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Sustainability Plan

Frenchs Forest Planned Precinct

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Executive Summary

Frenchs Forest Town Centre incorporates a significant commitment to sustainability. These initiatives are enabled by the unique nature of the site and early integration of strategies by the NSW Government prior to the sale of the land. The project is seeking to be aligned with Worlds Best Practice and specifically ensure future best outcomes aligned with the long-term development timeline of the site.

The project is proposing to incorporate:
1. Significantly increased Basix targets of 50% energy and 60% water reductions, whilst non-residential will be required to achieve a NABERS 5 star water and energy rating.
2. Shared precinct infrastructure to deliver 560kL/day of recycled water, increasing resilience to drought and reducing the cost of living for the occupants. The project will also include a centralised rainwater tank of 300kL
3. Onsite electricity generation will seek to enable installation of 2MW of Solar, and a Private Wire Network enabling sharing of renewable energy cost effectively between buildings and allowing future installation of onsite batteries. Recognising privately owned combustion engines will become extinct within the life of this project all parking spaces will be designed to enable EV owners to install chargers and bike space will also be provided with eBike charging. This will make the precinct both futureproof and reduce cost of living.
5. A community sustainability fund will enable continued investment in the site and will be seeded through a dividend created by the private precinct infrastructure.
6. The precinct will be healthy and comfortable for humans as well as flora and fauna. It will also be a resilient precinct to future climate impacts

Additional measures are also targeted through the 5 sustainability pathways as follows:

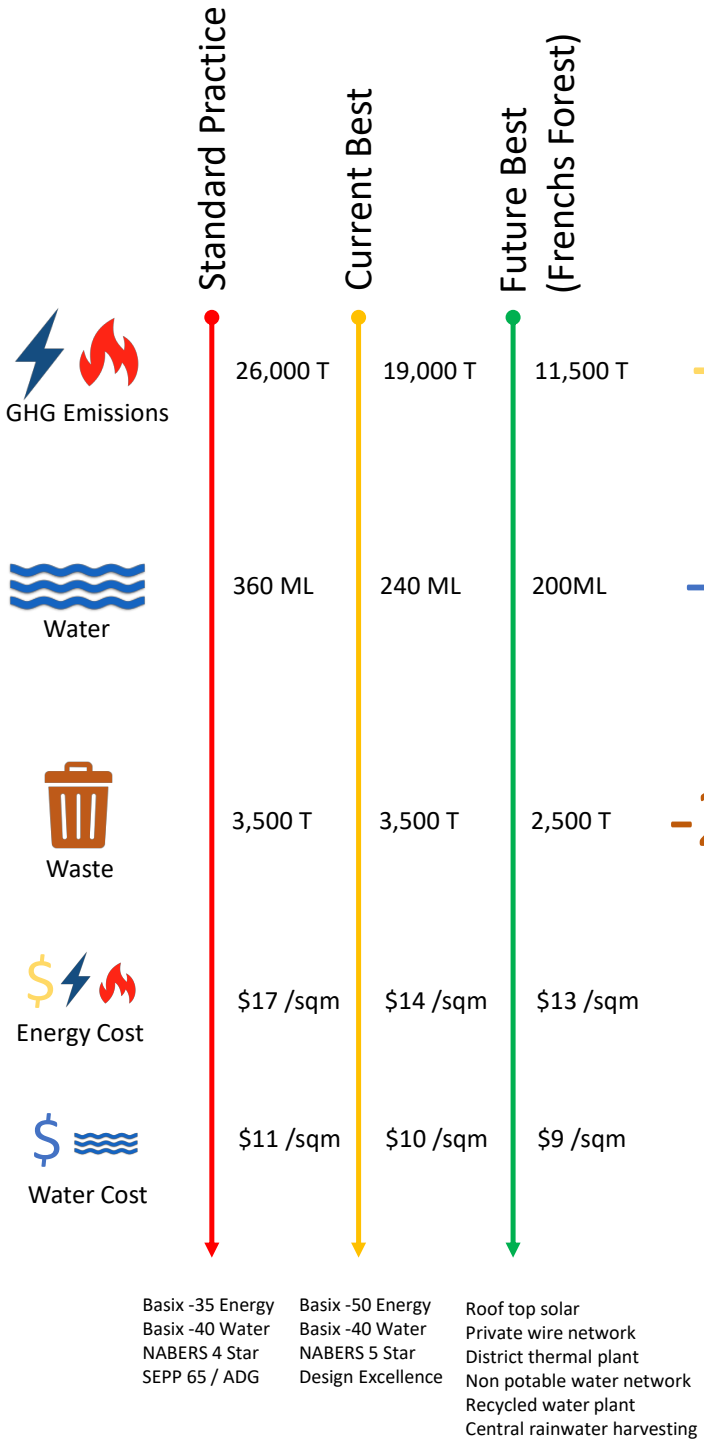
1. High performance buildings
2. Precinct energy infrastructure
3. Precinct water infrastructure
4. Precinct waste infrastructure
5. Connections and active transport

Finally a delivery strategy is identified to ensure elements are mandated through masterplanning, land sale and planning instruments.

Addressing sustainability in this way is expected to deliver the outcomes in the following figure.

Frenchs Forest

Annual Sustainability Impacts



-55% CO_2

Reduction in Greenhouse Gas Emissions

-110

Olympic Swimming Pools Saved

-28%

Less truckloads of waste dumped to landfill

Table of Contents

1. Introduction

The new town centre for Frenchs Forest is a rare opportunity to deliver the community a sustainable outcome that represents a genuine next step for Worlds Best Practice sustainability. NSW Government has recognised this opportunity and as a designated Planned Precinct integrated sustainability planning at the earliest possible stage.

This Sustainability Plan maps out the opportunities and pathways for their delivery. As the core of the site (the current Frenchs Forest High School) is currently Government owned land and without the constraints of multiple owners or existing infrastructure the opportunity and tools available to deliver sustainability at a precinct scale are unique and will significantly contribute to the projects ability to deliver an exemplary outcome.

Importantly this plan is focused on delivery. The recommendations of this plan are to be included within a number of key development mechanisms and relevant planning instruments including the new Masterplan, DCP, LEP, land sale agreements and covenants

1.1. Sustainability Vision

The vision for sustainability within the Frenchs Forest Planned Precinct is to deliver a town centre that:

- Reduces impact on both the local and global environment and where possible deliver restorative outcomes
- Create a healthy environment for people, flora and fauna
- Ensure the new precinct is both resilient and futureproofed
- Provide integration, connection and social infrastructure to both the existing community that surrounds the site and the new residents within
- Provide reduced cost of living and improved affordability
- Reduce demands on existing infrastructure services and provide greener servicing strategies

1.2. The Precinct

The Frenchs Forest Planned Precinct represents a significant opportunity to deliver a next generation town centre to the community. The development has been identified by the Greater Sydney Commission as part of a greater Health and Education Precinct which also incorporates the new Northern Beaches Hospital and a new Forest High School. The greater precinct also incorporates significant recreation and urban renewal components.

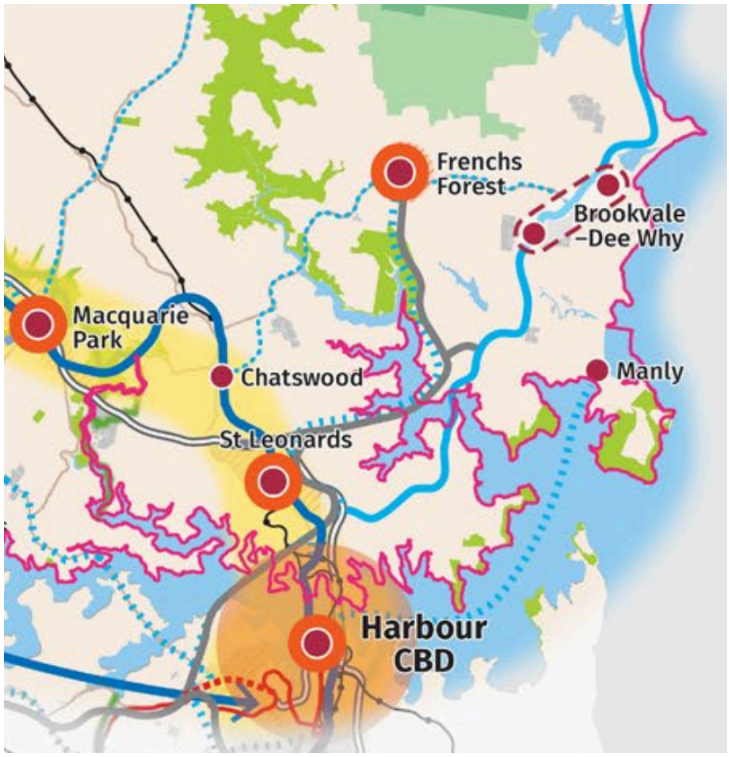


Figure 1 Greater Sydney Commission Plan

The Frenchs Forest Planned Precinct (FFPP) forms part of the Northern Beaches Hospital Precinct Structure Plan which was adopted by the Northern Beaches Council.

The development will be divided into three areas with different phases/stages of development:

Phase 1.	Short term, Immediate
Phase 2.	Medium term 10 years
Phase 3.	Long term 10 years +

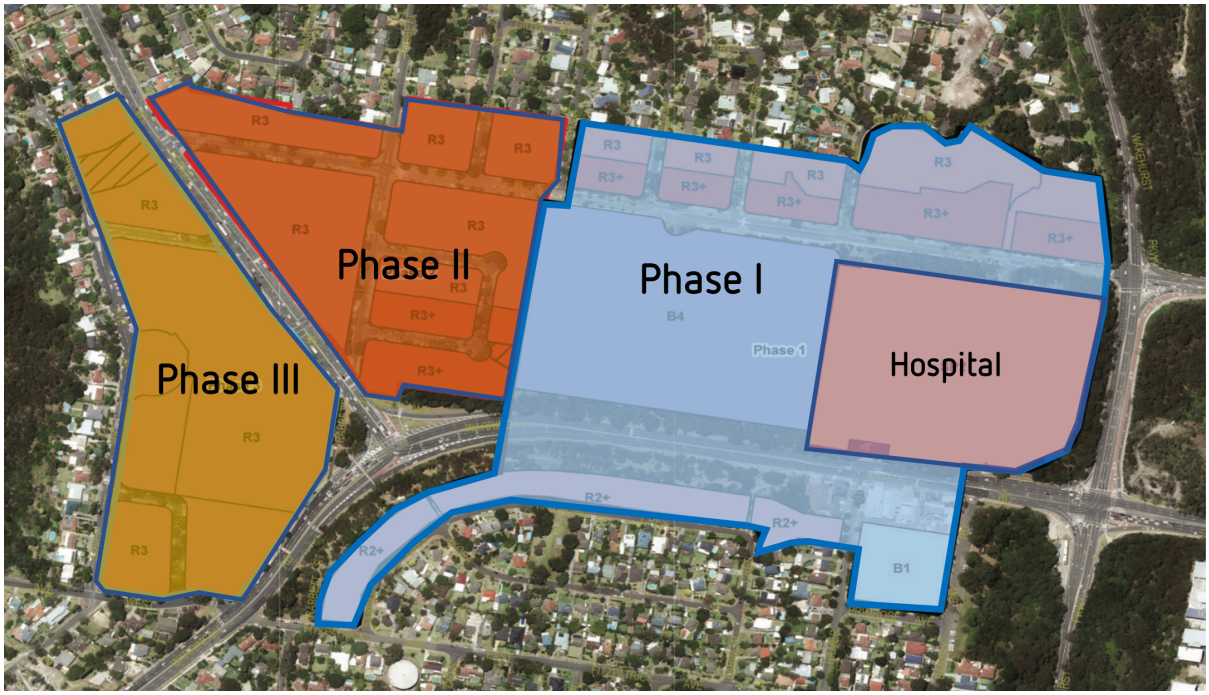


Figure 2. Phasing strategy for the site

This Sustainability Plan focuses on Phase 1 (excluding the Hospital Site). The site which is currently government-owned and occupied by Forest High School, is where the new town centre will be located. The sustainability strategies to be adopted in Phase 1 are set to be ambitious to pave the way for achieving optimum sustainability outcomes for the current and subsequent development stages.

The following figure defines the areas that make up Phase 1 of the FFPP development.

