FINAL REPORT

TOGA CENTRAL

SYDNEY, AUSTRALIA

PEDESTRIAN WIND STUDY
RWDI # 1902973
July 26, 2022

SUBMITTED TO

David Springford
Senior Project Manager
dspringford@toga.com.au

TOGA
Level 5, 45 Jones Street
Ultimo NSW 2007

SUBMITTED BY

Mazen Hama, MEng
Project Engineer
Mazen.Hama@rwdi.com

Dr Aman Choudhry, PhD., MIEAust
Senior Microclimate Engineer
Aman.Choudhry@rwdi.com

Michael Pieterse, MASc., P.Eng., CPEng, RPEN
Project Delivery Manager | Associate
Michael.Pieterse@rwdi.com
T: +61 2 8103 4020 x2324

Kevin Peddie, B.E.(Aero), MsEM, CPEng., RPEN
Director of Operations | Associate
Kevin.Peddie@rwdi.com
T: +61 2 8103 4020 x2325

RWDI Australia Pty Ltd.
ABN 86 641 303 871

EXECUTIVE SUMMARY

This Pedestrian Wind Study report has been prepared by RWDI Australia Pty Ltd (RWDI) to accompany a detailed State significant development (SSD) development application (DA) for the mixed-use redevelopment proposal at TOGA Central, located at 2 & 8A Lee Street, Haymarket (the site). The site is legally described as Lot 30 in Deposited Plan 880518, Lot 13 in Deposited Plan 1062447 and part of Lot 14 in Deposited Plan 1062447. The site is also described as 'Site C' within the Western Gateway sub-precinct at the Central Precinct.

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the SSD DA (SSD 33258337).

The pedestrian level wind assessment was conducted for the following two configurations of the precinct:

Configuration 1: Existing Site with Central Place Sydney and Atlassian Tower

Configuration 2: TOGA with Atlassian, Central Place Sydney, and Existing Surrounding Buildings

The potential wind conditions at pedestrian level on and around the proposed project were predicted using the results from a boundary-layer wind tunnel test combined with historical meteorological wind records. These are indicated on site plans in the Figures Appendix, while the associated wind speeds are listed in Table 1 Appendix.

A summary of the test results for the ground plane is noted below:

- The wind conditions around the Configuration 1 are predominantly suitable for sitting and standing use with localised walking use conditions noted at the intersection of Lee Street and Little Regent Street. Three ground level locations are also noted to exceed the stipulated safety criterion.
- With the introduction of the Proposed TOGA Tower (Configuration 2), the local wind environment around the precinct shifts. The three exceedances noted in Configuration 1 are replaced by three marginal exceedances localised at the southwest corner of TOGA. Therefore, the cluster of towers within the precinct work together in improving the local wind environment.
- Wind activity on terraces is noted to be suitable for passive use at most locations with a localised area on the northwest terrace where higher wind speeds (suitable for active use) are noted. However, the active use area on the terrace corresponds to glazed roof that will generally not be accessible.

This report concludes that the proposed mixed-use redevelopment is suitable and warrants approval subject to the implementation of the following mitigation measures.

- An extension of the awning above the southeast corner by an additional 1m will capture the winds and keep these above the ground level. This will resolve all safety issues within the precinct.

Following the implementation of the above mitigation measures, all wind impacts are appropriate as per the provisions of the Design Guide - Western Gateway Sub-Precinct (Section 3.1.5 Wind).

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

This report has been prepared to accompany a SSD DA for the for the mixed-use redevelopment proposal at TOGA Central, located at 2 & 8A Lee Street, Haymarket.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning and Environment (DPE) for assessment.

The purpose of the SSD DA is to complete the restoration of the heritage-listed building on the site, delivery of new commercial floorspace and public realm improvements that will contribute to the realisation of the Government's vision for an iconic technology precinct and transport gateway. The application seeks consent for the conservation, refurbishment and adaptive re-use of the Adina Hotel building (also referred to as the former Parcel Post building (fPPb)), construction of a 45-storey tower above and adjacent to the existing building and delivery of significant public domain improvements at street level, lower ground level and within Henry Deane Plaza. Specifically, the SSD DA seeks development consent for:

- Site establishment and removal of landscaping within Henry Deane Plaza.
- Demolition of contemporary additions to the fPPb and public domain elements within Henry Deane Plaza.
- Conservation work and alterations to the fPPb for retail premises, commercial premises, and hotel and motel accommodation. The adaptive reuse of the building will seek to accommodate:
    - Commercial lobby and hotel concierge facilities,
    - Retail tenancies including food and drink tenancies and convenience retail with back of house areas,
    - 4 levels of co-working space,
    - Function and conference area with access to level 7 outdoor rooftop space, and
    - Reinstatement of the original fPPb roof pitch form in a contemporary terracotta materiality.
- Provision of retail floor space including a supermarket tenancy, smaller retail tenancies, and back of house areas below Henry Deane Plaza (at basement level 1 (RL12.10) and lower ground (RL 16)).
- Construction of a 45-storey hotel and commercial office tower above and adjacent to the fPPb. The tower will have a maximum building height of RL 202.28m, and comprise:
    - 10 levels of hotel facilities between level 10 – level 19 of the tower including 204 hotel keys and 2 levels of amenities including a pool, gymnasium and day spa to operate ancillary to the hotel premises. A glazed atrium and hotel arrival is accommodated adjacent to the fPPb, accessible from Lee Street.
    - 22 levels of commercial office space between level 23 – level 44 of the tower accommodated within a connected floor plate with a consolidated side core.
    - Rooftop plant, lift overrun, servicing and BMU.
- Provision of vehicular access into the site via a shared basement, with connection points provided to both Block A (at RL 5) and Block B (at RL5.5) basements. Primary access will be accommodated from the adjacent Atlassian site at 8-10 Lee Street, Haymarket, into 4 basement levels in a split-level arrangement. The basement will accommodate:
    - Car parking for 106 vehicles, 4 car share spaces and 5 loading bays.
    - Hotel, commercial and retail and waste storage areas.
    - Plant, utilities and servicing.

- Provision of end of trip facilities and 165 employee bicycle spaces within the fPPb basement, and an additional 72 visitor bicycle spaces within the public realm.
- Delivery of a revitalised public realm across the site that is coordinated with adjacent development, including an improved public plaza linking Railway Square (Lee Street), and Block B (known as 'Central Place Sydney'). The proposal includes the delivery of a significant area of new publicly accessible open space at street level, lower ground level, and at Henry Deane Plaza, including the following proposed elements:
    - Provision of equitable access within Henry Deane Plaza including stairways and a publicly accessible lift.
    - Construction of raised planters and terraced seating within Henry Deane Plaza.
    - Landscaping works within Henry Deane Plaza.
- Utilities and service provision.
- Realignment of lot boundaries.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 17 December 2021 and issued for the SSD DA. Specifically, this report has been prepared to respond to the SEARs requirement issued below.

Item	Description of requirement	Section reference (this report)
5. Integration with surrounding area	• Consider the stand alone and cumulative impacts from the concurrent construction and/or ongoing operation, maintenance and potential future expansion requirements of the adjacent sites in the Central Precinct (including transport services rail, metro, light rail) including noise, vibration, air quality, amenity, safety and access. • Demonstrate how the site and development will be designed and staged to integrate with and not constrain the future development of surrounding sites, having regard to amenity impacts, wind impacts, visual and view impacts, servicing and loading arrangements.	Section 3.0
6. Environmental Amenity	• Assess amenity impacts on the surrounding locality, including lighting impacts, reflectivity, solar access, visual privacy, visual amenity, view loss and view sharing, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential or other sensitive land uses must be demonstrated.	Section 3.0

This report presents the project objectives, background and approach, and discusses the results from RWDI's wind tunnel assessment and provides conceptual wind control measures.

1.1. Project Description

The site is located within the City of Sydney Local Government Area (LGA). The site is situated 1.5km south of the Sydney CBD and 6.9km north-east of the Sydney International Airport within the suburb of Haymarket.

The site is located within the Western Gateway sub-precinct, an area of approximately 1.65ha that is located immediately west of Central Station within Haymarket on the southern fringe of the Sydney CBD. Immediately

north of Central Station is Belmore Park, to the west is Haymarket (including the University of Technology, Sydney and Chinatown), to the south and east is rail lines and services and Prince Alfred Park and to the east is Elizabeth Street and Surry Hills.

Central Station is a public landmark, heritage building, and the largest transport interchange in NSW. With regional and suburban train services, connections to light rail, bus networks and to Sydney Airport, the area around Central Station is one of the most-connected destinations in Australia.

The site is located at 2 & 8A Lee Street, Haymarket and is legally described as Lot 30 in Deposited Plan 880518, Lot 13 in Deposited Plan 1062447 and part of Lot 14 in Deposited Plan 1062447.

The land that comprises the site under the Proponent's control (either wholly or limited in either height or depth) comprises a total area of approximately 4,159sqm.

The location of the TOGA Central site is illustrated in Figure 1.

