

Charlton Riverside
London, UK

Final Report

Pedestrian Level Wind Microclimate Assessment

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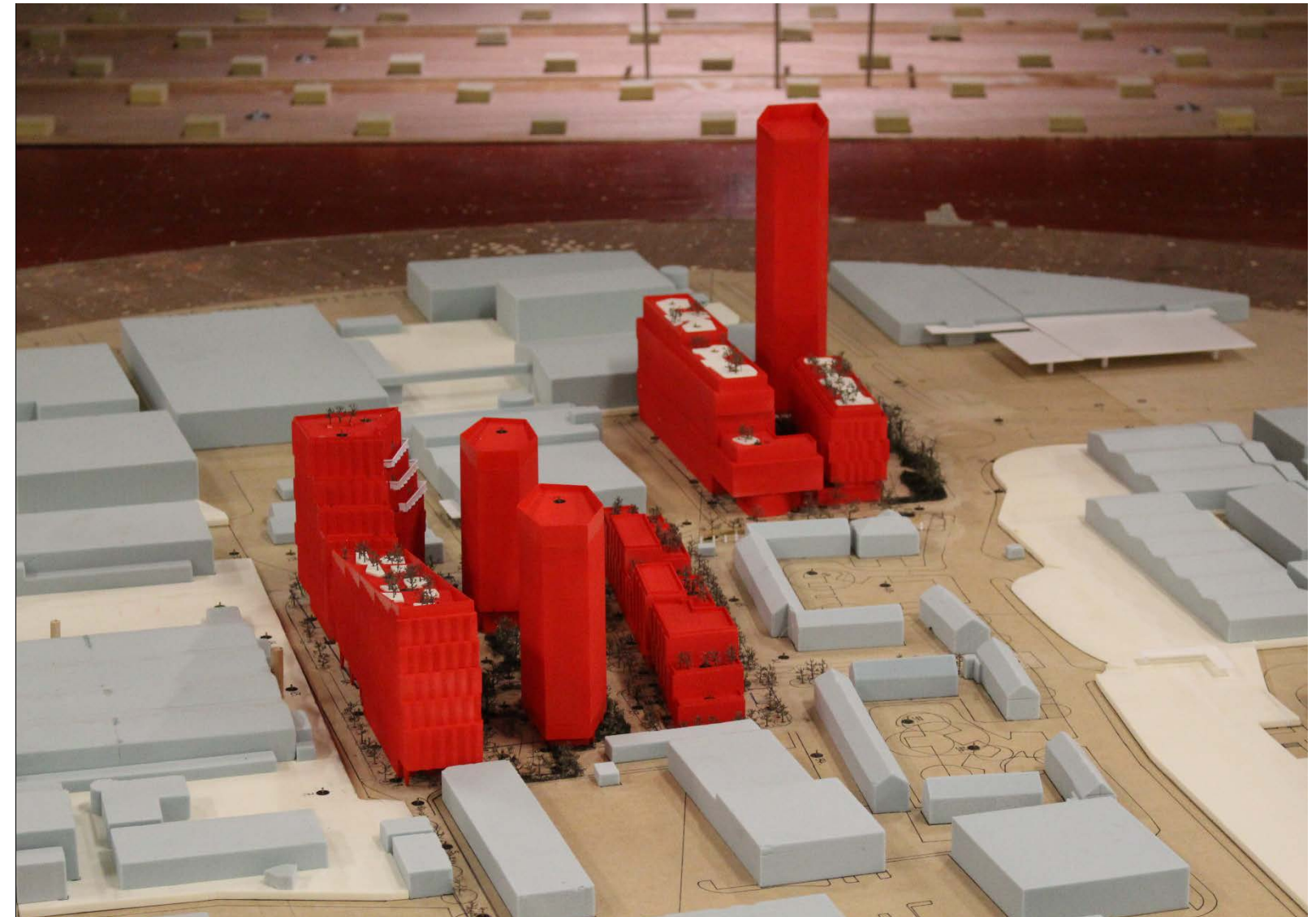
Rachel Naylor
Ramboll
240 Blackfriars Road
London SE1 8NW
United Kingdom

SUBMITTED BY

Jeniffer Lowther
Project Engineer
Jeniffer.Lowther@rwdi.com

Andy Gypps
Project Manager
Andy.Gypps@rwdi.com

Daniel Hackett
Senior Engineer
Daniel.Hackett@rwdi.com



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VERSION HISTORY

Index	Date	Pages	Author
A	November 25 th , 2016	All	J. Lowther

Checked by:

D. Hackett

OBJECTIVE

The objective of this study was to provide a ground, podium, terrace and balcony level wind microclimate assessment, based on a series of wind tunnel tests, for the proposed Charlton Riverside Development in London. This report presents a description of the methodology used and the results of three configurations tested in the wind tunnel, namely:

- Configuration 1: Existing building with existing surrounding buildings
- Configuration 2: Proposed Development with existing surrounding buildings;
- Configuration 3: Proposed Development with existing surrounding buildings and landscaping;

For each configuration the summer and winter seasons are assessed with landscaping modelled per season.

The results for Configurations 1 and 2 are based on the wind tunnel tests conducted on October 20th, 2016. The results for Configuration 3 are based on an iterative mitigation workshop held on October 27th, 2016, which developed a final mitigation scheme.

1. INTRODUCTION

Wind tunnel tests were conducted on a 1:300 scale model of the Charlton Riverside: Phase 1 Development (referred to as the 'Proposed Development' hereafter in this report) in the Royal Borough of Greenwich within the local area of New Charlton. The investigation quantifies the wind conditions within and around the site, by comparing the measured wind speed and frequency of occurrence with the well-established Lawson Comfort Criteria. Meteorological data for London has been analysed and adjusted to the site conditions by modelling the effect of terrain roughness on the wind speeds approaching the site.

Measurements were taken at up to 171 locations for 36 wind directions, in 10° increments. The measurements covered ground level locations along the building facades and at corners, near main entrances, within open amenity spaces and on pedestrian routes within and around the site. In addition, measurements at balconies and roof top terraces were taken. The report focuses on the windiest season results (typically winter) and those for the summer season, when pedestrian activity generally requires calmer conditions.

Three configurations of the wind tunnel model were tested, as follows:

- Configuration 1: Existing building with existing surrounding buildings
- Configuration 2: Proposed Development with existing surrounding buildings;
- Configuration 3: Proposed Development with existing surrounding buildings and landscaping

Results are presented in a series of 'dot-plots' which indicate the measured comfort criteria for the windiest and summer seasons for each configuration.

2. SITE DESCRIPTION

2.1 Site Location and Surroundings

The OS Landranger grid reference is TQ411789. The River Thames and existing industrial units form the northern boundary, and existing industrial units and Ropery Business Park bound the application site to the east. The A206 dual carriageway and Charlton Gate Business Park are located to the south and Anchor and Hope Lane along with adjacent residential properties forms the western boundary

The wider surrounding area is characterised predominantly by 'suburban' terrain. This results in a relatively turbulent wind environment with a lower mean wind speed (compared to an equivalent site in open terrain).

Figure 1 shows an aerial view of the site and surroundings (and a site plan of the development), with the approximate site location highlighted in yellow. The wind tunnel model is shown in Figure 2 and further photographs of the various test configurations are included in Appendix A.

2.2 The Existing Site

The Site is currently occupied predominantly by industrial warehouse and business park units. The wider area is characterised by existing warehouses and retail outlets that border the application site, with the exception of residential properties that bound the west.

2.3 The Proposed Development

The Proposed Development comprises of two plots (Plot A and Plot B) which have a variety of residential typologies (townhouses to high-rise apartments), with buildings ranging from 2 storeys to 28 storeys. In addition, there is a mix of public and private spaces at ground and roof levels.

The Proposed Development is expected to affect the wind microclimate on site, due to the addition of taller towers which are generally taller than the surrounding buildings, and will create downwashing winds at ground level. Also, the close proximity of the buildings to each other can cause channelling winds in some locations. The higher level amenity spaces may also experience windier conditions due to the lack of shelter from surrounding buildings.

2.4 Methodology and Assessment Criteria

Wind tunnel testing is the most well-established and robust means of assessing the pedestrian wind microclimate with the Proposed Development in place. It enables the wind conditions at the site to be quantified and classified in accordance with the widely accepted Lawson Comfort Criteria (which is referred to as the Criteria here-after).

To produce the results within the tunnel, a 1:300 scale model of the existing buildings at the site and the surrounding area within a 360 metre (m) radius of the centre of the site was constructed.

The basic methodology for quantifying the pedestrian level wind environment is outlined below:

- Measure the wind speeds at pedestrian level in the wind tunnel relative to a reference wind speed;
- Adjust standard meteorological data to account for conditions at the site;
- Combine these to obtain the expected frequency and magnitude of wind speeds at pedestrian level; and
- Compare the results with the Criteria to 'grade' conditions around the site.

2.5 Simulation of Atmospheric Winds

The wind is turbulent, or gusty, and this turbulence varies depending upon the site. It is necessary to reflect these differences in the wind tunnel test. In addition, the atmospheric boundary layer is a shear flow which means that the mean wind speed increases with height. Modelling these effects is achieved by a combination of spire and floor roughness elements to create a naturally-grown boundary layer that is representative of urban or open country conditions, as appropriate. The detailed contoured proximity model around the site is used to fine-tune the flow and create conditions similar to those expected at full scale (see Figure 2).

