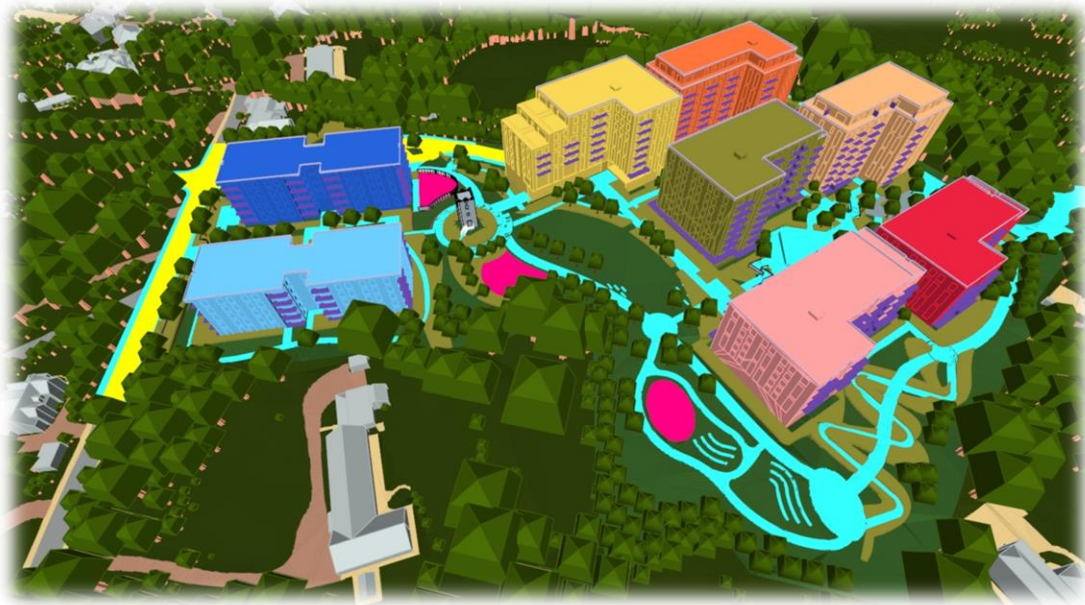




Barrington Tower Wind Study

Wind Microclimate Study



Report For: Cairn Homes Properties Ltd

Project No: 15498



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1 Executive Summary

IES Consulting have been commissioned to investigate the impact from wind around the proposed residential development on Barrington Tower, Brennanstown Road, Dublin 18. The development will provide a 'Build to Rent' (BTR) apartment development consisting of 8 no. blocks ranging in height up to 10 storeys (including lower ground floor).

For the analysis, 8 steady state Computational Fluid Dynamics (CFD) simulations were performed for the main wind directions (N, NE, E, SE, S, SW, W and NW) and annual average wind speed obtained from the Dublin IWEA weather data set. The results obtained from the simulations were extrapolated along the annual weather data to obtain the most probable local air speed for each hour of the year. Statistical analysis was performed on this dataset to check compliance against the Lawson's Pedestrian Comfort criterion.

The following table provides values for the Lawson's Pedestrian Comfort Assessment criteria for various activities.

Category	Pedestrian Activity	Threshold mean hourly wind speed not to be exceeded for more than 5% of the time (m/s)
C1	Business Walking	10
C2	Leisurely Walking	8
C3	Standing	6
C4	Sitting	4

The following table provides values for Lawson's Pedestrian Safety Assessment criteria.

Category	Pedestrian Type	Threshold mean hourly wind speed not to be exceeded more than once per annum ² (m/s)
S1	Typical Pedestrian	20
S2	Sensitive Pedestrian	15

The results are presented in the form of false colour contour images of the percentage of year that the local air speed is likely to exceed a certain value at every point on the locations of interest. The air speed threshold value is mentioned in the title of the colour legend at the top right corner of each image. Do note that the scale for the images for results of the comfort criteria goes from 0.1% to 100%, and the scale for images for results of the safety criteria goes from 0.001% to 1%.

The median wind speed recorded was more than 5 m/s for weather location's climatic conditions. That means, for 50% of year, the wind speed is higher than 5 m/s. The Lawson's Sitting Criterion requires the local air speed be more than 4m/s for no more than 5% of the year. Thus, the Lawson's Sitting Criterion presents a task of being 10 times better than the climatic conditions at location of interest.

1.1 Sitting and Standing Comfort Criteria

The Lawson's sitting comfort criteria states that the local air speed at designated locations should not exceed 4m/s for more than 5% of the duration analysed. The Lawson's standing comfort criteria states that the local air speed at designated locations should not exceed 6m/s for more than 5% of the duration analysed.

The results of the annual analysis for sitting and standing criterion are observed in the top left and right corners of the images in [section 7.1](#) respectively.

1.1.1 Balconies

It was observed that almost 93% of balconies show excellent results and fully meet requirements of the Lawson's sitting and standing criterion for the full year. The local air speed is generally lower than 4m/s for more than 95% of the year as per the criterion's requirement.

The remaining 7% of balconies show limited compliance with the requirements of the Lawson's Sitting Comfort criterion, i.e. the local air speed exceeds 4m/s for more than 5% of the year. These balconies lie on the southwest, west and north-west corner of Block F, Block G, Block H, Block I, and Block J circled yellow in [Figure 1](#). The local air speed is likely to exceed 4m/s for up to 20% of the year at these locations. These balconies are impacted due to prevailing westerly and southwesterly wind.

However, on comparing the results for these locations to Lawson's Standing Comfort Criterion results, they show excellent compliance, i.e. the local air speed does not exceed 6m/s for more than 5% of the year, see [Figure 2](#). For the 10% of year when the local air speed exceeds 4m/s, all four quarters of that collective time (i.e. 20% of the year) it does not exceed 6m/s. The local air speed on balconies will be less than 4m/s for 90% of the year and between 4-6m/s for 10% of the year. Any exceedance noted can be considered very marginal and it will not lead to an environment which is unpleasant to use. The local air speed is only going to be greater than a gentle breeze but most frequently less than a moderate breeze. Such conditions are unlikely to have any impact on usability of this private space for personal recreation. No further mitigation measures required as the balcony spaces are privately used by the people residing in the respective flat and can be used according to the comfortable climatic conditions. It is not a space that can be treated as a public open space where people have to use it frequently.

The remainder of the balconies are fully compliant with the requirements of the Lawson's Sitting and Standing Comfort Criteria, i.e. the local air speed does not exceed 4m/s for more than 5% of the year.



Figure 1: Sitting Comfort Criterion: View from the southwest



Figure 2: Standing Comfort Criterion: View from the southwest

1.1.2 Ground Amenities

It was observed that most of the ground amenity spaces show excellent results and fully met requirements of the Lawson's sitting and standing comfort criterion for the full year. The wind speed is generally lower than 4m/s for more than 95% of the year as per the criterion's requirement.

[Figure 3](#) and [Figure 4](#) below show the results of sitting and standing comfort of ground amenity spaces surrounded by the building blocks. Some of the ground amenity space in red and orange colour show limited compliance to the Lawson's sitting comfort criterion. The local air speed is likely to exceed 4m/s for up to 20% of the year at these locations. These spaces are impacted due to prevailing southwesterly wind and are subject to acceleration that can occur due to flow through narrow passage between blocks.

However, on comparing the results for these locations to Lawson's Standing Comfort Criterion results, they show excellent compliance, i.e. the local air speed does not exceed 6m/s for more than 5% of the year, see [Figure 4](#). For the 20% of year when the local air speed exceeds 4m/s, three quarters of that collective time (i.e. 15% of the year) it does not exceed 6m/s. The local air speed on these spaces will be less than 4m/s for 80% of the year. Any exceedance noted can be considered very marginal and it will not lead to an environment which is unpleasant to use. The local air speed is only going to be greater than a gentle breeze but most frequently less than a moderate breeze. Such conditions are unlikely to have any impact on usability of space for recreation.

No further mitigation measures are required. The ground amenity spaces include only walkway and activity area so are not intended for sitting purposes. The spaces are compliant to the standing and walking comfort criteria.



Figure 3: Sitting Comfort Criterion: Ground Amenities



Figure 4: Standing Comfort Criterion: Ground Amenities

1.1.3 Roof Amenities

1.1.3.1 Roof Amenities of Block E

[Figure 5](#) and [Figure 6](#) show the roof amenity on block E. A portion of the roof space shows good compliance with the sitting comfort criterion, however the corner space shows only limited compliance with the requirements of the Lawson's Sitting Comfort criterion. The local air speed is likely to exceed 4m/s for up to 20% of the year at these locations. These are impacted due to prevailing westerly and southwesterly wind.

However, on comparing the results for Lawson's Standing Comfort Criterion results, they show excellent compliance, i.e. the local air speed does not exceed 6m/s for more than 5% of the year, see [Figure 6](#). The local air speed on the roof will be less than 4m/s for 90% of the year and between 4-6m/s for 10% of the year. Any exceedance noted can be considered very marginal and it will not lead to an unpleasant environment to use. The local air speed is only going to be greater than a gentle breeze but most frequently less than a moderate breeze. Such conditions are unlikely to have any impact on usability of this private space for personal recreation.

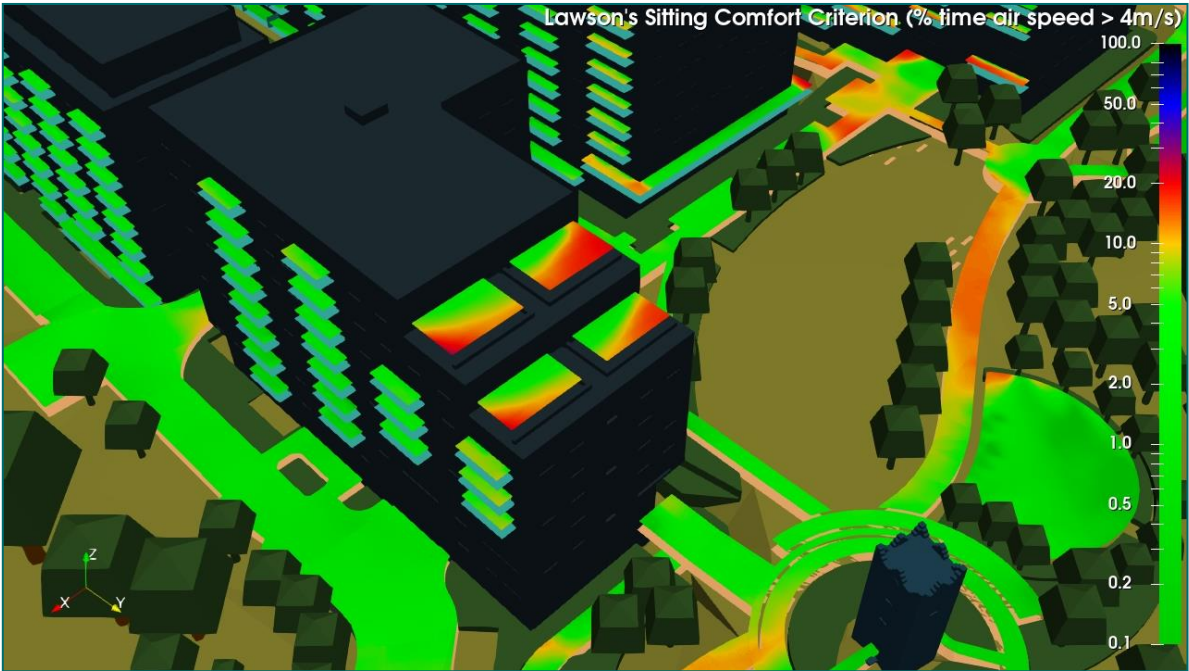


Figure 5: Sitting Comfort Criterion: Roof Amenities: Block E

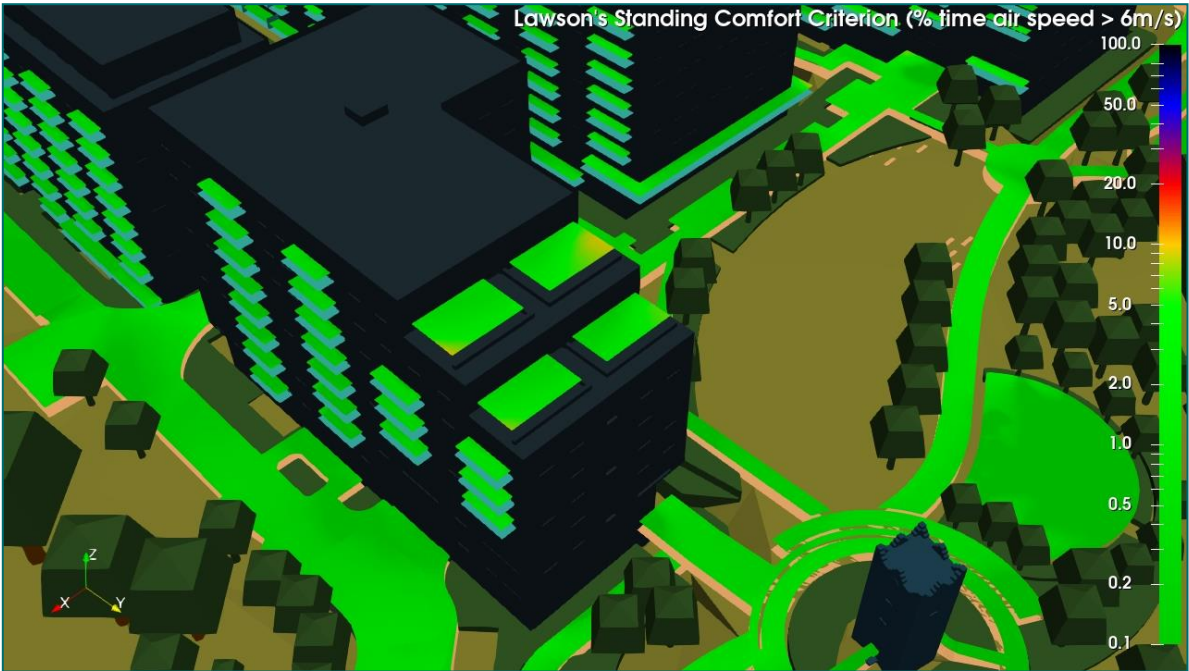


Figure 6: Standing Comfort Criterion: Roof Amenities: Block E

1.1.3.2 Roof Amenities of Block G

[Figure 7](#) and [Figure 8](#) show the roof amenities on the block G. These show good compliance with the requirements of the Lawson's Sitting and Standing Comfort Criterion, i.e. the local air speed does not exceed 4m/s for more than 5% of the year. There are unlikely to be any effects on sitting areas here, with no further mitigation measures required.