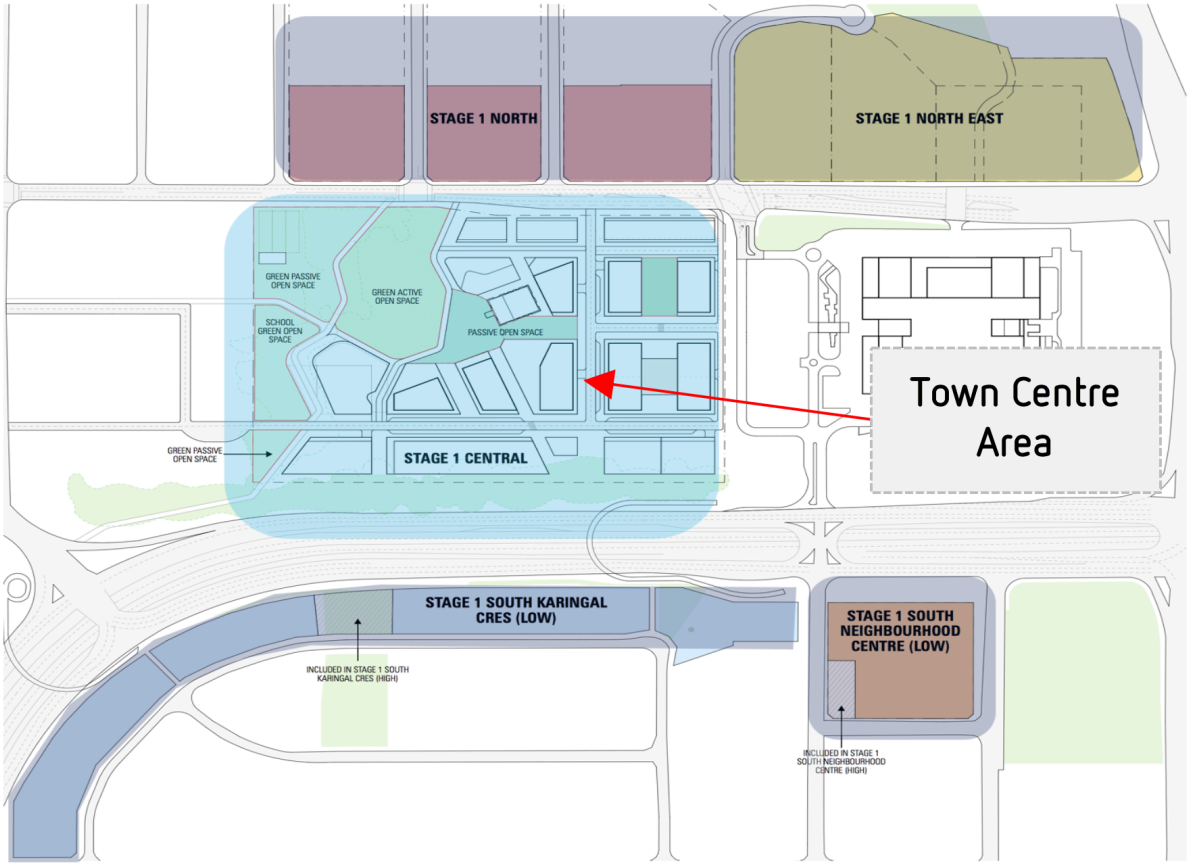


Figure 3. Site area

This study was completed at a point in time using forecast growth assumptions as provided by Department of Planning, Industry & Environment (DPIE), and prior to a final built form outcome. These are scheduled below:

Area	Typology		GFA (m^2)
Town Centre Area	Residential		89,527
	Non residential	Retail	18,332
		Commercial	8,789
		Hotel	8,124
		School / Childcare	18,517
		Total Sqm	53,762
All other areas	Residential		107,082
	Non residential	Retail	5,714
		Commercial	3,077
		Total Sqm	8,790

Figure 4. Site yields considered in this plan (DPIE)

1.3.Sustainability Objectives

The opportunity at Frenchs Forest with respect to sustainability is to establish a clear exemplar for the integration and delivery of sustainability within the planning process. This is important as the early intervention ensures sustainability is delivered at minimal cost while achieving the greatest impact.

This precinct is unique within the Sydney context with the site to be redeveloped being located within an established community in the presence of a newly completed hospital and existing Aquatic Centre, as well as a (to be relocated) High School.

There are very few local benchmarks that offer a direct comparison for establishing sustainability pathways for the site. The project should therefore look towards the world's best practice outcomes being achieved within the local marketplace such as Central Park and Barangaroo. Both projects feature high performance buildings, district sustainable utility infrastructure (including energy and recycled water) and significant open spaces, ecology, community infrastructure and connections. These projects were driven by both local and state government establishing high sustainability commitments prior to the commencement of their design.

Figure 5. Exemplar sustainable precincts (Central Park – L, Barangaroo – R)

The Frenchs Forest Planned Precinct (FFPP) has the same opportunity and this plan is intended to enable similar high levels of sustainability commitments as previous examples. This will help the development be recognised as an exemplar and meet the planning objectives of the Greater Sydney Commission.

1.4.Related Studies and References

This report has been prepared as part of a multidisciplinary urban design process and is informed by the findings and studies prepared by the wider team. Key report references and inputs into this report include:

- Frenchs Forest Precinct Urban Design Report and Public Domain Strategy: CHROFI + Architectus
- Frenchs Forest Precinct Employment Strategy: MacroPlanDimasi

- Frenchs Forest Social Infrastructure Needs Study: CRED Consulting
- Frenchs Forest Green Plan: AECOM
- Local Character Statement: Department of Planning, Industry & Environment (DPIE)
- Frenchs Forest Planned Precinct Flooding and Stormwater Assessment: Mott MacDonald
- Frenchs Forest Planned Precinct Utilities Capacity Assessment: Mott MacDonald
- Hospital Precinct Structure Plan: Northern Beaches Council
- North District Plan: Greater Sydney Commission

2. Sustainability Pathways

This section outlines each of the five sustainability pathways proposed for the Frenchs Forest Precinct Plan, broken down into key sustainability strategies. Sustainability benefits and outcomes are described and quantified, where possible, for each strategy and recommendations made as to how best to integrate these strategies into the project. Where more detailed analysis and/or an assessment of feasibility is required, this has been highlighted as the 'next steps'.

The FFPP Sustainability Plan is divided into five Sustainability Pathways focusing on key aspects of the site. Each pathway is then broken down into specific sustainability strategies to enable the objectives of this Plan to be met.

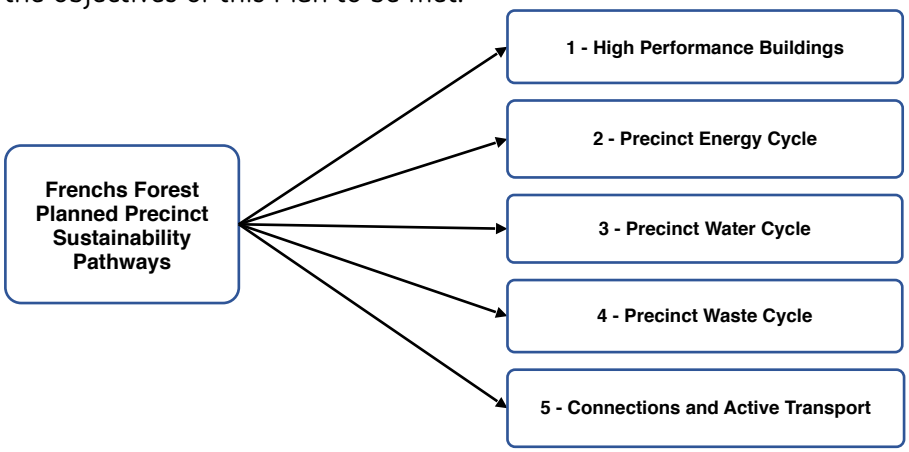


Figure 6. Sustainability Pathways

Where possible, the outcomes of sustainability strategies have been quantified for three incrementally increasing thresholds of sustainability defined as:

- Standard Practice
- Current Best Practice
- Future Best Practice

Standard practice or Business as Usual (BAU) corresponds to minimum market requirements for sustainability (codes and standards). Current best practice improves on aspects of standard practice, for example high performance glazing as opposed to simple clear glass. Future best practice incorporates the sustainability benefits of current best practice and uses technologies such as onsite electrical generation and precinct level infrastructures to harness the precinct's full sustainability potential.

Precinct level infrastructure such as electricity, water and waste has been initially considered for the town centre as this is government-owned land which allows an initial district level

implementation that can be progressively expanded beyond the site as the wider precinct is developed.

For each of the sustainability strategies outlined, recommendations have been made as to how best to incorporate these strategies into the project at the earliest stages of planning to ensure they are embedded in the design. In addition to the Masterplan and development controls, a key mechanism recommended for use in enabling the sustainability strategies to be achieved is the design excellence provisions of any competitive design process that is undertaken for the site. This will allow a clear framework to be provided from which all submissions will be able to demonstrate higher than standard practice sustainability is being proposed.

3. High Performance Buildings

3.1. Objectives

Buildings are the primary consumer of energy within precincts. This pathway has the objective to deliver buildings that represent best practice, achieving high performance outcomes. This will enable reduced carbon emissions and lower operating costs. The performance of the buildings will determine the overall sustainability outcomes of the precinct when in operation and therefore specific consideration is proposed. The precinct should not be constrained by legislated minimum targets that don't contemplate the unique opportunities of a newly developed planned precinct, but rather, seeks to showcase best practice.

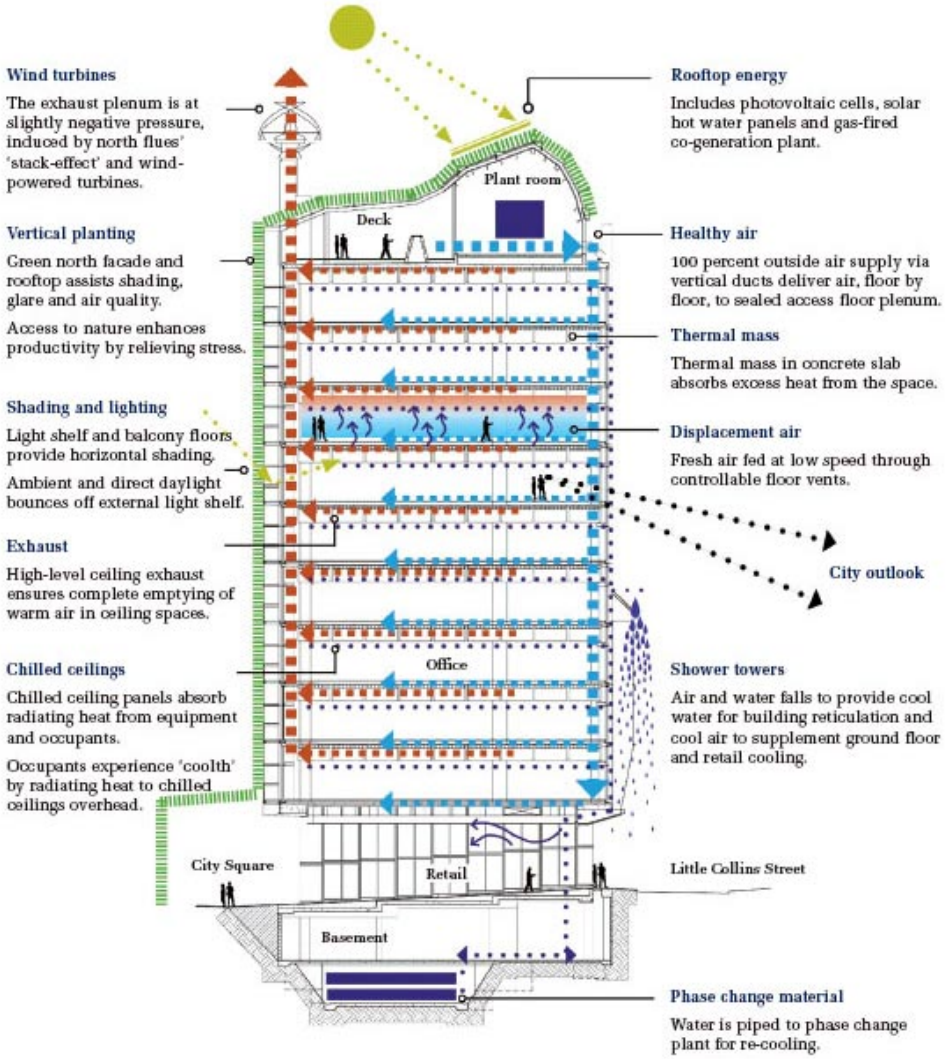


Figure 7. Exemplar high performance building (CH2 Melbourne)

3.2. Benefits

- Improved resilience and future-proofing
- Better comfort and reduced reliance on air-conditioning

- Reduced potable water and energy consumption
- Reduced carbon emissions
- Reduced utility costs leading to improved affordability

3.3.Strategies

The following strategies are proposed in Pathway 1: High Performance Buildings:

1. Best practice emissions and water targets for all buildings:
   - Residential targets: 50% reduction in emissions, 60% reduction in water usage (BASIX)
   - Offices and hotels: 5-star NABERS energy and water
   - All other building uses: 25% reduction in emissions and water use
2. Urban heat island mitigation strategy
3. Natural Ventilation assessment
4. Design Excellence process

3.4. Best Practice Emissions and Water Targets

Residential Targets

Outcomes:

- 50% reduction in residential emissions from NSW average
- 60% reduction in residential potable water usage from NSW average

It is mandatory for new residential buildings to comply with minimum BASIX (Building Sustainability Index) targets which set water and greenhouse gas (CO_2) reduction targets relative to the NSW average benchmark on a per person base. The reduction targets are determined from NSW average residential water, electricity and gas consumption data collected from energy suppliers by the Department of Planning, Industry & Environment (DPIE).

BASIX targets provide minimum legal performance at a statewide level for residential development and are set to be achievable for individual developments. Precinct development provide significant magnification of sustainability performance through scale and available technology and as such the normal BASIX targets are typically below standard practice for these types of development.

In order to ensure the sustainability benefits of a precinct development are achieved increased BASIX targets are proposed in line with the best practice objectives of the Frenchs Forest precinct. These will be implemented through a planning mechanism.

It is anticipated that the increased targets will cost less than $798 per apartment based on costs technology available in 2018. Annual energy savings alone will amount to $232p.a. increasing affordability for residents. Based on current trends the per apartment cost will continue to decrease whilst the annual saving is likely to increase. It is not expected the cost will affect the purchase price of apartments for residents.

