

State of the Environment Queensland 2011



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Foreword

The State of the Environment Queensland 2011 report presents a comprehensive picture of Queensland's environmental assets are faring, the pressures on them and the actions taken to protect, maintain and restore them.

This report is produced every four years to assess the key factors affecting Queensland's air, land, water and heritage and the progress towards achieving ecologically sustainable development.

Queensland's environment is essential for maintaining the high quality of life we have become accustomed to, as well as providing a base for Queensland's agricultural and tourism sectors. Our environment provides many essential ecosystem services that we take for granted on a daily basis, such as clean air and water.

Since the 2007 report, Queensland's environment has faced a number of key challenges including the accelerated use of Queensland's natural resources, a significant oil spill in 2009 and eight long years of drought, followed by extensive flooding across the state.

The 2011 report highlights that the environmental recovery from the summer 2010–11 statewide flooding is ongoing.

Over the past 18 months, the report has been prepared in collaboration with individuals and organisations from both the private and public sectors. Without the concerted effort and commitment of everyone involved, it would not have been possible to produce such a comprehensive report. I would like to personally thank the many contributors for their assistance over this period.

The information in this report will further our collective understanding of the status of Queensland's environment and inform environmental policy settings and programs.

In closing, I would like to look to the future and note the creation of the Department of Environment and Heritage Protection (EHP). The new agency will have a strong focus on the health of the environment in Queensland, including protection of its flora and fauna, landscapes, pristine waterways and biodiversity. The creation of EHP is recognition of the new government's commitment to the environment as a stand alone priority.

Andrew Chesterman
Director-General
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Executive summary

The wellbeing of all Queenslanders is intimately linked to and dependent upon the environment. It provides essential ecosystem services, including clean air and water. Queensland supports a population of more than four and half million people, with much of this population living in urban regions close to the coast. Queensland's agriculture, forestry, fisheries, mining, manufacturing, construction and tourism industries rely heavily on the environment for their resources and output. There is increasing focus on sustainability issues within these sectors and a number of industry initiatives are being undertaken to address potential environmental impacts associated with their activities.

Queensland's landscape is vast, covering an estimated area of 172.8 million hectares (ha). It is also very diverse—encompassing many relatively pristine areas such as national parks, to highly modified areas such as cities, mines and agricultural lands. The terrestrial (land-based) environment is complemented by an extensive marine environment. The mainland coastline of Queensland is approximately 6900 kilometres (km) in length and features 1165 offshore islands and cays.

Queensland has the greatest levels of biodiversity in Australia and is characterised by 85 per cent of the nation's native mammals, 72 per cent of its native birds, more than half of the nation's native reptile and frog species and close to 13 000 native plant species. Queensland also hosts five of Australia's 18 World Heritage areas, provides critical habitat for shorebirds as recognised through international agreements, and includes more than 6.8 million ha of natural or near natural wetlands.

State of the environment reporting is the internationally and nationally accepted method for assessing environmental performance. The State of the Environment Queensland 2011 report is Queensland's fifth state of the environment report. This report is a whole-of-Queensland Government initiative and is prepared to meet the legislative requirements under both the *Environmental Protection Act 1994* and the *Coastal Protection and Management Act 1995*.

The State of the Environment Queensland 2011 report highlights the many environmental challenges facing Queensland since the release of the State of the Environment Queensland 2007. Some challenges have arisen due to a chain of extreme weather events and associated natural disasters. Others have been caused by ongoing pressures on the environment that may have either increased, as in the case of activities associated with mining and energy extraction, or decreased, as in the case of vegetation clearing.

This report summarises the progress on actions developed in response to issues identified in previous reports, as well as the introduction of new initiatives to improve natural resource planning and management. This report enables the government, industry and community to consider the state of Queensland's environment and evaluate the effectiveness of the actions taken to protect it. The report will inform evidence-based decision making and adaptive management of Queensland's natural environment.

Key findings

Drivers of change

There are a range of social, economic, cultural and political factors that guide human behaviours, which can lead to changes in the state of the environment. These include demographics, economic activity, cultural values, human development, governance and science and technology. The consequences of behaviours stemming from these drivers has led to significant global environmental pressures, including habitat loss, the spread of invasive species, the unsustainable use of natural resources, the generation of pollutants resulting in the contamination of air, water and land resources, as well as a changing climate.

The size, growth rate, distribution and migration patterns of Queensland's population are all important factors that influence land and water use, and the provision of socio-economic services that support high or improved living standards. Queensland contains an ageing, highly urbanised population, with approximately 88 per cent of the population living within 50 km of the coast. In this reporting cycle, population growth in the regional centres has shown increases. At 30 June 2011, the estimated resident population of regional Queensland (Queensland, excluding the Brisbane Statistical Division) was 2 506 060 people, making up 54.7 per cent of the state's

population. The population growth rate for these regions between 30 June 2006 and 30 June 2011 was 2.33 per cent—slightly above the Queensland average of 2.29 per cent.

Queensland has a relatively strong economy with activity dampened over the past three years due to the impacts of the global financial crisis, widespread flooding in late 2010 and early 2011, and damage from Tropical Cyclone Yasi in early 2011. While economic growth provides a range of benefits to society, it can also lead to pressures on the environment.

Differences or changes in culture can also drive actions that can impact upon the environment. Consumption can result in environmental pressures. Ecological footprints provide a measure of human demand on the earth's ecosystems. In 2009, the ecological footprint for a person living in Queensland was 7.8 global hectares (gha) and for a Brisbane resident was 8.0 gha. This value is similar to the average Australian's ecological footprint of 8.1 gha but is approximately three times the world average of 2.7 gha.

Human development is about enabling people to lead long, healthy, educated and fulfilling lives. Sustainable human development is about ensuring that future generations are not disadvantaged. In 2010, Australia was ranked second highest in the world (out of 169 nations) for its Human Development Index (HDI), a composite measure of life-expectancy, access to knowledge and standard of living at a national level. There are some sectors of Australia's community that remain disadvantaged, as shown by the 7.9 per cent drop in HDI when it is adjusted for inequity. Much of this inequity lies within Aboriginal and Torres Strait Islander communities, where life expectancy, education outcomes and incomes are lower than for non-Indigenous populations.

Science and technological innovation continues to alter the structure of production, the nature of work and the use of leisure time. Fast changing technology can lead to a more rapid turnover in consumer and capital goods, creating waste as older stock is replaced. However, new technology often means the new goods are more energy efficient. Advances in science and technology have significantly improved our ability to monitor and understand the environment.

Air quality and climate

Air pollutants and emissions can damage human and ecosystem health, deplete stratospheric ozone (O₃) concentrations that protect us from damaging ultraviolet radiation from the sun, and alter the climate system.

Air quality in Queensland is generally good, with very few exceedences of national standards or guidelines for the air pollutants, air toxics and particles monitored by the Queensland Government. The potential for air pollution remains high in South East Queensland due to its increasing population, the dependence on motor vehicles and industrial activity.

The National Environment Protection (Ambient Air Quality) Measure (Air NEPM) provides a framework for monitoring, assessing and reporting on ambient levels of the six 'criteria pollutants'—carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), O₃ and particles (PM₁₀ and PM_{2.5}). These pollutants are emitted from a wide range of sources, including domestic, commercial, industrial, transport, agricultural and natural sources, and high concentrations can affect health and the environment. There were no exceedences of the Air NEPM standards for NO₂ and carbon dioxide (CO₂) in the past decade anywhere that monitoring was carried out in the state. Sulfur dioxide concentrations in Mount Isa, where a major emitter of this pollutant is located, exceeded Air NEPM 1-hour and 24-hour standards on occasions. However, the SO₂ levels measured in Mount Isa do not constitute a breach of the *Mount Isa Mines Limited Agreement Act 1985* air quality limits.

Periods of elevated particle levels have occurred in all areas of Queensland where monitoring takes place, largely as a result of events such as dust storms and bush fires. Breaches of the Air NEPM PM₁₀ goal (<5 days per year when PM₁₀ levels were above the Air NEPM standard of 50 micrometres per cubic metre (µm/m³)) were caused by major dust storms and/or bushfires during 2002, 2003, 2005 and 2009. South East Queensland and Gladstone PM_{2.5} levels occasionally exceed the Air NEPM advisory standards (<5 days per year), primarily as a result of smoke from vegetation burning.

Lead is monitored in Mount Isa and Townsville, the areas where there are industrial sources of lead emissions. There have been no exceedences of the Air NEPM air quality standard for lead in Townsville. Additionally, there have been no exceedences of the air quality limit for lead set in the *Mount Isa Mines Limited Agreement Act 1985* for Mount Isa since 2003.

The National Environment Protection (Air Toxics) Measure (Air Toxics NEPM) provides a framework for monitoring, assessing and reporting on ambient levels of five air toxics—benzene, formaldehyde, toluene, xylene and polycyclic aromatic hydrocarbons (PAHs).

Measurements of concentrations of air toxics in South East Queensland and Gladstone indicate that levels are well below the Air Toxics NEPM investigation threshold levels for the protection of human health.

Ozone levels in South East Queensland, Gladstone and Townsville have not exceeded air quality standards in the past five years. Prior exceedences were very low (<5 days per year). Additionally, there has been an overall downward trend in the number of days with reduced visibility throughout Queensland, with very few days recording poor visibility.

While Queensland's total greenhouse gas emissions in the global context are relatively small, the state is a high per capita emitter. Queensland's greenhouse gas emissions, excluding emissions associated with changes in land use and vegetation were 134.3 Mega tonnes of carbon dioxide equivalent (Mt CO₂-e) in 2009–10 (a 69.2 per cent increase on 1989–1990). When emissions and removals associated with changes in land use and vegetation such as the end of broadscale tree clearing is included, the total becomes 157.3 Mt CO₂-e (a 4.7 per cent decrease on 1989–1990). Emissions from the transport and energy sector continue to grow. Overall electricity generation in Queensland increased by five per cent between 2004–05 and 2008–09, from 51 635 gigawatt hours (GWh) to 54 222 GWh, of which the amount generated from gas increased from 2035 GWh to 5404 GWh. Queensland's carbon emissions are influenced by a range of factors, such as the key drivers of the economy, the significant decentralisation in the state and the large distances travelled, as well as the current pattern of industrial activity.