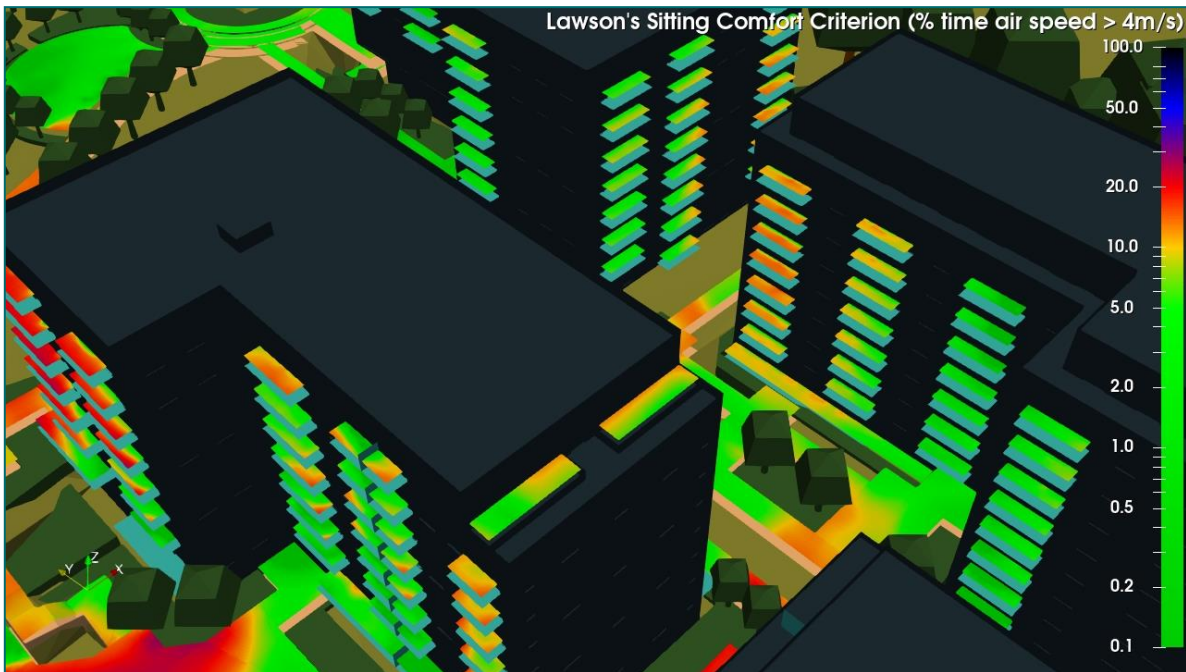


Figure 7: Sitting Comfort Criterion: Roof Amenities: Block G

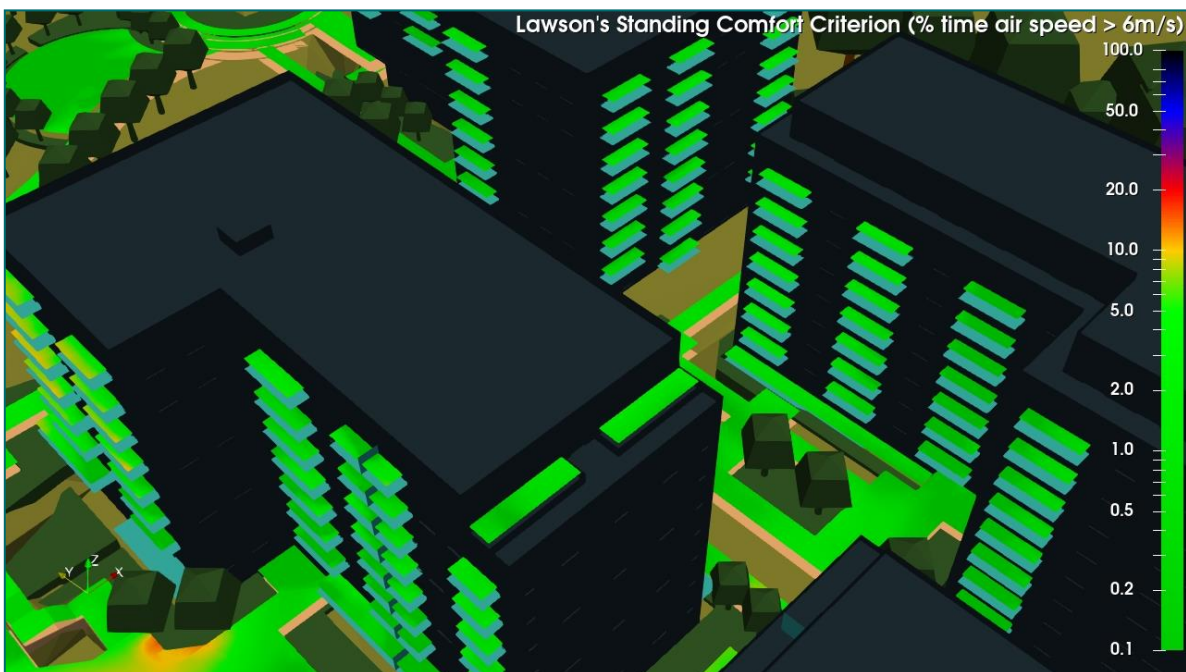


Figure 8: Standing Comfort Criterion: Roof Amenities: Block G

1.2 Walking Comfort

The Lawson’s Leisure Walking comfort criteria states that the local air speed at designated locations should not exceed 8m/s for more than 5% of the duration analysed, on the various paths around the development. The Lawson’s Business Walking comfort criteria states that the local air speed at designated locations should not exceed 10m/s for more than 5% of the duration analysed, on the various paths around the development.

[Figure 9](#) and [Figure 10](#) show the results of walking comfort criteria.



Figure 9: Leisure Walking Comfort Criterion: Top View



Figure 10: Business Walking Comfort Criterion: Top View

These show excellent compliance with the requirements of the Lawson's Leisure walking, and Business walking Comfort Criteria. The local air speed does not exceed 8m/s, and 10 m/s for more than 5% of the year, respectively.

1.3 Safety Criteria

The Lawson's Normal Pedestrian safety criteria states that the local air speed at designated locations should not exceed 20m/s for more than 0.01% of the duration analysed. The Lawson's Sensitive Pedestrian safety criteria states the local air speed at designated locations should not exceed 15m/s for more than 0.01% of the duration analysed. The Sensitive Pedestrian safety criterion applies to the vulnerable population such as pensioners and children. Note the limit of the criterion is 0.01% and not 5% as with the comfort criterion.

These criteria are also intended for various paths, and grounds around the development, as access is required at all times irrespective of weather conditions to enter or exit the various buildings. [Figure 11](#) and [Figure 12](#) show the results of safety criteria assessment. The criterion for the Normal and Sensitive Pedestrian is achieved throughout the site. None of the paths around the development show even 0.01% prevalence of local air speeds exceeding 20m/s i.e. Normal Safety Criterion threshold.

The green areas in [Figure 11](#) and [Figure 12](#) are fully compliant with the requirements of the Sensitive Pedestrian Safety Criterion.

The site can be considered as safe for all residents including those that would be considered vulnerable.



Figure 11: Normal Pedestrian Safety Criterion: Top View



Figure 12: Normal Pedestrian Safety Criterion: Top View



2 Introduction

IES Consulting have been commissioned to study the impact from wind around the proposed residential development on Barrington Tower, Brennanstown Road, Dublin 18. The development will provide a 'Build to Rent' (BTR) apartment development consisting of 8 no. blocks ranging in height up to 10 storeys (including lower ground floor).

The analysis is performed to study the effect from the building layout on pedestrian comfort as well as safety for people using the public and various amenity spaces around the site. The analysis will look at the air movement around the buildings for eight wind directions (SW, W, NW, N, NE, E, SE and S) with the wind velocity set to the mean value obtained from the weather file.

The following simulation report describes the modelling methodology used in the study, including assumptions made and calculations used to determine the boundary conditions and results obtained from the simulations.

3 Weather Data

The analysis is based on the ‘Dublin IVEC’ weather file. The variation of wind speed recorded in the weather file is shown in [Figure 13](#) below. [Figure 14](#) show the wind direction variation and [Figure 15](#) show the wind rose.

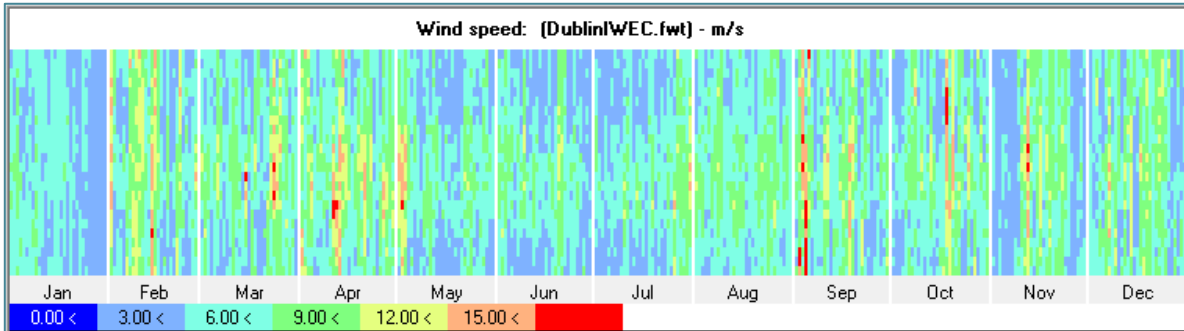


Figure 13: Wind speed variation as per DublinIVEC.epw

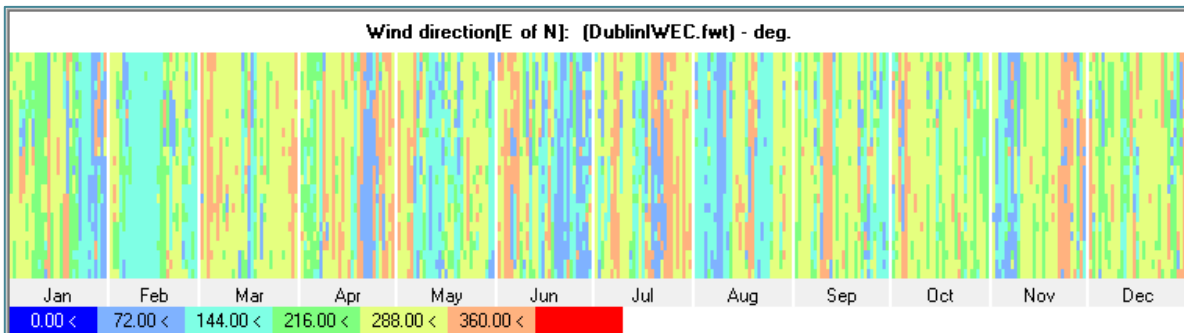


Figure 14: Wind direction variation as per DublinIVEC.epw

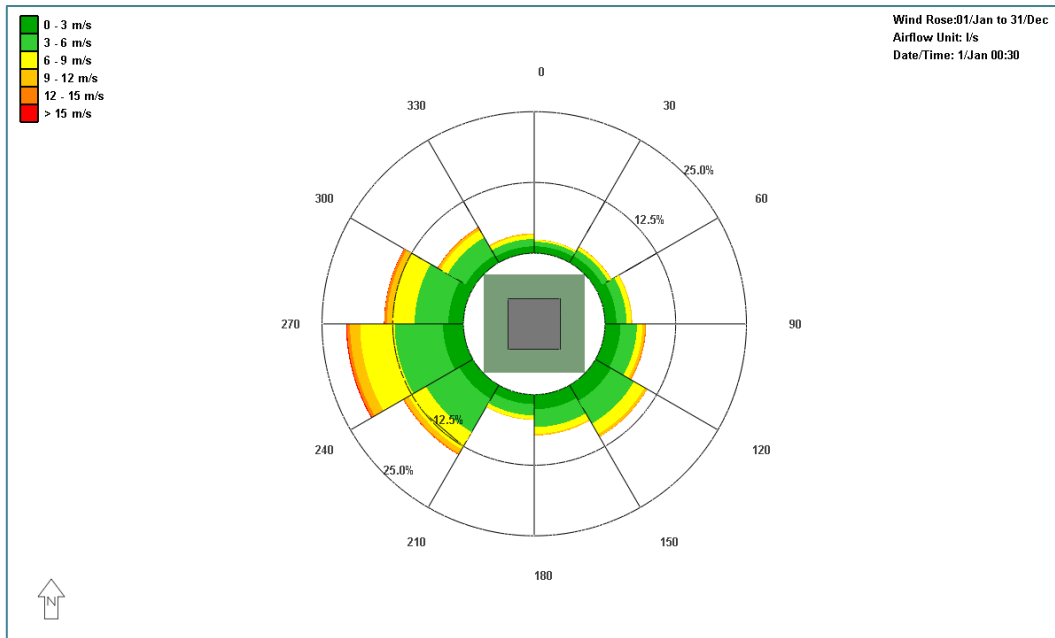


Figure 15: Wind rose as per DublinIVEC.epw

Based on this, the mean and median wind speed recorded was **5m/s** with a westerly prevailing direction.

4 Wind Boundary Layer

In an atmospheric boundary layer, wind speed increases with height due to the influence of surface roughness (i.e. the presence of buildings, trees, roads etc. on the ground), see [Figure 16](#).

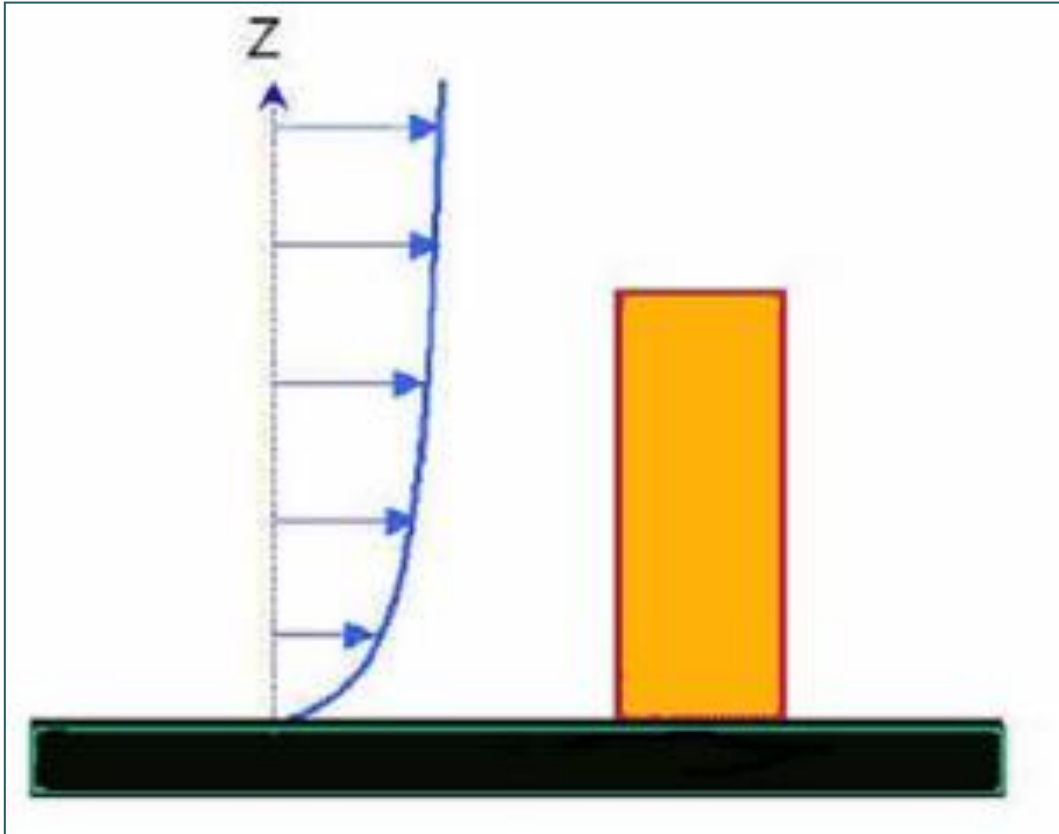


Figure 16: Typical velocity profile of an atmospheric boundary layer

In the current CFD modelling, the velocity profile was generated according to the parameterised ASHRAE methodology described below. This allows for different wind profiles across various terrain types: Open country; urban; and city centre.

The wind speed U_H at height H above the ground is given by:

$$U_H = U_{met} \left(\frac{\delta_{met}}{H_{met}} \right)^{a_{met}} \left(\frac{H}{\delta} \right)^a \dots \dots \dots (Eq. 1)$$

Where,

- a** = Exponent in power law wind speed profile for local building terrain
- δ** = fully developed strong wind atmospheric boundary layer thickness (m)
- a_{met}** = Exponent for the meteorological station

δ_{met} = Atmospheric boundary thickness at the meteorological station (m)

H_{met} = Height at which meteorological wind speed was measured (m)

U_{met} = Hourly meteorological wind speed, measured at height H_{met} (m/s)

The parameters for different types of terrain are given as in table 1.

