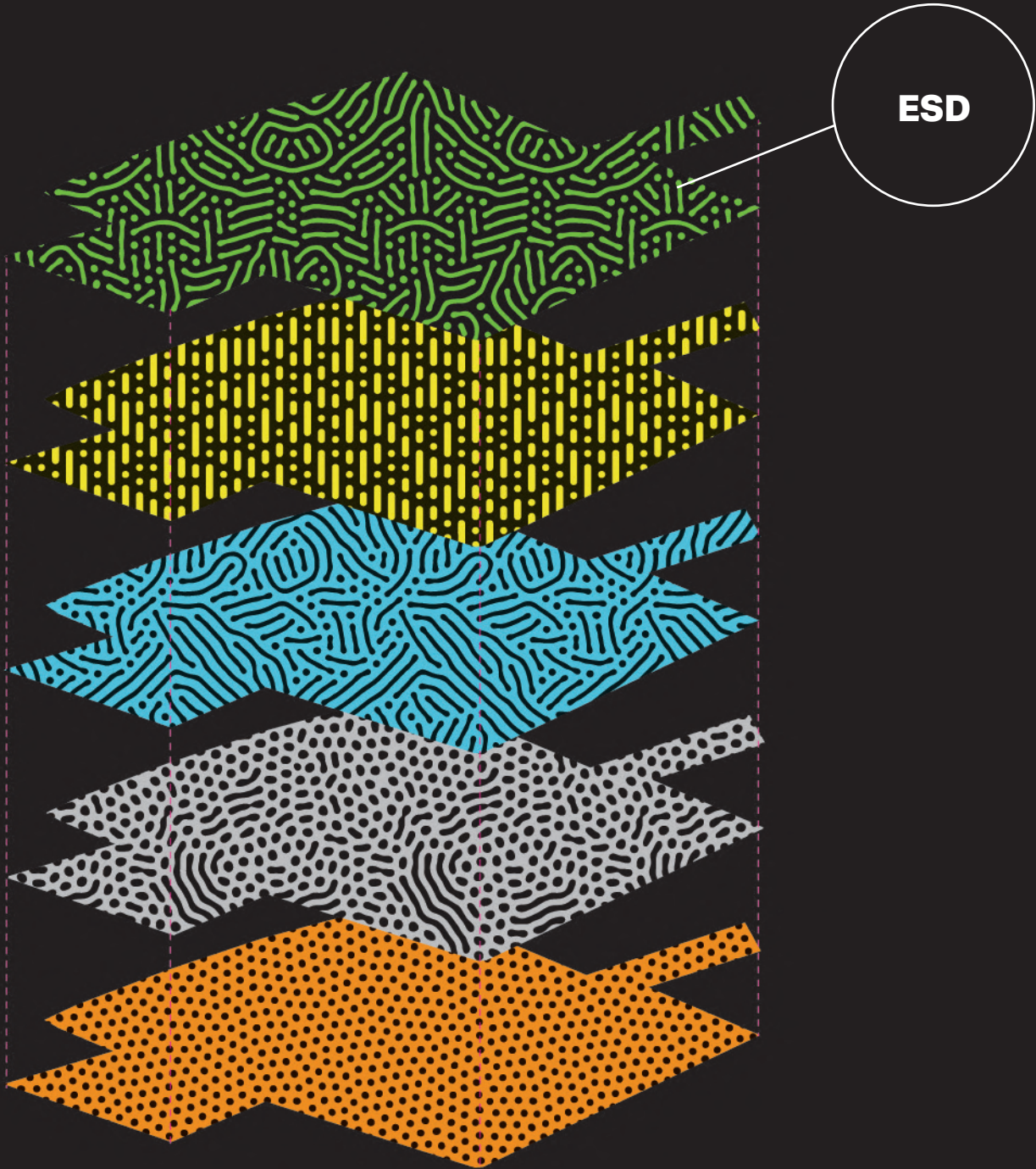


Attachment B21

**ESD Study – Waterloo Estate (South) –
Land and Housing Corporation**

WATERLOO SOUTH ESD STUDY



Prepared for
NSW Land and Housing Corporation
19 March 2020

AECOM

Quality information

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Executive Summary

NSW Land and Housing Corporation (LAHC) has engaged AECOM to undertake an Ecologically Sustainable Development (ESD) Study (this Report) for the Waterloo Estate. The Waterloo Estate comprises three stages: Waterloo South, Waterloo Central and Waterloo North. Waterloo South has been identified as the first stage for renewal and this Report is specific to Waterloo South. Waterloo South is approximately 3km south of the Sydney CBD. It is bordered by Surry Hills to the north, Moore Park to the east, Alexandria to the south and west.

This Report demonstrates how the Waterloo South planning and design process has incorporated sustainability design initiatives relevant at the master planning and rezoning stage. It seeks to ensure the appropriate targets are set and to ensure the corresponding considerations are made.

This Report references certain Study Requirements issued by the NSW Minister for Planning in May 2017. While the project is going through a different planning pathway, the overall SSP Study Requirements are still relevant and require LAHC to:

- 16.1. Provide an Ecologically Sustainable Development Report which details how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated, specifically:
 - identify performance benchmarks to allow sustainability to be considered in site planning, building design and in the construction and operational phases of the development to achieve best practice sustainability outcomes, and
 - commitment to compliance with a nationally recognised rating system (e.g. Green Star – Communities).
- 16.3. Identify options to achieve a minimum of 50% renewable energy for the precinct, by maximising on-site generation and renewable energy generated off-site.
- 16.4. Identify and implement waste management strategies to achieve the NSW Government's Waste Avoidance and Resource Recovery Strategy 2007 (WARR) and complements the NSW Government's Waste Less, Recycle More initiatives and EPA waste and recycling programs. Include measures to ensure effective operational waste management, for example, adequate space within buildings for waste infrastructure, accessibility for waste collection vehicles. Identify building and precinct-scale solutions.
- 10.1. Undertake a sustainability assessment of the proposal, reflecting the directions outlined in the NSW Climate Change Policy Framework October 2016 and Draft Central District Plan - Creating an efficient Central District to achieve net-zero carbon emissions by 2050. Investigate options for achieving both net zero buildings and a net zero precinct.
- 10.6. Demonstrate compliance with BASIX and investigate opportunities to deliver beyond compliance BASIX scores.

This Report includes a review of the relevant strategies, policies, market drivers, and guidelines to gain an understanding of the contextual background necessary for the consideration of ESD and sustainability in Waterloo South. The relevant regulatory and compliance requirements at the international, national, state, regional and local levels are highlighted and are integrated into a sustainability framework developed to guide the renewal of Waterloo South.

Additionally, the Waterloo Estate is committed to achieving a 6-star Green Star – Communities rating. It is recommended that the development target 5-star Green Star – Design & As-Built (v1.2) (Design Review certified) ratings for selected buildings within Waterloo South. This will be in line with the Ivanhoe Estate, part of the Communities Plus program, which has achieved a 6-star Green Star – Communities rating and 5-star Green Star – Design & As-Built for buildings.

Commitment to the Green Star – Communities rating tool is recommended as the most appropriate nationally recognised rating system. It has demonstrated strong alignment with relevant planning policies, regulation and guidelines, as well as addressing the Study Requirement 16.1 and showing good alignment with LAHC's redevelopment vision for the entire Waterloo Estate.

This Report also identifies potential pathways to achieve both net-zero carbon buildings and a net-zero carbon precinct through a combination of maximising energy efficiency measures, on-site renewable generation and

procurement of off-site renewable generation. Options have also been investigated for achieving 50% renewable energy for the Waterloo Estate during operation, including the contribution that Waterloo South makes to this target.

The investigated options include the potential of a fully integrated micro-grid, renewable energy procurement by body corporates, placing covenants on property titles to ensure compliance, and a build-to-rent ownership model. Opportunities to minimise waste generation and increase recycling and waste diversion rates have been explored in alignment with the NSW Environmental Protection Authority's Waste Avoidance and Resource Recovery Strategy and the City of Sydney's Guidelines for Waste Management in New Developments

1. Introduction

The Greater Sydney Region Plan and Eastern City District Plan seek to align growth with infrastructure, including transport, social and green infrastructure. With the catalyst of Waterloo Metro Station, there is an opportunity to deliver urban renewal to Waterloo Estate that will create great spaces and places for people to live, work and visit.

The proposed rezoning of Waterloo Estate is to be staged over the next 20 years to enable a coordinated renewal approach that minimises disruption for existing tenants and allows for the up-front delivery of key public domain elements such as public open space. Aligned to this staged approach, Waterloo Estate comprises three separate, but adjoining and inter-related stages:

- Waterloo South;
- Waterloo Central; and
- Waterloo North.

Waterloo South has been identified as the first stage for renewal. The lower number and density social housing dwellings spread over a relatively large area, makes Waterloo South ideal as a first sub-precinct, as new housing can be provided with the least disruption for existing tenants and early delivery of key public domain elements, such as public open space.

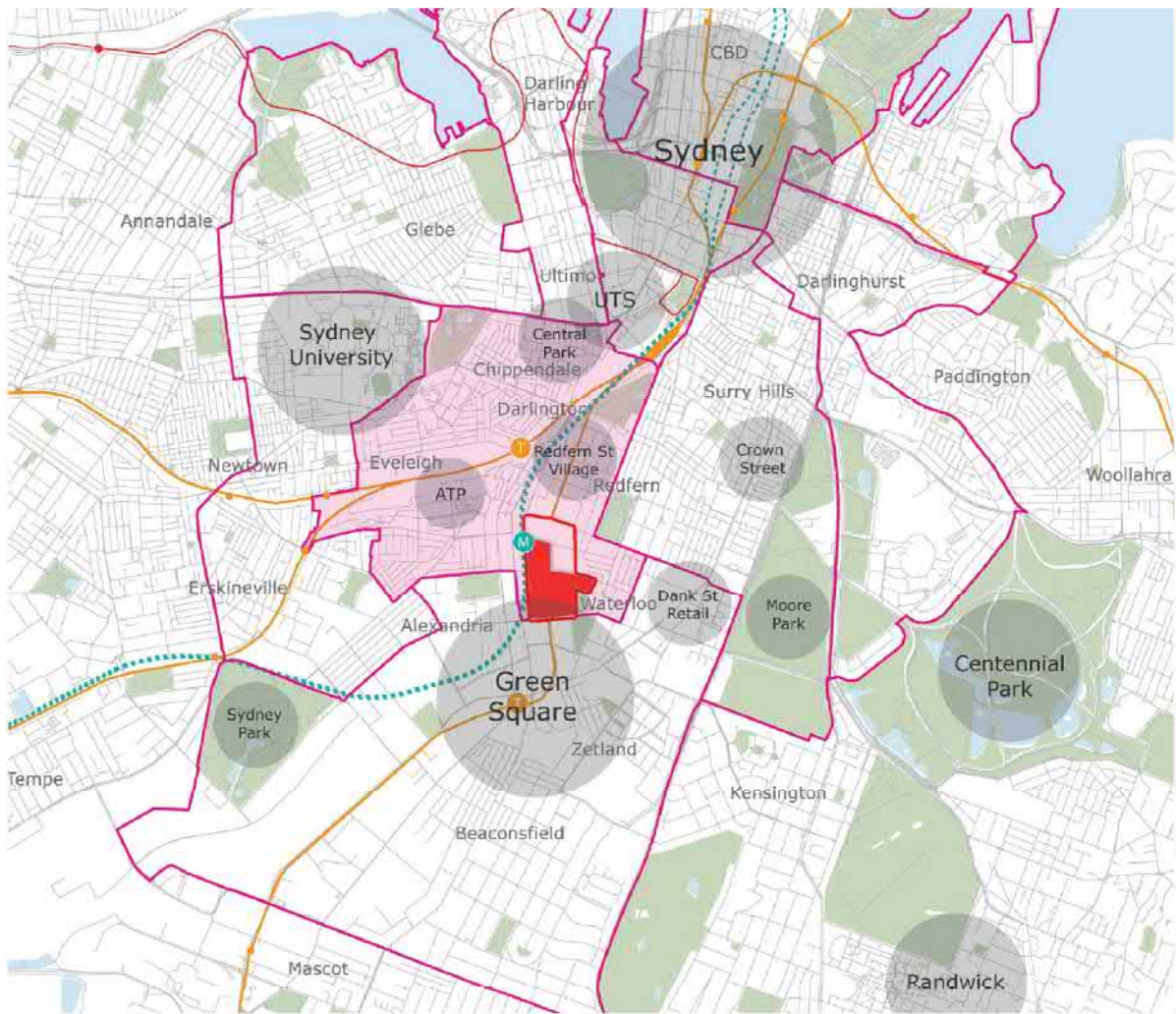
A planning proposal for Waterloo South is being led by NSW Land and Housing Corporation (LAHC). This will set out the strategic justification for the proposal and provide an assessment of the relevant strategic plans, state environmental planning policies, ministerial directions and the environmental, social and economic impacts of the proposed amendment. The outcome of this planning proposal will be a revised planning framework that will enable future development applications for the redevelopment of Waterloo South. The proposed planning framework that is subject of this planning proposal, includes:

- **Amendments to the Sydney Local Environmental Plan 2012** – This will include amendments to the zoning and development standards (i.e. maximum building heights and floor space ratio) applied to Waterloo South. Precinct-specific local provisions may also be included.
- **A Development Control Plan (DCP)** – This will be a new part inserted into ‘Section 5: Specific Areas’ of the Sydney DCP 2012 and include detailed controls to inform future development of Waterloo South.
- **An infrastructure framework** – in depth needs analysis of the infrastructure required to service the needs of the future community including open space, community facilities and servicing infrastructure.

1.1 Waterloo Estate

Waterloo Estate is located approximately 3.3km south-south-west of the Sydney CBD in the suburb of Waterloo (refer to **Figure 1**). It is located entirely within the City of Sydney local government area (LGA). Waterloo Estate is situated approximately 0.6km from Redfern train station and 0.5km from Australia Technology Park. The precinct adjoins the new Waterloo Metro Station, scheduled to open in 2024.

The Waterloo Metro Quarter adjoins Waterloo Estate and includes the station and over station development and was rezoned in 2019. Waterloo Estate comprises land bounded by Cope, Phillip, Pitt and McEvoy Street, including an additional area bounded by Wellington, Gibson, Kellick and Pitt Streets. It has an approximate gross site area of 18.98 hectares (14.4 hectares excluding roads). Waterloo Estate currently comprises 2,012 social housing dwellings owned by LAHC, 125 private dwellings, a small group of shops and community uses on the corner of Wellington and George Streets, and commercial properties on the south-east corner of Cope and Wellington Streets. A map of Waterloo Estate and relevant boundaries is illustrated in **Figure 2**.



Legend

- The Estate
- Waterloo South

Figure 1: Location plan for Waterloo Estate and Waterloo South

1.2 Waterloo South

Waterloo South includes land bounded by Cope, Raglan, George, Wellington, Gibson, Kellick, Pitt and McEvoy Streets, and has an approximate gross site area of 12.32 hectares (approximately 65% of the total Estate).

Waterloo South currently comprises 749 social housing dwellings owned by LAHC, 125 private dwellings, and commercial properties on the south-east corner of Cope and Wellington Streets. Existing social housing within Waterloo South is predominantly walk up flat buildings constructed in the 1950s and '60s, and mid-rise residential flat buildings (Drysdale, Dobell & 76 Wellington Street) constructed in the 1980s. Listed Heritage Items within Waterloo South include the Duke of Wellington Hotel, Electricity Substation 174 on the corner of George and McEvoy Streets, the terrace houses at 229-231 Cope Street and the Former Waterloo Pre-School at 225-227 Cope Street. The State Heritage listed 'Potts Hill to Waterloo Pressure Tunnel and Shafts' passes underneath the precinct. A map of Waterloo South and relevant boundaries is illustrated in **Figure 2**.



Figure 2: Waterloo Precinct

Source: Ethos Urban

1.3 Redevelopment Vision

The transition of Waterloo Estate will occur over a 20-year timeframe, replacing and providing fit for purpose social (affordable rental) housing as well as private housing to create a new integrated and inclusive mixed-tenure community.

This aligns with Future Directions for Social Housing in NSW – the NSW Government’s vision for social housing. It also aligns with LAHC’s Communities Plus program, which is tasked with achieving three key objectives:

1. Provide more social housing
2. Provide a better social housing experience
3. Provide more opportunities and support for social housing tenants

The following is LAHC's Redevelopment Vision for Waterloo Estate, which was derived from extensive consultation and technical studies:

	<p>Culture and Heritage</p> <ul style="list-style-type: none"> Recognise and celebrate the significance of Waterloo's Aboriginal history and heritage across the built and natural environments. Make Waterloo an affordable place for more Aboriginal people to live and work. Foster connection to culture by supporting authentic storytelling and recognition of artistic, cultural and sporting achievements.
	<p>Communal and Open Space</p> <ul style="list-style-type: none"> Create high quality, accessible and safe open spaces that connect people to nature and cater to different needs, purposes and age groups. Create open spaces that bring people together and contribute to community cohesion and wellbeing.
	<p>Movement and Connectivity</p> <ul style="list-style-type: none"> Make public transport, walking and cycling the preferred choice with accessible, reliable and safe connections and amenities. Make Waterloo a desired destination with the new Waterloo Station at the heart of the Precinct's transport network – serving as the gateway to a welcoming, safe and active community.
	<p>Character of Waterloo</p> <ul style="list-style-type: none"> Strengthen the diversity, inclusiveness and community spirit of Waterloo. Reflect the current character of Waterloo in the new built environment by mixing old and new.
	<p>Local Employment Opportunities</p> <ul style="list-style-type: none"> Encourage a broad mix of businesses and social enterprise in the area that provides choice for residents and creates local job opportunities.
	<p>Community Services, Including Support for Those Who Are Vulnerable</p> <ul style="list-style-type: none"> Ensure that social and human services support an increased population and meet the diverse needs of the community, including the most vulnerable residents. Provide flexible communal spaces to support cultural events, festivals and activities that strengthen community spirit.
	<p>Accessible Services</p> <ul style="list-style-type: none"> Deliver improved and affordable services that support the everyday needs of the community, such as health and wellbeing, grocery and retail options.
	<p>Design Excellence</p> <ul style="list-style-type: none"> Ensure architectural design excellence so that buildings and surrounds reflect community diversity, are environmentally sustainable & people friendly – contributing to lively, attractive and safe neighbourhoods. Recognise and celebrate Waterloo's history and culture in the built environment through artistic and creative expression. Create an integrated, inclusive community where existing residents and newcomers feel welcome, through a thoughtfully designed mix of private, social (affordable rental) housing.

Source: *Let's Talk Waterloo: Waterloo Redevelopment* (Elton Consulting, 2019)

1.4 Purpose of this Report

This Report relates to the Waterloo South planning proposal. While it provides comprehensive baseline investigations for Waterloo Estate, it only assesses the proposed planning framework amendments and Indicative Concept Proposal for Waterloo South.

The key matters addressed as part of this Report, include:

- Existing sustainability policy and regulatory context;
- Sustainability guidelines and City of Sydney policies;
- Energy, water and waste ESD considerations across Waterloo South;
- Recommendations to meet the Study Requirements, including recommendations to achieve net-zero buildings and a net-zero precinct, improve BASIX performance, achieve a minimum 50% renewable energy for the precinct and improve precinct waste management.

1.5 Waterloo South Planning Proposal

The planning proposal will establish new land use planning controls for Waterloo South, including zoning and development standards to be included in Sydney LEP 2012, a new section in Part 5 of DCP 2012, and an infrastructure framework. Turner Studio and Turf has prepared an Urban Design and Public Domain Study which establishes an Indicative Concept Proposal presenting an indicative renewal outcome for Waterloo South. The Urban Design and Public Domain Study provides a comprehensive urban design vision and strategy to guide future development of Waterloo South and has informed the proposed planning framework. The Indicative Concept Proposal has also been used as the basis for testing, understanding and communicating the potential development outcomes of the proposed planning framework.

The Indicative Concept Proposal comprises:

- Approximately 2.57 hectares of public open space representing 17.8% of the total Estate (Gross Estate area – existing roads) proposed to be dedicated to the City of Sydney Council, comprising:
 - Village Green – a 2.25-hectare park located next to the Waterloo Metro Station; and
 - Waterloo Common and adjacent – 0.32 hectares located in the heart of the Waterloo South precinct.
 - The 2.57 hectares all fall within the Waterloo South Planning Proposal representing 32.3% of public open space (Gross Waterloo South area – proposed roads)
- Retention of 52% of existing high and moderate value trees (including existing fig trees) and the planting of three trees to replace each high and moderate value tree removed.
- Coverage of 30% of Waterloo South by tree canopy.
- Approximately 257,000 sqm of GFA on the LAHC land, comprising:
 - Approximately 239,100 sqm GFA of residential accommodation, providing for approximately 3,048 dwellings (comprising a mix of market and social (affordable rental) housing dwellings);
 - Approximately 11,200 sqm of GFA for commercial premises, including, but not limited to, supermarkets, shops, food & drink premises and health facilities; and
 - Approximately 6,700 sqm of community facilities and early education and child care facilities.

The key features of the Indicative Concept Proposal are:

- It is a design and open space led approach.
- Creation of two large parks of high amenity by ensuring good sunlight access.
- Creation of a pedestrian priority precinct with new open spaces and a network of roads, lanes and pedestrian links.
- Conversion of George Street into a landscaped pedestrian and cycle friendly boulevard and creation of a walkable loop designed to cater to the needs of all ages.
- A new local retail hub located centrally within Waterloo South to serve the needs of the local community.
- A target of 80% of dwellings to have local retail services and open space within 200m of their building entry.
- Achievement of a 6 Star Green Star Communities rating, with minimum 5-star Green Star – Design & As-Built (Design Review certified).
- A range of Water Sensitive Urban Design (WSUD) features.

The proposed land allocation for the Waterloo South precinct is described in **Table 1** below.

Table 1: Breakdown of allocation of land within Waterloo South

Land allocation	Existing	Proposed
Roads	3.12ha / 25.3%	4.38ha / 35.5%
Developed area (Private sites)	0.86ha / 6.98%	0.86ha / 7%
Developed area (LAHC property)	8.28ha / 67.2%	4.26ha / 34.6%
Public open space (proposed to be dedicated to the City of Sydney)	Nil / 0%	2.57ha / 20.9% (32.3% excluding roads)
Other publicly accessible open space (Including former roads and private/LAHC land)	0.06ha / 0.5%	0.25ha / 2%
TOTAL	12.32ha	12.32ha

The Indicative Concept Proposal for the Waterloo South is illustrated in **Figure 3** below.



Figure 3: Indicative Concept Proposal

Source: Turner Studio

2. Sustainability Context

The following provides an overview of the key sustainability considerations within this Report. They include the Study Requirements as well as wider policy and guidance relevant to this stage of the project as well as some of the future drivers influencing consideration of a more sustainable design response.

2.1 Study Requirements

On 19 May 2017, the NSW Minister for Planning issued Study Requirements for the nominated Precinct. While this project is going through a different planning pathway, the overall SSP Study Requirements are still relevant and addressed below.

This Report primarily addresses the Study Requirements relating to the Ecologically Sustainable Development (ESD) criteria (SSP 16) and the related climate change requirements in consideration of carbon reductions (SSO 10.1 and 10.6). The climate change adaptation response to address remaining Climate Change SSP's requirements is provided in the AECOM *Climate Change Adaptation Report, Waterloo South*. Additional ESD Study Requirements are addressed in other reports, as indicated in Table 3.

