Issue No : 3
Issue Date : October 2014
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AIR VENTILATION ASSESSMENT FOR THE PROPOSED PUBLIC RENTAL HOUSING DEVELOPMENT AT FO TAN (AREA 16 & 58D), SHA TIN

INITIAL STUDY

Report Prepared by :
Allied Environmental Consultants Ltd.

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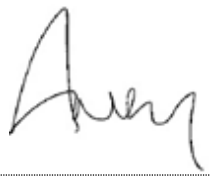
Author: 

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EXECUTIVE SUMMARY

Allied Environmental Consultants Limited (AEC) was commissioned by the Hong Kong Housing Authority to undertake an Air Ventilation Assessment (AVA) Initial Study for the proposed public housing development at Fo Tan.

The initial AVA study is to assess air ventilation performance of the building design and its impacts to the surrounding pedestrian accessible locations. Computational Fluid Dynamic (CFD) modelling is used for quantitative ventilation performance evaluation. There are two design schemes being reviewed in this Initial AVA Study and compared to the existing condition.

The Public Rental Housing project with 44000 square meters gross site area which will composed of five or six public housing blocks, providing a total of approximately 4200 and 4850 residential units respectively, was evaluated in this initial AVA study. To address the improvement measures suggested in the Expert Evaluation Report, the design was proposed to be revised. The air ventilation performance based on this revised design was evaluated as the Scheme B.

Based on the result of the wind rose analysis, the wind directions for the Subject Site and the surrounding area representative of the prevailing situations are determined to be mainly ENE, E, NE, ESE NNE, SSW, SE and SW. These 8 of the 16 wind directions which occur for about 79.7% of time in a year are adopted in the Initial Study.

According to the CFD modelling results, it can be concluded that both SVRw and LVRw are changed slightly from the Scheme A to the Scheme B. The overall air ventilation performance will have some minor impacts due to the development when compare to the existing where air ventilation may be slightly deteriorated at Kwai Tei New Village under ESE wind condition and Tat Yip Lane under SW wind condition, but most surrounding areas maintained in terms of wind performances with the proposed development. Besides, the Scheme B maintains a proper wind environment within the development where the wind environment is maintained to a level comparable to the existing condition.

1. INTRODUCTION

1.0. PROJECT BACKGROUND

1.0.1. Hong Kong Housing Authority (HKHA) proposes minor relaxation of building height and gross floor area restrictions and provision of a public vehicle park for a Public Rental Housing (PRH) development at Fo Tan, Sha Tin Area 16 & 58D (the Project). The application site for the PRH development is currently zoned "Residential (GroupA)2" under the draft Sha Tin Outline Zoning Plan S/ST/29. Detail design parameters of Design Scheme A and Design Scheme B discussed in this report is shown in ***Table 1*** below.

1.0.2. Allied Environmental Consultants Limited (AEC) was commissioned by HKHA to carry out an Initial Study on Air Ventilation Assessment (AVA-IS) to refine and substantiate the Expert Evaluation. The AVA-IS was carried out according to the air ventilation assessment framework as set out in Technical Circular No. 1/06 and its Annex A - Technical Guide for Air Ventilation Assessment for Development in Hong Kong issued jointly by Housing, Planning and Lands Bureau (HPLB) and Environment, Transport and Work Bureau (ETWB) in July 2006 (Technical Guide).

Major Development Parameters	**Design Scheme A (a)**	**Design Scheme B (b)**	**Differences (%) (b)-(a)**
Net Site Area (ha)	3.89 (about)	3.89 (about)	Nil
Maximum GFA (m^2) Domestic GFA (m^2) Non-Domestic GFA (m^2)	Not more than 194,500 About 181,000 About 13,500	Not more than 237,290 About 217,790 About 19,500	+42,790 (+22.0%) +36790 (20.3%) +6000 (44.4%)
Total Plot Ratio	5.0	6.1	+1.1 (+22.0%)
Site Coverage	About 29%	About 45%	+16%
Total No. of Flats	About 4,200	About 4,850	+650 (+15.5%)
Design Population	About 11,500	About 13,000	+1,500 (+13.0%)
No. of Residential Block	6	5	-1
Building Height (Main Roof) (mPD)	Max 160mPD ➢ Block 1 = 150.90 ➢ Block 2 = 156.40	Max 165mPD ➢ Block 1 = 150.00 ➢ Block 2 = 152.00	+5 (+3.1%)

Major Development Parameters	**Design Scheme A (a)**	**Design Scheme B (b)**	**Differences (%) (b)-(a)**
	➢ Block 3= 165.65 ➢ Block4 = 165.95 ➢ Block 5 = 159.70 ➢ Block 6 = 151.45	➢ Block 3= 160.00 ➢ Block4 = 165.00 ➢ Block 5 = 151.00	
No of Domestic Storeys	Ranged from 30-38	Ranged from 33-39	Max +3
Local Open Spaces (m^2)	11,500	Not less than 13,000	+1,500
Podium	A 3-storey podium (38.1-46.5mPD) consists of retail, social welfare, education and carpark facility and podium roof as landscape deck area as shown in ***Figure 1***	A 3 to 5 storey podium (~51–54mPD) consists of retail, social welfare, education, a public transport lay-by, carpark facility i(including a 30-space public vehichle park) and podium roof as landscape deck area as shown in ***Figure 1***	+2 (66.7%)

Table 1 Comparison of PRH Development Parameters of Design Scheme A and Design Scheme B

1.1. SCOPE OF STUDY

1.1.1. The objective of this study is to evaluate the wind performance of the Development using the methodology of Air Ventilation Assessment (AVA), based on the Technical Circular No.1/06 jointly issued by the Housing Planning and Lands Bureau (HPLB) and the Environment, Transport and Works Bureau (ETWB) in July 2006.The scope of the study includes as follows:

- To further refine of the understanding (good design features and problem areas) of the Expert Evaluation;
- To give a general pattern and a rough quantitative estimate of wind performance at the pedestrian level reported using Wind Velocity Ratio (VR);

- To refine of the project design and/or design options by applying wind VR as indicator of wind performance for the Air Ventilation Assessment, and reporting all VR of test points;
- To further define the "focuses", wind flow around the different options of block layouts should be simulated using computer model for different times of the year. To quantitatively evaluate the ventilation performance of mitigation measures considered.

1.2. PROJECT DETAILS

1.2.1. This Public Rental Housing project is located adjacent to Fo Tan Industrial Area, 2 design schemes to be investigated in this Initial Study, Design Scheme A and Design Scheme B. Both schemes comprise of a commercial / carpark podium where Scheme A comprises of 6 domestic blocks and Scheme B comprises of 5 domestic blocks.

1.2.2. In addition to the proposed PRH development, a proposed Home Ownership Scheme Development (HOS) is also located in close proximity and with the same development schedules. Therefore, the proposed HOS development Design Scheme A and Design Scheme B are incorporated within this AVA study, isolated and accumulative effects on the existing wind environment will be discussed. The design parameters of the HOS development are summarized in ***Table 2*** below.

1.2.3. For this AVA- Initial Study, the composition of the Design Scheme A and Design B of the PRH Project is summarized in ***Table 1*** above. The details of the building blocks are shown in ***Figure 1*** and ***Figure 2***. Detail layout plan and elevation of Design Scheme A and Design Scheme B of PRH development are appended in ***Appendix A*** and ***Appendix B***. Moreover, both Design Scheme A for both PRH and HOS development conform to current OZP requirements.

Major Development Parameters	**Design Scheme A**	**Design Scheme B**
Site Area	Around 8700 square meters	Around 8600square meters
No of Residential Blocks	2	1
No of Domestic Storeys	Ranged from 32-33	Ranged from 28-40
No of flats	Around 560 units	Around 806 units
Building Height	Max ~150mPD	Max ~170mPD

Table 2 Comparison of HOS Development Parameters of Design Scheme A and Design Scheme B

Figure 1Layout Plan for Design Scheme A

Figure 2Layout Plan for Design Scheme B

2. WIND AVAILABILITY

2.0.1. The wind data from Hong Kong Observatory (HKO) and Mesoscale Model (MM5) published by PlanD were adopted in this AVA-IS. The HKO wind data represents the lower level wind availability where the wind direction is influenced by local topography in the surrounding environment while the MM5 wind data represents the wind availability at boundary layer (i.e. 596mPD).

2.0.2. The occurrences of winds from different direction are referred to MM5 wind data while local wind conditions for different seasons (annual and summer periods) are referred to HKO wind data.

2.1. WIND DATA FROM HONG KONG OBSERVATORY

2.1.1. There is a HKO automatic weather station located in the vicinity of the subject site, Sha Tin (ST) which is approximately 1.2km on the east away from the subject site as shown in **Figure 3**. The wind data obtained from these automatic weather stations is to identify wind availabilities during annual and summer periods as this seasonal information are not available in MM5 data. The elevation of the anemometer of the Sha Tin Station is 16mPD.

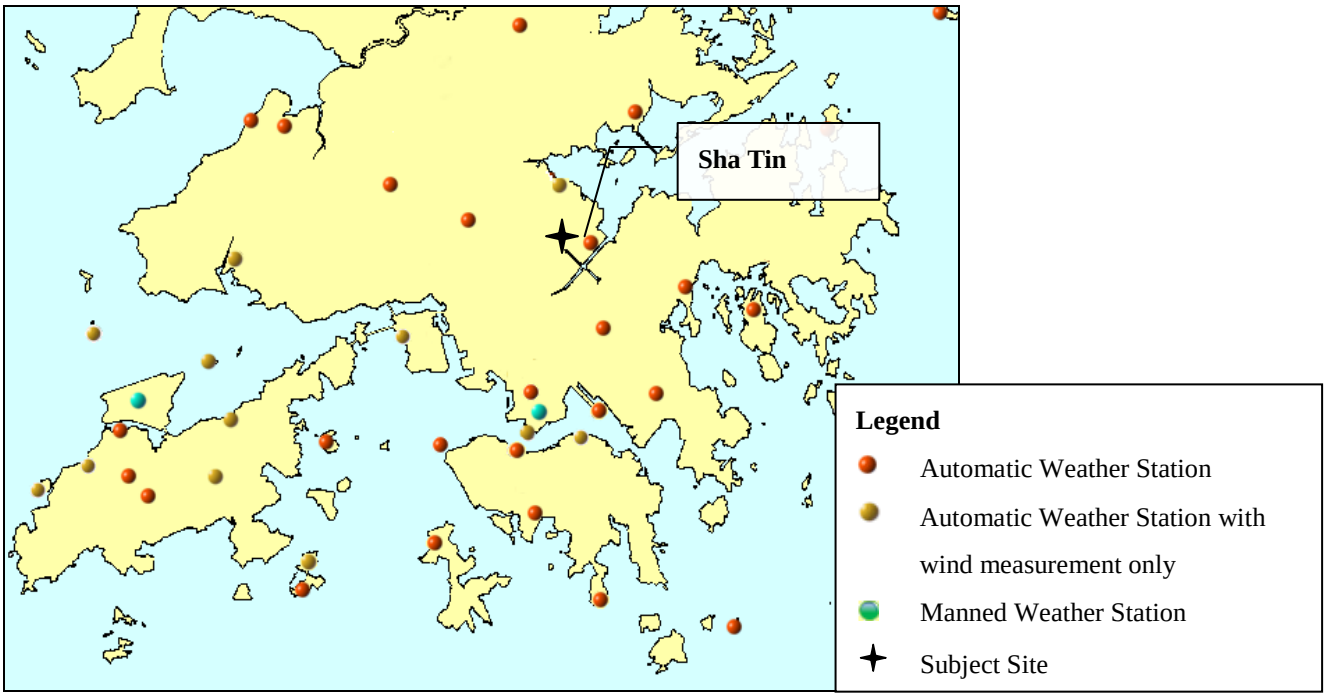


Figure 3 Locations of the Nearest HKO Weather Stations

2.2. SHA TIN WEATHER STATION

2.2.1. The recorded annual mean wind speed measured at anemometer of ST automatic weather station was 2.22 m/s (8km/hr) in 2010. Based on the Sha Tin wind rose as shown in **Figure 4**, it is found that east and NE quadrant winds dominate the annual wind frequency. The monthly prevailing wind direction and wind speed of year 2010 are listed in **Table 3**. It is found that wind mainly comes from southwest (SW) direction in summer period, while wind from east (E) dominates annually.

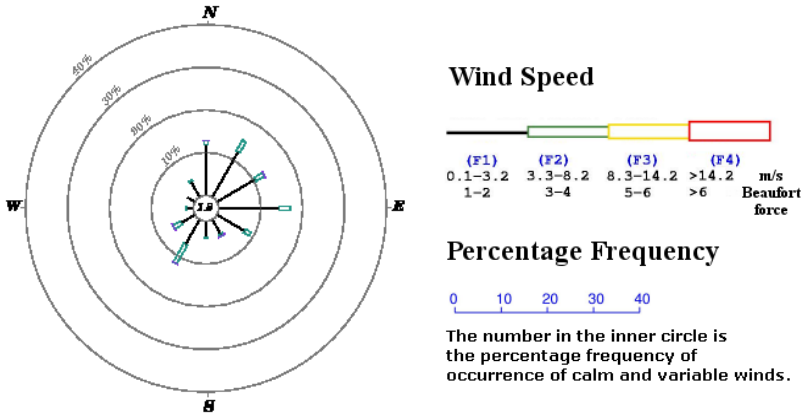


Figure 4 Sha Tin Wind Rose (2010)

Month	Monthly Prevailing Direction (Degrees)	Wind Speed (m/s)
January	30	2.11
February	90	2.22
March	80	2.28
April	90	2.25
May	90	2.17
June	220	2.50
July	220	2.53
August	220	2.14
September	90	2.06
October	90	2.22
November	30	2.17
December	30	2.08

Table 3 Wind Availability Data of Sha Tin, HKO 2010

2.3. WIND DATA FROM MM5

2.3.1. The wind availability to the subject site is evaluated with reference to the "Site Wind Availability Data" simulated by the Fifth-Generation NCAR/Penn State MM5 at the height of 596m above ground. The subject site is located within grid (28, 32) and its wind rose is shown in **Figure 5**. The wind velocity ranges from 0 to 14.2m/s from 16 wind directions and the mean wind velocity is 5.81m/s. It is found that east and northeast quadrant winds dominate the annual wind frequency.

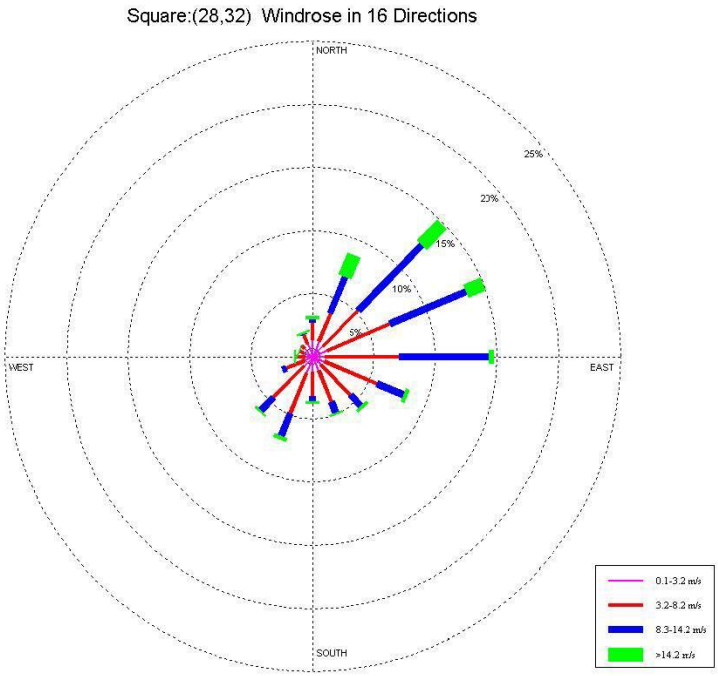


Figure 5 Wind Rose of Grid (28,32), MM5

2.3.2. Power law is used to convert the MM5 data at 596m above ground level to pedestrian level at 2m above ground level by taking consideration of the effect of topography/built-up area in the vicinity of the subject site on site wind availability.

2.4. FINDINGS OF WIND AVAILABILITY

2.4.1. Based on the wind data from HKO and MM5, it is concluded that winds come from NE and E are dominant annual wind directions. While in summer period, wind mainly comes from SW directions.

3. EXPERT EVALUATION

3.0.1. The AVA-EE qualitatively evaluates the ventilation performance in the site environs with and without the Project. The assessment area and surrounding area of the study is 234 and 500m from the subject site. The conditions under annual and summer prevailing winds are considered. Building heights, street/road orientation and patterns, topography and open spaces have also been taken into account for evaluating the characteristics of wind environment.

3.1. EXISTING CONDITION

3.1.1. The subject site is currently used as open carpark and bus depots (under short term tenancy) as shown in **Figure 6**. The existing conditions of subject site (i.e. without the Project) are summarized as the follows.

Building Heights

3.1.2. The subject site is located in the north-western end of Fo Tan Industrial Area, an open area within the area which facilitates air movement. The existing land in the vicinity of the subject site is mainly residential and industrial uses. The building heights of the existing buildings located within the study area are shown in **Figure 6**.

3.1.3. The heights of majority of the existing industrial buildings located to the east, southeast and south of the subject site are ranged from 90mPD to 120mPD. These high-rise industrial buildings might cause impediment to the oncoming land breezes and annual prevailing wind especially the E and NE winds to penetrate into the street level.

3.1.4. About 3 storeys high low-rise residential buildings are located on the hillside and the north of the PRH subject site. The average building heights of these residential buildings range from 80 to 120mPD. Due to the fact that they are relatively low in building height, no obstruction to prevailing wind is anticipated to the immediate surroundings.

Road/Street Pattern

3.1.5. Roads such as Wong Chuk Yeung Road, Shan Mei Street and Fo Tan Road are considered as wind corridors within the study area for both annual and summer prevailing winds.

Open Areas

3.1.6. Open spaces and areas located within 500m from the subject site as shown in **Figure 6**, including a bus depot, an open car park and public garden. These open spaces promote air circulation at pedestrian level and increase pedestrian comfort.

Topography

3.1.7. The subject site is surrounded by hills its north side and south-west side by Wo Sheung Tun and Wong Chuk Yeung hills with 295mPD and 255mPD high respectively. The approaching easterly wind is likely to be diverted at pedestrian level to the subject site and Kwai Tei New Village by Wo Sheung Tun Hill. Whereas the summer south-west wind is likely to be diverted by Wong Chuk Yeung hill and flow through the lower part of the hill at Wong Chuk Yeung Tsuen Path towards the subject site and the downstream area under the prevailing summer wind.

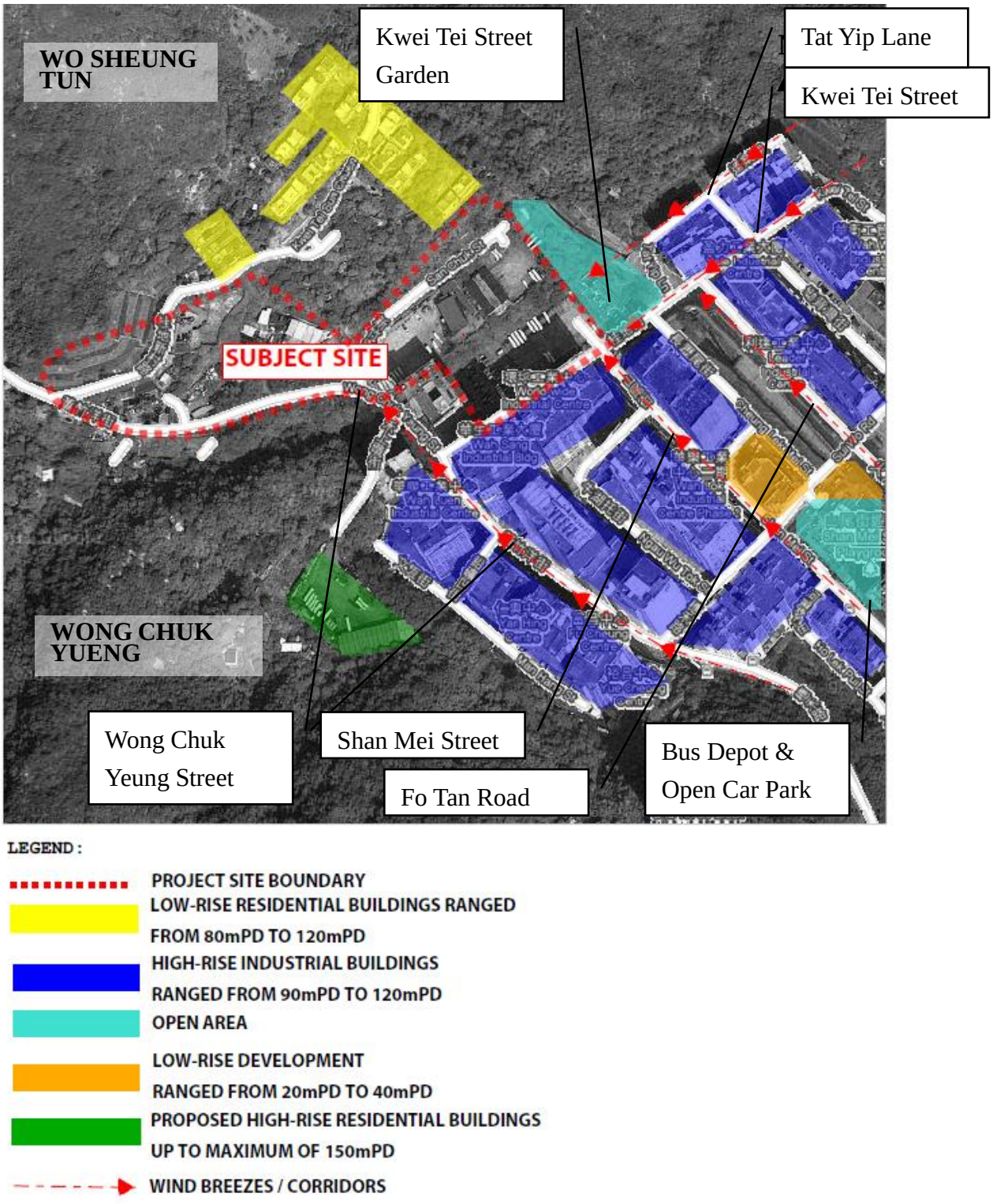


Figure 6 Site Environment and Wind Corridor

3.2. PROJECT AREA, ASSESSMENT AREA BOUNDARY AND SURROUNDING AREA BOUNDARY

3.2.1. As the proposed Fo Tan Home Ownership Scheme (HOS) Development and Public Rental Housing (PRH) Development are closely located, it is necessary to incorporate each other as committed developments in their separate assessments. In view of this, the cumulative impacts due to both proposed developments will be assessed.

3.2.2. The assessment area covers the surrounding environment of the project area up to a perpendicular distance H (where H is the height of the tallest building within the surrounding area i.e. HOS development); H is the height of HOS development, which is 117 m. However it is necessary to enlarge the area to distance of 2H up to 234m in order to define a representable assessment area.

3.2.3. The surrounding area should normally up to a perpendicular distance of 2H from the project area boundary, which is 234 m for this study. However a surrounding area of 2H is not large enough to condition the approaching wind due to the lack of neighbouring buildings. Therefore a surrounding area of 500m is adopted for this study.

3.2.4. ***Figure 7*** below illustrates the project area, assessment area and surrounding area for PRH and HOS development respectively. For this CFD analysis, one set of CFD simulation is conducted for both PRH and HOS development, therefore the model area of this CFD simulation covers the extents of both surrounding Areas for HOS and PRH development for all modelled scenarios.

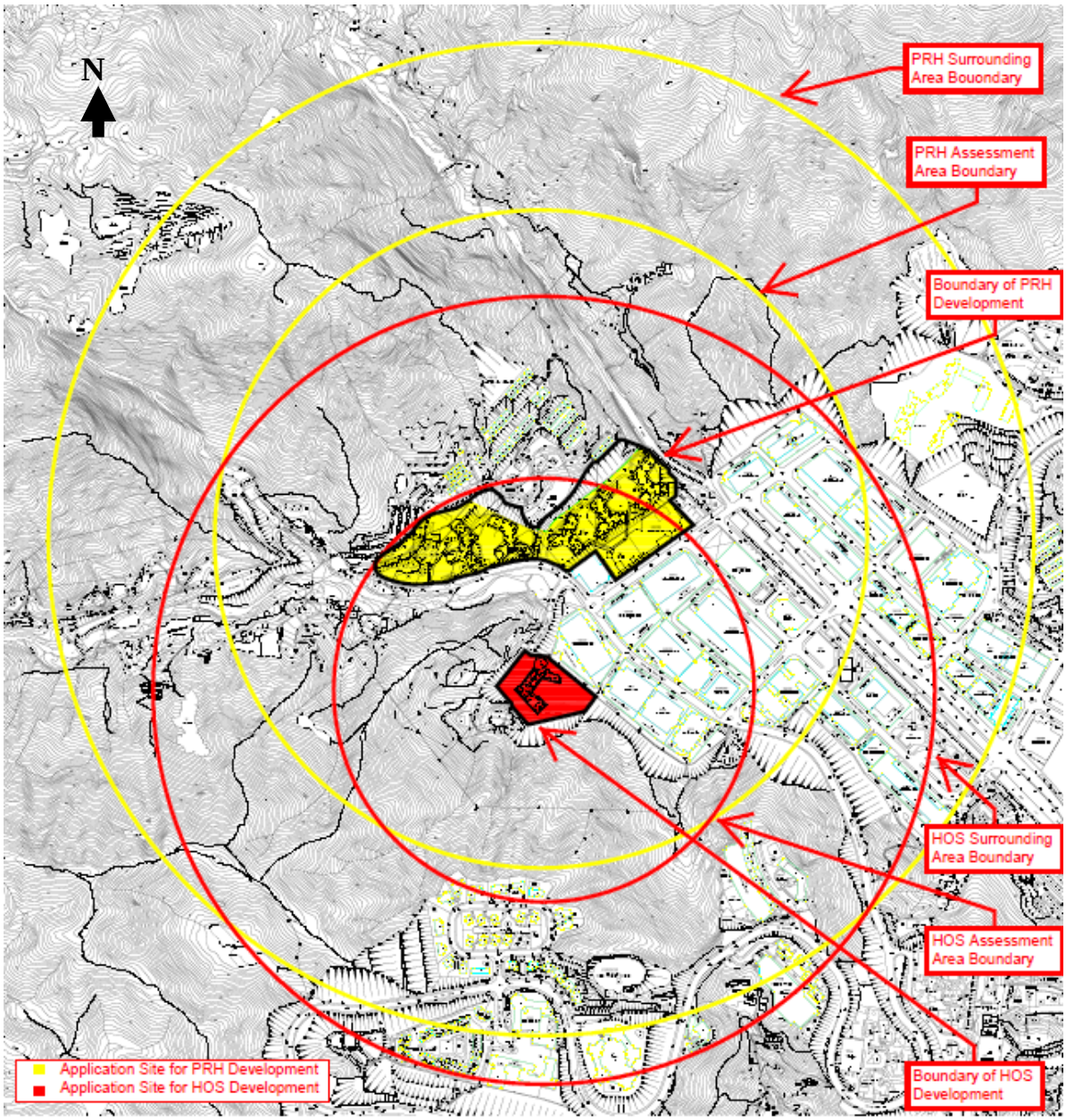


Figure 7 Project area boundary, assessment area boundary and surrounding area boundary

3.3. PREVAILING WIND CONDITION FOR EXISTING ENVIRONMENT

3.3.1. Throughout the year, it is expected that the prevailing winds from E and NE directions flow pass the subject site.

3.3.2. Although some high-rise industrial buildings are located to the east of the subject site as shown in **Figure 8** and **Figure 9**, the road in between these buildings acts as a ventilation

corridor to allow the prevailing winds reaching to the subject site and the ventilation at pedestrian level is generally maintained. Kwei Tei Street, Tat Yip Lane and Kwei Tei Street Garden in particular are facilitating the approaching easterly wind to penetrate through the area into and through the PRH subject site.

3.3.3. Setback distance of the proposed PRH development from the major streets Kwei Tei Street and Wong Chuk Yeung Street along the prevailing easterly wind is provided to reduce the impact on the approaching wind facilitating air movement towards the downstream areas.

3.3.4. There are no development located at the downstream area of the subject site under the annual prevailing E and NE winds. Therefore it is anticipated that no significant impact would cause to the surrounding area with the presence of proposed development.

3.3.5. Under the annual prevailing wind, the existing Kwei Tei New Village is anticipated to enjoy the approaching wind without any blockage from the upstream. Some downslope wind may also be anticipated from Wo Sheung Tun Hill to Kwei Tei New Village may also be anticipated.

3.3.6. On the other hand, Fo Tan Road and Sui Wo Road within the Fo Tan Industrial area provided an air path for ventilating through the are under the prevailing wind conditions as shown in ***Figure 8*** and ***Figure 9***.

3.3.7. During the summer period, it is expected that the prevailing winds from SW directions flow pass the subject site.

3.3.8. As shown on **Figure 10**, there is no building obstruction at the south-west of the PRH subject site. But Wong Chuk Yeung hill may divert the south-westerly prevailing wind to the lower part of the hill through to the PRH subject site. Moreover, the prevailing wind from SW direction can reach to the subject site directly via Wong Chuk Yeung Tsuen Path at the western side of the subject site.

3.3.9. As the subject site is surrounded by large hills, the subject site is likely to enjoy katabatic wind from the high elevations of the surrounding hills when the local temperature is relatively higher than the temperature at the high elevations. These downhill winds help improve the wind environment at subject site and Kwai Tei New Village during summer time in particular.

3.3.10. In terms of the assessment area as a whole, it is unavoidable that the proposed development would impact on the existing wind condition particular to the downstream such as Kwai Tei New Village under summer prevailing SW wind and annual prevailing easterly wind as

shown as ***Figure 9*** and ***Figure 10***. Therefore it is important that the proposed PRH development to carefully design the building disposition and orientation, maximizing building permeability in order to minimize the impediment to the approaching winds.