2.6 Measurement Technique

Wind speed measurements were made using Irwin probes. Both the mean wind speed and the peak wind speed are measured at selected locations at the Site and surrounding area to represent sensitive receptors, such as entrances, amenity areas and thoroughfares, at a scaled height of 2m above ground level. The typical equivalent full scale time period for measuring the mean wind speed is around 90 minutes, whereas the peak wind speed is taken as the wind speed exceeded for 1% of the time.

Wind speeds at each location were measured for 36 wind directions in 10° increments, with 0° representing a wind blowing from the north and 90° a wind blowing from the east.

2.7 Scaling

The length scale of the model was 1:300 and the velocity scale was approximately 1:2 for strong winds. Consequently the time scale for the tests was 1:150, or in other words 1 second in the wind tunnel is equivalent to 150 seconds at full scale.

2.8 Meteorological Data

Combined meteorological data derived from the meteorological stations of the major London airports (Heathrow, Gatwick and Stansted) were corrected to standard conditions of 10m above open flat level country terrain. The meteorological station data were then adjusted to the site conditions using the methodology implemented in the BREVe3 software package.

Approximately 30 years of meteorological data for London were used in this report and is presented in Appendix B as wind roses by season (refer to Figure 16 Appendix B) with the wind speed divided into Beaufort Force ranges (see Table 4, Appendix C). The radial axis indicates the cumulative number of hours per season that the wind speed exceeds the particular Beaufort Force. The seasons are defined as spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February).

The meteorological data indicate that the prevailing wind direction throughout the year is from the south-west. This is typical for many areas of southern England. There is a secondary peak from north-easterly winds, especially during the spring, and these tend to be cold winds.

The combination of meteorological data, site altitude and velocity ratios permits the percentage of time that wind speeds are exceeded at ground level on the site to be evaluated. The locations can then be assessed using the Criteria, as described below.

2.9 Pedestrian Comfort

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Criteria, which have been established for over thirty years and have been widely used on building developments across the United Kingdom. The Criteria, which seek to define the reaction of an average pedestrian to the wind, are described in Table 1 and illustrated in Figure 17 in Appendix C. If the measured wind conditions exceed the threshold, then they are unacceptable for the stated pedestrian activity and the expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria set out six pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The six categories are sitting, standing, entering/leaving a building, leisure walking, business walking and roadway/car-park, in ascending order of activity level. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past. The distinction between leisure walking and business walking is that in the business scenario, where pedestrians are on site because their livelihood depends upon it, they will be more tolerant of stronger winds.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is not part of the assessment.

The coloured key in Table 1 corresponds to the presentation of wind tunnel test results described in Section 4 of this report.

Table 1: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
●	Sitting	1% > B3	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
●	Standing/Entrance Use	6% > B3	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
●	Leisure Walking	4% > B4	Moderate breezes that would be appropriate for strolling along a city/town centre street, plaza or park
●	Business Walking	2% > B5	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
●	Roadway/Car-park	6% > B5	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

2.10 Strong Winds

Lawson¹ also specified a lower limit strong wind threshold when winds exceed Beaufort Force 6. Exceedance of this threshold may indicate a need for remedial measures or a careful assessment of the expected use of that location; e.g. is it reasonable to expect elderly or very young pedestrians to be present at the location on the windiest day of the year?

In the UK, stronger winds are associated with areas which would be classified as acceptable for business walking or roadway/car park use. In a mixed-use urban development scheme, business walking and roadway conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. This mitigation would also reduce the frequency of, or even eliminate, any strong winds.

For locations on a pedestrian thoroughfare, where the wind speed occasionally exceeds Beaufort Force 6, the wind is unlikely to generate nuisance to pedestrians. However, it is expected that pedestrians may experience difficulty in walking when the wind speed exceeds Beaufort Force 7 or 8.

If the wind speed exceeds the Beaufort Force 6 wind speed threshold (see Table 4, Appendix C) in a proposed external seating area or outside an entrance, the conditions are considered a safety concern and would require mitigation. However, in such a case the area would be likely to be classified as acceptable for leisure walking, business walking or roadway use and so would require mitigation to satisfy the Criteria in any case.

It is RWDI's practice to report incidences when the Beaufort Force 6, Beaufort Force 7 and Beaufort Force 8 thresholds are exceeded for more than 1 hour per annum. The results for this study are presented in Table 3, which also shows the wind direction that contributes most to the strong winds.

¹ Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

3. RESULTS

3.1 Details of the Analysis

To account for the difference in height and terrain roughness between meteorological conditions at the airports and the site, it was necessary to apply adjustment factors to the wind tunnel velocity ratios. Adjustment factors (mean factors) were computed for wind directions from 0° through to 360°. The reference height in the wind tunnel was at the equivalent full-scale height of 120 metres. Table 2 presents the mean factors for the site.

Table 2: BREVe3 mean factors at 120m above ground level

Wind Direction	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Mean Factor at 120m	1.40	1.44	1.51	1.44	1.37	1.37	1.43	1.41	1.38	1.35	1.38	1.36

3.2 Desired Pedestrian Activity around the (Amended) Proposed Development

Generally, for a mixed-use development, the target conditions are:

- Leisure walking during the windiest season on pedestrian thoroughfares;
- Standing/entrance conditions at main entrances, drop off areas or taxi ranks, and bus stops throughout the year; and
- Sitting conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians.

The business walking and roadway classifications are usually avoided because of their association with occasional strong winds, unless they are on a minor pedestrian route or a route where pedestrian access could be controlled in the event of strong winds.

Achieving a sitting classification in the summer usually means that a standing/entrance classification for the same receptor would be acceptable in the windiest season because winds are stronger at this time. This would be considered an acceptable occurrence for the majority of external amenity spaces because other factors such as air temperature and precipitation influence people's perceptions about the 'need' to use seating in the middle of winter.

3.3 Performance against the Criteria

The wind microclimate within and around the site has been assessed and classified using the Criteria as defined in Table 1. The results of the assessment for each configuration are described below and presented graphically in Figures 3 to 12.

3.3.1 Configuration 1: Existing building with existing surrounding buildings

Figures 3 and 4 show the windiest season results and summer season results respectively for the existing building with existing surrounding buildings.

3.3.2 Configuration 2: Proposed Development with existing surrounding buildings

Figures 5 and 6 show the windiest season results at ground and balcony/terrace levels respectively for the Proposed Development with existing surrounding buildings. Figures 7 and 8 show the summer season results at ground level and balcony/terrace levels respectively for the Proposed Development with existing surrounding buildings.

3.3.3 Configuration 3: Proposed Development with existing surrounding buildings and landscaping

Figures 9 and 10 show the windiest season results at ground and balcony/terrace levels respectively for the Proposed Development with existing surrounding buildings and landscaping. Figures 11 and 12 present the summer season results at ground and balcony/terrace levels respectively for the same configuration.

It should be noted that no cumulative buildings were proposed within the test radius at the time of testing. The effect of the cumulative buildings outside this radius would contribute to the background turbulence and approaching wind speed, which is modelled in the terrain analysis. Therefore, there was no additional test with cumulative surrounding buildings.

3.4 Occurrence of Strong Winds

Areas with occasional strong winds exceeding Beaufort Force 6 are listed in Table 3 together with the primary wind direction and the number of hours per annum for which the threshold wind speed is exceeded.

Table 3: Annual Exceedance of Strong Winds

Location	Beaufort Force Exceedance	Wind Direction	Hours per Annum
Configuration 1: Proposed Development with existing surrounding buildings			
No string winds exceeding Beaufort Force 6 for over 1 hour per annum.			
Configuration 2: Proposed Development with existing surrounding buildings			
13	B6	230	3.3
21	B6	250	2.9
57	B6	230	3.1
69	B6	190	5
71	B6	60	1.7
81	B6	240	1.4
88	B7	250	2.5
89	B6	240	2.5
93	B6	280	5.3
97	B6	180	2.2
120	B7	230	2.5
121	B6	230	4.1
122	B6	240	1.1

Location	Beaufort Force Exceedance	Wind Direction	Hours per Annum
127	B6	230	2.2
132	B7	220	1.3
133	B6	80	1
134	B6	280	2.2
136	B6	220	1.1
Configuration 3: Proposed Development with existing surrounding buildings and landscaping			
57	B6	230	4.1
89	B6	230	5
93	B6	290	3.8
97	B6	190	2.4
120	B6	240	1.2
167	B6	230	5

4. DISCUSSION

This section discusses the results of the wind tunnel tests and the resulting impact on the use of the site.

4.1 Configuration 1: Existing building with existing surrounding buildings

4.1.1 Pedestrian Comfort

The discussion of the wind microclimate in Configuration 1 is based on the results shown in Figures 3 and 4 for the windiest season and summer season respectively.

Thoroughfares

During the windiest season conditions within and around the Site are predominantly suitable for standing or sitting, as shown in Figure 3. However, conditions classified as acceptable for leisure walking use occur in more exposed areas at receptors 44, 102, 107, 109, 110 and 120.

The summer season results show that all receptors would be classified as suitable for standing or sitting use, as shown in Figure 4.

4.1.2 Strong Winds

There were no occurrences of strong winds in excess of Beaufort Force 6 recorded for over 1 hour per annum.

4.2 Configuration 2: Proposed Development with existing surrounding buildings

4.2.1 Pedestrian Comfort

The discussion of the wind microclimate in Configuration 2 is based on the results shown in Figures 5 and 6 for the windiest season for ground/podium level and balcony/terrace levels respectively, with Figures 7 and 8 showing the summer season results for ground/podium level and balcony/terrace levels respectively.