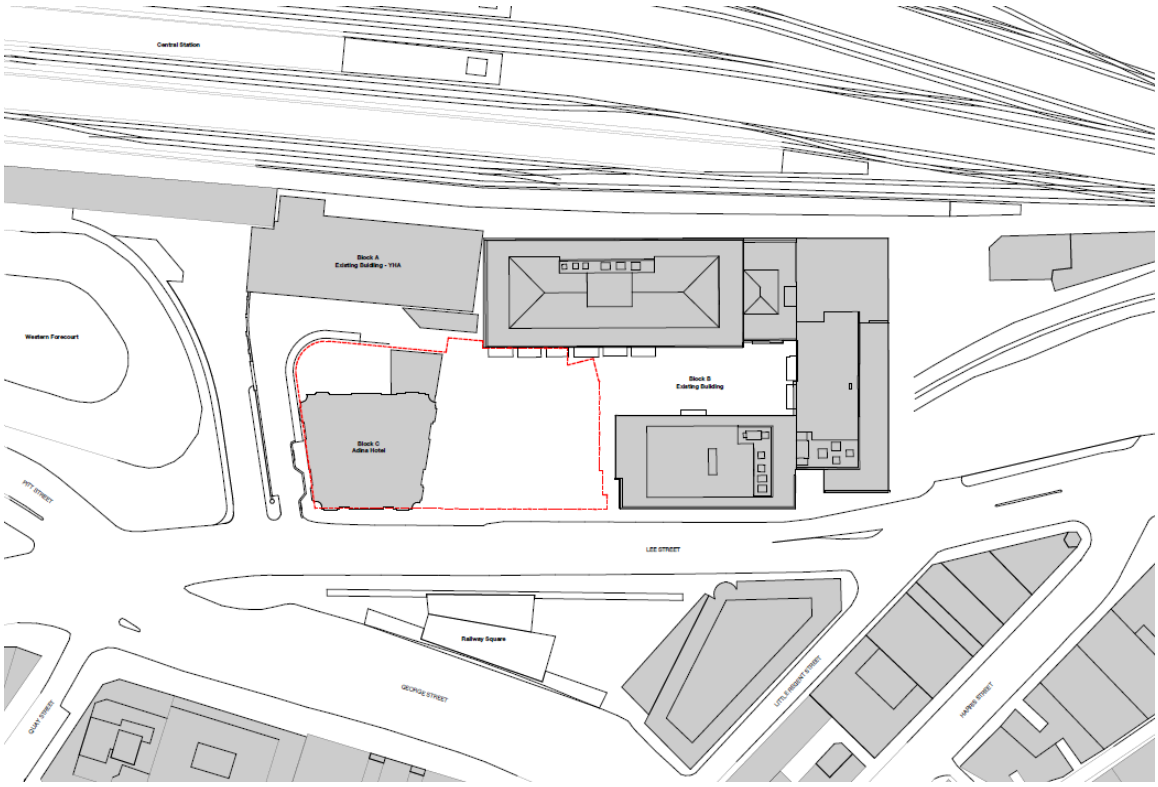


Image 1: Site Identification Plan (Source: Bates Smart)

The site currently comprises the following existing development:

- Lot 30 in Deposited Plan 880518 (Adina Hotel building): the north-western lot within the Western Gateway sub-precinct accommodates a heritage-listed building which was originally developed as the Parcels Post Office building. The building has been adaptively re-used and is currently occupied by the Adina Hotel Sydney Central. The eight-storey building provides 98 short-stay visitor apartments and studio rooms with ancillary facilities including a swimming pool and outdoor seating at the rear of the site.
- Lot 13 in Deposited Plan 1062447 and part of Lot 14 in Deposited Plan 1062447 (Henry Deane Plaza): the central lot within the Western Gateway sub-precinct adjoins Lot 30 to the south. It accommodates

22 specialty food and beverage, convenience retail and commercial service tenancies. The lot also includes publicly accessible space which is used for pop-up events and a pedestrian thoroughfare from Central Station via the Devonshire Street Tunnel. At the entrance to Devonshire Street Tunnel is a large public sculpture and a glazed structure covers the walkway leading into Railway Square. This area forms part of the busy pedestrian connection from Central Station to Railway Square and on to George and Pitt Streets, and pedestrian subways.

The site is listed as an item of local significance under Schedule 5 of the Sydney Local Environmental Plan 2012 'Former Parcels Post Office including retaining wall, early lamp post and building interior', Item 855.

The site is also included within the Central Railway Station State heritage listing. This is listed on the State Heritage Register 'Sydney Terminal and Central Railway Station Group', Item SHR 01255, and in Schedule 5 of the Sydney Local Environmental Plan 2012 'Central Railway Station group including buildings, station yard, viaducts and building interiors' Item 824.

The site is not however listed independently on the State Heritage Register. There is an array of built forms that constitute Central Station, however the Main Terminal Building (particularly the western frontage) and associated clocktower constitute key components in the visual setting of the Parcel Post building.

1.2. Objectives

The objective of the study was to assess the effect of the Proposed Development on local conditions in pedestrian areas on and around the study site and provide recommendations to minimise any adverse effects, if needed. This quantitative assessment was based on wind speed measurements of a scale model of the site and its surroundings in one of RWDI's boundary-layer wind tunnels. These measurements were combined with the local wind records and compared to appropriate criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including public footpaths.

2. BACKGROUND AND APPROACH

2.1. Wind Tunnel Study Model

To assess the wind environment around the Proposed Development, a 1:300 scale model of the development site and surroundings was constructed for the wind tunnel testing of the following configurations:

Configuration 1: Existing site with existing surroundings, including Central Place Sydney and Atlassian Central (Image 2A); and

Configuration 2: TOGA in context of the existing site with existing surroundings, including Central Place Sydney and Atlassian Central (Image 2C); and

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 360 m radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. The wind tunnel model was instrumented with up to 82 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 1.5 m above local grade in the pedestrian accessible areas throughout the study area. Wind speeds were measured for 36 directions at 10-degree increments. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site and reviewed by the client.

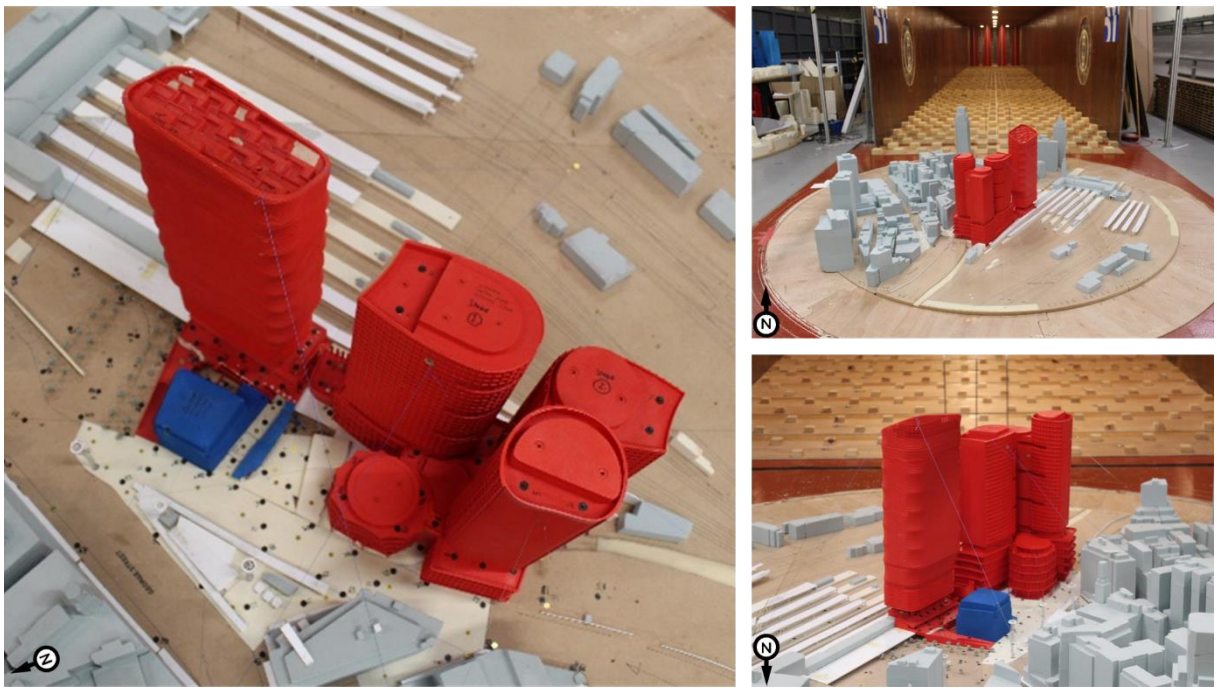


Image 2A: Wind Tunnel Study Model – Configuration 1

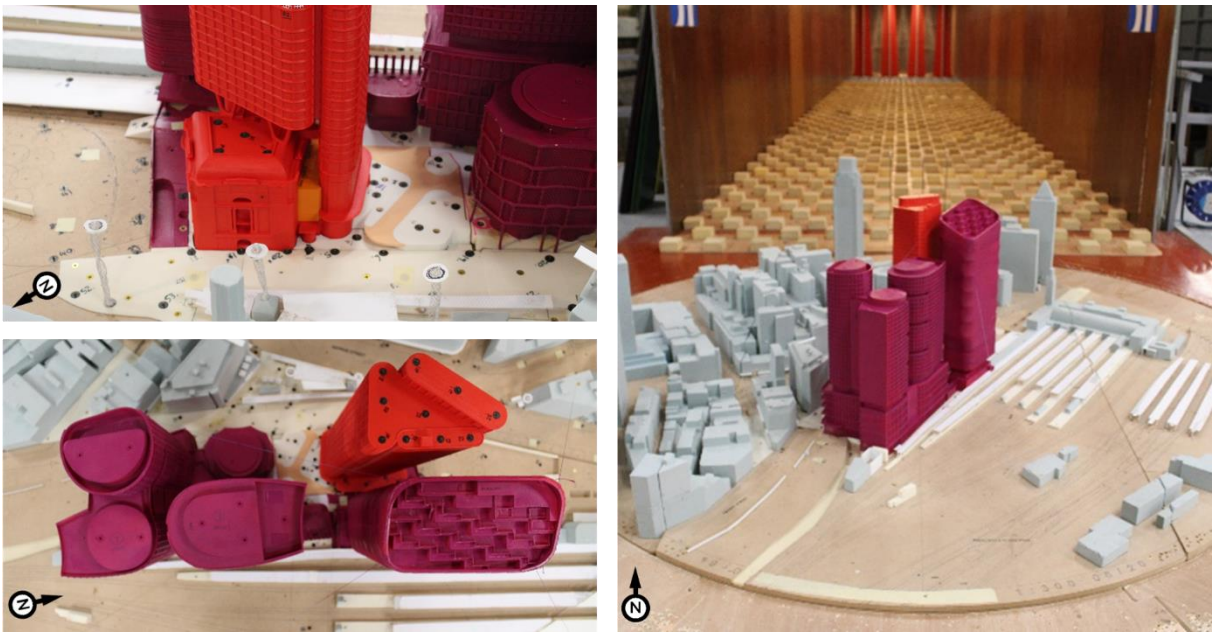
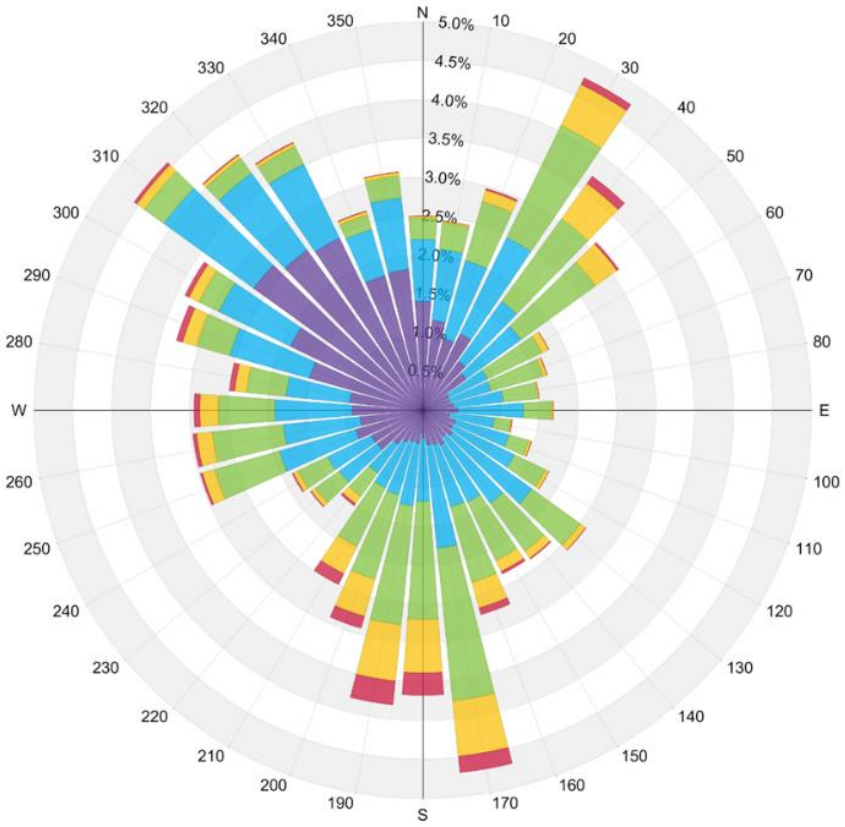


