



CLIMATE CHANGE ADAPTATION AND MITIGATION STRATEGY

2020/21 - 2025/26

Table of Contents

MAYORS MESSAGE	1
EXECUTIVE SUMMARY	2
1. Background	3
1.1. Purpose	4
1.2. Changing Climate	9
1.3. City of Wanneroo and Climate Change	11
2. CCAMS 2020/21-2005/26	18
2.1. Risk Assessment Approach	18
2.1.1. Additional Risks	18
2.2. Action Identification Process	18
3. Target Setting.....	20
3.1. Energy Use Emissions.....	20
3.2. Fleet Emissions.....	20
3.3. Waste generation reduction	22
4. Risk Management and Adaptation and Mitigation Actions.....	23
5. Implementation	35
References	36

MAYORS MESSAGE



The City of Wanneroo acknowledges the significant impact climate change has on our everyday lives and the importance of reducing the long-term effects.

Global climate change is everyone's responsibility and we can make changes to the way we live; whether it's reducing plastic usage, conserving energy or carpooling when possible.

The City has already undertaken numerous initiatives to adapt to the challenges of climate change. However, in order to become more resilient, further developments need to be made to ensure we are prepared to deal with future risks such as reduced rainfall, severe weather conditions, bushfires, storms and rising of sea levels.

This revised Climate Change Adaption and Mitigation Strategy provides an updated direction on how we plan, prepare and respond to the effects of climate change, including areas of mitigation.

The City is also in the process of developing an Urban Forest Plan, which will further assist us in preparing for the impact on the community; including alleviating rising temperatures through protecting and preserving existing trees and planting additional trees across the City.

It is heartening to see the commitment and enthusiasm of our younger residents towards climate change and working towards a brighter and more sustainable future. The City has a responsibility to these young people, and subsequent generations, to limit negative impact on our community.

The City is a signatory to the WA Local Government Association's Climate Change Declaration and was recently presented with a Certificate of Declaration which outlines initiatives the City can implement.

Together, all these programs will enable us to reduce our carbon footprint, become more agile in our approach and guide us to develop innovative plans to protect and enhance our natural environment and the lifestyles of future generations.

Mayor Tracey Roberts JP

EXECUTIVE SUMMARY

The City's Strategic Community Plan 2013/14 to 2022/23¹ aspires to achieve a *sustainable natural, built and healthy environment*. In response to this community vision, an action within the City's Corporate Business Plan 2015/16 - 2018/19 has been the preparation of the Climate Change Adaptation and Mitigation Strategy (CCAMS).

The purpose of the CCAMS is to identify areas where the City and the community it represents, are exposed to the effects of climate change and provide risk management adaptation measures to reduce the risk, as well as to identify practical mitigation measures that would aid with the mitigation of the impacts of climate change.

In Western Australia, the CSIRO predicts climate change to result in hotter days and nights; reduced rainfall but more intense rain periods; more extreme weather conditions such as long periods of drought and severe storms; more bushfires; and rising sea levels³. It is expected that the City will be affected by these impacts.

The original CCAMS placed more emphasis on adaptation i.e. the ways the City can adapt to, and be prepared for the unavoidable impacts of climate change as they arise. The revised CCAMS outlines the adaptation actions that are still required to be implemented across the City, as well as raising the importance of and putting in place a number of mitigation actions to be implemented i.e continue reducing energy consumption which will contribute to carbon emission reduction.

The City's Risk Management Framework has been used to identify effective management measures for the risks associated with climate change. The Framework will assist in the implementation of the CCAMS adaptation actions and will allow for efficient allocation of resources addressing the highest priority issues.



1. Background

The City recognises and acknowledges the risk that climate change presents to the City's community, Western Australians and the wider global community. To date, the City has made significant progress in terms of reducing its impact on climate change through a number of key initiatives including preparation and implementation of CCAMS 2016-2020. This document updates the previous Strategy and puts in place appropriate measures to effectively address climate change within the City's local government context, ability and jurisdiction.

Adaptation and Mitigation

Adaptation to climate change means taking action to adjust to the changes in the climate that are already underway such as temperature increases, reduced rainfall and extreme weather events, and to plan and prepare for the risk of bigger changes in the future, and resulting impacts such as sea level rise. For the City, this means changing the way we operate to safeguard our communities against the negative impacts of climate changes as above (e.g. ensuring homes are built in safer places, planting more trees to moderate ground temperatures, use plants that need less water, etc.).

The Intergovernmental Panel on Climate Change (IPCC) defines climate adaptation as: *"an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (2018)"*⁵

The City's main priority is to be able to adapt to the impacts of climate change that are predicted to be of a large scale, highly likely or inevitable as it impacts on the local government area and is within the City's ability and jurisdiction.

Climate change mitigation means taking initiatives to prevent (i.e. contribute to actions that help to delay, reduce or avoid) further climate change. The best example of mitigation is to reduce the carbon footprint, which is a global level initiative but must be contributed to at the local level, and primarily involves energy use reduction and shifting away from fossil fuels.

The CSIRO defines mitigation as actions that aim to reduce the amount of climate change, typically by limiting the future increases in concentrations of greenhouse gases in the atmosphere(2011)⁶

The City should demonstrate through its actions that it is taking active steps to reduce its contribution GHG emissions that are causing changes in the climate.

By implementing adaptation actions to reduce climate change impacts, the City can also indirectly reduce its overall contribution to GHG emissions, which would contribute to mitigation. For instance, an adaptive action to cope with a hotter climate such as planting trees throughout the City, can serve to reduce air-conditioning use required to ensure comfort to occupants of buildings. The reduced energy consumption leads to a reduction in greenhouse gases, and additionally trees will absorb carbon dioxide through photosynthesis so further reducing GHG emissions. In addition, the City will continue to undertake active

mitigation through implementation of its Energy Reduction Plan, which was an initiative of the previous CCAMS, to reduce City’s emissions. This scenario is outlined in Figure 1.

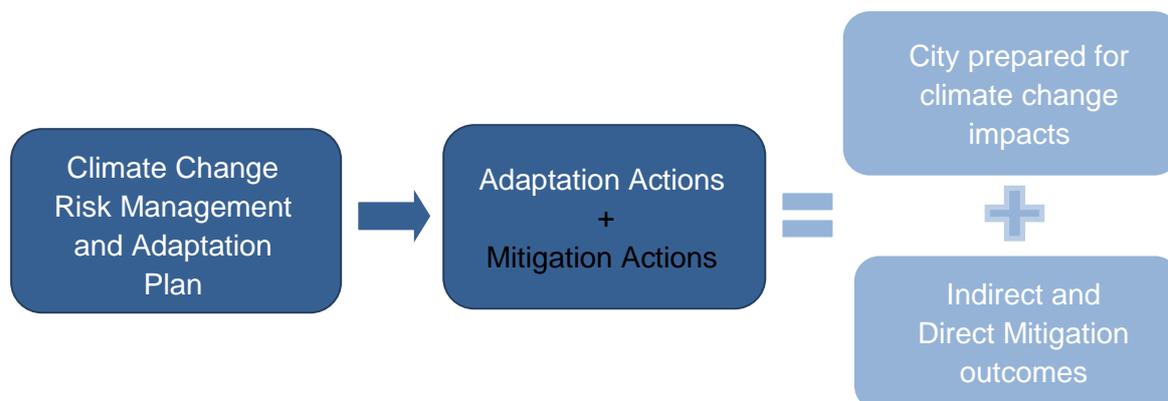


Figure 1 CCAMS outcomes

1.1. Purpose

As a local government, the City, on behalf of the community, shares a responsibility for the management of risks to public assets (including the natural environment) associated with climate change. This involves creating an institutional framework that promotes and supports adaptation to and mitigation of climate change whilst delivering services to the community. Through consultation with its residents, including the City’s youth, the City has identified the need to have a stronger vision and a clear strategy for responding to climate change. This conversation, which is ongoing, has informed the review of this revised strategy.

Global organisations, such as the IPCC and The United Nations Framework Convention on Climate Change (UNFCCC), an entity tasked with supporting the global response to the threat of climate change, have long been encouraging risk management, adaptation and mitigation strategies, so that society is prepared for climate change. The UNFCCC is the parent treaty of the 1997 Kyoto Protocol and the 2015 Paris Agreement. These aim to stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous climate system changes, allowing time for ecosystems to adapt naturally and enable sustainable development¹⁹. According to professor Jean Palutikof Director of the Australian National Climate Change Adaptation Research Facility, *“the scientific evidence points strongly that there will be unavoidable climate change even though our mitigation efforts can reduce some impacts. As Australia’s climate changes in increasingly significant ways over the coming decades we need to be sure that we are ready⁽⁴⁾”*.

Local governments are at the forefront in dealing with the impacts of climate change at a local level, so innovative planning and appropriate action in both mitigating the impacts of and adapting to the climate changes by the City is essential.

The CCAMS implements the aspirations identified by the community in the City’s Strategic Community Plan (SCP) 2017/18-2026/27 and implements the actions of the Corporate Business Plan (CBP) 2019/20-2022/23 as demonstrated in Figure 2. The SCP is a long-term, overarching document that presents the vision and aspirations for the future of the community, and sets out key strategies and actions required to achieve these aspirations.

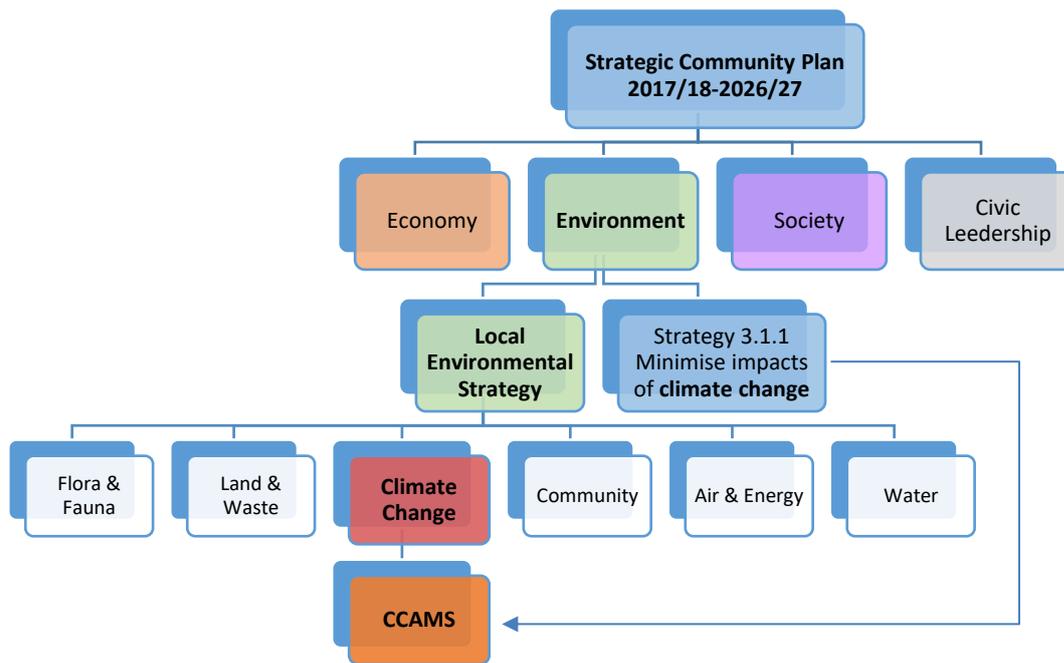


Figure 2 City of Wanneroo Climate Change Adaptation and Mitigation Strategy strategic alignment

In response to the SCP, the City's Local Environment Strategy 2019 (LES) outlines the City's overall approach to protecting and managing the key environmental resources and values important to the City's future. The LES acts as an extension to the Environmental pillar and provides a direct response to the community's expectations through the six themes of flora and fauna, land and waste, community, climate change, air and energy, and water. Climate change has impacts on and or gets impacted by the other five themes, however it has been separated due its complexity and level of importance.