Table 1: Atmospheric boundary layer parameters

Terrain Category	Description	a	δ
1	Large city centres 50% of buildings above 21m over a distance of at least 2000m upwind.	0.33	460
2	Urban, suburban, wooded areas.	0.22	370
3	Open, with scattered objects generally less than 10m high.	0.14	270
4	Flat, unobstructed areas exposed to wind flowing over a large water body (no more than 500m inland).	0.10	210

For the current project, we used the atmospheric boundary layer corresponding to the terrain category 2 i.e. Urban/Suburban type of site. The met data was taken on category 3 terrain at a height of 10m.

5 Methodology for Pedestrian Comfort Calculation

The methodology for the analysis was as follows:

- 1) The annual mean wind speed was determined from the 'casement_AMY_2018.epw' weather file.
- 2) 8 steady state CFD simulations were performed corresponding to the 8 directions – SW, W, NW, N, NE, E, SE and S respectively.
- 3) The local air speed at various designated locations around the site was recorded for each of the simulations.
- 4) This value was compared to the meteorological wind speed used and the magnification factor at that location for the corresponding wind direction was determined.
- 5) The magnification factor was used to determine the air speed at the designated locations for the various recorded values of the wind speed and direction in the weather file, thus generating the local air speeds at designated locations for a year.
- 6) These recorded values were compared to the Lawson Pedestrian Comfort/Safety Criteria.

5.1 Lawson Pedestrian Comfort/Safety Criteria

The Lawson Criteria¹ was used as a reference to assess the wind effects. It is the most widely used reference for assessment of pedestrian comfort. It considers the air speed at the location as well as the frequency of the occurrence of this air speed. It consists of two assessment criteria:

1. The first criteria assess whether the air movement will be comfortable for the pedestrian for different types of activities.
2. The second criteria assess the feeling of safety or distress by the pedestrian at higher air speeds.

The following table gives the values for the Lawson's pedestrian comfort assessment criteria for various activities.

Category	Pedestrian Activity	Threshold mean hourly wind speed not to be exceeded for more than 5% of the time (m/s)
C1	Business Walking	10
C2	Leisurely Walking	8
C3	Standing	6
C4	Sitting	4



The following table gives the values for Lawson’s Pedestrian Safety Assessment criteria.

Category	Pedestrian Type	Threshold mean hourly wind speed not to be exceeded more than once per annum ² (m/s)
S1	Typical Pedestrian	20
S2	Sensitive Pedestrian	15

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

²Once per annum means the safety threshold is not be exceeded 0.01% of the year.

6 CFD Model

The CFD model was created based on the CAD drawings provided.

6.1 Model Geometry

[Figure 17](#) to [Figure 36](#) show the geometry as modelled.

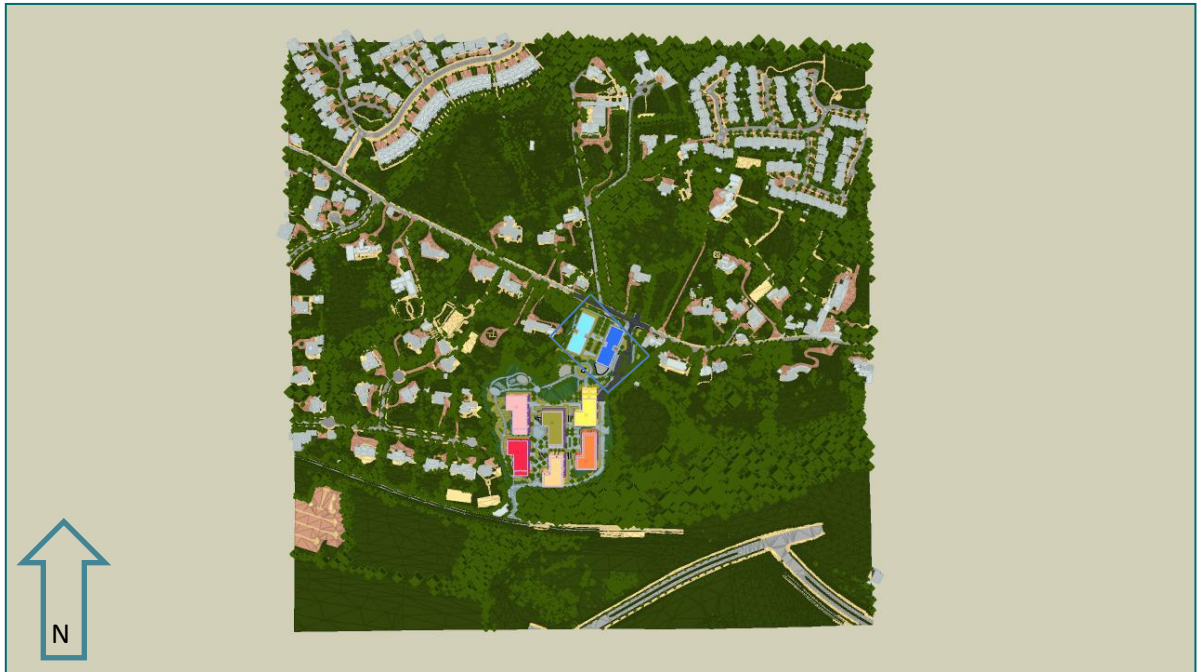


Figure 17: Plan view of the site

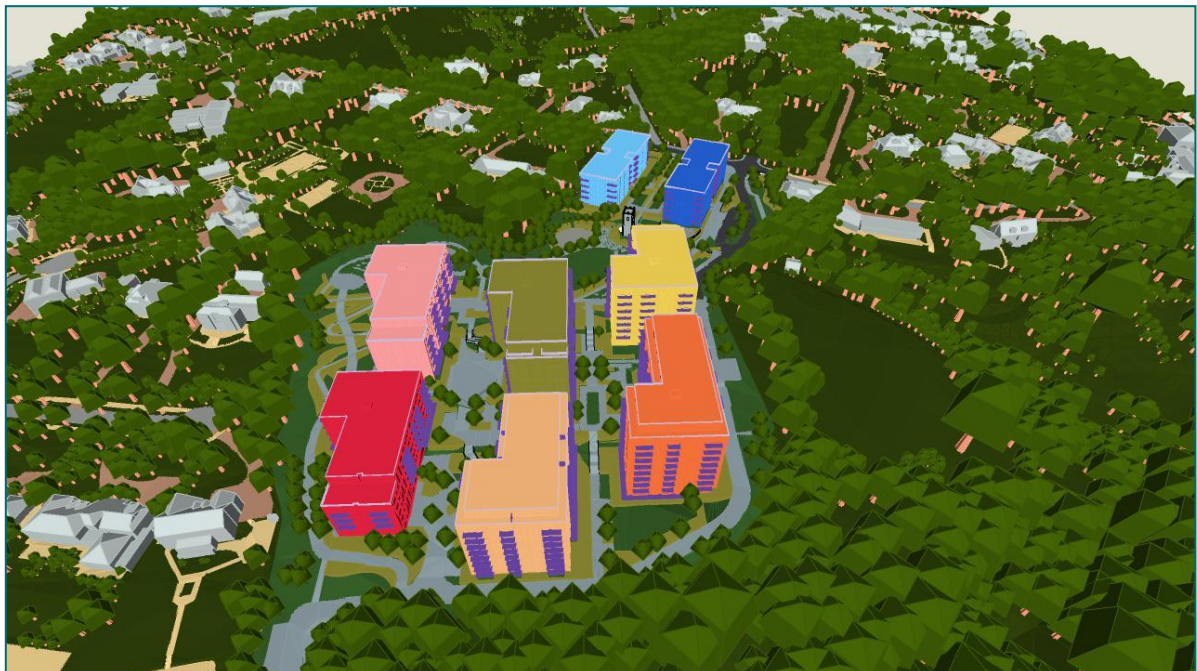


Figure 18: View of the site from the south



Figure 19: View of the site from the southwest



Figure 20: View of the site from the west



Figure 21: View of the site from the northwest



Figure 22: View of the site from the north



Figure 23: View of the site from the northeast



Figure 24: View of the site from the east



Figure 25: View of the site from the southeast

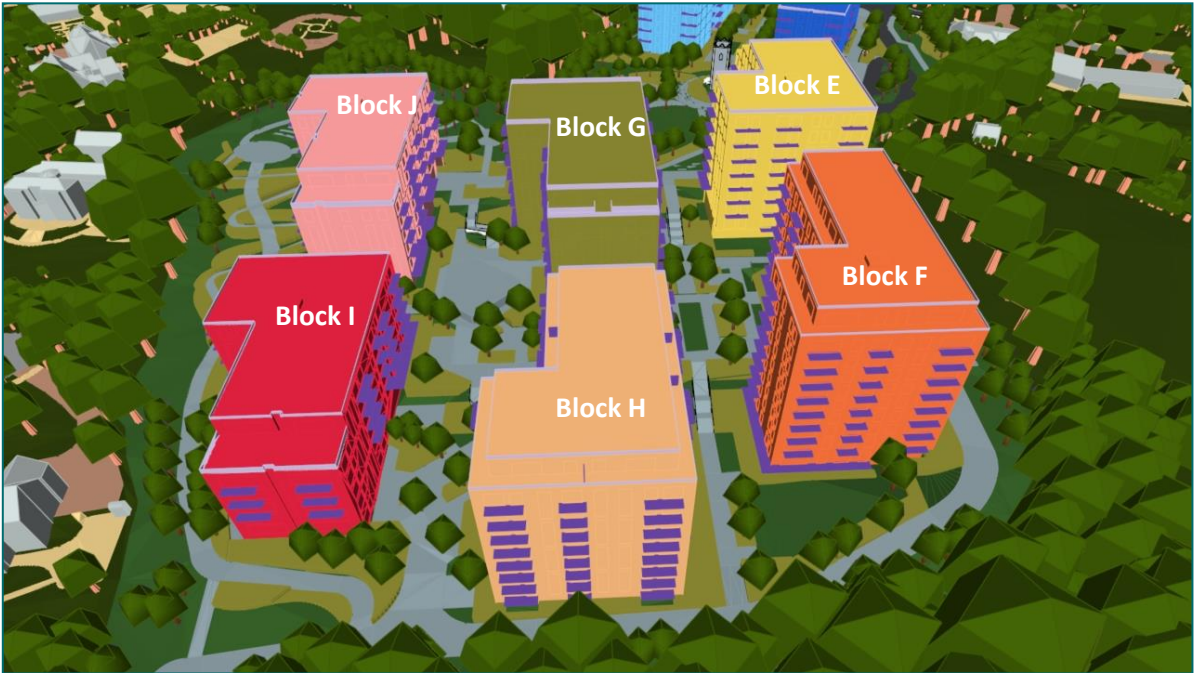


Figure 26: Closer view of the residential blocks from the south



Figure 27: Closer view of the residential blocks from the west



Figure 28: View of the residential blocks from the north



Figure 29: Closer view of the residential blocks from the east



Figure 30: Closer view-1 of the residential block AB and block CD

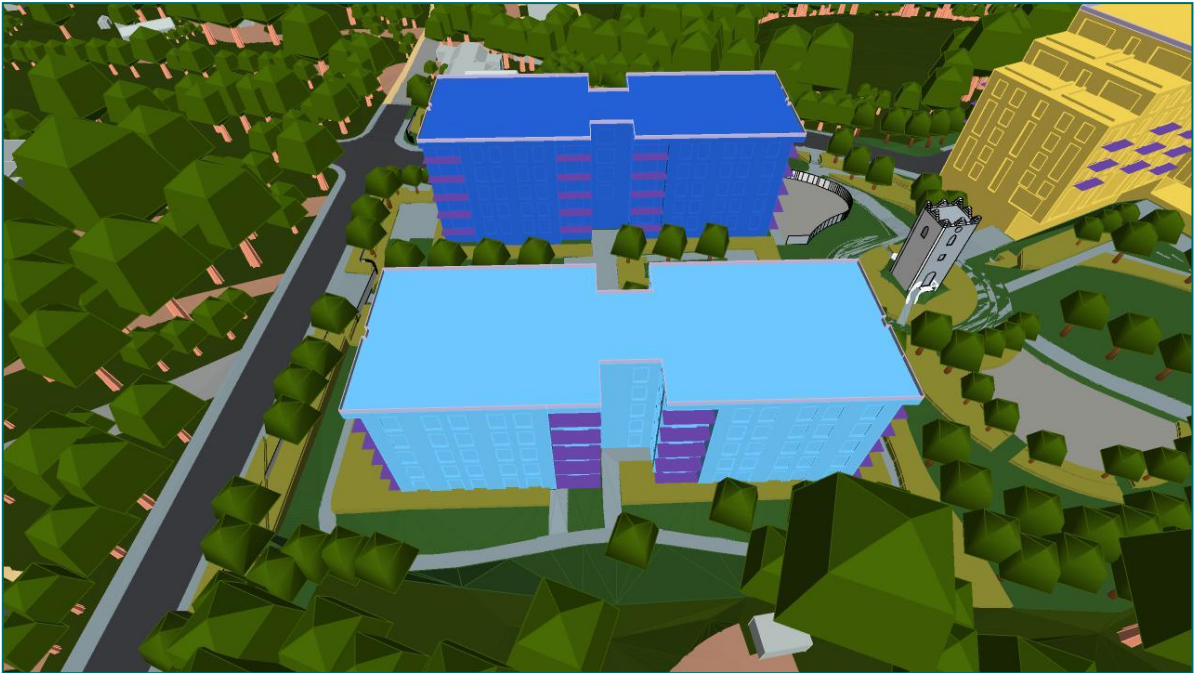


Figure 31: Closer view-2 of the residential block AB and block CD



Figure 32: Closer view-3 of the residential block AB and block CD



Figure 33: Closer view-4 of the residential block AB and block CD

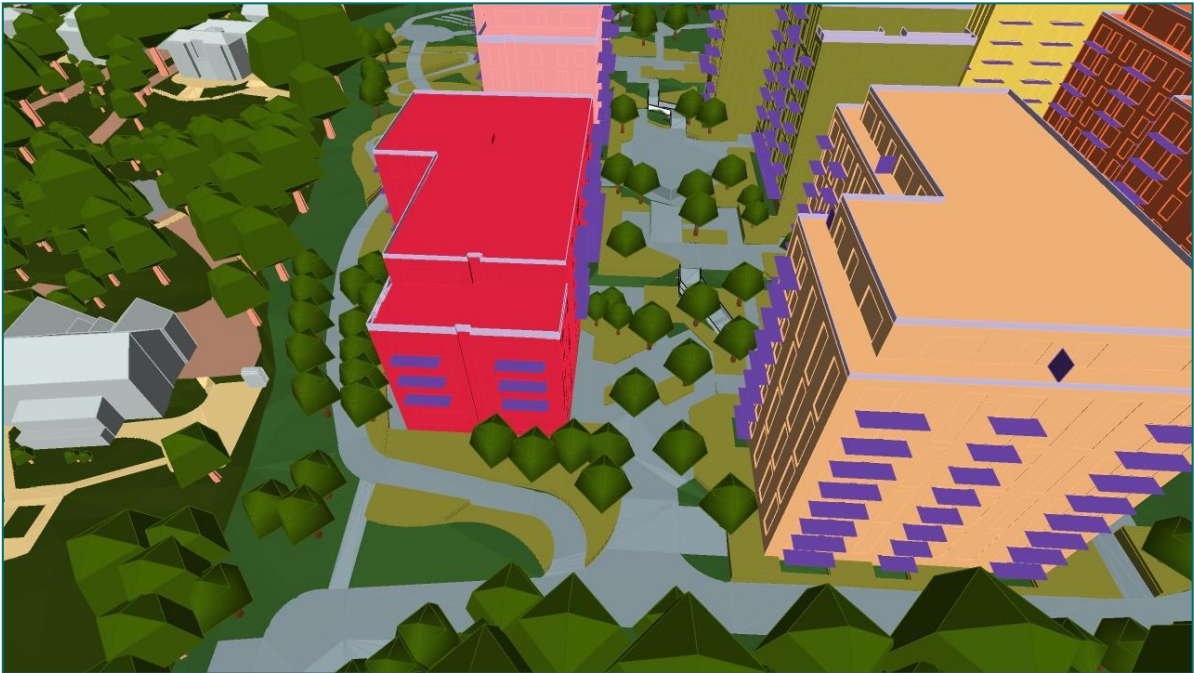


Figure 34: View of the amenity spaces inside the residential blocks



Figure 35: View of the amenity spaces inside the residential blocks



Figure 36: View of the amenity spaces inside the residential blocks

6.2 Designated Locations for Analysis

Figure 37 to Figure 43 show the designated locations with all lying 1.5m above the immediate ground/floor level.