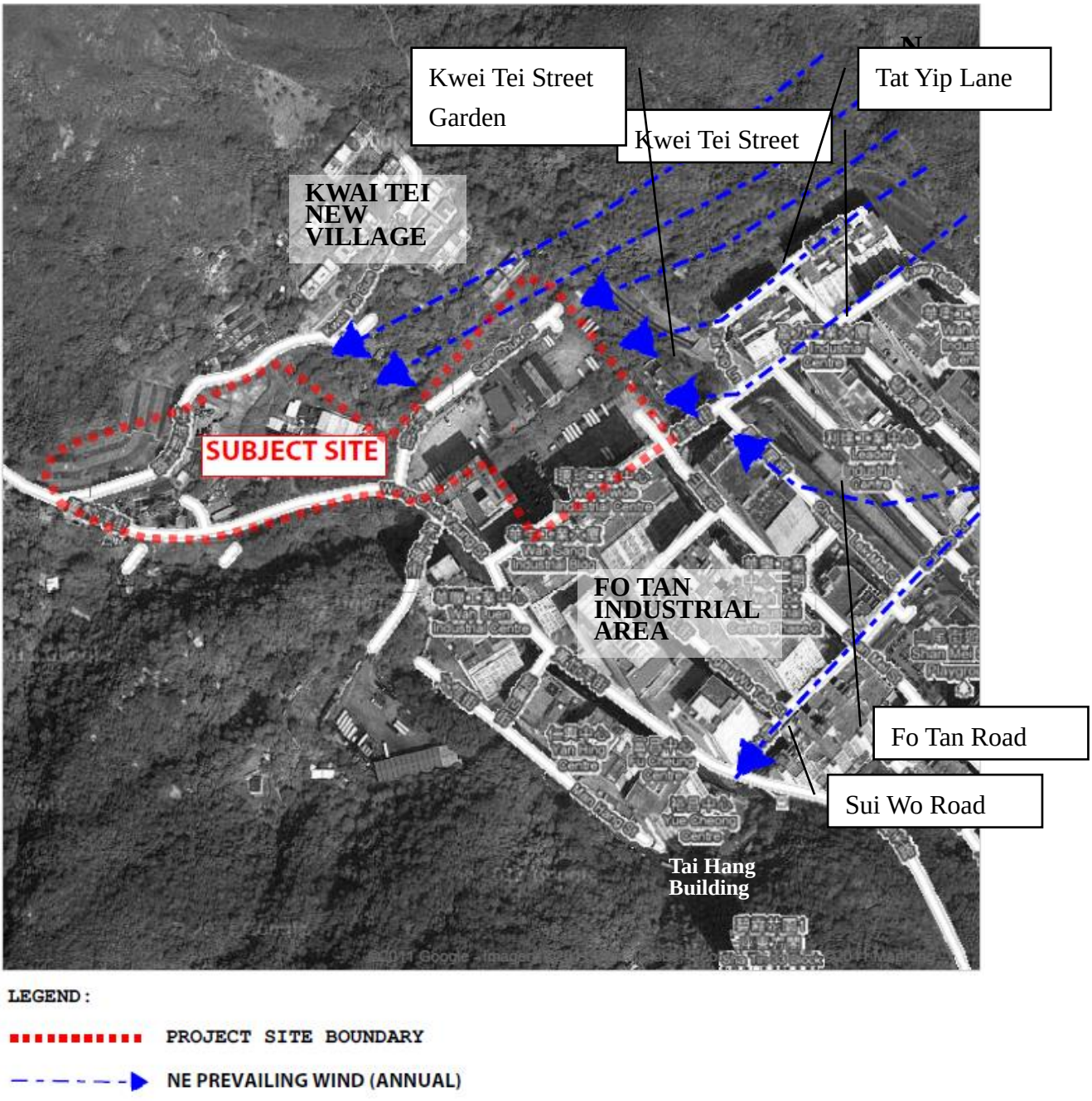


Figure 8 Existing Annual Wind Environment at Subject Site (NE Wind)

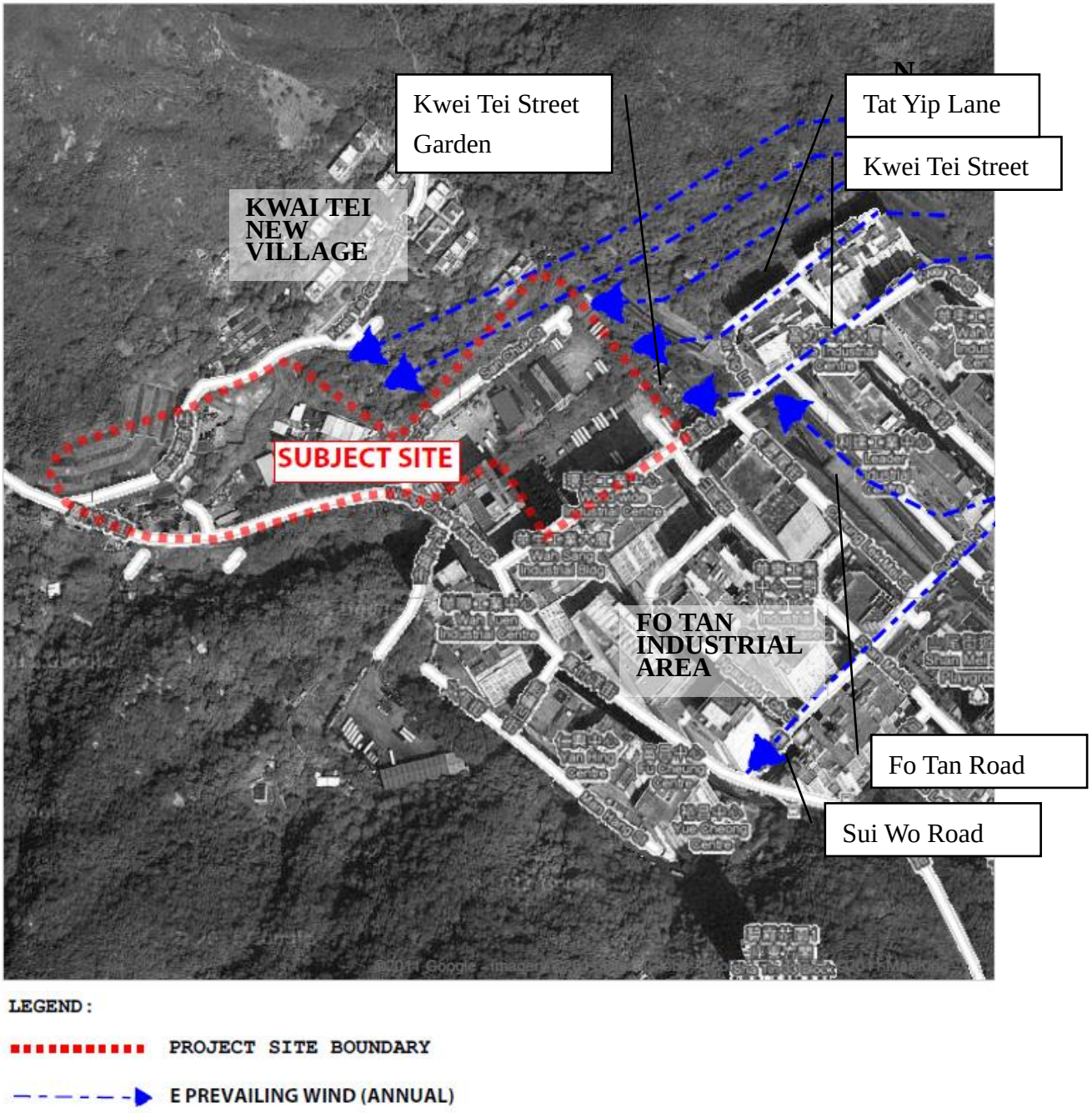


Figure 9 Existing annual Wind Environment at Subject Site (E Wind)

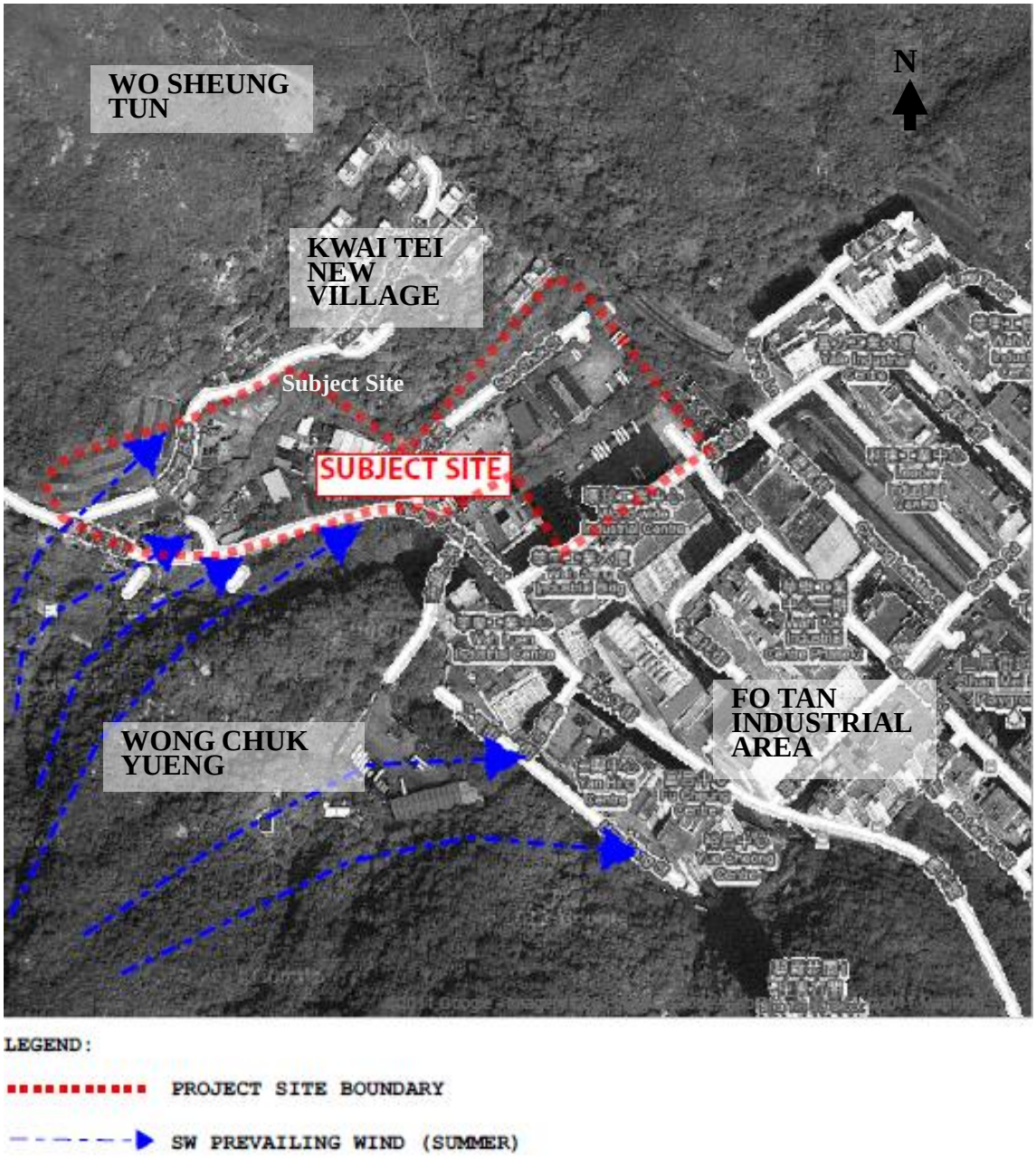


Figure 10 Existing Summer Wind Environment at Subject Site (SW Wind)

3.4. WIND CONDITION FOR PROPOSED DEVELOPMENT

3.4.1. Referring to the Expert Evaluation, with consideration of good design features and the enhancements of drawbacks, the Design Scheme A and B has been proposed as shown in ***Figure 1*** and ***Figure 2***, and the good design features are summarized as follows:

- **Building Disposition**: optimizing the orientation of the building to enhance separation between buildings; as shown in ***Figure 11***, the building blocks are aligned with the annual prevailing E and NE wind as far as practicable to reduce the blockage to the prevailing winds; the building separations for Design Scheme B is maximized with at 20m to 23.4m; for the details of building separations, please refer to ***Appendix A & B***.

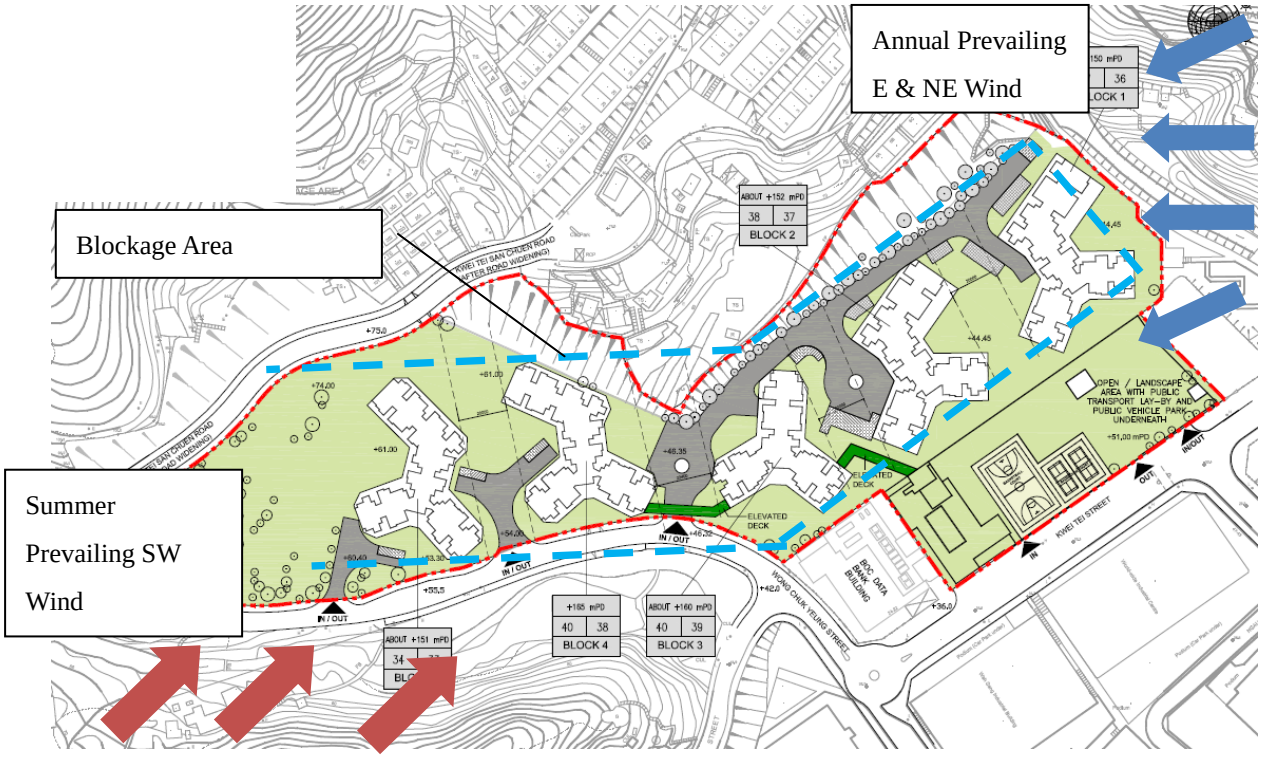


Figure 11 Building Disposition and Separations

- **Height Profiles**: promoting the air movement throughout the development by the varying height profile with strategic disposition of buildings; and optimizing the wind capturing potential of development by the stepping building height design as shown in ***Figure 12***;

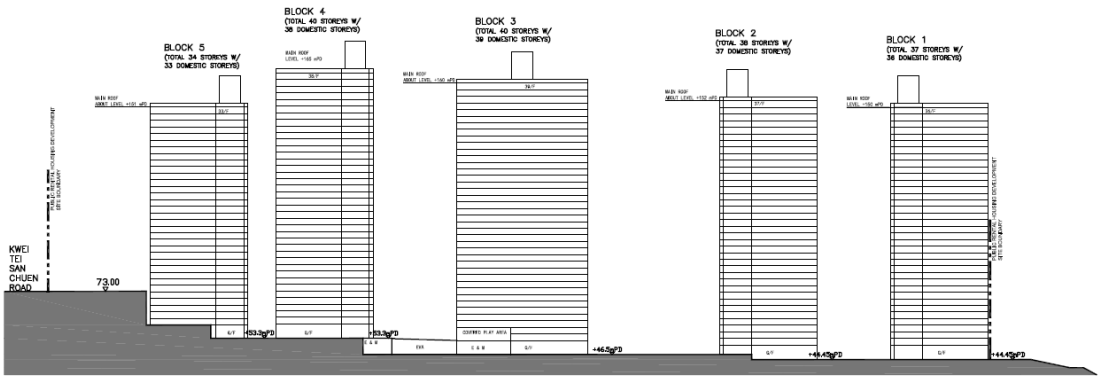


Figure 12 Varying Building Heights

- **Building Separation**: Allowing a free flow area to the existing village and the proposed podium deck and avoiding the wind screening effects during the summer prevailing SW wind as shown in ***Figure 11***, the building block is oriented and enlarge the building separation between building blocks is enlarged to enhance the free flow area between buildings;

- **Building form Design**: modifying the building's shape by minimizing the building bulks in order to allow the better penetration of both annual and summer prevailing winds. Moreover, the number of building blocks are reduced to 5 from 6 of Design Scheme A for Design Scheme B which further reduces the bulkiness of the proposed development as a whole as to enhance wind penetrations.

3.4.2. The extent of these impacts was quantitatively investigated by CFD simulation and details of methodology are given in **Section 4**.

4. ASSESSMENT APPROACH AND METHODOLOGY

4.0.1. A computational fluid dynamics (CFD) computer simulation model, ANSYS FLUENT, is used for the assessment. As the proposed Fo Tan Home Ownership Scheme (HOS) Development and Public Rental Housing (PRH) Development are closely located, it is necessary to incorporate each other as committed developments in their separate

assessments. In view of this, the cumulative impacts due to both proposed developments will be assessed.

4.0.2. A matrix of AVA schemes scenario with different Designs is illustrated in **Table 4** below. Site layout plan and elevation for both Design Scheme A and Design Scheme B of PRH Development are appended in **Appendix A** and **Appendix B**.

Scenario ID	Scenario	HOS Site	PRH Site
1	Existing Condition	Vacant	Vacant
2	Scenario A	OZP compliance scheme (Design A of HOS)	OZP compliance scheme (Design A of PRH)
3	Scenario B	Proposed Scheme (Design B of HOS)	Proposed Scheme (Design B of PRH)

Table 4 AVA Schemes Scenarios for HOS Development and PRH Development

4.1. GEOMETRY AND DOMAIN SETTING

4.1.1. Geometry and simulation options for the subject developments and surrounding environment have been set up to calculate the wind speed around the developments and in the surrounding ambient. In this study, 3-dimensional models within the surrounding and assessment area were built in order to conduct CFD simulation. CFD boundaries area places at least 5H (H=117m) away from the modelling buildings as shown in **Figure 13**, **Figure 14** and **Figure 15.**

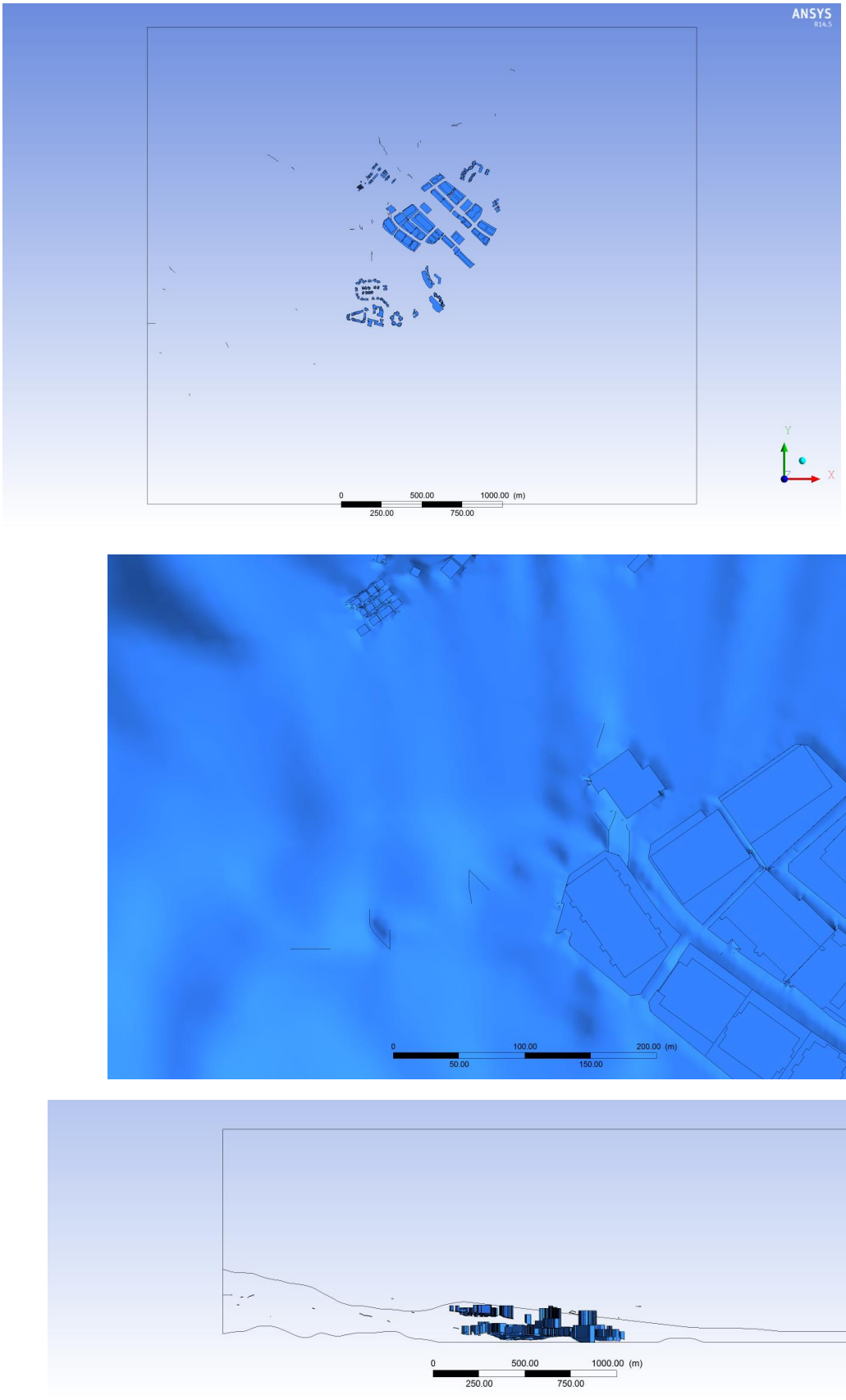


Figure 13 Dimensional Virtual Model of Existing Condition

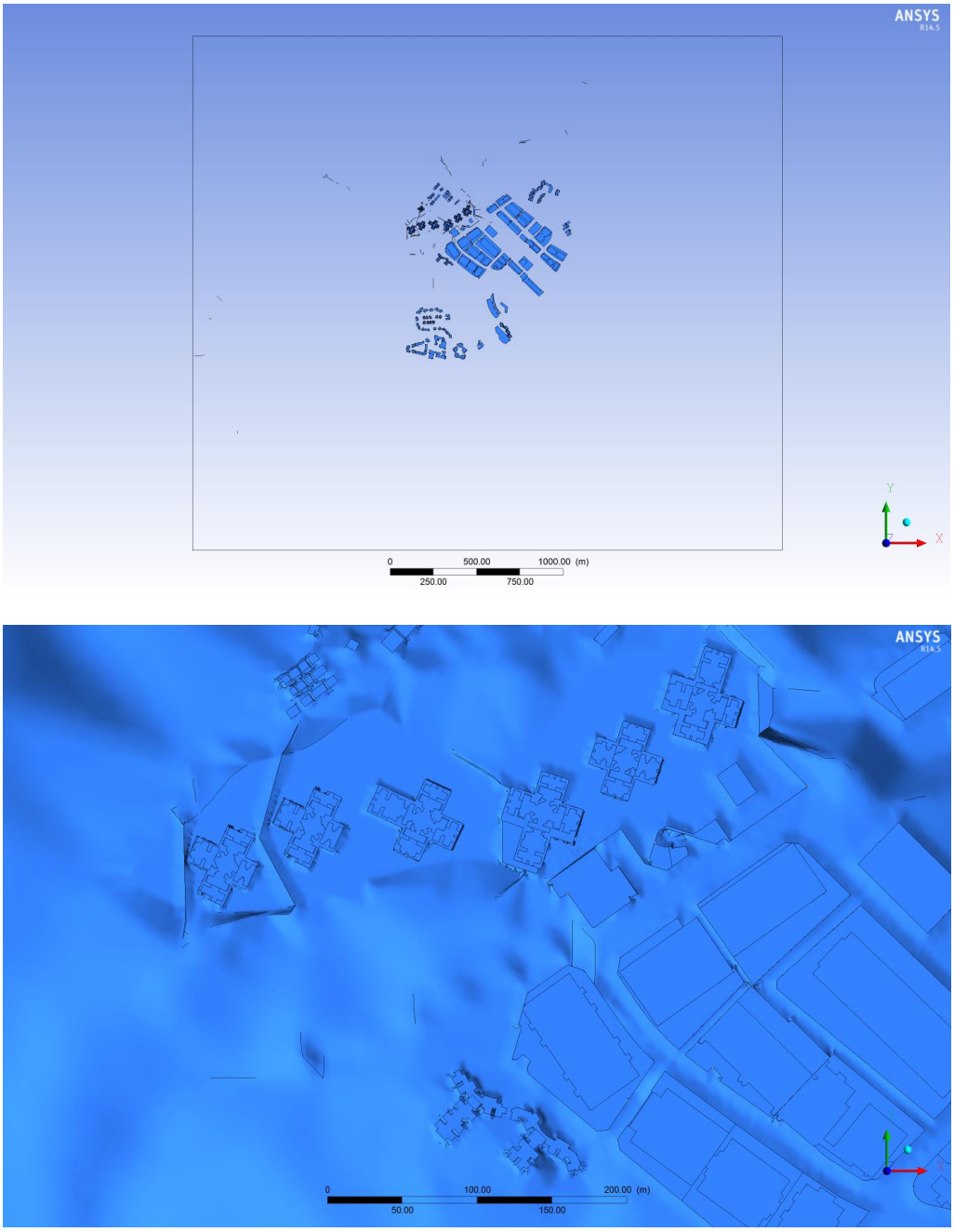


Figure 14 Dimensional Virtual Model of Scheme A

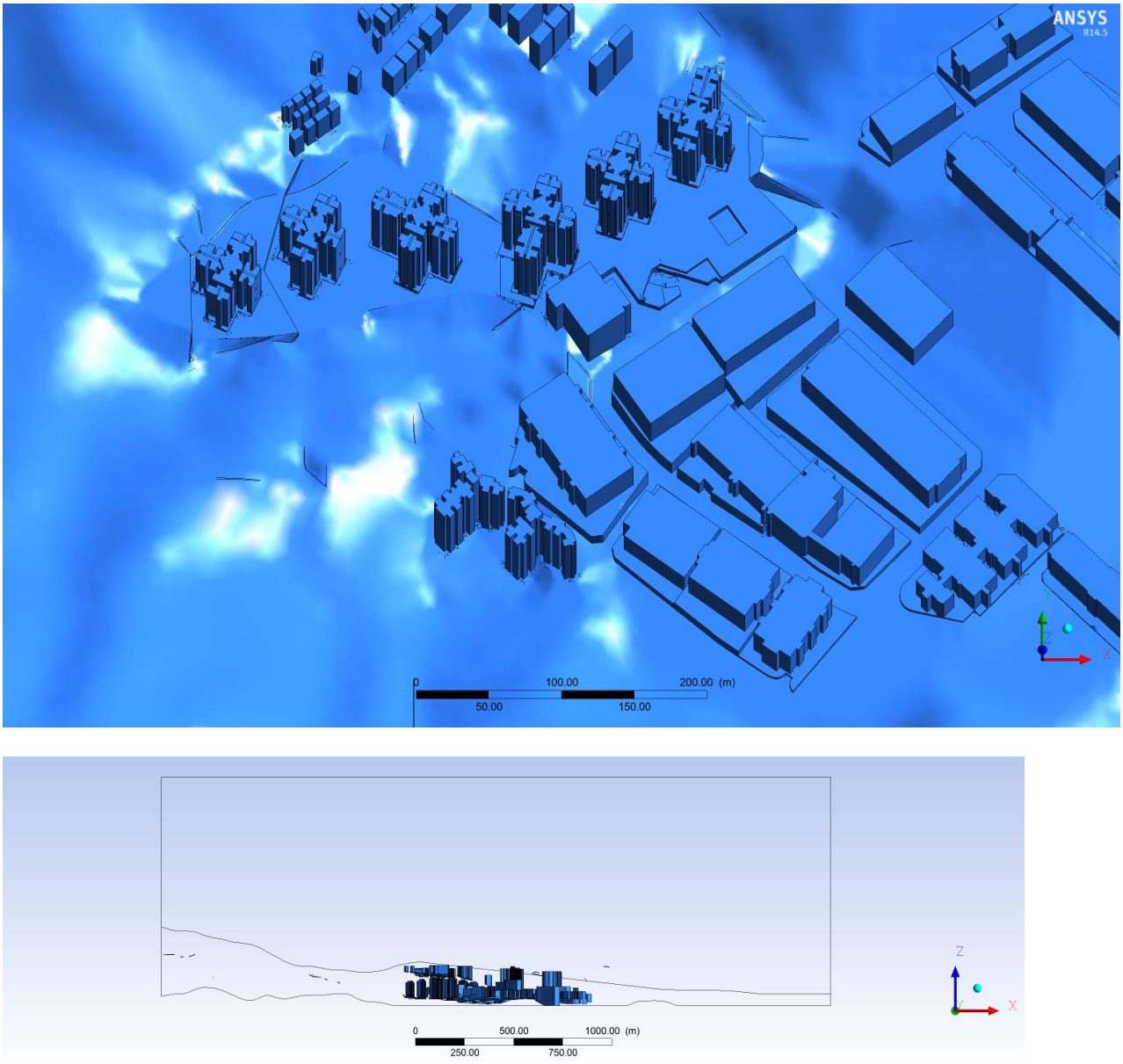
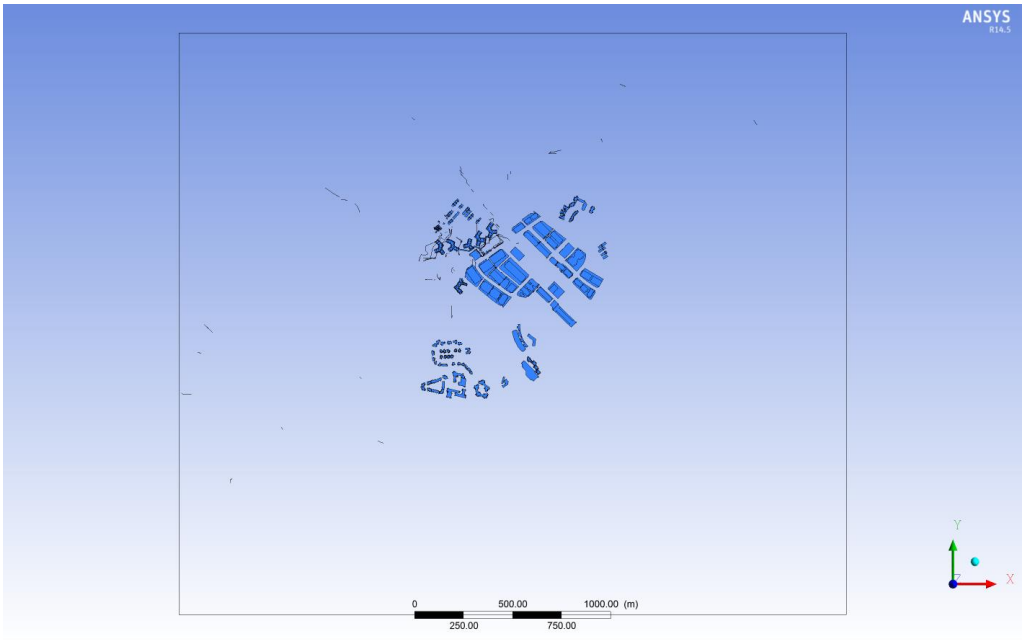


Figure 14 Dimensional Virtual Model of Scheme A (Continued)



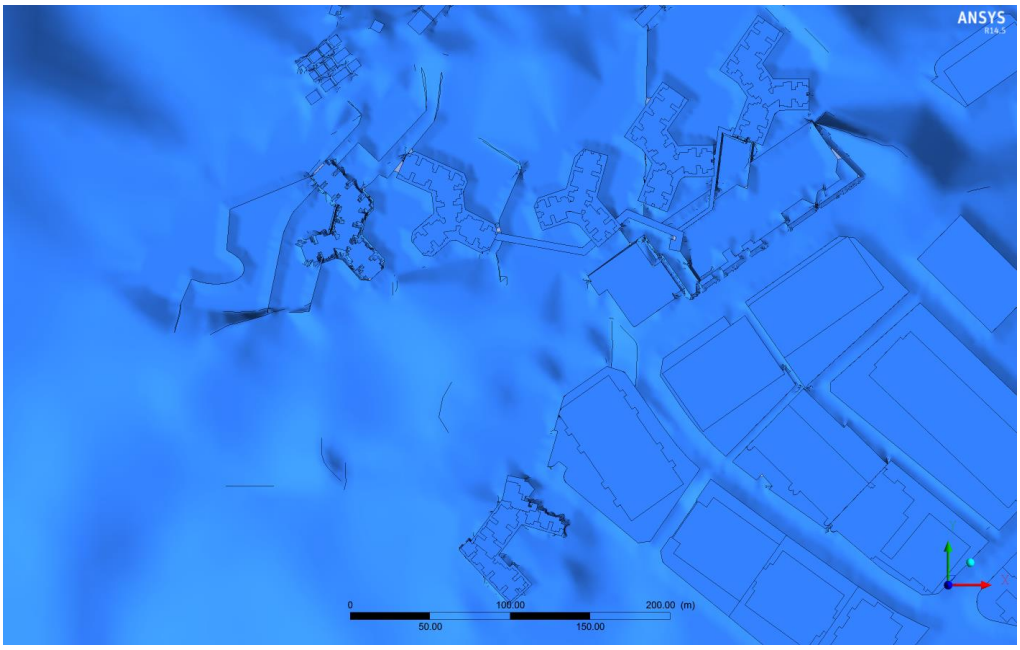


Figure 15 Dimensional Virtual Model of Scheme B

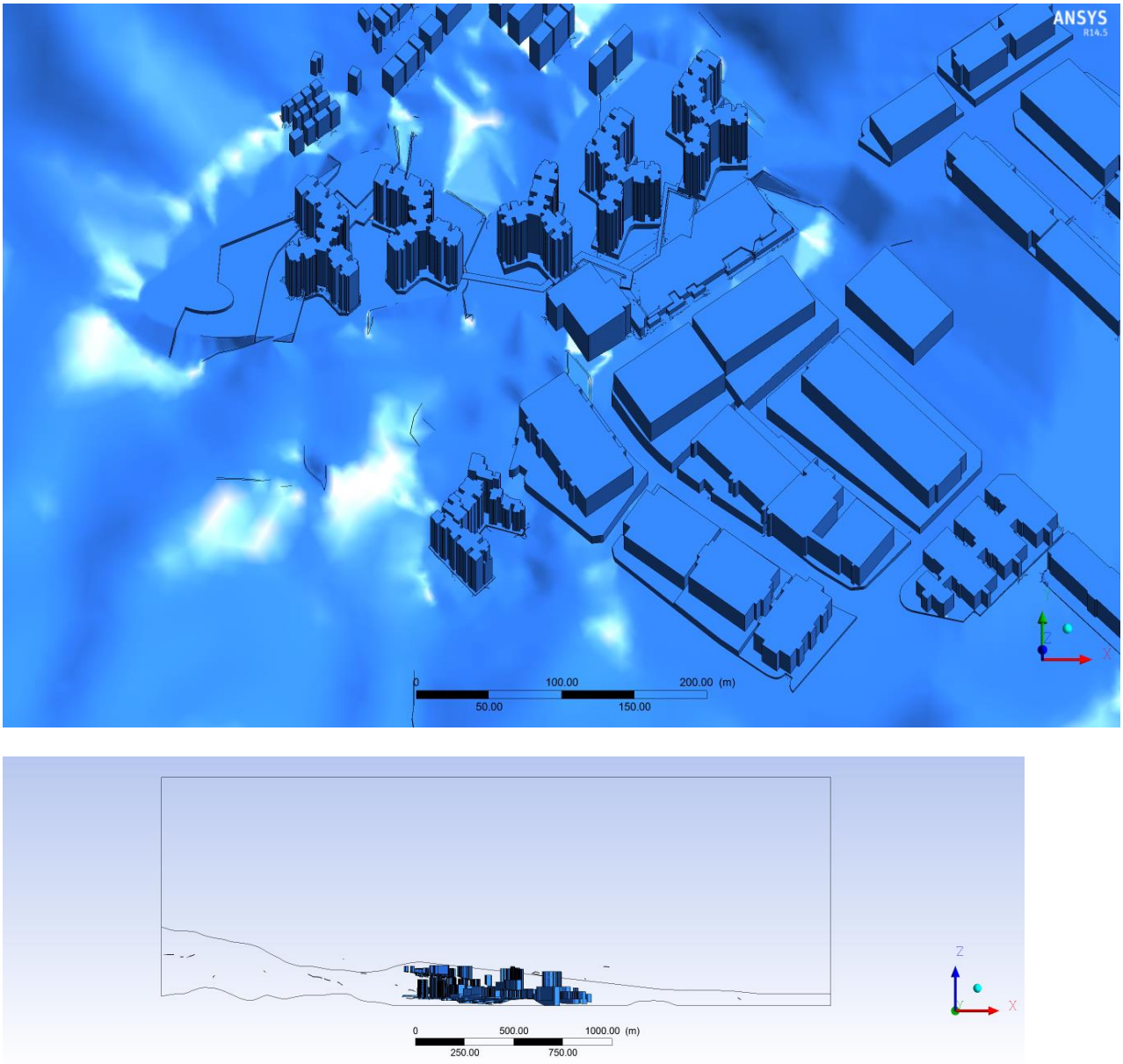


Figure 15 Dimensional Virtual Model of Scheme B (Continued)

4.1.2. The following assumption and inputs are adopted for CFD simulation:

Convergence	0.001
Numerical Scheme	Second order
Blockage Ratio	<3%
Setting of boundary condition	Refer to ***Appendix F***
Grid expansion ratio	1.2
Grid type	Tetrahedral
Prismatic mesh	4 layers of 0.5m

Table 5 CFD model assumptions

4.2. WIND PROFILE

4.2.1. Wind data used in CFD simulation should be referred to MM5 data published by Planning Department as recommended in the Technical Guide.

