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SUSTAINABLE DESIGN ASSESSMENT REPORT

PROPOSED TOWNHOUSES

91-93 CANNING HIGHWAY, EAST FREMANTLE – STAGE 1

PREPARED BY

CLAIRE CHAPMAN

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1 OVERVIEW

EMERGEN has developed a sustainable design report on the proposed townhouse development at 91-93 Canning Highway, East Fremantle in consultation with RAD Architecture.

The purpose of this report is to support the development application by identifying the principles incorporated in the design that meet sustainable objectives and targets for the site. The initial assessment is based on preliminary documentation with the outcomes subject to change during design development.

1.1 STATE PLANNING POLICY SUMMARY

EMERGEN (a division of CADDS GROUP), in collaboration with the design team (RAD Architecture) has developed a sustainable design strategy aligning with ***State Planning Policy 7.0,*** which focuses on the Design of the Built Environment - specifically, Principle 5: Sustainability.

This report serves the vital purpose of bolstering the development application by articulating the sustainability principles and commitments for the project site. We acknowledge the significance of State Planning Policy 7.0 in promoting sustainability within the built environment. Good design, as outlined in the policy, is not only about aesthetics but also optimises the sustainability of our built surroundings, yielding positive outcomes on environmental, social, and economic fronts.

Our approach to sustainable landscape and urban design adheres closely to the established water-sensitive urban design principles, ensuring minimal adverse impacts on existing natural features and ecological processes while promoting green infrastructure at all scales of the project. Furthermore, our strategy for sustainable built environments embraces passive environmental design measures tailored to local climate and site conditions. This includes careful consideration of optimal orientation, shading, building envelope, and natural ventilation, ultimately reducing reliance on energy-intensive heating and cooling technologies. This, in turn, results in reduced energy consumption, decreased resource usage, and lowered operating costs throughout the project's lifecycle.

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2 TARGETS

The design team will utilise a structured approach to a sustainable outcome for the design and construction of the development including the following Sustainable Targets.

Table 1: Sustainability Targets

DESCRIPTION	GOAL	SUSTAINABILITY COMMITMENTS
STRUCTURE DESIGN EFFICIENCY	Integrate passive solar design principles into optimising solar access in winter and shading in summer.	• Enhance solar passive performance by incorporating shading devices on north and west-facing windows to reduce summer heat gain and improve visual interest. • Above **60%** of the combined living and bedroom area of each unit have high level of daylight (above 160 Lux). • Building orientation and design to maximise natural ventilation and promote cooling opportunities • External shading devices to minimise heat gains • Building form and orientation to maximise natural daylighting
ENERGY EFFICIENCY	Enhance energy performance by reducing consumption through efficient design and the use of renewable and low-energy systems.	• Efficient LED Lighting. • Provision for future solar photovoltaic (PV) system to supply renewable energy. • All units meet the minimum NatHERS energy efficiency requirement of **7 stars for sole occupancy**, based on the NCC 2022.
WATER EFFICIENCY	Water efficient fixtures and Landscaping.	• High WELS Ratings • Water sensitive urban design, drip irrigation.
URBAN ECOLOGY	Reduce impacts of heat island effect	• Light roof colour (SRI ≥ 0.64). • Incorporate vegetation and green spaces around the building to provide shading and reduce surrounding air temperatures. • Landscaping plant selections are water-wise species
SUSTAINABLE TRANSPORT/ ACCESSABILITY	Low carbon options	• Provision for secure bicycle storage area. • Access to public transport
INDOOR ENVIRONMENT QUALITY	Enhance indoor air quality	• Natural ventilation to all townhouses. • Low VOC and Low Formaldehyde products to be used. • Minimum 95% of internally applied paints, adhesives, sealants (by volume), and carpets (by area) must meet TVOC limits.

3 PROJECT INFORMATION

The proposed residential development site is located at 91-93 Canning Highway, East Fremantle within the Town of East Fremantle. This project aims to revitalize a semi vacant and dilapidated site through the construction of 7, 4-storey and 2, 3-story townhouses as part of stage 1. A future stage will include a mixed use, multi-residential and commercial building. Stage 1 aims to contribute positively to the local streetscape by delivering contemporary, high-quality, and sustainable housing that respects and complements the suburb's medium-density residential zoning.

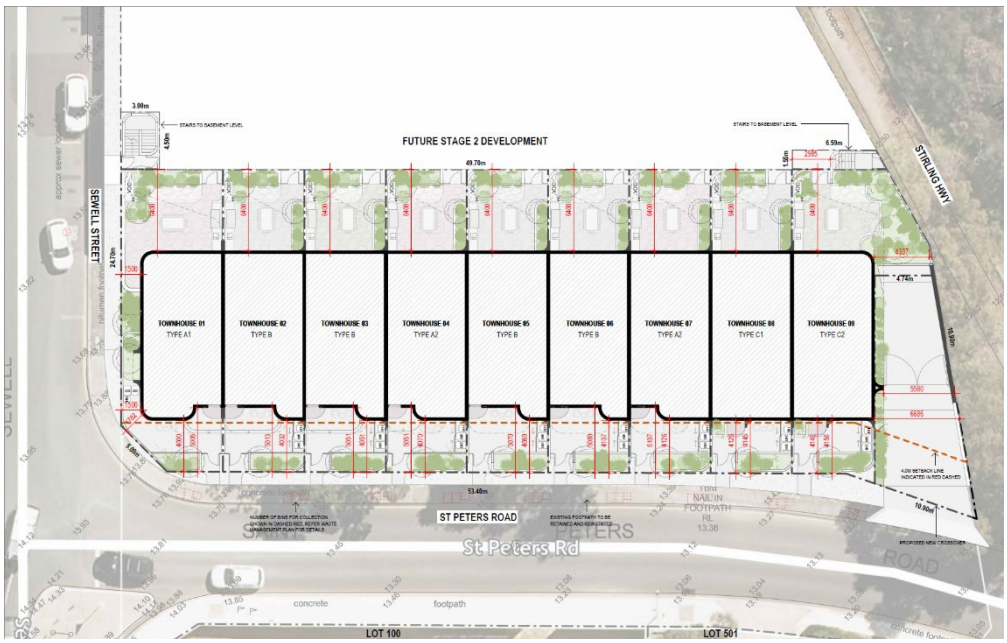

Figure 1: Existing Site Image/Proposed Development

4 STRUCTURE DESIGN EFFICIENCY

4.1 SOLAR PASSIVE DESIGN

Solar Passive design principles have been carefully integrated into the proposed development to enhance energy efficiency and occupant comfort. While the east- and west-facing glazing is less ideal for solar gain control, the design incorporates effective shading strategies to mitigate heat during the summer months, while still preserving views and maintaining a strong connection to the surrounding natural environment. Emergen has conducted a Solar Analysis to review efficiency of proposed shading design.