The wind conditions were found to be generally windier with the Proposed Development. The changes in wind conditions were generally due a combination of the additional massing causing channelling winds, the taller towers creating downwashing at ground level, and localised windy areas at building corners.

Thoroughfares

Wind conditions at thoroughfares were generally suitable for standing to leisure walking use during the windiest season. The only exception to this was at probe location 120, at the north west corner of Plot B, which had wind conditions suitable for business walking use. The windier conditions were caused by the predominant south westerly winds accelerating around the north west corner of Plot B, resulting in a localised windy area.

Entrances

Entrance locations were generally suitable for sitting use to standing/entrance use during the windiest season. There were two exceptions to this, at probe location 21 at the southern entrance of Pavilion 1, and probe location 88 at the northern entrance of Pavilion 2 (both in Plot A), which both had wind conditions suitable for leisure walking use. This is one category windier than required for entrance locations and therefore would require mitigation.

Probe location 21 had windier conditions due to several wind effects. Firstly, down washing winds were created when the predominant south westerly winds hit the southern tall façade and accelerate down to ground level creating a locally windy area. In addition, winds which were channelled between the Pavilions create windier conditions at this part of the Site, and were further accelerated by the southern building corner where the entrance is located.

The unsuitable conditions at probe location 88 were due to predominant south westerly winds accelerating around the north west corner, creating a localised windy area at the entrance. This is one category windier than required for entrance locations and therefore would require mitigation.

Ground Level Amenity Spaces

Figure 7 shows the wind conditions for the summer season at ground level. Plot A probe locations 13 and 78 had standing/entrance use wind conditions during the summer season and therefore these locations would require mitigation. Probe location 81 also had standing/entrance use conditions during the summer season, however as this is to be used as a sports area this is considered acceptable for a more active amenity space.

Plot B probe locations 117 and 119 in the outdoor café area also had wind conditions suitable for standing/entrance use during the summer season, which is one category windier than desired and therefore would require mitigation.

All other ground floor amenity areas on Site recorded wind conditions suitable for sitting use. Offsite, the gardens situated in Atlas Gardens and Derrick Gardens had wind conditions suitable for sitting use and are therefore also suitable for their intended use.

Podium Terrace

Figure 7 shows the wind conditions at podium level for the summer season in Configuration 2, where wind conditions were generally too windy for the intended use.

Channelling of winds occurred between the towers on Plot B and the building to the north, where the predominant south westerly winds were forced between the two buildings, leading to an acceleration across the podium area. In addition, the pressure difference between the south west and north east of Plot B creates a suction effect, which drove the wind through the podium space. North easterly winds during the spring and summer months also created adverse wind effects, where downwashing winds on the northern façade create a windier area at ground level.

Probe location 129 recorded wind conditions suitable for standing use during the summer season and is therefore suitable for the intended use.

Probe locations 130, 131, 133 and 134 had wind conditions suitable for standing/entrance use, and probe locations 132 had leisure walking conditions, which were up to two categories windier than required. Therefore, mitigation measures would be required at these locations.

Balcony Levels

Figure 8 shows the wind conditions at balcony level for the summer season for Configuration 2. Balcony locations 152-155 recorded sitting use conditions during the summer season and are therefore suitable for the intended use.

Probe locations 156 and 157 had wind conditions suitable for standing/entrance use which is one category windier than required for balcony spaces. The windier conditions are caused by the predominant south westerly winds accelerating around Pavilion 2 and reaching the west facing balconies, which do not receive enough shelter from the low balustrades.

Roof Terraces

Figure 8 shows the wind conditions at the rooftop terraces for the summer season. Plot A rooftop terraces generally recorded sitting use wind conditions during the summer season. The exception to this was at probe 166, located at the southern section of Pavilion 2, which had standing/entrance conditions during the summer season. This was due to this area of the terrace being relatively unsheltered from oncoming winds, with the lower balustrade also being at this side of the terrace. This location would require mitigation, should this space be intended as a seating area.

Plot B rooftop terraces mostly had standing/entrance use conditions, specifically at probe locations 135-138, 141 and 142 during the summer season, which is one category windier than desired for amenity use and would require mitigation.

4.2.2 Strong Winds

Strong winds in excess of Beaufort Force 7 occurred at receptors 88, 120 and 132 for up to 2.5 hours per annum. Strong winds of this magnitude are considered a safety concern and therefore these locations would require mitigation.

Strong winds in excess of Beaufort Force 6 occurred at receptors 13, 21, 57, 69, 71, 81, 89, 97, 121, 122, 133, 134 and 136, for up to 5.0 hours per annum. As receptors 21 and 71 are situated at building entrances, the occurrence of strong winds in excess of Beaufort Force 6 at these locations would be considered an issue.

As receptors 57, 69, 89, 97, 121, 122, are situated on thoroughfares, the exceedance of Beaufort Force 6 would be unlikely to cause nuisance. Receptors 13, 81, 133, 134, 136 are located in amenity areas, where strong winds would be more likely to occur during the windiest season (winter) in which the areas would be less frequently used, and would therefore be unlikely to cause a nuisance.

4.3 Configuration 3: Proposed Development with existing surrounding buildings and landscaping

4.3.1 Pedestrian Comfort

The discussion of the wind microclimate in Configuration 3 is based on the results shown in Figures 9 and 10 for the windiest season for ground/podium level and balcony/terrace levels respectively, with Figures 11 and 12 showing the summer season results for ground/podium level and balcony/terrace levels respectively.

Mitigation measures were tested during a mitigation workshop using an iterative test procedure. This began with the proposed landscaping scheme and additions were made (see appendix D). The landscaping consists of a proposed landscaping scheme (received October 26th, 2016) and the following additional features:

- A recessed entrance at location 88 by at least 1.5m
- 1m high shrubbery by the activity play area (near location 79);
- Small shrubs of 0.5m to 1m south of the outdoor seating area at location 13;
- Small shrubs of 0.5m to 1m west of the outdoor seating area at location 78;
- 2-3m trees at the river bed near the volleyball court (by location 61);
- No seating to be located at location 78;
- 1.5m solid balustrades on the balconies at locations 155 to 157;
- Planters and 1m high soft landscaping throughout the rooftop terrace at Building B2;
- Seating areas restricted to the northern section of the rooftop terrace at Building B2 (around location 163);
- 2m-3m deciduous trees on the Plot B podium;
- No seating areas are to be situated at locations 131 to 134 on the Plot B podium.

These mitigation measures are illustrated in Appendix D.

It should be noted that the existing 17m deciduous trees to the west of Plot B were included in testing, and were particularly beneficial in mitigating the wind conditions at Plot B.

The results with the final landscaping scheme show the same or calmer wind conditions throughout the Site in comparison to Configuration 2 (with no landscaping). The wind conditions were suitable for the intended use with the proposed mitigation measures included. The addition of soft landscaping diffused strong winds and provided shelter by taking the energy out of the wind; thereby reducing the wind speed. Additional localised shelter was provided by recessing entrances or increasing balustrades, to provide calm areas where needed.

Thoroughfares

Figure 9 shows the wind conditions at ground level for the windiest season in Configuration 3. Wind conditions at thoroughfares were generally suitable for standing to leisure walking use during the windiest season. The business walking wind conditions at probe location 120 in Configuration 2 were mitigated by the existing trees to the west as well as 1m shrubs lining the western boundary. Smaller 2m-3m trees along the western façade of Plot B also diffused winds at this area of the Site.

All thoroughfares had wind conditions suitable for the intended use and therefore no further mitigation is required.

Entrances

Figure 9 shows the wind conditions at ground level for the windiest season in Configuration 3. Entrance locations were generally suitable for sitting use to standing/entrance use during the windiest season.

Probe location 21, which had leisure walking conditions in Configuration 2, was mitigated by the additional 1m shrubs to the west and scattered trees of 4m-8m to the west and south west (see Appendix D). The additional soft landscaping diffused the predominant south westerly winds, creating a calmer environment suitable for sitting use during the windiest season.

Probe location 88 also had leisure walking conditions in Configuration 2; however, due to the mitigation measures in Configuration 3 it had wind conditions suitable for sitting use during the windiest season. The entrance has a localised area of shelter due to the 1.5m recess included in the mitigation measures.

As all entrances had wind conditions either suitable for the intended use or calmer and no further mitigation would therefore be required.

Ground Level Amenity Spaces

Figure 11 shows the wind conditions for the summer season at ground level. Amenity spaces at ground level had wind conditions suitable for either sitting use or standing/entrance use. The locations suitable for standing/entrance are to be used as an active amenity space, specifically probe location 60 which is a sports area. All other amenity locations at ground level were suitable for sitting use and therefore could be used as open seating areas.

Plot A probe location 13 had wind conditions one category calmer than Configuration 2, and was suitable for sitting use during the summer season. The calmer conditions were due to the addition of 3m-6m trees scattered around the border and throughout the seating area (please refer to Appendix D).

Probe location 78 had wind conditions suitable for standing/entrance use during the summer season with the inclusion of the final landscaping scheme, and therefore should not be used as a seating area. However, this area could be used as a more active amenity space, such as a play area or sports area.

Plot B probe locations 117 and 119 in the outdoor café area also had wind conditions one category calmer than Configuration 2, suitable for sitting use and therefore would be suitable for an outdoor seating space.

As all amenity spaces were suitable for the intended use no further mitigation is required.

Podium Terrace

Figure 11 shows the wind conditions at podium level for the summer season in Configuration 3, where wind conditions range from suitable for sitting use to standing/entrance use.

