

Appendix 15.2

Wind Microclimate Study (Application 5)



Far East Consortium Ltd. (FEC)

RED BANK PLOTS NT02-NT04

Wind Microclimate Study





Far East Consortium Ltd. (FEC)

RED BANK PLOTS NT02-NT04

Wind Microclimate Study

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70079268

PROJECT REF

DATE: APRIL 2023

WSP

WSP House
70 Chancery Lane
London
WC2A 1AF

Phone: +44 20 7314 5000

Fax: +44 20 7314 5111

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Revision 00	Revision 01		
Date	24.03.2023	13.04.2023		
Prepared by	Elvin Hii	Elvin Hii		
Signature	-----	-----		
Checked by	Stefano Cammelli	Stefano Cammelli		
Signature	-----	-----		
Authorised by	Stefano Cammelli	Stefano Cammelli		
Signature	-----	-----		
Project number	70079268	70079268		
Report number				
File reference	70079268_RedBank_NT02-NT04_Wind Microclimate_Study.pdf	70079268_RedBank_NT02-NT04_Wind Microclimate_Study.pdf		

CONTENTS

EXECUTIVE SUMMARY

1	INTRODUCTION	2
1.1	PURPOSE OF STUDY	2
1.2	URBAN WIND EFFECTS	2
2	METHODOLOGY	3
2.1	ASSESSMENT METHODOLOGY	3
2.2	SITE AND STUDY AREA	6
2.3	ASSESSMENT CRITERIA	8
2.4	WIND CLIMATE ANALYSIS	10
2.5	WIND TUNNEL SIMULATION	13
2.6	RECEPTORS AND PEDESTRIAN USAGES	14
3	RESULTS – FEBRUARY/MARCH 2023 WIND TUNNEL TESTS & WIND MITIGATION WORKSHOP	17
3.1	BASELINE	17
3.2	NT02-NT04 + EXISTING SURROUNDS	20
3.3	NT02-NT04 + CUMULATIVE SURROUNDS	27
3.4	NT02-NT04 + OPA + EXISTING SURROUNDS	34
3.5	NT02-NT04 + OPA + CUMULATIVE SURROUNDS	41
3.6	LANDSCAPING STRATEGY AND WIND MITIGATION	48
3.7	NT02-NT04 (ALL SCENARIOS) + LANDSCAPING STRATEGY + WIND MITIGATIONS	52
4	CONCLUSION	77
	REFERENCES	78



EXECUTIVE SUMMARY

This technical report summarises the process and the outcome of the assessment of the *wind microclimate* conditions pertaining to the proposed Plots NT02-NT04 - Detailed (Application 5), which form a part of the Proposed Development within the Red Bank Neighbourhood and New Town Neighbourhood. This technical report is based on the outcome of the wind tunnel testing campaign that took place in February/March 2023.

A series of boundary layer wind tunnel tests were conducted to determine the wind conditions within and in the immediate vicinity of the Site for the proposed Plots NT02-NT04 and to develop wind mitigation measures aimed at alleviating unwanted and undesirable windy conditions across the area of study.

With the introduction of the proposed landscaping strategy and targeted wind mitigation measures, no exceedances of the pedestrian *safety* and *comfort* criteria relevant to the design of the proposed Plots NT02-NT04 were observed.

Contact name: Stefano Cammelli

Contact details: +44 (0) 7717 652510 | stefano.cammelli@wsp.com

1 INTRODUCTION

WSP Wind Engineering were appointed by Far East Consortium Ltd. (FEC) to carry out the wind microclimate studies in support of the planning application for the proposed Redbank development in Manchester, UK.

The studies presented within this technical report are focused on the assessment of the *wind microclimate* conditions within and in the vicinity of the site of the proposed Plots NT02-NT04 - Detailed (Application 5), which form a part of the Proposed Development within the Red Bank Neighbourhood and New Town Neighbourhood. The corresponding wind microclimate assessment for the other part of the Proposed Development, i.e., Redbank Neighbourhood - Outline (Application 4), has also been conducted (using CFD simulations) and is detailed in a separate technical report – document ‘70079268_RedBank_OPA_Wind Microclimate_Study.pdf’ dated 24th March 2023.

1.1 PURPOSE OF STUDY

This study aims to compare the pedestrian level wind environment within and around the site against comfort and safety criteria. The study pays particular attention to pedestrian routes, seating and recreational areas as well as entrances, balconies and terraces of the proposed building.

1.2 URBAN WIND EFFECTS

The wind microclimate around an urban environment is affected by terrain, buildings, and other obstructions. The introduction of a new building development can affect the local wind flow patterns and has the potential to produce an uncomfortable and/or unsafe wind environment at pedestrian level.

This is particularly important in areas with many high-rise buildings and for buildings which are taller than their surroundings. Fast-moving high-level winds can downdraft to street level along windward faces of buildings. As air then moves into the low-pressure wake of the building, it can accelerate around corners and/or through restrictions, causing localised regions of relatively high wind speed.

The assessment of environmental wind flows in the built environment lies outside the scope of BS EN 1991-1-4:2005 [1], the current UK code of practice for the assessment of wind effects on buildings, which focuses on wind loading. Also, there are no handbooks or engineering methods from which reliable assessments of the complex environmental wind flows that shape the pedestrian level wind conditions can be derived. The set of results presented within this document is solely based on experimental wind tunnel testing and it makes use of the wind statistics derived from long-term meteorological data obtained from *Manchester Airport* to determine the probability of local wind speeds exceeding comfort and safety thresholds for a range of common pedestrian activities. The assessment of wind comfort and safety is based on the LDDC (London Docklands Development Corporation) version of the Lawson [2] criteria to ascertain the safety risks to pedestrians at various receptors.

2 METHODOLOGY

2.1 ASSESSMENT METHODOLOGY

The pedestrian level wind environment in an urban setting is influenced by the macroscopic wind conditions at the site as well as by the more local aerodynamic effects generated by the urban environment itself. For this reason, the assessment of the pedestrian level wind environment involves the following three steps: the evaluation of the aerodynamic effects generated by the urban environment on the on-coming winds, the combination of these with historical wind data and, finally, a comparison against a set of criteria to quantify the discomfort and/or level of distress caused by the wind.

A series of boundary layer wind tunnel tests were conducted to determine the wind conditions within and in the immediate vicinity of the project site and to develop wind mitigation measures aimed at alleviating unwanted and undesirable windy conditions across the project site and its surrounding.

Initially, the five (5) configurations shown in Figure 2-1 through to Figure 2-5 were wind tunnel tested in the absence of any existing or proposed landscaping. Subsequently, the proposed landscaping strategy and – where necessary – targeted wind mitigation measures were implemented to achieve the required levels of safety and comfort.

Figure 2-1 – Scenarios assessed in the wind tunnel tests – Existing Baseline.

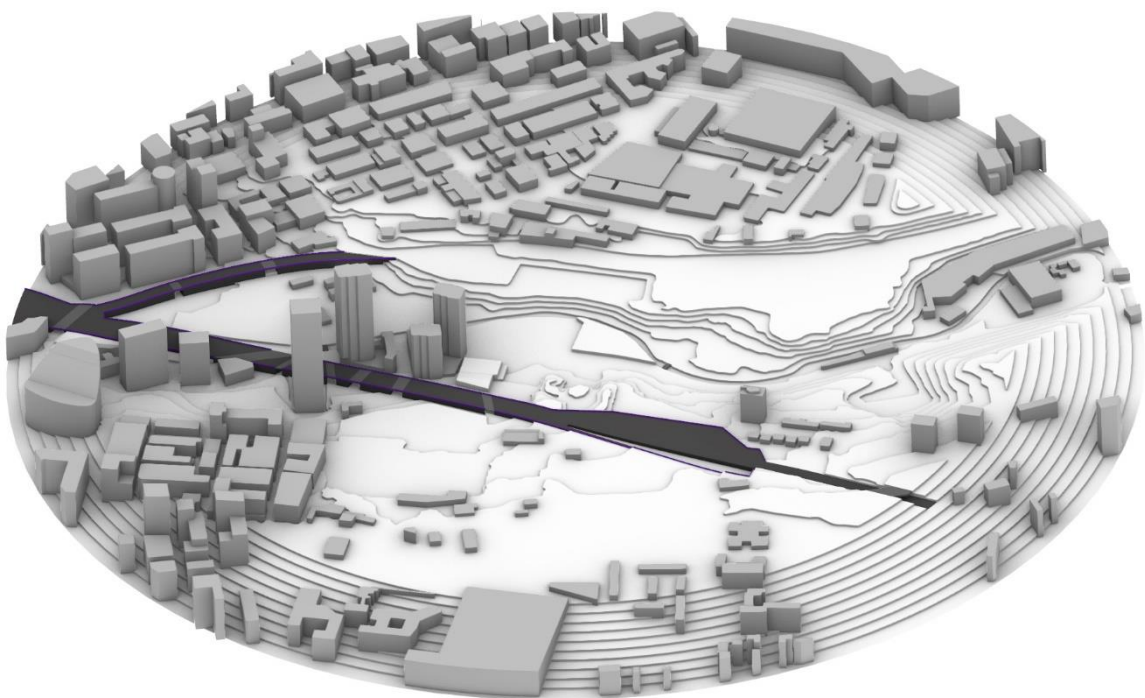


Figure 2-2 – Scenarios assessed in the wind tunnel tests – NT02-NT04 + Existing surrounds.

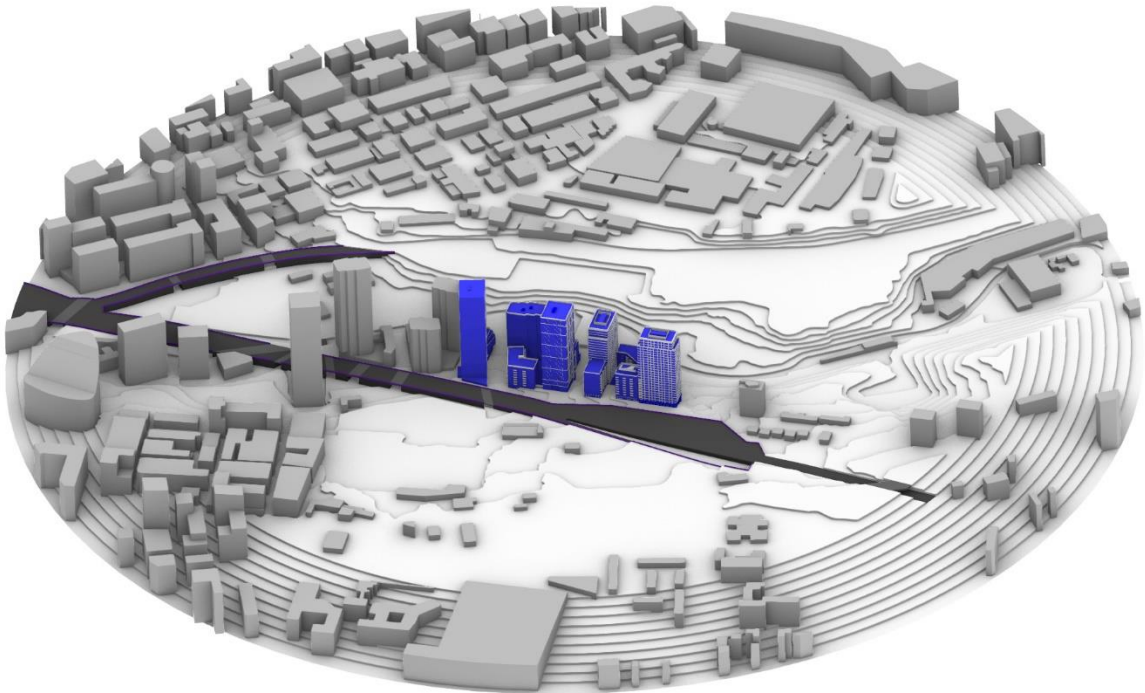


Figure 2-3 – Scenarios assessed in the wind tunnel tests – NT02-NT04 + Cumulative Surrounds.

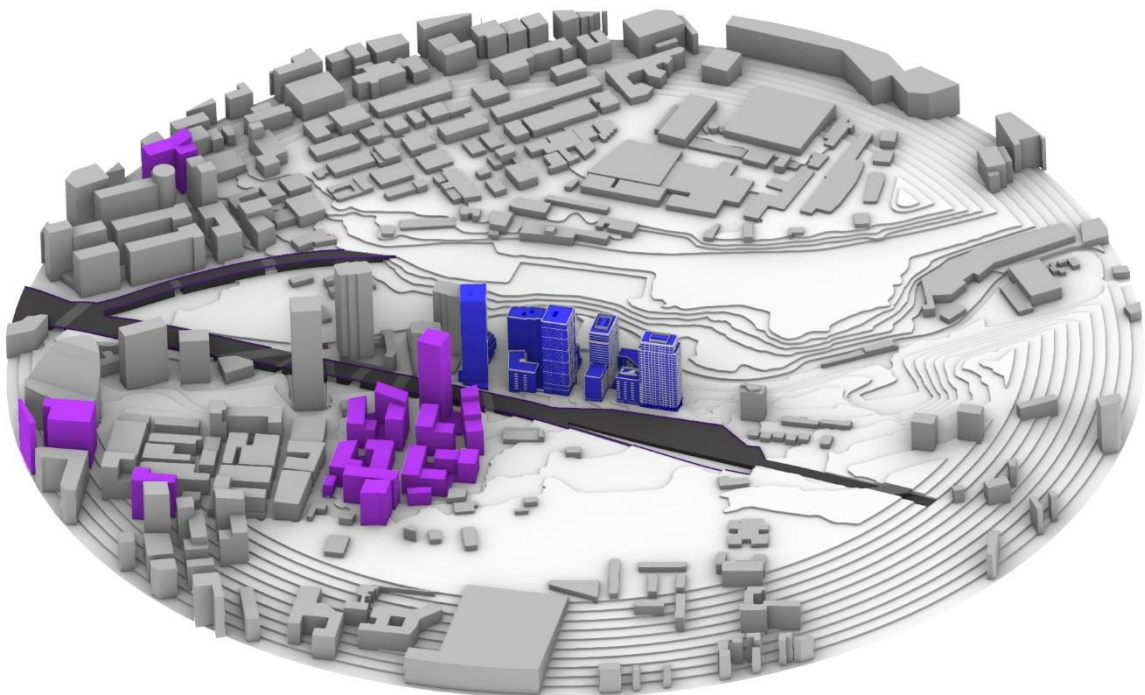


Figure 2-4 – Scenarios assessed in the wind tunnel tests – NT02-NT04 + OPA + Existing surrounds.

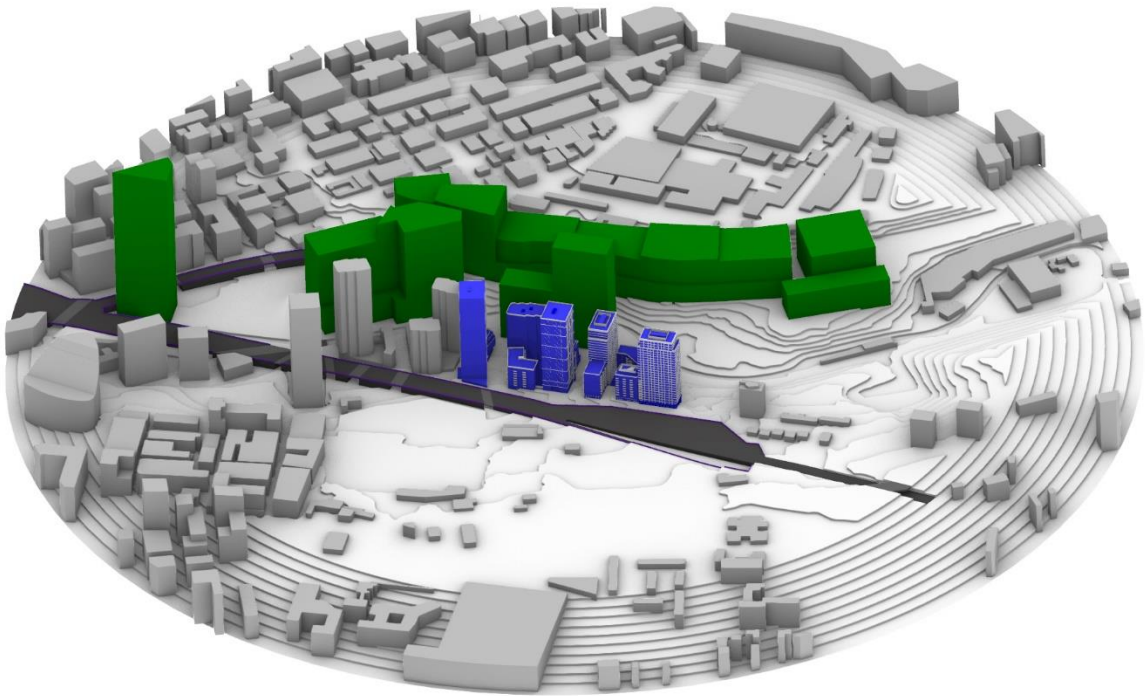
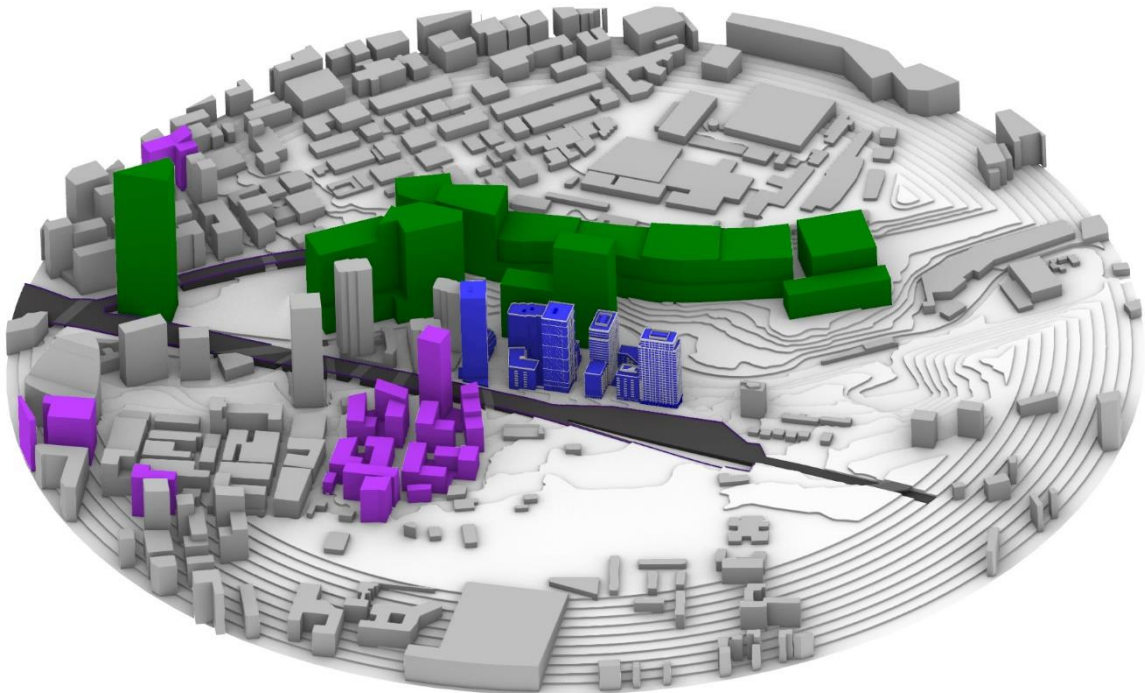


Figure 2-5 – Scenarios assessed in the wind tunnel tests – NT02-NT04 + OPA + Cumulative Surrounds.

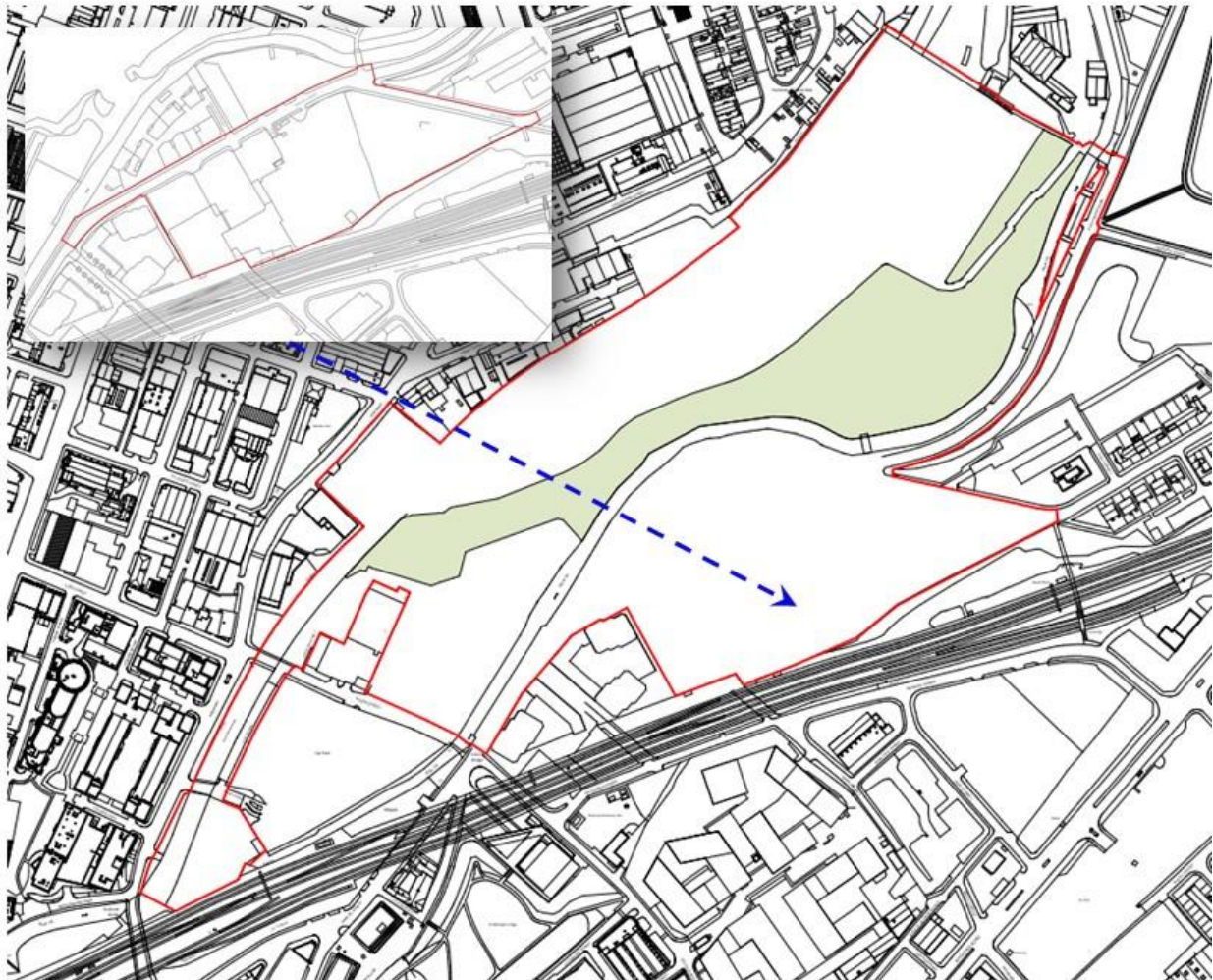


2.2 SITE AND STUDY AREA

The area of the Site for Plots NT02-NT04 - Detailed (Application 5) largely consists of hardstanding and prepared ground.

To the north, the Application 5 area of the Site is bound by Dantzic Street, beyond which is the Application 4 area of the Site. To the east, the Application 5 area is bound by Dalton Street and a small number of two-storey homes and a mid-rise residential tower building. To the south, the Application 5 area is bound by the railway line into Victoria Station. To the west, the Application 5 area is bound by the emerging Victoria Riverside development. Figure 2-6 provides a contextual view of the Site in its immediate surrounding and relative to the full extent of the Proposed Development within the Red Bank Neighbourhood and New Town Neighbourhood.

Figure 2-6 – Site layout for Plots NT02-NT04 and its location relative to the wider Proposed Development.



A three-dimensional CAD model of the Site and of the surrounding buildings was constructed based on information available in the public domain as well as using the drawings listed in Table 2-1.

Table 2-1 – Drawing sets used to construct the model.

Date received (dd/mm/yy)	Filename	Usage
20/12/2022	RDB-MLM-ZZ-XX-M3-AR-009001_EIA Combined Future Baseline.dwg	Construction of 3D CAD model (terrain/topography and Maximum Parameter plots for the Redbank Outline Application) for wind tunnel tests.
13/01/2023	230113-RDB-MLA-3D Model Cad_P05.04.dwg	Construction of 3D CAD model (NT04) for wind tunnel tests.
16/01/2023	RDB-HBA-2X-XX-M3-AR- XXXXXX_DetailedMassing.dwg	Construction of 3D CAD model (NT02 & NT03) for wind tunnel tests.
16/01/2023	RDB-OPN-XX-XX-M3-LA- 200000_detached230111.dwg	Construction of 3D CAD model (terrain/topography for plots NT02-NT04) for wind tunnel tests.
27/01/2023	SK-230127-001-QA Massing-Maximum height parameter Floor Plan-change tracker.pdf	Update to massing parameters of RB06, RB07, RB16 and RB17
30/01/2023	230130_NT02-03_Detailed Massing Update.dwg	Update to massing of NT02 – increased height of the clubhouse.
06/02/2023	230206-RDB-MLA-2D3 BTR Entrance.dwg	Chamfer modification to ground level entrance of NT04.
13/02/2023	M10394_NT02-NT04 Landscape Plan_Courtyards_230213.dwg	Proposed landscaping strategy for plots NT02-NT04 (courtyards).
13/02/2023	M10394_NT02-NT04 Landscape Plan_PublicRealm_230213.dwg	Proposed landscaping strategy for plots NT02-NT04 (public realm).

The model includes the site and all buildings within an approx. 600m radius from the site as shown in Figure 2-1 through to Figure 2-5. The following cumulative scheme applications were also considered in this study:

- The Gasworks (128248/FO/2020).
- 25 Rochdale Road (127537/FO/2020).
- 2 and 3 Angel Square (124973/FO/2019).
- 87 Rochdale Road (131708/FO/2021).
- 1 Lord Street (113914/FO/2016).

Figure 2-7 shows the 1:400 physical wind tunnel model in the context of the Outline Application 4 and cumulative surrounds.

During the construction stage of the wind tunnel model, updated information pertaining to the increase in height of the NT02 clubhouse by 2 storeys (as detailed in the file *230130_NT02-03_Detailed Massing Update.dwg* listed in Table 2-1) was received from the design team. The corresponding changes were incorporated on the wind tunnel model. However, as the model

construction approached completion, a further update was received, with the massing of the NT02 clubhouse reverting to its previous parameters. The latter changes were not incorporated, and the wind tunnel tests were conducted with the taller version of the NT02 clubhouse. From a wind microclimate perspective, the proposed changes were relatively minor and if anything, it is expected that the current assessment (with the taller massing of the NT02 clubhouse) would be slightly conservative.

Figure 2-7 – Photograph of the wind tunnel model: proposed Plots NT02-NT04 – Detailed (Application 5) in the context of the Redbank Neighbourhood – Outline (Application 4) and cumulative surrounds.



2.3 ASSESSMENT CRITERIA

The criteria used in this study were developed by Lawson [2] and are reproduced for easy reference in Table 2-2. Like most criteria used in the assessment of pedestrian wind conditions, they relate a threshold wind speed and a threshold frequency to the suitability of an activity.

The frequency threshold for each criterion is 5% - or about three weeks per year. It is also useful to assess frequency on a seasonal basis. For example, an outdoor seating area may require wind conditions suitable for sitting or standing in summer, but not in winter when the seating is unlikely to be used. For season-specific results, the criteria are based on 5% of hours across the months in that season.

Table 2-2 – Lawson criteria for pedestrian wind comfort.

Category	Mean and GEM wind speed (5% exceedance)	Description
Sitting	4m/s	Acceptable for frequent outdoor sitting use, e.g., restaurant, café.
Standing	6m/s	Acceptable for occasional outdoor seating, e.g., general public outdoor spaces, etc.
Walking	8m/s	Acceptable for strolling and general thoroughfare usage.
Business Walking	10m/s	Can be tolerated if one's objective is to walk, run or cycle without lingering, e.g., external pavements, walkways.
Uncomfortable	>10m/s	Not comfortable for regular pedestrian access.

Additionally, criteria for safety have been defined based on 0.025% exceedance per year (~2.2 hours). These are areas where someone could find walking difficult or even lose their footing. The criteria are reproduced in Table 2-3.

Table 2-3 – Lawson criteria for pedestrian safety.

Category	Mean and GEM wind speed (0.025% exceedance)	Description
S15	15m/s	Presents a safety risk for more vulnerable members of the public.
S20	20m/s	Presents a safety risk for all pedestrians.

2.4 WIND CLIMATE ANALYSIS

Wind data was obtained from the meteorological station at *Manchester Airport*, which is approximately 20km to the South of the site. The data consisted of mean wind speeds and directions over 20+ years. The data was discretised into 36 bins, representing 10° sectors. The nomenclature adopted in this report assigns 0° to winds coming from north and increases clockwise such that 90° refers to winds blowing from east, 180° from south and 270° from west.

Linear regression methods were used to fit the data to a Weibull probability distribution, i.e.:

$$P(U) = pe^{-\left(\frac{U}{c}\right)^k}$$

where the p, c and k coefficients are the probability of the wind direction occurring, the dispersion parameter and the shape parameter respectively.

Figure 2-8 shows a summary of the wind data at the project site for the whole year, whilst Figure 2-9 shows seasonal wind data, in the form of wind roses. Wind direction is shown on the angular axes, with percentage of hours on the radial axes. From these plots, it is possible to observe that southerly and westerly winds are the prevailing wind directions, with these winds also representing the largest proportion of higher wind speeds.

Figure 2-8 – Annual wind rose (10m reference height in open country terrain).

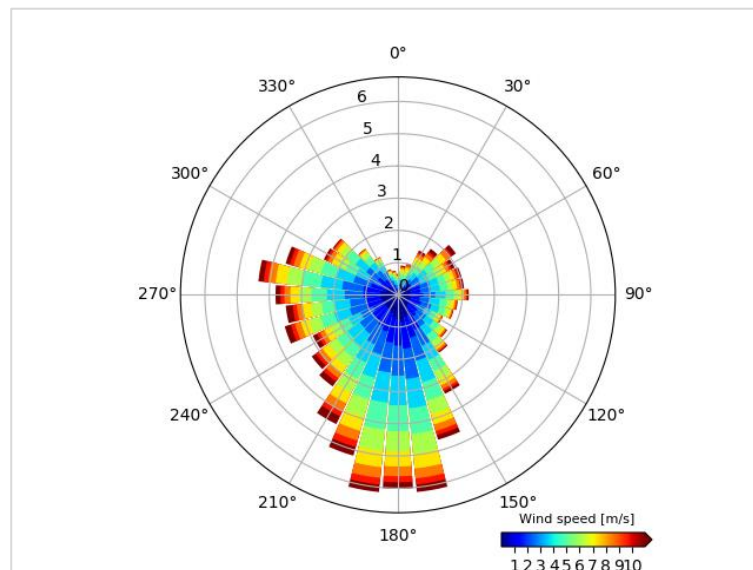
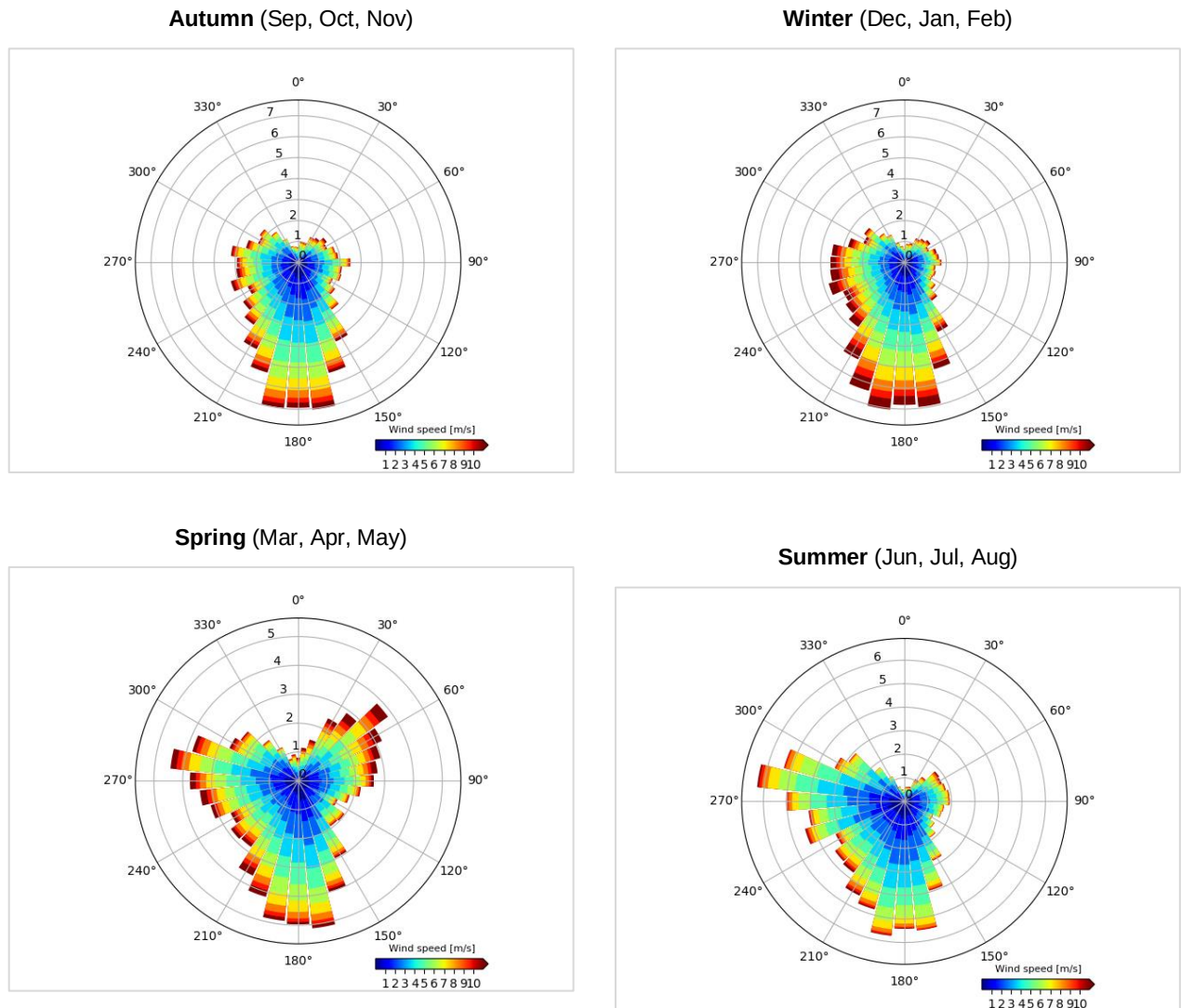


Figure 2-9 – Wind roses for each season (10m reference height in open country terrain).



To account for the differences in terrain surrounding the weather station at *Manchester Airport* and the site, adjustments were made using the wind model proposed by ESDU [3], an engineering advisory organisation based in the UK. This method assigns transposition factors to the 'c' term in the Weibull distribution of the data at the meteorological site, based on upwind aerodynamic roughness of the terrain. The airport data was initially transposed to open country terrain and subsequently transposed to the project site at a reference height of 130m. This terrain analysis was based on the CORINE Land Cover (CLC) dataset which is shown in Figure 2-8. This resulted in the transposition factors shown in Table 2-4.

Figure 2-10 – Aerodynamic roughnesses around the site used in the terrain translation.

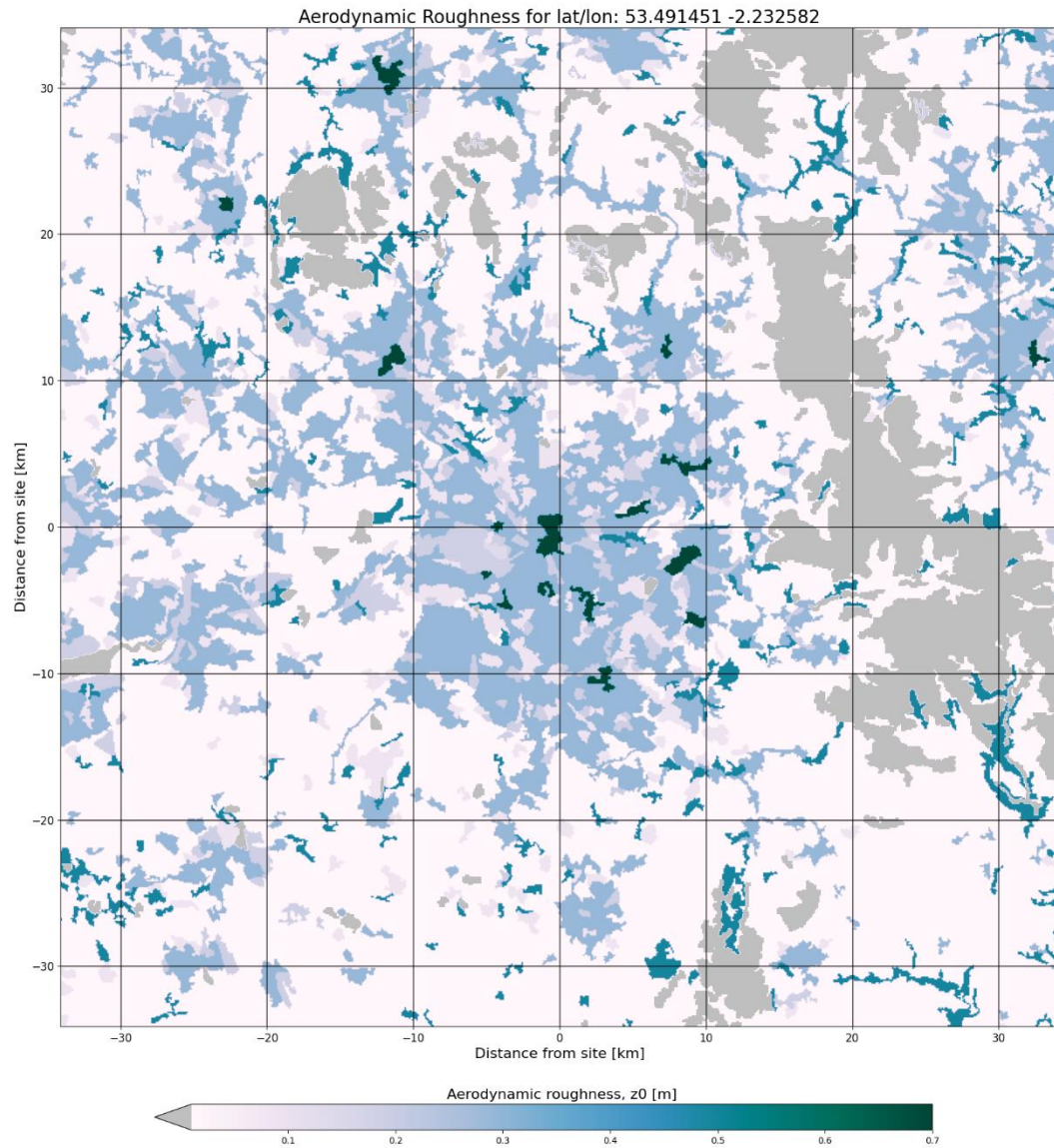


Table 2-4 – Ratio of 'c' term in the Weibull distribution for the site (130m at the site to 10m open country).

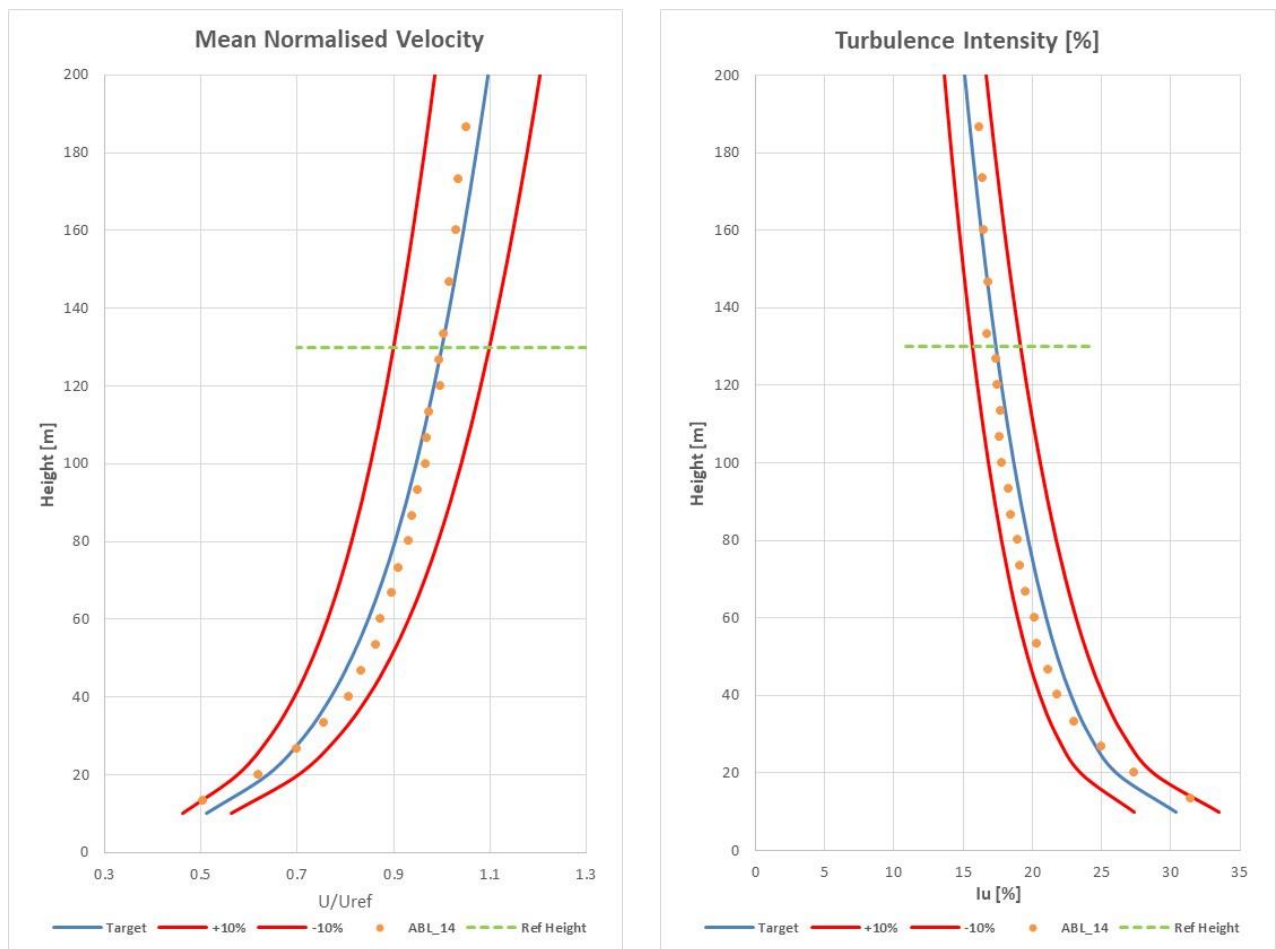
Dir. [°]	0	30	60	90	120	150	180	210	240	270	300	330
Ratio	1.31	1.32	1.31	1.30	1.30	1.30	1.28	1.26	1.28	1.29	1.28	1.30

2.5 WIND TUNNEL SIMULATION

The wind tunnel tests were performed at the *Imperial College* '10 x 5 Boundary Layer Wind Tunnel' facility (www.imperial.ac.uk/aeronautics/facilities/10x5-wind-tunnel) which uses a 20m inlet fetch to simulate an atmospheric boundary layer wind profile.

