundary	Example (location)	Landform/s
Collision	Himalayas	High mountains
Divergent		
Convergent (subduction)		
Transform		

### Activity 1.5

- 1** Using the internet, locate two maps showing:
  - a** the Pacific ‘Ring of Fire’
  - b** plate movements.
- 2** Identify the link between the types of plate boundaries around the Ring of Fire (collision, convergent (subduction), divergent or transform).
- 3** Consider whether particular types of plate boundaries have caused the Ring of Fire.
- 4** Investigate the career of a volcanologist. How do you become a volcanologist? What do volcanologists do? And are there any famous volcanologists? Choose one and give a short summary of their career and major findings.

**RESEARCH 1.3** //

In groups, select one of the major continental or oceanic plates and use the internet to gather information about the rate and direction of its movement. Assess what the likely outcomes of this movement will be over the next century, and share your results with the class in the form of a PowerPoint presentation.

## 1.4 Examining a landscape and its landforms

### Mountain landscapes

**collision plate boundary** the point where two plates of similar strength or speed collide

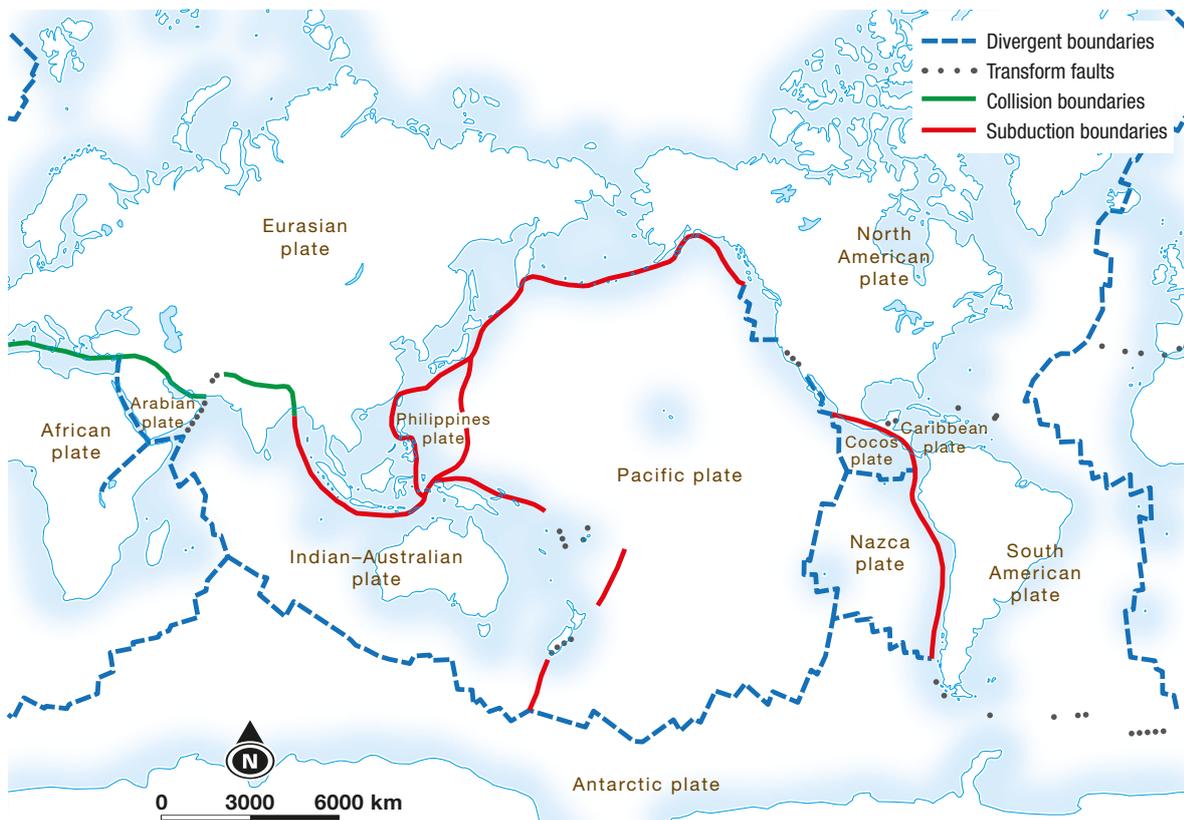
Generally mountains are formed due to **collision plate boundaries**. These boundaries occur when plates are moving towards one another, resulting

in the plates colliding. Even though plates are moving slowly, they often adjust quickly, causing earthquakes.

If the plates have approximately the same rock density, the collision forces parts of the landmasses upwards. The top of a fold is known as an **anticline**, whereas the bottom of the fold is the **syncline**, which represents the

**anticline** the upward bulging of rocks caused by compression

**syncline** the downward squeezing of rocks caused by compression



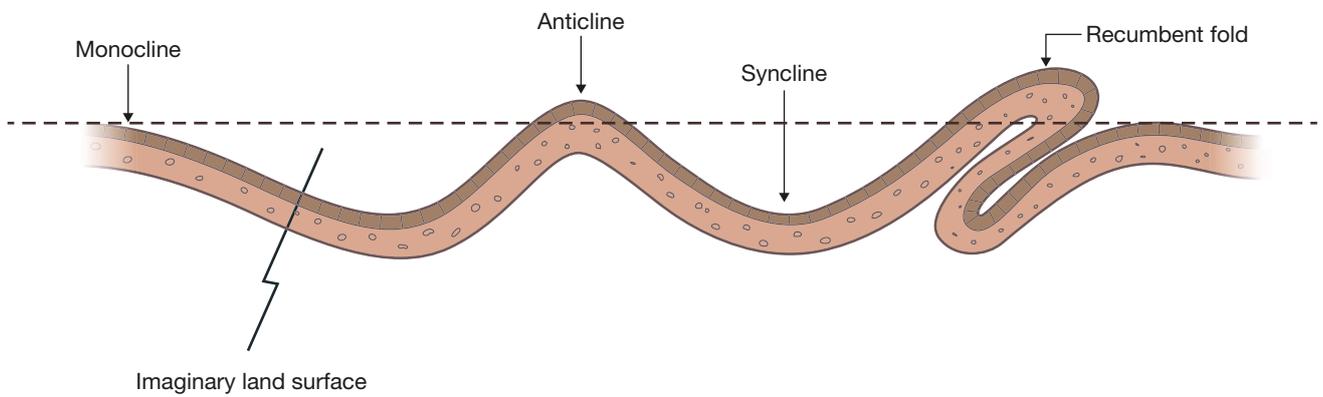
Source 1.15 Tectonic plates and their boundary conditions

**monocline** a simple fold that occurs singularly rather than as part of a series of anticlines and synclines

nearby rocks that have been squeezed downwards into a convex shape. **Monoclines** are a more simple and gentle fold – for example, the Lapstone Monocline at the eastern part of the Blue Mountains Range in New South Wales. **Recumbent folds** are those that have

folded over themselves or overturned ('reclining'), so that initially the youngest rocks are on the surface. Recumbent folds are frequently sighted in strongly folded terrains like the European Alps.

**recumbent folds** those that have folded over themselves or appear to have flopped over, strongly folded and squeezed into sharp folds as a result of great horizontal pressure



**Source 1.16** Different fold types

**Source 1.17** Matterhorn in the Swiss Alps, part of the European Alps, which has many examples of recumbent folds



## Geographical fact

The Himalayas mountain range grows by approximately 1 cm a year. Therefore Mt Everest will be another metre higher in 100 years.



**Source 1.18** A famous example of an anticline is the Himalayas, where the Indo-Australian Plate is moving northwards and the Eurasian Plate is moving southwards.

## Geographical fact

The Nullarbor Plain is the world's largest limestone karst landscape, covering 270 000 square kilometres. Nullarbor means 'no trees'. Two-thirds of the Nullarbor is in WA and one-third in SA.



**Source 1.19** The karst landscape of the Nullarbor plain

## Volcanoes

In 1815, the largest volcanic eruption during historical times took place in the Flores Sea near Lombok in Indonesia. Tambora had been considered an extinct volcano until then,

when approximately 50 km<sup>3</sup> of dense rocks were ejected. Before the eruption, Tambora stood at about 4300 metres but the summit exploded, leaving a **caldera** measuring 6 km wide and 1 km deep. The new summit reached only 2850 metres, a collapse of nearly 1.5 km. Apart from massive **pumice** flows, the volcano ejected an estimated 60 million

tonnes of sulfur – more than six times the amount from Mt Pinatubo (Philippines) in 1991 – and large amounts of fluorine, which is toxic to people and livestock. The violence of the eruption sent plumes of ash up to 43 km into the atmosphere, and explosions could be heard up to 2000 km away.

During the worst few days of the eruption, many places within 600 km of the volcano remained 'pitch black', and air temperatures dropped dramatically. Global temperatures may have dropped by up to 3°C. The after-effects of the volcanic eruption were severe. Immediately following the eruption and associated earthquakes, tsunamis reached a maximum height of 4 metres and inundated low-lying coastal areas. Ash build-up caused buildings to

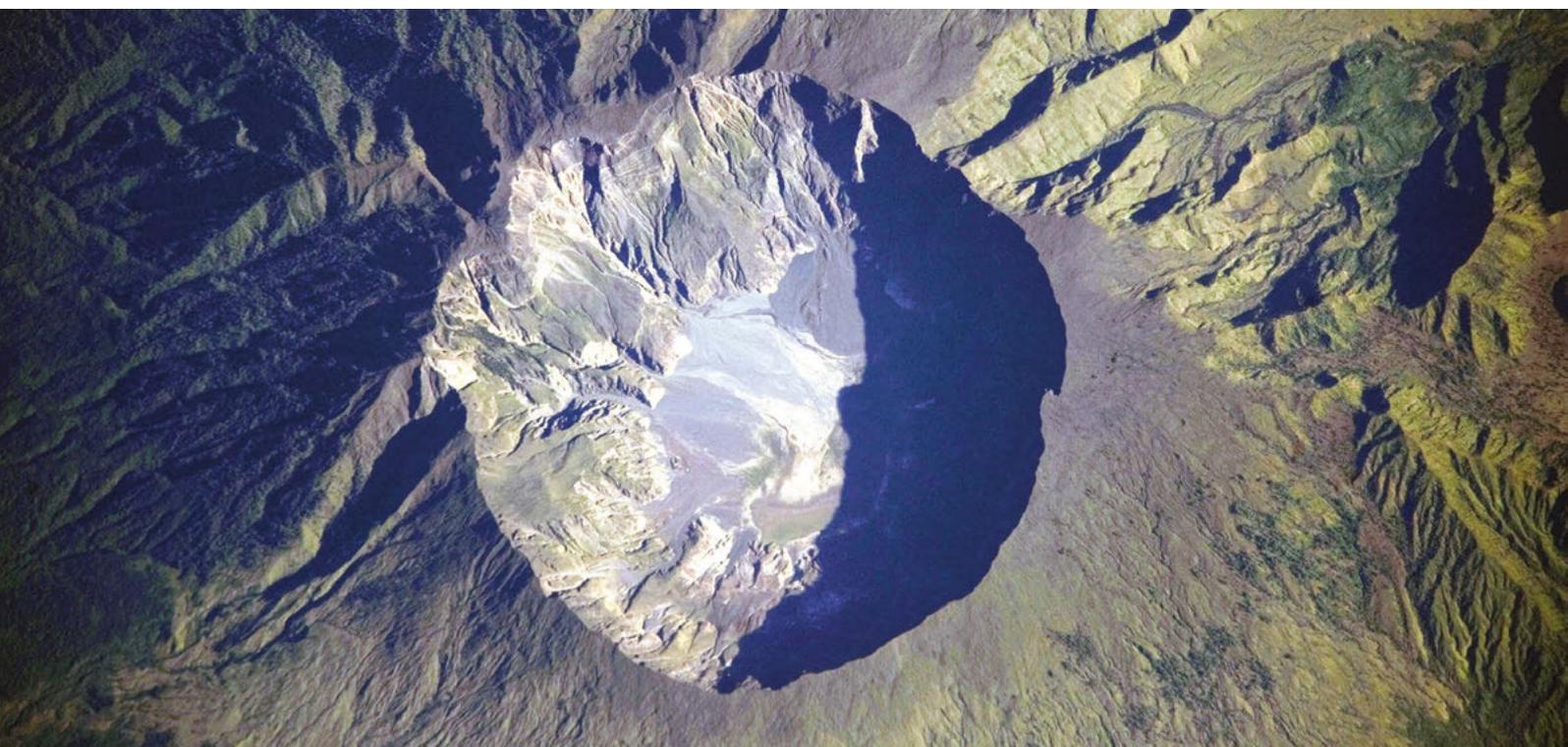
**caldera** large basin-shaped depression caused when the summit of a volcano collapses into the magma chamber below or explosions destroy the summit

**pumice** a light-coloured rock with many holes (vesicles) due to gases mixing with rapidly solidifying lava and trapping multiple air bubbles. Pumice is light and floats on water.

collapse and people had difficulty breathing. At least 71 000 people are estimated to have died during the eruption or immediately afterwards, when no food or uncontaminated water was available.

Up to 3 years after the eruption, pumice and tree trunks formed sea-borne rafts up to 5 km across, and posed a major hazard for shipping. The massive quantities of ash ejected into the atmosphere had climate impacts in the Northern

Hemisphere. On the positive side, sunsets and twilights in places like London were spectacular. However, the year following the eruption – 1816 – was called the ‘year without a summer’ in northeast North America and Europe. That year, the weather was much wetter than usual and cold temperatures shortened the growing season. Grain crops failed, potatoes rotted in the wet ground and people suffered from major outbreaks of typhus.



**Source 1.20** This detailed astronaut photograph depicts the summit caldera of the volcano. The huge caldera – 6 kilometres in diameter and 1100 metres deep – formed when Tambora’s estimated 4000-metre high peak was removed, and the magma chamber below emptied during the 1815 eruption.

### Activity 1.6

- 1 Locate the Tambora volcano on a map.
- 2 Identify whether the Tambora volcano lies on or near a plate boundary.
- 3 Assess two impacts of the Tambora eruption on human populations.

### Geographical fact

Pumice stones were used by clothing manufacturers to produce the original stone-washed jeans.

## Chapter summary

- There are many different types of landscapes, including coastal, riverine, arid, mountain and karst.
- ‘Weather’ and ‘climate’ do not have the same meaning. Weather refers to daily conditions in a particular location. Climate refers to long-term patterns in a particular region.
- Landforms are created by weathering, erosion, transportation and deposition.
- Coastal landforms are formed by weathering, erosion and deposition, particularly by water like the ocean e.g. tides and ocean currents.
- Rivers are agents of both deposition and erosion e.g. deltas.
- Arid regions tend to be deserts, often found around a latitude of 30° north/south of the Equator.
- Karst landscapes are limestone regions where underground water causes distinctive landforms such as karst towers or caves.
- Convergent, divergent, subduction and transform plate boundaries lead to different types of landforms.

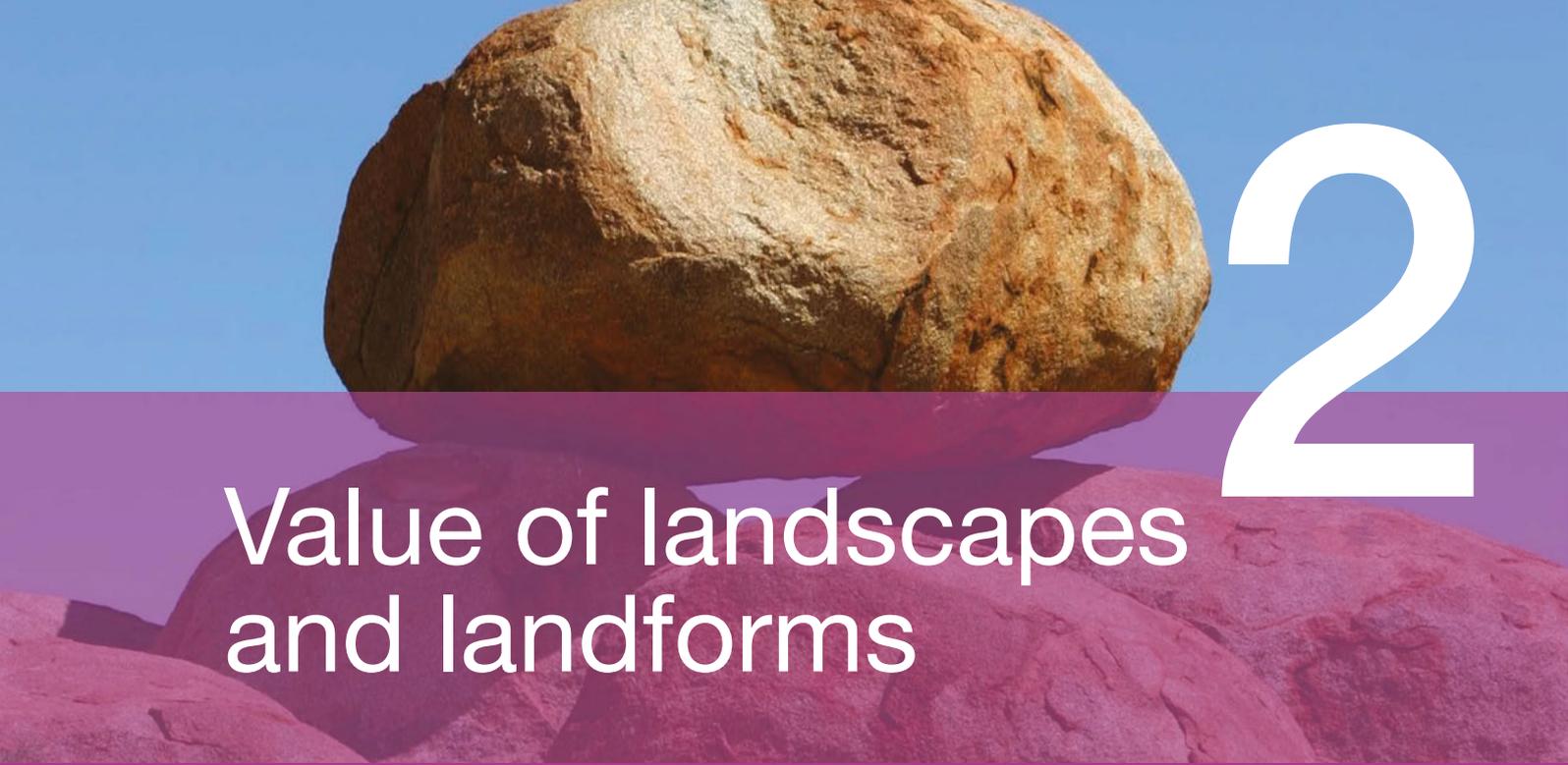
## End-of-chapter questions

### Short answer

- 1 List the two forces which act at different rates that contribute to the geomorphic processes that produce landforms.
- 2 Describe a karst landscape.
- 3 A year after the eruption of the Tambora volcano in 1815 what was the term for the year in northeast North America and Europe?

### Extended response

To what extent are landforms developed as a result of plate movements? Discuss this question in a short report by giving examples of both large-scale and small-scale landforms, showing your understanding of the role of plate movements in landform development. What other factors may affect landform formation?



# 2

# Value of landscapes and landforms

**Source 2.1** The Devil's Marbles possesses great significance for Aboriginal peoples, and the landform's creation is told in many Dreaming stories.

## Before you start

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### Main focus

There are a number of ways in which landscapes and landforms are valued by individuals, groups and organisations in society.

### Why it's relevant to us

It is important for us to investigate the different values people place on landscapes, as they play a significant role in tourism, literature, art and film.

### Inquiry questions

- What are the different values of landscapes and landforms for people?
- How do landscapes and landforms inspire the arts and shape identities?
- What is the role of landscapes and landforms in tourism?
- What are the meanings associated with landscapes and landforms by Aboriginal and Torres Strait Islander peoples?

## Key terms

- aesthetic value
- cultural value
- Dreaming
- identity
- place

## Let's begin

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Musicians sing about landscapes, poets describe landscapes, film directors use landscapes and artists paint landscapes. Not only are landscapes and landforms valued for their ability to inspire the arts, they also shape identities and support tourism industries. For example, Uluru is an iconic tourist attraction in the Northern Territory. This landform is a source of identity and holds spiritual value for the traditional people of the area, the Anangu people.

## 2.1 Aesthetic value of landscapes and landforms

People have always placed, and continue to place, **aesthetic**, **cultural** and spiritual value on landscapes and landforms.

**aesthetic value** value placed on something due to its beauty

**cultural value** the emphasis placed on something for its importance and place in society, such as the inclusion of water in rituals, heritage and the Dreaming

**place** an area that has a specific meaning or purpose

**identity** the way you see yourself and the way others perceive you

Landscapes inspire musicians, poets, artists and film directors. When people listen to a song, read a poem, admire a painting or watch a film, it evokes feelings, memories and associations. It can connect them to their sense of **place** and shape their **identity**.

Landscapes and landforms not only represent the geographical make-up of a land, but also create a feeling of uniqueness when it comes

to its inhabitants. A country such as Australia has a very strong sense of identity regarding

its landscapes and landforms. This identity is captured in the term *Australiana*, which represents typically Australian people, events and characteristics. From the desert landscape to the coast and the vastness of the Great Barrier Reef, Australia is represented as a diverse land, comprising all types of terrain. This in turn creates the representation of Australians as resilient and adventurous, with a deep connection to the land and all it has to offer.

This idea of a deep connection to the land can be seen in Aboriginal and Torres Strait Islander culture. Aboriginal Dreaming stories and legends of Torres Strait explore the creation of people, animals and the land. Aboriginal and Torres Strait Islander peoples believe they are born out of the earth, the mountains and the sky, and therefore will always have a strong connection to it. This connection to the land has remained the central focus of Aboriginal and Torres Strait Islander culture to this day.

### Activity 2.1

- 1 Define the term 'identity'.
- 2 Explain how landscapes and landforms shape identities.
- 3 Outline the importance of landscapes and landforms in shaping the identities of Aboriginal and Torres Strait Islander peoples.



## Fieldwork 2.1 Your capital city

### Aim

To discover and understand the values placed on your capital city.



**Source 2.2** Most capital cities include a tourist destination.

### Method

- 1 Note the various methods of travelling into your capital city. Typically, most schools will choose to visit by bus or train.
- 2 Travel into the city. Note the commuters and other passengers/drivers heading into the city. What is the inbound (entering the city) traffic like?
- 3 Break up into groups and 'stake out' as many tourist destinations as possible. Make sure to cover one or two places not typically viewed as tourist attractions.
- 4 Keep a tally of the types (culture, age, gender, etc.) of people visiting each destination or attraction.
- 5 Conduct a survey (20–100 people) in each location to assess where these people have come from, and why they are visiting this place. How did they reach this location? Do they agree with the costs (if any)? Where did they hear of this place?
- 6 Break your tally/survey into separate parts of the day. Note the flow of traffic. Are there peak and off-peak times? How does the location adjust itself for this (for example, cheaper rates, different opening hours)?
- 7 Explore and research your location. What are its opening hours? What do attractions charge? What is their history? How do they attract visitors? Do they change throughout the year? Include any other questions you feel are relevant.
- 8 On the trip home, again assess the commuters and passengers/drivers leaving the city. Compare inbound and outbound traffic.
- 9 Additionally, you could return if time is available throughout the week and complete the surveys on different days at different times.
- 10 Display the data collected in tables and charts to include in your presentation. What can you conclude from the data collected?

### Preparation

- Research your local capital city and list various tourist (and non-tourist) locations. This can include attractions, parks, stores, restaurants, streets and so on.
- Organise your class into groups and cover as many of these locations as possible.
- Prepare tallies that are divided into the different times of the days (such as morning/afternoon, or 9 a.m., 10 a.m., 11 a.m. and so on).
- Prepare questionnaires for visitors to each location.
- Prepare fact sheets on the intended locations.

### Data collection

Tally (to be taken based on all visitors)

Include:

- age group
- gender
- culture
- country of origin
- travel mode (where possible)
- any other factors you feel are relevant.

### Survey

Include (to be taken from a random sample of 20–100 visitors):

- all the items from the tally
- opinions of the location (i.e. cost, ability to find it)
- why the visitors chose this location
- how the visitors heard about this location
- any other questions you feel are relevant.

### The commute

- Are these people mostly workers or visitors?
- Where are they coming from?
- Are there any stations/freeway entrances in which more people join the commute?
- What other relevant information is there?

### The location

Include:

- cost
- opening hours
- attractions
- history
- any changes that occur through the year
- peak and off-peak times
- any other relevant information.

### PowerPoint presentation layout

Front slide	<b>Title and name</b> Include your location
Contents slide	Do this last, as well as numbering pages
Slide 1	<b>Aims and methods</b>
Slide 2	<b>Location map and images</b>
Slide 3	<b>Location information</b>
Slide 4	<b>Survey results</b> <ul style="list-style-type: none"> <li>• commute</li> <li>• tally</li> <li>• surveys</li> </ul>
Final slide	<b>Conclusion</b> What did you discover?

## 2.2 Cultural and spiritual value of landscapes and landforms

Landscapes and landforms have shaped the identity of cultures and communities for centuries. We will consider two examples in this section of the chapter: Aboriginal and Torres Strait Islander peoples and Hawaiians.

### Aboriginal and Torres Strait Islander peoples

‘There is another dimension that invests land with meanings and significance – which transforms land and environment into landscape, and into “country”. That other dimension is culture. Culture is what enables us to conceive of land and environment in terms that are different to conventional European notions. To us Indigenous peoples all landscapes are cultural ... In fact, “landscape” and “environment” are human constructs – they are terms that are inherently shaped by the ways in which humans perceive, or think about the world around them.’

Quotation from Indigenous barrister and academic Professor Mick Dodson, AM (1995)

Aboriginal and Torres Strait Islander peoples have cared for country on this island continent and on the islands for tens of thousands of years, and still tell cultural stories about its creation. They have evolved durable ways of living that have sustained them for countless generations. The statement by Aboriginal scholar Mick Dodson highlights that ‘nature’ and ‘culture’ are not separate. Aboriginal and Torres Strait Islander peoples have lived in, walked over, managed and celebrated Australian landscapes and landforms for many years. These landscapes and landforms are in fact anthropogenic. There is no empty space and no wilderness. Rather, all landscapes and landforms are particular places with particular cultural meanings.

These meanings are often reflected in place names and stories. In this way, landscape, landform, creation or Dreaming stories and place names are interconnected for Aboriginal and Torres Strait Islander peoples. For example, the south-west of Western Australia is the traditional country of the Nyungar people. Their word ‘Manjar’ means a place where a fair or trade occurs; where families of people gather for kinship and in-law making; where mothers, fathers and old people get together; and where young men and women who have ‘come of age’ meet future husbands and wives. There are several places, like Manjimup, Manjaree and Mandurah, whose names show their importance in Nyungar culture.



## ➔ Note this down 2.1

What place names near you are Aboriginal and Torres Strait Islander words? Who are the traditional owners and what is their language? Investigate the possible meanings of these place names. Research online for lists of words that can help you in your quest. Copy this graphic organiser and record your discoveries. An example is shown for 'Manjaree'.



### Geographical fact

The Kari-oca Declaration asserts that ancestral and current family ties connect Aboriginal and Torres Strait Islander peoples to lands for which they are responsible. These cultural and ancestral connections have been the basis for land rights struggles. They also underpin struggles for self-determination, or the right of Aboriginal and Torres Strait Islander peoples to govern themselves and their lands.

'We, the Indigenous peoples, walk to the future in the footprints of our ancestors. From the smallest to the largest living being, from the four directions, from the air, the land and the mountains. The creator has placed us the Indigenous peoples upon our Mother the Earth. The footprints of our ancestors are permanently etched upon the lands of our peoples. We, the Indigenous peoples, maintain our inherent rights to self-determination. We have always had the right to decide our own forms of government, to use our own laws, to raise and educate our children, to our own cultural identity without interference. We continue to maintain our rights as peoples despite centuries of deprivation, assimilation and genocide. We maintain our inalienable rights to our lands and territories, to all our resources – above and below – and to our waters. We assert our ongoing responsibility to pass these on to the future generations. We cannot be removed from our lands. We, the Indigenous peoples, are connected by the circle of life to our lands and environments. We, the Indigenous peoples, walk to the future in the footprints of our ancestors.'

The Kari-oca Declaration, signed at Kari-oca, Brazil on 30 May 1992

## Case study 2.1

### The symbolic meaning of the Torres Strait Islander flag

An understanding of the land is an important part of Torres Strait Islander culture and beliefs. This deep connection to the land and landforms is depicted in the Torres Strait Islander flag (see Source 2.3), which symbolises the relationship between the land, the sea and the people with a message of harmony and peace.



**Source 2.3** The Torres Strait Islander flag

The green panels at the top and bottom of the flag represent the lush green land, the blue represents the sea that surrounds the land, the thin black stripes and white **dhari** represent the people. Underneath the dhari is a white five-pointed star, which represents peace and unity among the five island groups. This star is also used by Torres Strait Islander peoples for navigation.

**dhari** a type of headdress

- 1 Explain how the Torres Strait Islander flag reflects its people and their connection to landscapes and landforms.
- 2 Investigate what the star on the flag represents.
- 3 Suggest what aspects of the flag show that Torres Strait Islanders are a seafaring people. What is the importance of this to their culture and way of life?

## Native Hawaiians

Hawaii has two of the most active volcanoes in the world. Mauna Loa (4170 m high) and Kilauea (1250 m) are located on the Big Island. In 1987 the Hawaii Volcanoes National Park on Hawaii was declared a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The National Park is often visited by researchers and tourists, but also by Native Hawaiians who visit to give their respects to the goddess Pele. Like Aboriginal and Torres Strait Islander peoples, Native Hawaiian culture is based on oral tradition, with many stories passed down from generation to generation. The goddess

Pele's home is Kilauea, and she is often cited as an old or young woman.

Hawaiian historian Herb Kane states that:

in folklore she may appear as a tall, beautiful young woman, or as an old woman, wrinkled and bent with age, sometimes accompanied by a white dog. When enraged she may appear as a woman all aflame or as pure flame ... To know Pele is to know the awe that the first Hawaiians must have felt when they came upon this huge island crowned with fiery volcanoes and trembling earthquakes.

Pele tends to be sighted just before an eruption from Kilauea. The most recent eruption from Kilauea was in 1983 and this eruption continues today. Visitors can best see the volcano's activity as night falls.

### Geographical fact

Kilauea means 'spewing' or 'much spreading' in Native Hawaiian. The volcano is Hawaii's youngest and it has continued to erupt since 3 January 1983.

The National Park also contains important historical and cultural sites, such as Pu'uloa Petroglyph Field, which contains over 2300000 ancient rock carvings, and the Footprints Area, where there are intact and preserved fossilised



**Source 2.4** Artist Ellen Houser Rankin (b.1853), working on her colossal statue, Pelee, Hawaiian goddess of fire, for the Hawaiian Building at the World's Columbian Exposition in 1893

**Source 2.5** The Kilauea volcano crater. It is 4.8 kilometres wide and 122 metres deep.





**Source 2.6** If conditions are deemed safe by authorities, visitors can hike near the slowly moving lava flows in the Hawaii Volcanoes National Park on the Big Island.

footprints of Native Hawaiians. The footprints were created in 1790 after a large eruption by Kilauea ejected a huge storm of ash, rocks and sand. The falling dense ash killed many people in its path and was also the perfect medium for creating fossils – such as the footprints.

Most importantly, the Volcanoes National Park holds historical sites that indicate how the Hawaiian ‘ohana’ communities began. Ohana means ‘family’. There are remnants of ancient shelters, old stone walls of canoe shelters and caves that were homes to Native Americans

many generations ago. The volcanoes and their surrounding landscape have a very special meaning and connection to Native Hawaiians.

## 2.3 Economic value of landscapes and landforms

Landscapes and landforms can have a significant economic value through tourism and art. The features of a landscape can capture the imaginations of people, inspire and motivate people to visit them, tell stories about them or capture them in media such as art and film, resulting in revenue for the residents of the landscape being depicted or the artists.

### Tourists

The tourism industry employs thousands of people worldwide who depend on the regular arrival of tourists. Not every town is a tourist

### Geographical fact

The Hawaii Volcanoes National Park on the Big Island has approximately 1.5 million visitors a year.

destination, but few towns are without either a billboard or a tourist centre identifying the attractions of their town. Indeed, some areas of Australia, and the world, are popular places to visit simply due to their landscapes and landforms.

At the end of 2014 the results of tourism show a continuation of an upward trend over the previous five years. Tourism is a key contributor to the Australian economy, generating \$102 billion in tourism spending. It employs almost 5 per cent of the Australian work force and contributes \$27 billion to Australian exports.

### Uluru

Uluru is one of Australia's most iconic tourist attractions, recognised all around the world. It is a large sandstone monolith that is 348 metres high and has a circumference of 9.4

km. In 1983, the then Prime Minister Bob Hawke announced the federal government's intention to hand ownership of Uluru back to its traditional owners, the Anangu people. However, the agreement required the traditional owners to lease the park to the Australian National Parks and Wildlife Service for a period of 99 years.

The park is recognised by UNESCO as a World Heritage Area for both its natural and its cultural values. Averages of around 400 000 people visit Uluru annually, providing a large economic boost to the Anangu people. This tourism also assists with the education of visitors and demonstrations are held on customs, beliefs and traditions. This has been made possible by the construction of a cultural centre, where tourists can come to learn about the traditional law of the Anangu people and the foundation of Anangu culture.

**Source 2.7** An average of around 400 000 people visit Uluru annually.



**RESEARCH 2.1** //

Where are Australia’s major tourist landscape and landform destinations?

- 1 In a group, brainstorm a list of top 10 tourist landscape and landform destinations in Australia.
- 2 Use these lists to decide on a top 10 list for your class.
- 3 Conduct a Google search of Australia’s top 10 tourist landscape and landform destinations. Did your list match the Google search list?
- 4 Discuss why the two may be different.

Indigenous art and artists

*Landscapes and landforms in Aboriginal and Torres Strait Islander peoples’ art*

Art is a significant and sacred part of Aboriginal and Torres Strait Islander culture. Much Aboriginal and Torres Strait Islander art

**Dreaming** a central concept in Aboriginal culture that explains how the world works through creation stories

conveys spiritual meaning, and many of these artworks are inspired by the stories from the **Dreaming**. This type of art shows a deep understanding of and connection to the land, with a heavy focus on the origin of landforms and landscapes. Often, specific features of

landscapes and landmarks are represented in forms showing a spiritual and symbolic interpretation, using the legends and stories from the Dreaming.

The most popular formats of Aboriginal and Torres Strait Islander artworks vary from dot painting, to rock painting and cave painting, and to bark painting. Dot paintings usually represent an aerial view of the land below, and can be equated to a map, showing all the vast amounts of desert beneath. Artists use natural sediments mined from ochre pits to draw and paint, and use colours like red to represent the earth and white to represent



**Source 2.8** One of the pioneers of Aboriginal art was Albert Namatjira, who used the Australian landscape as inspiration for his artwork. This image shows one of his paintings, *Mt Hermannsburg*, printed on an Australian stamp.

the sky. Not only do Aboriginal and Torres Strait Islander artists draw upon the influence of the landscape and their surroundings, they also use them as the main tools by which to create their art. Early Aboriginal artists such as

Albert Namatjira were heavily influenced by the European style of art. However, despite this influence, Namatjira's art still focuses on Australian landscapes and landforms.

## RESEARCH 2.2

- 1 Search online or in an art book for an artwork depicting a landscape. Choose one you like the most.
- 2 Research the area that the artwork is based on, and the artist's interest or motivation behind capturing the landscape in their art.
- 3 Share your findings with the rest of your class in the form of a short PowerPoint presentation.

## Activity 2.2

In groups of two or more, brainstorm responses to the following question. How have modern media – digital photography, film and television – changed the way in which landscapes are viewed? Present your ideas in a poster using examples.



**Source 2.9** Aboriginal landscape artist Albert Namatjira, photographed in Alice Springs in 1957

## Chapter summary

- Different people place different values on landscapes and landforms, including aesthetic, cultural and spiritual values.
- Landscapes and landforms play a significant role in the arts (art, music, poetry, film, literature) and in shaping identities.
- Aboriginal and Torres Strait Islander peoples place multi-layered meanings (material, cultural and spiritual) on landscapes and landforms.
- Iconic landscapes and landforms, such as Uluru, attract tourists from all over the world.

## End-of-chapter questions

### Short answer

- 1 Describe the difference between aesthetic, cultural and spiritual values in relation to landscapes and landforms.
- 2 Discuss how landscapes and landforms influence the arts.
- 3 Explain the role of landscapes and landforms in the tourism industry.

### Extended response

Landscapes and landforms help to evoke a feeling of identity for their inhabitants. Different landscapes help shape people's identity and create a sense of belonging. Reflect on the different landscapes and landforms Australia and the world have to offer, and explain how they have formed the identities of local populations.

# 3

## Changing landscapes

**Source 3.1** The Mount Rushmore memorial in South Dakota, United States, is an example of how humans continue to use and change the landscape.

### Before you start

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#### Main focus

The way we use land changes landscapes and can cause degradation.

#### Why it's relevant to us

It is important to manage and conserve landscapes for the good of our environment and to ensure landscapes remain intact for future generations.

#### Inquiry questions

- How do people use and change the land?
- What human activities tend to impact our landscapes?
- How does landscape degradation occur?

#### Key terms

- ballast water
- cay
- climate change
- coastal zone
- exotic
- landscape quality
- mariculture
- pastoral zone

- ribbon development
- siltation
- spatial distribution
- wheat-belt zone

### Let's begin

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Humans have been using and changing the landscape for centuries. On 4 October 1927 the United States memorial Mount Rushmore in the Harney National Forest was begun. It took over 400 men and 15 years to complete, with the memorial finished on 31 October 1941. Over 90% of Mount Rushmore was carved by dynamite, with the rest of the work being completed with jackhammers and hand-held tools. It is estimated that more than 400 000 tonnes of rock were blasted off to create the giant sculptures of four presidents: Washington, Jefferson, Lincoln and Roosevelt.

### 3.1 Ways people use and change landscapes

There are many ways that people use and change landscapes. Sometimes the use and change are temporary, but with globalisation and urbanisation they can be more permanent. In Australia, an iconic and valued landscape is our coastline. Over 80% of the Australian population live on the coast or within one hour's drive from the coastline. So it is important to investigate how Australians use and change our coastline.

Australia's oceans and coasts are dynamic and unpredictable at times, and provide many values and amenities to various groups. The uses of the coast bring great benefits to many people, but also place many harmful pressures on the environment. These can also harm people.

**Source 3.2** Houses situated beside the sea in Perth

### Building and development

Since European settlement, urban development on the coast has grown alongside port and supply infrastructure. As the human population has increased, **ribbon development** has occurred along the coast.

The majority of Australia's population occupies two widely separated coastal regions – the south-east and east, and the south-west. Of the two regions, the south-east and east is by far the largest in area and population.

Population density as of June 2010 was highest in the city centres, particularly in Sydney. This is broken down into Sydney – East (with 8800 people per sq km) and Sydney – West (7900). Waverley (7500), which is located just east of Sydney and contains the beachside suburbs of Bronte and Bondi,

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**ribbon development**  
the spread of urban areas along transport routes, such as main roads, bus routes, railway lines and coastlines

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had the third- and fourth-highest population densities in Australia.

Pressures on the coast resulting from urban development include:

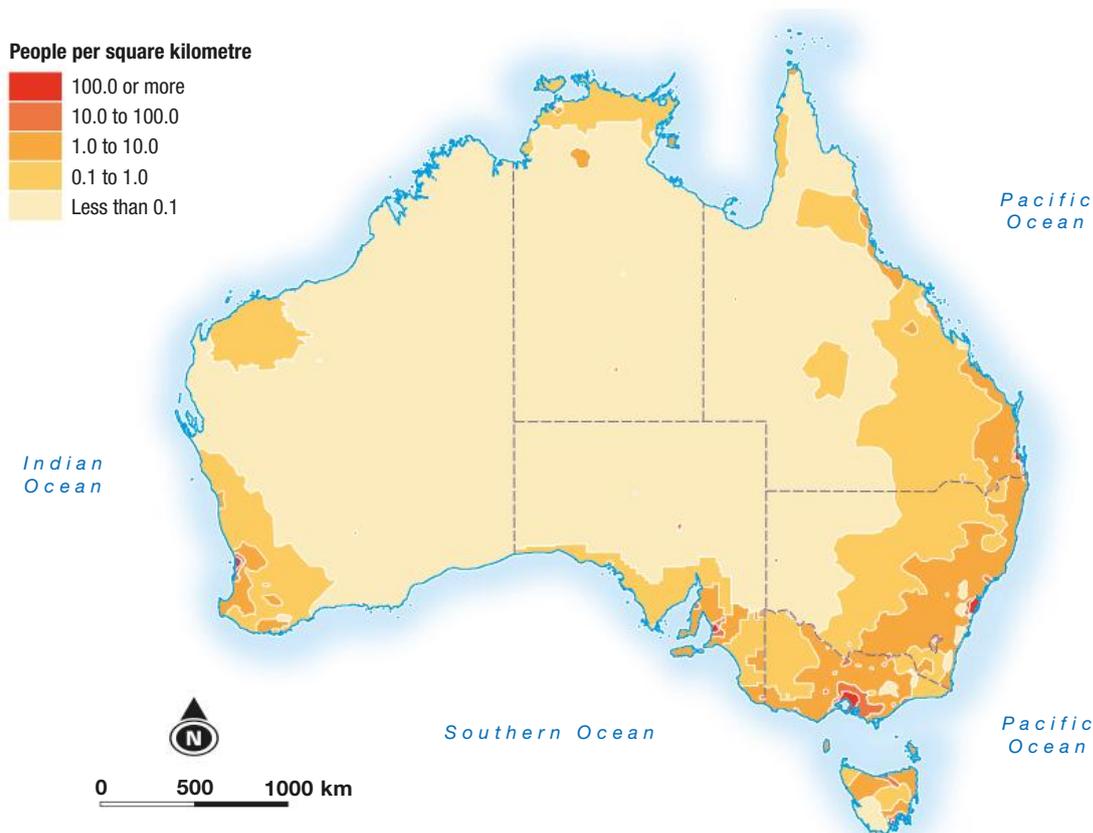
- stormwater run-off and sewage flow into rivers, sea and wetlands, polluting the coast so that recreation, human health and ecosystems are threatened
- pesticides, fertilisers and other chemicals are released into stormwater or sewerage systems, increasing levels of pollution
- coastal native bush and habitat is lost as city margins expand along the coast in a ribbon
- coastal wetlands are destroyed, leading to a loss of nursery grounds for fisheries
- toxic waste is released from old coastal industrial sites or rubbish dumps during redevelopment.

## Recreation and tourism

Tourism has become a major industry in Australia over recent decades, especially in the marine and coastal environment. The Great Barrier Reef, Sydney's beaches, the Gold Coast, Phillip Island and Sea World are all highly popular destinations. Most international visitors rate beautiful scenery, vastness, cleanness, natural wonders and wildlife, and good beaches as reasons for visiting Australia.

Pressures on the coast due to recreation and tourism include:

- tourism and recreation facilities expanding on to natural environments and destroying them
- incorrect anchoring causing destruction of corals and seagrass beds
- waste disposal from boats causing a reduction in water quality



**Source 3.3** Population density in Australia – note the concentration around coastal areas, especially on the east coast

- trampling and off-road vehicles causing destruction of coastal vegetation and dune structures
- treated and untreated sewage from island resorts causing local pollution
- tourism and recreation activities destroying the very basis of their existence in Australia: a clean, beautiful natural environment
- mass tourism impacting on local communities and cultures, with or without bringing financial benefits
- recreational fishing impacting heavily on popular target species.



**Source 3.5** The daily parade of penguins at Phillip Island draws thousands of visitors from around the globe every year.

**Source 3.4** Sea World is a leader in tourism on the Gold Coast, and Australia's first theme park to be inducted into the Australian Tourism Hall of Fame in 1992.





**Source 3.6** Bondi Beach is one of Australia's most famous beaches and well known worldwide.

### Activity 3.1

- 1 Identify the nearest coastal areas to you.
- 2 Describe the main human activities that occur there.
- 3 Assess the severity of impacts of these activities.



### Aboriginal and Torres Strait Islander peoples

The Australian landscape has been home to Aboriginal and Torres Strait Islander peoples for over 60 000 years. For Aboriginal and Torres Strait Islander peoples, their use of coastal areas is linked to both traditional and cultural practices. Many groups continue to live off the land as their ancestors did, by hunting and fishing. Importantly, many areas have significant spiritual meaning and are places that are highly respected.

Aboriginal and Torres Strait Islander peoples may change the landscape through practices such as burning areas of bushland for environmental purposes and to stimulate new growth (and therefore attract wildlife). This practice of burning off will be explored in more detail in the next chapter.



**PANGAEA**  
200 million years ago



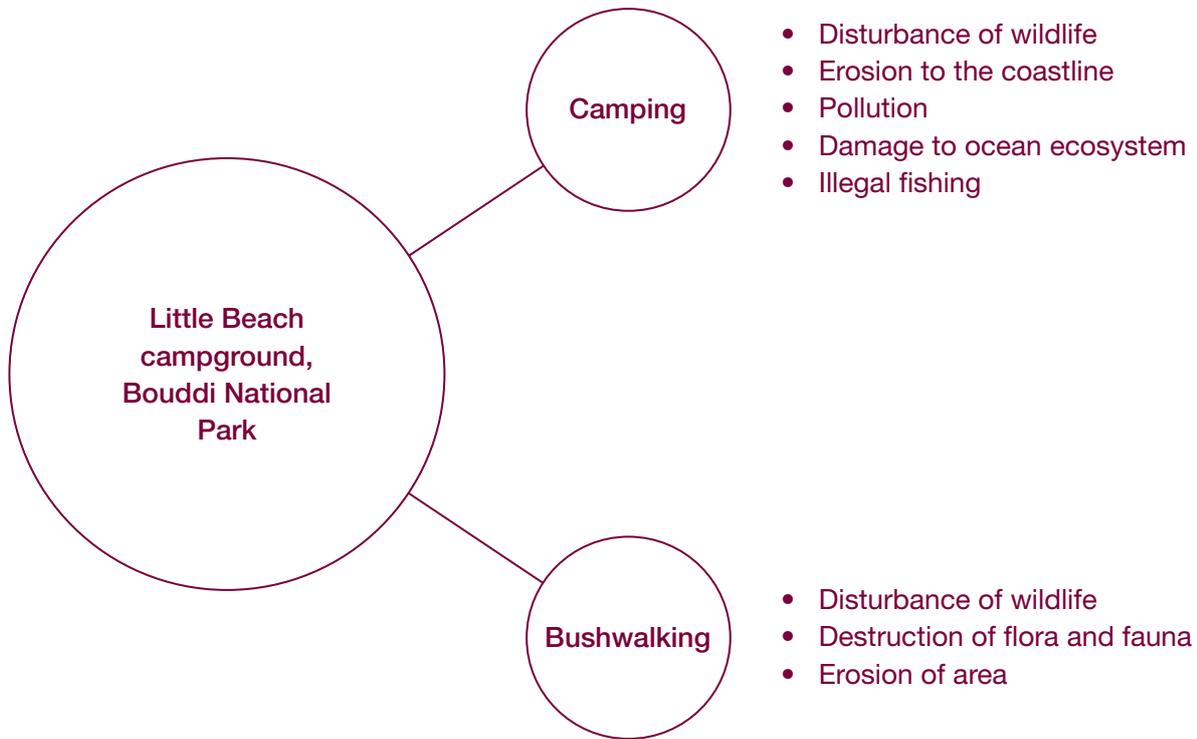
**LAURASIA & GONDWANA**  
120 million years ago



**Source 3.7** Some landforms that are now islands were once connected to the mainland. Indigenous people occupied many of these areas.

## ➔ Note this down 3.1

Copy the graphic organiser below and use your findings from Activity 3.1 to complete it. An example has been completed for you.



### 3.2 Impact of human activities on landscapes

Australians are famous for their love of the outdoors and appreciation of the landscapes the country has to offer, particularly their passion for the coast. Unfortunately, in many places this creates pressure on the coast. **Climate change** is

now recognised as an additional human impact that is likely to have serious implications for the coast in the coming decades.

Other human activities that impact our landscape include **aquaculture**, agriculture and commercial fishing.

---

**climate change** a long-term change in regional or global climate patterns e.g. annual precipitation, frequency of weather events

**aquaculture** the industry of cultivating aquatic plants and farming aquatic animals for food

---

#### RESEARCH 3.1 //

Dams, channel straightening and drainage can contribute to the degradation of riverine and wetland landscapes. Complete online research, and in a short report describe the effects of these human activities on the quality of these landscapes.

## Aquaculture

Global production in aquaculture has been expanding. In Australia, oysters, both edible and pearl, form the main part of **mariculture** production, with salmon, trout, abalone, marine finfish and giant clam production expanding quickly. They are usually grown on the coast and can have impacts on coastal ecology and use. Pressures on the coast resulting from

---

**mariculture** the cultivation of fish and other marine life for food – a type of aquaculture

---

aquaculture, especially sea-cage mariculture, can include:

- discharge of untreated wastes from cages or pens
- mass escapes from sea cages
- diseases and parasites, which can spread to wild populations
- the use of toxic chemicals
- habitat damage through **siltation** and altered currents
- visual effects.

---

**siltation** sand or earth being carried by running water and forming sediments in marine areas or water reservoirs

---



**Source 3.8** Edible oysters from Kangaroo Island – oysters are a significant component of Australia's mariculture.

## Agriculture

The high-rainfall coastal region of Australia features fertile flood plains, so it is highly productive for agriculture in many places. It also contains Australia's major cities, and in these areas agriculture often competes for space

with urban development. The **wheat-belt zone** lies largely between the coast and the dry interior, but it is also connected to the coast by waterways. The **pastoral zone** stretches throughout inland Australia

---

**wheat-belt zone** agricultural area where wheat is grown

**pastoral zone** inland areas of Australia where the climate is too dry to sow pasture or crops but livestock can be grazed on native vegetation

---

**coastal zone** where the sea and the land meet

**biodiversity** the variety of living organisms and the environments they form

across all states and territories. Much of our agricultural land is connected to the coast by water. The pressures on the **coastal zone** from agriculture include:

- the loss of coastal habitat and **biodiversity** due to land clearing
- pollutants in the form of fertilisers, pesticides and pathogenic organisms from animal manures carried down waterways to the sea
- specific toxins poisoning marine organisms
- soil erosion in catchments generating high loads of fine suspended sediments, which can smother organisms on the coast.

### RESEARCH 3.2

Mining and quarrying are human activities that impact on **landscape quality**. Select one of these types of human activity and examine its effects on landscapes by completing online research. Present your findings in the form of a PowerPoint presentation. Be sure to include photos and diagrams to illustrate your points.

**landscape quality**  
the human value placed on the condition and aesthetic appeal of a landscape

### Commercial fishing

Australia's commercial fisheries include prawns, rock lobster, abalone, scallops, oysters, finfish (including tuna, jack mackerel, pilchards, barramundi and snapper) and pearls. The value of Australia's fishing industry is around \$800 million, of which around \$700 million is in exports – mainly prawns, rock lobster and abalone – to Japan and the United States. Production in many fisheries has been declining from over-exploitation, despite developments in fisheries science and management. There has also been a trend towards larger companies, with some smaller fishers having to leave the industry.

Pressures on the coast resulting from commercial fishing include:

- widespread depletion of fishing stocks
- local **extinctions** of species
- wasted by-catch
- dolphins caught in tuna and other nets
- social disruption in fishers' lifestyles due to depleted stocks and changing regulations.

**extinction**  
disappearance of a species





**Source 3.9** Commercial fishing of scallops

## Coastal industries

Industries may locate themselves near the coast for ease of access to transport, for easy discharge and disposal of waste or because – as is the case with shipbuilding and ports – they are necessarily associated with the sea and the coast.

Ports and waterfronts are obviously an important link in import and export transportation. Ports have extensive storage facilities, and their location and contents often cause community concern. Most of Australia's reserves of oil and gas are offshore. Bass Strait and Western Australia's North-West Shelf are the most significant. The offshore engineering industry that supports petroleum production is economically significant. Pressures on the coast resulting from coastal industries include:

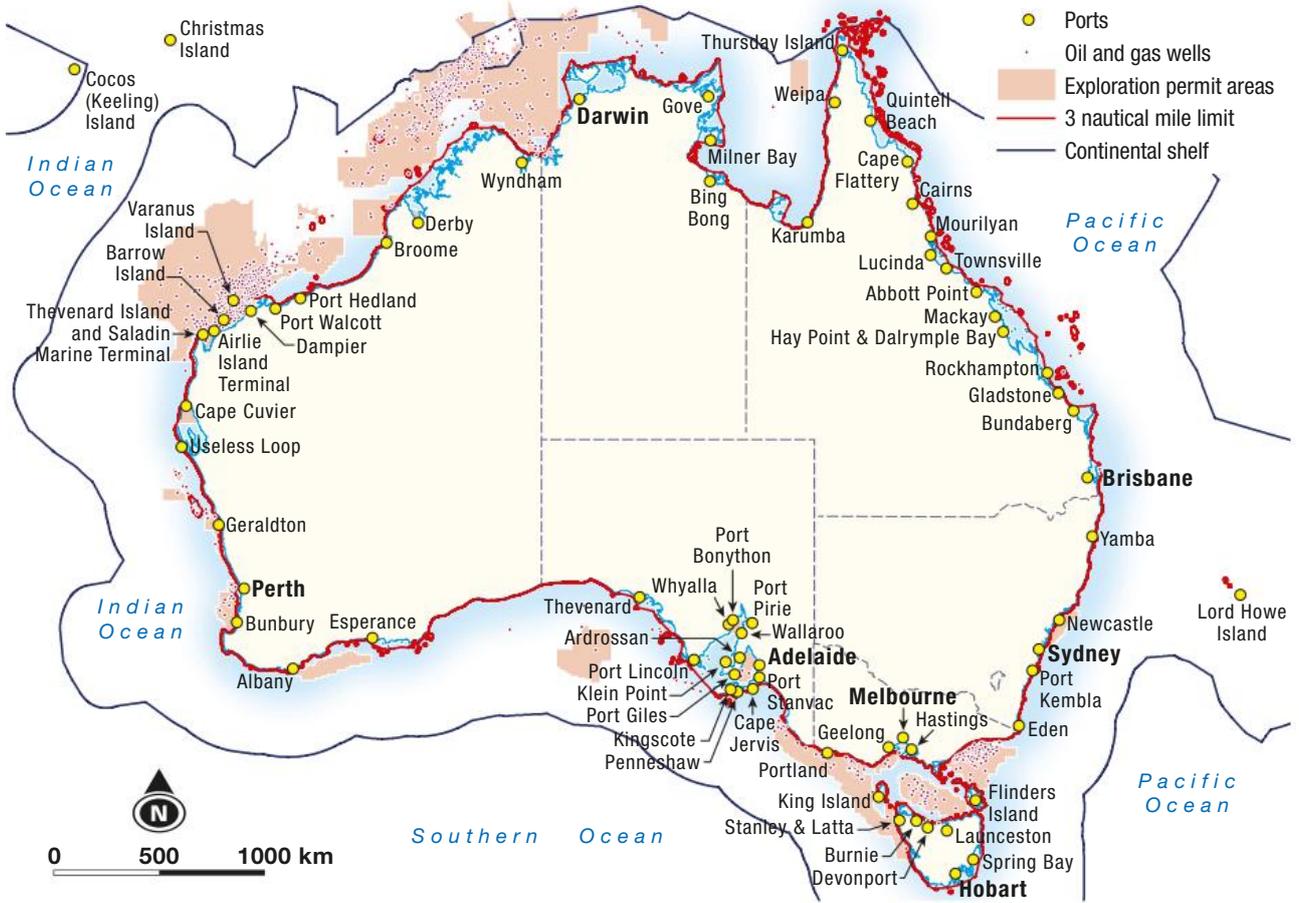
- land clearing, seabed reclamation and vegetation loss during construction and expansion of industry
- loss of sand to mining
- discharges of various substances, the worst of them including lead, copper, cadmium, mercury and zinc from industrial sources
- **ballast water** introducing foreign species such as Northern Pacific starfish, and **exotic** and toxic algae
- oil spills – the greatest threats from spills are during transportation from remote areas; in tropical areas, fields like Jabiru and the North-West Shelf are also vulnerable to cyclones, making accidents more likely
- visual effects.

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**ballast water** water held in tanks and cargo holds of ships to increase stability and manoeuvrability while under way

**exotic** not native to an area, usually introduced from another ecosystem or country

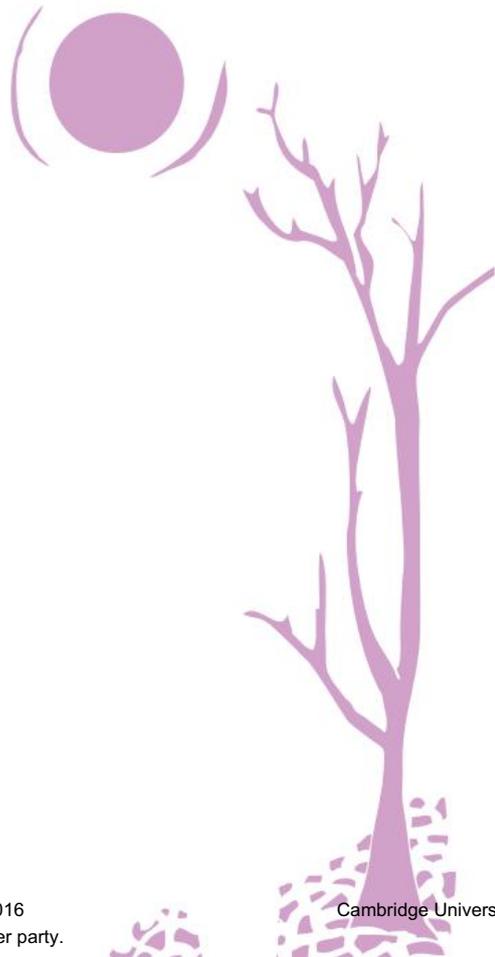
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Source 3.10 Locations of oil, gas and ports in Australia

### Activity 3.2

- 1 Choose one of the coastal uses discussed previously: building and development; recreation and tourism; aquaculture; agriculture; commercial fishing; or coastal industries.
- 2 Explain a range of benefits created by the use, and also the environmental pressures created by that use.
- 3 Present your findings as a poster with photographs and diagrams.



### 3.3 Examining landscape degradation

One of the most famous national landscapes is the Great Barrier Reef. It is home to a rich

#### spatial distribution

the location and arrangement of particular phenomena or activities across the surface of the Earth

#### land degradation

degradation of the health of land resources through human actions in ways that threaten their ability to maintain their environmental functions e.g. salinity, accelerated soil erosion, loss of biodiversity and habitats

ecosystem of different species of marine life and can even be seen from the moon. The Great Barrier Reef is protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

#### Spatial distribution

**Spatial distribution** is an important factor when examining any form of **land degradation**. The Great Barrier

Reef, the largest coral reef system in the world, is made up of 2900 coral reefs, over 900 islands and 300 coral **cays**.

These qualities make the North Queensland location a popular spot for coastal industries, tourism and recreational activities.

#### *Causes and impact of degradation*

The high level of human involvement in the Great Barrier Reef has had an increasingly negative impact on it, to the extent where the whole reef is now threatened. The corals and surrounding biodiversity are greatly affected by the pressure of human activity. One-fifth of the reefs have been destroyed and are showing no signs of recovery; a quarter are endangered; and another quarter of the reefs are facing the possibility of collapsing.

**cay** a small, low island on a coral reef formed of sand and/or coral pieces

**Source 3.11** Scuba diving amongst the coral reefs of the Great Barrier Reef holds negative consequences for the area.





**Source 3.12** Tourism remains an important part of the preservation and maintenance of the Great Barrier Reef.

Cause	Impact
Human activity and tourism	<ul style="list-style-type: none"> <li>• Tourist boats dropping fuel into the ocean are a major cause of pollution.</li> <li>• Scuba diving, walking along the reefs and even swimming in large groups negatively impacts the resilience of the area.</li> </ul>
Mining and farming	<ul style="list-style-type: none"> <li>• The run-off pollution from mining and farming is getting into rivers that lead into the ocean.</li> <li>• This run-off damages ecosystems and causes massive amounts of algae growth, making it hard for the coral reefs to survive.</li> </ul>
Rapid industry development	<ul style="list-style-type: none"> <li>• There has been an increase in shipping along the coast and on the islands next to the Great Barrier Reef.</li> <li>• Rapidly developing industries and major projects resulted in the dredging and dumping of 45 million tonnes of seabed and rock.</li> </ul>
Overfishing	<ul style="list-style-type: none"> <li>• Overfishing is a serious problem. Fishing affects target species, non-target species and their habitats. It can cause ecological impacts on both the fished areas and the reef system as a whole.</li> <li>• Fishing is banned in various parts of the Great Barrier Reef but illegal fishing still occurs and it is difficult to stop it completely.</li> </ul>

**Source 3.13** Causes and impacts of degradation on the Great Barrier Reef

### Activity 3.3

- 1 Explain why tourism continues on the Great Barrier Reef, even though it has negative effects on the landscape.
- 2 Suggest why it is so difficult to stop overfishing completely.
- 3 Work with a partner to add to the list of causes and impacts relating to the Great Barrier Reef.

## Fieldwork 3.1 Healthy environments

### Aim

To gain an understanding of the environments in your area. You will also analyse the role of the environment and describe the effects of human activity on the landscape.

### Method

Select an area nearby – this may be a national park, reserve, lake or coastal area. Visit the area.

Bring your camera phones or cameras.

### Preparation

Find a map of the selected area, and indicate the sections that will be visited and studied. You will also need to take a camera, the list of questions based on the ‘data collection’ section below, paper (on a clipboard) and pen.

### Data collection

Take photos of plants, animals or scenes that you think are interesting, striking or beautiful in some way. Select three of your favourite photos. Use these images and your notes to research answers to the following questions about the plant, animal or scene.

- 1 List the specific names of the area/objects/animals in your photographs.
- 2 Explain what role this environment plays. Consider the traditional owners, the surroundings and the ecosystem. Is the area used for recreation, industry or spiritual purposes?
- 3 To what extent does the location influence the types of activities that occur there?
- 4 Describe the positive and negative, and short-term and long-term, impacts of these activities on the area.
- 5 Analyse how healthy the area was at the time you visited.
- 6 Discuss what you or others could do to help sustain this environment and its inhabitants.

**Fieldwork presentation layout**

Front page	Title and name
Contents page	Do this last, as well as numbering pages
Page 1	Aims and methods
Page 2	Location map
Page 3	Introduction – brief description of the study sites
Pages 4–5	Description of uses and photos including the specific names of the items in your photographs
Page 6	Explanations of the role this environment plays in your local area
Page 7	Table of usage: Effects of use (positive or negative, short-term or long-term)
Pages 7–8	Description of effects of use, sketches and/or photos
Page 9	Association between use and effects of use
Page 10	Analysis of the health of the landscape
Page 11	Suggestions of sustainable strategies
Page 12	Conclusion summarising what you learnt about the area in this fieldwork activity
Page 13	Appendix, bibliography, glossary





## Chapter summary

- Indigenous societies traditionally understand the environment as a cultural landscape or 'country', to which nature and culture are integral; they care for country accordingly.
- Modern lifestyles place many pressures on the environment, which can reduce its health and its capacity to support us.
- Over 80% of the population of Australia lives in coastal areas. This has caused a number of environmental challenges in these areas.
- Human activities that impact our landscape include aquaculture, agriculture and commercial fishing.
- The Great Barrier Reef is experiencing degradation due to human activities including tourism, coastal and recreational activities.

## End-of-chapter questions

### Short answer

- 1 Do changes to the land always result in land degradation? Discuss why or why not.
- 2 Suggest two human activities that impact landscape.
- 3 Reflect on the pressures that humans currently place on our coasts.

### Extended response

Explain different methods to minimise human impacts on our landscape. Determine which would be the most effective and why.

# 4

## Landscape management and protection

**Source 4.1** A freshwater spring, Berry Springs, Darwin, Australia

### Before you start

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#### Main focus

It is important for the future of landscapes that we sustain biodiversity in order to meet the needs of humanity. There are different views about the value and protection of environments, including those of Aboriginal and Torres Strait Islander peoples.

#### Why it's relevant to us

Modern lifestyles place many pressures on our landscapes, which can reduce their integrity and their capacity to support human society. We need to find ways of being that will support and promote sustainability.

#### Inquiry questions

- What are the different views about the value and protection of particular landscapes?
- What is being done to protect significant landscapes?
- What is the contribution of Aboriginal and Torres Strait Islander peoples' knowledge to the use and management of landforms and landscapes?

### Key terms

- burning
- conservation covenant
- ecological
- endemic
- freehold
- self-determination
- stewardship
- subsistence
- swale country
- totem

### Let's begin

---

Landscapes have changed dramatically over the course of history as a result of climate change and human activity. Aboriginal and Torres Strait Islander peoples learned to adapt to these changes, and also created some changes themselves. Since European settlement, however, human pressures and now climate change have become more intense. Our insights can help us achieve more sustainable lifestyles, and these can help to protect cultural landscapes and society.

## 4.1 Landscape protection across different scales

Landscapes can be protected at a variety of levels. The highest level of protection is World Heritage listing.

### Locally protected places

Local governments, such as councils, work with their state and territory governments to

**conservation covenant** a promise contained in a deed (like a contract) which is binding upon the current owner and all future owners. It defines the limitations, conditions or restrictions on the use of that land.

ensure that the environment remains protected, and that any development follows the guidelines in their area.

If land is privately owned, an owner may enter a **conservation covenant** with the government. A conservation covenant is a voluntary

agreement that the land owner or landholder makes with the aim of protecting the landscape, or an area of cultural significance.



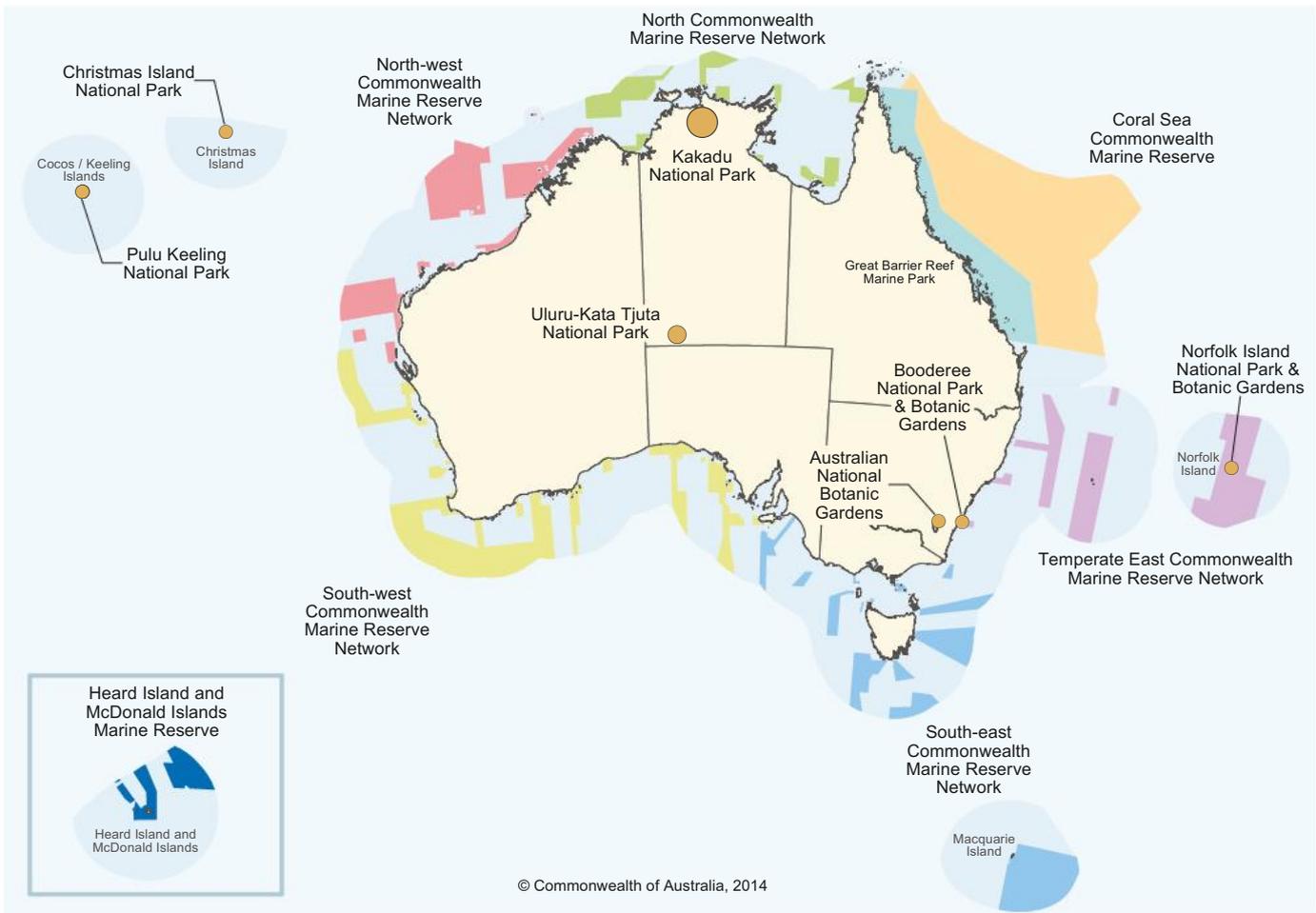
**Source 4.2** An example of a privately owned conservation reserve is Boolcoomatta, a former sheep station and now a privately owned conservation area of 63 000 hectares. Bearded dragons are one of the species now thriving in Boolcoomatta.

### National parks

In Australia, the management of national parks and reserves tends to fall on the state and territory governments. However, there are a select number of reserves managed by the



**Source 4.3** The Great Barrier Reef in Queensland, the Kakadu National Park in the Northern Territory and the iconic Uluru–Kata Tjuta National Park in central Australia are managed by the federal government.



Source 4.4 Australian national parks and reserves

federal government including six national parks, two botanic gardens, and 27 marine protected areas. The areas managed by the federal government tend to be of significant heritage to Australia as well as to the Aboriginal and Torres Strait Islander community.

### Conservation zones

Conservation zones are an important part of protecting our landscape and biodiversity.

Australia is home to approximately 700 000 species, many of which are **endemic**, such as the kangaroo and koala. In fact 84% of our plant species are endemic as are 83% of mammals and 45% of our birds.

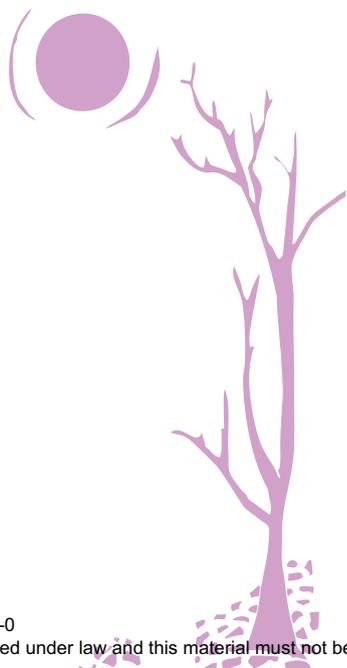
**endemic** native to a country, not found anywhere else in the world

Conservation zones allow our flora and fauna to be protected, for example in marine reserves in which people are not allowed to fish. In New South Wales, over 6.7 million hectares are conservation zones.





**Source 4.5** Barrenjoey Head, north of Sydney, is an aquatic reserve.



## World Heritage listing

Places or environments considered to be unique or special can be either natural or cultural (human-made). Countries can apply to UNESCO to have these places listed and protected for future generations. Australia has 19 World Heritage sites, of which three are listed for their cultural values: the Sydney Opera House, the Royal Exhibition Building in Melbourne and Australian convict sites throughout the country.

Properties inscribed on the World Heritage List (19)		
Natural	Cultural	Mixed
Australian Fossil Mammal Sites (Riversleigh/Naracoorte) (1994)	Australian Convict Sites (2010)	Kakadu National Park (1981)
Fraser Island (1992)	Royal Exhibition Building and Carlton Gardens (2004)	Tasmanian Wilderness (1982)
Gondwana Rainforests of Australia (1986)	Sydney Opera House (2007)	Uluru–Kata Tjuta National Park (1987)
Great Barrier Reef (1981)		Willandra Lakes Region (1981)
Greater Blue Mountains Area (2000)		
Heard and McDonald Islands (1997)		
Lord Howe Island Group (1982)		
Macquarie Island (1997)		
Ningaloo Coast (2011)		
Purnululu National Park (2003)		
Shark Bay, Western Australia (1991)		
Wet Tropics of Queensland (1988)		

**Source 4.6** Australia's World Heritage listed sites

## RESEARCH 4.1

Look at the list of World Heritage sites online and choose *one* site that interests you. Investigate the site and write a report. Your report must include each of the following:

- 1 What is UNESCO and what does it do?
  - 2 Location
    - Where is your chosen site? Include a map.
  - 3 A brief history of the site.
    - Describe the site too.
  - 4 Why is the site important today?
  - 5 How is the site being managed today?
    - How is it looked after?
    - Who looks after it?
  - 6 Are there any problems in the area?
    - Are people damaging it in any way?
    - Is pollution affecting it?
  - 7 Recommendations
    - Recommend appropriate management strategies.
  - 8 Other interesting information
    - A picture with an annotated photo sketch
  - 9 Bibliography
    - Where did you get your information from?
    - e.g. internet, names and authors of books, encyclopaedias, etc.
- Features of a good report:
- headings
  - introduction
  - formal writing and factual information
  - clear but detailed information (you can use adjectives)
  - recommendations based on information presented
  - graphics, tables, maps etc.
  - present tense
  - specific technical terms

## 4.2 Examining the management and protection strategies for a landscape

The impacts of humans on the coast are many and varied. Below is a situation of coastal conflict, which – although hypothetical – is

common in many places along the Australian coast. This hypothetical region is called Paradise Coast.

### Case study 4.1

#### Paradise Coast: developing a proposal for a landscape threatened by humans

##### Coastal conflict

Typically, the coast of Australia attracts a range of residents and visitors. Over the past 20 years, urban development has increased at a rapid rate. Paradise Coast is no different.

Because of its many values, the coast has attracted diverse groups such as ‘sea changers’, retirees, scientists, people who

fish, surfers, tourists, tourism operators, land developers, food and drink manufacturers, shop owners and many other businesses.

Aboriginal and Torres Strait Islander peoples have also valued the area for thousands of years for its rich food sources and liveable land conditions. There are several significant historical sites on its dunes and around its estuary.



**Source 4.7** The hypothetical Paradise Coast is home to a popular swimming beach close to town.



Paradise Coast is an extremely sought-after area, as the versatility of the land makes it a prime location for development. Additionally, the area includes an estuary that is bordered on either side by land owned by two local governments. Consequently, land use debates have divided the region as there is disagreement as to whether the seashore, dunes and estuary should be protected or if the area should be used for development. This divide is particularly evident between people who are new to the area and therefore more in favour of development and older residents, who have fond memories of moving to the coast and are sentimental about its quiet, untouched qualities.

The coast has been eroding for a long time. However, erosion of beaches and sand dunes is now advancing. Each winter, erosion eats further into the dunes, where the national park and housing developments are located. With climate change, these impacts will be made worse by:

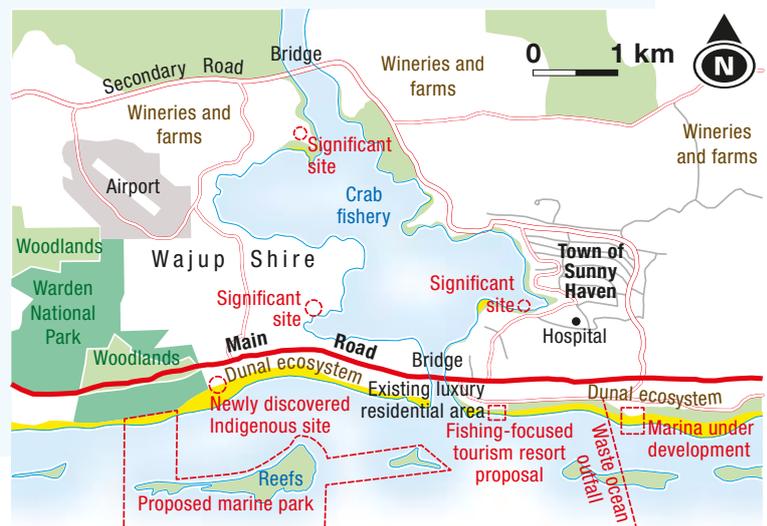
- changing patterns of longshore and onshore sand movement
- a rise in catchment flooding due to heavy rainfall
- a rise in sea levels causing erosion to occur more rapidly

- changes in sea currents and temperatures with unpredictable effects on fish stocks as well as marine ecology
- a greater frequency of coastal inundation caused by storm surges.

Impacts of these changes will include the loss of many amenities: houses, coastal ecosystems, beaches, beach quality and recreational facilities, infrastructure and economic value.

High demand for development in the tourism and residential industries is putting the two local governments under pressure to both ensure the protection of sensitive land and ecosystems and approve applications and plans for the development of properties and infrastructure.

Source 4.8 Map of Paradise Coast



This has become a problem with a number of controversial new developments in place and others being proposed vigorously by real estate and tourist developers:

- Currently under construction is a large marina, which includes both canal and island developments. The project plans to build boardwalk retail developments, approximately 1000 dwellings and hotels and will develop seawalls and beaches. During its construction the project would provide approximately 1000 jobs, as well as employment for 500 people

once it is up and running. The developer has supplied scientific evidence that the marina will create minimal impact on the coast, but this has been disputed by NGO groups, which have scientific evidence to show that there will be serious

---

**ecological** the relationship between living organisms and their environment

---

**ecological**, social and cultural implications.

- There is already a luxury residential development situated on the main dune system. This development would have access to the facilities of the marina.



**Source 4.9** A tourist resort could have ecological implications.

- A recently opened tourist resort hopes to concentrate its operations on recreational fishing that includes onshore angling and offshore big game. The owner of the resort requires support from both the state government and local council in order to expand their fishing amenities, fish cleaning areas, jetties and seating areas.
- A marine area that is home to several threatened species has become the focus of a local conservation group's campaign to ensure marine areas are protected. This group has gained the support of both national and international NGOs; however, commercial fishing organisations have questioned the validity of the science produced by these NGOs. The fishing companies have also claimed that this particular area is not unique as the NGOs claim.
- Wastewater is currently being discharged through an ocean outfall rather than being

**swale** low-lying land between two sand dunes

deposited in the **swales** in between sand dunes as occurred previously. Due to changes in the formations of beaches as well as ocean currents, storms are now resulting in some sewage washing back towards the beach.

- One result of erosion in the sand dunes is that an Aboriginal and Torres Strait Islander people's burial site located in the face of the dune has become exposed, along with several artefacts and tools. The significance of this discovery is that it provides evidence that Aboriginal and Torres Strait Islander people

had been present in this location for far longer than originally thought.

### Coastal sustainability and adaptation principles

Below are some principles for coastal sustainability and adaptation to climate change impacts to guide your proposal to resolve the conflict at Paradise Coast.

- 1 Think long term about strategy and resilience. A long-term plan is needed to cope with a retreating coastline. Climate change projections predict that rising sea levels will continue for a number of millennia beyond the year 2100. The world may be a drastically different place at this time, economically, socially and politically. Therefore a long-term plan must be able to incorporate new information as it is discovered and needs to include the coastal adaptation ladder (provided below).
- 2 Use the 'coastal adaptation ladder'. The coastal adaptation ladder suggests actions that can be taken. In order from highest to lowest priority:
  - a New development should be moved away from the coastline. By allowing considerable room (containing open public space or native vegetation) between the ocean and new developments, the creation of problems in the future can be avoided.
  - b Coastlines often contain their own natural buffer systems, for example wetlands or



**Source 4.10** Sand dunes provide natural buffers that can slow erosion.

dunes, which need to be both protected and enhanced. A benefit of having these natural buffer systems is that they can slow the effects of erosion. Buffers should be sustained by preventing developments that may destroy habitats and they can be enhanced by the planting of native vegetation.

- c** Roll back existing development. Move existing coastal development to safer areas, or plan for their complete removal. This process will need careful planning, and close community and stakeholder engagement. Specific local strategies will need to be developed.
- d** Developments need to be built with the possibility of sea level rise or floods in mind. If a development, for instance parkland or a sports and recreation facility, is resilient to the damage caused by flooding or inundation it may be permitted to remain in a transition zone for longer. Either the initial design of a development or retrofitting it with features can help to make it less susceptible to inundation or floods.
- e** Assets of great value should be protected through the implementation of coastal engineering structures. While this option appeals to stakeholders it can

have the downside of transferring the risk along the coastline, creating conflicts surrounding prioritisation, increasing the future maintenance liability, causing a loss of beach, incurring the expenses of construction and creating false perceptions of the actual risk reduction viable in the long term.

- 3 The sustainability of a coastline can be achieved through the positive interactions between the social, cultural, ecological and economic aspects of the lives of coastal dwellers. Keeping in mind the impacts of climate, consider the four aspects to coastal adaptation and sustainability.
  - a Culture. This aspect involves how we understand our heritage and our lifestyle and how we share meaning. It can include galleries, museums, music venues or Aboriginal and Torres Strait Islander sites.
  - b Social. This aspect involves the way in which people organise themselves in order to meet their needs. It can include clubs, schools, cafes, libraries, police stations and hospitals.
  - c Economic. This aspect involves both the resources we require to fulfil our wants and needs and the livelihoods we earn to finance this. It can include airports, energy, shops, waste-disposal infrastructure, farms, tourist sites, factories, water and mines.
  - d Ecological. This aspect involves the natural world we live in. It can include bushland, ocean and estuaries as well as processes such as the nutrient cycle or water cycle.
- 4 Engage the whole community to develop learning, literacy and capacity. Sustainability and climate change affect whole communities, and the costs of adaptation may affect whole states and countries. Discussions among society, Aboriginal and Torres Strait Islander people, government and scientists will help to establish learning and literacy about sustainability and coastal adaptation.
- 5 Aboriginal and Torres Strait Islander stories about the land need to be heard. These cultural stories passed down through generations of Aboriginal and Torres Strait Islander people can tell us about the last ice age – for instance, that today's seabeds were once coastal plains that were submerged when the ice melted. These stories can inform us of how the coastline has changed over the centuries and also heighten our awareness to the existence of societies that had to deal with coastal adaptation. Aboriginal and Torres Strait Islander stories can provide an important source for learning as they detail first-hand experience of achieving sustainability despite dramatic change in the coastal climate.

### Activity 4.1

The Commonwealth, state and local governments have decided to appoint a broad-based taskforce on coastal sustainability for the Paradise Coast region. As a member of this taskforce, your role is to create a brief, proposing a strategy to resolve the conflict at Paradise Coast. Your proposal needs to consider as wide a range of community interests as possible, and to think in the short and long term. Within your brief, address the following questions:

- 1 Identify and list the main stakeholders.
- 2 Summarise their values and views.
- 3 Investigate the region's assets and opportunities for sustainability.
- 4 Analyse the threats to sustainability in the region.
- 5 For each of the principles in the list above, develop one or more specific goals and actions that could help create a sustainable future for Paradise Coast.

## 4.3 Aboriginal and Torres Strait Islander peoples' use and management of landscapes

Aboriginal and Torres Strait Islanders have experienced and managed land in very different ways from non-Indigenous

Australians. Cultural practices vary, so there is no single Aboriginal and Torres Strait Islander perspective on the land. However, there are some common features in how Aboriginal and Torres Strait Islanders view landscape:

- Landscapes and culture are inseparable; the term **Country** or **Place** expresses this idea of a fully cultural landscape.
- Land, sea, waterways and sky are interconnected.

- Cultural stories describe features of country, and some place names and sacred sites reflect these stories.
- Community identity is closely related to country.
- Communities use resources for **subsistence**, culture and exchange. Communities traditionally managed their estates through cultural ceremonies such as song and dance, and many do so to this day. They restricted access to the landscapes according to season, **totem** and presence of sacred sites. Dreaming stories also affect management practices. For instance, Nyungars in the south-west of Western

**subsistence** collection or production of food for oneself and one's family, but not for sale

**totem** an object representing an animal or plant that is of special significance to a particular group or family

**Country/Place** country is a space mapped out by physical or intangible boundaries that individuals or groups of Indigenous peoples occupy and regard as their own. It is a space with varying degrees of spirituality. Place is a space mapped out by physical or intangible boundaries that individuals or groups of Aboriginal and Torres Strait Islander peoples occupy and regard as their own. It is a space with varying degrees of spirituality.



**Source 4.11** Aboriginal and Torres Strait Islander peoples are deeply connected to their land; landscapes and culture are inseparable.

Australia do not return beached whales back to the ocean, as they are regarded as vessels bringing human spirits ashore.

Aboriginal and Torres Strait Islander peoples of various cultures farmed or managed ecosystems to various extents. Aboriginal peoples of Australia and the Australian

landscape evolved together as a result of management practices such as **burning**.

In some cases, burning was done on a large scale; in other cases, a 'mosaic' landscape

of small patches was produced through strategic small-scale burning. Burning off is traditionally done by people who have a detailed knowledge of the country, of where and how to light fires, and of the likely movement of the winds. It is a very specialist skill that has been used for many generations. The act of burning managed landscapes benefited travel, hunting, communication and horticulture. It also resulted in the development of a unique growth process of vegetation that provided food and habitats to people and animals.

**burning** ritual practice of setting fire to areas of bushland for environmental purposes and to attract wildlife to the new growth



**Source 4.12** Traditional burning in central Australia



## Activity 4.2

- 1 Describe how Aboriginal and Torres Strait Islanders traditionally managed their land.
- 2 Explain what Aboriginal and Torres Strait Islander peoples mean by the term 'Country' or 'Place'.

## Geographical fact

In the north-west of Australia, the Martu people burn spinifex to reveal the hiding places of their food – for example, goanna burrows. It is easier to spot burrows and tracks in burnt country than in thick spinifex. Burning off spinifex and other grasses also encourages the growth of a wide range of plants and the animals that rely on those plants. The Martu burn country in patches of about 22 hectares to create a pattern of recently burnt earth and growing vegetation. These patches are small in comparison to those left by lightning wildfires.