Although the inclusion of trees and planters were beneficial to the wind microclimate at the podium level and created a calmer environment, the wind effects throughout the podium area were too strong to mitigate the entire area to be suitable for sitting use. Therefore, locations 131 to 134 should not be used as a seating area; however the rest of the podium space had sitting use wind conditions and could be used for outdoor seating.

Should there be a wish to place outdoor seating between the tower and the northern building (probe location 131 to 134), the addition of localised canopies and 1.5m-2m shrubs could be used to reduce the down washing winds, creating a localised sheltered area which would be suitable for sitting use. This method was tested as part of the mitigation workshop but not incorporated into the final landscaping scheme (see Appendix E).

As all locations would be suitable for the intended use, no further mitigation measures would be required.

Balcony Levels

Figure 12 shows the wind conditions at balcony level for the summer season for Configuration 3, which are all suitable for sitting use.

Probe locations 156 and 157 had wind conditions one category calmer than Configuration 2 as the balustrades were raised to 1.5m (from 1.1m). This created additional shelter throughout the area.

All balcony locations are suitable for the intended use and therefore no further mitigation is required.

Roof Terraces

Figure 12 shows the wind conditions at the rooftop terraces for the summer season for Configuration 3. Wind conditions ranged from suitable for sitting use to suitable for standing entrance use during the summer season. A mixture of sitting and standing/entrance use conditions is considered acceptable in larger amenity spaces on condition that seating should be only located in the calmer areas (suitable for sitting use). As the standing/entrance use wind conditions were located in areas where seating would be restricted (probe locations 137, 142, 166 and 168), these wind conditions would be suitable for the intended use. Therefore, no further mitigation measures would be required.

4.3.2 Strong Winds

There was a reduction in strong winds in Configuration 3 in comparison to Configuration 2. No strong winds in excess of Beaufort Force 7 occurred for over one hour per annum in Configuration 3.

Strong winds in excess of Beaufort Force 6 occurred at receptors 57, 89, 93, 97, 120, and 167 for up to 5.0 hours per annum. Probe locations 120, and 167 occur at amenity spaces, where the strong winds would be likely to occur during the windiest season (winter) when the space would not be frequently in use. Probe locations 57, 89, 93, 97 and 120 are thoroughfares where strong winds of this magnitude would not be expected to cause a significant nuisance to pedestrians. Therefore, no further mitigation would be required at these locations

5. CONCLUSION

In conclusion:

1. The meteorological data for the site indicate prevailing winds from the southwest quadrant throughout the year with secondary winds from the north-easterly direction, particularly during spring.
2. The Baseline scenario (Configuration 1) is acceptable for sitting to leisure walking use, typical of a predominantly mid-high rise urban area such as London where the sheltered conditions are in areas of medium and low-rise buildings.
3. The addition of the Proposed Development, with no landscaping (Configuration 2), would create a windier environment due to several wind effects throughout the site, and would be acceptable for sitting to business walking use during the windiest season. Without landscaping the majority of the Site would be acceptable for its intended use except several localised areas which would require the mitigation measures provided by the landscaping scheme.
4. At ground level in Configuration 2, location 120 had business walking conditions, one category windier than desired for thoroughfare use, requiring mitigation measures.
5. In Configuration 2 entrance locations were generally acceptable for sitting or standing entrance use, with the exception of probe locations 21 and 88, which were one category windier than desired and suitable for leisure walking use. Therefore, mitigation would be required at these locations.
6. Ground floor amenity spaces were generally suitable for sitting use, however four locations experienced adverse wind conditions without landscaping. Probe locations 13 and 78 in Plot A and 117 and 119 in Plot B were also too windy for the intended use (having standing/entrance use conditions during the summer season). These locations also required mitigations measures.
7. Podium locations 131 to 134 on the podium had wind conditions suitable for standing/entrance or leisure walking use during the summer season in Configuration 2 and would therefore be unsuitable for amenity use.
8. The balconies at locations 156 and 157 also had conditions windier than desired during the summer season in Configuration 2, however all other balconies had wind conditions suitable for intended use.
9. In Configuration 2, plot B rooftop terrace locations (with the exception of probes 139 and 140) had wind conditions suitable for standing/entrance use, one category windier than desired and requiring mitigation.
10. Configuration 3 tested the Proposed Development with existing surrounding buildings and the final landscaping scheme. The results showed that the wind condition were considerably calmer and all locations were suitable for the intended use with the final landscaping scheme.
11. The landscaping scheme, developed during a mitigation workshop, consists of proposed landscaping scheme (received October 26th, 2016) and the following additional features:
 - o A recessed entrance at location 88 by at least 1.5m
 - o 1m high shrubbery by the activity play area (near location 79);
 - o Small shrubs of 0.5m to 1m south of the outdoor seating area at location 13;
 - o Small shrubs of 0.5m to 1m west of the outdoor seating area at location 78;
 - o 2-3m trees at the river bed near the volleyball court (by location 61);
 - o No seating is to be located at location 78;

- 1.5m solid balustrades on the balconies at locations 155 to 157;
 - Planters and 1m high soft landscaping throughout the rooftop terrace at Building B2;
 - Seating areas restricted to the northern section of the rooftop terrace at Building B2 (around location 163);
 - 2m-3m deciduous trees on the Plot B podium;
 - Seating areas are not to be situated at locations 131 to 134 on the Plot B podium.
 - These mitigation measures are illustrated in Appendix D.
12. The existing trees to the west of Plot B on Anchor and Hope Lane have also been included as part of the assessment and should be considered as part of the final landscaping scheme.
13. With the measures developed through the mitigation workshop, a suitable wind environment would be provided for pedestrians/occupants. With the relevant design features implemented wind conditions throughout the Site would be suitable for the intended use.

FIGURES



Figure 1: Aerial Photograph of the Existing Site (Site highlighted in yellow)

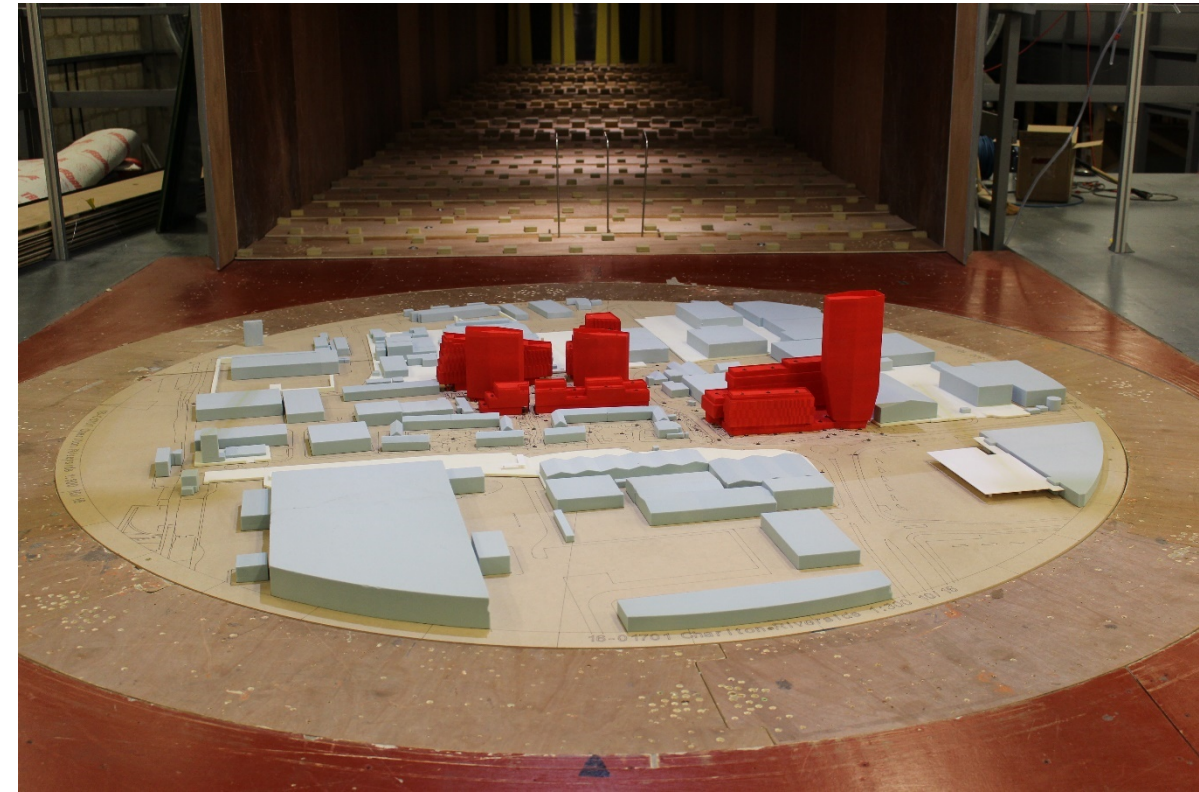


Figure 2: Image of the Proposed Development with existing Surroundings and no landscapang in the Wind Tunnel (view from west)



LEGEND:

LAWSON COMFORT CRITERIA:

- Sitting
- Standing/Entrance
- Leisure Walking
- Business Walking
- Carpark/Roadway

SENSOR LOCATION:

- Grade Level

Pedestrian Wind Comfort Conditions - Configuration 1: Existing building with existing surrounding buildings – no landscaping

Windiest Season

Charlton Riverside, London (U.K.)



