Issue No : Issue3
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AIR VENTILATION ASSESSMENT FOR THE PROPOSED DEVELOPMENTS AT THE "COMPREHENSIVE DEVELOPMENT AREA" ("CDA") SITE IN DIAMOND HILL, KOWLOON

INITIAL STUDY

Report Prepared by :
Allied Environmental Consultants Ltd.

COMMERCIAL-IN-CONFIDENCE

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AEC 沛然環境評估工程顧問有限公司

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Table of Contents

Lists of Figures

Lists of Tables

Lists of Appendices

Executive Summary

Allied Environmental Consultants Limited (AEC) was commissioned by Housing Department (HD) to undertake an Air Ventilation Assessment (AVA) Initial Study (IS) for the proposed development at the "Comprehensive Development Area (CDA)" (Subject Site) in Diamond Hill.

The proposed development is located in Diamond Hill. Majority of the Subject Site is currently works area for construction of the Shatin to Central Link by MTR Corporation. The Subject Site is surrounded by high-rise residential buildings to the north and industrial buildings to the south. The topographies within the site are relatively flat.

The proposed development, with approximately 7.42ha application site area, comprises a Public Housing development of seven residential blocks, underground car parks, retail and commercial facilities, a religious facility, a public transport interchange, a water feature park and landscaped walk with cultural theme.

The Public Housing development comprised of 5 Public Rental Housing (PRH) residential blocks and 2 Subsidised Sale Flats (SSF) residential blocks providing a total of approximately 4,050 residential units.

The AVA Initial 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:

1. Baseline Scheme: to evaluate the ventilation performance with the proposed development Scheme 74A is in place.

2. Proposed Scheme: to further evaluate the ventilation performance with the proposed development Scheme 95 is in place.

Based on the result of the wind rose analysis, annual prevailing winds are determined to be mainly E, ENE, NNE, ESE, NE, SE, SSW and SW which accounts for about 78.8% of occurrence in annual condition. Summer prevailing winds are determined to be mainly SW, SSW, E, SE, S, WSW, ESE and SSE, which accounts for about 81.3% of occurrence in summer condition. These wind directions are adopted in the Initial Study respectively. According to the CFD modelling results, it can be concluded that both SVRw and LVRw are improved from the Baseline Scheme to Proposed Scheme.

1. Introduction

1.1 Purpose of the Report

1.1.1. A number of developments including public housing, a religious facility, a public transport interchange, a water feature park and landscaped walk with cultural theme are proposed for the "Comprehensive Development Area (CDA)" (Subject Site) on the Approved Tsz Wan Shan, Diamond Hill and San Po Kong Outline Zoning Plan No. S/K11/27. Planning permission from the Town Planning Board for the proposed developments on the CDA site is required.

1.2 Project Background

1.2.1. The CDA has a site area of around 7.42 ha. The Baseline Scheme will comprise of the following developments: 9 Public Rental Housing (PRH) residential blocks, 3 Subsidised Sale Flats (SSF) residential blocks, underground car parks, retail and commercial facilities, a religious facility, a public transport interchange, a water feature park and landscaped walk with cultural theme. To improve the natural air ventilation in the neighbourhood and the Subject Site, the design of PRH and SSF development is therefore optimized.

1.2.2. The Proposed Scheme will comprise of the following developments: 5 Public Rental Housing (PRH) residential blocks, 2 Subsidised Sale Flats (SSF) residential blocks, underground car parks, retail and commercial facilities, a religious facility, a public transport interchange, a water feature park and landscaped walk with cultural theme.

1.2.3. Allied Environmental Consultants Limited (AEC) was commissioned by Housing Department to carry out an AVA IS. 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).*

1.3 Scope of Study

1.3.1. The objective of this study is to evaluate the wind performance of the Development using the methodology of AVA, based on *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 give a general pattern and a rough quantitative estimation 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 AVA, 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.

1.4 Project Details

1.4.1. This CDA site is located at Diamond Hill. It is bounded by Lung Cheung Road to the north, Choi Hung Road to the south and Po Kong Village Road to the west. The Shatin to Central Link (SCL) Diamond Hill Station currently under construction is located on the northern portion of the site. Majority of the site is currently works area for construction of the SCL by MTR Corporation; whilst part of the western portion is occupied by a temporary car park and part is vacant. The location of the Subject Site is demonstrated in ***Figure 1***.

Baseline Scheme

1.4.2. The Baseline Scheme consists of water feature park, landscape walk, twelve residential blocks, religious building and public transport interchange which is an OZP-compliant scheme. In the baseline scheme, the building blocks in PRH site would be aligned into two rows of four blocks (Block 1 to Block 4) and five blocks (Block 5 to Block 9) respectively with a retail podium at ground level connecting Block 6 to Block 10. The SSF site on the eastern site would include Block 10 to Block 12. At north of PRH and SSF site, there would be a landscaped walk and 2-storey GIC Block. At west of PRH site is the water feature park and at the east of SSF site is religious building and public transport interchange. The detail design parameters are shown in ***Table 1*** while detail building layout is shown in ***Appendix A***.

Proposed Scheme

1.4.3. The Proposed Scheme consists of water feature park, landscape walk, 7 residential blocks, religious building and public transport interchange. In the proposed scheme, there is five building blocks (Block 1 to Block 5) in PRH site and two building blocks (Block 6 and Block 7) in SSF site in a longer building shape. The retail podium would be connecting Block 1 and Block 3. At north of PRH and SSF site, there would be a landscaped walk and a pavilion. At west of PRH site is the water feature park and at the east of SSF site is religious building and public transport interchange. The detailed design parameters are shown in ***Table 1*** while detail building layout is shown in ***Appendix B***.

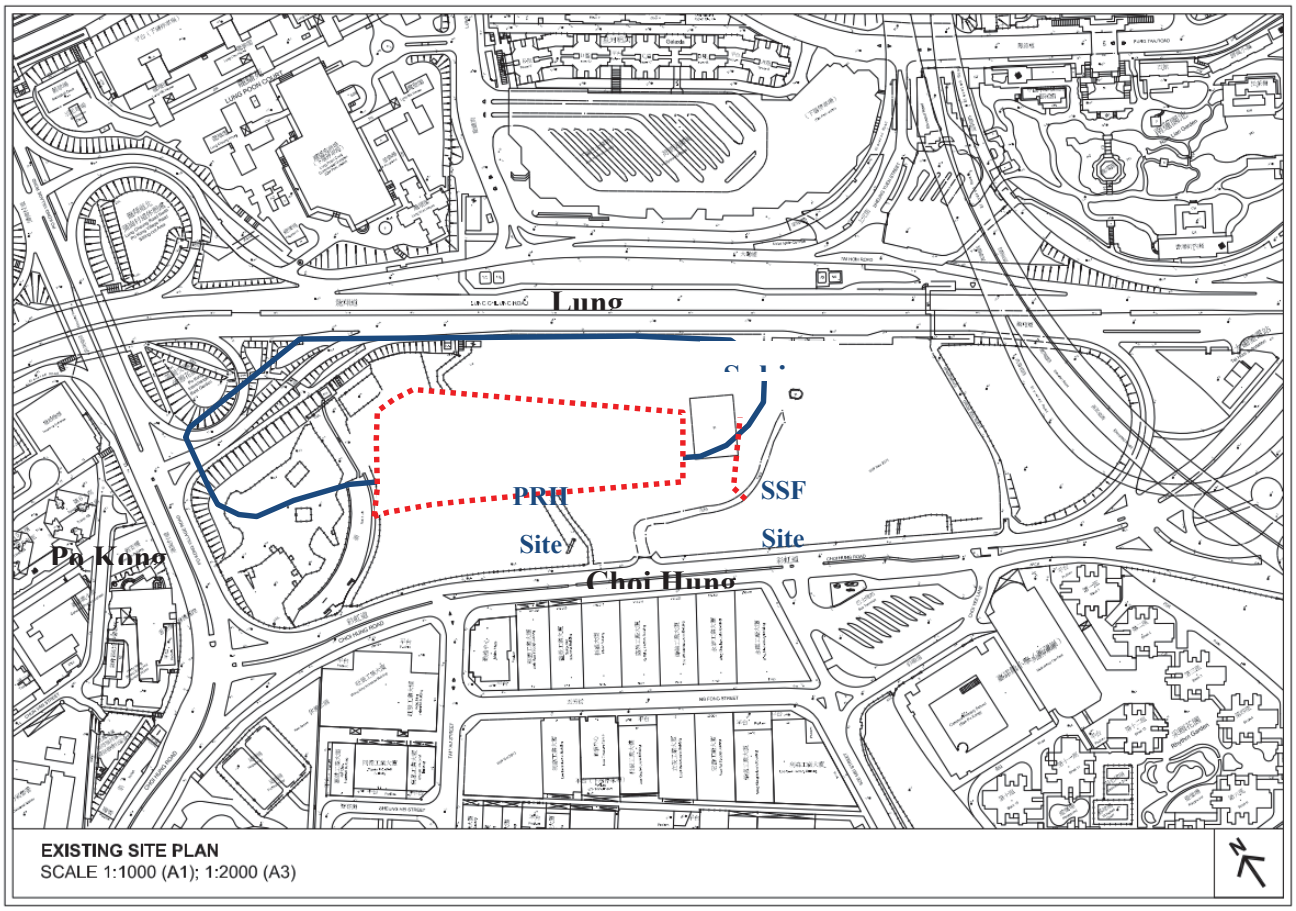


Figure 1 Location Plan of Subject Site

Table 1 Comparison of the CDA Development Parameters of Baseline Scheme and Design Scheme

