Hong Kong Housing Authority

Appendix C

Pak Tin Estate Redevelopment

Air Ventilation Assessment – Initial Study (AVA-IS)

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1 INTRODUCTION

1.1 Background

1.1.1 AECOM Asia Company Ltd. has been commissioned by the Hong Kong Housing Authority (HKHA) to undertake an Air Ventilation Assessment (AVA) Study – Initial Study for the Redevelopment of Pak Tin Estate to examine the air ventilation performance of its building design quantitatively and formulate effective and practicable measures enhancing the air ventilation as part of the continuous design improvement process.

1.1.2 In year 2013, a redevelopment layout at the Pak Tin Estate has been assessed and approved by the Town Planning Board, which consists buildings with maximum height of 122mPD (in Phases 7, 8 and 10) and 130mPD (Phases 11 and 13). While in 2018, an update of the development layout is proposed, with the major adjustment of the new scheme being the increase of building height (which had maximum height increased to 157mPD in Phase 13, and the maximum building height of Phase 10 is increased to 132mPD), as well as minor alteration of development morphology for the buildings in Phase 7, 8, 10, 11 and 13.

1.2 Objectives

1.2.1 The AVA Study for the Redevelopment of Pak Tin Estate (i.e. the Subject Site) has been conducted in accordance with the methodology outlined in the Technical Guide for AVA for Developments in Hong Kong (the Technical Guide) annexed in HPLB and ETWB TC No. 1/06. The main purposes of this AVA Study, echoing the Technical Guide, are:

- To assess the characteristics of the wind availability (V_∞) of the site;
- To give a general pattern and a rough quantitative estimate of wind performance at the pedestrian level reported using Wind Velocity Ratio (VR);
- To quantitatively assess the air ventilation performance in the neighbourhood of the proposed development; and
- To compare two design scenarios in terms of air ventilation performance aspect.

1.3 Content of this Report

1.3.1 Section 1 is the introduction section. The remainder of the report is organized as follows:

- Section 2 on expert evaluation;
- Section 3 on assessment methodology;
- Section 4 on key findings of AVA study; and
- Section 5 with a summary and conclusion.

2 EVALUATION OF THE SITE CONDITION

2.1 Site Location

2.1.1 The Subject Site, Phases 7, 8, 10, 11 and 13 of the Pak Tin Estate, is located in the Shek Kip Mei region, north-western part of Kowloon Peninsula. It currently consists of multiple residential building blocks situated to the north west of the Shek Kip Mei MTR station and the west of the Shek Kip Mei Park. A structure of water service reservoir is located on the hilly topography to the west, Nam Cheong Street to the east and north of the Subject Site in which it is bounded by the Wai Lun Street and Pak Tin Street to the South of the Subject Site.

Figure 2.1 Location of the Subject Site

2.2 Site Wind Availability

2.2.1 The Subject Site is located in the north-western part of Kowloon Peninsula. As shown in the **Figure 2.1** refers, the topography adjacent to the Subject Site comprises several open spaces and parks and also clusters of medium rise commercial and residential buildings. Also, to the western side of the subject site exist a water reservoir and to the north of it is a large open area named the Shek Kip Mei Service Reservoir Playground.

2.2.2 The previous Hong Kong Observatory Yau Yat Chuen automatic weather station is the closet weather station once existed near the Subject Site. According to the monthly wind roses from the Yau Yat Chuen automatic weather station shown in **Figure 2.2**. The wind roses proposed the annual wind is from the north eastern quadrant while the summer wind is from the south western quadrant and east.

2.2.3 For upper level unobstructed wind, the simulated RAMS wind data at 500m above terrain located at Grid (078, 046) (see **Figure 2.3**) showed the prevailing wind directions under both annual and summer conditions (**Figure 2.4** refers). From the wind rose obtained from the Planning Department's website, it is noted that the occurrence of wind from ESE, ENE and E directions occupy over 40% of the time throughout a year, while in summer, the wind environment is dominated by SW, SSW, S and ESE incoming winds, as the total occurrence of these winds being over 40%.

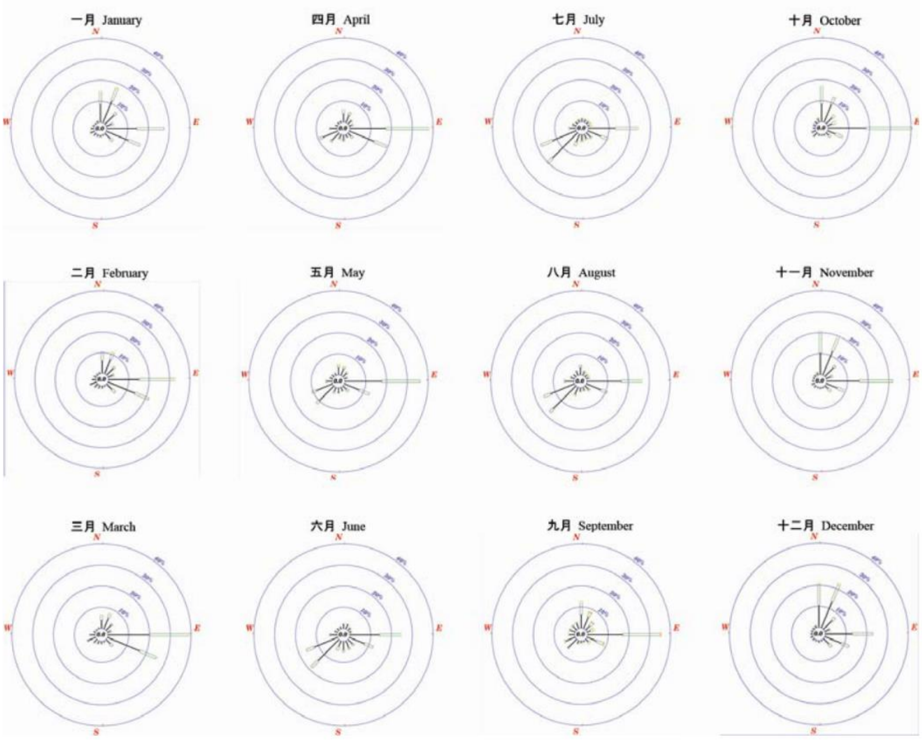


Figure 2.2 Monthly Wind Roses from the Yau Yat Cheun Weather Station (1998 to 2007)

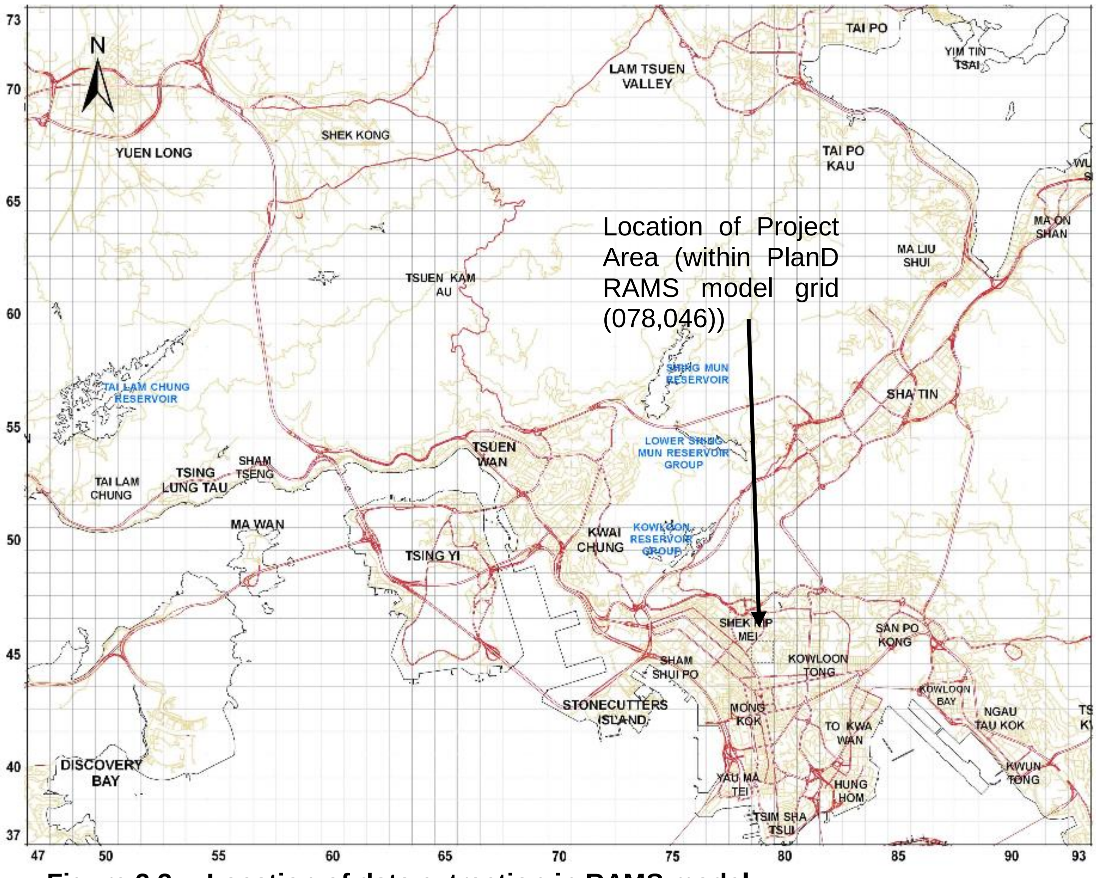
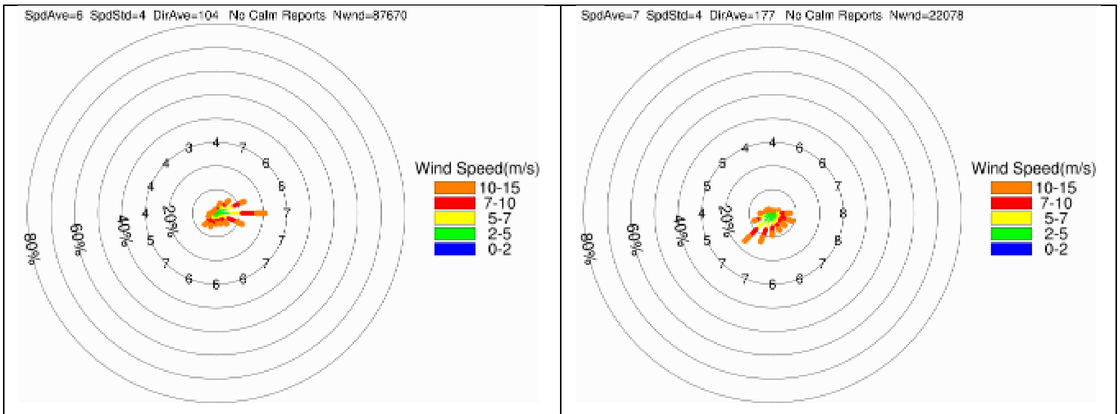


Figure 2.3 Location of data extraction in RAMS model



(a) Annual Wind Rose (b) Summer Wind Rose

Figure 2.4 RAMS Wind Rose at Grid (078, 046)

2.3 Major local morphologies near the site

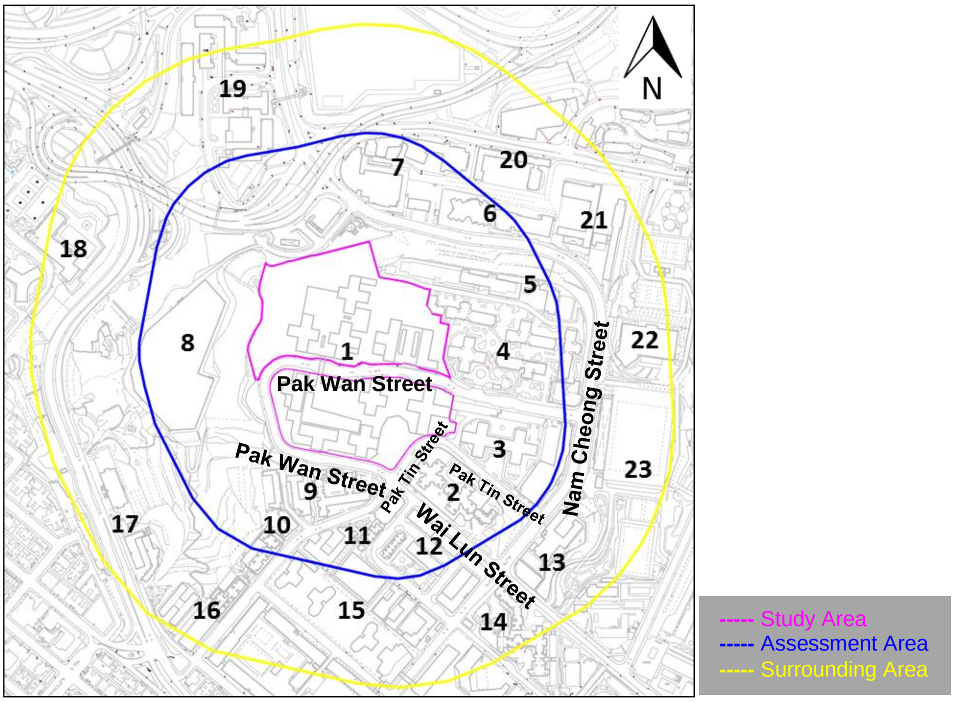
2.3.1 The Subject Site is surrounded by hilly terrain to the far north and north western direction, which mainly include the Beacon Hill to the far northern direction and Kam Shan to the far north western direction. To the East of the Subject Site exists some flat open spaces (Shek Kip Mei Park and the associated sports fields) with relatively few blockages against the prevailing wind, therefore it is expected that the winds from the east could reach the site without terrain obstruction. The topographical features to the south-east vicinity of the Subject Site is relatively flat and low-rise while a small hill existed to the west and southwest of the Subject Site. Hence, the terrain blockage against winds from the south-easterly directions is not expected, but the winds approaching from the southwest and west-southwest directions would likely be moderated before reaching the site at pedestrian level.

2.3.2 The Pak Tin Estate is located at the northern portion of the Shek Kip Mei area. The site is fronting the high-density, mid to high-rise urban districts of the Shek Kip Mei – Sham Shui Po region to the southeast, south and southwest. The major bulky buildings falls in these directions includes the developments of Shek Kip Mei Estate, the On Tin House, Nam Shan Estate, Tai Hang Sai Estate, and Shui Tin House – Tai Tin House, etc.. It can be expected that such morphology would weaken the approaching winds from the southerly directions flowing towards the site

2.3.3 On the other hand, the buildings to the near east / northeast of the Subject Site are less compacted while decent open spaces (such as the Shek Kip Mei Park, Kornell Street Park, etc.) are scattered in between clusters of buildings providing ventilation “breathing spaces”. Such morphology would allow a better wind permeability towards the site under easterly and north-easterly winds.

2.3.4 Pak Wan Street, located within the Subject Site and aligned in an east to west direction, serves to provide a wind corridor under the easterly and east north easterly wind. The north easterly, east north easterly and easterly winds. Apart from that, the portion of Pak Tin Street aligned in the south western direction, the portion of the Nam Cheong Street aligned in the North to South direction serve as wind corridors under the summer wind from the south/south western quadrant. Furthermore, Wai Lun Street located to the south of the subject site aligned in north western – south eastern direction linked with the Pak Wan Street also serve as potential wind corridors under the easterly winds.

2.3.5 **Figure 2.5** below shows the distribution of major buildings in the surrounding developments.



1. Subject Site	2. Tai Tin House / Lai Tin House	3. Shing Tin House / Cheung Tin House / Shui Tin House
4. Yun Tin / Tsui Tin / Yu Tin House / Fu Tin House	5. Pak Tin Catholic Primary School	6. HKSKH Li Ka Shing Care and Attention Home For the Elderly
7. Public Health Laboratory Center, The Mental Health Assn of HK Cornwall School	8. Shek Kip Mei Fresh Water Service Reservoir	9. On Tin House, The Elchk Faith Lutheran School
10. Former Kow Kong Commercial, Lingnan Univeristy Alumni Assn Primary School	11. Jockey Club Creative Arts Centre, Po Tin Building	12. Pak Yuk Building, Kam Yuck Building, Fook Tin Building
13. The HK Sze Yap Commercial & Industrial Assn Wong Tai Shan Memorial College	14. Shek Kip Mei Estate Phase 1	15. Shek Kip Mei Estate Phase 5
16. Shek Kip Mei Estate Phase 3 & 7, Mei Ho House Youth Hostel	17. Scad Hong Kong, Saviour Lutheran Church School	18. Lei Cheng Uk Estate
19. Chak On Estate	20. Society of Boy's Centres Chak Yan Centre	21. CMA Secondary School
22. Shek Kip Mei Park Sports Centre	23. Shek Kip Mei Park	

Figure 2.5 Major buildings surrounding the Study Area

3 ASSESSMENT METHODOLOGY

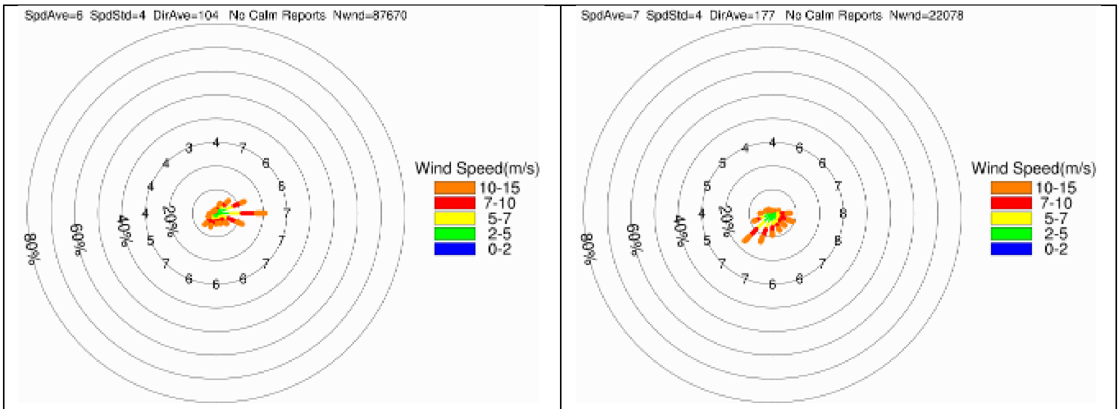
3.1 General

3.1.1 This AVA study was carried out in accordance with the guidelines stipulated in the Technical Guide for AVA for Developments in Hong Kong with regard to Computational Fluid Dynamics (CFD) modelling. Reference was also made to the "Recommendations on the use of CFD in Predicting Pedestrian Wind Environment" issued by a working group of the COST action C14 "Impact of Wind and Storms on City Life and Built Environment" (COST stands for the European Cooperation in the field of Scientific and Technical Research). COST action C14 is developed by European Laboratories/Institutes dealing with wind and/or structural engineering, whose cumulative skills, expertise and facilities have an internationally leading position. Thus, it is considered that the COST action C14 is a valid and good reference for CFD modelling in AVA study.

3.2 Modelling Tool and Model Setup

3.2.1 Assessment was conducted by means of 3-dimensional CFD model. The well-recognised commercial CFD package FLUENT was used in this exercise. FLUENT model had been widely applied for various AVA research and studies worldwide. The accuracy level of the FLUENT model was very much accepted by the industry for AVA application.

3.2.2 Wind Directions: In the CFD model, wind environment surrounding the Subject Site will be simulated under at least 8 most prevailing wind directions (which would represent occurrence of more than 75% of time) under both annual and summer condition to illustrate the change in local wind condition due to the proposed development. These prevailing wind directions are determined based on the wind availability simulation result of RAMS model published by Planning Department (PlanD from hereafter). The wind roses representing annual and summer winds at the Subject Site of this study are presented in **Figure 3.1** below. Furthermore, the summarized chosen prevailing wind directions and their related occurrence probability are listed in **Table 3.1**.



(c) Annual Wind Rose (d) Summer Wind Rose

Figure 3.1 Wind Rose at Grid (078, 046) at 500m

Table 3.1 Simulated Wind Directions and their corresponding percentage occurrence

Annual Wind Direction	**% of Annual Occurrence**	**Summer Wind Direction**	**% of Summer Occurrence**
22.5º (NNE)	4.8%	90º (E)	8.2%
45º (NE)	7.7%	112.5º (ESE)	9.6%
67.5º (ENE)	13.1%	135º (SE)	7.6%
90º (E)	21.1%	157.5º (SSE)	7.8%
112.5º (ESE)	12.2%	180º (S)	9.5%
135º (SE)	6.3%	202.5º (SSW)	13.2%
157.5º (SSE)	4.8%	225º (SW)	16.8%
202.5º (SSW)	6.2%	247.5º (WSW)	8.4%
225º (SW)	6.8%		
Annual Total	**83.0%**	**Summer Total**	**81.1%**

3.2.3 Vertical Wind Profiles: Wind environment under different wind directions will be defined in the CFD environment. According to the Technical Guide (HPLB and ETWB, 2006) per Para 20, wind profile for the site could be appropriated from the V_∞ data developed from RAMS and with reference to the Power Law or Log Law using coefficients appropriate to the site conditions. In this assessment, vertical wind profile condition below 20mPD is determined using the Log Law while the wind speed above 20mPD is adopted from the RAMS wind profile on PlanD's website.

3.2.4 Vertical wind profile and roughness lengths are determined accordingly as follows:

$$\text{Log Law} \quad U_z = \frac{u^*}{\sigma} \ln\left(\frac{Z}{Z_0}\right)$$

Where U_Z : wind speed at height z from ground
u^* : friction velocity
σ : von Karman constant = 0.4 for fully rough surface
Z : height z from ground
Z_0 : roughness length

3.2.5 The roughness length for determining vertical wind profiles under different wind direction is tabulated in **Table 3.2**. In this study, the land further away from the surrounding area are urban areas with mid to high-rise developments, as a result, a roughness length with Z_0=3 is adopted for the inflow wind profiles.

Table 3.2 Roughness Length for Determining Vertical Wind Profiles under Different Wind Directions

Land Type of Upwind Area(1)	Roughness Length(2), Z_O
Urban area with mid and high-rise developments	3
Sea or open space	0.1

Notes:

(1) The land type refers to the area upwind of the model domain further away from the Surrounding Area

(2) With reference to Feasibility Study for Establishment of Air Ventilation Assessment System (CUHK, 2005)

3.2.6 Turbulence Model: As recommended in COST action C14, realizable K-epsilon turbulence model was adopted in the CFD model to simulate the real life problem. Common computational fluid dynamics equations were adopted in the analysis.

3.2.7 Variables including fluid velocities and fluid static pressure were calculated throughout the domain. The CFD code captures, simulates and determines the air flow inside the domain under study based on viscous fluid turbulence model. Solutions were obtained by iterations.

3.2.8 Computational Domain: A 3-dimensional CFD model including major topographical features and building morphology which would likely affect the wind flow was constructed. The methodology described in the Technical Guide was adopted for this assessment. According to the Technical Guide, the Assessment Area should include the project's surrounding up to a perpendicular distance of 1H while the Surrounding Area should at least include the project's surrounding up to a perpendicular distance of 2H calculating from the project boundary, H being the height of the tallest building on site. In this study, the value of H being 150 meters with the computational domain size of around 6000 m (L) x 6000 m (W) x 2000 m (H). In addition, the blockage ratio would be not greater than 3%. The ground of the computational domain would include topography.

3.2.9 The inflow face of the computational domain is set as the velocity inlet condition and the outflow face is set as the zero gradient condition. For the two lateral and top faces, symmetric boundary condition is used. Lastly for the ground and building walls, no slip condition is employed.

3.2.10 The total number of cells for this study would be anticipated to be in the range of about 4,000,000 cells in polyhedral mesh. As polyhedral mesh cells counts can often be much smaller than comparable tetrahedral meshes with equivalent accuracy as well as improve mesh quality and manner of convergence (Franklyn, 2006). Grids may be converted to polyhedral mesh, if necessary. The horizontal grid size employed in the CFD model in the vicinity of the Project Area will be taken as a global minimum size of about 2m (smaller grid size was also employed for specific fine details) and increased for the grid cells further away from the Project Area. The maximum mesh size within the whole computational domain will be about 60m. Besides, four layers of prism cells (each layer of 0.5m thick) were employed above the terrain.

3.2.11 The advection terms of the momentum and viscous terms are resolved with the second order numerical schemes. The scaled residuals are converged to an order of magnitude of at least 1 x 10-4 as recommended in COST action C14.

3.2.12 **Figure 3.2** shows the boundaries of the Subject Site, Assessment Area and Surrounding Area that would examined in this Air Ventilation Assessment.

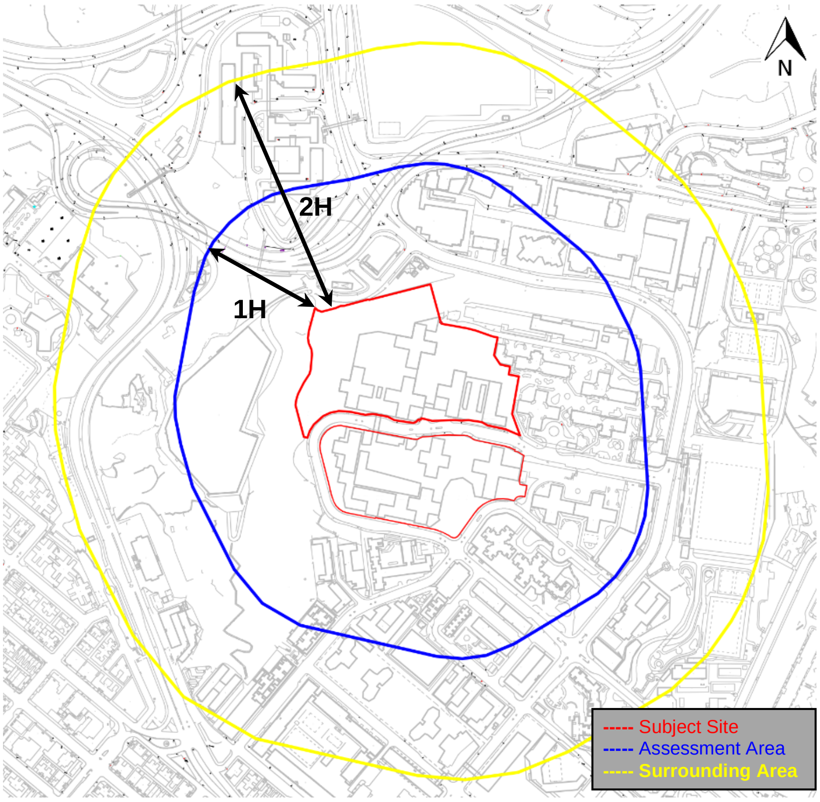
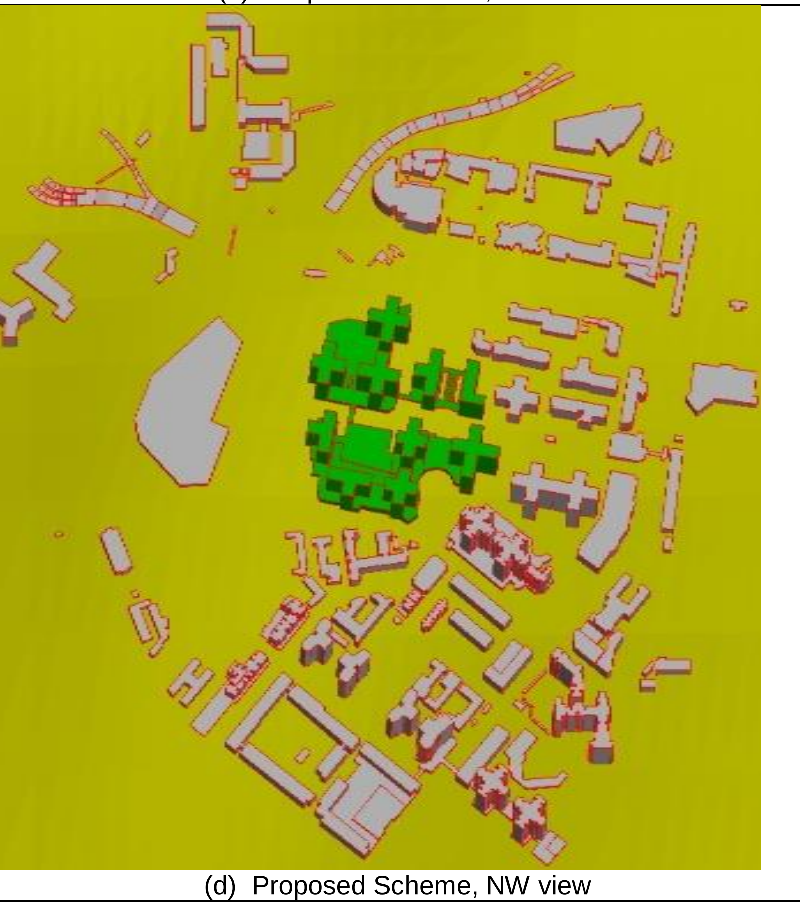


Figure 3.2 Boundaries of Study Area, Assessment Area and Surrounding Area

(a) Base Scheme, E view

(b) Proposed Scheme, E view

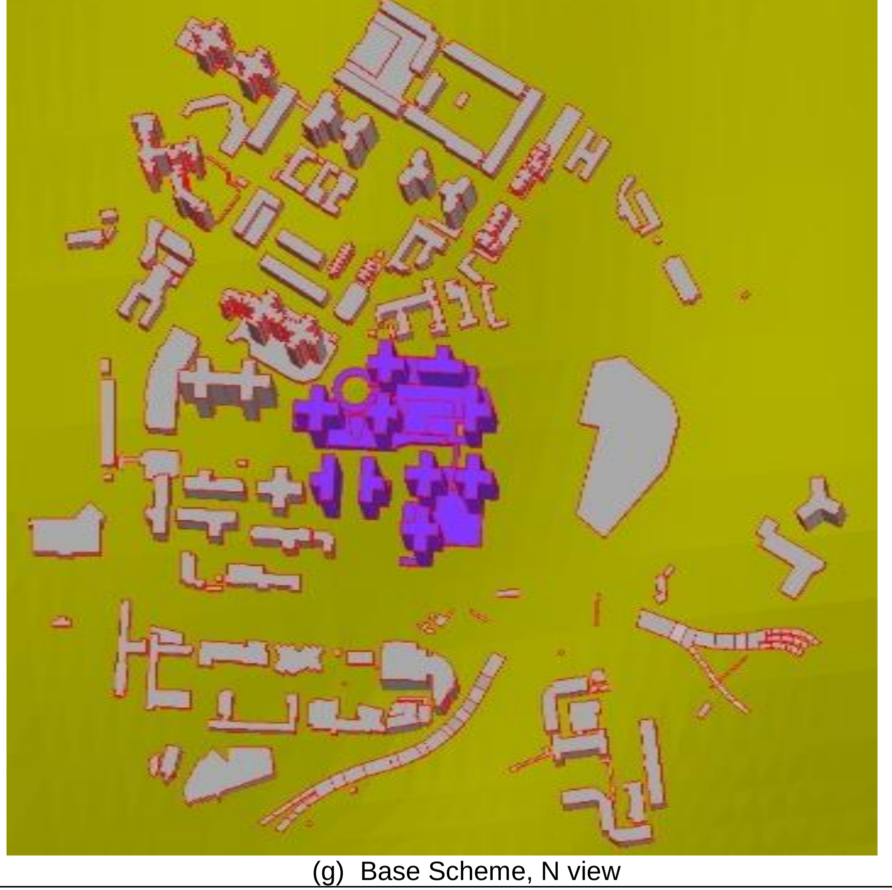
(c) Base Scheme, S view



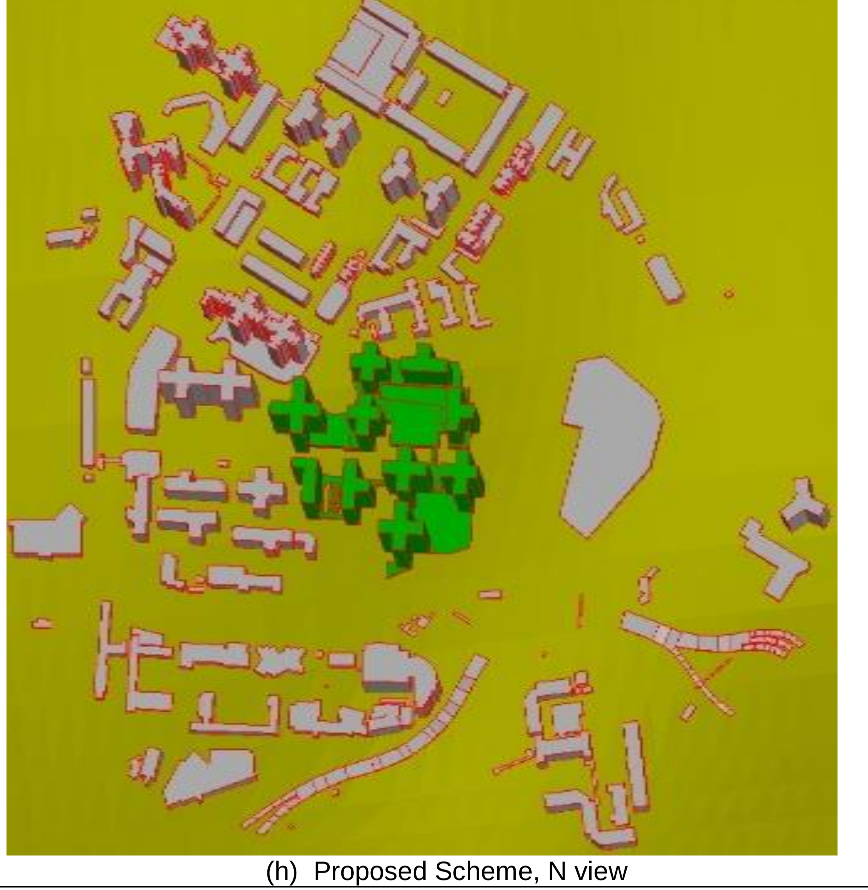
(d) Proposed Scheme, NW view

(e) Base Scheme, W view

(f) Proposed Scheme, W view



(g) Base Scheme, N view



(h) Proposed Scheme, N view

Figure 3.3 Images of 3D CFD Model

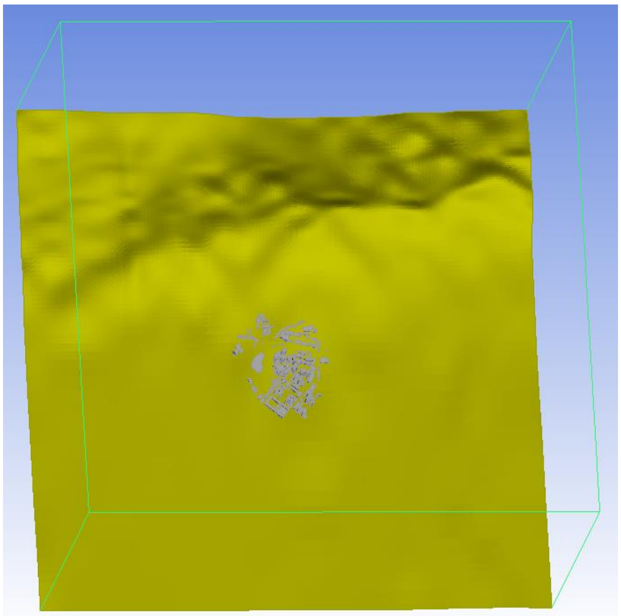


Figure 3.4 Images whole simulation domain for the CFD Model

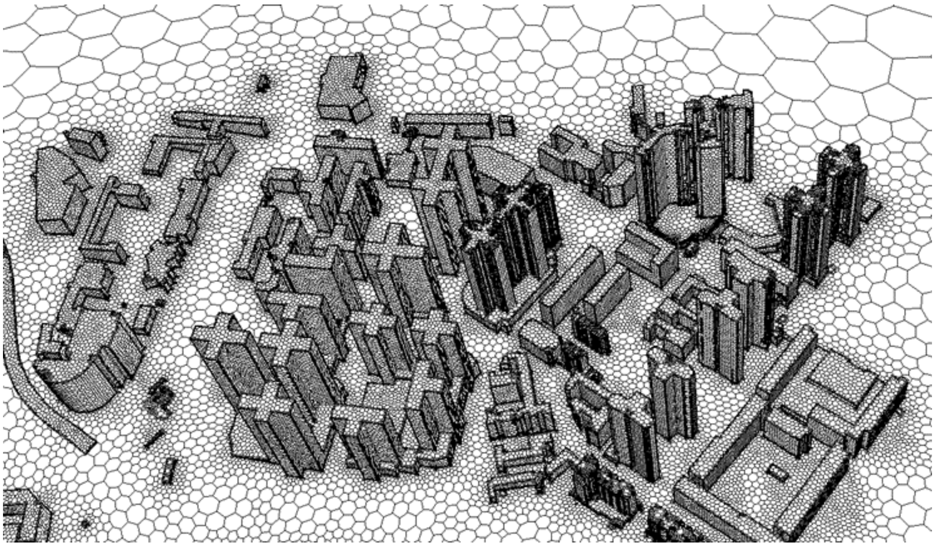


Figure 3.5(a) Images of Mesh Cells Setup in the CFD Model (Proposed Scheme)

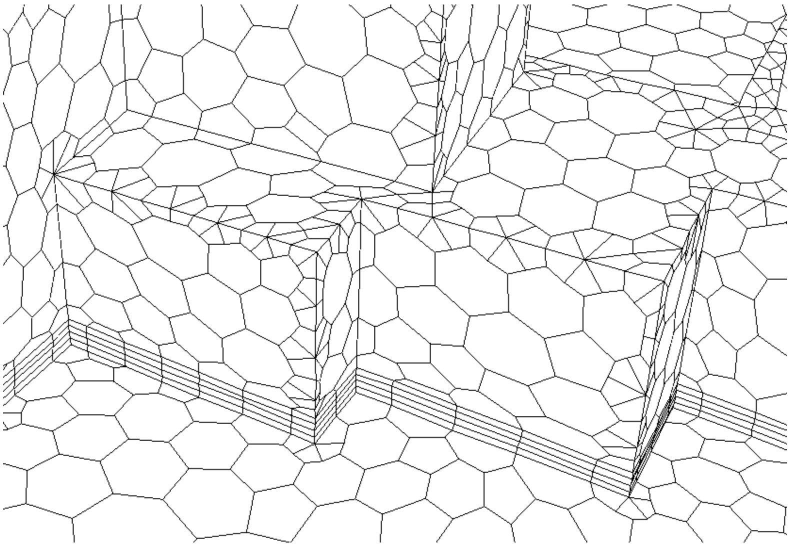


Figure 3.5(b) 4 layers of Prism Mesh Cells Setup in the CFD Model

3.3 Assessment Criteria and Test Points location

3.3.1 Wind velocity ratio (VR) indicates how much of the wind availability is experienced by pedestrians on the ground which is a relatively simple indicator to reflect the wind environment of the study site. VR is defined as VR = VP /VINF where VINF is the wind velocity at the top of the wind boundary layer (greater than 500m in height) would not be affected by the ground roughness and local site features and VP is the wind velocity at the 2m pedestrian level.

3.3.2 VRW is the frequency weighted wind velocity ratio calculated based on the frequency of occurrence of all the 17 wind directions for the purpose of comparison.

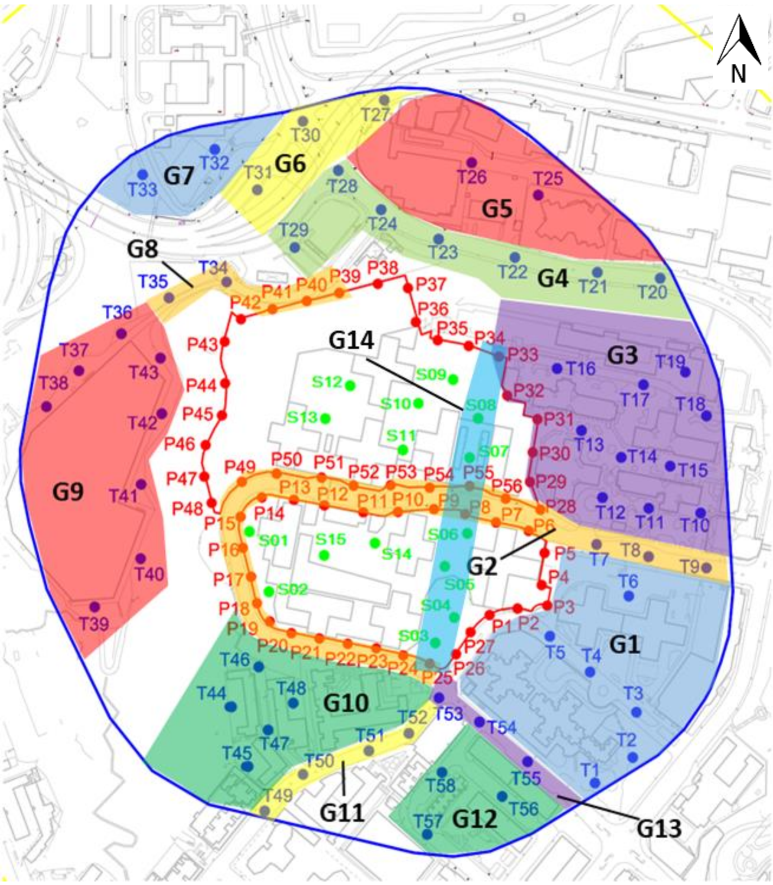
3.3.3 For Site Air Ventilation Assessment, the Site Spatial Average Wind Velocity Ratio (SVR_W) and individual VR_W of all perimeter test points are reported. SVR_W is the average of VR_W of all perimeter test points.

3.3.4 For Local Air Ventilation Assessment, the Local Spatial Average Wind Velocity Ratio (LVR_W) of all overall test points and perimeter test points, and individual VR_W of the overall test points are reported. LVR_W is the average of all overall test points and perimeter test points.

3.3.5 The SVR_W and LVR_W are worked out so as to understand the overall impact of air ventilation on the immediate and further surroundings of the Project Area due to the proposed development.

3.3.6 Test Points: Both perimeter test points and overall test points will be selected within the Assessment Area in order to assess the impact on the immediate surroundings and local areas respectively. Overall test points will be evenly distributed over surrounding open spaces, streets and other parts of the Assessment Area where pedestrian can or will mostly access. Preliminary locations of perimeter and overall test points together with 13 special test points within the Subject Sites are illustrated in **Figure 3.5**. There will be 56 Perimeter Test Points and 58 Overall Test Points. All Test Points are located at 2m above ground level.

3.3.7 The Test Points are consolidated into 4 groups for discussion on the wind influences in different specific regions.



