

An architectural rendering of a modern urban development. On the left is a multi-story building with a facade of vertical blue and white stripes. To its right is a taller, more uniform building with a grid of windows. In the foreground, there are trees and a paved area with some figures. The entire image has a blue color overlay.

June 2023
Wind Microclimate Study

Upper Brook Street Masterplan (McLaren / Kadans)

Upper Brook Street, Manchester, Wind Microclimate Study

For McLaren Property

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Disclaimer

The scope of this report is limited to the items detailed within, and conclusions outside this scope cannot be presumed.

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Summary

An assessment has been performed of the wind conditions surrounding the site of a proposed development on Upper Brook Street in Manchester consisting of purpose-built student accommodation and a new Sci Tech building. While the addition of the proposed development does increase the intensity of winds at pedestrian level, the magnitude of this increase is not sufficient to cause significant detriment to pedestrian comfort. There are no locations outside of the proposed site which are likely to involve sitting or standing that experience a change in the Lawson Criteria acceptability for sitting or standing respectively. There is likewise no change in the acceptability for strolling and business walking following the addition of the proposed development or the adjacent scheme.

Casual seating is currently planned in the region between the proposed buildings (Thorburn Walk), an area which is deemed unsuitable for sitting based on conditions with the landscaping scheme excluded. With the inclusion of the 30+ trees proposed for the site, consisting of a mixture of native broadleaf, bushy multi-stem and low-level shrub species, this flow channel is expected to be fully mitigated. This is particularly effective for warmer months in which outdoor seating is most desired. With the landscaping scheme planned, no issues are expected for this region.

Increased winds tend to be concentrated along Upper Brook Street and between the buildings of the proposed development. These occur as a result of wind from higher elevations, which have higher speeds, being redirected toward ground level in downdraughts. The buildings across Upper Brook Street add to this effect, creating a channel which concentrates wind. This does not cause any detrimental changes at acceptability receptors outside of the flow channel discussed above.

The addition of the neighbouring scheme being brought forwards by the Property Alliance Group (PAG) and Moda Living again increases the intensity of winds at pedestrian level. However, these effects are limited to the vicinity of this adjacent scheme, and create only minor detriments to the proposed development. These are viewed as a consequence of the adjacent scheme, and not of the proposed development.

Overall, once the landscaping scheme around the proposed development is implemented, no significant concerns are noted with the wind microclimate as a result of the proposed development.

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1.0 Introduction

1.1 Introduction

This report has been prepared by Wilde Analysis on behalf of McLaren Property Ltd. and Kadans Science Partner, to support a full planning application for a Sci-Tech and purpose-built student accommodation scheme (PBSA) scheme (hereafter referred to as the 'Proposed Development') on the project 'Upper Brook Street Masterplan- McLaren/ Kadans' (hereafter referred to as the 'Site'). This scheme would bring forward development on a Previously Developed site which is earmarked for commercial and PBSA uses in the Oxford Road Corridor SRFG 2019. This application has been accompanied by a suite of technical documents, reports and plans. This report covers the effects of the proposed development and nearby schemes on the local wind microclimate. Wind conditions are analysed using Computational Fluid Dynamics (CFD), under 3 landscapes – the current landscape, after the construction of the proposed development, and after the construction of both the proposed development and planned neighbouring schemes.

Data has been collected from project stakeholders and a variety of publicly available sources. The assessment is performed via analysis of wind statistics for the location, followed by an evaluation of the local microclimate using the Lawson Criteria for pedestrian comfort [1, 2].

2.0 Assessment Methodology

2.1 Wind Microclimate Criteria

The wind microclimate is typically assessed with reference to the Lawson criteria [Ref 1, 2]. The pedestrian comfort criteria take account of the continually varying strength and direction of the wind by stipulating values of wind speed above which conditions are deemed unsuitable for particular activities, if occurring more than 5% of the time. Criteria for safety (or “distress”) are defined on a similar basis.

The LDDC (London Docklands Development Corporation) offer a useful interpretation of the Lawson criteria from a planning authority’s perspective, shown in Table 1 below. The comfort threshold is set for the wind speed that is exceeded 5% of the time regardless of direction.

Table 1 - Lawson Criteria Thresholds (LDDC variant)

Category	Description	Unacceptability Condition
Sitting	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or sit for long periods.	Wind speed exceeds 4m/s for at least 5% of the time
Standing	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops.	Wind speed exceeds 6m/s for at least 5% of the time
Strolling	Breezes that would be appropriate for window shopping and strolling along a city/town centre street, plaza or park.	Wind speed exceeds 8m/s for at least 5% of the time
Business Walking	High speeds that can be tolerated if one’s only objective is to walk, run or cycle without lingering.	Wind speed exceeds 10m/s for at least 5% of the time

From these categories, so-called ‘receptor’ sites are identified locally to the proposed development. These are areas which require assessment under the sitting to strolling categories. Unspecified areas are assessed to the business walking criterion.

2.2 Assessment Against Microclimate Criteria

As Manchester City Council does not specify a particular assessment methodology, an 18-direction statistical approach has been utilised to determine wind acceptability. This was agreed with the wind consultants for phase 2 of the Upper Brook Street Masterplan, being delivered by the Property Alliance Group and Moda Living, such that the two applications will match in their approach. First, the local area is examined to identify receptors near to the proposed development (section 3.0). This often includes any gardens or seating areas included as part of the proposal, if details are provided. Wind statistics are then analysed (section 4.0), to determine directions from which the wind commonly

blows, and from which wind speeds are generally highest. As noted above, 18 directions were selected – 12 equi-spaced at 30° intervals, with the extra 6 being added around the most probable wind directions so as to increase resolution.

With the wind coming from a particular direction, the reference wind speed is that of the unimpeded approaching wind 10m above ground level. The actual wind speed at any point in the townscape can be expressed as a multiple of the reference speed for this direction. This multiple is referred to as the ‘speed up factor’.

Using CFD, the speed up factors for each wind direction were derived on a surface 1.5m above ground level (chosen so as to mimic pedestrian head height). These speed-up factors and the statistical distribution of reference wind speeds for each wind direction were used to calculate the probability that the wind speed at pedestrian level would exceed a defined threshold value, U , as defined by the Lawson criteria.

The probability of the wind being from each of these directions then allows for the calculation of the overall probability that U would be exceeded regardless of wind direction. These probabilities were compared with the limits defined in the Lawson criteria [1].

3.0 Site Description

3.1 Local Environment

The Site extends to 1.084 hectares and is partially in use as a temporary paid car park. The paid car park is located on a section of the Site which was formerly in use as a Citroën car dealership and is accessed from both Upper Brook Street to the west and Kincardine Road to the east. The remainder of the Site comprises the former Elizabeth Yarwood Court residential complex, which is accessed from Kincardine Road to the east of the Site. The Upper Brook Street masterplan intends to transform the currently vacant sites, re-establishing their important role in the area by reintroducing permeability, public realm, and active community-facing uses at ground floor. The emerging masterplan includes 2.9 acres of new public realm and green spaces, a new public square, as well as a series of high-quality new buildings of varying heights to provide for approximately 700,000ft² of sci-tech accommodation, 1,800 purpose-built student accommodation beds, and 25,000ft² of active ground floor uses.

The existing land uses surrounding the site are as follows:

- To the north of the Site is a vacant single-storey commercial building (also identified for redevelopment within the Oxford Road Corridor SRF) and the Grade II listed ‘Former Unitarian Chapel’ which now functions as student accommodation.
- To the east of the Site is Kincardine Road; beyond which is a 4 to 6-storey student accommodation building and 2-storey residential dwellings that form a part of the wider Brunswick Estate. The Brunswick Estate is an area currently undergoing extensive urban regeneration (see Cumulative Scheme 1 (Brunswick Neighbourhood)).
- To the south of the Site is Cottenham Street; beyond which is the Tai Wu restaurant and W.H. Lung Supermarket.
- To the west of the Site is Upper Brook Street, on the opposite side of which is the University of Manchester’s Main Campus, which includes the National Graphene Institute, the Manchester Engineering Campus and the Sir Henry Royce Institute, with buildings ranging from 4-storeys to 10-storeys in height.

Additionally, a planned neighbouring development consists of 5 buildings, with the tallest residing at 42 storeys (approximately 120m). The effect of this neighbouring development will be included in this analysis. No other significant, consented schemes were found on the Manchester City Council planning page.



Figure 1 - Local Area

3.1.1 Local Receptors

Receptor locations are those at which pedestrians are likely to be performing activities with a lower wind tolerance, such as sitting on benches, entering or exiting buildings, or window shopping. These are then assessed to more stringent criteria. Typical public receptor locations in the UK could include bus stops, parks, cycleways and footpaths. Figure 2 to Figure 5 show receptor locations nearby the proposed development and adjacent development, coloured by stringency of assessment. Seating, which would be assessed to the most stringent criterion, is typically located in the nearby parks and green spaces. Locations identified as likely to be used for standing, which adhere to the second-most stringent criterion, involve entrances to communal buildings and bus stops. Locations likely to be used for strolling involve parks, and are assessed to the third-most stringent criteria.

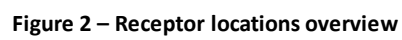




Figure 3 – Receptor locations, Gartside Gardens

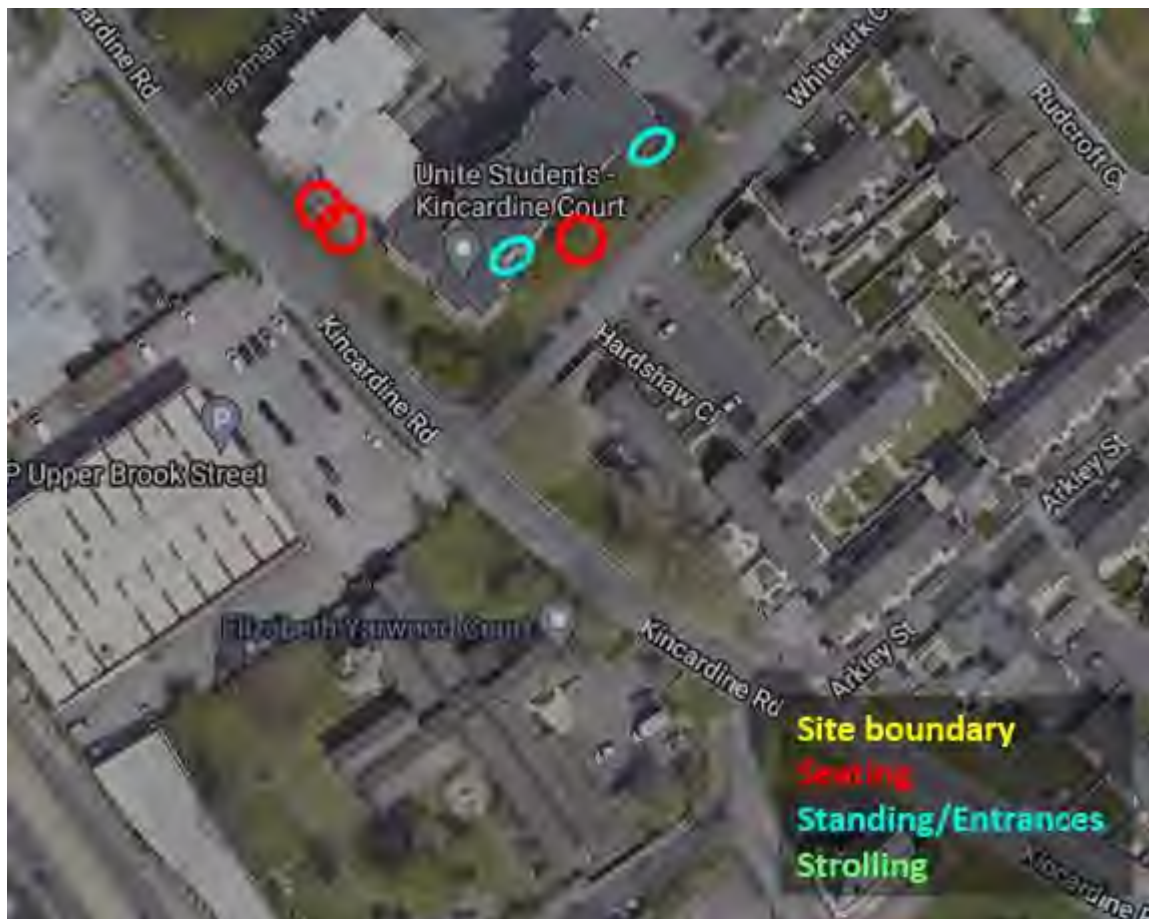


Figure 4 – Receptor locations, Kincardine Court



Figure 5 – Receptor locations, Brunswick Street

3.2 Proposed Development

This assessment is performed on the two parallel blocks of the PBSA building, which are up to 9 and 23 storeys in height. The PBSA development and the Sci Tech building of 6 to 9 storeys, including the PAG/Moda scheme, were supplied in the form of a CAD file. This CAD file [3] is overlaid on the existing landscape in Figure 6.

Figure 7 shows the ground floor layout of the north building of the proposed PBSA development. This features community space on the side of Kindcardine Road (north-east side) and retail space in the west corner along Upper Brook Street. These two spaces have their own main entrances, and a third main entrance (to the residential space) can be found on the south-east side. Cycle entrances, service access and fire exits are located around the full perimeter of the building. Landscape features and trees are found along both adjacent roads and between the two buildings. Note that these have not been included directly in the model; this is discussed in section 5.2. Communal outdoor space can be found on the first floor, shown in Figure 8. Likewise, the planned landscaping features in this location are not directly included in the model. Note that fire escapes are not marked as normal entrances on the below figures.