Drawn by: CAX | Figure: 3
 Approx. Scale: 1:1500
 Date Revised: Oct. 21, 2016



Project #1601701



LEGEND:

LAWSON COMFORT CRITERIA:

- Sitting
- Standing/Entrance
- Leisure Walking
- Business Walking
- Carpark/Roadway

SENSOR LOCATION:

- Grade Level

Pedestrian Wind Comfort Conditions - Configuration 1: Existing building with existing surrounding buildings – no landscaping

Summer Season

Charlton Riverside, London (U.K.)

True North

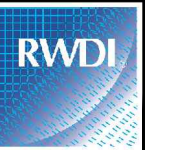


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Approx. Scale: 1:1500

Date Revised: Oct. 21, 2016

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GROUND FLOOR

0 30 60m



Pedestrian Wind Comfort Conditions - Configuration 2: Proposed Development with existing surrounding buildings - no landscaping

Windiest Season

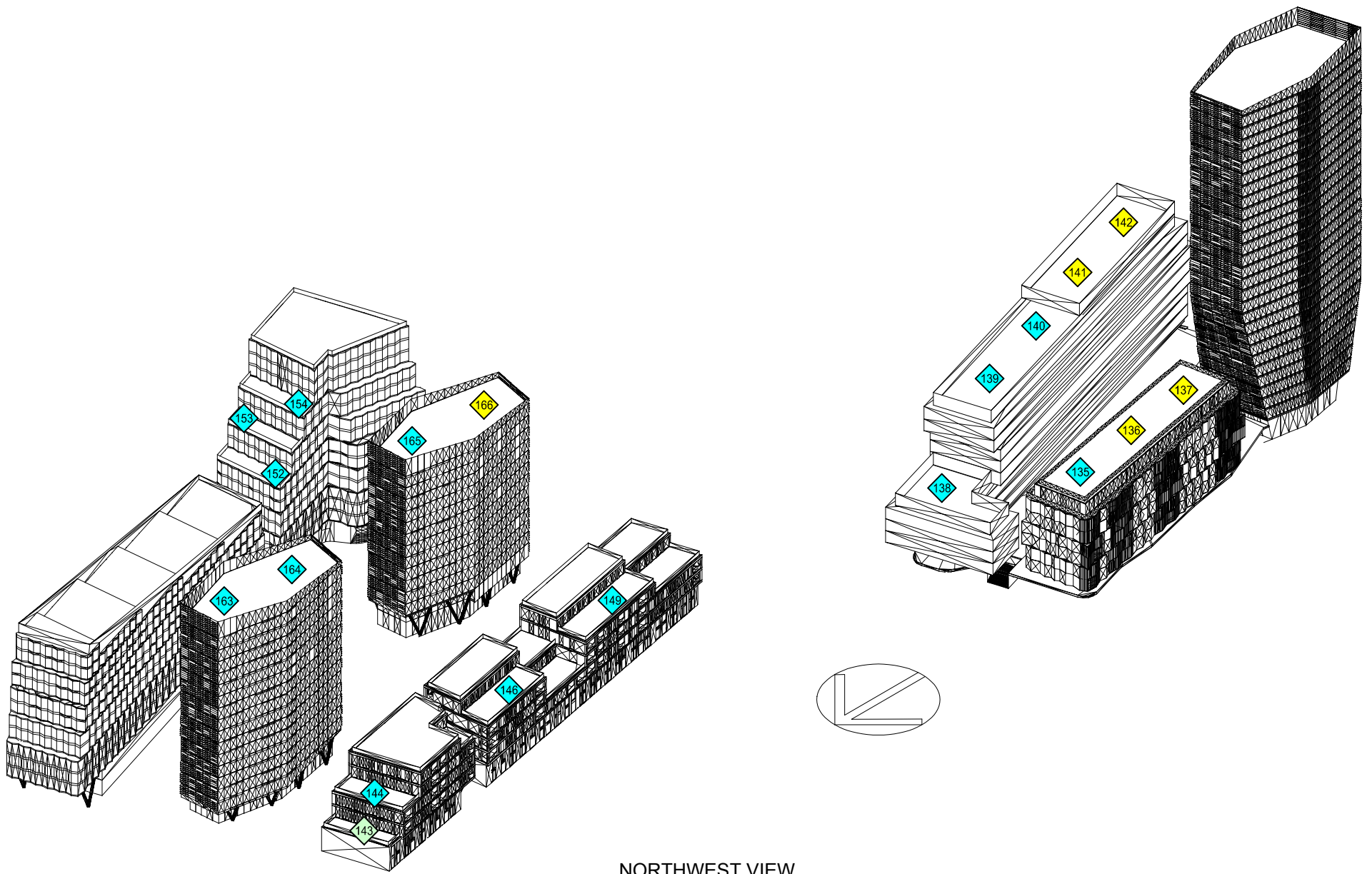
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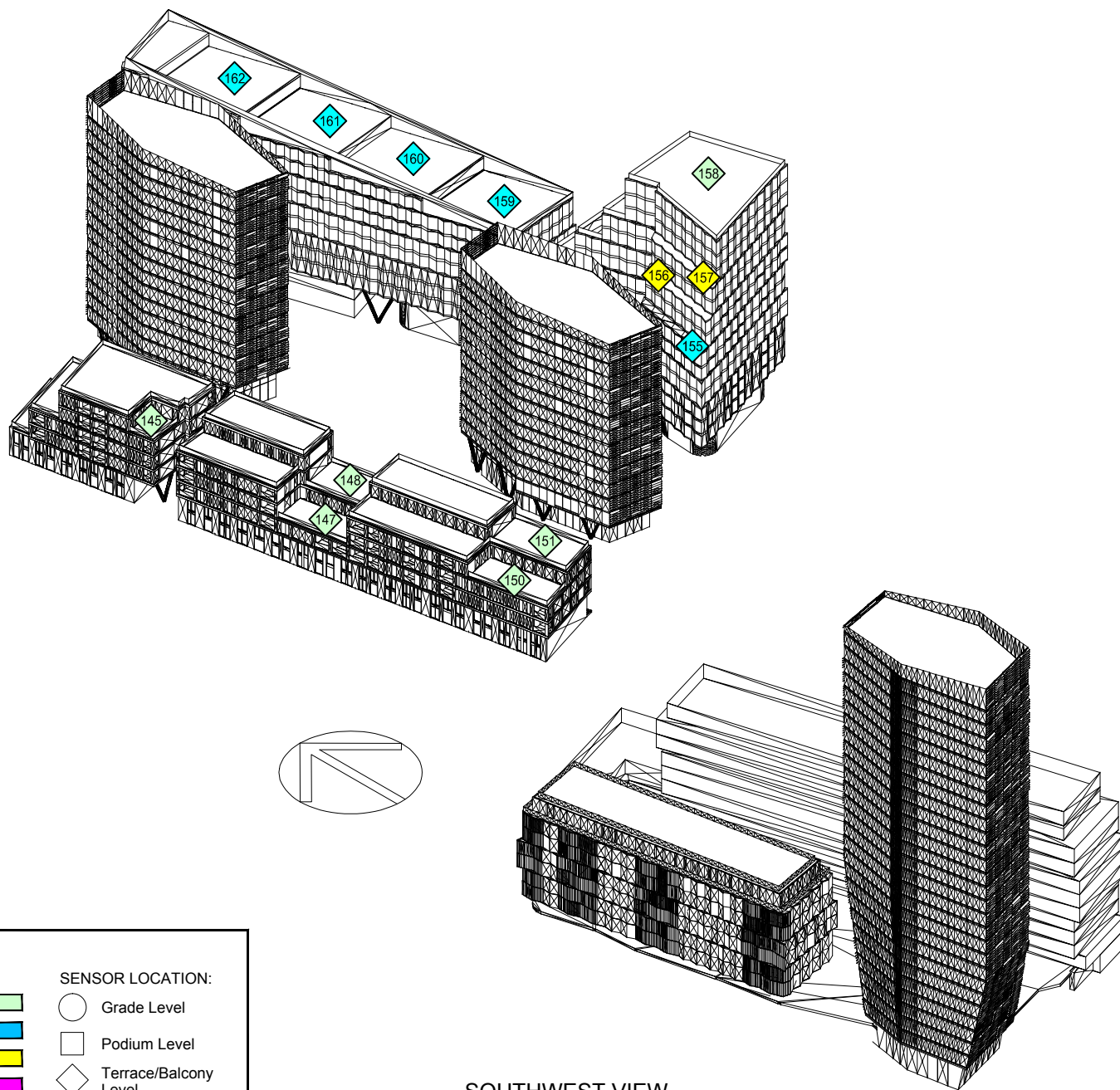
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 Approx. Scale: 1:1500
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NORTHWEST VIEW



SOUTHWEST VIEW

LEGEND:

LAWSON COMFORT CRITERIA:

- Sitting
- Standing/Entrance
- Leisure Walking
- Business Walking
- Carpark/Roadway

SENSOR LOCATION:

- Grade Level
- Podium Level
- Terrace/Balcony Level

Pedestrian Wind Comfort Conditions - Configuration 2: Proposed Development with existing surrounding buildings - no landscaping