Current land use by Aboriginal groups in Australia varies. Many believe that **self-determination** and secure title (whether **freehold** or native) over land is an important aspect of their cultural sustainability. Current uses of Aboriginal land include tourism, foraging and hunting, herding of animals, horticulture, national parks (with various degrees of joint control) and residential land.

**self-determination**  
freedom to live as one chooses

**freehold** a form of land ownership, which is inherited or held for life

Positive partnership projects for land management are also emerging. One project is operated by the North Australian Indigenous Land and Sea Management Alliance (NAISMA). The partnership aims to have traditional owners across the top of Australia manage the northern marine turtle and dugong populations, including hunting them for subsistence purposes. The project has been a success; however, there have been public concerns about the traditional Aboriginal and Torres Strait Islander peoples' management of animals that includes the hunting of species that are unusual or symbolic. On the other hand, it is worth acknowledging that it was not traditional Aboriginal and Torres Strait Islander peoples' practices that endangered these

marine species in the first place and, overall, Indigenous coastal **stewardship** is more likely to be sustainable than endanger such species.

**stewardship**  
responsible planning and management of resources

### Protecting landforms of significance to Aboriginal and Torres Strait Islander peoples

Along the coast of Perth in Western Australia is Derbal Nara, the Nyungar people's name for the area of Cockburn Sound. 'Derbal Nara' means 'estuary of salmon'. It includes the

water of Derbal Nara, the islands of Derbal Nara Wadjemup (Rottneest), Ngooloomayup (Carnac) and Meeandip (Garden) Islands, the dunes and coastal plains, and the freshwater lakes and waterways.



**Source 4.13** Map showing Nyungar names for key places within Whadjuk country in Western Australia (after Neville Green)

Nyungar oral histories tell of how these islands were linked to the mainland during the last ice age, when sea levels were much lower:

My grandmother used to live along the river right down there and she reckon they [ancients] used to walk right out to Rottneest Island; that it was all sandbanks way back. And they used to walk across there and because Rottneest Island is a hill and it stood out.

Traditional owner and Nyungar Elder Dorothy Winmar narrates one story that was told to her:

Accounts like this show that Aboriginal stories are still relevant to today's communities. By understanding and protecting landforms of significance to Aboriginal people, we preserve the whole cultural significance and history of an area. We can understand the connection between country, Dreaming story and place names as a holistic cultural account.



**Source 4.14** Nyungar oral histories tell how islands, such as Rottnest Island, used to be connected to the mainland.



## Chapter summary

- It is important to protect landscapes, particularly to preserve biodiversity, which supports the necessities of life.
- Landscapes can be protected at a variety of different levels such as World Heritage listing, national heritage, local governments and private landowners.
- Aboriginal and Torres Strait Islander peoples' use and management of land are different from that of non-Indigenous peoples. Landscapes and culture are intertwined and inseparable.
- Aboriginal and Torres Strait Islander peoples manage the landscape by restricting access to land according to season, presence of sacred sites, and using management practices such as burning.

## End-of-chapter questions

### Short answer

- 1 List the five most important reasons why landscapes need protection.
- 2 Explain why long-term planning is needed for protecting landscapes.
- 3 How was the Aboriginal and Torres Strait Islander peoples' practice of burning useful to them?

### Extended response

The federal government and traditional Indigenous landowners manage the Kakadu National Park. Compare and contrast the different values the Australian government and Aboriginal and Torres Strait Islander people may hold about Kakadu, and how these values shape their use and management of the national park and its landscapes.



# Investigating a contemporary geomorphic hazard

**Source 5.1** After the 2011 earthquake and tsunami in Japan, the radiation at the Fukushima nuclear power plant was eight times its normal level.

## Before you start

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### Main focus

Most of the world's population live in an area where one or more types of natural hazards are likely to occur. Geomorphic hazards are those that are caused by forces and processes in the earth's crust. People learn to live with these geomorphic hazards.

### Why it's relevant to us

We need to be able to identify the hazards likely to affect where we live, work and holiday, and know how to react if a hazard turns into a disaster.

### Inquiry questions

- What are geomorphic hazards?
- What are the natural causes of geomorphic hazards?
- To what extent have human alterations to the environment contributed to the occurrences of geomorphic hazards?
- How should people prepare for a particular hazard?

## Key terms

- Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys
- disaster
- earthquake
- Geographical Information Systems (GIS)
- geomorphology
- natural hazard
- Richter scale
- seismometer
- subduction collision
- tectonic plates
- tsunami

## Let's begin

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The earthquake off the coast of Japan on 11 March 2011 was one of the biggest recorded, measuring 9 on the Richter scale. The earthquake resulted in a devastating tsunami, which caused most of the destruction to the country. It ravaged the northeast of Japan, resulting in many people dead or missing, and many others had to be evacuated. Furthermore, various power generators failed. The Fukushima nuclear power plant experienced explosions and radioactive leaks.

## 5.1 Spatial distribution of the disaster

**geomorphology** the study of landscapes and landforms, and the processes that have made them the way they are

**geomorphic hazard** hazard events originating in the lithosphere e.g. volcanic eruptions, earthquakes, tsunamis and mass movement (landslides or avalanches)

**natural hazard** when the forces of nature combine to become destructive and have potential to damage the environment and endanger communities e.g. bushfires, tropical cyclones, floods, earthquakes

**Geomorphology** refers to the study of landscapes and the processes that have made them the way they are. A **geomorphic hazard** is a danger that occurs as a result of changes to a landform, affecting the stability of the site and resulting in devastating effects on the area and those living there. Geomorphic hazards are common around the world, due to natural causes and even human alteration of environments. These **natural hazards** include earthquakes, tsunamis, volcanic eruptions, landslides and avalanches.

### Japan 2011: earthquake and tsunami

At precisely 2.46 p.m. on Friday 11 March 2011, an **earthquake** began at sea 72 km east of Tohoku (in Japan) and 32 km below the surface. The Pacific plate moves beneath the Eurasian plate and at times they can stick or collide, causing earthquakes. This is a **subduction collision**. The Tohoku earthquake (as it became known) measured a magnitude of 9.0 on the **Richter scale**, making it the fourth-largest earthquake ever recorded.

**earthquake** the result of the Earth's tectonic plates moving against each other

**subduction collision** where one plate sinks down beneath another plate

**Richter scale** developed by Charles Richter and Beno Gutenberg to measure the severity of earthquakes. The scale was based on a logarithmic progression so that an earthquake of magnitude 5 was 10 times stronger than a quake of magnitude 4



**Source 5.2** On 11 March 2011, Japan experienced a 9.0 magnitude earthquake out at sea, causing a tsunami.

### Geographical fact

More than 1000 aftershocks have occurred since the day of the Tohoku earthquake.

earthquake; many of the waves were 9 metres high and the highest was recorded at 40.5 metres, which hit Miyako outside Tohoku.

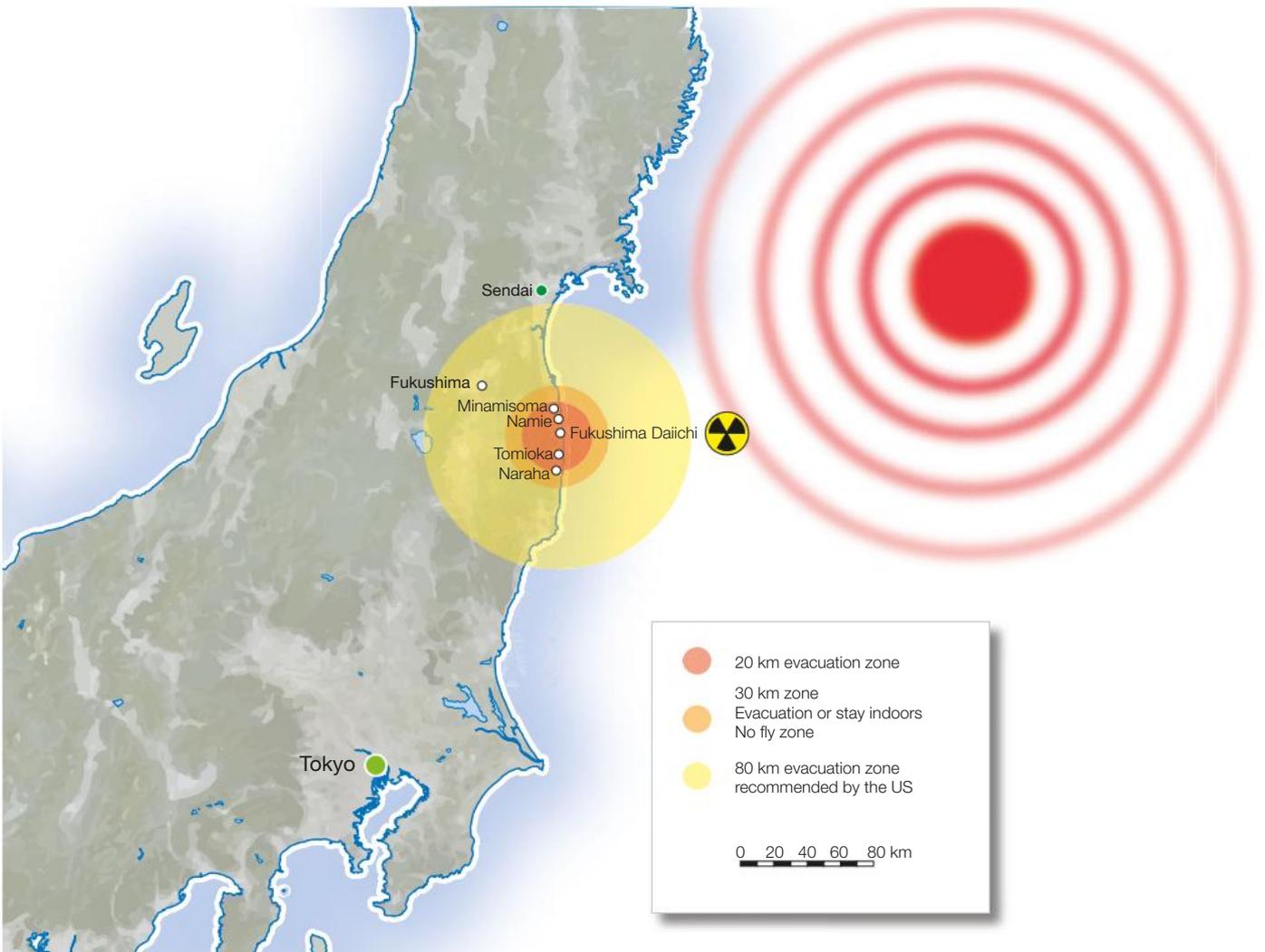
The following day, aftershocks from the earthquake continued, measuring around 6.2 on the Richter scale.

**tsunami** a series of ocean or lake waves with enormous destructive potential, usually created by an undersea earthquake

The Tohoku earthquake then set off a series of powerful **tsunami** waves. The Pacific Tsunami Warning Centre issued a warning for the Pacific Ocean. The tsunamis hit Japan less than an hour after the

### Geographical fact

The earthquake moved the main island of Japan (Honshu) eastward 2.4 metres and 400 km of its coastline dropped by 0.6 metres.



**Source 5.3** Map showing the epicentre of the Tohoku earthquake and the location of the Fukushima nuclear power plant



### Activity 5.1

- 1 Create a timeline of events for the Tohoku earthquake.
- 2 What caused the Tohoku earthquake?

## 5.2 Geomorphic processes causing the disaster and its impacts

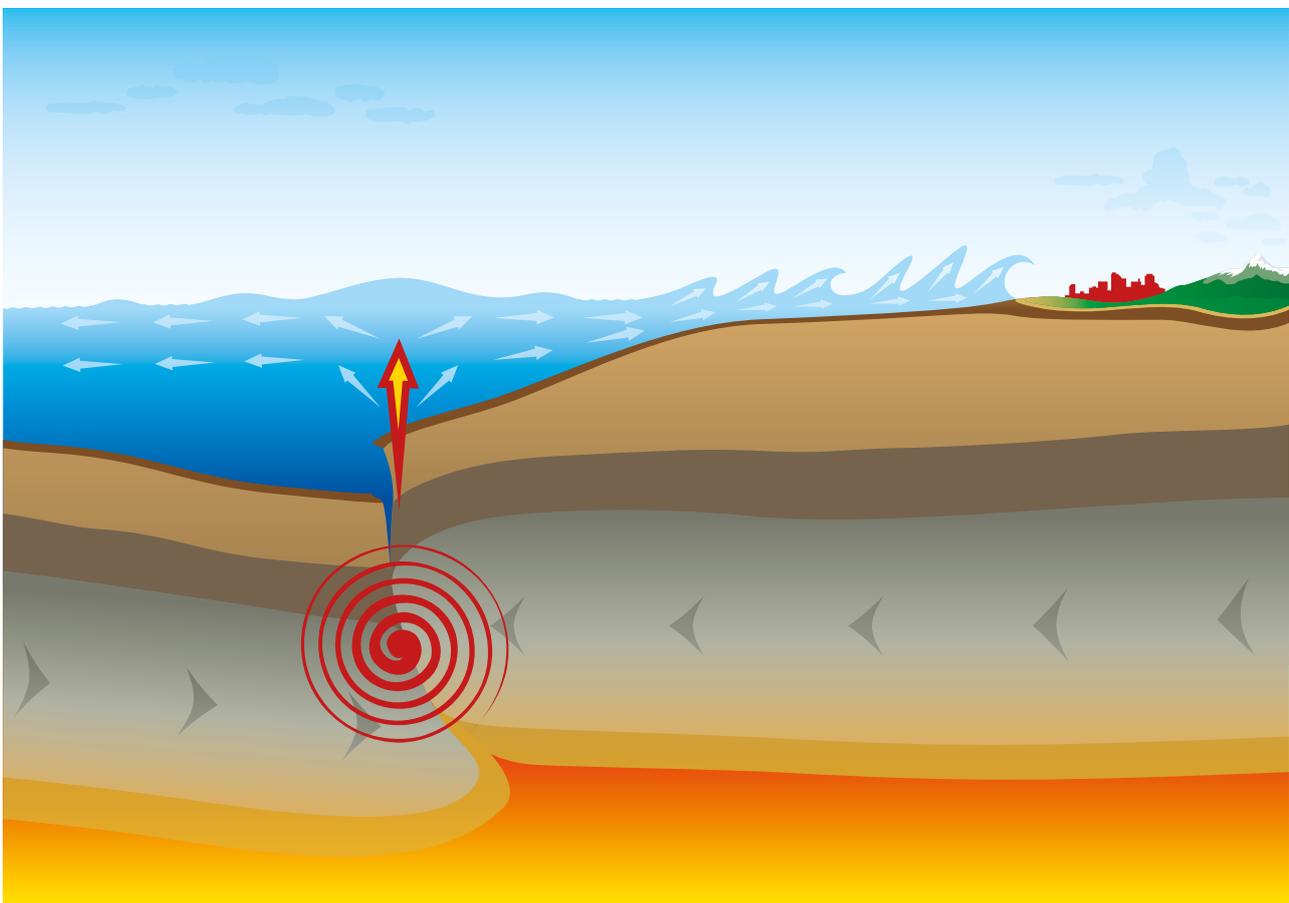
**disaster** when a hazard results in extensive damage to people, places and environments

There were two hazards at work during the 2011 **disaster** in Japan: the Tohoku earthquake and the resulting tsunami.

## Earthquakes

The outer layer of the Earth is broken up into **tectonic plates**. When these plates move in a way that is stressful to the Earth's layers, rocks are broken and move, resulting in an earthquake. Earthquakes commonly occur on the boundaries of the plates: one plate will be forced under another,

**tectonic plates** layers of the Earth's crust that move and float



**Source 5.4** The movement of an underwater earthquake can trigger a tsunami.

causing the geomorphic hazard. Plates may move away from each other, causing the land to subside between the two plates. Plates can also grind past each other, causing major damage when movement occurs.

### Geographical fact

Over one million minor earthquakes of 2.0–3.0 magnitude occur every year around the world. About 100–150 strong earthquakes (6.0–6.9) and 10–20 major earthquakes (7.0–7.9) occur every year. Earthquakes greater than 8.0 magnitude tend to only occur once or less per year around the world.

### Tsunamis

Tsunamis are very destructive. Unlike regular sea waves, tsunamis have an extremely long wavelength. Generally, tsunamis resemble a rising tide and consist of a series of wave periods. Tsunamis are a result of the displacement of a large volume of water, usually caused by earthquakes, volcanic eruptions or landslides. The smashing force of the walls of water has a destructive effect on both the land and infrastructure. After the waves have covered the land, the area is flooded and the water begins to drain back out, carrying debris and people with it.

**Source 5.5** Debris from earthquake and tsunami in Japan, 2011



## Geographical fact

Not all tsunamis are caused by earthquakes. In 563 AD, a tsunami wave between 3 and 8 metres high inundated the shores of Lake Geneva, Switzerland. Triggered by a massive rock fall, the tsunami pushed river sediments into the lake, resulting in a sudden rise in lake levels, flooding and loss of life. Currently, at least 1 million people live within the area flooded by the 563 AD tsunami.

## Activity 5.2

- 1 Recall how and where earthquakes commonly occur in relation to tectonic plates.
- 2 Suggest some reasons why plate movements can cause major damage.
- 3 Compare and contrast tsunamis and regular sea waves.
- 4 Describe the potential after-effects from waves covering land.

## Impact of the Tohoku earthquake and tsunami

The official death toll for the natural disaster was almost 16 000 people, and the cost to Japan was estimated to be \$300 billion.

The tsunamis destroyed three-storey buildings, tossed cars and boats over the countryside, swept highways away, and flooded an area of 571 sq km. Over 10 000 people were listed as missing; six million homes were without electricity and one million people without access to fresh water.

After the earthquake and tsunami, the Japanese Nuclear Agency announced that the radiation at the Fukushima nuclear power plant was eight times its normal level, and that three of the four cooling units of the thermal nuclear reactors were failing. Evacuation of the area continued with over 180 000 people relocated. The nuclear disaster was rated at a Level 7 – the same level as the 1986 Chernobyl disaster.

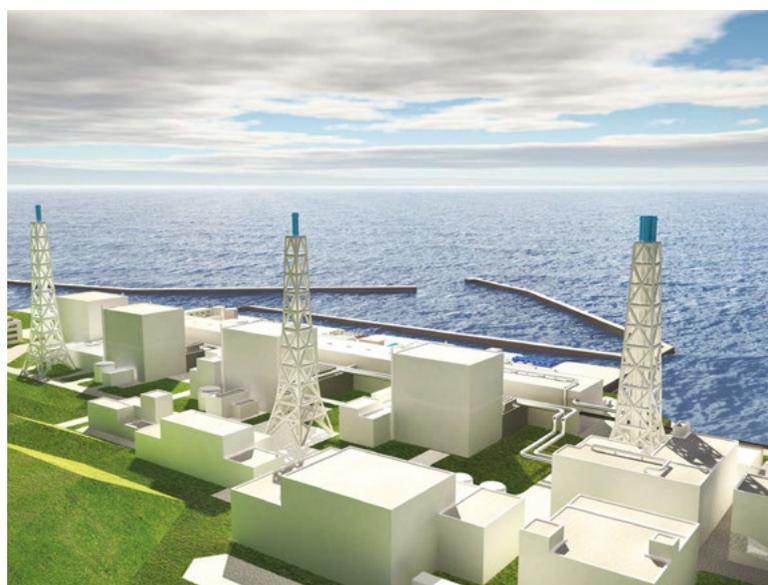
In an attempt to cool the over-heating reactors (which started to explode), the plant was pumped full of water. However, in the days following, three of the four reactors at Fukushima had a full meltdown.

## Geographical fact

Approximately 300 tonnes of radioactive groundwater still leaks into the Pacific Ocean every day as a result of the Japan earthquake; this is due to the huge amount of water used to cool the reactors in an effort to stop further release of harmful radiation into the environment. The Japanese government continues to forbid the sale of fish caught from the Fukushima area.



**Source 5.6** Destruction from the tsunami that hit the coastline of Japan on 11 March 2011



**Source 5.7** The town of Fukushima and the layout of the nuclear power plant

## 5.3 Responses to the impact

To ensure that aid was available for the survivors of the Tohoku earthquake, Japan's Defense Minister organised for 50 000 members of the Japan Self-Defense Forces (JSDF) to help. The Prime Minister during that time – Naoto Kan – increased this number two days later to 100 000. The JSDF were

also responsible for relocating the dead to temporary burial facilities.

Other emergency department groups also joined the rescue mission. These included the Japan Coast Guard and the police and fire departments. Members of each group pitched in to help and the availability and high number of helpers meant that many people were rescued even though they were perched on the top of buildings or swept out to sea.

### Activity 5.3

- 1 List a range of environmental effects of the Tohoku earthquake and the tsunami that followed shortly after.
- 2 Evaluate the impacts of the earthquake and tsunami on Japanese life and society.

### RESEARCH 5.1

- 1 Choose another geomorphic hazard and conduct research online.
- 2 Identify and explain the rescue efforts and the initial response.
- 3 Present your findings in dot point form and prepare a 3-minute oral presentation on your findings.



**Source 5.8** Japanese emergency services in action after the disaster



**Source 5.9** A 1-year-old girl wears a face mask for protection from radioactive dust after the Fukushima disaster, 2011

The JSDF also assisted with providing food and water and the transport of supplies to evacuation centres. Two hundred members were also assembled to inject water into the power plant's cooling systems.

After Fukushima was damaged, the Japanese government ordered the evacuation of everyone within approximately 19 km of the plant. The government requested that people living 19 to 29 km from Fukushima stay indoors and keep their windows closed.

Approximately 160 000 people were evacuated from their homes and only in 2012

were some allowed limited return, although certain areas are still off limits. This is due to the fear of radiation poisoning.

Radiation was never expected to have any considerable effect on the health of the population and this was confirmed in 2013 by the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). The government continues to monitor the health of all Fukushima residents. Stress, worry and the social problems of having to live somewhere else have been repeatedly identified as the only likely causes of ill health.

## 5.4 Management strategies to reduce the future impact of similar hazard events

Many lessons in life occur because we learn from our mistakes and accidents. The impact of a geomorphic hazard can result in management strategies that help reduce the impact from future similar occurrences.

For example, the Tokyo Electric Power company (Tepco) realised after the accident that not enough preparations had been put into place. The company could have taken steps to prevent a disastrous accident by embracing more wide-ranging safety measures.

Tepco's disclosure that it was not ready for the disaster came after a meeting of an independent advisory committee established to help the company reform its nuclear operations. The firm admitted that some advised safety improvements, such as using multiple power sources and cooling systems, would have required the plant's short-term closure and added to their costs, which is why they hadn't gone ahead with these safety measures.



**Source 5.10** Workers discuss the earthquake resistance of the Tokyo Skytree tower in October 2011, several months after the disaster

The March 2011 earthquake and tsunami in Japan that devastated the Fukushima nuclear complex showed the owners of other nuclear plants that they needed to reassess their security and safety measures.

What happened at Fukushima illustrated that there could be factors that other plants may not have previously considered. For example, at the Beaver Valley Power Station in the United States, FirstEnergy instigated more than two dozen safety recommendations drawn up by industry and federal regulators after the Fukushima accident. While still depending on preventative measures such as reassessments of seismic and flooding hazards, the plant's focus is on how operators respond in the immediate

aftermath of any possible natural disaster. One of their ideas was to design backup equipment titled 'FLEX'. If water is needed to cool the plant, the operators can evacuate down to the nearby Ohio River and send water up through underground pipes to a valve protected by a concrete bunker.

### The role of technology

The ability to predict natural hazards before they occur is an important step towards preventing them or at least decreasing their impact on the environment and ecosystems. Technology continues to improve, and tools are created to help with measuring changes of the Earth as they occur. Such tools include

**seismometer** a device that measures the movement of the Earth's crust (the ground)

**Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys**

measure changes in the surrounding water pressure as well as sea floor water pressure

**geographic information systems (GIS)** systems for storing, managing, analysing and portraying spatial data

**seismometers, Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys,** landslide fibre-optic sensors and **geographic information systems (GIS)** technology.

Along with these technology aids, government departments, academics and industry need to support research and assist the general public to gain awareness. For example, the Centre for Disaster Management and Public Safety (CDMPS) is a research centre established

in 2014 at the University of Melbourne. The University and IBM have built a system to share information – such as geospatial data, weather observations and traffic patterns – so that it can inform the general public and disaster management communities. Initial studies have shown that the system can, using information from past disasters, identify locations most at risk. According to Professor Abbas Rajabifard,

Academic Leader and Director of the Australia Disaster Management Platform, it will also allow other disaster management platforms worldwide to ‘plug in’ their models. Their aim is to train disaster management authorities and to continue their research.

### Earthquake early warning system

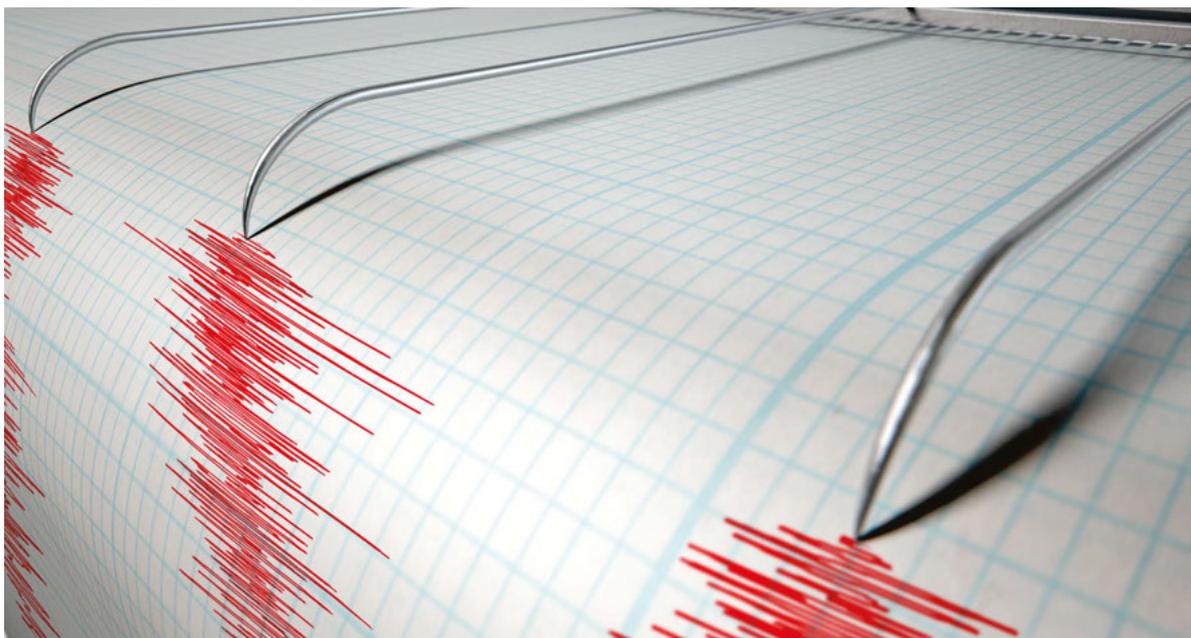
In the Japanese capital city of Tokyo, residents received a 1-minute warning before the earthquake hit the country. High-speed trains and factory assembly lines stopped immediately and residents received texted alerts on their mobile phones warning them.

Thanks to this warning system, as well as Japan's strict **seismic** building codes, many deaths were prevented.

**seismic** relating to vibrations of the earth due to earthquakes

### Seismometers

Seismometers are sensors that measure the seismic activity of the ground, and are used to detect seismic events such as earthquakes and explosions, and can also be used in predicting



**Source 5.11** A seismograph machine needle recording data

potential landslides. Seismometers convert ground motion into electrical voltage. There are two types of waves generated by seismic events: surface waves and body waves. Body waves are internal and move very quickly. Surface waves are slower but more dangerous as they can cause a lot of destruction. The size of the waves is received and recorded by the seismometer and then the result is measured according to the Richter scale.

### Geographical fact

People are not good at forecasting particular earthquakes, but toads may be able to assist. Five days before the L'Aquila earthquake in Italy in 2009, toads abandoned breeding sites and did not resume normal behaviour until several days after the earthquake.

### Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys

DART buoys measure changes in the surrounding water pressure as well as sea floor water pressure. The data is then transmitted via satellite to ground stations that can then issue a tsunami warning. DART buoy data can also be used in partnership with data collected from seismometers to help understand tsunamis and model their occurrence, in an effort to improve prediction and detection in the future.

### Geographical fact

There are 170 seismic stations around the world spread over 76 countries. Each station relays their data to the International Data Centre (IDC) in Vienna.

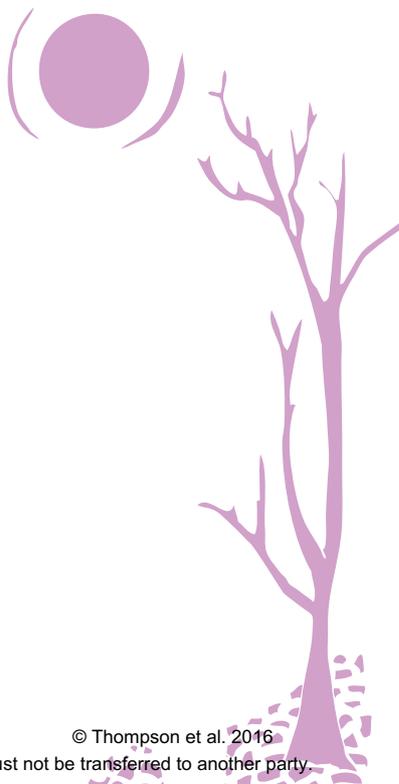
### Geographic Information System (GIS) technology

A GIS is a computer system that manages data by measuring, storing, checking and displaying data related to positions on Earth's surface. GIS can map different types of data, enabling people to more easily analyse and understand patterns and relationships. A GIS can help answer the following: what is located at that point on Earth? Or how much of this region is covered in wetland? GIS can also assist with detecting and predicting avalanches. Additional information such as weather conditions including precipitation (snow), temperature, wind and cloud cover can also assist with avalanche forecasting.





Source 5.12 Examples of Geographic Information Systems (GIS)



## Robots/drones

Technology is constantly evolving and robots and drones with cameras are currently being developed to assist with disaster management. For example, during the Fukushima disaster there was great concern about radiation levels. Robots and drones could have accessed the area to give the authorities important information on casualties and other potential dangers.

### Activity 5.4

- 1 Explain how seismometers record activity.
- 2 How do DART buoys and seismometers work together and for what purpose?
- 3 Outline the function and purpose of GIS.



**Source 5.13** Drones can enter quickly into unsafe situations, detect survivors and collect and transmit data about their location.

## Chapter summary

- Geomorphology is the study of landscapes and landforms, and the processes that have made them the way they are.
- A geomorphic hazard is a danger that occurs as a result of changes to a landform, affecting the stability of the site and resulting in devastating effects on the area and those living there. These natural disasters include earthquakes, tsunamis, volcanic eruptions, landslides and avalanches.
- Earthquakes occur when tectonic plates move, causing stress. They most commonly occur when one plate is forced under another.
- Tsunamis are giant waves that result from the displacement of a large volume of water usually caused by earthquakes, volcanic eruptions or landslides.
- Landslides are the movement of rock, debris or earth down a slope. They can be slow-moving or fast.
- The Japanese earthquake and resulting tsunami in 2011 killed nearly 16 000 people and caused a meltdown at the Fukushima nuclear power plant.
- Technology is an important part of measuring and forecasting geomorphic hazards.

## End-of-chapter questions

### Short answer

- 1 Compare and contrast earthquakes to another geomorphic hazard.
- 2 Explain how a disaster can help us learn to prepare for future risks.
- 3 Why is technology important for geomorphic hazards? Choose one type of technology and explain its contribution to our understanding of natural hazards.

### Extended response

Investigate online the relationships between earthquakes, tsunamis and landslides and summarise your findings.





**Source 5.14** A seriously damaged road in Christchurch, New Zealand, after the earthquake of 2011 which measured 6.3 on the Richter scale



## Topic 2

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# Place and liveability

**Source 6.1** Swallow's Nest castle, Crimea, Ukraine

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# 6

## Influences and perceptions

**Source 6.2** Sydney is a popular choice when people are looking for somewhere to live.

### Before you start

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#### Main focus

There are a number of factors that influence the choices we make about where we would like to live.

#### Why it's relevant to us

All places need to be liveable and governments need to plan for the needs of their community.

#### Inquiry questions

- What is liveability?
- What types of factors influence where people live?
- Why do people live where they do?
- Where would you like to live?

### Key terms

- continuous resources
- culture
- geographical concept
- liveability
- liveability criteria
- liveability index
- natural resources
- non-renewable resources
- perception
- renewable resources

### Let's begin

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A range of environmental and human factors will influence our decision on where we live, such as climate, landforms, natural resources, culture, income, employment, crime and safety. Where we choose to live is very personal and there are factors that influence this decision within our control, but there may be others that we have very little control of. For example, we may like the idea of living near a surf beach, but our work may be in a major city, well away from the coast.

## 6.1 Place and liveability

### Place

A place can range in size from a comfortable chair in a room to a national park, to a country or to the whole world. It can be a natural feature, such as an old-growth forest,

or a human construction, such as a house. It could also be a place where natural and human features and human constructions interconnect, such as a farm.

#### geographical concept

a key notion or idea that helps us to explore, understand and explain features, patterns and relationships on the Earth's surface

In geography we use the **geographical concept** of

space to better understand where, how and why places are located and connected over the Earth's surface. As we move, or send something, from one place to another place, we are using our understanding of space. For example, the form of transport you use and the route you take to go from your home to school is informed by your understanding of how they are connected across space. Often maps are used to show the location, distribution and reasons for the pattern of places over space. For example, Source 6.3 is a **political map** of Europe showing territorial boundaries between countries.

**political map** a map showing territorial boundaries between or within countries e.g. states and territories



Source 6.3 Maps, such as this political map of Europe, show us the distribution and location of places.

**perception** people's assessment of places and environments

How we connect and identify with a place depends on our personal **perception** of that place and why it is important to us, our people and our future. Perception

can differ depending on a number of factors including our **environmental worldview**, age, cultural background, and place of employment.

**environmental worldview** a person's view of the relationship between humans and nature e.g. *human-centred worldview*: humans are separate from nature and any environmental problems can be solved by technology; *earth-centred worldview*: humans are a part of, and dependent on, nature and have to work with nature to resolve environmental problems

## Note this down 6.1

Copy the graphic organiser and identify and describe the places you and other students find important.

Important places		
Think	Pair	Share
Choose a place that is important to you.	In a pair, discuss and compare your important places.	Join with one or two other pairs to share your discussion outcomes.
Describe the place and write down three reasons why it is an important place for you.	How are the places similar and different? How are the reasons for their being important similar and different?	Identify common reasons for the places you identified as being important.

Discuss with the class any common reasons you found for why places are important.

**liveability** an assessment of what a place is like to live in, using particular criteria such as environmental quality, safety, access to shops and services and cultural activities

## Liveability

How do people decide where they would like to live? There are a number of factors that influence a person's perception of the **liveability** of a place.

In this chapter we will begin by looking at how people's perceptions of liveability are influenced by both environmental and human factors.

### Activity 6.1

- 1 In small groups, reflect for a moment on what it is that you think attracts people to where they live or wish to live. The following list of features will help start this process:
  - the people are friendly
  - it's quiet and peaceful
  - the shops and cafes are good
  - there are plenty of sports facilities
  - it's easy to get around
  - the houses all look the same
  - it's safe
  - people speak many languages
  - there's no violence
  - I feel at home because ...
- 2 On the previous page, we considered environmental worldviews. They are:
  - human-centred
  - earth-centred.

Write a statement from each of the different perspectives, demonstrating your understanding of each worldview with examples.

## 6.2 Environmental factors that influence perceptions of liveability

The environment of a place contributes a great deal to peoples' perceptions of its

liveability. According to the Australian Bureau of Statistics, Australians are becoming increasingly concerned about the quality of our environment.

**Environmental quality** impacts our wellbeing, and we are taking more notice of air quality, water, biodiversity and land quality.

## Climate

The climate of a location has a definite impact on a person's perception of place. This can be seen in the movement of people from one location to another to live. The most common movement is from one capital city to another – though this is often linked to economic needs including employment and housing prices. However, one example of the way that people sometimes move for reasons of climate in Australia is the movement of people from southern states to live in northern Queensland to enjoy the warmer weather year-round.

According to the Queensland government's recent 'Population growth, highlights and trends: 2015 study', Queensland is the only

**environmental quality** the characteristics of an environment or place that affect people's physical and mental health and quality of life e.g. the extent of air and water pollution, noise, access to open space, traffic volumes, the visual effects of buildings and roads



**Source 6.4** Queensland has long received an annual influx of people moving from interstate to enjoy the warm climate.

**internal migration** the movement of people from living in one defined area to living in another within a country e.g. movement from cities to non-metropolitan coastal locations, or between states and territories

state in Australia to have had **internal migration** growth every year since 1981. In fact, the biggest number of people to move interstate to Queensland in 2013–14 was 4260 from New South Wales.

The Queensland government often mentions the state's famously warm climate in tourism campaigns, such as the 'Beautiful one day: perfect the next' slogan.

### Moving for the weather

So what types of people choose to move where they live for reasons of climate? You will most likely live in different places at different stages of life. Your age and whether you are employed, retired or gaining your education will influence where you live, which in turn influences the **development** and structures of towns and cities. According to the Australian Bureau of

**development** economic, social and political changes that improve the wellbeing of people

State	Locations	Average age (years)
New South Wales	Tuncurry	59
Victoria	Paynesville	56
Western Australia	Mandurah	49
Queensland	Bribie Island	57
South Australia	Victor Harbour	56
Tasmania	Triabunna	53
Northern Territory	Ross	42
Australian Capital Territory	Isaacs	47

**Source 6.5** Locations with the highest average age

Statistics Census 2011 data, the locations in each state that have the highest average age are mainly on the coast.

This data shows that once people reach retirement age, they tend to move or relocate to coastal towns. They do this because they want to enjoy their retirement and make the

most of the coastal lifestyle (with its strong sense of community and recreation activities). As a result of the movement of aged people towards the coast, state governments have to make sure that there are adequate services for these areas, such as health services, hospitals and aged care facilities.

**Source 6.6** The Wallis Lakes area, including Tuncurry, has the highest average age of any location in New South Wales.





**Source 6.7** Bribie Island has the highest average age in Queensland. It is suited to people who are looking towards retirement or are already retired.

## Sea changers

Who else chooses to move for reasons of climate? At any stage of life, people who have

had enough of the 'rat race' may choose to move out of a city to a more idyllic rural or seaside setting. These people have colloquially become known as 'tree changers' or 'sea changers'.

**sea changers** colloquial term for people who opt for what they perceive as an improved quality of life by the coast

## Geographical fact

As of September 2013, around two-thirds of the Australian population live in our capital cities. The largest growth outside our capital cities is on our coasts. The fastest growth rate in the time period between 2012 and 2013 is the Upper Coomera–Willow Vale (Gold Coast) area.



**Source 6.8** Port Macquarie on the coast of New South Wales is an example of a coastal town where people might choose to live for the lifestyle. The region's population is projected to soar by 19.3% by 2031.

## Landforms

As well as the appeal of a change in climate, distinctive landforms can be one type of natural feature that can attract people to a certain location. This is largely because the appearance of a place can also play a large role in shaping perceptions of liveability. For example, Cape Town in South Africa is considered one of the most beautiful cities

in the world. Cape Town is surrounded by impressive landforms, including mountains and sandy flats, and has over 307 km of coastline. The city is the centre of the Cape Floral Kingdom, one of the world's six 'floral kingdoms', and has over 9000 different plant species. Cape Town itself is reported to have over 3000 plant species. The city also has large areas of national parks and reserves.



**Source 6.9** Cape Town in South Africa is considered one of the most beautiful cities in the world. It is situated on the southwest tip of Africa. Here you can see the stunning landform Table Mountain lying behind the city.

Arguably Cape Town's most impressive landform is Table Mountain. Its name refers to its flat peak (or plateau), which is a beautiful sight for locals as well as a prominent tourist attraction. The mountain forms part of the Table Mountain National Park, and can be climbed or visitors can reach the top via a cable car. The main feature of Table Mountain is its flat peak, approximately 3 km wide.

This is flanked by the mountains Devil's Peak to the east and Lion's Head to the west, and together they form a dramatic backdrop to Cape Town. A further impressive sight occurs when orographic clouds cover the flat top of the mountain, which forms the famous 'tablecloth' of cloud. Such environmental beauty can certainly influence perceptions of liveability.



**Source 6.10** (Top) Table Mountain, seen from Table Bay, Cape Town. The flat top can be seen, between the mountains Devil's Peak on the left, and Lion's Head on the right. (Right) The impressive 'tablecloth' of cloud coming over Table Mountain.



## Natural resources

A major concern for geographers is the sustainability, or maintenance, of Earth's

**environmental resources**, especially those that support human life.

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**natural resources** resources provided by nature. Resources can be classified as renewable, non-renewable and continuous. Also known as *environmental resources*.

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Environmental resources are **natural resources** that have originated directly from the biophysical environment, such as water. Other examples include soil, wood, fish, minerals and fossil fuels. We

will soon consider how natural resources affect perceptions of liveability, but first we must understand how different types of natural resources are classified.

## Renewable resources

Environmental resources are classified as renewable or non-renewable, depending on the time taken for them to regenerate and the degree to which they can be sustained with continued human use. **Renewable**

**resources** are also called 'unlimited resources'. They can be replenished in a relatively short amount of time through reproduction or other biophysical processes.

For example, the life cycle of plants and animals enable the continuation of their species while the operation of the water cycle results in the continuous movement and renewal of water sources.

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**renewable resources** resources that can be replenished in a relatively short amount of time through reproduction or other biophysical processes

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**Source 6.11** The water cycle enables renewal of Earth's ground, surface and stored water sources.

### Non-renewable resources

**non-renewable resources** are resources that are unable to be naturally replenished and sure to be used up at the human rate of use

The second category of environmental resources is **non-renewable resources**. Also known as 'limited resources', non-renewable resources cannot be replenished in a human lifetime.

They are formed over geological time scales ranging from hundreds to millions of years. Minerals, including precious stones and metals, and fossil fuels, such as coal, oil and natural gas, all fall under this category. Since their rate of formation is extremely slow, they cannot be readily replenished once they are depleted.

### Continuous resources

Geographers also refer to a third category of environmental resources known as **continuous resources**. These resources, such as solar radiation, tides and winds, are available continuously though at a limited rate. Their quantity is not affected by human consumption and they are in no danger of being used in excess of their long-term availability.

**continuous resources** are resources that are in no danger of being used in excess of their long-term availability

### Natural resources and liveability

Natural resources can affect perceptions of liveability in a variety of ways. People may choose to live close to gardens or national parks, where natural resources are in abundance.

## ➤ Note this down 6.2

Copy the graphic organiser below and summarise what you have learned about environmental resources.

Environmental resources			
	Renewable	Non-renewable	Continuous
Also known as	Unlimited resources	Limited resources	Perpetual resources
Rate of replenishment			
Examples			

Some examples include:

- water, trees, and wildlife



**Source 6.12** Natural resources, such as those found in this World Heritage listed Lamington National Park on the border between NSW and Queensland, can affect perceptions of liveability. Also pictured is a typical little inhabitant of the park (green tree frog).

- snowfall.



**Source 6.13** Summer panorama from just above the Kosciuszko Express (chairlift) Terminal at Thredbo, NSW, looking down at the Thredbo River valley and Thredbo Village. This is the sort of place that not only might attract 'tree changers' to live, but also is extremely popular for winter sports.

## 6.3 Human factors that influence perceptions of liveability

Before we continue with this topic, it is useful to pause and consider your own personal choices

**liveability criteria** characteristics used to assess the liveability of places or their contribution to people's quality of life e.g. safety, healthcare, education, infrastructure and environment

regarding liveability. What do you think is the most important factor for where you choose to live? And is your own personal set of **liveability criteria** the same as someone else's?

Next we will consider how human factors influence people's perceptions about the liveability of a place. We will begin by looking at how liveability is influenced by culture, income and employment, and crime and safety.

## Culture

**Culture** influences how people connect to a place, and their perspective.

The Australian population is made up of many different **cultural groups**, and is known to be one of the most **multicultural** societies in the world. Throughout our history, Australia has been subject to immigration from all corners of the world. From the invasion of Europeans that first established towns and cities, to the arrival of Chinese workers attracted by the gold rushes of the nineteenth century, to the mass **international migration**

**culture** the customs, habits, beliefs, social organisation and ways of life that characterise different groups and communities

**cultural groups** people belonging to or identifying with a nationality, ethnic group, religion or social group with a distinct culture

**multicultural** describing a society that reflects and is open to many different cultures

**international migration** the voluntary or forced movement of people between countries

**Source 6.14** The Cabramatta Moon Festival held each year in the Sydney suburb. Culture is another human factor that can influence perceptions of liveability.



of eastern Europeans after World War II, to an influx of southeast Asian people during and after the Vietnam War, modern Australia has been built on the back of immigration.

When migrants come to Australia, many of them congregate and live in areas or suburbs where other migrants from their country live. There are a number of examples of how migrants have influenced the culture of an area. In Harris Park in Sydney, 43% of the population were born in India. In Perth, 43% of the residents of Jindalee were born in Britain. In Adelaide, the suburb of Hectorville has 16% of its population born in Italy. Pacific Pines and Upper Coomera on the Gold Coast in Queensland have 15% of their residents born in New Zealand.

When large concentrations of people from the same nationalities and cultures live in an area, they tend to have an impact on the built environment. For example, in the western

Sydney suburb of Cabramatta, 35% of the population were born in Vietnam. As a result of this, there have been changes in the built environment that reflect their culture, such as mall gates, which reflect and symbolise Vietnamese heritage and beliefs. Similarly, there are many specialty shops in Cabramatta such as grocery stores, bakeries, seafood stores and spice stores that cater to the Vietnamese community. Overall, these examples show that belonging to a cultural group can actually influence people's perceptions on the liveability of a place.

### Income and employment

People's economic status, including their level of income and type of employment, also dictates the locations in which they can choose to live. The higher your income, for example, the more choice you will have in selecting where you live. A higher average

State	Locations	Average income
New South Wales	Mosman	\$142 773
	Double Bay	\$141 544
Victoria	Toorak	\$150 548
	Brighton	\$111 966
Western Australia	Cottesloe	\$125 411
	Nedlands	\$116 269
Queensland	Ascot	\$96 281
	Hamilton	\$95 911
Australian Capital Territory	Red Hill	\$94 070
	Forrest	\$94 057
South Australia	North Adelaide	\$83 035
	Walkerville	\$78 108
Northern Territory	Anindilyakawa	\$75 484
	Nhulunbuy	\$64 839
Tasmania	Taroona Sandy Bay	\$60 548
	Mount Nelson West Coast	\$52 664

**Source 6.15** Wealthiest locations in Australia

income in a location generally indicates that the area is wealthier. A higher average income indicates that house prices are high and that predominantly wealthy people and families can afford to live there.

Source 6.15 (on the previous page) shows the two wealthiest locations in each state and territory of Australia as of 2010–2011 – the towns or suburbs where the average

income is the highest. These figures from the 2011 Census illustrate the division that exists between income levels and the state that people live in. This in turn influences the nature of the place and who lives there. For example, people seeking higher incomes are more likely to move to a wealthy city like Sydney or Melbourne, where the potential for a higher salary is greater.



**Source 6.16** Brighton in Victoria has one of the highest annual incomes in Australia. It is attractive to the wealthy due to its proximity to the beach.

**Source 6.17** Double Bay has New South Wales' 2nd highest annual income. It is desirable because of its location close to the Sydney central business district and the ocean.



Mining activity in Western Australia and Queensland has driven an economic boom in those states, boosted by a high international demand for resources. The need for skilled

workers in certain remote locations encourages some people to move to these areas, with an expectation of attractive wages and reasonably secure employment.



**Source 6.18** Western Australia's iron-ore mines are an example of places of employment that require people to move to live and work.

## Crime and safety

The crime rate

The crime rate contributes to our sense of safety, and can therefore have an impact on the perceived liveability of a place. Generally speaking, Australian cities have an average level of crime compared to the rest of the

world. The crime rate of a place is also greatly influenced by the socio-economic conditions of its residents. For example, some parts of Sydney have 10 times the crime rate of other areas of Sydney. However, at times the crime rate can be higher in rural and remote areas in Australia compared to the urban areas.

Social research in Australia indicates that the crime rate is higher in regional mining towns compared to the rest of the country. One of the reasons for the higher crime

rates in mining areas is thought to be an increase in alcohol-fuelled violence. Mines tend to have very strict ‘no alcohol’ policies and regularly conduct blood tests on their

NSW Statistical Area	Murder	Assault – domestic violence related	Assault – non-domestic violence related	Sexual assault	Indecent assault, act of indecency and other sexual offences	Robbery without a weapon	Robbery with a firearm	Robbery with a weapon not a firearm	Break and enter dwelling	Break and enter non-dwelling	Motor vehicle theft	Steal from a motor vehicle	Steal from a retail store	Steal from a dwelling	Steal from person	Fraud	Malicious damage to property
Greater Sydney	0.8	0.9	0.9	0.8	0.8	1.2	1.2	1.1	0.8	0.7	0.9	0.9	1.0	0.8	1.2	1.2	0.8
Capital Region	0.8	0.8	1.0	1.1	1.1	0.1	0.0	0.3	0.8	1.1	0.6	0.7	0.7	0.8	0.2	0.4	1.1
Central West	0.4	1.5	1.3	1.7	1.3	0.6	0.4	0.6	1.7	1.9	1.1	1.3	1.3	1.7	0.5	0.6	1.6
Coffs Harbour – Grafton	0.6	1.4	1.3	1.7	1.4	0.5	0.4	0.9	1.0	1.8	1.0	1.0	0.9	1.3	0.6	0.5	0.3
Far West and Orana	6.6	3.1	2.0	2.2	2.1	0.9	0.7	1.5	2.8	4.2	1.8	2.2	1.3	1.9	1.0	0.8	2.6
Hunter Valley excluding Newcastle	0.3	1.3	0.9	1.2	1.3	0.5	1.0	1.0	1.1	1.5	1.4	1.3	0.9	1.3	0.5	0.6	1.3
Illawarra	1.5	0.9	0.9	1.0	0.9	1.0	0.8	1.2	1.1	1.1	1.1	1.1	1.1	1.2	0.7	0.6	1.0
Mid North Coast	1.2	1.2	1.1	1.4	1.4	0.6	0.4	0.8	1.3	1.6	1.0	0.7	0.8	1.4	0.5	0.5	1.2
Murray	2.3	1.2	1.2	1.1	1.4	0.5	0.2	0.7	1.2	1.7	1.1	1.0	1.0	1.2	0.4	0.5	1.4
New England and North West	1.4	1.8	1.6	1.5	1.7	0.7	0.3	0.8	2.2	2.2	1.0	1.3	1.3	1.8	0.4	0.5	1.8
Newcastle and Lake Macquarie	0.7	1.0	1.2	1.4	1.2	0.6	0.9	1.4	1.0	1.3	1.3	1.4	1.2	1.1	0.9	1.0	1.2
Richmond – Tweed	0.7	1.0	1.2	1.3	1.1	0.6	0.1	0.6	0.9	1.3	0.9	0.9	0.8	1.0	0.7	0.6	1.1
Riverina	3.9	1.3	1.2	1.5	1.3	0.3	0.0	0.8	1.7	1.6	1.2	1.3	1.3	1.6	0.3	0.5	1.4
Southern Highlands and Shoalhaven	0.0	0.9	0.9	1.3	1.2	0.6	1.6	0.6	1.3	1.2	0.8	0.9	1.0	1.1	0.3	0.4	1.1
<b>NSW</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>

**Source 6.19** Ratio to NSW rate of recorded criminal incidents per 100 000 population for major offences over the 12 months to June 2015

## RESEARCH 6.1

Visit the NSW Bureau of Crime and Statistics (BOSCAR) website and click on ‘crime statistics’ and then access their data mapping tool. Use their mapping tool to compare the distribution of crimes across the state of NSW.

- 1 Identify three trends (patterns) in the maps.
- 2 Is the rate always higher in rural than urban for crimes? Why or why not? You should refer to examples.
- 3 Suggest how you think the rate is calculated.
- 4 If we looked at the number of incidents rather than the rate, what might we expect to see in urban compared to rural areas? Discuss with the student next to you or, with the guidance of your teacher, as a class.
- 5 If you had a good friend moving to Australia from overseas, where would you recommend they move to in NSW and why?
- 6 Explain whether you think crime is a major factor for the liveability of a place.

workers. So it would not be fair to claim that a rise in crime is due to the mine workers specifically. More research is needed to understand why crime might be higher in regional mining areas.

For geographers, it is also useful to refer to a table of data to understand the rate from a more numerical perspective.

## Safety

People's perception of their personal and public **safety** is an important part of liveability. Perception of safety is influenced by actual or perceived rates of injury or death, such as assault, motor vehicle accidents, damage

**safety** being protected from or in a condition or place where there is unlikely to be danger or risk of harm

to property or theft. However, perception of crime can often be worse than the actual crime rate and that can be simply due to how a person feels in their environment. Antisocial behaviour such as noisy neighbours, fighting, drunkenness, swearing or offensive behaviour can also make a person not feel safe.

Initiatives to increase a sense of wellbeing and safety in a place are therefore important. For example, to increase pedestrian safety, public transport areas can have pedestrian crossings, excellent lighting and signage that clearly indicates in which direction traffic (whether it be road or pedestrian) should be moving. In Australia, on a state and territory level, the Northern Territory is perceived as the least safe to travel on public transport and

## Geographical fact

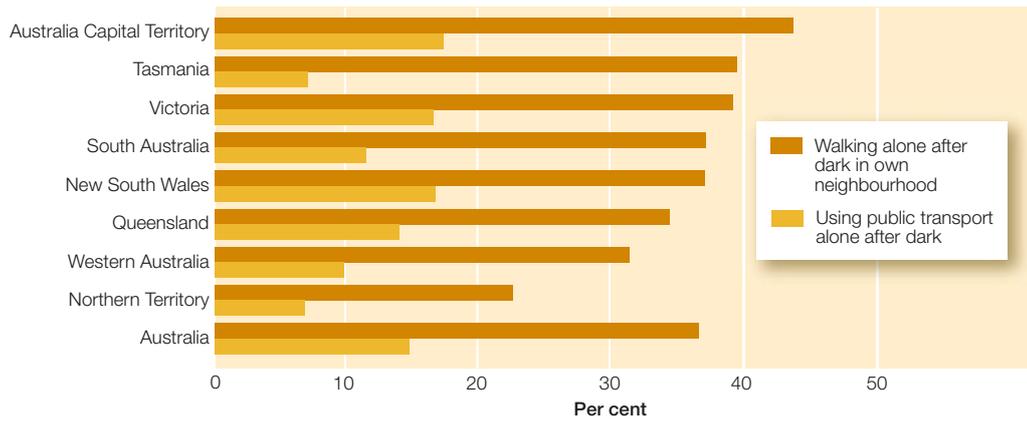
The city of Vancouver in Canada lost its title of most liveable city because of traffic jams on Vancouver Island, and it may fall further down the list because of the Stanley Cup riot of June 2011.

**Source 6.20** Vancouver, Canada, used to be the world's most liveable city, but dropped in its rating due to traffic jams and the Stanley Cup riot in 2011.



the Australian Capital Territory is perceived as the safest. By this single criterion, you could assume the ACT is more liveable than NT; however, this would not be a fair assumption.

All factors contributing to liveability need to be considered when deciding which state or territory might be the most liveable.



**Source 6.21** Feelings of safety described by persons aged 15 years and over, by state and territories – proportion of persons who reported they feel safe or very safe travelling alone after dark by mode, 2008–09

### Activity 6.2

- 1 Consider where you live. Are there places you avoid due to concerns about personal safety?
- 2 In 200 words, explain why some people might feel unsafe there and what could be done to improve personal and public safety.

## 6.4 Measuring the liveability of places

There are several ways that the perceived liveability of cities around the world is measured or ranked. We will now look at a few methods, beginning with surveys.

### Surveys

Australia has four cities included in the rankings of *The Economist Intelligence Unit (EIU) Global Liveability Survey*. The EIU's 2011

to 2015 surveys placed Melbourne at the top of their lists for these five consecutive years.

The EIU give cities a liveability score out of 100 with 100 being 'ideal' and 1 or 0 'intolerable'. There are five categories that the EIU measure: stability (essentially crime and conflict), health care, culture and environment, education and infrastructure. Each city is awarded a score out of 100 for each, which is then averaged for a final score of 100. The cities are also ranked. In the table below you can see the top 10 and the bottom 10 cities in the world according to the EIU.

Country	City	Rank	Overall rating (100 = ideal)	Stability	Health-care	Culture and environment	Education	Infrastructure
Australia	Melbourne	1	97.5	95	100	95.1	100	100
Austria	Vienna	2	97.4	95	100	94.4	100	100
Canada	Vancouver	3	97.3	95	100	100	100	92.9
Canada	Toronto	4	97.2	100	100	97.2	100	89.3
Australia	Adelaide	5	96.6	95	100	94.2	100	96.4
Canada	Calgary	6	96.6	100	100	89.1	100	96.4
Australia	Sydney	7	96.1	90	100	94.4	100	100
Finland	Helsinki	8	96.0	100	100	90	91.7	96.4
Australia	Perth	9	95.9	95	100	88.7	100	100
New Zealand	Auckland	10	95.7	95	95.8	97	100	92.9

**Source 6.22** The top 10 cities according to the EIU

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
Libya	Tripoli	132	44.2	45	41.7	37.0	50.0	51.8
Cameroon	Douala	133	44.0	60	25.0	48.4	33.3	42.9
Zimbabwe	Harare	134	42.6	40	20.8	58.6	66.7	35.7
Algeria	Algiers	135	40.9	40	45.8	42.6	50.0	30.4
Pakistan	Karachi	136	40.9	20	45.8	38.7	66.7	51.8
Nigeria	Lagos	137	38.9	25	33.3	53.5	33.3	46.4
PNG	Port Moresby	138	38.9	30	37.5	44.2	50.0	39.3
Bangladesh	Dhaka	139	38.7	50	29.2	43.3	41.7	26.8
Syria	Damascus	140	30.5	15	29.2	44.7	33.3	32.1

**Source 6.23** The bottom 10 cities according to the EIU

## The liveability index

Urbanisation, the gradual relocation of people into big towns and cities, is occurring in countries all over the world, and has taken on new momentum with the rapid growth of economies in Asia. New patterns of urbanisation that are emerging tell us much about the future course of economic activity

in the world, including the shifts in the global distribution of power and wealth. *The Global Cities Index* (GCI) released in 2008, 2010 and 2012 is a **liveability index** that assessed these urbanisation trends against five key indicators: business

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**liveability index** a measure of liveability/ quality of life based on a set of criteria and used to rank places. Used principally to rank the world's largest cities by the quality of life they offer

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activity, human capital, information exchange, cultural experience and political engagement (according to the 2013 report of AT Kearney, a global management consulting firm). The report also evaluated each city’s future political importance and influence in the surrounding region, based on urban connections or close alliances between cities.

This means that combined with its historical connections, sources of wealth, cultural beliefs and political leadership, a city’s geographical location can have influence over large areas or nations that are not always local. These regions are worth considering for improving our understanding of this urban growth phenomenon.

**RESEARCH 6.2** //

In 2015, Melbourne was announced as the world’s most liveable city for the fifth consecutive year by EIU, followed by Vienna, Vancouver and Toronto. Among the lowest ranked cities were Damascus (Syria), Dhaka (Bangladesh) and Port Moresby (PNG). Select three cities to research – one ranked high, one ranked low and one of your choice. Research why your chosen three cities received the ranking they did by comparing and contrasting facts and statistics collected. You may like to organise your notes using the following table.

Requirements for liveability	City 1 (high ranking)	City 2 (low ranking)	City 3 (own choice)
Stability			
Health care			
Culture			
Environment			
Infrastructure			



**Source 6.24** Panorama of Melbourne’s Yarra River at night



### Activity 6.3

- 1 There are a number of different scales used to measure liveability. Name and describe two of these.
- 2 Suggest why you think there are different scales for measuring liveability rather than just one. You may like to discuss this with a partner.
- 3 Refer to Sources 6.22 and 6.23, an atlas or the internet for the following questions.
  - a Why might the largest cities not necessarily be the most liveable?
  - b Identify which continent contains the most liveable cities.

## 6.5 Personal liveability criteria

Perceptions of the liveability of a place really come down to personal preference. Therefore, we really need to develop our own personal liveability criteria.

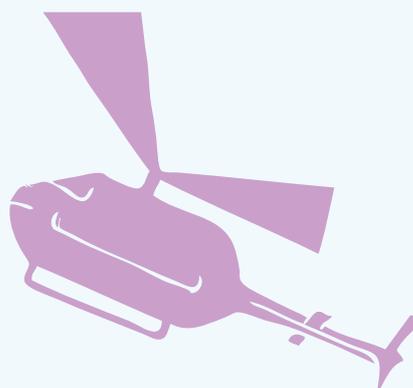
### Case study 6.1

#### Assessing the liveability of a small regional town

We need to ask ourselves what is it that gives people their sense of wellbeing and contentment with everyday life. It's more than a building or street or particular location. There is likely to be a complex mixture of elements that make a place liveable. While the actual physical location may differ, there are features of a liveable place that most people would agree are important.

Getting a sense of the liveable features of a place can be easier once you build up your knowledge and awareness of the criteria. According to the Australian Bureau of Statistics 2011 Census data, Westbury in northern Tasmania has a population of approximately

2000 residents. Nearby is the large regional town of Launceston, which has an airport and a university. The photographs in Source 6.25 provide illustrations of the activities found in settlements of this size.





**Source 6.25** Images of Westbury, a small Australian regional town located in northern Tasmania

Go back to **Activity 6.1** and consider the reasons you gave as to why some places are more liveable than others.

Now look at the photos of Westbury in Tasmania.

- 1** Why do you think Westbury might be considered liveable?
- 2** Is there anything the town could do to improve its liveability?



## Activity 6.4

- 1 Construct your own list of liveability criteria. You should have at least 10 factors or characteristics listed.
- 2 Which of these factors have impacted you? Explain why or why not for each: climate, landforms, natural resources, culture, income and employment, and crime and safety. Discuss your response with the rest of your class.
- 3 Apply this to where you actually live right now and state which criteria are met. Is your home, your place, liveable according to your criteria? Discuss.
- 4 Choose another place, for example, Hobart in Tasmania, and apply your liveability criteria. Does Hobart meet most of your criteria? Discuss.
- 5 Compare your liveability criteria to those of the person sitting next to you. Are your criteria similar to theirs? Discuss with your partner the similarities and differences between your liveability criteria.

**Source 6.26** The Hobart waterfront with Mount Wellington in the background



## Fieldwork 6.1 Surveying the liveability of your area

### Aim

To determine the liveability of different places and compare the liveability of each.

### Method

A survey can consist of questionnaires, interviews and observations. To determine the liveability of the place where you live and to provide a balanced viewpoint, you need to use all three primary methodologies. Select two or three sites or suburbs to examine liveability.

### Data collection

- **Questionnaire:** You will need to construct a questionnaire to find out what people think of your chosen areas. You can do this easily online using Survey Monkey or Zoomerang. When finished, you may email the questionnaire link to family and friends in your area. Try closed-ended (yes/no) questions, as these are easier to collate and derive statistics from.
- **Interview:** Think about who you would like to interview about the liveability of your area. For example, you may get different opinions from an elderly resident who has lived there for many years, a new resident who just moved in, or even different types of people who demand and use different resources, such as teenagers, full-time workers or stay-at-home mums.
- **Observations:** Select a few different sites in your chosen study locations to sit in, and observe and record what is going on around you; how people use facilities; ease of transport; number of cafes; and so on.

### Fieldwork presentation layout

Front page	Title and name
Contents page	Do this last, as well as numbering pages
Page 1	Aims and methods
Page 2	Location maps
Page 3	Introduction – brief description of the study sites and photos
Page 4–5	Site 1 survey results
Page 6–7	Site 2 survey results
Page 8–9	Site 3 survey results
Page 10	Discussion about liveability, strengths and weaknesses of each site
Page 11	Conclusion about the highest level of liveability
Page 12	Appendix, bibliography, glossary

## Chapter summary

- Places are parts of the Earth's surface that have specific meaning for some people.
- Liveability means the conditions of a place that make it easy or difficult to live there.
- Perception of a place means the way that we individually assess the value of a place or environment.
- A range of environmental factors can influence peoples' perceptions of liveability. Climate can influence people to move from one location to another, such as the warm climate of Queensland. Landforms can have a big impact on liveability for people, such as Cape Town, with South Africa's beautiful Table Mountain. Living close to natural resources (renewable, non-renewable and continuous) such as water can have a big impact on perceptions of the liveability of a place.
- A range of human factors can also influence peoples' perceptions of liveability of a place.
- Culture can influence people to live near people of a similar cultural background. Level of income and place of employment can have a big impact on liveability for people. For example, people often move to capital cities in the hope of earning more; or, alternatively, they may move to a new town due to gaining a new job, such as to mining towns in Western Australia. Crime and safety can impact liveability. The higher the crime rate, the lower the perception of liveability. Some parts of a city are more liveable than others depending on perceived safety, for example, parts of Wangaratta.
- The liveability of a place is measured or assessed in various ways, including through surveys and annual liveability indexes like the Global Cities Index (GCI).
- We all need to develop our own personal liveability criteria, as perceptions of the liveability of a place come down to personal preference.

## End-of-chapter questions

### Short answer

- 1 Suggest why most aged people want to live on the coast.
- 2 List the key reasons why young families move to the outer suburbs of towns and cities.
- 3 Explain how the crime rate can affect the liveability of a place.

### Extended response

Everyone has a sense of place, space and belonging. These senses affect our perceptions of the liveability of a place. Imagine you are a person with a disability or from a different culture. In a diary entry, explore your perceptions and use of places and spaces in your local area. How does your perception of place and accessibility affect how you engage with and connect to this place?

# Access to services and facilities

**Source 7.1** Old Nessebar city, Bourgas, Bulgaria

## Before you start

### Main focus

Infrastructure, including services and facilities, is an important part of the liveability of a place.

### Why it's relevant to us

Services and facilities, such as housing, water, sanitation, education, health care, transportation networks and cultural and recreational areas, contribute a great deal to our perception of a place's liveability.

### Inquiry questions

- Which services and facilities are considered important to people's wellbeing?
- Why do facilities and services vary between different locations?
- How does limited access to facilities and services affect the liveability of a place for different people?

### Key terms

- demographic
- green space
- housing

- infrastructure
- peninsula
- recreation
- remoteness
- safety
- sanitation
- socio-cultural
- transportation networks
- water

## Let's begin

Bourgas is a port city on the Black Sea located on the east coast of Bulgaria in Europe. It has a population of 226 000 (the 4th largest city in Bulgaria) and a land area of 48 200 hectares. After decades of neglect, Bulgaria is now looking to the future, though Bourgas is paying a price for poor planning, with environmental pollution in the air, water and soil. The city hopes to increase its liveability by improving its services and faculties, particularly its public transport, air quality, waste management and water accessibility.

## 7.1 Important services and facilities for people's wellbeing

As we have learnt in the previous chapter, environmental and human factors like climate or employment contribute to our perceptions of liveability. But another important factor that needs to be considered is **infrastructure**. Infrastructure

**infrastructure** structures and services needed for society to operate properly, such as transport, water supply, health services and education systems

refers to the services and facilities required to help a society operate and includes housing, water and sanitation, transport, education and health care, personal and public safety (discussed in Chapter 6) and recreational and cultural facilities. Healthy populations have a longer life expectancy and tend to be more productive in their activities.

**Source 7.2** A *favela*, a crowded Brazilian shanty town in Rio de Janeiro





**Source 7.3** Although Hong Kong is one of the most densely populated cities in the world, it ranks high in terms of liveability.

## Availability of housing

Housing is a basic necessity for life – we all need somewhere to live. The availability of housing and density of housing have an impact on liveability. There are many different styles of housing, each with its own advantages and disadvantages. Housing styles also influence the environment, affecting roads, water supply systems and transportation. There are particular styles that are popular in Australia and Europe, and the kinds of houses you find in the bush are very different from those you find in cities like Sydney.

For example, let us compare housing in Australia and Europe. According to the Australian Bureau of Statistics (ABS), the most common housing type in Australia in 2009–10 was separate housing (79% of the population), with 11% living in flats, units or apartments, and 10% living in **semi-detached houses, terraces** or townhouses. Europe has a very different composition of housing. According to the European Commission, 42% of the European population live in flats or apartments, with 34% living in separate housing and 23% in semi-detached housing.

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**semi-detached houses** two houses that are joined by a shared wall

**terraces** rows of houses that share their side walls

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## Activity 7.1

Conduct a class survey on housing.

- 1 Construct a table using the three types of houses (1 Separate house; 2 Unit, flat or apartment; 3 Semi-detached, terrace or townhouse)
- 2 Identify which type of house you reside in and mark it in the table.
- 3 Compare your experience with the rest of your class.
- 4 Collate the class results and use the data to construct a column graph.
- 5 Compare your class results with the ABS data on Australia. Do your class results match the ABS data? If not, why do they differ?

**Source 7.4** Oxford, England, is comprised predominantly of multistorey housing.



## Note this down 7.1

Copy the graphic organiser and compare the three different types of housing. In the first column, write down one or two positive things (pluses) about each type. In the second column, write down one or two negative things (minuses) about each type. In the third column, write down one thing you find interesting about each type.

Types of housing	Plus	Minus	Interesting
Separate house			
Unit, flat or apartment			
Semi-detached house, terrace or townhouse			

### Geographical fact

Australia's population is highly concentrated in our cities, with 64% of our citizens living in Sydney, Melbourne, Perth, Brisbane or Adelaide.

### Water and sanitation infrastructure

According to the United Nations, for a city to be liveable it needs to put the needs of its citizens first and provide the necessary infrastructure; water and sanitation are two such necessities. As cities grow, the pressure on water and sanitation services increases. Water kiosks (a small hut where tap water is sold) are now being built in poorer parts of the city of Nakuru in Kenya in an effort to provide water to those who have none. This project was in response to a major cholera outbreak in 2000. Cholera is a disease that is transmitted by water or food that has been contaminated by faecal matter (waste matter) of an infected person carrying the bacterium *Vibrio cholera*. Symptoms include severe diarrhoea and vomiting, which can lead to dehydration and

in some cases death. Globally, it is estimated that between three and five million people are infected with the bacteria, with 130 000 of those infected dying.

It is estimated that in Nakuru only 35 000 m<sup>3</sup> of water is available per day, although water requirements are estimated at 75 000 m<sup>3</sup>/day. The shortfall in water, known as **water scarcity**, negatively affects the liveability of Nakuru.

**water scarcity** the lack of sufficient available water resources to meet demand

In Australia, we take water access for granted. Nearly all Australians have running water in their homes. Not only that, but it is generally safe for us to drink our own tap water. This is simply not the case for many people around the world. In many places, people can become sick or even die from contaminated water, which is why sanitation is crucial.

## Geographical fact

Diarrhoeal diseases (such as cholera) are the 2nd leading cause of death in children aged less than five years. Diarrhoeal diseases kill more children than AIDS, measles and malaria combined.

In Australia, we also take our waste treatment system for granted. Almost all of us have a bathroom in our home with a running toilet where our waste is transported to sewerage treatment systems. We also have our rubbish bins collected every week, which are then transported to rubbish tips or recycling depots to be processed. In some countries, however, rubbish is not collected and can enter the water supply. The sewage is often in open sewers rather than in a **reticulated** system as in Australia.

**reticulated** the system of pipes and drains that takes raw sewage from a dwelling to a sewage treatment plant, removing the need for open channels that smell and are unhygienic. Importantly, reticulated systems decrease the likelihood of contaminated water and prevent the spread of disease.

According to the World Health Organization (WHO), 2.5 billion people across the world lack access to improved sanitation, and 1.8 billion people use water that is contaminated. From a basic hygiene and sanitation perspective, WHO

estimates that hundreds of millions of people have no access to water and soap for washing their hands that would empower them to prevent the spread of disease, such as cholera. However, countries are placing greater focus and attention on providing clean water supply and improved sanitation. For example, WHO reports that the number of children dying from preventable diarrhoeal diseases is falling. In 1990 it was estimated that 1.5 million children were dying a year but this has since fallen to 760 000 in 2013.

## Geographical fact

More people in the world have a mobile phone than a toilet.

### Activity 7.2

- 1 How many taps are in your home? And how many toilets do you have? Share this number with your class and reflect on how this might differ to family homes in developing countries.
- 2 Have you visited a country or region where you have not been able to drink the tap water? Outline the strategies a person may need to put into place to ensure they have access to safe water.
- 3 If Australia did not have sanitation services (rubbish and sewage removal), what might happen?

## RESEARCH 7.1 //

World Toilet Day has been announced by the United Nations as November 19. You have been invited to be the keynote speaker at a conference on improving global sanitation. The audience will be composed of world leaders, non-government organisations, policy makers and corporations. In your presentation you should include:

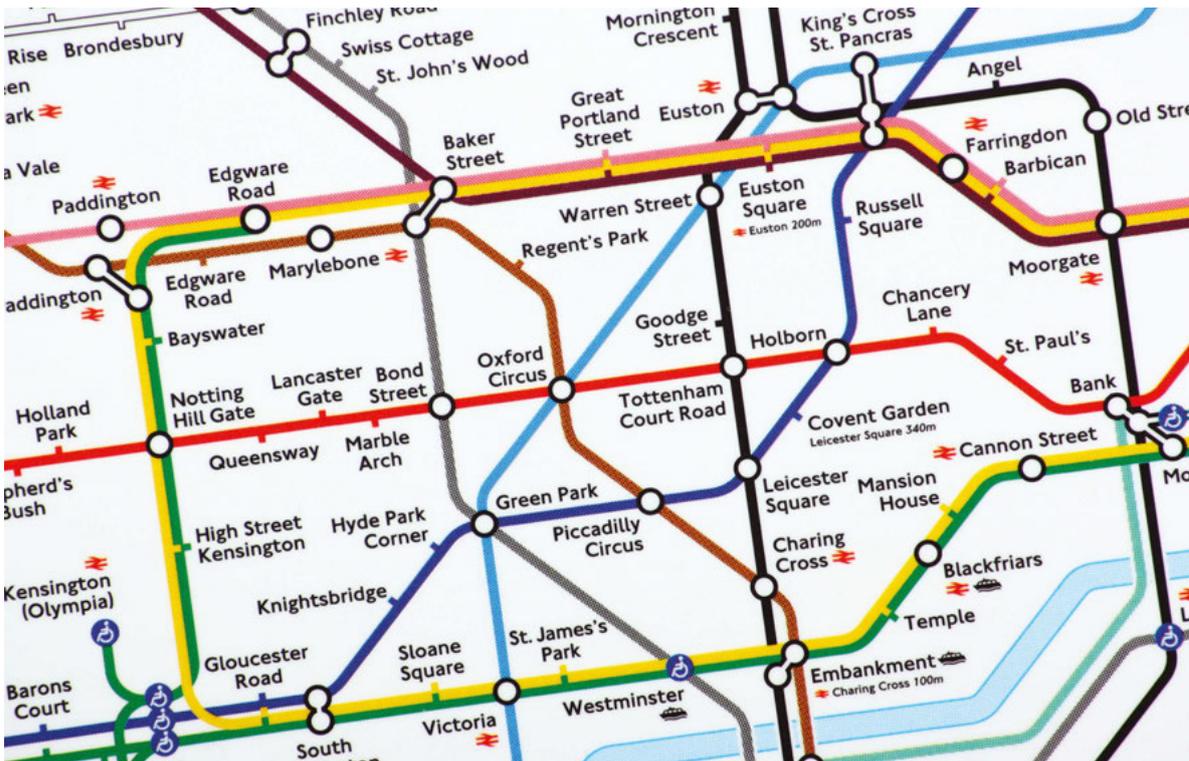
- a focus on one country where sanitation could be greatly improved
- an explanation of the need for women and children to have equal access to fresh water and sanitation
- an outline of strategies to improve sanitation in that country
- a list of things individuals and groups can do to help
- interesting graphs, facts and statistics.

### Transportation networks

The types of housing densities that exist within cities influence the type of transportation that is available in those areas. As the housing density increases, so does the population density; this creates a number of issues

with regard to transportation. The greater the population in an area, the better the transportation system needs to be to move larger volumes of people.

A good example of this is London, the capital city of England. In 2015, London's



**Source 7.5** A section of the London Underground map



**Source 7.6** Waterloo Station, London's busiest station with 89.4 million passengers per year as of 2015

population was 8.63 million people, who live primarily in medium-density housing. A number of transport modes are available to the people of London – the main types are trains, buses and cars. The most used of these is the above-ground and underground rail system called 'the Tube'. The underground railway was first run in 1863, and has been known as the Tube since 1890. There is now an extensive network of railway lines that stretches for 402 km around London. This railway system carried 1.265 billion passengers in 2013–14.

This shows how a city that is dominated by medium-housing density has to have a transport

mode that is able to cope with large volumes of people. By contrast, a city with a low density of housing has very different modes of transport. Dubbo is a city of around 41 000 in the central west of New South Wales. Dubbo's housing is dominated by separate, detached houses; these account for 83% of all housing in the city. This clearly puts Dubbo into the low-density housing category. Due to the dominance of low-density housing, Dubbo's urban area has sprawled out over a larger area, requiring people to travel increased distances to get around the city. This in turn has led to a heavy reliance on motor vehicles as the main form of transport.

According to the 2011 Census data, 38% of people in Dubbo owned one car and 49% owned two or three cars. This means that 87% of people in Dubbo own at least one car, making it the most common mode of transport. There are some other factors that contribute to this, such as the lack of other forms of

**public transport.** There are buses that run around Dubbo, but they are not as frequent as they would be in larger cities. This causes people to look for a more frequent and reliable mode of transport, such as cars.

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**public transport** a form of transport that can be used by any member of the public, whether free of charge or for a fee

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**Source 7.7** Cars are the most common mode of transport in Dubbo, New South Wales. Pictured is a road on the outskirts of town, and a typical house in Dubbo, with a two-car garage.

## RESEARCH 7.2 //

Use the Australian Bureau of Statistics website to conduct research into your local area. Select your local suburb or the town that you live in. Locate the following data:

- dwelling types (housing)
- car ownership
- public transport facilities.

Compare the data you obtain with those of Dubbo, and explain the reasons for the differences or similarities. Present your findings in a PowerPoint presentation.

## Public transport

An advantage of medium- to high-density housing is that it often provides greater opportunity to use public transport. Because this type of housing has a higher population density, there is more opportunity for people to avail themselves of public transport.

Public transport in cities primarily consists of buses, trains, light rail and ferries. For example, Source 7.8 shows a Melbourne tram; it provides a transportation link into the city's Central Business District.

In Sydney the ferry services provide an important transport link between regions of the city.



**Source 7.8** A tram in the city of Melbourne



**Source 7.9**

In Sydney, ferries are an important part of the transportation network.

## Education and health care services

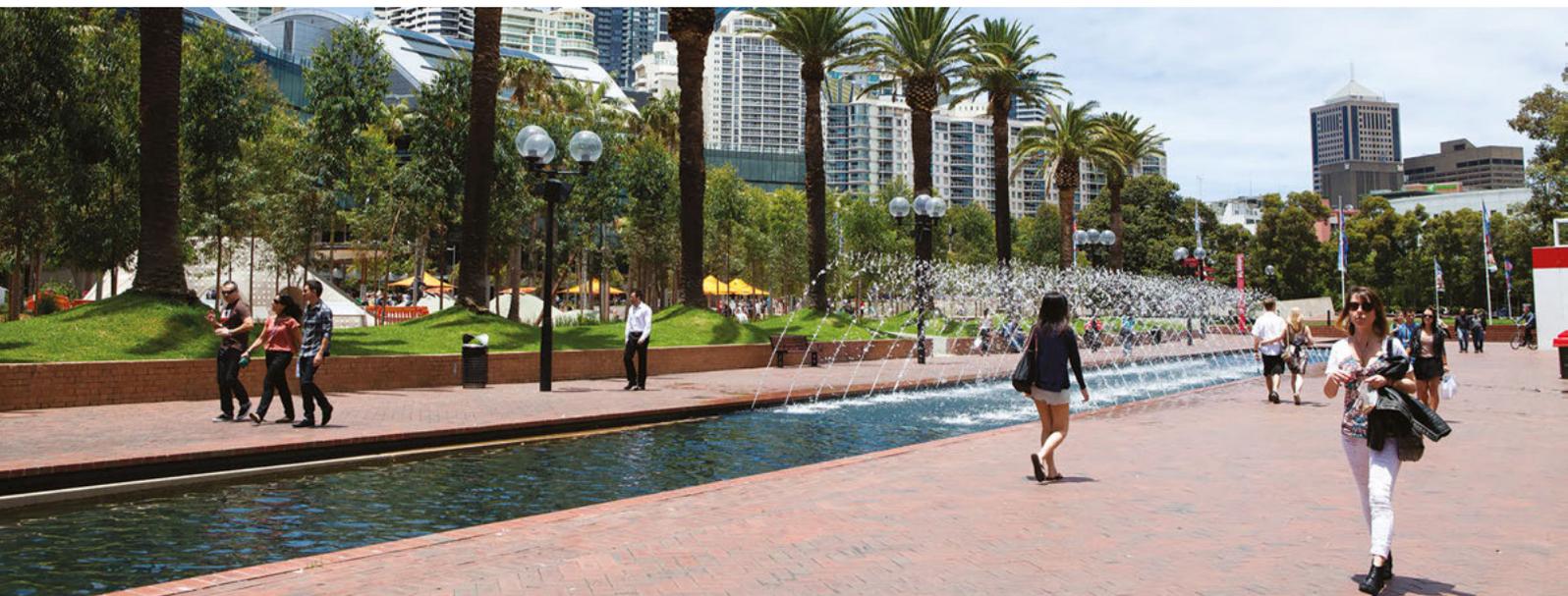
Accessibility to education and health care are important factors in the liveability of a place. The Economist Intelligent Unit's (EIU) Liveability Index has five broad categories it uses when determining a city's liveability – two of these categories are education and health care. Access to public transport is also intertwined with the availability of education and health care. Public transport gives all people access to services and facilities, regardless of their socio-economic status. Therefore, cities or places that have a good

public transport network tend to have greater liveability as the physically and economically disadvantaged people are able to travel from their home to centres of health care and education.

### Walkable neighbourhoods

The 'walkability' of a place also impacts on its liveability and access to health and education. People often have to walk to places of public transport (such as a bus stop or train station). According to the Bureau of Transport Statistics (BTS), 26% of trips to education and childcare in Australia are made on public transport.

**Source 7.10** The walkway at Darling Harbour Sydney helps people access services and parts of the city they need, such as health and education.



### Activity 7.3

- 1 What transport infrastructure exists where you live? Suggest how this could be improved.
- 2 Identify some of the other examples of major infrastructure in your area, such as education (schools, childcare centres and universities) and health care (hospitals, doctor clinics, ambulance services). How does the provision of infrastructure affect 'liveability'?

**RESEARCH 7.3** //

Using the internet or a newspaper, analyse the local advertisements for houses and businesses for sale. Take note of the details mentioned in the advertisements; for example, proximity to schools, services and good roads (passing traffic for commercial sites are often listed). This should provide you with a collection of terms that are used to describe highly liveable places. Present your findings in the form of a poster. Alternatively, write your own advertisement for a fictitious house or commercial property. Be sure to mention some of the liveability concepts covered in this chapter.

## Recreational and cultural facilities

### Recreation

People's recreation and leisure activities are likely to be motivated by personal choice and the availability of services. This is another interesting question to ask of grandparents or older residents in your area: what did they

do for leisure that is different from what you and your friends like to do in your spare time? Playing and attending sporting events are important pastimes for many Australian residents, as is playing computer or video games at home with friends. Other activities include going to cinemas and entertainment centres, or the zoo and botanical gardens, as well as cafes, restaurants, theatres and museums.

**Source 7.11** Sydney's Royal Botanical Gardens



## Arts and cultural landscape

Arts and culture may contribute to the appeal of a place. For example, is your town or city famous for any annual event? Perhaps the following are part of the annual calendar of arts and cultural activities:

- rock, jazz, country music festival (for example, Tamworth Country Music Festival, Parkes Elvis Festival, Port Fairy Folk Festival)
- agricultural show
- major events (such as the Sydney to Hobart yacht race or the Melbourne Cup)
- food-tasting festivals and farmers' markets
- busking and street performers
- museums and art galleries
- street markets (e.g. Southbank in Brisbane, Fremantle Market in Fremantle, Salamanca Market in Hobart, St Kilda and Southbank markets in Melbourne)
- annual parades (e.g. Anzac Parade; Australia Day; tulip festivals and other flower or botanical exhibits; street parades for sporting events).

**Source 7.12** Some of the racing yachts in the 2014 Sydney to Hobart yacht race – considered one of the greatest yacht races in the world. 2014 marked its 70th year.



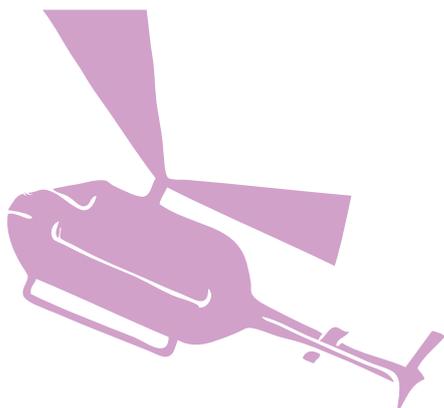
### Activity 7.4

- 1 List all the recreation and cultural facilities available within your local area.
- 2 Identify the facilities you and your family use and the frequency of their use.
- 3 Where are these located relative to your home? Which are furthest from home?
- 4 Locate the answers you gave to Question 2 on a map. What do you observe in the distribution?
- 5 Draft a letter to your local council arguing for a more diverse range of recreational and cultural facilities to improve the liveability of all individuals and groups in society.