Figure 6 – Development CAD file overlayed on existing landscape (viewed from east)



Figure 7 – Ground floor plan

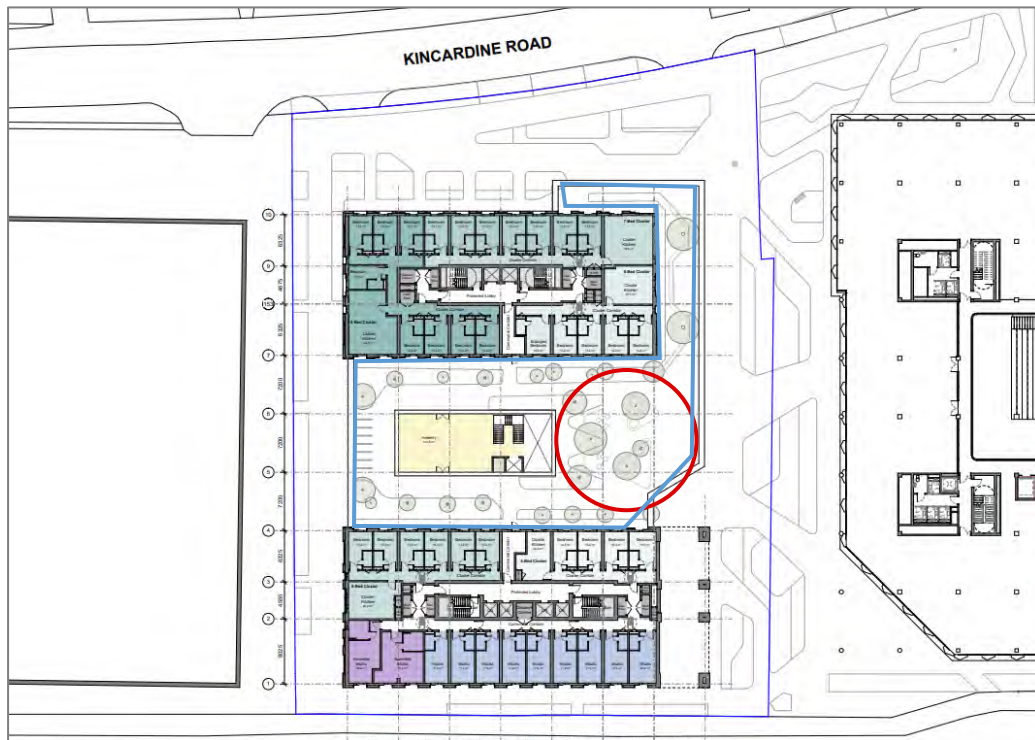


Figure 8 – North building first floor plan

4.0 Local Weather Conditions

The wind conditions used in this assessment have been taken from the weather station at Manchester Airport [4], approximately 12km west of the proposed development. A wind rose plotting half-hourly average wind speed and direction based on the available data starting January 2010 and ending May 2022 is shown in Figure 9.

The data obtained were split into 18 increments to effectively represent all possible wind directions. 12 of these directions are equally spaced at 30° increments, with the additional 6 placed around the most probable wind directions to increase resolution and fidelity. The array of wind speeds in each direction was fitted to a Weibull distribution to calculate the 95th percentile wind speed, i.e. the speed which will be exceeded 5% of the time. This is shown in Table 2 for each wind direction. 0° represents wind from the north, 90° wind from the east, and so on. Some additional statistics on wind speed are presented in Figure 10 and Figure 11. Note that uniform increments are used in these figures to allow comparison.

Table 2 – Wind Reference Speed (10 m Above Ground Level) by Direction

Wind Direction [degrees]	Bin Range [degrees]	Reference Wind Speed [m/s]
0	345-15	7.10
30	15-45	7.38
60	45-75	6.75
90	75-105	5.16
120	105-135	4.16
150	135-165	4.89
170	165-175	5.63
180	175-185	5.65
190	185-195	5.69
200	195-205	6.00
210	205-215	6.30
220	215-225	6.98
240	225-255	7.96
260	255-265	8.62
270	265-275	8.33
280	275-285	8.44
300	285-315	7.42
330	315-345	6.13

The most frequent and strongest winds blow from the west. Approximately 1.4% of wind speeds exceed 10m/s, and 0.36% of wind speeds exceed 12m/s. The overall average wind speed is approximately 3.4m/s.

Note that the wind speeds presented here were recorded at 10m above ground level; the wind speeds experienced at pedestrian height will generally be less.

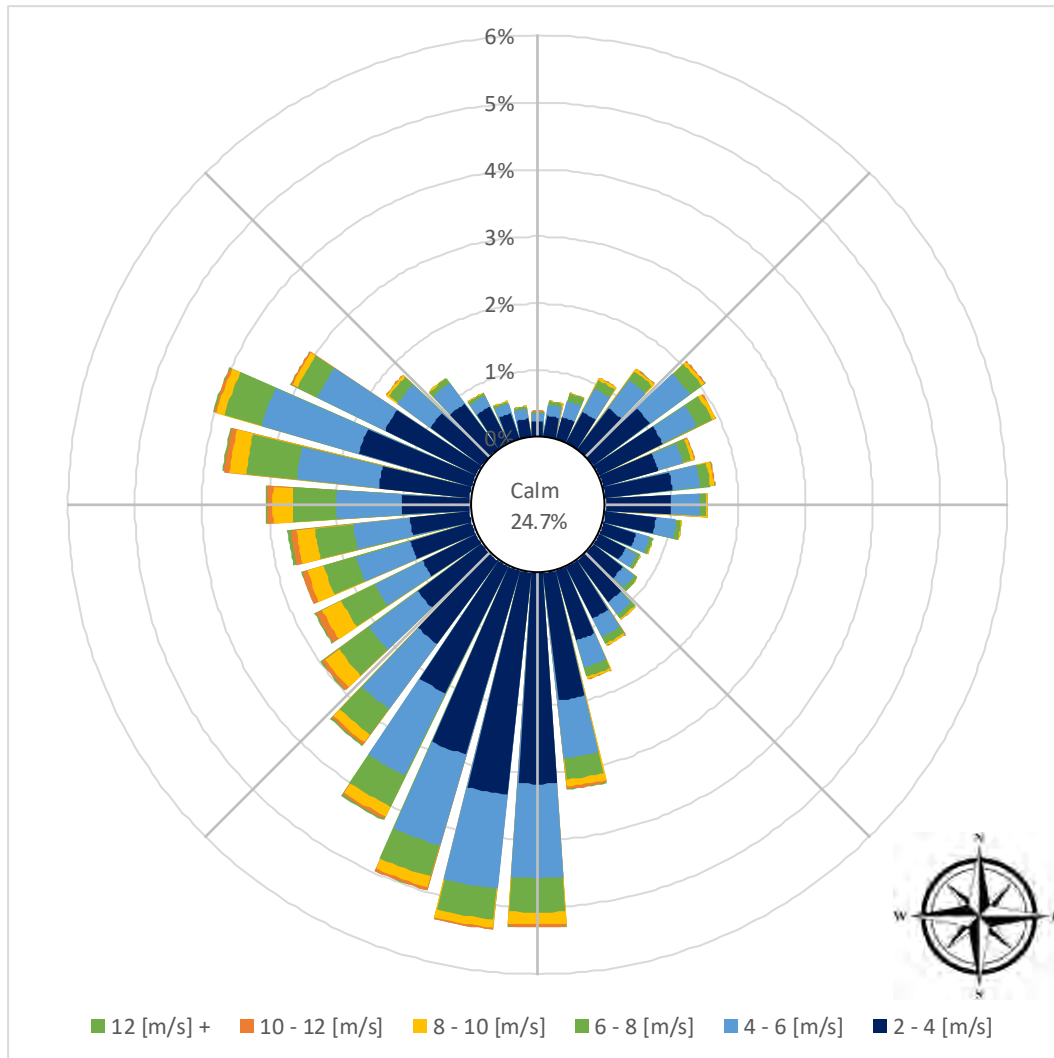


Figure 9 - Hourly Average Wind Speeds at Manchester Airport 10m Above Ground Level

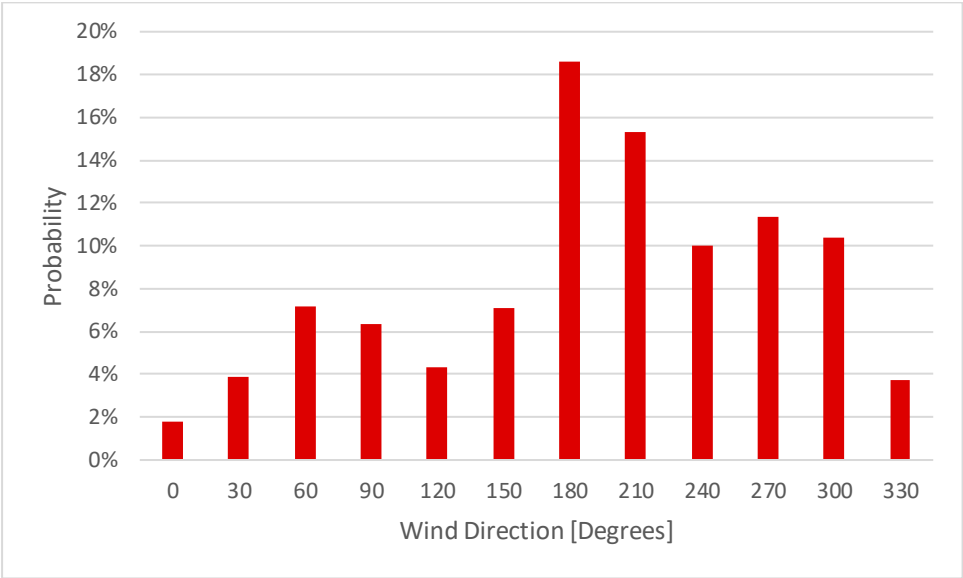


Figure 10 - Wind Direction and Probability at site

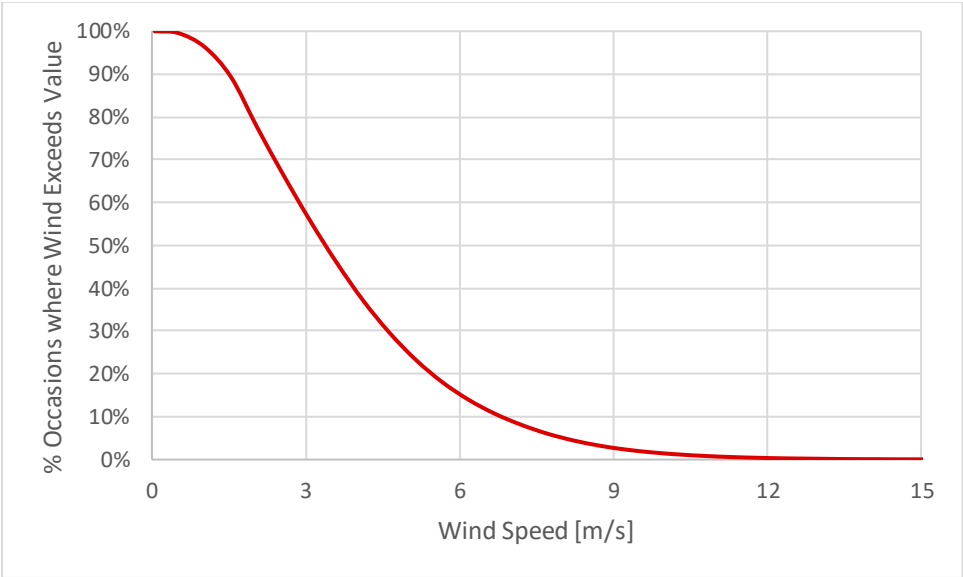


Figure 11 - Probability of Wind Speed Exceeding the Hourly Average, Regardless of Direction

5.0 Description of the CFD Model

5.1 Geometry

Three computational models were constructed – these represented the existing site, with the proposed development and with the neighbouring development. Buildings of the surrounding context up to a radius of 600m were included to get realistic flow paths through the development site. An outer rectangular domain was constructed for two purposes – to aid convergence and to rotate based on wind direction.

Details of the CFD domain (with the proposed development and adjacent development) are pictured in Figure 12 and Figure 13. Geometry of buildings and terrain were based on public data sources. Building geometry was de-featured; that is, minor geometrical features judged as unlikely to affect wind flow were removed.

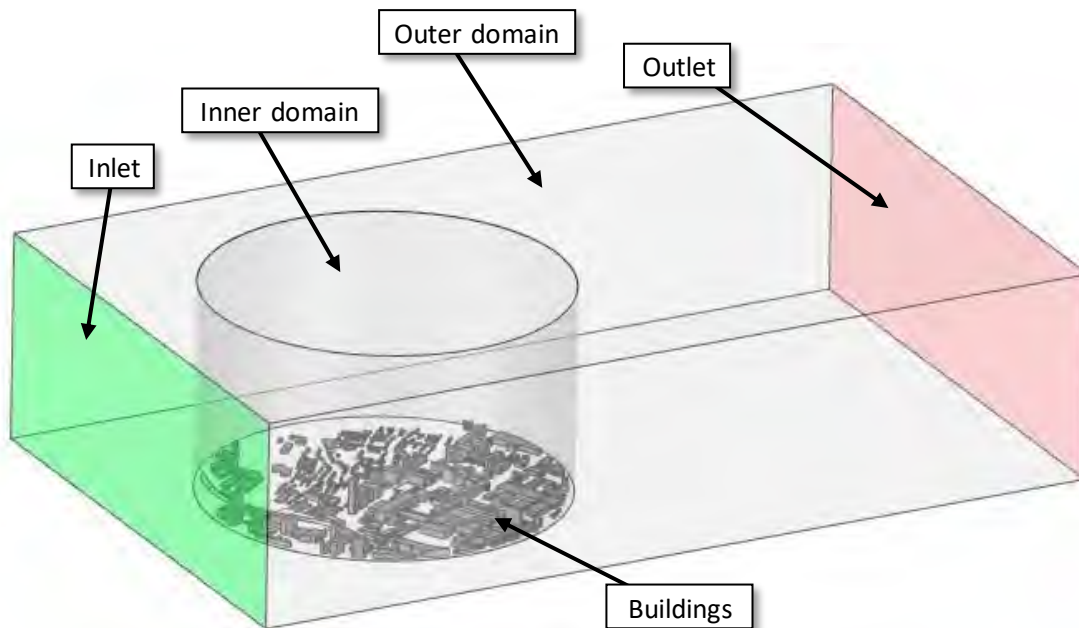


Figure 12 - CFD Domain Extents

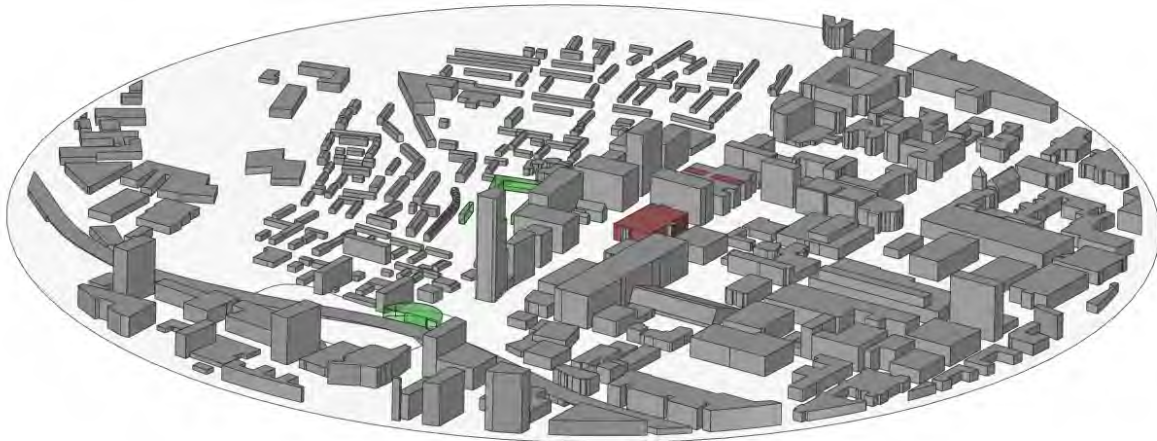


Figure 13 - Site Local Region (view from the northwest).