Image 2B: Wind Tunnel Study Model – Configuration 2

2.2. Meteorological Data

Wind statistics recorded at Sydney International Airport between 1999 and 2018, inclusive, were analysed annually. Image 3 graphically depicts the annual directional distributions of wind frequencies and speeds. Winds from the northwest, west and northeast, and south directions are predominant throughout the year as indicated by the wind rose (Image 3). Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur for 9.4% of the time throughout the year.

Wind statistics were combined with the wind tunnel data to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared with the wind criteria for pedestrian comfort and safety.



Annual Winds

Wind Speed (km/h)	Probability (%)
Calm	0.3
1-10	33.2
11-20	31.8
21-30	25.3
31-40	7.3
>40	2.1

Image 3: Directional Distribution of Winds Approaching Sydney International Airport From 1999 to 2018

2.3. Central Sydney Planning Strategy (2016-2036) Wind Criteria

The wind criteria presented in the Central Sydney Planning Strategy 2016-2036 are described in the table below. Regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can affect a person's perception of the wind climate. Therefore, comparisons of wind speeds for the existing and proposed building configurations are the most objective way of assessing local pedestrian wind conditions. In general, the combined effect of mean and gust speeds on pedestrian comfort can be quantified by a Gust Equivalent Mean (GEM).

Comfort Category	GEM Speed (m/s)	Description
Sitting	≤ 4	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away
Standing	≤ 6	Gentle breezes suitable for main building entrances, bus stops, and other places where pedestrians may linger
Walking	≤ 8	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	> 8	Strong winds of this magnitude are considered a nuisance for all pedestrian activities, and wind mitigation is typically recommended

Notes:
GEM speed = max (mean speed, gust speed/1.85); and,
GEM speeds listed above are based on a seasonal exceedance of 5% of the time between 6:00 and 22:00.

Safety Criterion	Gust Speed (m/s)	Description
Exceeded	> 24	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

Notes:
Based on an annual exceedance of 0.0171% of the time.
Only gust speeds need to be considered in the wind safety criterion. These are usually rare events but deserve special attention in city planning and building design due to their potential safety impact on pedestrians.

2.4. Western Gateway Wind Comfort Criteria

A Wind Criteria Map has been developed for the Western Gateway precinct and is noted in Image 4. The proposed Wind Comfort Criteria Map outlined in the Design Guide has been used as the basis to assess the results of this report. Following key aspects are noted from the wind criteria:

- Wind impacts from any development must not exceed the Wind Safety Standard which is an annual maximum peak 0.5 second gust wind speed in 1 hour of 24 m/s.
- Wind impacts from any development on public domain should not exceed the Wind Comfort Standard criteria for sitting, standing, and walking taking into consideration the intended use of the space. The wind comfort standard is an hourly mean wind speed or gust equivalent mean wind speed, whichever is greater, for each wind direction of no more than 5% of all hours in the year. These standards are:

- Walking through the over station development connection and footpaths - 8 m/s
- Standing at building entrances, bus stops - 6 m/s
- Sitting in future public spaces - 4 m/s

- New development within the Western Gateway Sub Precinct is to achieve the proposed wind comfort criteria on land outside the sub-precinct (i.e., the area outside the redline boundary on the Wind Criteria Map), unless it can be demonstrated that existing wind conditions in that area do not currently achieve the identified wind comfort criteria. If the existing wind conditions do not currently achieve the identified wind comfort criteria, new development is not to increase or worsen the current wind conditions for that area as measured by the wind comfort criteria.
- Development subject to a quantitative wind effects report must not cause a wind speed that exceeds the Wind Safety Standard, the Wind Comfort Standard for Walking and the Wind Comfort Standard for Sitting in Parks, unless it can be demonstrated that the existing wind speeds in those locations exceed the standard(s). If the existing wind conditions do not currently achieve the identified standard(s), new development is not to result in an increase to wind speeds in their respective locations as measured by the relevant standard(s).
- Despite the above point, a minimum of 200sqm of contiguous space that is open to the sky within the defined Railway Square area is to achieve the Wind Comfort Standard criterion for sitting.

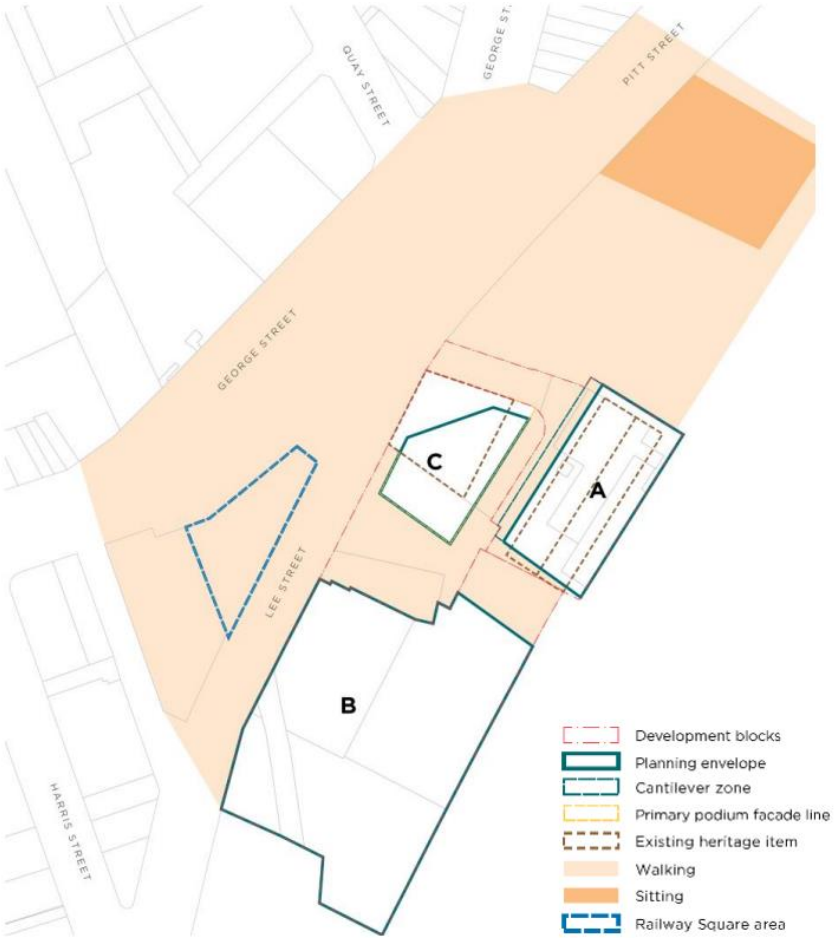


Image 4: Wind Criteria Map for the Western Gateway Sub-Precinct

3. RESULTS AND DISCUSSION

The predicted wind comfort conditions are presented on site plans using the following convention:

- Configuration 1 conditions are shown in Figures with the numeric 1 (e.g., A-1, B-1 etc.)
- Configuration 2 conditions are shown in Figures with the numeric 2 (e.g., A-2, B-2 etc.)

The figures have also been split into annual comfort and safety categories. These conditions and the associated wind speeds are represented in Table 1, located in the "Tables" section of this report. The following is a detailed discussion of the suitability of the predicted wind conditions for the anticipated pedestrian use of each area.

3.1. Configuration 1
Existing Site with Central Place Sydney and Atlassian Central

3.1.1. Pedestrian Comfort (Figure A-1)

3.1.1.1. Pedestrian Footpaths

Wind conditions are generally found to be relatively calm around the site due to the shielding afforded from the predominant southerly winds of the region by the built form massing of Central Place Sydney. Slightly higher wind activity is noted at the intersection of Lee Street and Little Regent Street with conditions suitable for walking. This is in accordance with the required comfort criteria for the area.

3.1.1.2. Henry Deane Plaza and Public Realm

Wind conditions within Henry Deane Plaza and Public Realm would be suitable for passive sitting or standing use throughout the year.

3.1.1.3. Western Forecourt

Wind conditions within the proposed Western Forecourt are generally suitable for passive pedestrian activity (sitting and standing) throughout the year.

3.1.1.4. Central Station

Wind conditions on Central Station platform will be suitable for sitting and standing use annually.