Major Design Parameters		**Baseline Scheme**	**Proposed Scheme**
Application Site Area (ha)		about 7.42	about 7.42
PRH & SSF	Maximum GFA (m^2) Domestic GFA (m^2) Non-Domestic GFA (m^2)	Not more than 209,800 About 204,300 About 5,500	Not more than 217,910 About 188,600 About 29,310
	Total Plot Ratio	7.3	7.7
	Site Coverage	40% (PRH) 44% (SSF)	63% (PRH) 40% (SSF)
	Total No. of Flats	About 4,200	About 4,050
	Design Population	About 13,000	About 11,160
	No. of Residential Block	12	7
	Building Height (Main Roof) (mPD)	Max 137mPD Block 1 = 136.20 Block 2 = 122.40 Block 3 = 122.40 Block 4 = 122.40 Block 5 = 122.40 Block 6 = 114.20 Block 7 = 114.20 Block 8 = 114.20 Block 9 = 111.40 Block 10 = 122.40 Block 11 = 122.40 Block 12 = 105.90	Max 128mPD Block 1 = 110.90 Block 2 = 119.15 Block 3 = 127.40 Block 4 = 127.40 Block 5 = 127.40 Block 6 = 119.85 Block 7 = 103.35
	Building Podium Height (mPD)	Block 1 = Nil Block 2 = Nil Block 3 = Nil Block 4 = Nil Block 5 = Nil Block 6 - 12 = 12.4	Block 1 = 25.65 Block 2 = 14.50 Block 3 = 14.65 Block 4 = 14.50 Block 5 = 14.50 Block 6 = Nil Block 7 = Nil

Major Design Parameters		Baseline Scheme	Proposed Scheme
	No. of Domestic Storeys	Ranged from 34-44	Ranged from 29-39
	Podium	Consists of retail, education and podium roof as landscape deck area and green roof.	Consists of retail, education and podium roof as landscape deck area and green roof.
	Local Open Spaces (m^2)	13,000	11,160
Religious Facility	Non-Domestic GFA (m^2)	Not more than 15,000	Not more than 15,000
	Site coverage	About 52%	About 52%
	No. of Storeys	4	4
Public Transport Interchange	Site Area (ha)	0.80	0.80

1.4.4. Comparison of the Baseline and Proposed Schemes regarding air ventilation are list below and as shown in ***Figure 2***.

Air Paths

- Air Path A aligned with Tai Yau Street in 15m width in Baseline and Proposed Schemes. The retail block connecting Block 1 and Block 3 at pedestrian road along Lung Cheung Road may reduce the ventilation effectiveness of air path at pedestrian level under Proposed Scheme.

- Air Path B aligned with Sze Mei Street in 20m width in Baseline Scheme and 21m width in Proposed Scheme. The stripped retail block connecting Block 9-10 at pedestrian road along Choi Hung Road may reduce the ventilation effectiveness of air path at pedestrian level under Baseline Scheme. Besides, part of the GIC block under Baseline Scheme falls within the air path mean while there is a pavilion of permeable design lying in the same area under Proposed Scheme.

Building Separations

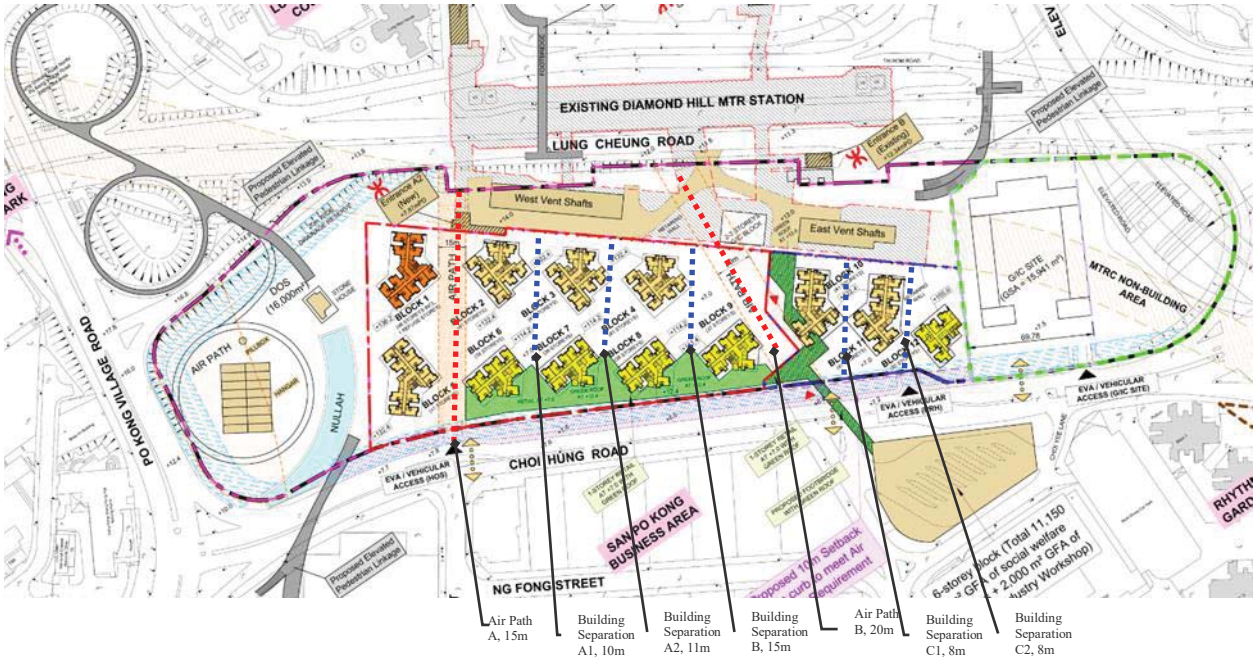
- To be considered as an effective Building Separation for air ventilation, it should at least be 15m width.

- In Baseline Scheme, Building Separations A1, A2 and B are with 10m, 11m and 15m width respectively. The stripped retail block connecting Block 6-10 at pedestrian road along Choi Hung Road may reduce the ventilation effectiveness of building separation at pedestrian level.