5.2 Porous Regions

Porous regions are separate zones in the CFD model which can be used to impart resistance to flow. These are shown as coloured blocks in Figure 13 above. Different resistances can be specified in different directions. Porous regions were utilised in three places – existing trees, the multistorey aquatics centre car park, and the semi-enclosed roof of the Alan Turing building. The locations of these porous regions are highlighted in Figure 14. The car park and semi-enclosed roof are shown in Figure 15 and Figure 16 respectively. Trees are modelled using a conservative resistance coefficient in CFX of 80m^{-1} [Ref 5].

Note that trees within the bounds of the proposed development were not included. The landscaping plans show an excess of 30 trees on-site, and detail species effective at reducing local wind speeds. However, the eventual size, permitting for growth and maintenance remains unknown, so removing these trees is a conservative assumption for this analysis. This allows for assessment of a worst-case condition, from which foliage placement can be examined, as opposed to an unknown condition which may present greater mitigation than in reality.

Anisotropic flow resistance was specified for the car park and semi-enclosed roof. For the car park, a resistance coefficient of 0.06m^{-1} was used in the plane of the floors, based on results of a simple sub-model. A high resistance was used in the vertical direction to prevent flow through the floors. For the semi-enclosed roof, a high resistance was used in the direction normal to the roof panels, while no resistance was used in perpendicular directions.

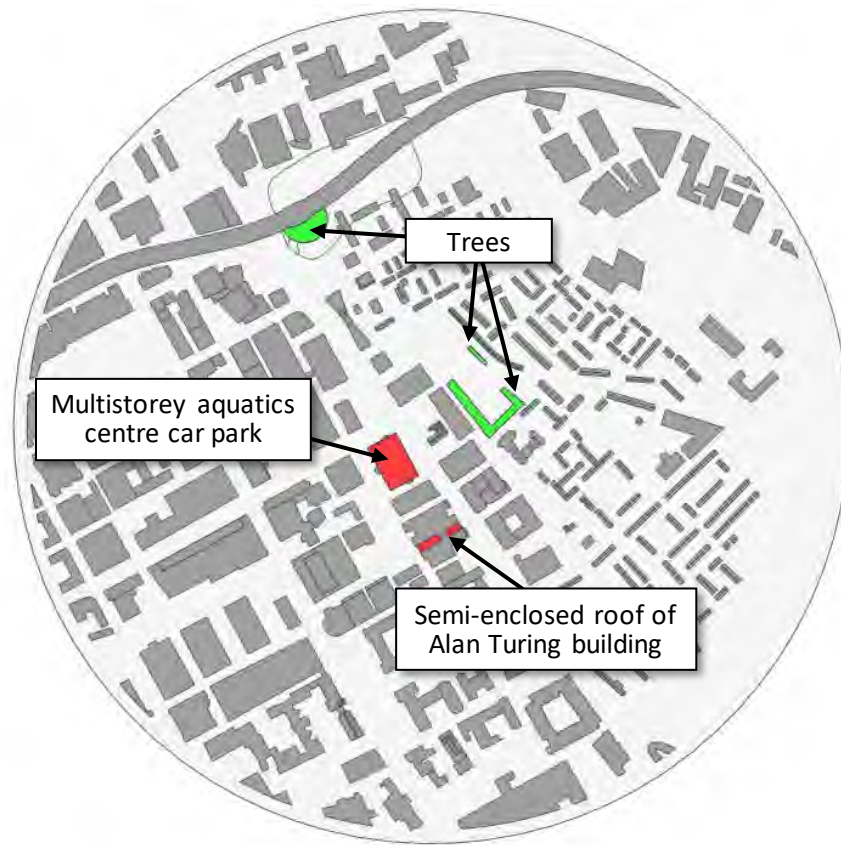


Figure 14 – Porous region locations



Figure 15 – Multistorey Aquatics Centre car park

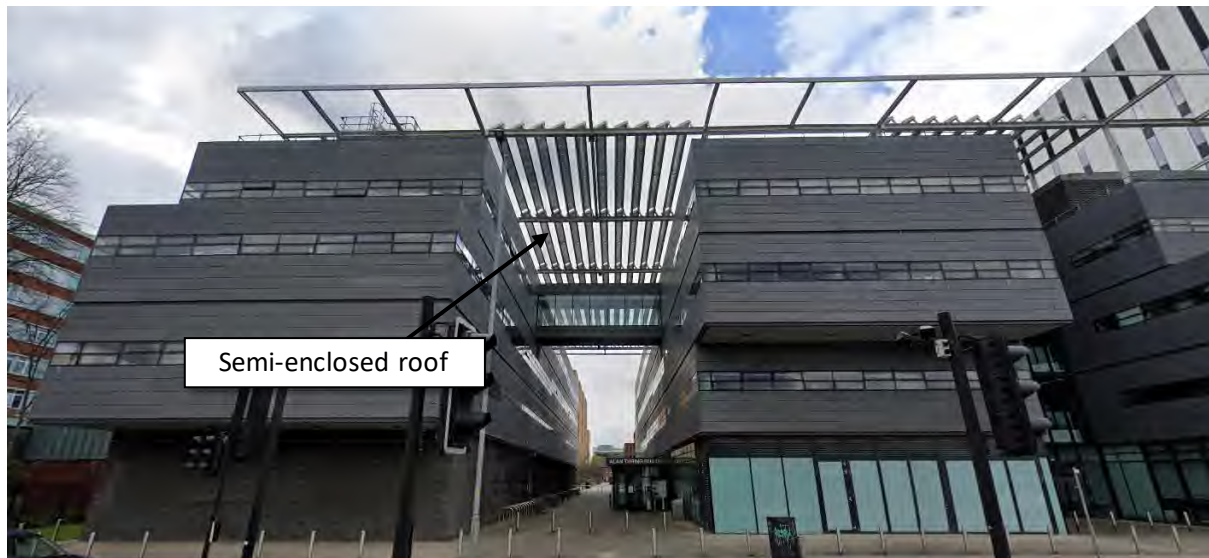


Figure 16 – Semi-enclosed roof of Alan Turing building

5.3 Boundary Conditions

As discussed in section 2.0, the 95th percentile wind velocity was determined for each direction. This was then used to calculate a velocity profile, an example of which is shown in Figure 17.

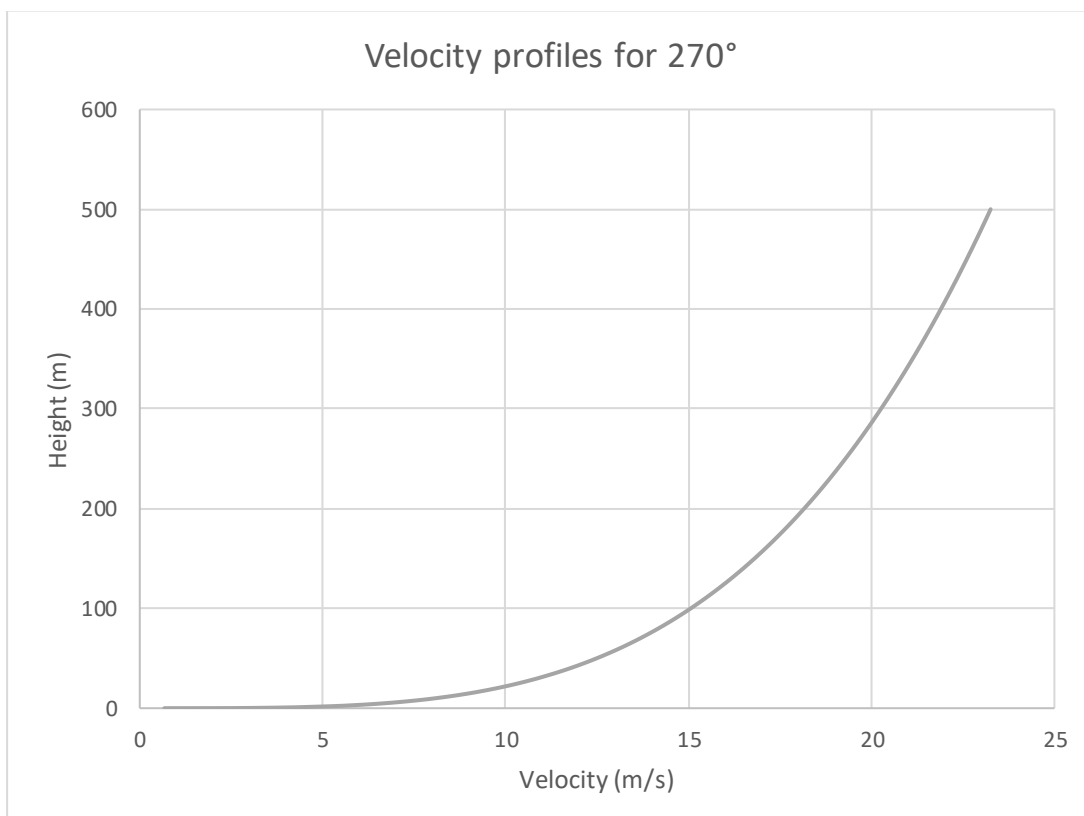


Figure 17 - Velocity Profile for wind from west

Each profile follows a power law based on the equation $v(z) = v_{0i} \left(\frac{z_c}{z_0} \right)^\alpha$ [Ref 6] where:

- v_{0i} represents the reference velocity of 10m/s,
- z_c is elevation, z, above ground level at a point on the inlet,
- z_0 is the reference height above ground level, in this case 10m,
- α depends on the nature of the terrain in the upwind direction. Given that this development is in an urban area, it takes a value of 0.27 in all cases [Ref 6].

This was applied to the inlet boundary, along with profiles for the associated turbulence parameters.

Flow was assumed to be turbulent, with parameters calculated similarly to the velocity profiles to be consistent with physical length scales. This was represented by a k- ω SST turbulence model.

5.4 Air Properties

Air was assumed to have a constant density of 1.185 kg/m³ and dynamic viscosity of 1.83 x 10⁻⁵ Pa.s. As density was considered constant, no natural convection effects were considered.

6.0 **Results**

6.1 **Lawson Criteria**

Analysis according to the LDDC interpretation of the Lawson Criteria is performed over 4 different conditions; sitting, standing, strolling and business walking. Sections 6.1.1, 6.1.2 and 6.1.3 present acceptability over the 4 conditions for the current site, with the proposed development, and with adjacent approvals. Flow patterns for each case and direction are further presented in Appendix A – Flow Conditions.

6.1.1 **Current Site**

The current site presents no significant concerns with respect to acceptability under the 4 conditions of the Lawson Criteria. Some locations are deemed inappropriate for sitting – of these, only the channel between the Henry Royce Institute and the Alan Turing building is in close enough proximity to the proposed development to be considered. None of these areas are assessed to the sitting criterion. All other conditions - standing, strolling and business walking - exhibit no exceedances of the Lawson Criteria.

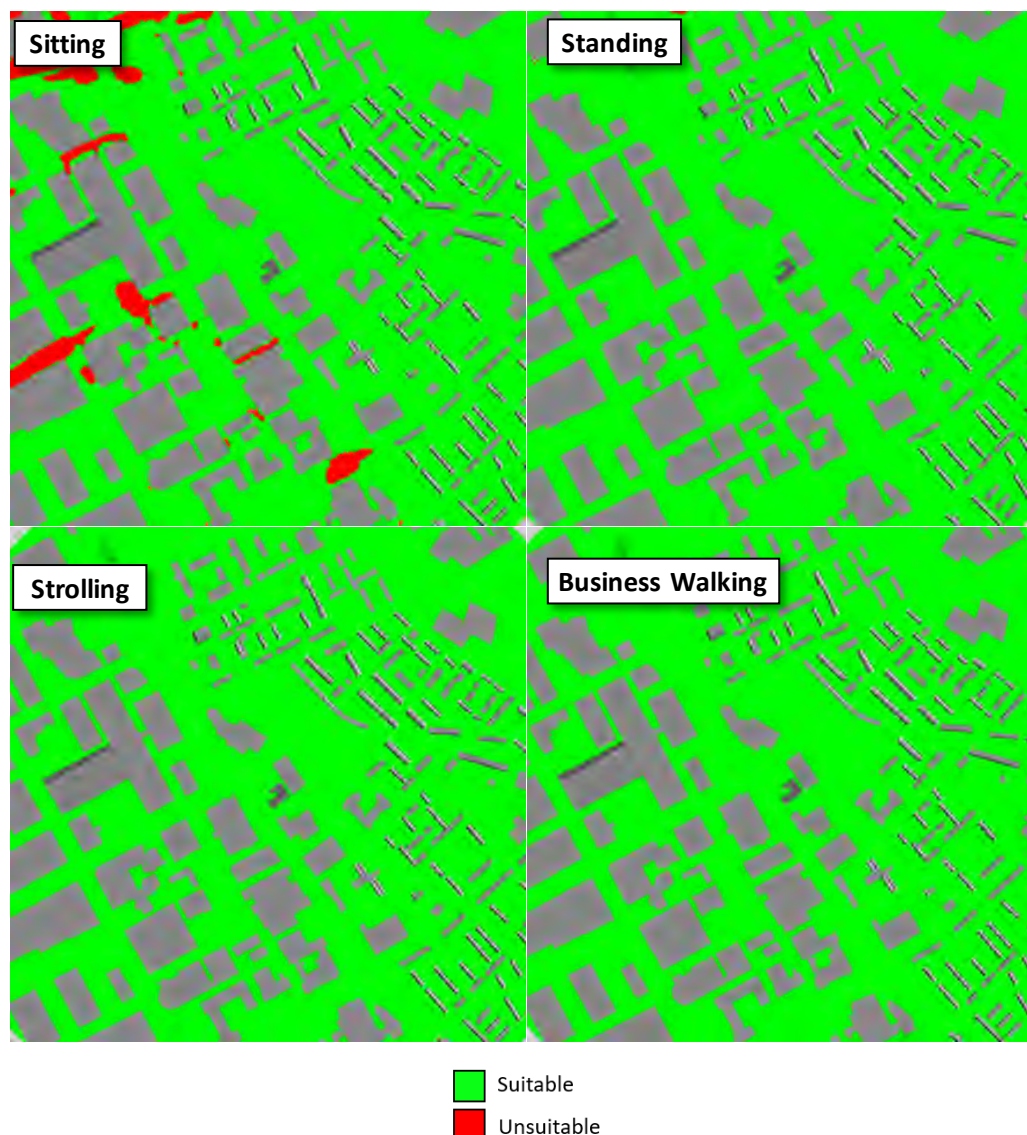


Figure 18 – Current Site; Lawson Criteria

6.1.2 With Proposed Development

With the addition of the proposed development (both PBSA and Sci-Tech Buildings, without associated landscaping), the regions deemed inappropriate for sitting become more widespread. These are located where wind channelling was previously observed - between the development and along Upper Brook Street. Casual seating is located in the communal space between the proposed buildings, called Thorburn Walk. This is expected to be effectively mitigated by the foliage included in the landscaping scheme, which focuses a large number of both canopy trees and low shrubs in this channel.