## 7.2 Accessing services and facilities in different places

Accessibility to services and facilities clearly plays a large role in a place's perceived liveability. The level of accessibility changes between urban, rural and remote places in Australia, including Aboriginal and Torres Strait Island people's communities.

People living in urban areas tend to have greater accessibility than those in rural areas, who may have to travel long distances to school or health care (for example). Although rural areas have less accessibility, they still have more facilities and services available than remote Australia.



### Remote Australia

The concept of **remoteness** in Australia refers to how far away something is from another **relative location**. There is a difference between how far people have to travel by road in a city for access to goods and services and the distances that people have to travel in the country.

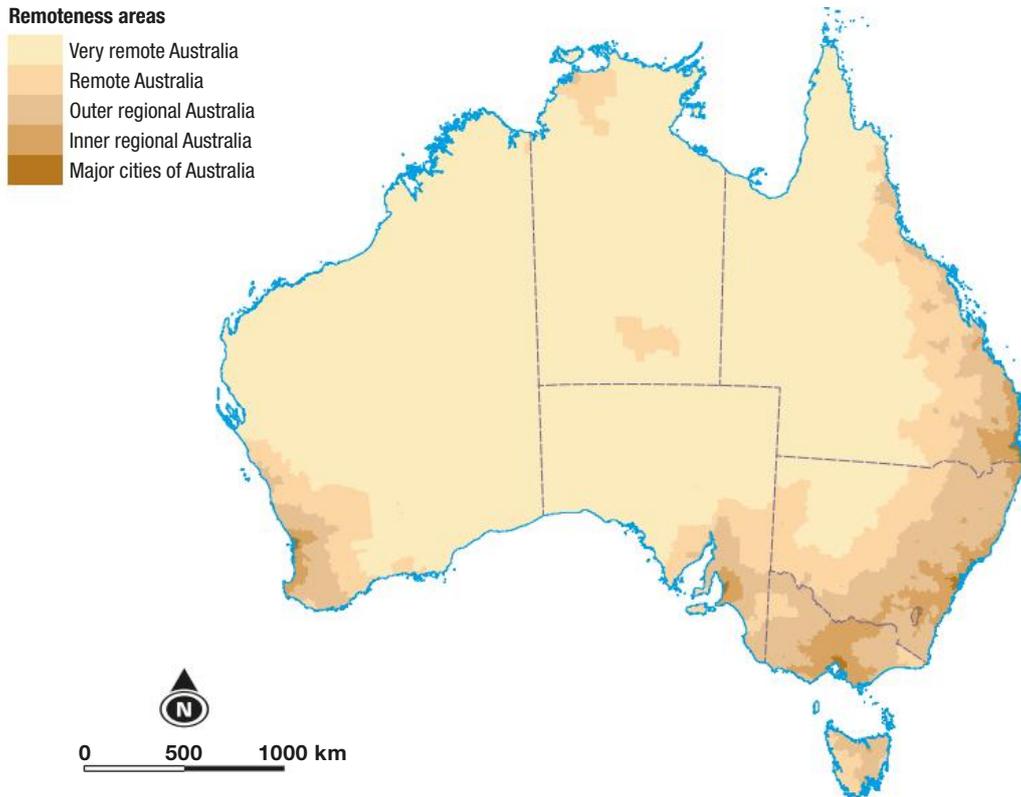
However, the distinction between city and country areas is often unclear. The Australian Bureau of Statistics (ABS) has developed an Accessibility/Remoteness Index in order to make data collection and classification of areas in Australia easier. Different groups of people have different perceptions about remoteness and this affects where they are prepared to live.

**remoteness** distance, a very distant situation

**relative location** location relative to other places e.g. the distance of a town from other towns

### Geographical fact

As of 20 June 2006, 25% of Aboriginal and Torres Strait Islander peoples lived in remote Australia and highly remote Australia, and 32% lived in the major cities of Australia.



Source 7.13 Map of Australia illustrating remoteness areas (based on the ABS, 2006)

**Activity 7.5**

- How is remoteness defined by the Australian Bureau of Statistics?
- Use the map showing remoteness and an atlas to classify the following settlements using the table below.
  - Albury
  - Bairnsdale
  - Brisbane
  - Broome
  - Cairns
  - Canberra
  - Charleville
  - Cobar
  - Cooper Pedy
  - Dubbo
  - Fremantle
  - Geelong
  - Katherine
  - Launceston
  - Mildura
  - Mt Isa
  - Rockhampton
  - Tennant Creek
  - Wagga Wagga
  - Yulara

Place	Highly remote	Remote	Outer regional	Inner regional	Major cities



**Source 7.14** Remoteness: the old telegraph station in Tennant Creek, Northern Territory



## 7.3 How limited access to services and facilities affects liveability

It is useful to now look at a place in Australia to see how limited access to facilities and services has impacted liveability for different

groups of people, and how this might be overcome.

We will look at Pyrmont in Sydney.

### Case study 7.1

#### Pyrmont, Sydney, New South Wales

**peninsula** a piece of land going out into water from a larger land mass

Pyrmont is a 1.6 km<sup>2</sup> **peninsula** next to the Sydney CBD. It has gone through a dramatic transformation in the last 30 years, from a major industrial

area and port facility to a high-density residential, commercial and recreational area.

The redevelopment of the Pyrmont area is one of the most significant urban renewal programs

undertaken in Australia. Pyrmont–Ultimo is one of the fastest growing areas of Sydney. In 1994, fewer than 5000 people lived in the area, but Pyrmont–Ultimo's population has increased as more facilities and services have been provided.

#### History

Pyrmont's history has seen many and varied uses for the small peninsula. During the time

**Source 7.15** The construction of a bridge between Sydney's CBD and Pyrmont in 1902 led to Pyrmont's rapid development.





of Indigenous Australians, Pyrmont was used as a location for hunting fish and gathering food, such as cockles. After 1788 and European occupation, the site of Pyrmont was owned by a number of individuals, who built sandstone quarries and port facilities. The rapid development of Pyrmont really began in 1902 when a bridge was built between Pyrmont and the Sydney CBD. During the early 1900s, Pyrmont saw a rapid growth of industrial activity. The suburb became the major port for Sydney, and a large number of other services sprang up around it, such as railway goods yards, wool stores and large **wharfs** to

**wharf** a human-made landing place for ships on a shore

accommodate the ships. There were also two major industrial businesses located in Pyrmont – a power station and a CSR sugar refinery.

During the 1970s and 1980s, Pyrmont started to fall into urban decay. One reason for this was the relocation of the port facilities to a modern site at Port Botany. Other reasons included the closure of the power station and the relocation of the sugar refinery to Queensland. As a result of this, the population fell dramatically; in the late 1980s it was only about 900 people. The built environment fell into disrepair, with houses and factories

left to decay. In 1992, the New South Wales government initiated a major urban renewal program for Pyrmont, funded in part by a \$241 million grant from the federal government's 'Building Better Cities' program. The aim of this program was to revitalise the suburb into a modern mix of residential, commercial, retail and recreational areas.

### Socio-cultural and environmental advantages

As part of the urban renewal process, a number of significant changes were made to the housing in Pyrmont. During the suburb's industrial period, the houses primarily consisted of small stone workers' cottages. During the renewal process, the new housing was instead designed as high-density housing. There are a number of **socio-cultural** and environmental advantages to this:

**socio-cultural** relating to both society and culture

- Providing a range of high-density housing is a good way to maximise the use of the restricted land available.
- Utilising high-density housing freed up large areas of land that have been designated as **green space**, such as Pirrama

**green space** an area of grass, trees or other vegetation set apart for recreational purposes in an urban environment

Park. This provides valuable recreational areas for residents and visitors, as well as improving the appearance of the suburb.

- A range of services to cater for the residents (e.g. cafes, restaurants, bars and supermarkets) has been developed; these are more commercially viable in high-density areas.
- Transport infrastructure has been developed to cater for the increased population (cycleways, walkways and monorail – though the rail system was removed in 2013).

The high-density housing, combined with the proximity to the Sydney CBD and the development of services, has catered for the young professional **demographic**, who are the

**demographic** a group of people defined by a particular shared characteristic

dominant age group that now live in Pyrmont (36% of the population is aged 25–34 years).

The development of medium-sized businesses in the area (particularly technology and entertainment businesses) allows people to be employed and live close to where they work. These businesses include Channel Seven, Channel Ten, Fox Sports, Google, Nokia, the Star Entertainment Complex and Nova radio station.

### Socio-cultural and environmental disadvantages

As well as all the advantages, there are some negative aspects to the development of Pyrmont:

- The domination of high-density housing creates environmental issues because it

**Source 7.16** After the removal of the monorail on Pyrmont Bridge in 2013, the resurfaced public space has improved the shared use between cyclists and pedestrians.



increases the production of waste products in a small area.

- Rents and housing costs in Pymont are higher than in other regions, making it difficult for many people to consider living there.
- The area is increasingly dominated by one demographic (young professional people) and is therefore not a real reflection of society as a whole. People living in Pymont may not have easy access to their extended families, and the community lacks variety and richness.

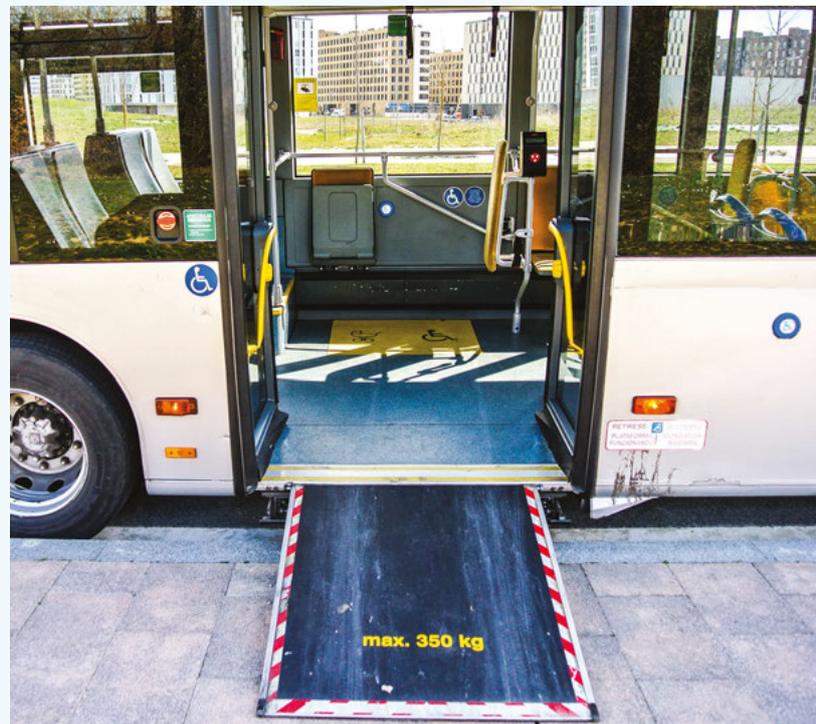
### The liveability of Pymont for different groups

As discussed, Pymont is a popular location for the young professional demographic. It would also be ideal for some middle-aged people who work in Sydney's CBD because of its easy access to places of employment, shops, cultural and leisure-time facilities, public transport, cycle ways and gardens. They are also the predominant group that can afford to rent or buy housing in expensive areas like Pymont. However, how would limited access to services and facilities affect Pymont's liveability for other groups in society? For example, Pymont might not suit families with children and educational needs, as often people choose to live close to schools, which are usually located in the outer suburbs.

### People with disabilities

In Australia, approximately 18.5% of the population has a disability. That is nearly one in five Australians. A disability is defined as any impairment, restriction or limitation that restricts

daily activities and has lasted for at least six months. People who are disabled often choose to live in places that offer the services they need. This means that, generally speaking, disabled people tend to prefer to live in urbanised areas that have better facilities and services. An inner-city location like Pymont may lack the specific services people with disabilities require such as health care providers, and high rates of city commuter traffic could pose problems for people with disabilities accessing public transport. Furthermore, many Australians with a disability are cared for by their family or friends in a household environment, often in urban areas. This contrasts sharply with Pymont's inner-city location and high-rise apartment living style.



**Source 7.17** A bus with ramp access for those with a mobility disability, such as a wheelchair

## Geographical fact

Approximately 18.5% of the Australian population lives with a form of disability; this means a little over 4 million people (ABS, 2012).

### The aged

Australia's population is ageing. In 2014, 14.7% of the population was 65 years or more, which is approximately one in every seven Australians. Older people generally spend more time on social and community interaction, especially as many of them have retired from work by age 65. Places that tend to be most liveable for the aged are those with accessibility to facilities and services, but also proximity to a community they care about. Retired people often choose

to escape the hustle and bustle of life of the inner city, and move to coastal environments for a 'change of pace'. For these reasons in particular, Pymont may possibly not suit the lifestyle preferred by many aged people.

- 1 Suggest one reason why the port facilities might have been moved from Pymont to Port Botany.
- 2 Why do you think the Australian government established a 'Building Better Cities' program? Investigate the history of the program and name two other regions that have benefited from it in the past.
- 3 Compare the changes in Pymont from colonisation to the modern day to the history of growth and change in your own town or suburb, or another town or suburb you know. Are they similar or different? Suggest three reasons why your suburb or another suburb changed in different ways from Pymont.
- 4 Explain in 200 words how limited access to facilities and services affects the liveability of Pymont for people with disabilities, the aged, or another group of your choice.



**Source 7.18** Generally speaking, older Australians prefer to retire to quieter locations rather than busy inner-city suburbs like Pymont.

## Fieldwork 7.1 Exploring your local community

### Aim

To analyse how your local community functions in the provision of goods and services, transport and utilities and recreational space and activities. Your local community may be a small town, region, suburb or city.

### Method

Define the borders and parameters of your local community. Your community must be able to be mapped within clear boundaries.

### Preparations

Find a map of your local community and indicate the areas that will be visited and studied (you must visit at least three sites). You will also need to take a camera/phone, a list of questions based on the 'data collection' section below, paper (in clipboard) and a pen.

### Data collection

As you travel along the suggested path on this fieldwork trip, stop at various sites and ensure that you collect the following information in preparation for your fieldwork report:

- 1 List all the public transport available in your community. Take photos of some of these. Mark the location of these on your blank map. Provide a key to display your data collection.
- 2 Show on your blank map any recreational spaces in your community.
- 3 Is there any evidence of visible pollution or rubbish in your community?
- 4 Locate on your map any available community services, such as senior citizens clubs, swimming pools and skate parks.
- 5 Locate on your map examples of health services: doctors, infant welfare centres and hospitals.

### Fieldwork presentation layout

Front page	Title and name
Contents page	Do this last, as well as numbering pages
Page 1	Aims and methods
Page 2	Location map
Page 3	Introduction – brief description of the study sites
Page 4–5	Description of uses and photos
Page 6	Table of usage: Effects of use (positive or negative, short-term or long-term)
Page 7–8	Description of effects of use, sketches and/or photos
Page 9	Association between use and effects of use
Page 10	Table or written description of management strategies
Page 11	Photos of sketches of management strategies
Page 12	Evaluation of these strategies
Page 13	Appendix, bibliography, glossary

## Chapter summary

- Infrastructure, such as services and facilities, is an important part of the perceived liveability of a place.
- The availability of and density of housing has an impact on a place. High-density housing, such as apartments, slows down urban sprawl, which has ecological advantages but then has a significant impact on services and facilities available in the area.
- Access to safe water and sanitation is crucial for liveability. Australians are very fortunate to have running taps with drinkable water in their homes as well as access to reticulated sewage systems, which transport and treat waste.
- Transportation networks, including public transport, allow people to access other services and facilities.
- Education and health care are important for a person's wellbeing and increase the liveability of a place.
- Recreational and cultural facilities add to the liveability of a place.
- Urban parts of Australia have greater access to services and facilities than rural Australia, which in turn has greater accessibility than remote Australia.
- Pyrmont's liveability in Sydney dropped when its port operations were shifted to Port Botany in the 1970s and 1980s. But thanks to an initiative started in 1992 by the NSW government, there is a rise in liveability again due to the increase in services and facilities available.
- Limited access to services and facilities affects the liveability of Pyrmont for different groups. While it is ideal for younger and middle-aged professionals working in Sydney's nearby CBD, people with young families, the disabled and the aged might find Pyrmont a less desirable place to live.

## End-of-chapter questions

### Short answer

- 1 Summarise the advantages and disadvantages of low- and high-density housing. Refer to their impacts on services and facilities.
- 2 Why are education and health care so important for a place?
- 3 With reference to other services and facilities, explain why public transport is crucial for a city. You may also like to refer to some actual examples, such as comparing Sydney to another city.

### Extended response

To what extent do services and facilities influence the liveability of your town or neighbourhood? In your response, consider the availability of housing, water and sanitation infrastructure, transportation networks, education and health care services, environmental quality, personal and public safety, recreational and cultural facilities. Also consider how the location – urban, rural or remote – of your town or neighbourhood influences access to these services and facilities.

# 8

## Environmental quality

**Source 8.1** Melbourne is considered to be one of the most liveable cities in the world. Pictured is St Paul's Cathedral and one of Melbourne's famous trams.

### Before you start

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#### Main focus

Environmental quality is a major factor impacting the liveability of a place.

#### Why it's relevant to us

People like to live in nice areas that are clean, well maintained and pleasant to walk or drive around.

#### Inquiry questions

- How does the environment influence a person's perception of its liveability?
- What are the factors that can reduce environmental quality?
- How does environmental quality impact the liveability of different places around the world?

#### Key terms

- conflict
- environmental quality
- land degradation

- natural hazards
- open spaces
- pollution
- population pressures
- traffic
- visual aesthetics
- water

### Let's begin

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Melbourne has been named the world's most liveable city by *The Economist* for five consecutive years. Factors taken into consideration for Melbourne's rating revolved around the city's environment. Melbourne has a lot of open spaces such as parks and public gardens, and has low levels of pollution compared to other large cities in the world. These and other factors contribute to the perceived environmental quality of Melbourne and its overall liveability.

## 8.1 Factors that reduce environmental quality

Environmental quality refers to the standard of the environment surrounding us. The higher the rating of environmental quality, the greater is **human wellbeing** and the higher the liveability of the region.

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**human wellbeing**  
the quality of life of a population

---

Environmental quality takes into consideration a wide range of environmental factors including air, water, soil, land, plants and animals (biodiversity).

The quality of our environment is important to our wellbeing. We would all like to have clean air, clean water and access to natural assets, such as the Great Barrier Reef or the Freycinet Peninsula in Tasmania.

In Australia, the 'State of the Environment Report' is produced every five years by the Australian Bureau of Statistics. At a federal and state/territory level, our governments have recognised that biodiversity, land, water, atmosphere and waste are all interlinked.

**Source 8.2** Environmental quality is important to us, and important in maintaining our natural assets, such as the Freycinet National Park in Tasmania.

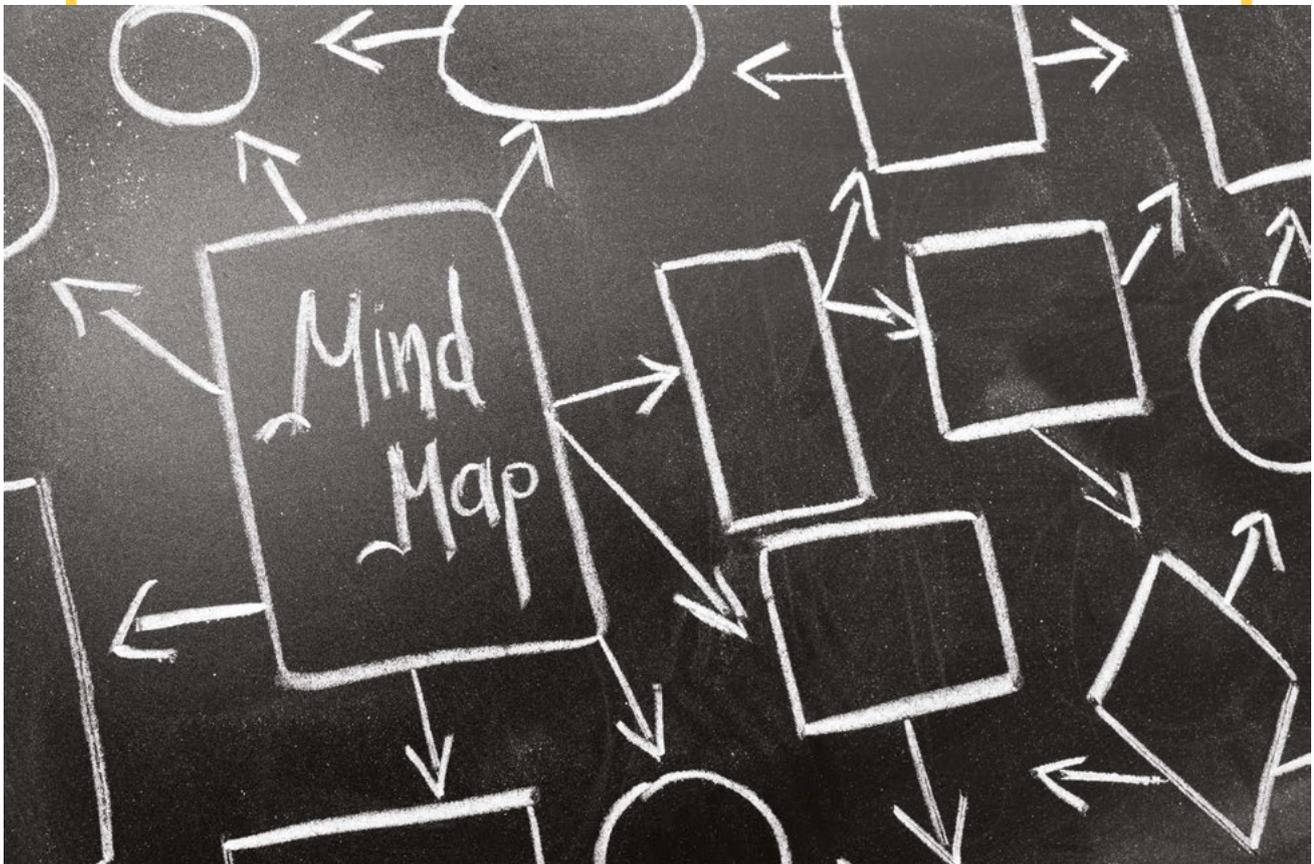


## Activity 8.1

Below is a list of factors that may reduce environmental quality.

- alteration of water courses
- alteration of water supplies
- exploitation of plant and animal species
- habitat loss for plant and animal species
- clearing of land
- overgrazing and overcropping the land
- heavy tourism
- introduction of foreign species
- demolition of historic cultural sites
- urban development
- industrial development – acid rain
- excessive car usage – smog
- global warming and the ozone layer
- waste disposal
- lack of funding
- absence of leadership and governance
- overfishing
- absence of government policy and practice

- 1 Create your own list using the factors above but place them in order from 1 (the biggest contributing factor) to 18 (the least).
- 2 Then draw a concept map connecting each of the 18 factors listed above to indicate which factors affect others. You should highlight the most important ones.



**Source 8.3** Creating a concept map helps identify links between factors.

## Natural hazards

One clear way that the environment can affect liveability is through the amount of natural hazards that occur in a place. There are two major types of natural hazards: atmospheric and hydrologic hazards. **Atmospheric**

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**atmospheric hazard**  
hazard event originating in the atmosphere e.g. storms, tropical cyclones

**hydrologic hazard**  
hazard events originating in the hydrosphere from changes to the water cycle e.g. floods and droughts

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**hazards** are any natural hazards that occur primarily due to processes in the atmosphere; for example, cyclones, bushfires and severe thunderstorms. **Hydrologic hazards** are any that occur primarily due to too much water (flooding) or too little

(drought). Importantly, atmospheric and hydrologic hazards tend to be linked. In other words, many hazards tend to be both

atmospheric and hydrologic in nature. For example, droughts occur not just due to a lack of water – processes in the atmosphere are also responsible. Similarly, bushfires occur not just due to the atmosphere but also availability of and accessibility to fresh water.

### Drought

Drought is a natural hazard that reduces the environmental quality of an affected location. The duration of most weather hazards is relatively brief. Cyclones will last a couple of hours before moving on, and the duration of floods can usually be measured in days – but not so with drought, a major atmospheric and hydrologic hazard.

The simple definition of drought is a lack of normal rainfall over an extended period

**Source 8.4** A severe thunderstorm developing over the plains of mid-western America





**Source 8.5** A Sudanese man rides a water carrier to the nearest water source near Khartoum. Sudan is one of the least developed countries in the world and has a serious water supply problem.

of time, although the causes of drought can be much more complex, such as higher than average temperatures causing abnormal evaporation and transpiration. Drought differs from aridity, which is a permanent feature of climate in regions with low rainfall. Many of the dry inland areas of central Australia would be classified as arid because of normally low

average rainfall. **Meteorologists** typically determine when a region is suffering drought by comparing the current patterns

**meteorologists** people who study weather and climate

of rainfall to an average based on a 30-year period of records.

Even areas that get regular rainfall can experience drought. Unlike other weather hazards that people can see happening before their eyes, such as heavy rainfall or surging water, drought is a slowly evolving menace that is usually only clearly perceived through

its effects: water supplies dry up, crops fail to grow, animals die, dust storms blow away the precious topsoil, and in poorer countries of the world malnutrition and ill health become widespread when people's normal sources of food no longer exist. Some of the most haunting pictures of drought are illustrated in communities in East Africa such as Sudan and Somalia, where drought and famine have severely impacted many generations.

### Bushfires

A dangerous side-effect of drought that is particularly hazardous in Australia is an increased risk of bushfires. The Ash Wednesday bushfires that devastated regions of Victoria and South Australia in 1983 were preceded by an 11-month drought. More recently the Black Saturday bushfires, on 7 February 2009, claimed 173 lives and



**Source 8.6** The Black Saturday bushfires on 7 February 2009 took 173 lives and over 2000 homes. Here you can see the devastation in South Gippsland, Victoria.

over 2000 homes. There had been at least 10 years of drought prior to this event, and in the two months preceding the bushfires there had been little to no rainfall. Furthermore, the days preceding the fires were some of the hottest on record with temperatures up to 46°C.

The threat of bushfire is a constant worry for many people living in areas of dense bushland. Places like California in the USA and many rural areas of Australia regularly suffer from bushfires. People living in areas prone to bushfire have to have fire evacuation plans in place in case of emergency and follow the guidelines of emergency services such as NSW's Rural Fire Service. The bushfire danger of certain environments is a factor that could certainly reduce the liveability of a location for many people.



**Source 8.7** A NSW Rural Fire Service helicopter fills with water in Penrith to fight bushfires in the Blue Mountains in October 2013. Smoke from the fires can be seen in the background.

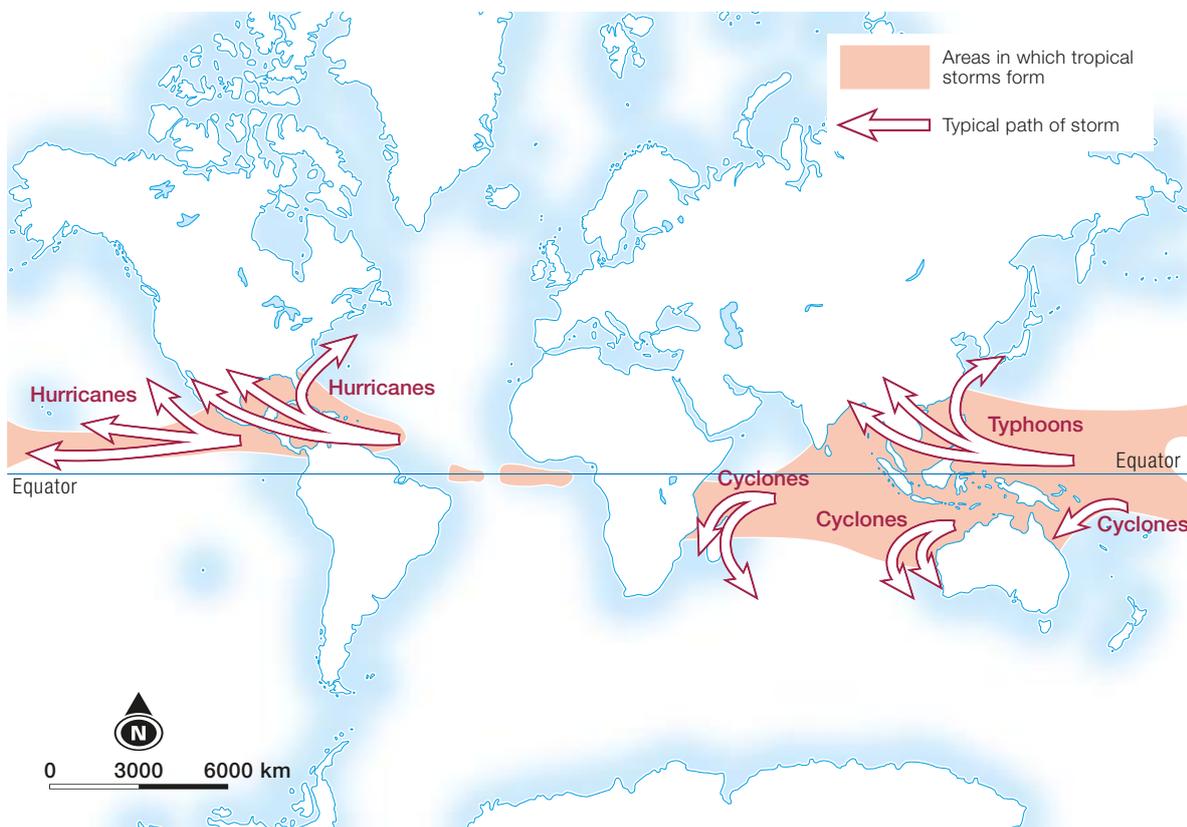
## Tropical cyclones

Another natural hazard that greatly reduces the environmental quality and affects the liveability of places is tropical cyclones. Around the world, about 80 tropical cyclones form every year. Some of these tropical cyclones pose enormous threats to life and property in tropical areas, from the northern coasts of Australia to the Bay of Bengal in south Asia. You may have heard of them by different names, which depend on where they form:

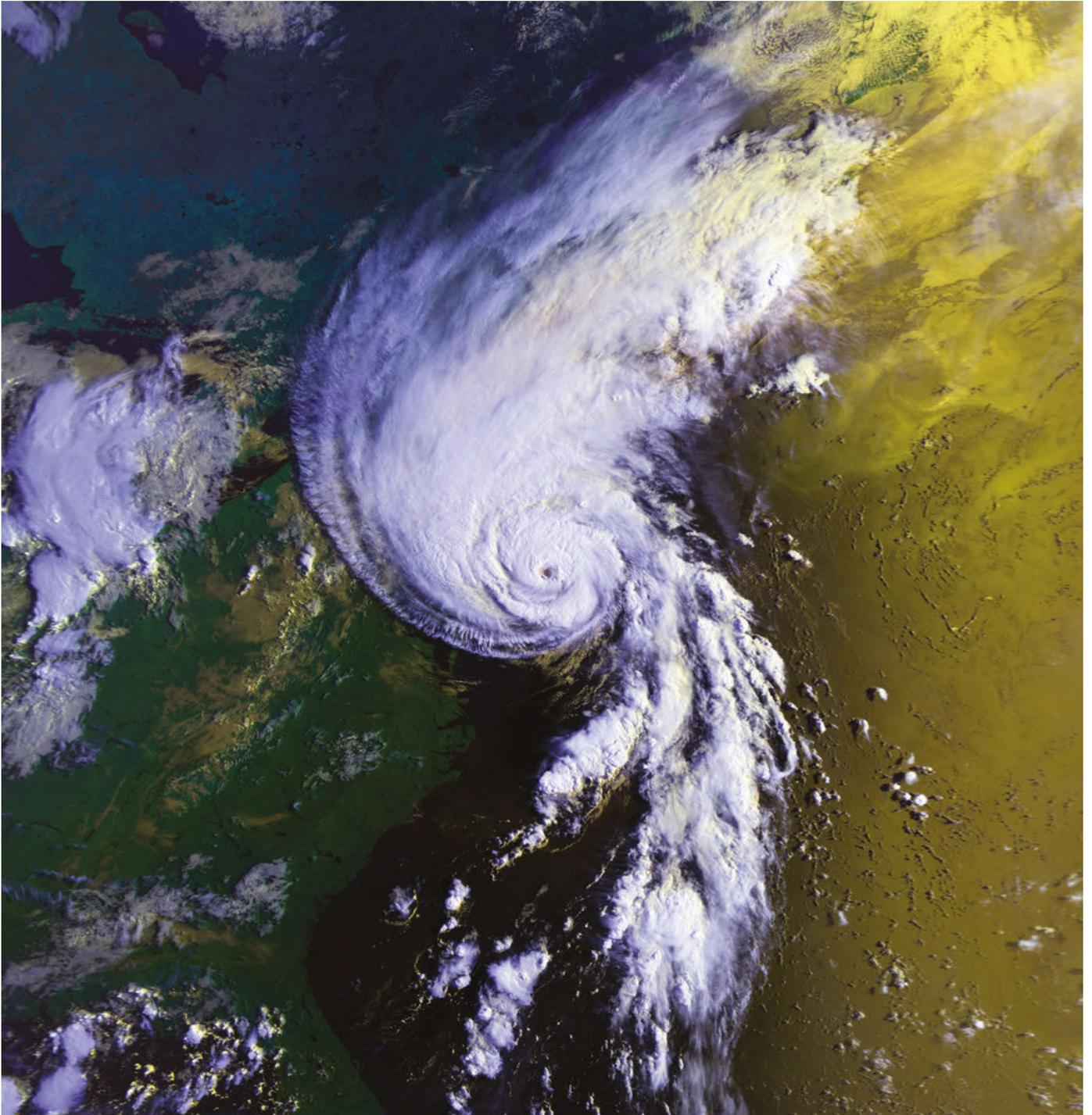
- typhoons, in the western North Pacific Ocean and the South China Sea
- hurricanes, in the Atlantic, the Caribbean and the Gulf of Mexico, and in the eastern North and Central Pacific oceans
- tropical cyclones, in the Indian Ocean and South Pacific regions.

Much the same as a thunderstorm, a tropical cyclone needs moisture, instability and the energy of the sun to form. Tropical cyclones are areas of air that rise rapidly and rotate around a central core (known as the 'eye'). They are generally accompanied by strong winds and torrential rain.

To be officially called a tropical cyclone, these storms must have wind speeds in excess of 119 km/hour. While the strongest winds are near the centre, damaging winds can extend several hundred kilometres from the centre. In some tropical cyclones, wind gusts of over 360 km/hour and rainfall of 1800 mm in 24 hours have been recorded. Clearly identifiable on satellite images as large swirling masses of cloud, tropical cyclones can cover large areas, from 80 km to over 1000 km in diameter. In the Southern Hemisphere these winds rotate in a clockwise direction; those in the Northern Hemisphere rotate anticlockwise.



**Source 8.8** Tropical cyclones as they are known in different parts of the world



**Source 8.9** A satellite image of Hurricane Bob, which greatly affected parts of the New England region in the USA in 1991

Tropical cyclones need the energy provided by warm water (at least  $26^{\circ}\text{C}$ ) to create the conditions for their formation, which means they generally form only in tropical waters in the summer months.

Above the warm ocean, water evaporates, rising into the atmosphere in its gaseous state to form clouds, which are bodies of condensed water. Clouds form because of the cooling of the water vapour that takes

place as the moist air rises higher into the atmosphere. As the water vapour condenses, it releases the heat contained in it that made it a gas in the first place. This released heat further warms the surrounding atmosphere, making it lighter and causing it to rise higher still. This light air creates an area of low pressure, which in turn draws more moist air from the ocean, creating an ongoing cycle that increases in intensity. It is this drawing-in of more moist air that creates the winds in a tropical cyclone.

What makes a tropical cyclone rotate is the Earth's rotation. This rotational force is called the Coriolis effect. Once a tropical cyclone moves over land or into the cooler waters away

from the tropics, it will usually disintegrate as it loses the moisture and heat needed to fuel it. The warm water needed for the formation of a tropical cyclone is found in the *tropics*, the zone between the Equator and the Tropic of Capricorn in the Southern Hemisphere and between the Equator and the Tropic of Cancer in the Northern Hemisphere. It is rare, however, to have a tropical cyclone form within 5° latitude of the Equator, because the Earth's rotational pull along this line isn't strong enough to cause the spinning force required. Therefore, there are only seven regions in the world where tropical cyclones form. In Australia, two of these are off the northern Queensland and northern Western Australian coasts.

**Source 8.10** Houses damaged by Hurricane Sandy in Queens, New York



## Activity 8.2

- 1 Construct your own annotated sketch of how tropical cyclones form.
- 2 In which direction do tropical cyclones travel in the Northern Hemisphere – clockwise or anticlockwise? In which direction do they travel in the Southern Hemisphere? What causes the difference in direction?
- 3 Referring to the table and an atlas, match the name of the country with the name used in that country to describe tropical storms. The first one has been done for you.

Country	Name
Fiji	Cyclone
United States of America	
Philippines	
Japan	
Bangladesh	
Madagascar	
Mexico	

## Conflict

Another potential hazard for the environment can result from military conflict. Luckily for us in Australia this is not really a problem in terms of liveability, but around the world there are many less fortunate people living in places suffering from armed conflict. As UN Secretary-General Ban Ki-Moon put it in a statement in November 2014 for the UN's International Day for Preventing the Exploitation of the Environment in War and Armed Conflict:

The environment has long been a silent casualty of war and armed conflict. From the contamination of land and the destruction of forests to the plunder of natural resources and the collapse of management systems, the environmental consequences of war are often widespread and devastating.

Throughout various conflicts, the environmental effects of war have often been overlooked or forgotten, because our main focus is on the human cost of such events. As an example of the environmental effects of conflict, in the first Gulf War in the early 1990s, the bombing campaign of the American-led coalition forces destroyed much of the region's infrastructure, resulting in destroyed oil pipelines polluting the soil, sewers running into the rivers and streets, and masses of garbage left uncollected. Retreating Iraqi soldiers also burnt down over 600 oil wells, causing massive environmental damage.



**Source 8.11** The environmental impact of armed conflict: oil fires burn outside of Kuwait City, Kuwait, during the Gulf War in 1991

## Population pressures

Population pressures can also reduce environmental quality. Overpopulation,

for instance, could lead to excessive food consumption and a lack of **food security**, and reduce the ability of an environment to support the population. However, we will

next look at two related results of population pressures in detail: pollution and traffic volumes.

**food security** when all people at all times have physical and economic access to sufficient, safe, nutritious food to maintain healthy and active lives

## Pollution

Pollution, unsurprisingly, is undesirable and it decreases the liveability of a place. Pollution impacts on quality of life. The World Health Organization (WHO) estimates that 800 000 people die globally per year due to urban air pollution. In addition, there are 50–70 million cases of respiratory illness each year – half of these are reported to occur in East Asia. For example, breathing the air in Mumbai, India, is reportedly the equivalent to smoking two-and-a-half packets of cigarettes a day. Water

pollution in poor cities and towns is also very concerning. People do not want to live in polluted areas that may impact on their health and wellbeing but, sadly, the most polluted areas in the world tend to be inhabited by the poor. The urban poor end up living where others choose not to as they have few other options.

### Traffic volumes

A large contributor to air pollution is traffic. The use of motor vehicles in the world is soaring, particularly in developing countries. The WHO estimates that by 2020 about half of the world's motor vehicles will be concentrated in third-world countries. For example, the city of Bangkok in Thailand is struggling with its

heavy traffic and resulting serious air pollution.

Thailand's government now has a 10-point plan for Bangkok in an effort to address some of these concerns and therefore improve the city's liveability. For example, the volume of traffic can be improved by effective public transport infrastructure. An added bonus of public transport is the reduction in air pollution.

### Land degradation

The way we use land changes landscapes and can cause degradation, which can have a negative effect on the biodiversity of a location. Human activities that adversely impact our landscape include aquaculture, agriculture and commercial fishing. Dams,

**Source 8.12** Heavy traffic, as shown here in Shanghai, China, can decrease liveability due to the increased air and noise pollution.





**Source 8.13** A green turtle at the Great Barrier Reef in Queensland – an environment that is experiencing degradation that puts pressure on the reef’s corals and biodiversity

channel straightening and drainage can contribute to the degradation of riverine and wetland landscapes. The Great Barrier Reef is experiencing degradation due to human activities including tourism, coastal and recreational activities. The reef’s corals and

surrounding biodiversity such as fish and other marine life are greatly affected by the pressure of human activity. The degradation of such a famous natural landmark as the Great Barrier Reef could ultimately affect the liveability of Queensland.

## Note this down 8.1

Copy the graphic organiser and describe each of the environmental characteristics affecting liveability. Also consider their impact on liveability.

Factor	Natural hazards	Conflict	Population pressures	Land degradation
Description				
Impact on liveability				

## 8.2 Comparison of the impact of environmental quality on the liveability of places

We will now study two places in the world to assess their environmental quality and how this has impacted their liveability. We will study two places with greatly contrasting scales: Port Hedland, a small mining town in Western Australia; and Nakuru, a major tourist and industrial city in Kenya.

### Small town: Port Hedland, Western Australia

#### Pollution

According to Environmental Justice Australia's 2014 report, Port Hedland is one of the most polluted towns in Australia. Port Hedland is a

mining town on the northern coast of Western Australia. It exports about 200 million tonnes of iron ore a year, which will increase to 450 million tonnes by 2015. Its biggest source of air pollution is the iron ore dust from port operations. This pollution is thought to exceed national standards, and hospitalisation for respiratory issues is 30% higher than the state average. Port Hedland's problem with pollution makes it less liveable.

#### Cost of living and services

In addition, however, there are other factors affecting its liveability – affordability and services. Port Hedland is a very expensive town to live in. For example, a three-bedroom house in the town costs approximately \$2500 a week. A lot of workers choose to fly in, fly out (FIFO), not only due to the high living costs but also because their families would rather

**Source 8.14** Port Hedland, a mining town in Western Australia, is one of the most polluted towns in Australia.



stay in their current homes than move to Port Hedland.

There are also fewer services available in Port Hedland compared to other parts of Australia. For example, more doctors are needed in the town. In fact the council of Port Hedland is currently investing in its services in order not only to attract workers to move permanently (rather than FIFO), but also to attract more GPs.

### Large city: Nakuru, Kenya

Nakuru is the 4th largest town in Kenya, and is located in the Rift Valley Province at an altitude of 1859 metres above sea level. On the outskirts of the town is the Lake Nakuru National Park, which is famous for its bird life, particularly the thousands of flamingos that live there.

**Source 8.15** Lake Nakuru on the outskirts of the town of Nakuru is famous for its large population of bird species, particularly flamingos.

### Population growth

Nakuru has experienced dramatic population growth, from 57 000 inhabitants in 1957 to more than 400 000 in 2004, and in 2015 the population is estimated to be 600 000. The population density has placed a great deal of pressure on the town's infrastructure including housing, water and sanitation. Poor waste management is posing a threat to the lake's ecosystem and the River Njoro.

### Pollution

Nakuru's main industry is agriculture. However, other industries include textiles, soap manufacturing, tanning, milling and oil refinement. Unfortunately, pollution has been created due to the lack of regulation of industrial waste, so there can be high levels



of metals in the lake's water, which has been linked to the death of wildlife in the national park, and to the health problems of the Nakuru population.

### Housing and water

Nakuru is divided into regions called wards. These are like suburbs. In the poorer parts of the town, like the Rhoda ward, there is a shortage of housing and hence there are many temporary dwellings built. Often there are as many as 30 single rooms on one plot, without running water or electricity. The poor access to water results in residents having to rely on sourcing their water elsewhere, such as buying water from private vendors.

Sadly, according to the WHO, waste management is a further issue, with the disposal of human waste occurring mostly through pit latrines which connect to open drains, leading to unhealthy living.

### Services: health care, roads and education

Services, such as health care, are lacking in the poorer parts of Nakuru. For example, in the Rhoda ward residents walk a minimum of 3 km to receive health care. Furthermore, even if transport is available, residents often need to walk as the roads are badly looked after, or due to their poor construction are often flooded or blocked due to heavy rains and poor drainage systems. Bicycle taxis are common in Nakuru, especially in Rhoda where there are reportedly 8000 bicycle taxis, but as they compete for space there are regular accidents on the road which further blocks traffic.

There is also a shortage of schools. The average class size is 48 students, and most children need to walk long distances to school. Furthermore, there is a lack of sporting grounds and social areas.



**Sources 8.16** In some of the poorest parts of Nakuru, residents have to walk kilometres to access water.



### Activity 8.3

- 1 Identify and briefly describe the factors reducing the environmental quality of the town of Port Hedland and the city of Nakuru.
- 2 Justify which factors you think have the most impact on each place's environmental quality.
- 3 Account for any similarities between the factors impacting Port Hedland and Nakuru.
- 4 Reflect on how the liveability of these places might be improved. Brainstorm with the person next to you and then share your findings with the class.



Sources 8.17 Port Hedland, mining town

## Chapter summary

- Environmental quality refers to the standard of the environment surrounding us. The higher the rating of environmental quality, the greater our wellbeing and the higher the liveability of the region.
- Therefore, the environment of a place contributes a great deal to people's perceptions of its liveability.
- Natural hazards, including drought, bushfire or tropical cyclones, can reduce environmental quality.
- Military conflict can greatly reduce environmental quality, including water and soil quality.
- Pollution, as a result of population pressures, can decrease a place's liveability so the quality of air and water, for example, is a factor.
- The volume of traffic is another influential population pressure – therefore, the heavier the traffic, the greater the pressure on roads and the environment, which can then lead to a decrease in perceived liveability.
- Land degradation through human activities like agriculture or tourism is another environmental pressure that can affect liveability.

## End-of-chapter questions

### Short answer

- 1 Discuss how natural hazards can reduce the environmental quality of a place.
- 2 Is there a relationship between pollution, traffic and liveability? Explain how they may/may not be connected.
- 3 Compare Port Hedland to a city like Sydney. Why might Sydney be more liveable than Port Hedland?

### Extended response

Discuss the most influential factors on the environmental quality of a place and how these can affect liveability.



# Community

**Source 9.1** The community identity of Bega, a country town in NSW, is influenced by its dairy farming industry.

## Before you start

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### Main focus

Community identity and social connectedness are important parts of the liveability of a place because they give people a sense of wellbeing and value.

### Why it's relevant to us

By understanding community identity and social connectedness, we can have an influence on the liveability of our places – whether our cities or our countries.

### Inquiry questions

- What is community identity and social connectedness?
- Why are they important for people?
- What factors help a place develop a community identity?
- How can social connectedness be enhanced?

## Key terms

- community identity
- Country/Place
- social connectedness

## Let's begin

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For many of us, the place where we live will be determined by our parents and their decisions. Often our parents and ancestors have links with our country and homes that go back for centuries. We can be born into a strong community identity. However, for other Australian families the choice of a place to live is a more recent decision and likely to be linked with employment, personal mobility and lifestyle, and social connectedness. For example, families that live in the NSW town of Bega may have connections to the dairy farming industry, which contributes to their community's identity.

## 9.1 Characteristics of places that influence community identity

In 2013 the Australian Bureau of Statistics (ABS) released a report on Australia's overall progress as a nation, across a range of criteria. One criterion was 'Community connections and diversity'. According to the ABS:

Australians told us that it was important for individuals to feel connected with, contribute to, feel included in and valued by their community beyond their family and friends. An important aspect of this relationship was reciprocity, where people both give to and receive from the community. Connectedness was seen as something that can be built through quality interactions, for example through cultural activities, volunteering and services provided within the community. It can be evident in the shared sense of identity that communities and Australians have.

Source: ABS, *Measures of Australia's Progress* (2013)

Identity and **social connectedness** are important in local communities. A human **community** is a group of people that share the same interests, place or space. Communities can be very small, like a tiny village of 100 people, or very large, like the international community. Each community has a goal of achieving what is best for that group in that setting. There are many different communities in and around Australia, for example:

- sporting groups, such as soccer and netball clubs
- skill-based communities, such as music groups and art and craft centres
- mothers' groups and play groups, such as the Crows Nest Community Centre, Sydney
- your school community
- ethnic groups, such as the Vietnamese community
- religious groups, such as the Buddhist community.

**social connectedness** a measure of the number and strength of people's social relationships with other people in the same place, or in other places via face-to-face connections or electronic methods. The opposite of good social connections is social isolation, or loneliness

**community** a group of people sharing the same locality or similar interest

**Source 9.2** Schools play a role in the identity of a community.



Strong and supportive communities mean that some people find those areas more liveable because they can contribute and also feel valued, heard and understood.

## Culture

Australia's population is one of the most multicultural in the world. There are many parts of Australia that have a community identity that is intertwined with the immigrants that now live in that area.

According to the ABS, between the years 1991 and 2011, the proportion of overseas-born Australian residents (who have lived here

for five years or more) who became Australian citizens rose from 70% (1.9 million people) to 80% (3 million people). This suggests that not only is Australia continuing its rich tradition of multiculturalism, but also that migrants feel a sense of identity and connection to the areas they are moving to. This is a very positive trend and indicates that Australia, as a whole, is considered to be a liveable nation. The ABS also states that the average Australian recognises the value of diversity and cultural and social differences in our population, particularly for Aboriginal and Torres Strait Islander peoples.



**Source 9.3** Australia's multiculturalism is a valued part of our community. Here is the Chinese Garden of Friendship at Darling Harbour in Sydney, not far from Chinatown.

## Aboriginal and Torres Strait Islander peoples

Aboriginal and Torres Strait Islander peoples have lived continuously in Australia for over 50 000 years. At the time of European settlement, approximately 600 different clan groups or 'nations' lived around the continent, each with its own language, cultural traditions, spiritual beliefs and unique identity.



**Source 9.4** The strong connection Aboriginal and Torres Strait Islander peoples have to their land is shown by their deep respect for the land and broad knowledge of the nature and character of the land.

## Geographical fact

Antarctica is the only continent without an indigenous community.

Despite this diversity, each group shared in common a rich connection to, and relationship with, its land or place, often referred to as 'Country'. The strong ties that Aboriginal and Torres Strait Islander peoples have with the environment can still be seen today through both their **custodial responsibility** and deep respect for the land and broad knowledge of what the land can provide if it is looked after. Therefore, there is a strong cultural influence on how they assess the liveability of a place or land.

**custodial responsibility** the obligation that Aboriginal and Torres Strait Islander peoples care for the Country/Place on which they live, even if they are not traditional owners of that Country/Place. Traditional owners have primary responsibility for Country/Place.

## Geographical fact

Sydney has the largest urban population of Aboriginal and Torres Strait Islander peoples. Proportionally, Darwin has the largest percentage, with 9% of their city's population being Aboriginal and Torres Strait Islander peoples. As a territory, the NT's population is 26% Aboriginal and Torres Strait Islander peoples.

## University culture

A particular culture can have a strong influence on the identity of the community. Next we will look at the town of Armidale in NSW, which has what we might term a 'university culture'.

## Case study 9.1

### The town of Armidale, New South Wales

Armidale is a regional town located in the northern tablelands of New South Wales. As it is inland and elevated, it has a cool climate and has a strong agricultural industry. It is situated between Sydney and Brisbane and is located approximately 500 km away from each of these capital cities. It is also 100 km north of Tamworth, the country music capital of Australia.

Situated in Armidale is the University of New England (UNE), and subsequently Armidale is also known as a 'university town'. It has a significant student population, and includes other organisations such as research institutions and libraries, and businesses targeting university students, such as printing services and bookshops. University life

pervades all social and economic activities in the town, so during semester breaks, the town is often quiet.

It is not surprising then that Armidale has a flourishing arts and culture scene, with many galleries and museums, such as the New England Regional Art Museum. Armidale is also picturesque, with old heritage buildings mixed with contemporary architecture, and many parks spread throughout the town.

- 1 List the features of Armidale.
- 2 Identify the characteristics of Armidale that contribute to community identity and connectedness.
- 3 Explain why you think Armidale would be considered by some people as highly liveable.



**Source 9.5** Armidale is a picturesque university town in northern New South Wales, known for its university culture, parks and heritage buildings.



## Environment

A few communities, such as the surfing community, have unique identities as a result of their interactions with the environment. Identity refers to the way you see yourself and the way others perceive you.

Some communities are created around water. Within these communities identities are created around different interactions with water, leading to the development and maintenance of customs, traditions or a particular way of life. In the same way, a lack of water also provides an identity for people no matter how remote they are or how dry the land is.

## Surfers

Surfers are a great example of a community that values water not only for recreation, but as part of their lifestyle. Surfers have a unique identity due to the nature of their sport. Reliant upon water conditions and large swells, they have a certain 'look' and way of life. The surf is a marker of their identity. With wetsuits, fibreglass boards, tanned skin, zinc and specific use of language, surf culture is present all around the coastlines of Australia. Sydney's northern beaches from Manly to Palm Beach offer over 20 km of sand and surf to visitors. Famous breaks such as Bells Beach in Victoria and Margaret River in Western Australia attract tourists from all over the world.



### Activity 9.1

Consider the surfing community.

- 1 How does water contribute to their identity?
- 2 Research online some media articles on surfers' reactions to recent shark attacks.
- 3 Describe how these events have affected their way of life.



#### Source 9.6

Australian professional surfer Mick Fanning, who was attacked by a great white shark in Jeffrey's Bay, South Africa, while competing in an event



**Source 9.7** Kite surfers are another community that strongly identifies with the water.

## RESEARCH 9.1 //

Investigate one of the following communities and create an interactive poster showing how water is a marker of their identity. Choose from:

- kite surfers
- fishers on the Mekong delta
- abalone divers in Western Australia
- another community associated with water, to be negotiated with your teacher.

Use the Glogster website to create your poster.

Explore some examples first to familiarise yourself with the features available. Make sure you include the following elements in your poster:

- a heading
- clear graphics with captions
- key terms
- at least one video embedded.

When you have finished you can copy the URL generated and email it to your teacher for checking. If you do this, do not forget to make your poster 'public'.

## Public events

Sydney's annual New Year's Eve celebration is a world-famous public event. It brings thousands of locals and tourists to the city each year, and ends with the famous fireworks display over Sydney Harbour and its bridge. It has been running since 1996. Another similar public event is the annual Chinese New Year celebrations held in various locations around Sydney, including the Town Hall, Cockle Bay and the Haymarket area. This event celebrates the Lunar New Year, which is important to many Asian cultures. Featured are Chinese street food vendors, paper lanterns, dragon boat races on Sydney Harbour and the twilight parade featuring colourful floats and dancers.

Each year the animal of the year is a feature. In 2015 it was the Chinese Year of the Sheep – and so the sheep was a major theme for the celebrations. Both the New Year's Eve and Chinese New Year celebrations are examples of public events that have helped to develop community identity and make Sydney a highly liveable place.

## Religious beliefs

The identity of a community can certainly be influenced by people's religious beliefs. As an example of this, let us now look at the communities who live alongside the Ganges River in India.

**Source 9.8** Sydney's New Years Eve and Chinese New Year's celebrations are annual public events that bring the community together.



## Case study 9.2

### The Ganges: a holy river

The Ganges River in India is considered by the Hindus to be the most holy of rivers. Bathing in its holy water is a key part of their religion.

Millions of Hindus travel long distances on

pilgrimages to towns along the river to bathe using **ghats**, particularly in Varanasi. Here the elderly and the sick also spend

their last days praying and being spiritually cleansed. The Ganges is significant for other Indian festivals, too. Petals and candles are sent downstream during the five-day Ganga Mahotsav festival that celebrates Varanasi as the cultural capital of India.

**ghats** steps leading down to the Ganges River

**ashram** a community where people (mainly Hindus) practise yoga, meditation and other spiritual activities

Ganges means 'river', from the Hindi *ganga*. People drink the holy water and take containers of it with them to nearby temples and **ashrams**. Water plays a significant part

in Hindu life and also in death. The body of a recently deceased Hindu will be laid on sandalwood logs and set alight; then, the scattering of ashes in the Ganges fulfils part of the *samsara* (cycle of successive lives). The clean, milky-coloured river runs fast near the source and through mountains above Rishikesh, but closer to the mouth the currents are slower as the water reaches flatter ground. Approximately 400 million people rely directly on the Ganges, and live close to it.

- 1 Identify the name of the holy town on the banks of the Ganges.
- 2 List four ways in which people use the Ganges.
- 3 Why is the Ganges significant to Hindus?
- 4 Identify the characteristics of the Ganges that contribute to community identity and connectedness.



**Source 9.9** A man praying in the Ganges during the Kumbh Mela festival

## 9.2 Factors that enhance social connectedness

Humans are social beings. Their basic needs include more than shelter to survive well; community is also important for health and wellbeing. Access to transport, technology, open spaces, meeting places and employment are all ways that social connections can be forged and the overall liveability of a place improved.

### Transport

All forms of transport allow us to connect socially. Cars and bikes are common modes of transport that give people great levels of freedom. Public transport is an important feature of the community, and further development

of its accessibility is part of many councils' (at local, city and state levels) community and wellbeing plans. Japan has a famous high-speed railway network called the *Shinkansen* (or bullet train). The network connects most major cities on two of Japan's four major islands, Honshu and Kyushu, and trains can reach speeds of 320 km/hr. The *Shinkansen* was first introduced in 1964, ahead of the Tokyo Olympics. The system revolutionised life for the Japanese people, as the bullet trains could connect people from all over the island nation in a matter of hours, which, for instance, allowed business meetings to become more efficient. The *Shinkansen* network is a famous example of public transport serving to both enhance social connectedness and improve the liveability of a country.

**Source 9.10** Public transport is an important feature of the community. Pictured is Japan's famous *Shinkansen* or bullet train, in front of Mount Fuji. This rail network is a famous example of public transport serving to enhance social connectedness.



## Fieldwork 9.1 Transport and amenities for young people

### Aim

This task involves a virtual tour and analysis of how your local community ensures that young people are provided for in terms of transport and recreational spaces and activities. Your local community may be a small town, region, suburb or city.

### Method

The whole class can undertake this fieldwork during a couple of periods without leaving the school by using previous visual observations and the internet. Define the borders and parameters of your local community and identify the transport and recreational options available for young people.

### Preparation

On a web mapping application such as Google Maps or Google Earth, locate your community. Draw a rough outline map utilising the web map image as a guide.

### Data collection

Research via the internet what transport options young people have as well as the recreational locations and activities. Note these down on your map to assist with what is currently available. Use a colour code to mark the following areas

on your map: transport routes (perhaps different colours to indicate rail and bus routes) sporting clubs, entertainment complexes, other (for example, library, dance classes, chess groups). Once your fieldwork is complete, you will need to transfer all of your data onto a completed map of A3 size. This map should show BOLTSS (except for Scale, which is not essential). Your map should have a:

- Border
- Orientation – indicating north
- Legend – showing the features on your map including what each area of shading represents.
- Title – a heading that describes the map and what it is showing
- Scale (not essential)
- Source – the details where the information used to create the map came from.

Once your fieldwork is complete, write a report on whether your findings indicate that young people are well provided for in terms of transport and recreational spaces and activities in your community. Suggest what is required if your conclusion is that they are not adequate. If your conclusion is that these facilities are adequate, then comment on the planning and geographical locations of these items.

### Field work presentation layout

Front page	Title and name
Contents page	Do this last, as well as numbering pages
Page 1	Aims and methods
Page 2	Location map
Page 3	Introduction – brief description of the study sites

Page 4–5	Description of uses and photos
Page 6	Table of usage: effects of use (positive or negative, short-term or long-term)
Page 7–8	Description of effects of use, sketches and/or photos
Page 9	Association between use and effects of use
Page 10	Table or written description of transport options
Page 11	Table or written description of recreational options
Page 12	Evaluation of these options and conclusion
Page 13	Appendix, bibliography, glossary

## Technology

Connecting to others in the community and sharing experiences is now made easier through digital communications. Social networks help build community and enable us to live more sustainable lives. Networks sustain our personal wellbeing, but also help us to

share information quickly in times of threat, such as from natural disasters. The NSW Rural Fire Service (RFS) provides regular updates about fire hazards on their website, including real-time updates to maps so that people can monitor how close fires are to where they live.



**Source 9.11** Technology including social media sustain our personal wellbeing, but also help us to share information quickly in times of threat, such as from natural disasters.

The RFS have also released a smartphone app called MyFirePlan, to help people prepare ahead of time in case an emergency situation arises. Digital technologies allow the RFS to connect with people in New South Wales when it really matters.

### Open spaces

People usually like to live in nice, non-polluted areas where the soil is not degraded and they can enjoy the scenery of the outdoors as they wish. As discussed in an earlier chapter, there is an increasing tendency for Australians to live closer to the coast. Part of the reason for this shift would be the allure of open space.

Open spaces are an important part of a place's liveability, according to the United

Nations Environment Programme (UNEP). The most liveable cities in the world, such as Melbourne and Vancouver, Canada, understand the value of open space. For example, they aim to have a large number of public parks in their city. According to the UNEP, parks provide essential open space for residents. They provide space for flora and fauna to co-habitate, but they also counteract the impact of CO<sub>2</sub> in the city, as well as traffic noise.

### Meeting places

Convenient meeting places can help to enhance a place's liveability. For instance, families and friends can organise to meet at a public park, shopping centre or the cinema, or even their private homes if convenient.

**Source 9.12** The beautiful Queen Elizabeth Park in Vancouver. Parks are a great example of how cities can enhance their liveability.



Business people can meet at a cafe or restaurant. Sometimes people choose to meet in public because their house or backyard is too small to fit many people. Landmarks or places of interest can sometimes help people meet in public places. People in Melbourne could meet at Federation Square in the middle of the city, or even the Melbourne Cricket Ground (MCG), which regularly hosts major sporting events. The Sydney Cricket Ground

(SCG) hosts the annual New Year's Test cricket match, and this is a regular meeting place for families and friends during the holiday period. The third day of each Test is known as Jane McGrath Day, named after the late wife of former Australian cricketer Glenn McGrath. Jane McGrath passed away in 2008, and in her honour many people flock to the ground dressed in pink as part of a fundraising effort for breast cancer awareness.



**Source 9.13** The annual New Year's Test is a cricket match held at the Sydney Cricket Ground, and a popular meeting place for people during the Christmas holiday period. Pictured is the famous Members Pavilion.

## Activity 9.2

- 1 List some of the social connections you have in your local community. For example, do you engage in any volunteer activities or sports? How are these activities organised and how do they involve members of the community?
- 2 Identify your local community spaces, including sports grounds, parks and buildings.
- 3 Use the internet to locate an example of a community group in your area that has an online presence. What sorts of activities or events does this group participate in? What kinds of people does it attract?
- 4 Plan a local community event and create invitations for residents to attend.

## Employment

How could employment enhance social connectedness? As mentioned at the start of the chapter, Bega in NSW is a town that is well known for dairy farming as well as cheese making. The farmland around Bega has been

used for dairy farming since the mid-1800s, and many families in the area are employed in this industry. Therefore, this employment type helps make social connections in the town of Bega for the local community.

**Source 9.14** The community of Bega, NSW



## Case study 9.3

### Halong Bay, Vietnam

Halong Bay is in northeast Vietnam and was declared a UNESCO World Heritage Site in 2000 due to its unique limestone karst landscape, which is thought to be over 20 million years old. Halong Bay contains over 2000 islets and is a very popular tourist destination due to its beauty.

Halong Bay is also home to over 1600 inhabitants who have built houses on the water. There are four floating villages. Fishing is the main source of income for this community and people row from one little house to another, selling their goods or fruits and vegetables that they have obtained elsewhere.

The water is very calm because the bay is dotted with large limestone domes that break up any waves, so they don't have to worry about large storm surges. The houses have larger 'outdoor' areas connected by a series of wooden planks tied together; these provide

stability for the house as well as a place for a pet dog to run around in, and for the family to fish from.

Cap La is a floating village where about 80 families, a total of 200 people, live in this World Heritage area. In some of the villages, there are television sets and tiled roofs, but in others electricity and fresh water are expensive and difficult to obtain at times. In another village, Cua Van, children row to school. Halong Bay, where daily cruises are offered to Cat Ba Island, is a popular tourist stop in Vietnam.

- 1 Use a map to locate Halong Bay, Vietnam.
- 2 List the features of a floating village.
- 3 Evaluate the characteristics of Halong Bay that contribute to community identity and connectedness.
- 4 Discuss why you think Halong Bay is a liveable place for people.

**Source 9.15** Part of a floating village in Halong Bay, Vietnam



## Chapter summary

- Connections with local community are highly valued, and are an important part of identity and perception of liveability.
- Families, and their proximity, can often play a large part in how connected a person feels to their community.
- Culture can influence community identity. For example, the number of immigrants staying in Australia long term and becoming citizens is rising, suggesting that Australia continues not only to be rich in its cultural diversity but also its liveability.
- Environmental factors such as the use of water by surfers can play a major role in shaping community identity.
- Public events like the New Year's Eve celebrations around Sydney Harbour can help develop community identity.
- Religious beliefs can influence community identity and the liveability of a place. The communities that rely on the Ganges River in India are one example of this.
- Transport, including access to public transport, enhances social connectedness, allowing people to meet one another.
- Technology is another example of how people in the community connect, such as the telephone or through various types of social media.
- Open spaces enable social activities. Public parks and gardens are important because they increase our perceptions of liveability.
- Meeting places are important locations for social gatherings, such as the Sydney Cricket Ground for the annual New Year's Test cricket match.
- Employment can also encourage social connections. For example, the town of Bega in NSW is famous for dairy farming, and many people in the local community work in that industry.

## End-of-chapter questions

### Short answer

- 1 How can a person's identity and connection to a place can be enhanced? Include at least three examples in your answer.
- 2 Why are open spaces an important environmental characteristic for a place?
- 3 Reflect on why transport and technology are such important factors in enhancing social connectivity. How do they affect the liveability of a place? Give examples in your answer.

### Extended response

Predict some major issues that need to be considered when planning for the future of large cities. What recommendations would you make for meeting these challenges and improving liveability? In your response, make reference to community identity and social connectedness.



# 10

## Enhancing liveability

**Source 10.1** Sydney is one of the top 10 most liveable cities in the world.

### Before you start

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#### Main focus

Many strategies are used to enhance the liveability of places for different groups of people.

#### Why it's relevant to us

Individuals and governments need a coordinated vision to develop strategies that ensure communities become more liveable.

#### Inquiry questions

- Why are some places considered to be more liveable than others?
- What strategies can be used to enhance liveability?
- How do different groups work to enhance liveability?
- How could we improve the liveability of a place in Australia?

#### Key terms

- community needs
- compromise
- consultation
- distribution
- personal needs
- strategies

### Let's begin

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People have different needs depending on where they live and who they are. Some places in the world will be starting from a low base. A city that has major pollution or crime problems, for example, will face steep challenges to enhance its standing on the liveability scale. Some places already have plans in place to address their liveability issues. Enhancing liveability is a task that requires a coordinated effort by governments and communities.

## 10.1 Characteristics of highly liveable places

Depending on where you live, the answer to the question ‘What makes a liveable place?’ could vary considerably. Consider the following quotations from 12-year-old students

located in rural Queensland, metropolitan Melbourne (outer suburbs) and coastal Tasmania:

Sometimes the whole sky seems to light up with stars and shapes and maybe other places.

I like the quiet, the space ... the birds. Not the flies or drought.

My family came to Australia from Sri Lanka when me and my brother were little. We like it here. There's lots to do and I can get a good education.

I like going to the city on the weekends. Sometimes we go to the football or a film. I really like going to the beach.

The fishing is really good – we fish on the beach, then barbecue them fresh.

Our footy team is winning this year – we may go to town for the finals.

Embedded in the quotations are references to family, education, nature, sport, climate, space, location and access to entertainment and city life. If these students were to ask their parents and older community members the same question – ‘What makes a liveable place?’ – the responses might include many other aspects, such as how beautiful the area is. A useful exercise to test this idea is to ask the same question of several people of different ages, genders and, if possible, ethnicities.





## Note this down 10.1

Copy the graphic organiser which lists the characteristics of 'liveable places'. Select five characteristics that matter most to you and number your choices in order of importance (1 – most important, 5 – least important). Have three other people complete the table. Discuss reasons for each person's preferences.

Characteristic	Me	Parent/ grandparent	Other person 1	Other person 2
Clean air and water				
Nearby hospitals and schools				
Access to good living wage and low poverty levels				
Affordable housing				
Efficient public transport				
Car friendly				
Safe neighbourhood				
Emergency services				
Recycling and waste management				
Sports fields				
Income support including pensions				
Social justice				
Large shopping centre				
Voting rights				
Cinema and entertainment centre				
Museum and art gallery				
Low crime rates				
Family and friends nearby				
Nature reserves and parks				
Inclusive communities				
Medical centre				
High speed internet				
Disability access				
Birds and wildlife				
Retirement housing				
Cultural festivals				
Banks				
Other – add to this list from all responses				

## Observable characteristics of a liveable place

Observable characteristics of highly liveable places can generally be measured. The most obvious indicator is population. More than

**distribution** the way in which something is shared out among a group or spread over an area

half of the world's people live in cities. Because this is such an important characteristic of population **distribution**, we need to look closely at

the characteristics of cities and consider why people seek them out as their place of choice to live. However, this does not mean that rural and regional places do not have their advantages.

### Liveability rankings

Source 10.3 includes cities around the world ranked first by population, next by measures of global influence, third and fourth by liveability

**Source 10.2** In 2014 Tokyo was listed as containing the largest population.



**megacities** cities with a population greater than 10 million

and in the fifth column by infrastructure. **Megacities** dominate the population column. These are a twenty-first century phenomenon, with many of the newer members of this club located in Asian and developing countries.

Notice that there are two rankings provided for liveability and they differ. The reasons can be complex and will have much to do with the

ways in which the surveys were conducted, including the variables that may or may not have been included in the decision-making process. You may like to consider the reasons for the differences in the scales. The last scale rankings based on infrastructure may provide some clues. Whatever the reasons, the important message from these scales is that they are not fixed. Much depends on the views and biases held by the data collection agencies.

Population <sup>a</sup>	Global influence <sup>b</sup>	Liveability <sup>c</sup>	Liveability <sup>d</sup>	Infrastructure <sup>e</sup>
1 Tokyo	New York	Vienna	Melbourne	Singapore
2 Jakarta	London	Zurich	Vienna	Frankfurt
3 Seoul	Paris	Auckland	Vancouver	Munich
4 Delhi	Tokyo	Munich	Toronto	Copenhagen
5 Shanghai	Hong Kong	Vancouver	Adelaide	Düsseldorf
6 Manila	Los Angeles	Düsseldorf	Calgary	Hong Kong
7 Karachi	Chicago	Frankfurt	Sydney	London
8 New York City	Seoul	Geneva	Perth	Sydney
9 Sao Paulo	Brussels	Copenhagen	Auckland	Hamburg
10 Mexico City	Washington DC	Sydney	Helsinki	Vancouver

a World Atlas  
 b A T Kearney  
 c Mercer Rankings 2012  
 d Economist Intelligence Unit's 2011 and 2012 Global Liveability Surveys  
 e Mercer's City Infrastructure Ranking 2012 is based on measures of the following: electricity, water availability, telephone, mail, public transportation, traffic congestion and airport effectiveness.

**Source 10.3** The top 10 cities globally in terms of population, services, liveability and influence

### A highly liveable place – Adelaide

An example of a city widely identified as highly liveable is Adelaide. South Australia's capital was recently rated equal-fifth on the Economist Intelligence Unit's 2015 Global Liveability Survey. In short, Adelaide offers:

- good weather and climate
- a simple grid design of the city which makes navigating easy
- walkability
- river views, abundant parklands and the botanic gardens
- world-class infrastructure
- easy access to facilities and services such as the nearby airport
- a good range of shops, quality restaurants and cafes
- close access to beaches, orchard-laden foothills, and the famous winemaking region, Barossa Valley.



**Source 10.4** Adelaide is considered to be a highly liveable city for a range of reasons, including its close proximity to the Barossa Valley winemaking region.

### Activity 10.1

- 1 Explain the term 'observable characteristics' and the role these play in measuring liveability.
- 2 Discuss why cities often have an advantage in terms of liveability and whether or not regional areas can reach the same level of liveability.
- 3 Adelaide came equal-fifth on the Economist Intelligence Unit's 2015 Global Liveability Survey with a score of 96.6, Melbourne came first with a score of 97.5. Suggest some changes and improvements Adelaide could make to reach the same score as Melbourne.
- 4 The top five most liveable cities include two Australian cities and three Canadian cities. Compare Australia to Canada and discuss their differences and similarities.

## 10.2 Assessing different roles in enhancing liveability

There are many different groups of people, with different levels of status and power, who have the ability to enhance liveability for the good of the community. We will briefly consider each of these.

### Role of international authorities

The United Nations and World Health Organization are able to collect a large amount of data which they then share with the rest of the world in an effort to improve our planet. The United Nations, for example, has an entire department committed to enhancing liveability called the UNEP – the United Nations Environment Programme. The UNEP creates strategies and plans for countries needing their liveability enhanced.

## Role of national and state governments

The cooperation of national and state governments in a country is crucial. The national and state governments set their budgets for the year and decide how and where the taxpayer dollar will be spent. The governments then approve initiatives that might increase liveability.

For example, in Australia our roads network is funded by not only the state or territory budget but also by the federal budget. Below you can see how much the Australian federal government has contributed to each state and territory, particularly for roads.

Jurisdiction	General purpose	Local roads	Total
New South Wales	\$510 449 725	\$205 226 443	\$715 676 168
Victoria	\$395 898 102	\$145 831 415	\$541 729 517
Queensland	\$320 607 800	\$132 532 773	\$453 140 573
Western Australia	\$174 564 649	\$108 155 915	\$282 720 564
South Australia	\$114 632 290	\$38 874 053	\$153 506 343
Tasmania	\$35 128 373	\$37 484 917	\$72 613 290
Northern Territory	\$16 635 820	\$16 569 711	\$33 205 531
Australian Capital Territory	\$26 200 935	\$22 681 706	\$48 882 641
<b>Total</b>	<b>\$1 594 117 694</b>	<b>\$707 356 933</b>	<b>\$2 301 474 627</b>

**Source 10.5** Financial Assistance Grants 2014–15: the aggregate grants for local government in each state and territory

**Source 10.6** Our roads network is funded by the state and federal budget.



## Role of non-government organisations (NGOs)

NGOs are a very important part of the community. They are independent of the government, which means they often have greater flexibility in how they operate, and they usually have humanitarian priorities. For example, the Salvation Army is one of the most well-known NGOs in Australia and they provide a lot of services to our community in an effort to assist those greatly in need, including: caring for the homeless, providing food and shelter, finding employment, emergency services (such as supporting families who lose their home after bushfires), and aged care.

## Role of communities and individuals

At a community level, there are councils which are part of the state government system, but who work with the priorities of their own community at heart.

Then there are all the community groups who volunteer their time, such as parents on the school board, or the local surf lifesaving club. A community is made up of many individuals. A person might think they are not capable of bringing about a needed change, but if they work together with others, change is always possible.

### Enhancing liveability for different groups

Diverse groups of people and communities have different needs depending on where they live and who they are. It is vital to develop policies and understandings that can be applied to society as a whole. Information should be available and public policies should be easy to understand and culturally appropriate. Sometimes this may be difficult

because our range of cultures is so diverse that at times they may contradict each other. However, it is important to be aware of the varying cultures in society and to communicate with this in mind.

**Compromises** may need to be made to encourage sectors in the community to begin to work together. Public consultation is an important part of this. A community leader could send out a questionnaire or survey asking the people in that community what they need in order to bring about a better standard of living.

A farming community, for example, in times of drought, may want to discuss the possibility of a dam being built in their area. A community that has a high percentage of elderly citizens may want better access to health care. **Personal needs** may not seem to be part of the 'big picture', but often they play an important

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**compromise** an agreement or a settlement of a conflict that is reached by each side making allowances

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**personal needs** needs of an individual rather than of the family or the community

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**Source 10.7** Public consultation in a farming community may be required for permission to build a dam in times of drought.

part in an individual's feeling of self-worth. If each group in a community joins forces with the others, they will all be more effective in reaching common goals than if each

group operates in isolation. By exchanging information each group gains an understanding of what the community as a whole requires.



## Activity 10.2

- 1 List any local community groups or individuals that contribute to enhancing the liveability in your area. For each item on the list explain how they are making a difference.
- 2 Research an Australian NGO of your choice and create a brochure outlining what the organisation does, how they help to enhance liveability and how others can support the organisation.

## 10.3 Strategies to improve the liveability of a place in Australia

Natural factors like climate change and location can influence liveability, but city councils and community groups can implement strategic plans to enhance the liveability of their city.

### The Sydney 2030 plan

In 2008, the City of Sydney council released their 2030 plan. The main purpose of their proposal was to increase the liveability of their city. The City of Sydney council has a 10-point plan to develop Sydney:

- 1 A globally competitive and innovative city
- 2 A leading environmental performer
- 3 Integrated transport for a connected city
- 4 A city for pedestrians and cyclists
- 5 A lively, engaging city centre
- 6 Vibrant local communities and economies
- 7 A cultural and creative city
- 8 Housing for a diverse population
- 9 Sustainable development, renewal and design
- 10 Implementation through effective partnerships

Source: City of Sydney, *Sustainable Sydney 2030 – Community Strategic Plan (2013)*, page 25

While developing their proposal, the City of Sydney council had an open consultation/ submission period where any member of the community could put forward their ideas about what was important to them. This is a great example of consultation. According to the council:

12 000 people were directly consulted

200 website visitors commented online (and 15 000 people visited the site)

2000+ callers got in touch via our 'Future Phone' line and 157 000 people went to Customs House when the vision was exhibited.

Source: City of Sydney, *Sustainable Sydney 2030 – Community Strategic Plan (2013)*, page 69

Although Sydney is already in the top 10 most liveable cities in the world, the city council has committed to continuing to maintain this status, and improve the services and facilities available to their community.

**Source 10.8** Sydney's famous Jacaranda trees give this Kirribilli street a 'vibrant' character – part of the Sydney 2030 plan.



### Activity 10.3

- 1 Think about the suburb you live in. Identify all the stakeholders responsible for governing it and briefly outline their responsibilities.
- 2 A popular community phenomenon is a 'men's shed'. These exist in many towns and suburbs, e.g. Lucknow near Orange, NSW. Investigate the origin, purpose and benefits of men's sheds to the community.
- 3 Do you see any NGOs working in your area? Explain why or why not. If NGOs do operate in your area, discuss when and where you see them.
- 4 Does your suburb have any community groups such as parent groups or surf lifesaving clubs? What is the purpose of community groups such as these?
- 5 Using the internet, visit the Sydney 2030 website. Other than the 10-point plan, what do you think the council's main priorities are?

## Chapter summary

- UNEP is encouraging cities to develop a strategic plan to enhance liveability.
- Adelaide is an example of a city that continues to try to enhance its liveability.
- Enhancing liveability is a task that requires a coordinated effort by governments and communities.
- The City of Sydney council is committed to maintaining and improving Sydney's liveability with the 2030 plan.

## End-of-chapter questions

### Short answer

- 1 Explain why reasons for the liveability of a place vary between age groups.
- 2 Discuss why megacities have such high populations.
- 3 Describe the role of city councils in improving the liveability of a place.

### Extended response

Debate the following statement: 'Enhancing the liveability of a city is only possible through a clear and concerted plan of action. It will not happen just on its own.'





**Source 10.9** Singapore's solid infrastructure includes high quality education and health care facilities, making it the most liveable location in Asia and the world on the global liveability index (in terms of infrastructure).

## Topic 3

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# Water in the world



**Source 11.1** Frozen lake in the south of Iceland during late winter

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# 11

## Water resources

**Source 11.2** Upper Wentworth Falls, near the town of Wentworth Falls in the Blue Mountains, NSW

### Before you start

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#### Main focus

Water is a renewable environmental resource and essential to all life on Earth.

#### Why it's relevant to us

From the simplest to the most complex of organisms, every living thing on Earth needs water to survive.

#### Inquiry questions

- What are the types of environmental resources?
- What are the different forms of water used as resources?
- What is the distribution and availability of water resources?

#### Key terms

- continuous resources
- groundwater
- ice
- non-renewable resources
- renewable resources
- salt water
- soil moisture (green water)

- surface water (blue water)
- waste water (grey water)
- water vapour

### Let's begin

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In 1961, Russian astronaut Yuri Gagarin became the first human to journey into space. As he looked back at our planet, Gagarin exclaimed, 'The Earth is blue ... How wonderful. It is amazing!' As Gagarin had observed, approximately 70% of Earth is covered with water. This amount never changes; instead water continuously changes state and moves from one place to another as a result of the water cycle. Without water, humans and other animals cannot function. Water is so important that we would perish without it. Approximately 60% of our human body consists of water, and 83% of our blood. Water also promotes life on Earth in other ways: we rely on it for industry, agriculture, sanitation, transportation, heating and cooling, recreation and many other purposes, as the next few chapters will discuss.

## 11.1 Classification of water resources

Environmental resources are natural resources that have originated directly from the biophysical environment, such as water. Water is often classified as a renewable resource because the operation of **water cycle processes** enables the replenishment

**water cycle processes** the physical changes to water that change its state and geographical location e.g. evaporation, precipitation

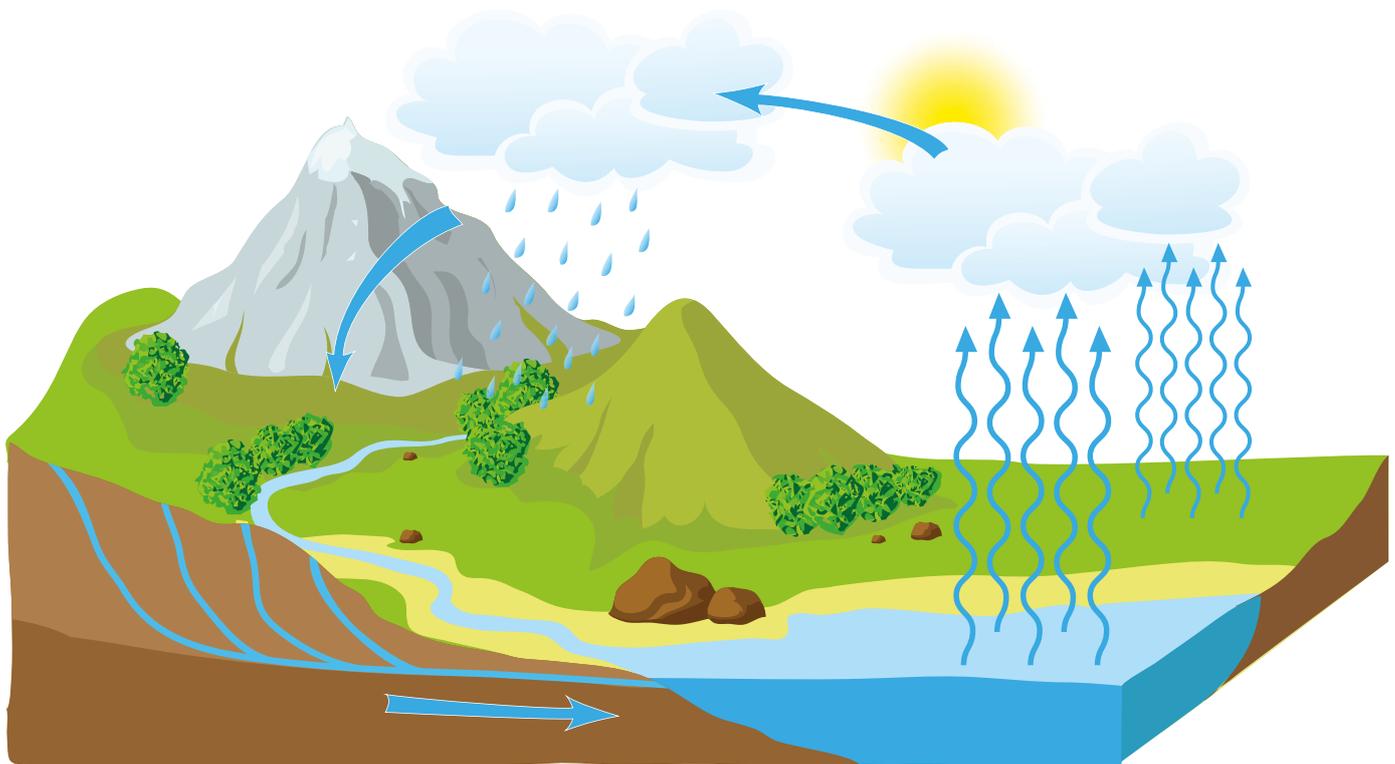
of ground, surface and stored water sources. However, as the world's population expands, enormous pressure is placed on all the Earth's resources, even the renewable ones.

Water is arguably the most important substance on Earth. Every living thing on Earth needs water to survive, particularly animals

and plants. As more people need access to water, reserves are reduced or depleted. Rates of replenishment depend on global rainfall distribution patterns, groundwater infiltration and consumption rates.

Also putting pressure on water supply are forms of environmental degradation, such as pollution.

Almost half the world's water is contaminated in some way by pollutants like raw sewage, agricultural and urban stormwater run-off, and discharge of industrial wastes. Polluted water is not only unsafe for humans, but can also have negative effects on biodiversity and comes at a significant economic cost. The status of fresh water as a renewable, unlimited resource is therefore vulnerable if the resource is not carefully managed.



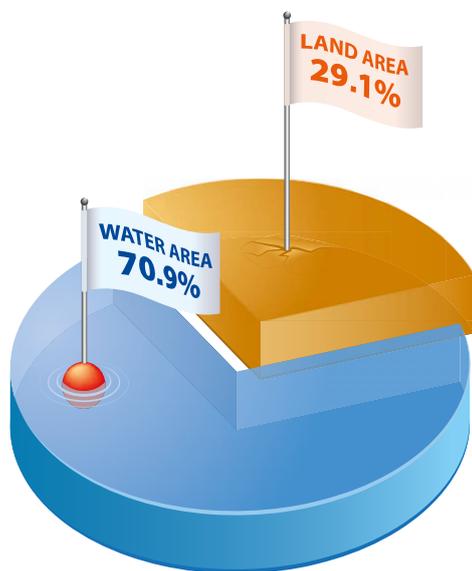
**Source 11.3** The water cycle enables renewal of Earth's ground, surface and stored water sources.

