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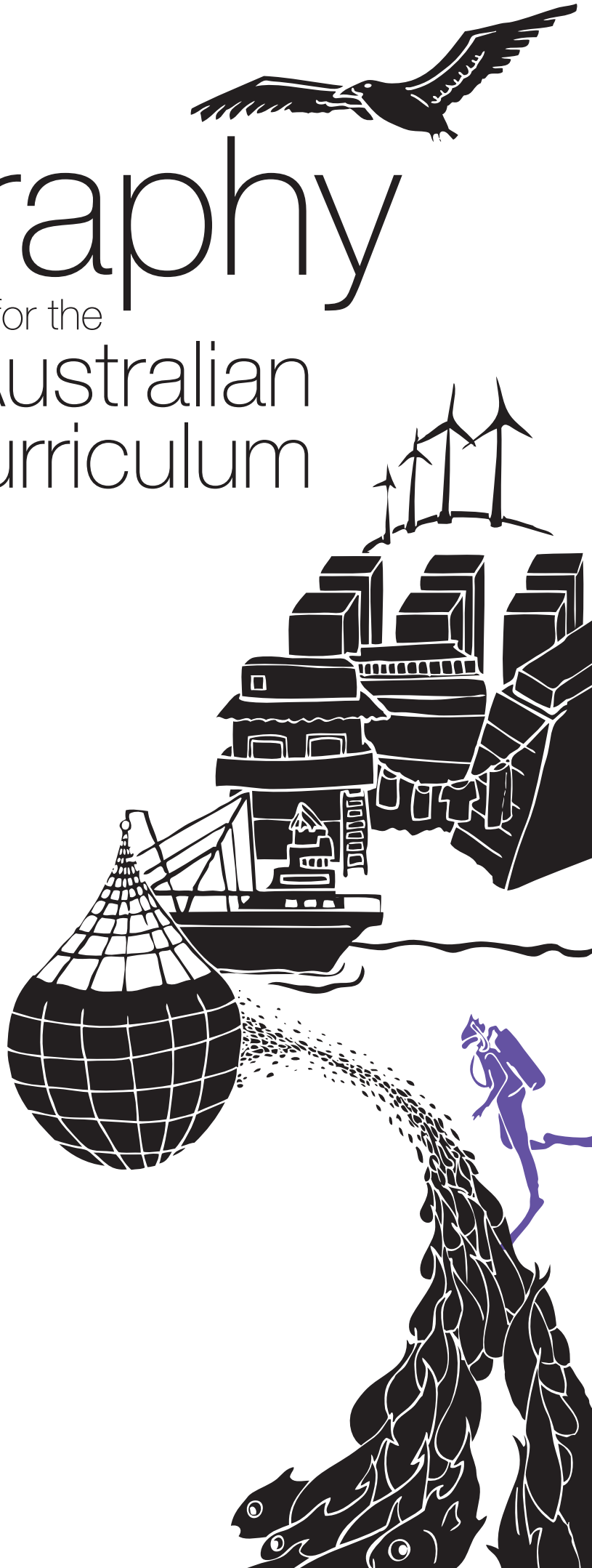
Geography for the 10 Australian Curriculum



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Geography 10

for the Australian Curriculum

Catherine Acworth | Alan Boddy | Tamara Boyer
David Butler | Rex Cooke | Matthew Davidson
Cheryl Desha | Deirdre Dragovich | Tony Eggleton
Xiumei Guo | Karlson 'Charlie' Hargroves | Grace Larobina
David Lergessner | Dora Marinova | Simon Miller | Peter Newman
Nonja Peters | Ken Purnell | Angela Reeve | Margaret Robertson
Heather Ruckert | Jesmond Sammut | Laura Stocker | Kate Thompson
Fiona Tonizzo | Andrew Walker | Michelle Walker

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Contents

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About the authors

Catherine Acworth is a senior coastal specialist within the Crown Lands division of the NSW Department of Primary Industries and has been working in the field of coastal management for over 5 years. In addition to working on the Tweed River Entrance Sand Bypassing Project, Catherine has managed significant storm surge and coastal inundation projects for the Queensland Government Coastal Impacts Unit, in particular the Gulf of Carpentaria Storm Tide and Inundation Study. She has an Honours degree in Marine Science from the University of Sydney and a Masters in Coastal Engineering and Management from the University of New South Wales. She has travelled extensively in developing nations and her personal research involves using film and photography to document the effects of climate change and climate change adaptation strategies in coastal communities.

Alan Boddy teaches at Bendigo Senior Secondary College and lectures in Geography Method at La Trobe University, Bendigo campus. Alan has been involved in Geography education for 32 years. He has taught Geography for 9 years at the 7–10 level and over 20 years at the senior level. He was Head of Department in Humanities at Bendigo Senior Secondary College and a lecturer at La Trobe University's Outdoor Education and Environment Centre for several years. He was Education Officer at Melbourne Zoo, the Central Deborah Gold Mine and the Discovery Science and Technology Centre for the City of Greater Bendigo. He has also contributed to the recent publication *The travellers' guide to the goldfields*.

Tamara Boyer has been teaching Geography, Studies of Society and Environment and Religious Education to high school students in the Catholic sector. Tamara has been the Head of Society & Environment at Aranmore Catholic College for the past 9 years. She graduated from Curtin University in Perth, Western Australia with a Bachelor of Education (Secondary) at the end of 1996. Her passion for geography led to her involvement as a Councillor for the Geographical Association of Western Australia. She was appointed as an adviser and writer for Geography curricula at both state and national levels and contracted to write resources and exams and provide professional development for Geography teachers. In 2008, she published her first textbook (*Sustainable planet: resource geography for senior school students*). She has also written online resources for the Australian Geography Teachers Association and it is her goal to get as many young people to love geography just as much as she does.

David Butler is the chief writer for Reconciliation South Australia in the development of the Foundation to Middle Years Reconciliation Education packs. David is an executive member of the Australian Association for Environmental Education (AAEE) and is coordinator of the AAEE Teacher and Teacher Education Special Interest Group (TTE SIG). He has over 30 years' experience in working with and writing Geography curriculum and teaching and learning guidelines through his involvement with South Australian state geography committees and the Geography Teachers' Association of South Australia (GTASA). He is former President of the Australian Geography Teachers Association (AGTA) and the GTASA, and is a life member of GTASA. He was also Manager of the Society and Environment curriculum in the South Australian Education Department and an Australian Curriculum: Geography Advisory Panel member for the Australian Curriculum, Assessment and Reporting Authority (ACARA).

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Rex Cooke is the Head of Social Studies at Waverley College. Rex has been teaching Geography for 12 years in a number of schools in regional and city areas of New South Wales. He completed a Masters of Educational Leadership (School Education) from Macquarie University in 2009. He has extensive experience with teaching Geography and is an experienced marker of the HSC Geography Examination and also a member of a committee that sets the Catholic Trial HSC Examination. He is also a lecturer at the University of Notre Dame Australia in Sydney for Geography teaching methodologies.

Matthew Davidson has been head Geography teacher at Waverley Christian College in Wantirna South, Victoria, for the past 8 years. Matthew has presented sessions at various conferences and events, including the annual Geography Teachers' Association of Victoria (GTAV) conference, Victorian Certificate of Education (VCE) conferences and Christian Schools Australia (CSA) conferences as well as Geography student exam revision lectures. He has also been a year level coordinator for a number of years and is currently a member of the GTAV Committee. He is an innovative Geography teacher who is passionate about developing curriculum that is relevant and engaging.

Cheryl Desha has a degree in Engineering (Environmental, first class) and a PhD in rapid curriculum renewal. Her research for the last decade has focused on building capacity for sustainable development within tertiary education, including outreach and bridging with secondary schools, managing the development of high school resources on a range of sustainability topics in collaboration with the Australian Sustainable Living Challenge (UNSW, Griffith University). She is a Senior Lecturer in the School of Earth, Environment and Biological Science (Science and Engineering Faculty) at the Queensland University of Technology (Brisbane, Queensland), and a Principal Researcher with The Natural Edge Project (TNEP), a sustainability think-tank which operates as a collaborative partnership for research, education and policy development on innovation for sustainable development.

Deirdre Dragovich is an associate professor in the School of Geosciences, University of Sydney and has taught both undergraduate and postgraduate geography and geomorphology. Deirdre currently supervises four PhD students and is responsible for teaching two postgraduate units in environmental science. She is co-author of *The Australian physical environment* (2008) and co-editor of the earlier Meridian series of first year university Geography texts. Previously she contributed to curriculum discussions in Geography at matriculation level, wrote materials for high school teachers, and was involved in 'Geography Update' days. As Associate Dean in the Faculty of Science, she was instrumental in establishing 10 postgraduate degrees, several involving inter-faculty contributions from Electrical Engineering, Economics, Agriculture, Veterinary Science, Architecture and Arts. She was awarded the Macdonald Holmes medal for contributions to geographical education by the Geographical Society of NSW and was a member of the advisory committee for the national Geography curriculum.

Tony Eggleton is an emeritus professor of the Australian National University. Tony graduated with first class Honours in Science from the University of Adelaide, then completed the degree of Doctor of Philosophy at the University of Wisconsin, USA. For his extensive research into mineralogy he was awarded the degree of Doctor of Science by the University of Adelaide in 1999.

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Xiumei Guo is a research fellow at the Curtin University Sustainability Policy (CUSP) Institute in Australia. Xiumei completed her PhD examining Chinese immigration in Australia and her research interests are in the areas of demography, economic development, energy efficiency and sustainability studies with a focus on China. She is currently conducting research for the Australian Research Council on energy efficiency, economic growth and the environment in China.

Karlson 'Charlie' Hargroves, after graduating from the University of Adelaide in 2000 and spending 2 years as a practising civil/structural design engineer, co-founded 'The Natural Edge Project' (TNEP), an internationally recognised team of early career academics across various universities including Curtin University, Adelaide University, QUT, Griffith University and ANU. He has led the TNEP team to deliver four international books on sustainable development (selling over 80 000 copies in four languages) in collaboration with some of the world's leaders in sustainability, such as Gro Brundtland, Ernst von Weisacker, Amory Lovins, Rajendra Pachauri and Peter Newman. The first book won the Australian Banksia Award for Environmental Leadership, Education and Training in 2005, and the two most recent books were ranked among the 'Top 40 Sustainability Books' in the world in 2010 by the Cambridge Sustainability Leaders Program. He joined the Curtin University Sustainability Policy (CUSP) team in 2010 and works on a series of projects focused on the sustainable built environment, in collaboration with the Sustainable Built Environment National Research Centre and the Cooperative Research Centre (CRC) for Low Carbon Living.

Grace Larobina is the HSIE faculty geography subject facilitator at The Hills Grammar School in New South Wales. Grace has taught years 7–8 History, years 7–12 Geography and years 11–12 Legal Studies over her 25-year teaching career. She has had experience in girls' education and coeducation at various NSW schools including Cerdon College and Mary MacKillop College. She completed her teacher training at the Catholic College of Education Sydney, where she graduated with her Diploma of Teaching, and at the South Australian College of Advanced Education, where she graduated with a Bachelor of Education. She has been employed by the Board of Studies for Geography School Certificate Marker and Higher School Certificate (2005), served on the Board of Studies Geography Reference Group (2012), served as the independent sector representative for the ACARA Mapping the Australian Curriculum Draft F–10 (2012) and is accredited by both the Independent Schools Teacher Accreditation Authority (ISTAA) at Classroom/Professional Excellence level (2007) as well as through the NSW Institute of Teachers to the level of Professional Accomplishment (2011). She has also served as a council member on the Geography Teachers' Association of NSW since 2010. She has travelled extensively in Europe, the USA, the Pacific Islands and Canada with an intense interest in the geography and history of societies.

David Lergessner is a former lecturer in Geography in the Faculty of Education, School of Cultural and Language Studies at the Queensland University of Technology (QUT). David has written extensively on the Geography curriculum and pedagogy, and wrote the 'People and environment' series (1989–92) as well as *Geomorphology* (1995). He was a high school Geography head of department for 35 years before retiring and joining QUT. He has held almost all positions in the Geography Teachers' Association of Queensland (GTAQ) except treasurer and for many years was the journal editor and conference convenor. He is a regular presenter at GTAQ and Australian Geography Teachers Association (AGTA) conferences on topics to do with physical geography, with his study of environmental hazards taking him to many places around the world including Mount St Helens, Greenland, New Zealand, Vanuatu and Antarctica.

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Dora Marinova is a professor of sustainability and deputy director of the Curtin University Sustainability Policy (CUSP) Institute in Perth, Western Australia. Dora's current research relates to population and sustainability, the role of new technologies, technology policy and economic development in Australia, including transformation towards a low-carbon economy. She has more than 300 publications and has supervised to completion more than 40 PhD students. She has conducted research for the Australian Research Council, CRC Desert Knowledge, and industry as well as the federal and Western Australian state governments.

Simon Miller is currently Head of Geography at Pembroke School in Adelaide. He has been a specialist Geography teacher for 10 years, working in both the United Kingdom and Australia. Simon is the vice-president of the Geography Teachers' Association of South Australia, where he has served on the executive committee for 6 years. He has co-authored a workbook for the BBC Bitesize series in the United Kingdom, where he has also contributed to the Geography Association's *Geography teacher's handbook*.

Peter Newman is the professor of sustainability at Curtin University and the director of the Curtin University Sustainability Policy Institute. Peter is a lead author for transport for the UN's Intergovernmental Panel on Climate Change (IPCC). He is on the board of Infrastructure Australia, which is funding infrastructure for the long-term sustainability of Australian cities. He has written 15 books, including his book with Jeff Kenworthy, *Sustainability and cities: overcoming automobile dependence*, which was launched in the White House in 1999. In 2001–03 he directed the production of Western Australia's Sustainability Strategy in the Department of the Premier and Cabinet. It was the first state sustainability strategy in the world. In 2004–05 he was a sustainability commissioner in Sydney, advising the government on planning issues. In Perth, he is best known for his work in saving, reviving and extending the city's rail system. He invented the term 'automobile dependence' to describe how we have created cities where we have to drive everywhere. For 30 years since he attended Stanford University during the first oil crisis, he has been warning cities about preparing for peak oil. In 2011 he was awarded the Sydney Luker medal for his contribution to the science and practice of town planning. From 1976 to 1980 he was a councillor in the City of Fremantle where he still lives.

Nonja Peters is the director of the History of Migration Experiences (HOME) Centre at Curtin University. Nonja is an historian, anthropologist, museum curator and social researcher with a special interest in the preservation of immigrants' cultural heritage, in particular Dutch maritime, military, migration and mercantile connections with Australia since 1606; the migration experience; and immigrant entrepreneurship. She is currently involved in academic and community-based research in all these fields. She sits on the board of the National Library of Australia, the Maritime Museum Advisory Committee, the National Archives Advisory Committee and Associated Netherlands Societies of Western Australia. She has been awarded the Centenary Medal and a Dutch Knighthood for the preservation of immigrants' cultural heritage. She has also published widely on issues relating to migration and her book *Milk and honey – but no gold: postwar migration to Western Australia 1945–1964*, was short-listed for the Western Australian Premier's 2001 Literary Award, the Queensland Premier's 2002 Literary Award for History and the New South Wales State Records John and Patricia Ward History Prize. She was formerly the director of the Migration, Ethnicity, Refugees & Citizenship Research Unit.

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Ken Purnell is editor of *Geographical Education* and on several other journal boards. Ken is also an associate professor at Central Queensland University (CQUniversity) Australia where he teaches Geographical Education as well as holding various academic leadership roles (see www.kp.cqu.edu.au). He has been involved with boards of studies over the years and since 2005 represents higher education on the Queensland Studies Authority Curriculum Committee, having been on the governing board. He has a real interest in building students' love of Geography as a way of seeing and experiencing their world.

Angela Reeve has a degree in Engineering (Environmental, first class) and is currently completing her PhD in policy pathways and mechanisms for change towards biophilic urbanism. Over the last 5 years, her research has been focused on fostering behaviour change for energy efficiency, rapid curriculum renewal for engineering programs in Australia to integrate more energy efficiency content into courses, and informing sustainability policies for regional plans. Angela is a PhD candidate at the Queensland University of Technology, and a researcher with the Natural Edge Project (TNEP), a sustainability think-tank which operates as a collaborative partnership for research, education and policy development on innovation for sustainable development.

Margaret Robertson is professor of Education at La Trobe University. Margaret is a former research director for the faculty and currently holds the position of Deputy Chair of the Australian Academy of Science's National Committee for Geography. Her long association with the International Geographical Union has included serving an 8-year period as executive secretary for the Geographical Education Commission. Her research and publication interests focus on cultural geography, particularly young people's geographies and applications of social media and digital technologies. She has been recognised for her contributions to education with a fellowship of the Australian College of Educators.

Heather Ruckert teaches Geography and is part of the Careers Consultancy team at Tintern Schools in Melbourne. Heather has a diverse background with tertiary studies in Geography, Economics, Information and Communications Technology, Management and Career Development. She is a highly experienced teacher with curriculum writing expertise across all secondary levels, including the International Baccalaureate, and her career spans over 20 years in the independent schools sector. Her roles as a former head of Geography and pastoral leader have shaped her holistic approach to student learning with her passion for geographic inquiry in the field.

Jesmond Sammut is an associate professor in Physical Geography, Faculty of Science at the University of New South Wales. Jesmond is also an adjunct professor and visiting professor at Gadjah Mada University and Hasanuddin University respectively. He conducts multidisciplinary research involving studies on soil and water processes, groundwater chemistry, river processes, causes of fish kills and fish disease outbreaks, the environmental impacts of development and sustainable development of coastal and inland resources. His current research involves improving food and income security in developing countries. He manages research and capacity-building programs in Indonesia, Vietnam and Papua New Guinea and has also worked in India, Thailand and the Philippines to apply geographical skills to environmental and aquaculture production problems. He teaches Environmental Impact Assessment (EIA) and Coastal Resource Management to undergraduate and postgraduate students in Australia and Indonesia, and also coordinates research and technical capacity building programs in developing nations. He is also the PNG Fisheries Consultant for the Australian Centre for International Agricultural Research (ACIAR) and an editor of the *Indonesian aquaculture journal*.

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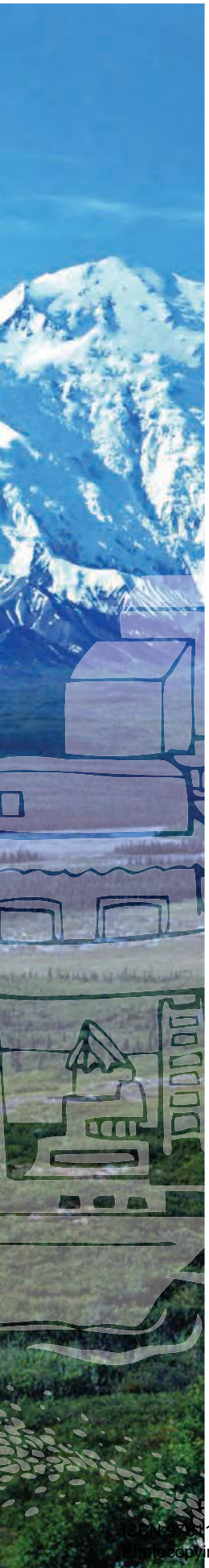

Laura Stocker is an associate professor in Sustainability at Curtin University and holds a PhD in marine ecology. In 1990, Laura established Australia's first university course in sustainable development. She now researches and teaches at the Curtin University Sustainability Policy (CUSP) Institute in coastal sustainability, governance of coastal adaptation to climate change, sustainability education, and sustainability mapping and planning. She coordinates the Master's degree course in Sustainability and Climate Policy. She is also deputy leader of the Coastal Collaboration Cluster, funded by the CSIRO Wealth from Oceans and Climate Adaptation Research Flagships, and deputy leader of the Governance Theme of the Cluster.

Kate Thompson is the Head Teacher of Teaching and Learning at Chatswood High School and lecturer to post-graduate students studying Master of Teaching/Education at the Australian Catholic University. Kate was awarded the New South Wales Premier's Teacher Scholarship for Business Studies 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 and support roles, developed HSC exams at the New South Wales Board of Studies and is passionate about engaging students and improving literacy. She is currently president of the Society and Culture Teachers Association and has co-written a widely used textbook for years 11 and 12 students. She is a regular presenter at professional development and student revision lecture days and has written a range of teaching materials published in the journal *Culturescope*.

Fiona Tonizzo is the VCAL and VCE educational leader at Pakenham Secondary College. Since beginning her teaching career, Fiona has been involved in curriculum development. She is passionate about teaching Geography and has taught at Patterson River Secondary College, where she was the Head of Humanities. She counts being a foundation staff member at Kambrya College (formerly known as Berwick South Secondary College) as one of her most satisfying roles: she was a member of the team that began the school and oversaw the first few years of VCE at the college. She has always believed in maintaining professional ties to fellow educators, including the Geography Teachers' Association of Victoria (GTAV). She has presented many workshops through the GTAV at annual conferences, as well as at specialty conferences such as 'Thinking skills in the Geography curriculum and VCE'. She is currently the network leader for the Berwick group of the GTAV.

Andrew Walker teaches Geography, History and English at Parade College in Bundoora. Andrew is also a teacher of Outdoor Education and has a hands-on approach to Geography. He takes every opportunity he can to get his students out into the field with a map, a compass and a GPS.

Michelle Walker has a degree in Environmental Science with first class honours. She has worked on water planning and water conservation projects, with a focus on behaviour change, in remote central Australia and Townsville, and she is a Research Fellow with The Natural Edge Project (TNEP). Michelle has spent time volunteering with the Swatcha Ganga Abhiyan (Clean Ganges Campaign) in India, where she lived in the city of Varanasi and worked to build youth environmental leadership skills. Currently Michelle is undertaking a PhD, conducting research into the value of Indigenous knowledge in protecting freshwater resources in the Kimberley region, WA.

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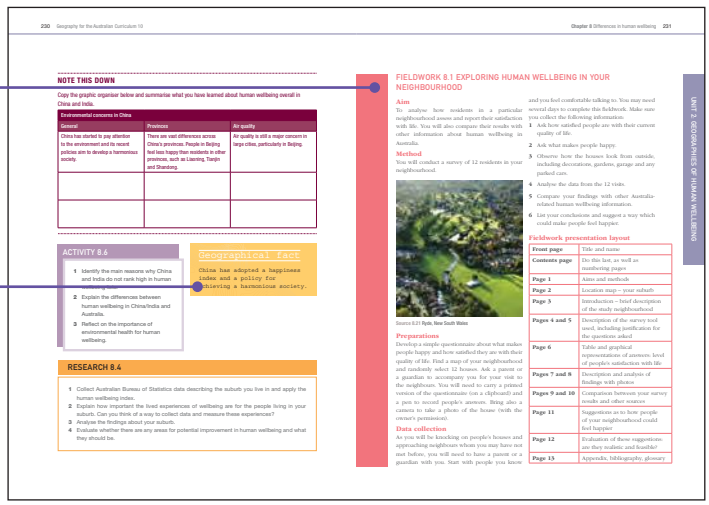
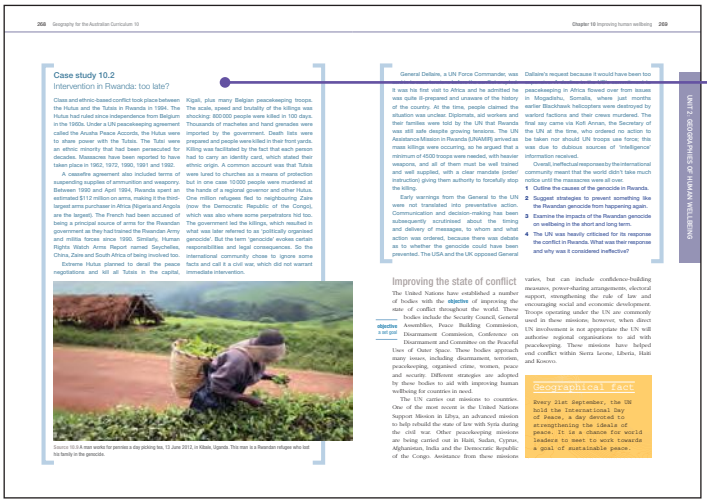


Case studies extend on information to add another layer to your knowledge and understanding.



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

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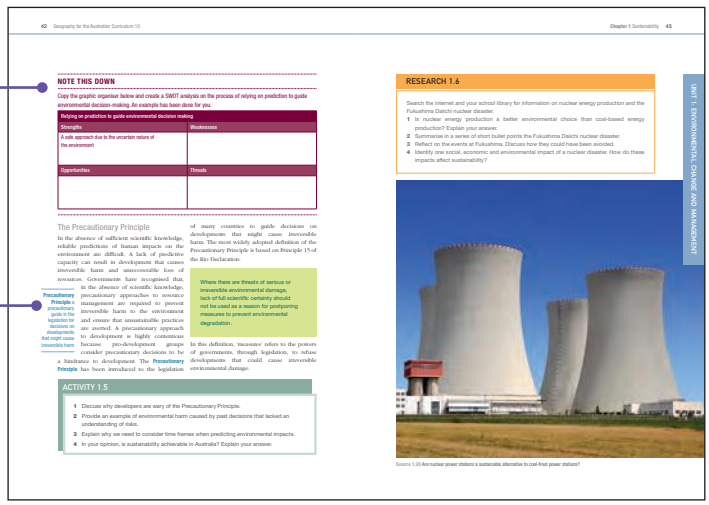

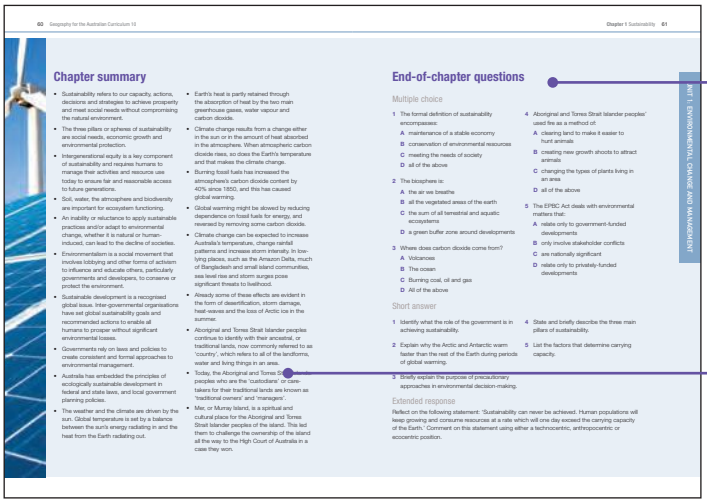

End-of-chapter questions include multiple-choice, short-answer, and extended response to test your knowledge through the reinforcement of key concepts and application of skills.

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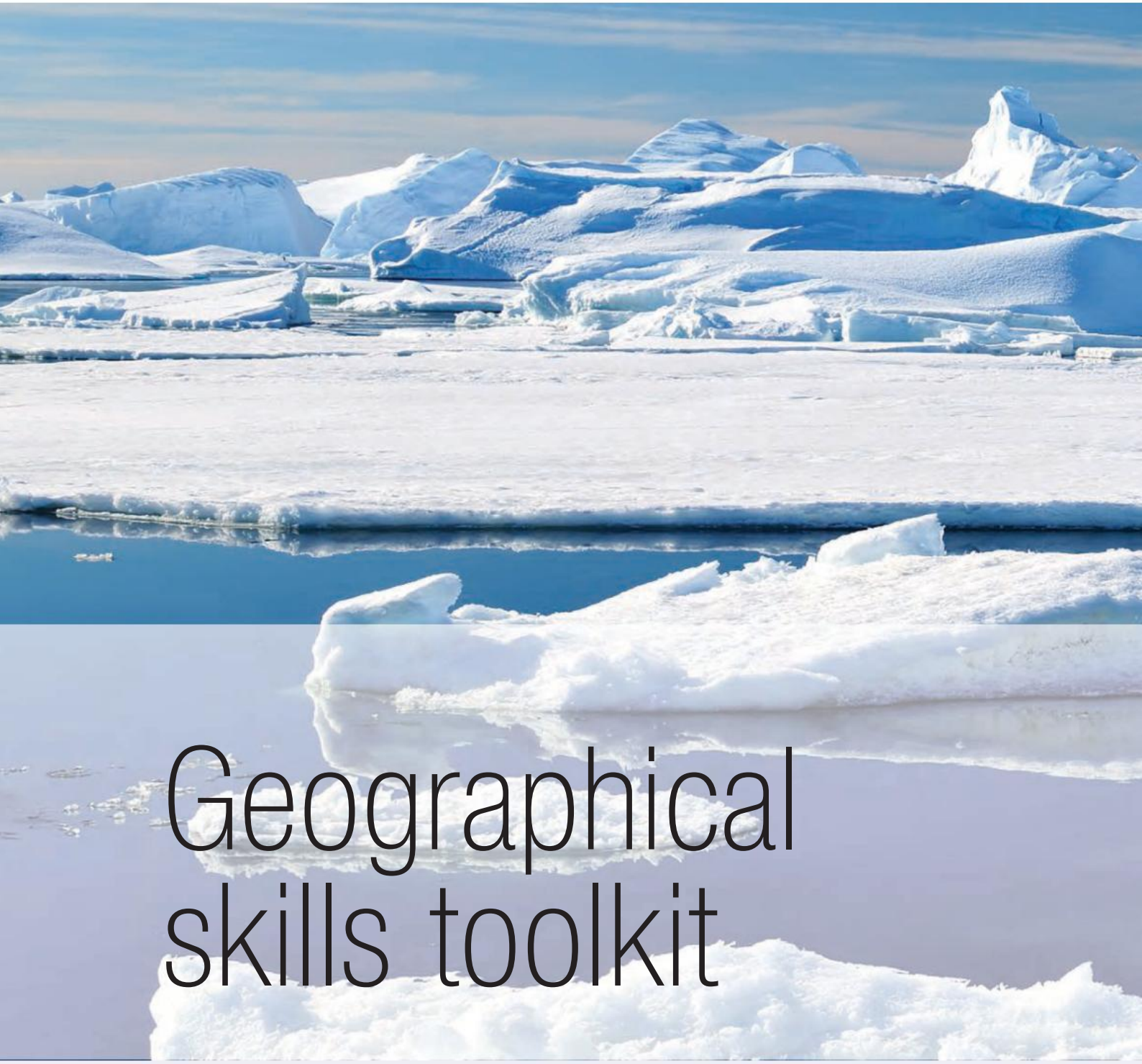

Geographical skills toolkit

0.1 Introduction

Geography is the study of the Earth, especially the surface; how it works and how humans interact with it. It involves describing, analysing and evaluating in order to understand and even predict how the elements that make up our world operate. It also includes the many ways that people can affect and use their environments, from the individual or family unit to the impact of larger groups, companies and even governments. How we live on the Earth and how we change the environment today influences what the planet will be like in the future. This geographical skills toolkit explains the skills and concepts used in the study of geography. These tools will help you to think like a geographer as you explore environmental change and differences in human wellbeing.

ISBN 9781107696969

Cambridge University Press

Source 0.1 There are a number of human-induced environmental changes that pose challenges for sustainability.

0.2 Geographical inquiry and skills

What often sets geographers apart from others interested in the world are the methods we use to investigate. Geographers are not truly happy until they have collected 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. As a geography student, you will be using the methods of the professional geographer, although on a smaller scale. You follow an inquiry approach by working through a set of skills that represent a complete investigation:

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

- observing, questioning and planning
- collecting, recording, evaluating and representing
- interpreting, analysing and concluding
- communicating
- reflecting and responding
- fieldwork.

Source 0.2 Geographers are involved in highly specialised work that helps us to live sustainably on the planet, minimising negative impact and supporting biodiversity in the environment as well as improving the lifestyles of people around the globe.

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Depending on the type of inquiry, you may only need to focus on a particular skill. Your work becomes part of the complex web of data collected and analysed to ensure our global footprint rests lightly on the planet, allowing environmentally sustainable and responsible human activities.

Observing, questioning and planning

Geography is a scientific study and uses the same methods as other branches of science. The geographer begins planning an inquiry by observing issues or problems and developing geographically significant questions.

Develop geographically significant questions

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 for the material ahead. They 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 challenges to be explored as an integral part of our understanding.

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 where information comes from in order to use it effectively.

Primary and secondary sources

Information gathered in the field or directly connected to our research is called a **primary source**. Primary sources are essential to valid scientific inquiry. They are targeted and specific to the task. We understand how it has been collected, the methodology used in the process and if there were any elements that may have given unexpected results.

primary source information that comes directly from the event or area we are studying. It is 'first hand' and is how we classify the majority of data collected during fieldwork

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

Inquiry questions

- How can social and economic needs be met without degrading the environment?
- What are the key threats to sustainability?
- Why is intergenerational equity fundamental to the decisions we make about development?
- What is our role in sustainability to protect Earth's resources for humans and all life forms?
- To what extent have human actions contributed to climate change in the previous 150 years?

Source 0.3 Examining the questions from Chapter 1 'Sustainability', it is clear in what direction the study will develop.

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called a **secondary source**. Secondary sources can also be valuable and even reduce the work we need to do directly. For example, the Australian Bureau of Statistics (go to www.cambridge.edu.au/geography10weblinks for a link to its website) conducts the Census every four 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 can be very useful.

secondary source information that is put together by someone else or someone not directly involved in the event or area that we are investigating

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

NOTE THIS DOWN

Copy the graphic organiser below and summarise what you have learnt about primary and secondary sources.

Sources	Definition	Examples
Primary		Field notes
Secondary		Census data

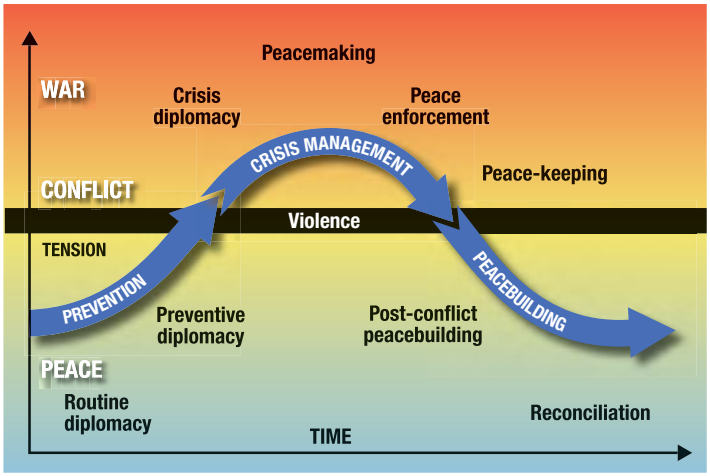
Evaluating for reliability, bias and usefulness

It is important that we can trust the data we use in our research. We need to know that the way they were collected has been appropriate and consistent. It is important that the way our data are gathered is reliable, but also that we are aware of any **bias** in the collection of the information that may make us review its value. If we are interviewing people in a town about where they prefer to source their energy supply, it is relevant to the integrity of the information to know if the person being interviewed is a high energy-using small business owner, or works for a coal-driven electricity company, or perhaps is a consumer with no particular economic interests in any energy supply networks. Knowing this allows us to evaluate whether we can trust the information and how useful it will be in our work.

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

Representing data

Once we have collected our data, we need to present them in the most appropriate form. 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 work well in an annotated photograph, a sketch or even a map. Geographers not only analyse the data they have, but view them critically to decide what the best format for sharing that information will be.



Source 0.4 Data can be represented in a range of appropriate forms including scatter plots, tables, field sketches and annotated diagrams.

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Source 0.5 Maps are probably the best-known geographic tool.

Constructing maps

The same river can be viewed on a series of maps with information adding to our understanding of the system. We can see how steep the river valley is, the direction it flows and the type of landscape it flows through. All of this information allows us to predict the impact of changes to the river if the surrounding environment changes.

Maps have a series of 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.

Interpreting, analysing and concluding

Setting a series of inquiry questions and gathering information to try to answer those questions is important, but how we understand our 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 our data are showing? Do they point to further questions that require investigation in order for our work to be considered complete?

If the initial inquiry questions are clear and detailed, and if the research was appropriately targeted, then we have the information required to make informed conclusions. Let's take a closer look at what that means.

- Was your inquiry specific and measureable?
- Did your research include data collection?
- Did you also check your data with another research tool such as the internet?

If you can confidently answer 'yes' to all of the questions above, then you are ready to begin analysing your data and reaching logical conclusions. Start by answering your inquiry questions, not with a yes or no, but explaining why/how you are sure of your response. What are the data you have that back up your answer? Do they clearly show that you have an answer, or is there a qualifying statement to be made? For example, 'The survey data from our visit

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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.'

It is important to not only analyse your information, but to also decide what it is telling you. Are you able to make any reasonable and logical statements based on your data? Are some aspects of them unclear? Sometimes, we need to be honest enough to say that our research might not have covered all angles and we need to investigate further before we 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.

Quantitative and qualitative methods

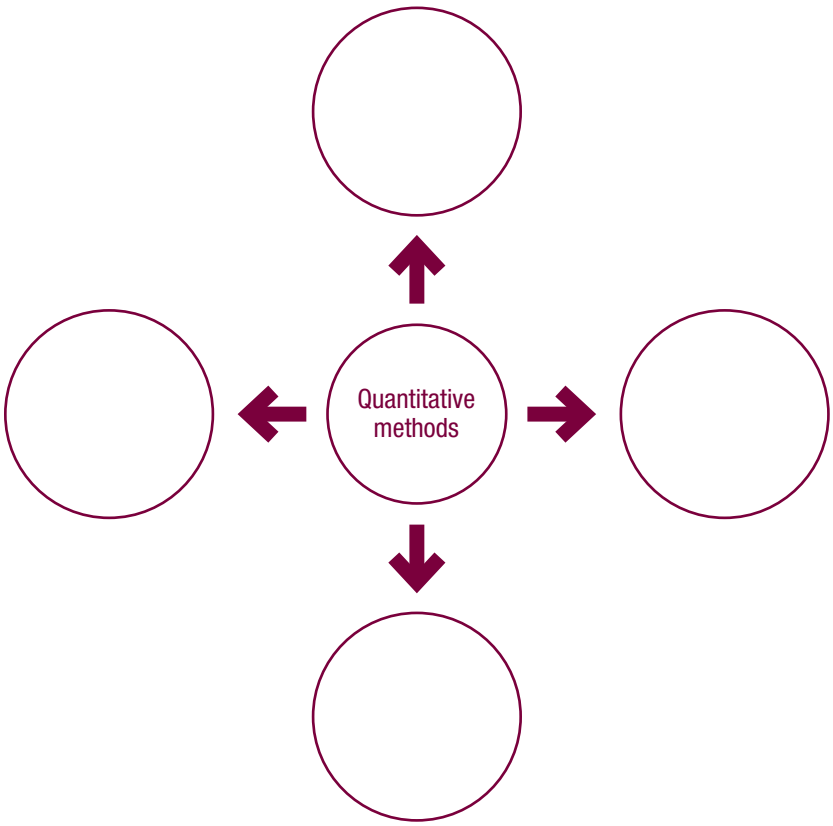
To assist with interpreting, analysing and developing conclusions, geographers use **quantitative methods** and **qualitative methods** to gather data. If we examine the Arctic region, we can talk to people who use the area to gain an understanding of how and when they use it, giving us qualitative methods for collecting information, while quantitative methods could include collecting information on the number of polar bears sighted or the area of ice for the year. This information may be gathered using measures that give numerical results. Both types of methods are important for the geographer to present a complete picture of the Arctic.

quantitative methods methods used to gather data that are expressed in numerical form

qualitative methods methods used to gather data that are expressed in non-numerical form (can only be described)

NOTE THIS DOWN

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



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ACTIVITY 0.1

1 Discuss the importance of inquiry questions.
2 Identify some of the ethical protocols we need to be aware of when collecting information.
3 Explain why it is important to use standard geographic conventions when creating a map.
4 If we analyse the impact of global warming on the Arctic, what qualitative and quantitative data could we use to support our conclusions?

Communicating

There are many ways to communicate the results of investigations. These include but are not limited to written, oral, graphical and visual methods. 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 terminology and digital technologies where appropriate.

Communication forms

Written

The most common method to convey research results is the written report. Other methods include essays and extended responses. There is a need to ensure that written pieces are easy to understand, logically organised, fluent and use the written 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 with an oral presentation as it is with 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.

Graphical

Some data are better presented visually, through graphs and diagrams, rather than in 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 that deserves to be discussed.

Visual

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 that you list information sources in a bibliography.

Using geographical terminology

Any subject you study will have specific terminology for particular ideas and topics. These words form a vocabulary, which makes it easier to convey ideas and meaning in the subject area. Important vocabulary is listed at the beginning of each chapter, highlighted and listed separately in the margins of the pages, and collated in the glossary at the back of the textbook.

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Key terms

- Biosphere
- Carbon dioxide
- Desertification
- Ecologically sustainable development
- Economic development
- Ecosystem functioning
- Environmental impact assessment
- Environmentalism
- Fossil fuels
- Global warming
- Greenhouse effect
- Intergenerational equity
- Land clearing
- Renewable energy
- Stakeholders
- The Precautionary Principle

Source 0.6 You should take the time to memorise and build your geographical vocabulary as it is introduced in each chapter.

ACTIVITY 0.2

With a partner, spend five minutes memorising the words in the vocabulary list below. When you and your partner are confident that you know all the vocabulary, select some words and test each other to see who remembers more.

carbon dioxide (CO_2) a chemical compound composed of two oxygen atoms bonded to a single carbon atom. It is a colourless, odourless gas.

carbon pricing placing a price on carbon put into the atmosphere as carbon dioxide through either subsidies, a carbon tax, or an emissions trading ('cap and trade') system

conservation the protection of plants and animals, natural areas, and interesting and important structures and buildings, especially from the damaging effects of human activity

ecological footprint the measure of human demands on the Earth's ecosystems

economic development sustained actions of stakeholders and communities that promote an improving standard of living and a healthy economy

egalitarian equality for everyone in terms of social, political, economic and civic rights

environmental management an attempt to control human impact on and interaction with the environment in order to conserve the environment

fertility rate the number of live births per 1000 head of population, usually shown as a ratio

fossil fuels natural fuels such as coal or gas, formed in the geological past from the remains of living organisms

global warming rise in the average temperature of the Earth's atmosphere

Greenhouse Effect the retention of the Earth's heat by atmospheric gases

Gross Domestic Product (GDP) the value of all the goods and services a country produces divided by the number of people living there

Gross National Product (GNP) the measure of the value of all the goods and services a country produces in a year

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ACTIVITY 0.2

Human Development Index (HDI) a tool that is used to measure the wellbeing of a country, developed to overcome the shortfalls of other economic measurements and takes into account aspects of life rather than simply finances

human wellbeing happiness in terms of how people actually feel (a subjective side) and the conditions for people to feel this way (an objective side)

indentured labour the labour of people who worked under very restrictive conditions and contracts in return for food and accommodation or to pay off debts; e.g. Indians in Fiji

land degradation the deterioration of land, including its top soil, vegetation and water resources

land management the process of managing the use and development of land resources

marine environments oceans, seas, bays, estuaries and other major water bodies, including their surface

marine hazard a geological process in the marine environment that has created conditions with a potential of being hazardous

mortality the number of people dying

ozone gas formed when oxides and nitrogen react with sunlight. In the upper atmosphere it absorbs UV rays, preventing them from reaching the Earth. At lower levels, ozone is a pollutant caused by vehicle and industrial emissions, the main component of smog

per capita per person

spatial scales the extent, size and location of something being studied. For example, the climate of a large area such as central Australia versus the microclimate of a small area such as a westward-facing slope

tariff a tax imposed on imports

Digital and spatial technologies

The use of digital and spatial technologies in geography is becoming more important, both in geographic work and in the wider community. Not only is this an employment growth area, but digital information has become part of everyday life for many people. There is also a range of digital communication technologies such as blogs and wikis, electronic surveys and social media applications that can be used effectively to gather data and share results. The trick is to make sure we use them because they are the best tools available for the specific task at hand.

Source 0.7 We easily view satellite maps and weather radar on smart phones from anywhere in the world without thinking about the technology that makes it all possible.

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Reflecting and responding

As already mentioned, 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.

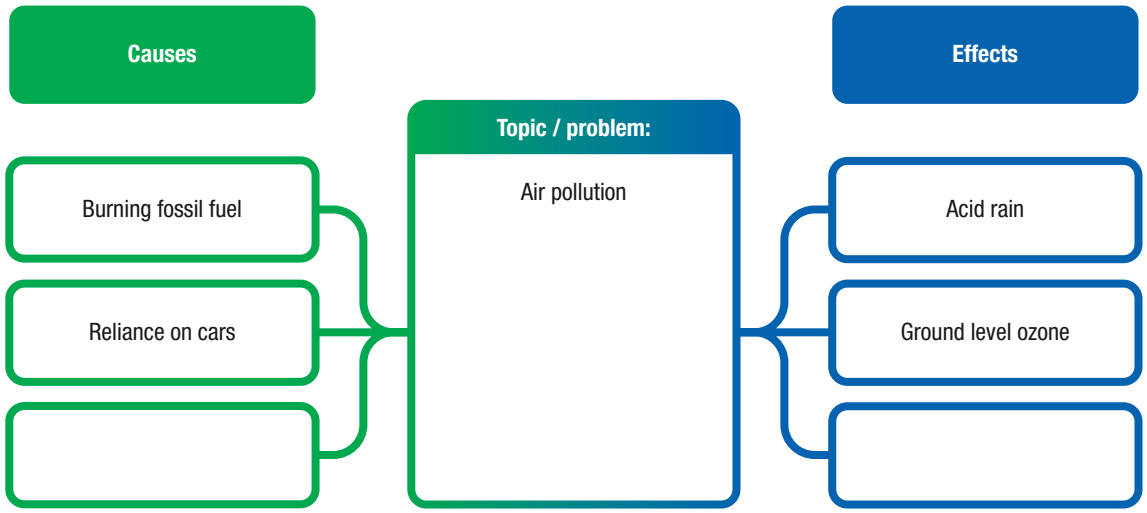
This also applies to data, whether we collected them or whether they are being presented to us by others. Can the information be checked through another source, or do we trust it because of a known collection method? What is the information showing us? How can we respond to it? How can we use it? These 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.

A possible method for achieving this is through a cause and effect graphic organiser outlined below.

Once our information is categorised into the cause and effect chart, we can start to analyse it more efficiently. Any discussion of the issue would want to examine the links between the causes and effects. How do the effects contribute to the original issue or create new ones? Could some items be in both columns?

If we look specifically at the issue of air pollution, we list the causes of air pollution, adding detailed notes. Then we list the effects of air pollution using the same process. Look for any unexpected links between causes and effects. One method of keeping the information organised is to maintain a separate page for each cause and effect.



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Fieldwork

Fieldwork is at the heart of geographic inquiry. It is any activity conducted outside the classroom, whether that is in your local area or 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 a number of 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 in the form of a fieldwork report. This method is used in the textbook and explained below.

Front page	***Title and name*** Ensure you have your own name (or names of group members) clearly identified. The front page should also contain a clear title indicating what your research was focused on.
Contents page	***Do this last, as well as numbering pages***
Page 1	***Aims and methods*** 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.
Page 2	***Location map*** 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. **BOLTSS** **B**order – 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. **O**rientation – show where north is using one of the conventional symbols, for example an arrow or full compass. **L**egend – the legend or key shows what all the symbols and colours you have used on your map mean. **T**itle – make sure your map has an accurate title that explains what the map is showing, for example *Shopping Centre Traffic Flow, 1–3 pm, Thursday 26 December 2013*. **S**cale – the map's scale shows how big the area shown on the map is in the real world. **S**ource – indicate where you obtained the information for the map. This could include your own measurements, a search engine, GPS mapping system or the local council offices.
Page 3	***Introduction*** Give a brief description of the study sites and any noteworthy features.
Pages 4 and 5	***Description of uses and photos*** What is the area currently used for – a written description accompanied by photographic evidence is good practice.

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Page 6	***Table of usage*** 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.
Pages 7 and 8	***Description of effects of use, sketches and/or photos*** 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.
Page 9	***Association between use and effects of use*** 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.
Page 10	***Table or written description of management strategies*** 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.
Page 11	***Photos or sketches of management strategies*** 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.
Page 12	***Evaluation of these strategies*** 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, not just describe. Make sure you are giving clear and balanced feedback on the current strategies.
Page 13	***Appendix, bibliography, glossary*** 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. 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 surname first, then initials (publication year in brackets). *Title in italics*. City location of publisher: publisher's name. A glossary is a mini-dictionary for your work. You should include any words in the glossary that your reader needs to know or understand your usage of.

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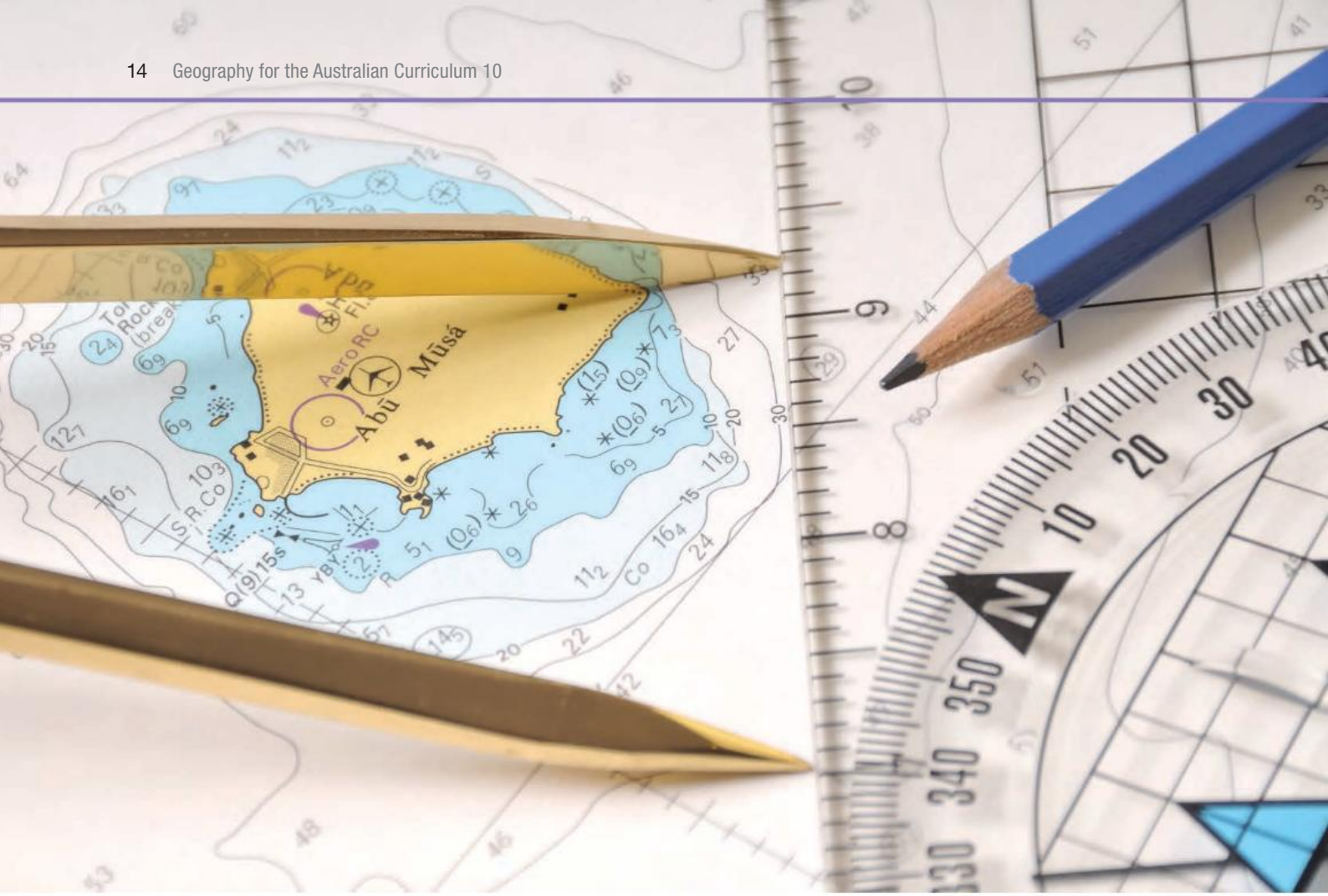

Source 0.8 The geographer at work: marking points on a map

ACTIVITY 0.3

1 What are the considerations you need to take into account when reflecting and responding to an issue or problem?
2 List five digital and spatial technologies and evaluate their usefulness in developing a fieldwork activity.
3 Identify two other ways of communicating your observations and data when undertaking a fieldwork activity, other than in the form of a report.

0.3 Concepts for geographical understanding

It is useful to have a framework that supports and guides us in our geographic studies: a range of tools and ideas that 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 work of others in the same field of study. In addition, it 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 shape their culture and identity. Places range in size from your classroom to a world region. Places are important locations for major events, social and human interactions as well as areas that have importance in the natural environment.

Where something is – its location – is very important to our studies. We can use the co-ordinates on a map, called **latitude**

latitude imaginary lines measured in degrees north and south of the Equator

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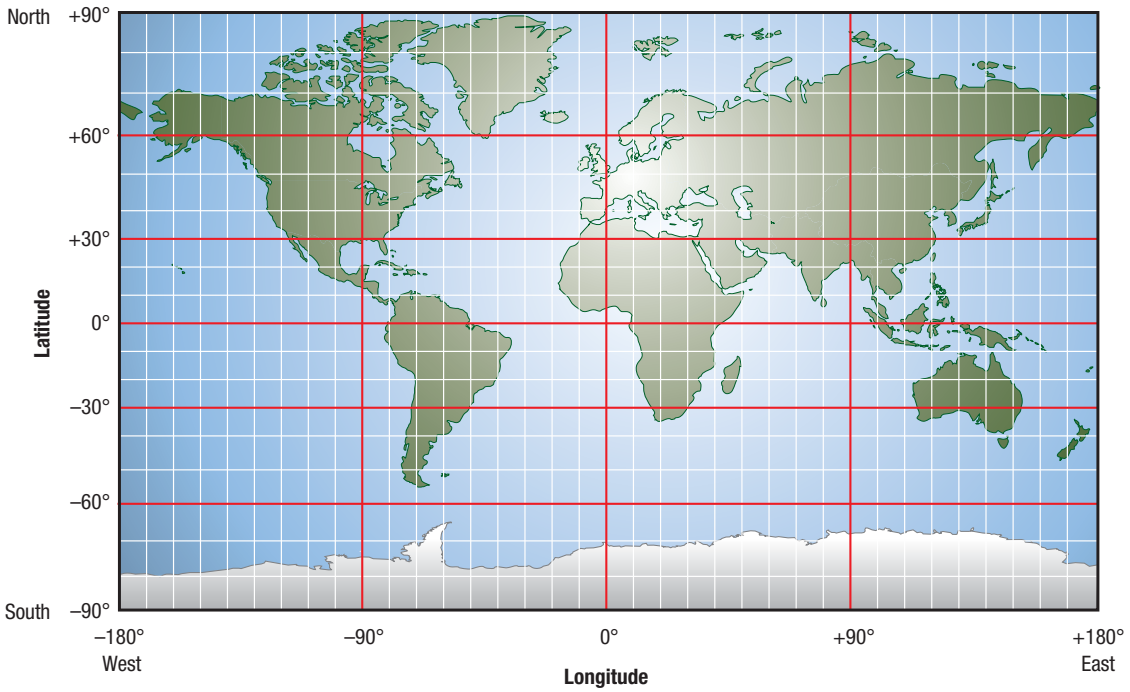
longitude imaginary lines measured in degrees east and west of the Prime Meridian (or the Greenwich Meridian)

and **longitude**, to show others where something is. Latitude and longitude divide the world up into a grid, and when using them, latitude is always stated first. You can see in Source 0.9 that the position of Brisbane is 27.5°S, 153°E.

Sometimes a description can help to show others where something is, or landmarks can help us to explain a place's location; for example, it is 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 north-east corner of the forest (for example, C4), allowing us to find the correct section of forest.



Source 0.9 The best-known system for locating a place is latitude and longitude. This is an imaginary grid that covers the Earth, allowing people all over the world to use and share consistent references.

Space

In geographical terms, space is the distance between things and can involve spatial patterns. The space around us, rather than outer space, is the key. Space refers to the organisation of an area, where things are (location) and their distribution. It is about how the area is perceived, structured and managed. 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 pattern of major transport networks like highways and trains. In the natural world, we can see mountains with a range, the web of streams and rivers in a catchment area or the frequency of lakes within a landscape. Space refers to the distribution of items as well as their frequency and helps us to describe the patterns we see.

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Environment

The environment has an importance in our world. It is a term that is often used and rarely defined, so what do we mean by 'environment'? It is 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 mean natural systems like forests and oceans, but it also applies to human-altered (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 system such as the Arctic not only supports the plants and animals of the region, but human populations as well. The region is modified to provide year-round tourism for visitors from around the globe.

Interconnection

Interconnection is based on the concept that nothing can be viewed in isolation, but has a relationship to other processes 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 and examines the level of influence to determine impact and predict future patterns. It supports looking at geographic phenomena such as urbanisation, global warming or erosion as processes within real and complex environments. Interconnections can be very detailed and lead us to look at spaces or environments holistically rather than viewing each element in isolation.

Sustainability

Sustainability refers to the ability for long-term balance, often in the environment, and refers to things that are not harmful, but able to continue far into the future. Sometimes, sustainability is thought of as being a 'hippy' concept, something that only environmentalists would concern themselves with, but it is increasingly used to mean any system (natural or human-made) being 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.

Source 0.10 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.

Scale

The main focus of this geographic concept is to see things at different levels, from the personal, to the local, national and through to global levels. How we view an issue or the types of solutions we can put forward changes as we move through these different scales. Growing our food for personal use is at a low scale and very controllable, with variables such as fertilisers and pest control being our own responsibility. Food production on a national or global scale is very different with a supply chain that includes producers, consumers and many levels of processing, marketing and sales in between.

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 carbon tax in Australia.

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. Looking specifically at our local area, it is clear that it is dynamic. Homes are built, roads 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 over space might initially seem more difficult. Think about what happens in your local area if a new shop opens. Consumers who were purchasing goods in another neighbourhood will begin to change their shopping patterns. As a result, traffic patterns and parking requirements may also change from one location to another. This is spatial change on a local scale.

ACTIVITY 0.4

1. In your own words, describe the concepts for geographical understanding.
2. Explain how latitude and longitude is used by geographers. What is their link to world time zones?
3. Evaluate the long-term sustainability of your home. Develop a plan to improve its sustainability including power supplies, water and food production.

Source 0.11
The carbon tax was designed to reduce the use of fossil fuels and thereby reduce impact on the environment.

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UNIT 1
Environmental change and management

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1 Sustainability

Source 1.1 Alternative energy-producing technologies can reduce environmental impacts.

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Before you start

Main focus

To understand why sustainable use of natural resources and maintenance of the quality and functioning of ecosystems is critical to all life on Earth.

Why it's relevant to us

Growing populations, economic growth and changes in lifestyle are placing pressure on natural resources and ecosystems. Humans must conserve and protect the environment so that social, economic and environmental functions are not degraded. All levels of society have a responsibility to protect cultural assets and conserve natural resources for fair access by future generations.

Inquiry questions

- How can social and economic needs be met without degrading the environment?
- What are the key threats to sustainability?
- Why is intergenerational equity fundamental to the decisions we make about development?
- How can we protect the Earth's resources?
- To what extent have human actions contributed to climate change in the previous 150 years?

Key terms

- Biosphere
- Carbon dioxide
- Desertification
- Ecologically sustainable development
- Economic development
- Ecosystem functioning
- Environmental impact assessment
- Environmentalism
- Fossil fuels
- Global warming
- Greenhouse Effect
- Intergenerational equity
- Land clearing
- Renewable energy
- Stakeholders
- The Precautionary Principle

Let's begin

Earth is home to 7 billion people and countless flora and fauna. Life is sustained by healthy ecosystems that are increasingly at risk of degradation from humans modifying the environment and over-exploiting natural resources. Humans depend on the biosphere to meet basic needs, but increasing development has led to pressure on natural resources. Humans can cause widespread changes that affect all living things, but we are intelligent enough to manage the biosphere properly.

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1.1 The concept of sustainability

Sustainability generally refers to the capacity to use resources so that they are maintained for future use and managed in a way that brings about economic and social improvements without significant environmental degradation. The environment in which we live is a complex of natural and human features and includes different ecosystems that form the **biosphere**. Ecosystems are communities of flora and fauna that interact with each other and the physical components of the environment, principally soil, water and the atmosphere. All living things, including humans, depend on the interaction of the biological and physical processes that support **ecosystem functioning**.

biosphere the sum of all terrestrial and aquatic ecosystems

ecosystem functioning the interaction between the biological and physical environment

When processes or components of an ecosystem are modified by human activities, the capacity of an ecosystem to function is reduced or may cease. Throughout history humans have been responsible for the degradation of soil, water and the atmosphere, extinction of plant and animal species, and the subsequent loss of **biodiversity**. Changes in ecosystem functioning also has a negative feedback effect on humans; a loss of ecosystem functioning threatens our health, access to food to sustain our populations and our ability to prosper. As the most intelligent life form on Earth, humans have the ability to understand ecosystem functioning and modify practices to sustainably utilise natural resources and minimise environmental impacts.

biodiversity the diversity of plant and animal life in a particular habitat

Since the 1980s, governments around the world have developed strategies to sustain human populations by integrating social, economic and environmental goals and values into decisions on development. In 1987 the Brundtland Commission of the United Nations proposed the following, now widely adopted definition of sustainable development:

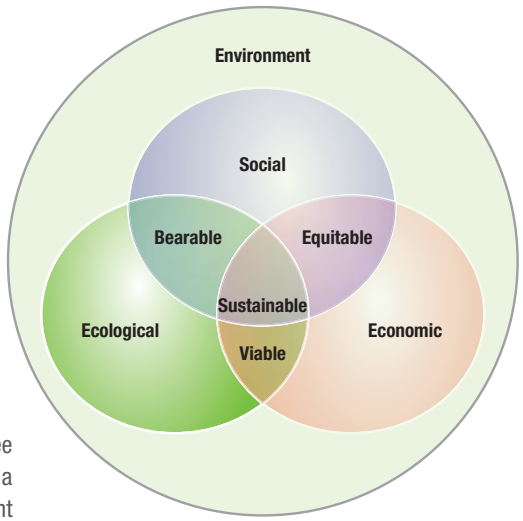
> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

This definition now commonly appears in laws, policies and guidelines for sustainable development. The Brundtland Report, from which this definition is sourced, identified three pillars for sustainable development:

- **economic growth** – promotion of **economic development** to improve the standard of living of humans, particularly those in poverty, without degrading natural resources
- **environmental protection** – to protect ecological processes and ecosystems
- **social equality** – a focus on ensuring the wellbeing of humans and raising the standard of living of all people. Central to this is equal access to resources.

economic development sustained actions of stakeholders and communities that promote an improving standard of living and a healthy economy

These three pillars are also often presented as interacting components or overlapping spheres of sustainable development. How we manage one component involves an understanding of the effect on the other two components. Environmentalists are, however, critical of the formal definition of sustainable development, arguing that it is vaguely worded and does not mention the environment. Similarly, the term 'sustainable development' itself is considered to be ambiguous and open to interpretation.



Source 1.2 A representation of the three spheres of sustainability embedded in a sphere that represents the environment

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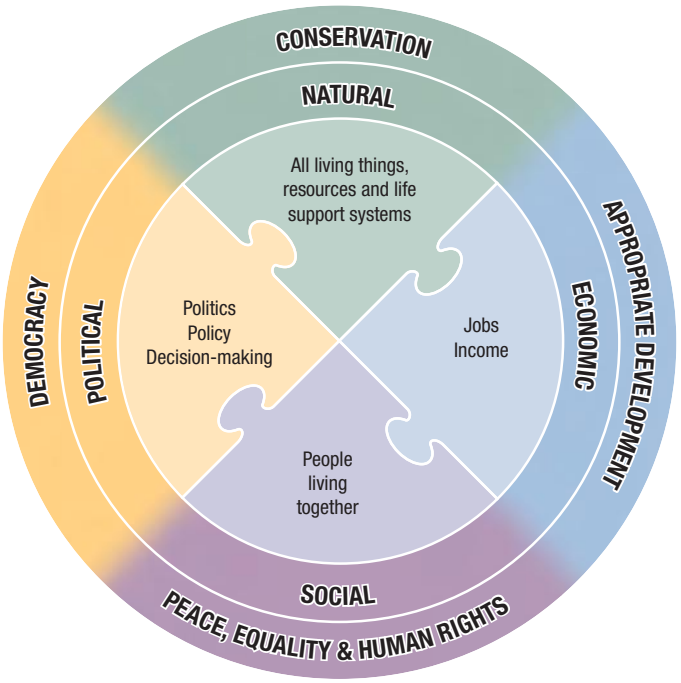
ACTIVITY 1.1

1 Identify three important environmental resources that humans and animals depend on.
2 Define social equality.
3 Analyse why the formal definition of sustainable development is criticised by environmentalists.
4 Discuss why we must manage the environment, economic growth and social needs collectively.

Geographical fact

More than 25% of the world's fish stocks are thought to be at the brink of collapse due to overfishing and habitat destruction.



Source 1.3 A four-dimensional representation of sustainability that includes political considerations

1.2 History of sustainability

The need for sustainability can be traced back to 10 000 years ago when humans established permanent settlements supported by agriculture. **Agrarian societies** that over-exploited resources and were unable to adapt to natural and human-induced changes in the environment declined or disappeared. For example, intensive farming initially provided abundant food that enabled the population of Mesopotamia to grow dramatically. Irrigation was introduced to increase crop yields to feed the growing population. Irrigation salinised the soil and extensive areas of once-productive farmland were abandoned. By 1700 BC, the population of Mesopotamia was reduced by 60% from its peak as a result of soil salinisation, climate change, and over-exploitation of other natural resources.

agrarian societies societies that are dependent on agriculture for economic growth and stability

Geographical fact

Some villages around the world are entirely sustainable. The people of Awana Kancha in Peru have no need for cash. They raise their own animals, spin their own fabric and grow their own food.

Over-exploitation of natural resources also caused population decline in predominantly hunter and gatherer societies. Deforestation on Easter Island caused soil erosion, destroyed

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habitat for birds that were important food sources, and denied the population a source of timber to build fishing boats. The loss of natural resources, and the reduced capacity to hunt and gather food, led to social conflict and cannibalism. The islanders struggled to replace their food sources through basic farming. The population declined dramatically because of unsustainable activities and was eventually wiped out by disease and slavery. By contrast, societies that used sustainable practices, whether for farming or hunting and gathering, were able to maintain their populations. Before Europeans settled in Australia, Aboriginal and Torres Strait Islander peoples maintained their populations through hunting and gathering for over 40 000 years in very harsh environments. However, there is evidence they altered vegetation communities through the use of fire. Shifting cultivators in New Guinea and parts of South America continue to farm sustainably to the present day by reducing pressure on soils and avoiding widespread deforestation for farming. There are also many examples of agricultural societies that have farmed their land continuously for centuries in Asia despite large populations. Key factors in the success or failure of societies include:

- an understanding of the **carrying capacity** of the environment
- an ability to use plant and animal food sources without loss of biodiversity
- the resilience of the environment – that is, its ability to recover from environmental impacts
- the intensity of human activities and the types of practices used to exploit resources
- the ability to conserve soil, water and air quality
- the capacity of humans to recognise and adapt to environment change.

carrying capacity the number of individuals that can be supported by the environment without causing significant harm

Source 1.4 Deforestation destroys habitat and exposes soil to erosion.

The Industrial Revolution

The Industrial Revolution, which occurred between the 18th and 19th centuries in England, Europe and the United States of America (USA), resulted in a transition from producing commodities by hand to mechanised manufacturing. This period of rapid development was significant in the history of sustainability because people were confronted by the widespread social and environmental impacts of unsustainable practices. The shift in production methods involved an unprecedented dependency on coal, timber and mineral resources. Advances in medicine and more efficient food production enabled populations to grow further and increased urbanisation in Europe and North America. Infrastructure such as roads and canals dissected farmland and natural environments, and factories began to pollute the air with smoke from burning fossil fuels. As a result of the Industrial Revolution, the population of England and many European countries doubled every 50 years. The growth in population and the associated increasing demand for water, soil and minerals led to a decline in the habitability of cities, which were often affected by pollution. Rivers became contaminated by sewage, domestic waste and chemicals, and many people were affected by lung and water-borne diseases caused by pollution. **Hinterland** resources were also progressively depleted to support growing cities and deforestation, to supply timber and create new farmland, irreversibly modified the environment.

hinterland the land behind the coast or the banks of a river, or an area of a country that is far away from cities

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RESEARCH 1.1

Search for information on the Mayan or Anasazi civilisations. Use 'environmental degradation' as a search term. Research only one of these civilisations and answer the following:

1 Identify which activities were thought to have caused environmental degradation.
2 Evaluate whether there were any natural changes to the environment that might have also been a factor in the decline of the society.
3 Explain why the society was unable to find a solution.
4 Distinguish which lessons can be learned from the experiences of the society.

Source 1.5 The wellbeing of children was not widely considered during the Industrial Revolution. They were engaged as poorly paid labourers.

Geographical fact

More than 20% of species are predicted to become extinct in the next 25 years. More than half of all current species could become extinct within 100 years.

1.3 Key concepts in sustainable development

Intergenerational equity

intergenerational equity the responsible use of natural resources to enable fair access to the same resources by future generations of humans

Intergenerational equity refers to the responsible use of natural resources to enable fair access to the same resources by future generations of humans. If today's populations deplete the Earth of critical resources, such as topsoil to grow food and fossil fuels to generate electricity and power vehicles, future generations will have less opportunity to prosper. Prosperity is intrinsically linked to consumption of resources, but it can deplete non-renewable resources or reduce access to renewable resources if they are destroyed or unable to be replenished because of over-exploitation. Accordingly, intergenerational equity is a key component of policies, laws and other management approaches that have sustainable development as a primary goal. Whether it can be achieved is highly contentious because the rate of urbanisation and growth in human population is increasing consumption of resources.

Uncertainty, risk and precaution

Sustainable development of Earth's resources involves the challenge of dealing with uncertainty and risk. In the context of sustainable development, uncertainty refers to our inability to be absolutely certain of the outcomes and risks of modifying the environment to meet our needs. Predicting the impacts of development depends on sound scientific knowledge of Earth's processes and how our actions modify them. For example, we know that humans have the potential to change climate by modifying atmospheric processes through pollution. Changing climate is a risk to the environment because it may increase sea levels, destroy temperature-sensitive ecosystems and cause local extinction of flora and fauna. Changes in temperature and water availability, along with the submergence of land from rising sea levels, can destroy habitat and lead to loss of species. The extent to which we influence climate has high levels of uncertainty. We are uncertain of

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the magnitude and the timing of climate change, and we are uncertain of how the environment will respond. Furthermore, we are uncertain over the management actions that can mitigate the negative impacts yet are compelled to develop in order to prosper. Stakeholder conflicts over development often involve debates about the level of uncertainty and environmental risks.

Geographical fact

As water heats up, it expands. Approximately half of the past century's rise in sea level is attributable to warmer oceans occupying more space.

1.4 Climate and climate change

'Weather' is what happened today or yesterday, or this year. 'Climate' is what you understand about a place when you have lived in it for 30 years or longer; but actually feeling climate change for yourself is almost impossible. The weather varies widely wherever you are, but the climate remains the same over half a lifetime, because climate is the average of all the weather's variations. From day to day and season to season the temperature change is large, but over the last 100 years **global warming** has seen Australia's average annual temperature rise by 1°C. This might appear to be a small amount, but not too small for changes to happen in the life cycle of plants, insects and animals.

global warming rise in the average temperature of the Earth's atmosphere

In climates where life pauses for the cold of winter, plants and animals respond to the warmth of spring. Trees bud, frogs spawn, birds mate and caterpillars hatch from their dormant eggs. And if spring comes early, so does the re-awakening of life. In most of Europe, Asia and North America, many plants and insects are now emerging from their winter shut-down a few weeks earlier than they did 50 years ago. This early awakening has occurred because the warmer days happen earlier than they used to.

Geographical fact

There is a swan farm in Dorset in England called the Abbotsbury Swannery. The swannery is over 600 years old, and has over 1000 white swans. By tradition, the first day of summer is proclaimed when the first cygnets hatch at Abbotsbury, which for centuries was in mid-May. In 2011 the first hatching was on May the 4th; in 2012, it was even earlier; April the 30th. The swans know the world is warming.

Source 1.6 Cygnets at the swannery in Abbotsbury, Dorset, England

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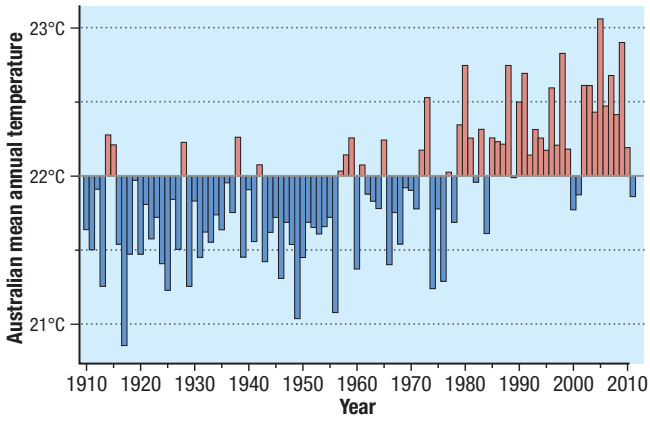
RESEARCH 1.2

1 Investigate how global warming has affected the life cycle of the Common Brown butterfly (*Heteronympha merope*) in Victoria. Present your results in the form of a life-cycle calendar now and 60 years ago.
You can find the science of this summarised via Cambridge weblinks: www.cambridge.edu.au/geography10weblinks
2 Explain the meaning of the word 'phenology'.

Measuring global warming

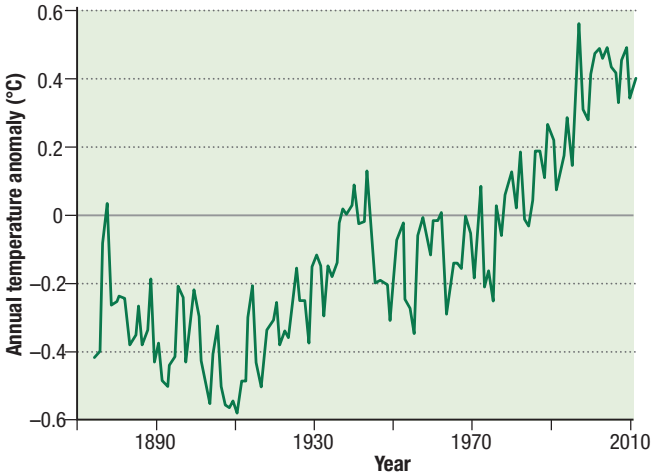
To calculate an annual average temperature for any place, meteorologists measure the daily maximum and minimum temperature for the entire year, and then average these 730 numbers (732 in a leap year).

Although temperature changes have alerted us to global warming, it is the record of temperature maintained by the world's meteorological stations that show the amount of warming that happened in the 20th century. Source 1.7 shows how Australia's average yearly temperature has changed since 1910. Australia spans the Earth's temperate and tropical zones and is clearly a warm continent. For the entire Earth, the average temperature is now approximately at 15°C.



Source 1.7 Australian mean temperature since 1910. Notice that from year to year the average temperature may vary by as much as 1°C, yet overall there is a trend towards warmer temperature. Source: Australian Bureau of Meteorology, product of the National Climate Centre

Temperature measurements taken in more than 30 000 meteorological stations around the world since 1880 have been compiled by four different groups of scientists, and they show very clearly how the world has warmed in the past 130 years (Source 1.8).



Source 1.8 The global land-based temperature anomaly (difference from the 1951 to 1980 average) drawn from data available from the Hadley Climatic Research Unit of the University of East Anglia, UK

Ice melt

Another very significant indication that global warming is happening can be seen by the changes in the amount of ice in the Arctic Ocean and on the great ice caps of Greenland and Antarctica. The warming ocean melts sea-ice from below while warmer air melts it from above. The area of Arctic sea-ice has been monitored by satellite since 1980, when the September area of ice was about 8 million square km – enough to cover Australia. Year by year more summer ice melted until by September 2012 Arctic sea-ice had shrunk to less than half its original area, to only 3.4 million square km. If this trend continues, the Arctic will be free of ice in the summer of 2030.

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ACTIVITY 1.2

1 Investigate the temperature range in your town or a nearby town between night and day in both January and July. Data for this can be found on the Bureau of Meteorology website via Cambridge weblinks: www.cambridge.edu.au/geography10weblinks

2 Research online what a Stevenson screen is and explain why it is used.

3 For the coming fortnight, record the daily maximum and minimum temperatures at your place using the newspaper, the Bureau of Meteorology's website or your own thermometer. Calculate the average temperature for the fortnight. Draw a graph showing the daily temperature anomaly (the difference between that day's average and the average for the fortnight).

RESEARCH 1.3

Investigate the history of the exploration of the North-west Passage between the Pacific Ocean and the Atlantic through the Arctic Ocean north of Canada.

Search for information in nauticapedia, Wikipedia and the Skeptical Science page via Cambridge weblinks: www.cambridge.edu.au/geography10weblinks

Use the scaffold below to help with the arrangement of your report.

- Include an introduction outlining the global warming trend and changes in Arctic sea-ice.
- Include descriptions and images of the type of boat used to explore this sea-route before 1950.
- Present a bar graph to compare the number of vessels sailing this route from the first passage until today.
- Compare the number of vessel passages with the changes in Arctic temperature since 1930.
- Re-emphasise your main point and reach a logical conclusion from the information you have presented.
- Data for temperature can be found via Cambridge weblinks (www.cambridge.edu.au/geography10weblinks) or from Source 1.8 above, though note that the latter graph is for global not Arctic temperatures.

What makes 'climate'?

To understand climate change we need to know the things that drive the weather and affect the climate.

The sun

Sunshine is made up of heat, light and ultraviolet (UV) rays, with most of its energy coming in as light. The different parts of sunshine, including the part you can see, light and the colours of the rainbow, can be described as having different wavelengths: longer wavelengths at the red end of the spectrum, shorter at the blue end. UV has the shortest wavelength and is the most energetic. Heat – also called infra-red – has longer wavelengths than UV (see Source 1.9). Heat, light and UV rays all warm the planet. You cannot specifically 'feel' UV, but it can burn your skin nonetheless.

The sun provides the energy to drive the weather. There is over 1 kilowatt (kW) of energy falling on each square metre when the sun is directly overhead – enough to power a small radiator. By the time it has passed through the atmosphere, that energy is reduced to a bit less than a kW during the Australian summer, and half a kW or less at noontime in winter.

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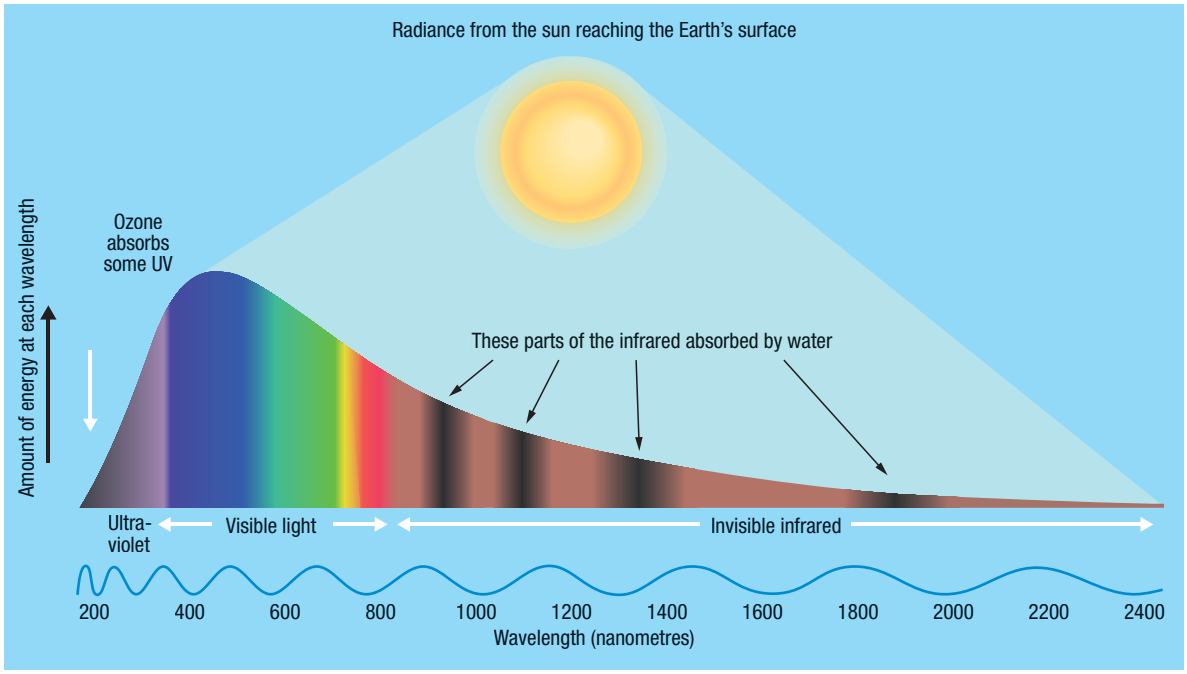


Source 1.9 The sun's radiation. Each part of the spectrum, not just the visible part as we see it in a rainbow, has its own wavelength, measured in nanometres (millionths of a millimetre). Various gases in the atmosphere, particularly ozone and water vapour, absorb different parts of the sun's radiance, as shown by the dark bands.

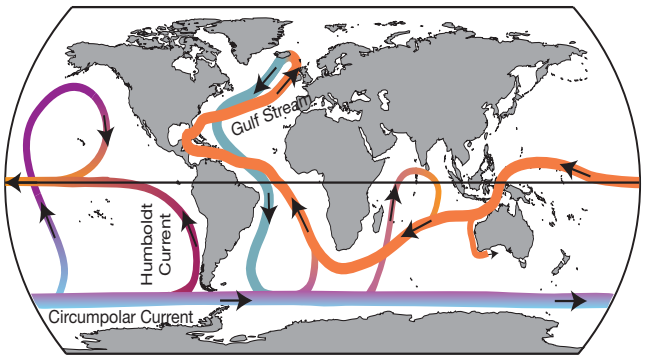
The sun is a very steady source of heat, and though minor variations of solar radiation occur, these are not enough to significantly affect climate. What can change the climate is the proportion of the sun's energy on the big landmasses of the northern hemisphere: Asia and North America. When there is slightly less summer sun there, something happens for reasons connected to the Earth's orbit and inclination of Earth's rotation axis: the winter snows do not melt as much as usual. If this lasts for thousands of years the overall amount of ice increases. Ice reflects almost all the sunshine that strikes it, and that helps cool the Earth – more area of ice means less of the sun's heat is absorbed. So the Earth cools and more ice forms. This is an important climate factor known as **feedback**. As this happens the world enters an ice age. There have been eight ice ages in the past million years. During each one the Earth's temperature fell by as much as 6°C. Astronomical calculations show we are now in a period called an **interglacial** with very slow cooling, and this should continue for approximately 50 000 years.

feedback change in one factor causing a change in a second and this then changing the first

interglacial warmer period between ice ages

Ocean currents

About 70% of the Earth's surface is ocean, and because water absorbs most of the sun's heat that falls on it, the oceans are the main store of the Earth's heat. Ocean currents encircling the globe are known as the Great Ocean Conveyor Belt (see Source 1.10). Surface currents take warm tropical waters towards the poles, and the cold, denser polar water sinks to the ocean floor and moves towards the Equator. In this way the sun's heat is distributed around the world.



Source 1.10 Main features of the Great Ocean Conveyor Belt. Note particularly the northward Humboldt Current, which carries cool Antarctic water up the South American coast before it turns west and is warmed. Note also the warm Gulf Steam, which carries warm water from the Gulf of Mexico to the North Atlantic.

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The atmosphere

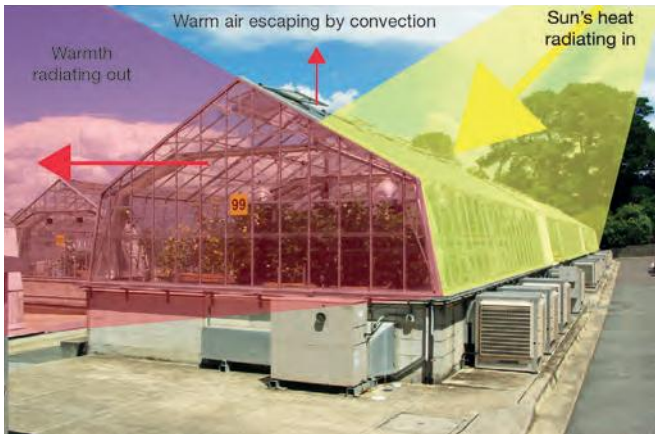
The Greenhouse Effect

A greenhouse works because incoming light and heat from the sun warm the air and plants in the greenhouse. The glass walls and roof prevent the warm air from flowing out by **convection** – warm air rises but the roof stops it escaping. Glass is not a good conductor of heat, so the warmth of the air in the glass house is taken away slowly by **conduction**. The greenhouse does lose heat by **radiation**, but enough heat is trapped inside by the glass for the greenhouse to remain warmer than the rest of the garden until sunset (see Source 1.11).

convection the transfer of heat from one place to another by the movement of liquids or gases

conduction the transfer of heat between substances that are in direct contact with each other

radiation the emission of heat energy in the form of waves travelling through space, air or anything transparent to heat

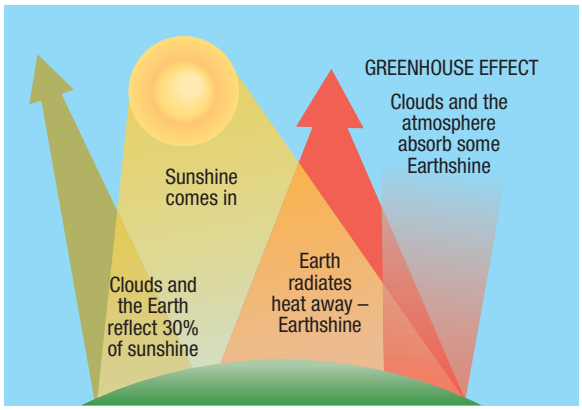


Source 1.11 How a greenhouse works. High-energy heat from the sun warms the interior, while lower-energy heat radiates out, keeping the greenhouse from overheating. Some heat escapes if a window is opened and some is conducted through the glass to the outside air.

While the Earth is not enveloped by a glass case, it is nevertheless protected by greenhouse gases which retain the Earth's heat. However, the process is quite different; Source 1.12 shows what happens. The Earth is warmed by the sun, which makes the Earth itself a radiator; not a very hot radiator, but a heat radiator nonetheless. The Earth's radiant heat, Earthshine, heads upward towards space and has to pass through the atmosphere to get out. Most Earthshine escapes; if it did not we would boil. But some of the Earth's heat is absorbed by water vapour and **carbon dioxide (CO_2)** in the air, and to a lesser extent by methane (CH_4) and other trace gases, and this absorbed heat stays with us and keeps the Earth at about 14°C. The way the Earth's heat is kept in is called the '**Greenhouse Effect**'. If it were not for our atmosphere, the temperature would be like the moon's, literally boiling during the day in the full light of the sun then dropping to 150°C below zero (–150°C) after sunset.

carbon dioxide (CO_2) a chemical compound composed of two oxygen atoms bonded to a single carbon atom. It is a colourless odourless gas

Greenhouse Effect retention of the Earth's heat by atmospheric gases



Source 1.12 The Earth's heat budget. Clouds and the Earth's surface reflect some heat, but most (70%) is radiated back towards space. About 10% of the Earth's heat is retained by the Greenhouse Effect.

Aerosols

'Aerosol' in this context does not mean a spray can. It refers to dust and other small particles which are always present in the air. Sulfuric acid droplets from volcanic and industrial emissions can float high up into the sky where they reflect a little of the sunshine and cool the Earth. Soot, on the other hand, absorbs heat and warms the air. Changes in the amount of these particles, known as aerosols, have a fluctuating effect on the Earth's temperature. During the period from 1945 to 1975 there was much industrial pollution, causing acid rain over Europe and damage to forests. An international agreement in 1979 reduced this pollution. Global warming, occurring at a rate of approximately 0.1°C every 10 years from 1900 to 1940, was slowed by these aerosols until 1975. Since the air was cleaned of sulfuric acid droplets the global temperature rise has averaged 0.15°C every 10 years.

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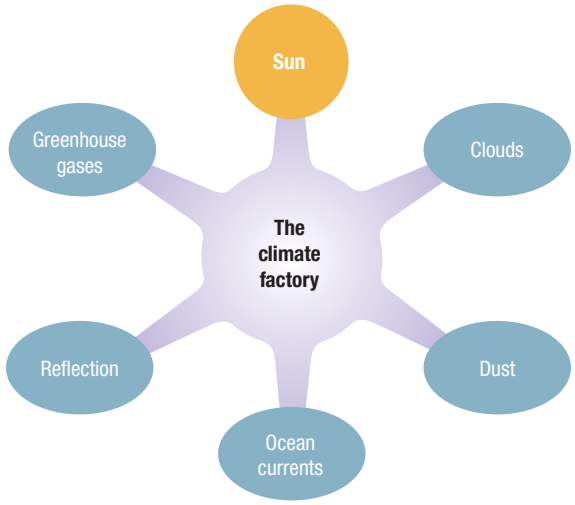


Source 1.13 Schematic of climate factors

Recent and past global warming

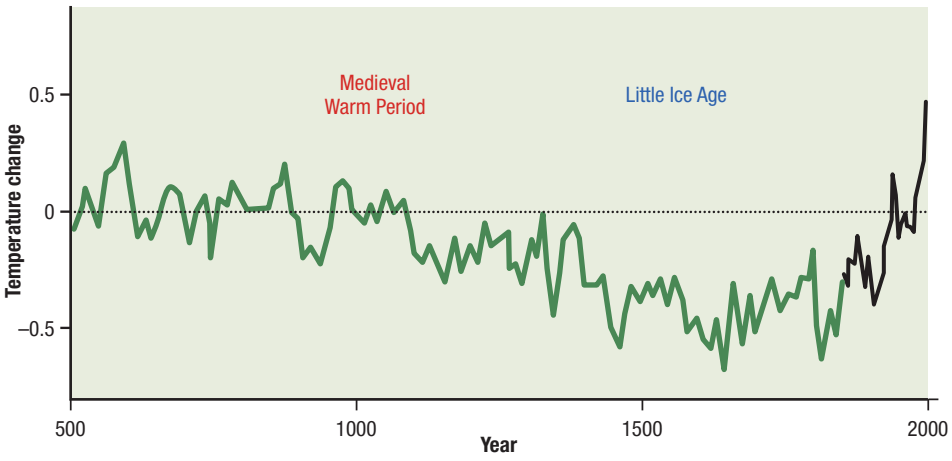
A change in the average temperature of 1°C in 100 years may not seem very much at all. To put this change in perspective we need to understand broad trends in temperature changes from past eras. Because thermometers are a recent invention, scientists have to work with what they call temperature proxies – natural phenomena that reveal the temperature by their effect on something. One proxy is the width of tree rings, because in the warmer year trees develop a slightly thicker layer of wood. Another is the composition of snow falling on Greenland and Antarctica. The detailed atomic composition of water depends on the temperature, and examination of annual ice layers can tell scientists how the temperature has changed. Putting these clues together has shown us that global temperatures cooled very slightly, with variations up and down, at least for the past 2000 years.

There are several things that can be seen in Source 1.14. One is that for 1500 years, global temperature varied by only a few tenths of a degree as it slowly declined. A second and very important thing is that since 1850 global temperature has risen extremely suddenly.

Going back as far as 400 000 years ago, global ice-age temperatures were about 6°C cooler than those of today, whereas the temperatures of the interglacial periods were not much different. What is very different is the rate at which temperature changed during the ice ages and the rate of change today. Ice-age cooling was slow – 1°C in 4000 years, with subsequent warming occurring at a rate of approximately 1°C in 1000 years. Today's rate is almost 20 times as fast: that is, 1°C in 60 years.