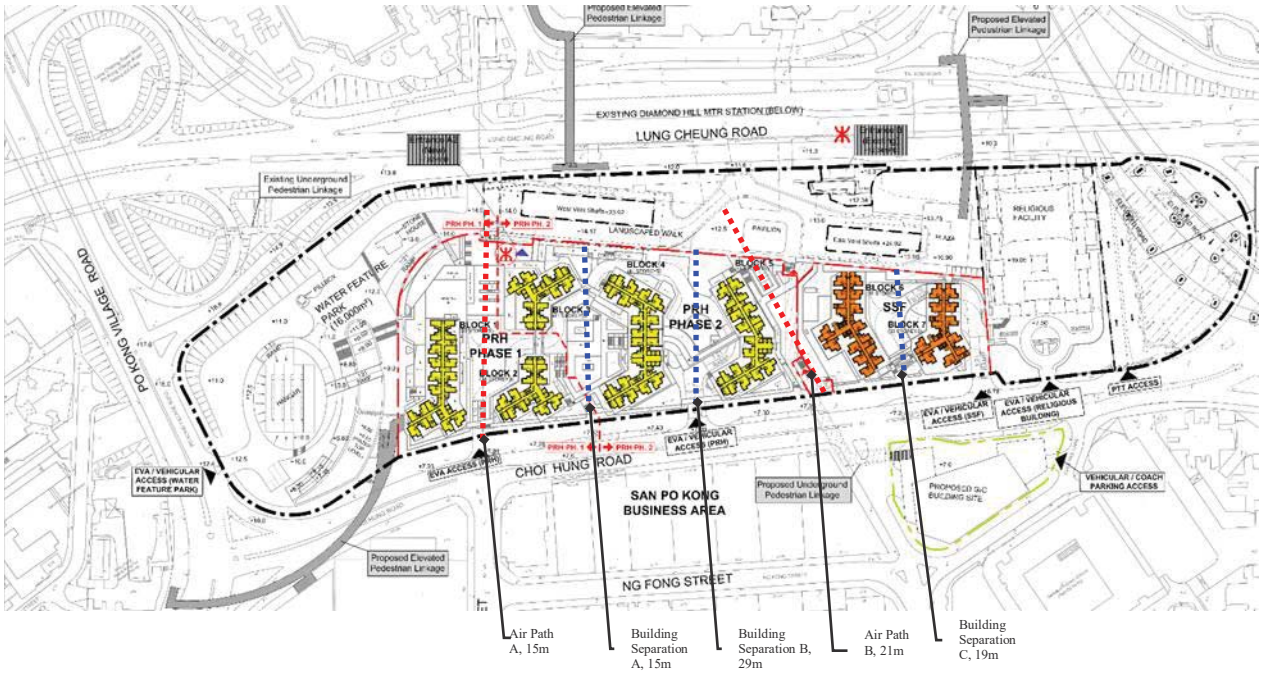
- In Proposed Scheme, Building Separation A and B of respective 15m and 29m width

are open to Lung Cheung Road and Choi Hung Road at pedestrian level.

- Nevertheless, at SSF site, Building Separation C1 and C2 in 8m width respectively in Baseline Scheme and Building Separation C in 19m width in Proposed Scheme are also open to Lung Cheung Road and Choi Hung Road.



Baseline Scheme



Proposed Scheme

Figure 2 Location Plan of Subject Site

2. Wind Availability

2.1.1. The wind availability to the Subject Site is evaluated with reference to the "Consultancy Study on Establishment of Simulated Site Wind Availability Data for Air Ventilation Assessments in Hong Kong"[1] simulated by the meso-scale model of RAMS Version 6.0 at the horizontal resolution of 0.5km * 0.5km.

2.1.2. The Subject Site is located within grid (086, 047) and its wind rose is shown in ***Figure 3***.

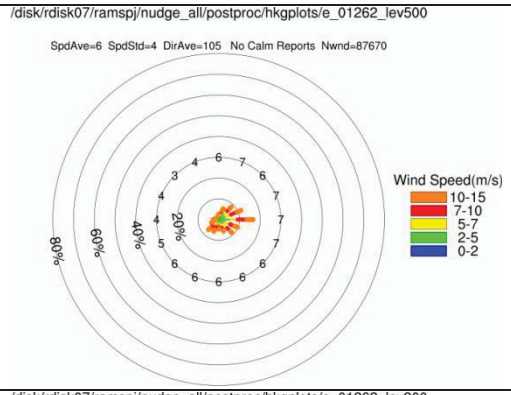
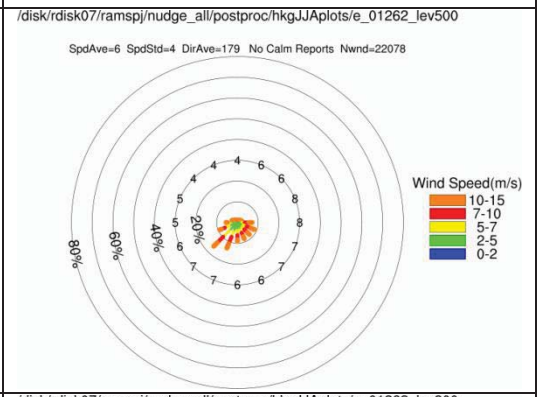
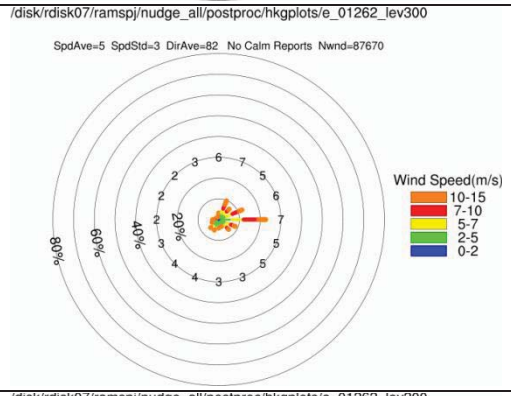
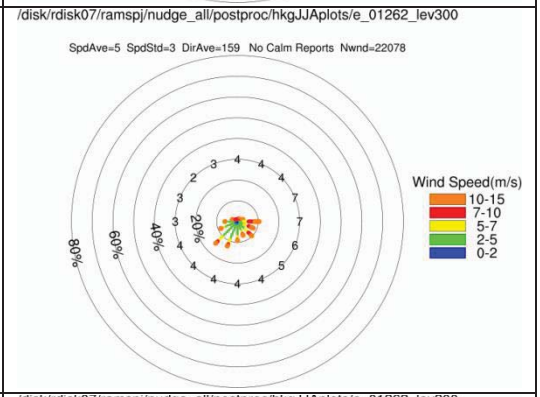
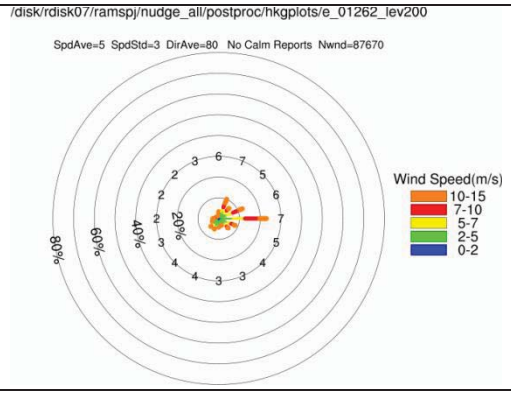
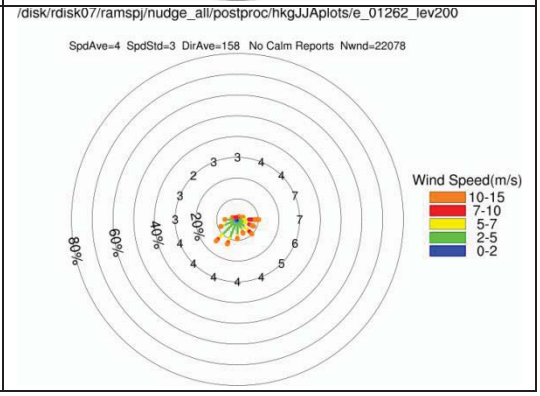
	Wind Rose – Annual	**Wind Rose – Summer**
500m		
300m		
200m		

Figure 3 Annual and Sumer Wind Roses at Grid (086, 047)

2.1.3. As the maximum building height within the assessment area is less than 200m, thus the wind

[1] http://www.pland.gov.hk/pland_en/info_serv/site_wind/site_wind/086047.html

data at 200m is considered as representative of the wind environment at the urban canopy. According to PlanD's simulated data, wind speed and wind probability data are provided in ***Table 2***.

Table 2 Probability of 16 Wind Directions at 200m at Grid (086, 047)

Wind Direction	Annual Probability	Summer Probability
N	3.4%	1.1%
NNE	10.3%	1.6%
NE	7.0%	1.4%
ENE	12.4%	3.0%
E	**23.1%**	10.4%
ESE	8.6%	8.6%
SE	6.5%	9.9%
SSE	3.6%	7.1%
S	4.1%	9.3%
SSW	5.5%	12.8%
SW	5.4%	**14.5%**
WSW	3.4%	8.7%
W	2.9%	6.1%
WNW	1.5%	2.6%
NW	1.1%	1.5%
NNW	1.3%	1.2%

Annual Wind Condition

2.1.4. The most probable annual wind direction is E, which accounts for 23.1% of the annual wind occurrence at 200m above ground. The eight most frequent wind directions include E, ENE, NNE, ESE, NE, SE, SSW and SW, which account for approximately 78.8% of accumulative annual wind occurrence.

