

PHOENIX WORKS

MANCHESTER, UK

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT

RWDI #2100815 – REV A

30 OCTOBER 2020

SUBMITTED TO

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VERSION HISTORY

RWDI Project #2100815		Phoenix Works Manchester, UK	
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Krishan Jayyaratnam	Rev A	30/10/2020	Andrew Proud

1 EXECUTIVE SUMMARY

This is a qualitative assessment of the likely wind conditions around the proposed Phoenix Works development in Manchester, UK. The report outlines the overall methodology and the use of the Lawson Comfort Criteria to describe the expected on-Site wind conditions. The assessment is based upon analysis of meteorological conditions for Manchester, UK, adjusted to the Site, and a review of the proposed drawings in the context of the meteorological data and surrounding area in combination with RWDI's extensive experience in wind flow in the urban environment.

The Site description is used mainly to identify building massing and features that are pertinent to the wind microclimate on-Site. The expected main flow interactions around the Site are then described and categorised in terms of the Lawson Comfort Criteria for pedestrian comfort and safety.

The meteorological data for the Site indicate strong prevailing winds from the southern quadrant throughout the year with secondary winds from the north-west direction which are more prevalent during the spring months. Winds from other directions do occur, and are considered within the assessment; however, their impact on the overall wind microclimate conditions tends to be low, due to being relatively infrequent (compared to the prevailing directions).

The existing Site is expected to have standing wind conditions during the windiest season, with one category calmer wind conditions during the summer season. There are no areas which would be anticipated to have strong winds exceeding the 15m/s safety threshold.

Wind conditions around the Proposed Development would be expected to be suitable for standing to strolling use during the windiest season, and generally one category calmer during the summer season. Strolling use wind conditions would occur along the western elevation and around the south-western and north-western corners of the Proposed Development with standing conditions expected everywhere else on-Site. These wind conditions would be suitable for thoroughfare use, however, entrances located at these corners are expected to be one category windier than desired and mitigation measures would be required. Localised measures have been suggested within this report to reduce wind speeds. It is noted that as the wider masterplan is built out, buildings to the south-west and west will help shelter these entrances.

The external walkways linking the two parts of the Proposed Development are expected to have suitable strolling use or calmer wind conditions during the windiest season. Additionally, elevated terraces spaces located on the 9th, 10th and 11th floors are expected to have sitting or standing wind conditions; suitable conditions for a mixed-use amenity space.

There are no expected areas around the Proposed Development which would have strong winds exceeding the 15m/s safety threshold.

Overall, with the mitigation measures described in this report implemented into the design, all areas of the Proposed Development would be suitable for the intended use.



2 INTRODUCTION

RWDI was retained to conduct a pedestrian level wind microclimate (PLW) assessment for the proposed Phoenix Works development (hereafter referred to as the 'Proposed Development') in Manchester, UK. This report presents the background, objectives, methodology, results and discussion from RWDI's assessment. A summary of the overall recommendations from the investigation are presented in Section 8 "Conclusions".

3 SITE DESCRIPTION

3.1 Site Description and Surroundings

The Site is located in Manchester, approximately 750m south-west of the Deansgate Railway Station. The Site is bounded by Ellesmere Street to the north; Bentinck Street to the East; and existing buildings to the south and west. The surrounding building immediately to the west is a low-rise warehouse building and immediately to the south is approximately 68m tall; the latter of the two is expected to provide substantial shelter to the Proposed Development from the prevailing southerly winds.

Generally, the surrounding buildings around the Site are medium-rise with low-rise schemes further afield to the south and west. As a result, winds approaching the Site would be expected to have a relatively lower mean wind speed and higher levels of turbulence compared to a Site surrounded by a more open terrain. An aerial view of the approximate location of the Site is highlighted in yellow with its surroundings in Figure 1a.

