Climate change – How will it effect us?

Discussion paper for Parks and Leisure Australia, WA

Prepared by David Deeley and Susan Shobbrook, Acacia Springs Environmental

April 2012

PLAWA

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Discussion paper for Parks and Leisure, Australia WA Region

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Lower: *The same scene showing storm surge on, 16 May 2003 (BOM[16] Courtesy of Lee Evelegh).*

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Information gained from more than 15 industry workshops gained as part of PLAWA's input to the development of the DSR Climate Change adaptation framework has also been included in this document. DSR's role is acknowledged. Appendix 3 provides information on the DSR framework.

Contents

Can we afford not to act on climate change?

In communicating the urgency of the climate crisis, it is important to use relevant, everyday language and to link the virtue of solving the crisis to the shared values and aspirational goals that have proved in our past to sustain long-term collective commitments. ***....Al Gore, Our Choice***

The science of climate change has been clear for some time. As part of a global trend, greenhouse gas concentrations are rising in the atmosphere and oceans are warming causing the sea level to rise and more extreme weather-related events. For southern Australia, this has seen temperatures increasing and rainfall decreasing significantly. To improve the user-friendliness of this discussion paper we have used everyday language to communicate the urgent issues presented by the climate change challenge supported by relevant quotations, diagrams and live web links throughout.

"It is very likely (at least 90 per cent likelihood) that most of the observed global warming since the mid-20th century is due to increases in greenhouse gases from human activities. Human activities also have influenced ocean warming, sea-level rise, and temperature extremes. It is very unlikely (less than ten per cent likelihood) that 20th century warming can be explained by natural variability alone." ***....****CSIRO State of the Climate 2012*[1]

Science deals in probabilities - it is almost impossible for science to precisely predict the future results of global warming due to the uncertainties and variabilities present in the physical and bio-chemical processes involved, the vastness of interacting forces across the planet, and the uncertain global political landscape - but the time series of data speak for themselves and are not in doubt.

The recent highly politicised climate change debate in Australia and elsewhere has confused the difference between the robust process of scientific uncertainty, and the fickleness of socio-political uncertainty. The climate change deniers have opportunistically gained disproportionate amounts of media time to confuse a public hungry for truthful and plain language explanations about the complex processes of climate change. The academies of science of all leading developed nations have concluded that climate change is real, is caused by human activities and requires urgent action.

"For now and for the foreseeable future, the climate skeptics have carried the day. They've understood the shape of politics far better than environmentalists. They know that it doesn't matter how many scientists are arrayed against you as long as you can intimidate newspapers into giving you equal time." ***.....****Bill McKibben*[2]

The atmosphere of scepticism around climate change created by those with short term vested self interest and their own economic advantage, is making it difficult for the public, for governments and businesses, to understand and to face up to the looming series of catastrophes that it represents. Time is of the essence, and governments, especially the Australian government, are falling behind.

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[1] csiro.au/Portals/Media/State-of-the-Climate-2012.aspx

[2] motherjones.com/politics/2005/05/climate-denial

Australia is struggling to meet any targets needed to reduce the effects of increased greenhouse emissions to a level where the overall global temperature rise is limited to 2 degrees - even this level is widely predicted to lead to significant disruptions to coastal infrastructure, agricultural systems, and human settlements globally.

> ***'Other nations are "already too far ahead" and Australia's risk, contrary to the popular debate, is being "a drag" on the global mitigation effort'***
>
> ***.....****Garnaut report 2011*

Of course there are factors other than climate change that will motivate change and policy locally, particularly for the parks and leisure industry. There is a real opportunity for PLAWA to lead climate change action and to set an example for industry peak bodies to inspire actions with their memberships. PLAWA can embrace its moral responsibility to its members and to future generations to deal with climate change issues head on and not enter the climate of denial and inaction that business-as-usual institutions are still bogged down in.

PLAWA has the opportunity to lead policy development for the parks and leisure sector as we move to a post carbon economy - a stance much needed as the world, and especially Australia, struggles to reduce carbon emissions. We all need to play our part in mitigation and adaptation action to avoid catastrophic climate change and assure quality of life for us all. We owe it to ourselves, to future generations and to poorer developing nations who have had little role in causing the problems but are increasingly experiencing catastrophic droughts, fires and floods and have limited capacity to adapt.

Mitigation involves cutting greenhouse gas emissions (*e.g.* burning of fossil fuels) and protecting 'sinks', such as forests or soils that naturally store CO_2 and other greenhouse gases. Since the results of mitigation are not immediately felt, especially locally, we must act in good faith and understand that what we do is important, and worthwhile, even if the results are difficult to measure immediately. We have no excuse - we are global citizens and we must take action now.

Adaptation involves addressing vulnerabilities in natural and human systems to risks posed by the range of climate change impacts. It involves predicting impacts, identifying vulnerabilities, managing risks and implementing innovative measures to manage exposure to adverse impacts.

Balance is required between mitigation and adaptation. In the absence of effective mitigation we may experience run away climate change and adaptation measures may be insufficient or too expensive to implement.

Photo 1 Maldives president and cabinet meeting underwater to sign a document calling on greater global action on climate change. His country is on average, only 1.5 metres above sea level and is in immediate threat of disappearing under the ocean unless strong international action is taken. A two degree C global temperature rise (Australia's current target), will completely inundate the Maldives.

"We have to be more imaginative, more creative if we are to solve the climate change dilemma" *.....Maldives President Mohammed Nasheed, 2009*

'Climate change poses clear, catastrophic threats. We may not agree on the extent, but we certainly can't afford the risk of inaction' ***..... Rupert Murdoch***

People tend to focus on the here and now. The problem is that, once global warming is something that most people can feel in the course of their daily lives, it will be too late to prevent much larger, potentially catastrophic changes. ***.....Elizabeth Kolbert, The New Yorker, Apr. 25, 2005***

All across the world, in every kind of environment and region known to man, increasingly dangerous weather patterns and devastating storms are abruptly putting an end to the long-running debate over whether or not climate change is real. Not only is it real, it's here, and its effects are giving rise to a frighteningly new global phenomenon: the man-made natural disaster.

.....Barack Obama, speech, Apr. 3, 2006

What evidence is there for climate change?

Temperature

Information from the latest Intergovernmental Panel on Climate Change (IPCC) summary report[3] states that eleven of the last twelve years rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850). The updated 100-year linear trend of 0.74°C for 1906 to 2005, is larger than the corresponding trend for 1901 to 2000 which was 0.6°C. The linear warming trend over the last 50 years of 0.13°C per decade is nearly twice that for the last 100 years. The total temperature increase from 1850–1899 to 2001–2005 is 0.76°C.

Temperature increases operate at a range of scales. Urban heat island effects are real but localised, and have a negligible influence of less than 0.006°C per decade over land and zero over the oceans. New analyses of balloon-borne and satellite measurements of lower and mid-tropospheric temperatures show warming rates that are similar to those for the surface temperature record and are consistent within their respective uncertainties, largely reconciling a previous discrepancy.

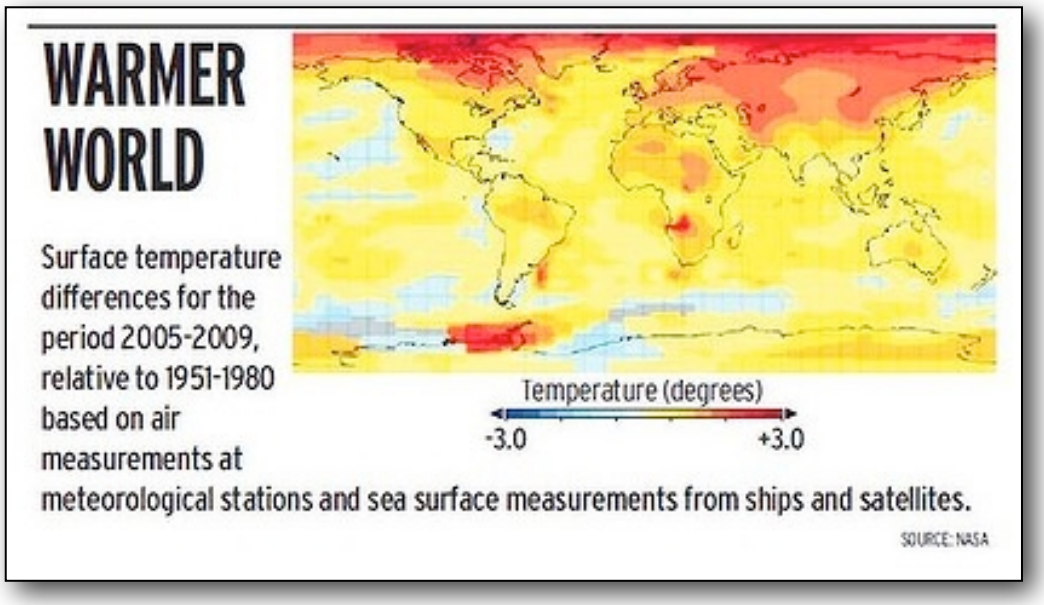

Figure 1 Global distribution of maximum temperature from 2005-2009 relative to 1951-1960.

A CSIRO state of the climate report of 2012[4] shows that Australian annual-average daily mean temperatures showed little change from 1910 to 1950 but have progressively warmed since, increasing by 0.9 °C from 1910 to 2011. The average temperature during the past ten years has been more than 0.5 °C warmer than the World Meteorological Organization's standard 1961-1990 long-term average. This increase continues the trend since the 1950s of each decade being warmer than the previous.

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[3] ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf

[4] csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx

The warming trend has occurred against a backdrop of natural, year-to-year climate variability. Most notably, El Niño and La Niña events during the past century have continued to produce the hot droughts and cooler wet periods for which Australia is well known. For example, 2010 and 2011, were the coolest years recorded since 2001 due to two consecutive La Niña events.

Australia's annual-average daily maximum temperatures have increased by 0.75 °C since 1910, with most of the warming trend occurring since 1970. There has been an increase in the frequency of warm weather and decrease in the frequency of cold weather.

Consecutive La Niña events in the past two years have kept average maximum temperatures below the long-term average – by 0.24 °C in 2010 and 2011. Very few extreme hot maxima were recorded during these two years, with the exception of three heat waves in 2011 in southeast Western Australia and central South Australia in January and February, southeast Australia in August, and in northwest Western Australia in December.

Australian annual-average overnight minimum temperatures have warmed more rapidly than daytime maximum temperatures. Minimum temperatures have warmed by more than 1.1 °C since 1910 – with more than 0.8 °C of that warming occurring since 1960.