Table 2 provides the relevant SSP requirements considered and addressed in this study:

Table 2: Study Requirements addressed in this Report

1. Vision, Strategic Context and Justification	Report Section
<p>1.5 Consideration of City of Sydney planning documents, strategies and policies including, but not limited to:</p> <ul style="list-style-type: none"> • Sustainable Sydney 2030 • Community Strategic Plan 2014 • Adapting for Climate Change 2015 	Section 2.3.4
<p>10. Climate Change Mitigation and Adaptation</p> <p>10.1. Undertake a sustainability assessment of the proposal, reflecting the directions outlined in the NSW Climate Change Policy Framework October 2016 and Draft Central District Plan - Creating an efficient Central District to achieve net-zero carbon emissions by 2050. Investigate options for achieving both net zero buildings and a net zero precinct.</p>	Section 3.2.3
<p>10.6. Demonstrate compliance with BASIX and investigate opportunities to deliver beyond compliance BASIX scores.</p>	Section 3.2.4 and Section 3.3.2
<p>16. Ecologically Sustainable Development (ESD)</p> <p>16.1. Provide an Ecologically Sustainable Development Report which details how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated, specifically:</p> <ul style="list-style-type: none"> • identify performance benchmarks to allow sustainability to be considered in site planning, building design and in the construction and operational phases of the development to achieve best practice sustainability outcomes, and • commitment to compliance with a nationally recognised rating system (e.g. Green Star – Communities). 	Section 3.1
<p>16.3. Identify options to achieve a minimum of 50% renewable energy for the precinct, by maximising on-site generation and renewable energy generated off-site.</p>	Section 3.2.2
<p>16.4. Identify and implement waste management strategies to achieve the NSW Government's Waste Avoidance and Resource Recovery Strategy 2007 (WARR) and complements the NSW Government's Waste Less, Recycle More initiatives and EPA waste and recycling programs. Include measures to ensure effective operational waste management, for example, adequate space within buildings for waste infrastructure, accessibility for waste collection vehicles. Identify building and precinct-scale solutions.</p>	Section 3.4.2

The following Study Requirements have been considered and detailed in other reports as indicated:

Table 3: Study Requirements addressed in other reports

<p>1. Vision, Strategic Context and Justification</p> <p>1.6 Consideration of other relevant strategies, reports, policies and guides including, but not limited to:</p> <ul style="list-style-type: none"> • Draft Climate Change Fund Strategic Plan and A Plan to Save NSW Energy and Money • NSW Climate Change Policy Framework 	<p>Refer to other Report:</p> <p>Climate Change Adaptation Report (AECOM)</p>
<p>10. Climate Change Mitigation and Adaptation</p> <p>10.2. Provide a Climate Change Adaptation Report which details how the proposal will address social, environmental and economic effects of climate change on future communities (see NSW and ACT Regional Climate Modelling: NARCLIM), including designing to manage changing temperatures and rainfall patterns through the integration of vegetation (existing and future), permeable and reflective surfaces, and Water Sensitive Urban Design.</p>	<p>Climate Change Adaptation Report (AECOM)</p>
<p>10.3. Assess the potential impacts of climate change on vulnerable groups, including older people, and mechanisms for implementing mitigation strategies.</p>	<p>Climate Change Adaptation Report (AECOM)</p>
<p>10.4. Undertake a sensitivity analysis to address the impact of climate change due to increased temperatures, extreme heat events and changing rainfall patterns integrated with the Water Quality, Flooding and Stormwater Study.</p>	<p>Climate Change Adaptation Report (AECOM)</p>
<p>10.5. Demonstrate consideration of the Urban Green Cover in NSW Technical Guidelines (OEH, 2015).</p>	<p>Urban Forest Report (Arterra)</p>
<p>16. Ecologically Sustainable Development (ESD)</p> <p>16.2. Provide an Integrated Waste Water Management Strategy that considers water, waste water and stormwater plus potential alternative water supply, demonstration of water sensitive urban design and any future water conservation measures, including reuse, following appropriate best practice and guidelines. Investigate any opportunities for and include an assessment of the feasibility of a precinct-scale recycled water scheme that includes nearby sites with the capacity to participate.</p>	<p>Water Quality, Flooding and Stormwater Report (AECOM) – Section 7 Water Cycle Management</p>
<p>16.4. Identify and implement waste management strategies to achieve the NSW Government's Waste Avoidance and Resource Recovery Strategy 2007 (WARR) and complements the NSW Government's Waste Less, Recycle More initiatives and EPA waste and recycling programs. Include measures to ensure effective operational waste management, for example, adequate space within buildings for waste infrastructure, accessibility for waste collection vehicles. Identify building and precinct-scale solutions.</p>	<p>Utilities and Infrastructure Report (AECOM) for BAU servicing strategy</p>

2.2 NSW Land and Housing Corporation

The NSW Land and Housing Corporation (LAHC) is responsible for the ongoing management of the NSW Government's social housing portfolio and operates under the portfolio and direction of the Minister for Water, Property and Housing.

LAHC owns and manages land, buildings and other assets within the social housing portfolio and supports the NSW Government's social housing policy, *Future Directions for Social Housing in NSW*. Future Directions sets out the Government's strategic priorities for the social housing system. LAHC is working to increase the supply of social and affordable housing through the \$22 billion Communities Plus program. This program is delivering up to 23,000 social housing dwellings, 500 affordable housing dwellings and 40,000 private dwellings.

LAHC has developed several design and operational guidelines to complement their development program. The relevant guidelines are detailed in the following sections.

2.2.1 Design Standards (2014)

LAHC have developed Design Standards which seek to encourage design, performance and functional innovation to create new social housing developments. It applies to all new LAHC housing and major refurbishment of existing housing. It may be taken as guidance rather than a prescriptive requirement for:

- Projects undertaken by the affordable housing or community housing sector which are mainly privately funded, or
- Aboriginal Housing Office projects.

The Design Standards are built upon five key design principles:

- Compliance with the National Code of Construction (NCC)
 - At minimum, all LAHC developments and refurbishments must comply with the NCC performance requirements. LAHC have some policies which exceed NCC requirements, such as window safety.
- Whole of Life cost effectiveness balanced with innovation:
 - Achieve directed site yields, reduce operating and maintenance costs, and aim for long-life spans by:
 - Utilising cost management throughout the planning and design development process.
 - Using economic analysis to evaluate construction alternatives, confirming the lowest cost structure that meets the program.
 - Recognising LAHC's 'designing out maintenance' approach to construction to reduce recurrent maintenance expenditure.
 - LAHC welcome cost-effective innovative solutions including alternate building systems, finishes and wall systems meeting the NCC performance requirements.
- Functionality:
 - Dwellings must be fit for purpose and flexible by meeting a variety of household sizes through appropriate space provision and storage.
 - Dwellings should be suitable for later modification to suit tenants with a disability, whilst meeting NCC access requirements.
- Energy and water sustainability:
 - Meet minimum statutory BASIX requirements.
 - Achieve a 6-star NatHERS rating.
- Aesthetics and a sense of home:
 - Projects must contribute positively to the streetscape and neighbourhood as well as recognise tenant needs for security, privacy and safety.
 - All buildings must address the design qualities contained in the Residential Flat Design Code (now superseded by the Residential Apartment Design Guide).

2.2.2 Component Requirements

LAHC own and manage over 130,000 dwellings with over 10 million components. Components in this sense are discrete items that together comprise a building and can be replaced as a unit, such as doors, basins, taps, windows, walls and roofs. As LAHC are the long-term managers of residential properties, life cycle costs are just as important as the purchase price and places different criteria when designing and procuring components to install within dwellings.

While many of the components detailed within the requirements are relevant at the detailed design stage, it should still be taken into consideration at the concept design stage for Waterloo South from a whole-of-life perspective. The design of buildings and places should be designed to maximise longevity of components and designing out maintenance where possible.

2.3 ESD Policy Context

To ensure alignment with government and community objectives and expectations, the following section provides a review of international, national, state and local policy drivers and context that inform or influence the sustainable development outcomes for Waterloo South.

2.3.1 National and International Context

United Nations Sustainable Development Goal (SDG)

In 2015, the United Nations General Assembly passed a resolution on the global agreement of 17 Sustainable Development Goals (SDGs) to form a roadmap for global development efforts to 2030 and beyond (see Figure 4). While non-binding, for Australia, the 2030 Agenda will be highly influential, shaping commitments, development cooperation and finance flows as well as global government and private sector reporting.

In 2018, Australia delivered its first Voluntary National Review on Australia's implementation of the Sustainable Development Goals. It features several case studies of projects around Australia that detail how they are contributing to Australia's progress against the SDGs.



Figure 4: United Nations 17 Sustainable Development Goals

Some of the SDGs have relevance to Waterloo South:

- SDG 6 - Clean water and sanitation:
 - 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
 - 6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
 - 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
- SDG 7 - Affordable and clean energy:
 - 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services.
 - 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix.
 - 7.3 By 2030, double the global rate of improvement in energy efficiency.
- SDG 11 – Sustainable Cities and Communities:
 - By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

- By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, for women and children, older persons and persons with disabilities.
- SDG 12 - Responsible consumption and production:
 - 12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, considering the development and capabilities of developing countries.
 - 12.2 By 2030, achieve the sustainable management and efficient use of natural resources.
 - 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

Paris Agreement – Framework Convention on Climate Change

The Paris Agreement formed by United Nations Framework Convention on Climate Change members, sets out a global action plan to reduce the impacts of climate change by limiting global warming to below 2°C and pursue efforts to keep warming below 1.5°C above pre-industrial levels. To limit global average temperature increase to 1.5 degrees Celsius means that all sectors of the economy need to achieve net zero emissions by 2050. Australia has set a target to reduce emissions by 26-28% below 2005 levels by 2030 which builds upon the current 2020 target of reducing emissions by 5% below 2000 levels under the Kyoto Protocol.

The planning and development of Waterloo South will occur under the carbon emissions trajectory set by Australia's involvement in the Paris Agreement. This has been reflected in the Study Requirements to identify options for 50% renewable energy on the project and identifications of pathways to net zero carbon emissions by 2050.

Renewable Energy Target (RET)

The Renewable Energy Target is a legislated target designed to ensure the increased uptake of renewable energy in Australia, and in the process, reduce overall GHG emissions. The current target is for 23.5% of Australia's energy, the equivalent of 33,000 GWh of electricity, to come from renewable sources such as wind, solar, and hydroelectric by 2020.

The RET allows both large-scale power stations and small-scale systems to create certificates for every megawatt-hour of energy they generate. Certificates are purchased by electricity retailers and surrendered to the Clean Energy Regulator to meet the retailers' legal obligations under the RET. This creates a market that provides financial incentives to both large-scale renewable energy power stations and the owners of small-scale renewable energy systems.

The momentum in new project announcement observed in late 2016 continued throughout 2017, firming sufficient capacity to announce the achievement of the Large-scale Renewable Energy Target (LRET) by the 2020 deadline¹.

The RET, though not directly relevant to the Waterloo South, sets out the overall trajectory on renewable energy uptake from a policy perspective. The RET also enables any on-site renewable generators to claim certificates to improve its overall business case.

National Energy Productivity Plan (NEPP)

The National Energy Productivity Plan aims to improve Australia's energy productivity² by 40% by 2030. The energy market is undergoing rapid disruptive changes with new technologies, new customer expectations, rising prices, falling demand and pressure from climate change impacts. Energy supply has moved away from predictable patterns and energy markets have struggled to forecast and plan for this change. The inability to plan effectively has resulted in inefficient investment which has led to higher costs for customers.

Over recent years, Australia's energy productivity has improved, growing at around 1.8% per annum over the last decade. However, Australia is still lagging behind other countries such as Japan, Germany and the UK. To meet the 40% target, a doubling of the rate of energy productivity improvement compared to business-as-usual is required.

¹ Clean Energy Regulator, 'Progress in 2017 Delivering Australia's 2020 Renewable Energy target', <http://www.cleanenergyregulator.gov.au/DocumentAssets/Documents/Progress%20in%202017%20Delivering%20Australia%E2%80%99s%202020%20Renewable%20Energy%20Target.pdf>

² Energy productivity is increasing the output using the same amount, or less, energy

The NEPP itself does not mandate any particular development to achieve certain energy productivity targets. However, it acts as general guidance for energy efficiency and energy productivity measures that could be considered for Waterloo South.

National Carbon Offset Standards (NCOS) for Buildings and Precincts

The Department of Environment and Energy released the National Carbon Offset Standards for Buildings and Precincts in October 2017. The Department collaborated with the National Australian Built Environment Rating System (NABERS), the Green Building Council of Australia (GBCA), carbon accounting experts and property sector businesses to develop the Standards.

These voluntary standards set rules for measuring, reducing, offsetting and reporting emissions required to make carbon neutral claims for building and precinct operations. Within precinct operations this includes energy, water, waste and transport emissions. These standards will frame the due diligence process and future carbon measurement and reporting efforts for Waterloo South and its buildings.

National Construction Code

The National Construction Code (NCC) is an initiative developed by the Coalition of Australian Governments to incorporate all on-site building and plumbing requirements into a single code.

The Code sets the minimum necessary requirements for safety, health, amenity and sustainability in the design and construction of new buildings (and new building work in existing buildings) throughout Australia. It is a standardisation of technical provisions for building work and plumbing and drainage installations whilst allowing for variations in climate and geological or geographical conditions.

Although developed at the national level, administration of the NCC is the responsibility of Australian States and Territories, which provide the legal framework to support the design and construction of buildings.

The NCC is published in three volumes. Volumes 1 and 2 are the Building Code of Australia, and Volume 3 is the Plumbing Code of Australia. These updates include changes to commercial building energy efficiency requirements including new verification methods for demonstrating compliance with the relevant performance requirements in NABERS and Green Star ratings. New heating and cooling load limits using the NatHERS compliance pathway for residential buildings have been introduced for building classes 1,2 and 4.

Section J is of importance in Waterloo South as it will drive building energy efficiency in a move towards a net carbon position of Waterloo South.

Sustainability Rating Tools

There are a number of rating tools available to assess the sustainability performance of buildings and precincts that are relevant to Waterloo South. NABERS and NatHERS are government initiatives while Green Star is an industry developed rating tool.

National Australian Built Environment Rating Systems (NABERS)

NABERS is a national rating system that measures the environmental performance and impacts of Australian office buildings and tenancies, shopping centres, hotels, data centres and apartment buildings in terms of energy efficiency, water usage, waste management and indoor environmental quality at the operational stage.

NABERS is mandated for commercial floor space within the development where the office space is greater than 1000m² via the Commercial Building Disclosure program. This requires all buildings on sale or lease to have and disclose the achieved NABERS Energy rating. There may be opportunity to consider other NABERS benchmarking and monitoring for water, waste and indoor environment to enable effective benchmarking and reporting if considered appropriate.

Given the high proportion of residential apartments, the NABERS for Apartment Buildings rating is highly relevant to Waterloo South. It rates the energy and water efficiency of a buildings common property and is applicable to areas such as lifts and lobbies, car parks, gyms, pools and water features.

Nationwide House Energy Rating Scheme (NatHERS)

The Nationwide House Energy Rating Scheme (NatHERS) rates the energy efficiency of a home on a 10-star rating system. NatHERS primarily focuses on the potential heating and cooling energy use, centred on thermal comfort of the building's inhabitants. NatHERS is built into the BCA and for multi-residential units must:

- Collectively achieve an average energy rating of not less than 6 stars; and
- Individually achieve an energy rating of not less than 5 stars.

NatHERS will provide greater opportunity for the reduction of energy used in buildings for thermal comfort as well as provide means for better future-proofing from climate change and related temperature increases.

Green Building Council of Australia (Green Star)

Green Star is an internationally recognised rating system that delivers independent verification of sustainable outcomes throughout the life cycle of the built environment. It is designed to be a voluntary rating tool to incentivise better practice within the property development industry. The Study Requirements for Waterloo South require commitment to compliance with a nationally recognised rating system such as GBCA's Green Star – Communities rating tool.



Figure 5: Green Star Suite of Ratings

The Green Star – Communities rating tool was released in 2012 and evaluates the sustainability attributes of the planning, design and construction of large-scale development projects at a precinct, neighbourhood and/or community scale. It provides a rigorous and holistic rating across five impact categories; Governance, Liveability, Economic Prosperity, Environment, and Innovation and strives to incentivise more sustainable outcomes from master plans.

Green Star – Communities also rewards credit points for non-residential buildings within certified Communities that are certified under building-scale rating tools. For Green Star – Communities, initial project certification is typically achieved following completion of the master plan and must be achieved within three years of project registration with the GBCA. Initial certification lasts for 5 years and the development must be recertified within this period. Recertification involves the verification of project commitments made at the master plan stage to ensure they have been implemented into the as-built development.

Green Star – Design & As-Built assesses the sustainability outcomes from the design and construction of new buildings or major refurbishments, across nine holistic impact categories. Green Star – Design & As-Built works to provide sustainability in the design and construction of buildings specifically. The Credits covered by this tool are:

- Management
- Indoor Environmental Quality
- Energy
- Transport
- Water
- Materials
- Land use and Ecology
- Emissions and
- Innovation

There is potential for Green Star – Design & As-Built rating to be applied to the retail, commercial and residential building elements within Waterloo South.

The Green Star – Design & As-Built rating applies to both building design and construction stages together. A complete Green Star – Design & As-Built rating can only be achieved after achieving the 'As-Built' certified rating. Projects have the option of seeking a 'Design Review' certified rating which can be submitted during the design development period. It is not a standalone rating and is an interim step towards the 'As-Built' certification. The 'Design Review' certified rating expires 24 months post practical completion of the building, or once the 'As-Built' certification is achieved.

2.3.2 NSW State Controls and Guidelines

Environmental Planning and Assessment Act 1979 and Regulation 2000

The redevelopment of Waterloo South is subject to the requirements set under the *Environmental Planning and Assessment Act (EP&A) 1979* and the regulations supporting the Act. The Study Requirements for Waterloo South specifically call out the ESD principles set out in the *Environmental Planning and Assessment Regulation* and requires an “*Ecologically Sustainable Development Report which details how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated*”.

The principles in the Regulation are outlined below:

- *the “precautionary principle”, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*
 - *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
 - *an assessment of the risk-weighted consequences of various options,*
- *“inter-generational equity”, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations*
- *“conservation of biological diversity and ecological integrity”, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration*
- *“improved valuation, pricing and incentive mechanisms”, namely, that environmental factors should be included in the valuation of assets and services, such as:*
 - *Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
 - *The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
 - *Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

This Report has been developed to demonstrate specifically how the development has considered the items above in accordance with the Study Requirements, as well as demonstrate compliance with the definitions specified within the Act. This is elaborated upon in Section 3.1.

Future Directions for Social Housing in NSW

Future Directions for Social Housing in NSW sets out the NSW Government’s strategy for social housing over the next 10 years. It seeks to drive better outcomes for tenants and provide additional assistance for those who can transition out of social housing.

Future Directions is underpinned by three strategic priorities:

- More social housing:
 - Increase redevelopment of LAHC properties to renew and grow supply
 - Increase the capacity of community housing providers and other non-government organisations to manage properties.
 - Innovative financing and social impact investment models.
 - Better utilisation of social housing properties.
- More opportunities, support and incentives to avoid and/or leave social housing:
 - Remove work disincentives.
 - Education and employment.
 - Private rental assistance.

- Affordable rental housing as a stepping stone.
- Collaboration and accountability.
- A better social housing experience:
 - Family and Community Services (FACS) customer service.
 - Better maintenance and community amenity.
 - Safe, stable communities.
 - A ‘place-making’ approach to building communities.
 - Regional options.



Figure 6: Future Directions for Social Housing Strategic Priorities

These priorities are seeking to achieve the following outcomes:

- Increase in successful transitions out of social housing by 5%.
- Increase the proportion of young people who successfully move from specialist homelessness services to long term stable accommodation by 10%.

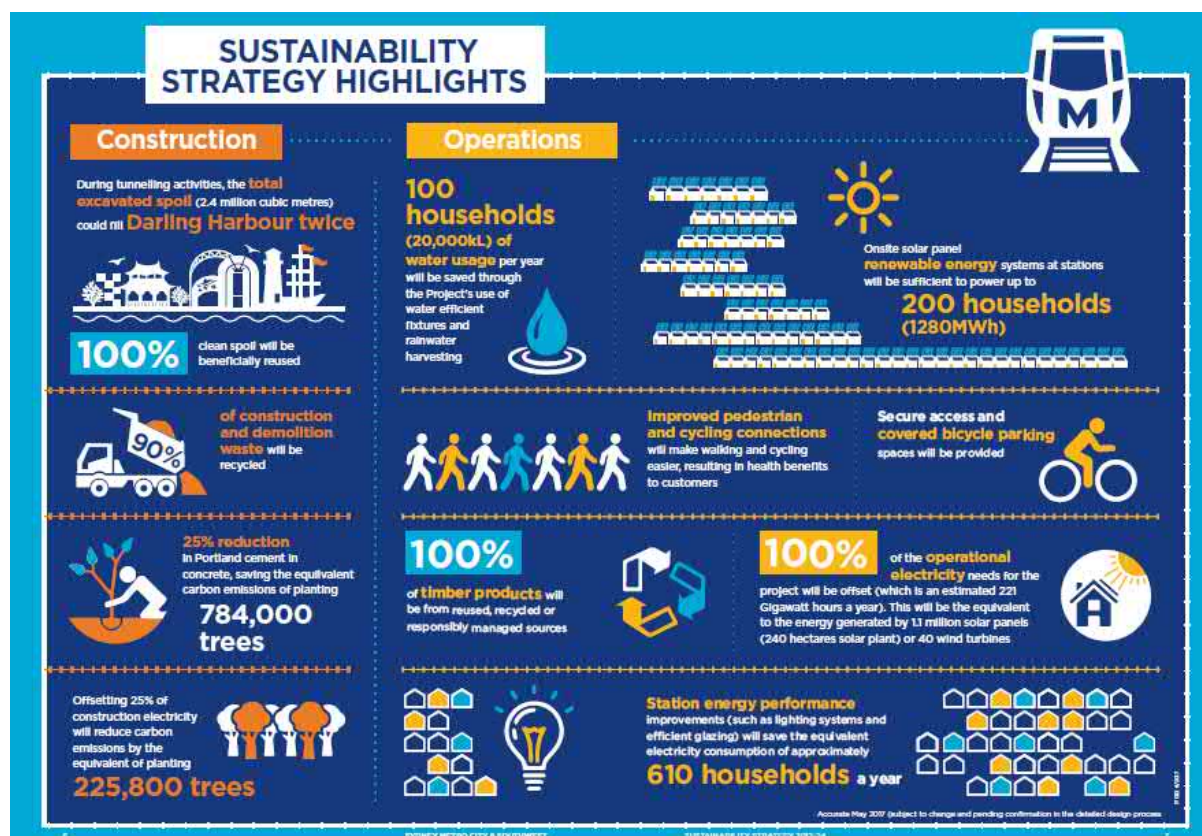
LAHC will commit up to 23,000 new and replacement social housing dwellings over the next 10 years under the Future Directions for Social Housing in NSW strategy. This provides a unique opportunity to improve the environmental and social sustainability of social housing in NSW. Quality urban and architectural design will deliver social housing that is integrated into well-located and diverse communities, promoting integrated communities and sustainable outcomes for social housing tenants. LAHC key sustainability objectives for newly built social housing will be to:

- Recognise the need to create homes and communities that support social networks, healthy living, social engagement and economic independence.
- Adopt an integrated approach that delivers sustainable outcomes for tenants and long-term management of social housing dwellings.
- Include environmental sustainability initiatives with an aim to promote sustainable living, improve the personal and social wellbeing of tenants, and reduce energy, water and living costs.

Sydney Metro City & Southwest Sustainability Strategy 2017-24

The Sydney Metro City & Southwest project is the second stage of the Sydney Metro program, extending from Chatswood, under Sydney Harbour, through the Sydney central business district and beyond the Bankstown. It includes new metro stations and the upgrade of all existing stations between Chatswood and Bankstown including a new station at Waterloo. While Waterloo South is not considered an Integrated Station Development (ISD), it is bordered by the Metro Quarter ISD.

