Griffith Base Hospital Redevelopment

22/12/2020

ESD Report

Prepared for

Health Infrastructure

Revision 02

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Revision Information

Project	Griffith Base Hospital Redevelopment
Title	ESD Report
Client	Health Infrastructure
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Revision Schedule

Revision	Date	Issue Name	Authorised
00	04/11/2020	Draft for Review	Paul Yoon
01	07/12/2020	Draft for Review	Paul Yoon
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Contents

1 Introduction

LCI has been engaged to provide an Ecologically Sustainable Development (ESD) Report as part of the State Significant Development Application (SSDA) for the proposed Griffith Base Hospital Redevelopment on 5-39 Animoo Avenue, Griffith, NSW (legally described as Lot 2 DP 1043580).

The report responds to the Ecolologically Sustainable Development requirements under the 'Planning Secretary's Environmental Assessment Requirements' (SEARs) issued on 29 October 2020 (SSD-9838218) by the Department of Planning and Environment, and are detailed below.

SEAR 7 | Ecologically Sustainable Development (ESD)

- Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design and ongoing operation phases of the development – ***See Section 3.1.***
- Detail proposed measures to minimise consumption of resources, water (including water sensitive urban design) and energy – ***See Section 3.2.***
- Detail how the future development would be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include waste reduction design measures, future proofing, use of sustainable and low-carbon materials, energy and water efficient design (including water sensitive urban design) and technology and use of renewable energy – ***See Section 3.3 & Appendix A – Green Star Design & As Built v 1.2***
- Include an assessment against an accredited ESD rating system or an equivalent program of ESD performance. This should include a minimum rating scheme target level – ***See Section 3.3 & Appendix A – Green Star Design & As Built v 1.2***
- Include a statement regarding how the design of the future development is responsive to the CSIRO projected impacts of climate change – ***See Section 3.4.***
- Include an Integrated Water Management Plan detailing any proposed alternative water supplies, proposed end uses of potable and non-potable water, and water sensitive urban design – ***See Section 3.5.***
- Address ESD in reference to NSW and ACT Government Regional Climate Modelling (NARCLiM) climate change projections – ***See Section 3.4.***

1.1 Project Overview

The Griffith Base Hospital Redevelopment is a $250million project committed to by NSW Government to provide upgrades and expanded facilities for priority services and enable future stage of the redevelopment. The following services are provided for the new hospital:

- Main entry with retail café
- Emergency department with acute beds, resuscitation bays, consulting rooms and an ESSU
- Medical Imaging with X-ray, fluoroscopy, ultrasound, CT, MRI and nuclear medicine modalities
- Wellness Centre with ambulatory care clinics, allied health and rehabilitation, specimen collection, oncology, hospital in the home (HiTH) and Renal
- Pharmacy
- Pathology
- Medical Records
- Administration facilities
- Perioperative unit with 2 operating theatres and a procedure room
- Critical Care / ICU
- Maternity and birthing unit with birthing rooms, inpatient beds and a SpecialCare Nursery
- Paediatric unit with a day recovery area
- Two medical/surgical inpatient wards
- An aged care and rehabilitation inpatient unit

1.2 Project Background

The following scope of works is included within the State Significant Development Application;

- Demolition of Building 25
- Construction of new clinical services building
- Construction of new western car park
- Demolition of Building 1, 2, 6, 15, 16, 17, 19, 20, 22, 28, 29, 31, 35
- Landscaping work
- Construction of new main car park
- Demolition of temporary car park

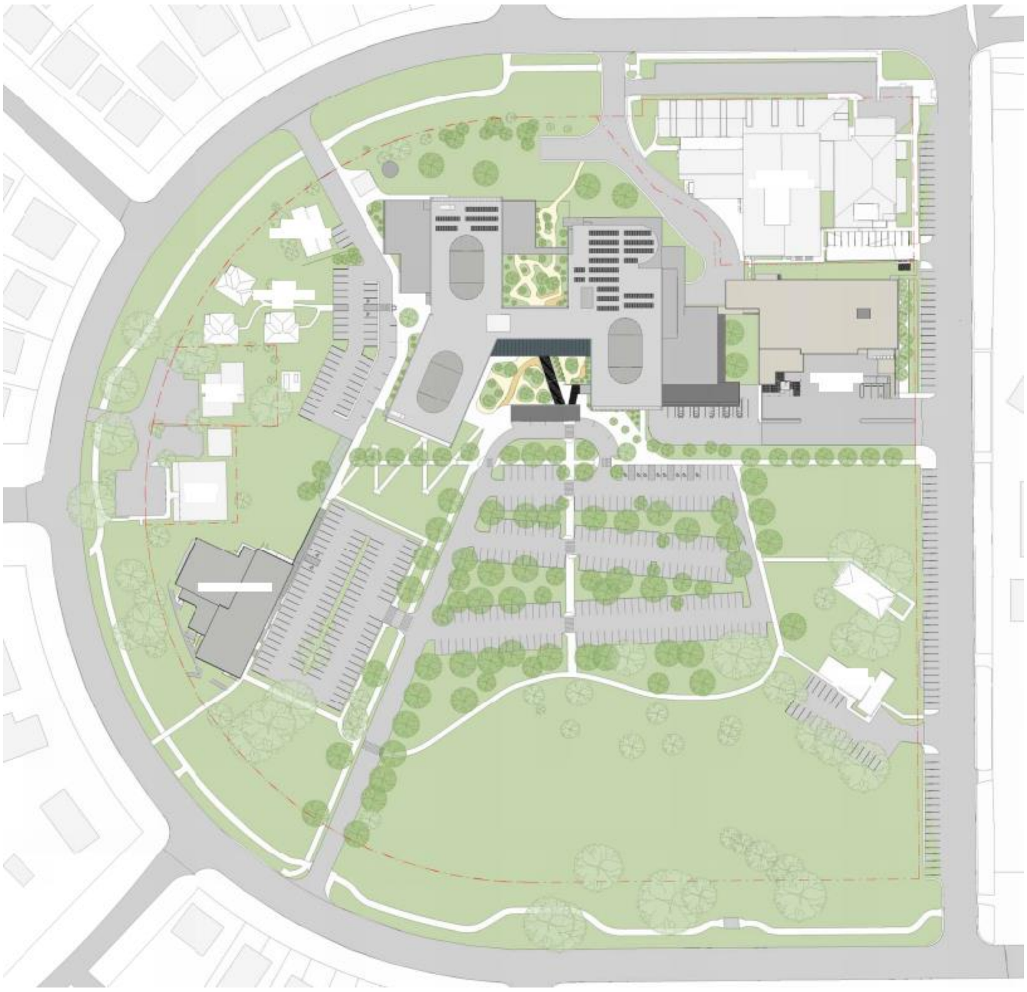


Figure 1: Architectural site plans (by DJRD Architects)

2 General Design Principles

2.1 Site Description

Griffith Base Hospital is located in Griffith, a regional city in the Riverina region of NSW, approximately 570km west of Sydney. The project area is approximately 6.4 hectares in a large D-shaped block facing 5-degrees north, bound by Warrambool Street to the north-east, Animoo Avenue and Nooremar Avenue to the North and South, respectively.