Queensland's climate and weather is highly variable. From 2001, drought conditions persisted over much of the state, followed by record flooding at the end of the decade. Queensland's rainfall is influenced by seasonal variations (such as the summer monsoon), year-to-year fluctuations in the climate system (such as the El Niño Southern Oscillation), and multi-year cycles (such as the Interdecadal Pacific Oscillation). These features of Queensland's climate provide much of the variability observed in Queensland rainfall.

The wettest year on record for Queensland was 2010, with a total rainfall of 1110 millimetres (mm) averaged over the state. At the start of 2010, El Niño conditions prevailed in the Pacific Ocean; however towards the end of 2010 there was a shift to a strong La Niña that resulted in higher than average rainfall across the state, with South East Queensland and inland areas experiencing severe flooding. Indicators of La Niña conditions showed that this La Niña event was the strongest at least since the mid-1970s and one of the four strongest in the last century. Previous strong La Niña events, such as those in 1973–74 and 1955, were also associated with severe flooding in Queensland.

In December 2010, the Southern Oscillation Index (SOI) was +27.1, the highest December value on record and the highest monthly value since 1973. The SOI is a key indicator of the development and intensity of El Niño or La Niña events in the Pacific Ocean. The SOI is usually persistently positive during La Niña events while with El Niño episodes the SOI becomes persistently negative, for example during the drought years of 2002–2008.

North Queensland experienced its largest and most intense cyclone since 1918. Category five Tropical Cyclone Yasi was 500 km wide with an eye of 30 km in diameter and crossed the coast near Mission Beach at approximately 00:30 AEST on 3 February 2011. Estimated wind gusts were up to 285 km per hour, with maximum recorded winds up to 185 km per hour.

The 10 years from 2002 to 2011 were Australia's equal-warmest 10-year period on record. The average surface temperature in Queensland has risen by almost 0.9 °C since early last century. In the last two decades up until 2011, Queensland experienced three years with an annual mean temperature below the 1961–1990 average.

Key initiatives relating to air quality implemented since the last reporting period include the Environmental Protection (Air) Policy 2008 and the State Planning Policy 5/10 Air, Noise and Hazardous Materials.

Aquatic ecosystems and the coast

For most of the first decade of the 21st century, drought dominated Queensland's weather and two-thirds of Queensland experienced eight years of exceptional drought. Widespread flooding towards the end of the decade broke the drought but brought new challenges. In January 2009, the Gulf of Carpentaria experienced extreme flooding and long periods (>10 days) of inundation. The catastrophic impacts of both the flooding events of 2010–

11 and the destruction caused by Tropical Cyclone Yasi saw more than 99 per cent of Queensland declared as disaster affected.

Major flooding from December 2010 to January 2011 affected the southern area of the Great Barrier Reef, while Tropical Cyclone Yasi (category five) in early February 2011 caused damage across 89 090 square kilometres (km²) of the Great Barrier Reef Marine Park. The effect of the cyclone on coral reefs was found to be highly variable, ranging from minor damage to 90 per cent of the same reef area. In the Great Barrier Reef Marine Park, 15 per cent of the total area incurred some coral damage, while six per cent was severely damaged.

The 2010–11 floods caused significant damage to waterways and adjacent floodplains in South East Queensland. It has been estimated that in 10 days during the floods the amount of sediment leaving non-urban areas in South East Queensland was just over three times the average annual sediment load.

On 11 March 2009, the Pacific Adventurer cargo ship was caught in Tropical Cyclone Hamish off the coast of Moreton Island. The vessel suffered two hull punctures from falling shipping containers. As a result, an estimated 270 tonnes of heavy fuel oil leaked into the ocean off the northern coast of Moreton Island in South East Queensland. The resultant oil slick affected beaches, rocky reefs, two coastal wetlands on the island, and beaches and mangrove wetlands between Bribie Island and Coolum Beach. The enormous clean up operation took over two months, involved 2500 people and resulted in the removal of 3000 tonnes of polluted sand.

Findings from the Ecosystem Health Monitoring Program, managed through Healthy Waterways Pty Ltd, indicates freshwater rivers and creeks in South East Queensland vary in condition, from good in systems such as the Noosa, Stanley and Nerang, to very poor in the Oxley, lower Brisbane and Redlands systems. Only the Bremer River appears to have shown an improvement in health over time. The Noosa River may be in decline; however this may be a reflection of previous drought conditions. In South East Queensland, there has been a general reduction in total phosphorus loads discharged from wastewater treatment plants over the last four years. While total nitrogen loads have remained steady in the four year reporting period, with a significant reduction in nitrogen loads discharged since 2002.

The Surface Water Ambient Network ambient water quality monitoring from across nine biological provinces in Queensland shows that of the sites where information was available, most sites passed guidelines for turbidity and electrical conductivity (a measure for salinity) (more than 90 per cent of the 192 sites sampled). For total phosphorus, 76 of the 118 sites sampled (or more than 64 per cent) met guideline values. For total nitrogen, 125 of the 154 sites sampled (or more than 81 per cent) met guideline values.

The Ecosystem Health Monitoring Program found estuaries in South East Queensland exhibited a wide range of conditions, from very good in the Noosa estuary to very poor in the Bremer, Oxley and Albert estuaries, all of which are subject to point discharges and considerable urban run-off. In the Fitzroy to Tin Can Bay region, monitoring showed that the condition of estuaries varied from near pristine to moderately impacted. Impacts on water quality were caused by both point source discharges and by inflows of catchment pollutant loads (i.e. nutrients and sediments). In many estuaries, greater impacts were probably associated with other factors, for example the restriction of freshwater inflows due to the construction of large and small impoundments and the associated impacts on fish passage between estuary and freshwater reaches.

In Gladstone Harbour, concerns about the impact of industry on ecosystems have also been highlighted by a number of abnormal occurrences associated with fish and other marine animal health. A major investigation program has been in place since September 2011 and includes fish health, water quality and human health aspects. At this stage, fish health is stabilising with slight improvement, water quality and sediment quality reports do not show a cause for the fish health issues. The human health cases described did not form a single outbreak of one disease and there was no indication of an outbreak of disease in fishers that could be linked with disease in fish. Of all the possible explanations, the data indicates the flood event at the beginning of 2011 as the most likely cause.

The Great Barrier Reef First Report Card established a baseline for key indicators in 2009. The results demonstrate that the overall condition of the Great Barrier Reef is moderate, with regional variability evident as summarised below:

- **Seagrass:** Inshore seagrasses are in moderate condition. Seagrass abundance is moderate and has declined over the past five to 10 years, associated with excess nutrients. The reproductive capacity of seagrass is poor or very poor in four of the six regions, indicating limited resilience to disturbance.

- **Water Quality:** Inshore water quality is moderate overall. Concentrations of total suspended solids range from poor (Burdekin and Mackay–Whitsunday regions) to very good (Burnett–Mary region).
- **Coral:** Most inshore reefs are in moderate condition, based on coral cover, macroalgal abundance, settlement of larval corals and numbers of juvenile corals; however corals in the Burdekin region are mostly in poor condition.

The catchment load estimates from the 2009 Reef report card for nutrients (total nitrogen, dissolved nitrogen, total phosphorus and dissolved phosphorus), sediments (total suspended solids) and pesticides are summarised below:

- Annual total suspended solid loads (sediment) were 17 million tonnes, of which 14 million tonnes was from human activity.
- The largest contribution of total suspended sediment load was from the Burdekin and Fitzroy regions (4.7 and 4.1 million tonnes respectively), mainly derived from grazing lands.
- Agricultural fertiliser use is a key source of dissolved nitrogen and phosphorus run-off, annual loads of dissolved nitrogen are 31 000 tonnes, of which 17 500 tonnes were from human activity.
- The highest total load of dissolved nitrogen was from the Wet Tropics region with 11 000 tonnes per year, of which 6300 tonnes were from human activity.
- The total annual pesticide loads were approximately 28 000 kilograms (kg), with the highest loads from the Mackay–Whitsunday and Wet Tropics regions (approximately 10 000 kg each per year).

Pollutants discharged from major wastewater treatment plants in the Great Barrier Reef catchments have been monitored over the last four years. Upgrades in treatment facilities have resulted in a significant reduction in loads of both total nitrogen and total phosphorus over this time.

The Sustainable Rivers Audit provides a long-term assessment of the condition and health of the 23 river valleys in the Murray–Darling Basin. The ecosystem health of catchments in Queensland was generally better than southern catchments due to cumulative pressures along the river system. The Paroo Valley was rated in good health, while the Border Rivers and Condamine valleys were rated in moderate health. However, the Warrego Valley was in poor health.

The reporting period 2005–09, represents the final years of a prolonged drought. Groundwater levels (quantity) fell in the long-term over most areas. The exceptions were aquifers along the coast around Bundaberg and north of Mackay where water tables tended to be stable or rising. The Great Artesian Basin water levels remained relatively stable, except around some intake areas. Most aquifers contained moderate to poor water quality.

Wetlands are widespread throughout Queensland and support the most diverse freshwater fish fauna of any Australian state, as well as 210 species of waterbirds both resident and migratory, and more than 3000 species of plants. In 2009, Queensland supported around 6.8 million ha of natural or near natural wetlands, which covered around 3.9 per cent of the state. Loss of wetlands over the 2001–05 period was 6790 ha, which reduced to a loss of 1890 ha over the 2005–09 period. These net figures included gains in the extent of lacustrine wetlands of 120 ha and 90 ha for each period due to modifications associated with levee construction. The highest losses were in the palustrine (includes vegetated non-estuarine wetlands, such as swamps and marshes) (2370 and 800 ha) and riverine (4290 and 1100 ha) systems.