In the case of water, the NSW benchmark (BASIX), is expressed in terms of potable water consumption and is equal to 90 kL of water per person per year and that for energy is expressed in terms of residential greenhouse gas emissions and is equal to 3.3 tonnes of CO_2 per person per year. A summary of the analysed scenarios for FFPP included in the following table:

Area	Benchmark	Standard Practice Scenario (Minimum legal requirements)	Current Best Practice Scenario **FFPP Target**
Emissions (kg of CO_2 per person)	3,292	2,140 (-35%)	1,646 (-50%)
Potable Water (litres of water per person)	90,340	54,200 (-40%)	36,136 (-60%)

Figure 8. BASIX emission and water targets for FFPP

The following figures present the predicted emissions and water consumption when the best practice targets are applied to the FFPP site:
Site Emissions - Residential:

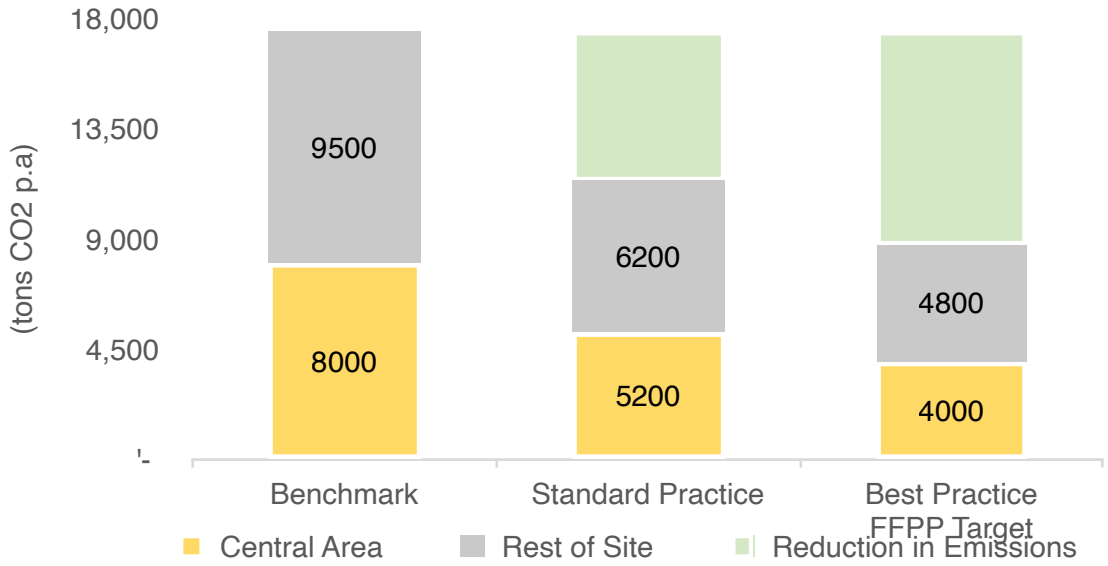


Figure 9. Increased residential targets, emissions

Site Water Usage - Residential:

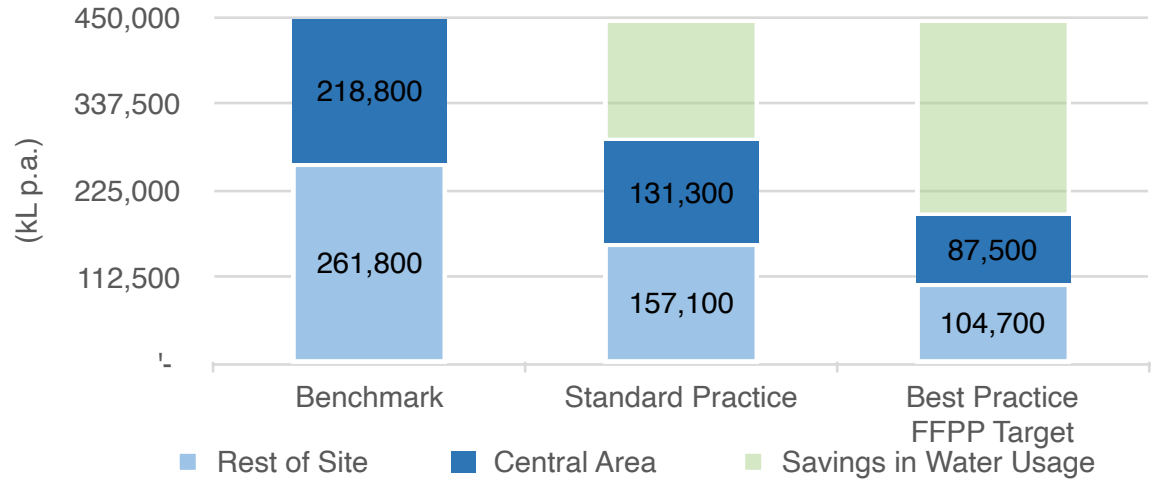


Figure 10. Increased residential targets, water usage

Recommendation:

- Include increased BASIX targets as requirements in design excellence provisions or land sale agreements.

Offices and Hotels -5 Star NABERS

Outcomes:

- 39% reduction in site emissions from standard practice[1]
- 46% reduction in potable water usage from standard practice

All office and hotel spaces must be designed to achieve 5-Star NABERS (National Australian Built Environment Rating System) ratings for energy and water. The following figures illustrate the emissions and water savings associated with achieving the best practice ratings.

Site Emissions – Offices and Hotels:

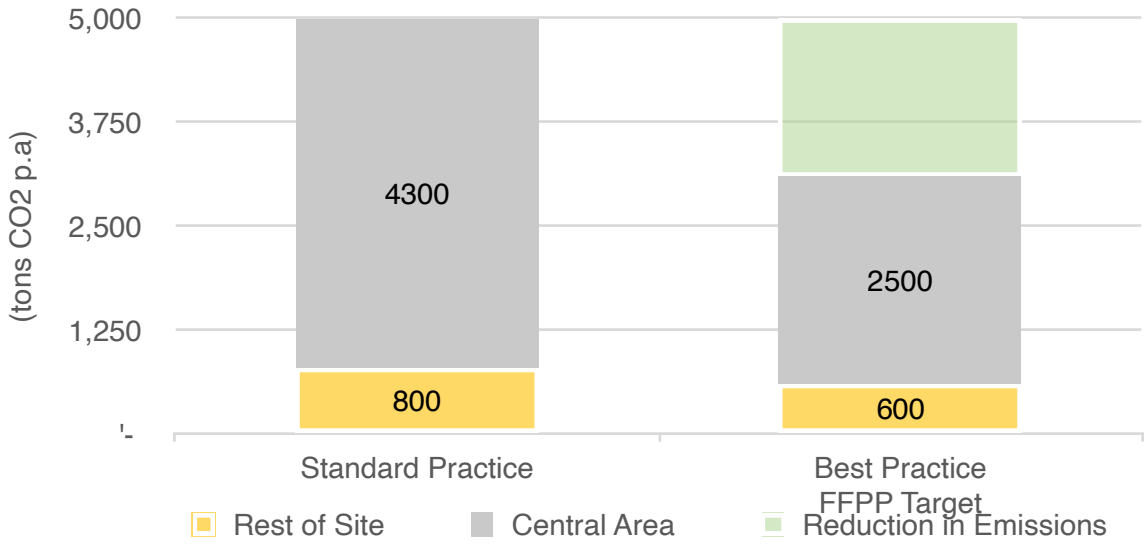


Figure 11. Office and Hotel, emissions

Site Water Usage – Offices and Hotels:

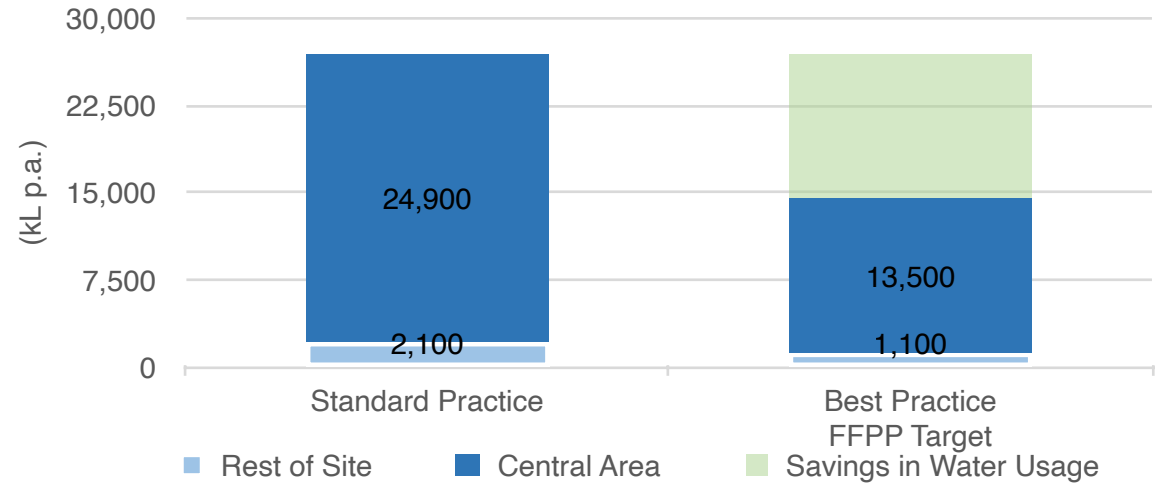


Figure 12. Office and Hotel, water usage

Recommendation:

- Include in DCP requirement for all Offices and Hotels to achieve 5 Star NABERS ratings

[1] Standard practice assumed to be 3 Star NABERS for Hotels and 4 Star NABERS for Offices

All other Buildings - 25% reduction in emissions and water usage

Outcomes:

- 25% reduction in site emissions
- 25% reduction in potable water usage

For all building uses, other than Residential, Offices or Hotels, a minimum of 25% energy reduction from standard practice for emissions and water must be achieved on site.

Site Emissions:

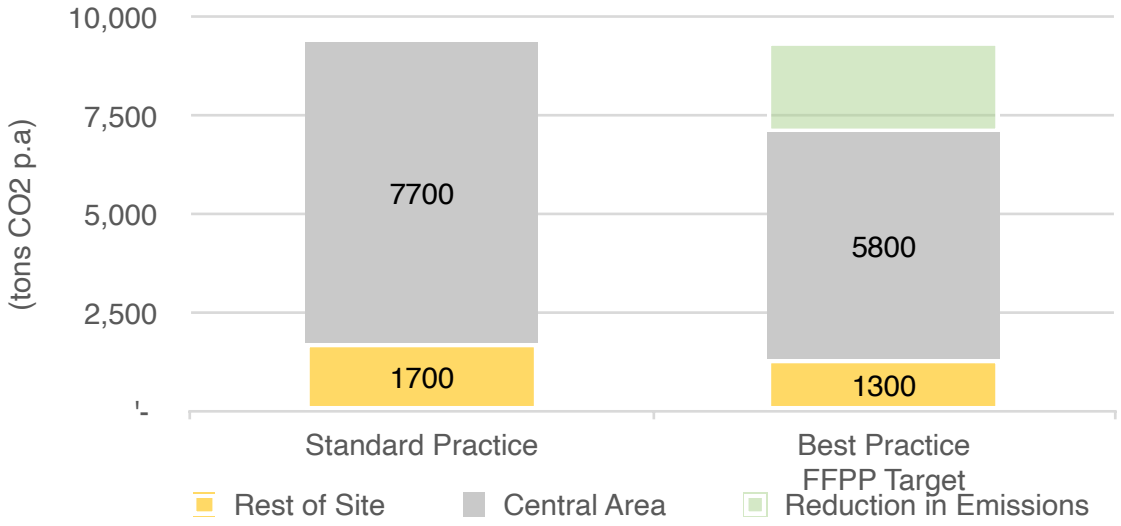


Figure 13. All other buildings, emissions

Site Water Usage:

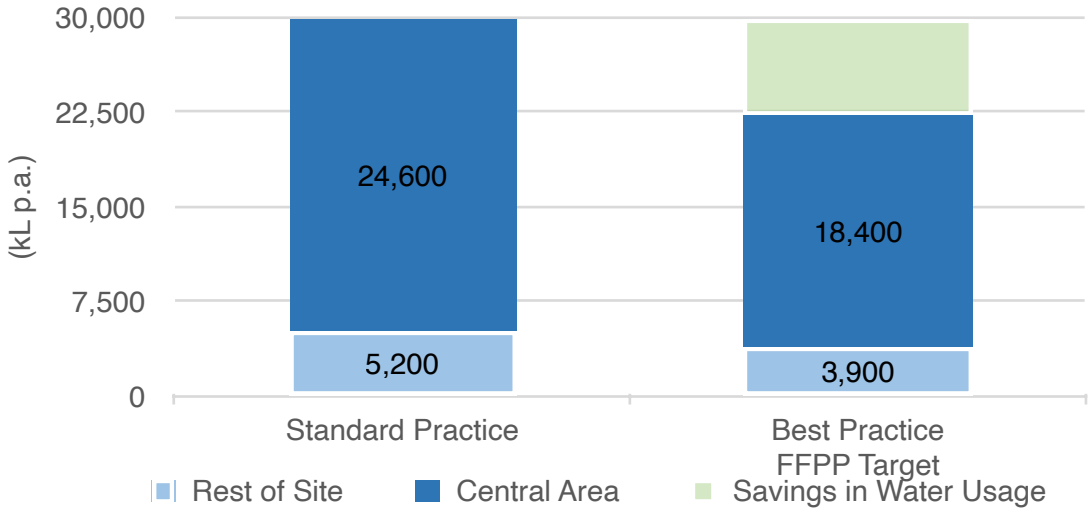


Figure 14. All other buildings, water usage

Recommendation:

- Include a 25% reduction in GHG emissions and potable water use in design excellence provisions or land sale agreement for all building uses other than Residential, Offices or Hotels.