4.1.1 SOLAR ANALYSIS

The architectural design incorporates several strategies to reduce unwanted heat gain from the north and west - critical for Climate Zone 5 conditions where afternoon solar exposure is significant.

Key measures include:

- Horizontal shading to north-facing glazing, blocking high-angle summer sun while allowing beneficial winter light.
- Limited use of dark cladding, with the façade predominantly finished in light, reflective materials, helping lower absorbed solar radiation.
- High-SRI roof covering, minimising heat absorption at the roof - the most solar-exposed surface.

Together, these elements reduce mechanical cooling demand, improve occupant comfort, and align with NCC 2022 thermal performance expectations.

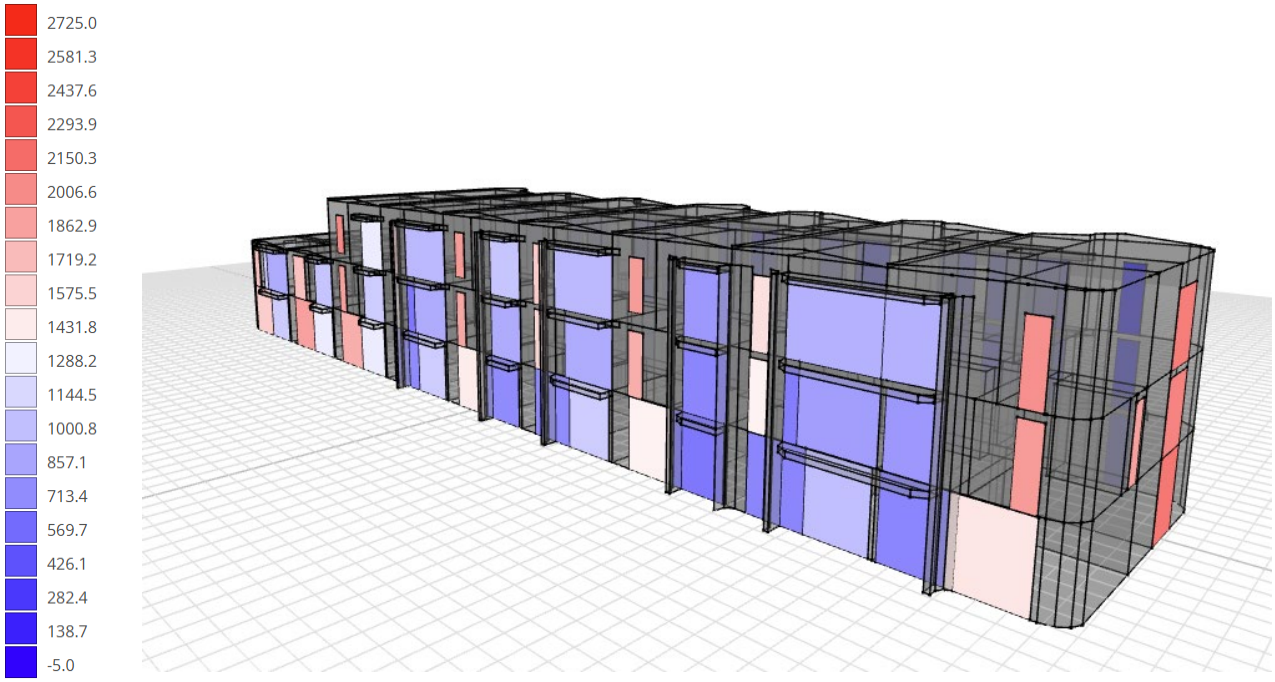

Figure 2: Solar Analysis showing the direct solar radiation MJ/m2 to the North and West Facade

Direct Solar (mean) W/m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12 AM	0	0	0	0	0	0	0	0	0	0	0	0
11 PM	0	0	0	0	0	0	0	0	0	0	0	0
10 PM	0	0	0	0	0	0	0	0	0	0	0	0
9 PM	0	0	0	0	0	0	0	0	0	0	0	0
8 PM	0	0	0	0	0	0	0	0	0	0	0	0
7 PM	584	366	0	0	0	0	0	0	0	0	53	545
6 PM	751	625	559	111	0	0	0	0	269	465	557	723
5 PM	852	698	669	461	401	328	375	393	463	590	677	822
4 PM	901	752	725	543	494	404	453	461	536	663	737	880
3 PM	920	793	765	613	565	468	507	495	547	720	769	905
2 PM	928	815	799	661	625	513	534	510	549	743	790	907
1 PM	906	821	790	670	638	527	536	539	567	746	780	906
12 PM	875	822	756	655	597	497	506	549	573	728	756	891
11 AM	842	803	723	609	536	441	442	493	549	695	741	857
10 AM	797	751	661	517	442	365	355	410	496	667	713	802
9 AM	723	658	549	372	316	169	178	315	405	600	650	717
8 AM	584	489	297	139	0	0	0	34	222	474	553	592
7 AM	248	54	0	0	0	0	0	0	0	159	351	393
6 AM	0	0	0	0	0	0	0	0	0	0	0	0
5 AM	0	0	0	0	0	0	0	0	0	0	0	0
4 AM	0	0	0	0	0	0	0	0	0	0	0	0
3 AM	0	0	0	0	0	0	0	0	0	0	0	0
2 AM	0	0	0	0	0	0	0	0	0	0	0	0
1 AM	0	0	0	0	0	0	0	0	0	0	0	0

Location
East.Fremantle, WA, AUS

Coordinates
32.05° S / 115.77° E

Weather File
AUS_WA_East.Fremantle.956050_TMYx

Figure 3: Average Direct Solar (W/m2)

Figure 3 displays average direct solar radiation by hour and month. It highlights peak solar loads from 7 PM–7 AM, especially in summer and early autumn, with the strongest heat on west-facing surfaces in the afternoon.

4.2 DAYLIGHTING

The proposed development has been designed to optimise natural daylight, improving occupant comfort and reducing reliance on artificial lighting.

To evaluate the effectiveness of these strategies, a detailed daylight assessment was undertaken using Green Star Buildings Credit 11 – Light Quality as the performance benchmark. Under this framework, high daylight levels are defined as at least 160 lux from daylight for 80% of occupied hours, with compliance achieved when 60% of the combined assessed areas meet this target. This methodology provides a recognised standard for assessing internal daylight performance.