The City and Southwest Metro line was planned, designed and is being constructed under the guidance of its Sustainability Strategy (2017-24). It demonstrates the integration of sustainability to date on the project and sets strong commitments to sustainable outcomes for the project as it progresses through detailed design and delivery. This includes the following headline initiatives:



Source : Sydney Metro City & Southwest Sustainability Strategy_1.pdf

Figure 7: Sydney Metro Sustainability Highlights

The Sydney Metro project has also set out criteria to seek best-practice sustainable design and governance outcomes for integrated station developments (ISDs) including:

- Achieving high benchmarks using Green Star – Design & As Built ratings and Green Star - Communities ratings where appropriate.
- Achieving high benchmarks using NABERS and BASIX ratings.
- Site-specific responses to the project’s sustainability objectives.
- Investigation and inclusion of affordable housing where appropriate.

For Waterloo South, consideration should be given to the above sustainability targets to provide consistency with the Metro Quarter.

Building Sustainability Index (BASIX) SEPP

The Study Requirements identify performance benchmarks for sustainability to be considered in site planning, building design and in the construction and operational phases of the development to achieve best practice sustainability outcomes.

BASIX controls are prescribed under a State Environmental Planning Policy (SEPP), which is implemented under the *Environmental Planning and Assessment Act 1979*. It is a statutory requirement for all residential developments including new constructions and renovations worth \$50,000 or more in NSW.

BASIX is one of the most stringent energy and water planning tools within Australia for residential developments. BASIX is a sustainability planning instrument that sets energy and water design standards for all residential dwelling types in NSW. It drives energy and water use efficiencies through specific design strategies and prescriptions for lighting, heating, cooling and ventilation for energy, and potable water use and non-potable water replacement rates for water.

BASIX mandates sustainability standards in residential developments. It assesses potable water use, energy use and thermal performance of the building. BASIX targets were revised in June 2017. Table 4 and Table 5 below provide the current minimum statutory BASIX targets for residential developments in Sydney, NSW.

Table 4: Statutory BASIX Energy Targets

Building Type	BASIX Target
Detached and semi-detached	50
Low-rise (3-storey units)	45
Mid-rise (4-5 storey units)	35
High-rise (6-storey units and higher)	25

Table 5: Statutory BASIX Water Targets

Building Type	BASIX Target
Detached and semi-detached	40
Low-rise (3-storey units)	40
Mid-rise (4-5 storey units)	40
High-rise (6-storey units and higher)	40

BASIX Energy and Water targets will influence overall electrical demand in Waterloo South, with an increase in BASIX targets implying decreased demand and more thermally efficient building envelopes and services required at later stages of development. This will ensure an extent of future-proofing from climate change and related temperature increases.

Overall, BASIX Energy and Water targets will influence overall electrical demand on Waterloo South, with an increase in achieved BASIX scores implying decreased energy consumption and peak demand due to more thermally efficient building designs. An additional co-benefit is that the more optimised building designs will be more resilient (to a certain extent) from climate change-related temperature increases.

SEPP 65 and the Residential Apartment Design Guide

The *State Environmental Planning Policy No. 65 – Design Quality of Residential Apartment Development (SEPP 65) (2015)* promotes better apartment design across NSW through the establishment of a consistent approach to the design and assessment of apartments and the way they are assessed by councils. SEPP 65 provides guidance on features for apartment buildings through a number of key design criteria relating to the sustainability performance of the development including:

- Bicycle and car parking
- Solar and daylight access
- Natural ventilation
- Apartment size and layout
- Universal design
- Energy efficiency
- Water management and conservation
- Waste management
- Building maintenance

The Residential Apartment Design Guide provides guidance on overall apartment building design within Waterloo South to drive sustainable design for the benefit of the residents as well as reduce energy and water demand and waste generation.

Future Transport Strategy 2056

The Future Transport Strategy 2056 is an overarching strategy supported by a suite of plans to achieve a 40-year vision for NSW's transport system. The Strategy and Plans focus on the role of transport in delivering movement and place outcomes that support the character of future places and communities. The Strategy recognises that transport infrastructure impacts every person, business and visitor in the state, as well as supporting economic, social and environmental outcomes.

The vision for future transport in NSW is built upon the following outcomes:

- Customer focus

- Moving to ‘mobility as a service’ (MaaS) and beyond
- Successful places
 - Activating centres with a new movement and Place framework
 - Encouraging active travel (walking and cycling) and using public transport
 - Strengthening local partnerships
- A Strong Economy
 - A transport system that powers our future \$1.3 trillion economy
 - Strengthening our global gateways and satellite cities
 - Connecting people to jobs, goods and services in our cities and regions
- Safety and Performance
 - Safety, security and performance are interlinked
 - A secure network in the digital ages
- Accessible Services
 - A fully accessible network that enables barrier-free travel for all
 - Inclusive customer service and information
- Sustainability
 - An affordable network that is responsive to change
 - Supporting more environmentally sustainable travel

The Future Transport Strategy responds to the way technology will change the way we travel and how transport infrastructure will be delivered. Traditional modes of transport such as buses, trains, cars and trucks are expected to become increasingly automated, safer, and will gradually need connection to a smarter network. The increasing availability of open data sources gives rise to improved customer choice and flexibility in transport services.

The 2056 Strategy is highly relevant to Waterloo South as the design decisions being considered now will have implications on the development and its surrounds for decades to come. With the construction of the nearby Waterloo Metro Quarter and Station, Waterloo South should consider how it can best align with and assist in the achievement of the desired outcomes.

NSW Energy Efficiency Action Plan

The Energy Efficiency Action Plan was developed with the goal of reducing the cost of living in NSW. It aims to put downward pressure on electricity bills by assisting households to reduce their energy use and improve energy productivity for businesses. The Action Plan aims to reach the following targets:

- Achieve 16,000 GWh in energy savings per year by 2020
- Support 220,000 low income households to reduce energy use by up to 20% by 2014
- Assist 50% of NSW commercial floor space achieve 4-star NABERS and water rating by 2020 through the delivery of high-standard building retrofit programs

The Energy Efficiency Action Plan sets out a number of actions ranging from educational programs, formation of partnerships with industry, and provides financial incentives for homes and businesses to participate in energy reduction schemes.

The Action Plan is primarily focused on retrofitted upgrades of fixtures, fittings and appliances in existing dwellings rather than new developments, as is the case for Waterloo South. Hence, while not directly applicable, it provides context to the minimum level of energy efficiency performance to be expected in Waterloo South.

NSW Electricity Strategy

The NSW Electricity Strategy was released by the NSW Government and aims to provide a “pathway for a reliable, affordable and sustainable electricity future”. The Strategy aims to encourage over \$8 billion of new private investment in the NSW electricity system; deliver coordinated Renewable Energy Zones; save energy during peak demand; develop new electricity generators; and set a target to boost NSW’s energy resilience. Renewable Energy Zones are delivered in line with the aims of the NSW Transmission Infrastructure Strategy to unlock a pipeline of large-scale renewable energy and storage projects. The zones will deliver significant amounts of new energy supply, increase energy affordability and reduce emissions.

The NSW Government intend the Strategy to:

1. improve the efficiency and competitiveness of the NSW electricity market by reducing risk, cost, Government caused delays and by encouraging investment in new price-reducing generation and energy saving technology;
2. prompt Government to act if there is a forecast breach of the EST which private sector projects are unlikely to address. This should be done in a way that minimises costs to consumers and taxpayers and does not give rise to moral hazard risk; and
3. ensure that there are appropriate powers available for Government to analyse and respond to electricity supply emergencies, if they arise.

The Strategy sets out 10 actions that will support a competitive electricity market with more resilient supplies. The actions were chosen to support an efficient, competitive and low-cost electricity market and making it easier to invest in clean energy; avoid electricity emergencies caused by capacity constraints; and having a strong emergency response to electricity system failures. The Strategy also outlines NSW’s Energy Security Target position: *“AEMO forecasts the 1-in-10-year peak demand for the summer of 2019-20 to be 14,373 MW. 57 The firm supply rating for each of the two largest generating units in the State is 680 MW. Accordingly, the EST is 15,733 MW. NSW’s firm capacity for 2019-20 is estimated at 15,545 MW. Therefore, this places NSW 188 MW short of its EST. In this respect, the State’s capacity shortfall on its EST is expected to be addressed by the summer of 2021, with additional projects providing further capacity increases through to 2022-23”.*

Whilst the Strategy takes a state-wide focus, it should be considered in the context of the increased population and electricity demand in Waterloo South. Energy efficiency measures and onsite renewable energy may be initiatives that can be implemented in Waterloo South to compliment the Strategy.

Urban Green Cover in NSW Technical Guidelines

The Office of Environment and Heritage’s (OEH) *Urban Green Cover in NSW Technical Guidelines (2015)* are also part of the NSW Government intent to minimise and accommodate the impacts of climate change to communities, health services and local infrastructure. The Guidelines recognise the need for urban environments to withstand projected increase in extreme heatwaves, intense storms and localised flooding.

OEH includes among urban green cover, a range of strategies such as vegetated and reflective roofs, green walls, street plantings, permeable and reflective road surfaces, and cool open spaces and parks. These are mostly low-cost approaches to cooling urban environments while providing ecosystem services such as stormwater management, clean air and biodiversity habitat in addition to reduced energy costs for cooling. The guidelines are meant for integration in strategic plans, development control plans, public domain guidelines or urban design studies.

NSW Waste Avoidance and Resource Recovery Strategy (WARR) 2014-21

The NSW Waste Avoidance and Resource Recovery (WARR) Strategy provides a clear framework for waste management over the next few years and aligns with the NSW Government’s waste reforms set out in ‘*NSW 2021: A Plan to make NSW number one*’.

The vision set by the WARR Strategy is to *“enable all of the NSW community to improve environment and community well-being by reducing the environmental impact of waste and using resources more efficiently. Using resources more efficiently and keeping materials circulating in the productive economy can also help to create jobs and grow the NSW economy”.*

The WARR Strategy is financially supported by the ‘*Waste Less, Recycle More*’ initiative. It has supported significant new recycling and waste infrastructure, litter programs and illegal dumping reduction strategies across the state.

The WARR Strategy's key objectives and targets are to: increase recycling across municipal, commercial/industrial and construction and demolition waste streams; divert waste from landfill; better manage problem wastes³, reduce litter and illegal dumping.

WARR Strategy 2014-21 Targets

Avoidance and reduction of waste generation	
By 2021–22, reduce the rate of waste generation per capita	
Reduce household chemicals, e-waste, organics and support collection for safe disposal and recycling drop-off facilities	
Increase recycling	Divert from landfill
<ul style="list-style-type: none"> • Municipal solid waste from 52% (in 2010–11) to 70% • Commercial and industrial waste from 57% (in 2010–11) to 70% • Construction and demolition waste from 75% (in 2010–11) to 80% 	<ul style="list-style-type: none"> • By 2021–22, increase the waste diverted from landfill from 63% (in 2010–11) to 75%

As part of WARR, a draft WARR Infrastructure Strategy (2017-2021) was developed to guide planning and decision making to ensure NSW gets the correct mix of infrastructure to meet future needs. It is imperative to understand the gap in existing capacity and the need for resource recovery facilities. The projected population growth is assumed to be the major driver for an increase in waste generated across the state.

Should the 2021 75% target for resource recovery diversion not be met, the demand for landfill capacity could increase. This could put a strain on the existing waste treatment infrastructure; hence there is an apparent need to increase the number of waste processing facilities. Under the Waterloo Study Requirements, identification and implementation of strategies in alignment with the WARR Strategy is required.

Waste Less, Recycle More

The Environmental Protection Authority's (EPA) *Waste Less, Recycle More* initiative provides funding for business recycling, organics collections, market development, managing problem wastes, new waste infrastructure, local councils and programs to tackle illegal dumping and litter. The program seeks to encourage local communities to think differently about waste avoidance, recycling, littering and illegal dumping, deliver conveniently located, value-for-money waste infrastructure to make it easier to 'do the right thing', and drive innovative regulatory approaches to protect the environment and support investment in new waste programs.

Better Practice Guide for Resource Recovery in Residential Developments

The Better Practice Guide for Resource Recovery in Residential Developments (2019) was released by the NSW EPA as a guide to assist local planners, architects, urban designers, developers and other professionals to incorporate better waste and recycling management design practices in residential developments. It applies only to residential developments, and does not cover commercial, retail or industrial premises. As such, the Guide can be referenced during the design of Waterloo South residential buildings to ensure the best waste management outcomes are realised.

The Guide provides information on how to make the collection of waste and recycling convenient and safe for all involved, how to improve the performance of waste collection systems and how to minimise the visual amenity impact of such systems. The Guide includes four waste and resource recovery design principles:

1. **Environmental and sustainability best practice:** Developments meet requirements for long-term sustainability and best practice when:
 - a. systems are designed to maximise waste separation and resource recovery
 - b. innovative and best practice waste management collection systems and technologies are supported where appropriate
 - c. flexibility in design allows for future changes in waste generation rates, materials collected and methods of collection

³ For example, by providing appropriate facilities for disposal of household problem waste such as paint, batteries, gas bottles and hazardous household products

2. **Effective waste and resource management:** Developments achieve effective waste and resource management when:
 - a. waste services can occur in a safe, seamless and timely manner
 - b. access to waste disposal and resource recovery services are safe and convenient for all residents
 - c. functional and adequate storage spaces are provided for all waste and recycling streams, including temporary storage areas for bulky materials like cardboard boxes and oversized household waste.
3. **Clean, safe and healthy living environments:** Developments protect and enhance the quality of life for the community when:
 - a. negative impacts on amenity for residents, neighbours and the public, such as visually unpleasant waste storage areas, bad odours and noise from waste collection are minimised
 - b. illegal dumping and litter from bins are minimised through good planning and installation of adequate storage and waste recovery infrastructure
 - c. safe and easy access to waste and resource recovery storage areas is provided for residents, building managers and collection contractors.
4. **Affordability:** Developments allow residents to engage in cost-effective waste services when:
 - a. careful design and construction prevents costly retrofits
 - b. flexibility in design allows for the collection of all waste and recycling streams to be cost-effective for residents.

2.3.3 Regional Controls and Guidelines

Greater Sydney Commission (GSC) District Plan

The GSC is an independent organisation formed to coordinate and align the planning to shape Greater Sydney in a 'one government' approach. The aim is to give rise to a productive, liveable and sustainable Sydney. The commission is underpinned by an environmental, social and economic commissioner with a focus on planning for improved futures across the triple bottom line. Waterloo South falls within the Eastern City District Plan which is characterised with high concentrations of jobs, with good road and public transport connectivity and high levels of interaction between business and people. The corridor contributed two-thirds of the State's economic growth over the 2015-16 financial year.

The District Plan recognises that anticipated urban renewal within the City of Sydney will drive an increase in population of 102,600 people by 2036. Urban renewal projects provide opportunity to improve the energy and water efficiency of new and existing buildings, incorporate building and precinct-scale renewables, and manage waste more efficiently to reduce greenhouse gas emissions and costs, and appeal to building owners and tenants. Better and more integrated design of such systems can encourage a more circular economy that focuses on improving efficiency.

The District Plan also identifies that people will want to live closer to jobs and services thus housing and jobs will need to be aligned with new or improved transport, education, health and other infrastructure. Better transport means people will be close to knowledge-intensive jobs, city-scale infrastructure and services, and lifestyle features. Walking and cycling will become an increasingly important part of daily travel, with well-designed paths in popular thoroughfares improving the sustainability of the region and the wellbeing of residents.

The Eastern City District Plan also includes the following planning priorities which are relevant to this strategy for Waterloo South:

- Planning Priority E14 - Protecting and improving the health and enjoyment of Sydney Harbour and the District's waterways.
- Planning Priority E19 - Reducing carbon emissions and managing energy, water and waste efficiently.

Under these planning priorities, there are a number of objectives and corresponding strategies. The relevant ones include:

- Objective 33: A low-carbon city contributes to net-zero emissions by 2050 and mitigates climate change.
- Objective 34: Energy and water flows are captured, used and re-used.

- Objective 35: More waste is re-used and recycled to support the development of a circular economy.

Some of the relevant actions include:

- Support initiatives that contribute to the aspirational objective of achieving net-zero emissions by 2050, especially through the establishment of low-carbon precincts in Planned Precincts, Collaboration Areas, State Significant Precincts and Urban Transformation projects.
- Support precinct-based initiatives to increase renewable energy generation, and energy and water efficiency, especially in Planned Precincts, Collaboration Areas, State Significant Precincts and Urban Transformation Projects.
- Encourage the preparation of low-carbon, high efficiency strategies to reduce emissions, optimise the use of water, reduce waste and optimise car parking provision where an increase in total floor area greater than 100,000 square metres is proposed in any contiguous area of 10 or more hectares.

Utilities

Energy - Ausgrid

Ausgrid are responsible for the energy networks for Waterloo South connections. They will be involved with setting the requirements for the energy servicing for Waterloo South. They will be key stakeholders for any significant energy efficiency, peak reduction and or onsite generation considerations. If any alternative network or internal distributed energy solutions are to be considered this would also need significant engagement with Ausgrid and the regulators.

Ausgrid is a key stakeholder involved in the planning and development of Waterloo South which is within their distribution network jurisdiction. Ausgrid will need to understand the overall electricity demand profiles of Waterloo South in order to develop and maintain the appropriate electricity infrastructure to service the development.

Energy - Jemena

Jemena own and operate a diverse portfolio of energy and water distribution assets. In NSW, Jemena's gas network distributes natural gas to 1.3 million residential and industrial customers across Sydney, Newcastle, the Central Coast, Wollongong and several regional centres.

Waterloo is currently serviced by Jemena's gas network and is a key stakeholder involved in the planning and development of Waterloo South and energy servicing infrastructure. Jemena will need to understand the impact of connecting Waterloo South on their gas network servicing capacity. Consideration will need to be given to the carbon intensity of the fuel and the ability of Waterloo South to progress toward a net-zero carbon emissions by 2050 target.

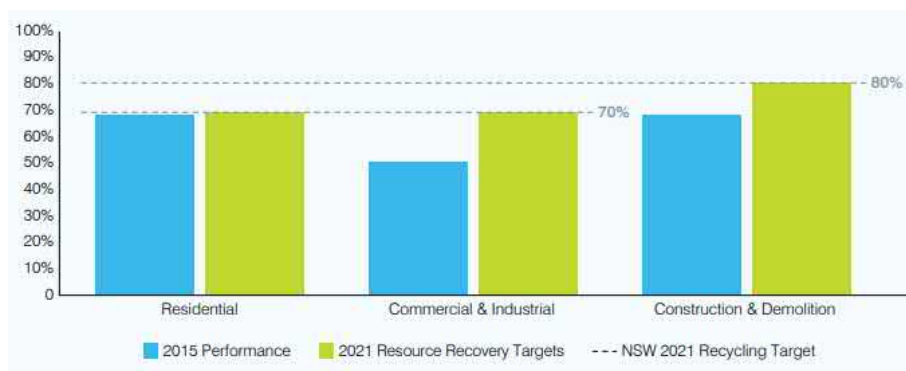
Water - Sydney Water

Sydney Water is Australia's largest water and wastewater service provider with an organisational commitment to enhancing Australian cities' sustainability and lifestyle. With Sydney's populations set to increase by 1.3 million residents in the next 20 years, Sydney Water recognises that population growth, increasing urban density, water security, and climate change will all affect the liveability and resilience of Sydney.

Sydney Water is a key stakeholder involved in the planning and development of Waterloo South which is within their network jurisdiction. Sydney Water will need to understand the overall water, stormwater and wastewater needs in order to develop and maintain the appropriate infrastructure to service Waterloo South.

Waste - City of Sydney

The City of Sydney controls domestic and public recycling and waste management. The 'Environmental Action Plan 2016-2021' sets an objective for a Zero waste city. The strategy reflects the government targets of reduction which can be seen in Figure 8 below.



Source: [City of Sydney Environmental Action Plan 2016-2021](#)

Figure 8: Waste Targets City of Sydney

This is further supported by the [Leave Nothing to Waste Strategy and Action Plan 2017-2030](#). This sets targets and strategies for residents to divert 70% of waste (with a minimum of 35% as source-separated recycling) away from landfill. It also sets targets for businesses and to divert 70% of waste from operating businesses in the local government area away from landfill and 80% of waste from construction and demolition activities in the local government area away from landfill.

City of Sydney's strategy for managing Sydney's waste to 2030 is set out in the plan outlines waste management action to achieve the zero-waste target by 2030. It will help the City of Sydney respond more effectively to the increasing demand for resources as the residential, worker and visitor populations continue to grow.

The strategy sets clear targets and recommendations to maximise diversion from landfill, focusing on 6 priority areas:

- Promote innovation to avoid waste
- Improve recycling outcomes
- Sustainable design
- Clean and clear streets
- Better data management
- Future treatment solutions

2.3.4 Local Controls and Guidelines

City of Sydney Sustainable Sydney 2030

Sustainable Sydney 2030 is the overarching program for the development of the city to 2030 and beyond. The overall themes within the strategy are 'Green', 'Global', and 'Connected'. The strategy ties together a number of plans covering the economy, carbon neutrality, green infrastructure, renewable energy, decentralised water, sustainable transport, light rail and car sharing.

Some of the key targets set out are:

- Reduce carbon emissions within the Sydney LGA by 70% on 2006 levels by 2030, and by 2050 achieve carbon neutrality
- 50% of electricity demand met by renewable sources
- Zero increase in potable water use from 2006 baseline
- Total canopy cover increased by 50% from 2008 baseline

City of Sydney's Environmental Action Plan 2016-2021

The Environmental Action Plan falls under the Sustainable Sydney 2030 strategy and sets out the short- and medium-term priorities and actions for the City. It focuses on defining actions to 2021 on the way to achieving 2030 environmental targets. By 2021, the City is committed to reducing emissions in its operations by 44% from 2006 levels and move to 50% renewable energy. And across the local government area, the City has set targets for 50% renewables by 2030, 70% reduction in 2006 greenhouse gas emissions levels by 2030 and net-zero emissions by 2050.