Group	Description	Test Points
G1	Tai Tin / Lai Tin / Wan Tin House and Shing Tin / Cheung Tin / Shui Tin House	T1– T6
G2	Pak Wan Street	T7 – T9, P6 – P25, P28, P49 – P56
G3	Tsui Tin House, Yue Tin House, Yun Tin House, Chak Tin House, Fu Tin House, Pak Tin Community Complex and Pak Tin Catholic Primary School	T10 – T19
G4	Nam Cheong Street and Chak On Road Driving Test Centre	T20 – T24, T28 – T29
G5	HKSKH Li Ka Shing Care and Attention Home for the Elderly, The Mental Health Association of Hong Kong Cornwall School and Public Health Laboratory Centre	T25 – T26
G6	Intersection of Cornwall Street, Nam Cheong Road and Lung Yuet Road	T27, T30 – T31
G7	Chak On Road	T32 – T33
G8	Chak On Road South and entrance to Water Reservoir	P39 – P41, T34 – T35
G9	Shek Kip Mei Fresh Water Service Reservoir	T36 – T43
G10	The ELCHK Faith Lutheran School and Kow Kong Commercial Association School	T44 – T48
G11	Pak Tin Street	T49 – T52
G12	Pak Yuk House, Tin Fung House and Fook Tin Building	T56 – T58
G13	Wai Lun Street	T53 – T55
G14	30m corridor across Phase 10 and 11	P8, P25, P33, P55, S3 – S8

Figure 3.5 Test Point Location of the study

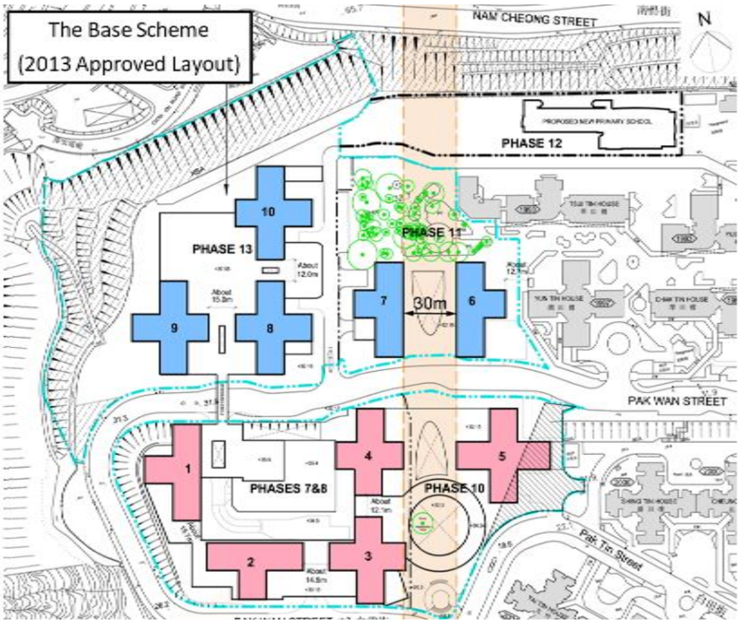
4 KEY FINDINGS OF AVA STUDY

4.1 Local Situation

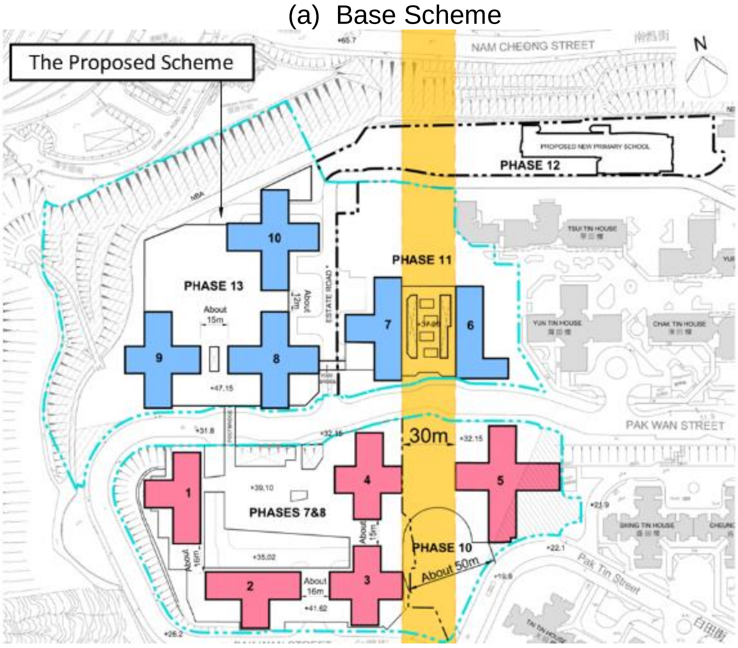
4.1.1 The local situation including the site environs, site wind environment, and site wind availability of the Study Area are described in **Section 2** above.

4.1.2 The Subject Site is located at the western portion of Pak Tin Estate, including the Pak Tin Redevelopment Phases 7, 8, 10, 11 and 13. Consisting a total of 10 proposed high-rise residential buildings within.

4.1.3 As described in Section 1, the 2013 approved layout has a building height of 122mPD to 130mPD. While the layout proposed in 2018 had adjustment in building morphology as well as an increased building height of Phase 10 to 132mPD, and the building height of Phase 13 has been increased to 157mPD. In this study, the layout approved in 2013 is adopted as Base Scheme, while the newly proposed layout with adjustment is nominated as Proposed Scheme. The layout plan of the two schemes are shown in **Figure 4.1** below.



(a) Base Scheme



(b) Proposed Scheme

Application Site Boundary

Figure 4.1 The layout of the Base Scheme and Proposed Scheme

4.2 Wind Velocity Ratio Results

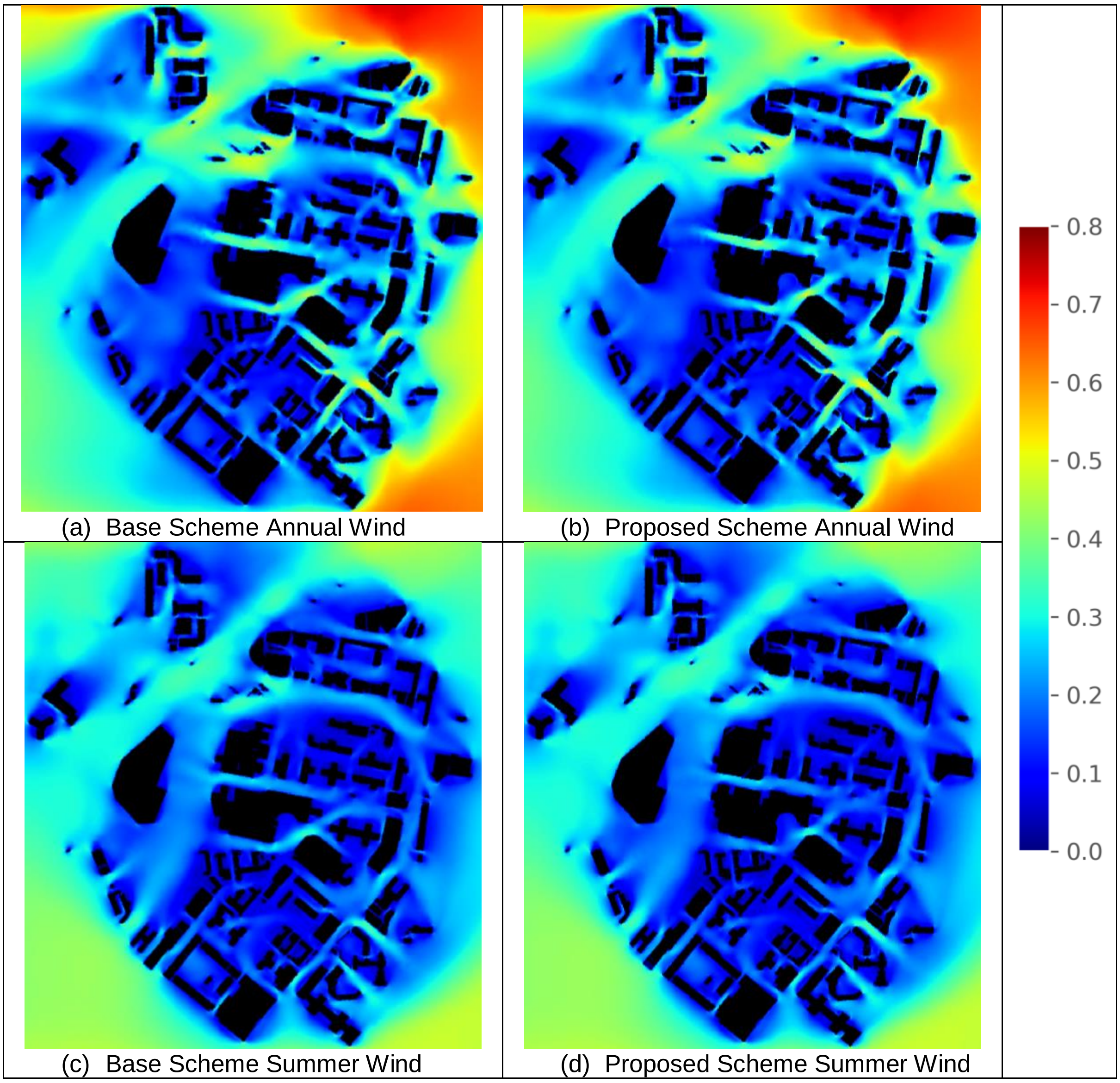
4.2.1 A summary of the predicted wind velocity ratios for the Perimeter Test Points and the Overall Test Points i.e. SVR_W and LVR_W under both annual and summer prevailing winds are presented in Table 4.1 below. Details of the predicted wind velocity ratios are presented in Appendix B.

Table 4.1 Summary of Wind Velocity Ratio

	Annual Winds		**Summer Winds**	
	Base Scheme	Proposed Scheme	Base Scheme	Proposed Scheme
SVR_W	0.24	0.24	0.18	0.18
LVR_W	0.22	0.22	0.17	0.17
Averaged VR at Special Test Points	0.14	0.15	0.11	0.11

4.2.2 The averaged VR_W plot for the Pak Tin area is presented in the in **Figure 4.2**.

4.2.3 Contour plots of wind velocity ratio and wind velocity vector plots at 2m above the pedestrian level of assessment area under different wind directions are shown in Appendix C and Appendix D respectively.



(a) Base Scheme Annual Wind (b) Proposed Scheme Annual Wind
(c) Base Scheme Summer Wind (d) Proposed Scheme Summer Wind

Figure 4.2 Frequency Weighted Wind Velocity Ratio Contour Plot at 2m above Ground

4.2.1 The results of VRW for different groups of test points are summarized in **Table 4.2** below.

Table 4.2 Summary of Wind Velocity Ratio for Different Test Point Groups

Group	Description	Test Points	Average VR_w (annual winds)		Average VR_w (summer winds)	
			Base Scheme	Proposed Scheme	Base Scheme	Proposed Scheme
G1	Tai Tin / Lai Tin / Wan Tin House and Shing Tin / Cheung Tin / Shui Tin House	T1– T6	0.25	0.25	0.16	0.16

Group	Description	Test Points	Average VR_w (annual winds)		Average VR_w (summer winds)	
			Base Scheme	Proposed Scheme	Base Scheme	Proposed Scheme
G2	Pak Wan Street	T7 – T9, P6 – P25, P28, P49 – P56	0.23	0.22	0.18	0.17
G3	Tsui Tin House, Yue Tin House, Yun Tin House, Chak Tin House, Fu Tin House, Pak Tin Community Complex and Pak Tin Catholic Primary School	T10 – T19	0.16	0.16	0.09	0.10
G4	Nam Cheong Street and Chak On Road Driving Test Centre	T20 – T24, T28 – T29	0.29	0.29	0.24	0.24
G5	HKSKH Li Ka Shing Care and Attention Home for the Elderly, The Mental Health Association of Hong Kong Cornwall School and Public Health Laboratory Centre	T25 – T26	0.21	0.20	0.15	0.14
G6	Intersection of Cornwall Street, Nam Cheong Road and Lung Yuet Road	T27, T30 – T31	0.25	0.25	0.22	0.22
G7	Chak On Road	T32 – T33	0.28	0.28	0.26	0.27
G8	Chak On Road South and entrance to Water Reservoir	P39 – P41, T34 – T35	0.37	0.37	0.28	0.28
G9	Shek Kip Mei Fresh Water Service Reservoir	T36 – T43	0.20	0.21	0.18	0.19
G10	The ELCHK Faith Lutheran School and Kow Kong Commercial Association School	T44 – T48	0.06	0.06	0.06	0.06
G11	Pak Tin Street	T49 – T52	0.13	0.13	0.11	0.11
G12	Pak Yuk House, Tin Fung House and Fook Tin Building	T56 – T58	0.11	0.11	0.10	0.10
G13	Wai Lun Street	T53 – T55	0.30	0.31	0.13	0.14
G14	30m corridor across Phase 10 and 11	P8, P25, P33, P55, S3 – S8	0.18	0.20	0.12	0.14

4.3 Site Ventilation Assessment

4.3.1 The SVR indicates how the lower portion of the buildings within the Study Area affecting the wind environment of its immediate vicinity. Under annual winds, the average of predicted SVR over these prevailing winds for the Base Scheme and Proposed Scheme are both 0.24 respectively. While in summer, the SVRw are maintained at 0.18 by both Base Scheme and Proposed Scheme respectively. The result indicates that the Proposed Scheme can be considered comparable the Base Scheme in terms of air ventilation performance in its immediate vicinity.

4.3.2 Test points P6 to P14, P28 and P50 to P56 located along the portion of the Pak Wan Street sandwiched between the development sites which serves as a major wind corridor for the site. In this study, the Base Scheme and Proposed Scheme would both maintain an average SVR of 0.25 under the prevailing annual winds, while in summer, the SVR for the aforementioned two schemes are both 0.18. The result indicating the revise of the layout in Proposed Scheme would maintains a comparable wind channelling effect to enhance the ventilation.

4.3.3 Although a generally comparable wind environment is maintained at the boundary of the sites, there exists drawback of ventilation performance at the southern boundary (i.e. the section of Pak Wan Street between the site and On Tin House), as the VR of Test points P20 to P24 under the annual winds being 0.22 in the Proposed Scheme, compare to that of 0.25 in the Base Scheme. This is due to the taller building in the Proposed Scheme, which creates more blockage against the incoming winds from NE quadrant. On the other hand, the Proposed Scheme maintained a similar air ventilation performance compared to Base Scheme at the same location under the summer prevailing winds, as the VR being 0.19 (Proposed Scheme) and 0.19 (Base Scheme). The relatively comparable result may be due to the fact that this sector of Pak Wan Street are located at the upwind side of the development under the summer winds, which would be relatively less affected by the variation of developments in the Base and Proposed Scheme.

4.3.4 On the other hand, the Proposed Scheme has maintained improvement in the potential future pedestrian frequent area between the Phase 11 and existing buildings of Yun Tin House / Tsui Tin House (where P28 – P32 test points are located), as the averaged VR under annual prevailing winds are 0.18 and 0.22 for Base Scheme and Proposed Scheme respectively. While in summer, the averaged VR for the two schemes are 0.09 and 0.10. The change of morphology for the Block 6 into “L-shape” footprint offers larger frontal area which induced more significant downwash wind under easterly prevailing winds, in turn enhanced the pedestrian wind environment in both annual and summer condition.

4.4 Local Air Ventilation Assessment

4.4.1 The Base Scheme and Proposed Scheme of this study contains 10 major blocks within the Subject Site. Developments in both schemes have separation distances in between. The LVRw indicates the overall wind environment within the Assessment Area of the two schemes under the annual and summer winds. The LVRw for the Base Scheme and Proposed Scheme are both 0.22 under the annual prevailing winds. While during the summer seasons, the LVRw are both 0.17 for Base and Proposed Scheme. The results indicate that the Proposed Scheme maintained a similar wind environment than the Base Scheme, throughout the Subject Sites boundary and Assessment Area under the annual prevailing winds, meanwhile the Proposed Scheme can also maintain an overall comparable wind environment for the vicinity of the Subject Site during summer seasons.

4.4.2 Wind environment within the sites is represented by the VR value of the Special Test Points. Under the annual prevailing winds, the averaged VR of Special Test Points for Base Scheme and Proposed Scheme are 0.14 and 0.15 respectively, while in summer, the averaged VR is maintained at 0.11 for both the two schemes. The result shows that despite the existence of differences in building height and footprint between the Base Scheme and Proposed Scheme, the Proposed Scheme would not likely to induce overall decline in air ventilation aspect within the Subject Site itself.

4.4.3 Base on the averaged VR of each group of test points, it is observed that the Proposed Scheme would maintain an wind environment which is similar to that of the Base Scheme in majority of the vicinity areas under the annual prevailing winds, However, there exist a few areas in which slight decline in VR is observed. Such areas include the G2 area and G5 area. The drawback occurred in the G2 area is mainly due to the southern sector of Pak Wan Street being shielded by the Proposed Scheme, as described in Paragraph 4.3.4 above. Meanwhile, the decline in HKSKH Li Ka Shing Care and Attention Home for the Elderly and its surrounding areas may be mainly caused by the increased building height of Phase 13, which induced a more significant wind shielding effect against this area under the southerly winds which are prevailing winds for both annual and summer seasons at Pak Tin.

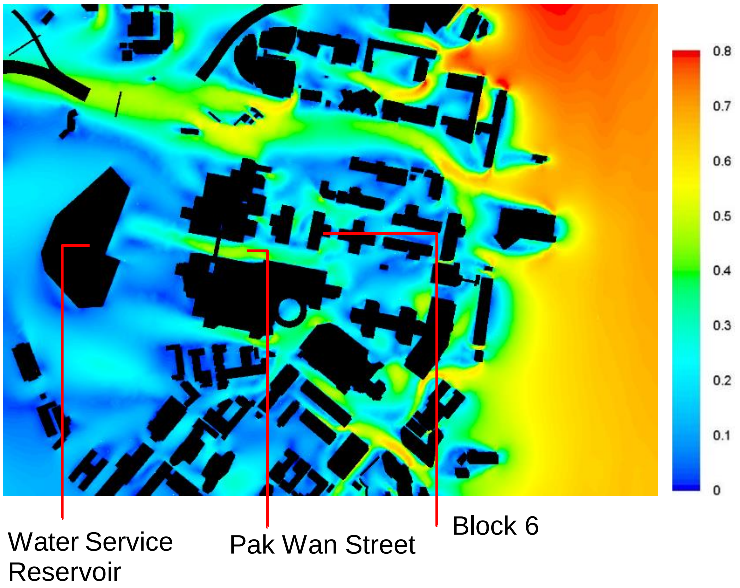
4.4.4 On the other hand, the G9 Test Points areas have maintained a slight increment of VR under the annual prevailing winds for the Proposed Scheme, since the change of podium structure under Phase 13 would induce a more significant wind channelling effect between the site and Public Health Laboratory Centre, which induced a slight enhancement at the locality and nearby downwind areas. Moreover, the overall wind environment along 30m width corridor penetrating the sites (Test Point Group 14) also maintains a slight improvement in both annual and summer seasons for Proposed Scheme, since the removal of the circular pedestrian footbridge between Phase 10 and Phase 7 / 8 would reduce the friction exerted on the air flow driven under by the prevailing winds.

4.4.5 The area immediate east to the Phase 11 (i.e. from the Community Complex to the Tsui Tin House, Test Point Group G3) has also maintained an improvement in wind environment for the Proposed Scheme under the summer winds. Such improvement maybe mainly due to the redirection of air flow induced by the Block 5 in the Proposed Scheme located to the south of this region, which induced the air flow passing through the gap between the block and Shing Tin House to flow towards the north and reaching the region when southerly wind becomes dominate, and the air flow would reach the G3 area to enhance the local wind environment.

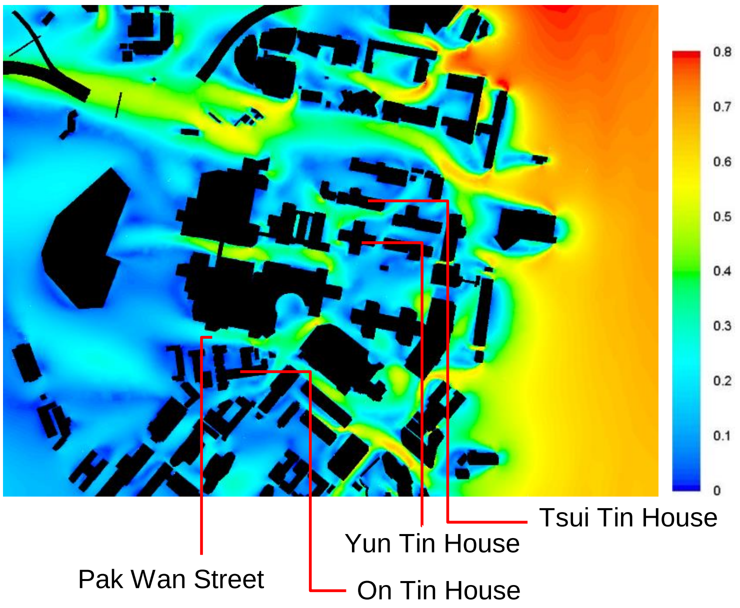
Directional Analysis

4.4.6 E: (Annual: 21.1%; Summer: 8.2%)

Base Scheme



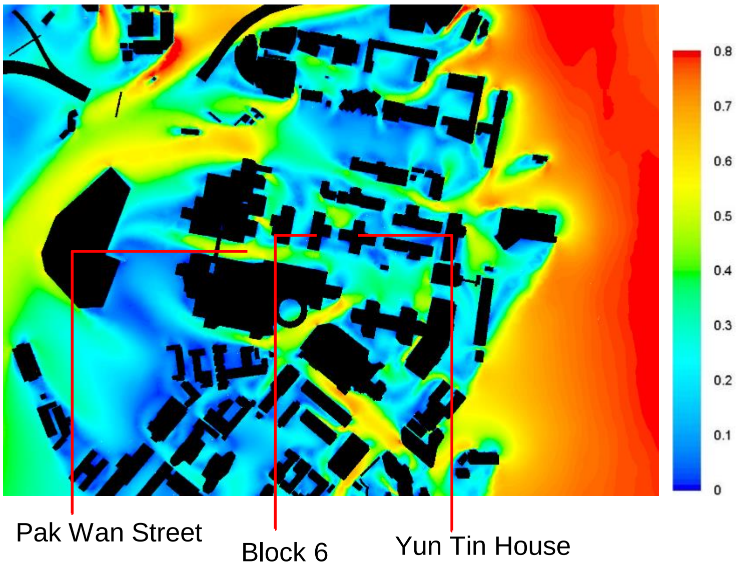
Proposed Scheme



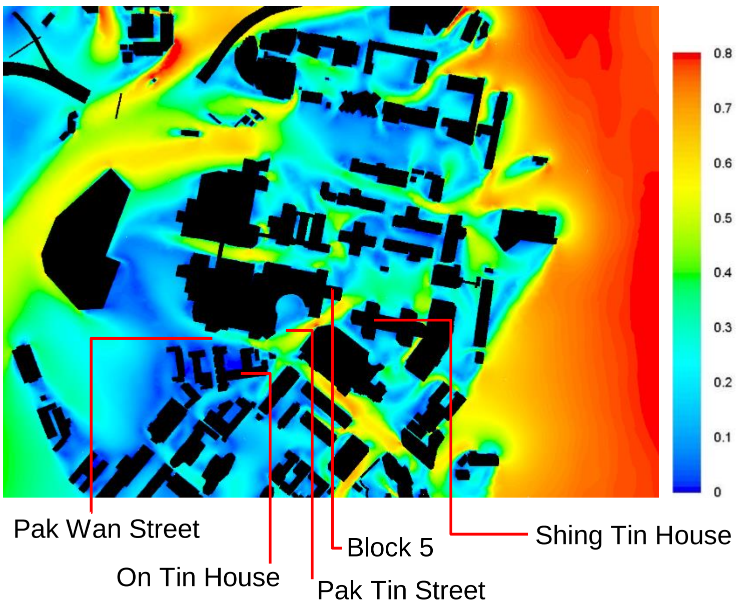
- Local enhancement of wind is observed at the Pak Wan Street between Phase 7 / 8 and 13 under the Proposed Scheme, the slight alteraion of podium at Phase 7 / 8 and Phase 13 of the Proposed Scheme enhanced the channelling effect of wind compared to the Base Scheme.
- There exists a slight drawback at the Pak Wan Street north to the On Tin House. The change of podium between the Block 4 and 5 weakened wind channelling effect under the easterly wind.

4.4.7 **ENE: (Annual 13.1%)**

Base Scheme



Proposed Scheme

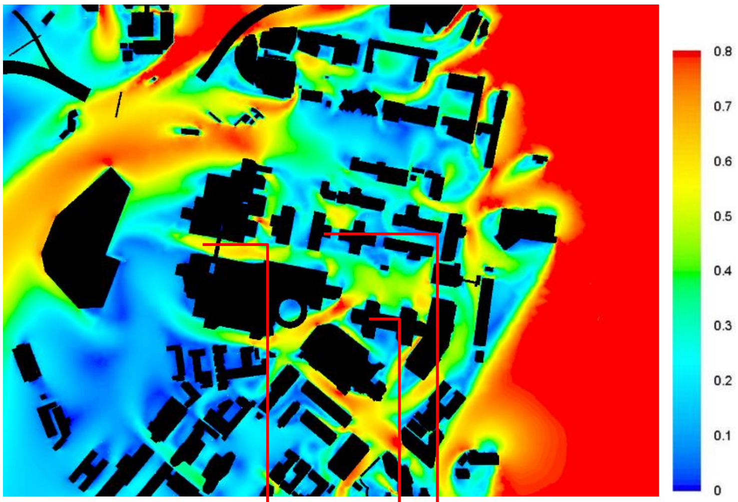


- Under the ENE wind, a slight enhancement occurred at the area near Yun Tin House, the change of morphology of Block 6 from T shape to L shape allows a portion of downwash flow to enter the Pak Wan Street.

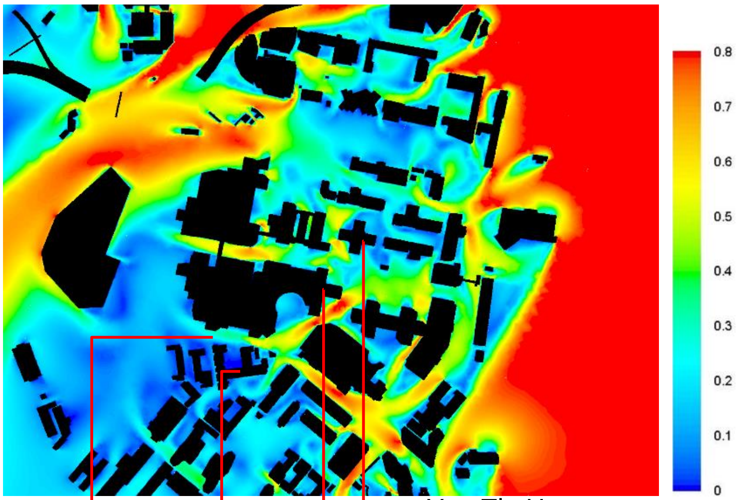
- Similar to that under the E wind, there is slight drawback observed at the Pak Wan Street north to the On Tin House. The change of podium near Pak Tin Street between Block 4 and 5 in the Proposed Scheme, as well as the extended north-wing of Block 5 weakened the wind channelling effect and wind entrance under the ENE wind.

4.4.8 **NE: (Annual 7.7%)**

Base Scheme



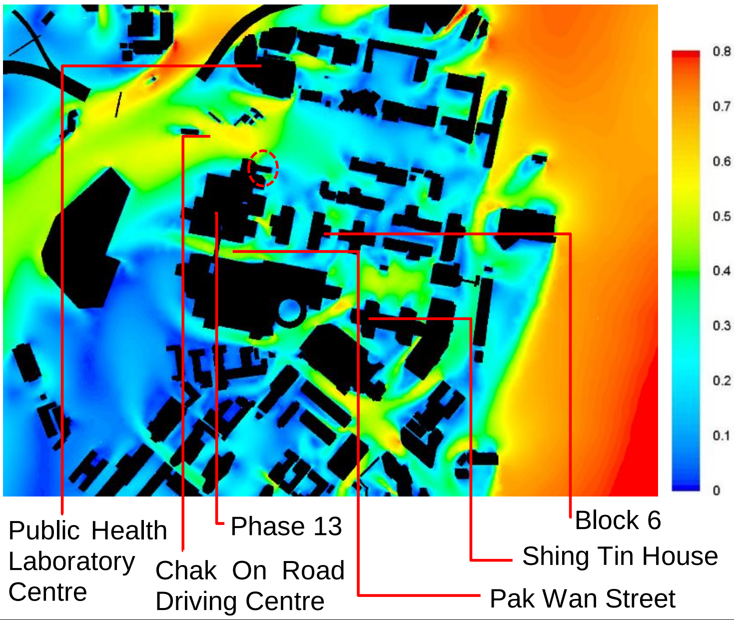
Proposed Scheme



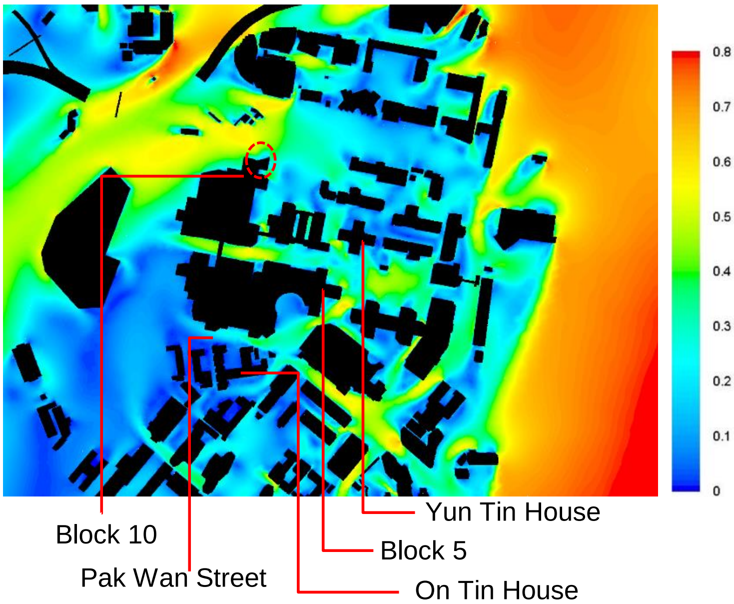
- Similar to that under the ENE wind, there is slight drawback observed at the Pak Wan Street north to the On Tin House under the Proposed Scheme. The change of podium between Block 4 and 5 weakened wind channelling effect under the NE wind.
- A slight decline in the region between Block 5 and Yun Tin House in Proposed Scheme is observed. A portion of downwash winds induced by Block 6 entered this region via the gap between Block 6 and Yun Tin House, which disturbed the main flow along Pak Wan Street near Block 5, generating a local stagnation zone.

4.4.9 **NNE: (Annual 4.8%)**

Base Scheme



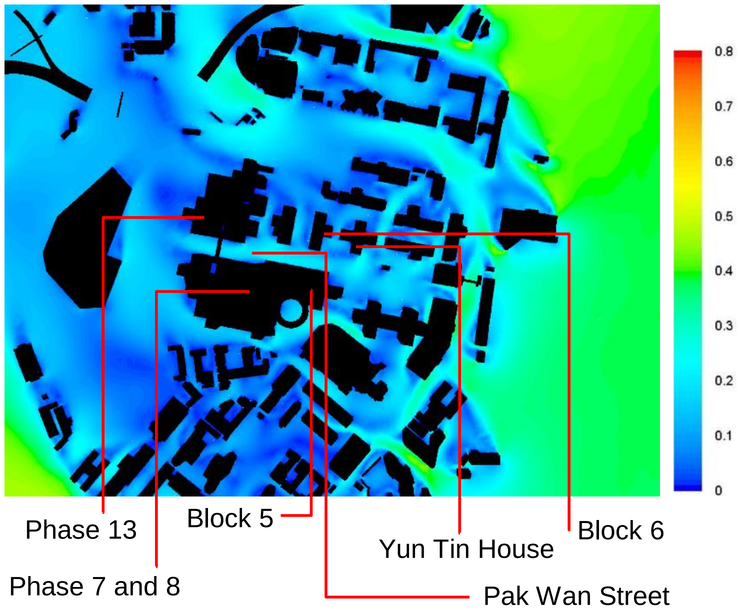
Proposed Scheme



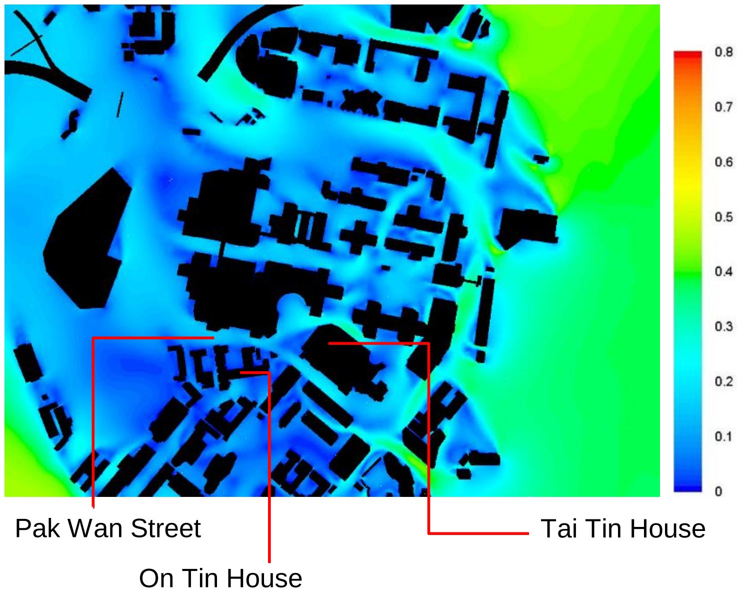
- It is noticed that a slight enhancement of wind occurred at the region of Chak On Road Driving Centre. The change of morphology of the podium for Phase 13 under Block 10 would narrow area between the site and Public Health Laboratory Centre, which leads to accelerated air flow between the site and the driving centre.
- A slight drawback for the Proposed Scheme is observed at the Pak Wan Street north to the On Tin House. The change of podium between Block 4 and 5 weakened wind channelling effect under the NE wind.

4.4.10 **ESE: (Annual 12.2%; Summer: 9.6%)**

Base Scheme



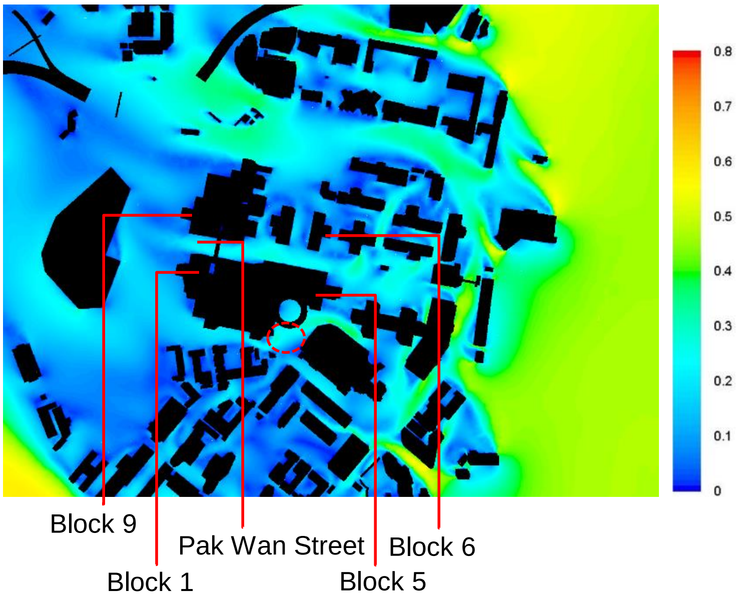
Proposed Scheme



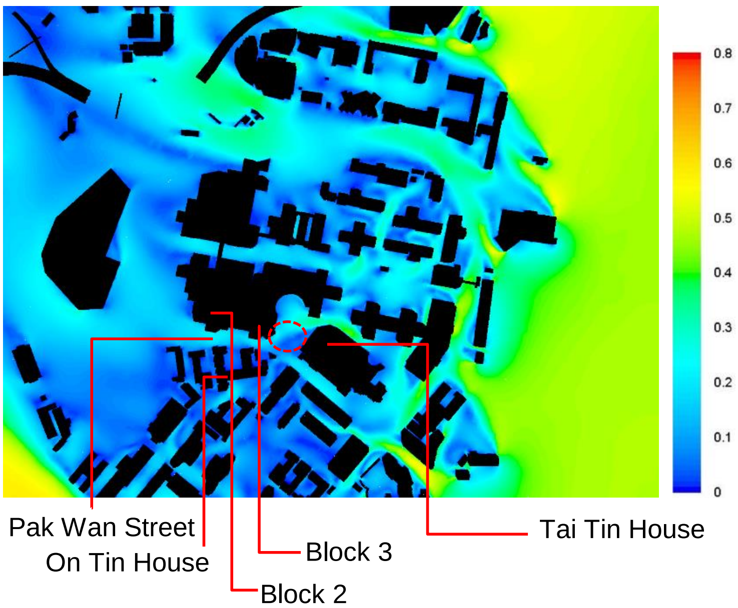
- Decline of wind VR in Pak Wan Street between Phase 7/8 and Phase 13 is observed in the Proposed Scheme. The building extension of north-wing of Block 5 would reduce the wind availability into this street.
- Slight enhancement of winds is observed at the region between Block 6 and Yun Tin House / Tsui Tin House. The change of building morphology of Block 6 allows a larger frontal area facing ESE direction to induce downwash of wind and redirect the air flow into this region.
- On the other hand, slight decline in air ventilation performance is observed near the area between Block 5 and the Tai Tin House, which is due to the change of podium under Block 5 limited the entrance of wind of this under the ESE wind.

4.4.11 **SE: (Annual 6.3%; Summer 7.6%)**

Base Scheme



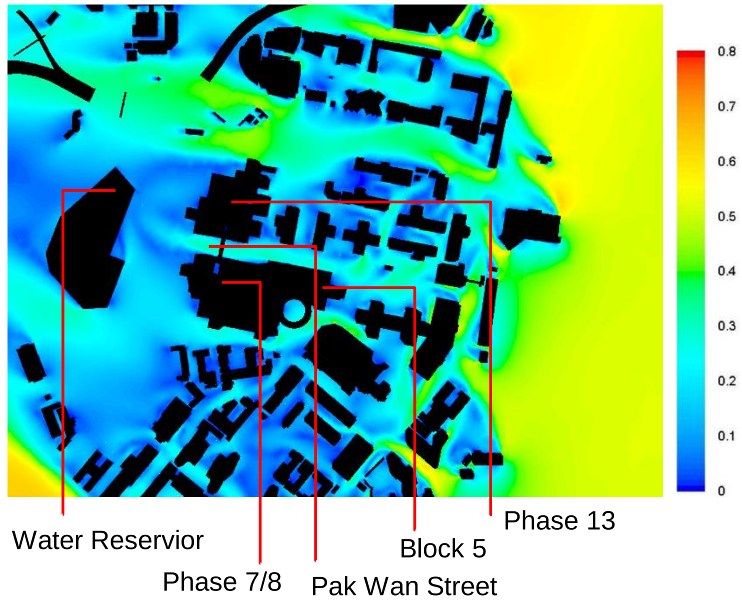
Proposed Scheme



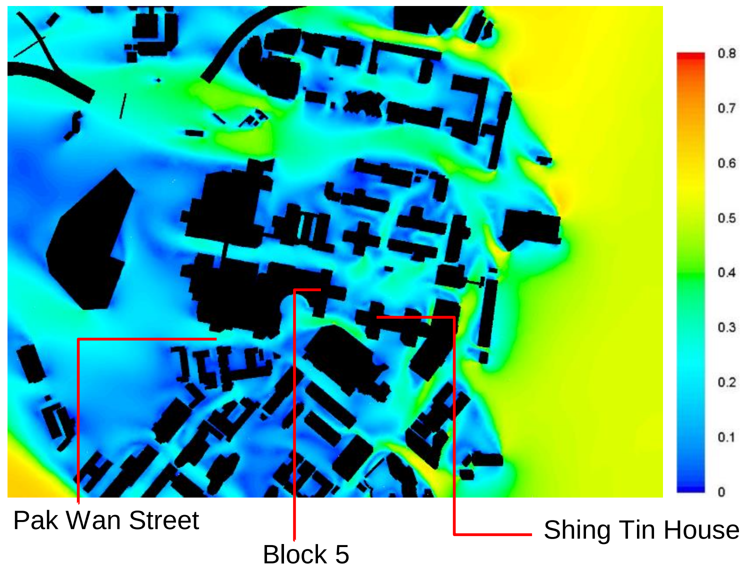
- A slight decline of air flow is observed at the area between Block 3 and Tai Tin House under the Proposed Scheme, since the reduction of the circular footbridge in Base Scheme lowered the wind channelling effect between the site and Tai Tin House.
- On the other hand, slight increment of VR is observed at the area between On Tin House and Block 2. The lowered wind availability near Block 5 would reduce the interference of wind at the intersection of the Pak Wan Street, which would in turn facilitate the air flow towards the Pak Wan Street near Block 2.

4.4.12 **SSE: (Annual 4.8%; Summer 7.8%)**

Base Scheme



Proposed Scheme

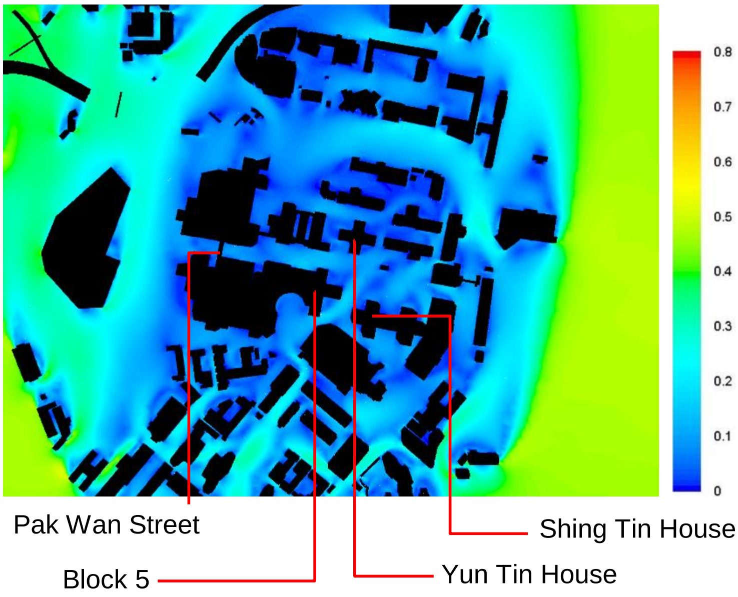


- Slight decline at Pak Wan Street between the Phase 13 and Phase 7/8 is observed for the Proposed Scheme. Comparing to the footprint of Block 5 in Base Scheme, the morphology of the podium and Block 5 would narrowed the wind entrance between Phase 10 and Phase 11, results in a reduce the wind availability of this street.
- However, a slight increment of VR is observed at location to the north of the water reservoir, since the reduction of wind availability at Pak Wan Street between Phase 13 and Phase 7/8 mentioned above, the interference of wind west to the site occurred under the Base Scheme, hence increasing the wind availability at the region north / northeast to the water reservoir.
- Slight enhancement of winds for the Proposed Scheme is also observed at the region between Block 5 and Shing Tin House. The increased height of Block 5 induced more downwash air flow, which would enhance the wind environment at pedestrian level.

4.4.13 **S: (Summer 9.5%)**

Base Scheme

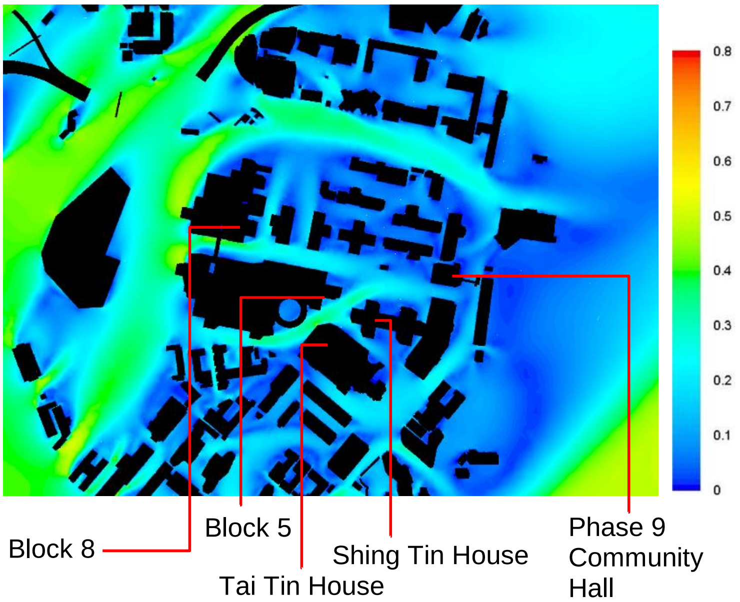
Proposed Scheme



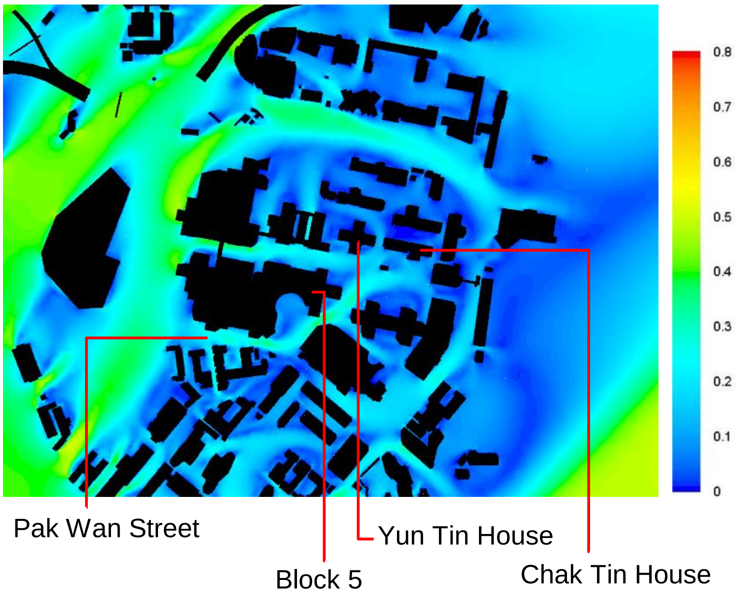
- Under the wind from southern direction, a slight wind enhancement is observed at the region between at Pak Wan Street south to the Block 8. The increased building height for the Phase 13 buildings enhanced the downwash air flow, which in turn facilitated the air flow at pedestrian level.
- A slight decline in VR for the Proposed Scheme is observed at the region near the Shing Tin House and Block 5, the further extension of south-wing of Block 5 would reduce the wind flow reaching this region at pedestrian level.
- On the other hand, slight increase in air ventilation performance is observed at the region near Yun Tin House, since the change of morphology for the podium and Block 5 (i.e. the east-wing and south-wing) in the Proposed Scheme divert a portion of air flow from the south towards this building, instead of flowing towards the east under the Base Scheme.

