

**ONE SYDNEY HARBOUR  
BARANGAROO**

**RESIDENTIAL BUILDING R5  
BARANGAROO SOUTH**

---

**ESD REPORT – DEVELOPMENT APPLICATION  
11 AUGUST 2016**

---

# One Sydney Harbour

## ESD Report Residential Building R5



### Document History

|                        |   |
|------------------------|---|
| <b>Prepared By</b>     | Daniel Grunbaum   |
| <b>Coordinated By</b>  | Daniel Grunbaum / Eunice Lee  |
| <b>Approved By</b>     | Graham Carter   |
| <b>Project Manager</b> |   |
| <b>File path</b>       | G:\Sustainability\Projects\Committed Projects\Barangaroo<br>1B\D_Reports\Drafts\Appendix_O_20160811_OSH_R5_ESD_Report Rev v8.docx |

| Issue | Addendum       | Revision                           | Date     |
|-------|----------------|------------------------------------|----------|
|       | Draft          | Issued for comment                 | 12-12-14 |
|       | Revised Draft  | Issued for comment                 | 02-02-15 |
|       | Final Draft    | Issue for final comment            | 24-04-15 |
|       | Final Draft v2 | Issued to JBA for comment          | 18-05-15 |
|       | Final Draft v5 | Issued to LLMP for comment         | 25-06-15 |
|       | Final Draft v6 | Issued for comment                 | 01-07-15 |
|       | Final v7       | Issued for BDA Review              | 19-08-15 |
|       | v8             | Issued for Development Application | 11-08-16 |

### Technical Enquiries

|   |  |
|---|--|
| Graham Carter<br>Position: Sustainable Design Manager                               | Graham Carter<br>Position: Sustainable Design Manager                        |
| Lendlease, Design, Building Pty Limited   | Lendlease, Design, Building Pty Limited                                      |
| Telephone: (02) 9236 6111   | Telephone: (02) 9236 6111  |
| Email: <a href="mailto:graham.carter@lendlease.com">graham.carter@lendlease.com</a> | <a href="mailto:graham.carter@lendlease.com">graham.carter@lendlease.com</a> |
|   |  |

### General Enquiries



**Table of Contents**

|            |  |           |
|------------|--|-----------|
| <b>1.0</b> | <b>Executive Summary.....</b>                              | <b>4</b>  |
| <b>2.0</b> | <b>Introduction.....</b>                                   | <b>5</b>  |
| 2.1        | Overview of Proposed Development .....                     | 5         |
| 2.2        | Site Location.....   | 5         |
| 2.3        | Purpose of This Report.....                                | 6         |
| 2.4        | Referenced Documentation .....                             | 6         |
| <b>3.0</b> | <b>Precinct Initiatives .....</b>                          | <b>7</b>  |
| <b>4.0</b> | <b>R5 Residential and Sustainability Contribution.....</b> | <b>8</b>  |
| <b>5.0</b> | <b>Conclusion.....</b>                                     | <b>10</b> |
| <b>6.0</b> | <b>Appendix – BASIX Summary Report.....</b>                | <b>11</b> |
| 6.1        | Introduction and Summary.....                              | 11        |
| 6.2        | Spatial Details .....                                      | 11        |
| 6.3        | Water.....   | 12        |
| 6.4        | Thermal Comfort .....                                      | 14        |
| 6.5        | Energy.....  | 15        |

### 1.0 Executive Summary

This ESD summary report has been produced by Lendlease Design to describe the initiatives that are to be included within residential building R5 proposed as part of Stage 1B Barangaroo South, which contributes to the achievement of the broader sustainability commitments for the Barangaroo Site under the Concept Plan.

This project aims to deliver a sustainable residential building, with low operational energy consumption, reduced potable water use, minimisation of waste to landfill and appropriate materials selection while at the same time maintaining a high level of indoor environmental quality through appropriate mechanical design, façade configuration and materials selection.

This report discusses project planning commitments, and the initiatives proposed to ensure that these commitments are achieved. The proposed R5 Residential Project will appropriately contribute towards the achievement of the sustainability requirements included in the Statement of Commitments of the approved Concept Plan, specifically there is a commitment to achieving a 5 Star Green Star rating and to meet the requirements of the Building Sustainability Index (BASIX).

The proposed residential development will benefit from Barangaroo South's precinct sustainability initiatives such as the district cooling plant, on-site renewables and generation strategy and precinct recycled water plant. These initiatives are essential to ensure that Barangaroo South achieves sustainability targets such as:

- Minimal operational energy consumption off-set by offsite renewable energy to ensure a carbon neutral precinct.
- The capability to export more recycled water than potable water is imported to ensure a positive water impact.
- An 80% operational waste diverted from landfill, targeting zero net waste to landfill by 2020.
- 20% reduction in embodied carbon (cradle to gate) not including tenant fit outs.
- On site renewables of an amount to offset public realm and recycled water treatment plant energy use.
- Green Star Multi Unit Residential Design and As-Built ratings for all eligible buildings within the precinct.

With the precinct sustainability initiatives and building specific initiatives, the proposed residential development will achieve the sustainability aspirations set for the Barangaroo South precinct and contribute to the achievement of the broader Barangaroo precinct-wide aspirations, as expressed in the Statement of Commitments of the concept plan. In particular, initiatives targeted as part of the Green Star Multi Unit Residential v1 tool will ensure significant sustainability principles will be incorporated into the design, appropriate management practices are applied through the construction period and facilities and resources are provided to ensure the delivery and operation of the building achieves the sustainability objectives.

## 2.0 Introduction

This report supports a State Significant Development Application (SSD 6966) submitted to the Minister for Planning pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Development Application (DA) seeks approval for construction of a residential flat building (known as Residential Building R5) and associated works at Barangaroo South as described in the Overview of Proposed Development section of this report.