The results confirm that all of the townhouses achieve adequate daylight, exceeding the 60% compliance threshold and demonstrating the success of the proposed daylighting strategies. Figure 5 to Figure 7 illustrate the distribution of daylight across the building, while Table 3 summarises compliance by floor.

Figure 4: Daylighting Model in BetterBuilding (Speckel)

Table 2: Calculation Conditions - Daylight

CALCULATION CONDITIONS	
TEST FACTOR	Daylight Autonomy
SKY FACTOR	CIE Overcast Sky
DATE	Annual 21st 12:00pm

Table 3: Daylighting Results for Sole Occupancy Units

LEVEL	PROPOSE USAGE	NOMINATED AREA (m^2)	COMPLIANT AREA (m^2)	COMPLIANCE (%)
G	Living	335.96	326.69	96.75
1	Bedrooms	203.82	203.82	100
1	Living	140.1	136.05	95.95
2	Bedrooms	125.95	125.95	100.00
2	Living	127.46	126.74	96.32

Based on the results above, the proposed development meets the required daylight percentage, enhancing occupant comfort, well-being, and productivity. Additionally, by reducing reliance on artificial lighting, it contributes to lower energy consumption and a reduced environmental impact.

Showing the area above the threshold value of 160 lux to bedrooms and habitable spaces:

Figure 5: Daylighting for Ground Floor

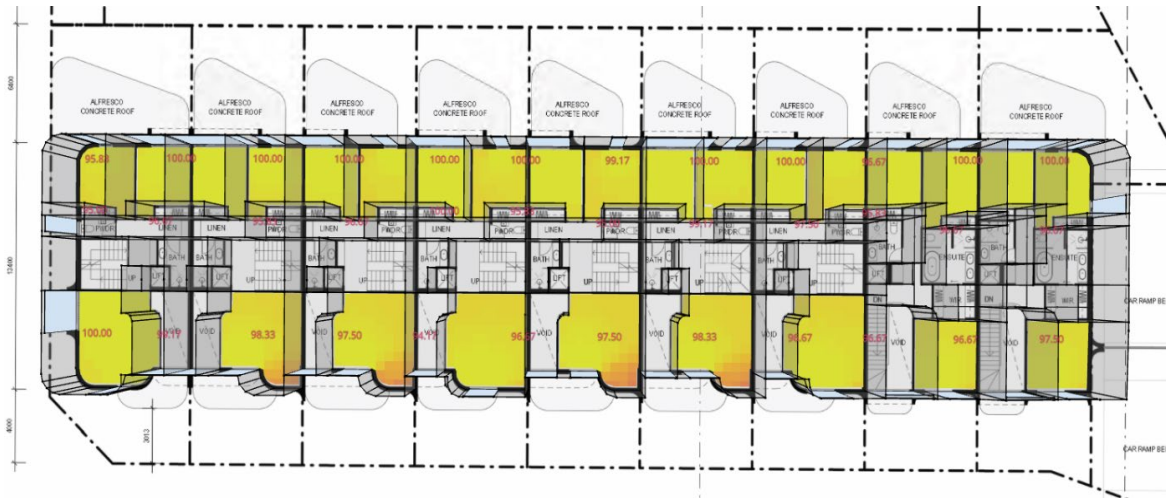

Figure 6: Daylighting for First Floor

Figure 7: Daylighting for First Floor

5 PASSIVE DESIGN

5.1 NATURAL VENTILATION

The natural ventilation strategy has been informed by the Built Environment Sustainability Scorecard (BESS), a recognised best-practice guidance tool commonly used to demonstrate effective ventilation outcomes at the planning stage.

- In townhouses, Cross ventilation can be designed for rooms or for an entire unit. Accordingly, cross ventilation principles are applied. BESS guidance for cross ventilation recommends that: The length of the breeze path should be a maximum of 15 metres; Ventilation openings should be at least 1m^2 or 2% of the floor area in size; Ventilation openings on adjacent walls should be at least 3 metres apart; There should not be more than 1 doorway or opening between ventilation openings.