Geographical fact

At the height of the last ice age, 21 000 years ago, New York was covered by ice as much as 1 km deep. As the Earth warmed, starting 18 000 years ago, the edge of the ice sheet retreated at a rate of about 50 m a year. Today, the edge of the Arctic sea-ice is retreating at the rate of 8 km a year.



Source 1.14 The green line shows global temperature reconstructions for the last 1500 years. The black line shows thermometer measurements of the last 150 years. Zero on this graph represents the average temperature from 1850 to 1995.

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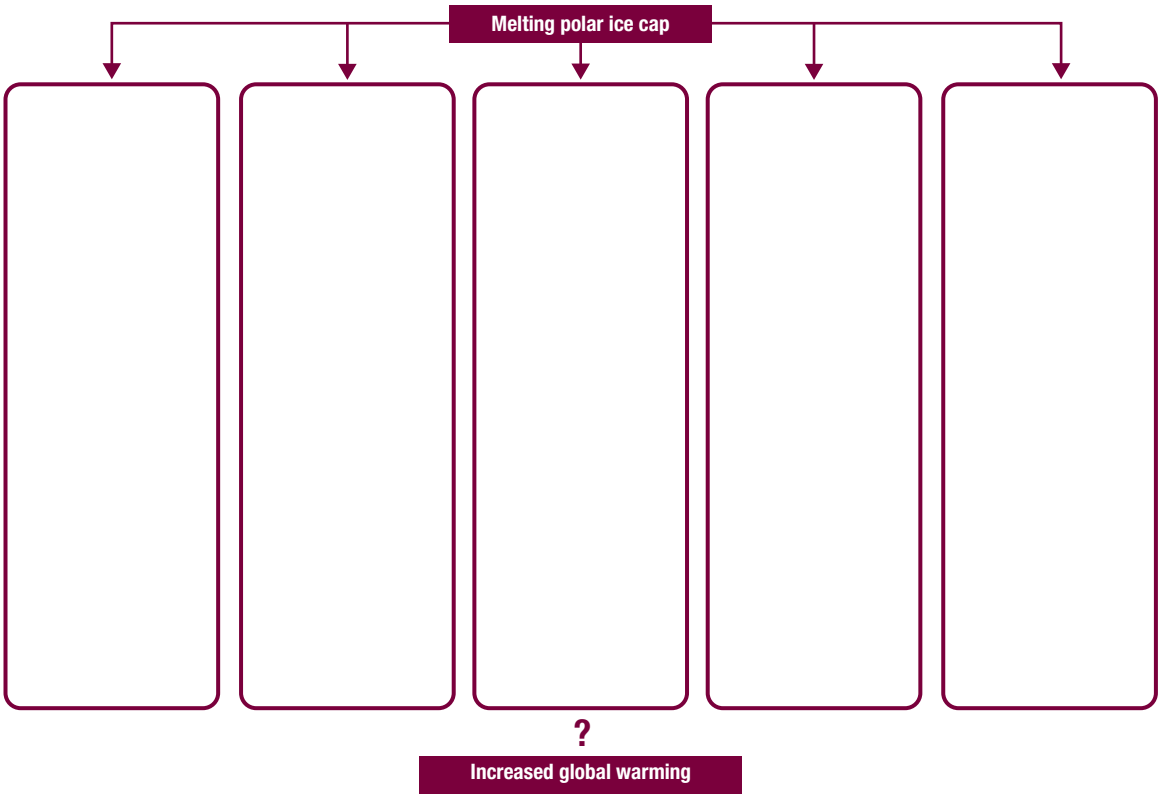
What is the cause of global warming?

We saw earlier that the Earth's climate is ruled by the sun. Some of the sun's heat is reflected, some of the heat is distributed by the ocean, and the atmosphere keeps the warmth in. If the Earth has warmed, then either the sun or the Earth's surface or the atmosphere must have changed. Astronomers are sure that the sun is not to blame; it has barely changed in the past 200 years. Similarly, there has been little change in the Earth's reflectivity. That only leaves the atmosphere, and it is a change in the Greenhouse Effect that scientists conclude is responsible for global warming.

The Earth's Greenhouse Effect is dominated by water vapour (about 60% of the effect) and by carbon dioxide (about 30%). It is water vapour that makes the air humid. In 1800 there were 280 molecules of carbon dioxide for every million molecules of air (76% nitrogen, 23% oxygen, 1% argon). You might think that 280 molecules in a million is not enough to do anything much, but it is enough to provide the carbon for all the plants on Earth. And it is enough to maintain a global temperature of about 14°C, helped by a big contribution from water vapour. Because of the way carbon dioxide can trap the Earth's heat, an increase in its amount must trap more heat. When that happens the warmer atmosphere can hold more water vapour, and that further increases the Greenhouse Effect. This is a second climate feedback just like melting polar ice – one warming factor drives another. Today the amount of carbon dioxide in the air is growing at a rate of 2 parts per million each year, and has currently reached 400 parts per million; that is, 40% more than there was in 1800. Not surprisingly, global temperatures have risen as a result.

NOTE THIS DOWN

Copy the graphic organiser below and summarise the consequences of melting polar ice. Consider also which, if any, consequences could cause further warming.



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ACTIVITY 1.3

1 Construct a table of the Greenhouse Effect of the following constituents of the atmosphere in order of their absorption of the heat radiated from the Earth (greatest to least): oxygen, water vapour, carbon dioxide, methane, ozone.

2 Research the meaning of the word 'albedo'. Construct a table of the albedo of forests, deserts, tundra, ocean, grasslands, Venus and the moon and arrange them in order of their albedo from greatest to least. (Wikipedia has data for these activities.)

3 Explain why, at least in the southern states, clear nights in winter are often frosty but cloudy nights are not.

Where did the carbon dioxide come from?

There are four sources of carbon dioxide to the atmosphere:

1 *From life itself.* As organisms live, breathe and die, their carbon is cycled from the atmosphere into plants and then into animals. When they die the carbon goes back to the atmosphere or ocean. Overall there is no significant change in the carbon dioxide content of the air.

2 *From volcanoes.* Volcanic gases contain carbon dioxide. Emissions from volcanic eruptions and fissures add approximately 300 million tonnes of carbon dioxide to the atmosphere every year. This is new carbon dioxide, but it contributes only 0.03 parts per million each year. Volcanoes are not the source of the global increase in carbon dioxide.

3 *From the ocean.* Most of the Earth's store of available carbon dioxide is dissolved in the waters of the oceans. If the ocean warms, some of the dissolved carbon dioxide comes out. Warming the oceans is certainly one way that atmospheric carbon dioxide can increase.

4 *From burning coal, oil and gas – the fossil fuels.* When a **fossil fuel** is burned, the carbon it contains combines with oxygen in the air to make carbon dioxide. Expressed as a chemical equation this statement can be written:

fossil fuels natural fuels such as coal or gas, formed in the geological past from the remains of living organisms

$$C + O_2 = CO_2$$

Coal is nearly pure carbon. Burning 1 tonne of coal produces about 3½ tonnes of carbon dioxide. Oil and gas contain both carbon and hydrogen, and when these fuels burn they produce both carbon dioxide and water. For light diesel oil the chemical equation is

$$C_{10}H_{20} + 15O_2 = 10CO_2 + 10H_2O$$

Since the beginning of the Industrial Revolution in 1750, more than a million million tonnes of carbon dioxide have been added to the atmosphere from burning coal, oil and gas. The source of the increasing amount of carbon dioxide in the atmosphere is fossil fuel burning.

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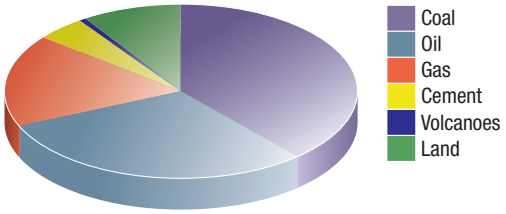
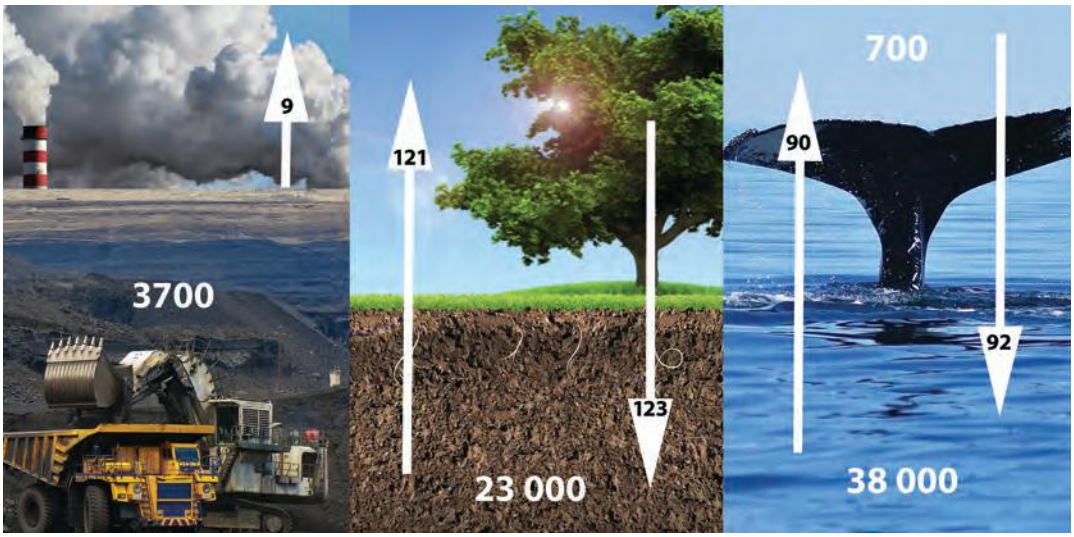
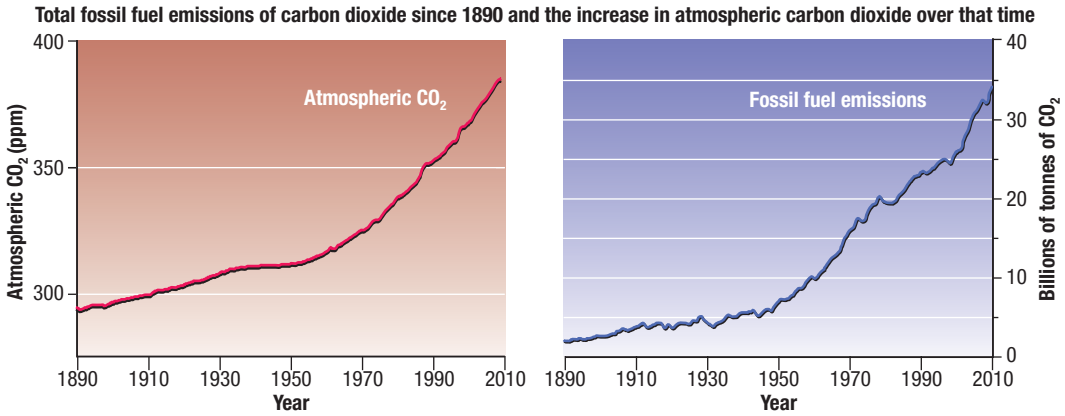
ACTIVITY 1.4

1. Research how the atmospheric carbon dioxide content has changed over the last 12 months at Mauna Loa Hawaii (see www.cambridge.edu.au/geography10weblinks) and at Cape Grim in Tasmania.
2. Explain the month-by-month variation at each locality.
3. Identify the change in the average atmospheric carbon dioxide content measured at Cape Grim, Tasmania, from 1955 to last year. (Go to the website of the World Data Centre for Greenhouse Gases and click the box Data-Quickplot. Under 'Station name' click the entry for Cape Grim – Australia – CSIRO. In the first column headed 'Parameter' click CO_2 flask. At the end of the third row headed 'Monthly data' click under 'Quick plot', either png or pdf)
4. Describe what has been happening to produce the extra carbon dioxide over this time.
5. Discuss (geographically) from where you think most of the increase in carbon dioxide has come.







Source 1.15 Summary of the way carbon dioxide is produced and cycled in the Earth

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1.5 What will climate change do?

We can understand what the future holds in terms of climate and weather firstly by looking at recent changes. An important effect of global warming is that the amount of water vapour in the air must increase simply because warmer air can hold more water. Indeed, this has been found: atmospheric water vapour has risen by 4% since 1970. More water vapour means more rain, though not necessarily everywhere, and this too has been seen. Northern Australia has had more rain since 1970. Record heavy rain, leading to floods, happened in eastern Australia in the summers of 2010 and 2011. Climate scientists point out that while no individual weather event can be attributed *to* climate change, every weather event is affected *by* climate change because the world is warmer, the air has more moisture, the Arctic is warmer and ocean currents are being affected. A storm can be stronger because of these changes, hot days can become more frequent and droughts may be longer and drier.

By looking at the geological record of past climates and levels of carbon dioxide, scientists have concluded that if the amount of carbon dioxide in the atmosphere doubles, the global temperature will rise by approximately 3°C. This is not an exact figure though and estimates by different scientists range between 2°C and 4.5°C, with 3°C as the most likely prediction at present.

For the next 20 years, we can expect the following small changes:

- global temperature will rise by at least another 0.3°C by 2030
- heat waves will be longer and more intense
- rainfall globally will be higher, though in eastern Australia it will be lower and more intense
- droughts will become more frequent
- sea-level will rise a further 6 cm
- alpine glaciers will retreat further and many will vanish
- arctic sea-ice will retreat, possibly vanishing in the summer
- the Antarctic and Greenland ice caps will become thicker from more snow, but with continued melting at lower altitudes
- the oceans will become more acidic
- hurricanes will be stronger and wetter.

If greenhouse gas emissions continue to increase as they have for 50 years, by the year 2100:

- Australia will be 4°C hotter
- the Arctic will be 8°C hotter
- sea level will be at least 30 cm higher; some say a metre is not too fanciful a prediction.

Case study 1.1

A British academic has warned that complacency could prove disastrous

Vast areas of regional Queensland, South Australia and Western Australia have been identified as among the most vulnerable in the world because of poor climate change policy and a failure to recognise the need to adapt to rising temperatures.

University College London's International Energy Policy Institute director Stefaan Simons said South Australia had already been identified as the driest state in the driest continent, but the failure of the federal and state governments to enact stable climate change policies, such as long-term **carbon pricing**, left it vulnerable to minor increases in temperature.

carbon pricing placing a price on carbon put into the atmosphere as carbon dioxide through either subsidies, a carbon tax, or an emissions trading ('cap and trade') system

Regional cities including Whyalla, Port Augusta and Port Pirie, as well as the Eyre Peninsula's western communities, were particularly at risk because of their ageing populations, the exodus of young people and poor access to services.

'If this inaction continues, then South Australia could find itself in very deep trouble,' Professor

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Simons said. He said sectors including agriculture, employment and fisheries could potentially be affected.

'If the temperatures increase, grapes will ripen more quickly, quality of wine goes down, people stop buying it around the world, there's a huge impact then on the economy,' he said.

Source: Verity Edwards, *The Australian*, Education Supplement, 5 December 2012.

1 Recall by how much the global temperature is predicted to rise if the carbon dioxide content of the atmosphere doubles from its pre-industrial level.

2 Research the value to the Australian economy of the South Australian grape harvest.

3 Investigate the change in the age distribution of the population of Port Augusta since 2001.

Source 1.16 Consequence of global warming

1.6 Can climate change be stopped?

Reducing carbon dioxide emissions

The **Kyoto Protocol** committed many countries, including Australia, to a reduction in their carbon dioxide emissions, but the biggest emitters, the United States of America and China, did not ratify this agreement. Since then a series of international meetings has failed to achieve much in the way of a reduction in the use of fossil fuels. After the Global Financial Crisis of 2010 there was a slight decrease in emissions, but 2011 and 2012 were years of increasing carbon dioxide emission.

Kyoto Protocol an international agreement created under the United Nations Framework Convention on Climate Change in Kyoto, Japan in 1997, which aimed to reduce the collective greenhouse gas emissions of developed country parties by at least 5% below 1990 levels during 2008 to 2012

Carbon dioxide from power stations can be trapped and stored underground – this is called carbon capture and storage. This would slow the increase of carbon dioxide to the atmosphere. But because carbon dioxide emissions have not decreased since 2008, **geoengineering** could buy time for alternative energies to be built. One idea is to mimic large volcanic eruptions by putting reflective aerosols such as sulphuric acid into the atmosphere. Because this is a known, natural process, the hope is it would not have too many unknown and possibly negative, effects.

geoengineering the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming

Some governments, including those of Australia and several European countries, have accepted that energy generation will have to change from using fossil fuels to using **renewable resources** such as wind, solar, tidal and geothermal energy. New Zealand, with its large sources of volcanic activity, already generates much of its electricity from **geothermal heat**. South Australia has invested heavily in wind power.

renewable resource any natural resource (such as wood or solar energy) that can be replenished naturally with the passage of time

geothermal heat heat from hot rocks

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Case study 1.2

Alternative energy sources in South Australia

Energy is fundamental to the way we live, our economy and our future. Like Australia's other states and territories, South Australia has relied mainly on gas and coal to produce its electricity. Burning of fossil fuels is the main source of greenhouse gases that are triggering the changes we are seeing in the global climate.

To avoid the most damaging consequences of climate change, we need to use energy more efficiently and harness low-emissions energy technologies, including renewable energy.

renewable energy natural energy which does not have a limited supply

South Australia reached its target of generating 20% of electricity from **renewable energy** in 2011, three years ahead of schedule. South Australia now has a target of producing one-third of its electricity from renewable energy by 2020.

Wind

South Australia's wind farms contributed about one-quarter of the state's total electricity production in 2011/12. Wind farms can provide employment and other economic benefits for regional communities.

Solar

About one in five South Australian homes have **rooftop solar photovoltaic (PV) systems** installed, producing the equivalent of 2.4% of South Australia's annual energy in 2011–12 (Australian Climate Commission, 5 Dec 2012).

rooftop solar photovoltaic (PV) systems energy generation equipment that works by converting sunlight directly into electrical power

1. Investigate from where South Australia gets its coal and gas.
2. Research and compare the cost of electricity generated by coal, by gas and by wind.
3. Analyse some reasons why the USA and China did not ratify the Kyoto Protocol.

RESEARCH 1.4

Prepare a poster to illustrate *one* of the *two* following topics:

- The impact of rising temperature and increased atmospheric carbon dioxide on the ocean.

Aspects you might include are:

1. causes of coral bleaching on the Great Barrier Reef
2. the effect of rising CO_2 on ocean acidity and marine life
3. the implications for a sustainable fishing industry in northern Australian waters as the global temperature rises

or

- how the Earth might be cooled by geoengineering.

Investigate such possibilities as injecting stratospheric sulfuric acid, ocean spray, mirrors in space, reflective surfaces on Earth, CO_2 scrubbers.

Sources for these topics can be found in 'A Short Introduction to Climate Change' and many internet sites.

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Case study 1.3

Sub-Saharan Africa – the Sahel

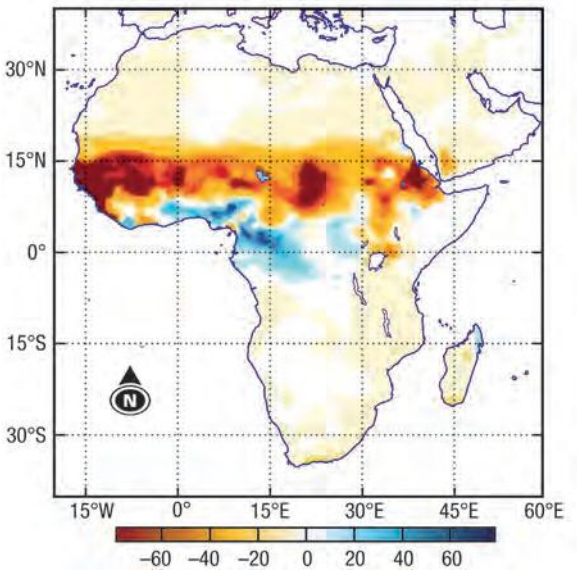
Major climate changes have taken place to the south of the Sahara Desert in a regional band known as the Sahel. The region includes the countries of Niger, Chad, Senegal, Sudan, Mali and several smaller countries. Source 1.17 shows the land near Timbuktu in Mali. Across the Sahel, the climate of the past 50 years has been disastrous. Rainfall – never abundant and once averaging between 100 and 400 mm annually – in some parts declined by 40% between 1950 and 1980.

Source 1.17 Near Timbuktu in the northern Sahel, Mali. The annual rainfall here has declined from 225 mm to 175 mm since 1950.

Changes in rainfall across the Sahel during the wet season for the 50 years from 1950 to 2000 are shown in Source 1.18. As rainfall has dwindled, so has the agricultural productivity of the Sahel, falling 1% every year from 1970 to 2000. In parallel, **desertification** has intensified. Although some improved farming practices have started to reverse the declining food production of the late 20th century, the region is still highly susceptible to drought. By early 2010, failure of the rains in the previous year had led to a 30% decline in cereal production in Chad. Neighbouring Niger had its worst crops in two decades. According to the United Nations Children's Fund (UNICEF), in the Sahel 300 000 children under age five die each year from **malnutrition.** The drying of the Sahel is attributed to an increased Atlantic sea-surface temperature difference north and south of the Equator, as well as warming of the Indian Ocean.

desertification
the change of dry land to desert

malnutrition
illness caused by inadequate food



Source 1.18 Wet-season rainfall changes in millimetres across Africa from 1950 to 2000

1 Reports from the Sahel shown here are only up to 2010. What has happened in the Sahel since then?

Points to consider:

- Has the drought broken?
- What are the main crops of the Sahel? Have they succeeded?
- International aid was needed in 2012. Did that aid eventuate?
- Did civil war or other conflict limit access to international aid?

Possible sources: Food and Agriculture Organization of the United Nations, Syngenta Foundation for Sustainable Agriculture, Wikipedia, UNICEF.

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Case study 1.4
Latin America

Latin America spans a vast region of the Earth, from the tropics almost to the Antarctic. Along the length of South America there are many different landscapes and climate zones, and each will be impacted by climate change in its own way.

Running along the whole western coast of the continent is the huge mountain range of the Andes. In the high Andes valley glaciers are important water sources, but through global warming these are melting and water supplies may be jeopardised.

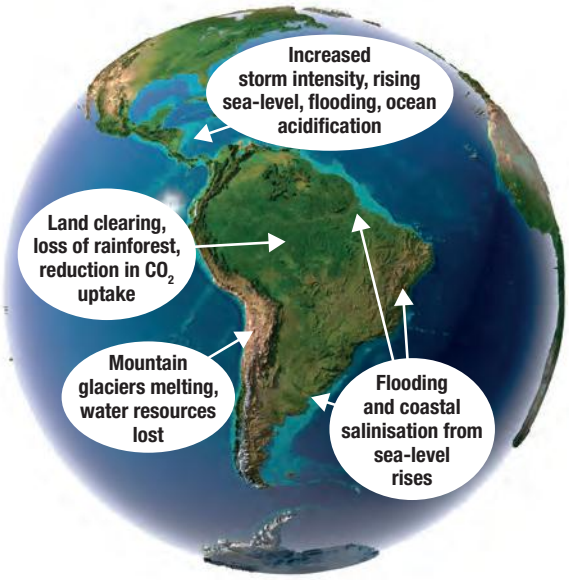
The Amazon Basin carries the world's largest rainforest with an area of 5.5 million square km, almost as big as Australia (7.7 million sq. km). Already a combination of **land clearing**, rising temperatures and changing rainfall is affecting the forest. Rainforests are the land's largest sink for atmospheric carbon dioxide.

land clearing is defined as the direct human-induced removal of vegetation cover from forested areas, in order to allow the land to be used for other purposes such as agriculture

In the Caribbean, higher rainfall, increasing storm intensity, floods, an increase in ocean acidity and sea level rise can all be expected to have a significant impact on property, the environment and coral reefs.

According to the Inter-American Development Bank:

> Latin America and the Caribbean contribute only 11 per cent of the emissions that cause global warming. However, some countries are especially vulnerable to its effects, given the region's dependence on natural resources, an infrastructure network that is susceptible to climate events, and the presence of bio-climate hotspots such as the Amazon basin, the Caribbean coral biome, coastal wetlands and fragile mountain eco-systems.
>
> Estimated yearly damages in Latin America and the Caribbean caused by the physical impacts associated with a rise of 2°C over pre-industrial levels are of the order of $100 billion by 2050, or about 2 per cent of GDP.
>
> The study cites climate impacts in areas such as agriculture, exposure to tropical diseases and changing rainfall patterns, among others. For instance, the report cites recent work estimating the loss of net agricultural exports in the region valued at between $30 billion and $52 billion in 2050.
>
> In Mexico and Brazil alone, almost one million hectares of land lie within 10 metres of sea level, making those countries vulnerable to rising sea levels. A rise of one metre in the sea level could affect 6700 km of roads and cause extensive flooding and coastal damage. A 50% loss of the coral cover in the Caribbean from coral bleaching would cost at least $7 billion to the economies in the region.



Source 1.19 Expected impact of climate change in Latin America

According to the World Bank (November 2012):

> Even today the global climate is changing, and so regions must adapt to it in order to maximise their resilience to the changes …
>
> For Latin America, this resilience means:
>
> - ensuring the region's infrastructure can withstand the new climatic 'extremes'
> - growing a wider variety of crops, which perform well in droughts, floods and heat, as well as guaranteeing future crops through seed-banksprioritising land use to preserve and manage multiple threats

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- implementing emergency response plans and early-warning alert systems
- developing social safety nets and insurance to protect the region's most vulnerable groups
- sharing best practices and information systems between countries
- monitoring the region's weather and climate.

Source: Inter-American Development Bank, *The Climate and Development Challenge for Latin America and the Caribbean: Options for Climate Resilient Low Carbon Development*, 5 June 2012; World Bank, *Climate Change: Is Latin America prepared for temperatures to rise 4 degrees?*, 19 November 2012

1 Draw up a graph of the loss of Amazon rainforest since 1970. (Sources: Wikipedia – search for 'Deforestation of the Amazon Rainforest' – and also National Geographic (see www.cambridge.edu.au/geography10weblinks).

2 List four major agricultural exports from Latin America, and explain how climate change might affect these.

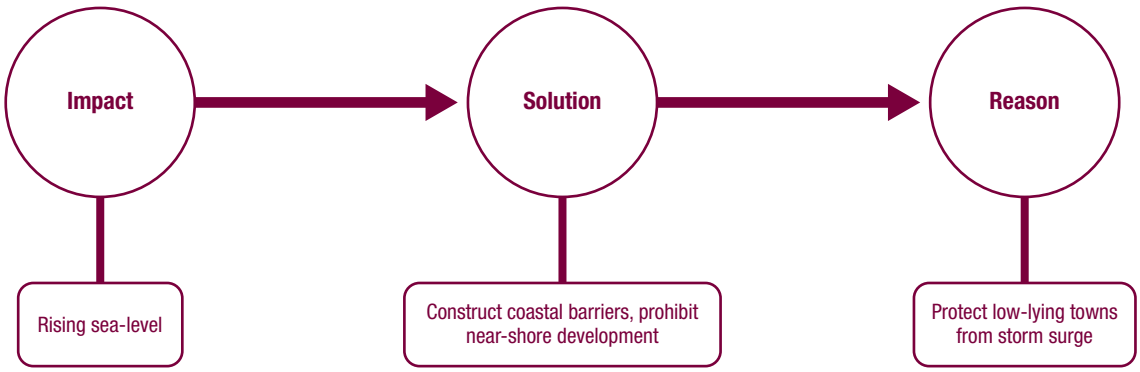
3 Explain what particular threats are caused by climate changes that could cause the collapse of the coral **biome**?

4 Discuss your thoughts on what 'prioritising land use to preserve and manage multiple threats' means?

biome the main groups of plants and animals living in areas of certain climate patterns

NOTE THIS DOWN

Copy the graphic organiser below and list the expected impacts of climate change. Suggest steps that could be taken to mitigate these impacts and explain why these steps should be taken.



Is it all doom and gloom?

Many of the scientists and engineers who advise governments about the impacts of climate change emphasise the bad things that might happen, such as longer droughts or more violent storms. This is perfectly sensible because governments need to prepare for weather that is likely to be damaging. But there is another side to climate change, and it might also be sensible to plan for the good things.

Plants need carbon dioxide to grow. If the atmosphere contains more carbon dioxide, plants grow larger and produce bigger crops, though not all such crops have better nutritional value. Another consequence is they may become more drought-tolerant and so extend **arable** land further into the dry country.

arable suitable for farming

The Arctic is known to be warming twice as fast as the rest of the world. As the snow melts and as the permanently frozen ground (permafrost) of Siberia and northern Canada warm up, these areas will become open to agriculture, benefiting those who live there.

Australian politicians agree that some control on carbon emissions is required, but they disagree about how to achieve this. Any mechanism designed to reduce dependence on fossil fuels will have the added benefit of extending their availability for longer.

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Prediction

Humans rely on prediction to guide environmental decision-making, which may be influenced by our understanding of past impacts and emerging scientific knowledge. This knowledge is the basis for estimating risks to the environment. Environmental impacts are not always immediate and there can be interactions between impacts over time that can have a cumulative effect on the environment. Indeed, many environmental impacts can occur decades or even centuries after development has altered processes. A lack of understanding of time frames of impacts can challenge our ability to conserve resources for future use. However, our capacity to predict and avoid impacts associated with development is improving as our scientific knowledge increases.

RESEARCH 1.5

In a class group, discuss what you might like to have at a party. What drinks, what food would you want? It is only a party, so maybe 'healthy eating' can be forgotten for this. Or maybe not. If you want Tim Tams and someone else says 'Yuck, too sweet, let's have chips,' would you say they are wrong, or 'OK, that's your opinion,' or 'Sor-ry!'?

Now discuss why the climate is changing. After all, this is a topic that gets much discussion in the media and the internet, but who has actually experienced it? Politicians are divided over it, and you might read that scientists are divided over it. In much of daily life there are two, sometimes more, sides to an argument. Is climate change a topic that should be resolved by debate?

To do this, have your teacher divide the class up into small groups, each to tackle one of the points below.

- Is 400 parts in a million of carbon dioxide trivial?
- Do you think the climate scientists who have studied this topic are dishonest, and report untrue but amazing results in order to scare governments into giving them more money to do their research and keep their jobs?
- How authoritative and reliable is the Intergovernmental Panel on Climate Change?
- Besides thermometer measurements, what evidence is there for global warming?
- What proportion of climate scientists doubt that global warming is happening as a result of burning fossil fuels?
- Some assert the world cooled since 1998. Do the data support that?
- Are you in a position to have an opinion on the science? An opinion about the scientists?
- Why do you think Australian politicians argue over this?
- Over the long term, do you think global warming will benefit or harm human wellbeing?

Bring all these topics, and others you might think of, together at a Forum on Climate Change. Perhaps invite other classes, invite a climate scientist, invite the Australian Youth Coalition for Climate Change.

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NOTE THIS DOWN

Copy the graphic organiser below and create a SWOT analysis on the process of relying on prediction to guide environmental decision-making. An example has been done for you.

Relying on prediction to guide environmental decision making	
Strengths	**Weaknesses**
A safe approach due to the uncertain nature of the environment	
Opportunities	**Threats**

The Precautionary Principle

In the absence of sufficient scientific knowledge, reliable predictions of human impacts on the environment are difficult. A lack of predictive capacity can result in development that causes irreversible harm and unrecoverable loss of resources. Governments have recognised that, in the absence of scientific knowledge, precautionary approaches to resource management are required to prevent irreversible harm to the environment and ensure that unsustainable practices are averted. A precautionary approach to development is highly contentious because pro-development groups consider precautionary decisions to be a hindrance to development. The **Precautionary Principle** has been introduced to the legislation of many countries to guide decisions on developments that might cause irreversible harm. The most widely adopted definition of the Precautionary Principle is based on Principle 15 of the Rio Declaration:

Precautionary Principle a precautionary guide in the legislation for decisions on developments that might cause irreversible harm

> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In this definition, 'measures' refers to the powers of governments, through legislation, to refuse developments that could cause irreversible environmental damage.

ACTIVITY 1.5

1. Discuss why developers are wary of the Precautionary Principle.
2. Provide an example of environmental harm caused by past decisions that lacked an understanding of risks.
3. Explain why we need to consider time frames when predicting environmental impacts.
4. In your opinion, is sustainability achievable in Australia? Explain your answer.

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RESEARCH 1.6

Search the internet and your school library for information on nuclear energy production and the Fukushima Daiichi nuclear disaster.

1. Is nuclear energy production a better environmental choice than coal-based energy production? Explain your answer.
2. Summarise in a series of short bullet points the Fukushima Daiichi nuclear disaster.
3. Reflect on the events at Fukushima. Discuss how they could have been avoided.
4. Identify one social, economic and environmental impact of a nuclear disaster. How do these impacts affect sustainability?

Source 1.20 Are nuclear power stations a sustainable alternative to coal-fired power stations?

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Human impacts

There are many human activities that degrade resources and threaten our capacity to achieve sustainability. The most common impacts are summarised in the table below:

Human activity	Immediate impacts	Short- to medium-term impacts	Long-term impacts
Deforestation	Loss of vegetation cover; increase in run-off; loss of habitat	Soil erosion and soil salinisation; degradation of streams through sedimentation and high turbidity	Reduced environmental quality for humans, plants and animals; desertification; reduced biodiversity.
Manufacturing and heavy industry	Contamination of soil, air and water; noise pollution; loss or degradation of cultural sites	Degraded habitats; accumulation of toxins in plants and animals; increase in acute diseases	Climate change; reduced biodiversity; extinction of species; increase in chronic diseases
Impoundment of water (dams and weirs)	Reduced river flows; degradation of water quality; changes in flood regimes; inability for fish to migrate	Erosion of downstream river; 'river chilling' from cold water releases; habitat degradation; reduced recruitment of aquatic organisms; reduced nutrient levels in flood plain soils	Loss of fish and other aquatic organisms; reduced productivity of agricultural land
Mining	Habitat loss or fragmentation; loss or contamination of groundwater resources	Weed infestation; reduced natural food resources; soil acidification and salinisation	Loss of biodiversity; low agricultural productivity; land subsidence
Over-fishing and harmful fishing practices	Loss of breeding population; damage to habitat	Habitat degradation; loss of seagrasses and coral; changes in food chain, changes in biodiversity	Extinction of species; reduced number of fish populations; changes in food web; loss of recreational and commercial fisheries and destruction of marine and freshwater systems
Urbanisation	Increased run-off; decreased infiltration; contamination of soil, air and water; stakeholder conflicts	Loss or degradation of habitat; downstream pollution of rivers; increase in invasive species; fragmented habitats	Extinction of species; loss of biodiversity; reduced food resources
Agriculture	Loss of natural vegetation; increased run-off; increased soil erosion; pollution of waterways	Habitat fragmentation; loss of habitat; sedimentation in nearby streams; water quality degradation in downstream areas	Reduced or loss of biodiversity; chronic soil salinisation

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1.7 Environmental worldviews

A worldview is a set of beliefs about what is real, what is valuable and what it means to be a human being. People hold different worldviews about the environment. People's worldviews affect their willingness to protect landscapes for aesthetic, cultural or spiritual reasons. Some worldviews are about benefits to the individual and some are more about ecological wellbeing. All worldviews are based on a set of values.

Value judgements are drivers for how we use and manage the environment. Our value judgements influence our decisions on whether we find environmental impacts acceptable or unacceptable, and also influence political positions on sustainability. Our environmental values are shaped by our exposure to environmental impacts and the influence of the media and education. The following ideologies influence how humans perceive environmental risks:

- *Ecocentrism* – places a focus on nature rather than humans. Ecocentrism proposes that we should consider humans as part of the biotic community and that we should modify our behaviour to protect the ecosystems to which we also belong. Sustainable development must consider our place in the ecosystem and build environmental goals rather than solely focus on meeting human needs.
- *Anthropocentrism* – places a focus on meeting human needs and recognises humans as the dominant species on Earth. Ecocentrics consider this ideology as the cause of unsustainable development.
- *Technocentrism* – proposes that environmental problems can be solved using science and technology. Ecocentrics are in conflict with technocentrics due to a lack of faith in technological solutions and a view that nature should not be controlled through technology.
- *Biocentrism* – endorses ethical treatment of all living things. Biocentrics consider that humans are not superior to other species and promote biodiversity. It differs from ecocentrism because it focuses on living organisms rather than the physical environment.

RESEARCH 1.7

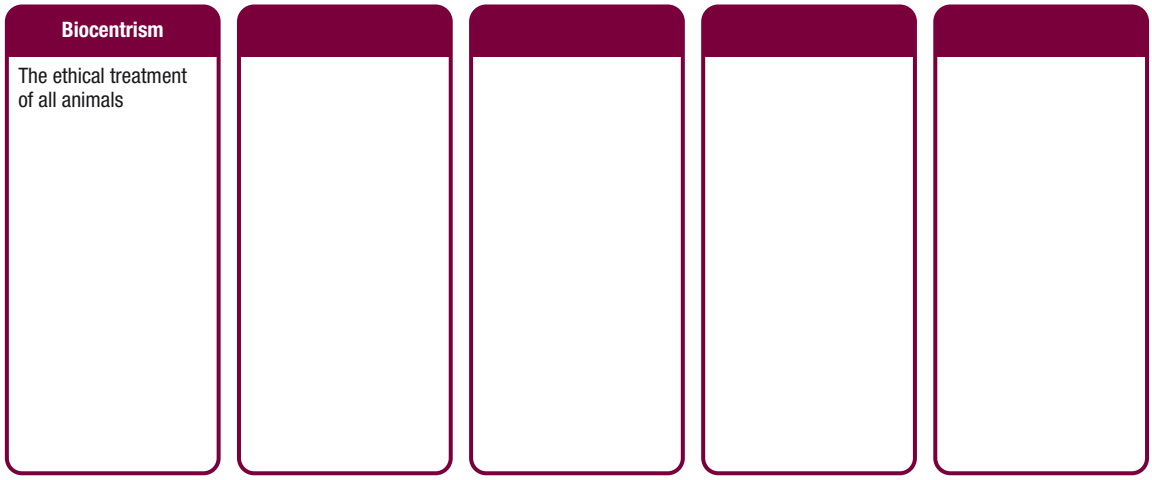
Search the internet and a dictionary for the term 'NIMBY' and Nimbyism.

1. Spell out the acronym for NIMBY and explain what the term means.
2. Examine whether the term is used in a negative or positive context.
3. Identify three examples of developments in your city or town that triggered Nimbyism.

Source 1.21 An environmental protest supporting clean energy in Brisbane

NOTE THIS DOWN

Copy the graphic organiser below and use it to summarise the different views of sustainability. An example has been provided.



Sustainability worldview

From a sustainability worldview, we seek to combine rather than trade off ecological, cultural, social and economic values. This means creating technologies and livelihoods for people that also protect the environment, strengthen society and respect cultures.

The role of the whole community is very important in sustainability for several reasons. Involving the community in environmental management can lead to creative strategies and decisions that reflect the values and interests of the community, sometimes including spirituality. Sustainability is most likely to be achieved when the community has sound ecological knowledge and a strong sense of place and belonging.

In working towards sustainability, community discussions about the varying worldviews on the environment can help to gain a shared understanding of all values and how to combine them.

Where we can successfully combine ecological, cultural, social and economic values, we are beginning to tread lightly on the Earth and move towards sustainability.

For example, rather than locating industrial development, nature conservation, social activity and cultural heritage at different points of the landscape, we could make these activities more compatible so they can support each other and exist together in the landscape. Here are some examples of where we are starting to do this:

- Miners can rehabilitate a mine site to restore its ecological value and can also provide recreational infrastructure like a swimming pool to the local community.
- A farmer can plant a variety of native trees as windbreaks on his or her farm. The windbreaks provide ecological diversity but also increase the productivity of the farm by protecting the pasture and the livestock. The trees can also add visual appeal to the landscape.
- National parks can be jointly managed by a government conservation agency and Traditional Owners to support both ecological conservation and Aboriginal and Torres Strait Islander peoples' empowerment. Renewable energy and passive solar design can be used for the park facilities. Tourism can develop as a result of joint management practice. Community education and the local economy can then also improve.

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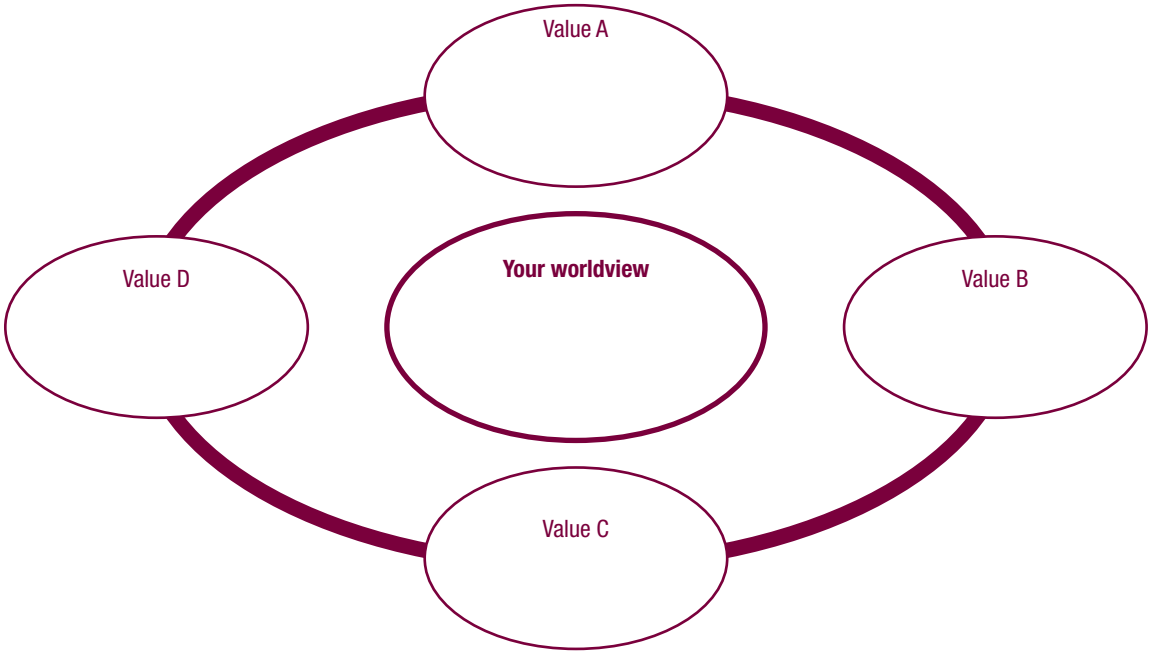
NOTE THIS DOWN

Copy the graphic organiser below and answer the following questions:

1 What do you value most about your environment? Write down your main values in the outside circles.

2 What do you conclude your worldview might be? Write it down in the centre circle.



Australian law

Ecologically sustainable development (ESD) is embedded in environmental decision-making in Australia. Legislation provides a legal framework for decision-making, guidelines for developers, processes for public participation and consistent measures to enforce compliance. **Environmental impact assessment** and planning laws were enacted during the 1970s following growing environmental activism that saw the public having a strong influence on environmental decision-making in this country. The Federal Government enacted the *Environmental Protection and Biodiversity Conservation Act* (EPBC) in 1999 to replace a number of environmental Acts from the 1970s and to streamline environmental decisions. The EPBC Act addresses the following matters of national significance:

- World Heritage sites
- National Heritage places
- nationally protected wetlands (Ramsar wetlands)
- nationally listed threatened species and ecological communities
- listed migratory species
- nuclear actions (including uranium mines)
- Commonwealth marine areas
- land owned by the Commonwealth
- activities by Commonwealth agencies.

Responsibility for environmental management and sustainable development is divided between all levels of government in Australia. If a development involves any of the previously mentioned matters of national significance, then the developer must seek approval from the Federal Minister for the Environment. This may require the submission of an Environmental Impact Statement.

ecologically sustainable development (ESD) the environmental component of sustainability that is embedded in environmental decision-making in Australia. It also considers the need to meet economic and social development goals

environmental impact assessment an assessment of positive and negative impacts an action or project will have on the environment

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Role of the public

Australian federal and state laws include opportunities for the public to make comment or to submit objections to developments. Major developments trigger the need for an **Environmental Impact Statement (EIS)** in most states and under the EPBC Act if there are matters of national significance. An EIS outlines the main activities of the development, predicts the potential impacts and describes strategies to minimise or prevent environmental impacts. The developer or proponent, who may also be the government, is required to produce an EIS that is subjected to review by **stakeholders**. Local government (councils) is also empowered to make decisions on development.

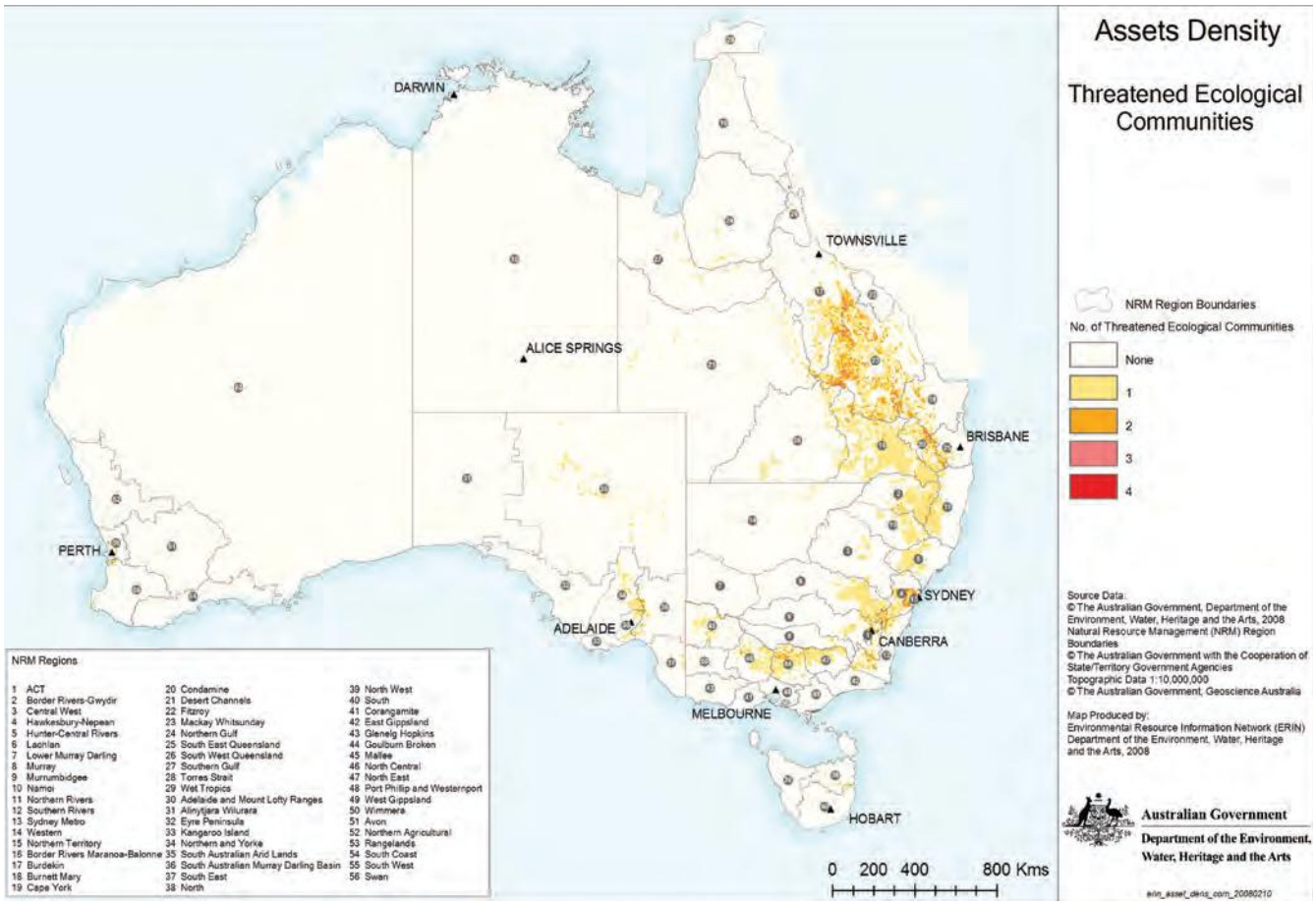
Environmental Impact Statement (EIS) a document that outlines the main activities of a development, predicts the potential impacts and describes strategies to minimise or prevent environmental impacts

stakeholder a party or person with an interest or concern in an organisation and its actions

Many Australian planning policies and environmental laws traditionally focused on approving single developments in an independent manner. That is, decisions were once made on the sole effects of one development at one location without considering the interactions with, and the sum of impacts of, other developments. There is now greater recognition of cumulative impacts and the importance of planning development strategically so that the effects of multiple projects can be predicted and considered. Although single developments can be considered sustainable, the environment may not be resilient to the effects of multiple developments. There can also be cumulative social impacts when multiple developments are approved separately. For example, truck movements to a single factory might cause acceptable noise levels. However, if there are multiple factories at a location, the increase in noise from trucks might become unacceptable. To address cumulative environmental impacts, environmental managers must consider the following:

- the spatial extent of the potential impacts of a development or activity; understanding the spatial extent enables decision-makers to determine who, what and where will be impacted and where interactions with other developments might occur

Source 1.22 Map of threatened ecological communities in Australia. Mapping is a useful tool for environmental decision-makers.



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Source 1.23 Coal seam gas exploration in Sydney's suburbs has triggered public objection and calls to apply the Precautionary Principle.

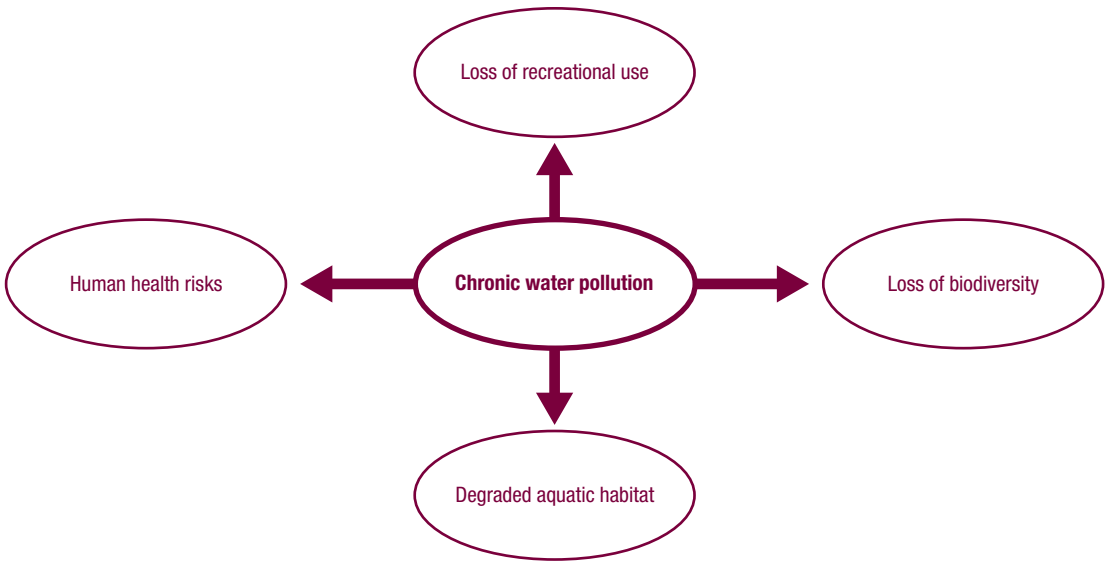
- the time over which an impact might occur and the length of time required to monitor; understanding the time frame for impacts enables decisions to be made about future impacts, future needs to be considered and projections on interactions between the current and future use of the environment to be made
- the interaction of impacts from past, present and future developments and activities; this knowledge is essential because decision-makers can more accurately predict if the impacts from a single development will add to or amplify the impacts from other developments
- the use of contingency plans and environmental monitoring to address impacts, over time, that were not accurately predicted; a lack of scientific knowledge or errors in past and current decisions on development can lead to cumulative impacts. Contingency plans and monitoring enable managers to quickly respond to negative changes in the environment by modifying development or implementing remediation strategies.

Geographical fact

In 2006–07, Australians generated approximately 48 million tonnes of waste. Only 52% of that waste was recycled.

NOTE THIS DOWN

Copy the graphic organiser below and show links between human activities and resulting impacts. You can add arrows to show interactions between impacts. An example has been completed for you below.



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Case study 1.5

The Green Bans: saving Sydney's historical sites

A green ban is strike action by a trade union or other group of labourers to protect the environment from development. The term originates from Black Bans, which involve strike or industrial action organised by unions. The term 'green ban' was coined to emphasise action taken to protect the environment from development. Until the mid-1970s, historical and cultural sites in Sydney were being demolished and redeveloped without passing through a rigorous process of planning decisions that involved public input. Communities were increasingly outraged by planning decisions that excluded them. Trade unions entered the public debate over redevelopment in the early 1970s when a group of women from Hunters Hill, a suburb of Sydney, sought help to stop the redevelopment of Kelly's Bush, the remaining bushland in the suburb. Union members working on the site of the redevelopment went on strike in what was the first of the green bans. Kelly's Bush was eventually preserved but a precedent was set and public groups continued to call on the trade unions to help protect areas of historical and cultural significance.

Source 1.24 Jack Mundey, who led union involvement in the green bans, being escorted by police during a protest. Jack Mundey coined the term 'green ban'.

Green bans helped to protect historical buildings in Glebe, The Rocks and Kings Cross, all parts of Sydney, and the redevelopment of the Royal Botanical Gardens and Centennial Park. Over 100 buildings of significant historical value were saved, and urban green space was preserved. The Sydney green bans inspired similar actions in other states and the practice was adopted internationally.

The green bans in Sydney, Melbourne and other cities triggered changes in federal and state environmental planning processes. Revisions to planning decisions, policies and environmental and planning laws included steps to protect historically and culturally valuable sites. The bans also led to a greater appreciation of public participation in development approvals. In 1975, the New South Wales State Government, aware of growing activism and changes in community attitudes, introduced the *NSW Heritage Act*, the *Environmental Protection and Assessment Act* and the *Land and Environment Court Act*, bringing to an end haphazard redevelopment of historic and cultural areas. These Acts ensured that proposals for redevelopment were carefully scrutinised by the public and state government and disputes could be addressed through the Land and Environment Court. The green bans also influenced politics in Europe where, as a result of the movement in Australia, the term 'green' was adopted to describe environmental issues and new 'green' political parties had formed. The preservation of historical and cultural sites is now embedded in environmental laws around the world to ensure that future generations have access to these assets.

1. Discuss one law that was enacted by the NSW Government that helped to protect the environment.
2. Explain in your opinion how effective green bans can be today. Can they still play a role in protecting the environment?
3. Reflect on the impact of 'people power' on environmental decisions. Besides green bans, what other ways can people influence bureaucrats to change how the environment is managed?
4. Analyse why the protection of historical and cultural sites is relevant to sustainable development.

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RESEARCH 1.8

Locate an online ecological footprint calculator; there are many, so choose a calculator that is most relevant to Australia. Prepare a list of your daily activities and record data on your use of resources such as electricity, water and food, fuel and paper and plastic products. Calculate your ecological footprint for one typical day using the online resource.

1. Explain which daily activity had the greatest energy demand.
2. Discuss what you can do to reduce your daily consumption of renewable and non-renewable energy sources.
3. Summarise the key activities that directly polluted the environment.
4. Describe how you might have impacted the environment outside the area where you conducted your activities.

1.8 Aboriginal and Torres Strait Islander peoples' approaches to custodial responsibility and environmental management

For tens of thousands of years, Aboriginal and Torres Strait Islander peoples have lived across Australia in hundreds of distinct groups with their own unique languages and cultural practices. All Aboriginal and Torres Strait Islander peoples held central to their beliefs and culture an ancestral Creation time now known to non-Indigenous people as the 'Dreaming' or 'Dreamtime'. During this time ancestral creatures moved across the landscape and created landforms, plants and animals, laws and customs, and people. Before European settlement, Aboriginal and Torres Strait Islander peoples modified the environment

Source 1.25 The Yarra River, which runs through Melbourne, has sadly attained poor water quality, impacting the ecosystem of the river.

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with fire but over a timescale that enabled the environment to reach a new balance. It is thought that through the use of fire, Aboriginal and Torres Strait Islander peoples had a major impact on Australia's landscape. Australian historian Bill Gammage published a book in 2011, *The Biggest Estate on Earth: How Aborigines made Australia*, that describes how important he thinks Aboriginal and Torres Strait Islander peoples' land management was for the Australian continent. Gammage draws upon the writings and paintings of early Australian settlers, who would often describe the landscape as looking like an English gentleman's park with large, widely spaced trees and undulating grassy slopes underneath. Often, they could not explain why one area appeared like a well-maintained parkland, whereas next to it, with the same soil, landforms and climate, was woodland or forest. It seems that this landscape was not coincidental; rather it had been created by long-term and deliberate burning by Aboriginal and Torres Strait Islander peoples to create a landscape that was easy to walk through and promoted abundant and easily accessible plant and animal resources.

The role of Aboriginal and Torres Strait Islander peoples in the extinction of megafauna is not fully understood. There is evidence that supports several theories for the extinction of Australian megafauna, which include changes in vegetation communities that were essential for food, hunting, climate change and the evolution of megafauna, through adaptation, to smaller, modern species. Nevertheless, Aboriginal and Torres Strait Islander communities were able to sustain their populations and not exhaust sources of food.

Although other scientists and land managers have known about 'fire-stick farming' for many years, Gammage presents a new hypothesis which emphasises how this use of fire created the entire landscape that early settlers encountered. After European colonisation, many traditional cultural practices of Aboriginal and Torres Strait Islander peoples, including burning, were interrupted or stopped completely. It is possible that by stopping this traditional method of burning, many grasslands disappeared and were replaced by shrubs, trees and even rainforest, the type of environments Australians are familiar with today. Unfortunately, it is also possible that without traditional burning, the landscape today is more prone to large, destructive wildfires that can damage property and endanger people and wildlife due to the build-up of vegetable litter and foliage that was once burnt regularly.

The First Fleet, which arrived in Botany Bay on 18 January 1788, soon realised the challenge of supporting a new settlement due to the poor-quality soils and limited water resources. On 26 January, Captain Arthur Phillip established a colony at Sydney Cove in Sydney Harbour where water resources and soil fertility were more suitable. Early farmers found they were unable to sustainably farm the shallow, sandy and low fertility soils of Sydney. European soils, by contrast, were deeper and more fertile. Recurrent crop failures forced settlers to move agricultural activities to the more fertile alluvial soils of the upper Parramatta River. The growing settlement also faced further environmental pressure when the main water supply, the Tank Stream, became polluted due to effluent from domestic activities and cottage industries. The pollution of the Tank Stream was potentially Australia's first example of a failure to control development and protect the sustainability of a water resource. In 1826, 38 years after English settlers occupied Sydney, the Tank Stream was abandoned as a source of potable water. The stream, which once provided water and food resources for Indigenous peoples, had become a toxic watercourse with no economic or environmental value.

The degradation of watercourses was repeated in many areas in Australia settled by Europeans. Degradation of naturally infertile and shallow soils also followed soon after settlement. Deforestation exposed the shallow soils to erosion, which was exacerbated by farming technologies imported from Europe. Since European settlement, more than half of Australia's forests have been cleared. Soil salinisation was caused by irrigation and tree clearing. Irrigation artificially raised water tables and, through evaporation, concentrated salt in the shallow topsoils. Tree clearing altered the water balance and increased the discharge of saline water in the landscape. Invasive species

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such as prickly pear and rabbits further degraded the land and jeopardised the food and income security of people. In New South Wales, the *Soil Conservation Act* was passed in 1938 and the NSW Soil Conservation Service was established to manage the declining soil resources. Other states soon followed with similar agencies.

Traditionally, Aboriginal and Torres Strait Islander peoples had an intimate knowledge of the plants, animals, water, and landforms that existed on their country. This knowledge was not written down but rather was held in many forms including songs, ceremonies and Creation stories. This knowledge was passed down through generations and many Aboriginal and Torres Strait Islander peoples continue to hold traditional knowledge and pass it down to their next generations, an important cultural responsibility. Aboriginal and Torres Strait Islander peoples held, and continue to hold, detailed knowledge about plants and animals and how they interact together. This allows people to use clues from the landscape to understand what is happening in their environment, such as when particular food resources are ready to eat. For example in northern Australia some people know that when the red kapok flower blooms, freshwater crocodiles are laying their eggs, a source of food.

Aboriginal and Torres Strait Islander peoples used, and continue to use, a range of methods that help to ensure food resources remain plentiful. This includes techniques like seasonal hunting of animals and types of farming. For instance, the Gunditjmara people from Lake Condah (350 km west of Melbourne) farmed eels through a system of channels and ponds.

Aboriginal and Torres Strait Islander peoples' natural resource management

The land rights movement has seen many Aboriginal and Torres Strait Islander peoples move back to their traditional lands and focus on sustaining their culture. In the last few decades programs have been developed that involve Aboriginal and Torres Strait Islander peoples working as rangers to care for their own country, protecting their environmental and cultural resources. These programs provide Aboriginal and Torres Strait Islander peoples with the ability to obtain an income, often in very remote areas while harnessing their knowledge and skills to provide important services.

Source 1.26 A red kapok flower, which in northern Australia signals that freshwater crocodiles are laying their eggs

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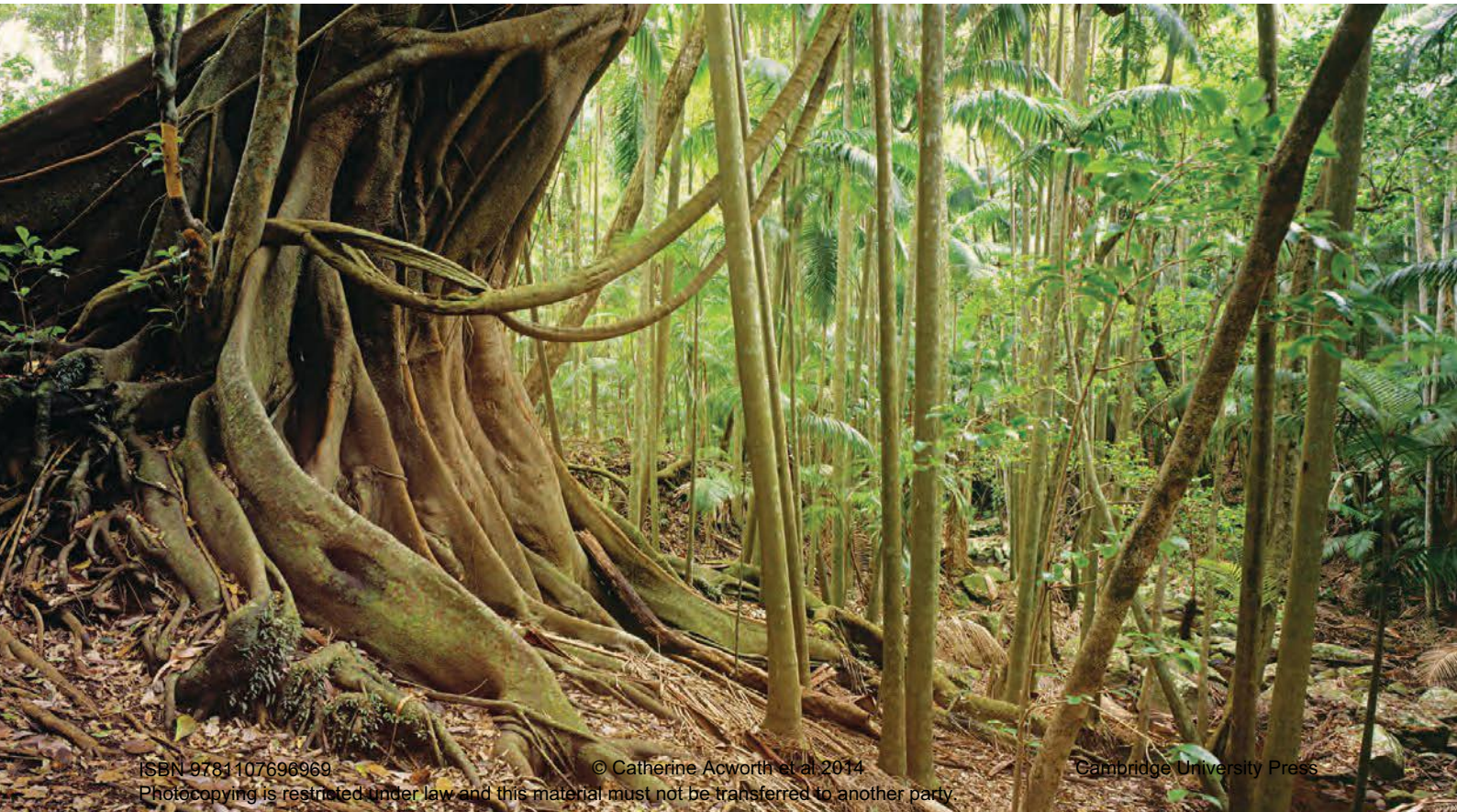
Language is a very important part of Aboriginal and Torres Strait Islander peoples' culture because it is only through language that people can express their culture, which includes caring for country. Many programs today, including ranger programs, use Indigenous language and names to express how Aboriginal and Torres Strait Islander peoples conduct environmental management. As non-Indigenous land managers increasingly recognise the importance of Aboriginal and Torres Strait Islander peoples' ecological knowledge, they are seeking to collaborate and work together with Aboriginal and Torres Strait Islander peoples to find the best ways to protect Australia's ecosystems, plants and animals. Special reserve areas, called 'Indigenous Protected Areas' (IPAs), are being created on parts of Aboriginal and Torres Strait Islander peoples' land and sea country. These are areas where traditional owners agree to promote the protection of environmental and cultural resources. IPAs recognise that the continued existence of Aboriginal and Torres Strait Islander peoples on their traditional lands across Australia provides great value in protecting the environment and its ecosystems.

ACTIVITY 1.6

1. Recall what 'fire-stick farming' is.
2. Discuss why early European farmers found they were unable to sustainably farm the shallow, sandy and low-fertility soils of Sydney.
3. List some of the programs that provide Aboriginal and Torres Strait Islander peoples with the ability to obtain an income in often very remote areas by harnessing their knowledge and skills.

Australian states and territories have engaged Aboriginal and Torres Strait Islander peoples' communities in catchment management and by establishing consultative reference groups. In most states and territories they are known as Aboriginal Reference Groups (ARGs). In Queensland they are known as Aboriginal and Torres Strait Islands Reference Groups to include island communities in Torres Strait. In New South Wales, for example, the Catchment Management Authority for the Central West established an ARG to:

Source 1.27 Guanaba IPA, at the foot of Mt Tamborine, Queensland, is one of the many Aboriginal and Torres Strait Islander peoples' Protected Areas in Australia.



- maximise the participation of Aboriginal and Torres Strait Islander peoples in all levels of natural resource management within the Central West area
- maximise the protection and maintenance of Aboriginal and Torres Strait Islander peoples' cultural heritage
- maximise opportunities for relevant skills development and capacity building in natural resource management
- maximise the opportunities for Aboriginal and Torres Strait Islander peoples' economic development in natural resource management
- maintain and enhance the integrity of Aboriginal and Torres Strait Islander peoples' intellectual property in traditional ecological knowledge and cultural and spiritual knowledge.

The ARGs are consulted in matters of natural resource management and the protection of cultural heritage. They are responsible for developing relationships between environmental decision-makers and other stakeholders, and participate in developing and implementing catchment management plans.

The Australian Government recognises the importance of Aboriginal and Torres Strait Islander peoples' knowledge in catchment management as well as the rights of native titleholders. Accordingly, laws and policies have been developed or amended to ensure that Aboriginal and Torres Strait Islander peoples' communities are fully engaged in natural resource management without detriment to livelihood opportunities or the loss of cultural heritage. A network of Indigenous Land Management Facilitators was established to help communities develop partnerships with government agencies and organisations involved in sustainable development. Under the Natural Heritage Trust, Aboriginal and Torres Strait Islander peoples' groups are able to apply for grants to support programs that manage rivers, protect threatened species, conserve cultural assets and improve the productivity of the land. The federal government has also established the Indigenous Land Corporation to enable Aboriginal and Torres Strait Islander peoples' communities to acquire and manage land according to sustainability principles. The goal of the Indigenous Land Corporation is to enable Aboriginal and Torres Strait Islander peoples' communities to meet their socio-economic needs and fund and facilitate programs that protect cultural and environmental assets for the benefit of all Australians.

Source 1.28 Ayers Rock Resort at Yulara, where the Indigenous Land Corporation has established a National Indigenous Training Academy

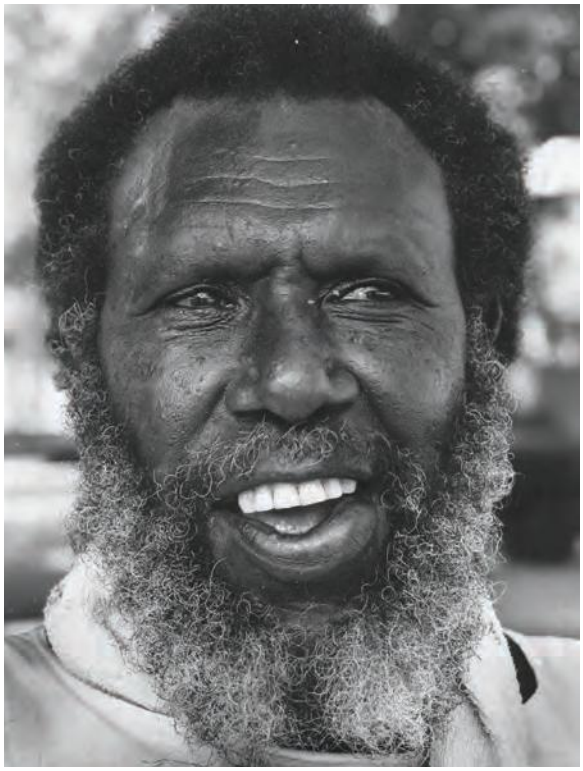
Case study 1.6

Mer – also known as Murray Island

Mer is a small volcanic island with a population of around 450 located at 9°and 144° in the eastern section of the Torres Strait Islands. Meriam people have inhabited this island for thousands of years and have a strong affiliation with the land. However, when Europeans arrived and started to settle on the island, the Queensland government claimed control in 1879.

Source 1.29 Location of Mer (Murray Island) with the Torres Strait between Queensland and Papua New Guinea

The sacred bond between its Aboriginal and Torres Strait Islander peoples, their traditional lives and the island has been the catalyst for a momentous decision in Australian history. Eddie Koiki Mabo, a native of Mer, who was working as a gardener at James Cook University in Townsville, spoke to two academics, Henry Reynolds and Noel Loos, at the university about traditional ownership or title of land on the island. They informed him that he had no legal ownership as the land was owned by the government as a result of *terra nullius*. *Terra nullius* is a Latin phrase meaning 'land belonging to no one'. When the British came to Australia they tried to identify a political system or settlement system of the Aboriginal and Torres Strait Islander peoples, and since they were not able to identify any system, they claimed the land as *terra nullius* and enforced British rule and law onto Australia.



Source 1.30 Eddie Mabo

In 1981 Eddie Mabo made a speech at James Cook University outlining the land ownership and inheritance system on Mer. A lawyer at the conference suggested there should be a test case on claiming land rights through the court system. Central to the case was challenging the concept of *terra nullius* – that land claimed by the Europeans was uninhabited. In 1982 Eddie Mabo, Sam Passi, David Pass, Celuia Mapo Salee and James Rice made a legal claim for ownership of their lands on Mer.

In 1985 the Queensland Government passed the *Queensland Coast Islands Declaratory Act* in an attempt to negate any claims Torres Strait Islanders had to the land. In 1988 the High Court found that the *Queensland Coast Islands Declaratory Act* contravened section 10 of the *Federal Racial Discrimination Act 1975* (Cth) and was therefore invalid.

Under the Constitution, federal acts of parliament take precedence over state acts of parliament. (This is to ensure that the federal parliament has the ultimate decision-making power.)

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In 1992 the High Court rejected the notion of *terra nullius* and recognised the Meriam people as the native title holders of traditional lands on the island. The ruling found that native title exists separate from Crown claims to the land, as long as a connection to the land for people claiming native title remains. It was hailed as a momentous victory by the Aboriginal and Torres Strait Islander peoples rights movement, but within the mining and pastoral sectors unease grows over the implications of the ruling. Sadly, Eddie Mabo was not present to celebrate the victory; he had died of cancer five months earlier, aged 56.

Source 1.31 The High Court of Australia in Canberra

The case was successful because it established that:

- the Meriam people have had continuous occupation of the islands
- anthropological evidence showed that the present inhabitants of the Islands were descended from the people in occupation at sovereignty
- the people lived in groups of huts strung along the foreshore or strand immediately behind the sandy beach. The cultivated garden land was and is in the higher central portion of the island
- the people used sub-tidal fish traps that would capture fish as the tides changed, allowing the Meriam to spear the fish easily. This demonstrates the Aboriginal and Torres Strait Islander peoples had a permanent part of the urban environment (rock pool fish traps) on their land.

Legacy of Mabo

In addition to rejecting the doctrine of *terra nullius*, the High Court also ruled that the common law of Australia recognised a form of native title that reflected the entitlement of the Aboriginal and Torres Strait Islander peoples to their traditional lands, in accordance with their laws and custom. In response to Mabo, the Australian Government enacted the *Native Title Act 1993* (the Act). The Act recognises and protects native title and sets up processes by which claims for native title can be determined and future activity impacting on native title may be undertaken. To May 2012, there have been 139 determinations recognising the existence of native title, and determined native title covers approximately 16% of Australia's landmass.

1 Explain why central to the case was challenging the concept of *terra nullius*.

2 Describe why, under the Constitution, federal acts of parliament take precedence over state acts of parliament.

3 Discuss why, this ruling was hailed as a momentous victory by the Aboriginal and Torres Strait Islander peoples rights movement, but was met with unease by the mining and pastoral sectors.

RESEARCH 1.9

View the ABC *Four Corners* episode titled 'Judgement Day', 3 May 2012 (for the link, see www.cambridge.edu.au/geography10weblinks)

Complete the following question after viewing 'Judgement Day':

Explain the importance of Mabo 20 years on. How has it impacted on Aboriginal and Torres Strait Islander peoples and non-Indigenous people?

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FIELDWORK 1.1 SUSTAINABLE CITIES

Aim

To identify land use and/or specific activities that cause environmental impacts, determine what measures that are being or could be used to mitigate impacts, and to determine if your city or town is following the principles of sustainability.

Method

Students will compile information on the inputs and outputs required for a city or town area to function, and to predict potential impacts on the environment from various activities. Form groups of three to five students to share the workload. This activity involves collecting information on key activities (e.g. transport, construction, disposal of domestic and industrial waste, energy use, water supply, stormwater drainage) and estimating what is required for the city or town to function. You will also investigate how resource use and waste disposal affect the local and off-site environments. General predictions are only required. You will use skills in observation and data collection.

Preparations

Locate a map of your city or town and download a satellite image at the same scale. You can utilise websites such as Google Earth or Google Maps to produce both. Download and print a second map showing the catchment area of your city or town. This catchment-level map will help you to predict off-site impacts. On this second map, draw a boundary of the city area where you will focus your investigation. On your city/town map, annotate stops for the field trip so you can locate where you are during the visit. Your teacher will advise you of the stops and the path you will take. Before the field trip, investigate and note the location of:

1. major roads
2. housing areas
3. industrial areas
4. retail and office areas
5. canals and natural waterways
6. parklands and natural areas
7. any other landscape features of importance.

You can pencil in boundaries around these features, or use highlighting or coloured pens to label key features.

Before commencing the field trip, each group should discuss key inputs (e.g. food, energy, water) and outputs (e.g. exhaust, garbage, stormwater) for the known activities, as well as consider the effect of landscape features. Use the table below to add information. You will continue to fill this table during your field trip.

Data collection

Location	Type of environment	Major activities	Inputs	Outputs	Potential environmental impacts
E.g. Queen Street Mall, Brisbane	Entertainment, retail and office space	Restaurants, shopping, commercial/ financial, pedestrian and vehicle traffic	Electricity, water, food, mineral resources, paper products	Car exhaust, run-off from hard surfaces, wastewater from shops, recyclable and non-recyclable waste	Air pollution, noise pollution, water pollution, loss of habitat, loss of land for garbage disposal

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1 Use the table to record information at each stop. You might have already partially completed the information from your maps, but use the field visit to expand information and capture photos of activities to use in your report.

2 Identify what activity at each location presents the greatest risk to the environment. Circle this activity in your table for future reference.

3 Discuss where the inputs are likely to be sourced, and where the likely destination of the outputs are.

4 Is there any evidence of environmental impacts at the location? If so, record the impacts in a notebook and rate them in terms of their magnitude (e.g. low, moderate, severe). What are the likely impacts of activities in areas outside of the city or town? Note where these impacts occur on your catchment map.

5 Is there any evidence of strategies to minimise impacts from activities at each location? Examples include: educational signs, trash traps, recycling bins, buffer zones around canals and streams and noise barriers.

6 Discuss how the environment has altered environmental processes that cause your identified impacts. Refer to hydrological, atmospheric and biological processes. For example, hard surfaces such as roads can reduce infiltration of rainwater and increase run-off. The increased run-off can transport pollution to nearby canals.

7 On return to the classroom, share your findings with other groups. Discuss the key activities that could significantly impact the environment. Which land use and its activities present the greatest risk to the environment? Propose new strategies that could be used to improve management and minimise impacts. Discuss the possible cumulative impacts on the environment; refer to your table and information provided by other groups. Synthesise information from your table and discussions and draw a conclusion on whether your city or town is sustainable.

8 Complete a group or individual report using the following presentation layout as a guide. Create section headings based on the layout:

Fieldwork presentation layout

Front page	Tile and name (or name of group)
Contents page	Complete this last so your page numbers match your section headings.
Page 1	Aims and methods
Page 2	Location map (include your local area and your catchment map)
Page 3	Introduction – brief description of the study site
Pages 4 and 5	Major activities – describe the major activities at each stop.
Page 6	Table of activities and impacts (use your data collection table. Be sure to update the information based on class discussions.)
Pages 7 and 8	Describe the observed or predicted impacts of the activities. Refer to the processes affected by the activities and how these have led to local and downstream impacts. Ensure you cover social, economic and environmental impacts.
Page 9	Discuss observed and potential strategies to minimise the impacts.
Page 10	Table or written description of management strategies
Page 11	Photos of observed strategies or sketches of proposed strategies
Page 12	Conclusion – in this section rate your city or town's sustainability status.
Page 13	Appendix (this may include photos or data you have not embedded in the main text but supported your written work), bibliography, glossary

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Chapter summary

- Sustainability refers to our capacity, actions, decisions and strategies to achieve prosperity and meet social needs without compromising the natural environment.
- The three pillars or spheres of sustainability are social needs, economic growth and environmental protection.
- Intergenerational equity is a key component of sustainability and requires humans to manage their activities and resource use today to ensure fair and reasonable access to future generations.
- Soil, water, the atmosphere and biodiversity are important for ecosystem functioning.
- An inability or reluctance to apply sustainable practices and/or adapt to environmental change, whether it is natural or human-induced, can lead to the decline of societies.
- Environmentalism is a social movement that involves lobbying and other forms of activism to influence and educate others, particularly governments and developers, to conserve or protect the environment.
- Sustainable development is a recognised global issue. Inter-governmental organisations have set global sustainability goals and recommended actions to enable all humans to prosper without significant environmental losses.
- Governments rely on laws and policies to create consistent and formal approaches to environmental management.
- Australia has embedded the principles of ecologically sustainable development in federal and state laws, and local government planning policies.
- The weather and the climate are driven by the sun. Global temperature is set by a balance between the sun's energy radiating in and the heat from the Earth radiating out.
- Earth's heat is partly retained through the absorption of heat by the two main greenhouse gases, water vapour and carbon dioxide.
- Climate change results from a change either in the sun or in the amount of heat absorbed in the atmosphere. When atmospheric carbon dioxide rises, so does the Earth's temperature and that makes the climate change.
- Burning fossil fuels has increased the atmosphere's carbon dioxide content by 40% since 1850, and this has caused global warming.
- Global warming might be slowed by reducing dependence on fossil fuels for energy, and reversed by removing some carbon dioxide.
- Climate change can be expected to increase Australia's temperature, change rainfall patterns and increase storm intensity. In low-lying places, such as the Amazon Delta, much of Bangladesh and small island communities, sea level rise and storm surges pose significant threats to livelihood.
- Already some of these effects are evident in the form of desertification, storm damage, heat-waves and the loss of Arctic ice in the summer.
- Aboriginal and Torres Strait Islander peoples continue to identify with their ancestral, or traditional lands, now commonly referred to as 'country', which refers to all of the landforms, water and living things in an area.
- Today, the Aboriginal and Torres Strait Islander peoples who are the 'custodians' or care-takers for their traditional lands are known as 'traditional owners' and 'managers'.
- Mer, or Murray Island, is a spiritual and cultural place for the Aboriginal and Torres Strait Islander peoples of the island. This led them to challenge the ownership of the island all the way to the High Court of Australia in a case they won.

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End-of-chapter questions

Multiple choice

1 The formal definition of sustainability encompasses:
   - **A** maintenance of a stable economy
   - **B** conservation of environmental resources
   - **C** meeting the needs of society
   - **D** all of the above

2 The biosphere is:
   - **A** the air we breathe
   - **B** all the vegetated areas of the earth
   - **C** the sum of all terrestrial and aquatic ecosystems
   - **D** a green buffer zone around developments

3 Where does carbon dioxide come from?
   - **A** Volcanoes
   - **B** The ocean
   - **C** Burning coal, oil and gas
   - **D** All of the above

4 Aboriginal and Torres Strait Islander peoples' used fire as a method of:
   - **A** clearing land to make it easier to hunt animals
   - **B** creating new growth shoots to attract animals
   - **C** changing the types of plants living in an area
   - **D** all of the above

5 The EPBC Act deals with environmental matters that:
   - **A** relate only to government-funded developments
   - **B** only involve stakeholder conflicts
   - **C** are nationally significant
   - **D** relate only to privately-funded developments

Short answer

1 Identify what the role of the government is in achieving sustainability.

2 Explain why the Arctic and Antarctic warm faster than the rest of the Earth during periods of global warming.

3 Briefly explain the purpose of precautionary approaches in environmental decision-making.

4 State and briefly describe the three main pillars of sustainability.

5 List the factors that determine carrying capacity.

Extended response

Reflect on the following statement: 'Sustainability can never be achieved. Human populations will keep growing and consume resources at a rate which will one day exceed the carrying capacity of the Earth.' Comment on this statement using either a technocentric, anthropocentric or ecocentric position.

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Cambridge University Press

2 Land environments

Source 2.1 Tundra in Alaska

ISBN 9781107696969

Cambridge University Press

Before you start

Main focus

To explore various human actions that affect the environment and to consider how the negative impacts can be reduced and ecosystems regenerated. To consider the drivers of environmental impact, the resilience of ecosystems and ways to understand various methods of managing environmental impacts and changes.

Why it's relevant to us

Land is where humans mostly live and work. To understand the environmental basis of how land is planned and managed is to understand the past, present and future of human civilisation.

Inquiry questions

- What are the various land types?
- How can impacts on land be reduced and managed?
- How can the resilience of ecosystems be estimated?
- How can land be restored and regenerated?

Key terms

- Ecological footprint
- Land degradation
- Land management
- Regenerative
- Resilience
- Terrestrial ecosystem

Let's begin

Humans have successfully created society on Earth based on their ability to shape terrestrial ecosystems. They create food, extract resources and alter landscapes to create cities and towns. Their ability to do this without degrading the land is less successful and the impacts are being felt around the world. The Earth has many different land-based ecosystems across its nearly 149 million km^2 of solid surface.

Each ecosystem type has been subject to human interactions and all of them have been modified.

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2.1 Human actions that produce environmental changes

The Earth is some 4.53 billion years old and human-like hominids have existed from about 3.6 million years ago. Human beings began making tools and modifying the environment, especially through fire, some 100 000 to 200 000 years ago. They have since spread to every land ecosystem on the planet and used these tools to create a future for their families and societies. The main sources of human-induced change to land are bushfire, agriculture and urban development.

Geographical fact

There are 12 biomes (general ecosystem types):

1. tundra
2. taiga/boreal forests
3. montane grasslands and shrublands
4. temperate coniferous forests
5. tropical and sub-tropical coniferous forests
6. temperate broadleaf and mixed forests
7. Mediterranean forests, woodlands and shrub
8. tropical and sub-tropical moist broadleaf forests
9. tropical and sub-tropical dry broadleaf forests
10. temperate grasslands, savannas and shrublands
11. tropical and sub-tropical grasslands, savannas and shrublands
12. deserts and xeric shrublands.

Bushfire

Many landscapes around the world have evolved with bushfires. Bushfires can be a natural phenomenon, helping landscapes to regenerate. In Australia, some plants are so well adapted to particular fire regimes that bushfires are both an advantage and, in some cases, a necessity for survival. Some plants have seed capsules that need to be burnt to release seeds before they germinate. Bushfires enrich the soil with ash, which assists plant regrowth. Experts try to manage fire regimes in ways that maximise biodiversity while reducing fire fuel loads which can, in dry conditions, enable bushfires to get out of control and lead to natural disaster, loss of life and significant costs. 'Wildfires' are bushfires which burn uncontrollably or in an unintended way. Wildfires can cause deaths, injuries and millions of dollars in damage.

Geographical fact

According to the CSIRO, while we consider it a threat, fire is a natural part of our landscape and many of our native plants have evolved to depend upon it.

Source 2.2 Wildfires endangering homes

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NOTE THIS DOWN

Copy the T-chart below and summarise the arguments 'for' and 'against' the use of bushfire as a **land management** tool in Australia.

land management the process of managing the use and development of land resources

The use of fire as a land management tool	
For	**Against**
Many plant species in Australia have evolved to depend on fire.	Fire can get out of control and threaten developed areas.
Fire reduces the vegetation load and minimises the risk of larger periodic 'wildfires'.	Fire destroys vegetation in the short term which may affect tourism to scenic areas.

ACTIVITY 2.1

1. Research the 'McArthur Forest Fire Danger Index (FFDI)' online and explain how it is used in Australia.
2. Identify the link between bushfires and climate change and how this may affect the FFDI of an area.
3. Identify three ways that the risk and vulnerability of homes to bushfires can be reduced.

Agriculture

The loss of natural ecosystems to agriculture has been occurring for around 8000 years, when people first began to grow crops. Agriculture has spread across every biome and now covers 15.3 million km² of land in intensive agriculture and 33.6 million km² of pastoral or rangeland grazing. In addition, forestry has modified or replaced 39 million km² of ecosystems. This means that 33% of the Earth's land surface is agricultural and pastoral land, and forested land is 26%. So what is the rest of the Earth's land cover? About 20% of the Earth is desert and 20% is permanently snow covered. This leaves just 1–2% of land that is used for cities and industry.

Agriculture contributes AUD$39 billion annually to the Australian economy, roughly 3% of Gross Domestic Product (GDP), and employs about 4% of the total workforce directly. The food processing and manufacturing industry, which depends significantly on the Australian agriculture sector, contributes over 6% of Australia's GDP, or AUD$71 billion per annum.

Geographical fact

According to the Garnaut Review, by 2100 some 92% of current agricultural production may be lost due to climate change.

ACTIVITY 2.2

View 'Global land cover change from 8000 BP to –50 BP' on YouTube.

1. Reflect on the changing nature of land use during this time to support the growth of civilisations.
2. Identify the link between agriculture and climate change and explain how this may affect agricultural yield in Australia.

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Source 2.3 Approximately 20% of the Earth is desert.

Urban development

Although cities in Australia cover a small percentage of land, some 1% to 2%, they have both a direct and indirect impact on the quality of **terrestrial ecosystems**. The direct impact is from the clearing of land to make way for new suburbs, roadways and other civil infrastructure. The indirect impact is from the greater demands on agriculture that growing cities produce, resulting in both greater coverage of land for agriculture and the use of fertilisers and pesticides that have adverse effects on natural ecosystems. There are various ways to measure this impact such as the '**ecological footprint**'.

terrestrial ecosystem a system of plants, animals, nutrients and elements, and the interactions between them, that is only found on land

ecological footprint the measure of human demands on the Earth's ecosystems

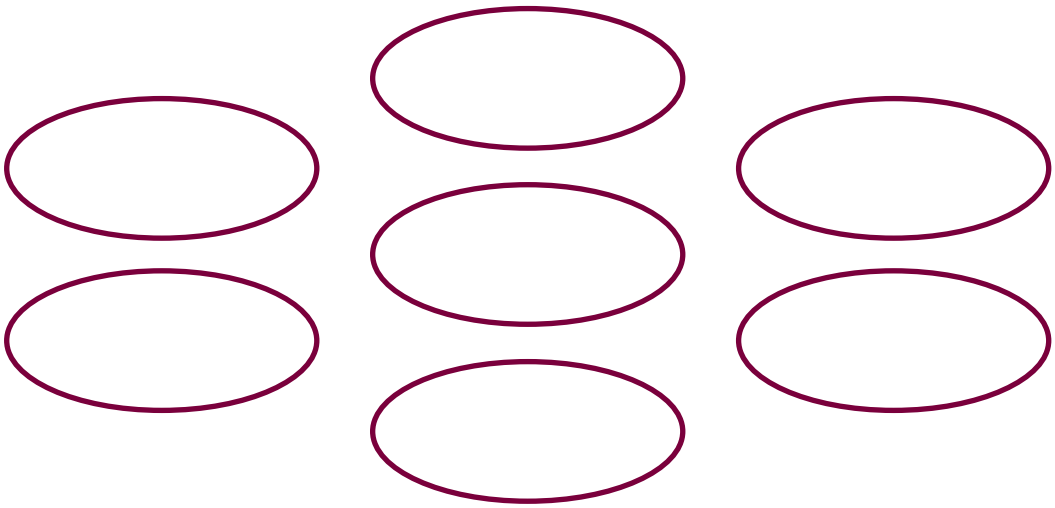
ACTIVITY 2.3

Complete the graphic organiser task below and answer the following questions.

1. Consider how climate change will affect each impact and identify evidence to support your answers.
2. Consider each impact and identify at least one method of reducing it that also assists Australia's response to climate change.

NOTE THIS DOWN

Copy the graphic organiser below to identify the various impacts that urban development has on land, both directly and indirectly.



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2.2 Drivers of environmental impacts

There has been much investigation of what drives environmental impacts around the world. A simplified formula, referred to as IPAT, is widely used to estimate the impact of human activities on the environment.

Impact = Population × Affluence × Technology

This model suggests that all forms of technology have a direct impact on the environment and that this impact will be multiplied by the number of people with access to the technology and their ability to afford to use it. This model provides a valuable basis for discussion of what is a very complex area; however, it has some limitations. For instance, how would you apply the IPAT formula to **land degradation**?

land degradation the deterioration of land, including its topsoil, vegetation and water resources

The biggest land degradation issues in Australia are related to overgrazing in pastoral areas and the salinisation of agricultural soils in the wheat belt. A common attribute of these areas is that they have shrinking populations; in fact, these areas are already among the least populated in the world. Land degradation in these areas came from the use of a model for producing wealth that did not consider the environment and led to over-clearing or over-stocking of the land with grazing animals. Hence in this case, the problem was not caused by excessive population; indeed if some of these rural areas did not have such population losses their local economies could have been more diverse and the need to have such local environmental impact would have reduced.

ACTIVITY 2.4

Research the history of the development of the IPAT formula.

1. Identify three criticisms of its use that relate to its application to land degradation.
2. Identify three technologies that can reduce the impact of land degradation.

Source 2.4 Soil erosion due to overgrazing, which has led to desertification

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2.3 The resilience of ecosystems

An ecosystem is made up of all the living organisms (biotic components) in a physical area, including plants, animals and microbes; as well as the non-living (or abiotic) components of the environment, including the soil, air and water. The ecosystem is defined by the interaction between all the living organisms and with the surrounding environment. These interactions include biological interactions, such as certain species feeding on other species and producing waste material that is in turn food for yet another species; physical processes, such as the weathering of rock or transportation of sediment and nutrients in and out of the ecosystem by wind and water; and chemical processes, such as the fixation of nitrogen in the soil.