3.5.Urban Heat Island Mitigation

Outcomes:

- Increase in occupant comfort and wellbeing
- Decrease in air-conditioning energy
- Improved air-conditioned performance

Urban Heat Island (UHI) is a significant issue especially when green space is being replaced with built form. The causes of UHI are being increasingly well-understood and there is opportunity to mitigate the impact through building and urban design.

UHI effect is caused by a multitude of factors which occur for that specific micro-climate. Some of these causes are due to the topography of the site, others, the use of the site, and some relate to the naturally occurring climate of the site such as rain and wind which helps to dissipate heat. The various causes of UHI are presented in the figure below:

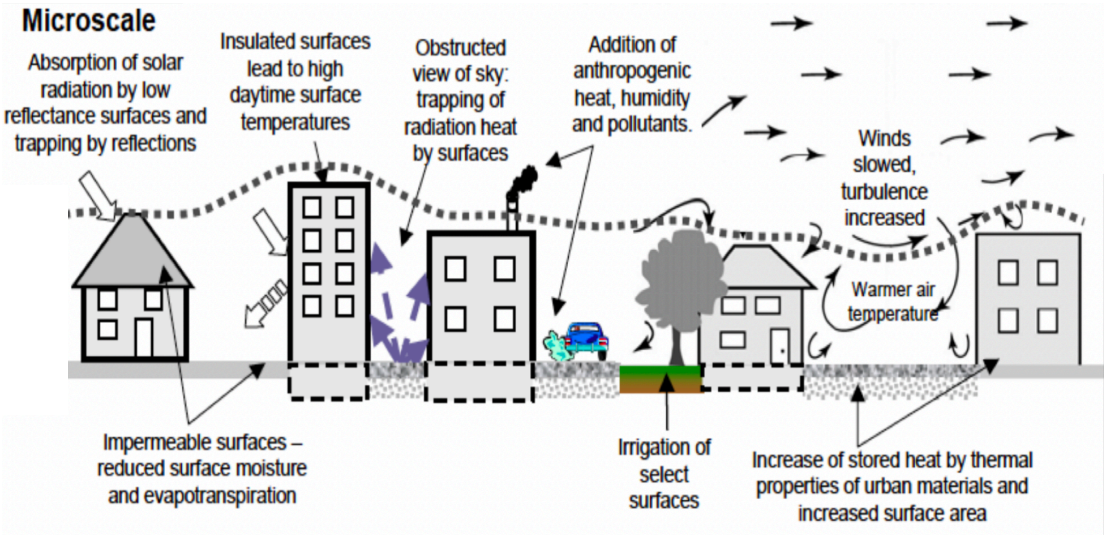


Figure 15. Causes of Urban Heat Island Effect[2]

[2] Voogt J, How Researchers Measure Urban Heat Islands – US EPA https://www.epa.gov/heat-islands/how-researchers-measure-urban-heat-islands visited

The impacts of UHI on people and precinct are:

People Impact	Precinct Impact
Periods of extreme heat can cause heat- related illnesses: - Dehydration - Heat cramps - Heat exhaustion - Heat stroke - Worsening of existing medical conditions.	Extreme heat: - Damages electricity and transport infrastructure - Increases need for air-conditioning which increases cost of living - Increases peak energy demand, driving up infrastructure costs - Increases the risk of power cuts - Increases air pollution - Increased temperature of stormwater run- off impacting aquatic life.

Figure 16. Impacts of UHI

Recommendation:

- UHI management controls should be further investigated and implemented effectively as per Masterplan and DCP requirements. An example of a possible control and its outcome is as shown below:

Figure 17. Example of a UHI control and outcome

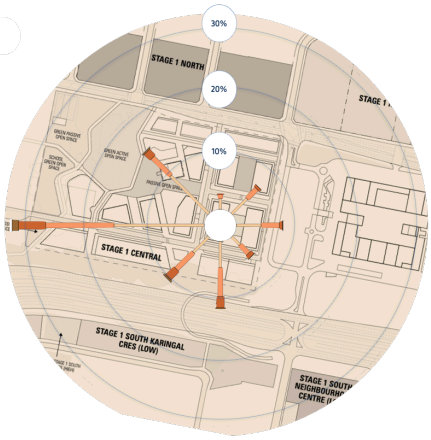
3.6.Natural Ventilation

Outcomes:

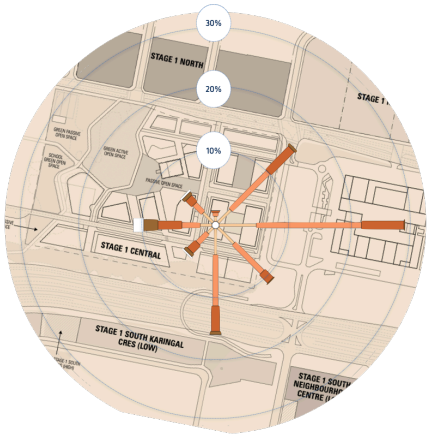
- Increase in occupant well-being
- Reduction in site emissions

The Sydney climate and site elevation makes the effective use of natural ventilation a viable strategy to reduce the use of air-conditioning for cooling while increasing resident well-being.

A summary of average wind conditions onsite, as shown below, further reinforces the increased performance potential for natural ventilation.



Average Annual % of Wind Conditions at 9 am



Average Annual % of Wind Conditions at 3 pm

Figure 18. Average wind conditions Sydney

Monthly average temperatures presented in the next figure also indicate the potential for large-scale use of natural ventilation.

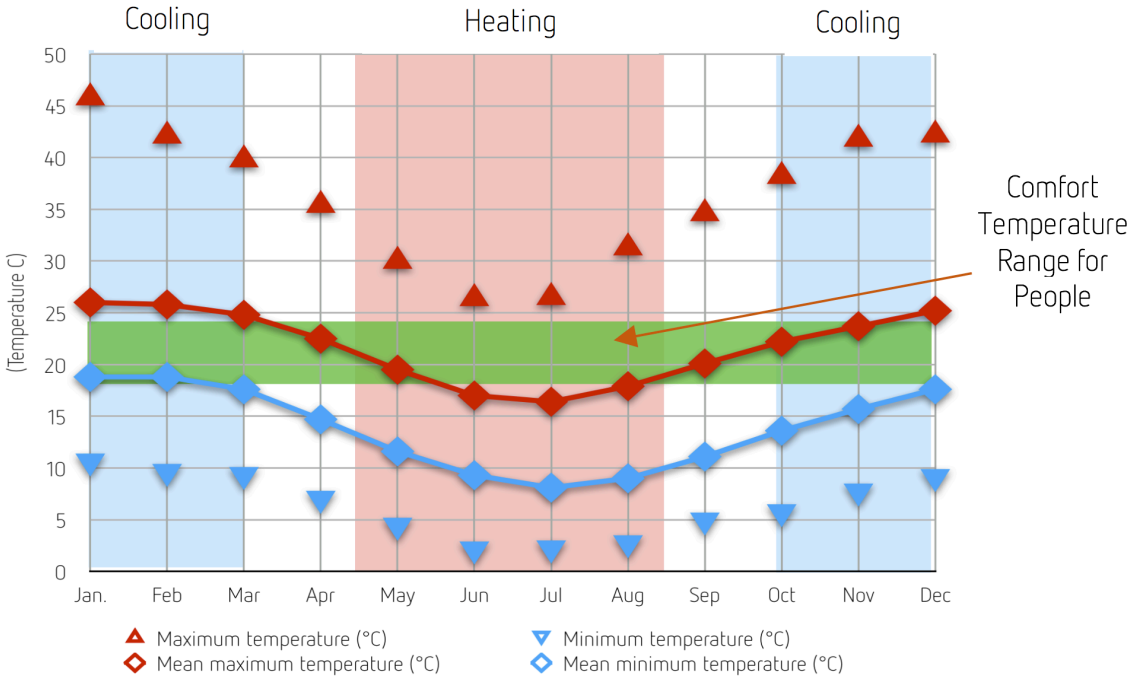


Figure 19 – Temperature profile for Sydney[2]

Natural ventilation opportunities should be maximised as far as possible for all buildings in order to increase occupant well-being and reduce site emissions.

Due to the noise emitted from the major roads that cross the site, it is expected that applications for residential developments will be seeking approval for natural ventilation systems that do not meet the prescriptive requirements of the Apartment Design Guide (ADG). Although the Building Code of Australia defines maximum levels of CO_2 and other indoor pollutants for residential purposes, no calculation method has been defined to verify them.

Recommendation:

- It is recommended that further analysis be carried out to define the requirements and criteria for natural ventilation for buildings in the precinct, to be included in the design excellence provisions.

3.7.Design Excellence incorporating Sustainability Criteria

Outcomes:

- Enable world's best practice sustainability to be achieved.

Considering that a typical building has an effective lifespan of more than 25 years, ensuring that all buildings deliver current and expected future best practice sustainability performance is critical. To achieve this, the design excellence provisions of the competitive design process must go beyond built-form and incorporate sustainability as one of the key criteria in building selection. The minimum starting point for sustainability requirements for applications are included in this plan, raising the bar to be in line with the objectives.

An example of a Design Excellence building is the Solaris in Singapore:

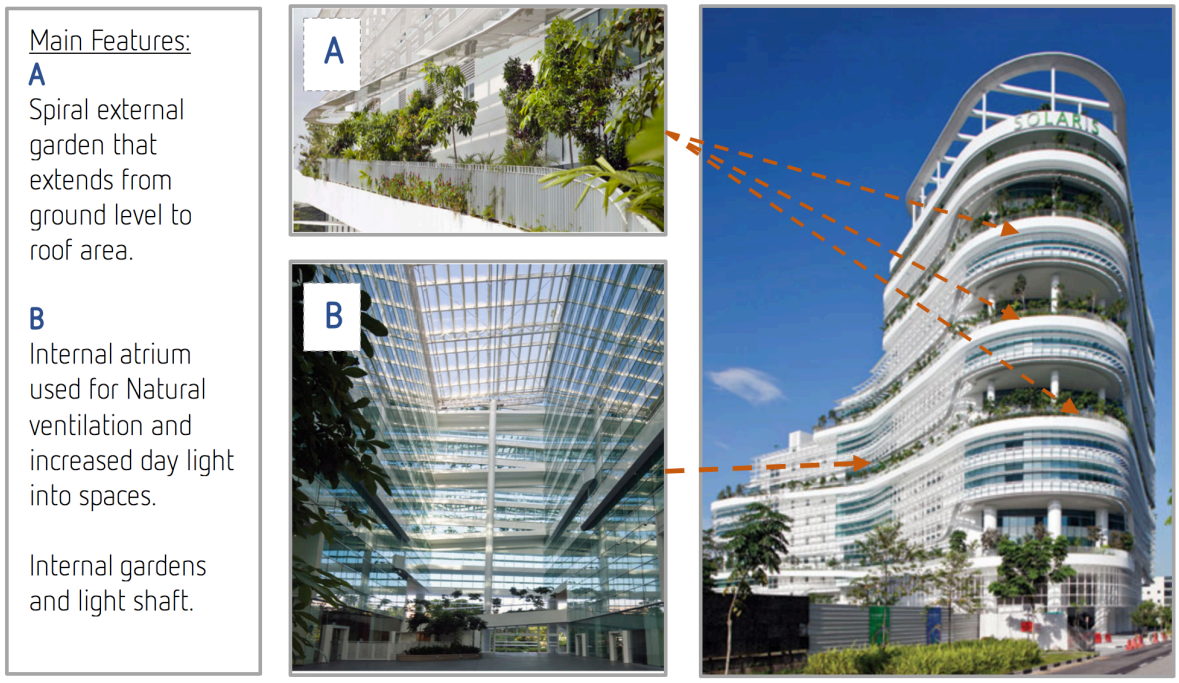


Figure 20. Example a Design Excellence Building[3] – Solaris, Singapore

Recommendation:

- Include requirement in the DCP for the sustainability component in the design excellence process to have at least the same importance as built-form.
- Design excellence provisions to include specific sustainability specifications in line with recommendations from this plan.

[3] Council on Tall Buildings and Urban Habitat

3.8.Summary

Figures 21 and 22, below, illustrate the potential emissions and water savings associated with the implementation of the strategies proposed for Pathway 1.