### 2.1 Overview of Proposed Development

The Residential Building R5 DA seeks approval for the construction and use of a 30 storey residential flat building comprising 151 apartments, ground floor retail, the allocation of car parking, services, plant and storage within the Stage 1B Basement (subject of a separate concurrent DA), and the construction of ancillary landscaping and temporary public domain.

Approval for the construction of Residential Building R5's core and associated plant and services within the basement is being sought as part of the concurrent Stage 1B Basement DA and do not form part of this DA.

### 2.2 Site Location

Barangaroo is located on the north western edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by large CBD commercial tenants.

The Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – Barangaroo Reserve, Barangaroo Central and Barangaroo South.

The R5 DA Site area is located within Barangaroo South as shown in Figure 1. The DA Site is located on land generally known and identified in the approved Concept Plan as Block 5.

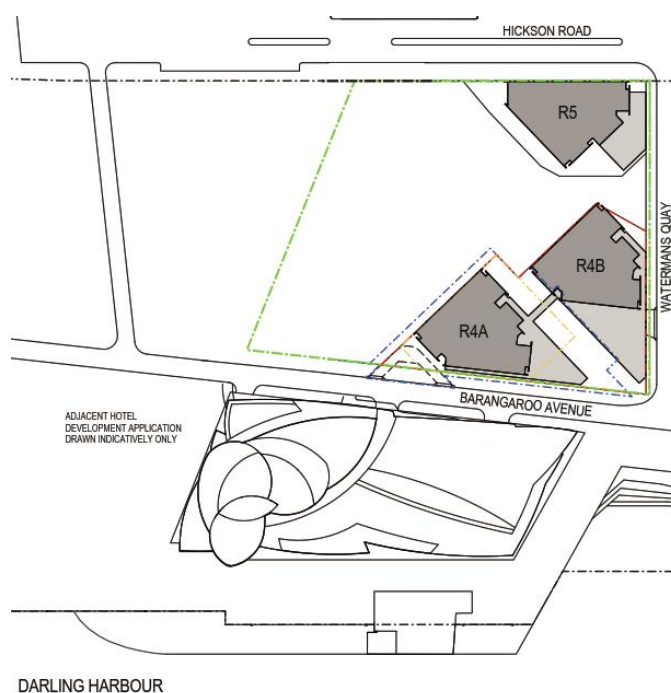


Figure 1: Stage 1B Barangaroo South

### 2.3 Purpose of This Report

This report has been prepared to accompany the Project Application for Residential Building R5 and associated works at Barangaroo South. It outlines the targets proposed for the precinct, which contribute to the achievement of the broader sustainability commitments for the Barangaroo Site under the Concept Plan. It also addresses the relevant Secretary's Environmental Assessment Requirements for the project, in particular demonstrating the compliance of the works with the relevant requirements from the Statement of Commitments of the Concept Plan. It should be noted that Concept Plan (Mod 8) which is currently under assessment, does not seek to modify the approved commitments for Barangaroo relating to ESD.

The ESD initiatives for the development aim to be world class, and will provide support for and complement work by the Council of the City of Sydney on its Sustainable Sydney 2030 plans. The Barangaroo South development aims to provide:

- Inspiring architecture with healthy, light filled homes and workplaces;
- Low energy buildings that respond to the environment and the people within;
- Transport links and options that make it easy to leave the car at home;
- A mixed use precinct with outdoor spaces that everyone can share and enjoy;
- Centralised precinct services that support a carbon neutral, water positive and zero waste outcome;
- A long term Governance structure that also delivers carbon reduction and community benefits;
- A focused approach on delivering social initiatives that will assist in establishing a healthy and happy community integrated into the Sydney CBD; and
- A broad based skill development program that will meet a wide range of learning and skilling needs – from blue and white collar to green.

### 2.4 Referenced Documentation

The calculations for Nationwide House Energy Rating Scheme (NatHERS) and Building Sustainability Index (BASIX) have been undertaken in line with the DA drawings.

Assumptions for energy and water consuming building services such as lighting, mechanical, hydraulic, and vertical transportation services are in line with the Building Services DA reports. Furthermore, the environmental performance of Residential Building R5 is supported by infrastructure within the basement as outlined in the Stage 1B Basement SSDA submission (SSD 6969). Where insufficient information is available, defaults in line with NatHERS and BASIX guidelines have been used.

This report is based on the above-referenced documentation supplied to Lendlease Design at the date of writing. This documentation is subject to change as the design progresses and specific outcomes may be substituted or omitted whilst still targeting the sustainability aspirations for the Barangaroo South precinct and maintaining compliance.

### 3.0 Precinct Initiatives

The Barangaroo South precinct has established a range of significant sustainability targets that will be delivered progressively throughout the development phase to contribute to the broader Barangaroo Concept Plan Commitments. This short overview provides the context for considering the Residential R5 application against the aspirations of the broader precinct. The descriptions in the section below are provided for information only and will be subject to more detailed reports and approvals for detailed design, prior to the issue of construction and occupation certificates, as necessary. The proposed precinct wide targets are:

#### Healthy Buildings:

- 5-Star Green Star Multi Unit Residential Design and As-Built ratings for residential buildings;
- Attuned to Sydney's climate and connected to outdoors;
- Passive design, low energy buildings; and
- Use of some sustainable materials, including recycled content and low emissions.

#### Energy and Carbon:

- A carbon neutral outcome supported by the use of new offsite renewable energy generation;
- Significant reduction in building energy consumption. The residential buildings throughout the precinct are targeting a 55% carbon reduction from business as usual performance;
- 20% reduction in embodied carbon within the built form;
- Efficient precinct infrastructure using central cooling plant and harbour heat rejection; and
- Onsite photovoltaic generation sized for the public domain and recycled water treatment plant.