There are no identified receptor locations outside the proposed site in the affected region which are likely to be used for sitting. Three small regions have appeared around the north building of the proposed development which is now deemed inappropriate for standing. These are sufficiently small that the proposed landscaping is expected to entirely remove this exceedance. An entrance to the Alan Turing building is close to an affected region, however the shape of the building provides

sufficient coverage for this to not constitute a problem. No other locations which are likely to be used for standing are found in the affected regions. Other conditions - strolling and business walking - exhibit no exceedances of the Lawson Criteria.

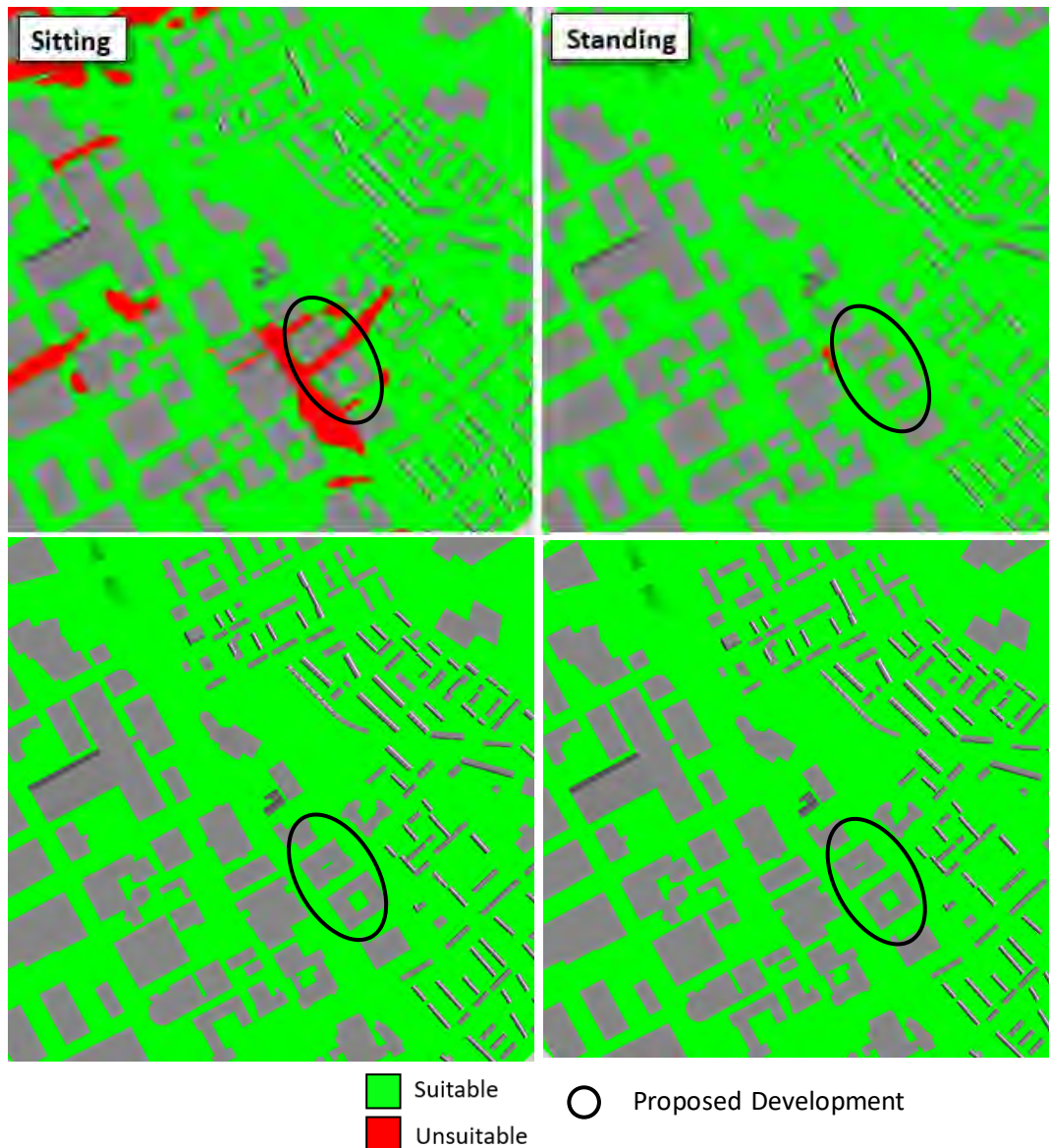


Figure 19 – With proposed development; Lawson Criteria

6.1.3 With Neighbouring Development

With the addition of the neighbouring development, there is no significant change to the acceptability of the Lawson Criteria around the proposed development. It should be noted that the representation of the neighbouring development does not include the final massing model, detailed landscaping or any other potential mitigation measures. These will come forward as part of a separate detailed planning application which will include its own wind assessment for that part of the wider masterplan site. As such, locations in the immediate vicinity of the neighbouring development are not discussed

further in this report. Regions deemed inappropriate for sitting are largely similar to conditions without the neighbouring development. In regard to the proposed development, the regions deemed inappropriate for standing have changed slightly (more concentrated between buildings, rather than on Upper Brook Street), but are overall similar in size. The regions which were deemed inappropriate for standing in the previous section also remain with the addition of the neighbouring development (although slightly different location and size). Again, these are sufficiently small that the proposed landscaping is expected to entirely remove this exceedance. Other conditions - strolling and business walking – still exhibit no exceedances of the Lawson Criteria.

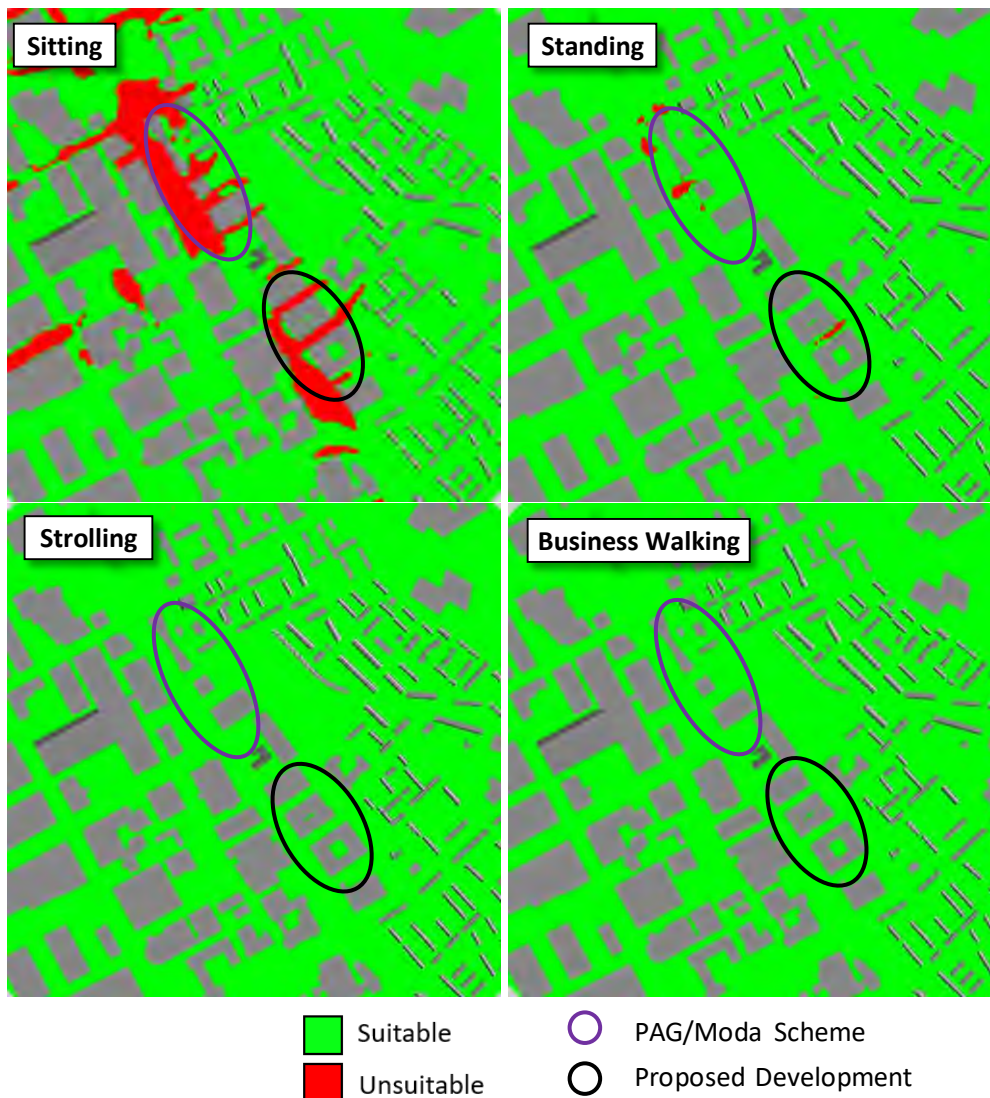


Figure 20 – With neighbouring development; Lawson Criteria

7.0 Conclusions

An assessment has been performed of the wind conditions surrounding the project 'Upper Brook Street Masterplan-McLaren/ Kadans', comprising of a PBSA development and a Sci-Tech building. While the addition of the two buildings does increase the intensity of winds at pedestrian level, the magnitude of this increase is not sufficient to cause significant detriment to pedestrian comfort. There are no locations outside of the proposed site which are likely to involve sitting or standing that experience a change in the Lawson Criteria acceptability for sitting or standing respectively. There is likewise no change in the acceptability for strolling and business walking following the addition of the proposed development or the adjacent scheme.

Casual seating is currently planned in the region between the proposed buildings (Thorburn Walk), an area which is deemed unsuitable for sitting based on conditions with the landscaping scheme excluded. With the inclusion of the 30+ trees proposed for the site, consisting of a mixture of native broadleaf, bushy multi-stem and low-level shrub species, this flow channel is expected to be fully mitigated. This is particularly effective for warmer months in which outdoor seating is most desired. With the landscaping scheme planned, no issues are expected for this region.

Increased winds tend to be concentrated along Upper Brook Street and between the buildings of the proposed development. These occur as a result of wind from higher elevations, which have higher speeds, being redirected toward ground level in downdraughts. The buildings across Upper Brook Street add to this effect, creating a channel which concentrates wind. This does not cause any detrimental changes at acceptability receptors outside of the flow channel discussed above.

The addition of phase 2 of the masterplan again increases the intensity of winds at pedestrian level. However, these effects are limited to the vicinity of the adjacent scheme, and create only minor detriments to the proposed development. These are viewed as a consequence of the adjacent scheme, and not of the proposed development.

Overall, once the landscaping scheme around the proposed development is implemented, no significant concerns are noted with the wind microclimate as a result of the proposed development.

8.0 References

Ref. No.	Title	Description
1	Lawson T (2001); 'Building Aerodynamics', Imperial College Press	Lawson Criteria for Pedestrian Comfort
2	LDDC Planning Advice Note – Wind Effects and Tall Buildings, July 2017	LDDC Comments on the Lawson Criteria
3	6601_UBS - Site Model NEW.sat	Supplied CAD File
4	http://mesonet.agron.iastate.edu/sites/site.php?station=EGGP&network=GB__ASOS	Airport weather station data
5	Buccoliere et al. "Aerodynamic effects of trees on pollutant concentration in street canyons", Science of the Total Environment, 407 (2009), pp:5247-5256	Flow Resistance of Trees
6	Architectural Institute of Japan, Guide for numerical prediction of wind loads on buildings, 2005	Developed velocity profile

9.0 Appendix A – Flow Conditions

9.1 Flow Patterns

Flow patterns are illustrated below, separated by wind direction. These are plotted on the pedestrian plane, or 1.5m above ground level. Contours are coloured using a relative speed up factor – this factor indicates how much wind speed at that location has increased or decreased relative to wind speed at 1.5m height on a flat featureless plane. Relative speed up factors for the current site, with the proposed development and with adjacent approvals are presented in sections 9.1.1, 9.1.2 and 9.1.3 respectively.

9.1.1 Current Site

Speed-up factors for the current site do not suggest any significant issues. Speed-up factors are generally less than 1 in the immediate vicinity of the site. This indicates that nearby buildings are providing shelter from the wind, rather than increasing its speed. A small degree of channelling along Upper Brook Street is visible when wind directions align with the orientation of the road – directions 0°, 150° and 300° show this. When considering wind from 90° and 220°, there is a degree of wind speed-up around the Henry Royce Institute building. Due to the size and frequency of the speed-up, this is not considered a problem currently, but should be monitored when the development is added.