The areas of impact of the Action Plan are:

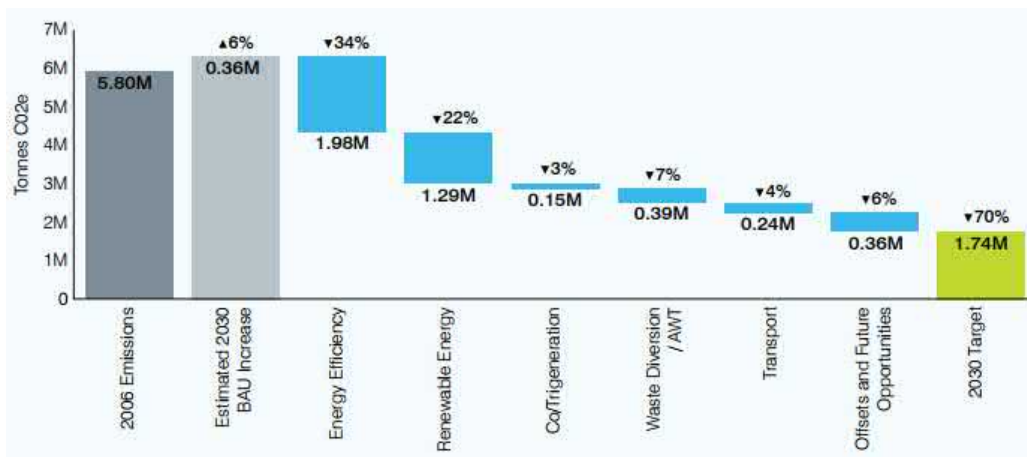
- Excellence in new building design – which sets guidance on voluntary standards for excellence in environmental performance in new buildings, detailed in Table 6

Table 6: City of Sydney guidance on voluntary standards for excellence in environmental performance in new buildings (as at 2017)

Energy and Emissions	Water Efficiency
Residential development <ul style="list-style-type: none"> • Single dwellings: BASIX 60+ • Apartments 2-3 storeys: BASIX 50+ • Apartments 4-5 storeys: BASIX 50+ • Apartments 6+ storeys: BASIX 40+ • Green Star – Design & As-Built – 5 Stars+ 	Residential development <ul style="list-style-type: none"> • BASIX 50 • BASIX 60 where recycled water is available • Green Star – Design & As-Built – 5 Star+
Commercial Office <ul style="list-style-type: none"> • NABERS Energy Commitment: 6 Stars • Premium office – Green Star – Design & As-Built – 5 Stars+ • Non-premium office – Green Star – Design & As-Built – 5 Stars+ 	Commercial office <ul style="list-style-type: none"> • Designed to meet Sydney Water Good Practice standard (w/o cooling towers 0.47kL/m²/yr, w/ cooling towers 0.84kL/m²/yr) • Green Star – Design & As-Built – 5 Star+
Hotels and serviced apartments <ul style="list-style-type: none"> • Materially exceed BCA Section J • Green Star – Design & As-Built – 5 Stars+ • Gold star LEED (build and construct) • Best Practice Earthcheck (planning and design) • NABERS Energy Commitment (when available) 	Hotels and serviced apartments <ul style="list-style-type: none"> • With cooling tower and laundry (0.43kL/m²/yr) • Without cooling tower and laundry (0.17kL/m²/yr) • Green Star – Design & As-Built – 5 Star+ • Gold Star LEED (build and construct) • Best Practice Earthcheck (planning and design) • NABERS Energy Commitment (when available)

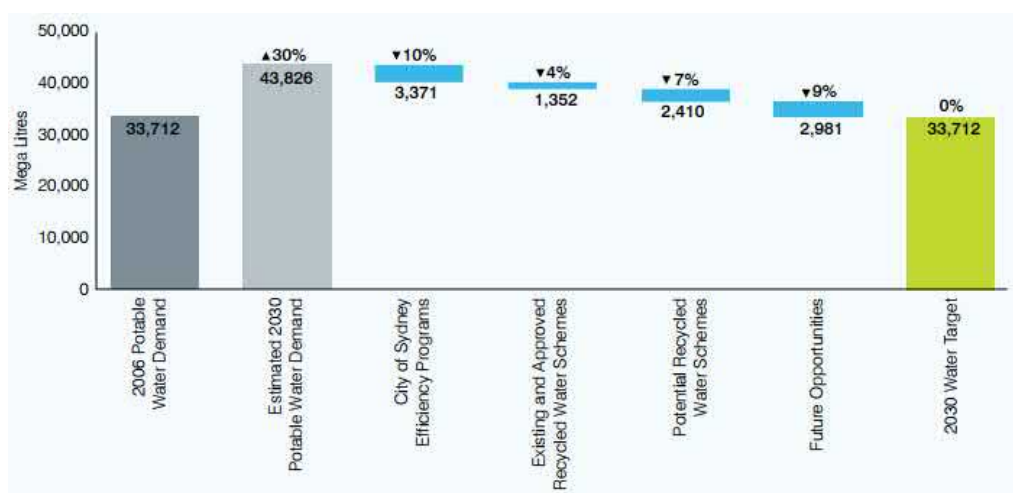
- Low-carbon city – sets a 2030 target to reduce emissions both across the city and in our operations by 70% below 2006. The identified reductions pathway:

Figure 9: Local government area greenhouse gas emissions



- Water sensitive city – an approach to drought-proof the city to ensure available water supply when it is hot and dry:

Figure 10: Local government area potable water use



- Green and cool city – aims to mitigate the urban heat island effect through increased urban canopy, raingardens, green roofs and walls. The City has set the following targets that are relevant to the energy and water scopes:
 - Average total canopy cover is increased by 50% by 2030 and increased by 75% by 2050 from a 2008 baseline.
 - Plant 700 street trees each year until 2021.
 - Tree species diversity will not consist of more than 40% of any particular plant family, 30% of any genus or 10% of any one species by 2021.
 - Plant 50,000 new trees and shrubs in City parks and street gardens each year until 2021.

City of Sydney’s Urban Forestry Strategy

In 2013, the City also adopted an Urban Forestry Strategy, which aims to provide healthy and diverse landscaping into our streets and parks, and to create beautiful streets and public spaces that contribute to the health and wellbeing of everyone in the community. Urban Forestry helps the adaptation to climate change by reducing the urban heat island effect, generating fresh air, absorbing stormwater, and providing cool spaces and respite during extreme heat. Accordingly, the City’s Greening Sydney Plan has overseen 10,250 new street trees planted since 2005 and 49,664 square meters of landscaping installed throughout the City of Sydney’s streets

and parks since 2008. A strategy has been developed in the Urban Forestry report by Arterra which details how the Estate will align with the City's Urban Forestry Strategy.

City of Sydney Climate Change Adaptation Plan

The City of Sydney developed the Climate Change Adaptation Plan as a supporting document to the Environmental Action Plan. The Plan outlines the key projected changes that may affect the City and its residents including increases in: temperature, heatwaves and extreme heat days, frequency of extreme rain events as well as dry spells, air pollution, bushfire conditions and sea levels. It outlines several adaptation measures to address these risks, as applicable to the LGA.

As part of the City of Sydney's participation in the 100 Resilience Cities project, the City produced a Resilience Sydney Report which includes research on the build environment and land use planning to adapt to the possible impacts of climate change.

Since that time, the City of Sydney has declared a climate emergency and have committed to source 100% renewable energy for their (City-owned) electricity needs from 2020 and replace all street lights with energy efficient LEDs.

The rezoning of Waterloo South will result in an increased population and intensity of use. In the context of climate and community resilience, this means the impacts of existing risks for Waterloo South and the Waterloo Estate on the whole are likely to increase, and the interdependencies of the development with the surrounding urban and natural environment must be considered. The City's Plan has been further considered from an adaptation and resilience perspective in the separate Climate Change Adaptation Report by AECOM.

City of Sydney's Community Strategy Plan

The Community Strategic Plan is an update of Sustainable Sydney 2030 to meet new legislative requirements and to ensure the program, which is driven by the community vision, is kept contemporary. The City surveyed the entire community and found that the environment and transportation were the top priority issues. Community harmony and social cohesion were also important, as was access to affordable and diverse housing options. The community also valued safe places to live, and well-planned places with good access to amenity and facilities that support active living.

The Community Strategic Plan has 10 key strategic directions:

- A globally competitive and innovative City.
- A leading environmental performer.
- Integrated transport for a connected City.
- A City for walking and cycling.
- A lively and engaging city centre.
- Vibrant local communities and economies.
- A cultural and creative City.
- Housing for a diverse population.
- Sustainable development, renewal and design.
- Implementation through effective governance and partnerships.

The Community Strategic Plan also has ten targets for 2030 to make the city more sustainable:

- 70% reduction in greenhouse gas emissions based on 2006 levels by 2030 and by 2050, achieve a net zero emissions city.
- 50% of electricity demand met by renewable sources: zero increase in potable water use from 2006 baseline, achieved through water efficiency and recycled water, total canopy cover increased by 50% from 2008 baseline.
- There will be at least 138,000 dwellings in the city (including 48,000 additional dwellings compared to the 2006 baseline) for increased diversity of household types, including greater share of families.

- 7.5% of all city housing will be social housing, and 7.5% will be affordable housing, delivered by not-for-profit or other providers.
- The city will contain at least 564,000 jobs compared to the 2006 baseline with an increased finance, advanced business services, education, creative industries and tourism sectors.
- Trips to work using public transport will increase to 80% for both residents of the city and those travelling to the city from elsewhere.
- At least 10% of total trips made in the city are by bicycle and 50% by pedestrian movement.
- Every resident will be within reasonable walking distance to most local services, including fresh food, childcare, health services and leisure, social, learning and cultural infrastructure.
- Every resident will be within a 3-minute walk (250m) of continuous green links that connect to the harbour foreshore, harbour parklands, Moore or Centennial or Sydney parks.
- The level of community cohesion will have increased based on at least 65% of people believing most people can be trusted.

The planning of Waterloo South and setting of targets will need to consider and seek alignment where possible with the directions and targets highlighted in the Community Strategic Plan.

City of Sydney Guidelines for Waste Management in New Developments

Building on the City of Sydney's 2005 Policy for Waste Minimisation in New Developments, the City has produced Guidelines for Waste Management in New Developments which falls under other sustainability policies including the City of Sydney's Sustainable Sydney 2030 Plan, the Environmental Action Plan 2016-2021, and Waste Strategy and Action Plan 2017-2030.

The Guidelines aim to assist architects, designers, developers, planners, consultants, builders and building managers to manage a building's waste outputs. They provide specific advice depending on development type and include provisions to address space, access and amenity requirements, safety, waste services and waste management systems.

The principals and practices presented in the Guidelines are relevant for consideration in the design for waste management in new buildings in Waterloo South. In particular, the Guidelines detail waste and recycling requirements for multi-unit residential developments with shared waste and recycling bins. This includes space for waste segregation and storage within individual dwellings and within the residential building and the design of waste disposal chute systems.

Development Control Plans (DCPs)

The Sydney DCP 2012 is a consolidation of the previously separate DCPs and policies in force within the City of Sydney LGA. The proposed planning framework will be a new part inserted into Section 5: Specific Areas of the Sydney DCP 2012 and include detailed controls to inform future development of Waterloo South.

Additionally, Waterloo South is surrounded by land that is bound by the Sydney DCP. To enable connection with the surrounding urban fabric, there are several general provisions that will have a measurable effect on the physical quality of the environment in Waterloo South. In the context of this Report, the following general provisions in the DCP should be considered:

- Streets, Lanes and Footpaths.
- Defining the Public Domain.
- Urban Ecology.
- Ecologically Sustainable Development.
- Water and Flood Management.
- Waste.

2.4 Trends and Drivers for Change

There are several market and industry drivers that will influence and act upon the overall outcome of Waterloo South from an ESD perspective. These come from emerging market innovation, pricing trends, supply constraints, climate change or policy changes that present either potential opportunities or emerging risks for Waterloo South. If considered early, these can be managed to improve the medium- and long-term future for Waterloo and the city from an environmental, social and economic sustainability perspective. These trends have been considered in setting the strategy and relevant initiatives for Waterloo South. This section highlights some of those drivers.

2.4.1 Retail Electricity Prices

Retail electricity prices are projected to remain steady or grow very steadily at up to 2.6%⁴ per annum under a neutral scenario. Between 2017 and 2020, retail electricity prices are expected to grow at a relatively fast rate due to the withdrawal of significant generators such as Hazelwood (brown coal-fired power plant in Victoria) from the National Electricity Market. The tightening supply is expected to drive prices up. From 2020 to 2030, falling demand due to the impact of energy efficiency schemes, increasing distributed generation and carbon price are expected to cause price decline by up to 3%. Projections predict this trend to reverse from 2030 and beyond due to retightening of supply, stabilising retail electricity prices.

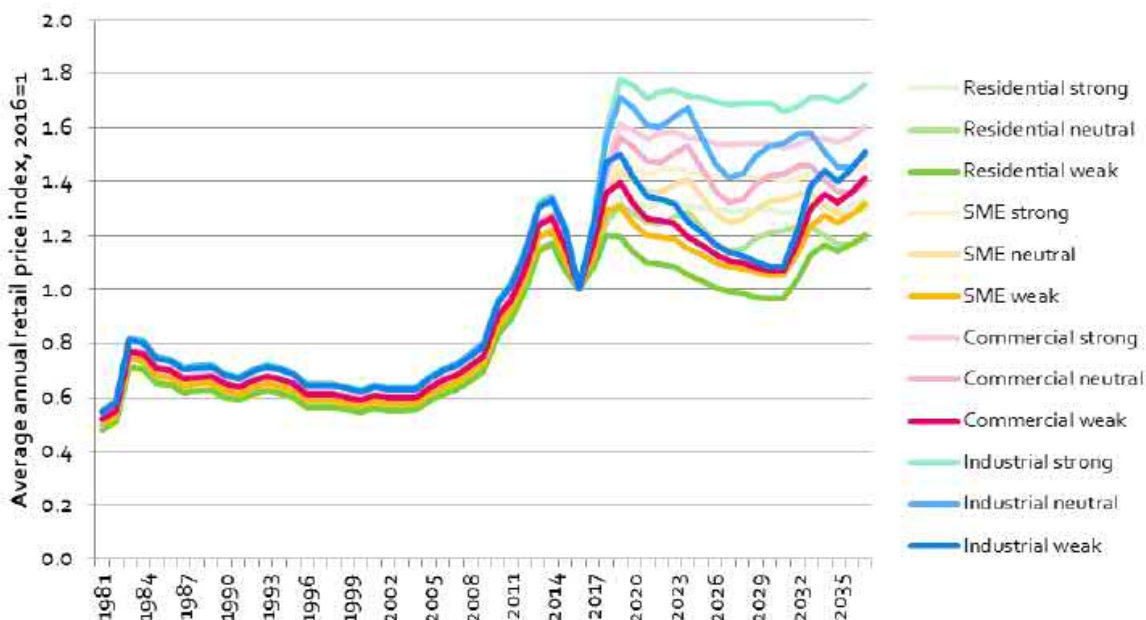


Figure 11: Comparison of NSW retail electricity prices by scenario and market

As retail electricity prices increase in the long run, price signals are created signalling the market to pursue other forms of energy generation such as on-site renewable generation and waste-to-energy initiatives.

2.4.2 Electric Vehicle Uptake

Electric vehicles (EVs) have rapidly gone from concept through to market emergence, with prices declining year on year. The primary driver behind the price reduction has been the mass production of lithium-ion batteries which EVs are dependent on.

While EVs made up only 0.2% of 2015 annual vehicle sales in Australia, this is anticipated to sharply increase in coming years as cost of production is expected to decline, availability and range capacity of electric vehicles improve, and public charging infrastructure is developed. Under a neutral scenario, forecasted electric vehicle sales vary from 16% to 45%⁵ of new light vehicle purchases, representing 9% to 33% of Australia's vehicle fleet under varying economic scenarios.

⁴ AEMO, Jacobs, 'Retail electricity price history and projected trends. Retail price series development', June 19 2017

⁵ AEMO, Energeia, 'AEMO Insights: Electric Vehicles', August 2016

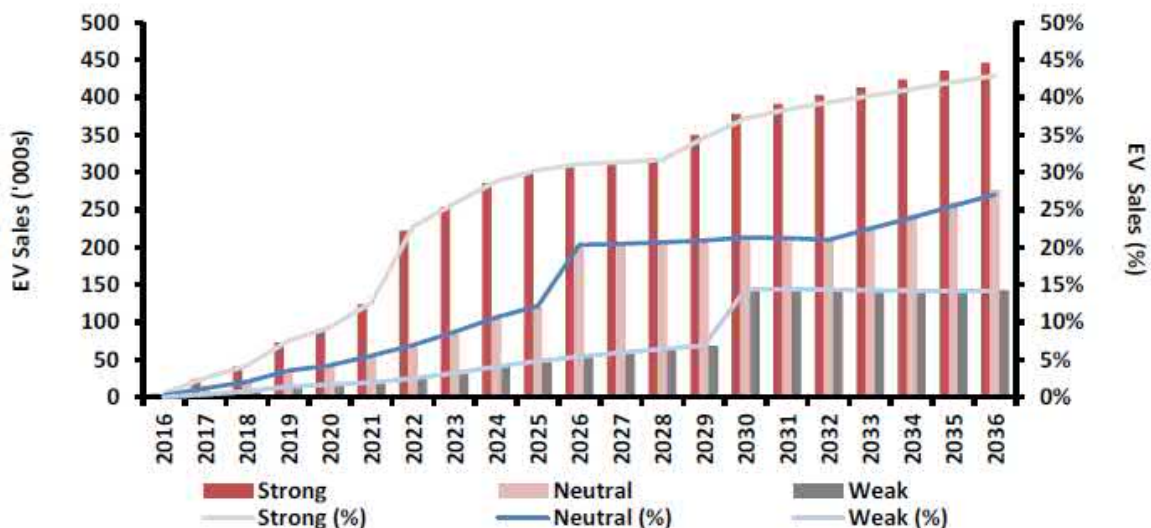


Figure 12: EV Annual sales by sensitivity (NEM)

If Waterloo South is to become a world-leading technology precinct, considerations should be made for the provision of electric vehicle charging infrastructure. However, this needs to be carefully managed with the impact of peak demand on electrical infrastructure. There is potential for EV charging behaviour to contribute to daily peak periods requiring costly augmentation of infrastructure. This can be managed through initiatives such as staggering of charging throughout the day or night to coincide with off-peak periods.

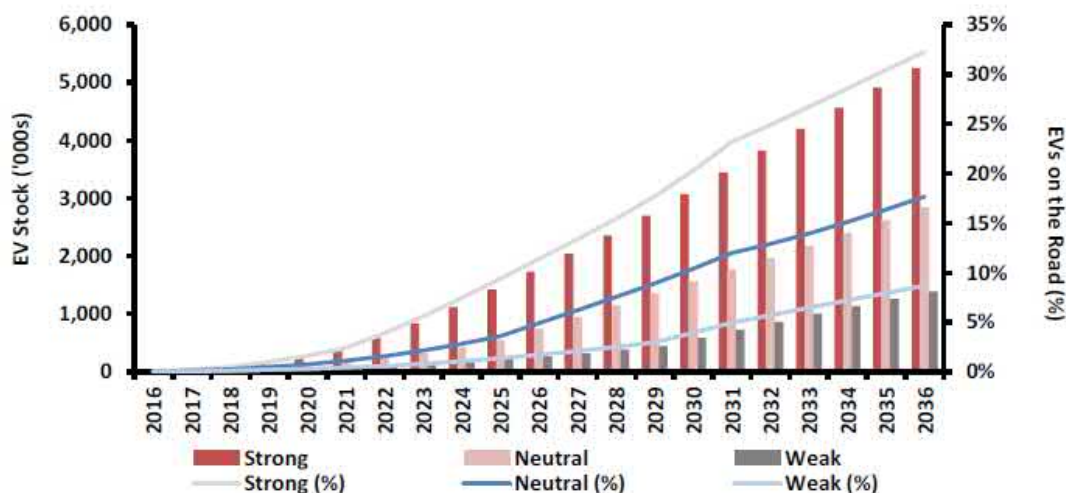


Figure 13: EV uptake by sensitivity (NEM)

2.4.3 Renewable Generation

Solar PV and wind generation have been in the market for some years. The price of solar PV panels has already reduced to a quarter of what it did in 2009 and is predicted to fall by another 66% by 2040. Similarly, the cost of onshore wind generation which has already declined by 30% over the past 8 years is anticipated to fall by a further 47% by 2040⁶.

Over 850 MW of wind energy was installed in Australia in 2018, the largest installation rate to date⁷ making up nearly 34% of Australia’s renewable energy generation and over 7% of total Australian electricity generation.

Small-scale solar systems (up to 100kW) are responsible for 20% of Australia’s renewable energy generation, producing over 4% of Australia’s generated electricity⁸. Installations of medium-scale solar (100kW to 5MW) also

⁶ BNEF, ‘Solar Power will Kill Coal Faster Than You Think’, June 15 2017, <https://about.bnef.com/blog/solar-power-will-kill-coal-sooner-than-you-think/>

⁷ Clean Energy Council of Australia, ‘Clean Energy Australia Report 2019’, 2019

⁸ Clean Energy Council of Australia, ‘Clean Energy Australia Report 2019’, 2019

grew by 80% in 2018. Medium-scale installations are commonly found on shopping centres, schools and commercial buildings.

In 2018, 15% of NSW’s electricity came from renewable sources. As of March 2019, NSW has over 3800MW, representing a \$4,714 million investment, solar projects under construction or financially committed. In Waterloo South there is potential to explore rooftop solar generation as a pathway to achieve 50% renewable energy generation.

2.4.4 Domestic Gas Supply

Australia is a major exporter of liquefied natural gas (LNG) with increased development of LNG infrastructure across all three major Australian gas markets. However, increasing local demand and tightening gas supply resulting in higher gas prices is likely to signal the market to explore other forms of energy. Waste-to-energy is likely an important factor as waste-generated methane can be a direct substitute for gas.

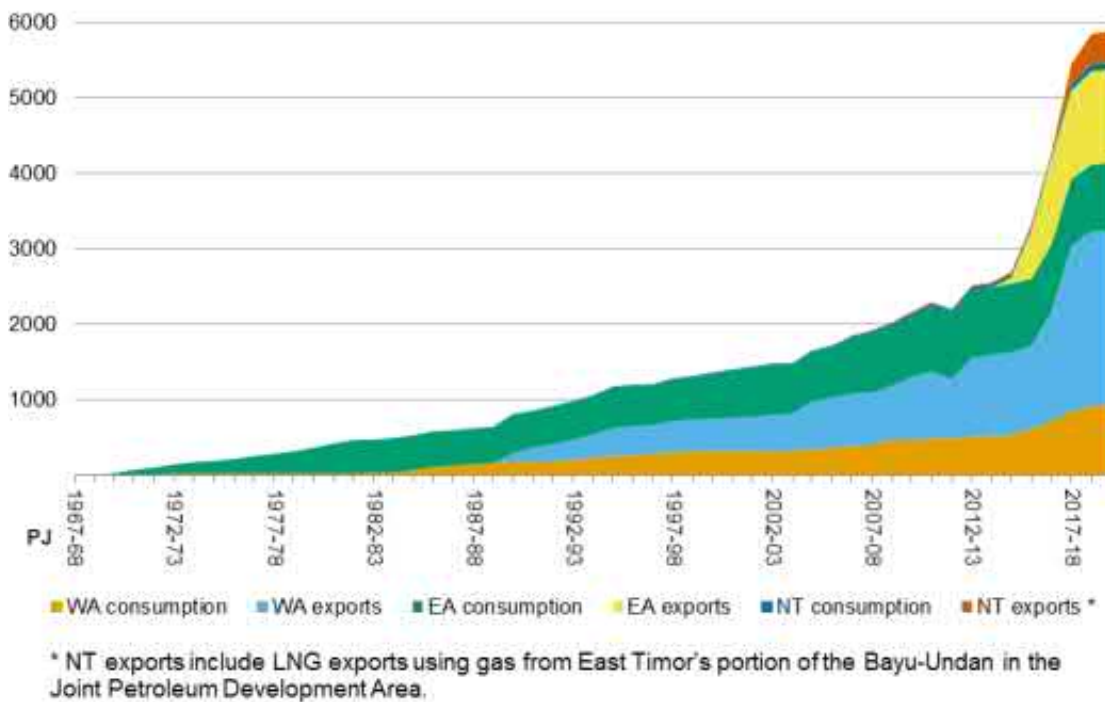


Figure 14: Domestic gas consumption and LNG exports

2.4.5 Grid Electricity Carbon Emissions

Grid electricity carbon emissions peaked in 2009 and are expected to fall until 2020, driven by the Renewable Energy Target, and the closure of high emissions intensity power plants such as Hazelwood in Victoria.

After 2020, absolute carbon emissions are projected to grow steadily, but more slowly than historical rates. The retirement of coal-fired generators is expected to be replaced with existing coal and gas fired generators. In combination with increasing demand due to electric vehicles, overall electricity sector emissions are anticipated to rise by a small amount.