Before development of CCAMS 2016-2020

Before development of the CCAMS, the City's risk management process identified climate change as a strategic risk to the City with the overall risk rated as high in the City's Risk Register. This had resulted in various initiatives being developed and implemented to deal with this risk.

The City's Local Environment Plan 2009-14⁷ later replaced by the Local Environment Strategy 2019, promoted a focus on reducing greenhouse gas emissions. In line with this, and to demonstrate its commitment to sustainability in 2011, the City in 2011 jointly sponsored the design and build of the award winning EcoVision display homes. The two homes showcased best practice affordable and sustainable design options including water conservation, greywater recycling, photovoltaics, healthy home principles and universal design. The homes were open to the public for 12 months and took out numerous awards including the National Greensmart Award for the Sustainable Townhouse/Villa category.

The City has also funded large scale solar panel systems at high energy usage sites that had been identified as having ideal conditions for solar panel investment. These include the Civic Centre, Aquamation, Kingsway Sporting Complex and Clarkson Library. This has ensured the City is less reliant on non-renewable electricity and has provided a demonstration of Council's commitment to the environment - achieving environmental outcomes in a financially viable way.

The City has diversified its investment in the future by installing a voltage optimisation system at Aquamotion. This electrical energy saving device is further cutting the City's energy usage by ensuring less energy is wasted within the facility. Undertaking the Civic Centre extension project has had a high level of sustainable inclusions, including passive solar design orientation, solar panels, energy efficient lighting and sunshades (reducing the need for air conditioning). All of these features ensure less reliance on electricity derived from non-renewable sources.

Changes since CCAMS 2016-2020 came into effect

In July 2019, through the City's risk management process, risk rating of climate change as a strategic risk to the City has been downgraded from high to moderate based on existing management systems and controls in place, including the City's:

- Local Environment Strategy 2019;
- Local Biodiversity Plan 2018/19-2023/24;
- Climate Change Adaptation and Mitigation Strategy 2016-2020;
- Energy Reduction Plan 2017-2020;
- Coastal Assets Policy;
- Local Planning Policy 4.21;
- Bushfire Committee;
- Bushfire Management Plan;
- Sand Renourishment Programs;
- Coastal Hazard Risk Management Adaptation Plan (CHRMAP) Development Consultation Process;
- District Emergency Management Committee;
- Local Emergency Management Committee;
- Local Emergency Management Arrangements; and
- Local Planning Policy 4.10 Streetscapes etc.

Implementation of the CCAMS has seen a number of initiatives and projects undertaken including energy and water audits of a number of high use facilities, implementing audit recommendations, and achieving significant water and energy savings. The City participated in the joint Department of Water and Environmental Regulation (DWER) and Water Corporation's Waterwise Council Program, and in 2020 received endorsement as a 'gold' Waterwise Council. The City is also putting in place an Environmental Management System (EMS) to record, manage and analyse environmental-related data relating to all the City's activities, and to identify where environmental impacts might or are occurring, ensure appropriate actions are put in place to prevent and eliminate them. The EMS is underpinned by a risk assessment approach and includes risks relating to climate change.

In September 2019 the City endorsed an Environment Policy which demonstrates the City's commitment to protecting and enhancing its natural environment and incorporating the principles of ecologically sustainable development throughout its operations and business activities to benefit current and future generations taking into account environmental, economic and social impacts (Triple Bottom Line). It also makes specific commitment to adapting to the changing climate and where practical, minimising its contribution towards climate change.

Following a community petition in October 2019, for the City to declare a climate emergency, the City strengthened its commitment to address climate change by becoming a signatory to the Western Australian Local Government Association's (WALGA) Climate Change Declaration. The Declaration acknowledges that climate change is occurring and will continue to have significant effects on the environment, society and economy, and that human behaviours, pollution and consumption patterns have both immediate and future

impacts on the climate and environment. Through the Declaration, the City also commits to strengthen its actions towards adaptation and mitigation, as reflected by the CCAMS.

In addition to the above adaptation actions, initiatives and resultant indirect climate change mitigation, the City has an Energy Reduction Plan (ERP). The ERP has been reviewed in line with the new CCAMS, and in its revised form will continue to reduce the City’s energy use. It will also seek to encourage the City’s community to reduce their energy use, thereby also contributing to overall reductions of GHG emissions. The City has conducted an independent energy audit of the top 20 energy use sites and has identified a range of energy efficiency improvements. The City also addresses GHG emissions issues through a range of policies, strategies and action plans including:

- Environment Policy
- Purchasing Policy (Sustainable Procurement)
- Investment Policy
- Local Biodiversity Plan
- Waterwise Council Action Plan
- Water Conservation Plan
- Waste Management Services Policy
- Waste Plan 2020-2025
- Waste Education Plan 2018/19-2022/23
- Bushfire Risk Management Plan

Table 1 below, outlines examples of completed/ongoing and current measures undertaken by the City to address impacts of climate change, including associated risks and related impacts.

Table 1 Risks, measures undertaken and related impacts

Risk	Measures undertaken	Related impact
Increasing temperature	<ul style="list-style-type: none"> • Implementation of Local Emergency Management and Recovery Plans; • Annual bushfire awareness community day; • Annual review of current emergency management risks within the City; • Quarterly local Emergency Management Committee meetings with all relevant agencies; and • Employment of Fire Protection Officers by the City. 	Increased potential for bushfires
Increasing temperature	<ul style="list-style-type: none"> • Annual tree planting programs implemented at various sites around the City including wetlands, bushlands, foreshore, parks/reserves, streetscapes and residential verges; • Shade policy incorporated into the Local Planning Policy 4.3: Public Open Space as a standard requirement with preference given to tree planting as primary shade provider for playgrounds and picnic areas, however, installation of a shade sail until such time as tree shade is adequate is required; • Shade sail installation program for existing sites that do not have adequate shade; • Preparation of Streetscapes local planning policy; • Implementation of a Mosquito Monitoring Program and public education campaign to reduce the potential increase of mosquitoes; • Investigation into alternative pathway and road materials to reduce urban heat island effect and increase proportion of recycled materials used; and • Commenced preparation of the Urban Forest Plan. 	Increase in surface temperature

Risk	Measures undertaken	Related impact
Reducing rainfall	<ul style="list-style-type: none"> • Implementation of Hydrozoning program involving the staged replacement of irrigation systems in parks and reserves, to ensure water is used more effectively throughout parks; • Wetting agent dosing units installed to all irrigation systems on Active Sports Fields and will continue to be installed at new sites; • Preparation and implementation of North West Corridor Water Supply Strategy (with Department of Water); • Comprehensive assessment of water usage within City buildings has been carried out (water audits of top 10 high use sites) identifying savings with a plan to continue; and • Participation in the Waterwise Council Program and development of a Waterwise Council Action Plan. 	Reduced water availability for parks and other irrigated areas
Extreme weather events	<ul style="list-style-type: none"> • Implementing the City's Coastal Monitoring Programme which includes: <ul style="list-style-type: none"> ○ Six monthly photographic monitoring; ○ Post storm inspections; ○ Six monthly coastal surveys of the whole City coastline; and ○ Annual condition assessment of coastal protective structures (groynes, breakwaters and seawalls). • Aerial Coastal Surveys; • Regular sand nourishment along areas of the City's coastline subject to coastal erosion; • Reviewed City's insurance policies to ensure they adequately treat climate change risks; • Conducted risk assessment on current (older) stormwater systems; and • Reviewed City's stormwater drainage specification design standards. 	More intense storms
Sea Level rise	<ul style="list-style-type: none"> • Implementation the Coastal Hazard Risk Management and Adaptation Plan; • Preparation of Coastal Assets Policy; and • Photographic monitoring and survey of beach levels twice yearly at Quinns Beach, Two Rocks and Yanchep Lagoon to monitor long term coastal erosion. 	Storm surges and flooding



1.2. Changing Climate

Over the last 130 years, the globe has warmed by approximately 0.85°C, with each of the last three decades being warmer than the previous one, as evident in Figure 3. Major contributors to this warming are human activities, which includes the burning of fossil fuels and release of large quantities of greenhouse gases into the atmosphere (Figure 4)⁸. These gases become trapped within the lower atmosphere increasing the temperature of the global climate, resulting in a range of effects including glaciers melting, sea levels rising, rainfall patterns changing and extreme weather events becoming more intense and more frequent⁸.