Figure 37 Designated locations for recording the air speed values



Figure 38 Designated locations for recording the air speed values



Figure 39 Designated locations for recording the air speed values



Figure 40 Designated locations for recording the air speed values: Ground Amenities

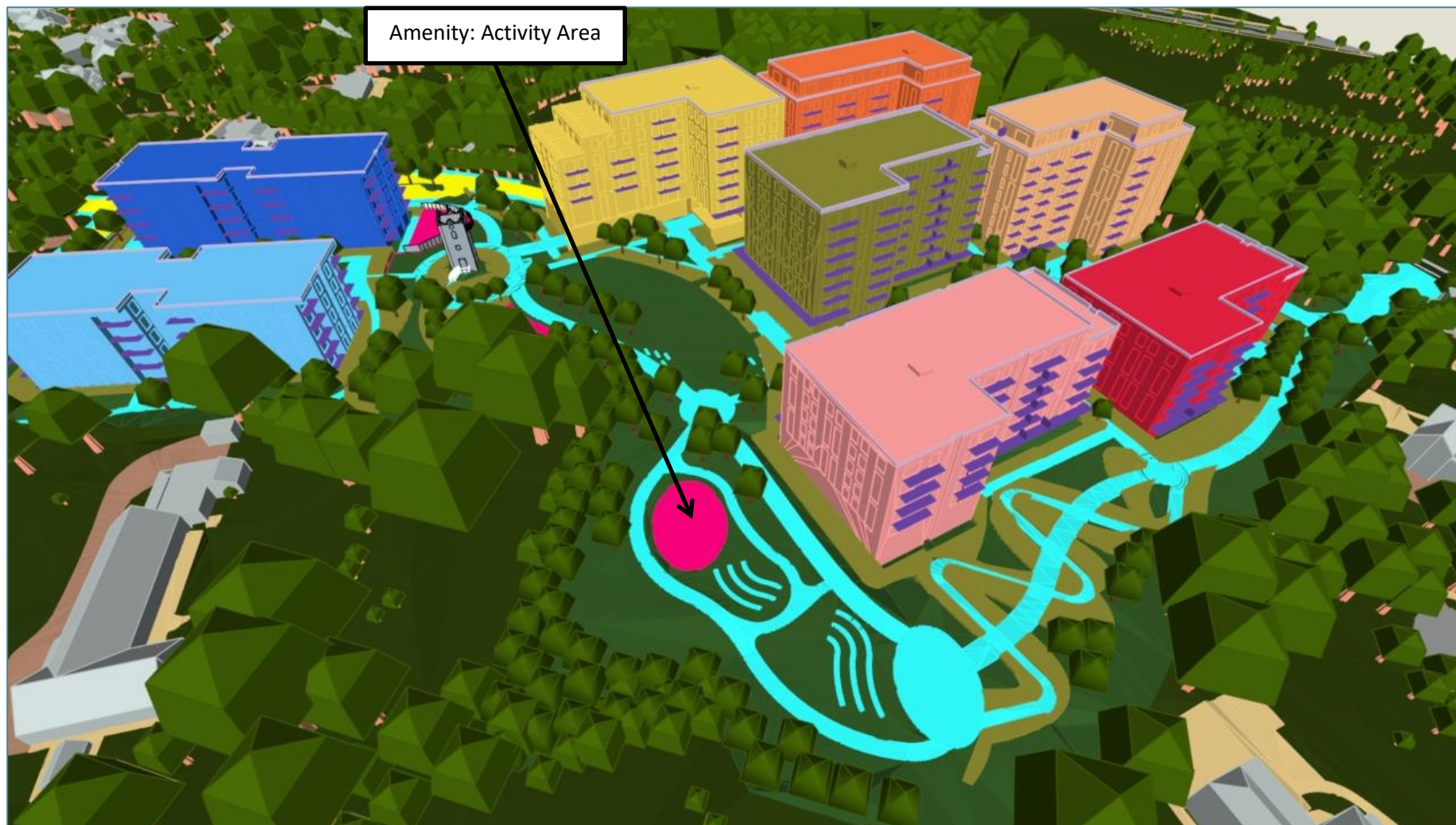


Figure 41 Designated locations for recording the air speed values: Ground Amenities

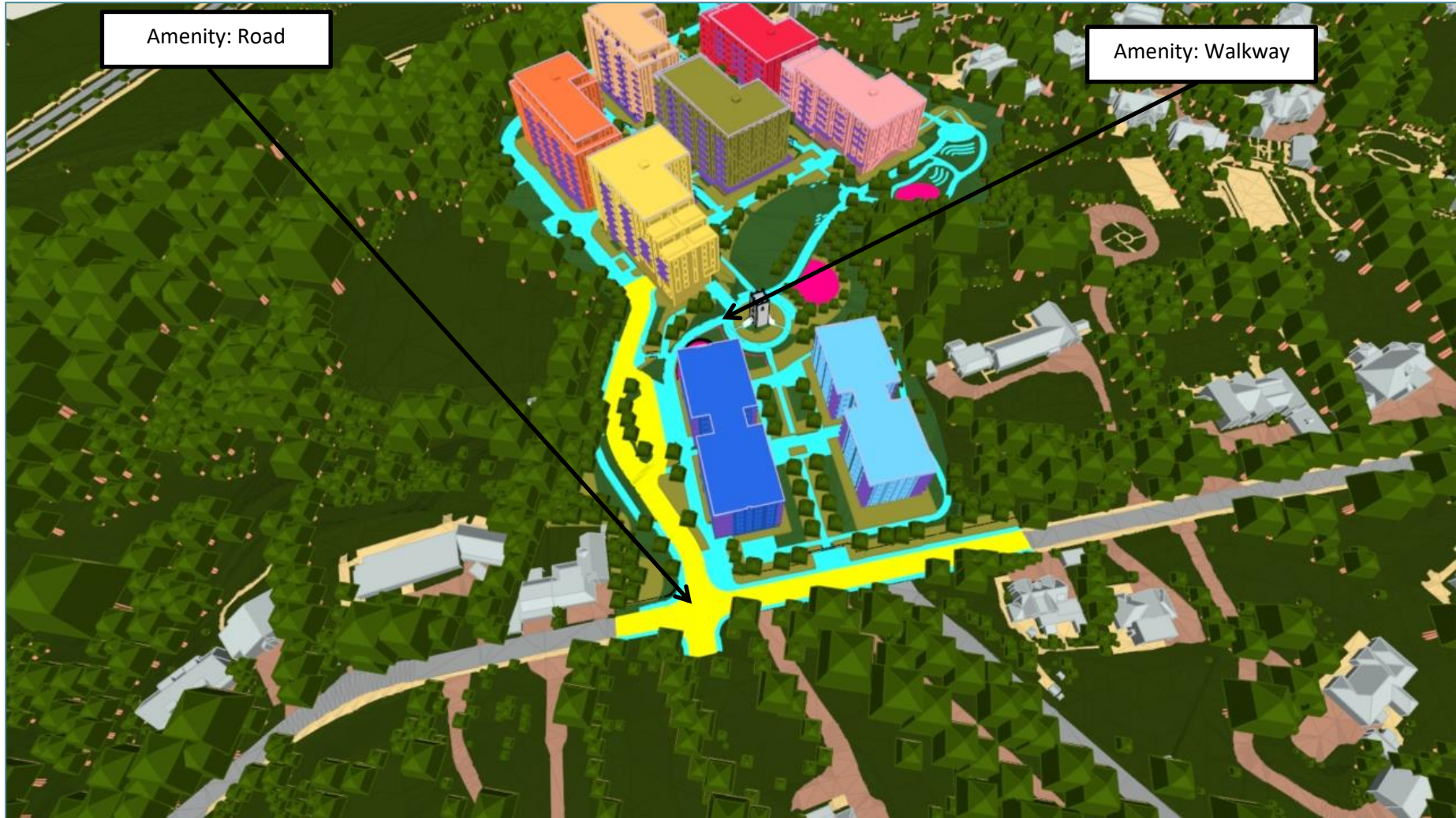


Figure 42 Designated locations for recording the air speed values: Ground Amenities

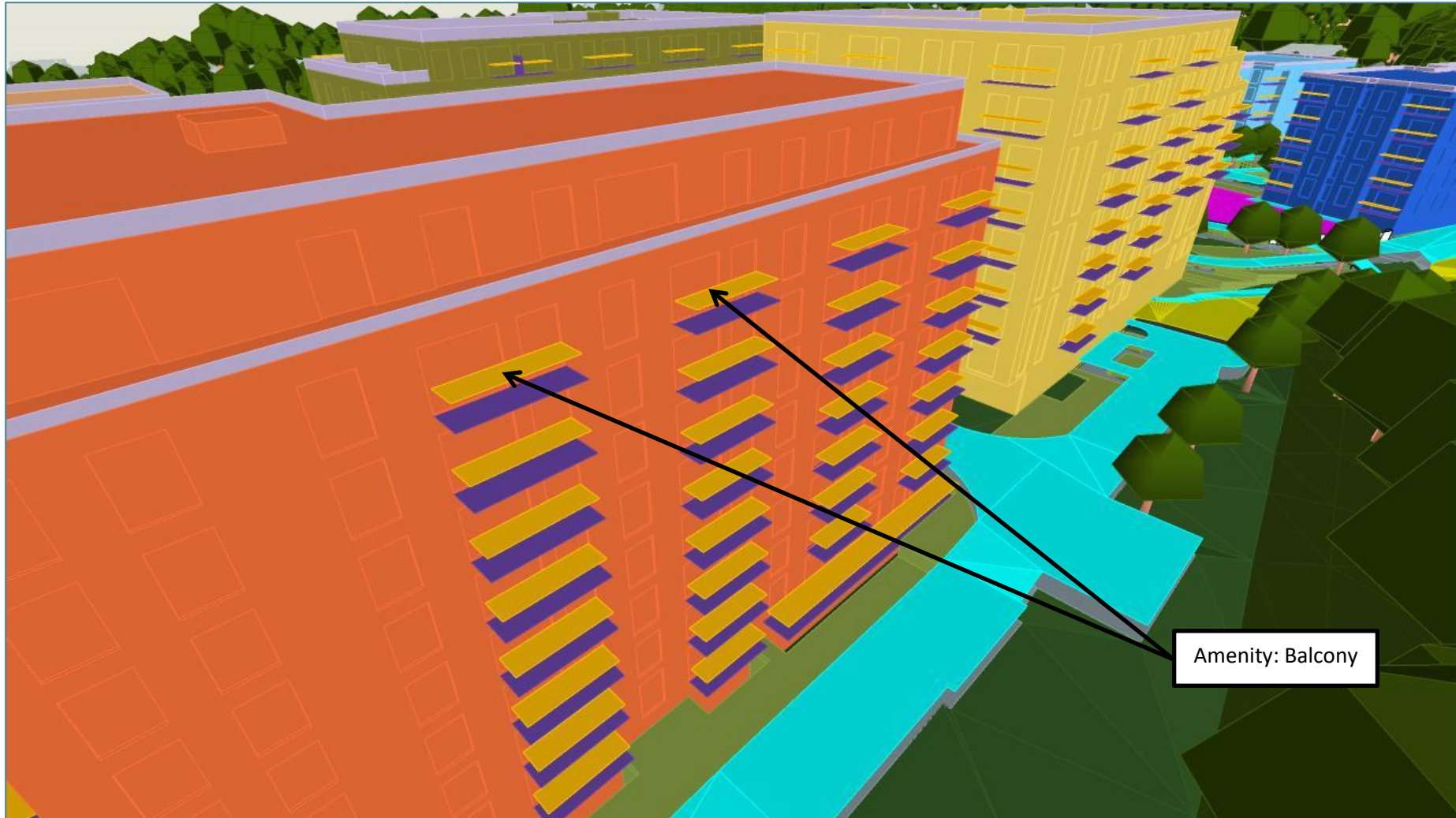


Figure 43 Designated locations for recording the air speed values: Ground Amenities

7 Results

7.1 Comfort Criteria

Figure 44 to Figure 52 show the percentage of the year the hourly wind speed exceeds the threshold value for the comfort criteria such as Sitting, Standing, Leisurely Walking and Business Walking for all seasons. The threshold values are 4m/s, 6m/s, 8m/s and 10m/s respectively.