## Geographical fact

While water appears to be an abundant resource on Earth, 97% of Earth's water is saline (salt water). Salt water is not drinkable and cannot be used for agriculture or industry without damaging land or equipment. That leaves only 3% of Earth's water inventory as fresh water, yet only one-third of this is available for human use as the rest is locked up in ice caps and glaciers. Therefore, only 1% of the Earth's water can be readily used by humans.

### Activity 11.1

- 1 Explain why only a limited amount of the Earth's water is available for human use.
- 2 Reflect on the importance of water to all life on Earth.

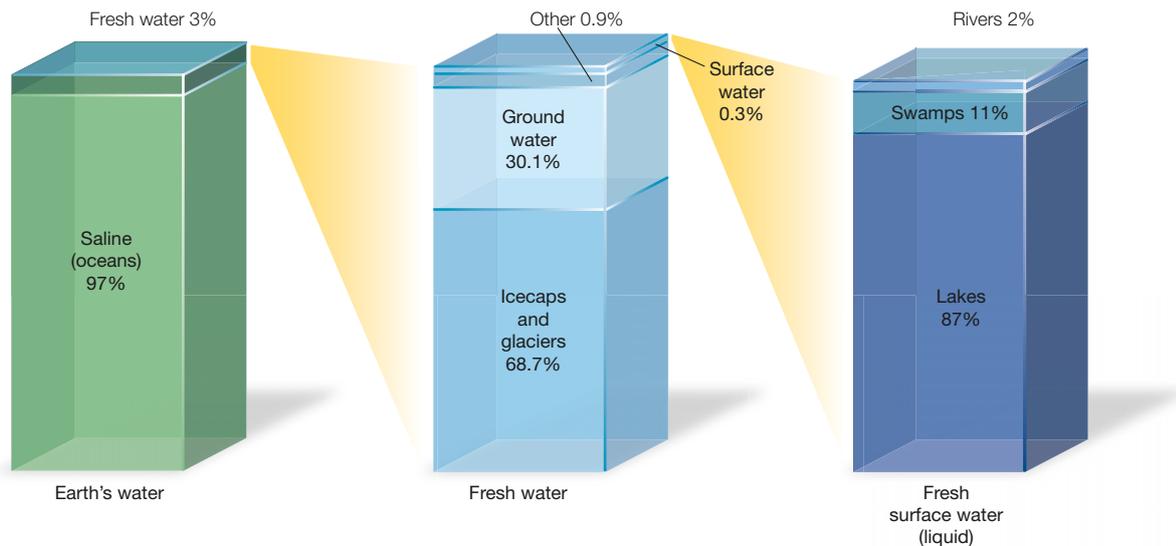


**Source 11.4** Comparison of the Earth's land and water areas



## 11.2 Different forms of water

There are seven main sources of fresh water: groundwater, soil moisture (green water), surface water (blue water), waste water (grey water), salt water, ice and water vapour.



Source 11.5 The distribution of water on Earth

### Groundwater

Groundwater is found below the Earth's surface. Rain and water from rivers travels through the ground where it is stored between grains of soil and rock. Groundwater moves through **aquifers**

**aquifer** geological formation containing groundwater that can supply water to wells or springs

and connects with river systems and lakes. The largest aquifer in the world is the Great Artesian Basin in central Australia. It contains groundwater more than a million years old and

covers 22% of Australia. Many parts of Australia, especially the outback, rely on groundwater. For example; farmers use bores in the ground and windmills to pump water from aquifers to the surface for them to use. Even cities rely on groundwater, like Perth in Western Australia. Seventy per cent of Perth's water is sourced from the Gnangara mound.

### Soil moisture (green water)

Green water is precipitation, such as rain, that is stored in the soil and does not become groundwater or does not run off into rivers. It instead stays on top of the soil. This can be beneficial for farmers growing crops; however, a lot of green water evaporates. Green water is discussed again when the water cycle is explored in the next chapter.

### Surface water (blue water)

Blue water refers to all the fresh water on the surface such as in lakes and rivers, as well as water stored in aquifers (groundwater). Blue water does not include the oceans or seas, which contain salt water.



**Source 11.6** Derwent Water, one of the main bodies of water in the Lake District National Park in northwest England

### Waste water (grey water)

Grey water refers to water that is used to dilute pollutants. Therefore it is a waste product.

Grey water tends to be produced by industries, but also by households when they do their washing. Grey water tends to be below

accepted standards for drinking, but people often use it for their gardens.

### Salt water

Ninety-seven per cent of Earth's water is salt water. Our oceans have, on average,

**Source 11.7** An aeration process is taking place in this waste water treatment tank.





approximately five teaspoons of salt for every litre of water (or 35g in every 1000g). This may not sound like a lot, but it would take around three 6-metre-long shipping containers full of salt to make an Olympic-size swimming pool as salty as the sea. This amount of salt enables seawater to become denser, and as a result the ocean needs to be colder than freshwater before it freezes. If this were not the case, we would be potentially in a constant ice age – even off the coast of Australia.

### Ice

There are three main states of water: gas (water vapour), liquid (water) and solid (ice). Water becomes ice as it freezes. This process is considered further when we look at the water cycle in the next chapter. As water freezes it expands and becomes lighter and floats. Ice shelves over the poles insulate the water below and stop it from freezing as well. As mentioned previously, of the 3% of water not stored in oceans, two-thirds is locked away in glaciers and ice sheets.

**Source 11.8** Jökulsárlón glacial lake in Iceland



## Water vapour

Water vapour is the gaseous state of water and is essential for our weather and climate. It is created mostly by evaporation of water from the Earth’s surface, by boiling of water

or **sublimation** of ice. It is invisible. Therefore if you see a cloud or mist, this is *not* water vapour. Clouds or mist actually consist of molecules of liquid water. You may have experienced this yourself

when walking through mist – your face and clothes feel damp. All the water vapour that evaporates from Earth returns to the Earth as some form of precipitation. Without water

vapour there would be no clouds or rain. It is a very important part of the water cycle.

The atmosphere is made up of four main layers, all varying in the amount and composition of gases. As you increase height, the air gets colder. The **troposphere** is where the weather occurs. In the upper parts of the troposphere, the temperature drops to a point where water molecules slow down and join together as they collide, through the process of **condensation**.

As condensation occurs, clouds begin to form, carrying the water that will eventually become rain.

**sublimation** the process where a solid becomes a gas directly without becoming a liquid first

**troposphere** the atmospheric layer closest to the ground, containing 99% of the atmosphere’s water vapour

**condensation** the process whereby water molecules join together and so change the water from a gaseous to a liquid state

## Note this down 11.1

Copy and complete the following graphic organiser comparing the seven main forms of fresh water.

Type of fresh water	Groundwater	Soil moisture (green water)	Surface water (blue water)	Waste water (grey water)	Salt water	Ice	Water vapour
Description							
Example							

### RESEARCH 11.1

Select a state or territory water corporation website. Find out where the state or territory obtains its water for agricultural, industrial or domestic use. Also identify what type of water source these are (e.g. groundwater) and how a balance is achieved so no single source is depleted.

## 11.3 Spatial distribution patterns of water resources

We live on a watery planet – about 70% of the Earth's surface is covered by ocean. At an average depth of about 1 km, this makes up a mind-boggling 1.26 billion trillion litres

of water! That is roughly 504 000 billion Olympic-sized swimming pools or 5000 billion times the size of the swimming pool in Source 11.9.



**Source 11.9** The world's largest pool in Chile holds 250 million litres, is nearly 1 km long and draws water from the ocean.

As previously mentioned, 97% of the Earth's water is in our salty oceans. It would solve many world problems if we could simply drink ocean water – although if we were to try this, we would die of dehydration. Nearly a quarter of all fresh water is in **groundwater**, which may be in underground reservoirs, or in soil moisture

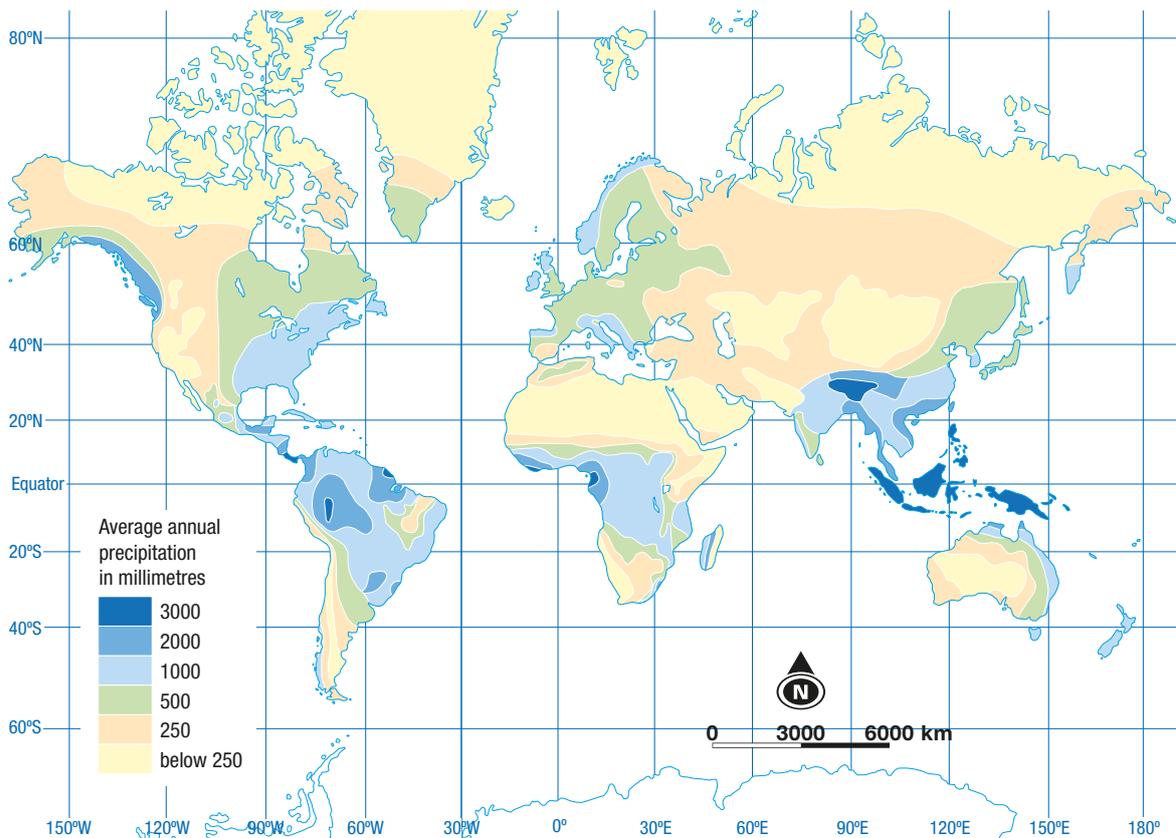
**groundwater** the water located beneath Earth's surface filling the spaces between grains of soil or rock. It slowly flows through aquifers; it connects with rivers, streams, lakes and wetlands; it feeds trees and vegetation.

(**green water**). Rivers and lakes, where we access most of our drinking water, contain a tiny 1% of all water on Earth. The rest of the water on the planet is either floating in the atmosphere or is contained in plants and animals. (Our bodies are approximately 60% water.) Also, imagine how many litres of water are sitting in our refrigerators and kitchen shelves in bottles of drink and foods

**green water** moisture in the soil

that contain water. One of the biggest issues in the world is that water is not distributed equally over the earth's surface. Rainfall across continents, and even across countries, is uneven and often inconsistent. Every continent (except Antarctica) has regions of high rainfall and

regions of low rainfall. Countries within these regions are sometimes referred to as 'water-rich' or 'water-poor' countries. For example, parts of central western Africa receive over 2000 mm of annual precipitation, whereas the Sahara desert to the north receives less than 250 mm.



**Source 11.10** The average amount of rain that falls around the world each year

Rainfall is crucial to life on earth. The amount of rainfall that flows over the surface of the earth is also important.

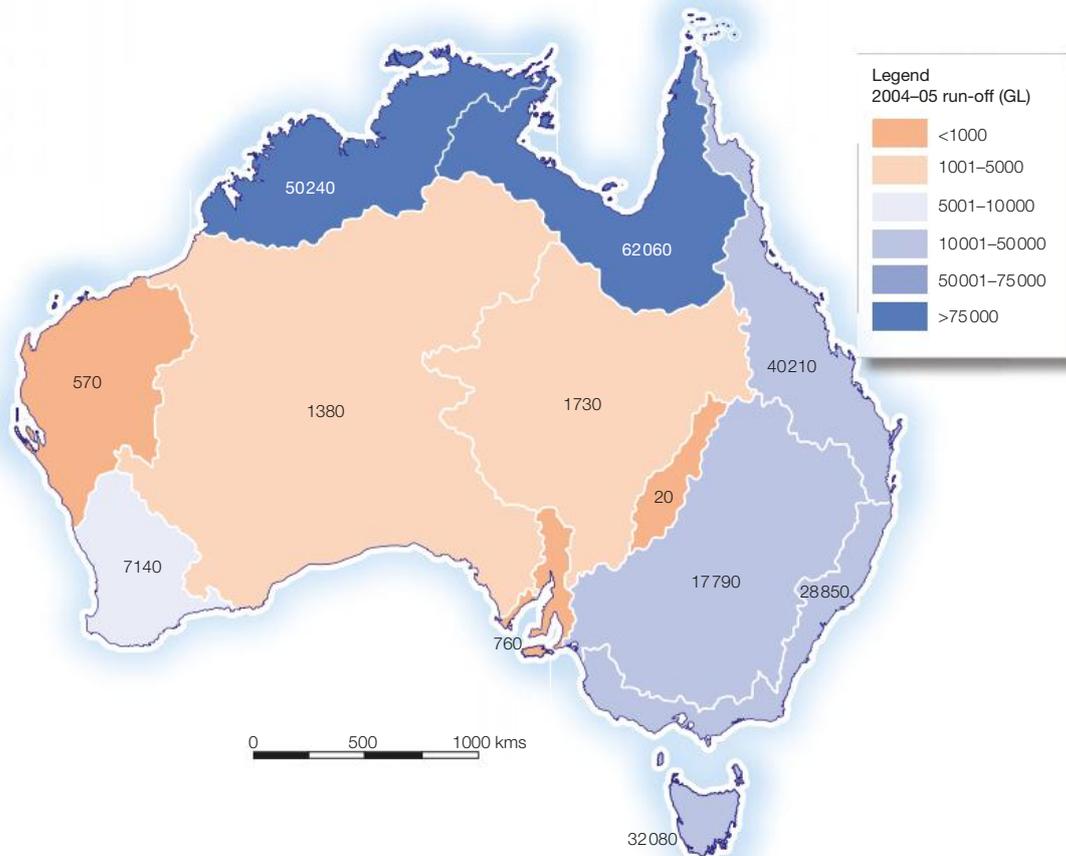
**run-off** water (from precipitation) that flows over the land and collects in rivers, lakes, seas and oceans

This is known as **run-off**. Although all rain makes its way to the ground, a number of factors determine how much of this rain actually makes its way into rivers and lakes, where humans extract nearly all of their water. One of these factors

is **evaporation** – in Australia, for example, only a small proportion of the rain that falls actually runs off the land into our river systems, due in large part to very high evaporation rates.

**evaporation** the part of the water cycle where water changes from a liquid into a gas and escapes into the atmosphere

Australia's run-off is the highest in northern regions, where the climate is tropical and rainfall is heavier and often more consistent.



Source 11.11 Average annual run-off in Australia

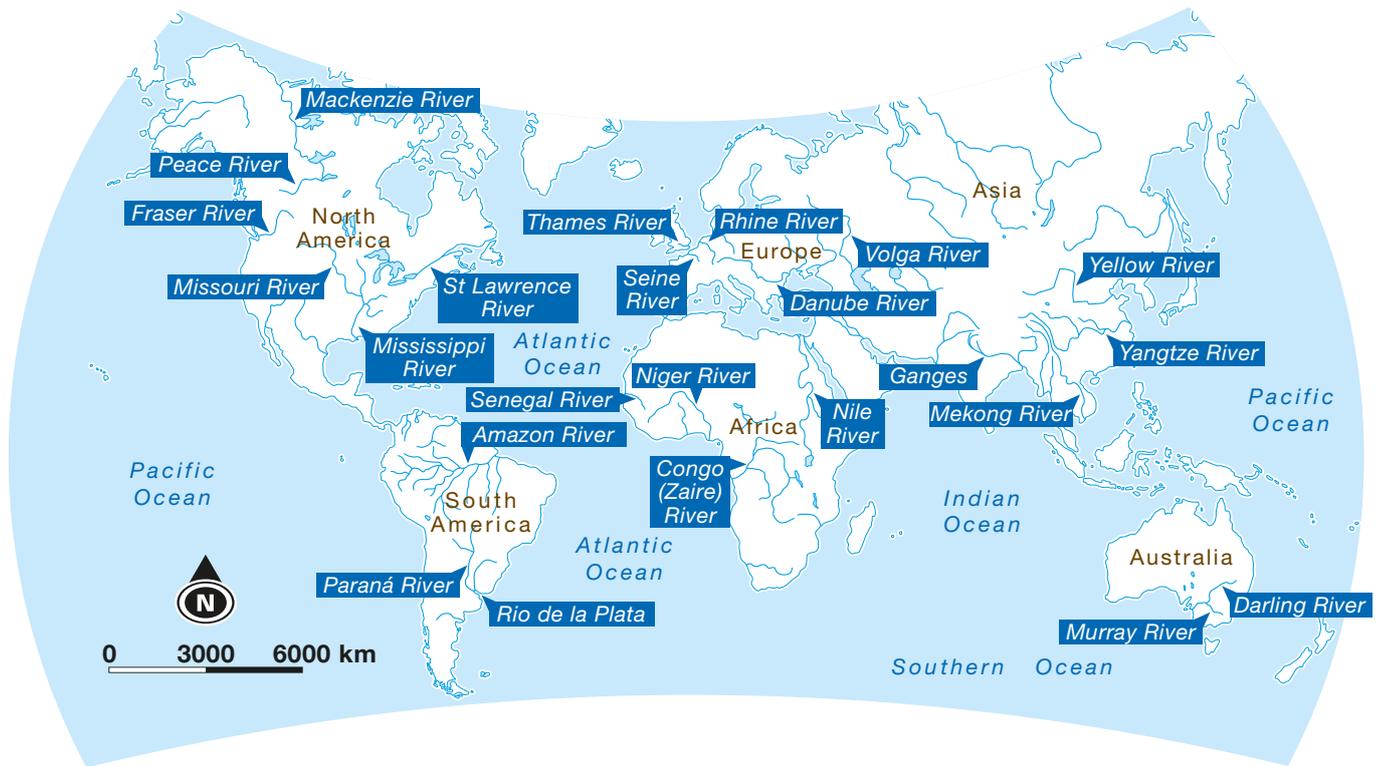
## Activity 11.2

- 1 Name five water-rich countries and five water-poor countries. Check your list by referring to rainfall data.
- 2 Report on other factors that affect the amount of run-off in Australia.
- 3 Discuss the importance of minimising run-off.

## Freshwater resources

There are currently more than 250 river basins and countless aquifers that cross the political boundaries of two or more countries. For example, 19 countries share the Danube River in Europe, 13 countries share the Congo River

in Africa and nine countries share the Amazon River in South America. Shared water resources have been a source of cooperation and conflict throughout history and continue to unite and divide places in the world today.



Source 11.12 Major rivers of the world

### Geographical fact

It is incredible to think that the total usable freshwater resource for humans and ecosystems is approximately 1% of all the water on the Earth. In addition, there is an uneven distribution of fresh water across the world.

### RESEARCH 11.2

Conduct research in one area of the world where freshwater sources or the use and ownership of rivers has created conflict. Write a newspaper article titled 'Water wars' that informs readers of the following:

- location of the conflict
- brief history explaining how and why the conflict began
- current tensions and impacts on communities
- proposed solutions.

## Geographical fact

The average distance a woman in Africa or Asia walks to get water is 6 km and the weight of water she carries on her head is approximately 20 kg (according to Women's Human Rights net, WHRnet).

### Case study 11.1

#### Water as a resource: the Grand Ethiopian Renaissance Dam

Situated in North Africa and flowing through 11 countries, the Nile River system is regarded as the longest in the world. The Nile is considered the most significant life source for its downstream countries, especially Sudan and

Egypt. It is estimated that approximately 160 million people rely on the Nile.

Access to water in Africa is critical for survival. The Nile's water has affected the politics of northeast Africa for many decades.

**Source 11.13** Juba, the capital of South Sudan, to the left of the Nile River



Several attempts have been made to establish agreements between the many countries that share the Nile. However, it has been very difficult for all countries to come to an agreement. In March 2011, Ethiopia made public its plans to construct the Grand Ethiopian Renaissance Dam, which will eventually create a lake containing more than 60 billion cubic metres of water. It is predicted to be the largest hydroelectric power plant in Africa when completed. Egypt and Sudan oppose the dam, which they believe will reduce the amount of water they get from the Nile. Ethiopia argues that the dam will not reduce water availability downstream. The countries involved are in the process of attempting to resolve the dispute. There is fear, however, by political commentators that conflict over access to the Nile may result in a war in the future.

- 1 Using your atlas or online maps to help you, sketch a map of North Africa showing the extent of the Nile River. Label the following: White Nile, Blue Nile, Nile River, Nile delta, Mediterranean Sea, the names of the countries through which the Nile flows, and the direction of flow. Remember to include BOLTSS (border, orientation, legend, title, scale and source).
- 2 Suggest why you think it has been difficult for all countries that share the Nile to reach a formal agreement regarding its use and management.
- 3 Conduct research online to determine the current progress on the Grand Ethiopian Renaissance Dam project. What viewpoints are held by the countries that share the Nile as a resource?



**Source 11.14** The Nile connects nine other countries before flowing north through Sudan and Egypt.

### RESEARCH 11.3 //

Use your atlas or online maps to find out which countries or Australian states share the following water bodies:

- Tigris and Euphrates rivers
- Jordan River
- Indus River
- Yangtze River
- Imjin River
- Aral Sea and source rivers Syr Darya and Amu Darya
- Limpopo River
- Murray–Darling river system.

In small groups, select one of the water bodies listed above. Research any conflict or cooperation that has resulted between the countries or states it connects. Share your findings with the class as an oral presentation.



**Source 11.15** The Yangtze River in Chongqing, China

**RESEARCH 11.4** //

The Ganges River is 2525 km long and runs through India and Bangladesh. It is considered a sacred river and worshipped as the goddess Ganga. Sadly, it is the 5th most polluted river in the world. Explain the significance of this river as a water source and what impact its pollution may have on the livelihoods of Indian people.



**Source 11.16** Devotees gathered for a holy dip in the Ganges River

## Chapter summary

- Ninety-seven per cent of the Earth's water is saline and 2% is locked up in ice caps and glaciers, leaving only 1% of water as fresh water available for human use.
- Water is often classified as a renewable resource because the operation of the water cycle enables the replenishment of ground, surface and stored water sources. However, the status of fresh water as a renewable resource is vulnerable if not carefully managed.
- There are seven main sources of fresh water: groundwater, soil moisture (green water), surface water (blue water), waste water (grey water), salt water, ice and water vapour.
- The distribution of water globally is uneven, with some continents having a greater amount of water available. There can be conflict over water sources such as the Nile River, which is shared by 11 nations. Cooperation is often essential, as sources of water supply span countries.

## End-of-chapter questions

### Short answer

- 1** Explain why water is considered a renewable resource, rather than non-renewable.
- 2** Distinguish between the different sources of water.
- 3** Describe the spatial distribution of fresh water on earth.

### Extended response

How does water promote life on Earth and what do we rely on it for? You should include examples in your answer.



# 12

## The water cycle

**Source 12.1** A geyser in Iceland – a hot spring that intermittently sends up fountain-like jets of water and steam into the air

### Before you start

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#### Main focus

Water is an abundant and important substance that shapes, sustains and connects all parts of nature as it cycles through the environment.

#### Why it's relevant to us

Its unique properties make water essential to all life on our planet and it sustains the natural environment that people constantly interact with.

#### Inquiry questions

- How does water cycle through the environment?
- How does water flow within a catchment area?
- How does water connect people and places on its journey?
- What factors affect the availability of water in different places?

#### Key terms

- altitude
- climate change
- condensation
- evaporation
- infiltration
- latitude
- percolation
- precipitation
- topography
- transpiration
- water availability
- water cycle

### Let's begin

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Water is one of the most crucial compounds in existence. However, most of us take for granted the ease of turning on a tap and enjoying a seemingly endless supply of water. Water cycles through the environment in various ways, but it is only a tiny fraction of this water that is both fresh and accessible. In Australia, where the climate is variable and water is sometimes scarce, our ability to access water is crucial.

## 12.1 Water cycle processes

Water is the only substance that can be commonly found on our planet in three different **states** – as a solid, a liquid and a gas – each of which is crucial to life on Earth. The movement of water is crucial on Earth and will be looked at in more detail in the next section of this chapter.

**state** a form that matter might take. Water has three states: solid (ice), liquid and gas (vapour).

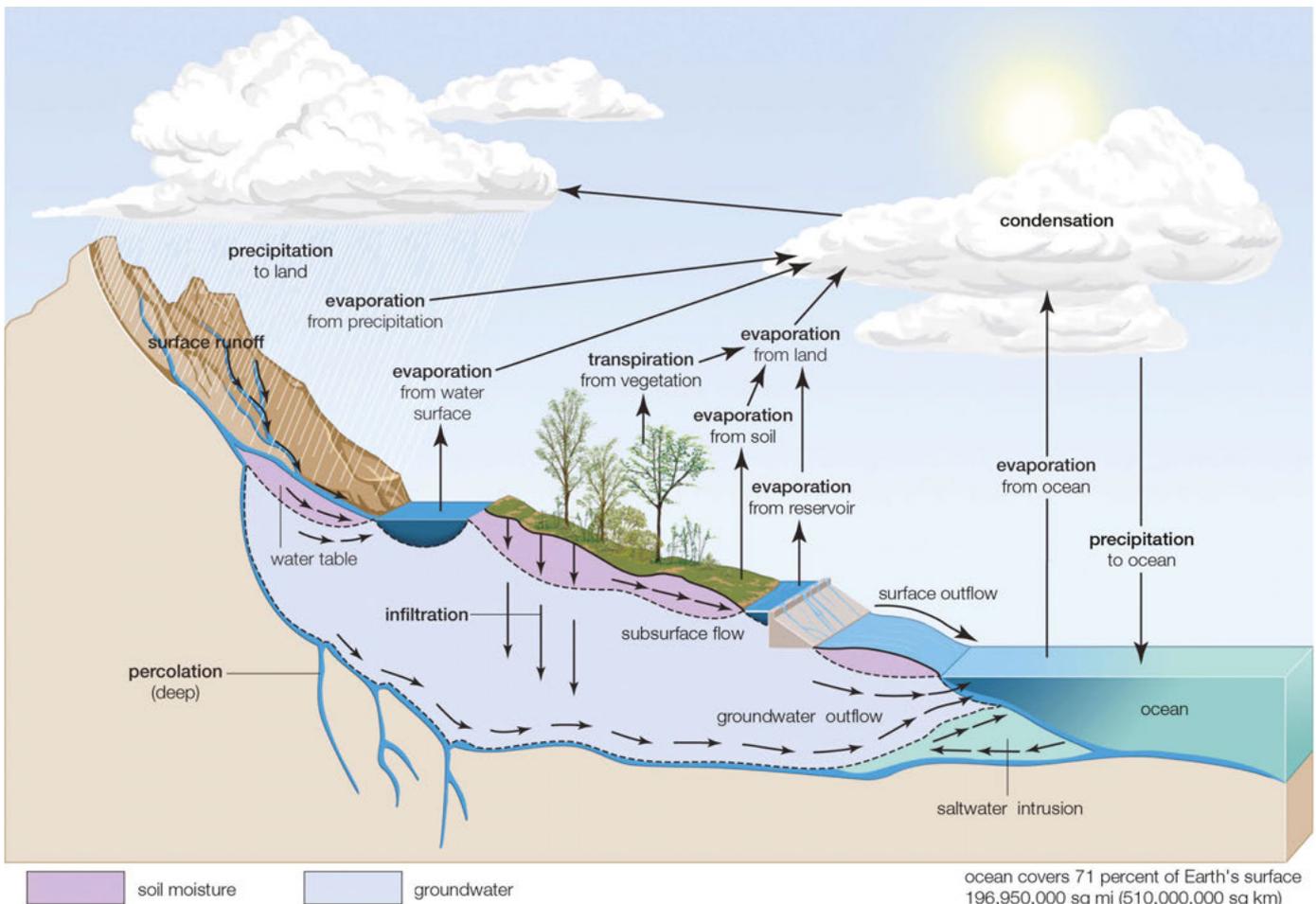
The water cycle is a closed and continuous system. This means that the world neither gains nor loses water – it just changes form (or state) and location. And it constantly keeps moving. As water moves through the cycle it

changes state from liquid (e.g. rainwater, salt water) to solid (ice or snow) or to gas (water vapour). These processes constantly replenish the Earth's fresh water supply by removing impurities. In fact, the water cycle is like Earth's own method of recycling.

Although much water on Earth is locked away for a time – for example, in ice sheets or underground – people are most interested in the water that is constantly on the move through the environment, connecting different locations and communities as well as shaping the landscape around us.

The following key processes can be seen in the water cycle, in Source 12.2:

- 1 Evaporation** – As water is heated by the sun, it changes form from liquid to a gas.



Source 12.2 The water cycle

This is called evaporation. Only fresh water evaporates. Any salt or impurities or metals are left behind.

- 2 Transpiration** – This is when water evaporates from plants, mainly through their leaves. This process releases water vapour (gas) into the air.
- 3 Condensation** – This is where gas changes back to a liquid. That is, water vapour turns into tiny liquid water droplets. These droplets merge together to form clouds.
- 4 Precipitation** – This is the process that most of us are the most familiar with. When

so much water has condensed that the air can no longer hold it, it falls downwards. Depending on the air temperature it can fall as liquid (rain) or solid as hail, sleet or snow.

- 5 Infiltration** – This is where water fills the porous spaces (cavities) in the soil, but continues to flow or slowly move. This includes run-off, which was looked at in the previous chapter.
- 6 Percolation** – This is where groundwater moves into the soil below the earth's surface.

## Geographical fact

Did you know that Antarctica is actually a desert? It is the driest continent on Earth with virtually no rainfall. The only precipitation falls as snow – on average 166 mm per year.

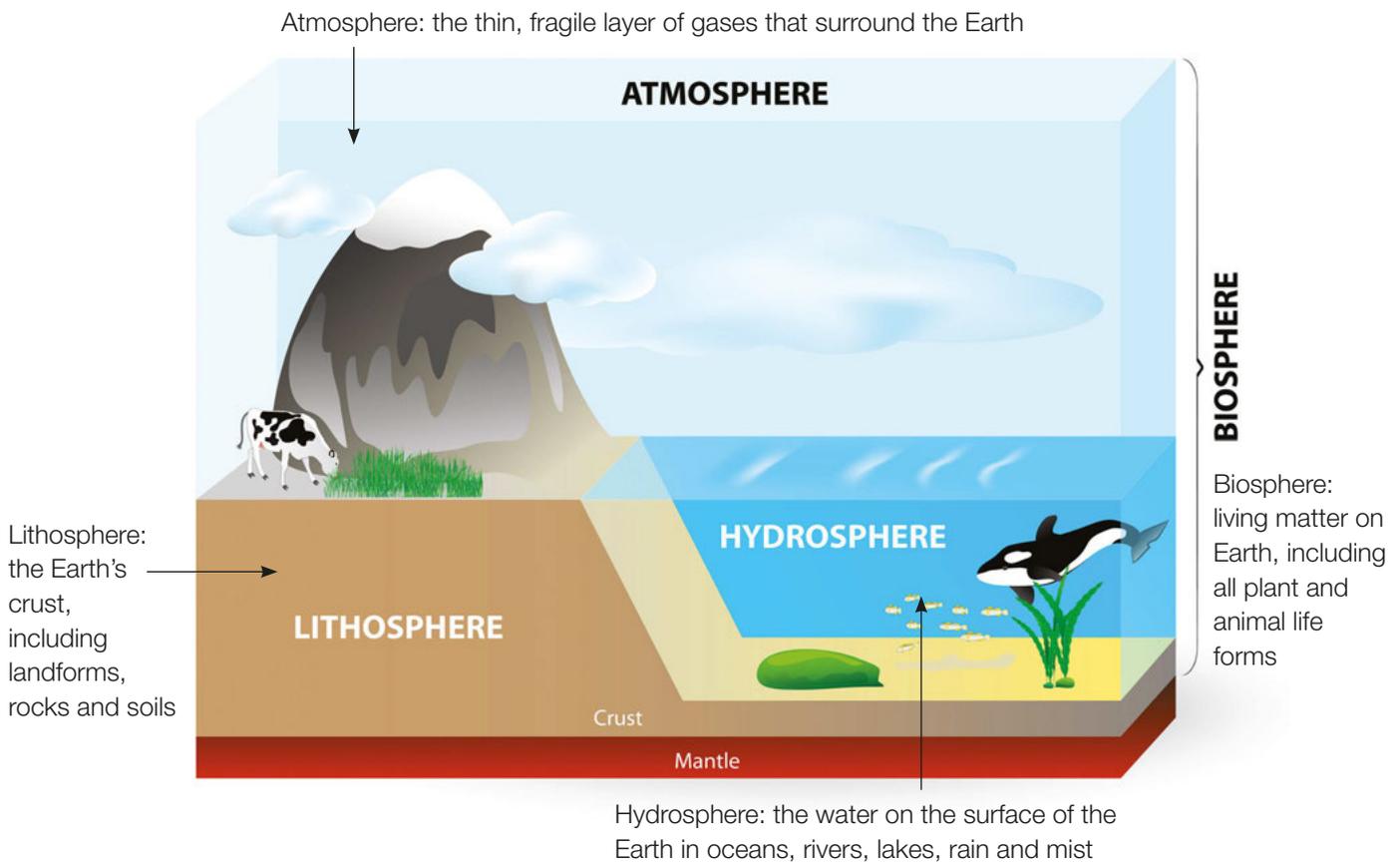
**Source 12.3** The Norris Geyser Basin in Yellowstone National Park is a great example of how water moves through the environment.



### Movement of water

As water moves through each process of the water cycle, it moves through each of the Earth's four spheres: the atmosphere, hydrosphere, biosphere and lithosphere. We think of water normally within the hydrosphere. This is the

water that we see in our oceans, rivers and lakes, as well as in dams (where water is diverted into the pipes that carry it to towns and cities and eventually into our houses, where we access it with the simple turn of a tap).



Source 12.4 The Earth's four spheres

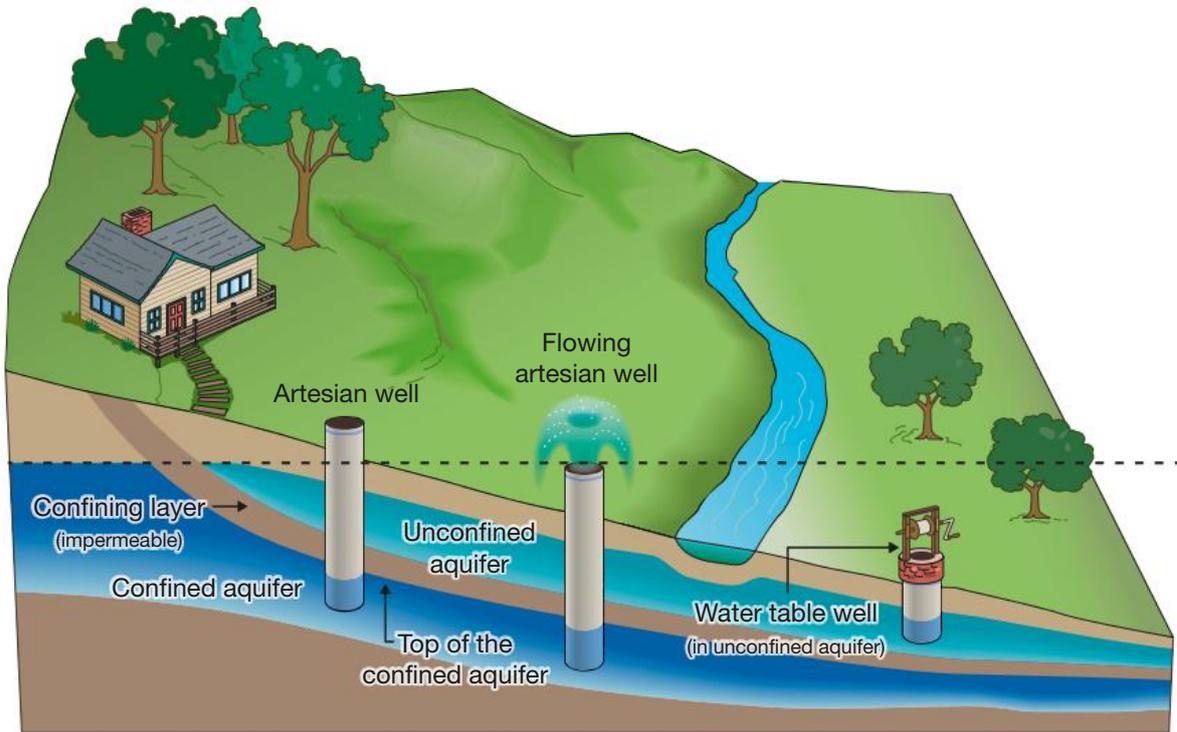
Most of the evaporation that essentially kick-starts the water cycle occurs over oceans, where water is transferred from the hydrosphere to the atmosphere. Water also moves from the lithosphere (in the soil) to the atmosphere, usually via trees and plants (i.e. the biosphere). Water moisture in the soil may be referred to

and rivers, or underground aquifers. This green water travels up through the soil via plant roots, then through the capillary action of water it moves up through the plant to the leaves, where the heat surrounding the leaves causes water to evaporate into the air – this whole process is referred to as **transpiration**. Animals also transpire as they sweat.

**blue water** fresh water in lakes or rivers

as 'green' water, as opposed to fresh water (e.g. surface water or **blue water**) in lakes

**transpiration** the process whereby water is released into the atmosphere through evaporation and the transpiration of plants or animals



**Source 12.5** Diagram showing how an aquifer works. Tapping into underground water systems, where water is confined between rock layers, is important in many regions worldwide.

## 12.2 How water flows within a catchment area

Evaporation rates are high in Australia due to the dry heat of our continent. Water also tends to flow slowly across our landscape due to the general flatness of our country. Therefore, as our water flows slowly it tends to evaporate

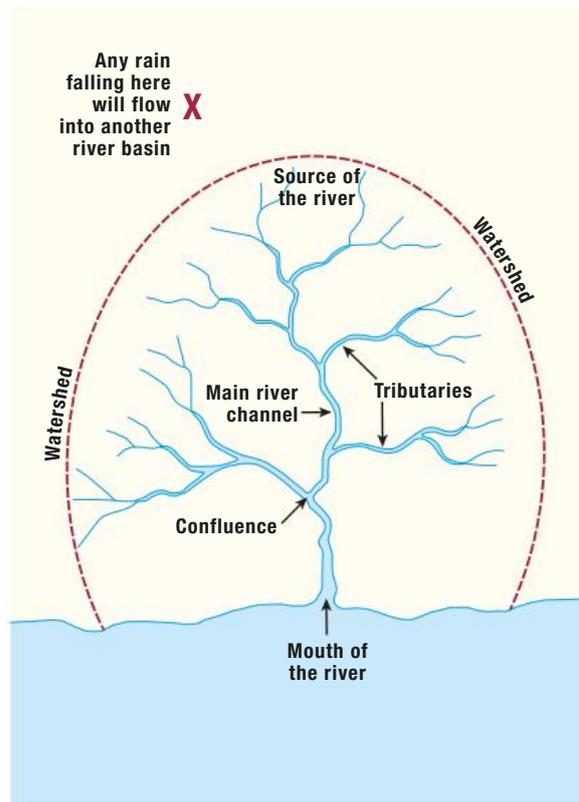
before it reaches a river as part of a **catchment area**. Changes in topography mean that water enters different catchments depending on where it falls.

Catchments are often separated from each other by a physical barrier, such as a ridge or mountain. Following rainfall, significant amounts of water can be collected and drained

through a river system. Points at which rivers and **tributaries** begin – their sources – are

**catchment area** the area drained by a river or water body. Also known as river basin.

**tributaries** smaller rivers that flow into larger rivers



**Source 12.6** An individual catchment

**river mouth** the end of the river system where water exits into a sea or lake

commonly higher up in the landscape. From there, water travels downhill by the power of gravity until it reaches the **river mouth**.

As water journeys along a river, it carves out the landscape through different processes.



**Source 12.7** The Murray–Darling Basin is Australia’s largest catchment.

## Activity 12.1

**1** With a partner, cut out 15 cards. On one side of the cards, write the key terms listed below:

- |                 |                |               |                |
|-----------------|----------------|---------------|----------------|
| • hydraulic     | • sediments    | • river mouth | • evaporation  |
| • erosion       | • condensation | • tributary   | • topography   |
| • precipitation | • river source | • abrasion    | • run-off      |
| • weathering    | • deposition   | • catchment   | • river valley |

On the other side of the cards, write definitions for the terms. Test your knowledge of these terms with your partner by randomly selecting cards. You might even like to join up with another pair and play a game of Pictionary with the cards.

**2** A home owner intends to dig a bore (hole) into the ground so that they can access the groundwater below to use on their gardens. The home owner thinks that this is not going to have an effect on the water cycle. Discuss in small groups whether you think the home owner is right or wrong. Justify your decision to the class.

## RESEARCH TASK 12.1 //

Cape Agulhas is the southernmost point of Africa. Refer to an atlas or research online to find out why this place experiences different ocean temperatures on either side. Explain how this affects rainfall in Cape Agulhas.

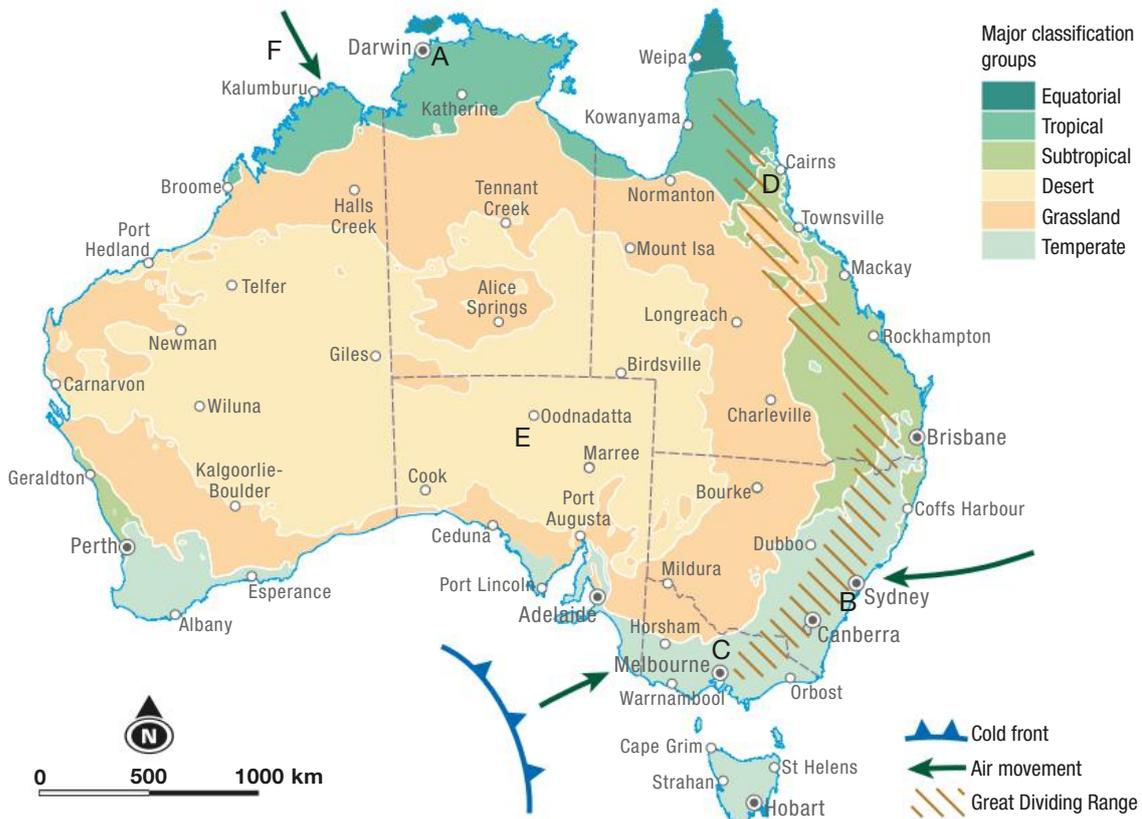
### 12.3 Factors influencing water flows and the availability of water resources

The availability of water is influenced by the following factors: latitude, altitude, topography, location and climate change. Each of these factors will be considered in this section.

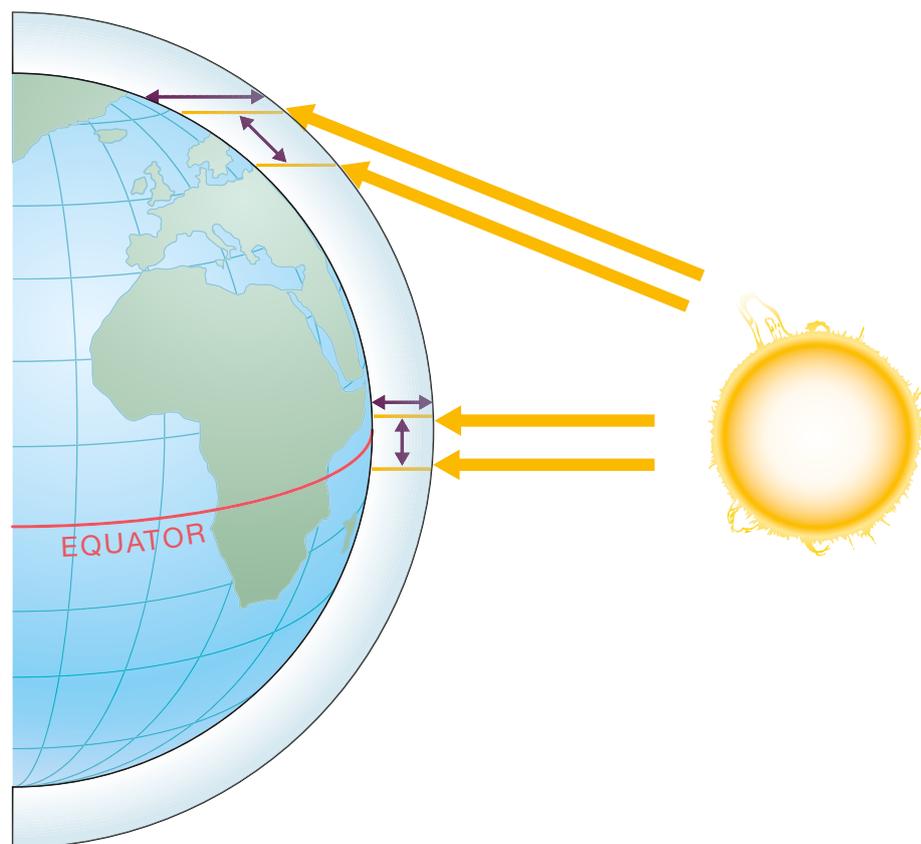
### Latitude

*Latitude* is an important factor in determining what type of climate a place on Earth will have, and subsequently the amount of water in that region. Generally, the closer a place is to the **Equator**, which has a latitude of 0°, the warmer the climate

**Equator** a reference point on Earth that has 0° latitude and is the same distance from the North and South Poles. It divides the Earth into the Northern and Southern Hemispheres.



**Source 12.8** Map of Australia showing some of the factors that influence water availability



**Source 12.9** Sunlight hits the Equator, which is latitude  $0^\circ$ . Sunlight hits the Equator most directly. The poles, on the other hand, are at a greater latitude and the sunlight that reaches the poles has a larger angle and therefore reduced energy.

will be. Places with lower latitude, closer to the Equator, will have more direct sunlight than places with higher latitude, closer to the poles.

**convective rainfall** caused when air containing water vapour is drawn upwards due to heating of the Earth's surface (e.g. in tropical regions)

**monsoon** seasonal winds that bring torrential rainfall

Latitude is one of the factors affecting rainfall. For example, Darwin, which is  $12.5^\circ$  south of the Equator, experiences **convective rainfall** as well as **monsoonal** rains during the Australian summer, referred to as the 'wet season' by those in the 'Top End' of Australia. As Darwin is close to the Equator

it receives a lot of direct sunlight, causing a high rate of evaporation. In Source 12.8 you can see Darwin located at 'A'.

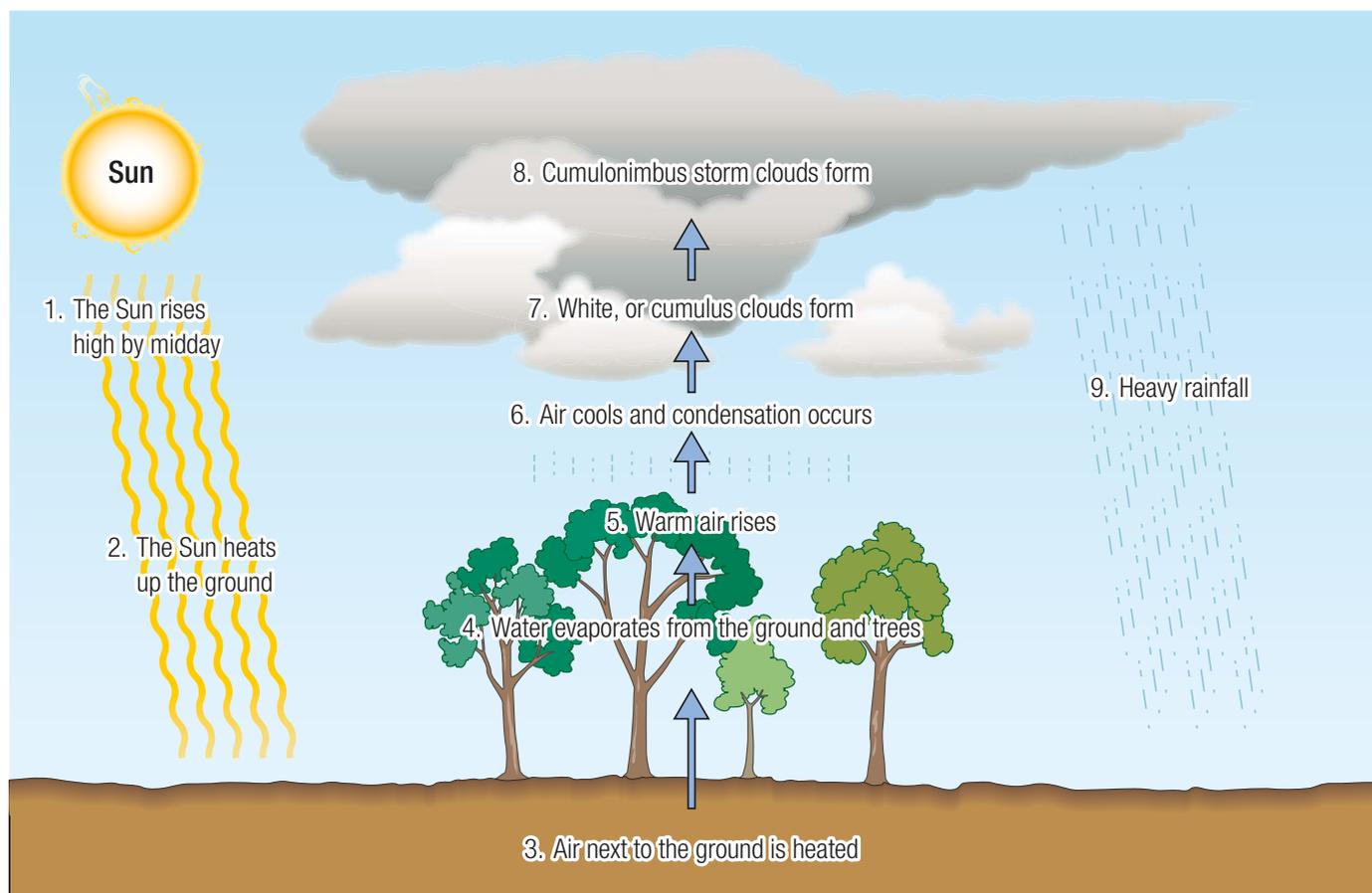
As the water vapour rises, the warm air (due to the warm air temperature) is drawn upwards

and then cools. This makes the air very moist – that is, the air has a high level of **humidity**.

**humidity** the amount of water vapour in the air

As the warm moist air rises it eventually cools and then condenses and falls back as rain.





**Source 12.10** Convectional rainfall formation is common in tropical regions such as Darwin, which is latitude 12.5°.

## Altitude

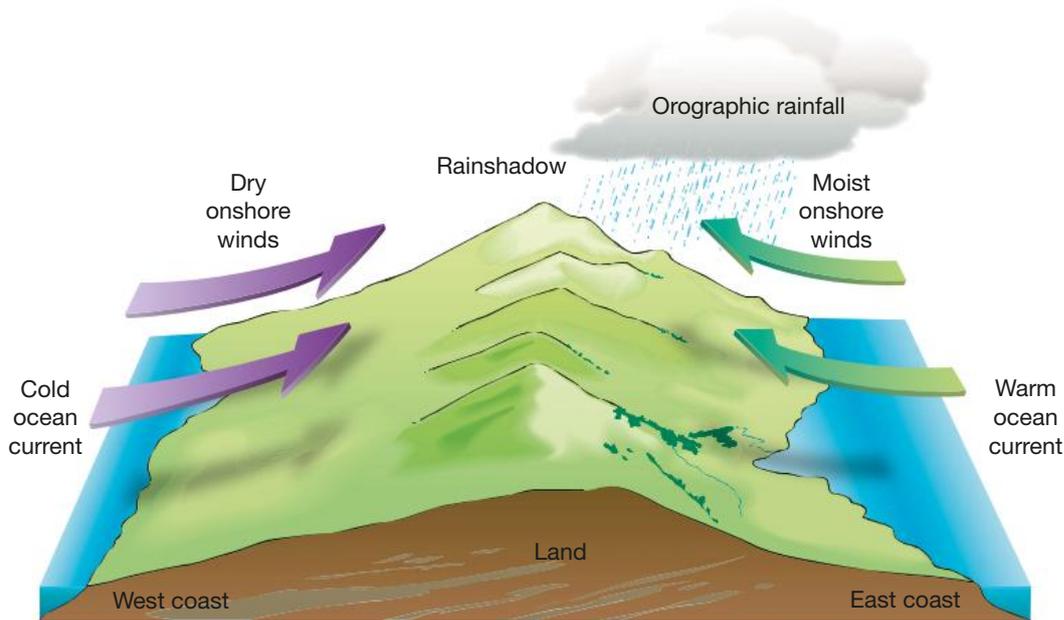
**altitude** height of a feature above sea level

Generally, as **altitude** increases the amount of precipitation also tends to increase. So the higher you go the more rainfall you get. This is a rough rule of thumb. It is demonstrated by the Great Dividing Range, which is Australia's largest mountain range, stretching for more than 3500 km from north-eastern Queensland and running close to the eastern coastline all the way to the central Victorian highlands. In Source 12.8 you can see the Great Dividing Range running up the eastern coastline of Australia. Easterly winds (carrying evaporated water vapour) move inland from the Pacific Ocean and travel over the coastal plains along the east coast

before reaching the Great Dividing Range. The sharp rise in altitude forces the moist air upwards and causes it to quickly cool, causing rainfall over mountain ranges. This type of rain is known as **orographic rainfall**.

Most of this rain falls on the eastern side of the ranges and runs off in the direction of the ocean. As the air continues over the ranges and then inland, it loses most of its moisture – this is why inland Australia is so dry. The air that moves towards the western coastline, from the Indian Ocean, is already dry, due to the lower rate of evaporation from the colder ocean currents.

**orographic rainfall** caused when masses of air containing water vapour are forced upwards by physical features such as mountain ranges



**Source 12.11** Simplified cross-section from east to west across the continent, showing orographic rainfall on the eastern side of the Great Dividing Range

### Topography

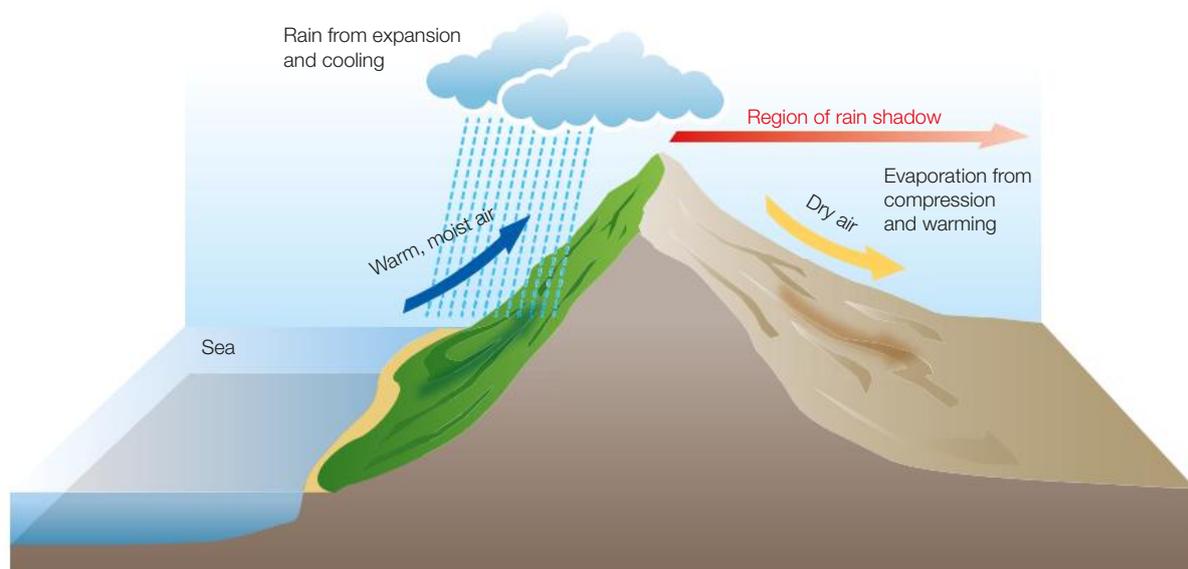
**topography** the relief and configuration of a landscape, including its natural and human features

Weather and climate patterns influence evaporation rates, as does **topography**.

The shape of the land, or topography, influences the availability of water. For

example, we have seen that the greater the altitude, the greater the likelihood of rain. Therefore, mountains, for example, are likely to have more water available.

Also, some parts of terrain, like sides of mountains, will receive more precipitation than others. For example, as air flows up one



**Source 12.12** More precipitation tends to fall on the windward side of a mountain compared to the leeward side.

**windward** upwind, or where air lifts

**leeward** downwind, or where air sinks

side of a mountain air is lifted up. The air on the other side is pushed down or sinks. The side that lifting occurs on is called the '**windward**' side. The

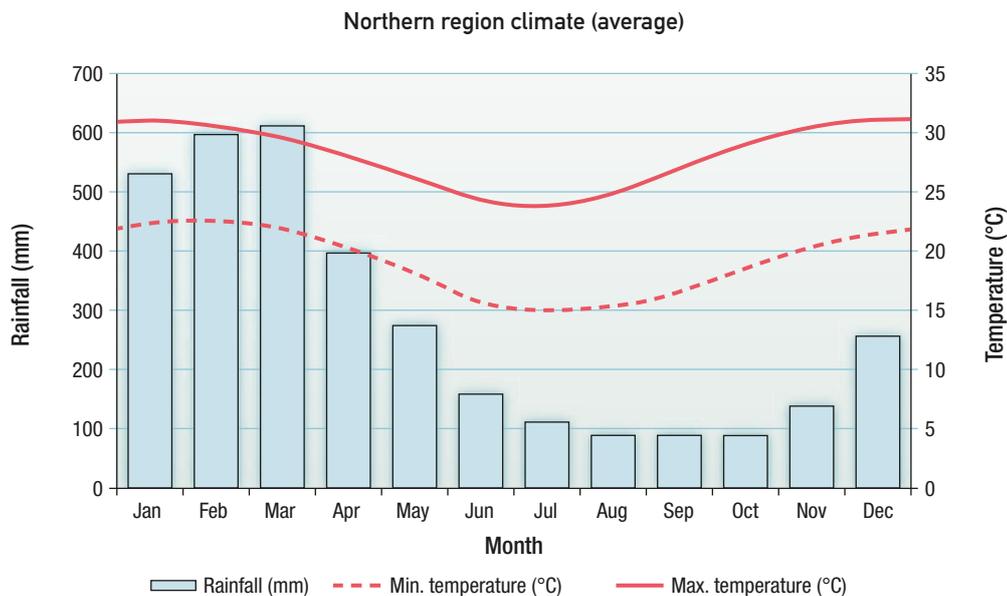
side that sinking occurs on is '**leeward**'. The windward side of a mountain always receives more precipitation than the leeward side.

## Location

The location of a place is another factor to consider regarding the availability of water. Two examples of this include the distance of a location from the sea, and its geology.

## Distance from the sea

Australia is a very large and flat country, and our climate relies heavily on the oceans that surround us. Therefore, the distance we are from the oceans greatly affects how much rainfall is received. The closer we are to the coast the more likely we are to have precipitation. For example, Cairns is on the northeast coast of Australia and also lies alongside the Great Dividing Range. Therefore it receives moist air from the warm ocean currents, as well as rainfall from the mountains that lie behind the city. That is, it receives a mixture of convectional and orographic

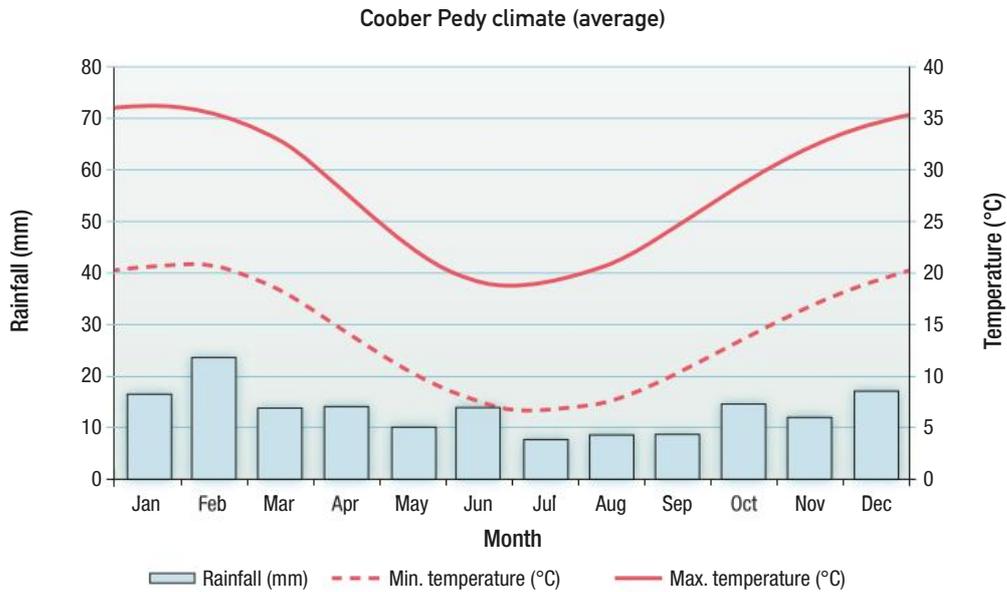


**Source 12.13** Climate of the northern agricultural region around Cairns

rainfall. Cairns receives about 3200 mm of rain a year. Conversely, Alice Springs in Central Australia only receives 267 mm a year. The Australian average is 464 mm a year, which by world standards is a very low average.

Coober Pedy, located in inland South Australia, is another example of a place too

far from the ocean to receive much rainfall. It is one of the hottest and driest places in the country, with only 157 mm of rainfall a year. This means it rains only approximately 20 days a year. Thus, distance from the sea plays a very large role in the availability of water.

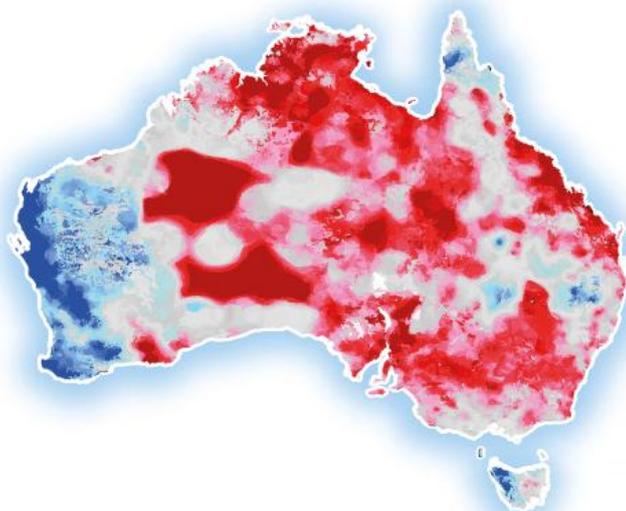


Source 12.14 Climate of Coober Pedy

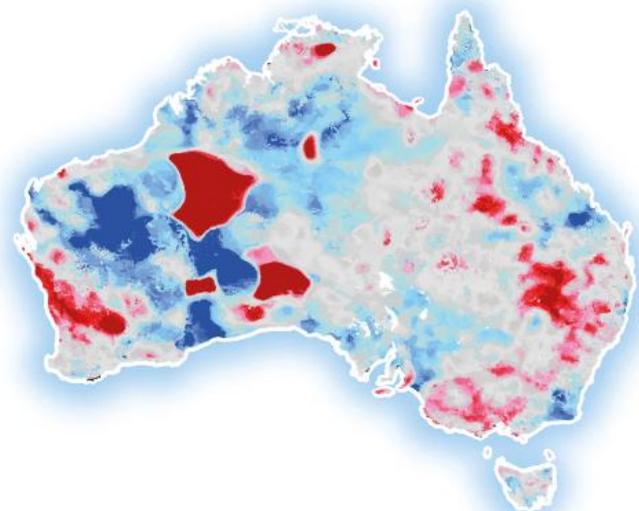
### Geology

The availability of water can also be influenced by geology – for example, the type of soil can impact the amount of run-off or infiltration. For example, loose, sandy soils allow rainfall

to sink through the ground easily, whereas clay soils form a barrier and more water runs off the land. Plant cover also contributes to this, since plants intercept and soak up water



Upper layer relative soil moisture (percentile rank) for the most recently available week. Blue is wetter than the 1961–1990 average for this month, red is drier.



Lower layer relative soil moisture (percentile rank) for the most recently available week.

Source 12.15 Map showing soil moisture in Australia. Blue is wetter, red is drier.

and may therefore reduce run-off. However, the most important factor in determining how much run-off occurs is the amount and regularity of rainfall. One large downpour of rain will not produce as much run-off as consistent rainfall. Once soil becomes soaked and is unable to soak up more water, any additional rainfall is able to run off into rivers or lakes. Australia's run-off is highest in northern regions, where the climate is tropical and rainfall is heavier and often more consistent.

While humans and animals rely directly on fresh water, 'green' water that infiltrates the soil is crucial to plants, crops and the habitats of many creatures.

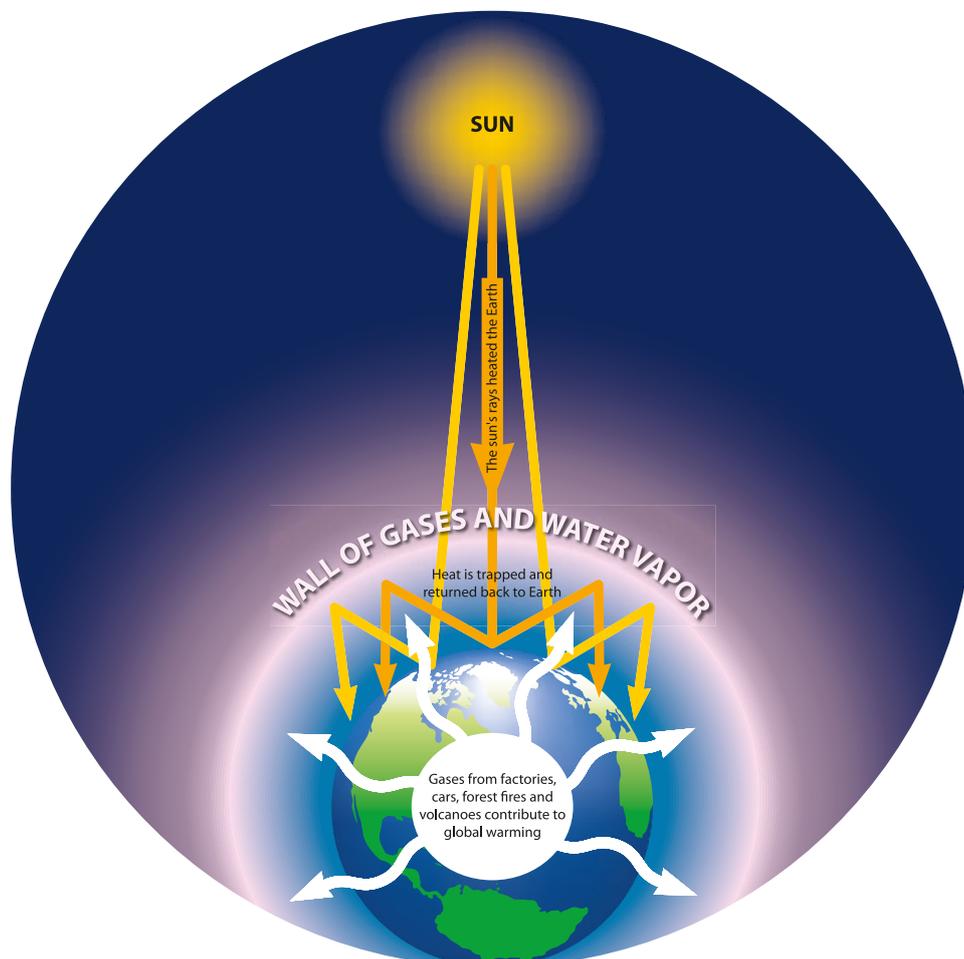
## Climate change

Climate change is an issue that affects all of us. It is a common topic for governments and authorities globally who grapple with how climate change may be slowed or prevented. The world is getting warmer due to the enhanced **greenhouse effect**, whereby our greenhouse gas emissions are trapping heat in the Earth's atmosphere. The Earth naturally retains some heat but human activity is exacerbating this effect to the extent that the Earth is not able to cool down

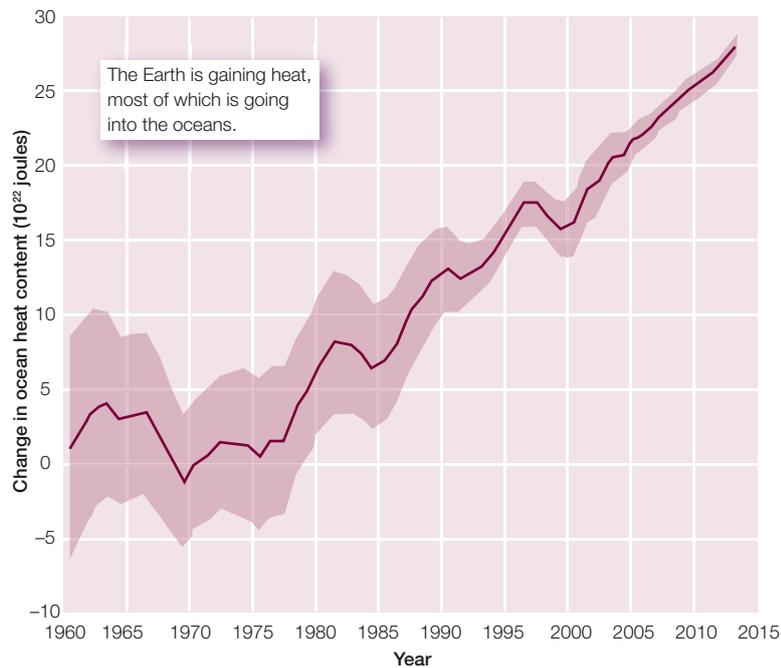
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**greenhouse effect** refers to the sun's energy that enters the Earth's atmosphere; some of it is absorbed by the land and water, and the rest is reflected back into space, but some of the energy reflected becomes absorbed or 'trapped' by greenhouse gases in the atmosphere

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**Source 12.16** The greenhouse effect



Change in ocean heat content (in joules) from the full ocean depth, from 1960 to present. Shading provides an indication of the confidence range of the estimate. (Source: CSIRO)

**Source 12.17** Our oceans are getting warmer due to climate change.

as much as in the past. Given current trends, Australia's climate is estimated to be 3.5°C warmer by 2070. This does not seem a lot but this increase means that:

- there will be more extreme weather days – more extreme heat and more extreme flooding
- the oceans will become warmer
- sea levels will rise as ice melts
- oceans and seawater will become more acidic, impacting their ecosystems.

According to the CSIRO in 2014, Australia's climate has warmed since official records began in 1910. The mean air temperature, as well as the mean surface sea temperature, has increased by 0.9°C. Indeed, seven of our 10 warmest months ever recorded have occurred since 1998. In addition, the number of cooler months has declined.

As Australian rainfall is variable, it is difficult to accurately predict the impact of climate change on Australia in the future. Currently, the average Australian rainfall has increased – mainly due to the increase in rainfall in northern Australia. In fact, some parts of northern Australia have received the highest rainfall ever on record. However, the amount of winter rainfall in southwest Australia has declined by 17% since 1970. The decline in rainfall in the winter months has impacted the stream flow in our rivers and streams in the southwest. The CSIRO and Bureau of Meteorology have estimated that the stream flow of the river systems in southwest Australia has declined by up to 50%.

### La Niña and El Niño

You may have heard of the El Niño effect. El Niño and La Niña are two parts of a complex

mix of sea-surface temperatures, air pressure and winds. It is important to acknowledge the impact they have on the Australian climate.

El Niño tends to bring drought conditions to Australia, whereas La Niña tends to bring above-average rainfall and increased cyclone events.



**Source 12.18** The El Niño effect in Australia tends to bring about drought conditions.



## Activity 12.2

- 1** Suggest why Australian rivers generally have a very low flow rate compared to other rivers around the world.
- 2** Refer to an atlas (or online map of Australia). In pairs, discuss which type of rainfall you would expect the following locations to experience. Suggest potential reasons.
  - a** Canberra
  - b** Mt Gambier
  - c** Cooktown
- 3** Explain why there is higher rainfall on the east coast of Australia than on the west coast.

## 12.4 How the water cycle connects people and places

As water moves, it connects people and places. We will next look at three ways that the water cycle has a large impact on people and their communities – environmental, economic and social.



**Source 12.19** Elakala Waterfalls in the Blackwater Falls State Park, West Virginia, USA

### Environmental

At this point, we have to ask two questions. What effect does the water cycle have on the environment, and how does this ultimately affect people? Everywhere we look in nature, the landscape has been shaped by wind and more significantly by water. Rocks along the

surface of river beds are broken down and carried away by the processes of weathering, erosion and transportation (which we looked at in Topic 1).

Weathering is essentially the loosening of rocks by atmospheric conditions (e.g. by heat or water) or by chemicals (such as the



**Source 12.20** Lake Pedder from Mt Eliza, Southwest National Park, Tasmanian Wilderness World Heritage Area, Tasmania, Australia

chemicals produced by biological organisms like fungi, or those found in the atmosphere). This loosened rock material may then be broken down further by erosion. Unlike weathering, erosion involves the movement of

material. The force of water as it travels with gravity downhill is enough to remove some rock material from its location (**hydraulic erosion**), while rocks and sediments carried by the river also wear away and erode the river bed (**abrasion**).

Finally, material that has been weathered and eroded can be transported along the river until there is not enough energy left to carry it any longer and deposition occurs. At this point, the sediments drop to the bottom and are deposited on the river bed. The distance sediments travel depends on both the speed of the river and

the size of the sediments, although most of the transported material is deposited near the river mouth, where the slope is very gradual. One key point here is that the sediments created by broken-down rock material are combined with organic (biological) material to create soil. Soils are crucial not only for the environment but also for farming, an important human activity upon which civilisation depends. While 'blue' surface water is where we access our drinking water, it is the 'green' water held in soils that supports most of the world's food production.

## Economic

How would changes to the water cycle affect the economy? Climate change can impact water movement, and there is concern over the impact of rising sea levels on the Australian coast, particularly in New South Wales where large population centres are located, like



Sydney. The sea level has been rising by approximately 3.2 mm (nearly half a cm) every year for the past 15 years. If this rate and rise continues, then in 100 years' time approximately 60 000 residential buildings, with a value of \$14–\$20 billion, and up to 5000 km of NSW's roads and railways, worth about \$10 billion, will be at risk.

One hundred years may seem a very long time, but if you consider your personal age expectancy and then consider the fact that you are likely to have children, then 100 years is not a long time at all.

In terms of water supply there may also be a decrease in annual run-off and rainfall in the inland catchments. Climate change may also increase the rate of evaporation from the catchment areas.

This change in water supply won't only impact households – it will also greatly impact

industry and agriculture. The gross value of NSW agriculture production in 2009–10 was \$8.4 billion, so it plays an important role in the state's economy.

### Social

If water supply drops, there is a social impact as people change the way they use water. For example, in households, people may endeavour to save water; not just to help the environment but also to save money as the price of water increases (should its availability decrease).

Due to water movement, people can also move due to circumstances. For example, if water movement affects agriculture, then families may choose to stop farming. If people choose to leave farming, often they move to a town or city centre. This has a social impact as then they compete for employment with

others. A sad but very good example of this is the Federation Drought, which began in 1895 and reached its peak in 1901 and 1902. River systems across Australia suffered, especially the Darling River, which virtually ran dry at Bourke in New South Wales. In Victoria, the Murray River ran dry through the towns of Deniliquin and Mildura, causing river transport to slow down or stop altogether. You can imagine this had a major social impact as the car industry was still in its infancy at this time.

As a result of the drought, sheep numbers fell from 91 to 54 million, and cattle from 11.8 to 7 million. Furthermore, rabbit numbers increased to plague proportions, resulting in degradation of farming land. Some farmers lost everything and left their properties.

### The Big Dry

A more recent example is 'The Big Dry' drought, which began in 1996 and worsened in 2002 and 2007. The Murray–Darling Basin's water storage levels fell to 17% capacity

in 2003 and remained below pre-drought levels until late 2011. In Victoria, strict water restrictions were put into place by the government. Fountains in Melbourne no longer operated, parks were no longer watered, golf courses did not irrigate, and the city yellowed. Socially, people were asked to water their gardens only on special days of the week. That is, people living in even-numbered houses were allowed to water only on three days a week (within strictly limited hours), and then it would be the odd-numbered houses the alternate days of the week. On the final day, watering was banned altogether. Many people opted to install greywater tanks in their homes to catch the waste water, which they then used to water their gardens. Many households publicly displayed signs outside their home to indicate they used grey water, so that they couldn't be accused of using water illegally. Some radio stations even ran segments where people could 'dob' others in for inappropriate use of water.



### Activity 12.3

- 1** Consider the closest body of water to your house. For example, it could be a river, lake, dam or the ocean. What would happen if its level increased or decreased? What impact would that potentially have on those near the source or even your family?
- 2** Which of the three effects (environmental, economic, social) is the most important when considering the effects of water movement? Choose one and support your argument. Be sure to include examples in your written response.

## Fieldwork 12.1 Water connecting places

### Aim

To visit a local waterway or water source and explore how different parts of the environment are interconnected by water.

### Method

Several organisations operate interesting excursions around the role of water in nature. For example, the Melbourne Water Discovery Centre (at the Western Treatment Plant in Werribee) provides students with an interactive journey of the water cycle through river systems. The centre also helps students discover how water connects places, from catchments to urban supply and treatment systems and eventually to bays and oceans. Another example of a potential excursion is at the Toolangi Forest Education Centre (operated by the Gould League), which investigates the role of water in forest ecosystems.

Alternatively, you could investigate similar organisations in your school's local river system, travelling to different sites along the river – for example, one upstream near the river source, one halfway down the river and another close to the river mouth.

### Preparations

You will need to take on your field trip:

- equipment for exploring the questions on this page (see if your science department has equipment for things like water quality tests and measuring velocity rates)
- a camera for photographs of each site
- a map of the river and surrounding area
- a pen and pencil for recording notes and annotated field sketches.

### Data collection

Types of questions to explore include:

- How fast is the flow of the river at each site? (This can be measured simply using an item such as a stick or leaf and timing its journey across a certain distance.)
- Is there evidence of processes such as erosion, transport or deposition? (Look at the shape of the river and along the river banks, as well as the colour of the river, to observe whether much sediment is being transported.)
- What are the width and depth of the river? (Check if it is safe enough to find out and only explore under direct teacher guidance.)
- What are the characteristics of the riverbank? (For example, observe vegetation types and cover, rock or soil characteristics, evidence of animal or human impact, and weed species.)
- Is there any evidence of recreation or other human activities being undertaken today or in the past? (This may be evident if studying larger rivers like the Yarra River in Melbourne.)
- Is there any evidence of human impact (such as litter, erosion or pollution) or management (such as water storages, fences or signs)?

### Fieldwork presentation layout

Present your findings, comparing all three sites, as a poster, report or digital display (e.g. PowerPoint). The focus question that should be addressed if studying a local river system is: 'How do the river system and its geographic characteristics change as you journey along its course?'

## Chapter summary

- Water is the only substance on the planet that can be commonly found in its three states – liquid (water), solid (ice, snow) and gas (water vapour).
- The water cycle is continuous and closed. This means it continues to change state and also never loses or gains water – it stays the same. The water cycle replenishes the Earth's freshwater supply by removing impurities.
- There are six processes in the water cycle: evaporation, transpiration, condensation, precipitation, infiltration and percolation.
- Water movement occurs through the water cycle. Furthermore it moves through each of the Earth's four spheres – the atmosphere, hydrosphere, biosphere and lithosphere.
- Water flows through catchments (or drainage basins), which are the total area where water from precipitation collects and drains downhill into a body of water such as a river, lake or ocean. The availability of water is influenced by the following factors: latitude, altitude, topography, location and climate change.
- The water cycle connects people and places in three important ways: environmental, economic and social. All have a large impact on people and their communities.

## End-of-chapter questions

### Short answer

- 1 Identify which process is associated with water movement from the hydrosphere to the atmosphere.
- 2 How do ocean temperatures influence the amount of rainfall that forms over different coastlines; for example, the eastern coastline compared with the western coastline of Australia.
- 3 Describe how the soil type (geology) influences the amount of run-off that enters a river system.

### Extended response

Describe in detail the journey of water in a large river system as it travels from the river source (high up in the hills) to the river mouth (where it exits to the sea). You may need to research types of landforms associated with river systems and where they occur.

You may choose to either draw a diagram of the river system (annotated with descriptions) or write your description as a story (with a water molecule as the main character). Include the following details in your description:

- how water enters the river system – via the water cycle
- processes of weathering, erosion, transportation and deposition
- landforms such as waterfalls, floodplains and estuaries or deltas.



# Australia's water resources

# 13

**Source 13.1** Sydney lies on the eastern coastline of Australia. The city is unique in how it is built around the harbour with many parts of the city lying near the water.

## Before you start

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### Main focus

Australia has limited water resources, particularly when compared to the rest of the world.

### Why it's relevant to us

Availability of water in Australia affects all of us as our population grows. Australia is naturally a drier continent than others, so access to fresh water is crucial for our livelihood.

### Inquiry questions

- Where are Australia's water resources located?
- What is Australia's primary source of fresh water?
- How can Australia increase the accessibility and availability of fresh water?
- Why does fresh water availability vary between continents?

## Key terms

- climate
- convective rainfall
- fresh water
- monsoon
- orographic rainfall
- run-off
- weather

## Let's begin

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As each continent has a unique landscape with distinct geographical features, it makes sense that the availability of fresh water varies between the continents. Australia faces unique issues in the supply, access to and availability of fresh water. This has greatly influenced the development of Australia, including where people live, what is cultivated and where efforts are directed towards the conservation of water. While some tropical parts of Australia experience high temperatures and heavy rainfall, other areas have relatively low average temperatures and low rainfall.

## 13.1 Spatial variations in Australia’s water resources

### Groundwater and rivers

The Great Artesian Basin is Australia’s biggest groundwater basin, and the largest groundwater system of its type in the world. As we can see from the map in Source 13.2, a large area in the southeastern region of the Artesian Basin is located underneath the Murray–Darling Basin. Some of the underground flows in the Artesian Basin recharge rivers in the Murray–Darling Basin,

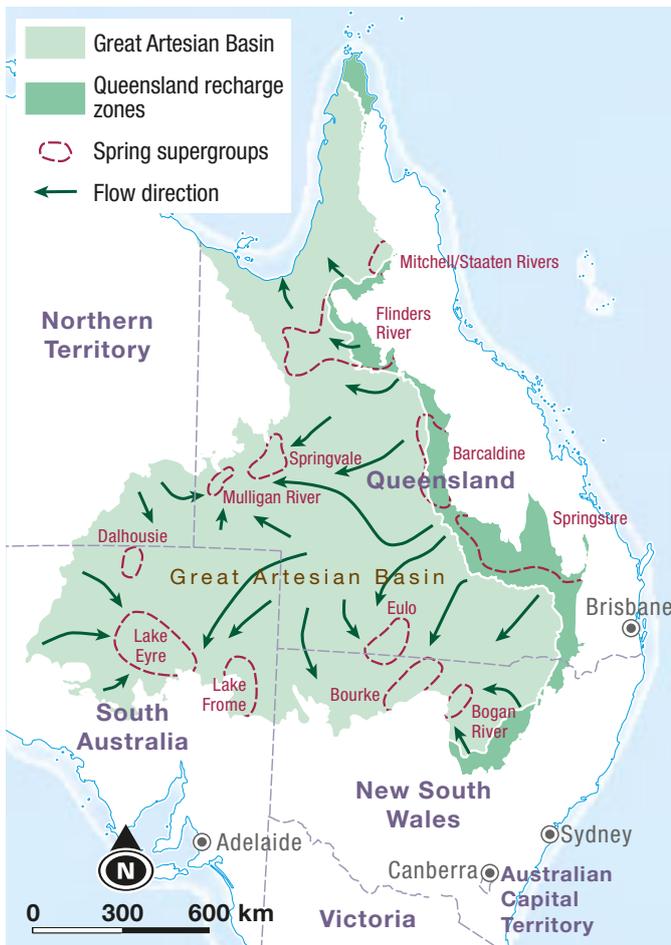
connecting these major systems. The Great Artesian Basin has been considered a water source in Australia for many years, with thousands of groundwater

**bores** extracting water from it. In arid western regions of New South Wales that are also within the Murray–Darling Basin, these bores are the only source of water for some towns and farms.