Summer Wind Condition

2.1.5. The most probable summer wind direction is SW, which accounts for 14.5% of the summer wind occurrence at 200m above ground. The eight most frequent wind directions include SW, SSW, E, SE, S, WSW, ESE and SSE, which account for approximately 81.3% of accumulative summer wind occurrence.

3. Site Information

3.1 Site Environment

3.1.1. The current construction of Shatin to Central Link (SCL) Diamond Hill Station is located on the northern portion of the subject site. Majority of the Subject Site is currently works area for construction of the SCL by MTR Corporation; whilst part of the western portion is occupied by a temporary car park and part is vacant. The existing conditions of subject site (i.e. without the Project) are summarized as the follows. Its surroundings and the wind environment under prevailing winds are indicated in ***Figure 4***.

Building Heights

3.1.2. The subject site is at a prime location in Diamond Hill. The Subject Site is surrounded by high-rise residential buildings located to the north, east and west of the subject site (including Plaza Hollywood, Lung Poon court, Galaxia, Bel Air Heights, Lions Rise, Mindas Plaza and 210-212 Choi Hung Road (proposed hotel development)) while San Po Kong Industrial area is located to the south. These buildings might cause impediment to the oncoming land breezes and annual prevailing wind especially the southerly winds to penetrate into the street level. The building height of major development is tabulated in ***Table 3***.

Table 3 Building Height of Major Development in the Surrounding

Building	Height, mPD
Lung Poon Court	126.9
Galaxia	153.3
Bel Air Heights	159.3
Plaza Hollywood	47.3
Choi Hung Estate	59.9
Rhythm Garden	71
Lions Rise	133.2
S.K.H. Nursing Home	30
Wong King Industrial Building	60
Mindas Plaza	110
Chinachem Industrial Mansion	50
Shing King Industrial Building	55
210-212 Choi Hung Road (Proposed hotel development)	120
Ka Wing Factory Building	40
The William Industrial Building	40
Wing Chai Industrial Building	40
Wing Hin Factory Building	45
Canossa Primary School (San Po Kong)	25

Road/Street Pattern

3.1.3. Lung Cheung Road and Eastern part of Choi Hung Road are wind corridors facilitate the E, ESE and SE winds. Hammer Road is wind corridor facilitates the ENE wind. Sze Mei Street is wind corridor facilitates the S wind. Tai Yau Street and Western part of Choi Hung Road are wind corridors facilitate the SW and SSW winds. Sheung Yuen Street, Lung Poon Street and Po Kong Village Road are wind corridor facilitate the NE and NNE.

Open Areas

3.1.4. Open spaces such as Kai Tak River promote air circulation at pedestrian level under SW and SSW winds. NE and NNE winds could penetrate through the Project Site and reach Choi Hung Road Playground then travel along the western part of Choi Hung Road. Nan Lian Garden, Hammer Hill Park and Religious Building at the east of Subject Site promote air circulation at pedestrian level under ENE, E and ESE winds. Muk Lun Street Playground and Fung Tak Park promote air circulation at pedestrian level under E and ESE winds. Kai Tak East Playground next to Sze Mei Street facilitates the air penetration under S wind. The above air paths are shown in ***Figure 4***.

Topography

3.1.5. The subject site is on a relatively flat land and gradually increase towards the north of the Subject Site to Diamond Hill. Winds from ENE, E and ESE are likely to be diverted at pedestrian level to the Subject Site through Hammer Hill Road, Lung Cheung Road and Choi Hung Road respectively. Whereas the SE, S, SSW and SW winds would likely to be diverted at pedestrian level to the Subject Site through Lung Cheung Road and Choi Hung Road. The winds would be slow down as continue flowing uphill to reach Diamond Hill.

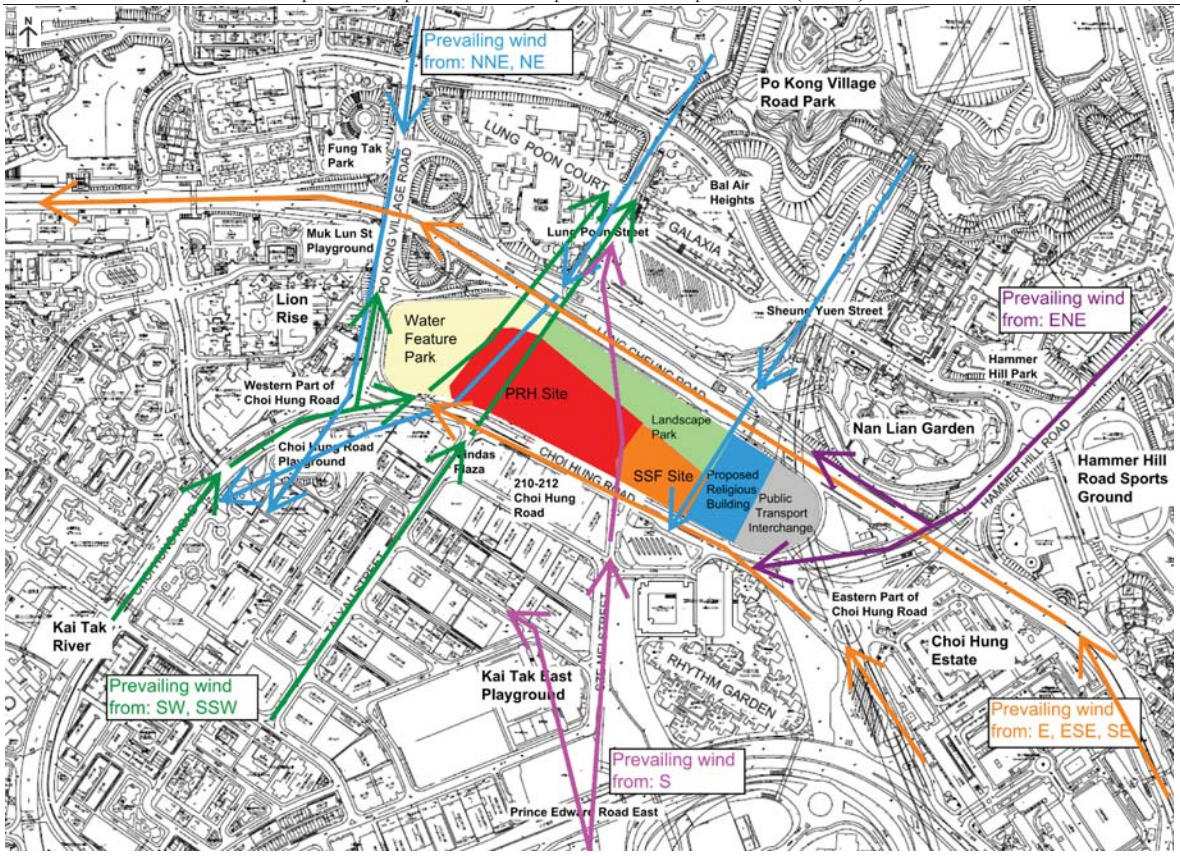


Figure 4 Site Wind Environment

3.2 Site Boundary, Assessment Area and Surrounding Area

3.2.1. It is recommended in the Technical Guide that the Assessment Area and Surrounding Area of the Project should include the Project's surrounding of up to a perpendicular distance H and 2H respectively from the Project boundary, while H being the height of the tallest building of the proposed development.

Assessment Area

3.2.2. The assessment area covers the surrounding environment of the project, which is up to a perpendicular distance H (where H is the height of the tallest building within the development area i.e. Block 1 of 136m in the Baseline Scheme).

Surrounding Area

3.2.3. The surrounding area should normally up to a perpendicular distance of 2H from the project area boundary, which is 272m for this study. In practice of a conservative approach, a surrounding area at least 500m measured from the CDA site boundary has been adopted in the model. ***Figure 5*** illustrates respectively the project area, assessment area and surrounding area for the project development.

Surrounding Buildings and Structures

3.2.4. All existing buildings and elevated structures has been included. Besides, committed developments as listed as below have been also included.

- Proposed hotel development at 210-212 Choi Hung Road
- Proposed GIC building near Choi Yee Lane
- Proposed Holistic Centre development by Tung Wah Group of Hospitals next to Kai Tak East Playground
- Trade and Industry Tower at Concorde Road
- Inland Revenue Tower at Concorde Road

3.2.5. Other proposed construction sites at Kai Tak Development Zone has been included based on their maximum height and plot ratio provided by Planning Department. Elevated structures such as Kwun Tong Bypass, noise barriers and enclosures at Lung Chung Road and Kwun Tong Bypass, flyover at Po Kong Village Road and Prince Edward Road East and footbridge connecting the Subject Site to surrounding existing developments has also been included.