The target wind profile (mean wind speed as well as turbulence intensity) for the exposure identified for the project site, together with the profile that was measured in the wind tunnel, are shown in Figure 2-9.

Figure 2-11 – Wind profiles: target vs. measured (normalised mean wind speed and turbulence intensity I_u).



2.6 RECEPTORS AND PEDESTRIAN USAGES

A total of up to 184 receptors (126 at street level and 58 at the elevated levels of plots NT02-NT04) were included in the wind tunnel model. Figure 2-12 to Figure 2-15 present maps of all receptors and their existing/intended usages.

For each receptor, local wind speeds were measured at a scaled height of 1.5m above the local ground and in 10° increments. Fluctuating local wind speeds were recorded at each receptor and mean as well as 'gust equivalent mean' (GEM) computed.

Figure 2-12 – Map of receptors and their existing usages (Baseline scenario).

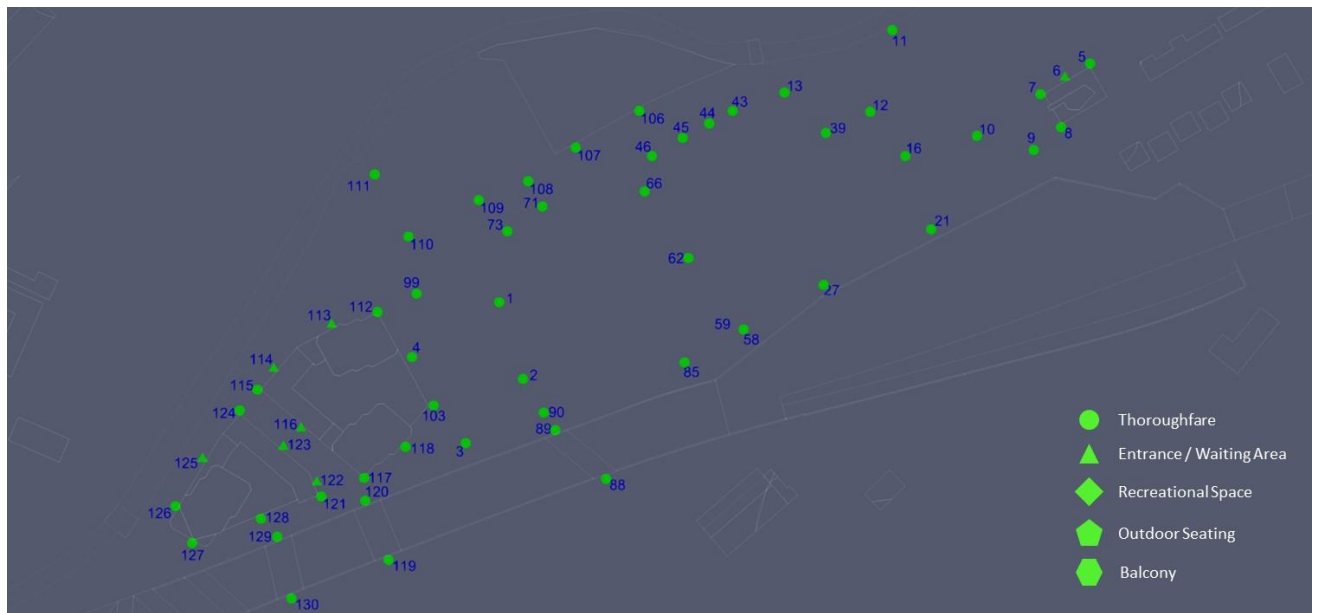


Figure 2-13 – Map of receptors and their existing/proposed usages (scenarios with plots NT02-NT04, ground level).

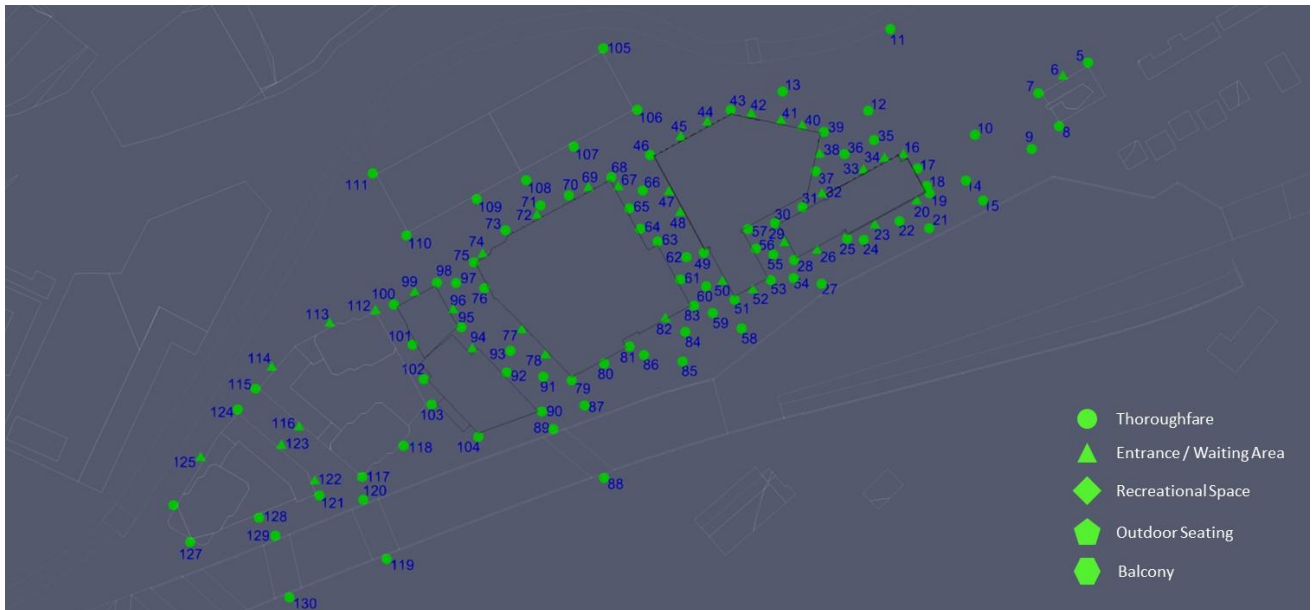


Figure 2-14 – Map of receptors and their proposed usages (scenarios with plots NT02-NT04, podium level).

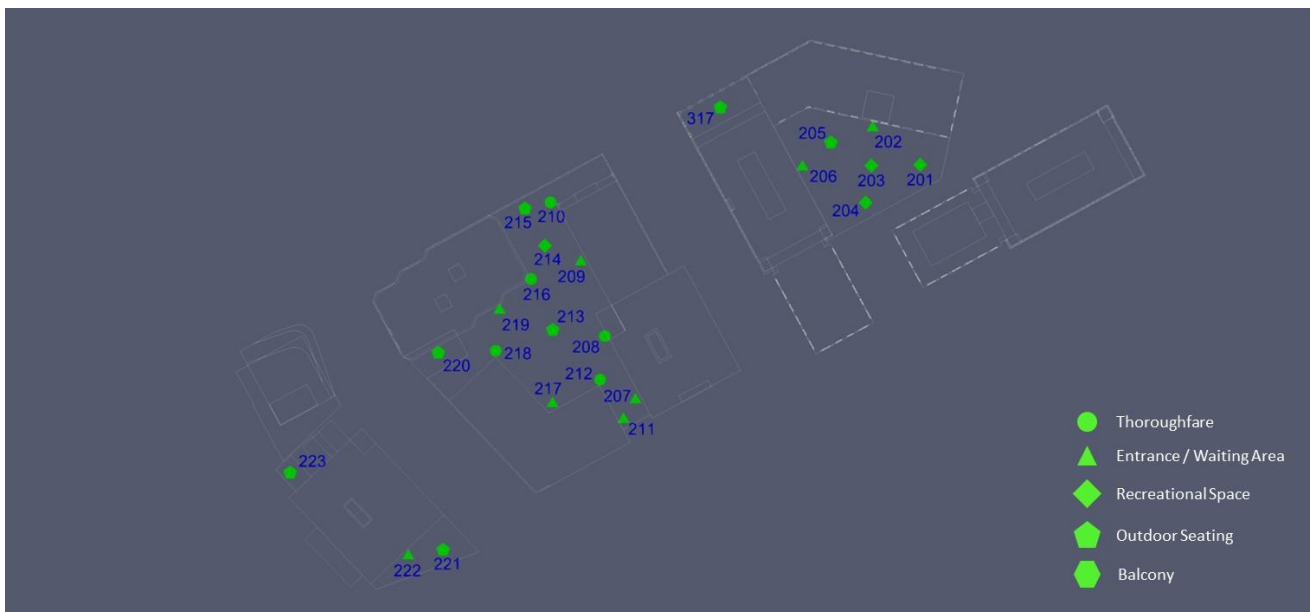
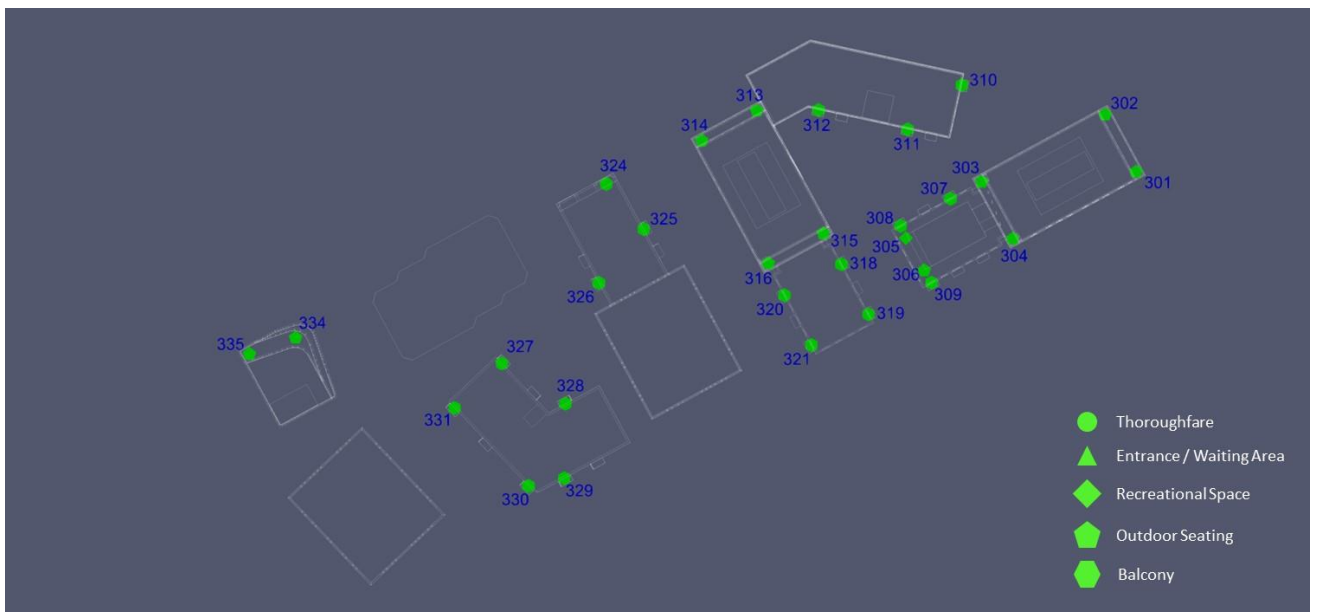


Figure 2-15 – Map of receptors and their proposed usages (scenarios with plots NT02-NT04, lower balconies).



Figure 2-16 – Map of receptors and their proposed usages (scenarios with plots NT02-NT04, upper balconies and terraces).



3 RESULTS – FEBRUARY/MARCH 2023 WIND TUNNEL TESTS & WIND MITIGATION WORKSHOP

Wind tunnel tests were carried out in February/March 2023. The following configurations were tested:

- Existing Baseline.
- NT02-NT04 in Existing Surrounds.
- NT02-NT04 in Cumulative Surrounds.
- NT02-NT04 + Outline Planning Application (OPA) in Existing Surrounds.
- NT02-NT04 + Outline Planning Application (OPA) in Cumulative surrounds.

The five (5) configurations above were first tested without any proposed landscaping elements to provide a conservative representation of overall wind conditions in and around the Site. Following this, the landscaping strategy was introduced, and targeted mitigation measures explored and integrated where necessary to alleviate exceedances of the applicable pedestrian safety and comfort criteria.

3.1 BASELINE

At street level, the sole exceedance of the pedestrian *safety* criteria was observed at Receptor 127 (southwest corner of Victoria Riverside Block A).

In terms of pedestrian wind *comfort*, wind conditions are generally suitable for their intended use. Some inherent exceedances of the wind comfort criteria occur, namely at:

- Receptors 113 and 116 – ground level entrances at the north and west facades of Victoria Riverside Block B.
- Receptor 123 – ground level entrance at the east façade of Victoria Riverside Block A.

Results for the 'Existing Baseline' configuration are illustrated in Figure 3-1 through to Figure 3-3.

Figure 3-1 – Annual safety (Existing Baseline).

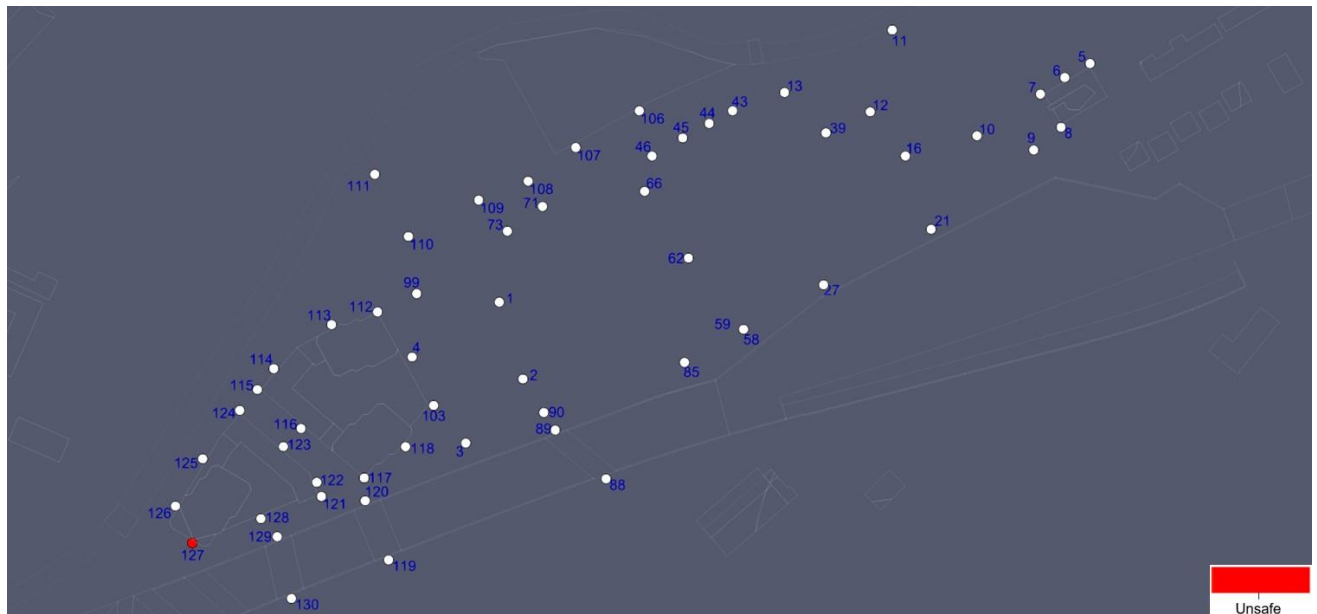


Figure 3-2 – Winter comfort (Existing Baseline).

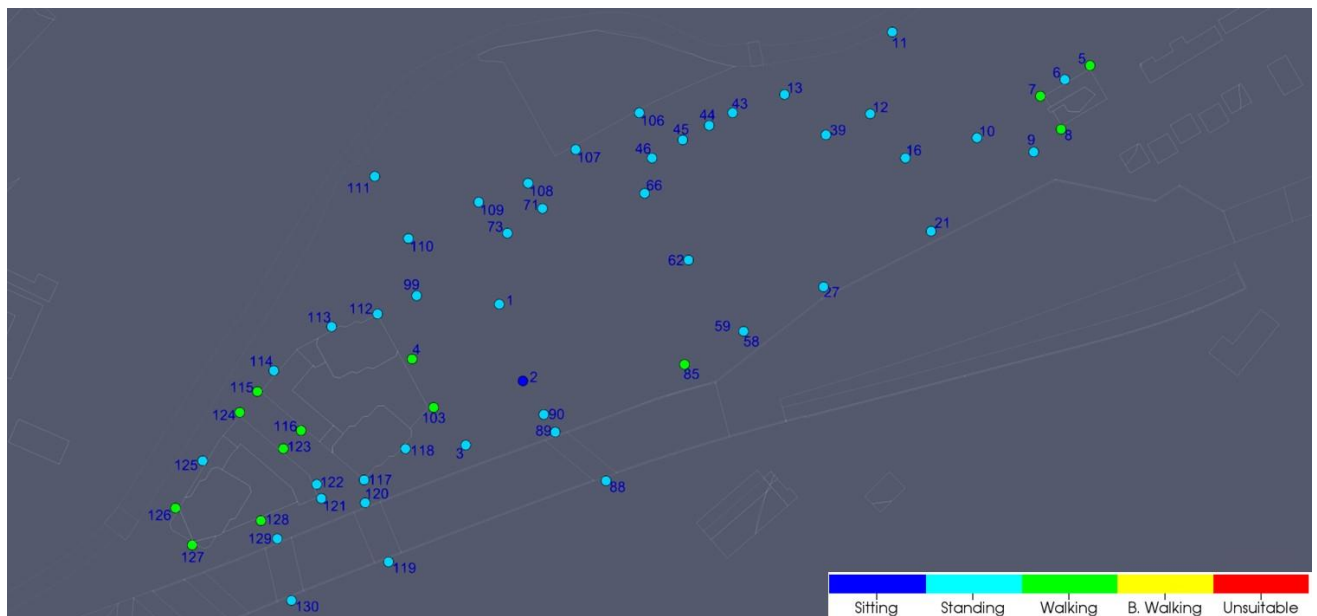
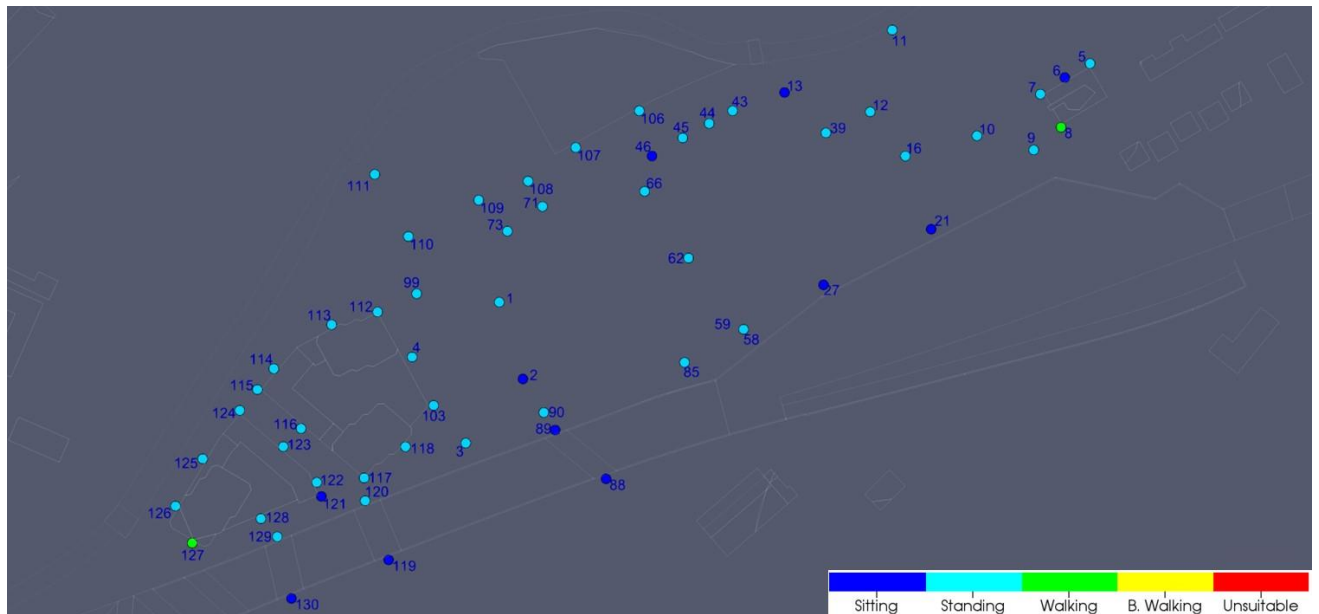


Figure 3-3 – Summer comfort (Existing Baseline).



3.2 NT02-NT04 + EXISTING SURROUNDS

With the introduction of the proposed Plots NT02-NT04 - Detailed (Application 5) in the context of the existing surrounds, the following exceedances of the pedestrian *safety* criteria were observed:

- Receptor 14 (thoroughfare to the east of NT04).
- Receptor 55 (thoroughfare between 2D.1 and 2D.3 of NT04).
- Receptors 49, 60 and 62 (thoroughfare locations within Travis Passage).

Additionally, the inherent exceedance of the *safety* criteria at Receptor 127 (southwest corner of Victoria Riverside Block A) persists.

At the elevated levels, wind conditions at all receptors are *safe* from a pedestrian level wind standpoint.

In terms of pedestrian wind *comfort*, wind conditions are generally suitable for their intended uses. The following exceptions occur:

- Thoroughfares:
 - Receptor 14 (to the east of NT04).
 - Receptor 30 (2D.3 – NT04).
 - Receptors 49, 60 and 62 (southern end of Travis Passage).
 - Receptor 55 (between 2D.1 and 2D.3 of NT04).
- Entrances / Waiting Areas:
 - Receptor 16 (2D.3 – NT04 lobby).
 - Receptor 20 (2D.3 – NT04 co-working space).
 - Receptor 29 (2D.3 – NT04 maisonettes).
 - Receptor 44 (2D.1 – NT04 commercial units).
 - Receptor 48 (2D.1 – NT04 lobby).
 - Receptor 50 (2D.1 – NT04 maisonettes).
 - Receptor 77 (NT03 Midrise 3 commercial unit).
 - Receptor 96 (NT02 Clubhouse lobby).
- Recreational Spaces / Terraces:
 - Receptors 201 and 203 (NT04 podium terrace)
 - Receptor 214 (NT03 podium terrace)
- Outdoor Seating:
 - Receptor 205 (NT04 podium terrace)
 - Receptors 213, 215 and 220 (NT03 podium terrace)
 - Receptors 221 and 223 (NT02 Tower 1 podium terraces)
 - Receptor 304 (2D.3 – NT04 private amenity terrace)

- Receptor 305 (2D.3 – NT04 roof amenity terrace)
- Receptors 334 and 335 (NT02 Clubhouse terrace)
- Balconies:
 - Receptor 333 (indicative of wind conditions at the lower balconies near the northwest corner of NT03 Midrise 3)

Results for the 'NT02-NT04 + existing surrounds' configuration are illustrated in Figure 3-4 through to Figure 3-15.

Figure 3-4 – Annual safety, NT02-NT04 + Existing Surrounds, ground level.



Figure 3-5 – Annual safety, NT02-NT04 + Existing Surrounds, podium level.

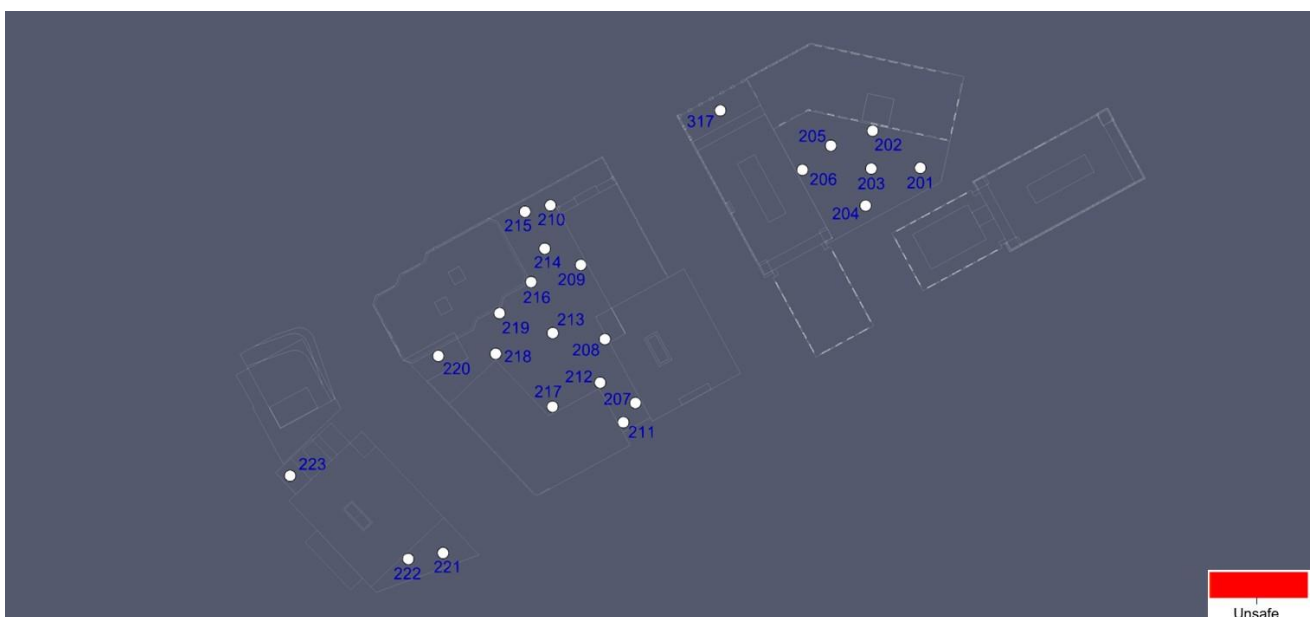


Figure 3-6 – Annual safety, NT02-NT04 + Existing Surrounds, lower balconies.

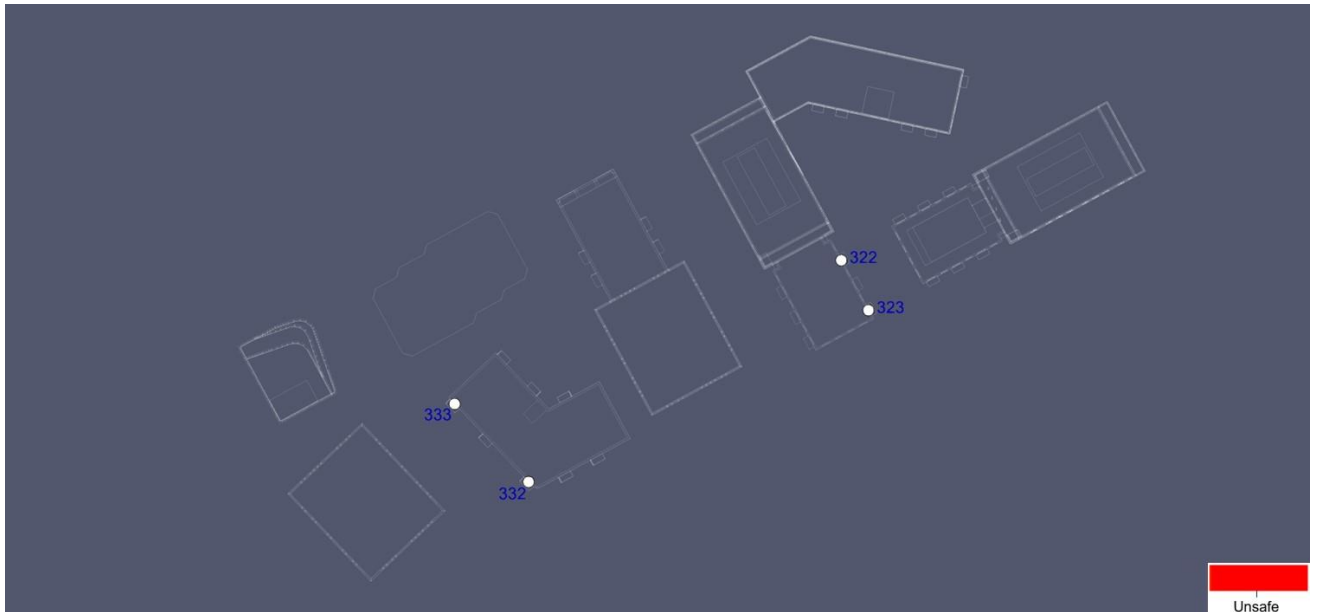


Figure 3-7 – Annual safety, NT02-NT04 + Existing Surrounds, upper balconies and terraces.

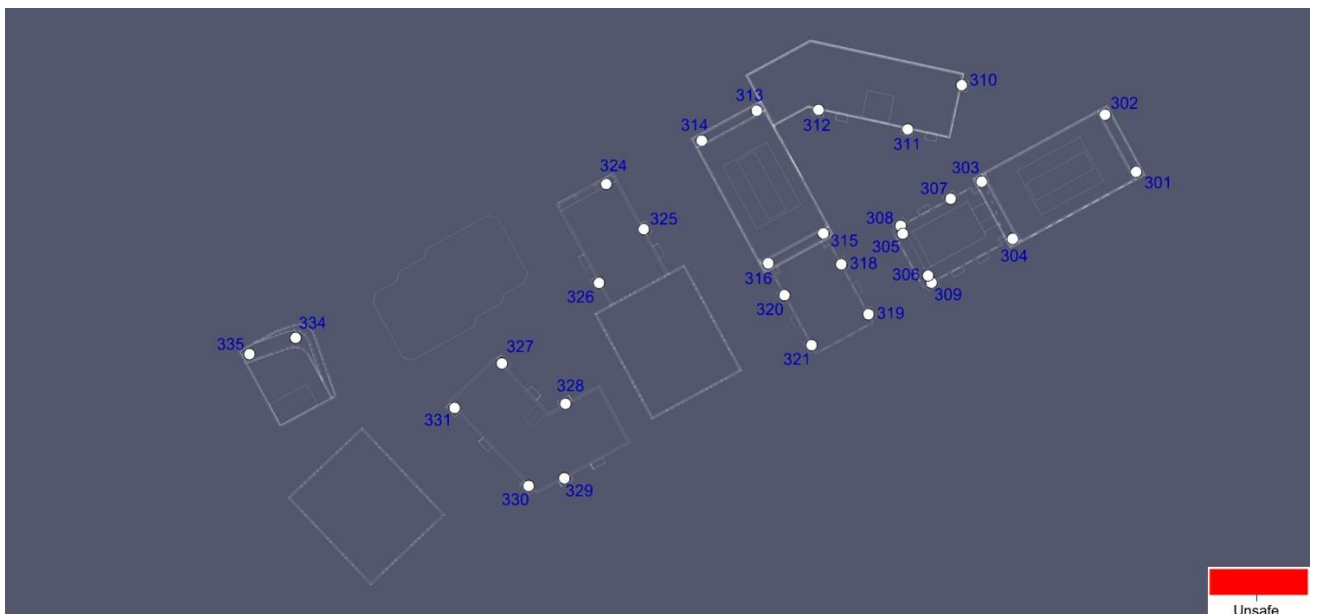


Figure 3-8 – Winter comfort, NT02-NT04 + Existing Surrounds, ground level .

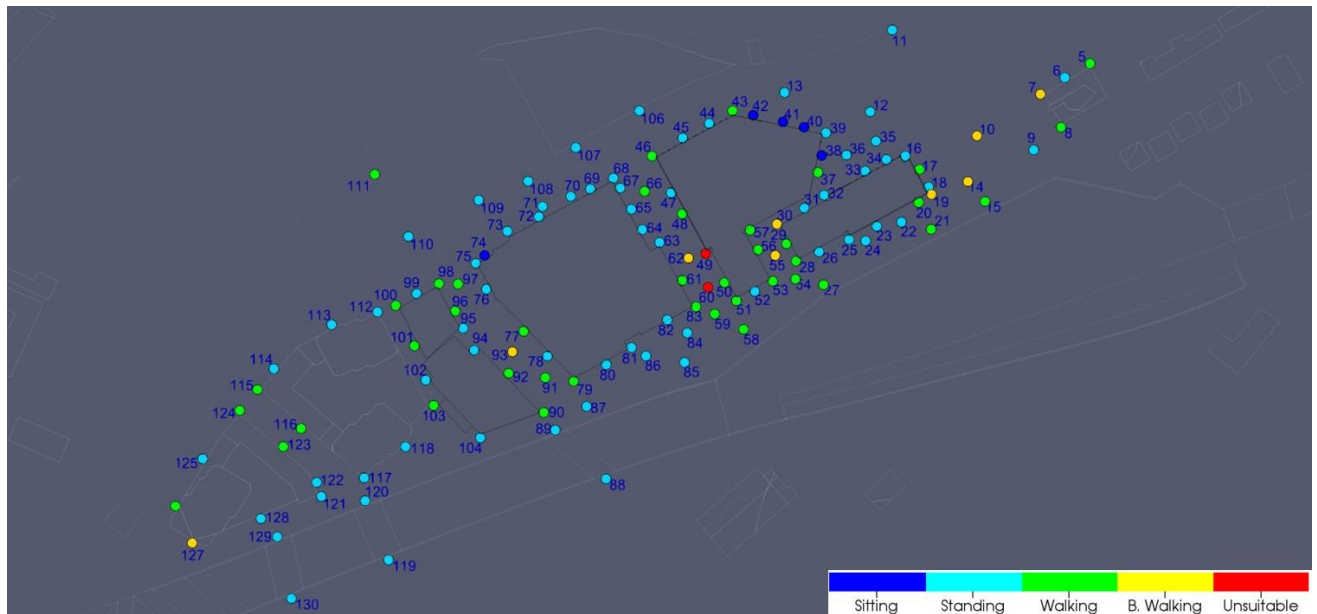


Figure 3-9 – Winter comfort, NT02-NT04 + Existing Surrounds, podium level.

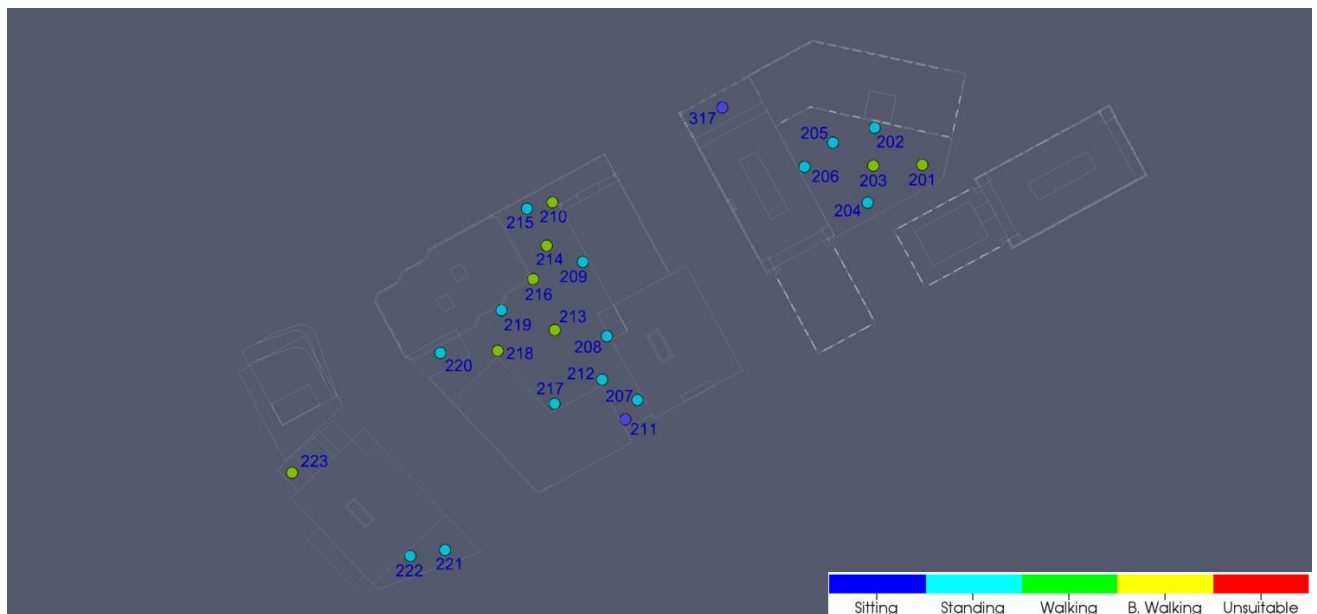


Figure 3-10 – Winter comfort, NT02-NT04 + Existing Surrounds, lower balconies.

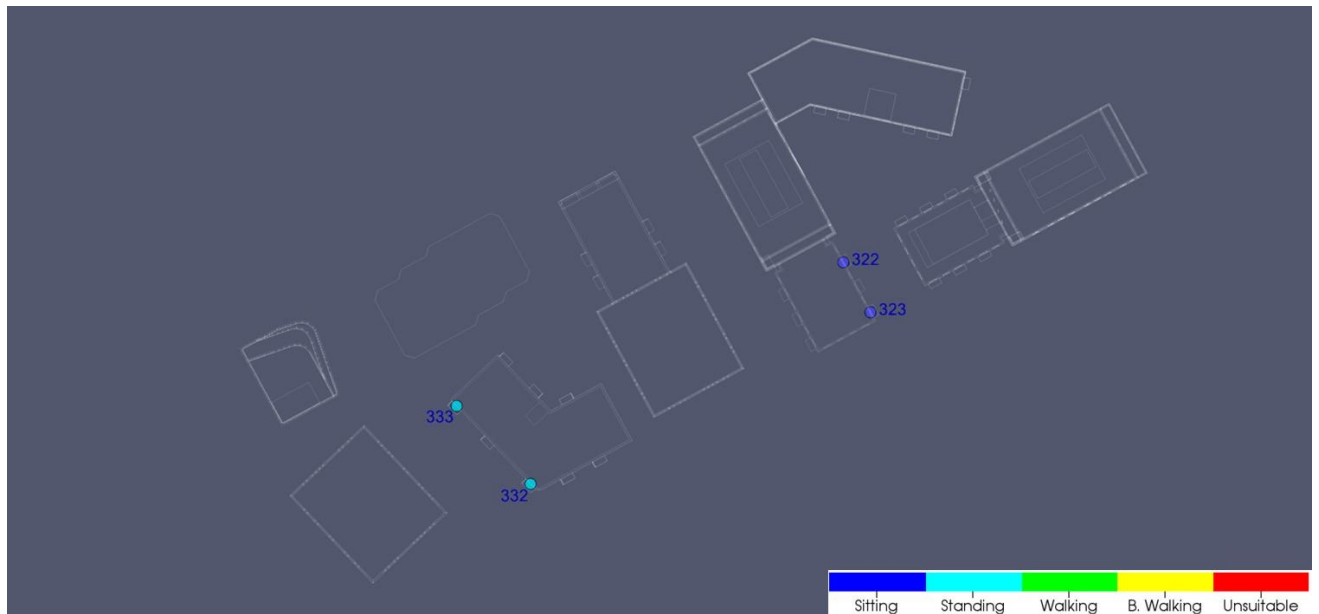


Figure 3-11 – Winter comfort, NT02-NT04 + Existing Surrounds, upper balconies and terraces.