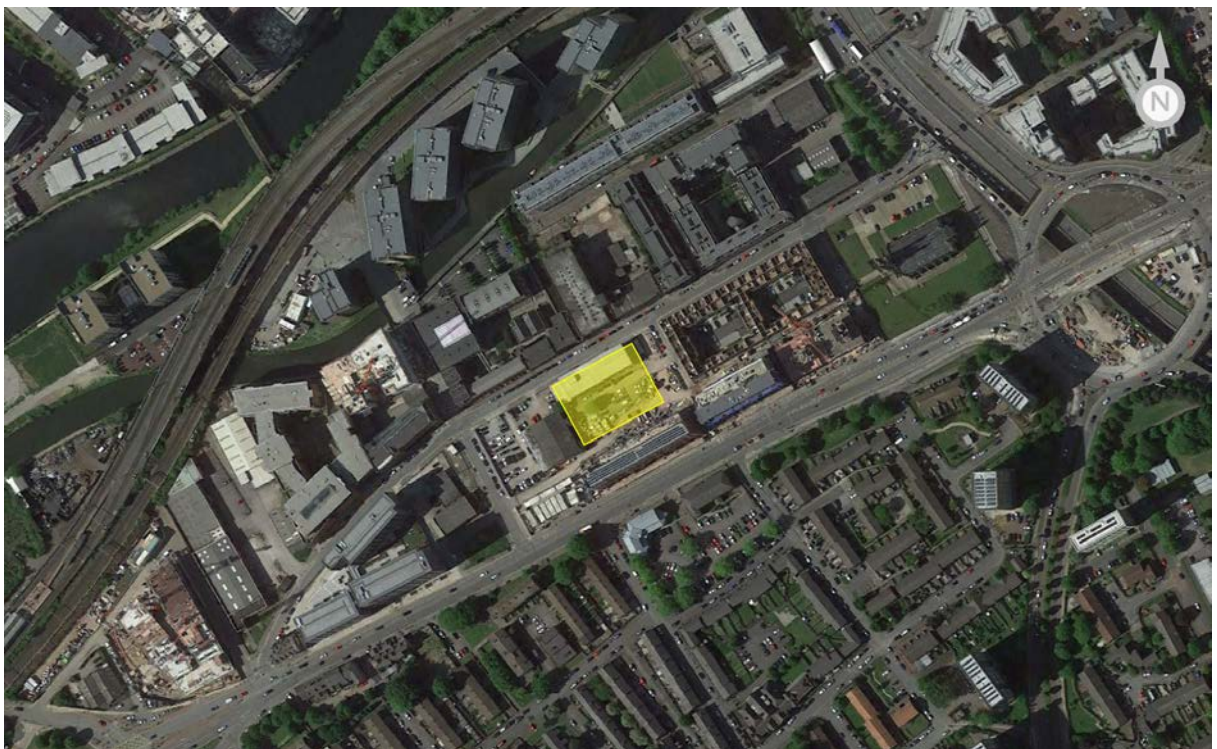


Figure 1a: Aerial view of the existing Site (approximate extent of the Site highlighted in yellow)

3.2 The Proposed Development

The Proposed Development is made up of two Blocks connected by a common podium and several walkways at each level up the height of the buildings. Ground level entrances are located along the southern and northern elevations; along the eastern side, recessed within the scheme, is a series of stairs leading from the ground floor to the first floor. Balconies are located along all elevations and are sheltered by façade articulation on all sides, and effectively recessed. There are roof level amenities located on the 9th, 10th and 11th floors. The Proposed Development is also part of a wider masterplan being design in this area and will likely benefit from the additional shelter provided by future buildings towards the south-west and west.

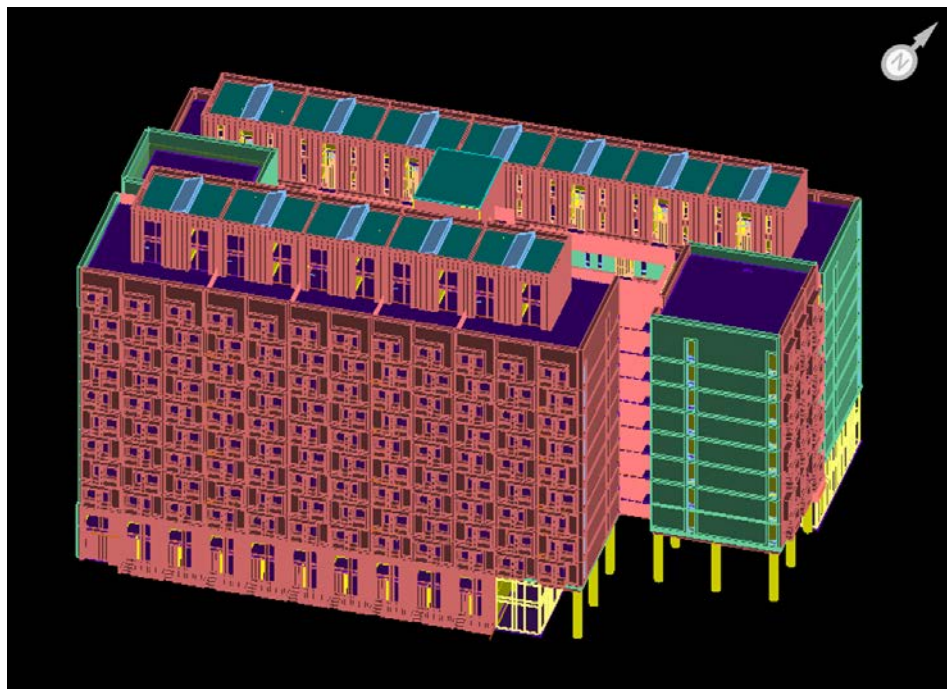


Figure 1b: 3D view of the Proposed Development from south-east

4 METHODOLOGY AND ASSESSMENT CRITERIA

The wind conditions at the Proposed Development have been qualitatively assessed based on the meteorological data for the area, a terrain assessment, and RWDI's extensive experience of wind flow in the urban environment.

Knowledge of the prevailing wind direction focuses attention on the likely impact of these winds on the Site except where the proposed building massing/layout indicates that winds from other directions are likely to be important.

4.1 General Meteorological Data

Meteorological data for Manchester was obtained from the meteorological station at Manchester Airport corrected to standard conditions 10m above open flat country terrain. These were combined with terrain roughness values at 2m and 10m above ground to provide an indication of wind conditions expected around the Site.

Approximately 30 years of meteorological data for the Manchester Airport was used in this report and is presented in Figure 2 below as wind roses by season, with the wind speed in m/s. The radial axis indicates the cumulative number of hours per season that the wind speed exceeds the particular wind speed. 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 prevailing winds blow from the southern quadrant (135 degrees through to 225 degrees) throughout the year and these account for around 40% of wind. There is a secondary prevailing wind from the north-west which is more prevalent during late spring. The wind roses are presented for 'meteorological standard conditions' which is a height of 10m above ground level in open, countryside terrain.

The stronger winds tend to blow from the south and west, and the windiest conditions tend to occur during the winter and, to a lesser extent, the spring and autumn.

The combination of meteorological data, site altitude and velocity ratios permit the percentage of time that wind speeds are exceeded at ground level on the Site to be evaluated. Areas around and within the Site can then be assessed using the Lawson Comfort Criteria, as described below.