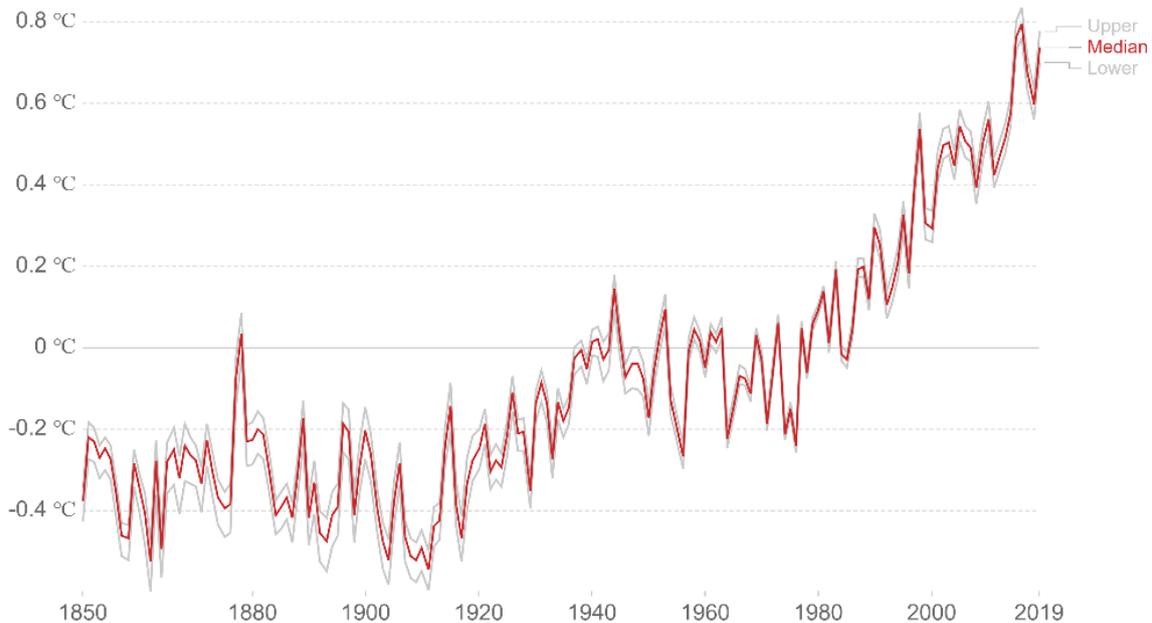


Figure 3 Global average temperature from 1850 to 2019¹⁵

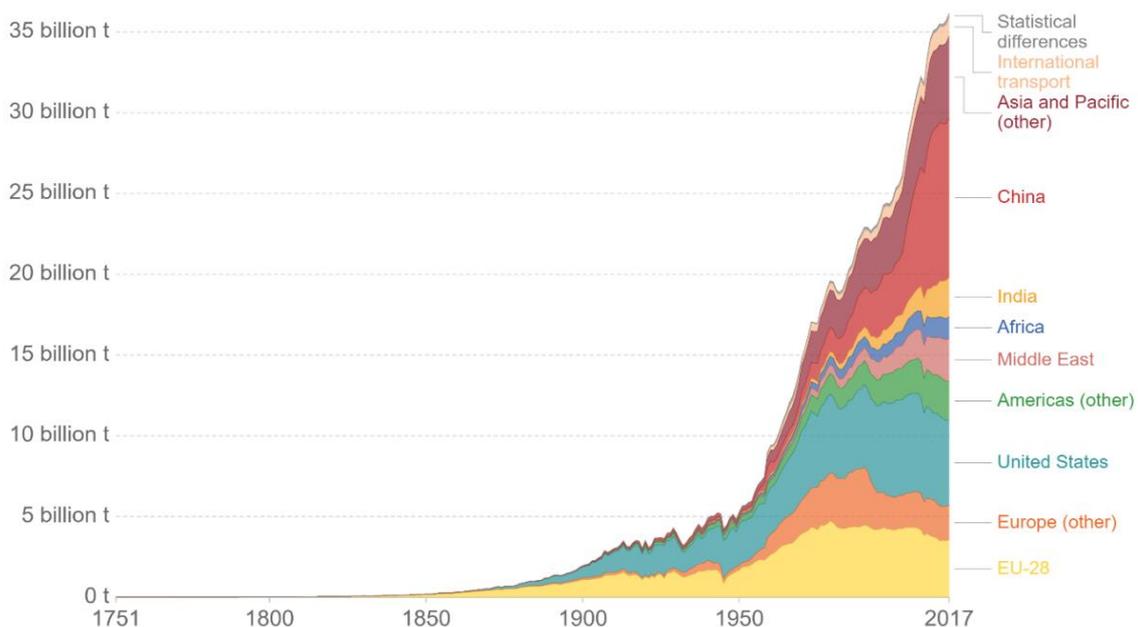


Figure 4 Annual total CO₂ emissions, by world region¹⁵

Over the past 50 years in Australia there has been an increase in heatwaves, less rain, less frosts, increase in droughts, and a slight rise in sea level. The Australian population have seen these changes in their daily lives, and through flow-on effects such as higher fresh

food prices and water restrictions in certain parts of the country⁹. In recent years, bushfires have become more frequent, more intense and affecting more people than ever. Also fire seasons have extended, now starting earlier and lasting longer. Making decisions for multiple futures requires recognising system uncertainty in planning and being flexible and adaptive. While it is important to have long term outlooks and actions, having shorter time scales allows for having more confidence and reduced uncertainty¹⁰.

The climate modelling community has developed Representative Concentration Pathways (RCPs) in 2011 to explore credible future options. The Australian climate change projections according to CSIRO are derived from climate models forced by the RCPs. There are four RCPs, RCP8.5, RCP6.0, RCP4.5 and RCP2.6¹¹. RCP8.5 predicts a future with little curbing of emissions, with a CO₂ concentration continuing to rapidly rise, reaching 940 ppm by 2100. RCP6.0 with application of some mitigation strategies and technologies predicts CO₂ concentration reaching 660 ppm by 2100. RCP4.5 predicts emissions peaking around 2040, and the CO₂ concentration reaching 540 ppm by 2100. RCP2.6 was the most ambitious mitigation scenario, with emissions peaking early in the century (around 2020), then rapidly declining. Considering the current global greenhouse gas concentration levels and trends (Figure 5), this scenario does not appear likely, which means not achieving the Paris agreement of 1.5°C temperature limit. The latest assessment found that the world in 2020 was on a path to 2.9°C of warming; however, because of the recent more ambitious targets and commitments by some countries warming is estimated at 2.1°C by 2100, which is still short of the Paris target.

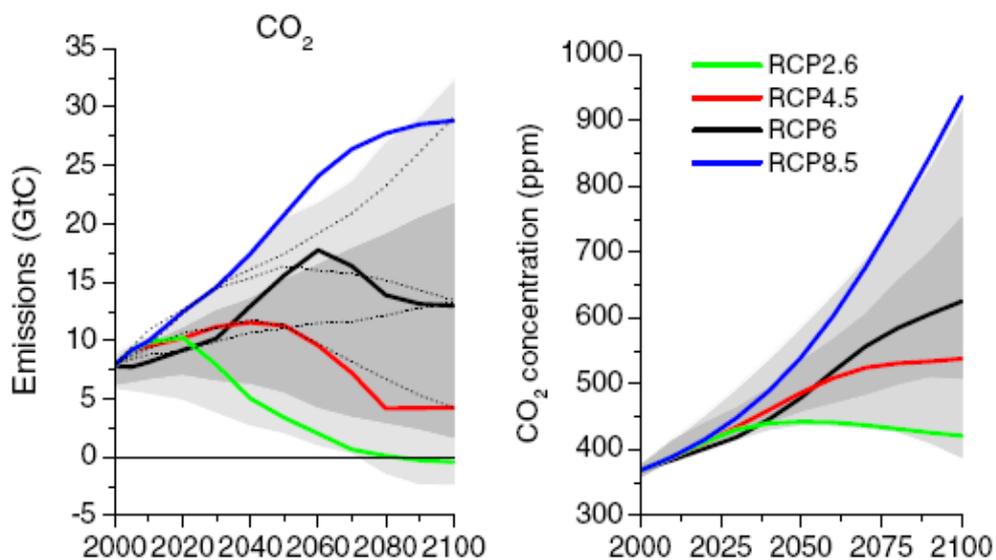


Figure 5 Emissions of CO₂ across the RCPs (left), and trends in concentrations of carbon dioxide (right). Grey area indicates the 98th and 99th percentiles (light/dark grey) of the values from the literature. The dotted lines indicate four of the SRES marker scenarios¹¹

The diagram in Figure 6 outlines the expected climate change impacts in Western Australia.



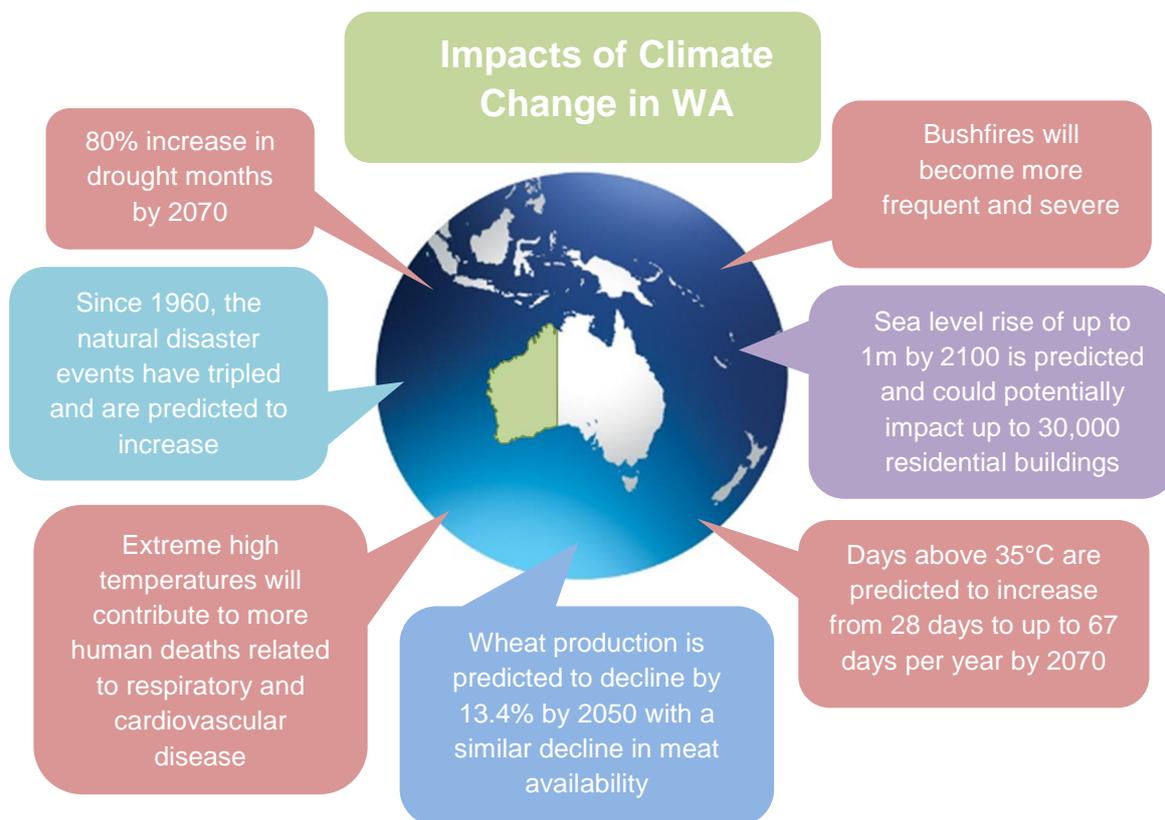


Figure 6 Impacts of Climate Change in WA (Sourced from WHO⁸ and Department of Environment¹²).