#### Water Positive:

- A water positive outcome – where more water is exported than potable water is imported;
- On-site waste water treatment and water recycling;
- Capacity to export recycled water allowing neighbours to reduce their potable water demands; and
- Sewer mining to reduce network demands.

#### Zero Waste:

- Greater than 90% diversion of construction waste from landfill.
- Greater than 80% diversion of operational waste from landfill

#### Sustainable Transport:

- A new connection/entry point for the CBD (with provision for light rail, ferries, and the Barangaroo Pedestrian Link);
- Car parking ratios resulting in less car parking spaces than normally provided for a CBD commercial building;
- Infrastructure and support for cyclists and pedestrians;
- Real-time commuter updates;
- Green travel plan to promote vehicle sharing, small cars and electric cars; and
- Safe, low-speed onsite environment.

#### Landscape and Biodiversity:

- Use of native flora and encourage habitats for fauna;
- Inclusion of water-sensitive urban design;
- Planning for climate change; and
- Landscaped public spaces and selected green roof features.

Many of these targets involve various third parties and authorities, and will need partnerships, and commitments to achieve these targets. These world leading initiatives will be evaluated, measured and reviewed progressively throughout the project life.

## 4.0 R5 Residential and Sustainability Contribution

The proposed Residential Building R5 will appropriately contribute towards the achievement of the sustainability requirements included in the Statement of Commitments of the approved Concept Plan and proposed Mod8. The table below summarises these requirements and confirms how the project will address each requirement.

| Category    | Clause | Approved Concept Plan  | Residential Building R5 Commitment   |
|-------------|--------|--|--|
| General ESD | 78     | There is to be an environmental focus on strategies for Water, Energy, Micro-Climate, Environmental Quality / Amenity, Landscape, Transport, Waste and Materials for the development. Each building on site will achieve the primary benchmark of a “5 star” standard of : Green Star 5 star, and Residential: Green Star Residential score >60, and each development will be required to demonstrate how it satisfies each of the following Key Performance Indicators for each of the ESD focus areas referred to below. | The R5 building will be designed and constructed to achieve a 5 Star Green Star Multi Unit Residential v1 Design and As-Built ratings.   |
| Water       | 79     | There is to be a 35% reduction in Potable Water Consumption compared to a standard practice development and a 40% reduction in flow to sewer compared to a standard practice development.  | The proposed R5 development will consume approximately 46% less mains water than average dwellings within NSW. This BASIX Water Score reported does not allow for the precinct recycling of fire system test water and assumes poorer than 1 Star washing machines thus the likely water performance is 50%+ better than the BASIX benchmark. This is calculated using the NSW Building Sustainability Index (BASIX). Flow to sewer will be reduced by 90%+ as all waste is processed by the recycled water treatment plant. |

| Category      | Clause | Approved Concept Plan  | Residential Building R5 Commitment   |
|---------------|--------|--|--|
| Energy        | 80     | There is to be a 35% reduction in Greenhouse Gas Emissions compared to a standard practice development. 20% of power is to be purchased from low impact, renewable sources or alternatively there should be a 20% reduction in GHG emissions through carbon offsets. The purchase of renewable energy should be at World Best Practice level.  | The proposed R5 development has the potential to result in 55% less greenhouse gas emissions when compared to an existing building benchmark of 127kgCO <sub>2e</sub> /m <sup>2</sup> . This is calculated using the NSW Building Sustainability Index (BASIX). Residual emissions will be offset as part of Barangaroo South's carbon neutral commitment. |
| Micro-Climate | 81     | Key public open spaces (parks and squares) are to receive direct sunlight in mid-winter.   | The shadow diagrams for the development indicate that Hickson Park to the north will receive direct sunlight during mid-winter.  |
| Landscape     | 82     | Primarily non-invasive plant species are to be used on the site.   | This requirement is met by the proposed development through the choice of appropriate non-invasive plant species.  |
| Transport     | 83     | Ensure that there is sufficient public transport to achieve points under the public transport credit for Green Star Rating Tools for buildings and a future Green Star Tool for residential buildings.   | Proximity to Wynyard station trains and buses within short walking distances will ensure a high score in the Green Star public transport credit.   |
| Waste         | 84     | Centralised recycling areas are to be provided in all buildings and 100% of waste bins for public use are to allow for waste separation.   | Waste collection areas for the building will be in the basement and will allow for the streaming of waste and recyclables.   |
| Wind          | 85     | Wind tunnel modelling and verification of proposed treatments will be carried out at the building design application stage due to the significant exposure of the site to the southerly and westerly winds. Any development proposal for the southern portion of the site should be subjected to a wind tunnel study, carried out in accordance with the procedures outlined in industry recognised guidelines such as the Australasian Wind Engineering Society Quality Assurance Manual. | This is addressed by a wind report.  |



## **5.0 Conclusion**

The proposed Residential Building R5 will support the sustainability aspirations set for the Barangaroo South precinct and the broader Barangaroo site, as expressed by the Concept Plan Statement of Commitments. In addition, the project is committed to a 5 Star Green Star Multi Unit Residential rating and will meet the requirements of the Building Sustainability Index (BASIX). The project will benefit from the precinct wide sustainability initiatives such as the district cooling plant, on-site renewables strategy and precinct recycled water plant. These initiatives are essential to ensure the precinct achieves the many sustainability objectives.

## 6.0 Appendix – BASIX Summary Report

### 6.1 Introduction and Summary

This appendix summarises the assumptions made for the BASIX assessment of the One Sydney Harbour residential buildings (R4a, R4b, and R5) within the Barangaroo Stage 1B development. Given limitations of the BASIX tool, the three buildings will be assessed independently. These assumptions are in line with current design intent.

The Building Sustainability Index (BASIX) sets energy reduction, thermal comfort and water reduction targets for new residential developments based on the average energy and water consumption of dwellings in NSW. For buildings with 6 or more stories such as the Barangaroo Stage 1B residential buildings, a 20% reduction in energy consumption and a 40% reduction in water use are required to pass.