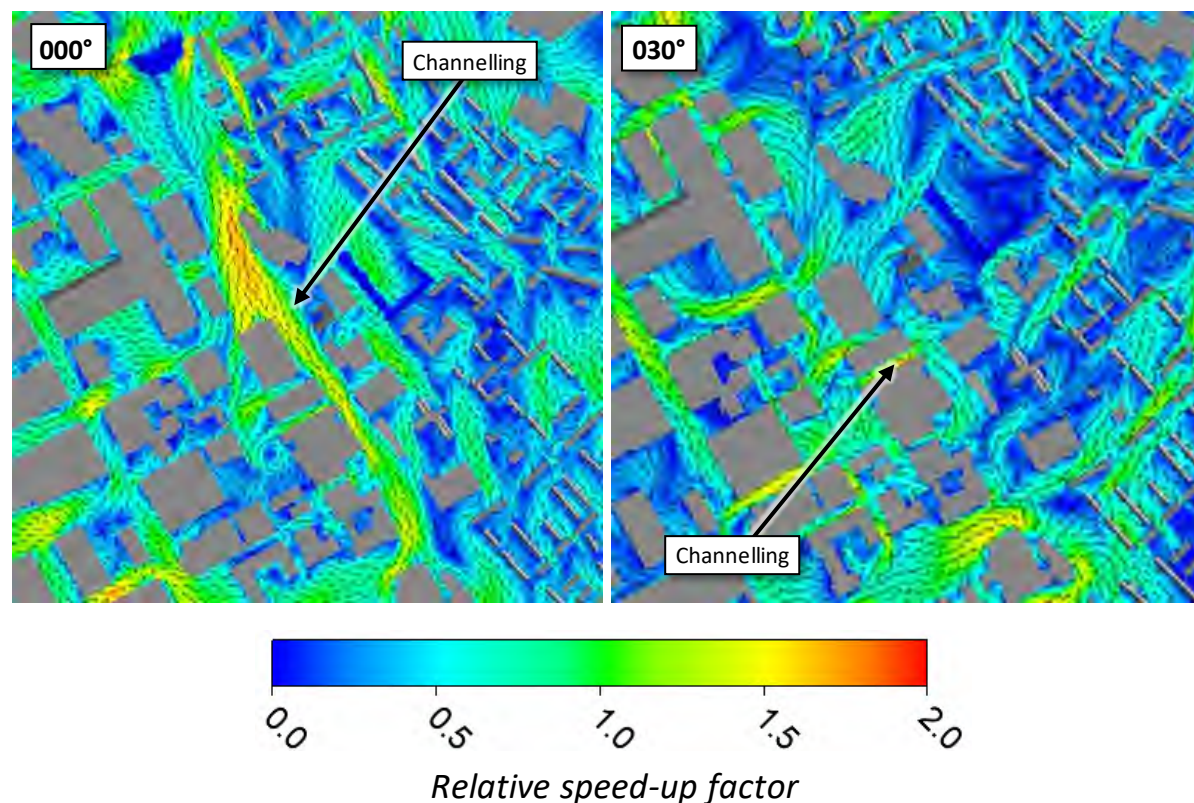


Figure 21 – Current site; speed-up factors for wind from 0° and 30°

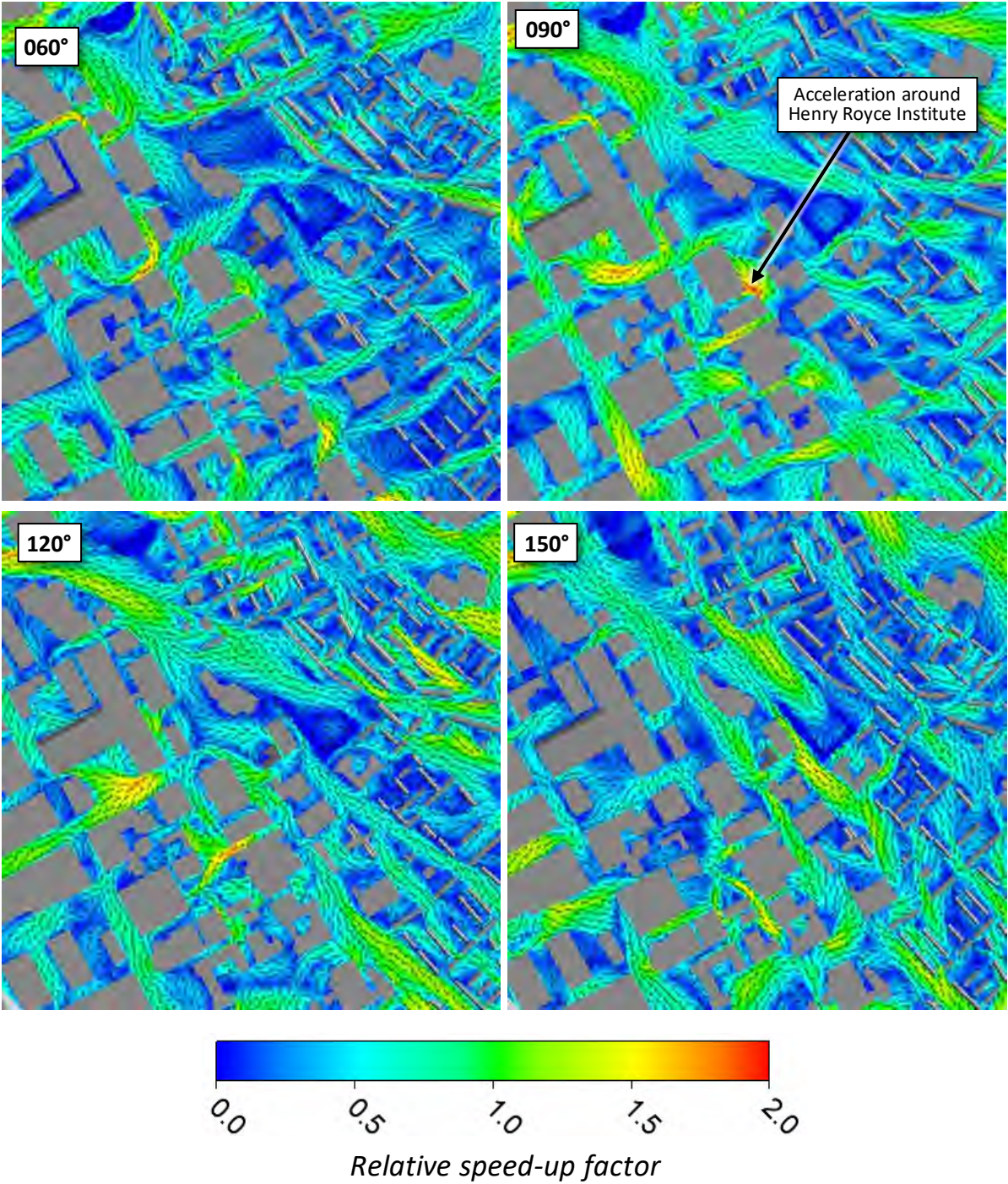


Figure 22 - Current site; speed-up factors for wind from 60°, 90°, 120° and 150°

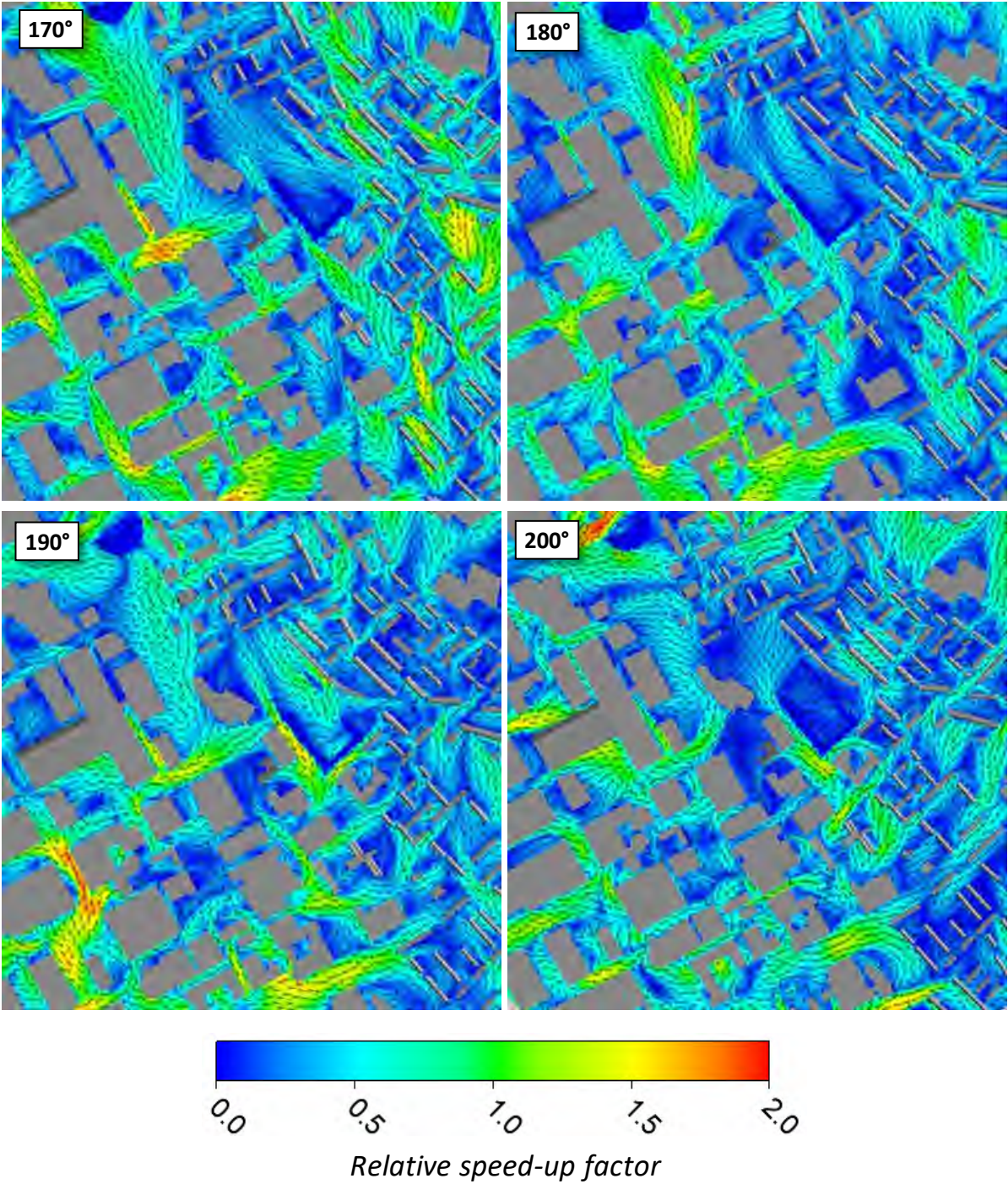


Figure 23 - Current site; speed-up factors for wind from 170°, 180°, 190° and 200°

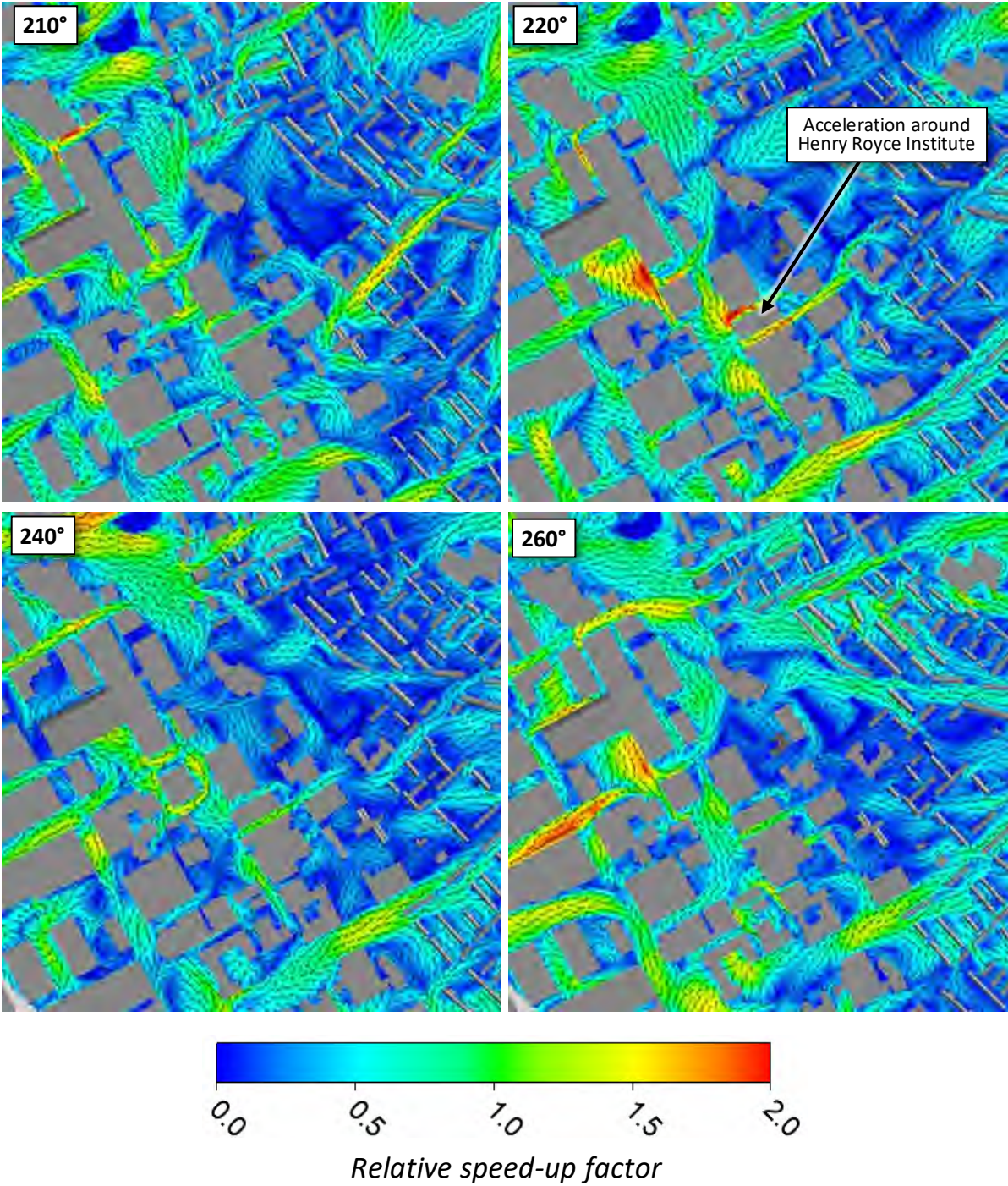


Figure 24 - Current site; speed-up factors for wind from 210°, 220°, 240° and 260°