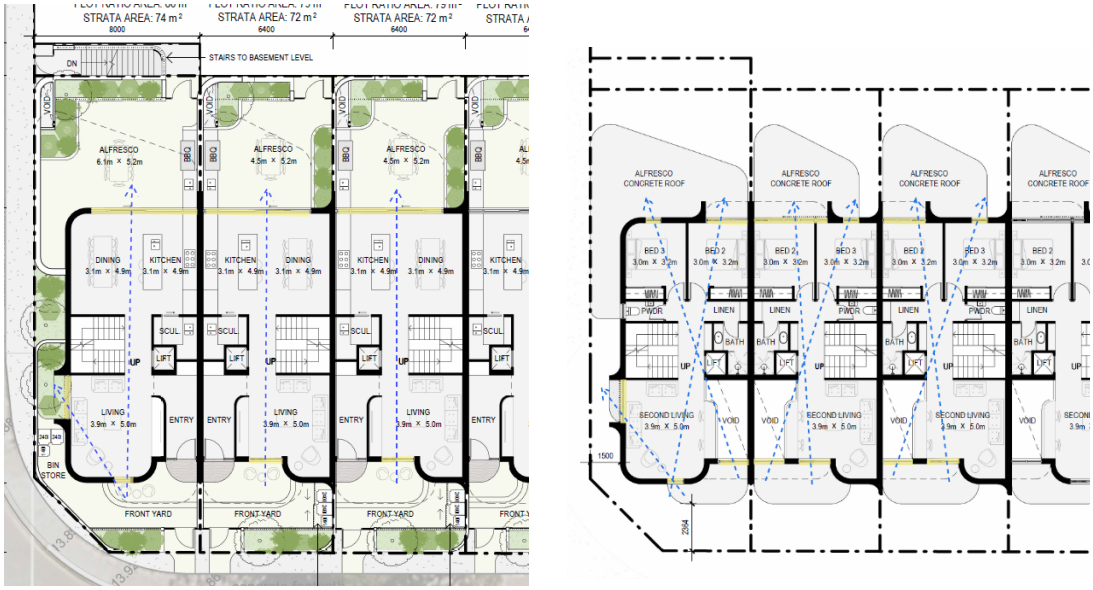

Figure 8 - GF and FF - Cross ventilation strategy

6 ENERGY EFFICIENCY

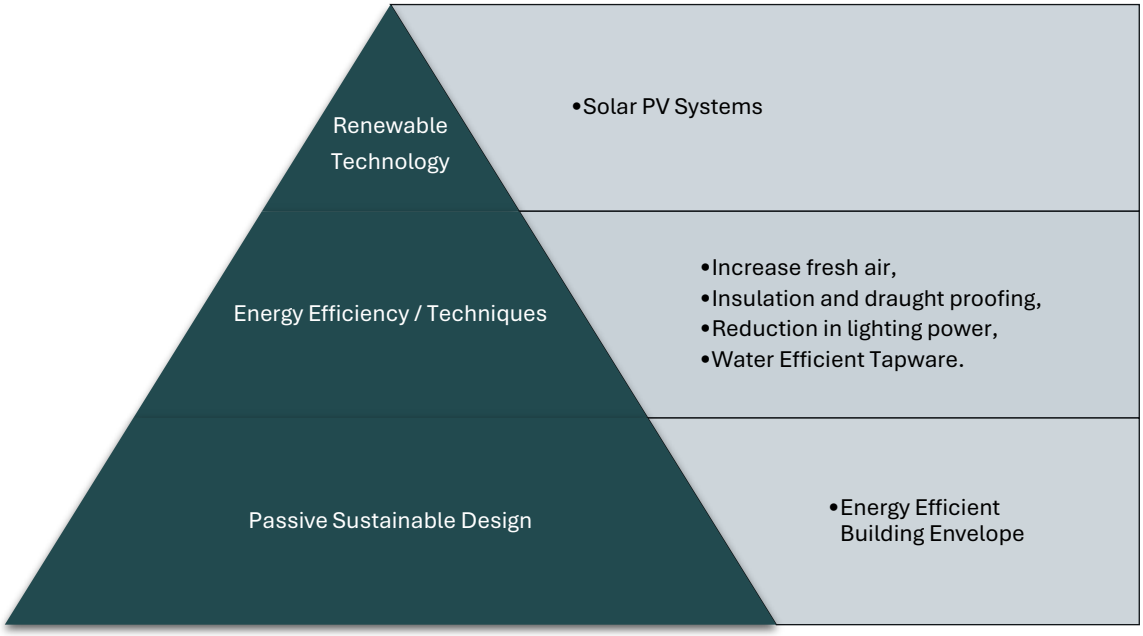

Figure 9: Energy Reduction Strategy

6.1 LIGHTING COMFORT

Lighting within the building must meet the following criteria:

- All lighting must be flicker-free.
- Light sources must have a minimum Colour Rendering Index (CRI) average R1 to R8 of 85 or higher and have a CRI R9 of 50 or higher.
- Light sources must meet best practice illuminance levels for each task within each space type with a maintained illuminance that meets the levels recommended in AS/NZS 1680.1:2006 series applicable to the project type and including maintenance.
- The maintained Illuminance values must achieve a uniformity of no less than that specified in Table 3.2 of AS/NZS 1680.1:2006, with a maintenance factor method as defined in AS/NZS 1680.4.; and
- All light sources must have a minimum of 3 MacAdam Ellipses.
- The walls within the field of view of occupants in regularly occupied spaces must have an average surface reflectance value of 0.70 and an average surface illuminance of at least 50% of the horizontal illuminance levels required for task.
- Vertical illuminance in workspaces: ensure that 50% of the horizontal task illuminance reaches the average eye height for 90% of primary spaces using vertical illuminance calculation grid.
- The illuminance values must be calculated in accordance with AS/NZS 1680 series for the relevant task.

6.2 EFFICIENT LIGHTING AND CONTROLS

The installed aggregate illumination power has been designed to be **20%** below the maximum illumination power based on maximum allowable lighting power densities defined in Table J7D3a of the NCC 2022. Motion Detectors and daylight sensors are provided to reduce demand.

Table 4: Lighting Characteristics

PARAMETER	PROPOSED BUILDING	REFERENCE BUILDING
LIGHTING TYPE	LED light fittings	LED light fittings
DESIGN ILLUMINANCE (LUX)	Various lux	Various lux
NOMINAL LIGHTING POWER DENSITY (W/M^2)	**20%** less compared to NCC max requirements.	As per NCC max requirements.
OCCUPANT SENSOR CONTROLS	Motion sensors	N/A
DAYLIGHT CONTROLS	Yes	N/A
OTHER LIGHTING CONTROLS	Timer switches	N/A
ADJUSTMENT FACTOR APPLIED	0.9 – Motion sensor 1 0.7 – Motion sensor 2 0.55 – Motion sensor 3	Room Aspect Ratio

6.3 ARTIFICIAL LIGHTING AND CONTROLS

All lighting will be equipped with light-emitting diodes (LEDs), covering all primary areas. Common area lighting will include controls like occupancy sensors (PIRs) and time switches to minimize energy usage when lighting is not needed.

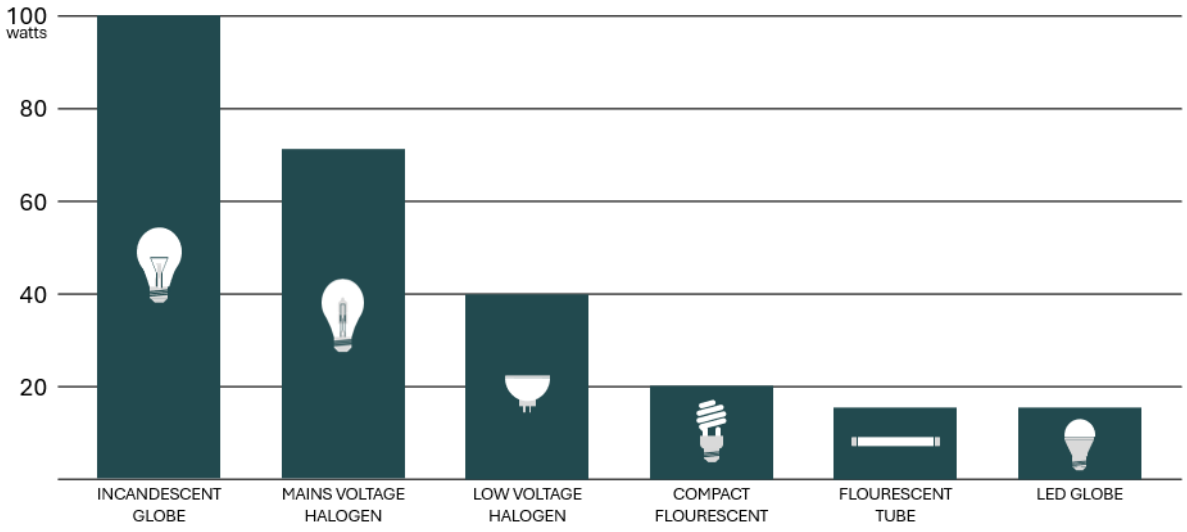

Figure 10: Comparison of LED Lighting with other Conventional Lighting

6.4 RENEWABLE TECHNOLOGY

Integrating solar panels into the residential development offers multiple benefits, including cost savings, improved energy independence, and reduced environmental impact. As the site will operate as an all-electric development, a future solar photovoltaic (PV) system will play a key role in reducing greenhouse gas emissions and offsetting grid electricity consumption, thereby enhancing the project's overall sustainability performance.