1.3. City of Wanneroo and Climate Change

The City will experience numerous impacts resulting from changing climate. This section details the changes in temperature, rainfall, extreme weather and sea level and outlines how these changes may impact the City.



Temperature

Wanneroo's average temperature has increased since 1910 in line with the Perth average and is predicted to continue rising. It is expected there will be more hot weather and less cold weather, with more record hot weather and an increase of average temperature (Figure 7). Perth's temperature has increased by just over 1.0°C since 1910 to 2018¹³. Under the Representative Concentration Pathway RCP8.5, the average temperature is predicted to increase between 0.5 to 1.5°C by 2030. If greenhouse gas emissions continue to rise at rates consistent with past trends, warming is projected to be in the range of 0.5 to 3.0°C by 2050, and between 3.0 and 4.5 by 2090⁹.

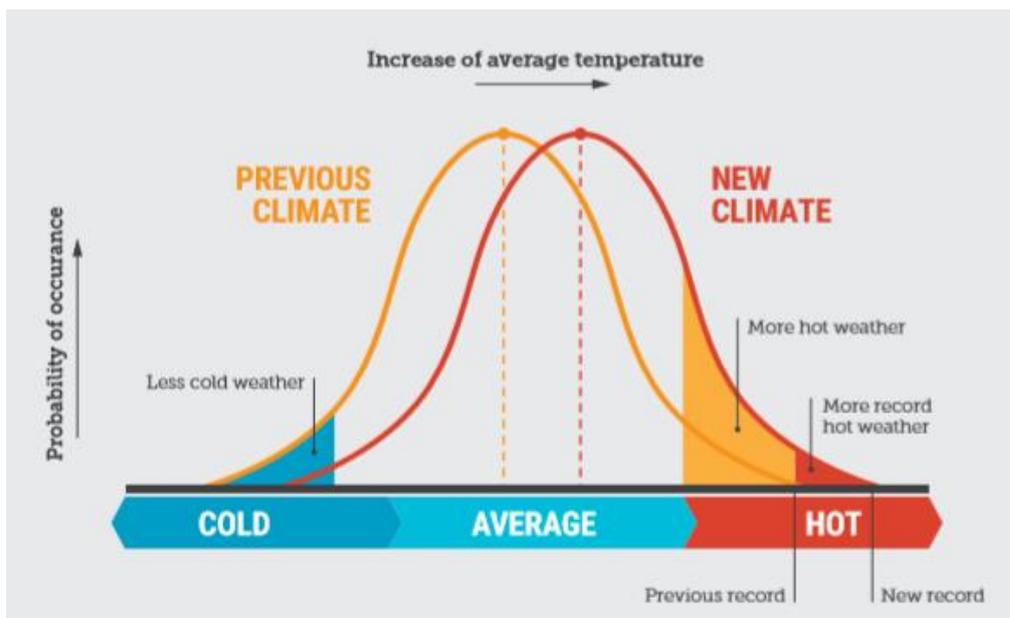


Figure 7 Increased probability of hot extremes and decreased probability of cold extremes with an increase in average temperatures¹⁷

The following impacts and consequences (Table 2) are predicted to apply to the City both in the immediate and long-term future, as a result of the predicted increase in temperature.

Table 2 Increased temperature impacts and consequences

Impacts	Consequences
Increased risk of bushfires (Figure 8)	<ul style="list-style-type: none"> • Increase in home evacuations to recovery centres; • Access blockage on major arterial roads and train lines; • Death of people unable to evacuate; • Disruption to the biodiversity cycle resulting in biodiversity loss; • Increase in weed invasion; • Impact on water quality; • Damage to council facilities and property; • Damage to street lighting; and • Loss of power.
Impacts upon human health	<ul style="list-style-type: none"> • Rise in food poisoning cases; • Increase in mosquito borne diseases (and various other potential disease vectors); and • A rise in heat stress and mental health issues particularly on vulnerable groups such as elderly and children, which will result in increased pressure on medical facilities.
An increase in surface temperature	<ul style="list-style-type: none"> • Loss of and/or severe stress on plants/vegetation cover and trees (i.e. street and civic landscaping, conservation reserves, etc.) • Potential air conditioner malfunction due to overuse; • Financial stress (cost of transport and cooling); and • Impacts on transport systems (buckling of rail lines and road wear and tear).
Damage to agricultural crops	<ul style="list-style-type: none"> • Increase in food costs and an overall reduction in productivity that will see changes in the agricultural industry; • Potential for cleared rural lands to become 'dead' zones with no vegetation cover; and • Subsequent impacts on land use, economy and employment.

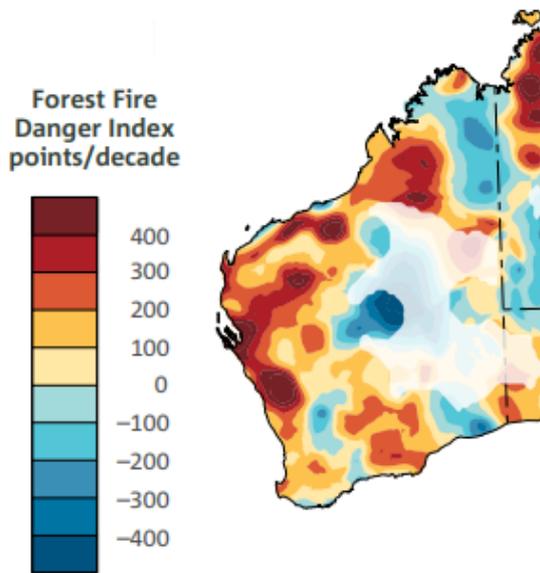


Figure 8 Severity of fire weather conditions across Western Australia (trends from 1978 to 2017)¹³

Figure 8 shows the trends from 1978 to 2017 in the annual (July to June) sum of the daily Forest Fire Danger Index as an indicator of the severity of fire weather conditions. Yellow to red colours, are indicative of an increasing length and intensity of the fire weather season. Climate change, including increasing temperatures, is contributing to these changes¹³.



Rainfall

Autumn and winter seasonal rainfall throughout the Perth Metropolitan area, including the City has declined by 20 per cent over the past 60 years¹⁴. This drying trend has intensified over the last 20 years with very much below average rainfall as per Figure 9, and with other parts of the state having lowest on record rainfall. Annual rainfall in the south-west is projected to decline by 6% by 2030 and 12% by 2090 for a medium-emission scenario, and

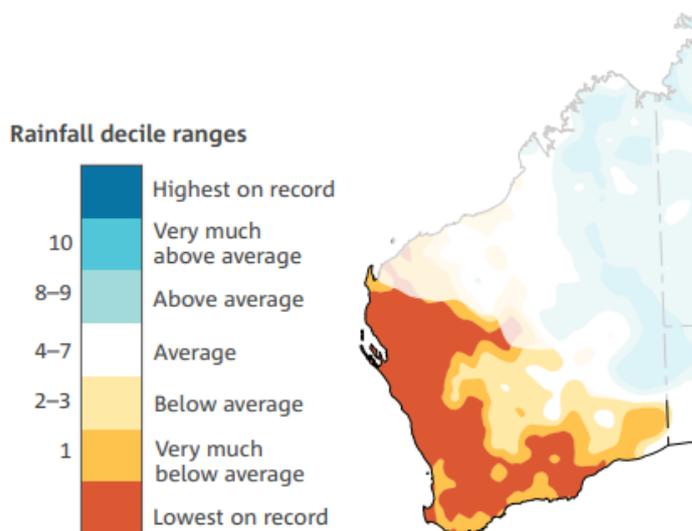
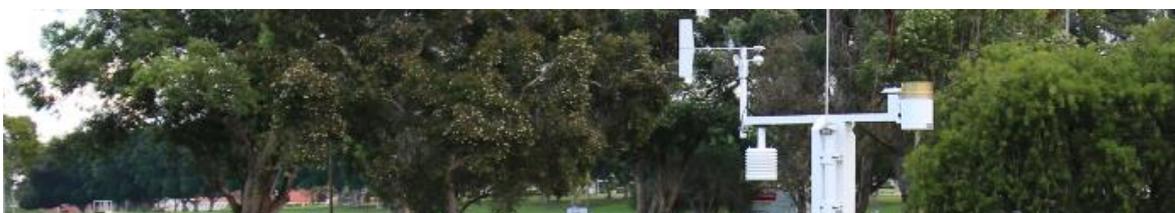
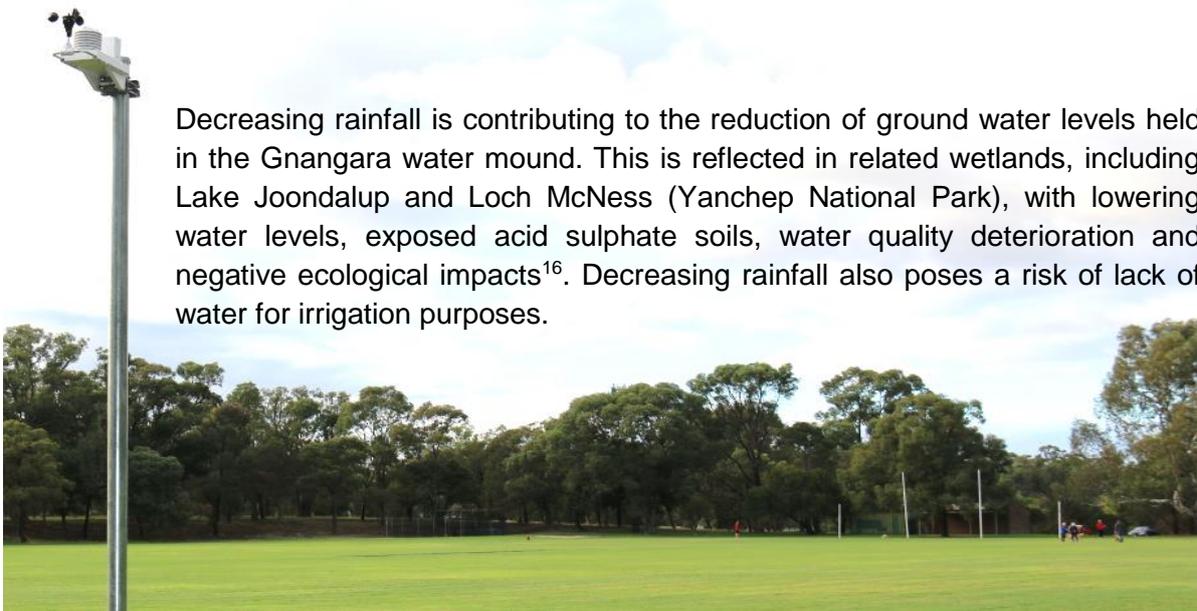