4.2.2. The occurrence of winds which exceed 75% of a reference year includes ENE, NE, E, NNE, ESE, SW, SE and SSW winds. As MM5 data indicates wind availability at 596m above ground level, in order to evaluate wind availability at pedestrian level (2m above ground level), the wind velocities of the eight probable winds obtained from MM5 are converted to pedestrian level. Wind profiles of different prevailing direction are determined using the Power Law:

$$\frac{U_z}{U_G} = \left(\frac{Z_Z}{Z_G}\right)^{\alpha}$$

Where U_Z is the wind speed at height z from ground;

U_G is the wind speed at reference height (top of wind boundary layer);

Z_Z is the height z from ground;

Z_G is the reference height (top of wind boundary layer); and

α is the power law exponent.

4.2.3. The power law exponent (α) is based on the roughness length of the approaching area outside the modelled area. With reference to the power law exponent suggested by Givoni (1998)[1], 0.25 for wooded land; 0.28 for city centres, buildings of medium to high density, typical building height 30 meters (10 storeys) by Poreh and Paciuk (1980). Wind profile for the 79.7% of wind occurrence and the velocity at the top of the wind boundary layer (596m) can be referred to **Table 6.**

Wind Direction	Probability (%)	Velocity (m/s)
ENE	0.148	8.743
NE	0.147	9.796
E	0.146	8.000
NNE	0.086	9.471
ESE	0.082	6.622

[1] Givoni, B. (1998). General modifications of the wind field by urbanization. In *Climate considerations in building and urban design.* John Wiley and Sons.

Wind Direction	Probability (%)	Velocity (m/s)	
SSW	0.07	6.229	
SW	0.061	6.016	
SE	0.057	6.289	~79.7%
SSE	0.049	5.378	
S	0.037	4.703	
N	0.032	4.094	
WSW	0.027	4.981	
NNW	0.021	2.500	
W	0.015	3.733	
WNW	0.012	2.708	
NW	0.012	2.708	

Table 6 Wind Direction for Air Ventilation Assessment

4.3. TEST POINTS

4.3.1. Test Points are the locations where Wind Velocity Ratio (VRs) at 2m above ground level is reported. Based on the VR of the test points, the resultant wind environment of the project can be assessed. Perimeter Test Points and Overall Test Points are distributed around the project site.

4.3.2. Perimeter Test Points are distributed to areas around perimeters of the project area boundary which are likely to be frequently accessed by pedestrians. Test Points in this group are named with prefix "P" (i.e. P1, P2…). There is a total of 38 Perimeter Test Points distributed at an approximate 50m interval along the perimeter of the subject site. This group of perimeter test points provides data for the Site Air Ventilation Assessment.

4.3.3. Overall Test Points are distributed on areas within the assessment area boundary and project site boundary, which are frequently accessed by pedestrians. Test points in this group are named with prefix "O" (i.e. O1, O2…). There is a total of 93 Overall Test Points evenly distributed on the streets, open space and places. This group of Overall test points, together with the perimeter test points provides data for the Local Air Ventilation Assessment.

4.3.4. Locations of the perimeter test points and Overall test points are shown in **Figure 16** and **Figure 17.**

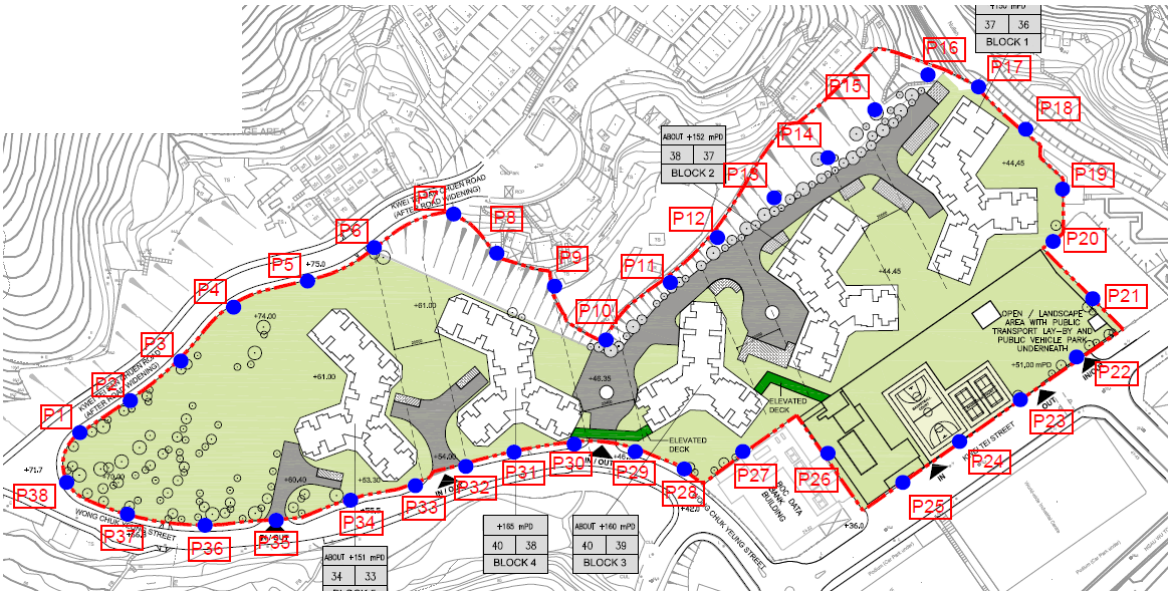


Figure 16Positions for Perimeter Test Points

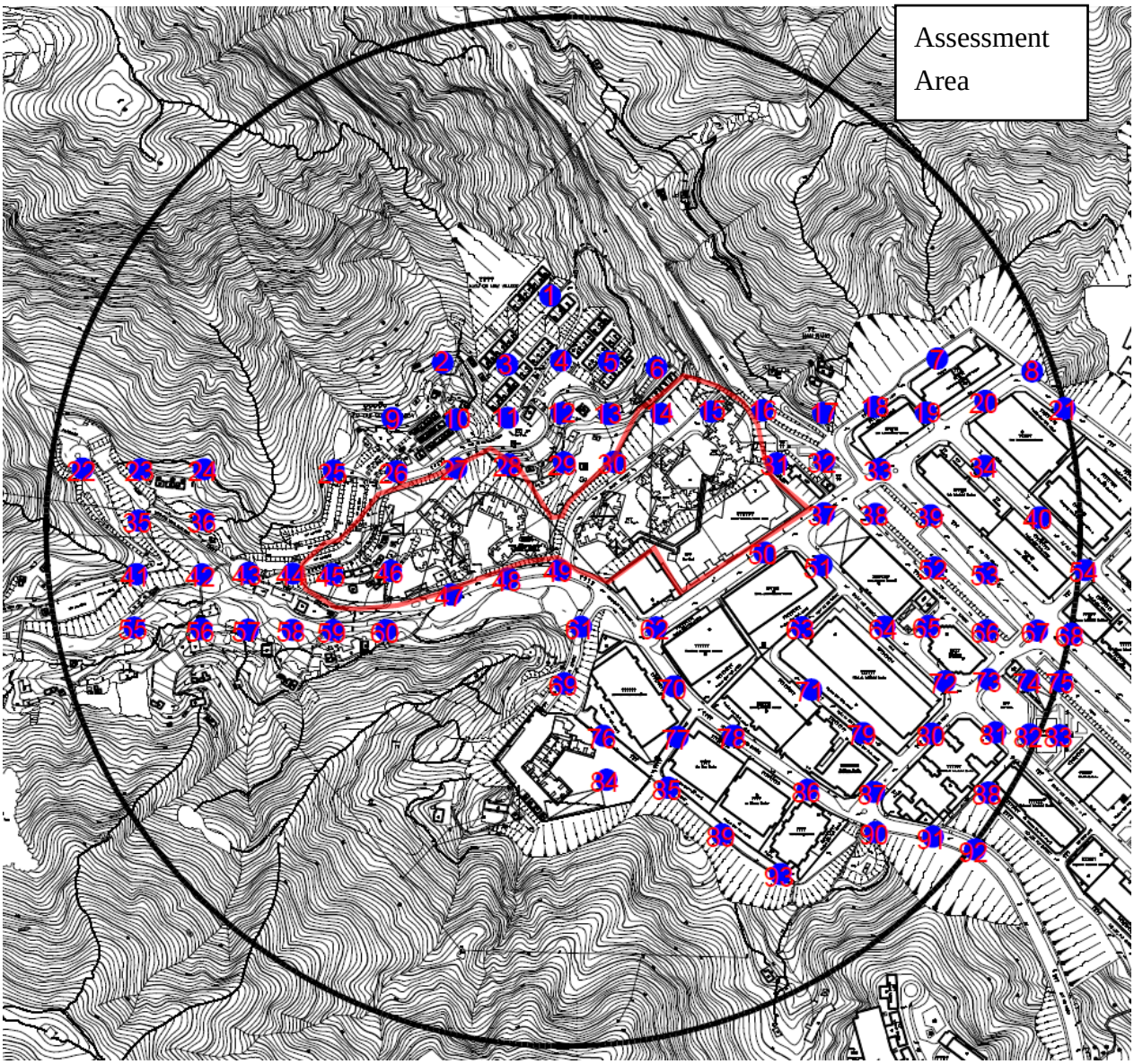


Figure 17Positions for Overall Tests Points

4.4. WIND VELOCITY RATIO

4.4.1. Wind velocity is assessed at 2m above ground level and podium level of the proposed residential tower. Wind Velocity Ratio (VR) should be used as an indicator of wind performance for the AVA. It indicates how much of the wind availability of a location could be experienced and enjoyed by pedestrians. The higher the wind velocity ratio, the less likely would be the impact of the proposed developments on the wind availability.

Wind Velocity Ratio is defined as follows:

$$VR_w = \frac{V_p}{V_\infty}$$

where

Vp is the wind velocity at the pedestrian level (2m above ground) after taking into account the effects of buildings; and

V∞ is the wind availability of the site, i.e. wind velocity at the top of the wind boundary layer. MM5 data are used to determine velocity at infinity level for the project site.

4.4.2. The assessment on the overall wind performance of the current situation and the proposed developments were analysed by comparing the weighted-mean wind velocity ratio (VRw') to account for wind coming from the 8 wind directions. VRw' is the sum of the Wind Velocity Ratio of wind from direction i (VRi) multiplied by the probability (Fi) of wind coming from that direction.

$$VRi = \frac{V_{pi}}{V_{\infty i}} \qquad VR_w = \sum_{i=1}^{16} Fi \times VRi$$

where

Vpi is the wind velocity at the pedestrian level (2m above ground) when wind comes from direction i; and

$V_{\infty i}$ is the wind availability of the site, when wind comes from direction i

Fi is the frequency occurrence of wind from direction i, 16 directions are considered.

VRw is the wind velocity ratio

4.4.3. The normalized weighting (Fi) for each wind direction is summarized in **Table 7.**

Wind Direction	**Occurrence frequency of the wind direction**	**Normalized weighting**
ENE	14.8%	18.6%
NE	14.7%	18.4%
E	14.6%	18.3%
NNE	8.6%	10.8%
ESE	8.2%	10.3%
SSW	7.0%	8.8%
SW	6.1%	7.7%
SE	5.7%	7.2%
Total	**79.7%**	**100%**

Table 7 Weighted occurrence frequency of the wind directions

4.4.4. For the Site Air Ventilation Assessment, the Site spatial average Velocity Ratio (SVR) is reported, which takes into account the perimeter test points (Point P1 to P38) evenly positioned on the project site boundary as shown in **Figure 16.**

4.4.5. For the Local Air Ventilation Assessment, the Local spatial average Velocity Ratio (LVR) is reported, which takes into account both perimeter test points and the overall test points evenly distributed and positioned in the open spaces, on the streets within the assessment area (Point O1 to O93 and P1 to P38) as shown in **Figure 16** and **Figure 17.**

5. INITIAL STUDY FINDINGS

5.1. AIR VENTILATION RESULT

5.1.1. The simulation results of velocity ratio demonstrated in terms of contour and vector plots for all prevailing wind directions are provided in **Appendix C**.

5.1.2. For the air ventilation assessment of the proposed schemes, 38 perimeter test point and 93 overall test points are assigned at the pedestrian area. The wind velocity ratios (VR) at each test points for all prevailing directions as well as weighted average wind velocity ratio (VRw) at each test points are tabulated in **Appendix D**.

5.1.3. The differences of VRw at each perimeter test point and overall test points between Existing Condition, Scheme A and Scheme Bare presented in **Appendix E.**

5.1.4. The site AVA results (SVR) evaluated by considering perimeter test points (38 points) are tabulated in **Table 8**; while the Local AVA results (LVR) evaluated by considering both perimeter test points (38test points) and overall test points (93 test points) are tabulated in **Table 9.**

Wind Directions	VRaverage (Existing Condition)	VRaverage (Scenario A)	VRaverage (Scenario B)	VRaverage Change (Scenario B - Scenario A)	% VRaverage Change (Scenario B - Scenario A)	VRaverage Change (Scenario B - Existing Condition)	% VRaverage Change (Scenario B -Existing Condition)
E	0.176	0.123	0.123	0.000	0.1%	-0.053	-43.3%
ENE	0.180	0.127	0.134	0.007	5.5%	-0.046	-34.3%
ESE	0.176	0.124	0.132	0.008	6.1%	-0.045	-34.0%
NE	0.261	0.292	0.280	-0.012	-4.4%	0.019	6.8%
NNE	0.308	0.286	0.295	0.010	3.3%	-0.013	-4.4%

SE	0.098	0.113	0.126	0.013	10.1%	0.028	22.2%
SSW	0.339	0.258	0.259	0.001	0.3%	-0.080	-31.1%
SW	0.354	0.278	0.248	-0.030	-12.0%	-0.106	-42.6%
SVRw	**0.218**	**0.179**	**0.181**	0.002	0.9%	-0.037	-20.5%

Table 8 Summary of Weighted Site Velocity Ratio (SVRw)

Wind Directions	VRaverage (Existing Condition)	VRaverage (Scenario A)	VRaverage (Scenario B)	VRaverage Change (Scenario B - Scenario A)	% VRaverage Change (Scenario B - Scenario A)	VRaverage Change (Scenario B - Existing Condition)	% VRaverage Change (Scenario B -Existing Condition)
E	0.25	0.205	0.208	0.003	1.4%	-0.040	-19.2%
ENE	0.22	0.205	0.234	0.030	12.6%	0.012	5.3%
ESE	0.23	0.202	0.218	0.016	7.1%	-0.017	-7.9%
NE	0.26	0.270	0.281	0.011	4.0%	0.018	6.4%
NNE	0.34	0.323	0.334	0.011	3.4%	-0.011	-3.2%
SE	0.16	0.166	0.170	0.004	2.3%	0.008	4.7%
SSW	0.28	0.220	0.213	-0.007	-3.4%	-0.062	-29.1%
SW	0.31	0.235	0.244	0.009	3.8%	-0.070	-28.8%
LVRw	**0.252**	**0.223**	**0.235**	0.012	5.0%	-0.016	-7.0%

Table 9 Summary of Weighted Local Velocity Ratio (LVRw)

5.2. AIR VENTILATION ASSESSMENT

5.2.1. For perimeter test points, as shown on **Table 8,** SVR of Scenario B varies from that of Scenario A ranging from -12% to 10.1% for various wind directions and the SVRw is increased by 0.9% for Scenario B. For both perimeter and overall test points, as shown on **Table 9**, LVR of the Scenario B varies from that of Scenario A ranging from -3.4% to 12.6% and the weighted average LVRw is increased by 5% for Scenario B. As compared with Scenario B which possessed a SVRw of 0.181 and LVRw of 0.235, Scenario A has a SVRw of 0.179 and LVRw of 0.223.

5.2.2. As compared to the existing condition, the SVR and LVR of Scenario B are decreased by 20.5% and 7% respectively. As shown from the above results, the slight increase in SVRw from Scenario B to A indicates the reduction on the number of building blocks enhances the wind performance of the lower portion of the proposed development. The 5% increase in LVRw fomr Scenario B to A indicates that although the increase in building heights of

the design schemes, the reduction of the number of building blocks of the PRH development gives and overall enhancement in terms of the overall upper portion of the development.

5.2.3. As Kwai Tei New Village is located immediate adjacent to the proposed PRH development, there may be concern that the development may have adverse impact to their ventilation particular under south-westerly wind directions such as SW and SSW wind analysed in this study.

5.2.4. From the contour vector plots shown in **Appendix C**, the wind environment around Kwai Tei New Village under summer prevailing SW wind condition is slightly enhanced particularly at Fo Tan Road and at some areas at Kwei Tei New Village in Scenario B compared with Scenario A, which has domestic block no.6 removed to enhances the ventilation performance together with the building setbacks from the development as shown in ***Figure 18*** & ***Figure 19***. In terms of SSW wind condition, the wind environment around the area at northern side of proposed development is slightly better in Scenario A than Scenario B, the building separations had been maximised to about 20m and reduced the number of building blocks, in order to enhance the wind availability at northern site of the proposed development. However, no major stagnant zone is observed.

Figure 18 Setback Distance from adjacent Kwai Tei New Village for Scheme A

Figure 19 Setback Distance from adjacent Kwai Tei New Village for Scheme B

5.2.5. By comparing the wind environment of Scenario B and the existing condition under the summer prevailing SW wind. It is observed that the approaching SW wind is diverted into 2 paths, to Kwai Tei New Village via the open area around Kwei Tei San Chuen Road and south east direction towards inner Fo Tan industrial areas and Shing Mun River.

5.2.6. The proposed PRH development is located at an open area of which was originally facilitating air movements to the inner Fo Tan industrial area under summer prevailing SW wind condition. As a result, impact to the approaching wind is anticipated with the proposed development. Wind availability is reduced at Fo Tan Road under SW and SE wind conditions for both Scenario A & B when compared to the existing condition.

5.2.7. Under SW wind condition, the proposed PRH subject site was an open area which facilitate the approaching wind to penetrate through to the inner Fo Tan Area. However, for Scenario A and B, stagnant area is located at Tat Yip Lane where the approaching wind is diverted by the proposed PRH development. With the carefully planned orientations and disposition of building blocks for both Design Schemes, it is observed that the impact has been minimized as far as practicable. However, the increase in building height of podium for Design Scheme B has a larger effect on the area downstream than Design Scheme A, wind availability in Tat Yip Lane near Grandville in Scenario B is not as good as Scenario A. Since the building form and height, especially to the proposed podium (green area as shown in Figure 19), has been optimized based on the latest ground condition and design headroom requirement, it is difficult for Scheme B to be further reduced in height above

ground, leading to difficulty for further enhancement of the wind environment at Tat Yip Lane. Nonetheless, the separation between the podium (Green area in Figure 19) and the residential building, which is about 12m in Scheme B, is suggested to be further widened as mitigation measure.

5.2.8. It is observed that under SSW condition, less but acceptable amount of wind is allowed to penetrate through PRH development in Scenario B, though the result is not as good as Scenario A. Scenario B has maximized the building separations to about 20m and reduced the number of building blocks, in order to enhance the wind availability at northern site of the development. Due to the constraint of surrounding cut slopes and limitation of site boundary, orientations and disposition of building blocks for Schemes B had been optimised. It would be very difficult to further change the orientations and disposition of building blocks as well as meeting the design requirements. Nonetheless, increase in quantity and size of empty bays in lower floor should be considered to alleviate the impact in surrounding area.

5.2.9. In terms of annual prevailing E and NE wind condition, it is shown by the contour vector plot that no major change in the wind environment is observed for Scenario A and Scenario B. As shown in ***Appendix A*** and ***Appendix B***, the building dispositions with about 20m building separations and orientations are optimized for both schemes where approaching annual prevailing winds are able to penetrate the proposed development without substantial impediments. Good design recommended by Urban Design Guideline of Planning Department is reference when optimizing the dispositions and building separations as shown in **Figure 20**.

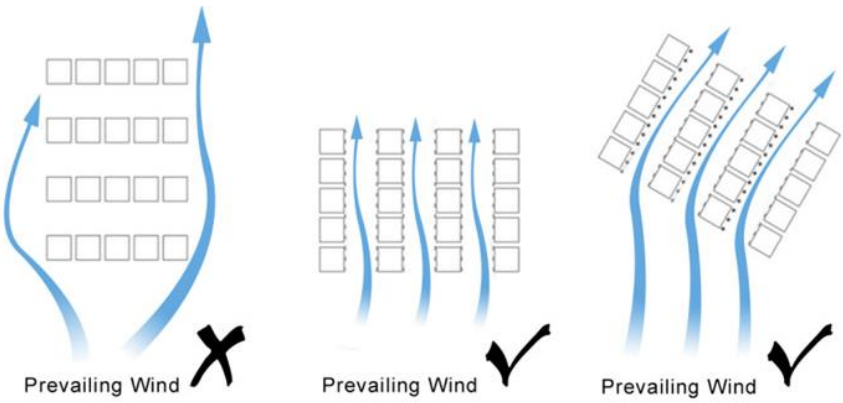


Figure 20 Good Ventilation Design Features recommended by Urban Design Guideline

5.2.10. In terms of ENE wind condition, a stagnant area is observed in the downwind area adjacent to Block 5 of both Scenario A & Scenario B at Wong Chuk Yeung Street. The wake region is created when the approaching wind passing through the proposed PRH development. However, the downstream area is not accessible by pedestrian. Kwei Tei Street along the proposed PRH development is slightly enhanced in Scenario B than Scenario A. the building form of Proposed Design Scheme B allow more wind to penetrate to the downstream Kwei Tei Street from Kwei Tei Street Garden.

5.2.11. Under ESE wind, the wind availability at Kwai Tei New Village is affected by the proposed PRH development. However, adequate building separation is provided by the proposed PRH development to facilities air penetration through to Kwai Tei New Village to mitigate the problem as far as practicable. Both SVR and LVR indicate Scheme B would impose better wind environment than Scheme A.

5.2.12. For SE wind condition, no major stagnant zone or wind gust problem is observed in the downwind Kwai Tei New Village. Again the building separation has provided air paths for the approaching SE wind to penetration through to Kwai Tei New Village and no major difference in terms of ventilation performance is observed for both PRH Design Schemes.

5.2.13. In terms of assessment area as a whole, with the proposed mitigation measures and enhancements, the wind environment with the presence of the proposed PRH and HOS development would impose some impact on the pedestrian wind environment under both annual and summer conditions when compared with the Existing Scenario, however no significant adverse impact is anticipated and the result shown that both Scenario A and B are comparable. The comparison of Scheme A and B are summarised in **Table 9a**.

Wind Direction	Comparison of Scheme A and B / Further Mitigation
E	• Both SVR and LVR indicate Scheme B would impose better wind environment than Scheme A
ENE	• Both SVR and LVR indicate Scheme B would impose better wind environment than Scheme A. In particular, Kwei Tei Street along the proposed PRH development is slightly enhanced in Scenario B than Scenario A. • The building form of Proposed Design Scheme B allow more wind to penetrate to the downstream Kwei Tei Street from Kwei Tei Street Garden.
ESE	• Both SVR and LVR indicate Scheme B would impose better wind environment than Scheme A

Wind	Comparison of Scheme A and B / Further Mitigation
NE	• Both schemes would impose better wind environment than existing scenario. No major stagnant zone or wind gust problem is observed, as the building dispositions with about 20m building separations and orientations are optimized for both schemes.
NNE	• Both SVR and LVR indicate Scheme B would impose better wind environment than Scheme A.
SE	• No major stagnant zone or wind gust problem is observed in both schemes. • Both SVR and LVR indicate Scheme B would impose better wind environment than Scheme A.
SSW	• Wind environment is slightly decreased in Scheme B from Scheme A, but still acceptable. • Due to the constraint of surrounding cut slopes and limitation of site boundary, orientations and disposition of building blocks for Schemes B had been optimized. It would be very difficult to further change the orientations and disposition of building blocks as well as meeting the design requirements. • Nonetheless, increase in quantity and size of empty bays in lower floor should be considered to alleviate the impact in surrounding area.
SW	• LVRs indicate slightly enhancement in Scenario B than Scenario A. However, SVR indicates that stagnant area is located at Tat Yip Lane is found and Tat Yip Lane near Grandville in Scenario B is not as good as Scenario A. • As the building form and height, especially to the proposed podium (green area as shown in Figure 19), has been optimized based on the latest ground condition and design headroom requirement, it is difficult for Scheme B to be further reduced in height above ground, leading to difficulty for further enhancement of the wind environment at Tat Yip Lane. • The separation between the podium (Green area in Figure 19) and the residential building, which is about 12m in Scheme B, is suggested to be further widened as mitigation measure.

Table 9a Comparison of Scheme A and B / Further Mitigation

5.3. PROBLEM AND FOCUS AREA

5.3.1. To further assess the impact of the development on the wind environment of its immediate vicinity, some focus areas were identified. **Figure 21** indicated the locations of the focus area and the relevant test points.

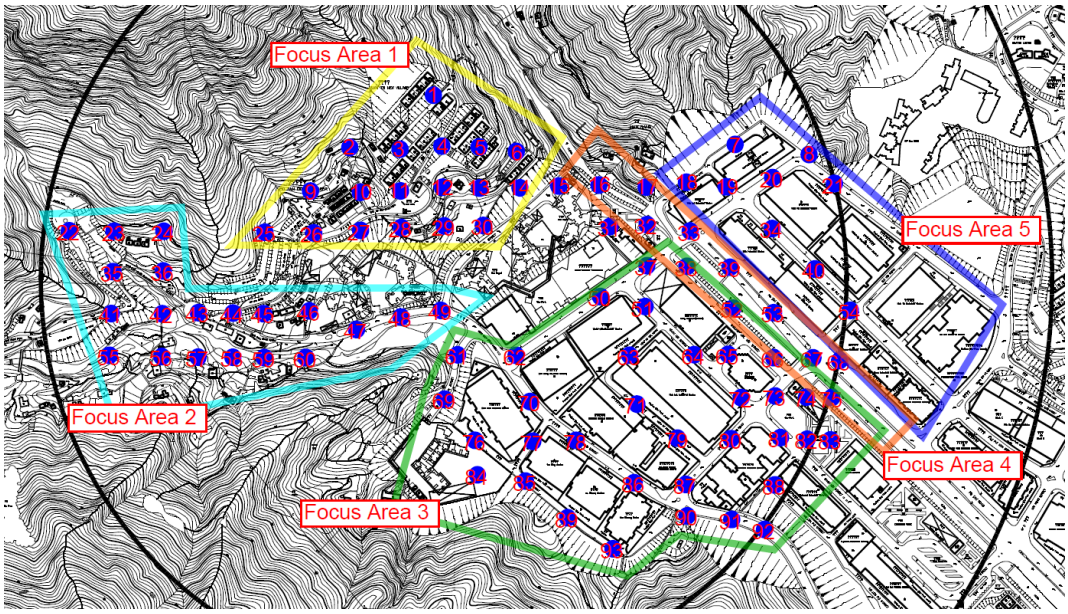


Figure 21Location s of Focus Areas

Focus Area	VRw (Existing Condition)	VRw (Scenario A)	VRw (Scenario B)	VR_w Change (Scenario B- Scenario A)	% VR_w Change (Scenario B- Scenario A)	VR_w Change (Scenario B- Existing)	% VR_w Change (Scenario B- Existing Condition)
Focus Area 1	0.216	0.190	0.176	-0.014	-7.8%	-0.04	-22.9%
Focus Area 2	0.287	0.224	0.249	0.025	10.1%	-0.04	-15.4%
Focus Area 3	0.281	0.243	0.270	0.026	9.8%	-0.01	-4.2%
Focus Area 4	0.274	0.247	0.279	0.032	11.4%	0.01	1.9%
Focus Area 5	0.250	0.245	0.258	0.013	5.0%	0.01	3.1%

Table 10Average Velocity Ratio of different Focus Areas

5.3.2. The VRw of Scenario B is generally increased as compared to the VRw of Scenario A. A slight increase in VRw is also observed when compared Scenario B with Existing condition in Focus Area 4 & 5 which is the south-east part of the Fo Tan industrial area.

5.3.3. The wind environment at Focus Area 1 is anticipated to deteriorate with the proposed PRH development. However, with the proposed mitigation measures of maximizing building separations and reduction of 1 number of building block of Scenario B; mitigation measured have been provided as far as practicable where the impact to the surroundings have been minimized and the overall wind environment at Fo Tan Area is maintained as far as practicable.

5.3.4. With the design mitigation measures such as building disposition and orientations, about 20m building separation between domestic blocks, the VRw of Scenario B is maintained to a level comparable as compared to the existing condition where no major stagnant zone or wind gust problem is observed.

5.3.5. As shown in the VRw for each test point **Appendix D**. No individual test point VRw is significant higher or lower than the LVR within the assessment area. This further suggests that there is no major stagnant zone or wind gust problem located within the assessment area.

6. CONCLUSION

6.0.1. In this Initial AVA Study, two scenarios, Design Scheme A and Design Scheme B for the subject site being assessed by CFD modeling are investigated.

6.0.2. Based on the result of the wind rose analysis, the wind directions for the Subject Site and the surrounding area representative of the prevailing situations are determined to be mainly ENE, E, NE, ESE, SSW, SE and SW. These 8 of the 16 wind directions which occur for about 79.7% of time in a year are adopted in the Initial Study.

6.0.3. According to the CFD modelling results, it can be concluded that both SVRw and LVRw are changed slightly from the Scheme A to the Scheme B. The overall air ventilation performance will have some minor impacts due to the development when compare to the existing where air ventilation may be slightly deteriorated at Kwai Tei New Village under ESE wind condition and Tat Yip Lane under SW wind condition, but most surrounding areas maintained in terms of wind performances with the proposed development. Besides, with the proposed mitigation measures of maximizing building separations and reduction of 1 number of building block of Scenario B; mitigation measured have been provided as far as practicable where the impact to the surroundings have been minimized and the overall wind environment at Fo Tan Area is maintained as far as practicable. As result, the Scheme B maintains a proper wind environment within the development where the wind environment is maintained to a level comparable to the existing condition.

APPENDIX A SITE LAYOUT PLAN FOR PUBLIC RENTAL HOUSING DEVELOPMENT SCHEME A

FO TAN COTTAGE AREA

KWAI TEI SAN CHUEN ROAD (AFTER ROAD WIDENING)

KWAI TEI SAN CHUEN ROAD +72.22 (AFTER ROAD WIDENING)

WONG CHUK YEUNG STREET

KWEI TEI STREET

PHASE 2

BLOCK 1

BLOCK 2

BLOCK 3

BLOCK 4

BLOCK 5

BLOCK 6

GARDEN DECK

Basement carpark

BASEMENT CARPARK RUN IN/OUT

DRIVEWAY / EVA

EVA

VEHICULAR ACCESS / EVA

E.V.A.