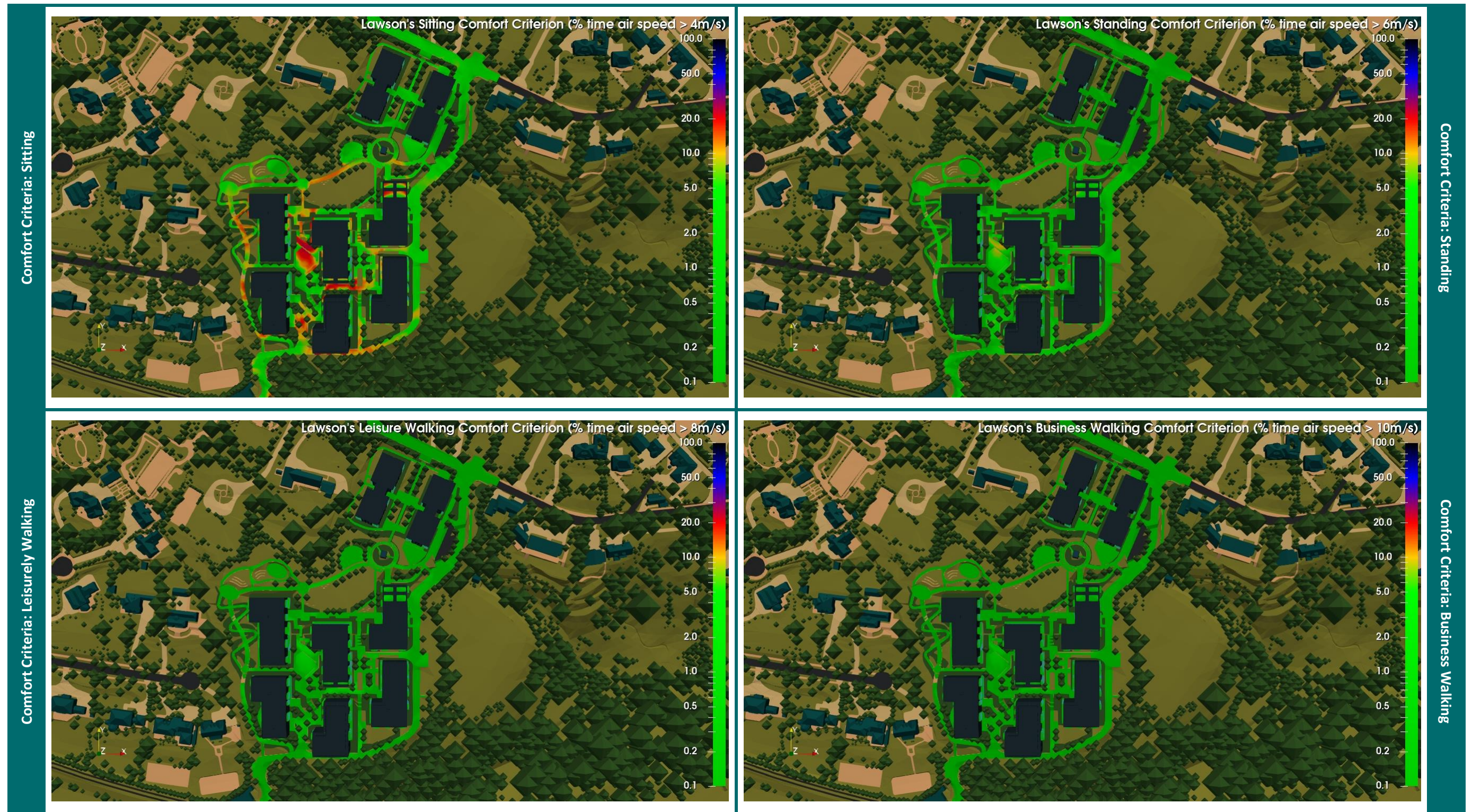


Figure 44: Comfort Criteria: All Seasons: View from the top

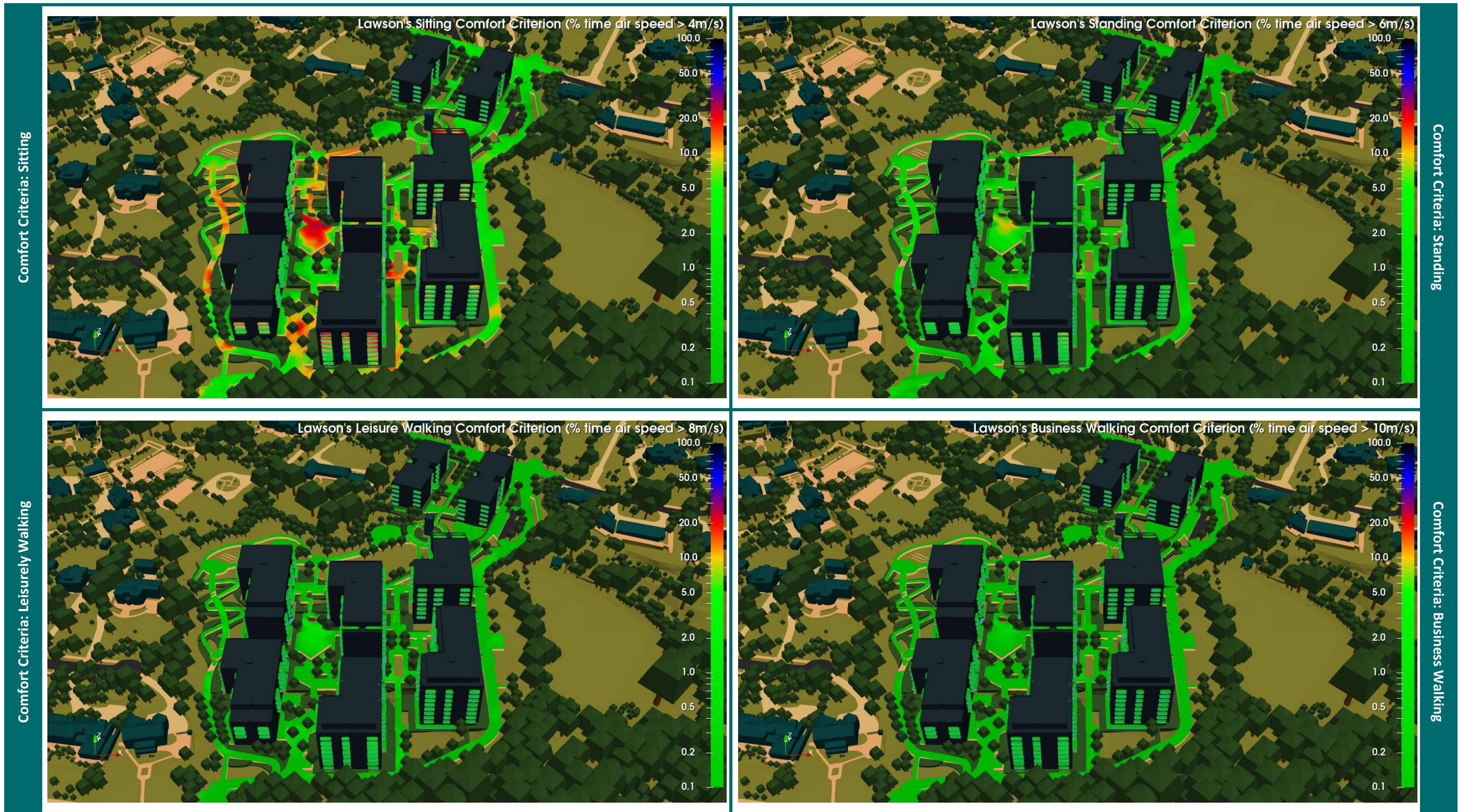


Figure 45: Comfort Criteria: All Seasons: View from the south

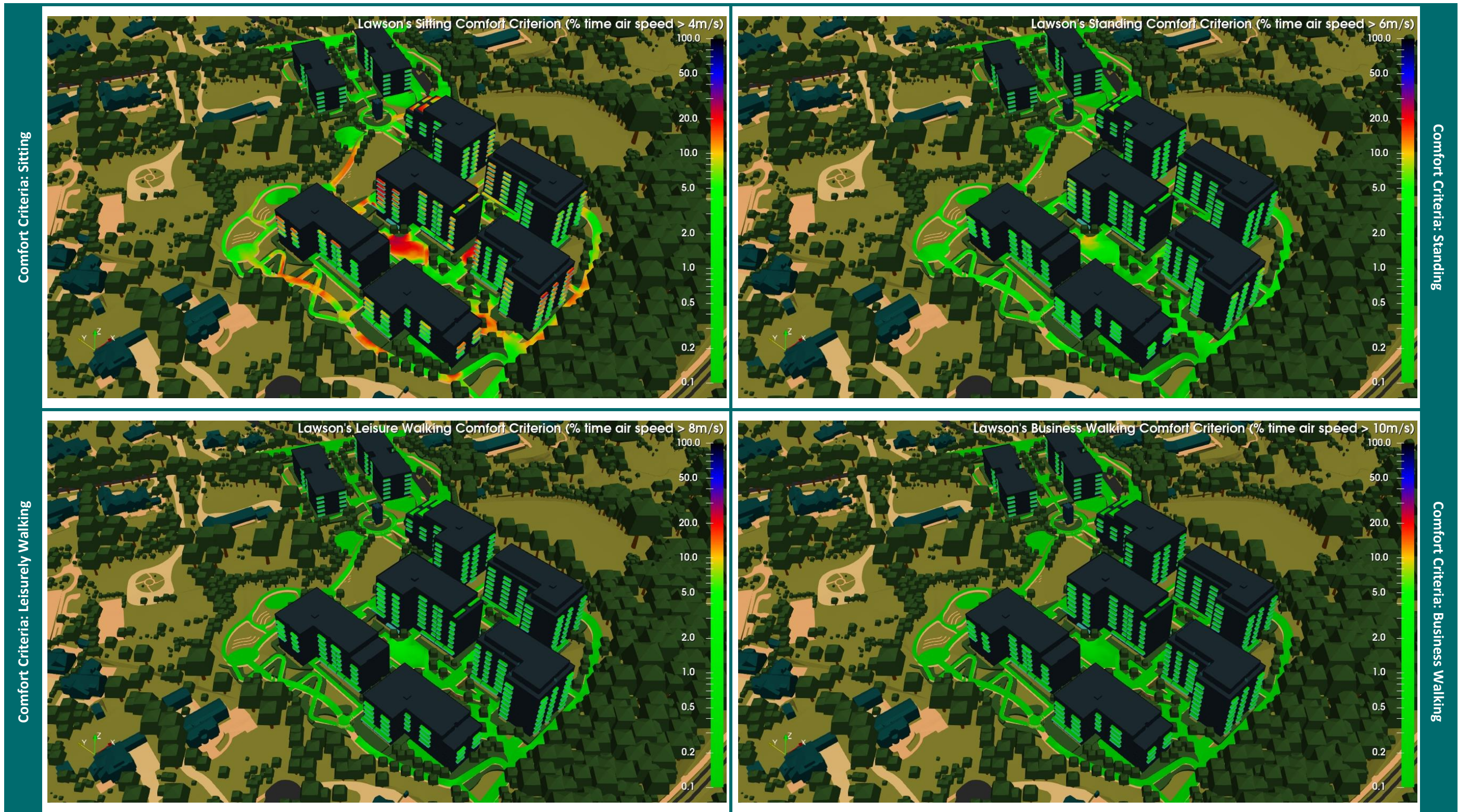


Figure 46: Comfort Criteria: All Seasons: View from the southwest

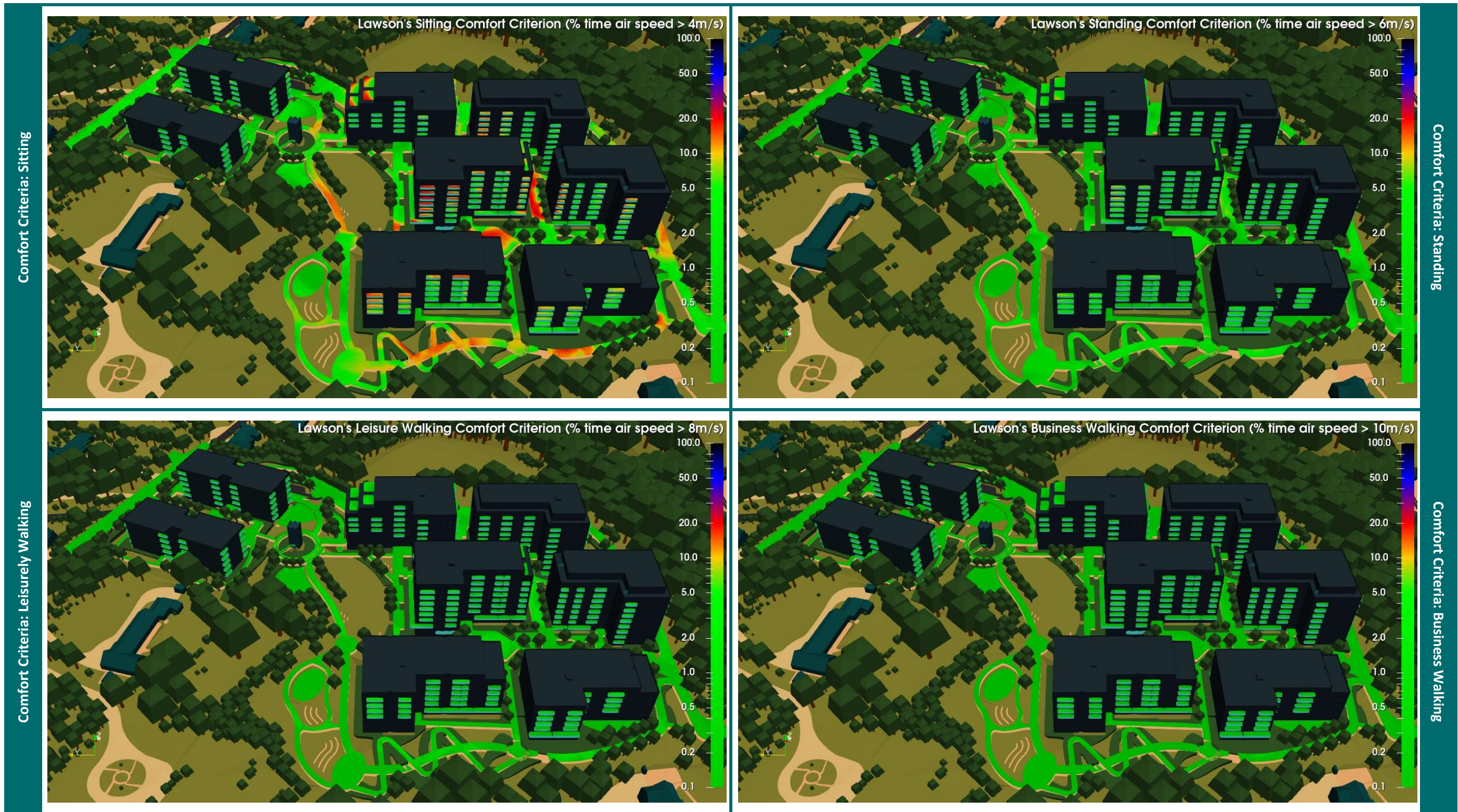


Figure 47: Comfort Criteria: All Seasons: View from the west

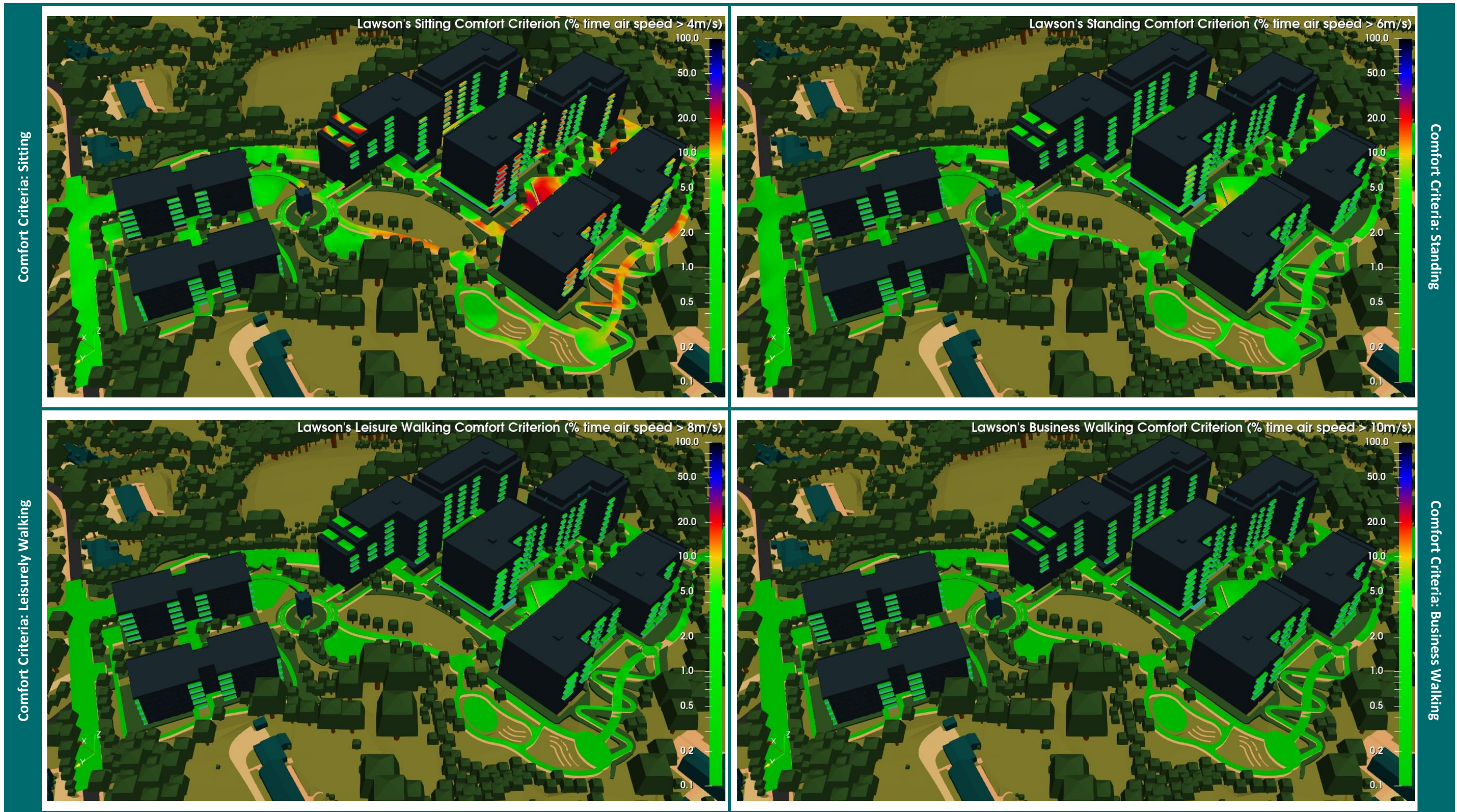


Figure 48: Comfort Criteria: All Seasons: View from the northwest

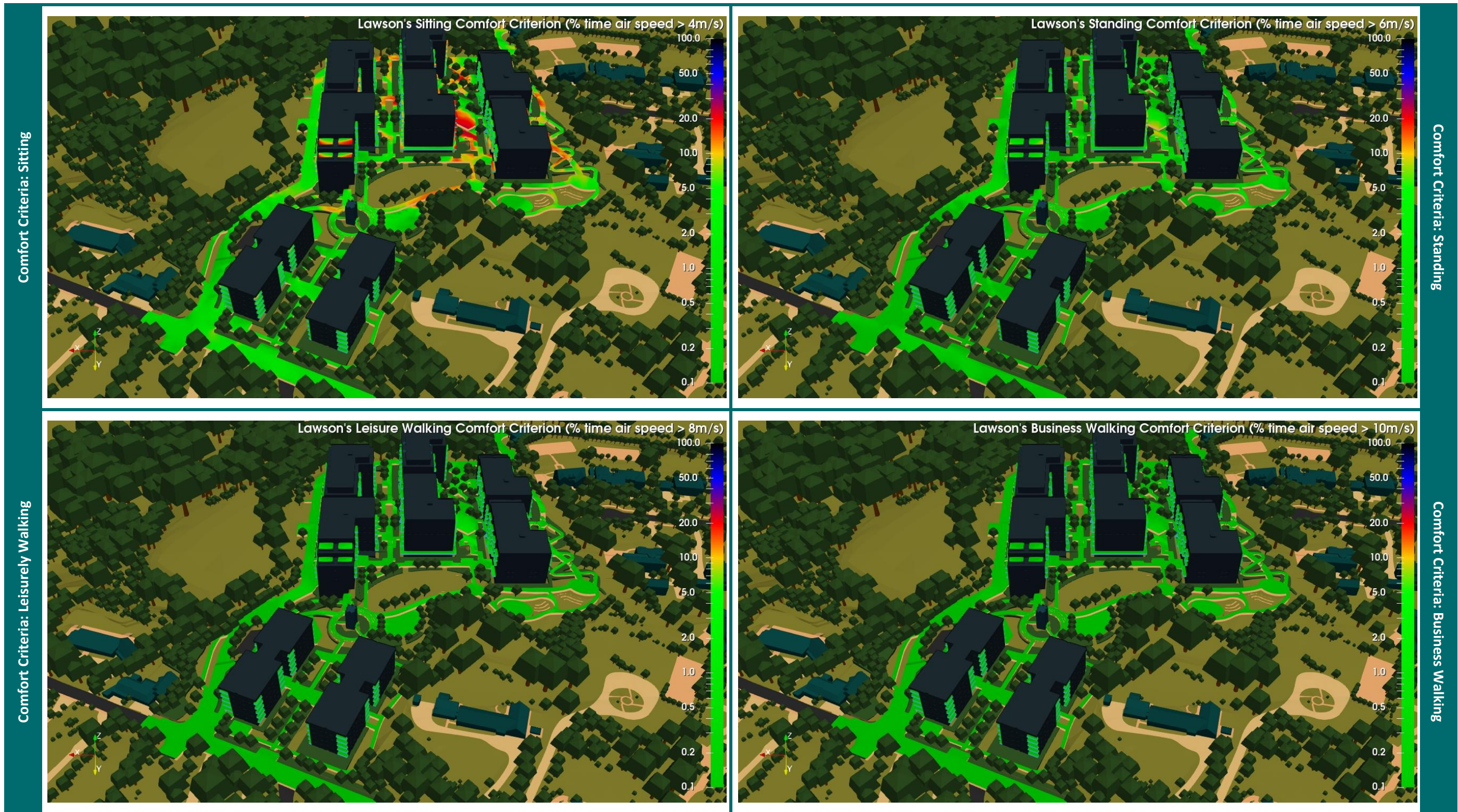


Figure 49: Comfort Criteria: All Seasons: View from the north