The locational context of the Site is shown in Figure 2, whilst the site boundaries and existing site surrounding features are shown in Figure 3.

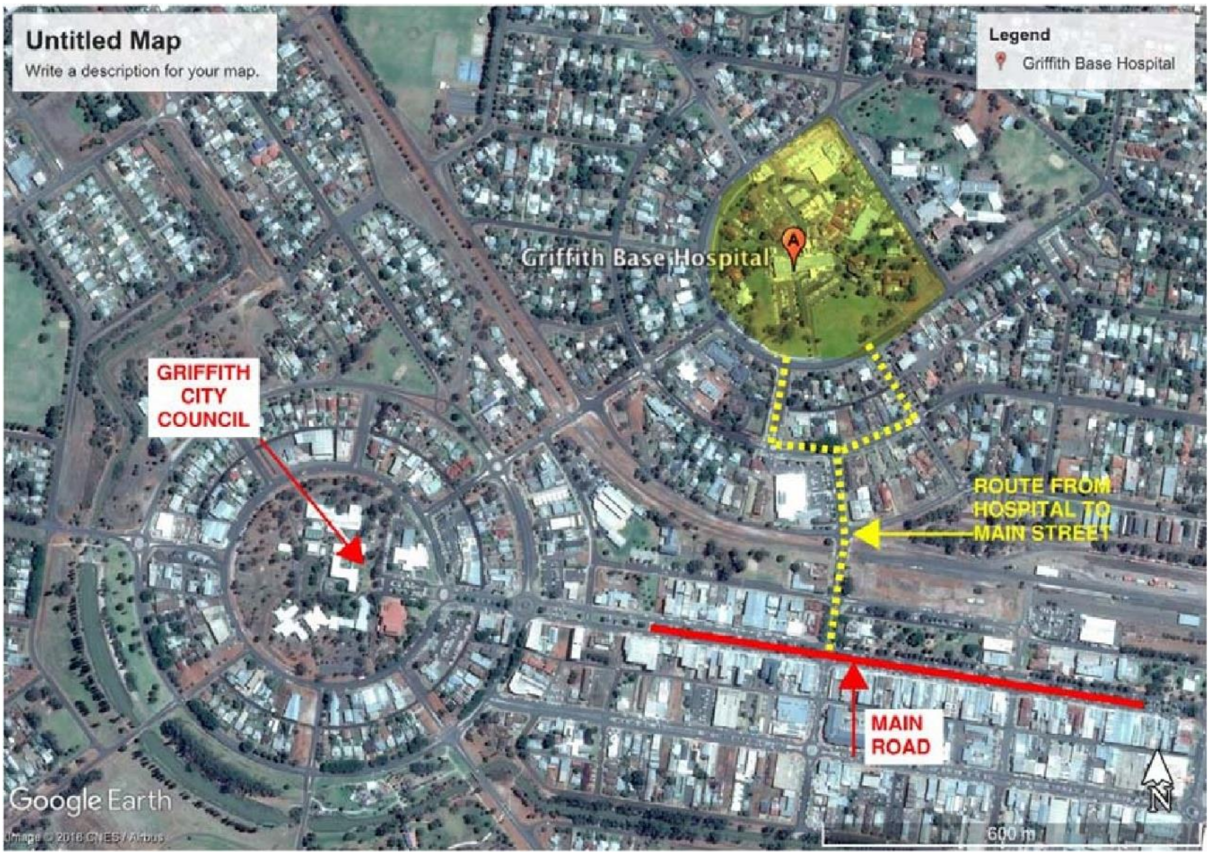


Figure 2: Local site context

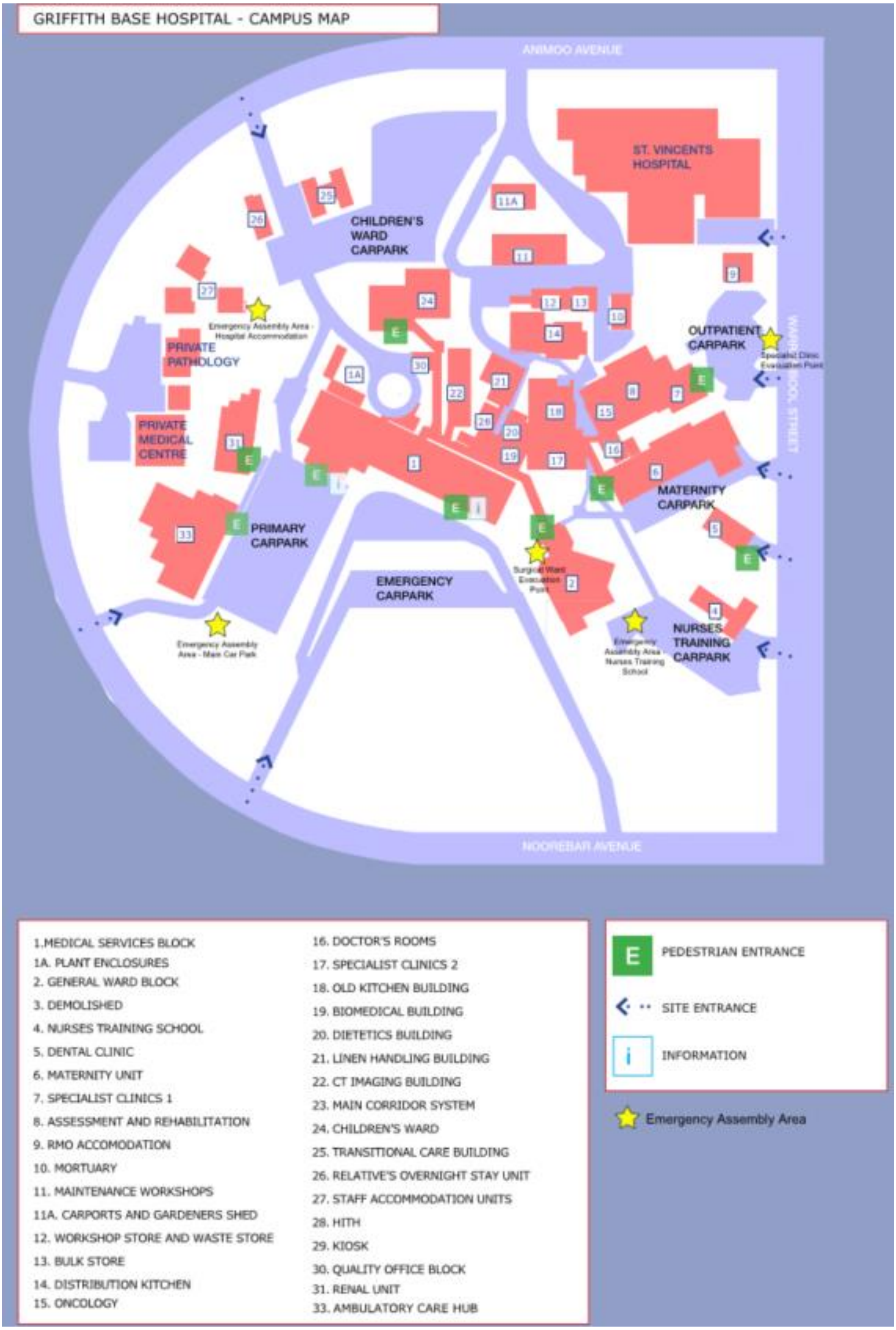


Figure 3: Existing site area and project boundary

2.2 Site Climate

The site is located in a steppe climate, characterised by its hot dry summers and cool winters, with maximum annual temperatures averaging 23.1ºC and minimum annual temperatures averaging 9.6ºC. Based on the BOM weather data for Griffith Airport, the annual precipitation is just over 400mm which is consistently significantly less than a coastal climate such as Sydney, as seen in Figure 4.