LIFT TOWER

GREEN ROOF +46.50

GREEN ROOF +38.10

BOC DATA BANK BUILDING

Kwai Tei Street Substation

Podium (Car Park under)

Wah Samp Industrial Building

Worldwide Industrial Centre

Podium

Graves

Nullah

MAN

PHASE 2

PHASE 1

PHASE BOUNDARY

BOUNDARY LINE

BOUNDARY LINE

BLOCK 6
(TOTAL 31 STOREYS W/ 30 DOM. STOREYS)

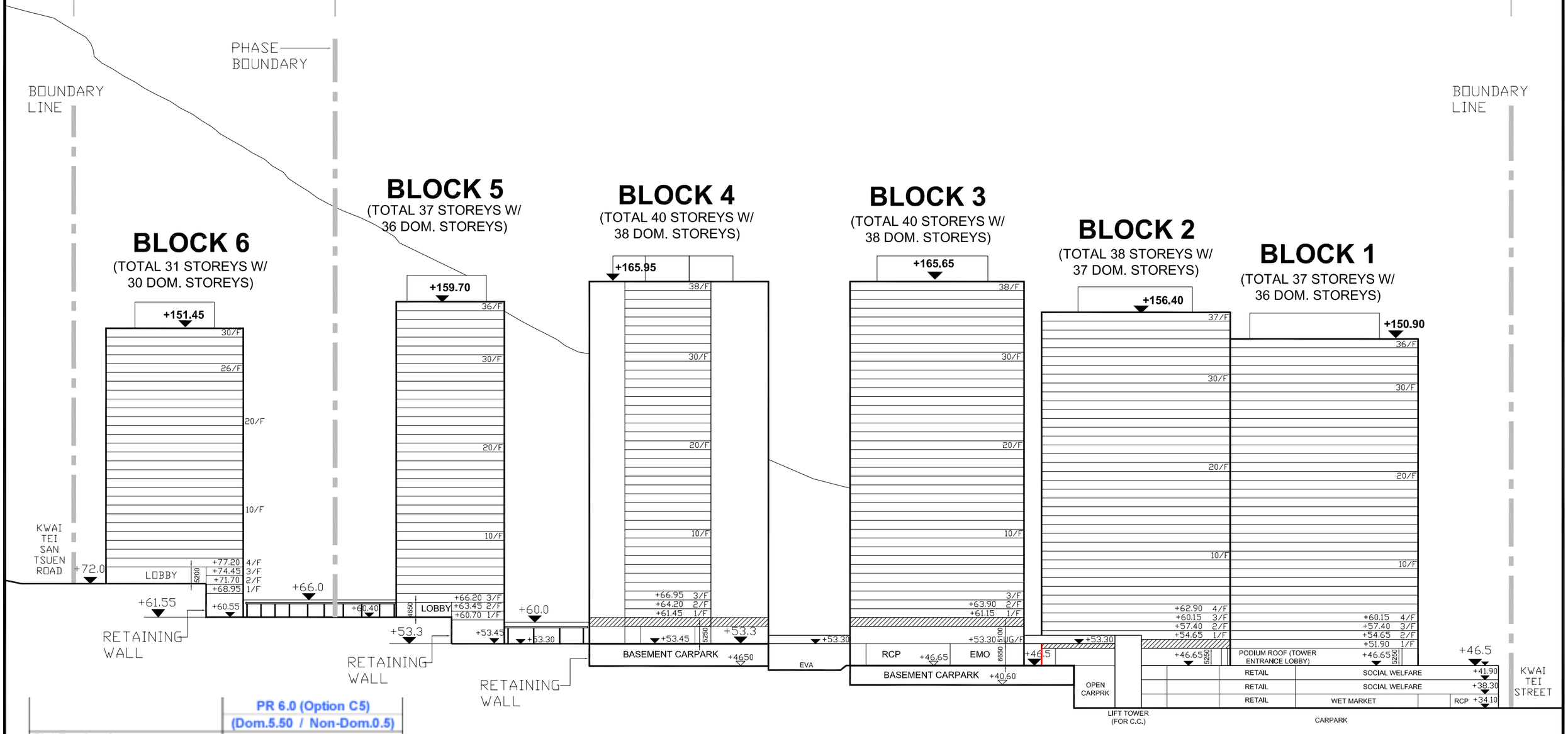
BLOCK 5
(TOTAL 37 STOREYS W/ 36 DOM. STOREYS)

BLOCK 4
(TOTAL 40 STOREYS W/ 38 DOM. STOREYS)

BLOCK 3
(TOTAL 40 STOREYS W/ 38 DOM. STOREYS)

BLOCK 2
(TOTAL 38 STOREYS W/ 37 DOM. STOREYS)

BLOCK 1
(TOTAL 37 STOREYS W/ 36 DOM. STOREYS)



		PR 6.0 (Option C5) (Dom.5.50 / Non-Dom.0.5)
Flat Production		4,788
Parking provision (Domestic)	Private	140
	Motor cycle	31
	LGV	14
Open Space		13,681 m2
Population		13,681
Max. GFA		234,000 m2
Retail (IFA)		3,600 m2

29 July 2013

PUBLIC RENTAL HOUSING AT FO TAN (SHA TIN AREA 16 & 58D)

SITE SECTION

SCALE : N.T.S.

房 屋 署
HOUSING DEPARTMENT

編 號 PLAN No.

日 期 DATE:

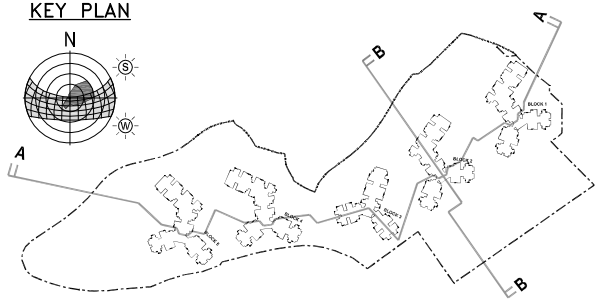
APPENDIX B SITE LAYOUT PLAN FOR PUBLIC RENTAL HOUSING DEVELOPMENT SCHEME B

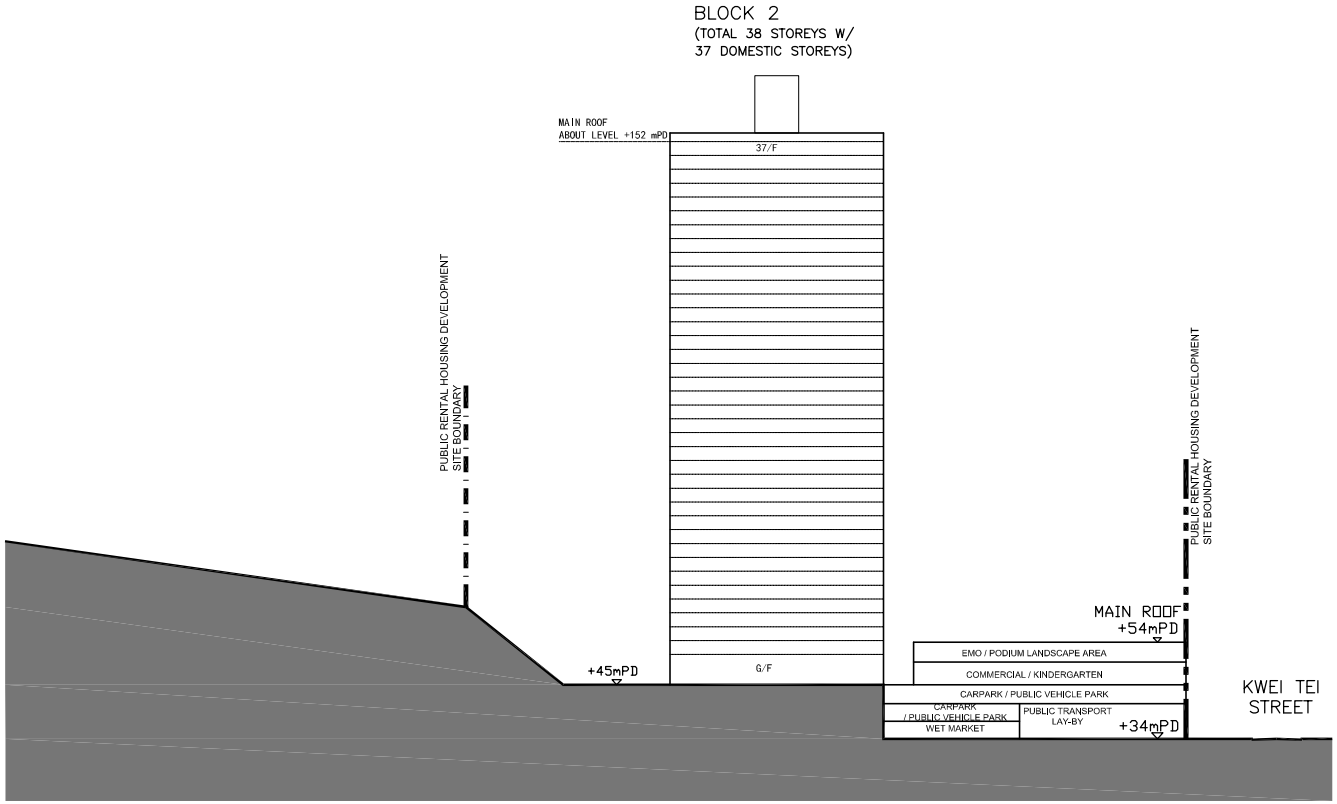
PUBLIC RENTAL HOUSING DEVELOPMENT AT FO TAN (SHA TIN AREAS 16 & 58D)

MASTER LAYOUT PLAN

DRAWING NO. MLP0001
SCALE 1:1800 (A4)
DATE : 12/08/2014

KEY PLAN



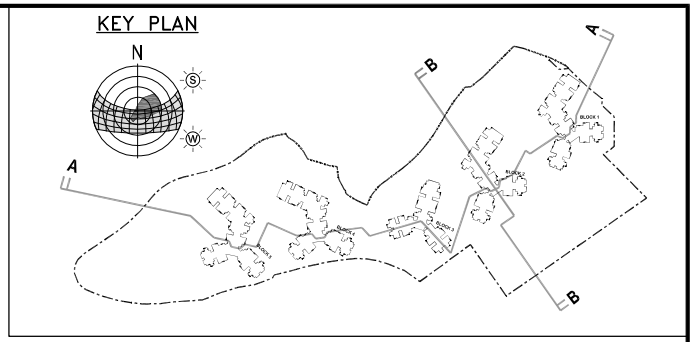


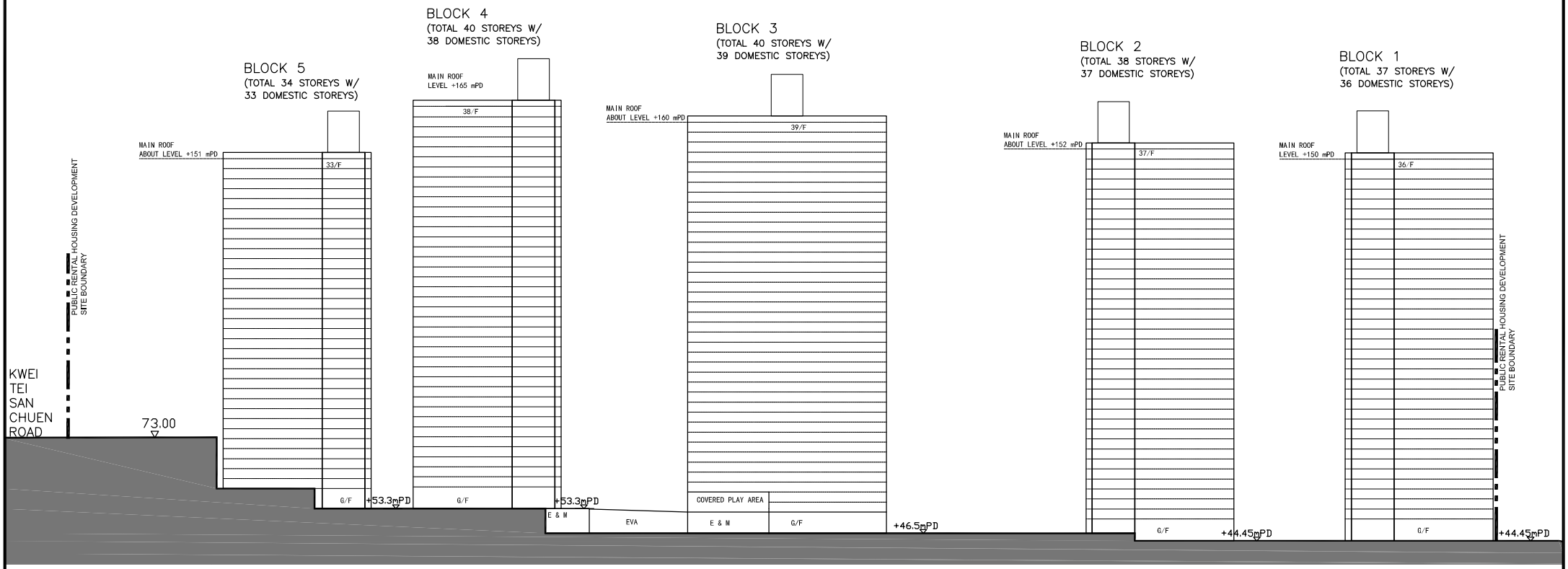
THE PUBLIC RENTAL HOUSING DEVELOPMENT INCLUDES THE APPLICATION SITE AND THE ADJOINING SLOPE ABUTTING SUN CHUK STREET AT THE NORTH OF THE APPLICATION SITE. THE SLOPE IS INCLUDED FOR SLOPE MAINTENANCE AND GREENING ONLY AND DO NOT COUNT TOWARDS THE NET SITE AREA FOR GFA CALCULATION.

PUBLIC RENTAL HOUSING DEVELOPMENT AT FO TAN (SHA TIN AREAS 16 & 58D)

SITE SECTION B - B

DRAWING NO. MLP0003
SCALE 1:1500 (A4)
DATE : 01/09/2014





THE PUBLIC RENTAL HOUSING DEVELOPMENT INCLUDES THE APPLICATION SITE AND THE ADJOINING SLOPE ABUTTING SUN CHUK STREET AT THE NORTH OF THE APPLICATION SITE. THE SLOPE IS INCLUDED FOR SLOPE MAINTENANCE AND GREENING ONLY AND DO NOT COUNT TOWARDS THE NET SITE AREA FOR GFA CALCULATION.

PUBLIC RENTAL HOUSING DEVELOPMENT AT FO TAN (SHA TIN AREAS 16 & 58D)

SITE SECTION A - A

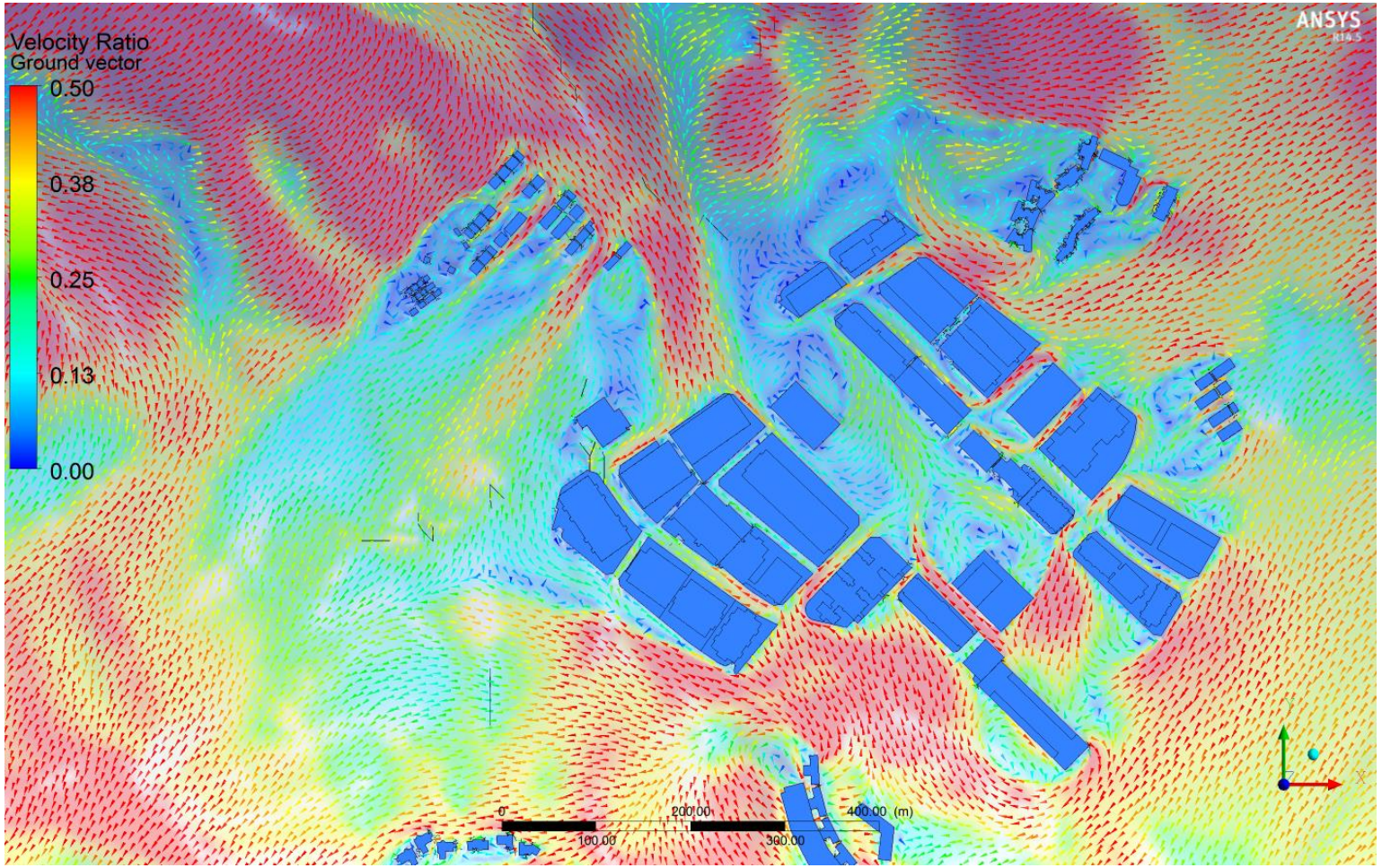
DRAWING NO. MLP0002
SCALE 1:1500 (A4)
DATE : 01/09/2014