**bores** holes drilled into the ground to extract groundwater

With significant investment and effort, northern regions of Australia could become an important additional food bowl in Australia, especially with global food shortages. However, it is important that we manage water resources with a degree of caution.

Significant issues have arisen with this water use. Most notably, the amount of water extracted from the Great Artesian Basin has in many areas far outstripped the rainfall entering and recharging the groundwater, especially since some areas are too salty to extract from. Some animal species have become extinct as a result. Another more recent issue has been the possible chemical pollution resulting from coal seam gas extraction, which would potentially not only cause environmental damage but also reduce the sustainability of water use in these regions. In conclusion, water use in Australia and indeed throughout the world needs to become much more sustainable if we are to use it in the future for as many purposes as we do today.



**Source 13.2** The Great Artesian Basin. The arrows show the direction of water flow through the groundwater system, with water at some points entering important rivers and lakes, some of these located in the Murray–Darling Basin. The dark green regions represent areas where water enters and recharges the groundwater basin.

### Activity 13.1

- 1 Identify what states the Great Artesian Basin extends through, and which contain recharge zones.
- 2 Explain why the Great Artesian Basin is important to Australia.
- 3 Describe some of the issues arising from human use of the Great Artesian Basin and areas around it.

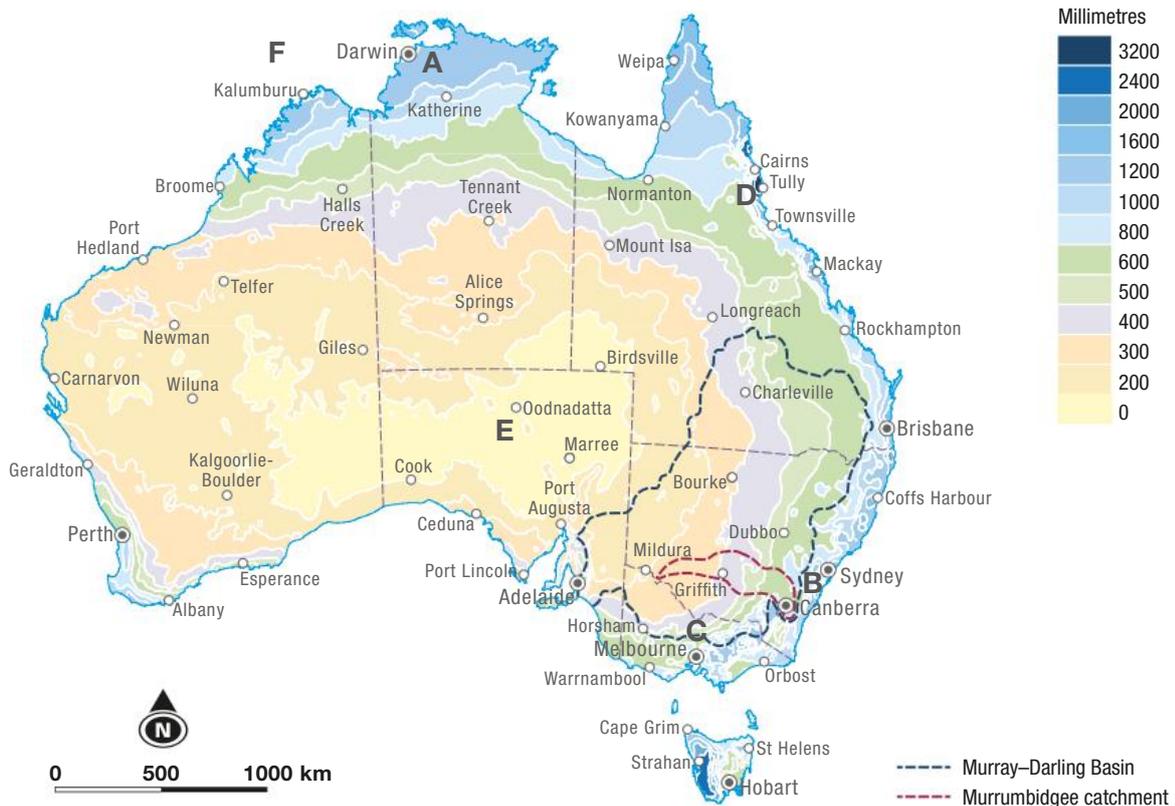
## 13.2 Variations in freshwater availability across Australia

### Precipitation

Precipitation (water that falls from clouds and may be in the form of rain, hail, snow or sleet) is a fundamental part of the water cycle. Without it, freshwater resources such as rivers, lakes and underground aquifers cannot be

replenished. When considering the amount of precipitation in a location, one factor that is carefully considered is the seasonal rainfall and any variations that might occur.

Australia is a large country and therefore it has a climate that varies considerably.



Source 13.3 Climate types in Australia (see the text for detail about the letters on the map)

Rainfall and temperatures differ significantly between the north and south of the country, as well as between coastal areas and inland regions. Let's explore the reasons for some of these differences. Source 13.3 is a map you are already familiar with from the previous chapter, and we will refer to it again as we look at some of the variation in rainfall in Australia.

#### Convective rainfall and the monsoon (A, D and F on the map)

The top northern part of Australia receives convective rainfall (also called tropical rainfall), as discussed in the previous chapter. Most of the rainfall is received in the summer months, with the winter months being referred to as the 'dry season' due to the little rain received.

Convective rain is also received by towns such as Tully (see D on the map). This town, 140 km south of Cairns, was once awarded the 'Golden Gumboot' as Australia's wettest town. The average rainfall in Tully is approximately 4490 mm a year! Not only does it receive a huge amount of rain, but the rain is also very consistent, with 150 days experiencing rainfall per year on average. Tully receives this much rain due to its location in the wet tropics, where cyclones and monsoonal rain can develop. The town is also situated alongside mountain ranges that attract rain clouds from across the Coral Sea. Thus Tully receives a combination of *orographic* and convective rainfall.

The 'Top End' of the Northern Territory and Western Australia has a relatively well-defined wet season that typically lasts from October through to April (see F on the map). During

**Source 13.4** Convective rainfall can be seen on the horizon from Nightcliff, a suburb in Darwin.



the winter months, rainfall is actually quite low in this region. The summer *monsoon* season occurs because of moist west to north-westerly winds moving in from the Indian Ocean and southern Asian waters, producing convective cloud and heavy rainfall over northern Australia.

One of the most famous monsoonal rain systems occurs in India. From June through to September, Indian Ocean winds travel in a very different direction compared to those in October through to April. These moisture-laden, south-westerly winds rush into India and are drawn towards the Himalayas. The massive mountain range acts like a high wall, forcing the winds to rapidly rise and create rainfall. Some areas of the region receive up to 10000 mm of rain annually, and almost all of it within a few monsoonal months!



**Source 13.5** In India, flash floods are a common occurrence during monsoon season.

**Source 13.6** The monsoonal torrential rain approaches Roebuck Bay in Broome, Western Australia



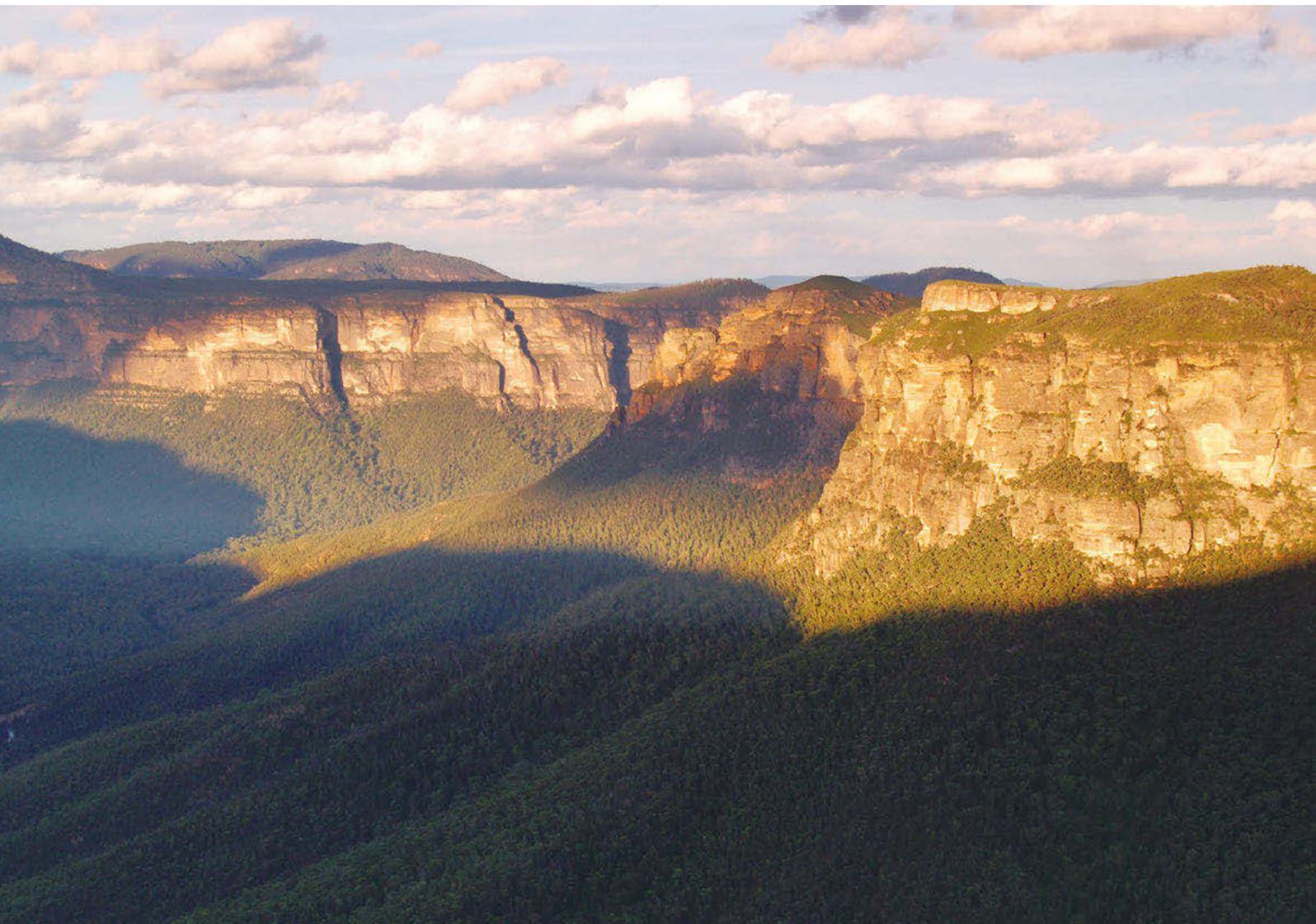
Similarly, in South America the Andes mountain range blocks moist air from the Pacific Ocean to the west and, as a result, a significant amount of rain falls on the eastern side of the mountain range, which becomes the source of the tributary rivers that enter into the mighty Amazon.

#### Orographic rainfall (B on the map)

The Great Dividing Range is Australia's largest mountain range, stretching for more than 3500 km along the eastern coastline of Australia (see the shaded area B on the map).

Easterly winds (carrying evaporated water vapour) move inland from the Pacific Ocean and travel over the coastal plains along the east coast before reaching the Great Dividing Range. The sharp rise in altitude forces the moist air upwards and causes it to quickly cool, causing rainfall over mountain ranges. As mentioned in the previous chapter, this type of rainfall is known as orographic. Generally, places on the windward side of the ranges (that is the coastal side) tend to receive the most rain during the year, whereas the leeward (inland) side is where you start to see dryer climates, such as deserts. We will discuss this further when we look at E on the map.

**Source 13.7** The Blue Mountains national park is part of the Great Dividing Range and receives orographic rainfall.





**Source 13.8** An orographic cloud captured in Canaima National Park, Venezuela

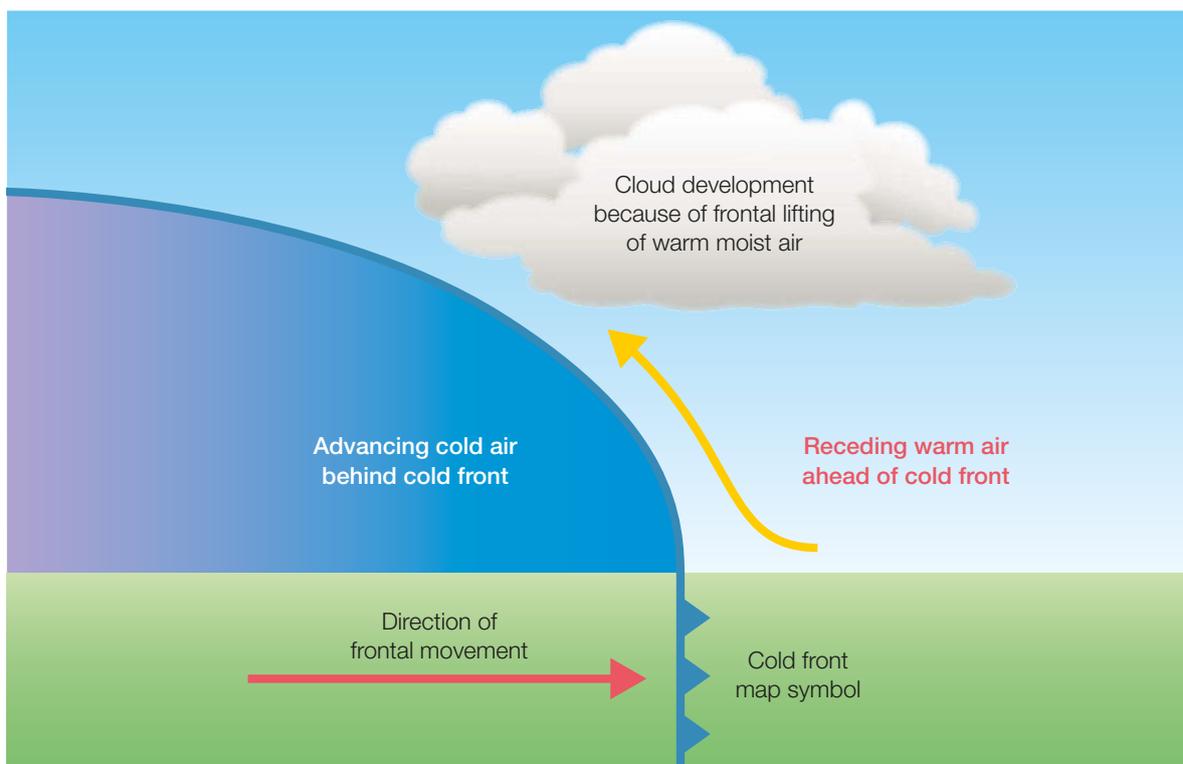
### RESEARCH 13.1 //

Parts of Australia have experienced a reduction in rainfall compared to the 1990s. Research the areas in Australia that have experienced a reduction in rainfall. Prepare an informative news report on this explaining what has caused the reduction and what this means for the future of Australia's climate and water resources.

#### Cold fronts (C on the map)

Have you ever experienced a cold front? If you have been outside on a sunny day, when the weather suddenly turns chilly, the wind picks up and clouds seem to appear out of nowhere, then you have experienced one. In the southeastern region of Australia, and to an extent the

southwestern corner, cold fronts are common. These weather systems are basically cold air moving northward from Antarctica. As the cold air moves over land, it pushes underneath the warmer air. The warmer air is forced upwards and cools, so that it is unable to hold its moisture any longer and it falls as rain.



**Source 13.9** A cold front: warmer air is forced above the mass of moving cold air, causing rain clouds to form.

### Inland Australia (E on the map)

Coober Pedy, located in inland South Australia, is one of the hottest and driest places in the country. Only 20 days a year experience rainfall on average for a total of 157 mm of rainfall per year (see Source 13.10). Coober

Pedy is sometimes referred to as the ‘opal capital of the world’. It is also famous for its underground houses, called ‘dugouts’. Around half the town’s residents live in these dugouts, which have a constant mid-20s temperature and provide relief from the relentless sun.

**Source 13.10** The township of Coober Pedy – one of the hottest and driest places in Australia



### Case study 13.1

#### The Murray–Darling Basin

A useful way of understanding how important precipitation is to the availability of water in Australia is to study the Murray–Darling Basin, which has a large catchment area reaching over four states. The Murray–Darling Basin contains the catchment areas of the Murray and Darling rivers and their many tributaries. It drains large sections of four states of Australia, including much of New South Wales, as well as the ACT. The Great Dividing Range runs along the eastern edge of the Murray–Darling Basin, providing the source of water for the major rivers.

Much of Australia's rainfall originates in the east and falls over the Great Dividing Range. However, most of this rain runs down the eastern side of the ranges and flows back towards the coast. The rain that does fall on the western side of the ranges runs into the Murray–Darling Basin. Of this rainfall, only 4% ends up as run-off, as 94% evaporates or transpires through plants and a further 2% drains into the ground. Since most of the basin is relatively flat and low-lying, it takes considerable time for water to travel through the river system.



**Source 13.11** Major rivers and towns in the Murray–Darling Basin. The major tributaries that run into the Darling River begin in southern Queensland and northern New South Wales, while the source of the Murray is in the highlands on the NSW–Vic border. Both rivers flow towards South Australia and exit into the Southern Ocean at the Murray mouth, south-east of Adelaide.



**Source 13.12** Diverting water from rivers in the Murray–Darling Basin for irrigated agriculture is crucial for Australia’s food supply and economy. However, water use will need to become more efficient as the need for water resources, and therefore competition, grows.

This, combined with a relatively hot and dry climate, contributes to very high evaporation rates and water loss. The basin receives just 6% of the country’s annual run-off, and yet it is Australia’s most significant farming region. The Murray–Darling Basin, sometimes referred to as ‘Australia’s food bowl’, produces 39% of the nation’s income from agricultural production. Well over three million people (living within or close to the basin) rely directly on this region for water use, while millions more (e.g. in major cities like Sydney and Melbourne) consume various foods produced in the basin.

When you go to your local supermarket, it is easy to pick up a steak for dinner, or a nice juicy orange, and not think about where it has come from. It is more than likely that it would have been produced somewhere in the Murray–Darling Basin, and it would have

required a significant amount of water. For example, CSIRO land and water scientists have measured that it takes 50 000 to 100 000 litres of water to produce just 1 kg of beef!

**Run-off**

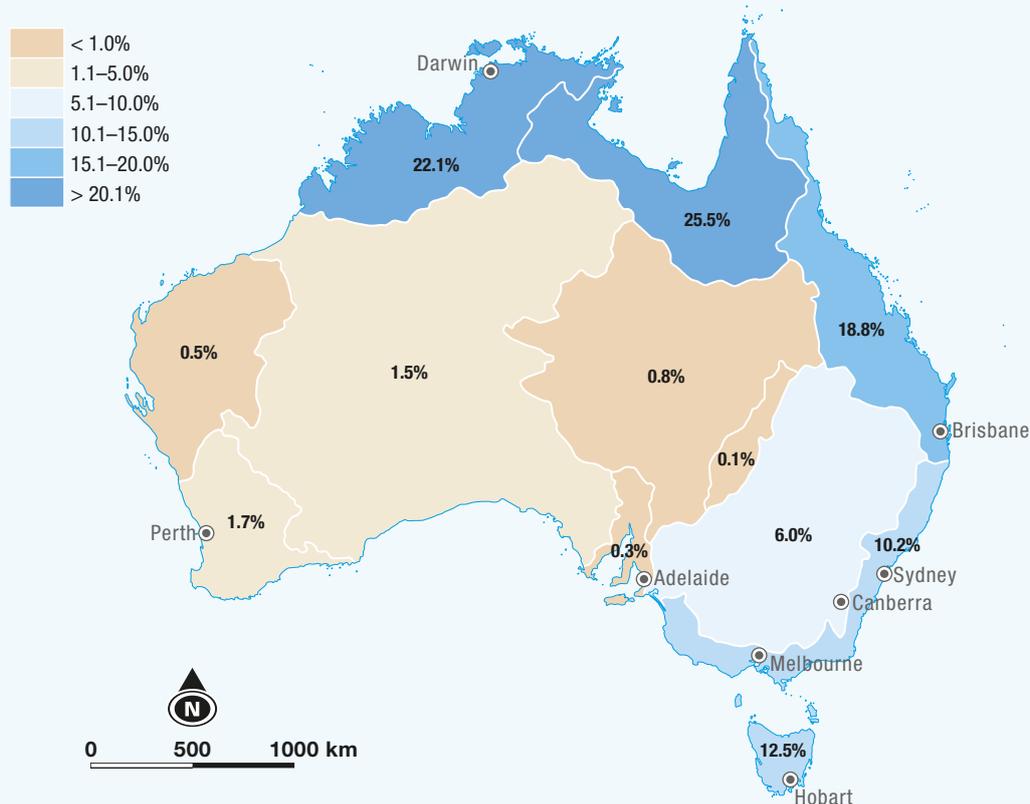
Considering Source 13.13, you can see that the Murray–Darling Basin is a region where every drop of water is highly valued and used. The map shows that regions in northern Australia receive significantly more run-off, and yet they are not farmed to anywhere near the extent or intensity of the Murray–Darling Basin. Conflicts in the Murray–Darling region have arisen over recent decades,

due largely to competition for water resources. Farming groups, **conservationists**, governments, local residents

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**conservationists**  
people who work to protect the natural environment and its living organisms

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**Source 13.13** Mean annual run-off in Australia's major drainage basins

and other groups all value water differently, and the amount of water available does not always meet everyone's needs.

The Murray–Darling Basin is a busy area, particularly agriculturally, with various types of farming distributed throughout different regions of the basin. The Murray–Darling Basin accounts for more than 70% of the irrigated agriculture in Australia. Its economic value to the nation is enormous, as irrigated crops are worth billions of dollars each year to the Australian economy. The main types of irrigated farming include rice, dairy, cotton, grapevines, fruit and vegetables.

For example, rice in Australia is grown almost entirely in the Murray–Darling Basin, in the irrigation regions along the Murray and Murrumbidgee rivers. Unlike the spectacular rice terraces in regions of Asia, rice farms in places like Deniliquin and Leeton in New South Wales require more water than natural rainfall is able to provide, and so water is diverted from the rivers by canals onto these farms. Cotton is grown mostly along the upper Darling and its tributaries in southern Queensland and northern New South Wales. Cotton farms in these regions do not divert water directly from the rivers; rather, they are often situated on the river flood

plains, and harvest rainwater before it enters the groundwater and potentially cycles into the river system.

Just as there are various types of farming in the Murray–Darling Basin, there are different ways in which the farms are watered. Some farming regions, particularly along the Darling River, rely only on rainfall. Other regions, such as those along the Murrumbidgee River, use irrigation water diverted from the river.

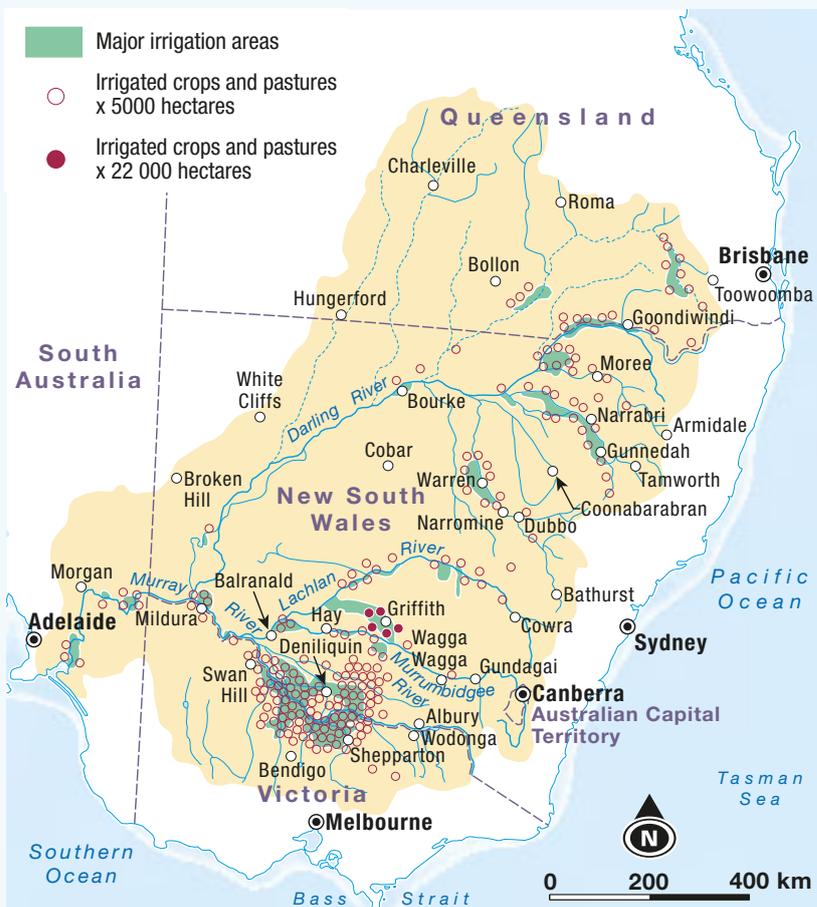
The way in which we use water in Australia has long been influenced by European settlers,

who were accustomed to high rainfall rates and a never-ending water supply. Droughts in recent decades, particularly through the very dry years of the mid-2000s, made it clear that this mindset in a predominantly dry country could not last. Later on in this book we will learn about how water management has become crucial to ensuring that the river and important **wetland environments**, as well as farms throughout the Murray–Darling Basin, maintain a

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**wetland environment**  
an area of land that is saturated with water, either permanently or periodically. It is an important ecosystem with a unique set of animals and plants

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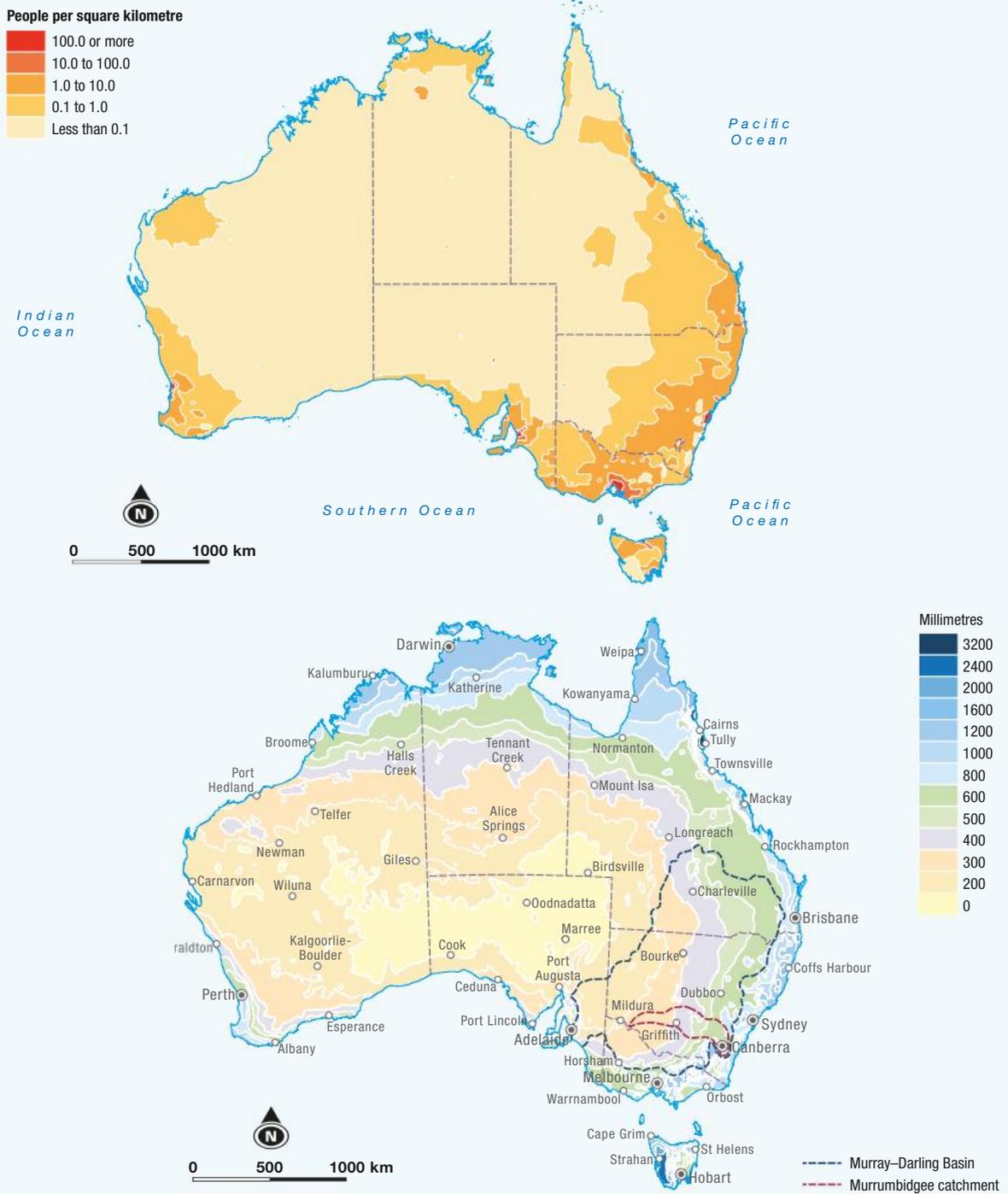
**Source 13.14** Murray–Darling Basin showing major irrigation areas and highlighting the intensity of irrigated farming and, therefore, the competition over water resources along major rivers such as the Murray, Murrumbidgee and Lachlan rivers



**Source 13.15** Irrigated watering of carrots. Irrigated farming continues to expand in Australia and is a crucial part of agriculture and the national economy.



**Source 13.16** Different types of irrigation, each very different in terms of water loss: pivot (rotational sprinkling), flood and drip



**Source 13.17** Population and average annual rainfall distribution in Australia. The rainfall map includes the Murray–Darling Basin catchment area and the Murrumbidgee catchment within it, where rice farms near Leeton are located.

sustainable water supply both today and in the future.

How crops are irrigated depends on the water requirements of that crop. For example, rice farming requires the whole field to be flooded with water, whereas fruit and vegetables are often irrigated by sprinklers or drip systems, in which holes in tiny pipes drip water directly onto the plant roots. A significant amount of water is lost into the soil by flood irrigation or by evaporation from sprinklers. More efficient systems (such as drip irrigation) as well as improved technologies (such as computer systems that detect plant water stress) make certain farming methods much more water-efficient than others.

There is considerable debate in Australia about whether we should begin to move towards using only water-efficient and sustainable farming methods. We can conclude from water-use practices in the Murray–Darling Basin that even while making significant efforts to apply more water-efficient methods and technologies, we need to start considering alternative sources for our water requirements.

Comparing the maps of Australia's rainfall and population distribution (Source 13.17), we can see that the population along the east coast is supported by reasonable levels of rainfall, combined with run-off from the eastern side of the Great Dividing Range. However, some regions of high population density, such as around Adelaide, have lower rates of rainfall. Just as importantly, regions of higher rainfall, such as those along nearly the entire northern coastline, have much lower population densities. The question arises – is this a largely untapped potential water resource in Australia?

- 1** Identify which mountain range is the source of most rivers in the Murray–Darling Basin.
- 2** Suggest why there are low run-off rates in the Murray–Darling Basin.
- 3** Outline why the Murray–Darling Basin is important not only to people who live in the basin, but also to those living outside the basin.
- 4** Account for the distribution (locations) of major irrigation areas in the Murray–Darling Basin.



### 13.3 Variations in freshwater availability between continents

So how does Australia’s availability of water differ to other continents and countries? In Australia, our water availability relies heavily on rainfall. Furthermore, our rainfall tends to be highly variable. Although the northern parts of Australia generally receive a high level of rain in the summer months, the rest of Australia is considered dry by world standards. In fact, Australia has an annual average rainfall of 472 mm, which is the lowest of all the continents in the world except for Antarctica. Furthermore, only a small proportion of our rainfall finds its way into our rivers, aquifers, lakes and dams. That is, we have a low run-off rate.

#### The Amazon River v Murray–Darling

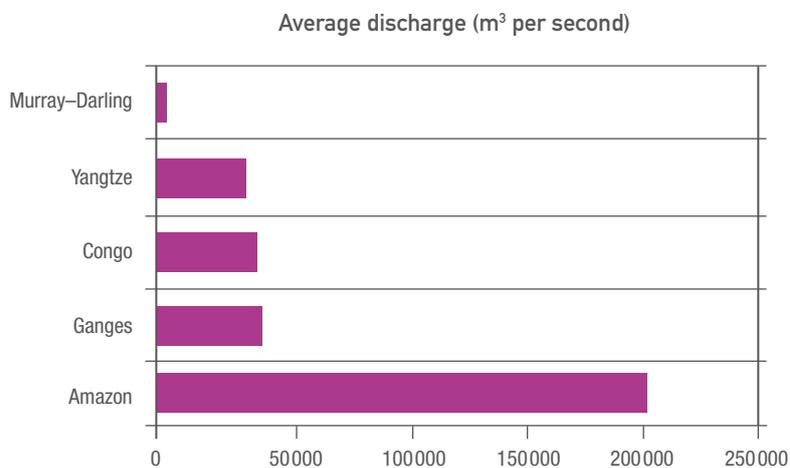
As we have seen, the Murray–Darling river basin is our most important farming region, producing around one-third of Australia’s food supply. Despite our reliance on this river system, the amount of water that travels through it is very small on a global scale. The

Amazon River is approximately 6400 km long and it discharges the highest volume of water in the world due to a massive catchment area and high rainfall. To put this in perspective, the Murray–Darling system in Australia is about half the length of the Amazon, its catchment area is about 15% of the Amazon’s area and it discharges less than 0.2% of what the Amazon does every year, making it the driest major river system in the world.

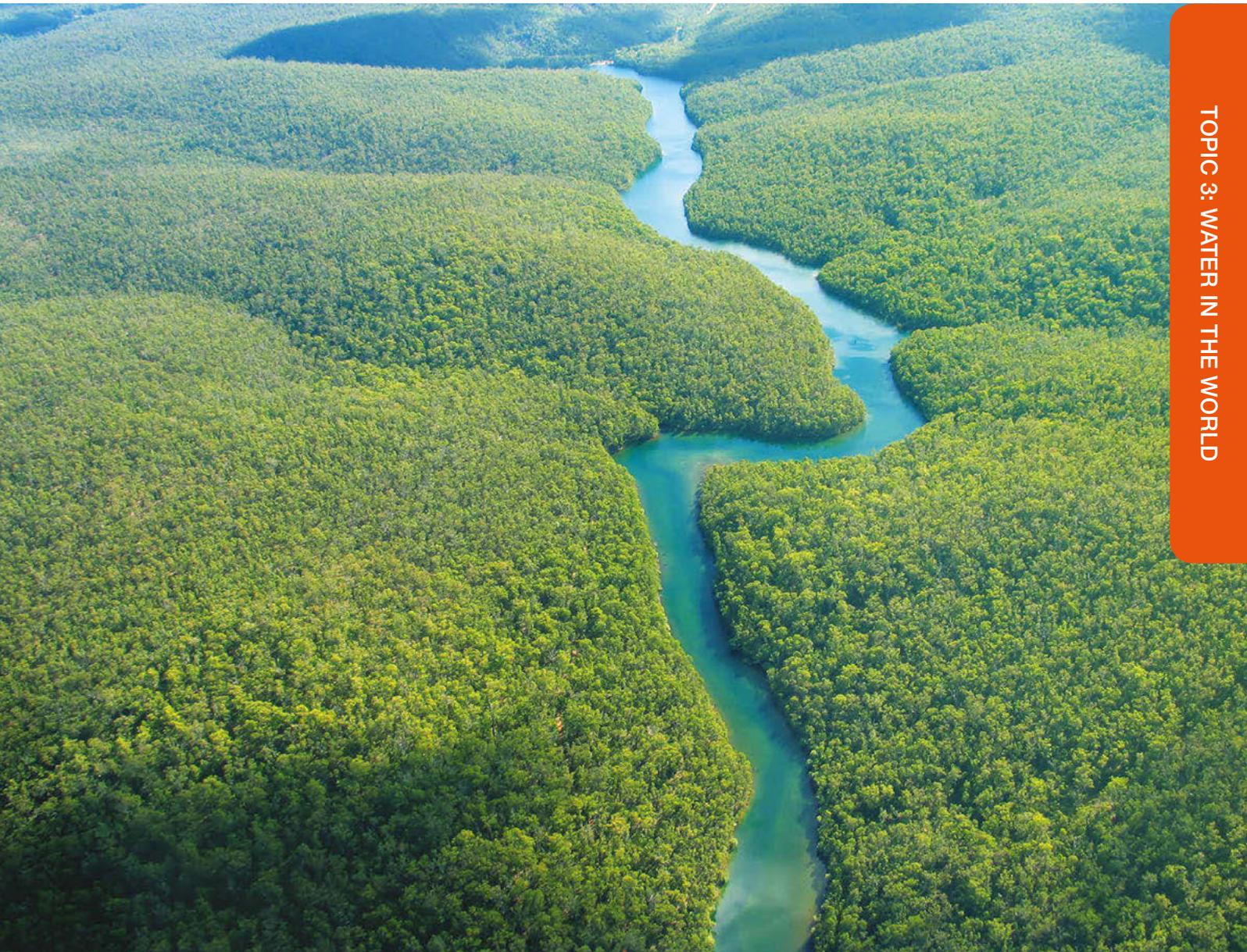
In fact, the same amount as the average annual flow through the Murray–Darling basin flows through the Amazon River in one day.

The 209 000 **cubic metres** of water that exits the Amazon River per second accounts for nearly one-fifth of all the fresh water that drains into the oceans of the world, and yet the Amazon River basin is currently accessible to just 25 million people (0.4% of the world’s population). So much water pours out of the Amazon that the salt content and colour of the Atlantic Ocean are altered for a distance of about 320 km from the mouth of the river. Compare this to the Murray–Darling river system, where only 391 cubic metres of water exit per second.

**cubic metres** the volume of a cube with edges 1 metre in length (equal to 1000 litres)



**Source 13.18** Average discharge of water from some of the world’s major river systems and the Murray–Darling system



**Source 13.19** The Amazon River discharges in one day the same amount of water that flows through the Murray–Darling in one year.

## The Mekong Delta

The Mekong River is the 12th longest in the world and runs through China, Burma, Laos, Thailand, Cambodia and Vietnam. It is a unique river system in that it is largely unaltered. That is, there have not been any large industrial developments or changes to the way the river runs. It is estimated that at least 40 million people in southeast Asia rely on this river as a freshwater resource.

The Mekong Delta is where the river meets the sea and is situated in Vietnam. For Vietnam, the delta of the river is a crucial part of their culture and economy. Agriculture and fishing are two of the main uses of the region. It is estimated that approximately 23 million tonnes of rice is grown annually in the Delta region – providing a little over 50% of Vietnam's total rice. From a fishing perspective nearly 60% of all fish caught are from the Delta region.



**Source 13.20**

Examples of life on Mekong Delta – floating homes, and floating flower beds



**Note this down 13.1**

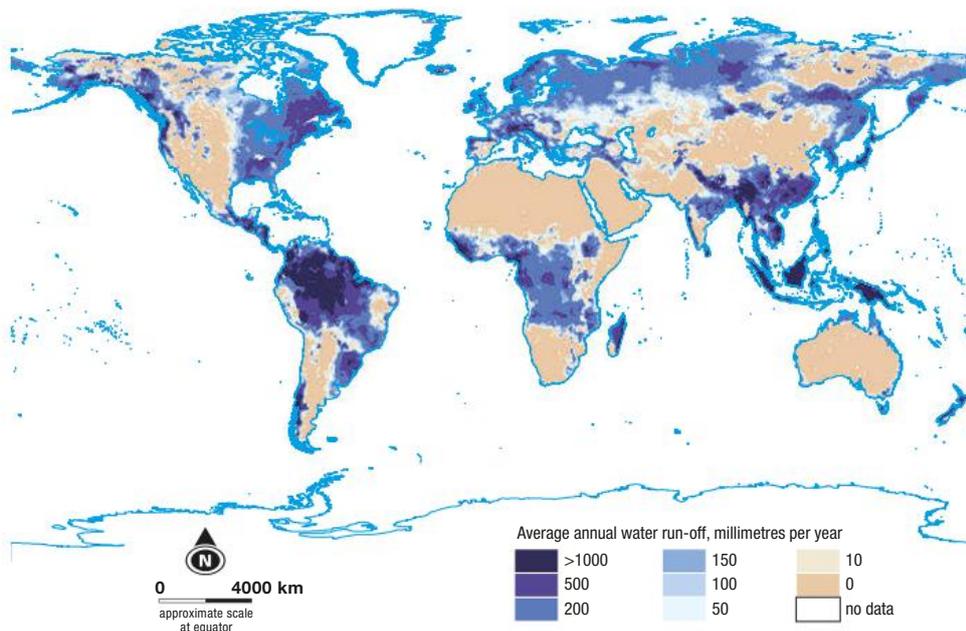
Copy the graphic organiser below and evaluate how each major geographical feature contributes to human sustenance and societal growth.

	Location	Physical characteristics	Advantages to surrounding human population
Amazon River			
Murray–Darling Basin			
Mekong Delta			

### Comparing Australia to the rest of the world

Source 13.21 shows the average volume of annual run-off by continent. It is important to note that the size of the continent will significantly affect run-off amounts, although comparing Australia and Asia, for example, reveals significant differences in water

availability. As for rainfall and run-off, the Earth's major river systems are unevenly distributed. The locations of rivers do not always correspond with areas of high rainfall. For example, a number of significant rivers, such as the Ob River in Siberia, flow through



Source 13.21 Average annual run-off by continent and volume

northern parts of Europe, where the annual average rainfall is very low (approximately 250 mm or below). When we consider the second illustration in Source 13.21, we notice that this region has a reasonable volume of annual run-off. How can this be? This is a region of substantial ice melt during warmer months, where arctic glaciers and ice caps grow and then melt on a yearly basis.

It is very clear that Australia has the lowest annual run-off, followed closely by Europe. In comparison, Asia and South America have the most. It is important to take into consideration the size of the continent. But even Europe, which has a much smaller land size than Australia, has greater run-off than we do. The high evaporation rate and variable rainfall all contribute to Australia's low run-off.

River	Location	Water run-off volume (km <sup>3</sup> /year)	Watershed population (million people)
Amazon	South America	6.92	14.3
Congo	Africa	3.50	48.3
Mississippi	North America	3.21	72.5
La Plata	South America	3.10	98.4
Ob	Siberia	2.99	22.5
Nile	Africa	2.87	89.0
Yenisei	Siberia	2.58	4.77
Lena	Siberia	2.49	1.87
Niger	Africa	2.09	131
Amur	Russia and China	1.86	4.46
Yangtze	China	1.81	346
Ganges (inc. Bhagirathi and Meghna rivers)	Asia	1.75	439
Mackenzie	Canada	1.75	0.35
Volga	Europe	1.38	43.3
Murray	Australia	1.07	2.1
Orinoco	South America	1.00	22.4
Indus	South Asia	0.96	150
Danube	Europe	0.82	85.1
Mekong	South East Asia	0.79	75.0
Yellow	China	0.75	82.0
Dneiper	Europe	0.50	36.6
Don	Russia	0.42	17.5
Amu Darya	Central Asia	0.31	15.5
Syr Darya	Central Asia	0.22	13.4

**Source 13.22** Table showing the run-off of major rivers in the world as well as the watershed population (a geographical region drained by its river and tributaries)

There are six countries that seem to have the greatest water availability when measured by river run-off: Brazil, Russia, Canada, United States, China and India. These six countries have rivers that discharge approximately half of the world's total river run-off into the oceans (see Source 13.22).

Another important consideration is the population of people accessing the water. Australia's population is modest compared to other countries, although the Australian Bureau of Statistics expects that our population will have doubled by 2061 and potentially reach 70 million by 2101.

### Activity 13.2

- 1 Why does Australia rely so heavily on rainfall?
- 2 Describe the importance of the Mekong Delta to southeast Asia. Compare this to the Murray River in Australia and list the similarities and differences.
- 3 Describe the considerations that affect the water availability of a continent.

**Source 13.23** Egypt's Nile River and its delta at night as seen from the International Space Station. The concentration of lights indicate that Egypt's population lives around the Nile River and relies heavily on access to it.



## Chapter summary

- The Great Artesian Basin is Australia's biggest groundwater basin, and the largest groundwater system of its type in the world.
- The amount of water extracted from the Great Artesian Basin has in many areas far outstripped the rainfall entering and recharging the groundwater.
- Water use in Australia and indeed throughout the world needs to become much more sustainable if we are to use it in the future for as many purposes as we do today.
- Precipitation is a fundamental part of the water cycle.
- Rainfall and temperatures differ significantly between the north and south of Australia.
- The top northern part of Australia receives convectional rainfall.
- One of the most famous monsoonal rain systems occurs in India.
- In South America a significant amount of rain falls on the eastern side of the Andes mountain range.
- The Great Dividing Range is Australia's largest mountain range, stretching for more than 3500 km, and much of Australia's rainfall originates in the east and falls over the Great Dividing Range.
- How crops are irrigated depends on the water requirements of that crop.
- There is considerable debate in Australia about whether we should begin to move towards using only water-efficient and sustainable farming methods.
- In Australia, our water availability relies heavily on rainfall. Furthermore, our rainfall tends to be highly variable.
- The Murray–Darling Basin in Australia is one of the largest catchments in the world, but it is also the driest.
- The Amazon River is approximately 6400 km long and it discharges the highest volume of water in the world due to a massive catchment area and high rainfall.
- The Mekong River is the 12th longest in the world and runs through China, Burma, Laos, Thailand, Cambodia and Vietnam.
- Australia has the lowest annual run-off, followed closely by Europe; in comparison, Asia and South America have the most.
- There are six countries that seem to have the greatest water availability when measured by river run-off: Brazil, Russia, Canada, the United States, China and India. These six countries have rivers that discharge approximately half of the world's total river run-off into the oceans.

## End-of-chapter questions

### Short answer

- 1 Identify two reasons why the Murray–Darling river system has less than 0.2% of the flow of the Amazon River.
- 2 Which town was awarded a prize for being the wettest in Australia, and why does it receive so much rainfall?
- 3 Describe the elements of a cold front.

### Extended response

More efficient systems (such as drip irrigation) and improved technologies (such as computer systems that detect plant water stress) make certain farming methods much more water-efficient than others. Discuss in two paragraphs the reasons why some farmers may not want to investigate or use new systems.



# 14

## Water scarcity and water management

**Source 14.1** Water pollution is the result of a variety of different factors – in this case, exploitation by a copper mine.

### Before you start

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#### Main focus

Water is a vital resource for all living things, but its limited supply means it can be difficult to manage, leading to issues with its supply and demand all over the world.

#### Why it's relevant to us

Water scarcity affects people's lives in different ways and it is important to look at how our actions now can ensure water security into the future.

#### Inquiry questions

- What is water scarcity and how does it affect different countries?
- How do different groups work to overcome water scarcity?
- How can individual actions contribute to water management?

### Key terms

- catchment
- conflict
- desalination
- economic water scarcity
- integrated catchment management
- physical water scarcity
- water recycling
- water scarcity

### Let's begin

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Water is a vital resource for all living things, but it is in limited supply. Water resources are difficult to manage and this issue is particularly important in Australia, as well as in other parts of the world. As the world's population continues to grow at a rapid rate, the demand for water and the way we manage it are becoming increasingly important issues. A safe, sustainable water supply allows populations to stay healthy and develop economically.

## 14.1 Water scarcity in different countries

It is estimated that a human needs around 1000 m<sup>3</sup> of water a year to drink, grow food and meet basic hygiene needs. In Australia, many of us do not spend time worrying about where we get our water from. We turn on the tap to get water to drink, jump into the shower to wash ourselves, and use water from a hose to wash our car or water our garden. But in other countries people are not so lucky. In developing

**water scarcity** the lack of sufficient available water resources to meet demand

nations, water is in short supply and must be collected daily. **Water scarcity** currently affects around 1.2 billion people worldwide.

The problem lies in the following factors:

- water is not always available all year round
- water is often located far away from where the population lives

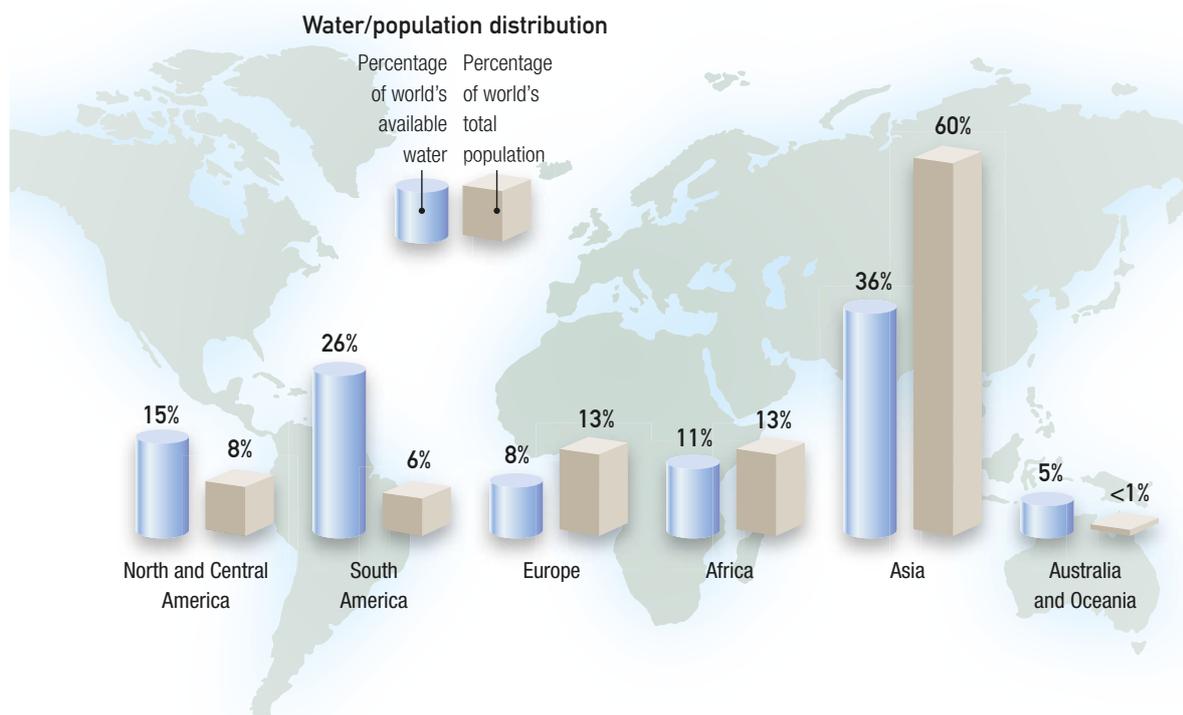
- many people mismanage, pollute or overuse their water supply.

Source 14.2 shows how many regions of the world have more people living in them compared to their proportion of the world's available water.

As regions such as Africa and Asia continue to experience population growth, this gap may continue to widen in the future. Other regions such as South America have far more water than they need. Some of these countries are now looking to export their water to regions that need to increase their supply. There are two types of water scarcity: **economic water scarcity** and **physical water scarcity**.

**economic water scarcity** a situation in which a place has adequate local supplies to meet its water needs, but lacks money to create the infrastructure for the population to access safe drinking water

**physical water scarcity** a situation in which a place lacks local supplies of water to sustain current standards of living



**Source 14.2** Comparing the percentage of water availability with the percentage of world population

## Causes of water scarcity

Water scarcity is caused by a wide range of human and natural factors. Increased populations, inefficient farming techniques, droughts, climate change, overuse of water for industrial and domestic use, poverty and a lack of infrastructure can all lead to water scarcity occurring.

Dry areas suffer from water scarcity only if there are people living there requiring water.

The point at which water scarcity occurs differs between places as the amount of water required to maintain standards of living also varies. So an irrigated farming region in Australia may use a lot of water and suffer from water scarcity, even though it may have much more water available than a North African farming village.

## Geographical fact

Did you know that women worldwide spend 200 million work hours a day collecting water for their families? This is the equivalent of building 28 Empire State Buildings every day.

## Access to fresh water

Access to fresh water is vitally important. A lack of water can have severe impacts on the health, employment and lifestyle of a population. Lack of water can lead to dehydration, for example; or industries and agriculture having to slow down or close,

**Source 14.3** Economic water scarcity: people filling drinking water from a tanker, Chennai, Tamil Nadu, India





**Source 14.4** An Ethiopian woman carries water on her back

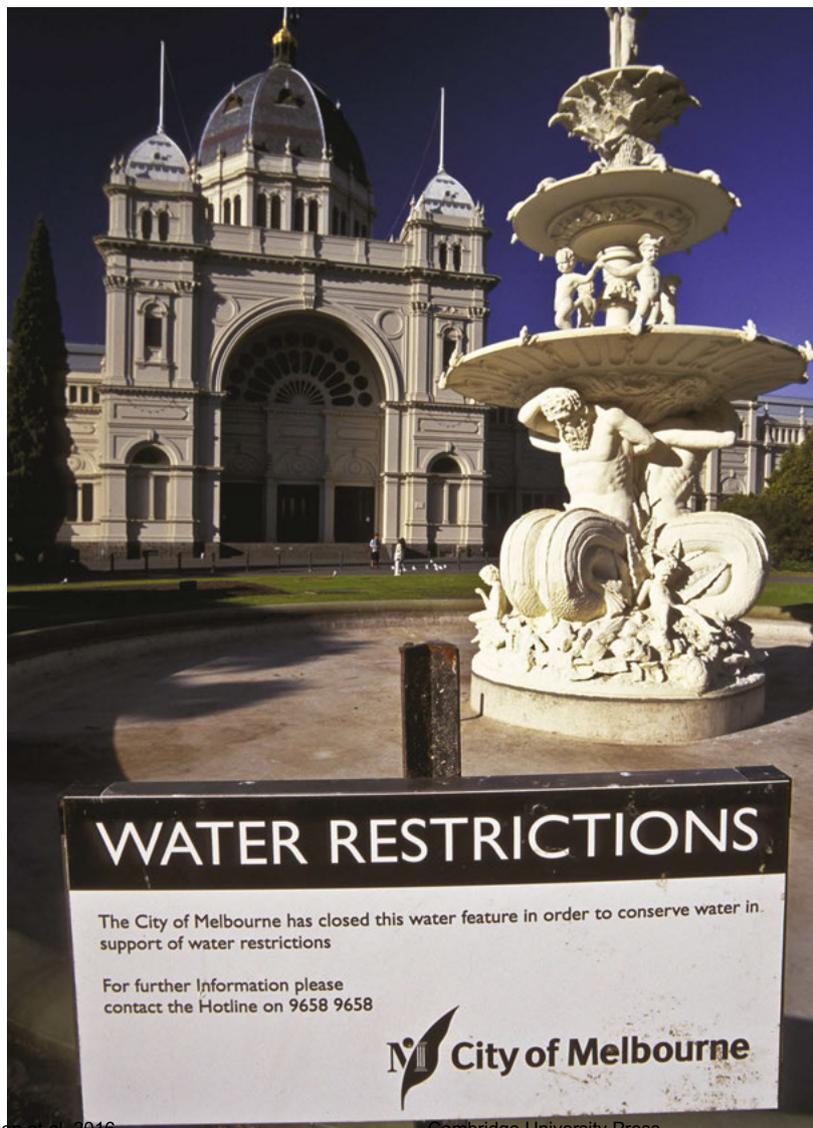
resulting in a loss of jobs to an area. From a lifestyle perspective, people need to make collecting water a priority if it is scarce; for example, people in developing countries may be forced to walk further to collect water. In rural Ethiopia, women and children can walk up to six hours to collect fresh water.

In Australia, when water is scarce, we may have water restrictions to adhere to – such as shorter showers, and using waste water on the garden.

**Source 14.5** Water restrictions in action outside Melbourne's Exhibition Building

**Activity 14.1**

- 1 Look at Source 14.2 and list the regions that have a greater percentage of the world's population than of the world's available water.
- 2 Explain the difference between economic water scarcity and physical water scarcity.
- 3 Describe some impacts of a lack of access to fresh water.



The town of Orange in New South Wales had the highest water restrictions in the state, with Level 5a in 2010. This meant that households could only use buckets of waste

water for the garden, and industries had to apply for council licences to use water. Due to an increase in rainfall after that period, the restrictions were dropped back down to Level 2.

USE	NSW Restriction Levels					
	1	2	3	4	5	6
<b>DOMESTIC</b>						
Garden watering	Sprinklers 2 hr a day	Sprinklers banned	Hand-held hoses 2 hr a day	Hand-held hoses 1 hr a day	Buckets only	Reused water only
Swimming pools private	Filling of pools prohibited		Filling and topping up of pools prohibited			
Wash paved areas and roof	No restrictions	Buckets only except as required by law				
<b>INDUSTRIAL</b>						
Soft drink manufacturer	No restrictions			8 hrs a day operation only	With Council Licence only	Banned
Ready-mixed concrete	No restrictions			8 hrs a day operation only	With Council Licence only	Banned
Abattoirs	No restrictions			With Council Licence only		
Others	No restrictions			With Council Licence only		

**Source 14.6** New South Wales water restriction levels for domestic and industrial sectors

Unfortunately, the availability and accessibility of fresh water is impacted by a number of factors, each of which will be briefly discussed in this section: political disputes, conflicting uses and water degradation.

### Political disputes

Disputes may occur over water when a water source is shared or needed by different groups of people.

Conflicts over water are particularly common where rivers flow over state or national borders, and in regions where water scarcity occurs. Water conflict may also occur

when supplies of water are threatened, or when the price of water increases. An example is Malaysia, which supplies over 50% of Singapore's water. In 1997, Malaysia threatened to cut off the water supply after Singapore criticised Malaysian policy.



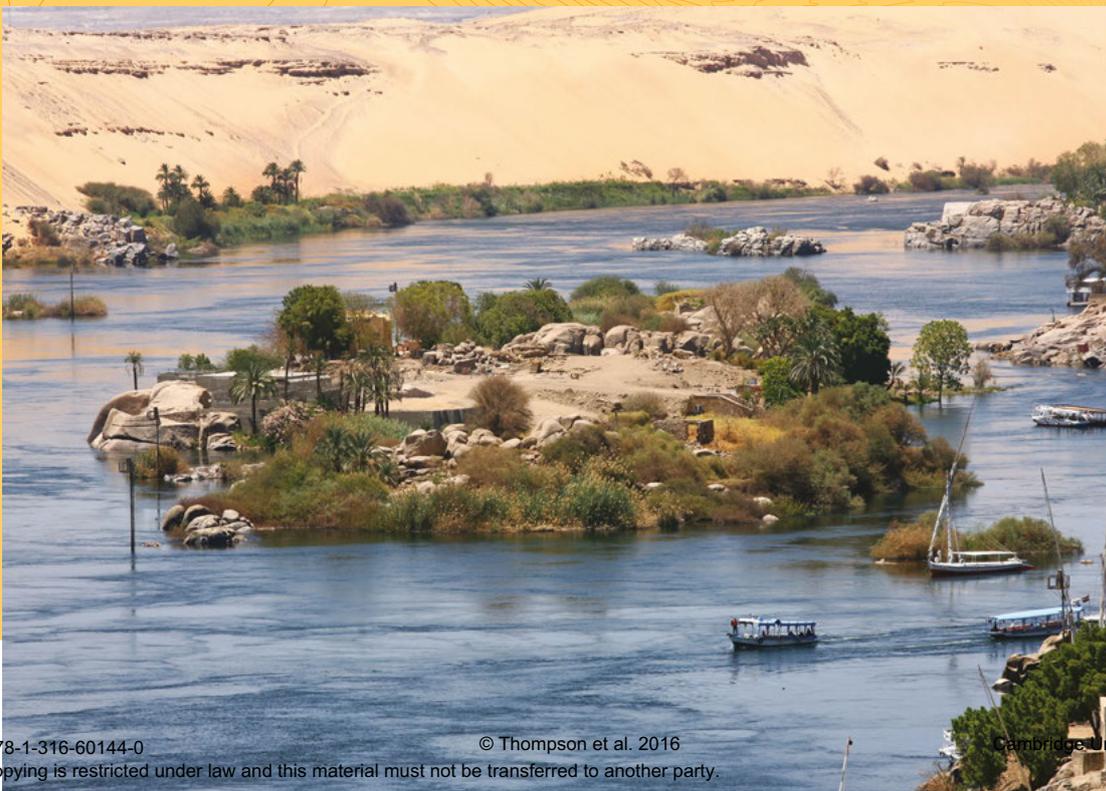


**Source 14.7** Conflicts over water can occur between neighbouring regions, such as Malaysia and Singapore in 1997.

## Geographical fact

The Nile River Basin is spread through 11 countries in Africa, the three most populated being Egypt, Ethiopia and Sudan. Egypt's reliance on the Nile River means it is currently allocated 75% of all water from the river. Sudan receives the other 25%. Ethiopia, which is the source for much of the water that flows into the Nile, receives no water from the river.

**Source 14.8** The Nile River is shared by 11 countries and through history has been the source of political disputes and conflict.



## Conflicting uses

The availability of and access to fresh water can also be impacted by the number of different uses people have or need for the water, and at times these uses are in conflict. Two examples of conflict of usage are urban usage and agriculture, and the resulting water diversion.

### Urban usage

If a human needs around 1000 m<sup>3</sup> of water a year to drink, grow food and meet basic hygiene needs then you can imagine the pressure on a freshwater source in densely populated areas. Added pressure also comes from industrial sites within urban areas, which often use water in large quantities.

### Agriculture

Agriculture uses up approximately 70% of the world's available fresh water, one-third of

which is used to grow grain to feed livestock. Beef production requires the most water, in fact 15 000 litres of water per kilogram of beef is required. Rice in comparison requires 3400 litres per kilo and potatoes require only 255 litres.

### Water diversion

Rivers have often been diverted to supply water to agriculture or urban areas, or to reduce the danger of flooding; for example, the Snowy Mountains Scheme. The diversion of water in the Snowy Mountains reduced the river's flow in some places to 1% of its original volume. In 1998 the New South Wales and Victorian governments held the 'Snowy Water Inquiry' and agreed that they would aim to restore the Snowy River back to 28% of its volume overall. Scientists calculated that 28% is the minimum amount for the river to be back at a healthy

**Source 14.9** Agriculture uses a considerable amount of the world's fresh water supply. Beef production requires the most water.



level for the ecosystem. The Snowy Mountains Scheme is a good example of how important it is to closely monitor the impact of water diversions on the overall environment.

### Water degradation

Freshwater sources are under threat. Key threats are overuse of water and pollution from agriculture, water diversion and pollution from urban areas and industry.

#### Overuse of water for agriculture

If too much water is taken out of rivers, they suffer from a lack of environmental flow. This means there is not enough water running to the mouth of the river to keep the system healthy. Ecosystems will die and salinity and algae levels may rise.

#### Pollution from agriculture

Soil erosion from river banks compacted by overgrazing can increase sediment entering the river, decreasing water quality. Excess fertiliser entering river systems is a major cause of **algal blooms**. Pesticides can also be washed into river systems, entering the food chain.

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**algal bloom** the build-up of algae that can destroy ecosystems

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#### Water diversion

Rivers have often been diverted to supply water or reduce flooding in urban areas, and dams have been built to secure water supplies. Both these activities can affect flows of sediment, slow the movement of water and prevent the migration of species, lowering water quality.



**Source 14.10** Algae growth can be accelerated by excess fertiliser use.

### Pollution from urban areas and industry

Urban areas can create high levels of pollution if industrial waste or chemicals are dumped in the river. Polluted stormwater from roads and drains

also enters rivers, killing aquatic life. Warm water, for example, from power station cooling towers, can also damage fragile ecosystems.

## ➔ Note this down 14.1

Copy the graphic organiser below and explore the factors contributing to access to fresh water.

Factor	Conflicting uses	Political disputes	Water degradation
Description			
How it impacts freshwater			

## 14.2 Overcoming water scarcity and the role of different groups in sustainable water management

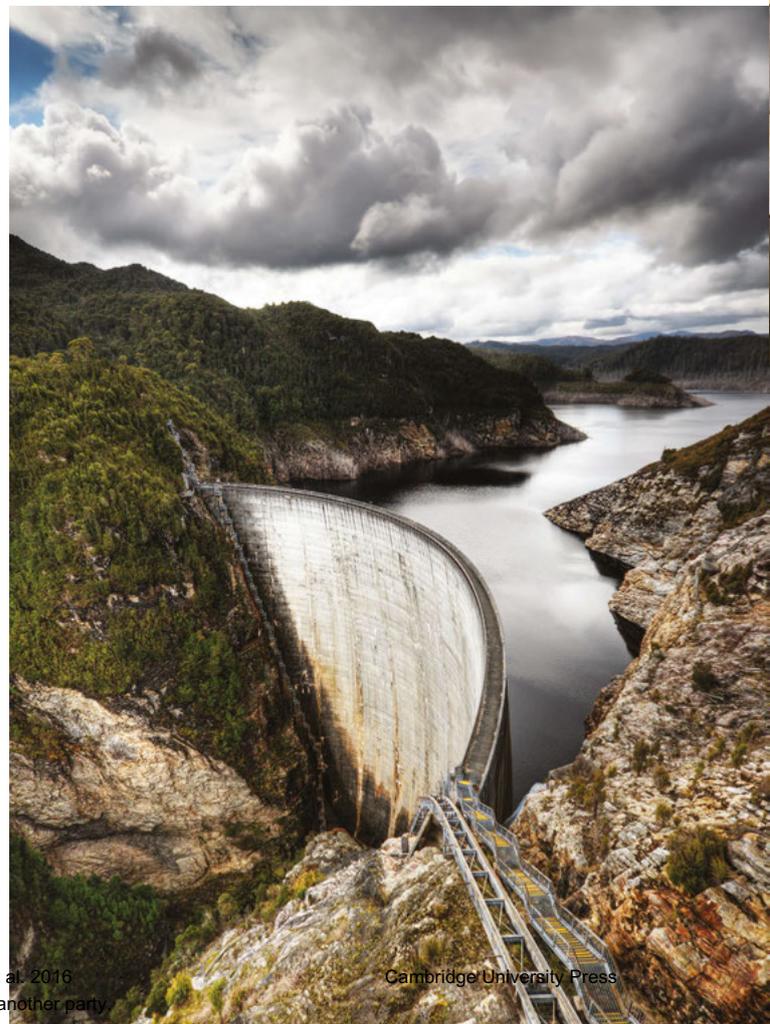
Water resources need to be managed to address water scarcity, and all groups in society including government, non-government organisations (NGOs), individuals and communities have the responsibility of managing water in an effective and sustainable manner.

Every area of land is part of a catchment. A catchment is the space on which rain falls and feeds into a watercourse. In other words, it's the drainage basin for a lake, river or creek. By studying river catchments, the role of each group in society can be analysed.

### Dam-building projects

Since European settlement, dams have been one of the main sources of water for Australia's rural and urban areas. A dam works by blocking off a river valley with a large concrete

**Source 14.11** The large concrete dam wall is in Southwest National Park in Tasmania, holding back the Gordon River.



wall. The area behind the wall is then flooded, creating a lake and storage site for large quantities of water. Smaller dams are often constructed on farms to catch and store rainfall as it runs off the land.

As well as providing water for drinking and irrigation, dams can also be used to prevent flooding and generate electricity. Dam projects often employ lots of people in local areas in their construction. For example, the Three Gorges Dam in China employed 26 000 people. Dams can, however, create a wide range of problems for both the natural and human environments. When a large area

behind a dam is filled with water, any habitats, farmlands or even human settlements are likely to be flooded. With little natural flow, such lakes may suffer from algal blooms.

People may be required to relocate from their homes. Downstream, dammed rivers can be affected by a lack of environmental flow and fish may struggle to migrate past the dam to feeding grounds where they reproduce. **Sediment** that would usually travel to the coast to form beaches is trapped, increasing the risk of coastal erosion and flooding.

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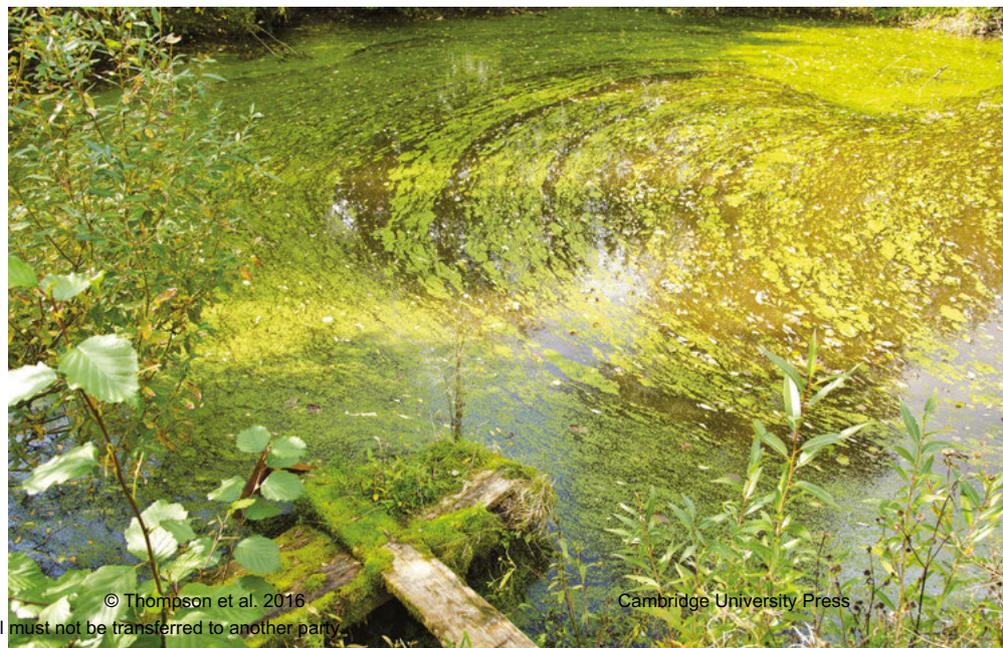
**sediment** material eroded from the land and river banks by water and deposited elsewhere

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**Source 14.12** The construction of the Three Gorges Dam impacted the environment and caused the displacement of millions of Chinese citizens.

**Source 14.13** Algal blooms can destroy ecosystems, and can build up in dams and other areas where there is little water flow. Here is an example of algal bloom in the Baltic Sea.



## **Note this down 14.2**

Copy the graphic organiser below and explore the advantages and disadvantages of dams from an environmental, social and economic perspective.

Dams					
Environmental		Social		Economic	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
Prevents flooding	Affects the river's ecosystem				

### Integrated catchment management

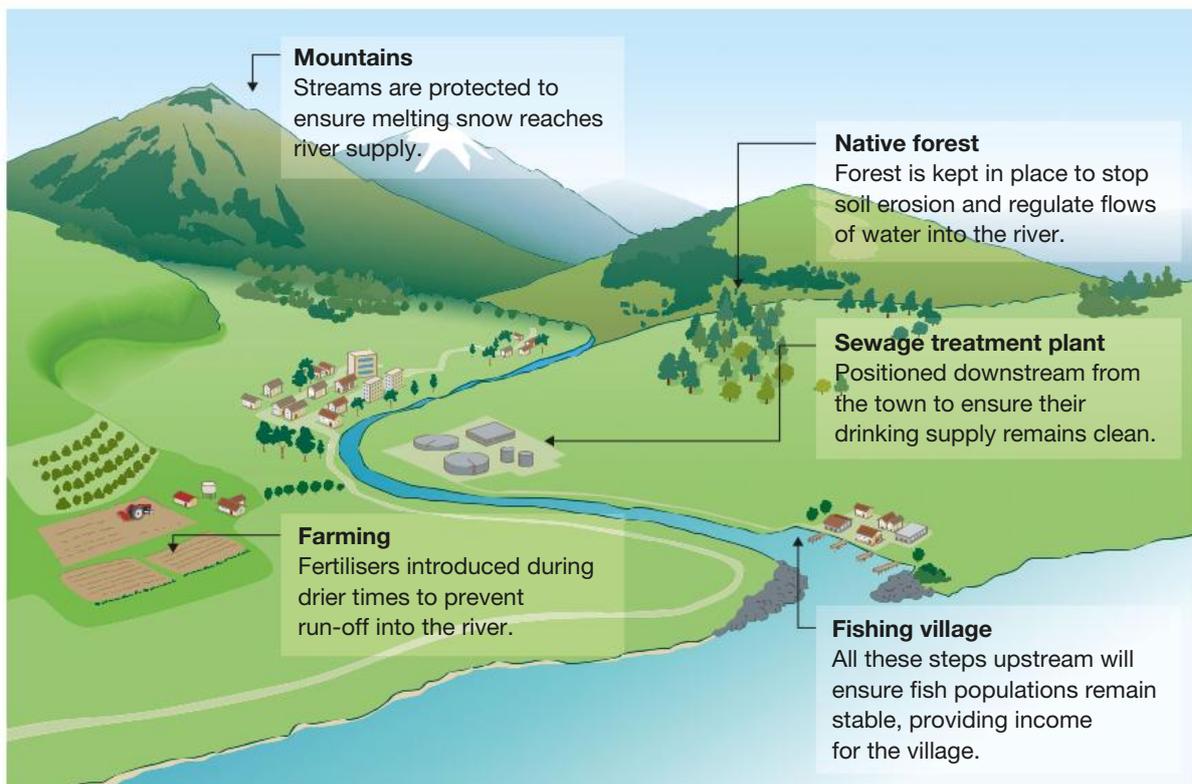
Problems often occur in river management through short-term benefits or local gains being given priority over the overall sustainability of the river system. Examples of poor river management include:

- withdrawal of excess water upstream
- release of contaminants or pollution into the river

- removal of native vegetation.

An integrated approach to managing a catchment means that the river catchment is looked at as a whole when making decisions about the way the land is used. This ensures that the river maintains its health while also allowing for economic development.

Integrated catchment management can be hard to achieve, as many rivers flow through different council, state or national boundaries.



Source 14.14 Integrated catchment management

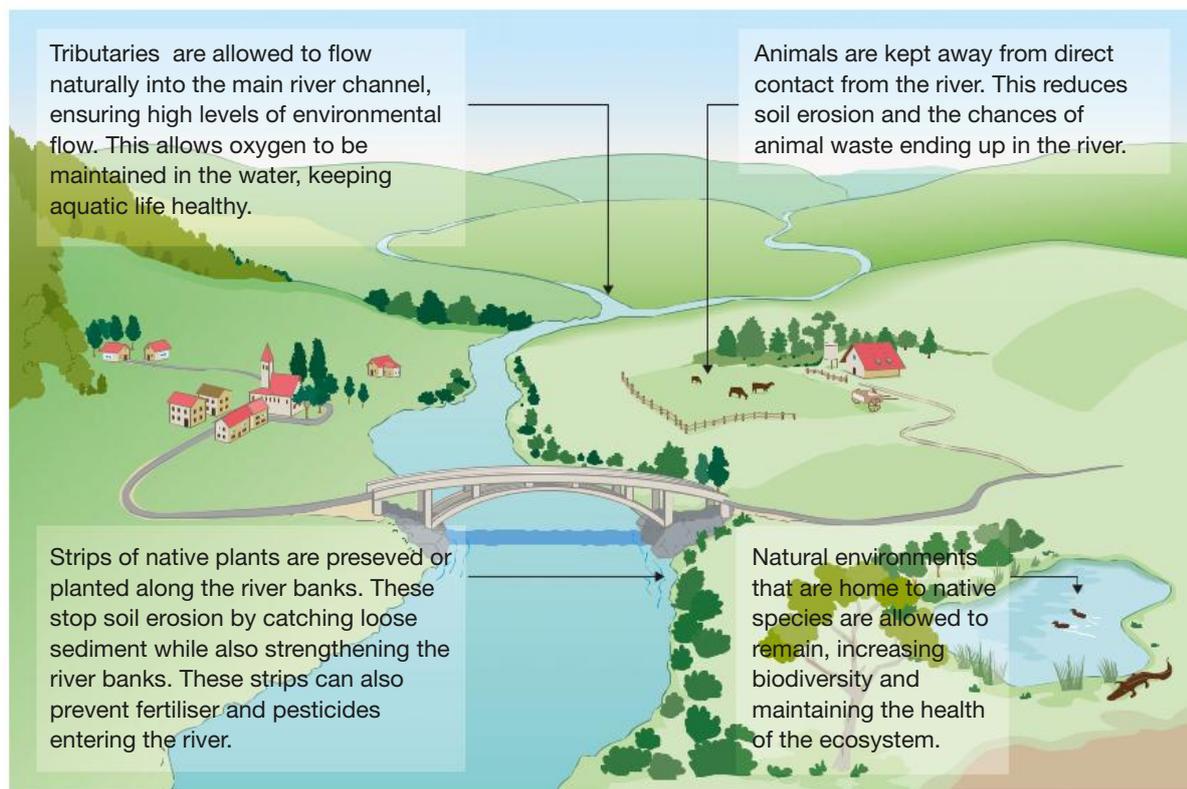
Increased awareness and education can assist people in understanding how their actions may put at risk the health of the entire catchment area. Local governments and NGOs like the Australian Conservation Federation or the Wilderness Society can play an important role here, in raising awareness and educating the public.

Communities and individuals can also play an important role. For example, they can help plant native vegetation and create wetlands to not only maintain biodiversity

but also improve the quality of the water flowing through their area. This is shown in Source 14.15.

### Geographical fact

Did you know that water quality in the Thames River in London has improved so dramatically that dolphins have been spotted recently in the middle of London?



Source 14.15 Maintaining healthy water quality

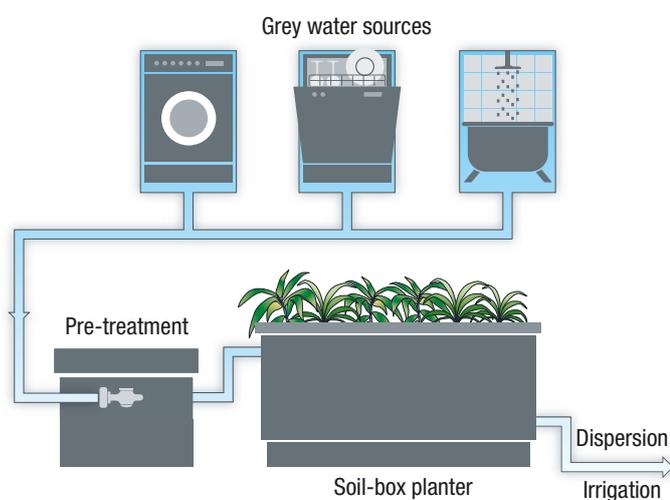
### Recycling water

Another role where governments, communities and individuals can make a difference to the future is the use of recycled water. All water can, essentially, be cleaned and treated to make it safe for drinking. In many European

and Asian countries, a considerable amount of drinking water comes from sources partly composed of treated sewage. In Australia this is far less common, although recycled water is used for a range of other purposes, depending on the method of treatment.

## Using grey water

Grey water is produced by every household. It is the water from showers, washing machines and sinks (but not toilets!) that would otherwise go down the drains. Grey water use may be as simple as having a bucket in the shower to collect excess water and then using that water on your garden.



**Source 14.16** Grey water system for home use

More sophisticated systems can pipe all this water directly into your garden to irrigate lawns and pipes. You can also buy advanced systems that will treat the grey water, making it suitable to flush toilets with, or to use in washing machines or dishwashers. Grey water cannot be drunk, and certain soaps and detergents may not be suitable for use in it, but extensive use of grey water can save a household up to 50 000 litres of water per year.

## Treated effluent and sewage

Wastewater treatment plants across the world use a range of steps to clean human waste. In many cases this treated water is pumped out to sea, but increasingly it is being used for irrigation, industry and other non-drinking applications. This reduces pressure on sources of water that are safe to drink. It also provides a regular supply of water that is not reliant on the rain. In Singapore, 30% of drinking water comes directly from raw sewage; technology

**Source 14.17** A treatment plant for industrial water



similar to that in desalination plants is used to make it safe. Many people, however, are uncomfortable with the idea of drinking raw

sewage. In Toowoomba in Queensland, a scheme to introduce drinkable recycled water from waste was rejected by 62% of residents.

### Activity 14.2

Split the class into groups representing the varying techniques for water recycling, as well as desalination. Each group is to present at a conference, selling your particular method of water supply to the public. You must explain:

- how your method works
- why it is suitable for your location
- what the advantages are
- any possible problems.

The class will then vote on the best solution at the end of the presentations.

## Fieldwork 14.1 Testing water quality in the Cooks River, NSW

*Please note: The Cooks River is a suggestion only. You may wish to adapt the following ideas and fieldwork techniques to test the water quality of a local site near your home or school.*

### Aim

To examine differences in water quality in the Cooks River, NSW, at three sections of the river.

### Method

Three different sites should be tested along the river, including one close to the mouth of the river at Botany Bay near Sydney Airport.

### Preparations

Borrow a water-testing kit from KESAB or another environmental organisation. Make sure you have a camera, note pad and pen with you. The water testing kit will include pH strips and a turbidity meter. You will also need a tape measure and something that floats to record the rate of flow

per metre at each site. To use a turbidity meter, first put a sample of water into the tube. Record the point at which you cannot see the mark on the bottom of the meter. If you do not have a turbidity meter, tie a heavy item, such as a stone, to a piece of string and lower it into the river, recording how deep the water is when it you can't see it any more. Clear water provides evidence of a lack of sediment and algae, and of good environmental flows. To measure pH, take a sample of water and dip the pH strip into the water. Measure this against the chart provided. If the water is very acidic or very alkaline, this may indicate pollution in the area.

To measure water flow, lay your tape measure out for 1 metre, throw in your float, and record how long it takes to travel 1 metre. Water flow varies depending on where you are in the river, but it can indicate environmental flow or a lack of regulation.

### Data collection

As you travel along the suggested path on this fieldwork trip, stop at the three sites and collect the following information in preparation for your fieldwork report.

- 1 Predict where you think the water quality is going to be the best.
- 2 Take photographs or sketch the area to record land uses, types of vegetation and any alterations to the river. Has the water been regulated? Does vegetation look native or introduced? What bird or aquatic life can you see?
- 3 Use the testing kit to record the pH of the water, how fast it is flowing and the turbidity (how clear the water is). Neutral pH, clear water and a fast rate of flow are usually indicators of good water quality.
- 4 Back at school, create graphs comparing flow rate, pH levels and turbidity and use them to draw up a profile of each site.
- 5 Now annotate the photographs of each site and recall the levels of wildlife, and try to connect these to your test results.
- 6 Conclude by relating your findings back to your predictions.

### Field work presentation layout

Front page	Title and name
Contents page	Do this last, as well as numbering pages
Page 1	Aims and methods
Page 2	Location map – Cooks River (or alternative)
Page 3	Introduction – brief description of the study sites
Page 4–5	Analysis of water tests and photographs
Page 6	Conclusions
Page 7	Appendix, bibliography, glossary

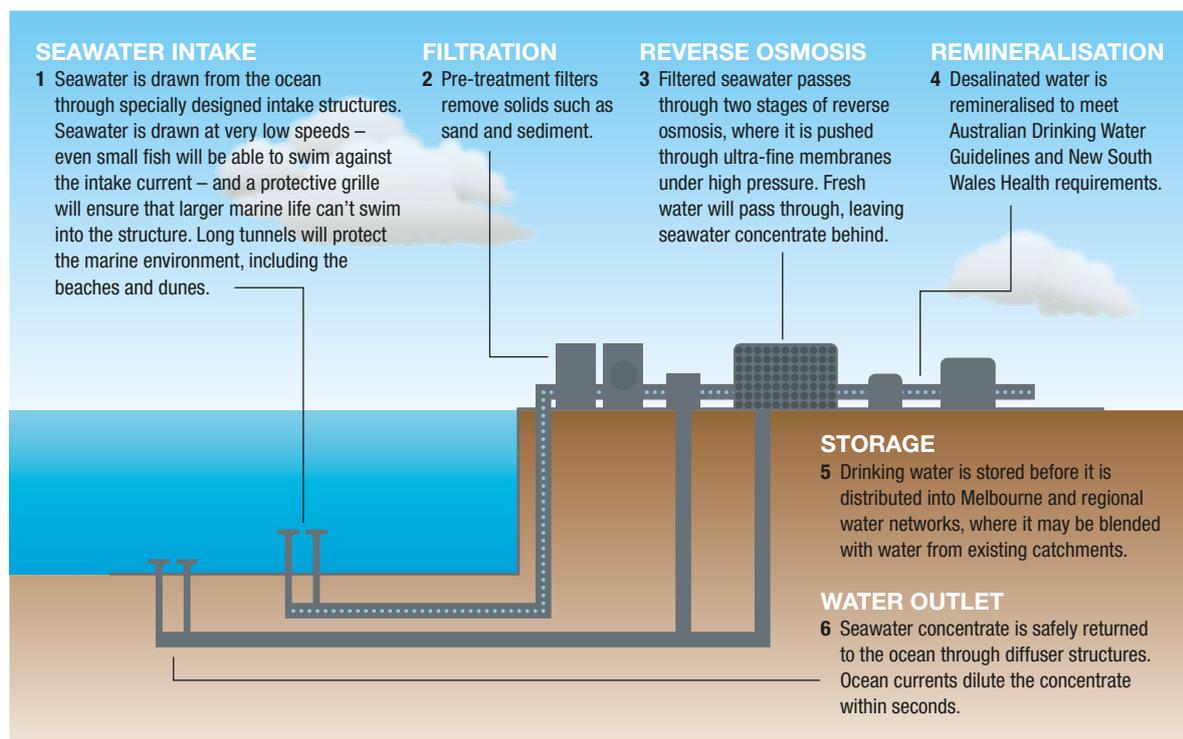
## 14.3 Individual actions contributing to water management

As water supplies continue to be depleted around the world, many people are looking for methods to increase the accessibility and availability of fresh water. China has built the Three Gorges Dam to assist with their

renewable energy production. In this section of the chapter we will look at what Australia is trying to achieve.