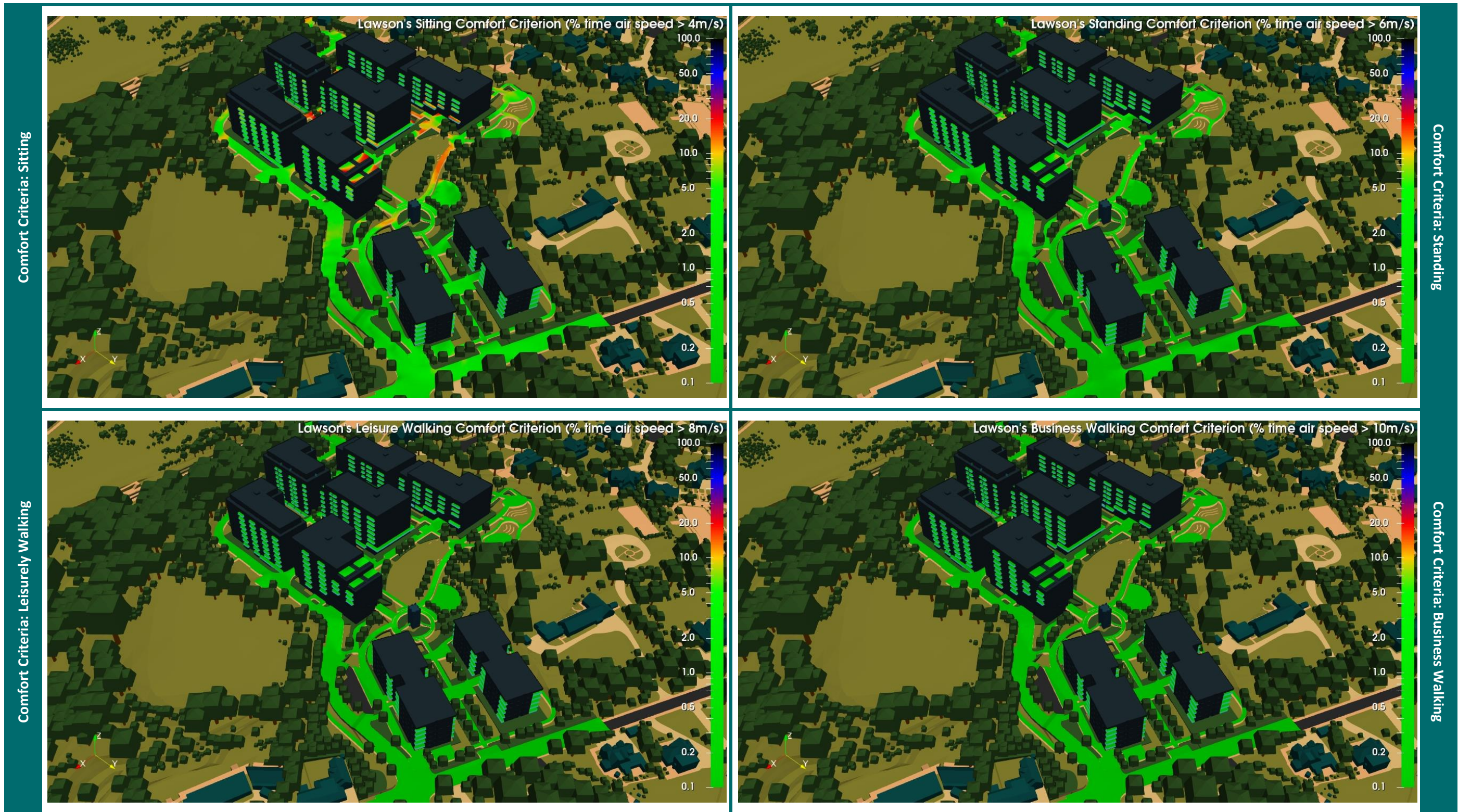


Figure 50: Comfort Criteria: All Seasons: View from the northeast

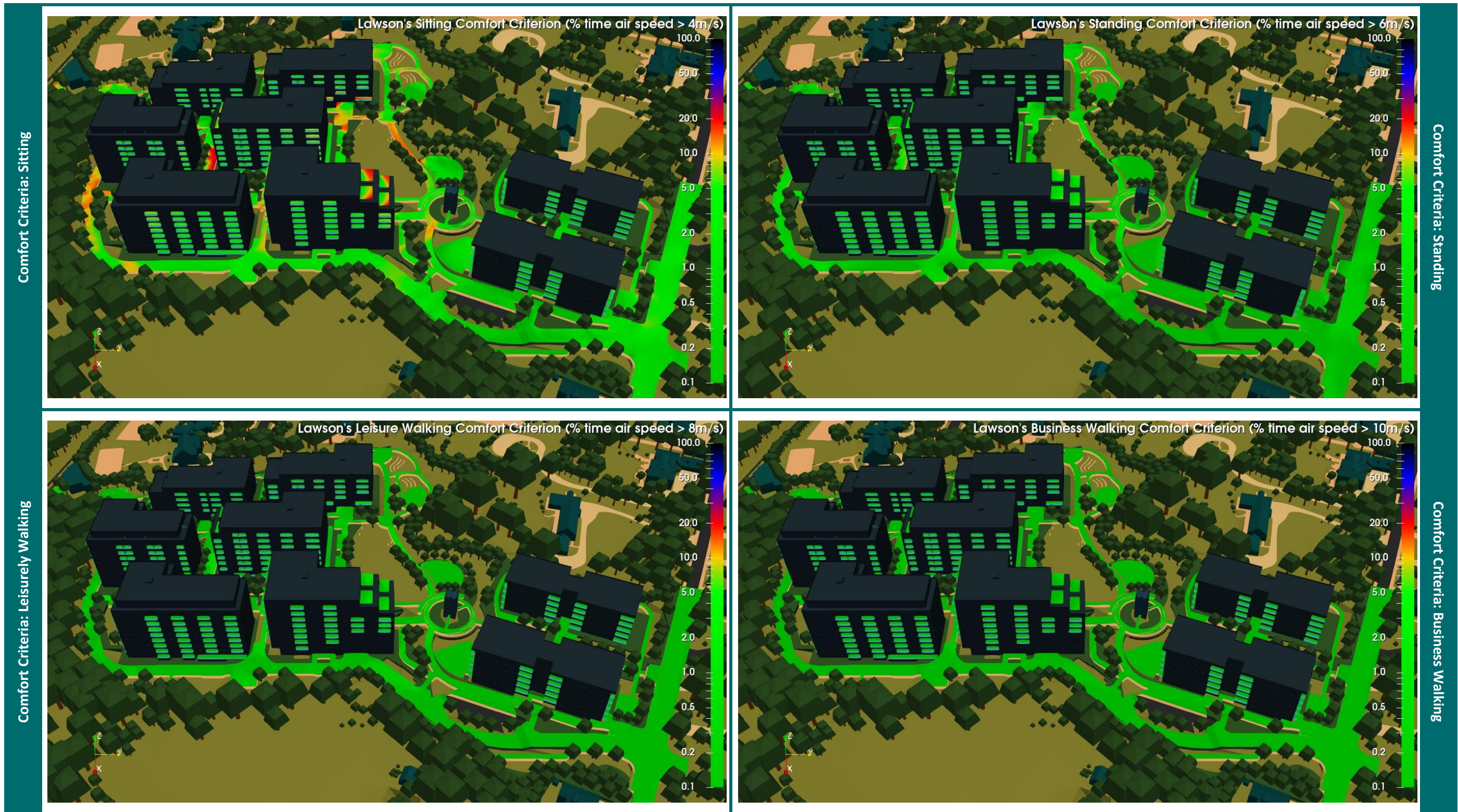


Figure 51: Comfort Criteria: All Seasons: View from the east

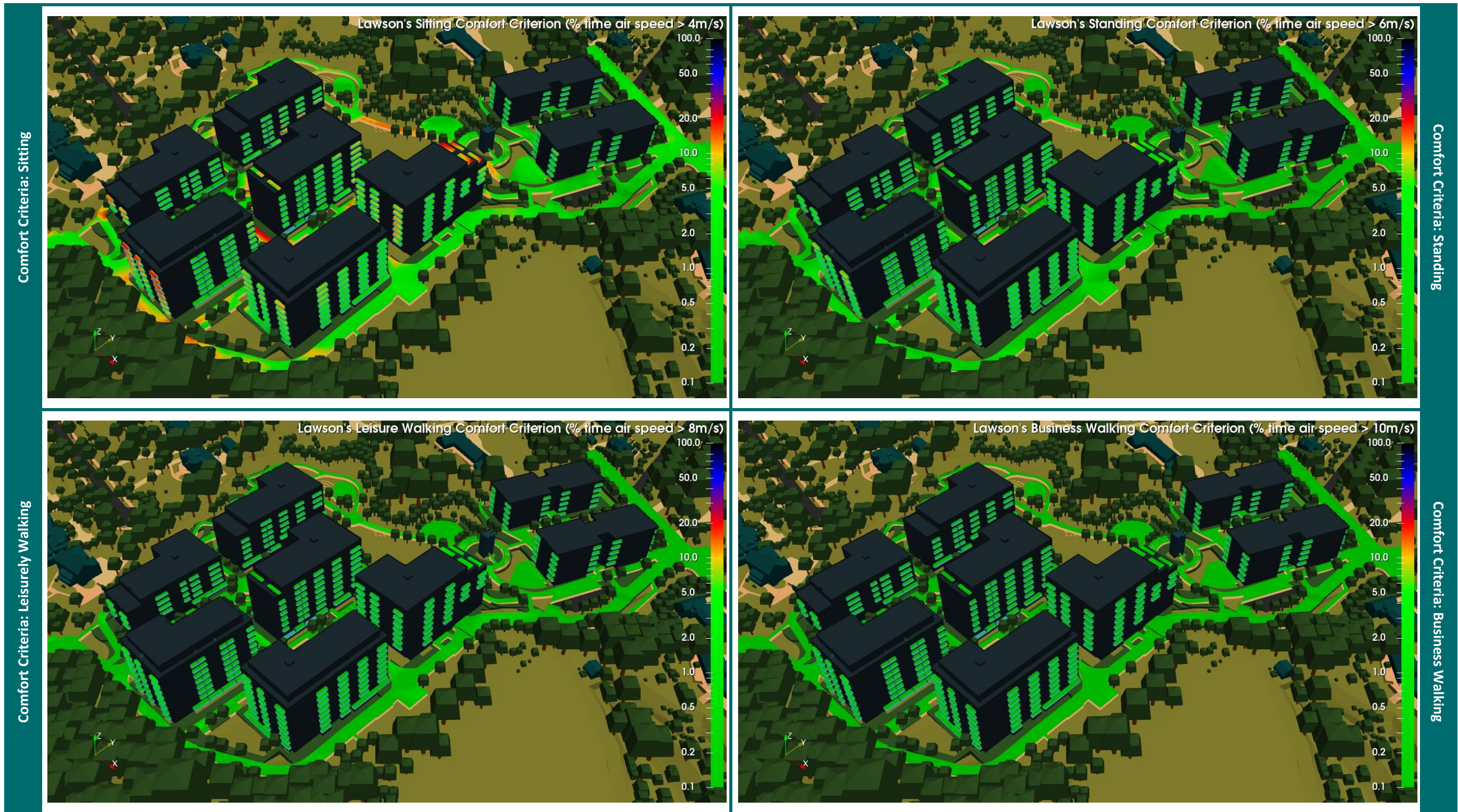


Figure 52: Comfort Criteria: All Seasons: View from the southeast

7.2 Safety Criteria

Figure 53 to Figure 61 show the percentage of the year the hourly wind speed exceeds the threshold value for the safety criteria for all seasons. The threshold values are 20m/s for normal pedestrian and 15m/s for sensitive pedestrian.