Windiest Season

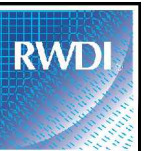
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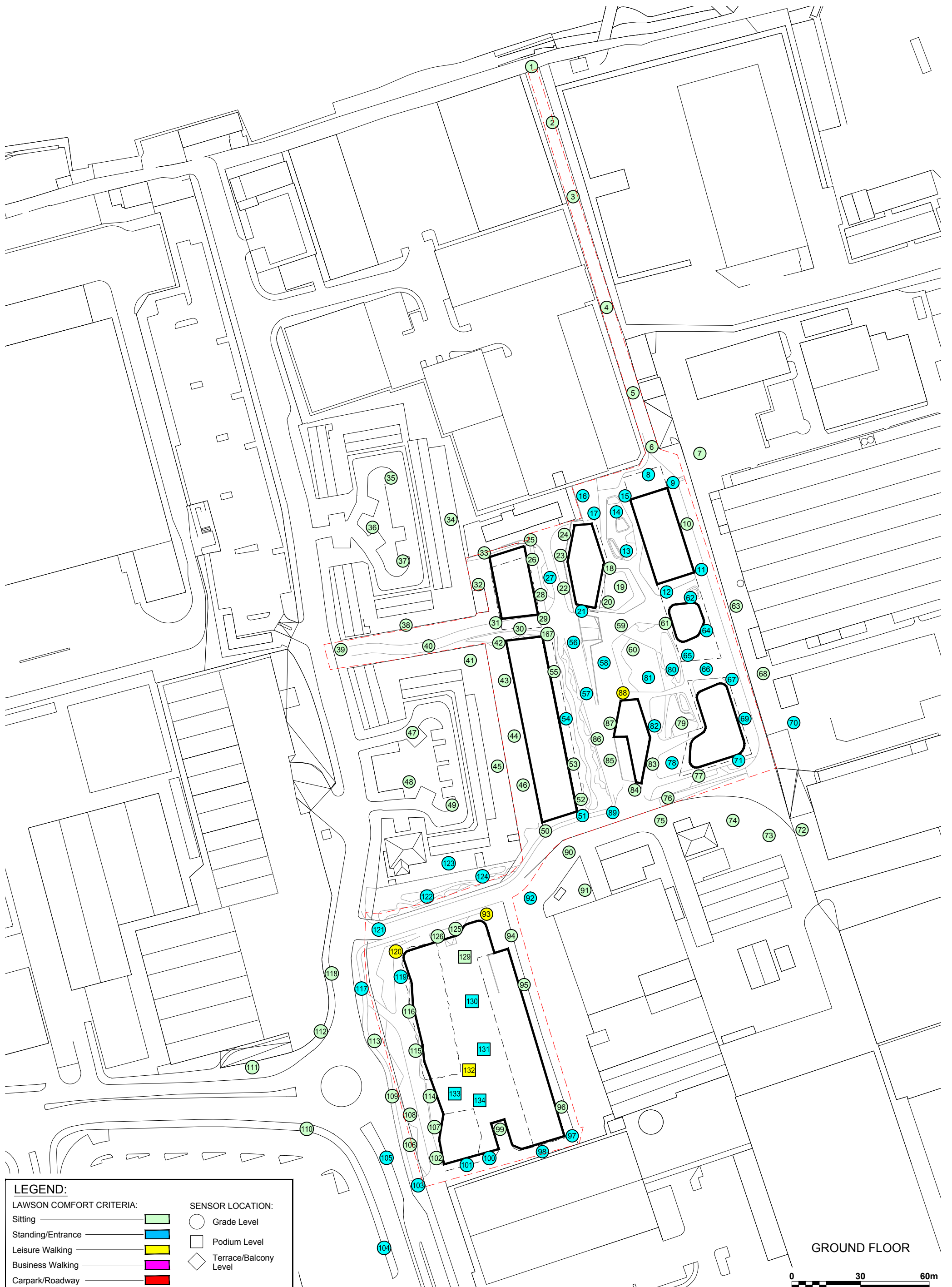
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Not to Scale:

Date Revised: Oct. 21, 2016

Project #1601701





Pedestrian Wind Comfort Conditions - Configuration 2: Proposed Development with existing surrounding buildings - no landscaping

Summer Season

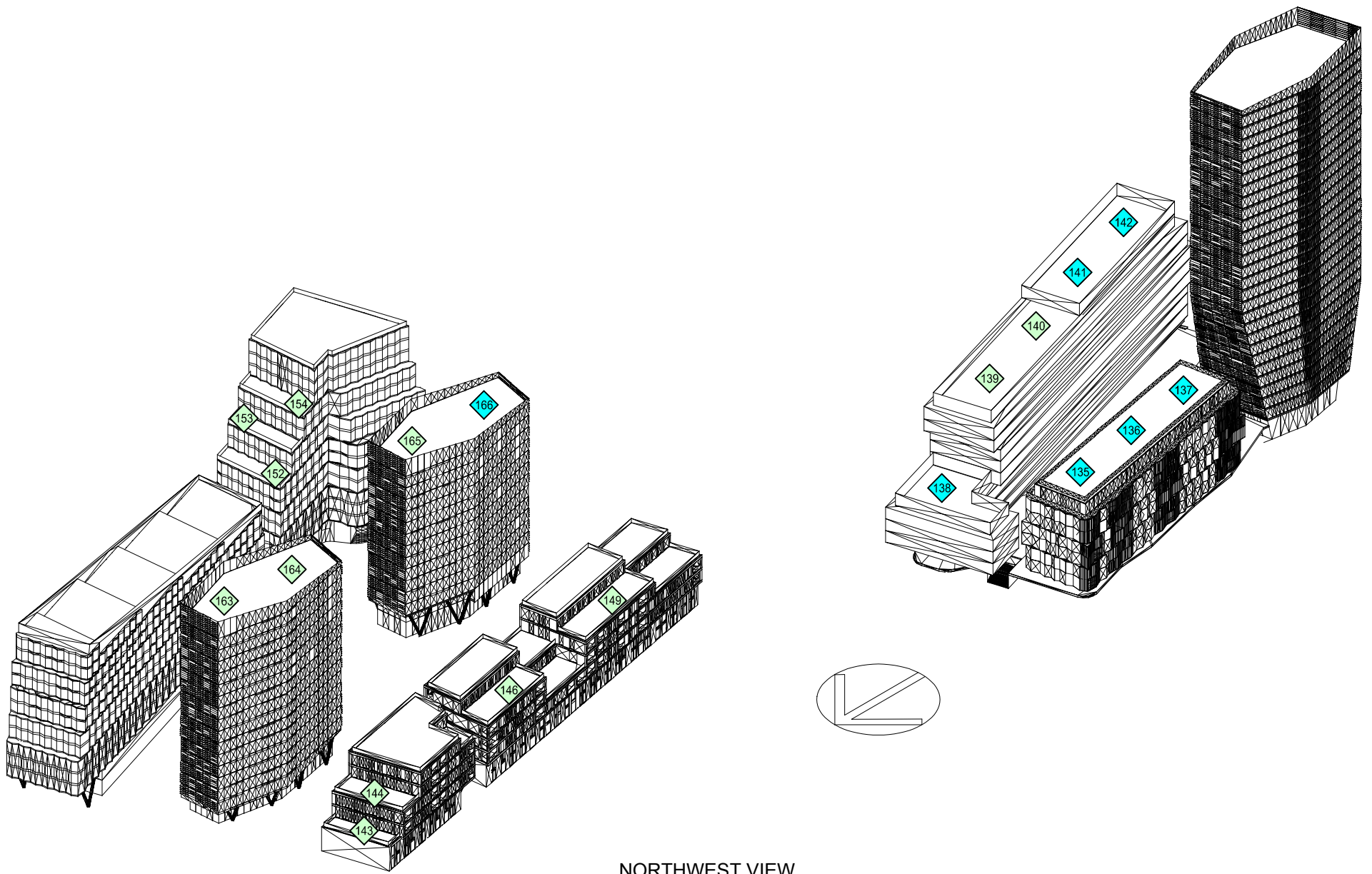
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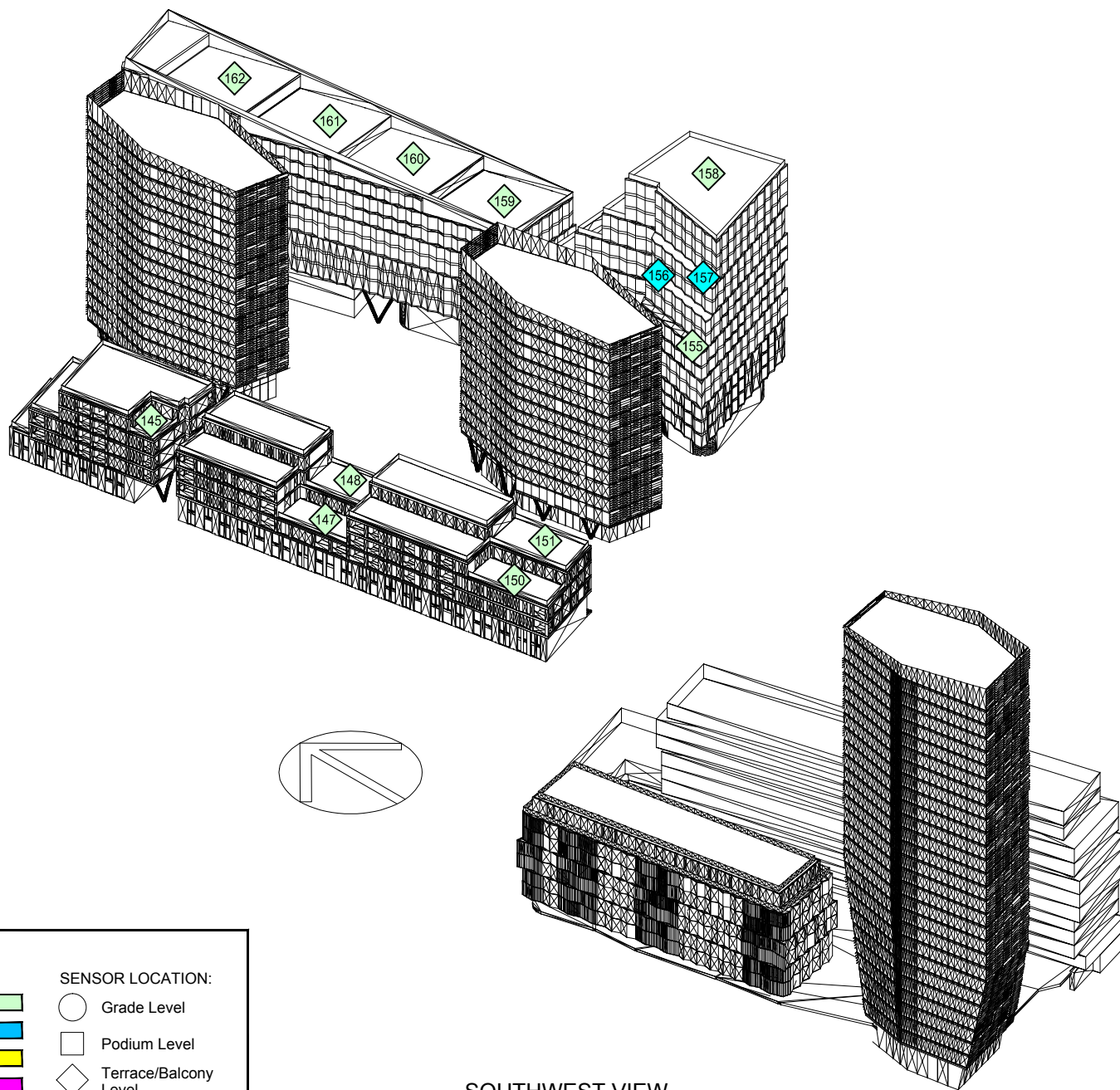
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 Approx. Scale: 1:1500
 Date Revised: Oct. 21, 2016