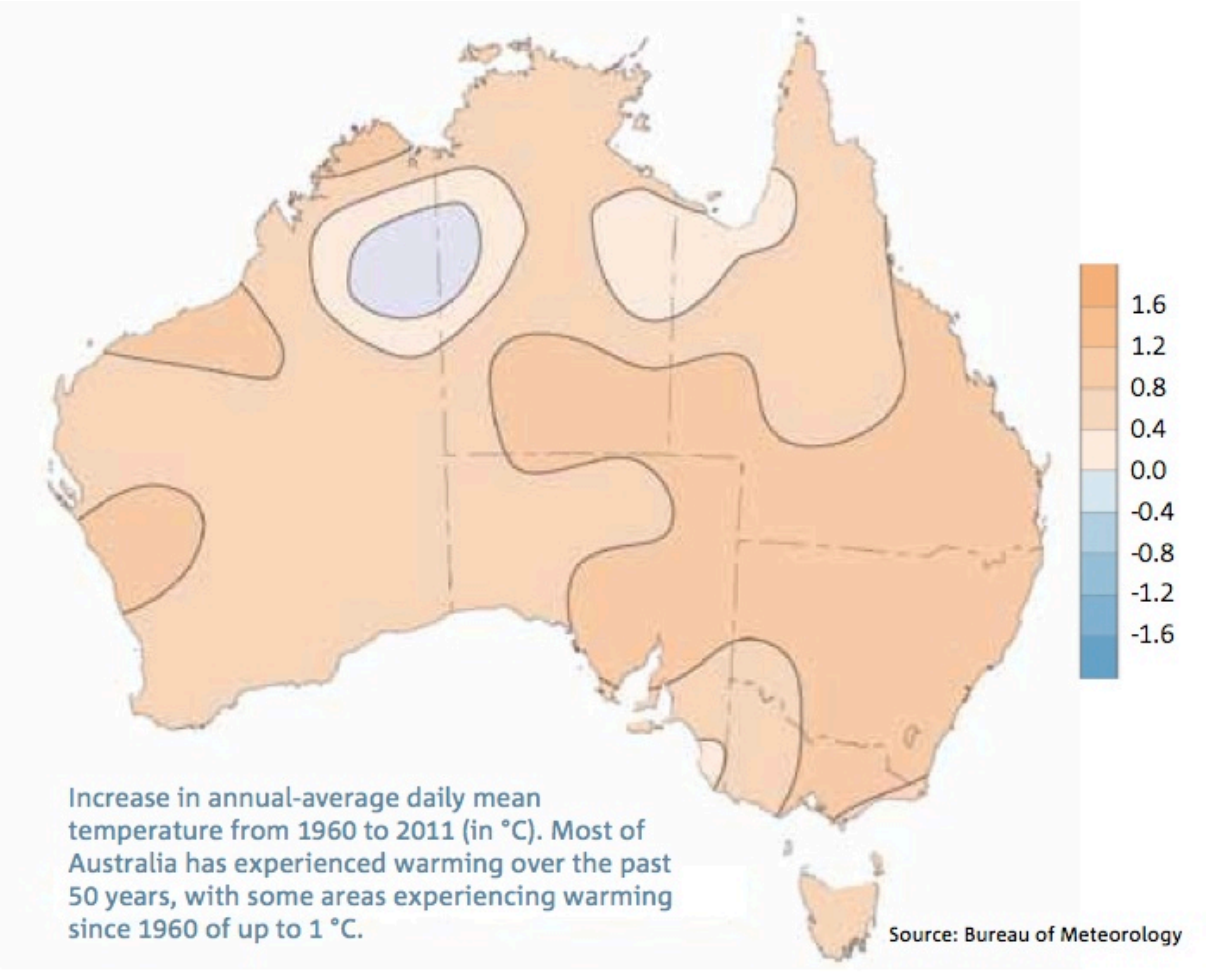


Figure 2 Trends in Australian maximum temperature.

The number of climate reference stations recording warm (top ten per cent) night-time temperatures and the frequency with which this occurs have increased since the mid 1970s. The rate of very hot (greater than 40 °C) daytime temperatures has been increasing since the 1990s. The frequency of extreme (record) hot days has been more than double the frequency of extreme cold days during the past ten years.

Key Points: Temperature

- Each decade has been warmer than the previous decade since the 1950s.
- Australian annual-average daily maximum temperatures have increased by 0.75 °C since 1910.
- Australian annual-average daily mean temperatures have increased by 0.9 °C since 1910.
- Australian annual-average overnight minimum temperatures have warmed by more than 1.1 °C since 1910.

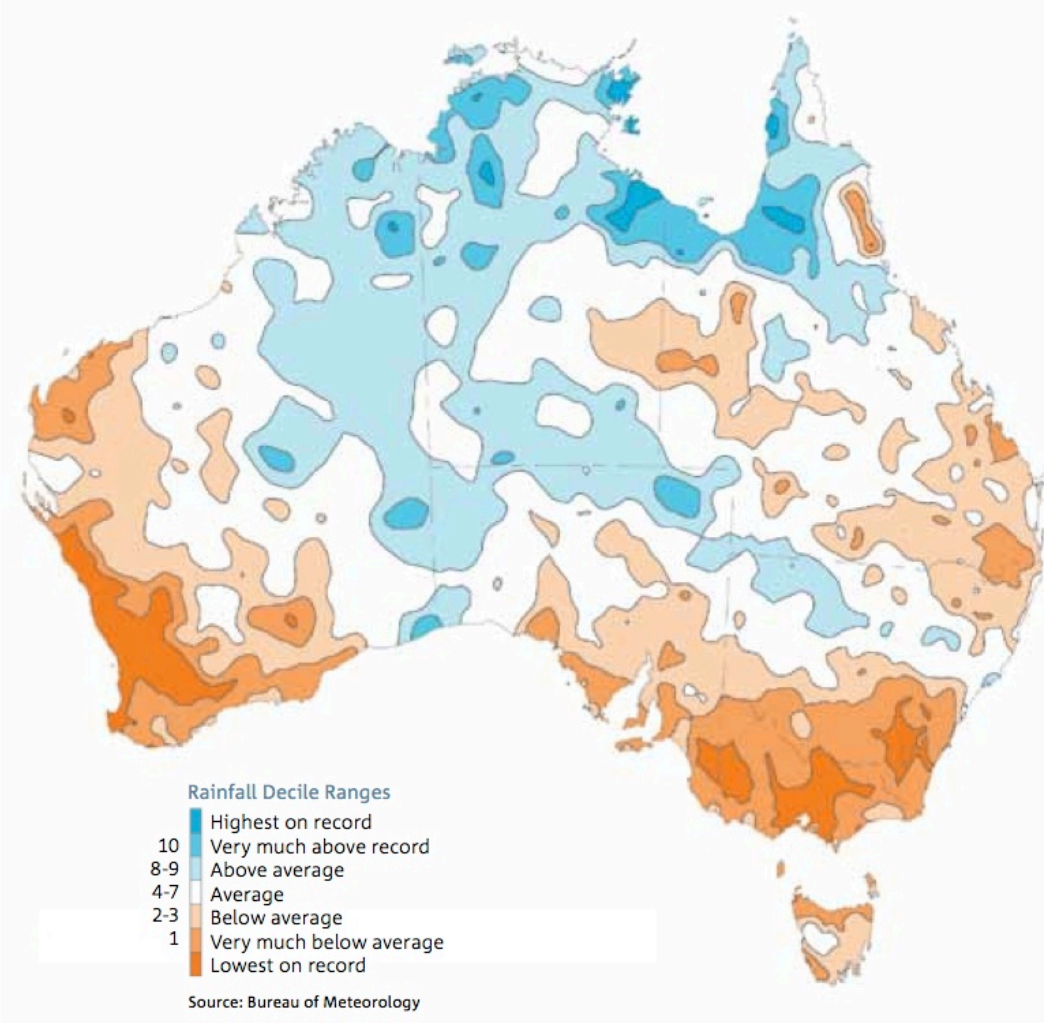
Rainfall

Long term trends in rainfall have been observed for many parts of the world for the last 100 years. These records have shown that reductions in rainfall and subsequent drying of landscapes have been observed in the Mediterranean, southern Africa parts of southern Asia and southern Australia. Large-scale changes in subtropical atmospheric circulation have been observed and are attributed as the cause of reductions in rainfall for southern Australia (Figure 3).

> ***"If the rains fail like they did last year we will go hungry. The rich have savings. They have stocks of food. They can sell their oxen for cash. But what do I have? If I sell my ox how will I plant next year? If my crop fails we have nothing. It is always like that. Everything depends on rain."***
>
> ***.....Kaseyitu Agumas, Lat Gayin, southern Gonda, Ethiopia, 20073***

Since 1950, most of eastern and south-western Australia has experienced substantial rainfall declines. Across New South Wales and Queensland these rainfall trends partly reflect a very wet period around the 1950s, though recent years have been unusually dry. In contrast north-west Australia has become wetter over this period, mostly during summer[5].

[5] http://climatechangeinaustralia.com.au/pastchange.php



April to September (autumn and winter) rainfall deciles from 1997 to 2011 for Australia (a decile rainfall map shows whether the rainfall is above average, average or below average for the most recent 15-year period, in comparison with the entire rainfall record from 1900). Areas of highest on record and lowest on record are also shown.

Figure 3 Distribution of changes in Australian rainfall.

Key Points: Rainfall

- Southwest and southeast Australia have experienced long-term reductions in rainfall during the winter half of the year.
- There has been a trend over recent decades of increased spring and summer monsoonal rainfall across Australia's north; higher than normal rainfall across the centre, and decreased late autumn and winter rainfall across the south.

Runoff

As a result of the reductions in rainfall in the southwest, there has been significant reductions in surface runoff to Perth's dams over the past 100years[6] (Figure 4). This considerable reduction in dam inflows is a stark example of what has happened for most potable and agricultural water supply dams in southern Australia.

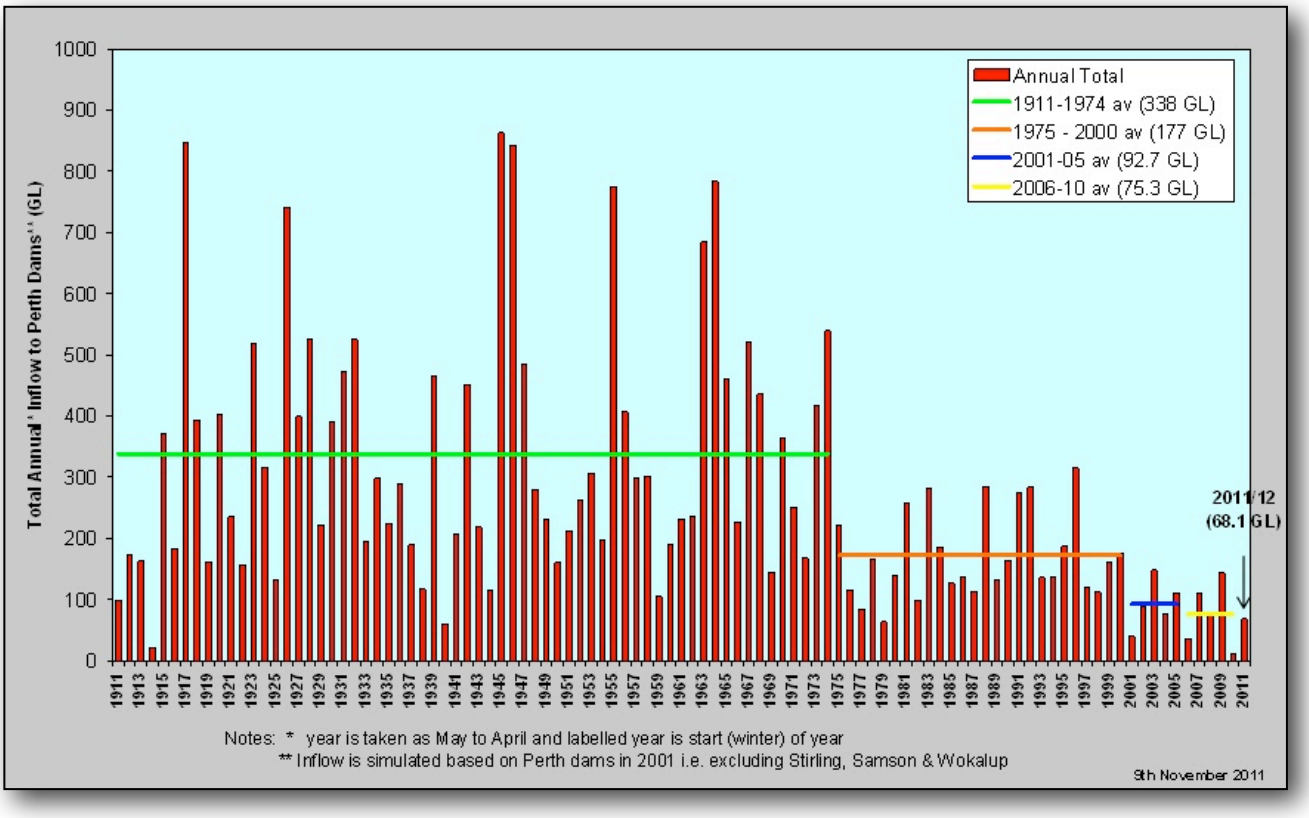


Figure 4 Trends in runoff to Perth's dams from 1911 to 2011.

Figure 4 above demonstrates the vulnerability of southwest Australia to water availability. Because of the observed reduction in available water for Perth's potable supplies, the Water Corporation[7] has had to alter its long established sourcing policy and increase the proportion of water it draws from groundwater to 80% to service demand.