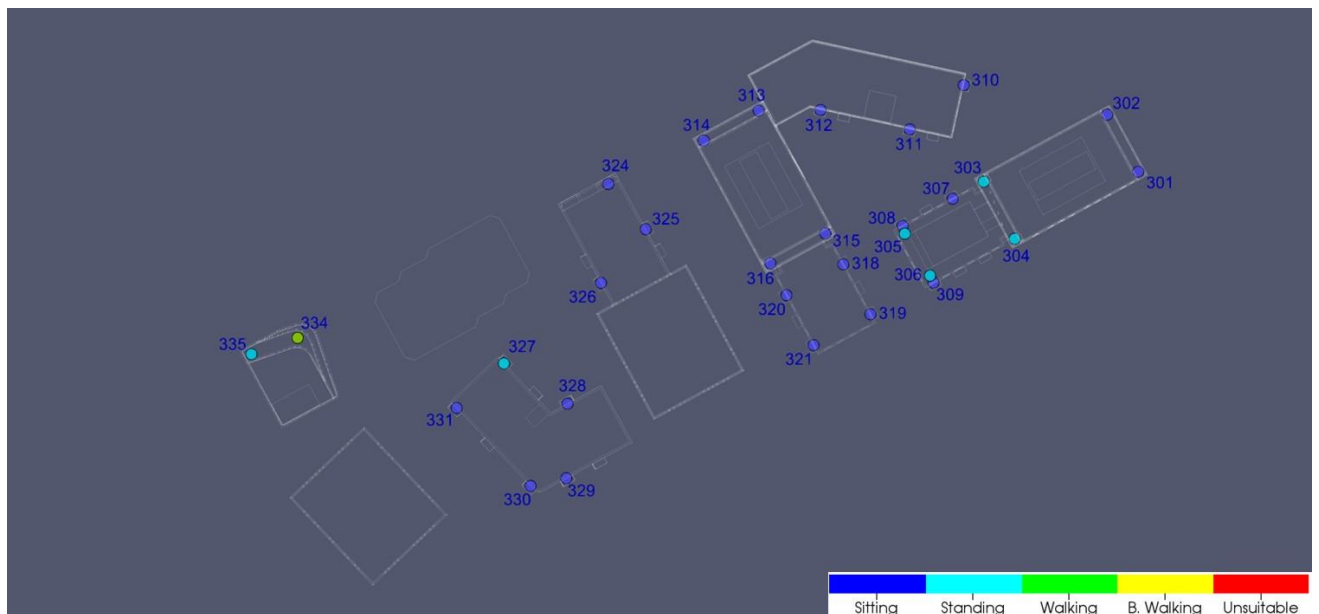


Figure 3-12 – Summer comfort, NT02-NT04 + Existing Surrounds, ground level .

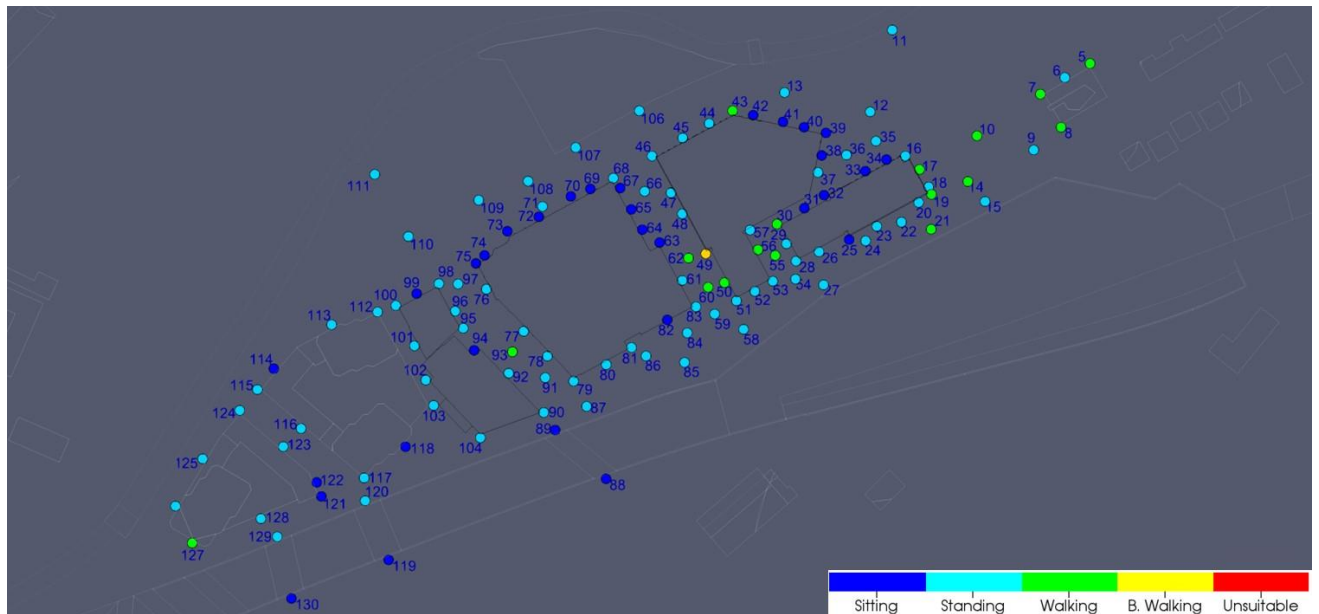


Figure 3-13 – Summer comfort, NT02-NT04 + Existing Surrounds, podium level.

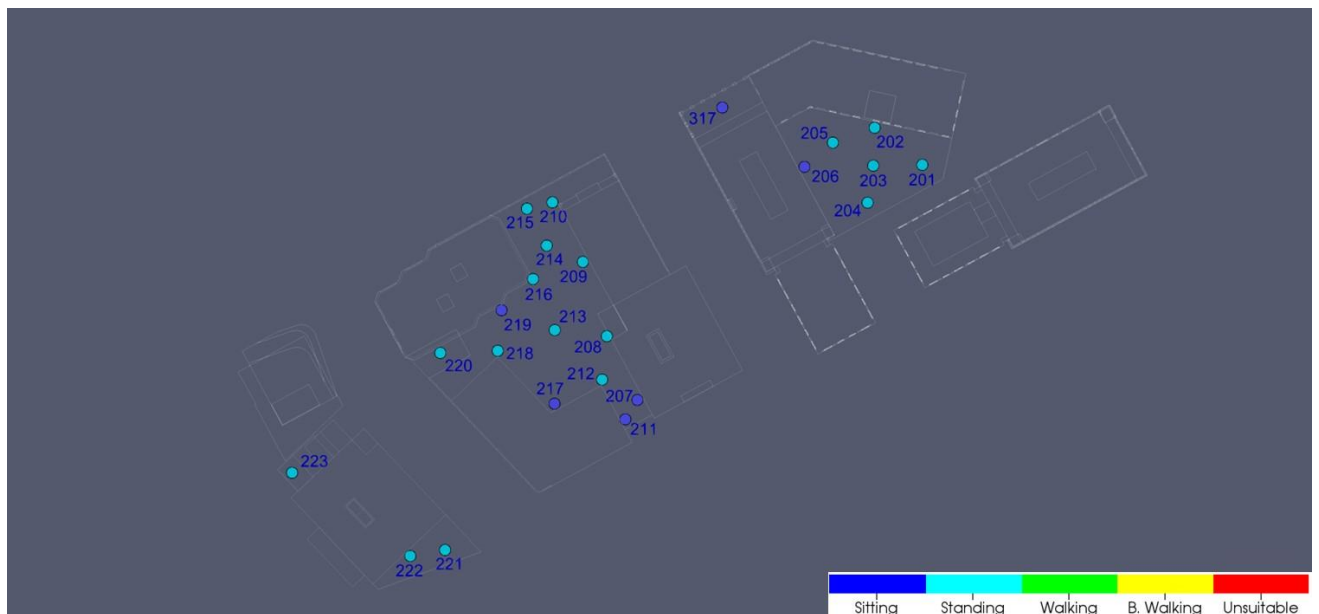


Figure 3-14 – Summer comfort, NT02-NT04 + Existing Surrounds, lower balconies.

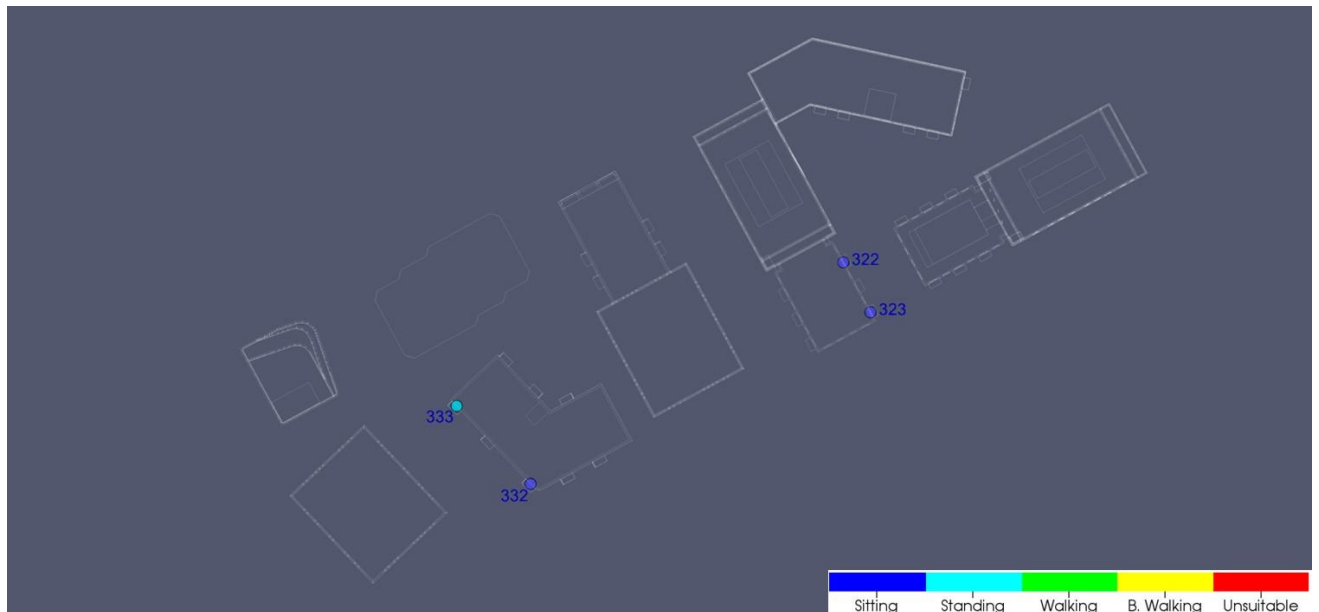
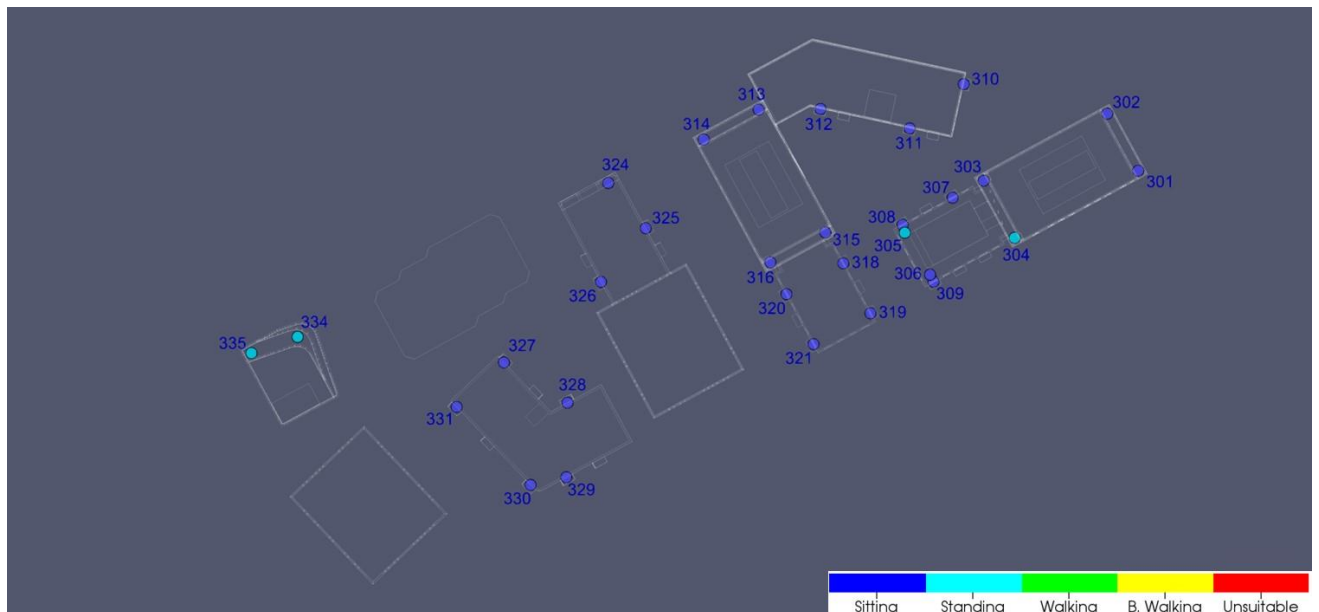


Figure 3-15 – Summer comfort, NT02-NT04 + Existing Surrounds, upper balconies and terraces.



3.3 NT02-NT04 + CUMULATIVE SURROUNDS

With the introduction of the proposed Plots NT02-NT04 - Detailed (Application 5) in the context of the cumulative surrounds, the following exceedances of the pedestrian safety criteria were observed:

- Receptor 55 (thoroughfare between 2D.1 and 2D.3 of NT04).
- Receptors 60 and 62 (thoroughfare locations within Travis Passage).

Wind conditions at Receptor 127 (southwest corner of Victoria Riverside Block A) improve, such that the inherent exceedance of the safety criteria is alleviated.

At the elevated levels, wind conditions at all receptors are *safe* from a pedestrian level wind standpoint.

In terms of pedestrian wind *comfort*, wind conditions are generally suitable for their intended uses. The following exceptions occur:

- Thoroughfares:
 - Receptor 55 (between 2D.1 and 2D.3 of NT04).
 - Receptors 60 and 62 (southern end of Travis Passage).
- Entrances / Waiting Areas:
 - Receptor 16 (2D.3 – NT04 lobby).
 - Receptor 44 (2D.1 – NT04 commercial units).
 - Receptor 50 (2D.1 – NT04 maisonettes).
 - Receptor 96 (NT02 Clubhouse lobby).
- Recreational Spaces / Terraces:
 - Receptors 201 and 203 (NT04 podium terrace).
 - Receptor 214 (NT03 podium terrace).
- Outdoor Seating:
 - Receptor 205 (NT04 podium terrace).
 - Receptor 213 (NT03 podium terrace).
 - Receptors 221 and 223 (NT02 Tower 1 podium terraces).
 - Receptor 304 (2D.3 – NT04 private amenity terrace).
 - Receptor 334 (NT02 Clubhouse terrace).
- Balconies:
 - Receptor 333 (indicative of wind conditions at the lower balconies near the northwest corner of NT03 Midrise 3)

Results for the 'NT02-NT04 + Cumulative Surrounds' configuration are illustrated in Figure 3-16 through to Figure 3-27.

Figure 3-16 – Annual safety, NT02-NT04 + Cumulative Surrounds, ground level .

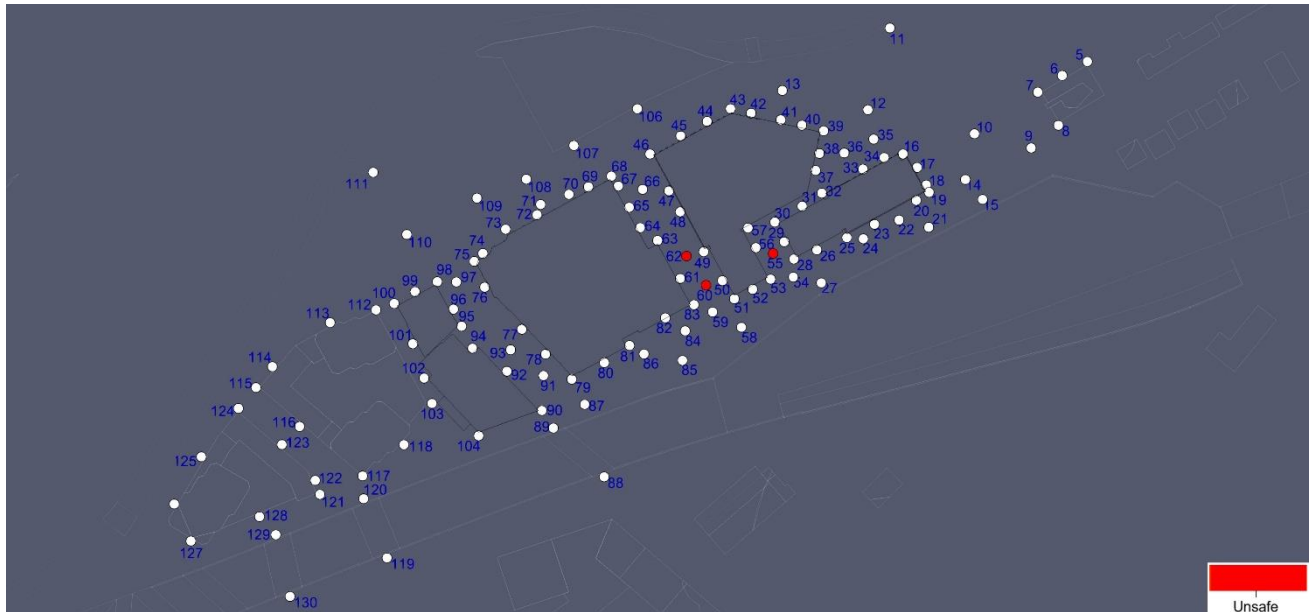


Figure 3-1716 – Annual safety, NT02-NT04 + Cumulative Surrounds, podium level.

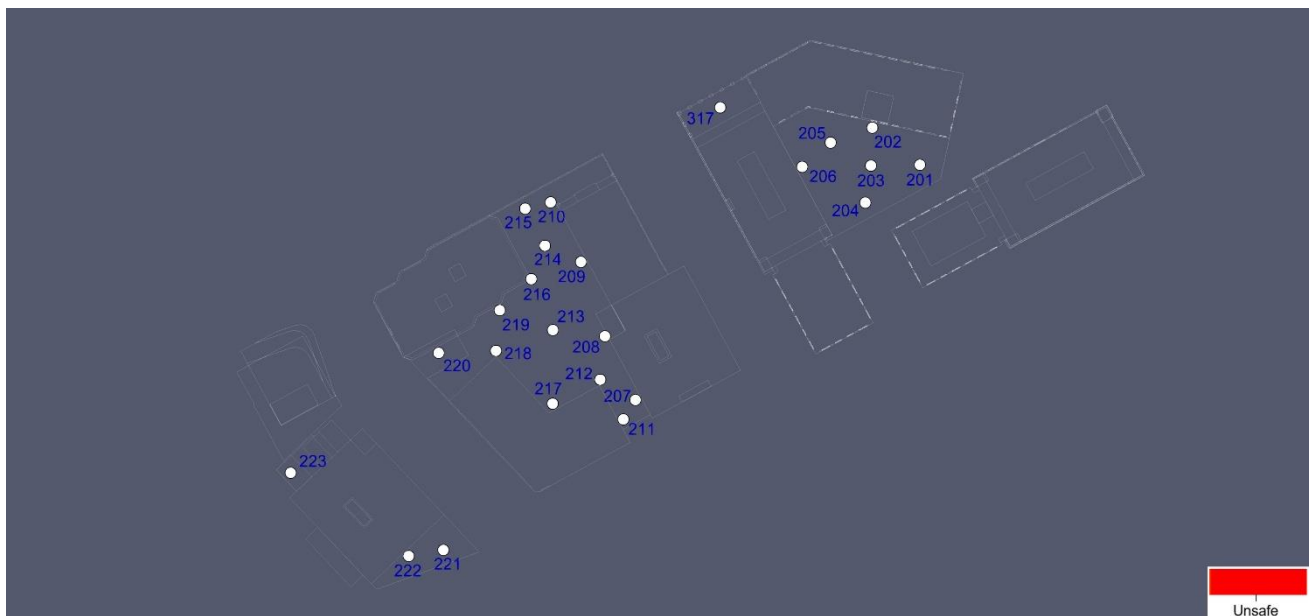


Figure 3-1817 – Annual safety, NT02-NT04 + Cumulative Surrounds, lower balconies.

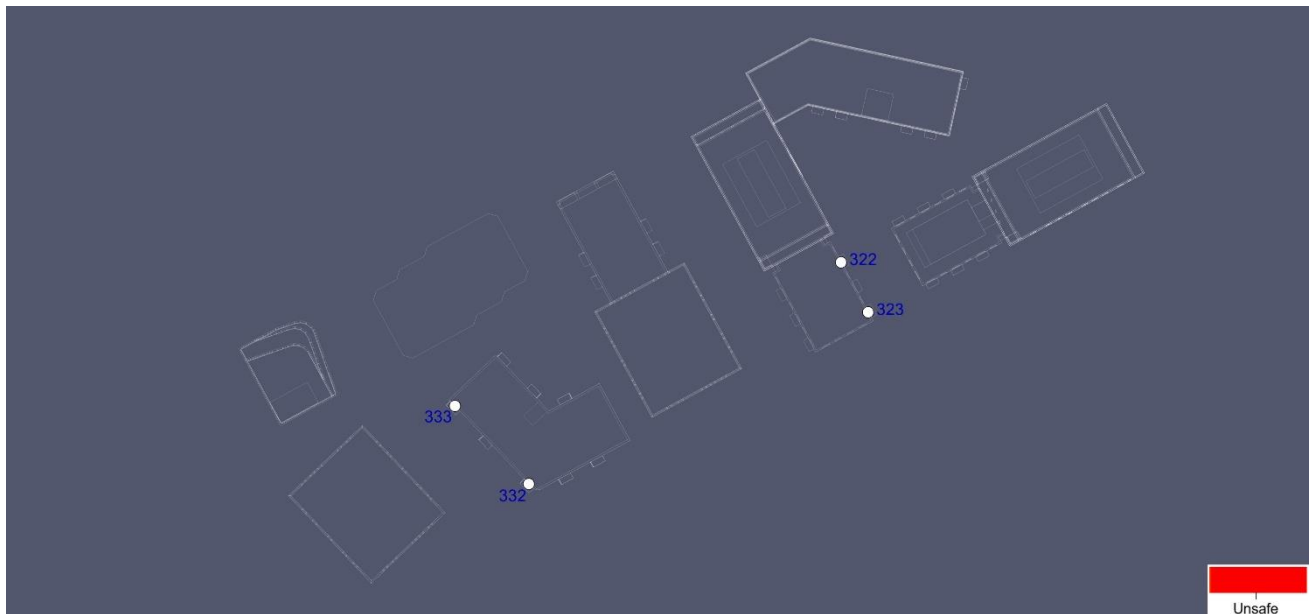


Figure 3-19 – Annual safety, NT02-NT04 + Cumulative Surrounds, upper balconies and terraces.

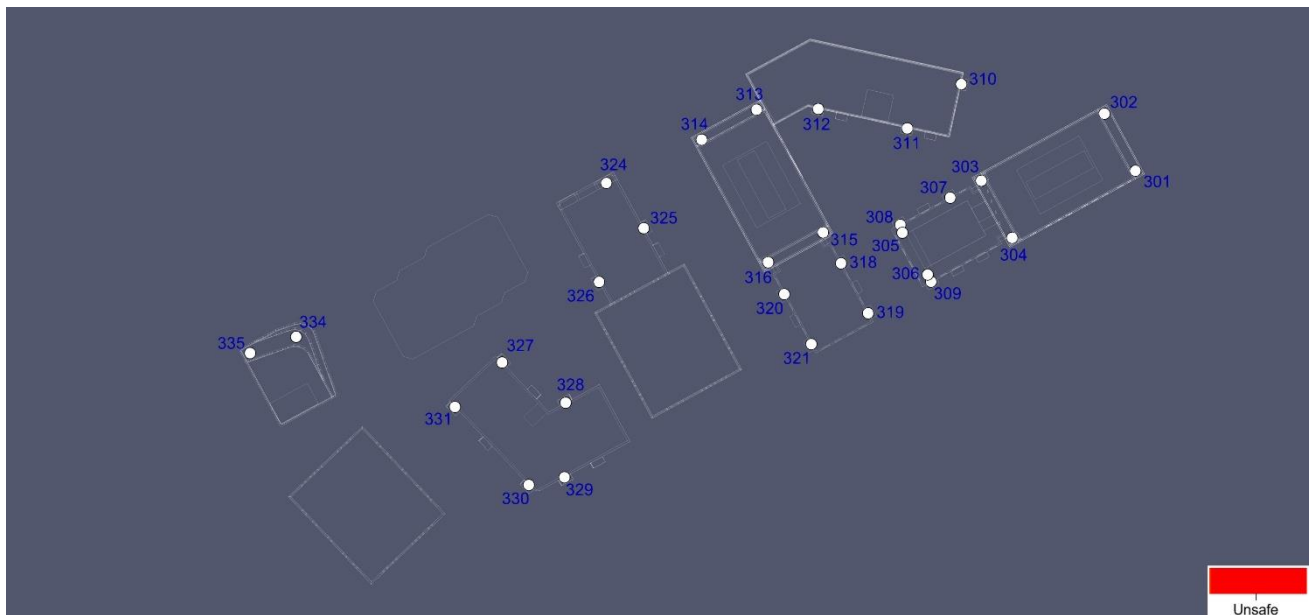


Figure 3-20 – Winter comfort, NT02-NT04 + Cumulative Surrounds, ground level .

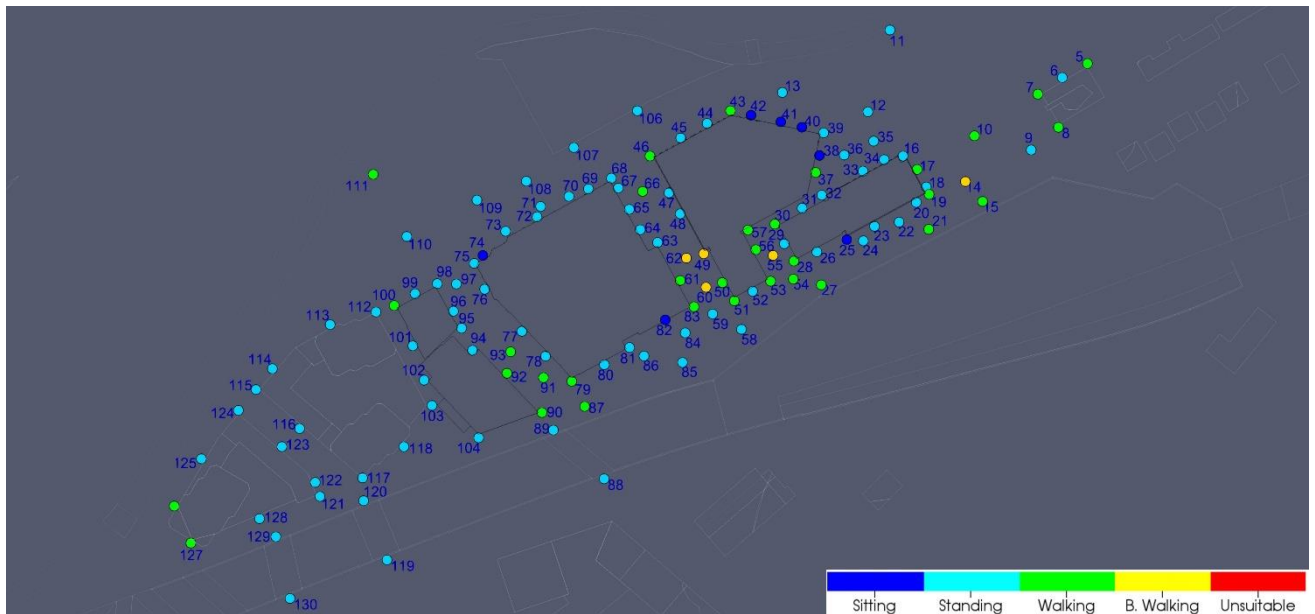


Figure 3-21 – Winter comfort, NT02-NT04 + Cumulative Surrounds, podium level.

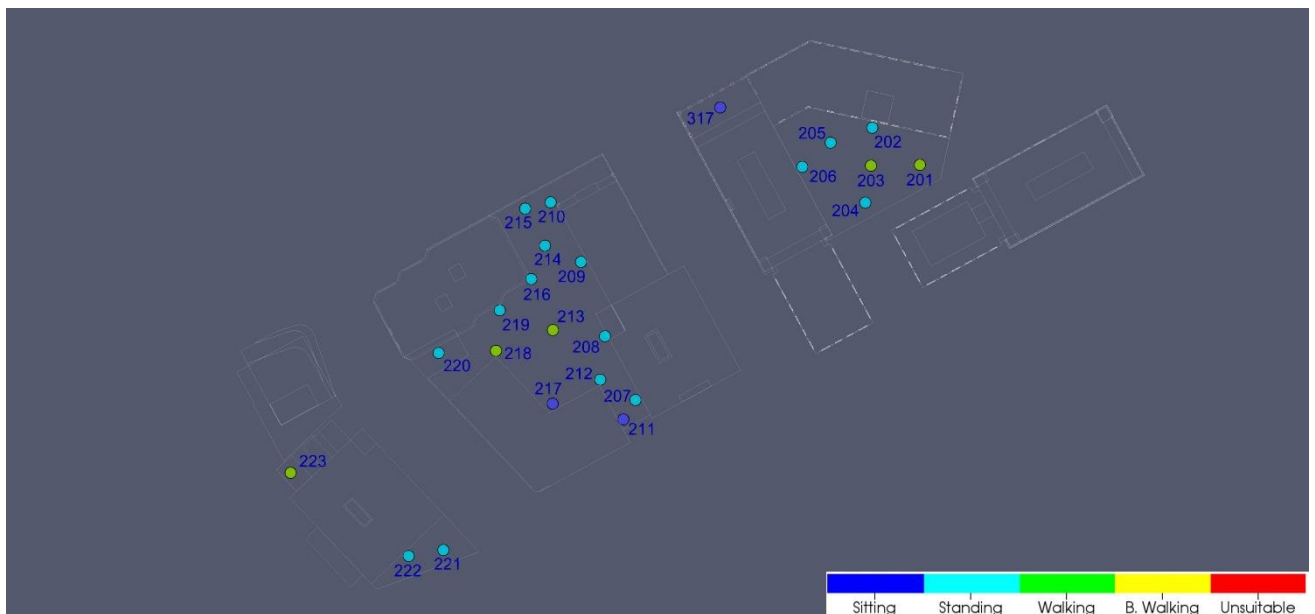


Figure 3-22 – Winter comfort, NT02-NT04 + Cumulative Surrounds, lower balconies.

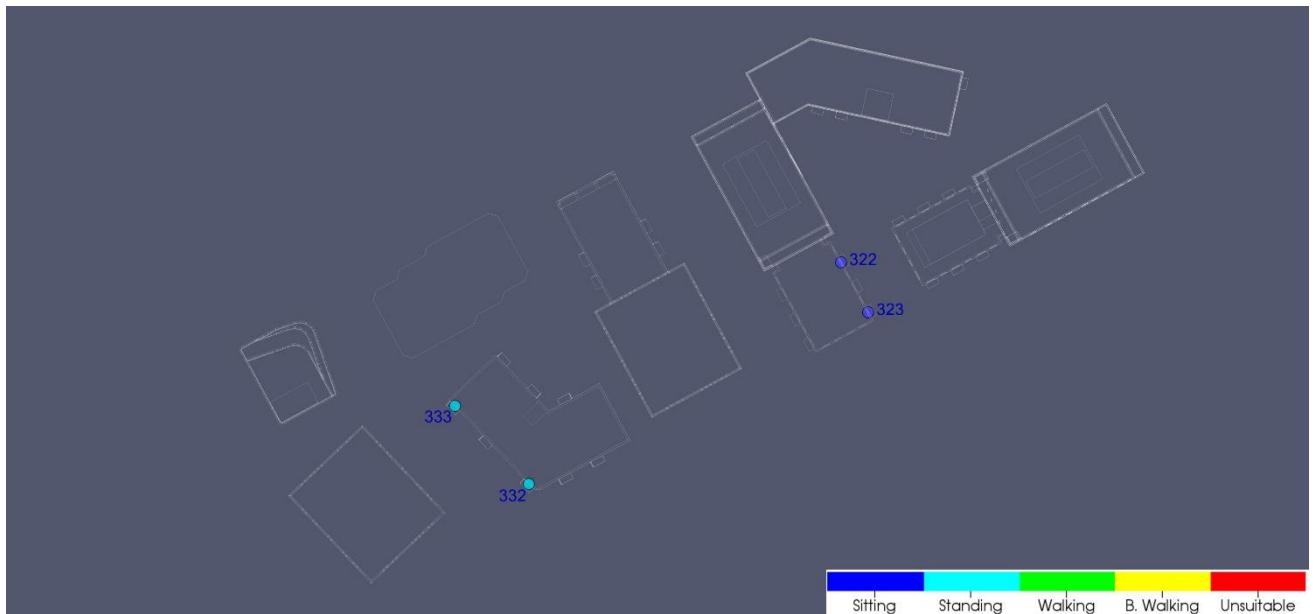


Figure 3-23 – Winter comfort, NT02-NT04 + Cumulative Surrounds, upper balconies and terraces.

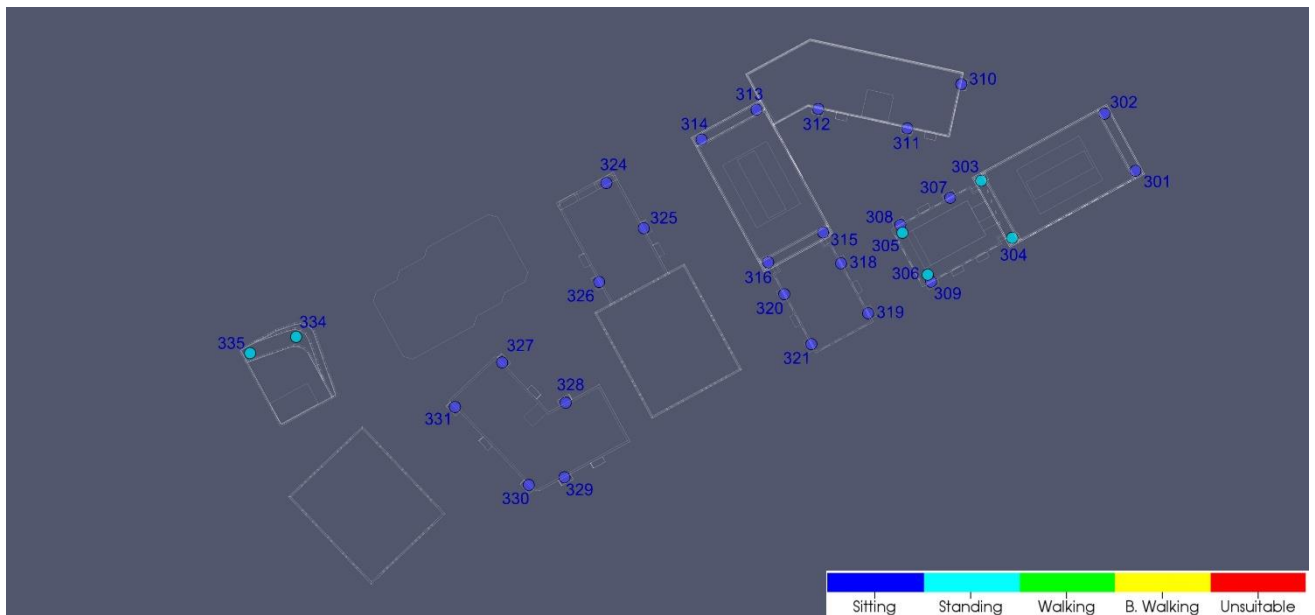


Figure 3-24 – Summer comfort, NT02-NT04 + Cumulative Surrounds, ground level.

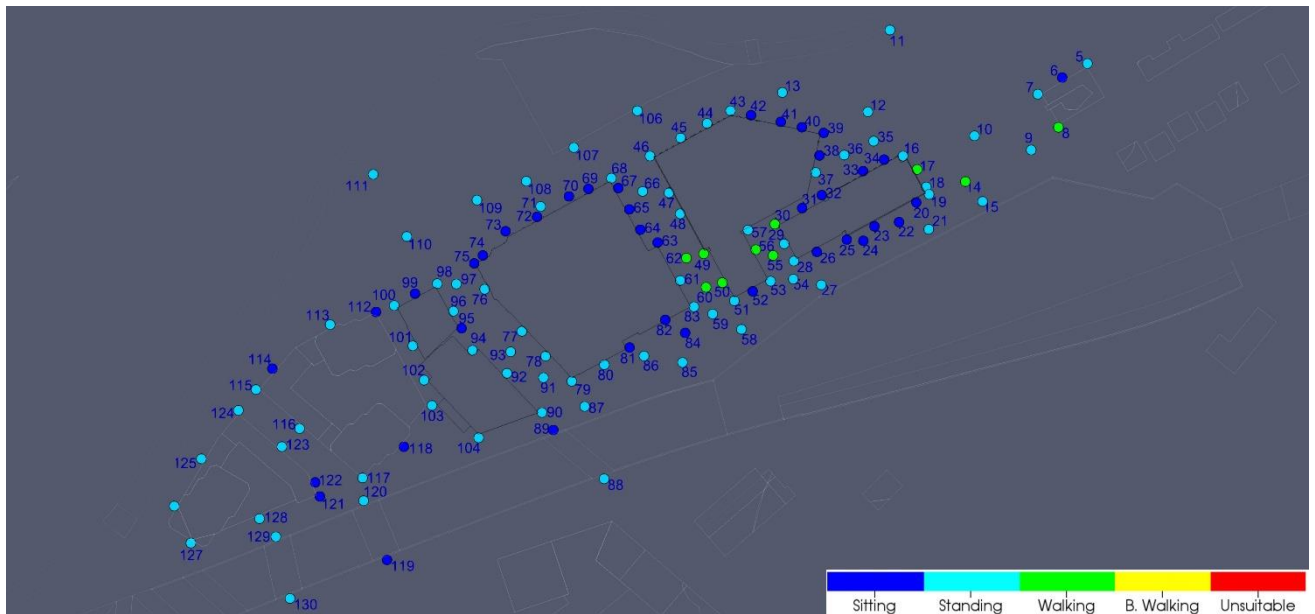


Figure 3-25 – Summer comfort, NT02-NT04 + Cumulative Surrounds, podium level.

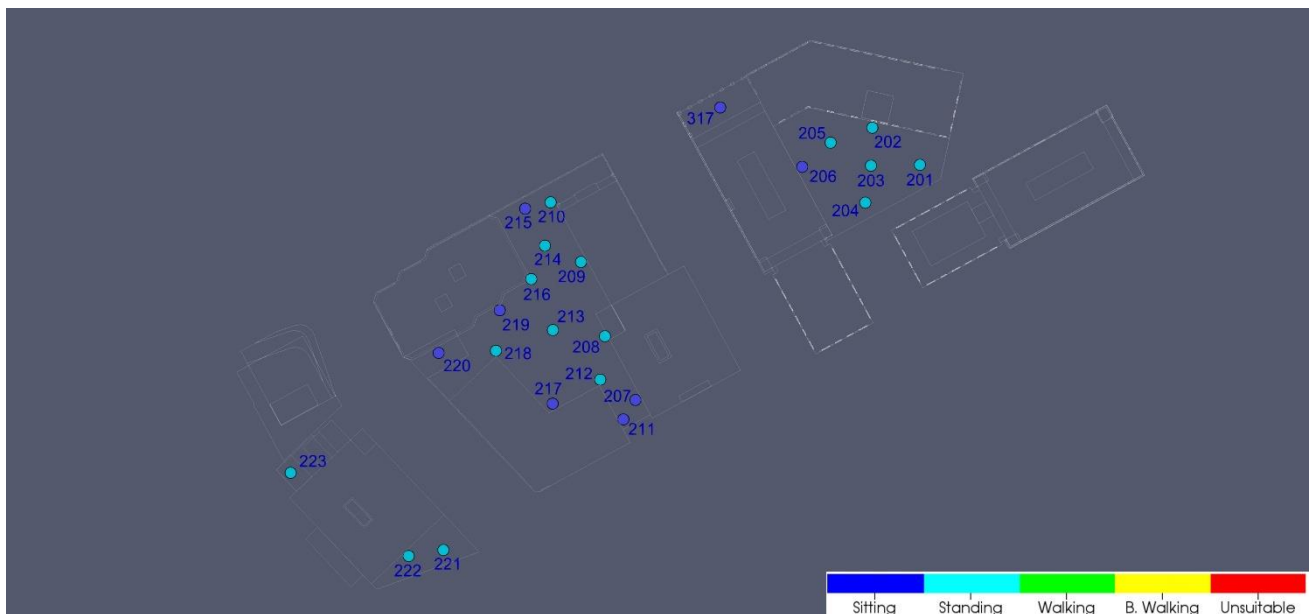


Figure 3-26 – Summer comfort, NT02-NT04 + Cumulative Surrounds, lower balconies.