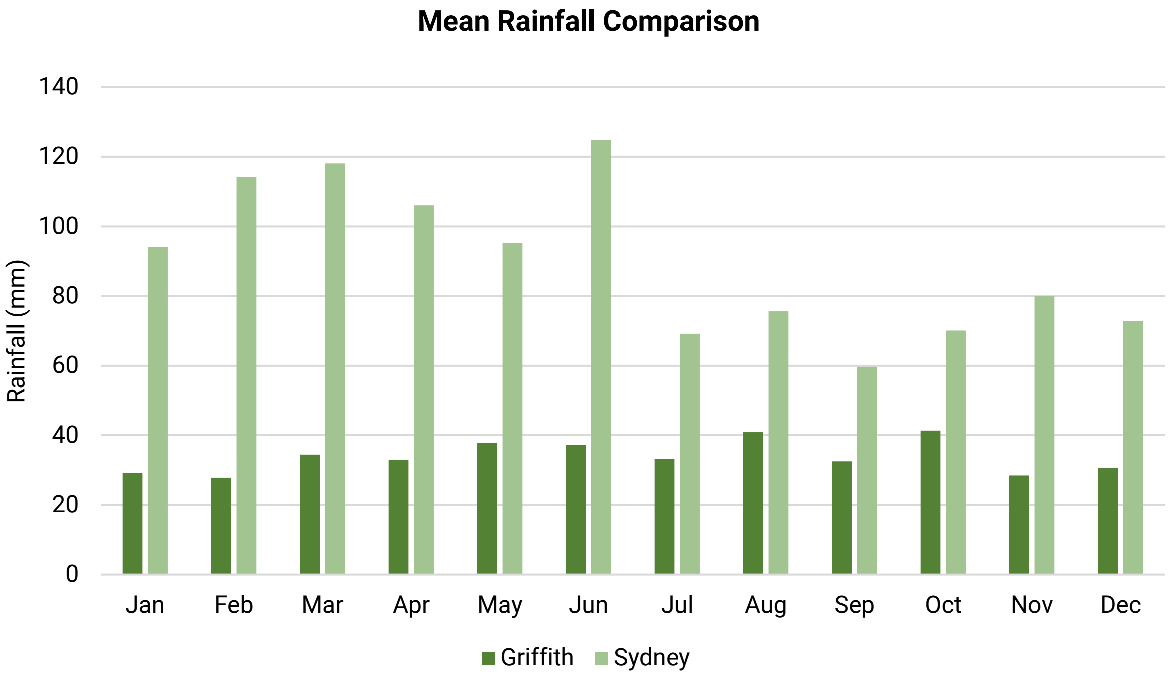


Figure 4: Comparison of Sydney and Griffith rainfall data

2.3 Passive Sustainable Design Principles

The project has adopted passive design principles that respond to the local climate and local sun path; reducing the building's demand for active building-services systems to provide thermal comfort and artificial lighting, and reducing peak energy demand and annual energy consumption.

Passive Cooling and Heating

Passive cooling and heating is a design principle in which the building design elements, such as the orientation, window-to-wall ratio (WWR), façade performance and extent of external shading, are optimised to improve thermal comfort and reduce building's reliance on mechanical systems; supporting a reduced peak energy demand and annual energy consumption.

According to the sun path diagram for the site:

(1) the morning and the afternoon sun during the Summer solstice can deliver direct, high solar radiation through the unprotected East and West facade causing thermal discomfort and increased cooling load; and
(2) the low sun during the Winter solstice can deliver direct, high solar radiation through the North façade, providing a free source of heating.

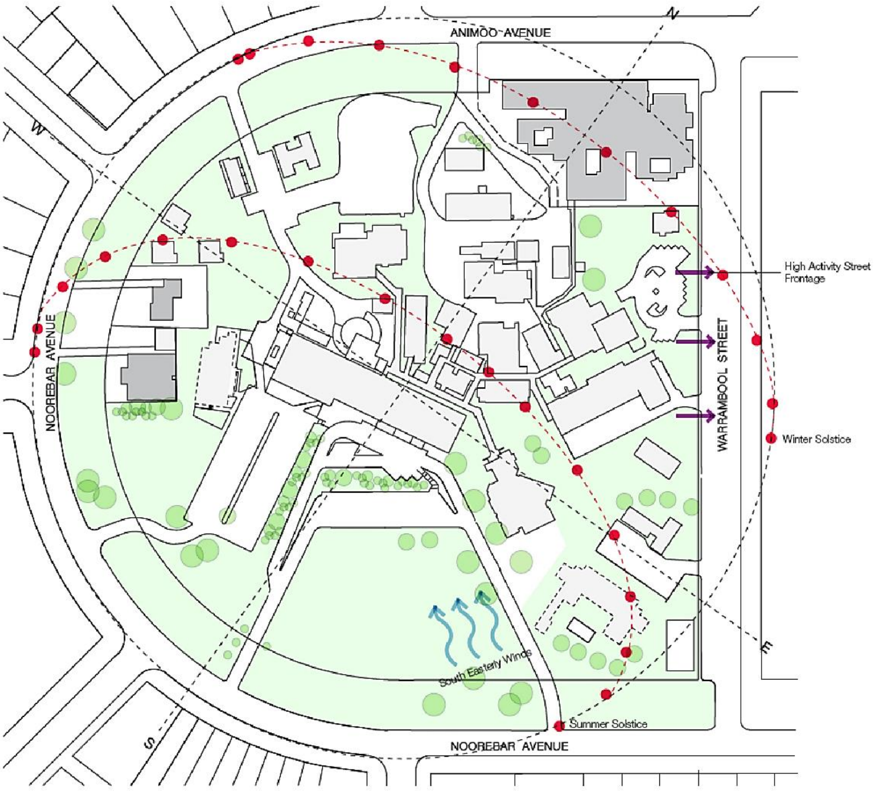


Figure 5: Sun Path for Existing Griffith Base Hospital

To take advantage of the sun path, the project will investigate:

- vertical external shadings to the building to prevent early and afternoon solar radiation from directly transferring into the building;
- a moderate WWR to the in-patient unit (IPU) rooms;
- position glazing to avoid direct solar radiation from the morning and afternoon sun from the East and the West, respectively; and
- oriented the building form (after a balancing activity of various factors such as site environmental setbacks, the orientation, daylight and external view availability) to avoid excessive direct solar radiation by minimising the façade area facing the early East and afternoon West sun during Summer, and to maximise the façade area facing the low sun during Winter to reduce heating loads.