The building design, including the roof layout, electrical distribution system, and metering infrastructure, will incorporate provisions to allow for the future installation of systems such as solar photovoltaic arrays and battery storage. This ensures the development remains adaptable and ready to accommodate emerging renewable energy technologies.

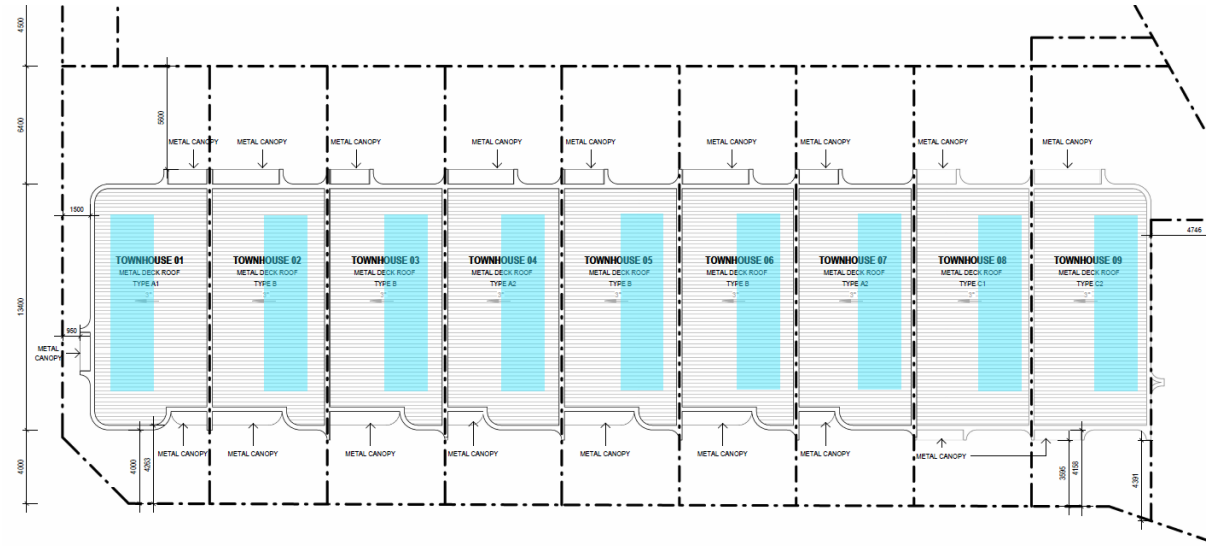

Figure 11: Indicative Provision for Solar PV System

6.5 ENERGY USE

Energy savings in a building can be realised by minimising the need for heating and cooling through a well-designed and insulated façade. The design team will focus on enhancing energy efficiency by exceeding the minimum requirements of NCC Section J. This will involve optimising the building envelope, air conditioning and ventilation systems, and lighting to ensure lower energy consumption.

The review has been undertaken in accordance with the Energy Efficiency provisions of the NCC 2022 – Amendment 1 for each class of building referred in the table below:

Table 5: Energy Compliance Overview

BUILDING	CLASS	VERIFICATION
9 x Sole Occupancy	1	NatHERS

These results are produced from models based on the documentation provided by the Architects. Any updates to these plans may affect the results and may require a change to specification (Section 5.1.1 – 5.1.2).

6.5.1 BUILDING SPECIFICATIONS FOR SOLE OCCUPANCY UNITS – CLASS 1

The construction for the proposed building envelope is as per plans provided during the DA stage are outlined below. *These specifications may require upgrades once all units are modelled.*

Table 6: Proposed Building Specifications for Apartment Units

CONSTRUCTION		DESCRIPTION	REQUIREMENT
EXTERNAL WALLS	External Cavity Brick Wall	2x90mm Brick with 70mm cavity.	**25mm R1.1 cavity board insulation**
INTERNAL WALLS	Single brick wall	90mm/110mm brick	**No Insulation Required.**
FLOORS	Slab on Ground	Concrete slab with ground contact. Floor coverings as per plans.	**No Insulation Required.**
	Suspended Slab	250mm suspended concrete Slab. Floor coverings as per plans.	**No Insulation Required.**
CEILINGS/ ROOFS	Roof Type 1	Metal deck roof sheet. Medium/light roof colour **(SA ≤ 0.45).**	**60mm Anticon (R1.3)** with **R4.0 Insulation Batts** to dropped plasterboard ceilings.

** Wall constructions have been simplified for modelling purposes using worst-case assumptions.*

Table 7: Proposed Glazing Specifications for Apartment Units

WINDOW SPECIFICATION		U-VALUE	SHGC
EXTERNAL GLAZING 1A	Double Glazed Low-E Clear in aluminium frame. *(Type B windows)* – T01 Only	**3.10**	**0.49**
EXTERNAL GLAZING 1B	Double Glazed Low-E Clear in aluminium frame. *(Type A windows)* - T01 Only	**3.10**	**0.39**
EXTERNAL GLAZING 2A	Double Glazed Clear in aluminium frame. *(Type B windows)* - T09 Only	**3.60**	**0.47**
EXTERNAL GLAZING 2B	Double Glazed Clear in aluminium frame. *(Type A windows)* - T09 Only	**3.60**	**0.54**
EXTERNAL GLAZING 3A	Double Glazed Low-E Clear in aluminium frame. *(Type B windows)* – Typical	**4.80**	**0.51**
EXTERNAL GLAZING 3B	Double Glazed Low-E Clear in aluminium frame. *(Type A windows)* - Typical	**4.80**	**0.59**

Note: The glazing values specified are for whole systems values (glass + frame).

6.5.2 ESTIMATED ENERGY USED FOR SOLE OCCUPANCY UNITS – CLASS 1

The results below are based on NatHERS rating. The minimum requirement under the NCC 2022 is 7 stars for sole occupancy for townhouses (class1).