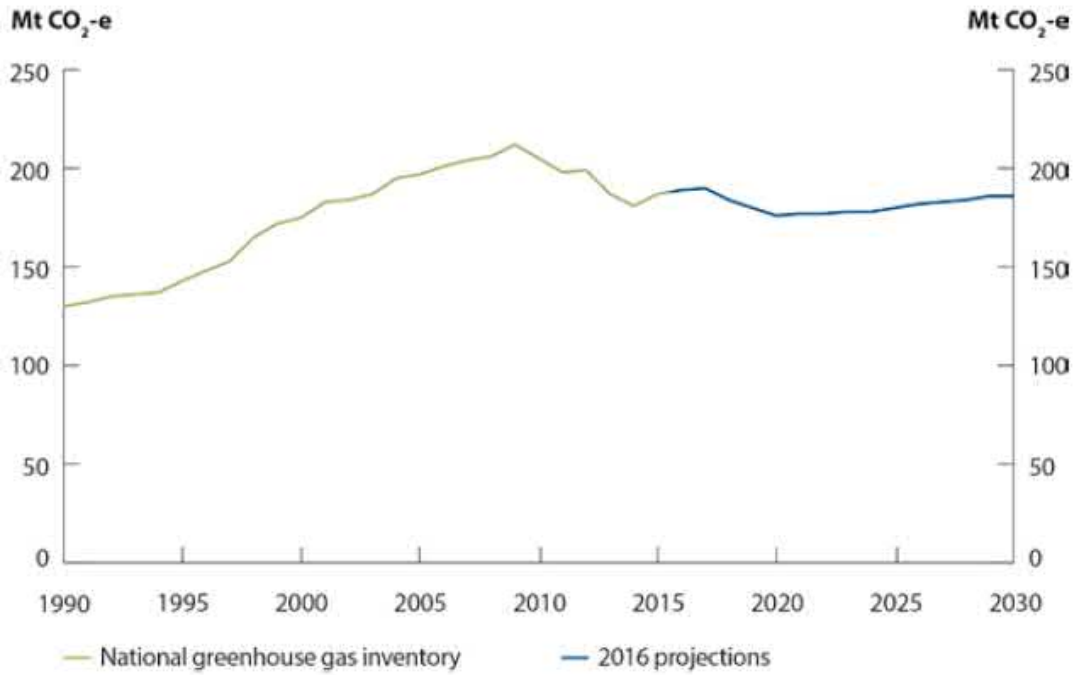


Figure 15: Electricity emissions from 1990 to 2030⁹

On a kgCO_{2-e} per kWh generated basis, the grid is seen to be decarbonising. Under a low decarbonisation scenario, NSW grid electricity intensity is projected to be 0.74kgCO_{2-e}/kWh and 0.55kgCO_{2-e} per kWh under a high decarbonisation scenario. Under either scenario, the NSW grid is unlikely to be completely decarbonised unless there is a radical shift in energy policy between now and 2050.

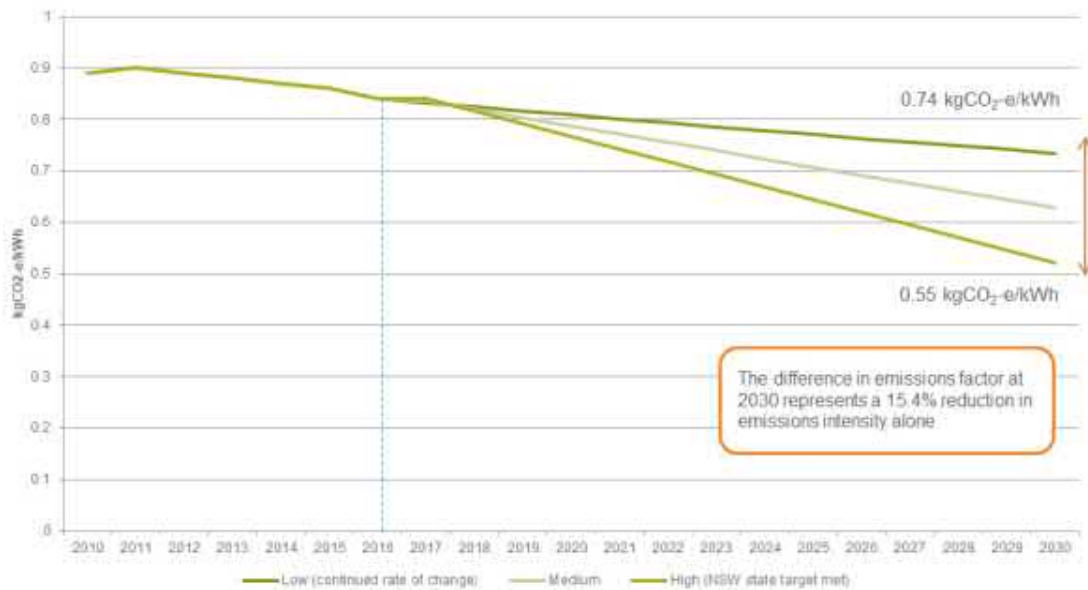


Figure 16: NSW electricity grid emissions factor (kgCO_{2-e}/kWh)

Source: Energetics, 2017

With the Paris Agreement setting Australia on a net zero carbon trajectory by 2050, continued reliance on grid electricity under the current projections will leave the wider Waterloo Estate exposed to carbon liability. However, there is the opportunity to set the wider Waterloo Estate onto an appropriate trajectory to become carbon neutral by 2050 during the early planning stages of Waterloo South.

It is also worth noting that the current carbon intensity of the grid does not fully account for all of the current growth in renewable energy as the current carbon pricing and RET mechanism effectively hides this carbon from

⁹ Department of the Environment and Energy, 'Australia's emissions projections 2016'

the grid intensity as the carbon is accounted for elsewhere. If the policies change on the RET or carbon pricing (which is likely) the relative intensity of the carbon on the grid would change.

2.4.6 Water Consumption

For Sydney Water, there are several potential future consumption scenarios being considered. Figure 17 presents some of the future water consumption scenarios forecast to 2022 based on existing consumption and projected future consumption.

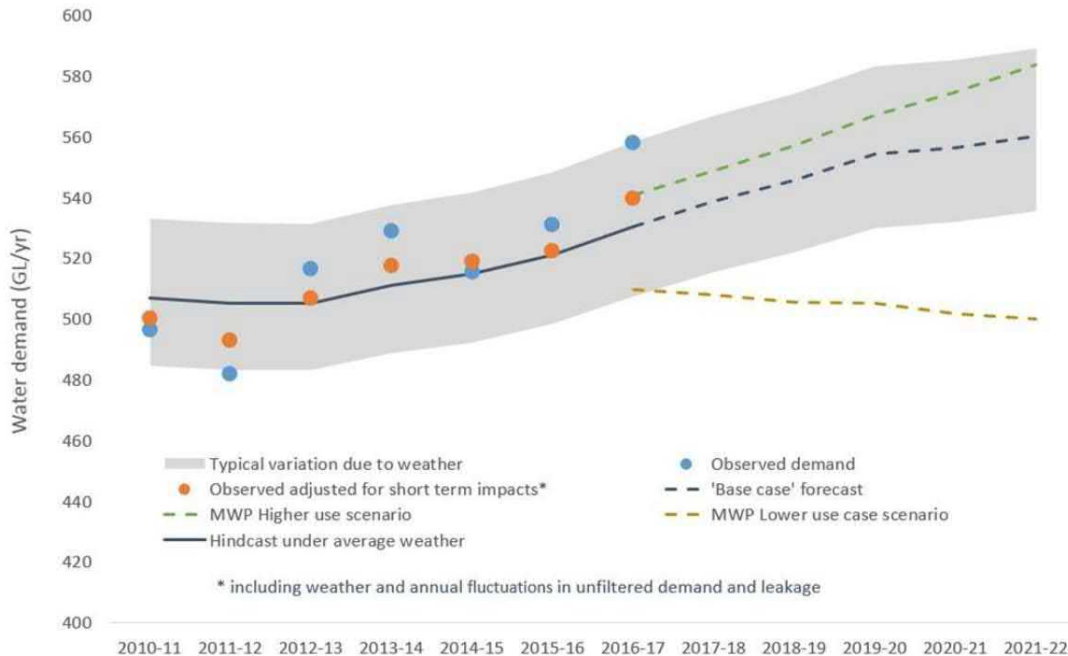


Figure 17: Water Consumption Future Scenarios¹⁰

It is important to note that average weather has a significant impact on potable water consumption with dryer weather leading to increased reliance on potable supply as water tanks run out and irrigation increases. Hot weather also has an impact on water consumption. As we move into warmer and more intermittent wet/dry periods this is likely to impact water consumption.

2.4.7 Waste Generation

In 2014-15 total waste generated in NSW fell by 4% from its peak in 2010-11. Per capita waste generation also fell 6% between 2012-13 to 2014-15¹¹. While recycling rates have increased, progress towards the NSW recycling targets has been steady but slow particularly in construction and demolition waste due to the recent significant increase in construction and demolition waste being produced in NSW.

¹⁰ Sydney Water, Water Conservation Report 2016-2017

http://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq3/-edisp/dd_047419.pdf

¹¹ NSW EPA, 'NSW State of the Environment 2018', 2019

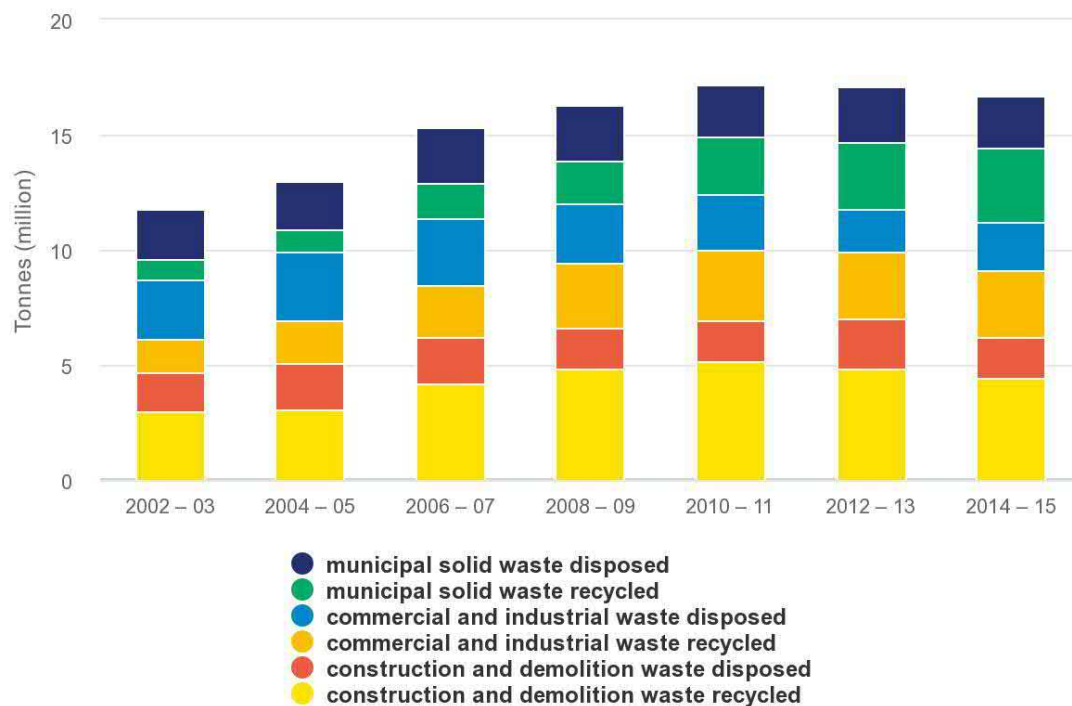


Figure 18: Waste disposed and recycled by waste stream in NSW (NSW EPA)

Waste generation rates are significantly linked to population growth and increased economic activity. By 2021, it is expected nearly 20 million tonnes of waste will need to be process a year in NSW. Globally, foreign markets have restricted the import of Australian mixed recycling material meaning there is an increased impetus to ensure Waterloo South is able to effectively management the waste generated by the new population and divert waste from landfill.

3. Sustainable Design Integration

Waterloo South and the entire Waterloo Estate will be an asset in Sydney for the next 100 or so years. It is situated on a highly complex site from an economic, environmental and social perspective. The greatest opportunity to be realised Waterloo South will be its ability to provide long-term value to the community by being more sustainable and resilient in the face of future opportunities and challenges. Careful consideration of the existing urban context, as well as an appreciation of stakeholder needs, expectations and impacts provides an important baseline upon which more sustainable outcomes can be achieved at Waterloo South.

As well as responding to the current needs and policies, an effective sustainability response needs to be considerate of the desired outcomes in the longer term. Given the future focus of sustainability integration, it is important to gain a sense of how decisions made now will affect the potential future benefits and the impacts associated with the development. Figure 19 illustrates the nature of uncertainty associated with future outcomes over time. We are confident of the actions made in the past and present, but decisions made today will influence the pathway forward, which will result in either a ‘possible’, ‘plausible’ or ‘probable’ future outcome. Amongst the three futures, there exists a ‘preferable’ future. We need to consider our current ability to influence the outcome reached by taking actions to include, or not preclude, the preferable future for it to be realised. For Waterloo South, this is in considering the actions we can take at this stage and how they inform a preferred future outcome.

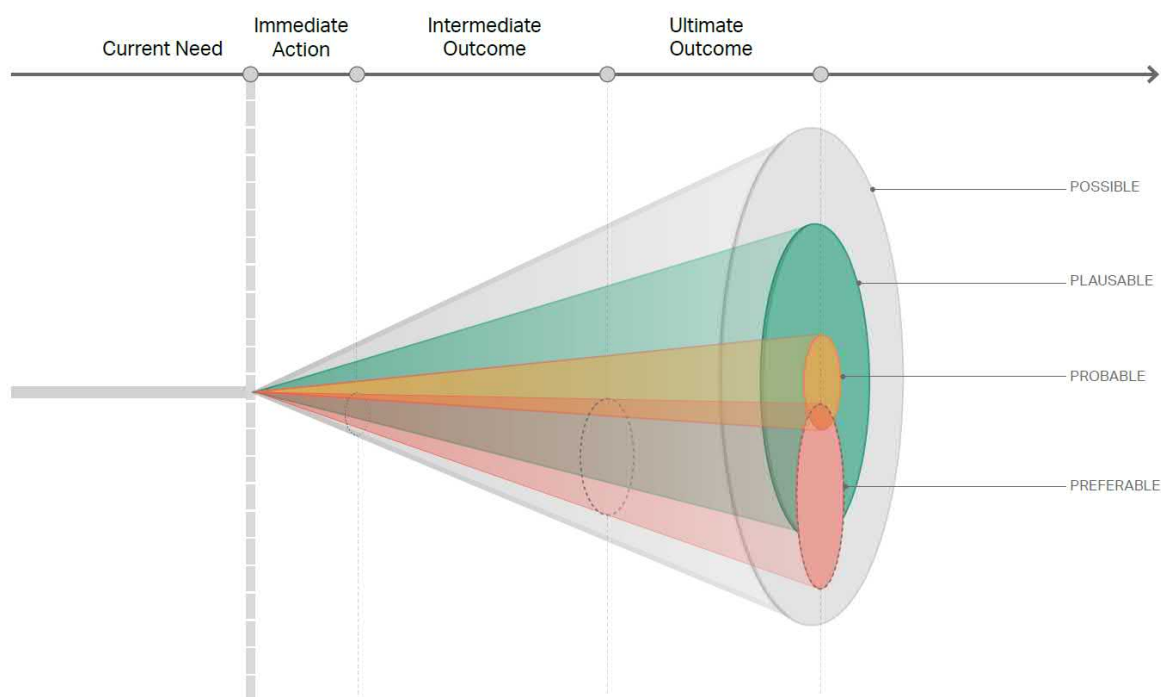


Figure 19: The Futures Cone: Probable, Plausible, Possible and Preferable Futures

It is critical that the desired long-term outcomes are well defined as early as possible to ensure that the appropriate actions are taken at the right time to enable the transition. Our ability to influence the pathway erodes over time and as more decisions are made without a guiding long-term vision. The approach taken for Waterloo South is to set out the vision for a preferable long-term future, known as the ‘Ultimate Outcome’, with a target timeframe of 2050 and beyond. From the ‘Ultimate Outcome’, ‘Intermediate Outcomes’ have been developed that look at the medium-term vision towards a preferable future to around 2030. While being considerate of the future vision, it is also critical to look at the ‘Current Need’ which encompasses the current policies, programs, site context and community needs to inform the direction and decisions for the project. The approach taken in this report is to ensure effective consideration of both the ‘Current Need’ as well as the ‘Ultimate Outcome’ in setting the direction for the sustainability response for Waterloo South.

For the incorporation of sustainability principles across the project, these have been considered within the framework and initiatives. For the energy, water and waste actions, these have been outlined in their respective sections.

3.1 Incorporation and Framing of ESD Principles

The Waterloo Study Requirements specifies the demonstration of ‘*how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000)*’ (the Regulation) will be incorporated into the SSP Study (see section 2.2.2). Specifically, it requires the identification of ‘*performance benchmarks to allow sustainability to be considered in site planning, building design and in the construction and operational phases of the development to achieve best practice sustainability outcomes. This includes a commitment to compliance with a nationally recognised rating system*’.

The principles of ecologically sustainable development as defined in clause 7(4) of Schedule 2 of the EP&A Regulation 2000 are as follows:

- *the “precautionary principle”, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*
 - *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
 - *an assessment of the risk-weighted consequences of various options,*
- *“inter-generational equity”, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations*
- *“conservation of biological diversity and ecological integrity”, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration*
- *“improved valuation, pricing and incentive mechanisms”, namely, that environmental factors should be included in the valuation of assets and services, such as:*
 - *Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
 - *The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
 - *Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

The ESD principles have been thoroughly considered throughout the planning process and have yielded sustainability initiatives for further consideration and discussion. Through a series of workshops and meetings, engagement with discipline specialist consultants and LAHC, sustainability initiatives were considered and integrated into the overall design. The decision-making process considered the context of the site, the desired sustainability outcomes, and cost-effectiveness of the initiative in achieving the outcomes.

In considering how to effectively demonstrate an alignment with the ESD principles outlined above, the project team have sought to align the design response against the Green Star Communities National Framework which broadly covers the following themes:

- Enhance liveability
- Create opportunities for economic prosperity
- Foster environmental responsibility
- Embrace design excellence
- Demonstrate visionary leadership and strong governance

This is considered by the industry as one of the best practice frameworks for integration of sustainability in urban developments, and in this case, it has been applied to demonstrate a practical alignment of the design with the ESD principles as defined within the Regulation. As such, identified sustainability initiatives have been framed against the Green Star Communities National Framework.

3.1.2 Sustainability Framework – Waterloo South

Framework Principle	Desired Outcome (Ultimate Outcome)	Embedded into Design (Immediate Action)	Future Considerations and Options (Intermediate Outcome)
Enhance Liveability	<ul style="list-style-type: none"> - A diversity of housing choices to house people from a wide range of socio-economic backgrounds. - A variety of effective and affordable transport options are made available to the community. - Support is provided for affordable lifestyles, including work and play 	<ul style="list-style-type: none"> - Full replacement of existing social dwellings in Waterloo South. - Approximately 72 (provided pro-rata) car share-only parking spaces have been designated to provide means for residents to access a private vehicle on an on-demand basis without the cost burden of ownership. - Commercial co-working spaces provided in Waterloo South to enable and facilitate low-cost start-ups and small businesses. - Provision of green roofs capable of becoming community gardens to enable residents to grow their own fresh produce. 	<ul style="list-style-type: none"> - Develop strategies to improve affordability of non-residential areas, such as subsidised leases for social enterprises and charity organisations. - Consider a 'hull-to-rent' model where a property portfolio owner can lease and adapt both affordability mix as well as operational efficiencies to drive down total costs. - Car parking spaces are separated from the property title to provide owners with the option of not acquiring a car parking space as default to reduce cost of the property and improve affordability.
Healthy, Safe & Secure	<ul style="list-style-type: none"> - Physical activity and social engagements are encouraged and enabled in a safe and comfortable environment - A precinct that is attractive and safe for walking and cycling - The development is designed to minimise crime - Align transport infrastructure with precinct growth 	<ul style="list-style-type: none"> - Provision for cycleways from North to South and East to West to connect Waterloo South to the broader cycleway network to provide a means for workers to commute to work and for residents to visit local parks and sporting grounds. - A minimum 20m wide pedestrian boulevard will be included along George St, through the central core of Waterloo South. Pedestrian access will be prioritised in Waterloo South through low speed, low traffic streets with pedestrian crossings. - Master plan and urban design strategy have incorporated Crime Prevention Through Environmental Design (CPTED), as detailed in the urban design report. - All public areas are visible from at least one street to encourage passive surveillance and deter crime. - The Village Green and Waterloo Common parks proposed with central pedestrian access along George St. These parks have been sized to provide a range of recreation uses. - Retail spaces have been distributed throughout Waterloo South to provide localised access for residents. This includes the provision of localised access to fresh food for residents including supermarkets as per Green Star - Communities (V1.1) guidelines (Credit 14) to encourage healthy lifestyles. - Provision of green roofs capable of becoming community gardens to enable residents to grow their own fresh produce. - Provision of bicycle parking spaces as per GSC guidelines to encourage the uptake of active transport modes and healthy lifestyles. 	<ul style="list-style-type: none"> - Consider allowing a community-led entity to manage the various community facilities within Waterloo South. - Consider allowing a community-led entity to manage at least one community program or service that serves Waterloo South. - Consider pet-friendly designed parks with appropriate fixtures and infrastructure for residents and visitors with pets to use. - Consider the provision of general access stairways between floors to create connection amongst residents and foster sense of community. - Consider the provision of breakout/open spaces every few floors to act as meeting points and recreational spaces, enhancing community connection. - Consider establishment of a community focus group/committee. - Consider diversity of retail and community services to provide for all individuals of all socio-economic backgrounds.
Inclusiveness and Cohesiveness	<ul style="list-style-type: none"> - Uses and environments within the development are diverse and inclusive for all ages, abilities, cultures and socio-economic backgrounds of the community – a place where everyone belongs - The development has access to the services, employment opportunities and communities of the wider region - The community's shared vision of diversity, tolerance and respect for each other's rights and responsibilities is reflected in the built environment. 	<ul style="list-style-type: none"> - New homes for social, affordable and private residents are not distinguishable and are modern, comfortable, efficient, sustainable and adaptable – blind tenure concept will apply. - Waterloo South aims to mix distribution of social and private dwellings to provide an inclusive and diverse community. - Community spaces distributed through Waterloo South to provide access for all residents. - Diversity in community meeting places planned through community gardens, parks, residential (private) community spaces (e.g. green roofs) and plazas. - Size and recreational focus of parks to provide multi-generational facilities. 	<ul style="list-style-type: none"> - Consider allowing a community-led entity to manage the various community facilities within Waterloo South. - Consider allowing a community-led entity to manage at least one community program or service that serves Waterloo South. - Consider pet-friendly designed parks with appropriate fixtures and infrastructure for residents and visitors with pets to use. - Consider the provision of general access stairways between floors to create connection amongst residents and foster sense of community. - Consider the provision of breakout/open spaces every few floors to act as meeting points and recreational spaces, enhancing community connection. - Consider establishment of a community focus group/committee. - Consider diversity of retail and community services to provide for all individuals of all socio-economic backgrounds.
Adaptability	<ul style="list-style-type: none"> - The development has flexibility to adapt to changing community and individual needs that may be influenced by economy, environment, culture or other circumstances - The Estate will be prepared for the likely impacts of the changing climate 	<ul style="list-style-type: none"> - Canopy coverage over paved surfaces serves as a cost-effective means of mitigating urban heat island effects – street trees provide areas of respite for pedestrians. The overall canopy target for the Precinct and Waterloo South is 30% canopy coverage. - Critical assets and access to underground areas will be located above the flood planning level (100-year ARI + 0.3 to 0.5m freeboard). Safe evacuation routes must be designated for units between the flood planning level and the PMF. Vulnerable residents such as those with mobility difficulties or difficulty in responding to stressful situations to be located above the PMF level to enable a passive shelter in place response. - Various climate change adaptation measures have been identified and embedded into the master plan. Refer to the Climate Change Adaptation Report (AECOM) for the relevant initiatives. - Defined land use zoning within Waterloo South provides flexibility for future adaptation to meet the needs of the community – retail and community use zones are interchangeable and therefore respond to community needs at the time. 	<ul style="list-style-type: none"> - Develop a climate adaptation plan for the site in response to projected future climate scenarios. - Develop a Community Resilience Plan that is specific to the Waterloo community. The Plan needs to address preparation, during- and post- disaster communication, safety, and response. It can potentially be provided as part of a welcome pack for new residents. - Consider designing underground carparks to allow them to be repurposed in the future when private car ownership drops.
Create Opportunities for Economic Prosperity	<ul style="list-style-type: none"> - The development provides accessible education facilities and connection to other education facilities to suit the needs of the community. 	<ul style="list-style-type: none"> - Local cycleways and pedestrian access connection to nearby schools and universities. - Buildings outlined for community uses are distributed throughout Waterloo South. These are able to provide a range of educational and training facilities for local community members. - A proportion of the 6,700m² of community facilities has been identified for 	<ul style="list-style-type: none"> - Consider access to regional education centres and schools in surrounding areas when planning the Waterloo South community to fill in educational gaps that may occur as a result of the development. - Assess capacity of local schools to accommodate the Waterloo South population in line with Department of Education proposed developments.