Improving Access to Natural Daylight

The building will be designed to maximise the amount of daylight access to the various functional zones, which contributes to a fostered sense of normality and wellbeing and enhances user comfort levels. Solar access also helps reduce stress levels, and generally improves the efficiency and productivity of the building users. Measures taken to improve solar access include:

- Incorporating internal courtyards within deep plan zones where achievable within the clinical planning constraints;
- Courtyards and key public spaces receive a good amount of direct sunlight; and
- Planning for glazed apertures as end conditions to major circulation routes provide light into corridors.

Improving Access to External Views & Glare Reduction

The patient rooms and bed space shall be orientated to capitalise on the available views from the site, allowing the patients access to views, daylight, and nature where possible. A daylight and views analysis may be done to confirm the levels of access for the perimeter patient zones. Glare management will be addressed in part within the performance characteristics of the glazing, complimented by adjustable room blinds that can cater for individual comfort.

2.4 NSW Health Infrastructure Engineering Services Guidelines

The Engineering Services Guidelines (NSW HI ESG) provide a performance-based guide for the development of design and specification documentation for healthcare facilities.

The guidance document states that integrated, built environment sustainability must be considered, including appropriate designs for energy and water, and the use of appropriate materials. In addition, the indoor environment must consider air quality, ventilation, daylight and other factors that influence thermal, visual, acoustic and psychological comfort. The basic design principles also include the following guidance and project responses detailed in Table 1 below. The design strategies adapted for the ESG requirements are cross-referenced in *Section 3* (Project responses to SEARs, see in particular, *Section 3.2.*) due to the similarity in its requirements.

Table 1. NSW HI ESG Requirements related to ESD

ESG Requirements	Project Response
General	
• Proposed designs should include: passive sustainable design strategies, such as daylighting, demand management, gravity systems, energy and water efficiency, and conservation techniques; use of non-toxic, environmentally sound materials and finishes, and consider life cycle sustainability and maintenance implications • All new facilities will target a Green Star Health Care 4-star equivalence rating, this has been and will continue to be considered as aspirational within the context of project location, scope and budgetary allowances; no documentation or certification is required	Passive sustainable design strategies, including passive cooling and heating, daylighting and access to views, as discussed above in *Section 2.3,* shall be implemented. Energy and water efficiency strategies, and sustainable material considerations are discussed in respective sections of this report. As per the "*Design Guidance Note No. 058 - ESD*" which supplements the NSW HI ESG, the project team has developed a Green Star Design & As Built v1.2. 4-star equivalency pathway in *'Appendix A – Green Star Design & As Built v 1.2'* to reflect an equivalent 4 star Green Star Design & As-Built v1.2 pathway.
Energy	
• All new standalone buildings will have a mandatory requirement of delivering a 10% improvement on national construction code (NCC) Section J. • Engineering design should be applied to reduce energy wastage and carbon dioxide emissions arising from the operation of the hospital, whilst maintaining clinical and functional standards. • Energy efficient design should consider: a. An enterprise-level energy management program integrated with other functions b. Integrated performance monitoring and controls c. The incorporation of variable speed pumps d. Efficient insulation of hot and warm water distribution pipework e. Consideration of opportunities for energy and heat recovery f. Appropriate system zoning and time control	The project shall be designed to deliver a 10% or more improvement on the NCC 2019-Section J. Strategies to meet the above target, and measures to demonstrate energy efficient design, reduction of energy wastage and the subsequent carbon dioxide emissions, are further referenced in *Section 3.2.*

ESG Requirements	Project Response
Water	
• The design of the water systems should include consideration of: a. Potential use of gravity systems b. Water (potable, grey, black) recycling options c. Options for maximising water conservation d. Appropriate metering and monitoring e. Opportunities for re-use of fire test water f. Rainwater harvesting to reduce potable water consumption g. Installation of high efficiency fixtures, such as those covered by the High Water Efficiency Labelling and Standards scheme h. Efficiency irrigation systems	Water efficiency measures to reduce potable water consumptions are targeted for the project and are further referenced in *Section 3.2 & 3.5.*
Materials	
• Consideration should be given to materials of low embodied energy content, high recycled content or that are highly recyclable • Designers should consider the quantities of materials and investigate opportunities for alternative design solutions that may reduce material use (e.g. mass concrete versus post-tension designs) • Material selection should focus on: a. Use of locally sourced materials b. Selection of low embodied energy materials c. Specification of products and materials that are either reused or contain high recycled content d. Promoting the specification of recyclable manufactured materials and fittings e. Giving preference to materials manufactured using renewable energy sources f. Designing to minimise material use and improve material efficiency • As a minimum, the below design options should be considered in the material selection process: a. Use of structural steel products composed of recycled content b. Use of recycled concrete c. Minimisation of PVC products d. Specification of low VOC materials e. Giving preference to reused timber, legally sourced timber, and timber sourced from forests whose conservation values are not degraded f. Designing to material sizes and common packaging quantities to avoid off-cut wastage and unnecessary consumption.	The project team shall take into consideration the sustainable strategies regarding materiality, waste reduction design measures, future proofing, and use of sustainable and low-carbon materials, as outlined *in Section 3.2.* Specification of materials or means to reduce waste will be confirmed in the detailed design.

3 Assessment Requirements and Project Responses

3.1 SEAR 7 | Ecologically Sustainable Development (ESD)

Clause 7(4) of Schedule 2

The ESD principles that are to be incorporated into the proposed development must be aligned with Clause 7(4) – Schedule 2 – Environmental Planning & Assessment Regulation (2000).

3.1.1 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:

(i) *Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and*
(ii) *An assessment of the risk-weighted consequences of various options.*

PROJECT RESPONSE

The proposed redevelopment will be constructed on a previously developed, the site housing the Griffith District Hospital in 1922. The redevelopment will not have an adverse environmental impact and therefore alleviates concern of serious or irreversible environmental damage. Proactive measures to prevent environmental degradation will be included within the design, construction and operational phases of the proposed development. During the design and construction phases, the main contractor will implement an independently certified Environmental Management System (EMS), which demonstrates formalised systematic and methodical approach to planning, implementing and auditing. Throughout the building's operation, adherence to procedures that account for environmental risk and mitigation measures will be met.

3.1.2 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.

PROJECT RESPONSE

To uphold inter-generational equity, the proposed development minimises the consumption of energy and water resources whilst reducing waste. The ESD principles incorporated into the proposed development facilitates the conservation of energy and water resources through energy and water efficiency measures.

Energy consumption will be designed to achieve a minimum 10% improvement above National Construction Code requirements. The reduction in water use will be established through high WELS rated water fixtures and fittings, unless otherwise required for clinical purposes. Waste generated during the construction and operational phases will be diverted from landfill to be recycled. An Environmental Management System (EMS) will be established and adhered to throughout construction. Operational waste streams will be separated to maximise recycled waste. Reducing energy, water and waste ensures that the health, diversity and productivity of the environment is maintained for the benefit of future generations.

The redevelopment of the hospital will provide improved health services in the region, streamlining the currently fractured system due to consistent small expansions. The presence of Charles Sturt University in close proximity to the site also presents opportunities for the future clustering of research and education institutions, with potential for establishing a health and education precinct in the future.

3.1.3 Conservation of Biological Diversity and Ecological Integrity

Namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.