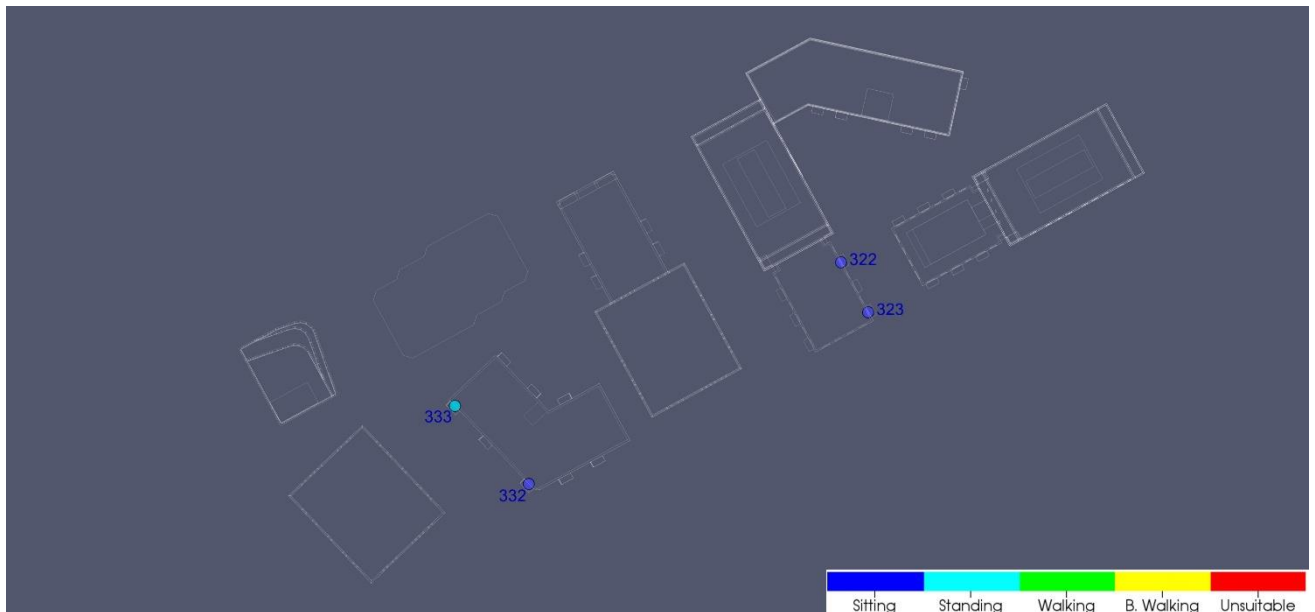
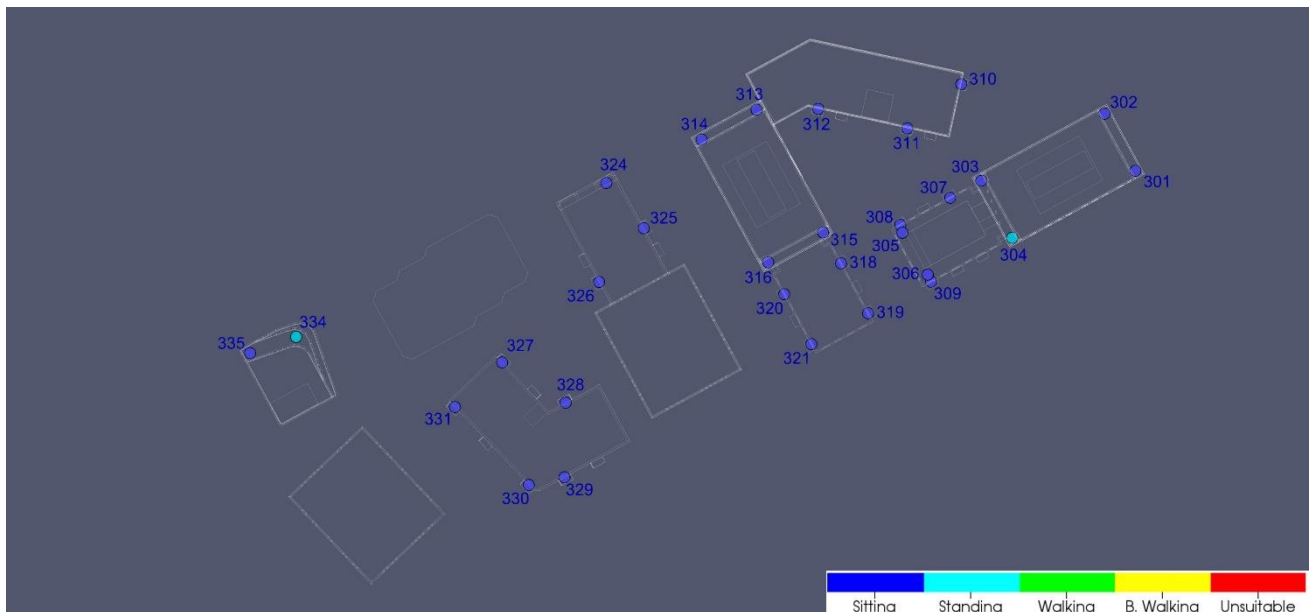


Figure 3-27 – Summer comfort, NT02-NT04 + Cumulative Surrounds, upper balconies and terraces.



3.4 NT02-NT04 + OPA + EXISTING SURROUNDS

With the introduction of the proposed Plots NT02-NT04 - Detailed (Application 5) in the context of the Outline Planning Application (OPA) and existing surrounds, the following exceedances of the pedestrian *safety* criteria were observed:

- Receptor 14 (thoroughfare to the east of NT04).
- Receptor 46 (thoroughfare at the northwest corner of 2D.1 – NT04).
- Receptor 49 (thoroughfare location within Travis Passage).
- Receptor 55 (thoroughfare between 2D.1 and 2D.3 of NT04).
- Receptor 125 (entrance along north façade of Victoria Riverside Block A).

Wind conditions at Receptor 127 (southwest corner of Victoria Riverside Block A) improve, such that the inherent exceedance of the *safety* criteria is alleviated.

At the elevated levels, wind conditions at all receptors are *safe* from a pedestrian level wind standpoint.

In terms of pedestrian wind *comfort*, wind conditions are generally suitable for their intended uses. The following exceptions occur:

- Thoroughfares:
 - Receptor 14 (to the east of NT04).
 - Receptor 46 (northwest corner of 2D.1 – NT04).
 - Receptor 49 (within Travis Passage).
 - Receptor 55 (between 2D.1 and 2D.3 of NT04).
- Entrances / Waiting Areas:
 - Receptor 20 (2D.3 – NT04 co-working space).
 - Receptor 29 (2D.3 – NT04 maisonettes).
 - Receptor 48 (2D.1 – NT04 lobby).
 - Receptor 125 (north façade of Victoria Riverside Block A).
- Recreational Spaces / Terraces:
 - Receptor 201 (NT04 podium terrace)
- Outdoor Seating:
 - Receptor 213 (NT03 podium terrace)
 - Receptors 221 and 223 (NT02 Tower 1 podium terraces)
 - Receptor 303 (2D.3 – NT04 private amenity terrace)
 - Receptor 305 (2D.3 – NT04 roof amenity terrace)
- Balconies:

- Receptor 333 (indicative of wind conditions at the lower balconies near the northwest corner of NT03 Midrise 3)

Results for the 'NT02-NT04 + OPA + Existing Surrounds' configuration are illustrated in Figure 3-281828 through to Figure 3-39.

Figure 3-2818 – Annual safety, NT02-NT04 + OPA + Existing Surrounds, ground level.

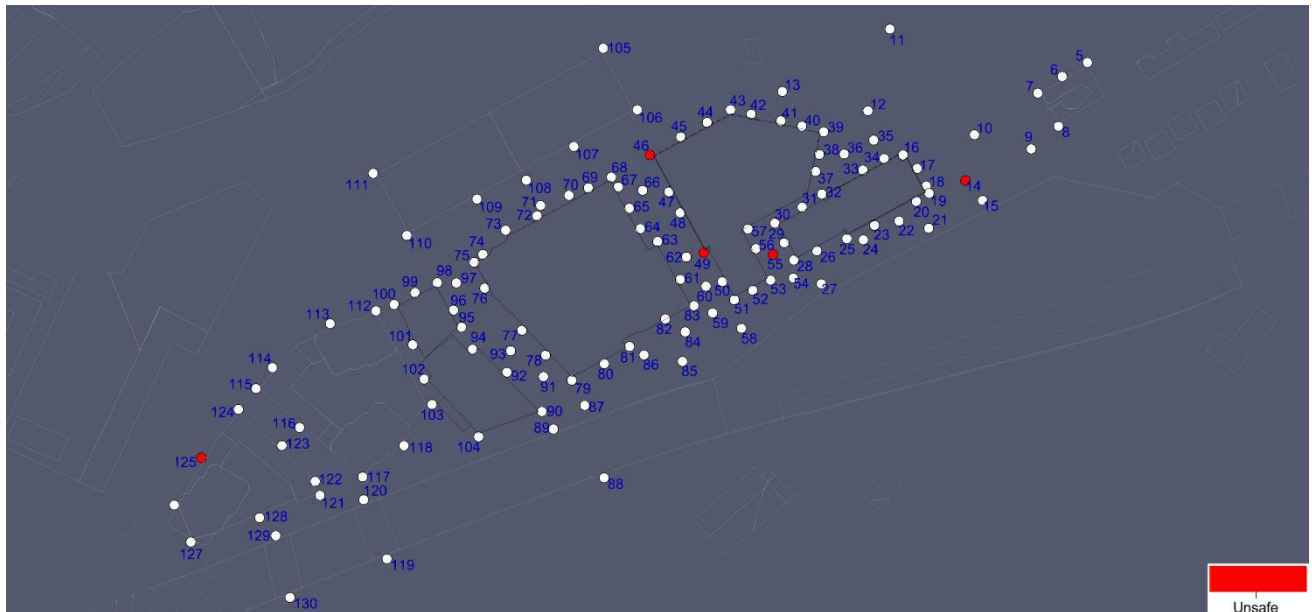


Figure 3-29 – Annual safety, NT02-NT04 + OPA + Existing Surrounds, podium level.

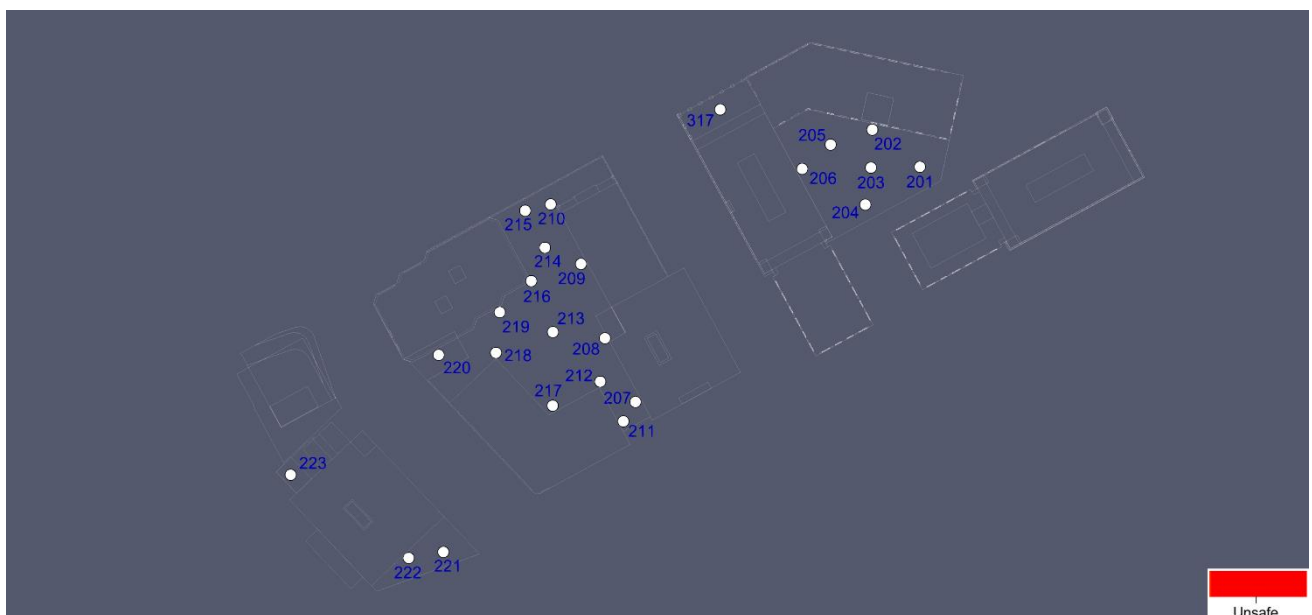


Figure 3-30 – Annual safety, NT02-NT04 + OPA + Existing Surrounds, lower balconies.

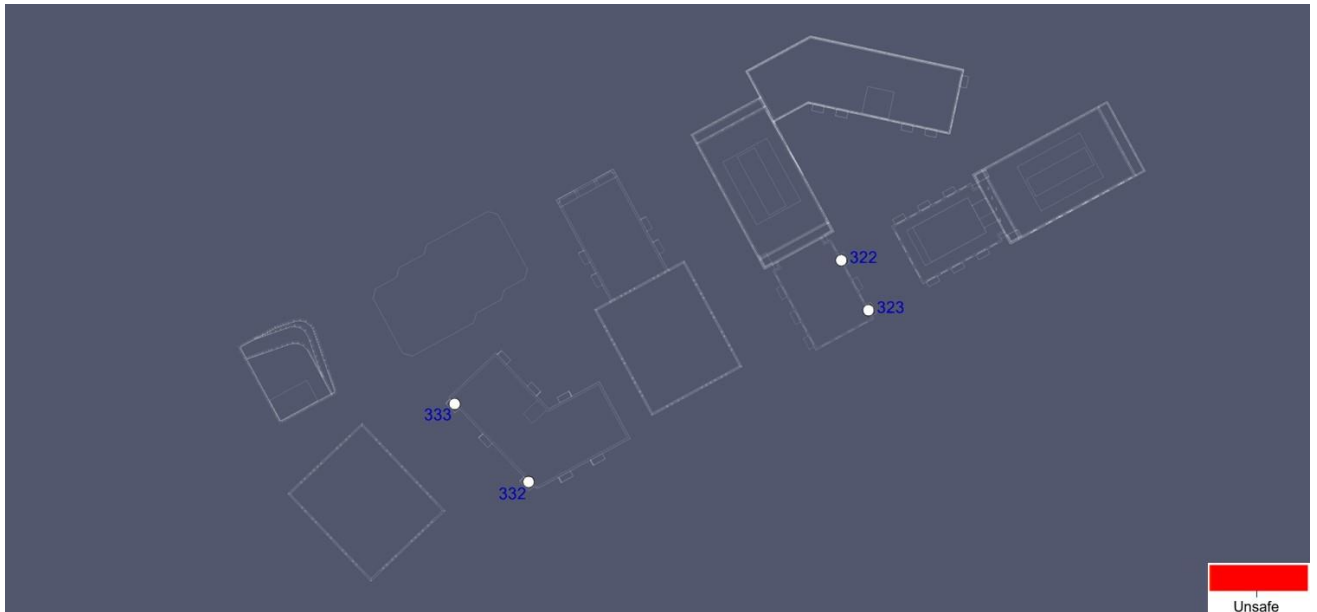


Figure 3-31 – Annual safety, NT02-NT04 + OPA +Existing Surrounds, upper balconies and terraces.

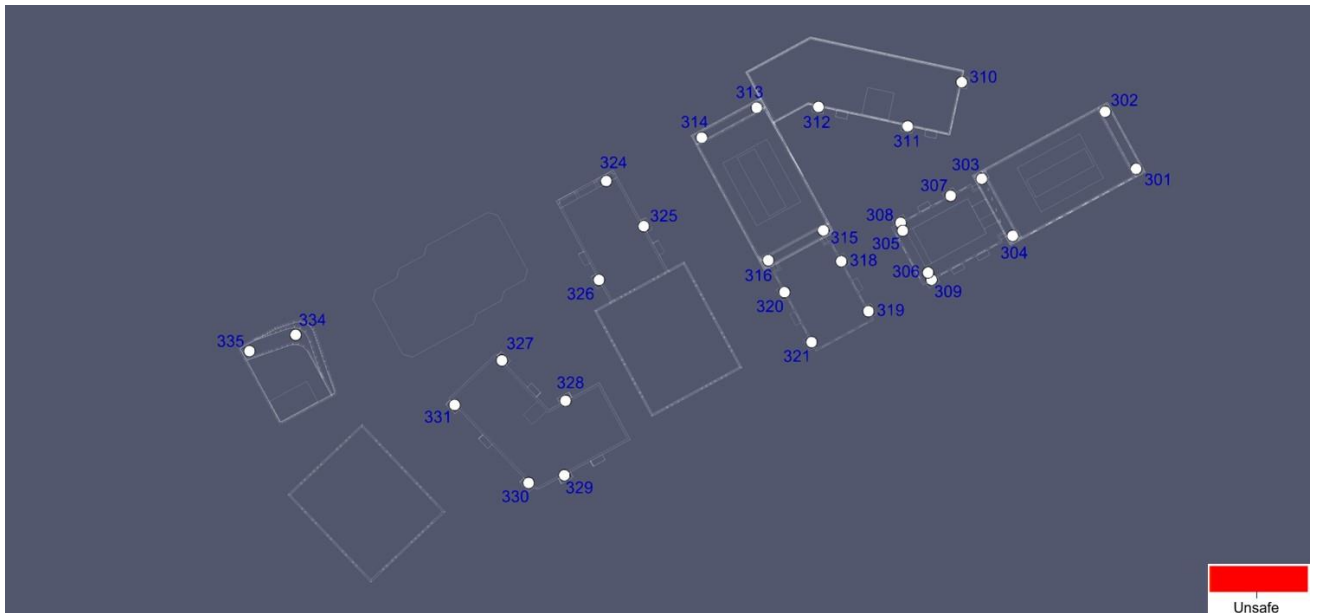


Figure 3-3219 – Winter comfort, NT02-NT04 + OPA +Existing Surrounds, ground level .

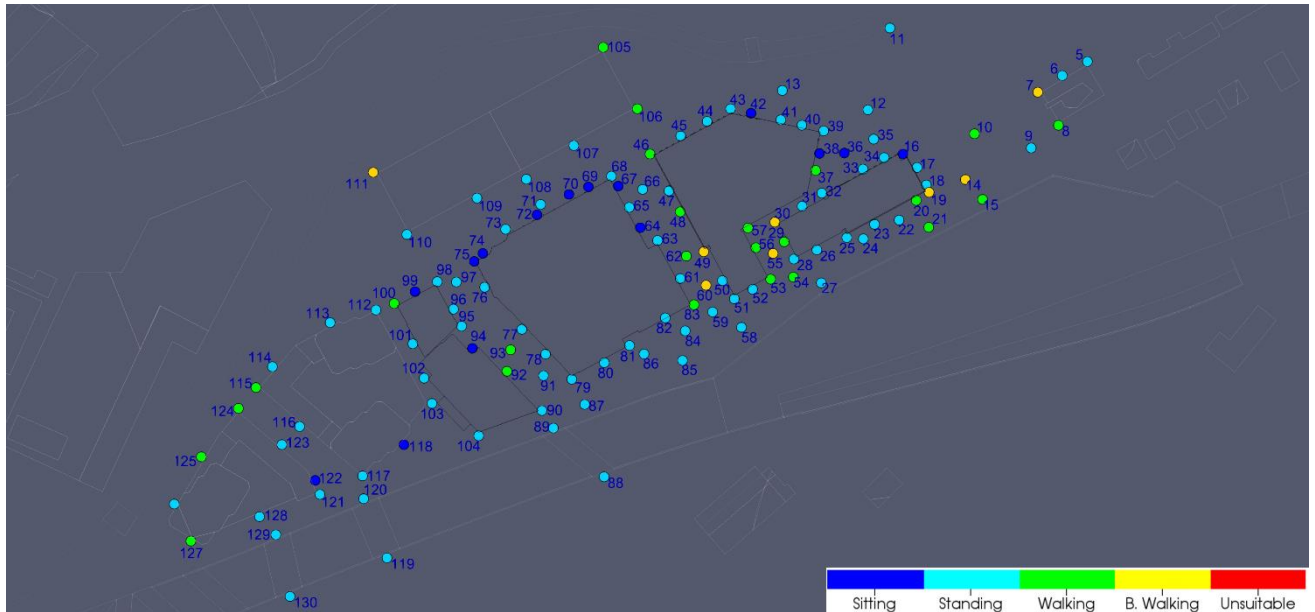


Figure 3-33 – Winter comfort, NT02-NT04 + OPA +Existing Surrounds, podium level.

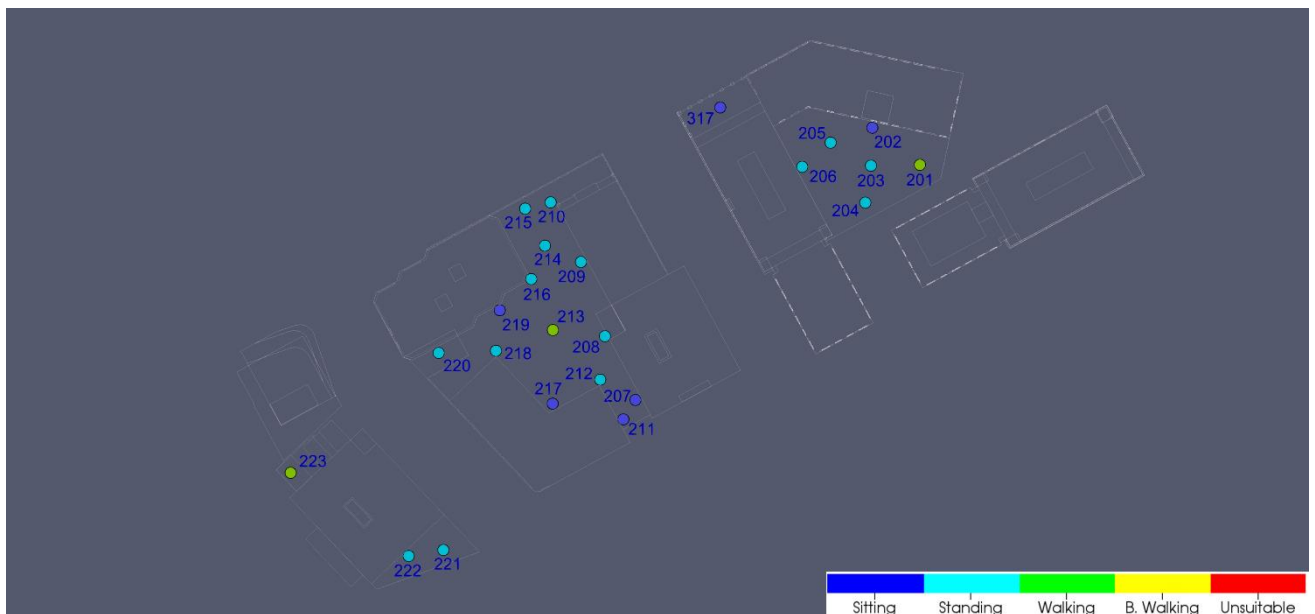


Figure 3-3420 – Winter comfort, NT02-NT04 + OPA +Existing Surrounds, lower balconies.

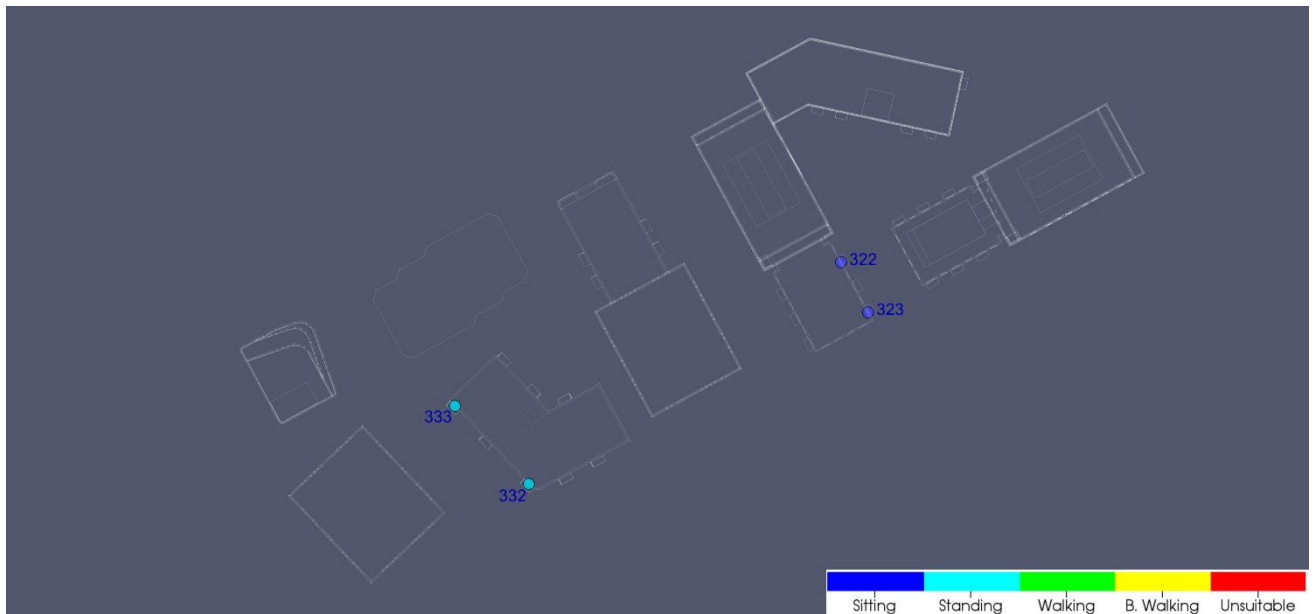


Figure 3-35 – Winter comfort, NT02-NT04 + OPA + Existing Surrounds, upper balconies and terraces.

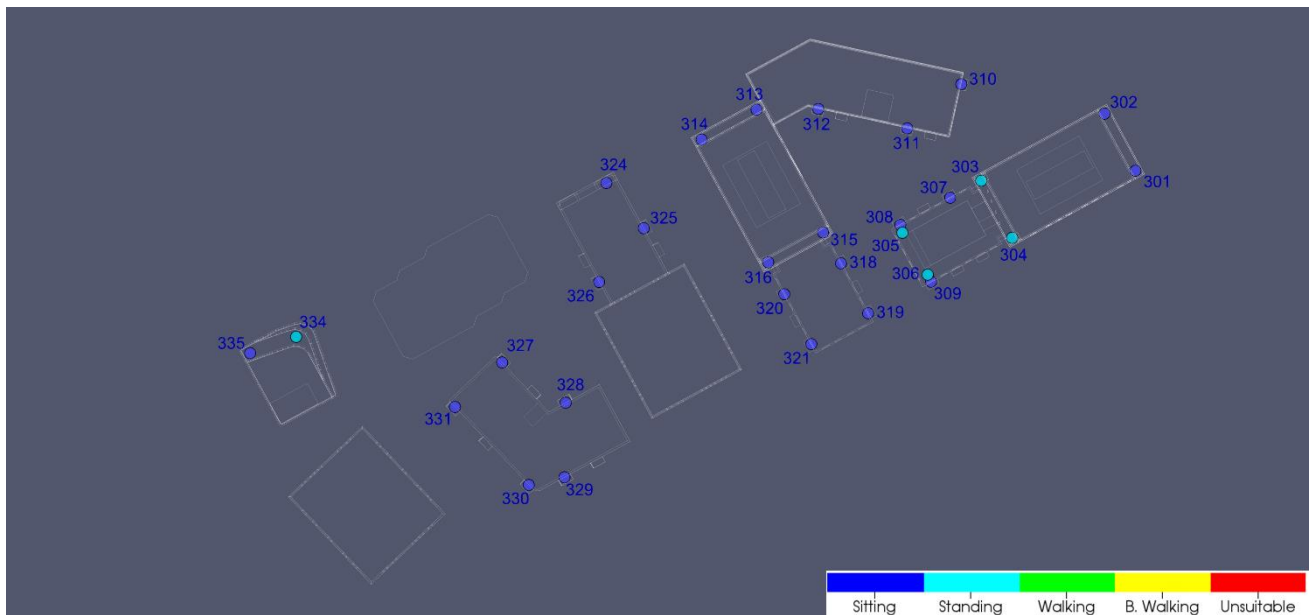


Figure 3-36 – Summer comfort, NT02-NT04 + OPA +Existing Surrounds, ground level .

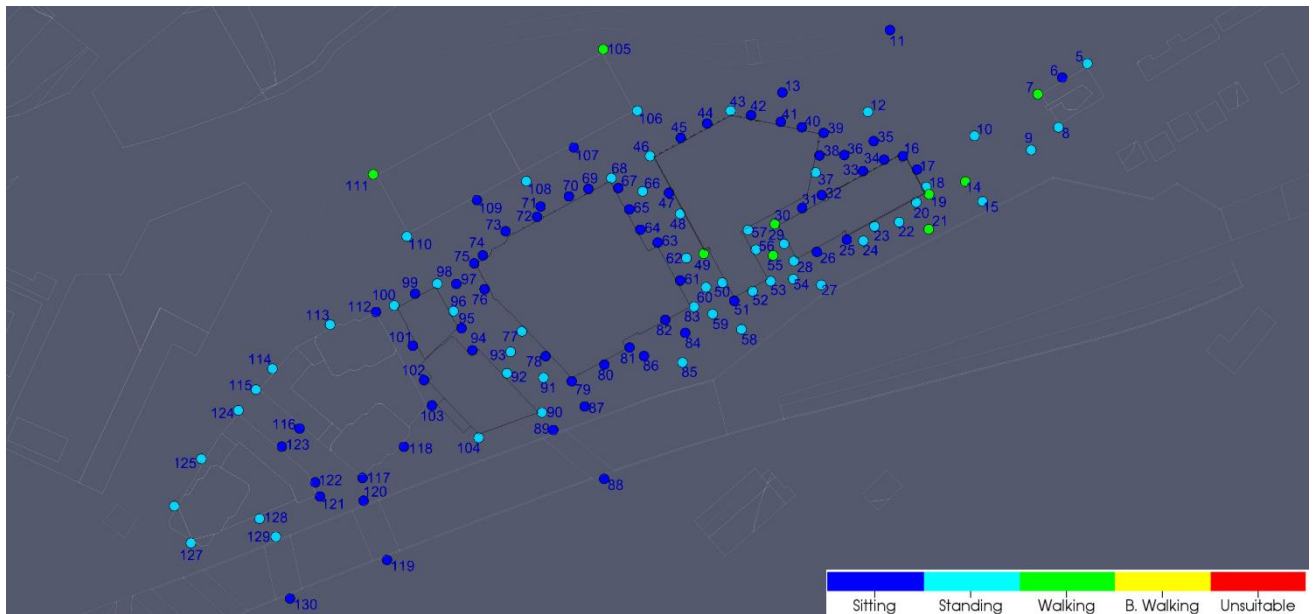


Figure 3-3721 – Summer comfort, NT02-NT04 + OPA +Existing Surrounds, podium level.

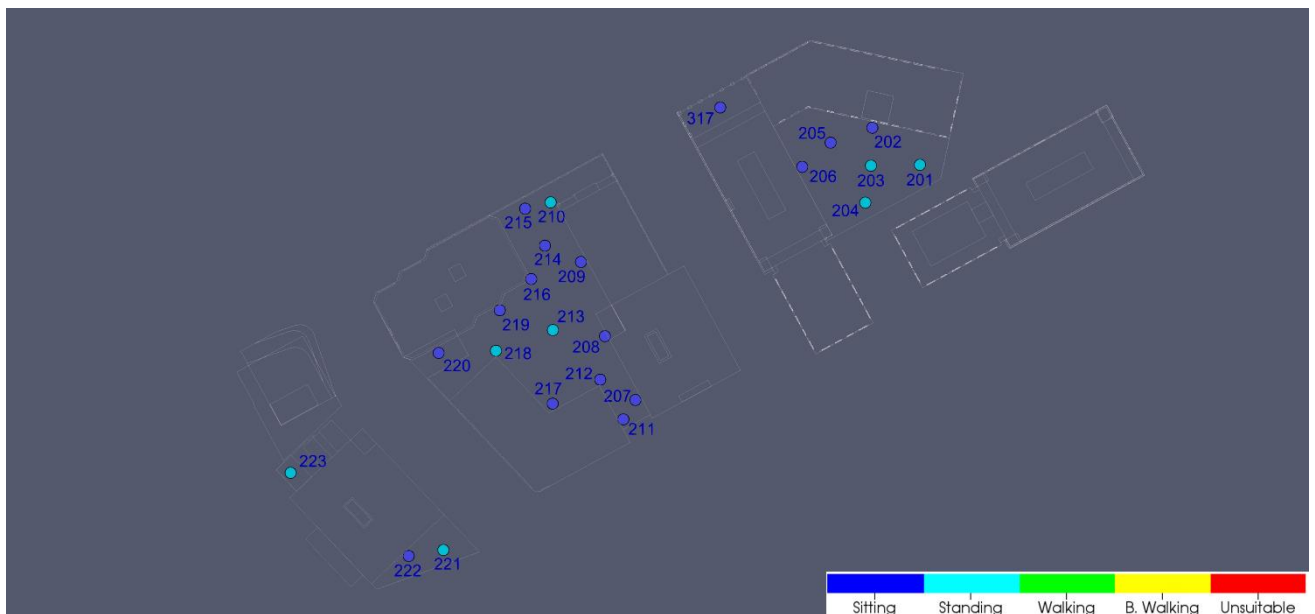


Figure 3-3822 – Summer comfort, NT02-NT04 + OPA +Existing Surrounds, lower balconies.

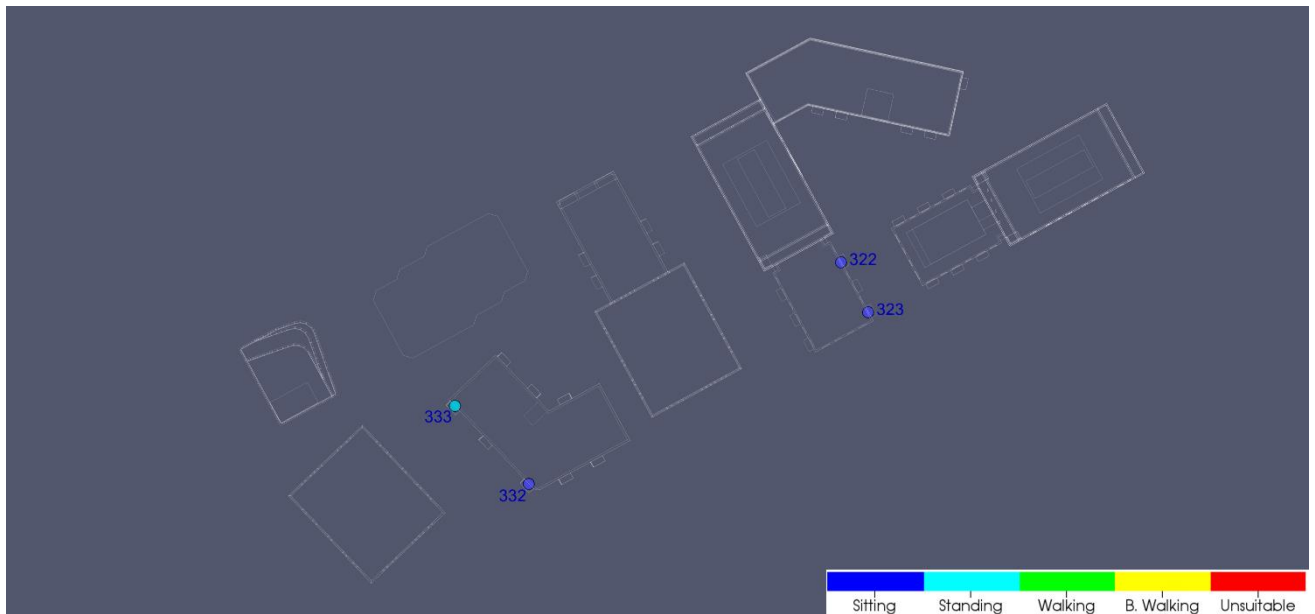
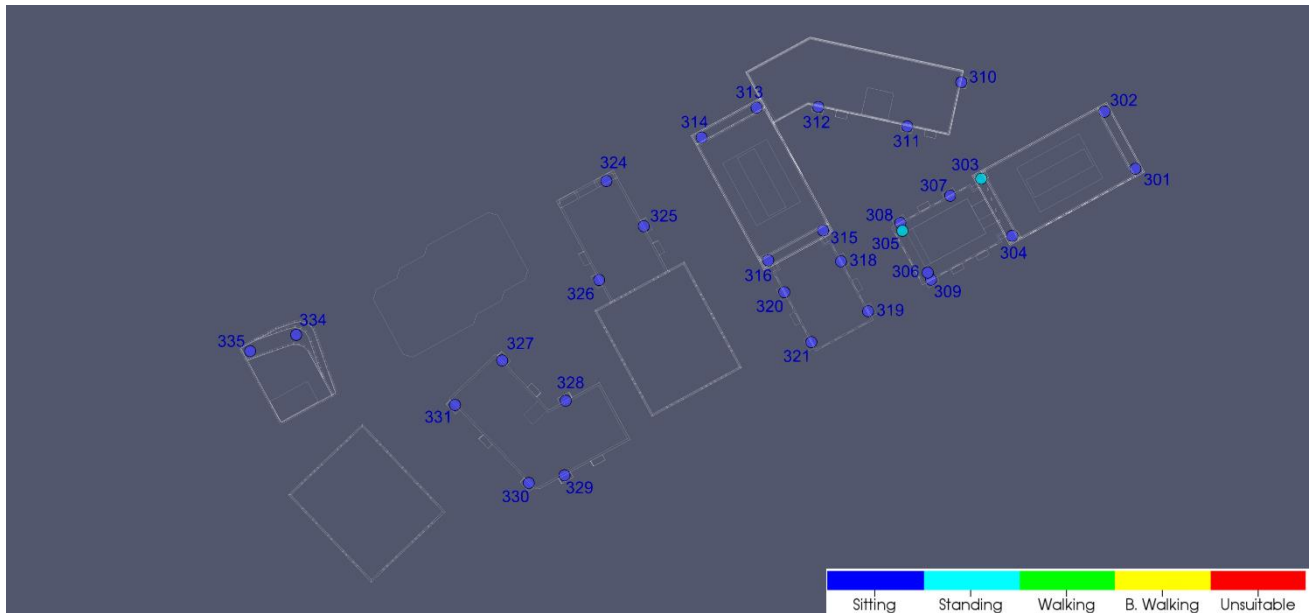


Figure 3-3923 – Summer comfort, NT02-NT04 + OPA +Existing Surrounds, upper balconies and terraces.



3.5 NT02-NT04 + OPA + CUMULATIVE SURROUNDS

With the introduction of the proposed Plots NT02-NT04 - Detailed (Application 5) in the context of the Outline Planning Application (OPA) and cumulative surrounds, the following exceedances of the pedestrian *safety* criteria were observed:

- Receptor 46 (thoroughfare at the northwest corner of 2D.1 – NT04).
- Receptor 125 (entrance along north façade of Victoria Riverside Block A).

Wind conditions at Receptor 127 (southwest corner of Victoria Riverside Block A) improve, such that the inherent exceedance of the *safety* criteria is alleviated.

At the elevated levels, wind conditions at all receptors are *safe* from a pedestrian level wind standpoint.

In terms of pedestrian wind *comfort*, wind conditions are generally suitable for their intended uses. The following exceptions occur:

- Thoroughfares:
 - Receptor 46 (northwest corner of 2D.1 – NT04).
- Entrances / Waiting Areas:
 - Receptor 125 (north façade of Victoria Riverside Block A).
- Recreational Spaces / Terraces:
 - Receptor 201 (NT04 podium terrace)
- Outdoor Seating:
 - Receptor 213 (NT03 podium terrace)
 - Receptor 223 (NT02 Tower 1 podium terraces)
- Balconies:
 - Receptor 333 (indicative of wind conditions at the lower balconies near the northwest corner of NT03 Midrise 3)

Results for the 'NT02-NT04 + OPA + Cumulative Surrounds' configuration are illustrated in Figure 3-24 through to Figure 3-35.

Figure 3-24 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds, ground level .

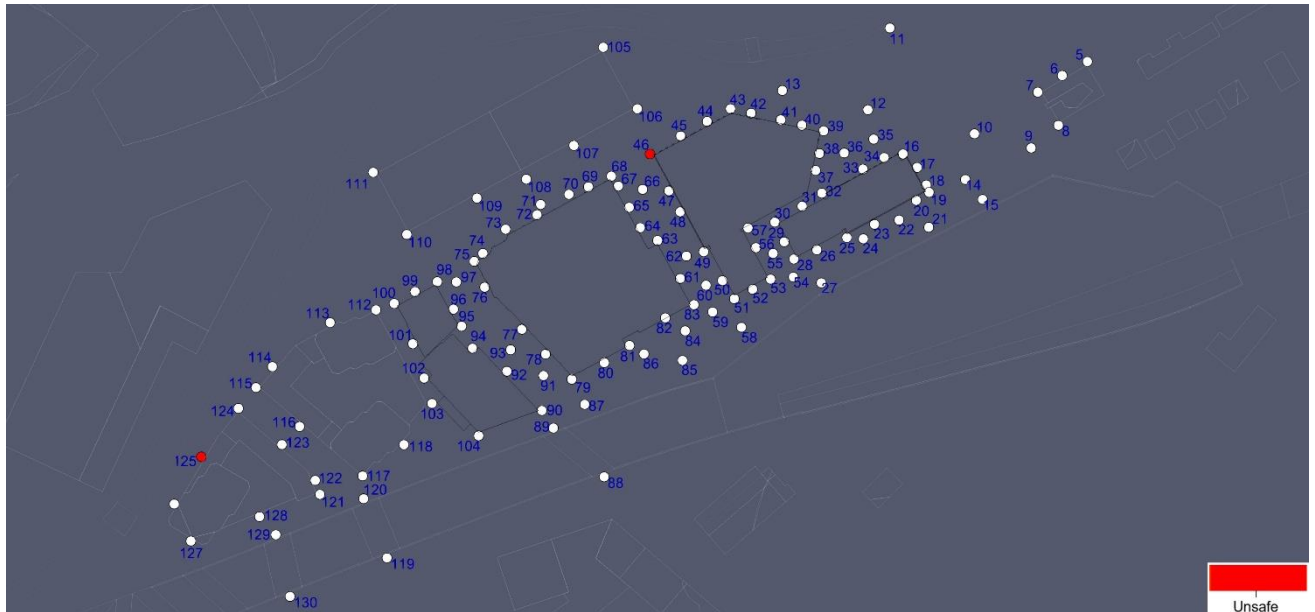


Figure 3-25 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds, podium level.