All ecosystems and environments are exposed to changing influences over time, with variations in the climate, nutrient loading, habitat size and connectivity, or exploitation of various species changing the balance of the system. It used to be assumed that natural systems respond to these changing influences in a smooth and linear way that could be predicted and managed. However, studies of ecosystems such as lakes, coral reefs, oceans, forests and deserts have shown that while ecosystems often do respond to changing influences in a smooth and gradual way for a while, at a certain point there is a sudden and drastic change in the ecosystem – and the ecosystem often becomes fundamentally different to how it was before. This occurs when the ecosystem crosses an 'ecological threshold'. Ecological thresholds are the points at which an ecosystem undergoes a sudden change in its quality, property or phenomenon, or where a small incremental change in an environmental driver results in a proportionally large response in the ecosystem. Thus, ecological thresholds are the 'breaking points' or 'tipping points' of ecosystems, at which the pressures on the system result in a sudden and often large change to the ecosystem. This phenomenon is a very important area of research, as humans are now exposing most of the world's ecosystems to change that is both greater and faster than at any other point in history.

Another key concept is '**resilience**', being the ability of a system to absorb and adapt to disturbance, so that it retains essentially the same function, structure, identity and feedbacks, and doesn't suddenly change into a different state, often by collapsing. Resilience is said to have at least three main physical components: latitude, resistance and precariousness.

resilience the ability to recover quickly from change

- *latitude*: the maximum amount a system can be changed before losing its ability to recover (before crossing a threshold which, if breached, makes recovery difficult or impossible).

Source 2.5 Australia's Great Barrier Reef is the world's largest coral reef.

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- *resistance*: the ease or difficulty of changing the system; how 'resistant' it is to being changed
- *precariousness*: how close the current state of the system is to a limit or 'threshold'.

A resilient ecosystem can handle more external shocks, or changes in external influences or pressures, without shifting to an alternative state. For example, a resilient lake ecosystem might be able to handle the sudden introduction of a lot of organic material that gets flushed into the lake when there are sudden rains and flooding, without the lake becoming eutrophic. A lake (or other water body such as a river) becomes eutrophic when, after excessive plant growth due to high nutrient levels, these plants decay and deplete the dissolved oxygen in the water, which may cause the widespread death of fish and other organisms. However, in a system that is already strained, such a sudden event may be 'the straw that broke the camel's back', which causes the ecosystem to cross a critical threshold and resulting in dramatic changes to the system. In practice, it can be very difficult to know when an ecological threshold is being approached in an ecosystem – although it is often clearer in retrospect that warning signs were present, hence the need to be always cautious.

Source 2.6 A shallow eutrophic lake

RESEARCH 2.1

The Sahel is an African ecosystem zone that lies between the Sahara desert to the North and the Sudanian savannas to the south; it has experienced desertification due to poor land management practices.

Write an essay on the resilience of the Sahel and investigate its latitude, resistance and precariousness. As part of the research, identify the key factors that have led to desertification, including changing rainfall and land management activities.

Geographical fact

Natural systems often respond linearly to external pressures (a small increase in the external pressure causes a comparable, small change in the ecosystem) up until a point when an ecological threshold is reached, at which point a further small increase in the external pressure causes a sudden and very large change in the ecosystem.

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ACTIVITY 2.5

1 Identify five key drivers that affect the resilience of Australia's rainforests and sclerophyll forests.
2 Consider how these drivers will be affected by climate change.
3 Investigate the 'ecological thresholds' of Australia's rainforests and sclerophyll forests and identify any warnings regarding the potential for ecosystem collapse.
4 Identify three ways that the resilience of Australia's rainforests and sclerophyll forests can be improved.

2.4 The management of environmental change

The human population has increased sixfold since the 1800s, with the land needed to supply the growing demand for agriculture, housing, resources and transport now taking up over 83% of the total land area of the Earth. As natural habitats are converted by humans to meet our needs, the biodiversity that was once there is threatened or lost. Biodiversity is a contraction of 'biological diversity', and refers to the number of different animals, plants and microorganisms. Thus it refers to both the diversity of species in an ecosystem, as well as the genetic diversity within each species. Biodiversity also refers to the variety of ecosystems, such as those found in deserts, forests, wetlands, mountains, rivers, lakes and landscapes more influenced by humans, such as urban areas or agricultural land.

Preserving ecosystem services

The loss of biodiversity is something that should concern us greatly, and calls for greater understanding of methods to manage and reduce environmental impacts. Biodiversity is essential for ecosystem services, which are in turn essential for human health and wellbeing – almost every aspect of how the world works is underpinned by ecosystem services, without which we may not be able to survive as a species.

Ecosystem services include:

- *Provisioning services*, such as providing food and clean water. Everything that we eat and drink comes originally from nature – the fruit, vegetables, grains, meat and dairy products. Imagine if all the bees suddenly died and we had to pollinate all the plants by hand, or if we had no more topsoil and couldn't grow fruit and vegetables, or if our water sources became so polluted we couldn't use the water to drink or grow food.
- *Regulating services*, such as flood and disease control – natural systems help to regulate the climate by absorbing and gradually releasing water. Trees help to raise groundwater and can create microclimates that are cooler and have more regular precipitation. Natural processes can disinfect water and reduce the risks of transmitting disease.
- *Supporting services* are those that ensure that ecosystems function, and although we may not directly benefit from these, without them, we would have none of the other ecosystem services. This includes, for example, biomass production, the creation of atmospheric oxygen by plants and microbes, soil formation, erosion prevention, nutrient cycling, water cycling and providing habitat for other species.
- *Cultural services* are those that benefit us spiritually, psychologically, culturally and socially – for example, experiences of nature have been shown to help people recover from stressful experiences, to be less depressed and anxious, to recover from illness more quickly and to have greater life satisfaction. Nature plays a role in many world religions, and people find that places with more natural features are more aesthetically pleasing to them.

It would be impossible to find other ways of providing these same services if the ecosystems

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Source 2.7 Biodiversity is essential for ecosystem services, which include the provision of clean water.

that provide them were damaged or destroyed beyond recovery in our lifetimes. Such loss of service provided by the environment also leads to significant economic impacts. For example, the destruction of coastal mangroves in Pakistan is estimated to have led to around US$20 million in fishing losses, US$500 000 in timber losses, and US$1.5 million in feed and pasture losses.

ACTIVITY 2.6

1. Identify five key ecosystem services provided by the tropical and sub-tropical rainforests of Southeast Asia.
2. Investigate reports on the economic impacts of the loss of these services.
3. Recommend three strategies to protect the ecosystem services in the tropical and sub-tropical rainforests of Southeast Asia.

Moreover, protecting such ecosystems can reap significant financial benefits. New York City faced the challenge of either having to build and maintain a filtration plant to clean the city's water supply, or to ensure that the water provided to the city's 9 million inhabitants was clean enough to drink without such treatment. The filtration plant would have cost approximately US$6 billion to build, and a further US$250 million each year to maintain. When the city realised that they could purchase the land in the watershed and protect it for only US$1.5 billion, it was an easy choice. By buying the land upstream and protecting it from pollution, upgrading treatment plants and septic systems, and assisting with environmentally sound development throughout the watershed, the city has saved itself between US$6.5 and US$8.5 billion in today's dollars, while providing a host of other social and environmental co-benefits.

Preserving biodiversity through reserves and corridors (a spatial strategy)

In recent years there has been growing attention globally on efforts to preserve and enhance the remaining pockets of biodiversity. However, research is showing that it is not enough to simply protect an isolated reserve of habitat; rather, these efforts need to be combined with corridors between different habitats and the creation of buffer zones.

There are various categories of habitat, such as:

- *core habitat reserves*: land that is protected or managed as habitat for one or more target species of plant or animal
- *habitat corridors*: strips of land that enable species to move between pockets of their natural habitat. These help ensure genetic diversity within species, can decrease population fluctuations by enabling mixing and repopulating of core habitats, and enable animals to migrate if conditions in a given core habitat change and cannot support them
- *buffer zones*: areas surrounding a core habitat, separating it from other landscapes (such as agricultural land, or urban areas). Buffer areas are often unsuitable habitats for many species; however, they are essential to protect the core habitat from the different microclimatic conditions, species, noise and other activities.

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Case study 2.1

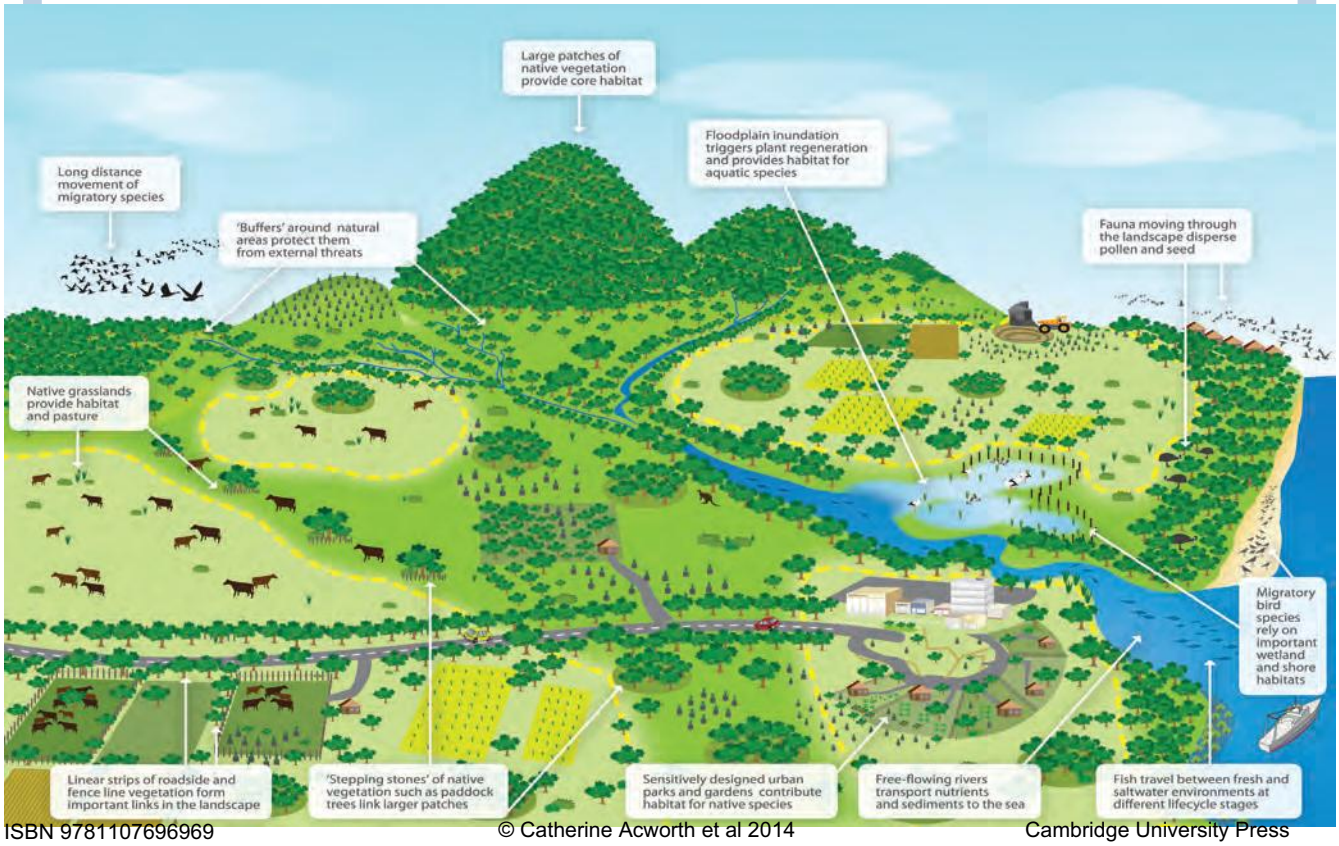
Australian conservation plans and strategies

The National Wildlife Corridors Plan is the Australian Government's strategy to restore and manage ecological connections in the Australian landscape. The Australian Government is working with private landholders, as well as managing publicly owned land, to develop corridors between habitat areas. These are on a wide range of scales, from revegetated areas along creeks that connect patches of forest, through to large-scale corridors that span hundreds of kilometres to connect habitat areas. Developing such large-scale corridors can require the cooperation and coordination of multiple jurisdictions and working groups. The plan allows communities to nominate an area that can be recognised as a National Wildlife Corridor and these areas may receive priority for Australian Government investment.

The Victorian Government introduced the The Melbourne Biodiversity Conservation Strategy (BSC) to simplify conservation in growth areas of Melbourne, and make it easier for property and land developers to understand and fulfil their requirements to protect native vegetation and animals. This sets aside areas of land that must be conserved within the growth areas, and also simplified the process of evaluating what offset requirements are necessary when native vegetation is removed from land allowed to be developed. The time-stamping project was introduced as an initiative for keeping data and maps of the growth corridors and helps to calculate native vegetation requirements for urban development. Overall, the strategy is estimated to have increased the amount of conserved habitat in the growth areas, while significantly simplifying processes.

1. Explain what is meant by the term 'habitat corridor'.
2. Suggest why it is important for property and land developers to understand why native vegetation needs to be protected.
3. Study Source 2.8 and list the landscape elements that contribute to wildlife corridors that exist in your town.
4. Describe an area in Australia or overseas you believe would benefit from a wildlife corridor plan.

Source 2.8 Landscape elements that contribute to wildlife corridors



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Case study 2.2

The Yellowstone to Yukon project

The Yellowstone to Yukon (Y2Y) project aims to connect the Yukon National Park in the Yukon Territory, Canada, to Yellowstone National Park in Wyoming in the United States. This thus encompasses an area of 1.3 million km^2, is 3200 km long, 500–800 km wide, and runs through five US states and four provinces and territories in Canada. The area contains habitats for many threatened species, including grizzly bears, wolves, wolverines, lynx, and some native fish, and the corridor will protect the migration route of large mammals including grizzly bears, wolves, caribou, elk and bison. As only 10% of the region is national park, the Y2Y project includes public education and community assistance to understand and adapt to living harmoniously with nature.

Source 2.9 Yellowstone National Park, USA and Yukon Territory, Canada

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RESEARCH 2.2

IMPACT OF CLIMATE CHANGE ON BIODIVERSITY CONSERVATION

Climate change is increasingly threatening the survival of many species around the world. As humans have altered landscapes and reduced natural habitat to isolated pockets, many species may not be able to migrate or adapt as the climate changes and their existing pockets of habitat become unsuitable for them. Species that require specific temperature ranges to survive, or a certain fire regime, precipitation pattern or other conditions affected by climate change can become locally, or globally, extinct if they are not able to migrate as the locally conditions become unsuitable. Wildlife corridors can enable species that are able to migrate to move to other areas; however, this will not necessarily mean that they will find suitable conditions elsewhere.

Write an essay on how the habitat of endangered marsupials from Australia's dry environments has been affected by human activity and identify three strategies to reduce the impact and provide suitable habitat for these animals.

Ecosystem-based management (an environmental strategy)

Ecosystem-based management (EBM) is a management approach that considers how human activities affect the health and resilience of ecosystems, and how they impact on the ability of these ecosystems to provide invaluable services to the environment and to society. It considers the entire ecosystem – including humans and the environment – rather than only looking at one issue, species, or resource in isolation. It recognises that there is a complex network of interrelationships between all of the living and non-living components of an ecosystem, and that the long-term management of the system has to consider the impacts on any and all of these.

Conventional environmental management has typically focused on a single resource, species or issue – and often one that is of particular interest to us as humans. For example, if on the Great Barrier Reef we only consider protecting certain species of fish that attract tourists, by limiting catch numbers and size, we may miss the fact that the Reef and the target fish are being affected by fishing of other species (that may be prey or predator), of declining water quality due to run-off from the land as well as pollution from other sources. Hence EMB has a goal of sustainably managing all species in an ecosystem, or restoring habitat to maintain ecosystem services. It recognises that all species and elements of the ecosystem play an important role in the overall health and integrity of that ecosystem – and that it is often not possible to protect a target species or resource in the long term without considering the whole ecosystem.

The key points of EBM are that it:

- emphasises the relationships and connectivity within the ecosystem, and also between ecosystems (such as how marine ecosystems are affected by runoff from the land)
- considers the impacts of human activity, and human demand for resources from the ecosystem, on ecosystem dynamics
- focuses on protecting and restoring ecosystem structure, function and key processes
- integrates biological, socio-economic and governance perspectives.

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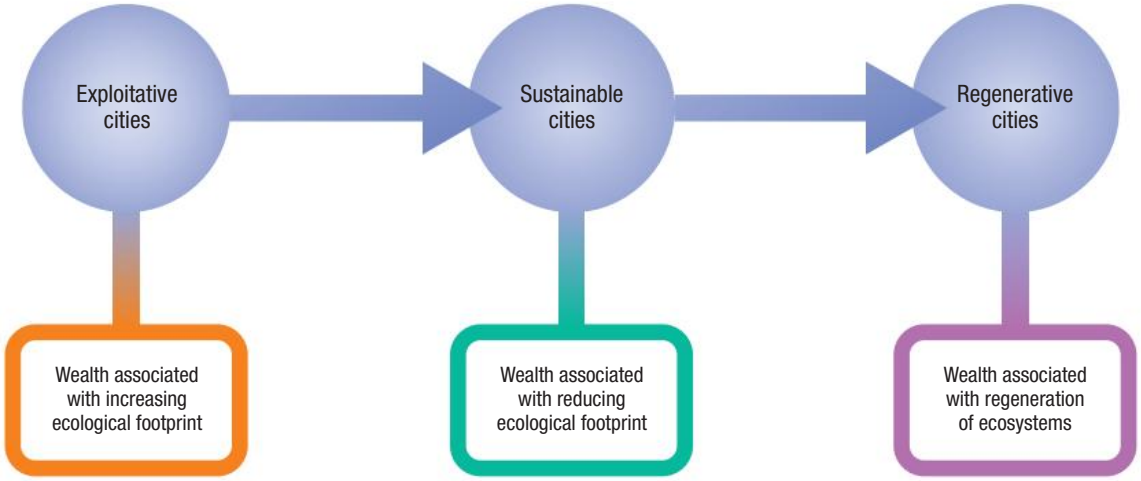
Urban planning to reduce environmental impacts (a spatial strategy)

Regenerative cities

Throughout history cities have been expanding their environmental footprint while creating wealth for their inhabitants. The visionary concept of Sustainable Cities was created to help us reduce the impact of our cities associated with the use of fossil fuels, the consumption of water and the production of waste, and to ease the loss of biodiversity while maintaining or improving livability. This is now under way as technology, planning regulations, governance and financing have combined to show we can reduce impact while improving livability. So what's next for our cities? The future of cities as shown in Source 2.10 is to transition from their wealth being based on the exploitation of the environment to being based on reducing environmental impacts, to being truly **regenerative**, meaning that the operation of the city actually regenerate and nurture ecosystems.

regenerative the process of rebirth or renewal



Source 2.10 The transition of cities from exploitive to regenerative and the wealth associated

ACTIVITY 2.7

1 In groups consider the following questions:
   - **a** Would it be possible for us to go beyond the reduction in impact to a new vision of how cities can begin to be *regenerative*?
   - **b** Could cities be a major part of the planetary solution instead of being part of the problem?
2 Following discussion with the group, identify five ways that cities can become regenerative of the world's ecosystems.
3 View 'Singapore: Biophilic City' by Professors Peter Newman and Tim Beatley and list five ways that Singapore is regenerating the environment in and around its city.

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Chapter summary

- Everything in nature exists as part of a system – any impact on any part of the system will have repercussions throughout the entire system.
- Human actions result in a range of changes to the environment, with most of them resulting in negative impacts and the reduced health of ecosystems.
- Measuring such impacts on ecosystems is difficult, and where measures such as the IPAT formula are used they must be balanced with an understanding of the conditions of the particular ecosystem being considered.
- The notions of resilience, ecological thresholds and adaptability are widely accepted as important tools to inform the management of ecosystems and assist efforts to understand and manage our impact on the environment.
- It is very difficult to actually determine the resilience of an ecosystem, and where its thresholds lie, simply because of the extraordinary complexity of the ecosystems.
- Typically, ecosystems around the world tend to display some level of resilience and many impacts caused by human activity can be 'absorbed' by the system, and after a certain amount of time, it will return to an equilibrium. Similar shocks occur naturally in the world, such as storms, floods, fires, volcanoes, etc. Human-caused impacts include pollution, harvesting of species, changing land use, and the introduction of new species.
- Once an ecosystem has been pushed beyond a critical threshold, it will find a new equilibrium that is different from the previous equilibrium. In many cases, it is not possible to reverse such changes to reinstate the previous equilibrium.
- In the past, human impact was largely localised – we may have impacted and fundamentally changed local ecosystems beyond their point of ecosystem resilience. We are now influencing ecosystems on a global scale – such as the global climatic system. The ramifications of pushing a global ecosystem beyond certain thresholds are unknown.

End-of-chapter questions

Multiple choice

1 What is the main source of human-induced change to land?

A Bushfire

B Agriculture

C Urban development

D All of the above

2 The 'resilience' of an ecosystem refers to:

A the ability of a system to absorb and adapt

B the ability of a system to retain the same function

C the ability of a system to handle external influences

D all of the above

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3 The IPAT formula estimates:

- **A** the environmental resilience of an ecosystem
- **B** the level of global warming potential
- **C** the human impact on the environment
- **D** the impact of climate change on habitats

4 Which of the following is not an ecosystem service?

- **A** The harvesting of crops
- **B** The regulation of flooding
- **C** The cleaning of the water cycle
- **D** The pollination of fruits and vegetables

5 Which of the following statements is not a key point of ecosystem-based management (EBM)?

- **A** EBM is the same as conventional environmental management
- **B** EBM emphasises the connectivity within the ecosystem
- **C** EBM considers the impacts of human activity
- **D** EBM focuses on restoring ecosystem structure

Short answer

1 Identify a type of biome close to your home and outline its key characteristics.

2 List three ecosystem services and outline their value to our society and the economy.

3 Investigate the ways research has supported the protection and management of koala populations.

4 Outline the reasons for and against the use of fire as a land management tool.

5 Outline three ways that society can reduce the negative impact of urban development on the environment.

Extended response

Many scientists and environmental managers suggest the use of the 'Precautionary Principle' in situations where we cannot be certain of the impact on ecosystems from human activities. The Precautionary Principle suggests that if an action or policy could plausibly cause harm to people or the environment, but there is a lack of scientific certainty over where the critical threshold for that harm is, or the extent of the harm that would occur, that those who would like to take the action or implement the policy in question have the responsibility to demonstrate that this is not harmful before taking action.

Write an essay on the application of the Precautionary Principle to the management and conservation of Australia's soils. Pay particular attention to key factors that will reduce the quality of Australia's soils and to how the Precautionary Principle can inform management of the soil.

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3 Inland water environments

Source 3.1 We all live in a catchment no matter where we call home.

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Before you start

Main focus

Most life on Earth depends on ecosystems and other resources found in catchments. Humans affect the quality and availability of natural resources by modifying catchment environments to meet their needs. Fresh water and fertile soils are valuable assets for humans and ecosystems, and their availability and quality are influenced by natural and human factors in catchments. Understanding the interactions between humans and natural environments in catchments is central to achieving sustainable development goals.

Why it's relevant to us

Humans develop catchments for urban areas, water supply, industry, agriculture and many other activities that support society. Developing catchments is unavoidable because humans require terrestrial and aquatic resources for economic growth and to sustain growing populations, yet the activities that drive prosperity also threaten catchment health and sustainability. Catchment ecosystems may not be sufficiently resilient to recover from the effects of rapidly expanding development.

Inquiry questions

- How do humans impact streams and catchments?
- How can we manage streams and catchments?
- What are the social issues that must be tackled to ensure sustainable development of catchments?

Key terms

- Dams
- Drainage basin
- Erosion
- Flow regulation
- Groundwater
- Infiltration
- Integrated catchment management
- Riparian
- Run-off
- Surface water
- Water quality
- Wetlands

Let's begin

We all live in a catchment! Streams, rivers and groundwater store and transfer water through a catchment and deliver nutrients to ecosystems. Lakes, wetlands, soils and vegetation are temporary stores of water and influence its availability and quality. Most catchments drain water to the marine environment through large rivers. Catchments that drain water to inland areas are called *endorheic basins* or *terminal basins*, and may include inland seas that have no connection to the marine environment. Sub-catchments are smaller drainage basins that comprise a larger catchment.

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3.1 What is a catchment?

Catchment factors

A catchment is a **drainage basin** that captures rainfall and is bounded by a watershed. In some countries the term 'watershed' is used to describe a catchment. In Australia a watershed is a ridge or elevated land that separates the flow of water between adjoining catchments. Catchments vary in their character based on a number of factors, which include:

drainage basin an area drained by a river system which includes all areas that gather precipitation water and direct it to a body of standing or streaming water

- *Geology* – the geology of a catchment can influence the shape of the drainage basin, soil development and the types of streams, rivers and estuaries.
- *Size* – the size of the catchment determines the amount of rainfall that can be captured in a catchment. Large catchments capture more rain and, therefore, tend to have many sub-catchments.
- *Rainfall* – rainfall, or precipitation, recharges **groundwater**, replenishes streams and rivers through **run-off**, and shapes the landscape through **erosion** and deposition.
- *Topography* – run-off moves faster over steep land and has less time to infiltrate than on flat land. Steeper areas in catchments may also have shallower soils, thereby lessening storage of water in soils and vegetation.

groundwater bodies of water which can occur beneath the land surface

run-off the draining away of water from the surface of an area of land or structure

erosion the act in which earth is worn away, often by water, ice or wind

Source 3.2 The build-up of nutrients from agricultural and urban areas, combined with low flows, can cause eutrophication, the over-enrichment of nutrients in waterways. It leads to excessive algal growth and reduced oxygen concentrations.

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- *Soils* – soils develop through the interaction of water, vegetation and geology. Soil depth and texture control the amount of water that can be stored in a catchment. Clayey soils tend to repel water and the water they absorb moves slowly to the groundwater. Sandy soils are more permeable than clays and have higher **infiltration** rates. Soils with high organic content can store water for longer periods than sands.

infiltration the process by which water on the ground surface enters the soil

- *Land use* – hard surfaces, such as roads and footpaths, prevent infiltration and, therefore, increase run-off. Agriculture exposes soils to erosion and may change groundwater or increase the salinity of soils through irrigation practices. Humans also alter river flows by storing and consuming water and redirecting flows to areas where there is a water deficit. Chemical pollutants and nutrients from land use can degrade soil, groundwater and **surface waters**.

surface water water found on the surface of continents and islands

- *Vegetation* – terrestrial vegetation increases infiltration by slowing down run-off and allowing water to enter the soil and the groundwater system. Vegetation also reduces erosion and is a key driver of catchment health.

Catchment water

Only 2.5% of the world's water is fresh and 70% of fresh water is locked up as ice. Fresh water is a valuable resource but vulnerable to over-exploitation and contamination. Water connects surface and sub-surface environments in a catchment and is a key factor in the types of ecosystems that exist in both terrestrial and aquatic areas. Surface waters include:

- *Streams and rivers* – a stream is a small to medium-size natural channel or tributary that connects to a river. Some streams and rivers are ephemeral because they may stop flowing during dry periods or their water is lost as they pass through porous sediments or fractures in bedrock. Streams and rivers are important components of the hydrological cycle and they can transport pollutants, eroded soils and excess nutrients sourced from human developments.
- *Natural lakes* – natural lakes are small (a few metres squared) or large (many kilometres squared) standing water bodies. They may or may not have a connection to a stream, a river or the sea. Estuarine embayments that are seasonally cut off from the marine environment by sand barriers are also classified as lakes.
- *Inland seas* – inland seas are large landlocked water bodies and usually features of endorheic catchments. They contain diverse ecosystems and resources utilised by humans but are vulnerable to pollution and over-exploitation of their water resources. The Aral Sea in central Asia is an example of an inland sea that is under stress from human activities. The Aral Sea is now only 10% of its original size due to diversion of waters and irrigation.
- *Artificial lakes* – humans can create lakes by damming rivers or by constructing them in impermeable soils. They can be used to store water or create recreational opportunities.
- *Freshwater and brackish water wetlands* – **wetlands** provide habitat for flora and fauna and also trap sediments and cycle nutrients. Freshwater wetlands can be permanently or periodically saturated with water and may have intermittent or no connection to a stream or river. Most freshwater wetlands require periodic flooding to enable their aquatic fauna to migrate to spawn or recruit.

wetlands land consisting of marshes or swamps

- *Estuaries* – fresh water that drains into the sea or ocean may pass through estuaries where it interacts with marine waters. Estuaries are sinks for nutrients, sediments and pollutants that originate from other parts of the catchment.

With the exception of lakes and wetlands, which are classified as **lentic** or standing water bodies, most surface waters are **lotic**; i.e. they have permanently or intermittently flowing waters.

lentic standing water bodies, the classification of lakes and wetlands

lotic surface waters with permanently flowing waters

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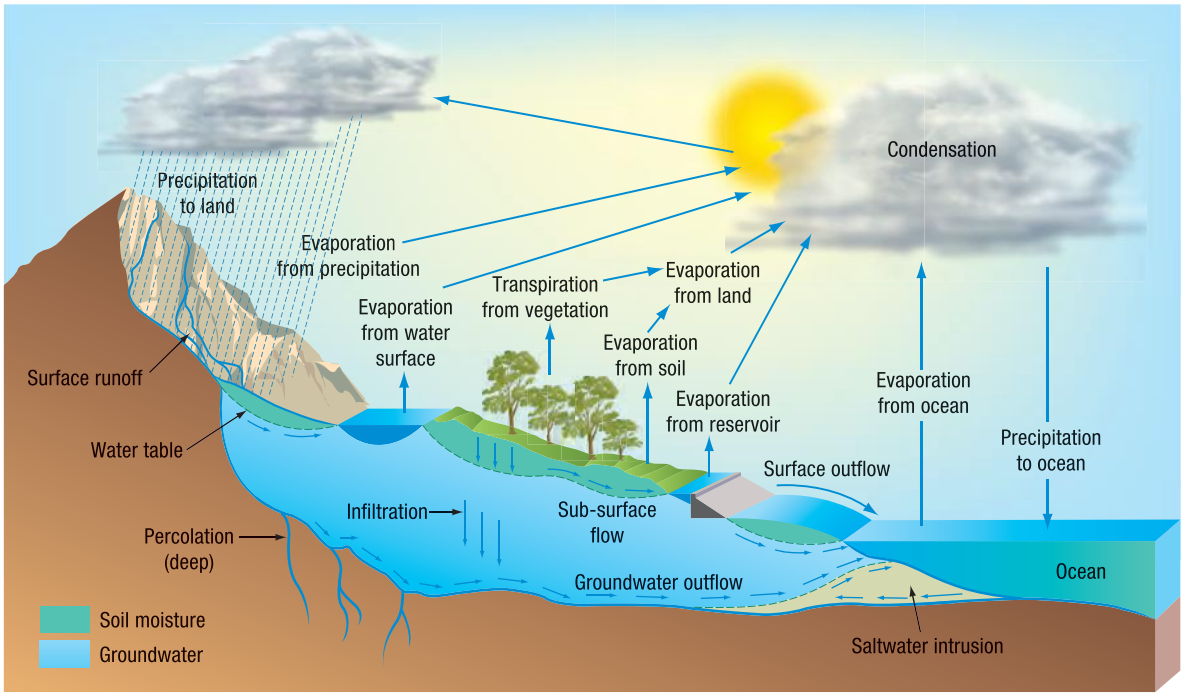

Source 3.3 The hydrological cycle comprises rainfall and surface and sub-surface bodies of water that interact with catchments and marine environments.

Source 3.4 Wetlands (above) and rivers (right) are important surface water environments in catchments. They are, however, connected to sub-surface waters that can maintain water during droughts.

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Small and large bodies of water can also occur beneath the land surface. Sub-surface waters are generally known as groundwater. Shallow groundwater can be recharged by rainfall over short time periods (weeks to months), whereas deep groundwater, such as the Great Artesian Basin in Australia, recharges over tens of thousands to millions of years. Water is also retained in the soil and is important to plants and microorganisms. More than 80% of the world's agriculture is rain-fed and, therefore, depends on water stored in the soil. Soil water is usually found in the top 200 cm of soil and is critically important to natural vegetation and crops and pasture that are not irrigated.

Geographical fact

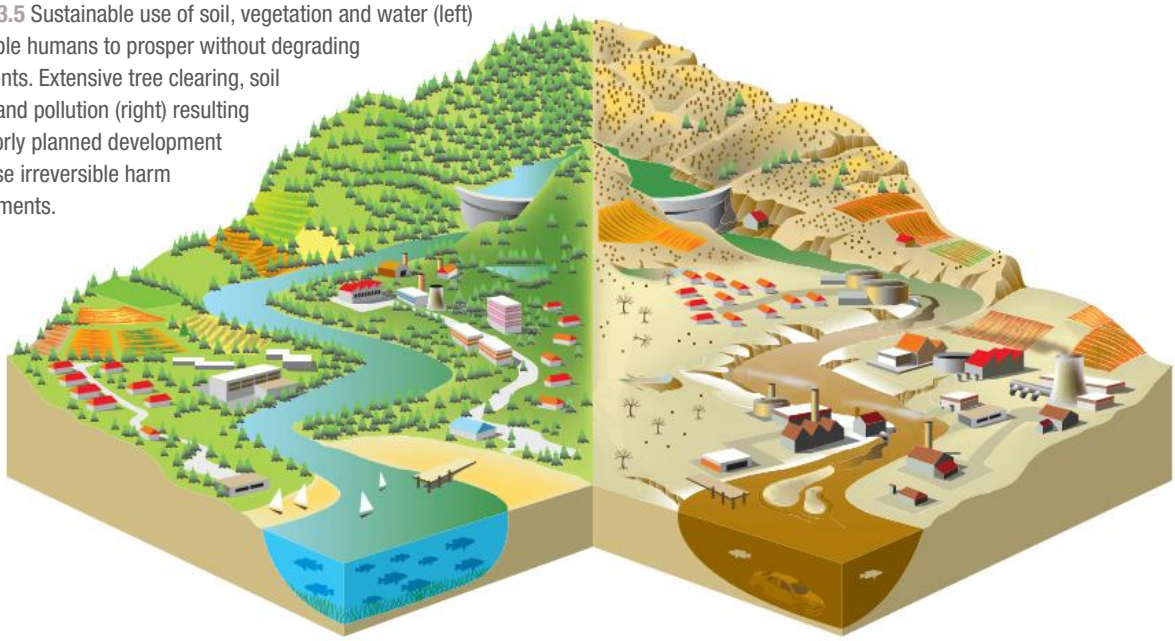
The Great Artesian Basin is the largest sub-surface supply of water in the world. It lies beneath 23% of the Australian continent.

ACTIVITY 3.1

1 List two surface and sub-surface water compartments found in catchments.
2 Explain where river systems drain in an endorheic catchment.
3 Describe what streams and rivers transport through a catchment.
4 Discuss why water that is stored in soil is important.

3.2 Human impacts

Although catchments are often perceived to be hydrological units, they contain environments that are characterised by diverse flora and fauna, different soil types and a variety of climatic conditions. Humans undeniably need to modify catchments for the wellbeing of populations and to drive the economy. Soil and water, in particular, are easily degraded in the absence of sound management. Soils form over hundreds to thousands of years and their loss through erosion can be devastating to humans and the environment. Humans nonetheless have the technological capacity and scientific knowledge to strike a balance between meeting the needs of populations and conserving the environment.



Source 3.5 Sustainable use of soil, vegetation and water (left) can enable humans to prosper without degrading catchments. Extensive tree clearing, soil erosion and pollution (right) resulting from poorly planned development can cause irreversible harm to catchments.

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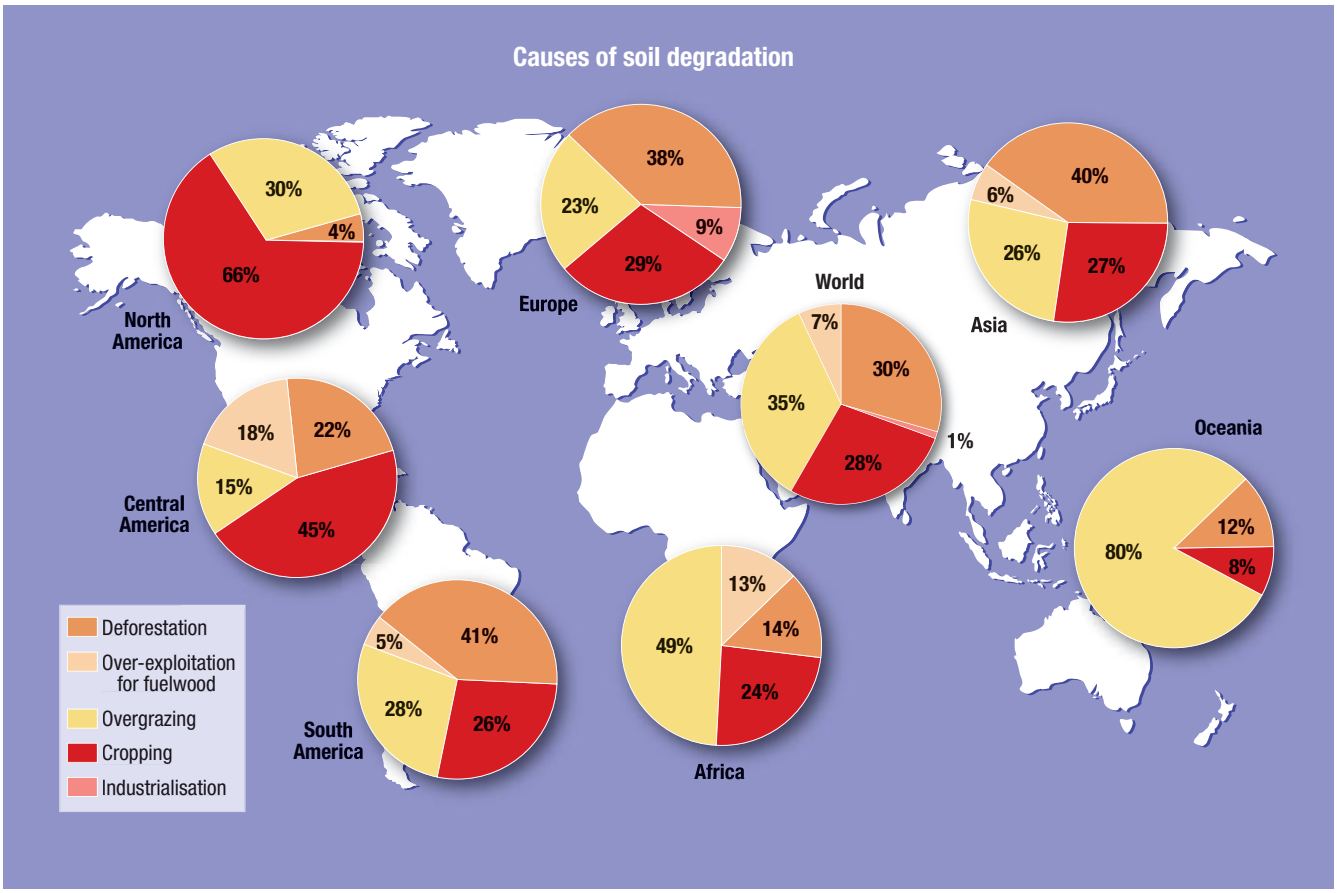
Land degradation

Overgrazing, intensive cropping and deforestation are the main causes of erosion and trigger sedimentation in streams, rivers, lakes, wetlands and estuaries. Overgrazing can denude vegetation and expose bare soils to wind and water erosion. Overgrazing occurs when pasture or grasslands are overstocked with cattle and/or sheep or as a result of continuously grazing land without intervening periods for recovery of grass cover. Overgrazing can also occur when the population of wild herbivores increases; this can occur when humans introduce species to an environment or by creating favourable conditions for population growth. Land is made available for grazing by clearing natural vegetation and introducing grasses. The change in vegetation type destroys habitat and reduces biodiversity. Overgrazing is a worldwide problem and has been responsible for extensive areas of soil erosion in Australia. Reduction in soil depth and fertility are also associated with erosion from overgrazing.

Cropping is another cause of erosion in catchments. Poorly managed cropping, which exposes soil to wind and water erosion between crops, can lead to many tonnes of lost soil per hectare per year. Soil losses of up to 300 tonnes/ha per year have been reported in Australian soils that are intensively used for crops. Intensive cropping can reduce soil fertility and also trigger soil salinity and acidification by modifying the local hydrology and increasing the amount of nitrogen in the soil by excessive, compensatory fertilising.



Source 3.6 Overgrazing, cropping and deforestation account for most of the world's degraded lands.

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Sheetwash and rill (hillslope)	highest in tropical northern Australia
	average erosion rate 4.4 t/ha/yr
	on average hillslope erosion is three times higher than the natural rate
Gully and riverbank erosion	main source of sediment delivered to streams in southern Australia
	4.4 billion tonnes of soils have been lost to erosion from 32 500 km of gullies since European settlement
	gully sediments cause poor water quality and require targeted restoration
River sediment loads and deposition	major problem in eastern Australia – native vegetation cleared from the riparian zone of two-thirds of streams in agricultural areas
	30 000 km of streams have sand and gravel from gully and stream-bank erosion, impairing stream health
	14 million tonnes of sediment is transported to the Queensland coast, and 3 million tonnes to the New South Wales coast each year
	river sediment loads are generally 10 to 15 times higher than pre-European settlement in some river basins
	on average 90% of suspended sediments reaching estuaries comes from 20% of the catchments
	sand deposits are significant in the Murray–Darling Basin, coastal New South Wales, south-east Queensland and the Glenelg region of Victoria and are moving slowly down the low-energy river systems, causing problems for dams and weirs.

Source 3.7 Australia's scorecard on erosion and sedimentation. The amount of soil loss from human practices continues to be a management challenge in Australia.

Deforestation is undertaken to supply timber, create agricultural land and to develop land for industry and housing. Only 50% of the world's forest cover remains. Deforestation is often intended to permanently transform the landscape whereas managed logging involves selectively removing trees or replanting logged areas. Deforestation exposes soil to the erosive effects of wind and water, and may also modify the interaction between surface and sub-surface waters by increasing run-off and reducing infiltration of water into the groundwater.

Run-off transports eroded soils into waterways where it either causes localised sedimentation or sedimentation of areas many kilometres downstream. The topsoil, necessary for crops and natural vegetation, can be severely depleted by run-off leaving infertile subsoils exposed. Sheet erosion (uniform layer of soil loss) and rill and gully erosion (formation of small and large eroded channels) can contribute hundreds of thousands of tonnes to the sediment load of rivers. Stream bank erosion, caused by the removal of **riparian** vegetation or wave action from boating, also contributes to the sediment load of rivers.

riparian living or located on the bank of a natural watercourse such as a river or a lake

In developing countries vegetation is often cleared to supply a cheap source of fuel. This practice also contributes to land degradation. Human changes to fire regimes may also expose soils to erosion.

Reduced river flows, caused by humans regulating flows with **dams**, diversion and irrigation can increase sedimentation of streams and rivers leading to shallower environments that are not suitable for local species of aquatic fauna. Consequently, streams and rivers may experience an ecosystem shift in response to physical changes. The turbidity of water may also increase thereby reducing the depth to which light can penetrate. Photosynthesis in aquatic plants and phytoplankton can be affected by the reduction of light in unnaturally turbid rivers.

dam a barrier constructed to hold back water and raise its level, forming a reservoir used to generate electricity or as a water supply.

Land degradation also has significant impacts on the local, regional and national economies. Agricultural productivity can decline due to low soil fertility and the effects of salinisation and acidification. Navigation in estuaries and rivers can also be significantly affected by sedimentation.

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ACTIVITY 3.2

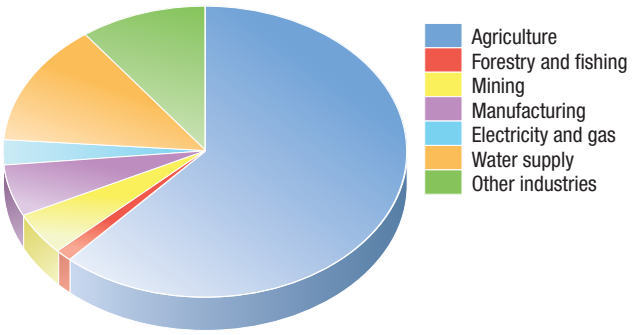
1 Explain how overgrazing degrades the environment.
2 Analyse how vegetation cover encourages infiltration of water into soils and groundwater.
3 Describe what role run-off plays in sedimentation of streams and rivers.
4 Discuss the average rate of soil erosion in Australia.

RESEARCH 3.1

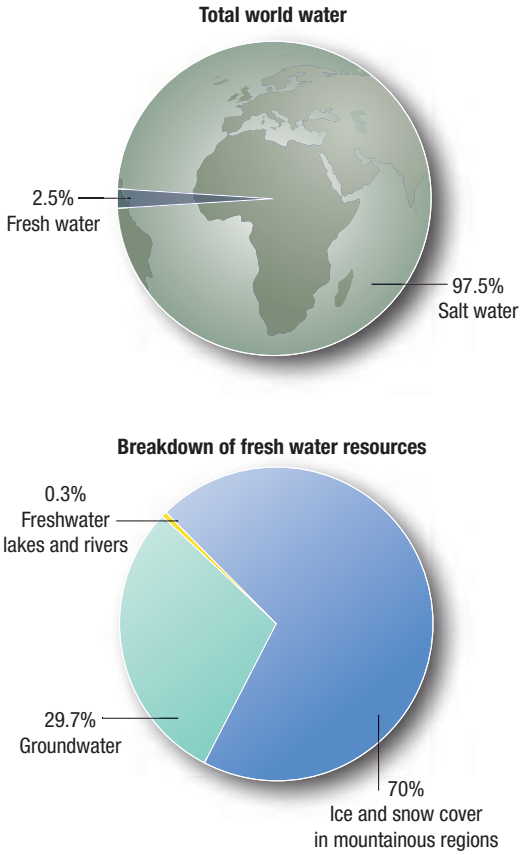
Conduct a literature search on the effects of rabbits in Australia and answer the following:
1 Discuss why rabbits were introduced into Australia.
2 Explain the environmental impacts of rabbits.
3 Analyse the strategies that have been used to control rabbits. Have they been successful?

Water use

Humans depend on clean, fresh water for domestic and agriculture activities, and are increasingly dependent on water for industry and energy production. More than half of the world's population faces water stress resulting in inadequate sanitation, competition for potable water and low agricultural productivity. Consequently the lack of fresh water has implications for human health and food and income security. More than 3 million die each year due to a lack of access to clean, potable water; 2 million of them are children. The East Africa Emergency in 2011, caused largely by drought, affected 8 million people. According to the United Nations, 40% of urbanisation is occurring under slum conditions and 50% of the world's urban population lives in cities of greater than 10 million people. In Australia almost every household has access to piped water and sewerage, yet almost one-third of the world's households still lack plumbing and sanitary disposal of sewage. Under these conditions, demands for water in urban areas are likely to be exceedingly high and the risk of polluting water sources is considerable.



Source 3.8 Water use in Australia in 2010/2011. Agriculture is the dominant user of water in Australia and the rest of the world.



Source 3.9 Fresh water is scarce and much of it is inaccessible to humans. Groundwater is a major source of water but is vulnerable to over-exploitation and contamination.

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Allocating water for human use is highly contentious because water has become a commodity that can be bought, sold or traded. Stakeholders compete for access to water resources and governments have responded by allocating water using licensing schemes, quotas and pricing. The commoditisation of water has the potential to cause social inequalities because water can become unaffordable for many. Balancing water use to meet human needs and economic growth against environmental needs can trigger conflict between stakeholders. The extraction and pollution of water reduces access to quality water by other users. Conflict over water can cross international borders and trigger political debate over access. The Middle East and Africa have experienced inter- and intra-nation conflict over access to surface and ground waters for decades. Large catchments that include multiple international borders are difficult to manage because of differences in jurisdiction and planning laws, and competing interests. For example, impounding water in one country can deny a downstream country of fair access to the water resource. The degradation of catchment environments and variable rainfall can also reduce the supply of fresh water and drive up its price. The quality of water is threatened by pollution from urban areas and industry, and the quality of run-off from the upper catchment can be degraded by deforestation, loss of wetlands that naturally filter water, and fertilisers and pesticides.

Geographical fact

According to the United Nations, more than 2 million tonnes of sewage are discharged into waterways every day. More than 70% of industrial waste is discharged into usable water.

Around the world, agriculture is the largest user of water. Agriculture meets most of the world's food requirements. More than 40% of agricultural land is now degraded as a result of nutrient depletion, salinisation, erosion and acidification. Humans face the dilemma of conserving water for the environment without compromising food production, manufacturing and household needs.

Pollution from industry and urban areas (drains and sewerage outlets) are point sources that contaminate streams and rivers that then transport pollutants to estuaries, wetlands and other environments. Non-point sources, such as agriculture and urban run-off, contribute pollutants (usually pesticides and fertilisers) when run-off transports them to waterways. Toxins from non-point pollutants can contaminate ground and soil water; the toxins can be taken up by terrestrial vegetation. Point sources can also contaminate groundwater through recharge via polluted surface waters.

Flow regulation

Humans control river flows to ensure access to water when it is required and to supply water where it is most needed. **Flow regulation** has been used for over 5000 years to irrigate crops and is now widely practised to supply urban areas with potable water. Natural river flows are variable because of seasonal disparity in rainfall; this can be problematic for human activities that require a regular supply of water. Also, demands for water may exceed supply from natural sources of water. To address deficiencies in the supply and access of water from natural waterways, humans have applied engineering works that alter natural processes and the form of waterways.

flow regulation when humans control river flows to ensure access to water when it is required and to supply water where it is most needed

Large dams

Large dams are built to impound water for irrigation, domestic water, energy production and for flood mitigation. The impounded water body directly behind a dam is called a reservoir or impoundment. Some dams meet all of the abovementioned needs while others are for specific purposes. Dams mitigate floods by controlling the volume of water that can flow downstream. Dams constructed for agriculture, domestic supply and industry are designed to store water that is released on demand; generally, they store water in wet periods and then control the release of water to meet downstream requirements. Stored water in dams can also be transferred to other catchments through tunnels and pumping stations without any need to release water downstream.

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Source 3.10 Large dams create deep impoundments that submerge habitat and restrict access to upstream resources.

Weirs and causeways

Weirs are small dams or barriers that are used to increase the upstream depth of streams and rivers. They are often constructed downstream of dams to compensate for reduced water depth caused by lower flows. Weirs can be constructed from concrete, stone or wood. Weirs are also built across tidal channels to block tides and create freshwater conditions upstream. Causeways are raised areas or embankments constructed over watercourses or wetlands. Their main purpose is to enable road, rail and pedestrian access in areas that are permanently or periodically submerged.

weirs low dams that are built across rivers to regulate flow or raise the water level

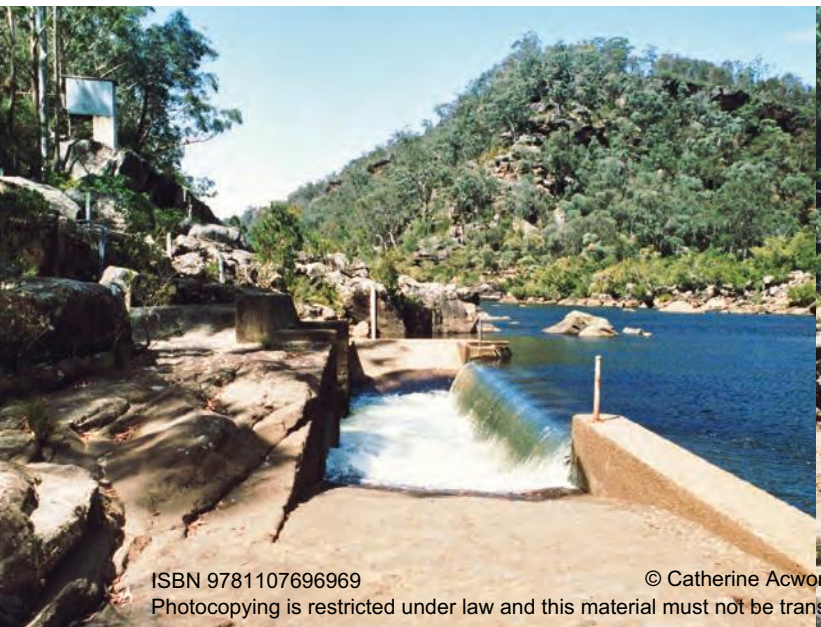
Canalisation

Canalisation refers to the conversion of natural streams and rivers into concrete canals. Canals can also be constructed where no watercourse previously existed and may or may not have concrete banks. Canals control the direction and rate of flow. Natural watercourses in soft sediments are able to meander by following the path of least resistance in the landscape. Riparian vegetation slows water flows and reduces erosion. By contrast, canals, usually in urban areas, often have concrete banks and direct flow over a planned pathway. Canal networks can increase the drainage density of a catchment and this leads to more efficient removal of water from the landscape. Canals are constructed to:

- supply water to irrigation areas
- transfer water for domestic supply
- channel stormwater to the sea
- transfer water between catchments (inter-basin diversion)
- reduce flooding in urban areas
- transfer water to flood detention basins
- improve navigation.

Canals are routinely used in the lower catchment areas of the world to prevent flooding of urban areas. Cities such as Amsterdam in the Netherlands, St Petersburg in Russia and Venice in Italy depend on canals to reduce the impacts of floods.

Source 3.11 Entrance to an interbasin diversion tunnel on the Upper Nepean River, NSW (left). The downstream reaches (right) experience low flow conditions for extended periods.



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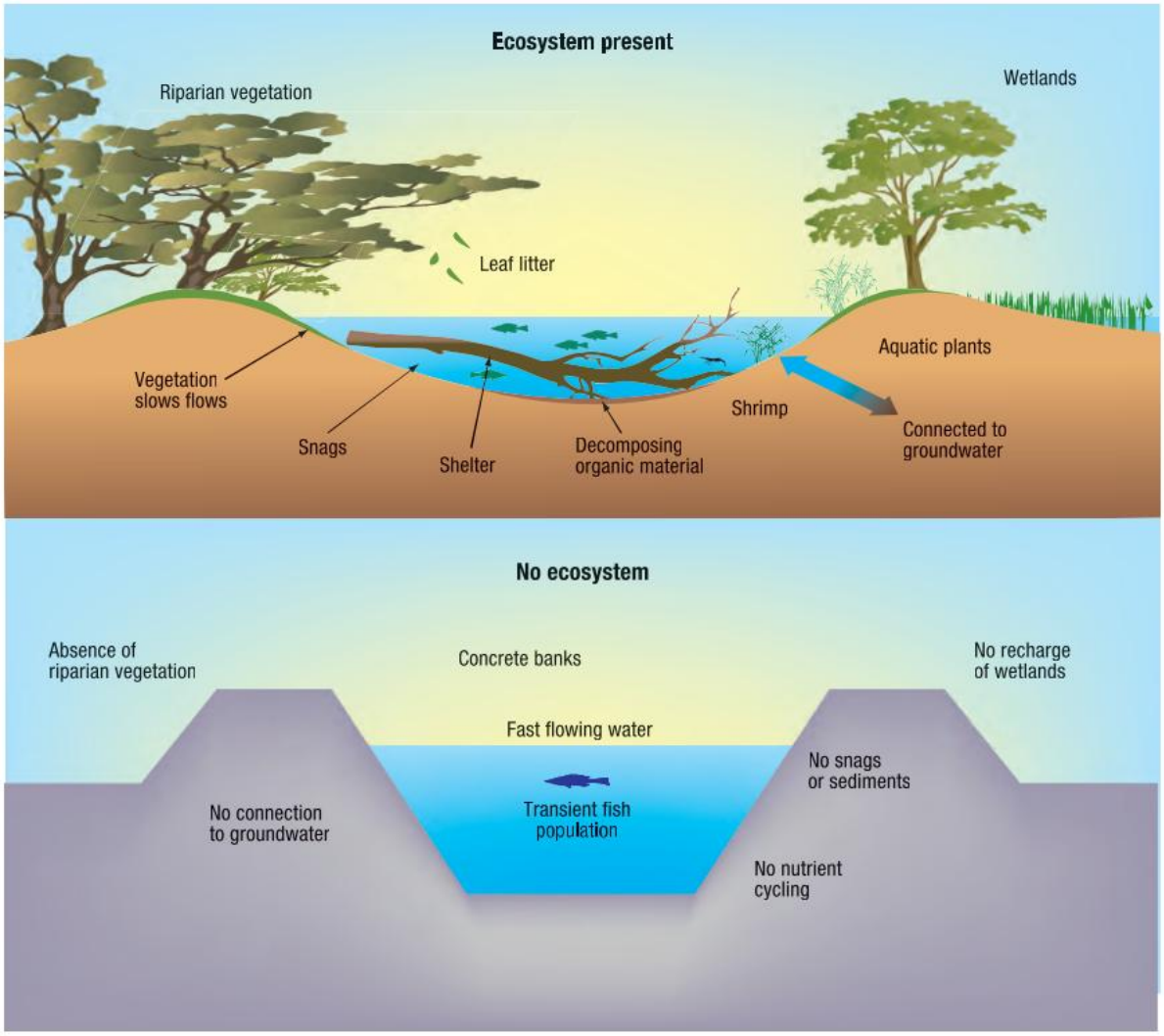

Source 3.12 Canals have uniform dimensions and are devoid of riparian vegetation. They have low biodiversity because of their lack of habitat.

Floodgates and barrages

Coastal lowlands are desirable for urban development, industry and agriculture. Floodgates are usually one-way valves that open on low tide to allow fresh water to flow into estuaries, and close on high tide to prevent tidal water entering canals and affecting farmland and urban areas. Barrages are larger structures that incorporate many floodgates. Floodgates and barrages have converted brackish water reaches of coastal rivers into freshwater environments. The Richmond River in northern NSW has over 270 floodgates that protect agricultural land from tidal inundation and reduce flood impacts. They have also reduced brackish water habitat and drained wetlands.

coastal lowlands an area of low-lying ground close to estuarine and marine environments

Interbasin diversion

Surface waters can be diverted between dams, lakes and rivers using canals, tunnels and pumping stations. **Interbasin diversion** is used to increase water supply in another catchment that is experiencing a water deficit. Hydroelectric dams, such as the Snowy Mountains Scheme in Australia, utilise interbasin diversion to ensure there is sufficient water to turn power-generating turbines. The Sydney water supply scheme diverts water between dams to improve supply to the Sydney, Wollongong and South Coast urban areas.

interbasin diversion interbasin diversion involves transferring water from one catchment to another.

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Source 3.13 Barrages in tidal areas convert upstream areas into fresh water by preventing the daily ingress of tidal water.

ACTIVITY 3.3

1 Discuss the differences between a canal and a natural watercourse.
2 List three functions of a large dam.
3 Reflect on the issue of water consumption and availability. In your view, how can humans reduce their consumption of water, yet meet their basic needs and also protect environments?

Impacts of flow regulation

The various forms of flow regulation have triggered many environmental impacts in catchments. Flow regulation is the primary cause of water deficits in the natural environment and its impacts are most obvious in the downstream river reaches. Humans benefit from, and are also affected by, flow regulation.

Impacts of large dams

Large dams cause upstream (above dam) and downstream (below dam) impacts. Upstream impacts include:

- *Flooding* of natural habitats, urban areas and agricultural lands – impounded waters can be tens of metres deep leading to expansive areas of submergence. The submergence leads to loss of riverine habitat, forced relocation of human populations and loss of agricultural land. Historical and cultural sites are also lost.
- *Stratification* of water – the deep waters of dams can experience thermal and associated oxygen **stratification**. Surface waters remain at similar temperatures to the natural, pre-dam riverine environment, but sunlight can only warm several metres of the reservoir water. During summer, the upper layers are warmer than lower layers and become less dense. Wind-driven mixing of the upper layer maintains normal oxygen concentrations. The upper, warm layer is known as an **epilimnion** whereas the deeper, colder layer is called a **hypolimnion**. There may be a transitional area, called a **metalimnion** or **thermocline**, where temperature decreases over a gradient. Oxygen also changes with depth and anoxic conditions can be present in the hypolimnion. There

stratification the process of waters with different properties forming layers to act as barriers to water mixing

epilimnion the upper, warm layer of water

hypolimnion the deeper, colder layer of water

metalimnion (thermocline) a transitional layer of water where temperature decreases

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is very little mixing through the water column during summer. However, during winter the epilimnion may become cold and sufficiently dense such that it sinks and mixes the entire water body. This process is called 'overturn'.

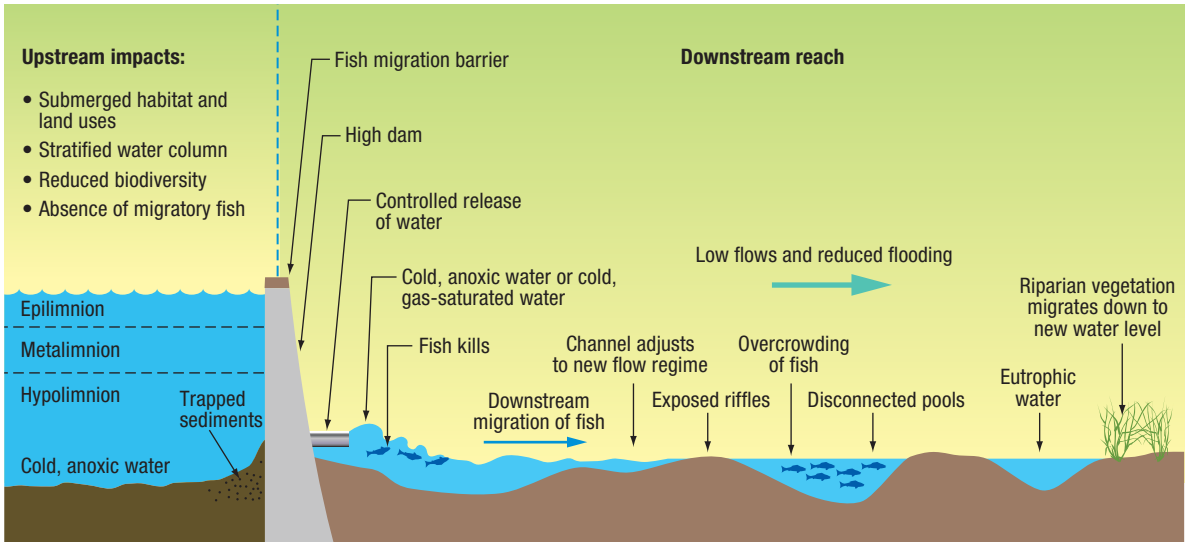
Stratification has ecological consequences. The differences in temperature and oxygen concentrations between the surface and bottom of the reservoir alter habitat. Fish that depend on the bottom environment are often unable to survive in the cold anoxic conditions of the hypolimnion and are forced to live close to the shoreline.

- *Sediment trapping* – dams can trap up to 99% of the sediments that enter the impoundment. The high sediment trapping efficiency can reduce the supply of sediment to downstream channels leading to changes in channel shape and form.

The downstream impacts of dams include:

- *Water quality degradation* – even the purest of water released from dams can affect **water quality** and hence aquatic organisms and vegetation. Dams that release water from the bottom of the reservoir can cause water temperatures in the downstream areas to fall dramatically, particularly during summer when reservoirs are thermally stratified. This can lead to 'river chilling' and force fish and other aquatic organisms to migrate downstream, where river water is closer to their preferred temperature. Dams can also release anoxic water that can cause fish kills. Some dams can release water under enormous pressure, which can have the opposite effect: the water can become supersaturated with dissolved gases, which can be harmful to aquatic organisms. Fish kills can occur below hydroelectric dams due to the saturation of gases caused by water flowing through turbines (that generate electricity) or plunging from great heights. The downstream effects of dams can extend for many kilometres. The distance over which the river reaches pre-impoundment conditions is known as the recovery distance or discontinuity distance.
- *Changes in flow regimes* – the storage and controlled release of water changes the flow regimes of river reaches downstream of dams. Flows are often reduced and river water levels fall exposing riffles and creating disconnected pools of water. When water is released, flow conditions may be temporarily higher than natural conditions and cause erosion. Floods are important to natural environments because they replenish water in wetlands and lakes, enable fish to migrate and also supply nutrients to soils. Dams reduce the frequency and magnitude of floods. Although urban areas benefit from flood mitigation, agricultural soils and natural environments can be negatively affected through reduced nutrient inputs.

water quality the physical, chemical and biological characteristics of water



Source 3.14 Thermal stratification of a deep impoundment during summer. Water released from the hypolimnion can cause 'river chilling' in downstream areas.

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NOTE THIS DOWN

Copy the graphic organiser below and outline the positive and negative dimensions to dams.

The impacts of dams	
Positive	Negative

Impacts of canalisation

Canalisation has multiple environmental impacts. The key impacts include:

- *Artificially lowered water tables* due to the diversion of run-off into the canals – wetlands depend on shallow water tables to maintain saturated soil conditions and surface waters. Wetlands are important ecosystems and their loss can reduce biodiversity and degrade habitat for migratory and resident bird populations, aquatic and semi-aquatic organisms.
- *Reduction in riverine habitat* through the removal of riparian vegetation and snags – vegetation provides structure and leaf litter, and traps sediment eroded from other parts of the catchment. Fish populations may decrease due to a lack of food, shelter, spawning areas and nursery grounds.
- *Loss of aesthetic value* – humans value the aesthetic appeal of natural watercourses. Stormwater canals, for example, are considered to be ugly features in the urban landscape and can lower land value. By contrast, the canals of Venice and Amsterdam are appealing because of the surrounding architecture and human activities that depend on them.

Impacts of interbasin diversion

Diversion weirs and tunnels can lead to cease-to-flow conditions for extended periods in downstream reaches. The impacts of lower flows or cease-to-flow conditions are similar to those of dams and include:

- *Exposure of riffles* (shoals or other shallow areas in between pools) for extended periods. Riffles are important for spawning and temporary shelter from predators.
- *Inability of fish to migrate* due to a lack of flowing water. Fish may become trapped within pools that are disconnected. The sudden cessation of flows, due to diversion, can leave fish stranded in downstream reaches.
- *The build-up of nutrients and warming of remaining pools* leading to anoxic conditions and eutrophication. Fish kills can occur when bacteria and algae deplete oxygen in eutrophied water.
- *Reduced navigation* – lower water levels in downstream river reaches may restrict the movement of boats.

Impacts of weirs and causeways

The main impacts of weirs and causeways include:

- *Lower opportunity to migrate* – fish are only able to migrate during floods because weirs and causeways can be a barrier to movement. A reduction in migratory fish populations can occur upstream of weirs.
- *Stratification of deep weir pools*, generally those that are greater than 2.5 m in depth.
- *Submergence of riffle zones* and loss of shallow habitats for small fishes and macroinvertebrates.

ACTIVITY 3.4

1. Briefly describe three downstream impacts of large dams.
2. Discuss during which season thermal stratification is likely to occur.
3. Analyse what is meant by a riffle zone and why it is important to fish.
4. Explain how flow regulation affects humans.

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RESEARCH 3.2

Conduct an internet search on the Three Gorges Dam, China and take notes on the purpose of the dam and its effects on humans and the environment.

1. Explain how the dam was constructed.
2. Describe how the dam has degraded the natural environment.
3. List the impacts of the dam on communities upstream and downstream.
4. Recall on the human and environmental impacts of the dam. Do you think that the economic benefits of the dam compensate for the environmental and social impacts?

Geographical fact

The Murray–Darling Basin holds 1000 times the volume of water in Sydney Harbour. The Murray River is the 16th-longest river in the world.

Case study 3.1

The Murray–Darling Basin – a catchment in crisis

The Murray–Darling Basin comprises the Murray and Darling Rivers, covers 1 million km^2 and is responsible for approximately 40% of Australia's agricultural production. Approximately 65% of Australia's irrigated farmland occurs in the Murray–Darling Basin, along with extensive areas dedicated to grazing. There are approximately 25 000 wetlands that cover 62 000 km^2. The Murray–Darling Basin drains river systems from South Australia, Victoria, Queensland, the Australian Capital Territory and New South Wales. Although the Murray–Darling Basin has a large drainage area, it experiences low rainfall and low river flows.

The Murray–Darling Basin has been farmed since the 1800s and is described as the 'food bowl of Australia'. During early European settlement, pressure on water and soil resources was low. As Australia's population grew, so too did demand for water to irrigate farmland. Soil fertility also decreased, and soil salinity became a problem due to over-irrigation of farmland. By the late 19th century, concern over water supply was exacerbated by recurrent drought conditions. Between 1922 and 1935, 10 weirs with locks were constructed to raise water levels in the river for irrigation, water diversion and navigation. There are now over 4000 weirs, dams and other infrastructure that regulate flows in the Murray–Darling Basin. The high level of regulation has fuelled conflict between stakeholders such as farmers, fishers, environmentalists, urban and rural communities, industry and government.

The River Murray Commission was established in 1917 following growing concern over declining water availability. For decades the River Murray Commission focused on the quantity of water and acted only as an advisory body for all concerned states, except Queensland. Increasing salinisation of farmland and waterways triggered changes to the role of the Commission in the early 1980s. In 1985 the Murray–Darling Basin Agreement was adopted and the Murray–Darling Basin Commission was then established in 1988. The Commission's main responsibility was to coordinate the management of water resources and the environment following decades of dispute between the five states and territories. The responsibilities of the Commission were transferred to the Murray–Darling Basin Authority (MDBA) in 2008 under the *Water Amendment Act*.

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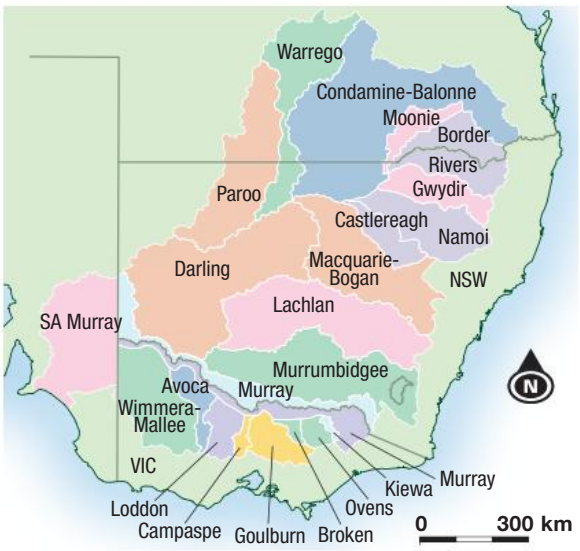
The MDBA is an independent authority and the first agency to have the responsibility to manage the water assets of the Murray–Darling Basin 'in the nation's interest'.



Source 3.15 The Murray–Darling Basin comprises a number of catchments and management areas (coloured) that drain water from Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia.

Environmental impacts of development

Irrigation draws more than 95% of water allocated to human use and is associated with declining river flows and the reduction of wetlands in parts of the basin, particularly during drought when natural flows are low and water demands for agriculture are high. Large dams have reduced the frequency of small to medium floods, which are important for wetlands. The impacts of flow regulation and over-exploitation of water include:

- eutrophication of waterways and recurrent blue-green algae blooms
- increased salinity of soils and water
- degraded in-channel and wetland habitats
- reduced opportunity for fish to migrate due to low flows and barriers such as weirs
- damage to Aboriginal sacred and cultural sites and reduced value of native title land
- reduction in the population of fish and birds
- reduction in riparian vegetation and the death and/or poor health of over 80% of river red gums.

The Murray–Darling Basin Plan

The Murray–Darling Basin Plan is a Federal Government initiative to address both environmental and land use issues. It was approved in 2012. The plan follows the principles of sustainable development that are embedded in natural resource management legislation and policy in Australia. The plan is the first to take a national approach to managing water resources in the Murray–Darling Basin after over 100 years of political conflict between states. The plan has set a target of 2750 gigalitres to be recovered from current water allocations for environmental purposes. The amount of water could increase or decrease based on monitored environmental outcomes of the current target. Each of the five states and territories will re-allocate water for environmental purposes. The overall objective is:

> for the Basin Plan as a whole is to achieve a healthy working Basin, which will include a healthy environment, strong communities and a productive economy, through integrated management of the water resources of the Murray–Darling Basin.

The environmental goals of the plan are:

- Protect and restore the dependent ecosystems of the Basin
- Protect and restore the functions of water-dependent ecosystems
- the context of the Basin Plan, 'protect and restore' refers to retaining or improving the ecological character and ecosystem functions of a site, such as connections along rivers and between rivers and wetlands, end-of-system water quality and flow, habitat diversity and food webs.
- Ensure that water-dependent ecosystems are to risks and threats
- Ensure that environmental watering is coordinated between managers of planned environmental water, owners and managers of assets, and holders of environmental water.

Source: Murray–Darling Basin Authority, 28 November 2011

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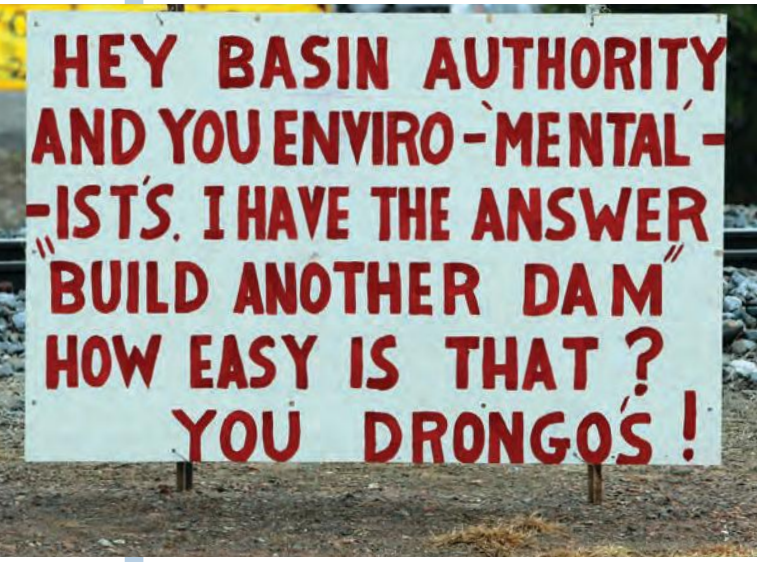

Source 3.16 Social conflict over water management in the Murray–Darling Basin has divided stakeholders.

Although the plan has advanced management of water assets and the environment, not all stakeholders have responded positively. Communities in the lower basin, farmers and environmentalists have continued to protest over the upstream extraction of waters.

1 Discuss which human activity draws the most amount of water from the Murray–Darling Basin.
2 Explain why the Murray–Darling Basin is important to Australia's economy.
3 Identify the stakeholders in the Murray–Darling Basin.
4 List three environmental objectives of the Murray–Darling Basin Authority.

3.3 Catchment management

Catchment management involves activities that restore or rehabilitate degraded terrestrial and aquatic environments, and environmental assessment and planning to ensure that current and future development does not continue to cause harm to the environment. Without cooperation between stakeholders it is not possible to foster stewardship of the environment or fully engage all stakeholders in decisions that affect them as well as the resource base that they seek to utilise. Catchment management is a responsibility for all of us. Humans are unable to vacate catchments to prevent environmental harm. Rather, humans must manage their activities in catchments to ensure sustainability goals are achieved.

To effectively manage human activities and their impacts at the catchment scale, environmental decision-makers must consider the following:

1 *Environmental processes and their interaction across the catchment* – efforts to manage localised problems that ignore catchment-wide factors often fail.
2 *Past changes to catchment processes and their impacts, how catchments are currently used, and future development* – reactive approaches to management deal with impacts that have already occurred, whereas proactive approaches, such as environmental planning, help to protect catchments from current and future developments.
3 *Human and environmental needs within the context of sustainable development goals* – humans depend on catchment resources, but without sustainability goals, catchment resources can be depleted or irreversibly degraded.
4 *Interactions between humans and catchment processes over time* – many environmental impacts are interconnected and negative feedback effects can occur many years after a human activity alters catchment processes.
5 *Stakeholder perceptions of the environment* – stakeholders have a vested interest in the commercial, recreational and environmental value of catchments and their perception and knowledge of the limits of the environment will influence their involvement in managing catchments.

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Integrated catchment management

Integrated catchment management (ICM) is a management strategy that takes into consideration that catchments are made up of different terrestrial and aquatic ecosystems that are interconnected through physical and biological factors. Importantly, ICM brings stakeholders together.

Integrated catchment management (ICM) a management strategy that takes into consideration that catchments are made up of different terrestrial and aquatic ecosystems that are interconnected through physical and biological factors

The main goals of ICM are to:

- increase awareness of catchment problems and engage stakeholders in management decisions and activities
- develop strategies for catchment management that are based on social, economic and environmental sustainability goals
- implement whole-of-catchment management strategies – that is, to consider the whole catchment rather than disconnected areas

Australian state governments have adopted ICM as a framework for catchment management. State governments have created authorities to oversee ICM; for example, the Catchment Management Authority in New South Wales and Victoria, Catchment Councils in Western Australia and Natural Resource Management Boards in South Australia. These authorities have a state-wide responsibility but establish Catchment Management Coordinating Committees (CMCC) to coordinate management across the many catchments under state jurisdiction. States also cooperate when catchments occur across state boundaries, such as the Murray River.

These CMCCs are responsible for:

- identifying and prioritising catchment problems
- facilitating cooperation between government agencies and stakeholders
- identifying resource needs and allocating resources following sustainability goals
- making recommendations on state-wide policies that facilitate ICM
- implementing and monitoring catchment management programs.

CMCCs are established in catchments that are vulnerable to human activities and where uncoordinated initiatives to tackle problems have been ineffective and require wider, catchment-level interventions.

The state governments are responsible for developing or amending laws that relate to ICM and ensuring that development decisions and ICM programs are legally implemented and consistent with the principles of ecologically sustainable development (see Chapter 1). All levels of government fund ICM activities often in collaboration with the business sector.

3.4 Catchment management practices

Environmental flows

Environmental flows are planned releases of water from dams to meet the needs of humans and ecosystems in downstream rivers. Environmental flows do not restore river flows to normal conditions. Rather, they are designed to:

- enable selected species of fish to migrate to and from spawning areas and to repopulate episodically isolated habitats
- provide the agricultural industry and urban areas with water during periods of low flow caused by drought
- sustain ecosystem functioning in rivers and the upper reaches of estuaries
- minimise the concentration of nutrients and pollutants in rivers
- stimulate the growth of riparian vegetation
- replenish the supply of water to wetlands.

Environmental flows are often implemented during drought to ensure there is sufficient water flowing in downstream rivers. However, most aquatic flora and fauna require variable flow conditions and at different times, which can be difficult to achieve because dams are designed to meet human rather than environmental needs. Some fish species, for example, require specific flow rates and water temperatures during a particular phase of their development in order to migrate and successfully spawn. Poorly timed environmental flows or those that focus on a single species of fish may not enable other species

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Source 3.17 Fish ladders enable fish to migrate upstream and downstream to complete their life cycle requirements.

with different flow requirements to successfully migrate. Fish ladders or fishways are sometimes incorporated into dams and weirs to facilitate fish passage.

Continuous release of water can be a challenge to water regulation authorities because the original purpose of impounding water can be undermined. Environmental flows can rarely reproduce all of the flow scenarios that influence downstream environments, particularly large floods which are beneficial to ecosystems but impact human activities. Unsurprisingly, setting environmental flows is controversial. Environmentalists lobby for the return of natural flow conditions or at the very least, an increase in environmental flows. By contrast, industries lobby for increased downstream water allocations, which can reduce the available water for ecosystems.

Wetlands management

Wetlands management is a challenge because of competition for water resources, changes in flow regimes and pollutants from human activities. Restoration and management of wetlands involves restoring water supply by enabling frequent flooding or reconnecting streams, preventing pollution, replanting vegetation and excluding harmful activities. Designating them as significant environments under local laws and international agreements can also protect wetlands. The Ramsar Convention (also known as the Convention on Wetlands of International Importance) protects wetlands that are considered critical habitat under an international treaty. There are now over 2100 wetlands around the world listed for protection under the Ramsar List of Wetlands of International Importance. The total area protected in Australia is over 8 million hectares.

Buffer zones

Buffer zones along the shoreline of natural channels, lakes and wetlands, which may be created by retaining or replanting shoreline vegetation, can help reduce sedimentation by trapping sediments in the terrestrial environment. Riparian buffer zones can enable streams and rivers to re-establish habitat by improving water quality and contributing leaf litter. The retention or construction of buffer zones can be a condition of development consent. Buffer zones may also exclude human activity within the vegetated area. The use of buffer zones has been recommended by UNESCO and can also be applied to cultural areas within catchments.

Land management

Land management is not independent of other catchment management practices. Rather, it contributes to efforts to manage soil and water quality and involves reforestation of previously cleared land and changes in farming practices. Soil conservation practices in urban and agricultural areas reduce erosion and sedimentation and protect valuable topsoils that are needed for natural vegetation and agriculture. Examples of soil conservation practices include:

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- reforestation
- land capability assessment and classification to avoid inappropriate use of landscapes
- on-farm strategies such as reduced soil tillage and crop rotation to conserve nutrients and reduce erosion
- use of windbreaks to reduce wind erosion and contouring of steep slopes to reduce the erosivity of run-off
- buffer zones along river banks to reduce sedimentation of streams and rivers.

Geographical fact

The year 2011 was named The International Year of Forests by the United Nations General Assembly. The event was a global celebration of people's actions in sustainable forest management.

NOTE THIS DOWN

Copy the graphic organiser below and complete the PMI table by outlining different perspectives of each catchment management practice.

Catchment management practices			
	Plus	Minus	Interesting
Environmental flows	Provide the agricultural industry and urban areas with water during periods of low flow caused by drought		
Wetland management		Competition for water resources, changes in flow regimes and pollutants from human activities	
Buffer zones			
Land management			

ACTIVITY 3.5

1 Discuss how buffer zones protect streams, rivers and wetlands.
2 Analyse in what ways you impact on your catchment during a typical day.
3 List three roles of a Catchment Management Coordination Committee.

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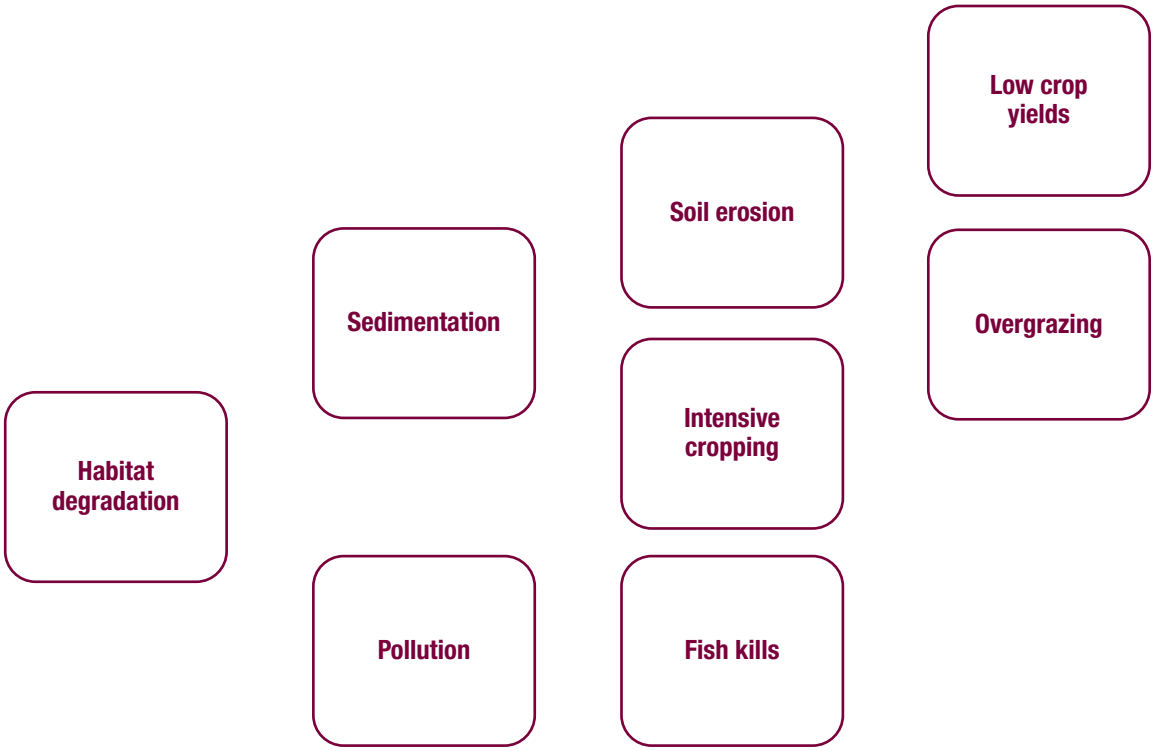
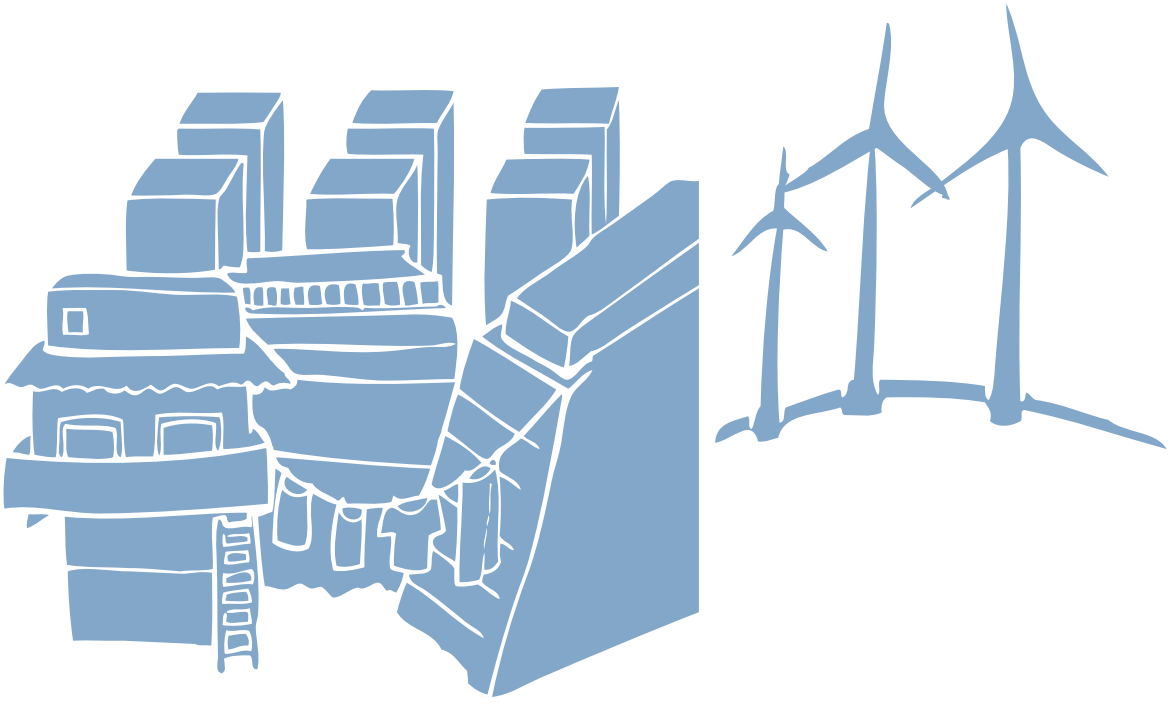
NOTE THIS DOWN

Copy the graphic organiser below and demonstrate the complex connections between human activities and environmental processes that can result in habitat degradation. Use the examples below as a guide, build on this and add more boxes as you demonstrate the connections.





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FIELDWORK 1.1 INVESTIGATING THE IMPACTS OF LAND USE ON A LOCAL CATCHMENT

Aim

To describe the impacts of land use on your local catchment and identify management strategies.

Method

Your local catchment will be investigated using information such as maps, aerial or remotely sensed imagery, and field observations.

Preparations

Locate a topographic map and an aerial photograph or remote sensing image for a local river from a mapping website. Draw a boundary around your local catchment area. The boundary can be determined from a topographic map by identifying ridges and other elevated areas that separate your local catchment from adjacent catchments. Streams and rivers can also be used to determine your catchment. Identify at least four stops in your catchment which should include streams and rivers. Attempt to locate stops that have easy access and represent different land uses.

Data collection

Record information on the human and natural components of the catchment at each stop. Take notes on the environment surrounding the river rather than focus only on the immediate channel and its banks. Record the following in your notebook and label, as required, your map and/or aerial photo:

1. Label the land use and outline its spatial extent. Describe the land use in your notebook. Take photos of the land use, especially activities that influence your catchment. Note the characteristics of the ground surface. Examples include: grass, native vegetation, bare soil, hard surfaces, rills and eroded soil.
2. Describe the channel characteristics at each stop. Note the presence or absence of vegetation. Is there a buffer zone? Is the water flowing or stagnant? Is there any evidence of sedimentation?
3. Are there any barriers to fish migration such as weirs or dams?
4. Are there any canals and pipes that discharge water into streams or a main river? If so, where do they originate and what type of effluent or water are they likely to discharge? Is there any evidence of environmental impacts below any pipes? Note any signs of pollution, litter, dying vegetation and evidence of vegetation having been cleared.
5. Is there any evidence of catchment management? Examples include: riparian buffer zones, sign posting, fencing, trash traps, revegetation works, fish ladders, and constructed wetlands.
6. Note down any terrestrial or aquatic fauna. Describe sources of food and other habitat qualities such as trees, aquatic plants and in-channel environments, such as riffles and pools that can provide opportunities for spawning or shelter.
7. Discuss your observations with your peers and make a general assessment of the environmental issues in your catchment. Prepare a report using the layout opposite:

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Fieldwork presentation layout

Front page	Tile and name
Contents page	Display section headings and page numbers. Revise when you have completed the assignment.
Page 1	Aims and methods
Page 2	Catchment map – show the boundary, streams, rivers, lakes and wetlands, and label land use. Use a legend.
Page 3	Introduction – provide a brief description of your local catchment.
Pages 4 and 5	Describe each stop. Use photos to enhance your description.
Page 6	Summarise the effects of land use in a table.
Pages 7 and 8	Describe any environmental impacts. Use a diagram to present your information or label the impacted areas on another map. Discuss associations between land use, run-off, water flowing through natural channels or canals and pipes, and any terrestrial or aquatic impacts.
Page 9	Table of impacts and any management strategies (if any).
Pages 10 and 11	Recommend management strategies. You may use a table or summarise them in expanded bullet points.
Page 11	Photos or sketches of examples of management strategies. You can annotate them onto a map.
Page 12	Conclusion – how healthy is your catchment?
Page 13	Appendix, bibliography, glossary

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Chapter summary

- Catchments are drainage basins that are bounded by a watershed. They capture rainfall that supplies water to streams, rivers, soil, lakes, wetlands and groundwater.
- Water and soil are important to the prosperity of humans and the maintenance of ecosystems. Poorly managed human activities can severely degrade both soil and water, leading to economic losses and irreversible harm to ecosystems.
- Agriculture is the largest user of water. Poorly managed agriculture can cause severe erosion and salinisation of soils.
- River regulation involves the engineering of watercourses to either divert flows from one catchment to another or store and release water as required. River regulation is a major threat to the environment because it reduces downstream flows in streams and rivers.
- Integrated catchment management (ICM) has been widely adopted in Australia and other countries to tackle environmental impacts from human activities by using a whole-of-catchment approach. ICM considers that ecosystems are connected in catchments. It facilitates cooperation between stakeholders.

End-of-chapter questions

Multiple choice

1 An endorheic catchment drains into:
- **A** the ocean
- **B** a large flood mitigation dam
- **C** a basin that has no connection to the ocean or another catchment
- **D** an urban area

2 Eutrophication occurs when:
- **A** an excess of nutrients leads to reduced dissolved oxygen levels in waterways
- **B** an increase in heavy rainfall flushes a river
- **C** saline water penetrates freshwater reaches of rivers
- **D** a lake completely dries out

3 River regulation refers to:
- **A** laws to control water consumption
- **B** the regulation of water through the construction of dams, weirs, locks and inter-basin diversions such as tunnels
- **C** the effect of wind on water flows
- **D** rules for navigation of waterways

4 What does 'environmental flows' refer to?
- **A** Water that flows from tributaries into the main channel of a river system
- **B** Water that is released from dams to improve the quality of downstream environments
- **C** The flow of water during heavy rainfall
- **D** Water that flows through natural environments

5 Catchments are best managed by:
- **A** government agencies
- **B** the community
- **C** conservation groups and other non-government agencies
- **D** collaboratively by all stakeholders

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Short answer

1 Explain why fresh water is considered a scarce resource.

2 Describe three environmental impacts of river regulation.

3 Analyse the benefits of integrated catchment management.

4 Summarise the catchment management practices.

5 List the factors that may lead to social conflicts over water.

Extended response

Describe the effects of two human activities on catchment processes and the resulting environmental impacts. Recommend management strategies that address existing impacts and prevent future degradation.