4.4.14 **SSW: (Annual: 6.2%; Summer 13.2%)**

Base Scheme



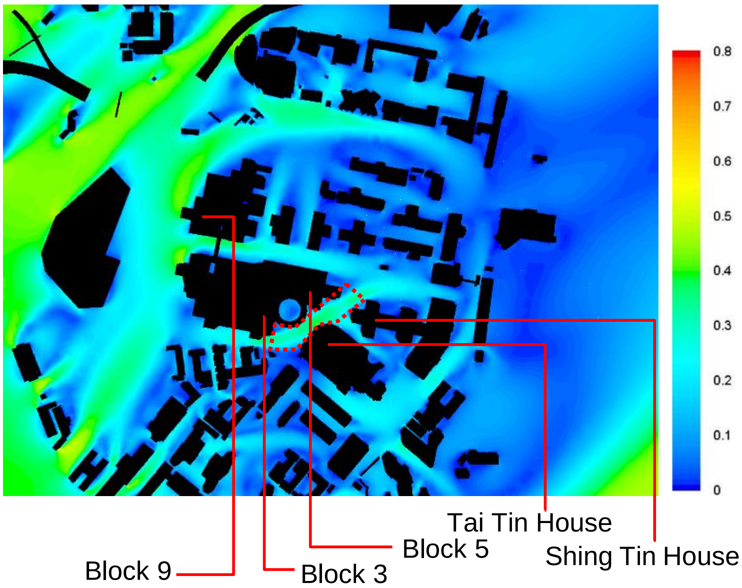
Proposed Scheme



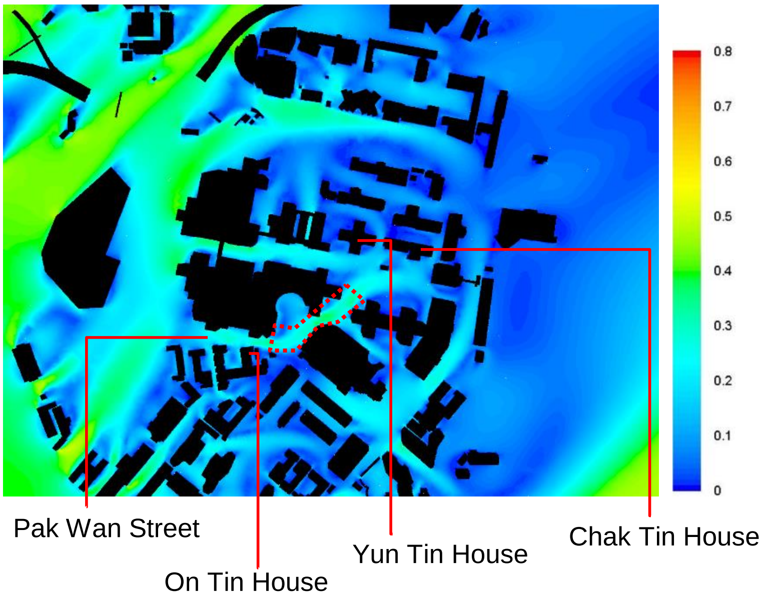
- Similar to that under the S wind, a slight decline in air ventilation performance is observed near the area between Block 5 and the Shing Tin House under the Proposed Scheme, which is due to the reduction of wind entrance resulted from the area between the Tai Tin House and Block 5.
- The air flow at Pak Wan Street near the Phase 9 Community Hall would also observe a decline in Proposed Scheme. Since the alteration described above results in a redirection of wind at the Pak Wan Street, which lowered the wind availability at the location.
- On the other hand, the change of morphology of Block 5 (i.e. the extension of south-wing of Block 5) redirected the air flow between the Block 5 and Shing Tin House, allowing a portion of air flow penetrating the building gap between the Yun Tin House and Chak Tin House, which in turn facilitate the wind environment north to the Yun Tin House under the Proposed Scheme.

4.4.15 **SW: (Annual: 6.8%; Summer 16.8%)**

Base Scheme



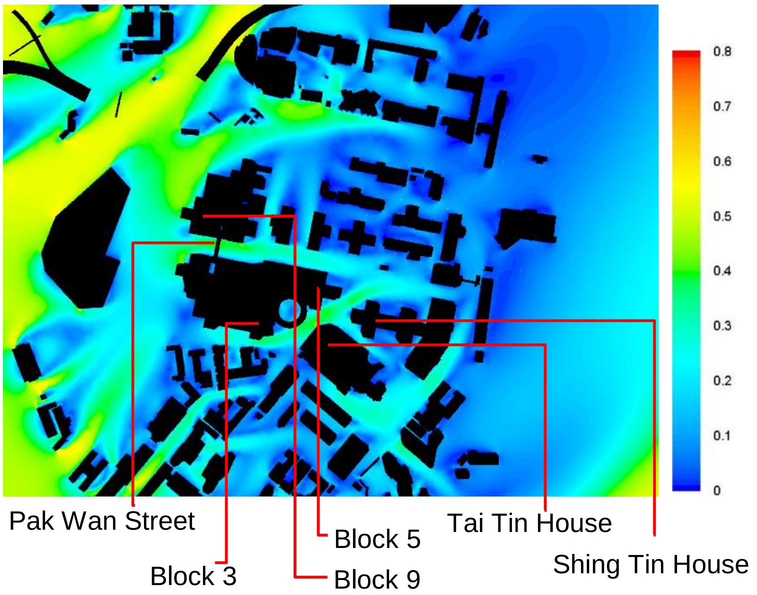
Proposed Scheme



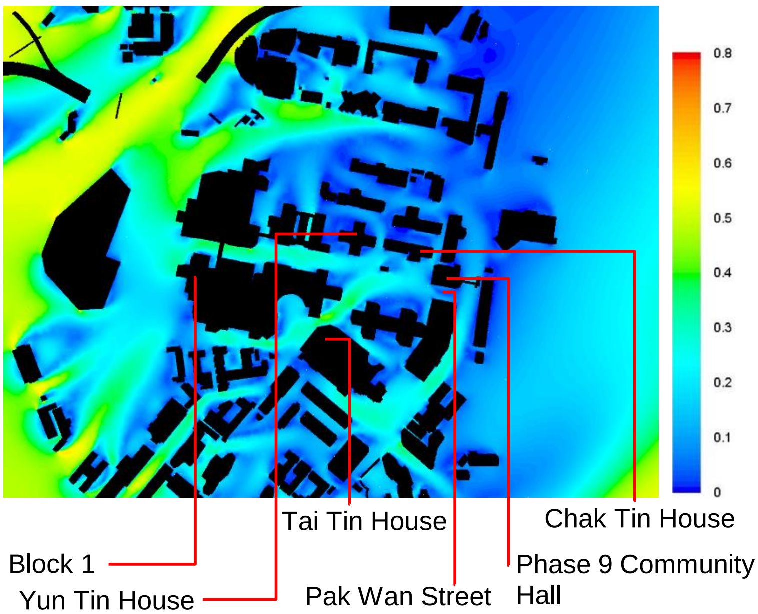
- The air flow at location between the Block3 / Block 5 and On Tin House / Tai Tin House has a decline in VR under the Proposed Scheme. The change of south-wing of the Block 5 and the reduction of circular bridge in between the Block 5 and Block 3 would lowered the wind channelling effect at the locality, in turn reducing the VR value.
- Similar to that occurred under the SSW wind, the change of morphology of Block 5 of the Proposed Scheme redirected the air flow between the Block 5 and Shing Tin House, thus a portion of air flow would penetrate the building gap between the Yun Tin House and Chak Tin House, and enhance the VR value at region north to Yun Tin House.
- On the other hand, slight enhancement in air ventilation performance is observed near between the Yun Tin House and Chak Tin House. Since the extension of east-wing of Block 5 induced a redirection of wind, under which a portion of air flow would reach the building gap between Yun Tin House and Chak Tin House, facilitating the air flow at the location as well as its north.

4.4.16 **WSW: (Summer 16.8%)**

Base Scheme



Proposed Scheme



- Similar to that under the SW wind, building Block 5 in the Proposed Scheme redirected the air flow between the Block 5 and Shing Tin House, inducing portion of air flow would penetrate the building gap between the Yun Tin House and Chak Tin House, and enhance the VR value at region north to Yun Tin House.
- On the other hand, slight drawback in VR value is found at Pak Wan Street near the Phase 9 Community Hall. Due to the change of podium and Block 5 morphology, a portion of winds at the local upwind of this area would be redirected towards the Yun Tin / Chak Tin House, thus weakened the air flow near the community hall.
- Slight decline in air ventilation performance is observed near the area between Block 3 and the Tai Tin House, which is due to the reduction of podium between Block 5 and Block 3 weakened the wind channelling effect.
- Slight decrease in VR is also found at the Pak Wan Street south to the Block 9 under the Proposed Scheme. Since the change of podium morphology under the Block 1 and Block 9 would reduce the air flow entering the Pak Wan Street.

5 SUMMARY AND CONCLUSIONS

5.1 This AVA Study Report aims at assessing the characteristics of the wind availability of the site, providing a general pattern and a quantitative estimate of wind performance at the pedestrian level under the annual and summer wind directions with the highest occurrence and investigating the effectiveness of ventilation for two developments namely the Base Scheme and the Proposed Scheme for the Pak Tin Estate Phases 7, 8, 10, 11, and 13 redevelopments.

5.2 From the finding of this AVA Initial Study, the SVRw for Base Scheme is maintained at 0.24 under the annual prevailing wind from NNE, NE, ENE, E, ESE, SE, SSE, SSW and SW directions which amount to about 83.0% of the whole time in a year, while that of the Proposed Scheme is maintained at 0.24. Thus, the Proposed Scheme is considered comparable to the Base Scheme in terms of air ventilation performance in the vicinity of the Study Area under annual prevailing winds.

5.3 The LVRw for the Base Scheme is 0.22 under the annual wind directions stated above, and that of the Proposed Scheme maintained at 0.22. It can be concluded that the Proposed Scheme maintains a similar air ventilation performance compared to the Base Scheme under the major annual winds.

5.4 From the finding of this AVA Initial Study, the SVRw for Base Scheme is maintained at 0.18 under the summer prevailing wind from E, ESE, SE, SSE, S, SSW, SW and WSW directions which amount to about 81.1% of the whole time in a year, while that of the Proposed Scheme is maintained at 0.18. Thus, the Proposed Scheme maintained a similar summer wind environment compared to Base Scheme at the immediate vicinity of the site.

5.5 The LVRw for the Base Scheme is 0.17 under the same summer wind directions, and that of the Proposed Scheme is also maintained at 0.17. It can be concluded that the Proposed Scheme would not likely to induce deterioration of wind environment compare to the Base Scheme during the summer seasons.

5.6 To conclude, despite the Proposed Scheme in this study has an increased building height and variation of the morphology, the CFD modelling results show that under the major annual and summer winds the Proposed Scheme would not likely to induce overall deterioration in the aspect of air ventilation performance compared to the Base Scheme at the Subject Site and its immediate vicinity.

Appendix A - Wind Probablity Table (Annual Wind)

Grid (078,046)	Wind Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
V_infinity(m/s)	Sum	0.018	0.048	0.077	0.131	0.211	0.122	0.063	0.048	0.046	0.062	0.068	0.036	0.027	0.015	0.014	0.012
00_to_01	0.026	0.001	0.002	0.002	0.002	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001
01_to_02	0.062	0.004	0.004	0.006	0.007	0.008	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.002	0.002	0.003
02_to_03	0.087	0.004	0.005	0.008	0.011	0.013	0.005	0.005	0.004	0.005	0.005	0.005	0.005	0.005	0.002	0.002	0.003
03_to_04	0.099	0.002	0.004	0.008	0.014	0.016	0.006	0.005	0.006	0.007	0.006	0.006	0.006	0.005	0.002	0.002	0.002
04_to_05	0.112	0.002	0.004	0.01	0.017	0.02	0.01	0.006	0.007	0.006	0.007	0.007	0.006	0.004	0.002	0.002	0.001
05_to_06	0.114	0.001	0.004	0.008	0.017	0.023	0.014	0.008	0.007	0.006	0.008	0.008	0.004	0.003	0.002	0.001	0.001
06_to_07	0.11	0.001	0.003	0.007	0.016	0.025	0.016	0.008	0.006	0.004	0.007	0.009	0.003	0.001	0.002	0.001	0
07_to_08	0.1	0.001	0.003	0.007	0.013	0.023	0.017	0.007	0.005	0.005	0.007	0.007	0.003	0.001	0.001	0	0
08_to_09	0.084	0.001	0.003	0.005	0.012	0.022	0.014	0.006	0.003	0.004	0.006	0.006	0.002	0.001	0	0	0
09_to_10	0.065	0	0.003	0.004	0.009	0.018	0.011	0.005	0.002	0.002	0.005	0.005	0.001	0	0	0	0
10_to_11	0.048	0	0.003	0.003	0.005	0.014	0.008	0.004	0.001	0.001	0.003	0.003	0.001	0	0	0	0
11_to_12	0.032	0	0.002	0.002	0.003	0.009	0.006	0.002	0.001	0.001	0.002	0.003	0	0	0	0	0
12_to_13	0.021	0	0.002	0.002	0.002	0.006	0.004	0.001	0.001	0	0.001	0.002	0	0	0	0	0
13_to_14	0.014	0	0.001	0.001	0.001	0.003	0.002	0.001	0	0	0.001	0.001	0	0	0	0	0
14_to_15	0.009	0	0.001	0.001	0.001	0.002	0.001	0	0	0	0	0.001	0	0	0	0	0
15_to_16	0.005	0	0.001	0	0.001	0.002	0.001	0	0	0	0	0	0	0	0	0	0
16_to_17	0.004	0	0.001	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0	0
17_to_18	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18_to_19	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19_to_20	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20_to_21	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21_to_22	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22_to_23	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_to_24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average Wind Speed at 500m, m/s		3.56	6.72	5.85	6.13	6.96	7.33	6.36	5.56	5.34	6.31	6.6	4.76	3.5	4	3.32	2.68

From PlanD RAMS

Appendix A - Wind Probability (Summer Wind)

Grid (078,046)	Wind Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
V_infinity(m/s)	Sum	0.01	0.011	0.014	0.031	0.082	0.096	0.076	0.078	0.095	0.132	0.168	0.084	0.053	0.03	0.023	0.012
00_to_01	0.021	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0
01_to_02	0.055	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.005	0.006	0.005	0.005	0.003	0.006	0.002	0.002	0.002
02_to_03	0.09	0.002	0.002	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.011	0.011	0.011	0.009	0.003	0.003	0.002
03_to_04	0.112	0.001	0.001	0.001	0.003	0.005	0.005	0.007	0.011	0.012	0.014	0.016	0.014	0.011	0.005	0.004	0.002
04_to_05	0.119	0.001	0.001	0.001	0.003	0.007	0.008	0.008	0.011	0.011	0.015	0.018	0.014	0.008	0.005	0.005	0.002
05_to_06	0.113	0.001	0	0.001	0.003	0.009	0.01	0.007	0.01	0.011	0.014	0.021	0.012	0.007	0.004	0.003	0.001
06_to_07	0.103	0.001	0	0	0.002	0.009	0.011	0.007	0.008	0.01	0.014	0.022	0.008	0.003	0.004	0.002	0.001
07_to_08	0.097	0	0	0	0.002	0.009	0.012	0.008	0.008	0.012	0.013	0.018	0.007	0.002	0.002	0.002	0
08_to_09	0.077	0	0	0	0.002	0.008	0.008	0.007	0.005	0.01	0.012	0.015	0.005	0.002	0.002	0.001	0
09_to_10	0.056	0	0.001	0	0.002	0.006	0.007	0.005	0.004	0.005	0.009	0.011	0.003	0.001	0.001	0.001	0
10_to_11	0.044	0	0.001	0.001	0.001	0.005	0.006	0.004	0.004	0.003	0.008	0.009	0.002	0.001	0	0	0
11_to_12	0.034	0	0.001	0	0.001	0.004	0.005	0.003	0.003	0.002	0.005	0.008	0.001	0.001	0	0	0
12_to_13	0.023	0	0	0.001	0.001	0.003	0.004	0.003	0.001	0.001	0.003	0.005	0.001	0	0	0	0
13_to_14	0.018	0	0	0.001	0.001	0.001	0.003	0.002	0.001	0.001	0.003	0.004	0.001	0	0	0	0
14_to_15	0.011	0	0	0	0.001	0.002	0.002	0.001	0	0.001	0.001	0.002	0.001	0	0	0	0
15_to_16	0.008	0	0	0	0.001	0.003	0.001	0	0	0.001	0.001	0.001	0	0	0	0	0
16_to_17	0.005	0	0	0	0	0.001	0.001	0	0	0.001	0	0.001	0	0	0	0	0
17_to_18	0.003	0	0	0	0	0.001	0	0	0	0.001	0	0	0	0	0	0	0
18_to_19	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19_to_20	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20_to_21	0.001	0	0	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0
21_to_22	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22_to_23	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_to_24	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average Wind Speed at 500m, m/s		3.17	4.8	5	6.5	7.61	7.68	6.68	5.8	6.32	6.58	6.92	5.46	4.31	4.84	4.58	3.6

From PlanD RAMS

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Annual Winds

	Base Scheme									
Test Point	NNE	NE	ENE	E	ESE	SE	SSE	SSW	SW	
Wind speed at infinity	6.72	5.85	6.13	6.96	7.33	6.36	5.56	6.31	6.60	VR_w
Wind probability	0.048	0.077	0.131	0.211	0.122	0.063	0.048	0.062	0.068	0.830
P1	0.34	0.49	0.49	0.36	0.20	0.24	0.28	0.24	0.28	0.34
P2	0.49	0.66	0.56	0.28	0.12	0.13	0.19	0.33	0.36	0.34
P3	0.47	0.68	0.47	0.10	0.08	0.09	0.07	0.24	0.25	0.24
P4	0.50	0.75	0.58	0.20	0.10	0.11	0.13	0.23	0.24	0.30
P5	0.38	0.18	0.13	0.33	0.12	0.17	0.19	0.05	0.05	0.19
P6	0.28	0.40	0.27	0.25	0.14	0.19	0.22	0.21	0.22	0.24
P7	0.16	0.19	0.23	0.30	0.19	0.24	0.28	0.22	0.22	0.23
P8	0.16	0.31	0.34	0.35	0.20	0.24	0.27	0.22	0.22	0.27
P9	0.32	0.47	0.44	0.36	0.21	0.25	0.27	0.21	0.21	0.32
P10	0.41	0.54	0.47	0.42	0.18	0.22	0.25	0.17	0.19	0.34
P11	0.41	0.52	0.44	0.40	0.14	0.17	0.21	0.12	0.15	0.30
P12	0.42	0.52	0.44	0.43	0.16	0.20	0.25	0.05	0.08	0.31
P13	0.37	0.39	0.35	0.37	0.16	0.20	0.25	0.05	0.07	0.26
P14	0.09	0.08	0.08	0.10	0.05	0.08	0.08	0.47	0.44	0.13
P15	0.09	0.11	0.06	0.08	0.08	0.06	0.07	0.45	0.42	0.13
P16	0.11	0.14	0.09	0.05	0.11	0.10	0.10	0.34	0.32	0.12
P17	0.08	0.10	0.08	0.06	0.09	0.10	0.11	0.19	0.20	0.09
P18	0.12	0.15	0.16	0.04	0.13	0.12	0.13	0.09	0.06	0.10
P19	0.22	0.29	0.27	0.14	0.16	0.18	0.22	0.15	0.09	0.18
P20	0.26	0.35	0.30	0.26	0.16	0.20	0.26	0.21	0.19	0.24
P21	0.27	0.34	0.31	0.31	0.15	0.20	0.26	0.19	0.20	0.25
P22	0.30	0.37	0.33	0.35	0.14	0.19	0.23	0.22	0.23	0.27
P23	0.30	0.37	0.29	0.30	0.11	0.14	0.15	0.24	0.25	0.24
P24	0.33	0.44	0.34	0.23	0.07	0.08	0.11	0.35	0.35	0.25
P25	0.35	0.53	0.48	0.38	0.17	0.22	0.25	0.31	0.31	0.34
P26	0.33	0.55	0.49	0.36	0.14	0.18	0.21	0.32	0.32	0.33
P27	0.39	0.60	0.52	0.37	0.21	0.27	0.30	0.30	0.34	0.37
P28	0.29	0.34	0.25	0.21	0.09	0.07	0.07	0.18	0.18	0.19
P29	0.21	0.15	0.15	0.35	0.15	0.15	0.16	0.06	0.04	0.18
P30	0.37	0.51	0.37	0.24	0.13	0.08	0.07	0.05	0.04	0.22
P31	0.04	0.06	0.05	0.03	0.01	0.01	0.01	0.01	0.01	0.02
P32	0.19	0.44	0.41	0.43	0.10	0.15	0.18	0.05	0.04	0.26
P33	0.25	0.23	0.16	0.09	0.06	0.15	0.21	0.07	0.09	0.12
P34	0.26	0.30	0.25	0.11	0.08	0.19	0.28	0.09	0.08	0.16
P35	0.23	0.24	0.21	0.13	0.10	0.21	0.29	0.13	0.14	0.17
P36	0.33	0.40	0.34	0.19	0.15	0.26	0.34	0.04	0.04	0.22
P37	0.47	0.58	0.47	0.43	0.21	0.31	0.40	0.21	0.20	0.37
P38	0.57	0.73	0.59	0.51	0.24	0.35	0.44	0.31	0.29	0.45
P39	0.56	0.78	0.64	0.52	0.21	0.33	0.44	0.39	0.36	0.47
P40	0.52	0.71	0.61	0.41	0.13	0.28	0.40	0.45	0.41	0.42
P41	0.53	0.71	0.60	0.27	0.07	0.16	0.32	0.40	0.37	0.36
P42	0.53	0.69	0.56	0.19	0.09	0.06	0.14	0.37	0.36	0.31
P43	0.50	0.63	0.50	0.11	0.08	0.08	0.05	0.36	0.35	0.26
P44	0.36	0.42	0.30	0.12	0.02	0.14	0.12	0.39	0.36	0.21
P45	0.24	0.23	0.13	0.09	0.03	0.07	0.07	0.39	0.36	0.15
P46	0.19	0.22	0.19	0.21	0.10	0.06	0.14	0.34	0.30	0.19
P47	0.13	0.08	0.09	0.11	0.08	0.08	0.06	0.24	0.21	0.11
P48	0.07	0.11	0.07	0.10	0.12	0.07	0.06	0.38	0.33	0.13
P49	0.25	0.25	0.24	0.26	0.11	0.16	0.20	0.40	0.36	0.24
P50	0.43	0.56	0.47	0.40	0.17	0.19	0.29	0.35	0.33	0.36
P51	0.24	0.34	0.29	0.21	0.08	0.10	0.15	0.28	0.28	0.21
P52	0.40	0.59	0.51	0.41	0.19	0.22	0.27	0.33	0.34	0.37
P53	0.04	0.07	0.06	0.05	0.03	0.03	0.04	0.05	0.05	0.04
P54	0.22	0.43	0.41	0.25	0.20	0.23	0.22	0.27	0.28	0.28
P55	0.15	0.23	0.25	0.18	0.13	0.14	0.15	0.20	0.21	0.18
P56	0.27	0.39	0.33	0.36	0.10	0.11	0.13	0.20	0.20	0.26
Average SVR	**0.30**	**0.39**	**0.33**	**0.25**	**0.13**	**0.16**	**0.20**	**0.23**	**0.23**	**0.24**
P_{Min}	0.04	0.06	0.05	0.03	0.01	0.01	0.01	0.01	0.01	0.02
P_{Max}	0.57	0.78	0.64	0.52	0.24	0.35	0.44	0.47	0.44	0.47

D:\Pak_Tin_Rerun_emma\The_post_processing\Appendix B\Testpoint VR annual Base

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Annual Winds

Test Point	Base Scheme									
	NNE	NE	ENE	E	ESE	SE	SSE	SSW	SW	
Wind speed at infinity	6.72	5.85	6.13	6.96	7.33	6.36	5.56	6.31	6.60	VR_w
Wind probability	0.048	0.077	0.131	0.211	0.122	0.063	0.048	0.062	0.068	0.830
T1	0.50	0.62	0.51	0.28	0.13	0.15	0.17	0.19	0.22	0.31
T2	0.32	0.37	0.19	0.38	0.19	0.25	0.28	0.18	0.19	0.27
T3	0.36	0.51	0.29	0.46	0.11	0.17	0.20	0.04	0.06	0.28
T4	0.31	0.39	0.13	0.20	0.14	0.16	0.16	0.16	0.18	0.19
T5	0.35	0.42	0.12	0.22	0.28	0.34	0.37	0.17	0.20	0.25
T6	0.27	0.41	0.29	0.19	0.12	0.16	0.18	0.03	0.03	0.19
T7	0.49	0.47	0.35	0.10	0.12	0.15	0.17	0.16	0.17	0.22
T8	0.45	0.46	0.34	0.18	0.17	0.24	0.28	0.21	0.23	0.26
T9	0.33	0.45	0.35	0.34	0.06	0.08	0.07	0.15	0.18	0.25
T10	0.36	0.42	0.30	0.21	0.21	0.26	0.28	0.07	0.09	0.24
T11	0.30	0.25	0.20	0.05	0.15	0.21	0.25	0.04	0.05	0.14
T12	0.19	0.10	0.04	0.18	0.07	0.07	0.10	0.03	0.03	0.10
T13	0.03	0.17	0.15	0.11	0.10	0.06	0.07	0.06	0.09	0.10
T14	0.10	0.15	0.15	0.24	0.16	0.19	0.19	0.05	0.06	0.16
T15	0.13	0.14	0.10	0.15	0.10	0.05	0.05	0.10	0.08	0.11
T16	0.18	0.18	0.28	0.16	0.04	0.03	0.02	0.08	0.08	0.13
T17	0.11	0.35	0.40	0.06	0.15	0.19	0.19	0.06	0.10	0.18
T18	0.32	0.44	0.51	0.25	0.08	0.09	0.13	0.06	0.09	0.24
T19	0.30	0.29	0.16	0.17	0.13	0.16	0.14	0.12	0.01	0.16
T20	0.14	0.05	0.06	0.45	0.25	0.32	0.34	0.21	0.22	0.25
T21	0.15	0.11	0.08	0.41	0.22	0.28	0.29	0.30	0.25	0.25
T22	0.24	0.13	0.11	0.36	0.13	0.14	0.16	0.37	0.33	0.23
T23	0.46	0.61	0.53	0.55	0.20	0.28	0.40	0.38	0.36	0.44
T24	0.38	0.35	0.24	0.39	0.31	0.36	0.39	0.22	0.22	0.32
T25	0.22	0.30	0.24	0.10	0.07	0.08	0.16	0.17	0.26	0.17
T26	0.31	0.48	0.30	0.24	0.19	0.22	0.24	0.13	0.05	0.24
T27	0.08	0.09	0.07	0.01	0.01	0.01	0.01	0.05	0.04	0.04
T28	0.16	0.26	0.20	0.07	0.29	0.27	0.22	0.20	0.21	0.19
T29	0.46	0.57	0.30	0.45	0.15	0.24	0.27	0.19	0.16	0.32
T30	0.68	0.87	0.61	0.13	0.25	0.19	0.06	0.42	0.45	0.37
T31	0.45	0.42	0.32	0.35	0.16	0.30	0.39	0.38	0.41	0.33
T32	0.38	0.56	0.44	0.25	0.13	0.25	0.26	0.34	0.35	0.31
T33	0.13	0.22	0.18	0.33	0.05	0.23	0.35	0.32	0.33	0.24
T34	0.46	0.62	0.46	0.31	0.08	0.16	0.28	0.33	0.35	0.33
T35	0.49	0.73	0.54	0.10	0.10	0.07	0.22	0.32	0.34	0.29
T36	0.53	0.80	0.60	0.15	0.13	0.09	0.14	0.35	0.40	0.33
T37	0.41	0.62	0.49	0.18	0.12	0.10	0.07	0.39	0.42	0.30
T38	0.42	0.63	0.48	0.17	0.13	0.13	0.07	0.39	0.43	0.30
T39	0.02	0.04	0.05	0.06	0.07	0.17	0.21	0.14	0.14	0.09
T40	0.02	0.04	0.07	0.09	0.15	0.13	0.13	0.17	0.13	0.10
T41	0.21	0.11	0.08	0.12	0.03	0.06	0.03	0.11	0.12	0.09
T42	0.31	0.38	0.27	0.10	0.15	0.12	0.07	0.23	0.21	0.19
T43	0.43	0.56	0.43	0.09	0.06	0.12	0.08	0.17	0.19	0.22
T44	0.07	0.08	0.08	0.04	0.04	0.04	0.06	0.10	0.07	0.06
T45	0.05	0.05	0.04	0.09	0.02	0.03	0.06	0.01	0.02	0.05
T46	0.03	0.03	0.07	0.06	0.07	0.10	0.13	0.13	0.12	0.08
T47	0.04	0.03	0.03	0.09	0.07	0.06	0.07	0.09	0.06	0.06
T48	0.04	0.06	0.06	0.02	0.03	0.02	0.01	0.05	0.05	0.04
T49	0.05	0.07	0.08	0.21	0.04	0.07	0.10	0.07	0.17	0.11
T50	0.04	0.12	0.13	0.14	0.06	0.10	0.13	0.06	0.09	0.11
T51	0.17	0.14	0.13	0.16	0.05	0.08	0.11	0.11	0.10	0.12
T52	0.23	0.32	0.29	0.24	0.07	0.12	0.17	0.03	0.02	0.18
T53	0.30	0.45	0.39	0.28	0.11	0.12	0.13	0.07	0.04	0.23
T54	0.34	0.50	0.36	0.34	0.17	0.19	0.19	0.02	0.04	0.26
T55	0.52	0.74	0.62	0.48	0.19	0.20	0.19	0.21	0.20	0.40
T56	0.07	0.10	0.13	0.15	0.07	0.08	0.07	0.14	0.14	0.11
T57	0.06	0.20	0.23	0.10	0.07	0.10	0.11	0.14	0.10	0.13
T58	0.10	0.09	0.18	0.04	0.02	0.05	0.08	0.13	0.11	0.08
Average LVR	**0.28**	**0.36**	**0.29**	**0.23**	**0.12**	**0.16**	**0.18**	**0.20**	**0.20**	**0.22**
T_{Min}	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.04
T_{Max}	0.68	0.87	0.62	0.55	0.31	0.36	0.40	0.42	0.45	0.44
S01	0.04	0.03	0.05	0.02	0.10	0.08	0.08	0.08	0.09	0.06
S02	0.04	0.03	0.03	0.03	0.01	0.01	0.01	0.10	0.42	0.06
S03	0.27	0.40	0.37	0.28	0.18	0.22	0.25	0.07	0.07	0.25
S04	0.05	0.06	0.16	0.15	0.15	0.17	0.18	0.07	0.15	0.13
S05	0.13	0.13	0.12	0.04	0.03	0.03	0.04	0.04	0.10	0.07
S06	0.11	0.13	0.11	0.06	0.02	0.02	0.02	0.05	0.14	0.07
S07	0.23	0.18	0.17	0.17	0.08	0.08	0.09	0.11	0.05	0.14
S08	0.26	0.25	0.24	0.27	0.07	0.08	0.10	0.13	0.19	0.19
S09	0.14	0.18	0.11	0.17	0.09	0.10	0.14	0.05	0.20	0.14
S10	0.32	0.43	0.37	0.24	0.07	0.07	0.16	0.23	0.36	0.25
S11	0.51	0.67	0.52	0.31	0.08	0.07	0.12	0.22	0.42	0.33
S12	0.13	0.18	0.17	0.13	0.02	0.03	0.02	0.11	0.19	0.11
S13	0.05	0.12	0.09	0.15	0.03	0.02	0.06	0.17	0.18	0.10
S14	0.07	0.05	0.05	0.13	0.02	0.03	0.05	0.20	0.03	0.07
S15	0.09	0.08	0.06	0.11	0.07	0.06	0.06	0.18	0.11	0.09
Average LVR	**0.16**	**0.20**	**0.17**	**0.15**	**0.07**	**0.07**	**0.09**	**0.12**	**0.18**	**0.14**
T_{Min}	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.04	0.03	0.06
T_{Max}	0.51	0.67	0.52	0.31	0.18	0.22	0.25	0.23	0.42	0.33

D:\Pak_Tin_Rerun_emma\The_post_processing\Appendix B\Testpoint VR annual Base

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Annual Winds

	Proposed Scheme									
Test Point	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**SSW**	**SW**	
Wind speed at infinity	**6.72**	**5.85**	**6.13**	**6.96**	**7.33**	**6.36**	**5.56**	**6.31**	**6.60**	**VR_w**
Wind probability	**0.048**	**0.077**	**0.131**	**0.211**	**0.122**	**0.063**	**0.048**	**0.062**	**0.068**	**0.830**
P1	0.16	0.21	0.18	0.14	0.20	0.27	0.28	0.15	0.28	0.19
P2	0.38	0.70	0.52	0.22	0.09	0.12	0.12	0.28	0.35	0.30
P3	0.51	0.66	0.48	0.07	0.10	0.11	0.10	0.25	0.26	0.25
P4	0.45	0.74	0.55	0.17	0.22	0.24	0.13	0.22	0.23	0.32
P5	0.44	0.26	0.10	0.31	0.12	0.18	0.18	0.06	0.07	0.20
P6	0.24	0.30	0.16	0.33	0.15	0.17	0.19	0.12	0.20	0.22
P7	0.31	0.44	0.44	0.29	0.16	0.18	0.20	0.15	0.20	0.28
P8	0.27	0.25	0.24	0.26	0.13	0.14	0.18	0.16	0.20	0.21
P9	0.37	0.40	0.36	0.28	0.15	0.17	0.20	0.14	0.20	0.26
P10	0.45	0.56	0.48	0.44	0.11	0.14	0.18	0.18	0.21	0.34
P11	0.42	0.53	0.47	0.45	0.10	0.12	0.18	0.16	0.20	0.33
P12	0.37	0.46	0.43	0.41	0.12	0.14	0.20	0.09	0.14	0.29
P13	0.29	0.29	0.26	0.15	0.11	0.13	0.17	0.05	0.05	0.17
P14	0.07	0.08	0.07	0.05	0.04	0.06	0.06	0.36	0.32	0.10
P15	0.09	0.13	0.11	0.08	0.08	0.05	0.06	0.43	0.39	0.14
P16	0.10	0.16	0.15	0.04	0.11	0.09	0.09	0.30	0.28	0.12
P17	0.09	0.14	0.14	0.04	0.10	0.09	0.10	0.17	0.18	0.10
P18	0.06	0.09	0.10	0.03	0.08	0.07	0.07	0.10	0.08	0.07
P19	0.11	0.17	0.18	0.09	0.13	0.13	0.14	0.14	0.08	0.13
P20	0.15	0.21	0.19	0.19	0.12	0.16	0.20	0.20	0.18	0.18
P21	0.19	0.24	0.23	0.27	0.13	0.19	0.25	0.23	0.23	0.23
P22	0.23	0.27	0.26	0.30	0.11	0.15	0.21	0.22	0.23	0.23
P23	0.20	0.19	0.19	0.28	0.10	0.15	0.20	0.22	0.20	0.21
P24	0.25	0.34	0.29	0.28	0.10	0.13	0.15	0.29	0.29	0.25
P25	0.31	0.51	0.45	0.36	0.05	0.06	0.06	0.26	0.33	0.29
P26	0.32	0.58	0.52	0.39	0.04	0.04	0.04	0.23	0.30	0.31
P27	0.33	0.55	0.47	0.37	0.22	0.28	0.30	0.29	0.29	0.36
P28	0.27	0.40	0.36	0.23	0.09	0.08	0.09	0.20	0.21	0.23
P29	0.49	0.64	0.50	0.37	0.17	0.17	0.19	0.09	0.05	0.32
P30	0.39	0.54	0.43	0.36	0.14	0.11	0.13	0.03	0.03	0.27
P31	0.03	0.05	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.03
P32	0.13	0.34	0.34	0.44	0.14	0.14	0.17	0.05	0.03	0.25
P33	0.23	0.25	0.17	0.08	0.05	0.14	0.19	0.11	0.08	0.13
P34	0.21	0.23	0.20	0.11	0.08	0.18	0.26	0.09	0.10	0.15
P35	0.21	0.26	0.19	0.31	0.10	0.20	0.27	0.06	0.06	0.20
P36	0.43	0.56	0.43	0.40	0.13	0.21	0.28	0.02	0.03	0.30
P37	0.48	0.59	0.50	0.40	0.20	0.32	0.40	0.20	0.20	0.37
P38	0.56	0.73	0.59	0.50	0.22	0.34	0.44	0.27	0.27	0.45
P39	0.55	0.78	0.64	0.52	0.18	0.32	0.43	0.36	0.34	0.47
P40	0.53	0.73	0.61	0.37	0.08	0.25	0.38	0.44	0.40	0.41
P41	0.56	0.75	0.61	0.24	0.09	0.11	0.29	0.40	0.37	0.36
P42	0.57	0.75	0.60	0.15	0.08	0.06	0.12	0.38	0.35	0.31
P43	0.54	0.68	0.53	0.16	0.03	0.14	0.06	0.37	0.35	0.29
P44	0.42	0.47	0.33	0.10	0.02	0.07	0.12	0.41	0.37	0.22
P45	0.30	0.27	0.17	0.09	0.04	0.03	0.08	0.41	0.36	0.17
P46	0.22	0.18	0.14	0.08	0.10	0.09	0.12	0.34	0.29	0.15
P47	0.11	0.05	0.06	0.14	0.08	0.05	0.04	0.22	0.19	0.10
P48	0.06	0.11	0.10	0.07	0.12	0.07	0.04	0.36	0.31	0.13
P49	0.21	0.19	0.19	0.19	0.09	0.12	0.16	0.37	0.35	0.20
P50	0.43	0.52	0.45	0.42	0.16	0.20	0.28	0.32	0.29	0.35
P51	0.27	0.34	0.28	0.26	0.09	0.10	0.14	0.28	0.26	0.23
P52	0.45	0.56	0.46	0.44	0.13	0.15	0.22	0.36	0.35	0.36
P53	0.06	0.07	0.06	0.06	0.02	0.02	0.03	0.05	0.04	0.05
P54	0.30	0.41	0.33	0.33	0.16	0.18	0.22	0.26	0.25	0.28
P55	0.20	0.22	0.19	0.38	0.14	0.15	0.19	0.22	0.23	0.24
P56	0.22	0.23	0.21	0.45	0.09	0.08	0.12	0.24	0.25	0.25
Average SVR	**0.29**	**0.38**	**0.31**	**0.24**	**0.11**	**0.14**	**0.17**	**0.22**	**0.22**	**0.24**
P_{Min}	0.03	0.05	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.03
P_{Max}	0.57	0.78	0.64	0.52	0.22	0.34	0.44	0.44	0.40	0.47

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Annual Winds

	Proposed Scheme									
Test Point	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**SSW**	**SW**	
Wind speed at infinity	**6.72**	**5.85**	**6.13**	**6.96**	**7.33**	**6.36**	**5.56**	**6.31**	**6.60**	**VR_w**
Wind probability	**0.048**	**0.077**	**0.131**	**0.211**	**0.122**	**0.063**	**0.048**	**0.062**	**0.068**	**0.830**
T1	0.49	0.62	0.44	0.30	0.13	0.15	0.16	0.19	0.22	0.30
T2	0.28	0.30	0.17	0.38	0.19	0.25	0.28	0.17	0.18	0.26
T3	0.32	0.52	0.29	0.44	0.11	0.17	0.20	0.04	0.04	0.27
T4	0.30	0.30	0.17	0.20	0.15	0.17	0.16	0.19	0.20	0.20
T5	0.34	0.36	0.19	0.20	0.31	0.38	0.35	0.13	0.16	0.25
T6	0.26	0.39	0.29	0.19	0.10	0.15	0.17	0.04	0.04	0.19
T7	0.44	0.41	0.33	0.13	0.08	0.13	0.18	0.23	0.24	0.22
T8	0.44	0.44	0.34	0.19	0.16	0.23	0.27	0.13	0.18	0.25
T9	0.33	0.44	0.35	0.33	0.04	0.05	0.06	0.09	0.13	0.23
T10	0.33	0.38	0.30	0.21	0.20	0.26	0.28	0.09	0.12	0.24
T11	0.29	0.22	0.19	0.06	0.14	0.19	0.24	0.10	0.10	0.15
T12	0.08	0.06	0.06	0.19	0.05	0.08	0.09	0.15	0.14	0.11
T13	0.04	0.19	0.09	0.13	0.11	0.13	0.15	0.01	0.02	0.11
T14	0.08	0.13	0.12	0.21	0.16	0.19	0.20	0.05	0.05	0.15
T15	0.16	0.13	0.07	0.32	0.13	0.05	0.05	0.10	0.08	0.15
T16	0.18	0.18	0.25	0.17	0.04	0.03	0.02	0.07	0.07	0.13
T17	0.10	0.33	0.37	0.04	0.15	0.20	0.20	0.05	0.10	0.17
T18	0.31	0.41	0.50	0.23	0.08	0.09	0.12	0.04	0.10	0.23
T19	0.30	0.29	0.16	0.21	0.13	0.16	0.15	0.09	0.01	0.17
T20	0.13	0.05	0.08	0.44	0.24	0.31	0.33	0.20	0.20	0.25
T21	0.15	0.12	0.07	0.39	0.21	0.27	0.29	0.31	0.21	0.24
T22	0.23	0.12	0.11	0.33	0.12	0.15	0.16	0.36	0.31	0.22
T23	0.47	0.61	0.52	0.53	0.20	0.28	0.38	0.38	0.35	0.43
T24	0.44	0.44	0.28	0.41	0.30	0.37	0.39	0.21	0.20	0.34
T25	0.23	0.29	0.23	0.08	0.07	0.07	0.16	0.15	0.25	0.16
T26	0.29	0.47	0.28	0.22	0.19	0.23	0.24	0.14	0.06	0.24
T27	0.08	0.10	0.07	0.01	0.01	0.01	0.02	0.05	0.04	0.04
T28	0.14	0.24	0.20	0.06	0.29	0.29	0.21	0.21	0.20	0.19
T29	0.46	0.57	0.31	0.50	0.14	0.24	0.28	0.19	0.14	0.34
T30	0.68	0.88	0.62	0.15	0.24	0.19	0.07	0.42	0.45	0.38
T31	0.44	0.43	0.32	0.36	0.13	0.30	0.39	0.37	0.40	0.33
T32	0.39	0.56	0.43	0.26	0.09	0.27	0.27	0.35	0.35	0.31
T33	0.14	0.19	0.17	0.39	0.10	0.21	0.34	0.32	0.32	0.25
T34	0.47	0.63	0.45	0.27	0.08	0.14	0.28	0.33	0.34	0.32
T35	0.51	0.76	0.55	0.08	0.12	0.09	0.18	0.32	0.33	0.29
T36	0.54	0.81	0.62	0.20	0.14	0.10	0.09	0.34	0.38	0.35
T37	0.43	0.65	0.51	0.22	0.14	0.12	0.05	0.38	0.42	0.32
T38	0.44	0.67	0.49	0.20	0.14	0.14	0.07	0.38	0.42	0.31
T39	0.02	0.04	0.12	0.07	0.07	0.18	0.22	0.13	0.14	0.10
T40	0.04	0.05	0.05	0.07	0.14	0.13	0.13	0.14	0.10	0.09
T41	0.29	0.15	0.08	0.12	0.03	0.06	0.03	0.11	0.11	0.10
T42	0.38	0.44	0.32	0.08	0.16	0.13	0.09	0.23	0.21	0.21
T43	0.47	0.62	0.46	0.11	0.07	0.06	0.09	0.17	0.20	0.23
T44	0.07	0.07	0.05	0.05	0.03	0.04	0.07	0.10	0.07	0.06
T45	0.04	0.05	0.04	0.08	0.03	0.02	0.05	0.02	0.03	0.05
T46	0.05	0.07	0.07	0.05	0.06	0.11	0.13	0.13	0.13	0.08
T47	0.03	0.03	0.02	0.07	0.06	0.07	0.10	0.09	0.06	0.06
T48	0.04	0.05	0.05	0.03	0.05	0.04	0.02	0.05	0.06	0.04
T49	0.05	0.08	0.06	0.19	0.05	0.06	0.11	0.07	0.18	0.11
T50	0.04	0.15	0.15	0.12	0.06	0.07	0.13	0.06	0.10	0.10
T51	0.17	0.15	0.14	0.16	0.08	0.08	0.12	0.12	0.10	0.13
T52	0.23	0.34	0.27	0.22	0.03	0.10	0.15	0.04	0.01	0.17
T53	0.29	0.44	0.38	0.30	0.09	0.11	0.13	0.05	0.03	0.23
T54	0.37	0.58	0.43	0.34	0.18	0.20	0.20	0.02	0.03	0.29
T55	0.53	0.78	0.64	0.48	0.20	0.21	0.20	0.21	0.20	0.41
T56	0.09	0.14	0.13	0.16	0.07	0.08	0.07	0.13	0.14	0.13
T57	0.06	0.21	0.23	0.08	0.06	0.10	0.11	0.13	0.09	0.13
T58	0.07	0.08	0.16	0.04	0.01	0.03	0.05	0.13	0.11	0.08
Average LVR	**0.28**	**0.36**	**0.29**	**0.23**	**0.12**	**0.15**	**0.17**	**0.19**	**0.19**	**0.22**
T_{Min}	0.02	0.03	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.04
T_{Max}	0.68	0.88	0.64	0.53	0.31	0.38	0.39	0.42	0.45	0.43
S01	0.07	0.08	0.06	0.03	0.05	0.06	0.06	0.08	0.11	0.06
S02	0.05	0.06	0.04	0.04	0.01	0.02	0.03	0.13	0.16	0.05
S03	0.20	0.24	0.19	0.18	0.14	0.19	0.20	0.07	0.06	0.17
S04	0.05	0.10	0.09	0.06	0.15	0.19	0.19	0.10	0.15	0.11
S05	0.41	0.52	0.41	0.30	0.16	0.22	0.25	0.16	0.13	0.29
S06	0.37	0.39	0.29	0.22	0.09	0.13	0.15	0.16	0.15	0.22
S07	0.18	0.24	0.11	0.09	0.10	0.11	0.10	0.09	0.09	0.11
S08	0.39	0.46	0.35	0.25	0.04	0.10	0.12	0.14	0.14	0.23
S09	0.15	0.28	0.24	0.15	0.15	0.09	0.10	0.03	0.04	0.15
S10	0.26	0.28	0.24	0.20	0.12	0.08	0.10	0.13	0.12	0.18
S11	0.40	0.57	0.43	0.26	0.07	0.03	0.05	0.20	0.19	0.26
S12	0.08	0.18	0.17	0.12	0.03	0.02	0.03	0.04	0.05	0.09
S13	0.27	0.11	0.11	0.12	0.02	0.02	0.06	0.15	0.15	0.10
S14	0.02	0.03	0.04	0.23	0.02	0.04	0.03	0.20	0.20	0.11
S15	0.08	0.08	0.07	0.25	0.07	0.08	0.08	0.19	0.28	0.15
Average LVR	**0.19**	**0.24**	**0.19**	**0.16**	**0.08**	**0.09**	**0.10**	**0.12**	**0.13**	**0.15**
T_{Min}	0.02	0.03	0.04	0.03	0.01	0.02	0.03	0.03	0.04	0.05
T_{Max}	0.41	0.57	0.43	0.30	0.16	0.22	0.25	0.20	0.28	0.29