Table 8: NatHERS Results

APARTMENT TYPE	HEATING (MJ/m²)	COOLING (MJ/m²)	TOTAL	STAR RATING
A1	19.8	21.8	41.6	**7.1**
B	17.3	16.4	33.7	**7.9**
C2	25.9	17.0	42.9	**7.0**

The project is committed to meet the minimum requirement under the NCC 2022 of 7 stars

7 URBAN ECOLOGY

Urban ecology is crucial for conserving biodiversity and enhancing urban life. Well-planned buildings and landscapes protect biodiversity and support sustainable practices, including low water and fertilizer use and the selection of native plants.

The current site has no existing vegetation. The proposed redevelopment restores ecological function through:

- >70% native or drought-tolerant species mix
- Deep soil zones along Sewell Street and St Peters Road
- Shrubs and low water planting
- Pedestrian-oriented front verge interface, improving amenity and microclimate

Figure 12- Landscaping allocated to the townhouses

7.1 HEAT RESILIENCE

The heat island effect occurs when urban areas are warmer than their rural surroundings due to the built environment. The roof and external finishes have been reviewed to ensure heat resilience and long-term comfort. A light-coloured roof with a Solar Reflectance Index (SRI) ≥70 has been proposed to minimise heat absorption and reduce urban heat island effects.

The strategies that can be used to reduce the heat island effect are:

- Vegetation
- Green roofs
- Roofing materials, including shading structures, having the following:
  – For roof pitched <15°– a three-year SRI of minimum 64
  – For roof pitched >15°– a three-year SRI of minimum 34
- Unshaded hard-scaping elements with a three-year SRI of minimum 34 or an initial SRI of minimum 39
- Hardscaping elements shaded by overhanging vegetation
- Water bodies and/or water courses

8 WATER EFFICIENCY

8.1 SUSTAINABLE WATER INITIATIVES

Western Australia has a limited potable water supply due to the increases in population and reductions in annual rainfall levels. By reducing demand this will help to alleviate the concerns related to potable water usage. The development aims to achieve a minimum 20% reduction in potable water consumption compared to established benchmarks.

Table 9: WELS Ratings

FIXTURE / EQUIPMENT TYPE	WELS RATING
TAPS	5 Star
TOILETS	4 Star
SHOWERS	3 Star
DISHWASHERS	4 Star
WASHING MACHINES	4 Star

8.2 WATER EFFICIENT LANDSCAPING

Water-efficient landscaping refers to techniques and strategies aimed at conserving water while maintaining aesthetically pleasing and functional outdoor spaces. This is important in Western Australia due to its semi-arid climate conditions, which often result in water scarcity. Key strategies include:

- **Plant Selection:** Choosing native or drought-tolerant plant species that are well-suited to the local climate can significantly reduce water requirements.

- **Soil Improvement:** Improving soil quality through methods such as mulching and composting can enhance water retention and reduce evaporation, thereby optimizing water usage in landscaping.
- **Irrigation Efficiency:** Employing efficient irrigation systems such as drip irrigation or micro-sprinklers helps deliver water directly to plant roots with minimal waste. Additionally, using smart irrigation controllers that adjust watering schedules based on weather conditions and soil moisture levels can further enhance water efficiency.
- **Water Harvesting:** Capturing rainwater through techniques like rainwater tanks will allow for on-site water storage and reuse, reducing reliance on potable water for landscaping needs.
- Overall, water-efficient landscaping plays a vital role in conserving water resources, promoting sustainability, and mitigating the impacts of water scarcity in urban and rural environments.

9 SUSTAINABLE TRANSPORT/ ACCESSABILITY

9.1 BICYLCE PARKING FACILITIES & SUSTAINABLE TRANSPORT FACILITIES

The intention of this category is to reduce occupants' reliance on carbon-intensive vehicles. To support this, the development will include infrastructure that facilitates the future installation of electric vehicle (EV) charging stations. Additionally, secure bike storage will be provided to encourage cycling as a sustainable mode of transportation.

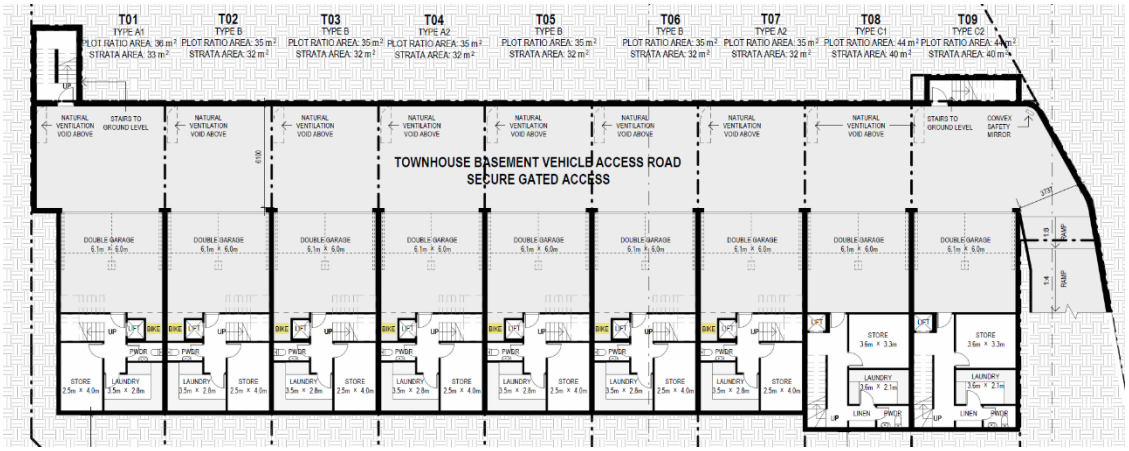

Figure 13 - Basement plan indicating bike storage

9.2 WALKABILITY TO THE SITE

The building's design and location encourage walking to and from several amenities within the vicinity. This means designing roads within the building boundary to prioritise pedestrians, and either providing within, or being located close to, several amenities.