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4 Coastal environments

Source 4.1 Coastal environments are under increasing pressure from development. Activities, such as urbanisation, can irreversibly modify coastal environments.

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Before you start

Main focus

The coastal zone is made up of dynamic and interacting environments shaped by human and natural processes. Coastal environments are important for the prosperity of humans but also vulnerable to degradation caused by human activities. Coastal zone management involves multiple stakeholders with a vested interest in the recreational, economic and environmental assets of the many coastal ecosystems and their resources.

Why it's relevant to us

Coastal environments are under increasing population pressure. More than 3 billion people live within coastal environments and depend on their physical and biological resources to thrive. Humans have a responsibility to repair degraded coastal environments and prevent further impacts. To achieve sustainable development goals, locally and globally, coastal environments and their resources must be managed.

Inquiry questions

- What are the functions of coastal ecosystems?
- What are the threats to coastal environments?
- How are coasts managed to ensure they are not degraded?

Key terms

- Aquaculture
- Coastal erosion
- Estuaries
- Fisheries
- Hard engineering
- Integrated coastal zone management (ICZM)
- Mangroves
- Saltmarsh
- Seagrass meadows
- Soft engineering

Let's begin

The term 'coast' describes the area where terrestrial and marine processes interact. Coastal environments contain a variety of fragile ecosystems that contribute significantly to biodiversity on Earth. Humans have utilised coastal environments and their abundant resources since early human evolution. Today coastal environments are used for urbanisation, industry, recreation and for food. Evidence of coastal degradation is now widespread and includes pollution of waterways, erosion of beaches and dunes, declining fish stocks and loss of habitat for a variety of terrestrial and aquatic flora and fauna. Humans have responded to the impacts of their activities through reactive measures that focus on rehabilitating or restoring degraded coastal environments, and strategic measures to prevent future damage.

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4.1 The coastal zone

There is a long-held misconception that coastal environments are resilient and capable of assimilating pollution and recovering from various activities that exploit coastal resources. However, this is often far from the reality; coastal areas need careful management in order to survive and thrive. Planners and environmental managers consider interactions between the various coastal processes and environments that comprise or influence a larger spatial area known as the coastal zone.

Defining the coastal zone

The term '**coast**' is not precise in common language. The term is often used to describe the shoreline or shore where land meets the sea. This interpretation of what comprises a coast provides limited scope for coastal management because it defines a geographically narrow area and does not consider the interaction of coastal processes both **landward** and **seaward** of the shoreline. Accordingly, the term 'coast' is often considered by planners, environmental managers and scientists to describe a much wider area of land and water beyond the shoreline where terrestrial and marine processes interact. The term 'coastal zone' has been adopted to cover all landward and seaward environments influenced by coastal processes.

coast a much wider area of land and water beyond the shoreline where terrestrial and marine processes interact.

landward tending towards the land and away from the coast

seaward tending towards the sea and away from land

The boundary of a coastal zone may vary at any location based on the purpose. Planners and politicians may focus on political or administrative borders to define the boundary of the coastal zone. By contrast, scientists often define the boundary of the coastal zone by the margin where terrestrial and marine processes cease to interact. Factors such as elevation, **geomorphological** and geological features, the transition from one ecosystem to another, and catchment and marine features may all be used to define the boundary of the coastal zone.

geomorphology the study of the physical features of the surface of the Earth and their relation to its geological structures

The NSW Coastal Policy 1997 (for the link, see www.cambridge.edu.au/geography10weblinks) defines the coastal zone for planning and management purposes. In New South Wales, the coastal zone is defined using the following criteria:

- three nautical miles seaward of the mainland and offshore islands;
- one kilometre landward of the open coast high water mark;
- a distance of one kilometre around all bays, **estuaries**, coastal lakes, lagoons and islands; and tidal waters of coastal rivers to the limit of **mangroves**, as defined by NSW Fisheries (1985) maps, or the tidal limit, whichever is closer to the sea; with the line on the maps being taken to the nearest **cadastral** boundary and/or easily recognisable physical boundary, in consultation with local councils.

This definition uses fixed distances, cadastral boundaries, and physical and biological features in the landscape as the basis of defining the boundary of the coastal zone. These fixed distances and landscape features are easily mapped, enabling planners and environmental managers to develop policies and management strategies using a clearly defined zone of interest. Natural environments and their ecosystems do not always have discrete boundaries that can be defined by fixed distances from tidal waters or shorelines. More often, natural boundaries tend to be 'fuzzy'. These fuzzy boundaries require significant data collection and synthesis in order to define them on a map. Nevertheless, the criteria used in New South Wales meet most planning and management needs.

estuary the wide lower course of a river where fresh and marine water mix

mangroves trees that have managed to adapt to growing in the harsh and difficult tidal zone between the land and estuarine waters

cadastral a public record, survey or map of the value, extent and ownership of land as a basis of taxation

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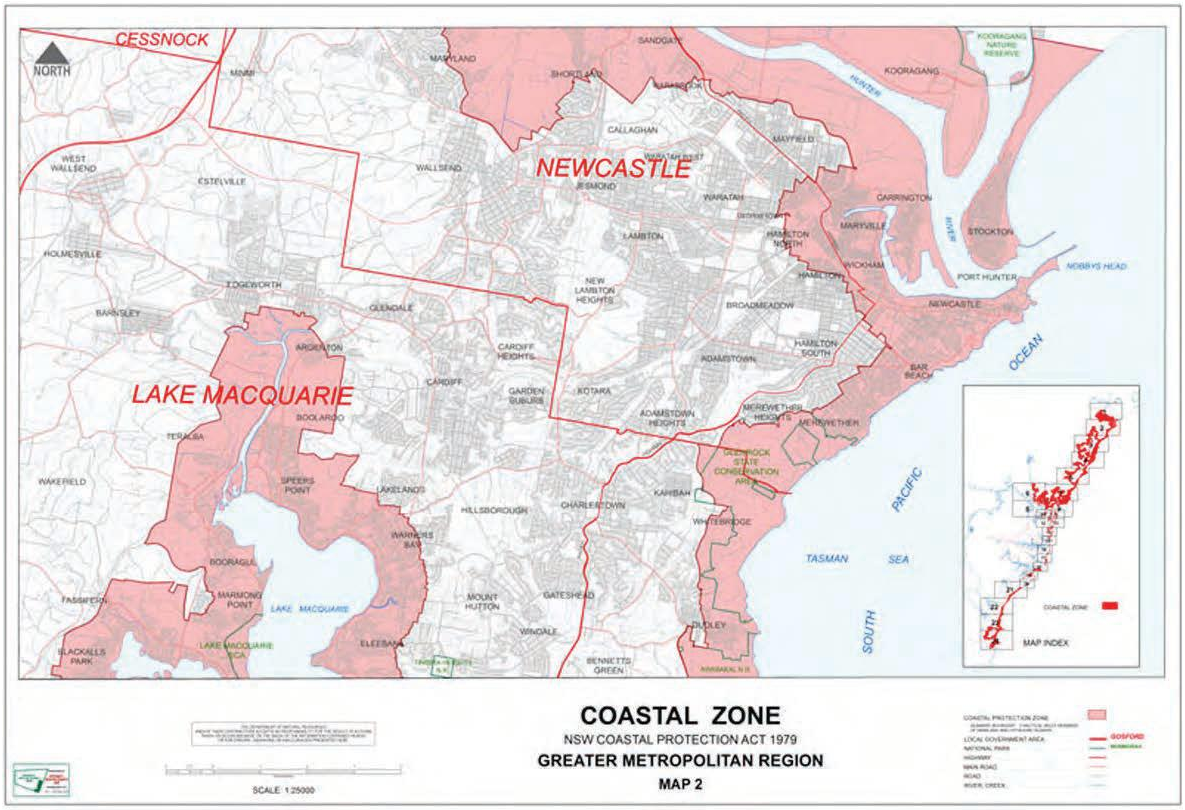
ACTIVITY 4.1

1 Explain why we need to define the coastal zone.
2 Analyse why planners largely rely on fixed distances from natural features, such as shorelines, to define the coastal zone.
3 Discuss why a boundary of a coastal zone may vary at any location based on the purpose.



Source 4.2 An example of the boundary of the coastal zone using the NSW Coastal Policy criteria

4.2 Coastal environments

The open coast

The open coast is the shoreline that faces the sea or ocean. The open coast is often subjected to high-energy conditions from waves and currents. Surfing beaches are a good example of a high-energy open coast. Some open coasts are protected from waves by coral reefs and offshore islands that dissipate wave energy. The shoreline can comprise cliffs and beaches consisting of boulders, sand, pebbles or coral materials. The aquatic flora and fauna of the open coast are adapted to live in seawater which is more saline than estuarine waters. Terrestrial flora and fauna are adapted to survive the effects of wind, salt spray and **storm surge**.

storm surge local and temporary rise in sea level that is primarily caused by a low-pressure system

Estuaries

An estuary is a semi-enclosed bay where seawater, which enters the bay through tides and currents, mixes with fresh water from the catchment. More than 70% of the world's marine fish species spend part of their life in estuaries. Australia has over 1000 water bodies classified as an estuary. Estuaries are an important component of the coastal zone because they provide:

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Source 4.3 A sandy shoreline with rocky headlands at Coogee, New South Wales (left) and cliff shoreline in Gozo, Malta (right)

- sheltered habitats and low-energy environments for seagrass meadows, mangroves and salt marshes
- nursery and spawning grounds for fish and other organisms
- recreational opportunities for humans; e.g. fishing, swimming and boating
- safe anchorage for ships and calm waters for port facilities
- a **fishery** for commercial supply of seafood.

In contrast to the open coast, estuaries are low-energy environments; they are largely protected from high wave-energy conditions normally experienced on the open coastline. Estuaries vary in depth, water quality and landforms depending on their basin shape, the width of their entrance, which controls tidal flows and currents entering the estuary, and the size of their catchment. Catchment size can determine the level of riverine influence mainly by the volume of fresh water and sediment that enters the estuary. Deep estuaries experience greater marine influence than shallow estuaries with narrow entrances. Sydney Harbour, for example, is a deep estuary, and experiences a wide tidal range. Consequently, it has water salinity that is close to that of seawater.

fishery a place where fish are harvested for commercial purposes

Geographical fact

Many estuaries were formed over the last 10 000 years following a period of rising sea level. Before sea levels rose, the open coast and estuaries were located kilometres seaward of their present-day location.

4.3 Coastal plains

Coastal plains are broad, flat areas adjacent to the sea and estuaries, often with ground elevation only a few metres above mean sea level. Many coastal plains are overlain by **alluvial** sediments deposited by floods and are, therefore, known as coastal floodplains. Under natural conditions, coastal plains may contain lagoons, swamps and other wetlands. Coastal plains are developed for urbanisation, agriculture and light and heavy industry because their flat landscape is well suited for building.

alluvial sediment deposited by flowing water, as in a riverbed, flood plain or delta

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Freshwater wetlands and lakes

Freshwater wetlands can occur in the **swales** of dunes and in depressions or **meander** cutoffs in coastal plains. They may also occur as swamps along the margins of estuaries if a sand barrier prevents tidal water from entering shallow depressions. Freshwater wetlands and lakes develop in the coastal zone when contact with tidal water ceases or is **ephemeral**. They provide an environment for freshwater aquatic flora and fauna. In swales, the presence of indurated sands, also known as coffee rock, can create an **impervious** barrier that prevents infiltration of water. Indurated sands form when organic material and iron in the sediments cement sand grains together creating a hard, rock-like structure. Compacted organic matter can also reduce infiltration. Fresh water becomes perched on top of the indurated sand or compacted organic layers creating a permanent or semi-permanent freshwater wetland or lake. A window lake may develop when a natural depression in the landscape exposes a fresh groundwater table. Barrage lakes can form in sandy environments when moving sands create a natural dam across a freshwater stream or river and prevent tidal waters from entering depressions in the landscape.

swale a low tract of land in between sand dunes or ridges, that may be moist or marshy

meander a winding curve or bend of a river

ephemeral lasting for a very short time

impervious incapable of being penetrated

The freshwater lakes of Fraser Island in Queensland are a good example of lakes that form in sandy environments surrounded by the sea. There are over 100 freshwater lakes on Fraser Island, many of which are vulnerable to human impacts because they cannot assimilate pollution. Aquatic organisms in these lakes are also at risk from introduced fish, aquatic weeds and cane toads. Introduced species can outcompete the native species and also modify food resources and habitat. Any species lost as a result of human actions may not recover because most lakes are not connected to waterways that would normally allow repopulation.

Freshwater lakes can also form on coastal plains when a meander loop of a coastal river is cut off from the main river flow. These lakes are called oxbow lakes, or billabongs in Australia. These lakes also occur outside of the coastal zone. In the coastal zone, they can persist as freshwater lakes because tidal flows do not enter the water body enabling freshwater conditions to persist. Flood events replenish fresh water in these lakes and also enable freshwater fauna, such as fish, to enter and exit the lakes in order to complete their life cycle.

Saltmarshes

Saltmarshes occur in estuarine areas that are protected from wave energy and strong currents. Saltmarshes develop in the upper areas of the inter-tidal zone on sandy or muddy **substrates**. They are occasionally inundated by tides, but for lesser periods than mangroves. Salt-tolerant, terrestrial grasses, herbs and small shrubs dominate saltmarshes. Although they are salt tolerant, these plants do not tolerate prolonged or continuous submergence by seawater. Saltmarshes were once considered a wasteland and were destroyed through land reclamation or degraded by rubbish dumping and trampling by vehicles and pedestrians. Saltmarshes are found throughout the temperate and high latitude shorelines of the world. Saltmarshes differ from adjacent terrestrial environments because of their exposure to tides. Tides deliver nutrients, sediment and water to the saltmarsh environment.

saltmarsh a coastal wetland that is flooded and drained by salt water brought in by the tides

substrates surface or material on or from which an organism lives, grows, or obtains its nourishment

Saltmarshes can be divided into lower and upper marsh zones that are determined by the response of plants to the level of tidal inundation. The lower marsh, close to the shoreline, is a more saline environment because of the more frequent inundation by tidal waters. Plants in this zone have a high tolerance to salt and waterlogged conditions. By contrast, the upper marsh is less saline because it is submerged by irregular spring high tides. Plants in this zone are less tolerant of continuously high soil salinity and prolonged submergence but more tolerant of low nutrient conditions. Salt-tolerant shrubs may inhabit the upper marsh area and provide habitat for terrestrial fauna. Saltmarshes help to trap and stabilise sediments and, therefore, contribute to the evolution of coastal landscapes.

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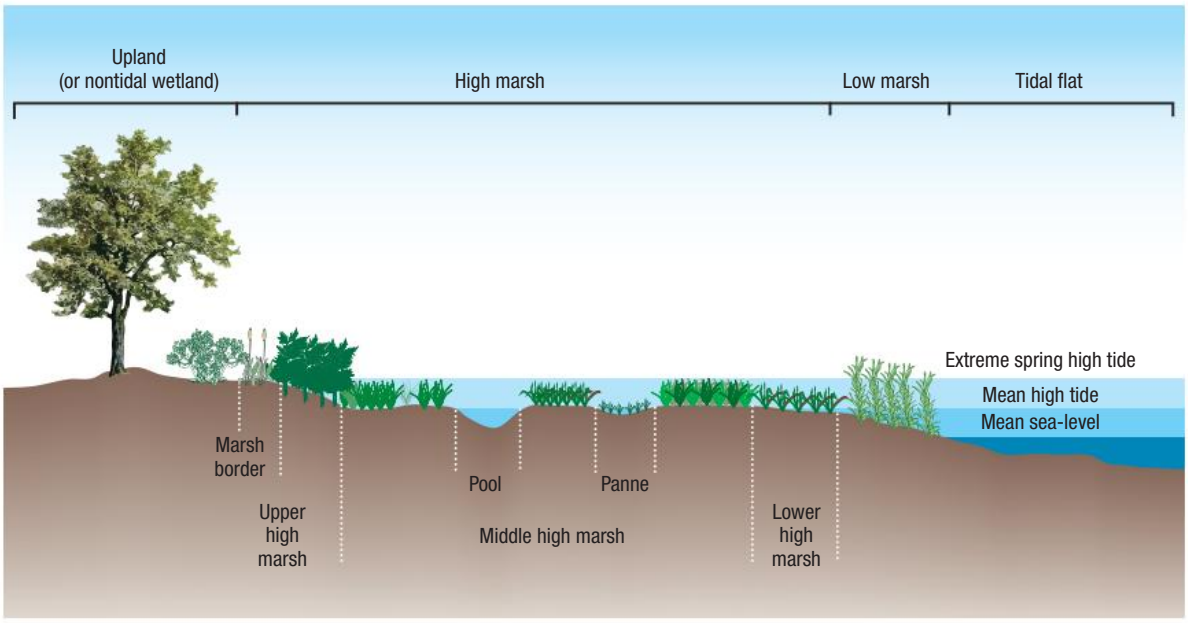
Their productivity is close to that of tropical rainforests but they are vulnerable to the effects of excessive nutrients from agriculture and urban areas. An excess of nitrogen, often sourced from fertiliser use and sewage disposal, can change the vegetation communities in saltmarshes. Saltmarshes have also been severely damaged as a result of mosquito control measures, such as the construction of canals to drain saltmarshes and reduce standing water where mosquitoes breed. Weed invasion is also a common problem. Sources of weed invasion include waterborne and airborne seed dispersal, nearby domestic sources such as parklands and gardens, and the dumping of plant materials.

ACTIVITY 4.2

1 Explain where in an estuary saltmarshes are most likely to occur.
2 Discuss which factors enable freshwater lakes and wetlands to exist in environments that are in proximity to seawater.
3 List three reasons why estuaries are important for aquatic organisms.



Source 4.4 Saltmarsh cross-section showing the relationship between the marsh zones and tides

RESEARCH 4.1

CHESAPEAKE BAY, USA

Conduct a literature or internet search on Chesapeake Bay and investigate its estuary resources, human activities and environmental impacts.

1 Discuss the main environmental resources of Chesapeake Bay.
2 Analyse how humans have affected the ecosystems of Chesapeake Bay.
3 List two strategies used to manage human impacts in the bay.

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Mangroves

Mangroves are shrub-like trees that are able to grow in saline soils in coastal areas. Mangroves cover approximately 137 700 km² of the world's coastal area. The term 'mangrove' is often used to describe the individual trees or a habitat dominated by mangroves. Habitats dominated by mangroves are also called mangrove swamps because of the waterlogged environment in which they occur.

Most mangroves are found in tropical and sub-tropical environments, but in Australia mangroves are found as far south as the temperate Victorian coastline. There are no mangroves in Tasmania. Although they are predominantly found in the low-energy areas, they can also occur along the open coast provided they are not subjected to high-energy conditions. Australia has approximately 11 600 km² of mangroves, about 8% of the world's mangrove area.

Mangroves are considered environmental assets for humans and important for ecosystem functioning in the coastal zone. The benefits of mangroves include:

- Habitat for many aquatic and terrestrial species: they provide habitat structure, food resources and shelter.

Source 4.5 Young mangrove plantation in Satun, Thailand

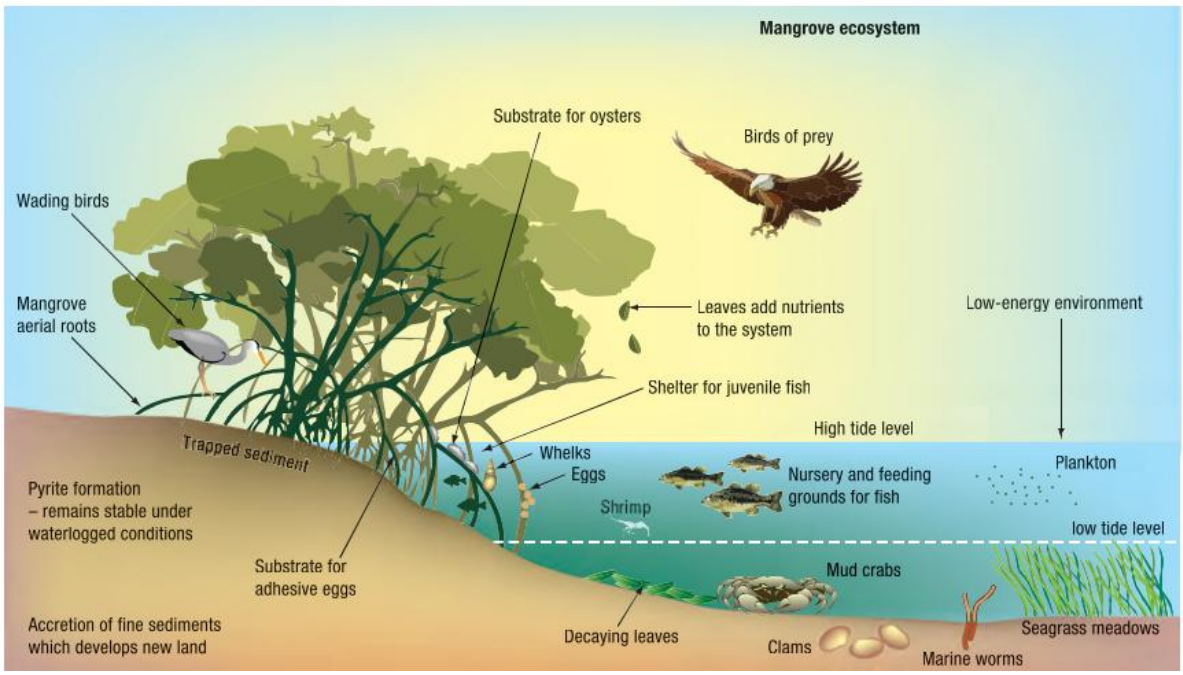
- Sediment trapping capacity: over time new land is formed. Other vegetation communities, such as **littoral forests**, can replace mangroves and create a new ecosystem.
- Protection of the coastline and inland environments: mangroves dissipate the energy of waves from boats and storm surge. They may also reduce the effects of tsunamis.

littoral forests occur within the influence of the sea, or a large coastal water body such as a lake or estuary

aquaculture the cultivation of aquatic animals or plants in a natural or controlled environment

Mangroves are threatened by many human activities such as **aquaculture**, charcoal production, mosquito control, use of mangroves for timber, rubbish dumping and pollution. Flood mitigation works, such as the construction of canals and installation of floodgates, can convert brackish

Source 4.6 Mangrove ecosystems provide food and habitat for a variety of aquatic and terrestrial organisms.



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water areas into fresh water, thereby creating conditions that are not suitable for mangroves. In the 1960s and 1970s, governments around the world promoted and funded the conversion of tidal streams into flood mitigation and irrigation canals leading to extensive degradation of mangroves.

The reclamation of mangroves for dry land activities is one the most destructive human activities in estuaries because it permanently converts mangroves to urban, agricultural and industrial land uses. The pollution of mangrove sediments can lead to **bioaccumulation** of toxins in the food chain. Bioaccumulation of toxins is a major concern for humans because it has been linked to cancers and birth defects. Loss of habitat and food resources may impact marine species that depend on mangroves for spawning and nursery grounds.

bioaccumulation the accumulation of a substance, such as a toxic chemical, in the tissues of different organisms in a food chain

The construction of canal estates on mangrove swamps, saltmarshes and along tidal creeks is now banned in many Australian states and other countries. Canal estates involve the stripping of mangroves and coastal vegetation and the construction of concrete banks to form artificial water bodies. The canals provide anchorage for boats and waterfront access to urban areas.

The destruction of mangroves affects human activities in various ways:

- increase in mosquitoes due to reduced numbers of fish that prey on mosquito larvae
- corrosion of infrastructure and building caused by acid sulfate soils and exposure to salt
- land subsidence because of changes in soil moisture and the use of landfill
- iron staining of boats and submerged infrastructure; iron leaches from acid sulfate soils and contaminates canal waters
- decline in oyster farm productivity due to poor water quality associated with urban run-off and acid and toxic metals from drained acid sulfate soils
- reduced recreational and commercial fishery catches.

Source 4.7 Land reclamation, vegetation clearing, canal construction and housing cause irreversible changes to coastal environments such as mangroves and saltmarshes.

Geographical fact

More than 17% of Australia's mangroves have been destroyed. Almost 40% of the world's mangroves were cleared over several decades in the late 20th century.

Seagrass meadows

Seagrasses depend on sunlight for **photosynthesis** and a stable substrate to anchor their roots and extract nutrients. Seagrasses are not true grasses; they gained their name because many species resemble terrestrial grasses. Seagrasses are flowering plants that complete their life cycle underwater. They can survive fully submerged in seawater because of their capacity to control the amount of salt and water they absorb through a process called **osmoregulation**. Seagrasses are an important source of food for aquatic animals and they create habitat for bottom-feeding fish and crustaceans. Because seagrasses depend on sunlight for photosynthesis, they occur in shallow waters typically found in estuaries. They thrive in low-energy environments. The ecosystem functions of seagrasses include:

seagrasses flowering plants that can live under water

photosynthesis a process by which a plant produces its food using energy from sunlight, carbon dioxide from the air, and water from the soil

osmoregulation a process of regulating water potential in order to keep fluid and electrolyte balance within a cell or organism

- absorption of dissolved nutrients and conversion of the nutrients into leaf material that is used by grazers

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- oxygenation of the water column which is important for gilled organisms
- dissipation of wave energy which reduces erosion
- storage of carbon; over 15% of the world's carbon is stored in seagrass meadows
- physical habitat for small fauna
- spawning and nursery grounds for fish and crustaceans.

Seagrasses are under threat from global warming and are often damaged by boat anchors, jet skies, boat propellers and changes in the wave regimes. **Dredging** is responsible for the extensive loss of seagrasses because it directly removes seagrasses and creates water that is too deep to enable seagrasses to re-establish. High water turbidities, due to forest clearing in the upper catchment and increased run-off, can also limit the depth that light can penetrate, and thus inhibit the growth of seagrasses.

dredging the use of various machines equipped with scooping or suction devices, used to deepen harbours and waterways and in underwater mining

ACTIVITY 4.3

1 List three benefits of mangroves.
2 Discuss in which part of an estuary you can find seagrass meadows.
3 Articulate which factors enable freshwater lakes and wetlands to exist adjacent to marine environments.
4 Identify one ecosystem service of seagrass meadows.

4.4 Coastal dunes

Wind, waves and currents readily transport sand in the coastal zone. Coastal sands originate from weathered and eroded rocks in catchments, which are delivered to the marine environment by rivers and then reworked by marine processes. Sands can be transported into the marine environment many kilometres from their original source. The process can take hundreds to thousands of years. For example, sand on Fraser Island in Queensland has been sourced to catchments on the mid and north coats of New South Wales. The sand was transported by currents along the coast and then deposited onto Fraser Island, first by wave action on the shoreline and then by wind into the inland areas. Many sand dunes along the coasts of the world were formed due to onshore winds entraining sand washed up on beaches by waves. Periodic, strong onshore winds entrain sands and deposit them further inland where vegetation can trap and stabilise the sand. This process of trapping, accumulating and stabilising sand is commonly known as 'dune building'.

Coastal sand dunes occur immediately behind a beach system. Dunes can be divided into zones:

1 *Incipient foredune* – this is an embryonic dune that forms at the back of the beach due to primary plant species that stabilise sand. Incipient foredunes do not necessarily develop into an established foredune because they are vulnerable to the effects of strong wind and storm surge. Primary plants are tolerant of salt spray and low nutrient conditions. They include grasses and small leafy plants.

RESEARCH 4.2

THE SUNDARBANS

Use the internet and other information sources to investigate the Sundarbans.

1 Investigate which countries share the resources of the Sundarbans.
2 Explain why the Sundarbans' mangroves are so extensive.
3 Discuss which activities threaten the environmental integrity of the Sundarbans.
4 List the ecosystem regions of the Sundarbans.

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Source 4.8 Primary vegetation on a foredune (left) and an eroded foredune at Curonian Spit and Curonian Lagoon, Nagliai (right). Primary vegetation plays an important role in re-establishing an eroded foredune.

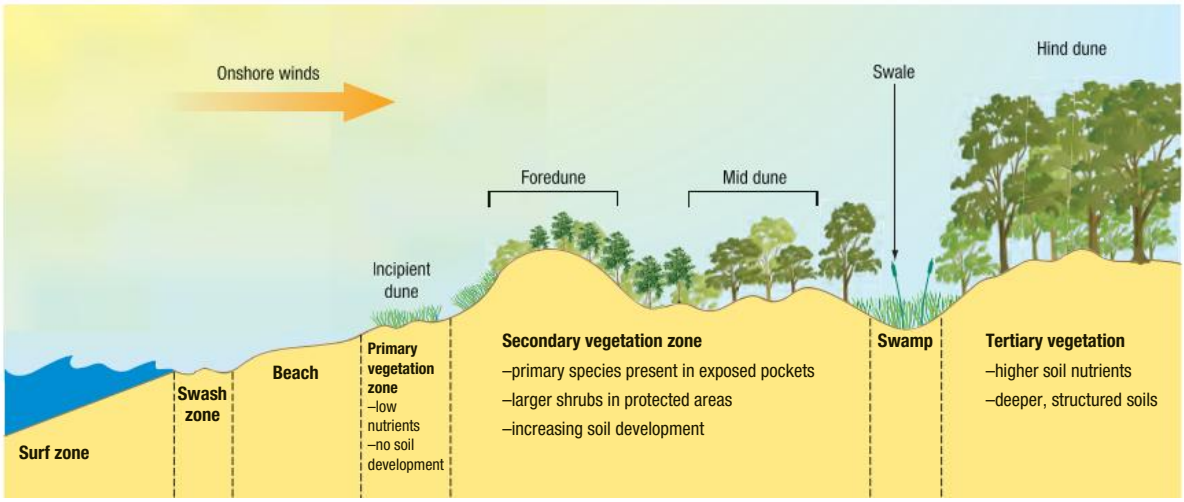
2 *Foredune* – foredunes develop when sufficient sand accumulates on the incipient foredune to create a larger dune that is stabilised by secondary plant species. Secondary plant species grow taller on the landward side of the dune where there is more protection from wind. Secondary species enable the dune to **accrete** sand and increase dune height. Their leaves provide a source of nutrients for the foredune soil. Primary species are still present on the foredune, usually at the seaward toe of the foredune.

accrete to make larger or greater, as by increased growth

3 *Mid dune* – the mid dune is a transitional environment between the foredune and hind dune. Mid dunes contain larger secondary species, often of the same species found on foredunes. Because the foredune protects them, shrubs grow larger. Primary plant species occur in smaller numbers, and usually on exposed areas that have not been stabilised by secondary species.

4 *Hind dune* – this zone is well protected from wind and salt spray. Hind dunes may occur immediately behind large, established foredunes where there is sufficient protection from wind and salt spray. Hind dune soils are well developed and have sufficient depth and nutrient levels to support large trees. The hind dune is the oldest and most stable dune environment. Many hind dunes have been converted to car parks and urban areas.

Dunes are vulnerable to the effects of regular fires, 4WD activity, pedestrian traffic and weed invasion. In eastern Australia large tracts of dunes have been infested with noxious weeds such as Boneseed and Bitou bush, which were introduced from South Africa in the early 1900s. These two species out-compete native vegetation and can completely invade a dune system. They reduce the biodiversity and habitat value of dunes.



Source 4.9 Cross-section of a typical coastal dune system. Vegetation is a major determinant of dune-building processes and the development of different zones in the dune sequence.

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Case study 4.1

Acid sulfate soils in Australia

How do acid sulfate soils form?

Most coastal sediments in low-lying areas are, or once were, influenced by tides. The breakdown of organic material, and regular inundation of accreted sediments by saline water, creates waterlogged conditions deficient in oxygen. Bacteria, adapted to this environment, convert iron from the sediments and sulfate from seawater into a mineral called pyrite. The bacteria utilise the decomposing organic material for energy. You can only see the pyrite crystals under a powerful microscope.

Waterlogged conditions maintain pyrite in a stable state. Pyrite continues to form in present-day coastal sediments and is found close to the surface in mangroves and saltmarshes, but can be buried by alluvial sediments in coastal plains. Coastal sediments that contain pyrite are called potential acid sulfate soils or pyritic sediments.

Under natural conditions, pyrite remains stable in the absence of oxygen. When oxygen enters the soil, pyrite oxidises and releases sulfuric acid. This often happens when humans drain the soil for dry land activities such as agriculture, urbanisation or industry. The strong acidic conditions dissolve iron, aluminium and other metals present in the soil. Ground and surface waters that are in contact with the acidic soil can also become acidic. Aluminium is particularly toxic when it is dissolved and can pollute coastal water bodies. Pyrite may also be exposed to oxygen when waterlogged sediments are dredged for land reclamation or the construction of **canal estates** and aquaculture ponds.

canal estate any development that requires a constructed waterway, canal or water body that is then inundated by or drains to a natural water body

Once the sediments become acidic they are called actual acid sulfate soils. The acidity of the soil and water is represented by pH. The lower the pH, the higher the acidity. Under natural conditions, coastal sediments containing pyrite have a neutral or slightly alkaline pH. (Between pH 7 and pH 7.5 is common.) When sulfuric acid is released through the oxidation of pyrite, the pH can fall rapidly (i.e. acidity levels increase). Soil pH can fall to less than 2 but is generally around pH 3.

What is the extent of acid sulfate soil?

Acid sulfate soils are found throughout the coastal areas of the world where mangroves, saltmarshes and other low-energy environments are frequently inundated by saline water. Australia has approximately 80 000 km^2 of acid sulfate soils.

Source 4.10 Fish kill (left) and an acidic plume (blue water) discharged from a drained swamp on the Richmond River, NSW. The acidic plume is 4.5 km in length.

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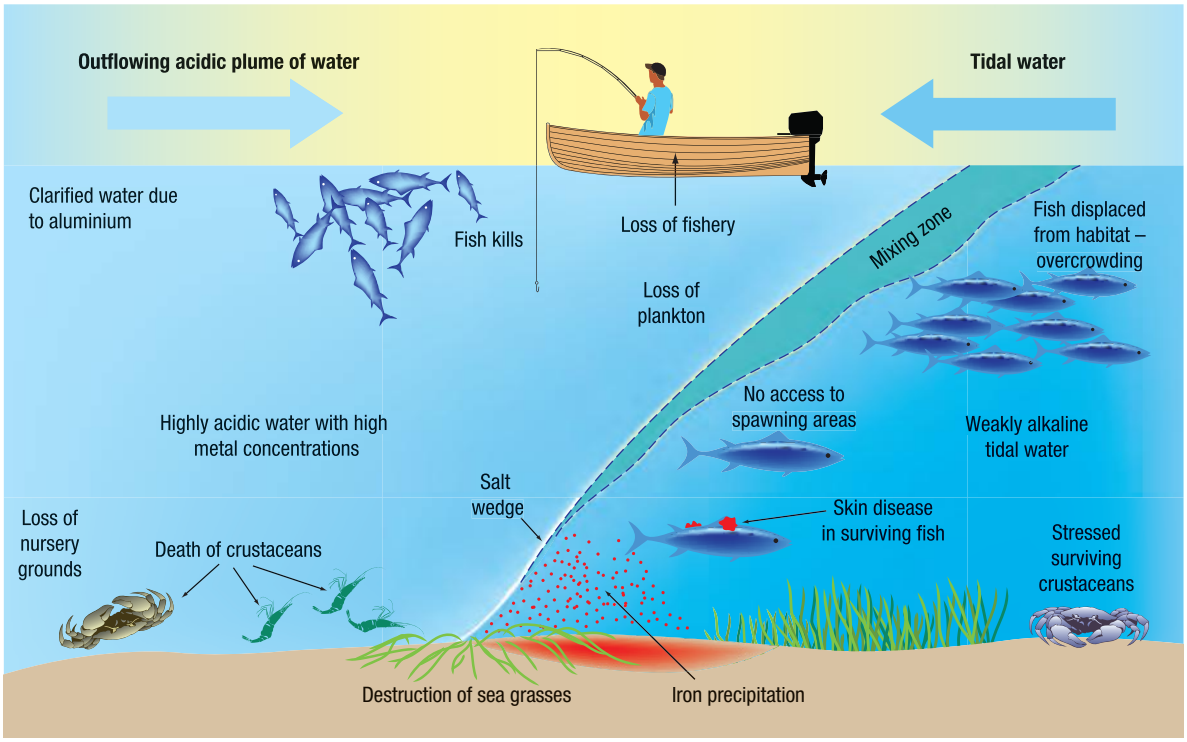

Source 4.11 Acidic water, originating from floodgates draining acid sulfate soils, causes significant environmental impacts in downstream reaches.

Why are acid sulfate soils harmful to coastal environments?

The acid and metals produced by acid sulfate soils cause on- and off-site impacts. The immediate soil and groundwater environment become extremely toxic. Heavy rain can flush the acid and metals many kilometres downstream causing off-site impacts. The plumes of acid water are often green or blue because of the aluminium. Aluminium also causes clay particles to drop out of suspension; this makes the water unusually clear.

The acid in the soil and water is directly toxic to flora and fauna. Iron reduces the availability of phosphate, an important nutrient for plankton and plants, and can precipitate and smother habitat when it enters saline water. Acidic water that enters streams and estuaries can cause fish kills by damaging the gills and skin of fish. Oysters stop feeding in acidic water, and after prolonged exposure their shells break down and the oysters die. Saltmarshes, mangroves and seagrasses can be killed by direct, prolonged contact with acid and dissolved metals. Acidic water and aluminium can also trigger ulcerative diseases in fish. Frequent or prolonged discharges of acidic water from floodgates can degrade habitat and destroy food resources. Important spawning grounds and nursery areas can be destroyed by the toxic conditions.

Socio-economic impacts of acid sulfate soils

Commercial fishers in Australia have reported annual losses of up to $23 million because of acid sulfate soils. Diseased fish caught in nets are discarded, and regular fish kills are thought to reduce catches. The tourism and oyster industries have reported significant economic losses; many oyster farms have been abandoned due to acidic waters. Coastal councils have spent millions

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of dollars repairing damaged infrastructure. A major fish kill on the Tweed River in 1987 raised awareness of the severe environmental and economic impacts caused by acid sulfate soils. Over 23 km of the river became acidic and a massive fish kill followed. The sight of thousands of dead fish alarmed many stakeholders and gained national media coverage. Land drainage, flood mitigation works and farming were blamed for the extensive acidification of the river. Commercial fishers, conservationists and farmers conducted fiery media debates in New South Wales and Queensland during the early to late 1990s. The issue became political and divided stakeholders over who was responsible and who should pay for the economic losses and efforts to remediate the problem. The environmental problem developed into a major environmental and social issue as a result of activism by affected stakeholders.

How are they being managed?

Although acid sulfate soils were discovered in the Netherlands over 270 years ago, they have only been widely recognised as a problem in Australia and other nations in the last 30 years. Many of the impacts of acid sulfate soils in Australia were erroneously blamed on other factors for over a century. The Tweed River fish kill, and the resulting social conflicts and public debates, was a turning point for acid sulfate soil research and management. Scientists implemented research projects to understand where acid sulfate soils occurred, how they degraded the environment and how they could be effectively managed. Scientists, landowners and government agencies formed committees and working groups to collectively resolve the problem. Attempts to manage acid sulfate soils have had mixed results because of the high cost of the approaches and the wide distribution of affected coastal environments. Some of the common approaches include:

- increased liming of agricultural soil to neutralise acid
- use of acid-resistant concrete and cement, and plastic coated pipes
- removal of floodgates to enable brackish water to neutralise acid in flood mitigation canals
- redesign of flood mitigation canals to prevent artificially lowering water tables
- policies and guidelines for development to minimise disturbance of acid sulfate soils or to ensure that developments implement appropriate management plans
- zoning of land to prevent or control development. Acid sulfate soil maps underpin zoning decisions in New South Wales and Queensland
- educating developers and decision-makers about the risks of disturbing acid sulfate soils
- formation of scientific and management communities to develop strategies to manage acid sulfate soils
- creation of granting schemes to support universities, government agencies and community groups to develop and implement remediation strategies
- conversion of agricultural land back to wetlands that can be inundated by saline or fresh water.

Australia has become a leader in the management of acid sulfate soils. Although social conflicts are considered undesirable, activism, led by fishers, oyster farmers and conservationists, led to government action. Many farmers who were once blamed for the problem have also worked with governments and affected stakeholders to find and fund solutions.

1 Discuss the role of bacteria in the formation of pyrite.

2 List three coastal environments that contain acid sulfate soils.

3 Analyse human activities which cause pyrite to oxidise and acidify the soil.

4 Investigate the identity of the stakeholders affected by acid sulfate soil-related impacts.

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4.5 Coastal resource management

Since the 1970s, there has been a large focus on managing the coastal zone to reduce impacts, sustain its valuable resources and protect ecosystems from irreversible damage. Coastal management is fundamentally tied to the principles of sustainable development. Coastal managers face the challenge of addressing social conflicts between multiple stakeholders, meeting social and economic needs and conserving coastal resources.

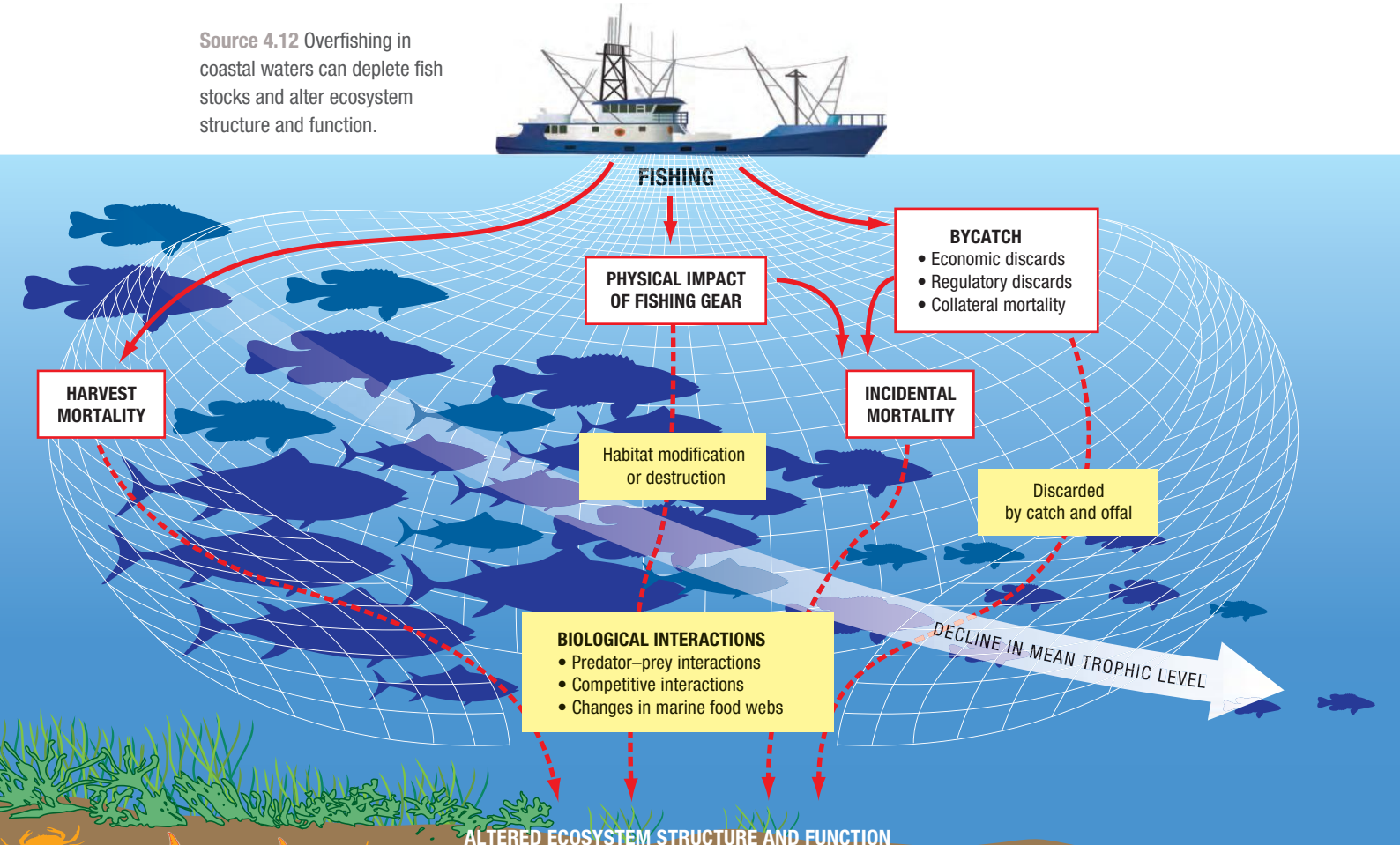
Human use of coastal resources and their threats

The following human uses of coastal resources are common throughout the world. These activities are considered important for economic prosperity, but if not properly managed, they interfere with environmental processes in the coastal zone and can cause irreversible damage or complete loss of resources:

- *Commercial fishing* – commercial fishing involves a range of practices. **Artisan** fishers use low-intensity methods such as handheld nets, spears and fishing rods. Their level of impact is considered negligible. By contrast, commercial-scale fishers use high-intensity fishing techniques such as large set or trawled nets, long lines with multiple hooks and large arrays of fish traps. Over-exploitation of fish stocks has been associated with an increase in the size of trawlers and the improved efficiency of fishing technologies. **Trawling** also destroys fish that are not targeted for human consumption; juvenile fish are also caught in nets and often crushed to death. These unwanted fish are known as by-catch or 'trash fish' because they have no or limited commercial value. Overfishing has caused declines in wild fish stocks, changes in food webs, ecosystem shifts and degradation of coastal habitats.

artisan a skilled manual worker; using low technology

trawling a method of fishing that involves pulling a fishing net through the water behind one or more boats



Source 4.12 Overfishing in coastal waters can deplete fish stocks and alter ecosystem structure and function.

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- *Sand and heavy mineral mining* – heavy minerals, such as rutile, zirconium and titanium, along with sand, accumulate in dunes and beaches. **Extraction** involves stripping away vegetation and removal of topsoil in dunes, in order to mine the sands. Sand mining is a controversial extractive industry because it competes with recreational uses and conservation of beaches and dunes. Sand mining has been associated with **coastal erosion**, loss of habitat and reduced biodiversity. It is now banned in many areas.

extraction involves stripping away vegetation and removing topsoil in dunes, in order to mine the sands

coastal erosion the gradual loss of material from a coast by the action of wind and waves

- *Shipping and ports* – shipping and port facilities often require dredging of shallow estuaries to enable large container ships to move through the water. Dredging results in higher wave energy, loss of seagrass meadows which depend on light to thrive, and changes in habitat that favour deep-water predator species. **Ballast waters** from ships have been linked to the introduction of invasive species.

ballast waters water that is pumped in and out of ballast tanks on board a vessel to increase the draft, change the trim, regulate the stability or to maintain stress loads

- *Urbanisation* – urban areas expand in proximity to major cities and ports to access services and employment and to utilise the recreational resources of the coast. Urbanisation places pressure on coastal zones through construction of housing and commercial buildings, road networks, pollution of waterways through stormwater run-off, and disposal of waste.
- *Sewage treatment* – there has been a long history of disposing of sewage into coastal waters. Before populations grew, the dumping of raw sewage was considered an acceptable practice because of a perception that coastal waters can assimilate organic materials. However, coastal populations have grown, and the level of treated and untreated sewage has led to pollution and **eutrophication** of coastal waters. Sewage disposal has been linked to the spread of human diseases and is a major threat to the oyster industry.

eutrophication an environmental response to high nutrient concentrations. Algal blooms and bacteria can deplete oxygen and degrade habitat

- *Light and heavy industry* – light and heavy industries are often located in coastal areas to access port facilities. Coastal areas also have a high consumer base for consumption of products produced by industry. Oil refineries are often constructed in the coastal zone in order to access a supply of imported oil and to transport fuel to coastal communities. Industrial activities are considered a coastal hazard because of the risk of chemical pollution of surface and ground waters.
- *Agriculture* – sugar cane farming, cropping and grazing commonly occur on coastal plains where alluvium provides nutrients. Agriculture is important for sustaining human populations but presents a threat to coastal environments because of fertilisers and chemicals that can be transported into nearby ecosystems. Land drainage, commonly practised in coastal plains with high water tables, may alter the hydrology of the landscape and affect saltmarshes and wetlands. Land drainage, described in the next section, also triggers soil acidification by exposing acid sulfate soils to oxygen (see Case study 4.1).
- *Land reclamation and drainage* – land reclamation involves creating new land from dredged coastal sediments. Common sources of sediments are estuaries, coastal rivers and also nearby marine areas. Examples of reclaimed lands include Port Botany in Sydney, Hong Kong International Airport and the Fens in England. About one-fifth of the Netherlands is reclaimed land. The deepening of estuaries, through dredging, can also increase wave height and wave patterns, which also increases erosion.

Dry land is also created by draining swamps and other wetlands. These environments are drained through the construction of canals and floodgates that channel run-off and groundwater into the estuary. Floodgates are installed at the end of the canal network to prevent tidal water from entering canals. Dry land created by artificial drainage is often used for grazing, sugar cane production, industry and also for housing areas. Reclaimed land is susceptible to subsidence and soil liquification caused by severe earthquakes. Drained land can also sink because of oxidation of peat soil, shrinking of clays and compaction from the overlying land use.

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Source 4.13 Abandoned shrimp farm constructed in acid sulfate soil in south-east Sulawesi, Indonesia

- *Land-based aquaculture* – fish and shrimp are often farmed in earthen ponds constructed in the coastal zone. Aquaculture depends on tidal waters to fill ponds and to export waste such as uneaten food and excrement from fish and shrimp. Chemicals, such as antibiotics, can also be discharged into nearby waterways. Fish and shrimp disease outbreaks can occur in aquaculture ponds and the **pathogens** can enter the natural environment and affect wild populations of fish and shrimp.

pathogen an agent that causes disease, especially a living microorganism, such as a bacterium or fungus

- *Recreation* – the coastal zone attracts activities such as swimming, boating and fishing. Boating can generate waves that erode the shoreline. Anchors can destroy seagrass meadows. Pedestrian access to beaches causes loss of dune vegetation as a result of trampling. Four-wheel driving is a popular coastal activity in sand dunes. If not properly managed, recreational activities can destroy dune vegetation and lead to erosion and reduced biodiversity.

ACTIVITY 4.4

1 Discuss the effects of dredging.
2 Evaluate the difference between land reclamation and land drainage.
3 Explain the ways in which agriculture can affect coastal waterways.

4.6 Coastal management strategies

Humans are faced with existing problems in the coastal zone caused by past poorly managed developments. Reactive approaches involve the design and implementation of strategies that address the existing problems. Some reactive strategies can be applied as preventative measures. For example, methods that rebuild dunes can be used to maintain relatively stable dunes that could be impacted by future storm events. Preventative measures are considered to be proactive. Environmental managers predict the effects of existing and future use, and consider natural and human-induced changes in coastal processes to develop strategies that protect coastal environments.

Controlling shoreline erosion

Shoreline erosion can involve hard and soft engineering techniques. These are used to reduce the erosive effects of waves and also trap and rebuild sediments along the shoreline. Examples of **hard engineering** techniques include:

hard engineering a controlled disruption of natural processes by using artificial structures such as concrete breakwalls

- construction of rock or wooden groynes perpendicular to the shoreline to trap sediments and prevent loss of sediments through longshore currents

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- construction of rock walls along shorelines at risk of erosion. Rock walls dissipate energy and prevent the loss of sediments, but they can also deflect energy onto other, unprotected shorelines.

Soft engineering techniques avoid the use of physical structures and depend more on ecological principles or changes in human activities. Examples of soft engineering techniques include:

- replanting mangroves along eroded shorelines
- nourishing beaches with imported sand
- relocating urban and industrial areas further inland and allowing the shoreline to naturally readjust to local processes
- restricting access to the shoreline to minimise further disturbance.

soft engineering the use of ecological principles and practices to reduce erosion and achieve the stabilisation and safety of shorelines, while enhancing the habitat, improving aesthetics and saving money by using vegetation and other materials

Source 4.14 Wooden groynes in the sea at Eastbourne, UK

Dune management

There are over 2000 Coastcare and Dunecare groups in Australia who work with government agencies and businesses to rehabilitate degraded coastal environment. Dune rehabilitation is a targeted activity of these groups. Dunecare and Coastcare groups undertake activities such as weeding dunes, installing fencing, revegetating bare dunes and improving the quality of coastal habitats. These volunteer groups are funded by various environmental granting schemes and by the support of businesses.

Already degraded dunes are often rehabilitated by:

- use of wind drift fences to trap and accrete sand
- planting primary species to recolonise exposed sand
- reshaping dunes with earth-moving equipment
- import of sand to replace eroded sand
- temporary surfaces that prevent erosion and enable plants to re-establish; these may involve the use of organic sprays that coat the surface sands.

Measures that prevent further dune degradation include:

- use of fences to restrict access to dunes
- use of wind drift fences to protect sensitive areas and create a more robust dune
- signs that educate and warn people about their effects
- use of boardwalks to prevent trampling of vegetation
- regular weed management to prevent invasion of dunes by exotic species.

Water quality management

Water quality management begins at the source of pollution. Water quality studies are regularly undertaken by managing authorities to test for the type and potential source of pollution. Most countries have developed licensing schemes to control the level and type of pollutants that can be discharged into waterways. Improving water circulation by temporarily opening estuary entrances is sometimes used to flush a buildup of nutrients and pollutants in intermittently closed estuaries.

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Zoning and planning controls

Land and water is now routinely zoned to control the types of human activities that can be undertaken. Areas that are vulnerable to human activities, or are considered to be historically or environmentally significant, can be zoned as conservation areas, reserves or national/marine parks. Fishing exclusion zones are declared, to minimise fishing pressure on stocks. Planning controls can be embedded into legislation or policies. Planning controls are intended to limit human activities so that the environment's carrying capacity is not exceeded and to ensure that there is fair access to resources for present and future generations.

Zoning and planning controls rely on scientific knowledge of processes and the potential for humans to modify processes. Maps are used to zone land and water according to its suitability for human activities. Site selection criteria for specific land and water uses facilitate decisions on where to undertake developments that won't harm coastal environments. In Australia, many coastal industries follow strict guidelines and site selection criteria when embarking on new developments. Environmental impact statements and other forms of environmental reporting are used by government agencies to guide decisions on approving developments in the coastal zone.

Integrated coastal zone management

Integrated coastal zone management (ICZM) an approach to coastal zone management that fosters inter-governmental cooperation, the involvement of other stakeholders, and recognition of the co-dependence of economic growth, social needs and protection of environmental assets

Integrated coastal zone management (ICZM) is an approach to coastal zone management that fosters inter-governmental cooperation, the involvement of other stakeholders, and a recognition of the codependence of economic growth, social needs and protection of environmental assets. Australia has adopted ICZM as a framework for coastal management in recognition of the national significance of protecting coastal resources. The main aim of ICZM in Australia is to 'restore or improve the quality of coastal zone ecosystems and the societies they support', according to the Natural Resource Management Ministerial Council, *National Cooperative Approach to Integrated Coastal Zone Management – Framework and Integration Plan,* 2006 (for the link, see www.cambridge.edu.au/geography10weblinks). The Framework for a National Cooperative Approach to ICZM was introduced in 2003 in an effort to facilitate coastal management at all levels of government and to include various **coastal stakeholders**. The main priority areas of the framework are:

coastal stakeholders individuals, organisations, community groups or government agencies that have an interest in, or are affected by, use of coastal resources

- integration across the catchment–coast–ocean continuum
- land and marine-based sources of pollution
- climate change
- pest plants and animals
- planning for population change
- capacity building.

ICZM utilises advisory groups and stakeholder inputs to develop management plans that can achieve sustainability goals. ICZM also employs adaptive management approaches because coastal environments are dynamic, human needs change and new issues emerge. Adaptive management enables managers and scientists to build an understanding of human impacts on the coastal environment and revise management strategies accordingly.

Geographical fact

Australia is the sixth-largest country. It is the only country in the top six that is completely surrounded by marine waters.

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RESEARCH 4.3

Use the internet to collect information on the 'Sea Change' phenomenon in Australia. Form groups of two to three students and discuss the following:

- Describe the Sea Change phenomenon.
- List the social and economic factors driving the Sea Change phenomenon in Australia.
- Discuss some of the negative and positive impacts of Sea Change on rural, coastal areas.
- Will the Sea Change phenomenon continue? Explain your answer.

NOTE THIS DOWN

Copy and complete the graphic organiser below to demonstrate your understanding of coastal environments, their ecosystem functions and the effects of human activities.

Ecosystem functions		
Coastal environment	**Ecosystem functions**	**Effects of human activities**
Mangroves are found in the tidal zone, particularly along the shoreline of estuaries	Mangroves are important because they: – provide habitat – trap and stabilise sand – protect the shoreline from erosion	Mangroves can be degraded by: – clearing – conversion to aquaculture ponds – pollution
Seagrass meadows		
Saltmarshes		
Coastal dunes		

Source 4.15 Hind dunes are often developed for housing, car parks and recreational areas.

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FIELDWORK 4.1 ASSESSING HUMAN THREATS TO COASTAL DUNES

Coastal dunes are often located within the vicinity of beaches and parklands used for recreation. The impacts of humans on dunes can be prevented or reduced through a variety of soil conservation measures that involve controlling access and the influence of nearby land use. You will identify reactive measures to rehabilitate dunes and preventative measures that minimise future impacts.

Aim

The aims of the fieldwork are to:

1. investigate human impacts on a dune system
2. describe the effectiveness of existing strategies for dune management
3. make recommendations to improve dune management.

Method

This activity involves using desktop skills such as map reading and interpreting satellite imagery. The field component requires observational and recording skills. The final output is a poster or information booklet and applies skills in written and visual communication.

Preparations

Locate a map and a satellite image of a dune system nominated by your teacher. A 1:25 000 topographic map of the area is also useful tool. Satellite imagery can be sourced from websites. Print the map and satellite image at the same scale. On either the map or the satellite image, label the following features using coloured pens and highlighters:

1. location of walking tracks and areas from which you can observe the dunes without damaging the dune vegetation. Label at least five stops, which may include the beach, foredune, mid dune and hind dune
2. the boundary of the foredune, mid dune and any hind dune. Use vegetation and any available topographic information to determine the boundaries
3. exposed bedrock, headlands, the beach and any other landforms
4. human features such car parks, fencing, boardwalks and parkland.

You can add more labels during the field trip.

Data collection

Stop no.	Location description	Vegetation type	Evidence of human impacts	Evidence of management
1	Foredune – approximately 0.5 m high and 3 m wide. Coarse sand with no topsoil.	Sparse cover of stunted shrubs.	Trampling of vegetation; litter.	Previous attempts to control pedestrian access with fences; signs noting that it is a revegetation area; sand drift fences to trap sand.

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5 Take photos of the vegetation and any evidence of human impacts and management strategies.

6 Describe the vegetation community in terms of the type of plants (e.g. grasses), their height and density (e.g. sparse). You may use common terms.

7 Describe evidence of human impacts. Evidence may include: trampled vegetation, the effects of fire, the presence of litter, garden plants and weeds, unmanaged tracks and vehicle tracks. Note the extent of the human activities. How have these activities affected the environment?

8 Create a cross-section of the dune system using distance and height. Sketch the dune shape and the form of the vegetation onto the cross-section. Label each zone (e.g. beach, foredune, mid dune and hind dune) and any key natural or human features (e.g. swales, wetland, car park, reserves).

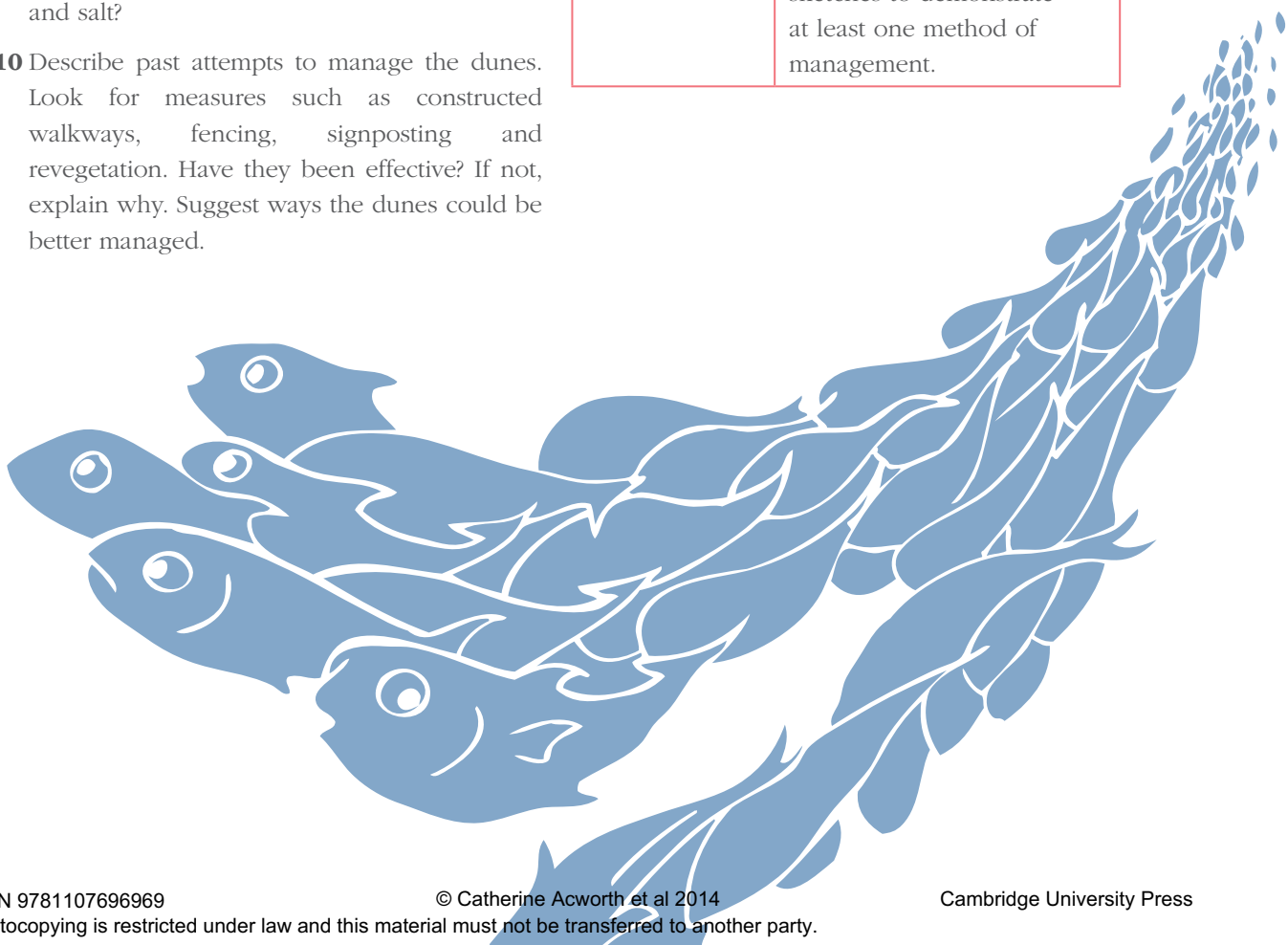
9 Observe the changes in vegetation from the foredune to the hind dune. What are the changes in height of the plants? What are the changes in the density of the vegetation? Is there any evidence of the effect of wind and salt?

10 Describe past attempts to manage the dunes. Look for measures such as constructed walkways, fencing, signposting and revegetation. Have they been effective? If not, explain why. Suggest ways the dunes could be better managed.

Poster layout

Create a poster or information booklet that summarises what you observed. Use the following suggested section titles and content.

Section heading	**Content**
Title	Brief descriptive title
Introduction	Provide a brief background and include a location map showing stops.
Dune features	Insert your transect into this section. Use brief text to describe the key features of the transect.
Human impacts	List the main human impacts. Use photos to illustrate the impacts.
Management strategies	List management strategies that would improve the dune system. Relate the strategies to key components of the dune system. Use photos or sketches to demonstrate at least one method of management.



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Chapter summary

- The coastal zone is defined as the area where terrestrial and marine processes interact.
- More than 3 billion people live in the coastal zone and depend on coastal environments for economic prosperity.
- The coastal zone is under threat from human activities. Impacts include the loss of habitat, coastal erosion, pollution of sediments and water, and loss of biodiversity.
- Mangroves, seagrass meadows, saltmarshes, freshwater wetlands and lakes, and dune systems provide habitat. They are economically and environmentally important components of the coastal zone.
- Estuaries are low-energy environments that contain many significant coastal ecosystems. They attract populations because of their abundant resources.
- Integrated coastal management brings stakeholders together to manage the coastal zone through a holistic approach.

End-of-chapter questions

Multiple choice

1 The coastal zone is:

A the coastal shoreline facing the sea

B the entire catchment from headwaters to the sea

C the area where terrestrial and marine processes interact

D the area submerged by seawater

2 Integrated coastal zone management is important because it:

A reduces impacts of human activities in the upper catchment area

B recognises all components of the coastal zone and brings together all stakeholders

C enables governments to collect more tax to fund management

D enables developers to indiscriminately modify the environment

3 Mangroves and saltmarshes are considered to be:

A marginal lands that should be drained and developed

B highly suitable for conversion to lakes and parklands

C significant ecosystems that enhance the quality of the natural environment

D a place for dumping household and industrial waste

4 Acid sulfate soils are a national coastal issue because they:

A are important for agriculture

B provide an ideal environment for urbanisation

C can be used for land reclamation

D release acid and toxic metals into the environment

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5 Hard engineering techniques involve:

- **A** using rock or wooden structures to protect or rebuild the shoreline
- **B** only using vegetation with hard trunks to protect the shoreline
- **C** dumping compost on the shoreline to stabilise sand
- **D** moving the population further inland

Short answer

1 Explain the differences between 'hard' and 'soft' engineering used to control coastal erosion. Give examples of each.

2 Describe one major coastal management issue in Australia and what is being done to tackle it.

3 Discuss the recreational, economic and environmental benefits of healthy mangroves.

4 Identify why biodiversity is important.

5 List the roles of the community, government and industry in coastal management.

Extended response

Discuss the challenges of applying integrated coastal zone management in Australia. Your answer should cover the following:

- a definition of integrated coastal zone management and its objectives
- current and emerging population pressure
- key human activities that impact the coastal zone
- addressing competing needs; these can be a mix of social, economic and environmental needs associated with sustainability goals
- collaboration between stakeholders.

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5 Marine environments

Source 5.1 Aerial view of the Tweed River Entrance Sand Bypassing Project

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Before you start

Main focus

Marine environments are essential to life on Earth. It is critical that we gain better understanding of the importance of marine environments and how humans affect them. In this chapter we will look at two case studies – one in Australia and one overseas – to see how people have responded to their marine environments. You will apply human-environment systems thinking to the causes of environmental change as required in the Geography Curriculum for Australia. You will also address major skills and concepts of the Geography Curriculum including environment, change, interconnections and sustainability as well as interpret maps, photographs and other geographic data.

Why it's relevant to us

About 70% of the Earth's surface is covered by water. Marine environments account for about 97% of that. In Australia, our marine environments extend from oceans near the Equator to the sub-Antarctic and are bigger than our landmass. We interact with marine environments in many ways – some positive and others detrimental. We need informed knowledge and skills on how best to work with this all-important resource.

Inquiry questions

- How do humans impact on marine environments?
- How can we better manage our marine environments to reduce environmental degradation and make them more sustainable?

Key terms

- Coastal system
- Environmental management
- King tide
- Longshore sand transport
- Low pressure system
- Marine environments
- Marine hazards
- Sediment
- Storm surge
- Waves

Let's begin

Ever wondered what a marine environment is? Is it shallow water, deep water, or both? A helpful definition comes from the US Department of Defense: marine environments are 'the oceans, seas, bays, estuaries, and other major water bodies, including their surface interface and interaction, with the atmosphere and with the land seaward of the mean high water mark'. Better understanding of marine environments gives us the ability to manage them more effectively.

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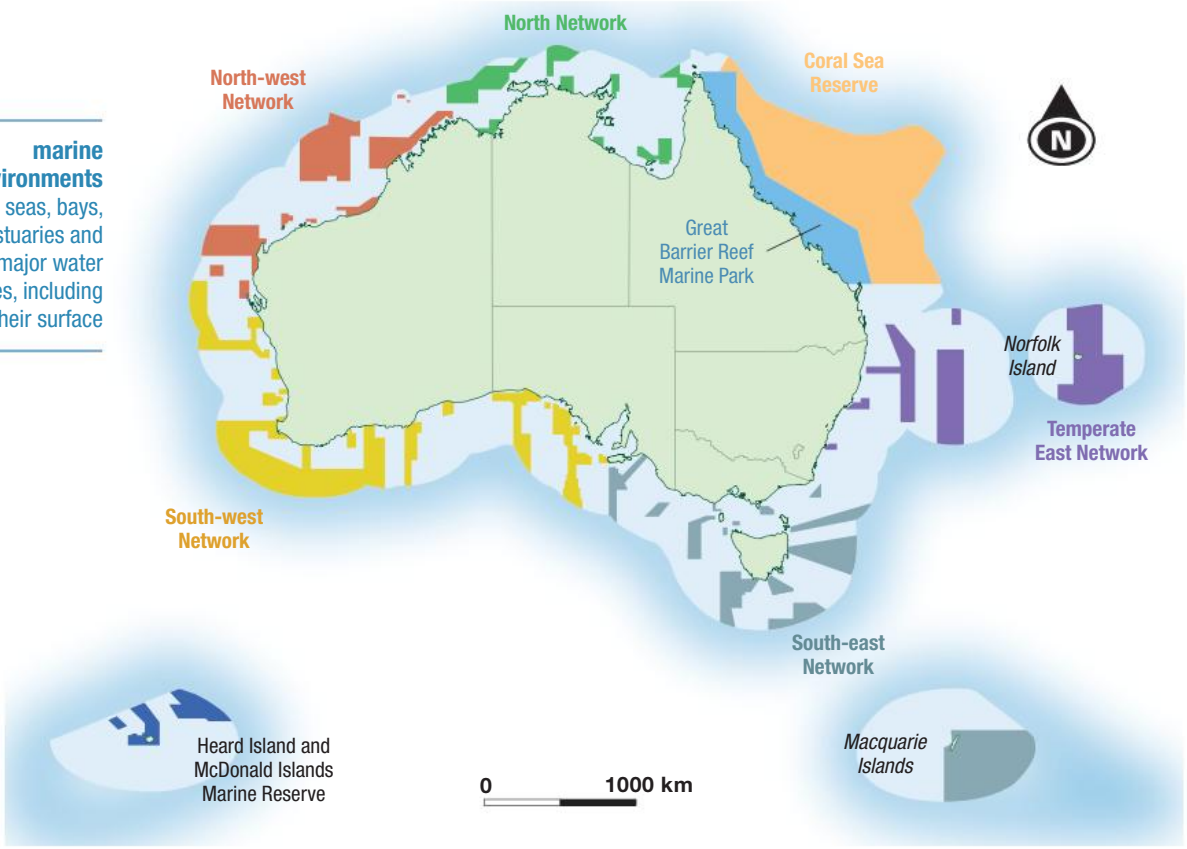
5.1 Australia's marine environments

Australia's **marine environments** are shown in the following map.

marine environments oceans, seas, bays, estuaries and other major water bodies, including their surface



Source 5.2 Australia's marine reserves

Geographical fact

Approximately 50% of the Earth's oxygen is produced in the oceans. Oceans take up around 70% of the Earth's surface.

ACTIVITY 5.1

1. Identify the six marine reserve areas in Australia from Source 5.2.
2. Analyse the definition of 'marine environments' and then write a definition in your own words.
3. List six ways in which you use marine environments.
4. Briefly describe one way in which people have a negative impact on marine environments. For example, coastal development or an oil spill.
5. Explain why an informed management of marine environments is so important.

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5.2 The Tweed River Entrance Sand Bypassing Project

A large part of the chapter is a study of the Tweed River Entrance Sand Bypassing Project, as well as an overseas example in the Caribbean. You will address various aspects of the year 10 geography curriculum for Australia, such as the use of geographical concepts and techniques applied to **environmental management** and engage in geographical inquiry and skills. Remember that the achievement standard for the end of year 10 includes the requirements that you understand human influences causing environmental change and the management strategies that may lead to a more sustainable future. You are to also design and conduct an inquiry; the content of this chapter and the suggested fieldwork will support you in demonstrating this.

environmental management an attempt to control human impact on and interaction with the environment in order to conserve the environment

The coastal system

To understand Tweed Sand Bypassing and why the project was necessary, it is important to have an understanding of coastal processes. The coastal zone can be viewed as an intricate system made up of different components that are all interconnected. The three main components of the **coastal system** are:

1. the underlying **geology** such as coastal headlands and near shore islands
2. the nature and abundance of the coastal **sediment**
3. the extent to which these controls are acted on by the waves and wind.

These components all interact to form what are known as coastal processes.

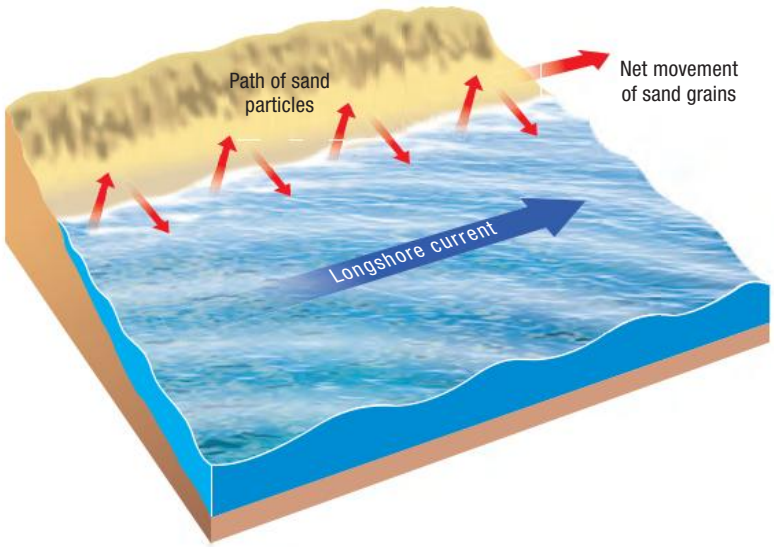
Coastal processes operate over a range of temporal (seconds, days, years, millennia) and **spatial scales** and are responsible for moving sand from one place to another, changing the shape of the beaches.

coastal system interconnected components which interact to form coastal processes

geology the study of the Earth: the materials of which it is made and their structure as well as the processes acting upon them. It also studies organisms of our planet and the study of how Earth's materials, structures, processes and organisms have changed over time

sediment material broken down by natural processes such as erosion which are transported by wind, water and other means

spatial scale the extent, size and location of something being studied. For example, the climate of a large area such as central Australia versus the microclimate of a small area such as a westward-facing slope



Source 5.3 Longshore sand transport along Letitia Spit, Northern New South Wales. Sand moves up the beach at an angle in the swash zone. Sand then moves down the beach under gravity. This process is repeated moving sand in a northerly direction.

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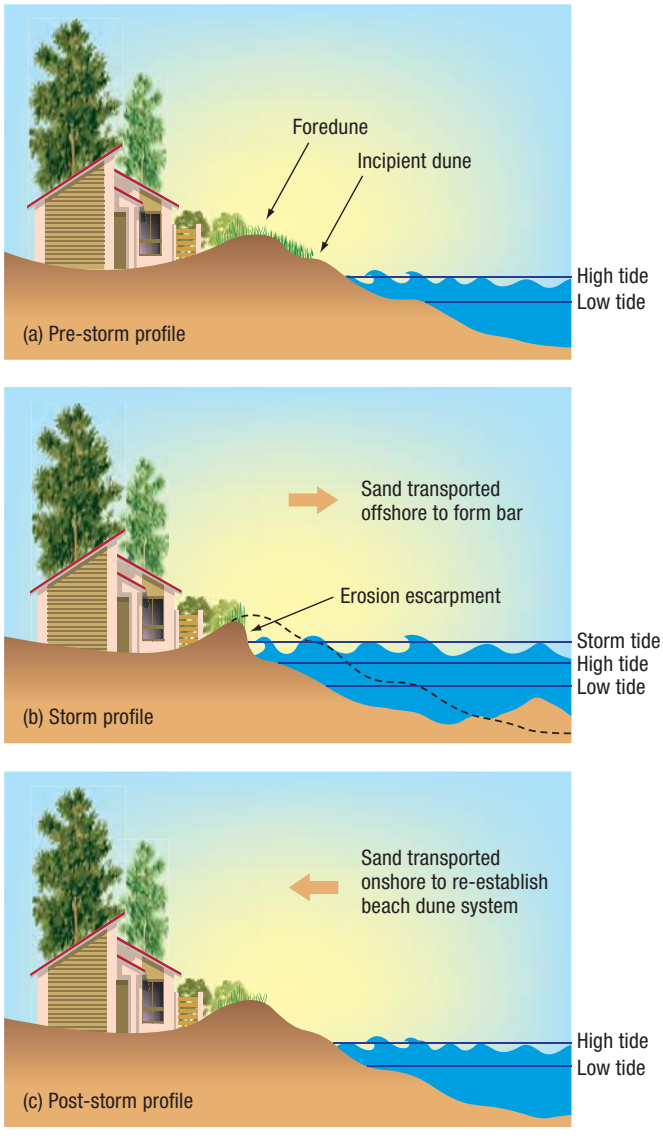
Longshore sand transport

Longshore sand transport is the process that moves sand parallel along a beach or coastline. On long open beaches such as the Tweed and Gold Coasts, this process moves sand predominantly from the south to north, pushed by the prevailing south-easterly waves.

longshore sand transport the process that moves sand parallel along a beach or coastline

swash zone the turbulent layer of water that is pushed up the beach face due to the energy of a breaking wave, and then runs back down the beach due to the effect of gravity

The crashing waves push the sand onto the beach; sand is then dragged offshore into the **swash zone**, before being pushed back onto the beach again. When the wave direction is from the north-east, sand is moved in the opposite direction, from north to south, but this is infrequent.



Cross shore sand transport

Cross shore sand transport is the process that moves sand perpendicular to the coastline. Cross shore sand transport is the dominant process in smaller pocket beaches such as those in Sydney, where headlands impede the movement of longshore sand transport. During calm conditions when the waves are not very big, this process moves sand from offshore reserves, onto the upper beach above the water line. Conversely, during storm events, large waves move sand from the beach, causing erosion scarps to form, and deposit the sand offshore in deeper water. This is shown for Duranbah Beach in the following pictures.

Source 5.4 Cross shore sand transport at Duranbah Beach, New South Wales. Sand is eroded from the beach due to large waves during storm events and is then pushed back onshore by small waves during calm conditions.

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Coastal processes move sand from one place to another (spatial scales), and also over a range of time scales:

- When a wave breaks, sand moves through the water, which happens almost *at once*.
- During a storm event, large waves and high tides can erode sand from the beach and deposit it further offshore in deeper water. This process happens over a few *hours*.
- During calmer wave conditions, waves move sand from offshore sand deposits onshore, gradually making the beach wider. This process happens over several *weeks*.
- Beaches can change seasonally, with the beach increasing in width in summer when there are smaller waves pushing sand onshore and then decreasing in width in winter when large waves move sand offshore. This process can take several *months*.
- Climatic effects such as the **Southern Oscillation Index (SOI)**, which is responsible for **El Niño** and **La Niña**, can affect the amount of storms and cyclone events which are responsible for moving large amounts of sand in a short period of time. These climatic cycles can be many *years* long.

Southern Oscillation Index (SOI) atmospheric pressure differences at sea level between Tahiti and Darwin. Sustained negative values of the SOI are associated with El Niño events, and positive values with La Niña events. As El Niño and the Southern Oscillation are related, the two terms are often combined with the abbreviation of ENSO.

El Niño (Spanish for 'the boy child') during an El Niño pattern, pressure at sea level is lower in the eastern Pacific and higher in the western Pacific. The opposite happens with a La Niña pattern

La Niña (Spanish for 'the girl child') during a La Niña pattern, pressure at sea level is higher in the eastern Pacific and lower in the western Pacific

NOTE THIS DOWN

Copy and complete the table detailing the coastal processes and the time periods over which they operate.

Spacial scales	Time periods

Geographical fact

The summers of 2010 and 2011 were the second and third wettest on record for Australia. At both times we were experiencing a La Niña pattern. Severe tropical cyclone Yasi was the strongest cyclone to cross the Queensland coast since 1918, which was also a La Niña year.

ACTIVITY 5.2

1. Briefly describe the difference between longshore sand transport and cross shore sand transport.
2. Consult an atlas or use Google Maps and draw your own map showing the location of the Tweed River mouth relative to nearby major urban areas.
3. Recall the three main components of the coastal system.

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History of the project

The Tweed River Entrance Sand Bypassing Project, or Tweed Sand Bypassing as it is also known, is a joint coastal management initiative of the state governments of New South Wales and Queensland. The project commenced in 2001 and consists of a permanent sand bypassing jetty and floating dredge that are used to shift longshore coastal sand drift from one side of the Tweed River to the other.

The project area is located on the border of New South Wales and Queensland, approximately 100 km south of Brisbane and 900 km north of Sydney. It falls into the jurisdiction of both the Gold Coast City Council and the Tweed Shire Council and is an area of natural beauty offering world-class beaches and surfing breaks to both local residents and domestic and international tourists.

The Tweed River has a **catchment** size of approximately 1000 km^2 and drains the remnants of what used to be a large volcanic **caldera**. The volcano has been inactive for many years and Mt Warning remains as the dominant volcanic plug. The river begins in the upper catchment and flows through the regional centre of Murwillumbah and extensive **estuarine** wetlands before flowing out through the trained entrance.

catchment an extent of land drained by a river or water body. It is sometimes referred to as a drainage basin

caldera formed by the collapse of land following a volcanic eruption – often as a result of magma being expelled and the resultant reservoir has the land above it collapse

estuarine the wide lower course of a river where it nears the sea and there is typically a mix of fresh and salt water.

The Tweed River entrance was first used in the 1800s to open up the Northern Rivers region to trade and settlement. Navigation of the Tweed River has historically been very dangerous with the sand shoals around the entrance constantly moving and changing in response to the varying wave climate. During the early years of use, the Tweed River entrance claimed many lives as boats capsized or were shipwrecked while trying to gain access to the river.

To control the sand shoal movement and improve navigation, training walls were constructed in the late 1890s, and then extended seaward by approximately 380 metres in the early 1960s. While improving navigation temporarily, the problem with the extension of the training walls was that the natural longshore drift that was travelling northwards along Letitia Spit was now being trapped behind the southern wall, unable to cross the Tweed River entrance bar and nourish the southern Gold Coast beaches in Queensland.

Issue 1

As a result, sand began to build up behind the southern training wall of the Tweed River entrance. Once the sand had built up to the end of the southern wall it began flowing around and into the Tweed River entrance, re-creating the bar that had historically been such a navigational hazard.

Issue 2

The beaches of the southern Gold Coast, including Rainbow Bay, Greenmount, Coolangatta and Kirra, are some of the most visited in Australia. Sandy beaches are very important to the tourist industry, as they are aesthetically pleasing and many people like to use the beach for recreational activities such as beach cricket, swimming and surfing. The tourist industry relies on the beaches being sandy so that people will want to come and stay at Coolangatta and put money into the local economy by staying at local hotels and spending money in shops and restaurants. In addition, sandy beaches provide a buffer of sand and can prevent extreme erosion from damaging high-rise buildings, roads and other infrastructure that have been built in close proximity to the shoreline.

Before the Tweed River entrance training walls had been extended, in the 1930s and 1950s there had been periodic erosion associated with storm and cyclone events. At this time, the natural coastal drift was not blocked by the Tweed River training walls and waves and currents supplied sand to the beaches after these storm events, replenishing the beach. Now that the natural sand flow was being blocked, there was very little sand available to replenish the beaches and two decades of stormy weather in the 1960s and 1970s left the beaches of the southern Gold Coast very severely damaged.

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The late 1970s to 1990s experienced fewer storm events but erosion continued, as the sand supply that was able to replenish the beaches was still blocked by the training walls.

Early efforts to resolve the issues

After the devastating 1967 cyclone, seawalls were constructed along the coastline and sand was periodically dredged from the sand reserve that was building up behind the southern training wall to artificially nourish the beaches and provide some protection to infrastructure and other assets. In 1974–75 a total of 760 000 cubic metres of sand (enough to fill just over 300 Olympic swimming pools) was dredged from the Tweed River entrance and deposited on Kirra Beach. This exercise was very expensive, costing over $1 million, and was not seen as being a permanent solution to the problem.

Resolution

In 1986 a sand bypassing system was built at the very northern end of the Gold Coast to bypass sand across the Gold Coast Seaway and onto South Stradbroke Island. During the mid-1990s suggestions were made for using a similar bypassing facility that would collect sand on the southern side of the Tweed River, pump it under the river and deliver the sand to the southern Gold Coast. This solution would prevent sand from building up across the Tweed River entrance and impeding navigation, as well as reconnect the natural flow of longshore drift.

The Tweed River Entrance Sand Bypassing Project was initiated by the New South Wales and Queensland governments who acknowledged that the problem affected both states and so they were willing to work together towards a solution. In 1996, an Environmental Impact Statement (EIS) was conducted by an external environmental management consultant to evaluate if the installation of a bypassing system would be of benefit. The EIS was a very thorough document and investigated in detail the environmental effects of installing the system.

The Tweed River Entrance Sand Bypassing Project was to be implemented in two stages. The first stage involved dredging from the Tweed River entrance and direct deposition of the sand on the southern Gold Coast beaches. In 1995–96 and 1998, 3 million cubic metres of sand was dredged from the river entrance and deposited on Rainbow Bay, Greenmount, Coolangatta, Kirra and North Kirra beaches.

The second stage of the project was installation of a permanent bypassing system which was designed, constructed and operated by a private engineering company called McConnell Dowell. This was carried out in 2000 and McConnell Dowell created a separate entity called the Tweed River Entrance Sand Bypassing Company to construct and operate the system. On 4 May 2001 sand bypassing commenced.

NOTE THIS DOWN

Construct a table showing the needs of the Tweed River entrance and southern Gold Coast beaches area and what was done to address those needs.

Tweed River entrance and southern Gold Coast beaches	
Issues	Resolution

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How is the system designed?

The objectives of Tweed Sand Bypassing are to establish and maintain a safe, navigable entrance to the Tweed River and to restore and maintain the coastal sand drift to beaches of the southern Gold Coast.

- Longshore drift is a natural coastal process that moves sand in a direction that is parallel to the coast. The direction of sand transport depends on the average wave direction, and at Letitia Spit the predominant south-easterly waves push sand along the coast from south to north.
- Between 200 000 cubic metres and 1 million cubic metres of sand can be transported along Letitia Spit in any year, depending on the wave conditions. The average sand transport rate is approximately 500 000 or half a million cubic metres of sand, which is enough to fill 200 Olympic swimming pools. This river of sand starts in large reserves just north of the Clarence River in mid-northern New South Wales and flows in a northern direction parallel to the coastline, before slipping over the continental shelf and into very deep water, just north of Fraser Island in Queensland.
- Tweed Sand Bypassing consists of a jetty and floating dredge, and was designed to collect the sand that is naturally transported northwards along Letitia Spit before it moves into the Tweed River entrance and restricts boating access.
- The jetty is 450 metres long and supports 10 submersible jet pumps that sit below the sea bed and collect the sand that is naturally transported towards them. The pumps do not 'suck' sand from the ocean bed, or out of the Tweed River, but collect sand that is naturally transported to the jetty through the process of longshore drift. This sand is then pumped under the Tweed River entrance and is deposited at one of the outlets before being naturally moved by waves and currents to nourish the southern Gold Coast beaches.
- The jetty is unable to collect all of the sand that is transported along Letitia Spit and some of this sand naturally bypasses the jetty and moves into the Tweed River entrance. This process is more pronounced during storm events when large waves and strong currents are able to transport sand in water that is much deeper than usual.
- Some of the sand that ends up in the Tweed River entrance moves naturally across the Tweed bar and forms sand shoals offshore of Duranbah and Point Danger. Over time, more and more sand will accumulate on the bar and when a certain threshold is reached the entrance is dredged.

Source 5.5 Jetty of Tweed River Entrance Sand Bypassing Project

The system

- Water from the Tweed River entrance is used to power 10 submersible jet pumps that sit below the surface of the water and create cone-shaped **depressions** in the seabed.
- Sand moving along the seabed, forced by longshore drift, falls into these depressions and is sucked up by the jet pumps.
- The water and sand mixture is then pumped into the main station, under the Tweed River and to one of the sand outlets.
- There are four outlets, with East Snapper Rocks and West Snapper rocks permanently installed, while Duranbah and Kirra are only temporarily installed when they are needed.

depressions hollowed-out areas in the sea floor, often the result of local currents

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Source 5.6 Overview of Tweed River Sand Bypass System

Stakeholders

Tweed Sand Bypassing has a wide range of stakeholders who each have a certain priority for the management of the coastline depending on their specific interests. Examples of these stakeholders include recreational fishermen, tourism operators, swimmers and surfers. Managing the interests of such a wide range of stakeholders is a very difficult process and not all stakeholders are generally satisfied at any one time.

Kirra Point v the Superbank

Surfing is an important part of everyday life for many southern Gold Coast residents, making surfers a large stakeholder group in Tweed Sand Bypassing. All parts of the coastal system are interconnected, with a change in one component of the system affecting the other. As a result, human-made changes to the underlying geology of the coastal system through the construction of training walls and **groynes** have altered sand movement and both created and taken away surfing breaks.

groyne a wall or similar built out from the seashore or riverbank to control erosion

Source 5.7 Interaction of the East Australian Current with Point Danger

In 1972 a groyne was built at Kirra to assist in retaining sand on Coolangatta when the beaches were badly eroded. Construction of the groyne unintentionally created one of the best surf breaks in Australia with generations of surfers enjoying the fast right hand point break. The groyne was

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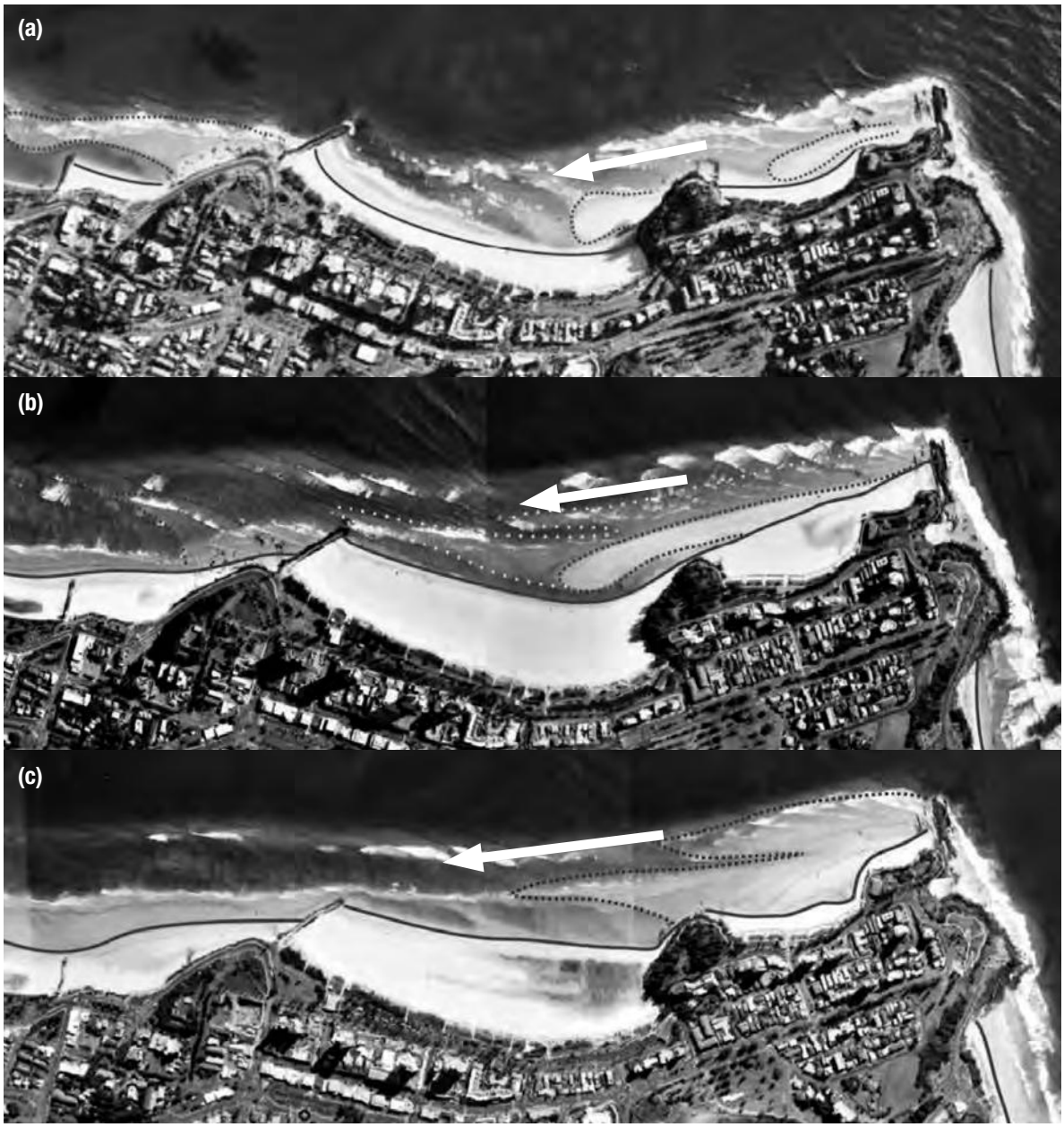
shortened by Gold Coast City Council in the 1990s to allow more sand to flow from Coolangatta to Kirra, but even after it was shortened Kirra Point still remained one of the best right hand point breaks in the country.