Riparian areas occur along watercourses, such as freshwater creeks, rivers and lakes. In 2009, 66.12 per cent (approximately 13.6 million ha) of riparian areas were forested and those areas with less than 15 per cent foliage projective cover had a mean ground cover of 57.59 per cent.

The introduction of the *Vegetation Management Act 1999* in 2000 and the *Vegetation Management and Other Legislation Amendment Act 2004* prohibiting broadscale clearing have seen a significant decrease in the rate of riparian vegetation clearing.

With regards to freshwater fish stocks, the number and conservation status of native fish species across Queensland are unchanged from the previous reporting period. However, when compared with 2007, the number of exotic species incursions has increased by one with the reporting of tilapia for the first time in the Burnett River catchment. Most Queensland fish stocks are either sustainably fished or their exploitation status is ‘uncertain’ or ‘undefined’ due to information deficiencies. Concerns remain for the status of snapper stocks in the Rocky Reef Fin Fish Fishery off southern Queensland.

In 2011, the reduction in seagrass meadows along the Queensland urban coast in response to flooding and cyclone damage took its toll. More than 1500 turtle strandings were reported in 2011, in comparison to an average of 900 strandings in previous years.

Queensland is largely free of marine pests. Twenty-six species are listed as actual or potential threats to Australia's marine resources on the National Introduced Marine Pest Information System. Asian green mussel and Asian bag mussel were detected in Queensland in 2007–08 and 2009. Queensland has experienced outbreaks of cyanobacteria (*Lyngbya*) and the crown-of-thorns starfish in the reporting period. Both of these species are native to Queensland. Freshwater pests are distributed predominantly along the coast and in South East Queensland. Species outbreaks in this reporting period included tilapia (five outbreaks), climbing perch and the red-eared slider turtle. The 2010 and 2011 flood events may result in further outbreaks.

Queensland has three state marine parks including the Great Barrier Reef Coast Marine Park, Great Sandy Marine Park and Moreton Bay Marine Park. The extent of Queensland's coastal waters marine park system in 2010 was 7 206 000 ha. In 2008, the area of green zones in Moreton Bay Marine Park increased from 0.5 per cent to 16 per cent of the total area of the marine park. In comparison with approximately 33 per cent and four per cent for the Great Barrier Reef Coast and Great Sandy marine parks respectively.

The *Water Act 2000* establishes a statutory planning framework for the sustainable allocation and management of Queensland's water resources. Water Resource Plans, under the Act, have been completed for 92 per cent of the state's key catchments.

Since the last reporting period, key initiatives relating to aquatic ecosystems and the coast implemented include the:

- *Great Barrier Reef Protection Amendment Act 2009* and the Reef Water Quality Protection Plan 2009 (Reef Plan)
- amendments to the *Water Act 2000* in 2010 to introduce a framework for managing the impacts of underground water extraction as part of the petroleum and gas industries
- Environment Protection (Water) Policy 2009
- State Planning Policy 3/11 Coastal Protection
- State Planning Policy 4/10 Healthy Waters
- State Planning Policy 4/11 Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments.

Land and terrestrial ecosystems

Intensification of land use and long-term changes in climate remain the most significant factors causing land degradation in Queensland. Both can lead to a range of impacts. Land-use change for food production, particularly irrigated agriculture and certain cropping activities may cause decline in soil quality, including nutrient imbalances, salinisation, soil erosion and loss and weed invasion.

Climate and weather variability adds to the severity of land-use impacts. The severe drought between 2001 and 2006, coupled with the retention of livestock numbers and elevated grazing pressures, caused impacts on landscape health. Since 2006, Queensland's rangeland areas have had higher rainfall resulting in an improved carrying capacity, with a partial recovery in landscape function across many areas. However, recovery remains slow in very low condition areas and regions that suffered recent extended flood inundation, such as the Northern Gulf.

The proportion of the total area of land used for agriculture in Queensland has declined by eight per cent from 2007 to 2010 to 129.7 million ha.

Estimated modelled average pasture utilisation for Queensland in 2010–11 suggests there was a significantly lower level of pasture utilisation by animals (stock) compared to the historical record. Studies show soil fertility is declining in most of the grain cropping lands in Queensland. During 2007–09, wind erosion was more active than the long-term average (1960–2009) in seven of the 13 natural resource management regions in Queensland.

More than half of Queensland—or 96.66 million ha—is under some form of granted exploration or production tenure for coal, mineral, petroleum, coal seam gas or geothermal energy. The actual current mining footprint (excluding coal seam gas) is 160 000 ha or 0.09 per cent of the state. The area affected by mining over the last 150

years is 170 000 ha or 0.1 per cent of the state. In 2011, there were 55 coal mines, 36 significant mines for metallic and industrial minerals and numerous smaller gold, industrial mineral, opal and gemstone mines.

Vegetation loss, primarily as a result of clearing, remains one of the major causes of landscape change and biodiversity loss. Queensland has approximately 140 million ha of remnant vegetation (81 per cent of the total area), of which some 70 million ha is woody remnant vegetation protected from broadscale clearing by vegetation management legislation. The loss of woody vegetation was reported at 482 000 ha per year for 2003–04, while for the most recent reporting period (2008–09) clearing totalled 99 940 ha per year. The 2008–09 results represent the lowest rate of woody vegetation clearing since the introduction of the *Vegetation Management Act 1999*.

The majority of remnant vegetation cleared in the period between 2006 and 2009 occurred in the Mulga Lands bioregion (45.3 per cent of clearing in Queensland). This was followed by the Brigalow Belt bioregion at 31.5 per cent. Most of the woody vegetation clearing was for conversion to pasture for grazing purposes (more than 90 per cent).

The northern and western bioregions of Queensland have the highest percentage of remnant regional ecosystems remaining, with percentages well above 90 per cent. Clearing has been more widespread across the east and south of the state with the Brigalow Belt, Southeast Queensland and New England Tableland bioregions retaining less than 45 per cent remnant regional ecosystem cover.

The widespread high rainfall during the 2010–11 summer resulted in a very high level of pasture biomass across much of Queensland, increasing bushfire potential. Long-term remote sensing of ‘fire scars’ indicates that areas with the highest fire incidence are in the Cape York Peninsula and the western region of the Gulf of Carpentaria. The risk of damaging bushfire is increased in areas where gamba grass has become established, including across an estimated 60 000 ha of North Queensland.

Invasive species can pose a significant threat to Queensland's environment. Queensland has 19 mammal, 13 bird, three reptile and one amphibian species that are naturalised. These are exotic species that have developed self-sustaining wild populations. The Indian house crow, yellow crazy ants and Asian honey bee have been introduced since the last state of the environment report. The distribution of cane toads continues to spread south and west across Queensland and has reached Windorah at the head of Coopers Creek.

The Queensland Herbarium has recorded 1260 naturalised plant species in Queensland. Of these, 23 are terrestrial ‘weeds of national significance’ with some representation in Queensland, 10 of which were added to the list in April 2012.

Myrtle rust is a serious fungal disease that was detected in Queensland in December 2010. It affects plants of the Myrtaceae family, the second largest plant family in Australia and also dominant in many of Australia's forests and woodlands. Hendra virus is another disease that has been of focus in this reporting cycle. Hendra virus is a zoonotic disease, which means it can transfer from animals to humans.

As of August 2011, 1372 species were listed as ‘near threatened’, ‘vulnerable’, ‘endangered’ or ‘extinct in the wild’ in Queensland under the Nature Conservation (Wildlife) Regulation 2006 (i.e. threatened species). In 2007, 1449 species were listed as ‘rare’, ‘vulnerable’, ‘endangered’ and ‘extinct in the wild’. The discontinuation of the ‘rare’ category since the 2007 reporting period and the introduction of the ‘near threatened’ category make comparison between the reporting periods challenging.

In 2008, surveys of the Koala Coast in South East Queensland found the koala population had declined by 50 per cent since the 2005–06 surveys (from an estimated 4600 animals to an estimated 2300 animals). In 2010, population estimates indicated a decline of 13 per cent since the 2008 surveys (to an estimated 2000 koalas). The decline between these two years was not statistically significant, however it should be noted that the long-term downward trend since the 1996–1999 survey is still statistically significant, demonstrating a 68 per cent decline between 1996–1999 and the latest (2010) survey. Further surveys will be required to determine whether the overall trend continues downward or whether there is a levelling off in the decline.

For mammals, the greatest percentage of threatened species occurs in the Cape York Peninsula, while for frogs it occurs in the Wet Tropics and Southeast Queensland bioregions. Percentages of reptile species threatened are mostly highest in the more easterly bioregions of the state, while for birds it is greatest in Southeast Queensland and the Brigalow Belt.

There are 90 regional ecosystems classed as ‘endangered’, 532 identified as ‘of concern’ and 764 listed as ‘least concern’ under the *Vegetation Management Act 1999*.

As at December 2011, over 8 662 744 ha—or approximately 5.01 per cent of Queensland—were included in protected areas including national parks, conservation parks or resource reserves.

Of the 1386 regional ecosystems recognised in Queensland, 80 per cent are represented in the protected area estate to some extent. This is an increase from 72 per cent in 1997 and 75 per cent in 2003. As at December 2011, Southeast Queensland, Central Queensland Coast and the Wet Tropics are the bioregions with greater than 90 per cent regional ecosystem representation in protected areas. The Gulf Plains, Mitchell Grass Downs and the Einasleigh Uplands bioregions have the lowest representation with 48 per cent, 53 per cent and 63 per cent respectively. Eighty six per cent of threatened animals and at least 71 per cent of threatened plants are represented in protected areas.