Project #1601701





NORTHWEST VIEW



SOUTHWEST VIEW

LEGEND:

LAWSON COMFORT CRITERIA:

- Sitting
- Standing/Entrance
- Leisure Walking
- Business Walking
- Carpark/Roadway

SENSOR LOCATION:

- Grade Level
- Podium Level
- Terrace/Balcony Level

Pedestrian Wind Comfort Conditions - Configuration 2: Proposed Development with existing surrounding buildings - no landscaping

Summer Season

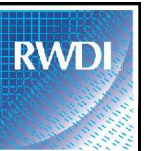
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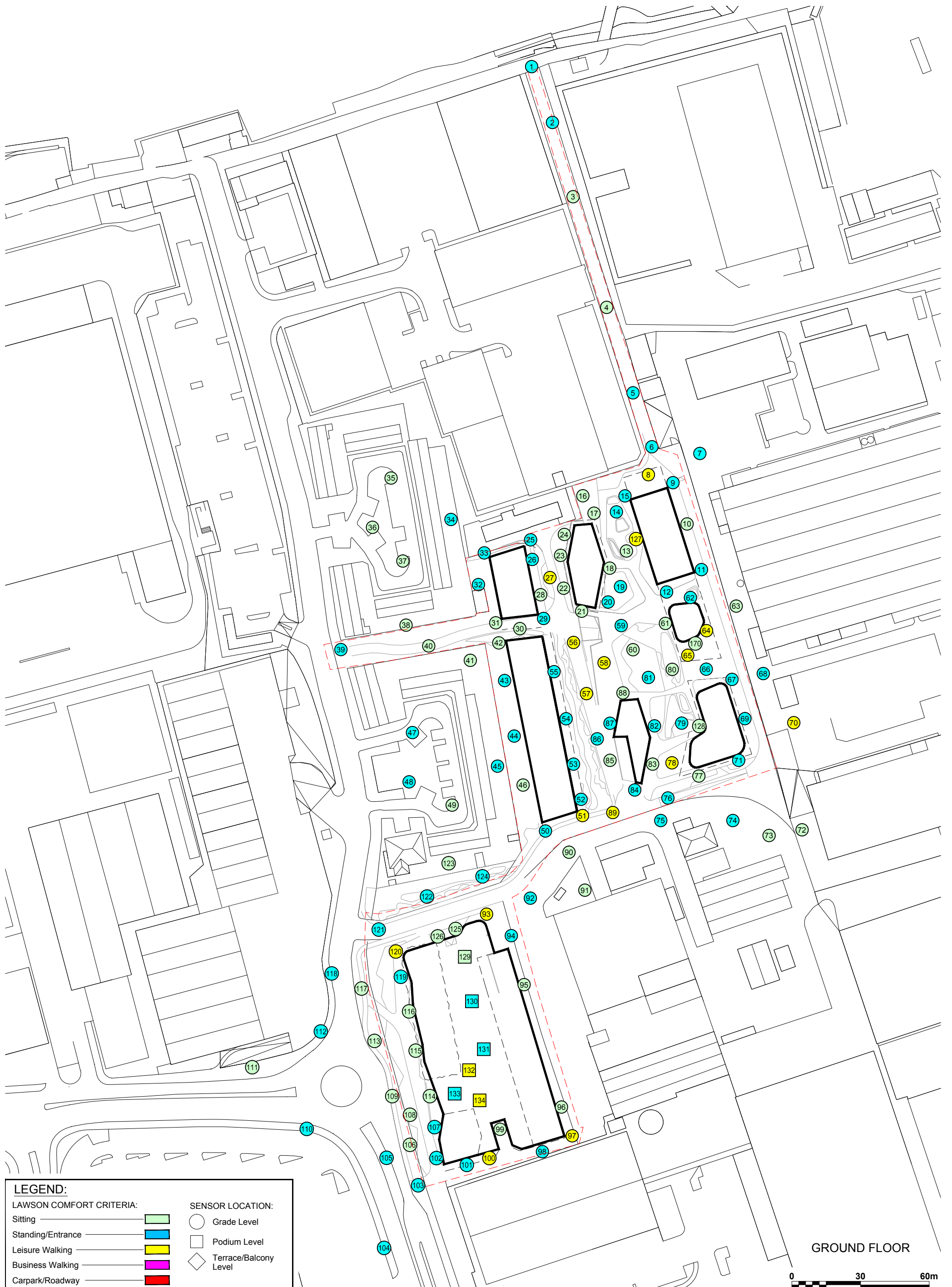
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Not to Scale:

Date Revised: Oct. 21, 2016

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Pedestrian Wind Comfort Conditions - Mitigation 4: Proposed Development with existing surrounding buildings and Proposed Landscaping