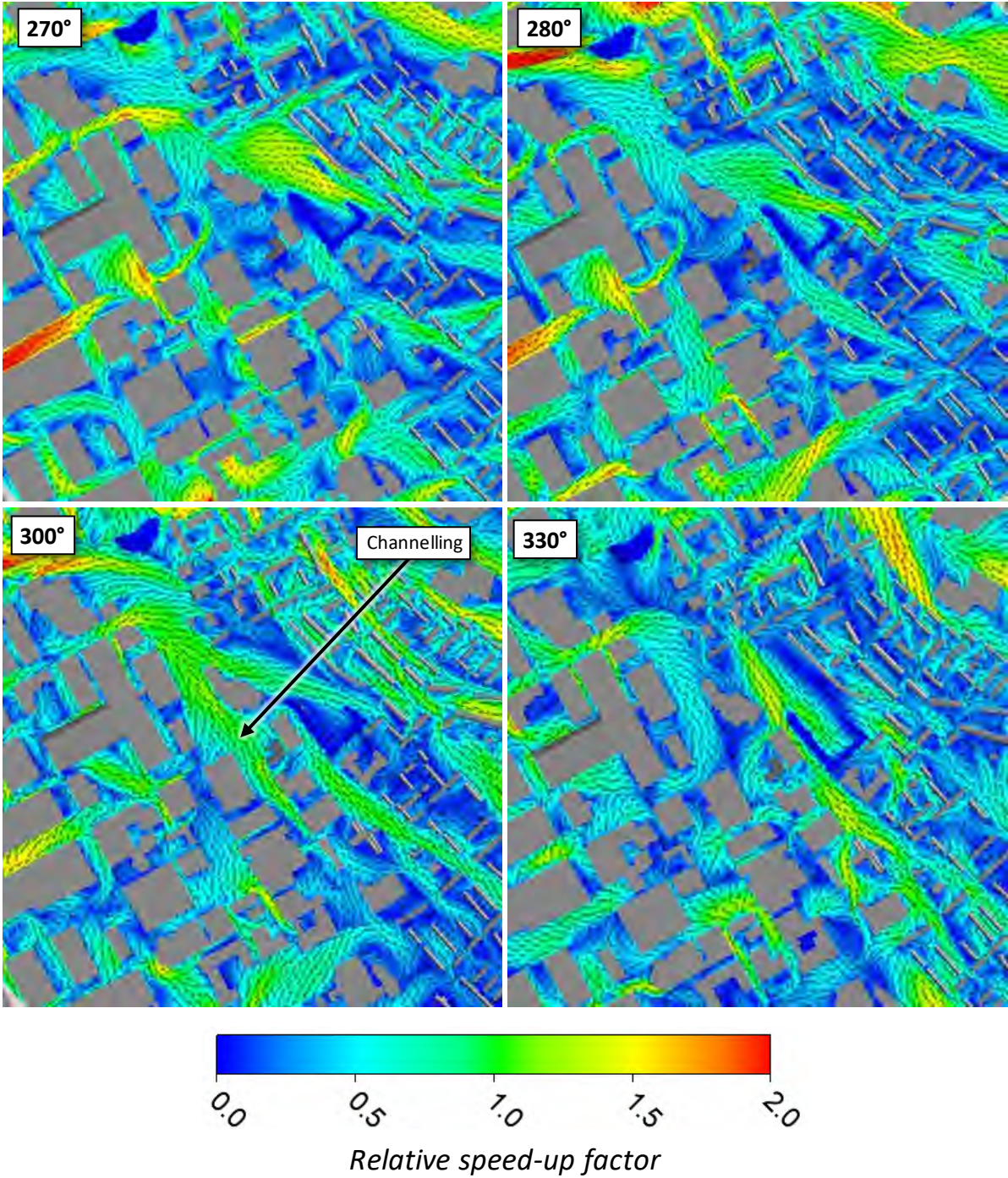


Figure 25 - Current site; speed-up factors for wind from 270°, 280°, 300° and 330°

9.1.2 With proposed development

The inclusion of the proposed development leads to some increased wind speeds in the area. In most cases, these increased winds remain local to the proposed development – resulting from downdraughts and acceleration around the buildings. This is noticeable to varying extents from all directions with the exception of wind from 150°, 170°, 280° and 300°. Some wind directions, however, also exhibit a combined channelling effect along the nearby roads – this effect is most prominent when considering wind from 190°, where channelling is observed along Upper Brook Street, and 240°, where channelling is observed between the proposed buildings toward the residential zone. The significance or otherwise of wind speed increases are examined in section 6.1.

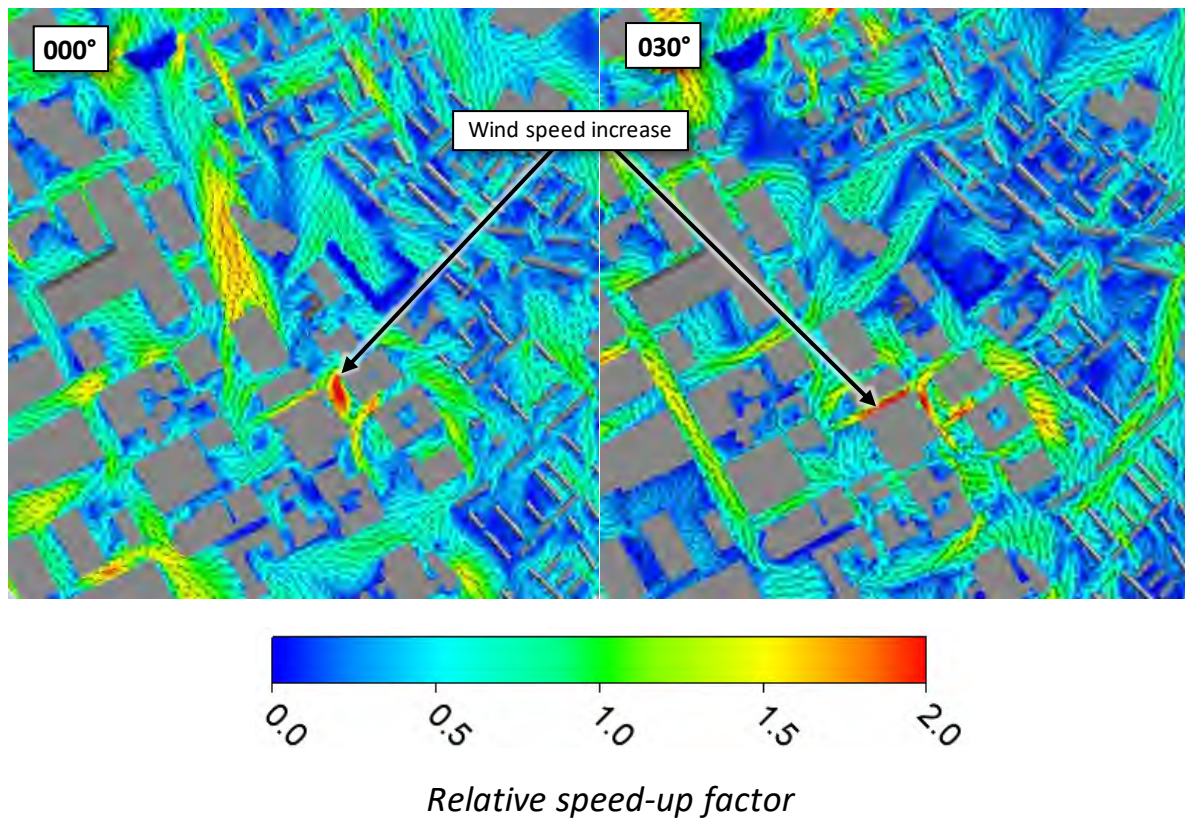


Figure 26 – With proposed development; speed-up factors for wind from 0° and 30°

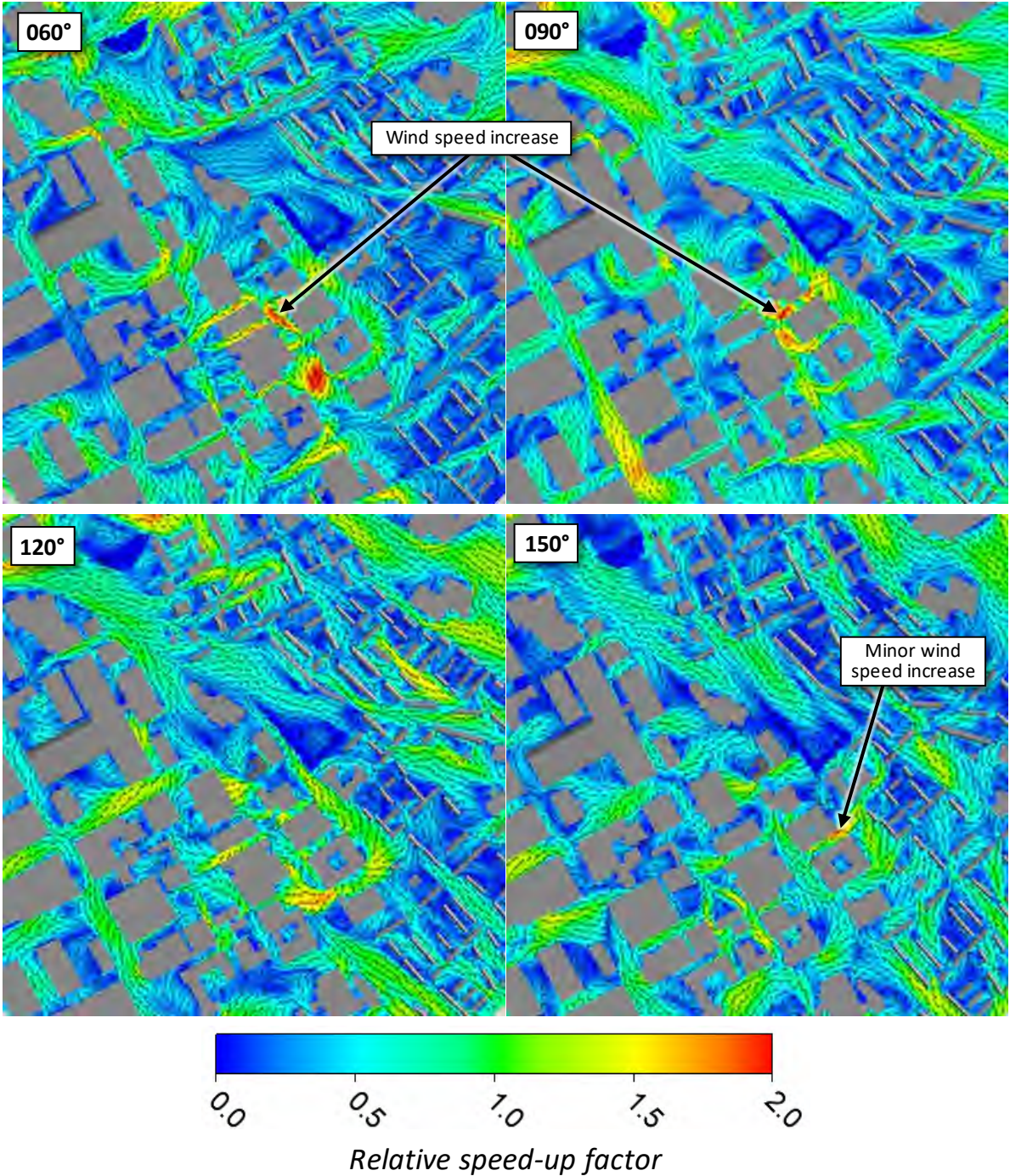


Figure 27 - With proposed development; speed-up factors for wind from 60°, 90°, 120° and 150°

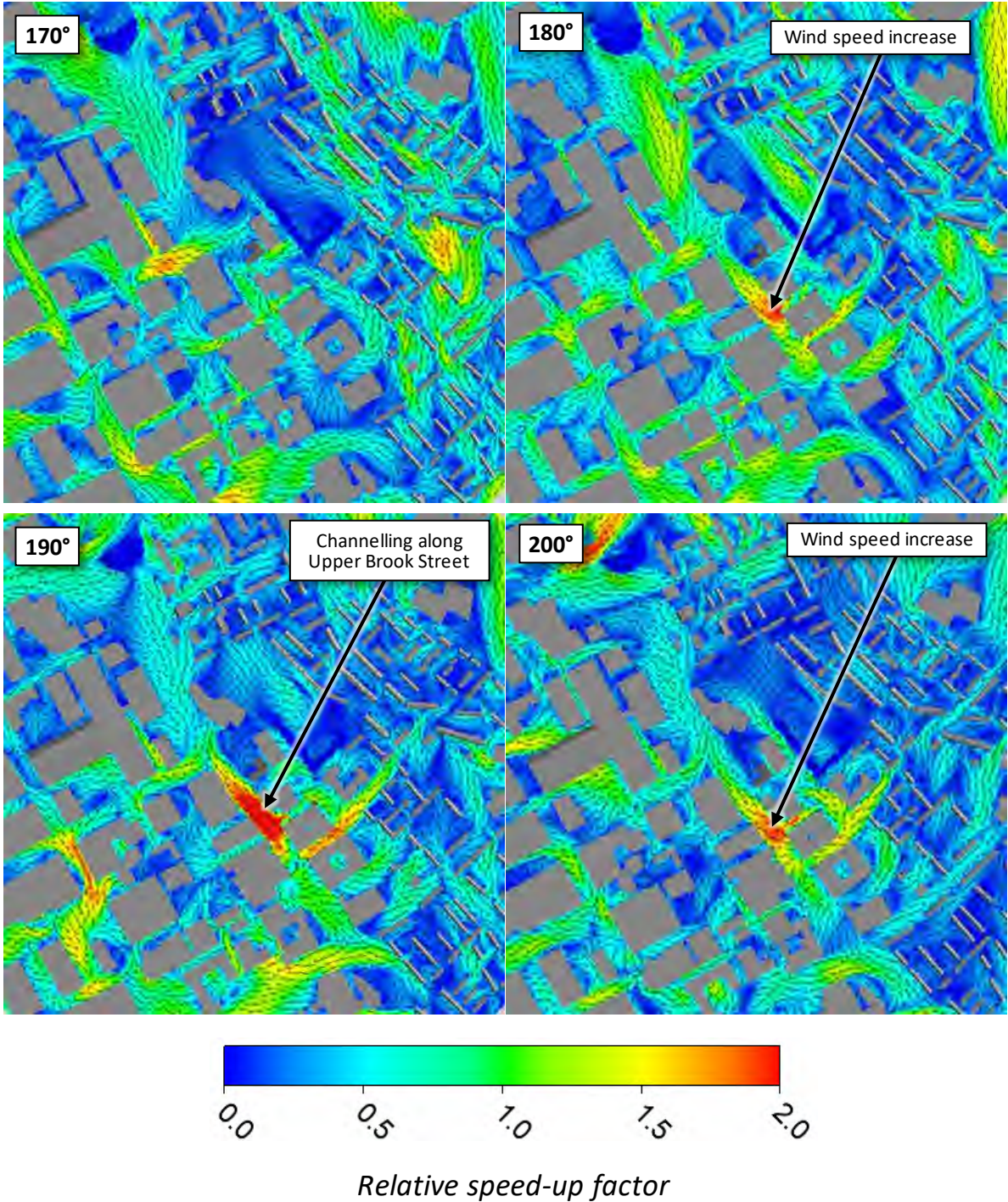


Figure 28 - With proposed development; speed-up factors for wind from 170°, 180°, 190° and 200°