The serious implications demonstrated in Figure 4, belie the fact that most rivers in the southwest of WA are experiencing the same decline in runoff. This has a compounding effect for farmers struggling with reduced runoff into farm water supply dams in that it may compromise their ability to harvest water under riparian rights from streams running through their properties.

The reductions in surface runoff and river flow will also have dire consequences for natural ecosystems. Reductions in flow of this magnitude will stress vegetation growing along the fringes of waterways potentially leading to accelerated bank erosion and sedimentation of deeper river pools. Animals and plants depending on waterways and wetlands that have experienced these reductions in flow will also suffer stress, loss of habitat value and even displacement.

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[6] http://www.watercorporation.com.au/_images/Dams/Streamflow_graph_2011.png

[7] http://www.thinking50.com.au/

Groundwater recharge

Reduced rainfall also leads to reduced groundwater recharge. This is reflected in the trends in seasonal depth to groundwater data for the Gnangara mound[8] (Figure 5). Clearly the Gnangara mound data also reflect abstraction patterns as well as reductions in recharge but the downward trend is of considerable concern. This is especially so when considering groundwater allocations for watering public open spaces (POS) which are a critical component of the preventative health agenda and in defining the quality of our urban spaces.

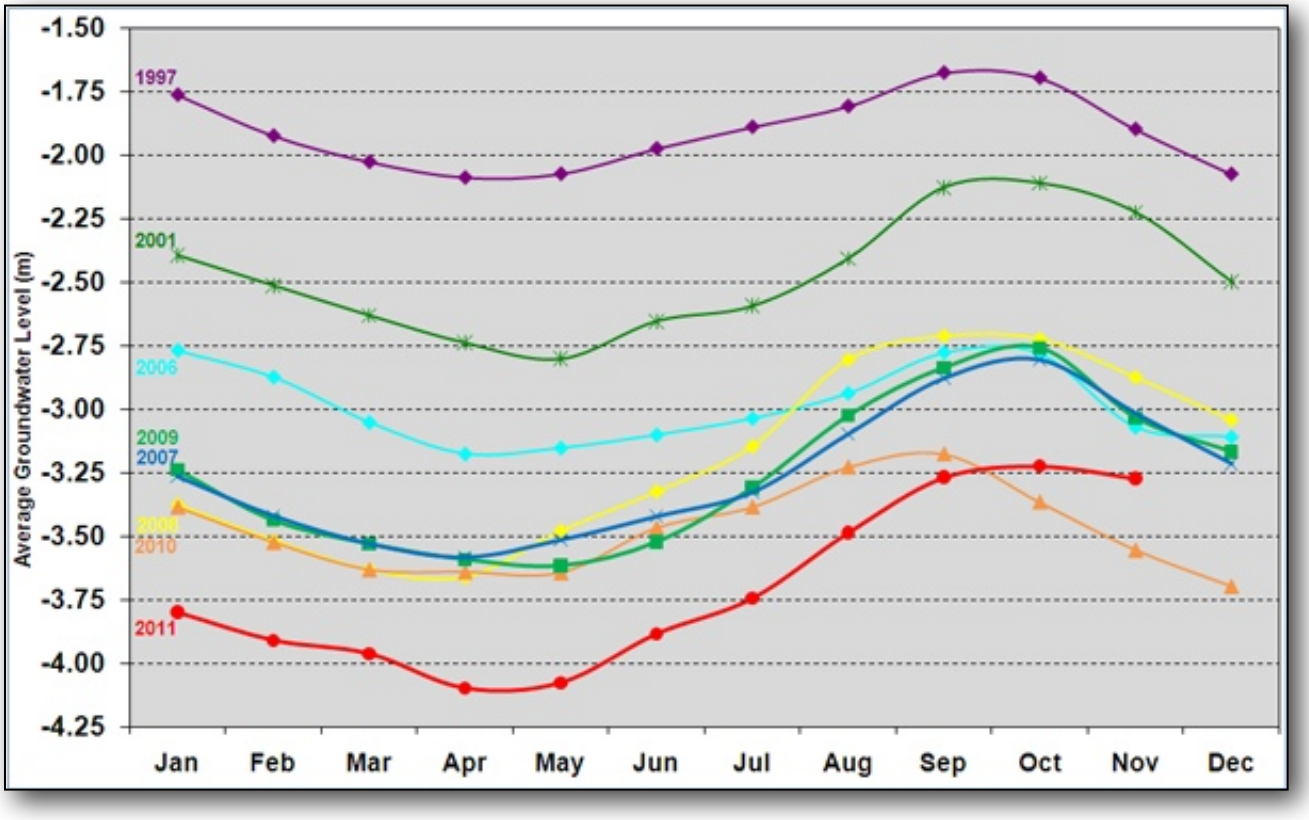

Figure 5 Groundwater level trends for the Gnangara mound.

More than 80 per cent of all the water used in Perth comes from groundwater. Less than 20 per cent now comes from the hills catchment, which historically was Perth's main water supply. ***..... Dr Anthony Smith, CSIRO[9]***

[8] www.water.wa.gov.au/Understanding+water/Groundwater/Gnangara+Mound/Gnangara+groundwater+level/default.aspx

[9] csiro.au/news/newsletters/0612_water/story7.htm

A State Government report is said to show our most important water supply, the Gnangara Mound, is in crisis and running out of water. The graph of water reserves has been plummeting downwards.

.....Wanneroo Mayor Tracey Roberts 20/Mar/2012

The Gnangara groundwater system in the Wanneroo area is fully allocated so there was no new water available for licensing

..... WA Water Minister Bill Marmion

'The community needs to look at alternative water supplies with groundwater availability at full allocation.' .....WA Water Minister Bill Marmion

The City of Wanneroo is growing by 8000 residents a year and it is not just drinking water that has to be found but also water to irrigate parks and sports grounds. .....Wanneroo Mayor Tracey Roberts 20/Mar/2012[10]

Key Points: Runoff and Recharge

- There have been significant reductions in runoff to southwest water supply dams and to rivers and wetlands.
- In a drying climate, a greater reliance on groundwater combined with reduced infiltration and recharge has seen very significant falls in superficial groundwater levels in many areas.
- Falling superficial groundwater levels may expose previously inundated soils rich in sulphides to the atmosphere. This increases the risk of acid sulphate formation in these areas, leading to adverse impacts on built infrastructure and the ability to utilise contaminated water supplies.

[10] inmycommunity.com.au/news-and-views/local-news/Mound-at-crisis-point/7617150/

Extreme events

The IPCC has stated that extreme events, like heat waves, droughts, floods and tropical cyclones are likely to keep increasing in frequency, duration and severity as climate change continues.

The European heat wave of 2003 and the increase in intensity of hurricanes in the USA[11] are examples of these changes occurring. Although no individual event is indicative of climate change, the probability of ordinary weather events becoming more extreme, and of extreme events becoming even more extreme, is increasing.

The Australian Government has estimated that coastal assets valued at more than $226 billion are at risk of damage from inundation and erosion by 2100.

Irrigated agricultural production in the Murray Darling Basin could decline by up to 92 per cent by 2100 as a result of longer and more frequent droughts from unmitigated climate change .....Garnaut Climate Change Review, 2008

There is likely to be an increase in the number of heat-related deaths. For example, the early 2009 heatwave in south-eastern Australia saw an increase in heat-related illness and deaths in Victoria and South Australia. Other health risks will come from severe weather events like bushfires, flood-borne infectious diseases and increases in air pollution.

The recent flooding in Queensland from cyclones provides an insight into the types of events that Australia could increasingly face. These events are estimated to have cost the economy about $12 billion in lost output.

.....Clean Energy Future, Australian Government's Climate Change Plan[12]

Floods in Toowoomba and fires in Victoria.

[11] ucsusa.org/global_warming/science_and_impacts/science/hurricanes-and-climate-change.html

[12] cleanenergyfuture.gov.au/wp-content/uploads/2011/07/Consolidated-Final.pdf

Sea level rise

Sea level rise caused by global warming is another issue of considerable concern. Sea levels have risen more than 20 cm since 1880, and more recently the rate of sea level rise has accelerated. Causal factors for sea level rise include increased ocean temperatures leading to thermal expansion of oceans, melting of glaciers and ice caps and melting of the Greenland and Antarctic ice sheets.

Sea level rise has already seen an increase in the threat to coastal populations in low lying areas and an increase in damage to coastal infrastructures such as wharfs, jetties, boat ramps and moorings.

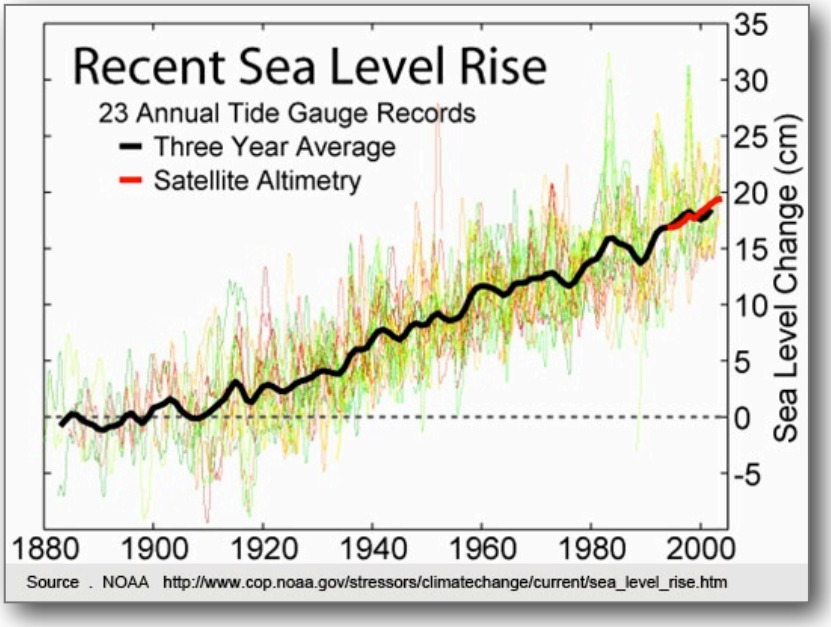

Figure 6 Sea level rise from 1880 to the present.

Photo 2 Aerial application of larvicide in mosquito prone areas experiencing regular inundation[13]

[13] http://www.mandurah.wa.gov.au/cms/11487.htm

Photo 2 Ice caps melting causing rising sea levels[14]

'The Arctic is sending us the clearest message that climate change is happening now, and much faster than scientists once thought. In the summer of 2007, the extent of Arctic sea ice decreased by nearly 40% -- a shocking wake-up call for the world that caused many scientists to revise their estimates for the scope, scale, and speed of predicted climate change impacts' ...350.org[15]

Interactions between factors

Unfortunately, climate change impacts often act in combination, compounding the potential risks, vulnerabilities and exposures. Wild fires occurring in hotter temperatures are more severe. The interaction between sea level rise and severe storm events leads to increasingly damaging storm surges. Sea level rise has already stressed many coastal structures, facilities and vegetation assemblages and foreshore erosion is widespread around the Australian coastline. Storm surge significantly increases the penetration of marine waters inland and adds a greater destructive force to already weakened coastal defences.

Climate change impacts operate at a number of scales. This chapter has mentioned global and regional stressors and impacts, but a range of localised issues are also emerging. Increases in surface air temperature exacerbate heat island effects experienced by many of our cities. The interaction of factors and the effect of scales are discussed in more detail in later sections of this document.

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14 tinyurl.com/7wjgf89

15 350.org/sites/all/files/science-factsheet-updated2011c.pdf

Photo 3 Upper: Storm Surge, Riverside Drive, Perth[16]. Lower Same scene in fine weather.

[16] www.bom.gov.au/wa/sevwx/perth/storms_cool.shtml

Impacts of climate extremes can be felt locally or regionally

AGRICULTURE	**"Russia, Crippled by Drought, Bans Grain Exports"** *August 5, 2010,* ***The New York Times***
ENERGY	**"Heatwave hits French power production"** *August 12, 2003,* ***The Guardian***
WATER	**"Lake Mead is at Record Low Levels. Is the Southwest drying up?"'** *August 08, 2010,* ***The Independent***
PUBLIC HEALTH	**"Pakistan floods: Aid trickles in for victims as cholera spreads in Pakistan's worst-ever floods"** *August 14, 2010,* ***The Guardian/Observer***
TOURISM	**"Alpine resorts feel heat during record warm spell"** *December 08, 2006,* ***CNN***
TRANSPORTATION	**"Flash flooding causes train to derail"** *July 30, 2001,* ***Chicago Sun Times***

nature and severity of event

vulnerability

exposure

What are the predictions for the future?