3.1.2. Strong Winds (Figure C1)

Two locations are noted to marginally exceed the stipulated safety criterion at the intersection of Little Regent Street and Lee Street (probe locations 23 and 64). The prevailing winds were found to be channelled within the street corridor resulting in localised exceedances. In addition, the northern part of Central Station platform is also expected to experience high winds (probe location 42).

3.2. Configuration 2:
TOGA Central with Atlassian Central, Central Place Sydney and Existing Surrounding Buildings

3.2.1. Pedestrian Comfort (Figures A-2 and B-2)

The Central Place Sydney development, as in Configuration 1, is expected to provide shelter to the Site from the prevailing southerly winds of the region leading to a comfortable wind amenity at most locations around the site. The cluster of towers is, therefore, able to work together to improve the overall wind environment. Higher wind activity is noted towards the south of the Proposed Development site as winds are channeled between the precinct buildings.

3.2.1.1. Pedestrian Footpaths

Wind conditions along the majority of pedestrian footpaths around the Site would predominantly be consistent with those reported in Configuration 1. All pedestrian footpaths around the Site would have wind conditions suitable for walking use or calmer throughout the year. The footpath towards the west of Lee Street would see an increase in windiness as winds are redirected by the massing of Central Place Sydney. This would result in probe locations 63-65 becoming suitable for walking use throughout the year; however, these wind conditions would still be acceptable for a pedestrian footpath. Note that conditions are likely to be calmer with the inclusion of street vegetation around the precinct.

3.2.1.2. Henry Dean Plaza

Wind conditions within Henry Dean Plaza (represented by probe locations 4, 7-10, 31, 32, 34 and 74) would predominantly be suitable for sitting or standing use throughout the year. Some localised walking conditions are noted at the base of the TOGA tower where winds are found to channel between the tower forms and impact these areas. Note that standing use wind conditions would be one category windier than that suitable for the seating provisions located within the Plaza. Additionally, the walking use wind conditions would be one category windier than suitable for mixed-use amenity spaces and two categories windier than suitable for seating amenity. Therefore, mitigation is recommended for these spaces to ensure comfortable amenity is achieved throughout the year. This can include targeted allocation of trees and interspersed vegetation within the Plaza to improve wind conditions within the area.

3.2.1.3. Western Forecourt

Wind conditions within the proposed Western Forecourt are generally suitable for passive pedestrian activity (sitting and standing) throughout the year.

3.2.1.4. Entrances

The eastern entrance at the corner of the proposed TOGA tower (probe location 11) is noted to experience higher wind speeds compared to the western entrance. This is due to the channelling of winds between the tower forms noted above. Mitigation measures for the Henry Dean Plaza noted above will also assist in improving the conditions at the entrance.

3.2.1.5. Elevated Level Amenity

Wind conditions at elevated levels on the Proposed Development are suitable for passive use at most locations. A single walking condition is noted on the northwest terrace at probe location 95 which corresponds to a glazed roof section of the space and is, therefore, considered appropriate for intended use of the area.

3.2.2. Strong Winds (Figures C-2 and D-2)

With the inclusion of the proposed TOGA Tower, the three exceedances noted in Configuration 1 are resolved. However, these are replaced by three localised exceedances concentrated at the southeast corner of Proposed TOGA Development. These are caused by the spilling of channelled winds between the Atlassian and CPS towers from the awning above and impacting the area. Therefore, extending the awning along the southeastern corner by an additional 1m will likely resolve this completely.

3.3. Compliance with Western Gateway Criteria

An overlay of the annual wind comfort conditions around the proposed TOGA tower site on the Western Gateway Wind Criteria Map is shown in Image 5. In accordance with the Western Gateway Criteria:

- Wind conditions within the existing site show that there are three distinct areas where strong winds exceeding the wind safety criterion are expected. These areas are also generally spread-out across the precinct site. With the inclusion of proposed TOGA Tower, these are replaced by localised events at the base of the TOGA tower at the southeast corner which is more manageable. Furthermore, as noted in the Tables section of the report, these are also marginal exceedances. This area has been further investigated and the proposed extension of the awning by 1m along the corner will likely resolve all exceedances within the precinct.
- All areas are within the stipulated wind comfort criteria with wind impacts due to the development on public domain not exceeding the Wind Comfort Standard criteria for sitting, standing, and walking use at any location based on the intended use of these areas.
- All areas outside the sub-precinct (i.e., the area outside the redline boundary on the Wind Criteria Map) achieve the proposed wind comfort criteria of walking. Wind conditions within the Central Station Forecourt to the north are suitable for passive use (sitting and standing) without the inclusion of any mitigation elements. The wind conditions are also equivalent to the existing site conditions in this area and, therefore, the proposed development does not result in an increase of the current wind conditions. Note that with the inclusion of landscaping (i.e., dense trees around the forecourt), it is highly likely that wind conditions will be suitable for sitting use throughout the year within the Central Station Forecourt.
- Probe location 57 corresponds to an area of approximately 200 sqm within the defined Railway Square area where wind conditions are suitable for the target Sitting use.

Therefore, based on the above discussions, the wind conditions within and around the proposed TOGA Tower Site comply with the provisions of the Design Guide - Western Gateway Sub-Precinct (Section 3.1.5 Wind).

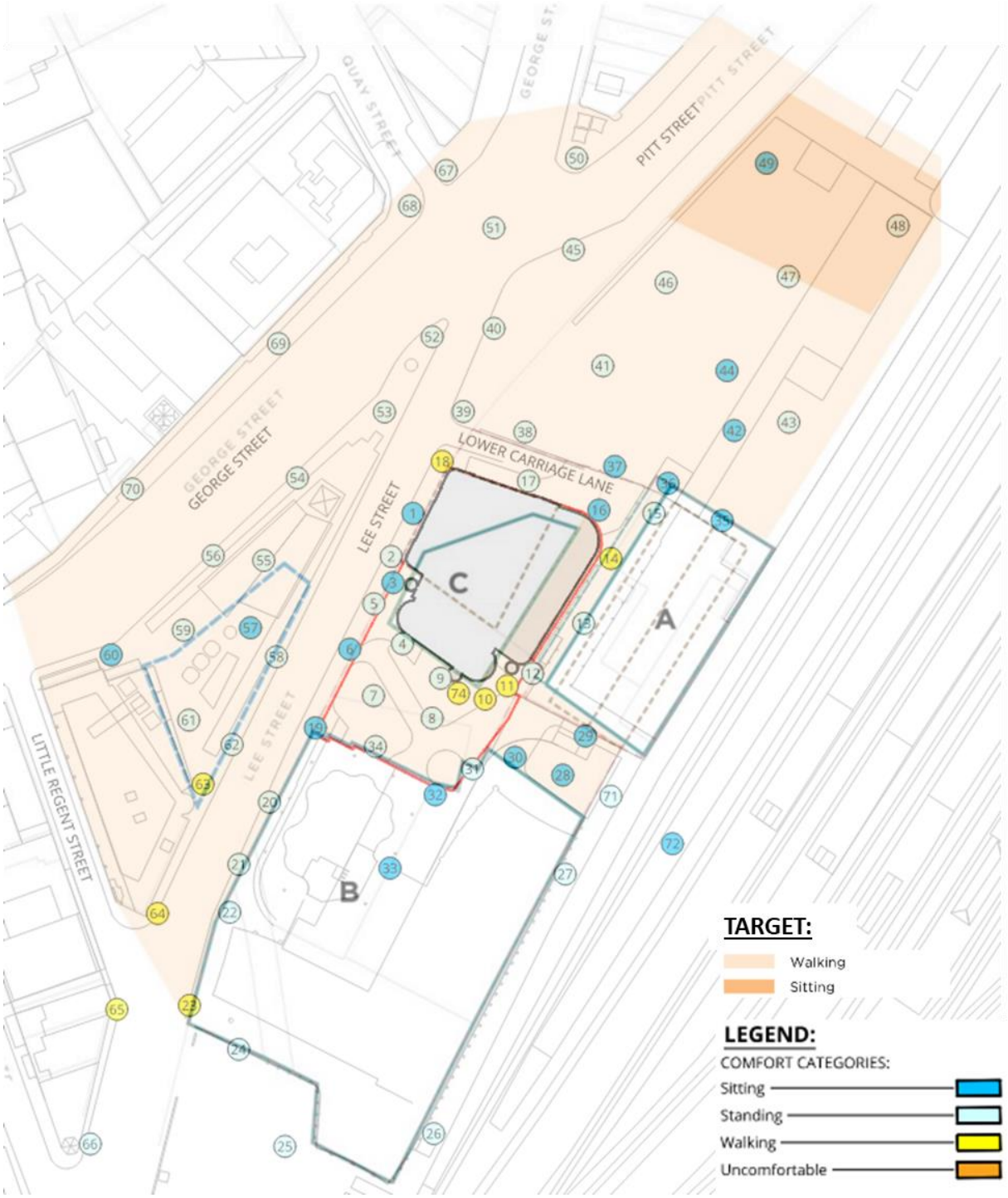


Image 5: Overlay of Annual Wind Comfort Conditions from Wind Tunnel Test on the Wind Criteria Map for the Western Gateway Sub-Precinct

4. MITIGATION MEASURES

The implementation of landscaping elements such as trees, trellises and planters will generally lead to the improvement of wind amenity around the site. Trees close to the north-eastern and north-western corners, would be expected to improve wind conditions in these areas and reduce wind accelerations around the corners. Additionally, as previously discussed, the inclusion of the landscaping within Henry Dean Plaza would be expected to improve wind conditions for patrons within this area. The entrance locations around the Proposed Development would also benefit from the landscaping within Henry Dean Plaza. Localised mitigation measures are also recommended around proposed seating areas. These can include screens or dense landscaping on two or more sides of the seating areas, or seating with high backs. Examples of these mitigation measures are presented within Image 6.

Image 5: Examples of Localised Mitigation Measures for Seating Amenity Areas

To resolve the areas of high wind speeds at the southeast corner of the development, it is recommended to extend the awning above the corner (probe locations 10, 11) by an additional 1m. The extension will capture the redirected winds and keep these above the ground level to resolve the marginal safety exceedances noted at the corner.