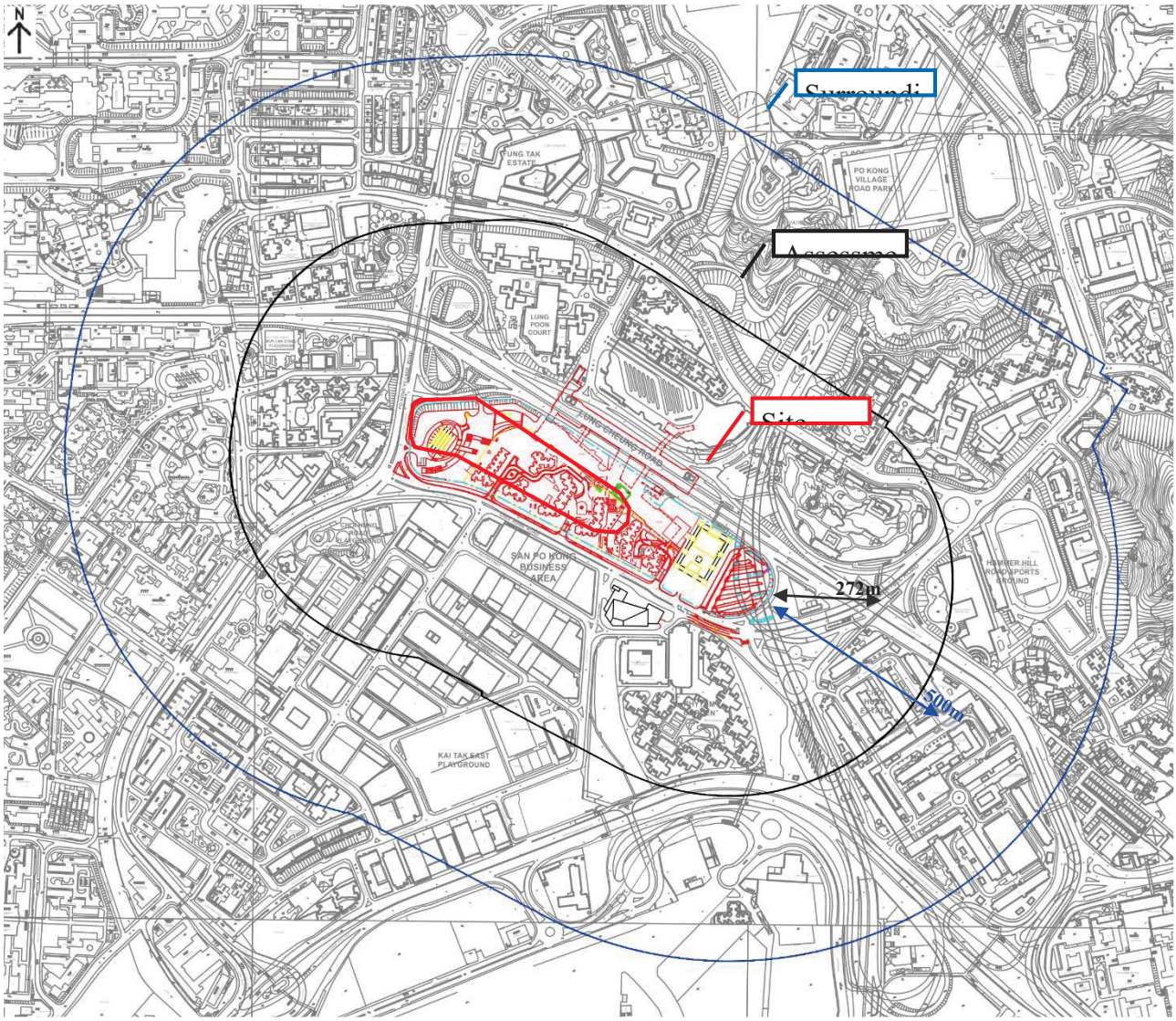


Figure 5 Site Boundary, Assessment Area and Surrounding Area

3.3 Site Wind Environment

3.3.1. In accordance with the wind availability data, the Subject Site experiences mainly E wind and SW wind during the year and during summer respectively. Therefore any blockage to the prevailing winds mentioned above should be avoided as far as possible.

3.3.2. To ameliorate the potential effects, the following good design features are recommended to be adopted in the detailed design of the Project in order to minimize any potential adverse ventilation impact on the surrounding environment; and are given in ***Figure 6*** and ***Figure 7***.

- To enhances the permeability of the proposed development by providing cross ventilation at the air paths along Tai Yau Street and Sze Mei Street and building separations.
- To maximize setback distance from all nearby corridors such as Kai Tak River, Choi Hung Road and Lung Cheung Road.
- To maximize separating distance between residential blocks and building orientation to allow air paths to penetrate the Subject Site.

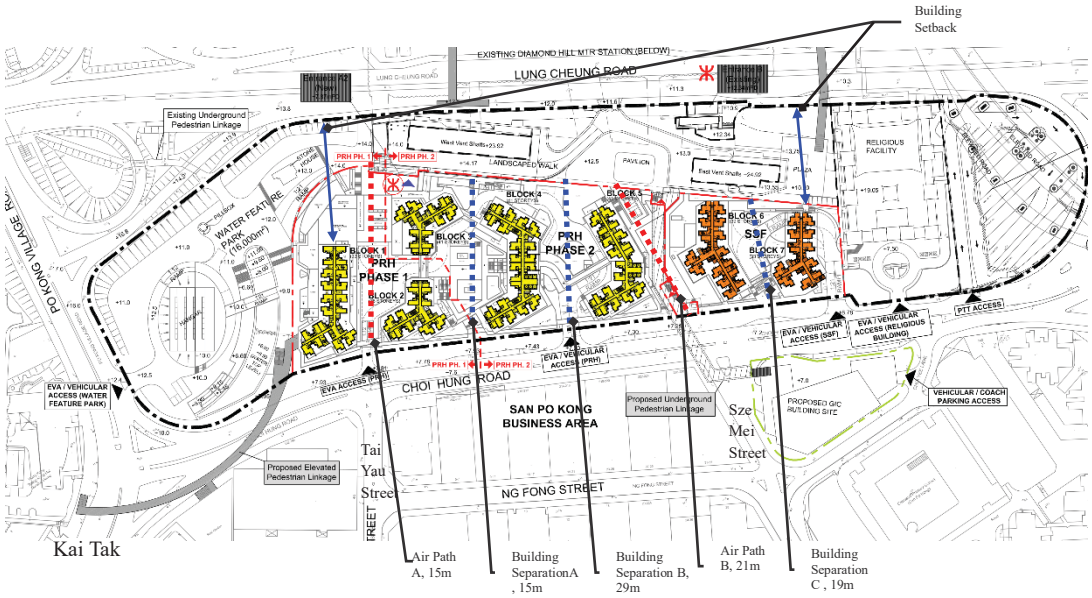


Figure 6 Designed Air Paths and Building Separations in the Proposed Scheme

- To provide empty spaces on G/F in Block1, Block 4, Block 5 and Block 7 respectively.