Nature refuges are a voluntary agreement between a landholder and the Queensland Government and reflect the landholder’s commitment to conservation, while allowing compatible and sustainable land uses. Since 2007, 194 nature refuges covering 2 336 298 ha have been established. This brings the total for the state to 398 nature refuges covering 2 799 393 ha. Nature refuges protect conservation values in all bioregions. Over 65 per cent of nature refuges contain ‘endangered’ or ‘of concern’ regional ecosystems. More than 20 per cent of nature refuges contain threatened ecological communities and more than 400 threatened species are known to be protected on nature refuges.

Land use conflicts increased over the reporting period, particularly in relation to the growing coal seam gas mining industry. The Coal Seam Gas and Liquefied Natural Gas Annual Compliance Plan 2011 establishes a strong monitoring program to ensure effective management and response to reports or complaints concerning the impacts of the industry.

Regulation including the *Nature Conservation Act 1992* and the *Vegetation Management Act 1999* play an important role in the protection of terrestrial ecosystems.

Key initiatives relating to land and terrestrial ecosystems implemented since the last reporting period include the:

- Queensland Biosecurity Strategy 2009–14 and ongoing work by Biosecurity Queensland
- Delbessie Agreement (Statewide Rural Leasehold Land Strategy) was introduced in 2008 as a framework of legislation, policies and guidelines to support the environmentally sustainable, productive use of rural leasehold land for grazing and agriculture. The Delbessie Agreement clarifies the duty of care obligations of all holders of rural leasehold land; however its primary focus is on the sustainable management of rural leases with terms of 20 years or more and covering an area of 100 ha or more
- *Strategic Cropping Land Act 2011* is designed to strike a balance between the agriculture, mining and urban development sectors to help maintain the long-term viability of our food and fibre industries, and support economic growth for regional communities.

Human settlements

Human settlements in Queensland are diverse, ranging from rural towns and communities to major cities. Human settlements have impacts on the environment through land use conversion, the development of physical and social infrastructure, the consumption of water and energy, and the generation of wastes.

The availability of fresh water is greatly influenced by climate and weather variability and demand. The millennium drought reduced the amount of water available for use in Queensland and major urban centres in South East Queensland were subject to unprecedented level 5 water restrictions.

In Queensland, a total of 3351 gigalitres (GL) of water was consumed in 2008–09. This was a 23 per cent decrease on the total amount consumed in 2004–05 (4361 GL). It is likely that the reduction is related to the widespread drought conditions and associated water restrictions in the intervening years.

In 2008–09, agriculture accounted for 64 per cent of Queensland’s water consumption (2 144 201 megalitres (ML)), while households consumed 9.1 per cent (308 037 ML).

The main mode of transport remains the private motor vehicle, with increases in the average distance people travel to and from work in the Gold Coast and Sunshine Coast. However, public transport use has, overall, increased

significantly in South East Queensland since 2002–03, peaking at 64.5 public transport trips per capita per annum in 2008–09.

Energy consumption in Queensland has increased since 2005, and most fuel was sourced from non-renewable sources. However, the use of black coal as an energy source has declined over the last four years due to uptake of gas as an electricity generation fuel as a result of the Queensland Gas Scheme.

Household waste in Queensland is mostly handled by local governments. They have recorded a steady increase in the amount of household waste generated with an increase of 59 per cent over a six-year period (2004–05 to 2008–09), in comparison to a 13 per cent growth in population for the same time period.

In 2008–09, Queensland households generated approximately 2.25 million tonnes of domestic waste, or about 438 kg of waste per capita, excluding segregated green waste dropped off at local government landfills and transfer stations. Local governments diverted 2.3 million tonnes of the 4.9 million tonnes of the wastes they received from landfill in 2008–09, recycling some of this material themselves and forwarding the remainder to composters and other recyclers in Queensland, other states or overseas. Queensland power stations generated 5.84 million tonnes of fly ash and Queensland alumina refineries generated 4.49 million tonnes of red mud. Other waste streams generated in 2008–09 included 2.35 million tonnes of construction and demolition waste, 1.4 million tonnes of clean fill, 830 000 tonnes of segregated green waste, 713 000 tonnes of contaminated and acid sulfate soils, 568 000 tonnes of biosolids and 2.65 million tonnes of other commercial and industrial wastes.

The growth in the number of households is occurring at a faster rate than population growth. New residential development across the state continues to be predominantly low density and mainly in the form of larger detached houses. Queensland has an increasing proportion of small households with one or two occupants.

Brisbane continues to be rated as a highly liveable city; however its ranking has dropped in comparison to other cities around Australia and the world. South East Queensland residents generally enjoy living in the region and believe they have a high quality of life.

The *Water Act 2000* continues to establish a statutory planning framework for the sustainable allocation and management of the state's water resources. A key initiative relating to the management of impacts from human settlements on the environment introduced in this reporting period, has been the introduction of the *Sustainable Planning Act 2009*, guiding ecologically sustainable development in the state.

Cultural heritage

Queensland's rich and diverse cultural heritage continues to be under significant pressure from a range of factors, including unauthorised collection, wear and tear from public access, poor maintenance, development and land clearing. In addition, climate and weather variability, storms and cyclones, and fire can all result in negative impacts on cultural heritage. A major factor limiting protection has been an imbalance in the identification and recognition of existing cultural heritage places.

South East Queensland has by far the largest amount of development activity in the state impacting on places entered in the Queensland Heritage Register. This is followed at some distance by North Queensland. While this generally reflects the level of development activity, it also has close parallels with the number and distribution of places entered in the Queensland Heritage Register.

A Statewide Heritage Survey was conducted between 2005 and 2010 and resulted in the Queensland Heritage Register being more representative of the range of Queensland's heritage places. As of December 2010, there were 1647 places entered into the Queensland Heritage Register, an increase of 170 places since 30 June 2006.

Condition audits found that more than seven per cent of heritage registered places were in need of significant repair and maintenance, or were completely destroyed.

Local governments play a key role in the conservation of cultural heritage. South East Queensland and Far North Queensland local governments lead the state in the identification of heritage precincts within their planning schemes.

The Queensland Heritage Strategy: a 10-year plan provides the policy framework for the pursuit of a range of innovative projects, such as planning, investment, partnerships and capacity building that will conserve Queensland's heritage.

The *Aboriginal Cultural Heritage Act 2003* and the *Torres Strait Islander Cultural Heritage Act 2003* continue to protect Aboriginal and Torres Strait Islander cultural heritage via a range of instruments.

A Cultural Heritage Register was established under these Acts. Between the end of June 2006 and June 2010, there was a 17 per cent increase in the number of sites in the register (from 23 613 sites in 2006 to 27 698 in 2010). The number of search requests made for information in the database has increased from 5770 in 2006–07 to 9898 in 2009–10.

Cultural Heritage Management Plans are a major element of the *Aboriginal Cultural Heritage Act 2003* and *Torres Strait Islander Cultural Heritage Act 2003*. The plans outline how land-use activities can be managed to avoid or minimise harm to Aboriginal or Torres Strait Islander cultural heritage. Cultural Heritage Management Plans are required for certain high-level impact activities—for example, where an environmental impact statement (EIS) is required under legislation—or where excavation or relocation of cultural heritage is proposed. In 2009–10 there were 29 registered Cultural Heritage Management Plans in Queensland.

Native title describes the rights and interests of Aboriginal people and Torres Strait Islander people under their traditional laws and customs. The *Native Title (Queensland) Act 1993* recognises and protects native title. It is administered by the state government, who also has a primary responsibility for implementing the Commonwealth *Native Title Act 1993* in Queensland. As at 31 December 2011, there were 101 active native title claimant applications. In 2011, 10 native title claims were resolved through consent determination, which brings the total number of claims resolved in Queensland to 63.

Museums are an avenue through which Queenslanders can connect with their cultural heritage. Museums play a key role in preserving our history, covering a diverse range of topics. They also provide access to research and heritage objects.

The Queensland Museum is a statutory authority of Arts Queensland, governed by a Board of Trustees under the provisions of the *Queensland Museum Act 1970*. For more than 148 years, the Queensland Museum has been documenting, preserving and sharing Queensland's natural and cultural heritage. More than one million items and specimens make up the state collection that tells the changing story of Queensland.

Throughout Queensland, 294 institutions self identify as museums out of 352 listed museums, galleries, historical societies, and other cultural heritage sites. The remainder of collections are kept within historical societies, cultural centres, galleries and historic houses.

The *Queensland Heritage Act 1992*, the *Aboriginal Cultural Heritage Act 2003* and *Torres Strait Islander Cultural Heritage Act 2003*, the *Aboriginal Land and Torres Strait Islander Land and Other Legislation Amendment Act 2010* and the Commonwealth *Historic Shipwrecks Act 1976* are the major instruments outlining how heritage is to be managed and protected. The Queensland Heritage Council continues to work to identify and protect places that have special cultural value to the community and future generations.

Outlook

The commitment to ecologically sustainable development, as set out in the *Environmental Protection Act 1994* and the *Coastal Protection and Management Act 1995*, continues to be a focus for the state. In this reporting cycle, many complex and inter-related environmental issues have come to the fore that have challenged existing approaches to environmental planning and management. This has led to the development and introduction of new and exciting approaches.

Adaptive management will be of ongoing relevance in addressing complex, inter-disciplinary environmental issues that often involve multiple stakeholders across a range of scales, such as from paddock to reef. Adaptive management is a cyclic process that depends on the regular review of performance indicators and objectives, backed by effective research, monitoring, evaluation and reporting. It can inform regular adjustment of planning and management to deal with changing circumstances and high levels of uncertainty.

Science is critical to adaptive management. It plays a key role in the development of environmental policy, setting of standards, monitoring of implementation of policy programs to assess whether desired objectives have been achieved, the evaluation of policy or management interventions to review appropriateness, effectiveness and efficiency, and in the redesign of initiatives to enhance outcomes.