Each new in-depth assessment has found that earlier projections of the worst-case outcome have understated how serious this crisis is..... Al Gore, Our Change

While we can measure what has already occurred, as described in the previous section of this report, it is much more difficult to make definitive statements about what future climate change impacts may occur. This is because of the vagaries of various international agreements and policy instruments and their success at the global scale. Climate change scientists have incorporated this uncertainty of policy outcomes (social uncertainty) by developing a range of possible future scenarios of climate change.

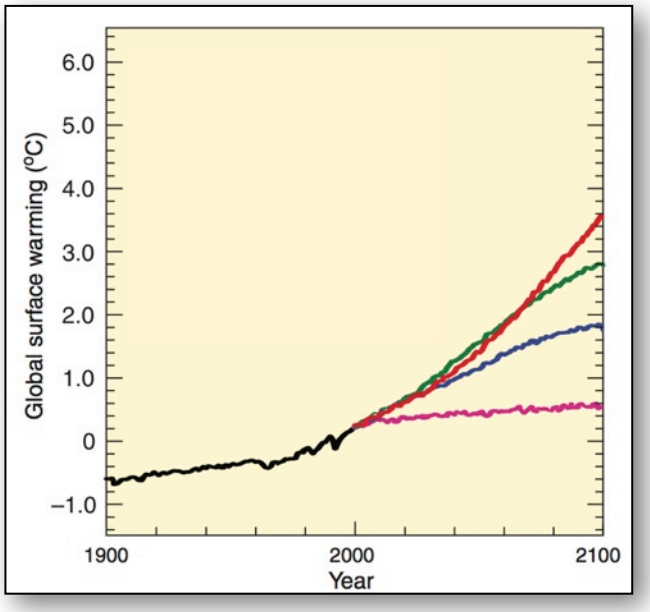

Figure 7 Predictions of global surface warming where the coloured lines represent some the modelled human responses to pollution reduction. The pink line shows results of holding emissions at 2000 levels. (See appendix 1 for detailed description of various predicted policy scenarios).

Scenarios are alternative images of how the future might unfold and are an appropriate tool to analyse how driving forces may influence future emission outcomes and to assess the associated uncertainties. They assist in climate change analysis, including climate modelling and the assessment of impacts, adaptation, and mitigation.

Surface temperature predictions

A range of best and worst case climate change scenarios have been developed and some of these are presented as Figure 7. This shows part of the range of predictions of global surface warming to 2100. The pink line shows surface temperatures stablised at 2000 levels. Under the A2 scenario (red line), surface temperatures will increase by 3.6°C over 2000 levels.

Rainfall and runoff predictions

Based upon the A1B scenario (green line in Figure 7), model predictions have concluded that rainfall levels in southwest WA could be further reduced by 10 - 25% for the decade 2090-2099 relative to 1980-1999 averages. This predicted reduction in rainfall would see greater than 25% reductions and more likely double this amount of decline in runoff to surface waterways and water supply dams and a similar decline in recharge to groundwater systems. This would have catastrophic impacts on natural vegetation assemblages, communities and farming systems throughout the southwest of WA.

Sea level rise

Under a range of Special Report on Emissions Scenarios (SRES[17]), sea level has been predicted to rise around 0.8m to 2030, 2.0m by 2070 and by up to 2.8m by 2100. This level of sea level rise would displace many millions of people living in low lying areas around the globe and inundate beaches and foreshores around Australia. Since 85% of the Australian population live within 50 kms of the coast, rising sea levels may have a devastating effect on large areas that are highly populated at present.

350 ppm

Dr James E. Hansen - a respected NASA and climate scientist, Dr Rajendra Pauchauri - the UN's top climate scientist, and leader of the IPCC, and others, have endorsed the idea that the CO_2 levels in the atmosphere must come down to 350 parts per million as an absolute top end of the scale, to avoid catastrophic climate change. We are already at 391 ppm and rising - pre-industrial times were 270 ppm. Some governments, including the Australian government, are accepting that 450 ppm will be an acceptable level, even though the science is clear. An increase of global temperature by more than 2 °C has come to be the majority definition of what would constitute intolerably dangerous climate change.

> ***Two degrees temperature rise will in fact lead to widespread environmental, social and economic disruption and -- most importantly -- pose a significant risk of a runaway, unstoppable warming period that could cause the collapse of civilisation. So it is an inadequate goal. It is a plan for failure.[18]***

> ***World temperatures could rise by between 1.1 and 6.4 °C during the 21st century. Anthropogenic warming and sea level rise will continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilised. .....IPCC[19]***

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17 http://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf

18 paulgilding.com/fileshare/p091101-The-one-degree-war-plan.pdf

19 ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf

Since many high carbon emitting governments globally are avoiding dealing with the severity and immediacy of the climate change issue, and even 2 degrees C will spell disaster for low lying, poor nations like the Maldives, the impact of climate change is looking bleak unless immediate radical action is taken globally, to move to a post carbon economy.

Key Points: Changes in landscape water availability and sea level rise

- Restricted access to affordable water for recreational facilities and landscapes
- Reduced opportunity for freshwater-based recreational pursuits due to low water levels and induced algal blooms
- Adverse impacts on diversity of natural bushland
- Increased erosion of coastlines and associated costs
- Greater risk of storm surges in low lying areas
- Adverse impacts on freshwater ecosystems

'If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm, but likely less than that… If the present overshoot of this target CO_2 is not brief, there is a possibility of seeding irreversible catastrophic effects.' ***.....Dr James Hansen, NASA scientist***

Key Points: Predicted increase in frequency and severity of extremes

- Greater risk of storm, fire or wind damage to facilities and infrastructure
- Increased damage to coastlines
- Inability to obtain adequate fire/ flood insurance
- Cancellation of key events, disrupting tight cash flows
- Need for night time lighting and air conditioning - leading to cost difficulties for poorer areas

Photo 4 Wagga Wagga in New South Wales under flood waters, 2012[20]

Photo 5 Alesund Stadium, Norway - Greenfields' first UEFA certified synthetic surface in Europe.

[20] climatetasmania.com.au/2012/03/13/a234/

How much carbon pollution is Australia emitting?

The local political debate in Australia has established a myth around the fact that we are a small country and our emissions are not significant when compared to the world's larger growing economies such as the USA, China and India. How does this myth stack up against the facts? As shown in Figure 8, in 2000, Australia was amongst the top 20 emitters in absolute terms (Figure 8a) and was the worlds worst carbon emitter - per capita (Figure 8b).

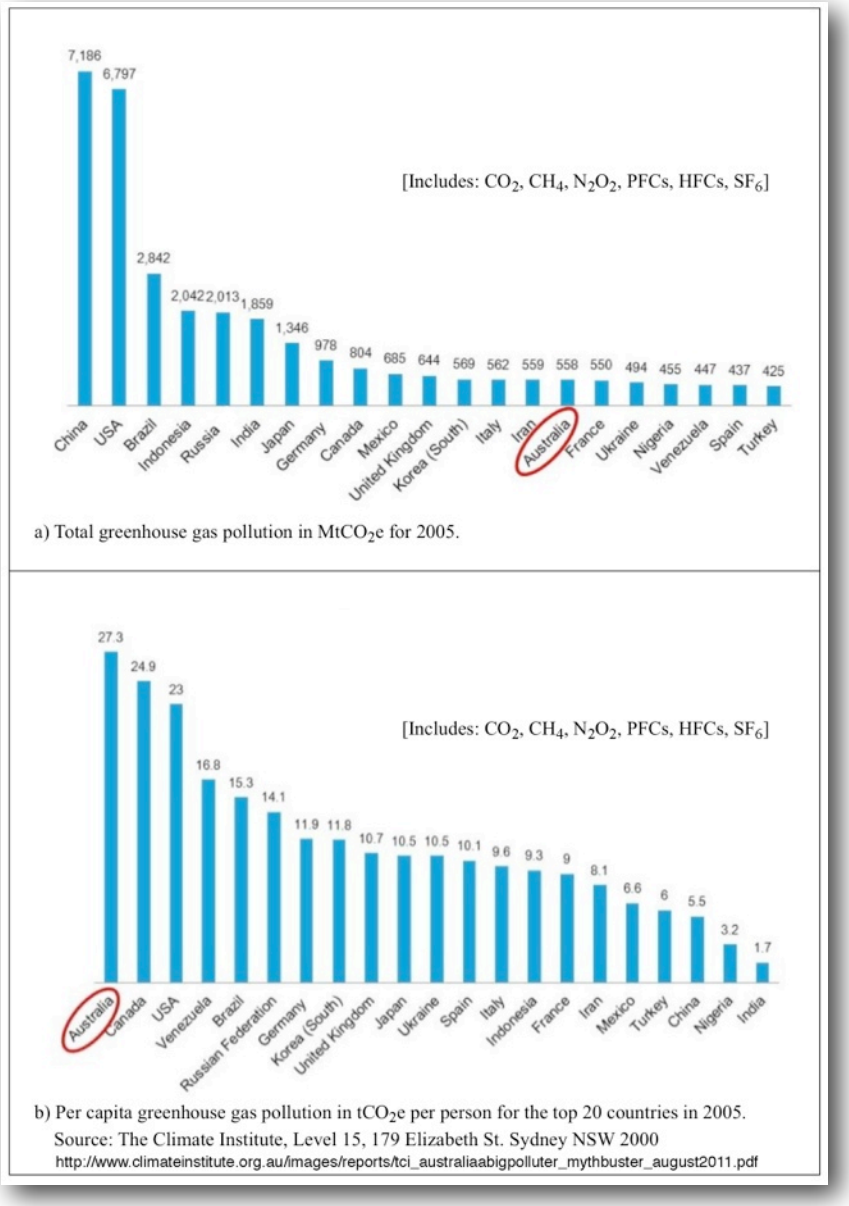

Figure 8 Australia's absolute and relative carbon emissions compared to the top 20 countries.

The dubious distinction of being the world's worst emitter per capita in 2000, was largely due to our dependance on coal-based power generation (Figure 9). Despite signing on to Kyoto targets for emissions reductions, Australia's emissions continue to rise by 2% per year.

In these and more recent data, it is clear that Australia, is lagging in facing up to its international responsibilities to do what is necessary to reduce emissions. The coal industry has great political power and right-wing media shock .jocks have deliberately muddied the debate - a debate that signalled a preparedness to act decisively, at least 10 years ago in much of Europe and other parts of the world.

'This latest drought is the "final nail in the coffin" for many cockies who have been hit by frosts and successive dry seasons. It's the worst season anyone has seen in their lifetime, It's dire out here. We're in real trouble.'

...Lake Grace farmer Bob Iffla, WA Farmers Federation regional president Oct 2010[21]

'The drought will soon hit home for metropolitan residents as well, because prices for meat, dairy, fruit and vegetables will go through the roof.'

....WA Farmers Federation President Mike Norton, Oct 2010[22]

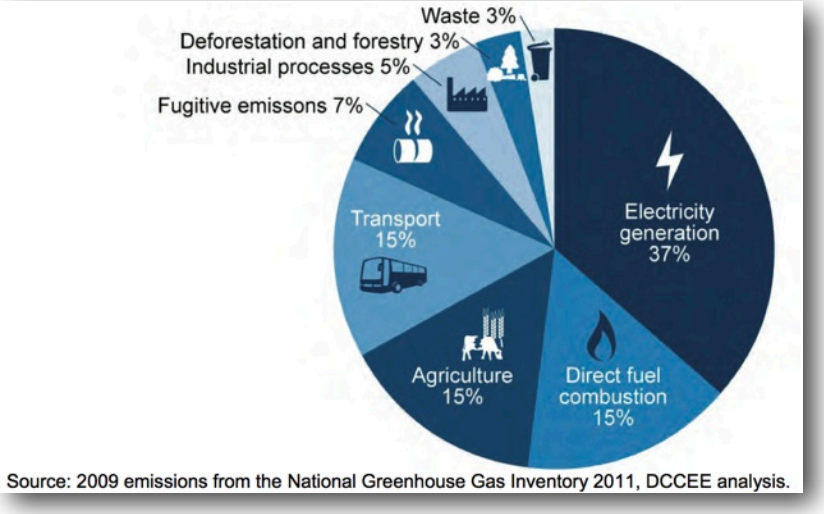

Figure 9 Showing the ways Australians proportionally produce most greenhouse gases.