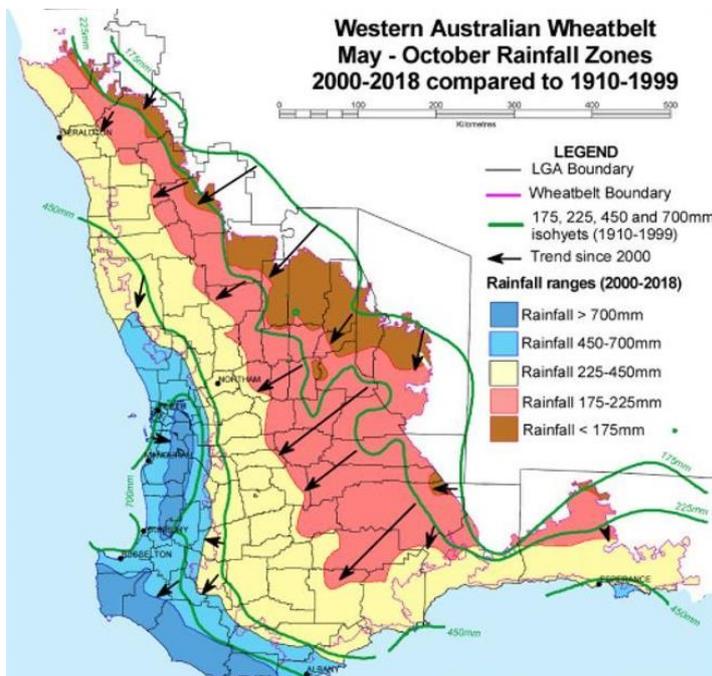
Figure 9 April to October rainfall declines between 1999 and 2018¹³

by 5% and 18%, respectively for a high-emission scenario¹⁴. April to October rainfall deciles (data ordered into 10 groups with an equal number of data points in each) for the last 20 years (1999–2018). A decile map shows where rainfall is above average, average or below average for the recent period, in comparison with the entire rainfall record from 1900. Areas across northern and central Australia that receive less than 40 per cent of their annual rainfall during April to October have been faded¹³.





Decreasing rainfall is contributing to the reduction of ground water levels held in the Gnangara water mound. This is reflected in related wetlands, including Lake Joondalup and Loch McNess (Yanchep National Park), with lowering water levels, exposed acid sulphate soils, water quality deterioration and negative ecological impacts¹⁶. Decreasing rainfall also poses a risk of lack of water for irrigation purposes.



Along with reduction in annual rainfall, rainfall zones are also shifting in the south west direction having a significant effect on the agricultural sector as well as other natural/ ecological processes dependent on seasonal rainfall (Figure 10)¹⁴. Table 3 presents the impacts and consequences that are predicted to affect the City.

Figure 10 May to October rainfall zones shifting due to climate change¹⁴

Table 3 Reduction of rainfall impacts and consequences

Impacts	Consequences
Reduced water availability for park areas	<ul style="list-style-type: none"> Reduced turf quality of playing fields and park closures affecting community health and lifestyle.
Increasing cost to deliver services	<ul style="list-style-type: none"> As water supply reduces the price is likely to increase.
Reduced water availability for agricultural crops	<ul style="list-style-type: none"> Increase in food costs and an overall reduction in productivity that will see changes in the agricultural industry; and Subsequent impacts on land use, economy and employment.
Reduced water availability for ecosystem services	<ul style="list-style-type: none"> Loss of biodiversity; and Loss of amenity and cooling affect from natural water bodies.



Extreme weather

Climate change induced extreme weather events are increasing in frequency and or severity as evident in Figure 11. Not shown on the graph, 2018 was a year of wild weather both globally and in Australia¹⁷. Drought-months (months without rainfall) are predicted to increase by 20 per cent by 2030 and up to 80 per cent by 2070¹⁴. This will consequently increase the number of fire-weather risk days.

In the south-west in recent years, including the metropolitan area, hot spells have become more frequent, and it is predicted that average annual number of days with temperatures over 35°C will increase from 28 days in the recent past (1971–2000 average) to 36 days in 2030, and to 40 days and 63 days in 2090 for intermediate and high-emission scenarios, respectively¹⁴.

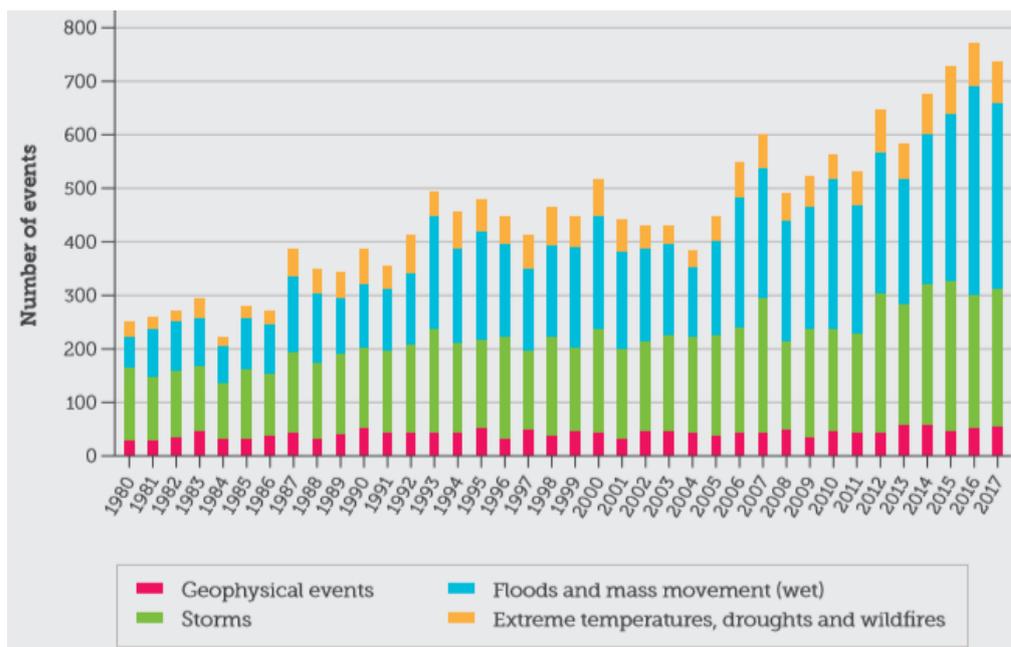


Figure 11 Number of extreme weather events worldwide¹⁷

It is predicted with medium to high confidence that the intensity of heavy rainfall events will increase¹⁴. This is likely to cause more flash flooding and with an increase in wind speed, damage both built infrastructure and natural assets. Impacts and consequences associated with extreme weather are presented in Table 4, with bushfire risk covered in Table 2 above.

Table 4 Extreme weather impacts and consequences

Impacts	Consequences
More intense storms	<ul style="list-style-type: none"> • Damage to vegetation causing hazards for people and animals (e.g. falling tree branches); • Damage to structures of all types; • Road closures; and • Loss of biodiversity.

Increase in storm surge	<ul style="list-style-type: none"> • Beach erosion; and • Damage to coastal facilities, property and structures.
Aberrant extreme weather events	<ul style="list-style-type: none"> • High costs due to damaged infrastructure and buildings; and • Increased risks to human safety.



Sea level rise

The rate of sea level rise is predicted to be greater in the 21st century than over the past four decades, with coastal cities such as Perth having an average increase of 60 – 66 cm by 2090 for RCP8.5 (high concentration scenario) and 45 – 47 cm for RCP4.5 (medium concentration scenario) (Figure 12). A likely range of change for RCP8.5 could be wider ranging from 38 cm to 89 cm across these cities¹⁸.

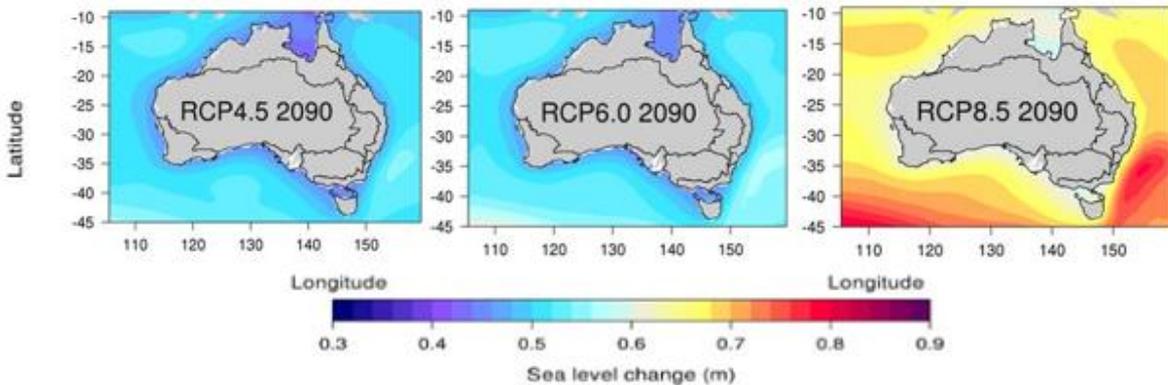


Figure 12 Sea-level change around Australia by 2090 (2081-2100) compared to 1986-2005 for the three concentration scenarios (RCPs) according to CSIRO and Bureau of Meteorology¹⁸

The City’s coastline extends 32 kilometres from Tamala Park to Two Rocks and is characterised by marinas, coastal limestone cliffs, coastal heathland vegetation and relic sand dune formations occurring as beach ridges. Even though there may not be serious direct impacts from the rise of the sea level (at ‘normal’ conditions) to the City’ coastline, impacts would be amplified when combined with intensified storm events. Table 5 outlines how the City will be impacted by sea levels rising.

Table 5 Sea Level Rise Impacts and consequences

Impacts	Consequences
Storm surges and flooding	<ul style="list-style-type: none"> • Erosion and inundation of dune systems; • Damage and loss of coastal structures including recreational facilities, marinas and harbours (including the damage and loss of boats and ships);

Impacts	Consequences
	<ul style="list-style-type: none"> • Damage to residential and commercial buildings, facilities and parks resulting in devaluation of private properties and litigation; • Effects on unconfined aquifers and contamination of bores; • Impacts on infrastructure including leakage to septic tanks and sewer systems, causing instability of swimming pools, tanks and other subsurface structures that are not anchored; and • Impact on roads and City owned infrastructure.



Conclusion

In summary, the City has a challenge ahead to ensure its assets and the community are prepared for the potential impacts of climate change. Effective adaptation and mitigation planning is needed to reduce the expected impacts, consequences and risks associated with climate change. Through the City’s risk management process and integration of climate related risks into the City’s Environmental Management System (EMS) the City will continue to address and strengthen the adaptation and mitigation efforts going forward.