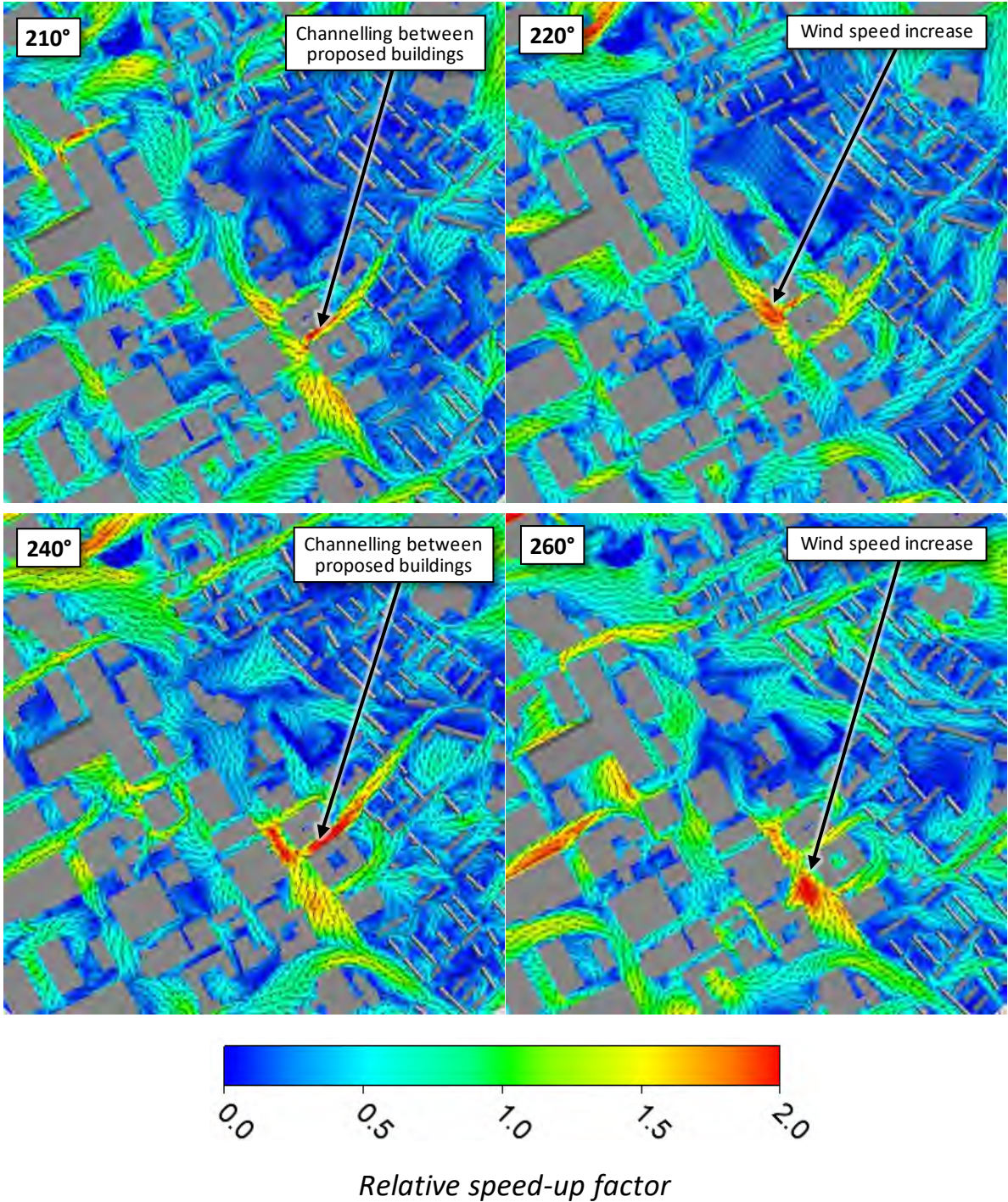


Figure 29 - With proposed development; speed-up factors for wind from 210°, 220°, 240° and 260°

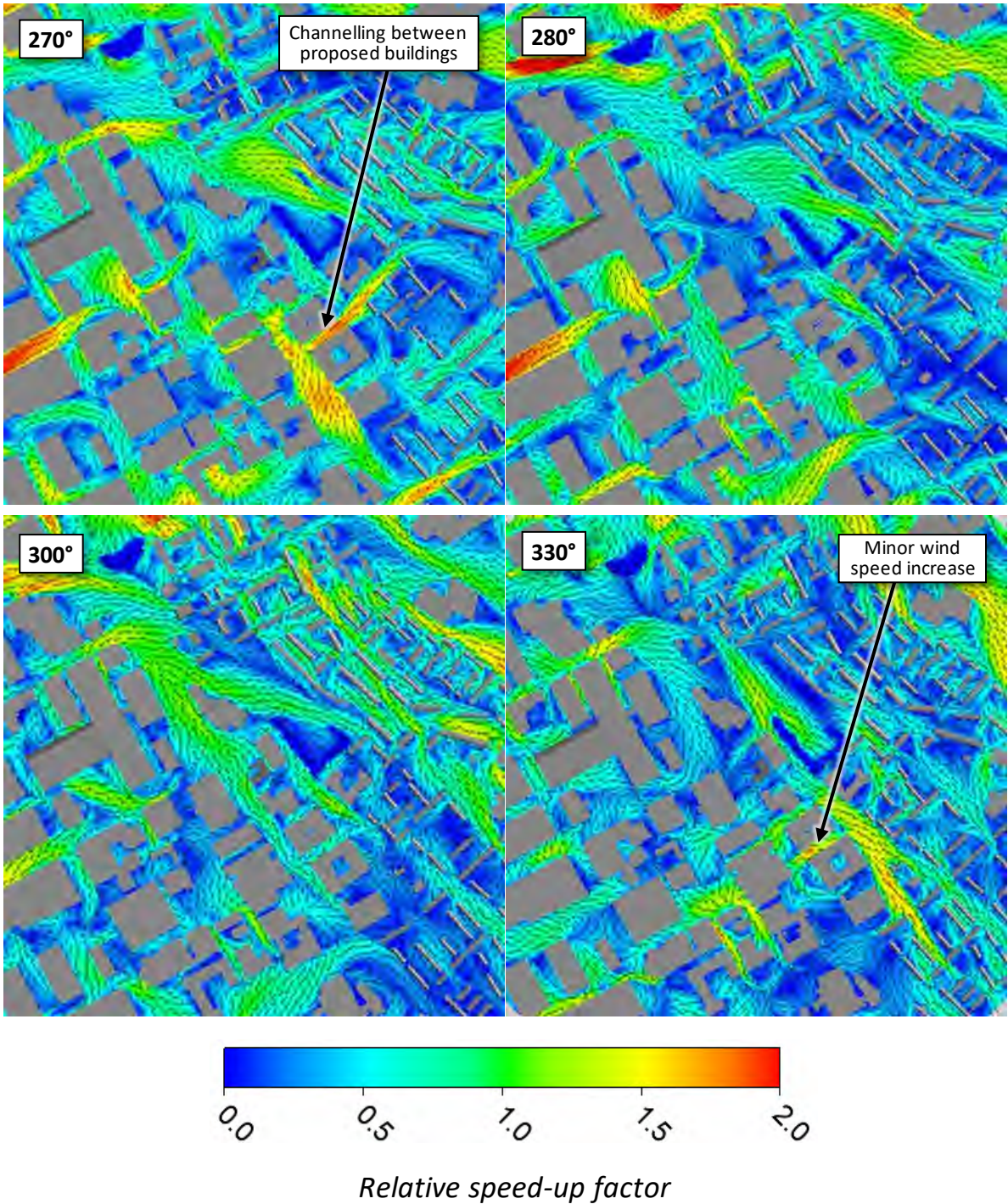


Figure 30 - With proposed development; speed-up factors for wind from 270°, 280°, 300° and 330°

To further analyse the cause of the increased winds, streamlines are presented for wind from 170° in Figure 31. Streamlines are coloured by a speed-up factor – that is, how much wind speed at that location has increased or decreased relative to wind speed at the same height on a flat featureless plane. The streamlines show how wind from higher elevations, which have higher speeds, are redirected toward ground level along Upper Brook Street and between the proposed buildings.

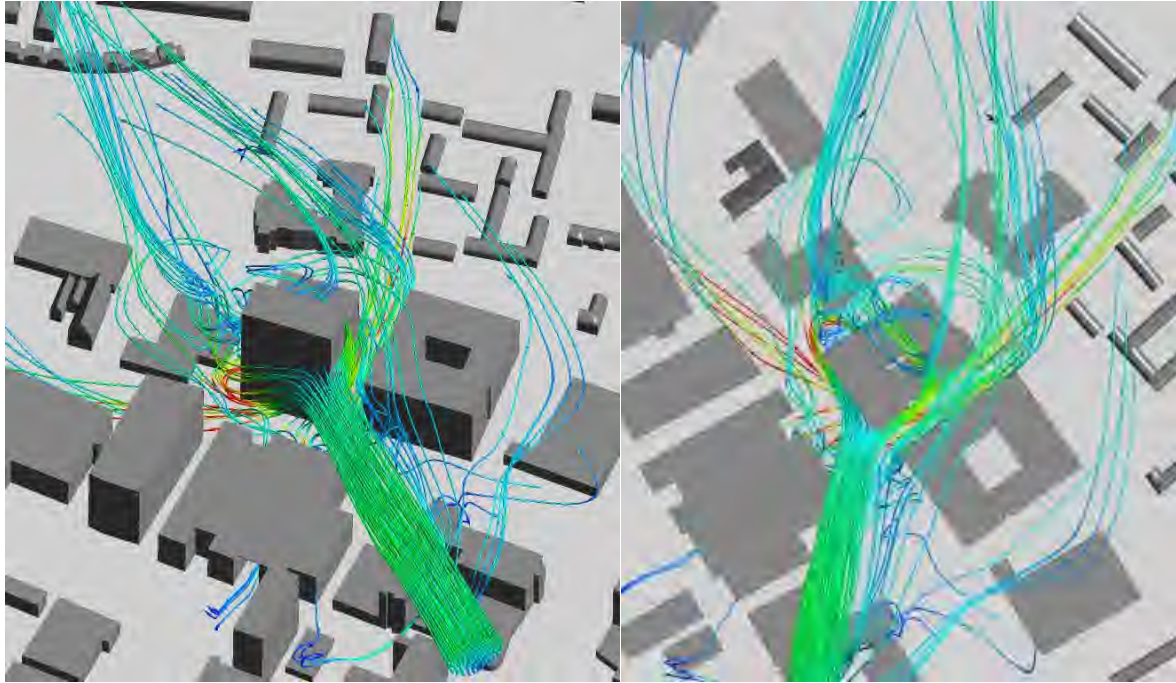


Figure 31 – Streamlines around proposed development with wind from 190°.

9.1.3 With neighbouring development

The addition of the adjacent development increases wind speed locally at ground level. The 120m tall building is responsible for this, redirecting faster winds at higher elevations toward ground level. This is noticeable from a number of wind directions. However, the location of these increased winds is sufficiently far from the proposed development that they are only influenced by the adjacent proposal. Some directions see the increased winds travel down Upper Brook Street toward the proposed development, although they tend to decrease in intensity as they travel. With some wind directions, the direction of flow along Upper Brook Street is reversed, with higher speed winds generated by the downdraughts travelling contrary to the overall flow direction. This is particularly notable for 220° and 260°.

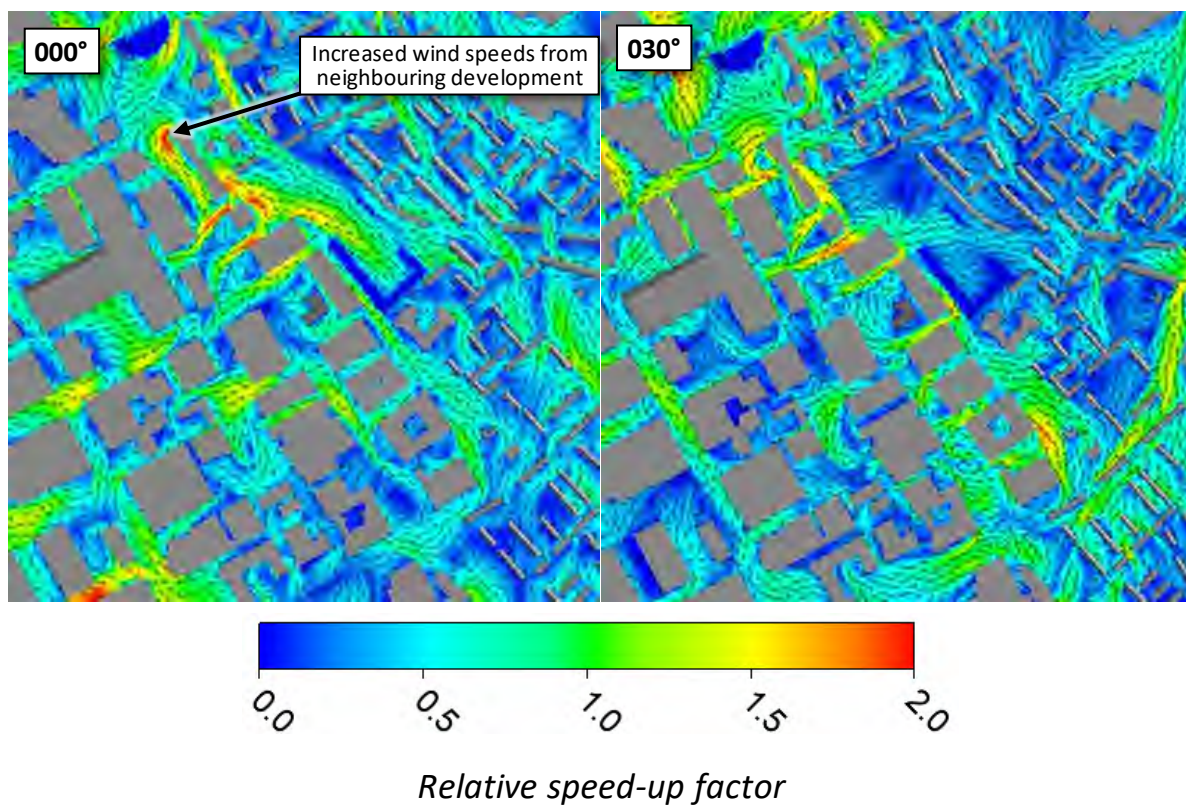


Figure 32 - With neighbouring development; speed-up factors for wind from 0° and 30°