It is anticipated that many of the key challenges discussed in this report will again be of focus in the next reporting cycle due to their complex, ongoing and inter-related nature. Arresting the decline in biodiversity, enhancing

sustainable practices that help with the achievement of the principles of ecological sustainable development, mitigating and adapting to a changing climate, implementing planning and regulatory frameworks that assist with managing the many different uses for our natural assets, and protecting, maintaining and restoring our significant natural and cultural heritage all fall into this category.

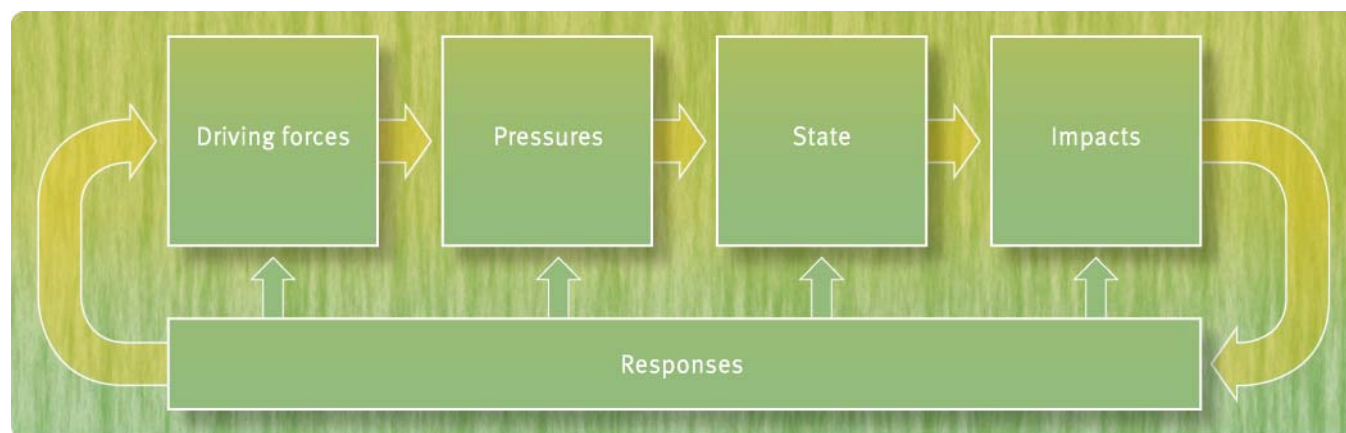
For the reader

State of the Environment Queensland 2011 is the fifth state of the environment report to be produced by the Queensland Government. State of the Environment reports are produced to ensure that decisions made in the pursuit of economic growth and higher living standards are well informed and do not result in unintended consequences arising from the degradation of the environment and the natural assets on which all life depend. Like its predecessors, this report explores the impact of human endeavour on the environment and society's capacity to respond and manage these impacts. This analysis has been achieved by applying the Driving forces–Pressures–State–Impacts–Responses (DPSIR) framework (see Diagram 1). The DPSIR framework is an internationally accepted approach to assessing environmental performance and the condition and trend of natural capital (Kristensen, 2004).

The approach generally taken in the 1999, 2003 and 2007 state of the environment reports revolved around key assets (atmosphere, land, water and cultural heritage) and examined these primarily in terms of their pressures, state and responses (EPA, 1999, 2003). Driving forces and impacts were incorporated into aspects of the sustainability and human settlements chapters.

In contrast to the three previous reports, the approach taken in this reporting cycle differs slightly through a more rigorous application of the DPSIR framework. The report begins with a general introduction to state of the environment reporting (Chapter 1) and then moves on to investigate the main driving forces that affect Queensland (Chapter 2). The subsequent chapters include Pressures (Chapter 3), State (Chapter 4), Impacts (Chapter 5) and Responses (Chapter 6). The report concludes with a summary of future challenges (Chapter 7).

In this report, the key natural and cultural assets—atmosphere, water, land and cultural heritage—are still central to the discussion. However, they are considered as topics under each of the DPSIR headings. The purpose of adopting this approach was to move away from a purely asset-based approach to reporting and towards a more integrated and synthesised analysis and presentation of issues. Data and information have been provided by a range of scientific researchers, policy makers, planners and other specialists.



Source: Adapted from UNEP, 2012.

Diagram 1. DPSIR framework.

Contents

1	Introduction.....	1
1.1	Statutory requirements	3
1.2	Scope	3
1.3	The importance of reporting.....	3
1.4	Queensland’s natural and cultural assets	4
1.4.1	Atmosphere.....	4
1.4.2	Aquatic ecosystems and the coast	5
1.4.3	Land and terrestrial ecosystems	5
1.4.4	Cultural heritage.....	6
1.5	DPSIR framework.....	6
2	Driving forces.....	8
2.1	An interconnected world.....	9
2.2	Key drivers for Queensland.....	9
2.2.1	Demography.....	9
2.2.2	Economic activity	10
2.2.3	Culture.....	11
2.2.4	Human development.....	12
2.2.5	Governance.....	12
2.2.6	Science and technology	13
2.3	Implications for the environment.....	14
3	Pressures	16
3.1	Climate change	21
3.1.1	Changes in atmospheric composition	21
3.1.2	Changes in sea levels.....	22
3.1.3	Productive lands and climate change	24
3.2	Vegetation management	24
3.2.1	Clearing rates.....	26
3.2.2	Woody vegetation clearing.....	28
3.2.3	Replacement land cover	28
3.3	Food and fibre production	29
3.3.1	Grazing pressure	29
3.4	Soil loss and degradation	32
3.4.1	Soil fertility decline	33
3.4.2	Effects of wind erosion on soils.....	33
3.5	Fire	33

3.5.1	Fire occurrence	36
3.6	Urban development	37
3.7	Invasive species.....	38
3.8	Disease	40
3.9	Identifying key pressures at a species level.....	40
3.9.1	Major pressures affecting priority species	40
3.9.2	Koala populations in Queensland	40
3.9.3	Kroombit tinkerfrog (<i>Taudactylus pleione</i>)	42
3.10	Pollution.....	42
3.10.1	Air pollution	42
3.10.2	Water pollution	43
3.10.3	Land pollution.....	46
3.11	Use of natural assets.....	47
3.11.1	Water extraction and consumption	48
3.11.2	Tourism and recreation	49
3.11.3	Fishing.....	49
3.11.4	Mining.....	50
3.11.5	Extractive industries.....	54
3.12	Environmental disturbances and natural disasters.....	56
3.12.1	From drought to flood.....	56
3.12.2	Flood plume effects on marine ecosystems in South East Queensland 2010–11	60
3.12.3	Northern Gulf flood.....	61
3.12.4	Floods and cyclones affecting the Great Barrier Reef.....	63
3.12.5	The 'Red Dawn' dust storm.....	63
3.13	Pressures on cultural heritage.....	64
3.13.1	Development activity.....	64
4	State.....	66
4.1	Atmosphere	67
4.1.1	Climate	67
4.1.2	Air quality	69
4.2	Water and aquatic ecosystems	71
4.2.1	Wetland distribution and extent.....	71
4.2.2	Riparian vegetation	78
4.2.3	Freshwater quality and quantity	83
4.2.4	Aquatic ecosystem health	94
4.3	Coastal and marine ecosystems	100
4.3.1	Ecosystem health.....	100
4.3.2	Communities and populations.....	106

4.4	Land and terrestrial ecosystems	110
4.4.1	Queensland's terrestrial biodiversity	110
4.4.2	Threatened species	113
4.4.3	Regional ecosystem extent and status	118
4.4.4	State of protected areas.....	124
4.4.5	State of nature refuges	127
4.4.6	Population estimates for selected species.....	131
4.5	Productive lands	132
4.5.1	Landscape function.....	132
4.5.2	Rangeland ground cover.....	135
4.5.3	Dust Storm Index	141
4.5.4	Recovery of flooded landscapes.....	143
4.6	Human settlements	144
4.6.1	Population size and distribution in Queensland.....	144
4.6.2	Human settlement patterns.....	144
4.6.3	Everyday travel	145
4.6.4	Use of resources.....	146
4.6.5	Waste generation and recycling.....	148
4.6.6	Liveability	149
4.6.7	Health.....	152
4.7	Cultural heritage	154
4.7.1	Heritage places	154
4.7.2	The condition of Queensland heritage places	157
4.7.3	Heritage places identified in local planning schemes	157
4.7.4	State of Aboriginal and Torres Strait Islander cultural heritage	161
4.7.5	Cultural heritage in museums	169
5	Impacts	175
5.1	The cost of impacts	176
5.1.1	Controlling weeds and pest animals	176
5.1.2	Animal management.....	176
5.1.3	Depletion of soil reserves.....	177
5.2	Positive spin-offs and flow-on effects	177
5.2.1	GhostNets Australia	178
5.2.2	Vegetation reforms.....	178
5.3	Responding to impacts	179
5.3.1	The Queensland Reconstruction Authority	179
6	Responses	181
6.1	Conserving natural assets	182

6.1.1	Biodiversity.....	182
6.1.2	Aquatic ecosystems and the coast	182
6.1.3	Terrestrial ecosystems.....	190
6.2	Sustainable use of natural resources.....	196
6.2.1	Sustainable fisheries.....	196
6.2.2	Ecologically sustainable aquaculture.....	197
6.2.3	Sustainable harvesting of kangaroos and wallaroos	198
6.3	Land management and use	198
6.4	Understanding and adapting to Queensland’s changing and variable climate	202
6.5	Responding to invasive species and diseases	202
6.6	Maintaining liveability	204
6.6.1	Urban, peri-urban and regional planning	204
6.6.2	Recreational areas.....	205
6.6.3	2 Million Trees – our urban forest	206
6.6.4	Industrial development and practices	207
6.6.5	Cleantech industry	208
6.7	Moving people and freight	208
6.7.1	Everyday travel	208
6.7.2	Freight movement	210
6.8	Reducing and managing waste and pollution	210
6.8.1	Waste management.....	210
6.8.2	Land contamination.....	210
6.8.3	Chemicals	211
6.8.4	Noise, air and water pollution.....	212
6.9	Delivering water security	214
6.9.1	Water supply regulation	214
6.9.2	Water resource planning and water security	215
6.9.3	Water management in South East Queensland	217
6.10	Understanding and protecting cultural heritage	218
6.10.1	Historic cultural heritage	218
6.10.2	Aboriginal and Torres Strait Islander cultural heritage.....	219
6.10.3	Museums.....	220
6.11	Managing disturbances (hazard events) and disasters.....	222
6.11.1	Recovering from the disasters of 2010-2011.....	222
6.12	Environmental compliance	222
6.12.1	Reactive and proactive reporting	223
6.12.2	Investigations of breaches	224
6.12.3	Imposition of penalties	224