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Summer Winds

	Base Scheme								
Test Point	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	
Wind speed at infinity	**7.61**	**7.68**	**6.68**	**5.80**	**6.32**	**6.58**	**6.92**	**5.46**	**VR_w**
Wind probability	**0.082**	**0.096**	**0.076**	**0.078**	**0.095**	**0.132**	**0.168**	**0.084**	**0.811**
P1	0.33	0.19	0.23	0.27	0.13	0.23	0.26	0.31	0.24
P2	0.25	0.11	0.13	0.18	0.18	0.32	0.34	0.40	0.25
P3	0.09	0.07	0.09	0.07	0.13	0.23	0.23	0.25	0.15
P4	0.19	0.09	0.10	0.13	0.13	0.22	0.23	0.27	0.17
P5	0.30	0.12	0.16	0.18	0.05	0.05	0.05	0.06	0.10
P6	0.23	0.13	0.18	0.21	0.06	0.20	0.21	0.25	0.19
P7	0.27	0.18	0.23	0.27	0.10	0.21	0.21	0.25	0.21
P8	0.32	0.19	0.23	0.26	0.07	0.21	0.21	0.26	0.21
P9	0.33	0.20	0.24	0.26	0.02	0.20	0.20	0.25	0.21
P10	0.38	0.17	0.20	0.24	0.03	0.17	0.18	0.25	0.19
P11	0.37	0.13	0.16	0.21	0.03	0.11	0.14	0.23	0.16
P12	0.39	0.16	0.19	0.24	0.05	0.05	0.08	0.20	0.15
P13	0.34	0.16	0.19	0.24	0.04	0.05	0.07	0.24	0.14
P14	0.09	0.05	0.07	0.07	0.03	0.45	0.42	0.39	0.23
P15	0.07	0.07	0.06	0.06	0.10	0.43	0.40	0.37	0.23
P16	0.04	0.10	0.09	0.10	0.08	0.33	0.31	0.27	0.18
P17	0.05	0.08	0.09	0.10	0.06	0.18	0.19	0.17	0.12
P18	0.03	0.12	0.12	0.13	0.07	0.08	0.06	0.05	0.08
P19	0.13	0.15	0.17	0.21	0.10	0.14	0.08	0.05	0.12
P20	0.24	0.16	0.19	0.25	0.12	0.20	0.18	0.16	0.18
P21	0.29	0.14	0.19	0.25	0.12	0.19	0.19	0.22	0.19
P22	0.32	0.14	0.18	0.22	0.08	0.21	0.22	0.25	0.20
P23	0.28	0.10	0.13	0.15	0.08	0.23	0.24	0.26	0.18
P24	0.21	0.07	0.08	0.10	0.07	0.34	0.33	0.35	0.21
P25	0.35	0.16	0.21	0.24	0.07	0.30	0.30	0.30	0.24
P26	0.33	0.14	0.17	0.20	0.11	0.31	0.31	0.32	0.24
P27	0.34	0.20	0.26	0.29	0.12	0.29	0.32	0.38	0.27
P28	0.19	0.09	0.07	0.07	0.04	0.17	0.17	0.21	0.13
P29	0.32	0.14	0.14	0.15	0.02	0.05	0.03	0.04	0.10
P30	0.22	0.13	0.08	0.07	0.05	0.05	0.04	0.04	0.08
P31	0.03	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01
P32	0.39	0.09	0.14	0.18	0.11	0.04	0.04	0.04	0.11
P33	0.08	0.06	0.14	0.20	0.10	0.06	0.09	0.10	0.09
P34	0.10	0.07	0.18	0.27	0.13	0.09	0.08	0.10	0.11
P35	0.12	0.10	0.20	0.28	0.10	0.12	0.13	0.16	0.14
P36	0.17	0.15	0.25	0.33	0.08	0.04	0.04	0.03	0.11
P37	0.40	0.20	0.30	0.38	0.10	0.20	0.19	0.28	0.24
P38	0.47	0.23	0.33	0.42	0.10	0.29	0.27	0.34	0.29
P39	0.47	0.20	0.31	0.42	0.07	0.38	0.34	0.39	0.32
P40	0.37	0.13	0.27	0.38	0.10	0.43	0.39	0.44	0.32
P41	0.25	0.07	0.15	0.30	0.15	0.38	0.36	0.41	0.27
P42	0.17	0.09	0.06	0.14	0.22	0.36	0.34	0.41	0.24
P43	0.10	0.08	0.07	0.05	0.23	0.35	0.33	0.40	0.22
P44	0.11	0.02	0.13	0.12	0.22	0.38	0.35	0.39	0.23
P45	0.08	0.03	0.07	0.07	0.20	0.38	0.34	0.36	0.21
P46	0.19	0.10	0.06	0.13	0.23	0.32	0.28	0.30	0.21
P47	0.10	0.07	0.07	0.06	0.14	0.23	0.20	0.19	0.14
P48	0.09	0.12	0.07	0.06	0.18	0.37	0.32	0.29	0.21
P49	0.23	0.10	0.16	0.19	0.11	0.39	0.35	0.32	0.24
P50	0.36	0.16	0.18	0.27	0.04	0.34	0.31	0.30	0.25
P51	0.20	0.08	0.09	0.14	0.05	0.27	0.26	0.28	0.18
P52	0.37	0.18	0.21	0.26	0.05	0.32	0.33	0.38	0.26
P53	0.04	0.03	0.03	0.04	0.01	0.04	0.04	0.05	0.03
P54	0.23	0.19	0.21	0.21	0.03	0.26	0.27	0.32	0.22
P55	0.17	0.12	0.13	0.14	0.11	0.19	0.20	0.25	0.16
P56	0.33	0.10	0.11	0.13	0.02	0.19	0.20	0.24	0.16
Average SVR	**0.23**	**0.11**	**0.15**	**0.18**	**0.09**	**0.22**	**0.21**	**0.24**	**0.18**
P_{Min}	0.03	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01
P_{Max}	0.47	0.23	0.33	0.42	0.23	0.45	0.42	0.44	0.32

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Summer Winds

	Base Scheme								
Test Point	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	
Wind speed at infinity	**7.61**	**7.68**	**6.68**	**5.80**	**6.32**	**6.58**	**6.92**	**5.46**	**VR_w**
Wind probability	**0.082**	**0.096**	**0.076**	**0.078**	**0.095**	**0.132**	**0.168**	**0.084**	**0.811**
T1	0.25	0.13	0.15	0.16	0.16	0.18	0.21	0.27	0.19
T2	0.34	0.18	0.23	0.27	0.08	0.17	0.18	0.21	0.19
T3	0.42	0.11	0.16	0.19	0.08	0.04	0.06	0.08	0.12
T4	0.18	0.13	0.15	0.16	0.07	0.15	0.17	0.23	0.15
T5	0.20	0.27	0.32	0.35	0.09	0.16	0.19	0.22	0.22
T6	0.18	0.11	0.16	0.17	0.03	0.03	0.03	0.03	0.08
T7	0.09	0.11	0.15	0.16	0.04	0.15	0.16	0.19	0.13
T8	0.17	0.16	0.23	0.27	0.05	0.20	0.22	0.25	0.19
T9	0.31	0.06	0.08	0.07	0.06	0.14	0.17	0.19	0.14
T10	0.19	0.20	0.25	0.27	0.08	0.07	0.09	0.12	0.14
T11	0.05	0.14	0.20	0.24	0.04	0.04	0.05	0.07	0.09
T12	0.16	0.06	0.07	0.10	0.05	0.03	0.02	0.04	0.06
T13	0.10	0.09	0.06	0.07	0.03	0.06	0.08	0.02	0.07
T14	0.22	0.15	0.18	0.18	0.02	0.05	0.05	0.01	0.09
T15	0.14	0.10	0.05	0.05	0.10	0.10	0.08	0.09	0.08
T16	0.15	0.04	0.03	0.01	0.07	0.07	0.07	0.06	0.06
T17	0.06	0.14	0.18	0.18	0.02	0.06	0.10	0.07	0.10
T18	0.23	0.08	0.09	0.12	0.03	0.06	0.09	0.13	0.09
T19	0.16	0.12	0.15	0.13	0.01	0.11	0.01	0.02	0.08
T20	0.41	0.24	0.30	0.32	0.20	0.21	0.21	0.16	0.24
T21	0.38	0.21	0.26	0.27	0.18	0.29	0.24	0.13	0.24
T22	0.32	0.12	0.14	0.16	0.04	0.35	0.31	0.34	0.23
T23	0.50	0.19	0.27	0.38	0.13	0.36	0.35	0.42	0.32
T24	0.36	0.30	0.35	0.37	0.15	0.21	0.21	0.24	0.26
T25	0.10	0.07	0.08	0.16	0.10	0.17	0.25	0.30	0.16
T26	0.22	0.18	0.21	0.23	0.06	0.12	0.05	0.08	0.13
T27	0.01	0.01	0.01	0.01	0.01	0.05	0.04	0.05	0.02
T28	0.07	0.27	0.26	0.21	0.12	0.20	0.20	0.24	0.19
T29	0.41	0.14	0.23	0.26	0.11	0.19	0.15	0.18	0.19
T30	0.12	0.23	0.18	0.05	0.27	0.40	0.43	0.53	0.30
T31	0.32	0.15	0.29	0.37	0.26	0.36	0.39	0.51	0.33
T32	0.22	0.12	0.24	0.25	0.23	0.33	0.33	0.32	0.26
T33	0.30	0.05	0.22	0.34	0.30	0.31	0.32	0.26	0.26
T34	0.28	0.07	0.15	0.27	0.25	0.31	0.33	0.41	0.26
T35	0.09	0.10	0.07	0.21	0.28	0.31	0.32	0.41	0.23
T36	0.14	0.12	0.09	0.13	0.22	0.34	0.38	0.50	0.26
T37	0.16	0.12	0.09	0.07	0.24	0.37	0.40	0.51	0.27
T38	0.15	0.12	0.12	0.07	0.27	0.37	0.41	0.51	0.27
T39	0.06	0.07	0.17	0.20	0.12	0.13	0.13	0.28	0.13
T40	0.08	0.14	0.13	0.13	0.28	0.16	0.12	0.11	0.14
T41	0.11	0.03	0.06	0.03	0.06	0.11	0.11	0.16	0.08
T42	0.09	0.14	0.12	0.07	0.24	0.22	0.20	0.24	0.17
T43	0.08	0.06	0.11	0.08	0.18	0.16	0.19	0.24	0.14
T44	0.04	0.03	0.04	0.06	0.05	0.09	0.07	0.04	0.05
T45	0.08	0.02	0.03	0.06	0.03	0.01	0.02	0.10	0.03
T46	0.05	0.06	0.09	0.13	0.08	0.12	0.12	0.10	0.09
T47	0.08	0.07	0.06	0.06	0.11	0.08	0.06	0.05	0.07
T48	0.02	0.03	0.02	0.01	0.07	0.05	0.05	0.08	0.04
T49	0.19	0.04	0.06	0.09	0.22	0.06	0.16	0.34	0.14
T50	0.13	0.06	0.10	0.13	0.11	0.06	0.09	0.19	0.10
T51	0.15	0.05	0.08	0.11	0.03	0.11	0.10	0.20	0.10
T52	0.22	0.06	0.12	0.16	0.07	0.03	0.02	0.11	0.08
T53	0.26	0.10	0.11	0.12	0.03	0.07	0.04	0.12	0.09
T54	0.31	0.16	0.18	0.18	0.14	0.02	0.04	0.07	0.11
T55	0.44	0.18	0.19	0.18	0.05	0.20	0.19	0.25	0.20
T56	0.14	0.07	0.08	0.06	0.09	0.13	0.13	0.15	0.11
T57	0.09	0.07	0.10	0.10	0.11	0.14	0.09	0.15	0.10
T58	0.04	0.02	0.05	0.07	0.23	0.12	0.10	0.11	0.09
Average LVR	**0.20**	**0.11**	**0.14**	**0.17**	**0.10**	**0.19**	**0.18**	**0.22**	**0.17**
T_{Min}	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
T_{Max}	0.50	0.30	0.35	0.38	0.30	0.40	0.43	0.53	0.33
S01	0.02	0.10	0.08	0.08	0.04	0.07	0.08	0.12	0.07
S02	0.03	0.01	0.01	0.01	0.06	0.09	0.40	0.15	0.12
S03	0.26	0.17	0.21	0.24	0.04	0.07	0.07	0.07	0.12
S04	0.13	0.14	0.16	0.18	0.04	0.06	0.14	0.10	0.11
S05	0.04	0.03	0.03	0.04	0.03	0.03	0.09	0.03	0.04
S06	0.05	0.01	0.02	0.02	0.06	0.05	0.13	0.08	0.06
S07	0.16	0.08	0.07	0.09	0.07	0.10	0.05	0.10	0.08
S08	0.25	0.07	0.08	0.10	0.05	0.12	0.18	0.13	0.12
S09	0.16	0.09	0.09	0.14	0.08	0.05	0.19	0.04	0.10
S10	0.22	0.07	0.07	0.15	0.05	0.23	0.34	0.25	0.19
S11	0.29	0.08	0.06	0.12	0.03	0.21	0.40	0.23	0.19
S12	0.12	0.02	0.03	0.02	0.01	0.11	0.18	0.03	0.07
S13	0.14	0.03	0.02	0.06	0.09	0.16	0.17	0.19	0.11
S14	0.11	0.02	0.03	0.05	0.12	0.19	0.03	0.19	0.09
S15	0.10	0.07	0.06	0.06	0.07	0.17	0.10	0.28	0.12
Average LVR	**0.13**	**0.06**	**0.06**	**0.08**	**0.05**	**0.11**	**0.17**	**0.13**	**0.11**
T_{Min}	0.02	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.04
T_{Max}	0.29	0.17	0.21	0.24	0.12	0.23	0.40	0.28	0.19

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Annual Winds

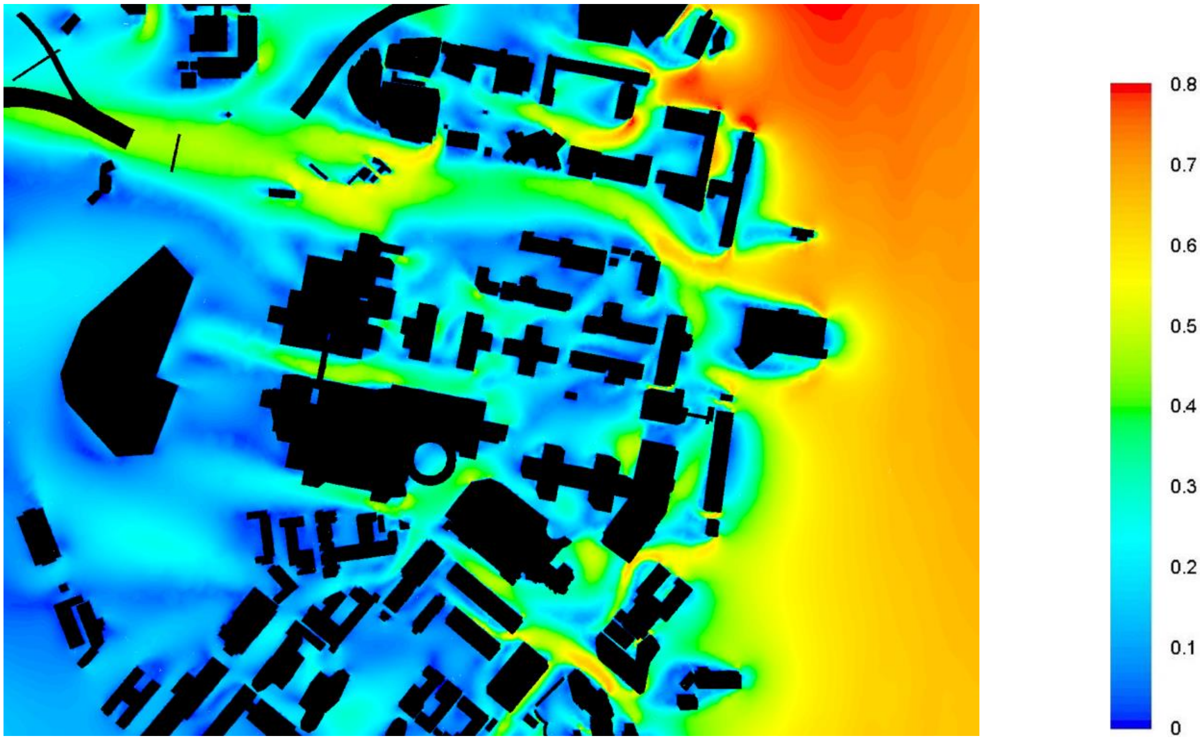
Test Point	Proposed Scheme								
	E	ESE	SE	SSE	S	SSW	SW	WSW	
Wind speed at infinity	**7.61**	**7.68**	**6.68**	**5.80**	**6.32**	**6.58**	**6.92**	**5.46**	VR_w
Wind probability	**0.082**	**0.096**	**0.076**	**0.078**	**0.095**	**0.132**	**0.168**	**0.084**	**0.811**
P1	0.12	0.19	0.25	0.27	0.12	0.15	0.27	0.23	0.20
P2	0.20	0.09	0.11	0.11	0.13	0.27	0.34	0.35	0.22
P3	0.06	0.10	0.11	0.09	0.13	0.24	0.25	0.28	0.17
P4	0.15	0.21	0.23	0.12	0.14	0.21	0.22	0.29	0.20
P5	0.28	0.12	0.17	0.17	0.03	0.06	0.06	0.08	0.11
P6	0.30	0.14	0.16	0.19	0.08	0.11	0.19	0.16	0.17
P7	0.27	0.15	0.17	0.19	0.12	0.14	0.19	0.21	0.18
P8	0.24	0.13	0.14	0.17	0.14	0.15	0.19	0.26	0.18
P9	0.25	0.14	0.16	0.20	0.09	0.13	0.19	0.22	0.18
P10	0.41	0.11	0.13	0.18	0.05	0.18	0.20	0.25	0.19
P11	0.42	0.10	0.12	0.17	0.08	0.15	0.19	0.26	0.19
P12	0.38	0.12	0.14	0.19	0.07	0.08	0.14	0.21	0.16
P13	0.13	0.11	0.13	0.16	0.05	0.05	0.05	0.26	0.10
P14	0.05	0.03	0.05	0.06	0.09	0.35	0.31	0.33	0.19
P15	0.07	0.08	0.05	0.06	0.03	0.41	0.37	0.33	0.21
P16	0.03	0.10	0.08	0.08	0.03	0.28	0.27	0.22	0.16
P17	0.04	0.09	0.09	0.10	0.01	0.16	0.17	0.13	0.11
P18	0.03	0.08	0.07	0.06	0.02	0.10	0.08	0.06	0.06
P19	0.08	0.12	0.12	0.14	0.05	0.13	0.08	0.05	0.10
P20	0.17	0.12	0.15	0.19	0.08	0.19	0.17	0.15	0.16
P21	0.24	0.12	0.18	0.24	0.09	0.22	0.22	0.24	0.20
P22	0.27	0.10	0.15	0.20	0.05	0.21	0.22	0.24	0.19
P23	0.26	0.10	0.14	0.19	0.02	0.21	0.20	0.21	0.17
P24	0.25	0.10	0.13	0.15	0.05	0.28	0.27	0.31	0.21
P25	0.33	0.05	0.05	0.05	0.07	0.24	0.31	0.29	0.19
P26	0.36	0.04	0.03	0.04	0.11	0.22	0.28	0.28	0.18
P27	0.34	0.21	0.27	0.29	0.11	0.19	0.27	0.29	0.24
P28	0.21	0.09	0.08	0.09	0.10	0.20	0.20	0.23	0.16
P29	0.34	0.16	0.16	0.18	0.06	0.08	0.05	0.04	0.12
P30	0.33	0.14	0.10	0.12	0.05	0.02	0.03	0.03	0.09
P31	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
P32	0.40	0.14	0.13	0.16	0.08	0.05	0.03	0.03	0.11
P33	0.07	0.05	0.13	0.18	0.03	0.11	0.08	0.09	0.09
P34	0.10	0.07	0.18	0.25	0.08	0.09	0.10	0.11	0.11
P35	0.29	0.09	0.19	0.26	0.07	0.06	0.05	0.06	0.12
P36	0.36	0.12	0.20	0.27	0.06	0.02	0.03	0.03	0.12
P37	0.36	0.19	0.30	0.39	0.08	0.19	0.19	0.28	0.23
P38	0.46	0.21	0.33	0.42	0.01	0.26	0.25	0.35	0.27
P39	0.47	0.17	0.30	0.41	0.09	0.34	0.32	0.40	0.31
P40	0.34	0.07	0.24	0.37	0.09	0.42	0.38	0.44	0.31
P41	0.22	0.08	0.11	0.28	0.09	0.38	0.35	0.41	0.26
P42	0.13	0.07	0.05	0.12	0.18	0.36	0.34	0.41	0.23
P43	0.14	0.03	0.14	0.06	0.20	0.35	0.33	0.39	0.23
P44	0.09	0.02	0.07	0.12	0.17	0.39	0.35	0.38	0.23
P45	0.08	0.04	0.03	0.08	0.16	0.39	0.35	0.35	0.21
P46	0.08	0.10	0.09	0.11	0.21	0.32	0.28	0.28	0.20
P47	0.12	0.08	0.05	0.04	0.13	0.21	0.18	0.17	0.13
P48	0.06	0.12	0.07	0.04	0.16	0.35	0.29	0.26	0.19
P49	0.18	0.08	0.12	0.16	0.09	0.36	0.33	0.27	0.22
P50	0.38	0.15	0.19	0.27	0.04	0.30	0.28	0.30	0.24
P51	0.24	0.08	0.10	0.14	0.04	0.27	0.25	0.26	0.18
P52	0.40	0.13	0.15	0.21	0.09	0.34	0.33	0.36	0.26
P53	0.05	0.02	0.02	0.03	0.00	0.04	0.04	0.04	0.03
P54	0.30	0.15	0.17	0.21	0.09	0.25	0.24	0.27	0.21
P55	0.35	0.14	0.14	0.18	0.06	0.21	0.22	0.27	0.20
P56	0.41	0.09	0.08	0.11	0.12	0.23	0.23	0.28	0.20
Average SVR	**0.23**	**0.11**	**0.13**	**0.17**	**0.08**	**0.21**	**0.21**	**0.23**	**0.18**
P_{Min}	0.03	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
P_{Max}	0.47	0.21	0.33	0.42	0.21	0.42	0.38	0.44	0.31

Appendix B - Details of the Predicted Wind Velocity Ratio (VR_W)
Annual Winds

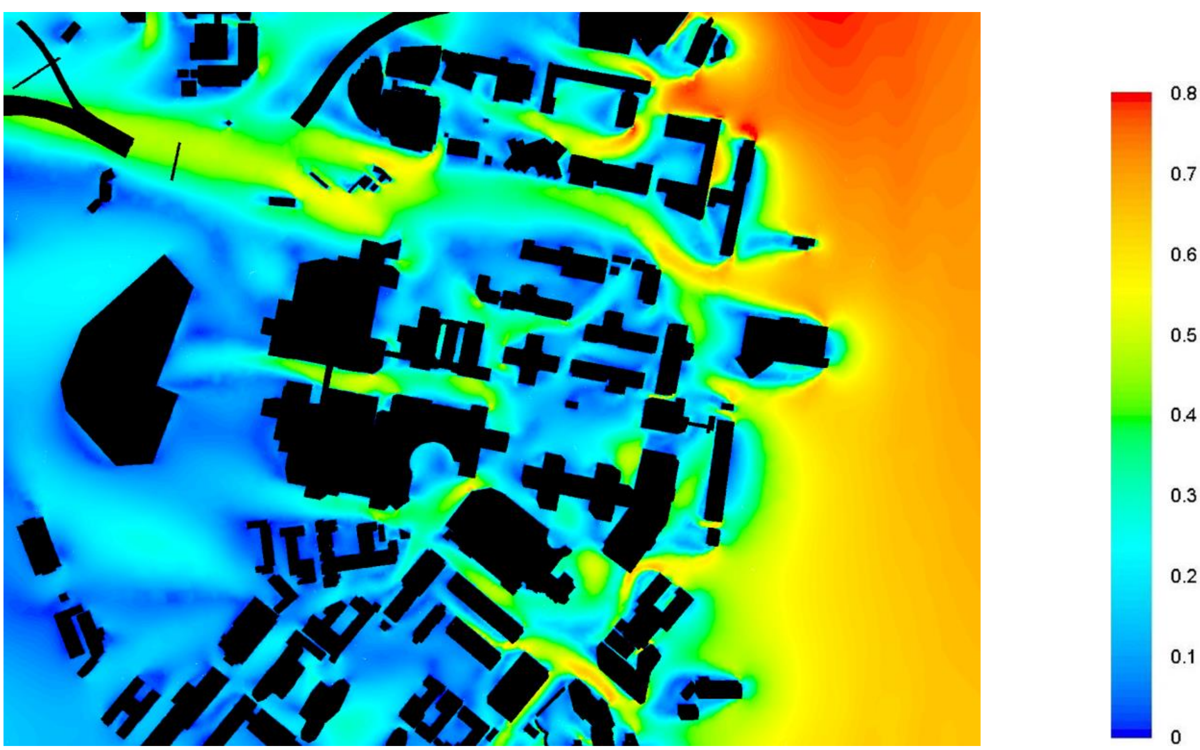
Test Point	Proposed Scheme								
	E	ESE	SE	SSE	S	SSW	SW	WSW	
Wind speed at infinity	7.61	7.68	6.68	5.80	6.32	6.58	6.92	5.46	VR_w
Wind probability	0.082	0.096	0.076	0.078	0.095	0.132	0.168	0.084	0.811
T1	0.27	0.13	0.15	0.16	0.15	0.18	0.21	0.27	0.19
T2	0.34	0.18	0.24	0.27	0.08	0.16	0.17	0.21	0.20
T3	0.40	0.11	0.16	0.19	0.06	0.04	0.04	0.08	0.12
T4	0.18	0.14	0.17	0.15	0.07	0.19	0.19	0.23	0.17
T5	0.18	0.30	0.36	0.34	0.09	0.12	0.15	0.10	0.20
T6	0.18	0.10	0.14	0.17	0.06	0.04	0.04	0.04	0.09
T7	0.12	0.08	0.13	0.17	0.07	0.22	0.23	0.27	0.17
T8	0.18	0.15	0.22	0.26	0.13	0.12	0.17	0.20	0.18
T9	0.30	0.04	0.05	0.06	0.04	0.09	0.12	0.14	0.11
T10	0.19	0.19	0.25	0.27	0.07	0.09	0.12	0.15	0.16
T11	0.06	0.13	0.18	0.23	0.05	0.10	0.10	0.12	0.12
T12	0.18	0.05	0.07	0.09	0.07	0.14	0.13	0.16	0.12
T13	0.12	0.11	0.12	0.14	0.04	0.01	0.02	0.02	0.07
T14	0.19	0.15	0.18	0.19	0.03	0.04	0.04	0.06	0.10
T15	0.29	0.12	0.05	0.05	0.07	0.09	0.08	0.08	0.11
T16	0.16	0.04	0.03	0.02	0.04	0.07	0.07	0.06	0.07
T17	0.04	0.14	0.19	0.19	0.01	0.05	0.10	0.07	0.10
T18	0.21	0.07	0.09	0.12	0.03	0.04	0.09	0.12	0.10
T19	0.19	0.12	0.15	0.14	0.02	0.09	0.01	0.02	0.08
T20	0.40	0.23	0.30	0.32	0.19	0.19	0.19	0.14	0.24
T21	0.36	0.20	0.26	0.28	0.18	0.30	0.20	0.13	0.24
T22	0.31	0.12	0.15	0.15	0.08	0.34	0.29	0.34	0.24
T23	0.48	0.19	0.26	0.37	0.04	0.36	0.34	0.41	0.31
T24	0.37	0.29	0.35	0.37	0.12	0.21	0.19	0.22	0.25
T25	0.08	0.07	0.06	0.15	0.10	0.14	0.24	0.29	0.15
T26	0.20	0.18	0.22	0.23	0.06	0.13	0.06	0.07	0.13
T27	0.01	0.01	0.01	0.02	0.01	0.05	0.04	0.05	0.03
T28	0.06	0.27	0.27	0.20	0.10	0.20	0.19	0.24	0.19
T29	0.46	0.14	0.23	0.27	0.05	0.18	0.13	0.16	0.19
T30	0.13	0.23	0.18	0.07	0.27	0.40	0.42	0.53	0.30
T31	0.33	0.12	0.29	0.38	0.25	0.36	0.38	0.50	0.33
T32	0.24	0.09	0.25	0.26	0.24	0.34	0.34	0.34	0.27
T33	0.36	0.09	0.20	0.32	0.30	0.31	0.31	0.27	0.27
T34	0.25	0.08	0.13	0.27	0.24	0.32	0.33	0.41	0.26
T35	0.08	0.11	0.09	0.17	0.28	0.30	0.32	0.41	0.24
T36	0.19	0.13	0.10	0.08	0.22	0.33	0.36	0.48	0.26
T37	0.20	0.13	0.12	0.05	0.24	0.37	0.40	0.50	0.27
T38	0.18	0.13	0.13	0.06	0.27	0.37	0.40	0.50	0.28
T39	0.06	0.07	0.17	0.21	0.12	0.13	0.13	0.29	0.14
T40	0.06	0.13	0.13	0.13	0.26	0.13	0.10	0.10	0.13
T41	0.11	0.03	0.06	0.03	0.06	0.11	0.11	0.15	0.09
T42	0.07	0.15	0.12	0.09	0.24	0.22	0.20	0.24	0.18
T43	0.10	0.07	0.06	0.09	0.18	0.16	0.19	0.24	0.14
T44	0.04	0.02	0.04	0.07	0.05	0.10	0.07	0.05	0.06
T45	0.08	0.02	0.02	0.05	0.03	0.01	0.03	0.10	0.04
T46	0.05	0.06	0.11	0.13	0.07	0.13	0.12	0.10	0.10
T47	0.07	0.05	0.06	0.10	0.12	0.08	0.06	0.04	0.07
T48	0.03	0.04	0.04	0.02	0.08	0.05	0.06	0.09	0.05
T49	0.17	0.05	0.06	0.10	0.21	0.07	0.17	0.35	0.15
T50	0.11	0.06	0.07	0.12	0.12	0.06	0.10	0.20	0.10
T51	0.14	0.08	0.08	0.12	0.04	0.11	0.10	0.23	0.11
T52	0.20	0.02	0.09	0.14	0.07	0.04	0.01	0.12	0.07
T53	0.27	0.08	0.11	0.12	0.04	0.04	0.03	0.13	0.09
T54	0.31	0.17	0.19	0.19	0.14	0.02	0.03	0.06	0.12
T55	0.43	0.19	0.20	0.19	0.05	0.20	0.19	0.25	0.21
T56	0.15	0.07	0.07	0.07	0.09	0.13	0.13	0.15	0.11
T57	0.08	0.06	0.10	0.10	0.12	0.13	0.09	0.15	0.10
T58	0.04	0.01	0.03	0.04	0.23	0.13	0.11	0.10	0.09
Average LVR	**0.21**	**0.11**	**0.14**	**0.16**	**0.10**	**0.18**	**0.18**	**0.22**	**0.17**
T_{Min}	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.03
T_{Max}	0.48	0.30	0.36	0.38	0.30	0.40	0.42	0.53	0.33
S01	0.03	0.05	0.05	0.06	0.02	0.08	0.11	0.17	0.07
S02	0.03	0.01	0.02	0.03	0.05	0.13	0.15	0.19	0.09
S03	0.17	0.13	0.18	0.20	0.06	0.07	0.06	0.05	0.10
S04	0.06	0.14	0.18	0.18	0.05	0.09	0.14	0.19	0.13
S05	0.28	0.16	0.21	0.24	0.10	0.15	0.12	0.11	0.16
S06	0.21	0.09	0.12	0.15	0.17	0.16	0.14	0.11	0.14
S07	0.08	0.10	0.10	0.09	0.01	0.08	0.08	0.08	0.08
S08	0.23	0.04	0.09	0.12	0.03	0.13	0.13	0.15	0.12
S09	0.14	0.14	0.09	0.10	0.06	0.03	0.03	0.05	0.07
S10	0.18	0.12	0.08	0.10	0.06	0.13	0.11	0.13	0.11
S11	0.24	0.07	0.03	0.05	0.04	0.19	0.18	0.21	0.13
S12	0.11	0.02	0.02	0.03	0.10	0.04	0.05	0.06	0.05
S13	0.11	0.02	0.02	0.06	0.11	0.14	0.14	0.16	0.10
S14	0.21	0.02	0.03	0.03	0.06	0.19	0.19	0.21	0.13
S15	0.23	0.07	0.07	0.08	0.11	0.19	0.27	0.30	0.17
Average LVR	**0.15**	**0.07**	**0.08**	**0.10**	**0.06**	**0.11**	**0.12**	**0.14**	**0.11**
T_{Min}	0.03	0.01	0.02	0.03	0.01	0.03	0.03	0.05	0.05
T_{Max}	0.28	0.16	0.21	0.24	0.17	0.19	0.27	0.30	0.17

Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

E at 2mAG (Base Scheme)

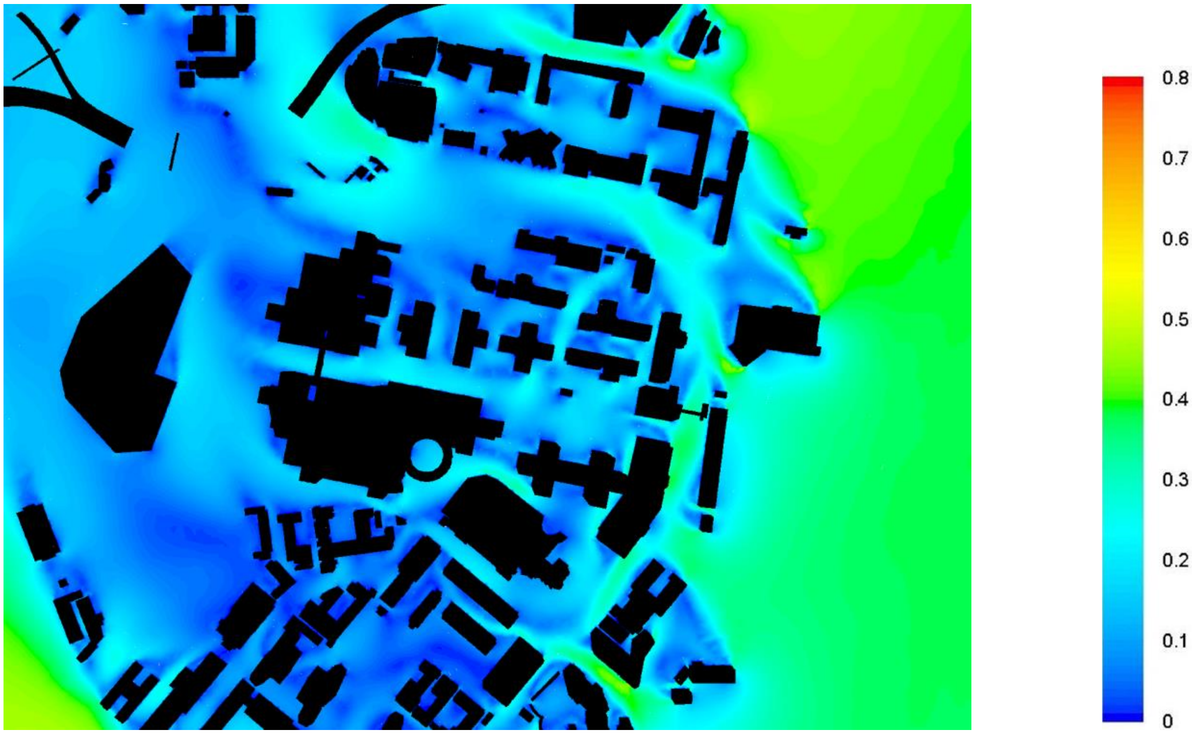


E at 2mAG (Proposed Scheme)

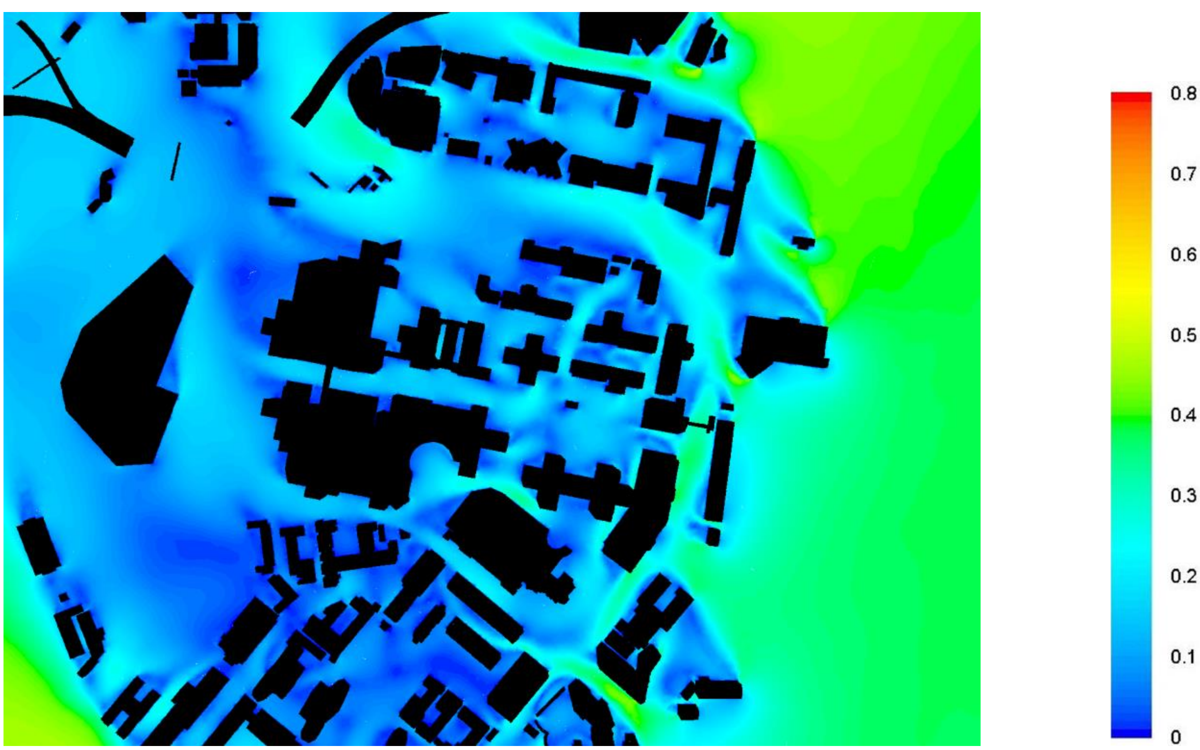


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

ESE at 2mAG (Base Scheme)

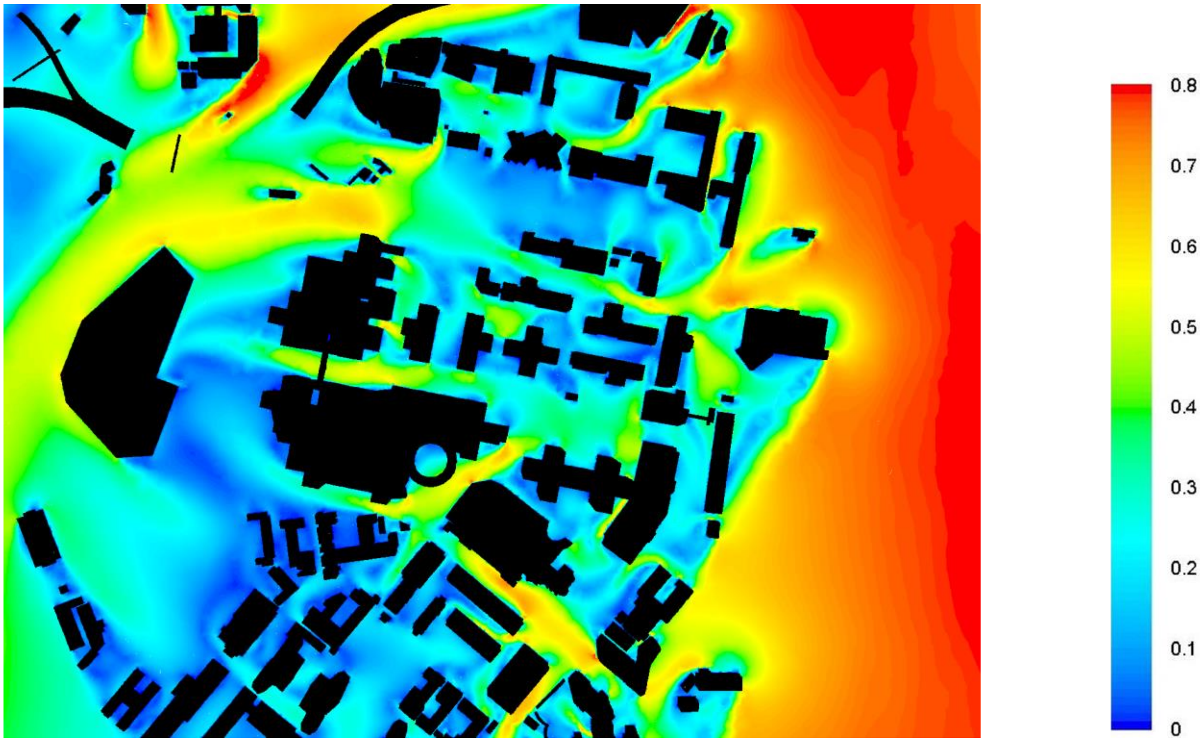


ESE at 2mAG (Proposed Scheme)