PROJECT RESPONSE

Site specific Biodiversity Development Assessment Report (BDAR) was developed for the project by Abel Ecology to assess the likely impacts of the proposal on species and ecological communities present on the site, and to ascertain opportunities to minimise impacts. Recommendations has been detailed in the BDAR to preserve and protect the existing flora and fauna species.

Further, the project's ESD principles to reduce energy, water and waste consumption have an indirect impact to conserve biodiversity and ecological integrity to the surrounding area. By minimising demand on energy and water resources, the need for land-clearing and the pollution generated from utility infrastructure to support the surrounding area will be minimised.

3.1.4 Improved Valuation, Pricing and Incentive Mechanisms

Namely, that environmental factors should be included in the valuation of assets and services, such as:

(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement;
(ii) 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; and
(iii) 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.

PROJECT RESPONSE

The valuation of the project's assets and services consider environmental factors through the implementation of various ESD initiatives. An Environmental Management System will be in place throughout the construction to ensure that excessive pollution and waste are minimised, and to establish recycling and landfill waste streams during construction and operational phases. This creates a system where pollution is managed and controlled and creates an incentive to reduce pollution and waste.

3.2 Improving Environmental Performance and Reducing Ecological Impact

The project shall be designed to achieve a minimum 10% improvement on NCC 2019 Section J, reducing the operational energy of the development and enhancing the thermal comfort of the occupied spaces. Each of the services have strategies to improve the environmental performance, as detailed in the following sections.

PASSIVE COOLING AND HEATING DESIGN

The design shall adopt passive cooling and heating design principles to reduce the building's reliance on mechanical HVAC system and artificial lighting; acting to reduce energy consumption. These include: orientation and form of the building suited for the sun path to avoid direct solar radiation in summer and to benefit from free source of heating during winter; implementation of external shading to limit solar penetration in summer but optimise passive heating in winter; limiting window to wall ratio (WWR) and the use of a high-performance prefabricated façade with improved thermal resistance. More detail on passive cooling and heating design is described above in *Section 2.3*.

MECHANICAL SERVICES

The building services will be designed to achieve a high level of energy efficiency to achieve a 10% or more improvement on NCC 2019-Section J. The following mechanical strategies will be considered for implementation, subject to detailed design of the project:

- All mechanical equipment to be efficient, subject to mechanical designer's life cycle cost analysis
- Mechanical system to consider consisting of a centralised plant configuration, which allows for diversity and improves energy efficiency
- Ductwork/pipework systems to be designed to reduce system pressure losses and reduce fan and pump motor power
- A Building Management Control System (BMCS) to be installed with automatic intelligent controls to optimise plant efficiency, and monitor and record energy consumptions to reduce energy wastage
- Air-cooled, heat recovery VRF (variable refrigerant flow) systems to be investigated where applicable
- Airlocks at the entrances to be provided to avoid conditioned air from escaping the building, reducing energy wastage
- Where applicable, refrigerants to be specified that have low ozone depletion potential, and low global warming potential

ELECTRICAL SERVICES

The project team will work to implement electrical services that assist energy efficient design, as detailed below, subject to detailed design of the project:

- Robust, long-life LED lighting with automatic lighting control system to reduce energy wastage – lighting control strategies may include implementation of area dimming, time clock, daylight sensors or PIDs, subject to room function
- External artificial lighting to be designed to exceed minimum energy efficiency requirements and, where possible, specified with LED luminaires with photocell and manual override control
- Electrical equipment to be specified to be energy efficient to reduce building electricity consumption, unless otherwise required for clinical purposes
- Major energy uses to be sub-metered by end use, and function area / department
- Where appropriate, reliance on internal artificial lighting to be reduced by consideration of the façade design, i.e. the application of daylight dimming controls. *Section 2.3* above discusses design strategies used to improve daylight to the building form.

HYDRAULICS SERVICES

The project team will implement the hydraulics services that assist water efficient design as detailed below, subject to detailed design of the project:

- Potable water using fixtures to be high efficiency rated by WELS as outlined below, unless otherwise required for clinical purposes. Specification of fittings to be confirmed in the detailed design.

  - Showerheads ≥ 3 stars (maximum flow rate at 7.5 L/min)
  - Toilets and urinals ≥ 5 stars
  - Washing machines ≥ 5 stars
  - Dishwashers ≥ 5 stars
  - Taps and flow controllers ≥ 5 stars
- Drainage capture and reuse strategy to be implemented to reduce potable water consumption
- Potable water sub-metering to be connected to the BMCS to reduce wastage through identifying leaks or poor operational performance. Sub-meters to be installed at:
  - Cold water inlet to each domestic hot water unit plant, and Renal Department
  - Cold water supply to each floor/major department, kitchen, retail tenancy, make-up water to re-used rainwater system
  - Hot water supply to each floor/major department (supply & return) and kitchen
- Gravity drainage systems to be investigated for sewer and trade waste
- High efficiency, gas-fired domestic hot water plant to be specified

CIVIL ENGINEERING SERVICES

The project team will implement design strategies to cater for water sensitive urban design principles (WSUD), with the aim of reducing pollutants and not effecting the increase in natural annual average load of nutrients and sediments. Further details are provided in *Section 3.5*.

SUSTAINABLE MATERIALS AND REDUCING WASTE

The project team will take into consideration the sustainable strategies outlined below regarding materiality, waste reduction design measures, future proofing, and use of sustainable and low-carbon materials. Specification of materials or means to reduce waste will be confirmed in the detailed design.

- Specifying low VOC emitting materials to improve indoor air quality
- Specifying engineered wood products with low or no formaldehyde limits
- Applying life cycle assessment principles and learnings in relation to:
  - concrete, steel and timber
  - minimising mass or volume of materials; and
  - implementing sound procurement practices.
- Pipe material selection based on current best practice such that:
  - PVC-u to be specified based on the GBCA guidelines
  - Polyethylene material to be specified for pressure water and gas services, as Polyethylene is recyclable and has significantly lower environmental impact than the alternative ductile iron material
  - Pipe bedding materials to be specified to be locally sourced, where practical
- Selecting permanent formworks, flooring, blinds and cables with no PVC or PVC products that comply to GBCA's best practice guidelines for PVC
- Prioritising locally sourced materials
- Specifying salvaged and/or recycled materials
- Specifying materials sourced with cradle to cradle credentials
- Reuse of materials on the site to limit waste, e.g. excavated bulk soil used in the formation of landscaped landforms for playgrounds around hospital
- Efficient selection of materials to limit off-cut wastage during construction
- Promotion of off-site prefabrication to limit construction waste impacts
- Provision of flexible floor plates to reduce the construction waste associated with future refurbishments

3.3 Preliminary Consideration of Building Performance & Climate Change Mitigation

Preliminary consideration of building performance for the proposed development is reflected by applying passive sustainable design principles (see *Section 2.3*) and achieving the minimum performance requirements stipulated under NCC 2019-Section J. Further, the building design addresses mitigation of climate change by improving the building's energy efficiency via adopting energy conservation strategies in building services design, as detailed in *Section 3.2*. A Climate Adaptation Plan (CAP) analyses mild and extreme climate prediction models in the near and far future to assess the site-specific climate risks and mitigate them through design and governance. Finally, the building's sustainable design and management practices are further supplemented by implementation of the design practices stipulated within the 4-star Green Star Design & As Built v 1.2 equivalency pathway.