6.13	Science informing policy and management actions	225
6.13.1	Shorter term studies and programs	225
6.13.2	Longer term continuous programs	232
7	Challenges for the future	237
8	References	240
9	Glossary	254

List of tables

Table 1. Summary of status for marine, freshwater and terrestrial invasive species.....	38
Table 2. Water use by sector in Queensland for the period 2008–2009.	48
Table 3. Longer term trends in levels of ambient air quality indicators and air toxics reported against Air NEPM standards and Air EPP objectives.	69
Table 4. Current (2009) extent , percentage of total area, percentage of pre-clear area and change over the 2001–2005 and 2005–2009 period for wetland systems by drainage division in Queensland***.	73
Table 5. 2009 riparian vegetation extent and 2005–2009 loss for major drainage divisions.	79
Table 6. Ecosystem Health Monitoring Program report card grades for South East Queensland freshwater rivers and creeks 2003 to 2011.	94
Table 7. Murray–Darling Basin 2004–07—trends in ecosystem health, hydrology, fish and macro-invertebrates for Queensland river valleys.	99
Table 8. Ecosystem Health Monitoring Program report card grades for South East Queensland estuaries 2000–2010.	101
Table 9. Ecosystem Health Monitoring Program report card grades for Moreton Bay and Gold Coast Broadwater 2000–2010.	102
Table 10. Fisheries Queensland stock status summary 2011.	106
Table 11. Percentage of bioregions in protected areas.	125
Table 12. Number of regional ecosystems by biodiversity status in protected areas.	126
Table 13. Number and area of nature refuges	128
Table 14. Number and percentage of ecosystems and communities present on nature refuges.	129
Table 15. Area of bioregion protected in nature refuges.	130
Table 16. Regional ecosystems protected by nature refuges with little or no representation in national parks.	130
Table 17. Threatened species protected in nature refuges.	131
Table 18. The total number of lone person and couple without children households, estimated (1996–2006) and projected (2011) for Queensland.	144
Table 19. Proportion of energy consumption in Queensland and Australia by fuel source, 2004–2005 and 2008–2009.	147
Table 20. Queensland electricity generation by fuel source (GWhs).	147
Table 21. The 2010 Mercer Worldwide Quality of Living Survey results for major Australian cities.	151
Table 22. A summary of the Australian Conservation Foundation’s sustainable cities index results for Queensland cities and the highest ranking city, Darwin.	152
Table 23. Number of places entered and removed from the Queensland Heritage Register.	154

Table 24. The number of places identified in the Queensland Heritage Register audit that have a condition of concern.....	157
Table 25. Changes in the recorded number of Aboriginal and Torres Strait Islander cultural heritage places in the Cultural Heritage Database for Queensland in 2006 and 2010.	162
Table 26. Number of registered cultural heritage management plans in Queensland.....	164
Table 27. Distribution of museums in Queensland by region.	170

List of figures

Figure 1. Protecting Queensland's environment through an integrated management framework.....	4
Figure 2. The Global Environment Outlook 4 conceptual framework*.....	7
Figure 3. Population growth patterns for Queensland.	10
Figure 4. Age structure for Queensland's population.	10
Figure 5. Economic growth for Queensland and the rest of Australia, from 1986–1987 to 2010–2011. ..	11
Figure 6. Ratification of major multilateral environmental agreements from 1971–2010.....	13
Figure 7. (a) Areas of the state where aquatic ecosystems are under greatest ongoing pressure from human activities and (b) areas of the state where aquatic ecosystems are may be most susceptible from incident-based point source pressures.	19
Figure 8. Concentration of three greenhouse gases, (a) carbon dioxide, (b) methane and (c) nitrous oxide in the atmosphere.....	22
Figure 9. Local sea-level rise (mm/year) around Australia from the early 1990s to June 2011.....	23
Figure 10. Average sea-level trends in Queensland.	23
Figure 11. Remnant vegetation in Queensland in 2011 by subregions.....	25
Figure 12. Average annual clearing rates for remnant vegetation from 1997 to 2009.....	26
Figure 13. Average annual clearing rate of remnant vegetation as a percentage of the starting year by subregion.	27
Figure 14. Woody vegetation clearing by replacement land cover from 1988–2009.....	28
Figure 15. Broad change in land use in Queensland from 2007–2010.	29
Figure 16. Extent of Australian rangelands.	31
Figure 17. Maps created from the AussieGRASS model for assessing fire risk for April 2011: (a) Pasture curing index (from 0 % actively growing pasture to 100 % fully dried/cured), (b) Potential grassfire risk (low–high—combining degree of curing and level of biomass), (c) total standing dry matter (percentiles) relative to historic record and (d) total standing dry matter biomass (kg dry matter/ha).....	35
Figure 18. Incidence of fire occurrence in Queensland for the period 1994 (Jan) to 2011 (May).....	36
Figure 19. Annual remote-sensed area of Queensland burnt for the period 1998–2011.	37
Figure 20. Distribution of koalas in Australia (main box) and location of the Koala Coast study area (inset).	41
Figure 21. Queensland emissions by sector in 1990 and 2009.....	43
Figure 22. Conceptual model of the current ecosystem health of Moreton Bay and its river estuaries based on community derived environmental values.	45
Figure 23. Comparison between 2004–2005 and 2008–2009 water consumption by sector in Queensland.....	48
Figure 24. Commercial fishery harvest in Queensland managed fisheries (2005–2009).	50

Figure 25. (a) Catchment pressure scores, ranging from low to high for mines and (b) catchment pressure scores, ranging from low to high for coal mines.....	52
Figure 26. Catchment pressure scores for extractive, industrial mineral and gem mines, and fossicking areas.....	55
Figure 27. (a) Drought status map for Queensland in March 2007 and (b) flood and cyclone disaster map for Queensland for the 2010–11 summer.	58
Figure 28. Landsat satellite image 16 January 2011 showing the flood plume for an incoming tide at the mouth of the Brisbane River into Moreton Bay.	61
Figure 29. Inundation map of the Gulf of Carpentaria region for the period 13 February–3 March 2009.	62
Figure 30. The number of development applications and exemption certificates for places entered into the Queensland Heritage Register for the period 2003–2010.....	65
Figure 31. Development applications and exemption certificates for places entered in the Queensland Heritage Register (2005–2010) by region.	65
Figure 32. Time-series (1910–2011) of Queensland’s annual mean surface temperature anomalies.	68
Figure 33. Change in the extent of (a) all wetland systems compared to pre-clearing extent and loss of wetlands over the 2001–2005 and 2005–2009 period for Queensland, (b) palustrine wetlands and (c) riverine and fringing riverine wetland.	75
Figure 34. Annual riparian forest loss within Queensland catchments.	78
Figure 35. (a) Riparian forest loss as mapped by the Statewide Land cover and Trees Study (SLATS) 2005–2009 and (b) riparian forest extent 2009.....	80
Figure 36. Riparian mean ground cover for 2009.....	82
Figure 37. (a–h) Condition of surface water quality for the nine provinces covered under SWAN.....	85
Figure 38. End of system flows for Queensland's river systems.	90
Figure 39. (a) Groundwater quantity statewide and regionally for Queensland and (b) groundwater quality statewide and regionally for Queensland.....	92
Figure 40. Total nitrogen and phosphorus loads discharged from major wastewater treatment plants in South East Queensland catchments.....	95
Figure 41. Loads for the Great Barrier Reef catchments from human activity and natural loads.	97
Figure 42. Total nitrogen and phosphorus loads discharged from major wastewater treatment plants in Great Barrier Reef catchments.	98
Figure 43. (a) Number of waterbirds over time and (b) wetland area index over time.....	100
Figure 44. Results of marine aquatic ecosystem health for the Great Barrier Reef regions.....	105
Figure 45. Seagrass trends in Queensland's coastal natural resource management regions.	108
Figure 46. Trends in population for (a) green turtles at Heron Island, (b) loggerhead turtles at Woongarra Coast and (c) the number of marine turtle strandings by year up to January 2012.	110
Figure 47. Number of vertebrate animal species per million hectares by bioregion.....	112
Figure 48. Number of vascular plant species per million hectares by bioregion.....	113