Framework Principle	Desired Outcome (Ultimate Outcome)	Embedded into Design (Immediate Action)	Future Considerations and Options (Intermediate Outcome)
Employment Opportunities	<ul style="list-style-type: none"> - Diverse local employment opportunities are available to meet the needs of the community - Diverse local employment opportunities are available to meet the needs of the community 	<ul style="list-style-type: none"> - The provision of 11,200 m² of retail GFA, and 6,700m² of community facilities will increase the total number of jobs available in the local area. - Local cycleways connect into the wider cycleway network to provide broader regional network connections for commuters. - Integration with Metro Station and Metro Quarter to provide connections to the CBD and other employment centres. 	<ul style="list-style-type: none"> - Consider educational facilities within Waterloo South to educate the community on the embedded sustainability initiatives. - Consider provision of screens in public open spaces to show live 'smart data' of demonstrating sustainability in practice (e.g. energy and water use monitoring). - Consider Wi-Fi 'hot spot' access throughout public areas of Waterloo South. - Consider the provision of co-working spaces and 'innovation hubs' to provide affordable working spaces for small business owners and remote workers. - Consider the use of public space/community buildings for employment fairs.
Economic Investment	<ul style="list-style-type: none"> - Investment will be attracted into the area through the provision of key infrastructure to enable business and community connectivity. 	<ul style="list-style-type: none"> - Waterloo South will have high speed internet connections available to all residents, retail and commercial tenants. This will enable the use of tele-commuting co-working hubs. - The adjacent Waterloo Metro Station will provide a key source of economic activation for Waterloo South. - Mix of retail, health, cultural and community spaces designed to provide local access to services whilst stimulating economic investment. 	<ul style="list-style-type: none"> - Consider periodic community-run programs and events to draw visitors into Waterloo South and boost the local economy.
Innovation and Competition	<ul style="list-style-type: none"> - Facilitate new business opportunities to enhance competitiveness and innovation - Consideration is given to lifecycle impact to encourage resource and cost efficiency - Contribute to Sydney's global competitiveness 	<ul style="list-style-type: none"> - Defined land use zoning within Waterloo South provides flexibility for future adaption to meet the needs of the community – retail and community use zones are interchangeable and therefore respond to community needs at the time. - Explore options to use of on-site and offsite renewables proposed to provide clean energy to Waterloo South and potentially the broader Estate. - Explore options to use of decentralised technologies including micro-grids and recycled water networks identified to reduce energy use and potable water demand. - Adaptive use of spaces proposed to create multi-functional areas of Waterloo South. This includes use of basement car parking for residential and service vehicle use. - Optimised size and spatial configuration of rooftop elements such as building plants and lift overruns to maximise open up spaces for community use or solar PV. - Pedestrian and traffic modelling undertaken during detailed design to ensure design can meet forecast demand. - Tiered/podium structures proposed to provide elevated open spaces. - Efficiencies associated with economies of scale identified for utilities, services and communal spaces. 	<ul style="list-style-type: none"> - Consider the provision of co-working spaces and 'innovation hubs' to provide affordable working spaces for small business owners and remote workers. - Consider selection of retail and community facilities to provide wider regional benefits and attract visitors. - Consider inclusion of cooled storage drop off zones in residential complexes to accept food deliveries with short-term storage. - Consider provision of a courier hub with dedicated parking and cycling infrastructure to minimise congestion on local roads. - Consideration of bulk waste from moving houses and or renovation in terms of reuse, recycling, temporary storage / removal to avoid dumping. - Consider designing underground carparks to allow them to be repurposed in the future when private car ownership drops. - Optimised size and spatial configuration of rooftop elements such as building plants and lift overruns to maximise open up spaces for community use or solar PV. The Waterloo Estate has a potential PV generation capacity of approximately 4MW across building rooftops and podiums. - Consider mounting solar PV systems on awnings above rooftop communal areas and/or building plant and equipment to maximise on-site renewable energy generation.
Efficiency and Effectiveness	<ul style="list-style-type: none"> - Land use and infrastructure are tailored to meet forecasted demand efficiently - Consideration is given to lifecycle impact to encourage resource and cost efficiency - Highly optimised use of high-value spaces such as podiums and rooftops 	<ul style="list-style-type: none"> - Green roofs considered on open podium areas to provide open space, recreation or community vegetable gardens and high-quality native vegetation. - Water Sensitive Urban Design (WSUD) measures provided to detain and treat runoff from development areas prior to discharge into existing watercourses. Tree pits, bioswales and other landscaping options included to treat runoff. Blue Line proposed for George St will consist of a number of WSUD features. - Stormwater detention tanks included as part of the stormwater design. - Overall street tree canopy coverage target of 30% in the public domain to create sense of place and improve microclimate conditions. - 50% High and Moderate value trees are to be retained. All High and Moderate value trees removed will be replaced at a ratio of 3 new for each 1 removed. 	<ul style="list-style-type: none"> - Consider use of high-performance building envelope with shading on western façade to minimise undesirable summer afternoon solar gain. - Consider designing hallways and common areas to maximise natural ventilation to reduce overall HVAC energy consumption. - Consider the provision of real-time smart metering to all residential units and commercial tenants to understand energy usage patterns and reduce accordingly. - Consider appropriate glazing options to improve thermal comfort and reduce heating and cooling loads.
Foster Environmental Responsibility			
Environmental Enhancement & Conservation	<ul style="list-style-type: none"> - High quality native vegetation is protected and enhanced - Design and construction of the development has sought to minimise greenhouse gas emissions, contaminants and other pollutants to the environment. 	<ul style="list-style-type: none"> - Green roofs considered on open podium areas to provide open space, recreation or community vegetable gardens and high-quality native vegetation. - Water Sensitive Urban Design (WSUD) measures provided to detain and treat runoff from development areas prior to discharge into existing watercourses. Tree pits, bioswales and other landscaping options included to treat runoff. Blue Line proposed for George St will consist of a number of WSUD features. - Stormwater detention tanks included as part of the stormwater design. - Overall street tree canopy coverage target of 30% in the public domain to create sense of place and improve microclimate conditions. - 50% High and Moderate value trees are to be retained. All High and Moderate value trees removed will be replaced at a ratio of 3 new for each 1 removed. 	<ul style="list-style-type: none"> - Consider use of high-performance building envelope with shading on western façade to minimise undesirable summer afternoon solar gain. - Consider designing hallways and common areas to maximise natural ventilation to reduce overall HVAC energy consumption. - Consider the provision of real-time smart metering to all residential units and commercial tenants to understand energy usage patterns and reduce accordingly. - Consider appropriate glazing options to improve thermal comfort and reduce heating and cooling loads.
Reducing Footprint	<ul style="list-style-type: none"> - Energy & Carbon - Energy is net-zero carbon and sourced renewably by 2050 - Energy use efficiency is maximised - Energy generation is efficient and produced locally - Energy supply is resilient through local generation and storage - Energy supply is flexible and adaptable to demand - Retail energy prices are low and affordable 	<ul style="list-style-type: none"> - Passive design measures, considering the site context and building orientation and form, have been included where possible to reduce need for mechanical heating, cooling and ventilation. - Building massing and spatial configuration designed to encourage cross ventilation through Waterloo South, alleviating the impacts of urban heat island effect. This has been carefully considered to minimise undesired street canyon/wind tunnel impacts. - Commitment to beyond compliance targets for BASiX Energy and Thermal Comfort for buildings - Use of on-site renewables (PV panels) where roof space allows to generate renewable energy for building and broader precinct using micro-grids. - Energy and carbon saving opportunities associated with decentralised technologies and micro-grids are identified and will require further consideration. 	<ul style="list-style-type: none"> - Provision of high energy efficiency appliances in residential apartments as part of apartment package or offering financial incentive for residents to purchase high efficiency appliances. - Consider use of ground source heat pumps for heating and cooling. These systems may need boosting or limited to certain areas due to limited physical space for sufficient number of bore holes to meet total precinct heating and cooling demand. - Consider optimising the size and spatial configuration of rooftop elements such as building plants

Framework Principle	Desired Outcome (Ultimate Outcome)	Embedded into Design (Immediate Action)	Future Considerations and Options (Intermediate Outcome)
	<p>Water</p> <ul style="list-style-type: none"> - Water has net-zero or low carbon intensity - Low waste water generation rates - Water use efficiency is maximised - Water supply is resilient - Potable water is affordable and accessible - The real cost of water is recognised in water pricing 	<ul style="list-style-type: none"> - Commitment to beyond compliance target for BASIX Water. - Water Sensitive Urban Design (WSUD) measures proposed throughout Waterloo South. Blue Line proposed for George St will consist of a number of WSUD features to improve water quality. - Stormwater detention tanks outlined in 'Water Quality, Flooding and Stormwater Report' by AECOM. - Measures to manage stormwater flows and water quality discussed in 'Water Quality, Flooding and Stormwater Report' by AECOM. 	<ul style="list-style-type: none"> - High efficiency (4, 5, 6-star WELS rated) water fixtures to reduce potable water consumption and align with Green Star – Design & As-Built (V1.2) Credit 18 – Potable Water. - Consider on-site stormwater harvesting and treatment for reuse in irrigation of green roofs, green walls and open space and align with Green Star – Design & As-Built (V1.2) Credit 18 – Potable Water. - Explore opportunities for rainwater/stormwater harvesting tanks to meet BASIX Water Requirements and opportunities for additional tanks for beyond BASIX Water compliance. Rainwater can be used to irrigate public open spaces. Further consideration should be given in the use of recycled rainwater in toilet flushing and laundry uses. - Consider the selection of drought-tolerant or zero-irrigation species vegetation to reduce irrigation requirements and align with Green Star – Design & As-Built (V1.2) Credit 18 – Potable Water. - Consider potential connection to nearby recycled water infrastructure at Green Square and Australian Technology Park has been considered in utilities and infrastructure planning and align with Green Star – Design & As-Built (V1.2) Credit 18 – Potable Water.
	<p>Waste</p> <ul style="list-style-type: none"> - A circular economy is established for waste - More waste is treated locally rather than centrally - The real cost of waste is realised such that it becomes a resource as raw material or as an energy source 	<ul style="list-style-type: none"> - Street and road design have been considered to allow the safe navigation of large garbage trucks through Waterloo South. - Consider provision of separated, but co-located residual waste and recycling chutes in buildings to encourage recycling. - Residential and commercial/retail waste disposal rooms separate to avoid overloading issues 	<ul style="list-style-type: none"> - Consider the provision of space for residents to temporarily store unwanted bulky items to be recycled or disposed of to avoid kerbside dumping of bulky goods. - Consider the provision of waste and recycling bins in the public domain to reduce littering and encourage recycling. - Consider financial incentives/disincentives such as a 'pay-as-you-throw' waste management system or reduced waste levies/fees to reduce waste generation rates. - Consider creating a Return and Earn container collection point to allow the community to access a new income stream and promote recycling rates. - Consider facilitation of local flea market to extend effective lifetime of goods and products, organic waste is reused locally. - Consider recycling waste bins are readily available in all areas of Waterloo South, education material available to educate residents and visitors of recyclable products. - Consider the implementation of automated vacuum waste system solution. The appropriate spatial provisions will need to be made within buildings for vacuum piping.
	<p>Transport</p> <ul style="list-style-type: none"> - Sustainable transport options are available and encouraged to reduce the use and reliance on fossil fuels 	<ul style="list-style-type: none"> - Street and neighbourhood design have prioritised active transport modes such as walking and cycling. A minimum 20m wide pedestrian boulevard will be included along George St, through the central core of Waterloo South. Pedestrian access will be prioritised in Waterloo South through low speed, low traffic streets with pedestrian crossings. - Provision for cycleways from North to South and East to West to connect Waterloo South to the broader cycleway network to provide a means for workers to commute to work and for residents to visit local parks and sporting grounds. - Assessment of electrical infrastructure requirements (in the Utilities and Infrastructure Servicing report by AECOM) have accounted for the potential impact of electric vehicle charging infrastructure in max demand - Provision of bicycle parking spaces as per Green Star – Communities (V1.1) guidelines to encourage the uptake of active transport modes and healthy lifestyles. 	<ul style="list-style-type: none"> - Consider the provision of electric vehicle charging infrastructure to encourage and support the uptake of electric vehicles. Ideally, charging infrastructure should be made available to all parking spots, particularly car-share only parking spots. - Consider caged bicycle parking spaces in the basement to provide peace of mind to bicycle owners and encourage bicycle ownership and active transport. - Consider in unit bicycle storage as an alternative or addition to the basement storage. - Consider lift or stair design to facilitate cycle access within the lifts such as thin side ramps on stairs to allow ease of bicycle movement. - Consider provision of stairs for, at minimum, the first 4 storeys of residential buildings to avoid unnecessary use of lifts and encourage more active and healthy lifestyles. - Provision of bicycle parking spaces within the Estate precinct for residents, commuters and visitors. Number of bicycle parking spots should be allocated to achieve Credit 17 Sustainable Transport. - Incorporate bus routes and stops into the overall precinct transportation strategy.
	<p>Materials</p> <ul style="list-style-type: none"> - The development uses materials of high environmental quality 	<ul style="list-style-type: none"> - Integrated design will seek to realise efficiencies in built form, facilities, amenities, parking and peak load shifting to drive efficiencies in the build. - Natural materials and features prioritised in public spaces to reduce embodied carbon. - Consider use of low-embodied carbon materials such as recycled materials or timber products. 	<ul style="list-style-type: none"> - Consider architectural design to maximise the use of modularised and prefabricated components in alignment with Green Star – Design & As-Built (V1.2) Materials credits. - Low VOC finishes, paints and products should be preferred in the design.
<p>Embrace Design Excellence</p>	<p>Effective Planning</p> <ul style="list-style-type: none"> - The master plan sets clear planning and design direction for the future <p>Practices</p> <ul style="list-style-type: none"> - Waterloo 	<ul style="list-style-type: none"> - The planning process for Waterloo South is highly transparent and has been carefully considered to deliver a more sustainable precinct. Long term targets and visionary objectives have been set to guide the design and planning of Waterloo South. - Community consultation is also a key part of the planning process to ensure community feedback 	<ul style="list-style-type: none"> - Consider setting planning controls and incentives that provide clear direction to achieve the desired sustainability outcomes for the development. Planning controls would require developers to meet certain targets, while incentives would encourage the achievement of outcomes.

Framework Principle	Desired Outcome (Ultimate Outcome)	Embedded into Design (Immediate Action)	Future Considerations and Options (Inmediate Outcome)
Integrated Design	<ul style="list-style-type: none"> - The design of the development responds to the Waterloo's land, water and climatic characteristics, constraints and opportunities. - The development is consistent and sympathetic to the character of the surrounding neighbourhood - Residents, commuters and visitors are able to easily access essential services and facilities including health, wellbeing, community support, retail and government services 	<ul style="list-style-type: none"> - Selected buildings within Waterloo South will target achievement of Green Star – Design & As-Built – (Design Review certified) rating which will interface with the Green Star – Communities (V1.1) rating, NatHERS rating, NABERS for Apartments Buildings rating, and BASIX. - Passive design measures, considering the site context and building orientation and form, have been included where possible to reduce need for mechanical heating, cooling and ventilation. - Predict-scale solutions such as embedded networks and distinct rainwater and stormwater capture networks have been specified and earmarked in the master plan. This will impact the overall design of public spaces and buildings with respect to recycled water and energy use. - Car parking basements will be shared across residential buildings. - Sufficient easement along street corridors has been provided to enable and support full sized street tree canopies. 	<ul style="list-style-type: none"> - Consider researching and interpreting the culture, heritage and identity of Waterloo South to include as part of the master plan and detailed design.
Flexibility & Adaptability	<ul style="list-style-type: none"> - Buildings and spaces are able to be changed to meet different needs or in response to changing community and environmental conditions. 	<ul style="list-style-type: none"> - Various climate change adaptation measures have been identified and embedded into the master plan. Refer to the Climate Change Adaptation Report (AECOM) for the relevant initiatives. - Master Plan and defined land use zoning provides flexibility for future adaption to meet the needs of the community – retail and community use zones are interchangeable and therefore respond to community needs at the time. 	<ul style="list-style-type: none"> - Consider caged bicycle storage areas which can also act as general storage space. - Consider design to enable potential for unit merging and de-merging to create units that are more responsive to changing housing needs. - Consider design of underground carparks to allow car parking spaces to be reconfigured into bicycle parking/storage space. - Consider designing underground carparks to allow them to be repurposed for other uses in the future when private car ownership drops, such as on-site battery energy storage banks or rainwater capture tanks. - Consider designing apartments for flexible uses in mind, such as multi-purpose rooms, or ability to combine apartments to accommodate multi-generational families. - Consider developing a community adaptation plan to improve community resilience in response to acute shocks and chronic stresses.
Desirable Places	<ul style="list-style-type: none"> - Development has a distinct and recognisable identity and character. - The development creates functional, vibrant, stimulating and memorable places that evoke for people to live, work and play. - The built form and landscapes are responsive to climate, context and heritage. - The development has good visual amenity and a sense of connection with nature. - The development has activity both day and night, where people feel safe, at ease and part of a cohesive and proud community 	<ul style="list-style-type: none"> - Building messaging, form and location designed to enhance public realm through passive design responses, such as maintain human thermal comfort levels and avoiding street canyon/wind tunnel impacts. - Canopy coverage over paved surfaces serves as a cost-effective means of improving microclimate conditions and mitigating urban heat island effects – street trees provide areas of respite for pedestrians and create comfortable spaces for recreation. The Waterloo Estate is currently targeting overall 30% street tree canopy coverage. - Retail and community use zones have been spread out across Waterloo South to improve street activation and create a stronger sense of community. - The Village Green and the Waterloo Common are connected by the 'Blue Line' which is dotted with several play areas, cafe breakout spaces, community gardens and public art displays to create desirable places with good amenity. 	<ul style="list-style-type: none"> - Consider periodic community-run programs and events to draw visitors into Waterloo South and boost the local economy. - Consider provision of thin-bicycle ramps on stairs in public areas to improve bicycle accessibility in the Estate. - Consider developing a wayfinding strategy for residents and visitors to easily move about and find their way within Waterloo South precinct.
Accessible Places	<ul style="list-style-type: none"> - The development provides physical connections internally and to surrounding areas to meet both local and metropolitan needs - The new Waterloo Metro Station and other modes of transport is well integrated such that residents, commuters and visitors can get around easily, safely and efficiently 	<ul style="list-style-type: none"> - All streets are paved for ease of pedestrian access and disabled access. - Delineated cycleways will be provided along Cope St connecting the existing George Street cycleway to the Waterloo Metro station from North to South. A delineated cycleway will also be provided along Wellington St to provide connectivity through the Estate from East to West. 	<ul style="list-style-type: none"> - Consider provision of thin-bicycle ramps on stairs in public areas to improve bicycle accessibility in the Estate.
Demonstrate Visionary Leadership and Strong Governance			
Coordination & Transparency	<ul style="list-style-type: none"> - The development shares the achievements of its vision in partnership with key stakeholders - The desired outcomes identified in this table are aligned with strategic objectives of the City of Sydney, the State Government and the Greater Sydney Commission 	<ul style="list-style-type: none"> - Development and adherence to the ecologically sustainable development framework identified in this table which has been developed in alignment with City of Sydney, NSW State Government and Greater Sydney Commission targets objectives and targets. - The Site Planning, Layout and Urban Design for Waterloo South will undergo an in-house, mixed and then fully-independent design review before finalisation. - The finalised preferred plan for Waterloo South will go on public exhibition and through community consultation periods. 	<ul style="list-style-type: none"> - Consider contractually engaging Green Star Accredited Professionals (GSAP) to lead and facilitate the Green Star – Communities (V1.1) rating process. The GSAP will assist to provide accountability to the rating tool and the rating process from an early design stage. - Set responsibility for establishing the next action towards achieving the desired sustainability outcomes is transferred to the next development phase. - Consider including the initiatives identified in the 'Future Considerations and Options' in this table in the evaluation of property development tenders.
Committed to Implementation	<ul style="list-style-type: none"> - The vision for Waterloo will be delivered through practical and market appropriate staging through utilising the governance embedded in the planning and approvals framework - Applications throughout the development process provide an assessment of the proposal against the provisions of this sustainability framework - Significant property transactions or development agreements include an assessment against the desired outcomes set out in this framework 	<ul style="list-style-type: none"> - Optimise the planning system to provide certainty to future developers and users as to the sustainability expectations and desired outcomes for Waterloo. - Planning controls will be set based on the recommendations made in this report and other specialist consultant reports and will form the conditions for approval for future developers. 	<ul style="list-style-type: none"> - When developing community-related strategies, ensure that there is consultation with the community to enhance community culture, heritage and identity.
Engaged Stakeholders	<ul style="list-style-type: none"> - The shared vision for Waterloo has been built with the buy-in of the existing community, industry and government 	<ul style="list-style-type: none"> - Stakeholder engagement has been undertaken through the Technical Working Groups with the Department of Planning and Environment, the City of Sydney and other agencies. There have been community information and engagement sessions. Further engagement will continue through the planning and development phases. 	

Framework Principle	Desired Outcome (Ultimate Outcome)	Embedded into Design (Immediate Action)	Future Considerations and Options (Inmediate Outcome)
Sustainable Cultures and Behaviours	<ul style="list-style-type: none"> - The development provides a case study for effective sustainability for the community and development industry - The community is educated and aware of their environmental impact and are encouraged to improve their environmental performance 	<ul style="list-style-type: none"> - The close proximity to the Waterloo Metro Station and the inherent nature of the Estate being a 'transit-oriented development' encourages residents and employees to travel via the Metro as opposed to using private vehicles. - Active modes of transport have been encouraged through urban and traffic design. A minimum 20m wide pedestrian boulevard will be included along George St, through the central core of the Estate. Pedestrian access will be prioritised in Waterloo South through low speed, low traffic streets with pedestrian crossings. 	<ul style="list-style-type: none"> - Consider contractually engaging Green Star Accredited Professionals to lead and facilitate the Green Star – Communities (V1.1) rating process to provide advice and information relating to the rating process to ensure the most sustainable outcomes are achieved. - Provision of bicycle parking spaces within the Waterloo South precinct for residents, commuters and visitors. Number of bicycle parking spots should be allocated to achieve Credit 17 Sustainable Transport.

Rewarding Innovation	<ul style="list-style-type: none"> - The development provides the flexibility to support innovations in planning for improved liveability, economic and environmental outcomes 	<ul style="list-style-type: none"> - All residential units will have access to high-speed internet connection as part of the National Broadband Network (NBN). - Co-working spaces available in Waterloo South will attract and enable entrepreneurial start-ups and small businesses to set up and gain access to necessary business infrastructure. - This sustainability framework seeks to ensure that 'winning technologies' are not selected through prescriptive requirements or recommendations. Instead, it seeks to set target outcomes which are technology-agnostic and encourages the use of the most cost-effective and applicable technology available at the time to achieve the targeted outcomes. 	<ul style="list-style-type: none"> - Consider Wi-Fi 'hot spot' access throughout public areas of the Estate. - Ensure the appropriate spatial provisions are made so as to not preclude future technologies from being implemented in Waterloo South.
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3.1.3 Green Star – Communities

As part of the commitment to delivering a more sustainable outcome, Waterloo South will be aligned with the Green Star – Communities National Framework and rating tool. Green Star – Communities is a framework and rating scheme set up by the Green Building Council of Australia to guide and incentivise best practice sustainable urban development outcomes that considered environmental, liveability, economic and governance themes.