When Tweed Sand Bypassing was commissioned, the river of sand once again flowed from south of the Tweed River entrance and onto the southern Gold Coast beaches. In the early years of sand bypassing, many of the beaches dramatically increased in width and Kirra Point became saturated with sand. As a result, the waves at Kirra Point did not break as well as they used to.

With large amounts of sand now being pumped to Snapper Rocks, there was a trade-off for the loss of Kirra Point with the accidental formation of what was known as the 'Superbank'. The sand that was delivered by the project to the Snapper Rocks East outlet was shaped by waves and currents and created a shore parallel beach bar that extended from Snapper Rocks right through to Kirra. This sand bar promoted a wave that when the wave conditions were right, peeled from Snapper Rocks right through to Kirra Point. The Superbank became ranked as one of the top 10 surfing destinations in the world.



Source 5.8 Beach and 'Superbank' development occurring from 29 May 2001 (a), 30 August 2002 (b) and 11 May 2003 (c)

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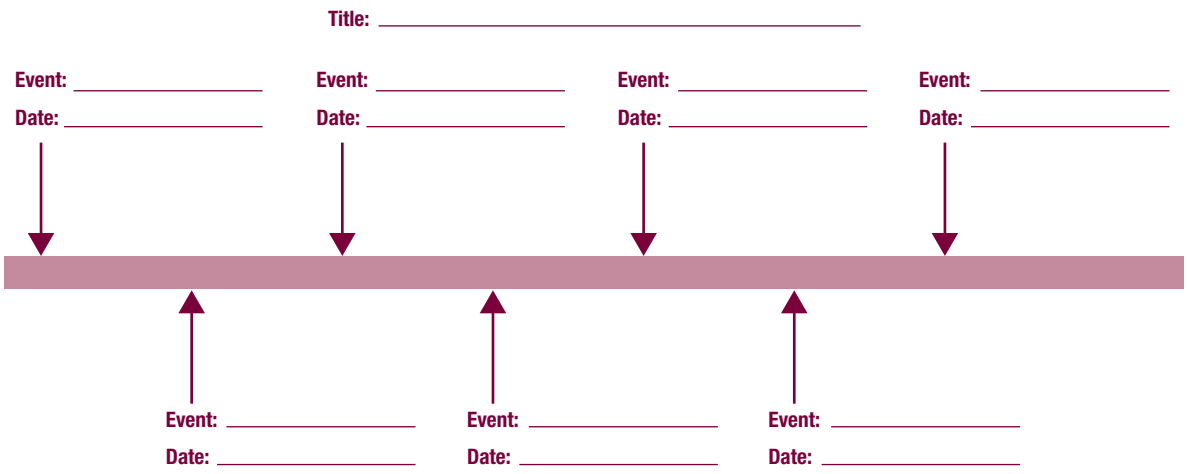
In the early years, shortly after commissioning, Tweed Sand Bypassing deliberately pumped volumes of sand that were larger than the natural rate. This was to provide a 'catch-up' quantity of sand to the southern Gold Coast beaches that had been so badly eroded for so many years. It was this additional sand that caused the beaches to become so wide and also created the Superbank. Since 2005 the project has been pumping smaller quantities of sand that are consistent with the natural longshore drift.

Source 5.9 Gold Coast, Australia

Source 5.10 In the early years of sand bypassing, many of the beaches increased in size.

NOTE THIS DOWN

Copy and construct a timeline for the major events associated with the Tweed River Entrance Sand Bypassing Project.



Economics

Over the years millions of dollars have been spent on restoring and maintaining the southern Gold Coast beaches. A socio-economic assessment (refer to www.cambridge.edu.au/geography10weblinks for a link to the case study) found that for every dollar spent on beach protection and enhancement, $60 to $80 was returned to the economy through tourism. This study showed that there is clear economic benefit in protecting the southern Gold Coast beaches as well as providing beach amenity.

Studies have also been done on the amount of money that surfing brings the local economy.

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When people travel to a certain wave break to go surfing, they might stay overnight at one of the hotels, spend money on breakfast in the morning, and may also buy some wax and a new leash for their surfboard. This is all money that is being spent in the local economy purely because the surfer was attracted by the waves. There are numerous interconnections between natural, cultural and economic environments.

Geographical fact

99 per cent of the planet's living space by volume is in the ocean. This is the largest space known in the universe to be inhabited by living organisms.

RESEARCH 5.1

TWEED RIVER ENTRANCE SAND BYPASSING PROJECT

To begin, view the video on the Tweed River Entrance Sand Bypassing Project on YouTube (for the link, see www.cambridge.edu.au/geography10weblinks).

1 Investigate other areas that may benefit from a project like this.
2 Describe the implications if this project had not gone ahead.
3 Discuss your views on the validity of this project.

5.3 Storm surge

storm surge local and temporary rise in sea level that is primarily caused by a low pressure system

marine hazard a geological process in the marine environment that has created conditions with a potential of being hazardous

low pressure system a region where the atmospheric pressure is lower than that of surrounding locations

Tropic of Cancer the parallel of latitude 23°27' north of the Equator, the most northerly latitude at which the sun can be directly overhead

Tropic of Capricorn the parallel of latitude 23°27' south of the Equator, the most southerly latitude at which the sun can be directly overhead

A **storm surge** is a **marine hazard** that is a local and temporary rise in sea level that is primarily caused by a low pressure system. When a low pressure system sits over the ocean, there is reduced atmospheric pressure pushing down on the ocean and the sea level rises in response. There are two main types of low-pressure systems that can cause a storm surge in Australia. The first and most significant is a cyclone, which is a severe **low pressure system** that causes a rise in sea level, intense rainfall and very strong winds. Cyclones form in tropical areas and develop in oceans and seas in the tropics – between the **Tropic of Cancer** and the **Tropic of Capricorn**. Cyclones have different names in other parts of the world and are called hurricanes on the continent of North America and typhoons in Asia. Cyclones that have been particularly destructive in Australia include Cyclone Tracy in 1974 and Cyclone Yasi in 2011.

The second most prevalent type of low pressure system is called an East Coast Low which occurs in the southeastern states of Australia, primarily in Victoria, New South Wales and south-east Queensland. An East Coast Low is a less intense system, but still brings a rise in sea level, strong winds, large waves and heavy rainfall. An East Coast Low in June 2007 was responsible for the beaching of a large carrier, the *Pasha Bulker* in Newcastle.

There are several factors that contribute to the overall height of a storm surge, which include the tide, wind and waves. The first is the tide that is responsible for the constant change in sea level and varies geographically. In some parts of Australia there are two high tides and two low tides every day with little difference in sea level between the low and high tide (1 to 2 metres). In other parts of Australia, particularly north of the Tropic of Capricorn, there is only one high tide and one low tide each day and the sea level difference between the two can be very large (several metres).

If a storm surge arrives at the coastline when the tide is low, in some parts of northern Australia the sea level will not even rise as high as the highest high tide (which is called a **king tide** – a

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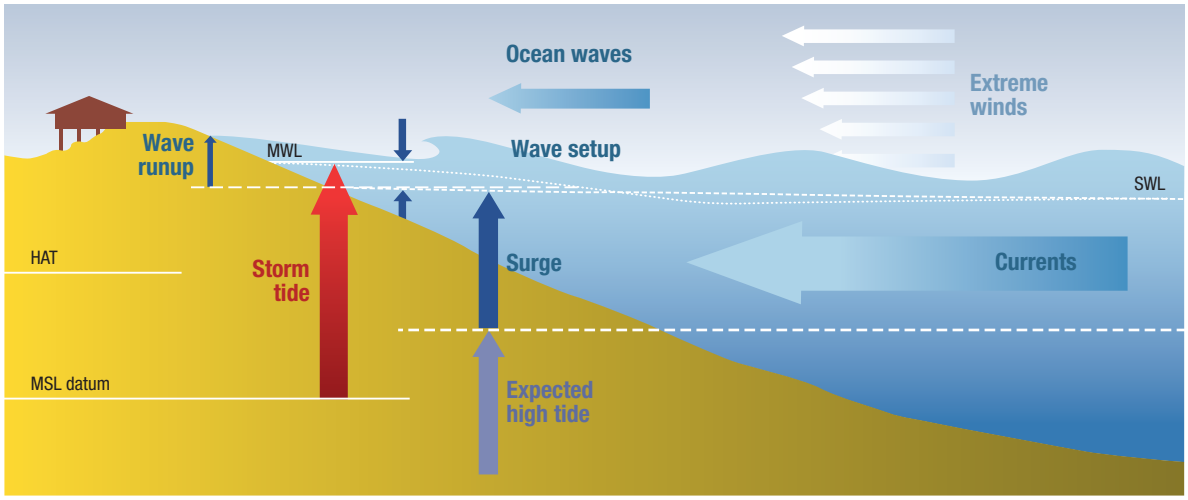

Source 5.11 Storm surge

high tide well above average height). If the storm surge arrives at the coast when there is a king tide, then there can be severe flooding, not only of the coastal areas along the beach, but also along estuaries, through the stormwater network and also along other low-lying areas.

king tide a high tide well above average height

The wind is also a significant contributor to a storm surge, and can increase sea levels significantly along the coast. This is possible because the wind associated with the low pressure system pushes and piles the water along the coastline. As cyclones in the southern hemisphere move in a clockwise direction, the wind on the southern side of the cyclone centre (or 'eye') is coming from an easterly direction, or onshore, and pushes water up along the coastline. It is for this reason that the area to the south of the eye on the east coast of Australia is the region that experiences the greatest storm surge.

The final component that makes up a storm surge is the waves. As waves are formed by wind blowing across the surface of the ocean, strong winds will create large waves. As the waves break at the shoreline they release a large amount of energy that not only further increases the sea level but can also cause extensive coastal erosion and damage to coastal infrastructure.

To revise, the factors that combine to create a storm surge include:

a drop in atmospheric pressure + the tide + the wind + the waves

The coastal flooding associated with a storm surge can also be exacerbated by intense and prolonged rainfall. As a flooded river pushes water out towards the ocean, the elevated sea level can block the flow which causes floodwaters to remain at higher levels for a longer period of time.

Elevated sea levels due to the effects of storm surge, prolonged rainfall or both of these effects can have severe impacts on Australia's infrastructure and communities, particularly in coastal locations. Houses can become flooded and roads cut off restricting access to remote communities. With the effects of climate change and sea level rise, Australian communities may have to adapt to the effects of increased sea levels on a more frequent basis.

Geographical fact

Tropical Cyclone Mahina is thought to be the most intense tropical cyclone to cross the Australian coastline in recent times. The cyclone crossed Bathurst Bay on the Cape York Peninsula, Queensland on 22 March 1899 with a central pressure of 914 hPa. Over 300 people were killed when the storm surge, which was reported to be 13 metres in height and extended for up to 5 km inland, destroyed and sank a fleet of pearling ships.

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RESEARCH 5.2

Conduct a search on the internet to answer the following:

1. Draw a diagram illustrating the El Niño effect and La Niña effect. The Australian Bureau of Meteorology website is a useful source for this (for the link, see www.cambridge.edu.au/geography10weblinks).
2. Recall why the area to the south of the eye on the east coast of Australia will experience the greatest storm surge.
3. Construct a poster with pictures and words that shows the effects of storms or king tides at a particular location, such as the Gold Coast in Queensland. Coastalwatch is a source (for the link, see www.cambridge.edu.au/geography10weblinks).

5.4 Colon Island in the Caribbean Sea

Australia is not the only country that lives with the effects of increased sea levels. In many other countries, particularly in the developing world, people live in environments that are frequently inundated by the ocean. One such example is the town of Bocas del Toro on Colon Island (Isla Colon) in the Caribbean Sea, Panama. Panama's total population has a high mortality risk from numerous hazards. Health, coastal zone management, agriculture, water resources and forestry are particularly at risk due to climate change. Recurring and severe storms, floods and droughts cause economic losses and affect people's livelihood.

Bocas del Toro is the north-westernmost province in the Republic of Panama. It borders Costa Rica to the west, the Caribbean Sea to its north, the mountains of Chiriqui Province to the south and the Ngäbe and Bugle indigenous reservation to its east. Like other regions along the Caribbean coast, rainy seasons and dry seasons are not as distinct as in other parts of Panama.

History

The province of Bocas del Toro had been dominated by the banana industry, dating back to 1880. In the 1930s at the height of the region's prosperity, a fungus known as Panama Disease destroyed the banana industry. In the 1950s disease-resistant plants were developed and the industry once again began to grow. Around this time large numbers of Ngäbe families migrated from the mountains looking for work with banana companies. These people often settled in the established towns and then others followed suit. Eventually the area became crowded and people had to settle in rural lowland valleys along rivers and streams. They continued farming, fought for available land and eventually formed communities.

Issues

Bocas del Toro receives a remarkable amount of rain, sometimes 3 metres per year.

This small town is very low lying and during the winter, low pressure systems frequently cause elevated water levels in the town and surrounding islands that can last for weeks to months at a time. Prolonged and intense rainfall can also contribute to flooding events. Sea level change is a source of increasing concern for environmental scientists. Sea level rise causes changes to shorelines and disturbs delicate environments such as beaches, barrier islands and wetlands through enhanced erosion and deluge. These changes affect the terrestrial biodiversity of areas due to the loss of habitat.

Measuring the sea level assists with understanding the variability of sea. Data from **tide gauges** is one

tide gauges installations that measure relative sea level at a specific point along the shoreline. They are usually secured on piers or on platforms a few metres off

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satellite altimeter an instrument for determining elevation, especially an aneroid barometer used in aircraft that senses pressure changes accompanying changes in altitude

form of measurement that is easily obtained and evaluated. Though tide gauges do not provide as exact measurements as **satellite altimetry**, benefits can be gained from this form of data and its analysis.

Resolution

The people of Bocas del Toro are very well adapted to living with elevated water levels. Some of the strategies that they use include:

- houses are constructed on stilts
- transport by boat
- temporary dozing of sand in front of properties
- all taxis are 4WD to navigate eroding coastal roads
- abandonment of older buildings that were subject to ongoing inundation
- use of rubble from the mainland to reclaim some of the lower-lying foreshores
- use of tyres and rubble to create ad-hoc sea walls
- professionally designed sea wall structures.

ACTIVITY 5.3

Examine a range of videos on storm surges on YouTube. An example may be found about from Tropical Cyclone Oswald in Queensland in 2013 (for the link, see www.cambridge.edu.au/geography10weblinks).

1 List strategies to minimise risks for people living in areas vulnerable to storm surge (which includes a significant proportion of Australia's population).

2 If you were a town planner in a coastal community in Australia, what sorts of conditions would you have on proposed new developments or improvements to existing ones?

3 What can we learn from adaptations in other cultures to marine events such as storm surges that may be of relevance in informing Australian views on how best to live in areas influenced directly by marine hazards?

Source 5.12 Bocas del Toro

FIELDWORK 5.1 INVESTIGATING THE IMPACTS OF PEOPLE ON A MARINE ENVIRONMENT

Aim

To analyse the impacts of people on a local marine environment and identify management strategies using fieldwork to create a report.

Method

A local marine environment will be investigated using information such as maps and aerial or remotely sensed imagery, and field observations.

Preparations

Locate images for a local marine environment from Google Maps and other sources. Construct your own map of the marine environment following mapping conventions (title, north arrow, print labels, legend, etc.).

Search local newspapers and other sources such as the internet to get background information about humans on this marine environment and write down a brief summary of your key findings.

Name at least two spots of interest in the marine environment from where you would like to do field observations.

Data collection

At the two or more stops you identified for your marine environment, using field sketches and notes, record information on the human and natural components of the marine environment at each stop. Record the following in your notebook and label, as required, your map and/or aerial photo:

1. Label the key features that you can see and the main uses of the marine environment on your map/image of the area.
2. Describe the characteristics of the marine environment at each stop. Take field photos and draw a field sketch of what you select as the most salient features of the marine environment. Write brief notes focusing on the key features of the marine environment. These may be things such as: natural features like the dominant wind and wave direction; the size and intensity of waves observed (things like wave height and period – the time taken for two successive wave crests to pass a point); and features built by people such as groynes and rock walls; as well as the extent of houses, roads and so on.
3. Note any signs of pollution and where and how people may have any stormwater or greywater outlets in the area. (Greywater is treated waste water from urban and industrial sources.)
4. What is the evidence, if any, of people managing this marine environment? If there is management evident, what sorts of things are being done and how effective do you think these are?
5. Discuss your observations with your class and make a general assessment of the environmental issues in this marine environment. Prepare a report using the following layout:

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Fieldwork presentation report layout

Title page	Title and name
Contents page	Display section headings with the page numbers the heading starts on.
Page 1	Executive summary – in a succinct manner state what you did (fieldwork at two or more marine sites) and what your key findings were.
Page 2	Aims and methods – state these clearly and succinctly.
Page 3	Introduction – provide a brief description of your marine environment. Include a map/aerial photo map showing the area. Include, at a minimum, title, arrow north, relevant printed labelling and a legend.
Pages 4 and 5	Field stops – provide notes and photos as well as relevant field sketches to describe the main features of the marine environment observed at each stop.
Pages 6 to 8	Human impacts and environmental management – summarise the impacts that you observed in written and diagrammatic form.
Page 9	Identify any key recommendations that you may have from your fieldwork, background readings and viewing videos, etc. to further improve the management of the marine environment studied in the field management strategies.
Page 10	Conclusion – summarise your key findings from your report. A reader should be able to read your Introduction and have a good idea of what you will be looking at. They should then be able to go to your Conclusion and, as it succinctly summarises your key findings, will have a very good idea of what is between the Introduction and the Conclusion.
Page 11	Bibliography – state the various resources used following the Harvard (author, year) or similar writing style.

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Chapter summary

- Marine environments are fundamental to life on Earth and their sustainability involves interconnections between natural processes and human activities.
- The Tweed River Entrance Sand Bypassing Project provides a valuable example of quality environmental management strategies to effect positive outcomes for the environment and for people. It required considerable cooperation between stakeholders to come about and to be continually managed effectively.
- Marine environments are subject to natural events such as cyclones, storm surges, king tides and rises in water levels that have impacts on both the natural environment and people.
- Poorly managed marine environments can have significant negative impacts on people; however, people in some parts of the world such as Colon Island in the Caribbean are testimony to how the negative effects of marine environments can be well managed. Their clever use of available resources and technology has lessons for the developed world.

End-of-chapter questions

Multiple choice

1 What is a main component of the coastal system?

A The underlying geology

B The coastal sediment

C Waves and wind

D All of the above

2 The Tweed Sand Bypassing project has provided evidence that:

A marine tourism works best where there are large investments in infrastructure

B people can intervene positively in marine environments

C engineering works in marine environments are harmful

D intergovernmental cooperation is not feasible

3 The Superbank is ranked in the top 10 surfing destinations in the world and is the result of:

A careful design

B the request of tourists

C pumping sand volumes greater than the natural rate

D none of the above

4 Which of the following is not a factor in creating a storm surge?

A Waves

B Sand

C A drop in atmospheric pressure

D Wind

5 People who live on Colon Island in the Caribbean are concerned that:

A their houses are built on stilts

B there is temporary dozing of sand in front of properties

C inundation from the sea is common due to their island being so low lying

D they experience more severe cyclones in the Caribbean than anywhere else

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Short answer

1 Briefly describe the importance of marine environments to people.

2 List the key features of the Tweed River Entrance Sand Bypassing Project.

3 Contrast the marine management strategies of the Tweed River Entrance Sand Bypassing Project and Caribbean examples given in this chapter.

4 Describe how the Superbank came to be such a popular surfing location.

5 Discuss the two main types of low-pressure systems that can cause a storm surge in Australia.

Extended response

In a short report, detail what strategies you might use to protect your home from water inundation from the ocean if you lived on Colon Island in the Caribbean.

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6 Urban environments

Source 6.1 Aerial view of Tokyo, the world's largest city

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Before you start

Main focus

The 'urban environment' refers to everything around us that is human-made. Humans have always changed the landscape that they live in, and this change has sometimes caused pollution, disease, extinction of plant or animal species and other environmental damage. In this chapter we will investigate some of the types and extent of change caused by urban environments and consider management strategies that can be used for prevention or response.

Why it's relevant to us

To minimise the impact that we have on our surroundings and the environment, we need to study the changes that occur in urban environments. Only by understanding how human behaviour and increases in population affect our environment can we develop strategies for managing land space, resources and pollution, strategies that will improve the world we live in.

Inquiry questions

- How have humans affected the degradation of urban environments?
- How can urban environments be better managed to reduce pollution and the affects of pollution?

Key terms

- Air pollution
- Biomimetics
- Conservation
- Heritage
- Management
- New urbanism
- Urban environment

Let's begin

Throughout history, humans have developed unique and extraordinary urban environments. However, the management, restoration and preservation of cultural and historic sites have at times been controversial issues. Modern approaches to the development of urban environments are being implemented around the world, using new technologies to reduce pollution and its effects and implementing new urban development philosophies to improve quality of life.

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6.1 What is the urban environment?

The **urban environment** is defined as the human-made areas that allow human activities to take place. The scale of the urban environment varies from houses and buildings to large cities such as Tokyo, which has around 30 million people. The urban environment also consists of human-made green spaces such as parks and gardens, which are integrated into the structure of towns and cities. Infrastructure such as roads, railways, water, waste and electricity services are also part of the urban environment because they provide the fundamental services that allow towns and cities to function.

urban environment the human-made areas that allow human activities to take place

To gain a greater understanding of the changes that occur in the urban environment, the focus of this chapter will be on efforts to manage pollution in densely populated cities, the use of environmental design to make buildings more efficient and sustainable, and to understand the importance of the **conservation** of culturally and historically significant sites. The concluding section focuses on a modern development called 'new urbanism' (see later in this chapter) and how this has been applied to locations in Australia and the United States.

conservation the protection of plants and animals, natural areas, and interesting and important structures and buildings, especially from the damaging effects of human activity

6.2 Environmental change: smog

What is **smog**? How can it be managed?

smog a mixture of smoke and fog that has come to mean man-made pollution that can be seen in the atmosphere

Case study 6.1

What caused the Great Smog, London 1952?

'Pea-soup' thick smog was a common occurrence in 1950s London, but on 5 December 1952 conditions became so bad that 4000 people were left dead, animals at the Smithfield Show dropped dead and there were reports of cows choking to death in the fields. Visibility was so bad that people reported not being able to see their feet. Buses and taxis were unable to operate.

Source 6.2 London smog 1952

Sulphur dioxide was identified as the main pollutant, caused by much higher than usual coal burning as London residents fought off the winter cold. The government estimated the number of deaths caused by the smog were between 3412 to 4075. Respiratory diseases accounted for 59% of the increase in deaths in the week ending 13 December and 76% in the week ending December 20.

According to meteorologist Peter Cockcroft:

> Winter arrived early in 1952 and very cold snowy weather in November continued into December.
>
> Londoners tried to keep warm by burning lots of coal on their home fires. This extra domestic smoke added to that belched out by power stations and factory chimneys.
>
> As an area of high pressure arrived over the capital, the skies cleared and the wind fell light. On 5 December fog started to form.
>
> In a 'high' the air is pushing down – exerting a higher pressure. So, anything in the lowest part of the atmosphere becomes trapped; in this case the noxious combination of smoke and fog – smog.
>
> Because the winds remained light there was nothing to blow it away.

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> Thousands of tonnes of soot and carbon dioxide were pumped into London's air, made worse by some of the fog droplets turning into harmful acids.
>
> Little wonder then, at the time, Londoners described 'gasping for air'.

Source: Peter Cockroft, Meteorologist, BBC London online

The UK government responded with the *Clean Air Act* of 1956, which introduced measures to try to cut **air pollution**. The main target of the legislation was to reduce the dirtiest pollutants. Factory furnaces were prohibited from emitting 'dark smoke' and grants were offered to householders who converted their coal-burning fireplaces to smokeless fuel.

air pollution when the air contains gases, dust, fumes or odours in harmful amounts

Public opinion was that the Clean Air legislation of the 1950s had resulted in a major improvement in public health. But according to the Department of Environment, Food and Rural Affairs (DEFRA), of the 29 000 deaths that still occur each year in the UK related to air pollution, around 4000 are in London. New pollutants such as nitrogen dioxide from vehicle exhaust fumes are causing the mortality rate to stay high.

The UK is failing to meet European Union (EU) air quality standards and London has one of the highest levels of nitrogen dioxide of the Union's capital cities, reaching three times the legal limit on busy roads. ClientEarth, an environmental organisation, says 16 UK regions and cities will have air pollution at levels above the legal limits until at least 2020, and London will not comply with air quality regulations until 2025 at the earliest.

Dr Frank Kelly of London University's King's College said that the *Clean Air Act* had had an impact on pollution but that new laws were needed now to deal with new problems. Car ownership has dramatically increased and exhaust fumes from traffic have caused a new kind of pollution that needs new legislation. He said that the Congestion Charge legislation of 2003 and the Low Emission Zone (LEZ) legislation of 2008 had made just a tiny difference to air quality in the city.

Air quality is a key factor in a variety of health issues, such as heart disease, strokes and diabetes. Politicians across the world are realising that only action to clean up the air will make a difference to health issues.

In the first four months of 2012, air pollution in London had exceeded EU daily limits more than 35 times. EU air quality laws state that daily pollution levels must not be above the legal limit on more than 35 days in a calendar year.

DEFRA has said that the aim is to keep improving air quality and reduce the impact it can have on human health and the environment. Much of the UK already meets EU standards and air quality is generally good. However, there are limited areas, including London, where air pollution remains an issue.

Management of air quality in London

Legislation	Clean Air Act	Congestion Charge	Low Emission Zone
Date	**1956**	**2003**	**2008**
Description	Factories banned from emitting 'dark smoke'. Grants to householders who convert from coal to smoke-free fuel	A fee charged on motor vehicles during peak times on weekdays, aimed at reducing traffic in the centre of the city and raising investment funding for public transport	A scheme to charge commuters if their cars emit higher than the allowed level of pollution. The scheme gets stricter over time to encourage commuters to switch to cleaner forms of transport

1 Recall what causes smog.

2 Discuss how smog is affected by increases in population, economic growth and politics.

3 Evaluate if the methods used to manage air pollution have been successful. Explain your reasons.

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Environmental change: air pollution

China

Coal and other fossil fuels are burned in power plants across China. While the power generated is used to fuel China's economic boom, the plants emit pollutants such as ozone and particulates that mix with sunlight and form smog. Some of the ozone produced in this smog rises high into the atmosphere and joins the flowing air stream to spread across nations and continents.

ozone gas formed when oxides and nitrogen react with sunlight. In the upper atmosphere it absorbs UV rays, preventing them from reaching the Earth. At lower levels, ozone is a pollutant caused by vehicle and industrial emissions, the main component of smog

Ozone forms when oxides and nitrogen react with sunlight in the atmosphere. In the upper levels of the atmosphere it absorbs UV rays, preventing the rays from reaching the Earth's surface. However, at lower levels, ozone is a pollutant caused by vehicle and industrial emissions and the main component of ground level smog.

Source 6.3 Severe air pollution on 12 January 2013 in Beijing, China. Air quality index levels were classed as 'Beyond Index' (PM 2.5 of over 700 micrograms per cubic metre).

Source 6.4 Smog over Sydney

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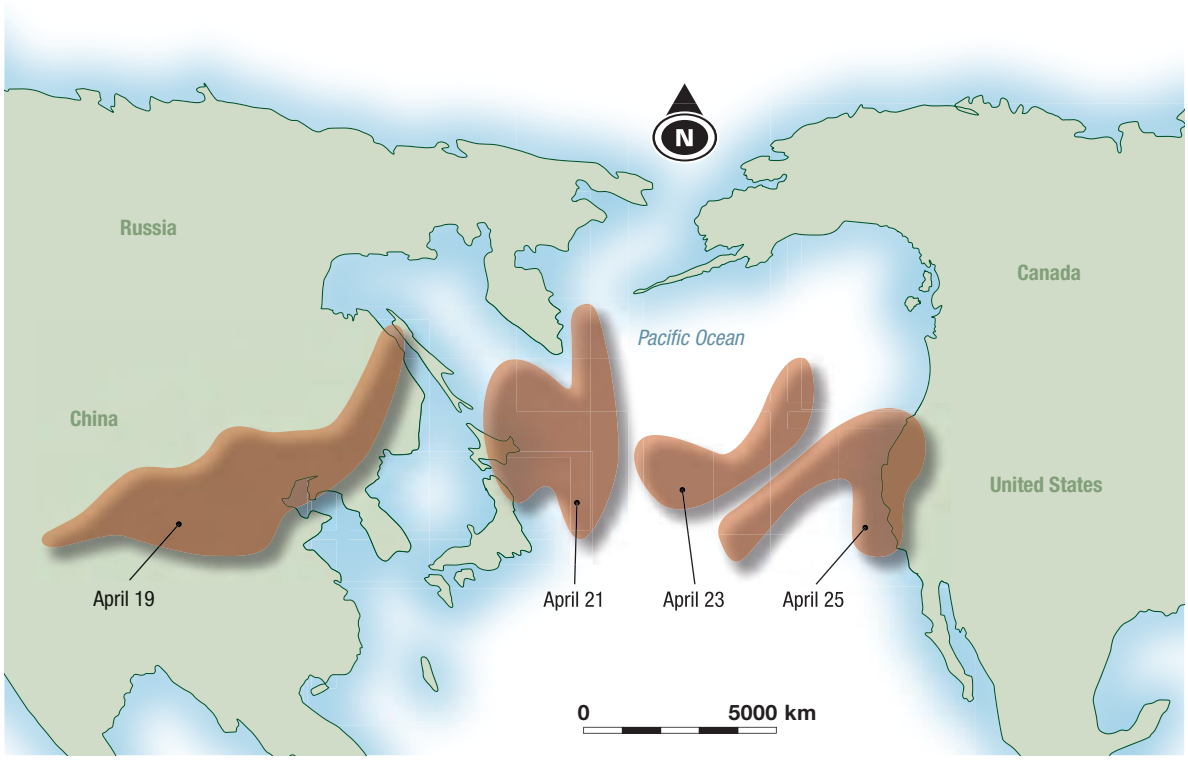

Source 6.5 Pollution travels the air stream from China to the USA.

Air pollution and dust from central China rises a kilometre or more and joins an air current heading east towards Beijing. Some of the pollutants may drop in rain over the city, but additional pollution from the city itself rises to join the noxious cloud. This pollution continues to rise higher into the atmosphere into faster-moving air currents, taking the pollution east over Korea where it picks up more pollutants from industry and other sources there.

The pollution stream then heads north across Japan and joins the strong air currents of the Pacific Ocean. After passing over Hawaii the stream continues over California and the western United States. Along the way, some particles and gases will drop to the ground, having an impact on air quality in western North America, while the remainder of the pollution heads inland, resulting in 'Asian dust events' in Arizona and Colorado.

Global air pollution

In the USA, the National Oceanic and Atmospheric Administration's (NOAA) Earth System Research Laboratory's (ESRL) Global Monitoring Division is part of efforts to monitor and measure global air pollutants. Agencies such as the ESRL have been collecting data for decades. There is evidence showing that the mixture of pollutants such as ozone, particulates and mercury flows in a continual stream high up in the Earth's atmosphere. One country's industrial emissions become another country's air as the mixture crosses the borders of nations and demonstrates the ineffectiveness of country-specific air quality laws.

Air pollution from Asia is not a new problem. While California breathes the pollution from China, Europe lives with air polluted by North America, a phenomenon that has been going on for decades. Any pollution rising into the atmosphere from China, the USA or anywhere in the world will travel around the world in a matter of weeks.

According to the NOAA, the amount of ozone crossing the Pacific Ocean to North America may soon exceed levels permitted by US law. One of NOAA's network of observatories sits on Trinidad Head in California, a remote site that sticks out into the Pacific Ocean. The remote site was chosen as it is far from centres of population, making it ideal for measuring cross-border air pollution streaming across the ocean. These observatories collect jars of air that are studied and stored; and at night particles are measured in the air using lasers.

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In 2011, the first of four missions by unmanned planes to investigate high-altitude air pollution was launched from California. One of the remaining three will be launched from Australia. With the aim of understanding more about the global consequences of burning fossil fuels, these windowless aircraft carry scientific equipment to measure ozone, greenhouse gases and other pollutants. This equipment is so accurate that it can identify where pollutants come from, sometimes even the actual factory of origin. The study found that although the USA itself contributes to the global ozone pollution problem, rising air pollution recorded over the western USA is not locally originated.

Management options

Since the 1970s, the USA, Canada and Europe have agreed to work together on the issue of air pollution and have agreed on some standards. However, as we have seen, air pollution in one country is often increased because of activities in another part of the world. Asian countries have not yet agreed to standards – there is no global agreement. Air-quality experts say local emissions from cars and power plants are still more harmful to human health than travelling air pollution.

Efforts are being made to globalise existing international air pollution agreements. The aim is to get climate and air-quality scientists from around the globe to collaborate on a full understanding of how pollution migrates, and inspire forward-thinking air pollution regulations in China and other countries.

The main effort comes from a group chaired by the USA and the EU called the Task Force on Hemispheric Transport of Air Pollution. This task force operates under a convention dating from 1979 called the Long-Range Transboundary Air Pollution (LRTAP) Convention. LRTAP covers the USA, Canada, Europe and central Asia. The agreement addresses sulphur oxides, nitrogen oxides, ammonia, heavy metals and other pollutants and is considered the most important air pollution treaty so far. Asian countries have shown interest in developing LRTAP into a global agreement and negotiations so far have involved more than 750 scientists from 38 nations, but agreement is still a distant hope.

In China, monitoring by government and private organisations has improved. Beijing's smog has been so bad at times it has forced flight cancellations, leading to pressure for change from citizen groups angry over air quality in major cities. Just as the people of London had to stop burning coal in the 1950s, the people of Beijing are switching from coal to natural gas for their heating needs.

While local laws are still the most effective way to reduce air pollution that travels across borders, officials are working on improving collaboration between scientists from around the globe.

Australia

Australian scientists are predicting climate change will cause the number of hospitalisations in Sydney to increase threefold and deaths of elderly people due to heat stress will double by 2060. At the Greenhouse 2009 conference, scientists presented evidence that suggests yearly heat-related deaths in Sydney will rise from about 150 to 200 to between 300 and 400, even without allowing for an ageing population that will see the number of over 65s increase. Climate change is likely to increase the number of days per year where temperatures are in excess of 30° from 24 to 30 days in the city and from 40 to up to 50 days in western Sydney.

Rising temperatures increase fire risk and air pollution. Pollutants from motor vehicles or bushfires react and make ozone, the main component of smog. Human health issues such as asthma, emphysema and bronchitis are set off by high levels of smog.

Around 250 people a year visit hospitals in Sydney suffering from the effects of photochemical smog caused mainly by vehicle emissions. This number will likely treble to 750 a year. Compounding this, increased temperatures caused by climate change would cause an expansion of air pollution in the atmosphere.

The New South Wales Department of Climate Change is planning for an increase in health problems and is looking into ways to control increases in pollution.

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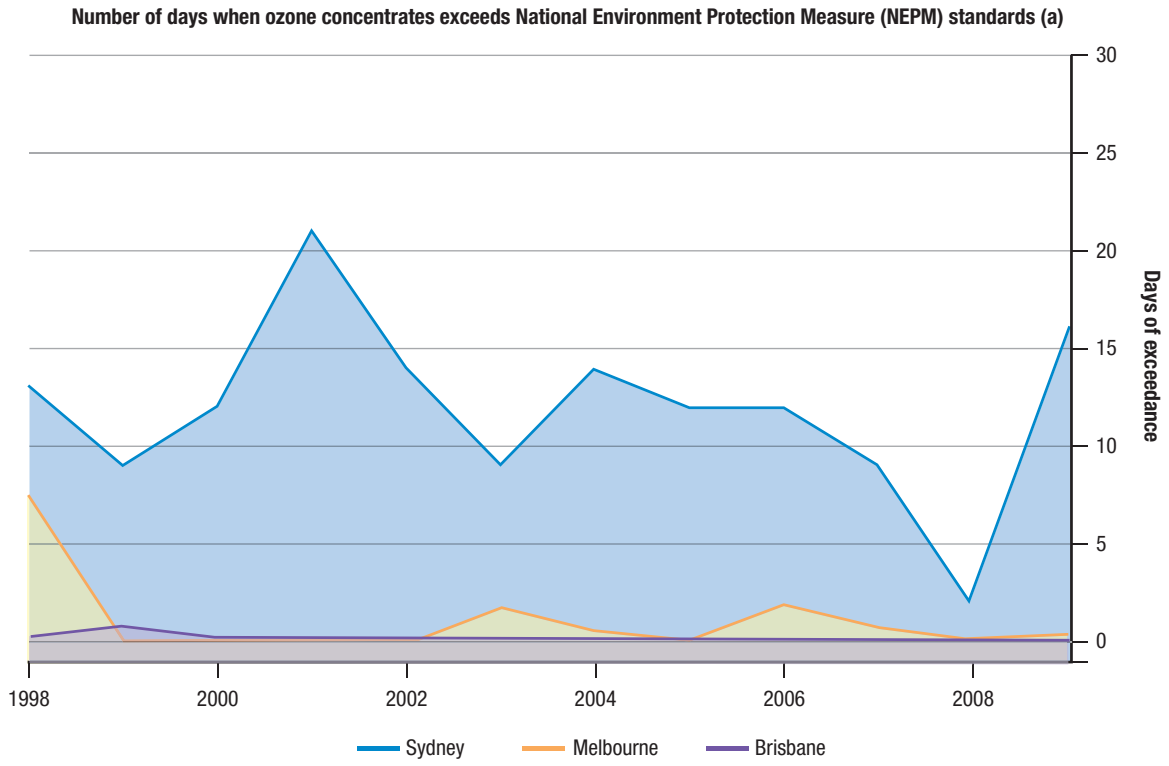

Footnote(s): *(a) Each city contains several ozone monitoring stations. The data presented are an average of exceedance days across all ozone monitoring stations in each city. Melbourne averages only consider stations with data available for at least 74% of days in a given year.*
Source(s): *NSW Department of Environment, Climate Change and Water Air quality; Qld Department of Environment and Resource Management Resource Centre; Victoria Environment Protection Authority Air quality.*

Source 6.6 Air quality in Australian cities

6.3 Management of environmental change

Environmental design: Sydney Opera House

The Sydney Opera House is one of the world's most iconic buildings – a busy centre for the performing arts, a major tourist attraction and internationally recognised for the originality of its architectural design. Jorn Utzon designed the building after winning a competition established by the New South Wales Government in the late 1950s. His design was deemed unique and the construction of the building was challenging and at times controversial. An indication of the complexity of its design and construction is that the Sydney Opera House was not officially opened by Queen Elizabeth II until 20 October 1973. In 2007, the Sydney Opera House was awarded World Heritage listing.

Sustainable management of the Sydney Opera House

As with all major structures, the impact on the surrounding environment of the Sydney Opera House is important to consider.

In February 2012, the management of the Sydney Opera House released an 'Environmental Sustainability Policy' to counter any ecological damage that the Opera House may cause within its environment. In this policy, the Sydney Opera House expresses a commitment to sustainable management of the site in the following four areas:

1. conserving natural resources
2. minimising waste and pollution
3. reducing greenhouse gas emissions
4. enhancing the natural environment.

Three objectives, encompassing a variety of measures geared towards ecological sustainability, have been set.

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The first objective aims to reduce energy use by moving the Sydney Opera House towards a low-carbon future. It aims to achieve this by:

- reducing electricity consumption by 15% by implementing energy efficiency upgrades to the building
- exploring possible carbon offset programs.

The second objective aims to embed environmental sustainability in everything that the Sydney Opera House does including:

- reducing or recycling 70% of the Opera House precinct's paper through the implementation of a waste reduction and recycling plan
- reducing drinking water by 15% by implementing a water-saving action plan.

The final objective positions the Sydney Opera House in the role of engaging and inspiring others in the area of ecological sustainability. It aims to do this by:

- engaging staff by creating a culture of environmental awareness through leadership and strategic direction
- collaborating with external commercial partners to achieve these ecological goals.

Source 6.7 Opera House and its unique design

RESEARCH 6.1

Go to the Opera House project website (see Cambridge weblinks, www.cambridge.edu.au/geography10weblinks).

Read through the site to gain a greater understanding of the development of this unique Australian building. Investigate the issues that were caused throughout the construction of the Opera House. Can you suggest alternative solutions?

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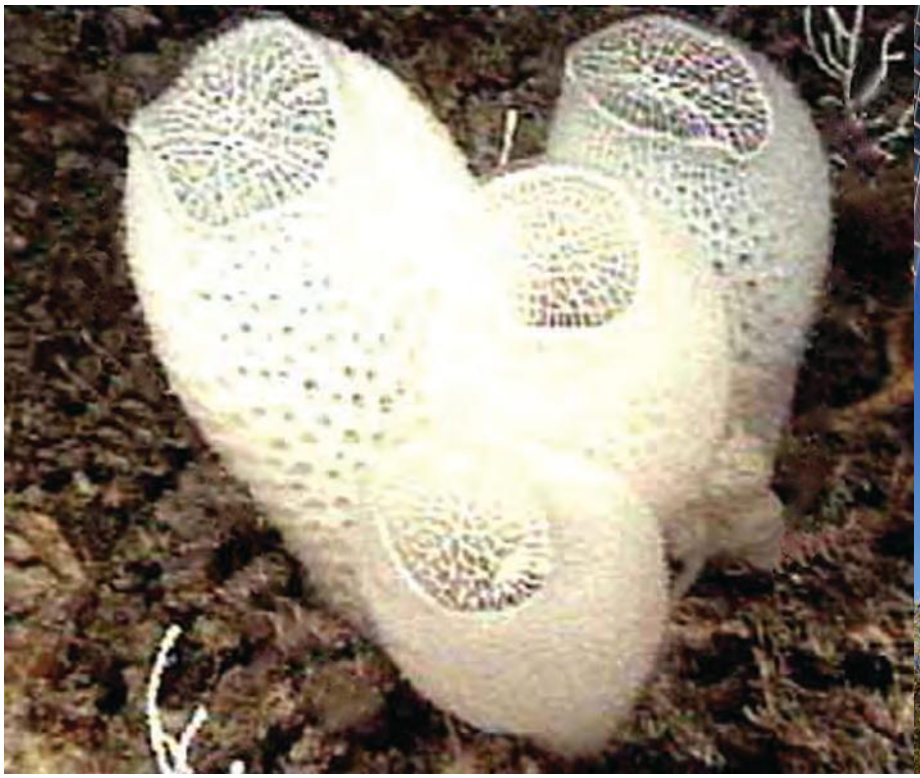
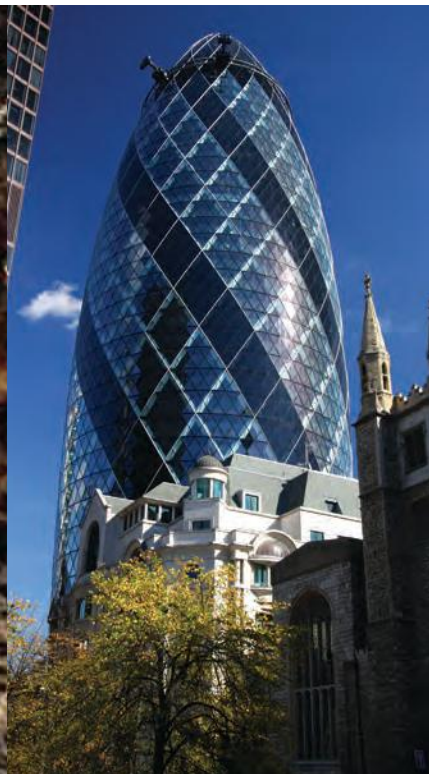
Environmental design: living buildings



Source 6.8 The Venus Flower Basket



Source 6.9 'The Gherkin'

Deep in the ocean there lives a glowing sea sponge called the Venus Flower Basket. This animal forms a lattice-like exoskeleton from shiny silicon-based material that gives it both a strong structure and efficiently filters water and nutrients. In London, Lord Norman Foster's 200-metre-high glass tower, finished in 2004, affectionately known locally as 'The Gherkin', was inspired by this strange sea creature. The building's spiral lattice naturally directs the air flow from ground level upward, funnelling it through its offices and reducing the need for energy needed to run air-conditioning.

The world's population is seven billion and increasing. The pollution produced by the manufacture of materials needed to make and sustain our urban environment rises with population. The way we build and maintain our cities is undergoing a necessary and radical change. Experts at the United Nations Intergovernmental Panel on Climate Change claim that this change is humankind's best chance of reducing greenhouse gases.

Architects, scientists and designers are investigating the natural world – even to microscopic levels – to look for ways to mimic biological systems that have already evolved solutions to similar problems. The '**biomimetic**' architecture movement has brought synthetic biologists, botanists and other scientists together with builders, manufacturers and artists to learn how to create structures that work with nature, instead of against it. In nature, an organism cannot expend more energy than it produces and so evolves over billions of years to be as efficient as possible.

biomimetics the study of the structure and function of biological systems to create models for the design and engineering of materials and buildings

Innovations have already given us new revolutionary concepts for heating and cooling, one of the highest energy-consuming systems in buildings. By studying how animals cool themselves, such as by absorbing water in hot, dry and resource-scarce environments, we have already made advances in sustainable design. For example, why add solar panels to a building to run the cooling system if there is a way to use natural design to cool the building without the need for electricity?

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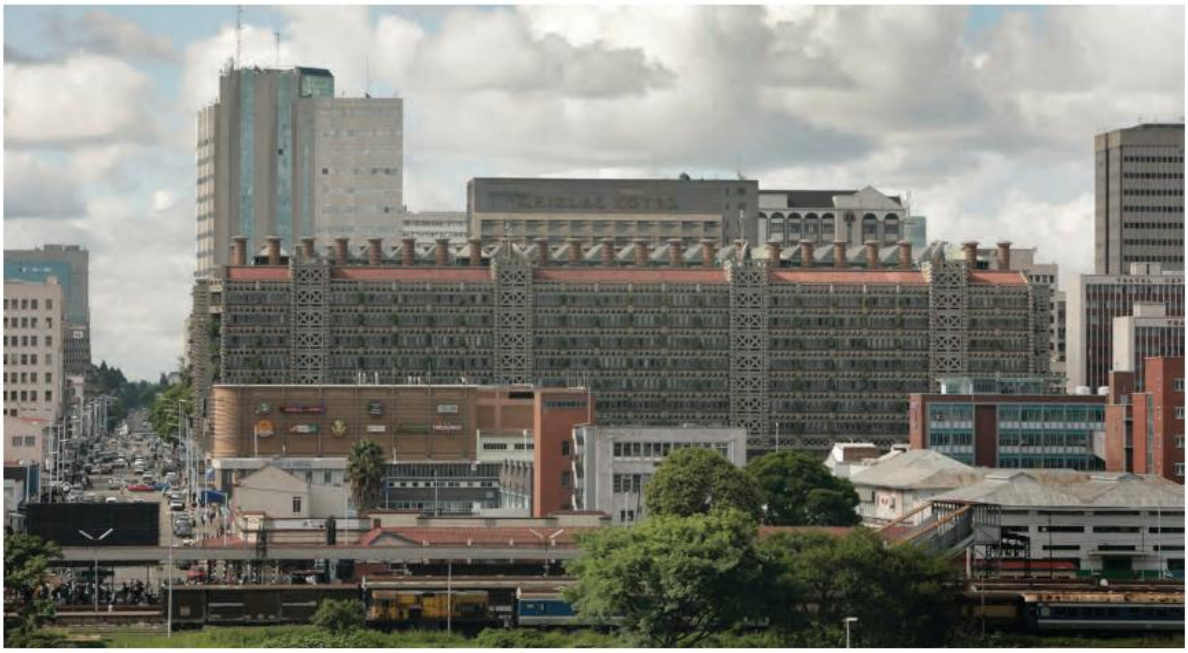
Learning from termites

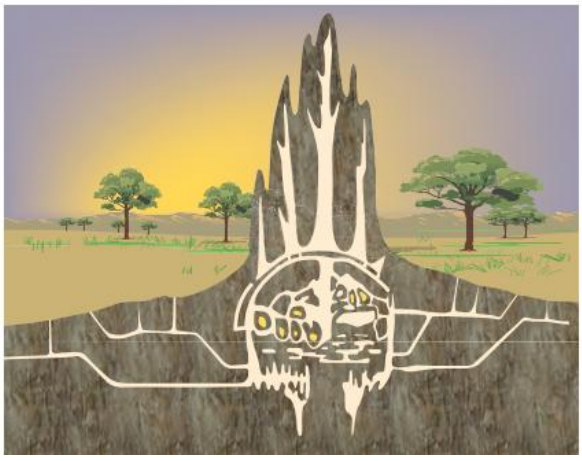


Source 6.10 Eastgate Centre, Harare, Zimbabwe

Source 6.11 Termite mounds

In Zimbabwe, architect Mick Pearce studied the way that termites construct their earthen towers. The mounds are constructed in a way that captures desert breeze and channels it into subterranean chambers where the moist earth is cooler. Warm air is expelled through a flue in the top of the mound while cooler air is drawn up through the mound. Without this design, termites would not survive the desert heat. Pearce used the termite's concept in his design of the huge retail and office building called the Eastgate Centre in Harare.

In the Eastgate Centre, fans take the cooler night air into chambers under the office floors.



Source 6.12 Diagram of termite mounds

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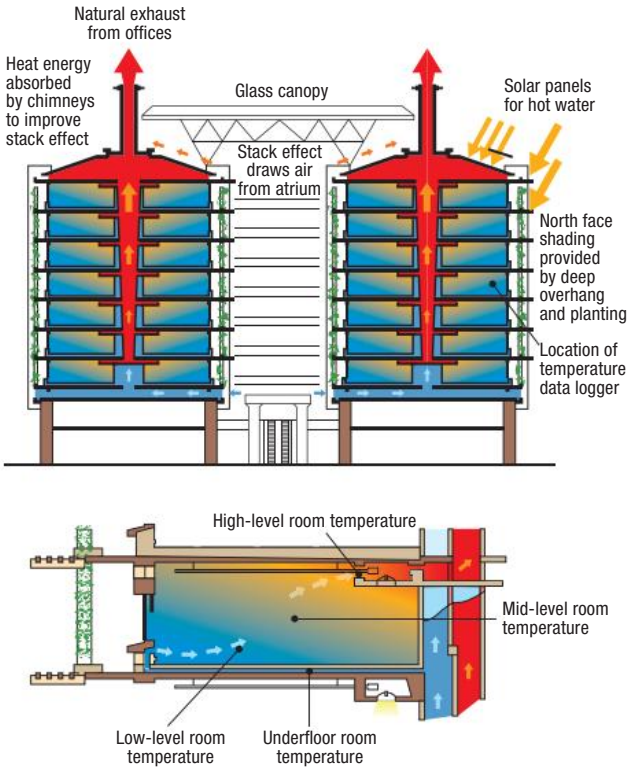
In the daytime when temperatures are higher, the air is circulated through the structure allowing the offices to be cooled at 10% of the cost of conventional air-conditioned buildings.



Source 6.13 Diagram of Eastgate schematic

Forest in the city

Italian architect Renzo Piano collaborated with San Francisco botanists to create a 'living roof' at the California Academy of Sciences. Instead of a traditional hard roof, 1.7 million plants, including many native plants and a field of California poppies, form the canopy.

Although roof gardens are not new, Piano's roof is constructed with seven vegetation-covered 'hills' that channel the cool Pacific Ocean breeze into grates. A computer takes data from weather monitoring instruments on the roof causing vents to open and close to control the flow of natural cool air through the building underneath.

Green roofs still require considerable energy to maintain, so architects and synthetic biologists are collaborating to design wall coverings that could be used to absorb greenhouse gases from the air.

Buildings are still made of materials that are difficult to recycle, and often end up as waste. Huge amounts of energy are used in dismantling and disposing of old buildings let alone the energy and pollution caused by building new ones. Architects and scientists are investigating resins as replacements for plastics.

In order to accommodate the world's ever-expanding population in ways that are more sustainable, designers and botanists are searching for practical ways to blur the line between human-

Source 6.14 The living roof at the California Academy of Sciences

made construction and nature. This could be called the 'reforesting of cities', where rooftops and industrial sites are repurposed and give a positive contribution to the urban environment.

Living buildings

Research suggests that soon the designs of Foster, Pearce and Piano will seem old and quaint. Scientists are working on actual living materials for use in architecture. Some examples are:

- Bioluminescent bacteria to provide lighting without needing electricity. These bacteria could also be grown in decorative patterns on walls or used as warning indicators when certain pollutants are present.
- Bio-paint to absorb carbon from air pollution and at the same time provide insulation.
- Synthetic biological materials that respond to the environment by growing, repairing or replicating.

As populations of cities increase causing issues of pollution to worsen, architects and scientists are working at breakneck speed to rethink how the urban environment interacts with the natural world. Using technological advances inspired by the biological processes of nature, dreams are becoming a reality.

ACTIVITY 6.1

1 Deduce why it is necessary to change the way we design buildings and our urban environment.
2 Recall how nature has inspired efficiency in new buildings.
3 Discuss further innovations that are likely to come and why they are significant for the future of humanity.

RESEARCH 6.2

In New York, designers and architects worked with planting designers to repurpose an unused, elevated rail-bed called the 'High Line'. Visit the High Line website via Cambridge weblinks (www.cambridge.edu.au/geography10weblinks) and discover what they did and why.

Case study 6.2
The heritage of Kolkata

Kolkata has a rich legacy of architecture from its days as the first British capital of India. However, as late as 1984, there was still no movement to preserve this heritage. By then it was already too late to save some of its landmark urban environment – including the Senate Hall of Calcutta University, the most ornamental portion of the Bengal Club, Darbhanga Palace, the original office of All India Radio at Garstin Place and the Dalhousie Institute.

Since there was no official or private organisation for conservation in Kolkata at that time, public protests were not strong enough to prevent the demolition of these significant structures. In 1984, a Kolkata chapter of the Indian National Trust for Art and Cultural Heritage (INTACH) was established and awareness began to rise. However, efforts to protect the architectural **heritage** of the city were still difficult until the Kolkata Municipal Corporation legislated in 1997.

heritage features belonging to the culture of a particular society, such as traditions, languages or buildings that were created in the past and still have historical importance

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The 1997 legislation separated the heritage buildings of the city into three categories according to level of importance. There are 611 buildings regarded as Grade 1 – the highest priority for preservation. Buildings are chosen as Grade 1 either because of how early they were constructed or because of the significant events or personalities associated with it. The law states that no changes can be rendered to the facades of these Grade 1 buildings.

Source 6.15 Currency Building at Dalhousie Square, Kolkata

Conservationists like GM Kapur of INTACH believe that although awareness has risen, conservation is still not a priority, especially in the case of family-owned properties, due to legal issues and lack of funds. For state-owned premises it is often bureaucracy which causes heritage buildings to fall into a state of irreparable damage.

Owners of Grade 1 buildings need to be educated about the difference between restoration and simple repair. In a large number of cases involving private owners, buildings were not restored using compatible materials used in the original construction. In these cases the repairs actually made the damage worse.

A massive restoration project is under way at St James Church (Jora Girja). The steeple and spires of the church are extremely high, making it difficult to reach them using scaffolding. This unique project is being done by labourers sourced from Murshidabad, who are experts in lime work. These labourers are key as there has been widespread use of concrete in heritage buildings, which causes irreparable damage. Similarly, the landmark Currency Building at Dalhousie Square has been restored under the guidance of the Archaeological Survey of India (ASI). The building had stood abandoned for decades, leaving vandals to destroy cast-iron railings, wooden doors and coloured glass murals.

1 List the factors that make a site culturally or historically significant.

2 Explain why some efforts to preserve the architectural heritage of Kolkata have failed.

6.4 New urbanism

new urbanism an urban design movement which promotes walkable neighbourhoods that contain a range of housing and job types

New urbanism is a city planning movement that promotes a hybrid of traditional town planning and contemporary infrastructure to meet the needs of the modern community. This town planning strategy uses a pedestrian-orientated approach and focuses on elements such as sustainability and convenience.

Towns and suburbs built according to a new urbanism planning strategy focus on a community approach, ensuring residential, retail and employment sectors are in close proximity thus cutting down on motor vehicle and traffic congestion.

Cities have expanded outwards to accommodate population growth. Residential areas develop further and further away from main central business districts, forcing people to commute long distances in cars or on public transport. New urbanism counteracts the repercussions of this growth by developing smaller communities with all the necessary amenities that a town or a suburb needs in close proximity, to maintain a sustainable environment.

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The key principles of new urbanism include:

1 *Walkability*
- Residential and business sectors are in close proximity to each other.
- Streets are designed specifically to promote pedestrian-oriented living with enforcement of slow speeds for traffic and easy access to buildings and on-street parking.
- Pedestrian-only streets are incorporated into the design.

2 *Connectivity*
- A street grid network plan is created that allows every street to be accessible on foot and provides multiple alternate routes to alleviate traffic congestion.
- A system of street hierarchy is designed which includes streets, boulevards and alleyways.
- Accessible walkway and pathway networks encourage walking.

3 *Mixed-use and diversity*
- Residential and business sites are combined and mixed within blocks and buildings.
- Socially and ethnically diverse areas are created, accommodating all types of families and individuals.

4 *Mixed housing*
- Different types of housing are created in close proximity, ranging in sizes and prices.

5 *Quality architecture and urban design*
- Surroundings are aesthetically pleasing.
- There is easy access to public amenities within the community.
- The emphasis is on design for efficient use of space rather than grandeur.

6 *Traditional neighbourhood structure*
- There is a distinct centre and edge.
- There is a city centre for the public.
- Attractive open planned public spaces are included.
- Amenities are in close proximity to each other, within a 10-minute walk.
- A higher density centre is created, which reduces towards the edge of the town.

7 *Increased density*
- A large number of residences, businesses and buildings are close together to promote convenience and travel on foot.
- The design can be applied to all sorts of urban environments, from small towns to large cities.

8 *Green transportation*
- A quality public transport network conveniently connects all areas.
- Accessible walkways and bike paths promote use of bicycles and other forms of green transport.

9 *Sustainability*
- Eco-friendly town planning means ensuring minimal impact on the environment.
- Eco-friendly infrastructure is created with technologies using natural systems.
- There is an energy-efficient town structure.
- Use of sustainable energy and less finite fuel is encouraged or mandated.
- There is a focus on local production of goods and services.
- There is a focus on pedestrian living rather than reliance on motor vehicles.

10 *Quality of life*
- The focus is on having a high quality of life using all the amenities the town has to offer.

RESEARCH 6.3

1. Using the 10 new urbanism principles, evaluate the suburb, town or city that you live in. How many principles does your local area achieve?
2. If you were a town planner, would you change any aspects of your local area? Explain your reasons.

Source 6.16 A range of architectural designed houses close together is a feature of new urbanism.

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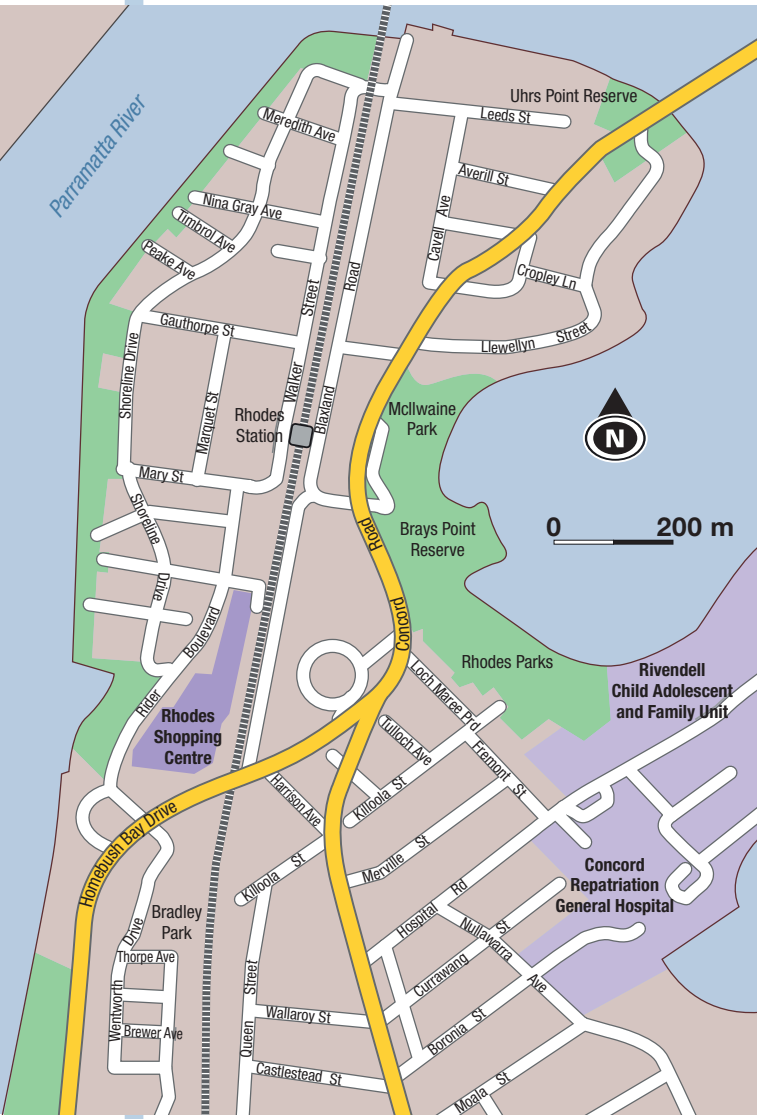
Case study 6.3

Rhodes, New South Wales, Australia

Rhodes is a suburb located in the inner west of Sydney around 16 km from the central business district of Sydney. Rhodes is a peninsula that has Brays Bay to the east, Homebush Bay to the west and the Parramatta River flowing along its northern tip. According to the 2011 census, Rhodes has a current population of 5679 people, an increase from 1668 people in 2006. Once urban development is complete it is expected that Rhodes will have a population of 11 000 people.

Source 6.17 Layout of the suburb of Rhodes



Rhodes has undergone a major urban regeneration and renewal program. The western part of the peninsula was an industrial area with a range of heavy industries causing major environmental damage to the soil and waterways. Companies such as Union Carbide, who manufactured banned pesticides and the defoliant Agent Orange used during the Vietnam War, polluted the soil and waterways with dioxins from the manufacture of these chemicals. In 2002 the New South Wales Government approved a $90 million large-scale remediation program undertaken to remove dioxins from the soil. Once the remediation program was complete the sites were sold to be developed into an urban area of medium and high-density apartments.

Rhodes development

The Rhodes Redevelopment Project was a multi-billion dollar infrastructure and development project designed around a major retail centre and public domain, office developments and residential units; integrated with major highway improvements (Homebush Drive) and the railway line and station upgrades. Similarly, increasing the density of development within the vicinity of the railway station was desirable from a public policy perspective to meet the needs of the State Government's Population Policy.

The Rhodes development was set up using the principle of new urbanism; all the stakeholders (Canada Bay Council, the State Government and developers) believed that the best use of this site was to develop a suburb that utilised the existing infrastructure (railway), mixed use (integrating residential, retail and commercial together), was more sustainable (encouraging greener transport options such rail, walking and bicycle) and had higher urban densities (medium to high-density residential apartments). Therefore, a development plan was established that segmented the development into stages. The first stage was the development of the Rhodes Waterside Shopping

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Centre, a commercial tower adjoining the shopping centre and one residential complex. This stage was completed in December 2004.

In the following years another commercial complex was built along with around 13 more unit complexes that have greatly increased the permanent residential population within the area. Retail shops have developed outside of the shopping centre with a number of cafes, restaurants, gyms and convenience stores being established to cater for the increased number of residents in the area. Another major design feature of the Rhodes development which fits into the new urbanism principle is the development of a foreshore cycleway around the western edge of the peninsula. This cycleway links up with the cycleway to the adjoining Bicentennial Park and Sydney Olympic Park. This allows people to walk or cycle to the Olympic site and the multiple events hosted there. It also allows residents to cycle to other parts of Sydney including to other centres of employment, thus deceasing the number of cars on the roads.

The greening of the suburb is another indicator of new urbanism. Green spaces and parks provide valuable recreational areas for residents especially needed to balance the medium to high-density housing in the area. The establishment of a high proportion of trees and shrubs along the streets lessens the impact of the urban environment and creates a more natural landscape for residents and visitors to the area.

Source 6.18 Remediation of the former Union Carbide Australia Limited herbicide and pesticide plant at Rhodes, New South Wales

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Case study 6.4
Seaside, Florida, USA

Seaside is located on the north-west coast of Florida, in Walton County. It is an 80-acre community development that is promoted as the first development in America of the new urbanism style. It has become well known for its unique architectural styling of the housing in the community. Seaside became internationally recognised because it was the main location used during the filming of the movie *The Truman Show* (1998).

Source 6.19 Seaside's location within the north-west of Florida

In the late 1970s, Robert and Daryl Davis planned to create a unique residential community with the 80-acre site they had inherited. They toured the southern United States looking at the architectural features that give small towns their distinct character. In collaboration with Miami architects Andres Duany and Elizabeth Plater-Zyberk, the elements of small-town design were used to create Seaside, a sensibly laid-out town that would have all of the necessities and pleasures of daily existence within walking distance of one's residence.

Created in 1981 the development is built on a 'neighbourhood' scale and is designed to foster a sense of community. The streets are all interconnected, creating a network that eliminates 'collector' routes and reduces congestion. Walkways crisscross the development to encourage walking and cycling, while narrow streets serve to reduce traffic speed. By keeping the number of parking lots in the community to a minimum, parallel street parking is encouraged, providing pedestrians with a buffer between them and the traffic. Building fronts are a uniform distance from the curb and all streets are tree-lined.

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Source 6.20 Entrance sign to Seaside, Florida

The most important features of this development are the ones that promote interaction among community residents. Mandatory porches are set close enough to walkways to enable porch sitters and passersby to communicate without raising their voices. The community has a discernible centre, creating a common gathering place, and essential services such as shops, schools and post offices are located within a five-minute walk of each home. Community zoning provides for a mix of residential structures, ensuring that the community can provide homes to everyone, including young and old, rich and poor. Seaside contains 350 houses and 300 other dwellings, including apartments and hotels. The town's population of 2000 compares in size to a typical American small town or city neighborhood from the 1920s or 1930s, as does its mixture of uses.

Features of Seaside

- The Seaside plan was designed to optimise waterfront access and views for all of the town's residents not just those with beach-front sites.
- The community's porch-lined streets and walkways all lead to the beach or town centre.
- Seaside's design places an emphasis on the town's public spaces, which range from its main square to the pedestrian-only footpaths at the centres of blocks.
- Considerable architectural variety exists at Seaside.
- A network of sand walkways cuts through the middles of blocks, enabling one to walk comfortably to the beach in bare feet.

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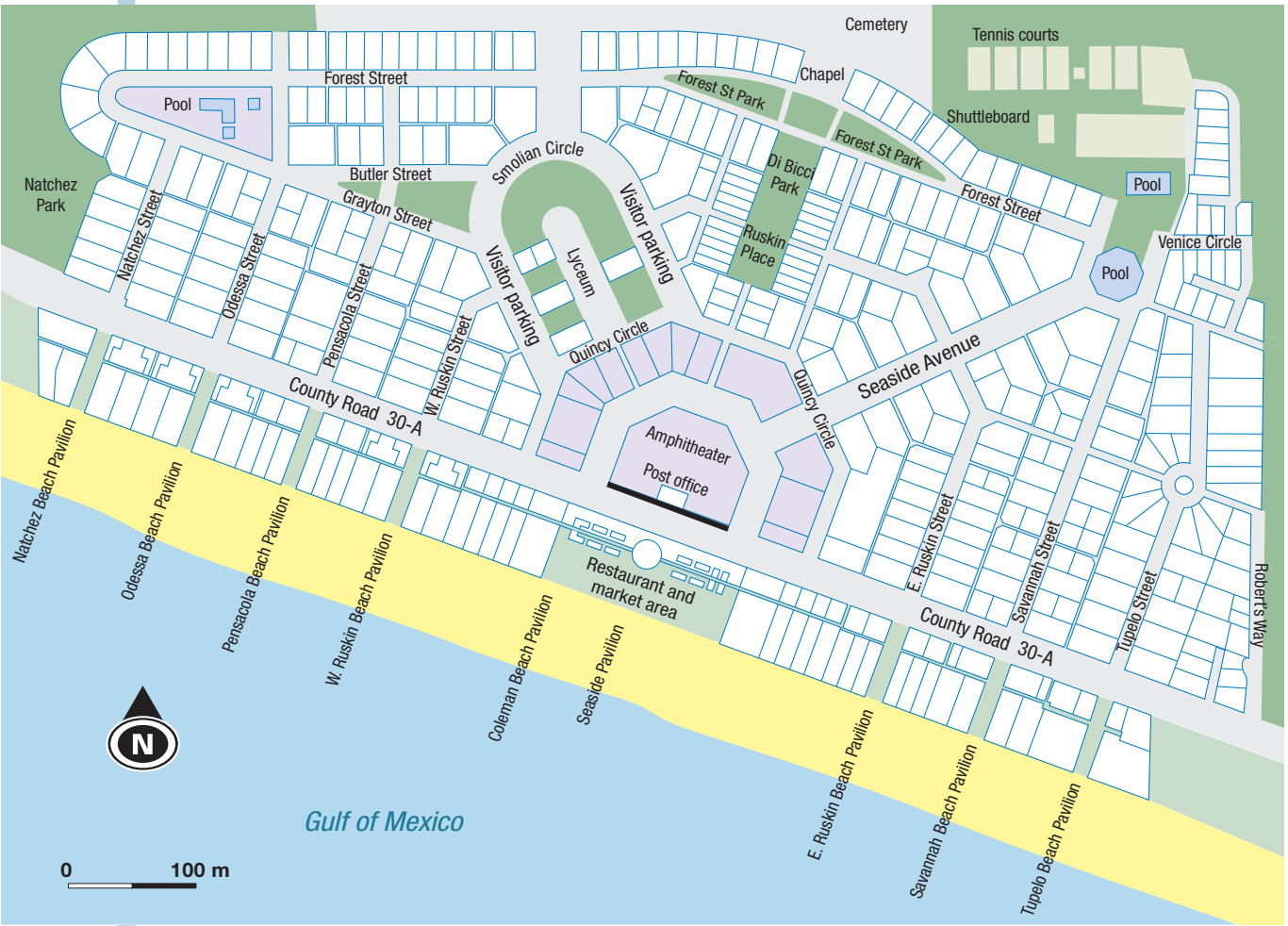
- The majority of the buildings on the beach are public.
- Fences must be of a different style to all the others on the block.
- Front porches are set back about 5 metres behind the fences.
- The streets offer pedestrians the feeling of being in a public room. Keeping the streets narrow and having buildings with uniform fronts achieve this.

1 Explain what the common features are of the design of Rhodes and Seaside.

2 Discuss the benefits to people of living in a town or city designed this way.

3 Justify what the benefits of new urbanism are to the environment.



Source 6.21 This map illustrates the layout and design of Seaside. You can see the central square is the focal point with all roads leading to the central point.

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Chapter summary

- The urban environment is defined as the human-made areas that allow human activities to take place.
- The management of air quality is a major global concern as pollution travels across borders.
- Environmental design is making buildings more energy efficient by mimicking nature.
- Sydney Opera House has implemented an Environmental Sustainability Policy to counter the effects the site has on the local environment.
- Architects are working with scientists to discover ways to use biotechnology to make the urban environment more efficient.
- Efforts to preserve historically significant buildings in Kolkata have sometimes failed or been made worse by poor repairs.
- New urbanism is a movement in city planning that tries to recommit traditional town planning designs to a modern context.

End-of-chapter questions

Multiple choice

1 The best description of a urban environment is:

A an area that incorporates physical features such as rivers, lakes and mountains

B the human-made areas that allow human activities to take place

C a town designed on new urbanism principles

D a building that uses less energy

2 The number of deaths resulting from air pollution in the UK each year is:

A 0

B 700 000

C 4000

D 29 000

3 The best description of biomimetics is:

A the study of how designs can be made more efficient by copying nature

B the study of how animals cool themselves

C the study of how termites stay out of the sun

D the distance between roof gardens

4 Which of these is not a principle of new urbanism?

A Mixed use and diversity of buildings

B Walkability

C Residential and business buildings built closer together than in traditional towns

D Residential and business buildings built further apart than in traditional towns

5 Air pollution in China:

A only occurs in Beijing

B is naturally occurring and made up of dust

C travels up into the atmosphere and to other countries

D is only a problem for China

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Short answer

1 Explain what smog is, in your own words.

2 Describe two ways that architects are making buildings more energy efficient.

3 Compare the difference between new urbanism and traditional urban planning.

4 Give reasons why Rhodes would be classified as a new urbanism development.

5 Would you like to live in the Seaside development in Florida? Justify your reasons.

Extended response

What constitutes an urban environment for cultural or historical purposes and how should planners balance the need for modern sustainable architecture with the preservation of heritage?

In your answer refer to:

- sustainable design
- new urbanism
- spiritual sites of cultural or historical significance.

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UNIT 2
Geographies of human wellbeing

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7 Measuring human wellbeing

Source 7.1 Tea picking on a plantation in Assam, India

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Before you start

Main focus

To explore the multifaceted nature of wellbeing – how it is measured, factors affecting wellbeing, spatial patterns of wellbeing and trends in wellbeing over time.

Why it's relevant to us

The level of human wellbeing is crucial to the effective functioning of society. Standards of living, health and education are top priorities for all governments. Society always seeks to improve people's level of wellbeing.

Inquiry questions

- What is human wellbeing?
- How is wellbeing measured?
- What factors affect the level of wellbeing?
- How do Aboriginal and Torres Strait Islander concepts of wellbeing compare to other Australians?
- Why does wellbeing change over time?
- How has colonialism affected wellbeing?

Key terms

- Colonialism
- Cultural imperialism
- Development
- Gross Domestic Product (GDP)
- Gross National Product (GNP)
- Human Development Index (HDI)
- Ideology
- Spatial patterns
- Wellbeing

Let's begin

The problematic issue of wellbeing is that a high quality of life means different things to different people. Concepts of human wellbeing have changed over time. While levels of economic development as measured by Gross National Product (GNP) and Gross Domestic Product (GDP) are still used, there are more comprehensive measurements available now, such as the Human Development Index (HDI). Colonisation and decolonisation have had profound and lasting impacts on some countries but now less physically intrusive but equally pervasive strategies to accumulate power and wealth are evident in unequal trade relations and neo-imperialism. These new forms of dominance over other cultures have significant impacts on human wellbeing around the world.

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7.1 What does 'wellbeing' mean?

The **wellbeing** of humans is multi-dimensional. It refers to peoples' quality of life. It can be measured in a number of ways such as income, life expectancy, **literacy rates**, women's participation in public life, infant **mortality** and many other indicators. But one commonality is that collecting accurate data is important for monitoring, problem-solving and planning for issues associated with a country's level of wellbeing and even more important for ensuring equal opportunities, outcomes and access to socially valued resources for everybody in society.

wellbeing people's quality of life and happiness that can be measured by health, income, life expectancy, literacy rates, women's participation in public life, infant mortality and many other indicators

literacy rate the percentage of people that can read and write

mortality the number of people dying

Economic wellbeing

Economic wellbeing is the ability to maintain a minimum standard of living. It means you can afford to buy goods and services that you need and want. Income derived from employment is the main determinant of economic wellbeing. Income is often shared between people at home such as between a husband and wife. But income is different to wealth. Wealth refers to assets and valuable possessions. Some retirees have a low income but assets worth thousands of dollars – they are said to 'be asset rich but income poor'. Assets can be sold if needed, to ensure people maintain their standard of living. Both income and wealth are used to measure economic wellbeing.

Another common economic measure of wellbeing is **Gross Domestic Product (GDP)** per capita. This is the value of all the goods and services a country produces and is divided by the number of people living there. This is not a measure of income but is an indicator of the standard of living.

Gross Domestic Product (GDP) the value of all the good and services a country produces divided by the number of people living there

Common measurements of economic wellbeing include:

- average income per person
- unemployment rate
- GDP **per capita**
- **gini coefficient**.

per capita per person

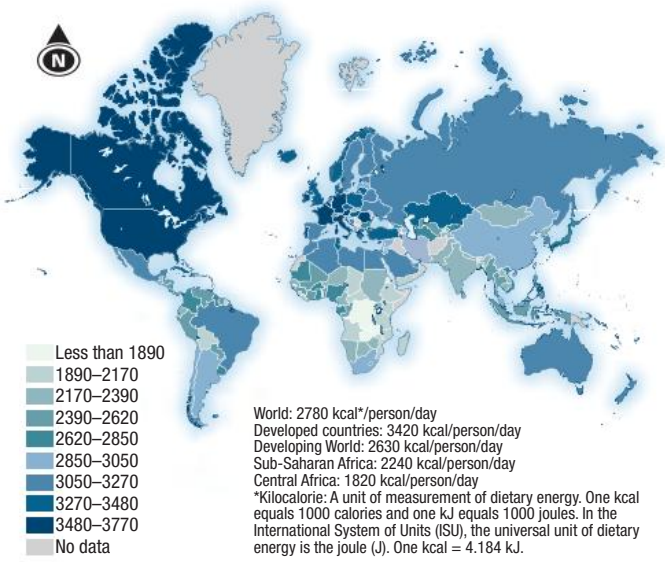
gini coefficient an index which measures the distribution of income

Health and wellbeing

Indicators of health used to measure the wellbeing of a population are many and varied. Each tells us a little bit about what life might be like in a particular region or country. Some indicators include:

- birth rate per 1000 people
- infant mortality rate
- kilojoule intake
- number of doctors per 10 000 people
- life expectancy
- maternal mortality
- death from **non-communicable diseases (NCDs)**
- immunisation rate
- fertility rate
- government expenditure on health
- recorded incidence of diseases such as tuberculosis, malaria, measles, polio and hepatitis B.

non-communicable disease (NCD) a non-infectious disease that cannot be passed from one person to another such as heart disease, cancer, diabetes and mental health issues



Source 7.2 Daily calorie intake per capita

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Political wellbeing

Political wellbeing from an Australian perspective refers to the application of democracy, where all people have a say. Indicators of political wellbeing can include:

- free and fair elections
- representation in parliament/government
- incidence of rallies, protests or demonstrations
- searching for political information
- contacting a politician
- signing a petition
- number of **prisoners of conscience**.

prisoner of conscience a person who is imprisoned because of their beliefs and political allegiances

ACTIVITY 7.1

1. Discuss what is meant by wellbeing.
2. Analyse why wellbeing is difficult to measure.
3. Distinguish between income and wealth as indicators of economic wellbeing.
4. Indicate how economic wellbeing can be measured.
5. Using your knowledge and experience, examine the level of political wellbeing in Australian society.

RESEARCH 7.1

Explore the website of the World Health Organization (find the link on Cambridge weblink www.cambridge.edu.au/geography10weblinks). Write a report that addresses the following:

- the role of the WHO
- current projects and campaigns of the WHO
- compare the health statistics of Australia and three other countries.

Demographics and wellbeing

Demography is the study of people and human populations, so in a way this relates to all the other indicators of wellbeing. Aspects associated with populations that can be used to measure wellbeing include:

- population density
- percentage of people aged 15 and under
- percentage of people aged 65 and older
- population projections.
- migrant population
- refugee population
- gender inequality/equality
- cultural diversity
- number of registered marriages/divorces
- sustainability
- public services and facilities
- literacy rate
- university enrolments.

Geographical fact

In 2011 Sweden ranked the highest in the world for its level of gender equality while Yemen ranked the lowest (UNDP 2011).

Social wellbeing

Social wellbeing not only encompasses other aspects of wellbeing already mentioned but also often refers to the level of 'harmony' and progress made in society. Some measurements may include:

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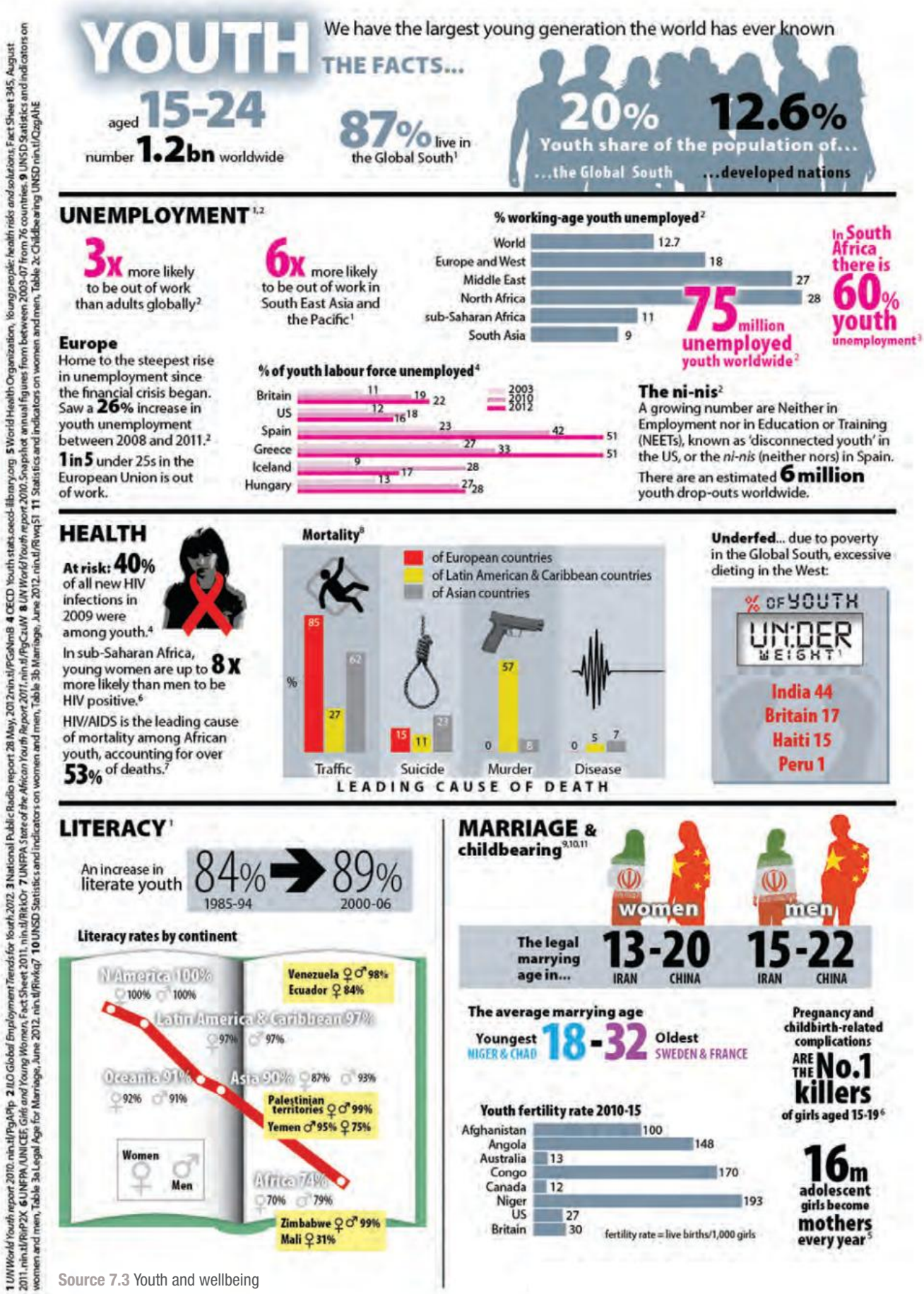

1 UN World Youth report 2010. nin.tl/PgAPlp 2 ILO Global Employment Trends for Youth 2012. 3 National Public Radio report 28 May, 2012 nin.tl/PGsNmB 4 OECD Youth stats.oecd-ilibrary.org 5 World Health Organization, Young people: health risks and solutions, Fact Sheet 345, August 2011. nin.tl/RiP2X 6 UNFPA/UNICEF, Girls and Young Women, Fact Sheet 2011. nin.tl/RtkOr 7 UNFPA State of the African Youth Report 2010. Snapshot annual figures from between 2003-07 from 76 countries. 9 UNSD Statistics and indicators on women and men, Table 2c Childbearing UNSD nin.tl/QzgAhE 10 UNSD Statistics and indicators on women and men, Table 3a Legal Age for Marriage, June 2012. nin.tl/Rivkq7 11 Statistics and indicators on women and men, Table 3b Marriage, June 2012. nin.tl/Rivq51

Source 7.3 Youth and wellbeing

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Spiritual wellbeing

Spiritual wellbeing is integral to the social and emotional health of many people. Spirituality refers to seeking and/or following a certain path in life, and finding solace in particular activities. Spirituality is different from religion. Religion implies an adherence to a faith tradition such as Islam, Hinduism, Buddhism, Judaism or Christianity. Religions seek to answer life's big questions such as 'how did we get here?' and 'what happens when we die?'

Spiritual wellbeing means that people can choose their path or faith without persecution or harassment. It is difficult to determine spiritual wellbeing as it is highly personal in nature, but some academics have developed questionnaires targeting how people feel about themselves, the community, the environment and **transcendence**. Scores are allocated according to the responses and conclusions can then be drawn from trends in data.

transcendence relationship with a higher being or force

Other measurements for spiritual wellbeing are:

- adherence to a faith
- attendance at a religious ceremony or service.

Geographical fact

Hinduism is the fastest-growing religion in Australia (2011 Census).

ACTIVITY 7.2

1. Explain what is meant by demography.
2. Distinguish between social wellbeing and spiritual wellbeing.
3. Deduce how a lack of spiritual wellbeing could affect society.
4. Justify the need to ensure wellbeing for youth. Use statistics as evidence in your response.

7.2 Ideology and wellbeing

Ideology can influence views about wellbeing. Ideology refers to a set of beliefs or ideas about how society should function, aiming to satisfy the aspirations of an individual, group or organisation. Different people hold vastly different views about this, often sparking intense debate, conflict and, in extreme cases, war about the best ways to divide resources and power among people, businesses or governments.

ideology a set of ideas about how society should run; for example, the political system

macro level large scale as opposed to micro level (small scale)

Ideology directly impacts policies made at a **macro level** (i.e. government policies) that affect the population of a country and its people. For example, Australia is a capitalist country where people can buy and sell assets and property as they please. There is private ownership of resources and businesses. This in turn may influence the details of taxation law, whereby companies are taxed higher than individuals. The ideology of socialism believes the greatest welfare for all people affects tax laws. In Norway, people are taxed sometimes 60% of their income. This is then put towards benefits for those who need it, such as money in the health system for the sick and welfare payments for the unemployed. Each country pursues the goals of wellbeing in a different manner.

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Ideology	Main ideas
Economic ideologies	
Communism	A classless society where all are equal except the government plans and owns resources. Collective ownership of property
Feminism	Movement seeking to gain equal civil, political and economic rights for women
Environmentalism	Work towards protecting the environment
Socialism	Community ownership, focus on equality of wealth. Welfare of the people is a high priority
Nationalism	Devotion to your country, pursuing national rather than international goals, at times fanatical patriotism
Political ideologies	
Capitalism	Private ownership of property
Democracy	Individuals have power; they elect representatives to form the government

The subjective nature of wellbeing

It is important to note that the concept of wellbeing can be quite **subjective** dependent on personal **paradigm**. For example, economic wellbeing depends on your view. The pursuit of a high income is not sought after by everybody in society. Volunteers may have a low level of economic wellbeing compared to other occupations but they may have an incredible sense of social and emotional wellbeing because they are contributing something to society and acting for the benefit of others. Similarly, political wellbeing is rather subjective. Not all people participate in government elections in the USA, but voting is compulsory in Australia. Both countries consider themselves democracies yet one forces people to vote.

subjective personal views and feelings associated with a topic. Opposite to 'objective' which is factual information

paradigm thought patterns or concepts

Source 7.4 Different ideologies exist all over the world.

ACTIVITY 7.3

1 Define the term 'ideology'.

2 Explain why Norway has a high level of wellbeing.

3 Complete the table below to show what you think are the impacts of different ideologies on wellbeing. The first one has been done for you as an example

Ideology	Impact on wellbeing (positive or negative?)	Example
Environmentalism	Positive – promotes sustainability and ensures society thinks about responsible resource use	Greens political party in Australia
Communism		
Feminism		
Socialism		
Nationalism		
Capitalism		
Democracy		

4 Project yourself into the position of a person in a country affected by spiritual restrictions. Compose a diary entry that highlights your level of wellbeing and significant thoughts, feelings and actions of living in a **theocracy**.

5 Explain why the concept of wellbeing is subjective.

theocracy system of government in which priests rule in the name of God or a god

RESEARCH 7.2

Investigate what irredentism is. Discuss how irredentism could be both beneficial and detrimental to the wellbeing of some communities. Use the scaffold below to help you structure your extended response. Each box represents a paragraph but obviously, you can include more points or expand your information as you are able.

Introduction
Foreshadow your main points.

Provide background to your argument
Clarify exactly what it is you're talking about (define irredentism)
Mention findings of past studies and data.

Beneficial – point 1
Topic sentence
Explanation
Evidence/example (reliable source)

Beneficial – point 2
Topic sentence
Explanation
Evidence/example (reliable source)

Beneficial – point 3
Topic sentence
Explanation
Evidence/example (reliable source)

Detrimental – point 1
Topic sentence
Explanation
Evidence/example (reliable source)

Detrimental – point 2
Topic sentence
Explanation
Evidence/example (reliable source)

Detrimental – point 3
Topic sentence
Explanation
Evidence/example (reliable source)

Conclusion
Re-emphasise your main point and reach a logical conclusion from the information you have presented.

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7.3 Australian cities and spatial patterns of wellbeing

In Australian cities, wealthy suburbs, poorer suburbs and suburbs dominated by particular ethnic, cultural or religious groups have formed. This has occurred for a variety of reasons. People tend to congregate towards like-minded people but a prime factor in these suburbs is income. Income was once closely linked to family history and education. Those who could afford university went, and those who completed university attained higher paying jobs. But with the rise of information technology, social media and skills shortages in trades, the old-fashioned paradigm has been challenged as to who the wealthy people are. There are prolonged trends though of where the advantaged and disadvantaged people live. Facilities and support have become structured in ways to suit the clientele in a specific area. For example, the retail shops and charities operating in various suburbs can be an indication of the relative wealth of the population there.