The success of the climate deniers in confusing the well-accepted facts of climate change is illustrated in the results of an April 2012 poll conducted by the ABC with 14,000 respondents[22].

- 53% of Australians who took the survey are Dismissive of global warming- they are sure it isn't happening, that it is not at all important to them, they are fixed in their view and not interested in changing their mind.
- 10% are Doubtful- think if it will effect us it won't be till much later
- 3% are Cautious- not too worried
- 1% are Disengaged- hardly thought about it
- 3% are Concerned- tend not to worry too much about it
- 24% are Alarmed- believe they are well informed, very concerned about it, and sure it is harming people already

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[21] perthnow.com.au/news/western-australia/drought-ravaged-farmers-head-to-waca-as-was-big-dry-hits-hard/story-e6frg13u-1225942660195

[22] http://www.abc.net.au/tv/changeyourmind/

What are people doing about it?

A recent IPCC document[23] examined case studies of extreme climate events, vulnerable regions, and management approaches in order to learn lessons and identify best practices. It was found that in order to implement a successful disaster risk reduction or climate change adaptation strategy, legal and regulatory frameworks were beneficial in ensuring direction, coordination, and effective use of resources. Effective legislation can create a framework for governance and coordination of disaster risk management actions across agencies.

This type of approach is mainly for national and state governments and the ways in which they devolve responsibilities to local government agencies. Frameworks that facilitate cooperation between agencies to attain better analysis of the risks will allow institutions to modify their focus with changing risks and therefore maintain their effectiveness. This cooperation could be at the local through state to national levels. Here and in other ways, the community has an important role.

Insurance and other forms of risk transfer can be linked to disaster risk reduction and climate change adaptation by providing knowledge and incentives for reducing risk, reducing vulnerability, and enabling recovery.

It was also found that effective education about disaster risk reduction and climate change adaptation combine to reduce risks and losses. It was most effective when it was not done in isolation, but was consistent across contributing agencies and concurred with other policies. The integration of activities relating to education, training, and awareness-raising into relevant ongoing processes and practices is important for long-term success. Investing in knowledge at primary to higher education levels produces significant benefits.

> ***'Effective and robust adaptation strategies are not significantly limited by the absence of accurate and precise regional climate predictions. They are limited more by a multitude of technological, institutional, cultural, economic and psychological factors that lie beyond the reach of climate models — and always will.[24]'***

A common factor was found to be the need for greater amounts of useful information on risks before the events occur, including early warnings. The implementation of effective early warning systems has been found to reduce the loss of lives and to a lesser extent damage to property. Early warning was identified by all the extreme event case studies – heat waves, wildfires, drought, cyclones, floods, and epidemics – as key to reducing the impacts from these extreme events. A need for improving **national** cooperation and investments in forecasting was recognized in some of the case studies, but equally the need for **regional** and **local** early warning systems was heavily emphasized, particularly in developing countries.

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[23] http://ipcc-wg2.gov/SREX/

[24] Hulme,M. and Dessai,M. (2008) Ventures should not overstate their aims just to secure funding Nature (Correspondence) 453, 979 (19 June 2008) | doi:10.1038/453979a

A further common factor identified overall was that it is better to invest in **preventative** disaster risk reduction plans, strategies, and tools for adaptation than in **response** to extreme events. Investment in increasing knowledge and warning systems, adaptation techniques and tools, and preventive measures will cost money now but they will save money and lives in the future

Research also improves our knowledge, especially when it includes integration of natural, social, health, and engineering sciences and their applications. In all cases, the point was made that with greater available information it would be possible to better understand risks and to ensure that response strategies were adequate to manage the risks.

Mitigation Actions - Global

There has been a range of responses both internationally and in Australia to mitigating climate change. While many governments have implemented robust mitigation measures, some are still in denial and making only token gestures towards reducing greenhouse emissions at a rate below that acknowledged by scientists as being necessary (see Figure 10). Many European Union countries are facing the climate change issue head on, and in these countries the public has generally accepted the changes they need to make. Unfortunately it is the majority of the world's population who live in poverty and who do not produce large amounts of greenhouse gases, who are being most affected by weather-related climate change impacts. It is of utmost importance that primary emitters in the developed world take responsibility for the impacts they are causing.

Many **governments** have produced plans to move to lower carbon economies in the next few decades. These plans range from complete reliance on renewable sources of energy to using nuclear power or gas to substitute for coal burning power stations (both of which are dubious substitutes for various reasons).

Links to selected government climate mitigation strategies

California's Clean Energy Future
www.cacleanenergyfuture.org/progress.html

European Union- Roadmap for moving to a low-carbon economy in 2050
http://ec.europa.eu/clima/policies/roadmap/index_en.htm

UK- The Carbon Plan- delivering our low carbon future
www.decc.gov.uk/assets/decc/11/tackling-climate-change/carbon-plan/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf

Korea's National Strategy for Green Growth- Korean Government
Programmegreengrowth.go.kr/english/

China's Policies and Actions for Addressing Climate Change
no2.mofcom.gov.cn/aarticle/hostcountry/populationhost/201111/20111107845000.html

India's Interim Report of the Expert Group on Low Carbon Strategies for Growth
planningcommission.nic.in/reports/genrep/Inter_Exp.pdf

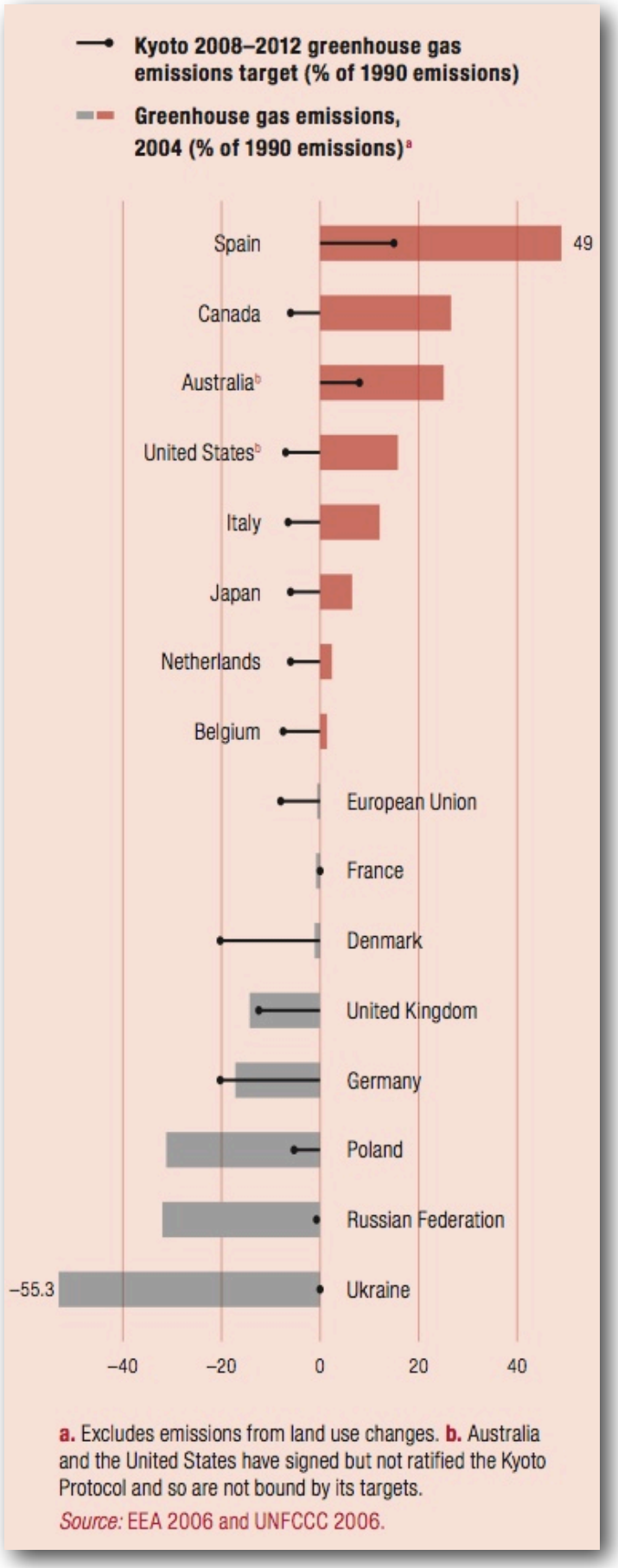

Figure 10 Kyoto emissions targets and performance against them by selected countries.

There are also many **non- government** studies, reports and strategies being produced that have been well researched and considered.

Links to selected non-government mitigation strategies

Zero Carbon Britain 2030
www.zcb2030.org

World Wildlife Fund's The Energy Report
wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions/renewable_energy/sustainable_energy_report/

The One Degree War
paulgilding.com/fileshare/p091101-The-one-degree-war-plan.pdf

Al Gore Our Choice- downloadable
pushpoppress.com/ourchoice/

'By 2050, we could get all the energy we need from renewable sources. Such a transition is possible and also cost-effective, providing energy that is affordable for all and producing it in ways that can be sustained by the global economy and the planet. This should inspire governments and business to come to grips with the challenges that undoubtedly exist and to move boldly to bring the renewable economy into reality.'

....Jim Leape, Director General, WWF International

We believe that public awareness of the dangers associated with climate change will increase over the next decade, to the level where it is perceived to be a significant threat to global economic and geopolitical stability.

The public will then demand emergency action to cut global climate gas emissions. We argue that such emergency action ought to be based on a well prepared crisis response plan that seeks to keep global warming below plus 1°C over pre-industrial levels.

We have prepared a first draft of the crisis response plan – "The One Degree War Plan" – and encourage further broad efforts to improve the plan.

....Paul Gilding, The one degree war plan.

Mitigation Actions - Australia

Even though Australia has agreed to the international community to reduce its carbon emissions by a minimum of 5% (on 2000 levels) by 2020, and by 80% by 2050, our emissions are still rising by 2% per year.

> ***The Australian Government's 2020 emissions reduction target (a 5 per cent decrease on 2000 levels) is clearly still far from the level required for Australia to make a responsible and fair contribution to global emissions reductions. While Australia's 2050 target (an 80 per cent decrease on 2000 levels) is more robust, there is no detail as yet as to how this target will be achieved[25]***
>
> **..... Post Carbon Pathways[24]**

To help meet its international obligations, the Australian government has introduced a 4 part plan to reduce carbon emissions including:

- a carbon tax, moving to a cap and trade system in the next 3-5 years.
- encouraging innovation in clean energy with a $10billion commercially-oriented Clean Energy Finance Corporation which will invest in renewable energy, low pollution and energy efficiency technologies
- Assistance to move towards more energy efficiency - closing down some coal fired plants, establishing more gas fired ones, and supporting businesses both large and small to become more energy efficient.
- Help for people on the land with the Carbon Farming Initiative, and the Biodiversity Fund, both of which support farmers to grow and retain trees for carbon sequestering.

Adaptation Actions - Global

The key to adaptation is to make it happen. Adaptation will not happen[26] if:

- changes in climate are too great
- it costs too much
- people don't accept that impacts will be averted
- responses do more harm than good

So:

- mitigation is necessary to avoid exceeding thresholds for run away climate change
- beware expensive fixes
- decisions need to be legitimate
- decisions need to be screened for maladaptation.

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[25] cpd.org.au/2012/03/post-carbon-pathways/

[26] http://www.nccarf.edu.au/sites/default/files/Barnett_Masterclasstalk2011.pdf

An important consideration in developing adaptation plans and actions is to assess the synergies and trade offs of various alternatives. It is a complex process and sometimes the negative consequences of a particular action will outweigh the potential benefits. This is called maladaptation.