APPENDIX C CONTOUR VECTOR PLOT OF CFD ANALYSIS RESULT

ENE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

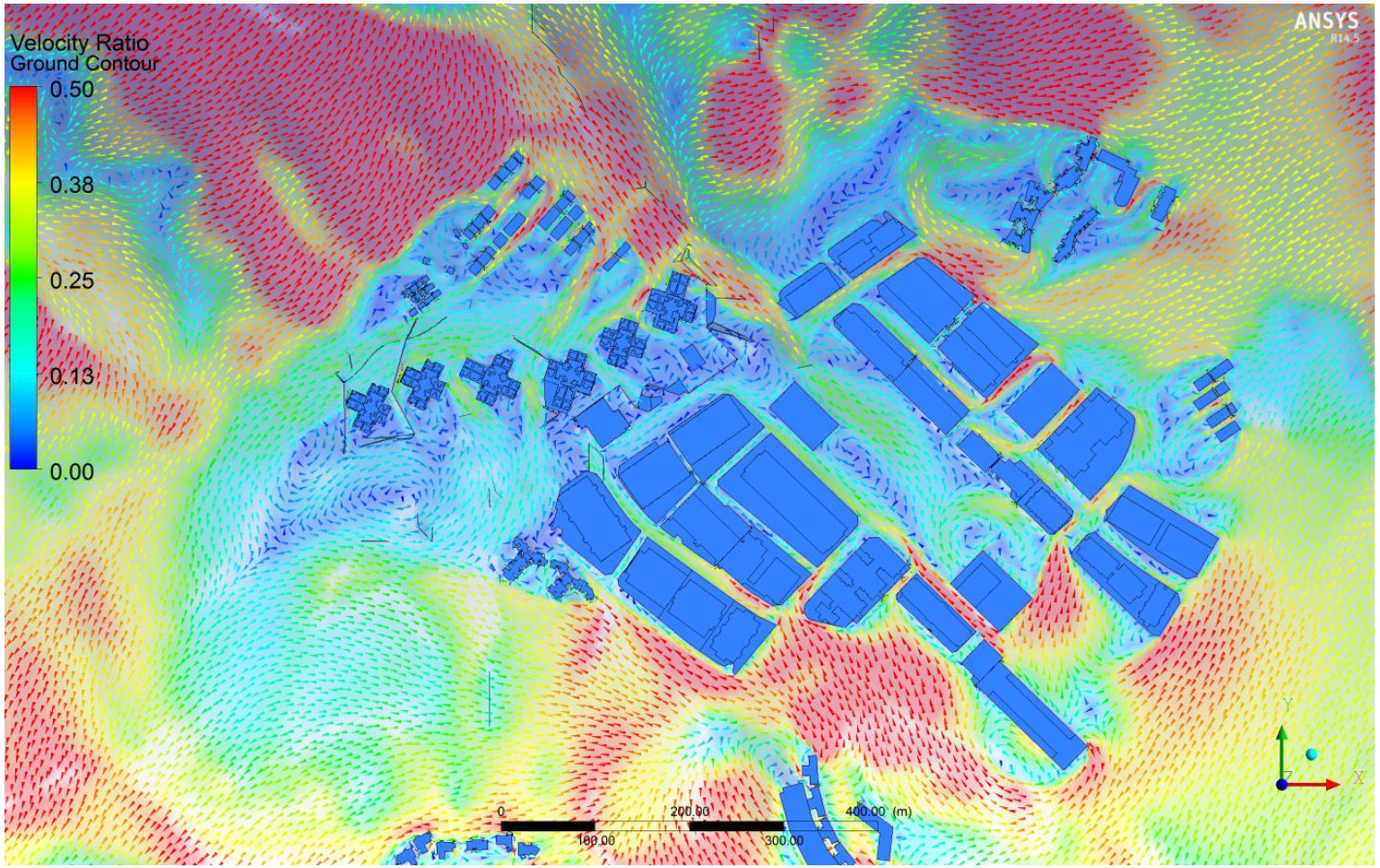
Existing Condition Scenario



ENE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

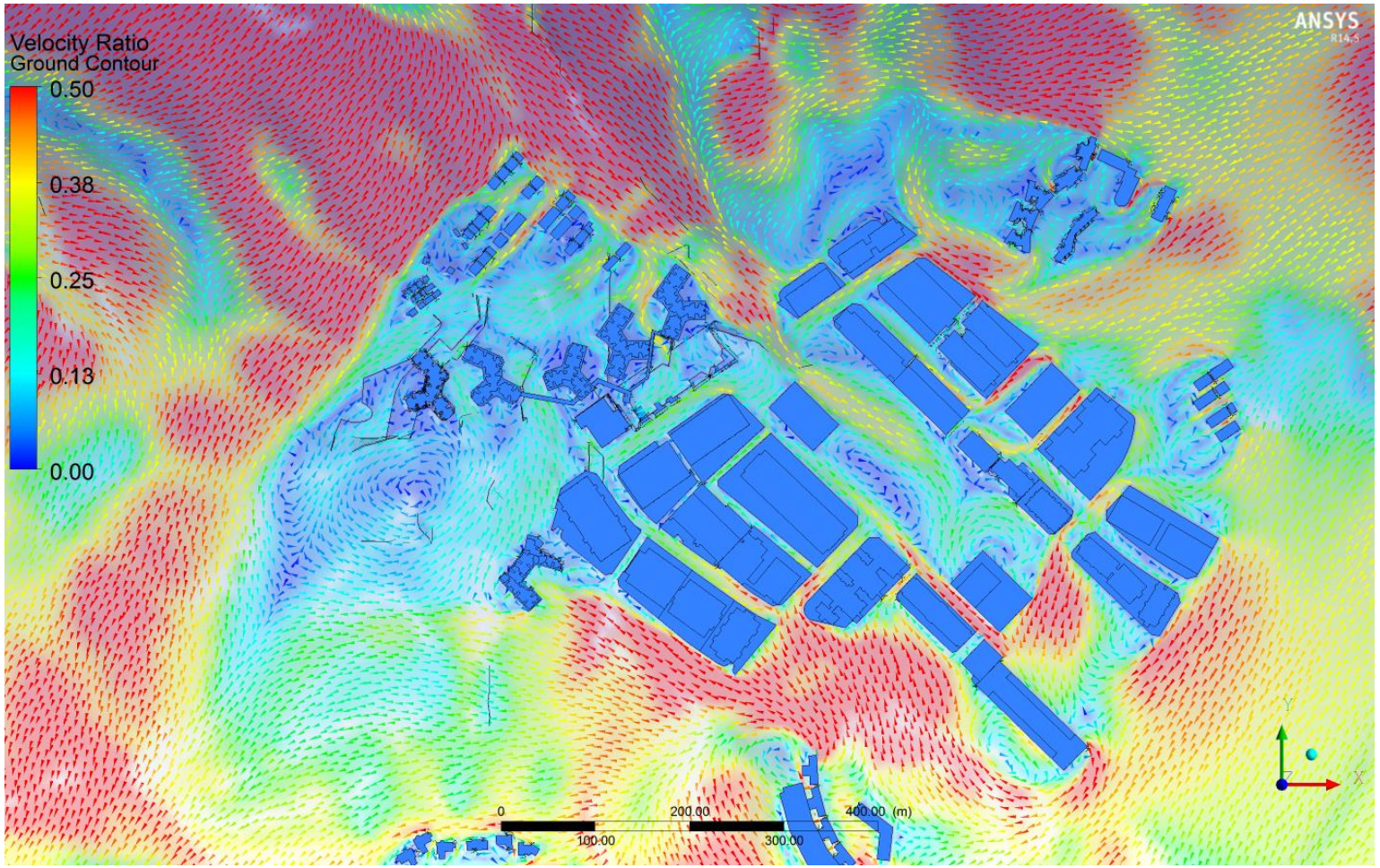
Scenario A



ENE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

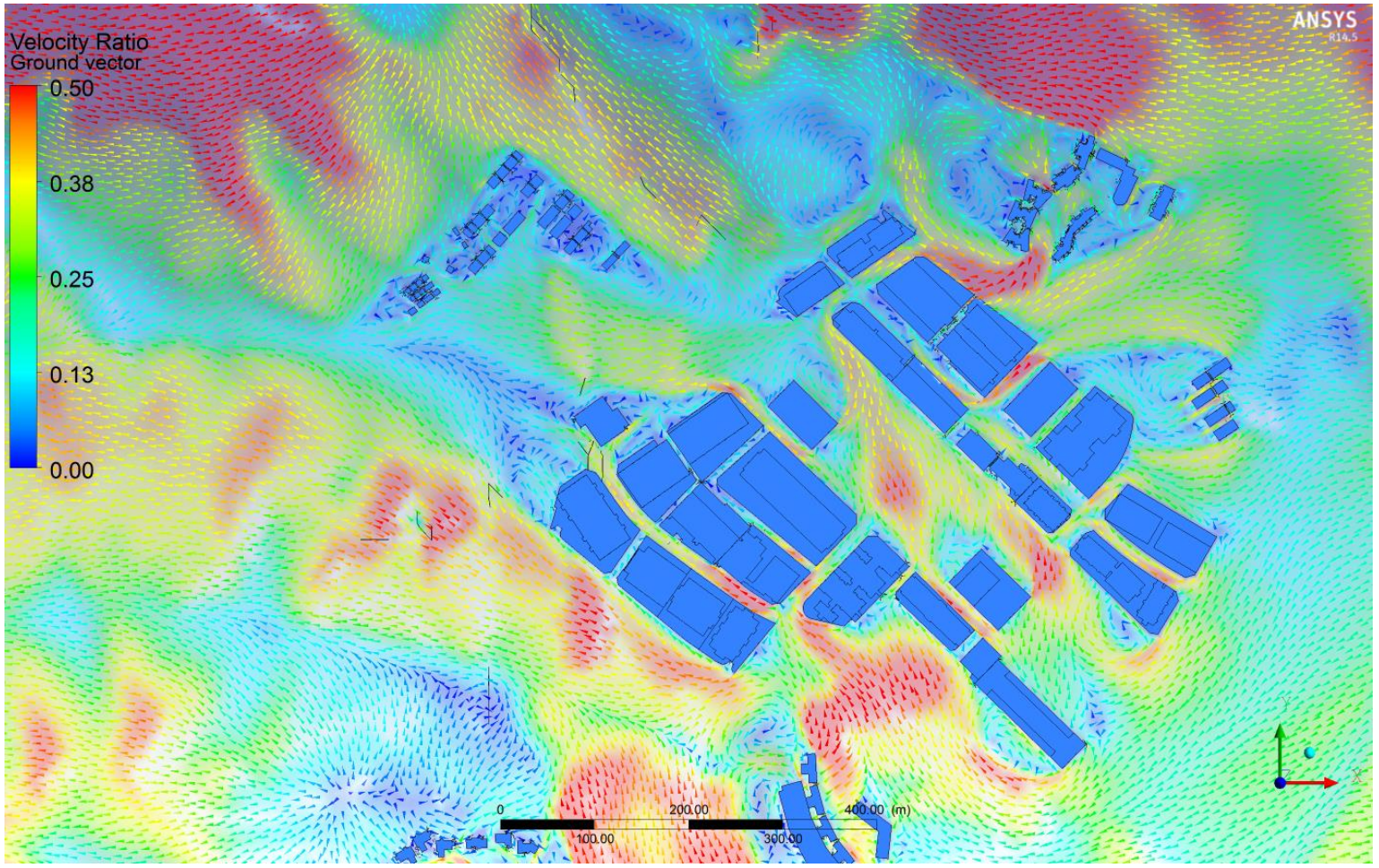
Scenario B



E wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

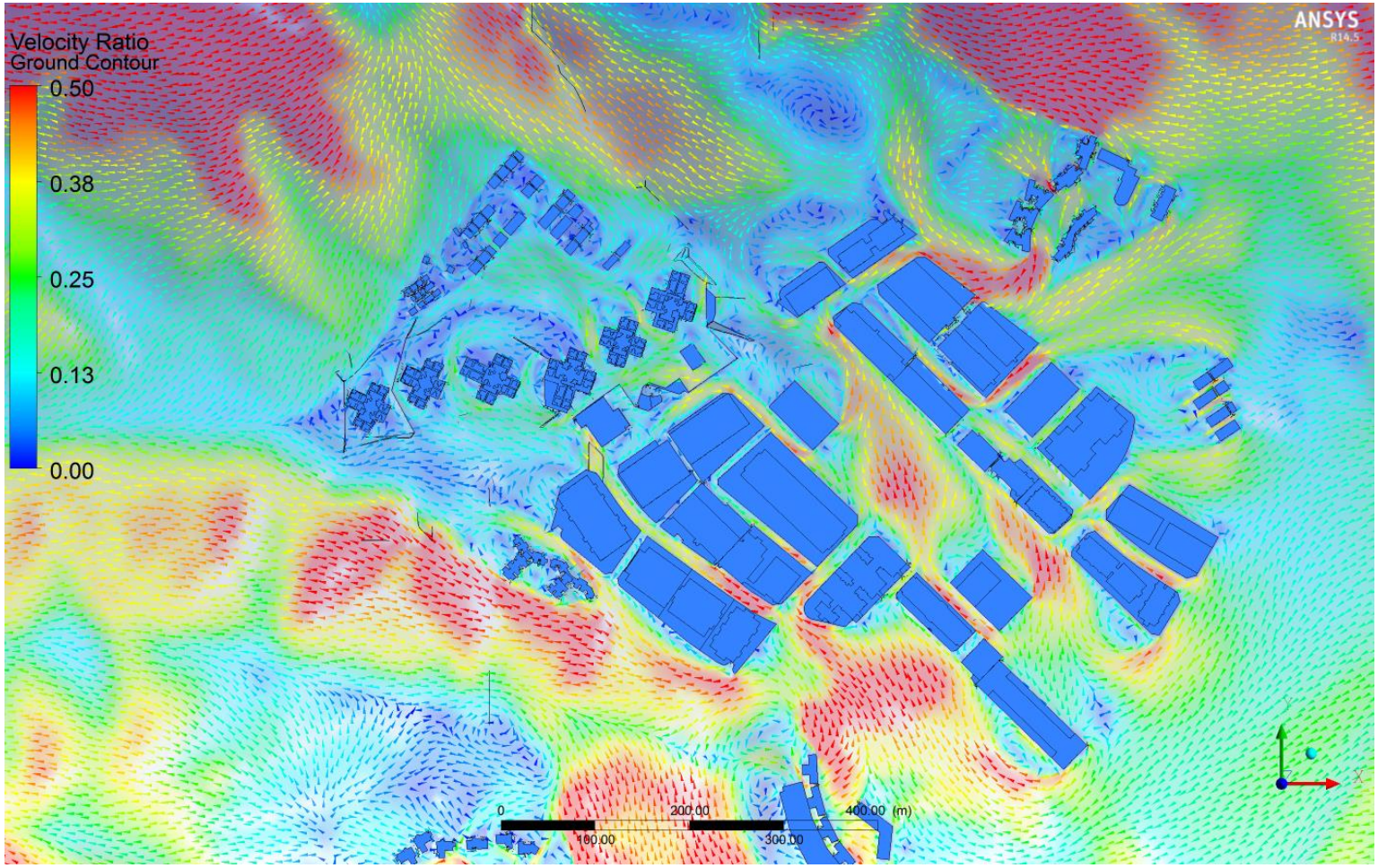
Existing Condition Scenario



E wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

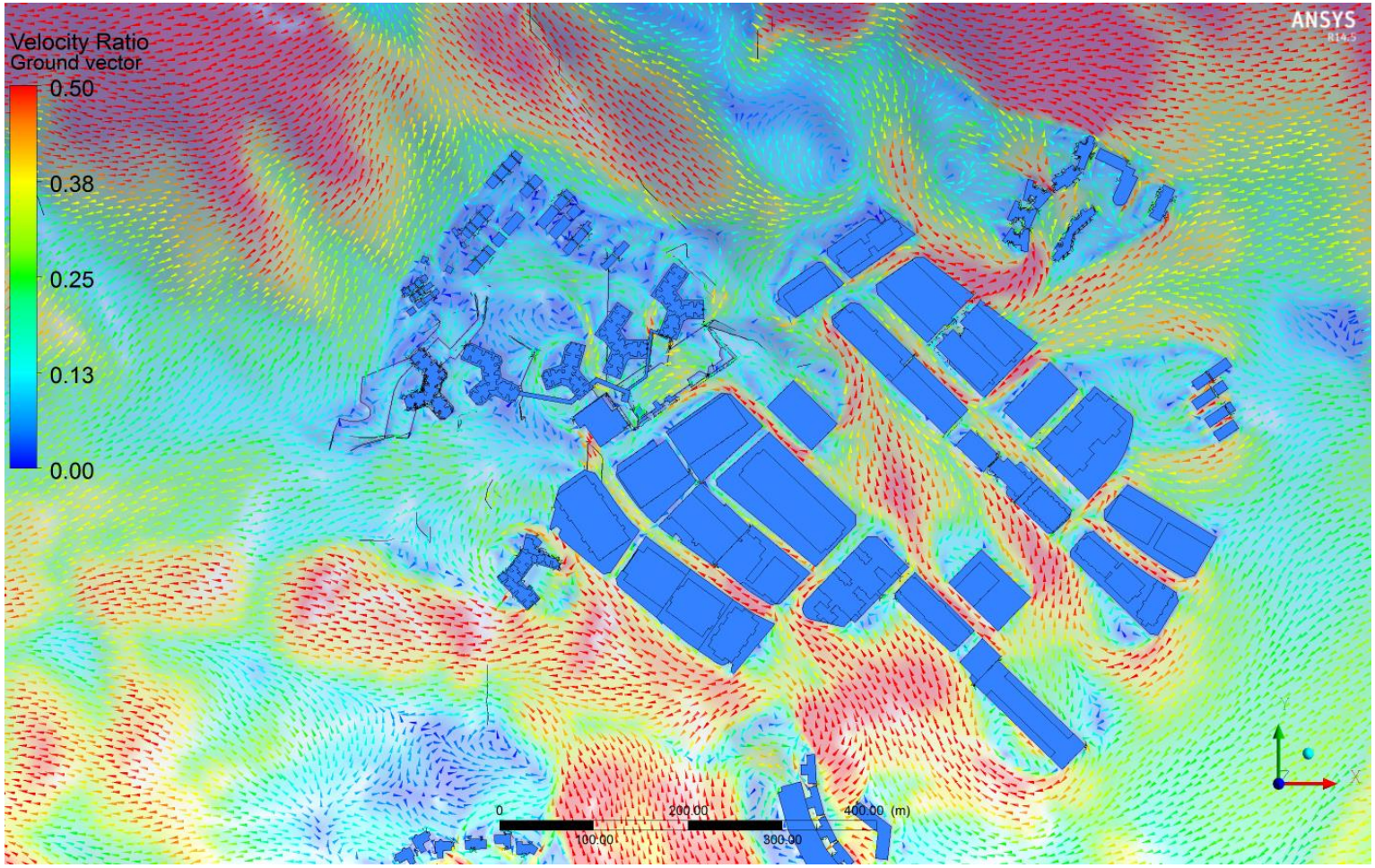
Scenario A



E wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

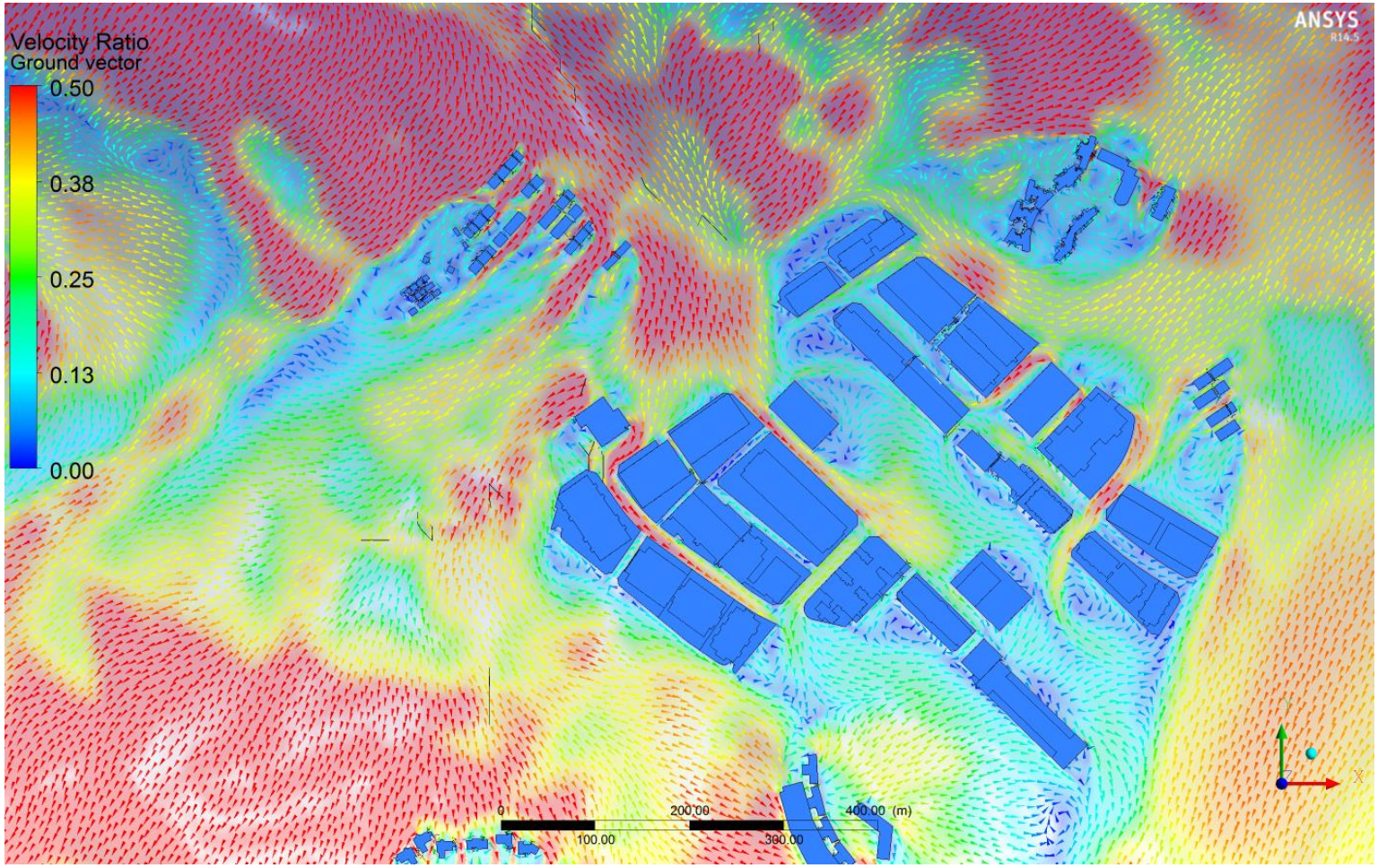
Scenario B



NE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

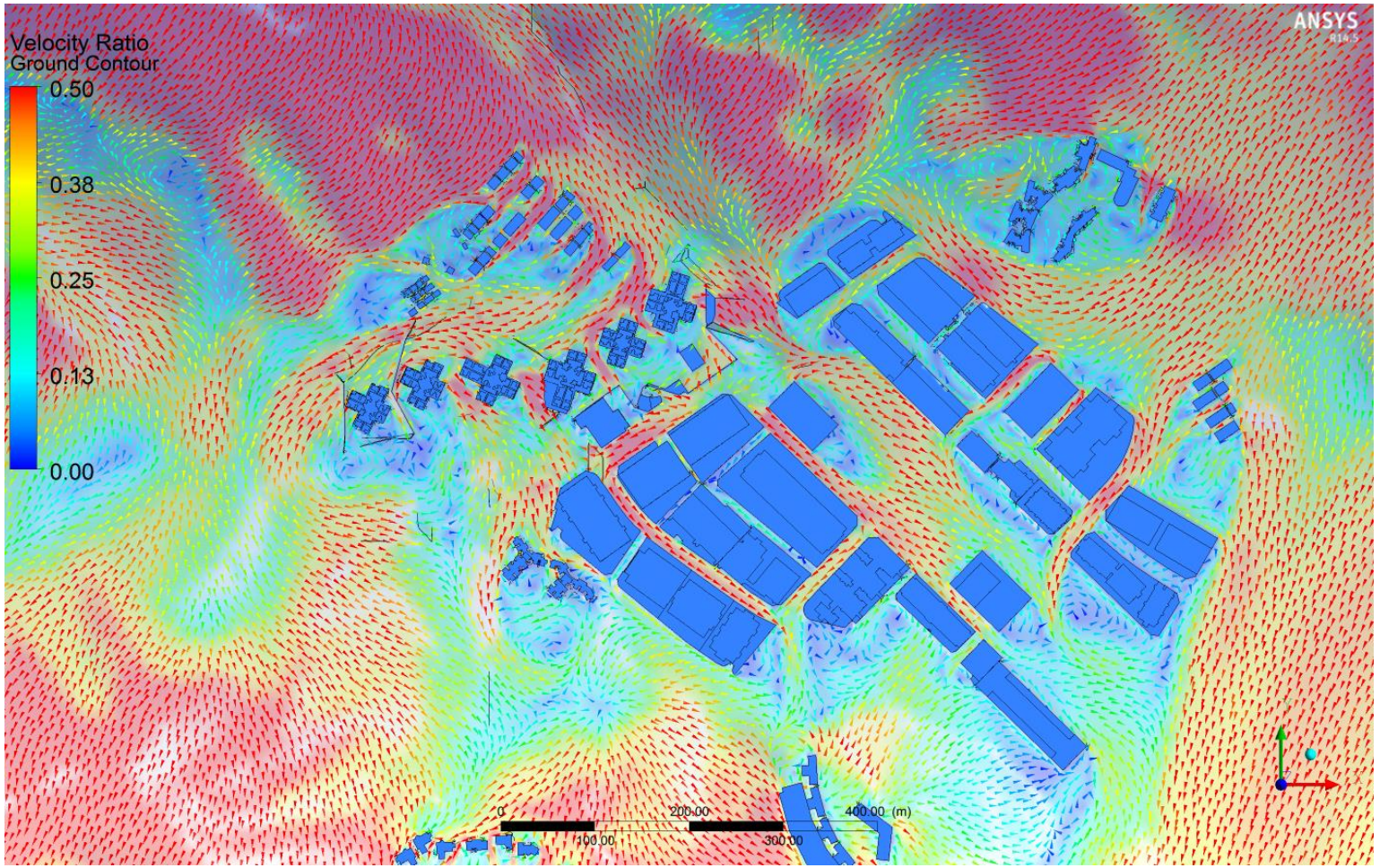
Existing Condition



NE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

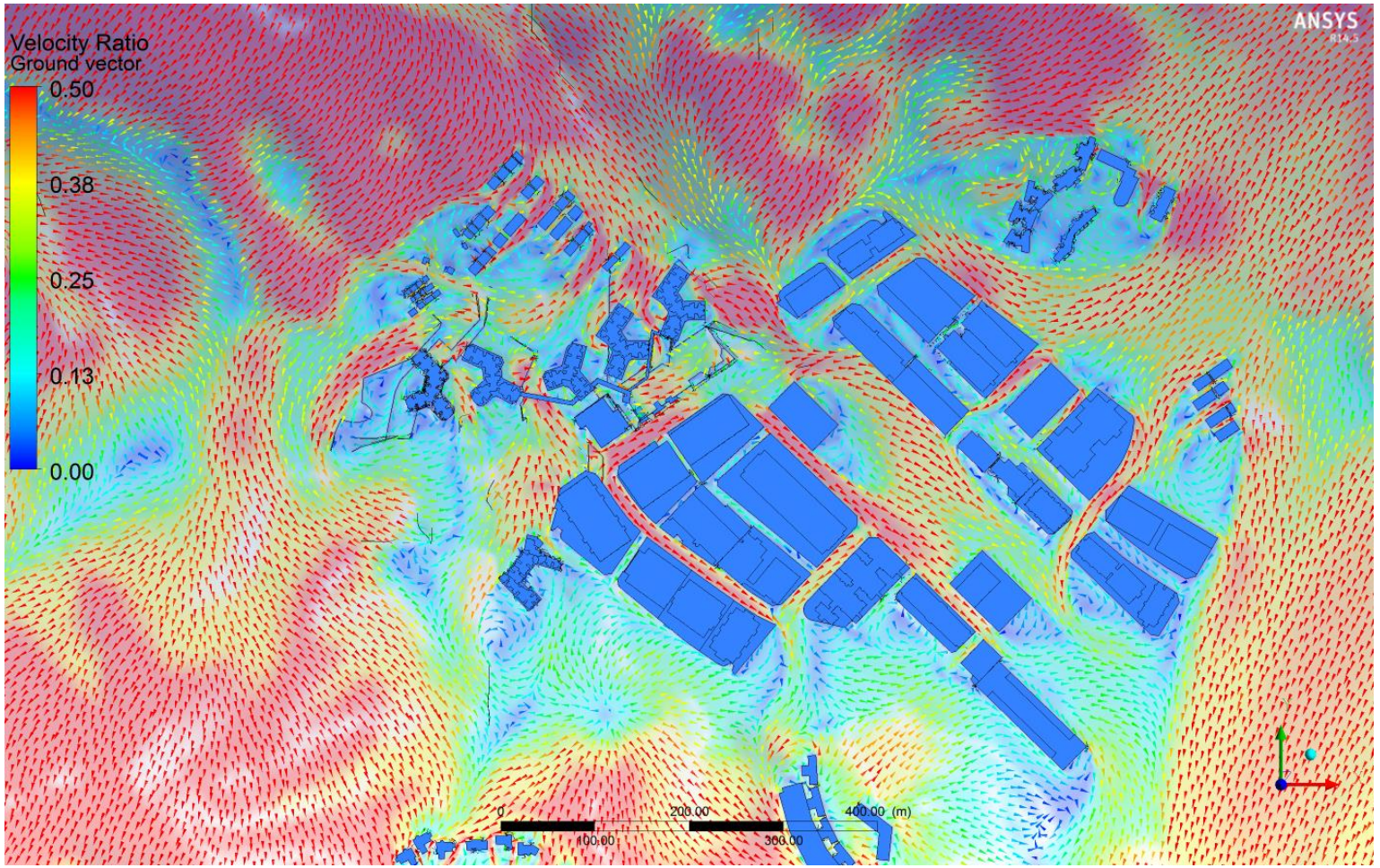
Scenario A



NE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

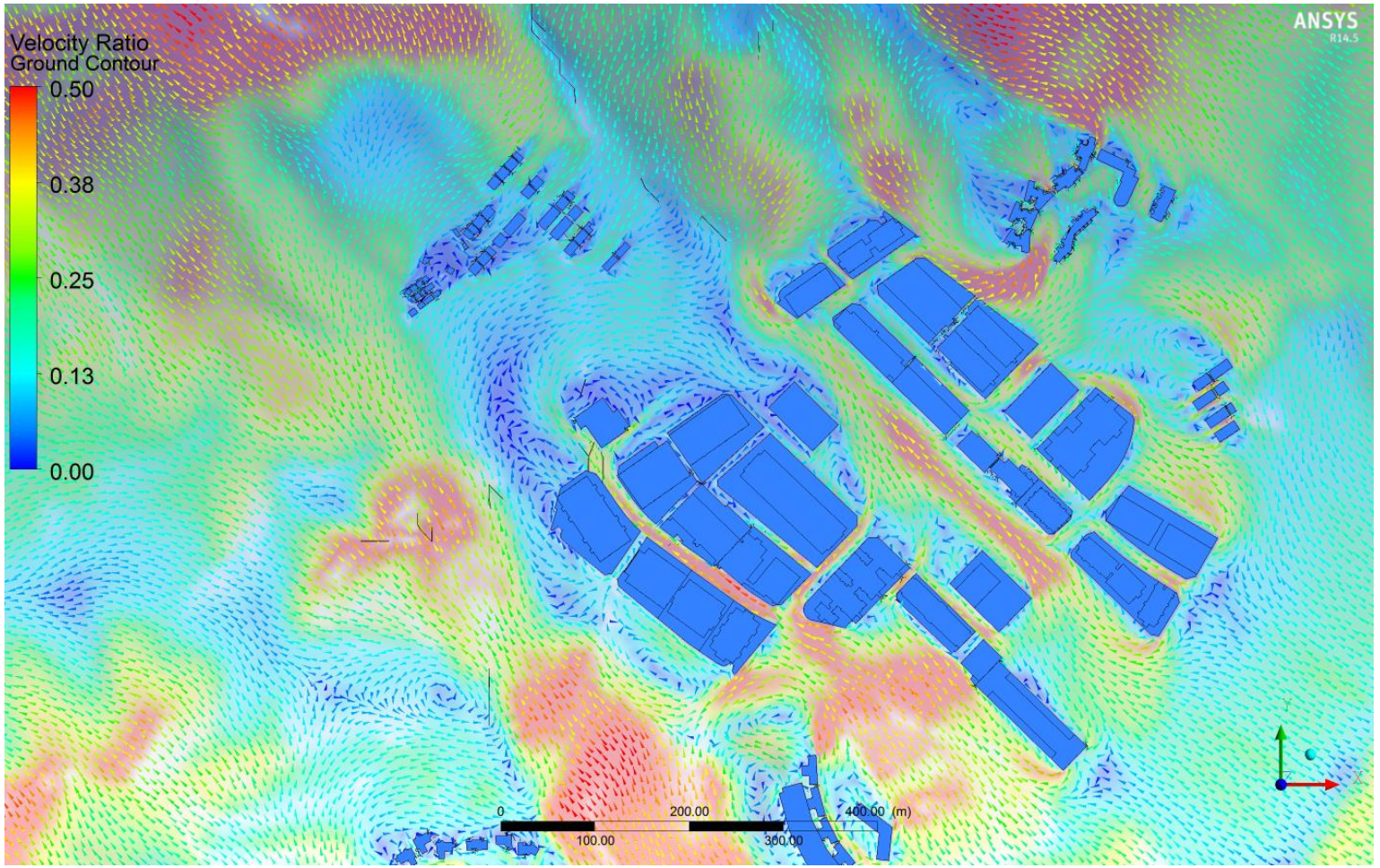
Scenario B



ESE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

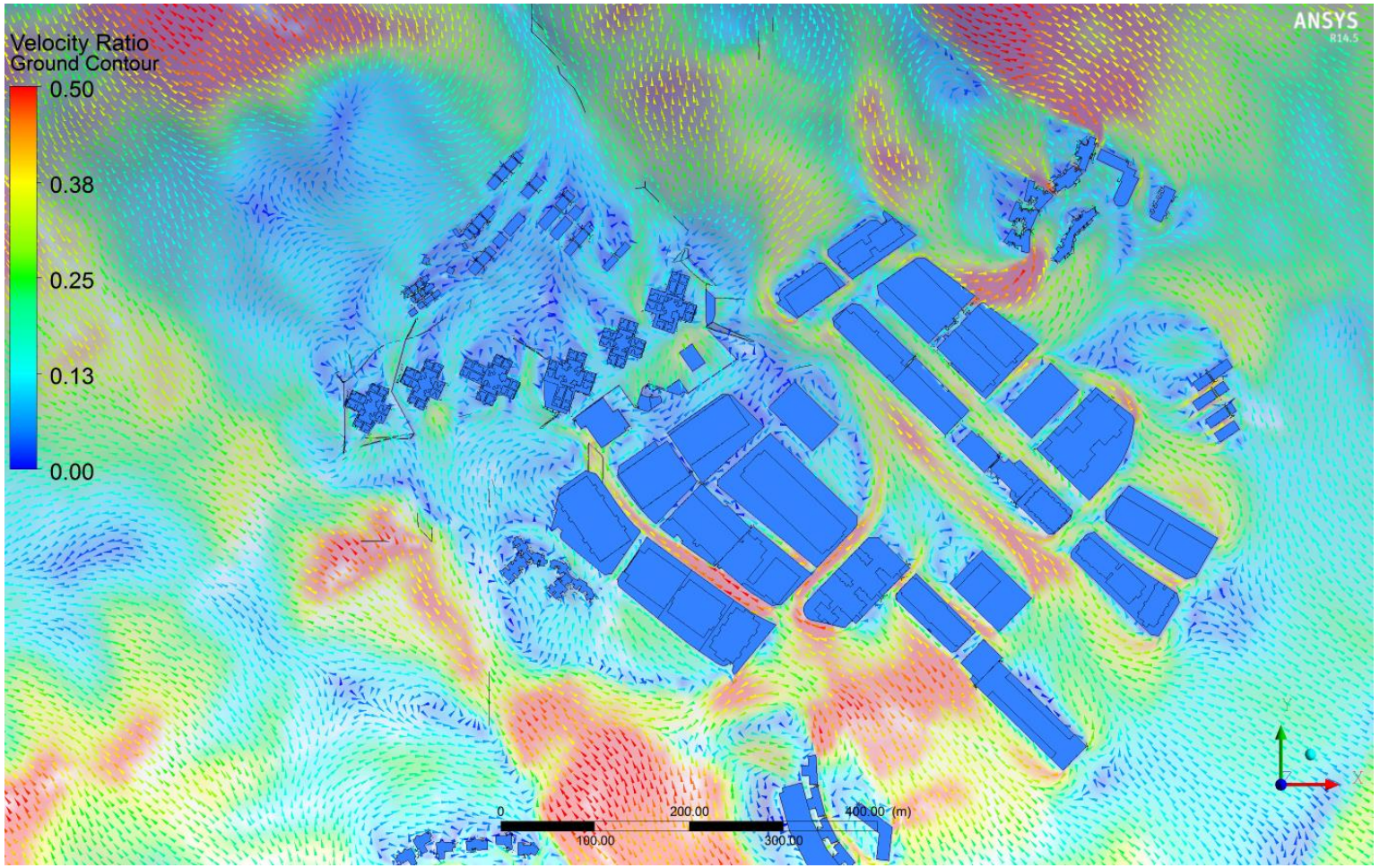
Existing Condition Scenario



ESE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

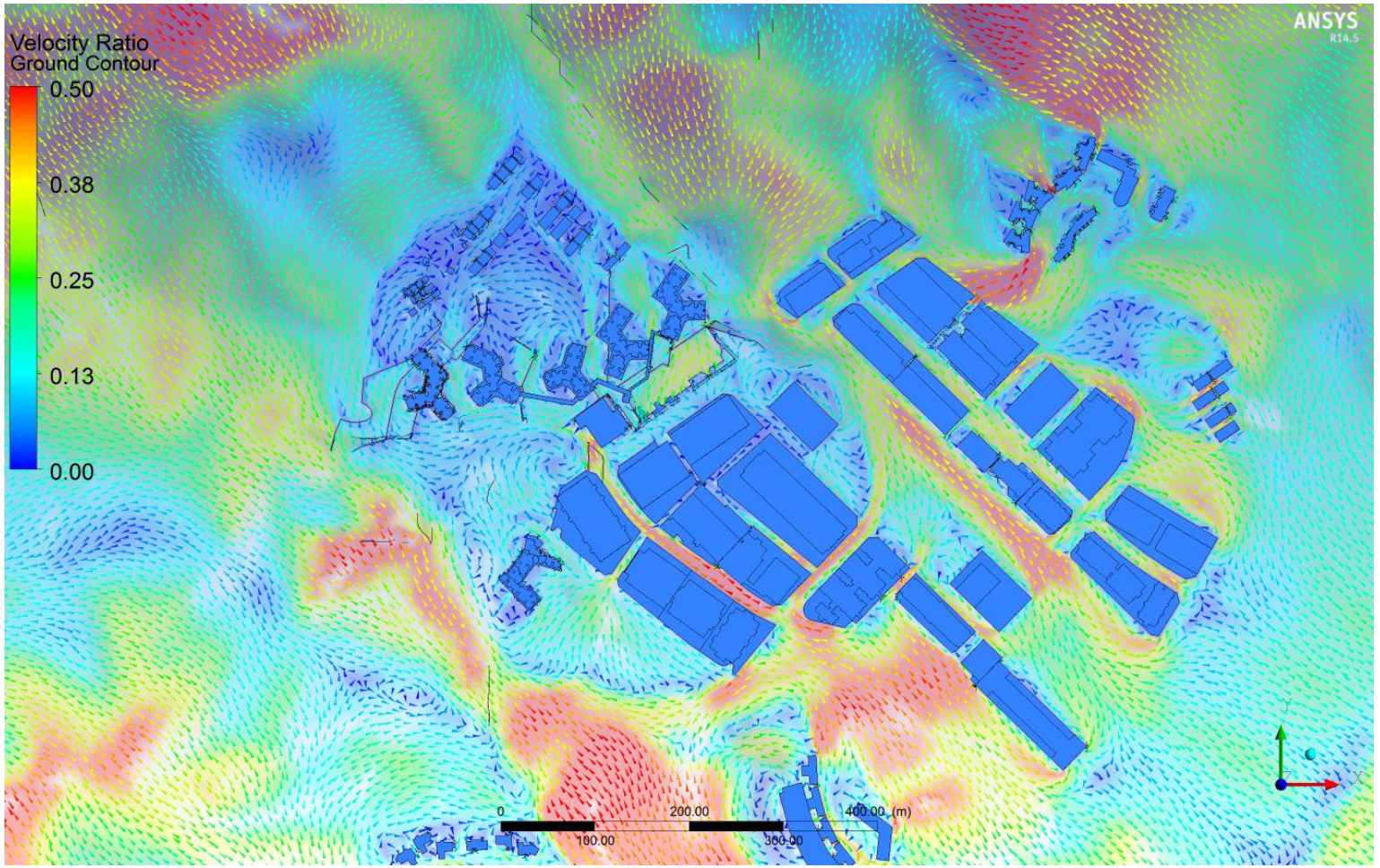
Scenario A



ESE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