5. APPLICABILITY OF RESULTS

The drawings and information listed below were received from Bates Smart and were used to construct the scale model of the proposed Toga Central development in Sydney. The wind conditions presented in this report pertain to the Proposed Development as detailed in the architectural design drawings listed in the table below.

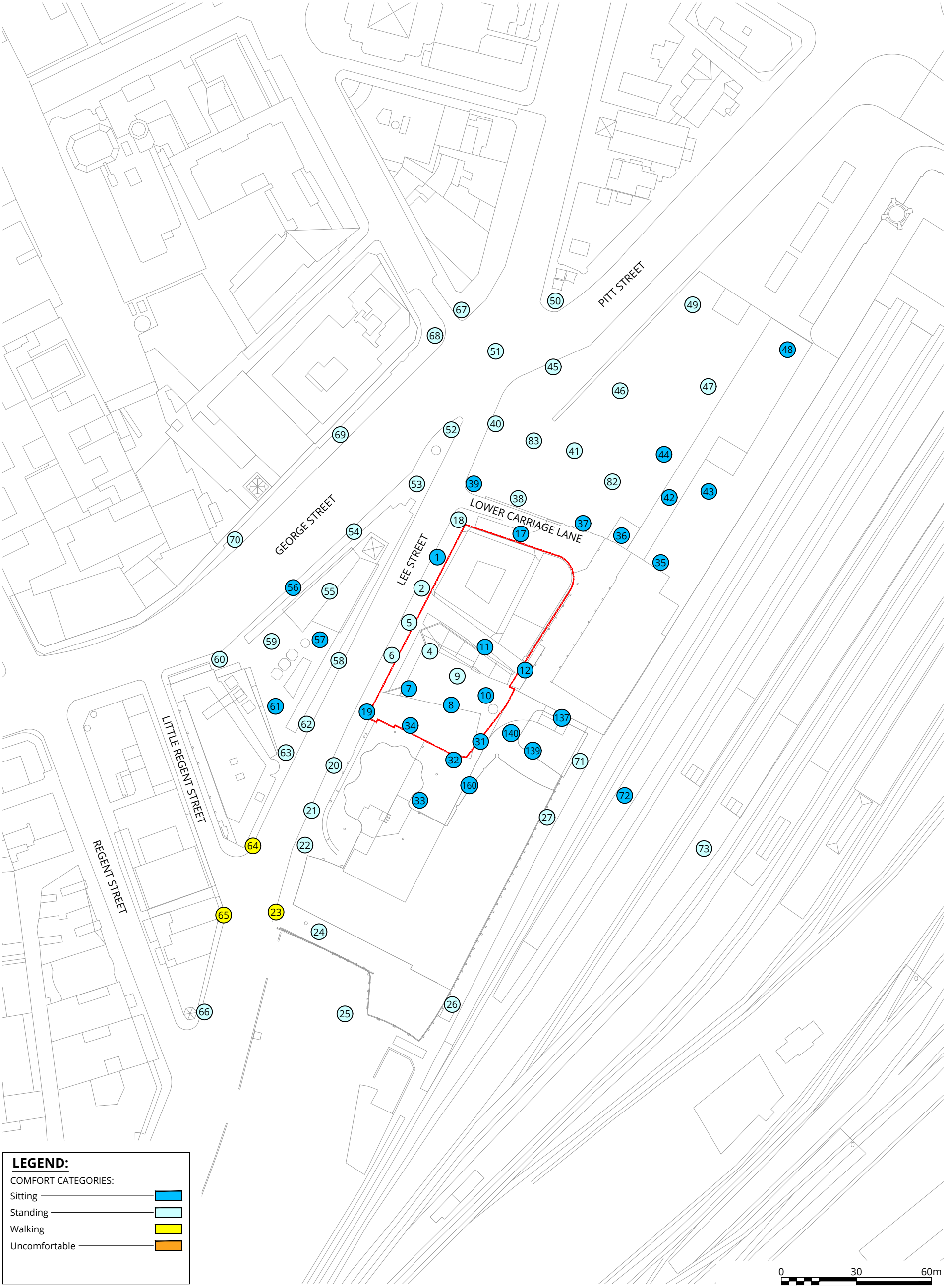
Should there be any design changes that deviate from this list of drawings, the wind condition predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

File Name	File Type	Date Received (dd/mm/yyyy)
TOGA CENTRAL_BS_FACADE_R2020	ifc	07/04/2022
TOGA CENTRAL_BS_ARCH_DA_R2020	ifc	07/04/2022
Appendix R - 3D Revit of Parcels Post and Surrounds	ifc	07/04/2022

6. REFERENCES

- ASCE Task Committee on Outdoor Human Comfort (2004). *Outdoor Human Comfort and Its Assessment*, 68 pages, American Society of Civil Engineers, Reston, Virginia, USA.
- Williams, C.J., Hunter, M.A. and Waechter, W.F. (1990). "Criteria for Assessing the Pedestrian Wind Environment," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.36, pp.811-815.
- Williams, C.J., Soligo M.J. and Cote, J. (1992). "A Discussion of the Components for a Comprehensive Pedestrian Level Comfort Criteria," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.41-44, pp.2389-2390.
- Soligo, M.J., Irwin, P.A., and Williams, C.J. (1993). "Pedestrian Comfort Including Wind and Thermal Effects," *Third Asia-Pacific Symposium on Wind Engineering*, Hong Kong.
- Soligo, M.J., Irwin, P.A., Williams, C.J. and Schuyler, G.D. (1998). "A Comprehensive Assessment of Pedestrian Comfort Including Thermal Effects," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.77&78, pp.753-766.
- Williams, C.J., Wu, H., Waechter, W.F. and Baker, H.A. (1999). "Experiences with Remedial Solutions to Control Pedestrian Wind Problems," *Tenth International Conference on Wind Engineering*, Copenhagen, Denmark.
- Lawson, T.V. (1973). "Wind Environment of Buildings: A Logical Approach to the Establishment of Criteria", *Report No. TVL 7321*, Department of Aeronautic Engineering, University of Bristol, Bristol, England.
- Durgin, F. H. (1997). "Pedestrian Level Wind Criteria Using the Equivalent average", *Journal of Wind Engineering and Industrial Aerodynamics*, Vol. 66, pp. 215-226.
- Wu, H. and Kriksic, F. (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.104-106, pp.397-407.
- Wu, H., Williams, C.J., Baker, H.A. and Waechter, W.F. (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
- Williams, C.J., Wu, H., Waechter, W.F. and Baker, H.A. (1999). "Experiences with Remedial Solutions to Control Pedestrian Wind Problems," Tenth International Conference on Wind Engineering, Copenhagen, Denmark.

FIGURES



LEGEND:

COMFORT CATEGORIES:

- Sitting
- Standing
- Walking
- Uncomfortable

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 1: Central Place Study Stage 2 and Atlassian Tower

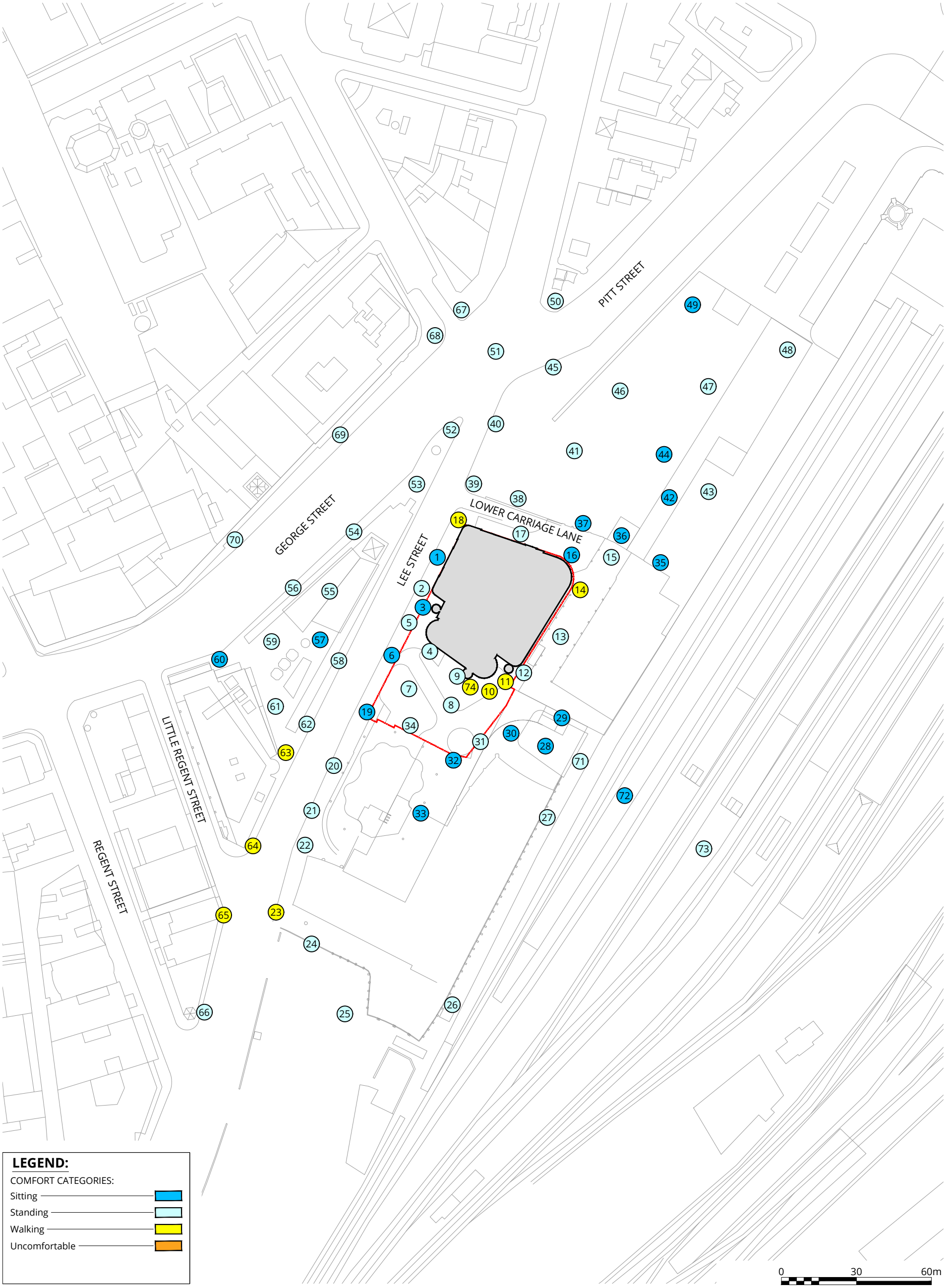
Annual

Toga Central Redevelopment - Sydney, NSW

True North

Project #1902973

Drawn by:	EN	Fig:	A-1
Approx. Scale @A3:	1:1500		
Date Revised:	May 23, 2022		



LEGEND:

COMFORT CATEGORIES:

- Sitting
- Standing
- Walking
- Uncomfortable

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 2: TOGA [Baseline Design] with Atlassian, Central Place Sydney Stages 1 and 2 and Existing Surrounding Buildings

Annual

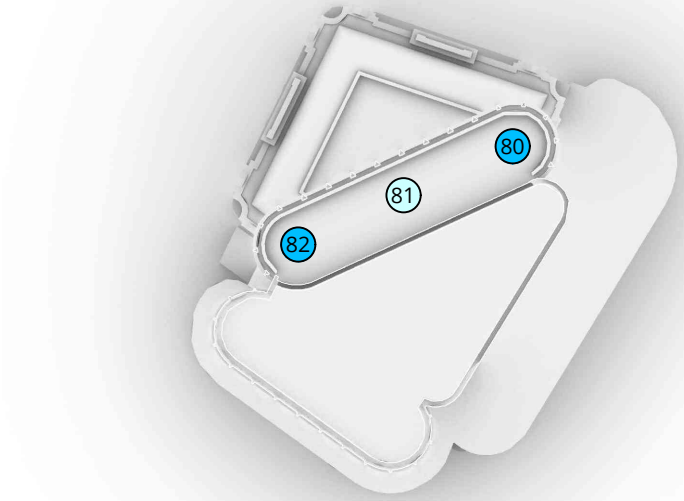
Toga Central Redevelopment - Sydney, NSW

Project #1902973

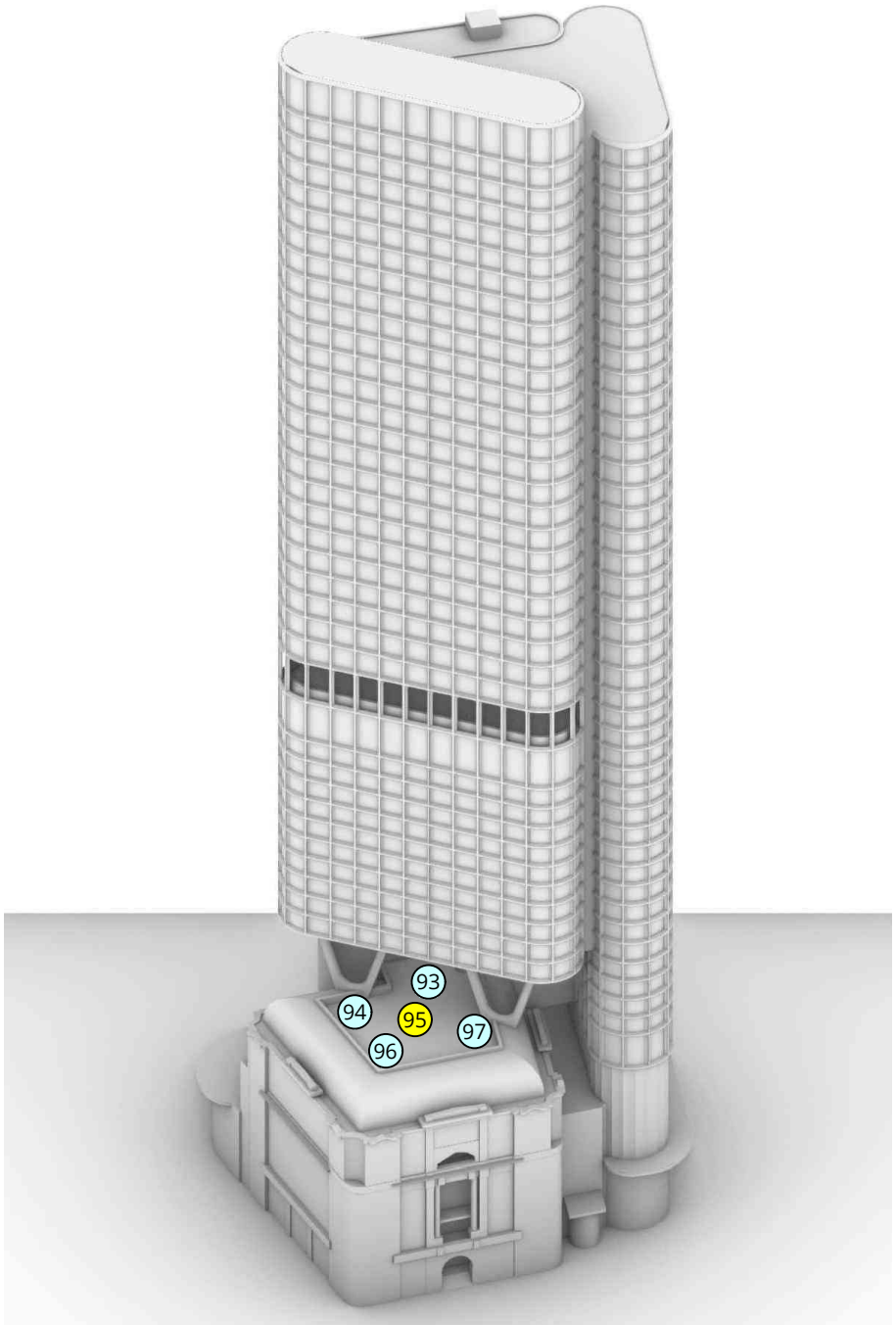
True North

Drawn by:	EN	Fig:	A-2
Approx. Scale @A3:	1:1500		
Date Revised:	May 23, 2022		

True North



LEVEL 21 TERRACE



NORTH / WEST

LEGEND:

COMFORT CATEGORIES:

- Sitting
- Standing
- Walking
- Uncomfortable

0 20 40m

Pedestrian Wind Comfort Conditions - Elevated Levels

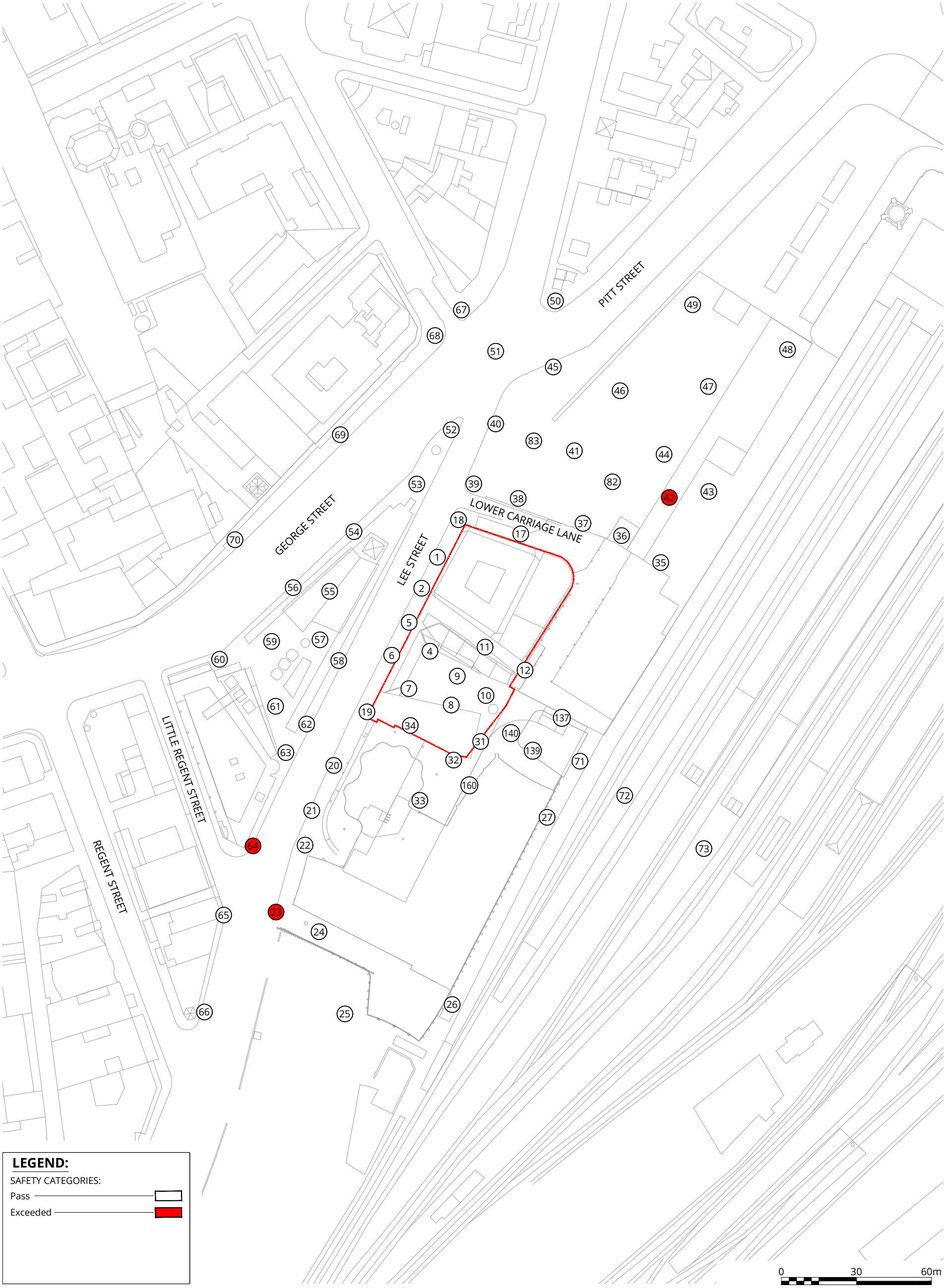
Configuration 2: TOGA [Baseline Design] with Atlassian, Central Place Sydney Stages 1 and 2 and Existing Surrounding Buildings