Emissions:

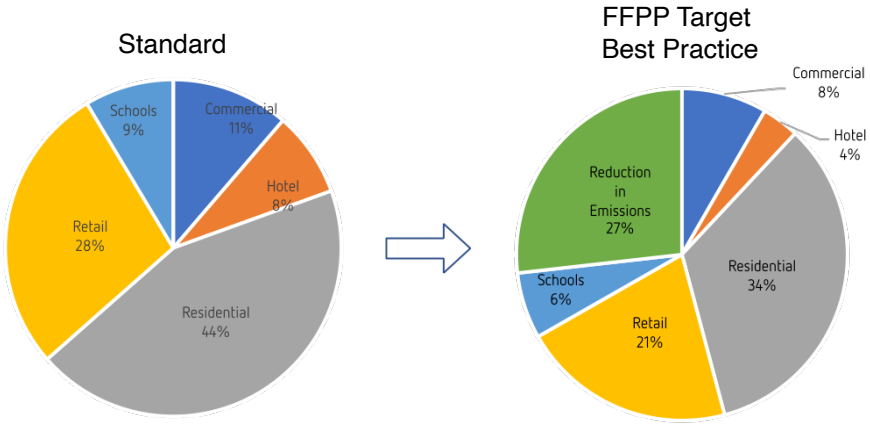


Figure 21. Emissions

Water:

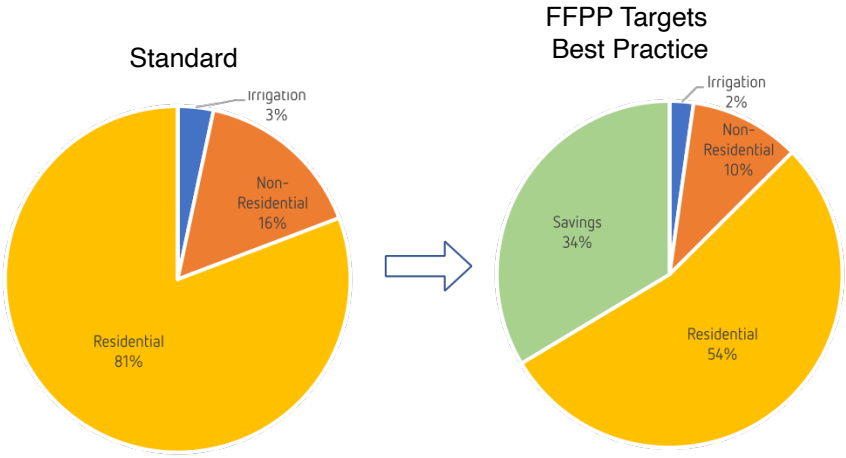


Figure 22. Water Usage

3.9.Next Steps

- Implement sustainability strategies within the Masterplan.
- Investigate and develop DCP controls to drive UHI management and natural ventilation assessment.
- Detail proposed requirements for high performance buildings, that will form part of the design excellence provisions or land sale agreements.

4. Precinct Energy Infrastructure

4.1. Objective

Ensure that the high-performance buildings delivered in the precinct are serviced by equally high performing infrastructure. Capture the benefit diverse usage to steer towards a carbon neutral precinct. As stated in Section 1.2, only the Central Area of the site will be outfitted with precinct level utilities and corresponding infrastructure.

4.2. Benefits

- Future-proofing to enable future onsite energy generation and storage technologies
- Development of a saleable asset to help fund sustainability
- Reduced costs, improved affordability and income stream to fund community sustainability
- Move towards carbon neutral precinct
- Increased resilience
- Increased GFA in buildings

4.3. Strategies

The following strategies are proposed:

1. Onsite production of electricity and central thermal plant
    - Roof top photovoltaics
    - District Thermal Plant
2. Electric vehicle charging
3. Private wire network
4. District Thermal Network

4.4. Roof Top Photovoltaics (PV)

Outcomes:

- 17% reduction in Central area and 12% reduction in total site emissions
- Future-proofing
- Increased resilience

Figure 23. Roof-top PV installation in a community (Freiburg, Germany)

Photovoltaic Panels (PV), a technology that is reaching its maturity, is to be installed on all new buildings. With the incorporation of a private wire network, a substantial solar energy generation system enables the provision of zero-carbon electricity without the premium cost to residents and businesses within the town centre.

The current site yield has a rooftop area that can accommodate a PV with a capacity of 2,000 KW being comprised of 5,500 individual solar panels. The DCP / LEP will mandate requirements that the buildings are to have in order to enable the installation of auxiliary equipment. To enable the storage of electricity for use at night or at peak consumption periods, batteries could be considered. Currently they are not widely used due to cost issues however it is expected that this will change and be more affordable in the near future.

Site emissions:

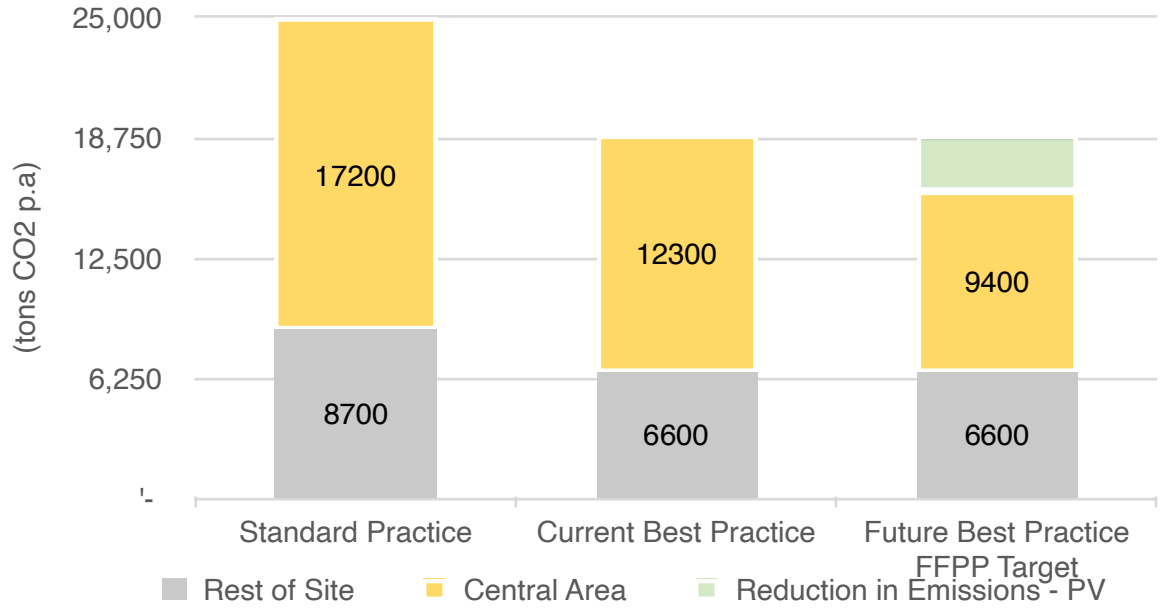


Figure 24. Pathway 2 – Emissions, PV

Recommendation:

- Include in the DCP / LEP, the requirement that all building roofs are to be designed to accommodate PV panels and the building is to be equipped with the necessary infrastructure for its installation, reticulation and operation by a third party.

4.5.District Thermal Plant

Outcomes:

- 8% reduction in Town central area and 5% reduction in total site emissions
- Future-proofing
- Reduction in energy costs for residents
- Increased usable area for residents

A district thermal plant will enable the majority of heating and cooling requirements for the Central precinct to be produced centrally. A district thermal plant produces chilled and hot water respectively for cooling and heating purposes, achieving higher efficiencies than typical split air-conditioning units. Using a central district system will mean that individual dwellings will not need exterior "split" type units making more GFA available for residents. An estimate of 1,500 m^2 in exterior balcony area may be made available to residents with this strategy.

The district thermal plant will use water cooled chillers for chilled water (cooling) and gas fired boilers for hot water (heating) production. In the future, in order to move towards a carbon neutral outcome, consideration may need to be given to the use of high temperature heat pumps in place of gas fired boilers however this is not considered feasible at this point of time.

Site Emissions:

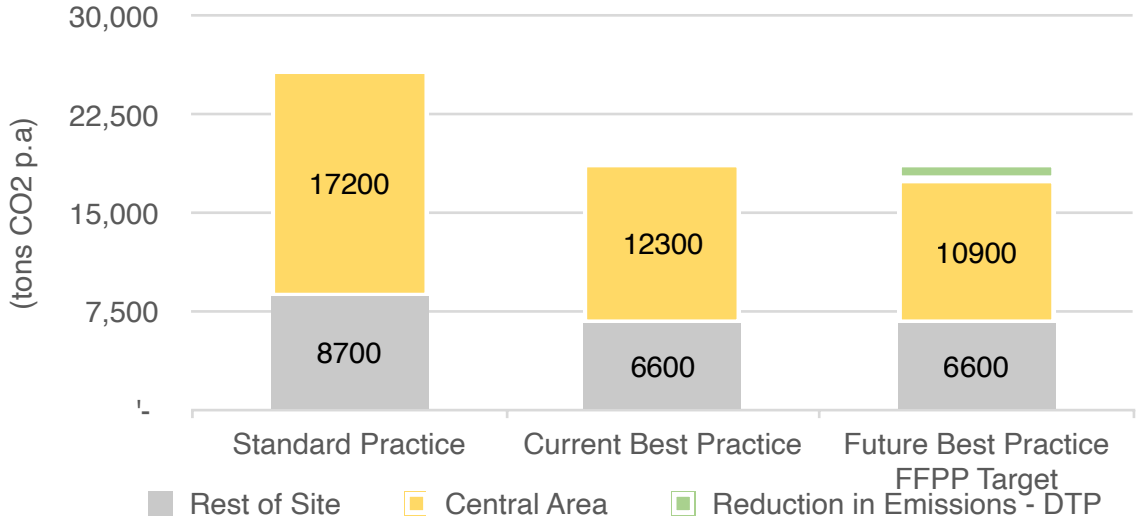


Figure 25. Pathway 2 – Emissions, DTP

Recommendation:

- Include in the design excellence process or land sale agreement a requirement for the installation of the district thermal plant.
- A location should be established within the current masterplan and the requirement to provide space scheduled within the land sale agreement.

4.6.Electric Vehicle Charging

Outcomes:

- Future-proofing_

According to the Australian Electric Vehicle (EV) Market Study[4], annual sales are set to rise steadily and expected to reach 100% of all motor vehicle sales between 2036 and 2046, making charging availability for electric car or bicycles an essential future-proofing initiative. A portion of public car and bike parking's will also be provided with charge points (Type 2).

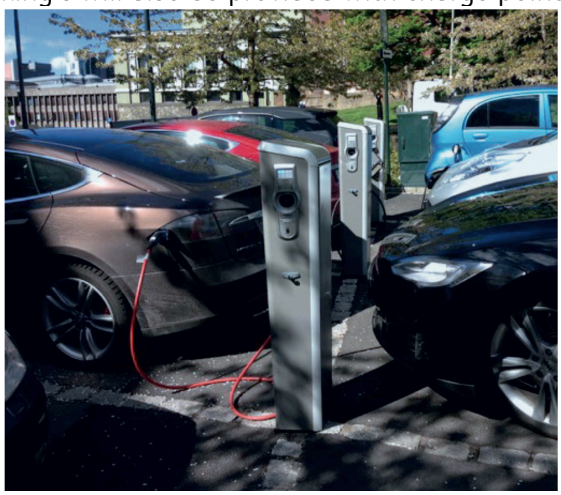


Figure 26. EV Public charging station Norway[5]

Recommendation:

- Individual Buildings – Incorporate DCP requirements to provide a 15A power point to allow for the installation of EV chargers.
- Central Precinct - on street EV charging points to be installed.

[4] Australian Electric Vehicle Market Study – May 2018

[5] Zero Carbon Australia – Electric Vehicles

4.7.Private Wire Network (PWN)

Outcomes:

- Increased resilience
- Reduced costs
- Future-proofing

A private wire network involves providing a connection to the High Voltage (HV) grid and then placing the wires within the site under private ownership. The private wire network model within individual building is becoming common practice with individual buildings in NSW and precinct level systems have been implemented at major developments such as Barangaroo and Central Park.

It incentivises low carbon electricity site generation and is therefore an important facilitator to delivering a high-performance sustainable precinct. Soft infrastructure options, including RECs generation as well as the resale of electricity to other private wire network customers, could be also be accommodated by the private wire network.

By delivering the PV in conjunction with a private wire network in the Central area of the development, a reduction in utility costs for building users in this area and an increase in precinct resilience will be achieved. In the near future, it would also enable battery systems to operate and potentially further reducing utility bills and dependency on the electrical grid.

The design of a private wire network is generally identical to a conventional electrical network delivered by an incumbent utility with the exception that it is privately owned. The private wire would increase resilience within the precinct and enable onsite storage and electric car charge stations installation to be fed by PV as well as other onsite electricity generation technologies. Examples of emerging local renewable energy production technologies are fuel cells which are to be distributed within the precinct, reducing environmental impacts and reliance on the electricity grid.

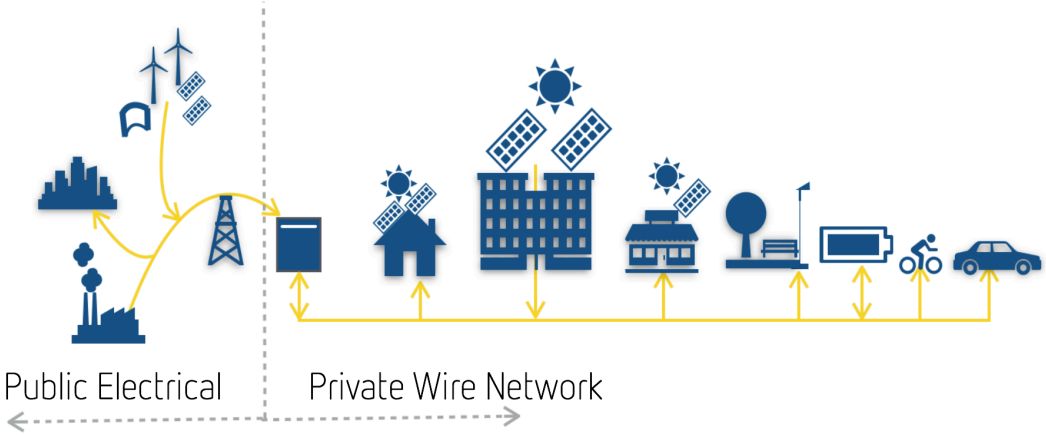


Figure 27. Diagram of a PWN

Recommendation:

- Individual Buildings - Incorporate DCP requirements for all buildings to be connected to the private wire network
- Central Precinct - Masterplan to provide space to accommodate a private wire network
- Masterplan to allow for potential connection of other areas of Phase 1 or additional development within subsequent phases.