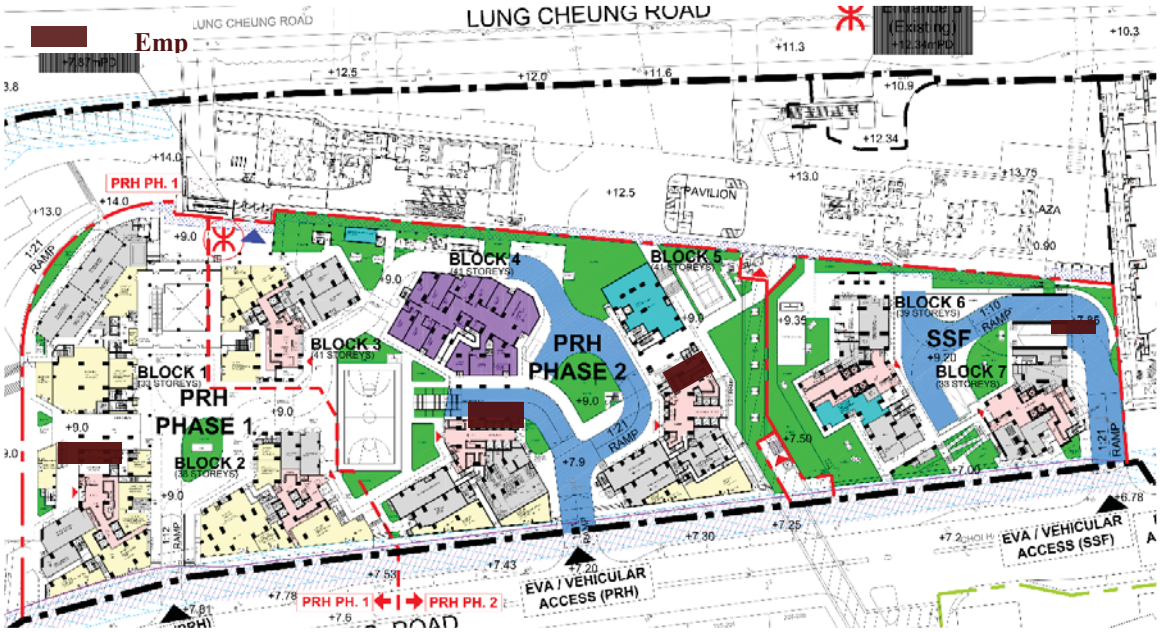


Figure 7 Subject Site Empty Spaces on G/F in the Proposed Scheme

3.3.3. The above mentioned and recommended design measures has been incorporated into the Proposed Scheme for the Project. An AVA Initial Study using Computational Fluid Dynamic (CFD) Simulation was recommended to quantitatively assess the air ventilation.

4. Assessment Methodology of Initial Study

4.1 Modelling Tool

4.1.1. ANSYS FLUENT version 15, as a computational fluid dynamics (CFD) simulation model, has been used for the natural ventilation study. It is a sophisticated modelling method, which takes into account the usual fluid dispersion calculation method under both laminar and turbulence flow stimulation. The equations that the CFD model solves are algebraic equations which result from applying the conservation laws of physics to finite volumes of space and time.

4.1.2. The geometry and simulation options for subject development and surrounding environment have been set up to calculate the wind speed at the development and surrounding ambient. Related wind speeds around the development were assessed by setting up a scaled model of the development with surrounding building structures and topographical features.

4.2 Geometry and Domain Setting

4.2.1. Geometry including roads and buildings was imported to the CFD modelling for an area of approximately 500m radius around the development. The CFD set-up of different perspectives are shown in ***Figure 8*** and ***Figure 9***. Their four different views on 3D model set-up are also respectively shown in ***Figure 10*** and ***Figure 13***.

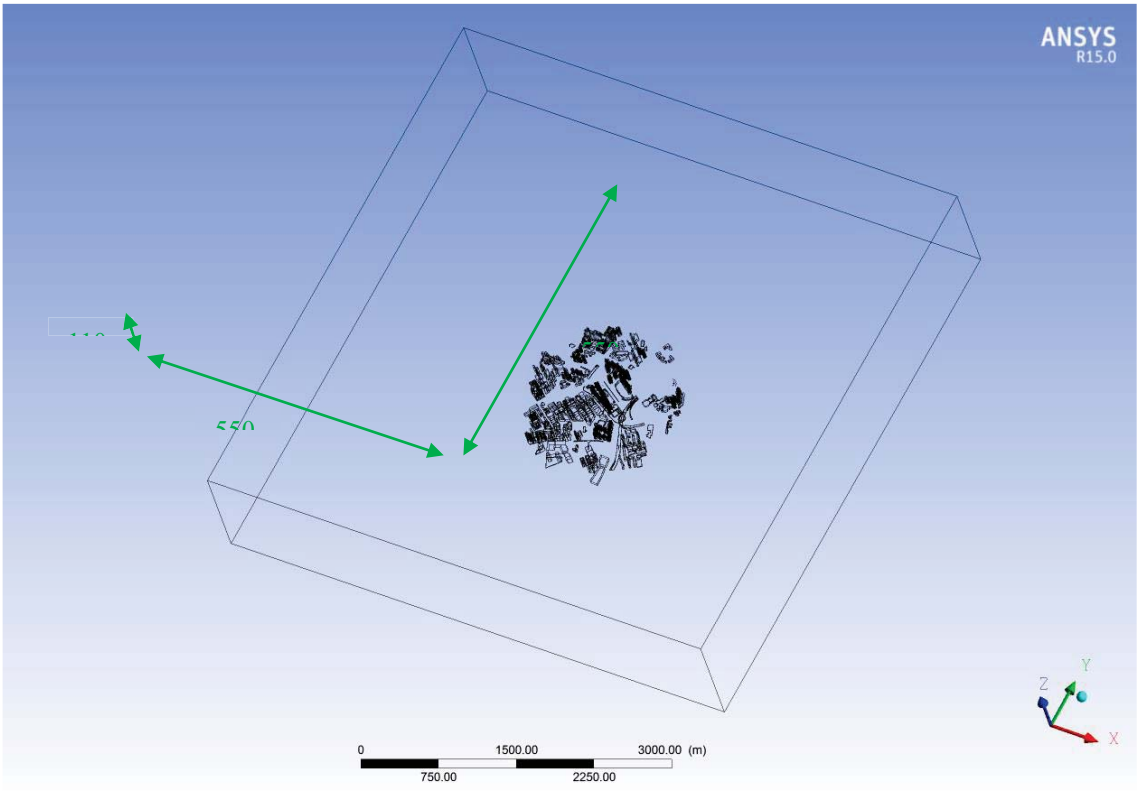


Figure 8 CFD Geometry Set-up (Perspective View)

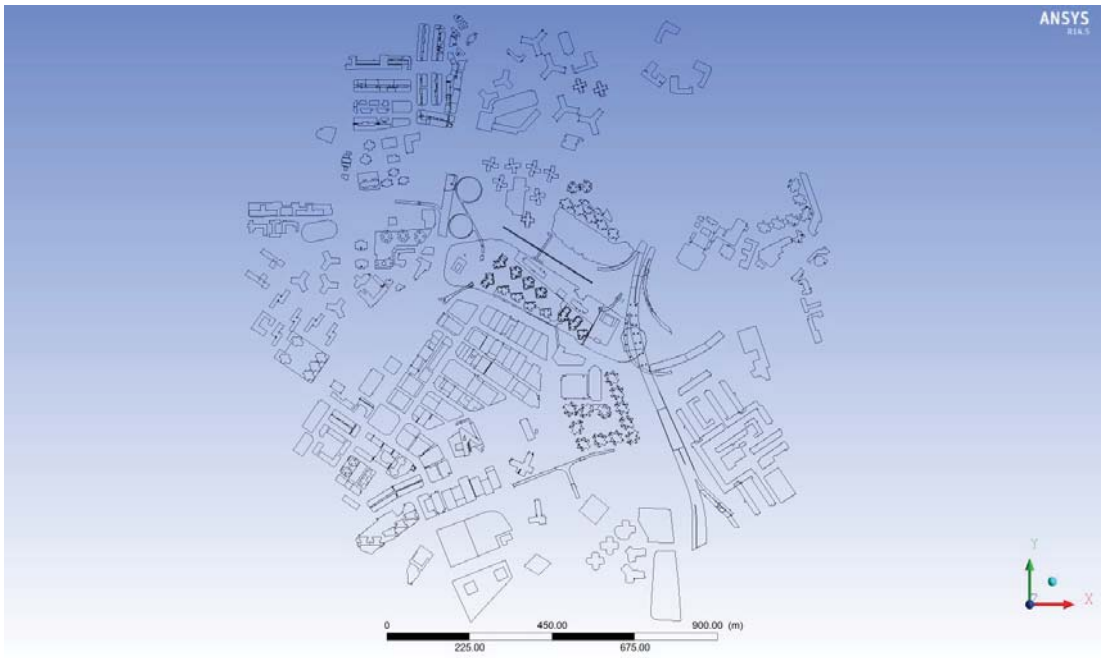
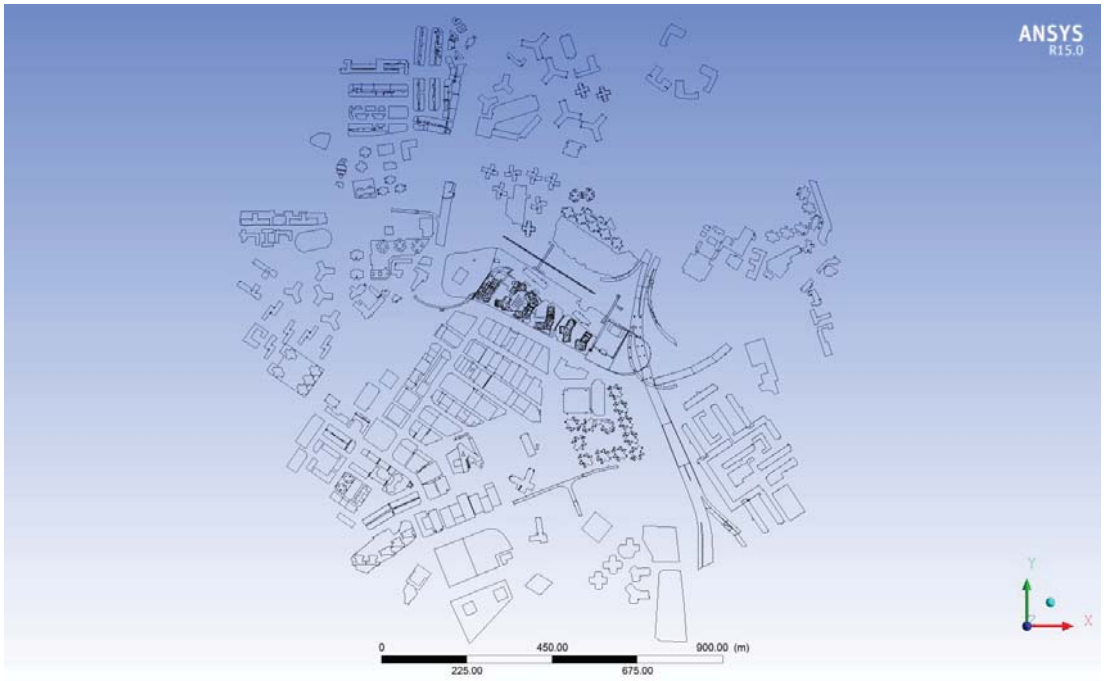
Baseline Scheme	
Proposed Scheme	