### Desalination plants

An increasingly popular method is turning seawater into fresh water, through a process called desalination. This has been widely used across the world, particularly in dry



**Source 14.18** How a desalination plant works

regions such as the Middle East. Other heavily populated regions in countries such as Japan use desalination plants to cater for large numbers of people.

Desalination plants are a particularly popular option with governments because they:

- provide a reliable source of drinking water
- are not reliant on rainfall
- are located in coastal locations, which are usually where the population is concentrated
- have produced water with a taste that the public has found acceptable
- provide employment in the construction and maintenance of desalination plants.

Australia now has seven desalination plants in use, in progress or planned, providing water

for urban centres in all the mainland states.

While major desalination plants are securing water for the major urban centres, the same technology is also being used in remote communities across Australia to provide clean and reliable drinking water. These systems are used when bore water is too salty to drink. Similar systems are also used on remote resort islands, on cruise ships and in submarines.

Despite the importance of desalination as a source of drinking water, it is still a somewhat controversial choice. It is extremely expensive, and Australia's major plants cost between \$1 billion and \$3.5 billion to build. These costs are then passed on to the public through increased water bills. Many plants have been built at huge expense, only to be 'mothballed' – turned off until they are required.



**Source 14.19** Cruise ships utilise a technology similar to that used in desalination plants in order to produce clean drinking water.

## RESEARCH 14.1 //

Research a desalination plant in Australia and answer the following:

- 1** Locate the desalination plant.
- 2** Explain why it was constructed.
- 3** Identify how much water it produces.
- 4** Assess the concerns or negative impacts.
- 5** Reflect on whether the construction of this desalination plant is a good decision.

The plants also use huge amounts of energy, creating greenhouse gases when powered by fossil fuels. Perth's desalination plant has its own wind farm, located to the north of the city, but it and those of other cities

are also reliant on coal- and gas-fired power stations.

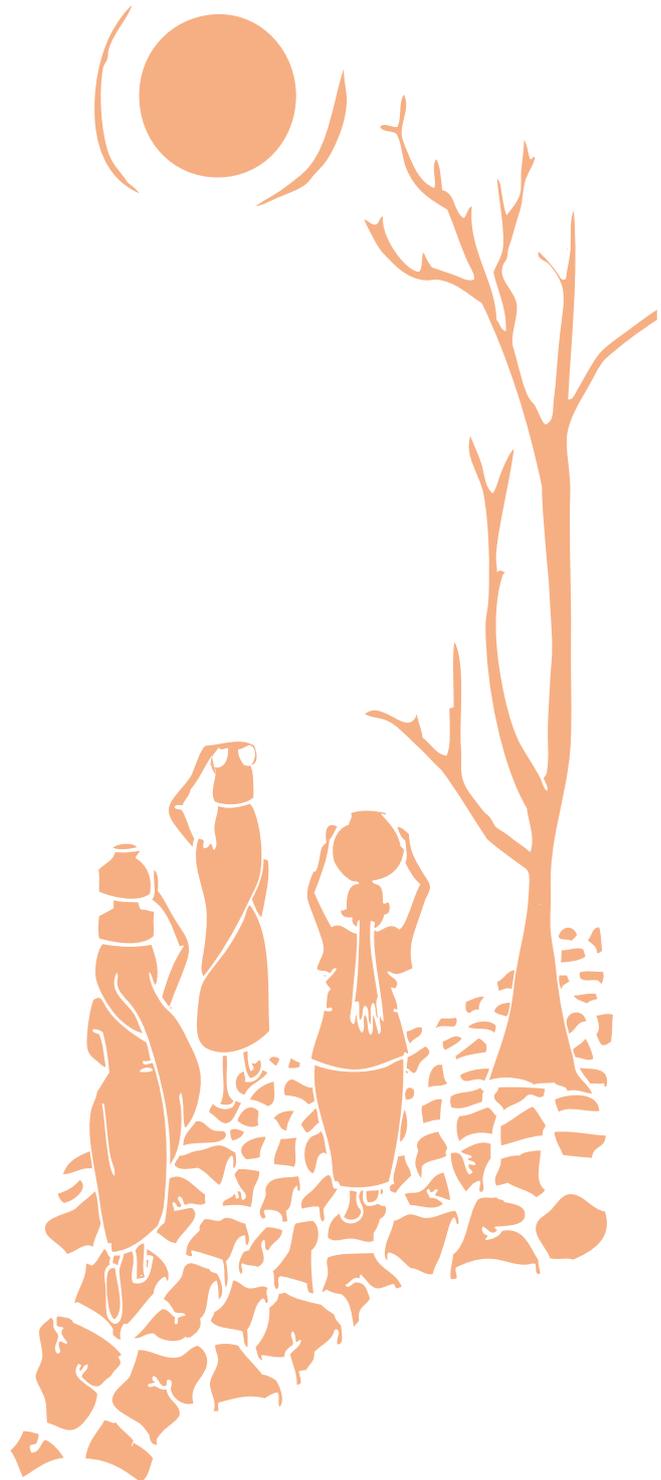
One of the biggest concerns involves the pumping of concentrated salt back into the oceans. Without careful monitoring

and planning, the high levels of salt found near desalination pipes can damage marine ecosystems. To avoid this problem, plants are constructed in areas of deeper water with strong tides to disperse the water, which is high in salt concentration.

Also, because desalination plants are often needed only in times of drought, the desalination plant in the Gold Coast has been put on stand-by until it is needed sometime in the future.

### Activity 14.3

- 1 Outline a range of conflicting uses of water.
- 2 Explain the causes of water degradation and justify which cause you believe is the most severe.
- 3 Describe two negative environmental impacts of desalination plants and two ways these impacts can be minimised.
- 4 Provide two reasons why desalination plants are being built. Why might they be a more reliable method of supplying water than dams or diverting water?



## Chapter summary

- A human needs around 1000 m<sup>3</sup> of water per year to drink, grow food and meet basic hygiene needs; however, water scarcity affects around 1.2 billion people.
- There are two types of water scarcity. Economic water scarcity is when a place lacks money to provide the population with access to safe drinking water. Physical water scarcity is when a place lacks the actual supply of water to sustain current standards of living.
- Availability and accessibility of water is vital. However, it is impacted by a number of factors including dam-building, political disputes, conflicting uses and water degradation.
- There are ways to overcome water scarcity. China, for example, has built the Three Gorges Dam to assist with their renewable energy production. Australia has built desalination plants to increase the nation's freshwater supply.
- All groups in society including government, non-government organisations (NGOs), individuals and communities are responsible for managing water resources to address water scarcity.

## End-of-chapter questions

### Short answer

- 1 Describe three factors that increase the likelihood of conflicts over water to occur.
- 2 Water degradation greatly impacts the accessibility and availability of fresh water. Give two examples of how water can be degraded, and then offer two solutions or methods to try to minimise the degradation.
- 3 List three situations in which a desalination plant is a preferred water supply alternative.

### Extended response

Write a report on water scarcity in a country or region other than the examples provided. Your report must include the following:

- a map of the area
- information on the population, industry and environmental geography
- an analysis of the main causes of water scarcity in the region with graphs, maps and images explaining these causes
- an outline of the effects on the human population and physical environment
- an evaluation of strategies put in place to reduce water scarcity.



# 15

## The value of water

**Source 15.1** Safe, fresh drinking water is a valuable resource. Due to the lack of piped water, people in rural Ethiopia have to fetch water from its natural sources and carry it back to their homes.

### Before you start

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#### Main focus

Water is valued in different ways by individuals, groups and organisations in society because they all use water differently.

- cultural value
- economic value
- identity
- irrigation
- spiritual significance

#### Why it's relevant to us

Water is all around us. It is a valued natural resource that plays a part in every culture on Earth.

#### Inquiry questions

- What are economic, cultural, spiritual and aesthetic values of water?
- What are the different ways that people use water?
- Why do people live near water?
- How do different people perceive the value of water?

#### Key terms

- aesthetic value
- agriculture
- commodity

### Let's begin

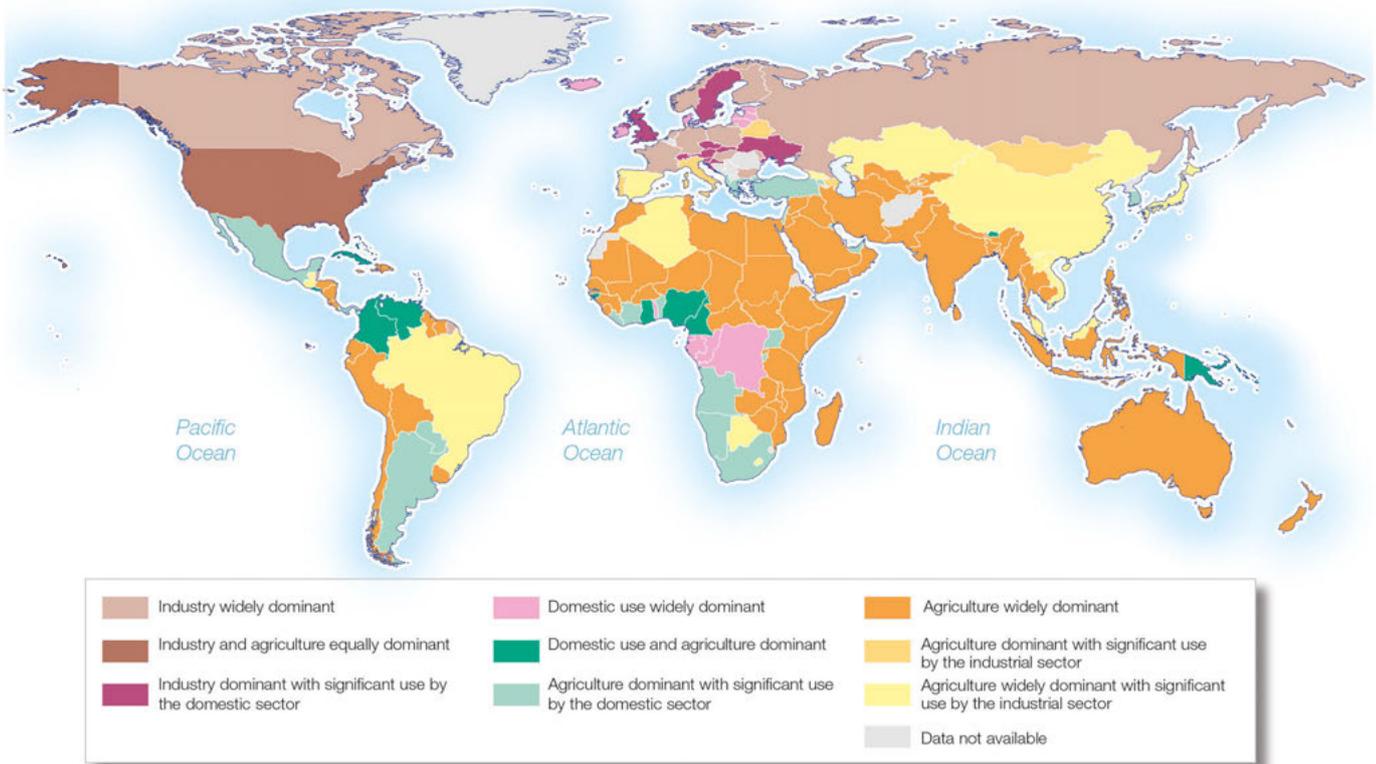
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People see and value water in different ways. Some use it for profit, some use it for sport and some link it to health. Others interact with it because water is a part of their culture and they appreciate it for what it is. Some people travel to see spectacular landforms shaped by water and amazing geographical features, such as Niagara Falls, on the border of Canada and the USA, and the Victoria Falls, on the border of Zambia and Zimbabwe. From the largest ocean to the smallest drop of rain, water affects people's daily lives; it is a precious resource that needs to be looked after now and for future generations.

## 15.1 Ways water is used by people

Water is valued in different ways by individuals, groups and organisations in society because they all use water differently. The

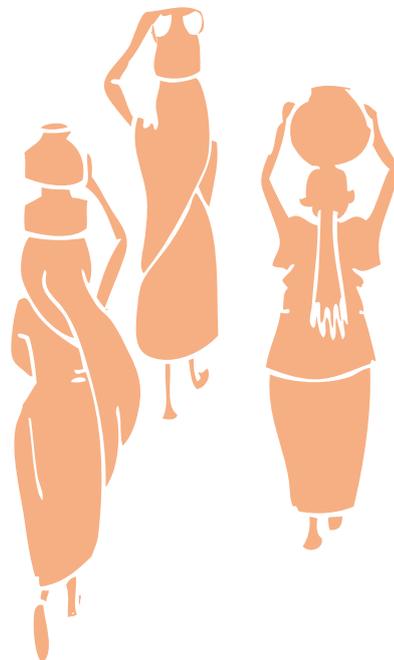
majority of human uses require fresh water. Uses of water include agricultural, commercial, industrial and recreational uses.

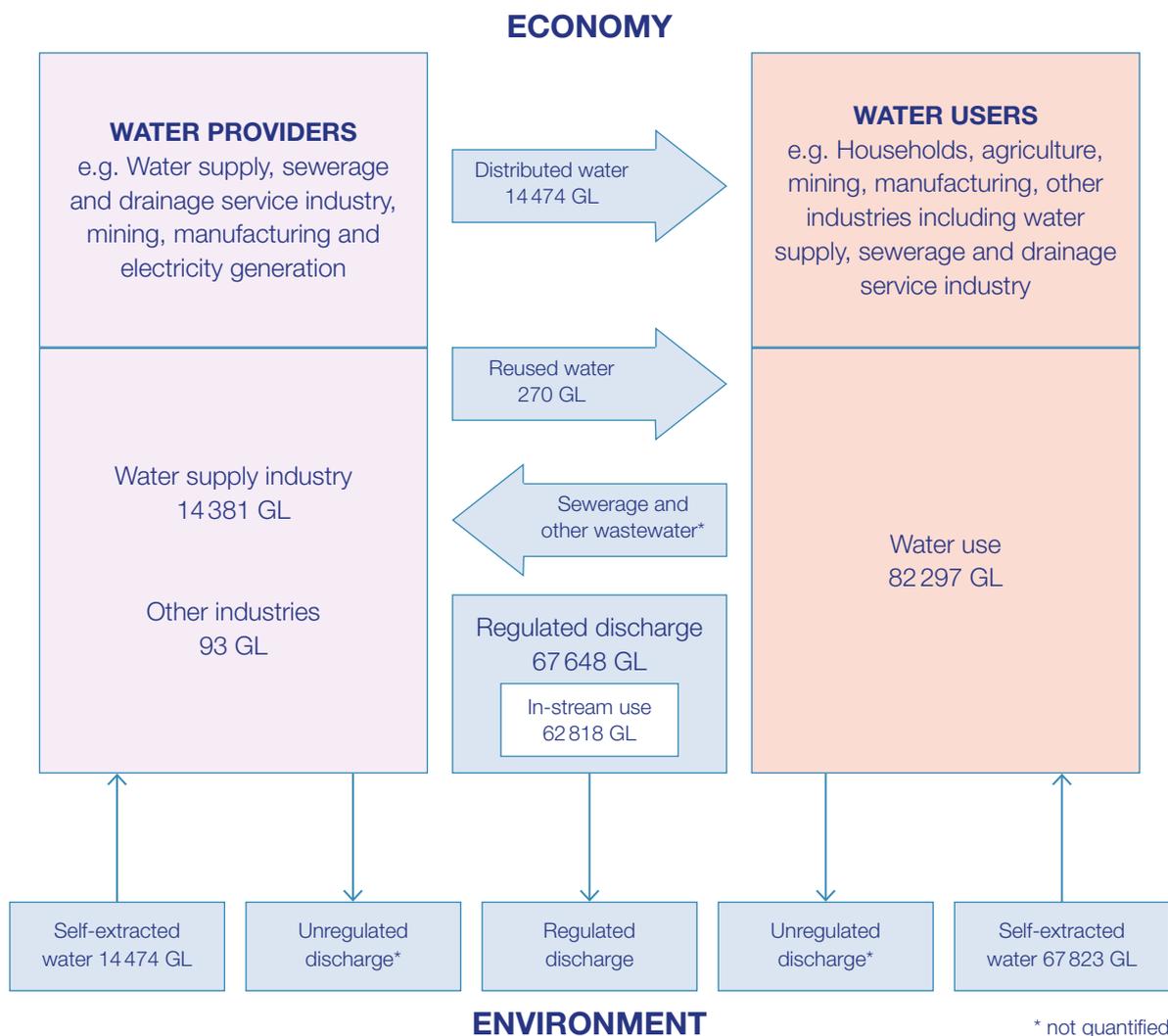


**Source 15.2** This map shows freshwater usage across the world.

### Geographical fact

At least one-eighth of the world's population does not have access to safe drinking water, according to the World Health Organization (WHO).





Source 15.3 Water supply in the Australian economy

### Agricultural

One of the most important uses of water throughout history has been in **agricultural production**. Since the beginning of human

settlements, water has been required to grow crops and food. The first successful efforts to control the flow of water were made in **Mesopotamia** and in ancient Egypt, where a lack of rainfall caused the pharaohs and rulers of other areas in the region to order the construction

of underground canals to tap into groundwater aquifers. These canals, some several kilometres long, required a great amount of labour to dig; once completed, the canals operated using gravity to reach settlements throughout northern Africa and the Middle East, which relied on this groundwater for their existence.

As discussed in Chapter 13, the Great Artesian Basin in central Australia has played an important role in agriculture in Australia. There are thousands of groundwater bores extracting water from the basin – in fact, for many remote and arid parts of New South Wales this is one of their only sources of water.

**agricultural production** using the land to produce food crops, non-food crops, industrial products and livestock

**Mesopotamia** the region around the Tigris and Euphrates rivers – modern-day Iraq



**Source 15.4** Example of an artesian bore in outback Australia

## Commercial

Rivers and groundwater sources are not the only water resources that have been used for farming. Commercial fishing is one of the oldest and most important industries in the world. Today, more than 90 million tonnes of fish are captured each year through commercial fishing, but at a cost, with hundreds of species extinct already and global fish stocks at a critical low. It is estimated that around one-fifth of all fish species are at risk of extinction, a figure which drastically highlights the need to apply more sustainable harvesting methods. Where in the past fish were caught one at a time using a line and a rod or simple nets, now fishing boats trawl the oceans using large nets.

As well as catching vast amounts of fish, industrial fishing boats can also net large volumes of bycatch, consisting of species other than the targeted fish, which are then discarded. Bycatch can include turtles, sharks, whales, dolphins, porpoises and birds. The impact that these fishing practices have on the oceans is reflected in plummeting fish stocks around the world.

Today, ocean agriculture also uses food and water resources on a significant scale. For example, seaweed farms have been established and are growing in places like China and Indonesia. The harvested seaweed is used for food, medicine, fertilisers and industrial purposes.



**Source 15.5** As fishing techniques have improved and become more efficient, overfishing has become a more prominent issue in society.

## Industrial

**industrialisation** the modernisation of a country, involving large-scale infrastructure development, economic growth and development of more efficient, mechanised methods of production

**globalisation** the process by which the world is becoming more interconnected, with an increase in social and economic integration between countries (e.g. an increase in international trade and communication)

Several of the largest ports in the world today are located in China. Illustrating the rapid and immense scale of China's **industrialisation**, these ports connect the country with hundreds of other countries and ports around the world, and handle millions of cargo containers every year. They represent the enormous importance of water transport to world economies and to **globalisation**.





**Source 15.6** Today, as a consequence of rapid globalisation, Chinese shipping ports see thousands of containers imported and exported every day.

## Geographical fact

Port Phillip Bay in Victoria handles over \$75 billion in trade every year. Other more contemporary and environmentally friendly industrial examples include the King Street Wharf in Sydney, which has three seawater processing centres that provide cooling for Precincts 1 and 2.

**Source 15.7** The King Street Wharf uses seawater machinery and equipment to provide cooling to the buildings.



## Activity 15.1

- 1 Referring to Source 15.2, explain what the main uses of fresh water are around the world.
- 2 Discuss the effects advanced fishing techniques technology has had on the industry and the environment.
- 3 Explain at least one role of water in the process of globalisation.

### Recreational uses

Water is used for recreation too; for example, surfing is a popular leisure-time activity in Australia. Numerous sports revolve around

**recreational value** the emphasis people place on something in terms of its leisure purposes and enjoyment

water. Some are simply for **recreational value**, but at elite levels each has specific requirements for optimal conditions.

Swimming is a popular sport in Australia – both recreational swimming at the beach and competition swimming in a 50-metre pool. For Olympians, the water quality is important for peak performance. Specific requirements about temperature, chlorination, bacteria elimination and monitoring water quality were in place at the Olympic Games in London in 2012.

**Source 15.8** The official swimming arena for the 2014 Swimming World Cup in Moscow



There was quite a lot of discussion and debate about the quality of the water with respect to the Olympic Games in Brazil's Rio de Janeiro in 2016. In August 2015, 11 competitors and four coaches of the United States rowing crew were sick after competing in a pre-Olympics test event.

The official response from Olympic officials was that they were looking into the cause of the illness and that it was not possible to identify the cause. They insisted that the city's waters were safe for competition events and were no threat to the participants' physical condition.

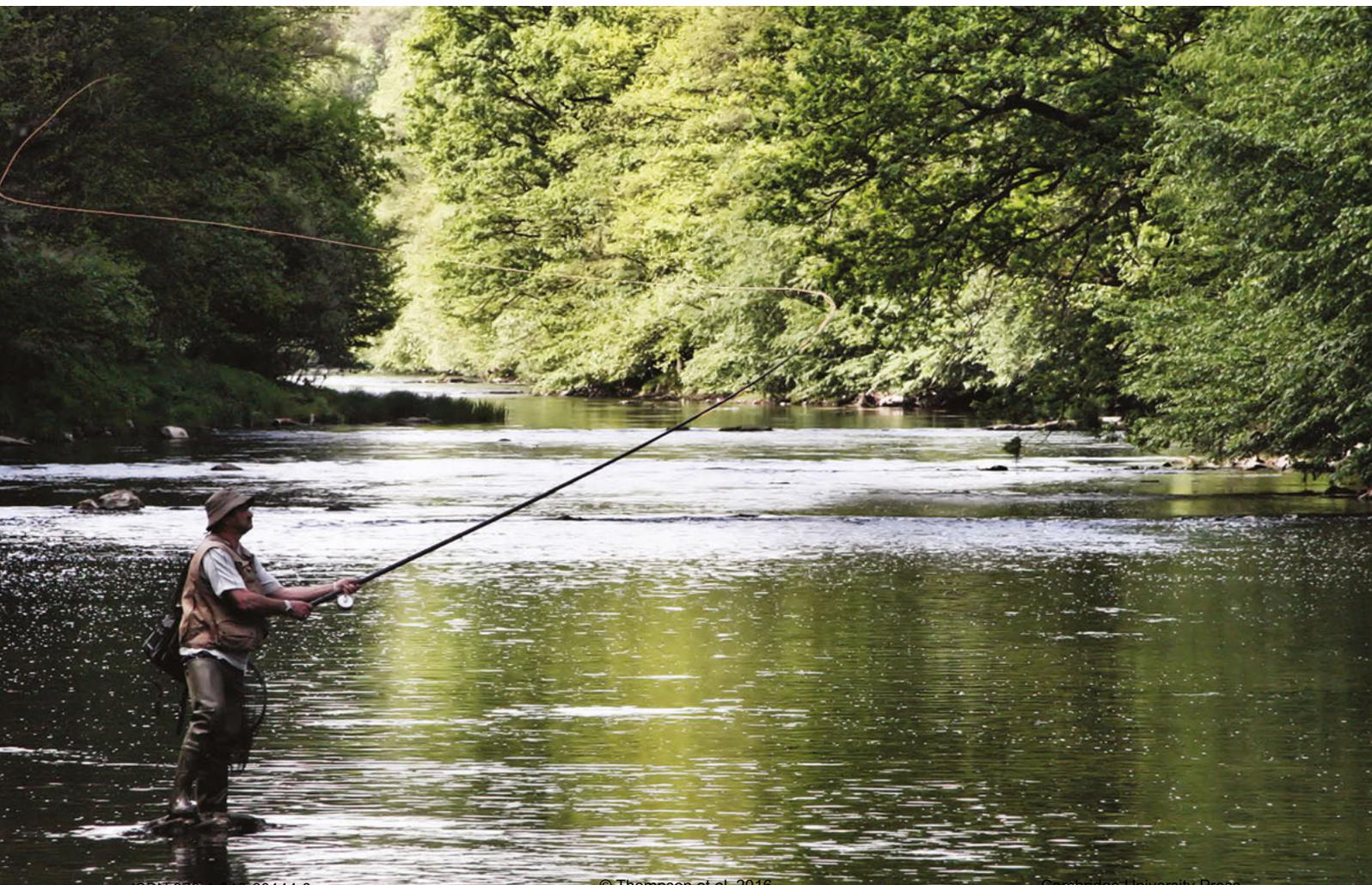
Rowers usually rise early in the morning to capitalise on the smooth, calm water that develops overnight. Scullers, oarsmen and oarswomen need these conditions – their

vessels are lightweight and sit low in the water. At an elite level, special rowing courses, such as the Nepean rowing course in Penrith, Sydney, have been constructed to minimise wind and disturbance to the water surface.

On the other hand, windsurfers like choppy conditions where wind has whipped up waves. They use the waves as a jump-off point, as well as to perform tricks or gather speed. A popular spot to windsurf is Inverloch, Victoria.

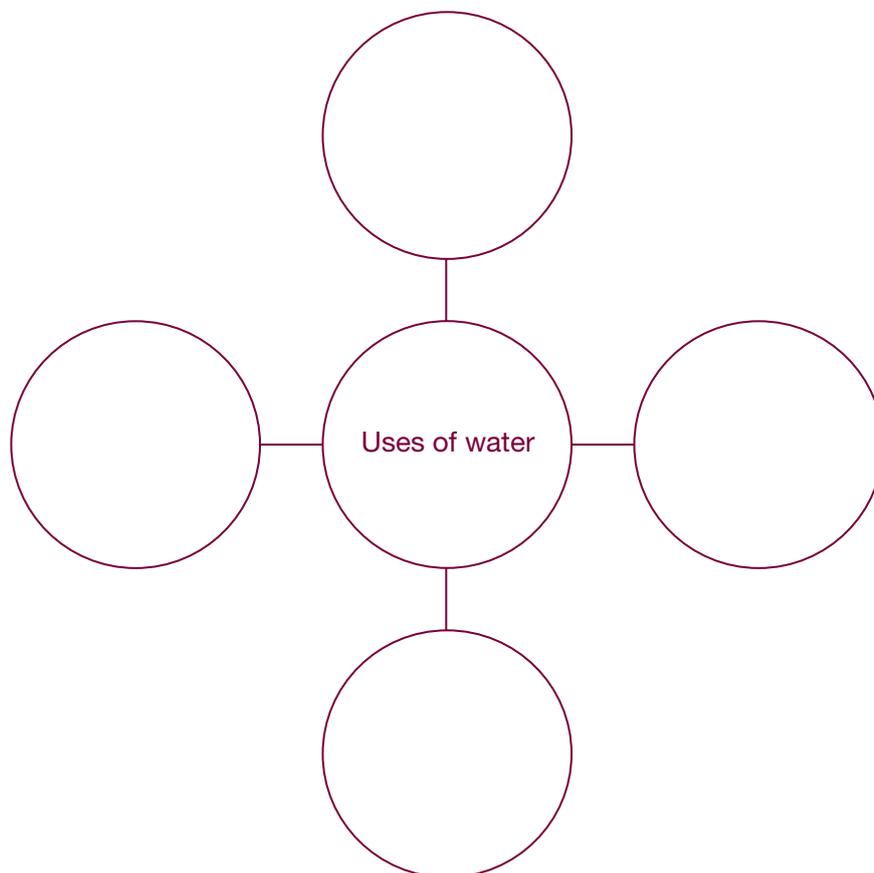
Another well-loved recreational activity in Australia is fishing. Many Australians are keen anglers – whether they like to fish at sea or on the many lakes or rivers in our country. Fly fishing is a favourite hobby for many. But fishing is not only recreational. It is also a large industry worth billions of dollars to the Australian economy.

**Source 15.9** Fly fishing is an activity that has an obvious reliance on water for recreation.



## Note this down 15.1

Copy the graphic organiser below and give examples of how water is used by one of the following: agriculture, commerce, industry or recreation.



## 15.2 People's perceptions about the value of water

Water is arguably the most valuable resource we have on Earth. Yet people perceive water in a variety of ways – from being simply essential for survival, to more as a lifestyle and aesthetic part of their lives.

**economic value** a dollar amount placed on an asset to show how much it is worth

### The economic view of water

Even though water may have a lower **economic value** than

other commodities, it is crucial to acknowledge the exploitation of water by societies as they seek to gain greater profits for various activities.

Historically, water has played a huge role not only in our survival and growth, but also in exploration through transport and globalisation. For example, the Qingdao port in China, located on the Yellow Sea, has connections with 450 ports in 130 countries and has strengthened significant trade relations with other nearby ports in Korea.

As societies have progressively developed, access to water has taken on more of an



**Source 15.10** The Qingdao port in China

**commodity** a resource that can be bought and sold

economic aspect. Water has also become a **commodity** – a marketable item, bought and sold to satisfy the needs and wants of people. Today, in Australia, state governments regulate water supplies from ground, surface and stored water sources, as

well as from desalination plants. This water is usually treated before being piped and sold to residential as well as agricultural, commercial and industrial customers. When you turn on a tap at home, this is the water you are most likely using. In fact, Australian households spend approximately \$5 billion a year on water.

**Source 15.11** Tap water has been heavily treated in order to meet the requirements for human consumption.



**RESEARCH 15.1** //

Investigate a desalination plant in Australia. In a short essay, explain how desalination plants are examples of both renewable and non-renewable resource use.

**Bottled water**

In recent years, the market for water has greatly expanded. People around the world now also demand bottled water. Bottled water is usually sourced from natural underground springs, although some brands are sourced from other supplies and then treated. Bottled water has become increasingly popular, as consumers testify in favour of its convenience, better taste compared to tap water, and benefits as a healthy alternative to other drinks.

Such claims, however, have been opposed by various groups, including health professionals and environmentalists. Despite such debates, the popularity of bottled water and its market continues to grow.

**Real estate**

People often want to live close to water for a variety of reasons, including access to work via ferry, lifestyle on the weekends, the picturesque views and prestige. Living or

**Source 15.12** Beachside holiday homes suggest luxury and status. Pictured is an impressive house in Miami, Florida, USA.



operating businesses near freshwater rivers and saltwater oceans is popular because people get a financial return for their water-related activity, although at times this has been at the cost of environmental deterioration. Coastal dwellings are also very much in demand and often fetch higher house prices compared to similar homes inland. To purchase a house with ocean views therefore requires significant

**investment** spending money on something for a financial reward or return

amounts of money. Often people will purchase dwellings in beachside suburbs such as Avoca and Terrigal in New South Wales as an **investment**, and then lease them to other families for their beach holidays.

The economic value of water cannot be denied; however, there are also myriad other values people around the world hold about water influenced by their culture, spirituality and aesthetics.

## Other views of water

### Cultural

Water can be a marker of identity for communities – such as the peoples of some of the island nations in the Pacific Ocean, such as Palau, Fiji and Samoa. Their iconic bungalows over crystal-clear water, coral reefs and unique cultures have resulted in a booming tourist industry. Aquatic activities such as fishing, snorkelling and scuba diving are common.

**Source 15.13** A tourist industry has emerged around the beauty of a tropical paradise featuring bungalows and snorkelling.



The different cultures of islanders and their different ways of life have largely been dependent on water. Ceremonies, foods and traditions stem from water resources and their cultural significance. For example, community fishing is controlled by a fishing chief who is bound by strict traditional rules and the whole community is involved in catching schools of fish.

### Spiritual

Another value of water for people has been in its use for spiritual purposes. In the Christian religion, a **baptism** with holy water indicates a person's commitment to the faith. It is also used to christen infants and dedicate them to Jesus Christ. Depending on the church, some people will be fully or partially immersed in water to signify new beginnings and purification.

**baptism** a ceremony purifying the spirit through contact with holy water



**Source 15.14** A mass baptism ceremony at the Jordan River in northern Israel

### Aesthetic

Water can be beautiful to look at, and most people appreciate water views. Some people appreciate the sound of rolling waves or bubbling streams, and find them relaxing.

Such aesthetic values placed on water often make people want to capture the nature and character of water and subsequently depict these by creative means. Water is often

represented in dance and drama by fluid movement, or by blue and green hues in oil paintings.

‘Sculpture by the Sea’ is an annual outdoor exhibition in Sydney, between Bondi and Bronte beaches along the coastal walk. It

features works of sculpture that draw inspiration from the beautiful **seascapes** that line the coast, and attracts thousands of visitors each year. There is a similar exhibition at Cottesloe, Western Australia.

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**seascape** a view of the sea

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**Source 15.15** A sculpture at the 15th annual Sculpture by the Sea exhibition held along the Bondi to Bronte coastal walk

## RESEARCH 15.2 //

Investigate how water is used in either two religions, or in two pieces of art not discussed in this chapter. Identify common themes and uses for water. Compare different values and perceptions of water. Present your findings in a PowerPoint presentation.

## Activity 15.2

- 1 Outline the advantages and disadvantages of living in a seaside property. Consider how the environment may affect the property.
- 2 Identify a famous body of water that has become a tourist hotspot. Explain its importance to the local community and how this view may differ to that of the tourists.
- 3 Water is a source of inspiration for many works of art. Construct a piece of artwork that displays what water means to you. It can be a piece of music, a poem, a drawing or even a sculpture. If you cannot construct your own, research a water-inspired piece of art that reflects your connection to water and explain why you chose this piece.

## 15.3 The importance of water to Aboriginal and Torres Strait Islander communities

In Australia, the value of water to Aboriginal and Torres Strait Islander peoples is immense. Though Aboriginal and Torres Strait Islander communities have traditionally used water

in a range of ways, including for transport, fishing and recreation, next we will focus on the spiritual and artistic values that the first Australians have found in water.

**Source 15.16** Water was and still is an essential part of the Aboriginal and Torres Strait Islander peoples' way of life.



## Spiritual value

Aboriginal and Torres Strait Islander peoples have a strong spiritual connection between water and their creation stories or Dreaming. For example, the rainbow serpent is a key symbol of creation and features in the Dreaming stories of many Aboriginal nations. The serpent is almost always associated with the creation of watercourses, such as billabongs, rivers, creeks and lagoons.

Aboriginal and Torres Strait Islander peoples lived with the land rather than off it. Many had a nomadic lifestyle and ensured that water resources were not depleted before moving with the next season to the next location. Their way of life was sustainable.

## Art

Water is an important feature in the art of Aboriginal and Torres Strait Islander peoples, both historically and in contemporary art. Aboriginal art has varied uses – it can tell stories (for example, of the Dreaming, moral

tales or for entertainment), and it can function as a language through its use of symbols. Some of the most important symbols of the Dreaming are associated with water, such as the Rainbow Serpent (often shown connected to billabongs, rivers, creeks and other waterways), fish, turtles, dolphins and crocodiles. All these symbols appear regularly in rock art, some of which dates back 40 000 years. Rock art shows us what was important, culturally, mythically or environmentally, to the first inhabitants of Australia, and therefore the constant presence of water or creatures associated with water demonstrates its importance in Aboriginal cultures. Bark paintings and dot paintings also both often depict waterways and water creatures.

Aboriginal art uses many symbols to show water because waterholes are imperative for survival in the outback, and so will traditionally appear in art both as places on a sort of map, and to indicate where important or sacred things have occurred.

### RESEARCH 15.3 //

Investigate the use and cultural significance of a major river such as the Nile, the Rhine, the Yangtze or the Mekong. Critically analyse the significance of the river for local people. Present your findings to the class in the form of a visual display or electronic presentation. You must include the following:

- cultural value of the river
- economic value of the river
- aesthetic value of the river
- recreational value of the river
- how the river contributes to the identity of local people
- spiritual significance of the river (if applicable).

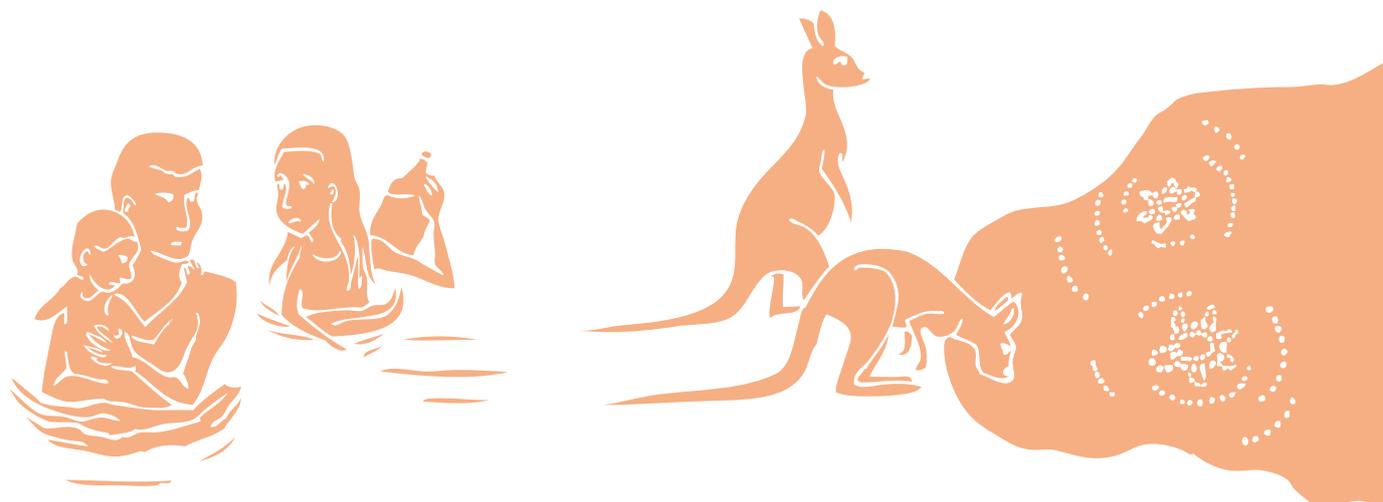
### Activity 15.3

- 1 Clarify what is meant by the phrase 'live with the land rather than off it'.
- 2 Describe the symbolism of the rainbow serpent.



**Source 15.17** Rock art in Namadji National Park, Australian Capital Territory

- 3 Interpret the art in Source 15.17. How does it show the importance of water in Aboriginal and Torres Strait Islander peoples' art?





## Chapter summary

- Water is used in different ways by people around the world. The main uses of water include agricultural, commercial, industrial and recreational.
- For thousands of years people have found ways of accessing and using water resources (surface water and groundwater) to farm the land.
- Water is highly valued economically. Its greatest value is through irrigation, and also its essential role in farming.
- Water itself is also now considered a commodity. Water is used in hydropower, and plays a significant role in energy production, for which consumers pay. Water is also bottled and sold due to greater market demand for its convenience.
- Perceptions of water vary between different groups of people and places; for example, for many people water has crucial economic value. In terms of real estate value, properties are more expensive the closer they are to an ocean view.
- Water also has cultural, spiritual and aesthetic values around the world.
- In Australia, Aboriginal and Torres Strait Islander peoples have a strong cultural and spiritual connection to water and their creation stories or Dreaming.

## End-of-chapter questions

### Short answer

- 1 Reflect on Australia's usage of water in the household. Where in the house is water used the most? And who in Australia uses the most water? Discuss why these higher uses of water might be occurring.
- 2 Briefly describe how water can be valued culturally, spiritually and aesthetically.
- 3 What does conservation and sustainability mean and how do they contribute to our understanding of the importance of protecting our water sources?

### Extended response

How can humans use water in a sustainable way, given all the different perceptions, uses and values by different groups in society? In your answer you should address the following:

- competing demands for water and areas of highest use
- suggestions about how to ensure water as a resource can be enjoyed by all
- consideration of the water needs of future generations.

# 16

## Investigating a contemporary natural hazard

**Source 16.1** A severe storm developing over the plains of central Illinois, USA

### Before you start

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#### Main focus

Water is not only one of the basic ingredients for all life on Earth and an important part of environmental systems that keep the planet healthy; it is also a central element in some of Earth's greatest hazards, such as floods and drought.

#### Why it's relevant to us

Unlike with other natural hazards, such as earthquakes or bushfires, there are few places on Earth that are not susceptible to hazards associated with too much or too little water. In a world where the climate is changing and more and more people are settling in areas that are subject to water hazards, understanding how these hazards arise and how to effectively manage them is essential.

#### Inquiry questions

- What are natural hazards and how do they occur?
- How do natural hazards impact both human communities and the environment?

- How are natural hazards managed?
- Are natural hazards going to be much worse in the future?

#### Key terms

- bushfires
- climate change
- drought
- floods
- hydrological hazards
- meteorological
- severe storms
- tropical cyclones
- tsunami
- water cycle

### Let's begin

---

Australia is the flattest and driest continent on Earth (excluding Antarctica), though like many other communities around the world, Australians have learned to live with water-associated natural hazards. Australians are fortunate, however, in that the relative number of lives lost to these types of hazards is low and the ability to recover economically after disaster strikes is far greater compared to poorer communities around the world, where hazards associated with too much and too little water bring devastation, death and disease on a huge scale.

## 16.1 Natural hazards

As we discussed in a previous chapter, there are two major types of natural hazards: atmospheric and hydrological hazards.

Atmospheric hazards are any natural hazards that occur primarily due to processes in the atmosphere (cyclones, bushfires and severe thunderstorms); while hydrological hazards are any that occur primarily due to too much water (flooding) or too little (drought). Importantly, many hazards tend to be both atmospheric and hydrological in nature.

Though there are many different types of natural hazards, in this chapter we will focus on severe storms and floods.

## Storms

**Severe storms** occur more frequently than any other natural hazard. Even though they are formed by the same forces that drive the formation of other types of cloud and precipitation, they have the potential to be deadly. Severe storms produce lightning, hail, tornadoes, waterspouts, **storm surges**, damaging winds and intense rainfall, all of which can be very destructive.

The weather events that are categorised as ‘severe storms’ can range from isolated thunderstorms that affect only a few square

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**severe storms** storms, including thunderstorms and cyclones, that cause serious damage to the country

**storm surge** an increase in the height of coastal waters as a result of onshore winds, usually associated with a cyclone

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**Source 16.2** An immense storm at the mouth of the Douro River, Portugal, in the Atlantic Ocean



**low pressure system** a weather pattern in which atmospheric pressure at sea level is below that of surrounding locations

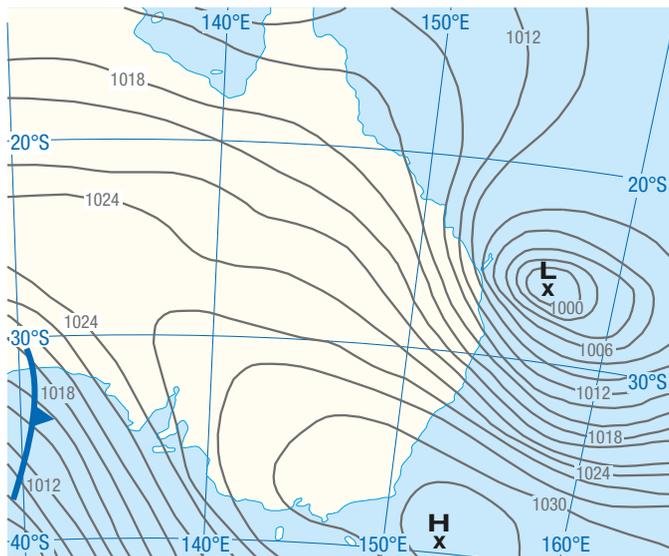
kilometres, to intense **low pressure systems** that affect thousands of square kilometres. A low pressure system can also be associated with a tropical

cyclone, which is a type of low pressure system originating over the tropical oceans.

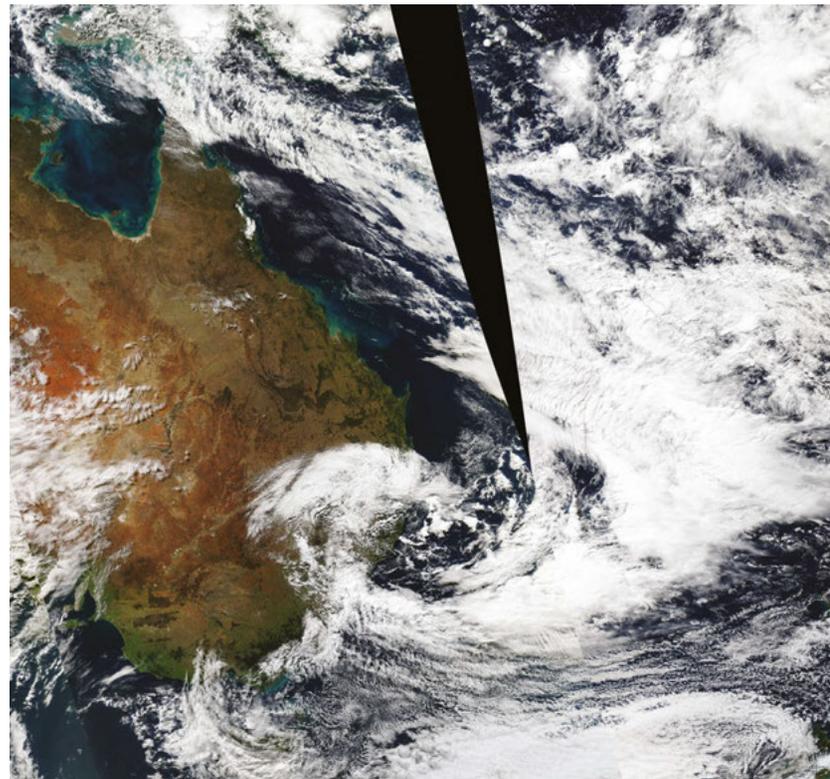
In Australia, a typical example of a widespread intense low pressure system is that which generally forms during autumn and winter along Australia's east coast, and is known as an 'east coast low'. East coast lows also form on the east coast of Africa and the United States. Different from tropical cyclones, these weather events do not need warm tropical seas to provide energy for them to form.

Also, unlike isolated thunderstorms, these types of weather systems are widespread in area. In Australia, east coast lows are created by the temperature difference between the warmer air in the Tasman Sea and cold air in the high levels of the atmosphere over the Australian continent.

They are also different from tropical cyclones in that they will often intensify rapidly overnight, unlike tropical cyclones, which have life cycles of typically about a week. The speed and intensity of these low pressure systems make them one of the more dangerous types of weather systems to affect the Australian east coast, generating strong winds, heavy widespread rainfall, very rough



Source 16.3 An east coast low



seas and prolonged heavy swells over coastal waters, and causing damage to the coastline and posing a major threat to ships and boats.

In one east coast low in June 2007, the Hunter and Central Coast regions of New

South Wales were lashed with severe weather conditions. Torrential downpours and gale-force winds over three days caused enormous destruction, with nine people losing their lives. Such was the force of the storm that the



**Source 16.4** The cargo ship *Pasha Bulker* is stranded at Nobby's Beach, NSW by a storm in June 2007

giant coal carrier *Pasha Bulker*, buffeted by wind gusts up to 124 km/hr and heavy ocean swells, ran aground on one of Newcastle's most popular beaches. If the ship had broken up, the 700 tonnes of fuel on board would have created an environmental catastrophe.

Thunderstorms are another type of potentially severe storm. At any given moment, over 1800 thunderstorms are in progress

over the Earth's surface, and about 18 million occur around the world annually. Not all thunderstorms are classified as severe – usually only 10–20% of them are. What makes a thunderstorm severe is if it has one or more of the following characteristics:

- rainfall heavy enough to cause flash flooding
- hail at least 20 mm in diameter
- winds over 90 km/hr.

Severe storms are estimated to cost on average about \$284 million every year in Australia. This represents over a quarter of the average annual cost of all natural disasters in the country. For example, one of Australia's more costly natural disasters, in dollar terms, was a hailstorm that hit Sydney on 14 April 1999; over 20 000

properties and 40 000 vehicles were damaged by hail the size of cricket balls, which also damaged aircraft at Sydney airport. In just over an hour, this storm created over \$1.5 billion in damage. The estimated total weight of the hail that fell over the city was around 500 000 tonnes.



### Activity 16.1

- 1 On weather maps, areas of equal pressure are indicated by circular lines called *isobars*. In Source 16.3, an intense low pressure system is indicated by a series of closely spaced isobars that surround the centre of the system. These types of maps are also useful for determining the relative strength of winds across a region. When the isobars are closer together, this indicates stronger winds. When they are further apart, it indicates milder winds.

Referring to the weather map in Source 16.3, note how close the lines are surrounding the low pressure system off Australia's east coast. The regions experiencing strong winds can be determined by noting where the lines touch or cross the coast. Using an atlas, identify some of the major towns and cities along Australia's east coast that would have experienced strong winds and possibly heavy rainfall.

- 2 Strong winds in low pressure systems like the east coast lows create heavy waves and ocean swells that pummel beaches and other coastal land formations, causing erosion and flooding of low-lying areas. What are some of the hazards that these types of weather systems pose to life and property in coastal areas?

## Floods

**flood** a large overflow of water that drowns areas of land, usually causing extensive damage to those areas

The term '**flood**' in its most basic sense refers to a flow of water over areas that are habitually dry. Floods include a range of events, many of which can include other sources of damage, such as wind damage associated with severe storms, or landslides when waterlogged soil becomes unstable. Sources of floodwater can come from the sea (in the form of storm

surge or **tsunami**), from the melting of glaciers or winter snow, or from rainfall if the volume of water exceeds the capacity of rivers and creeks or other drainage systems to deal with it.

Globally, floods are the most frequently occurring destructive natural events, affecting both rural and urban settlements, and are extremely costly in social, economic and

**tsunami** a series of ocean or lake waves with enormous destructive potential, usually created by an undersea earthquake

environmental terms. In Australia, since the first recorded death as the result of a flood in 1790, there have been over 2300 flood-related deaths. In the period between 1967 and 1999, the cost of floods in Australia, through the destruction of economic assets such as homes and businesses and the washing away of roads and railway lines, has been estimated at \$10.4 billion – the equivalent of \$314 million annually. The environmental costs of floods are also rising

because agriculture and greater urbanisation are contributing to problems like increased soil erosion; and during periods of flood the by-products of agricultural processes, such as fertilisers and pesticides, as well as industrial pollutants from urban areas are washed into our oceans, causing long-term environmental damage to marine ecosystems. It is the combination of these factors that makes floods the most costly of natural hazards in Australia.

## Geographical fact

The definition of a flood does not have to include water. In January 1919 in Boston in the United States, a large molasses storage tank at an alcohol distilling company burst, sending a wave of molasses through the streets at an estimated 56 km/hr. This most unusual of urban floods killed 21 people and injured 150 more.

**Source 16.5** The suburb of Milton was severely affected by the great Brisbane Flood of 2011.



**Activity 16.2**

- 1 Explain why floods are the most widespread of natural hazards.
- 2 Are only humans affected by flooding? Discuss how floods can affect animals, particularly farm animals.

**RESEARCH 16.1** //

- 1 Investigate why China’s Yellow River has been given the name ‘River of Sorrow’.
- 2 In Australia, most local governments have flood maps that show the potential for flooding along creeks and rivers. Analyse how flood maps may help when planning development in these areas.
- 3 Recall if there has been a flood in the area or state in which you live. Describe the ways in which this event was destructive to both the human and natural environments.

**Note this down 16.1**

Copy the graphic organiser below and list the positive and negative effects of flooding on both the human and natural environments.

Human environments		Natural environments	
Positive	Negative	Positive	Negative
Deposits fertile soil on the flood plain for growing crops like rice	Inundates homes	Provides wetlands for breeding birds	Erodes river banks

**16.2 Spatial distribution and cause of disasters**

To help manage and predict hazards, it is useful to investigate the spatial distribution of hazards. That is, where in the world they are most likely to occur. Spatial distribution of natural hazards can depend on both the topography and the nature of the region itself.

Hazards such as severe storms and droughts have the potential to occur anywhere in Australia. In comparison, flooding tends to be limited to low-lying areas near watercourses, such as river catchments. Similarly, tropical cyclones tend to occur in tropical regions, such as the northern parts of Australia. About 90% of tropical cyclones occur less than 20° from the Equator.

From a topographical perspective, bushfires spread faster when travelling upwards.

The distribution of hazards can also be associated with sea-surface temperatures and air pressure – like the effects seen with the La Niña and El Niño.

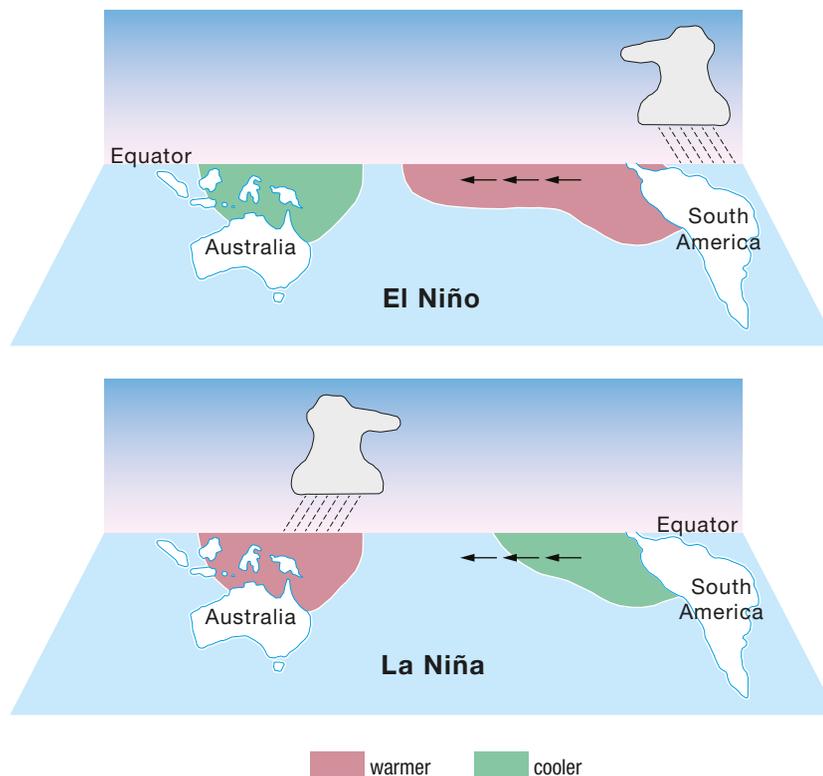
## La Niña and El Niño

La Niña and El Niño are two parts of a complex mix of sea-surface temperatures, air pressure and winds, which play a role in how weather is experienced in the countries that border the South Pacific Ocean, such as Australia. These events have also been discovered to have an influence on the temperatures of the Indian Ocean, which in turn influences the Indian monsoon.

El Niño was originally recognised by fishermen off the coast of South America, as

the appearance of unusually warm water in the Pacific Ocean. Because this condition often occurs around Christmas, it was named El Niño, which is Spanish for ‘boy child’, referring to Jesus Christ. La Niña, meaning ‘girl child’, is its opposite.

In simple terms, understanding how La Niña and El Niño work comes down to understanding that there are two bodies of water in the South Pacific of different temperatures, one cooler than the other. In ‘normal’ conditions, cold water from the eastern side of the South Pacific Ocean (near Chile) pushes warm water westwards, and this warm water evaporates, feeding the formation of clouds, which bring average rainfall over Australia. During an El Niño event, the cold water doesn’t push strongly enough, causing the warm patch of water to drift towards the



**Source 16.6** The difference between the El Niño and La Niña weather patterns. El Niño brings drought conditions to Australia and La Niña brings above-average rainfall and increased cyclone events.

middle of the South Pacific. This results in fewer rain-bearing clouds forming east of Australia, and is one of the reasons why El Niño is connected with drought.

So drought years in Australia are linked to this pattern. La Niña, the opposite of El Niño,

forms when the cold water in the South Pacific pushes the warm waters strongly against the east coast of Australia. When this happens, vast quantities of moisture-laden air bring above-average rainfall to Australia, and increase the likelihood of flooding and tropical cyclones.

### RESEARCH 16.2

For over 150 years since the European settlement of Australia, farmers were at the mercy of a climate with a large amount of variability that they never really understood. Farmers could never reliably predict which years would be normal or which would be years of drought or flood, so activities like planting crops could be hit-or-miss. The work of modern **meteorologists** has allowed farmers to predict weather patterns more accurately. In 200 words, explain some of the advantages for farmers in being able to predict weather patterns.

**meteorologists**  
people who study  
weather and climate

## 16.3 Impact of climate change on floods

Are the chances of disasters like floods likely to rise in the future? Climate scientists, using powerful computers to model extremely complex weather and climate information, have recently suggested that in future the severity of rainfall events will increase. This means that rainfall events such as the one that affected Queensland and many other parts of Australia in 2010–11 will be much more severe, creating greater flood risk.

The other way in which climate change will influence atmospheric hazards is in the threat of inundation from rising sea levels. Global warming is melting ice that has been locked away for hundreds of thousands of years in the polar regions and in mountain glaciers. These

melting bodies of ice, which are increasing the volume of the world's oceans, are predicted to raise sea levels 0.5–1 metre over the next century. Humans are therefore vulnerable to increased hazards in the coastal zones.

Many of the world's largest cities and industrial facilities are located on the coast, and one-quarter of the world's population lives within a 100-km distance and 100-metre **elevation** of the coastline, with significant increases in the number of people living in coastal regions expected over the next 50 years. Impacts include sea-level rises; a higher risk of exposure to extreme water-associated events, such as intense storms, storm surges and flooding; and the threat of saltwater contamination of freshwater resources and farmland.

**elevation** height above  
sea level

## 16.4 The impact of and responses to disasters

When a natural hazard occurs, the impact on people, places and environments can be significant.

### 2010 Pakistan floods

There are few places on Earth where flooding is not a concern. Anywhere that rain falls is vulnerable. Like everywhere else, flooding is part of the natural cycle in Pakistan, in south Asia, and the Pakistani people rely heavily on

the regular rains of the **Indian monsoon** for agriculture and industry. The major rivers in Pakistan – the Indus and its tributaries – are fed by

**Indian monsoon**  
seasonal heavy rains that fall in the Himalayan regions of south Asia

these annual monsoonal rains falling on the mountains in the north of the country.

In July 2010, heavier than average monsoonal rains lasting for over two months fell in the upper catchment of the Indus River in Pakistan, causing flooding along its entire length. In certain areas, more than four times the normal monthly rainfall fell within three days. The 2010 flood was the most destructive flood in Pakistan's recorded history. Floodwater in Pakistan's water catchments combined to create a moving body of water equal in dimension to the landmass of the United Kingdom.

The impacts of the 2010 monsoon were catastrophic: approximately one-fifth of Pakistan's total land area was under water (about 796 095 km<sup>2</sup>) and flooding killed over



**Source 16.7** A 3D relief map of Pakistan



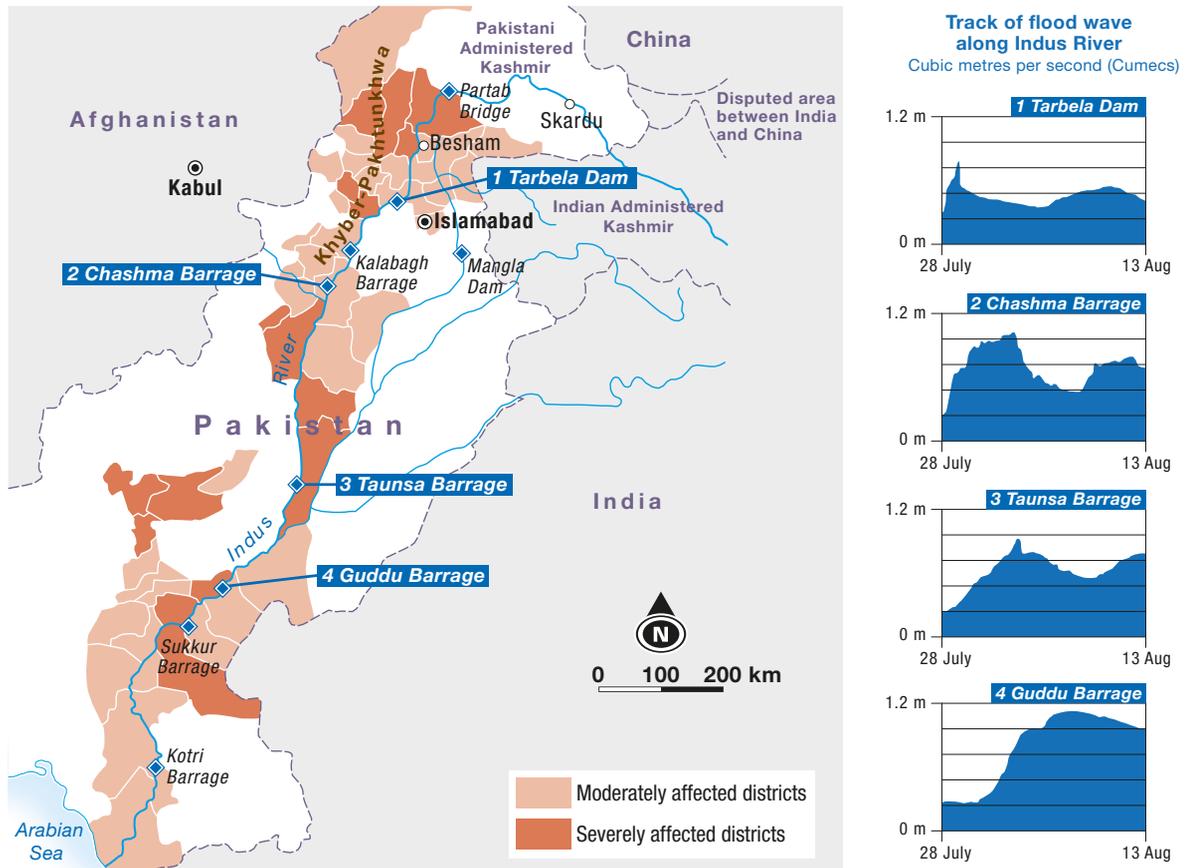
**Source 16.8** Floodwater surrounds houses in the Punjab region of Pakistan during the 2010 flood emergency

1800 people and affected 21 million more – a greater number than were affected by the Indian Ocean tsunami, the Haiti earthquake and Pakistan’s 2005 earthquake combined.

The country suffered more than \$10 billion in damage to infrastructure such as irrigation systems, bridges, houses and roads. Vital food crops such as rice, grain, sugar cane and pulses were destroyed, and over 200 000 head of livestock – cattle, sheep and goats – were killed. People lost not only their lives; a great many lost their homes, their farms and their businesses.

The development of towns and villages in Pakistan and the threat they face from flooding is typical of many places around the world, and it is this pattern that highlights the interaction between humans and natural processes. People are attracted to flood plains along rivers where fertile soil has been deposited over tens of thousands of years of flooding. The rich soil encourages farming, which then encourages the growth of settlements; but these will always be under the threat of flooding.

Much of Pakistan is arid or semi-arid, and only about 24.4% of land is suitable for



**Source 16.9** The passage of the flood wave along the Indus River during the 2010 flood

farming. Much of this takes place along the fertile flood plains of the Indus River and its tributaries, where the water is heavily relied

**population density** the number of people in an area of land usually expressed as a number per square kilometre

upon for irrigation, making it one of the largest irrigation systems in the world. The region along the Indus River and its tributaries is heavily populated, with **population**

**densities** ranging from between 200 to 1000 people per square kilometre.

Pakistan is not a wealthy country: the average family income in Pakistan is low, with about 22.6% of the population estimated to be living on less than \$1.25 a day. Many of these people are involved in small-scale agriculture, living in villages built on the flood plains, with

much of the housing constructed of mud brick, which is quickly washed away in a flood.

After the **flood peak** had passed through, the people of Pakistan faced a further crisis. The irony of flooding caused by heavy rainfall is that, despite the huge volumes of water that are involved, fresh drinking water becomes scarce.

Many of the wells and storage reservoirs in the flood-affected regions were contaminated by water that carried deadly pollutants, such as raw sewage and the rotting corpses of drowned animals. The threat of waterborne diseases such as **cholera** was enormous. Many

**flood peak** the highest point that floodwater reaches

**cholera** an infectious disease caused by contaminated water; it causes severe vomiting, cramps and diarrhoea, and can often be fatal



**Source 16.10** Flood-affected children fill their containers from emergency water tanks on 19 September 2010 in Peshawar, Pakistan

homes were destroyed in the floods and roads and bridges were swept away by floodwater or destroyed by landslides.

Over the longer term, the ability of the Pakistani people to recover from the floods was affected by the enormous amount of mud and debris carried in the floodwater that swamped farming land, making it difficult to get the ground ready for future crops.

The flooding also caused other long-term problems like unemployment in the devastated regions, because of the destruction of business and industry, which affected the ability of communities to recover. This was further compounded by the fact that rebuilding facilities like roads and bridges was hampered by the enormous amounts of money needed.

**Source 16.11** Roads damaged by the 2010 Pakistan floods, cutting off people and help



## 16.5 Responses to floods and management strategies for future disasters

The 2010 Pakistan floods created a crisis for millions of people who were without proper shelter, fresh drinking water, food and medical supplies. And this crisis was made even worse because many of these people were isolated, not only by the floodwater, but by the fact

that roads and bridges were impassable. This put enormous pressure on the Pakistani government and international relief agencies such as UNICEF to deliver essential supplies.

The response strategies of the region affected play a large role in how the hazard is handled. For example, the experiences of people caught in a flood may vary according to a number of factors:

- The time of year the flood comes. People regularly experience floods that are linked



**Source 16.12** An example of flood damage: comparison satellite images taken before and after the 2011 floods in Ayutthaya Province, Thailand

to the seasons, such as rain in spring or during the wet season in the tropics. Heavy rainfall outside these regular patterns can catch people unexpectedly.

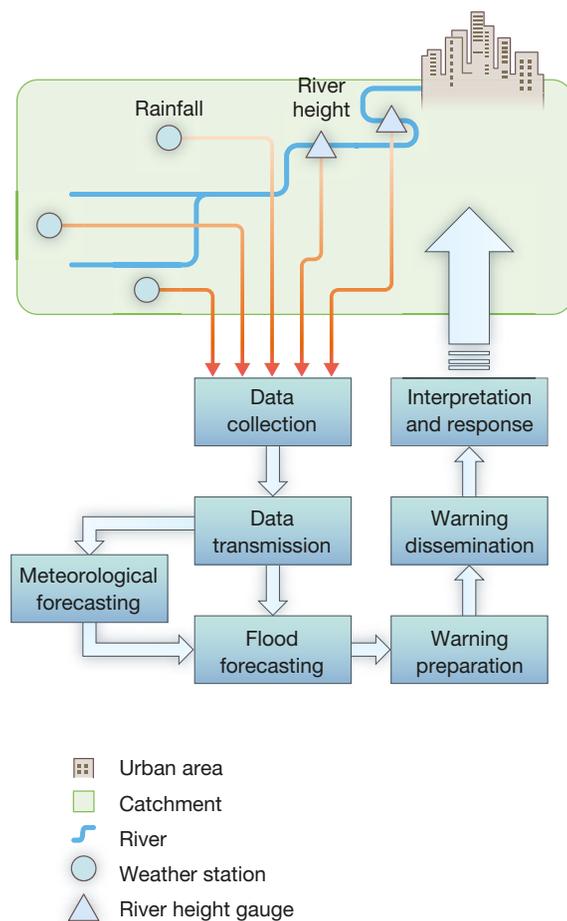
- The time of day when the worst flooding occurs, how quickly the flood arrives, and how quickly the water rises. For instance, flooding that occurs at night poses a greater potential threat because people are more disoriented than they would be during the daytime.
- How long the flood lasts. In some parts of northern Victoria, floodwater still covered farmland almost two years after the January 2011 floods.
- The depth of the water and the speed at which it flows. There is little defence from great volumes of rushing water. Many deaths from flooding in places like Australia are the result of people underestimating the depth and speed of water and attempting to drive their cars through a flooded roadway, or walking or swimming across flooded watercourses and being washed away.
- How well prepared people are for a flood. People in developing countries such as Pakistan are affected far more severely by the devastation caused by floods than people in Australia. Australia has comprehensive communication systems to warn people of flooding and Australian authorities have stringent planning guidelines for where people can build and what types of houses they can build. In poorer countries, building regulations are less stringent and people, many of them poor, often build in areas that are vulnerable to flooding because of the cheapness of the land. Many people in poorer countries also don't have easy access to telephones, television and the internet,

so information that they get about potential floods is often limited.

- The amount of outside help that is available for rescue and relief operations. Many countries in the developing world do not have adequate money or resources to deal with flood disasters, and it is because of this difference that people in Bangladesh, for instance, have a far more devastating experience than people in developed countries like Australia.

### Management strategies for future flood disasters

When an emergency such as a flood threatens a region, a coordinated response needs to take place so that the safety of people and



Source 16.13 An emergency management system during a potential flood crisis

the protection of property can be maximised. Source 16.13 shows how an emergency management system works during a potential flood crisis in Australia.

Meteorological organisations such as the Commonwealth Bureau of Meteorology in Australia monitor weather conditions like rainfall and river height. This information is collected and forecasts are made, such as the chance

of further rainfall and the behaviour of the floodwater in the catchment. The information is then passed on to emergency and government organisations like the police and government emergency management coordinators. This information is then collected and emergency management plans are set in place. Warnings are sent out to communities and preparations are made to deal with the crisis.

### RESEARCH 16.3 //

Write a short report on the floods in Pakistan in 2010. You may use the information provided above and you may also supplement your answers with further research.

- 1** Describe the spatial distribution of the Pakistan floods in 2010.
- 2** Account for the location of the floods.
- 3** What geographical processes contributed to the flooding?
- 4** Assess the economic, social and environmental impacts of the floods.
- 5** Outline the responses of individuals, groups and local governments to floods. (You may need to do some further research here.)
- 6** Provide recommendations for Pakistan so it can plan for and attempt to reduce the impact of similar floods in the future. Suggest a range of planning and management strategies Pakistan might use.
- 7** Predict the impact of climate change on the occurrence, frequency and extent of flooding around the world.

You may like to illustrate your report with diagrams and pictures. You should also include a bibliography.



## Chapter summary

- Hazards associated with water include a wide range of phenomena, from floods and drought to severe storms, tropical cyclones and tsunamis. Unlike other hazards such as earthquakes that are regionally specific, water-associated hazards affect communities all over the world.
- Globally, floods are the most destructive frequently occurring natural event, but they are also a part of natural environmental cycles, which are needed to ensure the health of ecosystems.
- Communities around the world have learned to live with water-associated hazards, but as populations are increasing around the world in areas such as flood plains and in coastal areas, the risk that these hazards pose to communities is increasing.
- Climate change is predicted to increase the frequency and magnitude of water-associated hazards such as floods, droughts, severe storms and tropical cyclones.
- In Australia, management strategies for future flood disasters (to limit loss of life and property) include partnerships between the Bureau of Meteorology and emergency service providers.

## End-of-chapter questions

### Short answer

- 1 Discuss the effect El Niño and La Niña events have on Australian weather patterns and how these affect Australian communities.
- 2 Identify what factors other than rainfall lead to flooding.
- 3 Describe how the shape of the land affects the behaviour of floodwater.

### Extended response

Source 16.13 shows how an emergency management system works during a potential flood crisis.

Who do you think should be involved at each step and what sort of actions might take place?

Create a disaster emergency plan for the town or city that you are located in and present it as a brochure. If you live in a community that does not suffer the threat of flooding, describe another threat such as bushfire or tropical cyclone.

## Topic 4

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# Inter-connections

**Source 17.1** A commercial airliner taking off. Travel is one common way that people and places are connected.



# 17

## Personal connections

**Source 17.2** Sydney is one of the locations most visited by domestic tourists in Australia.

### Before you start

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#### Main focus

The future of different places is influenced and affected by people's travel, recreational, cultural and/or leisure activities or connections.

#### Why it's relevant to us

People's personal choices influence their personal identity and connection with a place, as well as their perceptions of other places.

#### Inquiry questions

- What attracts people to places?
- In what ways is a place influenced by people's personal choices?
- What are the patterns and trends in people's travel, recreational, cultural and/or leisure activities?
- What impact do people's travel, recreational, cultural and/or leisure activities have on different places?

#### Key terms

- culture
- migration
- personal mobility
- rural
- urban
- urbanisation

### Let's begin

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Australia's history of settlement reflects a process of migration and travel. This has changed the landscape of the continent, adding towns and cities, farms and mines, factories and shops, and roads, railways and airports. The flow of people from other places continues, with arrivals from all parts of the world. A multitude of reasons help explain these movements. People travel to places for personal choices including recreational, cultural, and leisure activities.

## 17.1 Patterns and trends in people's activities

People's recreational, cultural and leisure activities can change over time for many different reasons. One of the reasons their activities might change is if they move places.

**rural** areas with a low population count that are located far away from the nearest urban centre

**urban** areas with a high population and easy access to services

### Travel

People move from **rural** to **urban** areas for education and jobs, travel to remote mining

settlements for employment, cluster around the coasts for easy access to other places, and seek warmer climates during winter – all within Australia. Movement can be short term (such as holidays), medium to long term or permanent. Access to transport means Australian citizens can choose, at a relatively low cost, a variety of holiday movements – nearby, or further away in Australia or, increasingly, overseas.



**Source 17.3** People holidaying at a beach in Kent, England

### Migration

**migration** movement from one location to another

**Migration** is another reason why people's recreational, cultural and leisure activities can change. According to the ABS 2011 census, 27% of the resident population were born overseas (6.0 million people). This was an increase from 10 years

earlier – the figure then was 23.1% (4.5 million people). People born in the United Kingdom are the largest group of overseas-born residents, accounting for 5.3% of Australia's total population at 30 June 2011. This is followed by people born in New Zealand (2.5%), China (1.8%), India (1.5%) and Vietnam and Italy (0.9% each).

## Tourism

According to the United Nations World Tourism Organization, tourism is the fastest growing economic activity in the world. The amount of revenue raised by tourism equals oil

exports and food products (UNWTO, 2014). It is fast becoming the main income source for many developing countries.



**Source 17.4** Europe is a popular tourist destination.

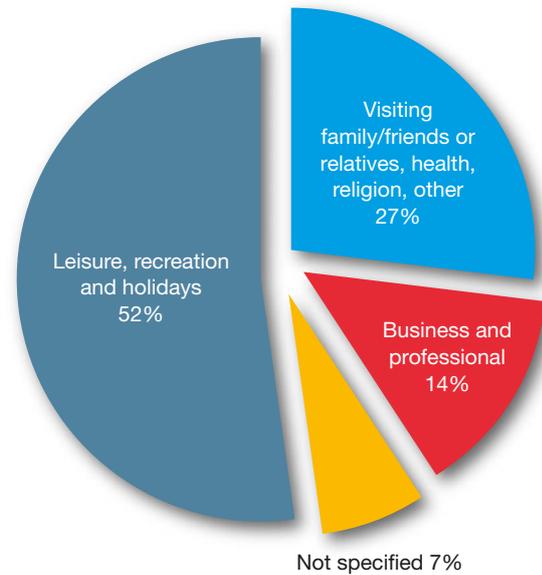


**Source 17.5** Events and festivals, such as the International Festival of Street Arts, Belgium, help attract tourists.

## Tourism around the world

According to the UNWTO, there are over 1 billion people in the world travelling as tourists to other countries. The number of tourists is forecasted by UNWTO to increase by at least 3% every year. In 2013, global tourism generated US\$1.4 trillion in export earnings.

Of the 1 billion-plus people travelling, 52% of them are travelling as part of recreation (holiday) or leisure, 27% travel to visit family or for cultural purposes, and 14% travel for business. The remaining 7% is not specified by UNWTO.



**Source 17.6** Pie graph showing purpose of tourism around the world (UNWTO, 2014)

## Geographical fact

According to the UNWTO, the top 10 tourist destinations in the world are: France, the United States, Spain, China, Italy, Turkey, Germany, United Kingdom, Russia and Thailand.

The most widely travelled are Chinese people who reportedly spent US\$129 billion in 2013 on international tourism.

**Source 17.7** France is the most popular tourist destination in the world, with millions of people visiting sites like the Eiffel Tower each year. Pictured is the medieval island fortification Mont Saint-Michel in Normandy.



## Tourism in Australia

Like the rest of the world, tourism is an important industry in Australia, contributing \$34 billion to our economy annually. There are two types of tourism: international and domestic. Internationally, more and more Australians are travelling, with over 7 million Australians travelling overseas every year.

Domestic travel within Australia is an important part of tourism. It accounts for three-quarters of the tourism spend in Australia annually: \$25 billion a year. According to

Tourism Australia, the domestic overnight leisure market is a key segment of the Australian tourism industry. The core target is families, with parents who are 30–54 years old: this represents 35% of Australia's population.

The locations most visited by domestic tourists are the major capital cities – Sydney, Melbourne and Brisbane. Outside these, the most popular locations are the Gold Coast, the Whitsundays, tropical North Queensland, the Hunter Valley and the Blue Mountains.

**Source 17.8** The Gold Coast



**Source 17.9** The Whitsundays



**Source 17.10** The Daintree Rainforest in tropical North Queensland



TOPIC 4: INTERCONNECTIONS



**Source 17.11**  
The Hunter Valley

**Source 17.12** The Blue Mountains



In 2011–12 the most common state for domestic tourists to go to was New South Wales, which had 33% of all visitors from outside the state. This was followed by Queensland, with 25%, and Victoria, with 24%. These three states

dominated domestic tourism, with a total of 82% of all visitors. The main reasons domestic tourists gave for their travel during this period were going on a holiday (43%), visiting friends and relatives (34%) and business (19%).

## RESEARCH 17.1

Select a town or area and evaluate the impact of tourism on it. In a short report, refer to tourism's:

- economic impact
- environmental impact
- social/cultural impact.

## Leisure and culture

**culture** the customs, habits, beliefs, social organisation and ways of life that characterise different groups and communities

People's leisure and **cultural** activities can have an influence on places like cities. Cities have infrastructure and facilities that allow them to host certain large events that towns cannot

support. These events can bring economic, social and cultural benefits to the city. Many large cities in Australia host major events, from food and wine festivals to global events such as the 2000 Summer Olympic Games in Sydney. These events are important for cities because they bring people, goods, services

**Source 17.13** Travelling exhibitions featuring ancient artefacts such as those from Tutankhamen's tomb in Egypt attract tourists, stimulating the local economy.



and investment into the cities and their communities.

The benefits of hosting events has led the New South Wales and Victorian governments to set up organisations, such as Destination NSW, to attract major events into their cities and regional areas. This has seen many international sporting and cultural events come to New South Wales and Victoria. These have provided economic benefits for the

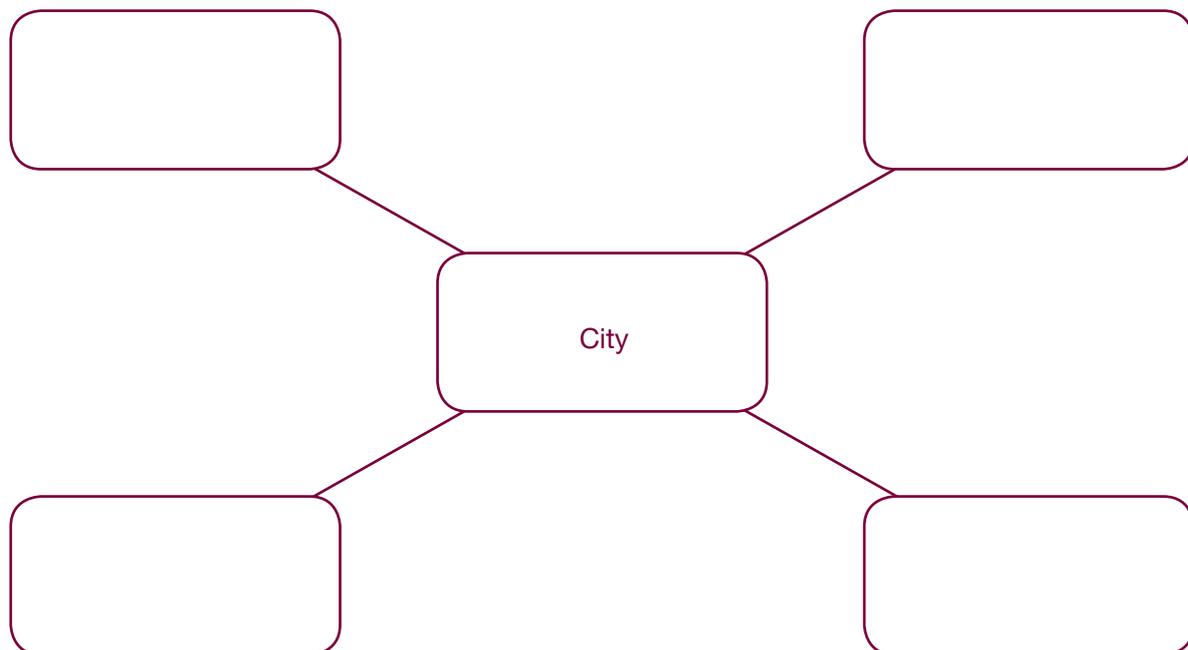
local economy via tourism and hospitality. For example, an exhibition of artefacts from the tomb of the ancient pharaoh of Egypt, Tutankhamen, was brought to Melbourne, and international football (soccer) team Manchester United played 2013 pre-season games in Sydney. These events provided national and global exposure that promoted both Melbourne and Sydney as major cities in Australia.

**Activity 17.1**

- 1 List the reasons you visit your capital city.
- 2 Discuss the benefits of attracting large numbers of people to metropolitan areas.
- 3 Identify disadvantages of having so many people in the one place.

**Note this down 17.1**

Copy the graphic organiser below and outline the known features of one Australian capital city, including celebrations, festivals and businesses that attract visitors.



## 17.2 Impact of people's travel on the future of places

**urbanisation** the process of economic and social change in which an increasing proportion of the population of a country or region live in urban areas

People's travel, recreational, cultural and/or leisure activities can impact the future of places. This can be seen with the impact of **urbanisation**.

Where people live in Australia is largely linked to settlement history. The major

cities along the east coast provide sea links for trade and the movement of people. Sydney, Melbourne and Brisbane alone account for more than 40% of Australia's total population; if we add two other state capitals – Adelaide and Perth – it totals more than 50%. With the addition of all other significant urban areas, the population that reside in cities is estimated to be around 90% of Australia's total population. Source 17.14, based on ABS figures, shows the percentage change in rural and urban growth since 1950, with projections to 2025.

Indicator	1950	1970	1990	2010	2025
Rural population	1 881 000	1 876 000	2 496 000	2 439 000	2 428 000
Urban population	6 297 000	10 853 000	15 601 000	19 829 000	22 813 000
% urban	77	85.3	85.4	89.0	90.4
Rural annual growth rate (over 5 years)	0.22%	0.84	-0.40	-0.50	-0.04
Urban annual growth rate (over 5 years)	2.98%	1.90	1.49	1.49	1.14
<b>Major cities</b>					
Adelaide	429 000	792 000	1 046 000	1 181 000	1 535 000
Brisbane	442 000	798 000	1 329 000	1 993 000	2 627 000
Melbourne	1 332 000	2 334 000	3 117 000	3 896 000	4 962 000
Perth	311 000	611 000	1 160 000	1 955 000	2 121 000
Sydney	1 690 000	2 667 000	3 632 000	5 254 000	5 646 000

**Source 17.14** Rural and urban population figures including major cities

The figures indicate the gradual decline in rural population and the increasing percentage of people living in the major capital cities. Factors that help explain these outcomes include: declining rural employment and consolidation of small farms into large ones; redistribution of infrastructure including services and employment; migration from rural areas to cities; and expansion of the major cities by the addition of job-seekers and new arrivals.

The ABS explains how migration has added to this growth pattern:

'Since the end of World War II, over 6 million new settlers have arrived in Australia. Over the same period, from 1947 to 2001, the proportion of the population born overseas increased from 10% to 23%. Most people born overseas have shown a preference for



**Source 17.15** It is estimated that there will be 5 646 000 people living in Sydney by 2025.

city living – 81% or 3.3 million people lived in capital cities in 2001, making them more highly urbanised than the Australian-born population. This is not a new phenomenon – it has been evident since at least the 1970s. Some of the main factors that affect where migrants decide to live are the location of family members or people of the same ethnic background, the point of entry into the country, and the economic attractiveness of the destination in terms of employment opportunities.’

One of the consequences of this trend is urban sprawl. Accommodating the new arrivals is difficult, and affects both rental and home ownership costs and options. Many new settlers – and others – have to move to the city fringe, where housing is more affordable.

**personal mobility** one's ability to move around

This requires **personal mobility** to get to work and access services – often through car ownership – because of poor public transport locally.



**Source 17.16** High levels of car ownership can be due to poor public transport.

There are positive effects of increased population on urban areas: more people create more economic activity and potentially economic growth, leading to developments in housing, education and services. Negative consequences often affect those services in expanding suburbs; also, communities can suffer through having limited access to support services and to parks and green spaces.