A number of nationally recognised rating tools were considered for application by the wider project team. Green Star – Communities was selected as the most appropriate rating tool for the entire Estate for its ability to influence precinct wide sustainable planning and design outcomes. This rating demonstrates strong alignment with relevant planning policies, regulation and guidelines, as well as addressing the Study Requirement 16.1 and showing good alignment with LAHC’s redevelopment vision for the Estate (see Section 3.1.1).

In order to drive heightened sustainable performance for the Estate precinct and its residents, a commitment to achieving a 6-star Green Star – Communities (v1.1) rating is recommended. A 6-star rating is indicative of ‘World Leadership’ outcomes, as per Table 7. In contrast, a 2 or 3-star rating is reflective of ‘Average Practice’ and ‘Good Practice’, indicating that achieving a 6-star rating is well above and beyond current typical industry practice, or business as usual.

This recommendation is for version 1.1 of the rating tool and subsequent revisions may alter the ability for the Estate to achieve a 6-star rating. It is suggested that the Estate master plan is registered prior to the release of future versions to lock in the version 1.1 credit requirements under which this report has been prepared. If the Estate is not registered before an update to Green Star – Communities is released, re-scoping of the recommendations made regarding the rating tool will need to be made to understand implications of new design and evidence requirements.

Table 7: Green Star – Communities (v1.1) Rating Scale

Rating	Minimum Total Score	Minimum Category Score				Outcome
		GOV	LIV	ECON	ENV	
1 Star	10 – 19	-	-	-	-	Minimum Practice
2 Star	20 – 29	-	-	-	-	Average Practice
3 Star	30 – 44	-	-	-	-	Good Practice
4 Star	45 – 59	3	2	2	3	Australian Best Practice
5 Star	60 – 74	6	4	4	6	Australian Excellence
6 Star	75+	8	7	6	9	World Leadership

Source: Green Star – Communities Submission Guideline (v1.1) (also applicable for Green Star – Design & As-Built)

As Green Star- Communities is typically aligned with master planning, specific initiatives have been identified and embed within the Waterloo South master plan with the aim of aligning to a 6-star rating.

Buildings are major consumers of energy and water and designing to achieve a Green Star – Design & As-Built rating will reduce overall environmental footprint and ultimately reduce greenhouse gas emissions. The rating also has consideration for indoor environmental quality and therefore can also bring human health benefits. It is recommended that the development target 5-star Green Star – Design & As-Built (v1.2) (Design Review certified) ratings for selected buildings within Waterloo South.

Master Plan Considerations

The master plan includes a number of design initiatives and considerations that have been incorporated to ensure achievement of certain credits are not precluded from in future detailed design. The following is a list of credits that have implications or considerations at the masterplanning stage:

- Green Star – Design & As-Built (v1.2)
 - Credit 15 – Greenhouse Gas Emissions: spatial provision of on-site renewable generation, building form, massing and orientation design.
 - Credit 16 – Peak Electricity Demand Reduction: spatial provision for on-site electrical generation or energy storage systems.
 - Credit 17 – Sustainable Transport: public transport design, walkable urban design, provision of low-emission transport infrastructure (e.g. electric vehicle charging), reduced car parking provision and increased bicycle parking provision.
 - Credit 18 – Potable Water: provision of rainwater capture and/or stormwater treatment facilities can greatly contribute to achieving high scores.
 - Credit 23 – Ecological Value: avoid damage to existing sites of ecological value, and provision of natural habitats.
 - Credit 25 – Heat Island Effect: spatial provision of green photosynthetic infrastructure such as street trees and parks.
 - Credit 26 – Stormwater: design and spatial provision of stormwater detention tanks to mitigate stormwater peak discharge.
- Green Star – Communities (v1.1)
 - Credit 9 – Healthy and Active Living – provision of footpaths and cycling infrastructure and pedestrian-friendly urban design.
 - Credit 23 – Peak Electricity Demand Reduction: spatial provision for on-site electrical generation or energy storage systems.
 - Credit 25 – Greenhouse Gas Strategy: spatial provision of on-site renewable generation, building form, massing and orientation design.
 - Credit 27 – Sustainable Transport and Movement: public transport design, walkable urban design, provision of low-emission transport infrastructure (e.g. electric vehicle charging), reduced car parking provision and increased bicycle parking provision.
 - Credit 31 – Heat Island Effect: spatial provision of green photosynthetic infrastructure such as street trees and parks.

3.1.4 Recommendations

From the assessment above, we recommend that the following commitments are made at this planning stage:

- A commitment is made to delivering the initiatives in the 'Embedded into Design' column within the framework (see section 3.1.2).
- Further consideration is taken to the 'Future considerations and options' column within the framework (see section 3.1.2).
- 6-star Green Star – Communities rating is achieved (based on Version 1.1 submission guidelines).
- 5-star Green Star – Design & As-Built rating (Design Review certified) is achieved for selected buildings (based on Version 1.2 submission guidelines).

- Consider NABERS for Apartment Buildings rating to be managed by the body corporate/strata at operational stage.
- The sustainability framework is considered in preparing any future procurement decisions.

3.2 Energy & Carbon

Energy is a costly resource to generate and distribute to its point of use. Electricity from the grid is currently highly carbon intensive due to its reliance on fossil fuel generators. Mains natural gas, while currently less carbon intensive than grid electricity per unit energy, is still a fossil fuel and releases greenhouse gases when combusted. If the goal is to transition to a zero economy by 2050, the focus must be on minimising the use of energy and switching to low-carbon or renewable energy sources. There are several pathways to achieve this, each with its own merits and drawbacks. This chapter section will provide the discussion and rationale behind the thought and decision-making process.

The reduction in energy consumption and carbon emissions is a desired outcome of Waterloo South and is pivotal to many Study Requirements. In considering what an ultimate outcome would look like for Waterloo in 2050, the energy story should ensure the following:

- Retail energy prices are low and affordable.
- Energy is low carbon and sourced renewably.
- Energy generation is efficient and produced locally.
- Waste energy is minimised via heat capture and reuse.
- Energy supply is resilient through local generation and storage.
- Energy supply is flexible and adaptable to demand.
- Energy use efficiency is maximised.

The current design considerations need to consider a pathway that enables what is possible in the current design and ensures it does not preclude future positions, while also setting out a transition strategy to enable the outcomes to be realised.

3.2.1 Context

The context outlines the 'Current Need' that the framework is addressing.

The Study Requirements relating to Energy and Carbon are outlined below:

- Ecologically Sustainable Development (ESD)
 - 16.3. Identify options to achieve a minimum of 50% renewable energy for the precinct, by maximising on-site generation and renewable energy generated off-site.
- Climate Change Mitigation and Adaptation
 - 10.1 – Undertake a sustainability assessment of the proposal, reflecting the directions outlined in the NSW Climate Change Policy Framework October 2016 and Draft Central District Plan – Creating an efficient Central District to achieve net-zero carbon emissions by 2050. Investigate options for achieving both net zero buildings and a net zero precinct.
 - 10.6 – Demonstrate compliance with BASIX and investigate opportunities to deliver beyond-compliance BASIX scores
- Utilities
 - 9.6 – Integrate outcomes of the ESD Study to ensure optimisation of sustainable infrastructure opportunities

Other relevant policies and programs relating to Energy and Carbon are outlined below:

- City of Sydney Sustainable Sydney 2030;
- City of Sydney Environmental Action Plan;
- SEPP 65 & Apartment Design Guidelines;
- Paris Agreement;
- National Construction Code – Building Code of Australia;
- Renewable Energy Target;
- National Energy Productivity Plan;

- National Australian Built Environment Rating System;
- Nationwide House Energy Rating Scheme;
- NSW Electricity Strategy;
- Sydney Local Environmental Plan; and the
- Sydney Development Control Plan

Demand Forecast

Maximum electrical demand forecast can be found in the Utilities and Infrastructure Servicing Report.

Consumption Forecast

Table 8: Waterloo South Estimated Annual Electricity Consumption

	Typical Energy Use Density (kWh/yr/m ²)	Waterloo South (GFA m ²)	Estimate Energy Consumption (MWh/yr)
Residential (Apartment)	64	239,100	15,320
Retail/Community	127	17,900	2,273
Car Park	30	56,453	1,694
Total			19,269

3.2.2 50% Renewable Energy

One of the Study Requirements for Waterloo South is the identification of pathways to achieve 50% renewable energy for the development through a combination of both on-site and off-site procurement options. On-site procurement options for Waterloo South may include solar photovoltaic systems, micro-wind generators and geothermal systems. Off-site options may involve the purchase of externally generated renewable electricity which is imported (via the existing electricity network) to Waterloo South for consumption.

Pursuing this 50% renewable energy target through on-site options alone may be difficult, given spatial constraints of the site. It is recommended that future design development assess the extent to which the 50% renewable energy target can be delivered through on-site means.

The following section provides a very high-level estimate of the total annual solar PV generation on the entire Waterloo Estate, based on roof-mounted solar PV systems only. This is likely to change as the design progresses.

Total appropriate roof area (50% of total roof area identified): 33,800m²
Assume 80% coverage (of the 50% roof space identified as suitable): 27,040m²
Assume solar PV energy density: 150W/m²

Total PV generation capacity = 4.056MW

Assume average daily PV generation of 3.9kWh/kW_P

Total average PV generation per day = 15.82MWh/day
 Total average PV generation per year = 5,773.72MWh/year

Assume system efficiency of 85% to account for losses

Total average PV generation per year (after losses) = 4,908MWh/year

This is equivalent to meeting approximately **13%** of the Estate's annual energy consumption

There are a number of technology options available to achieve the 50% renewable energy target for Waterloo South. A combination of these options has been used to develop potential pathways to achieving the target (see Table 9):

- Power Purchase Agreements (PPAs) – Purchase of off-site renewable electricity via PPAs may potentially be a cheap option, the generation assets are not owned by Waterloo South. There are benefits of having some level of on-site renewable generation, some of which are difficult to quantify, such as the improved energy independence, energy resilience, and the public perception of the Estate’s sustainability credentials. Hence, there is an optimal balance between on-site and off-site generation that needs to be found. A potential issue may be the need for several, separate PPAs for each building if there is no centralised governance structure.
- Embedded Networks (micro-grids) – Managing the procurement of renewable electricity for the entire Estate may require the implementation of governance structures due to varying building ownership, differing project staging, and end-user electricity retailer contestability:
 - The staging of the project over 15 to 20 years may mean that each property developer will have individual and potentially inconsistent approaches to renewable energy procurement. From a governance perspective, this may add complexity to ensuring compliance with the renewable energy target. A micro-grid within each staged parcel of land will need to consider how it would interface with future micro-grids in other lots.
 - Electricity consumers in NSW have the power of choice over their electricity retailer. An electricity customer cannot be forced to purchase GreenPower or choose a specific retailer over another. As such, it can be challenging to ensure compliance with the renewable energy target.
 - A micro-grid may not be feasible to service Waterloo South alone. Consideration of this technology will need to include the demand requirements for the entire Waterloo Estate and the ability to stage the development of the micro-grid with the development of the Estate.
 - A possible option is to set up a centralised utility and energy services company (ESCO) to operate a micro-grid that provides comprehensive energy services for the entire development. The ESCO would provide all electrical services in buildings and the public domain. The micro-grid would only require a single connection between electricity networks within the Estate and can purchase all or some of that as renewable electricity to service the micro-grid via a PPA, ensuring the target is achieved. Note that ‘single connection’ in this context refers to the singular interface between the private micro-grid and the rest of the electricity network. This still allows for more than one physical trunk connections for the purposes of redundancy and backup supply to the micro-grid.
- Governance and Planning Measures – A precinct-wide target for a precinct with potentially several owners and stakeholders will require coordination via strong governance frameworks and/or planning measures. The balance between ease of compliance and individual decision-making power exists on a spectrum. Stakeholders can act at the individual level, personally opting to purchase renewable energy, or building operators can choose to supply only renewable energy at the building level, or Waterloo South can collectively act in a unified manner to procure renewable energy. The more power given to the individual, the more challenging it is to achieve Waterloo South and Estate-wide targets.

Irrespective of the off/on-site renewables composition, an important factor to consider is the absolute amount of energy consumed. By firstly seeking ways to reduce total energy consumption through energy efficiency measures, the total amount of on or off-site renewable energy required will be reduced.

The cost of energy efficiency and optimisation is often cheaper than procuring larger generation systems and follows the principles of the energy reduction hierarchy. From a life cycle cost perspective, energy efficiency measures are superior as they typically have relatively lower capital costs and very minimal or no ongoing operational costs. There are also implications on reduced absolute energy demand on the infrastructure servicing strategy.

Given the physical site constraints of Waterloo South, it may be that off-site renewable generation will be pursued as the main contributor towards this target. On-site solar PV and solar thermal systems will contribute negligible amounts in the early years. The following table summarises some of the pathways using a combination of the above options to achieve a minimum of 50% renewable energy across the entire Waterloo Estate.

Table 9: Pathways to minimum 50% renewable energy for the Waterloo Estate

Option	Description	Benefits/Pros	Risks/Cons
Fully Integrated Micro-grid	Establish a localised electricity micro-grid (embedded network) to service the Estate. The micro-grid operator purchases electricity from	<ul style="list-style-type: none"> - Retailer contestability remains intact. - Innovative and elegant 	<ul style="list-style-type: none"> - Limited market experience in micro-grid operation.

Option	Description	Benefits/Pros	Risks/Cons
	<p>the network distributor (Ausgrid) and then on-sells to the Estate residents via their selected retailers.</p> <p>As the 'gatekeeper' for all electricity flow into the Estate, the micro-grid operator engages into a PPA to supply minimum 50% of its electricity from a renewable source.</p>	<p>solution.</p> <ul style="list-style-type: none"> - Simple integration of on-site renewable generators into micro-grid from governance perspective. - Potential to incentivise the micro-grid operator to also reduce energy use on the network (energy as a service rather than as a kWh). 	<ul style="list-style-type: none"> - Long term commercial viability and market volatility. - Guaranteeing affordable energy supply for tenants and residents.
Body Corporate and Base Building Green Power or Power Purchase Agreement for 100% of their load	<p>The body corporate, as a single entity can directly influence 50% of the site's total energy demand. The body corporate enters into a PPA to ensure 100% renewable energy supply, thus meeting the 50% precinct renewable energy target.</p> <p>Centralise building hot water systems (preferably as heat pumps) which account for approximately 25% of energy use. Hot water circulated through building to the residents.</p> <p>A solar thermal hot water system to provide hot water boosting, or on-site PV to supply electricity, equivalent to 5% of total energy use</p> <p>Elements of the base building such as lifts, basement HVAC and common area lighting (approx. 20% of total energy) to be operated by the body corporate.</p> <p>Under these conditions, 50% of the Estate energy could be met by renewable sources due to the body corporate's PPA.</p>	<ul style="list-style-type: none"> - Minimal parties involved in the arrangement – only the body corporate is required to enter into a PPA or Green Power agreement. - Avoids potential regulatory issues with retailer contestability. 	<ul style="list-style-type: none"> - Risks that are inherent to PPAs such as generator failure will apply. - Green Power may be a safer alternative. - A covenant may be required to guarantee purchase which may be subject to legal challenges. - Staging of the development may impact the feasibility of a PPA across the entire Estate.
Property Title Covenants	<p>Introduce a covenant into the property titles mandating the purchase of minimum 100% GreenPower from the electricity retailer. Total energy use from private residential units is expected to be about 50% of total precinct energy.</p>	<ul style="list-style-type: none"> - GreenPower is an established and accredited scheme to guarantee supply of renewable energy 	<ul style="list-style-type: none"> - Potentially introduces regulatory complexities due to large number of parties involved - May be difficult to enforce requirement and ensure compliance
Single Building Owner (Build to Rent)	<p>A build to rent model for the housing component of the development would encourage a single owner of the entire asset (residential, commercial and retail) and therefore a single owner responsible for offsetting all communal energy sources through a PPA or GreenPower purchases. This may extend to the private consumers if the owner becomes an energy retailer within the development. It could also allow for significant efficiencies in design, services and plant driving better energy and cost efficiencies.</p>	<ul style="list-style-type: none"> - This may extend to the private consumers if the owner becomes an energy retailer within the development. - It could also allow for significant efficiencies in design, services and plant driving better energy and cost efficiencies. 	<ul style="list-style-type: none"> - May still require a covenant over the title to enforce a 50% renewable energy requirement.

3.2.3 Net-Zero Carbon Precinct by 2050

Developing pathways towards a net-zero precinct by 2050 will require a longer-term view on the market with respect to energy, water, transport and waste where some technologies and applications have not been invented or commercialised. This likely outcome will be influenced by several external factors in which the project team have very limited control over at this stage of planning.

Assumptions

The following assumptions for the 2050 market are as follows, and will be the scenario under which the pathways will be developed under:

- NSW electricity grid will be 100% carbon neutral, through renewable generation or residual carbon offsetting
- All private vehicles will be electric powered vehicles (either powered or shared)
- Sydney Metro operation is 100% carbon neutral in operation
- No mains gas consumption, or gas consumption is carbon neutral
- Waste is converted to energy, with residual emission offsetting

While the above assumptions define the end goal at 2050, the primary purpose of planning at this stage is to enable the appropriate transitional pathway towards net zero carbon.

In the journey towards 2050, solar PV technology is expected to improve in efficiency through research breakthroughs which are brought to market. Commercialisation of new applications of solar PV such as building-integrated solar PV (BIPV) is expected to introduce new means of renewable generation in a precinct aside from conventional solar panel systems. In combination with ongoing improvements in energy efficiency of appliances, lighting, HVAC, hot water systems, the proportion of renewable energy serving Waterloo South will increase.

At the current stage of planning, the initiatives that are unlikely to be impacted by future technological changes need to be considered for incorporation and locked in.

Considerations such as optimising the passive design (building orientation and massing) elements of the buildings within Waterloo South will have the same impact today as it will in 2050. Shading devices on the western façade can be considered later at detailed design, but it is important that the façade and building envelope designs do not preclude future installation or retrofitting of BIPV.

Identification of potential locations for future expansion of solar PV systems is a worthy consideration so as to earmark opportunities to increase on-site renewable generation. Unconventional locations such as on building envelopes enabled by BIPV or airspace should be considered and not excluded. Consideration should examine experimental applications of solar PV to identify potential future locations in Waterloo South.

Under the assumption of no gas or net-zero carbon gas consumption, it is likely that hot water heating will be serviced by heat pumps which can achieve significantly higher thermal output levels than conventional gas boiler systems. While gas infrastructure may be installed in time for 2025 operation, it should be designed with disassembly in mind when gas becomes an unviable fuel source from a carbon perspective. Spatial provisions should also be made or identified for the siting of heat pump systems which can be installed later in the project lifecycle. Risers should also be designed to not preclude future retrofitting of centralised thermal networks to accommodate for the heat pump system.

The future position of transport is assumed to be fully electric. Internal combustion engine vehicles will become uncompetitive compared to electric vehicles due to a price on carbon emissions. Car parking spaces in 2050 will require EV charging infrastructure, thus spatial considerations should be made at the current planning and design stages to ensure that charging of EVs in Waterloo South is not precluded.

Scenarios

A set of assumptions have been made about the carbon intensity of grid electricity, cost of renewable energy, transport emissions, and waste emissions (offset or utilised). Assumptions also need to be made about a carbon, remote renewable or offset market operating at that time. It is also recognised that the policy environment is likely to change significantly between now and 2050 and for example, the current Renewable Energy Target (RET) is likely to change and impact on the current carbon accounting mechanisms. In seeking out Waterloo South's role in supporting this pathway, it is primarily about identifying initiatives to enable transition rather than achieve it now. The following scenarios have assumed potential future positions that are inherently uncertain, but they provide valuable insight into what the Estate and current planning for Waterloo South needs to consider now to enable the respective pathways.

Table 10: Visions and pathways to Carbon Neutrality by 2050

Scenario	Description
Net-zero emission electricity grid	Under the 2050 net-zero emissions target, the NSW electricity network has become zero emissions through transition of the generation mix. Therefore, all electricity consumption is calculated at be zero emissions. Any waste emissions are offset through purchase of accredited Australian carbon offsets.
Grid still running with low carbon intensity.	By 2050, energy efficiency improvements across the Estate will generate a 40% reduction on 2022 energy use. There will be a 20% increase in on-site generation through super-efficient solar PV or other on-site renewables installed throughout the Estate. This now means that the development generates more than it can use on an average day. A cheap battery pack is now needed to store the excess energy generated during the day for use within the Estate at night. The Estate is still connected to the grid for security and resilience however the grid has a small amount of carbon left on it. With the current efficiencies and solar with the battery. The Estate is operating at net-zero carbon over the year.
Grid still running at high carbon intensity	Significant energy efficiency actions have been taken across the Estate as energy prices are very high and the payback of energy efficiency is one of the best investments you can make. Some new solar is providing some additional generation however the development still relies on the grid for 50% of its power needs. Any waste emissions will be offset through purchase of accredited Australian carbon offsets.
Micro-grid ESCO	The Estate has had a micro-grid operator for the last 20 years who sells energy as a service rather than as kilowatt hour (kwh) to all users. This micro-grid operator manages all the carbon intensity and is, like all reputable micro-grid operators, certified 100% renewable. The operator is also fundamentally incentivised to reduce the kWh for the unit of service as the kWh's are so incredibly expensive, so the estate is running very efficiently.

Options

Develop options to meet these criteria will need to take a medium to long-term view on the energy market, given that the development will be staged over the next 20 years. During this time, the energy market will be in a continual state of flux. The solution adopted at the present time will need to have sufficient flexibility for Waterloo South and the entire Estate and its community to adapt to future changes.

The pathway towards net-zero carbon will likely occur via a combination of energy efficiency measures, low emission transportation, uptake of on-site and off-site renewable energy, and purchase of accredited carbon offsets. As discussed in Section 3.2.2, the NSW electricity grid is expected to gradually decarbonise through the increasing penetration of large-scale renewable generation and withdrawal of fossil-fuel generators. This is expected to contribute to the journey towards a net-zero carbon economy. The Study Requirement target for 50% renewable energy on the Estate will significantly help to meet the net-zero carbon precinct goal from a stationary energy perspective. Increasing availability of renewable technologies such as hydrogen fuel cells and waste-to-energy generators will provide a greater variety of options to the market to decarbonise, as well as place downward pressure on renewable energy prices.

For reference, the City of Sydney Environmental Action Plan (EAP) has set a target of 70% reduction in greenhouse gas emissions by 2030 based on 2006 levels and net zero emissions by 2050 which is in alignment with the Study Requirement. The City's identified pathway to achieving this is primarily through implementing energy efficiency measures and increasing renewable energy generation, as shown in Figure 20. It focuses strongly on improving energy efficiency and procurement of renewable energy.