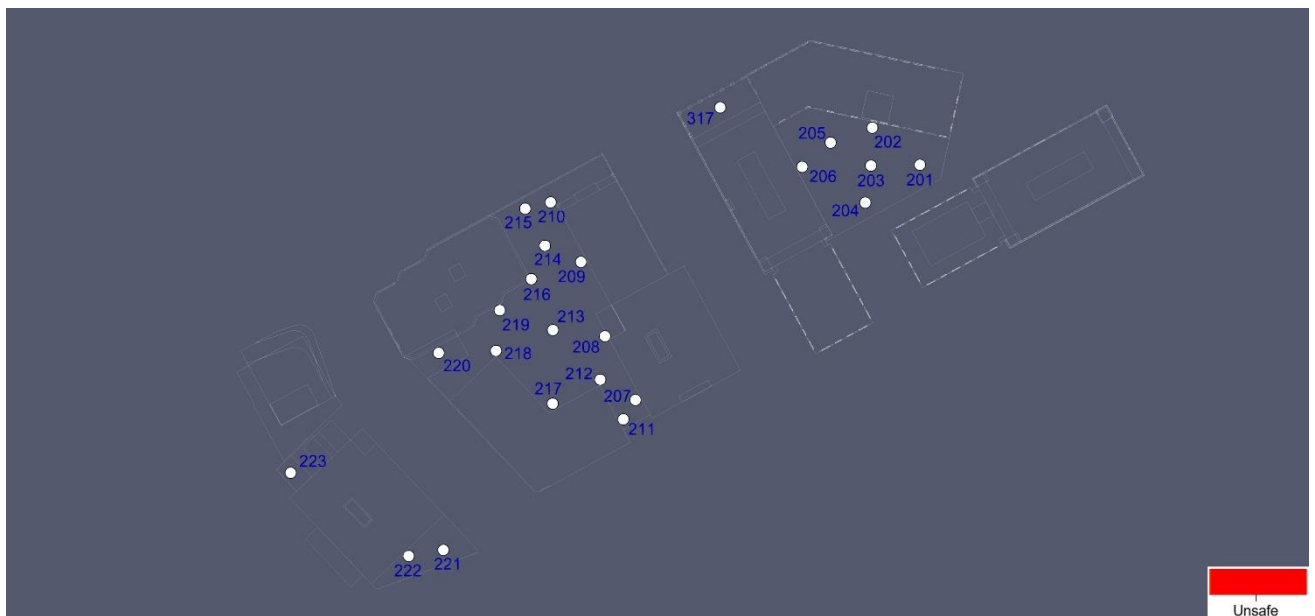


Figure 3-26 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds, lower balconies.

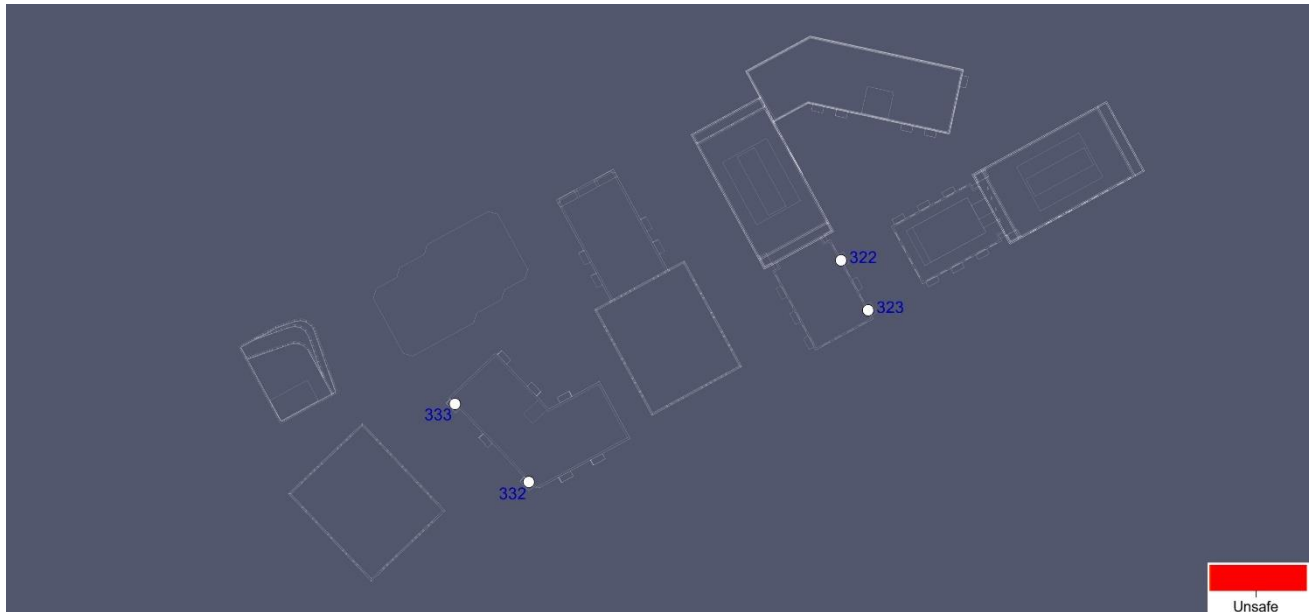


Figure 3-27 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds, upper balconies and terraces.

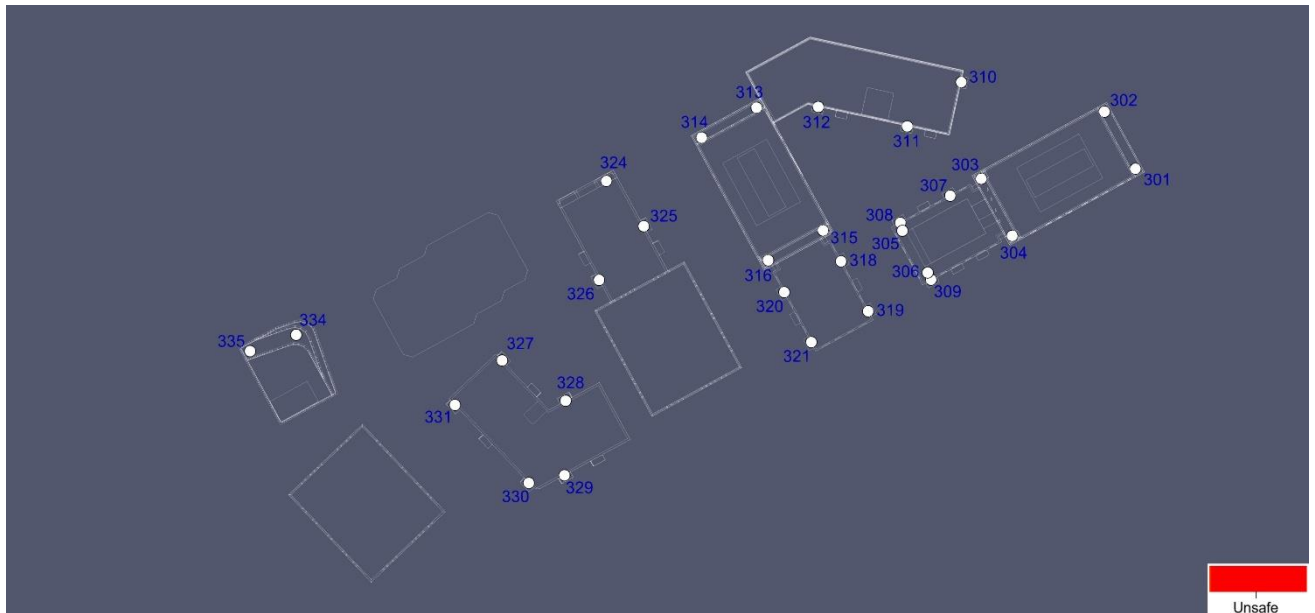


Figure 3-28 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds, ground level .

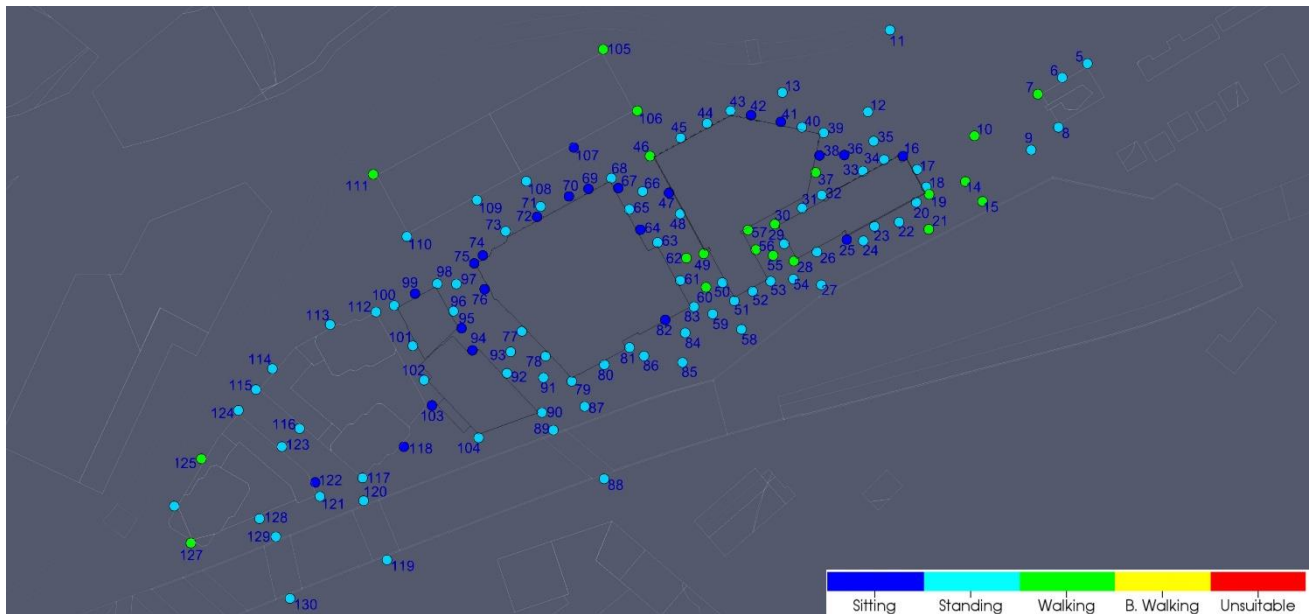


Figure 3-29 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds, podium level.

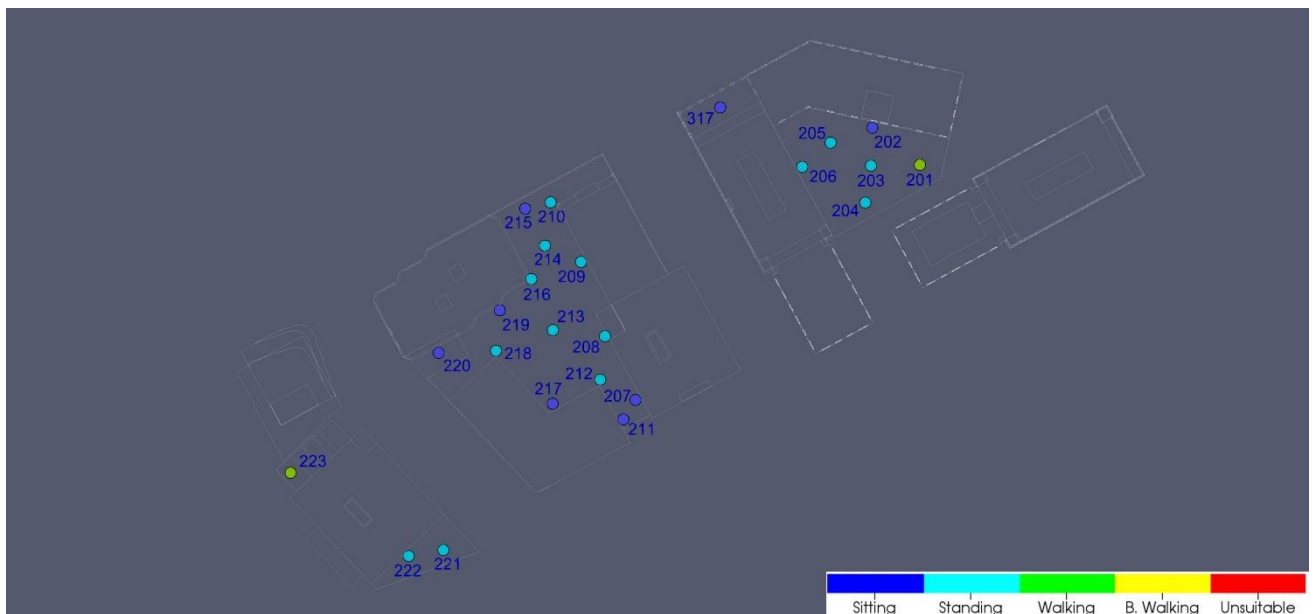


Figure 3-30 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds, lower balconies.

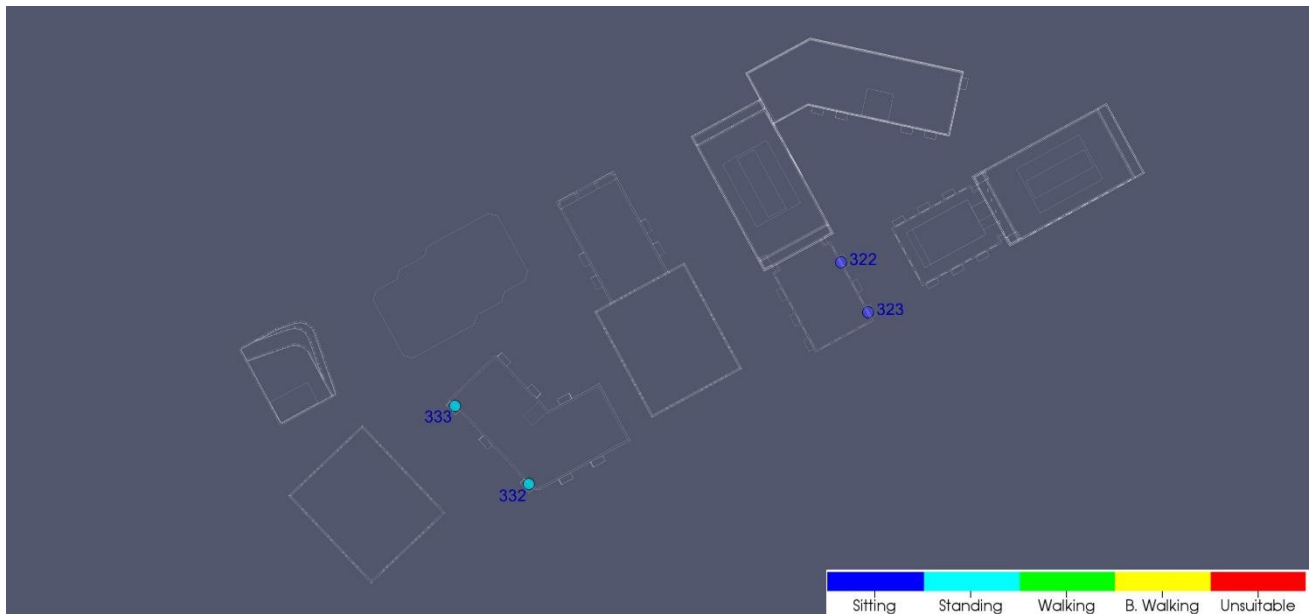


Figure 3-31 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds, upper balconies and terraces.

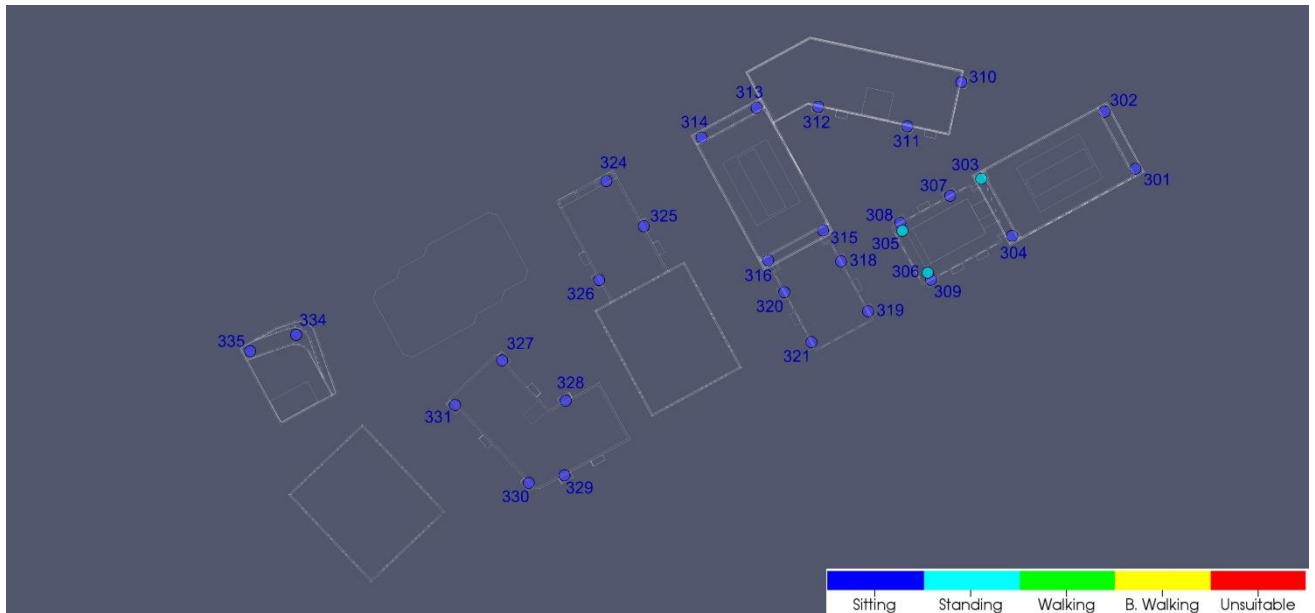


Figure 3-32 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds, ground level .

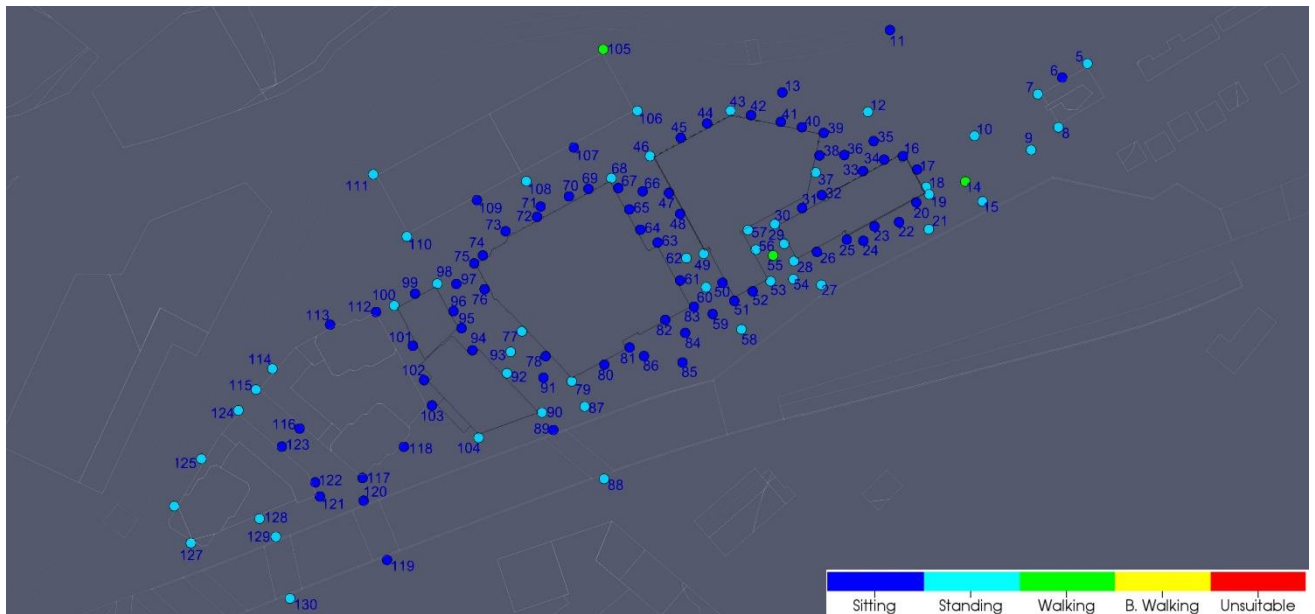


Figure 3-33 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds, podium level.

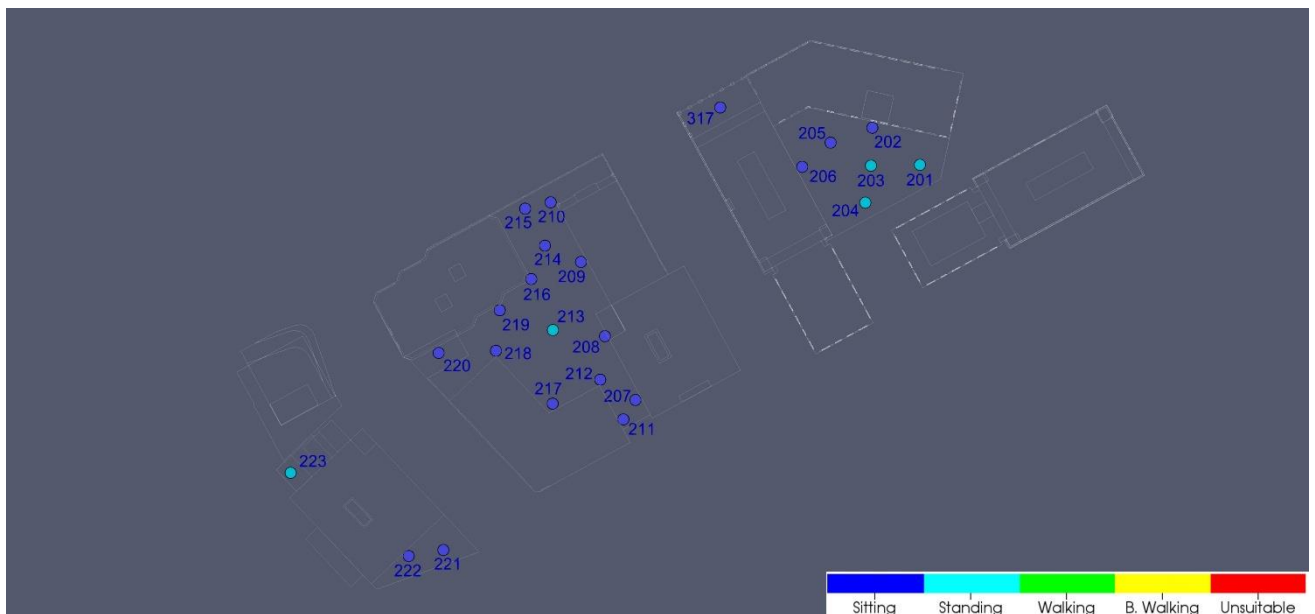


Figure 3-34 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds, lower balconies.

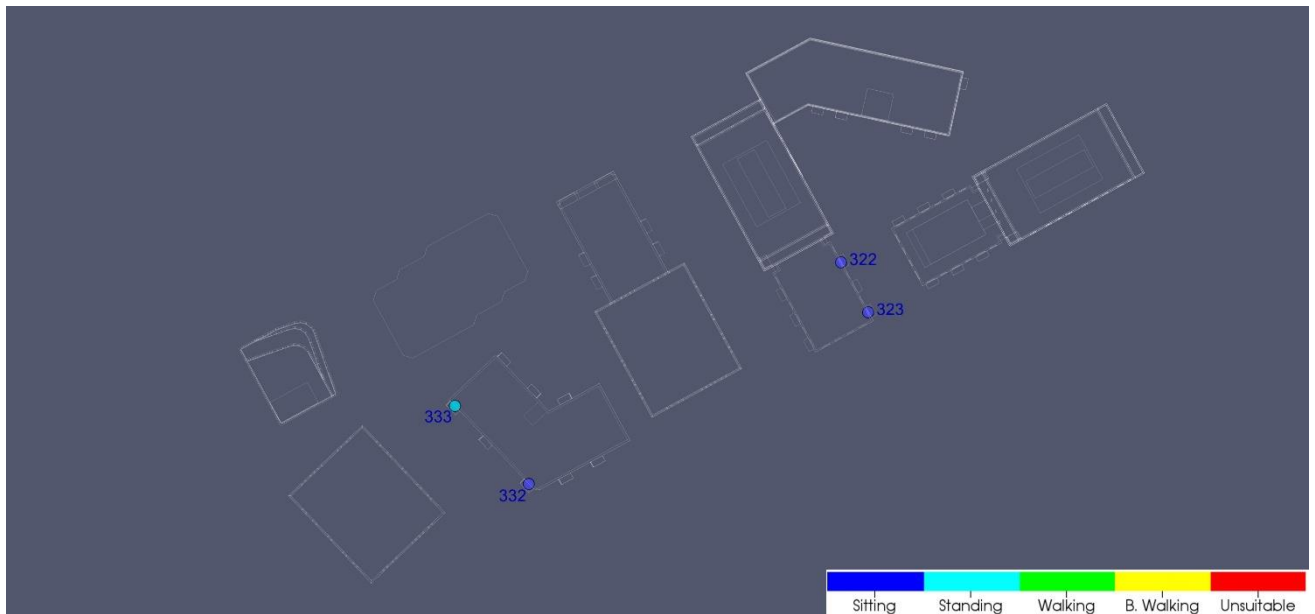
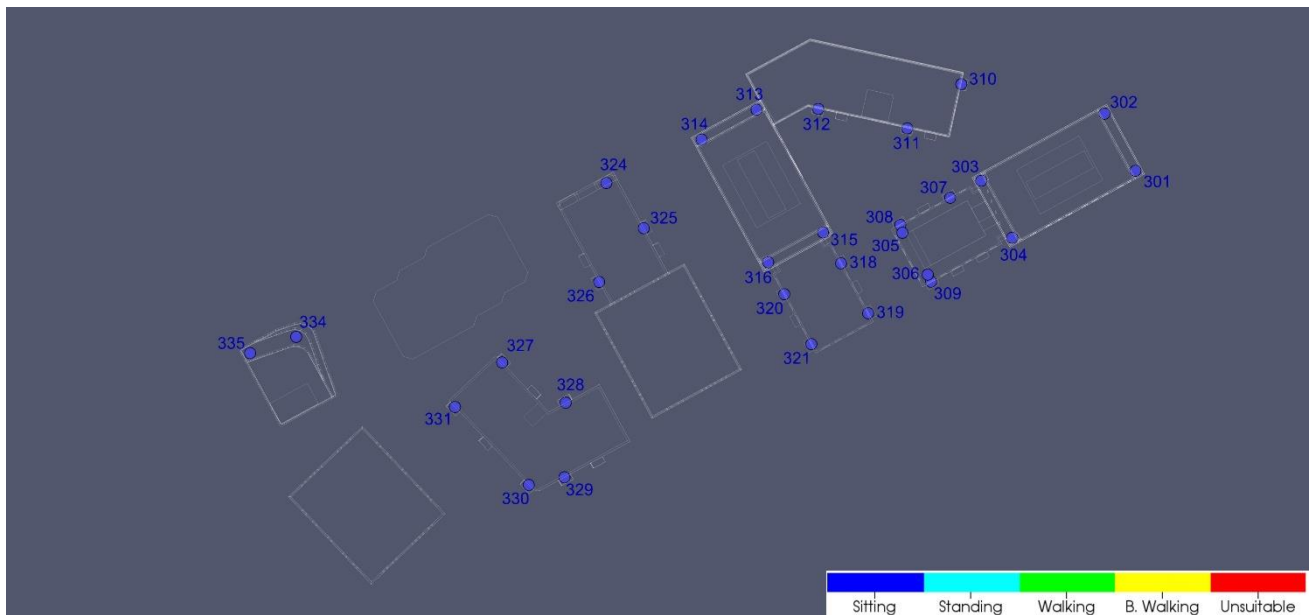


Figure 3-35 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds, upper balconies and terraces.



3.6 LANDSCAPING STRATEGY AND WIND MITIGATION

As part of the wind mitigation workshop in the wind tunnel, the landscaping scheme was implemented in accordance with the information outlined within the following documents provided by the landscape architects of the scheme (OP-EN):

- *M10394_NT02-NT04 Landscape Plan_Courtyards_230213.pdf*
- *M10394_NT02-NT04 Landscape Plan_PublicRealm_230213.pdf*

All trees were initially implemented as winter/bare format trees, for conservatism. Based on tree height information provided by OP-EN, a mix of small trees (4m tall) and standard trees (6m tall) were modelled. During the wind mitigation exercise, a number of these trees were subsequently replaced with evergreen trees, which – due to the additional foliage – were more effective in alleviating adverse wind effects. The changes to the initial landscaping strategy are illustrated in Figure 3-36.

The wind mitigation measures that were developed with input from the design team and the Applicant during the interactive wind tunnel workshop session include:

- 1.5m (D) x 2m (H) solid side screens on both sides of the entrances within the vicinity of Receptors 29, 44, 50, 77 and 96.
- 1m (D) x 1.5m (H) planter with hedges on both sides of the commercial entrances along the north façade of Block A of the Victoria Riverside scheme (*).
- 1m (H) x 3m (W) planter with hedges near the rounded building corner at the NT02 Clubhouse terrace.
- 1.5m (H) parapet, comprising 0.5m (H) perforated panels (50% solid) on top of a 1m (H) solid balustrade, along the perimeter of the NT02 Clubhouse terrace.
- 1.5m (H) parapet, comprising perforated panels (50% solid), at the private amenity terraces of NT04.
- 2m (H) solid screens/dividers at the private amenity terraces of NT04.
- 1.5m (H) parapet, comprising 0.6m (H) perforated panels (50% solid) on top of a 0.9m (H) solid balustrade, along the perimeter of the NT04 external amenity terrace.
- 1.8m (H) fence, comprising perforated panels (50% solid), along the southern boundary between the podium and 2D.3 of NT04.
- 1.5m (H) backrests/screens, comprising perforated panels (50% solid), at the seating areas within the central courtyard on the NT03 podium terrace. These should be strategically oriented to shield the seating areas from southerly winds.
- 1.5m (H) solid side screen and 1.2m (H) balustrade comprising 50% perforated panels, at the lower balconies along the west elevation of NT03 Midrise 3.

Figure 3-37 through to Figure 3-40 show the wind mitigation measures tested in the wind tunnel.

It should be noted that the localised wind mitigation measure at the Victoria Riverside scheme – marked (*) above – was developed during the wind tunnel tests to demonstrate a viable option for the mitigation of the adverse wind effects observed when both the detailed and outline applications are present. However, it is expected that this will not become necessary as the exceedance will be

addressed through the massing and/or landscaping strategy for Plots RB06 and RB07 (part of the current outline application) when they are brought forward for detailed application.

Figure 3-36 – Landscaping Strategy.

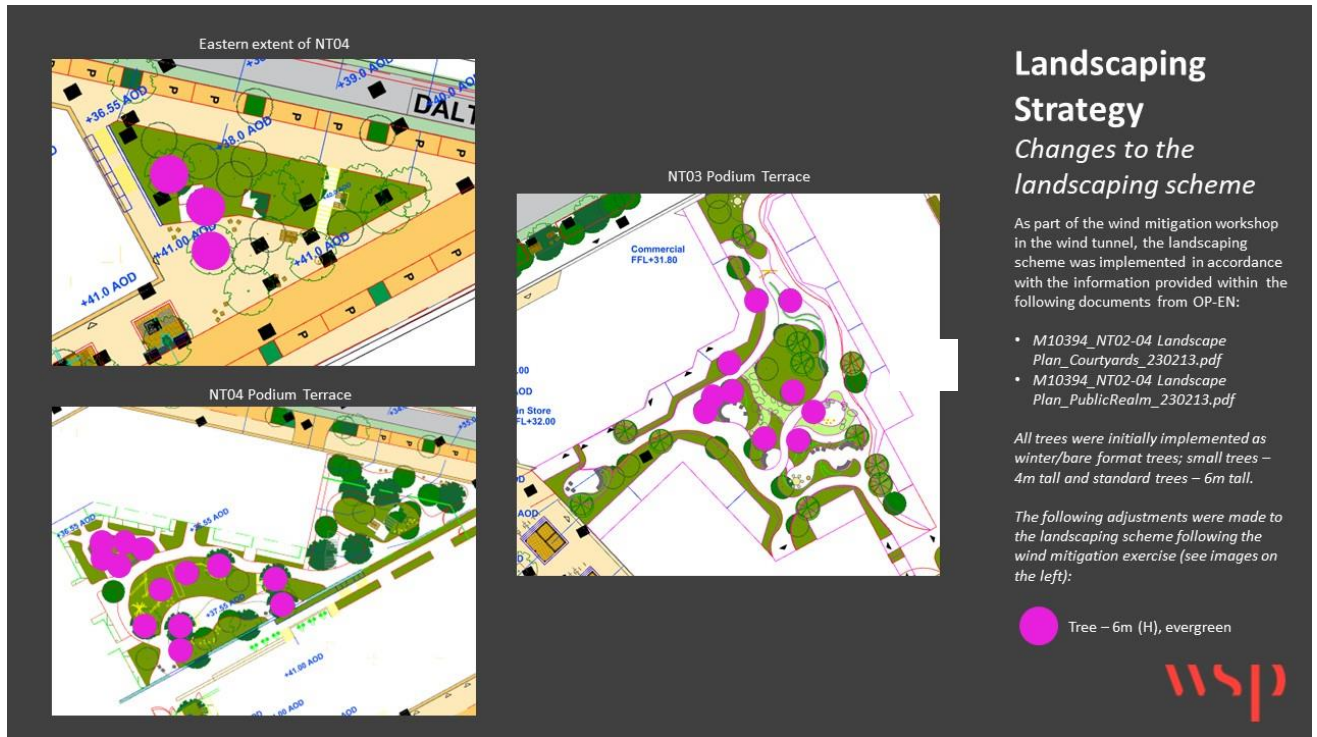


Figure 3-37 – Proposed wind mitigation (street level).

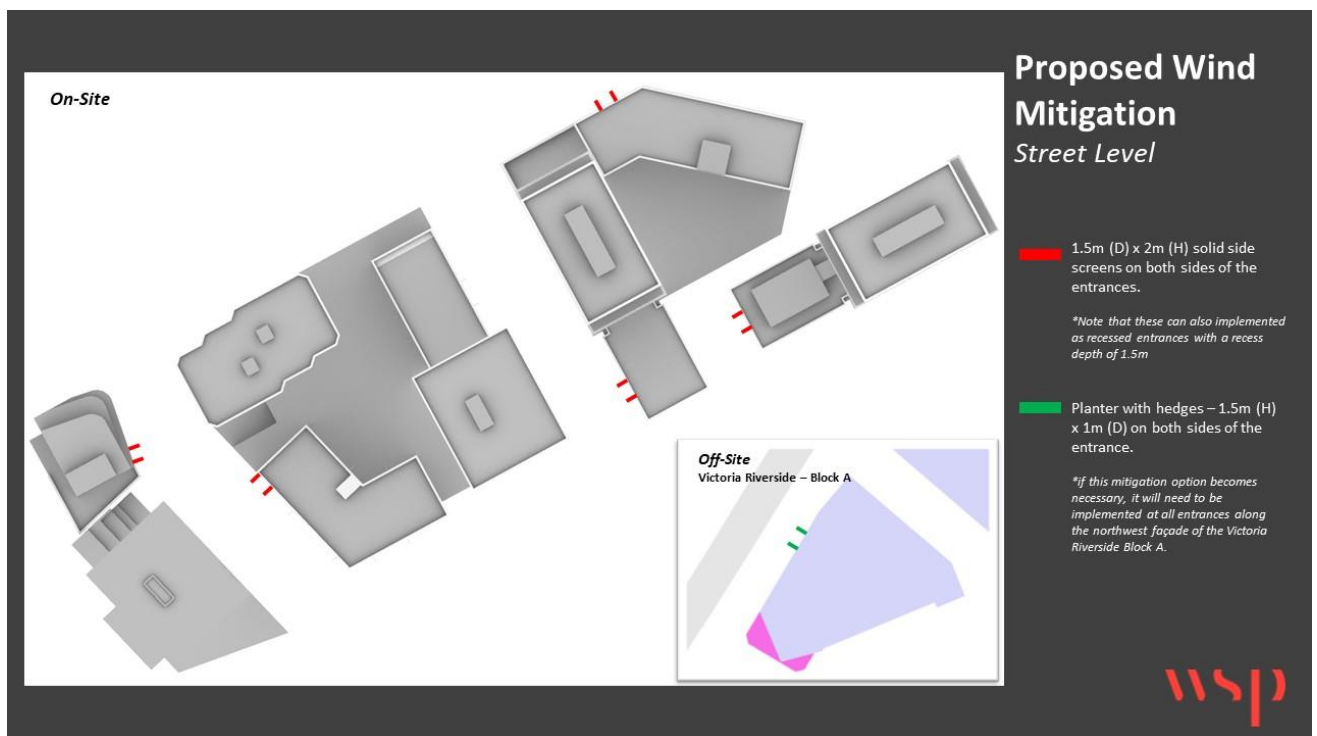


Figure 3-38 – Proposed wind mitigation (podium and elevated terraces).



Figure 3-39 – Proposed wind mitigation (balconies).

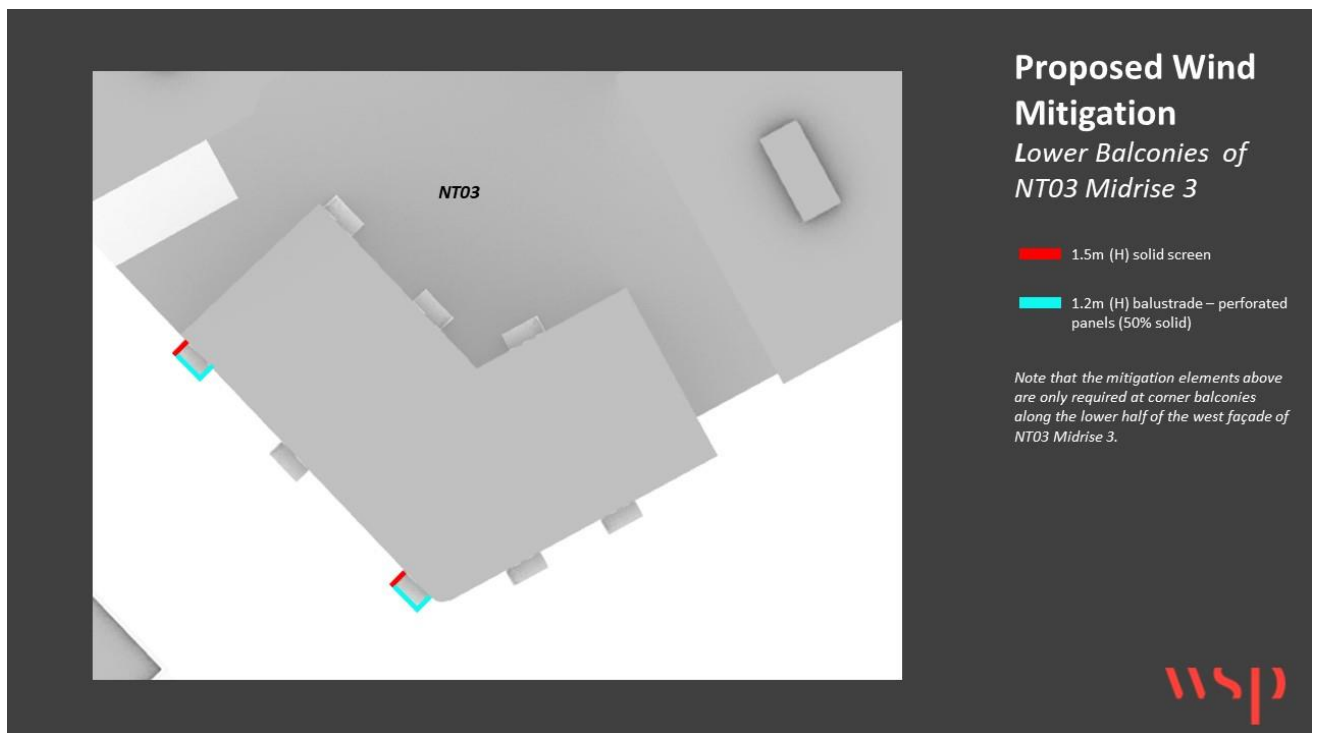


Figure 3-40 – Landscaping and wind mitigation (wind tunnel model photos).



3.7 NT02-NT04 (ALL SCENARIOS) + LANDSCAPING STRATEGY + WIND MITIGATIONS

With the introduction of the proposed landscaping strategy and the wind mitigation elements within the context of all the scenarios featuring the proposed Plots NT02-NT04 - Detailed (Application 5), all exceedances of the pedestrian *safety* criteria resulting from the introduction of the proposed NT02-NT04 have been fully mitigated.

Additionally, almost all the exceedances of the pedestrian wind *comfort* criteria have also been alleviated. The only exceptions occur at:

- The northwest corner of the NT04 external amenity terrace (Receptor 305) – for scenarios with the existing surrounding context – where wind conditions in summer are uncomfortable for sitting but are perfectly suitable for standing/short periods of sitting. Feedback from the design team has indicated that the immediate vicinity of Receptor 305 will not feature any outdoor seating furniture and will be intended for more active recreational pursuits. Therefore, the wind comfort rating at this receptor is considered suitable for its intended use.
- The lower balconies at the northwest corner of NT03 Midrise 3 (Receptor 333), where wind conditions in summer are uncomfortable for sitting but are suitable for standing/short periods of sitting. For context, wind conditions at these balconies are suitable for sitting at least 92% of the time in summer (worst-case across all scenarios), which is just shy of the targeted threshold requirement of 95%. Furthermore, it is also noted that these balconies are intended for private recreational use by the respective residents. Overall, the local wind conditions at these balconies are considered acceptable for their intended use.