Patterns of inequality are evident in data collection via the **Census** and academic research. Recent research by Griffith University's Urban Research Program revealed the following trends regarding segregation, coexistence, social inclusion, social exclusion and social polarisation in Australian cities. **Spatial patterns** showing where these trends are taking place can then be mapped to provide a visual depiction of wellbeing.

Census initially the ancient Roman registration of citizens and their property to calculate tax, it is now a count of the population with additional details such as age, sex, occupation, residence, transportation and religion

spatial patterns patterns and trends in where things are located

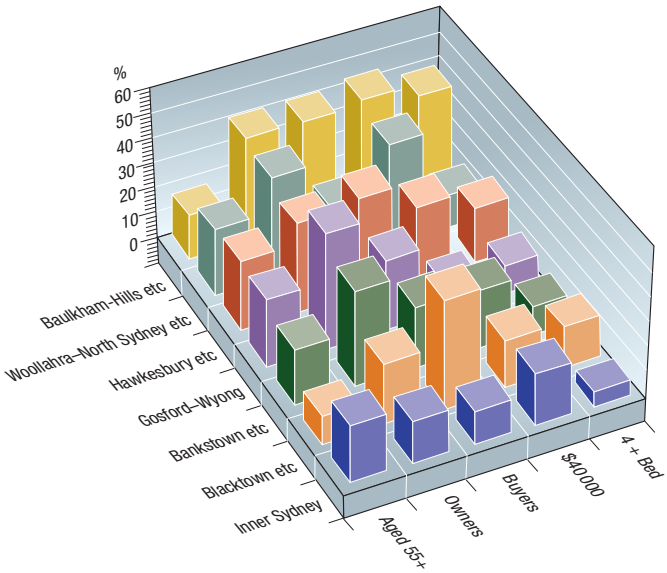
Segregation and coexistence

Segregation refers to the separating of people or groups in society. In the past, this has occurred largely to migrants from a different ethnic, religious or cultural background than the majority of Australians. Segregation can affect the wellbeing of a city because it is not a positive outcome of government policy or social practice. It can lead to a decline in the wellbeing of a city. Segregation can be the result of activities restricted due to income or language spoken. Segregation may have stemmed from the White Australia Policy, where all non-Caucasians were not permitted entry into Australia. However, following this, the government pursued a policy of multiculturalism and Australia is now one of the most culturally diverse countries in the world. Such **coexistence** of a range of groups provides Australia with a unique identity and a rich multicultural heritage. Despite this, a number of **enclaves**, or pockets within cities, have developed over time where people of similar background are concentrated, usually due to familial ties, support structures and sense of comfort settling in. However, now segregation is based more along economic lines, and depending on where you live you may see just one end of the spectrum or anywhere in between – you may see evidence of segregation or different groups coexisting in harmony.

segregation a division or parting of something

coexistence when two or more things or people live together in the same space or place

enclave a pocket of land or territory surrounded by another territory



Source 7.5 Graph showing wellbeing in different areas within Sydney

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Social inclusion and social exclusion

Cities are complex and dynamic places where life happens at a fast pace. Continual changes mean that some people can be 'left behind' or feeling like society is changing rapidly and they have little to no involvement or control over events. Social exclusion is about people not feeling connected to society. Their perception is subjective to some extent. The elderly and the homeless are two groups who can feel socially excluded because they may not be involved in paid work (although many wish to be), they may not have the means or capacity to manage their own affairs due to illness or loss of skills, and they may not be aware of community events or changes. The wellbeing of society must take into account all people, not just those who can keep pace with rapid change. Social inclusion refers to the opportunity to connect with the community, family and friends, participate in society through avenues such as employment and access to services and be heard. The first person appointed as the Minister for Social Inclusion was Julia Gillard, when she was Deputy Prime Minister to Kevin Rudd.

Social polarisation

Social **polarisation** refers to the disparity between rich and poor. It is about income inequality. Spatial patterns are evident in Australian cities based upon households with high, middle or low incomes. All Australian state capitals have experienced social polarisation. For example in Sydney, high-income households tend to be located on the north shore and eastern suburbs. Spatial patterns tracking income of households build a picture of wellbeing in cities. In the late 1990s Australia underwent significant economic growth, from which the upper and middle classes seemed to benefit greatly, many of whom were engaged in the 'new economy'. However there was also a growth in poverty, creating a widening gap between rich and poor. In the outcomes of economic restructuring during the late 1970s and early 1980s resulted in localities on the northern and southern fringes of the metropolitan area becoming more unequal in terms of income and access to viable employment opportunities.

polarisation a widening gap between two things, creating stark differences, almost opposite each other

ACTIVITY 7.4

1. Discuss why spatial patterns have emerged in wellbeing.
2. Describe the meaning of an enclave.
3. Explain how it is possible that we can have a segregated yet coexisting society.
4. Distinguish between social inclusion and social exclusion.
5. Examine the maps on pages 182 and 183 showing the location of high-income households in Sydney and unemployment in Sydney to answer the following questions:
   - **a** Name 2 suburbs with 48% or more households having a high income.
   - **b** Name 2 suburbs where less than 13.3% of households have a high income.
   - **c** Suggest reasons why the west and south-west may have few high-income households.
   - **d** Brainstorm the types of jobs people in high-income households might have.
   - **e** Name 2 suburbs with over 8.4% unemployment.
   - **f** Analyse the spatial patterns of unemployment and high-income households in Sydney.

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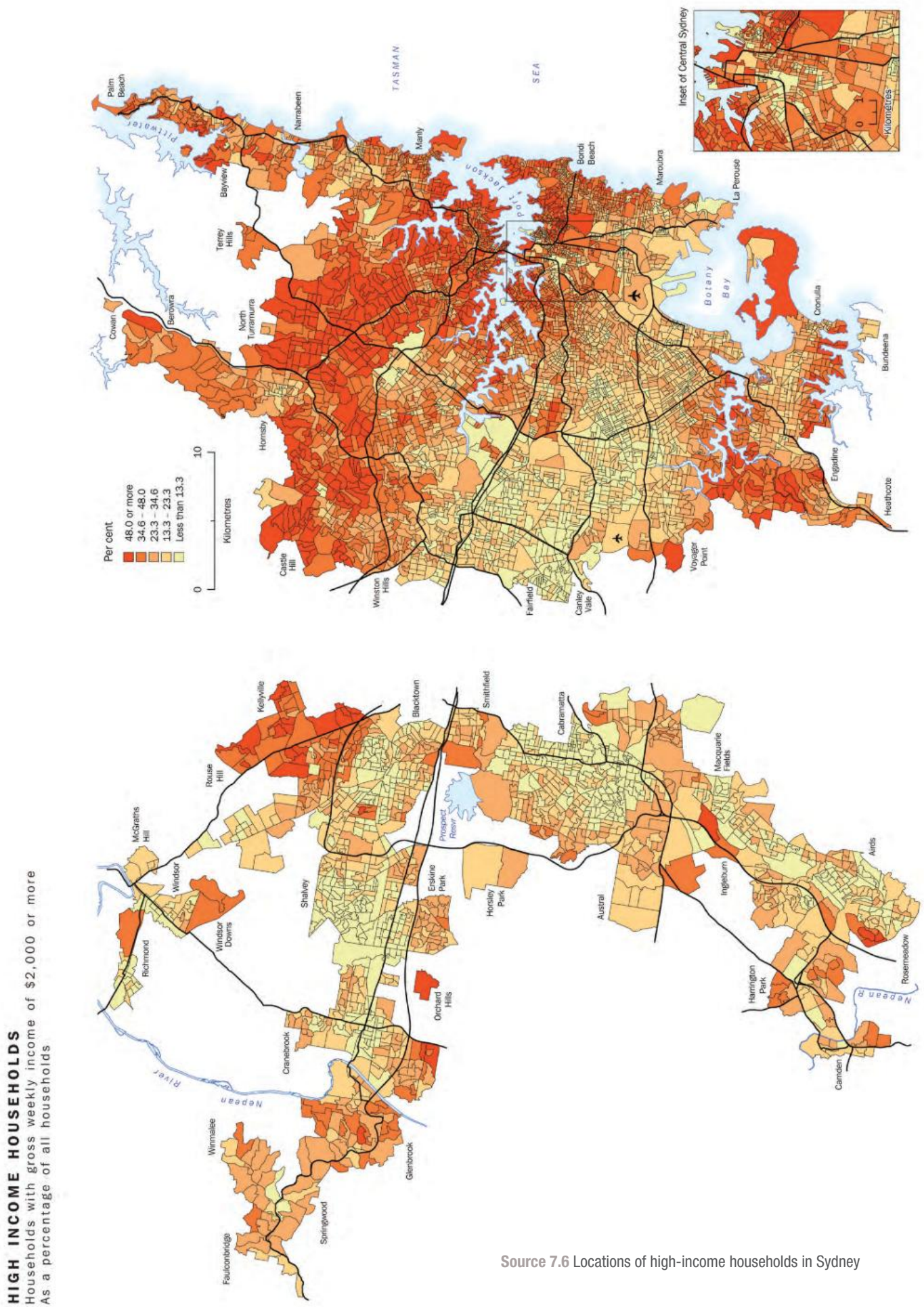

Source 7.6 Locations of high-income households in Sydney

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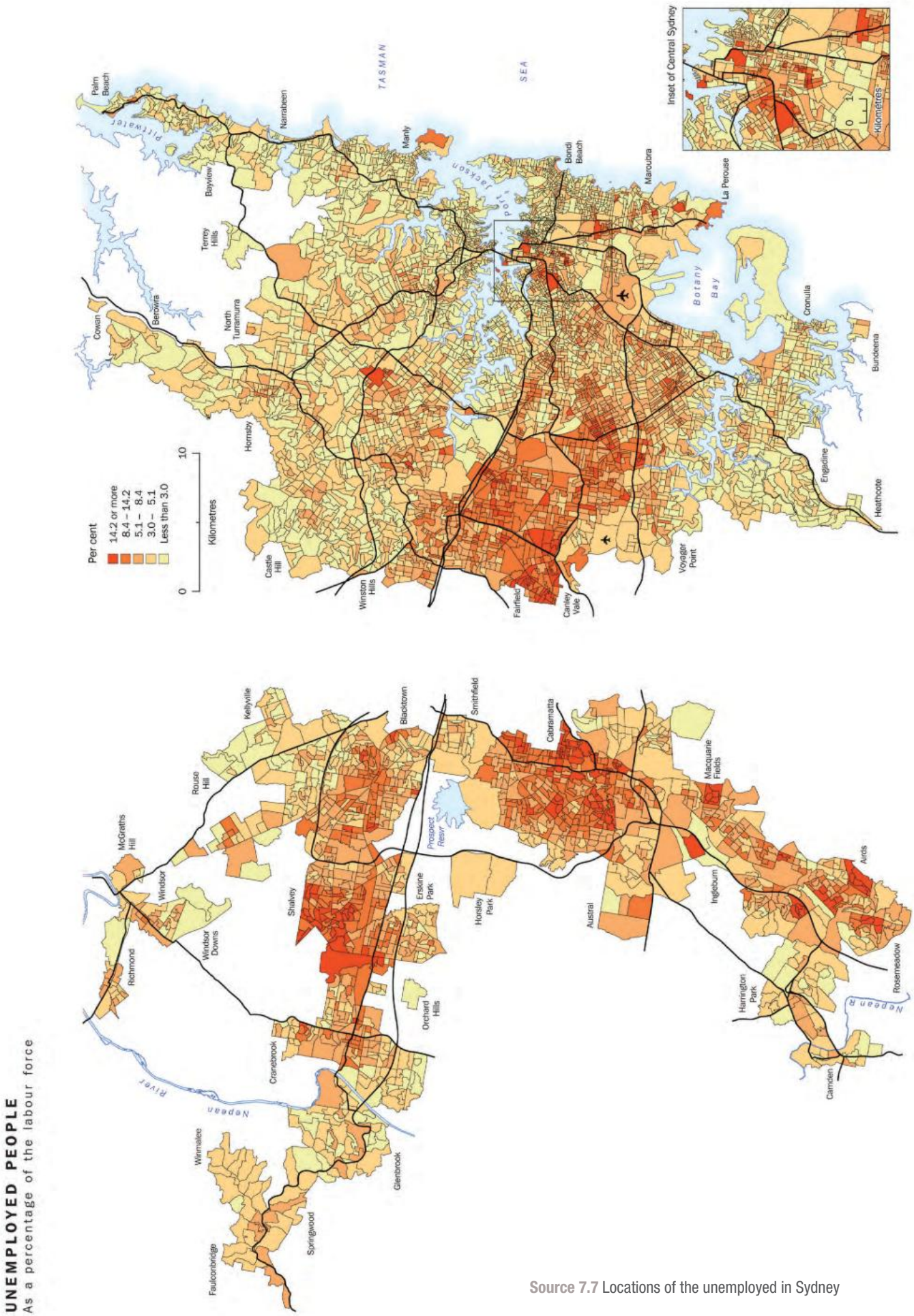

Source 7.7 Locations of the unemployed in Sydney

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Suburbanisation of poverty

Large working-class communities once dominated the centres of the major cities of Melbourne, Brisbane, Sydney, Perth, Adelaide, Hobart, Darwin and Canberra, but have now moved to the outer suburbs of these cities. Such a phenomenon is known as the **suburbanisation** of poverty. This trend has occurred for a number of reasons, including higher land prices and high rents close to central business districts (CBDs) forcing factories and residents to move out; and **economic restructuring** policies placing an emphasis on services rather than manufacturing. The wellbeing of a city is dependent upon low levels of unemployment so as to ensure people are not living in poverty. It needs to cater for those involved in the 'old economy' manufacturing jobs. These people are also more likely to be under housing stress – defined as more than 30% of income being dedicated to housing, either mortgage or renting. Now there are over 3.5 million people living in poverty. New economy jobs are those in service-based industries such as legal services, advertising, communication, entertainment and retail. They usually generate higher incomes than manufacturing-based jobs and this can create spatial patterns of economic wellbeing within a city.

suburbanisation a process whereby people, businesses and warehouses move from the inner city out to the suburbs, usually due to cheaper land, accessibility to major transport routes and labour supply

economic restructuring an economy moving from a manufacturing base to a service base

Social mobility

Social mobility is the degree to which families or individuals can move up the social strata over a period of time, otherwise known as intergenerational mobility. It mostly is the result of a change in income. The new economy has provided millions of Australians with the means to 'better' their circumstances. For example, many stockbrokers, software developers, online retailers, merchant bankers, underwriters for insurance and owners of media, and social media **entrepreneurs** have made millions in the new economy. Australia has also prided itself on being a classless or **egalitarian** society but in reality, it is not very easy to move up the social **strata**, despite being one of the most socially mobile and geographically mobile populations in the world. New wealth generated provides an increased level of economic wellbeing for some people. (To learn more, visit the Griffith University study via Cambridge weblinks, www.cambridge.edu.au/geography10weblinks.)

social mobility the ease of moving up 'levels' in society

entrepreneur someone who takes a risk in owning or operating a business

egalitarian equality for everyone in terms of social, political, economic and civic rights

strata layers or levels

ACTIVITY 7.5

1. Define the term 'suburbanisation'.
2. Distinguish between the 'old' and 'new' economy.
3. Explain why manufacturing-based jobs have moved out to the suburbs and away from the city centres.
4. Discuss the spatial patterns of secondary and tertiary jobs using the maps provided.
5. Distinguish why Australia is considered one of the most socially mobile countries in the world.
6. Analyse whether social mobility should be used as an indicator of wellbeing. Provide reasons for your answer.

RESEARCH 7.3

Use the Australian Bureau of Statistics Social Atlases to critically analyse spatial patterns of wellbeing in your state or territory's capital city. In your report you must include the following:

- information on population, cultural diversity, education, labour force, income and housing
- relevant maps
- significant statistics
- reference to specific suburbs or regions within the city.

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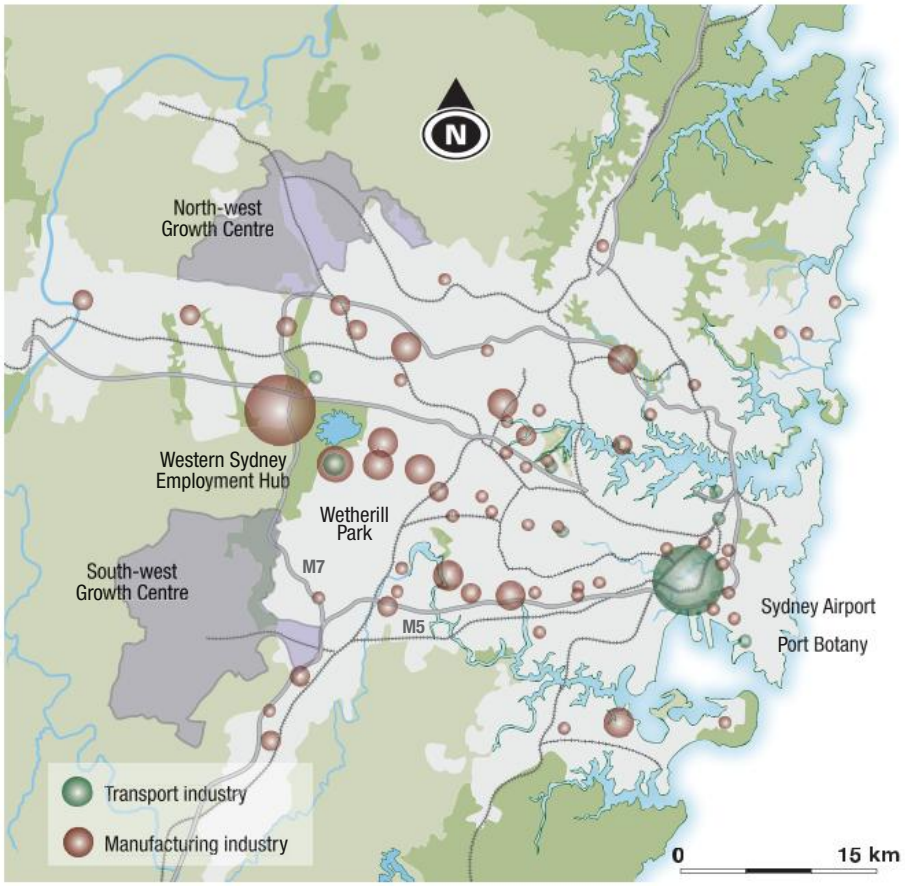

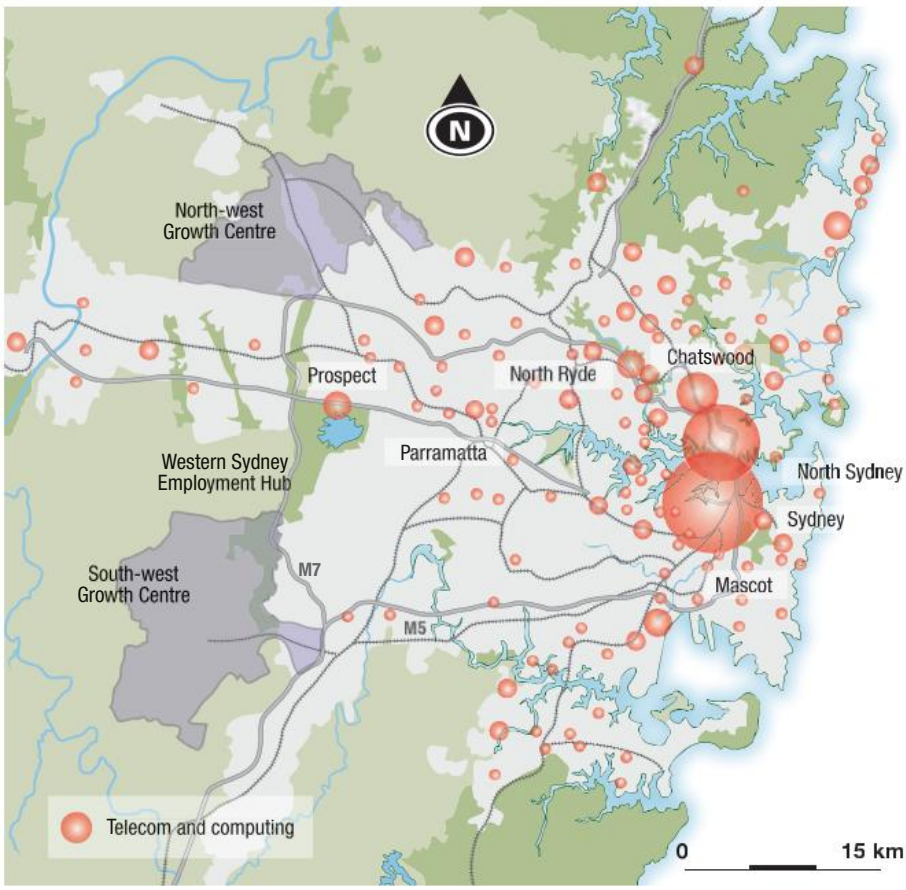

Source 7.8 Locations of secondary and tertiary industries

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7.4 Aboriginal and Torres Strait Islander peoples' perspectives of wellbeing

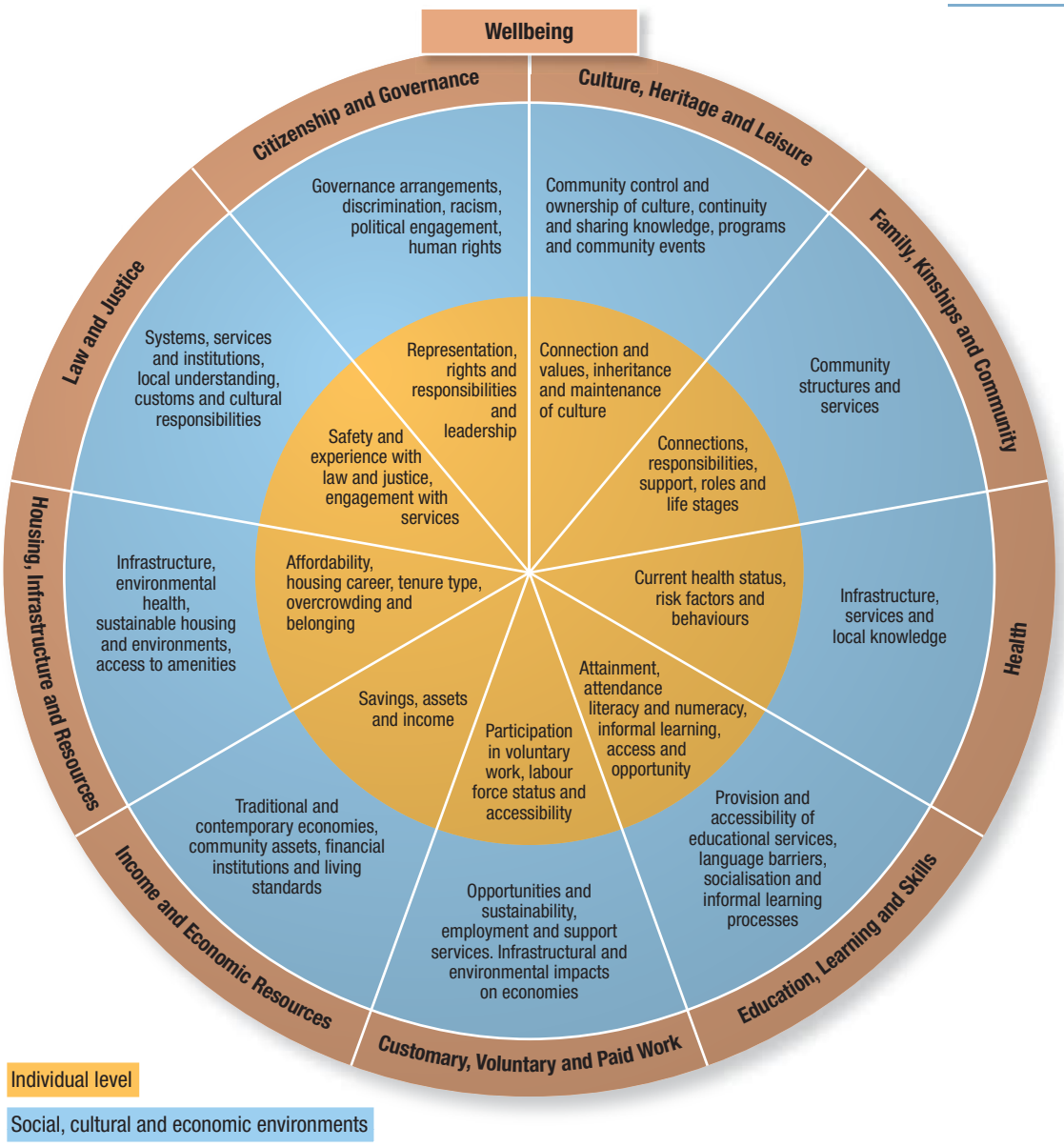
The notion of wellbeing for Aboriginal and Torres Strait Islander peoples is quite different from that of non-Indigenous Australians. Aboriginal and Torres Strait Islander peoples' wellbeing is collective – it relates to the community, so the wellbeing of the community is of utmost importance. And of course **self-determination** and **reconciliation** are crucial. For non-Indigenous Australians, wellbeing is more about the individual and most likely to be associated with trying to increase their income and wealth as these then have flow-on effects to other forms of wellbeing.

Aboriginal and Torres Strait Islander peoples' perspectives of wellbeing hinge upon identity and can include cultural attachment, understanding of the Dreaming, cultural continuities, sense of pride and identity, control over ways of life and economic **developments**, security for the adequate supply of basic materials, and personal

self-determination the right to choose to act in a certain way. The term is most often associated with indigenous peoples around the world and their right to govern and make decisions for the betterment of their people as they see fit

reconciliation a process of restoring respect and understanding for each other to create positive change in relationships

development a state of growth or progress



Source 7.9 Aboriginal and Torres Strait Islander peoples' wellbeing framework

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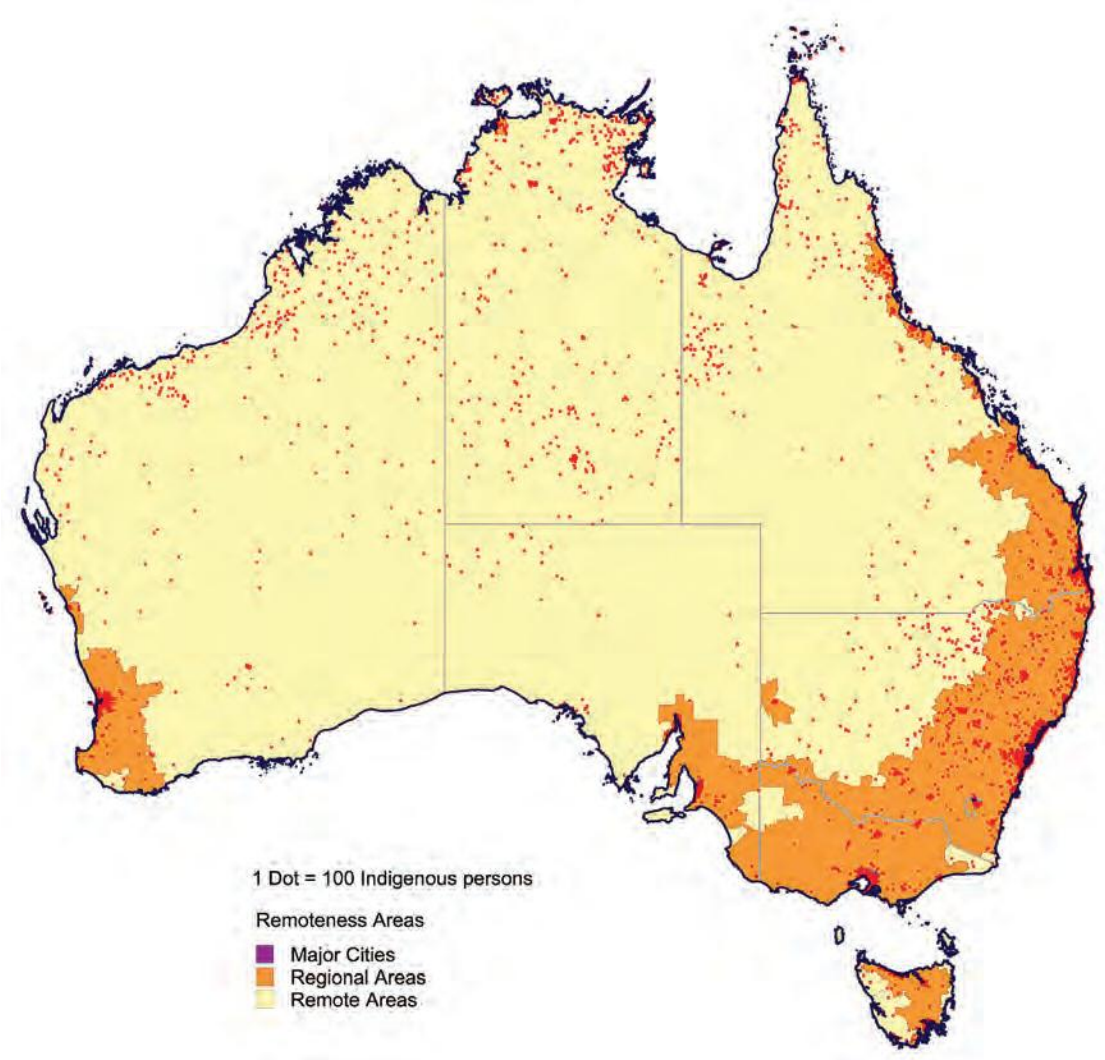

Source 7.10 Population distribution of Aboriginal and Torres Strait Islander peoples

freedom. Together, all the elements combined provide a **holistic** view of Aboriginal and Torres Strait Islander peoples' wellbeing.

holistic the importance of the entire or whole of something but recognising the interdependence of inner parts

The Australian Bureau of Statistics has found stark differences between the wellbeing of Aboriginal and Torres Strait Islander peoples in remote areas compared to those living in major cities. People in remote areas:

- are more likely to have more children than in other areas; 24% of Aboriginal and Torres Strait Islander women over 40 have five or more children compared to 13% in major cities
- are more likely to report having higher levels of cultural attachment (e.g. speak an Indigenous language at home, participate in cultural activities and identify with a language group)
- are less likely to be engaged in full-time employment or education
- experience a high income disparity compared to people in regional areas or major cities
- are more likely to live in overcrowded conditions; 52% of people live in households without a sufficient number of bedrooms
- overall have a greater sense of positive wellbeing than their urban counterparts.

One government initiative to promote Aboriginal and Torres Strait Islander peoples' cultural wellbeing is 'use and occupancy maps'. The ABC reported that use and occupancy maps have been drawn up for the Yawuru people of Broome to illustrate peoples' connection to country. Such maps have been used extensively in Canada as well and help to strengthen the community's ties to the land, contribute to a sense of place and give indigenous youth a tangible link to their own history.

Contemporary measures of Aboriginal and Torres Strait Islander peoples' wellbeing have been imposed by various institutions and include things such as social wellbeing, health and other economic and legal indicators. Measurements are required in

contemporary refers to the current time. In some contexts it can mean modern too

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order to determine if improvements have been made. Major attempts to reduce inequalities between Aboriginal and Torres Strait Islander peoples' and non-Indigenous peoples' wellbeing outcomes have been made in the last 15 years in particular – gaps still exist but some improvements have occurred. The Australian Human Rights Commission has reported significant inequalities between Aboriginal and Torres Strait Islander peoples' health outcomes and non-Indigenous health outcomes.

- Between 1996–2001 life expectancy for Indigenous people was 17 years below the national Australian average.
- In 2003–04, Aboriginal and Torres Strait Islanders were up to twice as likely to be hospitalised for mental and behavioural disorders as other Australians.
- In 2000–02, babies with an Aboriginal and Torres Strait Islander mother were twice as likely to be low birth weight babies (those weighing less than 2500 grams at birth), compared to babies with a non-Indigenous mother.
- In 1999–2003, two of the three leading causes of death for Aboriginal and Torres Strait Islander people in Queensland, South Australia, Western Australia and the Northern Territory were chronic diseases of the circulatory system and cancer.
- In 2003, notification rates among Aboriginal and Torres Strait Islander Australians for the majority of communicable diseases were higher than among other Australians. Rates of chlamydia, gonococcal infection and syphilis infection among Aboriginal and Torres Strait Islander people were up to 93 times the rates among other Australians.

ACTIVITY 7.6

1. List three disadvantages that Aboriginal and Torres Strait Islander peoples in remote areas may face in regard to wellbeing.
2. Describe the holistic approach to Aboriginal and Torres Strait Islander peoples' wellbeing.
3. Outline how use and occupancy maps can contribute to Aboriginal and Torres Strait Islander peoples' wellbeing.
4. Explain why self-determination, reconciliation and identity are crucial to Aboriginal and Torres Strait Islander peoples' wellbeing.
5. Compare the health and wellbeing of Aboriginal and Torres Strait Islander peoples and non-Indigenous people.

RESEARCH 7.4

Investigate the purpose, implementation and outcomes of the Northern Territory Intervention. Draw conclusions, based upon evidence you collect, to determine whether this strategy to improve the health and wellbeing of Aboriginal and Torres Strait Islander communities has been successful or not. Create a mini-documentary of approximately five minutes to show your class group. For your documentary you must:

- first, read and research
- write your commentary
- record your commentary (you can download 'audacity' for free)
- source relevant graphics, news reports and other clips to enhance your documentary
- add any titles, captions, credit and special effects.

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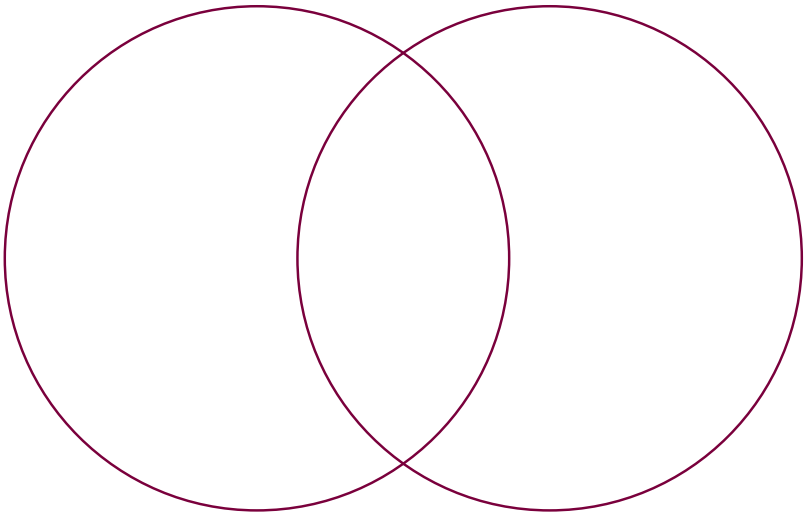
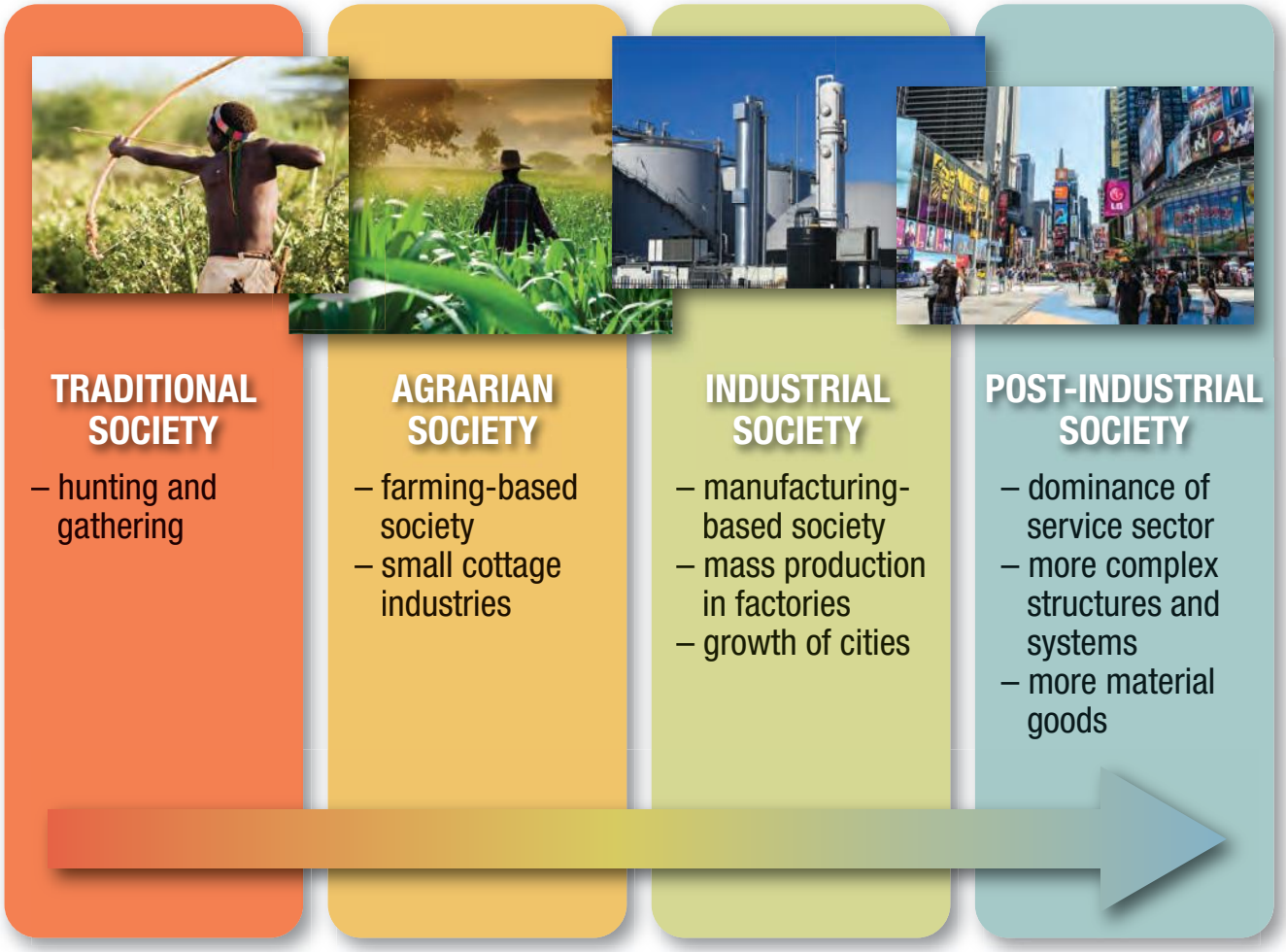
NOTE THIS DOWN

Copy the graphic organiser below and compare and contrast Aboriginal and Torres Strait Islander peoples and non-Indigenous concepts of wellbeing.





Source 7.11 Traditional path of development

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7.5 Traditional measures of development

Development has traditionally been thought of as a **linear** process whereby nations follow one path moving from **agrarian** to industrial to post-industrial societies. Many assume that the processes of **industrialisation** and **modernisation** are beneficial, advanced and better than those countries that may not have experienced such things.

linear in a line or tracking along one path

agrarian agricultural, farming-based activity

industrialisation the process of a society moving from being largely agriculturally based to manufacturing based, often characterised by mass production

modernisation the process of society moving from traditional systems to other systems using technology efficiency, often linked to higher incomes and higher standards of living

Development usually entails a holistic improvement to society from which the whole population benefits. This might be a greater income, better health care, higher standards of education, environmental conservation, upholding of human rights, a just legal system, availability of employment and the preservation of cultural heritage. Two main methods of measuring development on a national scale include Gross National Product and Gross Domestic Product. Each has its own advantages and disadvantages; but now a mix of indicators are used to create a picture of what a country is really like.

Gross National Product

Gross National Product (GNP) is the measure of the value of all the goods and services a country produces in a year. It is measured in dollar units and indicates the general direction of a country's economy. The level of development of a country once equated to the level of material output but this is not the case any more. GNP was mainly used to highlight poverty in some countries. If trends indicated falls in GNP then this meant a fall in the wealth of the population. GNP measures the output of a country including those businesses that are located overseas but owned by the same country.

Gross National Product (GNP) the measure of the value of all the goods and services a country produces in a year

Gross Domestic Product

Gross Domestic Product (GDP) is a commonly used measure of wealth generated by all the output produced within a year by a country, whether the enterprises are owned locally or by foreign companies. It is an indicator of the health and size of the economy. GDP consists of consumer spending, investment by businesses and government spending. All the goods and services produced, government purchases, corporate investment plus net imports and exports are included in this measurement so the size of the economy can be determined. One advantage of using this measurement is that it is relatively easy to compare growth from year to year. It is also used in the same manner by nearly all countries in the world so it is easy to compare statistics with other countries.

One disadvantage is that because it only takes productive activity into account, other things like volunteer work are not considered. It is a good measure to use but does not provide a complete picture about the wellbeing of people because it doesn't take into account environmental degradation, which can severely affect people's livelihoods. A total figure may be derived for GDP and country rankings made, but when the measurement of GDP per capita is formed, country rankings change. For example, GDP does not show the impact of natural disasters (but government spending in relief efforts is included in GDP), the quality of goods (because cheaper goods may not last as long, therefore people have to buy more), or debt.

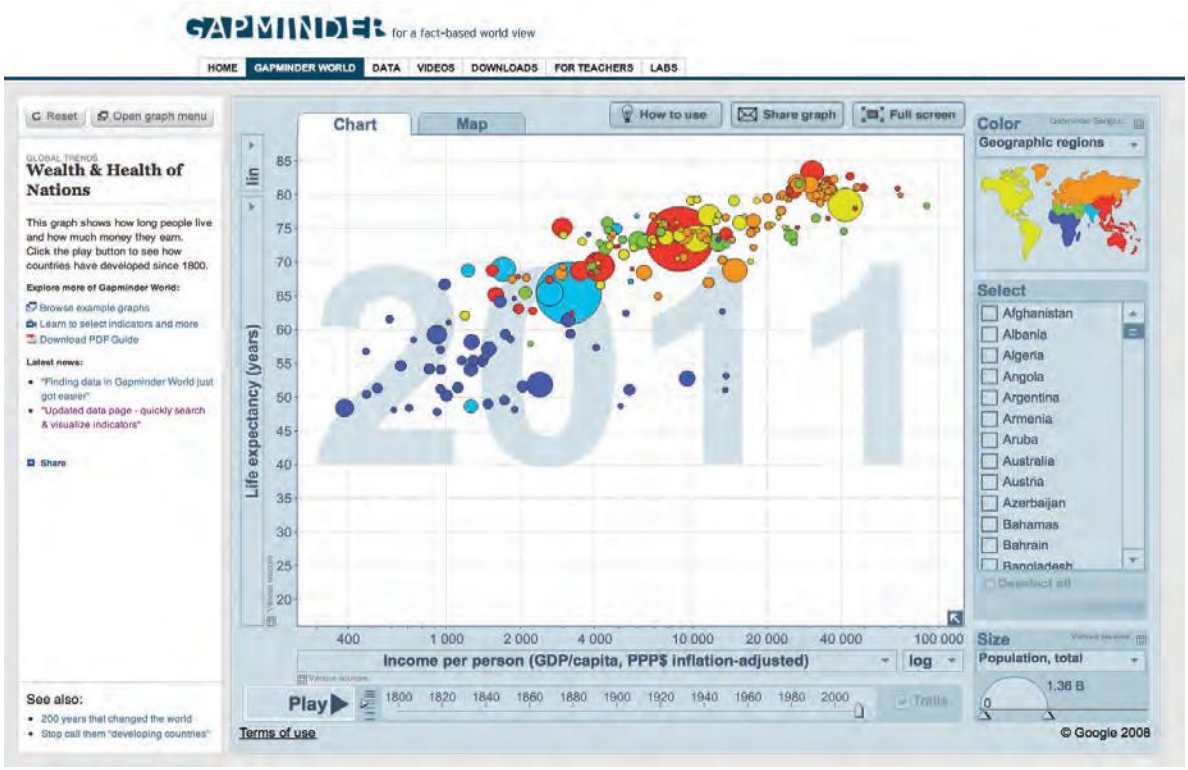
Geographical fact

Qatar and Luxembourg have the highest GDP per capita of over $80 000 while the Democratic Republic of Congo has the lowest, the only country under $400 (IMF and World Bank 2011).

ISBN 9781107696969

ACTIVITY 7.7

1. Describe what the traditional notions of development entail.
2. Distinguish between GNP and GDP.
3. Use the Gapminder website (for the link, see www.cambridge.edu.au/geography10weblinks) to view the 'wealth and health of nations' graph. Play the animation and examine the changes over time for different countries. Examine the relationship between life expectancy and GDP per capita. In your response you must refer to:
   - specific countries and regions of the world
   - specific statistics (life expectancy and GDP per capita).



Source 7.12 Gapminder website

NOTE THIS DOWN

Copy the graphic organiser below and list the advantages and disadvantages of using GNP and GDP as measurements of wellbeing.

Measurement	Advantages	Disadvantages
GNP		
GDP		

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The Human Development Index

The **Human Development Index (HDI)** is a tool to measure the wellbeing of a country. It was developed to overcome the shortfalls of other economic measurements and takes into account more aspects of life rather than simply finances.

Human Development Index (HDI) a tool that is used measure the wellbeing of a country, developed to overcome the shortfalls of other economic measurements and takes into account aspects of life rather than simply finances

The first Human Development Report was produced in 1990. It was the idea of a Pakistani economist who had previously worked for the World Bank. Since then the HDI has had a profound impact on global and domestic policy and has been refined to depict a more balanced view of wellbeing than other indicators. The human development approach to measuring development attempted to put people back at the centre of wellbeing, rather than simply focusing on economics.

The HDI is called a **composite** index because it comprises more than just one measurement. Other composite indicators are the gender equality index and the multidimensional poverty index. There are three dimensions to the HDI:

composite made up of many things

1. Health – measured by life expectancy
2. Education – measured by years of schooling
3. Living standards – measured by GNP per capita.

Countries are given a score from zero to one. One is perfect and zero is the worst. Then, all the countries are ranked according to their scores. These are divided into four categories of human development – very high, high, medium and low. Countries that have consistently remained in the same four categories include:

- *Very high*: Australia, Norway, USA, Canada, Netherlands, Germany, Japan
- *High*: Russia, Cuba, Mexico, Saudi Arabia, Malaysia, Lebanon
- *Medium*: Fiji, China, Egypt, Philippines, South Africa, Samoa, Vietnam
- *Low*: Nigeria, Rwanda, Afghanistan, East Timor, Yemen, Pakistan, PNG, Zimbabwe

Geographical fact

Norway has topped the HDI nine times since 1990 while Canada has been number one eight times.

The basic purpose of development is to enlarge people's choices. In principle, these choices can be infinite and can change over time. People, often value achievements that do not show up at all, or not immediately, in income or growth figures: greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and sense of participation in community activities. The objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives.

Mahbub ul Haq (1934–1998), founder of the Human Development Report

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Advantages and disadvantages of using the HDI	
Advantages	**Disadvantages**
• The three dimensions are weighted equally meaning there is no overemphasis on economic wellbeing • Data for countries can be **disaggregated** to see differences in development for groups within a country • Highlights uneven development • Provides a good and useful summary of three different dimensions of a country • Used in conjunction with other measures it can provide an accurate picture of the wellbeing of a country • Promotes the idea that income is not the sum total of human life and cannot be the only measure • It has informed government policies and encourages countries to concentrate on the broader picture • It has changed the way resources are allocated and the distribution of resources, e.g., between upper and lower Egypt, and the provision of free anti-retroviral drugs for AIDS sufferers in Botswana • Has sparked a healthy competition between countries to improve their rankings • Has lead to better monitoring and evaluation of programs • Has led to in-depth academic and **empirical** studies and refinements	• Cannot be used alone to determine a country's level of economic development • Does not show gender inequalities • Does not show political participation • Has been misused to represent the level of 'happiness' of people or the best place on Earth to live • The emphasis on those things that are measured can sometimes mean other things are not as important, e.g., infant mortality is not measured but reducing levels of this is very important • Human rights and non-discrimination are not included • Disregards **qualitative methods** assessments of wellbeing such as culture and political freedom

disaggregated separated or broken up into different parts

qualitative methods methods used to gather data that is expressed in non-numerical form (can only be described)

empirical information from observations and experiments

ACTIVITY 7.8

1 Define the meaning of the HDI.

2 Explain how nations are categorised under the HDI.

3 Argue that the HDI is a more accurate measure of wellbeing and development than other measurements.

NOTE THIS DOWN

Copy the graphic organiser below and complete the think, pair, share activity. If you were in charge of the HDI, what other indicators would you include and why?

Additional indicators		
Think	Pair	Share

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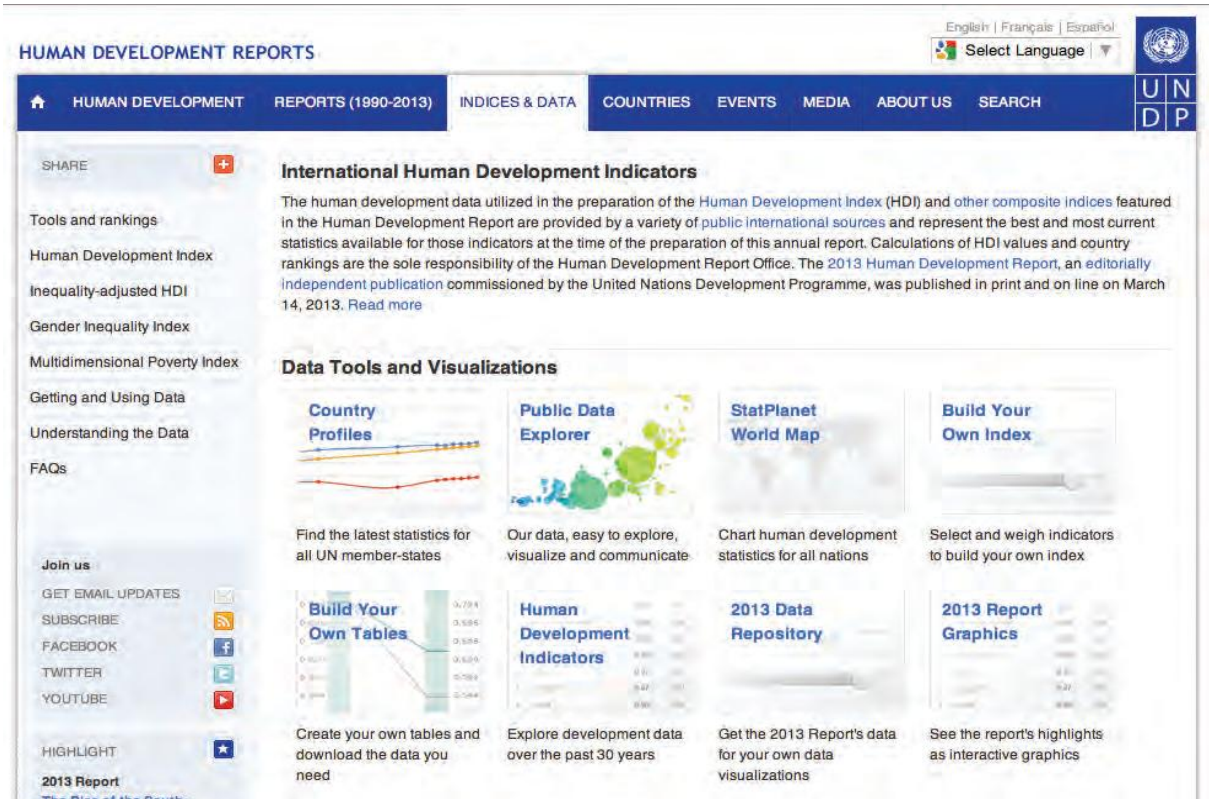
RESEARCH 7.5

Select four countries to investigate (one from each category of human development) and spend some time exploring the maps, statistics and reports for these countries available via the UNDP website (for the link: www.cambridge.edu.au/geography10weblinks). Comment on the trends evident over time.



Source 7.13 UNDP indices and data screenshot

7.6 Categorising nations according to levels of development

A problem with using any system to categorise countries by levels of development can mean that others are blinded by the statistics and measurements yet remain completely unaware of how rich a culture could be. It is important when studying any place in geography to go beyond the quantitative information (i.e. the statistics) and search for qualitative information that can provide a realistic but fuller picture, such as including personal anecdotes, family heritage, cultural practices and celebrating the unique aspects of daily life.

Developed, developing and underdeveloped

The terms 'developed', 'developing' and 'underdeveloped' refer to a country's level of industrialisation. The International Monetary Fund (IMF) uses these terms or similar in their *World Economic Outlook* reports.

Developed countries are those that have undergone the process of industrialisation. Typically, it involves moving from an agrarian-based society and **cottage industries** to a manufacturing-based society where goods are mass produced and as such contribute to higher levels of

cottage industry products were made at home on a small scale compared to large amounts of produce being processed in factories

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urbanisation the process of people moving to large urban centres such as cities

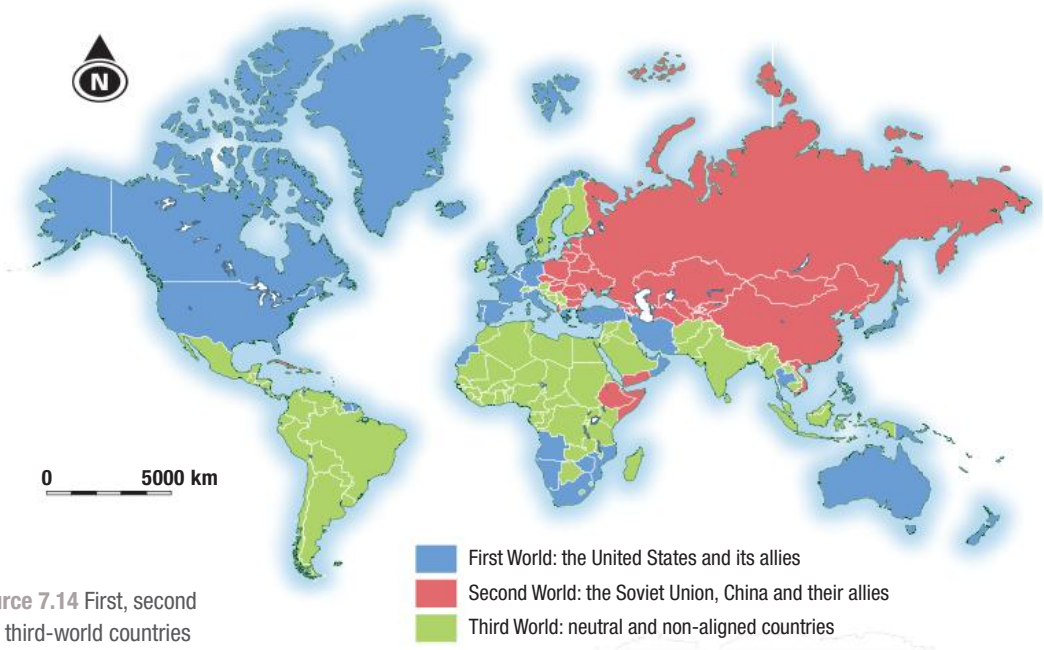
GDP. Industrialisation is also linked with other processes and characteristics such as **urbanisation** and modernisation. For example, England experienced all the above in the 18th century, followed by France and Germany.

Developing countries are those that are in the process of becoming industrialised, such as Chile in South America.

And the term 'underdeveloped' is not politically correct, but previously referred to economically poor countries, most of which are located in Africa and some parts of Asia. The more acceptable terms now are less-developed countries (LDCs) or Less Economically Developed (LED) countries.

First world, second world and third world

The first world referred largely to the US and its allies during the period of the Cold War. The second world referred to the communist Soviet Union, China and its allies and the third world referred to those non-aligned countries who were not involved; this was most of Africa, Central and South America and Asia. Trends tended to indicate the democratic and capitalist nature of first world countries. Over time the term 'third world' was used to describe poorer living conditions, lower levels of education, lower levels of income and worse health outcomes than those countries of



Source 7.14 First, second and third-world countries

Geographical fact

You may see or hear about 'first-world problems', particularly on Twitter where people comment on the frustrations associated with the luxuries of living in wealthy countries, all in good humour. For example a Twitter search of #firstworldproblems revealed the following:

- I have so much food in my fridge, it's hard to get to the back of my fridge.
- One side of my bed has wifi and the other side doesn't.
- My shampoo and conditioner never run out at the same time.
- I hate it when iMessage goes down and you have to send regular text messages.
- The regular kitchen is being remodelled, so I have to eat in the basement kitchen now.

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the 'first world'. Third-world countries were also associated with high population growth rates. All those countries with categories in the 'first world' tended to be those with **western culture**, many of which were colonial powers and tended to have higher standards of living at the time.

western culture ideas, fashion, food and ways of life from the US, UK and western Europe which are located in the western hemisphere

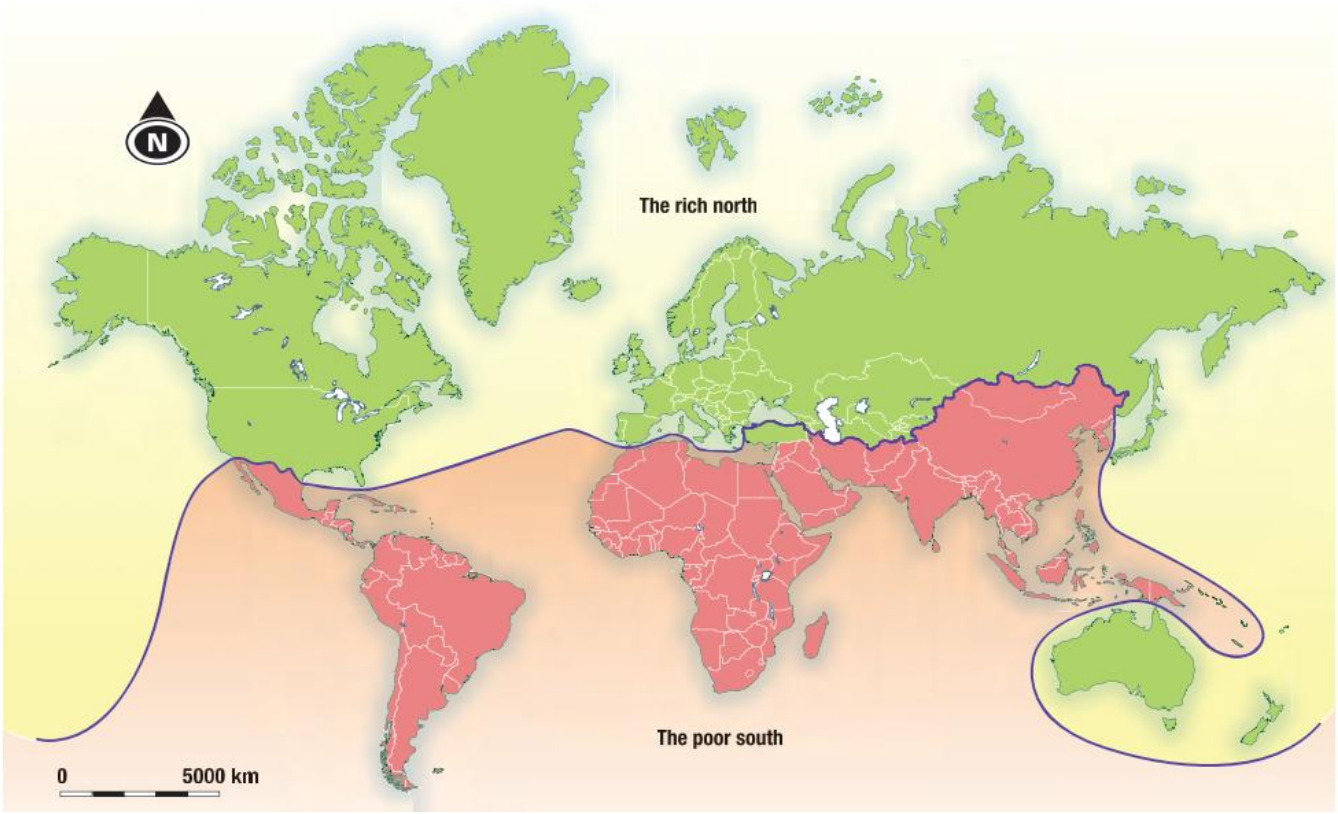
dissolution to end an agreement and break up into separate parts

These terms are not used regularly nowadays due to other more appropriate terms being applied to countries. The terms have become defunct as lines are blurred and other, non-western nations' levels of economic development have grown; and may now be on par with the west. Some limitations with this method of categorising nations have also arisen since the end of the Cold War. The Soviet Union does not exist any more; it has been broken up into Russia and a plethora of other former 'Eastern Bloc' countries. This **dissolution** has created newer low-income countries that would have perhaps previously been considered part of the third world.

The north–south divide

The terms 'north' and 'south' when referring to the level of economic development were developed in the 1970s with an aim to being non-discriminatory when describing countries, as most of the developed nations were in the northern hemisphere and most of the developing nations were in the southern hemisphere. German Chancellor Willy Brandt decided that by drawing a line depicting the north and south countries it could be easily understood but Australia and New Zealand were exceptions to this so these terms were not universally accepted. The most powerful and influential nations in the world are located in the north which is also where most of the 'western' cultures are too. The G8 countries (the most economically powerful nations in the world) are also all in the north.

The world can no longer be neatly divided by a line. Limitations of using this method to categorise nations include the higher level of economic development in some areas of the



Source 7.15 North and south countries divided by the Brandt line

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ACTIVITY 7.9

1 List five countries that could all be categorised as developed, first-world and north countries.
2 List five countries that could all be categorised as developing, third-world and south countries.
3 Explain why it is no longer appropriate to categorise nations as first, second or third-world.
4 Identify why the categories of 'north' and 'south' can no longer be used.
5 Discuss the need to categorise countries according to their level of economic development.

world previously considered to be countries of the 'south'. For example, the **tiger economies** of Hong Kong, South Korea, Kuwait and Singapore have grown and living standards have markedly improved since the Brandt line was drawn. Similarly, some countries in South America such as Brazil have become much more powerful on the global stage, as have China and India. Not only do these three countries have an increasing level of economic authority but they have asserted their cultural authority too in hosting Soccer World Cup, Olympics and Commonwealth Games respectively.

tiger economy an economy that grows very quickly. This was typical of some southeast Asian nations in the early 1990s. However, they grew too rapidly and were affected greatly by the Asian Financial Crisis of 1997

Colonialism and wellbeing: the questionable creation of small nations

Colonialism is the control of one country over another's territory. In the past it has meant that people from one country established themselves in another, usually through force. Major colonising countries were the British, French, Spanish, Dutch and Portuguese. It was mainly only European countries that sought to establish colonies elsewhere to gain power and control over many parts of the world, creating **empires**. The 'white' settlers imposed their religions on host nations, used their resources and applied their own cultural standards in places vastly different from their countries of origin. Upheavals in these civilisations took place as the government, economy and even social structure were changed to suit the colonising countries.

colonialism one country controlling another

empire a group of countries owned by another e.g. the British empire

Unequal relationships were forged between the colonising powers and their colonies where the wealthier and more powerful European nations put practices in place that favoured themselves and greatly disadvantaged the civilisations they invaded. This is known as **cultural imperialism**. It often involved the exploitation of local people in order for the colonising country to maintain power. At times, culture was manipulated by the dominating ruling 'class' who imposed and enforced their worldviews on others who subsequently accepted that as the norm. This is known as **cultural hegemony**. Impacts of colonisation were many and varied; some were positive but the majority were negative. For example, colonialism often involved:

cultural imperialism the dominance of one culture over another, usually through policy, coercion or heavy-handed trade relations from transnational countries. Usually one culture assumes they are more superior to the other

cultural hegemony dominance of one culture over another

colony an area/territory under the control of another power (country)

- introducing disease to places that had not previously been exposed
- establishing trade routes that provided access to other goods not available in the **colony**
- assisted intercultural understanding through the spread of languages
- slavery and **indentured labour**.

Various events saw the end of colonisation, such as World Wars I and II and changing political priorities. Sometimes civil war erupted as the original

indentured labour people who worked under very restrictive conditions and contracts in return for food, accommodation or to pay off debts; e.g. Indians in Fiji

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sovereign nation-state an area with a permanent population, a government and complete control over its territory

people in that colony fought for independence and the chance at self-government. They wanted to become a **sovereign nation-state** meaning that only they have control over the country not others. It is important to note though, that struggles for independence still exist today and that elements of colonisation still linger in some parts of the world.

Source 7.16 Cartoon depicting colonisation

Cultural imperialism meant that the colonial powers thought their systems and ideologies were the best and despite attempts at negotiations for independence by the original people, these often failed and struggles would ensue. When struggles became widespread and involved the population en masse, a revolution took place, which often entailed armed resistance and bloodshed on both sides. However, **decolonisation** can also be a peaceful process where people of the colony participate in a democratic vote to either retain or shed their colonial ties. Also, some colonising countries sought to rid themselves of the economic and military burdens associated with governing another territory. It is an incredibly momentous occasion for a society to gain independence, particularly after fighting for sought-after freedom for years.

decolonisation the withdrawal of colonial rulers from their colony and the country's move towards independence

Geographical fact

The smallest country in the world is the Vatican, where the Pope lives. This is a country within the city of Rome. It is less than 0.5 km^2, which means you can walk around it in less than an hour!

Regardless of when the decolonisation process took place, the colonial ruling class thought they knew best when sorting out issues. Problems were created when dividing up country boundaries. They often ignored tribal or ethnic boundaries naturally created by local populations. An example of where this has occurred is in Kashmir, a disputed territory between India and Pakistan. The British withdrew in 1947 leaving a partition that has resulted in decades of overt and covert conflict.

Colonial powers are to some extent responsible for the poor economic conditions in the countries they once controlled, because of the exploitative practices that took place. Some of these poor conditions prevail today.

ACTIVITY 7.10

1. Define colonialism.
2. Describe impacts of colonialism on wellbeing.
3. Discuss what cultural imperialism is and how it may affect wellbeing.
4. Debate the following statement, 'Decolonisation is positive but can be brutal at the same time'.

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Case study 7.1

British colonial empire: The Commonwealth of Nations

England's quest for power led them to colonise other countries. The beginning of the empire began in 1583 when an Englishman called Humphrey Gilbert sailed across the Atlantic Ocean to Newfoundland; however, no colonists were left behind and Gilbert died on his return trip to England, meaning the first attempt at colonisation failed. Following this, another trip across the Atlantic by Walter Raleigh established a colony in Virginia; however, it failed several years later. Eventually, British colonies were successfully established in North America and the Caribbean, and the British eventually claimed Canada, parts of the Caribbean and the east coast of North America.

But the empire was struck a major blow when Americans fought for independence in 1776 and won, thus forming the USA. Around the same time, Captain Cook 'discovered' Australia, and the British established a colony in Australia in 1788. After winning the Napoleonic wars, the British took over more overseas territories, especially in Asia. The British East India Company, a private company licensed by the British government since 1602, exported tea from China and later from the subcontinent. It became so wealthy and powerful that its influence spread throughout east Asia. Indians resented British rule and rebelled in 1857 in what became known as the Indian Mutiny. But the British army crushed the uprising and Queen Victoria took over the country as India's Empress.

At the end of the 19th century, British and Empire troops (including some from Australia) fought in South Africa, after warring with the Dutch-descended settlers who previously claimed it as part of their empire. This was known as the Boer War. By the beginning of World War I, over one-third of Africans were ruled by the British, in places such as Egypt and Sudan. By the end of the war just a few years later one-third of all countries on Earth were under British rule. However, this extensive domination was disrupted by countries such as Canada, Australia and Egypt demanding recognition and full independence. (Countries such as Canada, Ireland and Australia had already become sovereign nations, but relied on Britain for diplomatic and military assistance.) Following

Source 7.17 Propaganda poster promoting solidarity and unity in the British Commonwealth

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World War II, Britain's funds were drained, putting pressure on its ability to effectively govern and maintain the empire. India gained independence in 1947; a large number of other countries, such as Sudan, Cyprus, South Africa, Zanzibar, Malta, Singapore and Fiji gained independence in the decades that followed.

The Commonwealth of Nations is a group of countries, previously under British rule, that have agreed to share and promote common goals; including those they set which increase wellbeing, such as human rights, democracy, trade and law. All 54 member countries must acknowledge that the Queen is the Head of State. A number of former British colonies chose not to join the Commonwealth, as membership is voluntary, most likely due to differences in ideology. These are mainly in the Middle East such as Bahrain, Qatar, UAE and Oman.

The Commonwealth of Nations countries share similar characteristics in their political, legal and education systems due to the legacy left by the British. Some of these customs and attributes include, for example:

- driving on the left
- sport – cricket, rugby and participation in the Commonwealth Games
- law – common law and an adversarial legal system, where one is innocent until proven guilty and both sides must present their case
- Parliament – usually bicameral (two houses) and democracy.

1 Explain how Britain expanded its empire.
2 Describe two issues Britain had within its empire.
3 Outline the extent of the British Empire and when it began to decline.
4 What is the Commonwealth of Nations?
5 List four common elements shared between all nations in the Commonwealth.

Case study 7.2
The 'scramble for Africa'

European colonising countries such as France and Britain were involved in what was called the 'scramble for Africa' at the turn of the 19th century. There was much competition between these countries and control over land was tenuous. They thought the best way to control was via settlement and that this would ensure long-term control over land and resources. They also thought it was their mission to bring a proper way of life to what they called the 'savages' of Africa who lived differently from them. British colonies in West Africa were in Gambia, Ghana, Nigeria and Sierra Leone while French West Africa consisted of eight colonial territories and controlled what is now Burkina Faso, Mali, Benin, Ivory Coast, Niger, Guinea and Senegal. The federation of territories was reorganised many times.

Wellbeing on this continent is inextricably linked to economic performance. Compared to the rest of the world Africa's level of development has been poor and some people attribute this to two main things – the slave trade and colonial rule. Much of sub-Saharan Africa has been in decline over the past 30–40 years.

One finding from the *Journal of Development Economics* claims that the more slaves that were taken during the slave trade, the worse the country's economic performance is today. Some nations experienced severe labour shortages meaning there were not enough people engaged in productive economic activity to sustain the rates of development required. Colonial empires not only extracted labour but also a range of natural resources from these countries and set up trading routes to ensure wealth was returned back to the home of the empire.

Following World War II a staged withdrawal of occupation took place, leaving some established colonial institutions and practices that are in place today. Another finding in the *Journal of Development Economics* is that it was in those colonies where strong institutions were set up, the rule of law was enforced and private property was protected that are the wealthiest today. For

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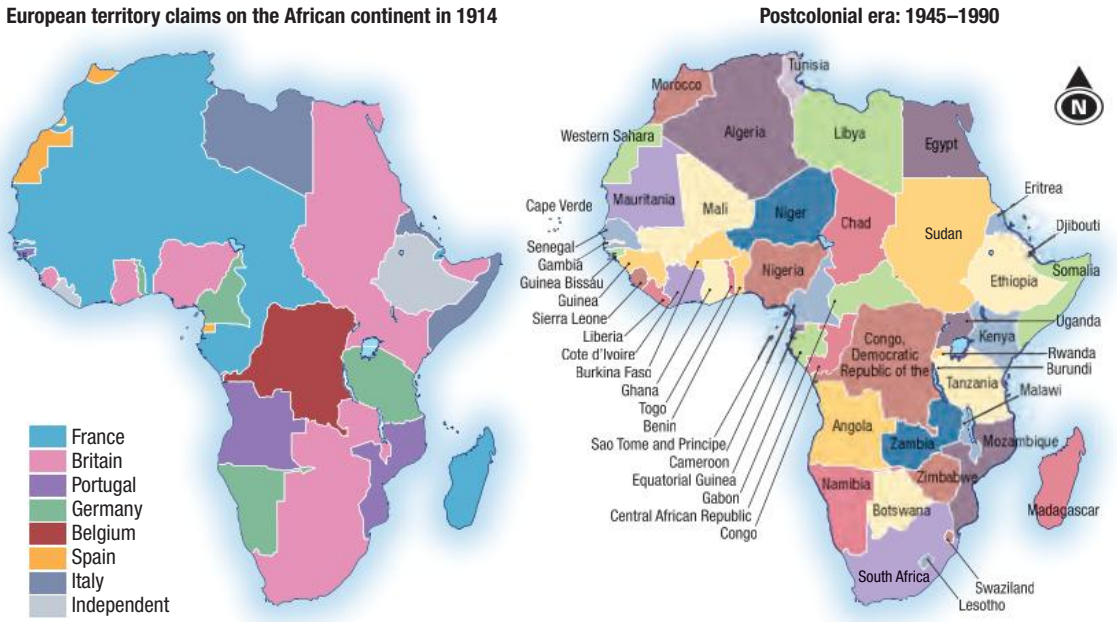

Source 7.18 The scramble for Africa

example, the British invested more in education than the French, which has been cited as a reason for Ghana being wealthier than other West African nations at independence in 1957.

The Ivory Coast is a prime example of a small state experiencing continuing issues with development, economic sustainability and wellbeing. It gained independence from France in 1960 and for a couple of decades the economy grew through primary exports of coffee, cocoa and palm oil – a good thing, considering agriculture engaged 68% of the population. French imperialism meant that everyone from the Ivory Coast had to speak French, abide by French laws and practise French customs. The United Nations High Commission for Refugees (UNHCR) has reported that political instability and uncertainty has kept tensions high in the Ivory Coast.

The creation of small West African states by colonial powers created major issues. Conflict has been ongoing within and between some countries due to a range of factors such as:

- country borders were not often precise
- country borders did not reflect ethnic divisions
- some borders excluded people from accessing valuable resources such as diamonds and oil.

Continued conflict has implications on economic, social and political wellbeing as well as affecting health outcomes of the population. The UNHCR reports that the following human rights abuses either have occurred or are occurring in West Africa:

- restriction of citizens' right to change their government (i.e. lack of democracy)
- random and illegal killing/execution by security forces, militias and student groups
- disappearances, torture and other cruel, inhuman or degrading treatment
- arbitrary arrest and detention; denial of a fair public trial
- arbitrary interference with privacy, family, home and correspondence
- use of excessive force and other abuses in internal conflicts
- restrictions on freedoms of speech, press, peaceful assembly, association and movement; corruption
- discrimination and violence against women
- child labour.

1 Explain the 'scramble for Africa'.
2 Describe how colonialism in West Africa affected wellbeing.
3 Account for the low level of economic development in some West African states.
4 Discuss the ongoing issues with wellbeing in West African states.
5 Analyse wellbeing in West African states. Do you think they will improve? Provide reasons for your answer.

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Unequal trade and wellbeing

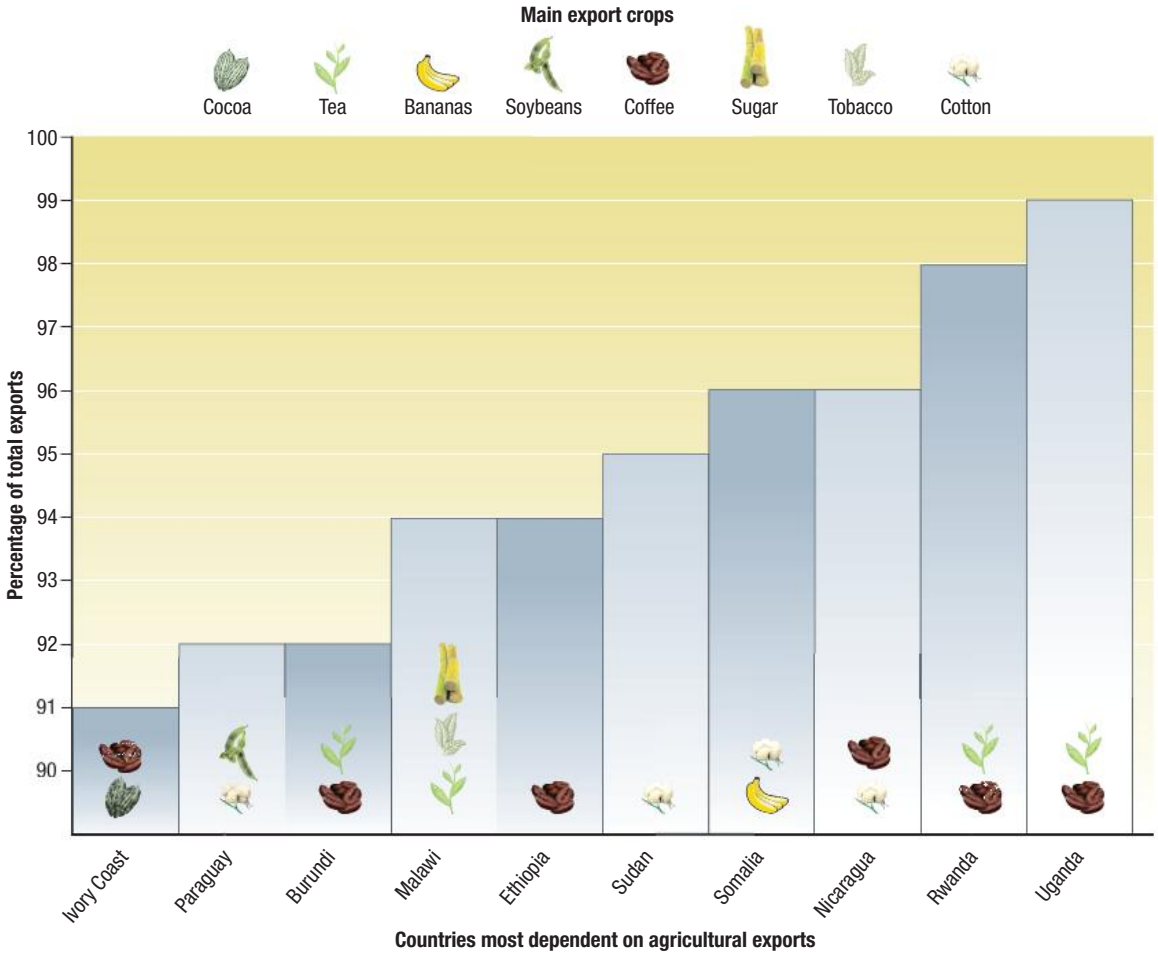
Trade is a major factor in development, as most countries cannot produce all the things they need to be self-sufficient, so they import it from elsewhere. They also export excess goods and those produced especially for export plus services in which they specialise. Inequality can arise in trading goods, as those countries that are less developed tend to be more reliant on agricultural produce because of the resources in that country, colonial preferences for cultivation that have lingered, or because of a lack of industry and services requiring sophisticated technology.

Even though everybody needs food and clothing to survive, the problem with exporting agricultural goods is that they fetch low prices on global markets in comparison to manufactured goods (which can be simple or elaborate). A country dependent on exporting items such as coffee, wool, wheat, cocoa and other primary produce is subject to natural disasters and seasonal variation, plagues, disease and other things that may decimate production, meaning income derived from them can be unreliable. And that level of income plays a significant role in the level of human wellbeing. Dependence on a single **commodity** is more pronounced in tropical countries. Usually if a country is exporting large amounts of primary produce, they need to import most of the manufactured goods they use and many services they employ. Approximately 50%–60% of the workforce in low-income countries is employed in the agricultural sector compared to 4% of high-income countries.

commodity a physical product such as grain or metal able to be sold

Manufactured goods attract higher prices than primary products because of the inputs and greater number of alterations and processes taken place. This is called 'value-adding'. Those countries that have focused on industrial development have boomed in recent times. China has entire cities comprising factories. Manufacturing employs approximately 27% of the Chinese workforce. Secondary industry jobs such as manufacturing jobs tend to earn a little more than primary sector jobs (except for mining and other activities where the materials are more valuable and in high demand). Wellbeing in

Source 7.19 Tonga exports pumpkins to the Japanese. Pumpkins are now more important than bananas, vanilla and kava in trade value.



Source 7.20 Countries most dependent on agricultural exports

countries with a large amount of manufacturing also tends to be a little higher; however, breaches of human rights, poor working conditions, gender inequality and other indicators of wellbeing may still remain low.

Unequal trade relations are largely instigated and promoted by the high-income countries, where the headquarters of large transnational companies are situated. Factories are moved offshore to places where labour is abundant and wages are low. While the low-paid work is conducted overseas the well-paid service/tertiary sector jobs such as marketing, design, legal and financial services are all conducted in major cities around the world including New York, Tokyo and London. Wellbeing in these countries is rather high due to higher incomes, higher levels of education and higher levels of health care.

High-income countries also have trading agreements that prevent others from joining. These are called **trading blocs** where member countries trade on favourable terms with other member countries. One of the most powerful trading blocs is the European Union. Also, some countries have imposed **tariffs** on imported goods, which means they add a fee to it, so locals prefer buying locally made goods because of the lower price. This protects local industry and jobs too, even though it may not be the most efficient way of producing.

trading bloc a group of countries, traditionally in the same geographical region, agree to protect their industries by creating barriers to trade for non-member countries. Often trade is made freer within the bloc e.g. Association of South East Asian Nations (ASEAN)

tariff a tax imposed on imports

The specialisation of production in different countries, for many reasons including historical and colonial factors, has meant that they continue to produce such goods. So a poorer nation may continue to produce agricultural goods that continue to fetch low prices; similarly, a wealthier

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country may continue to produce expensive goods and mostly services and continue to fetch higher prices. So the poorer country has a trade deficit because they continually export cheaper goods and import expensive goods.

Such inequitable trade relations are perpetuated by large international companies. As a result, the 'fair trade' movement seeks to help farmer's wellbeing through:

- a decent and stable price for their goods
- seeking to improve working conditions
- use of sustainable farming methods
- engaging in and honouring long-term contracts
- investing in the local community
- assisting in the teaching and learning of skills useful in global markets.

Neo-imperialism and wellbeing

Where imperialism is the control of one state by another by physical dominance in the territory using the military, **neo-imperialism** is a new form of control. Now imperialism takes shape in terms of economic control and dominance over other nations without the physical presence. This is mostly in the form of exerting western influences over others such as western culture, products and brands. Cultural hegemony means that through western beliefs, values, perceptions, brands and even fast food, local cultures are affected. There may be a loss of unique cultural identity, norms and other things due to the dominance of more economically powerful nations. This affects wellbeing in some countries as cultural connections and heritage are lost.

neo-imperalism one country dominating another country's economy usually though trade relations, international pressure and foreign policy

Source 7.21 90% of farmers in Ghana and the Ivory Coast rely on cocoa as their main form of income.

ACTIVITY 7.11

1. Explain how inequalities in trade arise.
2. Identify reasons why farming primary products can be risky.
3. Analyse unequal trading relationships between high, middle and low-income countries.
4. Examine how fair trade seeks to rectify unequal trade relations.
5. Is neo-imperialism the new colonialism for the 21st century? Provide reasons for your answer.

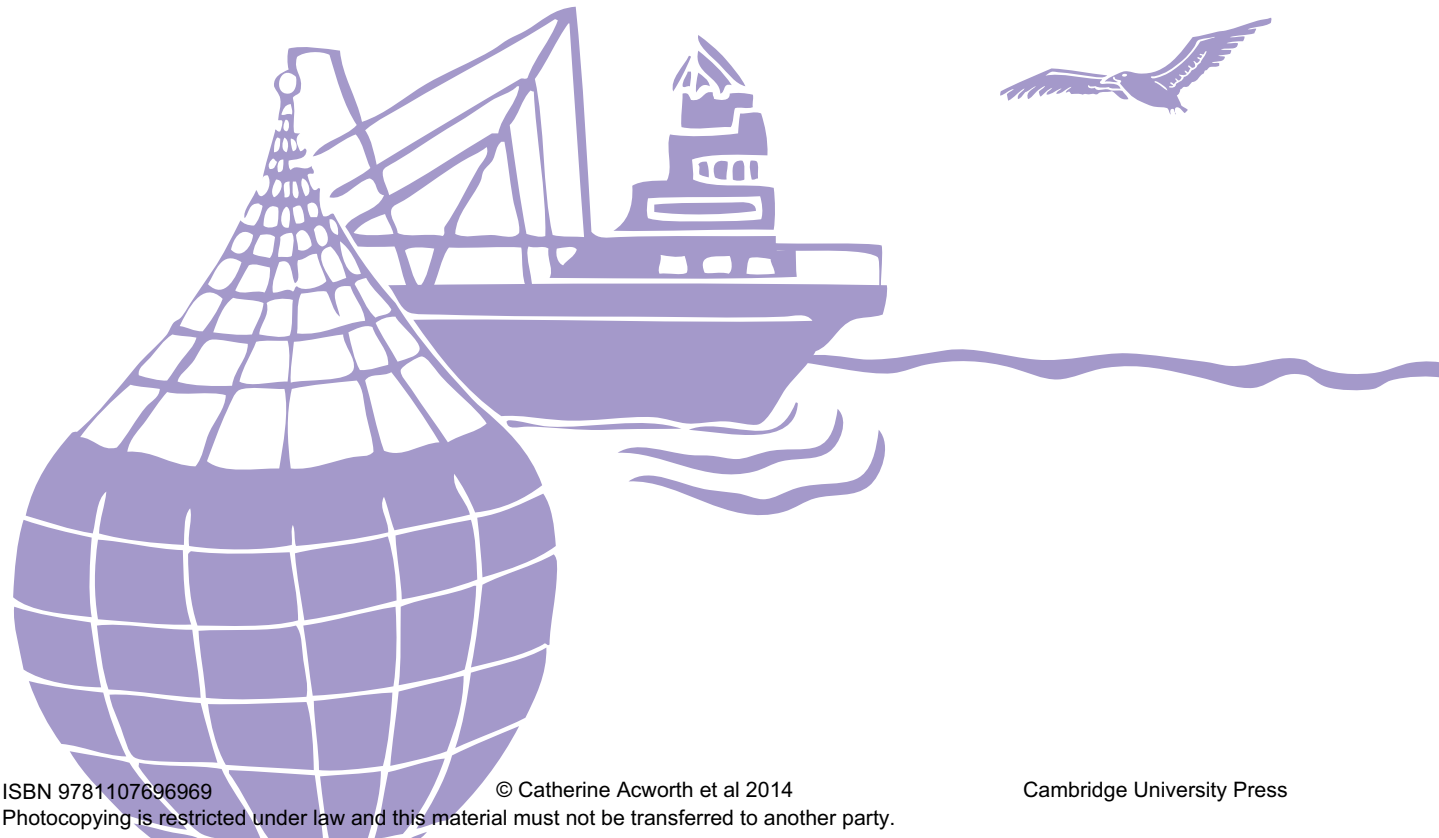
RESEARCH 7.6

Evaluate the success of fair trade practices in improving wellbeing. In small groups, investigate fair trade in one of the following commodities and present your information to the class.

- coffee
- sugar
- tea
- cocoa
- cotton
- soccer balls.

Your presentation should include:

- top five countries producing the commodity
- projects to promote fair trade for farmers
- a range of appropriate examples and statistics
- engaging graphics.



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Chapter summary

- Wellbeing is multi-dimensional and can be measured in many different ways. Data collected are indicators of economic, demographic, social, spiritual, health and political wellbeing but the concept of wellbeing is subjective in nature.
- Ideology affects peoples' wellbeing on a large scale if governments pursue goals according to a certain set of beliefs.
- Spatial patterns of wellbeing exist in most major cities, e.g. Sydney. The level of segregation, social exclusion, social polarisation and poverty can be documented to show variations on wellbeing within and between suburbs. Data can also be mapped to reveal spatial patterns of inequality in wellbeing.
- Aboriginal and Torres Strait Islander peoples' perspectives of wellbeing centre upon identity. Other aspects of particular importance include culture, heritage, self-determination and reconciliation. Despite numerous government initiatives, stark differences between Aboriginal and Torres Strait Islander peoples and non-Indigenous people's wellbeing continue to exist.
- Development can be measured in a variety of ways – two traditional methods are GNP and GDP.
- The HDI is a newer composite index, taking into account health, education and living standards, which ranks countries according to the level of wellbeing.
- Countries can be categorised according to their level of economic development in a number of ways, such as 'developed, developing and underdeveloped', 'first, second or third world' and 'north or south' countries.
- Colonialism around the world has had enormous and catastrophic effects on many countries. Some of the impacts on wellbeing are long-lasting e.g. in West African states.
- Inequalities in trade impact negatively upon wellbeing.

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End-of-chapter questions

Multiple choice

1 Which of the following is used to measure health and wellbeing?
   - **A** Population density
   - **B** Gender equality
   - **C** Literacy rate
   - **D** Life expectancy

2 Which ideology, most evident in Norway, promotes the welfare of all people?
   - **A** Communism
   - **B** Socialism
   - **C** Feminism
   - **D** Environmentalism

3 What is the term given to growing disparities between rich and poor people?
   - **A** Social segregation
   - **B** Social exclusion
   - **C** Social polarisation
   - **D** Suburbanisation of poverty

4 What three aspects does the HDI take into account?
   - **A** Health, education and living standards
   - **B** Spiritual wellbeing, ideology and income
   - **C** Political wellbeing, GNP per capita and multiculturalism
   - **D** Capitalism, wealth and distribution of income

5 Which commodities fetch higher prices when being traded?
   - **A** Coffee and cotton
   - **B** Electronic goods and furniture
   - **C** Education and tourism
   - **D** Uranium and cocoa

Short answer

1 Describe three different ways to measure wellbeing and development.

2 Explain why wellbeing is subjective in nature.

3 Compare and contrast the different perspectives of wellbeing between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians.

4 Discuss the advantages and disadvantages of using the HDI to measure wellbeing.

5 Examine the issues of colonial powers creating small nation-states.

Extended response

To what extent is colonialism responsible for the low level of wellbeing in some nations?

In your response you should:

- define colonialism
- refer to colonial powers and the regions they invaded
- research and comment on indicators of wellbeing in countries that were once colonies
- evaluate the impact of colonialism on local populations
- use specific examples and geographic concepts and terminology
- include relevant statistics, maps, graphs, or images as appropriate.

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8 Differences in human wellbeing

Source 8.1 Living conditions vary around the world

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Before you start

Main focus

Human wellbeing varies across regions and locations with some people having more opportunities and living happier lives than others. It also depends on achieving the sustainability goal of integrating social advancement, environmental protection and economic prosperity.

Why it's relevant to us

People always strive to live better and longer lives but this is also influenced by the place where they live. There are large differences in human living conditions between different countries as well as between different communities within the same country. Understanding what contributes to people's happiness allows individuals and societies to improve human lives.

Inquiry questions

- What are the differences in human wellbeing between countries, such as Australia, India and China?
- What are the differences in human wellbeing between communities within the same country?
- What are the main factors contributing to human wellbeing?

Key terms

- Ecological footprint
- Happiness
- Health
- Human wellbeing
- Populous country
- Prosperity
- Spatial difference
- Sustainability
- Vulnerability

Let's begin

While hard to define, human wellbeing is probably best described by 'happiness'. Human wellbeing has two sides – firstly, how people actually feel (a subjective side); and secondly, what the conditions are for people to feel this way (an objective side). There are constantly efforts made to describe and measure human wellbeing across countries and regions. We are particularly interested to know how things are in Australia – our home country – as well as in China and India, the world's most populous countries and two emerging global economic powerhouses.