3.3.1 NCC 2019-Section J Requirements

The National Construction Code (NCC): Building Code of Australia (BCA) 2019 Section J Energy Efficiency sets minimum energy performance requirements for all new developments, including the performance of building fabric and building sealing, glazing thermal performance, heating, air conditioning and ventilation systems, artificial lighting and power, and heating water supplies. The project will demonstrate NCC 2019-Section J compliance by complying with the Deemed-to-satisfy (DTS) provisions stipulated and/or via an Alternative Solution – JV3 Verification Method approach.

3.3.2 Green Star Design & As Built v1.2

Green Star is a voluntary scheme administered by the national, not-for-profit organisation, Green Building Council of Australia (GBCA). The Green Star suite of tools provides an environmental sustainability rating of a building's performance. The tools are performance based and assess the environmental attributes of new and refurbished buildings in every state across Australia. The Green Star rating system is scaled to a star level from 0 to 6 stars.

6 STAR	5 STAR	4 STAR	3 STAR	2 STAR	1 STAR
75+ Weighted Points Score	60 Weighted Points Score	45 Weighted Points Score	30 Weighted Points Score	20 Weighted Points Score	10 Weighted Points Score
World Leadership	Australian Excellence	Best Practice	Good Practice	Average Practice	Minimum Practice
6 Star rating	5 Star rating	4 Star rating	Currently not eligible for Green Star certification	Currently not eligible for Green Star certification	Currently not eligible for Green Star certification

Figure 6: Green Star rating scale

Griffith Hospital will not be targeting an official Green Star certification, rather it will follow the aims of specific credits to achieve the equivalency of a 4-star Green Star. The alignment of Green Star principles will be peer reviewed by a third party to ensure compliance with the targeted star rating.

An equivalent 4 star Green Star Design & As Built v1.2 Pathway (See *Appendix A* – Green Star Design & As Built v 1.2) has been developed by the project team which outlines the relevant initiatives considered to the project. The pathway reflects the requirement of a minimum 45 points to be achieved. Typically, buffer points are allocated to ensure a targeted performance is maintained as emerging design and construction constraints may prevent points from being achieved. This represent a pathway that will be tested and refined as the project progresses through its design and construction phases.

3.4 Design for Climate Change Resilience

The Griffith Base Hospital will be designed to future-proof itself from the potential impacts of climate change.

NARCLiM Climate Change Projections

The NSW Office of Heritage and Environment, now part of the NSW Department of Planning, Industry and Environment, has developed the NSW and ACT Government Regional Climate Modelling (NARCLiM) climate change projections to provide a dataset for detailed near future (2020-2039) and far future (2060-2079) projections. Generally, it determines that there will be:

1. more hot days and fewer cold nights;
2. an increase in the number of heatwave events;
3. more hot days above 35°C; particularly in Spring and Summer;
4. an increase in rainfall in Summer and Autumn and a decrease in Winter and Spring; and
5. a change in rainfall patterns that will affect drought and flooding events.

CSIRO Climate Future Projections

In addition, the Intergovernmental Panel on Climate Change (IPCC) published four greenhouse gas (GHG) concentration trajectories known as Representative Concentration Pathways (RCPs) which are used by CSIRO for climate projection modelling at a regional scale within Australia. The four RCPs and its definitions include:

- **RCP 2.6** – Emissions peak 2010-2010, decline substantially – 1.0°C of Global Warming Mean and likely temperature range of 0.3°C – 1.7°C
- **RCP 4.5** – Emissions peak around 2040, then decline – 1.8°C of Global Warming Mean and likely temperature range of 1.1°C – 2.6°C
- **RCP 6.0** – Emissions peak around 2060, then decline – 2.2°C of Global Warming Mean and likely temperature range of 1.4°C – 3.1°C
- **RCP 8.5** – Emissions continue to rise throughout the 21st century – 3.7°C of Global Warming Mean and likely temperature range of 2.6°C – 4.8°C

The series of climate futures matrices representing the combination of time periods and greenhouse gas scenarios and classified by the combined changes of the climate variables identified above are provided in Table 2.

PROJECT RESPONSE (*See Table 3*)

To provide practical and realistic design advice, the use of climate projection data from the medium range scenarios, RCP 4.5, is considered for the 2030 climate projections. The RCP 8.5 scenario is considered an extreme worst-case scenario and has been considered for the 2070 climate projections.

The projections will have an impact on operational costs and occupancy comfort and safety. Hotter days with more heatwave events will particularly affect patients and the operation of building services equipment. This will also require higher capacity and operational costs for mechanical services to maintain occupancy comfort. Increased drought events will require provisions to supplement shortages in potable water. Stronger and reinforced façade components will be required to withstand increased rainfall.

The design initiatives in Table 3 aim to mitigate the effect of future climate change. These measures should allow the project to meet the difficulties predicted by the CSIRO's climate change projections while maintaining occupancy comfort and operational efficiency.

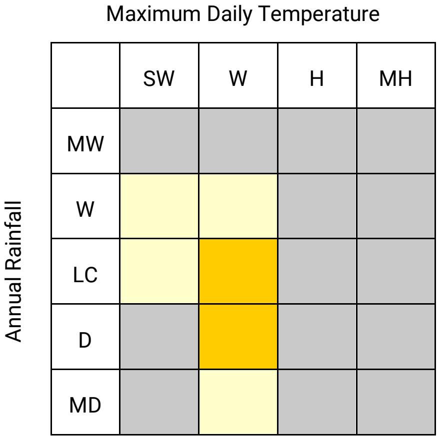
Table 2. Climate futures matrices for RCP 4.5 and RCP 8.5 at Murray Basin