Figure 49. (a) Number of threatened vertebrate animal species by taxa in 2007 and 2011; and (b) Number of threatened vascular plant species by taxa in 2007 and 2011.	114
Figure 50. Number of threatened vertebrate animal species by bioregion.	115
Figure 51. Number of threatened vascular plant species by bioregion.	116
Figure 52. Percentage of threatened vertebrate animal species by bioregion.	117
Figure 53. Percentage of threatened vascular plant species by bioregion.	118
Figure 54. Number of regional ecosystems by bioregion per million hectares.	120
Figure 55. (a) Number of 'endangered' regional ecosystems by bioregion, (b) 'of concern' regional ecosystems by bioregion and (c) 'least concern' regional ecosystems by bioregion.	121
Figure 56. Number and area of protected areas over time.	124
Figure 57. Number of threatened (a) vertebrate animal and (b) vascular plant species in protected areas.	127
Figure 58. (a) Nature refuges across Queensland and (b). increase in nature refuges over time—cumulative hectares and number (1994–2011).	128
Figure 59. Koala Coast koala population decline (1996–2010).	132
Figure 60. The decline in number of male Kroombit tinkerfrogs heard on the plateau at Kroombit Tops.	132
Figure 61. (a) AussieGRASS estimated landscape function and trend 1991–2005. (b) AussieGRASS estimated landscape function and trend 2007–2011.	134
Figure 62. Mean ground cover for Queensland derived from annual dry season GCI (Landsat imagery) for the period 1987–2010.	136
Figure 63. Mean ground cover in 2010 summarised by sub-IBRA.	137
Figure 64. (a) Persistence (% of observations) of ground cover at levels below 30 % during the period 1987–2010 and (b) difference between median ground cover (1987–2010) and ground cover estimated for 2010.	139
Figure 65. (a) Wind erosion patterns based upon the mean Dust Storm Index for 2007–2009 and (b) long-term wind erosion patterns based upon the mean Dust Storm Index for 1960–2009.	142
Figure 66. The average daily mode share in South East Queensland in 2009.	146
Figure 67. The total number of trips per capita per annum made by passengers on bus, train, and ferry services within the TransLink network in South East Queensland.	146
Figure 68. The contribution of coal, hydro and gas to electricity generation in Queensland in 2005 and 2010.	147
Figure 69. The recycling rates for (a) glass, paper and cardboard, and (b) plastic, steel and aluminium containers (kg/capita) collected by Queensland local governments, 2003–2004 to 2008–2009.	149
Figure 70. The Mercer quality-of-life rankings of selected Australian major cities (2004–2009).	151
Figure 71. Self-reported height and weight transformed into body mass index (BMI) categories involving Queensland adults in 2010.	153
Figure 72. Number of places by region entered into the Queensland Heritage Register.	155

Figure 73. WWII cultural heritage places identified in North Queensland during the Statewide Heritage Survey.....	156
Figure 74. Local government areas with precinct provisions in local planning schemes as of December 2010.	158
Figure 75. The per cent of Queensland local heritage places by region.	159
Figure 76. Protected zones around historic shipwrecks off the coast of Queensland.	160
Figure 77. The location of Cultural Heritage Register sites (studies) in Queensland in 2006 and 2010.	163
Figure 78. Area covered by Cultural Heritage Management Plans in Queensland in 2006 and 2010. ..	165
Figure 79. (a) Party boundaries in Queensland as at July 2010 and (b) cultural heritage bodies registered in Queensland in 2006 and 2010.	166
Figure 80. The range of institutions holding collections.....	171
Figure 81. The composition of Queensland Museum's cultural heritage collection.....	172
Figure 82. Forms of visitor access to Queensland Museum collections outside of museum visits.	173
Figure 83. Cost of replacing nutrients removed in harvested product from the districts of the northern grains region of the agricultural industry.	177
Figure 84. Summary of woody vegetation clearing rates and carbon dioxide emissions in relation to <i>Vegetation Management Act 1999</i> (VMA) reforms.	179
Figure 85. Queensland water resource planning areas.....	184
Figure 86. Healthy waters for Queensland framework.	185
Figure 87. Queensland macropod population estimates for harvest areas.	198
Figure 88. Regional water supply strategy areas in Queensland.	216

List of photos

Photo 1. Demonstrating the observant telemetry system.....	14
Photo 2. Moreton Island oil spill showing (a) oil washed up around coffee rock and (b) members of the Moreton Bay Oil Spill Environmental Restoration Program.	46
Photo 3. View from Mt Coot-tha outlook in Brisbane on a clear day and during the 23 September 2009 dust storm.	64
Photo 4. Dive team member investigating cyclone damage to the SS Yongala in March 2011.....	161
Photo 5. Northern Peninsula Area Rangers freeing turtles prior to recording information on hand held computer.	169
Photo 6. Objects from Queensland Museum's Cultural Celebrations: Feasts loan kit.	174
Photo 7. Collaborative installation created at the Cairns Indigenous Art Fair 2011 made of bamboo and cane, ghost nets, buoys and floats.....	178
Photo 8. Urban greenspace, such as this park in Bundaberg, provide a range of benefits to the community and contribute to the liveability of an area.	206
Photo 9. An example of one of the sites undergoing revegetation as part of the 2 Million Trees project, Queensland Corrective Service land at Wacol.....	207
Photo 10. Public transport in South East Queensland has been improved by the construction of the busways network.....	209
Photo 11. Song and dance ceremony for reburial on North Stradbroke Island.	221
Photo 12. Sampling water quality in Moreton Bay after the January 2011 flood.	226
Photo 13. Wireless monitoring equipment at Springbrook.....	227
Photo 14. Cave fern re-introduction.....	229
Photo 15. Adult Richmond birdwing butterflies mating in captivity.	230
Photo 16. Perched lake on North Stradbroke Island	232
Photo 17. Some of the components of SLATS: (a) reconciling field and satellite information, (b) a map of the field sites and (c) conducting field work to ground truth and validate information.....	234

1 Introduction



The wellbeing of all Queenslanders, both now and into the future, is intimately linked to and dependent upon the natural environment. Queensland's landscape is vast, covering an area of around 172.8 million ha. It is also very diverse, encompassing relatively pristine areas such as national parks, to highly modified areas such as cities, mines and agricultural lands. The terrestrial (land-based) environment is complemented by a large marine environment. The mainland coastline is approximately 6900 km in length, and features 1165 offshore islands and cays.

Historically, the environment has been regarded as a resource, providing us with minerals, food and fibre, building materials and fuel. More recently, there has been greater acknowledgement of the many other services provided by the environment that are necessary for our long-term survival. These services are known as ecosystem services (see text box below).

Sustaining healthy, functioning ecosystems to deliver the range of ecosystem services currently available to us will ensure that the state's environment, society and the economy all work together and remain in good condition. Achieving the right balance between maintaining enough natural capital to deliver nature's free ecosystem services, while supporting the demands of a growing population, is a major challenge for all Queenslanders.

Ecosystems have been naturally adapting to changing conditions and natural disasters over many millennia. This capacity to absorb change without altering the state is known as 'resilience'. Resilience can be defined as:

‘the capacity of a system to absorb disturbance and re-organise while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks’ (Walker et al., 2004).

There is a threshold point beyond which the state of the system is altered, sometimes irreversibly. In natural systems, this usually results in a shift from a higher functioning state to a lower one. This change in state leads to a loss of ecosystem function and subsequently, a loss or reduction in ecosystem services.

Human activities often exacerbate and can even drive this shift in state. While it may be possible to rehabilitate and regenerate affected ecosystems to facilitate recovery back to the higher functioning state, this is a costly exercise that may not always succeed. This suggests that, wherever possible, it is far better to prevent these shifts occurring in the first place (TEEB, 2010).

Ecosystem services

All humans depend on nature for their existence and wellbeing—from their basic physical needs such as food, fresh water, fibre or fuel, to requirements such as storm protection and air regulation, or to satisfy more intrinsic needs such as recreation and spiritual fulfilment. The earth's many and diverse ecosystems provide these benefits upon which humans depend. Collectively, ecosystems form the earth's green infrastructure or natural capital and the benefits derived from them are known as ecosystem services.

Ecosystems services are classified as:

- supporting (e.g. soil formation and nutrient cycling)
- provisioning (e.g. food, fibre and water)
- regulating (e.g. regulating climate, flood and disease)
- cultural (e.g. aesthetic, spiritual and educational).

The ecosystem services approach recognises that in order to maintain healthy ecosystem functions (i.e. the processes that generate ecosystem services), resources should not be used at a rate faster than they can be replenished and/or recycled; or the environment's capacity to absorb and neutralise waste. Additionally, the ecosystem services concept recognises that the environment provides more than just its productive or extractive value to humans, it provides for spiritual needs and has its own intrinsic value separate to the services it provides. Ecosystem services are an important approach for directly relating human health and wellbeing to environmental health and wellbeing.

Sources: Costanza, et al., 1987; Colby, 1991; Costanza and Daly, 1992; de Groot, et al. 2002; Millennium Ecosystem Assessment, 2003; Norgaard, 2010

State of the environment reporting is the internationally accepted method for assessing environmental performance. In Queensland, state of the environment reporting includes an assessment of the state of major environmental and

cultural assets and the identification of significant trends. Reporting also includes a review of the significant programs, activities and achievements of public authorities in the protection, maintenance, restoration and enhancement of the state's environment.

The State of the Environment Queensland 2011 report represents a collaborative effort between experts from government, the research sector, industry, non-government organisations and the community. This is the fifth report produced for Queensland.

1.1 Statutory requirements

State of the environment reporting in Queensland is a statutory requirement under both the *Environmental Protection Act 1994* (EP Act) and the *Coastal Protection and Management Act 1995* (Coastal Act). The EP Act requirement applies to Queensland's environment generally, while the Coastal Act requirement relates specifically to the coastal zone.

The EP and Coastal Acts require the preparation of an assessment of the state of the environment and the coastal zone at least every four years. This report is designed to meet the requirements of both Acts. Section 547 of the EP Act and section 166 of the Coastal Act specify that the report must:

- include an assessment of the condition of Queensland's major environmental and coastal resources
- identify significant trends in environmental and coastal values
- review significant programs, activities and achievements of persons and public authorities relating to the protection, restoration or enhancement of Queensland's environment and coastal zone
- evaluate the efficiency and effectiveness of environmental and coastal management strategies implemented to achieve the objects of the Acts.

1.2 Scope

The scope of this report is broad, examining a range of physical and cultural topics. The physical aspects revolve around the state's major natural assets of atmosphere, water and land. The cultural aspects relate to Queensland's heritage given that the state's history and traditions greatly influence the present, including how the environment is perceived, used and managed.

The topics considered in this report are consistent with the definition of the environment provided in section 8 of the EP Act:

- a. ecosystems and their constituent parts, including people and communities
- b. all natural and physical resources
- c. the qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community
- d. the social, economic, aesthetic and cultural conditions that affect, or are affected by, the things mentioned in paragraphs (a) to (c).