Annual

Toga Central Redevelopment - Sydney, NSW

Project #1902973

Drawn by:	EN	Fig:	B-2
Approx. Scale @A3:	1:1000		
Date Revised:	May 23, 2022		



LEGEND:

SAFETY CATEGORIES:

Pass

Exceeded

Pedestrian Wind Safety Conditions - Ground Floor

Configuration 1: Central Place Study Stage 2 and Atlassian Tower

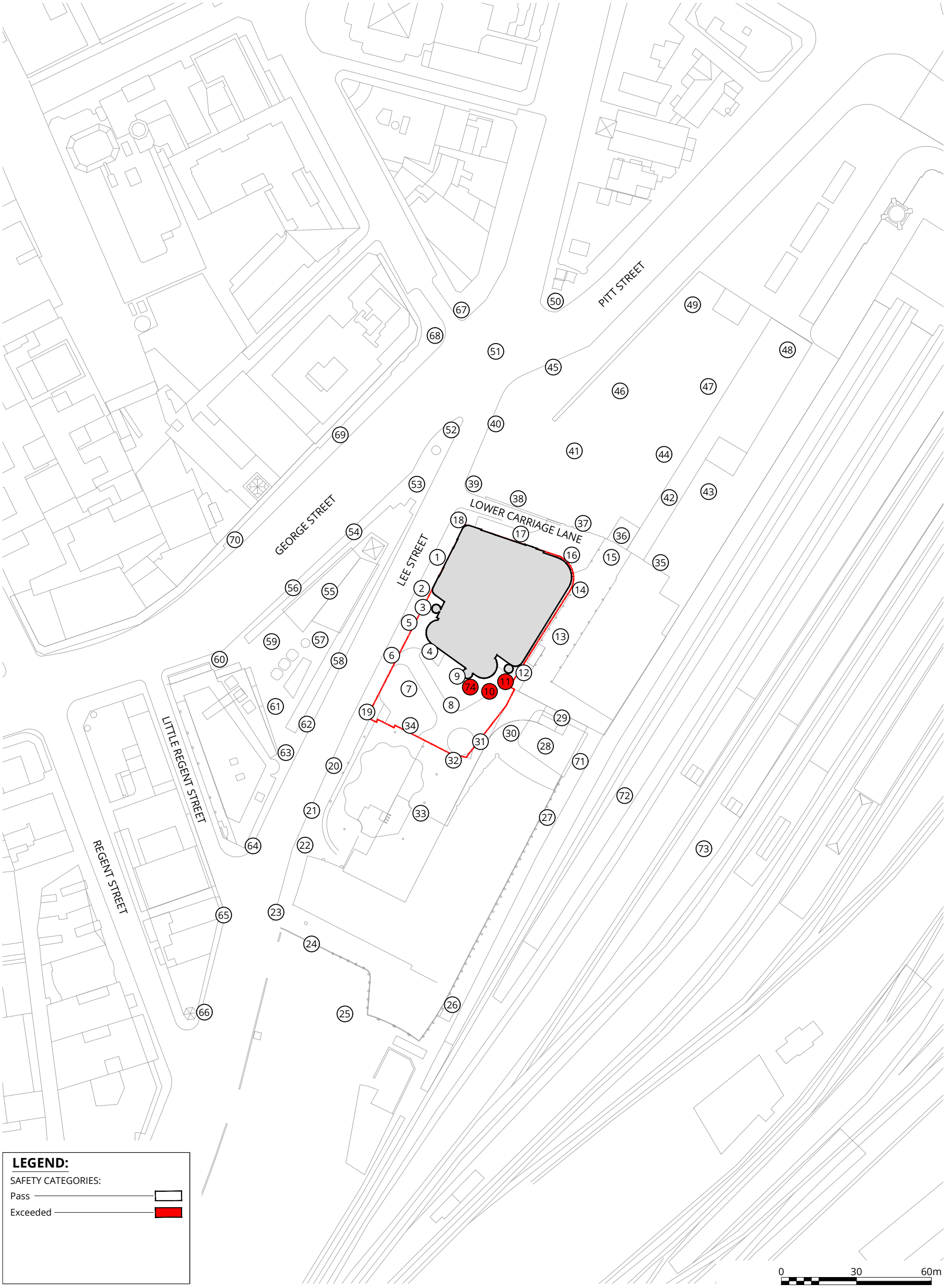
Annual

Toga Central Redevelopment - Sydney, NSW

Project #1902973

True North

Drawn by:	EN	Fig:	C-1
Approx. Scale @A3:	1:1500		
Date Revised:	May 23, 2022		



LEGEND:

SAFETY CATEGORIES:

Pass

Exceeded

Pedestrian Wind Safety Conditions - Ground Floor

Configuration 2: TOGA [Baseline Design] with Atlassian, Central Place Sydney Stages 1 and 2 and Existing Surrounding Buildings

Annual

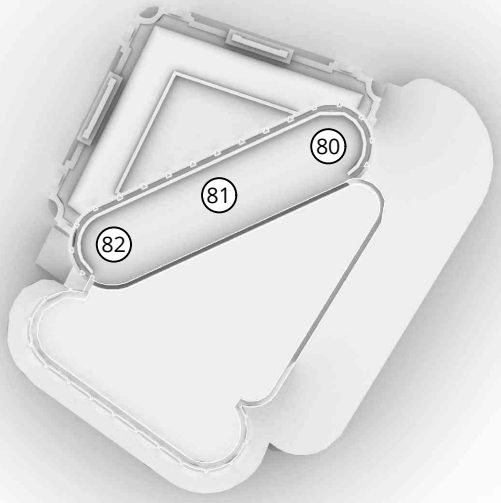
Toga Central Redevelopment - Sydney, NSW

Project #1902973

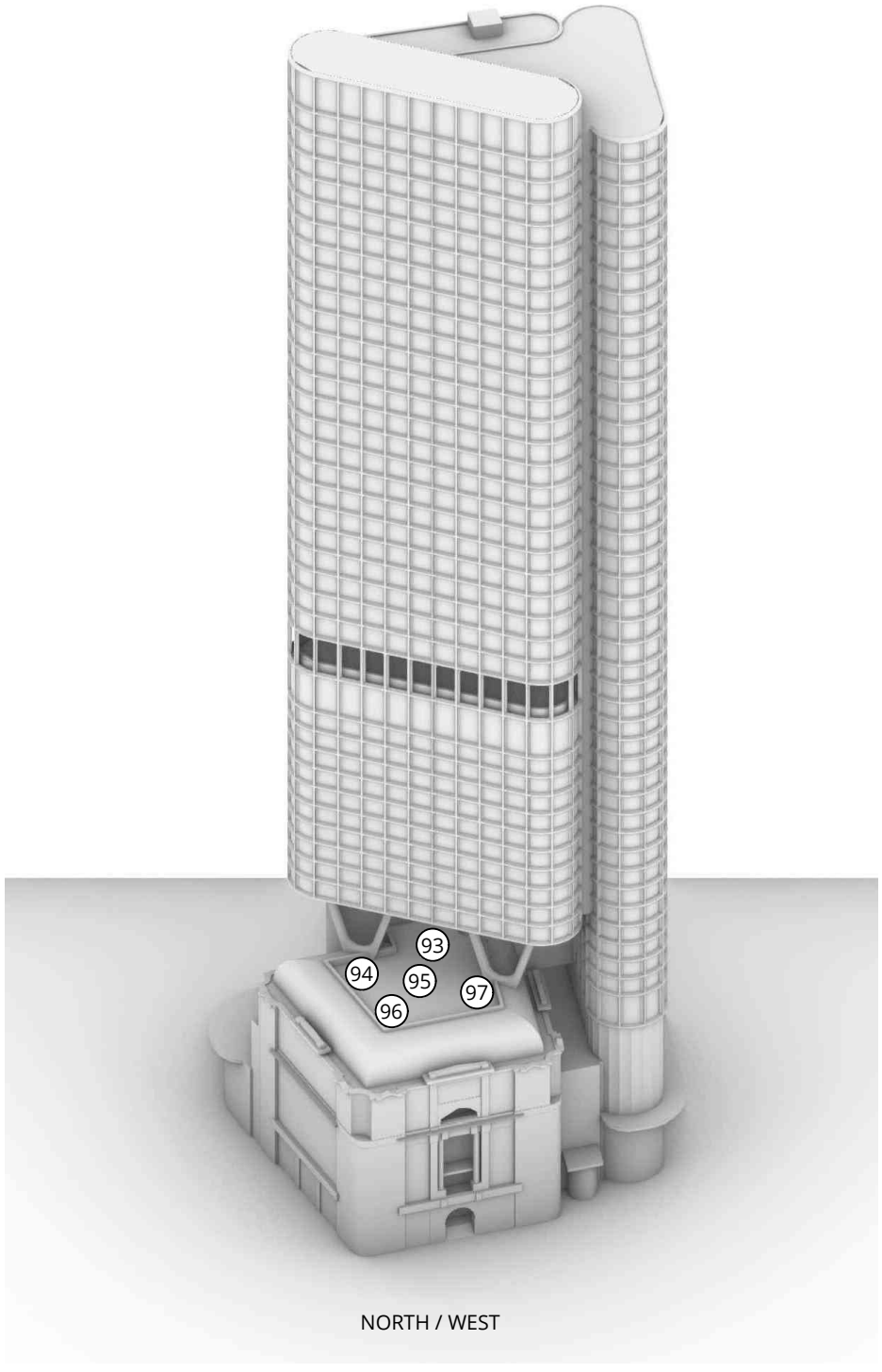
True North

Drawn by:	EN	Fig:	C-2
Approx. Scale @A3:	1:1500		
Date Revised:	May 23, 2022		

True North



LEVEL 21 TERRACE



NORTH / WEST

LEGEND:

SAFETY CATEGORIES:

Pass

Exceeded

0 20 40m

Pedestrian Wind Safety Conditions - Elevated Levels

Configuration 2: TOGA [Baseline Design] with Atlassian, Central Place Sydney Stages 1 and 2 and Existing Surrounding Buildings