Figure 9 CFD Geometry Set-up (Top View)

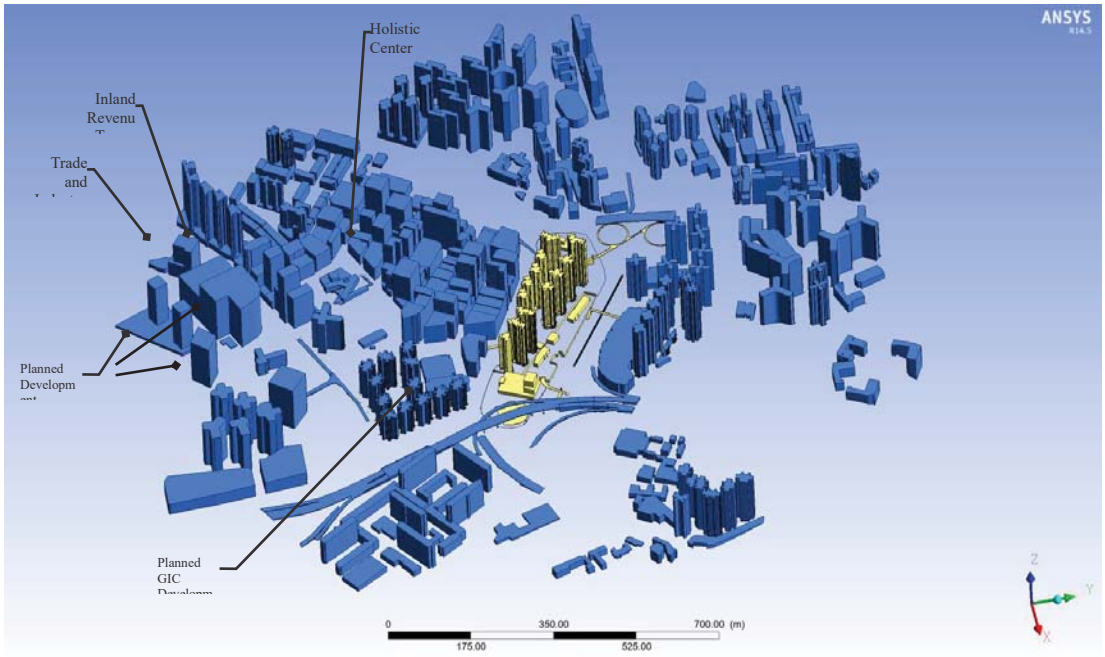
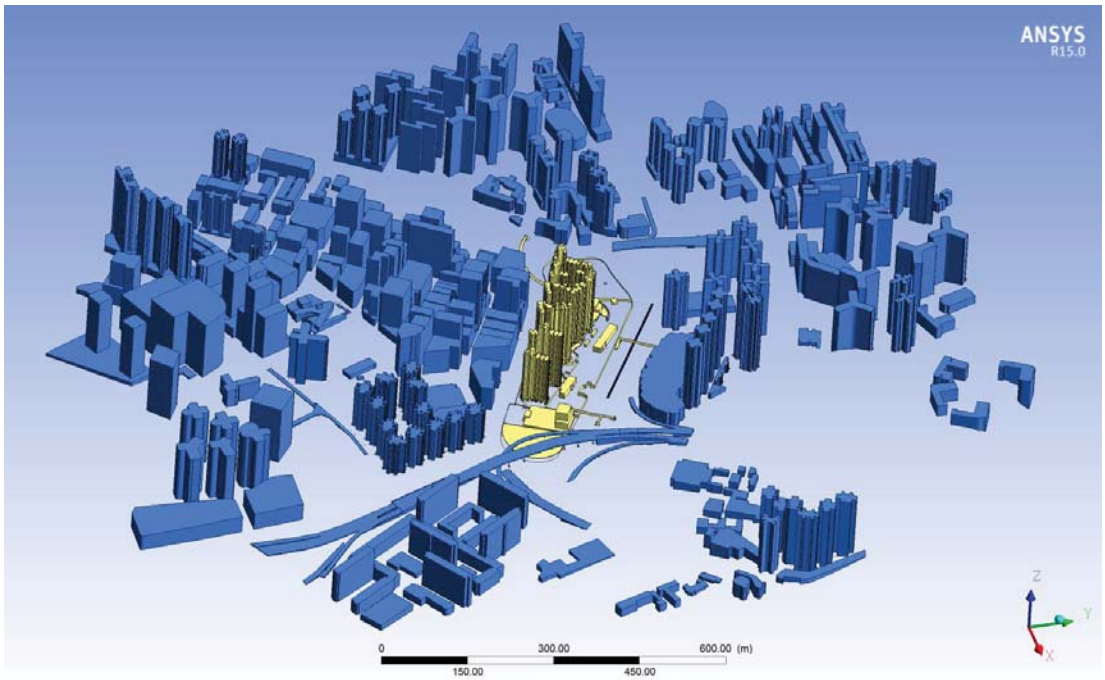
Baseline Scheme	
Proposed Scheme	

Figure 10 CFD Geometry Set-up (Side View from East)