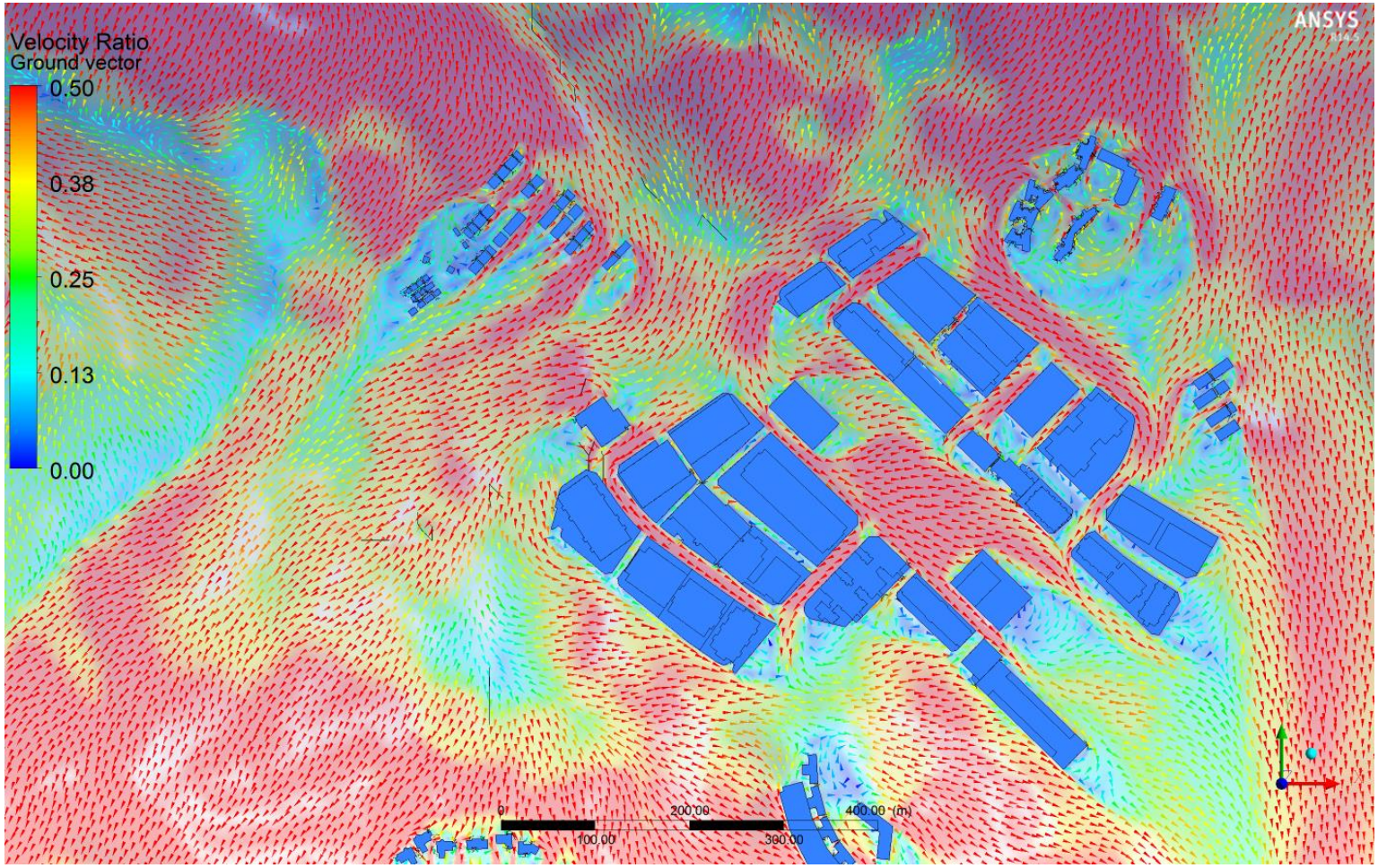
Scenario B



NNE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

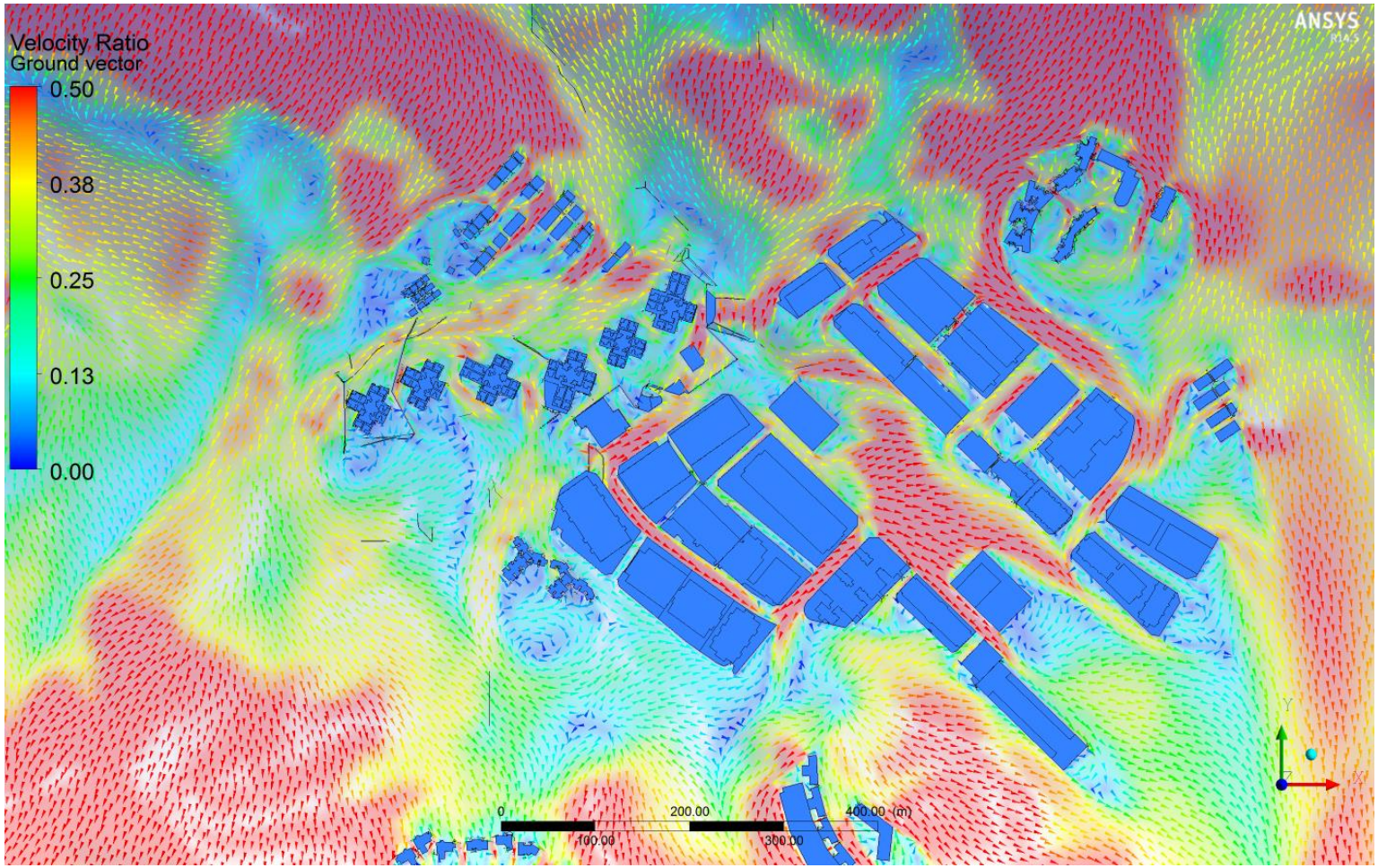
Existing Condition Scenario



NNE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

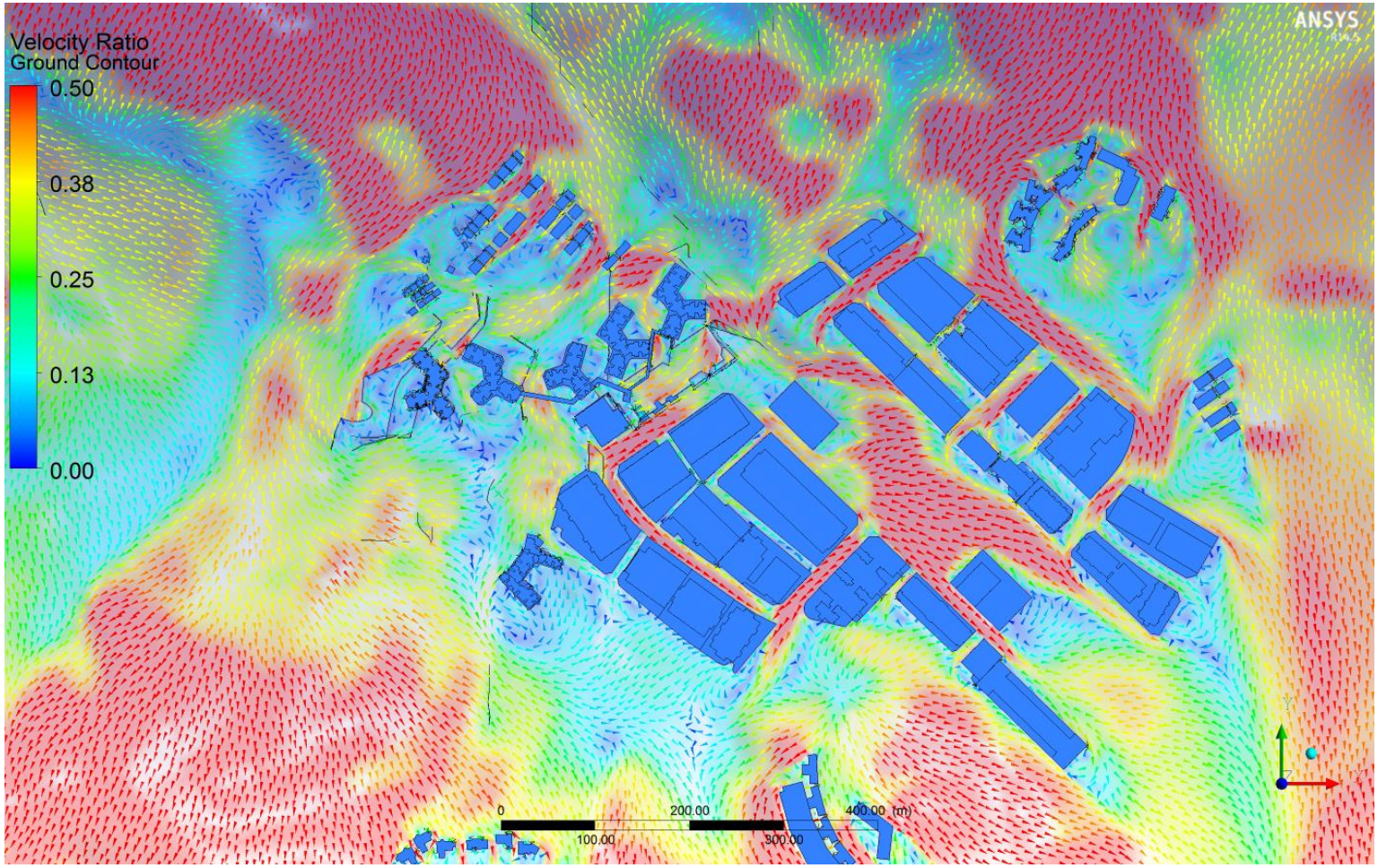
Scenario A



NNE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

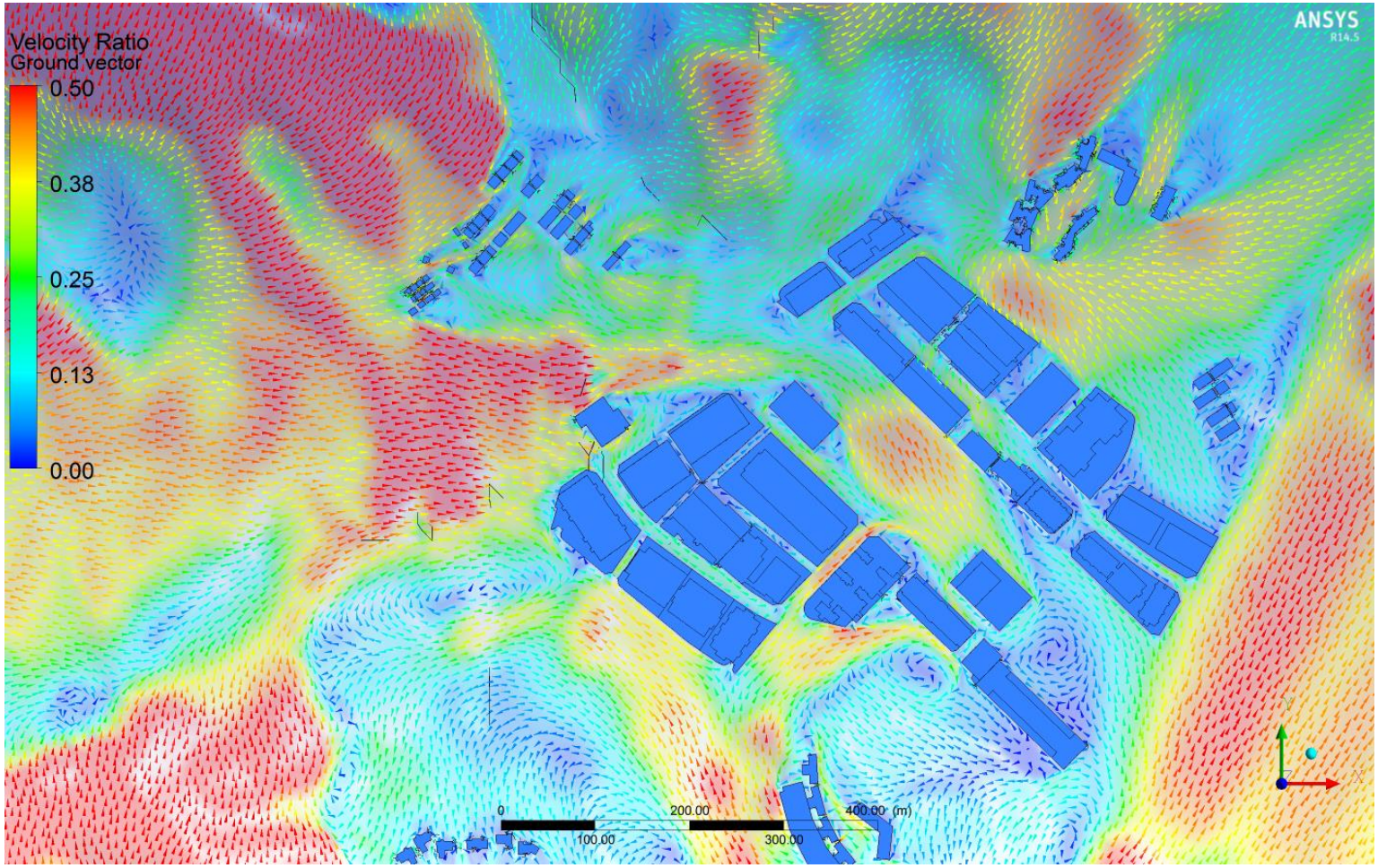
Scenario B



SSW wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

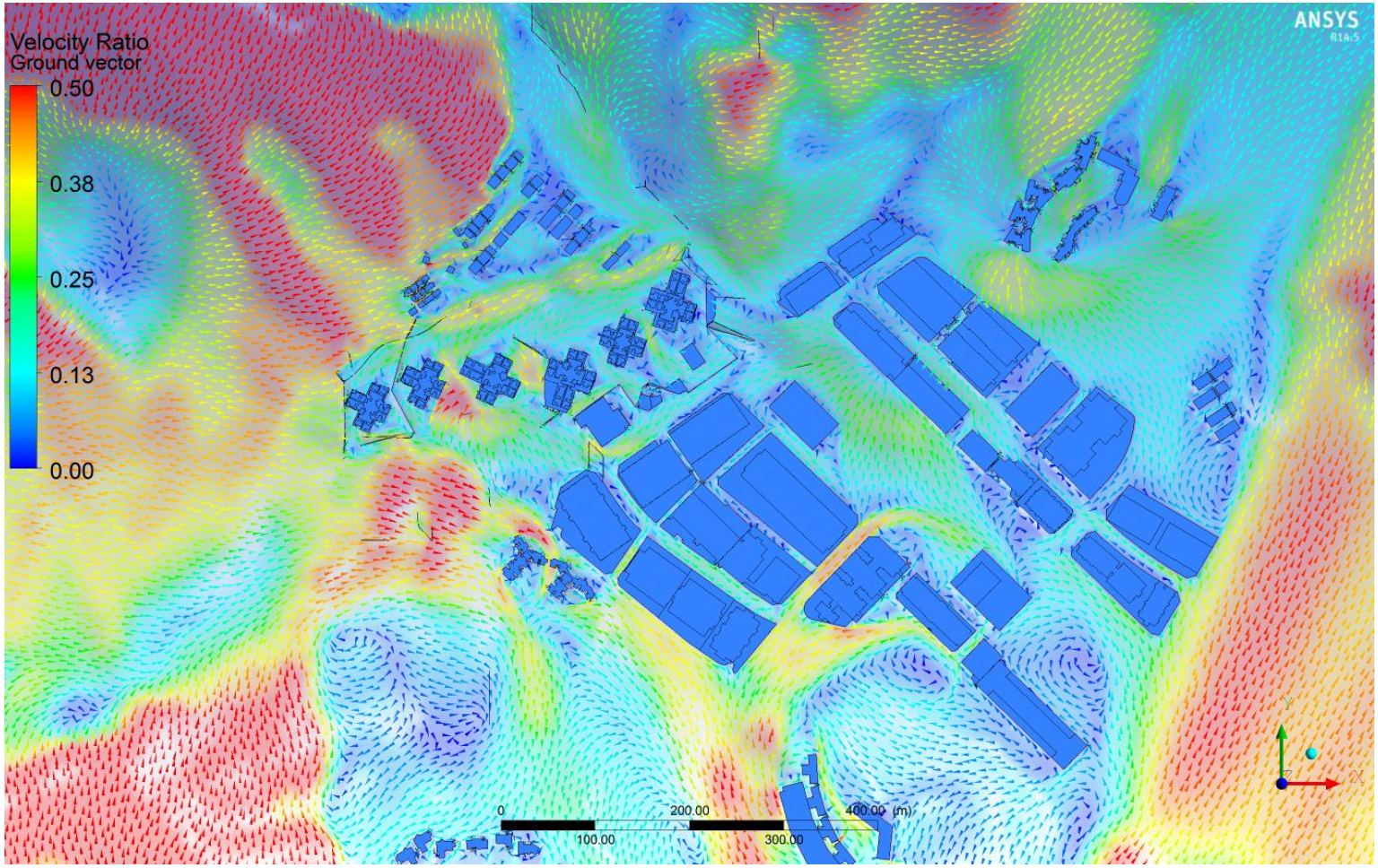
Existing Condition Scenario



SSW wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

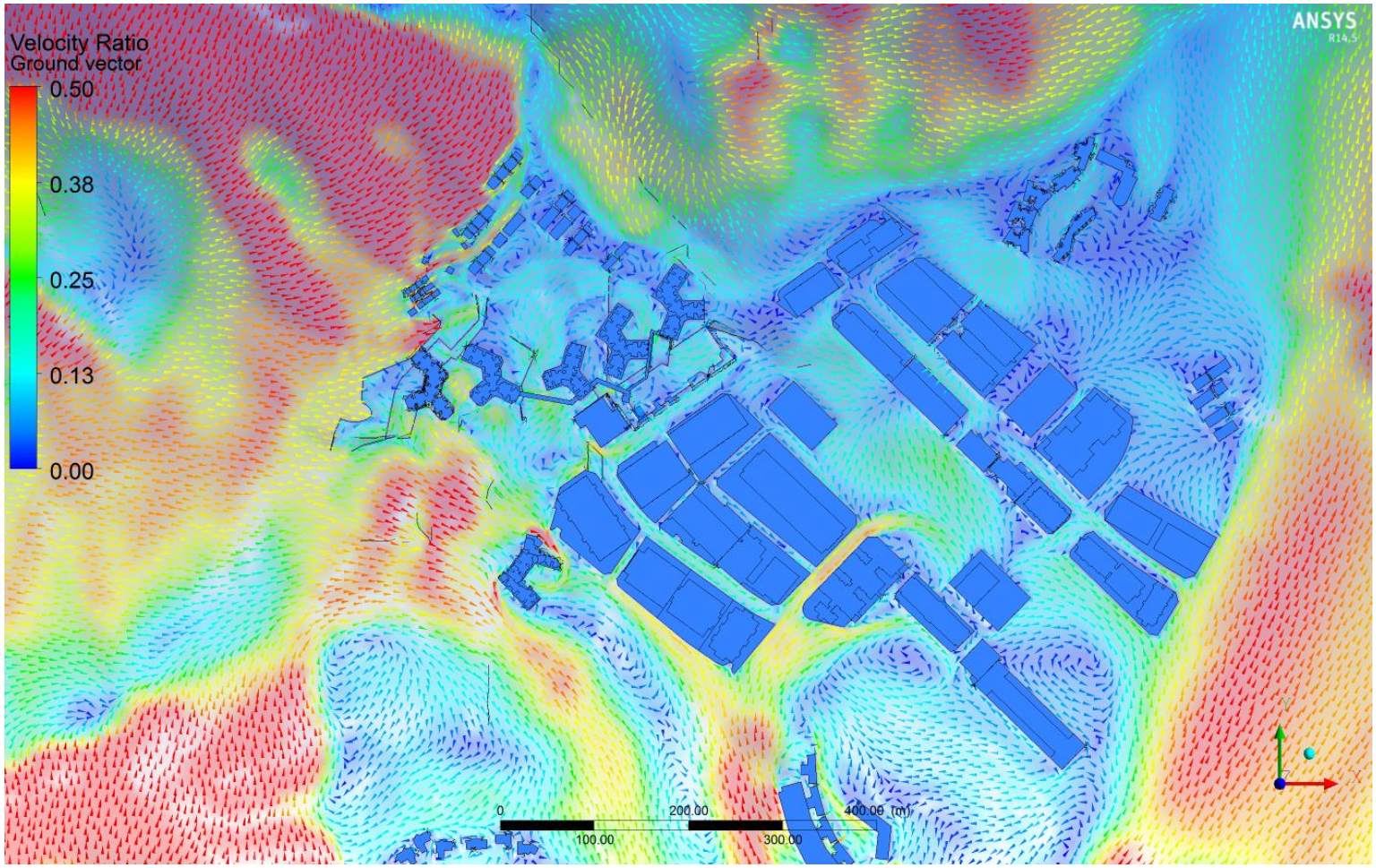
Scenario A



SSW wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

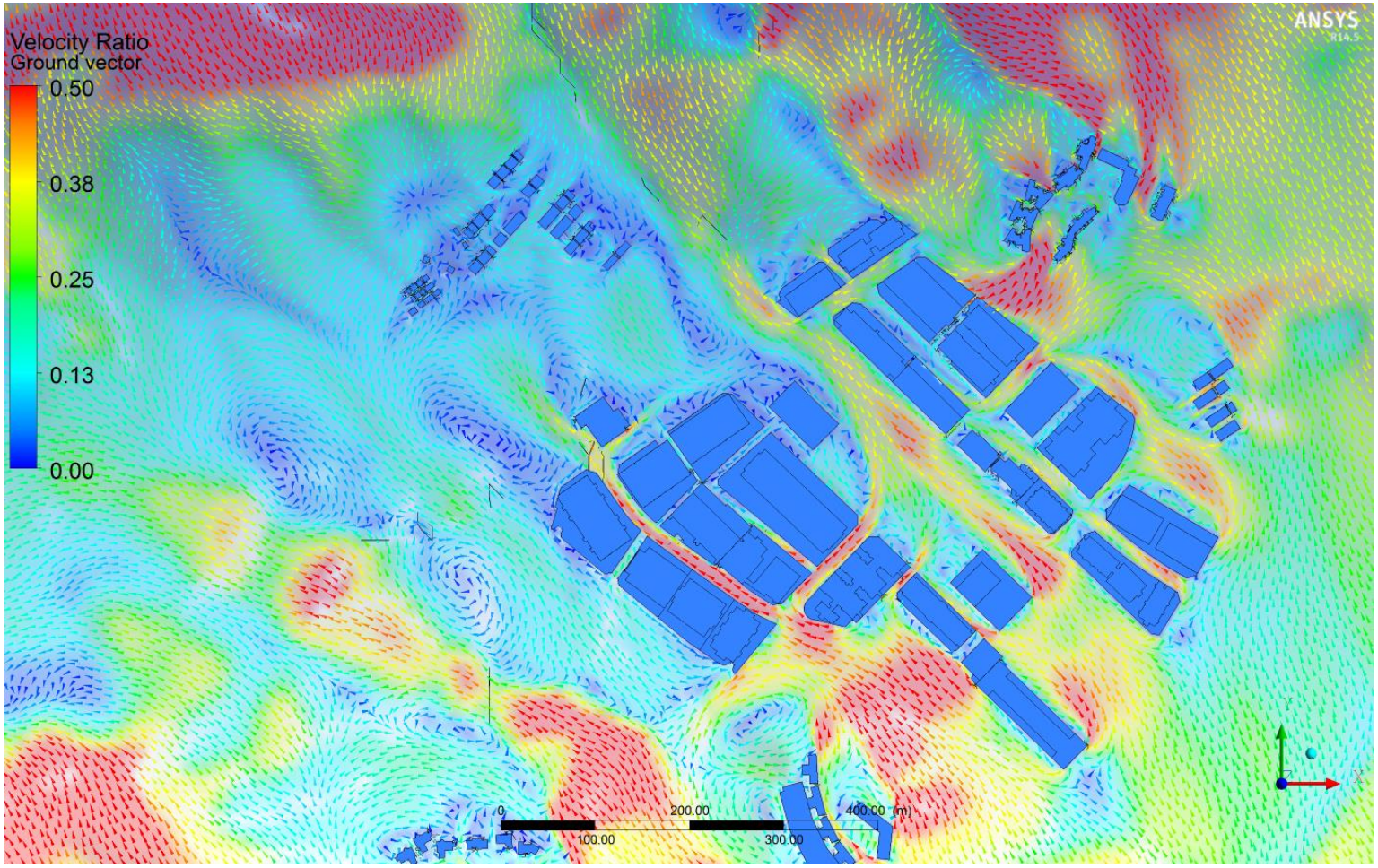
Scenario B



SE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

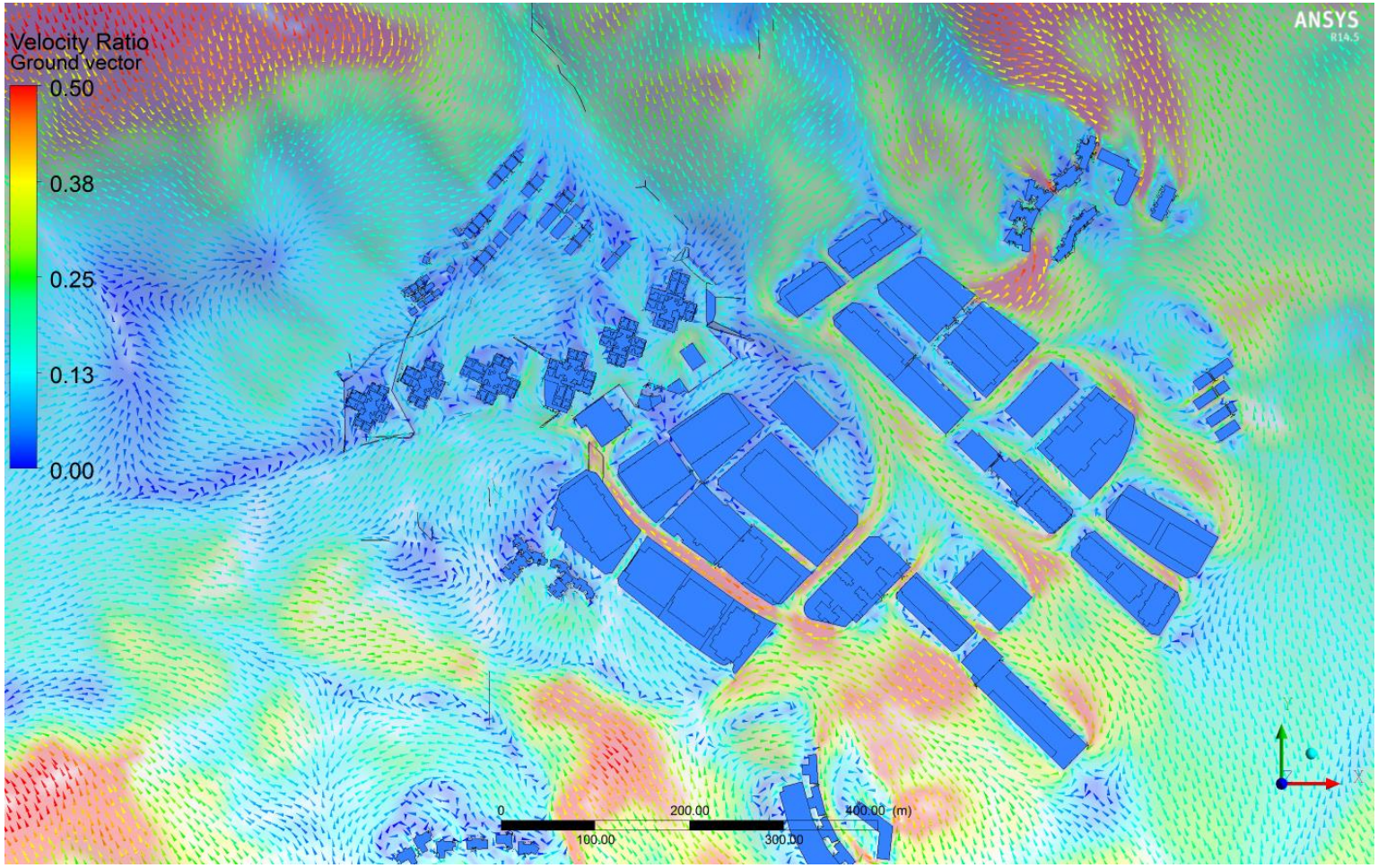
Existing Condition Scenario



SE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

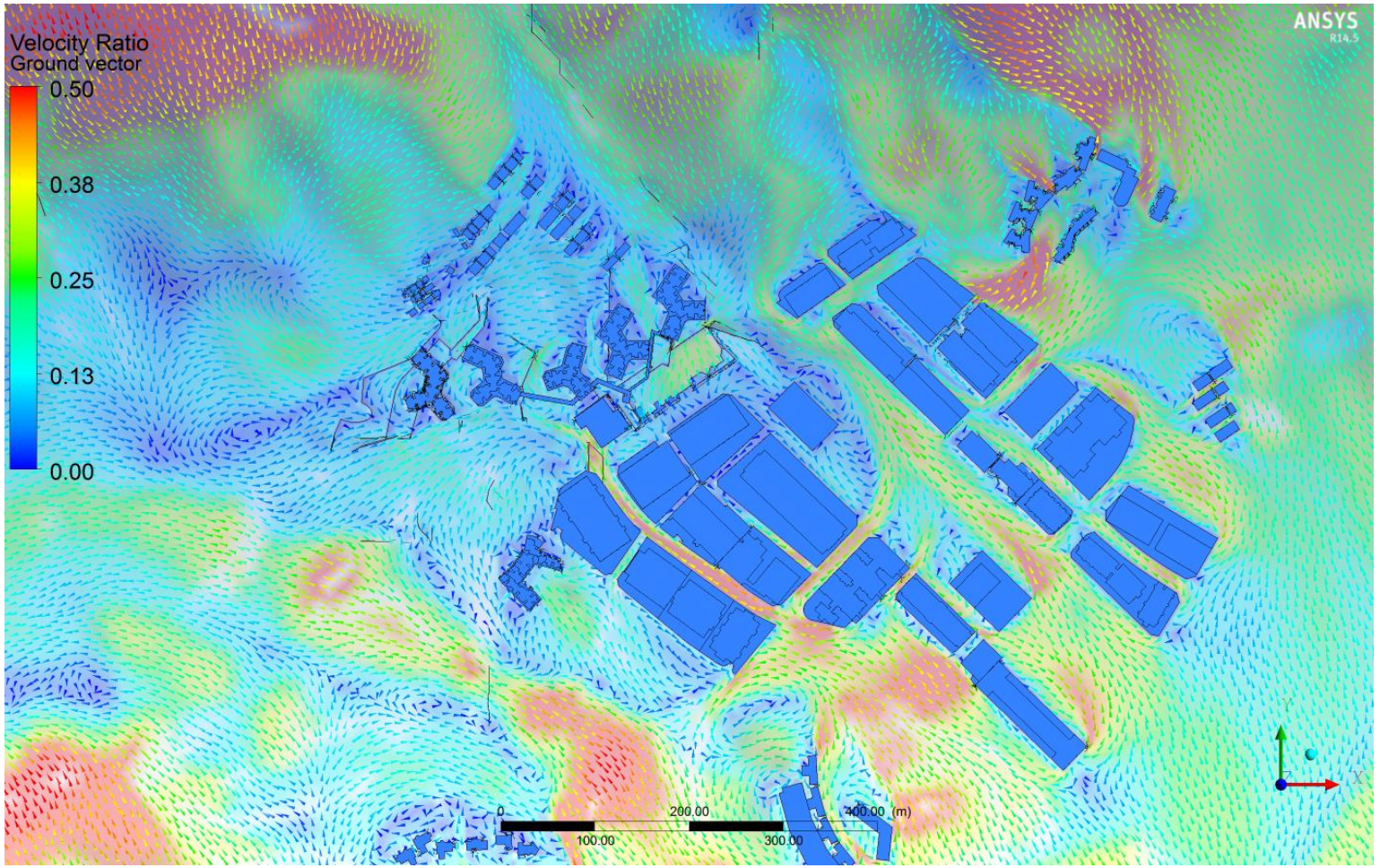
Scenario A



SE wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

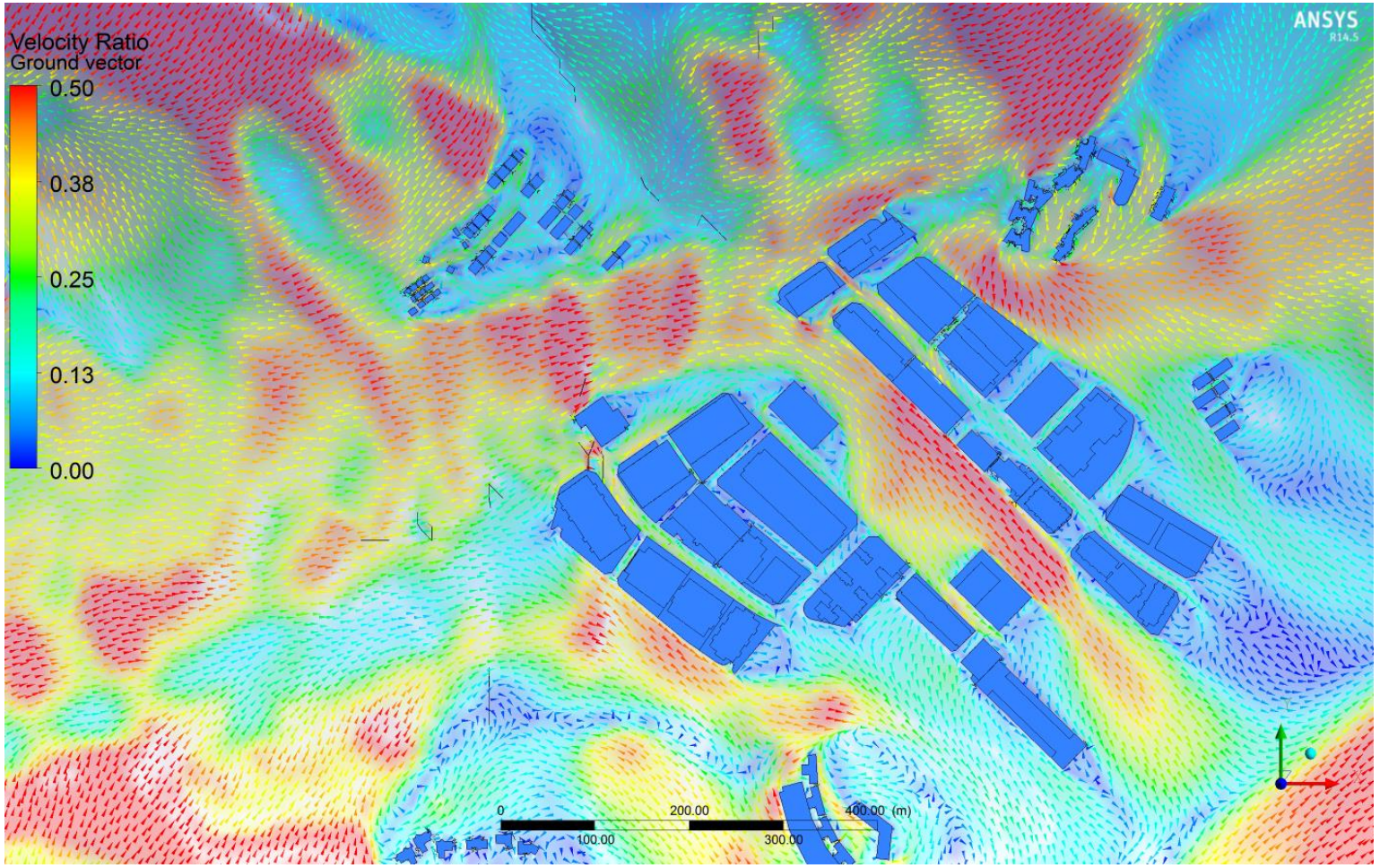
Scenario B



SW wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

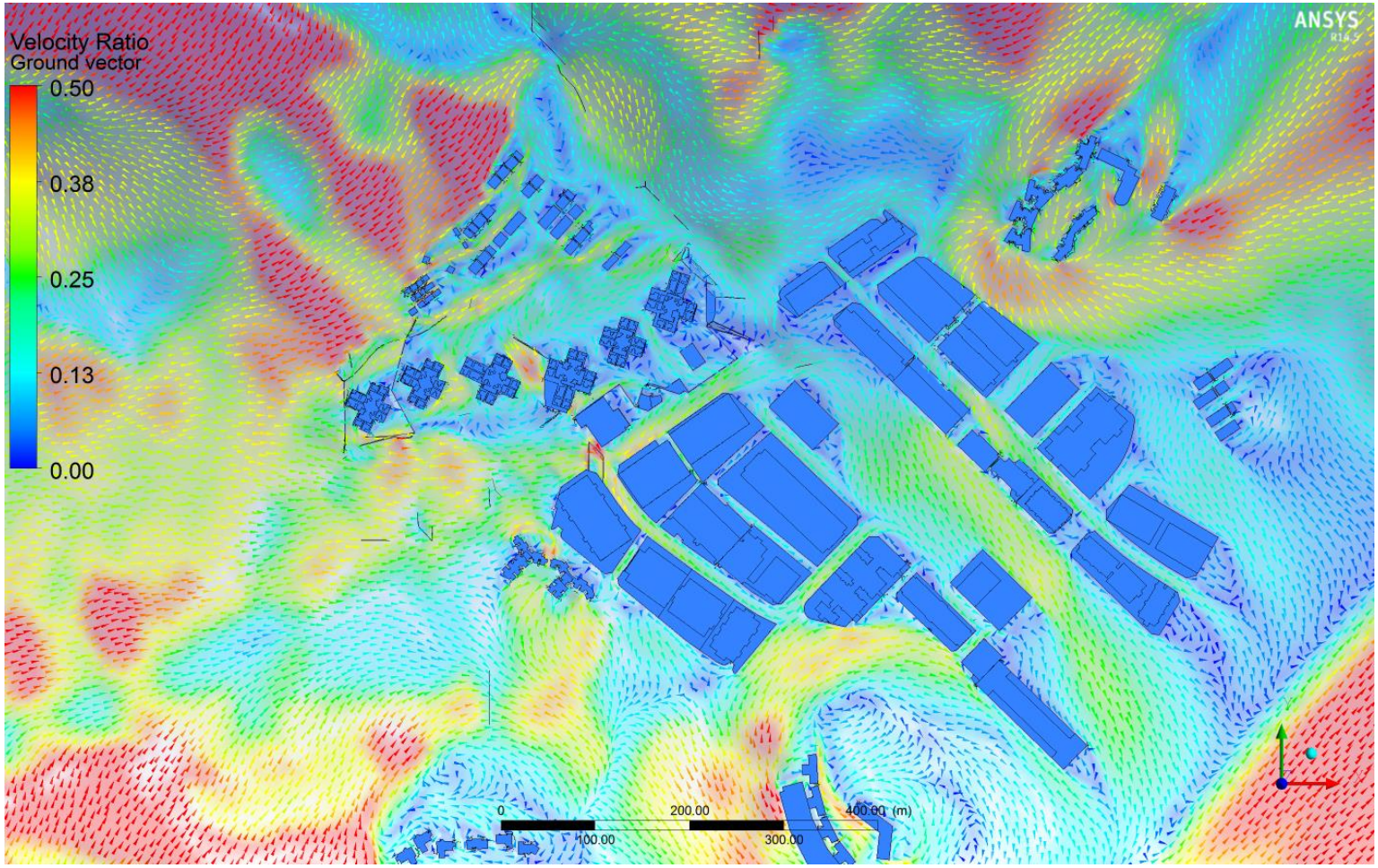
Existing Condition Scenario



SW wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

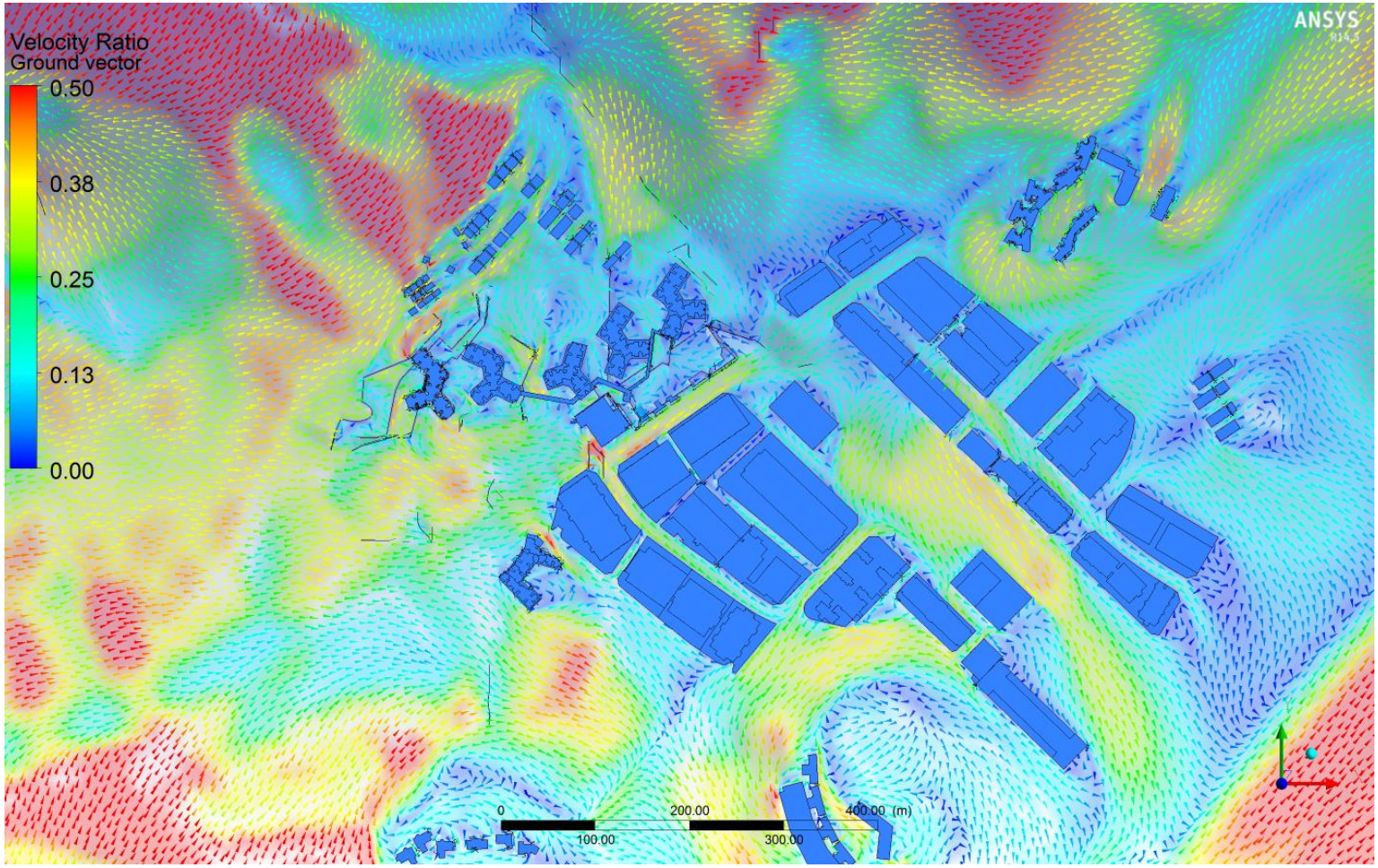
Scenario A



SW wind

Wind Velocity Ratio Contour Vector Plot (2m from Ground Level)