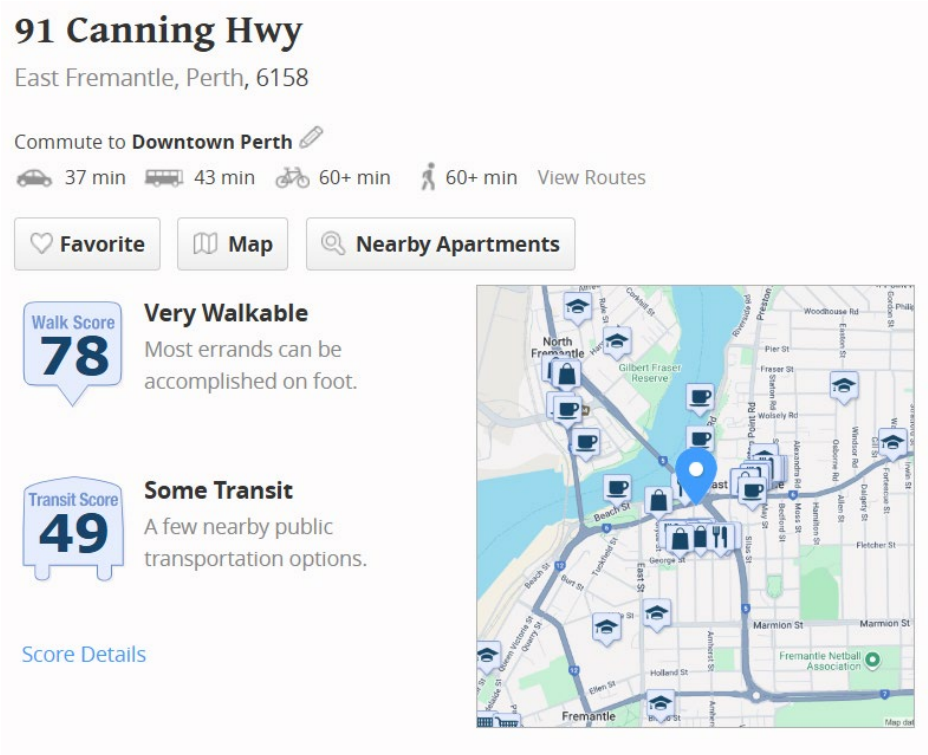

Figure 14: Walkability Score of the Proposed Development

10 INDOOR ENVIRONTMENT QUALITY

10.1 INTERNAL FINISHES

Internal finishes (paints, adhesives, sealants, carpets) with low VOC and formaldehyde content will be prioritised.

Using low VOC (volatile organic compounds) products offers numerous benefits, primarily by enhancing indoor air quality and promoting better health. These products release fewer harmful chemicals, reducing the risk of respiratory issues, headaches, dizziness, and long-term health problems. Environmentally, low VOC products contribute less to air pollution and smog formation, supporting a healthier ecosystem.

10.2 PAINTS, ADHESIVES, AND SEALANTS

To meet the requirements, at least 95% of internally applied paints, adhesives, sealants (by volume), and carpets (by area) must meet TVOC (Total Volatile Organic Compounds) limits. Compliance with these limits can be achieved through one of the following methods:

1. **Product Certification Scheme:** The contractor can use products that are certified under a recognized and current Product Certification Scheme at the time of purchase. These schemes assess and verify the TVOC content of the materials, ensuring they meet the specified limits.
2. **Laboratory Product Testing**: If there are no certified products available, the contractor can conduct laboratory testing on the paints, adhesives, and sealants, to determine their TVOC content. The testing should be carried out using the whole paint, including water and tinters, to obtain accurate results.

3. **Absence of Non-compliant Materials**: Alternatively, if none of the materials mentioned (paints, adhesives, sealants, and carpets) are present at the time of practical completion (PC), and thus no TVOC emissions are expected, compliance can be achieved.

All paints used for internal application on the job are to have a low TVOC content as outlined below. TVOC content must be based on whole paint (water and tinters included):

Table 10: Paint VOC limits

PRODUCT TYPE / SUBCATEGORY	MAX TVOC CONTENT (G/L OF READY TO USE PRODUCT)
Walls and ceilings – Any gloss level	16
Trim, varnishes and wood stains	75
Primers, sealers and prep coats	65

Maximum TVOC Content Limits for Paints, Varnishes and Protective Coatings
*EU Directive
The TVOC content of the 'ready-to-use' paint shall be theoretically calculated as the sum total of the VOCs of each of the raw material component comprising the paint.

Where the TVOC content of individual components is not known, it must be determined experimentally by one of the following testing methods as appropriate:

- ISO Method 17895 (2005), for a material with a presumed VOC content <1%;
- ISO Method 11890-2 (2006), for a material with a presumed VOC <15%;
- ISO Method 11890-1 (2007), for a material with a presumed VOC content >15%;
- ASTM D3960, which is comprised of four individual testing procedures that measures TVOC (D2369) as well as density (D1475) and water content (D4017). Exempt compounds (D4457) must not be subtracted in the calculation of VOC content.

The contractor must obtain written approval from the design team before using any sealant, adhesive, paint, flooring or fit out items. This approval will be contingent on the provision of proof that the product has a VOC content below that noted above.

At the end of construction, the contractor is required to undertake a final audit to ensure that the correct products have been used.

All sealants used in an internal application on the job are to have a low TVOC content as outlined below.

Table 11: Adhesives/Sealants VOC limits

PRODUCT	MAXIMUM TVOC CONTENT (G/LITRE)
General purpose adhesives and sealants	50
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants and adhesives	250
Structural glazing adhesive, wood flooring and laminate adhesives and sealants	100
Primers, sealers and prep coats	65

One and two pack performance coatings for floors	140

Maximum TVOC limits for Adhesives & Sealants
*Sealants used to enhance the fire- and water-proofing properties are included.

The testing method applicable to adhesive and sealants is only ASTM D3960 as detailed above for paints. For more information on ASTM D3960 refer to South Coast Air Quality Management District Rule 1168.

The contractor must obtain written approval from the design team before using any sealant, adhesive, paint, flooring or fitout items. This approval will be contingent on the provision of proof that the product has a VOC content below that noted above.

At the end of construction, the contractor is required to undertake a final audit to ensure that the correct products have been used.

All carpets and/or other flooring used on the project are to have low TVOC emission rates as outlined below.

Table 12: Carpet VOC limits

ALL CARPET/FLOORING PRODUCTS MUST COMPLY WITH TVOC EMISSION LEVELS	
Total VOC limit	0.5 mg/m^2 per hour
4-pc (4-Phenolcycohexene) limit	0.05 mg/m^2 per hour

Compliance Testing: Refer to Carpet and Rug Institute Green Label (US) OR American Society for Testing and Materials (ASTM) D5116 Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Material/Products OR

For carpets and laminate floor coverings, an option for demonstrating compliance with TVOC levels is as follows: ISO 10580 (also known as ISO/TC 219) – Document N238 – Resilient,

Textile and Laminate Floor Coverings Evaluation of Volatile Organic Compounds Emissions, with a limit of 500µg/m^2/hr at 24 hours. OR

For floor coverings (other than carpet), an option for demonstrating compliance with TVOC levels is as follows:

ISO16000 parts 9, 10 and 11 (also known as the EN 13419), with a TVOC limit at three days of 5mg/m^2/h and 0.5mg/m^2/h at 28 days.