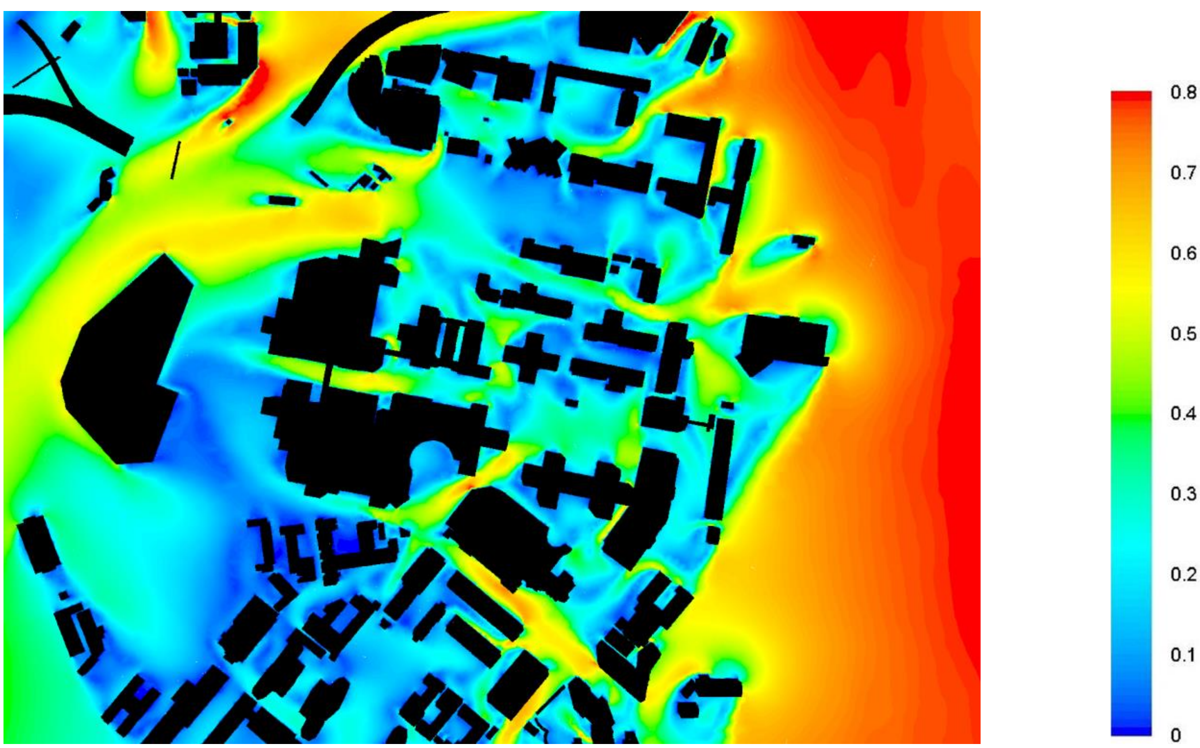


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

ENE at 2mAG (Base Scheme)

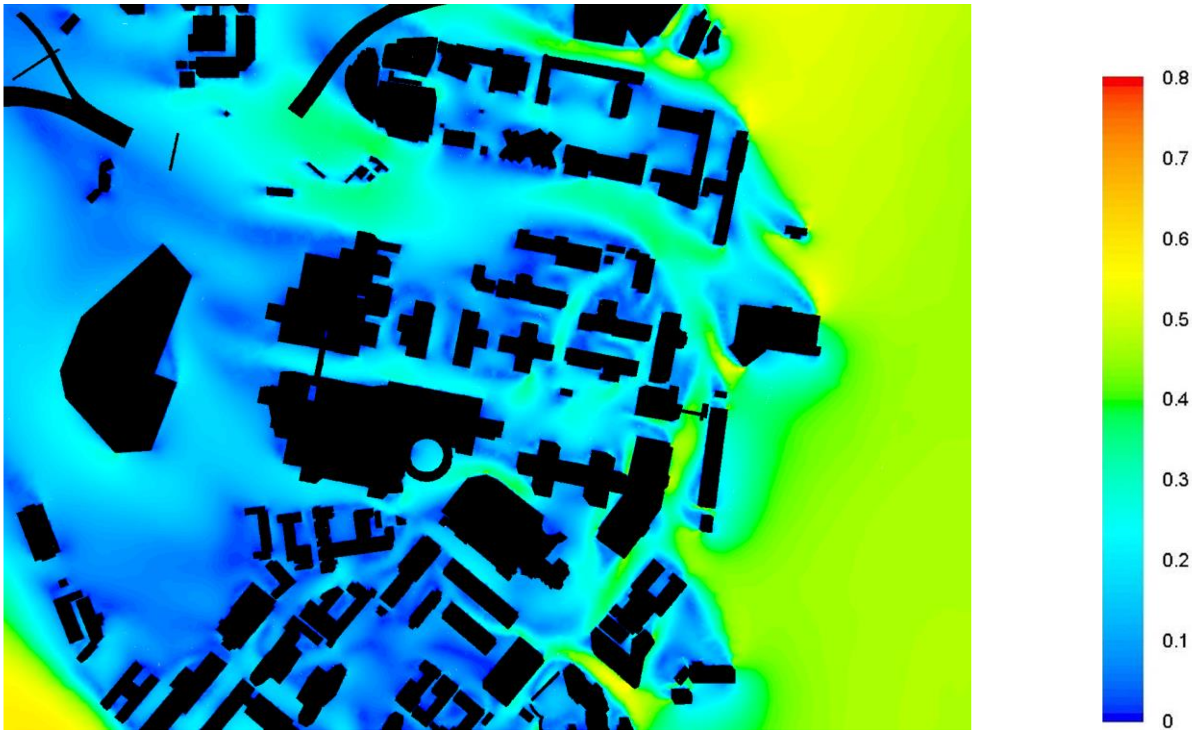


ENE at 2mAG (Proposed Scheme)

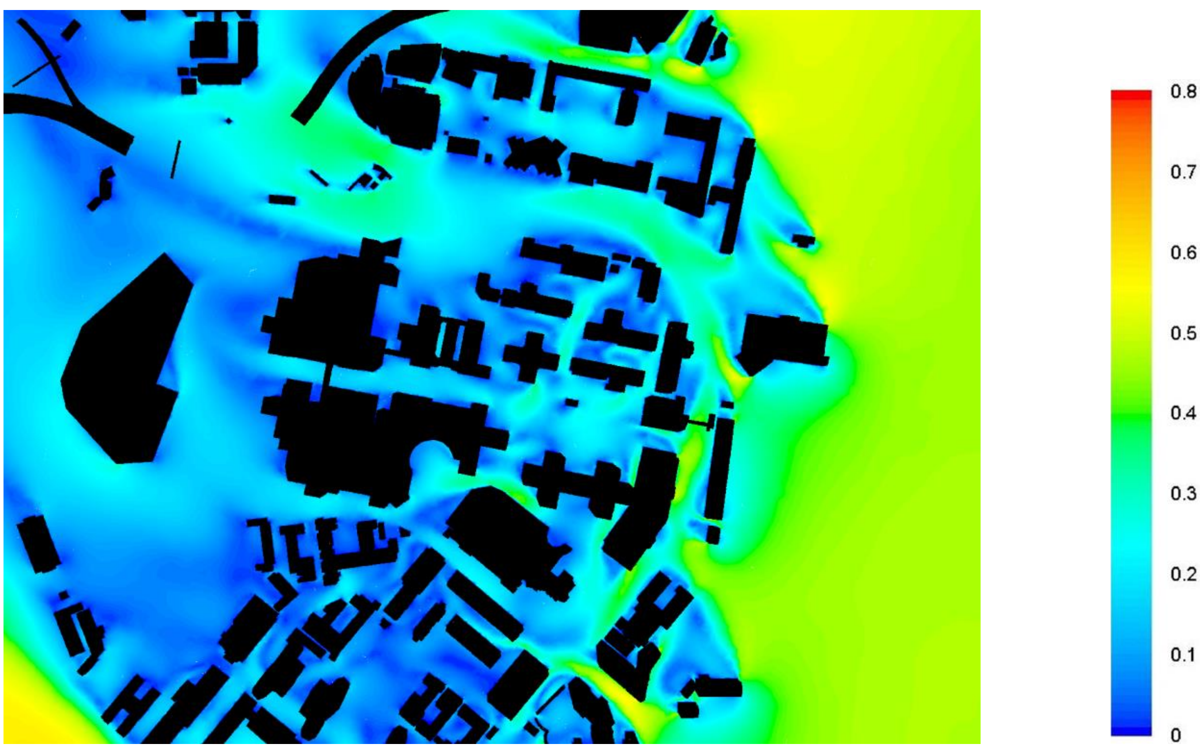


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

SE at 2mAG (Base Scheme)

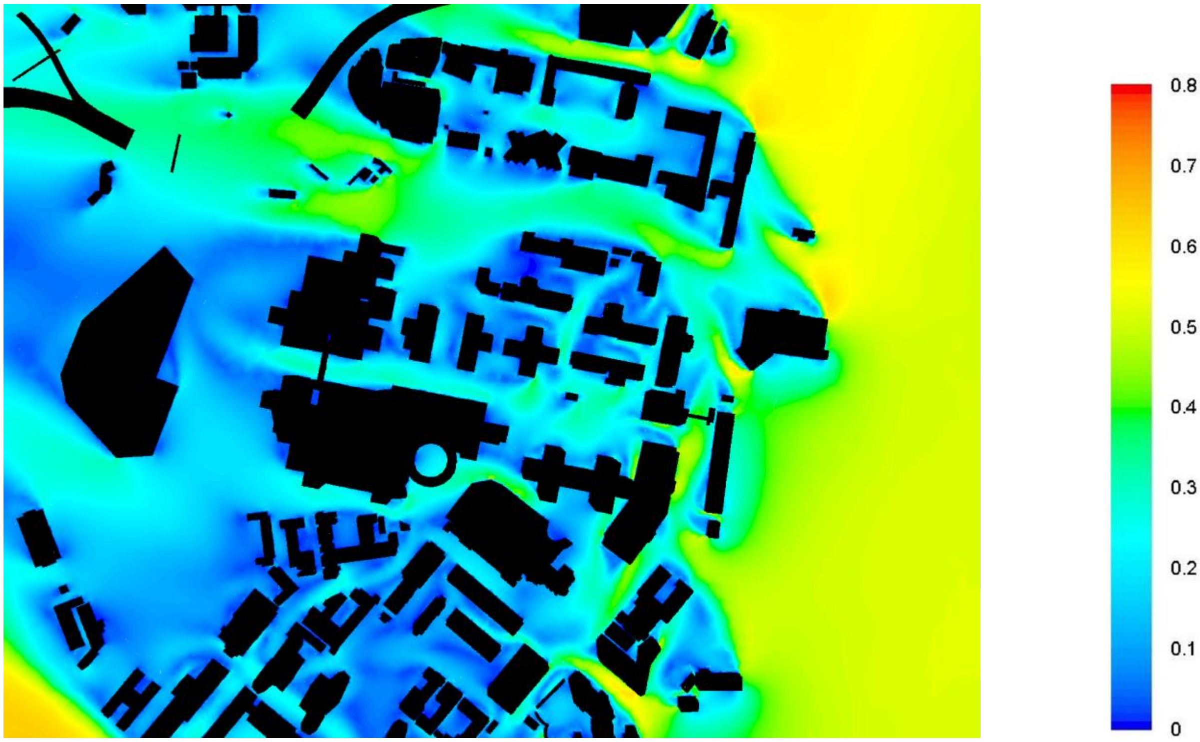


SE at 2mAG (Proposed Scheme)

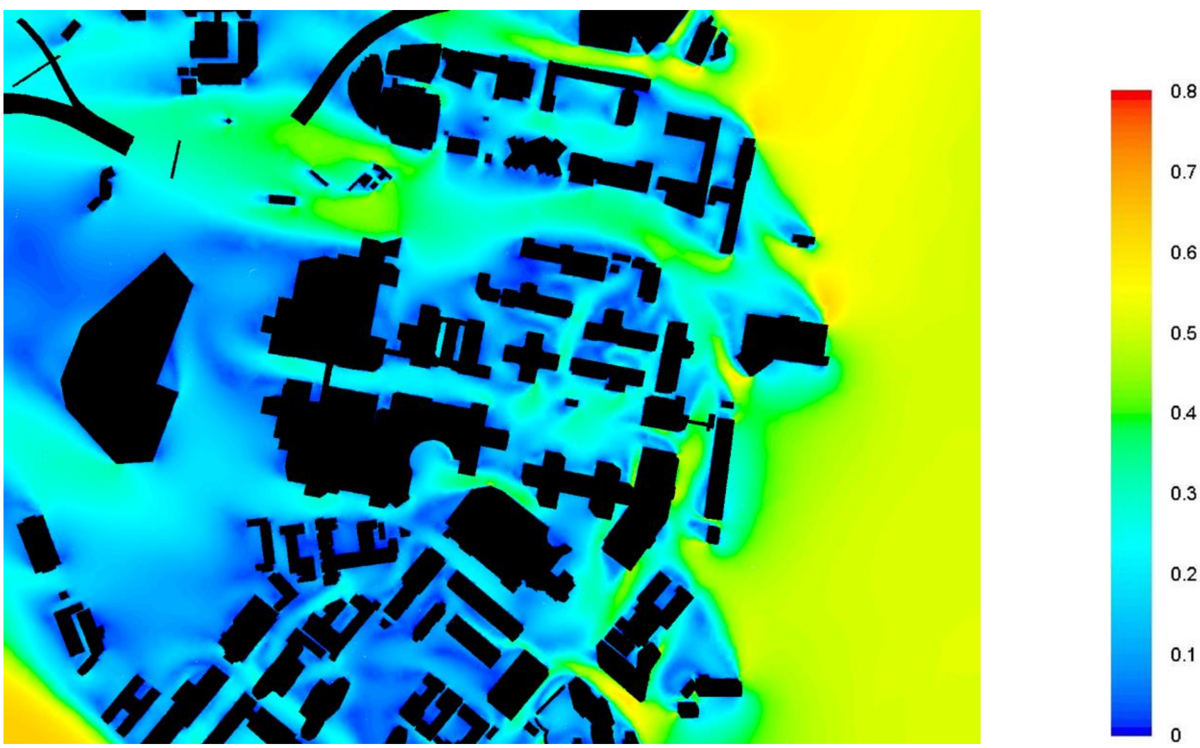


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

SSE at 2mAG (Base Scheme)

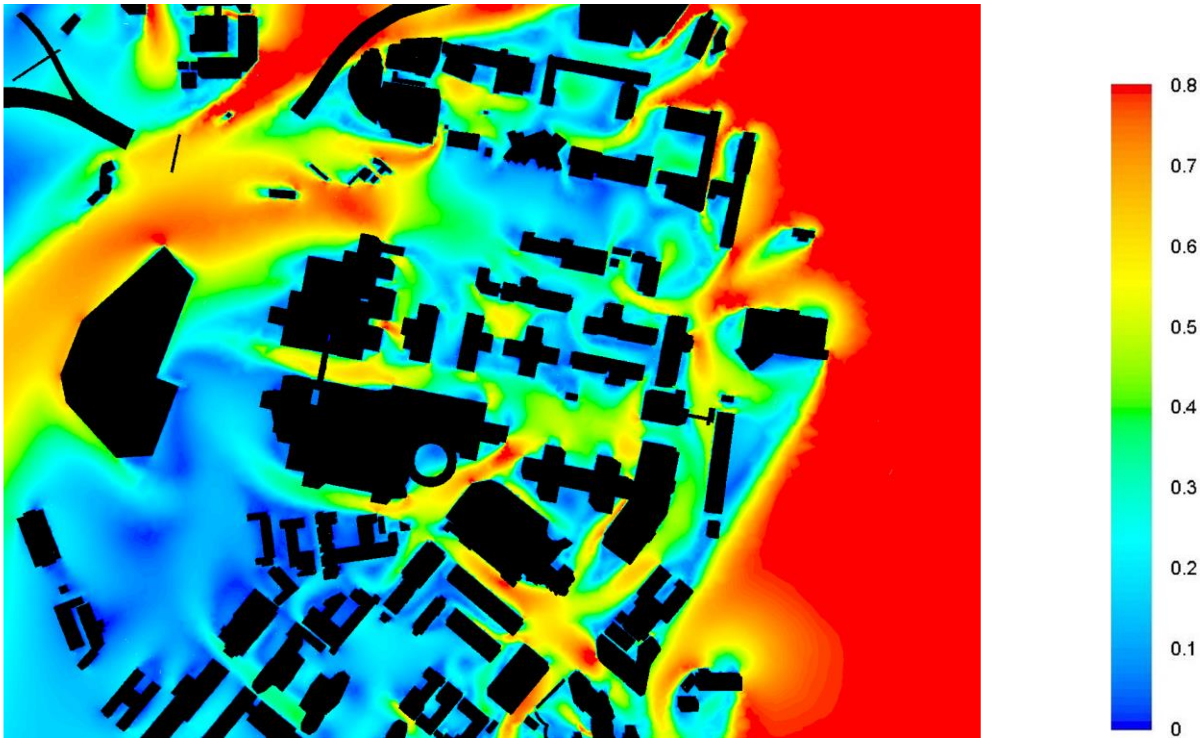


SSE at 2mAG (Proposed Scheme)

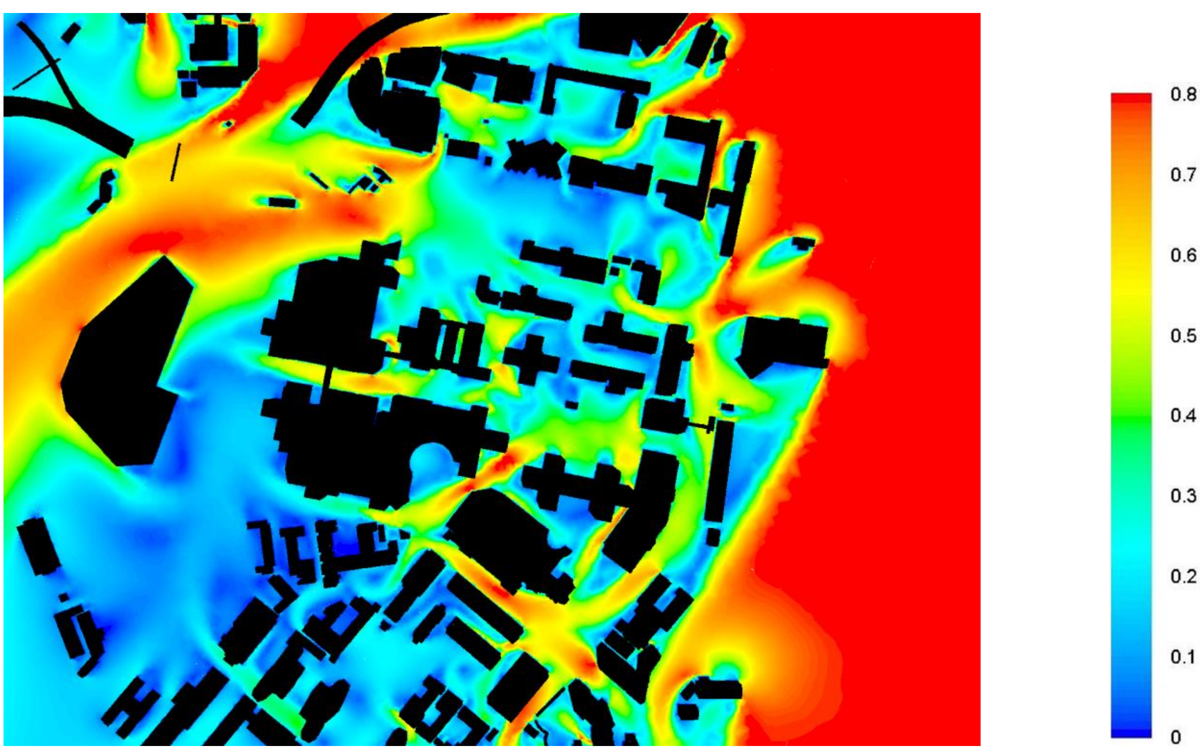


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

NE at 2mAG (Base Scheme)

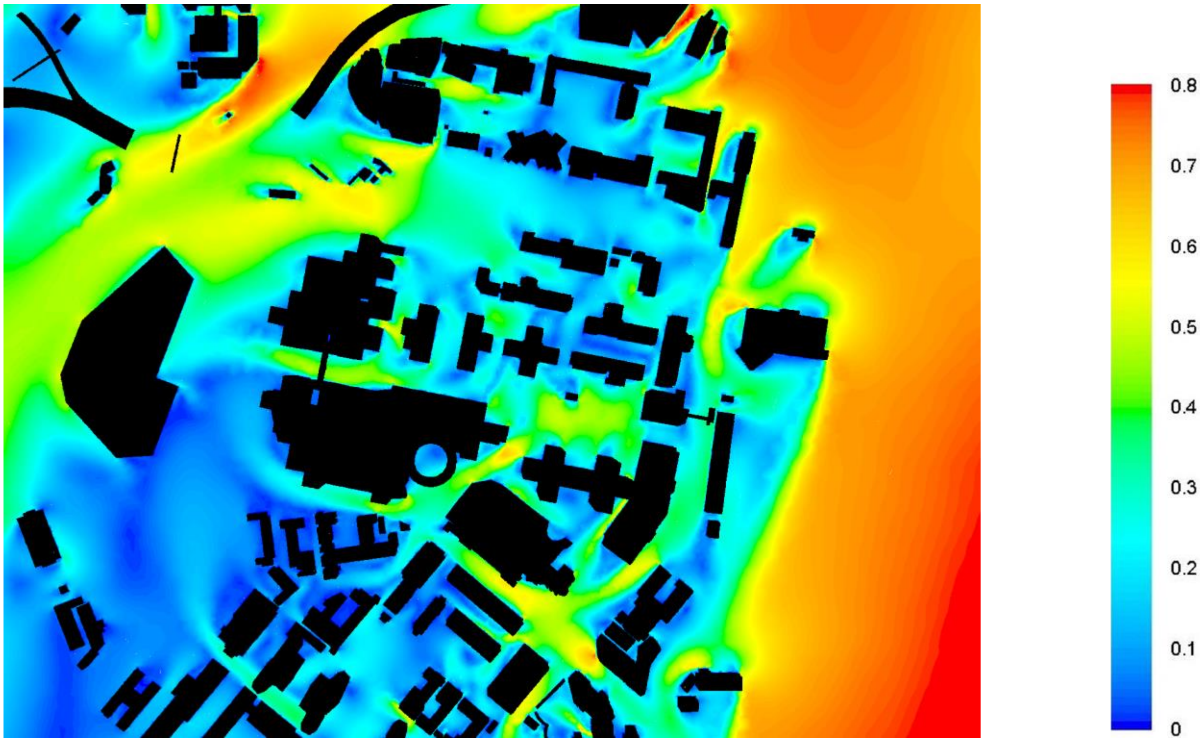


NE at 2mAG (Proposed Scheme)

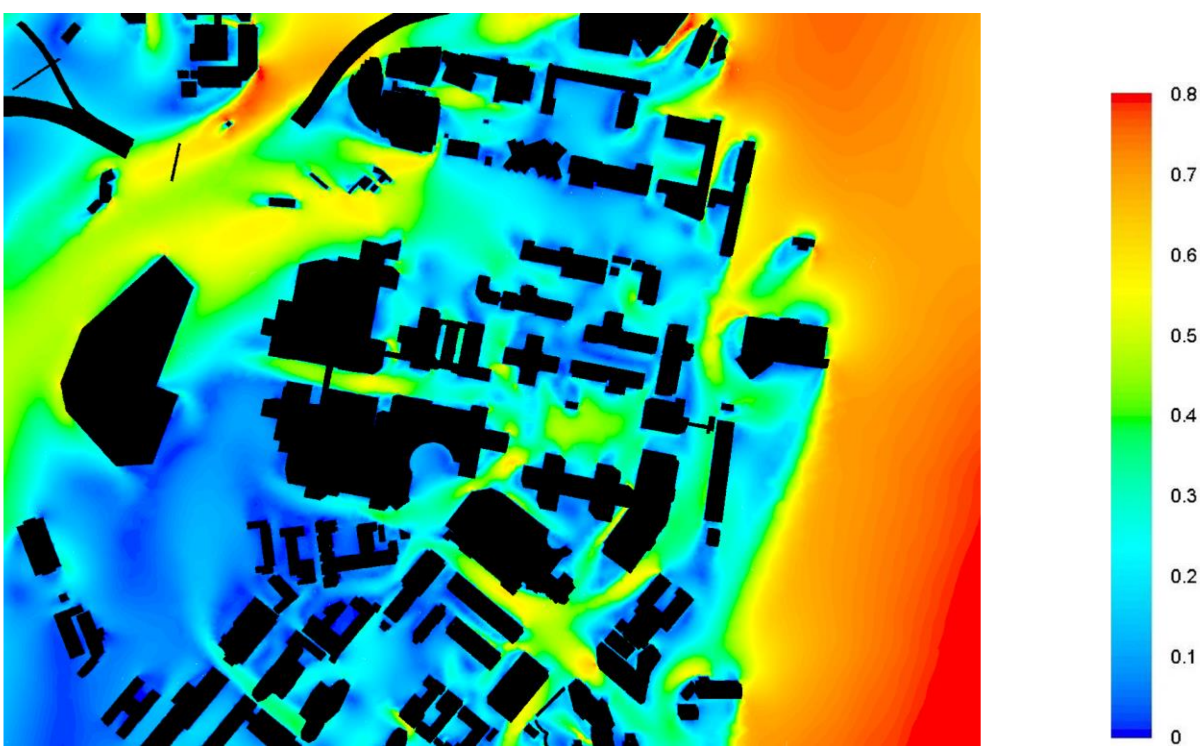


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

NNE at 2mAG (Base Scheme)

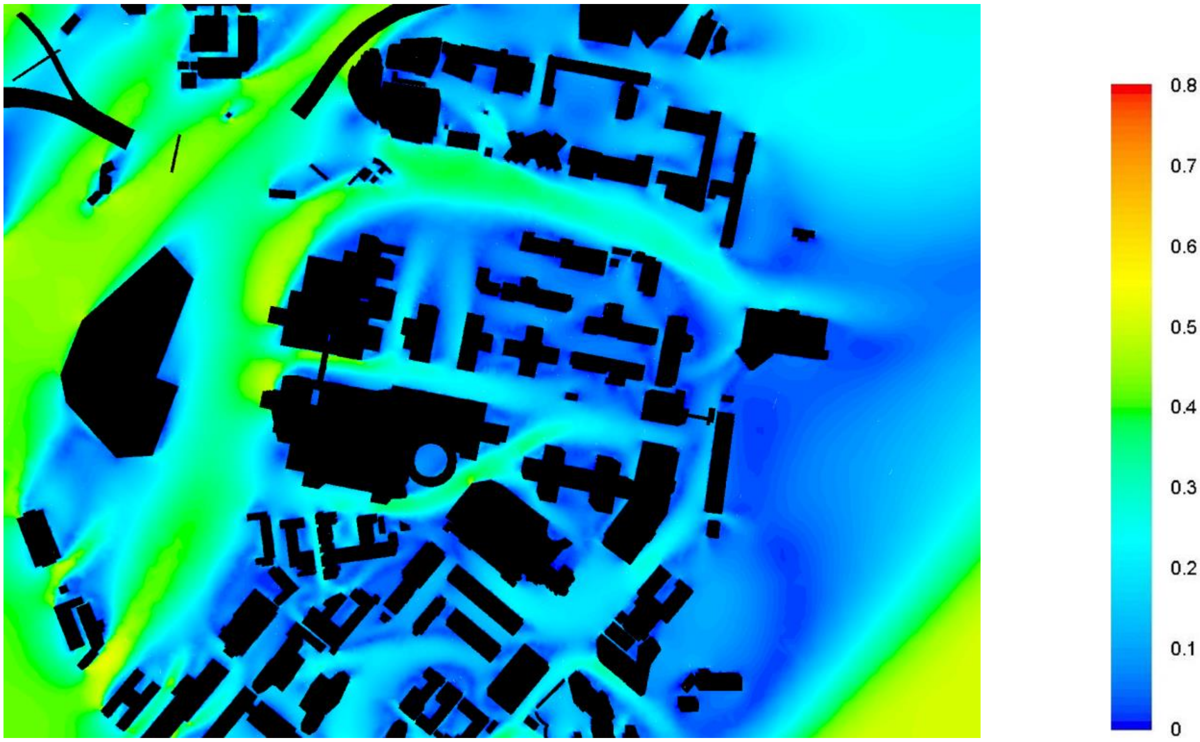


NNE at 2mAG (Proposed Scheme)

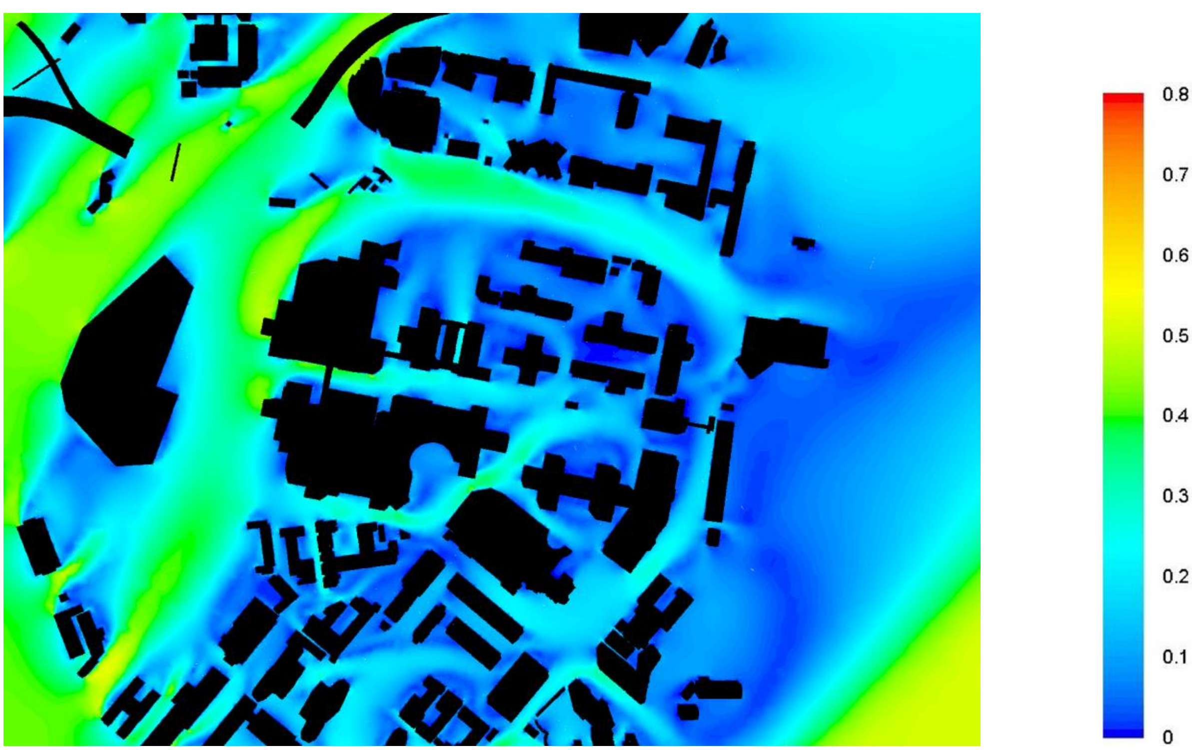


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

SSW at 2mAG (Base Scheme)

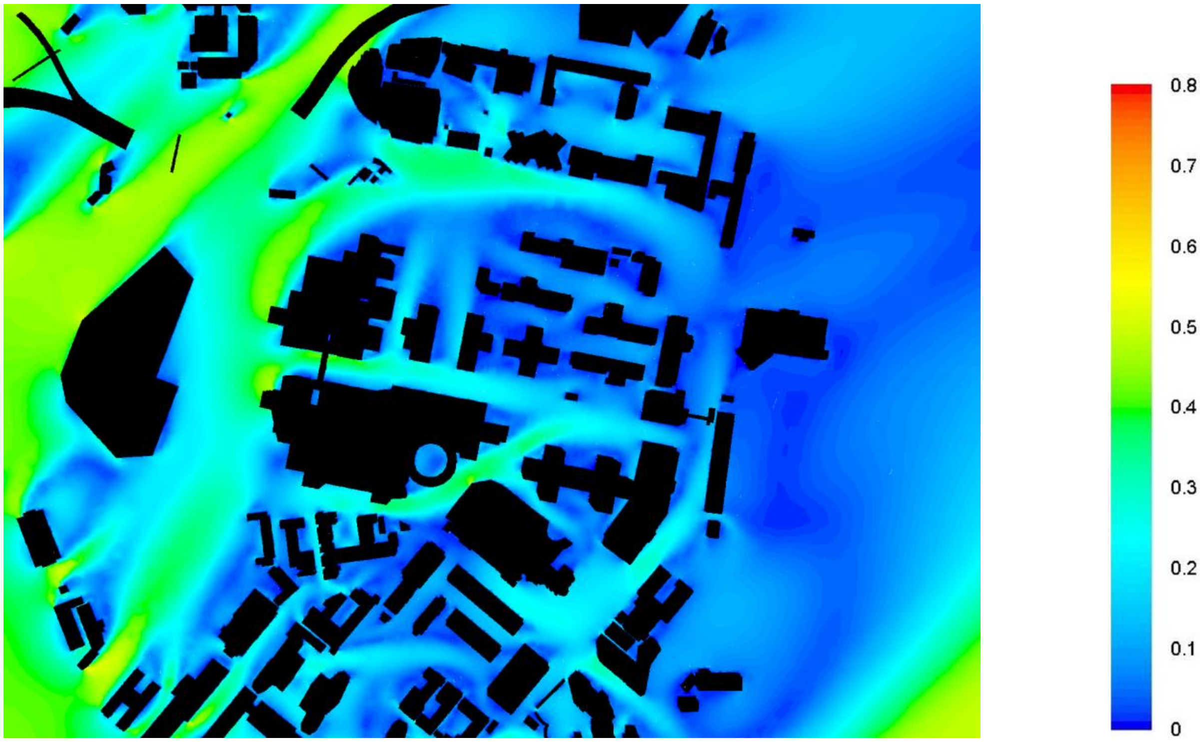


SSW at 2mAG (Proposed Scheme)

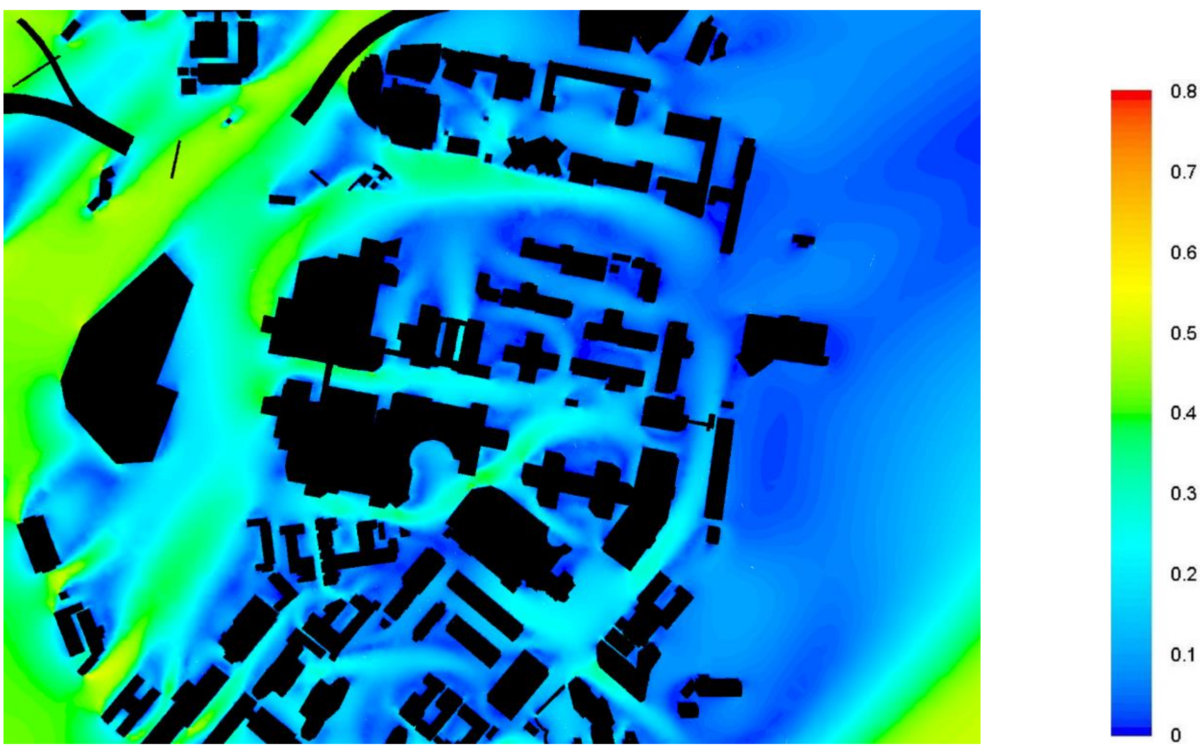


Appendix C – Wind Velocity Ratio Contour Plots for Annual Wind

SW at 2mAG (Base Scheme)

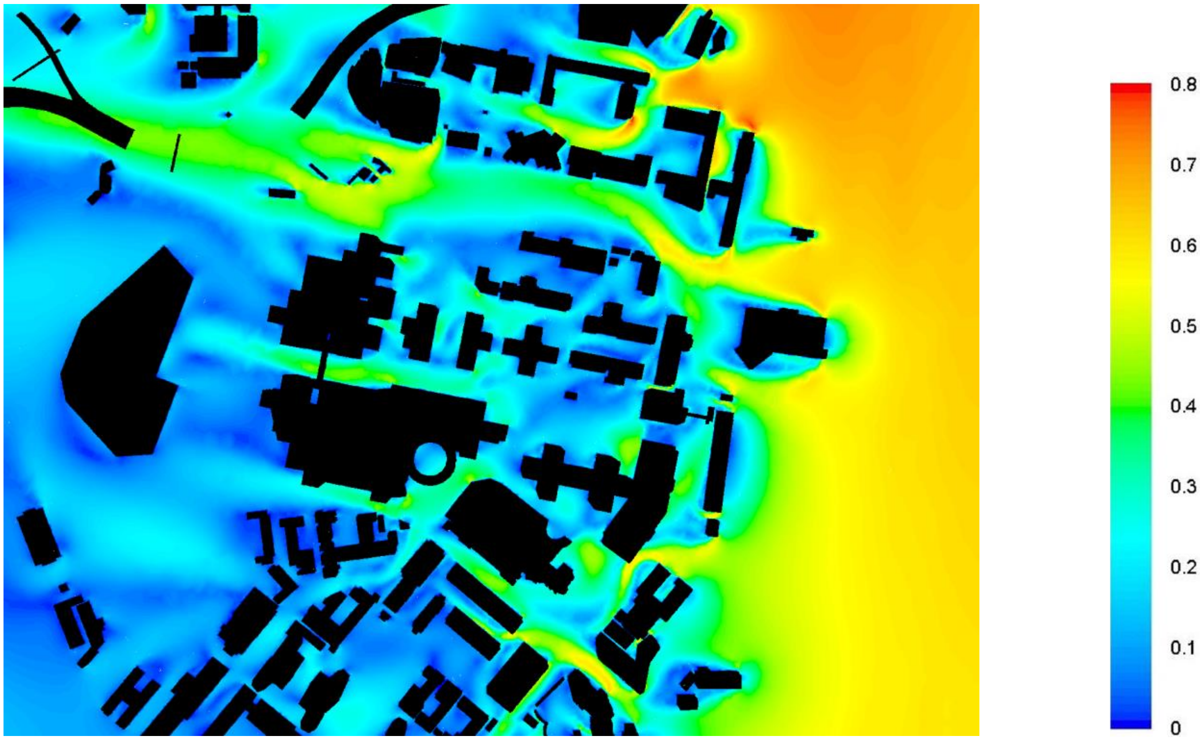


SW at 2mAG (Proposed Scheme)

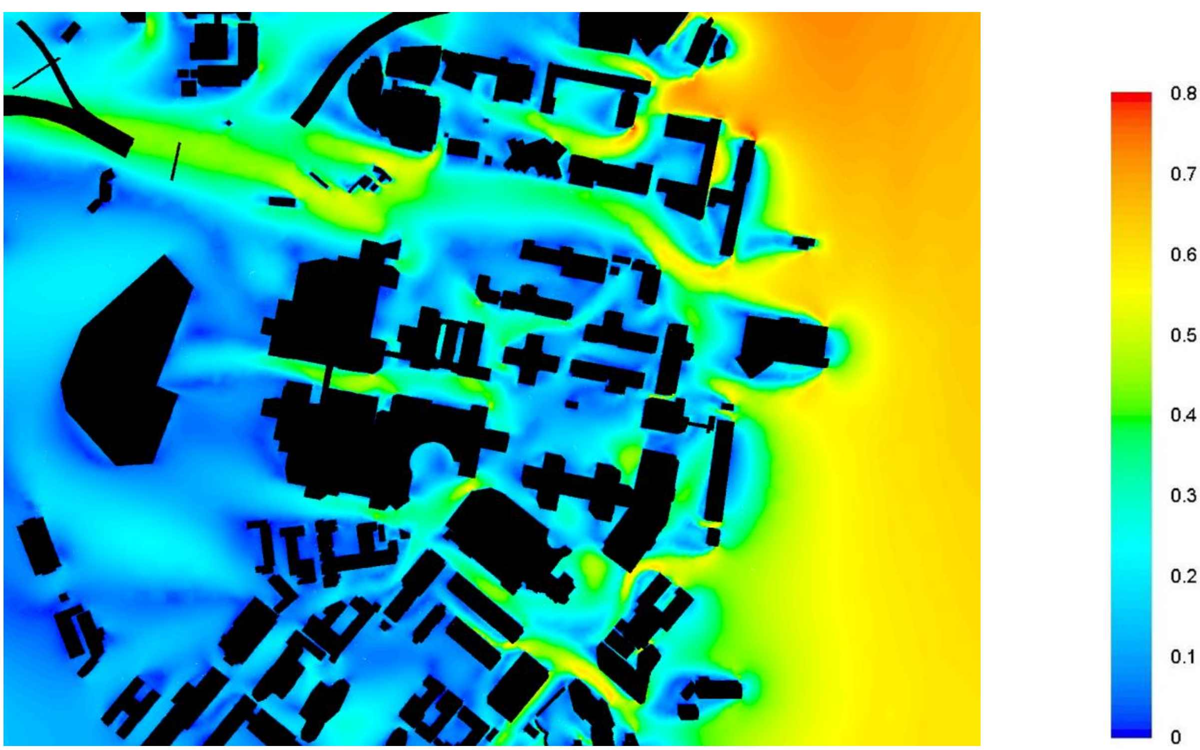


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

E at 2mAG (Base Scheme)