Source: Crops Wanneroo (Wes Cooper), Loch McNess Dried up (Steve Copsy) and Mental Health (WA Government)

2. CCAMS 2020/21-2005/26

At present the City is improving its management of climate change by developing and its EMS in alignment with international standards (ISO 14001). This has resulted in the following advances.

2.1. Risk Assessment Approach

As part of the preparation of the previous CCAMS, the initial risk assessment process examined the level of climate change risk for the City in the areas of temperature, rainfall, extreme weather events and sea level rise, with temperature and rainfall rated as high, and extreme weather and sea level rise as moderate.

The re-assessment of climate change related risks as part of the new CCAMS was undertaken slightly differently by incorporating them into the City's risk management process by using the City's EMS, rather than in the CCAMS itself. Corporate level as well as operational level risks associated with areas of temperature, rainfall, extreme weather events and sea level rise, were identified and assessed or re-assessed in August 2020 and incorporated onto the EMS. Going forward, these risks will be monitored along with other significant environmental risks within the EMS's Environmental Aspect Register and reviewed on a regular basis through the City's Risk Management process.

2.1.1. Additional Risks

The review process recognised there are subsequent risks to climate change adaptation as a consequence of insufficient mitigation actions. If there are insufficient or no actions taken to mitigate, over a longer period the result would be an escalation in adaptation related issues and impacts, which would in turn increase the risk rating. A more immediate risk to the City would be reputational resulting from community dissatisfaction. Nevertheless, it is noted that the City as a local government has a limited capacity and jurisdiction to implement various mitigation strategies that the community often assume their local government should act on. Having said this, the City has been addressing all possible areas it can take action on within its jurisdiction at this stage, and will strive to do increasingly more in the future as the implementation of the Strategy progresses.

From a sustainability perspective, there are also opportunities associated with the risks and GHG emission reductions in particular. It is important that the City take all opportunities to pursue proactive initiatives, particularly those that translate to economic benefits to the community, good business management and financial outcomes. There are social and corporate responsibility requirements associated with this.

2.2. Action Identification Process

A review of the nominated actions identified by the previous CCAMS has been conducted as part of the CCAMS review. Actions completed or that have become standard operational practice or policy, have been removed, whilst some existing actions will continue and a number of new actions introduced. The new actions were developed based on the risks

and opportunities identified through the EMS risk assessment approach, learnings from implementation of previous CCAMS actions, internal consultation, updated science and research available. Policies that need to be updated or newly created to address risks have also been identified. The City has taken into account the views and concerns raised in the Climate Change Youth Forum conducted in December 2020. The document has also been advertised and feedback obtained from the wider community.

Section 4 outlines the risks and actions identified to address the following:

Temperature related risks – Impacts associated with increase in temperature will be alleviated through various actions with one being development and implementation of an Urban Forest Plan that will decrease negative impacts on human health, decrease carbon emissions and cost of living, and improve liveability.

Rainfall related risks – In response to the impacts of declining rainfall the City will amongst other actions be advocating to State Government as well as developers to adopt innovative approaches to water reuse and recycling, reducing dependency and need for both scheme and groundwater.

Extreme weather events related risks – Dealing with impacts of extreme weather, the City will continue implementing the coastal monitoring and storm response program for the City's coastline and associated assets.

Sea level rise related risks – In order to provide accurate and up to-date advice in relation to planning and dealing with impacts of sea level rise the City plans to review and update Coastal Vulnerability Assessment and Hazard Mapping as per the schedule and as new scientific data and mapping becomes available.

Mitigation related risks – The City is planning to strengthen existing and develop new policies related to emission reduction and will investigate various practical opportunities that would result in substantial energy and therefore carbon emission reductions.

Multi-risk adaptation and mitigation – Opportunities that will deal with multiple risks and will achieve both adaptation and mitigation outcomes have been segregated and include actions such as revising Local Planning Schemes and local planning policies. This will ensure climate change impacts and relevant mitigation and adaptation measures are adequately addressed through appropriate land use planning mechanisms in terms of liveability, emergency response and creating resilient communities.

In order to implement the various actions, the timeframe for the commencement and completion of the actions have been identified. Relevant service units have also been assigned to lead the implementation, with others identified to support the implementation of the actions.



3. Target Setting

Understanding where and how greenhouse gas (GHG) emissions are produced/emitted is the first step towards effective emission reductions. The second step involves measuring the emissions to allow for setting baseline data and finally setting of the targets. Target setting is important as it creates a method for quantifying a desired outcome and tracking progress towards it.

Targets have been determined considering both industry best practice and the need for improved data collection and analysis, while being realistic and recognising that the City is growing with the number of assets increasing each year as well as the number of households being serviced for waste collection. Due to complexity of monitoring and calculating the emissions, the City has decided to split the target into three categories.

- Emissions from energy use (electricity and gas) by City assets;
- Emissions from fuel use by City fleet (diesel and unleaded petrol); and
- Waste generation reduction (reducing emissions associated with decomposition of waste).

Long-term target year 2029/30 has been chosen for energy use emissions and waste reduction with interim target year 2024/25. Short-term target year 2024/25 has been chosen for emissions associated with fleet. Fleet targets only consider the City owned and operated vehicle fuel use, with plans to establish better data collection to capture emissions associated with contracted services. Targets will be revised at end of interim target period (as part of the next CCAMS review) or earlier if significant data collection improvements are identified, including contractor data and past data collection or analysis.

3.1. Energy Use Emissions

With increasing population and more assets to service the growth, the City has chosen to set an average 'per asset' emission reduction target as outlined in Table 6. This is based on the overall use of energy averaged per asset with an asset being identified by having a gas and/or electricity account associated with it (e.g. parks, community facilities, etc). The reason for choosing this target is because it relates to City owned and/or managed assets over which the City has control or potential to influence.

Table 6 GHG emission reduction targets associated with energy use at City assets

Year	Number of assets	Energy use (MWh equivalent)	Total emissions (t CO ₂ -e) *	Average emissions per asset (t CO ₂ -e)
2019/20 (baseline)	380	12,151	8,384	22
2024/25	Interim target (10% reduction from baseline by 2024/25)			20
2029/30	Long-term target (25% reduction from baseline by 2029/30)			17

* Emissions resulting from electricity and gas used at council owned buildings and parks (excluding Western Power street lighting).

3.2. Fleet Emissions

The City vehicle fleet consists of various types and size of vehicles using either unleaded petrol or diesel, with the exception of two electric vehicles. Targets have been split into fleet (ULP) and fleet (diesel) due to different emission factors being used to calculate emissions

produced. The overwhelming majority of diesel consumption is attributed to waste trucks with small to medium size vehicles using predominantly unleaded petrol (ULP).

Baselines selected for Fleet (ULP) and Fleet (Diesel) differ slightly due to an anomaly in diesel data. Both baselines align with the development and endorsement of the CCAMS 2016-2020 and Energy Reduction Plan 2017/2020.

The Fleet (ULP) target of 25 % reduction in GHG emissions from 2017/18 baseline by 2024/25 as outlined in Table 7 is based on the current trend and the plans the City has to continue improving efficiency, reducing fleet size and purchasing hybrid and or electric vehicles.

Table 7 GHG emission reduction targets associated with fleet using ULP

Fleet (ULP)		
Year	(kL)	GHG emissions (t CO2-e)
2017/18 (baseline)	119	275
2018/19	116	268
2019/20	105	242
Target (25 % reduction from baseline by 2024/25)		
2024/25	89	206

Note: GHG emissions were calculated using factors taken from Department of Environment and Energy (National Greenhouse Accounts Factors August 2019).

For the diesel fleet the target has been set based on the emissions per bin serviced per year. The reason for this target is an expectation that the total fuel use and therefore associated emissions will increase in the short term as a result of the city growing and more households being serviced. The target chosen has been based on the projections from current per bin emission trend, the City progressively replacing the fleet with more efficient trucks, and looking into hybrid technologies. Even though the total emissions are expected to see an increase in the short term, the City can still show that is doing all it can to improve efficiency.

The City is planning to introduce a 3rd bin system to separate the greens which will result in an increase in the number of bin collections and associated trips to empty the trucks. This service will be contracted out and excluded from current targets, but with a view to include it at the next review together with other contractor data.

The target is to reduce the diesel using fleet GHG emissions per bin serviced per year by **25%** from 2016/17 base year level by 2024/25 (target 0.47 kg CO2-e per bin per year).

Table 8 GHG emission reduction targets associated with fleet using diesel fuel

Fleet (diesel)						
Year	Diesel (kL)	GHG emissions (t CO2-e)	# of bins serviced (current 2 bin system)	GHG emissions per bin serviced per year (kg CO2-e)	# of bins serviced (future 3 bin system)	t CO2-e
2016/17 (baseline)	1,242	3,378	5,365,620	0.63		
2017/18	1,191	3,240	5,465,772	0.59		

2018/19	1,145	3,115	5,547,516	0.56		
2019/20	1,155	3,141	5,649,228	0.56		
2024/25	Target (25% reduction per bin serviced per year from baseline by 2024/25)		0.47	8,073,498	3,795	

Note: GHG emissions were calculated using factors taken from Department of Environment and Energy (National Greenhouse Accounts Factors August 2019). Number of households estimated using 'Average people per households' from 2016 ABS Census Quickstats.

3.3. Waste generation reduction

It is well known that a significant by-product of waste disposal is gas emissions into the atmosphere. When organic waste decomposes in landfills, it releases methane and other greenhouse gases, contributing to climate change. Calculating the emissions from waste is complex and dependent on a number of factors such as the size, type and operation of landfill as well as legacy emissions. Therefore, rather than attempting to estimate and convert amount of CoW waste being deposited to the landfill managed by Mindarie Regional Council, the City has decided to set a waste generation reduction per capita per year target.

The target is to reduce Municipal Solid Waste generation per capita by **10%** by 2024/25 and **20%** by 2029/30 based on 2014/15 levels. This target, including the baseline aligns with the Waste Strategy 2030, with the City already meeting its target of 10% in 2018/19, therefore being on track for the target years (Table 9).

Table 9 Waste generation reduction per capita per year

Year	Population	Total domestic waste generated (t)	Waste generation per capita/year (kg)	Reduction to date from base year (%)	Target status
2014/15 (baseline)	185,876	90,297	486	-	
2015/16	194,778	90,483	465	4.4	
2016/17	198,787	90,905	457	5.9	
2017/18	202,051	90,205	446	8.1	
2018/19	204,788	89,429	437	10.1	Target met
2019/20	206,860	90,237	436	10.2	Target met
2024/25	Target (10% reduction from baseline by 2024/25)		437	-	On target
2029/30	Target (20% reduction from baseline by 2029/30)		389	-	On target

Note: Bins serviced are based on population and household forecasts sourced from profile id (2016 to 2041, prepared by .id, May 2020.)