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8.1 Wellbeing around the globe

Due to global economic development, overall **human wellbeing** has improved dramatically. People now live longer than ever before and there have been significant achievements in education, health care and living conditions. However, there are still large differences and inequalities between different communities. Those who have better access to resources enjoy more opportunities; there is consequently a wide gap in wellbeing between them and the underprivileged. There are also obvious differences in human wellbeing between developed and developing countries and this is evident in the variations in their socio-economic development and governance. Countries like Australia, India and China provide interesting examples which help in understanding these issues. For example, in Australia there is a gap in wellbeing between the Aboriginal and Torres Strait Islander peoples and non-Indigenous people; similar cases exist at regional level in both India and China.

human wellbeing happiness described by how people actually feel (a subjective side) and the conditions for people to feel this way (an objective side)

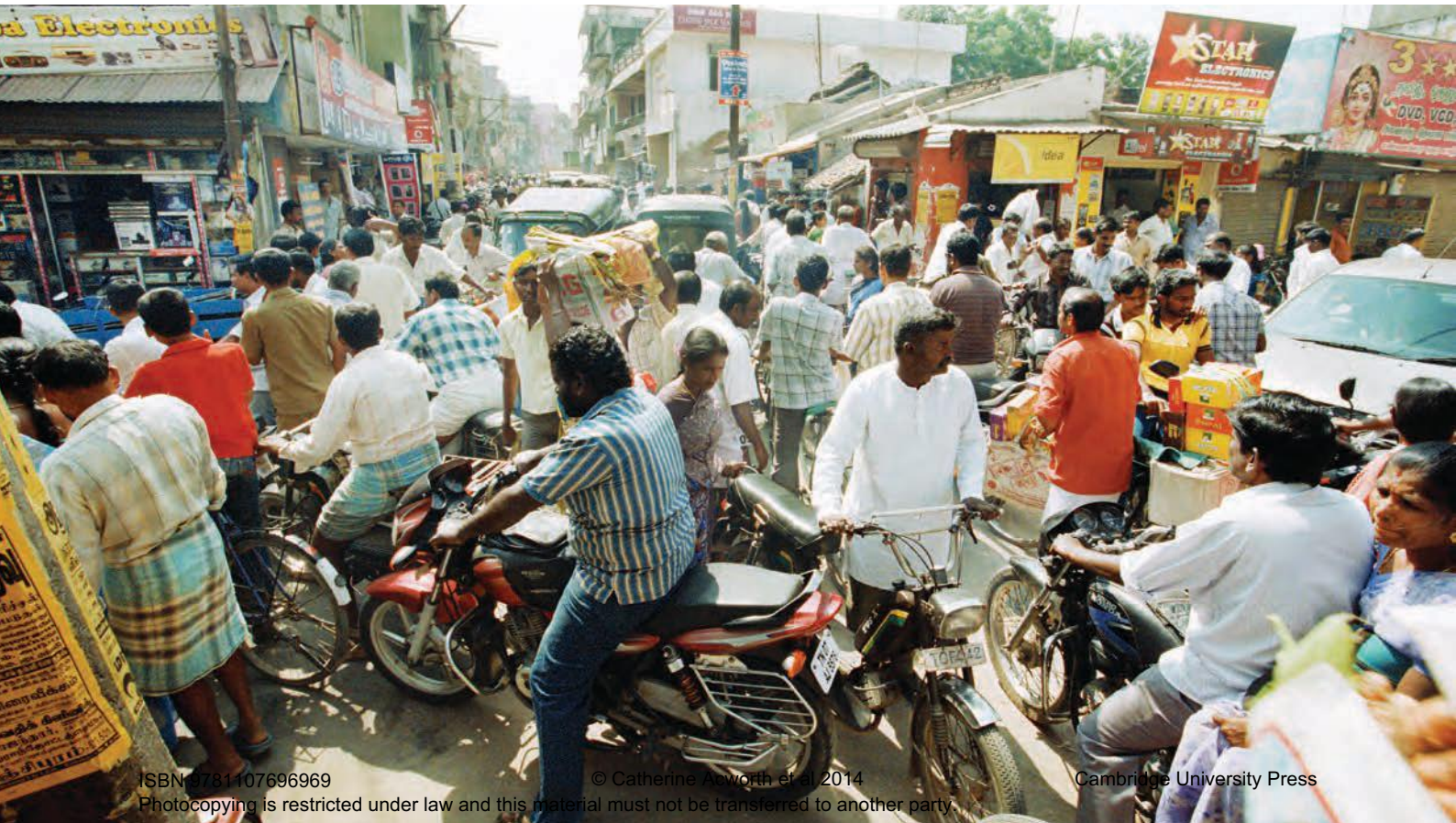
Despite being essential for human wellbeing, improving economic conditions is not enough for real progress to be achieved. While **economic wealth** can meet demands for material goods and services, people also need clean air, access to water and contact with a healthy natural environment for their mental and physical **health**. Human wellbeing is complex and multi-dimensional. It has physical, social, economic as well as emotional and spiritual characteristics. Some people are happy with less; others have higher expectations and requirements. Irrespective of all these subjectivities, improving overall living conditions, reducing inequality between people and increasing opportunities for all are essential to achieving high levels of human wellbeing.

economic wealth a strong economy or abundance of items of economic value

health a state of complete physical, mental and social wellbeing

Geographical fact

Aboriginal and Torres Strait Islander Australians have lower levels of wellbeing than non-Indigenous Australians.



Source 8.2 India is one of the most populous countries in the world.

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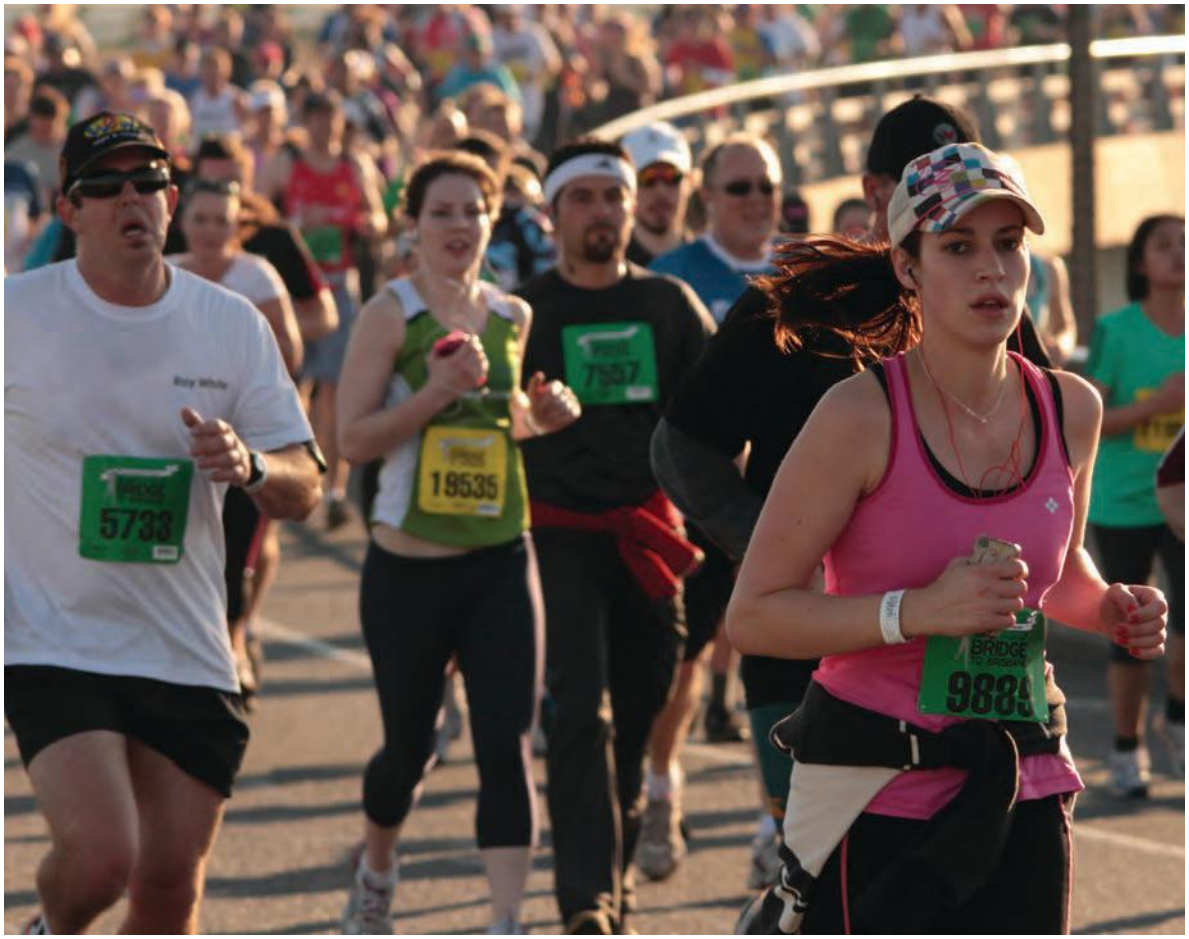
Human wellbeing in Australia, China and India

As explained in Chapter 7, there are many dimensions of human wellbeing and many ways to measure it. It is difficult to say which way of measuring is better as they all have their strengths and weaknesses. As long as we know what the meaning of a measurement or index is and it is consistently applied, we can draw comparisons between various regions and localities. It is also important to be aware that any results obtained through such measurements are very dynamic and they can change each time an assessment is made. Therefore, researchers release rankings and classifications of countries and regions on a regular basis and while there are some patterns that persist, others are prone to variations. Hence, any data we use to describe human wellbeing need to be referenced to the date when they were produced, the specific measurement(s) used and the organisation(s) which they originated from.

According to the Commission on the Measurement of Economic Performance and Social Progress (for the link, see Cambridge weblinks, www.cambridge.edu.au/geography10weblinks), key dimensions of human wellbeing (in no particular order of significance) are:

i Health
ii Social connections and relationships
iii Environment (present and future condition)
iv Education
v Material living standards (income, consumption and wealth)
vi Personal activities including work
vii Political voice and governance
viii Insecurity, of an economic as well as physical nature



Source 8.3 Health is one of the key dimensions of wellbeing.

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Living in Australia, it is always of relevance to us how our country ranks among others. On the other hand, China and India are of interest as they are not only the world's most populous countries, but are emergent economic powers and important to Australia as trading partners. The quality-of-life index, which links the results of subjective life-satisfaction surveys (that is, how happy people say they are) and objective determinants of quality of life (related to factors such as geography, demography, politics, income, crime, trust in public institutions and health of family life), was developed by the Economist Intelligence Unit to forecast how countries across the globe will be ranked in 2030. This will also be the year when a child born in 2013 will reach adulthood. Australia is the second-most desirable country in the world (after Switzerland) for a child to be born in 2013 (see Source 8.7), China ranks 49th and India 66th. This is a very encouraging achievement for Australia as a country, but despite this there are significant differences between Australia's regions and suburbs as well as between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians. We discuss this further later in the chapter; but before that, let's examine some other indicators describing human wellbeing.

The last column in Source 8.7, life expectancy at birth, shows the number of years a child born in 2013 is expected to live depending on the country where it is born. This is a very concise demographic indicator (you will read more about demography in Chapter 9), which describes human presence on Earth. Prolonging human life is the ultimate goal in development, and Australia, China and India have all been successful in achieving this (see Source 8.5) through advances in medicine, improvements in living conditions and increased health-related knowledge. However, human wellbeing is not only about living longer, it is also about living *healthier* (or disease- and injury-free) and *happier* lives.

Source 8.4 As wellbeing increases in each country, so does the life expectancy at birth.

Source 8.5 Life expectancy at birth in Australia, China and India for selected years

	1995	2005	2015	2025
Australia	78	81	82	83
China	69	74	75	77
India	60	65	68	71

Australia is a relatively healthy country for both women and men (see Source 8.6) with 2010 estimates showing that Australian women enjoy 69.0 and Australian men 66.8 healthy years. The respective figures are 68.6 and 64.7 for China and 57.1 and 54.6 for India. Source 8.8 shows the large disparities in the world with many African countries having the lowest numbers of healthy years (presented in purple on the map).

Source 8.6 Top 10 healthy countries in the world in 2010

Top healthy countries for men

1 Japan – 68.8 years
2 Singapore – 68.1 years
3 Switzerland – 67.5 years
4 Spain – 67.3 years
5 Italy – 66.9 years
6 Australia – 66.8 years
7 Canada – 66.7 years
8 Andorra – 66.7 years
9 Israel – 66.7 years
10 South Korea – 66.7 years

Top healthy countries for women

1 Japan – 71.7 years
2 South Korea – 70.3 years
3 Spain – 70.1 years
4 Singapore – 70.0 years
5 Taiwan – 69.6 years
6 Switzerland – 69.5 years
7 Andorra – 69.3 years
8 Italy – 69.1 years
9 Australia – 69.0 years
10 France – 68.8 years

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Rank	Country	Score (out of 10)	Life expectancy at birth
1	Switzerland	8.22	82
2	Australia	8.12	82
3	Norway	8.09	80
4	Sweden	8.02	81
=5	Denmark	8.01	79
=5	Singapore	8.00	84
7	New Zealand	7.95	81
8	Netherlands	7.94	81
9	Canada	7.81	82
10	Hong Kong	7.80	82
11	Finland	7.76	80
12	Ireland	7.74	80
13	Austria	7.73	80
14	Taiwan	7.67	80
15	Belgium	7.51	80
=16	Germany	7.38	80
=16	United States	7.38	79
18	United Arab Emirates	7.33	77
19	South Korea	7.25	80
20	Israel	7.23	81
21	Italy	7.21	82
22	Kuwait	7.18	77
23	Chile	7.10	78
23	Cyprus	7.10	78
25	Japan	7.08	84
26	France	7.04	82
27	Britain	7.01	80
=28	Czech Republic	6.96	78
=28	Spain	6.96	81
=30	Costa Rica	6.92	78
=30	Portugal	6.92	79
32	Slovenia	6.77	78
33	Poland	6.66	76
34	Greece	6.65	80
35	Slovakia	6.64	76
36	Malaysia	6.62	74
37	Brazil	6.52	73
38	Saudi Arabia	6.49	75
39	Mexico	6.41	77
=40	Argentina	6.39	77
=40	Cuba	6.39	78
42	Colombia	6.27	75
43	Peru	6.24	73
=44	Estonia	6.07	74
=44	Venezuela	6.07	74
=46	Croatia	6.06	76
=46	Hungary	6.06	75
48	Latvia	6.01	73
49	China	5.99	75
50	Thailand	5.96	74
51	Turkey	5.95	73
52	Dominican Republic	5.93	78
53	South Africa	5.89	49
=54	Algeria	5.86	76
=54	Serbia	5.86	75
56	Romania	5.85	74
57	Lithuania	5.82	76
58	Iran	5.78	71
59	Tunisia	5.77	75
60	Egypt	5.76	73
61	Bulgaria	5.73	74
62	El Salvador	5.72	74
=63	Philippines	5.71	72
=63	Sri Lanka	5.71	76
65	Ecuador	5.70	76
=66	India	5.67	67
=66	Morocco	5.67	76
68	Vietnam	5.64	73
69	Jordan	5.63	80
70	Azerbaijan	5.60	72
71	Indonesia	5.54	72
72	Russia	5.31	70
73	Syria	5.29	75
74	Kazakhstan	5.20	70
75	Pakistan	5.17	67
76	Angola	5.09	55
77	Bangladesh	5.07	70
78	Ukraine	4.98	69
79	Kenya	4.91	63
80	Nigeria	4.74	52

Source 8.7 Where to be born in 2013 and 2013 life expectancies at birth

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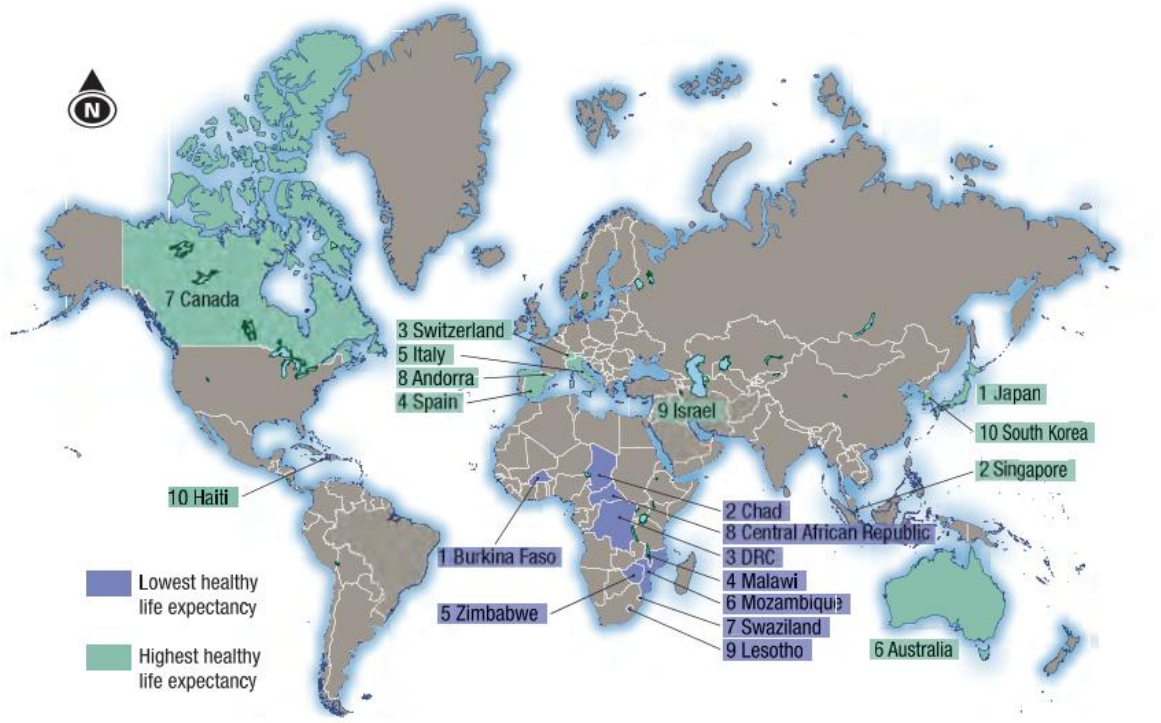

Source 8.8 Healthy life expectancies across the globe in 2010

ACTIVITY 8.1

1 Explain what is meant by life expectancy.
2 Discuss the ultimate goal in development in Australia, China and India and how each country is working towards that goal.
3 Provide examples for each of the key dimensions of human wellbeing that reflect on your life.

The feeling of happiness is at the core of human wellbeing. In an age of stark contradictions, when one billion people are hungry and an even larger number are overweight and obese, when technology has allowed unforseen ways of communication and increased productivity but is also destroying the natural environment and habitat for us and other species, we continue our search for happiness. China started its quest for a harmonious society, Portugal is talking about a happy economy and Bhutan adopted the goal of Gross National Happiness (instead of Gross National Product). Happiness differs vastly across societies and over time. Only if happiness is taken seriously as the essence of quality of life can there be effective policies for improving human wellbeing locally, regionally, nationally, internationally and globally.

8.2 The World Happiness Report

The first World Happiness Report, launched at the United Nations in 2012, ranks 187 countries (see Source 8.9, columns 2 and 3) according to the way their residents feel. In order to be able to assess this, different surveys are conducted. They ask respondents to answer questions such as: 'Taking all things together, how happy would you say you are (on a scale of 1 to 4)?' (European Values Survey); 'Taking all things together, would you say you are: Very happy, Quite happy, Not very happy, or Not at all happy?' (World Values Survey); or 'On a scale of 0 to 10, how do you evaluate your quality of life?' (World Gallup Survey). Australia is placed 8th according to the World Gallup Survey

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(India is 94th and China 112th); however, Australia doesn't rank in the top 10 in the combined World/European Values Survey data. Nevertheless at 32nd position in the latter, it is way ahead of China (55th) and India (92nd). The report points out that social issues, such as democracy, human rights and strong communities are often considered as significant as economic factors in explaining human wellbeing, which makes people happy. Individual mental and physical health, job security, family relations and friendships are also similarly important.

The analysis carried out in the *World Happiness Report* finds out that in the last 30 years overall the world has become a little bit happier, but it also outlines significant regional differences in the level of life satisfaction experienced by people from various countries across the globe. Below is a summary of its findings:

- Happier countries tend to be wealthier and Australia is one of them. China and India are still in the process of creating economic **prosperity** and this is reflected in their lower rankings. However, more important for happiness than income are social factors, such as the strength of social support, the lack of corruption and the degree of personal freedom.
- Unemployment causes as much unhappiness as bereavement caused by the loss of loved ones or breakdown in family relationships. Work, job security and good relationships do more for job satisfaction than high pay and convenient hours. Unemployment levels in Australia have overall been very low in the 2000s and this contributes to the feeling of happiness. Job insecurity is high in India while high level of pressure and competition in the work environment are characteristic of China's emerging economy.
- Behaving well makes people happier. This is a two-way relationship – people are happier when they experience kindness from other people but offering acts of kindness to other people also makes all of us happy. This seems to be a universal experience across the globe.
- Mental health is the biggest single factor affecting happiness in any country. Yet only a quarter of mentally ill people get treatment for their condition in advanced countries, such as

prosperity having success, flourishing or thriving

Source 8.9 Happiness and prosperity ranking of countries

Happy Planet Index, 2012	World Happiness Report: World Gallup Survey, 2005–2011 average	World Happiness Report: Combined European Values Survey (2011) and World Values Survey (2009)	Legatum Prosperity Index, 2012
(1)	(2)	(3)	(4)
1 Costa Rica	1 Denmark	1 Puerto Rico	1 Norway
2 Vietnam	2 Finland	2 Denmark	2 Denmark
3 Colombia	3 Norway	3 Colombia	3 Sweden
4 Belize	4 Canada	4 Mexico	4 Australia
5 El Salvador	5 Switzerland	5 Iceland	5 New Zealand
6 Jamaica	6 Sweden	6 Norway	6 Canada
7 Panama	7 New Zealand	7 Malta	7 Finland
8 Nicaragua	8 Australia	8 Switzerland	8 Netherlands
9 Venezuela	9 Ireland	9 Northern Ireland	9 Switzerland
10 Guatemala	10 United States	10 Ireland	10 Ireland
---	---	---	---
32 India	94 India	32 Australia	55 China
---	---	---	---
60 China	112 China	55 China	101 India
---		---	
76 Australia		92 India	

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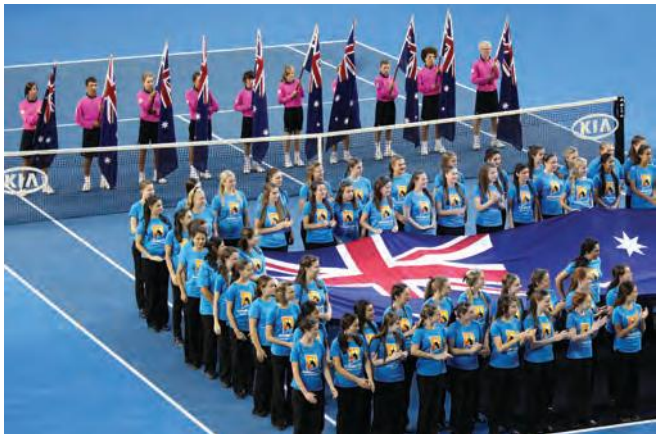
Australia, and treatment rates are even lower in poorer countries, such as India. Mental health is a very complex social, economic and environmental issue. Among the myriad of factors affecting people's mental state, recent research findings reveal evidence that the food we consume, and particularly the amount of fruit and vegetables, can influence how happy people feel on the day.

- Stable family life and enduring marriages/de facto relationships are important for the happiness of parents and children. Again, this is universal across the globe.
- In advanced countries (Australia falls within this group), women are happier than men, while the position in poorer countries is mixed.
- Happiness is lowest in middle age. Unsurprisingly, this perhaps confirms the midlife crisis theory developed by psychologists to describe the time when adults realise their mortality and start to question their satisfaction with life. Despite what is considered common behaviour across all cultures, good physical and mental shape combined with a healthy environment and the availability of attractive opportunities and prospects can all increase people's **happiness** and satisfaction with life.

happiness a state of wellbeing and contentment

While the happiness surveys measure the subjective (or experienced day-to-day) side of human wellbeing, the Legatum Prosperity Index (see Source 8.9, column 4), developed by the independent London-based Legatum Institute, assesses objective conditions, such as the economy, entrepreneurship and opportunity, governance, education, health, safety and security, personal freedom and social capital. Ranked at 4th position, Australia is again much higher than China (55th) and India (101st). Please note that this index does not take into consideration environmental health conditions which are essential not only from a **sustainability** perspective but also for the physical and mental health of any country's population. Moreover, various countries have different impacts on the local, regional and global environment. For example, people in India eat very little meat and as meat production is the biggest contributor to greenhouse gas emissions, water depletion, land degradation and biodiversity loss, the ecological impact of the Indian population per capita is very small, particularly compared with Australia – one of the highest meat-consuming nations in the world on a per-person basis. The term used to describe environmental impact is **ecological footprint**; in other words, the mark on the planet that a particular lifestyle leaves.

sustainability the ability to continue with minimal long-term effect on the environment



Source 8.10 Australia is considered a very happy and healthy country.

ecological footprint the measure of human demands on the Earth's ecosystems

The Happy Planet Index (see Source 8.9, column 1) combines life expectancy, experienced wellbeing and ecological footprint to rank 150 countries in the world. The **spatial differences** here are also strongly pronounced; however, Australia ranked 76th is doing much worse than India (32nd) and China (60th). Irrespective as to what people's personal experiences of wellbeing are and what objective conditions exist for them to live meaningful and satisfactory lives, the long-term sustainability and future of the human race depend on the ecological wellbeing of the planet and this is where Australia is not doing well.

spatial difference relating to difference in the position, area and size of things

Geographical fact

India is the largest democracy in the world but is yet to provide a pathway for improving human wellbeing.

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NOTE THIS DOWN

Copy the graphic organiser below and summarise what you have learned about the human wellbeing rankings of Australia, China and India.

Human wellbeing indices		
Australia	**China**	**India**
Australia ranks relatively high in human wellbeing indices that do not include the country's environmental impact. Its high life expectancy at birth of 82 years translates to only 67 healthy years for men and 69 healthy years for women.	China's ranking in human wellbeing is relatively low. Its life expectancy at birth is 75 years.	India's ranking in human wellbeing is relatively low. Its life expectancy at birth is 67 years.

ACTIVITY 8.2

1. Identify and list what makes you feel happy and content.
2. Explain the difference between the Happy Planet Index, World Happiness Report and Legatum Prosperity Index country rankings.
3. Calculate online your own personal ecological footprint; describe which are the worst ecological components of your footprint and how you can reduce them. Possible websites that you can use can be found at Cambridge weblinks (www.cambridge.edu.au/geography10weblinks).
4. Reflect on the problems societies around the world might face in the future if human wellbeing continues to rely heavily on economic prosperity.

ACTIVITY 8.3

1. Explain what is meant by ecological footprint and sustainability.
2. Discuss the single factor affecting happiness in any country.
3. Analyse Source 8.9 and discuss why each happiness survey or index has a different country as number 1.

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8.3 Human wellbeing in Australia

In the previous section, we saw that Australia performs very well according to many human wellbeing measurements, with the exception of its environmental impact. Even with its heavy environmental footprint, Australia has a relatively small population and a sparsely populated large territory. It has a reputation of being a healthy and happy country with well-established educational and social security systems as well as with a beautiful and clean environmental landscape. This attracts large numbers of migrants from many countries around the world. The OECD Better Life Index, based on 11 essential topics (see Source 8.12), does not rank countries as it does not assign a relative importance to these topics (in other words, it does not say whether the economy is more important than the natural environment, education more important than housing, etc.). It uses an 11-petal flower design, where the length of each petal describes the score of the topic (from 0 to 10) and its width shows the importance assigned by respondents to this topic. Based on currently available data, the Better Life Index shows that in 2012 Australia is doing better than the average OECD indicators (see Sources 8.12, 8.13 and 8.14). This index is available as an interactive tool online for individuals or organisations to construct their own Better Life Indices.

Source 8.11 Australians have good access to education.

Source 8.12 Topics in the OECD Better Life Index

i Housing
ii Income
iii Jobs
iv Community
v Education
vi Environment
vii Civic engagement
viii Health
ix Life satisfaction
x Safety
xi Work–life balance

Despite the relatively good scores Australia has in the OECD Better Life Index, there are still areas that can be improved. Let's look at the bottom two, income and work–life balance. The average annual income per person in Australia as at 2012 is AU$28 096 (or US$26 927 using the 1.0434 1 January 2013 exchange rate of the Reserve Bank of Australia). This is 20% better than the average OECD citizen but the income component of Australia's Better Life Index is only 4.5 (out of 10). The main reasons for this are the big disparities between those who have large earnings and those who don't. In fact, in Australia the top 20% of the population earn five times as much as the bottom 20%. Even if the average figures look satisfactory, the actual wellbeing of Australia's population is affected by these stark contrasts in the earning levels of its people.

Another area affecting the wellbeing of Australians is work–life balance. Australians spend a lot of time working. According to the OECD data, 14% of Australian employees work very long hours, that is more than 50 working hours per week, compared to the 9% OECD

Source 8.13 Australia and OECD Better Life Index, 2012 comparison

Australia	OECD
The average Australian earns US$26 927 a year.	The OECD average earning per person is US$22 387 a year.
Over 72% of Australians aged 15–64 have a paid job.	The average OECD employment rate for the 15–64 age group is 66%.
71% of Australian adults aged 25–64 have the equivalent of a high-school degree.	The OECD average for a high-school degree for the 25–64 age group is 74%.
The average Australian student scored 519 in reading literacy, mathematics and science in the OECD's Program for International Student Assessment (PISA).	The OECD PISA average is 497.
Australia's life expectancy at birth is 82 years.	The average OECD life expectancy at birth is 80 years.
97% of Australians believe that they know someone on whom they could rely in a time of need.	The OECD average of people who know somebody on whom they can rely in a time of need is 91%.
The level of atmospheric PM10 (tiny air pollutant particles which can enter and cause damage to human lungs) is 14 micrograms per cubic metre.	The OECD PM10 average is 22 micrograms per cubic metre.
74% of Australians say that in an average day they have more positive experiences (such as feelings of rest, pride in accomplishment and enjoyment) than negative ones (such as pain, worry, sadness and boredom).	The OECD average for people who have more positive than negative experiences in an average day is 72%.

Scores (out of 10):	
Community (red)	9.6
Civic engagement (yellow)	9.4
Safety (black)	9.3
Health (purple)	9.1
Environment (dark green)	9.0
Life satisfaction (orange)	8.6
Jobs (dark blue)	7.8
Education (light green)	7.6
Housing (turquoise)	7.0
Work–life balance (brown)	5.6
Income (light blue)	4.5

Source 8.14 Better Life Index: Australia, 2012

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Cambridge University Press

average, but Australia's country average at 1687 hours per year is just below the OECD average of 1718. The Australia Institute, however, estimates that Australians work the highest number of hours in the developed world. Long working hours can have many negative consequences to individuals and their families, including high levels of stress, impaired health, jeopardised safety, less time spent on personal care, household activities, cooking and meal preparation, leisure, hobbies as well as time with family and friends. While the health score for Australians is still relatively high, there is a range of health problems that are directly or indirectly linked to the unsatisfactory work–life balance. For example, 60% of the adult Australians are overweight or obese; by 2031 it is expected that more than 3 million Australians will have the lifestyle and food-related Type 2 diabetes.

The OECD Better Life Index is a combination of 10 objective measurements and one subjective personal experience, namely life satisfaction. Overall, Australians appear to be quite content with their life but there are some differences and people with a lower socio-economic status generally report lower levels of happiness. The following two sections explore differences among Australians.

RESEARCH 8.1

Use the OECD Better Life Index to create your own human wellbeing index. In groups, discuss with others what the width of the petal (that is, the importance of each area) should be. Use the website to explore in more detail:

- What exactly is hidden behind each of the 11 areas?
- How do countries that you (or your parents or friends) have visited perform according to this index?
- Compare Australia with a developed and developing country of your choice.
- Share your findings with the rest of the class.

Spatial differences in Australia

The main government organisation in Australia which collects and makes available information about the state of the Australian population, society, environment and economy is the Australian Bureau of Statistics (ABS). At this time, the ABS does not provide data about spatial differences in human wellbeing within the states, regions, cities, towns, or suburbs of our country. However, there are other studies that attempt to measure happiness and they often focus on a particular aspect depending on the interests of the researchers. For example, in 2011 research conducted by psychologists from the University of Sydney pointed out that people in Tasmania, with a score of 61 (a score of 50 indicating that an individual is neither happy nor sad), feel the happiest in Australia. The differences with the other states in people's subjective assessment of their wellbeing were not that pronounced – Victorians had a score of 59, residents in New South Wales, South Australians and Western Australians 58, Queenslanders and residents of the Australian Capital Territory 57 and the Northern Territory 52.

In order to better understand the objective conditions that can impact on human wellbeing in Australia, researchers from Griffith University developed the VAMPIRE (Vulnerability Assessment for Mortgage, Petroleum and Inflation Risks and Expenditure) index, which identifies the degree of socio-economic stress experienced across the suburbs of Australia's state capital cities of Adelaide, Brisbane, Melbourne, Perth and Sydney. The conditions that the researchers identified as having a strong impact on people's happiness are linked to housing affordability and transportation costs, particularly as most Australian cities are planned around the use of the car. Source 8.15 presents some of the results from this study, which identifies large differences in **vulnerability** between richer central suburbs and those of the fringe. In general, suburbs within 10 km of the Central Business District (CBD) appear to be less vulnerable to oil price and mortgage rate increases, thus providing

vulnerability the degree to which people, property, resources, systems and cultural, economic, environmental and social activity are susceptible to harm, degradation or destruction on being exposed to a hostile factor

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stable living conditions. On the other hand, however, these are also more expensive suburbs, often beyond reach for people with lower socio-economic status. As the vulnerability of other Australian suburbs continues to increase (see Source 8.15, 2nd column), this will have a negative impact on human wellbeing. Access to rail, tram, buses and other means of public transport is an important way to reduce exposure to higher petrol prices. Such services are very limited in many Australian suburbs, particularly in the outer metropolitan areas where cheaper house prices attract modest income earners and where transport is highly dependent on car travel.

Source 8.15 Vulnerability of Australian suburbs, 2008

State capital	Changes since 2006
Adelaide **Low vulnerability:** Central Adelaide, North Adelaide, Hyde Park, Beaumont **High vulnerability:** Wingfield, Seaford, Parafield Gardens, Elizabeth	17% of suburbs are less vulnerable. 38% of suburbs are more vulnerable.
Brisbane **Low vulnerability:** Indooroopilly, New Farm, Coorparoo, Bulimba **High vulnerability:** Browns Plains, Caboolture, Redcliffe, Capalaba	25% of suburbs are less vulnerable. 25% of suburbs are more vulnerable.
Melbourne **Low vulnerability:** Port Melbourne, Brunswick, Camberwell, Bentleigh **High vulnerability:** Deer Park, Beaconsfield, Roxburgh Park, Knoxfield	24% of suburbs are less vulnerable. 42% of suburbs are more vulnerable.
Perth **Low vulnerability:** Central Perth, Crawley, Claremont, Carine **High vulnerability:** Banksia Grove, Marangaroo, Huntingdale, Armadale	22% of suburbs are less vulnerable. 39% of suburbs are more vulnerable.
Sydney **Low vulnerability:** North Sydney, Mosman, Potts Point, Pymble **High vulnerability:** Cabramatta, Parramatta, Hebersham, Fairfield East	18% of suburbs are less vulnerable. 41% of suburbs are more vulnerable.

Source 8.16 An aerial view of Brisbane and its surrounding suburbs

RESEARCH 8.2

Using secondary sources, research the human wellbeing of young people comparing Australia with a country of your choice. Present your findings in an essay.

ACTIVITY 8.4

1. Explain the role of the Australian Bureau of Statistics (ABS).
2. Discuss the definition of vulnerability and how it affects wellbeing.
3. Analyse Source 8.14; discuss the possible reasons why Australia has low scores in income and work–life balance.

RESEARCH 8.3

Investigate whether there are any recent human wellbeing studies that analyse spatial or social differences in human wellbeing. Write a short essay explaining the contributions and limitations of one such study.

Differences between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians

The resilience of Aboriginal and Torres Strait Islander peoples is manifested in their capacity to maintain themselves and their culture in a historically imposed foreign culture following the European settlement of the continent. Despite being culturally and linguistically diverse, Aboriginal and Torres Strait Islander communities share a culture very different from that of non-Indigenous Australians. Considerations related to conceptions of family structure and community obligation, language, obligations to country and continuation of traditional knowledge are highly important to their wellbeing. The list below represents the nine domains of Aboriginal and Torres Strait Islander peoples' wellbeing, conceptualised by Aboriginal and Torres Strait Islander peoples' researchers and other stakeholders, which is adopted by the Australian Bureau of Statistics. The ABS is yet to produce a publication dedicated to Aboriginal and Torres Strait Islander peoples' wellbeing; instead it uses a long list of issues which cover individual aspects or indicators of this framework.

i Culture, heritage and leisure
ii Family, kinship and community
iii Health
iv Education, learning and skills
v Customary, voluntary and paid work
vi Income and economic resources
vii Housing, infrastructure and services
viii Law and justice
ix Citizenship and governance

However, there is ample evidence that Aboriginal and Torres Strait Islander communities have poorer levels of emotional, social, economic and health wellbeing than the rest of the Australian population. Below are some examples:

- 25% of Aboriginal and Torres Strait Islander people over 15 live in overcrowded housing; the overcrowding is even higher in remote areas where it reaches 48%.
- The retention rate of year 7/8 to year 12 at school is only 43% for Aboriginal and Torres Strait Islander peoples compared to 76% for other students.
- Poverty rates among Indigenous Australians are also much higher; income levels are much lower.
- The rate of community mental services contact for Aboriginal and Torres Strait Islander peoples is often twice as high as that for non-Indigenous Australians.

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- Aboriginal and Torres Strait Islander peoples are twice as likely to be hospitalised for intentional self-harm than non-Indigenous people.
- Aboriginal and Torres Strait Islander peoples' children under 5 are three times more likely to die than non-Indigenous children.
- Aboriginal and Torres Strait Islander people are 13 times more likely to be in prison than other Australians; Aboriginal and Torres Strait Islander youth are 28 times more likely to be in prison than non-Indigenous youth.

Given these alarming indicators, it is not surprising that Indigenous people experience poorer physical and mental health and live shorter lives, approximately 10 years less than the overall Australian population according to the ABS (the Australian Institute of Health and Welfare claims this difference to be 16–17 years). They experience higher infant **mortality rates** and a higher incidence of diseases such as diabetes, respiratory disorders, some cancers, ear and eye disorders as well as alcohol-related problems.

mortality rate the number of deaths per 1000 head of population, often expressed as a ratio

According to the ABS study, *National Aboriginal and Torres Strait Islander Survey, 2004–05*, Aboriginal and Torres Strait Islander peoples also report higher rates of mental health problems:

- 27% of Aboriginal and Torres Strait Islander peoples report high or very high levels of psychological distress.
- Aboriginal and Torres Strait Islander peoples are twice as likely to report high or very high levels of psychological distress than non-Indigenous Australians.
- One in 10 Aboriginal and Torres Strait Islander peoples had visited a doctor or health professional in the four weeks prior to the interview due to feelings of psychological distress.
- Four in 10 Aboriginal and Torres Strait Islander adults indicated that they, their family, or a friend had experienced the death of a family member or a close friend in the previous year.

Despite the significantly poor objective measures of Aboriginal and Torres Strait Islander peoples' wellbeing in Australia, the subjective experiences and life satisfaction of Aboriginal and Torres Strait Islander peoples are less pessimistic. The *2004–05 National Aboriginal and Torres Strait Islander Health Survey* (NATSIHS) reports that 51% of Indigenous adults feel calm and peaceful and 71% had been happy in the past four weeks.

NOTE THIS DOWN

Copy the graphic organiser below and summarise what you have learned about spatial differences in human wellbeing in Australia.

Vulnerability		
Suburban Australians	**Aboriginal and Torres Strait Islander peoples**	**General**
People living in outer metropolitan areas (where house prices are cheaper but there is limited public transport) are most vulnerable to increases in petrol prices and mortgage interest rates.	Aboriginal and Torres Strait Islander peoples feel vulnerable because they experience high levels of psychological distress.	The majority of Australians are dissatisfied with their level of income despite the country's average income being relatively high. Most people feel vulnerable as there is a large difference between those who earn a lot and the rest.

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ACTIVITY 8.5

1. Explain why Australians are generally unhappy with their work–life balance and income.
2. Select a suburb in an Australian state that you are relatively familiar with (it may be a suburb that you live in or have visited), locate it on the VAMPIRE map (for the link, see www.cambridge.edu.au/geography10weblinks) and analyse its vulnerability to changes in petrol prices and mortgage interest rates.
3. Justify whether or not you agree that Australia is doing better than the average OECD country in human wellbeing, and why.
4. Reflect on how the differences in wellbeing between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians can be reduced and what contribution you can personally make.

Wellbeing of Australian children and youth

The years of childhood and adolescence are a vital period for developing positive health and social behaviours. These years determine in many ways the future wellbeing of individuals. Improving the living conditions for Australian children and youth, including Aboriginal and Torres Strait Islander youth, recent migrants and those from socio-economically disadvantaged families, is very important in creating the prerequisites for happy lives as young people transition into adulthood.

For example, a healthy family life and maintaining contact with parents in cases of separation (around half of all divorces in Australia involve children under 18) create a positive social environment for growing adolescents, help prevent mental health problems and provide the best possible start in life. A nutritious and healthy diet within the dietary guidelines for Australians combined with exercise and other physical activities are essential in maintaining good health. These things can help prevent and reduce problems such as obesity and related diseases, maintain physical and emotional wellbeing and, most importantly, set up children, youth and young adults on a happy trajectory allowing them to reach their full potential.

Geographical fact

Australia is the second-most desirable country in the world for a child to be born into in 2013.

Source 8.17 Physical activities are essential for everyone including children and young adults.

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8.4 Human wellbeing in China and India

The unprecedented economic growth in China and India, the two Asian giants, has attracted a lot of attention in the world but their regional growth disparities have determined significant differences in the levels of wellbeing. Both countries are experiencing unbalanced development with their more developed areas being much ahead of the poorer regions. As a result, the gaps in regional wellbeing have worsened.

The theme of pursuing happiness has recently become part of the process of economic development in China and India where governments are trying to find answers to questions, such as: Where does happiness come from? What is the state of wellbeing of children, particularly those left in rural areas while their parents are looking to make money in the cities? Human wellbeing is high on the political agenda with both governments realising that it needs to be promoted, monitored and measured in order to achieve meaningful progress at the local and national levels.

As we saw earlier in this chapter, in both China and India the levels of wellbeing are generally lower than in the developed world. With these countries' limited **socio-economic** resources, the road to happiness is not easy. Development so far has benefited urban areas at the expense of rural communities. Both countries are facing issues related to food security, environmental degradation, political corruption and civil discontent.

socio-economic the interaction of social and economic aspects

As developing countries and emerging economies, the most important aims in improving human wellbeing in both China and India are reduction of poverty, hunger and mortality, and focusing on universal primary education and gender equality. However, this should not come at a cost to the natural environment as ecosystem deterioration has a direct negative impact on wellbeing. As China and India continue to increase the per-capita income of their citizens, they also need to take into account equity considerations and environmental protection. Wellbeing is a complex concept and the variations in socio-economic development, culture and tradition mean that different indicators and approaches may be needed.

China's harmonious society

With rural dwellers earning only a third of what their urban counterparts make, regional differences are becoming a serious concern for the Chinese government. Economic expansion in China has created many megacities, luxury shopping markets and fast train connections, but the country has a long way to go to balance the needs of the rich and poor, the advantaged and the disadvantaged and vulnerable groups. In order to achieve the goal of harmonious society in China, a happiness index (see below) is used to assess the performance and accomplishments of local governments. The aim is to achieve a resource-efficient and environmentally friendly society where people are happy.

i Overall evaluation
ii Personal development
iii Quality of life
iv Spiritual life
v Social environment
vi Government services
vii Ecological environment

The first 2012 application of the happiness index revealed Liaoning province as the happiest, followed by Tianjin and Shandong. The capital city of Beijing achieved a low score, with its residents being unhappy with the increasing costs of living, prices of goods and diminishing employment opportunities, and expectations of social development and social security. Environmental pollution also remains high on the health wellbeing concerns for Beijing residents. Although nowadays happiness is becoming a catchword with some provinces using slogans such as 'Happy Hubei' and 'Happy Ningxia', there is a lot more work to be done in understanding and measuring human wellbeing in China.

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Case study 8.1
Air pollution in Beijing

Pollution in Beijing has hit record levels recently, prompting citizens to ask if they're paying for economic growth with their health. In January 2013, the data on PM2.5 (airborne particles smaller than 2.5 micrometres) intensity monitored for Beijing's air quality index reached above the scale's maximum pollution level of 500. The PM2.5 particles which come from vehicle waste and coal burning are harmful to people's health, particularly for the young and aged. The number of patients with respiratory complaints suddenly increased. Outdoor sports activities for primary and middle schools were cancelled. The health of 20 million people in Beijing was severely affected by the smog.

The following report describes in detail the effect on people's daily lives.

Chinese struggle through 'airpocalypse' smog

The Observer

Jonathan Kaiman, 17 February 2013

Hu Li's heart sank when she realised that she could gauge how close she was to home by the colour of the air. Driving 140 kilometres from Tianjin City to Beijing last week, she held her breath as the chalky-white horizon became a charcoal grey haze. The 39-year-old businesswoman has lived in Beijing for a decade, and this past month, she said, brought the worst air pollution she has ever seen. It gave her husband a hacking cough and left her seven-year-old daughter housebound. 'I'm working here and my husband's working here, so we have no choice,' she said. 'But if we had a choice, we'd like to escape from Beijing.'…

'PM 2.5 and data measurement issues with regard to air quality have entered into mainstream Chinese life,' said Angel Hsu, a doctoral candidate at Yale University. Hsu has tracked usage of the term 'PM 2.5' on Sina Weibo, China's most popular microblog, over

Source 8.18 Air pollution in Beijing

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the last two years. In January 2011, it was mentioned about 200 times. Last month, the number soared above three million.

In China, PM 2.5 has acquired a symbolic weight to parallel its medical gravitas. Young internet users post photos of themselves wearing air filtration face masks. One popular mask is hot pink; another looks like a panda bear. Last spring, Shanghai hosted a PM 2.5-themed rock music festival. A music video called 'Beijing, Beijing (Big Fog Version)' went viral on video sharing websites. 'Who is searching in the fog? Who is weeping in the fog? Who is living in the fog? Who is dying in the fog,' a man croons over images of cars crawling along smog-choked highways.

Experts say that the last month's pollution was probably caused initially by a cold snap, forcing huge use of coal, followed by a rare temperature inversion, which trapped emissions under a blanket of warm air. Others say that it could be related to a prolonged period of high humidity, trapping particulate matter in the air. Pollution levels depend heavily on the force and direction of the wind. A strong north-eastern gust can blow the smog out to sea; a few stagnant hours are enough to make noon look like early evening.

The standard international measurement for air quality – the US Air Quality Index, or AQI – rates air quality on a scale of zero to 500. With experience, it becomes possible to guess the AQI in Beijing without looking at official readings. One hundred correlates to a thin grey gauze hovering above the horizon. When the index hits 200, the sky is visible only in a small patch directly overhead. An AQI reading of 300 blots out the sun, smothering the city in drab uniformity. When the AQI reached 755 on 12 January, the worst day on record, the air felt like industrial smoke – chemical-tasting, eye-watering.

On particularly smoggy days, the toxic cloud is visible in satellite photos. The worst of the last month's pollution stretched 1,100 miles south, closing highways near the south-western city Guiyang. When the smog clears, it doesn't simply vanish, but instead drifts to surrounding countries. January's smog spurred Japanese authorities to release health warnings to people living in the country's western cities. Traces of China's smog have been detected as far afield as California.

The Beijing municipal government has taken steps to curb the pollution, temporarily shutting down factories and ordering government cars off the roads. While propaganda authorities used to quash reports of air pollution for fear that they could spark social unrest, Chinese newspapers were allowed to report freely on the crisis. Shanghai's Environmental Protection Bureau has designed a cartoon accompaniment to its AQI readings – a pigtailed girl with big anime-style eyes, green-haired and smiling when the index reads 'excellent' but maroon-haired and weepy when smog rolls in.

'I'm pretty optimistic that this happened at the right time to prompt the most action possible,' said Deborah Seligsohn, an expert on China's environment at University of California, San Diego. President Xi Jinping took the reins of the Communist party in November; incoming prime minister Li Keqiang has promised to make environmental protection a focus of his tenure. Beijing authorities hope to wean the city off coal and implement stricter vehicle emissions standards by 2016.

Seligsohn added that changes would take a while. 'If Beijing were surrounded by cities that were doing the same thing that Beijing was doing, it would be fine, but it isn't,' she said. A short drive from central Beijing, the landscape fans out into sprawling, dusty plains, where farmers burn coal to heat their concrete homes. Small factories there often escape the notice of environmental watchdogs. PM 2.5, she explained, is produced by four airborne pollutants – sulphur dioxide, nitrous oxides,

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Source 8.19 Unidentified female child with mask riding on ice, *c.* January 2013 in Beijing, China

volatile organic compounds, and black carbon – each of which would require its own slew of regulations to curb.

People have begun to take protection into their own hands. 'People are starting to treat air purifiers as a necessary appliance like a washing machine or computer,' said Bi Xiuyan, a 56-year-old product salesperson for Amway. Bi has sold about 50 air purifiers in the last month, each of which costs £960, about twice the average monthly income for Beijing residents. 'Everybody needs to breathe,' she said.

Louie Cheng, the president of Shanghai-based Pure Living China, a small company that tests indoor air pollution, said that the current situation boosted the company's web traffic 30-fold. 'Literally you can see it – this isn't compared with a year ago, this is compared with a month ago,' he said. Cheng said that he helped start the company three years ago when an expat friend with an asthmatic daughter couldn't find a local company to competently test his house for pollutants. His client-base has tripled since January, and now includes more than half of Shanghai and Beijing's international schools. 'It's just hard to keep up with the demand,' he said.

Awareness of the problem has spread beyond major urban centres. Ma Shiying, who sells moist towelettes in the small coastal city of Weifang, Shandong province, heeded the government's warning and lit fewer fireworks this year. 'Over the past few months, the whole world has begun to pay close attention to this problem,' he said. 'It's become impossible for anyone to ignore.'

Yet interpretations of the issue vary. Eva Zhong, the head of exports for a fireworks manufacturer in Hunan province, said that the government's fireworks warnings were misplaced. 'Fireworks are very innocent,' she said. 'Car exhaust is a far greater problem.'

Despite the government figures, she added, her company's sales this year have been unscathed.

1 Explain why air quality is essential for human wellbeing.
2 Explain what is meant by the term 'PM 2.5' and why Chinese people are familiar with it.
3 Outline China's responsibilities regarding national and global environmental health.
4 Discuss measures, including environmental monitoring, that China is taking to improve air quality.

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Wellbeing in India

In contrast to China, India – the country which gave yoga to the world as one of the most powerful tools for individual physical and spiritual health – is also a place of institutionalised democracy. Its government does not have an active political platform encouraging happiness. Poverty is unevenly spread throughout the country with the regions of Uttar Pradesh, Bihar, Madhya Pradesh, West Bengal and Orissa accounting for almost 70% of the poor. Three-quarters of the poor live in rural areas with no access to land, productive resources or employment. Spatial disparity is also visible in educational levels with 92% literacy rates in the state of Kerala and only 48% in Bihar. Gender rights, inequality, social exclusion and child welfare remain areas with many unresolved problems affecting not only human rights but also overall human wellbeing.

Many questions are raised in relation to the world's largest democracy and whether **civil society** in India can mobilise itself to effectively remove these barriers. Material and non-material dimensions of wellbeing, including environmental health, are equally important for India. Its government is currently aspiring to join the OECD Better Life Index, as a vehicle for data and measurement of India's human wellbeing.

civil society a 'third sector' separate from government and business, which refers to institutions such as religious groups and unions

Source 8.20 Poverty is a large problem in India, severely affecting the wellbeing of the population.

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NOTE THIS DOWN

Copy the graphic organiser below and summarise what you have learned about human wellbeing overall in China and India.

Environmental concerns in China		
General	**Provinces**	**Air quality**
China has started to pay attention to the environment and its recent policies aim to develop a harmonious society.	There are vast differences across China's provinces. People in Beijing feel less happy than residents in other provinces, such as Liaoning, Tianjin and Shandong.	Air quality is still a major concern in large cities, particularly in Beijing.

ACTIVITY 8.6

1. Identify the main reasons why China and India do not rank high in human wellbeing lists.
2. Explain the differences between human wellbeing in China/India and Australia.
3. Reflect on the importance of environmental health for human wellbeing.

Geographical fact

China has adopted a happiness index and a policy for achieving a harmonious society.

RESEARCH 8.4

1. Collect Australian Bureau of Statistics data describing the suburb you live in and apply the human wellbeing index.
2. Explain how important the lived experiences of wellbeing are for the people living in your suburb. Can you think of a way to collect data and measure these experiences?
3. Analyse the findings about your suburb.
4. Evaluate whether there are any areas for potential improvement in human wellbeing and what they should be.

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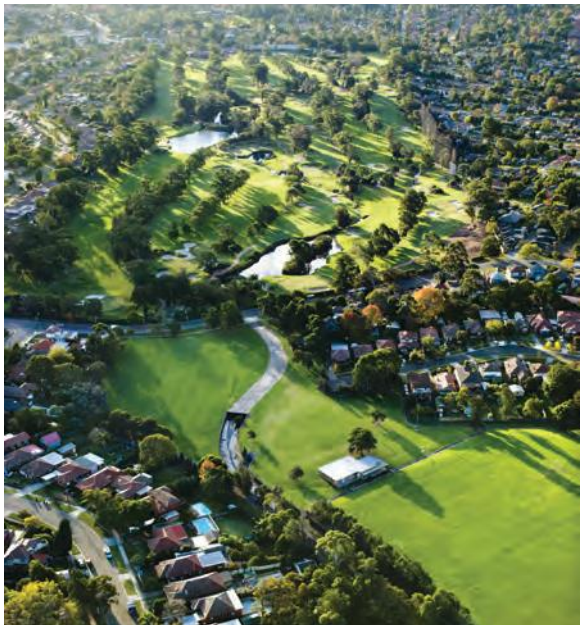
FIELDWORK 8.1 EXPLORING HUMAN WELLBEING IN YOUR NEIGHBOURHOOD

Aim

To analyse how residents in a particular neighbourhood assess and report their satisfaction with life. You will also compare their results with other information about human wellbeing in Australia.

Method

You will conduct a survey of 12 residents in your neighbourhood.



Source 8.21 Ryde, New South Wales

Preparations

Develop a simple questionnaire about what makes people happy and how satisfied they are with their quality of life. Find a map of your neighbourhood and randomly select 12 houses. Ask a parent or a guardian to accompany you for your visit to the neighbours. You will need to carry a printed version of the questionnaire (on a clipboard) and a pen to record people's answers. Bring also a camera to take a photo of the house (with the owner's permission).

Data collection

As you will be knocking on people's houses and approaching neighbours whom you may have not met before, you will need to have a parent or a guardian with you. Start with people you know and you feel comfortable talking to. You may need several days to complete this fieldwork. Make sure you collect the following information:

1. Ask how satisfied people are with their current quality of life.
2. Ask what makes people happy.
3. Observe how the houses look from outside, including decorations, gardens, garage and any parked cars.
4. Analyse the data from the 12 visits.
5. Compare your findings with other Australia-related human wellbeing information.
6. List your conclusions and suggest a way which could make people feel happier.

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 – your suburb
Page 3	Introduction – brief description of the study neighbourhood
Pages 4 and 5	Description of the survey tool used, including justification for the questions asked
Page 6	Table and graphical representations of answers: level of people's satisfaction with life
Pages 7 and 8	Description and analysis of findings with photos
Pages 9 and 10	Comparison between your survey results and other sources
Page 11	Suggestions as to how people of your neighbourhood could feel happier
Page 12	Evaluation of these suggestions: are they realistic and feasible?
Page 13	Appendix, bibliography, glossary

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Chapter summary

- Improving human wellbeing is about making all people feel happy in the place where they live. Achieving this goal, however, is a complex task and involves satisfying many external conditions.
- Australia – 'the happy country' – still has a long way to go to witness the same level of satisfaction and wellbeing among its Aboriginal and Torres Strait Islander peoples' population.
- China and India are on the same path of improvement, with issues such as the environment, literacy and gender equality being important challenges for the future.
- It is important to strike the right work–life balance, have a stable income, and enjoy a clean and productive physical environment, the care and company of friends and family, political freedom and … everything else that makes you happy.
- 'What makes me feel happy?' and 'How can I make other people feel happy?' Our life is a journey to find the answers to these questions.

End-of-chapter questions

Multiple choice

1 What are the dimensions of human wellbeing?

A Social, environmental and economic

B Health, personal and social

C Economic, health and personal

D Health, social, environmental, economic and personal

2 How does Australia rank among other countries in relation to life expectancy?

A High

B Middle of the range

C Top

D Low

3 The OECD Better Life Index:

A does not measure environmental health

B does not provide country rankings

C has nine topics

D does not allow for changes in the importance of the topics

4 Aboriginal and Torres Strait Islander peoples have lower levels of wellbeing than the non-Indigenous population. Is this:

A true only in the cities

B not true

C true

D wrong for remote areas

5 The VAMPIRE index measures:

A ecological degradation

B social resilience

C vulnerability to petrol prices and bank interest rates

D all of the above

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Short answer

1 Describe the strengths and weaknesses of the OECD Better Life Index.

2 Explain why Australia is one of the top places in the world for a child to be born into in 2013.

3 There are vast spatial differences in human wellbeing between Chinese provinces. The eastern coastal provinces generally have higher levels of wellbeing; however, Beijing ranks poorly. Discuss why this is the case.

4 India is a vast country with the world's second-largest population. Analyse how human wellbeing can be improved in India.

5 Analyse and discuss how the wellbeing of Aboriginal and Torres Strait Islander peoples is worse than the average for Australia.

Extended response

Discuss the issue about spatial differences in human wellbeing in your capital city:

- Identify literature sources that discuss human wellbeing for your city.
- Analyse what measurements are used to describe wellbeing and what the outcomes are from this analysis.
- Critically examine the findings from the literature and suggest policies and other measures that can be taken to improve the level of human wellbeing.

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9 Population and human wellbeing

Source 9.1 Working towards better global outcomes – a better world for all people

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Before you start

Main focus

The main focus of this chapter is to understand how the use of demographic statistics and data can build a picture of how people live and provide the basis for improving lifestyles globally as well as in smaller communities. It will help you to see how decisions based on collected data can be made to improve people's lives and wellbeing.

Why it's relevant to us

The effective use of demography ensures more efficient planning for populations and better understanding of what populations need to promote human wellbeing, including improved health outcomes.

Inquiry questions

- What is demography?
- How are statistics gathered?
- How are the data used to make decisions by governments and other agencies?
- How does the study of demography support human wellbeing?

Key terms

- Demography
- Fertility
- Migration
- Mortality
- Wellbeing

Let's begin

Demography is the study of people, specifically the statistics and data that not only build a picture of society, but also provide the basis for government policy and support of populations. Some of the key data that are used include births, deaths, marriages, location (residential, occupational, recreational and services), movement and industry-specific information. Good use of demographic data can make a big difference to how well a government can plan for the smooth running of a society and provision of services for the population.

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9.1 Theories of demography

Demography is used thoroughly in contemporary society to provide the basis for government policy and support of populations. Throughout history, people have attempted to explain their environment, to make sense of current conditions to understand and predict future trends. The following theories were created by a number of different scholars from different backgrounds at different times. They provide an insight into the developments of demographics.

demography the study of people to build a picture of society

Malthusian theory

Thomas Malthus (1776–1834) argued that human population size would always be restricted by the capacity of environment, and that if the population became too large there would be an intervention by nature that would force a reduction in numbers, such as a famine or flood. He also believed that if populations expanded too much, they would take over too much of the land they relied on for food production as residential living space and that this would also enforce change. Malthus was seen as an unconventional thinker during his lifetime, but many of his ideas have been linked to the work of Charles Darwin (Theory of Natural Selection) and John Maynard Keynes (a later economist). While his work has become better accepted as viable and logical during the 20th and 21st centuries, it was not based on research or data, rather on observation of historical patterns.

Doomsdayists

Doomsdayists or Doomsdayers are a collection of people who all believe that the end of the world is coming soon. Each group has a different view on what will cause the apocalypse, ranging from environmental disasters to religious **armageddon** to an asteroid colliding with the Earth or even an aggressive alien invasion, but they all believe that the world as we know it will cease to exist and only a very select few will survive. They believe that disaster will happen regardless of human intervention for demographic reasons and will often happen because of increasing population size. They believe that human populations have little control over what will happen to them and their beliefs are based on faith rather than fact.

armageddon the Bible scene of the final battle between good and evil forces occurring when the world is to end

'Populate or Perish'

During World War II and the years immediately following, it had become clear that Australia did not have a large enough army (or the population to provide enough manpower) to defend the country unassisted. We would always need to rely on the help of other nations such as Great Britain or the United States of America, but any

Source 9.2 Going off the Mayan calendar, many Doomsdayers around the world believed that 21/12/12 would be the end of the world.

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potential help was distant and would take time to arrive. During the 19th and early 20th centuries, the Australian people felt isolated and vulnerable, worried about the 'Yellow Peril' – the possibility that the country could be taken over by an invasion from an Asian culture. The movement south by the Japanese army during World War II further alarmed the Australian people and government, so plans were begun to protect the established British-based culture. By 1942, the Prime Minister (John Curtin) and his Minister in charge of the Department of Information (Arthur Calwell) began plans to increase **migration** to Australia. There was a belief that people from Europe would integrate better into the Australian way of life so plans were developed with Great Britain for the Assisted Passage Program, where immigrants to Australia would have the majority of their transport to the new country paid for. The implementation of this successful policy in 1945 by the new Prime Minister (Ben Chifley) and the first Minister for Immigration (Arthur Calwell) brought about an influx of British migrants known as 'Ten Pound Poms' or 'Ten Pound Tourists', because of the £10 price each immigrant paid towards the cost of their migration.

migration the movement of people from one place to another

Myth v reality

Although the Populate or Perish Program was based on some data from the Ministry of Information, the reality is that it was heavily influenced by the prejudices and beliefs of the time. Rather than being founded on the industrial/economic needs of the nation or on each migrant's willingness to contribute to a remote rural community, it was a government attempt to strengthen the dominant culture of the time, thereby managing the characteristics of the population and making what were seen as desirable changes to it.

Emotive response

However, the real aims of the program were more complex. The population was fearful of attack and felt that the north and west coasts of the continent were so sparsely populated that they were easy targets. Likewise, the interior of the country would present little resistance to any attack purely because of low population density. The Populate or Perish Program did not address these fundamental concerns as many of the new migrants stayed in the coastal fringe of the country or in the relatively fertile areas of Victoria and eastern New South Wales. They preferred these areas as they more closely resembled the wetter climate and greener countryside they had left behind in the United Kingdom.

Source 9.3 Migrants leaving for Australia

ACTIVITY 9.1

1. Define the term demography.
2. Explain the key points in Malthusian theory.
3. Analyse why the Populate or Perish policy was developed in Australia.
4. Using the internet, investigate Doomsdayists and their many views that represent the apocalypse. Summarise three views and explain whether you think the size of the human population would actually affect their views.

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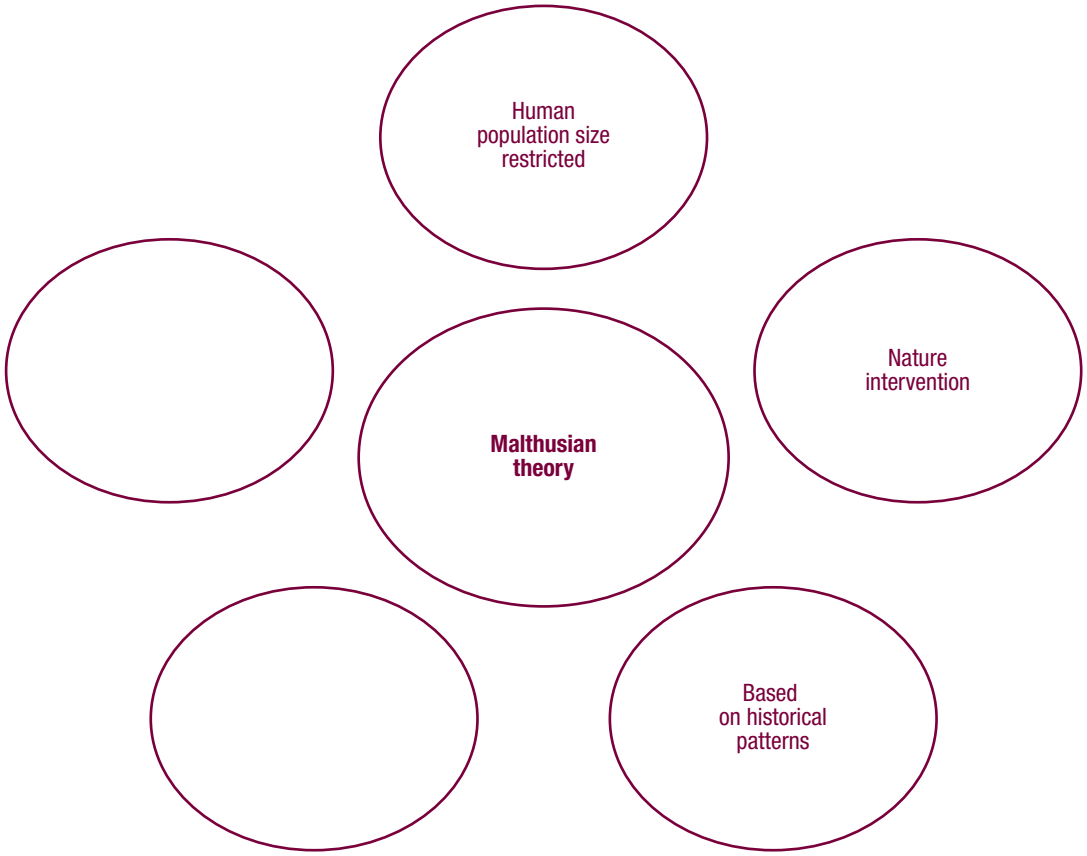
NOTE THIS DOWN

Copy the graphic organiser below and select one of the theories of demography mentioned so far. Summarise the chosen theory and relate it back to demography in a concept map. One theory has been started for you. Add more circles wherever you feel they are needed.



9.2 Research and data tools

There is a wealth of data that are collected regularly and that are available for planning the future. Every four years in Australia there is a Census and the Australian Tax Office collects official information, as do other government agencies such as Centrelink and Medicare. In addition, there are the many unofficial information collection groups that we trust our details with: supermarkets, online shopping sites, social media sites, market research companies, telecommunications companies etc. We often agree to share our location via GPS (Global Positioning Satellite) software on our mobile phones, tablets and computers, sometimes even 'checking in' to openly share our location and activity with others. All of this is supporting the development of demographic data-based advertising and marketing. Loyalty cards and programs linked to our purchasing patterns further add to the picture of each one of us allowing companies and governments to track what we do and where we do it.

What are we trying to achieve by all this data collection? Planning for the future development of communities is the most obvious use. Town planners could use common sense or intuition to decide what services a community needs, but accurate data are more efficient and effective. For example, in a new suburban area, we can guess that the majority of new residents will be young families who will require schools, infant welfare centres, shopping centres and active recreation. What we don't know is how many of

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these things will be needed or where specifically they should be located. We also don't know the demographic characteristics of other groups that may be in the community, such as migrant groups, or specialised interest groups. Some data are more useful than others when planning for the future of communities.

ACTIVITY 9.2

1 Explain the concept of data collection.

2 Justify reasons for the collection of data during a Census in Australia.

3 Provide four examples of places you go to or things you use or do that develop and collect research data. As a consumer or user, do you realise that your data is being used in each of your examples?

9.3 Fertility and mortality rates

The **fertility rate** and **mortality rate** are the basis of any set of detailed demographic data. They are usually calculated for larger regions or countries, but can be used in smaller areas. They are also used to work out the rate of natural population increase or decline and can therefore be used to decide if migration is required to maintain a stable population size or if an area's population is growing too fast for the environment to adequately cater for it. These data help to inform government policy and action, including the Populate or Perish policy.

fertility rate the number of live births per 1000 head of population, usually shown as a ratio

mortality rate the number of deaths per 1000 head of population, often expressed as a ratio

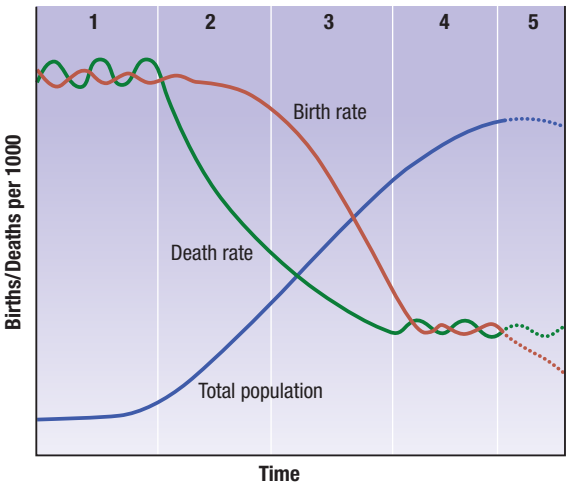
We can analyse specific data for a range of countries to make judgements about how quickly their population is growing and what this might mean for their government. In general, more economically developed countries tend to have lower, or even negative, natural population growth.

Source 9.4 Fertility and mortality rates for 2011

Country	Fertility rate	Mortality rate
Mali	50.54	14.29
Madagascar	37.51	7.79
Pakistan	24.81	6.92
Mexico	19.13	4.68
Australia	12.33	6.88
United Kingdom	12.29	9.33
European Union	9.83	10.33
World Average	20.2	8.00

The Demographic Transition Model

The demographic transition model shows population change over time. It studies how the fertility rate and mortality rate affect the total population of a country.



Source 9.5 The transition from high fertility and mortality rates to low fertility and mortality rates as a country develops

The five stages of the demographic transition model are:

1 High fertility and mortality rates. This indicates low levels of contraception (knowledge and use) and medical intervention. There are also low levels of medical intervention to increase lifespans, and as a result, population numbers are stable. There are very few countries left in this stage.

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2 High fertility rate, declining mortality rate. While contraception is not yet widely used, medical practices are increasing life expectancy and improving overall health for the population. Population numbers are increasing.
3 Declining fertility and mortality rates. Contraception becomes more accepted by the population and there continues to be improvement in the health and life expectancy for the population. Population continues to increase, but at a slower rate.
4 Low fertility and mortality rates. Contraception and small families are common while medical care for people is very good and results in a high life expectancy. Many westernised countries are in this stage.
5 Fertility rates continue to drop while mortality rates are stable. This indicates an ageing population and a country that will need to supplement population with migrants if population levels are to be maintained. There are an increasing number of western countries entering this stage.

At any point in time, countries are at different stages on the Demographic Transition Model, and are usually moving towards stage 5. For many countries, the data are complex and there are many factors to be taken into account. For example, Australia's population is supplemented with migrants each year. Many of these are at the stage in their lives when they are starting families, so their fertility rate is not necessarily the same as the fertility rate of the long-term resident population. This means that we need to be careful when using these data and ensure that we look at multiple sources to gain a clearer picture. During 2011, Australia's net migration was 170 270, with the average age of new arrivals being 27 years. The new migrants were approximately 50% male, 50% female.

Obviously, if Australia's population is being supplemented by migrants, the countries they are coming from have a decrease in population. Depending on the ages and skills of the migrants, this could have a negative effect on the country of origin. Imagine how a country would be impacted if a large number of specialists like doctors or lawyers left the country. Even if there is a spread of occupations, losing healthy, young people still has an impact. The same happens if we change the scale of the issue. Consider a small agricultural town in rural Australia where the majority of young people have decided that they cannot remain in the town due to a range of factors including a lack of employment or opportunities. The town becomes socially poorer and has a further reduction of employment and social richness. In an extreme case, the businesses in the town may cease to remain viable, with the result being that the town 'dies' and the remaining residents become linked to a larger nearby town. The area becomes a locality and loses its original identity. There are many of these towns across Australia, but some of the notable ones are Silverton (NSW) which is now often used by the film industry, Walhalla (Victoria) which has become a tourist area, Cook (South Australia) that has a current permanent population of four, Betoota (Queensland) whose last permanent resident died in 2004 and Gwalia (Western Australia) which has been deserted since the gold mine closed in 1963.

The influence of income

At first it may not seem as if there are links between income and fertility or mortality, but if we look at national income levels and compare them to the same nation's demographic transition model's stage it becomes clear that there are patterns to be found. Higher income levels are consistent with higher education levels and, in general, higher education levels across both genders correspond to lower fertility and mortality rates. Increased literacy rates improve access to information on contraception, hygiene and health awareness. It also reduces superstition and the impact of cultural tradition, allowing better analysis of situations and options. It is a cycle that, once begun, can rapidly improve the life expectancy of individuals and the overall health of a community.

Gender equality in opportunity

The ability of increased education and opportunity to improve the quality of lives is stronger where both males and females have equity of access. Historically, not all cultures have delivered equality in this area; however improved education for girls

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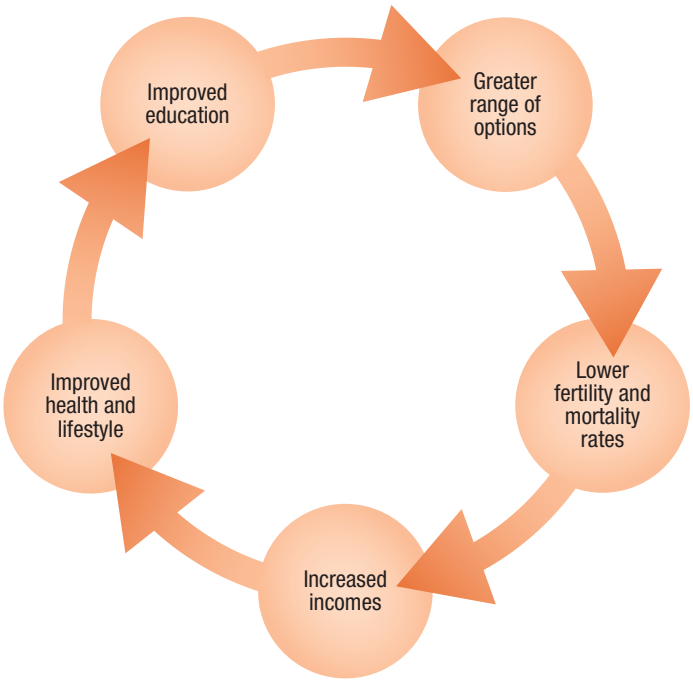
Source 9.6 Income influencing the world

can significantly improve family and community health. Often it is women who run a home and provide care for the sick, making them pivotal in the community's health status. Ensuring equal education opportunities provides the community with more rapid reduction in fertility and mortality rates, supporting overall improvement in the health of each individual and better understanding of community health issues.



Source 9.7 Equal opportunity

Can a fertility rate be too low?

Global fertility rates are reducing, especially in developed countries, but is there a point where a low fertility rate becomes a problem? The simple answer is yes. In Australia, fertility rates have been below mortality rates for many years now, increasing the overall age of the population. This has far-reaching implications for the community and the government as it changes the age balance for the country. We rely on there being enough people in the workforce to not only provide the goods and services that we require, but also to be paying income tax. If a population has a low fertility rate, there will eventually be less people in the group that pays income tax and an increased proportion in the older age groups, creating an imbalance.

Geographical fact

Of the 40 poorest and hungriest nations on Earth, 36 actually export food to richer countries.

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Case study 9.1
Diabetes in the Pacific Islands

The Pacific Islands region has a high level of non-communicable disease. The level of disease has increased so dramatically the situation has been labelled a 'diabetes pandemic'. The widespread rate of Type 2 diabetes ranges from 9% to 47.3% of the population. Almost 50% of deaths in the region are due to the disease. It is also the leading cause of cardiovascular disease, blindness and renal disease in the Pacific region. The diabetes pandemic is a result of changing cultures and socio-economic and political environments, and many issues are affecting control of the situation.

Some hypotheses propose that the diabetes pandemic is a result of genetics and lifestyle, originating from a foetal life of poor nutrition. Pacific populations have been reported to be among the most obese populations in the world. Studies completed have found a low involvement in leisure-time activities and diets of high calories and animal fats. Areas of the Pacific Islands that have experienced high levels of social and cultural change are most affected by this, as 'western'-influenced diets and lifestyles become more popular. Although these are high-risk factors for diabetes, the vast and increasing spread is unusual and goes deeper than these problems.

Social and economic factors have had a serious effect on the diabetes pandemic. Inequitable land distribution dramatically decreases access to fertile land to produce traditional food items or even fish. This affects the region's ability to promote a traditional lifestyle, as it is becoming more and more unlikely to produce such products. The price of healthier, low-fat sources of protein is much higher (from 150% to 50% more) than the unhealthier options of imported, cheaper food products. The World Trade Organization (WTO, formerly the General Agreement on Tariffs and Trade (GATT)) makes it very difficult to oppose or restrict the importation of unhealthy food products, which as a result of the economy and an unsuitable 'western diet' has contributed to the increase in diabetes.

As the level of disease has reached disaster level, recommendations are being put forward to try and control it. The Pacific Chronic Disease Coalition (PCDC) is working on the development of a model aimed at proactively targeting health care systems and community outreach efforts. Efforts to control the pandemic require advancements in policies and environmental strategies across the region. The model pushes for a collaborative approach to controlling the situation, health promotion programs, and efforts from medical professionals and active public; social and government participation are required. Diets and social environments need to be modified and primary health care facilities need to be taken advantage of to change the current pattern. This can only happen successfully once all issues – economical, social and cultural – are understood by all sectors of the region.

1. Summarise the factors that have led the increase of diabetes in the Pacific Islands region to disaster level.
2. Explain why the introduction of the 'western' diet and lifestyle has had such a negative effect on the Pacific Island region regarding people's health.
3. Suggest how traditional Pacific Island diets and lifestyles differ from western lifestyles.
4. Construct a brochure for the Pacific Island region explaining the factors contributing to the diabetes pandemic and suggest what they can do to help control the issue.

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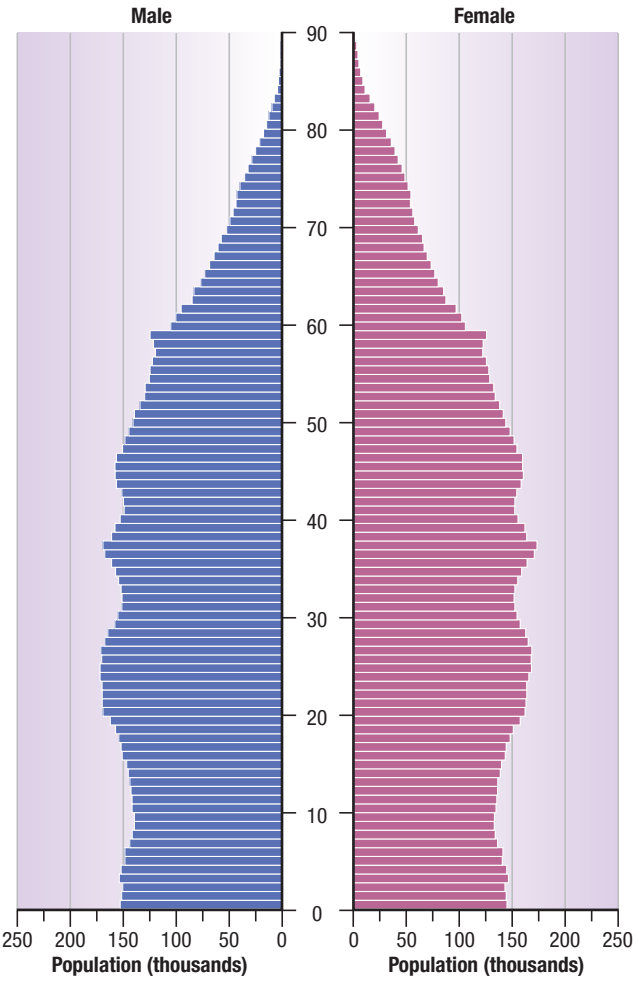
Population pyramids

A very effective data tool used by demographers is the 'population pyramid'. This is a graphic method of presenting the age and gender groups of a country or state, giving a clear picture of which groups dominate or are significantly smaller than the others. In the Australian 2012 pyramid, it is clear that there is approximate gender balance in most age groups, with the most obvious exception being more females in the age groups above 80 years. The Australian Bureau of Statistics (ABS) produces interactive pyramids for the country and each state and territory of Australia on its website. This means that you can manipulate the pyramids, play simulations of them and look at the predictions for national population growth into the future.

Geographical fact

Every minute, 10 people die as a result of water pollution. Unsafe and unclean drinking water is the cause of approximately 14 000 people dying each day.



Source 9.8 Age structure population pyramid

ACTIVITY 9.3

1. Explain why fertility and mortality rates are calculated.
2. Discuss why you think economically developed countries tend to have a lower natural population growth.
3. Analyse the purpose of the Demographic Transition Model.
4. Using Source 9.4 and the Demographic Transition Model, analyse which stage Mali, Mexico and the United Kingdom were in 2011 and give reasons for your choices.
5. Discuss the links between income and fertility or mortality.
6. Explain gender equality.

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9.4 Migration

Source 9.9 Immigration stamps in a passport

It has never been easier, and people have never been more willing, to move from place to place. Technology means that we can stay connected to others across the globe, allowing people to take advantage of migration opportunities that arise. Not all people choose to migrate, some have to move and others make a deliberate decision.

Why do people migrate? What conditions would have to exist before you would consider moving yourself or your entire family to another regional area of the country or even to another part of the world? There are 'push' and 'pull' factors at work. A 'push' factor is one at the place of origin. It is something that is making or causing you to move, such as famine or war. A 'pull' factor is at the relocation place, one that makes that location desirable, such as employment opportunities. If we look at the historical reasons for migration to Australia, we begin to build a picture that helps us to understand.

Global migration

Initial European migration to Australia was based primarily on push factors. Convicts were given no choice but go to the new colony and serve their sentences. As time passed, some free settlers began to join the settlements. Many of them were coming for a better life, a chance to access land and build a successful business. This was a combination of push and pull factors. Life was not what they wanted in the old country and they were hoping for better conditions in the new. Still later, with the discovery of gold in the colonies, the pull factors became even more important, with settlers coming to make their fortunes. Push factors have been dominant after major upheavals in other areas of the world such as wars and for refugees, while Australia's climate and lifestyle have been effective pull factors. Globally, there is constant movement of people from one area to another.

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Europe's population would be much higher now if there had not been high levels of migration to places such as Canada, the United States of America, South Africa, Australia and New Zealand over the past 300 years. Equally, those countries would have much lower current populations if these migrations had not occurred.

RESEARCH 9.1

Immigration is a controversial topic in Australia. Using secondary resources, research the immigration debate in Australia. Consider why people leave their home country for Australia, think of the conditions they would be living in, their employment and safety. Imagine you are an immigrant coming to Australia, and using the information you have collected write a short essay explaining why you are leaving your country and why Australia was your chosen destination. Explain the barriers you have to overcome when living in a new country.

National migration

Within Australia, there is also migration happening. There are people who move interstate for employment, such as workers in the mining industry going to Western Australia or the western districts of Queensland. Retirees often move to warmer climates within the country, with the north coast of New South Wales and south-eastern Queensland being popular. Large corporations move their workforces to suit their current business needs, and other people move to be near family members. Ultimately, the reasons for moving are the same as those on global scales, and they also have an impact on the delivery of services and town planning for regions.

Source 9.10 The mining industry in Western Australia has attracted many new workers from across Australia.

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Local migration and movement

Once again, the push and pull factors are at work. Why do people move from one area of a city to another? Their employment, housing costs and the location of family and friends are all integral to their decisions and have implications for local government bodies and the provision of services for residents. In many of our large cities, there are 'growth corridors' – areas that people choose to move to in high numbers. These corridors often occur along major transport routes such as train lines or freeways to facilitate commuting to employment in the city. There are however, drawbacks to the daily commute. Large numbers of people all travelling in the same direction are creating more peak-hour traffic and overcrowding on trains. There is a need to re-evaluate and plan more effectively for the growth corridors of our largest cities.

Refugees

There has been significant media focus on the group of migrants known as refugees. A refugee is someone who needs to leave their current home during a time of upheaval such as war in order to find safety or 'refuge'. They often go to a foreign country, leaving behind familiar people, culture and belongings. The 1951 United Nations Convention relating to the Status of Refugees is a legal document used around the world. It defines refugee status, lists the rights and obligations of both refugees and governments in managing refugees. Australia has signed the Convention and is bound by its boundaries and rules. Each year, Australia accepts refugees as a part of its global obligations and as a member of the United Nations. Refugees account for a small percentage of total migration to Australia.

Migration and economics

People often complain that migrants take jobs away from already established residents, especially during times of economic hardship such as a recession, but is this really the case? The Australian Bureau of Statistics has published data that show the national economy has grown at rates around 3% to 4% over the past two decades, with just under half of this growth being attributed to increased population.

In ancient times, increased populations meant that communities could have people specialise in various skills, so that one family no longer had to provide all goods and services they required, but could trade with others to gain additional items. Increasingly, this encouraged them to develop skills and talents to produce items they could also 'sell' to others. This increase in population led the individual to specialise and the community to trade, allowing the development of economically viable towns and even nations.

Today, an increase in population creates an increase in demand for goods. A migrant family will need goods like housing, clothing, food and services such as health care and education, just as any other family does, in addition to their need for employment. An increase in population enriches the economic platform of a nation, adding employment opportunities for everyone through increased demand.

Geographical fact

Every second, 5 babies are born and 2 people die, giving a net gain of 3 people. How many babies were born in the time you took to read this?

ACTIVITY 9.4

1. Discuss the meaning of migration.
2. Explain 'push' and 'pull' factors.
3. Analyse the differences between an increase in population in 'ancient times' and today.

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RESEARCH 9.2

Source 9.11 Technology is changing the way people live.

Technology is changing how we live in many ways. It is making us rethink age-old practices and re-evaluate our lifestyles. How is the Earth going to be able to provide enough food and resources to support our ever-increasing population? Increasing education and knowledge have led to the rapid increase in human population, and it is also education levels that are going to lead us to answers on this issue.

Contrary to the beliefs of the Doomsdayists, we are learning to make more effective use of our agricultural land through more efficient farming practices. We are improving our understanding of how to reduce the impact of our choices on our environment and how more people can enjoy a western-style life. One of the biggest issues we have to face is how to feed our people. Scientific research has led us to many advances that assist in increasing the total amount of possible food production: from the earliest times, when irrigation and crop rotation were used, to today where our farmers are refining these processes.

Using the internet, gather information about current and traditional agricultural processes (e.g. modern irrigation or traditional crop rotation) and evaluate the sustainability of them both environmentally and economically.

You should work in groups for this task, discussing criteria for assessing each method.

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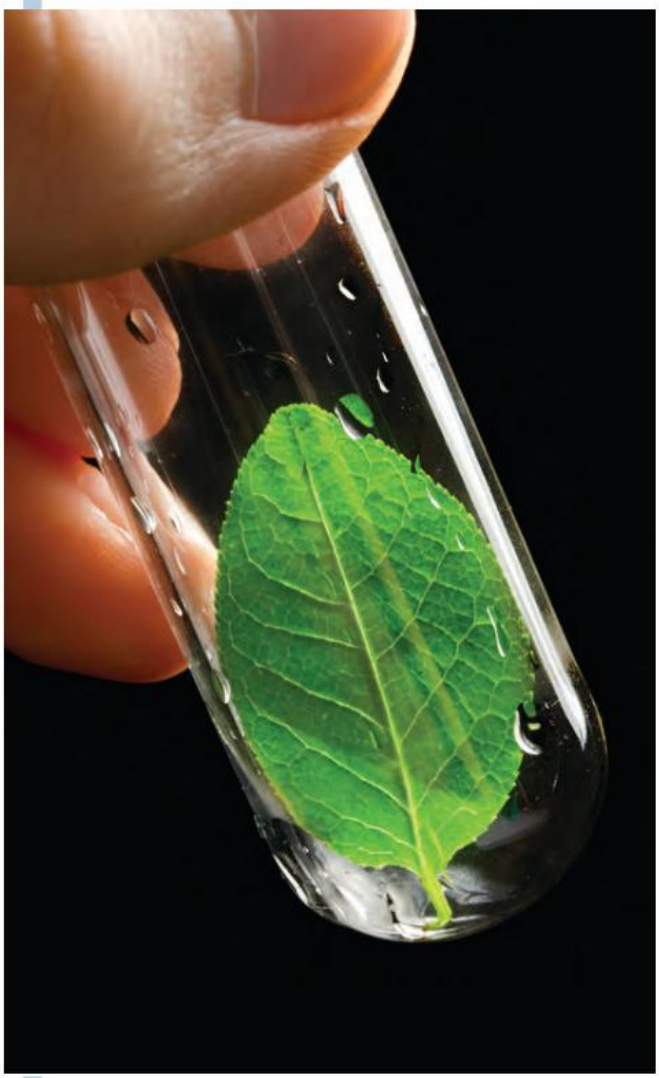
Case study 9.2
Genetically modified food



Source 9.12 Genetically modified foods are more popular than ever.

Genetically modified (GM) food is a heavily debated topic. Humans have been genetically modifying foods for thousands of years, selecting characteristics in crops that give greater harvest yields or better tasting food. Intense scientific research has accelerated changes to plant and animal foods for human consumption. Recently, modifying foods has become a contentious issue with some claiming that there are links to increased health issues and diseases. How we manage food will be a large part of how successfully we manage our rapidly increasing global human population.

Food Standards Australia New Zealand (FSANZ) currently monitors the safety of GM foods in Australia and New Zealand. The government regulates GM foods by using offices such as the Office of the Gene Technology Regulator (OGTR) and code regulations. GM foods undergo safety assessments such as comparing the GM food to the conventional food options and testing toxicity. In Australia any GM food product must be labelled to help consumers make informed decisions about the food they buy. Although these regulations are in place they are not always effective: in 2012 a study found that rats fed a GM corn diet over two years were subject to severe liver and kidney damage and even tumours. Although the corn was from an American company, it forced Western Australian crop growers to prove their GM crops were safe.

There are a number of benefits to GM foods, including: sturdier plants ensure longer lasting crops; access to inexpensive foods; longer shelf lives for food; edible vaccines; and insect-resistant crops. However, many believe GM foods involve too many risks, like side effects, pesticide-resistant insects, affects on biodiversity and cross-contamination. It also raises social and ethical issues of animal welfare and monopolisation of the food market.

1. Describe the current situation in Australia with genetically modified foods and consumer access to products made with these foods.
2. Explain how this differs from the situation in the United States of America. Use the internet to research America's policy on GM foods if necessary.
3. Develop arguments both for and against the increased consumption of GM foods.
4. Write a letter to the Australian Government, outlining how you think GM foods should be regulated by them and why this should happen.

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9.5 Human wellbeing

Source 9.13 Relaxation and peace are basic indicators of wellbeing.

Source 9.14 Happiness and wellbeing can come from simple joys and activities.

What do we mean by the term human **wellbeing**? Is it something measureable or is it less tangible? As geographers, town planners or policy makers, how do we know that we are using the data available to improve wellbeing for others? Certainly wellbeing must include a happiness factor – the feeling that our basic needs and wants have been met, that we are safe and well.

wellbeing the state of happiness, prosperity and good health by income, life expectancy, literacy rates, women's participation in public life, infant mortality and many other indicators

Location, migration, fertility and mortality all contribute to the health and wellbeing of people. Of these, location plays a larger role than we might first think. Where we live determines how we live, what our choices are in life, our standard of living, education, career options and income levels.

It plays a large part in how wealthy we are. When we look at global incomes, it is easy to see links between low income levels and perceptions of increased health concerns. This is further supported by statistics on mortality and life expectancy.

The phrase 'first world problem' sums up the differences. Not being able to find your mobile phone charger may seem like an issue, but it is insignificant if you don't have enough to eat and completely irrelevant if you don't have electricity connected to your home. If you are unemployed in a developed country, you have access to social welfare support to help financially, but in the developing world no job often means no food for the family. In places like Australia, Europe and the United States, education is seen as a non-negotiable right: access is not determined by your social status, wealth or gender. But this is not the case in all countries. War, poverty and family circumstances can all change a child's ability to regularly attend school, and education is one of the ways people can escape from poverty, using their knowledge to help themselves, their families and their communities. Knowledge through education is valuable and often a prerequisite for higher paid employment.

Geographical fact

Based on current information, it is likely that one person in every 2 billion people will live to be 116 or older.