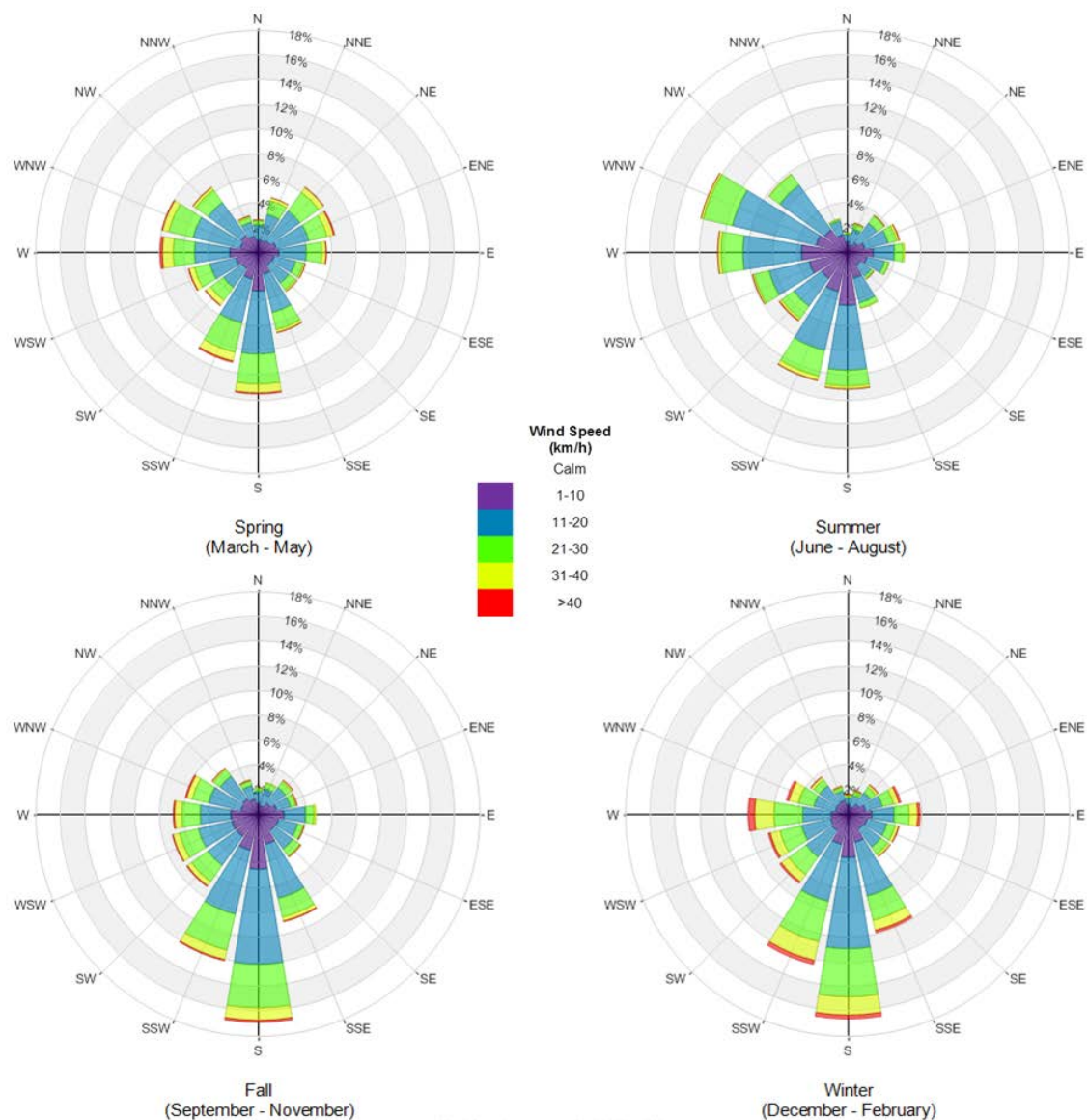


Figure 2: Seasonal wind roses from Manchester Airport (in m/s) – Radial axis indicates the percentage of time for which the stated threshold is exceeded

4.2 Terrain Roughness

Another consideration is the terrain roughness in each wind direction because wide, open spaces permit the wind to flow smoothly at ground level generating conditions similar to those of open countryside even within a built-up area. An assessment of the terrain roughness for the Site was conducted using the methodology implemented in ESDU 01008¹ which models the wind characteristics caused by changes in the terrain roughness.

¹ ESDU International, Computer program for wind speeds and turbulence properties: flat or hilly sites in terrain with roughness changes, ESDU 01008, 2001 01008

4.3 Pedestrian Comfort

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria² that have been established for over thirty years and have been widely used on building developments across the United Kingdom. The comfort criteria seek to define the reaction of an average pedestrian to the wind as described in Table 1. If the wind conditions exceed the threshold wind velocity for more than 5% of the time, then they are deemed unacceptable for the intended pedestrian activity. The expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria sets out four pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The categories are sitting, standing, strolling and walking, in ascending order of activity level, with a fifth category for conditions that are uncomfortable for all pedestrian uses. 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 strolling and walking is that in the strolling scenario pedestrians are more likely to take on a leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to 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 discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

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

Table 1: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
	Sitting	0-4 m/s	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
	Standing	4-6 m/s	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
	Strolling	6-8 m/s	Moderate breezes that would be appropriate for strolling along a city/town street, plaza or park
	Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
	Uncomfortable	>10 m/s	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

² Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press



4.4 Strong Winds

In addition, the criteria stipulate two strong wind threshold limits; when winds exceed 15m/s or 20m/s for more than 2.2 hours of the year. The lower limit, 15m/s, if exceeded may require remedial measures depending on the sensitivity of the location i.e. is it reasonable to expect an elderly or very young pedestrian to be present at the location on the windiest day of the year? Wind speeds that exceed the 20m/s threshold for more than 2.2 hours per year would represent a safety risk for all members of the population and would therefore require mitigation to provide an appropriate wind environment.