## Activity 17.2

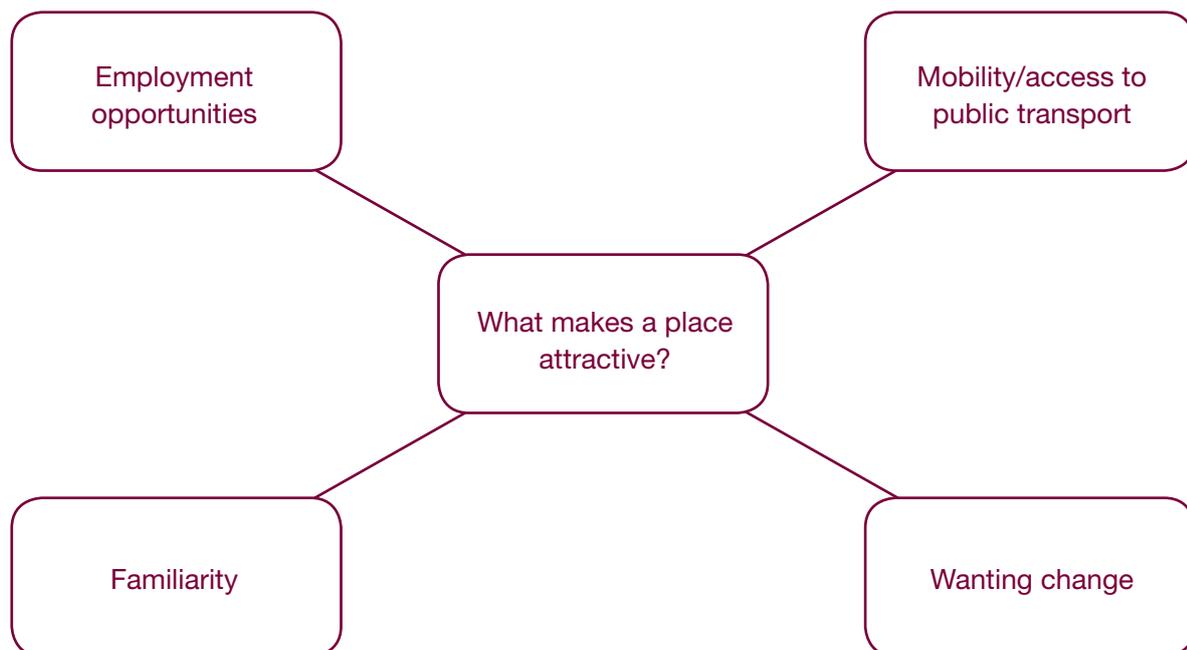
Look around your area and identify signs of negative and/or positive growth.

- 1 Discuss the effects of this on your community.
- 2 Projecting to 2030, what is your vision for your area?



## Note this down 17.2

Copy the graphic organiser below and explore the reasons why people are attracted to a particular place.



## 17.3 Impacts of tourism on Phillip Island and Monkey Mia

There are many tourist destinations in Australia that appeal to both domestic and international tourists. We will investigate the main activities that occur at Phillip Island in Victoria and Monkey Mia in Western Australia, how people

live there, what impact tourism has and how the sustainability of each place can be ensured for the future.

### Phillip Island, Victoria

Phillip Island is 140 km south-southeast of Melbourne. The island is 26 km long and 9 km wide, and it has a population of 9406 people. There are two major tourist attractions, and



**Source 17.17** Phillip Island, Victoria

they bring 3.5 million visitors to the island each year. The first is the area's natural and wildlife features, such as the Little Penguin colony, Seal Rocks and the Koala Conservation Centre.

One unique and very popular wildlife feature of Phillip Island is the Penguin Parade. The little penguins of the colony (formerly known as 'fairy penguins') go out to sea each day to catch food (mostly pilchards and other small fish) for themselves and their young. Just on dusk every evening they return and make their way up the beach to their burrows in the sand dunes. Tourists can sit and watch the

penguins come up onto the beach and into their burrows; Phillip Island is one of the few places in the world where you can watch such an event.

The second major tourist event is the island's program of motor sport. The Phillip Island Grand Prix Circuit is home to major motor racing events each year, including events for the MotoGP series (motorcycles), the World Superbike Championship and the V8 Supercar Series. The events attract thousands of people; for example, the 2012 MotoGP attracted a 3-day record of 122 465 people.



**Source 17.18** One of the little penguins on Phillip Island



**Source 17.19** The visitor centre on Phillip Island

With both the motor sports and wildlife features attracting such a large number of visitors, Phillip Island faces major issues in protecting the environment from the tourists. A special visitor centre had to be built to cater for the large numbers of people going to the Penguin Parade. Governments and local authorities have to ensure that environment and wildlife tourism remains ecologically sustainable and is not exploited for purely economic reasons.



## Monkey Mia, Western Australia

Monkey Mia is located in the Shark Bay World Heritage Area, around 800 km north of Perth. It is famous for its bottlenose dolphins; for the past 40 years, the dolphins have come in to the shallow waters and allowed humans to feed fish to them. The amazing thing about this is that it has been a completely natural behaviour; humans have not trained these bottlenose dolphins to come in – the dolphins do so by themselves.

Around 100 000 tourists go to Monkey Mia each year to see and feed the dolphins. The large number of tourists has created

some major concerns about the management and protection of the dolphins and the environment of the area. The Western Australia Department of Conservation and Environment manages the dolphin experience by:

- regulating dolphin feeding
- maintaining a dolphin interaction area
- careful recruitment of new dolphins into the interaction program
- regulation of boat encounters.

The government is hoping to protect the dolphins and maintain an ecologically sustainable tourism industry here, ensuring that Monkey Mia can be enjoyed by future generations.

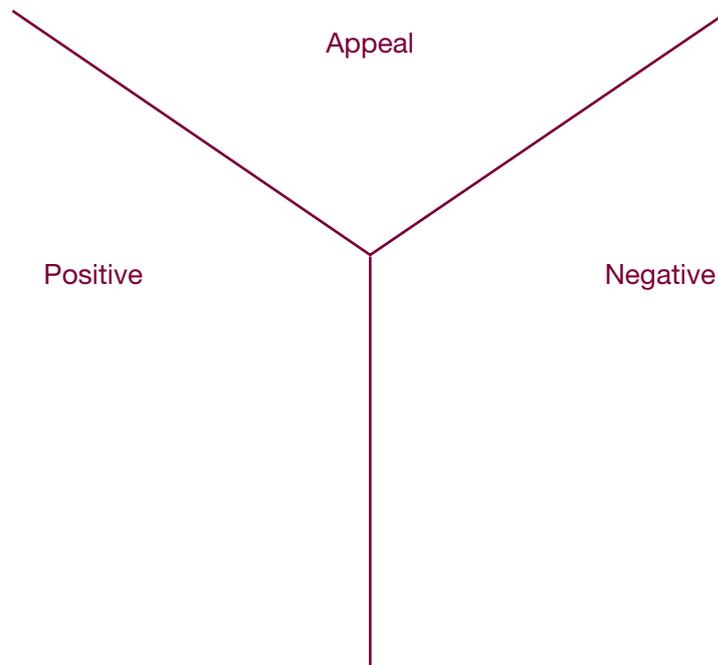


**Source 17.20** Dolphin feeding time attracts many tourists to Monkey Mia, Western Australia.



## Note this down 17.3

Copy the graphic organiser and look at the positives, negatives and appeal of one of the Australian tourist destinations discussed in this chapter.



### RESEARCH 17.2 //

- 1** Use the internet to gather information about another popular tourist destination in New South Wales.
- 2** Use the information you have gathered to prepare a report on the following:
  - the main tourist activities in the place
  - the challenges arising from the tourist activities
  - the impact of tourism on the quality of the environment and the people living there
  - one way the sustainability of the tourist destination can be improved for future use.

## Chapter summary

- People's recreational, cultural and leisure activities can change over time for many different reasons. One of the reasons their activities might change is if they move places.
- Where people live in Australia is largely linked to settlement history. The major cities along the east coast provide sea links for trade and the movement of people.
- According to the United Nations World Tourism Organization (UNWTO), there are over 1 billion people in the world travelling as tourists to other countries. The number of tourists is forecasted by UNWTO to increase by at least 3% every year.
- Some of the most popular tourist destinations in Australia are marine and coastal sites, including Phillip Island in Victoria and Monkey Mia in Western Australia. Tourism can encroach on the natural state of these areas and place demands on the resources. So sustainable management is a must for the future of these places.

## End-of-chapter questions

### Short answer

- 1 Outline how human activity can change a place. Use examples.
- 2 Assess the impact of migration and urban sprawl on places.
- 3 Explain how tourism can impact on the liveability of places.

### Extended response

Choose one place in Australia or in the world and evaluate the effects people's travel, recreational, cultural and/or leisure choices have on this place and the future implications for this place.



# Technology

**Source 18.1** Social media – connecting people all over the world

## Before you start

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### Main focus

Transportation and information and communication technologies (ICT) are used to connect people to services, information and people in other places.

### Why it's relevant to us

Rapid changes in transportation and ICT create both opportunities and challenges. Geographic inquiry should go beyond issues of access, to the effective use of these technologies and their potential benefits for people.

### Inquiry questions

- How do transport technologies connect people to places?
- How does ICT increase people's connections to services, information and people in other places?
- How has increasing global connectivity impacted on people and places?

## Key terms

- city
- information and communication technologies (ICT)
- internet
- metropolitan
- population
- service centres
- town
- world wide web

## Let's begin

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Transport and ICT that allow people to move and communicate across the world are changing our perception of space. Understanding the nature and global patterns of ICT provides a basis from which to analyse its impacts on development in middle- and low-income countries. The increasing use of mobile technologies and social media is creating new relationships – at local, regional and international scales.

## 18.1 How transport technologies connect people to places

Where we live and the types of transport available to us have a major influence on how we live and connect with other places. People who live in a **metropolitan** capital **city** have different transport choices and access to more services, such as specialist doctors and universities, than people living in remote areas of the world.

**metropolitan** pertaining to a large city, its surrounding suburbs and other neighbouring communities

**city** a larger town; in Australia this is generally defined as being a metropolitan area

### History of transport technologies

Advances in transport technologies have helped to bring humanity together over the centuries. There are several modes of transport, including land (rail or road), aviation and water-going ships. Over the years transport technologies have developed from a reliance on animal-powered forms like the horse-drawn cart to human-powered (bicycles) or machine-powered forms of transport like most forms used today. Generally speaking, technological advancements have made the various forms of transport operate faster and more efficiently in moving people from one place to another.



**Source 18.2** Then and now: a steam-powered train developed in the 19th century and a modern electric train today



Some notable developments in the history of transport technology over the years include:

- 8200–7600 BC – first-known canoe constructed
- 4500–3300 BC – earliest-recorded vehicles using wheels
- 3000 BC – Ancient Egyptians construct ships
- 1044 – the compass invented in China
- Late 16th century – ocean-going great sailing ships invented
- 1622 – first public horse-drawn bus service
- 1783 – hot air balloons
- 1801 – steam-powered train invented
- 1807 – first steam-boat
- 1816 – the bicycle
- 1899 – Zeppelin airship
- 1903 – Orville and Wright create the first motor-driven airplane
- 1939 – first jet-powered engine plane takes flight
- 1969 – first flight of the commercial Boeing 747
- 1976 – Concorde makes the world's first commercial passenger-carrying supersonic flight
- 2002 – the Segway is invented

### Activity 18.1

- 1 Identify other transport types that were not mentioned above. Discuss with a partner and try to list five other forms of transport.
- 2 Select five of the transport technologies listed in this book. For each mode of transport, explain how it would help connect people to places.
- 3 Identify which transport type you think has been the most important in connecting people to services and places. Explain your reasons in a paragraph.

## Transport in Australia

Transport technologies are used in Australia today for so many important purposes, including for work, commerce, travel and leisure activities. Transport, in particular public transport networks, cars and bicycles, help to connect people to places, and are an integral part of modern life.

We will next investigate connections between people and places in Australia, particularly the connections between remote

**town** a built-up area somewhere between a city and a village in size

areas, **towns** and cities. We briefly looked at the concept of remoteness back in Chapter 7, but it is worth revisiting in

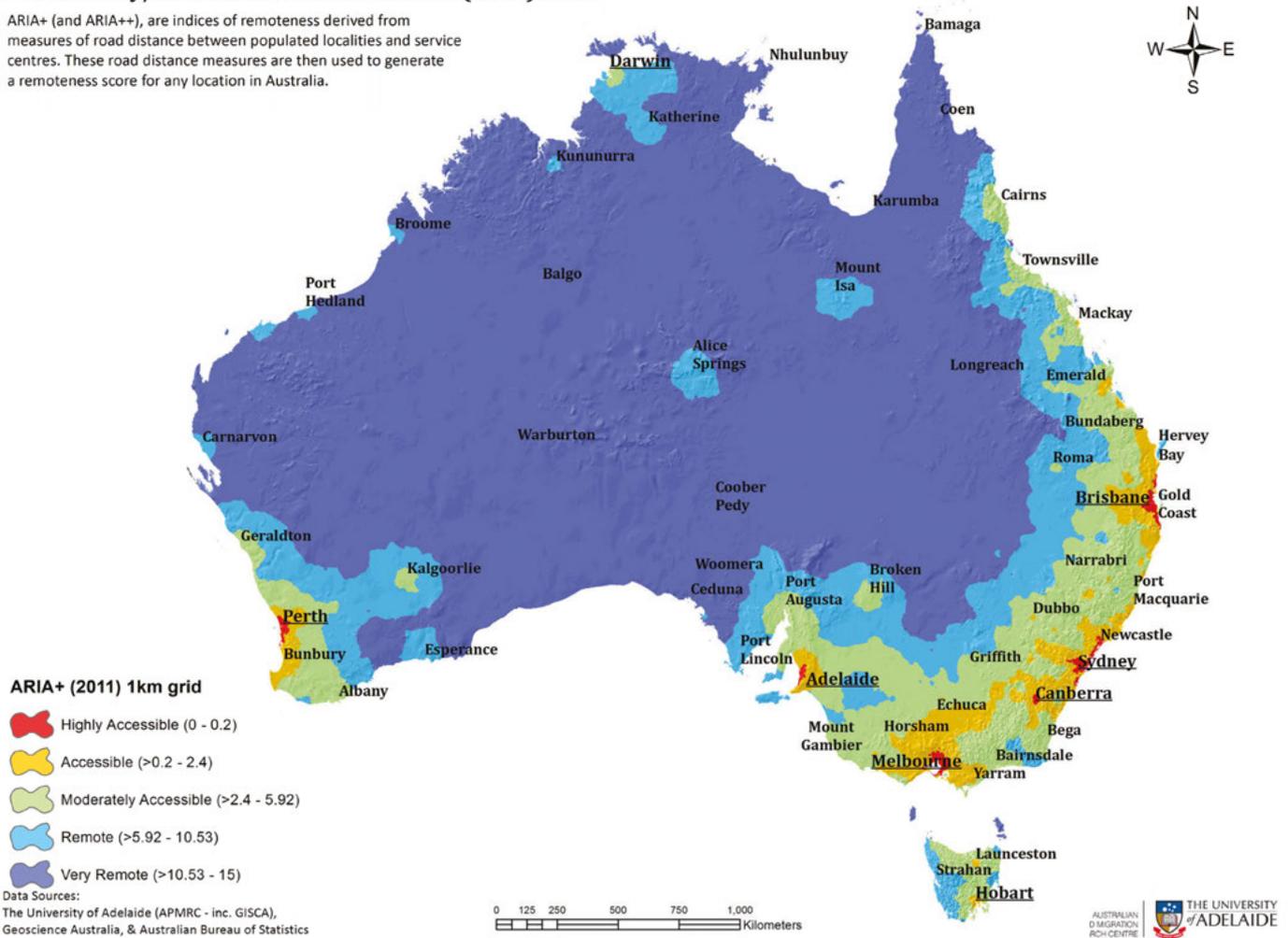
terms of how people are connected to remote places in Australia via transport technologies.

The Australian Bureau of Statistics (ABS), with the Adelaide University Australian Population and Migration Research Centre, has developed the Accessibility and Remoteness Index Australia (ARIA) map to show the levels of accessibility to and remoteness from **service centres** in Australia. Access and remoteness are determined by the physical road distance from the settlement to the nearest service centre – there are five service centre categories,

**service centres** settlements (villages, towns and cities) that have shops and services such as education, health and banking. Larger service centres (cities) have a greater range of services than smaller service centres.

### Accessibility/Remoteness Index Australia (ARIA) 2011

ARIA+ (and ARIA++), are indices of remoteness derived from measures of road distance between populated localities and service centres. These road distance measures are then used to generate a remoteness score for any location in Australia.



Source 18.3 Accessibility and Remoteness Index Australia (ARIA) map

**population density**  
the number of people in an area of land usually expressed as a number per square kilometre

based on **population density**. The index ranges from 0 (high accessibility to largest service centre) to 15 (high remoteness from small and large service centres): an inner regional zone

has larger service centres, of between 48000 and 249999 people, and an outer regional zone has service centres of between 18000 and 47999 people.

As members of our community we have a right and responsibility to be involved in planning for the future of our community and its connection with other places.

Area	People (millions)
Major cities	15.1
Inner regional	4.3
Outer regional	2.1
Remote	0.324
Very remote	0.17

Source 18.4 The distribution of the Australian population according to ARIA



## Activity 18.2

- 1 Suggest why settlements such as Broome and Mt Isa are identified as remote rather than very remote, even though they are located in very remote regions of Australia.
- 2 Use the Accessibility Remoteness Index map, an atlas or your own experience to identify three places – a capital city, an outer regional settlement and a remote or very remote settlement – in Australia. Use your knowledge and research from the web and other sources (for example, you could contact a school) to complete the following table on transport choices and issues.

	Capital city	Outer region	Remote/very remote region
Transport choices			
Major transport and access to services issues			

- 3 Provide an argument to either support or reject the statement that ‘the internet has reduced the isolation of remoteness’. Hold a class discussion on this topic.

**Source 18.5** A city is characterised by the diverse range of products, services and employment opportunities it is able to offer. Bendigo in Victoria grew into a city during the gold rush due to the need for more services for the growing population.





**Source 18.6** Melbourne is the 2nd largest city in Australia.

## 18.2 How ICT increases people’s connections to other places

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**ICT** Information and communications technologies; tools that help people connect with each other, such as the internet or mobile phones

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Information and communications technologies (**ICT**) are the tools that help us connect with each other. At a local scale this may involve linking computers in a school or accessing the global community

using the **internet**. The internet and the **world wide web (www)** are not the same thing. The internet is all the networks of computers that are linked together; the world wide web is the linked pages that are accessed using the internet and web browsers. The internet combined with the world wide web enables file sharing, social networking, gaming, research, email, telephone and video calls, and more.

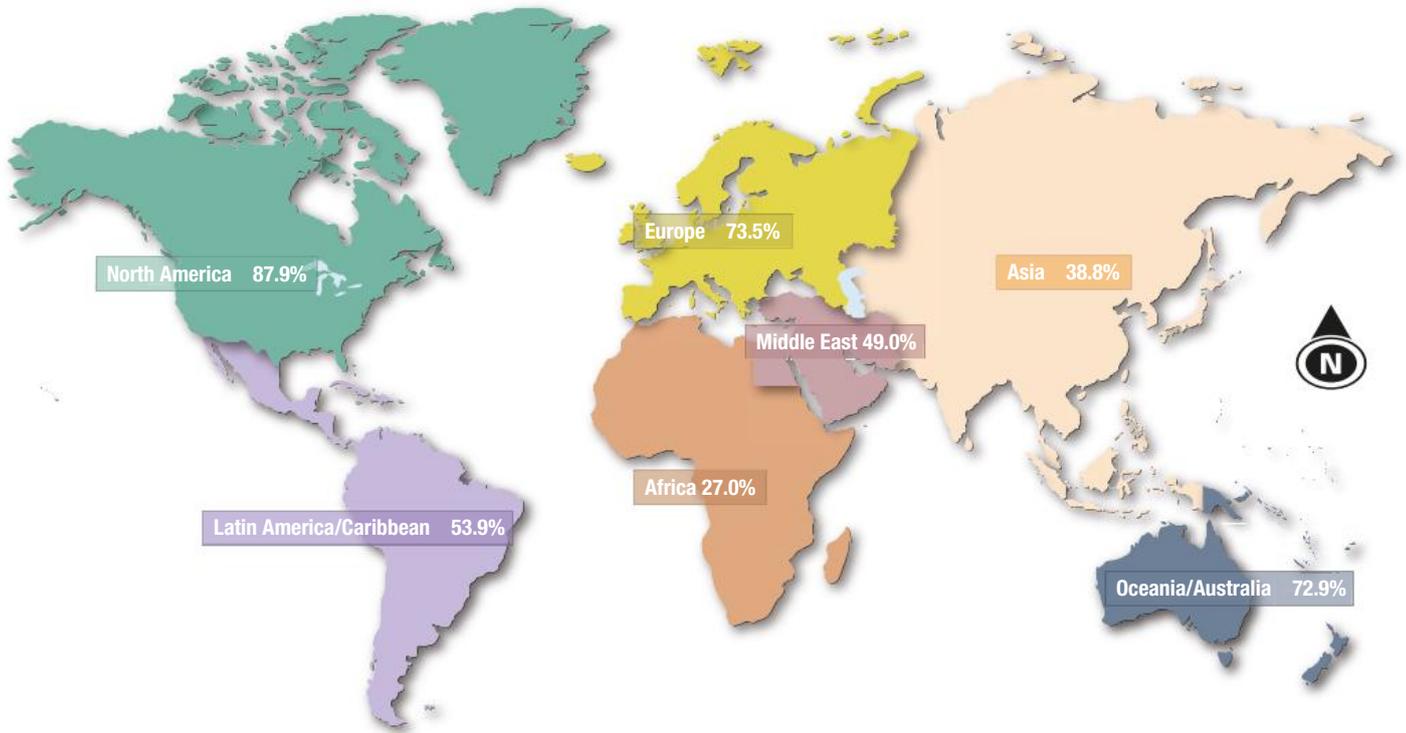
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**internet** a worldwide interconnected network of computers

**world wide web (www)** the sites and pages that are connected across the internet

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**Source 18.9** Distribution of internet penetration by world regions (30 October 2015)



### Activity 18.3

Refer to Source 18.8 for the following questions.

- 1 Name the region with the largest number of internet users and the region with the smallest.
- 2 Explain how the internet penetration figures are calculated.
- 3 Compare the number of internet users with the internet penetration figures.

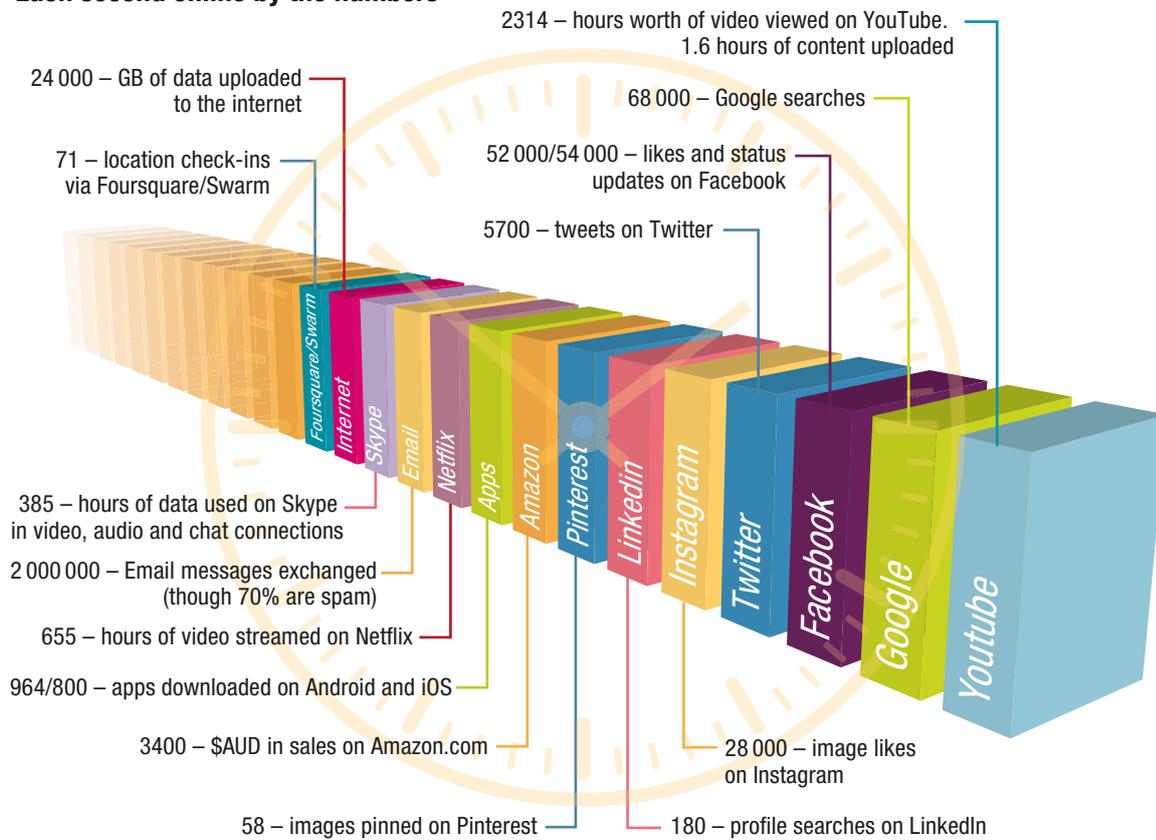
## Communication technologies

Communication involves the transfer of information using technologies or tools. In order to connect to the internet, infrastructure is needed – it may include cable, wireless, microwave or satellite technologies.

There are a number of ways that people can connect to other people and places using ICT. Two main methods of connecting people are via mobile phones and social media.



**Each second online by the numbers**



**And future growth is staggering**

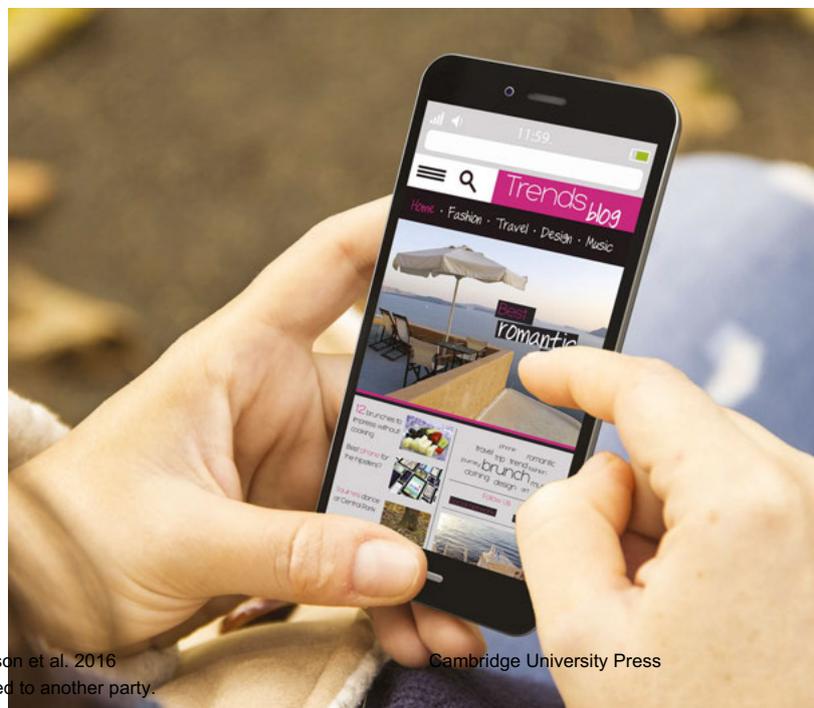
<p><b>Today</b>, the number of networked devices = </p> <p>2 x the global population</p>	<p><b>By 2040</b>, the number of networked devices = </p> <p>6 x the global population</p>	<p>In <b>2040</b>, it would take you <b>15 years</b> to view all video crossing IP networks each <b>second</b>.</p>
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**Source 18.10** The internet is host to a vast number of communications every second.

**Mobile phones**

In recent years the increasing use of mobile technology and social media has changed the way people use the internet, which has implications for low- and middle-income countries.

**Source 18.11** Mobile technology has changed how people connect with the world.



Vodafone and Oxfam International are examples of a business and a non-government organisation working collaboratively to reduce the impacts of rural poverty. Mobile phones can play a role in this by helping overcome infrastructure barriers. For example, mobile technologies can give isolated and poor farmers access to information and to services, such as micro-banking and insurance. One example is the Kenyan Farmers Helpline, known locally as Huduma Kwa Wakulima, which allows farmers to access assistance for immediate issues, such as weather information and pest control. M-Farm is another example: it allows farmers in Kenya to buy and sell their produce or obtain information about market prices via their mobile phones.

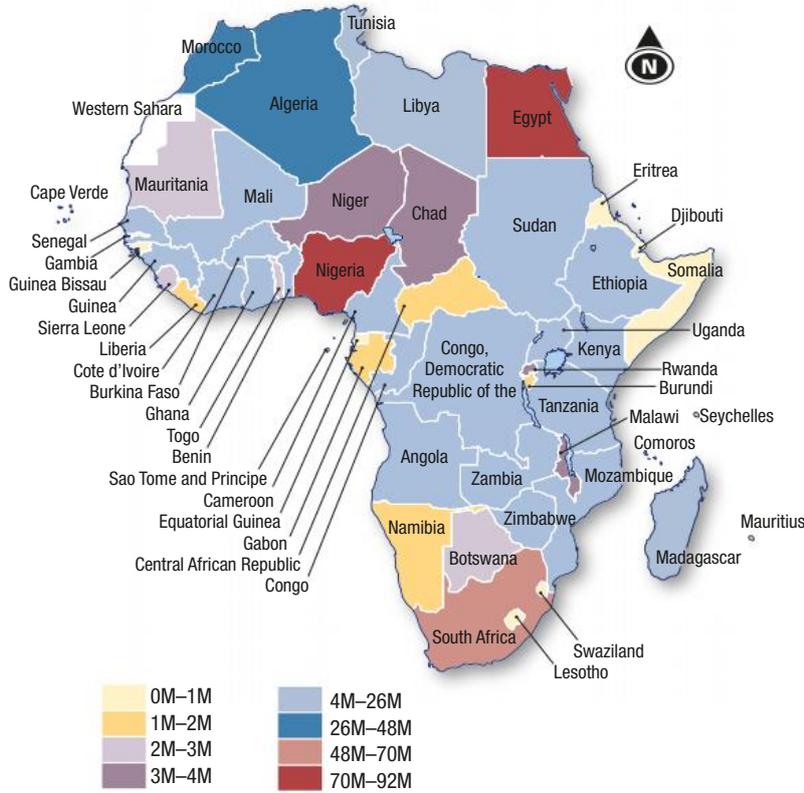
The introduction of solar-powered recharge devices has reduced the need to walk (sometimes long distances) to a power

source, but the rate of change in technology, compatibility issues and affordability are still problems. A recent report relating to mobile phone use and gender in low- and middle-income countries by the GSMA (Global System for Mobile Communications Association) revealed the following data in 2015:

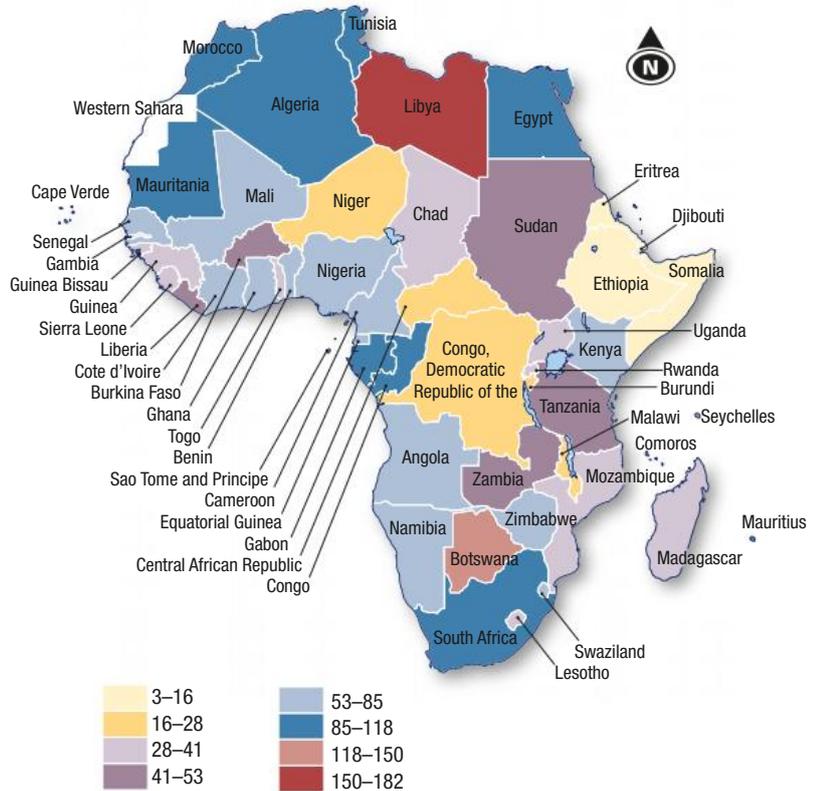
- Women are 14% less likely than men to own a mobile phone.
- Women in rural areas are 26% less likely to own a mobile phone than women in urban areas.
- There are estimates of US\$170 billion in future business opportunities in these countries in the next five years.
- To bridge the gender gap in mobile phone ownership in these countries, over 200 million women would require phones.
- 68% of women feel safer when they have a mobile phone.



**Source 18.12** In 2015 women were 14% less likely to own a mobile phone, with 68% of women reporting they felt safer with one.



Source 18.13 Mobile cellular telephones in Africa



Source 18.14 Estimated number of mobile phone lines per 100 people in Africa

Socio-cultural factors are significant when seeking to explore the gender gap in mobile phone use and ownership: the traditional role of women, rural living, education and income levels all make a contribution. Also, the introduction of any new technology needs to include respect for cultural differences. For example, an online database may be useful to record health details of people living in rural communities but inconsistencies with data may arise if a person's date of birth is given as 'the day of the torrential rains'.

#### *Mobile technology – issues for consideration*

The following are some of the challenges for the future:

- lack of computers and equipment
- difficulty of teaching skills needed to make effective use of equipment in terms of accessing and evaluating information
- lack of teachers with ICT skills
- breakdowns and maintenance of devices, software and network connections
- lack of electricity and other infrastructure

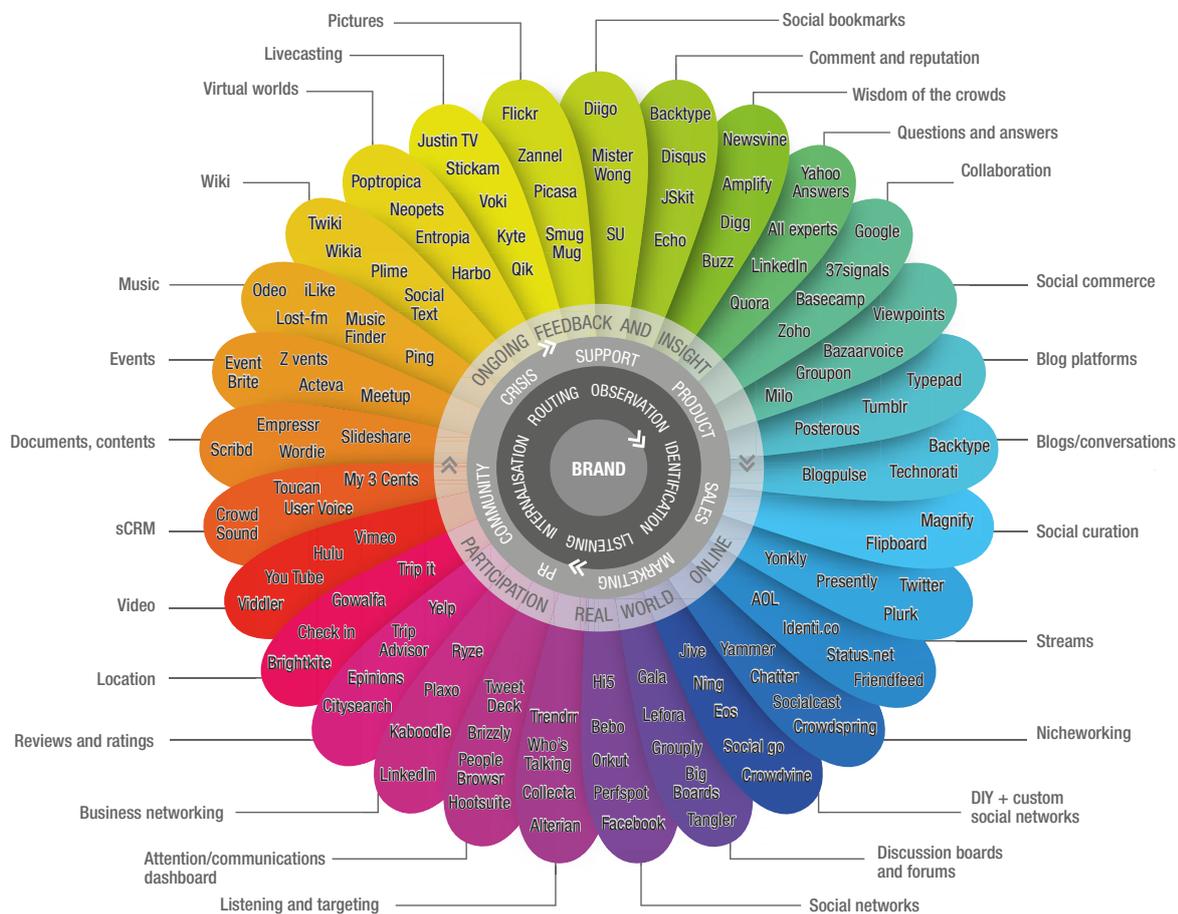


**Source 18.15** A classroom in Mombasa, Kenya. The lack of computers and equipment is a challenge for the future.

- cost of computers, mobile phones and internet connection
- theft of equipment
- cyberbullying and other forms of anti-social or criminal behaviour on the internet, such as viruses and scams
- inadequate personal skills to make effective use of equipment in terms of accessing and evaluating information.

### Social media

Social media use and sophistication have increased dramatically during the last 10 years. It is enabling new ways of map-making and understanding relationships across virtual space. While social networking originated as a means of maintaining relationships between already established friendship groups, the use of the likes of LinkedIn and Twitter are now also considered part of social networking.



Source 18.16 Visual representation of social media

In general, social media involves internet-based applications that allow users to create and share content that is in a variety of multimedia formats. The following are some examples of social media:

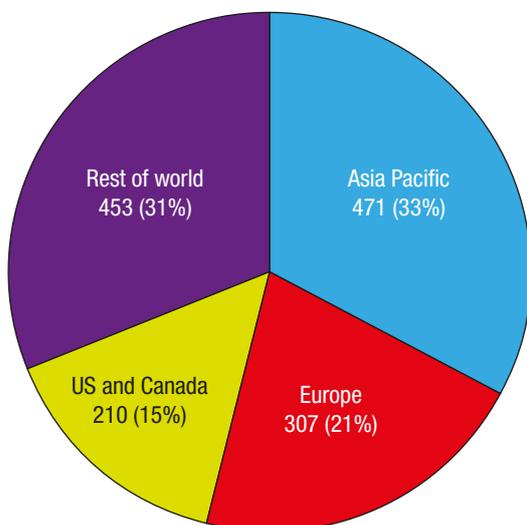
- 1 collaborative projects and content communities where users add or delete information in a continuous manner via wikis and/or that are interest specific – such as Instagram or Pinterest for images or YouTube for videos



**Source 18.17** There is a wide variety of social media apps.

- 2 blogs, which can range from personal travel diaries to a discussion forum about a product or company
- 3 social networking, which generally involves making connections between people
- 4 virtual gaming and social worlds using avatars, such as ‘Second Life’.

In 2012, the number of active Facebook users had exceeded 1 billion. Active users are those who have logged in to Facebook during the last 30 days. In 2015, Facebook had 1.44 billion monthly active users. Africa is the region with the fastest growth in users.



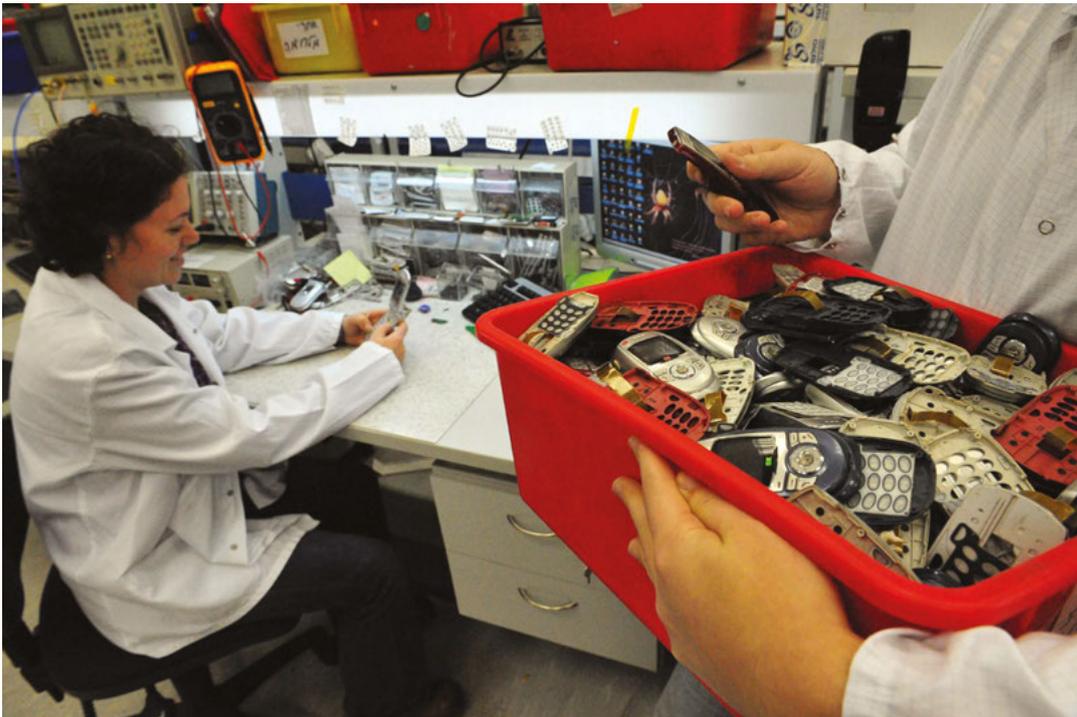
**Source 18.18** Facebook users by world regions in millions (April 2015)





## Activity 18.4

- 1 A child aged between 10 and 15 living in a rural village in northern Kenya has pains in the stomach, diarrhoea and vomiting. Identify the medical condition by only searching on the internet, then:
  - a explain your diagnosis (that is, of the health problem)
  - b list the disadvantages of using the internet to research a health issue without consulting a doctor.
- 2 Investigate the access, cost and use of mobile phones in the poorer regions of Nairobi, Kenya. Present a written report, using subheadings to organise your findings.
- 3 Take action: It is estimated that there are 22 million disused mobile phones in Australia alone. Organisations such as Mobile Muster provide opportunities for mobile phone recycling. Investigate the environmental costs of unrecycled electronics waste (e-waste). Create a poster for a campaign to recycle mobile phones in your school or local community. Include in the poster the environmental costs of e-waste in Australia.



**Source 18.19** A mobile phone recycling plant in Sderot, Israel

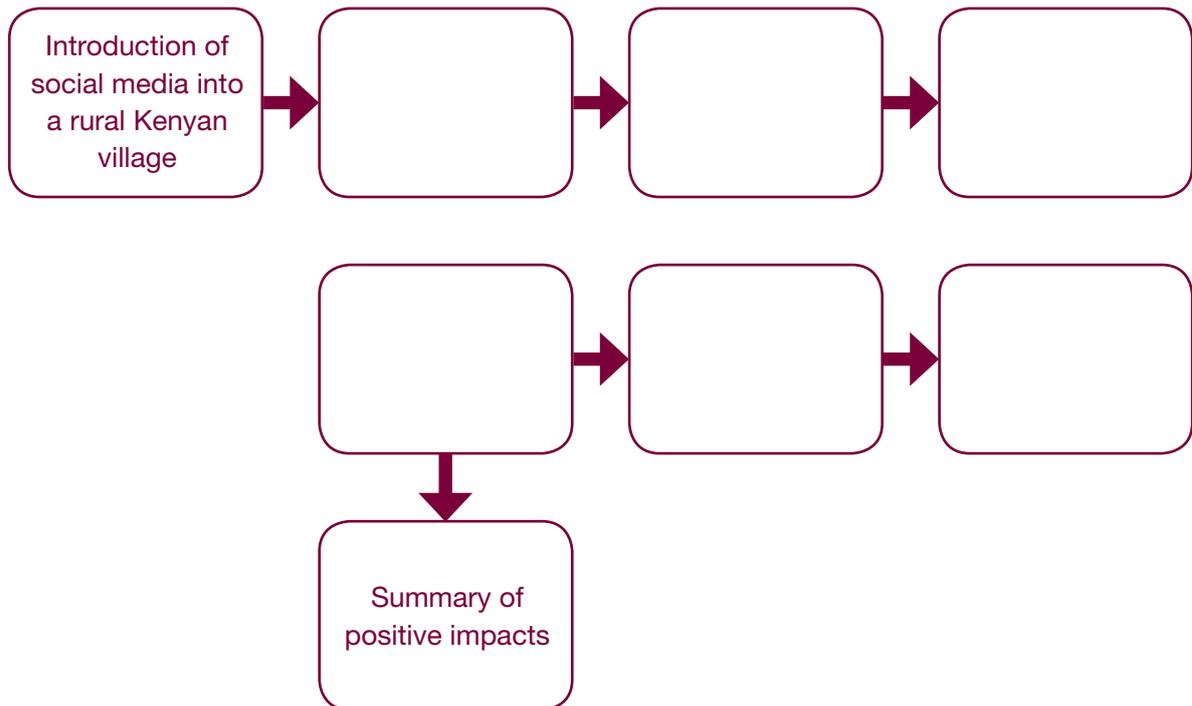


## Note this down 18.1

Copy the graphic organiser below and analyse the flow-on effects of using social media in a rural African village.

Repeat the procedure for the negative impacts.

### Positive impacts of social media



## 18.3 Impact of increasing global connectivity on people and places

There have been positive impacts of increasing global connectivity on people and places, such as in the case of the One Laptop Per Child (OLPC) project.

The general goal of the One Laptop Per Child project (OLPC) is for children in the least economically developed regions to gain empowerment using a laptop as a learning tool and as a means of connecting them with the wider world. The non-profit organisation based

in the United States began providing laptops to children in 2007. The green and white XO laptops are generally sold to governments and then allocated within the country by the Ministry of Education.

The XO laptops use a wireless broadband connection. They can be used with electricity or other renewable energy options such as solar, wind, hydro or even 'human power'. According to the Project Coordinator, Nkubito Bakuramutsa, the 2012 shipment cost about US\$200 for each laptop: the aim was to allocate 200 000 by the end of the year to upper primary school children. Given that

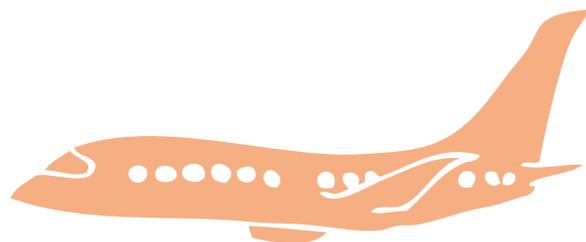


**Source 18.20** The One Laptop Per Child program in effect in Uruguay – note the XO laptops used by students.

the laptops were designed for children, the processing speed is slower, but estimates suggest that they are about five times more energy efficient than conventional laptops. They are also tough, so they can cope with student use. The key advantage of the laptop is its mobility. Students can take them home and therefore involve the family in shared learning. The philosophy of the project is that the computer should be regarded as a tool, like a pencil or paper. It is also important that students take ownership of – and care for – the technology.

Over 1500 teachers have been trained, which is another benefit in terms of the transfer of knowledge within these

predominantly rural communities. The President of Rwanda introduced the project in 2008 to build the capacity of young learners and promote the country's future development as a knowledge-based rather than a rural-based economy.





**Source 18.21** Children in economically underdeveloped regions can gain empowerment with access to technologies as a learning tool and as a connection to the wider world.



### Activity 18.5

- 1 Discuss why the laptops need to be tough.
- 2 Contrast a laptop with a mobile phone in terms of increasing learning opportunities for children in rural communities in Africa.
- 3 Suggest other benefits of the XO laptops for the students at school and at home.

## Chapter summary

- Where we live and the types of transport available to us have a major influence on how we live and connect with other places.
- People who live in a metropolitan capital city have different transport choices and access compared to people living in remote areas of the world.
- Technological advancements have made the various forms of transport operate faster and more efficiently in moving people from one place to another.
- ICT is rapidly changing, with increasingly merging and wireless tools that enable easier connections to be made between people.
- The distribution of ICT around the world, as measured by internet-related use, is uneven.
- Internet-enabled mobile phones and social media are changing the use of the internet.
- Generally, people have greater access to ICT, but access is not universal: it is more limited in rural areas, for example. The poorest sectors of society remain excluded, and there is a possibility that the 'digital divide' may widen, increasing the gap in living standards between these people and those who are better off.
- ICT has the potential to assist development, as is evident in the many successful (and generally small-scale) initiatives of government, non-government and corporate organisations, but barriers remain in terms of cost, pace of change, infrastructure and research data.

## End-of-chapter questions

### Short answer

- 1 Marshall McLuhan (1911–80) was a Canadian philosopher with an interest in media and communications who coined the phrase 'global village'. How could the increasing use of ICT create a 'global village'? (Hint: use the concepts of distance and movement in your answer.) Create a cartoon strip to illustrate your explanation.
- 2 Assess the impact of mobile phones in the development of low- and middle-income countries.
- 3 How could social media be used to enhance development in rural Africa?

### Extended response

You are a Minister for Information, Communications and Technology in a low/middle-income country. You need to provide your Prime Minister with a report about the extent and impact of access to ICT within your country.

In your report you should refer to:

- one low/middle-income country
- current uses of ICT
- positive outcomes of using ICT
- negative outcomes of using ICT
- future development opportunities due to ICT.



# 19

## Trade

**Source 19.1** Buddhist temple in the mountains of China. China is one of Australia's major trade partners.

### Before you start

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#### Main focus

What we consume and where it is produced connect places around the world.

#### Why it's relevant to us

Over the last 20 years there have been sizeable shifts in patterns of production and consumption. As technology becomes more advanced, there have been changes in what we buy and where it is produced. Manufacturing is shifting to China and other countries, while industry in developed countries is changing.

#### Inquiry questions

- What are goods and services?
- How have traditional centres of production changed?
- How is technology shifting patterns of production?
- How does consumerism link places around the world?

### Key terms

- consumer
- goods and services
- imports and exports
- industrialisation
- manufacturing
- outsourcing
- production
- redevelopment
- Special Economic Zone
- trade

### Let's begin

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As economic connections between countries become ever more important, they inevitably shape the geography of countries. These economic connections are ever more complex and have influenced practically every area of our country. This has happened not just in Australia but all around the world. Places and people all over the world are interconnected through the trade of goods and services.

## 19.1 Trade connections in Australia

**trade** the buying and selling of goods and services

Australia is connected by **trade** on local and state levels.

### Local farmers markets

There is a growing trend towards buying locally grown or sourced food in Australia. People are becoming more and more concerned about where their food comes from and how their consumption affects the environment and the economy.

Farmers markets, such as Carriageworks Farmers Market (previously known as Eveleigh Farmers Market) in NSW or the Collingwood Children's Farm Farmers' Markets in Victoria, create a link between rural and urban areas and communities.



**Source 19.2** Locally grown produce is becoming a more popular option for consumers in Australia.

**Source 19.3** Queen Victoria Market in Melbourne is the largest open market in the Southern Hemisphere.



Farmers markets represent 7% of all fresh food sales. Between 2004 and 2011, the number of markets in Australia more than doubled; there has been a significant increase in stallholders and customers.

At the markets, farmers sell the produce they grow or raise directly to the public, cutting out the 'middle man' and engaging directly with the consumer. This means higher profits for farmers. By shopping at these markets, people support Australian farmers, suppliers and the industry, strengthening the economy and providing local jobs.

## Geographical fact

The term 'food miles' refers to how far a food item has been transported from producer to consumer. According to a CERES report in 2008, the average shopping basket containing 29 food items travelled over 70 000 km – that's almost twice the distance around the Earth.



**Source 19.4** Farmers selling directly to consumers means more profit for the farmer, which stays in the local economy.

## Interstate business

Australian states and territories are connected by trade that requires freight by road, air or sea. Historically, many companies requiring the use of rail or ship transportation have located their factories close to railways and ports to make the transport of goods easier.

Domestic trade (trade within Australia) helps grow the economy as well as improving the standard of living and employment rate.



**Source 19.5** The green and gold Australian Made, Australian Grown kangaroo logo is a trademark that certifies a product is wholly Australian.

Australia trades domestically in a wide range of products including water, aluminium and iron ore, coal, fertiliser, livestock, grains, produce and other agricultural or raw material products. Road freight carrying these materials connects places like Sydney and Melbourne via the Hume

Highway, Sydney and Brisbane via the Pacific Highway, and Melbourne and Brisbane via the Newell Highway. According to the Department of Infrastructure and Regional Development's 2014 report, most rail freight originates from Victoria, Western Australia and New South Wales.



**Source 19.6** Freight connects states and territories across Australia.

## 19.2 Examining a country's trade links with other countries

Places and people can be connected by trading goods and services across all scales. A good example of this is Australia's trade with countries around the world.

Australia's geography has been shaped by the connections and relationships built with other countries we import from and export to. Some examples of how these relationships are shaping places in Australia are shown in Source 19.7.



Source 19.7 The influence of economic relationships

- **Mining:** Australian and foreign-owned mines have attracted huge amounts of investment in regional areas. Almost \$190 billion worth of mined resources is sent overseas each year.
- **Education:** Foreign students are vital to the economy of Australia, with many coming from India and China to study. Almost 100 000 international students live in Melbourne, adding cultural diversity and economic value to the city.
- **Tourism and property development:** The ability to invest and develop property overseas has also shaped places. Much of the property on the Gold Coast has been developed as a result of finance from Japan and other nations.
- **International business:** Many companies have offices or regional headquarters in Australian cities. Sydney's CBD is home to

many of the world's biggest companies' Asia-Pacific headquarters, bringing in money and workers from overseas.

Countries including Australia have a variety of products they export and import:

- *primary goods:* products that are extracted or grown in the ground or water – for example, wheat, iron ore, fish
- *manufactured goods:* products that are made or refined from primary goods – for example, furniture, petrol, televisions
- *services:* services or activities purchased by people from another country – for example, overseas students, tourism.

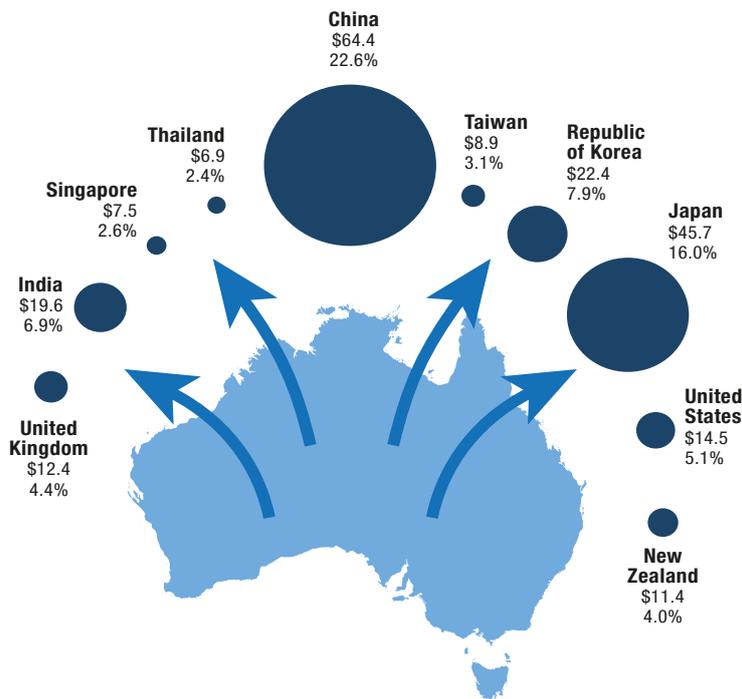
While most exports are sent overseas, services such as education and tourism that occur in Australia, but are purchased by people from other countries, are still considered exports.

## Geographical fact

Over 60% of those employed in Australia work in service industries.

Export	Value (billions)	Import	Value
Iron	\$69.4	Personal travel services (excluding education)	\$24.7
Coal	\$39.8	Crude petroleum	\$20.2
Education-related travel services	\$15.0	Passenger motor vehicles	\$18.3
Natural gas	\$14.6	Refined petroleum	\$18.2
Gold	\$13.8	Freight transport services	\$9.3
Personal travel services (excluding education)	\$13.1	Telecom equipment and parts	\$9.1
Petroleum	\$9.0	Medicaments (including veterinary)	\$7.8
Wheat	\$6.1	Computers	\$6.9
Aluminium	\$5.9	Passenger transport services	\$6.8
Beef	\$5.7	Goods vehicles	\$6.4

**Source 19.8** Australia's biggest imports and exports (goods and services) as at 2013, Department of Foreign Affairs and Trade and ABS (2015)



**Source 19.9** Australia's main export and import markets (totals in A\$ billion; % = share of total market)



## Activity 19.1

- Classify the following possible exports as primary goods, manufactured goods or services:
  - potatoes
  - accounting services
  - t-shirts
  - coal.
- Using the table in Source 19.8, calculate how many billions of dollars Australia's exports are worth in the categories of primary goods, manufactured goods and services. Calculate the figure for imports as well.
- Now draw a bar graph (or use a spreadsheet to create the graph) of the information found in your answer to Question 2, comparing exports and imports for Australia in the three categories. Describe the trends shown in two sentences.
- Locate Australia's main partners for imports and exports on a blank world map, and apply three colours to mark the countries on the map: one colour for importers, one for exporters and one for countries that are both main exporters and importers. Organise a title and key for your map.
- Describe where most of our import and export partners are located, and explain why you think this is.
- How does trade influence Australia's connections to other places? And if trade was the biggest contributor to establishing connections, who would Australia have the biggest connection with? Would this connection remain without trade? Explain your answer and then share your views with the class.

## Major trade partners: China

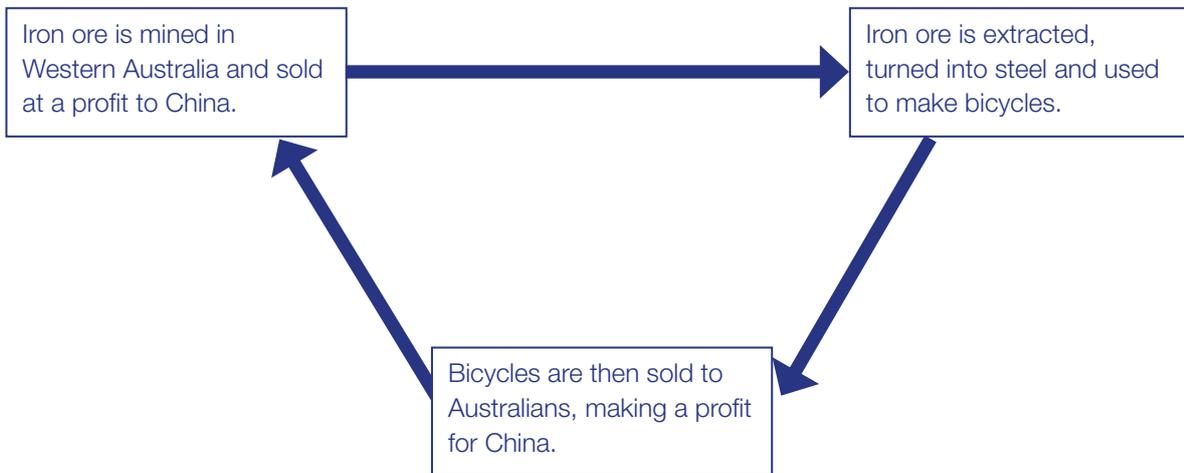
Global interconnections of trade have an influence on the global market for consumer goods. The economies of different nations have different comparative advantages. Trade allows nations to take advantage of these differences in economies to supply and

receive goods. **Bilateral** trade between Australia and China allows both economies to work successfully (see Source 19.10).

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**bilateral** between two nations

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**Source 19.10** Bilateral trade between Australia and China

Who benefits from this interconnection in Australia?

The bilateral trade between China and Australia has led to considerable benefits for a number of different parties within Australia:

- *Mining companies and their shareholders.* The resources boom has meant Australian mining companies such as BHP Billiton and Rio Tinto have become highly profitable. This benefits shareholders (people who own a small percentage of a company), but also leads to more employment and investment in areas where mines are located, as the companies look to continue to increase their profits. Without the demand for their minerals in China, this boom would not exist.
- *Areas where mining is occurring.* With mining occurring in many regional areas, money is being spent on new facilities, roads and other infrastructure, which also benefits local populations. As demand from China continues to increase, more and more regional areas are being explored for mineral growth.
- *Governments.* Through mining royalties and taxes of both companies and workers, mining provides a profitable revenue stream for governments at the national and state levels. This money is then spent on providing services such as health, education and defence. Chinese companies are also investing in mining projects around Australia, which are taxed by the government.

**Source 19.11** Mining around Australia, in which Chinese companies invest, provides a profitable revenue stream for governments.



## Changing patterns of production and consumption of goods: China

China has become a rising giant of industry. In 2011 China took over from the US as the country with the largest industrial output, producing over 20% of all manufactured goods globally. Its rise in this sector of the economy has been rapid, with spectacular growth in a wide range of industries, most notably in the last 20 years.

### *Reasons for the growth of Chinese industry*

With a population of around 2 billion, China has both a large available workforce and a significant domestic market for manufactured goods. Also, China's position in the centre of Asia means it is close to a large number of strong economies, such as Japan and India, which are valuable trading partners. Developments in agriculture have reduced the need for large numbers of rural workers, which has led to rural–urban migration.



**Source 19.12** China's large workforce has contributed to the growth of its industry.

China's economic systems are quite different from what we are used to in Australia. In Australia, most businesses are privately owned. China is a one-party **communist** state with a very high degree

**communism** a type of political system that has been in place in China since 1949

of central control, and until recently no private ownership of property or companies was allowed. It has planned its industrial growth carefully, with all large investments in technology and infrastructure being made by the state. In

the last two decades the government has taken a different approach, trying to attract investment from foreign companies through the establishment of Special Economic Zones (SEZ) where taxes and restrictions on import and export are removed. Wages are lower in China than in western countries, and laws regarding the conditions of workers and environmental regulations are generally weaker. These combine to reduce the cost of goods produced, which has made those goods very competitive on the world market.



**Source 19.13** Shoppers in Shenzhen, China. Shenzhen is considered one of the most successful Special Economic Zones.

## ➤ Note this down 19.1

Copy the graphic organiser below and categorise the factors behind the growth of industry in China. An example has been provided for you:

	Categories	Factors behind industrial growth
<p><b>physical geography</b> the study of the natural features of the earth, such as mountains and rivers</p> <p><b>human geography</b> the study of the different ways in which human societies develop and operate in relation to their physical environment</p>	<b>Physical geography</b>	Abundance of natural resources
	<b>Human geography</b>	
	Government	
	Working conditions	
	Technological advances	

### China's economy

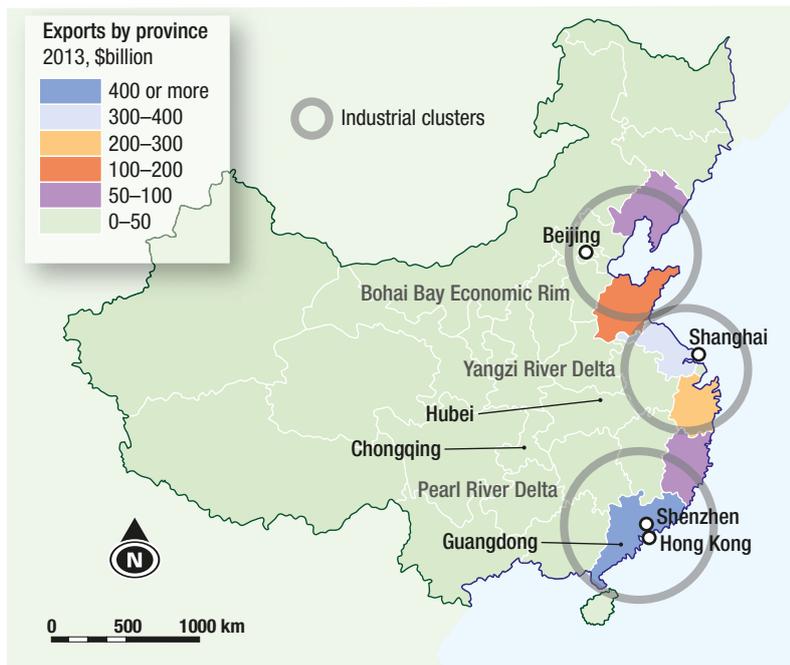
Prior to 1975 China's economy was dominated by agriculture, although there was some manufacturing, with an emphasis on heavy industry such as chemicals – these were used to make fertilisers, which increased agricultural production. In the last 20 years, manufacturing has become the dominant force, as a result of government plans to increase this sector.

China now manufactures a huge variety of goods, including clothing, cars and trucks, electronics and, increasingly, advanced technology such as computers and mobile phones.

While a lot of goods produced are exported, China's huge population and growing wealth mean there is also a large domestic market now able to afford an increasing range of products.

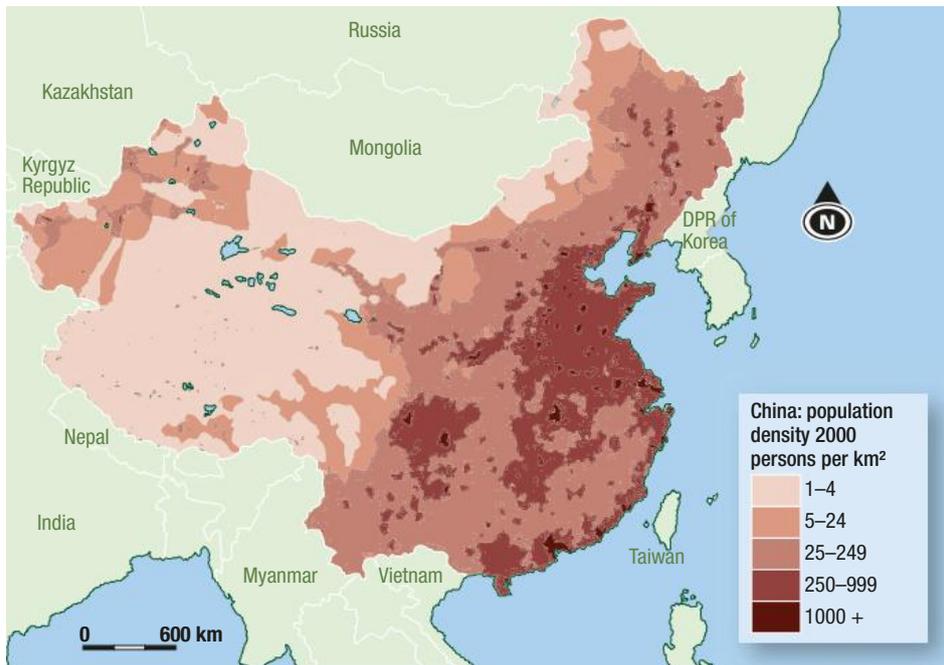
#### Geographical fact

China produces 50% of all the cameras made in the world.



Source 19.14 China's industrial clusters





**Source 19.15**  
Population density map of China

Most of China's industry is based in the coastal regions. This, unsurprisingly, is where most of the population is to be found. These areas were settled early, before industrialisation, as they provided trading links, fertile soils and a ready water supply. These regions are also attractive to industry, because:

- coasts provide ports to import raw materials and export goods
- the east coast is close to major markets such as Japan, and is the start of shipping routes to the US
- there are large local populations that provide both a workforce and a market
- the area has a good water supply for industry and domestic use through major river catchments
- there is flat land suitable for building factories. These areas were also targeted in the setting up of Special Economic Zones, largely as a result of the factors outlined above.



## Activity 19.2

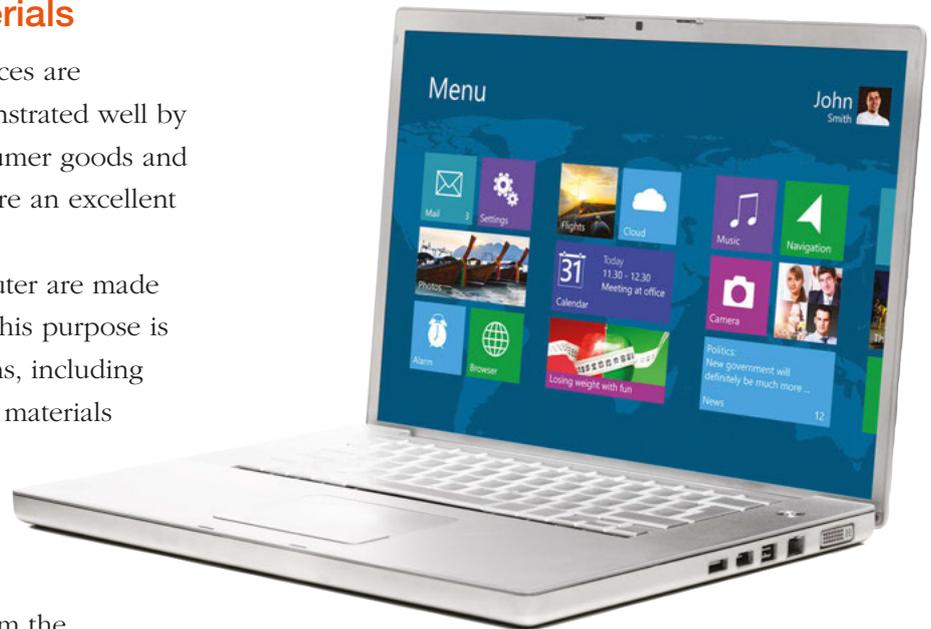
- 1 Describe how China's economy has changed in the last 20 years.
- 2 State two physical and two human factors that affect the location of China's industry.
- 3 Describe some of the interconnections between China and other nations around the world.

## Sources of raw materials

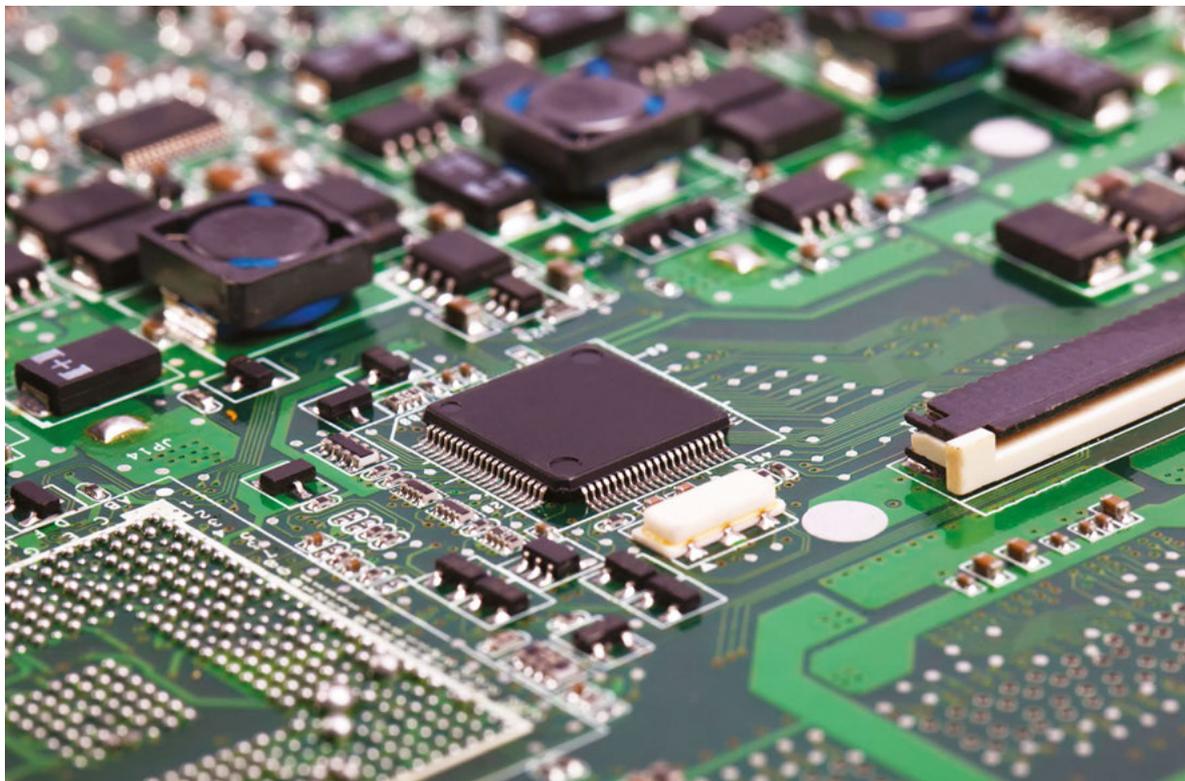
The way that people and places are interconnected can be demonstrated well by the origins of everyday consumer goods and services. Laptop computers are an excellent example.

Many parts in your computer are made from silicon chips. Silica for this purpose is mined in a variety of locations, including Nevada in the US. Other raw materials required may include rubber for keys, which may come from Brazil or Malaysia, as well as copper and other metals. Copper from the mines at Mt Isa, Queensland may even make its way into your laptop.

A wide variety of raw materials like minerals are used in the manufacturing of electronic devices. Coltan is an ore that



**Source 19.16** What are the origins of your laptop computer?



**Source 19.17** A laptop motherboard with silicon chips

**tantalum** a heat-resistant powder, refined from ores such as coltan (columbite-tantalite), that can hold a high electric charge

**capacitors** passive electronic components – i.e. they do not require extra electricity to function – that, in a circuit, hold a voltage or a charge, for a specific period of time when the electronic device is unplugged from electrical outlets

contains the mineral **tantalum**, which is used in the **capacitors** of laptops.

Tantalum is an essential element in smartphones, laptops and most other electronic goods. Australia, Brazil, Canada, the Democratic Republic of the Congo (DRC), Ethiopia and Rwanda are among the world's leading tantalum producers.

Tantalum, as well as other minerals mined in the DRC, are known as **conflict minerals**.

A great deal of the mining is done by small groups of people, often farmers, who mine by hand with basic tools – this is known as **artisan mining**.

**conflict minerals** minerals mined in areas where there is armed conflict and human rights abuses

**artisan mining** individual or small group mining activity carried out using minimal machinery and very basic tools, such as a bucket and spade



Source 19.18 Coltan ore being ground

### 19.3 Spatial patterns of global trade

People and places can also be interconnected as one place (such as a city or rural area) sells a product or service to other places.

As most developed countries have experienced a decline in heavy industry in the last 25 years, new industries, with vastly different

requirements in terms of location and workforce, have sprung up. Jobs in heavy industry have been replaced by employment in **hi-tech** companies, including information technology,

**hi-tech** products and technology that are complex, and that use or produce the latest advances in computers and electronics

specialised electronic and advanced manufacturing, and in other sorts of industries, such as financial services and communication-based businesses.

These hi-tech industries are known as **footloose**. While heavy industry was tied to a particular location as a result of the need for raw materials such as coal, modern hi-tech industries, such as software development companies, can be far more flexible in their choice of location. A very good example of this is 'Silicon Valley' in Northern California in the United States.

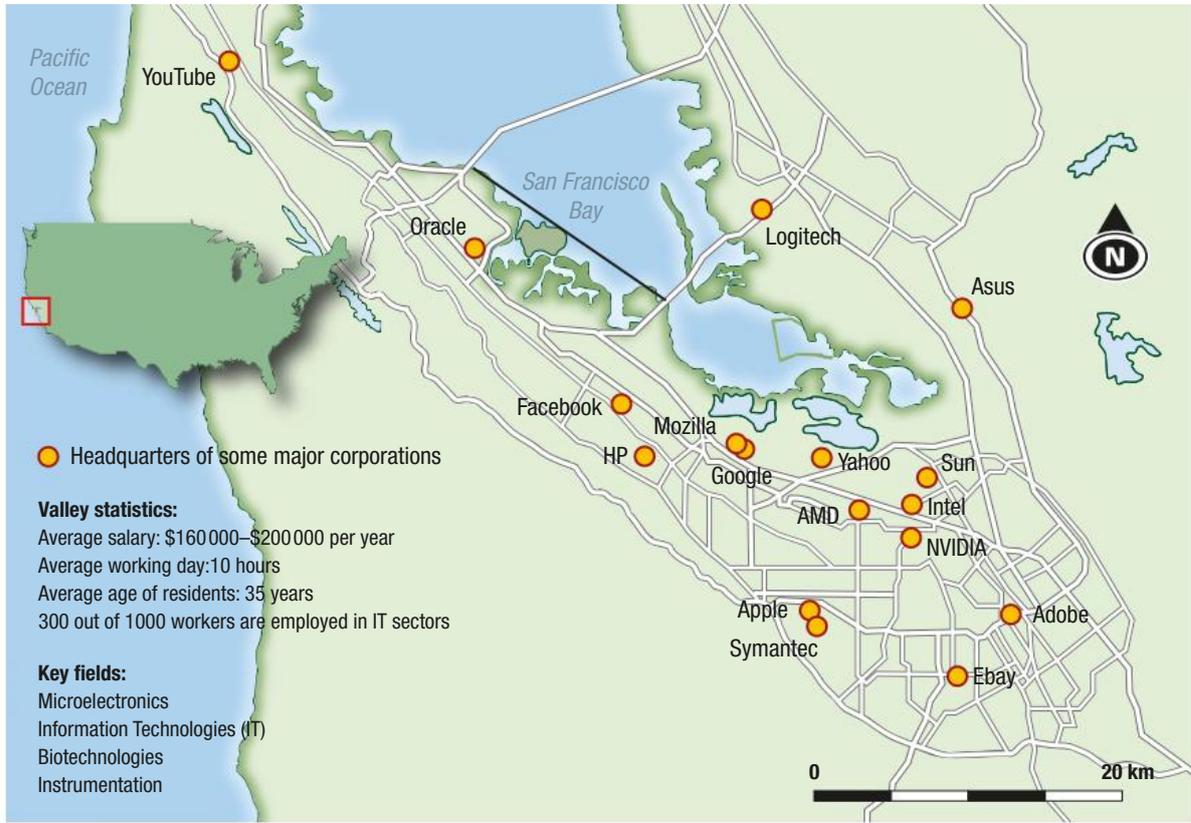
**footloose** an industry that can relocate easily



**Source 19.19** Laptops are likely to have been designed in Silicon Valley.

Your laptop, if it is made by a company such as HP or Apple, is likely to have been designed in Silicon Valley. These companies keep processes such as designing and research and development in these types of regions to take advantage of the expertise and skills of the workers there.

Silicon Valley is the biggest and most famous example of an area dominated by hi-tech industry. With around 300 000 workers in these industries generating \$200 billion in turnover each year, this region is vital to the US economy.



Source 19.20 Map of Silicon Valley

## Countries of production and consumption

The production and consumption of goods today is essentially global in nature. For example, often the goods we consume in richer countries like Australia have been produced in poorer countries, under the

direction of **transnational companies**. We will look at this topic in greater detail in Chapter 20 to investigate the effects the production of goods can have on places and environments.

However, for now let us investigate the global patterns of the production and consumption of a product. Our example is laptop computers.

### Manufacturing of components

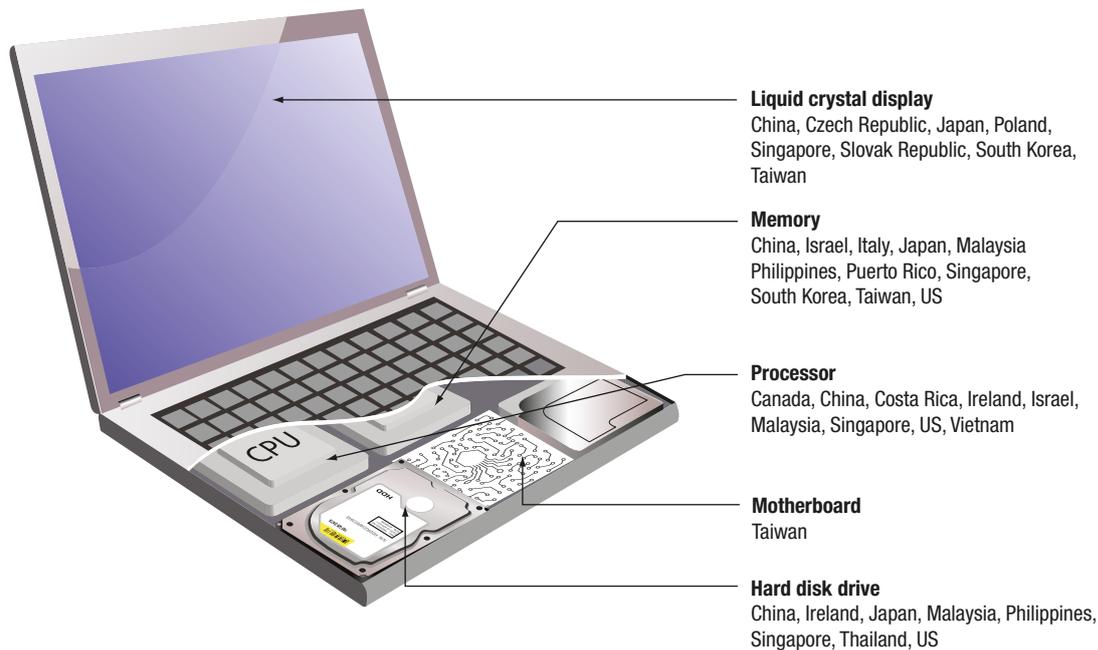
A laptop has up to 30 components. These components are likely to be made in a wide

range of countries. The country of origin is usually dictated by how advanced the manufacturing process is. So some complex items, such as the main CPU, are probably still manufactured in the US, South Korea or Taiwan, although new hi-tech factories are being built in southeast Asia. Other items, such as keys, are likely to be pressed out in huge volumes in factories in China, or in countries with low labour costs, such as the Philippines or Thailand.

### Assembling the laptop

Chinese factories assemble 70% of the world's laptops. While some companies, such as Toshiba, have their own factories, most businesses **outsource** their assembly lines to companies in China. Many of these assembly lines will be producing

**outsourcing** contracting part of a business function to another person or business



**Source 19.21** Major laptop components and possible country of origin

computers for a number of companies at the same time. These factories are likely to be near ports and airports so that components can be shipped in and laptops shipped or flown out.

### Selling laptops

Until recently laptops may have been assembled in China but sold through retail outlets all over the world. Advances in communication and technology are now allowing companies to bypass this process, and sell direct to the consumer. Computers can be ordered in the US, custom built in

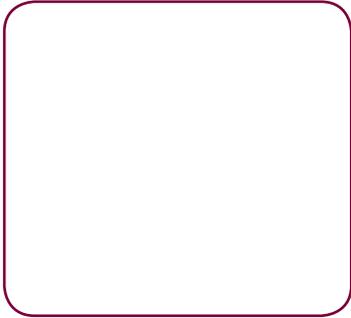
Shanghai with the desired components, and shipped out directly to the customer within 24 hours. This type of process maximises profits for the computer companies, as they cut the retail step out of their costs, while increasing convenience for the consumer. It has, however, affected physical computer shops, which are struggling to compete with the computer companies because of their overheads – such as rent and staff. People are becoming more comfortable buying expensive goods over the internet, so this change in business practice is likely to accelerate.

### Activity 19.3

- 1 Explain why many computers are designed in countries such as the US.
- 2 List the steps in the designing, making and assembling of a laptop and then compare the levels of technology required for each step.
- 3 Discuss why computer companies outsource the assembly of their laptops.
- 4 Create a rough world map and highlight the countries where the various components in Source 19.21 may have been manufactured.

## Note this down 19.2

Copy the graphic organiser below and create a storyboard that follows the production of a laptop.



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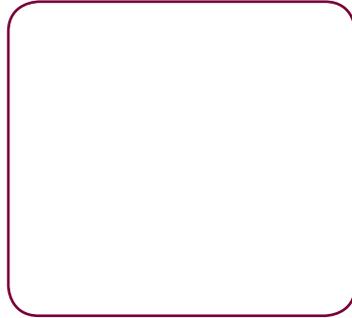
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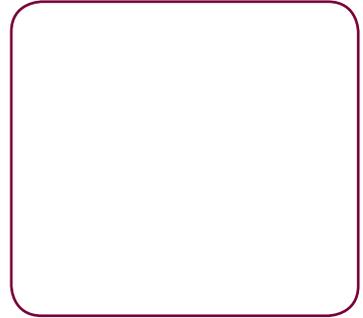
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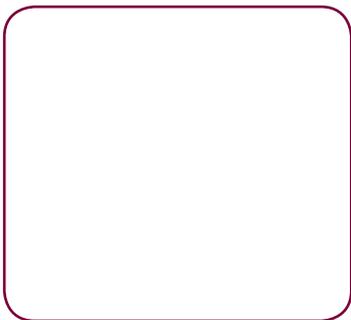
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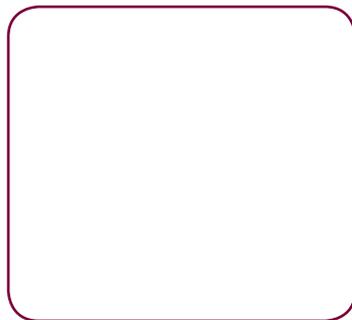
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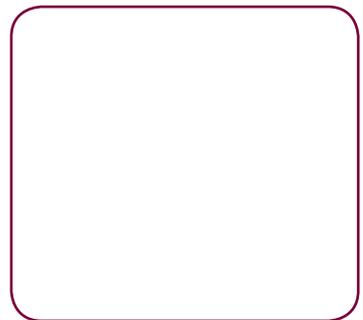
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Find or draw an image of each step, and include notes on the process.

## Global shipping and freight routes

Because of the global nature of business, and the fact that goods may be produced in one place but sold in another, many companies rely on various forms of **freight** to transport their products. Trade between an origin country (or countries) and a destination country (or group of countries) is referred to as a **trade route**.

**freight** to transport goods in bulk by truck, train, ship, or aircraft

**trade route** the trade between an origin group of countries and a destination group of countries

### Shipping

The exchange of capital, goods and services across international borders is known as international trade and in many countries it represents a significant share of the nation's gross domestic product (GDP.) Shipping is a

very popular method of transporting goods, because it is often cheaper than other forms of transport. Goods are stored in large containers strong enough to withstand the effects of shipment, storage and handling. Container ships have the capacity to carry several warehouses-worth of goods, which makes one journey very efficient.