For Thermal Comfort, BASIX awards a pass/fail based on heating and cooling maximum average loads set by BASIX; however the thermal performance of a development will affect its energy score. A development that has excellent thermal performance reduces its reliance upon air conditioning, and is therefore awarded in BASIX with a positive contribution to its energy score.

The results of the BASIX assessment with the inputs as described in the sections below are:

|     | Energy        | Thermal Comfort | Water         |
|-----|---------------|-----------------|---------------|
| R4A | 21% reduction | Pass            | 45% reduction |
| R4B | 21% reduction | Pass            | 44% reduction |
| R5  | 35% reduction | Pass            | 46% reduction |

### 6.2 Spatial Details

Due to limitations in the BASIX tool, the BASIX assessment has been split across 3 certificates, one per residential building. As directed by ePlanning NSW, shared facilities within the podiums or shared basement have been pro-rated to each tower by the number of dwellings:

|                     | Units | R4A | R4B | R5  |
|---------------------|-------|-----|-----|-----|
| Number of dwellings | No.   | 327 | 297 | 151 |

In summary, for the purposes of this assessment:

- Pools, gyms and function rooms have been allocated to the three buildings in proportion to apartment numbers.
- The basement has elements dedicated to each residential building.
- The basement also has shared facilities like carparks which are assigned in proportion to apartment numbers.

### 6.3 Water

This section outlines the assumptions made for the water consumption and supply.

#### Central system & common areas Water

##### Summary

| Rooftop garden area   | Units          | R4A | R4B | R5  |
|---|----------------|-----|-----|-----|
| Common area lawn <sup>1</sup>   | m <sup>2</sup> | 135 | 96  | 97  |
| Common area garden – vegetated area excluding lawn <sup>1</sup>       | m <sup>2</sup> | 79  | 163 | 164 |
| Common area garden – indigenous or low water use species <sup>1</sup> | m <sup>2</sup> | 0   | 0   | 0   |

Notes 1) For the common podium roof top garden, native or endemic species should be targeted to minimise water consumption. However the area has been assumed to be covered half with exotic species and half with lawn to enable flexibility as the design progresses.

##### Alternative Water Supply & Use

| Barangaroo Recycled Water Treatment Plant                   | Units          | R4A        | R4B | R5 |
|---|----------------|------------|-----|----|
| Water supply <sup>1</sup>                                   | -              | See note 1 |     |    |
| Area of common landscape – using recycled water             | m <sup>2</sup> | 0          | 0   | 0  |
| No. of car washing bays <sup>2</sup> – using recycled water | No.            | 1          | 1   | 0  |

Notes 1) The residential towers will be connected to the Barangaroo South Recycled Water Treatment Plant (RWTP) as an alternative water supply. The precinct RWTP is designed to fully meet the non-potable water demands, consistent with the district plant's design.  
2) There are 2 car washing bays in the shared basement, these are available to residents in all towers but have been apportioned to R4a & R4b for the purposes of BASIX.

##### Pool and Spa

| Pool                                  | Units | R4A    | R4B     | R5  |
|---------------------------------------|-------|--------|---------|-----|
| Indoor/Outdoor                        |       | Indoor | Outdoor | n/a |
| Volume of swimming pool <sup>1</sup>  | kL    | 150    | 76      | NA  |
| Will the pool be shaded? <sup>2</sup> | -     | Yes    | No      | NA  |

| Spa                                  | Units | R4A    | R4B     | R5  |
|--------------------------------------|-------|--------|---------|-----|
| Indoor/Outdoor                       |       | Indoor | Outdoor | n/a |
| Volume of spa <sup>1</sup>           | kL    | 23.1   |         | NA  |
| Spa cover?                           | -     | Yes    |         | NA  |
| Will the spa be shaded? <sup>2</sup> | -     | Yes    |         | NA  |

Notes 1) R4A & R4B have shared podium facilities; but pool and spa facilities are rated by attached building.  
2) Shade must be either:

- Opaque,
- Have a shade ratio of not less than 80%, or
- Have a shading co-efficient of less than 0.35.

### Other

It has been assumed that the common shower and amenities in all buildings are fitted with water efficient fixtures as per the table below. The fire sprinkler systems will be tested in a closed system, where the test water will be reticulated through the basement and drained to the precinct fire tank in stage 1A.

| Common area fixtures   | WELS rating                            |
|------------------------|--|
| <b>Showerheads</b>     | <b>3 star (&gt; 7.5, but ≤ 9L/min)</b> |
| <b>Toilets</b>         | <b>4 star</b>                          |
| <b>Taps</b>            | <b>4 star</b>                          |
| <b>Clothes Washers</b> | <b>No common laundry facility</b>      |

| Fire Sprinkler System   | Yes/No    |
|---|-----------|
| <b>Fire sprinkler contained in a closed system?<sup>1</sup></b> | <b>No</b> |

Notes 1) The fire system test water is predominantly recycled into the precinct fire services water tank. Due to gravity return not being possible to the fire services tank, a small amount of test water at level B1 and below is returned to the recycled water treatment plant. As this does not strictly meet the closed system criteria within BASIX we have not assumed this benefit within BASIX. We have not pursued an alternative assessment within BASIX to recognise the benefit as it is not needed for compliance.