Strong winds are generally associated with areas which would be classified as acceptable for walking or as uncomfortable. In a mixed-use urban development scheme, walking and uncomfortable conditions would not usually form a part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. The same mitigation would also typically reduce the frequency of, or even eliminate, any strong winds.

4.5 Typical Wind – Building Interactions

The wind conditions at the Proposed Development are expected to be due to typical flow behaviour which are common at most suburban/urban developments.

As the Proposed Development is not significantly taller than the surrounding area, it is not expected that down-washing winds (where a taller development forces high level winds to ground level which then create locally high wind speeds) would significantly occur at the Proposed Development (Figure 4a).

Corner acceleration (Figure 3c around building corners may occur due to the difference in pressure on the upwind and downwind façades (low pressure zones on the leeward side and zones of higher pressure on the windward side of the building). This effect is particularly pronounced around sharp corners which create localised windy areas in the vicinity of the corner where the flow is accelerated around the building. This wind effect is expected to occur at the Proposed Development and would be the primary cause of the windiest conditions.

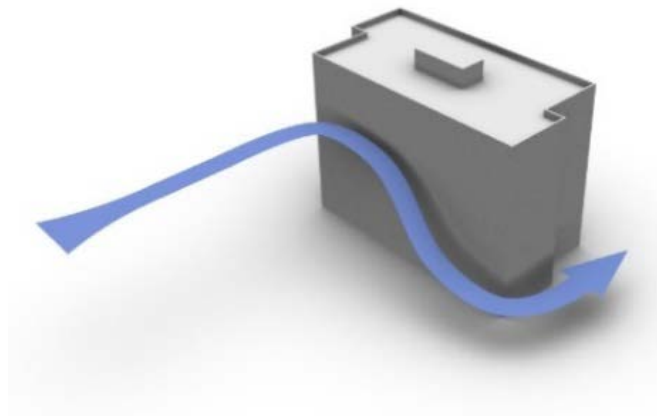


Figure 3: Corner acceleration

5 EXISTING SITE WITH EXISTING SURROUNDING BUILDINGS

Often a new development will alter the pedestrian activity (i.e. intended use) on site. Occasionally, although wind conditions may not change after the Proposed Development is completed (e.g. stay suitable for strolling), mitigation would still be required if, on the new development, the location of interest is intended for a critical activity (e.g. a main entrance) for which the wind conditions would be unsuitable. Assessment in terms of the desired pedestrian activity on, or around, a site takes into consideration any change of use and this is where the comfort criteria are particularly helpful.

5.1 Pedestrian Comfort

Based on the terrain roughness analysis discussed in section 4.2, the baseline conditions at 2m above ground level at an idealised “empty” Site would be acceptable for sitting use throughout the year.

The Site is currently occupied with a 3-storey building and a surface car park to the south. Due to the taller surrounding buildings, there is expected to be substantial shelter to the Site and therefore wind conditions would be suitable for standing use throughout the Site with localised areas of strolling use near building corners.

Wind conditions are expected to be suitable for the current use.

5.2 Strong Winds

Strong winds in excess of 15m/s for more than 2.2 hours per year are not expected to occur at the existing Site as walking and uncomfortable wind conditions are not expected to occur on-Site.

6 THE PROPOSED DEVELOPMENT WITH EXISTING SURROUNDING BUILDINGS

Wind conditions suitable for strolling use or calmer are desirable on main thoroughfares during the windiest season for a residential development in an urban area. Standing use wind conditions or calmer are generally required at entrances throughout the year. Amenity spaces where seating is designated require sitting use conditions during the summer season. Amenity areas where seating is not designated (such as play areas or private terraces) would tolerate standing use wind conditions during the summer season.

Occurrences of strong winds in excess of 15m/s are expected to be limited when wind conditions meet the above criteria and are suitable for pedestrian comfort.

The assessment made below is based on a worst-case assessment of the expected wind conditions at the Site. This worst-case assessment assumes no proposed landscaping to be present on-Site.

The qualitative assessment was based on the following information architectural plans:

- “20098-CWA-B1-ZZ-M3-A-BUIL-S1.dwg” – received October 20, 2020; and
- “2200 – GA 00 Ground Floor Plan BW.dwg” – “2212 – GA 12 Twelfth Floor Plan BW.dwg” – received October 20, 2020.

6.1 Pedestrian Comfort

The expected wind conditions at the Proposed Development are shown in Figures 5 to 8 at ground and 1st floor levels for the windiest and summer seasons respectively and Figure 9 for elevated areas (9th, 10th and 11th floors) for the summer season.

During the windiest season, the expected wind conditions on-Site would range from suitable for strolling to standing use, which would represent similar wind conditions to the baseline (existing scenario). Due to the medium-rise buildings surrounding the Site, in particular the building immediately to the south, there would be significant shelter provided to the Site from the prevailing wind directions. Windier conditions are expected along the western elevation due to the limited shelter from westerly and south-westerly winds; however, it is noted that when the wider masterplan is built, further shelter will be provided to the Proposed Development from these directions. During the summer season, when wind comfort conditions are generally one category calmer than the windiest season, the expected wind conditions would range from suitable for sitting to standing use at ground level.

6.1.1 Thoroughfares (Figures 5 and 7)

It is expected that all thoroughfare areas at the Site would have wind conditions suitable for standing to strolling use during the windiest season. Wind conditions at the south-western and north-western corners and along the western frontage of the Site would have strolling conditions and elsewhere would be suitable for standing. This is due to the exposure of the Site to winds from these directions.