Maladaptation is action that, relative to alternatives[25]:

- increases emissions of greenhouse gases
- disproportionately burdens the most vulnerable
- has high opportunity costs
- reduces incentives to adapt
- sets paths that limit future choices

'We know enough to make good decisions about managing the risks of climate-related disasters. Sometimes we take advantage of this knowledge, but many times we do not,'[27]

Disaster risk management as part of adaptation, has historically operated under the premise that the future climate will resemble that of the past. Climate change now adds greater uncertainty to the assessment of hazards and vulnerability. This will make it more difficult to anticipate, evaluate, and communicate disaster risk. Uncertainty, however, is not a 'new' problem. Previous experience with disaster risk management in the face of uncertainty, or where rarer, very extreme events prevail, can inform vulnerability assessment, risk reduction and response as well as disaster risk management strategies in general.

It was also identified in the IPCC SREX report[22] that disaster risk management and preventive public health are closely linked and largely synonymous. Strengthening and integrating these measures, along with economic development, should increase resilience against the health effects of extreme weather and facilitate adaptation to climate change. Extreme weather events and population vulnerability can interact to produce disastrous epidemic disease through direct effects on the transmission cycle and also potentially through indirect effects, such as population displacement.

Photo 6 Pakistan floods, 2010, 6 million left homeless

[27] ipcc.ch/news_and_events/docs/srex/SREX_slide_deck.pdf

Figure 11 Example for coastal communities, of risk management process developed by IPCC[22].

Adaptation Actions - Australia

Australians have a long history of responding to an extremely variable climate and to climatic extremes, such as floods, droughts and cyclones. This history, as well as the high educational standards and standard of living in Australia, provides Australians with a strong capacity to adapt to many of the expected impacts of climate change[28].

However, climate change will pose new risks outside the range of historical experience. The continuing drought in many parts of Australia and the bushfires, floods and storm tides experienced in 2009, highlight Australia's vulnerability to extreme events. There is a need to enhance society's resilience to weather-related events and to build our capacity to respond and adapt to the impacts of climate change, which will likely fall beyond the range that Australia has experienced so far.

Amongst a range of actions, the Australian government established the National Climate Change Adaptation Research Facility (NCCARF). This agency has developed a local government portal, and provided a range of fact sheets to guide those beginning the process of developing adaptation and disaster risk management plans. NCCARF has also provided a range of traveling road show presentations by panels of experts, undertaken research and distributed research funding.

A Coastal Collaboration Cluster has also been established, lead by Professor David Wood at Curtin University, and funded by the CSIRO and NCCARF, involving seven universities across Australia. The project examines how to improve the dialogue between knowledge-makers and decision-makers with a view to improving coastal sustainability, especially with respect to climate adaptation.

[28] http://www.nccarf.edu.au/climate-change-adaptation

Examples of adaptation measures include[29]:

- construction of sea walls;
- building of new water reservoirs;
- establishment of early warning systems;
- revision and/or modification of building codes;
- alteration of farming practices and crop use;
- improvement of risk management; and
- enhancement of water use efficiency.

The NCCARF conducted a survey[30] at a recent conference of the Australian institute of landscape architects (AILA) in August, 2011, to gauge industries' opinions around the capacity of agencies to support practitioners in the development of adaptation and disaster risk management plans. They found that:

- Most people look to the web first for climate adaptation information although some use in-house experts
- Peak bodies are important information providers and information directors
- Climate adaptation information tends to be project specific but case studies, successful examples and local information are invaluable
- Including information likely climate change is relatively new in (landscape) design projects.

Perth has been described[31] as Australia's 'thirstiest' city and indeed compared to the other capitals and prior to restrictions, had the highest domestic water use per capita – at 289 litres per person per day, twice that of Brisbane or Melbourne. Despite having the highest per capita water consumption among Australia's capital cities, drought restrictions in Perth until recently, were the least severe, permitting sprinkler irrigation and unlimited watering with hoses. Regulations on sprinkler use restricting irrigation to daylight hours only were introduced in 1996, and current water restrictions permit use of sprinklers to two days per week, although hand-held hose watering is still allowed.

An example of a climate change adaptation plan is the WA Water Corporation's Water for All Forever Program[32]. This ten-year plan, is designed to sustainably drought-proof Perth against the full range of climate scenarios. In terms of water resilience for Perth, it sets out to:

- Transfer ground water abstraction to the deeper aquifers to protect the shallow groundwater environment on which natural ecosystems depend;
- Replenish deep aquifers with recycled water through a new groundwater replenishment scheme;
- Expand seawater desalination capacity to offset the declining inflow to dams
- Continuing to make gains in water use efficiency, while preserving outdoor lifestyles and continued growth
- Using waste-water recycling as a resource for industry, public open spaces and agriculture.

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29 http://www.nccarf.edu.au/masterclass

30 http://www.nccarf.edu.au/node/755

31 waset.org/journals/waset/v70/v70-69.pdf

32 watercorporation.com.au/_files/waterforever/10_year_Water_Supply_Strategy.pdflivepage.apple.com

Figure 12 Perth's desalination plant - An example of maladaptation averted.

'As many know, the Chinese expression for crisis consists of two characters side by side. The first is the symbol for danger, the second the symbol for opportunity.[33]'

Climate adviser, Ross Garnaut, has lashed Australian business for playing a "spoiler" role in the carbon price debate, saying it is putting short-sighted "self-interest" ahead of the national interest[34].

[33] Al Gore, An Inconvenient Truth: The Planetary Emergency of Global Warming & What We Can Do About It

[34] larvatusprodeo.net/archives/2011/06/01/garnaut-review-2011-update/

What are the implications of changes in climate for parks and leisure nationally?

One of the important components in determining exposure to climate change impacts is assessing the vulnerability of communities, infrastructures, facilities and natural systems. Vulnerability translates into risk to the observed and predicted impacts that are likely to arise. Because of the nature of outdoor parks and leisure activities, assessing vulnerabilities and risk of exposure means a broad assessment of the range of likely impacts across the full range of outdoor pursuits.

This includes impacts on **provision and quality of urban POS,** impacts on **coastal infrastructures** and **marine ecosystems,** impacts on **nature-based activities** in bushland and marine areas and impacts to **recreational and irrigation water supply dams**.

Two workshops were held by staff from the CSIRO's National Research Flagship: Climate Adaptation, in December 2010 to develop localised and plausible storylines around the SRES[17] scenarios. Preliminary results from the workshops were distributed as an internal working document. The technical and community participants attending the two workshops were carefully selected so as to represent a broad range of lived experience, training and opinion.

While the results of the workshops must be seen as preliminary, the workshop process used and the representativeness of the participants, serves to add credibility to the results. The impacts, vulnerabilities, implications and indicative costs of these plausible WA local-scale storylines were further developed at a workshop with PLAWA regional council and are summarised for the energy sector as an example in Table 1 below (see Appendix 2 for results for all 8 industry sectors).

Table 1 Climate change vulnerability and implications for impacts for the energy sector. See Appendix 2 for complete analysis for 8 industry sectors including parks and leisure.

Impact	Vulnerabilities	Implications	Costs	Certainty & Measurement
Energy sector				
Increase in temperatures Increase in extreme events	Climate sensitive design is not wide spread Vulnerable energy infrastructures	Increasing reliance on air conditioning, increasing costs of energy Recreation centres used as emergency refuges, disrupting normal events and income streams	Significant increase in costs for cooling of recreation centres etc during hotter summers Reduced reliability of energy supplies because of extreme events damaging energy infrastructures	Some scientific uncertainty in predictions of the speed and extend of temperature increases & extent and severity of extreme events.

The analysis demonstrated in Table 1 above was used to develop an understanding of the nature of vulnerabilities and risks for parks & leisure in Australia. These are presented in Appendices 3 & 4.

Vulnerable communities nationally

Higher temperatures and extreme events will impact disproportionately on vulnerable sectors of the community such as the elderly, infirm and the very young. In Western Australia, regional communities will probably be more severely impacted by heat-related extreme events than southern communities. Southwest communities will probably be more adversely impacted by emerging water shortages than northern regional communities who have already learned to live with water scarcity. Northern communities will be more severely impacted by increasing severity and frequency of severe cyclones.

Parks and leisure as an industry with its reliance on irrigated turf for outdoor organised activities, could be seen as being highly vulnerable to water availability. A number of vulnerable sports and recreational pursuits were identified. These include pursuits that are: long-duration, water-based, turf-based, equestrian or animal-based, bushland-based and those not readily able to shift to night fixtures in heat-prone areas such as small ball sports.

Other vulnerable communities are those where rainfall is already minimal and becoming more so, such as inland towns and agricultural areas. The cost of water will almost certainly rise and water for irrigation will be priced at a premium through tradable water entitlements.

Nationally, coastal communities (85% of Australians live within 50kms of the coast), are more vulnerable to sea level rises, which are predicted to be anything from 80 cms to 2.8 metres by 2100. Sealevel rise at the upper end of the range will have a devastating effect on low lying coastal areas. The cost of sea walls is prohibitive.

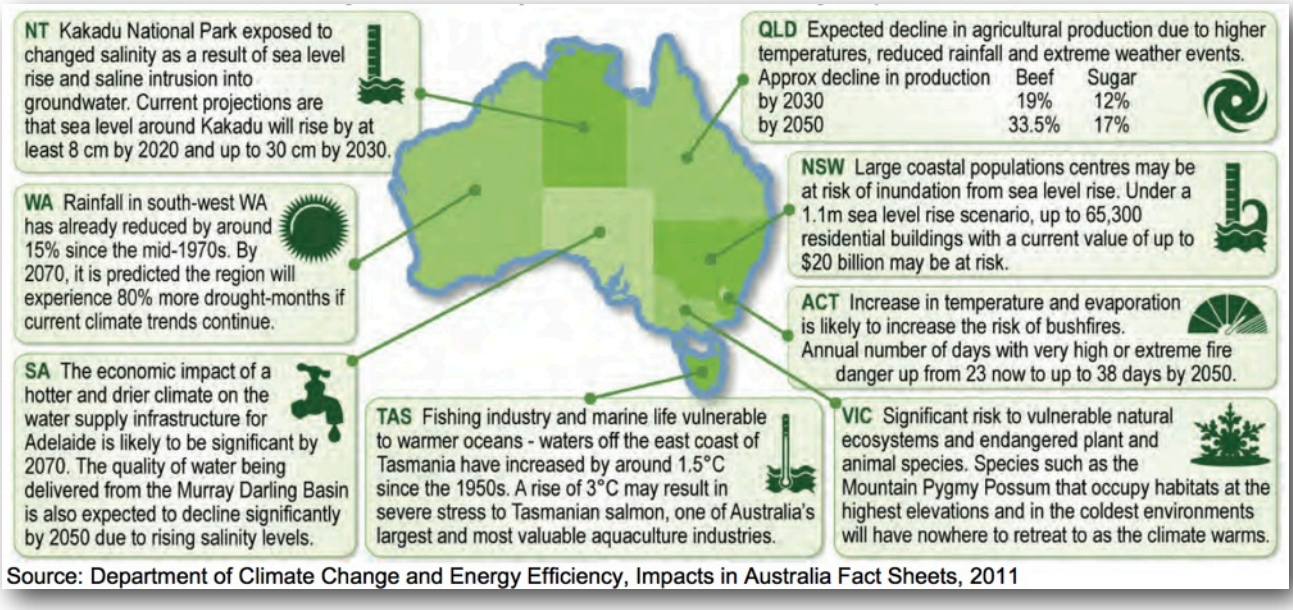

Figure 13 Main predicted impacts of climate change for Australia.