Scenario B



APPENDIX D CALCULATION OF WIND PROFILE WIND VELOCITY RATIO

D.1 Existing Condition Scenario: Wind Velocity Ratio

Overall Test Points

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**
O1	0.01	0.39	0.28	0.56	0.53	0.10	0.06	0.14
O2	0.20	0.06	0.16	0.14	0.13	0.08	0.38	0.34
O3	0.14	0.29	0.08	0.41	0.20	0.09	0.14	0.21
O4	0.18	0.50	0.07	0.67	0.64	0.15	0.22	0.16
O5	0.01	0.34	0.26	0.53	0.54	0.11	0.26	0.20
O6	0.22	0.38	0.21	0.44	0.37	0.03	0.24	0.29
O7	0.23	0.11	0.19	0.05	0.46	0.16	0.25	0.48
O8	0.39	0.38	0.41	0.31	0.26	0.32	0.09	0.17
O9	0.18	0.12	0.26	0.15	0.02	0.11	0.31	0.25
O10	0.17	0.07	0.02	0.10	0.12	0.03	0.15	0.13
O11	0.13	0.26	0.19	0.41	0.38	0.12	0.12	0.08
O12	0.20	0.17	0.15	0.27	0.29	0.10	0.17	0.11
O13	0.19	0.40	0.19	0.59	0.62	0.14	0.29	0.25
O14	0.08	0.16	0.08	0.28	0.25	0.11	0.08	0.29
O15	0.17	0.54	0.15	0.57	0.40	0.07	0.17	0.42
O16	0.20	0.28	0.27	0.48	0.38	0.14	0.17	0.41
O17	0.23	0.02	0.38	0.39	0.36	0.22	0.17	0.39
O18	0.13	0.04	0.12	0.03	0.46	0.03	0.21	0.39
O19	0.21	0.01	0.21	0.05	0.35	0.21	0.11	0.46
O20	0.35	0.35	0.13	0.27	0.68	0.27	0.24	0.06
O21	0.47	0.48	0.43	0.41	0.17	0.23	0.23	0.34
O22	0.11	0.49	0.33	0.38	0.28	0.23	0.06	0.18
O23	0.17	0.38	0.42	0.23	0.36	0.15	0.24	0.23
O24	0.20	0.19	0.41	0.13	0.26	0.12	0.33	0.25
O25	0.21	0.43	0.33	0.08	0.44	0.11	0.46	0.45
O26	0.05	0.04	0.27	0.05	0.09	0.10	0.33	0.28
O27	0.15	0.20	0.17	0.28	0.22	0.08	0.04	0.26
O28	0.21	0.07	0.11	0.14	0.37	0.08	0.23	0.44
O29	0.23	0.15	0.10	0.30	0.47	0.07	0.17	0.41
O30	0.29	0.28	0.15	0.19	0.20	0.12	0.22	0.46
O31	0.13	0.30	0.05	0.48	0.40	0.11	0.15	0.39
O32	0.11	0.05	0.33	0.44	0.58	0.36	0.12	0.38
O33	0.22	0.17	0.41	0.16	0.19	0.37	0.15	0.45
O34	0.08	0.21	0.22	0.19	0.23	0.06	0.06	0.33
O35	0.36	0.35	0.37	0.19	0.27	0.17	0.38	0.33

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**
O36	0.29	0.29	0.35	0.32	0.14	0.13	0.35	0.29
O37	0.26	0.27	0.32	0.29	0.12	0.13	0.29	0.27
O38	0.12	0.04	0.13	0.11	0.35	0.13	0.26	0.33
O39	0.42	0.21	0.39	0.14	0.46	0.35	0.19	0.42
O40	0.25	0.23	0.20	0.08	0.33	0.03	0.27	0.34
O41	0.42	0.43	0.31	0.45	0.20	0.16	0.45	0.41
O42	0.35	0.36	0.26	0.32	0.13	0.12	0.38	0.34
O43	0.43	0.26	0.39	0.10	0.40	0.08	0.46	0.44
O44	0.39	0.12	0.40	0.21	0.32	0.11	0.43	0.42
O45	0.32	0.13	0.39	0.23	0.22	0.16	0.42	0.40
O46	0.31	0.20	0.38	0.36	0.39	0.15	0.51	0.46
O47	0.26	0.23	0.30	0.32	0.41	0.09	0.50	0.41
O48	0.10	0.30	0.06	0.28	0.38	0.05	0.44	0.33
O49	0.10	0.21	0.11	0.42	0.38	0.22	0.38	0.31
O50	0.04	0.31	0.07	0.29	0.44	0.03	0.04	0.30
O51	0.38	0.32	0.07	0.45	0.41	0.00	0.11	0.13
O52	0.18	0.10	0.06	0.08	0.21	0.01	0.18	0.22
O53	0.40	0.24	0.37	0.11	0.36	0.34	0.33	0.39
O54	0.33	0.32	0.32	0.31	0.40	0.29	0.32	0.18
O55	0.40	0.35	0.23	0.30	0.12	0.17	0.43	0.35
O56	0.41	0.31	0.26	0.18	0.41	0.14	0.42	0.36
O57	0.46	0.15	0.28	0.27	0.36	0.04	0.44	0.41
O58	0.39	0.13	0.25	0.27	0.24	0.05	0.41	0.36
O59	0.32	0.12	0.25	0.22	0.24	0.08	0.37	0.29
O60	0.41	0.19	0.32	0.27	0.37	0.15	0.50	0.39
O61	0.07	0.14	0.03	0.23	0.14	0.07	0.36	0.30
O62	0.33	0.21	0.36	0.30	0.35	0.38	0.12	0.38
O63	0.11	0.15	0.05	0.04	0.23	0.06	0.06	0.10
O64	0.46	0.11	0.19	0.43	0.50	0.03	0.26	0.23
O65	0.17	0.11	0.08	0.03	0.41	0.10	0.10	0.15
O66	0.44	0.20	0.39	0.24	0.63	0.33	0.44	0.43
O67	0.34	0.16	0.47	0.14	0.37	0.37	0.42	0.48
O68	0.31	0.08	0.28	0.06	0.18	0.25	0.30	0.51
O69	0.05	0.17	0.09	0.35	0.33	0.06	0.30	0.20
O70	0.42	0.17	0.47	0.59	0.63	0.47	0.18	0.35
O71	0.10	0.20	0.00	0.15	0.24	0.09	0.06	0.02
O72	0.27	0.07	0.05	0.38	0.45	0.09	0.16	0.31
O73	0.51	0.11	0.30	0.35	0.64	0.26	0.35	0.44
O74	0.35	0.04	0.35	0.21	0.55	0.27	0.37	0.43
O75	0.35	0.23	0.49	0.16	0.47	0.38	0.31	0.48

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**
O76	0.34	0.08	0.07	0.10	0.24	0.04	0.10	0.19
O77	0.14	0.27	0.12	0.17	0.21	0.21	0.26	0.23
O78	0.37	0.24	0.55	0.48	0.57	0.53	0.21	0.29
O79	0.48	0.19	0.47	0.04	0.05	0.48	0.12	0.08
O80	0.15	0.30	0.36	0.30	0.61	0.48	0.44	0.06
O81	0.34	0.12	0.05	0.35	0.62	0.06	0.01	0.33
O82	0.22	0.16	0.06	0.29	0.57	0.17	0.33	0.36
O83	0.16	0.09	0.25	0.20	0.50	0.17	0.27	0.37
O84	0.42	0.09	0.05	0.23	0.35	0.14	0.24	0.32
O85	0.37	0.16	0.16	0.12	0.28	0.17	0.37	0.43
O86	0.52	0.36	0.65	0.41	0.54	0.61	0.15	0.27
O87	0.41	0.42	0.44	0.29	0.54	0.42	0.34	0.10
O88	0.19	0.21	0.26	0.08	0.29	0.27	0.08	0.13
O89	0.36	0.28	0.26	0.25	0.36	0.08	0.37	0.48
O90	0.31	0.48	0.42	0.21	0.25	0.42	0.38	0.08
O91	0.45	0.54	0.44	0.16	0.23	0.38	0.38	0.16
O92	0.46	0.53	0.45	0.14	0.39	0.44	0.10	0.16
O93	0.46	0.57	0.20	0.34	0.43	0.15	0.17	0.43

Perimeter Test Points

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**
P1	0.29	0.13	0.40	0.17	0.21	0.16	0.44	0.44
P2	0.21	0.16	0.37	0.17	0.17	0.12	0.48	0.48
P3	0.12	0.16	0.34	0.16	0.20	0.11	0.45	0.44
P4	0.10	0.18	0.27	0.19	0.22	0.11	0.45	0.42
P5	0.14	0.19	0.19	0.21	0.22	0.10	0.45	0.47
P6	0.15	0.17	0.16	0.20	0.22	0.07	0.08	0.34
P7	0.20	0.09	0.12	0.11	0.25	0.05	0.18	0.33
P8	0.21	0.11	0.09	0.23	0.47	0.11	0.26	0.49
P9	0.20	0.26	0.06	0.42	0.47	0.15	0.40	0.48
P10	0.15	0.19	0.02	0.15	0.25	0.06	0.05	0.17
P11	0.14	0.25	0.04	0.23	0.39	0.03	0.07	0.24
P12	0.12	0.30	0.07	0.32	0.43	0.13	0.16	0.30

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**	**VR (Existing Condition)**
P13	0.05	0.10	0.04	0.28	0.15	0.05	0.06	0.08
P14	0.11	0.10	0.02	0.42	0.44	0.04	0.47	0.45
P15	0.05	0.20	0.04	0.53	0.42	0.04	0.39	0.43
P16	0.02	0.20	0.16	0.41	0.37	0.27	0.35	0.31
P17	0.08	0.29	0.01	0.36	0.43	0.12	0.47	0.37
P18	0.13	0.27	0.09	0.24	0.33	0.03	0.39	0.27
P19	0.21	0.27	0.21	0.30	0.44	0.04	0.53	0.40
P20	0.26	0.24	0.26	0.29	0.41	0.10	0.48	0.36
P21	0.33	0.23	0.36	0.31	0.43	0.16	0.54	0.43
P22	0.10	0.06	0.07	0.09	0.11	0.05	0.15	0.12
P36	0.33	0.13	0.29	0.25	0.25	0.13	0.39	0.32
P37	0.35	0.11	0.31	0.24	0.24	0.10	0.39	0.32
P38	0.36	0.11	0.40	0.25	0.20	0.13	0.41	0.39

D.2 Scenario A: Wind Velocity Ratio

Overall Test Points

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**
O1	0.02	0.43	0.20	0.51	0.50	0.18	0.02	0.12
O2	0.18	0.08	0.14	0.13	0.18	0.16	0.41	0.44
O3	0.06	0.31	0.10	0.17	0.12	0.13	0.16	0.24
O4	0.11	0.50	0.09	0.58	0.57	0.11	0.10	0.11
O5	0.01	0.33	0.06	0.51	0.53	0.16	0.05	0.27
O6	0.16	0.40	0.04	0.37	0.31	0.01	0.08	0.20
O7	0.07	0.07	0.32	0.02	0.46	0.25	0.15	0.14
O8	0.40	0.37	0.35	0.30	0.27	0.31	0.07	0.16
O9	0.20	0.03	0.16	0.08	0.07	0.17	0.35	0.35
O10	0.02	0.11	0.05	0.24	0.20	0.05	0.15	0.15
O11	0.17	0.17	0.10	0.14	0.14	0.10	0.01	0.08
O12	0.23	0.08	0.09	0.16	0.18	0.12	0.09	0.32
O13	0.21	0.22	0.10	0.40	0.53	0.14	0.32	0.25
O14	0.13	0.12	0.16	0.05	0.50	0.13	0.25	0.25
O15	0.16	0.36	0.10	0.33	0.44	0.06	0.29	0.24
O16	0.15	0.46	0.06	0.33	0.06	0.05	0.15	0.16
O17	0.07	0.21	0.17	0.37	0.18	0.17	0.23	0.22
O18	0.14	0.04	0.21	0.06	0.43	0.17	0.14	0.09
O19	0.18	0.02	0.19	0.12	0.41	0.18	0.03	0.20
O20	0.38	0.35	0.28	0.29	0.71	0.25	0.08	0.06
O21	0.48	0.47	0.38	0.41	0.22	0.24	0.13	0.21
O22	0.16	0.39	0.40	0.40	0.30	0.03	0.09	0.10
O23	0.17	0.28	0.28	0.31	0.39	0.06	0.26	0.21
O24	0.19	0.24	0.17	0.14	0.23	0.13	0.35	0.32
O25	0.26	0.29	0.04	0.12	0.18	0.19	0.47	0.52
O26	0.15	0.08	0.17	0.11	0.05	0.13	0.35	0.37
O27	0.09	0.17	0.10	0.37	0.35	0.11	0.27	0.35
O28	0.06	0.13	0.11	0.38	0.41	0.15	0.36	0.27
O29	0.10	0.13	0.05	0.36	0.41	0.13	0.27	0.22
O30	0.23	0.20	0.12	0.15	0.37	0.09	0.19	0.20
O31	0.22	0.30	0.17	0.37	0.48	0.12	0.11	0.17
O32	0.20	0.40	0.21	0.58	0.59	0.16	0.04	0.14
O33	0.30	0.12	0.40	0.12	0.22	0.37	0.22	0.02
O34	0.04	0.19	0.25	0.13	0.38	0.08	0.06	0.08
O35	0.17	0.32	0.41	0.30	0.29	0.09	0.37	0.37
O36	0.15	0.32	0.23	0.31	0.15	0.18	0.34	0.30
O37	0.11	0.01	0.05	0.19	0.21	0.06	0.09	0.16

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**
O38	0.08	0.22	0.14	0.40	0.44	0.06	0.22	0.18
O39	0.40	0.04	0.35	0.34	0.49	0.33	0.20	0.10
O40	0.33	0.23	0.33	0.08	0.48	0.08	0.19	0.21
O41	0.13	0.45	0.38	0.29	0.21	0.07	0.44	0.42
O42	0.12	0.35	0.30	0.36	0.28	0.13	0.37	0.32
O43	0.13	0.20	0.25	0.21	0.41	0.21	0.42	0.39
O44	0.13	0.22	0.22	0.39	0.42	0.14	0.33	0.31
O45	0.03	0.17	0.12	0.36	0.43	0.08	0.30	0.27
O46	0.04	0.03	0.17	0.05	0.06	0.06	0.05	0.04
O47	0.10	0.05	0.26	0.10	0.06	0.17	0.19	0.02
O48	0.19	0.17	0.18	0.33	0.26	0.20	0.33	0.08
O49	0.23	0.22	0.20	0.39	0.37	0.21	0.17	0.08
O50	0.24	0.07	0.04	0.42	0.46	0.01	0.18	0.30
O51	0.40	0.16	0.01	0.35	0.27	0.04	0.07	0.13
O52	0.15	0.22	0.06	0.02	0.16	0.10	0.13	0.10
O53	0.43	0.25	0.28	0.32	0.41	0.18	0.26	0.18
O54	0.29	0.28	0.35	0.36	0.31	0.31	0.22	0.33
O55	0.31	0.33	0.26	0.22	0.12	0.08	0.42	0.33
O56	0.30	0.23	0.31	0.30	0.39	0.08	0.41	0.34
O57	0.30	0.18	0.38	0.29	0.32	0.03	0.41	0.37
O58	0.19	0.02	0.21	0.30	0.37	0.04	0.33	0.30
O59	0.08	0.07	0.15	0.07	0.13	0.12	0.33	0.28
O60	0.06	0.10	0.16	0.07	0.12	0.16	0.40	0.38
O61	0.13	0.09	0.08	0.31	0.20	0.12	0.20	0.28
O62	0.33	0.15	0.40	0.32	0.34	0.45	0.17	0.44
O63	0.13	0.12	0.03	0.05	0.37	0.04	0.09	0.06
O64	0.46	0.26	0.06	0.46	0.37	0.05	0.15	0.20
O65	0.18	0.05	0.14	0.07	0.42	0.11	0.18	0.14
O66	0.45	0.19	0.34	0.34	0.62	0.33	0.22	0.25
O67	0.34	0.09	0.44	0.32	0.29	0.34	0.24	0.29
O68	0.34	0.03	0.27	0.07	0.07	0.23	0.01	0.30
O69	0.11	0.13	0.11	0.41	0.38	0.07	0.11	0.26
O70	0.35	0.22	0.46	0.53	0.62	0.53	0.02	0.37
O71	0.22	0.08	0.02	0.14	0.23	0.03	0.04	0.14
O72	0.28	0.23	0.09	0.43	0.26	0.09	0.10	0.15
O73	0.50	0.02	0.25	0.35	0.64	0.22	0.06	0.24
O74	0.39	0.15	0.24	0.28	0.52	0.24	0.16	0.25
O75	0.24	0.26	0.46	0.21	0.43	0.39	0.10	0.29
O76	0.38	0.09	0.24	0.31	0.19	0.09	0.24	0.11
O77	0.16	0.19	0.18	0.08	0.14	0.21	0.31	0.24

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**
O78	0.35	0.27	0.55	0.48	0.55	0.59	0.20	0.28
O79	0.48	0.26	0.49	0.02	0.04	0.47	0.14	0.09
O80	0.20	0.09	0.46	0.39	0.68	0.45	0.43	0.25
O81	0.30	0.46	0.15	0.43	0.68	0.06	0.06	0.08
O82	0.27	0.20	0.08	0.31	0.59	0.19	0.24	0.19
O83	0.20	0.10	0.21	0.17	0.52	0.20	0.21	0.21
O84	0.23	0.30	0.10	0.10	0.07	0.17	0.03	0.21
O85	0.29	0.27	0.24	0.21	0.18	0.14	0.32	0.03
O86	0.52	0.38	0.63	0.47	0.52	0.66	0.15	0.19
O87	0.43	0.45	0.46	0.30	0.63	0.37	0.35	0.25
O88	0.18	0.28	0.24	0.11	0.32	0.27	0.07	0.11
O89	0.21	0.48	0.23	0.20	0.15	0.13	0.40	0.18
O90	0.33	0.49	0.42	0.26	0.14	0.44	0.39	0.38
O91	0.42	0.55	0.41	0.03	0.34	0.41	0.33	0.40
O92	0.42	0.52	0.43	0.18	0.36	0.46	0.06	0.32
O93	0.50	0.55	0.24	0.24	0.12	0.08	0.27	0.07

Perimeter Test Points

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**
P1	0.11	0.28	0.05	0.50	0.51	0.11	0.40	0.44
P2	0.10	0.23	0.05	0.41	0.38	0.09	0.33	0.37
P3	0.03	0.24	0.16	0.42	0.42	0.10	0.30	0.37
P4	0.03	0.26	0.16	0.49	0.45	0.11	0.35	0.40
P5	0.06	0.21	0.07	0.41	0.38	0.09	0.35	0.39
P6	0.03	0.16	0.08	0.39	0.38	0.11	0.35	0.38
P7	0.02	0.13	0.11	0.38	0.40	0.13	0.36	0.37
P8	0.12	0.16	0.09	0.40	0.41	0.15	0.26	0.13
P9	0.08	0.16	0.05	0.21	0.18	0.07	0.17	0.30
P10	0.36	0.14	0.13	0.26	0.28	0.13	0.11	0.26
P11	0.31	0.07	0.06	0.39	0.43	0.06	0.14	0.28
P12	0.19	0.08	0.06	0.47	0.51	0.03	0.19	0.33
P13	0.12	0.08	0.14	0.13	0.08	0.05	0.06	0.08
P14	0.17	0.05	0.08	0.26	0.30	0.20	0.28	0.31

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**	**VR (Scenario A)**
P15	0.19	0.12	0.15	0.38	0.30	0.20	0.20	0.18
P16	0.21	0.18	0.23	0.50	0.30	0.19	0.12	0.05
P17	0.18	0.05	0.10	0.21	0.14	0.13	0.27	0.11
P18	0.17	0.15	0.17	0.31	0.21	0.20	0.33	0.06
P19	0.13	0.04	0.16	0.04	0.04	0.16	0.24	0.17
P20	0.10	0.06	0.23	0.06	0.12	0.17	0.18	0.34
P21	0.08	0.04	0.07	0.02	0.05	0.04	0.31	0.35
P22	0.07	0.07	0.16	0.07	0.09	0.15	0.33	0.39
P36	0.09	0.03	0.18	0.12	0.11	0.04	0.29	0.38
P37	0.08	0.02	0.12	0.14	0.22	0.04	0.27	0.26
P38	0.03	0.15	0.23	0.37	0.44	0.08	0.30	0.25

D.3 Scenario B: Wind Velocity Ratio

Overall Test Points

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**
O1	0.07	0.24	0.05	0.55	0.55	0.15	0.03	0.28
O2	0.20	0.07	0.04	0.14	0.18	0.16	0.48	0.47
O3	0.01	0.30	0.08	0.07	0.05	0.14	0.21	0.26
O4	0.04	0.48	0.04	0.59	0.59	0.11	0.06	0.26
O5	0.01	0.03	0.02	0.49	0.52	0.17	0.03	0.29
O6	0.02	0.37	0.08	0.41	0.32	0.07	0.20	0.34
O7	0.12	0.17	0.39	0.13	0.43	0.18	0.06	0.07
O8	0.40	0.41	0.37	0.28	0.35	0.31	0.10	0.04
O9	0.21	0.39	0.05	0.06	0.04	0.14	0.41	0.41
O10	0.09	0.08	0.03	0.31	0.25	0.04	0.17	0.19
O11	0.13	0.21	0.07	0.10	0.10	0.13	0.01	0.39
O12	0.20	0.11	0.06	0.16	0.16	0.16	0.16	0.20
O13	0.18	0.29	0.10	0.41	0.51	0.16	0.12	0.14
O14	0.03	0.06	0.16	0.32	0.50	0.13	0.05	0.06
O15	0.12	0.23	0.07	0.43	0.49	0.06	0.08	0.08
O16	0.11	0.38	0.16	0.32	0.22	0.13	0.21	0.14
O17	0.20	0.49	0.28	0.35	0.12	0.18	0.11	0.06
O18	0.13	0.12	0.28	0.19	0.39	0.17	0.09	0.03
O19	0.21	0.03	0.15	0.18	0.38	0.19	0.01	0.05
O20	0.37	0.37	0.23	0.32	0.79	0.25	0.06	0.17
O21	0.48	0.52	0.39	0.44	0.21	0.23	0.08	0.12
O22	0.16	0.45	0.40	0.48	0.30	0.13	0.07	0.14
O23	0.21	0.32	0.41	0.46	0.36	0.05	0.28	0.21
O24	0.23	0.25	0.34	0.21	0.20	0.15	0.36	0.29
O25	0.26	0.59	0.25	0.25	0.31	0.17	0.49	0.48
O26	0.16	0.11	0.07	0.06	0.09	0.11	0.38	0.39
O27	0.01	0.13	0.04	0.27	0.29	0.12	0.38	0.34
O28	0.06	0.07	0.03	0.18	0.16	0.04	0.03	0.10
O29	0.05	0.20	0.06	0.33	0.40	0.15	0.14	0.17
O30	0.22	0.13	0.04	0.14	0.19	0.08	0.03	0.11
O31	0.28	0.23	0.17	0.23	0.67	0.12	0.06	0.15
O32	0.16	0.51	0.35	0.68	0.55	0.18	0.03	0.07
O33	0.32	0.23	0.43	0.13	0.23	0.38	0.05	0.15
O34	0.30	0.21	0.25	0.02	0.34	0.06	0.09	0.05
O35	0.20	0.36	0.45	0.33	0.28	0.10	0.39	0.37
O36	0.16	0.38	0.37	0.29	0.14	0.14	0.36	0.31
O37	0.16	0.12	0.14	0.25	0.27	0.15	0.08	0.24

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**
O38	0.10	0.31	0.17	0.48	0.47	0.09	0.14	0.21
O39	0.41	0.06	0.35	0.42	0.53	0.32	0.17	0.09
O40	0.37	0.24	0.33	0.06	0.43	0.04	0.18	0.16
O41	0.15	0.49	0.39	0.19	0.20	0.08	0.47	0.43
O42	0.13	0.49	0.32	0.38	0.15	0.11	0.40	0.34
O43	0.13	0.46	0.42	0.40	0.45	0.09	0.48	0.43
O44	0.12	0.37	0.36	0.25	0.41	0.04	0.40	0.36
O45	0.09	0.04	0.10	0.40	0.36	0.06	0.40	0.33
O46	0.11	0.11	0.19	0.11	0.10	0.07	0.18	0.21
O47	0.17	0.02	0.11	0.04	0.11	0.10	0.32	0.28
O48	0.10	0.10	0.14	0.09	0.20	0.17	0.24	0.17
O49	0.07	0.17	0.18	0.34	0.38	0.20	0.19	0.16
O50	0.14	0.23	0.13	0.52	0.55	0.07	0.16	0.37
O51	0.45	0.12	0.09	0.38	0.30	0.06	0.05	0.10
O52	0.14	0.32	0.09	0.08	0.18	0.08	0.09	0.08
O53	0.44	0.35	0.30	0.25	0.42	0.18	0.13	0.20
O54	0.30	0.33	0.37	0.37	0.40	0.24	0.16	0.33
O55	0.22	0.41	0.25	0.11	0.11	0.03	0.47	0.36
O56	0.23	0.46	0.30	0.39	0.22	0.04	0.46	0.37
O57	0.23	0.34	0.36	0.42	0.42	0.09	0.47	0.42
O58	0.16	0.05	0.36	0.22	0.36	0.10	0.40	0.35
O59	0.12	0.10	0.29	0.15	0.27	0.11	0.37	0.32
O60	0.19	0.09	0.15	0.20	0.32	0.19	0.39	0.35
O61	0.11	0.18	0.07	0.35	0.33	0.08	0.04	0.20
O62	0.34	0.15	0.45	0.35	0.39	0.46	0.07	0.48
O63	0.11	0.23	0.04	0.10	0.37	0.02	0.06	0.03
O64	0.51	0.20	0.03	0.53	0.43	0.09	0.11	0.15
O65	0.25	0.04	0.10	0.09	0.45	0.09	0.16	0.31
O66	0.45	0.22	0.36	0.33	0.68	0.35	0.22	0.29
O67	0.29	0.23	0.52	0.37	0.31	0.35	0.26	0.38
O68	0.38	0.02	0.39	0.06	0.03	0.24	0.18	0.42
O69	0.22	0.19	0.16	0.42	0.40	0.14	0.28	0.27
O70	0.35	0.13	0.49	0.60	0.64	0.50	0.10	0.37
O71	0.22	0.21	0.07	0.14	0.23	0.08	0.07	0.13
O72	0.30	0.29	0.10	0.50	0.35	0.12	0.08	0.27
O73	0.53	0.01	0.25	0.35	0.68	0.27	0.09	0.35
O74	0.35	0.20	0.24	0.32	0.61	0.24	0.20	0.37
O75	0.26	0.19	0.49	0.34	0.52	0.41	0.20	0.41
O76	0.45	0.04	0.18	0.20	0.24	0.11	0.21	0.24
O77	0.29	0.21	0.30	0.15	0.14	0.26	0.24	0.21

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**
O78	0.33	0.27	0.60	0.53	0.55	0.57	0.20	0.28
O79	0.40	0.29	0.53	0.02	0.07	0.50	0.13	0.10
O80	0.21	0.31	0.46	0.44	0.66	0.48	0.43	0.32
O81	0.37	0.47	0.12	0.51	0.67	0.07	0.05	0.11
O82	0.15	0.21	0.17	0.35	0.61	0.13	0.25	0.31
O83	0.12	0.10	0.15	0.20	0.54	0.20	0.13	0.29
O84	0.10	0.38	0.18	0.12	0.11	0.27	0.08	0.13
O85	0.42	0.31	0.16	0.18	0.09	0.15	0.31	0.11
O86	0.51	0.38	0.67	0.52	0.53	0.67	0.14	0.21
O87	0.39	0.43	0.44	0.32	0.64	0.41	0.37	0.26
O88	0.16	0.26	0.24	0.12	0.30	0.27	0.06	0.10
O89	0.40	0.58	0.17	0.14	0.12	0.07	0.39	0.15
O90	0.31	0.52	0.44	0.25	0.12	0.46	0.39	0.34
O91	0.42	0.57	0.42	0.15	0.36	0.39	0.13	0.40
O92	0.43	0.53	0.47	0.14	0.37	0.45	0.02	0.33
O93	0.48	0.64	0.29	0.18	0.16	0.10	0.38	0.17