### Individual Dwellings Water

#### Fixtures and Alternative Water

The assumptions listed below have been made for the water fixtures and fittings installed for all dwellings in all buildings. The Green Building Council of Australia awards appliances that have a WELS rating within one star of the highest rating available.

| Fixtures       | Water supply                     | WELS rating   |
|----------------|----------------------------------|---|
| Showerheads    | <b>Potable mains</b>             | <b>3 star (&gt; 7.5 L/min and ≤ 9 /min)</b>                       |
| Toilets        | <b>Blackwater plant</b>          | <b>4 star</b>   |
| Kitchen taps   | <b>Potable mains</b>             | <b>4 star</b>   |
| Bathroom taps  | <b>Potable mains</b>             | <b>4 star</b>   |
| Clothes washer | <b>Potable mains<sup>1</sup></b> | <b>Not specified</b>  |
| Dishwasher     | <b>Potable mains</b>             | <b>Low/mid rise - 5.0 star<br/>High rise/penthouse - 5.5 star</b> |

Notes 1) It is proposed that both potable and non-potable water connections are provided to laundries. Potable water has been assumed here to give a conservative result.

It is assumed that:

- There is no private landscaping to the dwellings and that all balconies are hard surface. Any private landscaping to the penthouses should be confirmed following the layout.
- A hot water diversion system will not be installed.

#### Pool & Spa

The following assumptions were made for the private pools to the penthouses.

|               | R4a Penthouse   | R4b Penthouse   | R5 Penthouse    |
|---------------|-----------------|-----------------|-----------------|
| Pool location | <b>Outdoors</b> | <b>Outdoors</b> | <b>Outdoors</b> |
| Pool volume   | <b>43 kL</b>    | <b>43 kL</b>    | <b>22 kL</b>    |
| Pool cover    | <b>Yes</b>      | <b>Yes</b>      | <b>Yes</b>      |
| Pool shaded   | <b>Yes</b>      | <b>Yes</b>      | <b>Yes</b>      |

It is assumed that:

|                      | <b>R4a Penthouse</b> | <b>R4b Penthouse</b> | <b>R5 Penthouse</b> |
|----------------------|----------------------|----------------------|---------------------|
| Plunge pool location | <b>Outdoors</b>      | <b>Outdoors</b>      | <b>NA</b>           |
| Pool volume          | <b>7 kL</b>          | <b>7 kL</b>          | <b>NA</b>           |
| Pool pool cover      | <b>Yes</b>           | <b>Yes</b>           | <b>NA</b>           |
| Pool shaded          | <b>Yes</b>           | <b>Yes</b>           | <b>NA</b>           |

#### **6.4 Thermal Comfort**

The dwellings on all representative floors within the Barangaroo One Sydney Harbour (OSH) residential buildings have been assessed to determine the minimum thermal performance characteristics required to meet the Thermal Comfort requirements set by BASIX. The BASIX Thermal Comfort section is passed where the following heating and cooling loads are not exceeded on both an individual dwelling and building average basis:

|                      | <b>Heating<br/>MJ/m<sup>2</sup>.annum</b> | <b>Cooling<br/>MJ/m<sup>2</sup>.annum</b> |
|----------------------|---|---|
| Individual dwellings | <b>50</b>                                 | <b>41</b>                                 |
| Average              | <b>40</b>                                 | <b>32</b>                                 |

The results of the Thermal Comfort section will also contribute towards the Energy score.

There are several façade typologies under consideration for One Sydney Harbour. However, as the design is yet to be fully resolved and BASIX requires very specific assumptions to be made, the DA allows for minimum performance requirements which will allow a number of façade typologies to be utilised and for design development of the facades to occur. The actual performance of the facades is likely to be much better than the minimum performance assumed within this DA.

#### **Model Assumptions**

The site is predominantly open and bounded to the north by the undeveloped Barangaroo Central precinct, to the east by the Sydney CBD and to the west by Sydney Harbour. While the Crown Hotel Resort is planned to the north west of R4A, this does not yet have development approval and cannot be included in the thermal modelling for BASIX. R4B is overshadowed by R4A to the north west. We note that while excluding Crown is a requirement of the BASIX thermal comfort protocol, excluding Crown also provides overall a more conservative result as the west and north west façade minimum performance requirements are primarily governed by solar heat gain in the summer.

The dwellings have been modelled in accordance with the BASIX Thermal Comfort Protocol (December 2014) in the Accurate software package (version 2.3.3.13 SP2). The energy simulation was performed using preloaded Sydney weather data.

Minimum insulation and façade performance requirements are noted on the DA drawings.

### Results

The following table gives the average loads based on the heating and cooling loads extracted from the AccuRate thermal simulations. Due to the large number of thermally unique apartments not all results have been reproduced here.

| Thermal Performance                | Units                    | Compliance Requirement | R4A | R4B | R5  |
|------------------------------------|--------------------------|------------------------|-----|-----|-----|
| Average area adjusted heating load | MJ/m <sup>2</sup> .annum | 40                     | 14  | 16  | 16  |
| Average area adjusted cooling load | MJ/m <sup>2</sup> .annum | 32                     | 25  | 26  | 22  |
| Average star rating                | Stars                    |                        | 6.2 | 6.0 | 6.2 |

One of the main façade typologies proposed for OSH is an open cavity façade which will result in higher performance than assumed in the results above. However, as the design is yet to be completely resolved and BASIX requires very specific assumptions to be made, we have worked to find the minimum performance requirements to allow us to demonstrate BASIX compliance while allowing flexibility as the façade design is resolved. The actual performance will likely be much better than the minimum performance indicated above. This approach minimises the probability of having to resubmit BASIX once the final façade details are known.

### 6.5 Energy

The energy section of BASIX calculates a percentage reduction in expected greenhouse gas emissions compared with an average NSW dwelling. It considers the energy demands of the central systems, as well as the energy demands of the common areas and dwellings from the domestic hot water system, the HVAC system, lifts, lights and appliances.