The external walkways linking each side of the Proposed Development are expected to have standing wind conditions at all levels. These walkways are sheltered by winds from all directions by the Proposed Development geometry. All thoroughfare around the Proposed Development would be suitable for the intended use.

6.1.2 Entrances (Figure 5)

The majority of entrances to the Proposed Development at the ground floor level would be suitable for standing use and no mitigation would be required. However, entrances located along the northern and southern elevations at the western corners would have strolling wind conditions. It is noted that the entrances are somewhat recessed from the thoroughfare; nevertheless, there is limited shelter from wind accelerating around these corners and therefore are expected to be windier than suitable. Mitigation will be required for these entrances and are discussed further in “Section 7: Mitigation Measures”.

As mentioned in previous sections, the Proposed Development is part of a wider masterplan designed for this area and will include further development to the south-west and west of the Site. These buildings, depending on their geometry and vicinity to the Proposed Development Site, could provide the needed shelter to reduce wind speeds to a standing classification at the above highlighted entrances. Therefore, any mitigation measures described in this report could be temporary, and it is recommended that when these future buildings are designed, RWDI should be consulted to ascertain if they would provide the needed shelter to the entrances in question.

6.1.3 Private Balconies

Balconies are located along all elevations of the Proposed Development. The design of these balconies creates a recessed balcony design as all sides of the balcony are sheltered by façade articulation. As a result, it is expected that all balconies would have a sitting/standing wind condition during the summer season and therefore suitable for the intended use.

6.1.4 Roof Terraces (Figure 9)

All roof terraces of the Proposed Development are expected to have suitable sitting/standing use wind conditions. The 9th level terrace space is expected to have sitting use wind conditions throughout as it is sheltered from the southerly and south-westerly winds by the taller elements of the Proposed Development in these directions. Similarly, the northern side of the 11th floor terrace would also be expected to have sitting wind conditions. Both the southern and western sides of the 11th floor terrace and the large terrace space located on the eastern side of the 10th floor would likely have standing wind conditions as these areas are exposed to the southerly winds. If fixed seating areas are desired in areas where standing wind conditions are predicted, localised mitigation measures will be required (suggestions are given in Section 7: Mitigation Measures)



6.2 Safety

Strong winds in excess of 15m/s for more than 2.2 hours per year would not be expected to occur as walking wind conditions during the windiest season would not occur anywhere at the Proposed Development.

7 MITIGATION MEASURES

Wind conditions within and around the Site were considered devoid of landscaping or wind mitigation measures in order to assess a worst-case (i.e. windy) scenario. The expected wind conditions at the Proposed Development in the context of existing surrounding buildings are generally expected to be suitable for the intended use throughout the year, with isolated entrances at ground level which would be windier than desired. The areas that are expected to require mitigation are at the south-western and north-western entrances to the Proposed Development.

Additionally, if fixed seating arrangements are required at roof terrace levels in areas where standing wind conditions are predicted, localised measures would be required,

7.1 Entrances

Due to the corner accelerations expected at the south-western and north-western areas, some of these entrances are expected to have strolling wind conditions. The entrances at ground level are noted to be set back from the thoroughfare in front with a railing structure. If these structures were made to be solid or have shrubs placed behind them, this would provide local shelter to the entrances by breaking up the accelerated winds (Figure 4a). Alternatively, recessing the entrances into the building footprint by 1.5m would also provide sufficient shelter. It is noted that future development of the wider masterplan, when designed could potentially help to reduce wind speeds at these corners (potentially making any mitigation measures suggested for these entrances temporary in nature) and therefore it is recommended that RWDI are consulted when these designs are developed.



Figure 4a: Entrance mitigation recommendations

7.2 Roof Level Seating

If seating arrangements are desired at roof level in areas predicted to have standing wind conditions, locally providing shelter to occupants/residents can be used. This can be in the form of localised 1.5m screening on two sides or shrubs in planters of the same size. Additional landscaping throughout the terrace space will further help to break up the flow. Some suggestions are shown in Figure 4b, below.