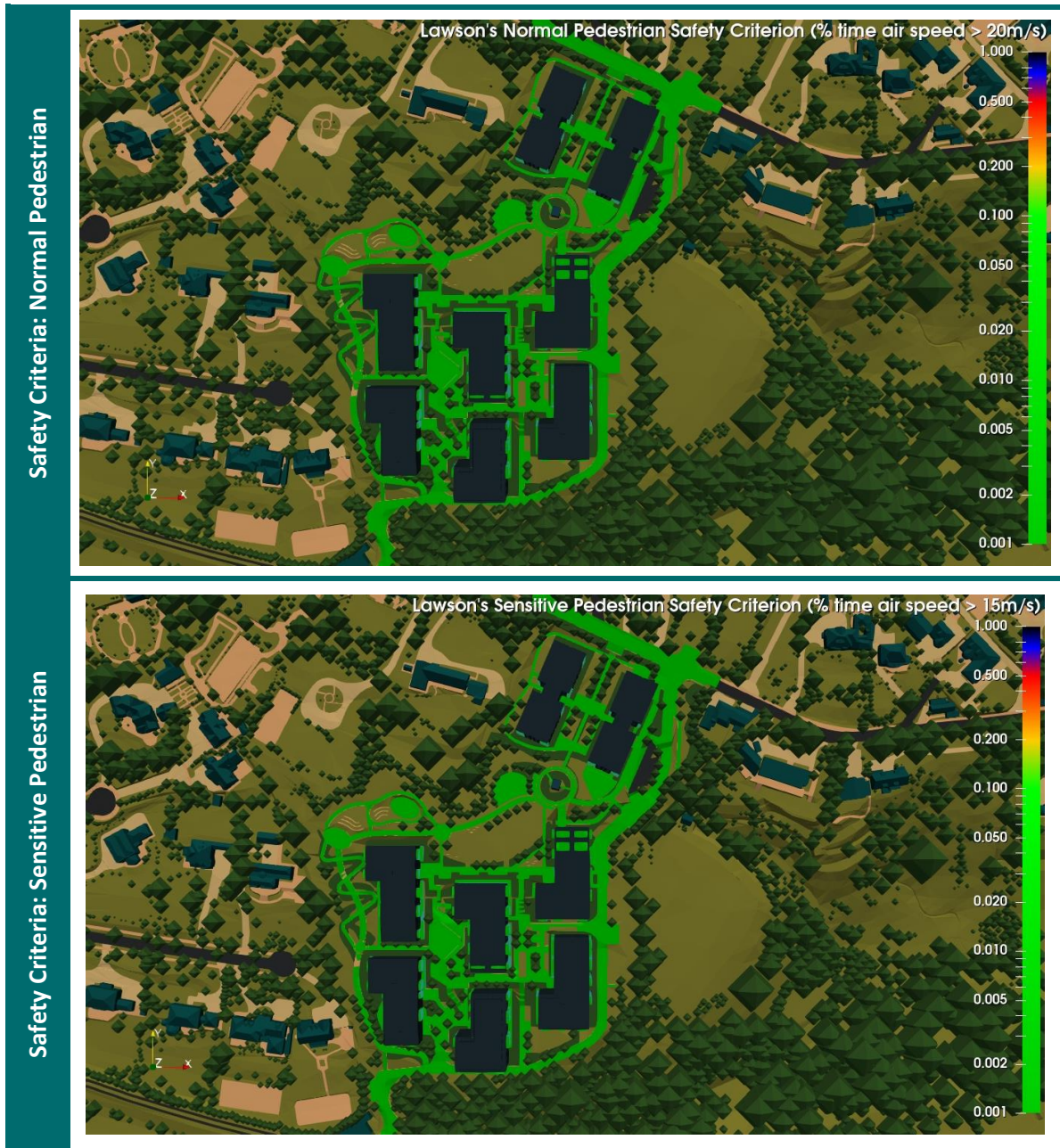


Figure 53: Safety Criteria: All Season: View from above

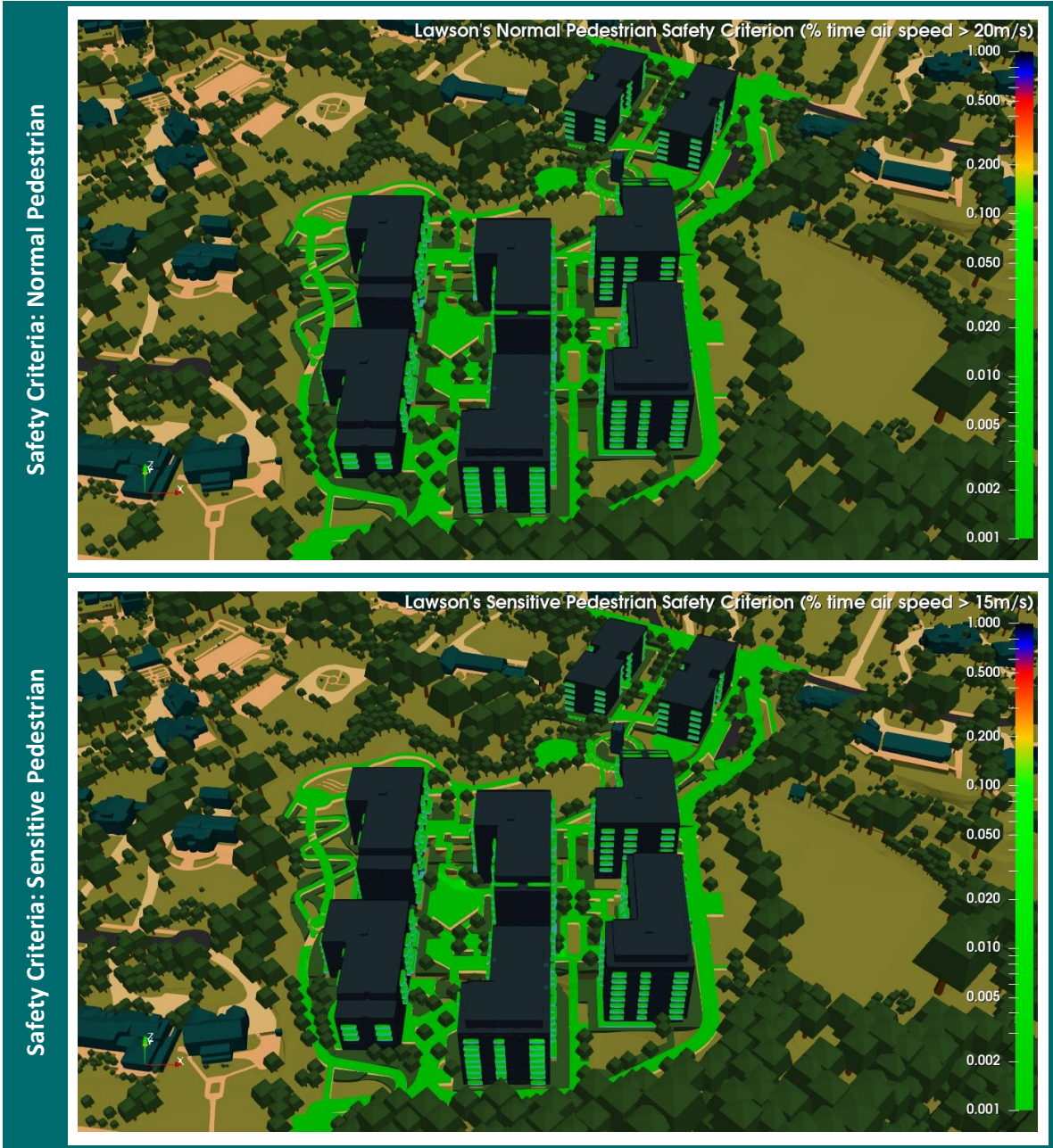


Figure 54: Safety Criteria: All Season: View from the south

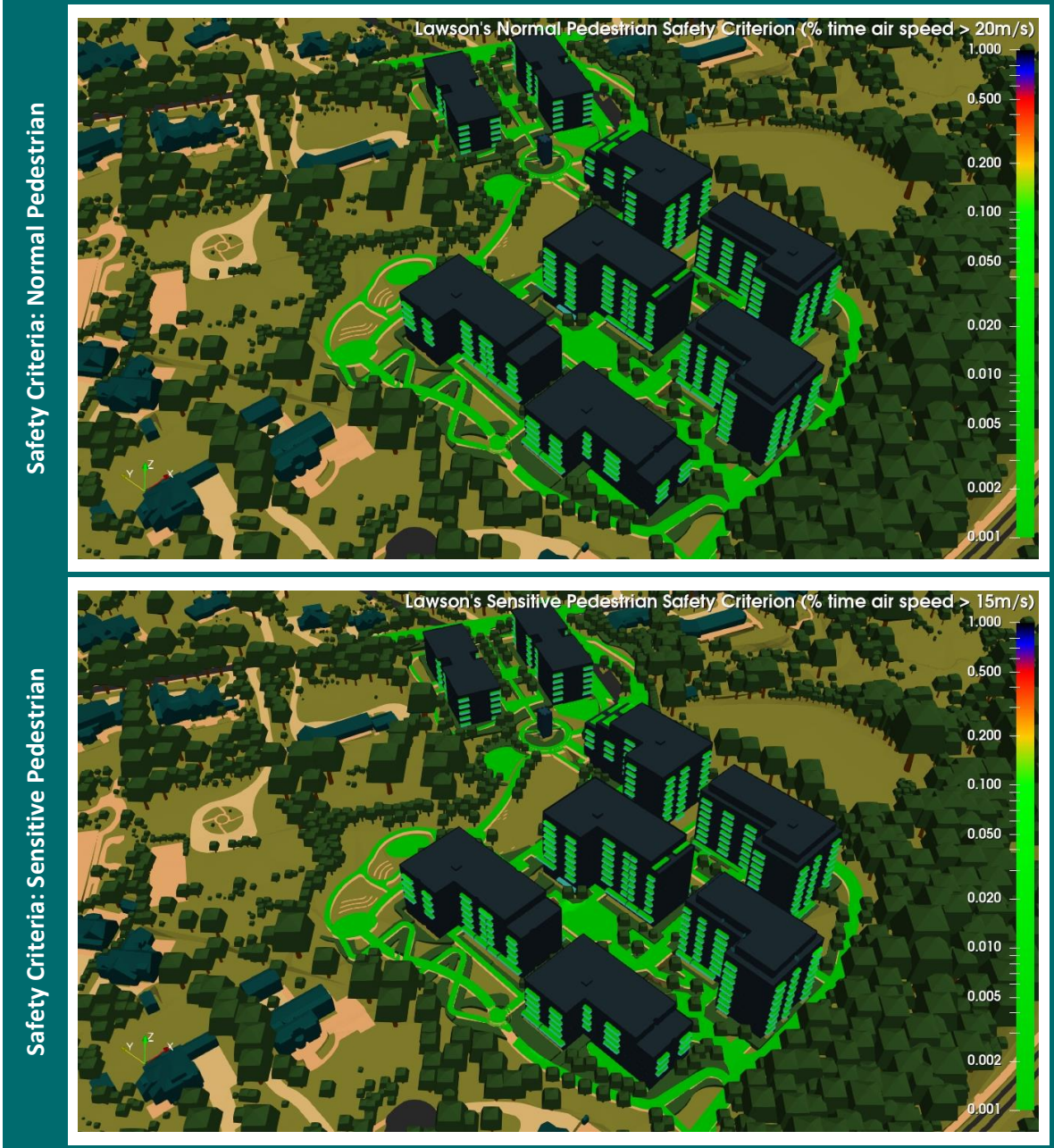


Figure 55: Safety Criteria: All Season: View from the southwest

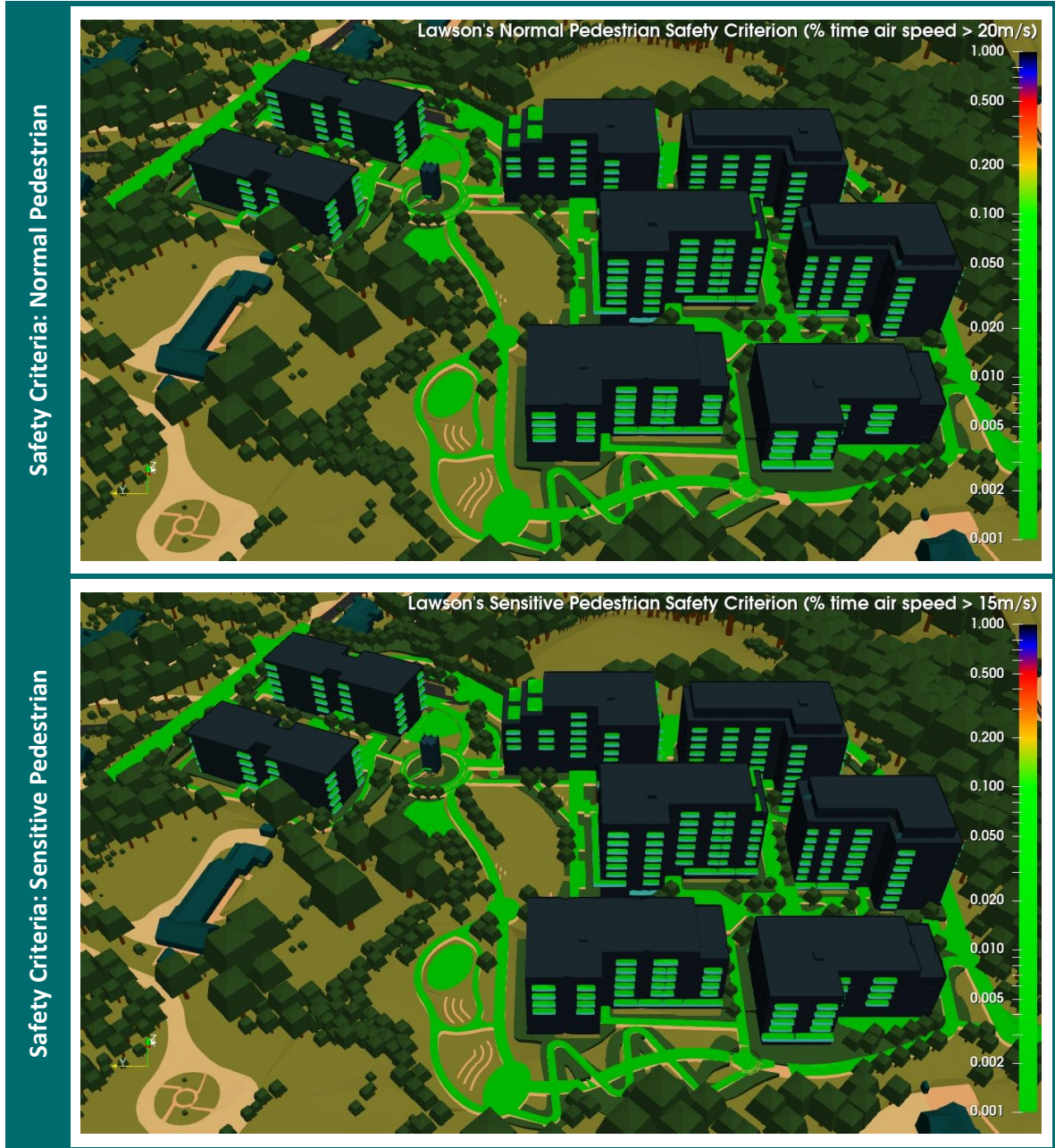


Figure 56: Safety Criteria: All Season: View from the west

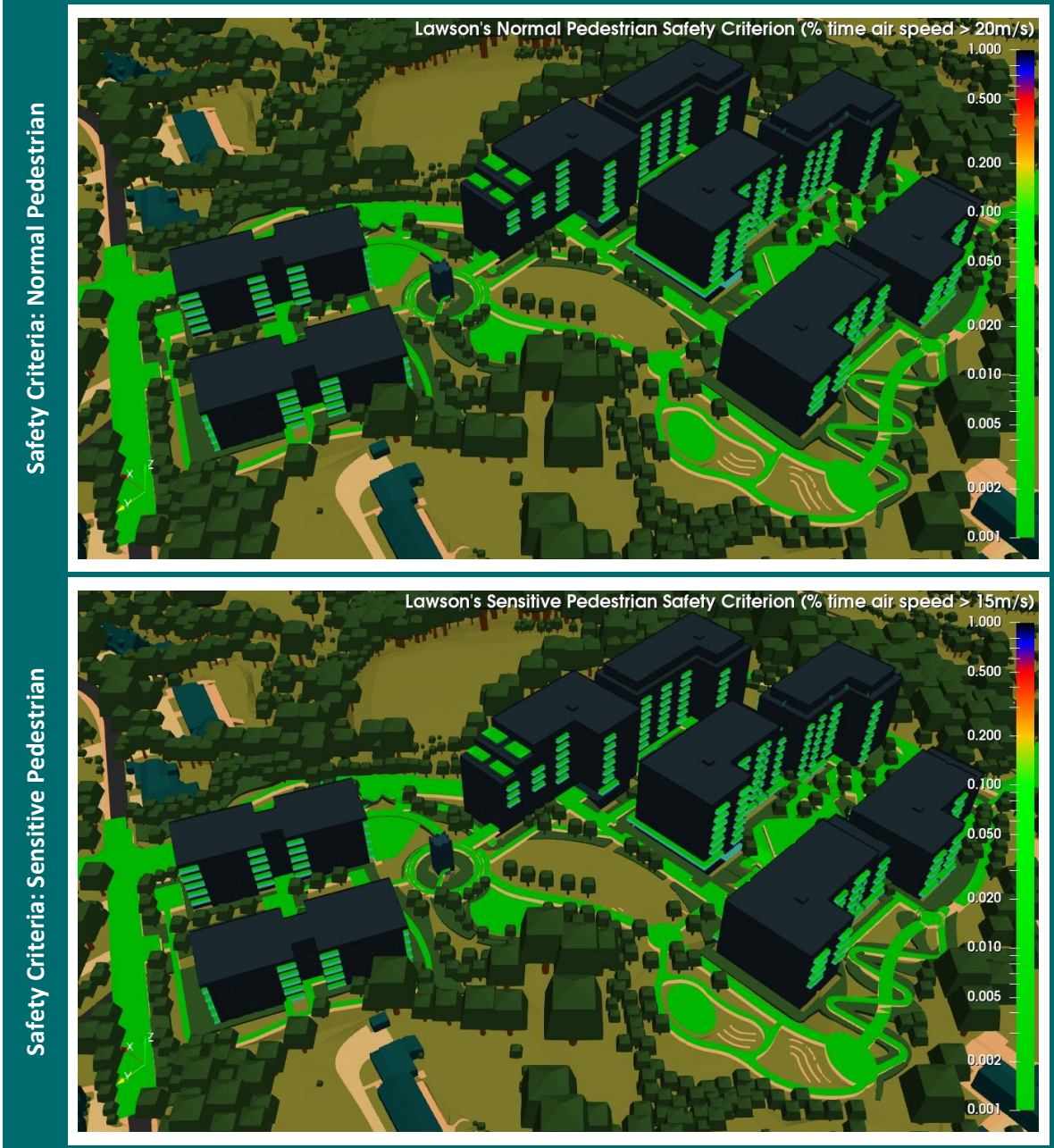


Figure 57: Safety Criteria: All Season: View from the northwest

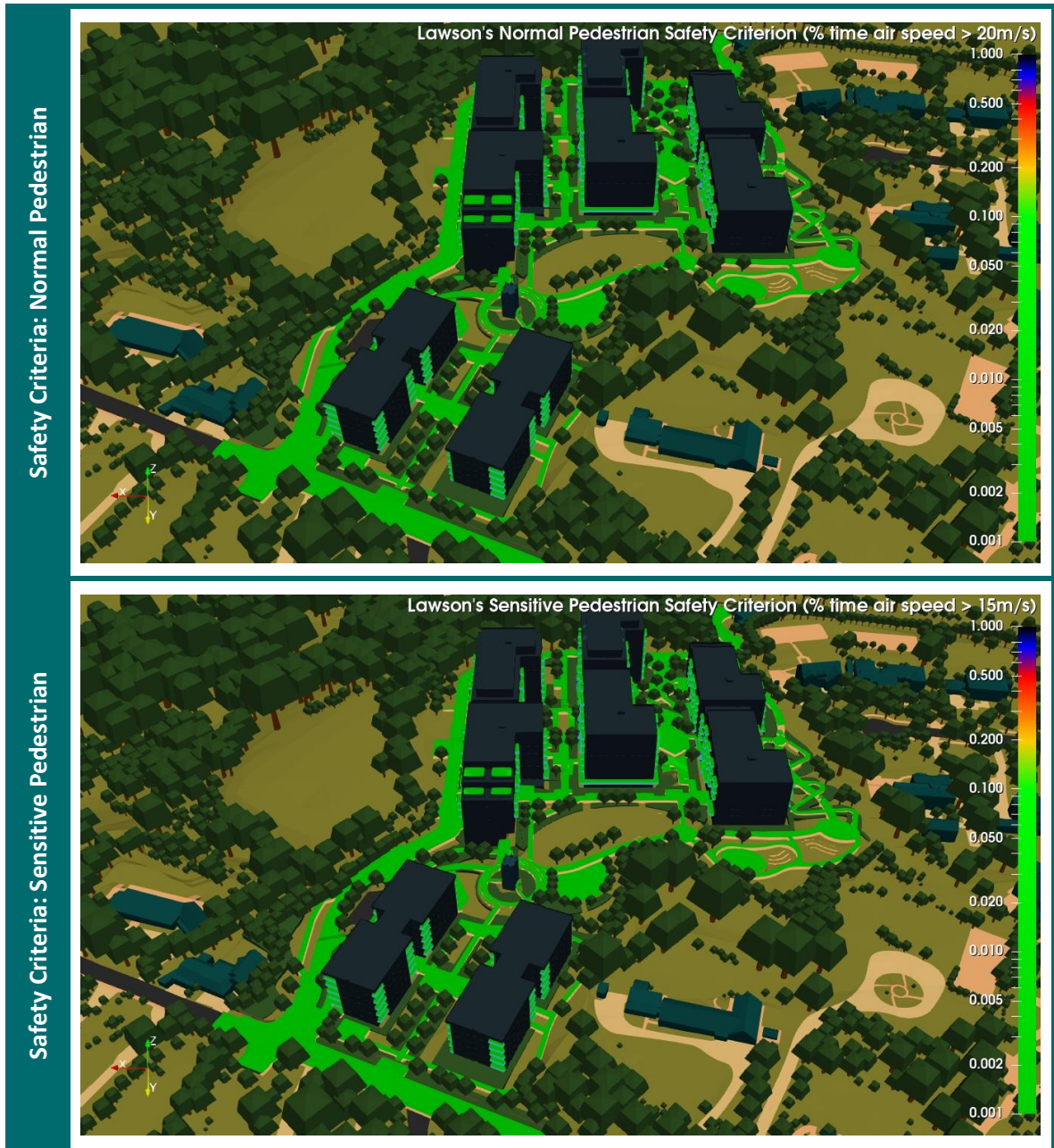


Figure 58: Safety Criteria: All Season: View from the north



Figure 59: Safety Criteria: All Season: View from the northeast

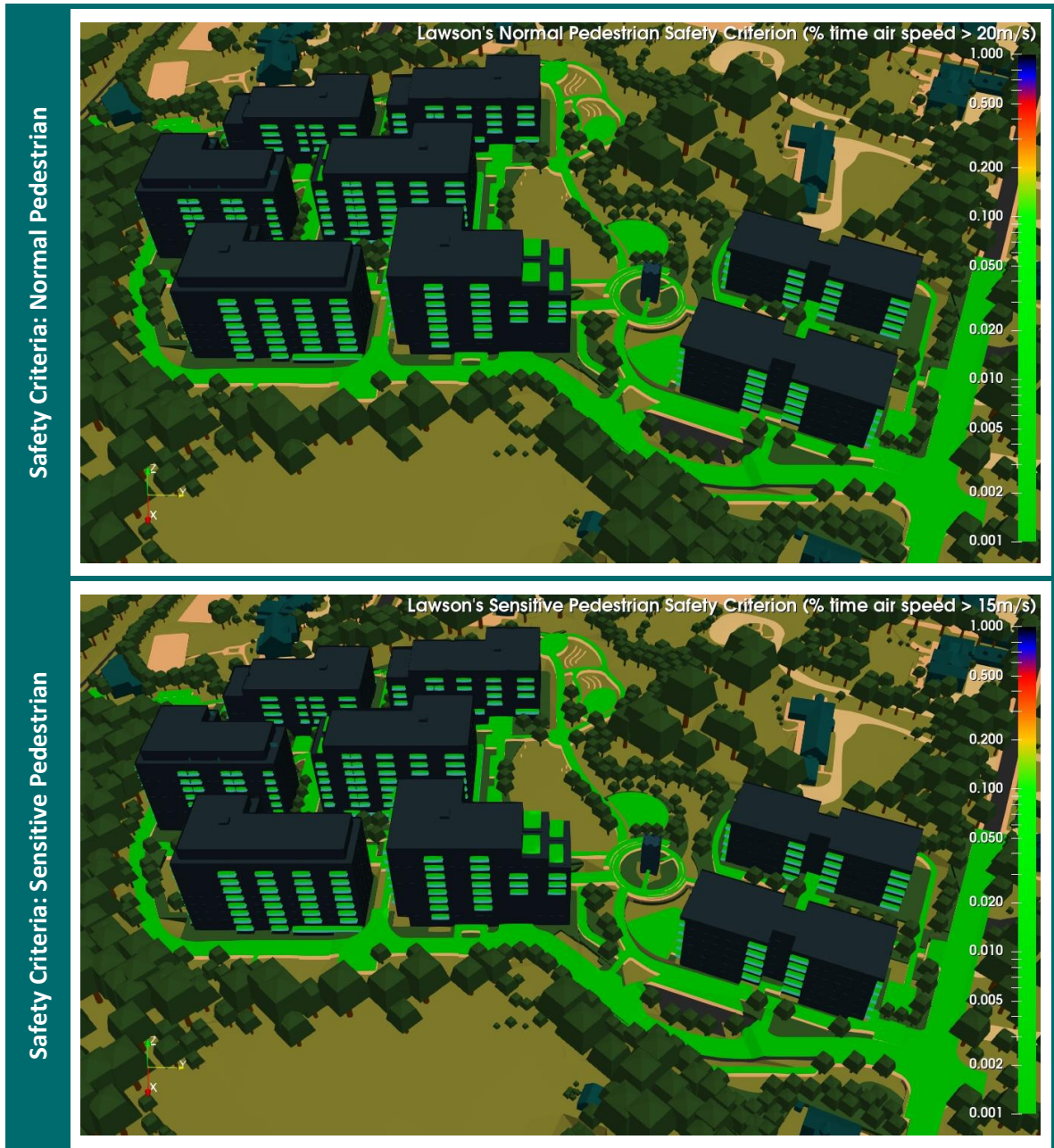


Figure 60: Safety Criteria: All Season: View from the east