East Coast Climate Futures — **Year**: **Summer 2030** | **Summer 2070**

Emissions Scenarios

RCP 4.5

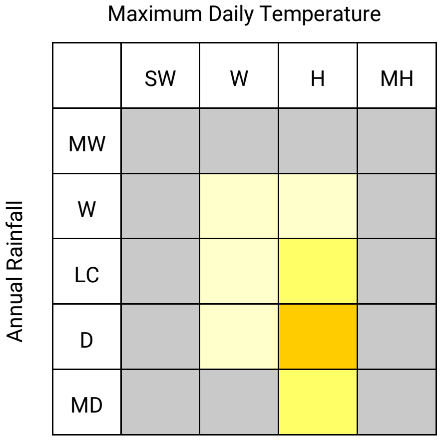
Summer 2030



Maximum Daily Temperature / Annual Rainfall

	SW	W	H	MH
MW	▨	▨	▨	▨
W	⬜	⬜	▨	▨
LC	⬜	🟧	▨	▨
D	▨	🟧	▨	▨
MD	▨	⬜	▨	▨

Summer 2070

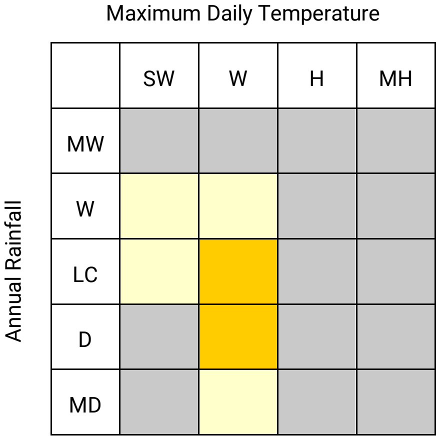


Maximum Daily Temperature / Annual Rainfall

	SW	W	H	MH
MW	▨	▨	▨	▨
W	▨	⬜	⬜	▨
LC	▨	⬜	🟨	▨
D	▨	⬜	🟧	▨
MD	▨	▨	🟨	▨

RCP 8.5

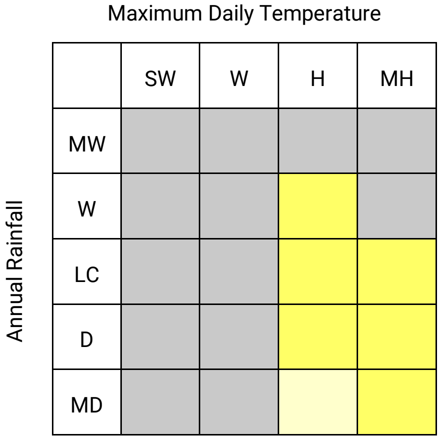
Summer 2030



Maximum Daily Temperature / Annual Rainfall

	SW	W	H	MH
MW	▨	▨	▨	▨
W	⬜	⬜	▨	▨
LC	⬜	🟧	▨	▨
D	▨	🟧	▨	▨
MD	▨	⬜	▨	▨

Summer 2070



Maximum Daily Temperature / Annual Rainfall

	SW	W	H	MH
MW	▨	▨	▨	▨
W	▨	▨	🟨	▨
LC	▨	▨	🟨	🟨
D	▨	▨	🟨	🟨
MD	▨	▨	⬜	🟨

Keys

Maximum Daily Temperature

SW	Slightly Warmer < 0.50
W	Warmer 0.50 to 1.50
H	Hotter 1.50 to 3.00
MH	Much Hotter > 3.00

Rainfall

MW	Much Wetter > 15.00
W	Wetter 5.00 to 15.00
LC	Little Change -5.00 to 5.00
D	Drier -15.00 to -5.00
MD	Much Drier < -15.00

	Consensus	Proportion of models
▨	Not projected	No models
⬜	Very Low	< 10%
🟨	Low	10% - 33%
🟧	Moderate	33% - 66%
🔶	High	66% - 90%
🟥	Very High	> 90%

Source: CSIRO and Bureau of Meteorology, Climate Change in Australia website (https://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-futures-tool/projections/)

Table 3: Climate change projections and response initiatives for the Griffith Hospital

Climate Change Projections	Project Responses
Increased average temperature and duration of heatwaves	**Mechanical System Provision** The climate futures matrix in Table 2 above predicts that under the both climate scenario RCP for 2030, the site has a very low consensus to experience a warmer maximum daily temperature. To reasonably future proof the building, the mechanical design has considered a suitable peak temperature to calculate the required cooling load of the building. The cooling load is satisfied by the chillers, cooling towers, chilled water pumps, condenser water pumps, pipework and air side systems, and, as such, all the aforementioned equipment associated with cooling will adequately cater for the requirement of the projected climate of 2030. The increase in temperatures as per 2070 RCP8.5 projections will be met as the main HVAC equipment that will satisfy the cooling demand will be replaced in approximately 25-30 years. Spatial provision may be enabled through the equipment selection process which inherently provides for larger equipment typically in the range of 4-8% than that of the design requirement. However, it is also noted that equipment produced in 25-30 years will be of a much higher efficiency then that currently produced and, as such, will require a smaller footprint to satisfy the same load as that of its current day equivalent. Selecting external ambient conditions now to account for the provisions of RCP8.5 projections would be counter intuitive, as the main equipment items which satisfy the cooling demand will be oversized and will not operate with the desired efficiency. **Architectural Design** Increase in hotter ambient temperature is combated via use of high-performance façade with reduced WWR to improve overall thermal resistance, minimising radiation penetrating the building, which affects energy consumption and thermal comfort. In addition, external shadings are to be implemented to further reduce direct solar radiation.
Extended drought periods	The hydraulic services design implements a drainage capture and reuse strategy to reduce potable water consumption that will assist in combating extended drought periods. The design incorporates a rainwater harvesting and reuses system that captures rainwater from the roof areas to reuse for irrigation. In addition, strategies that assist water efficient design include, subject to detailed design of the project: • Potable water using fixtures to be high efficiency and WELS rated as detailed below, unless otherwise required for clinical purposes. • Potable water sub-metering to be connected to the BMCS to reduce wastage through identifying leaks, or poor operational performances • High efficiency, gas-fired domestic hot water plant to be specified • Reuse of Reverse Osmosis water for irrigation will be investigated
More extreme rainfall events	The project responds to the potential effects of climate change – an increase in rainfall intensity – as demonstrated in the flood assessment that has been carried out. Griffith City Council has commissioned a series of flood studies including Main Drain J and Mirool Creek Study (2015 and the CBD Overland Flow Floor Study (2012) that both show the land surrounding the hospital site is elevated such that it would not be significantly affected by flooding. The maximum flood case of 200 year flood event indicates inundation of 0.25-0.5m extended to Wakaden Street, approximately 350m from Griffith Base Hospital site. All roads, buildings and other infrastructure will be constructed above the PMF flood level (approx. RL 8.0m AHD).

3.5 Implementation of Water Sensitive Urban Design Principles

The project shall implement water sensitive urban design (WSUD) measures. The pre and post development peak stormwater flows remain the same or lessen, removing much of the need for on-site detention as per the Griffith City Council requirements. A final check of pre and post impervious area will be conducted to ensure that on-site detention is not required. The quality of stormwater will be managed to enable the reduction of suspended solids (TSS), phosphorus (TP) and nitrogen (TN). Water quality control strategies will be incorporated in response to further stormwater analysis.

Vegetation plays an important role in the efficiency of bio-retention and bio-detention systems. The surface will be densely planted, which retards and distributes the flows across the filter media. Below ground, the roots, which are highly biologically active, physically trap/take up the materials (both fine soils and soluble nutrients). The plant growth and death cycle also play an important role, maintaining the soil structure and hydraulic conductivity of the media.

4 Conclusion

This report details responses to the Department of Planning, Industry and Environment's SEARs for the preparation of an Environmental Impact Statement (EIS) for the proposed redevelopment. The report demonstrates that a myriad of ESD initiatives have been incorporated within the current project design, complies to the NSW Health Infrastructure Engineering Services Guidelines (ESG) and the NSW Health Infrastructure Design Guidance Note (DGN) 058 - ESD, and all the policy requirements under SEAR 7.

Further, the project team has developed an equivalent 4 star Green Star Design & As-Built v1.2 pathway (See *Appendix A* – Green Star Design & As Built v 1.2) outlining the relevant initiatives considered to the project. This represent a preliminary pathway that will be tested and refined as the project progresses through its design and construction phases.