Figure 4b: roof level mitigation measures

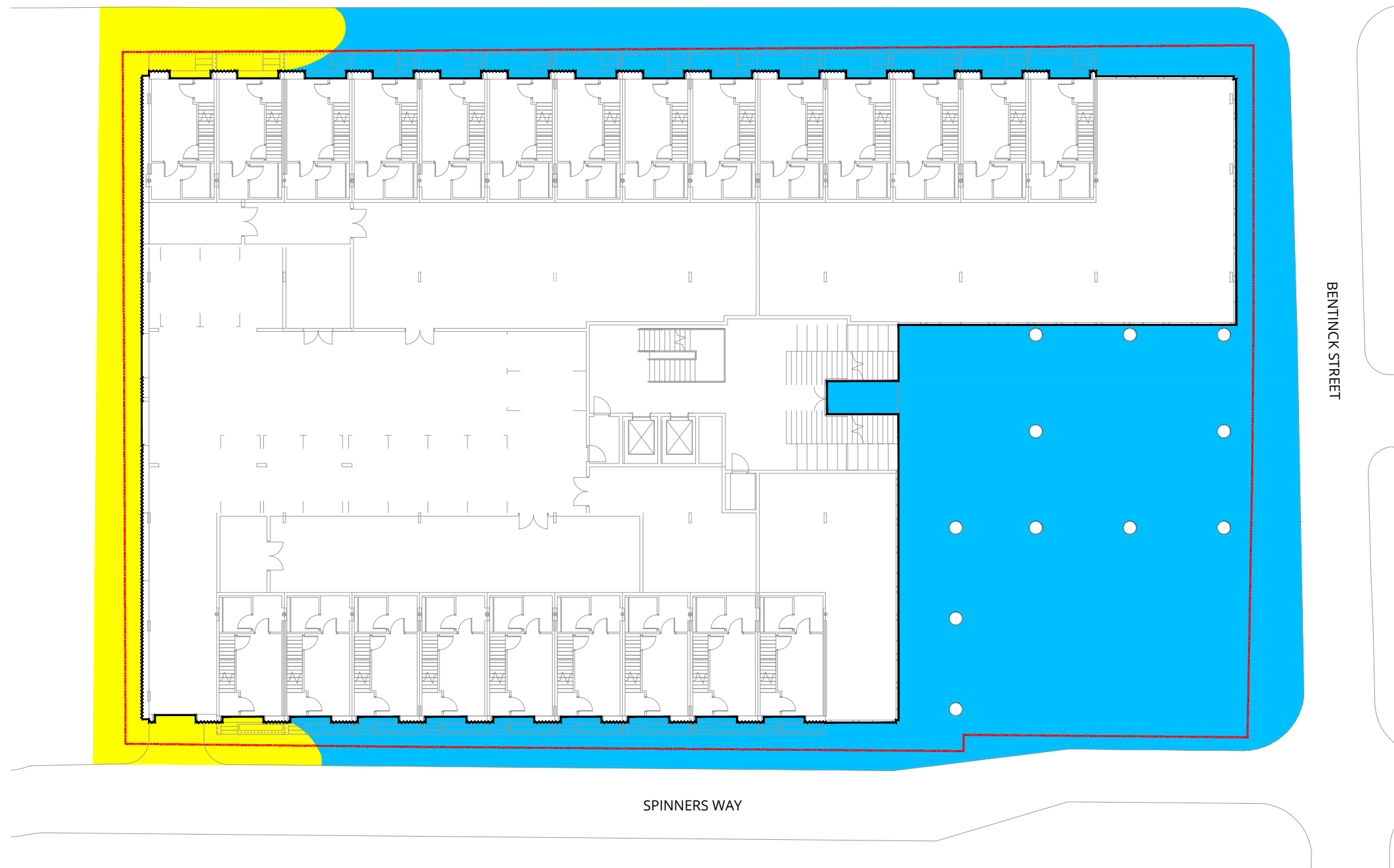
8 CONCLUSIONS

In conclusion:

1. The Proposed Development has been qualitatively assessed based on meteorological data, terrain assessment and professional judgement/experience.
2. The meteorological data for the Site indicates prevailing winds predominantly from south throughout the year and secondary winds from the north-west during spring.
3. For the existing Site, the wind microclimate at ground level is expected to be acceptable for the current use throughout the year without safety exceedances.
4. With the introduction of the Proposed Development, wind conditions at the Site would generally be similar and acceptable for the intended use except at entrances located at the south-western and north-western corners. Additionally, if fixed seating is desired at roof level amenity spaces, localised measures would be required and are described within this report.
5. As the Proposed Development is part of a wider masterplan being designed for this part of Manchester, as the design of the future buildings to the south-west and west are progressed, RWDI should be consulted to understand if these future buildings would provide shelter to the windier than desired entrances. In which case, any measures described in this report could be temporary.
6. Strong winds in excess of 15m/s for more than 2.2 hours per year would not be expected to occur at the Proposed Development.
7. Overall, the wind conditions at the Proposed Development would be suitable and safe for the intended use with isolated instances of windier than desired conditions which would be readily mitigated with the measures described.

FIGURES





LEGEND:

LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Comfort Desk Study - Expected Wind Conditions - Ground Level

Proposed Site with Existing Surrounding Buildings
Windiest Season

Phoenix Works - Castlefield, Manchester, UK



Project #2100815

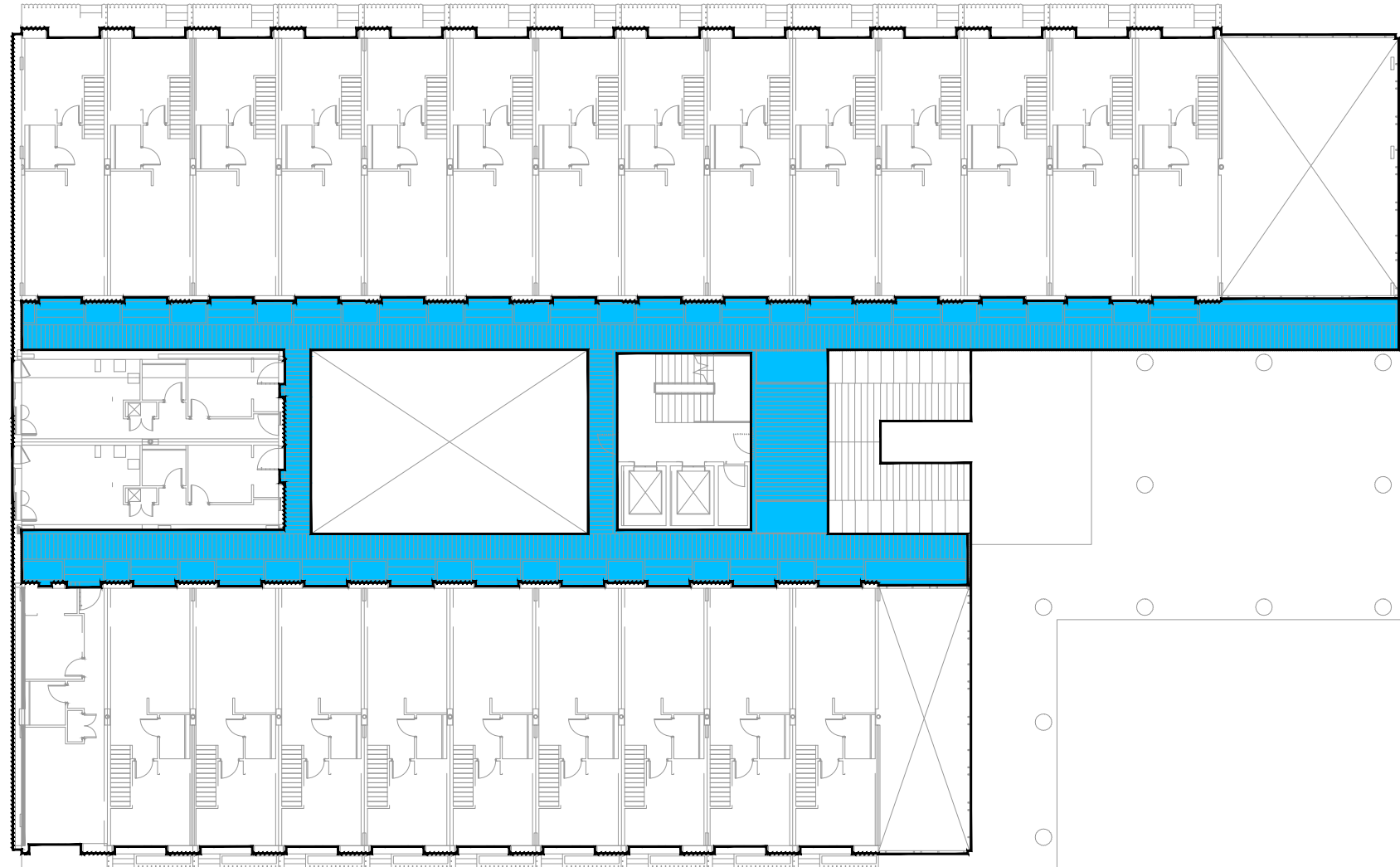
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LEGEND:
 LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