Perimeter Test Points

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**
P1	0.13	0.21	0.19	0.49	0.36	0.03	0.40	0.34
P2	0.19	0.23	0.17	0.52	0.48	0.13	0.40	0.27
P3	0.11	0.21	0.01	0.53	0.54	0.19	0.41	0.20
P4	0.01	0.21	0.08	0.50	0.56	0.18	0.50	0.52
P5	0.04	0.13	0.05	0.28	0.36	0.13	0.56	0.41
P6	0.12	0.11	0.14	0.25	0.32	0.15	0.29	0.20
P7	0.03	0.15	0.02	0.44	0.42	0.16	0.31	0.08
P8	0.05	0.08	0.04	0.22	0.29	0.05	0.05	0.17
P9	0.06	0.03	0.06	0.07	0.22	0.11	0.12	0.30
P10	0.33	0.29	0.12	0.24	0.28	0.07	0.13	0.33
P11	0.09	0.24	0.13	0.47	0.49	0.07	0.13	0.36
P12	0.14	0.24	0.15	0.54	0.57	0.10	0.18	0.38
P13	0.09	0.04	0.11	0.12	0.10	0.08	0.05	0.08
P14	0.26	0.09	0.24	0.39	0.30	0.08	0.18	0.16
P15	0.20	0.05	0.21	0.07	0.08	0.12	0.20	0.06
P16	0.12	0.22	0.20	0.49	0.48	0.13	0.26	0.15

	E	ENE	ESE	NE	NNE	SE	SSW	SW
Test points	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**	**VR (Scenario B)**
P17	0.03	0.07	0.13	0.14	0.15	0.11	0.26	0.20
P18	0.12	0.12	0.13	0.24	0.18	0.18	0.16	0.19
P19	0.18	0.03	0.10	0.02	0.06	0.19	0.39	0.44
P20	0.21	0.07	0.11	0.11	0.15	0.22	0.37	0.35
P21	0.17	0.09	0.09	0.13	0.21	0.19	0.14	0.14
P22	0.13	0.12	0.07	0.18	0.29	0.18	0.25	0.20
P36	0.08	0.10	0.15	0.08	0.07	0.11	0.20	0.20
P37	0.08	0.11	0.28	0.05	0.07	0.10	0.12	0.12
P38	0.10	0.09	0.32	0.46	0.37	0.09	0.40	0.35

D.4 Weighted Wind Velocity Ratio (VRw)

Normalized Weighting

Wind Direction	Occurrence frequency of the wind direction	Normalized weighting
ENE	18.30%	22.9%
E	15.80%	19.8%
NE	13.10%	16.4%
ESE	8.80%	11.0%
NNE	7.50%	9.4%
SSW	5.90%	7.4%
SE	5.30%	6.6%
SW	5.30%	6.6%
Overall Value	80.00%	100%

Comparison of Scenario A VRw and Scenario B VRw

Overall Test Points

Test points	**VRw (Existing Condition)**	**VRw (Scenario A)**	**VRw (Scenario B)**	**VRw Diff (Scenario B - Scenario A)**	**VRw Diff (Scenario B -Existing Condition)**
O1	0.263	0.250	0.220	-0.03	-0.04
O2	0.166	0.185	0.177	-0.01	0.01
O3	0.194	0.157	0.132	-0.03	-0.06
O4	0.319	0.277	0.261	-0.02	-0.06
O5	0.269	0.220	0.154	-0.07	-0.12
O6	0.277	0.204	0.210	0.01	-0.07
O7	0.218	0.179	0.207	0.03	-0.01
O8	0.324	0.310	0.321	0.01	-0.00
O9	0.172	0.155	0.203	0.05	0.03
O10	0.095	0.105	0.127	0.02	0.03
O11	0.215	0.126	0.136	0.01	-0.08
O12	0.183	0.148	0.141	-0.01	-0.04
O13	0.324	0.250	0.236	-0.01	-0.09
O14	0.153	0.180	0.151	-0.03	-0.00
O15	0.312	0.242	0.193	-0.05	-0.12
O16	0.283	0.192	0.214	0.02	-0.07
O17	0.254	0.190	0.257	0.07	0.00
O18	0.150	0.154	0.182	0.03	0.03
O19	0.180	0.160	0.153	-0.01	-0.03

Test points	VRw (Existing Condition)	VRw (Scenario A)	VRw (Scenario B)	VRw Diff (Scenario B - Scenario A)	VRw Diff (Scenario B -Existing Condition)
O20	0.299	0.323	0.335	0.01	0.04
O21	0.379	0.356	0.359	0.00	-0.02
O22	0.279	0.264	0.297	0.03	0.02
O23	0.289	0.250	0.302	0.05	0.01
O24	0.242	0.210	0.255	0.05	0.01
O25	0.309	0.230	0.349	0.12	0.04
O26	0.136	0.154	0.144	-0.01	0.01
O27	0.178	0.196	0.157	-0.04	-0.02
O28	0.181	0.200	0.075	-0.12	-0.11
O29	0.219	0.182	0.168	-0.01	-0.05
O30	0.236	0.192	0.125	-0.07	-0.11
O31	0.231	0.247	0.246	-0.00	0.02
O32	0.266	0.301	0.340	0.04	0.07
O33	0.260	0.238	0.265	0.03	0.01
O34	0.172	0.158	0.193	0.03	0.02
O35	0.317	0.290	0.315	0.02	-0.00
O36	0.279	0.242	0.275	0.03	-0.00
O37	0.252	0.096	0.170	0.07	-0.08
O38	0.155	0.206	0.240	0.03	0.08
O39	0.328	0.284	0.299	0.02	-0.03
O40	0.216	0.258	0.253	-0.00	0.04
O41	0.362	0.300	0.305	0.01	-0.06
O42	0.290	0.270	0.293	0.02	0.00
O43	0.326	0.249	0.349	0.10	0.02
O44	0.296	0.250	0.284	0.03	-0.01
O45	0.276	0.191	0.183	-0.01	-0.09
O46	0.330	0.068	0.131	0.06	-0.20
O47	0.298	0.122	0.127	0.00	-0.17
O48	0.216	0.212	0.138	-0.07	-0.08
O49	0.232	0.236	0.197	-0.04	-0.04
O50	0.183	0.195	0.250	0.06	0.07
O51	0.249	0.188	0.211	0.02	-0.04
O52	0.125	0.125	0.149	0.02	0.02
O53	0.319	0.302	0.310	0.01	-0.01
O54	0.315	0.309	0.321	0.01	0.01
O55	0.297	0.267	0.248	-0.02	-0.05
O56	0.314	0.290	0.312	0.02	-0.00
O57	0.297	0.284	0.333	0.05	0.04
O58	0.257	0.198	0.228	0.03	-0.03
O59	0.232	0.131	0.198	0.07	-0.03
O60	0.316	0.151	0.205	0.05	-0.11

Test points	VRw (Existing Condition)	VRw (Scenario A)	VRw (Scenario B)	VRw Diff (Scenario B - Scenario A)	VRw Diff (Scenario B -Existing Condition)
O61	0.139	0.156	0.164	0.01	0.02
O62	0.305	0.316	0.331	0.01	0.03
O63	0.105	0.110	0.129	0.02	0.02
O64	0.278	0.264	0.267	0.00	-0.01
O65	0.137	0.152	0.170	0.02	0.03
O66	0.376	0.345	0.364	0.02	-0.01
O67	0.332	0.294	0.342	0.05	0.01
O68	0.230	0.177	0.221	0.04	-0.01
O69	0.173	0.183	0.245	0.06	0.07
O70	0.404	0.386	0.387	0.00	-0.02
O71	0.111	0.114	0.153	0.04	0.04
O72	0.201	0.210	0.254	0.04	0.05
O73	0.356	0.288	0.310	0.02	-0.05
O74	0.300	0.279	0.306	0.03	0.01
O75	0.356	0.309	0.344	0.04	-0.01
O76	0.150	0.218	0.215	-0.00	0.06
O77	0.195	0.180	0.236	0.06	0.04
O78	0.409	0.411	0.420	0.01	0.01
O79	0.276	0.292	0.296	0.00	0.02
O80	0.324	0.341	0.395	0.05	0.07
O81	0.227	0.302	0.321	0.02	0.09
O82	0.238	0.245	0.251	0.01	0.01
O83	0.228	0.214	0.194	-0.02	-0.03
O84	0.219	0.167	0.187	0.02	-0.03
O85	0.245	0.227	0.238	0.01	-0.01
O86	0.467	0.469	0.482	0.01	0.02
O87	0.390	0.422	0.416	-0.01	0.03
O88	0.201	0.212	0.202	-0.01	0.00
O89	0.301	0.260	0.285	0.02	-0.02
O90	0.341	0.367	0.367	0.00	0.03
O91	0.378	0.382	0.387	0.01	0.01
O92	0.378	0.377	0.383	0.01	0.00
O93	0.366	0.309	0.345	0.04	-0.02

Perimeter Test Points

Test points	VRw (Existing Condition)	VRw (Scenario A)	VRw (Scenario B)	VRw Diff (Scenario B - Scenario A)	VRw Diff (Scenario B -Existing Condition)
P1	0.270	0.257	0.246	-0.01	-0.02
P2	0.255	0.211	0.275	0.06	0.02
P3	0.227	0.225	0.236	0.01	0.01
P4	0.217	0.248	0.258	0.01	0.04
P5	0.217	0.208	0.190	-0.02	-0.03
P6	0.169	0.194	0.177	-0.02	0.01
P7	0.154	0.197	0.173	-0.02	0.02
P8	0.213	0.196	0.104	-0.09	-0.11
P9	0.267	0.136	0.099	-0.04	-0.17
P10	0.130	0.212	0.231	0.02	0.10
P11	0.169	0.203	0.226	0.02	0.06
P12	0.215	0.204	0.266	0.06	0.05
P13	0.098	0.097	0.084	-0.01	-0.01
P14	0.203	0.175	0.215	0.04	0.01
P15	0.219	0.202	0.130	-0.07	-0.09
P16	0.223	0.230	0.244	0.01	0.02
P17	0.226	0.139	0.116	-0.02	-0.11
P18	0.200	0.193	0.155	-0.04	-0.05
P19	0.278	0.115	0.143	0.03	-0.14
P20	0.284	0.143	0.173	0.03	-0.11
P21	0.334	0.095	0.138	0.04	-0.20
P22	0.088	0.138	0.159	0.02	0.07
P36	0.254	0.133	0.115	-0.02	-0.14
P37	0.256	0.123	0.124	0.00	-0.13
P38	0.280	0.207	0.244	0.04	-0.04

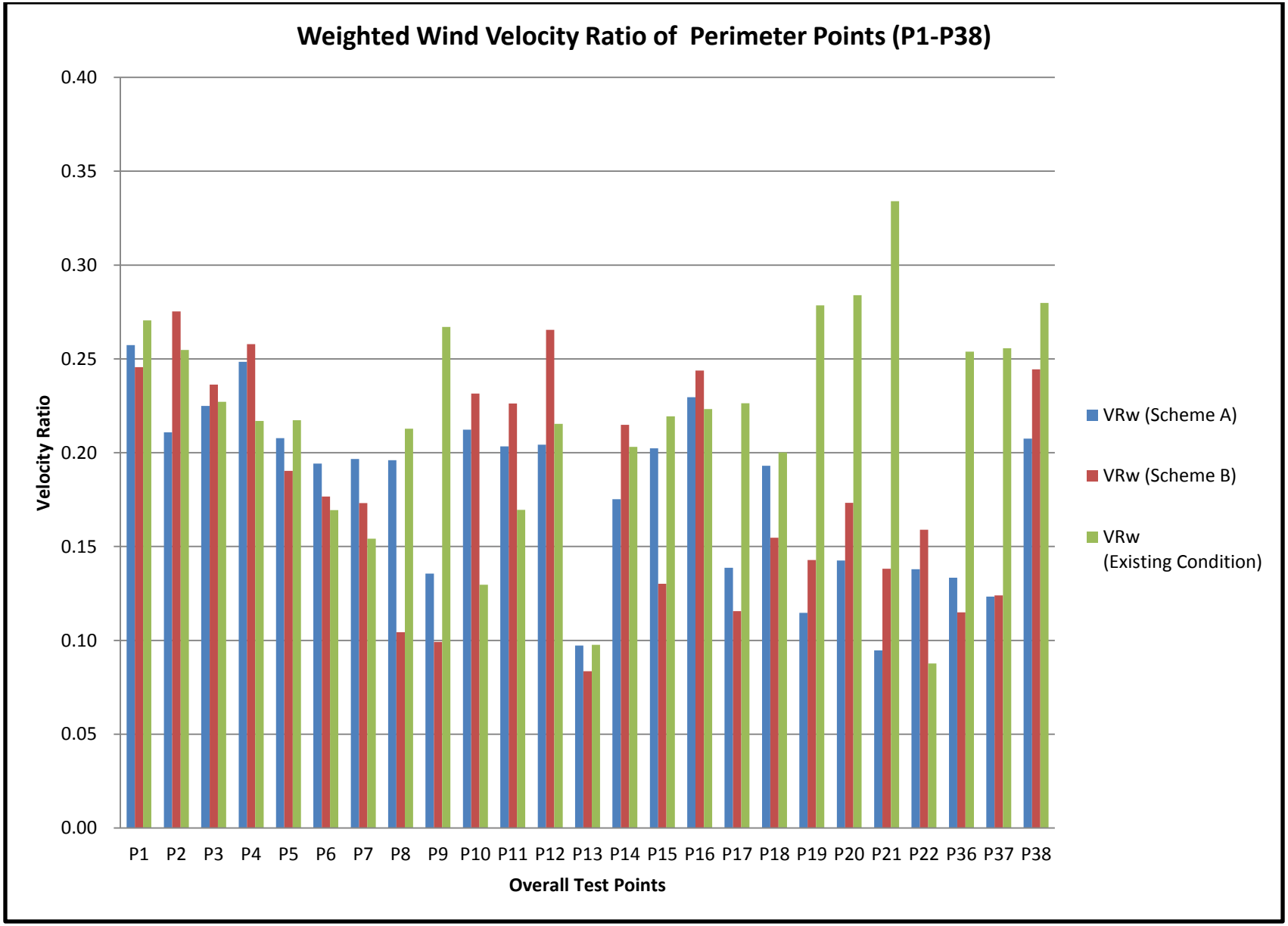
Local Spatial Average Velocity Ratio (LVR)

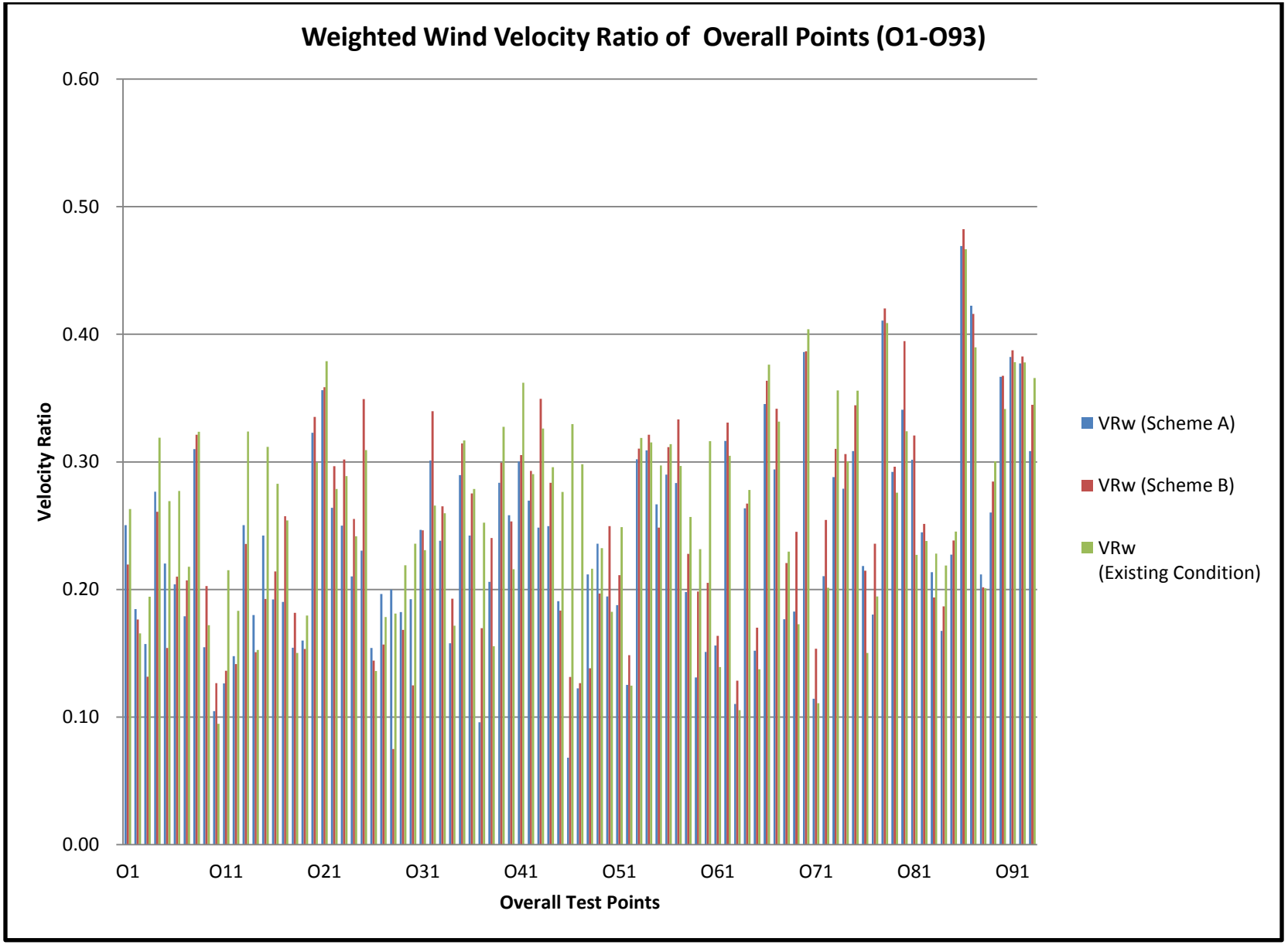
Wind Directions	VRaverage (Existing Condition)	VRaverage (Scenario A)	VRaverage (Scenario B)	VRaverage Change (Scenario B - Scenario A)	% VRaverage Change (Scenario B - Scenario A)	VRaverage Change (Scenario B - Existing Condition)	% VRaverage Change (Scenario B - Existing Condition)
E	0.25	0.205	0.208	0.003	1.4%	-0.040	-19.2%
ENE	0.22	0.205	0.234	0.030	12.6%	0.012	5.3%
ESE	0.23	0.202	0.218	0.016	7.1%	-0.017	-7.9%
NE	0.26	0.270	0.281	0.011	4.0%	0.018	6.4%
NNE	0.34	0.323	0.334	0.011	3.4%	-0.011	-3.2%
SE	0.16	0.166	0.170	0.004	2.3%	0.008	4.7%
SSW	0.28	0.220	0.213	-0.007	-3.4%	-0.062	-29.1%
SW	0.31	0.235	0.244	0.009	3.8%	-0.070	-28.8%
LVRw	**0.252**	**0.223**	**0.235**	0.012	5.0%	-0.016	-7.0%

Site Spatial Average Velocity Ratio (SVR)

Wind Directions	VRaverage (Existing Condition)	VRaverage (Scenario A)	VRaverage (Scenario B)	VRaverage Change (Scenario B - Scenario A)	% VRaverage Change (Scenario B - Scenario A)	VRaverage Change (Scenario B - Existing Condition)	% VRaverage Change (Scenario B - Existing Condition)
E	0.176	0.123	0.123	0.000	0.1%	-0.053	-43.3%
ENE	0.180	0.127	0.134	0.007	5.5%	-0.046	-34.3%
ESE	0.176	0.124	0.132	0.008	6.1%	-0.045	-34.0%
NE	0.261	0.292	0.280	-0.012	-4.4%	0.019	6.8%
NNE	0.308	0.286	0.295	0.010	3.3%	-0.013	-4.4%
SE	0.098	0.113	0.126	0.013	10.1%	0.028	22.2%
SSW	0.339	0.258	0.259	0.001	0.3%	-0.080	-31.1%
SW	0.354	0.278	0.248	-0.030	-12.0%	-0.106	-42.6%
SVRw	**0.218**	**0.179**	**0.181**	0.002	0.9%	-0.037	-20.5%

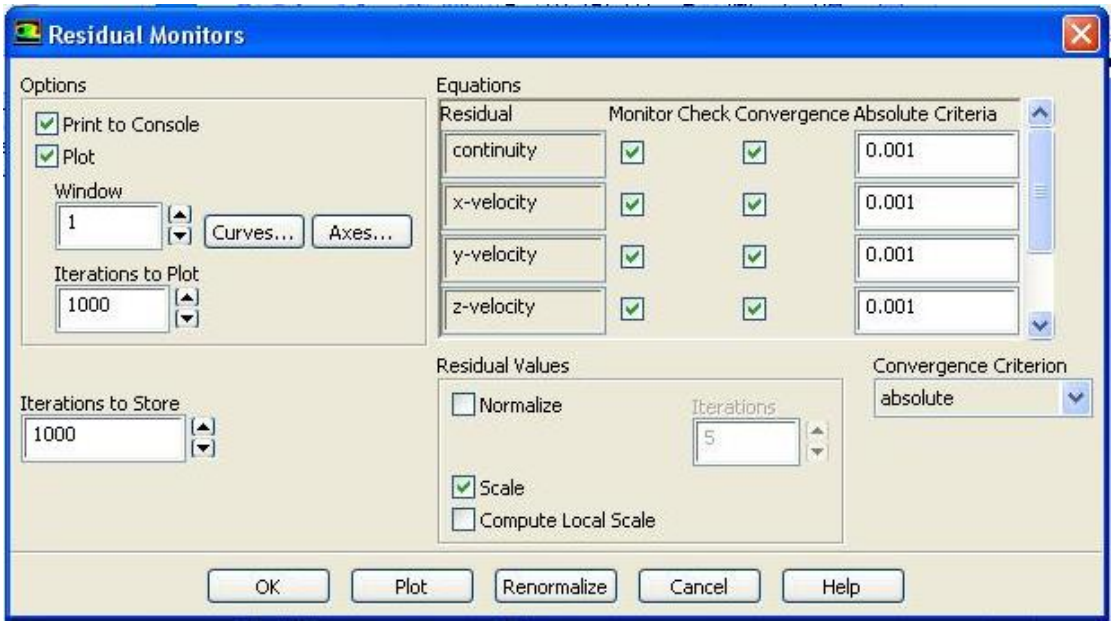
APPENDIX E GRAPHICAL PLOT OF WEIGHT VELOCITY RATIO OF PERIMETER TEST POINTS AND OVERALL TEST POINTS

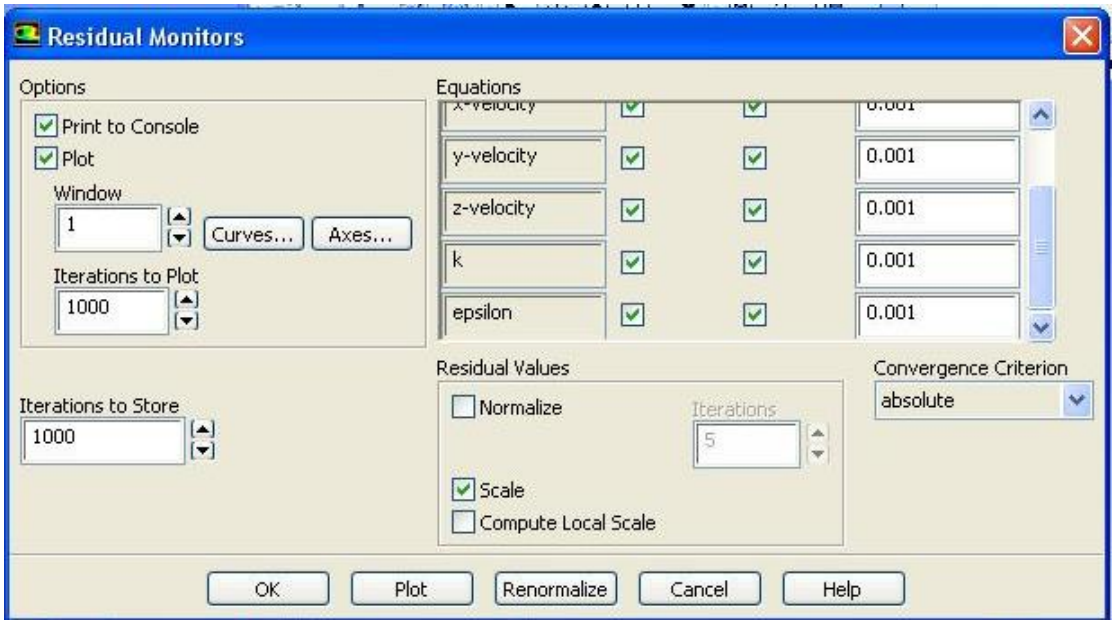

Weighted Wind Velocity Ratio of Perimeter Points (P1-P38)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Velocity Ratio
P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P36 P37 P38
Overall Test Points
VRw (Scheme A)
VRw (Scheme B)
VRw (Existing Condition)


Weighted Wind Velocity Ratio of Overall Points (O1-O93)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Velocity Ratio
O1
O11
O21
O31
O41
O51
O61
O71
O81
O91
Overall Test Points
VRw (Scheme A)
VRw (Scheme B)
VRw
(Existing Condition)

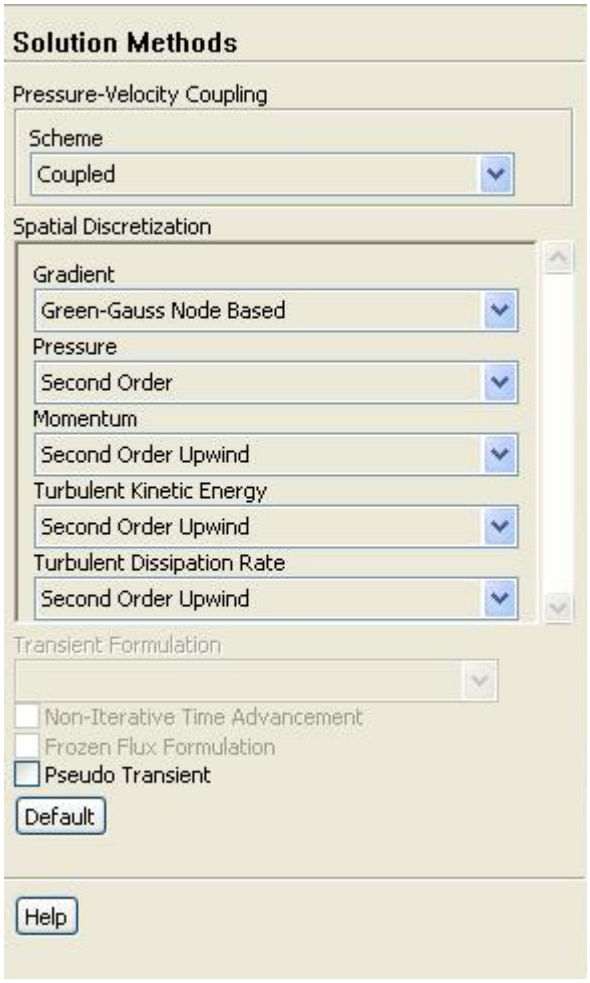
APPENDIX F GENERAL ASSUMPTION AND INPUT FOR CFD SIMULATION

Convergences Criteria inputs





Numerical Scheme inputs



Wind Direction	East	North	South	West	Top	Bottom
ENE	Velocity-inlet	Velocity-inlet	Pressure outlet	Pressure outlet	Symmetry	Wall
NE	Velocity-inlet	Velocity-inlet	Pressure outlet	Pressure outlet	Symmetry	Wall
E	Velocity-inlet	Symmetry	Symmetry	Pressure outlet	Symmetry	Wall
NNE	Velocity-inlet	Velocity-inlet	Pressure outlet	Pressure outlet	Symmetry	Wall
ESE	Velocity-inlet	Pressure outlet	Velocity-inlet	Pressure outlet	Symmetry	Wall
SSW	Pressure outlet	Pressure outlet	Velocity-inlet	Velocity-inlet	Symmetry	Wall
SW	Pressure outlet	Pressure outlet	Velocity-inlet	Velocity-inlet	Symmetry	Wall
SE	Velocity-inlet	Pressure outlet	Velocity-inlet	Pressure outlet	Symmetry	Wall

Boundary Condition Setting for CFD Modelling

APPENDIX G MM5 DATA AND PREVAILING VELOCITY PROFILES

A.1 MM5 Wind Data (28, 32)

Square	(28,32)	Wind	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
V	infinity	(m/s)	0.032	0.086	0.147	0.148	0.146	0.082	0.057	0.049	0.037	0.07	0.061	0.027	0.015	0.012	0.012	0.021
0_to_1		0.5	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.001	0.002	0.001	0.002	0.002
1_to_2		1.5	0.004	0.004	0.003	0.003	0.004	0.004	0.003	0.005	0.006	0.005	0.004	0.003	0.002	0.004	0.004	0.004
2_to_3		2.5	0.005	0.006	0.006	0.006	0.005	0.004	0.004	0.005	0.005	0.006	0.004	0.003	0.003	0.002	0.003	0.005
3_to_4		3.5	0.005	0.004	0.007	0.011	0.007	0.006	0.006	0.005	0.004	0.007	0.005	0.002	0.003	0.001	0.002	0.004
4_to_5		4.5	0.005	0.006	0.007	0.011	0.009	0.006	0.007	0.006	0.004	0.006	0.005	0.004	0.002	0.001	0.001	0.003
5_to_6		5.5	0.004	0.004	0.009	0.01	0.011	0.011	0.006	0.005	0.005	0.005	0.008	0.004	0.002	0.001	0	0.001
6_to_7		6.5	0.001	0.006	0.009	0.013	0.014	0.012	0.008	0.006	0.004	0.01	0.008	0.004	0.001	0	0.001	0
7_to_8		7.5	0.001	0.005	0.007	0.01	0.015	0.009	0.006	0.005	0.002	0.007	0.009	0.003	0.001	0.001	0	0
8_to_9		8.5	0.001	0.006	0.011	0.015	0.016	0.01	0.005	0.005	0.002	0.006	0.005	0.002	0	0	0	0
9_to_10		9.5	0	0.004	0.009	0.01	0.018	0.007	0.003	0.002	0.001	0.005	0.005	0.001	0	0	0	0
10_to_11		10.5	0	0.008	0.012	0.011	0.017	0.003	0.002	0.002	0	0.003	0.002	0	0	0	0	0
11_to_12		11.5	0	0.007	0.014	0.011	0.014	0.003	0.002	0.001	0.001	0.004	0.002	0	0	0	0	0
12_to_13		12.5	0.001	0.004	0.015	0.013	0.006	0.002	0.001	0	0	0.001	0.001	0	0	0	0	0
13_to_14		13.5	0	0.003	0.013	0.007	0.004	0.001	0.001	0	0.001	0.001	0	0	0	0	0	0
14_to_15		14.5	0.001	0.003	0.007	0.008	0.002	0	0	0	0	0.001	0	0	0	0	0	0
15_to_16		15.5	0	0.002	0.007	0.004	0.001	0	0	0	0	0	0	0	0	0	0	0
16_to_17		16.5	0	0.003	0.002	0.002	0	0.001	0	0	0	0	0	0	0	0	0	0
17_to_18		17.5	0	0.004	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0
18_to_19		18.5	0	0.003	0.002	0	0	0	0	0	0	0	0	0	0	0	0	0
19_to_20		19.5	0	0.002	0.002	0	0	0	0.001	0	0	0	0	0	0	0	0	0
20_to_21		20.5	0	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0
21_to_22		21.5	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0
22_to_23		22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23_to_24		23.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A.2 Prevailing Wind Profile

	NNE	NE	ENE	E	ESE	SE	SSW	SW
Ug	9.47	9.80	8.74	8.00	6.62	6.29	6.23	6.02
Zg	596	596	596	596	596	596	596	596
a	0.25	0.25	0.25	0.28	0.28	0.28	0.25	0.25
Zz	Uz	Uz	Uz	Uz	Uz	Uz	Uz	Uz
10	3.41	3.53	3.15	2.55	2.11	2.00	2.24	2.17
20	4.05	4.19	3.74	3.09	2.56	2.43	2.67	2.58
30	4.49	4.64	4.14	3.46	2.87	2.72	2.95	2.85
40	4.82	4.99	4.45	3.75	3.11	2.95	3.17	3.06
50	5.10	5.27	4.71	4.00	3.31	3.14	3.35	3.24
60	5.33	5.52	4.92	4.21	3.48	3.31	3.51	3.39
70	5.54	5.73	5.12	4.39	3.64	3.45	3.65	3.52
80	5.73	5.93	5.29	4.56	3.77	3.58	3.77	3.64
90	5.90	6.11	5.45	4.71	3.90	3.70	3.88	3.75
100	6.06	6.27	5.60	4.85	4.02	3.82	3.99	3.85
150	6.71	6.94	6.19	5.44	4.50	4.27	4.41	4.26
200	7.21	7.46	6.65	5.89	4.88	4.63	4.74	4.58
250	7.62	7.88	7.04	6.27	5.19	4.93	5.01	4.84
300	7.98	8.25	7.36	6.60	5.46	5.19	5.25	5.07
350	8.29	8.58	7.65	6.89	5.71	5.42	5.45	5.27
400	8.57	8.87	7.91	7.15	5.92	5.62	5.64	5.45
450	8.83	9.13	8.15	7.39	6.12	5.81	5.81	5.61
500	9.06	9.38	8.37	7.62	6.30	5.99	5.96	5.76
550	9.28	9.60	8.57	7.82	6.47	6.15	6.10	5.90
600	9.49	9.81	8.76	8.01	6.63	6.30	6.24	6.03

Note:
α=0.25 for wooded land; 0.28 for city centres, buildings of medium to high density