Windiest Season

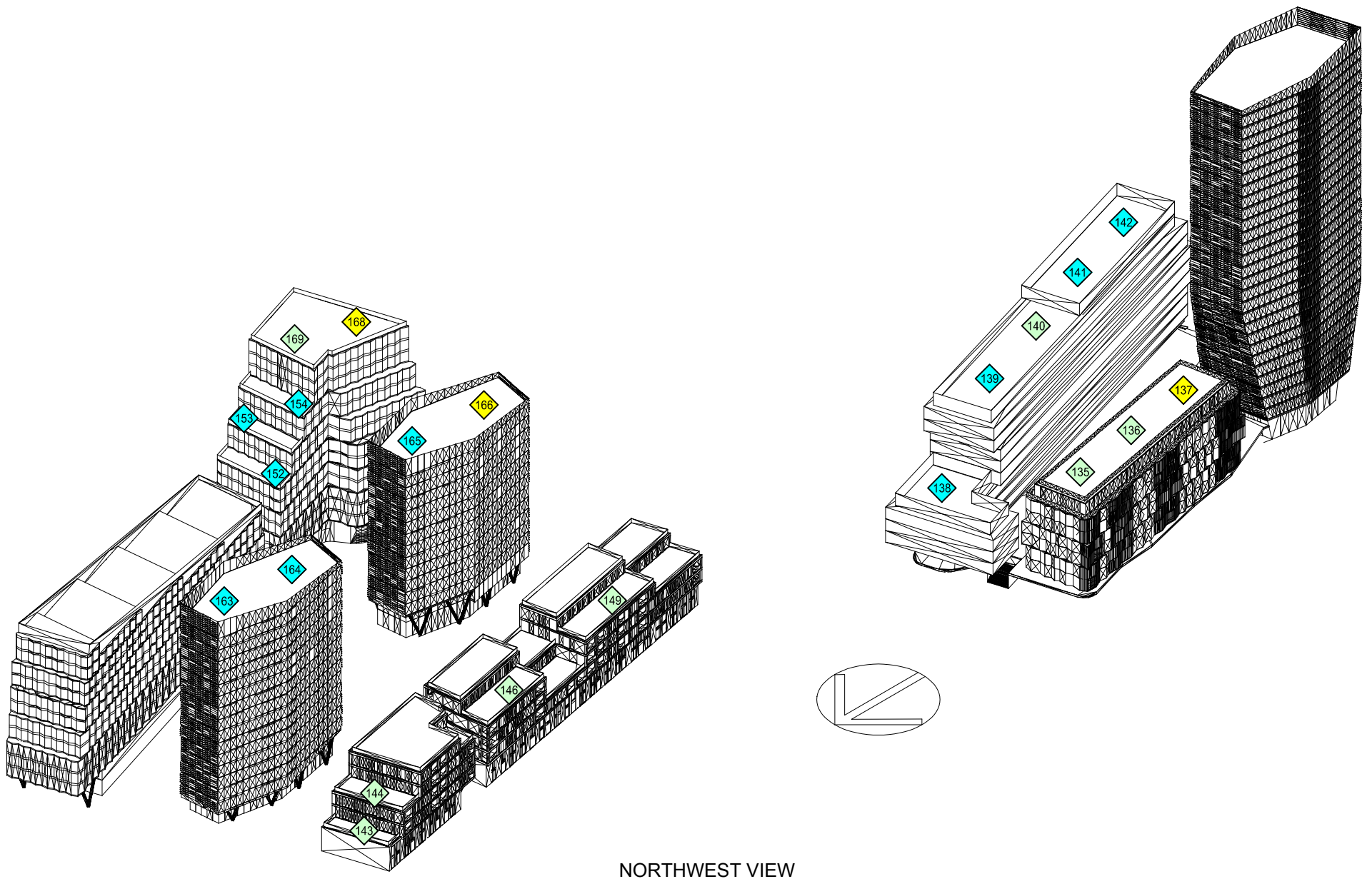
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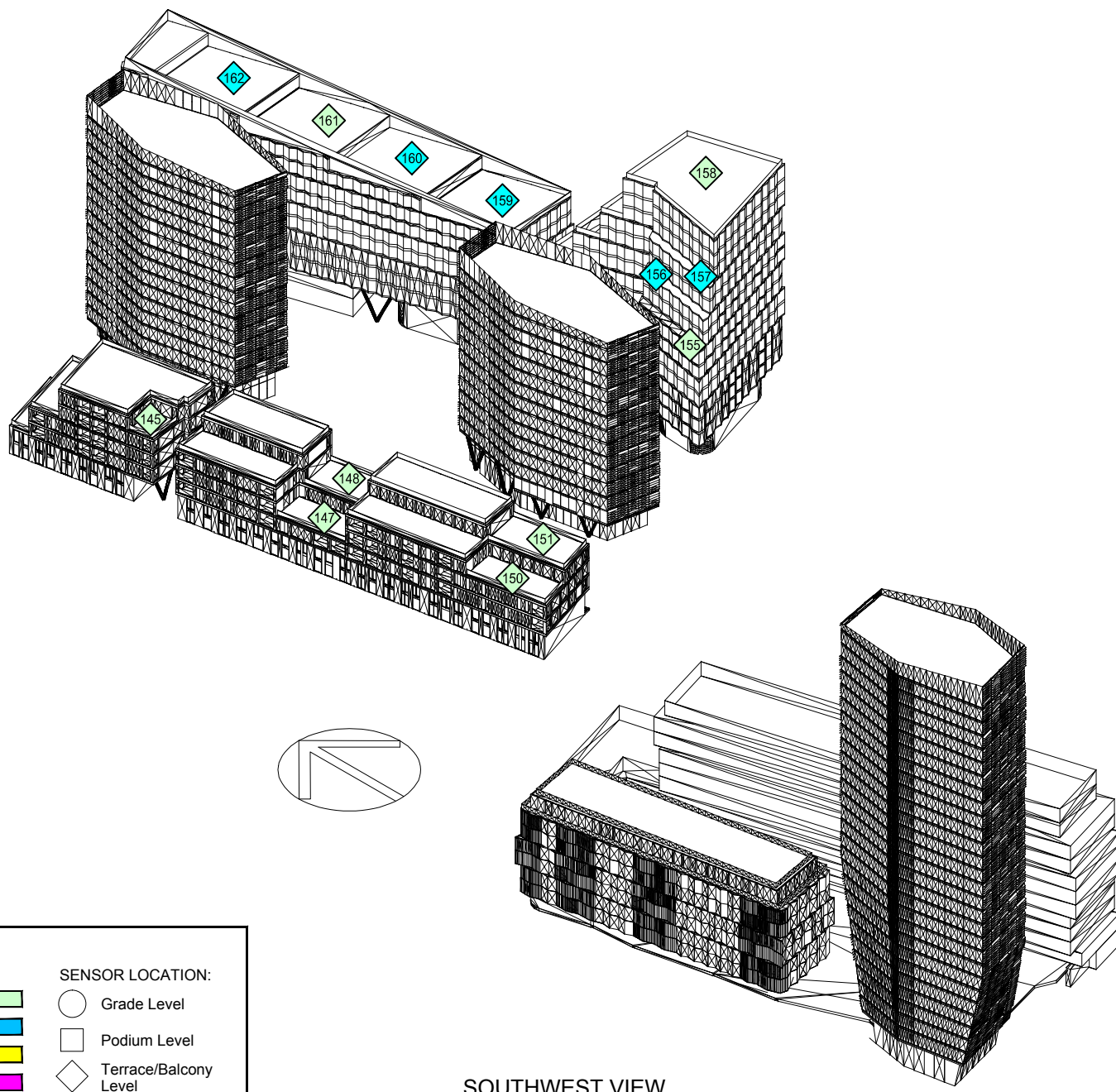
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 Date Revised: Oct. 27, 2016

Project #1601701



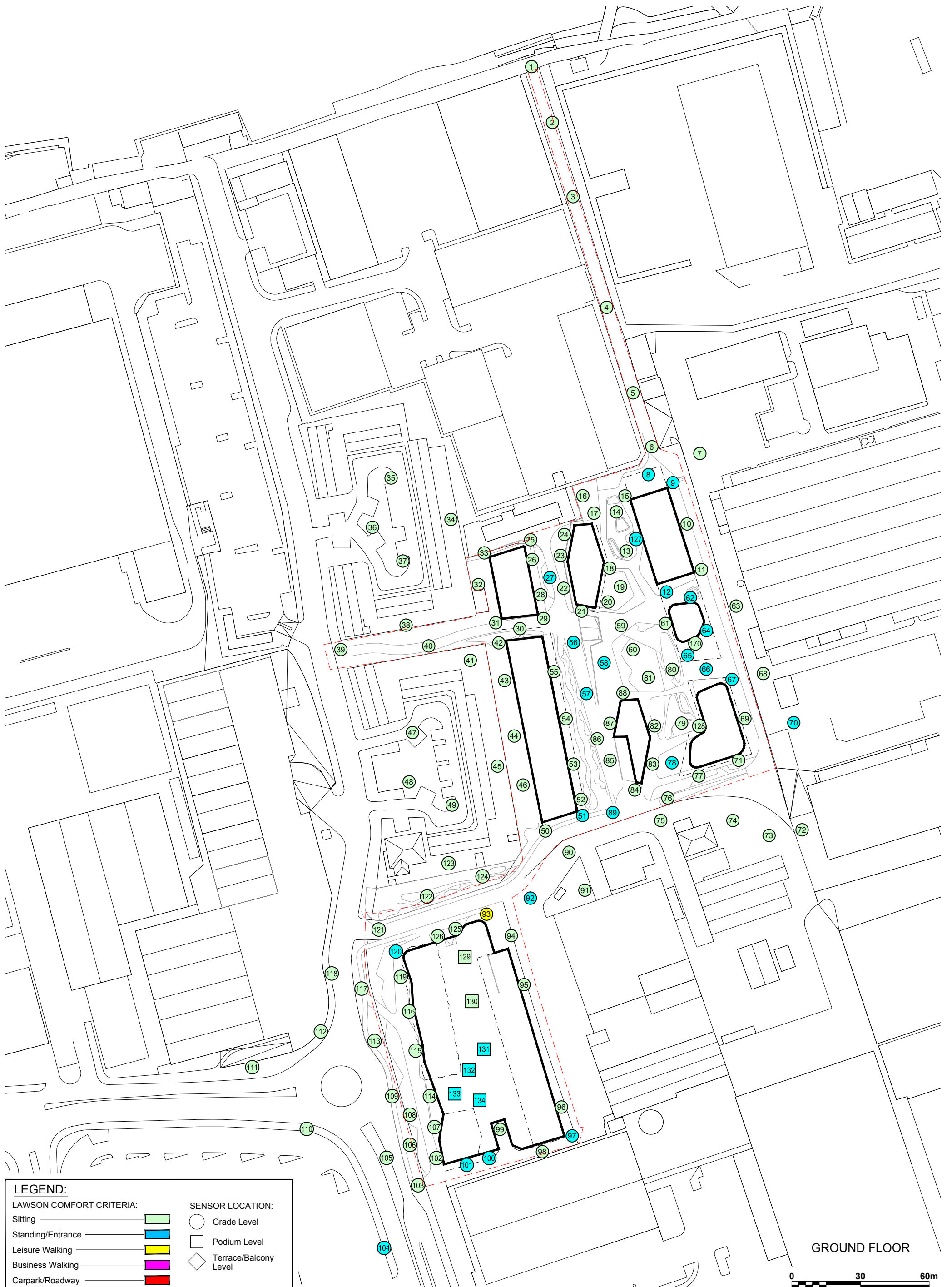


NORTHWEST VIEW



SOUTHWEST VIEW

LEGEND:	
LAWSON COMFORT CRITERIA:	SENSOR LOCATION:
Sitting ———— ■	○ Grade Level
Standing/Entrance ———— ■	□ Podium Level
Leisure Walking ———— ■	◇ Terrace/Balcony Level
Business Walking ———— ■	
Carpark/Roadway ———— ■	



Pedestrian Wind Comfort Conditions - Mitigation 4: Proposed Development with existing surrounding buildings and Proposed Landscaping

Summer Season

Charlton Riverside, London (U.K.)



Drawn by: CAX | Figure: 11

Approx. Scale: 1:1500

Date Revised: Oct. 27, 2016

Project #1601701