Interactions between factors nationally

For some issues, environmental, economic and social interactions will provide additional challenges. The climate change impacts described earlier are likely to have added socio-cultural implications nationally when considered with the **compounding** effects of:

- Water use for maintaining public open space has been seen as discretionary use in the eastern states of Australia. This perception is a major threat to government policies for participation, fitness promotion and obesity management, and while this perception is maintained, the sport, leisure and recreational sectors will remain the poor-cousins of decision making by larger planning and water allocation agencies.
- Water shortages may be used by developers as an excuse to erode the required level of provision of open space and related facilities in favour of greater residential lot yields.
- Potential loss of specialist staff experience during temporary and permanent facility closures.
- Increased community expectations in terms of access, availability and quality of sporting and recreation facilities, particularly in terms of technical improvements in facilities and equipment and the flow-on effect of increased cost of participation.
- Adjustments to working patterns (late night trading, all day Saturday trading, 7-day trading, 24-hour trading) making traditional sport and recreation times more difficult to identify and secure commitments for participation.
- Ongoing adjustments to the nuclear family concept with an increasing proportion of single parent and same sex households.
- Changes in general leisure patterns from organised club activities to informal and extreme activities.
- The enormous capture of leisure time by television and other multimedia sources competing with promotion of the health benefits of increased outdoor activity.

Working for the earth is not a way to get rich, it is a way to be rich
...Paul Hawken, entrepreneur, environmental activist and author (May 2009)

'Public space is for living, doing business, kissing, and playing. Its value can't be measured with economics or mathematics - it must be felt with the soul.'
....Enrique Peñalosa

You can forget the idea that a low-carbon future will be boring and dull, it can be exciting, as aspirational as we want, so let's make it happen
- Will Day, Chairman, Sustainable Development Commission (February 2010)

Possible approach and actions for PLA

It has been shown in earlier sections of this report, that peak bodies have an important role to play in helping practitioners and the community undertake mitigation actions, but more importantly in preparing and implementing disaster risk management and adaptation plans. PLA has the opportunity to play a significant leadership role in assisting the parks and leisure industry in: establishing effective partnerships that will be required across disciplines, between agencies, practitioners and the community; to understand and have access to relevant information; to provide advocacy and capacity-building for the industry and to facilitate applied research required to maintain the right to recreate.

With the plethora of information available about climate change, why is it often ignored or not acted upon?[35]

- Mismatches between what scientists can provide and what end-users need
- Mistrust of science and the information used to create government agenda
- Untimely delivery of information
- Media and political bias
- Lack of communication between knowledge providers and end-users
- Lack of resources to help interpret science
- Lack of time to carefully consider, learn, and understand science
- Need for researchers to demonstrate the usefulness and legitimacy of knowledge products

Upshot:

i) It takes time, continual interaction, mutual learning, and persistent reaching out to each other to achieve acceptance and adoption of science-based knowledge products.

ii) Improving interactions between providers and users of information must be matched by a change in attitude, measures of accountability and accessible decision support.

'The strategy we follow must give people an active role in helping to solve the climate crisis and to connect the value of what we're encouraging them to do to personal experiences that carry emotional meaning' .....Al Gore, Our Choice

Principles for Effective Decision Support include:[34]

1. Begin with users' needs
2. Give priority to process without neglecting products
3. Link information producers and users
4. Build connections (partnerships) across disciplines and organizations
5. Seek institutional stability
6. Design for learning.

[35] http://www.nccarf.edu.au/sites/default/files/Moser_2011_The%20Art%20and%20Science%20of%20Connecting%20at%20the%20Science-Practice%20Interface.pdf

Central issues in efforts to provide climate services to decision-makers, stakeholders and the community include:[36]

- Determining who matters and why they matter
- The need for ongoing dialogue between providers, users and the community
- Bringing together top-down (institutional) and bottom-up (community) knowledge
- Recognising local knowledge as legitimate
- Encouraging local initiative.

But we have not yet figured out how to mobilise the bottom-up part!

- Who are they?
- How to represent the bottom-up community effectively and fairly?
- How to sustain its active participation?

'When asked if I am pessimistic or optimistic about the future, my answer is always the same:

If you look at the science about what is happening on earth and aren't pessimistic, you don't understand the data.

But if you meet the people who are working to restore this earth and the lives of the poor, and you aren't optimistic, you haven't got a pulse.'

.....Martin Keogh, Hope Beneath Our Feet: Restoring Our Place in the Natural World

There are at least three fundamental obstacles to community participation including:

- Global science does not always consider local knowledge to be scientifically valid
- Policy arenas often question whether local knowledge is apolitical
- Innovative problem-solving capacity for adaptation is usually bottom-up, while resource availability and decision-making authority is top-down.

The disconnect between bottom-up community and practitioners and those who provide resources and data top-down, has been recognised as a significant impediment in many fields of endeavour.[37] Experience elsewhere has shown that the community and field-based practitioners can be extremely valuable and capable partners. They provide:

- Perspectives on issues needing attention
- Sources of not only experience but also local information and insight not otherwise readily available
- Opportunities for learning by the "global" experts!

This more inclusive approach requires "different horses for difference courses," i.e. different standards for local knowledge in determining what is "possible." rather than standards for determining what is "scientifically valid."

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[36] http://www.nccarf.edu.au/sites/default/files/Wilbanks_Aust-MasterClass-TJW%5B1%5D%5B1%5D.pdf

[37] http://www.nccarf.edu.au/sites/default/files/Wilbanks_Aust-MasterClass-TJW%5B1%5D%5B1%5D.pdf

Experience elsewhere has also shown that plans are more likely to be implemented if they are relevant to *local* situations and if they speak in local language.

A key to maintaining effective partnerships, is in fostering an atmosphere of mutual trust rather than mutual suspicion: toward a partnership paradigm. This includes:

- Finding a way to emphasise, to value, and to reward co-benefits
- Getting help from intermediary third parties who act as interpreters, advocates and facilitators
- Utilising social media to reduce gaps in knowledge, improve access, trust and credibility
- Processes of collective leadership

Climate change adaptation **knowledge** & climate change adaptation **capacity** - evolving together...

SUMMARY - What it will take to maintain effective partnerships?

Recognising that **relationships are primary**

- Respecting and honouring the capacities, assets and passions of all people
- Continual self-reflection and willingness to transform
- Understanding relationships between the parts and the whole
- Understanding relationships between our aims and our programs
- Understanding relationships between people and between people and landscapes

Communicating in a way that is **Real**

- Being in open, two-way dialogue
- Using common language - translating science speak and government speak
- Taking time to listen, making time to learn
- Unfolding shared meanings instead of agreeing on one meaning
- Uncovering and evaluating assumptions rather than justifying assumptions

Building capacity to collaborate through training and **learning by doing**

- Improving skills to work together
- Growing skills in mediation and advocacy
- Developing problem solving skills
- Evolving interpersonal skills

Improving Performance

- **Inspire action**, don't expect it
- Maintaining effective, two-way monitoring and evaluation
- Using indicators of outcomes not measures of input or activity

Evolving our Institutions to be **in service**

- Providing incentives and support
- Using performance measures, recognition and accreditation
- Stabilisation and **accountability**

Planning

PLA can champion effective strategic and operational planning for Climate Change Mitigation, Disaster Risk Management and Adaptation (CCMDRMA) through leadership, advocacy and promotion. PLA has the opportunity to:

- **Grow and promote partnerships for planning and actions for CCMDRMA.**

  Partnerships based on functional and sustaining relationships will be required between parks and leisure industry practitioners, knowledge-providers, decision-makers and the community to develop effective.

  Facilitate the formation of professional and technical networks across sectors to progress CCMDRMA.

- **Create with partners, a parks and leisure framework.**

  A parks and leisure framework should be established to facilitate a common understanding and consistent approach to CCMDRMA, across all sectors (government, research, parks and leisure industry and the community).

- **Explore how other parks and leisure people globally are addressing CCMDRMA.**

  Undertake through desktop review an assessment of plans and actions for CCMDRMA in other regions (locally, nationally and internationally).

  Acquire first hand insights of innovative practice through overseas visits and staff exchanges, sabbatical leave, conference attendances and speaker invitations etc.

- **Evolve our own portfolio of CCMDRMA strategies and plans.**

  Showcase through icon projects, learning by doing, and review of international efforts, a portfolio of innovative CCMDRMA strategies and plans suitable for regional and local application.

  Maintain an ongoing watching brief on international and local efforts in CCMDRMA so as to remain relevant and to continuously improve performance.

Actions

PLA can inspire actions by showcasing innovative solutions being implemented elsewhere. People are also inspired to act when they are part of vibrant networks, are undertaking meaningful work and are in dialogue with other motivated groups and individuals. PLA has the opportunity to:

- Undertake a **needs analysis** for local and regional clients
- Build capacity to act through training, promotion and facilitating **learning by doing**
- Develop **benchmarks** - quantitative where possible, qualitative where appropriate
- **Advocate** for greater access to advice, information, technical products and supplies for achieving CCMDRMA outcomes.

- Implement branding, certification and **recognition** for innovation in CCMDRMA
- Identify, develop and promote **icon** projects showcasing aspects of CCMDRMA
- PLA can encourage the reporting of performance against targets as part of undertaking actions.

Carbon footprint

- PLA to continue its **endorsement** of, and being carbon neutral in all its activities
- Promotion of carbon neutral and emissions **reduction** for the parks and leisure community

Water

- PLA to continue to **benchmark**, promote and provide decision support for water wise cities, water smart parks and water wise facilities.
- Audit regional facilities provision for **water conservation** measures. Regional communities particularly in arid regions of WA have much to teach us in terms of water-use efficiencies and adaptation as they have been doing it for a long time

Extreme events

- Provision of DRM strategies and plans.
- Insurance premiums can be used to foster best practice in DRM. PLA could advocate to insurers the benefits of a sliding scale of insurance premiums for best performers.

Sea level rise

- PLA to advocate for coastal vulnerability assessment with coastal communities.

Facilities

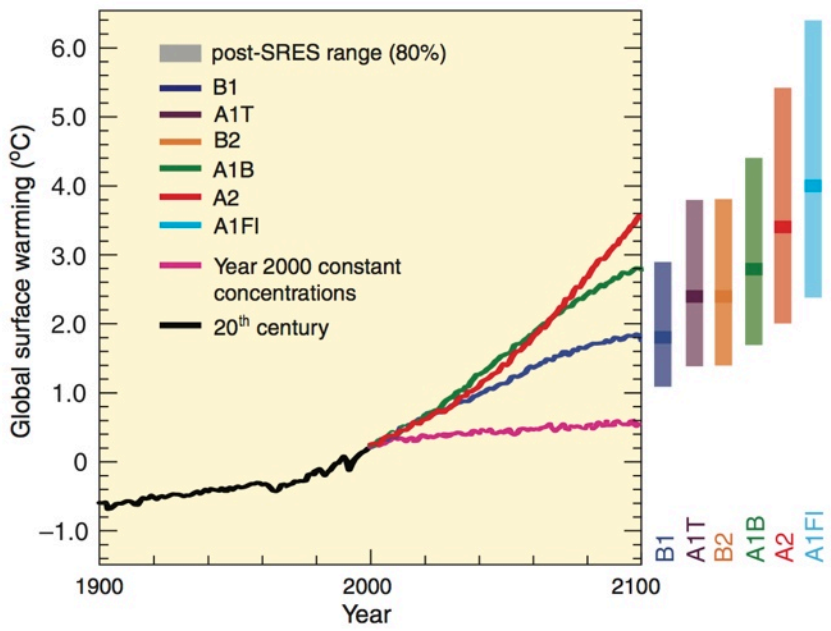
- Provide assistance in attaining better scheduling (sharing) of events and facilities use ie shift to night events, shift to alternative days or times during the day
- Identify and promote best practice and alternative management options (e.g. synthetic turf)

Messages

Effective and open communication builds bridges to the community and between parks and leisure partners, particularly for the jargon-laden climate change dialogue. The community is hungry for simple and factual information about this complex issue. PLA, in all of its promotional material and advocacy, has the opportunity to use clear, accessible language at all times.

- Prepare and advocate for the provision of clear and accessible **information** about all relevant aspects of CCMDRMA.
- PLA has the opportunity to publicise the results of its exploration of global and local examples of **innovation** and best practice in CCADRMA.
- PLA has the opportunity to promote thorough example, the benefits of effective partnerships and networks. PLA can promote the benefit of effective relationships between practitioners and the community and particularly with our stakeholder institutions as they evolve to being in service around CCADRMA opportunities**.**

Appendix 1 The emission scenarios of the IPCC special report (SRES[17])



A1. The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies.

Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil-intensive (A1FI), non-fossil energy sources (A1T) or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

A2. The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self- reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

B1. The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

An illustrative scenario was chosen for each of the six scenario groups A1B, A1FI, A1T, A2, B1 and B2. All should be considered equally sound.

The SRES scenarios do not include additional climate initiatives, which means that no scenarios are included that explicitly assume implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol.

Appendix 2 Implications of climate change for various sectors

Impacts and implications of climate change for various industry sectors from the perspective of parks and leisure. (Adapted from Bates, L., Green, M., Greenhill, M. [2101] Developing storylines for alternative climate futures: A snapshot of results from the Swan-Canning workshops. CSIRO pers comm).

Impact	Vulnerabilities	Implications	Costs	Certainty & Measurement
Water supply *Temperatures*: increase particularly in summer *Rainfall*: reducing rainfall in winter in south Rainfall: modest increases in summer rainfall in the north	Current widespread use of exotic vegetation requiring irrigation Current heavy reliance on surface dams and groundwaters Political heat in policy setting for demand management (restrictions) & water pricing	Reductions in water availability in southern Australia, water restrictions Recreational & sporting use of water & provision of irrigated landscapes curtailed	Significant increases in the cost of provision of parks and leisure facilities Reduced access to parks and leisure facilities leads to declining physical, mental and spiritual health of communities	Some scientific uncertainty in the magnitude and speed of predicted changes. Little political certainty in the nature and severity of direct impacts.
Health Increase in extreme events: fire, flood, cyclones, drought, dust storms, hail storms Increase in temperatures and rainfall in northern areas	Current community vulnerability to extreme events Costs of insurance Vulnerability to tropical disease vectors	Increase in southerly extent and disease risks associated with wetlands eg malaria etc Increased heat island effect in cities Increased water temps leading to increased disease risk (eg. amoebic meningitis in swimming areas)	Increasing costs of insurance protection against extreme events. Social and emotional costs of catastrophic loss of facilities Increased stress and reduced physical, mental and spiritual health of communities	Difficult to accurately predict the severity & frequency of changes in extreme events
Coastal management Sea level rise, storm surge, beaches	Coastal infrastructure: jetties, moorings, boat ramps, retaining walls Erosion-prone coastal areas Low lying areas at risk of saline inundation	Damage to coastal infrastructure from sea level rise and storm surge Erosion of fragile coast lines Inundation of low-lying coastal recreation areas Loss of beaches	Opportunity cost of infrastructure protection lost for other expenditures	High degree of certainty in future predictions of sea level rise under the various climate scenarios. Some difficulty in accurately predicting the magnitude and frequency of storm surge events.
Biodiversity & amenity Increase in temperatures and evapo-transpiration Reduced rainfall in southern areas Increase in wild fire frequency and intensity	Vulnerable marine ecosystems Bushland vegetation areas, nature-based recreation and sporting areas Lack of corridor connectedness & buffers	Coral bleaching, southward migration of marine pests (eg sea wasps), disruption of marine food webs Localised extinctions of terrestrial species	Significant costs associated with the loss of recreational opportunities for beaches and other low lying areas.	Difficult to accurately predict impacts & changes in land and marine ecosystems. Many uncertainties and unknown tipping points for species assemblages

Impact	Vulnerabilities	Implications	Costs	Certainty & Measurement
Agriculture[a] Shortened growing seasons Water shortages in southern WA Increase in evapo-transpiration Increase in extreme events	Cropping systems in marginal lands, salinity issues for southern rural towns Irrigated enterprises Crops without adequate wind and fire breaks	Reduced reliability of farm incomes Greater population drift away from rural and regional areas Reduced viability of rural and regional sporting facilities and events	Significant costs for individual farmers and rural communities as low-rainfall farm land becomes more marginal Increasing stress & social costs	Considerable evidence from changes that have already occurred. Some uncertainty in predictions of the speed and extend of adverse changes to cropping etc
Energy sector Increase in temperatures Increase in extreme events	Climate sensitive design is not wide spread Vulnerable energy infrastructures	Increasing reliance on air conditioning, increasing costs of energy Recreation centres used as emergency refuges, disrupting normal events and income streams	Significant increase in costs for cooling of recreation centres etc during hotter summers Reduced reliability of energy supplies because of extreme events damaging energy infrastructures	Some scientific uncertainty in predictions of the speed and extend of temperature increases & extent and severity of extreme events.
Local government Hotter drier summers, increase in temperatures Increase in extreme events	LGAs with low rate base and aging infrastructure	Flood and fire control, disease and pest management, water management, POS provision, coastal, urban and risk management. Increasing expectations by community for indoor centres, synthetic surfaces, lighting for night fixtures	Increasing costs of infrastructure provision for parks and leisure for most LGAs.	Some scientific uncertainty in predictions of the speed and extend of temperature increases & extent and severity of extreme events.
Parks & leisure Increase in temperatures Increase in extreme events	Outdoor recreation and sporting events over hotter months Marginal sports and recreation services adversely impacted by extreme events Potential conflict around shared use of facilities Technology adoption not matching requirements	Disruption of outdoor sport and recreation events Disruption of indoor recreation events where facilities are used as part of emergency response Risk of falling participation and volunteering rates	Increasing costs of infrastructure provision for parks and leisure for most LGAs.	Some scientific uncertainty in predictions of the speed and extend of temperature increases & extent and severity of extreme events.

Agriculture[a] Includes viticulture (wine & table grapes), horticulture and amenity horticulture (POS).

Appendix 3 Impacts identified in the WA Dept of Sport and Recreation's 2007 Climate change adaptation framework.

The Department of Sport and Recreation commissioned PLAWA to develop a Climate Change adaptation framework[38] in 2007. More than 15 workshops were held to seek the views and recommendations of Sport and Recreation stakeholders throughout WA during the preparation of the DSR framework. The following sections present these findings which have been further developed and refined by the PLAWA regional council members.

The range of potential direct and indirect impacts of climate change were thought by stakeholders to include the following:

- water shortages arising from climate change were seen as an immediate and serious threat to sport and recreation generally and to the achievement of DSR initiatives specifically,
- higher temperatures and increased frequencies of extreme events were seen as having relevance and needed to be accounted for in a climate change adaptation strategy,
- sea level rise was seen as having the potential to impact on sport and recreation but its time frame and severity of potential impact was seen as a lower priority,
- there is a need to better define the relativities of various impacts in space and time on sport and recreation,
- there is a lack of a comprehensive early warning system for facilities managers in the face of extreme events particularly in sport-tainment where the immediate economic effect is greatest,
- contingency planning is required to lessen the impacts of extreme events, and
- DSR has a good network for partners, stakeholders and clients and this will be of benefit in evolving the climate change adaptation framework.

[38] http://www.dsr.wa.gov.au/assets/files/Research/Climate_Change.pdf

Appendix 4 Implications of climate change on parks and leisure in WA

Reductions in rainfall, water availability and increased evaporation

The following table summarises issues for parks and leisure concerning water availability.

Topic	Impact
supplies for irrigation of dedicated sports grounds and public open spaces	Direct
increased evaporation requiring more irrigation for existing turf and landscapes	Direct
increased costs of alternate water supplies	Indirect
greater requirement for monitoring, reporting of facilities water-use efficiencies	Indirect
reductions in the quality of playing surfaces and irrigated open spaces	Direct
permanent damage to facilities during temporary or permanent water shortages eg clay tennis courts, cricket pitches drying out and being permanently damaged	Direct
greater frequencies and severity of drought conditions as an impediment to sport and recreation	Direct
forced or temporary closure of facilities	Direct
greater risk of saline intrusion into nearshore superficial aquifers	Direct
increased evaporation from open water swimming pools etc	Direct
reduced access or availability to shared facilities	Direct
greater reliance on user-pays and cross-jurisdictional turf wars	Indirect
competition for narrow grey water-reuse windows	Indirect
less runoff could lead to reduced flushing of waterways or higher concentrations of bio-stimulants in runoff leading to more potentially harmful algal blooms and closure of direct contact recreational pursuits	Direct
compromising of fitness related health programs	Indirect
loss or disruption of icon tourism events such as the Avon Decent	Direct
cost of retro-fitting water-use efficiency measures	Indirect
socio-cultural tensions between sports groups and between leisure-based groups	Indirect
reduced opportunity for fresh-water based recreational pursuits	Indirect
adverse impacts on the diversity of natural bushland particularly for water-sensitive species	Direct

Higher temperatures

The following table summarises issues for parks and leisure concerning higher temperatures.

Topic	Impact
increased frequency of heat-stress related impacts	Direct
increased demand for water-based recreational pursuits under hotter conditions	Indirect
increased exposure to UV radiation	Indirect
southern extension of the range of marine stingers and other tropical species of concern may need to be managed	Direct
schools-based physical education programs curtailed or cancelled	Direct
increase exposure to pathogens eg. amoebae) in recreational waters experiencing elevated temperatures	Indirect
reduced participation in outdoor fitness related health initiatives	Indirect
need to reschedule summer day time events to night-time fixtures and the increased demand for sports field lighting and the capital requirement to provide this	Indirect
move to air conditioned indoor facilities will require additional funding	Indirect
inability of poorer clubs to afford lighting for night events	Indirect

Increased frequency and severity of extreme events

Extreme events include: cyclones, floods, fires and gale-force winds

Topic	Impact
increased frequency, severity of extreme events such as cyclones, floods, fires	Direct
greater risk of storm or fire damage to facilities and infrastructure	Direct
extreme events may adversely impact on or knock out key events eg. cancellation of an AFL grand final or other major fee-paying spectator events with huge financial ramifications to industry	Direct
current planning models now place facilities within multiple-use corridors associated with drainage lines, greater risk of flood damage	Direct
increased damage to coastal facilities (beaches) requiring additional planning and management	Direct
current flood models	Direct
potential structural engineering issues from extreme events or geotechnical problems from over-abstraction of groundwater	Both
inability to obtain or increased costs of flood or extreme event insurance for individual clubs or group schemes	Indirect
greater requirement for facilities such as recreation centres to provide emergency response backup during extreme events	Indirect
event cancellation and disruption to electricity supplies during extreme events,	Indirect
economic stress for facilities managers from loss of income and loss of assets.	Indirect

Sea level rise

Topic	Impact
dislocation of facilities and communities in low lying areas	Direct
greater risk of storm surge in low lying areas	Direct
adverse impacts on fresh water ecosystems in areas of greater inundation	Direct
increased mosquito nuisance in low lying areas	Direct

Competition for space and access

Topic	Impact
increased competition for land space,	Direct
increased competition for access to finite facilities,	Direct
greater fragmentation of public open spaces,	Direct
fewer larger reserves for walking,	Direct
lack of opportunity for DSR input to regional sport and recreational planning,	Direct
lack of opportunity for DSR input to regional water allocation planning.	Direct

Appendix 5 Conclusions of the PLAWA industry climate change workshop.

Wednesday 7 December 2011

Claremont Bowling Club

Capabilities

- Manage public expectations and increase in population and usage
- Partner with nursery industry to broaden plant palette
- We have the technology to treat waste water, need partnerships to make it happen
- More effective partnerships to exchange information across tiers of government
- Better understanding of relationships between water, soil and use
- Better partnerships and info sharing between LGA's

Requirements

- Adequate stocks of appropriate species
- Relevant planting guidelines for landscaping
- More flexible water allocation distribution policy
- Better understanding of form function of hierarchy of parks
- Regional LGAs resource starved
- Better understanding of applied best practice on the ground – innovative – quantitative
- Networking
- Better understanding of climate change in practice on industry practice
- Better planning control of developer provision and handover

Vulnerabilities

- Don't understand the full range of benefits of specific vegetation (and value). Better understanding of the broader role and value of plants in the landscape
- Disjointed government policies – four departments involved
- Finite water supplies and lack of effective pricing signals
- Financial impact on rate payers of increasing costs
- Keeping pool of trained staff in budget costs
- Lack of contingency when catastrophic events(and flow on effects) derail routine activities ie fire, increased arson, cleaning up times after storms means regular maintenance in not maintained
- Competing uses of MUCs
- Smaller clubs access to information and resources to improve.