#### Central Systems

##### Central Domestic Hot Water System

A gas-fired plant is proposed for each building. The hot water reticulation system will be continuous flow, eliminating the heat losses associated with storage systems. The facility to connect to the waste heat from a future cogeneration system located in the Stage 1B basement will be provided.

| Central hot water system     | All Buildings            |
|------------------------------|--------------------------|
| System type                  | Gas fired storage system |
| Insulation – external piping | No external piping       |
| Insulation – internal piping | R 0.75                   |

### Central Cooling and Heating System

The development will be connected to the Barangaroo South precinct district cooling plant (DCP) which will use water from the adjacent harbour for heat rejection. The heating hot water will be provided by one gas fired heating hot water (HHW) unit for each building. These systems will provide the heating and cooling via individual fan coil units to each apartment.

| Central cooling system             | District Cooling Plant              |
|------------------------------------|-------------------------------------|
| System type                        | <b>Chilled water fan coil units</b> |
| Energy source                      | <b>Electric driven compressor</b>   |
| Heat rejection method <sup>1</sup> | <b>Air cooled condenser</b>         |
| Unit efficiency <sup>2</sup>       | <b>High – COP &gt; 4.5</b>          |

| Central heating system | Individual Buildings           |
|------------------------|--------------------------------|
| System type            | <b>Fan coil + heated water</b> |
| Energy source          | <b>Gas HHW Unit</b>            |

- Notes
- 1) The BASIX portal does not have the option of a seawater cooling system. All other BASIX options available assume water consumption (for cooling towers), therefore the air cooled condenser option achieves the closest outcomes.
  - 2) ePlanning NSW have provided an alternative method to acknowledge a portion of the District Cooling Plant's higher efficiency. A COP > 5.5 has been assumed for BASIX purposes.

### Alternative Energy Supply

A rooftop photovoltaic system is proposed for the One Sydney Harbour residential buildings and Stage 1B infrastructure. The relevant inputs into the BASIX tool are displayed in the table below.

| Photovoltaic System                                  | R4a   | R4b   | R5    |
|--|-------|-------|-------|
| <b>Rated electrical output (peak kW)<sup>1</sup></b> | 21 kW | 21 kW | 68 kW |

- Notes
- 1) It has been assumed that 35% of the roof of each tower can be utilised for solar and that 50kWp/m<sup>2</sup> of generation can be achieved for the allocated roof or façade area.

The building will also have the ability to accept electricity and waste heat (where available) from a carbon abatement system should one be provided within the Stage 1B basement in the future. It is proposed that the waste heat from the future system would be reticulated to each building for use in heating pools / spas and for domestic hot water.

### Lifts

The plans indicate the number of lifts in each building. Lifts will also service four basement levels and three podium levels in addition to the residential levels.

| Low rise lifts                           | R4A                               | R4B | R5 |
|--|-----------------------------------|-----|----|
| Quantity                                 | 3                                 | 3   | 2  |
| System type                              | Gearless traction with VVVF motor |     |    |
| Equivalent number of floors <sup>1</sup> | 25                                | 25  | 14 |

| High rise lifts                          | R4A                               | R4B | R5 |
|--|-----------------------------------|-----|----|
| Quantity                                 | 3                                 | 3   | 2  |
| System type                              | Gearless traction with VVVF motor |     |    |
| Equivalent number of floors <sup>1</sup> | 37                                | 27  | 33 |

Notes 1) ePlanning NSW have provided an alternative method to calculate the equivalent number of floors as BASIX does not accurately assess lift energy use where lifts are split into low and high rise in the case of R4a and R4b - it assumes all lifts stop at all floors. BASIX also does not account for recuperation (regenerative braking) and permanent magnet (PM) motors. The proposed lift supplier has estimated the benefits of recuperation and PM motors to be 43% in energy savings relative to the most efficient option that can be selected within the BASIX tool. The ePlanning team have approved an alternative method to input a reduced number of equivalent floors for each lift to account for the energy savings for the above technologies. The equivalent number of floors indicated allows for both the modern technology and for low and high rise lifts.

### Pool and Spa

Pool and spa heating are a significant component of the total energy consumption.

|                                 |            |
|---------------------------------|------------|
| <b>Pool</b>                     | <b>All</b> |
| <b>Pool heating system</b>      | Gas        |
| <b>Pump controlled by timer</b> | Yes        |
| <b>Spa</b>                      | <b>All</b> |
| <b>Spa heating system</b>       | Gas        |
| <b>Pump controlled by timer</b> | Yes        |

### Sauna

There are no saunas.

### Other Central Systems

The following energy details of central systems are additional fields required by BASIX:

|   | All Buildings              |
|---|----------------------------|
| <b>Building Management System (BMS)</b>       | Yes                        |
| <b>Active power factor correction (PFC)</b>   | Yes                        |
| <b>Common area clothes drying line</b>        | No                         |
| <b>Common area electric/gas clothes dryer</b> | No common clothes dryer    |
| <b>Common area clothes washer</b>             | No common laundry facility |

## Common Areas

### Ventilation

| Common Area                                   | Ventilation System Type        | Efficiency Measure           |
|---|--------------------------------|------------------------------|
| Pool & spa area                               | No mechanical ventilation      | -                            |
| Gym   | Air conditioning system        | Time clock or BMS controlled |
| Car park                                      | Ventilation (supply + exhaust) | CO monitors + VSD fan        |
| Lift motor room                               | Air conditioning system        | Thermostatically controlled  |
| Garbage room (Basement)                       | Ventilation exhaust only       | n/a                          |
| Garbage room (Tower)                          | Ventilation exhaust only       | n/a                          |
| Community Room                                | Air conditioning system        | Time clock or BMS controlled |
| Plant or service rooms                        | Ventilation supply only        | Interlocked to light         |
| Grease Arrester rooms                         | Ventilation exhaust only       | None i.e. continuous         |
| Plant or service rooms (Naturally ventilated) | No mechanical ventilation      | n/a                          |
| Plant or service rooms (Conditioned)          | Air conditioning system        | Thermostatically controlled  |
| Other internal common area (Fire stair)       | No mechanical ventilation      | -                            |
| Other internal common area (Amenities)        | Ventilation exhaust only       | Time clock or BMS controlled |
| Ground floor lobby                            | Air conditioning system        | Time clock or BMS controlled |
| Hallways/ lobbies (Podium)                    | Ventilation supply only        | Time clock or BMS controlled |
| Hallways/ lobbies (Tower)                     | Ventilation supply only        | Time clock or BMS controlled |
| Hallways/ lobbies (Basement)                  | Ventilation supply only        | Time clock or BMS controlled |
| Hallways/ lobbies (Keyworker)                 | No mechanical ventilation      | n/a                          |
| Store rooms (Enclosed)                        | Ventilation supply only        | Time clock or BMS controlled |
| Security & Control rooms                      | Air conditioning system        | Time clock or BMS controlled |