4.8.District Thermal Network

Outcomes:

- Reduced utility costs for residents
- Future-proofing_

A District thermal network will enable the delivery of chilled and heated water, produced at the district thermal plant, to buildings to be used for cooling and heating.

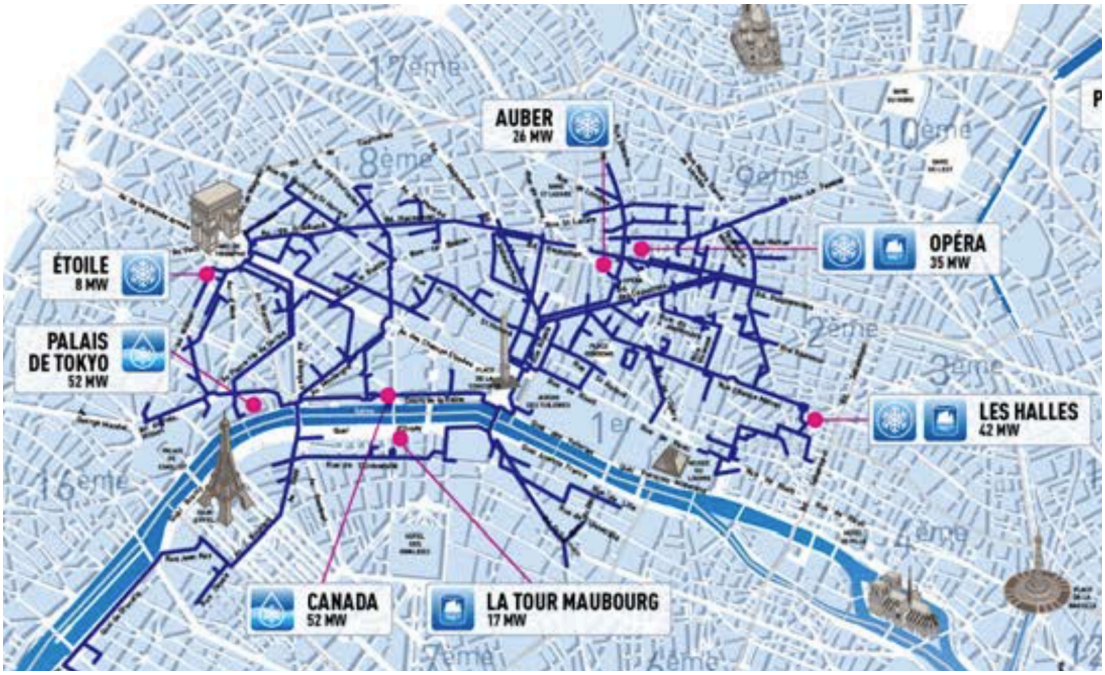


Figure 28. District thermal network diagram – Paris[6] (District Network is purple lines)

Recommendation:

- Individual Buildings - Incorporate DCP requirements for all buildings to be equipped and connected to the district thermal network
- Central Precinct - Masterplan to provide space to accommodate district thermal network
- Masterplan to allow for potential connection of other areas of Phase 1 or additional development within subsequent phases.

[6] United Nations Environment Program - District Energy in Cities Paris Case Study

4.9.Summary

Figure 29 compares the emissions of a standard practice solution with the emissions predicted from the implementation of Pathway 2 – onsite production of electricity and central thermal plant. The 25% reduction in emissions from the Central Area equates to a 17% reduction in emissions across the entire site.

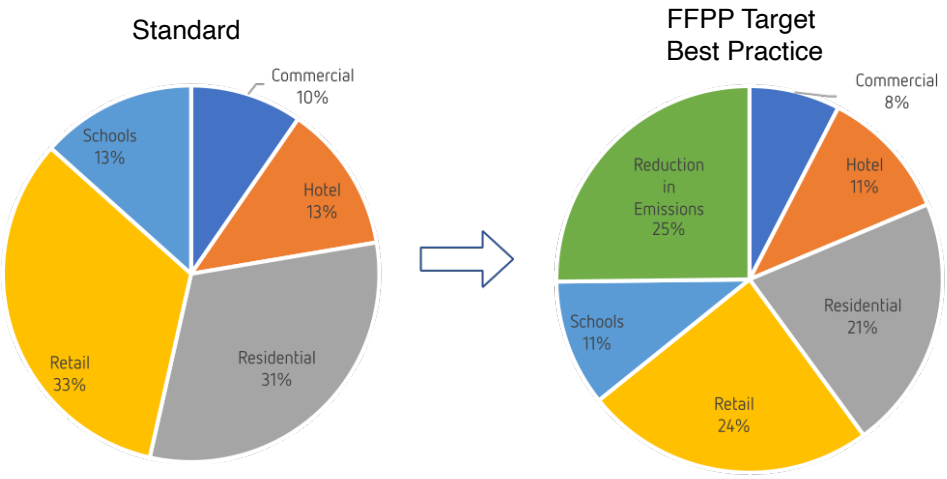


Figure 29. Pathway 2 - Emissions – Central area

4.10.Next Steps

- Conduct a detailed feasibility study on sustainable utility infrastructure elements and procurement strategies
- Investigate and develop planning controls for solar generation, private wire network, electric vehicle charging, thermal district plant and thermal network.

5. Precinct Water Infrastructure

5.1. Objective

Reduce reliance on the water utility network and discharge of wastewater into the ocean. Work towards minimising use of potable water and ultimately enable a Water Positive Outcome by exporting more recycled water than potable water imported into the site.

5.2. Benefits

- Improved resilience
- Improved affordability
- Future-proofing
- Low cost irrigation of playing fields
- Reduced waste discharge to sewer and ocean outfalls
- Reduced use of potable water

5.3. Strategies

The following strategies are proposed:

1. Purple Pipe Network (PPN)
2. Private Sewer Network (PSN)
3. Recycled Water use and increased rain-water collection
    - Recycled water plant (RWP)
    - Increase in rain-water collection
4. Water Sensitive Urban Design (WSUD)

5.4.Purple Pipe Network (PPN)

Outcomes:

- Improved resilience
- Future-proofing
- Reduced potable water use

A purple pipe network delivers recycled water to buildings for non-potable uses such as toilet flushing, wash-down, washing machines and irrigation. The purple pipe network is an essential future-proofing initiative at this stage for the precinct and buildings as it is extremely difficult and costly to retrofit. The purple pipe network could be supplied by either rainwater or recycled water and topped up by conventional water sources.

Recommendations:

- Individual Buildings – DCP to include developer obligation to fit purple pipe network for all buildings.
- Central Precinct Level – Public domain to be fitted with purple pipe network.

5.5.Private Sewer Network (PSN)

Outcomes:

- Improved resilience
- Future-proofing
- Reduced waste discharge to sewer and ocean outfalls

A private sewer network delivers sewage and waste water to the recycled water plant (see diagram below), for treatment, and also enables the discharge of the by-products of the recycled water plant to conventional sewer main as trade waste.

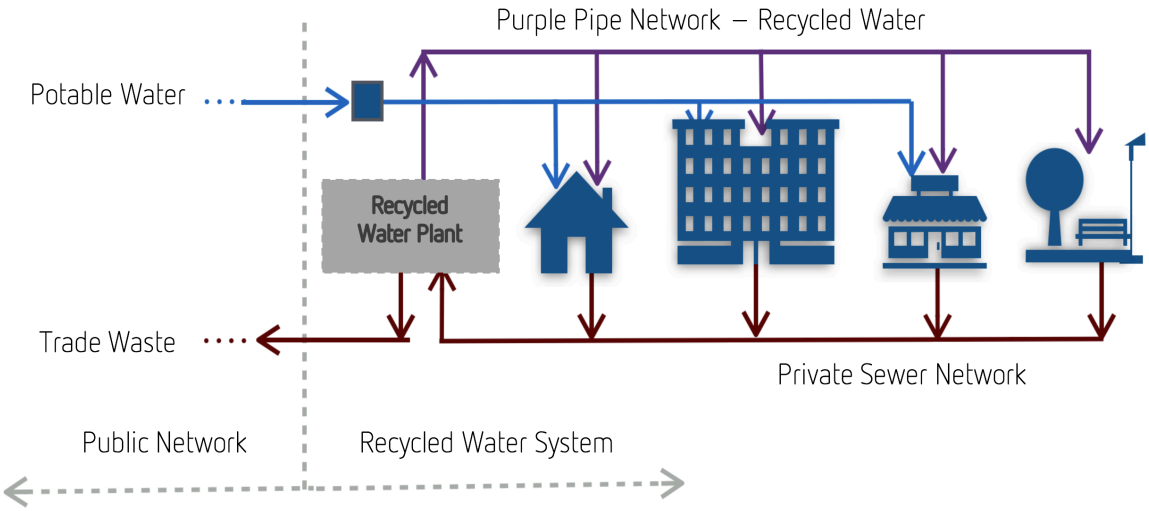


Figure 30. Diagram of recycled water system

Recommendations:

- Individual Buildings - DCP to include developer obligation to fit a private sewer network for all buildings
- Central Precinct - Masterplan to provide space to accommodate private sewer network
- Masterplan to allow for potential connection of other areas of Phase 1 or additional development within subsequent phases.

5.6.Recycled water use and increased rain-water collection

Recycled water plant
Outcomes:

- Improved resilience
- Improved water affordability
- Reduced potable water use
- Reduced waste discharge to sewer and ocean outfalls

A district recycled water plant captures and treats the blackwater in the precinct, producing recycled water that can be used for non-potable purposes such as toilet flushing, wash-down, washing machines and irrigation. Recycled water plants have been installed in many of the new precinct developments in Sydney including Barangaroo and Central Park.

The recycled water produced will undergo a bioreactor process, followed by a reverse osmosis process and a UV disinfection process. The following diagram represents a typical recycled water system:

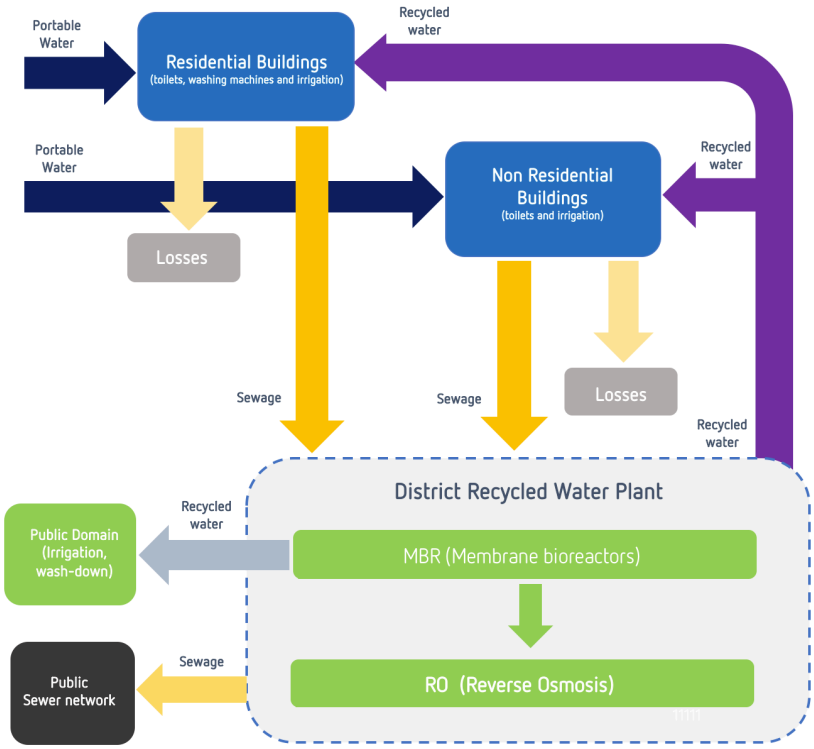


Figure 31. Diagram of a Recycled Water System

The recycled water system can be delivered as a viable business that could be run either by Council, or by a third party operator. The recycled water plants at Barangaroo and Central Park were both delivered using this model.

To ensure buildings are ready for recycled water, all buildings are required to be equipped with non-potable/purple pipes (in line with the LEP/DCP resilience requirements.).

The recycled water plant and networks will be delivered in parallel to the delivery of buildings. A modular design will be planned in line with increasing loads on the network.

Water Usage:

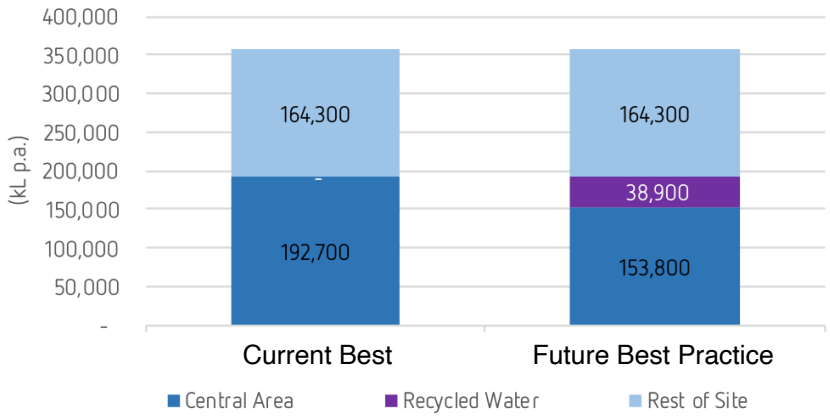


Figure 32. Pathway 3 – Water usage

Recommendation:

- Include in the design excellence or land sale agreement the requirement to provide space for the installation of the district recycled water plant.
- A location should be identified within the current masterplan and the requirement to provide space scheduled within the land sale agreement.