Results for the ‘NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation’ configuration are illustrated in Figure 3-41 through to Figure 3-52.

Results for the ‘NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation’ configuration are illustrated in Figure Figure 3-69 through to Figure 3-80.

Results for the ‘NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation’ configuration are illustrated in Figure 3-81 through to Figure 3-92.

Results for the ‘NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation’ configuration are illustrated in Figure 3-53 through to Figure 3-64.

The results from each of the scenarios above can be compared against the results from the corresponding unmitigated scenarios to assess the impact of the landscaping strategy and wind mitigation measures in place.

Figure 3-41 – Annual safety, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

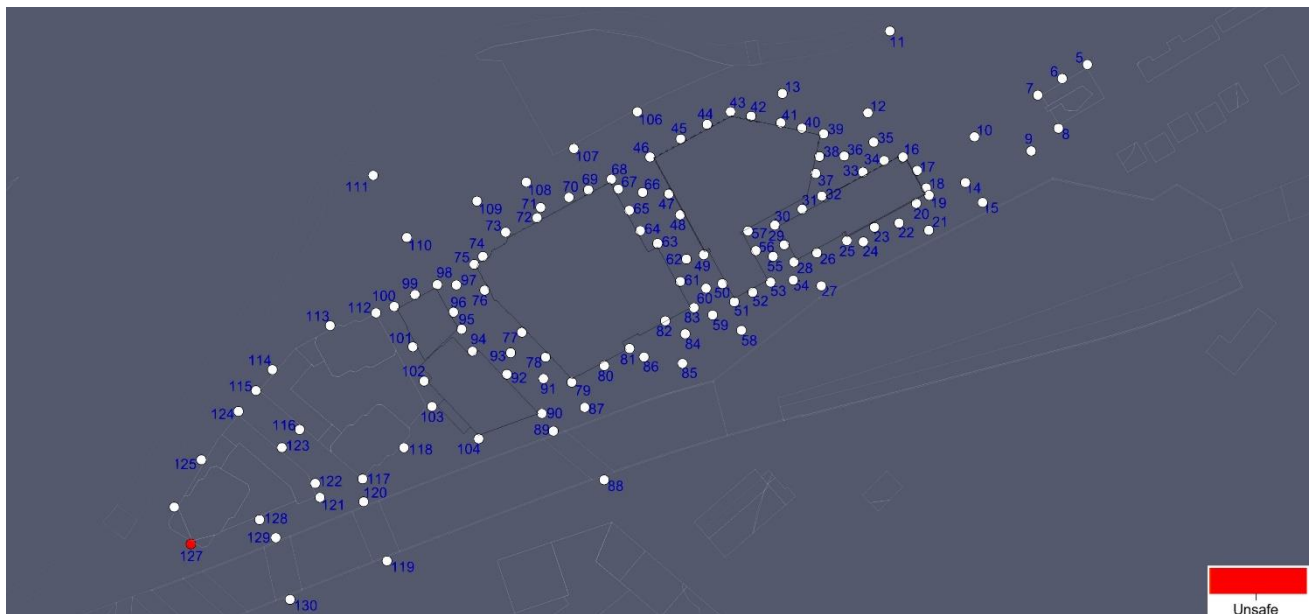


Figure 3-42 – Annual safety, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

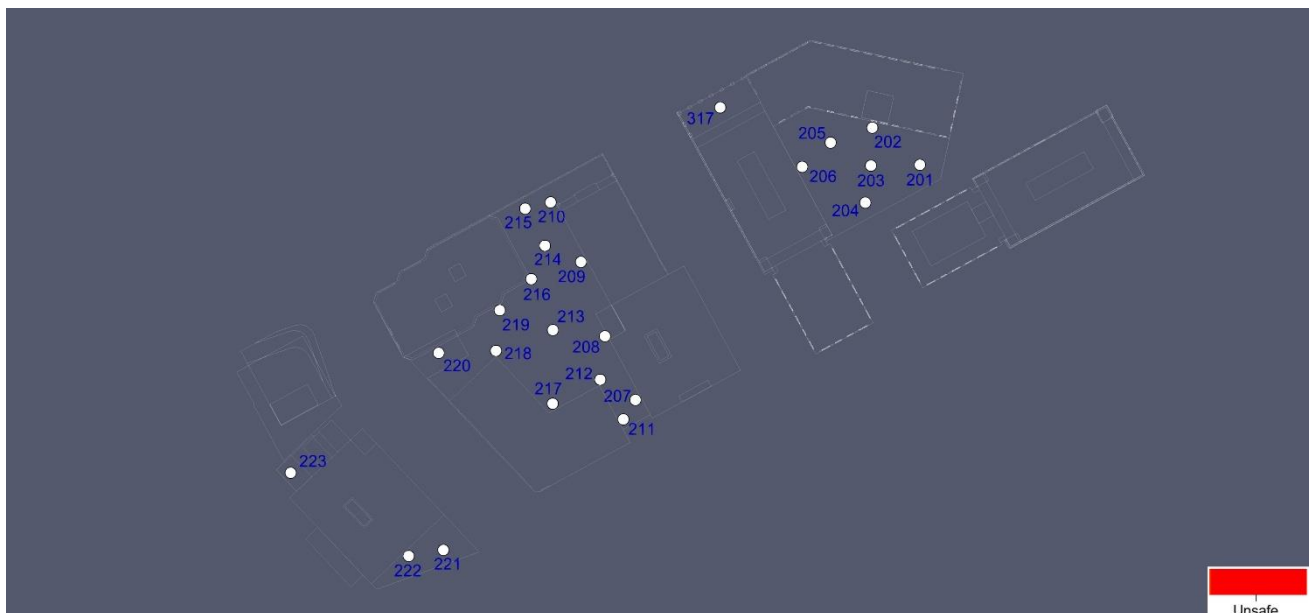


Figure 3-43 – Annual safety, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

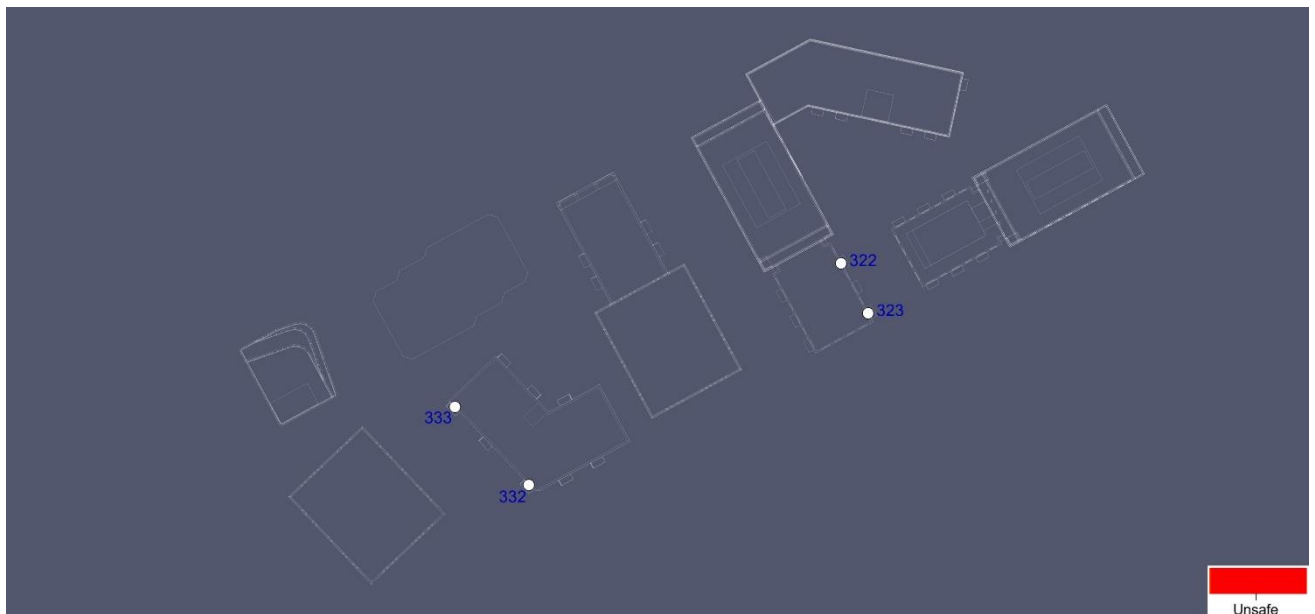


Figure 3-44 – Annual safety, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

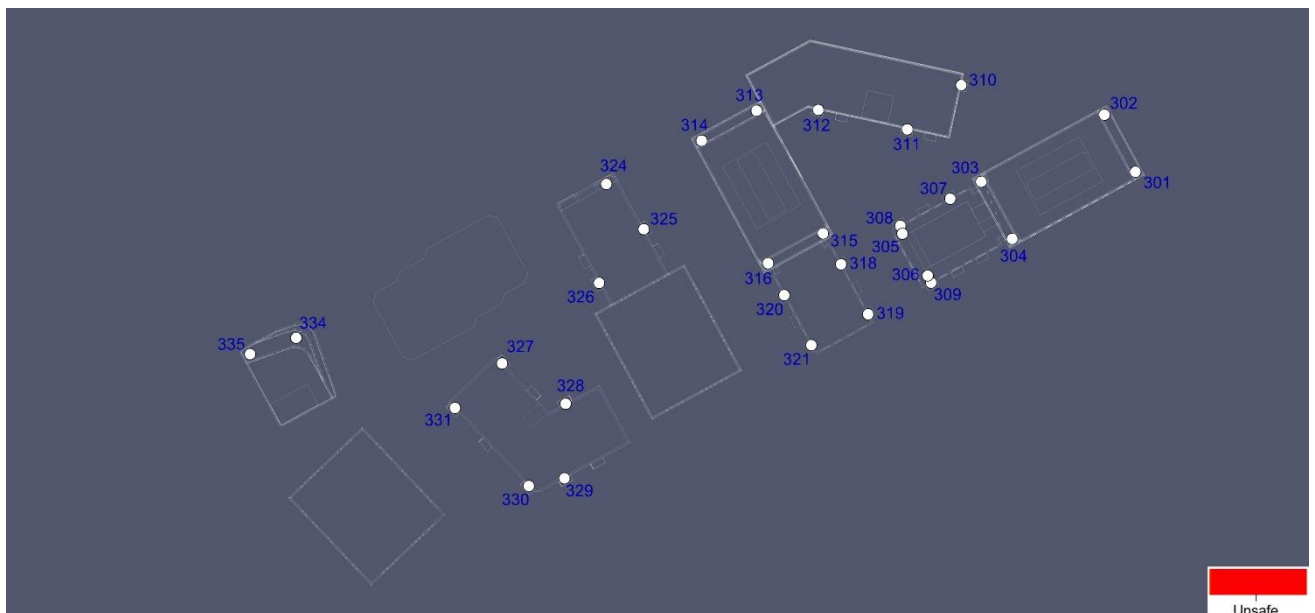


Figure 3-45 – Winter comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

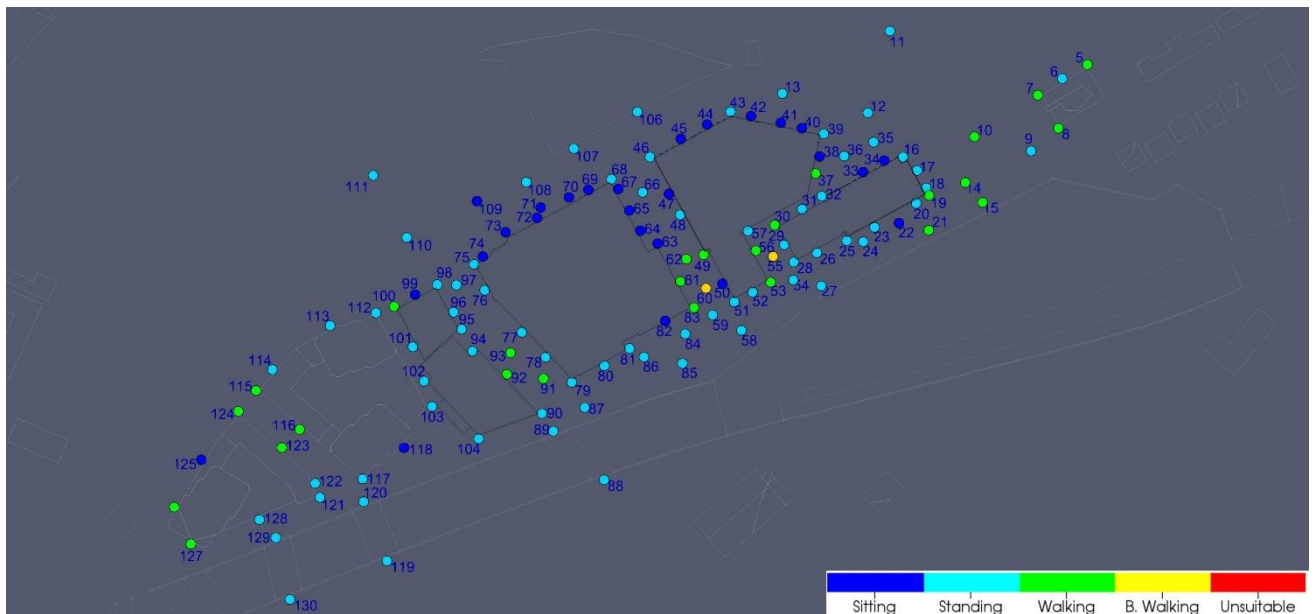


Figure 3-46 – Winter comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

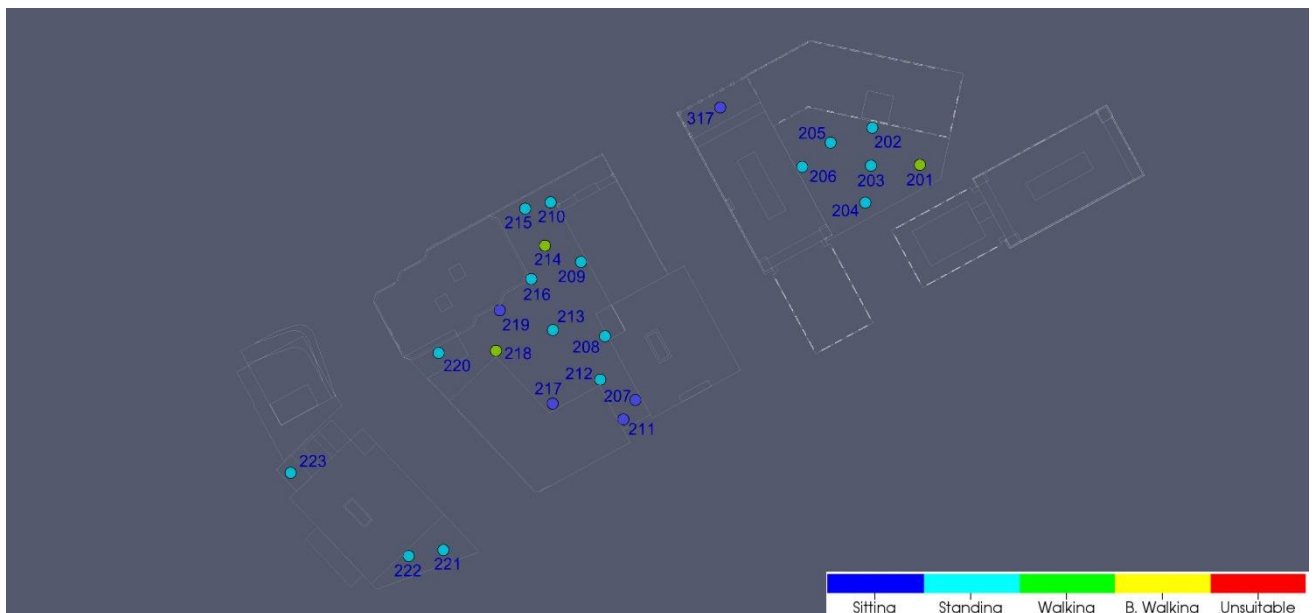


Figure 3-47 – Winter comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

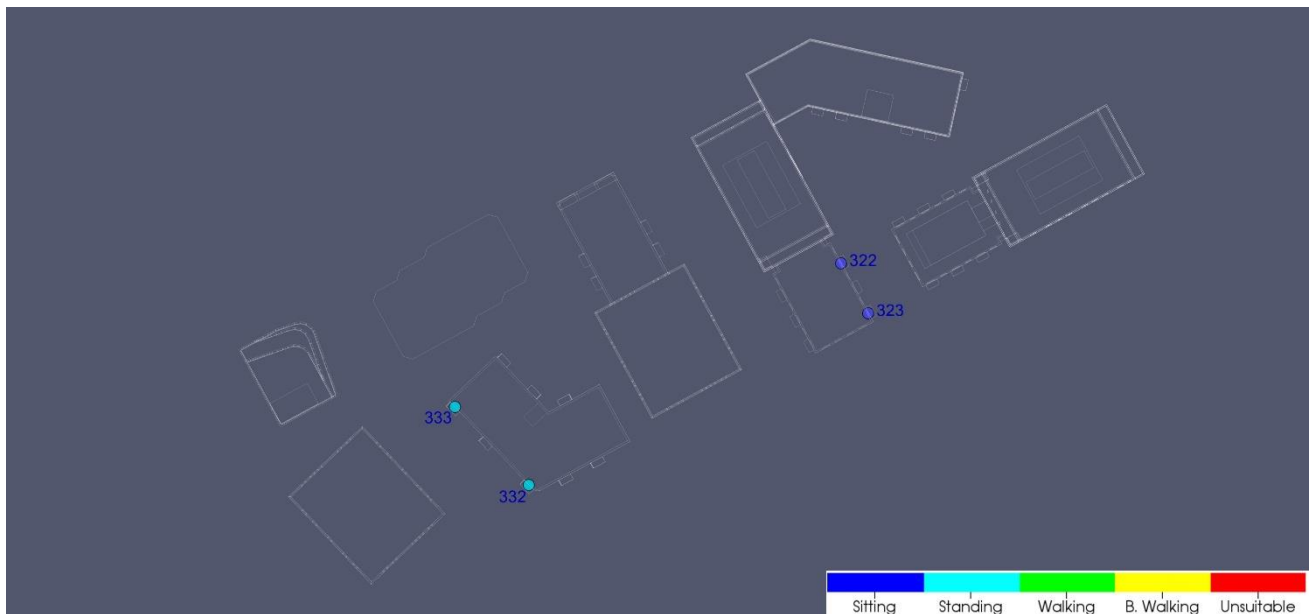


Figure 3-48 – Winter comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

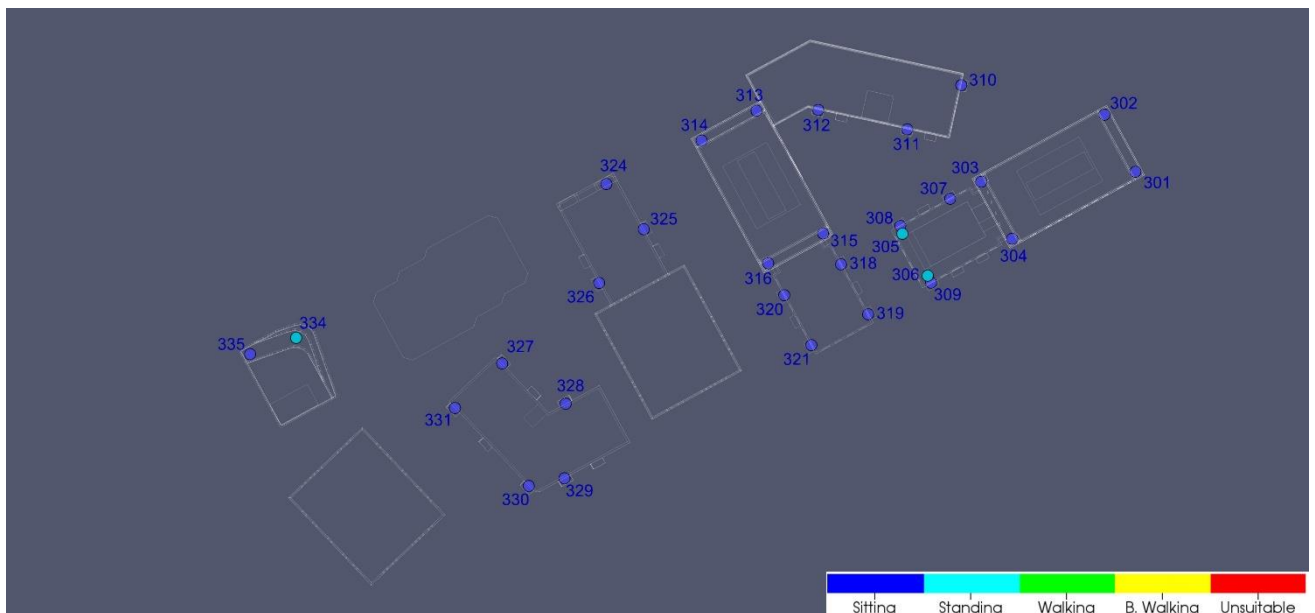


Figure 3-49 – Summer comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

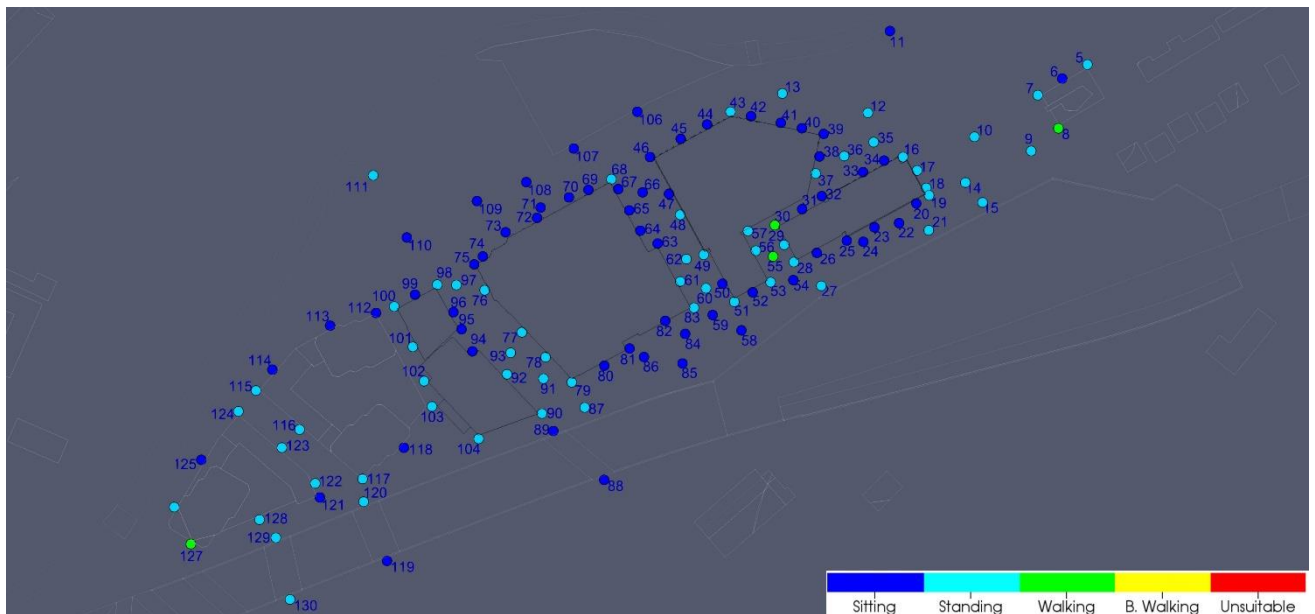


Figure 3-50 – Summer comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

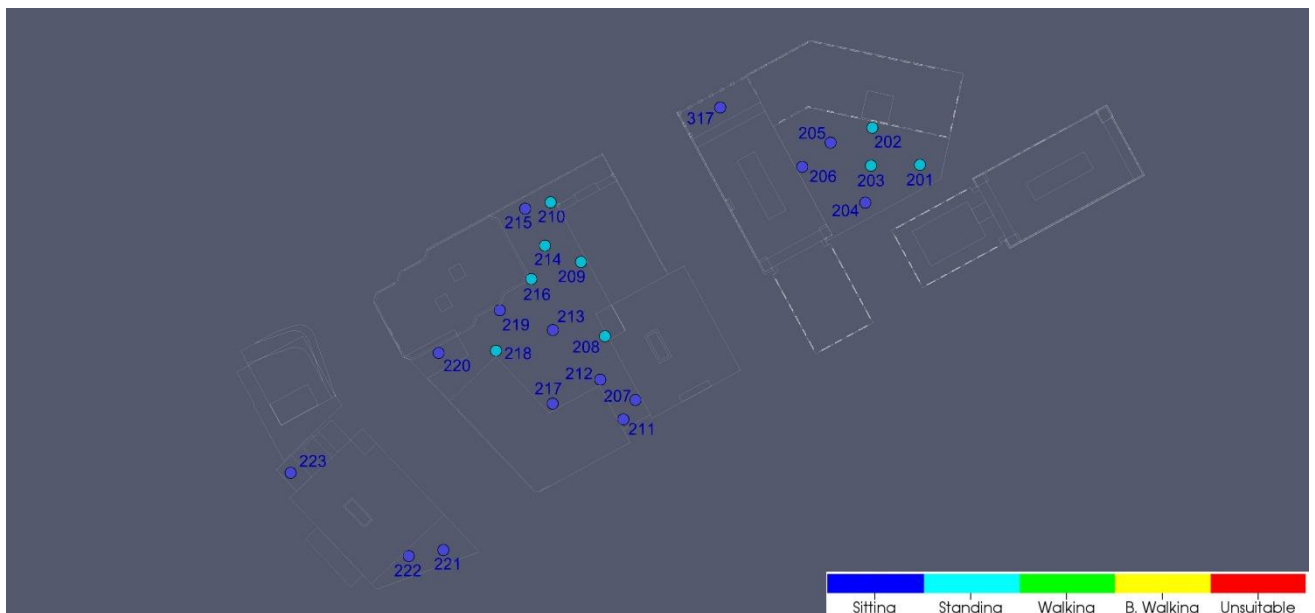


Figure 3-51 – Summer comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

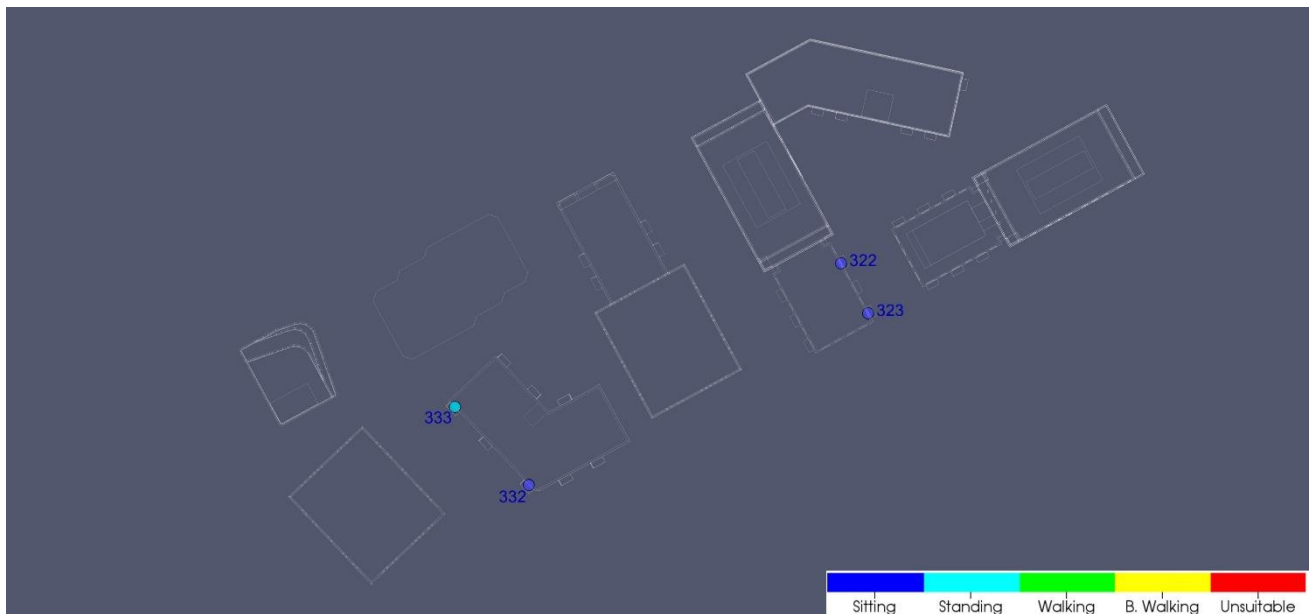


Figure 3-52 – Summer comfort, NT02-NT04 + Existing Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

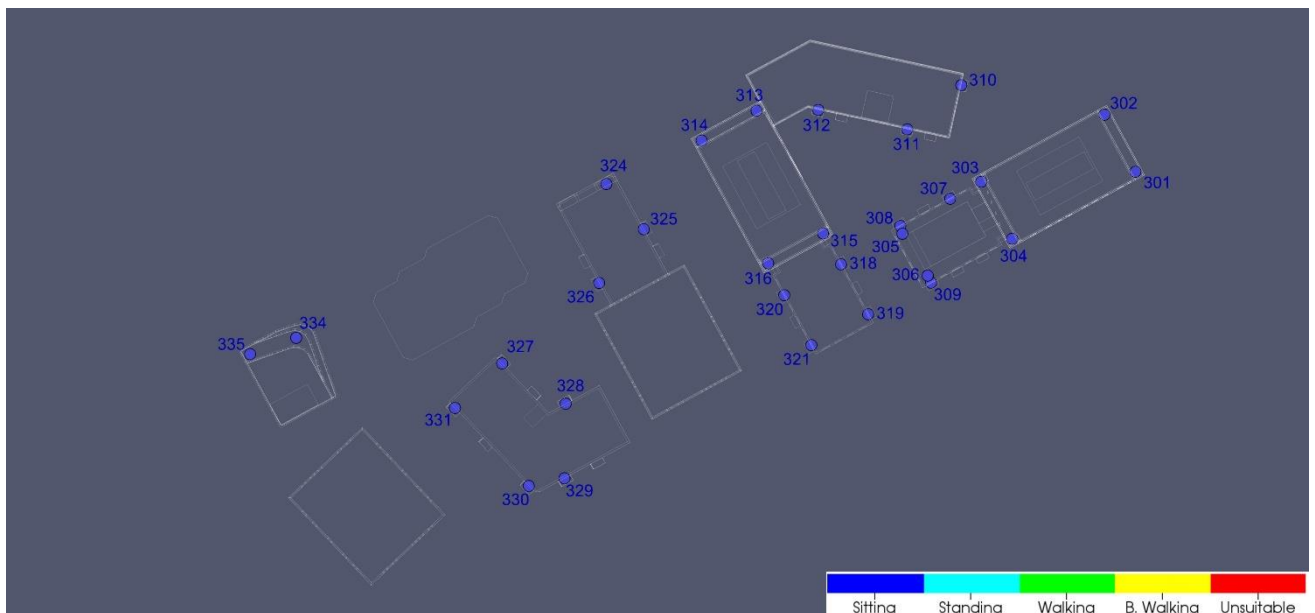


Figure 3-69 – Annual safety, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

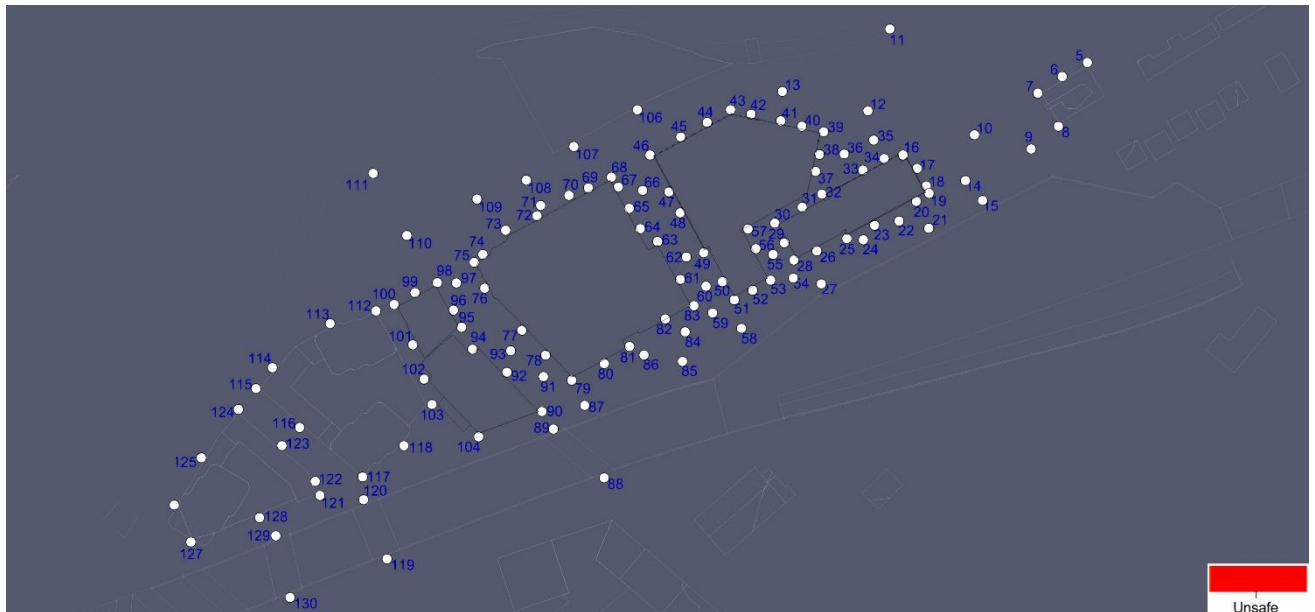


Figure 3-70 – Annual safety, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

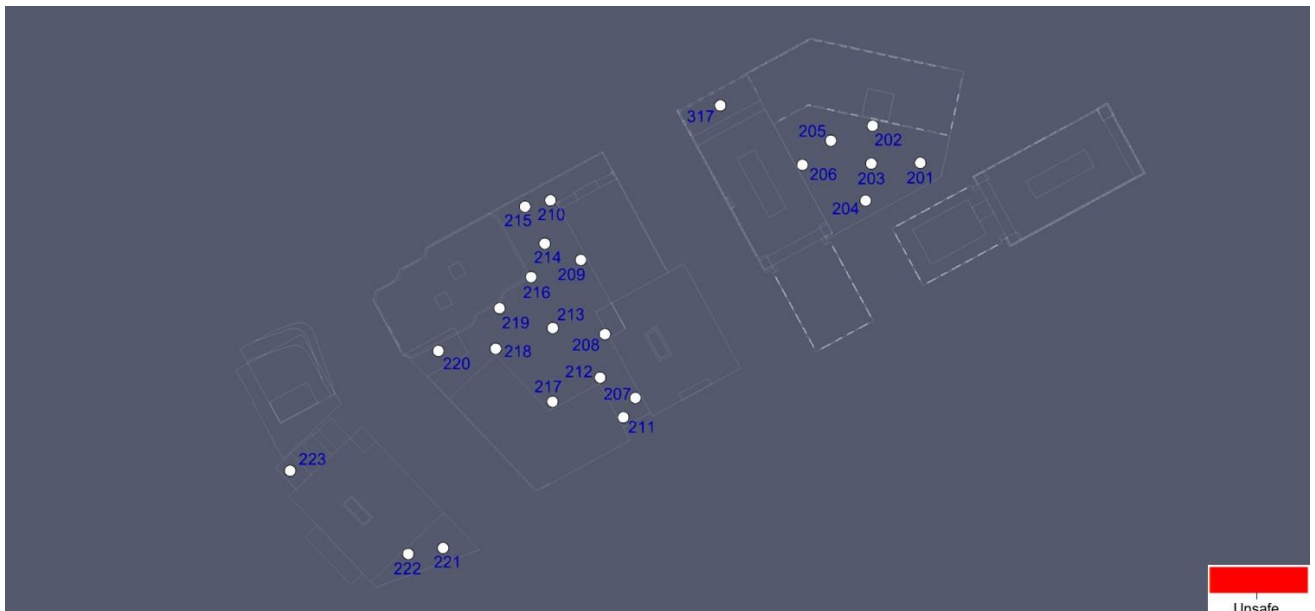


Figure 3-71 – Annual safety, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

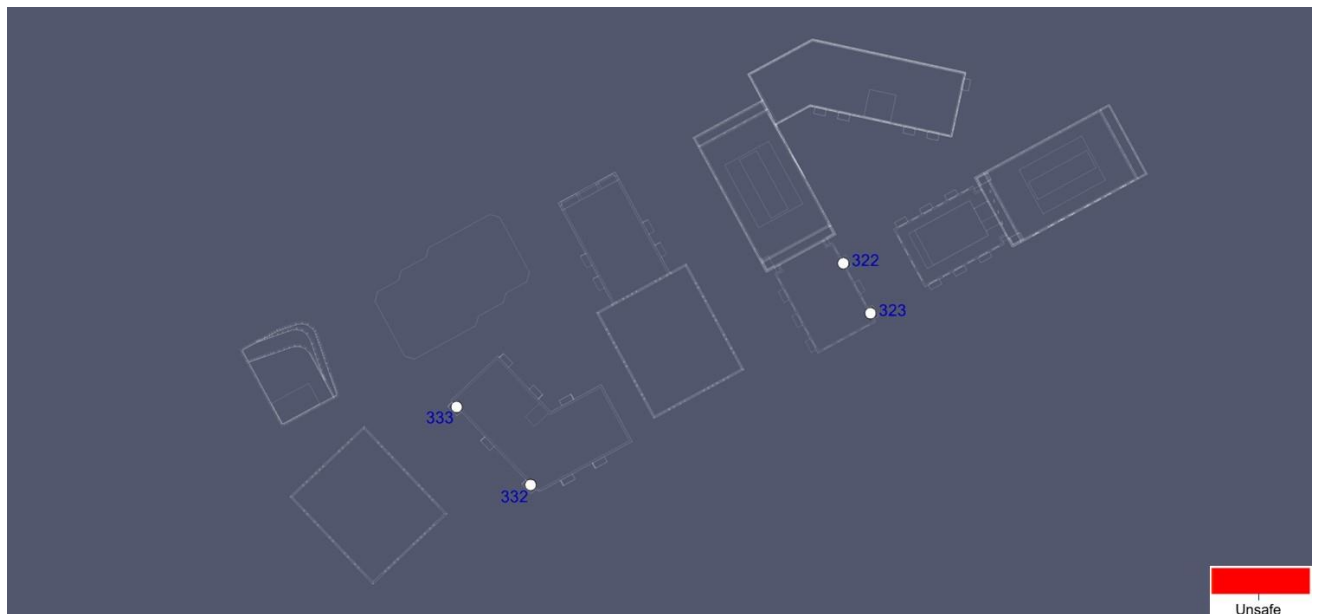


Figure 3-72 – Annual safety, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