### Geographical fact

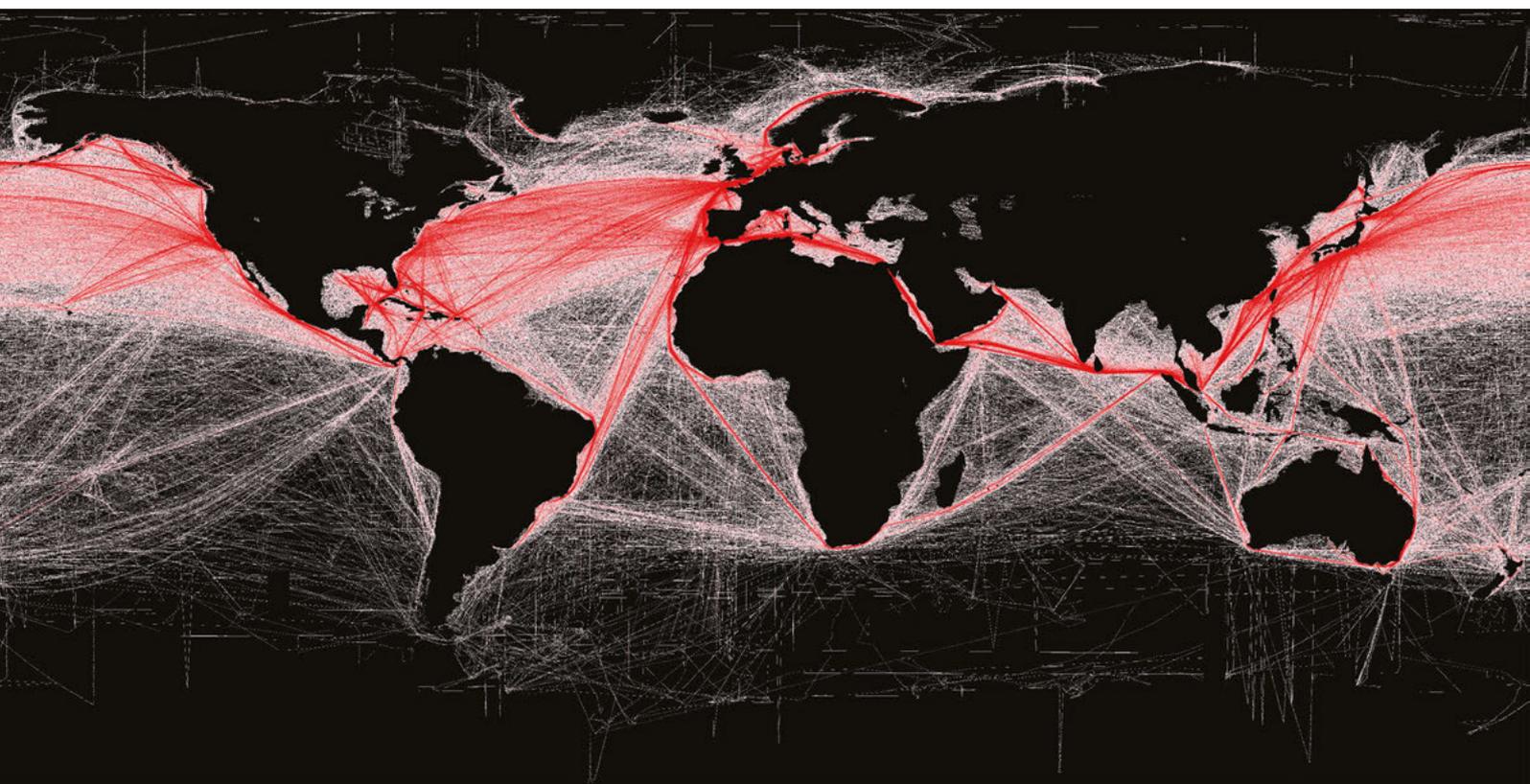
According to the World Shipping Council, in an average year a large container ship travels three-quarters of the distance to the moon. Therefore, in its lifetime it travels to the moon and back around 10 times!



**Source 19.22** A cargo ship fully laden with containers of products

According to the World Shipping Council, globally there are around 500 shipping liner companies that provide weekly services that enable goods to move between ports along the many trade routes of the world. More than 200 countries have shipping ports, and by far the most heavily trafficked shipping trade

routes are between Asia and North America, and Asia and northern Europe. As of October 2015, there are almost 5000 container ships operating around the world, and liner ships transport more than US\$4 trillion worth of goods annually. This highlights how important shipping freight is to global trade practices.



**Source 19.23** World map showing shipping trade routes. Red lines indicate the density of trade routes.

### Other methods of freight

Other methods that companies can use to transport goods either internationally or domestically include freighting by air, road or rail.

#### *Air*

Sending freight via air can be much faster than by sea, but this can be a much more expensive practice. While there are specially designed cargo planes that can transport goods

by air, Bloomberg Business has estimated that 50% of all air freight is moved on commercial passenger airlines. Airlines have been making a lot of money by carrying 'belly cargo' as well as passengers. Air freight is a good option for companies that need to send products in smaller quantities in a hurry.

#### *Road*

Trucks are widely used in Australia and across the world as the primary form of

road freight. In fact, according to the Truck Industry Council, as of 31 January 2014, there were 582 119 trucks registered in Australia. In terms of geography, Australia's huge land mass and sparse population means that the industry covers more kilometres and carries more freight per capita than any other trucking industry around the world.

### *Rail*

Rail freight is another method of transport used globally for trade. It is generally considered to be more efficient and cost-effective than road freight. Freight trains are a series of connected freight cars driven by a locomotive. They can carry bulk loads such as iron ore or haul containers of goods. Companies in Australia, North and South America, Asia and Europe rely on rail for trade.



**Source 19.24** Goods can be freighted by road, air or rail.





## Activity 19.4

- 1 List the advantages and disadvantages of shipping freight.
- 2 Can you identify any current risks involved for companies shipping freight near Africa?
- 3 Tony has to quickly deliver a product from Asia to a client in Sydney. What would be the quickest method?

**Source 19.25** A shipyard for loading and unloading cargo ships for the global import and export of goods



## Chapter summary

- Places and people can be connected through trade in goods and services across all scales. A good example of this is Australia's trade with countries around the world. Australia's geography has been shaped by the connections and relationships built with other countries we import from and export to.
- The way that people and places are interconnected can be demonstrated well by the origins of everyday consumer goods and services. Laptop computers are an excellent example of the complexities revolving around where a product is designed and manufactured.
- Products such as computers are designed, manufactured and assembled in a wide range of locations, linking developed and less developed nations. The way we buy items such as computers is also changing as a result of technology.
- People and places can also be interconnected as one place (such as a city or rural area) sells a product or service to other places. The hi-tech industry in Silicon Valley is a very good example of this.
- Global interconnections of trade have an influence on the global market for consumer goods. Economies of different nations have different comparative advantages. Trade allows nations to take advantage of these differences in economies to supply and receive goods.
- Because of the global nature of business, and the fact that goods may be produced in one place but sold in another, many companies rely on various forms of freight to transport their products, including by sea, air, road or rail.

## End-of-chapter questions

### Short answer

- 1 Describe how trade can interconnect people and places with other places.
- 2 The manufacturing of some goods can be outsourced to other countries such as China. Explain why this might be so.
- 3 Refer to Source 19.23. Describe the spatial patterns of shipping trade routes. Provide reasons for the intensity/lack of intensity in various regions.

### Extended response

Write a report comparing industry in China with that in Silicon Valley. You must:

- describe the different types of industry found in the two locations
- explain the causes of the two types of industry growing in these regions (refer to both the physical and human geography of the two locations)
- investigate the connections these two regions have with others around the world, and how this links people and places
- evaluate the effects of industry using the terms 'economic', 'environmental' and 'social'.



# 20

## Production and consumption

**Source 20.1** Liquid metal being poured at a metallurgical plant

### Before you start

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#### Main focus

Decisions about what we buy, use and discard have short- and long-term social and environmental consequences throughout the world.

#### Why it's relevant to us

As global citizens, we are connected with all people living on Earth and the environments in which we live, and hold ultimate responsibility for the wellbeing of future generations. It is in our best interests to use sustainable practices.

#### Inquiry questions

- What determines our purchasing decisions?
- What do we need to know to make our purchasing more socially, environmentally and economically sustainable?
- What effect does the production or consumption of goods have on places and environments?
- How can we bring about more sustainable manufacturing, consuming and waste disposal?

#### Key terms

- fair trade
- global citizenship
- globalisation
- north–south divide
- principles
- shareholder
- trade

### Let's begin

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As consumers of numerous products and services that are developed, manufactured and transported worldwide, we are connected with the social, economic and environmental consequences of globalisation. When we buy something, we need to consider more than just how much it costs and what we will use it for. Where was the item made? Who made it? In what workplace conditions was it made? What will happen to the item after we have finished with it? What alternative items are available?

## 20.1 Impacts of production and consumption of consumer goods

The increase in trade across the world is part of *globalisation*. Globalisation is the process of countries around the world becoming more connected.

links between the social and economic impacts of globalisation and changing global environmental patterns and processes. For example, there are now studies on the relationships between human activities, such as urbanisation, and changing global weather and climate patterns.

The impacts of consumer goods can be demonstrated by the production of palm oil. Often we are not aware of the ingredients in the products we buy so we are ignorant of the environmental and social consequences of our purchases.

How we see and understand our rights and responsibilities, as connected global consumers, and how we use those rights and bear those responsibilities, means engaging in **global citizenship**.

People are becoming much more aware of the

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**global citizenship** our rights and responsibilities as citizens of the global community as well as our rights and responsibilities as citizens in our local community and the country we live in

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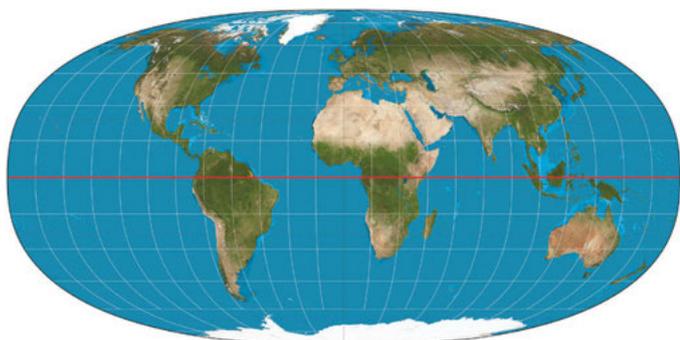


**Source 20.2** Studies have shown links between urbanisation and changing climate patterns.

## What is palm oil?

Palm oil comes from the fruit of the *Elaeis guineensis* species of palm, which originates in the equatorial (between 10°N and 10°S of the Equator) coastal regions of West Africa. It has been used by humans for over 5000 years.

Palm oil has a high resistance to oxidation, and therefore to decaying, so it is used in the production of margarine, sweets and baked goods to increase their shelf life.



**Source 20.3** Palm fruit is grown 10° north and 10° south of the Equator (shown here as a red line in the centre of the world map).

## Geographical fact

Palm oil is found in many of the products we buy at the supermarket. These include cooking oil, chocolate, cosmetics, chips, instant noodles, biscuits, margarine, shower gel, shampoo and soaps.

**Source 20.4** A palm oil plantation in Malaysia





**Source 20.5** Fruit from the palm oil plant

Because it originates in the wet equatorial region of West Africa, palm oil is ideally suited for growing in other equatorial regions of the world, especially in southeast Asia. Four West African Deli Dura palm oil seedlings were planted in Buitenzorg's (Java) botanic gardens in 1848. The descendants of these four seedlings became the breeding stock for the first commercial plantings in Indonesia and Malaysia in the early 1900s. Southeast Asia has

both a favourable growing environment and a lack of pests and diseases, so these plants produced oil that was superior in quality to that from West Africa.

Since the 1980s there has been a rapid increase in the production of palm oil, particularly in Indonesia and Malaysia, which together produce over 80% of the world's palm oil.

### Activity 20.1

- 1 Make a list, over 1 week, of all the products that contain palm oil that your family buys.
- 2 At the end of the week share your list with the class and draw up a list of the top five products.
- 3 Discuss your findings with your family or friends and find out if they knew that palm oil was used in so many products.

## Environmental impacts

The expansion of palm oil production is leading to the clearing of the natural rainforest in large areas of Indonesia and Malaysia. The clearing of the forest often also involves large wildfires and illegal logging operations.

This clearing is the major cause of deforestation in these countries. This deforestation results in a loss of habitat for animal and insect species and a reduction in plant biodiversity. The United Nations Environment Program (UNEP) has predicted that by 2022 the palm oil industry could wipe out 98% of Indonesia's remaining rainforests.

The reduction of habitat in the southern Malaysian peninsula has resulted in more than a 70% reduction in bird numbers, and in Indonesia it could result in the loss of the orang-utan and Sumatran tiger.

The extensive deforestation also has major climatic implications, as mature tropical rainforest acts as a store or sink of carbon. When the forest is burnt or logged, carbon dioxide is released into the atmosphere. As the life cycle of a palm oil plantation is very short (less than 30 years) compared with that of rainforests, plantations contribute to carbon emissions into the atmosphere rather than acting as carbon sinks.

The threats of deforestation and greenhouse emissions from oil palm plantations are so grave that the World Bank has now suspended lending to palm oil producers until safeguards are developed and implemented to ensure that such lending doesn't cause further social or environmental harm. The industry is making progress towards sustainable production.

**Source 20.6** A forest being cleared to make way for an oil plantation





**Source 20.7** Both the Sumatran tiger and the orang-utan in Indonesia are under threat due to the destruction of natural habitat.

### Social impacts

The destruction of the rainforests and the creation of large palm oil plantations, many of which are owned by transnational companies,

has had a considerable impact on the lifestyle and rights of the people who have lived with the forests for hundreds, if not thousands,

**Source 20.8** Palm oil plantations can adversely affect the health of workers.



of years. Their sources of food have been removed and the use of pesticides and weedicides in the plantations has had adverse health effects, especially for those who work in the plantations.

### Economic impacts

However, although the plantations have had negative environmental and social impacts, they have had some positive economic impacts. The plantations have improved the

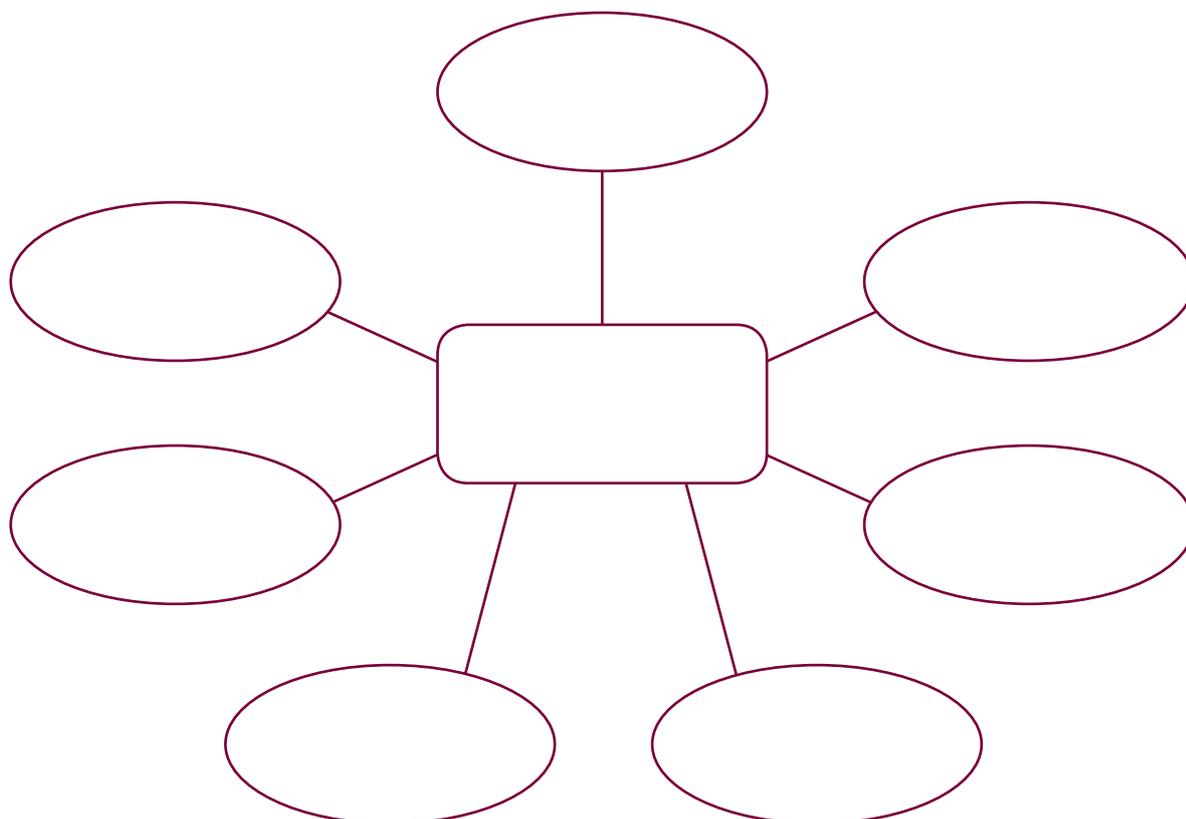
opportunities for employment in often very poor communities. They are a big contributor to the local economy. In Indonesia, for example, the agricultural industry employs over 41% of the population, and provides two-thirds of rural household income. Over half the population in Indonesia lives in rural areas, with 20% of those living in extreme poverty. The palm oil industry provides them with much needed income opportunities and helps to improve their standard of living.



**Source 20.9** Palm oil production can help improve the economy in poorer countries.

## Note this down 20.1

Copy the graphic organiser below and identify the major competing issues involved in the production of palm oil in southeast Asia.



## 20.2 Effect of production of goods on a place

While globalisation and transnational companies are bringing the world together, there is a widening gap between the economically wealthy and the poorer countries of the world.

mainly in the Northern Hemisphere (North America, Europe, Japan) and are the wealthy countries. These countries have high levels of industrial development, higher standards of living (in health and education, among other things) and are home to most of the transnational companies.

The south (or developing) countries are mainly in the Southern Hemisphere (South America, Africa and Asia) and are the poorer countries. These countries have less industrial development, lower standards of living and weak workplace protection laws.

This gap between the richer and poorer countries is often referred to as the **north-south divide**. The north (or developed) countries are

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**north-south divide**  
the gap between the economically 'richer' and economically 'poorer' countries of the world

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**Source 20.10** Countries like Japan have a high level of industrial development and wealth.

Transnational companies are major drivers of globalisation. Most of the goods we buy have been touched in some way or other by transnational companies. For example, many clothes companies manufacture their goods in Bangladesh.

The main aim of the great majority of transnational companies is to increase their company profits and so please their **shareholders**.

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**shareholder** a person with a financial interest in a company

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Companies gain economic advantages through operating in more than one country.

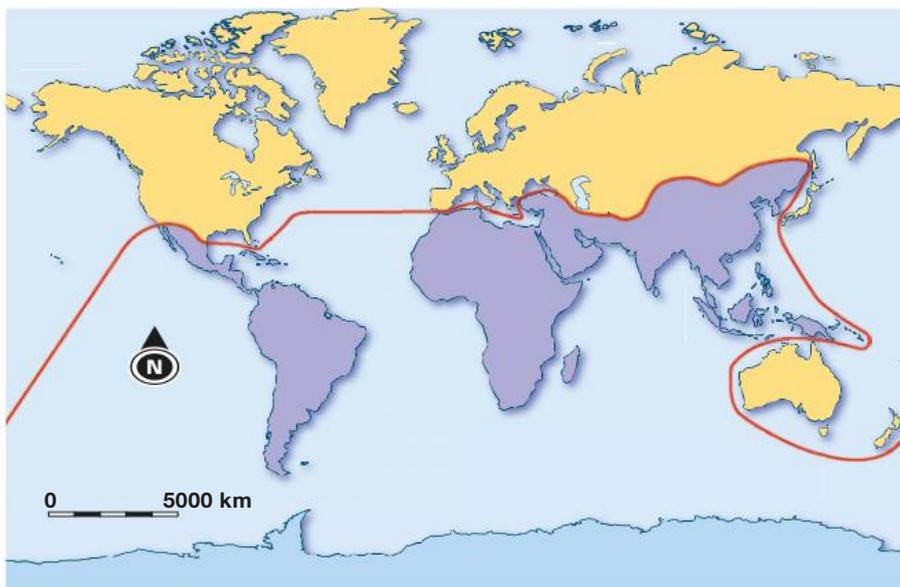
These include:

- having more control over the sources – and therefore the costs – of the raw materials they use
- being able to reduce labour costs, especially in industries that depend on labour rather than machines, such as clothing and assembling electronic goods
- paying lower taxes to governments
- increasing the size of their markets.

These advantages mean that transnational companies can become very large and wealthy.



**Source 20.11** Developing countries like Brazil, located in South America, have less wealth than developed countries in the north.



**Source 20.12** The north–south divide. Notice that Australia and New Zealand are included in the northern category of richer nations.

These very large companies are often much wealthier than the countries they operate in.

This makes them very powerful, because poor countries depend on these companies to employ and provide their people with skills, pay taxes for the mining of their resources, and build factories and road, rail, sea and air transport networks.

Transnational companies can therefore help poor countries develop and protect their environment.

However, this is not always the case. Some transnational companies are willing to sacrifice human rights and the environment in order to make a bigger profit. The recurring factory collapses in Bangladesh are one such example.



**Source 20.13** Large, wealthy companies often increase their profits by using cheap labour in poorer countries.



## Case study 20.1

### Bangladesh garment factory fire kills at least 112

A company that makes clothes for Sean Combs' clothing brand ENYCE and other US labels reassured investors that a factory fire that killed 112 people over the weekend would not harm its balance sheet, and also pledged to pay the families of the dead \$1200 per victim.

In an announcement on Monday (26 November), Li & Fung Ltd, an outsourced company (a small local company) that supplies clothes from Bangladesh factories to US brands, said 'it wishes to clarify' that the deadly Saturday night blaze at the high-rise Tazreen Fashions factory outside Dhaka 'will not have any material impact on the financial performance' of the firm.

The fire broke out on the ground floor of the nine-floor building as hundreds of workers were upstairs on a late-night shift producing fleece jackets and trousers for the holiday rush at American stores, including Wal-Mart, according to labour rights groups. Fire officials said the only way out was down open staircases that fed right into the flames. Some workers died as they jumped from higher floors.

After reassuring investors about its financial health, Li & Fung's statement went on to express 'deepest condolences' to the families of the dead, and pledge the equivalent of \$1200 to each family. The company also said it would set up an educational fund for the victims' children.

As reported on ABC World News with Diane Sawyer earlier this year, Bangladesh has become a favourite of many American retailers, drawn by the cheapest labour in the world,

as low as 21 cents (US) an hour, producing clothes in crowded conditions that would be illegal in the US. In the past five years, more than 700 Bangladeshi garment workers have died in factory fires.

'[It's] the cheapest place, the worst conditions, the most dangerous conditions for workers and yet orders continue to pour in,' said Scott Nova, executive director of Worker Rights Consortium, an American group working to improve conditions at factories abroad that make clothes for US companies. Nova said the fire was the most deadly in the history of the Bangladesh apparel industry, and 'one of the worst in any country'.

Source: ABC News (US) Brian Ross, Matthew Mosk and Ned Berkowitz, 26 November 2012

- 1** Describe the reason given for the workers working the late-night shift. Identify the main concern of Li & Fung Ltd about the consequences of the fire.
- 2** The US transnational companies whose clothing brands were being manufactured in the Tazreen Fashions factory said that they would no longer contract with the factory to make their clothing. Suggest, with reasons, other choices the US transnational companies could take to protect the rights and safety of the Li & Fung textile workers.
- 3** As a concerned and responsible citizen, you feel you should take action on this issue. Outline how you will respond.

## Geographical fact

In Australia, as of 1 July 2015 a trainee textile worker must be paid a minimum of \$17.29 per hour and a minimum \$656.90 weekly wage; the highest skilled workers are paid \$21.39 per hour and \$812.80 per week.



**Source 20.14** Textile workers in poorer countries are paid much lower wages than those in wealthy nations like Australia.

## ➤ Note this down 20.2

Copy the table below and research online to compare the working conditions of Australian and Bangladeshi textile workers.

Australian textile workers	Bangladeshi textile workers

## Activity 20.2

An increasing number of companies are following socially and environmentally sustainable principles and practices in all the countries they operate in.

A transnational company has asked you, as a global citizen, to form a team to write up a list of four social and/or environmental sustainability **principles** for their company to follow for all the countries they work in.

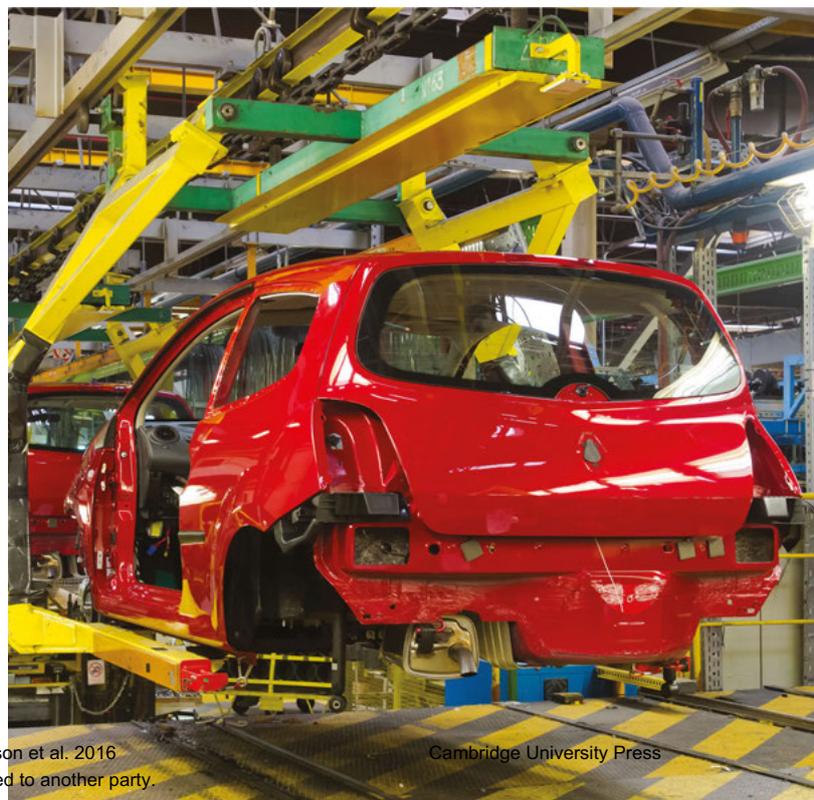
Work in a small group (up to five people).

- 1 Decide what the main business of the company is – for example, is it a mining company, clothing company, soft drink manufacturer, fast food chain, motor vehicle manufacturer? Give the company a name.
- 2 Identify two to four human rights issues that are important to the type of company you have chosen. (Hint: go online to the Universal Declaration of Human Rights [UDHR], Articles 23 and 24, for some ideas.)
- 3 Identify two to four environmental issues that are important to the type of company you have chosen. (Hint: you could consider biodiversity, waste reduction, impact on carbon emissions, water quality.)
- 4 Choose four issues the company would like you to write principles for.
- 5 Write a principle for each of the four issues you have selected.
- 6 Check that the principles make sense, then share them with your class.

**principles** rules or morals that a person or company/group decides to follow

A principle is an underlying value or rule that an individual or organisation uses to guide their decision making in their day-to-day life and work. For example, if the issue for a car manufacturer is to reduce waste, the principle could be: The motor company will design its vehicles so that all components of their vehicles are either reusable or recyclable. (The value is to eliminate waste and the rule is to recycle and reuse.)

**Source 20.15** If you are a car manufacturer aiming to reduce waste, what principles do you work to?



## 20.3 Responses to minimise the effects of production and consumption

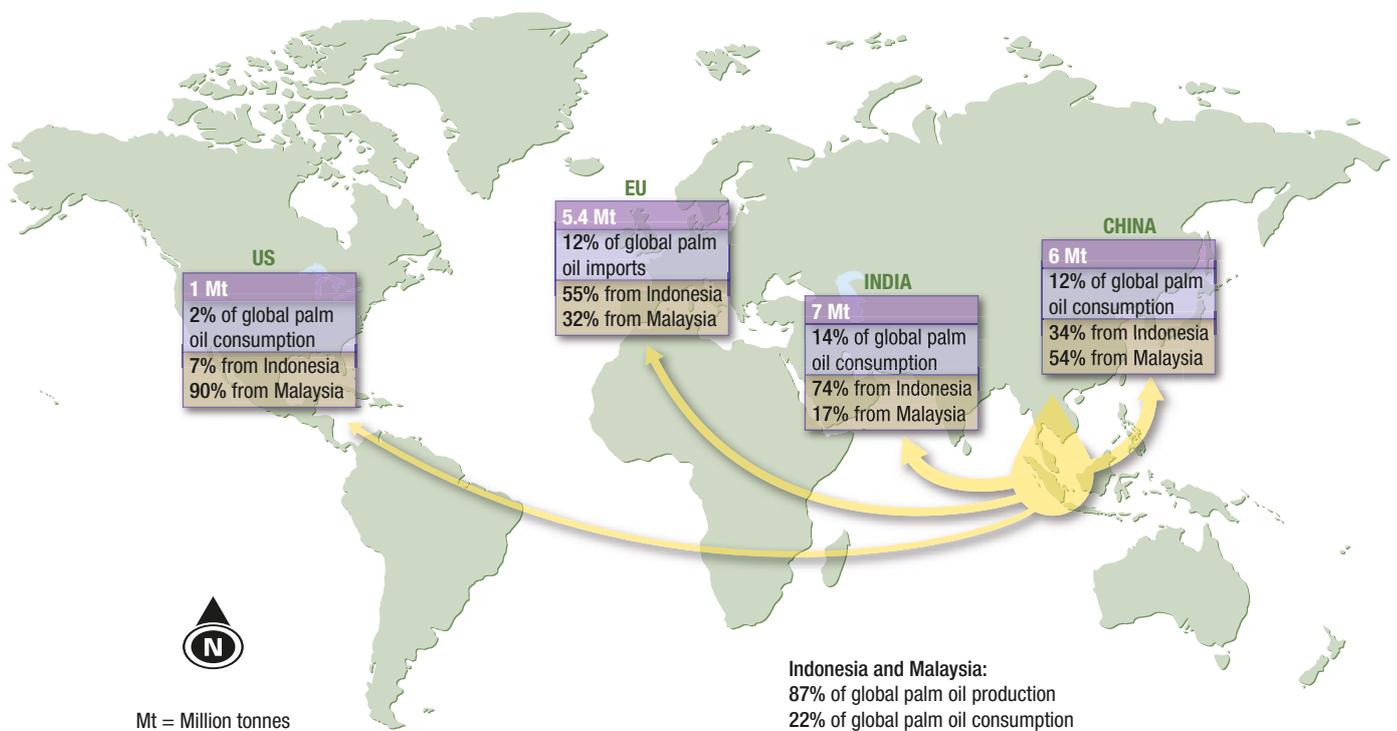
How have various groups around the world acted to minimise the negative effects of the production and consumption of goods on people, places and environments? To help us understand the ways that governments, groups and individuals have responded we will again consider the case of palm oil.

### Governments

Let's return to the idea of the north–south divide. It will come as no surprise that palm oil is produced in countries on the south side of the divide. However, governments of both north- and south-divide nations can play a key role in influencing supply and demand

for sustainable palm oil. Government policy makers in countries that produce palm oil can promote greater environmental and social stewardship by reforming land allocation and land use policy to be more transparent, enforceable and based on conservation needs and priorities.

For example, recently the Malaysian and Indonesian governments have been looking to establish policies that more effectively address environmental and social issues. For instance, the new Indonesian Sustainable Palm Oil (ISPO) standard sets mandatory sustainability requirements for all oil palm growers. In Australia, the political debate about use of



Source 20.16 Major trade flows of palm oil

palm oil has so far centred on food labelling to enhance consumer awareness. In January 2011, an independent Review of Food Labelling Law and Policy presented 61 recommendations to government ministers for action. One recommendation was for a number of changes to the way that food producers declare added sugars, fats and vegetable oils, including palm oil, on food labels.

## Groups

The exploitation of the traditional landowners and the natural environment has led to movements to establish ethical palm oil production methods. For instance, the establishment of the Roundtable on Sustainable Palm Oil (RSPO) in 2004 to promote more

environmentally and socially sustainable palm oil products is a major step towards ethical palm oil production.

### Roundtable on Sustainable Palm Oil

RSPO's members include palm oil growers, palm oil processors and/or traders, consumer goods manufacturers, retailers, banks and investors, environmental/nature conservation non-government organisations (NGOs) and social/developmental NGOs. Note that the traditional owners of the land are not included.

It remains to be seen how well the RSPO will be able to meet the economic demands of the palm oil industry while at the same time reducing, even eliminating, social and environmental harm.

**Source 20.17** Palm oil traders, manufacturers, retailers and NGOs are RSPO members.





### Activity 20.3

- 1 List the countries that are the major producers of palm oil.
- 2 Identify the regions/countries that are the major consumers of palm oil.
- 3 Describe the major environmental issues of the palm oil plantation industry.
- 4 Explain what we can do to encourage environmentally and socially sustainable palm oil production.

#### Fair trade

Trade between north and south countries is seen as an essential way to reduce global poverty and close the gap between the rich and poor countries. Developing countries trade mainly in primary goods (food and raw materials such as minerals and cotton) and

labour-intensive manufactured goods such as clothing. There are few controls over working conditions and environmental standards. The prices for their goods are largely set by the importing developed countries.

This raises a question – is trade between the south and north countries fair?



**Source 20.18** Is trade between countries fair if workers in developing countries are mistreated by transnational companies?

**fair trade** trade based on the buying and selling of products (usually from poorer nations) that have been mined, grown or manufactured under humane working conditions, with appropriate wages for the workers and minimal environmental impact

The **fair trade** movement says that often the trade is not fair as workers, producers and the environment in the developing countries are often mistreated by transnational companies and restrictions are placed on their trade by the developed countries.

Fairtrade International's network, including TransFair, Max Havelaar, Fairtrade Foundation, and 1.24 million farmers and farm workers from 66 producing countries. Fairtrade International certifies individual products that bear the blue and green FAIRTRADE Mark.

### Geographical fact

The name 'Oxfam' comes from the Oxford Committee for Famine Relief, founded in Britain in 1942 during World War II. The group campaigned for food supplies to be sent through an Allied naval blockade to starving women and children in enemy-occupied Greece.

In 1997, Fairtrade International, formerly known as the Fairtrade Labelling Organization (FLO), was established as an umbrella organisation for 20 Fairtrade certification initiatives in Europe, the US, Canada, Mexico, Japan, Australia and New Zealand. There are currently 586 Fairtrade-certified producer organisations and 469 certified traders in



Source 20.19 The FAIRTRADE sticker on a banana

### Geographical fact

#### Fair trade towns

Since 2001, starting with Garstang in England, there have been an increasing number of towns, especially in the United Kingdom and the US, that are committed to following fair trade principles. By the end of 2015 there were over 600 fair trade towns listed in the UK, and worldwide there were over 1100 free trade towns spread across 31 countries.

## The World Fair Trade Organization

The World Fair Trade Organization (WFTO), formerly the International Federation of Alternative Traders (IFAT), is a separate global network of Fair Trade Organisations. In 2004, WFTO launched its Fair Trade Organization Mark (FTO), through which organisations

that meet WFTO's fair trade standards for working conditions, wages, child labour and environment can receive certification as Fair Trade Organisations. The FTO mark is a company label, or logo, and goes on the company letterhead.

Food products	Non-food products
Bananas	Cotton
Cocoa	Cut flowers
Coffee	Ornamental plants
Cotton	Sports balls
Dried fruit	
Fresh fruit and fresh vegetables	
Herbs and spices	
Honey	
Juices	
Nuts/oil seeds and purees	
Quinoa	
Rice	
Soya beans and pulses	
Sugar	
Tea	
Wine	

**Source 20.20** Examples of food and non-food products that have received Fairtrade International certification

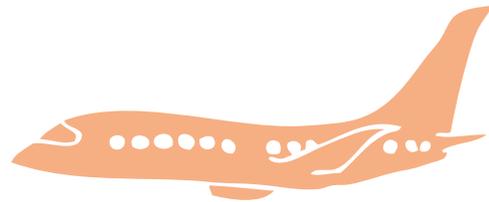
## Individuals

Individuals can also take steps towards ethical palm oil production. They can play a significant role in promoting more environmentally and socially sustainable products by:

- learning which of the products they consume contain palm oil
- avoiding buying palm oil products where possible
- buying only certified sustainable palm oil (CSPO) products
- participating in petition and letter writing campaigns to encourage companies to switch to CSPO products
- donating time or money to groups dedicated to halting destructive palm oil development
- educating others on the negative effects of unsustainable palm oil plantations, while being conscious of the positive economic effects the palm oil industry has on poorer countries that rely on the work to survive extreme poverty.



**Source 20.21** Both Coles and Woolworths have made the switch to certified sustainable palm oil in their products; their own-brand donuts, for example, use CSPO.





## Chapter summary

- Global citizenship requires us to understand how our views of the world and the actions we take in our everyday life have consequences for the economic, social and environmental sustainability of our world.
- The environmental, social and economic impacts of consumer goods can be demonstrated by the manufacturing of palm oil.
- The rapid expansion of palm oil production provides a powerful example of the interdependence of economic, social and environmental sustainability in the mass production of goods, and of what needs to be done to adopt more sustainable practices.
- The gap between richer and poorer countries is often referred to as the north–south divide. The north (or developed) countries are wealthy countries in the Northern Hemisphere with high levels of industrial development, high standards of living and are home to many transnational companies. The south countries are the poorer countries in the Southern Hemisphere. These countries have less industrial development, lower standards of living, and less employment regulations.
- Transnational companies often use cheap labour in poor countries to produce their products. Some transnational companies are willing to sacrifice human rights and the environment in order to make a bigger profit – the recurring Bangladesh factory disasters are one such example.
- Governments in both north- and south-divide countries can act in different ways to influence the sustainable production and consumption of palm oil.
- Non-government groups can also help limit the negative environmental and social effects of palm oil production. The establishment of the Roundtable on Sustainable Palm Oil (RSPO) in 2004 to promote more environmentally and socially sustainable palm oil products is a major step towards ethical palm oil production.
- The fair trade movement is an important movement trying to improve the working conditions and income of workers in poorer countries by making consumers in the richer countries more aware of the working conditions in the poorer countries and the purchasing choices available to them.
- Through understanding the effect of globalisation and what transnational companies are and how they operate in and across countries, individuals are better able to influence these companies to adopt and follow more responsible human rights and environmental sustainability principles.

## End-of-chapter questions

### Short answer

- 1** Discuss how consumers of palm oil are contributing to environmental damage in many parts of the world.
- 2** Describe how we could be more responsible in our production and consumption of goods.
- 3** Reflect on the statement 'The fair trade movement has been able to make trade between richer and poorer countries fairer.' Identify three arguments for both the positive (affirmative) and negative positions for this debate. Write a summary paragraph. Share with the class.

### Extended response

Write a short essay (up to 250 words) explaining what the problems are and the actions you can take to reduce your environmental and human rights impact as a consumer and discarder of clothing manufactured in Bangladesh.

# Glossary

- abrade** to wear down by rubbing against something
- abrasion** erosion caused by rocks that are carried along by water
- aesthetic value** value placed on something due to its beauty
- agricultural production** using the land to produce food crops, non-food crops, industrial products and livestock
- algal bloom** the build-up of algae that can destroy ecosystems
- altitude** height of a feature above sea level
- anthropogenic** related to human activity e.g. impacts or changes in the environment
- anticline** the upward bulging of rocks caused by compression
- aquaculture** the industry of cultivating aquatic plants and farming aquatic animals for food
- aquifer** geological formation containing groundwater that can supply water to wells or springs
- arid** dry or parched, refers to regions such as deserts
- artisan mining** individual or small group mining activity carried out using minimal machinery and very basic tools, such as a bucket and spade
- ashram** a community where people (mainly Hindus) practise yoga, meditation and other spiritual activities
- atmospheric hazard** hazard event originating in the atmosphere e.g. storms, tropical cyclones
- ballast water** water held in tanks and cargo holds of ships to increase stability and manoeuvrability while under way
- baptism** a ceremony purifying the spirit through contact with holy water
- bedding plane** surface between layers of deposited materials or sandstone that make up sedimentary rocks
- bias** a particular interest or view that limits one's ability to make a fair judgement
- bilateral** between two nations
- biodiversity** the variety of living organisms and the environments they form
- biophysical processes** interconnected sequences that form and transform natural environments in a cause-and-effect relationship e.g. erosion, deposition, soil formation, nutrient cycling
- blue water** fresh water in lakes or rivers
- bores** holes drilled into the ground to extract groundwater
- burning** ritual practice of setting fire to areas of bushland for environmental purposes and to attract wildlife to the new growth
- calcite** the main mineral in limestone and marble, composed of calcium carbonate
- caldera** large basin-shaped depression caused when the summit of a volcano collapses into the magma chamber below or explosions destroy the summit
- capacitors** passive electronic components – i.e. they do not require extra electricity to function – that, in a circuit, hold a voltage or a charge, for a specific period of time when the electronic device is unplugged from electrical outlets
- cartographic conventions** accepted practices associated with constructing and interpreting maps e.g. using a border, orientation or compass point, legend or key, title, scale, giving latitude readings before longitude etc.
- catchment area** the area drained by a river or water body. Also known as river basin.
- cay** a small, low island on a coral reef formed of sand and/or coral pieces
- channel** the hollowed-out path formed by a river or stream
- characteristics** the tangible and intangible elements of a place or environment

- cholera** an infectious disease caused by contaminated water; it causes severe vomiting, cramps and diarrhoea, and can often be fatal
- city** a larger town; in Australia this is generally defined as being a metropolitan area
- climate** the average types of weather, including seasonal variations, experienced by a place or region over a long period of time
- climate change** a long-term change in regional or global climate patterns e.g. annual precipitation, frequency of weather events
- coastal zone** where the sea and the land meet
- collision plate boundary** the point where two plates of similar strength or speed collide
- commodity** a resource that can be bought and sold
- communism** a type of political system that has been in place in China since 1949
- community** a group of people sharing the same locality or similar interest
- compromise** an agreement or a settlement of a conflict that is reached by each side making allowances
- condensation** the process whereby water molecules join together and so change the water from a gaseous to a liquid state
- conflict minerals** minerals mined in areas where there is armed conflict and human rights abuses
- conservation covenant** a promise contained in a deed (like a contract) which is binding upon the current owner and all future owners. It defines the limitations, conditions or restrictions on the use of that land.
- conservationists** people who work to protect the natural environment and its living organisms
- constructive forces** those that build new landforms or add to those already there
- continuous resources** resources that are in no danger of being used in excess of their long-term availability
- convective rainfall** caused when air containing water vapour is drawn upwards due to heating of the Earth's surface (e.g. in tropical regions)
- convergent (subduction) plate boundary** the point where two plates are moving towards each other and collide, with one plate being pushed beneath the other; the lower plate is the 'subducted' plate
- Country/Place** Country is a space mapped out by physical or intangible boundaries that individuals or groups of Indigenous peoples occupy and regard as their own. It is a space with varying degrees of spirituality. Place is a space mapped out by physical or intangible boundaries that individuals or groups of Aboriginal and Torres Strait Islander peoples occupy and regard as their own. It is a space with varying degrees of spirituality.
- cubic metres** the volume of a cube with edges 1m in length (equal to 1000 litres)
- cultural groups** people belonging to or identifying with a nationality, ethnic group, religion or social group with a distinct culture
- cultural value** the emphasis placed on something for its importance and place in society, such as the inclusion of water in rituals, heritage and the Dreaming
- culture** the customs, habits, beliefs, social organisation and ways of life that characterise different groups and communities
- custodial responsibility** the obligation that Aboriginal and Torres Strait Islander peoples care for the Country/Place on which they live, even if they are not traditional owners of that Country/Place. Traditional owners have primary responsibility for Country/Place.
- Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys** measure changes in the surrounding water pressure as well as sea floor water pressure
- delta** fan-shaped deposit of river sediments found at the mouth of a river
- demographic** a group of people defined by a particular shared characteristic

- deposition** the process of eroded material being deposited
- depressions** sunken places or hollow surfaces
- destructive forces** those that wear down and degrade landforms, infrastructure and property
- development** economic, social and political changes that improve the wellbeing of people
- dhari** a type of headdress (Torres Strait Islands)
- disaster** when a hazard results in extensive damage to people, places and environments
- distribution** the way in which something is shared out among a group or spread over an area
- divergent plate boundaries** the point where plates are pulled apart, allowing molten rock to emerge at the Earth's surface
- drainage network** pattern of gullies, streams, rivers and lakes in a drainage basin that allows water to flow to the lowest point
- Dreaming** a central concept in Aboriginal culture that explains how the world works through creation stories
- earthquake** the result of the Earth's tectonic plates moving against each other
- ecological** the relationship between living organisms and their environment
- economic value** a dollar amount placed on an asset to show how much it is worth
- economic water scarcity** a situation in which a place has adequate local supplies to meet its water needs, but lacks money to create the infrastructure for the population to access safe drinking water
- elevation** height above sea level
- endemic** native to a country, not found anywhere else in the world
- environment** the living and non-living elements of the Earth's surface and atmosphere. Where unqualified, it includes human changes to the Earth's surface e.g. croplands, planted forests, buildings and roads.
- environmentalist** a person who acts to preserve the quality of the natural environment
- environmental quality** the characteristics of an environment or place that affect people's physical and mental health and quality of life e.g. the extent of air and water pollution, noise, access to open space, traffic volumes, the visual effects of buildings and roads
- environmental resources**, *see* **natural resources**
- environmental worldview** a person's view of the relationship between humans and nature e.g. *human-centred worldview*: humans are separate from nature and any environmental problems can be solved by technology; *earth-centred worldview*: humans are a part of, and dependent on, nature and have to work with nature to resolve environmental problems
- Equator** a reference point on Earth that has 0° latitude and is the same distance from the North and South Poles. It divides the Earth into the Northern and Southern Hemispheres.
- erosion** the wearing away of the surface of the Earth by the action of wind and water
- estuary** a body of water formed where fresh water from rivers and streams flows into the ocean, mixing with the seawater
- ethical protocols** the application of fundamental ethical principles when undertaking research and collecting information e.g. confidentiality, informed consent, citation and integrity of data
- evaporation** the part of the water cycle where water changes from a liquid into a gas and escapes into the atmosphere
- exotic** not native to an area, usually introduced from another ecosystem or country
- extinction** disappearance of a species
- fair trade** trade based on the buying and selling of products (usually from poorer nations) that have been mined, grown or manufactured under humane working conditions, with appropriate wages for the workers and minimal environmental impact

- fault lines** lines on the earth's surface that trace a break
- features** the tangible elements of a place or environment
- field sketches** annotated line drawings created to record features of an environment during fieldwork activities
- flood** a large overflow of water that drowns areas of land, usually causing extensive damage to those areas
- flood peak** the highest point that floodwater reaches
- flood plain** low-lying ground that is subject to flooding from a nearby river
- food security** when all people at all times have physical and economic access to sufficient, safe, nutritious food to maintain healthy and active lives
- footloose** an industry that can relocate easily
- freehold** a form of land ownership, which is inherited or held for life
- freight** to transport goods in bulk by truck, train, ship, or aircraft
- geographical challenges** issues and problems arising from interactions between people, places and environments that threaten sustainability e.g. biodiversity loss, food insecurity, inequality
- geographical concept** a key notion or idea that helps us to explore, understand and explain features, patterns and relationships on the Earth's surface
- geographical data** quantitative or qualitative information about people, places and environments
- geographical processes** the physical and human forces that work in combination to form and transform the world e.g. erosion, the water cycle, migration and urbanisation. Geographical processes can operate within and between places
- geographical questions** questions that inquire into the spatial and environmental dimensions of places and environments
- geographic information systems (GIS)** systems for storing, managing, analysing and portraying spatial data
- geomorphic hazard** hazard events originating in the lithosphere e.g. volcanic eruptions, earthquakes, tsunamis and mass movement (landslides or avalanches)
- geomorphic processes** natural processes that transform the lithosphere to create distinctive landscapes and landforms e.g. erosion, weathering, tectonic activity
- geomorphology** the study of landscapes and landforms, and the processes that have made them the way they are
- ghats** steps leading down to the Ganges River
- global citizenship** our rights and responsibilities as citizens of the global community as well as our rights and responsibilities as citizens in our local community and the country we live in
- globalisation** the process by which the world is becoming more interconnected, with an increase in social and economic integration between countries (e.g. an increase in international trade and communication)
- global positioning systems (GPS)** navigation systems that provide location and time information anywhere there is a line of sight to GPS satellites
- greenhouse effect** refers to the sun's energy that enters the Earth's atmosphere; some of it is absorbed by the land and water, and the rest is reflected back into space, but some of the energy reflected becomes absorbed or 'trapped' by greenhouse gases in the atmosphere
- green space** an area of grass, trees or other vegetation set apart for recreational purposes in an urban environment

- green water** moisture in the soil
- groundwater** the water located beneath Earth's surface filling the spaces between grains of soil or rock. It slowly flows through aquifers; it connects with rivers, streams, lakes and wetlands; it feeds trees and vegetation.
- hi-tech** products and technology that are complex, and that use or produce the latest advances in computers and electronics
- human geography** the study of the different ways in which human societies develop and operate in relation to their physical environment
- human wellbeing** the quality of life of a population
- humidity** the amount of water vapour in the air
- hydraulic action** the process of waves compressing air within gaps in the rock, and this air being explosively released when the waves retreat
- hydraulic erosion** erosion caused by the power of water and gravity
- hydrologic hazard** hazard events originating in the hydrosphere from changes to the water cycle e.g. floods and droughts
- hypothesis** a proposition made on the basis of limited evidence, used as the starting point for further investigation
- ICT** information and communications technologies; tools that help people connect with each other, such as the internet or mobile phones
- identity** the way you see yourself and the way others perceive you
- Indian monsoon** seasonal heavy rains that fall in the Himalayan regions of south Asia
- industrialisation** the modernisation of a country, involving large-scale infrastructure development, economic growth and development of more efficient, mechanised methods of production
- infrastructure** structures and services needed for society to operate properly, such as transport, water supply, health services and education systems
- internal migration** the movement of people from living in one defined area to living in another within a country e.g. movement from cities to non-metropolitan coastal locations, or between states and territories
- international migration** the voluntary or forced movement of people between countries
- internet** a worldwide interconnected network of computers
- investment** spending money on something for a financial reward or return
- joint planes** vertical, horizontal and angled patterns of cracks in rocks
- karren** small grooves or furrows in rock (usually limestone) formed by running water
- land degradation** degradation of the health of land resources through human actions in ways that threaten their ability to maintain their environmental functions e.g. salinity, accelerated soil erosion, loss of biodiversity and habitats
- landform** the individual surface features of the Earth identified by their shape e.g. dunes, plateaus, canyons, beaches, plains, hills, rivers, valleys
- landscape** a landscape is an area, created by a combination of geological, geomorphological, biological and cultural layers that have evolved overtime e.g. riverine, coastal or urban landscapes
- landscape quality** the human value placed on the condition and aesthetic appeal of a landscape
- latitude** distance from the Equator measured in degrees north or south
- leeward** downwind, or where air sinks
- levee** a sediment embankment bordering a channel
- liveability** an assessment of what a place is like to live in, using particular criteria such as environmental quality, safety, access to shops and services and cultural activities

- liveability criteria** characteristics used to assess the liveability of places or their contribution to people's quality of life e.g. safety, healthcare, education, infrastructure and environment
- liveability index** a measure of liveability/quality of life based on a set of criteria and used to rank places. Used principally to rank the world's largest cities by the quality of life they offer.
- longitude** degrees east or west of Greenwich
- longshore drift** the movement of sediment, usually sand, shingle or mud, along a coastline driven by the direction of the prevailing wind
- low pressure system** a weather pattern in which atmospheric pressure at sea level is below that of surrounding locations
- map** a diagrammatic representation of particular features of a place, usually drawn on a flat surface
- mariculture** the cultivation of fish and other marine life for food – a type of aquaculture
- meandering** a series of wide curves and loops of a river channel when viewed from above
- megacities** cities with a population greater than 10 million
- Mesopotamia** the region around the Tigris and Euphrates rivers – modern-day Iraq
- meteorologists** people who study weather and climate
- metropolitan** pertaining to a large city, its surrounding suburbs and other neighbouring communities
- migration** movement from one location to another
- monocline** a simple fold that occurs singularly rather than as part of a series of anticlines and synclines
- monsoon** seasonal winds that bring torrential rainfall
- multicultural** describing a society that reflects and is open to many different cultures
- natural hazard** when the forces of nature combine to become destructive and have potential to damage the environment and endanger communities e.g. bushfires, tropical cyclones, floods, earthquakes
- natural resources** resources provided by nature. Resources can be classified as renewable, non-renewable and continuous. Also known as environmental resources.
- non-renewable resources** resources that are unable to be naturally replenished and sure to be used up at the human rate of use
- north–south divide** the gap between the economically 'richer' and economically 'poorer' countries of the world
- orographic rainfall** caused when masses of air containing water vapour are forced upwards by physical features such as mountain ranges
- outsourcing** contracting part of a business function to another person or business
- pastoral zone** inland areas of Australia where the climate is too dry to sow pasture or crops but livestock can be grazed on native vegetation
- peninsula** a piece of land going out into water from a larger land mass
- perception** people's assessment of places and environments
- personal mobility** one's ability to move around
- personal needs** needs of an individual rather than of the family or the community
- physical geography** the study of the natural features of the earth, such as mountains and rivers
- physical water scarcity** a situation in which a place lacks local supplies of water to sustain current standards of living
- place** an area that has a specific meaning or purpose
- political map** a map showing territorial boundaries between or within countries e.g. states and territories

- population density** the number of people in an area of land usually expressed as a number per square kilometre
- precipitation** forms of water falling from the atmosphere to the Earth's surface e.g. rain, hail, snow, sleet
- primary data** original materials collected by someone e.g. field notes, measurements, responses to a survey or questionnaire
- principles** rules or morals that a person or company/group decides to follow
- public transport** a form of transport that can be used by any member of the public, whether free of charge or for a fee
- pumice** a light-coloured rock with many holes (vesicles) due to gases mixing with rapidly solidifying lava and trapping multiple air bubbles. Pumice is light and floats on water.
- qualitative methods** explanatory and interpretive methods e.g. participant observation, focus group discussion or interviews, which are used to gather qualitative data
- quantitative methods** statistical and other methods used to analyse quantitative data
- quartz** rock composed of silicon dioxide; a hard mineral that resists weathering
- recreational value** the emphasis people place on something in terms of its leisure purposes and enjoyment
- recumbent folds** those that have folded over themselves or appear to have flopped over, strongly folded and squeezed into sharp folds as a result of great horizontal pressure
- relative location** location relative to other places e.g. the distance of a town from other towns
- remoteness** distance, a very distant situation
- renewable resources** resources that can be replenished in a relatively short amount of time through reproduction or other biophysical processes
- reticulated** the system of pipes and drains that takes raw sewage from a dwelling to a sewage treatment plant, removing the need for open channels that smell and are unhygienic. Importantly, reticulated systems decrease the likelihood of contaminated water and prevent the spread of disease.
- ribbon development** the spread of urban areas along transport routes, such as main roads, bus routes, railway lines and coastlines.
- Richter scale** developed by Charles Richter and Beno Gutenberg to measure the severity of earthquakes. The scale was based on a logarithmic progression so that an earthquake of magnitude 5 was 10 times stronger than a quake of magnitude 4
- riverine** associated with rivers
- river mouth** the end of the river system where water exits into a sea or lake
- run-off** water (from precipitation) that flows over the land and collects in rivers, lakes, seas and oceans
- rural** areas with a low population count that are located far away from the nearest urban centre
- safety** being protected from or in a condition or place where there is unlikely to be danger or risk of harm
- sea changers** colloquial term for people who opt for what they perceive as an improved quality of life by the coast
- seascape** a view of the sea
- secondary information sources** sources of information that have been collected, processed, interpreted and published by others e.g. census data, newspaper articles, and images or information in a published report
- sediment** material eroded from the land and river banks by water and deposited elsewhere
- seismic** relating to vibrations of the earth due to earthquakes

- seismometer** a device that measures the movement of the Earth's crust (the ground)
- self-determination** freedom to live as one chooses
- semi-detached houses** two houses that are joined by a shared wall
- service centres** settlements (villages, towns and cities) that have shops and services such as education, health and banking. Larger service centres (cities) have a greater range of services than smaller service centres.
- severe storms** storms, including thunderstorms and cyclones, which cause serious damage to the country
- shareholder** a person with a financial interest in a company
- siltation** sand or earth being carried by running water and forming sediments in marine areas or water reservoirs
- social connectedness** a measure of the number and strength of people's social relationships with other people in the same place, or in other places via face-to-face connections or electronic methods. The opposite of good social connections is social isolation, or loneliness.
- socio-cultural** relating to both society and culture
- spatial distribution** the location and arrangement of particular phenomena or activities across the surface of the Earth
- spatial variation** the difference or variation in natural and human features over an area of the Earth's surface e.g. water, population, Gross Domestic Product (GDP), life expectancy
- state** a form that matter might take. Water has three states: solid (ice), liquid and gas (vapour).
- stewardship** responsible planning and management of resources
- storm surge** an increase in the height of coastal waters as a result of onshore winds, usually associated with a cyclone
- subduction collision** where one plate sinks down beneath another plate
- sublimation** the process where a solid becomes a gas directly without becoming a liquid first
- subsistence** collection or production of food for oneself and one's family, but not for sale
- swale** low-lying land between two sand dunes
- syncline** the downward squeezing of rocks caused by compression
- tantalum** a heat-resistant powder, refined from ores such as coltan (columbite-tantalite), that can hold a high electric charge
- tectonic activity** movement of layers of the Earth's crust known as plates that move and float
- tectonic plates** layers of the Earth's crust that move and float
- terrace** a 'platform' of fairly flat land, often a former flood plain that has become stranded by later down-cutting by the river
- terraces** rows of houses that share their side walls
- tidal range** difference in height between low tide and high tide
- topographic map** a detailed, large-scale map of part of the Earth's surface which illustrates the shape of the land and selected natural and human features from the surrounding environment
- topography** the relief and configuration of a landscape, including its natural and human features
- totem** an object representing an animal or plant that is of special significance to a particular group or family
- tower karst** towers or pinnacles remaining after limestone has been weathered in tropical regions
- town** a built-up area somewhere between a city and a village in size
- trade** the buying and selling of goods and services
- trade route** the trade between an origin group of countries and a destination group of countries

**transform plate boundary** the point where two plates slide, grate or jerk past one another

**transnational companies** companies that operate in more than one country

**transpiration** the process whereby water is released into the atmosphere through evaporation and the transpiration of plants or animals

**tributaries** smaller rivers that flow into larger rivers

**troposphere** the atmospheric layer closest to the ground, containing 99% of the atmosphere's water vapour

**tsunami** a series of ocean or lake waves with enormous destructive potential, usually created by an undersea earthquake

**turbid** cloudy or muddy

**urban** areas with a high population and easy access to services

**urbanisation** the process of economic and social change in which an increasing proportion of the population of a country or region live in urban areas

**water cycle processes** the physical changes to water that change its state and geographical location e.g. evaporation, precipitation

**water scarcity** the lack of sufficient available water resources to meet demand

**watershed** a geographical region drained by its river and tributaries

**weather** the condition of the atmosphere at a point in time e.g. temperature, humidity

**weathering** the breakdown of rocks and sediments into smaller particles or a solution

**wetland environment** an area of land that is saturated with water, either permanently or periodically. It is an important ecosystem with a unique set of animals and plants.

**wharf** a human-made landing place for ships on a shore

**wheat-belt zone** agricultural area where wheat is grown

**windward** upwind, or where air lifts

**world wide web (www)** the sites and pages that are connected across the internet

# Index

- Aboriginal and Torres Strait Islander peoples  
art 54–5, 300  
burning practices 62, 85–6  
connection to land  
    ('Country') 45, 48–50, 84, 178  
Dreaming stories 45, 48, 54, 84, 300  
importance of water 299–300  
landscape use and  
    management 62, 84–8  
perceptions of liveability 178  
protection of significant  
    landforms 87–8  
in remote areas 147  
self-determination 87  
abrasion 27, 238  
Accessibility/Remoteness Index  
    (ARIA) 147, 341, 342  
aquifers 209  
Adelaide, SA: liveability 196–7  
aeolian processes 32  
aesthetic value: landscapes and  
    landforms 45  
Africa: mobile phones 348, 349, 350  
ageing population 154  
agriculture  
    impact on landscape 64–5  
    use of freshwater 272, 273, 287–8  
    water pollution from 273  
air freight 378  
algal blooms 273, 275  
altitude: and water resources 230  
Amazon River 215, 258–9  
Anangu people 53  
Andes 248  
Antartica 224, 249  
anthropogenic systems 6  
anticlines 39, 41  
aquaculture 63, 64  
arid landscapes 25  
    deposition 32  
Armidale, NSW 178–9  
artisan mining 372  
arts and cultural landscape 146  
ashrams 183  
atmospheric hazards 160  
Australia Disaster Management  
    Platform 100  
Australian Bureau of Statistics:  
    State of the Environment  
    Report 158  
ballast water 66  
Bangkok, Thailand: traffic  
    problems 168  
Bangladesh: factory  
    conditions 392, 393  
baptism 297  
bedding planes 34  
Bega, NSW 189  
bias 18  
'The Big Dry' drought 240  
bilateral trade 365–6  
biodiversity 65  
biophysical processes 27  
blue water (surface water) 209,  
    225  
Boolcoomatta conservation  
    area 74  
bores 244, 287–8  
bottled water 295  
Bribie Island, Qld 114  
'Building Better Cities'  
    program 151  
bushfires 161–2, 186–7  
Cairns, Qld: climate 232  
calcite 34  
calderas 41, 42  
capacitors 372  
Cape Town, South Africa  
    115–17  
cartographic conventions 16  
catchment areas: water flows  
    within 226–7  
caves 34, 35, 36  
Centre for Disaster Management  
    and Public Safety  
    (CDMPS) 100  
change: as geographic  
    concept 8–9  
channels 25  
China  
    economy 369–70  
    growth of industry 367  
    industrial clusters 369  
    population density 370  
    ports 289, 290, 293, 294  
    production and consumption  
    patterns 357  
Special Economic Zones  
    (SEZ) 367, 368  
Three Gorges Dam 275, 280  
trade with Australia 365–6  
cholera 138, 314, 315  
Christchurch: New Zealand;  
    earthquake 105  
climate 26–7  
    and liveability 111–15  
    types in Australia 245  
climate change 63  
    impact on floods 311  
    and water resources 234–6  
climate graphs 19  
coastal industries: impact on  
    landscape 66–7  
coastal landscapes  
    deposition 28–9  
    recreation and tourism  
    pressures 59–61  
    urban development  
    pressures 59  
coastal sustainability and adaptation  
    principles 81–3  
coastal zone 65  
cold fronts 249–50  
collision plate boundaries 37, 39  
coltan 371–2  
commercial fishing 65–6, 288  
commodities 294  
communicating geographical  
    information 13–14  
communication technologies 346–  
    52  
communism 367  
communities  
    role in enhancing  
    liveability 199–200  
    types 176  
community identity  
    and culture 177–9  
    and environment 180–1  
    influencing factors 176–83  
    and public events 182  
    and religious beliefs 182–3  
    and water uses 296–7  
compromises 199  
condensation 212, 224  
conflict: and environmental  
    quality 166–7  
conflict minerals 372  
Congo River 215

- conservation covenants 74  
 conservation zones 75  
 conservationists 252  
 constructive forces 26  
 consumer goods  
   effect on places 389–95  
   impacts of production and  
     consumption 383–8  
 continuous resources 118  
 convective rainfall 229, 230,  
 246–8  
 convergent (subduction) plate  
 boundaries 36  
 Coober Pedy, SA: climate 232–3,  
 250  
 coral cays 68  
 Coriolis effect 165  
 crime rate 123–5  
 cubic metres 258  
 cultural activities 328–9  
 cultural groups 120  
 cultural identity: and use of  
   water 296–7  
 cultural value 45  
   landscapes and landforms 48–52  
 culture  
   and community identity 177–9  
   and liveability 120–1  
 custodial responsibility 178
- dam-building projects 217–18,  
 274–5  
 Danube River 215  
 Deep-ocean Assessment and  
 Reporting of Tsunamis  
 (DART) buoys 100, 101  
 deforestation 386  
 deltas 30  
 Democratic Republic of the Congo  
 (DRC) 372  
 deposition 26  
   in arid landscapes 32  
   in coastal landscapes 28–9  
   in karst landscapes 34–6  
   in riverine landscapes 29  
   tectonic activity 36–8  
 depressions 28  
 desalination plants 280–3  
 deserts  
   Antarctica 224  
   in Australia 33  
   temperature and rainfall 34
- destructive forces 26  
 diarrhoeal diseases 139  
 divergent plate boundaries 36, 37  
 Dodson, Mick 48  
 dolphin feeding 336  
 domestic trade 361  
 drainage networks 27  
 Dreaming stories 45, 48, 54, 84,  
 300  
 drones 103  
 drought 160–1, 236, 240, 311  
 Dubbo, NSW: transport in 141–2
- earthquakes 93–4  
   aftershocks 92  
   Christchurch, New Zealand,  
     2011 106  
   early warning systems 100  
   and toad behaviour 101  
   Tohoku, Japan, 2011 91  
   and tsunamis 92, 93, 94–5  
 economic status: and perceptions  
   of liveability 121–3  
 economic value  
   of landscapes and  
     landforms 52–5  
   of water 293–6  
 economic water scarcity 267, 268  
 Economist Intelligence Unit (EIU)  
   Global Liveability Index 144  
*Economist Intelligence Unit  
 (EIU) Global Liveability  
 Survey* 126–7, 196  
 economy: impact of water  
   cycle 238–9  
 education: access to 144, 172  
 education industry 363  
 El Niño 235–6, 310–11  
 electronic devices: raw  
   materials 371–2  
 employment: and social  
   connectedness 189  
 endemic species 75  
 environment  
   and community identity 180–1  
   as geographical concept 6  
   impact of water cycle 237–8  
 environmental quality  
   and conflict 166–7  
   factors that reduce 160–9  
   impact of liveability 170–3  
   and land degradation 168–9
- and natural hazards 160–5  
 nature of 111, 158  
 and population pressures 167–  
 8  
 environmental worldview 110  
 environmentalists 8  
 Equator 228  
 erosion 26, 27–8, 238  
 estuaries 28  
 ethical protocols 11  
 Ethiopia 271  
 Europe  
   housing 136–7  
   political map 109  
 evaporation 214, 223–4  
 exotic species 66  
 exports 363  
 extinction of species 65
- Facebook: users by world  
   region 352  
 facilities *see* infrastructure  
 fair trade movement 398–9  
 Fair Trade Organization (FTO)  
   Mark 400  
 Fairtrade International 399  
 Fairtrade Labelling Organization  
 (FLO) 399  
 FAIRTRADE Mark 399  
 farmers markets 359–60  
 fault lines 37  
*favelas* 135  
 features 7  
 Federation Drought 240  
 field sketches 16  
 fieldwork 11, 16  
 fieldwork reports 16–17  
 fishing  
   commercial fishing 65–6, 288  
   recreational fishing 292  
 flood plains 25  
 floods 307–8  
   flood peak 314  
   impact of climate change 311  
   management strategies for  
     future 317–18  
   in Pakistan in 2010 312–15  
   responses to 316–17  
 flowline maps 15  
 food labelling 397  
 food miles 360  
 food security 168

- footloose industries 373  
 freehold 87  
 freight transportation 361, 378–9  
 freshwater resources  
   access to 268–70  
   availability across  
     Australia 245–57  
   conflicting uses 272–3  
   desalination plants 280–3  
   distribution 216  
   extent of 208, 215–16  
   forms 209–12  
   variations between  
     continents 258–63  
     and water scarcity 268–70
- Ganges River 183, 220  
 gas wells 66, 67  
 geographic information system  
   (GIS) technology 101–2  
 geographical challenges 10  
 geographical concepts 3–9  
 geographical data 18  
 geographical information  
   acquiring 9–11  
   analysing 13  
   collecting, recording, evaluating  
     and representing 11  
   communicating 13–14  
   conclusions from 13  
   interpreting 12–13  
   observing, questioning and  
     planning 9–10  
   processing 12–13  
 geographical processes 7  
 geographical questions 9  
 geographical skills 9–14  
 geographical tools 14–20  
 geology: and water  
   resources 233–4  
 geomorphic hazards  
   causes 93–6  
   definition 91  
   spatial distribution of  
     disasters 91–2  
   strategies for reducing  
     impact 98–103  
 geomorphic processes 26  
   causing geomorphic  
     disasters 93–6  
 geomorphology 91  
 ghats 183
- Global Cities Index* (GCI) 127–8  
 global citizenship 383  
 global connectivity: impact  
   of 354–6  
 global positioning system  
   (GPS) 17  
 globalisation 289, 290, 383, 389,  
   390  
 Gondwana 62  
 government policies 396  
 Grand Ethiopian Renaissance  
   Dam 217–18  
 graphs 18–19  
 Great Artesian Basin 244  
 Great Barrier Reef  
   impact of human activity 68–9,  
     169  
   tourism 68, 69  
 Great Dividing Range 230, 232,  
   248  
 green spaces 151  
 green water (soil moisture) 209,  
   213, 233–4  
 greenhouse effect 234  
 greenhouse emissions 386  
 grey water (waste water) 210,  
   278  
 groundwater 209, 213, 244  
 Gulf War 166–7
- Halong Bay, Vietnam 190  
 Harris Park, Sydney 121  
 Hawaii Volcanoes National  
   Park 50–2  
 Hawaiians: cultural and spiritual  
   value of landscape and  
   landforms 50–2  
 health care services: access  
   to 144, 172  
 Hectorville, Adelaide 121  
 hi-tech products and  
   technology 373  
 Himalayas 41  
 Hinduism 183  
 housing  
   affordability 170–1  
   availability 136–7, 172  
 human wellbeing 158  
 humidity 229  
 hurricanes 163  
 hydraulic action 28  
 hydraulic erosion 238
- hydrologic hazards 160  
 hypotheses 9
- ice 211  
 identity 45  
 imports 363  
 Indian monsoon 312  
 Indigenous art: landscapes and  
   landforms in 54–5  
 Indonesian Sustainable Palm Oil  
   (ISPO) standard 396  
 industrialisation 289  
 infiltration 224  
 information 345  
 information and communications  
   technologies (ICT): and  
   people's connections to  
   places 344–53  
 infrastructure 135  
   arts and cultural landscape  
     146  
   education 144  
   health care services 144  
   housing availability 136–7  
   impact of limited availability and  
     access 150–4  
   recreational facilities 145  
   in remote Australia 147–9  
   transportation networks 140–3  
   water and sanitation 138–9  
 integrated catchment  
   management 276–7  
 interconnection: as geographic  
   concept 7  
 internal migration 112  
 international business 363  
 International Federation of  
   Alternative Traders  
   (IFAT) 400  
 international migration 120–1  
 internet 344  
   extent of communications 347  
   global usage 345  
   penetration by world  
     region 346  
 interstate business 361  
 irrigation 253–4, 255, 257
- Japan  
   high-speed railway 184  
   nuclear disaster following  
     tsunami 95, 98

- responses to tsunamis
    - disaster 97–9
    - Tohoku earthquake and tsunamis 91–2
  - Japan Self-Defense Forces (JSDF) 97, 98
  - Jindalee, Perth, WA 121
  - joint planes 34
- Kane, Herb 50
- Kari-oca Declaration 49
- karren 35
- karst landscapes 41
  - deposition 34–6
- Kenyan Farmers Helpline 348
- Kilauea 50
- La Niña 235–6, 310–11
- land degradation 68
  - and environmental quality 168–9
- landforms
  - aesthetic value 45
  - cultural and spiritual value 48–52
  - definition 25
  - economic value 52–5
  - and perceptions of
    - liveability 115–16
  - protection of significant sites for
    - Aboriginal and Torres Strait Islander peoples 87–8
  - types 25
- landscape degradation 68–9
- landscape management and protection
  - Aboriginal and Torres Strait Islander peoples 84–8
  - levels of 74–7
  - strategies 78–83
- landscapes
  - aesthetic value 45
  - and building and development 58–9
  - cultural and spiritual value 48–52
  - definition 25
  - economic value 52–5
  - impact of human
    - activities 63–7
  - types 25
  - uses and changes to 57–60
- laptop computers
  - assembly 374–5
  - manufacturing of
    - components 374
  - purchasing of 375
  - raw materials 371
- L'Aquila earthquake 101
- large-scale maps 15
- latitude 5
  - and water resources 228–30
- Laurasia 62
- leeward side 232
- leisure activities 328–9
- levees 25
- limestone terrain 34–6, 41
- liveability
  - characteristics 193–7
  - and climate 111–15
  - criteria 120
  - and culture 120–1
  - enhancing 197–200
  - environmental factors 111–19
  - human factors 120–6
  - income and employment
    - 121–3
  - and landforms 115–16
  - measuring 126–8
  - and natural resources 118–19
  - nature of 111
  - and open spaces 187
  - personal criteria 129
  - and personal safety 123–6
  - of Pyrmont, Sydney 153–4
  - strategies for improving 200–1
  - surveys 126–7
- liveability *see* environmental quality; infrastructure
- liveability index 127–8
- liveability rankings 195–6
- local farmers markets 359–60
- local government: landscape management and protection 74
- London underground railway 140, 141
- longitude 5
- longshore drift 28
- low pressure systems 305–6
- M-Farm 348
- Malaysia 270, 385
- manufactured good 363
- maps 14–16
  - conventions 16
  - types 15
- mariculture 64
- Martu people 86
- Mauna Loa 50
- meandering of river channels 30
- meeting places: and social connectedness 187–8
- megacities 196
- Mekong Delta 259–60
- Mekong River 259
- Mesopotamia 287
- meteorologists 161, 311
- migration
  - internal migration 112
  - international migration 120–1
  - patterns and trends 323
  - and urban population
    - growth 330–1
- minerals 371–2
- mining industry 363, 366
- mobile phones 347–50
- mobile technology: issues 350–1
- Monkey Mia, Western Australia 336
- monoclines 40
- monsoon 229, 246–8, 312
- motor sport 334–5
- mountain landscapes
  - formation 39
  - landforms 39–40
- Mt Everest 41
- Mt Pinatubo 41
- multicultural societies 120, 177
- Mumbai, India: pollution 167
- Murray–Darling Basin 240, 244, 251–7, 258
- Nakaru, Kenya 138, 171–2
- Namitjira, Albert 55
- national governments: role in enhancing liveability 198
- national parks and reserves 74–5
- natural hazards
  - causes 309–10
  - and environmental quality 160–5
  - impacts and responses to 312–15
  - nature of 91
  - spatial distribution 309–10

- types 160, 304
- natural resources 117
  - and liveability 118–19
- New Zealand: Christchurch
  - earthquake 105
- Nile River 217–18, 271
- non-government organisations (NGOs) 199
- non-renewable resources 118
- north–south divide 369, 391, 396
- Northern Australian Indigenous Land and Sea Management Alliance (NAILSMA) 87
- NSW Rural Fire Service 186–7
- nuclear disasters 95
- Nullarbor Plain 41
- Nyungar people and culture 48, 84–5, 87–8
  
- Ob River 261
- ocean agriculture 288
- ocean currents 28–9
- oil wells 66, 67
- Olympic Games
  - London 2012 291
  - Rio 2016 292
- One Laptop Per Child (OLPC)
  - project 354–6
- open spaces: and social connectedness 187
- oral presentations 14
- Orange, NSW 270
- orographic rainfall 230, 246, 248–9
- outsourcing 374
- Oxfam 348, 399
  
- Pacific Pines, Gold Coast 121
- Pakistan: 2010 floods 312–15
- palm oil 384–5
- palm oil production
  - economic impacts 388
  - environmental impacts 386
  - and government policies 396–7
  - in Indonesia and Malaysia 385
  - promotion of ethical production 397, 400, 401
  - social impacts 387–8
- Pangaea 62
- pastoral zone 64
- penguins 60, 334, 335
- peninsulas 150
- perceptions 110
  
- percolation 224
- personal mobility 331
- personal needs 199
- Phillip Island, Vic. 60, 333–5
- physical water scarcity 267
- pictorial maps 15
- place
  - as geographical concept 3, 109
  - identification and connection with 110
  - sense of 45
- political maps 15, 109
- pollution
  - from agriculture 171, 273
  - from mining operations 170
  - from urban areas 274
  - industrial waste 171–2, 274
  - and liveability 167–8, 170, 171–2
  - of waterways 273, 274
- population: overseas-born
  - Australians 177
- population density
  - Australia 58–9, 342
  - China 370
  - Pakistan 314
- population distribution 114, 256, 330, 342
- population growth 330, 331
- population pressures: and environmental quality 167–8
- Port Hedland, WA 170–1
- Port Macquarie, NSW 115
- ports 66, 67, 289, 290, 293, 294
- precipitation 26, 224, 245–50, 251
- primary data 11
- primary goods 363
- principles 395
- processing geographical information 12–13
- production and consumption
  - countries of 374–5
  - impacts of consumer goods 383–8
  - laptop computers 374–5
  - minimising negative effects 396–401
  - and waste reduction 395
- public events: and community identity 182
- public transport 142, 143, 184
- pumice 41
  
- Pymont, Sydney: urban renewal and liveability 150–4
  
- qualitative methods 18
- quantitative methods 18
- quartz 27
  
- rail freight 379
- rainfall
  - in Australia 245–50, 310–11
  - convective rainfall 229, 230, 246–8
  - and latitude 229
  - orographic rainfall 230, 246, 248–9
  - population and average rainfall distribution in Australia 256
  - world averages 214
- raw materials: sources of 371–2
- recreation
  - pressures on coastal landscapes 59–60
  - use of water resources 291–2
- recreational facilities: availability of 145
- recreational value 291
- recumbent folds 40
- recycling water 277–9
- reflection 14
- relative location 147
- relief maps 15
- religious beliefs: and community identity 182–3
- remote areas: accessing services and facilities 147, 170–1
- remoteness 147, 148, 149
- renewable resources 117
- reticulated sewage systems 139
- ribbon development 58
- Richter scale 91
- ‘Ring of Fire’ 37
- river management:
  - integrated catchment management 276–7
- river mouths 227
- riverine landscapes 25
  - deposition 29
- rivers
  - in Australia 244
  - location and rainfall 261–2
  - major rivers of world 216

- run-off and watershed population  
of major rivers 262
- road freight 378–9
- robots 103
- Roundtable on Sustainable Palm Oil  
(RSPO) 397
- run-off 214  
average run-off in Australia 215  
by continent and volume 261  
in Murray–Darling Basin 252–4,  
257
- safety: personal and public 125–6
- salt water 208, 210–11
- sanitation: access to 138–9
- scale: as geographic concept 7
- sea changers 114
- Sea World 60
- seascapes 298
- secondary information sources 11
- sediment 275
- seismic building codes 100
- seismometers 100–1
- self-determination 87
- semi-detached houses 136
- service centres 341
- service industries 363
- services *see* infrastructure
- severe storms 304, 307
- sewage treatment systems 139,  
278–9
- shareholders 390
- Shinkansen* rail network 184
- shipping 377–8
- silicon chips 371
- Silicon Valley 373–4
- siltation 64
- Singapore 203, 270–1
- sinkholes 35
- sketches 15
- small-scale maps 15
- Snowy Mountains Scheme 272–3
- Snowy River 272
- Snowy Water Inquiry 272
- social connectedness  
and employment 189  
enhancing factors 184–90  
and meeting places 187–8  
nature of 176  
and open spaces 187  
and technology 186–7  
and transport 184
- social media 351–2
- soil moisture (green water) 209,  
213, 233–4
- South Africa: Cape Town 115–17
- space: as geographical concept 5
- spatial distribution 68
- spatial technologies 19–20
- spatial variation 5
- spiritual value  
landscapes and landforms 48–  
52  
water resources 297
- state/territory governments: role in  
enhancing liveability 198
- statistics 18–19
- stewardship 87
- storm surges 304, 307
- storms 304–7
- subduction collisions 91
- subduction plate boundaries 37
- sublimation 212
- submarine volcanism 37
- subsistence 84
- Sudan 161, 271
- surface water (blue water) 209,  
225
- surfing community 180
- surveys: of liveability 126–7
- sustainability: as geographic  
concept 8
- swales 81
- Sydney 2030 plan 200–1
- Sydney: public events 182
- Sydney Cricket Ground (SCG)  
188
- synclines 39
- synoptic charts 15
- Table Mountain 116–17
- Tambora (volcano): impact of  
eruption 41–2
- tantalum 372
- technology: and social  
connectedness 186–7
- tectonic activity 26  
and volcanoes 36–8
- tectonic plates 93  
and boundary conditions 39
- terrace houses 136
- terraces 25
- thematic maps 15
- Thredbo, NSW 119
- Three Gorges Dam, China 275,  
280
- thunderstorms 306
- tidal ranges 29
- Tohoku earthquake  
aftershocks 92  
epicentre and magnitude 91,  
92  
impact 92, 95–6  
speed and height of  
tsunamis 92
- Tokyo Electric Power company  
(Tepco) 98
- topographic maps 25
- topography: and water  
resources 231–2
- Torres Strait Islander flag: symbolic  
meaning 50
- Torres Strait Islanders *see* Aboriginal  
and Torres Strait Islander  
peoples
- totems 84
- tourism  
around the world 325  
in Australia 326–8  
on Great Barrier Reef 68, 69  
impacts on Monkey Mia 336  
impacts on Phillip Island 333–5  
patterns and trends 324–8  
pressures on coastal  
landscapes 59–60  
and property development 363  
top destinations 325
- tourist attractions  
landscapes and landforms 52–3  
Uluru 53
- tower karst 35
- trade: domestic 359–61
- trade: international  
bilateral trade with China 365–6  
countries of production and  
consumption 374–5  
fair trade movement 398–9  
freight methods 377, 378–9  
links between countries 362–72  
major export and import  
markets 364  
major exports and imports 363  
shipping 377–8  
sources of raw materials 371–2  
spatial patterns of global  
trade 372–9

- traffic volumes 168  
 transform plate boundaries 36, 37  
 transnational companies 374, 389, 390, 392  
 transpiration 224, 225  
 transport  
   of freight 361  
   infrastructure 140–3, 172  
   and social connectedness 184  
 transport technologies  
   in Australia 341–3  
   connecting people to places 340–4  
   history 340–1  
 travel  
   impact on future of places 330–3  
   patterns and trends 323–8  
 tree changers 114  
 tributaries 226–7  
 tropical cyclones 163–5, 305  
 troposphere 212  
 tsunamis 92, 93, 94–5, 307  
 Tully, Qld 246  
 turbid water 28  
 typhoons 163  
  
 Uluru 53  
 United Nations 197  
 United Nations Educational, Scientific and Cultural Organization (UNESCO) 50, 53, 76  
 United Nations Environment Programme (UNEP) 187, 197  
 United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR) 98  
 university culture 178–9  
 Upper Coomera, Gold Coast 121  
 urban sprawl 331  
 urbanisation 330  
  
 Vancouver, Canada 125  
 Vietnam  
   Halong Bay 190  
   Mekong Delta 259–60  
 visual representations 20  
 Vodafone 348  
 volcanoes  
   eruptions 41–2  
   in Hawaii 50–2  
   submarine volcanism 37  
   and tectonic activity 36–8  
  
 wages 393, 394  
 walkability 144  
 Wallis Lakes area 113  
 waste reduction: and production principles 395  
 waste water (grey water) 210, 278  
 wastewater treatment plants 278–9  
 water  
   aesthetic value 297–8  
   cultural value 296–7  
   economic value 293–6  
   importance to Aboriginal and Torres Strait Islander communities 299–300  
   spiritual value 297  
 water cycle  
   economic impact 238–9  
   environmental impact 237–8  
   key processes 207, 223–6  
   movement of water 225–6  
   nature of 118, 223  
   social impact 239–40  
   water degradation 273–4  
   water diversion 272–3, 273  
 water flows  
   factors influencing 228–36  
   within catchment areas 226–7  
 water quality 277–8, 291  
 water resources  
   agricultural uses 272, 287–8  
   and altitude 230  
   availability of 228–36  
   classification 207–8  
   and climate change 234–6  
   commercial uses 288  
   as commodities 294–6  
   and distance from sea 232–3  
   forms of water 209–12  
   and geology 233–4  
   industrial uses 289–90  
   and latitude 228–30  
   perceptions of value 293–8  
   political disputes over 270–1  
   recreational uses 291–2  
   spatial distribution patterns 213–16  
   spatial variations in Australia 244  
   states of water 211, 223  
   and topography 231–2  
   urban usage 272  
   usage across the world 286  
   uses by people 286–92  
 water resources *see* freshwater resources  
 water restrictions 240, 269–70  
 water scarcity 138, 267  
   and access to freshwater 268–70  
   causes 268  
   and conflicting uses of resources 272–3  
   economic water scarcity 267, 268  
   impact 267  
   overcoming 274–9  
   physical water scarcity 267  
   and political disputes over resources 270–1  
   and recycling water 277–9  
   types 267  
   and water degradation 273–4  
 water services: availability of 138–9, 172  
 water vapour 212  
 waterfront dwellings/businesses 295–6  
 weather  
   definition 26  
   and internal migration 112–13  
 weathering 26, 27–8, 237–8  
 wet season 246–7  
 wetland environments 254  
 wheat-belt zone 64  
 wind processes 32  
 windward side 232  
 World Fair Trade Organization (WFTO) 400  
 World Health Organization 197  
 World Heritage Areas 53  
 World Heritage listing 76–7  
 World Heritage sites 50, 76, 77  
 world wide web (www) 344  
 written reports 14