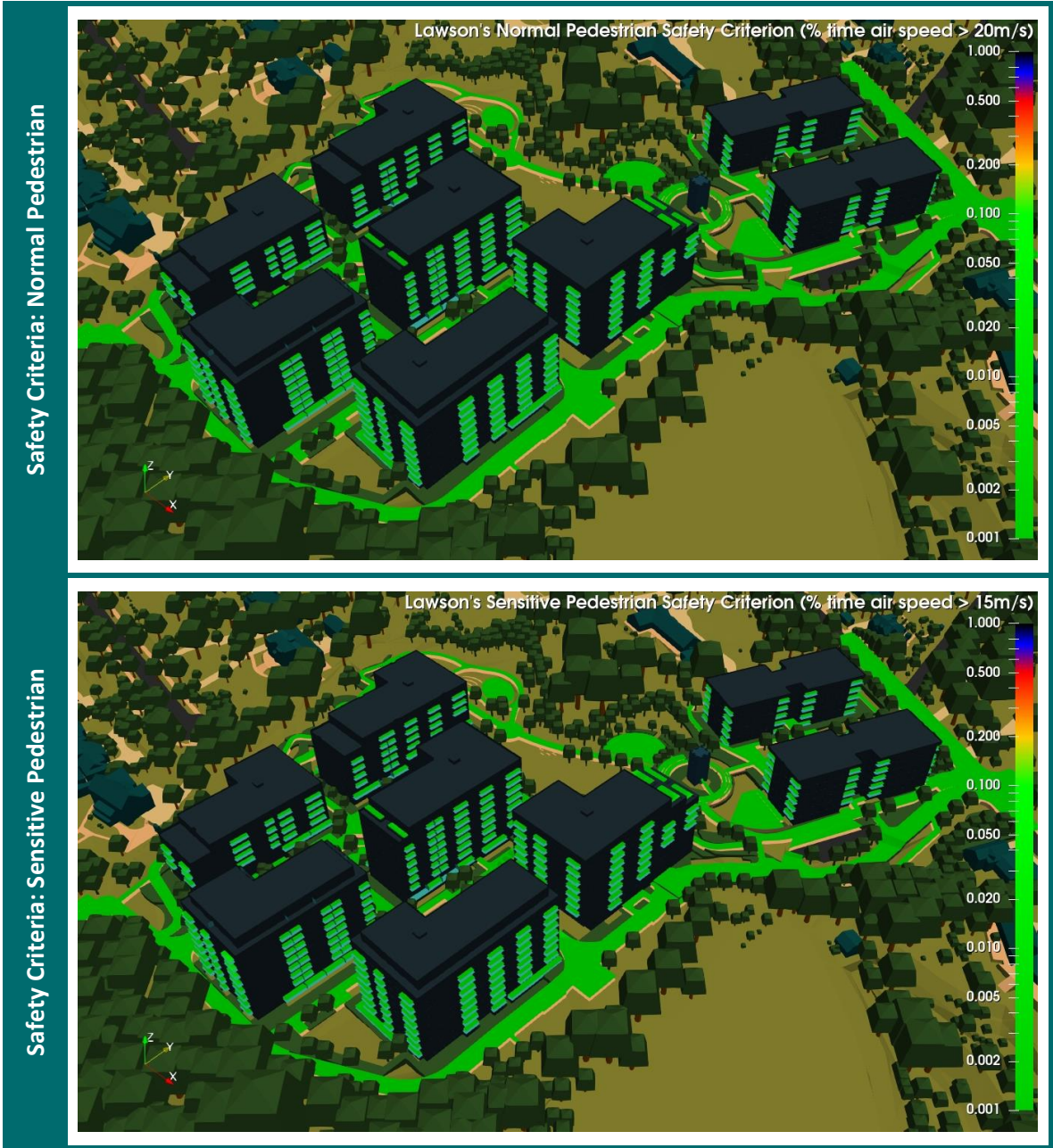


Figure 61: Safety Criteria: All Season: View from the southeast

8 Conclusion

The site is still completely safe for pedestrians. It meets the Lawsons's Walking criteria requirements. It generally meets requirements of Lawsons's Standing and Sitting criteria in conjunction with each other.

Some balconies are seen to experience exceedance of the Lawson's Sitting and Standing criteria. However, the balcony spaces are the private spaces which are used by the people residing in the respective flat. They will be expected to use their own discretion in judging the comfortable weather conditions. It is not a space that can be treated as a public open space where people have to use it frequently. So, no further mitigation measures required as such.