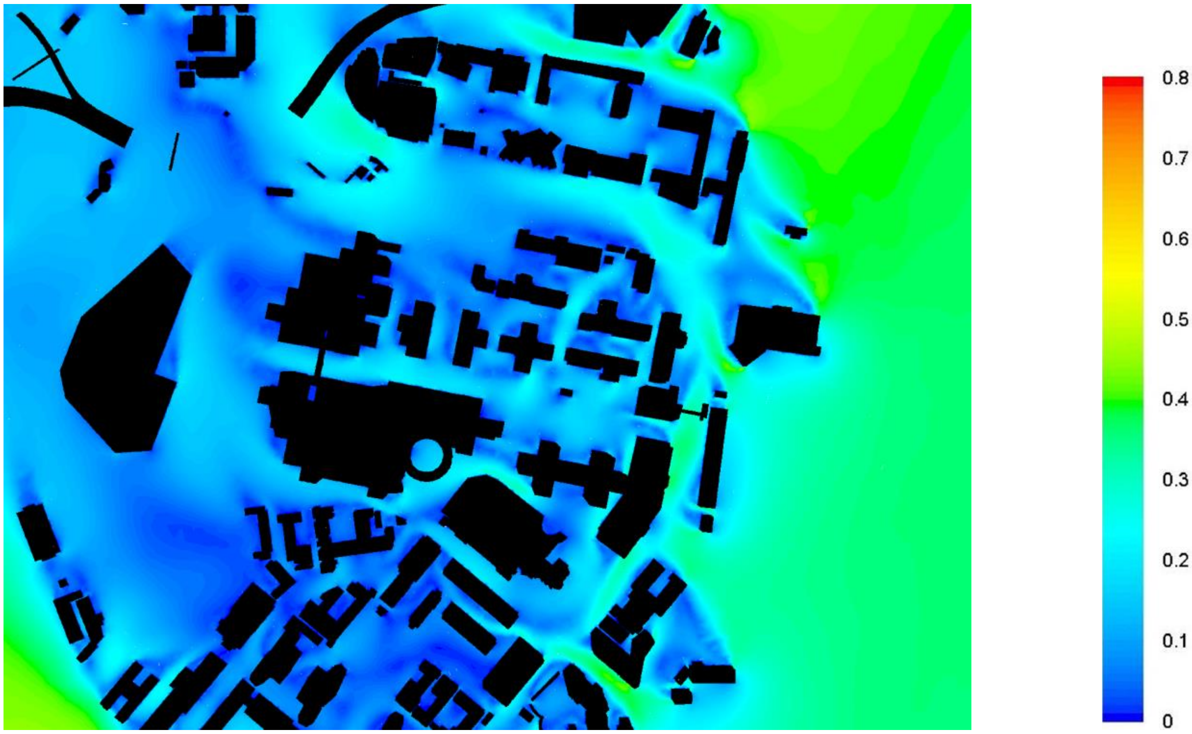


E at 2mAG (Proposed Scheme)

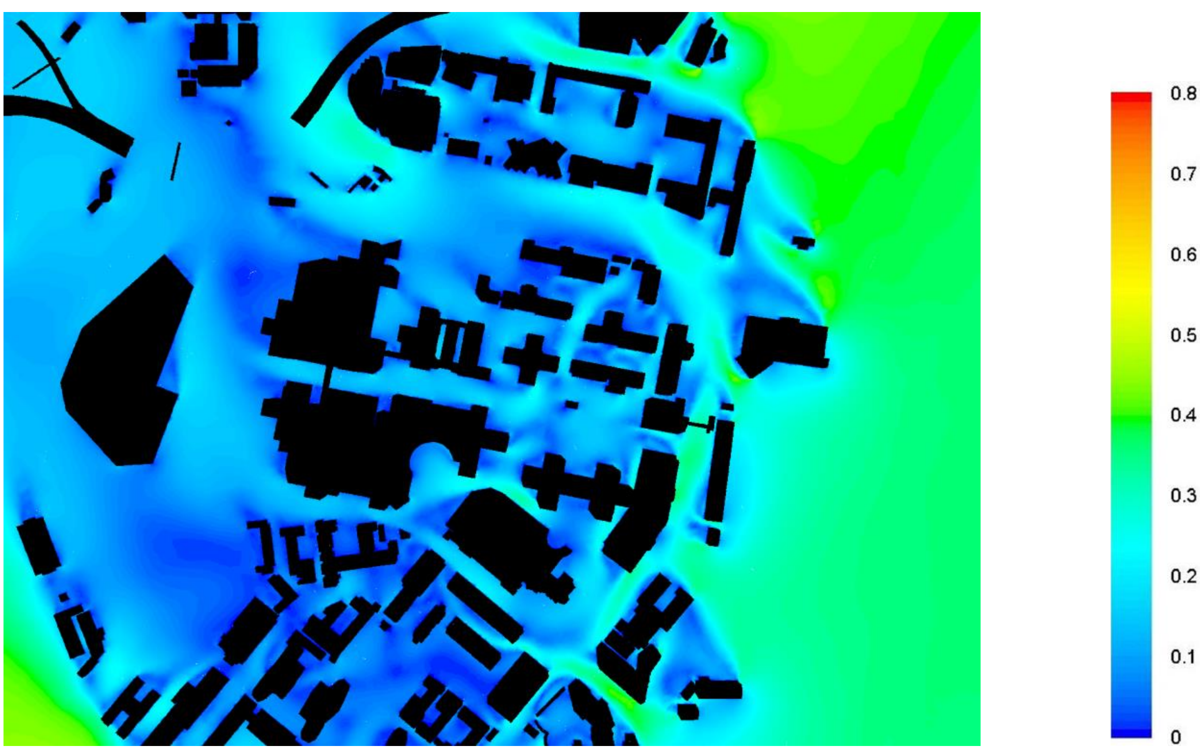


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

ESE at 2mAG (Base Scheme)

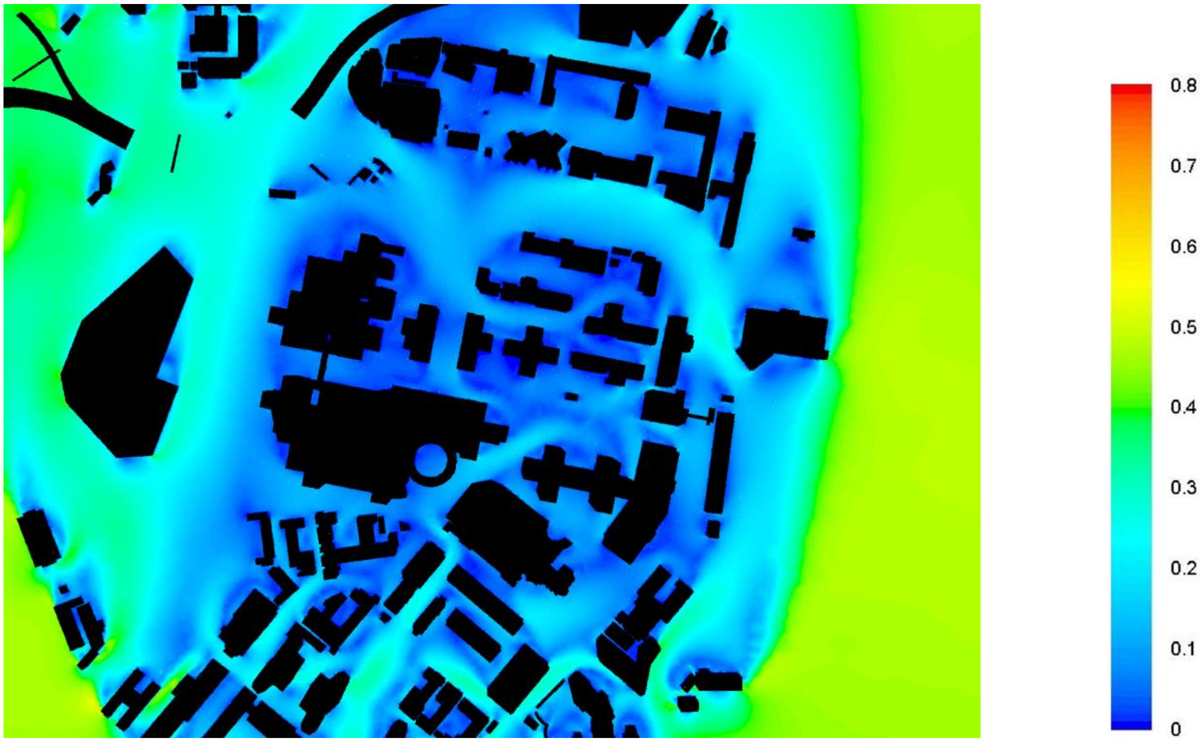


ESE at 2mAG (Proposed Scheme)

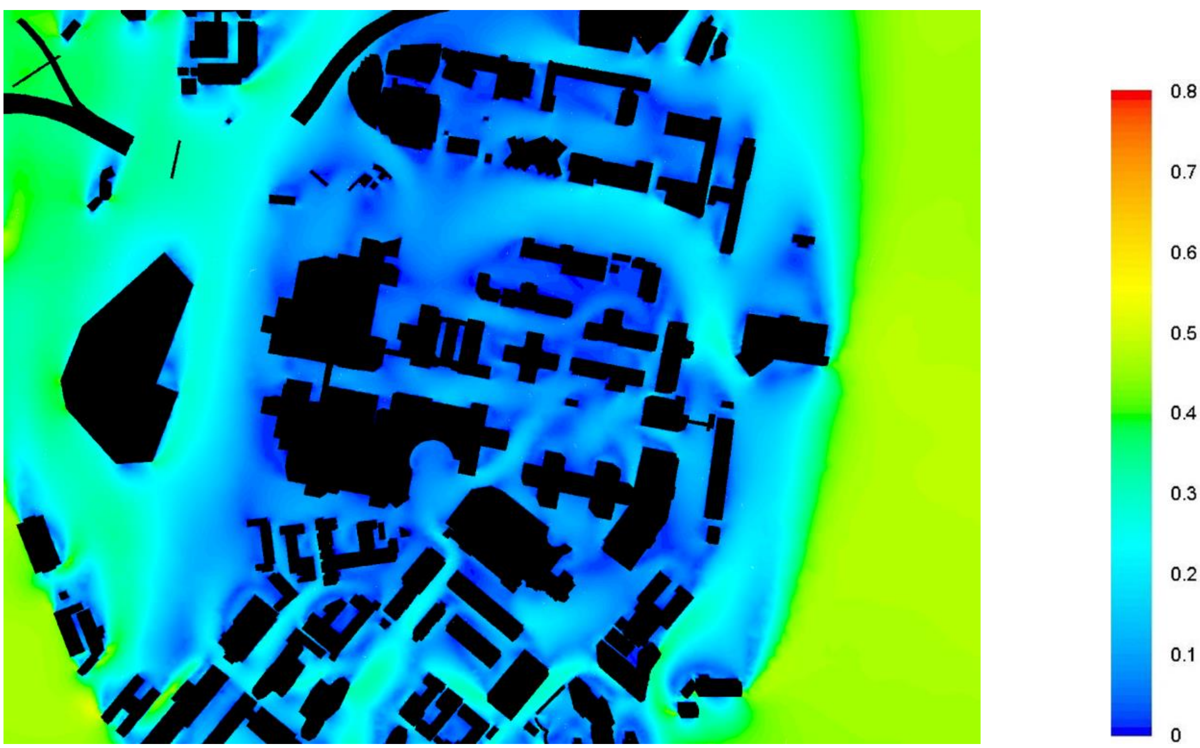


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

S at 2mAG (Base Scheme)

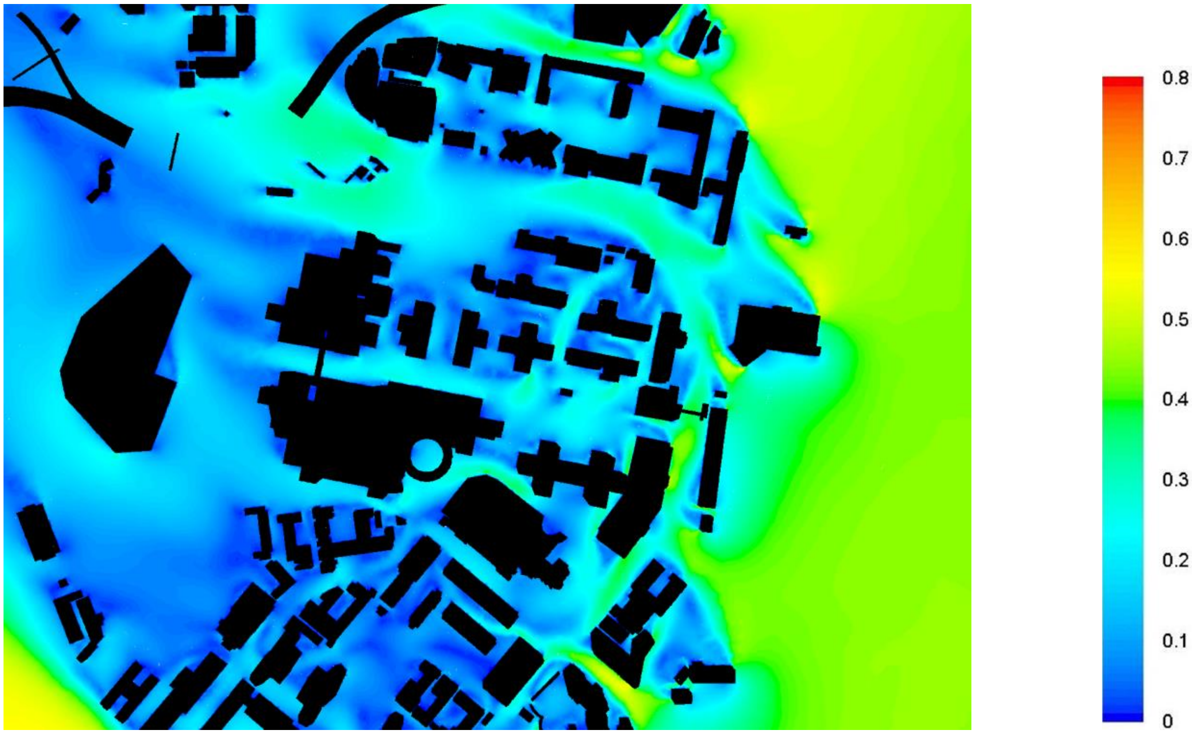


S at 2mAG (Proposed Scheme)

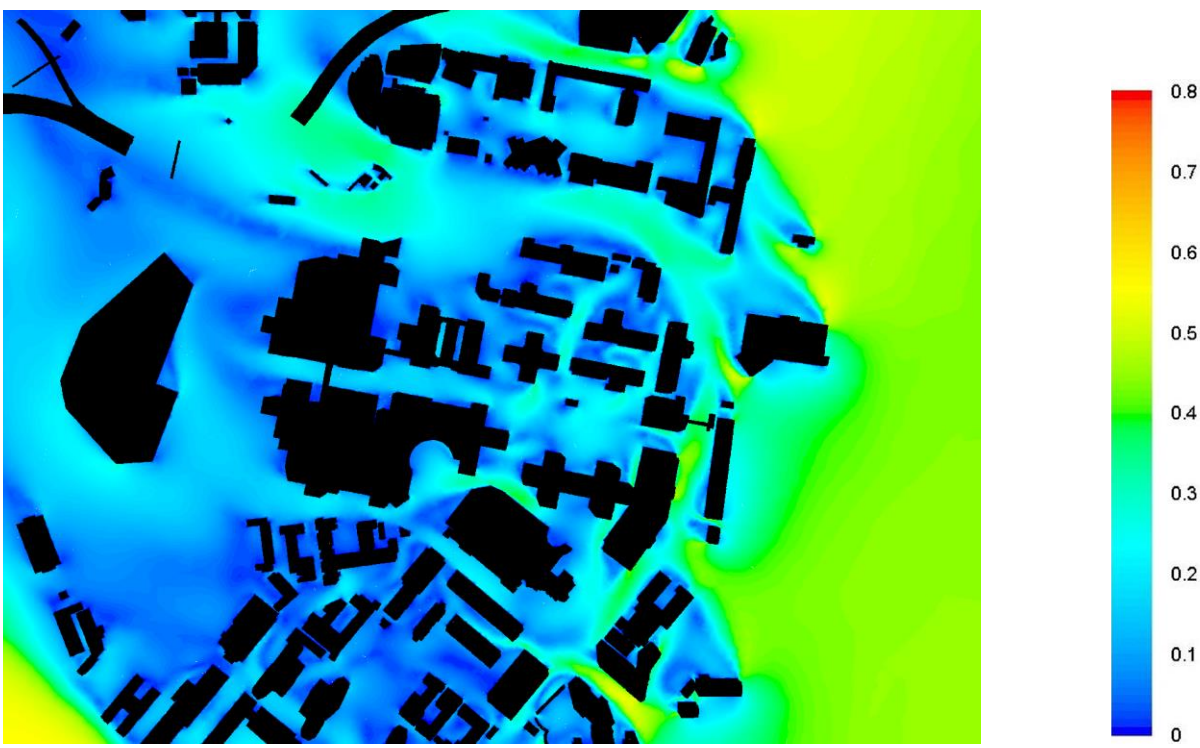


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

SE at 2mAG (Base Scheme)

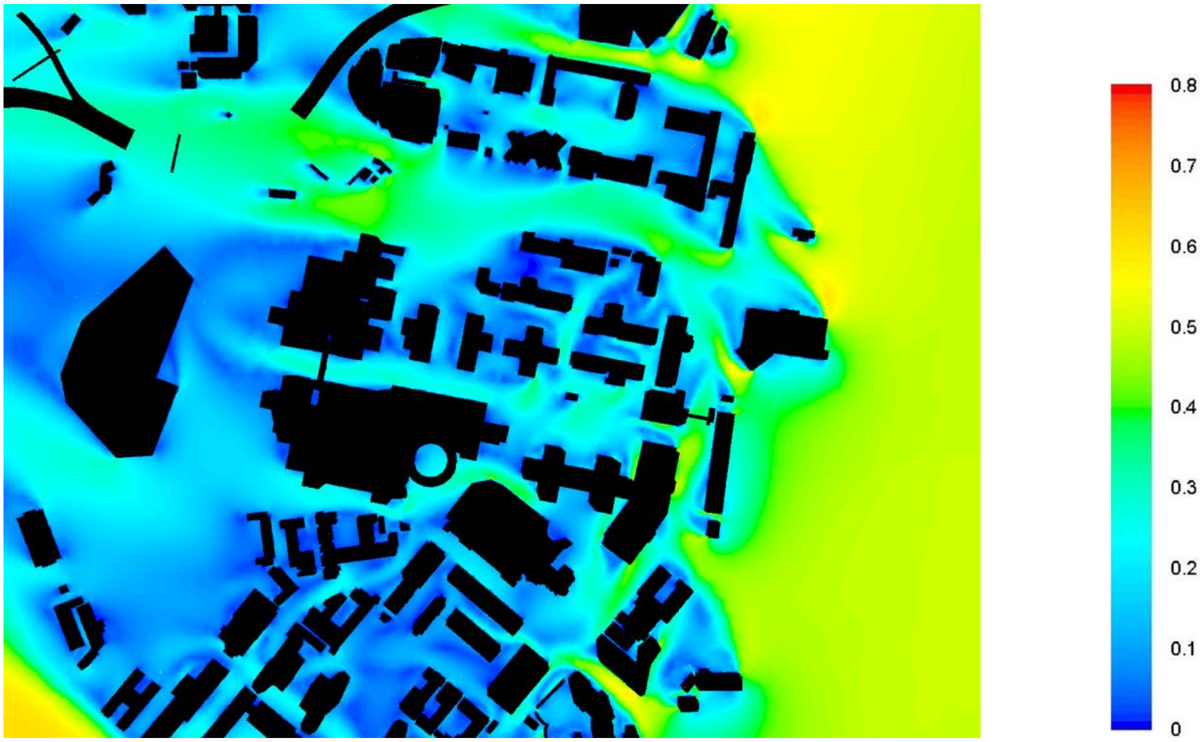


SE at 2mAG (Proposed Scheme)

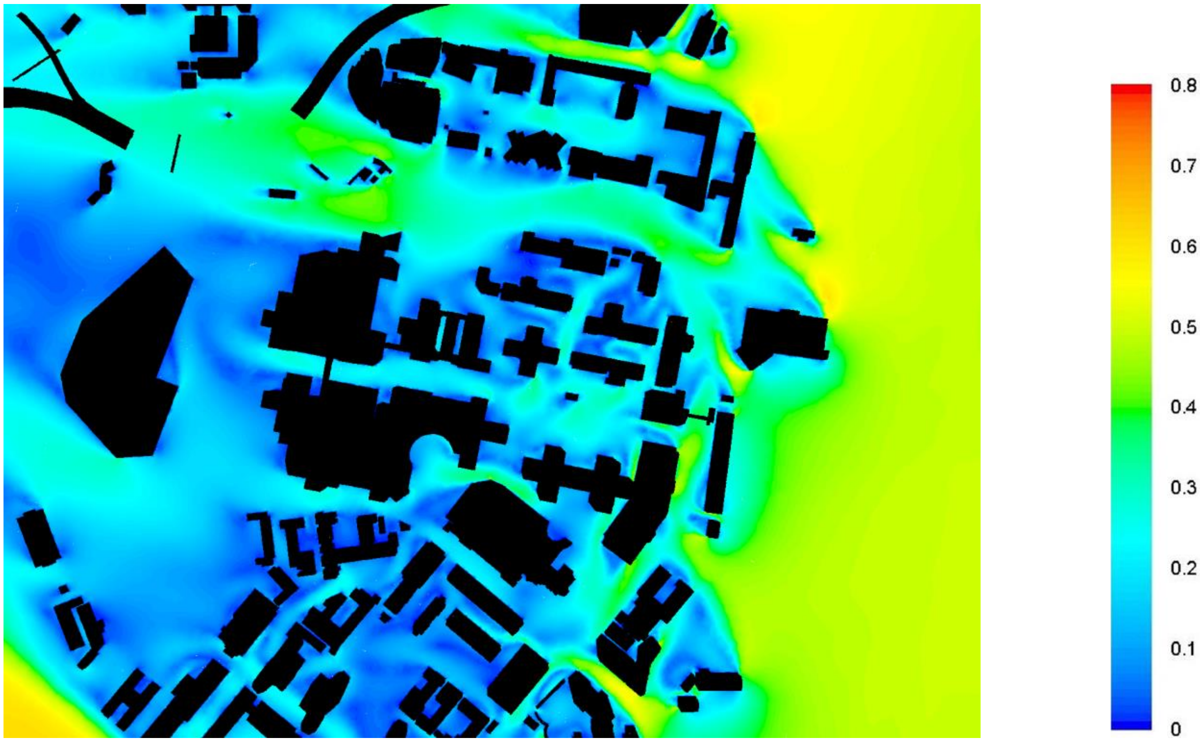


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

SSE at 2mAG (Base Scheme)

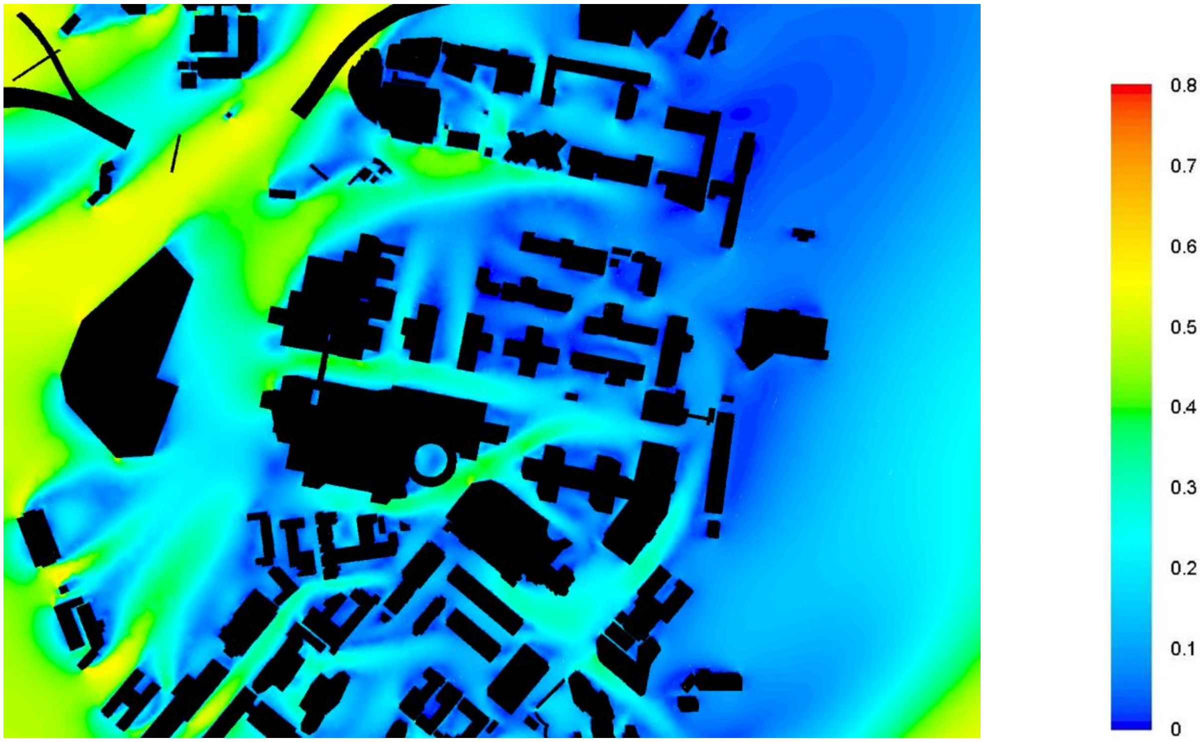


SSE at 2mAG (Proposed Scheme)

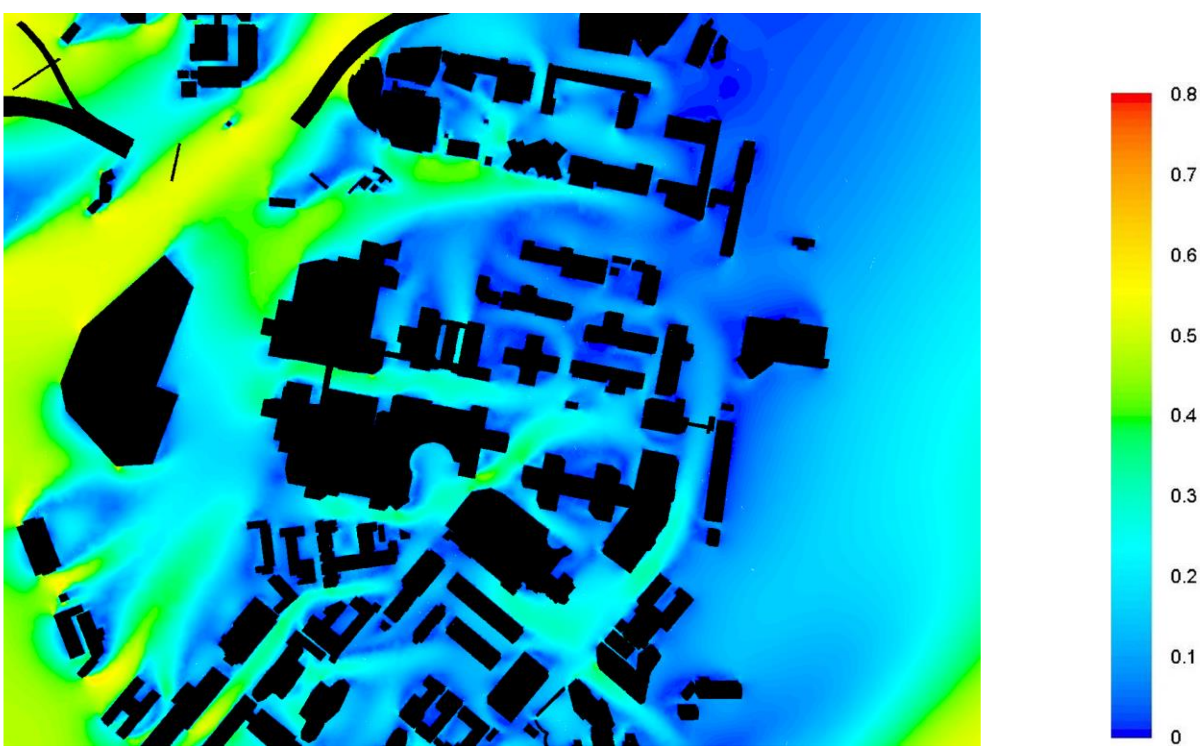


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

WSW at 2mAG (Base Scheme)

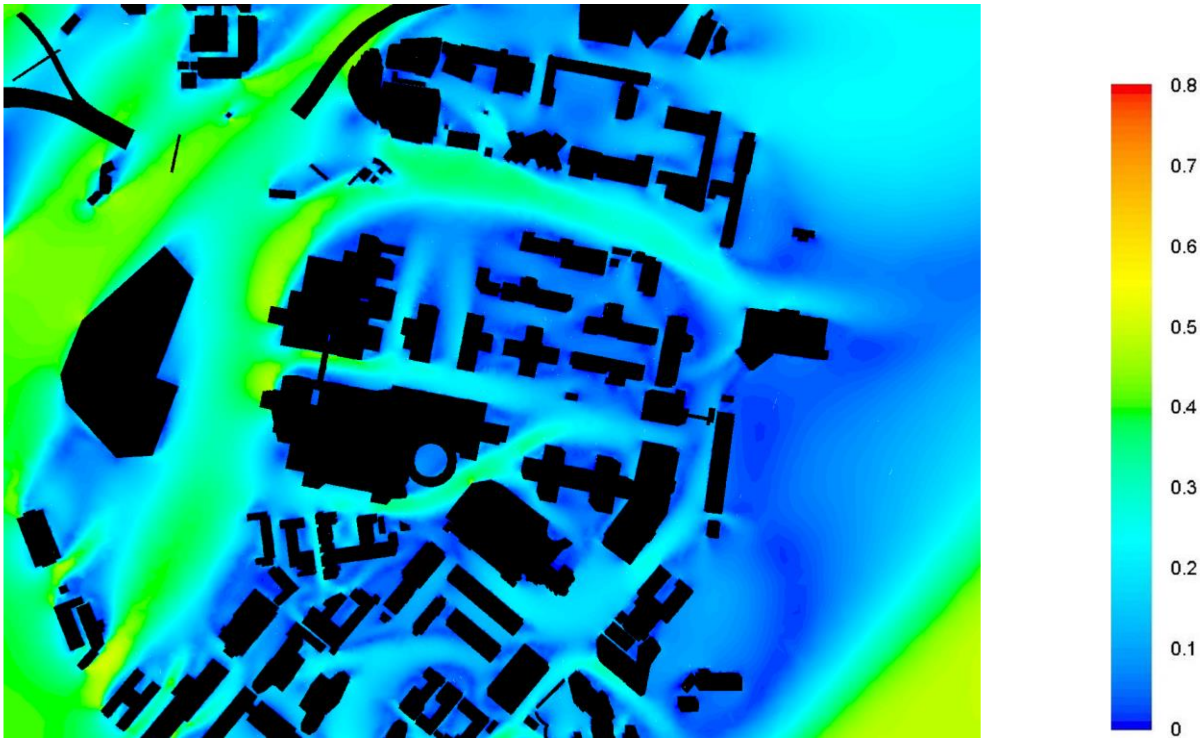


WSW at 2mAG (Proposed Scheme)

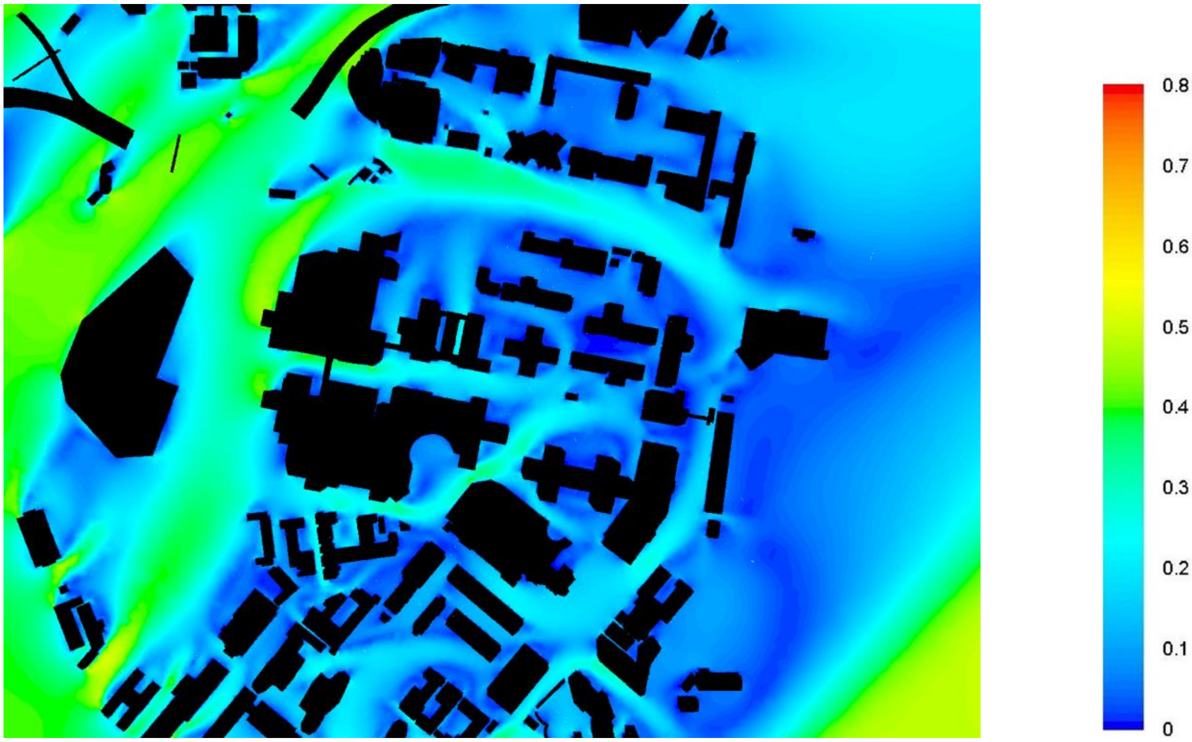


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

SSW at 2mAG (Base Scheme)

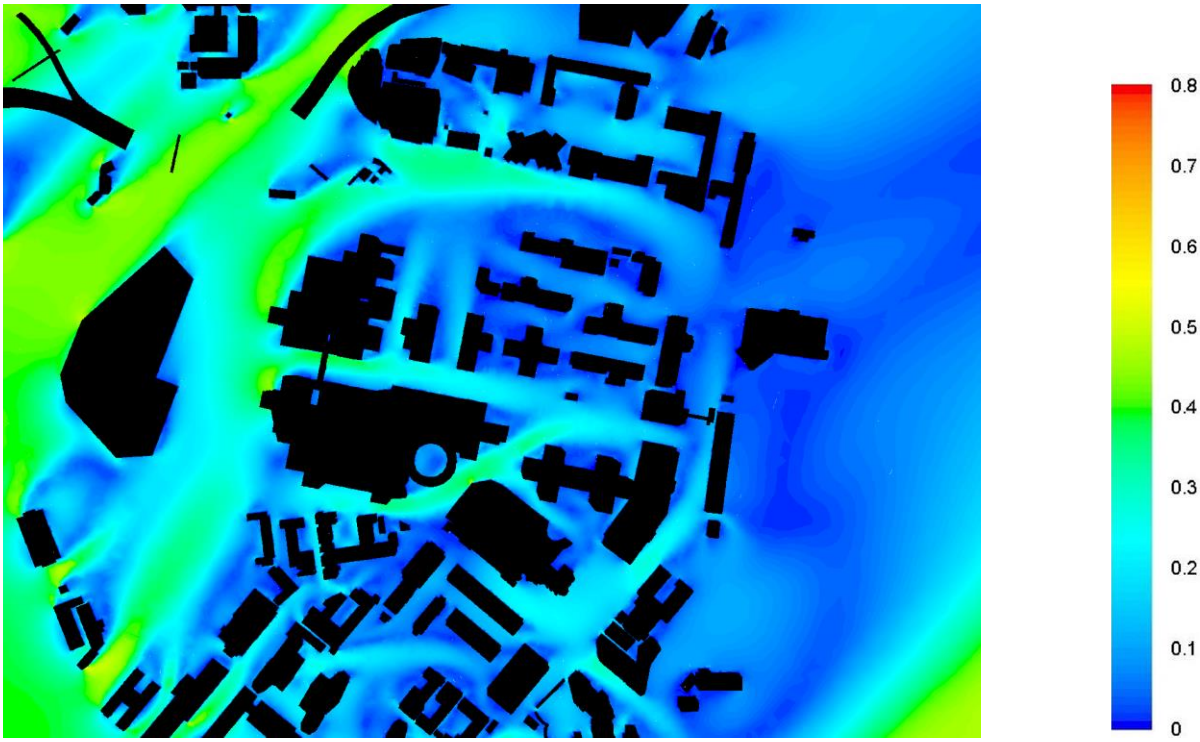


SSW at 2mAG (Proposed Scheme)

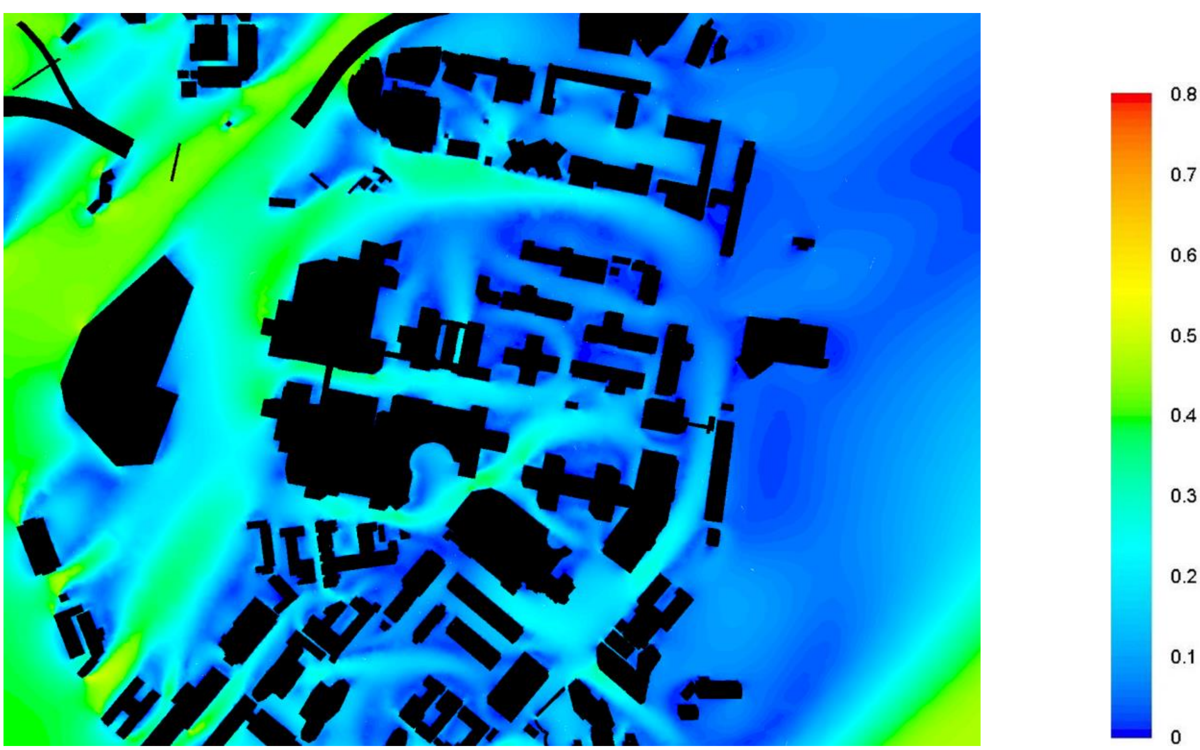


Appendix C – Wind Velocity Ratio Contour Plots for Summer Wind

SW at 2mAG (Base Scheme)

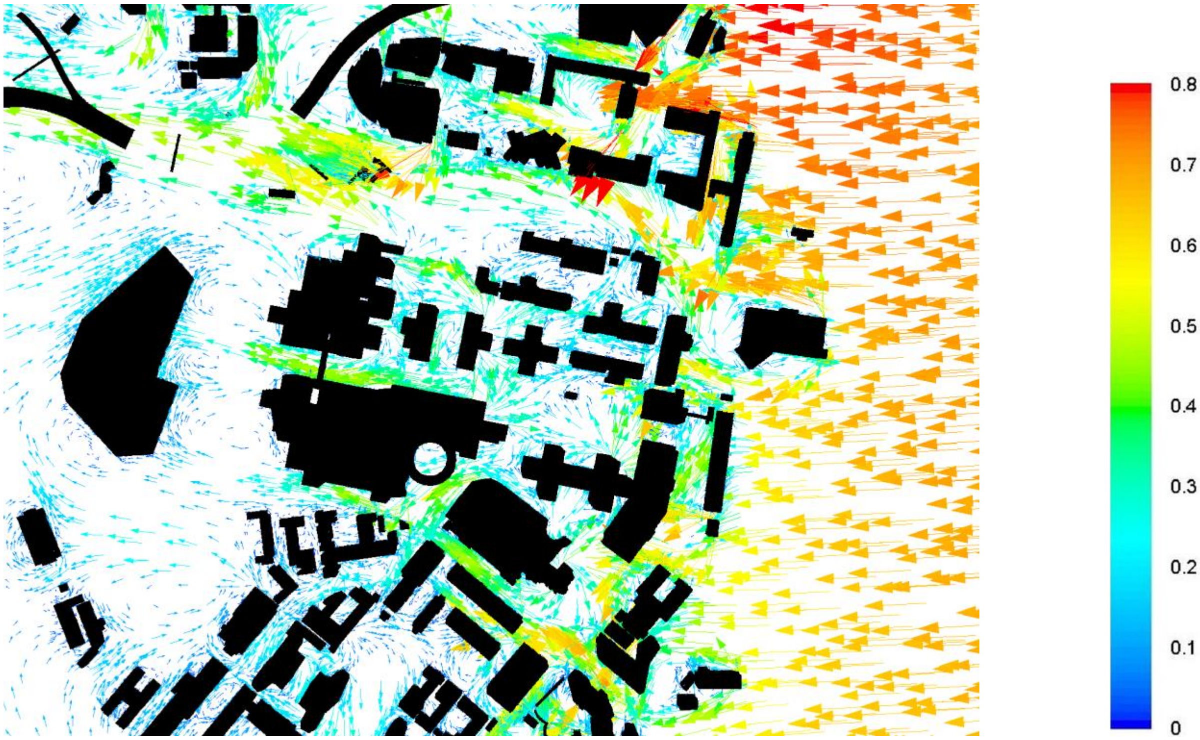


SW at 2mAG (Proposed Scheme)

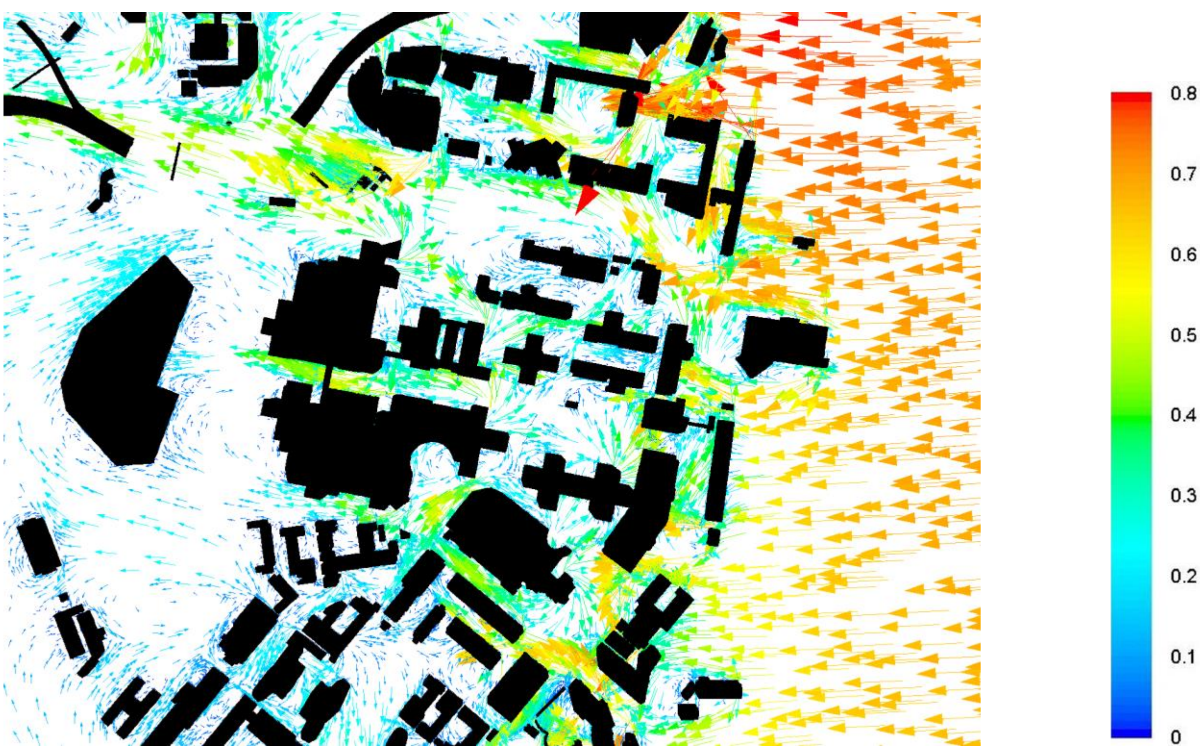


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

E at 2mAG (Base Scheme)