Appendix A – Green Star Design & As Built v 1.2 Pathway

Green Star - Design & As Built Scorecard

Project: Griffith Base Hospital Redevelopment

Targeted Rating: 4 Star - Best Practice

Core Points Available	Total Score Targeted
100	57.9

CATEGORY / CREDIT	AIM OF THE CREDIT / SELECTION	CODE	CREDIT CRITERIA	POINTS AVAILABLE	POINTS TARGETED
Management				14	
Green Star Accredited Professional	To recognise the appointment and active involvement of a Green Star Accredited Professional in order to ensure that the rating tool is applied effectively and as intended.	1.0	Accredited Professional	1	1
Commissioning and Tuning	To encourage and recognise commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.	2.0	Environmental Performance Targets	-	Complies
		2.1	Services and Maintainability Review	1	1
		2.2	Building Commissioning	1	
		2.3	Building Systems Tuning	1	1
		2.4	Independent Commissioning Agent	1	
Adaptation and Resilience	To encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.	3.1	Implementation of a Climate Adaptation Plan	2	2
Building Information	To recognise the development and provision of building information that facilitates understanding of a building's systems, operation and maintenance requirements, and environmental targets to enable the optimised performance.	4.1	Building Information	1	1
Commitment to Performance	To recognise practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way.	5.1	Environmental Building Performance	1	1
		5.2	End of Life Waste Performance	1	
Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering	-	Complies
		6.1	Monitoring Systems	1	1
Responsible Building Practices	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan	-	Complies
		7.1	Formalised Environmental Management System	1	1
		7.2	High Quality Staff Support	1	1
Operational Waste	Performance Pathway	8A	Performance Pathway - Specialist Plan	1	1
		8B	Prescriptive Pathway - Facilities	-	
Total				14	11

Indoor Environment Quality				17	
Indoor Air Quality	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	1	1
		9.2	Provision of Outdoor Air	2	1
		9.3	Exhaust or Elimination of Pollutants	1	1
Acoustic Comfort	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.1	Internal Noise Levels	1	1
		10.2	Reverberation	1	1
		10.3	Acoustic Separation	1	1
Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	-	Complies
		11.1	General Illuminance and Glare Reduction	1	1
		11.2	Surface Illuminance	1	
		11.3	Localised Lighting Control	1	
Visual Comfort	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	-	Complies
		12.1	Daylight	2	1
		12.2	Views	1	1
Indoor Pollutants	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1	Paints, Adhesives, Sealants and Carpets	1	1
		13.2	Engineered Wood Products	1	1
Thermal Comfort	To encourage and recognise projects that achieve high levels of thermal comfort.	14.1	Thermal Comfort	1	1
		14.2	Advanced Thermal Comfort	1	
Total				**17**	**12**

Energy				**22**	
Greenhouse Gas Emissions	E. Modelled Performance Pathway	15A.0	Conditional Requirement: Prescriptive Pathway	-	
		15A.1	Building Envelope	-	
		15A.2	Glazing	-	
		15A.3	Lighting	-	
		15A.4	Ventilation and Air-conditioning	-	
		15A.5	Domestic Hot Water Systems	-	
		15A.6	Accredited GreenPower	-	
		15B.0	Conditional Requirement: NatHERS Pathway	-	
		15B.1	NatHERS Pathway	-	
		15C.0	Conditional Requirement: BASIX Pathway	-	
		15C.1	BASIX Pathway	-	
		15D.0	Conditional Requirement: NABERS Pathway	-	
		15D.1	NABERS Energy Commitment Agreement Pathway	-	
		15E.0	Conditional Requirement: Reference Building Pathway	-	Complies
		15E.1	Comparison to a Reference Building Pathway	20	4.9
Peak Electricity Demand Reduction	Performance Pathway	16A	Prescriptive Pathway - On-site Energy Generation	-	
		16B	Performance Pathway - Reference Building	2	2
Total				**22**	**6.9**

Transport				**10**	
Sustainable Transport	Performance Pathway	17A.1	Performance Pathway	10	4
		17B.1	Access by Public Transport	0	
		17B.2	Reduced Car Parking Provision	0	
		17B.3	Low Emission Vehicle Infrastructure	0	
		17B.4	Active Transport Facilities	0	
		17B.5	Walkable Neighbourhoods	0	
Total				**10**	**4**

Water				**12**	
Potable Water	Performance Pathway	18A.1	Potable Water - Performance Pathway	12	4
		18B.1	Sanitary Fixture Efficiency	0	
		18B.2	Rainwater Reuse	0	
		18B.3	Heat Rejection	0	
		18B.4	Landscape Irrigation	0	
		18B.5	Fire System Test Water	0	
Total				**12**	**4**

Materials				**14**	
Life Cycle Impacts	Performance Pathway - Life Cycle Assessment	19A.1	Comparative Life Cycle Assessment	6	4
		19A.2	Additional Life Cycle Impact Reporting	4	1
		19B.1	Concrete	0	
		19B.2	Steel	0	
		19B.3	Building Reuse	0	
		19B.4	Structural Timber	4	
Responsible Building Materials	To reward projects that include materials that are responsibly sourced or have a sustainable supply chain.	20.1	Structural and Reinforcing Steel	1	1
		20.2	Timber Products	1	1
		20.3	Permanent Formwork, Pipes, Flooring, Blinds and Cables	1	1
Sustainable Products	To encourage sustainability and transparency in product specification.	21.1	Product Transparency and Sustainability	3	1
Construction and Demolition Waste	Percentage Benchmark	22A	Fixed Benchmark	-	
		22B	Percentage Benchmark	1	1
Total				**14**	**10**

Land Use & Ecology				6	
Ecological Value	To reward projects that improve the ecological value of their site.	23.0	Endangered, Threatened or Vulnerable Species	-	
		23.1	Ecological Value	3	
Sustainable Sites	To reward projects that choose to develop sites that have limited ecological value, re-use previously developed land and remediate contaminate land.	24.0	Conditional Requirement	-	Complies
		24.1	Reuse of Land	1	1
		24.2	Contamination and Hazardous Materials	1	1
Heat Island Effect	To encourage and recognise projects that reduce the contribution of the project site to the heat island effect.	25.0	Heat Island Effect Reduction	1	1
Total				**6**	**3**

Emissions				5	
Stormwater	To reward projects that minimise peak stormwater flows and reduce pollutants entering public sewer infrastructure.	26.1	Stormwater Peak Discharge	1	1
		26.2	Stormwater Pollution Targets	1	
Light Pollution	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Bodies	-	Complies
		27.1	Light Pollution to Night Sky	1	1
Microbial Control	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28.0	Legionella Impacts from Cooling Systems	1	
Refrigerant Impacts	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.0	Refrigerants Impacts	1	1
Total				**5**	**3**

Innovation				10	
Innovative Technology or Process	The project meets the aims of an existing credit using a technology or process that is considered innovative in Australia or the world.	30A	Innovative Technology or Process	10	
Market Transformation	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in	30B	Market Transformation		
Improving on Green Star Benchmarks	The project has achieved full points in a Green Star credit and demonstrates a substantial improvement on the benchmark required to achieve full points.	30C	Improving on Green Star Benchmarks		2
Innovation Challenge	Where the project addresses an sustainability issue not included within any of the Credits in the existing Green Star rating tools.	30D	Innovation Challenge		2
Global Sustainability	Project teams may adopt an approved credit from a Global Green Building Rating tool that addresses a sustainability issue that is currently outside the scope of this Green Star	30E	Global Sustainability		
Total				**10**	**4**