It is assumed that common area ventilation will be controlled via the BMCS using daylight or motion sensors, or alternatively by time clock, to ensure that mechanical ventilation energy is only consumed when necessary.

ePlanning NSW have provided an alternative method to account for efficiencies in the duty point and run time estimates of common area ventilation systems that currently cannot be reflected in the BASIX tool.

**Lighting**

The BASIX tool requires inputs for the primary lighting type in each zone, where the primary lighting type is defined as the lamp type fitted to 80% or more of the light fittings to be installed. The following fittings have been assumed for the common areas.

| Common Area  | Primary lighting system type | Efficiency Measure            | BMS controlled? |
|--|------------------------------|-------------------------------|-----------------|
| Swimming pool & spa areas <sup>1</sup>               | Compact fluorescent          | Daylight sensors              | Yes             |
| Gym <sup>1</sup>                                     | Compact fluorescent          | Time clock                    | Yes             |
| Undercover car park area                             | LED                          | Time clock & motion sensor    | Yes             |
| Lift car   | LED                          | Connected to lift call button | Yes             |
| Lift motor room <sup>1</sup>                         | Fluorescent                  | Motion sensors                | Yes             |
| Garbage rooms <sup>1</sup>                           | Fluorescent                  | Motion sensors                | Yes             |
| Community rooms                                      | LED                          | Time clock & motion sensor    | Yes             |
| Plant or service rooms <sup>1</sup>                  | Fluorescent                  | Motion sensors                | Yes             |
| Other internal common area (fire stair) <sup>1</sup> | Fluorescent                  | Motion sensors                | Yes             |
| Other internal common area (amenities) <sup>1</sup>  | Compact Fluorescent          | Motion sensors                | Yes             |
| Ground floor lobby                                   | LED                          | Time clock & motion sensor    | Yes             |
| Hallways/ lobbies                                    | LED                          | Time clock & motion sensor    | Yes             |

Notes 1) These areas should have LED lighting however the BASIX portal does not provide LEDs as a lighting option for these space types.

Similar to the common area mechanical ventilation system, it is assumed that a lighting control system or connection to the BMCS via motion sensors or a time clock will be installed as a controls mechanism to ensure that lighting energy is not consumed where there are no occupants. A lighting controls system will also be implemented in the basement BOH areas, by both motion sensors and time clocks. Furthermore, it is assumed that the lighting controls in the lifts are triggered by the lift call button to avoid wasting energy in these spaces.

ePlanning NSW have provided an alternative method to account for efficiencies in the circuit load and run time estimates of common area lighting that currently cannot be reflected in the BASIX tool.

### Dwellings

#### Hot Water

It is proposed that all domestic hot water (DHW) demand to the dwellings will be met by the central domestic hot water plant.

#### Ventilation

Ventilation within dwellings is provided for bathrooms, kitchens and laundries. Each dwelling has an individual laundry as no common laundry facilities are provided.

| Exhaust location | Exhaust system type                                 | Operation Control    |
|------------------|---|----------------------|
| <b>Bathroom</b>  | Individual motorised damper into central duct + VSD | Manual switch on/off |
| <b>Kitchen</b>   | Individual motorised damper into central duct + VSD | Manual switch on/off |
| <b>Laundry</b>   | Individual motorised damper into central duct + VSD | Manual switch on/off |

Motorised dampers are proposed to enable the central ventilation fans to be controlled to minimise ventilation energy consumption

#### Cooling & Heating

It has been assumed that all heating and cooling in the dwellings will be serviced by individual fan coil units. These fan coil units will receive chilled water from the harbour-water cooled district cooling plant, and receive heating hot water from the gas fired heating hot water (HHW) plant in each tower. It has been assumed that the air conditioning in the dwellings will not be day-night zoned.

As discussed earlier, BASIX has accepted an alternative method that recognises a portion of the higher efficiency of Barangaroo South's district cooling plant.

Variable speed fan coil units with digital / electrically commutated motors are proposed for the apartments. We do not believe that BASIX would be fully accounting for the fan energy savings benefits of these technologies thus the BASIX energy score is considered conservative with all else equal.