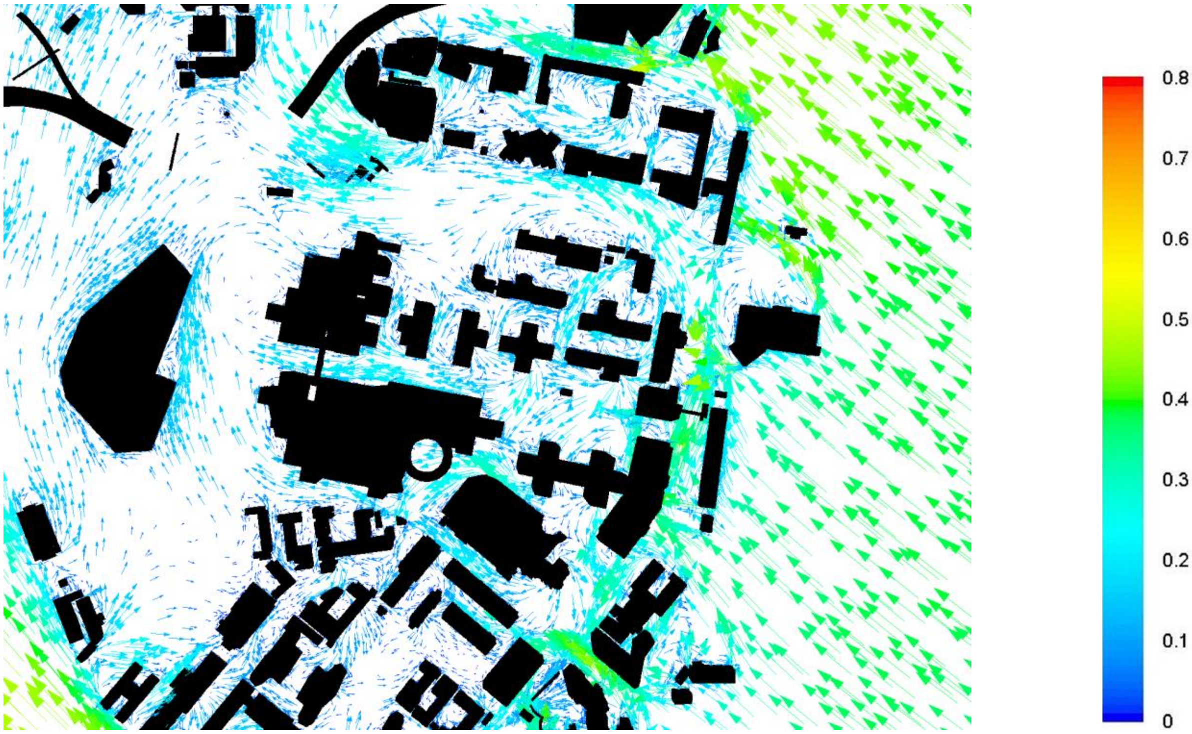


E at 2mAG (Proposed Scheme)

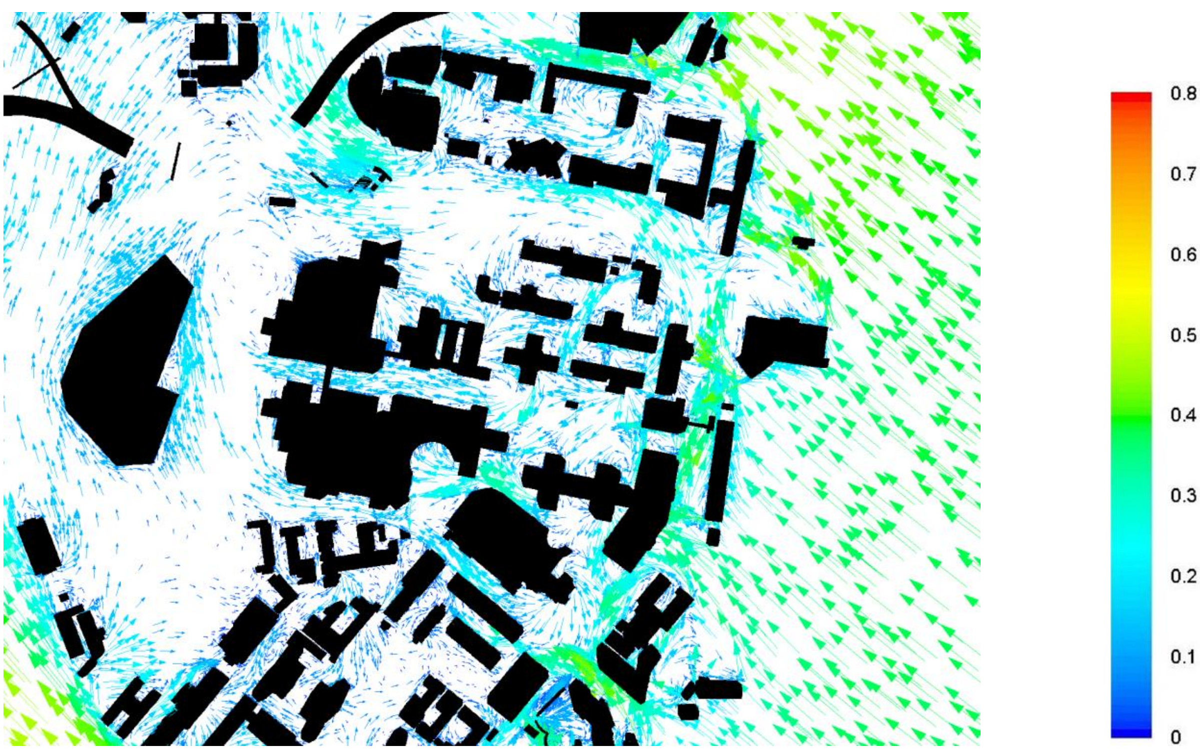


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

ESE at 2mAG (Base Scheme)

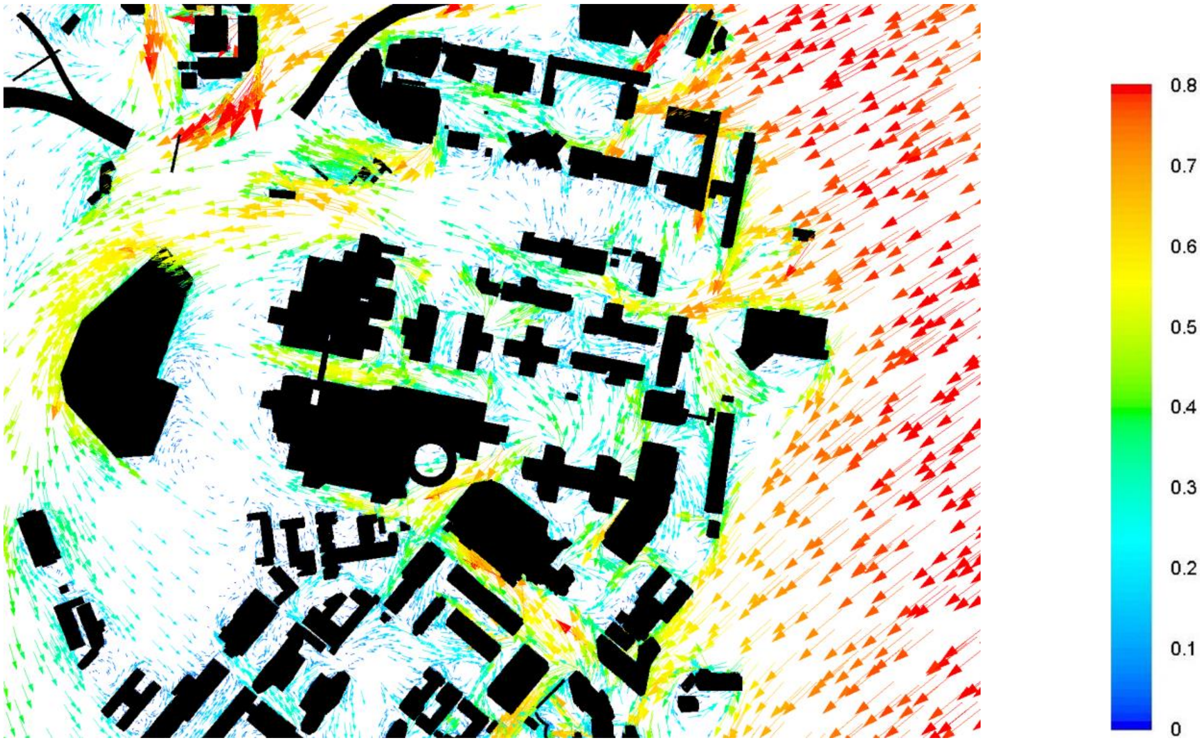


ESE at 2mAG (Proposed Scheme)

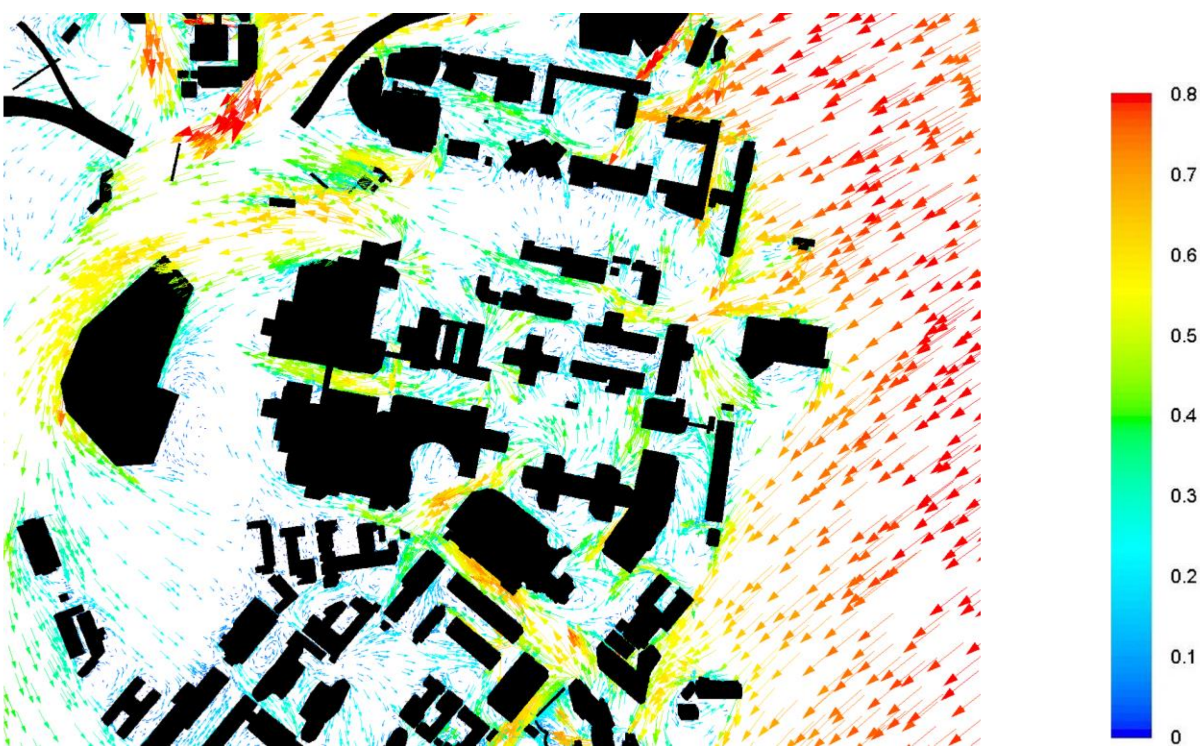


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

ENE at 2mAG (Base Scheme)

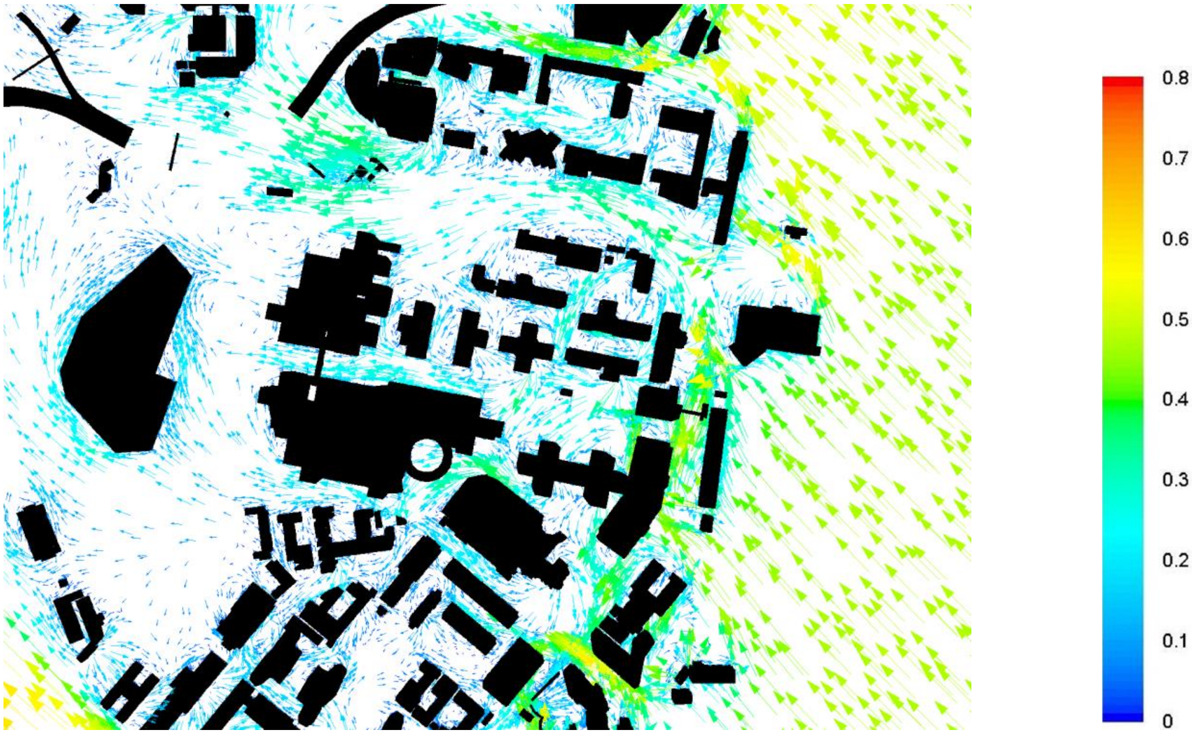


ENE at 2mAG (Proposed Scheme)

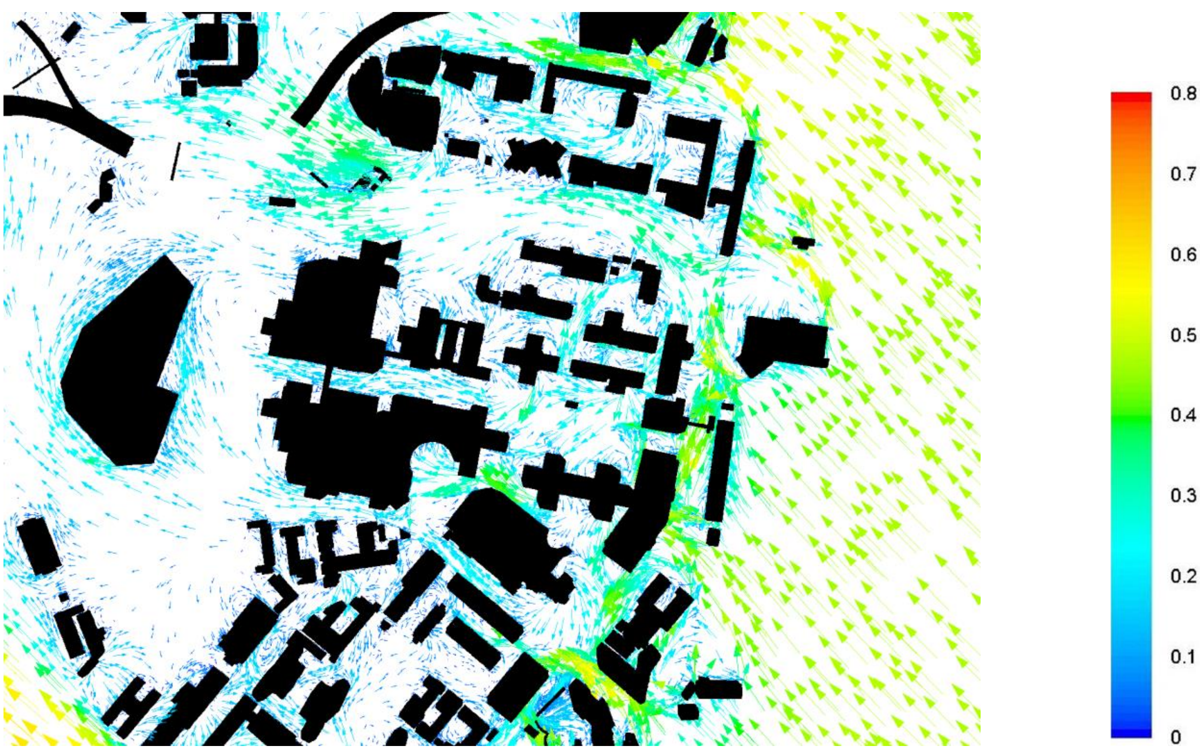


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

SE at 2mAG (Base Scheme)

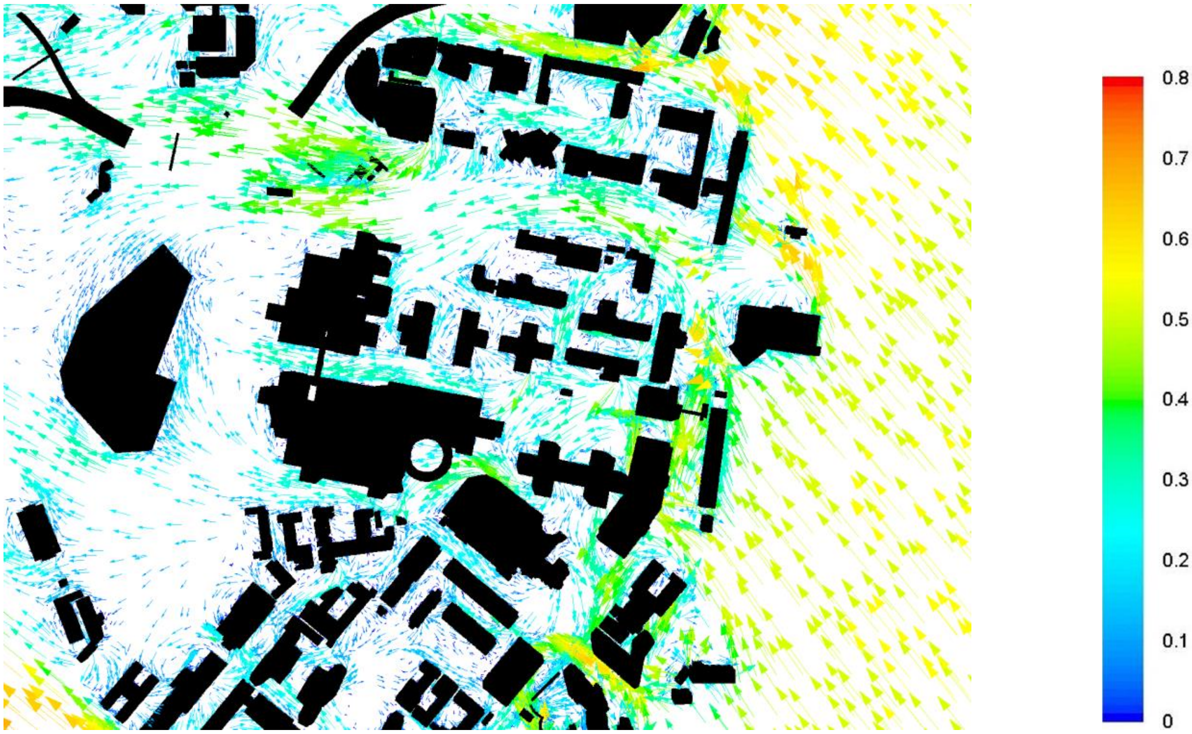


SE at 2mAG (Proposed Scheme)

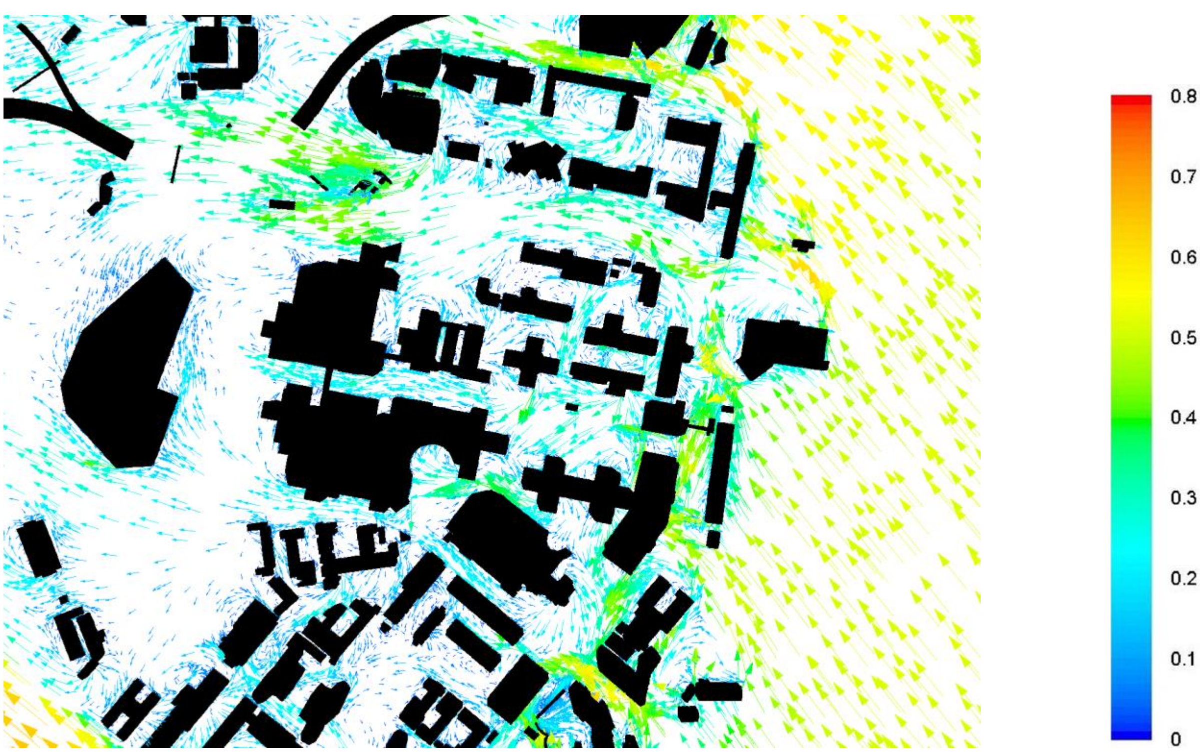


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

SSE at 2mAG (Base Scheme)

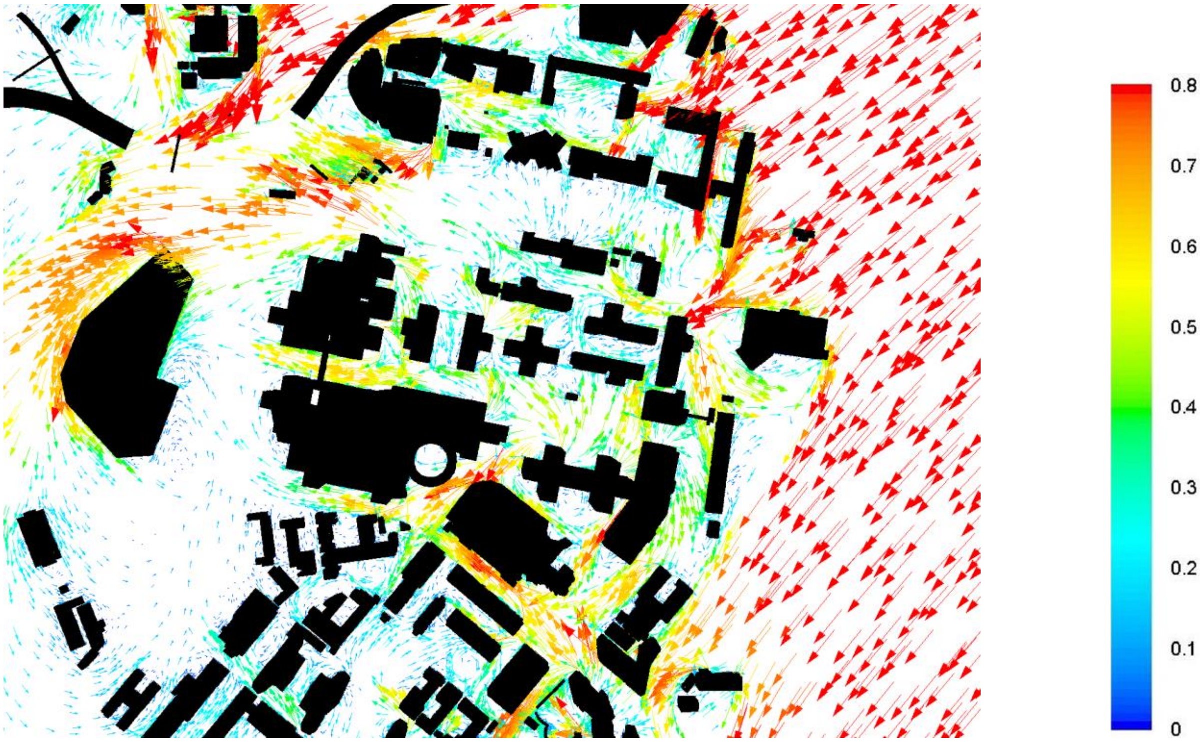


SSE at 2mAG (Proposed Scheme)

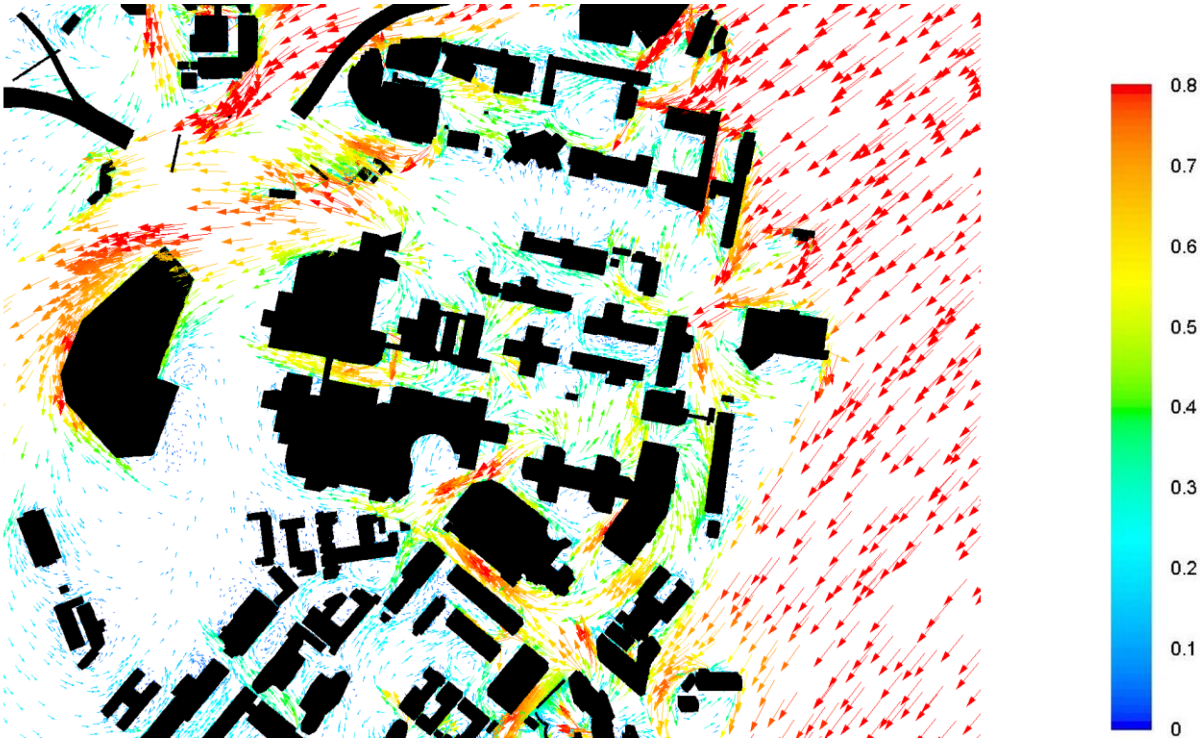


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

NE at 2mAG (Base Scheme)

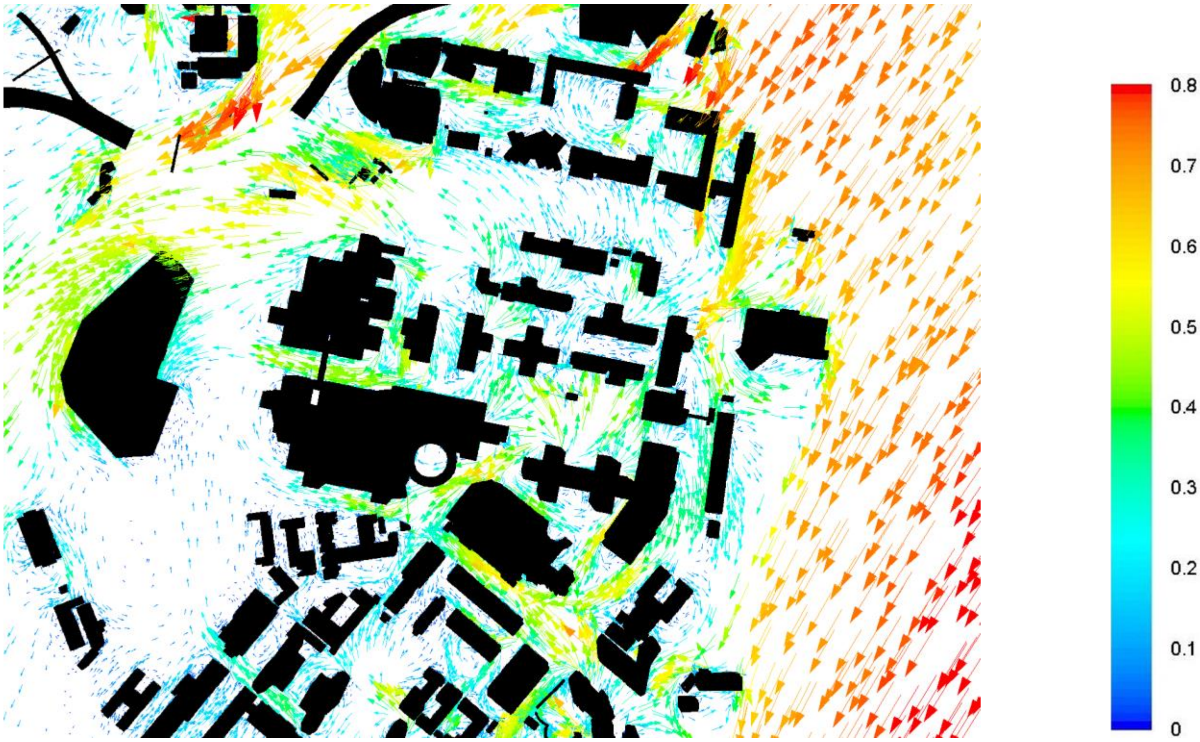


NE at 2mAG (Proposed Scheme)

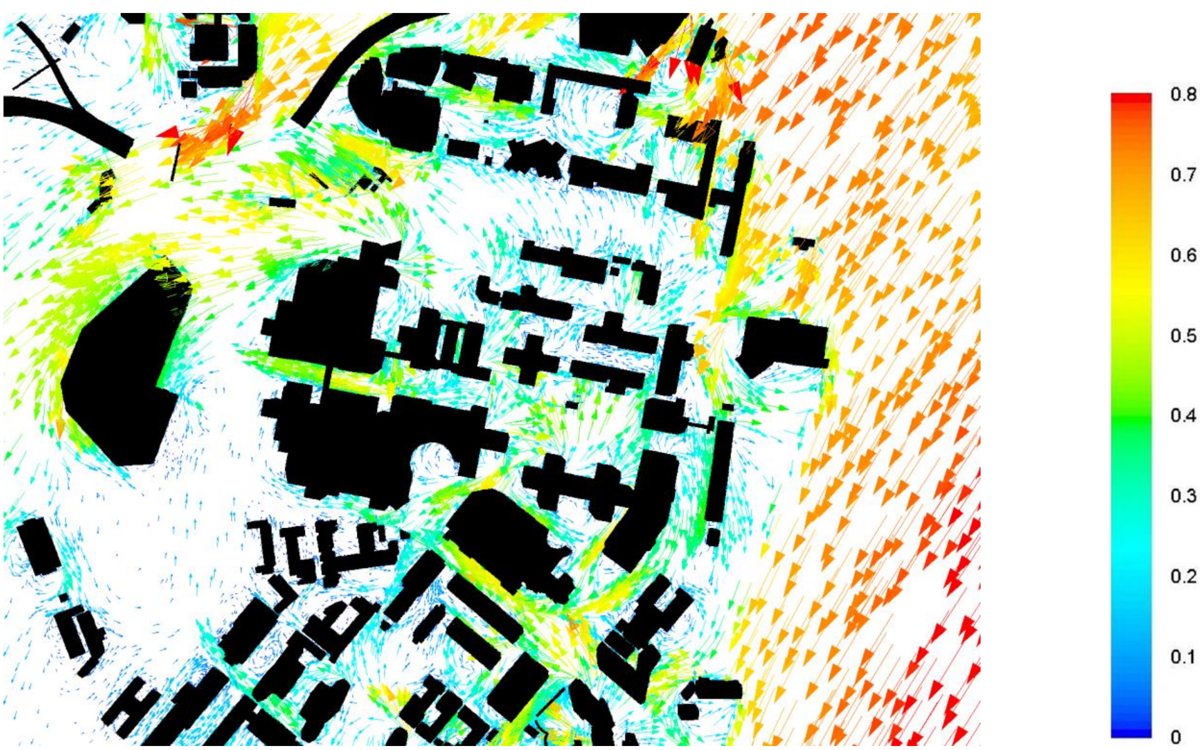


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

NNE at 2mAG (Base Scheme)

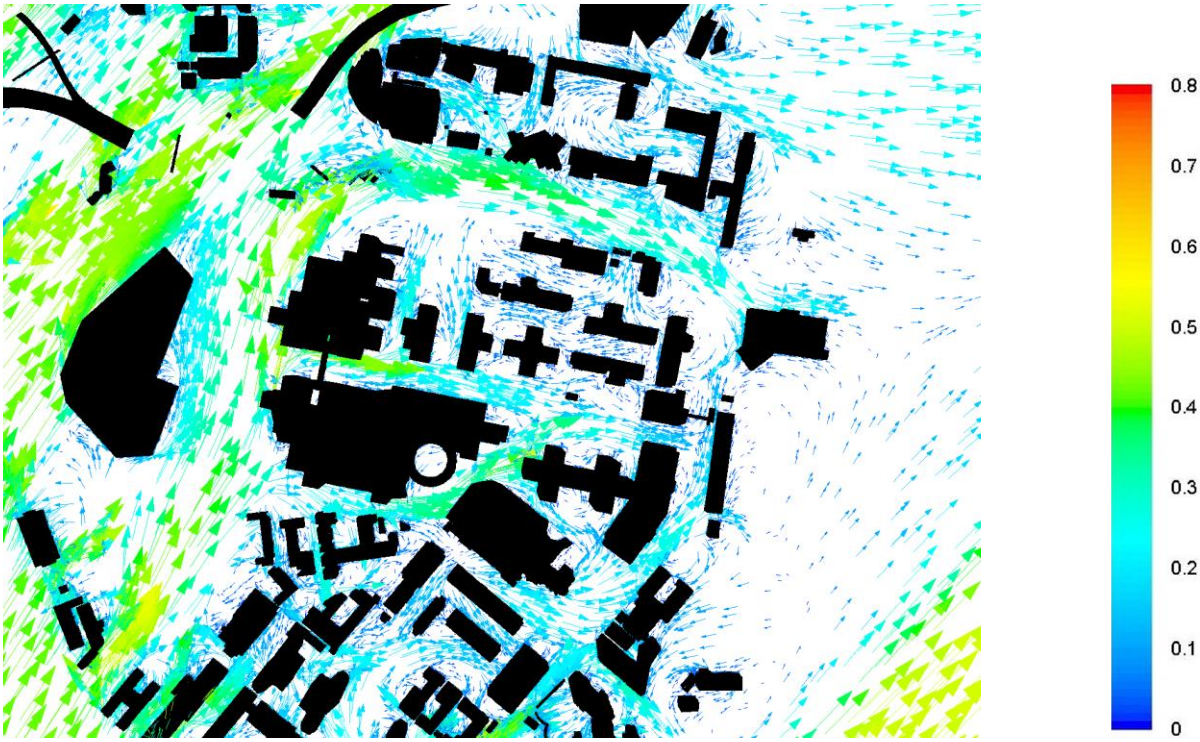


NNE at 2mAG (Proposed Scheme)

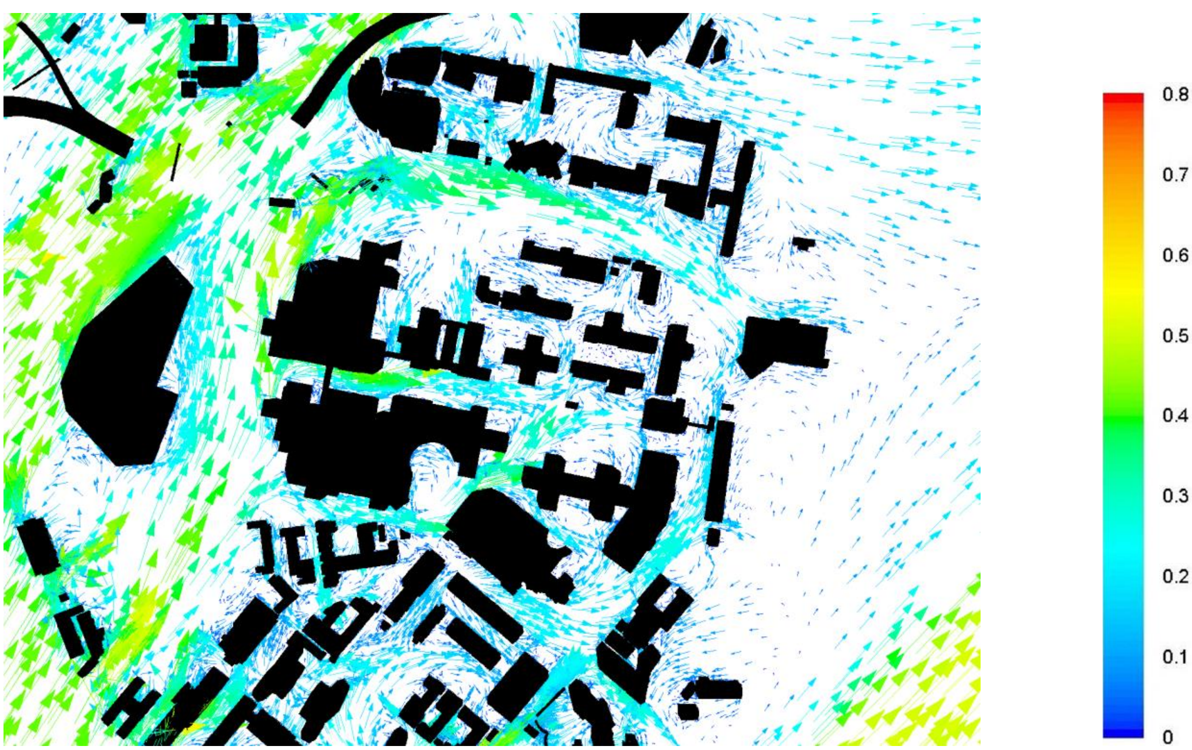


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

SSW at 2mAG (Base Scheme)

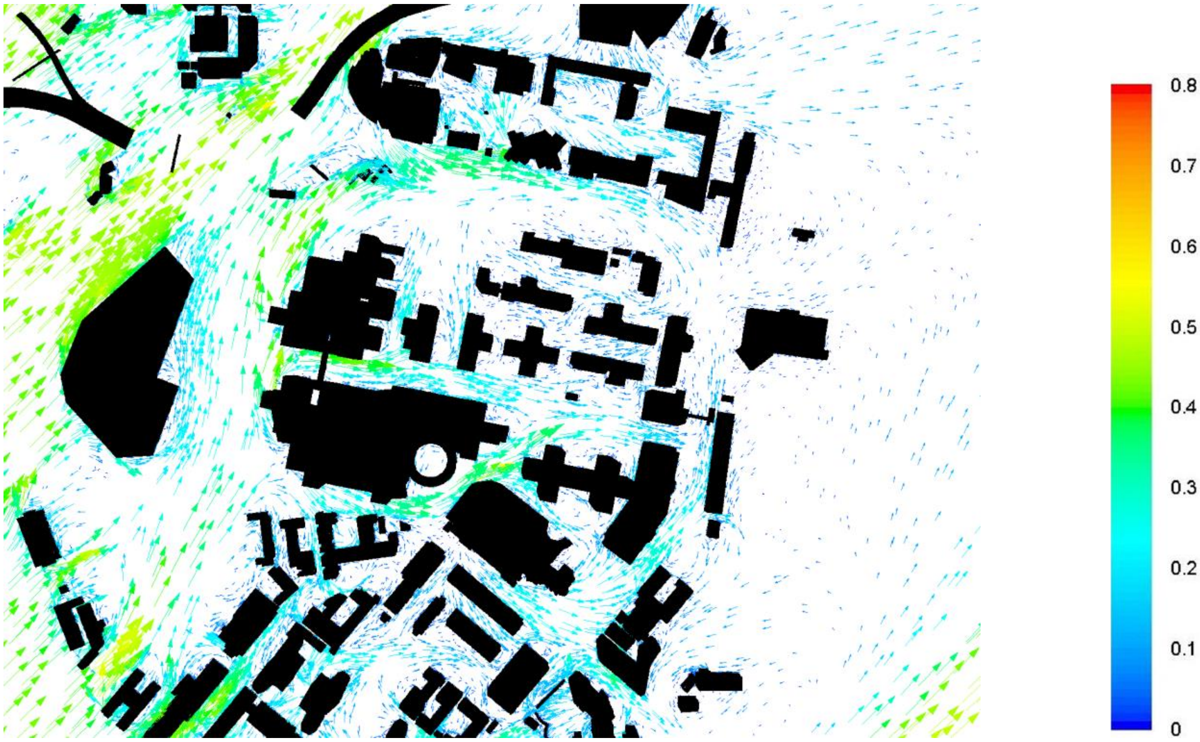


SSW at 2mAG (Proposed Scheme)