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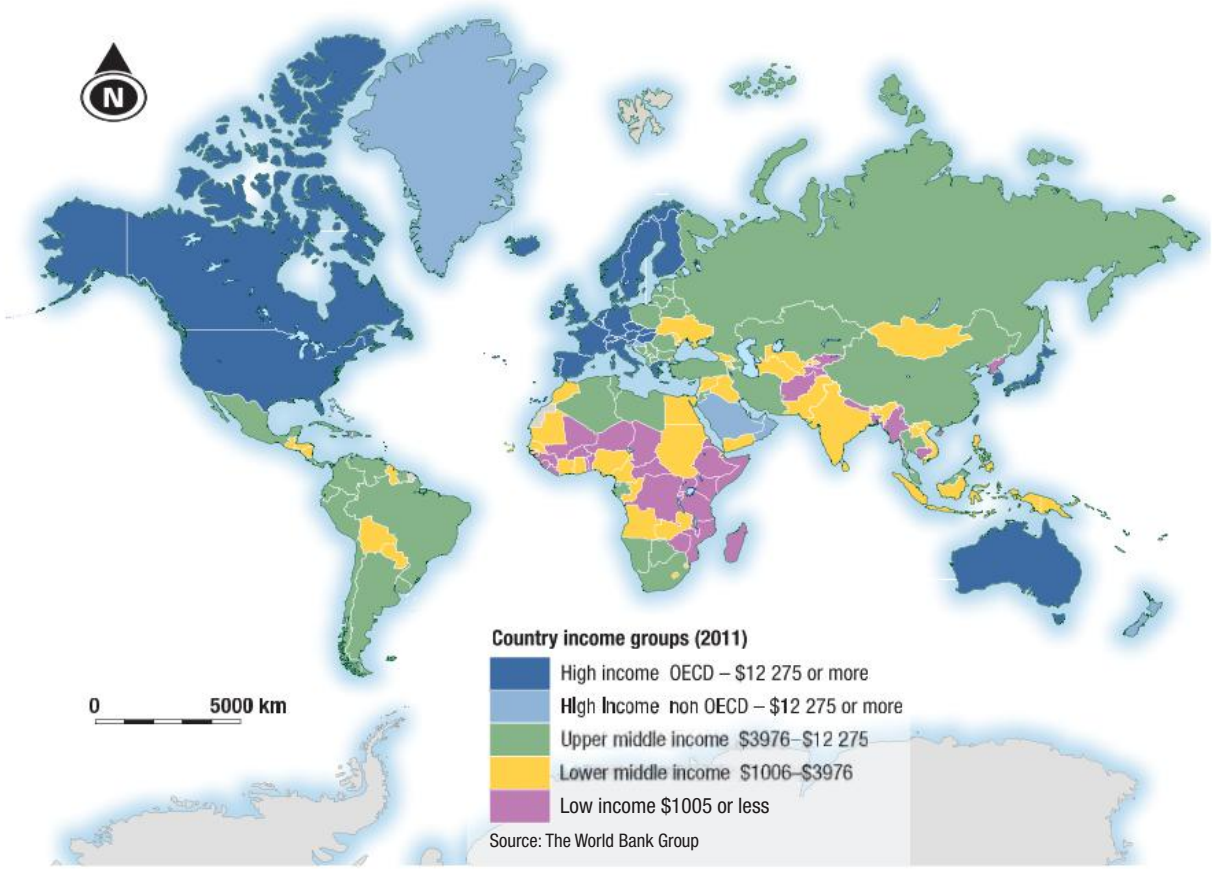

Source 9.15 Map of global incomes

Location

Where we live can have a huge impact on our wellbeing and also on our health. Across the globe there are huge differences in the location of resources. These are not restricted to physical resources like gold, oil or building materials, but include less obvious resources like clean drinking water and unpolluted fresh air. They include living in a community that has a variety of specialists and services that can improve our health and lifestyles: teachers, farmers, reliable transport systems and health care. A key indicator for the health and wellbeing of any nation is the ratio of doctors to population.

There is a strong correlation between the numbers of doctors in a population and that country's place on the Demographic Transition Model. Greater access to quality medical care and information is a primary factor in decreasing mortality, which can take a country from stage 1 to stage 2. It is just as important as a country moves towards stages 4 and 5, as it supports better survival rates of babies through pregnancy and childbirth as well as improved knowledge of contraception. Both of these will help to reduce the fertility rate: the first because greater survival rates means fewer pregnancies are required to build the family; and the second as it improves the ability to regulate how many pregnancies are wanted by the family.

Number of doctors per 10 000 people 2005–10	
World	8
Mali	Less than 1
Madagascar	2
Pakistan	8
Mexico	20
United States of America	24
United Kingdom	27
Australia	30
Austria	49

Source 9.16 Number of doctors per 10 000 people in certain countries

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NOTE THIS DOWN

Many countries have tried to manage their population growth through intervention focused on fertility. Copy the graphic organiser below and use the internet to investigate and compare China's One Child Policy and Australia's Baby Bonus Scheme, filling in the table with the information you find.

	China – One Child Policy	Australia – Baby Bonus Scheme
What was the government trying to achieve?		
Why was the government trying to change the fertility rate of the country?		
What measures did they put into place?		
How is/was the program implemented/ managed?		
Was the program successful?		
Any other information		

RESEARCH 9.3

When you have completed the 'Note this down' above, write a report evaluating the effectiveness of each program.

Access to medical treatment when needed provides not only physical wellbeing but also emotional wellbeing, as there is comfort in the knowledge that the services are available if required. Services are not equally distributed across the globe and these statistics are an effective measure of human wellbeing. It is easy to see how these data could also be used to support fertility and mortality measures of wellbeing. Looking back to the Demographic Transition Model, it is access to medical information and services that supports a country as it moves from stage 1 to stage 2. Decreasing mortality rates are inevitably the result of access to better medical care. Equally, decreases in fertility rates are linked to health care service provision, since information on birth control methods becomes more widely understood and accepted, especially when combined with higher levels of education.

However, it is not enough to look at access to medical care for a whole country. There can be marked differences between regions within that country. In Australia, each state has its ratio and the numbers change again when comparing cities to remote areas.

Source 9.17 Number of doctors per 10 000 people per state

State/Territory	Number of doctors per 10 000 people, 2011
New South Wales	31
Victoria	33
Queensland	33
South Australia	35
Western Australia	34
Tasmania	37
Northern Territory	44
Australian Capital Territory	47

Source 9.18 Number of doctors per 10 000 people per type of region

Region	Number of doctors per 10 000 people, 2011
Major cities	36
Inner regional areas	21
Outer regional areas	19
Remote areas	21

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The data provide a picture of the current situation, but can also be used to plan where services need to be located in order to achieve a more balanced and equitable distribution of medical services in the country.

ACTIVITY 9.5

1. Explain how the ratio of doctors to population is an important measure of human wellbeing.
2. Analyse the Australian data on the number of doctors in inner regional areas and remote areas. Present your ideas on why these two very different areas would have the same ratio of doctors to population.

NOTE THIS DOWN

Copy the graphic organiser below and summarise what you have learned about issues that can affect a population's health and wellbeing.

Issues in population, health and wellbeing		
Fertility factors	**Mortality factors**	**Migration factors**
Increased medical care during pregnancy and childbirth can increase the number of babies born in a population.	In stage 1 of the Demographic Transition Model, mortality declines, increasing the numbers of older people in a population.	Push factors such as war make it necessary for people to move location for the safety and wellbeing of themselves and their families.

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Case study 9.3

Education to change the world

Source 9.19 Education is one of the most important things in the world.

It could be argued that education is the single most important factor in changing the health and wellbeing of people across the globe. It doesn't matter what situation people are in, increased knowledge will help them to solve the problems they face and to contribute positively to their community. Developing countries need people who can work with others to improve the productivity of the land and to support sustainable lifestyle changes, while developed countries need people who are able to help clean up the environment and develop 'green' products that minimise our impact on the world. We all need people who are able to work with others, negotiating peaceful solutions to the issues that face humanity in the 21st century.

Cambodia is a developing country that has progressed very slowly in the area of education. During the regime of the Khmer Rouge (1975–79), education was banned and destroyed by Pol Pot's Communist government. Children's education was damaged from then on: illiteracy rates reached 40% and young people did not gain an education. Although education has been reintroduced to the country and is improving, there is a serious lack of qualified teachers, options for further education, access to technology and a problem with student attendance. Many children in rural parts of the country choose to stay home and help their family rather than attend school. Funding is scarce for Cambodian schools, resulting in many schools being incomplete and not having the resources to teach a full curriculum; this contributes to the dropout rates and the struggle to provide higher education. The Ministry of Education, Youth and Sport is putting plans such as the Education for All National Plan 2003–2015 in hopes of a better future for students in Cambodia.

1. List the main barriers to accessing education in developing countries.
2. Explain how increased education levels would improve community health in all countries.
3. Prepare a speech in which you explain how improved education levels will help control the world's population levels.

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Differing perspectives

No investigation of demography and human wellbeing would be complete without looking at the relationship between population data, economics, global variation and human perceptions. People have always attempted to make sense of the world around them, to explain and improve the current situation. Sometimes, there is an over-reliance on anecdotal methods rather than a use of data to do this, leading to inaccurate conclusions and ineffective plans for the future.

Population growth and age/gender balance impact on the economic development of a nation, influencing governments in designing policies to manipulate or change the demographic profile of their country. This has been a regular occurrence in Australia from the beginning of white settlement to the present day, with either our own or pre-Federation English government policies deciding the population's make-up. The challenge for any government is to balance the views of the competing theories and stakeholders, in order to make decisions that support the health and wellbeing of individuals and the whole community.

From the days of the convicts, to the idea that we must 'Populate or Perish', from the White Australia Policy to the current debate on refugees and migration levels, and the introduction and recent abolition of the 'Baby Bonus', Australia has been a nation that has continually tried to manipulate its demography. Where there is an understanding of the links between demography and economic prosperity it is logical for governments to enact policies to provide for the community and plan for the future.

Source 9.20 A growing population and age/gender balance severely impact the economic development of a nation.

FIELDWORK 9.1 DEMOGRAPHIC PATTERNS IN YOUR LOCAL GOVERNMENT AREA

Aim

To identify a local issue and to develop a plan for addressing that issue.

Method

To gather demographic data from the Local Government Area (LGA)/Council or Shire for analysis and planning.

Preparation

Find a map of your Council area. It should be clear enough for you to transfer data onto it, but should still contain detail such as main roads.

Data collection

Access the Council website or contact the Council directly to gain age/gender data for the LGA or obtain this from the Australian Bureau of Statistics website.

1. Identify the largest age group in the LGA.
2. What services currently exist for this group within the area?
3. To what extent are these services accessed by this age group? E.g. if the group is aged five years and under, what childcare and kindergarten facilities are there and what is the percentage of usage?
4. What are the positives and negatives of the current services provided?
5. Develop a survey/questionnaire that you can undertake and gain additional data to assist you to develop your plan for future developments to support this age group.
6. Present your findings in report format.

Fieldwork presentation layout

Front page	Tile and name
Contents page	Do this last, as well as numbering pages
Page 1	Aims and methods
Page 1	Age and gender demographic data for the Local Government Area
Page 2	Location map – Local Government Area with current services located
Page 3	Introduction – brief description of the current services
Pages 4 and 5	Description of uses and photos
Page 6	Copy of your survey/questionnaire
Pages 7 and 8	Summary of survey/questionnaire results including a table and analysis
Pages 9 and 10	Proposed plan to improve current services situation including positive and negative results expected from the plan
Page 11	Appendix, bibliography, glossary

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Chapter summary

- Demography is the study of statistics related to people and is used by many agencies including governments to make informed decisions about how to support populations.
- There have been many theories about how populations behave, but researched data are efficient in providing services targeted to the needs of the people.
- Data are collected every four years in the Census of Australia.
- Fertility and mortality rates are key indicators of a population's health and wellbeing.
- The Demographic Transition Model is a useful tool for predicting future population growth trends.
- Migration patterns and numbers can change key characteristics of a population.
- Population wellbeing is a complex issue that is supported by key factors – income, education and access to medical services.
- Doctor-to-population ratios are important on global and local levels as they clearly show the wealth and resources of countries and regions in their ability to provide services to their populations.
- Demographic data collection can be difficult, but is ultimately the best and most effective way of providing the services required by a population.

End-of-chapter questions

Multiple choice

1 Demography is:

A data about people

B the study of people

C data about population

D the study of population data

2 Thomas Malthus argued that:

A human population size would always be restricted by the capacity of the environment

B there would be famine or flood if the population became too large

C change would be enforced if too much land relied on for food production is taken over by residential living space

D all of the above

3 Mortality rate is:

A where people are put after they have died

B the number of deaths per population

C not important to governments

D always the same as the fertility rate

4 Low fertility rates can be an issue because:

A there are fewer people to feed

B kindergartens will close

C there will be fewer people to fill jobs in the future

D there will be empty houses in the future

5 A population pyramid shows:

A how many people there are

B gender ratios

C age/gender ratios

D total population numbers

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Short answer

1 Using the Demographic Transition Model, explain how access to medical information and services would support a country to move from stage 1 to stage 4.

2 Explain why Australia's population increase is linked to migration as well as to natural increase.

3 Make a list of the five items you believe are important to human wellbeing and explain why you chose each of the items.

4 What is the difference between a push and a pull factor and which do you think is more important in an individual's decision to migrate? Why?

5 Analyse the data on the number of doctors in each state/territory and region in Australia to identify the area that is most likely to need more doctors. Explain your response.

Extended response

The United Nations is a global organisation comprising representatives from most of the world's nations. It takes a lead role in the collection of data related to populations, planning future projects in developing countries, delivering humanitarian aid in crisis situations and oversees guidelines for the management of refugees. Using the report procedure outlined at the end of this book to complete your findings, research the work of the United Nations in relation to populations. Ensure you cover the following:

- a brief history of the United Nations (how it formed and the key areas it covers)
- why the United Nations is involved in global population migration
- the Refugee Convention
- an analysis of Australia's rights and responsibilities under the Refugee Convention
- the way forward – your views (supported by data from this chapter and your own research) on how Australia could proceed with migration policy and procedures for the next 10 years.

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10 Improving human wellbeing

Source 10.1 The Ikea Foundation have partnered with the UNHCR to improve wellbeing for children in developing countries.

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Before you start

Main focus

To explore the role of international and national government and non-government organisations (NGOs) in improving human wellbeing in relation to the environment and conflict.

Why it's relevant to us

International and national government organisations play an important role in improving wellbeing. However, not all important issues are dealt with by government organisations, which is why NGOs also work towards improving the impact of conflict and environmental matters.

Inquiry questions

- What organisations are improving wellbeing in Australia and around the world?
- How and why are NGOs important?
- What are the outcomes of conflict and environmental issues and how do these impact human wellbeing?
- How are different organisations approaching conflict and the environment?

Key terms

- Colonisation Initiative
- Environmentalism
- Inter-governmental organisations
- Missions
- Non-government organisation (NGO)
- Objectives
- Private sector
- Wellbeing

Let's begin

Different types of organisations and initiatives around the world aim to improve wellbeing. In this chapter we will refer to disagreements resulting in conflict and practices harming the environment that greatly affect human wellbeing. The wellbeing of Aboriginal and Torres Strait Islander peoples has at times had a controversial relationship with government initiatives. They have also been victims of environmental degradation, impacting the wellbeing of their land and culture.

Conflicts around the world have led to individuals and groups fleeing their homelands, sometimes only to find they face dangerous and unliveable conditions. Environmental factors are one of the causes of conflict, proving that initiatives targeting environmental sustainability and conflict resolution are important in improving human wellbeing.

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10.1 The impact of conflict

armed conflict severe conflict involving weapons and fire power such as tanks, guns, bombs, air strikes, etc

Conflict can take shape in many different forms but some of the most common **armed conflicts** are defined below. These severe types of conflict often result in injury and death with obvious impacts on human wellbeing.

- **Inter-state conflict** – between two nation-states
- Intrastate conflict – within a **nation-state**, otherwise known as **civil war**; a rebellion to overthrow the government
- Extra-state conflict – reprisal against **colonisation**. Anti-colonial conflicts tended to end in the 1970s
- **Coup d'état** – violent and undemocratic change by the military. Eighty such violent changes of government occurred in sub-Saharan Africa during the last four decades.
- Urban violence – tends to be intermittent rather than ongoing. There may be a spate of shop looting or attacking houses of the wealthy; e.g.: in Zimbabwe, white famers were attacked. Now it is more about reacting to poverty and struggles between supporters of political parties.

inter-state conflict combat between two different nation-states

nation-state a group of people (nation) governed within a certain area (state). Also known as a country

civil war a war involving conflict between regions of the same country

colonisation the establishing and development of colonies in a country

coup d'état a sudden and violent appropriation of leadership

New forms of conflict have developed since World War II involving warlords, gangs and terrorist and **guerrilla groups**. Violence against children and gender-based violence are also used as instruments of war. New forms of conflict have coincided with new modes of funding. Alliances with other countries mean more funds are available externally than there otherwise would have been available internally. There are also different methods of fighting, such as targeting tourist sites and civilians rather than more traditional fighting documented as having taken place on battlefields.

guerrilla group different from a traditional army; people are involved in a style of warfare that is smaller in scale but aims to affect the enemy all the same. It often includes sabotage and surprise attacks (ambushes)

Geographical fact

Between 1987 and 2007 Fiji averaged one coup every five years.

Spatial and temporal dimensions of conflict

The western world has remained relatively free of conflict since World War II. Since then conflicts have been concentrated in the poorer countries of the world. This localisation of conflict has seen a disproportionate number of conflicts located in Africa, often in the form of civil war rather than inter-state conflict. The United Nations' system of regulating inter-state war seems to have been fairly effective since its inception in 1949, as trends in the level of armed conflict have remained at a low level. The UN was formed as a method of preventing another world war and the associated atrocities, so mechanisms have been put in place to attempt to prevent interstate conflict on such a large scale. The preceding organisation, called the League of Nations, failed in its regulation of conflict and global wellbeing. The devastating impacts of World War II on human wellbeing largely led to the formation of the UN. Its specific purposes are to:

temporal dimension associated with time. In this case we are looking at patterns of conflict over time

- Maintain international peace and security – prevent and remove violence, settle international disputes
- To help develop friendly relations between countries – via respect, equality and self-determination
- To achieve international cooperation – solve humanitarian issues, promote human rights and freedoms and for all people to be free from discrimination
- To be a place when the above activities can take place.

Developing countries experience more war than developed countries like Australia because there is usually a lower level of access to socially valued resources such as adequate housing, education, health, and employment; plus there is a lower

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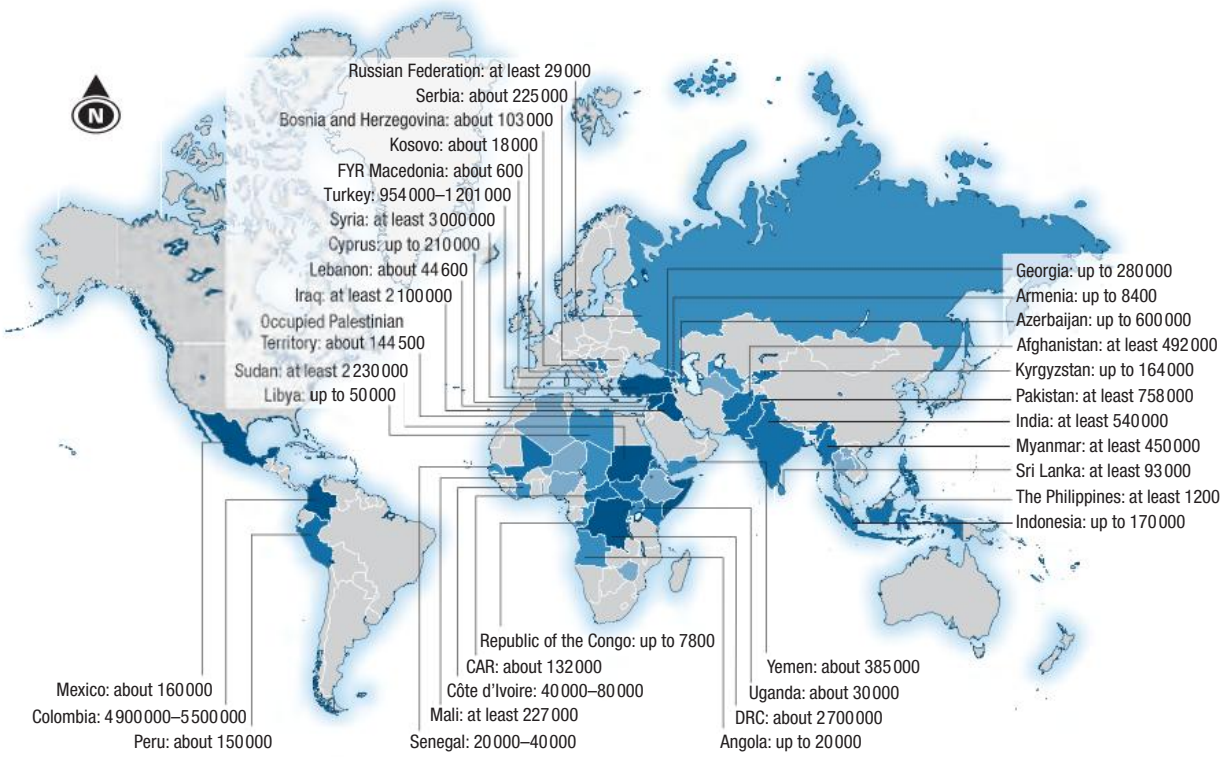

Source 10.2 World map showing the countries with the highest numbers of people internally displaced through conflict

level of wealth due to a range of factors such as colonisation, government mismanagement, or lack of productive environmental resources. As a result of diminished access and opportunity, fierce competition can arise due to individuals and groups seeking to improve their own level of wellbeing. Such competition means some countries have seen violence, rebel groups, militia, political controversy and injustice. These civil wars often cause people to flee their home countries in search for a better life. Refugees may be fleeing because their political, environmental, economic or religious rights have been curtailed and they seek to improve their level of wellbeing in another location.

In Syria, 8.3 million people are in need of assistance due to the civil war that started in 2011. The civil war in Syria has led to much of the population being displaced. Most have fled to neighbouring countries, such as Jordan, Lebanon and Turkey, where they have no choice but to live in refugee camps. Jordan's refugee camps hold more than one-third of Syria's refugees and it requested assistance from the UN. The **World Bank** responded by announcing more assistance and funding to be directed toward the refugees to assist in improving their wellbeing. Conditions in refugee camps are not ideal, and in warm countries such as Jordan, the risk of disease is high. Many NGOs, and intergovernmental organisations, have sought to condemn the ongoing violence in Syria and/or sought to provide basic needs in refugee camps. For example, humanitarian help has been provided by Caritas, UNHCR, Arab League, USAID and Islamic Relief.

World Bank an international bank dedicated to providing financial aid and advice to developing nations in order to improve their economic advancement

Geographical fact

80% of the world's refugees are in developing nations. Pakistan, Iran and Syria have the largest refugee populations.

ACTIVITY 10.1

1 Describe the spatial patterns of conflict in the world.
2 Account how the United Nations formed and what its purpose is.
3 List some of the counter-trends in conflict.

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RESEARCH 10.1

Scenario: The UN wish to undergo a review of their current practices and policies in order to become more effective. They have selected your class to provide an independent and unbiased report to the General Assembly later this year. In groups, you will evaluate the effectiveness of the United Nations in improving wellbeing at a global scale and provide related recommendations.

Each group will investigate a different aspect of the UN and present their findings to the class or broader audience. Remember, that 'evaluate' means to make a judgement based on criteria.

Group 1 – The state of the world's children (UNICEF)	**Group 2** – The UN Refugee Agency (UNHCR)	**Group 3** – International Court of Justice (ICJ)
Group 4 – World Food Program (WFP)	**Group 5** – World Health Organization (WHO)	**Group 6** – International Monetary Fund (IMF)

In your presentation you will need to include:

- a brief overview of your allocated branch of the UN
- current practices and programs and how they seek to improve wellbeing
- international commentary/critique of practices
- case study/illustrative example
- recommendations
- relevant statistics, facts, graphics or video clips to engage the audience.

10.2 Causes of conflict that impact wellbeing

Conflict within and between nation-states is often far more complicated than identifying one simple root cause. War can be seen as an expression for controlling valuable resources that humans need for their wellbeing. Many reasons for war can be attributed to a quest for greater resources, whether these resources take the form of monetary, environmental or human forms; even spreading a religion or ideology can be used to control human populations that subsequently can be exploited or controlled by warmongers to create greater wealth for themselves. Alliances and retaliation have also exacerbated conflict at times.

Geographical fact

Civil wars are the most common form of armed conflict and the most common cause of armed conflicts are access to resources.

Conflict may be the result of many factors including:

- *political factors* – power struggles between political parties, dissatisfaction over weak institutions, anger over government policy, unfair laws that target certain groups
- *sociological factors* – deep divisions between people concerning class and ethnicity, inequality, poverty, high levels of unemployment, landlessness and persecution by a ruling class/group towards minority groups
- *environmental factors* – scarcity of natural resources, environmental degradation, natural disasters causing famine, overgrazing, tightly controlled oil extraction and local communities not reaping the benefits, high population growth leading to pressure on productive land and resources, the search for new valuable resources and control over these such as the 'conflict minerals and diamonds' of the Congo
- *economic factors* – high inflation and cost of basic necessities such as food, high levels of debt, poor exchange rates
- *territorial factors* – disputed country boundaries, conflicts over grazing and farming,

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e.g. land disputes lasting for over three decades between the Karamojong of Uganda and the Pokot of Kenya on either side of the border

- *legal factors* – independence and voting rights e.g. Kosovo, Georgia and East Timor; attempts at secession causing considerable damage and destruction, e.g. Biafrans in Nigeria
- *religious factors* – conflict over beliefs, missionaries imposing belief systems on other societies, deep disagreements between various sects of one religion e.g. Sunni and Shia Muslims in Iraq
- *ideological factors* – conflict over the way countries should be run such as **communist**, **democratic**, **theocratic**, e.g. Cold War conflict

communist a classless, society where all assets are community owned

democratic government by the people where all citizens have an equal say

theocratic a god or religious being is the supreme ruler and the government is guided by this

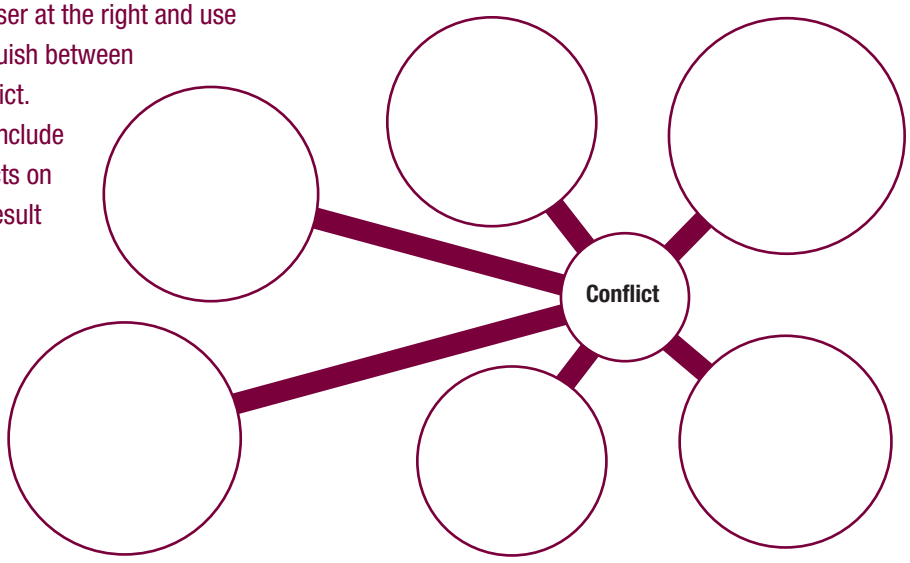
Source 10.3 Digging for conflict minerals in the Congo

RESEARCH 10.2

Choose one of the causes of conflict mentioned in this chapter. Using the internet find a well-known conflict that came as a result of the cause you are researching. Record the details of this conflict such as when, where, why and how it happened. Using your findings create a PowerPoint presentation explaining the conflict, the cause and an organisation that provided assistance to improve human wellbeing during or after the conflict.

NOTE THIS DOWN

Copy the graphic organiser at the right and use the mind map to distinguish between different causes of conflict. Branch out further and include an assessment of impacts on human wellbeing as a result and as an example of a conflict for each factor.



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Case study 10.1

Assaults on Latin American farmers

Conflict has plagued some countries in Latin America for decades. This has affected long-term wellbeing. At different times in history this conflict has taken the form of war, dispossession of land, genocide, gang rivalry, death squads, gender-based violence and aggressive **expansionist policies** from foreign governments. Perhaps each interest group involved adopts a certain approach, strategy or policy in the genuine belief that they are improving wellbeing, when in fact their programs and policies may be detrimental.

expansionist policy one country seeking to take amounts of land or increase their economic income at the expense of the other

El Salvador, Nicaragua and Guatemala have veered between dictatorships and dysfunctional democracy, so social change has been taking place there for some time. At times, this was more like social upheaval. After being conquered by the Spanish several hundred years ago, land and economic power was concentrated in the hands of only a few people, who formed an **oligarchy** and created an extremely unequal distribution of wealth. More recently, the investment of foreign companies for the extraction of resources and raw materials put pressure on communal land, resulting in the dispossession of land for the original inhabitants.

oligarchy power in the hands of a few people or businesses

Source 10.4 Straw huts occupied by peasants burned in Guatemala

Governments facilitated the introduction of new forms of agricultural production, often referred to as agrarian reform, but it also sought to suppress the uprisings of peasant farmers. Rural and particularly indigenous peoples had their land seized as part of centralising control. The USA perceived protests against such moves as the spreading of communism and therefore frequently instigated a rather heavy-handed foreign policy. The 'family' that governed Nicaragua for decades was overthrown by the Sandinista rebels in 1979, but by end of the conflict nearly 30 000 people had died and the county's economy was decimated. However, to try to prevent Nicaragua moving towards socialism in the 1980s, US President Ronald Reagan channelled US$500 million to back the neighbouring Salvadoran military, and illegally sold weapons to Iran to fund the Contras' fight against the Nicaraguan Sandinista government.

Guatemalan history has been similarly marked by bloody battles. Land ownership is very important but heavily skewed land distribution has led to power struggles and to civil wars, among other contributing factors. The Guatemalan government planned to break up large plantations into smaller private plots of land in 1954 which the US did not like, so an invasion ensued and a 36-year-long civil war erupted, killing 200 000 people and creating another 50 000 'disappeared'. In 1979 2.5% of Guatemala's 5.3 million farms controlled 65% of agricultural land, while only 16% of the land was cultivated by 88% of the smallest farms (World Bank, 1995). In the 1970s and 1980s at least 70 000 people died as a result of armed conflict.

In El Salvador rural peasant and workers' movements in the 1930s were violently suppressed, and resulted in approximately 30 000 deaths. The concentration of land ownership here too led to class warfare where large numbers of the working poor fought against the wealthy few who controlled much of society.

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Transnational corporations (TNCs) have also impacted wellbeing in Latin America. TNCs, in particular, supermarket chains, have often exhausted their **domestic markets** or are possibly constrained by domestic laws, so in the last 10 years, they have turned their attention to this region. Latin America now has one of the highest levels of foreign direct investment per capita in the world. TNCs promote their business as a means of improving wellbeing by providing a wider range of goods and services.

transnational corporation (TNC) a corporation that operates in more than one country

domestic market all the buyers and sellers of a targeted market within one country

A range of influences have attracted Wal-Mart (America's and the world's largest retailer) and France's Casino and Carrefour. Carrefour is a hypermarket – a combination of a supermarket and a department store where you can get everything you need under the one roof. There are now 64 Carrefour hypermarkets in Brazil. The process began in the 1990s and now 70% of foodstuffs are sold through supermarkets, whereas that figure was a mere 20% at the end of the 1980s. The 10 biggest chains currently control 22% of the market.

Source 10.5 Carrefour shopping trolleys outside one of its many hypermarkets

Some factors influencing decisions to invest in Latin America mirror those that indicate an improvement in human wellbeing such as:

- rising incomes
- more female participation in the labour force
- growing middle class wealth
- relatively steady economy
- the liberalisation of trade and investment policies
- growth and urbanisation creating significant demand
- desire to emulate western culture, spurred on by the globalisation of the media and advertising.

The introduction of supermarkets in the region has had a domino effect. Costa Rica's chain has spread into Nicaragua where supermarkets were established in large cities, then cascaded down to smaller settlements in wealthy neighbourhoods and then to middle class and poor regions. TNCs' impact on wellbeing can be devastating as they infiltrate local markets and can often provide goods for a lower price than local businesses, due to economies of scale (i.e. large companies operating at the most efficient size and cost-effective volumes of production for maximum return). This change in the traditional retail format then forces local businesses to close as they cannot compete with large global entities and therefore negatively impacts the livelihood of famers, their families and their communities. Between 1984 and 1993, 64 000 small businesses closed in Nicaragua.

1 Explain how assaults on Latin American farmers affected wellbeing.

2 Summarise the impact of the US government's policies and its fear of communism in Latin America.

3 Discuss how and why the agrarian reform came about in Latin America.

4 Civil wars are part of Latin American history. Comment on the impact of civil war on wellbeing.

5 Analyse the actions of transnational companies, particularly supermarket chains, in Latin America.

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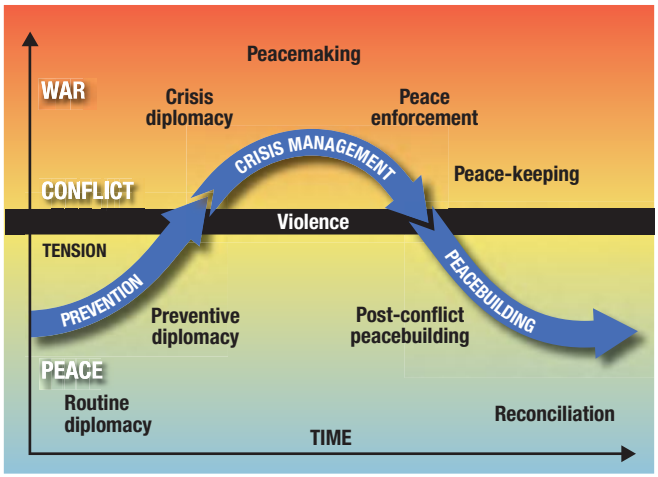
Outcomes of conflict

At times, conflict may be in the form of a simple disagreement between groups. Human wellbeing may be affected gradually by policies implemented as a result, but when conflict escalates into high tension and violence, then the impact on human wellbeing can be catastrophic. Either way, conflict itself impacts wellbeing negatively. However, the outcomes of conflict are many and varied. Results can be positive or negative, but even so it is difficult to summarise the outcomes without oversimplifying events leading up to the fact, which are actually quite devastating in real life. Impacts on human wellbeing become more severe as the conflict escalates from tension to war. The 'conflict curve' has been developed to depict the elapsed time against severity of a hypothetical conflict. As the conflict peaks and troughs, different mechanisms are employed to attempt to diffuse or solve the problem. This curve has been criticised for inaccurately showing times of peace and war because during real events there are a series of peaks and troughs as tensions build and vary in intensity, not just one peak.



Source 10.6 The conflict curve

Source 10.7 The negative and positive outcomes of conflict

Outcomes of conflict	Negative	Positive
Short term	Environmental destruction Disruption of local governance Human rights abuses Casualties – civilian and military No access to land due to land mines Reduced access to water points **Genocide** Unemployment Loss of income Dependence on aid Rape Food insecurity Children abducted Displacement of communities Refugees and forced migrations	Social solidarity among some groups Humanitarian aid more readily available than previously Ceasefires Recognition of minority groups
Long term	Environmental degradation Loss of human life affects families, heritage and social structures Decreased access to land Unstable, untrusted government Sanctions imposed by international organisations Loss of investment Economic stagnation Loss of biodiversity, endangered species Lack of funding available Psychological problems Longstanding prejudices and discrimination Refugee resettlement difficulties Changed land boundaries	Environmental rehabilitation Social cohesion and support for the common good New territory formed reflecting ethnic boundaries Reconstruction creates new infrastructure and facilities Peace agreements can lead to sustainable practices Empowerment of minority groups

genocide deliberate killing of people targeted because of their identity. It is the systematic destruction of people from a certain race, ethnic origin, religious affiliation or cultural group

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ACTIVITY 10.2

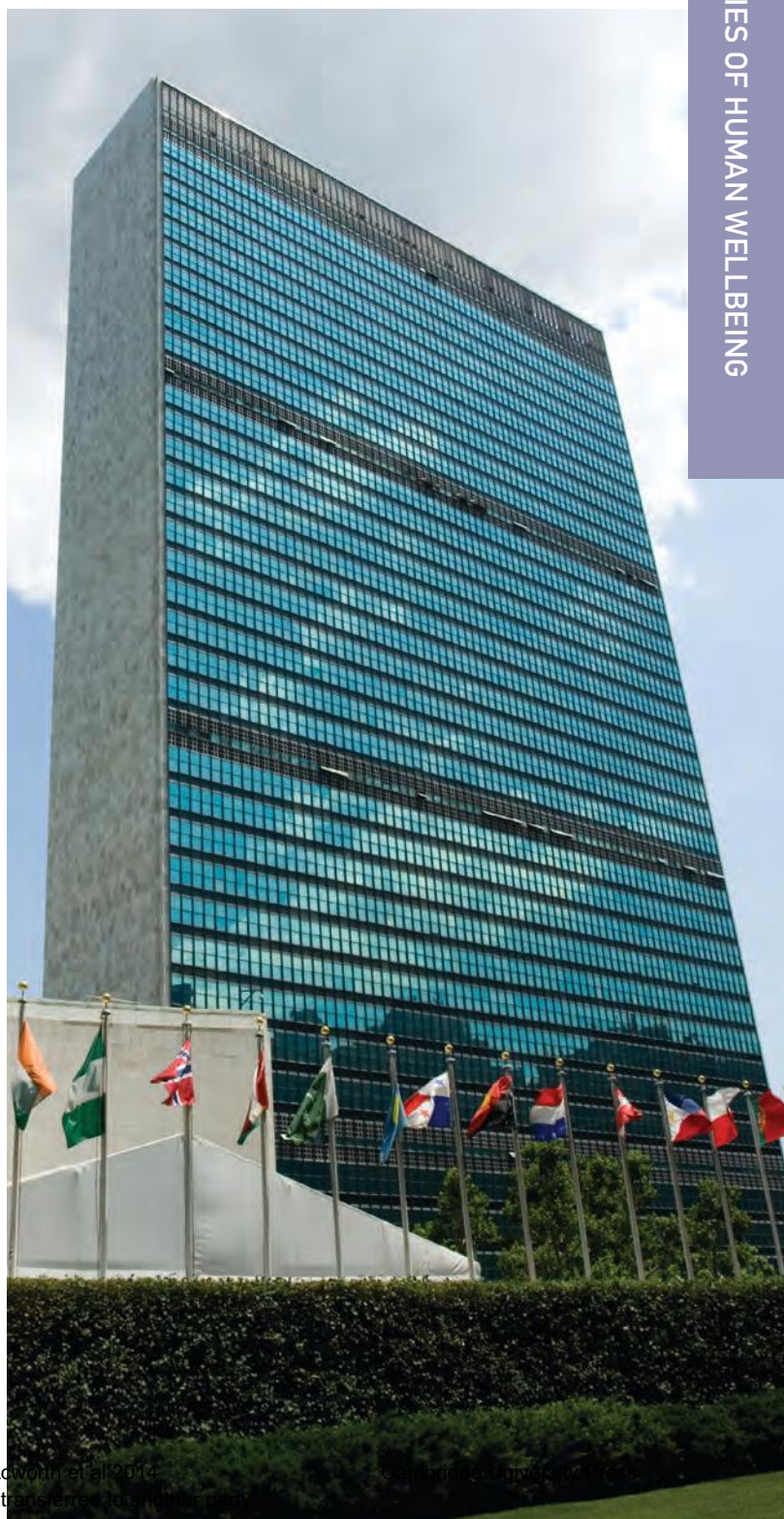
1 Explain the changes in conflict over time according to the conflict curve.
2 Critique the use of the conflict curve and how it may or may not apply to various conflicts.
3 Asses how short- and long-term outcomes of conflict may affect wellbeing.
4 Categorise each of the outcomes of conflict into the following groups: environmental, economic, social, technological and political impacts.

10.3 International and national government responses to conflict

The United Nations Security Council and the Northern Atlantic Treaty Organization (NATO) are powerful bodies comprising a number of nations that make decisions about intervention in conflicts, e.g. using drone strikes and other methods. Some decisions are highly sensitive in nature because differences in judgement arise due to different socio-cultural and economic perspectives and political alliances between countries. This is called **moral relativism** and it affects the decision-making process. One nation may see intervention as good and morally worthwhile, while another may see it as an attack on their sovereignty. Some people claim that intervention does not necessarily end or reduce the conflict. Early intervention by the UN has been found to significantly reduce conflict, but intervention by international bodies such as NATO is not a significant factor in reducing conflict. If there is to be intervention, it must be appropriate, empowering for locals and sustainable. Intervening nations also bring with them some indirect impacts. However, intervention and the deployment of thorough peacekeeping/peacebuilding **missions** have helped improve opportunities for peace.

moral relativism actions deemed right or wrong depending on which perspective you're coming from

mission an important assignment carried out due to wishes from the government or an important organisation



Source 10.8 United Nations (UN) Headquarters building in New York, USA

ISBN 9781107696969

Case study 10.2

Intervention in Rwanda: too late?

Class and ethnic-based conflict took place between the Hutus and the Tutsis in Rwanda in 1994. The Hutus had ruled since independence from Belgium in the 1960s. Under a UN peacekeeping agreement called the Arusha Peace Accords, the Hutus were to share power with the Tutsis. The Tutsi were an ethnic minority that had been persecuted for decades. Massacres have been reported to have taken place in 1962, 1972, 1990, 1991 and 1992.

A ceasefire agreement also included terms of suspending supplies of ammunition and weaponry. Between 1990 and April 1994, Rwanda spent an estimated $112 million on arms, making it the third-largest arms purchaser in Africa (Nigeria and Angola are the largest). The French had been accused of being a principal source of arms for the Rwandan government as they had trained the Rwandan Army and militia forces since 1990. Similarly, Human Rights Watch Arms Report named Seychelles, China, Zaire and South Africa of being involved too.

Extreme Hutus planned to derail the peace negotiations and kill all Tutsis in the capital, Kigali, plus many Belgian peacekeeping troops. The scale, speed and brutality of the killings was shocking: 800 000 people were killed in 100 days. Thousands of machetes and hand grenades were imported by the government. Death lists were prepared and people were killed in their front yards. Killing was facilitated by the fact that each person had to carry an identity card, which stated their ethnic origin. A common account was that Tutsis were lured to churches as a means of protection but in one case 10 000 people were murdered at the hands of a regional governor and other Hutus. One million refugees fled to neighbouring Zaire (now the Democratic Republic of the Congo), which was also where some perpetrators hid too. The government led the killings, which resulted in what was later referred to as 'politically organised genocide'. But the term 'genocide' evokes certain responsibilities and legal consequences. So the international community chose to ignore some facts and call it a civil war, which did not warrant immediate intervention.

Source 10.9 A man works for pennies a day picking tea, 13 June 2012, in Kibale, Uganda. This man is a Rwandan refugee who lost his family in the genocide.

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General Dellaire, a UN Force Commander, was sent in to ease tensions before the conflict erupted. It was his first visit to Africa and he admitted he was quite ill-prepared and unaware of the history of the country. At the time, people claimed the situation was unclear. Diplomats, aid workers and their families were told by the UN that Rwanda was still safe despite growing tensions. The UN Assistance Mission in Rwanda (UNAMIR) arrived as mass killings were occurring, so he argued that a minimum of 4500 troops were needed, with heavier weapons, and all of them must be well trained and well supplied, with a clear mandate (order/instruction) giving them authority to forcefully stop the killing.

Early warnings from the General to the UN were not translated into preventative action. Communication and decision-making has been subsequently scrutinised about the timing and delivery of messages, to whom and what action was ordered, because there was debate as to whether the genocide could have been prevented. The USA and the UK opposed General Dallaire's request because it would have been too expensive. A decline in the US's commitment to peacekeeping in Africa flowed over from issues in Mogadishu, Somalia, where just months earlier Blackhawk helicopters were destroyed by warlord factions and their crews murdered. The final say came via Kofi Annan, the Secretary of the UN at the time, who ordered no action to be taken nor should UN troops use force; this was due to dubious sources of 'intelligence' information received.

Overall, ineffectual responses by the international community meant that the world didn't take much notice until the massacres were all over.

1 Outline the causes of the genocide in Rwanda.
2 Suggest strategies to prevent something like the Rwandan genocide from happening again.
3 Examine the impacts of the Rwandan genocide on wellbeing in the short and long term.
4 The UN was heavily criticised for its response the conflict in Rwanda. What was their response and why was it considered ineffective?

Improving the state of conflict

The United Nations have established a number of bodies with the **objective** of improving the state of conflict throughout the world. These bodies include the Security Council, General Assemblies, Peace Building Commission, Disarmament Commission, Conference on Disarmament and Committee on the Peaceful Uses of Outer Space. These bodies approach many issues, including disarmament, terrorism, peacekeeping, organised crime, women, peace and security. Different strategies are adopted by these bodies to aid with improving human wellbeing for countries in need.

objective
a set goal

The UN carries out missions to countries. One of the most recent is the United Nations Support Mission in Libya, an advanced mission to help rebuild the state of law with Syria during the civil war. Other peacekeeping missions are being carried out in Haiti, Sudan, Cyprus, Afghanistan, India and the Democratic Republic of the Congo. Assistance from these missions varies, but can include confidence-building measures, power-sharing arrangements, electoral support, strengthening the rule of law and encouraging social and economic development. Troops operating under the UN are commonly used in these missions; however, when direct UN involvement is not appropriate the UN will authorise regional organisations to aid with peacekeeping. These missions have helped end conflict within Sierra Leone, Liberia, Haiti and Kosovo.

Geographical fact

Every 21st September, the UN hold the International Day of Peace, a day devoted to strengthening the ideals of peace. It is a chance for world leaders to meet to work towards a goal of sustainable peace.

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Case study 10.3
Government and private sector partnerships

How Ikea's partnership with the UN is helping child refugees

The Guardian

Tim Smedley, 31 July 2012

It started with a tent. In 2009 the Ikea Foundation – the philanthropic arm of Ikea – partnered with the United Nations High Commissioner for Refugees (UNHCR) with the idea of designing a new tent for emergency refugee accommodation.

Given the foundation's core aim to improve opportunities for children in developing countries, and that half of all refugees are children, it seemed a good fit. Not just that, but designing flat-packed home and furniture solutions was something that Ikea knew it could do well.

At any given time, UNHCR has the capacity to respond to an emergency involving up to 600 000 people within 72 hours. Currently, the tents it provides are only suitable for six months. In reality, many refugee camps remain for several years. Children literally grow up in them. As such, routinely replacing tents comes at a big cost.

private sector the part of the economy run by individuals and companies for profit

'Because Ikea's core competence is about improving homes we thought it would be a very interesting way to co-operate,' says Olivier Delarue, the UNHCR's senior advisor on **private sector** partnerships. 'Flat-packing ... is so critical for UNHCR in terms of reduction of cost and efficiency for loading aircraft or trucks.

Source 10.10 Rows of tents within a refugee camp

Per Heggenes, CEO of the Ikea Foundation explains:

'We are looking to develop a solution that fits the same requirements in terms of cost and weight, size and packaging, because they need to be airlifted out to people at very short notice. So we are trying a more lasting solution, a shelter that would last for many years ... which would ultimately solve a big financial problem.'

However, collaborating over tents soon led to a much broader remit. 'We realised that we could do so much more together than just a shelter,' says Delarue. 'We could work together as partners in a more holistic way.' This became an innovative 'knowledge partnership', whereby Ikea could share with UNHCR its entire supply chain and logistics expertise.

'What we normally do as a foundation is provide monetary donations', explains Heggenes. 'In this case we said we wanted to take it one step further and see if we could find a way of helping UNHCR to be more efficient in what they do in the supply chain.

'The reason being that Ikea is a large international company dependent on having a very efficient supply chain and might have some tricks up their sleeve.

'Refugees are probably one of the most marginalised groups in the world, they don't attract a lot of interest from the private sector. We looked at the situation and felt we could get involved and help children that are growing up in very difficult circumstances.

In June 2012, the Ikea Foundation brought together logistics experts from Ikea and UNHCR for 11 workshops across seven specialist areas: quality, product design, packaging, warehouse network design, procurement, transportation and IT. The similarities of size and scale between Ikea's and the UNHCR's logistics offered what Delarue calls a 'values fit'.

For such a partnership to work, he says,

'It has to fit the strategic objective of the company and respond to the needs of an organisation like UNHCR. If there's a mis-match

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then the partnership will not go very far ... the deeper the roots of a partnership, the longer and more fruitful the partnership will be.'

Indeed, Delarue argues that the partnership has not only been of benefit to the UNHRC logistics team.

'Ikea has learnt from UNHCR as well because we operate in a very unusual and difficult places ... so the logistics guys from Ikea were also exposed to different realities.'

The teams were, he says, excitedly comparing photographs.

Delarue believes this form of knowledge-sharing works best with large companies who truly understand the global complexities that humanitarian organisations face. 'The core competencies and the transfer of knowledge is a difficult undertaking to make it successful, therefore it is [currently] reserved to only a few companies where the value fit is strong enough', he says.

The select few for UNHCR currently includes partnerships with Microsoft and PwC on ICT projects for refugees in very remote areas; ManPower for training and skills assessments; HP for learning and development technology; Facebook, Yahoo and Google to maximise digital presence during emergencies. Even Lego is providing educational toys for refugee children.

While UNHCR partners with smaller companies too, the current focus is on fundraising. However, Heggenes believes that the potential for knowledge partnerships need not be the sole reserve of blue chip companies.

'I think companies of any size can do this,' he says. 'It's about sharing knowledge. If it fits the needs of a humanitarian organisation, then any company can do that ... we're not only giving [UNHCR] money but also giving them expertise, and I think that is just as valuable – maybe even more valuable.'

As austerity measures increasingly infect the global economy, relying on the world's governments is no longer an option for UNHCR. 'We have a $3.7bn budget that is voluntarily funded, and we currently have around $1.2bn of unfunded activity – activity on the ground that we cannot do because we don't have the funding for it', informs Delarue.

'The secretary general Ban Ki-moon has said we will not be able to solve the problems of the world without the private sector, that it is a critical part of the solution.'

Heggenes draws a similar conclusion.

'As some governments are experiencing financial difficulties, [humanitarian organisations] see a reduction in funding on the one hand and an increase in need on the other. So there is a gap, and I think ... the private sector can fill that gap.

'I think the business world has also come to recognise that it has to play a bigger role ... and with more involvement from the private sector on the funding side you also see an increased engagement on knowledge-sharing. As we go forward I think knowledge-sharing could be just as important as donating money.

As for its own partnership with UNHCR, Heggenes says it is too early to assess what it has achieved. His gut feeling is that Ikea will do more of this in future. It is Delarue's gut feeling for the UN too. 'The private sector partnership is a new world for the UN', he says. 'Not many organisations are able to harness the power of the private sector in a way that is truly beneficial for all parties involved.

'This is something that I have been driving forward – to maximise our relationship with the private sector in a way that is a win-win-win: a win for the refugees, a win for the company, and a win for the humanitarian organisation as well.'

1 Suggest why a private sector business, like Ikea, would want to work with an international government organisation to improve wellbeing.

2 List the benefits that have arisen from this partnership for each of the parties involved.

3 Discuss the considerations IKEA and the UN would have had to address when redesigning the new shelter.

4 Account for the increasingly important role of business in improving human wellbeing.

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The Australian government and Aboriginal and Torres Strait Islander peoples' wellbeing

Colonisation was not a peaceful process in Australia. The frontier wars were between the invading Europeans and the original inhabitants of the land, Aboriginal and Torres Strait Islander peoples. As Europeans cleared land for farming and expanded settlements, pressure on food resources also increased, taking away access to areas that to Aboriginal and Torres Strait Islander peoples were both culturally significant and valuable for survival. Some interactions between the two groups were peaceful; however, the series of conflicts that began a couple of months after British settlers arrived in 1788 were quite violent and lasted for over 150 years. The battles impacted both sides with ambushes and revenge attacks, but it was the Aboriginal and Torres Strait Islander populations that suffered the most, with tens of thousands of deaths recorded. Further impacts of this conflict on Aboriginal and Torres Strait Islander peoples' wellbeing include:

- the introduction and spread of diseases such as smallpox, influenza and tuberculosis, causing infertility and death
- massacres e.g. Myall Creek 1838
- **dispossession** of land
- denial of access to traditional food and water sources
- loss of cultural identity
- loss of land
- Europeans cleared vegetation and erected fences which prevented access to hunting grounds and lead to starvation
- Europeans poisoned food and water sources to 'disperse the natives' as was the practice at the time
- non-recognition of customary laws.

dispossession to no longer have ownership

The legacy of European policies, firstly non-recognition of occupancy, then 'protection' in the 1880s, then assimilation has had devastating effects on Aboriginal and Torres Strait Islander people's identity and spirituality. For example, wellbeing in Queensland deteriorated very quickly. Laws meant Aboriginal and Torres Strait Islander workers were required to work without payment, ultimately treating them like prisoners. They were forbidden to participate in cultural traditions and rituals. It was institutionalised discriminatory practices such as these that formed feelings of powerlessness and psychological stress. All that remained by 1850 was 10% of the original Queensland population.

The long-term ramifications of losing land have continued to impact upon Aboriginal and Torres Strait Islander peoples today. Spirituality, which pervades every aspect of Aboriginal and Torres Strait Islander peoples' life, is the aspect most affected. Being separated from their land means a loss in social and cultural identity. The Dreaming is linked to the land but the loss of land means people are unable to fulfil their ritual responsibilities. The fragmentation of Aboriginal and Torres Strait Islander societies, caused by Europeans, broke down connections within and between kinship groups, which meant a loss of language. Language is tightly linked to identity and the passing on of oral traditions to younger generations. Such a disconnect has meant many Aboriginal and Torres Strait Islander peoples feel disempowered and displaced.

In attempts to regenerate wellbeing, government funding has been directed towards various projects and programs, some of which have failed and some of which have succeeded. One with reported positive results was the Indigenous Protected Areas (IPA) program whereby traditional owners of the land enter into agreements with the federal government to 'protect and enhance Indigenous culture and history, while encouraging and protecting the natural environment and conserving biodiversity'. The Department of Environment and Heritage documented positive outcomes for those participating in the program including:

- 95% reported economic participation and development benefits
- 85% reported that IPA activities improve early school engagement
- 74% reported that IPA activities have contributed to reduced substance abuse
- 74% reported that IPA participation resulted in more functional families by reinforcing family and community structures, and restoring relationships.

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Source 10.11 Warul Kara (Deliverance Island) was declared an Indigenous Protected Area (IPA) in February 2001.

Source 10.12 Land divided by frontier wars

ACTIVITY 10.3

1. Examine the extent of the frontier wars in Australia.
2. List a number of impacts of the frontier wars and explore the long-term implications of this on wellbeing.
3. The succession of policies – non-recognition, protection then assimilation – had devastating consequences on Aboriginal and Torres Strait Islander peoples' wellbeing. Discuss this statement with reference to examples.
4. Explain how the dispossession of land has far-reaching implications for Aboriginal and Torres Strait Islander peoples' culture.
5. Comment on the success of the Indigenous Protected Areas program as a means of improving wellbeing.

RESEARCH 10.3

Use the internet to investigate the Northern Territory Intervention. Compose a newspaper article (may even be an opinion piece) or short documentary that addresses the following aspects:

- rationale for the intervention
- areas affected by the intervention
- process and time frame of the intervention
- specific and detailed impacts on Aboriginal and Torres Strait Islander communities
- success or failure of the intervention (must be based on evidence)
- your opinion on this issue.

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10.4 Non-government organisation responses to conflict

Although government organisations strive to improve human wellbeing and close the chapter on conflict nationally and internationally, efforts from **non-government organisations (NGOs)** are also important. NGOs possess the strengths of being able to reach the most vulnerable and rely on public support and voluntary contributions. NGOs cover a range of sectors including development, human rights, the environment and peace building. They provide active local, national and international support and can focus on sensitive areas government organisations may miss.

non-government organisations (NGOs) not-for-profit groups that work outside of government control

Some of the top NGOs in the world created as a response to conflict include Cure Violence, APOPO, the Danish Refugee Council and Search for Common Ground. These organisations operate on very different levels. Cure Violence is a local peace-building organisation in Chicago, dedicated to addressing everyday interpersonal violence. Their success stories exist in cities like Chicago, New York City and Baltimore. Although their successes are local, they adopt a global perspective to curing everyday violence, hoping education and the spread of their work improves the wellbeing of other areas experiencing conflict.

Search for Common Ground are also a peace-building NGO; however, they operate on a global scale. Search for Common Ground currently have peace-building programs in Sri Lanka, the USA, Indonesia and Ukraine, among other countries. The programs vary from security and peace for women and promoting civic participation to school curriculum reform. The organisation also promotes local and regional programs, such as focusing on youth in Morocco. NGOs like Cure Violence and Search for Common Ground seek to improve human wellbeing, generally on a global level, but not always through global strategies. They understand that local-scale missions are important and violence and conflict can affect many different regions and different people in a number of ways.

Government organisations utilise the strengths of NGOs by often partnering with them to improve wellbeing. Australia's aid program, AusAID, offers overseas help in developing countries in the Asia Pacific region. Aid includes delivering goods and services, building local institutions and policy dialogue and reform. AusAID relies on local NGOs in order to achieve their goals of improving wellbeing overall. Creating partnerships and providing funding allows NGOs and AusAID to reach more countries in need and add both local knowledge and experience to the program.

Source 10.13 AusAID member working in Indonesia

RESEARCH 10.4

Use the internet to research NGOs in Australia. Select one that supports a cause you feel passionately about. With the information you gather on the organisation, prepare a presentation for the class explaining who they are, what they do and any success stories they have. Finish the presentation by identifying why you feel strongly about this organisation.

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10.5 Environmental sustainability and human wellbeing

Many conflicts around the world are a result of environmental issues and competitiveness for natural resources. The condition of the environment also contributes to human wellbeing; for example, healthy landscapes, pristine areas and precincts set aside for production or agriculture actually help to improve the health and wellbeing of the population. This is why, like groups resolving conflict, there are many government organisations and NGOs dedicated to improving environmental sustainability.

The emergence of environmentalism

The industrialisation of Europe and the USA triggered the emergence of modern **environmentalism**. During the 18th century, communities and prominent members of society in the USA lobbied to stop industry from dumping waste into waterways. In the 19th century, a conservation movement had gained momentum in the USA and lobbied against the over-exploitation of forests and other natural resources. Henry David Thoreau published his landmark book, *Walden*, which was an account of his experiences of living with nature. *Walden* inspired community interest in sustainable use of natural resources. In the late 19th century British intellectuals objected to the industrialisation of England and lobbied for social reforms and a return to a simpler lifestyle and activities that did not harm the natural environment. This pressure group is considered an early version of the 'Back to Nature' movement that became well established across the world in the 20th century and a cultural phenomenon that persists today. The belief that humans are capable of de-materialising and living sustainably in harmony with nature was widely embraced in the 20th century and fuelled the growth of environmentalism.

environmentalism advocacy for the protection of the environment from destruction and/or pollution

A Sand County Almanac was published in 1949, a year after the death of its author, Aldo Leopold. Leopold was a scientist,

Source 10.14 The proposed flag for Earth Day

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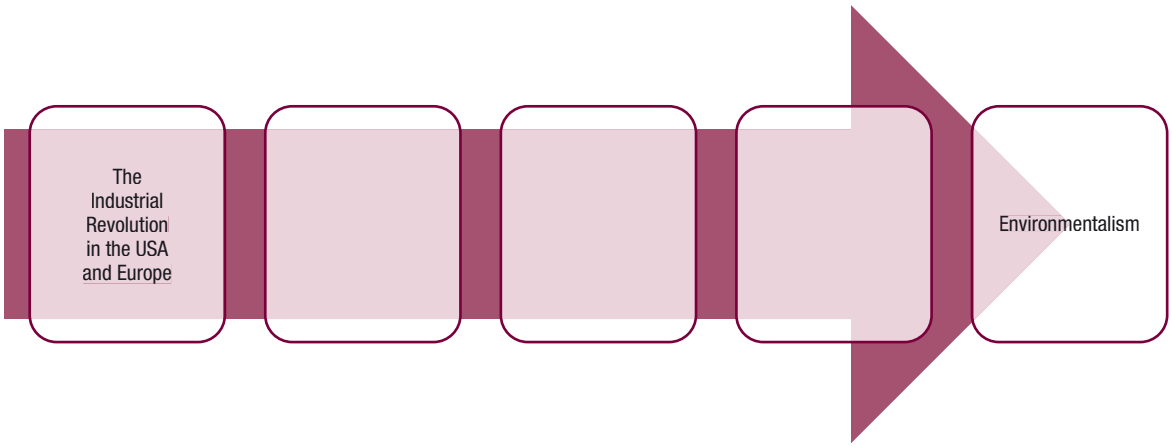
ecologist and environmentalist who advocated the protection of biodiversity, sustainable development and the need for environmental responsibility and environmental ethics. The book has been published in 12 languages and is considered to be one of the most influential publications on environmentalism. During the 1940s, 1950s and 1960s, photography, music and books on the environment, both fiction and non-fiction, continued to promote sustainable development. *Silent Spring*, published in 1962 by the prominent American biologist Rachel Carson, drew attention to the impacts of toxic pesticides on humans and the environment. Associations between pesticides and cancer drew significant community attention to the risks of polluting the environment. A change in attitudes towards development and its impacts on the environment and increased environmental activism fostered the establishment of groups such as Greenpeace and Friends of the Earth.

The first Earth Day was observed in San Francisco in March 1970 and is now celebrated by over 175 countries. Earth Day raises awareness of the importance of managing the environment for all living things. The increase in environmental activism in the 1960s and 1970s encouraged governments to establish departments and agencies with the primary responsibility of managing development and the natural environment. Environmental laws were also enacted in many countries to protect endangered species and reduce or prevent the impact of development on the environment

NOTE THIS DOWN

Copy the graphic organiser below and use the flow chart to summarise the emergence of environmentalism. The first point has been completed for you. Add more boxes as needed.



ACTIVITY 10.4

1. Explain why Earth Day a significant annual event.
2. Is environmentalism still influencing our attitudes towards development and its impacts on the environment? Provide one example from your local area.
3. Discuss in what ways you have been influenced to think about sustainability.

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Environmentalism in Australia

Environmentalism in Australia grew rapidly after World War II, by which time the effects of land degradation were felt throughout the nation. The post-war boom in development, fuelled by an increase in manufacturing, the construction of new infrastructure and increased urbanisation, sparked more concern for the environment. Insecticides and other toxic chemicals were widely used in the 1960s and 1970s. Lessons were learned from experiences in other developed nations and stricter controls were introduced to minimise impacts. Australia's first national Minister for the Environment, Aborigines and the Arts was appointed in 1970. State Ministers for the Environment were also appointed and Australia embarked on a new era of environmental management that included the creation of environmental laws and the establishment of various government agencies that are involved with environmental management and sustainability.

RESEARCH 10.5

Try to imagine a world without environmentalism. Research all the benefits of the emergence of environmentalism in Australia. Consider these benefits and prepare an essay describing what Australia would be like without environmentalism. Consider human wellbeing, Aboriginal and Torres Strait Islander peoples and sustainability.

10.6 Government responses to environmental issues

Inter-governmental action

As a result of the growing activism and environmental awareness campaigns, particularly in the 1960s and 1970s, governments around the world acknowledged that environmental sustainability was a global issue that required **inter-governmental** action. Not taking action would entail negative consequences on human wellbeing. The following international meetings and organisations are examples of key international, inter-governmental efforts to move the global community towards sustainability:

inter-governmental an act conducted between two or more governments

- The United Nations Education, Scientific and Cultural Organization (UNESCO) was established in 1945. Global sustainable development remains a core component of its programs.
- The International Union for the Preservation of Nature (IUPN) was established in 1948. In 1956 the IUPN changed its name to the International Union for the Conservation of Nature and Natural Resources (IUCN). The IUCN promotes prosperity through stewardship of natural resources by fostering a sense of ownership of environmental assets.
- In 1959 the IUCN prepared an international list of nature parks and natural environments for UNESCO.
- The World Wildlife Fund (WWF), which is also known as the World Wide Fund for Nature, was established in 1961. The WWF's central objective is to 'halt and reverse the destruction of the environment'.
- The 1972 Stockholm Conference on Human Development garnered inter-governmental commitments needed to control development for the benefit of the human environment. The conference recommended the annual celebration of World Environment Day on 5 June.
- The Convention Concerning the Protection of World Cultural and Natural Heritage, coordinated by UNESCO, was held in Paris in 1972. The convention made recommendations to protect cultural and natural assets, and promoted global action on sustainable development.

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- The IUCN, UNESCO and WWF published the 1980 World Conservation Strategy. The strategy aimed to maintain ecological processes and life systems, preserve genetic diversity and sustainably use species and ecosystems.
- The United Nations General Assembly adopted the World Charter for Nature in 1982. The charter proposed that governments espouse, and should be judged by, five principles of conservation.
- The Brundtland Commission, formally known as the World Commission on Environment and Development (WCED), was established in 1984. It dissolved in 1987 after it published the first volume of 'Our Common Future' which set sustainability goals and recommended actions to protect natural resources from over-exploitation.
- The United Nations Conference on the Environment and Development was held in Rio de Janeiro in 1992. Also known as the Earth Summit, the conference adopted Agenda 21, a document that was a blueprint for global sustainable development. This meeting, held 20 years after the Stockholm meeting, is considered a landmark event in sustainable development because of the involvement of 172 nations.
- The Commission on Sustainable Development was established in 1992 to implement key strategies under Agenda 21.
- The World Summit on Sustainable Development (WSSD), also known as Earth Summit 2002 and RIO +10, was held in Johannesburg, South Africa.
- In 2012, 20 years after the ground-breaking Earth Summit, the United Nations Conference of Sustainable Development was held in Rio. At this meeting, nations agreed to 'not carry out any activities on the lands of indigenous peoples that would cause environmental degradation or that would be culturally inappropriate'. Several other significant agreements were signed at this meeting.

These events have underpinned many international agreements on environmentally sustainable practices and have enabled governments to engage with non-government organisations and the community. Importantly, they have all focused on addressing social needs without ignoring the limits of the natural environment.

Source 10.15 Shark populations are in decline worldwide due to fishing pressure.

Geographical fact

More than 20% of species are predicted to become extinct in the next 25 years. More than half of all current species could become extinct within 100 years.

ISBN 9781107696969

ACTIVITY 10.5

1 Analyse why inter-governmental action is important to achieving sustainability.
2 Explain why there is a relationship between growing population and exploitation of resources.
3 Discuss how music and literature influenced people's attitude to the environment.
4 Define what sustainability means to you.

10.7 Non-government organisations and environmental wellbeing

Much like the NGOs that are dedicated to improving human wellbeing through decreasing conflict, NGOs in the environmental sector are working towards a better future. Environmental NGOs also assist in reducing environmental conflicts.

NGOs around the world work independently, partner with governments and even private sectors. One environmental NGO that is famous for its partnerships with private sectors is Ceres, an NGO that came in 6th place in *The Global Journal* top 100 NGOs for 2013. The organisation focuses on mobilising business to achieve a sustainable world by incorporating long-term improvements to environmental and social risks. As *The Global Journal* cited:

> Key to Ceres' deep impact is the group's unique position at the nexus of the business, investment and advocacy communities. The Ceres Coalition, which comprises more than 130 institutions, public interest groups and investors, the Company Network, which connects over 80 leading corporations, and the Investor Network on Climate Risk (INCR), which includes in excess of 100 investors collectively managing more than $11 trillion in cumulative assets, together allow Ceres to engage in a robust dialogue with powerful decision-makers in order to mobilize meaningful corporate commitments. Just some of Ceres' achievements to date include the wide uptake of its Global Reporting **Initiative** – a de facto international standard used by more than 4,000 companies for triple bottom line reporting – successful advocacy campaigns requiring companies and insurers to provide climate risk disclosure in financial filings and the use of the Company Network as an incubator for new best practices in corporate sustainability.

initiative a leading action

Ceres approaches environmental issues of climate change, energy, supply chains and water. Their company network members include hair care brand Aveda, Ben & Jerry's ice-cream, Coca-Cola, Nike and many more. Ceres assists these companies with the key building blocks for integrating environmental challenges within their business practices.

Ceres is an example of a large NGO working on a global scale. Countries all over the world have different NGOs of all different sizes that approach their cause at different levels. One thing that often is noticeable in environmental NGOs is that they overlap into different fields, especially when it comes to development, as a healthy environment is so important to the development of countries. This is evident in the frontier war of the Xhosa people in South Africa, who experienced invasion of their territory and dispossession of land at the hands of European settlers. Competition over land and cattle-grazing erupted into violence. A series of attacks from both sides was punctuated by drought and flood, and the wars lasted approximately 100 years. A sustainable and healthy environment means improved, ethical access to natural resources, land management, better health and a brighter future.

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Case study 10.4

Improving relationships between land managers and traditional owners

Tension between traditional land owners and land managers had been evident in Australia since the arrival of the European settlers. After decades of conflict and disagreements, organisations have put in place projects to improve relationships with traditional owners, for the benefit of the environment and for members of communities and all-round wellbeing.

NGO Landcare Australia uses locally based community groups to care for the natural resources of Australia. In 2011 Landcare Australia completed the project titled 'Building relationships between land managers and Traditional Owners' with success.

The Project

Through the 'Building relationships between land managers and Traditional Owners' project, the Merri Creek Management Committee (MCMC) further developed their relationship with the local Indigenous community, the Wurundjeri People, through a range of community projects and activities. Previously, they had focused on arts and culture to engage with the Wurundjeri People; however this project extended the relationship to encompass the cultural context of the landscape including vegetation management. The Be Natural funding supported the two organisations to develop a wide-ranging partnership which enabled Wurundjeri people to play an active role in natural resource management.

The Merri Creek flows about 60 km from the Great Dividing Range through Melbourne's northern suburbs to the Yarra River. Tributaries of the Merri Creek include: Edgars, Merlynston, Central, Curly Sedge, Aitken and Malcolm Creeks.

The Merri Creek is an environmental, heritage and recreation corridor that draws its significance from its role as a continuous habitat corridor. All areas of the Creek are

Source 10.16 Traditional grassland burning

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important because they contribute to the linking of areas of environmental, heritage and recreational value along the Creek.

The Merri Creek and its immediate surrounds is host to some of the most threatened ecosystems in Australia. The Creek has a unique role to play in the preservation of threatened flora and fauna and the maintenance of vegetation communities that in other places have almost been totally destroyed, including native grasslands and native grassy woodlands of the Victorian Volcanic Plains.

MCMC worked with Wurundjeri Tribe Land and Compensation Cultural Heritage Council and Traditional Owners to plan and implement a range of land management and cultural activities, including participation in traditional grassland burns, two Indigenous digging activities, and an information exchange day. MCMC's Parkland Team also increased their awareness and respect for the cultural context of their land management work.

Wurundjeri people along with MCMC attended Kalkallo Common on 25 November 2011 as the site for the information exchange day. Kalkallo Common site contains native grassland where the once staple Wurundjeri food, yam daisy still survives today. MCMC hosted the day and shared information about the grassland area. Fast Facts:

- Three grassland burns undertaken by traditional owners
- Two Indigenous digging activities
- Information exchange day held
- MCMC's Parkland Team increased their awareness and respect for the cultural context of their land management work.

1 Suggest how projects like the 'Building relationships between land managers and Traditional Owners' project improves relationships between land managers and the traditional owners.

2 Describe the role the Merri Creek plays in the preservation of the ecosystem.

3 Explain why Aboriginal and Torres Strait Islander peoples' land management activities are so suitable for Australian land.

4 Identify how this project improves human wellbeing.

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Chapter summary

- The nature of conflict is complex and varied e.g. inter-state, intrastate, extra-state.
- Spatial patterns of conflict show that countries with low levels of economic development experience the highest levels of conflict. Temporal patterns show that since WWII, conflict has declined in the western world but a spike in 1992 was due to the dissolution of the USSR.
- Causes of conflict include political, sociological, environmental, economic, territorial, legal, religious and ideological factors.
- Outcomes of conflict can be both short and long term and can have devastating impacts on wellbeing.
- The frontier wars in Australia have impacted the wellbeing of Aboriginal and Torres Strait Islander peoples. Dispossession of land is linked to the loss of identity and collective heritage.
- The United Nations Security Council and the Northern Atlantic Treaty Organization (NATO) are powerful bodies comprising a number of nations that make decisions about wars, drone strikes and to intervene or not.
- Non-government organisations provide active local, national and international support and can focus on sensitive areas government organisations may miss.
- Environmental wellbeing contributes to human wellbeing, by assisting in resolving conflict and improving the health and surroundings of the population.
- The industrialisation of Europe and the USA triggered the emergence of modern environmentalism.
- In 1970 Australia embarked on a new era of environmental management that included the creation of environmental laws and the establishment of various government agencies that are involved with environmental management and sustainability.
- NGOs around the world work independently, partner with governments and even private sectors.
- Improving relationships between land managers and traditional owners benefits the environment, members of communities and all-round wellbeing.

End-of-chapter questions

Multiple choice

1 What is the term given to a military takeover of the government?

A Civil war

B Coup d'état

C Extra-state conflict

D Interstate conflict

2 Moral relativism can be defined as:

A aggressive foreign policy

B indoctrination

C perceptions about what is right and wrong

D ethical arms dealing

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3 Environmentalism was triggered by:

- **A** industrialisation of Europe and the USA
- **B** the US Civil War
- **C** a large lawsuit regarding poisoned water
- **D** the movie, *An Inconvenient Truth*

4 Environmental NGOs often overlap with which field:

- **A** technology
- **B** justice
- **C** children and youth
- **D** development

5 The purpose of Earth Day is:

- **A** to learn about other cultures and their development
- **B** to teach people around the world about recycling
- **C** to raise awareness of the importance of managing the environment for all living things
- **D** for leaders around the world to meet and discuss peacekeeping

Short answer

1 Define the different types of conflict.

2 Examine why you would find different types of conflict in different places around the world.

3 Analyse the extent to which conflict impacts wellbeing. Use examples to support your answer.

4 Explain why businesses would want to work with government and non-government organisations to aid in improving wellbeing.

5 Describe how the goals of environmental organisations overlap with those goals of organisations concerned with development.

Extended response

Old-fashioned conflict, such as fighting in trenches, is now obsolete. Conflict will continue to morph according to technological developments, hidden economic motives and political powers. Predict what conflict and wellbeing will look like in the future. In your report you will need to address the following:

- the nature of conflict in the future
- spatial and temporal patterns of conflict in the future
- outcomes of conflict in the future
- the roles of government and non-government organisations in conflict.

Base your predictions on patterns of the past and current missions from peace-building organisations.

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Glossary

accrete to make larger or greater, as by increased growth

agrarian agricultural, farming-based activity

agrarian societies societies that are dependent on agriculture for economic growth and stability

air pollution when the air contains gases, dust, fumes or odour in harmful amounts

alluvial sediment deposited by flowing water, as in a riverbed, flood plain or delta

aquaculture the cultivation of aquatic animals or plants in a natural or controlled environment

arable suitable for farming

armageddon the Bible scene of the final battle between good and evil forces occurring when the world is to end

armed conflict severe conflict involving weapons and fire power such as tanks, guns, bombs, air strikes, etc

artisan a skilled manual worker; using low technology

ballast waters water that is pumped in and out of ballast tanks on board a vessel to increase the draft, change the trim, regulate the stability or to maintain stress loads

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

bioaccumulation the accumulation of a substance, such as a toxic chemical, in the tissues of different organisms in a food chain

biome the main groups of plants and animals living in areas of certain climate patterns

biomimetics the study of the structure and function of biological systems to create models for the design and engineering of materials and buildings

biosphere the sum of all terrestrial and aquatic ecosystems

cadastral a public record, survey or map of the value, extent and ownership of land as a basis of taxation

caldera form by the collapse of land following a volcanic eruption – often as a result of magma being expelled and the resultant reservoir has the land above it collapse

canal estate any development that requires a constructed waterway, canal or water body that is then inundated by or drains to a natural water body

carbon dioxide (CO_2) a chemical compound composed of two oxygen atoms bonded to a single carbon atom. It is a colourless, odourless gas

carbon pricing placing a price on carbon put into the atmosphere as carbon dioxide through either subsidies, a carbon tax, or an emissions trading ('cap and trade') system

carrying capacity the number of individuals that can be supported by the environment without causing significant harm

catchment an extent of land drained by a river or water body. It is sometimes referred to as a drainage basin

census initially the ancient Roman registration of citizens and their property to calculate tax, it is now a count of the population with additional details such as age, sex, occupation, residence, transportation and religion

civil society a 'third sector' separate from government and business that refers to institutions such as religious groups and unions

civil war a war involving conflict between regions of the same country

coast a much wider area of land and water beyond the shoreline where terrestrial and marine processes interact

coastal erosion the gradual wearing away of material from a coast by the action of sea water

coastal lowlands an area of low-lying ground close to estuarine and marine environments

coastal stakeholders individuals, organisations, community groups or government agencies that have an interest in, or are affected by, use of coastal resources

coastal system interconnected components which interact to form coastal processes

coexistence when two or more things or people live together in the same space or place

colonialism one country controlling another

colonisation the establishing and development of colonies in a country

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colony an area/territory under the control of another power (country)

commodity a physical product such as grain or metal able to be sold

communist a classless, society where all assets are community owned

composite made up of many things

conduction the transfer of heat between substances that are in direct contact with each other

conservation the protection of plants and animals, natural areas, and interesting and important structures and buildings, especially from the damaging effects of human activity

contemporary refers to the current time. In some contexts it can mean modern too

convection the transfer of heat from one place to another by the movement of liquids or gases

cottage industry products were made at home on a small scale compared to large amounts of produce being processed in factories

coup d'état a sudden and violent appropriation of leadership

cultural hegemony dominance of one culture over another

cultural imperialism the dominance of one culture over another, usually through policy, coercion or heavy-handed trade relations from transnational countries. Usually one culture assumes they are more superior to the other

dam a barrier constructed to hold back water and raise its level, forming a reservoir used to generate electricity or as a water supply

decolonisation the withdrawal of colonial rulers from their colony and the country's move towards independence

democratic government by the people where all citizens have an equal say

demography the study of people to build a picture of society

depressions hollowed-out areas in the sea floor, often the result of local currents

desertification the change of dry land to desert

development a state of growth or progress

disaggregated separated or broken up into different parts

dispossession to no longer have ownership

dissolution to end an agreement and break up into separate parts

domestic market all the buyers and sellers of a targeted market within one country

drainage basin an area drained by a river system which includes all areas that gather precipitation water and direct it to a body of standing or streaming water

dredging the use of any various machines equipped with scooping or suction devices and used to deepen harbours and waterways and in underwater mining

ecological footprint the measure of human demands on the Earth's ecosystems

ecologically sustainable development (ESD) the environmental component of sustainability that is embedded in environmental decision making in Australia. It also considers the need to meet economic and social development goals

economic development sustained actions of stakeholders and communities that promote an improving standard of living and a healthy economy

economic restructuring an economy moving from a manufacturing base to a service base

economic wealth a strong economy or abundance of items of economic value

ecosystem functioning the interaction between the biological and physical environment

egalitarian equality for everyone in terms of social, political, economic and civic rights

El Niño (Spanish for 'the boy child') during an El Niño pattern, pressure at sea level is lower in the eastern Pacific and higher in the western Pacific. The opposite happens with a La Niña pattern

empire a group of countries owned by another, e.g. the British empire

empirical information from observations and experiments

enclave a pocket of land or territory surrounded by another territory

entrepreneur someone who takes a risk in owning or operating a business

environmental impact assessment an assessment of positive and negative impacts an action or project will have on the environment

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Environmental Impact Statement (EIS) a document that outlines the main activities of a development, predicts the potential impacts and describes strategies to minimise or prevent environmental impacts

environmental management an attempt to control human impact on and interaction with the environment in order to conserve the environment

environmentalism advocacy for the protection of the environmental from destruction and/or pollution

ephemeral lasting for a very short time

epilimnion the upper, warm layer of water

erosion the act in which earth is worn away, often by water, ice or wind

estuary the wide lower course of a river where fresh and marine water mix

estuarine the wide lower course of a river where it nears the sea and there is typically a mix of fresh and salt water

eutrophication an environmental response to high nutrient concentrations. Algal blooms and bacteria can deplete oxygen and degrade habitat

expansionist policy one country seeking larger amounts of land or even economic income as a result of government policy

extraction involves stripping away vegetation and removing topsoil in dunes, in order to mine the sands

feedback change in one factor causing a change in a second and this then changing the first

fertility rate the number of live births per 1000 head of population, usually shown as a ratio

fishery a place where fish are harvested for commercial purposes

flow regulation when humans control river flows to ensure access to water when it is required and to supply water where it is most needed

fossil fuels natural fuels such as coal or gas, formed in the geological past from the remains of living organisms

genocide deliberate killing of people targeted because of their identity. It is the systematic destruction of people from a certain race, ethnic origin, religious affiliation or cultural group

geoengineering the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming

geology the study of the Earth: the materials of which it is made and their structure as well as the processes acting upon them. It also studies organisms of our planet and the study of how Earth's materials, structures, processes and organisms have changed over time

geomorphology the study of the physical features of the surface of the Earth and their relation to its geological structures

geothermal heat heat from hot rocks

gini coefficient an index which measures the distribution of income

global warming rise in the average temperature of the Earth's atmosphere

Greenhouse Effect the retention of the Earth's heat by atmospheric gases

Gross Domestic Product (GDP) the value of all the goods and services a country produces divided by the number of people living there

Gross National Product (GNP) the measure of the value of all the goods and services a country produces in a year

groundwater bodies of water which can occur beneath the land surface

groyne a wall or similar built out from the seashore or riverbank to control erosion

guerrilla group different from a traditional army; people are involved in a style of warfare that is smaller in scale but aims to affect the enemy all the same. It often includes sabotage and surprise attacks (ambushes)

happiness a state of wellbeing and contentment

hard engineering a controlled disruption of natural processes by using artificial structures such as concrete breakwalls

health a state of complete physical, mental and social wellbeing

heritage features belonging to the culture of a particular society, such as traditions, languages or buildings that were created in the past and still have historical importance

hinterland the land behind the coast or the banks of a river, or an area of a country that is far away from cities

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holistic the importance of the entire or whole of something but recognising the interdependence of inner parts

Human Development Index (HDI) a tool that is used to measure the wellbeing of a country, developed to overcome the shortfalls of other economic measurements and takes into account aspects of life rather than simply finances

human wellbeing happiness in terms of how people actually feel (a subjective side) and the conditions for people to feel this way (an objective side)

hypolimnion the deeper, colder layer of water

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

ideology a set of ideas about how society should run; for example, the political system

impervious incapable of being penetrated

indentured labour the labour of people who worked under very restrictive conditions and contracts in return for food and accommodation or to pay off debts; e.g. Indians in Fiji

industrialisation the process of a society moving from being largely agriculturally based to manufacturing based, often characterised by mass production

infiltration the process by which water on the ground surface enters the soil

initiative a leading action

integrated catchment management (ICM) a management strategy that takes into consideration that catchments are made up of different terrestrial and aquatic ecosystems that are interconnected through physical and biological factors

Integrated coastal zone management (ICZM) an approach to coastal zone management that fosters inter-governmental cooperation, the involvement of other stakeholders, and recognition of the codependence of economic growth, social needs and protection of environmental assets

interbasin diversion involves transferring water from one catchment to another

intergenerational equity the responsible use of natural resources to enable fair access to the same resources by future generations of humans

interglacial warmer period between ice ages

inter-governmental an act conducted between two or more governments

inter-state conflict combat between two different nation-states

king tide a high tide well above average height

Kyoto Protocol an international agreement created under the United Nations Framework Convention on Climate Change in Kyoto, Japan in 1997, which aimed to reduce the collective greenhouse gas emissions of developed country parties by at least 5% below 1990 levels during 2008 to 2012

La Niña (Spanish for 'the girl child') during a La Niña pattern, pressure at sea level is higher in the eastern Pacific and lower in the western Pacific

land clearing is defined as the direct human-induced removal of vegetation cover from forested areas, in order to allow the land to be used for other purposes such as agriculture

land degradation the deterioration of land, including its topsoil, vegetation and water resources

land management the process of managing the use and development of land resources

landward tending towards the land and away from the coast

latitude imaginary lines measured in degrees north and south of the Equator

lentic standing water bodies, the classification of lakes and wetlands

linear in a line or tracking along one path

literacy rate the percentage of people that can read and write

littoral forests occur within the influence of the sea, or a large coastal water body such as a lake or estuary

longitude imaginary lines measured in degrees east and west of the Prime Meridian (or the Greenwich Meridian)

longshore sand transport the process that moves sand parallel along a beach or coastline

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lotic surface waters with permanently flowing waters

low pressure system a region where the atmospheric pressure is lower than that of surrounding locations

macro level large scale as opposed to micro level (small scale)

malnutrition illness caused by inadequate food

mangroves trees that have managed to adapt to growing in the harsh and difficult tidal zone between the land and estuarine waters

marine environments oceans, seas, bays, estuaries and other major water bodies, including their surface

marine hazard a geological process in the marine environment that has created conditions with a potential of being hazardous

meander a winding curve or bend of a river

metalimnion a transitional layer of water where temperature decreases

migration the movement of people from one place to another

mission an important assignment carried out due to wishes from the government or an important organisation

modernisation the process of society moving from traditional systems to other systems using technology efficiency, often linked to higher incomes and higher standards of living

moral relativism actions deemed right or wrong depending on which perspective you're coming from

mortality the number of people dying

mortality rate the number of deaths per 1000 head of population, often expressed as a ratio

nation-state a group of people (nation) governed within a certain area (state). Also known as a country

neo-imperalism one country dominating another country's economy usually though trade relations, international pressure and foreign policy

new urbanism an urban design movement which promotes walkable neighbourhoods that contain a range of housing and job types

non-communicable disease (NCD) a non-infectious disease that cannot be passed from one person to another such as heart disease, cancer, diabetes and mental health issues

non-government organisations (NGO) not-for-profit groups that work outside of government control

objective a set goal

oligarchy power in the hands of a few people or businesses

osmoregulation a process of regulating water potential in order to keep fluid and electrolyte balance within a cell or organism

ozone gas formed when oxides and nitrogen react with sunlight. In the upper atmosphere it absorbs UV rays, preventing them from reaching the Earth. At lower levels, ozone is a pollutant caused by vehicle and industrial emissions, the main component of smog

paradigm thought patterns or concepts

pathogen an agent that causes disease, especially a living microorganism, such as a bacterium or fungus

per capita per person

photosynthesis a process by which a plant produces its food using energy from sunlight, carbon dioxide from the air, and water from the soil

polarisation a widening gap between two things, creating stark differences, almost opposite each other

Precautionary Principle a precautionary guide in the legislation for decisions on developments that might cause irreversible harm

primary source information that comes directly from the event or area we are studying. It is 'first hand' and is how we classify the majority of data collected during fieldwork

prisoner of conscience a person who is imprisoned because of their beliefs and political allegiances

private sector the part of the economy run by individuals and companies for profit

prosperity having success, flourishing or thriving

qualitative methods methods used to gather data that are expressed in non-numerical form (can only be described)

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quantitative methods methods used to gather data that is expressed in numerical form

radiation the emission of heat energy in the form of waves travelling through space, air or anything transparent to heat

reconciliation a process of restoring respect and understanding for each other to create positive change in relationships

regenerative the process of rebirth or renewal

renewable energy natural energy which does not have a limited supply

renewable resource any natural resource (such as wood or solar energy) that can be replenished naturally with the passage of time

resilience the ability to recover quickly from change

riparian living or located on the bank of a natural watercourse such as a river or a lake

rooftop solar photovoltaic (PV) systems energy generation equipment that works by converting sunlight directly into electrical power

run-off the draining away of water from the surface of an area of land or structure

saltmarsh a coastal wetland that is flooded and drained by salt water brought in by the tides

satellite altimeter an instrument for determining elevation, especially an aneroid barometer used in aircraft that senses pressure changes accompanying changes in altitude

seagrasses they are the only flowering plants that can live underwater

seaward tending towards the sea and away from land

secondary source information that is put together by someone else or someone not directly involved in the event or area that we are investigating

sediment material broken down by natural processes such as erosion which are transported by wind, water and other means

segregation a division or parting of something

self-determination the right to choose to act in a certain way. The term is most often associated with indigenous peoples around the world and their right to govern and make decisions for the betterment of their people as they see fit

smog a mixture of smoke and fog that has come to mean man-made pollution that can be seen in the atmosphere

social mobility the ease of moving up 'levels' in society

socio-economic the interaction of social and economic aspects

soft engineering the use of ecological principles and practices to reduce erosion and achieve the stabilisation and safety of shorelines, while enhancing the habitat, improving aesthetics and saving money by using vegetation and other materials

Southern Oscillation Index (SOI) atmospheric pressure differences at sea level between Tahiti and Darwin. Sustained negative values of the SOI are associated with El Niño events, and positive values with La Niña events. As El Niño and Southern Oscillation are related, the two terms are often combined with the abbreviation of ENSO

sovereign nation-state an area with a permanent population, a government and complete control over its territory

sparsely existing in small amounts, or a large distance apart

spatial difference relating to difference in the position, area, and size of things

spatial patterns patterns and trends in where things are located

spatial scale the extent, size and location of something being studied. For example, the climate of a large area such as central Australia versus the microclimate of a small area such as a westward-facing slope

stakeholder a party or person with an interest or concern in an organisation and its actions

storm surge local and temporary rise in sea level that is primarily caused by a low pressure system

strata layers or levels

stratification the process of waters with different properties forming layers to act as barriers to water mixing

subjective personal views and feelings associated with a topic. Opposite to 'objective' which is factual information

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substrates surface or material on or from which an organism lives, grows, or obtains its nourishment

suburbanisation a process whereby people, businesses and warehouses move from the inner city out to the suburbs, usually due to cheaper land, accessibility to major transport routes and labour supply

surface water water found on the surface of continents and islands

sustainability the ability to continue with minimal long-term effect on the environment

swale a low tract of land in between sand dunes or ridges, that may be moist or marshy

swash zone the turbulent layer of water that is pushed up the beach face due to the energy of a breaking wave and then runs back down the beach due to the effect of gravity

tariff a tax imposed on imports

temporal dimension associated with time. In this case we are looking at patterns of conflict over time

terrestrial ecosystem a system of plants, animals, nutrients and elements, and the interactions between them, that is only found on land.

theocratic a god or religious being is the supreme ruler and the government are guided by this

thermocline *see* metalimnion

tide gauges installations that measure relative sea level at a specific point along the shoreline. They are usually secured on piers or on platforms a few metres off

tiger economy an economy that grows very quickly. This was typical of some South-east Asian nations in the early 1990s. However, they grew too rapidly and were affected greatly by the Asian Financial Crisis of 1997

trading bloc a group of countries, traditionally in the same geographical region, agree to protect their industries by creating barriers to trade for non-member countries. Often trade is made freer within the bloc; e.g. Association of South East Asian Nations (ASEAN)

transcendence relationship with a higher being or force

transnational corporations (TNC) a corporation that operates in more than one country

trawling a method of fishing that involves pulling a fishing net through the water behind one or more boats

Tropic of Cancer the parallel of latitude 23°27' north of the Equator, the most northerly latitude at which the sun can be directly overhead

Tropic of Capricorn the parallel of latitude 23°27' south of the Equator, the most southerly latitude at which the sun can be directly overhead

urban environment the human-made areas that allow human activities to take place

urbanisation the process of people moving to large urban centres such as cities

vulnerability the degree to which people, property, resources, systems and cultural, economic, environmental and social activity are susceptible to harm, degradation or destruction on being exposed to a hostile factor

water quality the physical, chemical and biological characteristics of water

weirs low dams that are built across rivers to regulate flow or raise the water level

wellbeing peoples' quality of life and happiness that can be measured by health, income, life expectancy, literacy rates, women's participation in public life, infant mortality and many other indicators

western culture ideas, fashion, food and ways of life from the USA, UK and western Europe which are located in the western hemisphere

wetlands land consisting of marshes or swamps

World Bank, the an international bank dedicated to providing financial aid and advice to developing nations in order to improve their economic advancement

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