1.3 The importance of reporting

The EP Act outlines that the protection of Queensland's environment is to be achieved by an integrated management program that is consistent with ecologically sustainable development (ESD). Ecologically sustainable development is defined in the EP Act as:

‘...protecting the environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.’

Under the EP Act, state of the environment reporting is an important part of an integrated management framework (Figure 1). State of the environment reports provide an assessment of Queensland's natural and cultural assets at least every four years. The reports outline if the state of natural and cultural assets has remained the same,

improved or deteriorated. The findings reflect how well Queensland is responding to environmental challenges, both in reducing or eliminating pressures and the underlying driving forces that cause these pressures. Actions to achieve this include protecting the environment and preventing or limiting damaging activities, restoring and rehabilitating degraded natural assets, and changing behaviour and practices to reduce the demand or pressures placed on environmental resources. Usually, a combination of these actions is required to produce the desired outcome of a win-win solution for the economy, society and the environment.

Reporting on the state of the environment is important to ensure accountability of environmental strategies and policies. It also provides objective measures of environmental performance to inform evidence-based decision making and progress towards sustainability. Additionally, state of the environment reporting plays a role in assisting strategic planning by identifying new and emerging issues that require intervention.

The successful performance of the initiatives instigated by public authorities is often not immediate due to long environmental time lags. Thus, the importance of a continuous reporting system such as state of the environment reporting that assesses progress over time becomes apparent.



Figure 1. Protecting Queensland's environment through an integrated management framework.

1.4 Queensland's natural and cultural assets

Queensland's natural and cultural assets include the atmosphere, water, land and cultural heritage. These assets are the cornerstone for our existence and support the high quality of life enjoyed by Queenslanders.

1.4.1 Atmosphere

The atmosphere is essential for life and links all the principal components of the earth's systems including water, land and the organisms living within them. It provides us with clean air, the stratosphere protects us from damaging ultraviolet radiation from the sun, and it plays a major role in regulating climate. Good air quality is critical to the health and wellbeing of all living things that use the atmosphere as the basis of their metabolic processes that sustain life.

Air pollution can result in impacts to human health, ecosystem processes and climate change.

Queensland's climate is naturally highly variable. The major climate features affecting the amount and pattern of rainfall across Queensland are the El Niño Southern Oscillation (ENSO), the Inter-decadal Pacific Oscillation (IPO), the Madden-Julian Oscillation (MJO) and the Sub-Tropical Ridge (STR). The impacts of climate change on these major climate features (and the associated climate variability) are difficult to assess.

1.4.2 Aquatic ecosystems and the coast

Queensland's aquatic ecosystems are diverse and encompass rivers (riverine), lakes (lacustrine) and swamps (palustrine), underground water bodies (subterranean), coastal creeks and rivers (estuarine) and coastal waters, such as bays and inshore areas (marine). Mainland Queensland is divided into 120 catchments that are grouped into four drainage divisions, two of these divisions are internally draining and one division occurs entirely within Queensland.

Queensland's wetlands support much of the state's native biodiversity, including migratory birds, frogs, dugongs, dolphins, turtles and commercially important fish species. Additionally, many unique species occur in these important systems, such as the red-finned blue eye fish found in the groundwater-fed mound springs of the inland arid and semi-arid zones.

Queensland also contains a large section of the Lake Eyre Basin, along with South Australia, New South Wales and the Northern Territory. The Lake Eyre Basin is one of the largest internally draining systems in the world, covering approximately 1.2 million km², and is the world's fifth largest terminal lake.

Many of Queensland's wetlands are recognised at a national and international level for their role in supporting migratory bird populations and other values, as is the case with the five Ramsar wetlands including Moreton Bay in South East Queensland and Bowling Green Bay in North Queensland.

The Great Barrier Reef, stretching more than 2000 km along the Queensland coastline and covering 35 million ha, is the world's largest coral reef. More than 1500 species of fish, 4000 species of molluscs, 400 species of sponge and 300 species of hard corals live here. Extensive seagrass beds provide a home for the threatened dugong. Green and loggerhead turtles nest on islands in the reef and humpback whales migrate there to give birth. Birdlife is also abundant and hundreds of species nest in the reef islands. The reef is very important to Aboriginal and Torres Strait Islander people, and there are significant cultural sites on many of its islands.

The Great Barrier Reef is not discussed in depth in this report because its status is assessed under the *Great Barrier Reef Marine Park Act 1975* by the Great Barrier Reef Marine Park Authority, with findings released via outlook reports every five years. The first Great Barrier Reef Outlook Report was released in 2009 (GBRMPA, 2009). However, in this report the Great Barrier Reef is considered within the context of the work being carried out under the Reef Water Quality Protection Plan 2009 (DPC, 2009a). This work has been incorporated into this report because it involves the effects of activities in the adjacent catchments on the water quality of the Great Barrier Reef lagoon.

1.4.3 Land and terrestrial ecosystems

Queensland's land area is approximately 172.8 million ha of which 74 per cent (129.7 million ha) is used for agriculture and 2.2 million ha of this area—or 1.3 per cent—is used for cropping. Overlaying these land uses, more than half of Queensland—or 96.66 million ha—is under some form of granted exploration or production tenure for coal, mineral, petroleum, coal seam gas or geothermal energy (DEEDI, 2011a).

The state supports a wide range of ecosystems that are grouped into 13 bioregions. One thousand, three hundred and eighty-six regional ecosystems have been mapped across most bioregions for 85 per cent of Queensland. As at December 2011, more than 8 662 744 ha—or approximately 5.01 per cent of Queensland—was contained in national parks, conservation parks or resource reserves. Since 2007, 194 nature refuges covering 2 336 298 ha have been established. This brings the total for the state to 398 nature refuges covering 2 799 393 ha.

Queensland's terrestrial (land-based) ecosystems are biologically diverse, containing 85 per cent of Australia's native mammals (239 species), over 70 per cent of its native birds (562 species) and just over half of the nation's reptiles (473 species) and native frogs (127 species). Many of these species are endemic to Queensland, meaning they do not occur anywhere else (DERM, 2011a).

Queensland also supports an abundance of invertebrates and microorganisms that are a vital component of the state's biodiversity. These organisms play a crucial role in food webs, as pollinators, and in recycling, mulching and composting of organic matter.

More than 8400 species of native flowering plants, gymnosperms (e.g. cone producing, non-flowering plants such as bunya pines), ferns and fern allies are known to occur in Queensland, representing approximately 45 per cent of the known Australian species. More than 30 per cent of these are endemic to Queensland (DERM, 2011a).

There are more than 900 species of mosses, liverworts and hornworts in Queensland and more than 1500 species of algae. Lichens account for more than 1900 known species, while macrofungi number over 1100 species. There are many species yet to be discovered—especially of algae, fungi and lichens—and their importance in ecosystem health and function is still poorly understood (DERM, 2011a).

All landscapes change continually over time from natural processes. However, our use of the land can alter the condition of natural resources and affect many of the processes within ecosystems. The cumulative impacts of agriculture, grazing, mining, urbanisation and transport, if not managed well, can degrade the quality of land and water resources and adversely affect agricultural production and other uses we make of our land (EPA, 1999, 2003, 2008).

1.4.4 Cultural heritage

Cultural heritage is the invaluable physical, spiritual and intellectual evidence of who and what has been here before us. Aboriginal and Torres Strait Islander people were the first human colonisers of Queensland. Traditionally, they lived as part of the land and their lifestyle was nomadic.

Today, Aboriginal and Torres Strait Islander cultural heritage remains highly diverse and covers both the tangible and intangible. The tangible cultural heritage includes places and items, such as shell middens, rock art and hunting implements (Horton et. al, 1994a, b), while the intangible cultural heritage includes language, spiritual beliefs and stories.

The traditional knowledge within the cultural heritage of Queensland's Aboriginal and Torres Strait Islander people is an exceptionally important resource. For at least 60 000 years, the Aboriginal and Torres Strait Islander people of Australia actively managed their natural environment. The integration of traditional and modern principles into environmental and natural resource management is a key step towards achieving future sustainable outcomes, and encourages the re-establishment of connections between humans and their landscape.

Historic cultural heritage encompasses the important places, artefacts and stories associated with the people of Queensland since European settlement, including shipwrecks, the built environment and the development of landscapes that are now considered quintessentially Queensland. It is heavily influenced by colonial European and subsequent migrant settlement.

Museums are an avenue through which Queenslanders can connect with their cultural heritage. Museums play a key role in preserving our history, covering a diverse range of topics. They also provide access to research and heritage objects, which can give context for how we live today and assist Queenslanders to understand the different cultures within their state.

1.5 DPSIR framework

The state of the environment report uses the Driving forces–Pressures–State–Impacts–Responses (DPSIR) framework to explore key contemporary environmental issues for Queensland. The DPSIR framework was developed by the European Environmental Agency to improve the socio-economic and socio-cultural aspects of environmental reporting.

This framework recognises the role of humans in environmental degradation and the capacity for society to manage these impacts (Figure 2). Driving forces are the socio-economic, cultural and political forces that guide human activities and that increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State encompasses quantity, quality, extent and/or condition of the environment, while impacts are the consequences of environmental degradation and/or interventions. The responses refer to the actions undertaken by society to improve, manage, mitigate and adapt to environmental changes.

It is widely recognised that the costs of prevention of environmental damage are lower than the costs of rehabilitation or repair of degraded areas and the costs associated with threat of extinction, habitat loss, loss of ecosystem functionality, or impaired human health. Indeed, some environmental damage is irreversible in that no amount of action can remedy the impact. Thus, understanding driving forces and the pressures they exert is critical to the development and implementation of initiatives (legislation, policies, strategies, plans, partnerships and projects) that change human behaviour to facilitate sustainable practices and inhibit harmful ones.