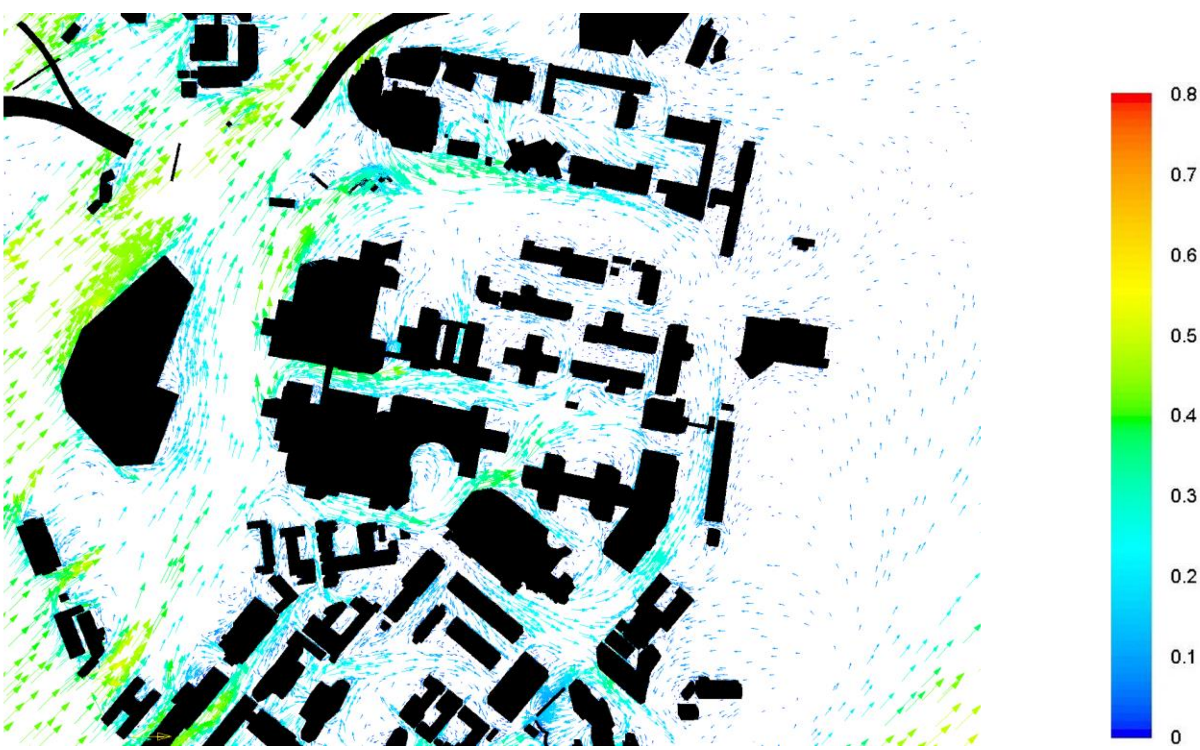


Appendix D – Wind Velocity Ratio Vector Plots for Annual Wind

SW at 2mAG (Base Scheme)

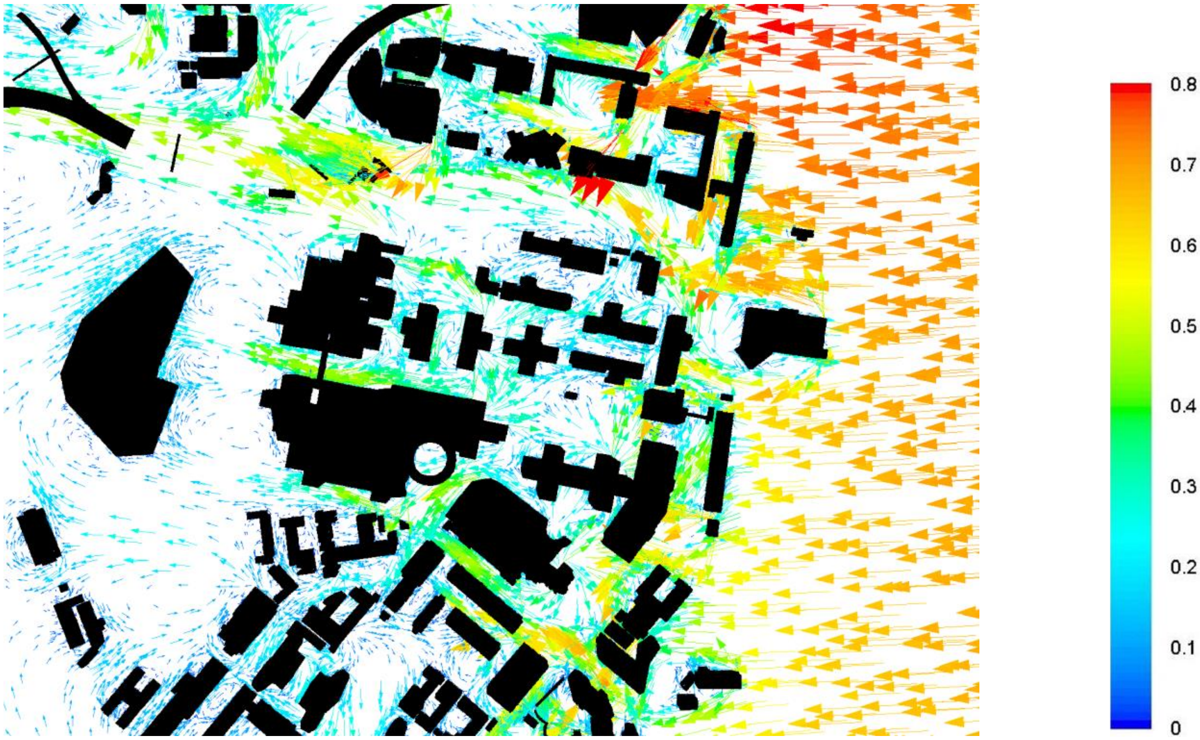


SW at 2mAG (Proposed Scheme)

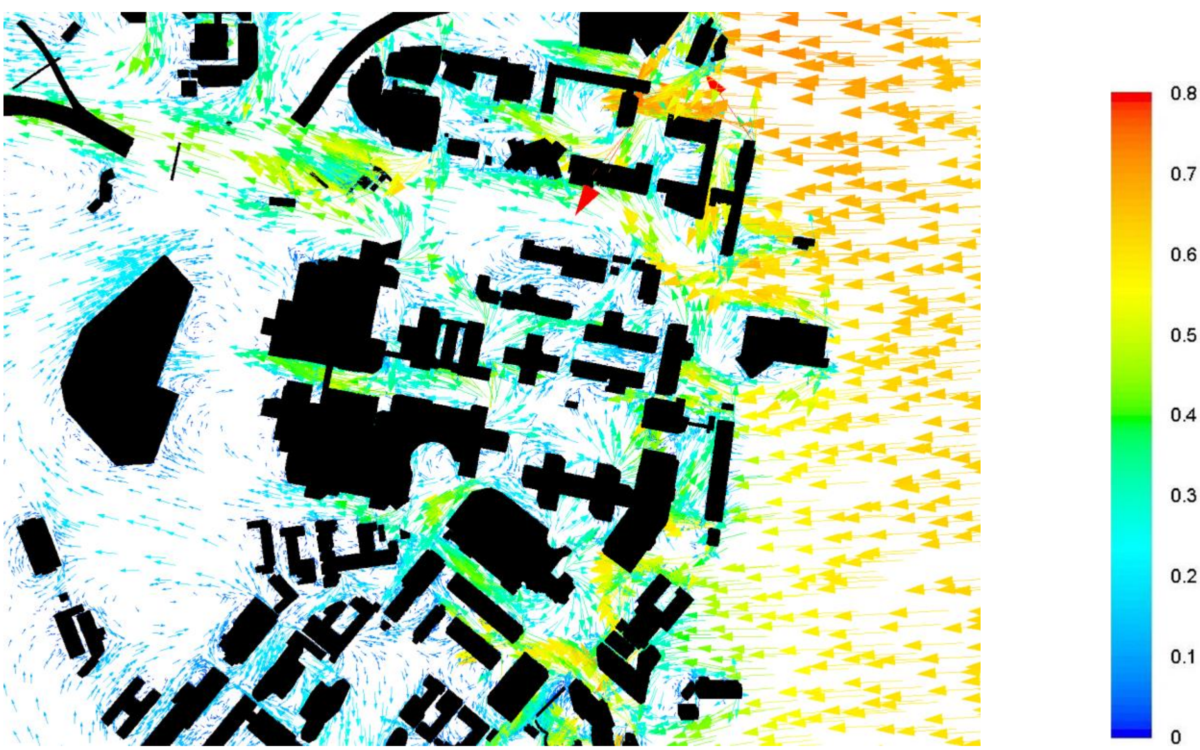


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

E at 2mAG (Base Scheme)

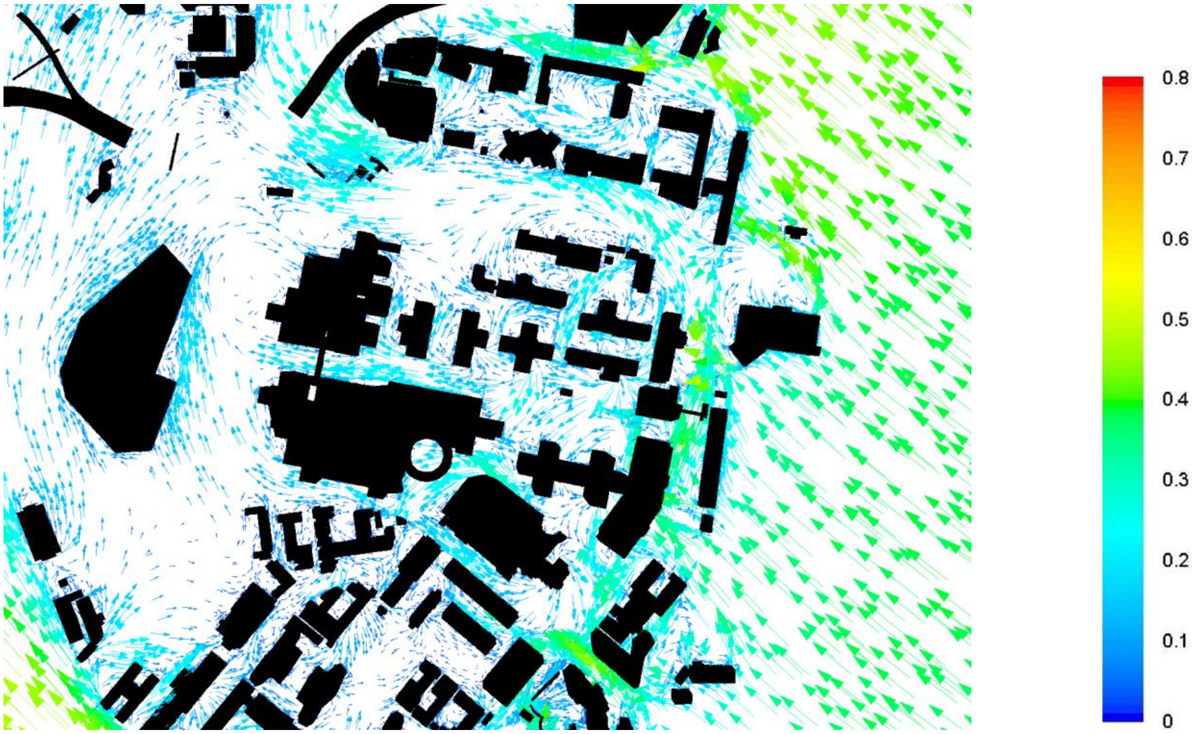


E at 2mAG (Proposed Scheme)

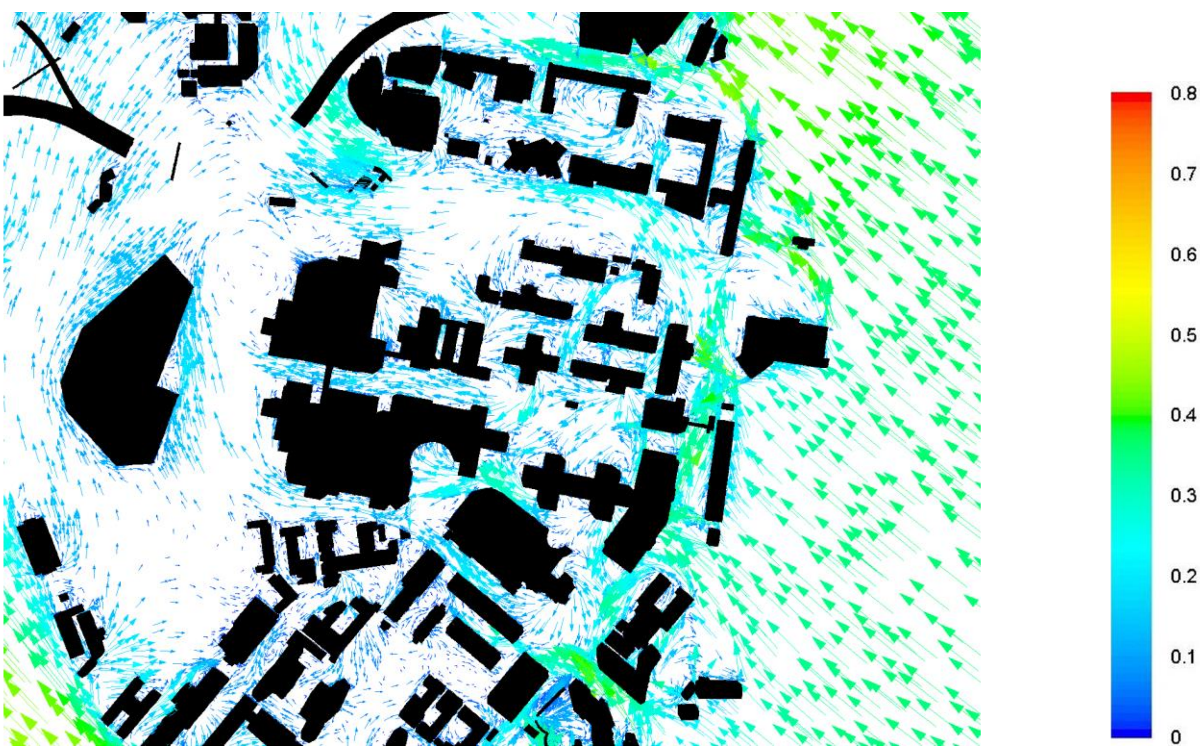


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

ESE at 2mAG (Base Scheme)

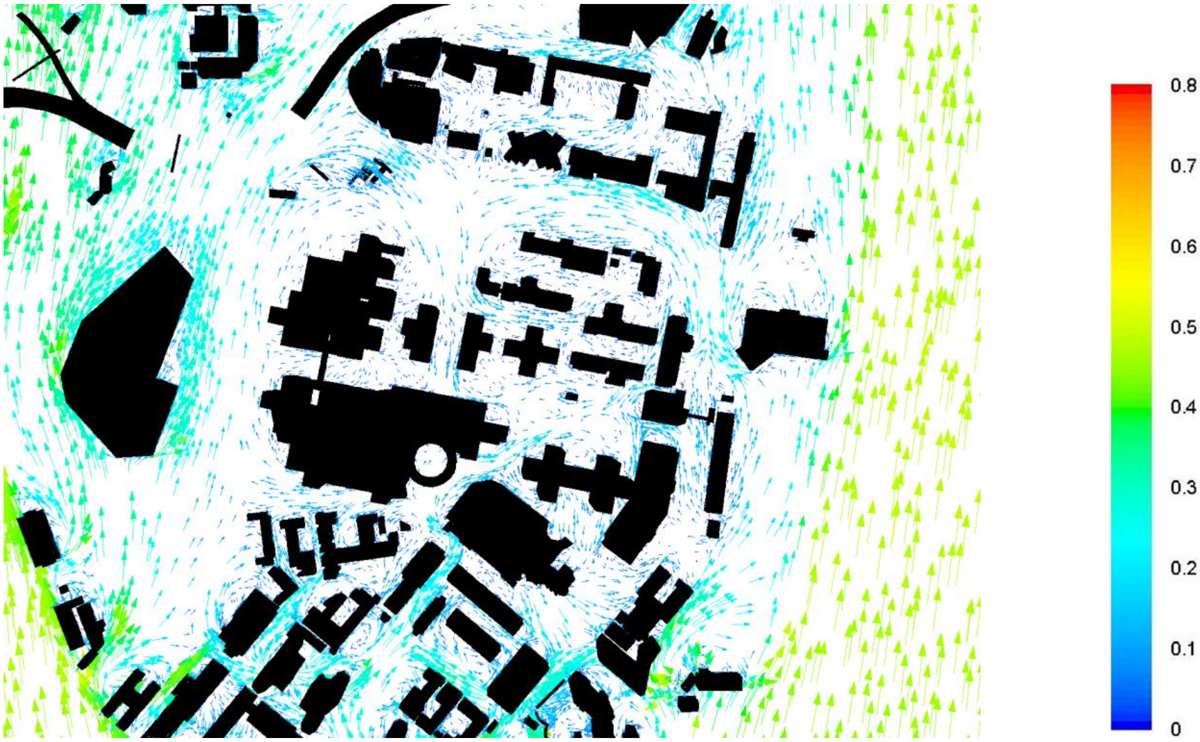


ESE at 2mAG (Proposed Scheme)

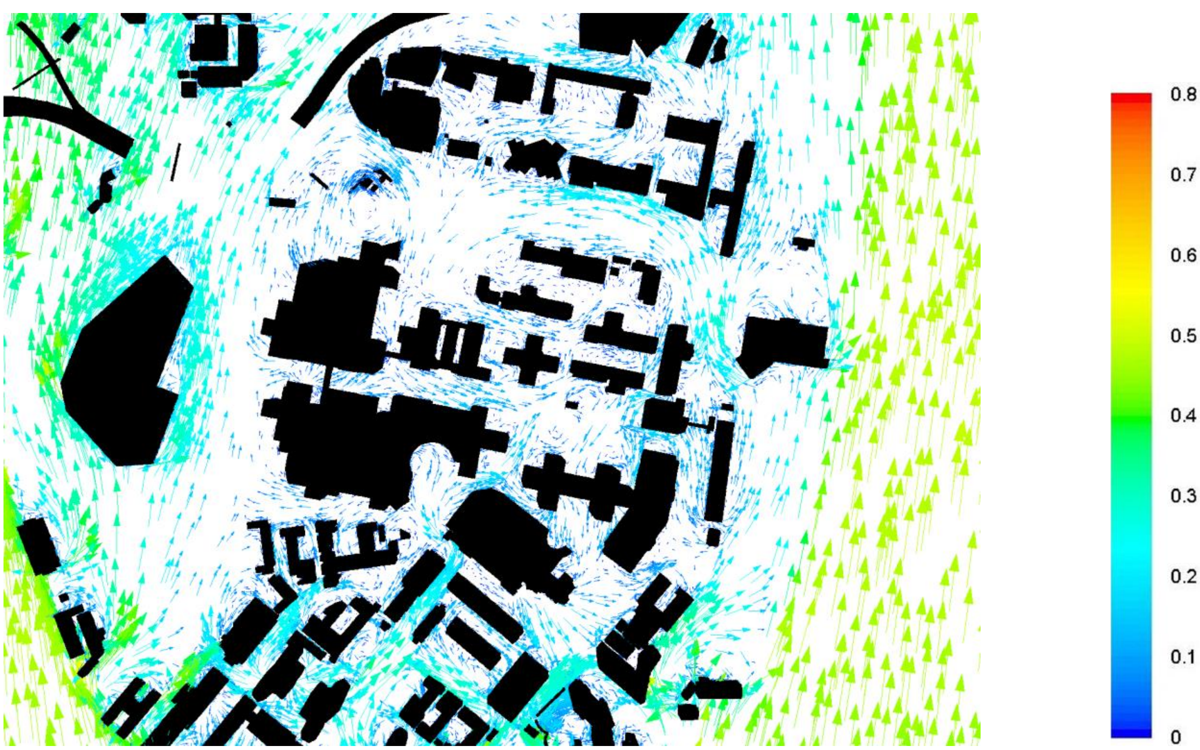


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

S at 2mAG (Base Scheme)

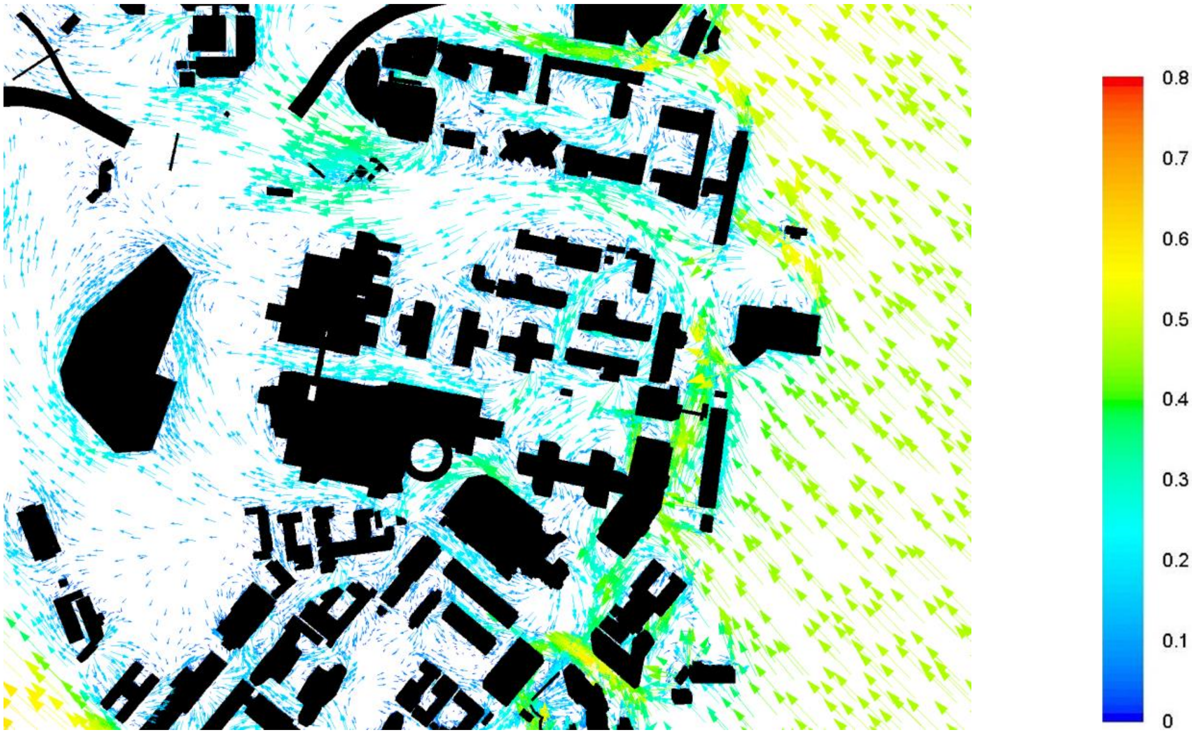


S at 2mAG (Proposed Scheme)

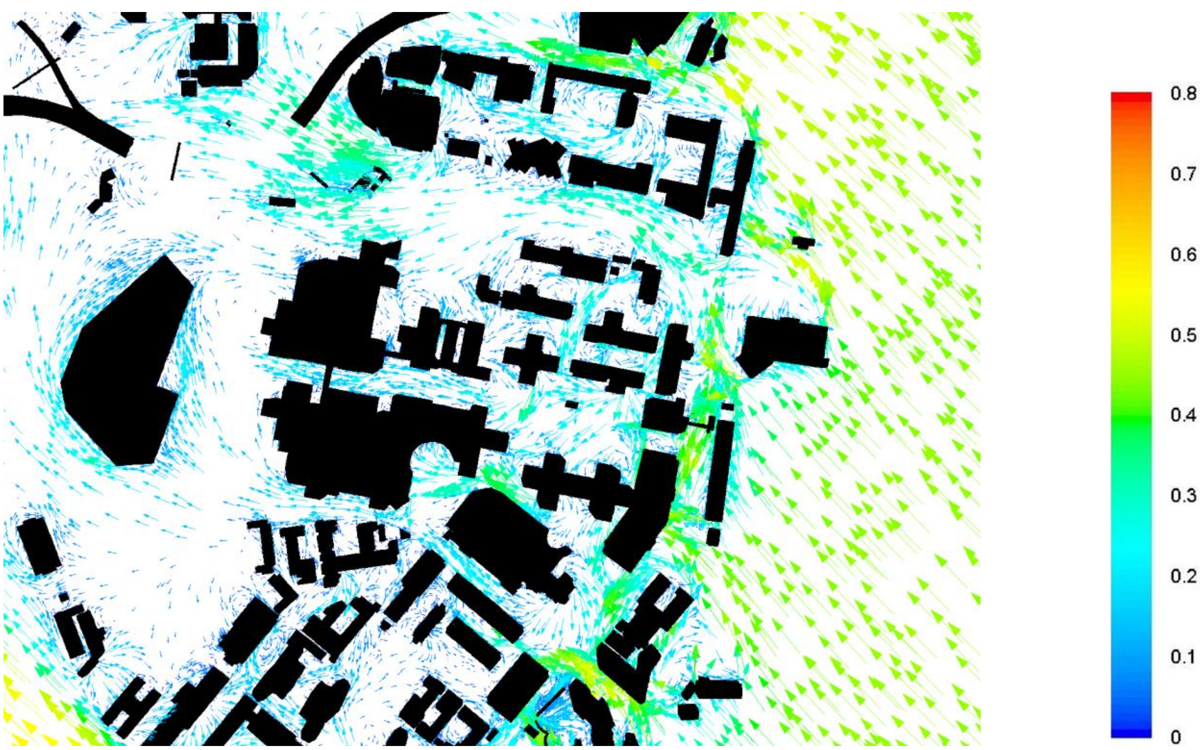


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

SE at 2mAG (Base Scheme)

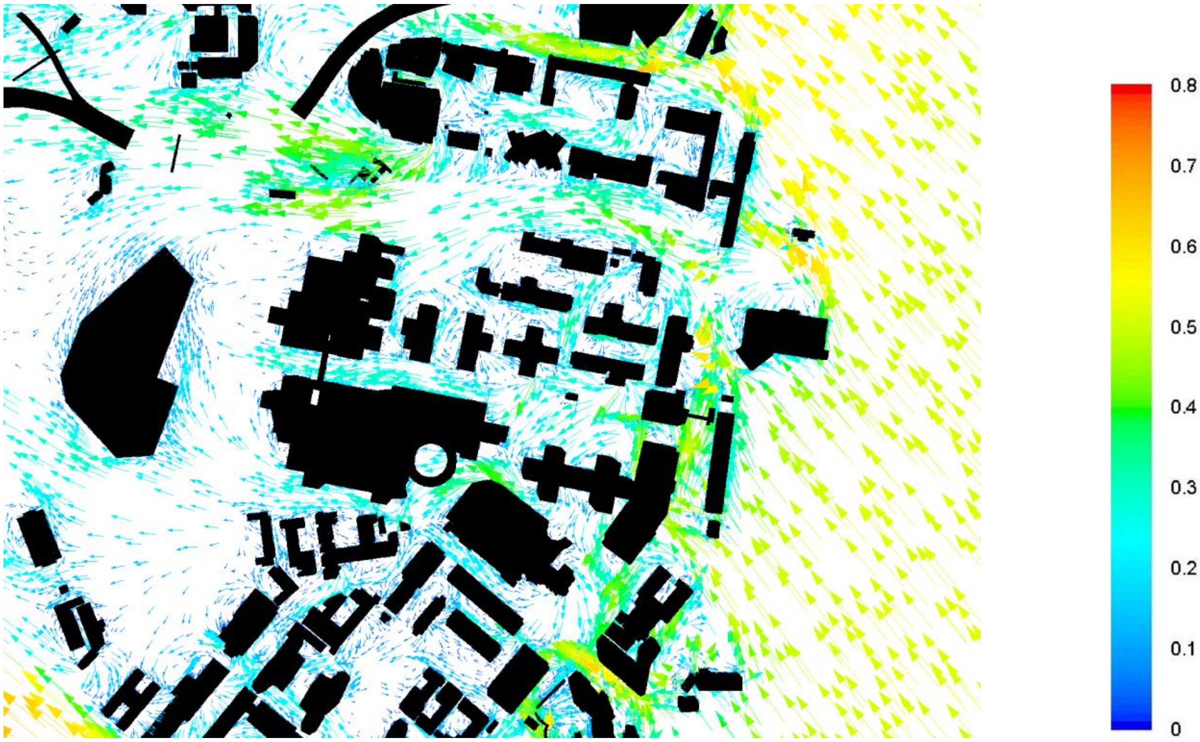


SE at 2mAG (Proposed Scheme)

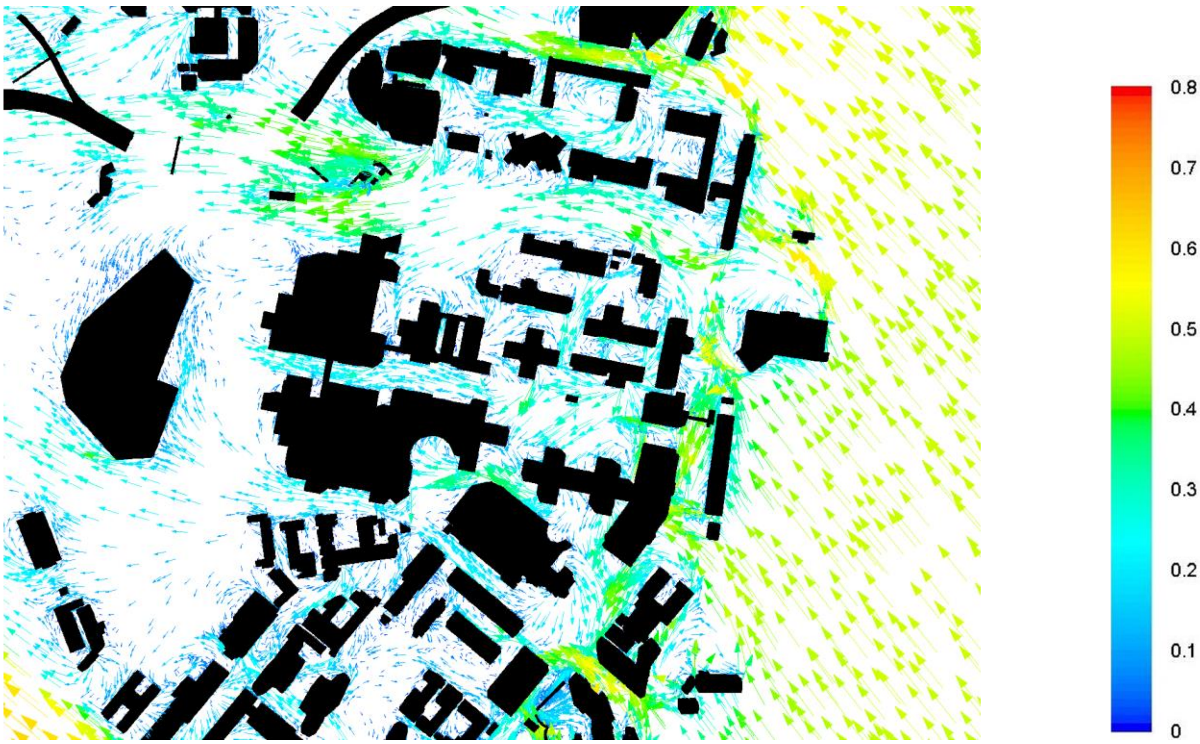


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

SSE at 2mAG (Base Scheme)

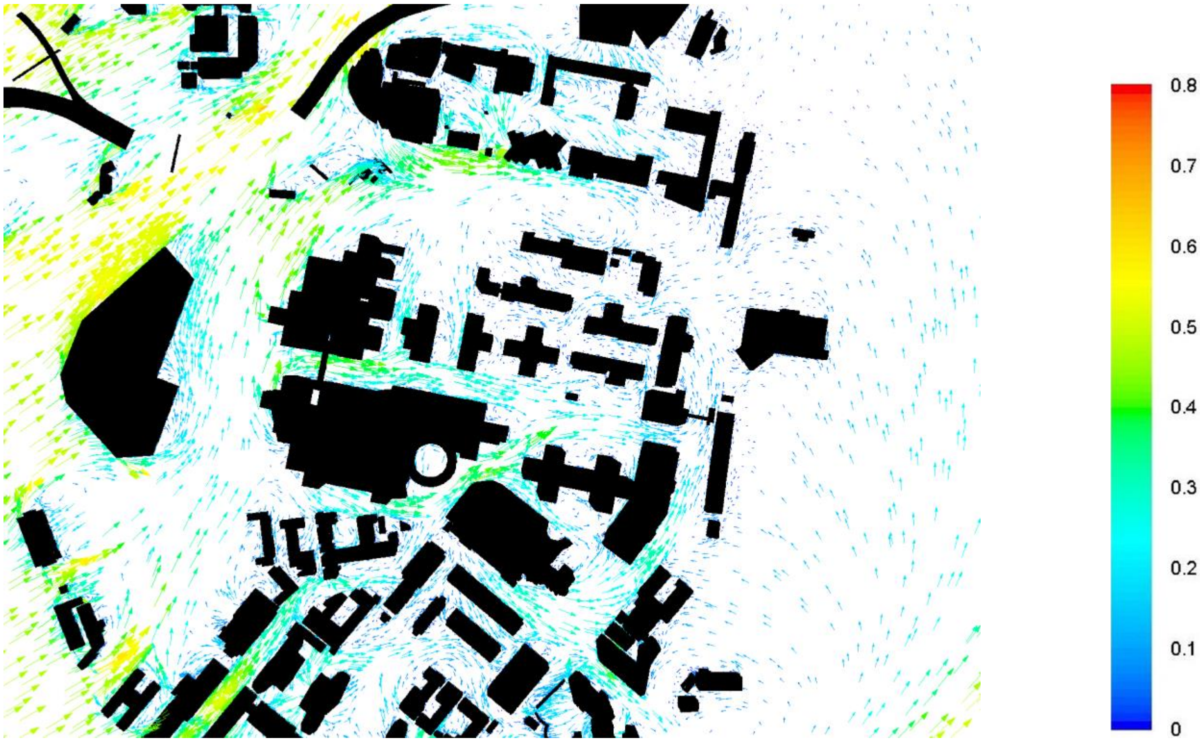


SSE at 2mAG (Proposed Scheme)

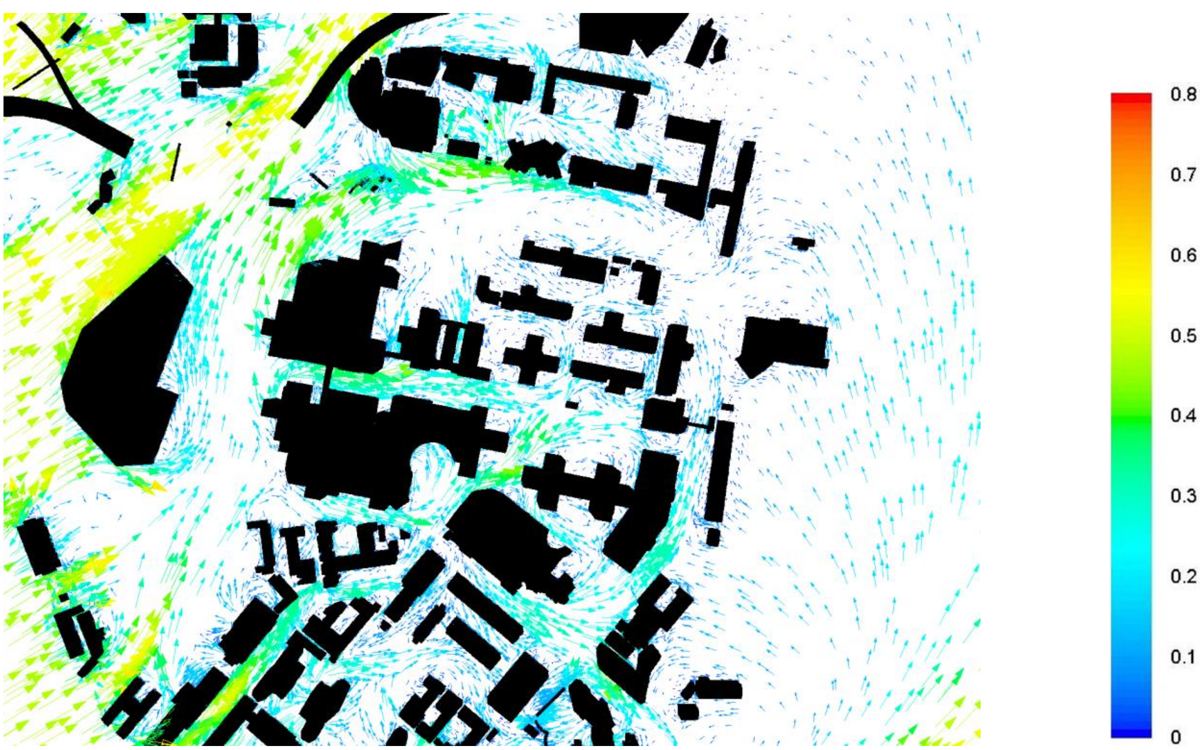


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

WSW at 2mAG (Base Scheme)

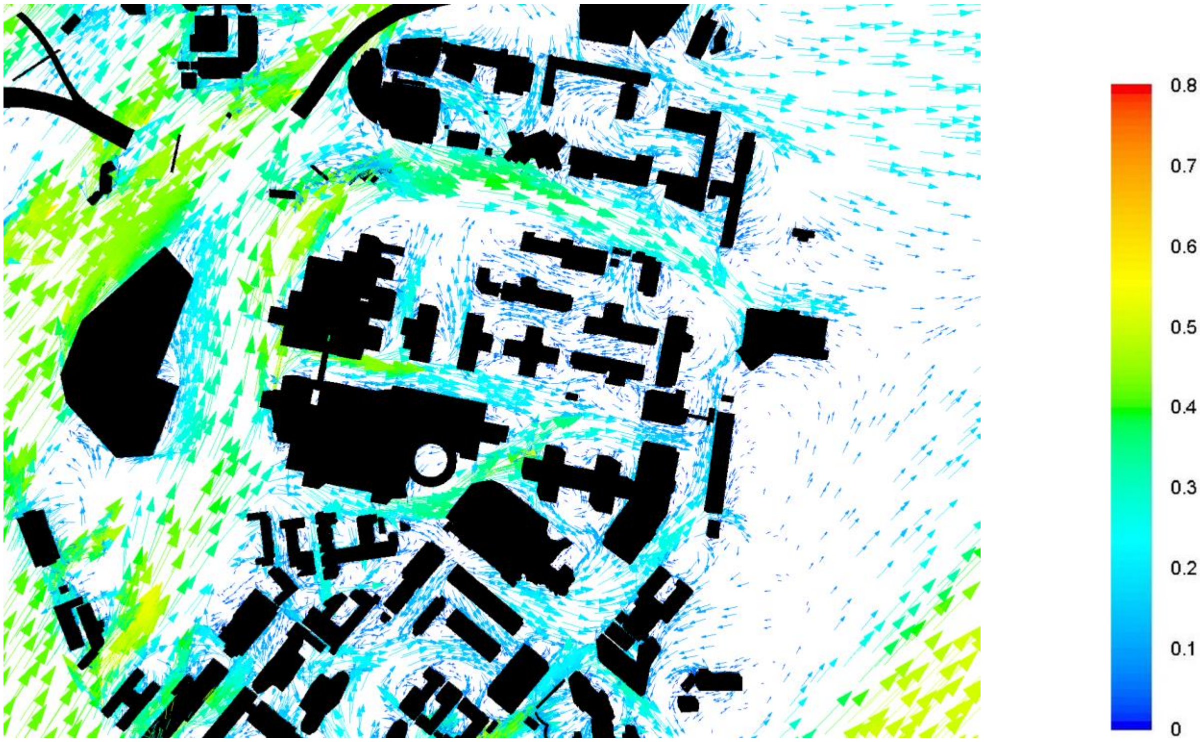


WSW at 2mAG (Proposed Scheme)

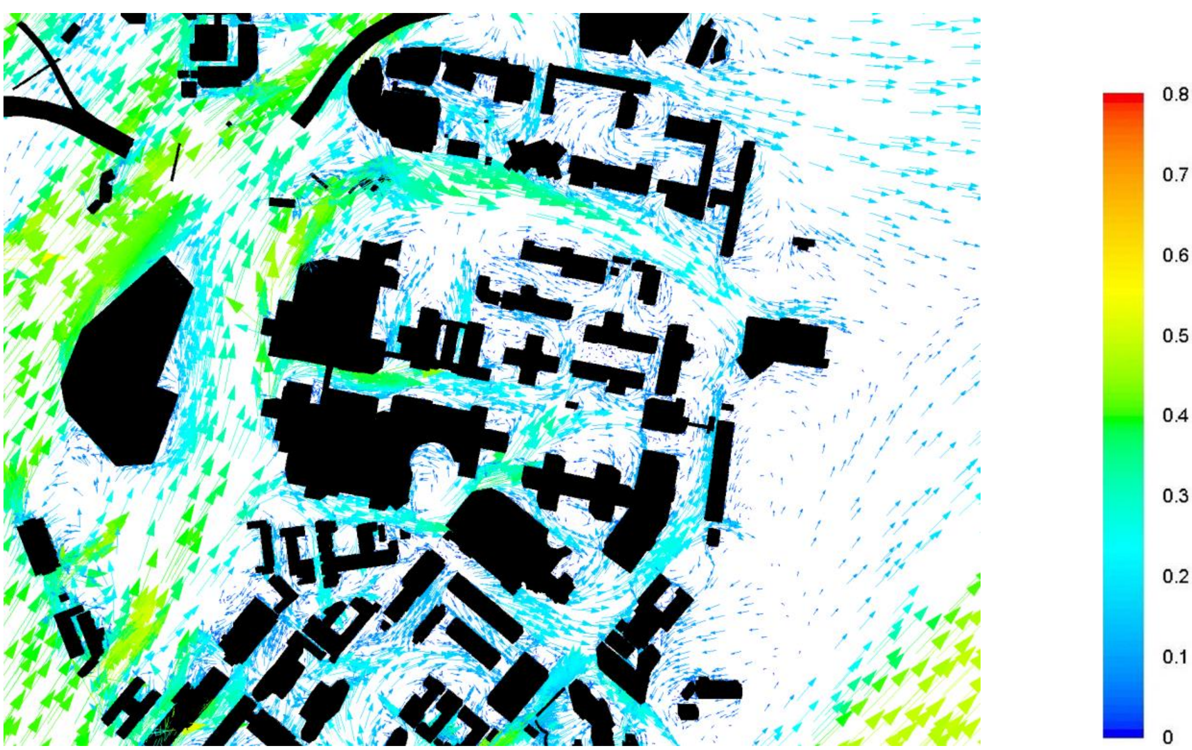


Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

SSW at 2mAG (Base Scheme)

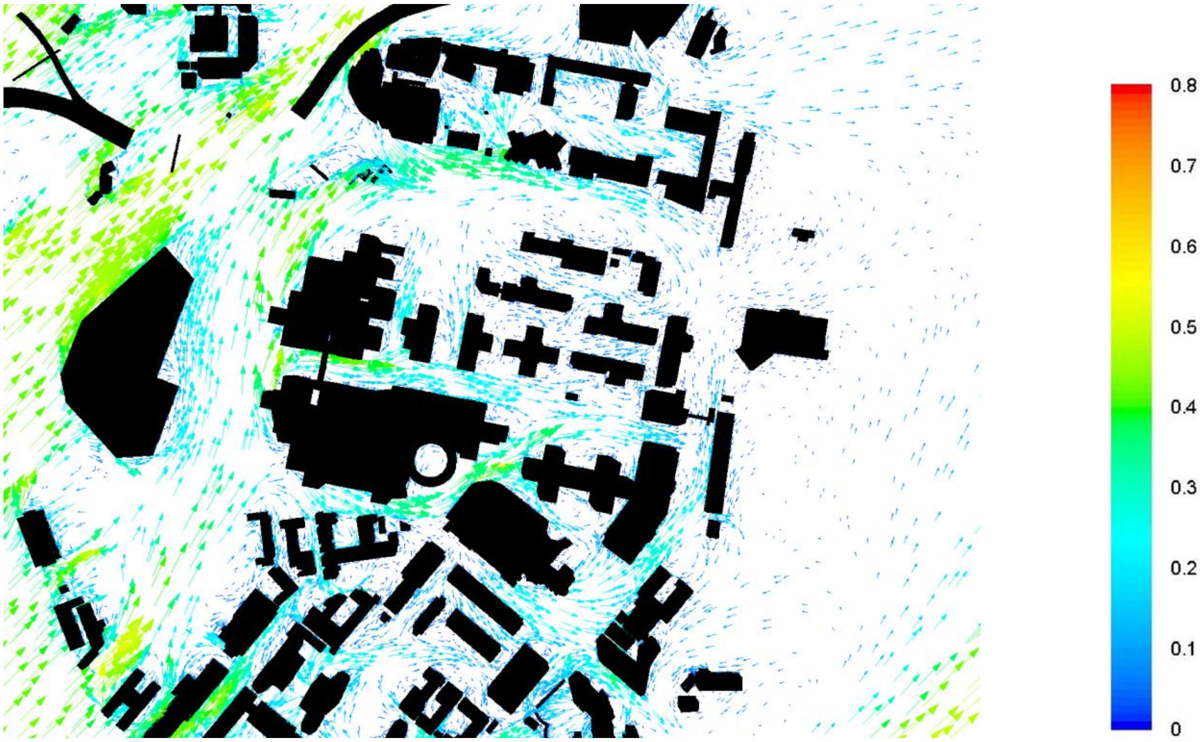


SSW at 2mAG (Proposed Scheme)



Appendix D – Wind Velocity Ratio Vector Plots for Summer Wind

SW at 2mAG (Base Scheme)



SW at 2mAG (Proposed Scheme)