4. Risk Management and Adaptation and Mitigation Actions

The timeframe relating to how long it is expected for an action to be completed following commencement will be set as SHORT, MEDIUM and LONG term and defined as:

SHORT	1 - 2 years
MEDIUM	3 - 5 years
LONG	over 5 years

1. TEMPERATURE RELATED RISKS

Temperature increase of up to 3°C by 2050

Increased surface temperature, increased bushfire potential, impacts on public health, increased stress on biodiversity, impacts to agriculture, impacts to transportation systems and financial costs.

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
1.1 Develop an Urban Forest Plan (UFP) and incorporate actions into the City's Environmental Management System (EMS) and relevant Service Unit Plans.	Human health impacts. Increased emissions and cost of living from use of air-conditioning.	Strategic Land Use Planning & Environment	Parks & Conservation Management	Additional staff resources required	Report on targets (i.e. # of trees planted, preserved, creation of breezeways etc..).	2020/21	Long	10 + years
1.2 Investigate preparation of a local planning policy and/or guidelines for developers to improve energy efficiency performance of the built form within the City.	Impacts upon human health. Increased emissions and cost of living from increased use of air-conditioning.	Strategic Land Use Planning & Environment	Land Development	Staff time	Draft planning policy and guidelines developed (with examples from other LGAs) and presented to working group for further consideration.	2022/23	Medium	Up to 10 years
1.3 Undertake investigation into materials for roads that can reduce pavement temperatures to help mitigate the Urban Heat Island Effect, including financial viability.	Increase in surface temperature	Strategic Asset Management	Land Development; Engineering Maintenance.	Staff time and consultant costs	Results of the investigation to inform the feasibility of using the material on a wide scale.	2020/21	Short	N/A

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
1.4 Investigate appropriate instrument (policy or other) to enable minimisation of exposed hard surfaces to direct sunlight throughout the City, reducing thermal banking and the Urban Heat Island effect.	Increase in surface temperature	Land Development	Strategic Asset Management	Staff time Material costs and contractor costs	Report on steps taken to identify and developed a suitable instrument/policy.	2022/23	Medium	10 + years

The timeframe relating to how long it is expected for an action to be completed following commencement will be set as SHORT, MEDIUM and LONG term and defined as:

SHORT	1 - 2 years
MEDIUM	3 - 5 years
LONG	over 5 years

2. RAINFALL RELATED RISKS

20% reduction in rainfall since 1960s with further 18% reduction by 2090

Reduced water availability for public open space irrigation affecting the community and lifestyle, increase in costs to deliver services, reduced water availability for natural wetlands affecting the natural environment and reduced water availability for agricultural crops affecting local agribusiness and increasing cost of living.

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
2.1. Analyse City's current policies and laws relating to standards and specifications on the amount and type of permeable surfaces including permissible and non-permissible verge treatments, and amend existing or introduce new policies to ensure rainwater infiltration is maximised and water retained and delivered to the root zones of trees and plants on verges and in front yards (relates to action 1.4).	Reduced water availability for park areas	Land Development		Staff time	Analysis of policies and laws complete. Relevant policies/laws amended or new policies adopted.	2021/22	Medium	10 + years
2.2 Continue to review water use for irrigation incorporating best industry practice and reflect changes in the City's Irrigation Specification and irrigation management practices.	Reduced water availability for irrigation purposes	Parks & Conservation Management	Land Development	Staff time Material costs and potential contractor costs	Annual reduction in scheme and groundwater use per hectare for irrigation use with details provided to Waterwise Council Program.	2021/22	Long	Ongoing
2.3 Develop a five-year prioritised plan of action to address high water use sites on an annual basis, based on continued assessment of water use across all City owned buildings.	Increasing costs to deliver services	Strategic Asset Management	Building Maintenance	Staff time	Five year prioritised plan of action complete.	2021/22	Short	N/A

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
2.3.1 Implement the five year prioritised plan of action.		Strategic Asset Management	Building Maintenance	Staff time Consultant Costs Material costs and potential contractor costs	Actions implemented as per the plan and informing the Waterwise Council Program.	2022/23	Long	5 + years
2.4 Advocate to State Government as well as developers to adopt innovative approaches to water reuse and recycling, where viable, reducing dependency and need for both scheme and groundwater - in response to the impacts of declining rainfall.	Increasing cost to deliver services	Strategic Land Use Planning & Environment	Advocacy & Economic Development; Land Development.	Staff Time	Responded to invitations to comment/ participate in development of water management reports.	2021/22	Long	Ongoing
2.5 Investigate opportunities to reduce City's use of scheme and groundwater for irrigation.	Reduced water availability for irrigation purposes	Parks & Conservation Management		Staff time	Annual reduction in scheme and groundwater use per hectare for irrigation use with details provided to Waterwise Council Program.	2020/21	Medium	Ongoing
2.6 Advocate to the Department of Water and Environmental Regulation to further develop and implement effective integration of land use and water management planning for the Gngara groundwater system, to achieve a sustainable management and use of the groundwater system. (As per the intention of the initial Gngara Sustainability Strategy).	Reduced water availability for irrigation and ecological services	Strategic Land Use Planning & Environment	Advocacy & Economic Development	Staff time	Establish an ongoing consultative program with DWER and report on progress made as a result of an annual/biannual working sessions.	2021/22	Long	10 + years

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
2.6.1 At the regional and sub-regional planning stages, the City will request State government agencies overseeing the preparation of District, Regional or Local Water Management Strategies to ensure effective integration of land use and water management planning for the Gngara groundwater system area.	Reduced water availability for irrigation and ecological services	Strategic Land Use Planning & Environment		Staff time	All water management plans at regional and sub-regional planning stages have been reviewed and commented on by the City.	2021/22	Long	10 + years
2.7 Consider participation in the Water Sensitive Cities Benchmarking Index workshop with DWER and Water Corporation to assist with assessing where along the 'Water Sensitive Cities' journey the City is, identify areas of improvement (requirement for Waterwise Platinum status).	Reduced water availability for irrigation and ecological services	Strategic Land Use Planning & Environment	Multiple	Staff time	Decision made whether to participate or not. If yes, workshop outcomes incorporated into the Waterwise Council Program.	2021/22	Short	5 + years

The timeframe relating to how long it is expected for an action to be completed following commencement will be set as SHORT, MEDIUM and LONG term and defined as:

SHORT	1 - 2 years
MEDIUM	3 - 5 years
LONG	over 5 years

3. EXTREME WEATHER EVENTS RELATED RISKS

Increased wind speed and wind gusts, flash flooding and hail

This will cause damage to infrastructure and both the natural and built environment.

Note: Fire is also an identified risk of extreme weather events (see Table 1 for City's response to this risk).

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
3.1 Continue implementing the coastal monitoring and storm response program for the City's coastline and associated assets.	More intense storms	Assets Maintenance		Staff time Material costs and potential contractor costs	- Six-monthly photographic monitoring - Post storm inspections - Six monthly coastal surveys of the whole City coastline - Annual condition assessment of coastal protective structures	2020/21	Long	Ongoing
3.2 Undertake periodic (biennial) review the City's insurance policies to ensure they adequately treat climate change risks.	More intense storms	Governance & Legal		Staff time	Review undertaken and outcomes communicated to relevant service units. Risk register updated accordingly.	2021/22	Long	N/A

The timeframe relating to how long it is expected for an action to be completed following commencement will be set as SHORT, MEDIUM and LONG term and defined as:

SHORT	1 - 2 years
MEDIUM	3 - 5 years
LONG	over 5 years

4. SEA LEVEL RISE RELATED RISKS

0.4 to 0.9 m sea level rise predicted by 2090 compared to 1986-2005 levels

This will potentially cause inundation of infrastructure in low lying areas, loss of recreational facilities, litigation, increase in community concern, contamination of aquifer, damage to coastal structures and beach erosion.

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
4.1 Review and update Coastal Vulnerability Assessment and Hazard Mapping as new scientific data and mapping becomes available.	Storm surges and flooding	Strategic Land Use Planning & Environment	External contractors	Staff time and expert consultant costs	Coastal Vulnerability Assessment and Hazard Mapping reviewed and updated.	2023/24	Medium	Ongoing
4.1.1 Ensure relevant planning policies are updated to reference the latest CHRMAP data, and any new developments in the vulnerable areas address the risk of sea level rise.	Storm surges and flooding	Strategic Land Use Planning & Environment		Staff time	Relevant planning policies are updated to reference the latest CHRMAP data.	Following completion of 4.1.	Short	Ongoing

The timeframe relating to how long it is expected for an action to be completed following commencement will be set as SHORT, MEDIUM and LONG term and defined as:

SHORT	1 - 2 years
MEDIUM	3 - 5 years
LONG	over 5 years

5. MITIGATION RELATED RISKS

Lack of mitigation will result in increased risks and exacerbated impacts of climate change

Mitigation actions are required to prevent or limit further emissions being released into the atmosphere contributing to the global causes of climate change. Besides the direct climate change contributors there are other indirect causes and contributors that also need to be addressed.