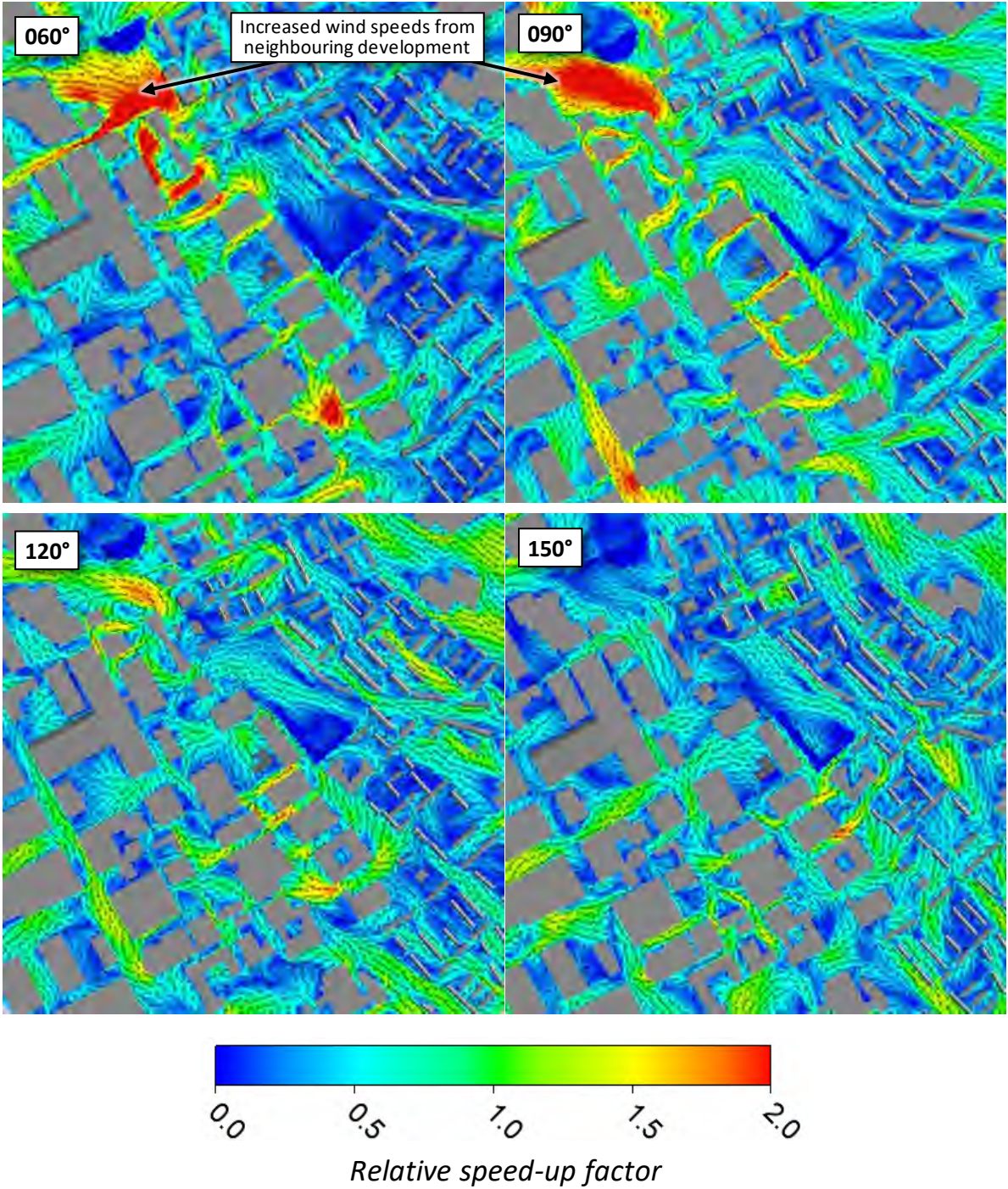


Figure 33 - With neighbouring development; speed-up factors for wind from 60°, 90°, 120° and 150°

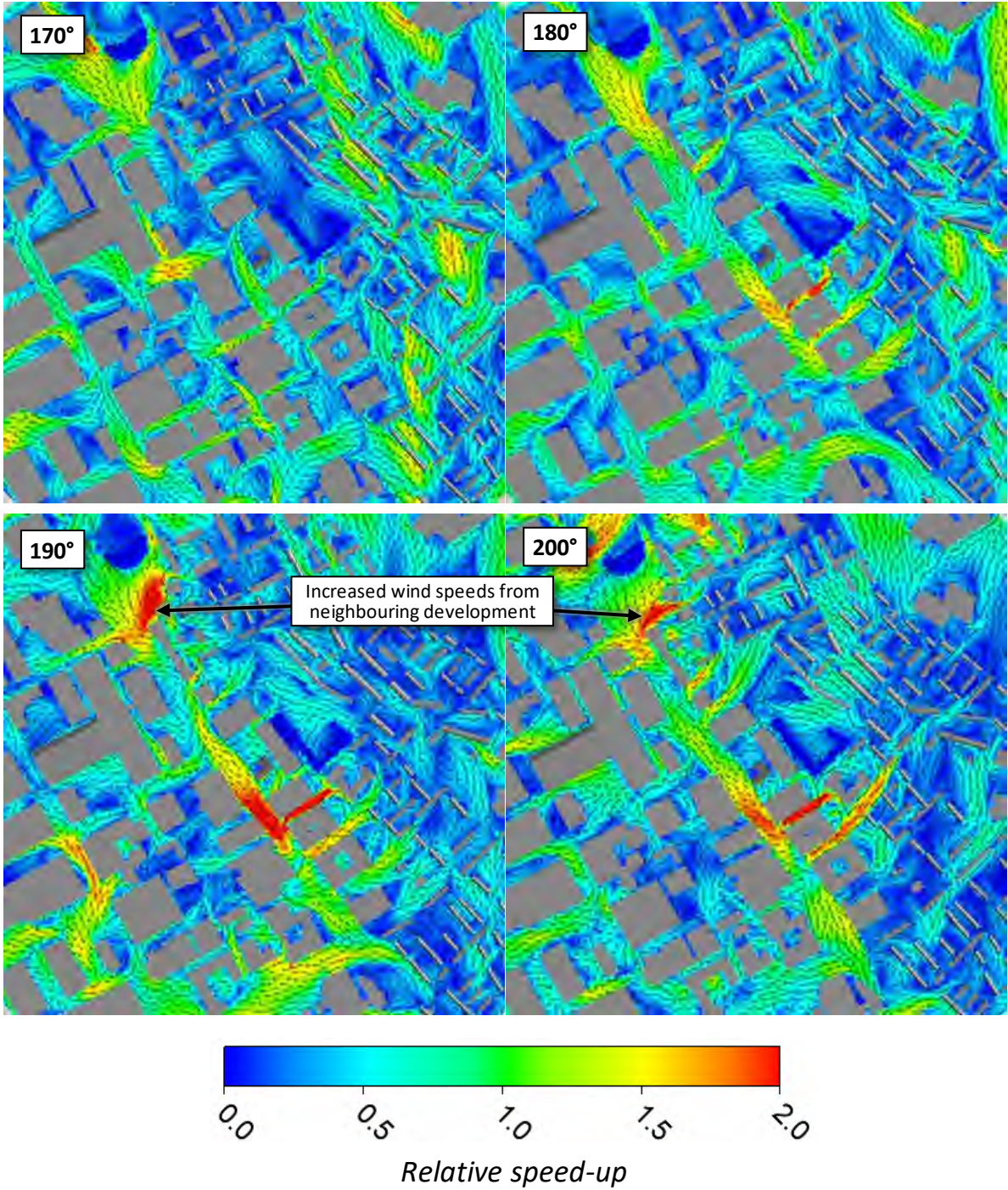


Figure 34 - With neighbouring development; speed-up factors for wind from 170°, 180°, 190° and 200°

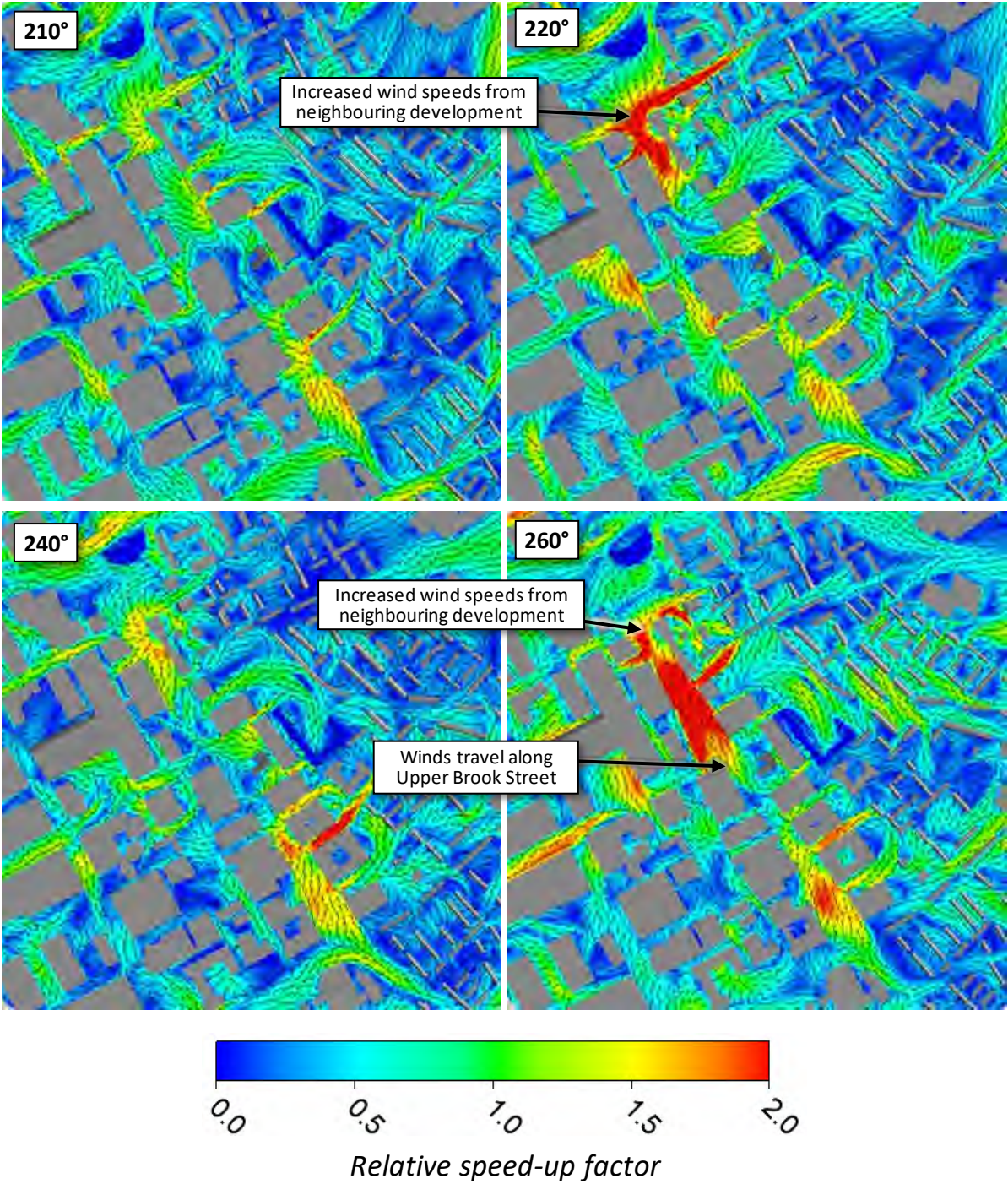


Figure 35 - With neighbouring development; speed-up factors for wind from 210°, 220°, 240° and 260°

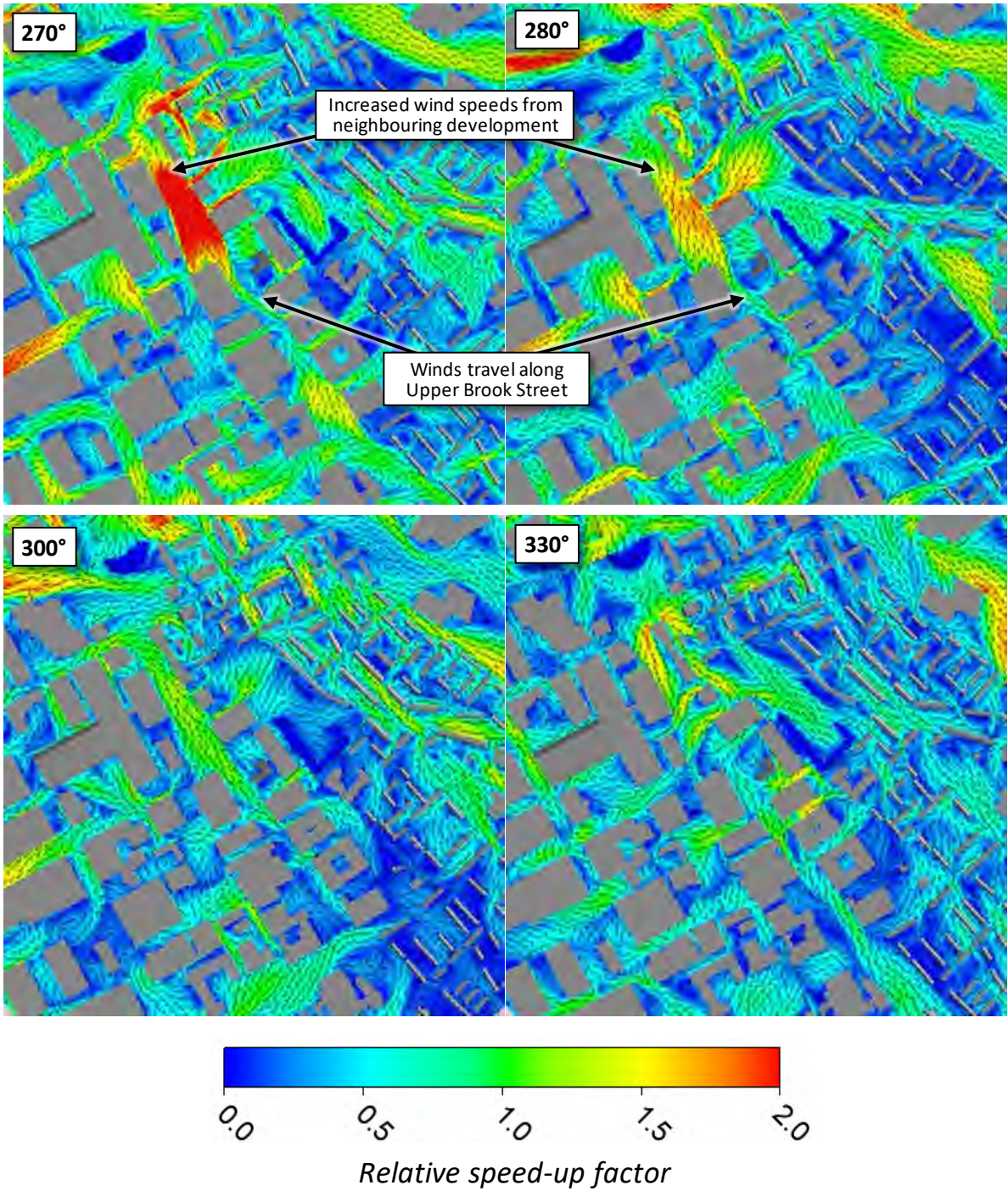


Figure 36 - With neighbouring development; speed-up factors for wind from 270°, 280°, 300° and 330°