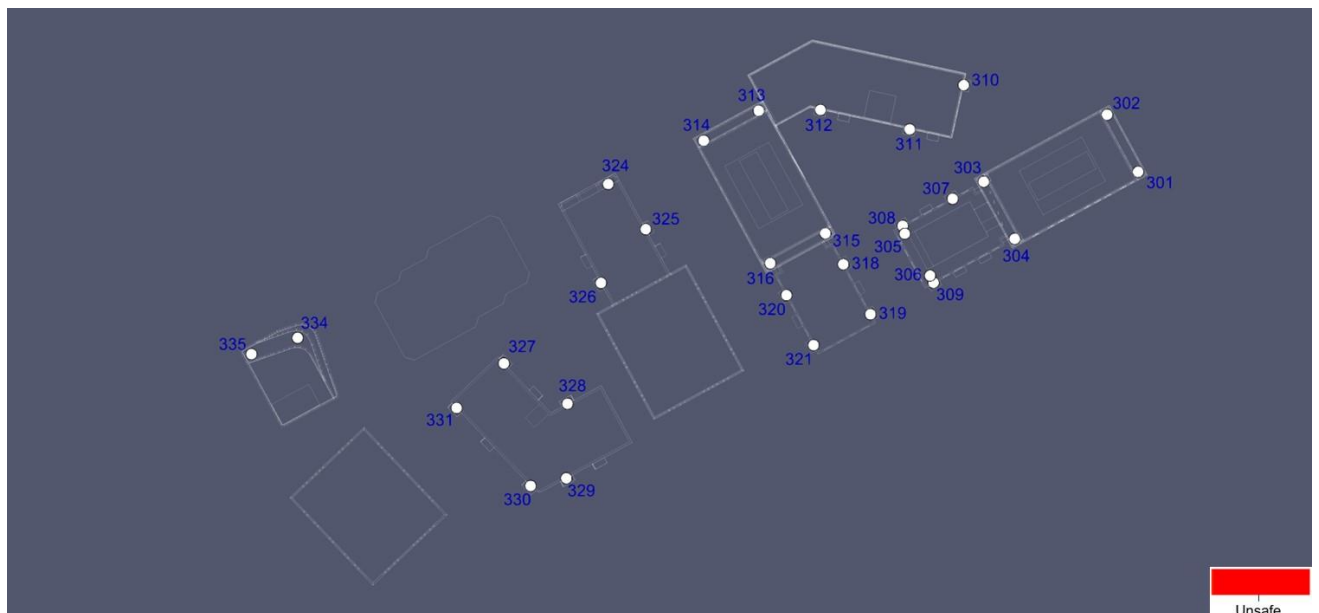


Figure 3-73 – Winter comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

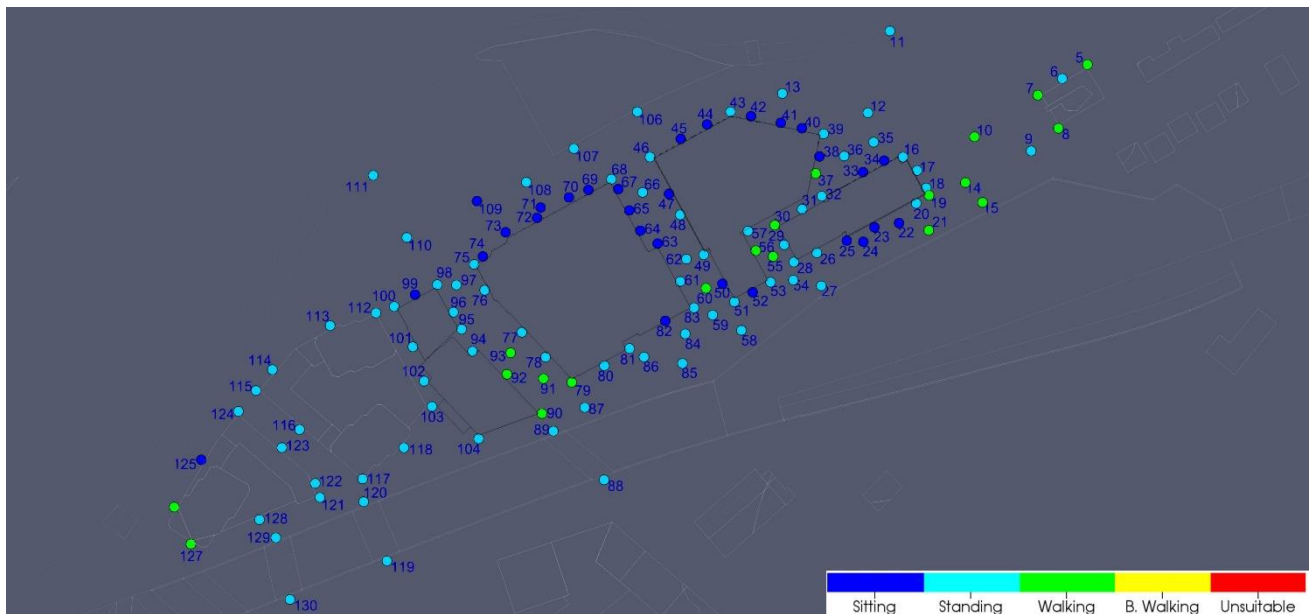


Figure 3-74 – Winter comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

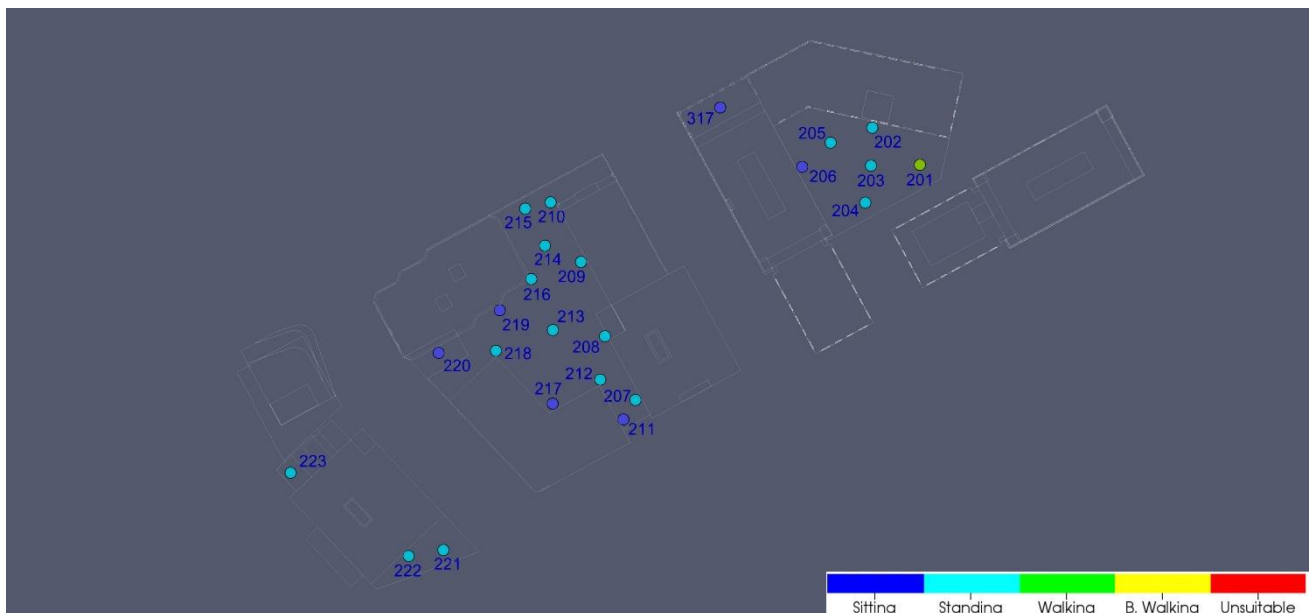


Figure 3-75 – Winter comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

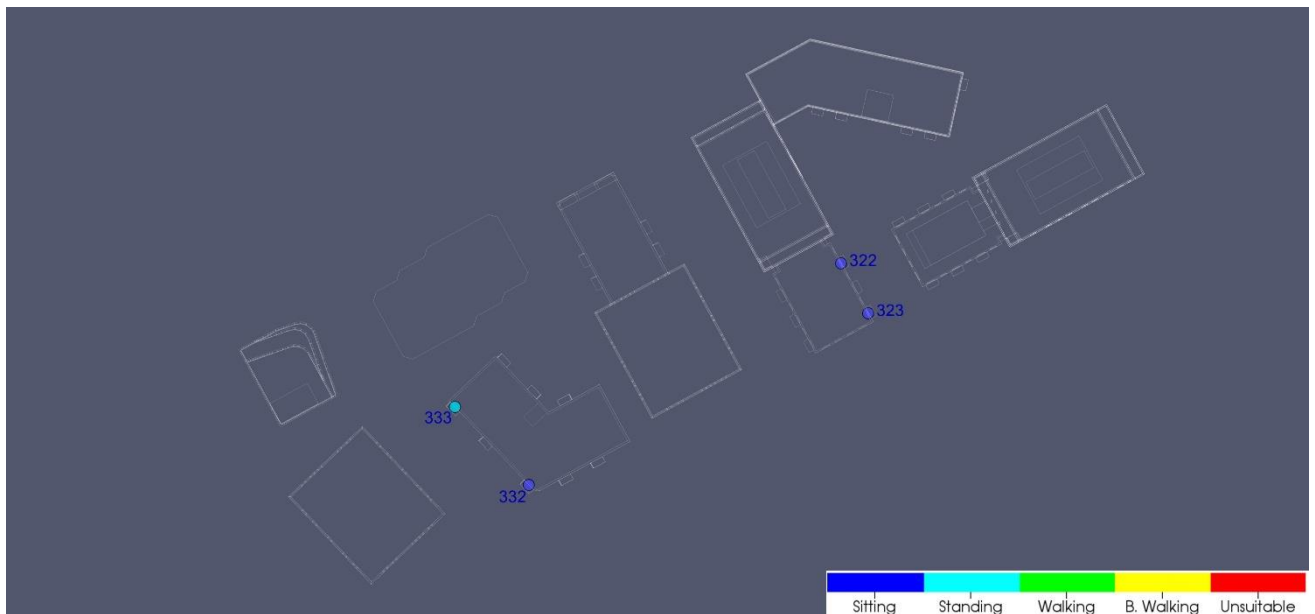


Figure 3-76 – Winter comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

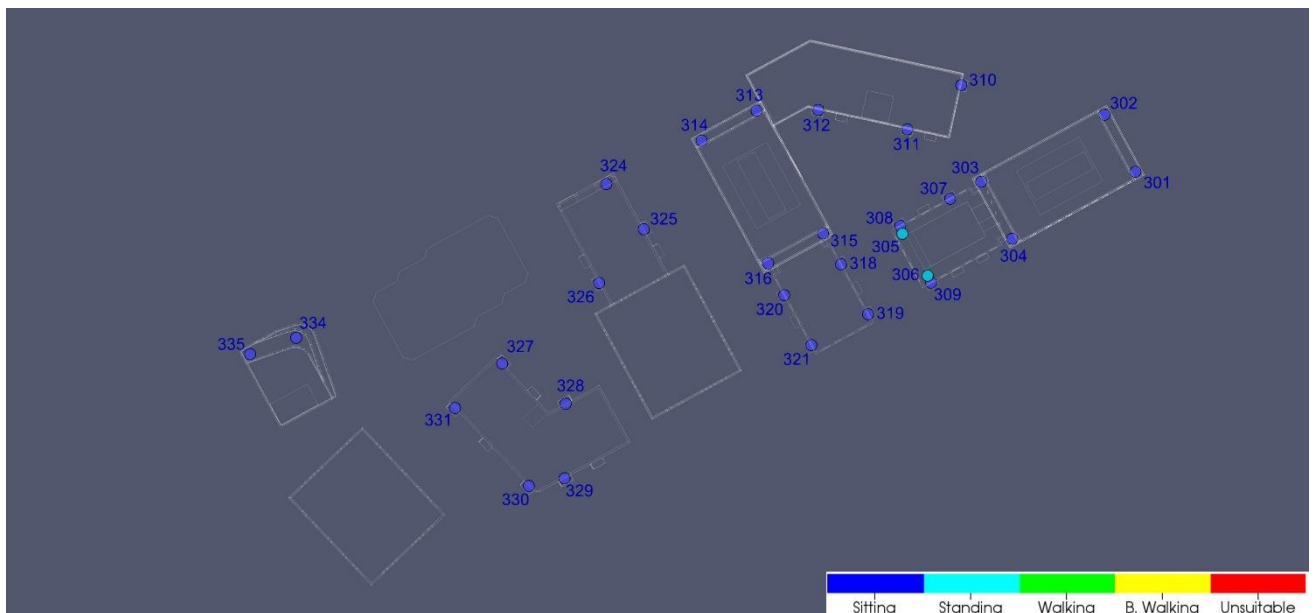


Figure 3-77 – Summer comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

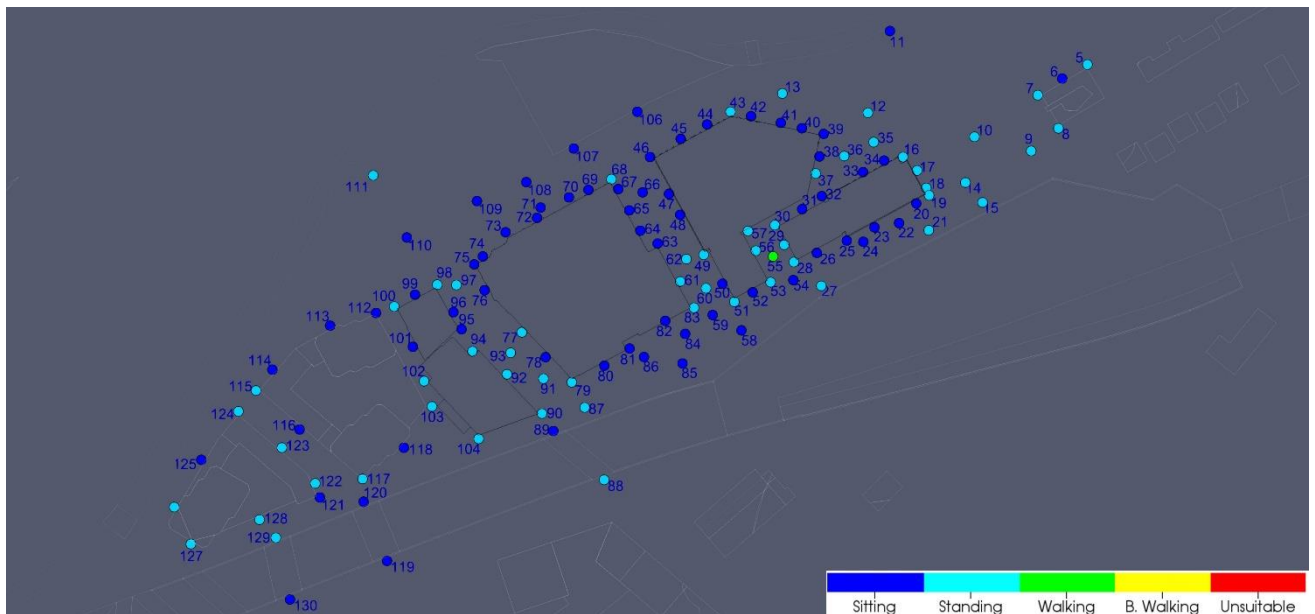


Figure 3-78 – Summer comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

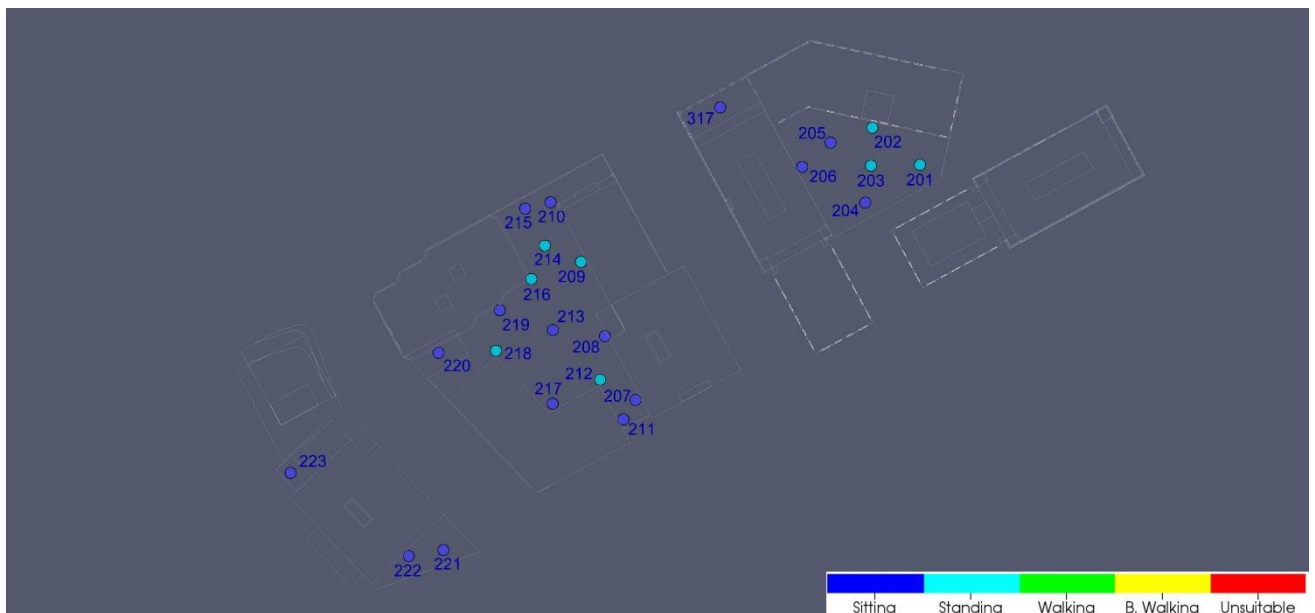


Figure 3-79 – Summer comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

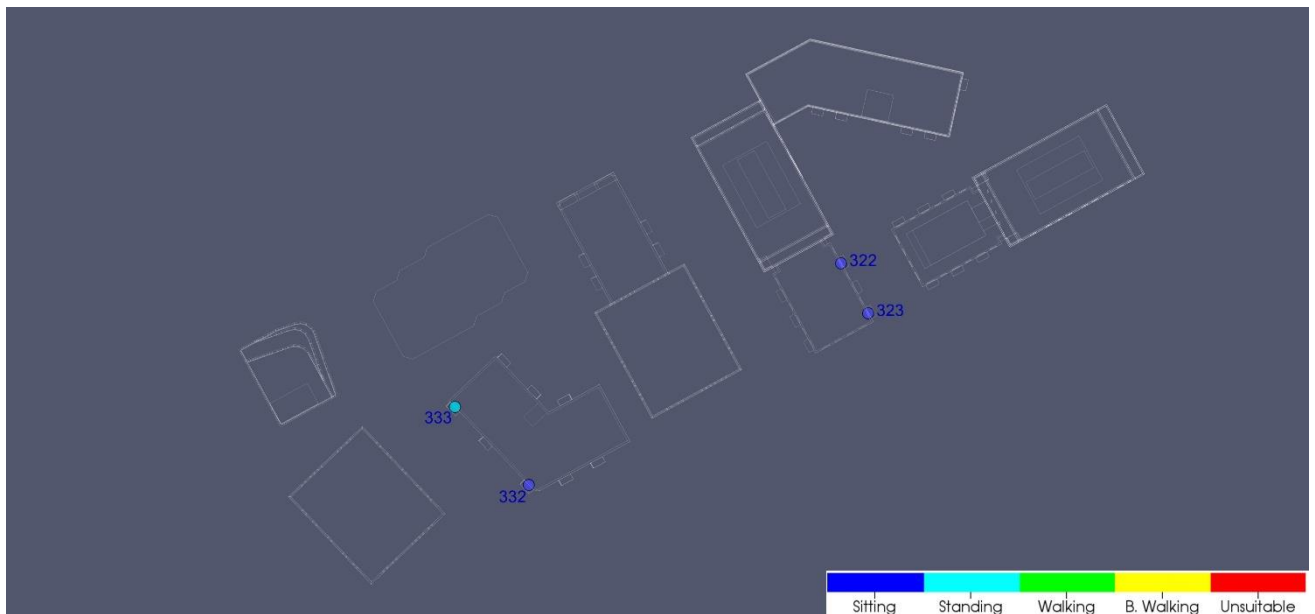


Figure 3-80 – Summer comfort, NT02-NT04 + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

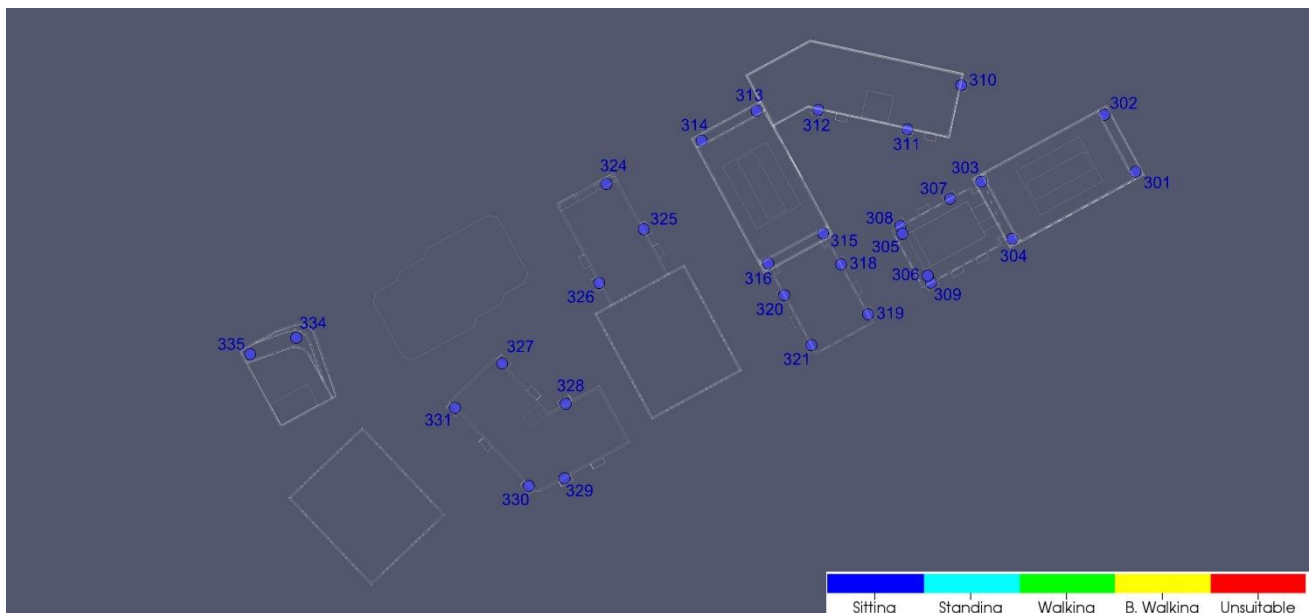


Figure 3-81 – Annual safety, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

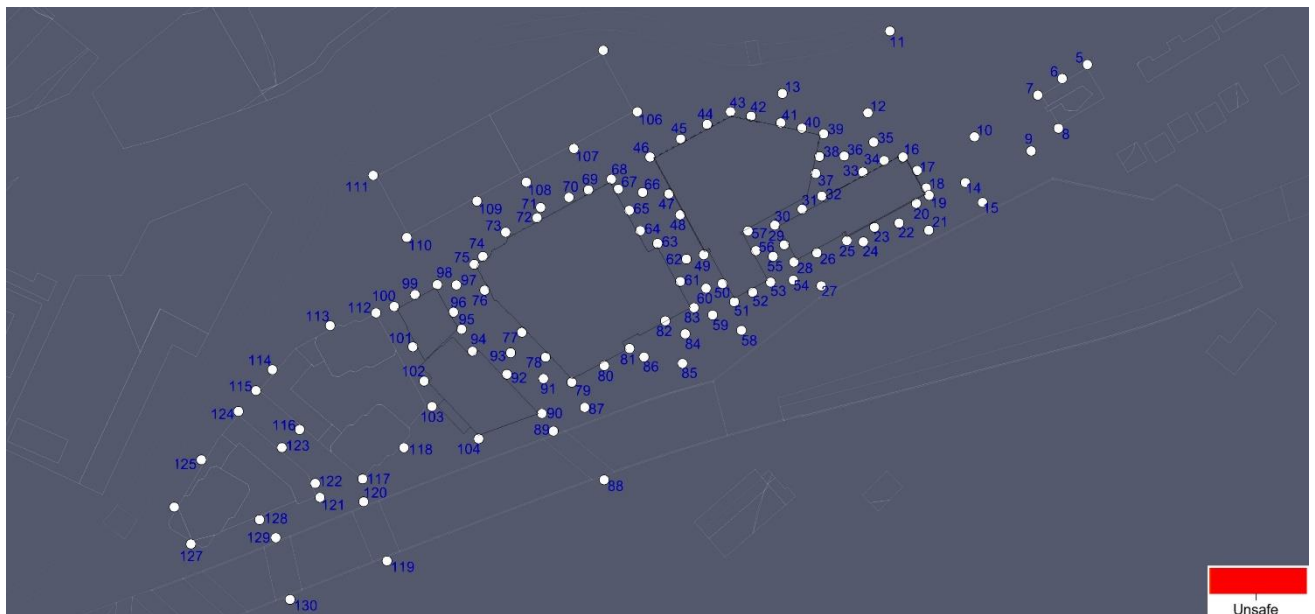


Figure 3-82 – Annual safety, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

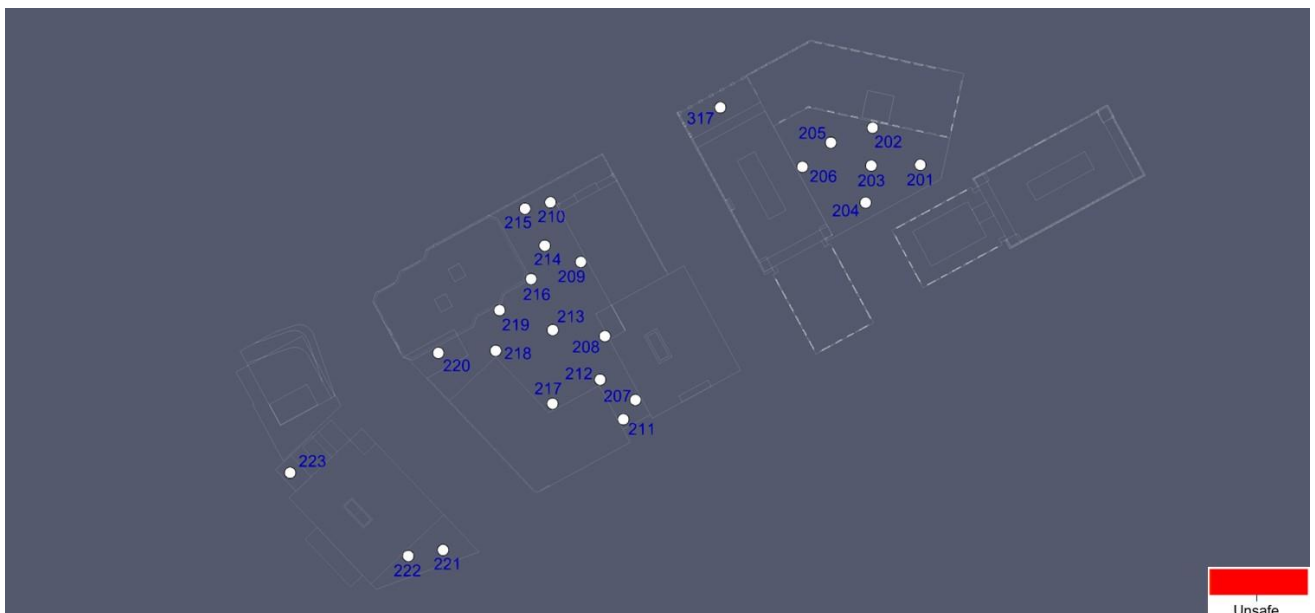


Figure 3-83 – Annual safety, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

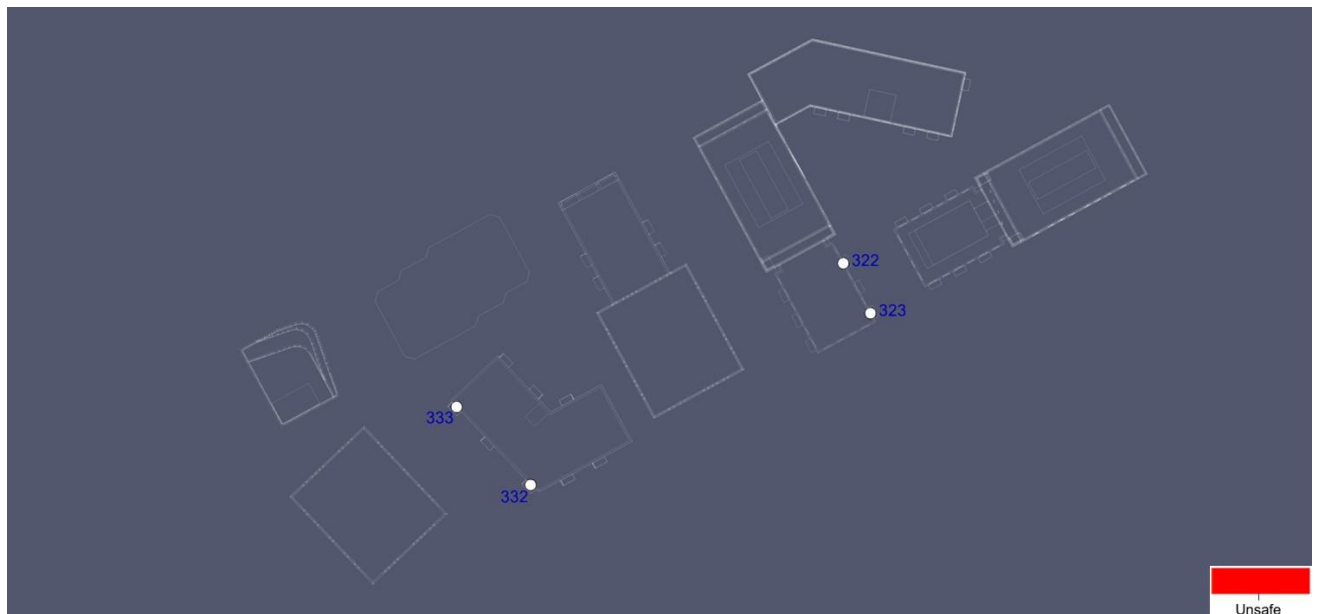


Figure 3-84 – Annual safety, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