<u>Increased Rain-water collection</u>

Outcomes:

- Improved resilience
- Future-proofing
- Reduced potable water use

Increase rain-water harvesting compared to standard practice to supplement the recycled water supply and be used for irrigation.

Recommendation:

- Include increased rain-water harvesting targets as a requirement in design excellence provisions or land sale agreement.

5.7.Water Sensitive Urban Design (WSUD)

Outcomes:

- Reduction in stormwater runoff
- Enhanced water quality in downstream runoff areas

The Frenchs Forest Planned Precinct is at the top of the watershed and therefore is the first possible opportunity to ensure downstream waterways are protected. Water Sensitive Urban Design uses the natural landscape to reduce and passively treat stormwater runoff. Examples of components used in WSUD are retention ponds, filtration and bio-swales to reduce and treat stormwater. This shall be implemented within the public domain strategy and masterplan.

Stormwater emissions from the precinct will meet the following targets:

- Gross pollutants: 90% reduction
- Total suspended solids: 85% reduction
- Total phosphorus: 65% reduction
- Total nitrogen: 45% reduction
- 75% of all stormwater harvested on site and no increase in peak flow from the pre-development in a 1 year ARI event.

Recommendation:

- Masterplan to contain WSUD features
- Include WSUD requirements in the design excellence provisions or land sale agreement

5.8.Summary

The following figure compares the potable water usage of standard practice to Pathway 3 - recycled water use and increased rain-water collection for the Central area. The 22% reduction in potable water usage within the central area equates to a 12% saving in potable water usage across the entire site.

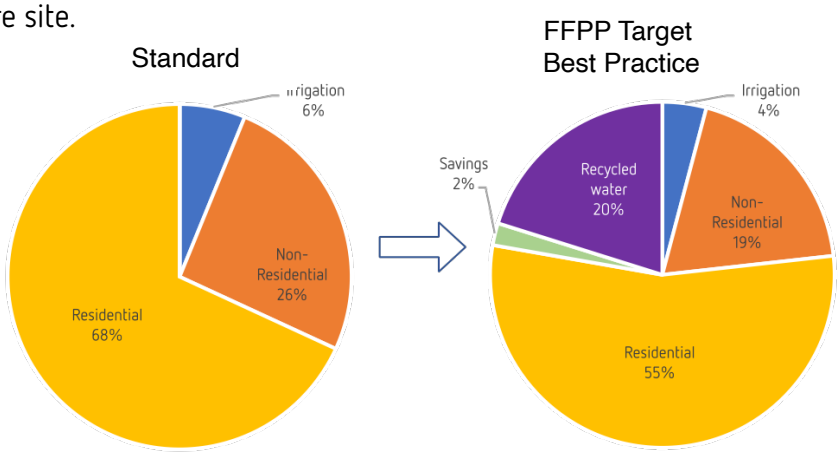


Figure 33. Pathway 3 – Water usage – Central area

5.9.Next Steps

- Conduct a detailed feasibility study on sustainable utility infrastructure elements and procurement strategies
- Incorporate future-proofing requirements of the purple pipe installation within DCP to be delivered by developers during the construction of each building.
- Investigate option of including the development of a district water treatment plant as a bidder requirement in the land sale process for the existing school site.

6. Precinct Waste Infrastructure

6.1. Objectives

Enable a reduction in waste being sent to landfills and provide the necessary infrastructure to enable a zero-waste outcome in the future.

6.2. Benefits

- Improved waste management procedures including better source separation
- Organic waste capture
- Reduced collection vehicle movements on site
- Reduced waste management costs
- Reduce emissions

6.3. Strategies

The following strategies are proposed:

1. Provision of a smart waste chute within buildings
2. Provision of a centralised waste collection facility
3. Electricity Production from on-site organic collection

6.4. Smart waste chute within buildings

Outcomes:

- Better source separation
- Reduced special requirements in buildings

A smart chute system only requires a single chute while still enabling separation of waste to the corresponding bin by means of a mechanical system located at the bin storage room.

Recommendation:

- Include in the DCP the requirement for a smart waste chute system

6.5.Provision of a centralised waste collection facility

Outcomes:

- Reduce heavy vehicles circulating in the precinct
- Reduce cost for end user

Provide a centralised waste collection facility to remove/reduce the circulation of collection vehicles in the public domain. Consideration could also be given to a vacuum waste installation in which the waste is transported by creating an air vacuum effect in pipes from the buildings to the central collection facility.

Recommendation:

- Size and location of centralised waste collection facility shall be identified through the masterplan process and delivery would be part of the land sale agreement.

6.6.Electricity Production from on-site organic waste

Outcomes:

- Reduce organic waste being sent to landfill
- Reduction in emissions by producing electricity

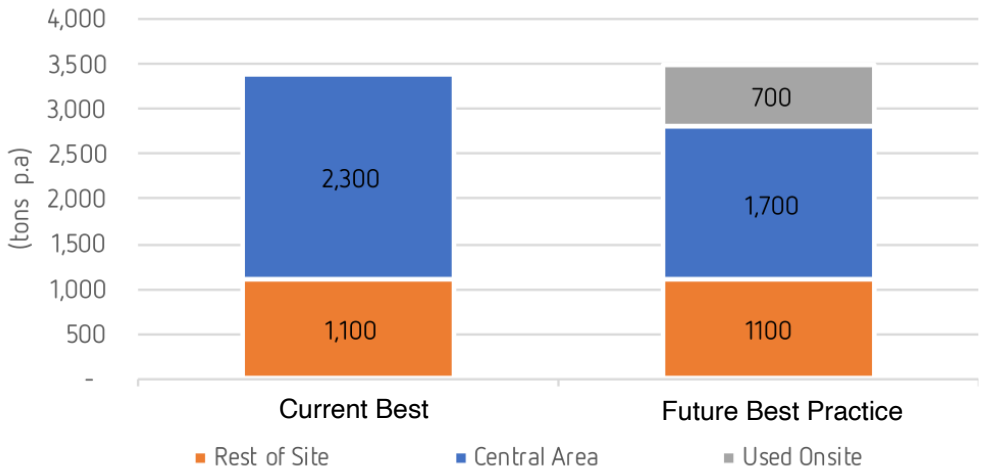


Figure 34. Pathway 4 – Waste Reduction on Site

A bio-reactor (anaerobic digester) uses organic matter, normally leftovers and kitchen waste, and through anaerobic processes produces bio-gas which is then used in a conventional generator to produce electricity. The by-products of this process are electricity and fertilizer.

The reduction in emissions expected from the production of electricity are presented in the following figure.

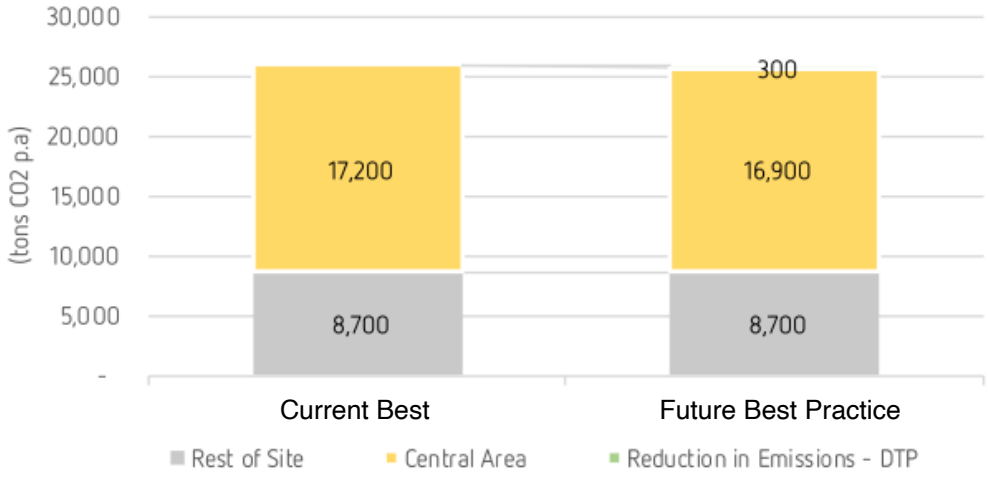


Figure 35. Pathway 4 – Emissions Reduction

Recommendation:

- Include in the design excellence or land sale agreement the requirement to provide space for an anaerobic digester.

6.7.Summary

The following compares the percentage of waste generated on site and sent to land fill of a standard practice solution to that of Pathway 4 - Electricity Production from on-site organic waste. A 29% reduction in waste sent to land fill from the town centre site is achievable corresponding to 19% for the whole site.

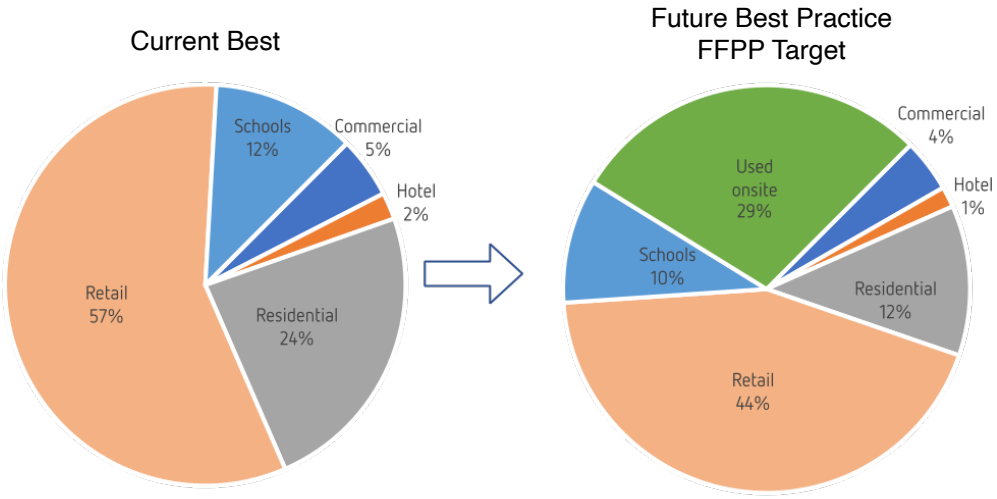


Figure 36. Pathway 4 - Waste – Central area

6.8.Next Steps

- Identify necessary planning controls and space allocations within the masterplan.
- Investigate emerging vacuum waste technologies and their feasibility
- Investigate feasibility of waste to energy

7. Connections and Active Transport

7.1. Objective

Ensure the new town centre provides connections to the surrounding community and provides ecological corridors for wildlife to prevent the site being cut off by main roads. Ensure a clear and strong connection between the town centre, hospital and recreation and education precincts.

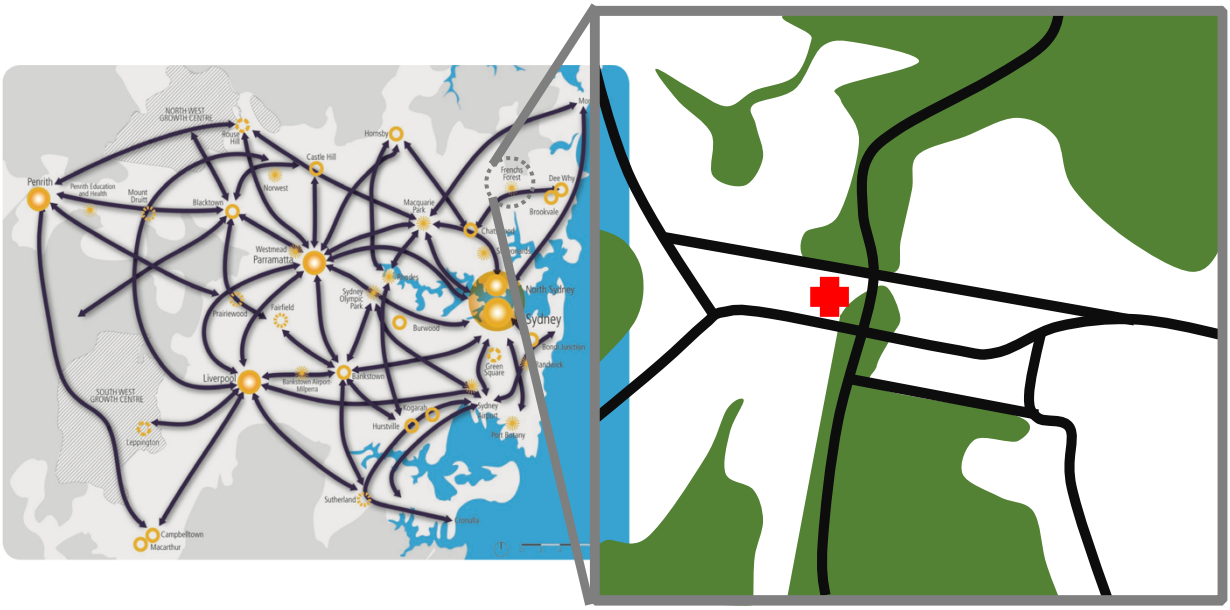


Figure 1. Current green corridors and major roads surrounding the site

7.2. Benefits

- Safety, especially for children and elderly who do not drive.
- Reduced car usage
- Increased community utilisation and custodianship
- Breakout/recreation opportunities for staff employed within the town centre, hospital and recreation and education precincts.
- Healthier community and ecology
- Passive wildlife and pest management

7.3. Strategies

The following strategies are proposed:

1. Integrated bicycle parking
2. Dedicated active transport connections
3. On street cycle and pedestrian paths
4. Off-street parking for visitors and deliveries
5. Green corridor within the site

7.4. Integrated bicycle parking

Outcomes:

- Reduced car usage
- Increased bus use
- Active, healthy lifestyles are incentivised

All bus-stop for major commute destinations will be required to have dedicated bicycle parking to incentivises the use of public transport over cars.