ACTIONS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
					Commence	Timeframe	
5.1 Continue implementing revised Energy Reduction Plan and embed actions into the EMS and relevant service plans.	Strategic Land Use Planning & Environment	Strategic Asset Management; Community Facilities + others	Staff time	Actions incorporated into the EMS and relevant service plans.	2020/21	Short	10 + years
5.2 Improve data collection, analysis and reporting in relation to electricity, gas, and water use by the City, as well as data related to municipal waste.	Strategic Land Use Planning & Environment	Community Facilities; Transactional Finance; Waste Services; Strategic Asset Management.	Staff time and potential consultant costs	Progress toward obtaining comprehensive and accurate data, and processes substantially in place to ensure consistency.	2020/21	Long	Ongoing
5.2.1 Assess the data validity/completeness and City's progress and revise goals and emission targets in line with the analysis.	Strategic Land Use Planning & Environment	Multiple	Staff time	Goals and targets established/revised.	2022/23	Medium	N/A
5.3 Continue installing solar photovoltaic systems on new and existing buildings as appropriate, and investigate incorporation of battery storage at both new and existing locations suitable for solar PV system installation, developing a plan of installation.	Strategic Land Use Planning & Environment	Strategic Asset Management; Building Maintenance; Community Facilities.	Staff time and consultant costs	Short report on investigations undertaken, providing list of identified projects and draft implementation plan.	2022/23	Medium	10 + years
5.3.1 Investigate potential for battery storage at Kingsway Reserve, and if viable develop a plan of delivery for future years.	Strategic Asset Management	Infrastructure Capital Works;	Staff time and consultant costs	Report on the investigation undertaken with an	2020/21	Medium	5 to 10 years

ACTIONS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
					Commence	Timeframe	
		Community Facilities; Building, Parks & Engineering Maintenance.		implementation plan developed.			
5.4 Investigate the opportunities and viability for the City to transition City's light fleet from fossil-fuel powered engines to electric, as well as alternative fuels and electrification of the heavy fleet (waste trucks). Outcomes of investigation to inform development of a strategic roadmap for City's fleet.	Contracts & Procurement	Asset Maintenance; Waste Management.	Staff time Additional funds may be required for execution of the strategic roadmap.	Report on investigation outcomes (separate reports for light and heavy fleet). Strategic roadmap for the City.	2020/21	Short	10 + years
5.5 In addition to installing solar PVs to generate electricity, investigate and assess potential locations and viability of installing solar PV systems to provide multiple benefits (i.e. creating shade and Electric Vehicle (EV) charging stations in car parks).	Strategic Land Use Planning & Environment	Strategic Assets Management; Infrastructure Capital Works; Contracts & Procurement.	Staff time Additional funds to be identified for proposed projects.	Short report on the investigation undertaken with a list of potential projects identified.	2021/22	Medium	10 + years
5.6 Continue to investigate alternative energy options through collaboration with research institutions, government and industry including waste to energy opportunities for Neerabup Industrial Area. Increase awareness of local businesses of the benefits of clean technology.	Advocacy & Economic Development	Waste Services	Staff time. Budget will be allocated to identified approved projects.	Continued investigation and collaboration activities. Engagement activities with local businesses e.g. e-news article.	2020/21	Long	10 + years
5.7 Integrate 'zero-emissions' building principles encompassing the whole lifecycle of planning, designing, constructing, operating, decommissioning and disposal into the building design and construction specifications.	Infrastructure Capital Works & Strategic Asset Management	Strategic Land Use Planning & Environment	Staff time	Existing policies amended or a new policy created.	2022/23	Medium	Ongoing
5.8 Revise and strengthen the Purchasing Policy to ensure waste reduction and use of recycled materials for City assets (i.e. parks furniture, roads) is incorporated and elevated in the purchasing processes, supporting circular economy establishment.	Contracts & Procurement	Waste Services; Strategic Land Use Planning & Environment; Infrastructure Capital Works.	Staff time	Policy amended and endorsed.	2021/22	Short	Ongoing

ACTIONS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
					Commence	Timeframe	
5.9 Collaborate with stakeholders including industry and State Government departments (DWER & DPIRD) to reduce grower uncertainty about long term water supplies for agriculture in Wanneroo. The City will work with State Government and other stakeholders to achieve access to sustainable groundwater supplies and the development of new climate independent water supplies to augment sustainable groundwater supplies.	Advocacy & Economic Development		Staff time. Budget will be allocated to identified approved projects.	Quarterly Meetings with DPIRD & DWER. Quarterly meetings with North Wanneroo Growers Group. Projects or events supported.	2020/21	Long	10 + years
5.9.1 Support industry and stakeholders to increase the capacity of the industry to adapt to climate change through adoption of new infrastructure and practices to improve water, nutrient and energy use efficiency.	Advocacy & Economic Development		Staff time. Budget will be allocated to identified approved projects.	Quarterly Meetings with DPIRD & DWER. Quarterly meetings with North Wanneroo Growers Group. Projects or events supported.	2020/21	Long	Ongoing

The timeframe relating to how long it is expected for an action to be completed following commencement will be set as SHORT, MEDIUM and LONG term and defined as:

SHORT	1 - 2 years
MEDIUM	3 - 5 years
LONG	over 5 years

6. MULTI-RISK ADAPTATION AND MITIGATION

Climate change is multi-faceted and complex issue and requires multidimensional approaches in addressing diverse challenges.

ACTIONS	RISK RELATED IMPACTS	LEAD SERVICE UNIT	COLLABORATING SERVICE UNIT	RESOURCES	MEASURABILITY	ACTION DURATION		IMPLEMENTATION OF SUBSEQUENT ACTIONS/PLANS
						Commence	Timeframe	
6.1 Investigate and develop a practical approach for the City to help enhance and strengthen the community's capacity (both household and business) to respond to perceived climate change challenges, as they have direct bearing on the community (e.g. improved building design, energy efficiency, water conservation, waste reduction, environmental protection, liveability in a hotter and drier climate, etc.).	Reduced water availability, health impacts, increased temperatures, sea level rise, more intense storms, increased cost of living, liveability.	Strategic Land Use Planning & Environment	Waste Services; Land Development; Community Development.	Staff time Costs associated with running an event or marketing collateral.	Approved and agreed upon approach (with timing and duration to be determined)	2022/23	Medium	10 + years
6.2 Retention and evolution of agricultural industry in North Wanneroo through collaboration with state Government and industry to confirm the long term land use expectations for urban agricultural areas. The subsequent preparation of the Local Planning Strategy and Local Planning Scheme to accommodate the industry long term in North Wanneroo. Detailed review of land uses and zoning in North Wanneroo to provide flexibility for business development, innovation and	Reduced water availability, health impacts, increased temperatures, sea level rise, more intense storms, increased cost of living, liveability.	Strategic Land Use Planning & Environment	Advocacy & Economic Development	Staff time Costs associated with public consultation of draft and final documents.	North Wanneroo Land Use Concept Discussion Paper, Preparation of the Local Planning Strategy and Local Planning Scheme 3	2021/22	Long	10 + years

adaptation of the industry to climate change.								
6.3 Prepare the Local Planning Strategy (LPS), the Local Planning Scheme No. 3 (LPS3) and revise local planning policies to ensure climate change impacts and relevant mitigation and adaptation measures are adequately addressed through appropriate land use planning mechanisms in terms of liveability, emergency response and creating resilient communities.	Reduced water availability, health impacts, increased temperatures, sea level rise, more intense storms, liveability.	Strategic Land Use Planning & Environment	Approval Services; Place Management; Community Development; Community Facilities; Advocacy & Economic Development.	Staff time	WAPC endorsement of LPS. Gazettal of LPS3 and Council adoption of revised local planning policies.	2021/22	Long	10 + years

5. Implementation

In order for the City to adapt to the predicted impacts of climate change, a cross-directorate approach is required. The City's service units are required to continue implementing the existing actions and assume the new identified actions as per the Risk Management and Adaptation and Mitigation Actions tables. In addition to this, close co-operation with relevant state and federal government departments is essential for achieving desired outcomes.

The City has a comprehensive risk management process. The actions identified in section 3, as part of the risk management process form part of the City's Strategic and Operational Risk Registers and will be incorporated into the EMS which will be used as a tool to track progress on the actions, responsible owners as well as provide resources to assist with their implementation and risk mitigation. The Risk Registers categorise the risks and identify which actions are to be carried out by the responsible service unit and by when. The adaptation actions will form part of each service unit's plans as part of the integrated planning process.



References

- 1 City of Wanneroo, (2013). *City of Wanneroo Strategic Community Plan 2013/14 to 2022/23*
- 2 City of Wanneroo, (2019). *Corporate Business Plan 2019/20 to 2022/23*
- 3 CSIRO, (2018). *State of the Climate 2018*. Retrieved from <https://www.csiro.au/en/Research/OandA/Areas/Assessing-our-climate/State-of-the-Climite-2018/Australias-changing-climate> in July 2020
- 4 NCCARF, (2013). NCCARF Media Release. Retrieved from https://www.nccarf.edu.au/sites/default/files/attached_files_news/Are-we-ready-NCCARF-PGB-launch.pdf in July 2020
- 5 IPCC, (2018). *Adaptation Needs and Options*. Retrieved from: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap14_FINAL.pdf in July 2020
- 6 CSIRO, (2011) *Climate Change: science and solutions for Australia*. Retrieved from: <https://www.publish.csiro.au/book/6558> in July 2020
- 7 City of Wanneroo (2009). *Local Environment Plan 2009-14*
- 8 World Health Organization (WHO), (2020). *Climate Change and Health Fact Sheet*. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health> in June 2020
- 9 Climate Change in Australia, (2016). *Projections for Australia's NRM Regions*. Retrieved from: <https://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/super-clusters/?current=SSC&tooltip=true&popup=true> in July 2020
- 10 Adapt NRM CSIRO, (2014). *Applying an Adaptation Lens*. Retrieved from: <https://adaptnrm.csiro.au/adaptation-planning/applying-an-adaptation-lens/> in July 2020
- 11 van Vuuren et. al. (2011). *Greenhouse Gas Scenarios*. Retrieved from: <https://www.climatechangeinaustralia.gov.au/en/climate-campus/modelling-and-projections/projecting-future-climate/greenhouse-gas-scenarios/> in July 2020
- 12 Department of Health, (2007). *Health impacts of climate change: Adaptation strategies for Western Australia*. Retrieved from https://ww2.health.wa.gov.au/Articles/A_E/Climate-change-and-health-in-July-2020
- 13 Bureau of Meteorology (BOM) and CSIRO, (2018). *State of the Climate 2018*. Retrieved from: <http://www.bom.gov.au/state-of-the-climate/State-of-the-Climite-2018.pdf> in July 2020
- 14 Department of Primary Industries and Regional Development, (2020). *Climate Change in Western Australia*. Retrieved from: <https://www.agric.wa.gov.au/climate-land-water/climate-weather/climate-change> in July 2020

15 Our World in Data, (2019). Average temperature anomaly, Global. Retrieved from: [https://ourworldindata.org/grapher/temperature-anomaly in July 2020](https://ourworldindata.org/grapher/temperature-anomaly-in-july-2020)

16 Hill, A., & Scott, B. (n.d.) Rainfall Patterns over the Gnangara Mound. *School of Environmental Science, Division of Science and Engineering, Murdoch University, Perth.*

17 Climate Council of Australia, (2019). *Weather Gone Wild: Climate Change – Fuelled Extreme Weather in 2018.*

18 NCCARF and Department of the Environment and Energy, (2018). *Climate change and sea-level rise in the Australian region.* Retrieved from: <https://coastadapt.com.au/climate-change-and-sea-level-rise-australian-region#:~:text=Changes%20in%20sea%20level,over%20the%20past%20half%20century.>
In July 2020

19 United Nations Framework Convention on Climate Change (UNFCCC), (2020). United Nations Climate Change. Retrieved from: <https://unfccc.int/about-us/about-the-secretariat>
in August 2020



City of Wanneroo

23 Dundobar Road, Wanneroo, WA 6065

Locked Bag 1, Wanneroo, WA 6946

T (08) 9405 5000

After Hours 1300 13 83 93

E enquiries@wanneroo.wa.gov.au

wanneroo.wa.gov.au