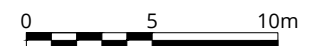


First Floor

LEGEND:

LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	



Pedestrian Comfort Desk Study - Expected Wind Conditions - First Floor

Proposed Site with Existing Surrounding Buildings
Windiest Season

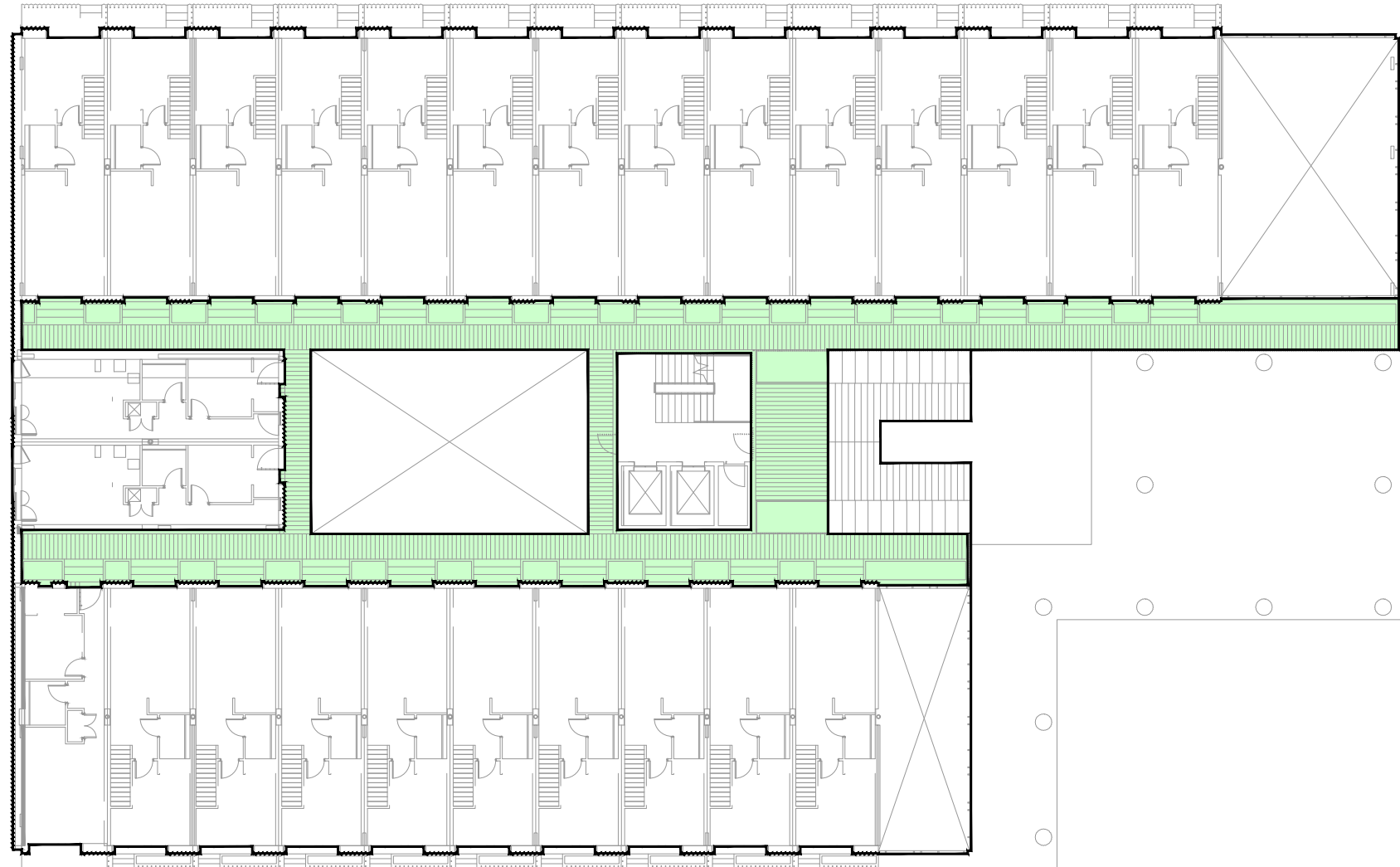
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Project #2100815