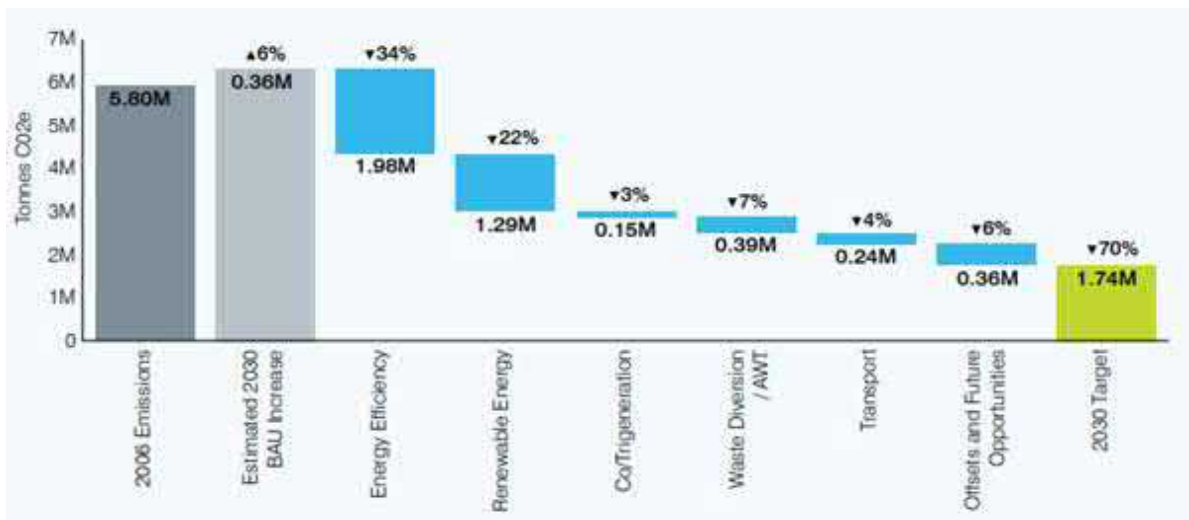


Figure 20: City of Sydney Greenhouse Gas Emissions Reduction - Estimated contribution of initiatives

Source: City of Sydney Environmental Strategy and Action Plan 2016-2021

- Maximising Energy Efficiency – The adopted pathway should utilise the most cost-effective technologies available at the given time with an appropriate staging program and payback to match the development schedule. As a result, energy efficiency measures should be pursued and maximised before renewable energy technologies are considered. This is in line with the energy hierarchy. Energy efficiency can be achieved through attainment of high BASIX, NatHERS, and Green Star – Design & As-Built ratings and scores.
- Elimination of High Carbon Gas Consumption – At present, mains natural gas has lower carbon intensity than NSW grid electricity for thermal end-use purposes. However, this is expected to change over the next 20 to 30 years as the large-scale renewables continue to come online in the electricity network and drive down grid carbon intensity. While there are early investigations into the decarbonisation of the gas network, it is still in its infancy and much more research is still required. The market will also take additional time to adopt and commercialise low carbon gas. There is currently still too little information available to make an informed decision on whether the development should be committed to natural gas or not. Commitment to use of gas would be of benefit in the short term from a carbon reduction perspective but will also lock in the development to reliance of gas if the future electricity network decarbonises beyond the gas network.
- Zero-emissions Transportation – Efforts to lowering precinct transport emissions is helped by the Sydney Metro station at the Waterloo Metro Quarter, which has targeted 100% carbon neutral operation. Other low emission transportation can be encouraged through the provision of appropriate cycle infrastructure, end of trip facilities, and pedestrian-oriented urban design. A below average provision of car parking spaces can discourage private car ownership. However, allocation of car-share only parking spaces can be an effective means to reduce transport emissions while still providing residents the option of vehicle travel on as-needed basis. Where private vehicle car parking is provided, electric vehicles (EVs) should be preferred through designated ‘EV only’ parking spaces with charging infrastructure. The car share provider should be encouraged to consider including offset electric vehicles as part of their start-up fleet. This may impact electrical demand and has been considered with the Utilities scope.
- Waste to Energy – Waste to energy is a technology that may be implemented in Waterloo South or across the rest of the Estate in later stages. Waste-generated gas can be captured from precinct waste to be used as a carbon neutral substitute for mains gas. There are many significant factors to consider including the spatial requirements of the necessary infrastructure, air quality impacts, and overall feasibility of the technology in this application.

3.2.4 BASIX Energy and Thermal Comfort

'Mid-rise' and 'high-rise' buildings, as defined by BASIX, are required to demonstrate compliance with the minimum BASIX Energy target of 25 or 35 respectively. In comparison to the compliance target for a detached/semi-detached residential building within the same region, the BASIX Energy target is 50.

Without a more detailed design, it is not possible to demonstrate compliance with BASIX.

Regardless, going beyond compliance is reasonable and achievable, particularly given the potential for reduced underground car parking provision. This results in reduced ventilation requirements which is typically very intensive and is a primary factor behind the lower compliance target for high rise buildings compared to detached buildings. There are a number of initiatives to consider achieving beyond minimum compliance:

- Provision of centralised hot water, heating and cooling systems
- Installation of photovoltaics systems
- Optimising the number of lifts and installing stairs for general access
- Optimising design of common areas to minimise mechanical ventilation, HVAC and lighting requirements
- Design apartment dwellings to reduce need for heating and cooling through building orientation, building shape and appropriate building materials
- Provide high efficiency kitchen appliances

3.2.5 Recommendations

From the assessment above, we recommend that the following commitments are made at this planning stage:

- Planning Controls:
 - 6-star Green Star – Communities rating is achieved (based on Version 1.1 submission guidelines).
 - Commitment to beyond compliance target for BASIX Energy and Thermal Comfort.
 - At development completion, the Estate is to source a minimum of 50% renewable energy by prioritising on-site generation and procuring the remaining deficit through off-site renewable energy.
 - Engage with energy utilities to incentivise development peak shifting, reducing need for network augmentation.
- Management Alternatives/Initiatives:
 - 5-star Green Star – Design & As-Built (Design Review certified) rating should be targeted for selected buildings (based on Version 1.2 submission guidelines).
 - Consider a micro-grid operator to manage peak demand and carbon emissions. An additional step may be to consider an 'energy services company' (ESCO) instead of a 'traditional' electricity retailer.
 - Consider the design to either enable, or not preclude, future energy technologies and initiatives.
 - Recognise technology is going to change, so through procurement, specify intended outcomes rather than specified technologies.
 - Permit residents to air dry laundry on balcony. Design measures such as screened outdoor areas on balconies should be considered to facilitate.
 - Consider seeking a NABERS Energy rating for the residential apartments and retail areas.
- Design Considerations
 - Design building systems to enable future retrofitting of new technologies such as building integrated PV.
 - Consider designing Waterloo South and the entire Waterloo Estate to be 100% electric for the buildings (i.e. no gas).
 - Identify potential future sites for solar installations as the price reduces and the need increases.
 - Design the risers with capacity and accessibility to enable future additions of thermal or water networks.
 - Consider heat pumps to achieve the required hot water demand.

- For thermal comfort within the development:
 - Design residential units to achieve optimal thermal comfort conditions in such a way that minimises the need for active systems.
 - Prioritise passive design measures in the buildings such as optimised orientation, western shading devices, minimised glazing and using high thermal performance glazing to reduce overall energy consumption.
- Provide mixed mode HVAC for commercial and retail with maximised COP ratios to drive energy efficiency.
- For residential units, reconsider the installation of split system fan coil units on balconies to avoid formation of heat drafts and undesirable outdoor balcony conditions. The following solutions are not mandated, but noted as potential technical solutions available:
 - Designing residential units for potential retrofitting of mechanical cooling systems comprising of indoor direct expansion fan coil unit with pipe reticulation to an outdoor air-cooled condenser unit located in a designated plant room, as opposed to on the unit balcony. Consider locating a plant room every 10 floors to house the condenser unit.
 - Centralised chilled and heating water systems with fan coil units servicing residential units. The thermal energy (chilled and hot water) is metered to allow energy from the central plant and operating cost to be appropriately allocated. The heating would be provided by electrically driven heat pumps to negate the need for gas.

3.3 Water

Our relationship with water in Australia tends to change in cycles. During periods of drought, residents can become extremely efficient in their water consumption, particularly with water-use restrictions in place. However, when dam levels are full, water can be easily squandered. The perceived value of water changes depending on climate patterns and cycles. Ideally, the real value of water should be accurately reflected consistently throughout the years and should be considered a valuable resource regardless of dam levels.

For Waterloo south and the Estate, the primary aim will be to change the way water is perceived and used. By 2050, the ultimate outcomes for water could be:

- Potable water is affordable and accessible.
- Direct potable recycling of water is realised.
- The real cost of water is recognised in water pricing.
- Water has low carbon intensity.
- Water supply is resilient.
- Low waste water generation rates.
- Water use efficiency is maximised.

The local water cycle is categorised into use of water, the reuse of waste water, rain water and ground water. The current design considerations need to consider a pathway that enables what is possible in the current design, ensures the current design does not preclude future positions, and sets out a transition strategy to enable this outcome to be realised.

3.3.1 Context

The context outlines the current need that this report is addressing.

Planning and Policy Context

- Relevant Study Requirements
 - Ecologically Sustainable Development (ESD)
 - 16.1. Provide an Ecologically Sustainable Development Report which details how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated, specifically:
 - identify performance benchmarks to allow sustainability to be considered in site planning, building design and in the construction and operational phases of the development to achieve best practice sustainability outcomes, and
 - commitment to compliance with a nationally recognised rating system (e.g. Green Star – Communities).
 - Climate Change Mitigation and Adaptation
 - 10.6 – Demonstrate compliance with BASIX and investigate opportunities to deliver beyond-compliance BASIX scores.
 - Utilities
 - 9.6 – Integrate outcomes of the ESD Study to ensure optimisation of sustainable infrastructure opportunities.
- Other Targets and Requirements
 - City of Sydney Sustainable Sydney 2030;
 - City of Sydney Environmental Action Plan;
 - National Australian Built Environment Rating System;
 - Sydney Local Environmental Plan; and the
 - Sydney Development Control Plan.

Demand Forecast

Maximum daily potable water demand forecast can be found in the Utilities and Infrastructure Servicing Report.

Table 11: Estimated Cumulative Maximum Daily Potable Water Demand

Study Area	Water Demand (kL/day – Cumulative inc. BASIX)	Total per Study Area (kL/day)
Waterloo South - Apartments	1440	1520
Waterloo South - Commercial	80	

3.3.2 BASIX Water

'Mid-rise' and 'high-rise' buildings, as defined by BASIX, are required to demonstrate compliance with the minimum BASIX Water target of 40. This target is the same as that of a detached residential building in the same region. Without a more detailed design, it is not possible to demonstrate compliance against BASIX. Regardless, going beyond compliance may require concerted effort due to the residential, commercial and retail land uses and the site's physical constraints.

On-site rainwater or stormwater harvesting systems typically have high spatial uptake requirements. It is anticipated that non-potable water supply options will be limited by the amount of space available.

A range of identified design considerations leave open the option of providing alternative water supply systems. Although Sydney Water does not provide recycled water service to Waterloo South, the adjacent Green Square Town Centre has a privately-operated recycled water scheme wherein there may be opportunity to extend to Waterloo South. An option for further investigation is the possible establishment of a dedicated water treatment facility at Waterloo South. Pending additional scoping studies, it may be justified given the size of Waterloo South and expected population and land uses. It is suggested for such a scheme to extend to Waterloo Central and North and possibly the Metro Quarter to benefit from economies of scale. However, there are several constraints including the potential need for additional space and possible land take as well as additional piping infrastructure. These constraints are recommended to be investigated as part of a broader study into the potential feasibility of such a facility.

In summary, there are opportunities to consider in going beyond BASIX Water compliance:

- Identification and further investigation into potential options to harvest and store rainwater, including the need for an adjacent site, and potential land take, for use in Waterloo South. There may be strong synergies with the Waterloo Metro Quarter which has little space for siting of rainwater tanks however this would be subject to further investigation.
- Stormwater harvesting of the on-site water detention tanks should be considered although water treatment may be required before it can be reused.
- Connecting into the recycled water infrastructure at Green Square Town Centre.
- Recycling of greywater for reuse in irrigation. A cost-benefit analysis should be performed to assess the feasibility of a water treatment system. Consider sharing the system with the entire Estate.

There are also initiatives on reducing potable water demand that should be pursued to meet and achieve beyond the BASIX Water compliance:

- Drought-tolerant, low water use vegetation in gardens & green roofs to reduce irrigation water use.
- Designing in high efficiency water fixtures rated at 4, 5 or 6-star WELS, depending on the fixture type.
- Inclusion of high-water efficiency appliances such as dishwashers and laundry machines as a package with the apartment, or offer financial incentive for residents to purchase high efficiency appliances.

3.3.3 Recommendations

From the assessment above, we recommend that the following commitments are made at this planning stage:

- Planning Controls:
 - 6-star Green Star – Communities rating is achieved (based on Version 1.1 submission guidelines).
 - Commitment to beyond compliance target for BASIX Water.
 - Detail water sensitive urban design considerations into the DCP.

- Management Alternatives/Initiatives:
 - 5-star Green Star – Design & As-Built (Design Review certified) rating should be targeted for selected buildings (based on Version 1.2 submission guidelines).
 - Consider servicing options that may allow for a public or private water utility for the Estate.
 - Consider providing storm water storage and recycling facilities to irrigate the public domain.
 - Consider seeking a NABERS Water rating for the residential apartments and retail areas.
- Design Considerations:
 - Install a third pipe system to plumb toilets and laundries with recycled water, to provide resilience if a recycled water network is installed at a future date
 - Consider potential for connection to the recycled water infrastructure at Green Square Town Centre.
 - Selection of drought-tolerant, low water use vegetation in gardens and green roofs to reduce irrigation needs.
 - Provision of high efficiency water fixtures (4, 5, 6-star WELS), inclusion of high-water efficiency appliances as part of apartment package, or offering financial incentives for residents to purchase high efficiency appliances.
 - Consider spatial provision for rainwater/stormwater harvesting tanks and pumps.

3.4 Waste

Waste is a key aspect of sustainability but is often overlooked for energy and water. Waste is likely to become a major issue in the future especially if waste management practices do not innovate to shift the rising rates of waste generation. Waste will also become a significant hurdle in achieving net-zero carbon precincts and buildings due to its residual emissions.

For Waterloo South, the primary aim will be to change the way waste is perceived by the population and reduce rates of waste going to landfill. By 2050, the ultimate outcomes are to ensure:

- The real cost of waste is realised such that it becomes a resource as raw material or as an energy source.
- A circular economy is established for waste.
- More waste is treated locally rather than centrally.
- Product design shift away from 'design for obsolescence'

The current design considerations need to consider a pathway that enables what is possible in the current design, ensure the current design does not preclude future positions, and sets out a transition strategy to enable this outcome to be realised.

3.4.1 Context

The context outlines the current need that this report is addressing.

Planning and Policy Context

Relevant Study Requirements are outlined below:

- Ecologically Sustainable Development (ESD)
 - 16.4. Identify and implement waste management strategies to achieve the NSW Government's Waste Avoidance and Resource Recovery Strategy 2007 (WARR) and complements the NSW Government's Waste Less, Recycle More initiatives and EPA waste and recycling programs. Include measures to ensure effective operational waste management, for example, adequate space within buildings for waste infrastructure, accessibility for waste collection vehicles. Identify building and precinct-scale solutions.

Other relevant targets and requirements are outlined below:

- City of Sydney Sustainable Sydney 2030;
- City of Sydney Guidelines for Waste Management for New Developments;
- City of Sydney Environmental Action Plan;
- and the
- Waste Avoidance and Resource Recovery Strategy.

3.4.2 Waste Avoidance and Resource Recovery (WARR) Strategy

The Study Requirements specify the identification and implementation of waste management strategies in alignment with the WARR Strategy, and complements the Waste Less, Recycle More initiatives, and the NSW Environment Protection Authority's (EPA) waste and recycling programs.

The WARR Strategy sets out overarching waste and recycling targets for NSW (detailed in section 0) out to 2021. The 'Waste Less, Recycle More' initiative provides the funding under which the EPA can modernise the NSW waste sector and deliver waste and recycling services to the community. In parallel, there are other EPA waste and recycling programs to facilitate, coordinate and implement waste reduction and recycling initiatives with the relevant stakeholders, including the 'Return and Earn: *NSW Container Deposit Scheme*' and provide educational material to the public to improve waste management practices. The City of Sydney's 'zero waste city' targets under their '*Environmental Action Strategy and Action Plan*' and the requirements under the Guidelines for Waste Management for New Developments are aligned to or exceed the WARR targets.

The 'Utilities and Infrastructure Servicing Report' by AECOM provides a waste management strategy to provide base waste management services. This chapter discussed the potential future opportunities for further waste reduction and waste diversion, and is intended to complement the 'Utilities and Infrastructure Servicing Report'.

The operational waste management strategy has been developed by adopting the waste hierarchy as a framework for waste management practices to achieve the best environmental outcomes. The referred of adoption is as follows:

- Avoid the potential of waste generation;
- Reduce waste during operations;
- Re-use waste where applicable;
- Recycle waste whenever possible;
- Recovery of waste materials; and
- Disposal of waste when there is no reuse or recycling potential.

Opportunities for Consideration

Given the current stage of planning, waste-related design initiatives have not yet been embedded into the master plan. They are primarily incorporated at the detailed design stage. Regardless, they have been raised with the design team for future consideration. In addition, a number of these can be funded through the '*Waste Less, Recycle More*' program to offset the cost of implementation.

To reduce the rate of municipal solid waste generation, separate recycling chutes should be co-located with regular waste chutes within apartment buildings. The recycling chutes should be easily accessible with clear signage and posters to educate residents on recyclable materials. The chutes could feed into carousels with compactors located in the waste disposal rooms located at ground level.

Ideally, waste rooms for commercial and retail tenants should be separate from the residential waste disposal rooms to prevent overloading of either waste system. Mobile Garbage Bins (MGBs) for residual and recyclable waste should be provided and located within separate waste rooms servicing the commercial and retail stores.

Given the large volumes of dwelling units in Waterloo South, there is likely to be a regular turnover of residents. Consideration should be given to providing space for residents to store unwanted bulky items to prevent illegal dumping on footpaths and impacting on the development's quality and appearance. Education on availability of such services will encourage the use of bulky storage areas.

Recycling services are commonly expected in public spaces and has increasingly become part of everyday life. Residual waste and recycling bins should be provided in the public domains to discourage littering and detracting from the development's quality of open space. Recycling bins should be positioned next to a residual waste bin, ideally in a 3-bin configuration (with the recycling bin in the centre) to help avoid contamination of recycling waste streams. Where only 2-bin configurations are reasonable, the residual waste bin should be located closest to the high traffic area. Bins with ashtrays should be provided in designated smoking areas.

A 'pay-as-you-throw' system is a potential option to minimise waste generation as it places financial incentive for residents to reduce their waste. An appropriate reduction in strata fees reflective of the reduced waste demand should be considered if a 'pay-as-you-throw' system is introduced. This will need to be carefully considered with waste and recycling schemes in the public domain.

To further reduce waste generation rates, the apartment fitouts can include built-in small residual waste bins to discourage waste generation and incentivise reuse of waste. Provision of in-sink food waste disposers should be considered to provide residents ways to reduce organic waste and potentially use as fertilisers.

The detailed design plan should consider the provision of '*Return and Earn*' container collection points within Waterloo South to service the community and promote recycling rates for glass bottles, plastic bottles and aluminium cans. Partnerships with local retail stores to serve as 'over-the-counter collection points' or locating a 'reverse vending machine' are some options that can be considered. It is noted that the reverse vending machines are large shipping container sized machines and may require additional space that may not be available in Waterloo South.

Under business as usual, there would typically be several waste disposal rooms across the Waterloo South precinct which are taking up highly valuable and contested space. Detailed design should consider vacuum (pneumatic) waste collection systems as a possible solution that can reduce the land-take and create more lettable retail and commercial space. Waste across Waterloo South is collected at a central point by an automated vacuum system which needs to be serviced by a single loading bay. The vacuum system can be deployed in the urban environment as well, removing the need for daily waste collection by Council.



Figure 21: Outdoor waste inlets as part of a precinct vacuum waste collection system

For construction and demolition waste, waste targets can be imposed onto the developers during construction with ongoing monitoring and to ensure waste targets are met. Ideally, the target and reporting requirements would be established in contracts with the developers so that the appropriate design initiatives such as incorporating use of recycled construction materials can be appropriately implemented by building engineers and designers.

3.4.3 Recommendations

From the assessment above, we recommend that the following commitments are made at this planning stage:

- Planning Controls:
 - 6-star Green Star – Communities rating is achieved (based on Version 1.1 submission guidelines).
- Management Alternatives/Initiatives:
 - 5-star Green Star – Design & As-Built (Design Review certified) rating should be targeted for selected buildings (based on Version 1.2 submission guidelines).
 - Planning and design of precinct to facilitate and prioritise waste management practices in line with the waste hierarchy.
 - Consider incentives to encourage reduction of waste generation rates, potentially through reduced waste levies and fees.
 - Consider seeking a NABERS Waste rating for the residential apartments and retail areas.
 - Consider creating a 'Return and Earn' container collection point to allow the community to access a new income stream and promote recycling rates.
- Design Considerations:
 - Consideration of the NSW EPA Better Practice Guide for Resource Recovery in Residential Developments.
 - Consider the potential provision of in-sink food grinders for food waste to reduce organic waste and encourage conversion of waste into renewable energy and fertiliser. Would need to be discussed with Sydney Water.
 - Provision of waste and recycling bins in the public domain to reduce littering and promote recycling.
 - Design in smaller residential waste bins into the residential apartment fit-out to disincentivise waste generation.
 - Residential and commercial/retail waste disposal rooms separate to avoid overloading issues.
 - Provision of space for residents to temporarily store unwanted bulky items to be disposed of.
 - Future consideration of an automated vacuum waste solution should be considered for its merits within Waterloo South and across the broader Waterloo Estate. Due to the ground level space constraints there may be potential for a vacuum waste system that would separate and centrally transfer and store waste, ready for collection either on-site or off site. This will reduce the need for multiple waste

collections and reduce storage / separation facilities within buildings and reduce loading docks size. It may also have amenity improvements within the streets with reduced loading docks and waste vehicle movements. It may also allow for a change in street geometry.

3.5 Climate Adaptation and Resilience

Recommendations made within this report should be considered in tandem with the Waterloo South Climate Adaptation Report (AECOM) as there are co-benefits of implementing many actions. For example, the adoption of a 6-star Green Star – Communities target strengthens a number of adaptation actions around community resilience, and provides a framework for cross-cutting actions to be implemented. Similarly, targeting 5-star Green Star building ratings has co-benefits related to adaptation, such as the development of energy and water efficient buildings. Buildings that consume fewer resources are less reliant on the stability of wider utility networks that may become increasingly prone to failure during extreme events.

Overall, extreme rainfall and flooding, extreme heat, and extreme storm events are hazards considered to have the most potential impact on the development and its community. Extreme rainfall can damage properties through flooding, increase costs associated with flood protection and insurance, limit safe access and egress from a site, and cause structural damage to buildings. Given the site is historically affected by overland flooding and can reasonably be expected to become more severe under all climate change scenarios, flood risks have been identified as the most relevant to the site.

Similarly, extreme heat can cause heat stress to residents and increase the incidence of illness, increase the cost of keeping buildings cool because more energy is needed, and increase the risk of critical energy infrastructure failing. There are significant health impacts associated with heatwaves and extreme heat days, particularly for vulnerable members of the community Estate (e.g. children, the elderly, and those experiencing illness). Extreme heat can cause heat stress to residents and increase the incidence of illness, increase the cost of and carbon emissions associated with keeping buildings cool, and increase the risk of critical energy infrastructure failing. Adaptation actions regarding the management of heat and its impacts primarily relate to ensuring the health and safety of community members and understanding the implications for infrastructure continuity and building performance.

Adaptation actions and responses identified and ultimately implemented by LAHC seek to reduce the risk exposure of the whole community, including the Waterloo South public and social housing residents, and ensure a thriving and resilient community. Specific adaptation actions and mitigation measures within the Waterloo South Climate Adaptation Report (AECOM) have been identified for vulnerable populations and all responses would serve to improve the resilience of the community vulnerable populations both visiting and residing in the Waterloo South new development. Actions have been prioritised based on their cross-cutting benefits, where gains in resilience also lead to gains in resource efficiency, human health, and community cohesion.

It is also recommended that recommendations within this report are considered alongside Resilient Sydney – A strategy for city resilience (City of Sydney). Identifying the key shocks and stresses, as well as taking a systems view of how Sydney supports residents, communities, government and businesses helps to manage community needs, risks and vulnerabilities.



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