Recommendation:

- Masterplan to include integrated bicycle parking

7.5. Dedicated active transport connections

Outcomes:

- Increased bus use
- Active, healthy lifestyles are incentivised

Provide a connection for active transport between the Recreation/Education precinct and the Town Centre (and similarly to the primary school to the West of the Town Centre).

Recommendation:

- Masterplan to include integrated bicycle parking

7.6. On-street cycle and pedestrian paths

Outcomes:

- Reduce in car usage
- Active, healthy lifestyles are Incentivised

On-street dedicated cycle and pedestrian paths within the site will incentivise the use of active transports. It is recommended that the paths should be uninterrupted all across areas of the site especially across busy roads.

Recommendation:

- Include in the Master plan on street cycle and bicycle parking.

7.7. Off-street parking for visitors and deliveries

Outcomes:

- Increased community utilisation

Create off-street parking for visitor and deliveries.

Recommendation:

- Include in the Master plan off-street parking.

7.8. Green corridor within the site

Outcomes:

- Passive wildlife and pest management

Provide a green corridor within the site.

Recommendation:

- Include in the Master plan.

7.9. Next Steps

- Investigate the outcomes of extending the northern corridor through the central area of the site.

8. Delivering World's Best Practice

8.1. Objective

Ensure the project delivers a holistic sustainability outcome in line with Worlds Best Practice, including the pathways identified within this report and ensure the future developer is bound to deliver.

8.2. Requirements

Delivery requirements and mechanisms

I. Precinct Plan	II. Planning Instruments (LEP/DCP)	III. Land Sale process/ Covenants
A. Plans 1. Community Program Management Plan 2. Interpretation Plan **B. Amenities/Space allocations/ Connections** 1. Sustainability Education facilities 2. Community facilities 3. Accessibility to open area (eg local park) and public sports facilities for all habitable buildings 4. Walkable access to diverse amenities for all habitable buildings 5. Accessibility to fresh food source 6. Accessibility to a productive landscape	**A. Plans to be required to be provided with every planning application** 1. Stakeholder Strategy 2. Climate Adaptation Plan 3. Community Resilience plan 4. Community Facilities Plan 5. Community Users' Guide 6. Environmental Management Plan 7. Active Lifestyle Strategy 8. Planning tool for healthy places 9. Community Development Plan 10. Community Culture Plan 11. Crime Risk Assessment 12. Residential Affordability Strategy Plan 13. Water Sensitive Urban Design 14. Site contamination investigation 15. Biodiversity Management Plan 16. Waste Management Plan **B. Specific Requirements** 1. Designs to be in independently reviewed 2. Pedestrian facilities 3. Onsite power generation 4. Stormwater and potable water reduction 5. ≥25% parking lots for shared/pool/common user 6. Heat island effect mitigation 7. >95% of all external public lighting luminaires to have an upward light output ratio of ≤5%	**A. Tender Requirements** 1. Corporate Responsibility Policy 2. Annual Sustainability Reporting 3. Community Events Plan 4. Community Information and dissemination plan **B. Developer Responsibility** 1. Stakeholder Strategy Plan 2. NBN connection to all habitable buildings 3. Public Wi-Fi **C. Land Covenants** 1. Min of 5-star Green Star rating for all buildings 2. Min NatHERS 7-stars for all residential spaces 3. Min reduction of ≥69% GHG emissions

Figure 2. Sustainability elements grouped into their recommended development mechanism

9. Conclusion

The following tables contain the strategies and recommendations of this Sustainability Plan. Cells coloured green have had their impacts assessed later in this section.

Pathway 1	Strategies:	Recommendations:
High Performanc e Buildings	1. Best practice carbon (emissions) and water targets for all buildings	– Include increased BASIX targets as requirements in Design excellence process or land sale agreements. – Include in DCP requirement for all Offices and Hotels to achieve 5 Star NABERS rating. – Include a 25% reduction in GHG emissions and potable water use in Design excellence process or Land Sale agreement for all building uses other than Residential, Offices or Hotels
	2. Urban heat island mitigation strategy	– UHI management controls should be further investigated and implemented effectively as per Masterplan and DCP requirements.
	3. Natural Ventilation	– Include in the Design Excellence process, a requirement for all residential buildings with noise affected façades to incorporate a natural ventilation analyses as part of its DA submission. It is recommended that further review be carried out to establish the requirements and criteria prior to its integration into the Design Excellence requirements.
	4. Design Excellence process	– Include requirements in the DCP for sustainability within the design excellence process to have at equal priority to built form. – Design Excellence process to include specific sustainability specifications in line with recommendations from this plan.
	Next Steps: – Implement sustainability strategies within the Public Domain Strategy and Masterplan. – Investigate and develop DCP controls to drive UHI management and natural ventilation assessment. – Detail proposed requirements for high performance buildings, that will be part of the Design Excellence process or land sale agreements.	

Figure 3. Pathway 1 – High performance buildings

Pathway 2	Strategies:	Recommendations:
	1. Onsite production of electricity, centralized heating and cooling Production	– Include in the DCP / LEP, the requirement that all building roofs are to be designed to accommodate PV panels and the building is to be equipped with the necessary infrastructure for its installation, reticulation and operation by a third party. – Include in the design excellence process or land sale agreement a requirement for the installation of the district thermal plant. – A location should be established within the current masterplan and the requirement to provide space scheduled within the land sale agreement.
	2. Electric vehicle charging	– Individual Buildings – Incorporate DCP requirements to provide a 15A power point to allow for the installation of EV chargers. – Central Precinct - on street charging points to be installed.

Precinct Energy Cycle	3. Private wire network	– Individual Buildings – Incorporate DCP requirements for all buildings to be connected to the private wire network – Central Precinct – Masterplan to provide space to accommodate private wire network – Masterplan to allow for potential connection of other areas of Phase 1 or additional development within subsequent phases.
	4. District Thermal Network	– Individual Buildings – Incorporate DCP requirements for all buildings to be equipped and connected to the district thermal network – Central Precinct – Masterplan to provide space to accommodate district thermal network – Masterplan to allow for potential connection of other areas of Phase 1 or additional development within subsequent phases.
	Next Steps: – Conduct a detailed feasibility study on sustainable utility infrastructure elements and procurement strategies – Investigate and develop DCP controls for PV, private wire network, EV charging, thermal district plant, thermal network and EV Charging. – Investigate the potential of installing batteries at a precinct level.	

Figure 4. Pathway 2 – Precinct water cycle summary

Pathway 3	Strategies:	Recommendations:
Precinct Water Cycle	1. Purple Pipe Network (PPN)	– Individual Buildings – DCP to include developer obligation to fit a private sewer network for all buildings – Central Precinct – public domain to also be fitted with private sewer network where relevant
	2. Private Sewer Network (PSN)	– Individual Buildings – DCP to include developer obligation to fit a private sewer network for all buildings – Central Precinct – Masterplan to provide space to accommodate private sewer network – Masterplan to allow for potential connection of other areas of Phase 1 or additional development within subsequent phases.
	3. Recycled Water use and increased rain-water collection	– Include in the design excellence or land sale agreement the requirement to provide space for the installation of the district recycled water plant. – A location should be established within the current masterplan and the requirement to provide space scheduled within the land sale agreement. – Include increased rain-water harvesting targets as a requirement in Design excellence process or Land Sale agreement.
	4. Water Sensitive Urban Design (WSUD)	– Masterplan to contain WSUD features – Include in the design excellence or land sale agreement WSUD requirements.
	Next Steps: – Conduct a detailed feasibility study on sustainable utility infrastructure elements and procurement strategies – Incorporate future-proofing requirements of the purple pipe installation within DCP to be delivered by developers during the construction of each building. – Investigate option of including the development of a district water treatment plant as a bidder requirement in the land sale process for the existing school site.	

Figure 5. Pathway 4 – Precinct water cycle summary

Pathway 4	Strategies:	Recommendations:
Precinct Waste Cycle	1. Provision of a smart waste chute within buildings	– Include section in DCP the requirement for a smart waste chute system.
	2. Provision of a centralised waste collection facility	– Size and location of centralised waste collection facility shall be identified through the masterplan process and delivery would be part of the land sale agreement.
	3. Electricity Production from on-site organic collection	– Bio-reactor to be installed the centralised waste collection facility.
	Next Steps: – Identify necessary planning controls and space allocations within the masterplan. – Investigation of emerging vacuum waste technologies — Investigate feasibility of vacuum waste	

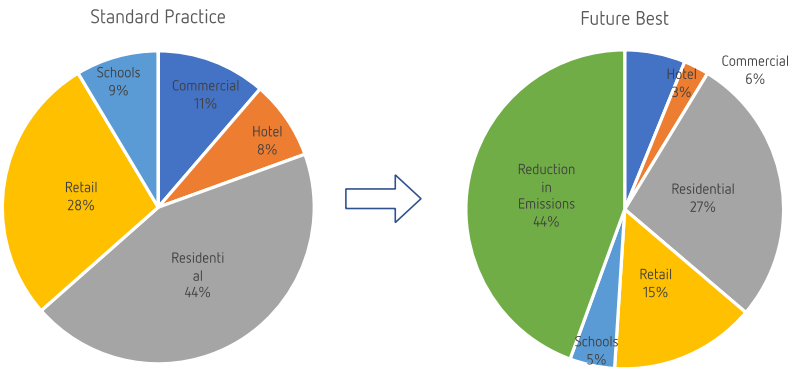
Figure 6. Pathway 4 – Precinct waste cycle summary

Pathway 5	Strategies:	Recommendations:
Connections and Active Transport	4. Integrated bicycle parking	– Masterplan to include integrated bicycle parking
	5. Dedicated active transport connections	– Masterplan to include integrated bicycle parking
	6. On street cycle and pedestrian paths	– Include in the Master plan on street cycle and bicycle parking.
	7. Off-street visitor parking and deliveries	– Include in the Master plan off-street parking.
	8. Green corridor within the site	– Include in the Master plan.
	Next Steps: – Investigate the outcomes of extending the northern corridor through the central area of the site.	

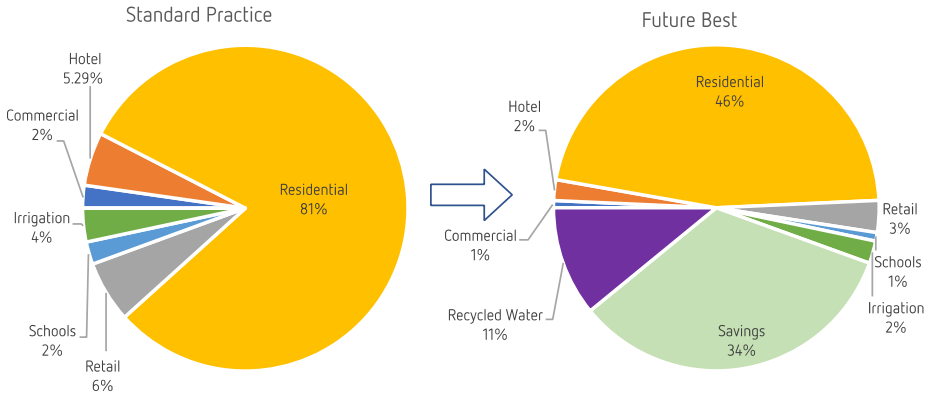
Figure 7. Pathway 5 – Connections and active transport summary

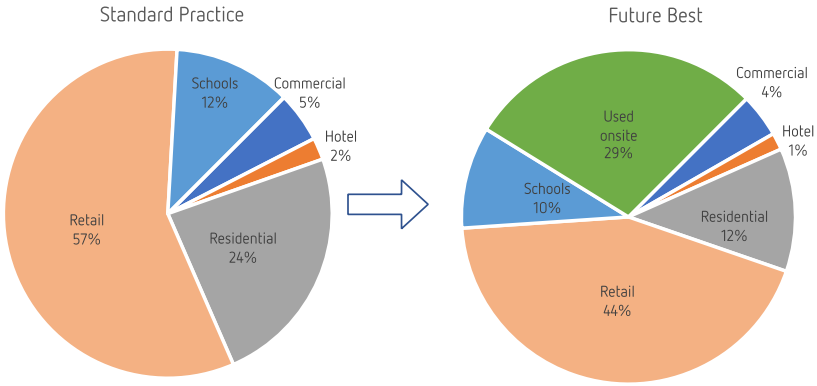
The reductions in emissions, waste and water savings achieved from the application of the sustainability pathways of this plan to the whole site are shown below:

Emissions:



Water:





Waste:

Figure 9. Emissions, water and waste reduction