#### Lighting

The BASIX tool also takes into account energy consumption from lighting based on the lighting strategy. For each dwelling, the BASIX tool awards the number of bathrooms and kitchens that are naturally lit by either a window or skylight. BASIX awards the rooms which are primarily lit by fluorescent or LED lamps as these are more energy efficient lighting options; and further awards projects where these fittings cannot be replaced by alternatives.

| R4A Unit Code | Naturally lit bathrooms/toilets | Naturally lit kitchen | Bedrooms lit by LEDs | Living/dining rooms lit by LEDs | Dedicated LED fittings? |
|---------------|---------------------------------|-----------------------|----------------------|---------------------------------|-------------------------|
| L-A1          | 0                               | No                    | 3                    | 1                               | Yes                     |
| L-A2          | 0                               | No                    | 1                    | 1                               | Yes                     |
| L-A3          | 0                               | No                    | 1                    | 1                               | Yes                     |
| L-A4          | 1                               | Yes                   | 2                    | 1                               | Yes                     |
| L-A5          | 0                               | Yes                   | 1                    | 1                               | Yes                     |
| L-A6          | 0                               | No                    | 2                    | 1                               | Yes                     |
| M-A1          | 0                               | No                    | 3                    | 1                               | Yes                     |
| M-A2          | 0                               | No                    | 2                    | 1                               | Yes                     |
| M-A3          | 0                               | Yes                   | 2                    | 1                               | Yes                     |

# One Sydney Harbour

## ESD Report Residential Building R5



| R4A Unit Code     | Naturally lit bathrooms/toilets | Naturally lit kitchen | Bedrooms lit by LEDs | Living/dining rooms lit by LEDs | Dedicated LED fittings? |
|-------------------|---------------------------------|-----------------------|----------------------|---------------------------------|-------------------------|
| M-A4              | 0                               | Yes                   | 1                    | 1                               | Yes                     |
| M-A5              | 0                               | No                    | 2                    | 1                               | Yes                     |
| U-A1              | 0                               | No                    | 4                    | 1                               | Yes                     |
| U-A2              | 1                               | No                    | 4                    | 1                               | Yes                     |
| U-A3              | 1                               | No                    | 3                    | 1                               | Yes                     |
| P-A1 <sup>1</sup> | 2                               | No                    | 5                    | 1                               | Yes                     |

| R4B Unit Code     | Naturally lit bathrooms/toilets | Naturally lit kitchen | Bedrooms lit by LEDs | Living/dining rooms lit by LEDs | Dedicated LED fittings? |
|-------------------|---------------------------------|-----------------------|----------------------|---------------------------------|-------------------------|
| L-B1              | 0                               | No                    | 3                    | 1                               | Yes                     |
| L-B2              | 0                               | No                    | 1                    | 1                               | Yes                     |
| L-B3              | 0                               | No                    | 1                    | 1                               | Yes                     |
| L-B4              | 1                               | Yes                   | 2                    | 1                               | Yes                     |
| L-B5              | 0                               | No                    | 1                    | 1                               | Yes                     |
| L-B6              | 0                               | No                    | 2                    | 1                               | Yes                     |
| M-B1              | 0                               | No                    | 3                    | 1                               | Yes                     |
| M-B2              | 0                               | No                    | 2                    | 1                               | Yes                     |
| M-B3              | 0                               | Yes                   | 2                    | 1                               | Yes                     |
| M-B4              | 0                               | No                    | 1                    | 1                               | Yes                     |
| M-B5              | 0                               | No                    | 2                    | 1                               | Yes                     |
| U-B1              | 0                               | No                    | 4                    | 1                               | Yes                     |
| U-B2              | 1                               | No                    | 4                    | 1                               | Yes                     |
| U-B3              | 0                               | No                    | 2                    | 1                               | Yes                     |
| U-B4              | 0                               | No                    | 1                    | 1                               | Yes                     |
| U-B5              | 0                               | No                    | 2                    | 1                               | Yes                     |
| P-B1 <sup>1</sup> | 0                               | No                    | 4                    | 1                               | Yes                     |

| R5 Unit Code | Naturally lit bathrooms/toilets | Naturally lit kitchen | Bedrooms lit by LEDs | Living/dining rooms lit by LEDs | Dedicated LED fittings? |
|--------------|---------------------------------|-----------------------|----------------------|---------------------------------|-------------------------|
| L5-01        | 1                               | No                    | 3                    | 1                               | Yes                     |
| L5-02        | 0                               | No                    | 2                    | 1                               | Yes                     |
| L5-03        | 0                               | No                    | 1                    | 1                               | Yes                     |
| L5-04        | 0                               | No                    | 1                    | 1                               | Yes                     |
| L5-05        | 1                               | No                    | 2                    | 1                               | Yes                     |
| L5-06        | 0                               | No                    | 2                    | 1                               | Yes                     |
| M5-01        | 1                               | No                    | 3                    | 1                               | Yes                     |
| M5-02        | 0                               | No                    | 2                    | 1                               | Yes                     |
| M5-03        | 0                               | No                    | 2                    | 1                               | Yes                     |
| M5-04        | 0                               | No                    | 1                    | 1                               | Yes                     |
| M5-05        | 1                               | No                    | 2                    | 1                               | Yes                     |
| M5-06        | 0                               | No                    | 2                    | 1                               | Yes                     |
| P-R5         | 0                               | No                    | 5                    | 1                               | Yes                     |

Notes 1) Floor plan for this apartment is not available – assumed worst case daylight condition.

# One Sydney Harbour

## ESD Report Residential Building R5



### Pool & Spa

The following inputs were assumed for the private pools to the penthouses.

| Pool                       | R4a Penthouse | R4b Penthouse | R5 Penthouse |
|----------------------------|---------------|---------------|--------------|
| <b>Pool heating system</b> | Gas           | Gas           | Gas          |
| <b>Timer</b>               | Yes           | Yes           | Yes          |

It is assumed that:

- There are no private spas.

### Appliances

| Appliance                      | All   |
|--------------------------------|---|
| <b>Cooktop</b>                 | Gas   |
| <b>Oven</b>                    | Electric  |
| <b>Refrigerator</b>            | 3 Star High Rise, 3.5 Star for Mid and Low Rise |
| <b>Ventilated fridge space</b> | No  |
| <b>Dishwasher</b>              | 3.5 star  |
| <b>Clothes washer</b>          | Not specified                                   |
| <b>Clothes dryer</b>           | 2 star  |

### Other

The provision of clothes lines reduce the energy associated with clothes drying.

It is assumed that:

- There are **no** indoor clothes drying lines provided.
- There are **no** private outdoor clothes drying lines provided.