Carpet or other flooring installed as part of the base building works prior to fit out works, can be deemed re-used for the purpose of this credit.

The contractor must obtain written approval from the design team before using any sealant, adhesive, paint, flooring or fit out items. This approval will be contingent on the provision of proof that the product has a VOC content below that noted above.

At the end of construction, the contractor is required to undertake a final audit to ensure that the correct products have been used.

There are two options for demonstrating compliance for carpets, as follows:

Option A - Product Certification:

Carpets certified under a relevant Product Certification Scheme standard recognised by the GBCA under the GBCA assessment Framework for Product Certification Schemes are deemed to satisfy the requirements of this criterion. Relevant GBCA recognized standards are listed on the GBCA web site. The certificate must be current at the time of project registration or submission and list the relevant product name and model.

A UL GREENGUARD Children & Schools® certification current at the time of project registration or submission is another acceptable evidence for demonstrating compliant TVOC levels for carpets.

Option B - Experimental Testing

All carpets comply with the Total VOC (TVOC) limits within Table below. The emission levels detailed in this table must be established by a NATA or another ISO/IEC17025 accreditation laboratory.

Table 13: Flooring VOC limits

ALL CARPET/FLOORING PRODUCTS MUST COMPLY WITH TVOC EMISSION LEVELS – TO ASTM D5116 TEST PROTOCOL	
Carpets using ASTM D5116 Test Protocol:	
Total VOC limit	0.5 mg/m^2 per hour
4-pc (4-Phenolcycohexene) limit	0.05 mg/m^2 per hour
Carpet using ISO 16000 test protocol (also known as EN 13419)	
TVOC at three days-	0.5 mg/sqm per hour
Flooring using ISO 10580 (also known as ISO/TC 219) – Document	
TVOC at 24 hours - 0	0.5mg/sqm per hour

10.3 FORMALDEHYDE MINIMISATION

All engineered wood products used internally, including exposed and concealed applications, must have low formaldehyde emissions as defined in the table below, or contain no formaldehyde. Engineered wood products are defined as particleboard, plywood, veneer, MDF, Laminated Veneer Lumber (LVL), High-Pressure Laminate (HPL), Compact Laminate and decorative overlaid wood panels and include both finished and unfinished products.

These requirements are not applicable to exterior applications, formwork, internal car park applications, reused engineered wood products or raw timber.

The contractor must obtain approval from the design team before substituting any product.

The limits listed here are defined according to the test method. The levels listed are equivalent results for different test procedures.

Table 14: Formaldehyde emission limits

TEST PROTOCOL	EMISSION LIMIT/ UNIT OF MEASUREMENTS
AS/NZS 2269:2004, testing procedure AS/NZS 2098.11:2005 method 10 for Plywood	< 1.0 mg/L
AS/NZS 1859.1:2004 - Particle Board, with use of testing procedure AS/NZS 4266.16:2004 method 16	< 1.5 mg/L
AS/NZS 1859.2:2004 - MDF, with use of testing procedure AS/NZS 4266.16:2004 method 16	< 1.0 mg/L
JIS A 5908:2003- Particle Board and Plywood, with use of testing procedure JIS A 1460	< 1.0 mg/L
JIS A 5905:2003 - MDF, with use of testing procedure JIS A 1460	< 1.0 mg/L
JIS A1901 (not applicable to Plywood)	< 1.0 mg/L
ASTM D5116	<0.1 (+/- 0.0005) mg/m^{2}hr (may also be represented as mg/m^2/hr)
ISO 16000 part 9, 10 and 11 (also known as EN 13419)	<0.1 (+/- 0.0005) mg/m^{2}hr (may also be represented as mg/m^2/hr)
ASTM D6007	0.12mg/m^3*
ASTM E1333	0.12mg/m^3**
EN 717-1 (also known as DIN EN 717-1)	0.12 mg/m^3
EN 717-2 (also known as DIN EN 717-2)	3.5 mg/m^{2}hr (may also be represented as mg/m^2/hr).
*The test report must confirm that the conditions of Table 1 comply for the particular wood product type, the final results must be presented in EN 717-1 equivalent (as presented in the table) using the correlation ratio of 0.98.	

11 CONCLUSION

In conclusion, the report outlines sustainability commitments that align with core principles, focusing on energy and water efficiency. It highlights efforts to promote environmental responsibility and resource efficiency, underscoring a commitment to a greener, more sustainable future.

Table 15: Sustainability Commitments

DESCRIPTION	GOAL	SUSTAINABILITY COMMITMENTS
STRUCTURE DESIGN EFFICIENCY	Integrate passive solar design principles into optimising solar access in winter and shading in summer.	• Enhance solar passive performance by incorporating shading devices on north and west-facing windows to reduce summer heat gain and improve visual interest. • Above **60%** of the combined living and bedroom area of each unit have high level of daylight (above 160 Lux). • Building orientation and design to maximise natural ventilation and promote cooling opportunities • External shading devices to minimise heat gains • Building form and orientation to maximise natural daylighting
ENERGY EFFICIENCY	Enhance energy performance by reducing consumption through efficient design and the use of renewable and low-energy systems.	• Efficient LED Lighting. • Provision for future solar photovoltaic (PV) system to supply renewable energy. • All units meet the minimum NatHERS energy efficiency requirement of **7 stars for sole occupancy**, based on the NCC 2022.
WATER EFFICIENCY	Water efficient fixtures and Landscaping.	• High WELS Ratings • Water sensitive urban design, drip irrigation.
URBAN ECOLOGY	Reduce impacts of heat island effect	• Light roof colour (SRI ≥ 0.64). • Incorporate vegetation and green spaces around the building to provide shading and reduce surrounding air temperatures. • Landscaping plant selections are water-wise species
SUSTAINABLE TRANSPORT/ ACCESSABILITY	Low carbon options	• Provision for secure bicycle storage area. • Access to public transport
INDOOR ENVIRONMENT QUALITY	Enhance indoor air quality	• Natural ventilation to all townhouses. • Low VOC and Low Formaldehyde products to be used. • Minimum 95% of internally applied paints, adhesives, sealants (by volume), and carpets (by area) must meet TVOC limits.