Annual

Toga Central Redevelopment - Sydney, NSW

Project #1902973

Drawn by:	EN	Fig:	D-2
Approx. Scale @A3:	1:1000		
Date Revised:	May 23, 2022		

TABLES

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
1	Annual	C1	3.9	-	Sitting	15.7	-	Pass
		C2	3.3	-15%	Sitting	12.3	-22%	Pass
2	Annual	C1	5.6	-	Standing	21.6	-	Pass
		C2	4.2	-25%	Standing	15.9	-26%	Pass
3	Annual							
		C2	4.0	-38%	Sitting	15.9	-33%	Pass
4	Annual	C1	4.2	-	Standing	16.4	-	Pass
		C2	4.2		Standing	16.5		Pass
5	Annual	C1	4.5	-	Standing	17.4	-	Pass
		C2	4.5		Standing	17.0		Pass
6	Annual	C1	5.0	-	Standing	18.7	-	Pass
		C2	3.6	-28%	Sitting	13.3	-29%	Pass
7	Annual	C1	3.9	-	Sitting	14.7	-	Pass
		C2	5.1	31%	Standing	18.3	24%	Pass
8	Annual	C1	3.6	-	Sitting	13.8	-	Pass
		C2	5.7	58%	Standing	20.4	48%	Pass
9	Annual	C1	4.3	-	Standing	15.8	-	Pass
		C2	5.3	23%	Standing	19.2	22%	Pass
10	Annual	C1	3.8	-	Sitting	14.1	-	Pass
		C2	6.6	74%	Walking	24.5	74%	Exceeded
11	Annual	C1	4.0	-	Sitting	15.7	-	Pass
		C2	6.3	58%	Walking	24.8	58%	Exceeded

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
12	Annual	C1	4.0	-	Sitting	17.4	-	Pass
		C2	5.8	45%	Standing	20.8	20%	Pass
13	Annual	C2	5.3	-17%	Standing	17.2	-30%	Pass
14	Annual	C2	6.4	-25%	Walking e	21.5	-29%	Pass
15	Annual	C2	4.2	-11%	Standing	16.5		Pass
16	Annual	C2	3.7	-36%	Sitting	15.6	-39%	Pass
17	Annual	C1	4.0	-	Sitting	16.8	-	Pass
		C2	4.2		Standing	16.7		Pass
18	Annual	C1	6.0	-	Standing	20.5	-	Pass
		C2	6.5		Walking e	20.8		Pass
19	Annual	C1	3.9	-	Sitting	13.9	-	Pass
		C2	3.9		Sitting	15.1		Pass
20	Annual	C1	4.9	-	Standing	18.6	-	Pass
		C2	4.8		Standing	19.0		Pass
21	Annual	C1	5.3	-	Standing	19.1	-	Pass
		C2	5.3		Standing	19.1		Pass
22	Annual	C1	5.3	-	Standing	20.1	-	Pass
		C2	4.8		Standing	18.5		Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
23	Annual	C1	7.6	-	Walking	24.5	-	Exceeded
		C2	7.1		Walking	23.1		Pass
24	Annual	C1	4.4	-	Standing	15.9	-	Pass
		C2	5.0	14%	Standing	16.8		Pass
25	Annual	C1	4.3	-	Standing	15.6	-	Pass
		C2	4.3		Standing	15.9		Pass
26	Annual	C1	4.7	-	Standing	14.9	-	Pass
		C2	5.0		Standing	16.8	13%	Pass
27	Annual	C1	4.4	-	Standing	14.9	-	Pass
		C2	5.0	14%	Standing	18.3	23%	Pass
28	Annual	C2	2.2		Sitting	8.2		Pass
29	Annual	C2	1.6		Sitting	5.2		Pass
30	Annual	C2	4.0		Sitting	15.0		Pass
31	Annual	C1	3.2	-	Sitting	13.8	-	Pass
		C2	4.5	41%	Standing	17.0	23%	Pass
32	Annual	C1	3.1	-	Sitting	11.9	-	Pass
		C2	3.5	13%	Sitting	12.2		Pass
33	Annual	C1	2.3	-	Sitting	10.1	-	Pass
		C2	2.1		Sitting	11.8	17%	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
34	Annual	C1	3.9	-	Sitting	18.0	-	Pass
		C2	5.2	27%	Standing	18.6		Pass
35	Annual	C1	1.9	-	Sitting	6.8	-	Pass
		C2	3.4	79%	Sitting	18.4	171%	Pass
36	Annual	C1	3.4	-	Sitting	12.0	-	Pass
		C2	3.4		Sitting	12.2		Pass
37	Annual	C1	3.7	-	Sitting	14.2	-	Pass
		C2	3.7		Sitting	14.9		Pass
38	Annual	C1	4.6	-	Standing	16.9	-	Pass
		C2	4.6		Standing	16.0		Pass
39	Annual	C1	3.8	-	Sitting	13.0	-	Pass
		C2	5.2	37%	Standing	17.3	33%	Pass
40	Annual	C1	4.4	-	Standing	16.4	-	Pass
		C2	4.6		Standing	16.5		Pass
41	Annual	C1	4.4	-	Standing	16.9	-	Pass
		C2	4.9	11%	Standing	18.9	12%	Pass
42	Annual	C1	4.0	-	Sitting	24.1	-	Exceeded
		C2	3.4	-15%	Sitting	16.3	-32%	Pass
43	Annual	C1	3.3	-	Sitting	12.5	-	Pass
		C2	4.3	30%	Standing	16.8	34%	Pass
44	Annual	C1	4.0	-	Sitting	22.0	-	Pass
		C2	4.0		Sitting	18.3	-17%	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
45	Annual	C1	4.9	-	Standing	19.8	-	Pass
		C2	4.6		Standing	17.3	-13%	Pass
46	Annual	C1	4.5	-	Standing	20.5	-	Pass
		C2	4.4		Standing	19.2		Pass
47	Annual	C1	4.4	-	Standing	19.7	-	Pass
		C2	4.4		Standing	17.9		Pass
48	Annual	C1	2.1	-	Sitting	8.5	-	Pass
		C2	4.9	133%	Standing	19.6	131%	Pass
49	Annual	C1	5.9	-	Standing	17.9	-	Pass
		C2	4.0	-32%	Sitting	14.9		Pass
50	Annual	C1	5.3	-	Standing	21.6	-	Pass
		C2	4.8		Standing	20.5		Pass
51	Annual	C1	5.1	-	Standing	19.5	-	Pass
		C2	4.8		Standing	17.4	-11%	Pass
52	Annual	C1	4.7	-	Standing	16.4	-	Pass
		C2	5.0		Standing	17.8		Pass
53	Annual	C1	4.9	-	Standing	20.3	-	Pass
		C2	5.4	10%	Standing	17.9	-12%	Pass
54	Annual	C1	4.5	-	Standing	15.5	-	Pass
		C2	5.2	16%	Standing	17.1	10%	Pass
55	Annual	C1	4.3	-	Standing	16.3	-	Pass
		C2	4.6		Standing	17.4		Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
56	Annual	C1	4.0	-	Sitting	15.1	-	Pass
		C2	4.3		Standing	16.0		Pass
57	Annual	C1	3.9	-	Sitting	14.4	-	Pass
		C2	4.0		Sitting	15.2		Pass
58	Annual	C1	4.6	-	Standing	17.9	-	Pass
		C2	5.2	13%	Standing	20.7	16%	Pass
59	Annual	C1	4.6	-	Standing	17.6	-	Pass
		C2	4.5		Standing	17.9		Pass
60	Annual	C1	4.4	-	Standing	17.5	-	Pass
		C2	3.9	-11%	Sitting	16.0		Pass
61	Annual	C1	4.0	-	Sitting	14.9	-	Pass
		C2	4.5		Standing	16.5	11%	Pass
62	Annual	C1	5.8	-	Standing	21.7	-	Pass
		C2	5.9		Standing	22.4		Pass
63	Annual	C1	5.7	-	Standing	20.6	-	Pass
		C2	6.4	12%	Walking	22.4		Pass
64	Annual	C1	8.0	-	Walking	24.8	-	Exceeded
		C2	6.9	-14%	Walking	20.5	-17%	Pass
65	Annual	C1	7.3	-	Walking	22.1	-	Pass
		C2	7.6		Walking	23.4		Pass
66	Annual	C1	4.7	-	Standing	16.2	-	Pass
		C2	4.8		Standing	17.7		Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
67	Annual	C1	4.8	-	Standing	17.1	-	Pass
		C2	4.7		Standing	15.8		Pass
68	Annual	C1	4.7	-	Standing	16.8	-	Pass
		C2	4.6		Standing	15.6		Pass
69	Annual	C1	4.4	-	Standing	17.0	-	Pass
		C2	4.7		Standing	18.5		Pass
70	Annual	C1	4.2	-	Standing	15.3	-	Pass
		C2	4.5		Standing	15.9		Pass
71	Annual	C1	4.3	-	Standing	16.7	-	Pass
		C2	4.5		Standing	17.1		Pass
72	Annual	C1	3.9	-	Sitting	15.9	-	Pass
		C2	3.8		Sitting	13.6	-14%	Pass
73	Annual	C1	5.3	-	Standing	19.5	-	Pass
		C2	5.8		Standing	20.9		Pass
74	Annual	C2	6.2	27%	Walking	24.6	24%	Exceeded
80	Annual	C2	2.8		Sitting	11.3		Pass
81	Annual	C2	4.2		Standing	15.3		Pass
82	Annual	C2	3.2		Sitting	16.9		Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort			Wind Safety		
			Speed (m/s)	% Change	Rating	Speed (m/s)	% Change	Rating
93	Annual	C2	4.6		Standing	17.0		Pass
94	Annual	C2	5.2		Standing	20.2		Pass
95	Annual	C2	6.1		Walking	22.7		Pass
96	Annual	C2	4.1		Standing	15.5		Pass
97	Annual	C2	5.4		Standing	17.7		Pass

Seasons	Months	Hours	Wind Comfort (m/s)		Wind Safety (m/s)	
Annual	January - December	0:00 - 23:00	< 4	Sitting	≤ 24	Pass
			≤ 6	Standing	> 24	Exceeded
			≤ 8	Walking		
			> 8	Uncomfortable		

Configurations	
C1	Central Place Study Stage 2 and Atlassian Tower
C2	TOGA [Baseline Design] with Atlassian, CPS Stages 1 and 2 and Existing Surrounding Buildings