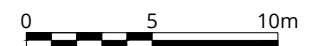


First Floor

LEGEND:

LDDC COMFORT CATEGORIES:

- Sitting —
- Standing —
- Strolling —
- Walking —
- Uncomfortable —



Pedestrian Comfort Desk Study - Expected Wind Conditions - First Floor

Proposed Site with Existing Surrounding Buildings
Summer Season

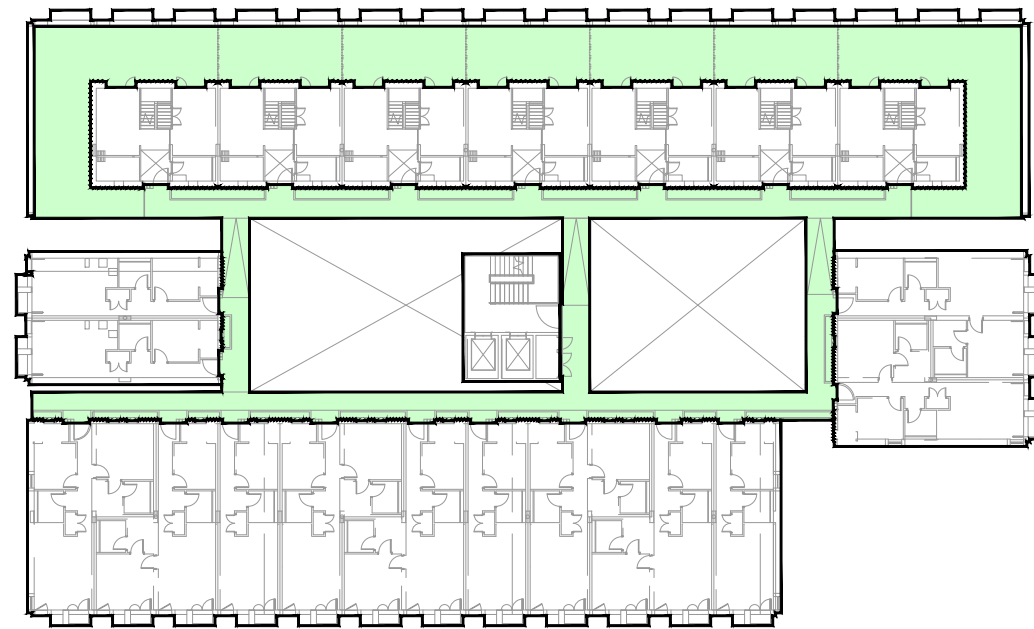
Phoenix Works - Castlefield, Manchester, UK



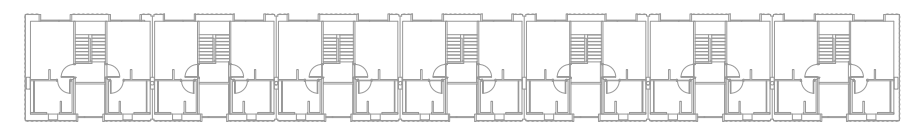
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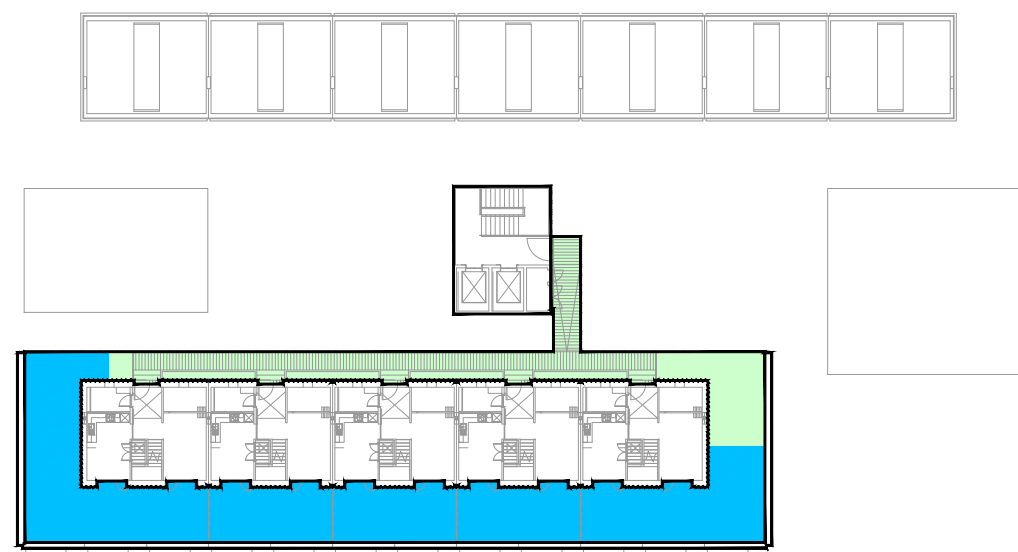
Project #2100815



Ninth Floor



Tenth Floor

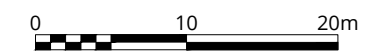


Eleventh Floor

LEGEND:

LDDC COMFORT CATEGORIES:

- Sitting —
- Standing —
- Strolling —
- Walking —
- Uncomfortable —



Pedestrian Comfort Desk Study - Expected Wind Conditions - Elevated Levels

Proposed Site with Existing Surrounding Buildings
Summer Season

Phoenix Works - Castlefield, Manchester, UK



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Date Revised: Oct. 26, 2020	



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