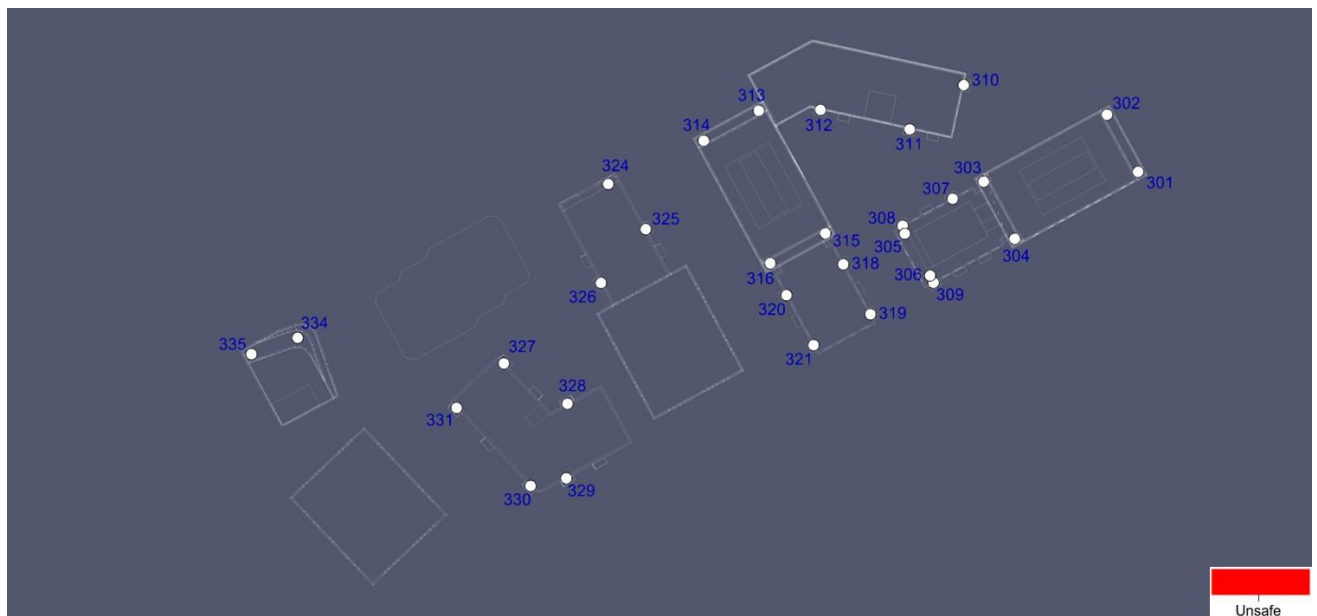


Figure 3-85 – Winter comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

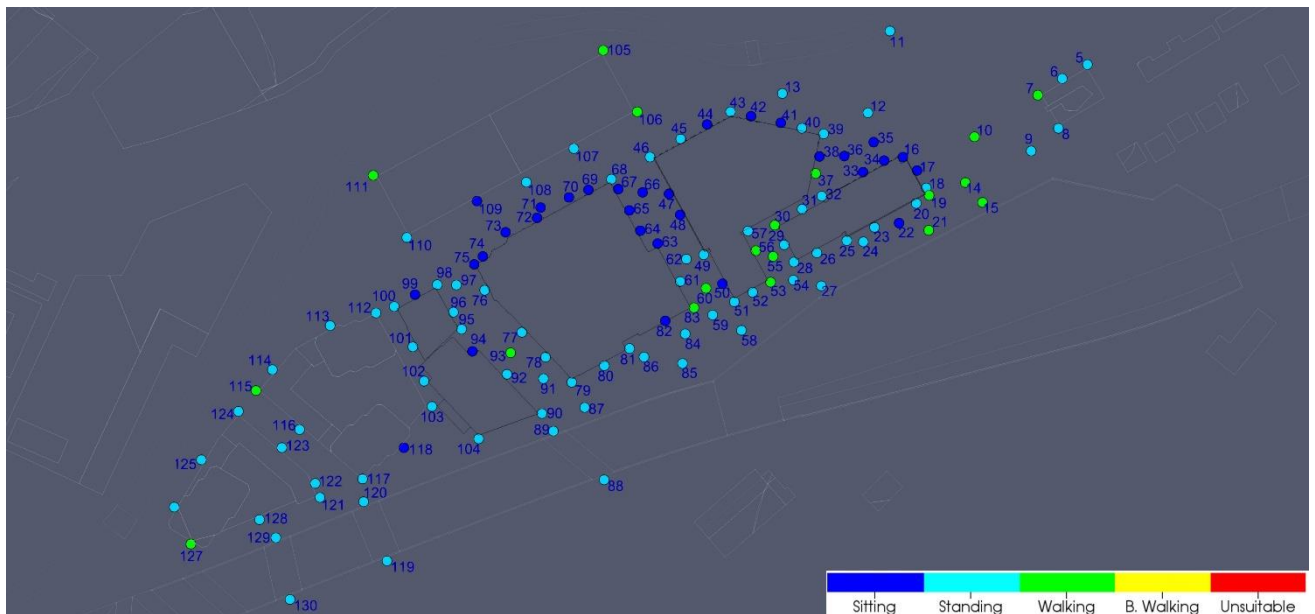


Figure 3-86 – Winter comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

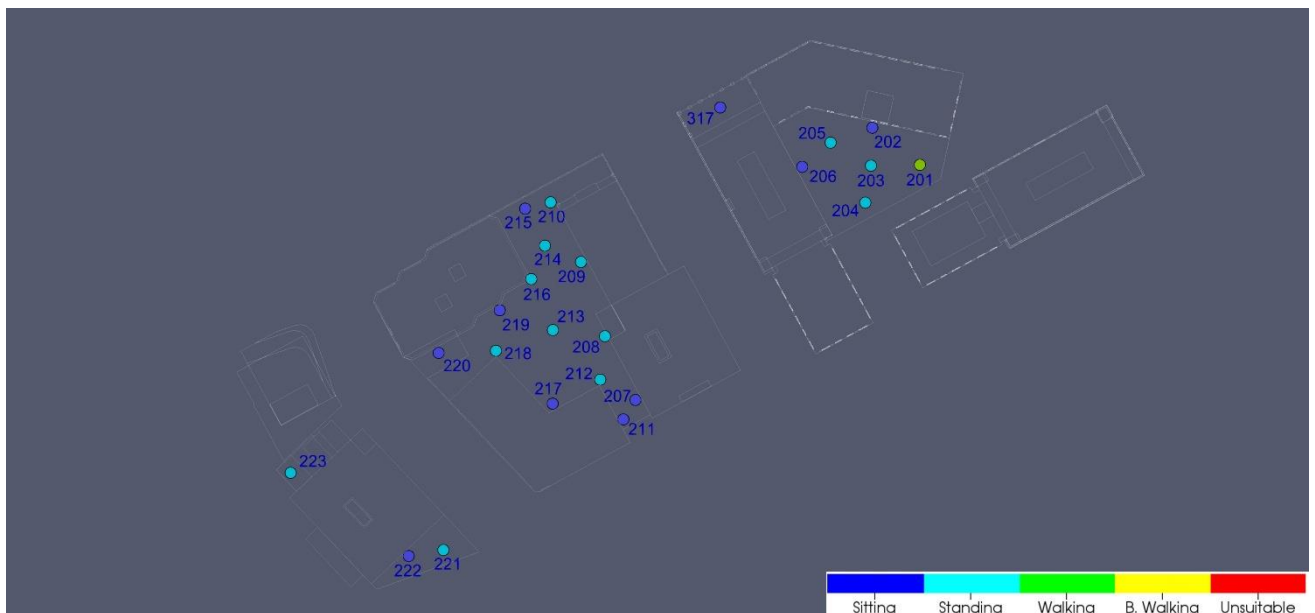


Figure 3-87 – Winter comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

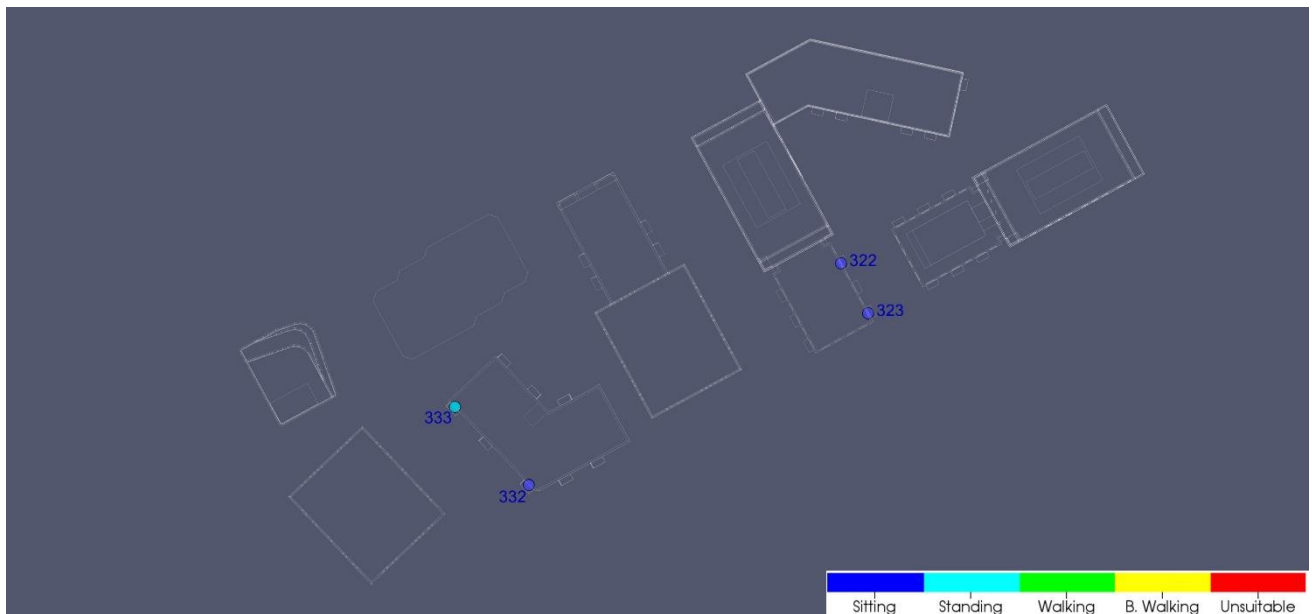


Figure 3-88 – Winter comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

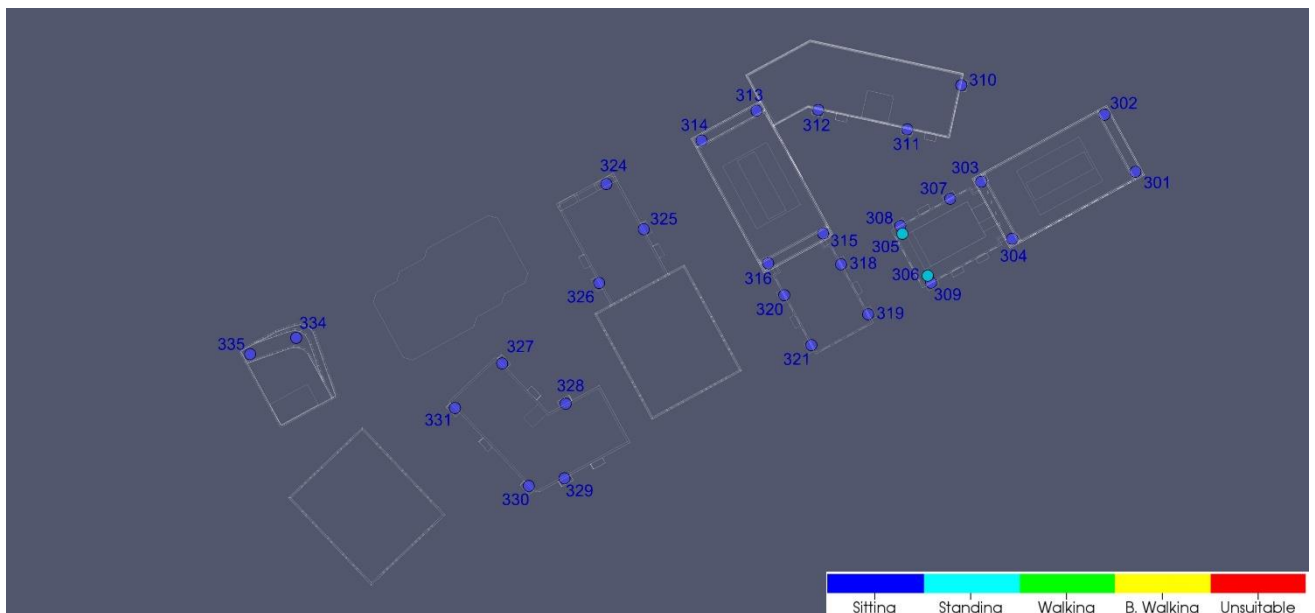


Figure 3-89 – Summer comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

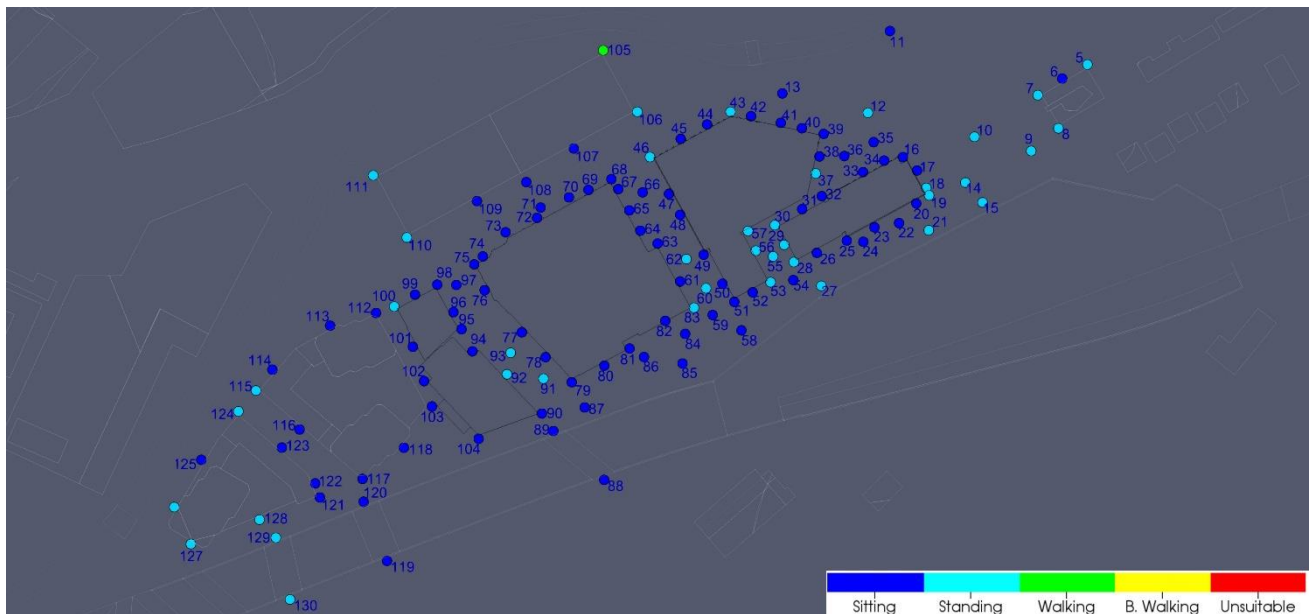


Figure 3-90 – Summer comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

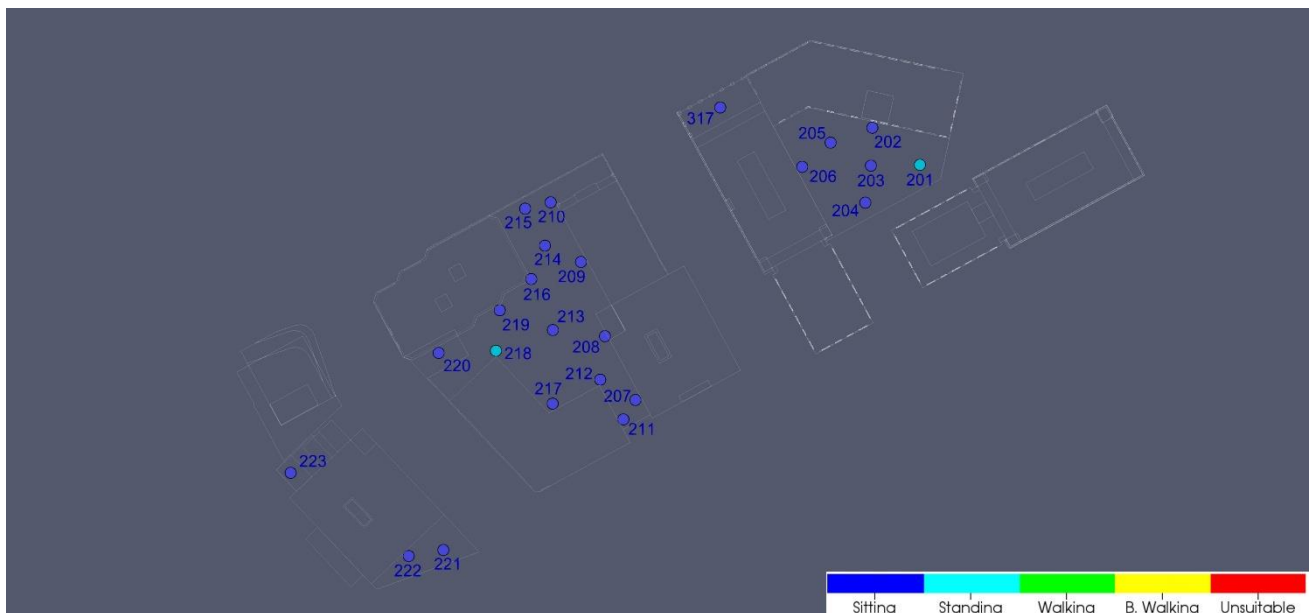


Figure 3-91 – Summer comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

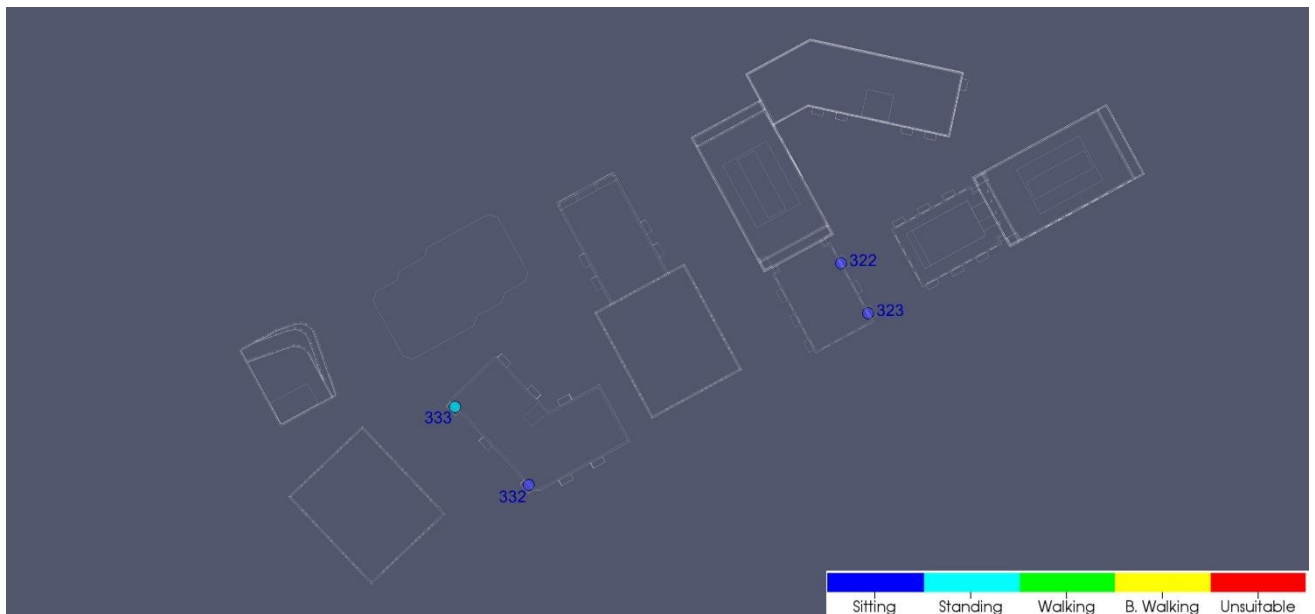


Figure 3-92 – Summer comfort, NT02-NT04 + OPA + Existing Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

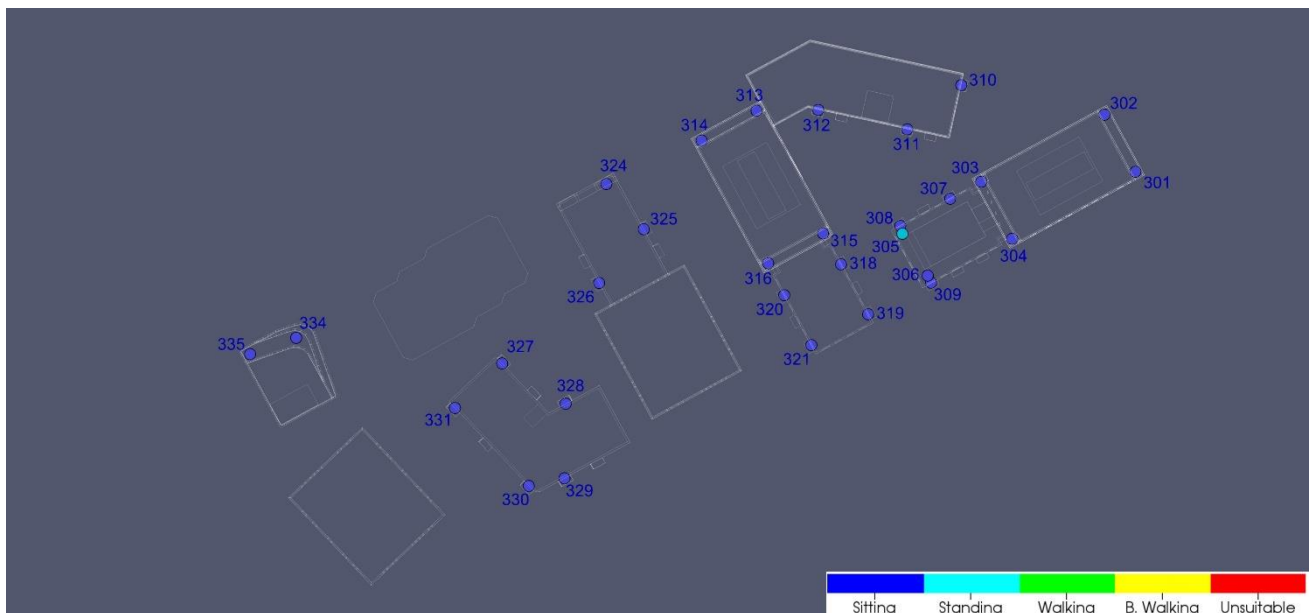


Figure 3-53 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

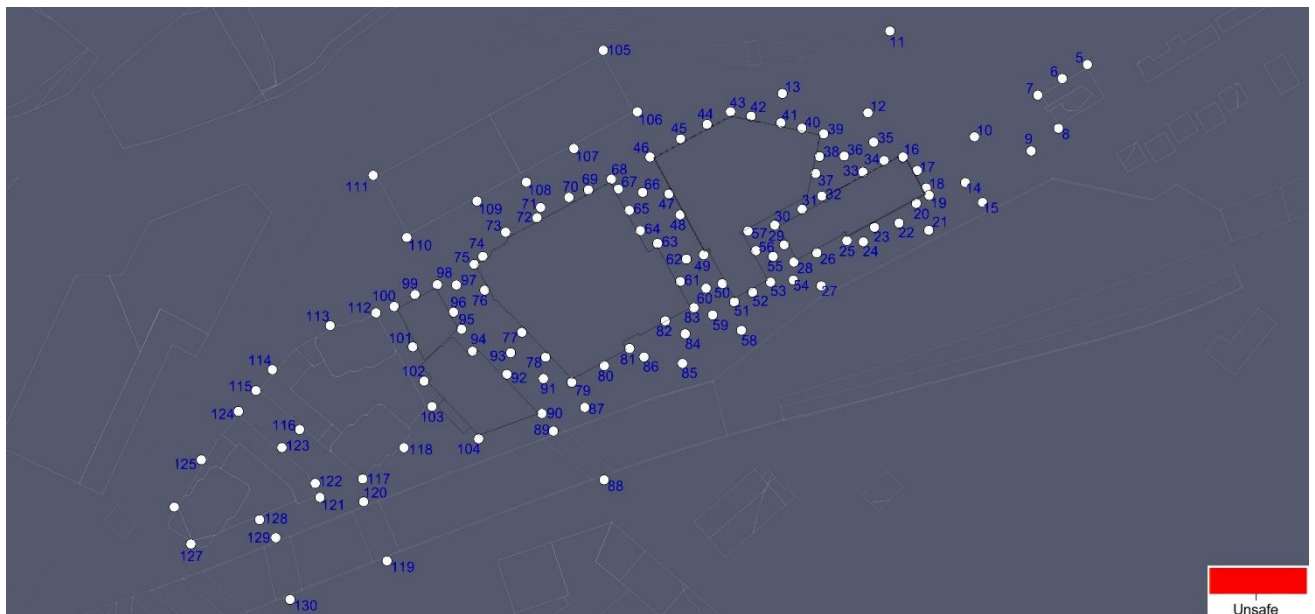


Figure 3-54 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

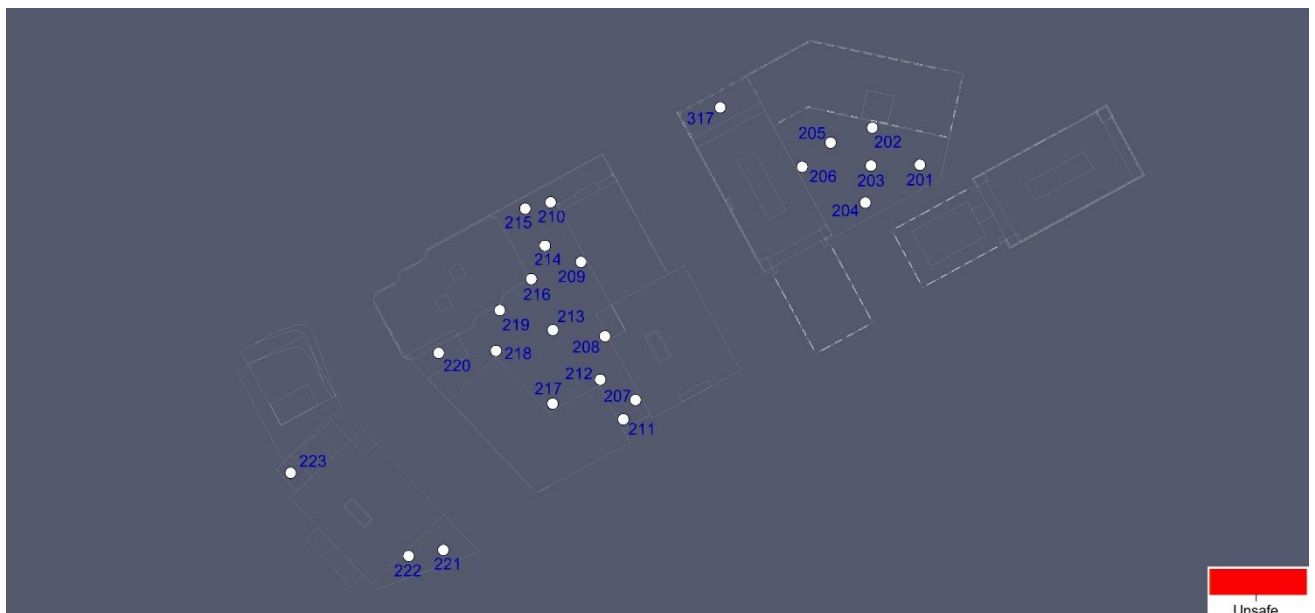


Figure 3-55 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

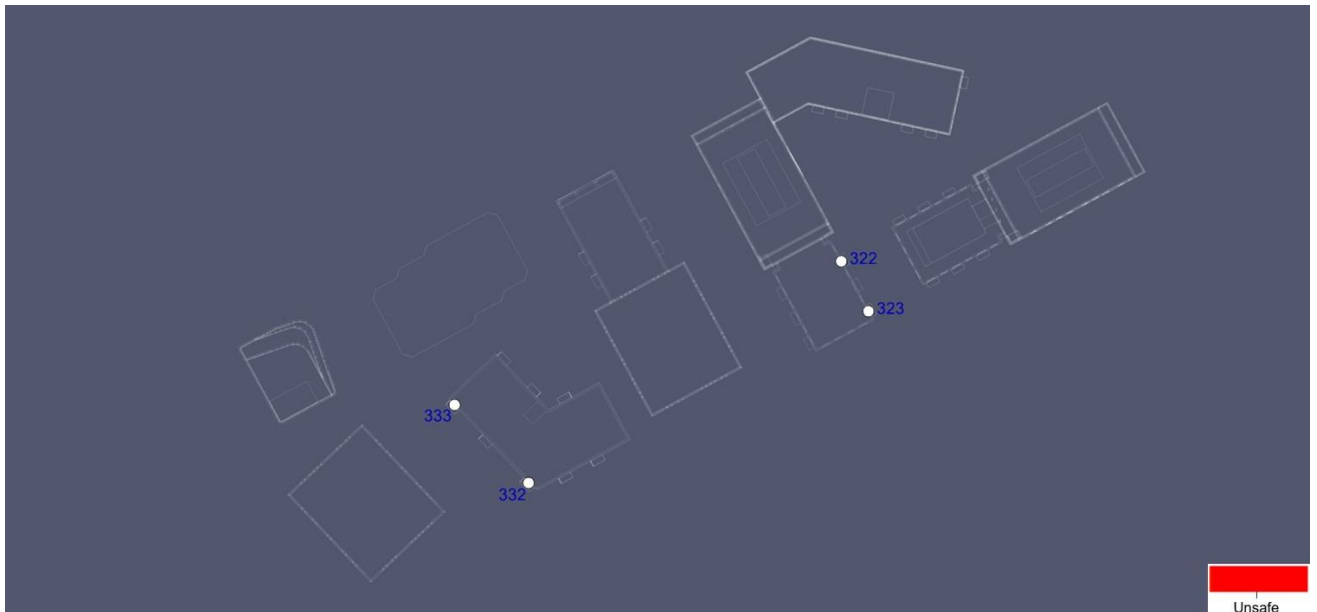


Figure 3-56 – Annual safety, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

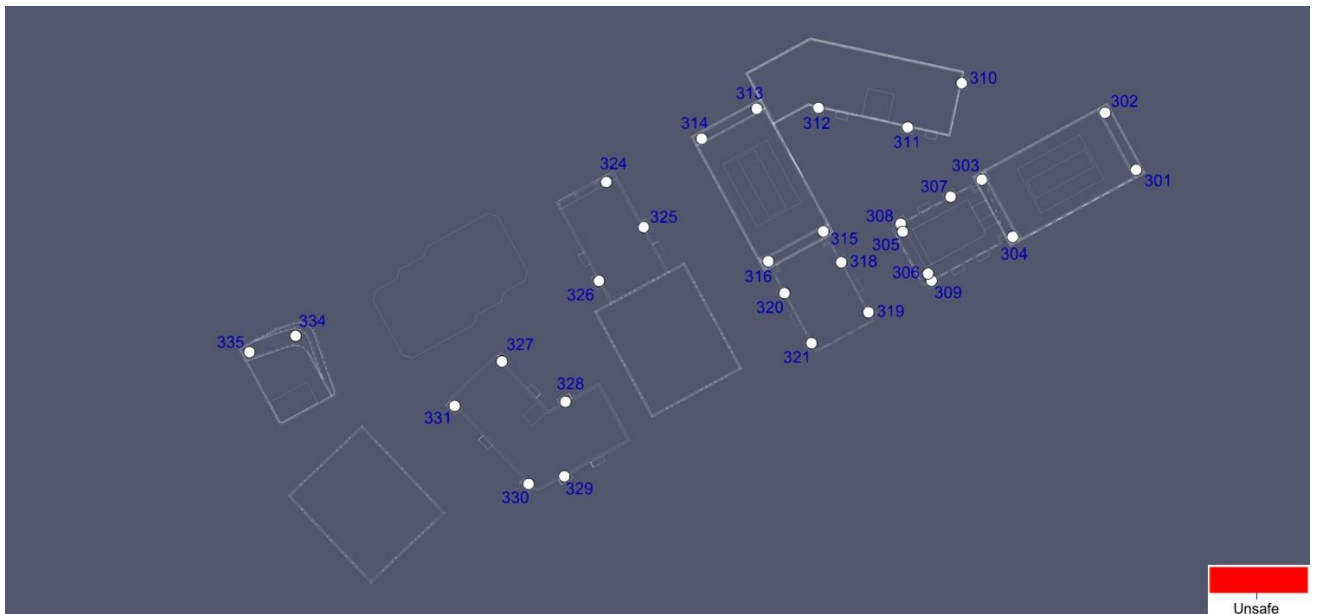


Figure 3-57 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

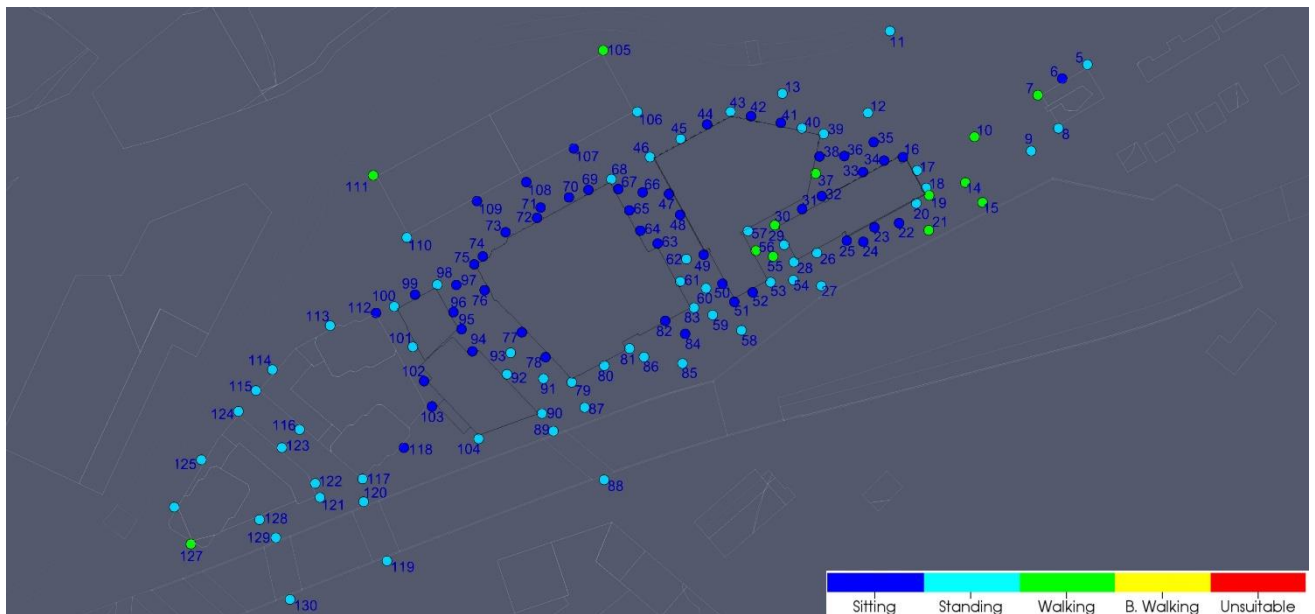


Figure 3-58 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

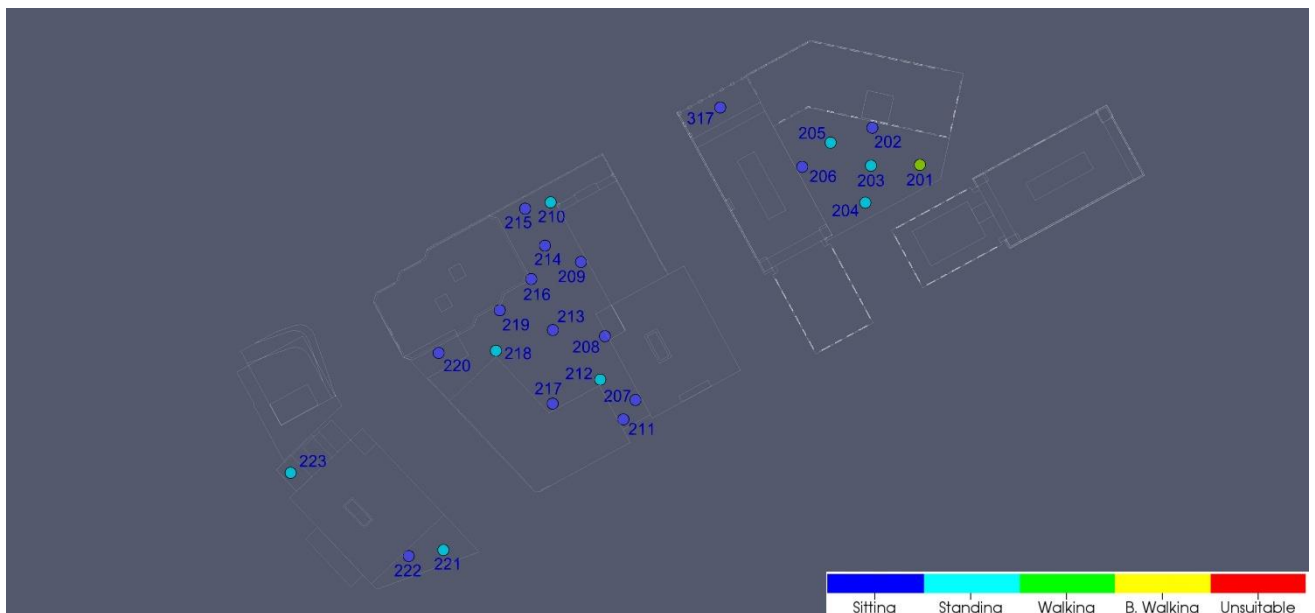


Figure 3-59 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

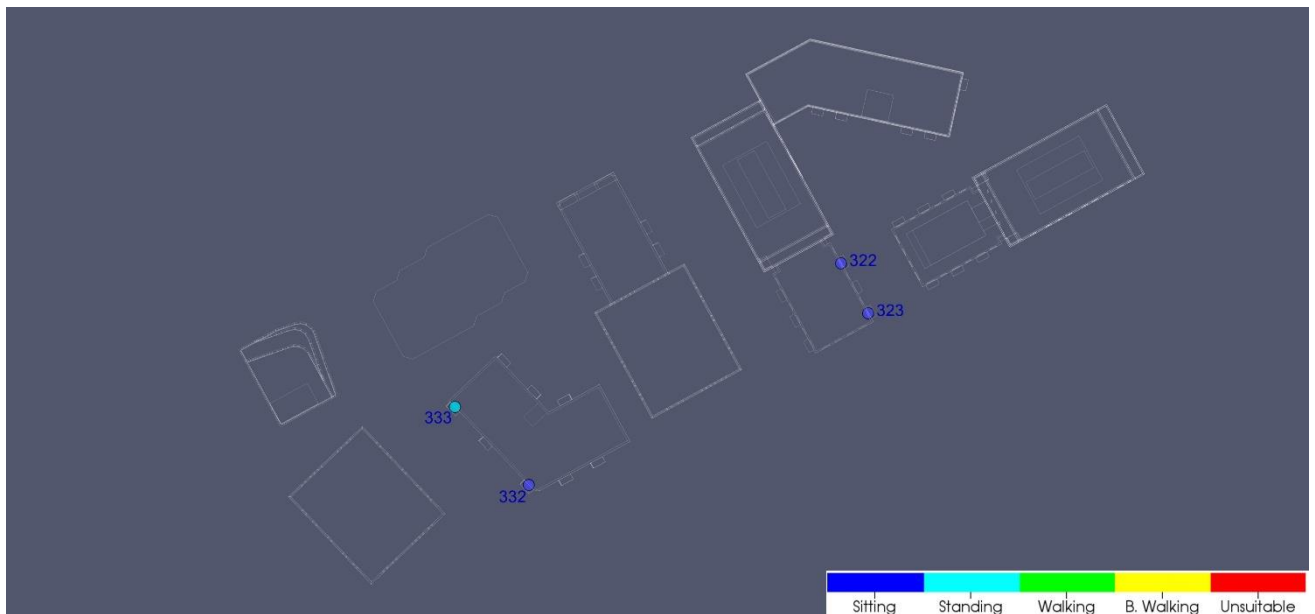


Figure 3-60 – Winter comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.

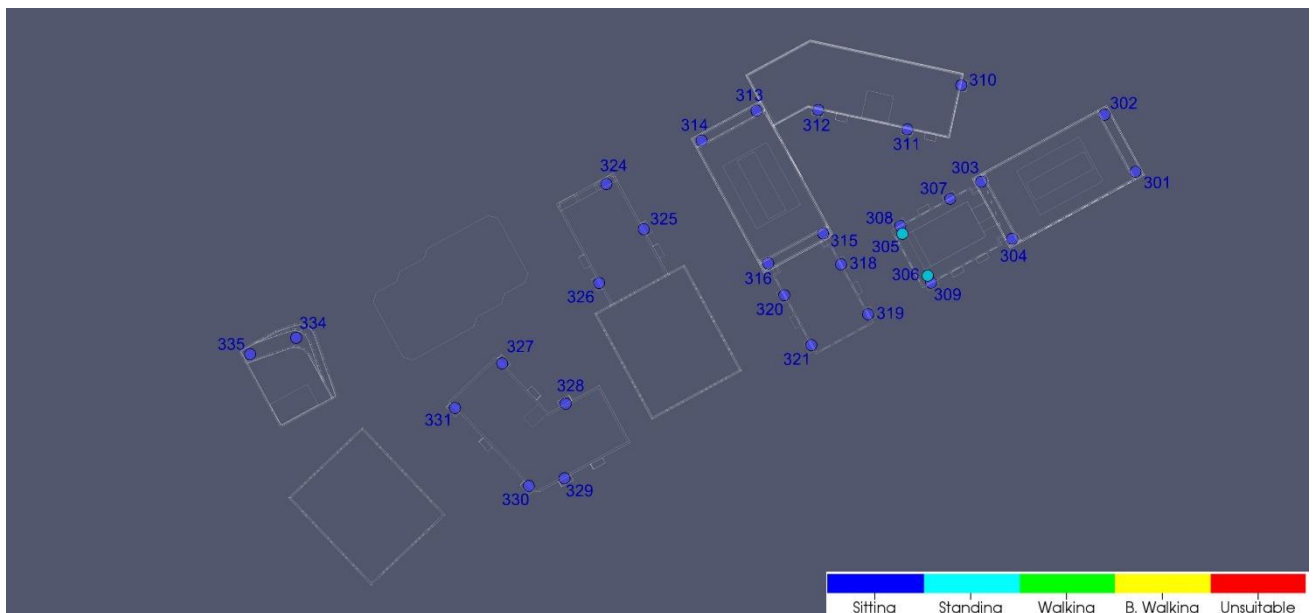


Figure 3-61 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, ground level .

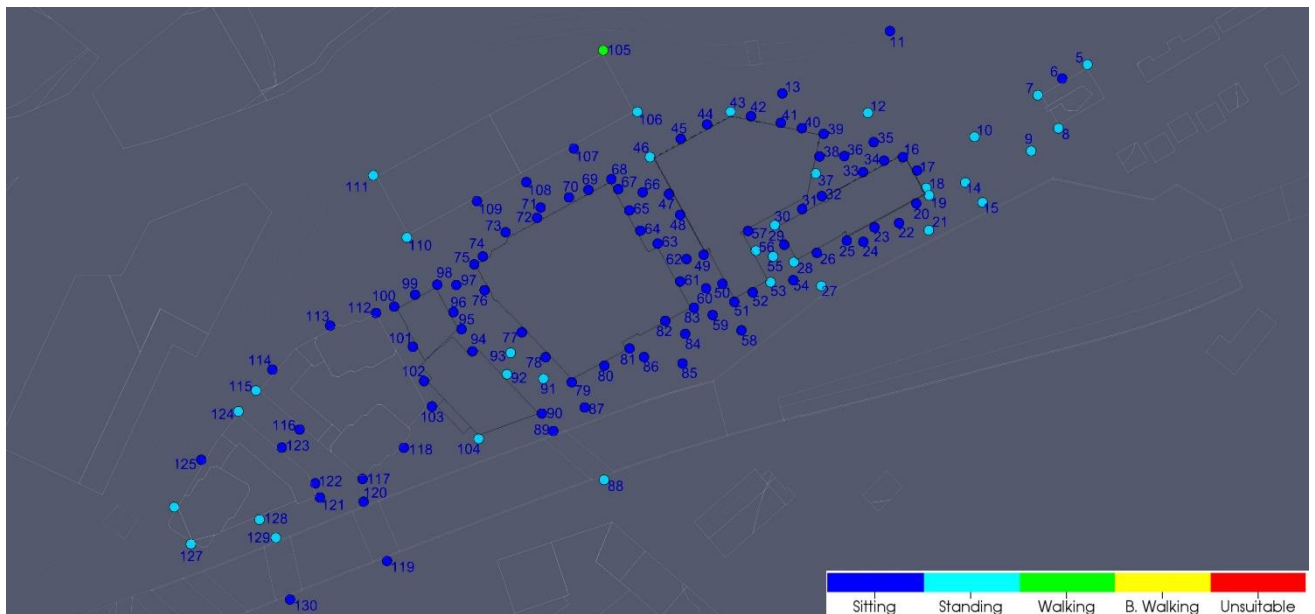


Figure 3-62 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, podium level.

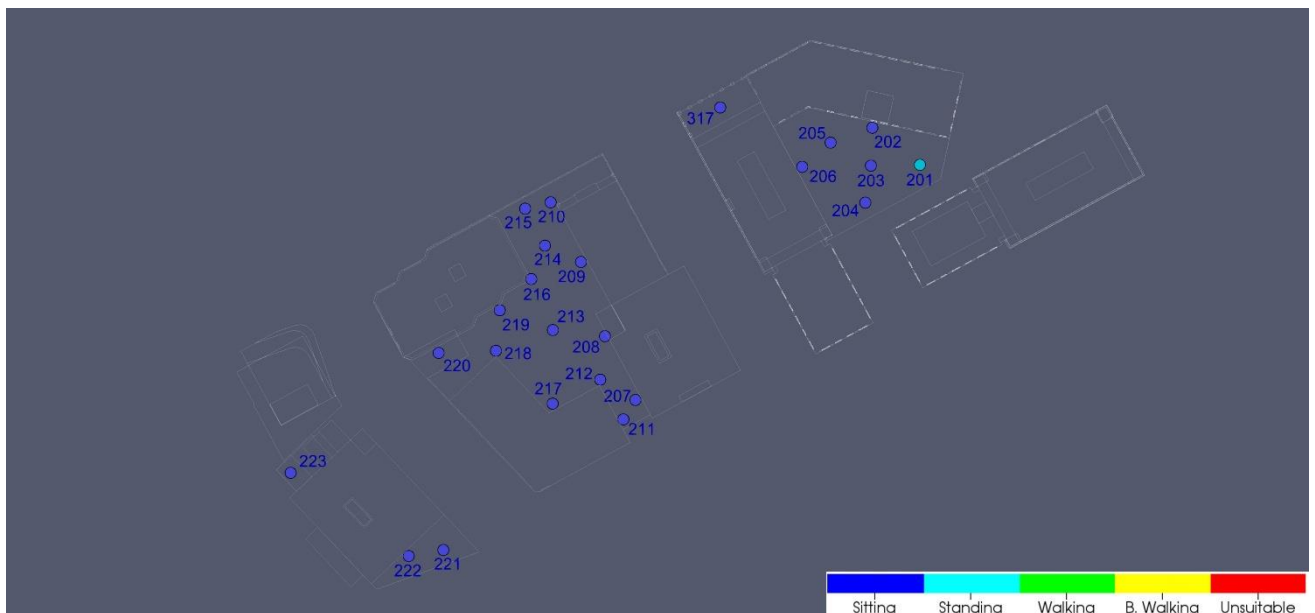


Figure 3-63 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, lower balconies.

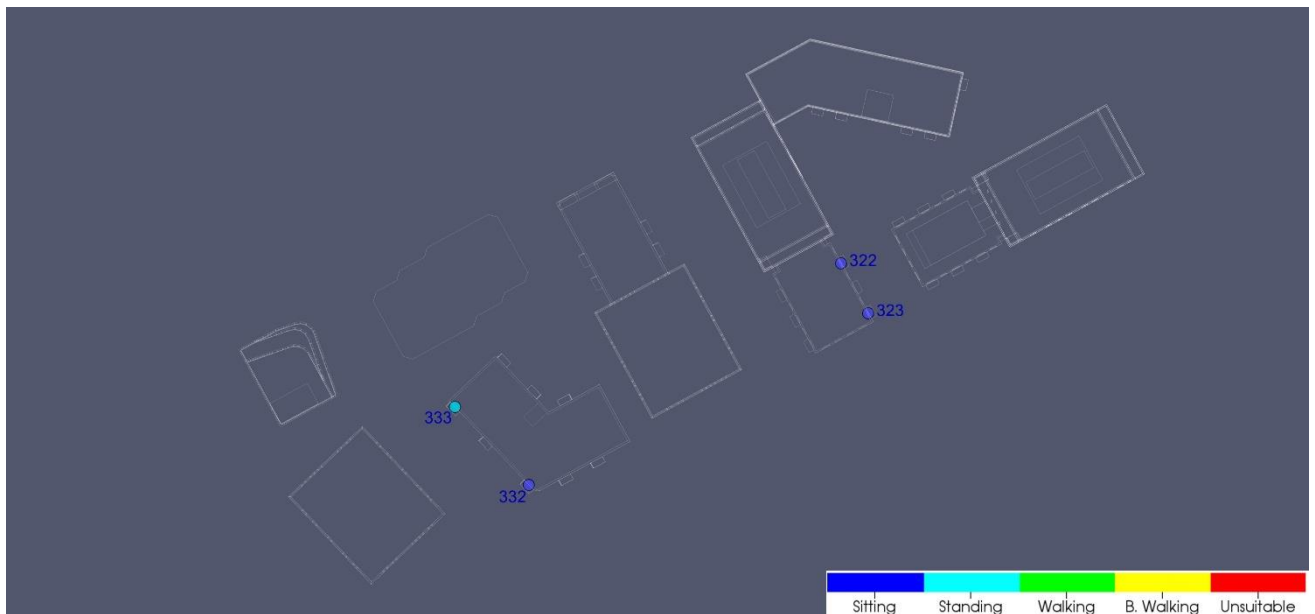
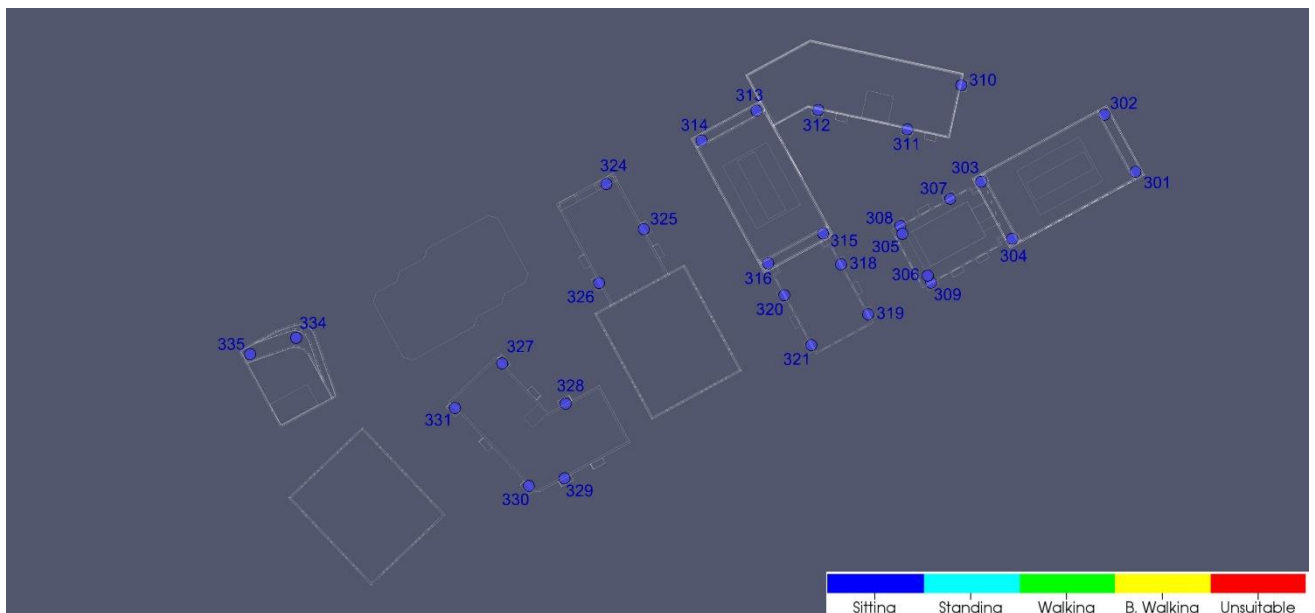


Figure 3-64 – Summer comfort, NT02-NT04 + OPA + Cumulative Surrounds + Landscaping Strategy + Wind Mitigation, upper balconies and terraces.



4 CONCLUSION

A wind microclimate study was conducted for the proposed Plots NT02-NT04 - Detailed (Application 5). The set of results presented within this document is solely based on experimental wind tunnel testing.

The main findings of the study are:

- In the baseline scenario, an inherent exceedance of the pedestrian *safety* criteria and a few exceedances of the pedestrian *comfort* criteria were identified, primarily within the site of the neighbouring Victoria Riverside scheme.
- With the introduction of the proposed Plots NT02-NT04 (all scenarios) in the absence of landscaping strategy and targeted mitigation measures, several exceedances of both the pedestrian *safety* and *comfort* criteria were observed. In general, the number of receptors featuring these exceedances decreased as the surrounding context progressively transitioned to a more built-up environment, i.e., introduction of cumulative schemes and the Red Bank Neighbourhood - Outline (Application 4). This is primarily attributed to the shielding effects provided by the massing and/or proximity of these schemes.
- With the introduction of the proposed landscaping strategy and the wind mitigation measures, all exceedances of the pedestrian *safety* and *comfort* criteria were resolved, except for two areas – northwest corner of the NT04 external amenity terrace (Receptor 305) and the lower balconies at the northwest corner of NT03 Midrise 3 (Receptor 333). Wind conditions at these receptors in summer are only rated as suitable for standing/short periods of sitting. Based on the minor extent of the respective exceedances and feedback from the design team on the nature of the expected recreational activities at these areas, the overall consideration is that the wind conditions at these receptors are acceptable for their intended uses.

REFERENCES

- [1] Eurocode 1 – Actions on Structures, Part 1-4: General Actions – Wind Actions (BS EN 1991-1-4:2005).
- [2] Lawson, T. V., "The determination of the wind environment of a building complex before construction". University of Bristol, Department of Aeronautical Engineering, 1990.
- [3] ESDU Item 82026, "Strong winds in the atmospheric boundary layer. Part 1: hourly-mean wind speeds". ESDU International, London, 2002.



WSP House
70 Chancery Lane
London
WC2A 1AF

wsp.com

PUBLIC