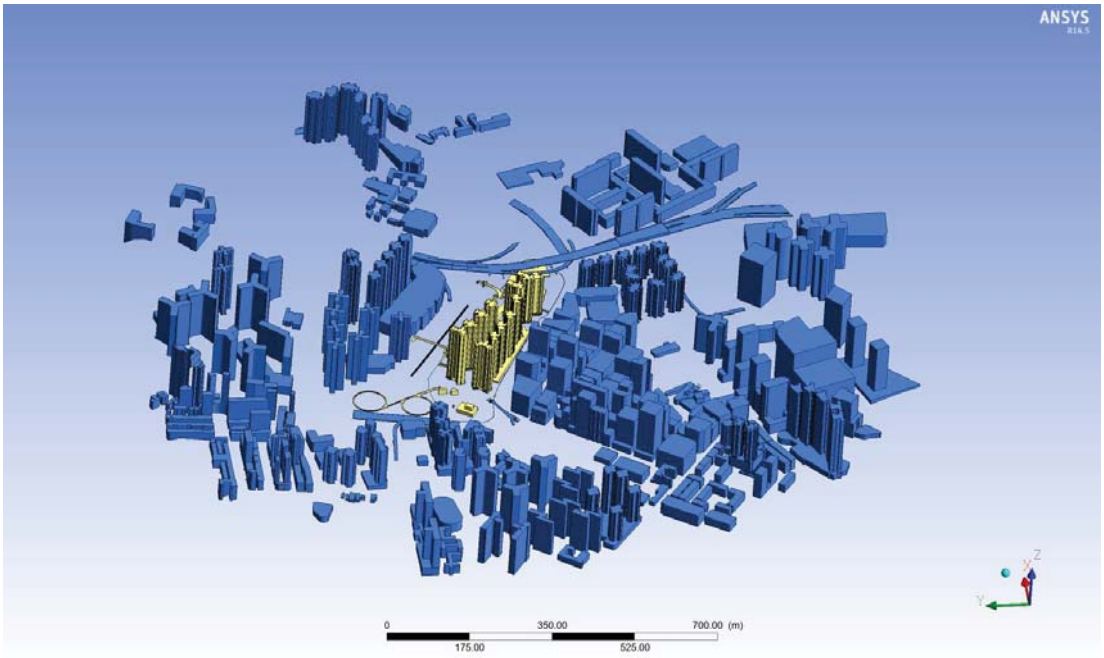
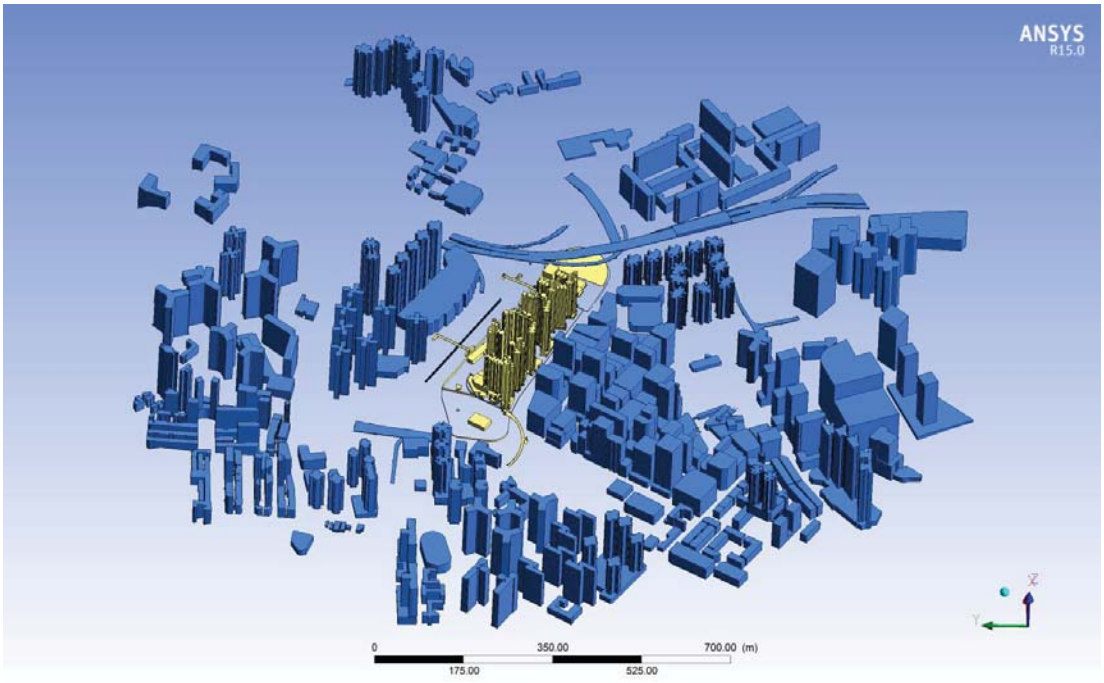
Baseline Scheme	
Proposed Scheme	

Figure 11 CFD Geometry Set-up (Side View from West)

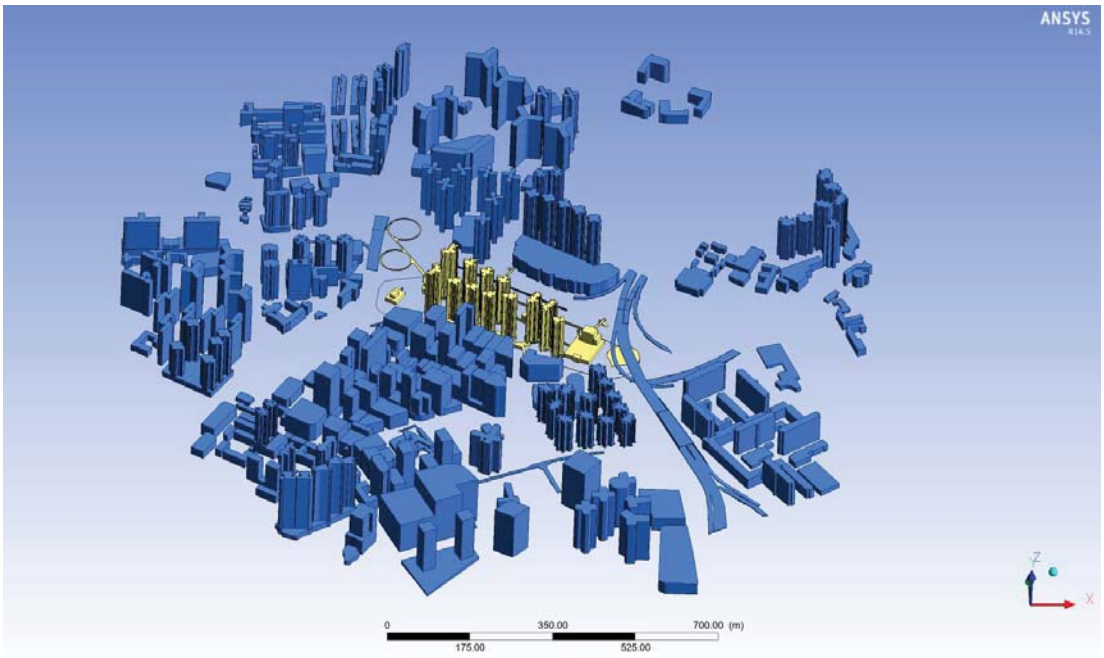
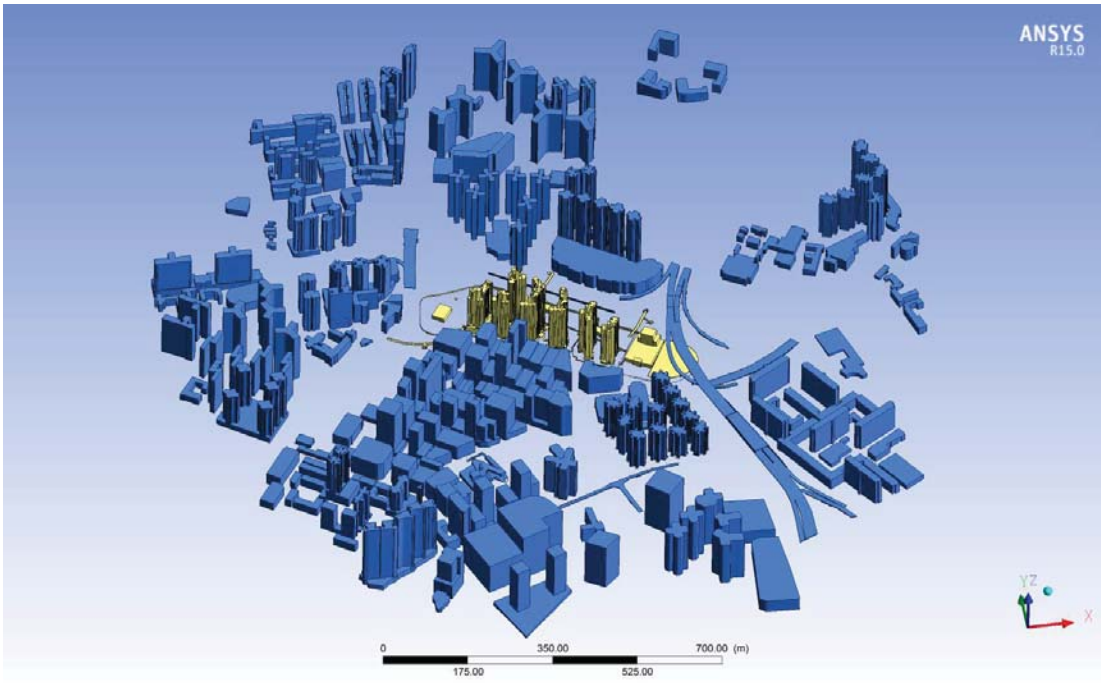
Baseline Scheme	
Proposed Scheme	

Figure 12 CFD Geometry Set-up (Side View from South)

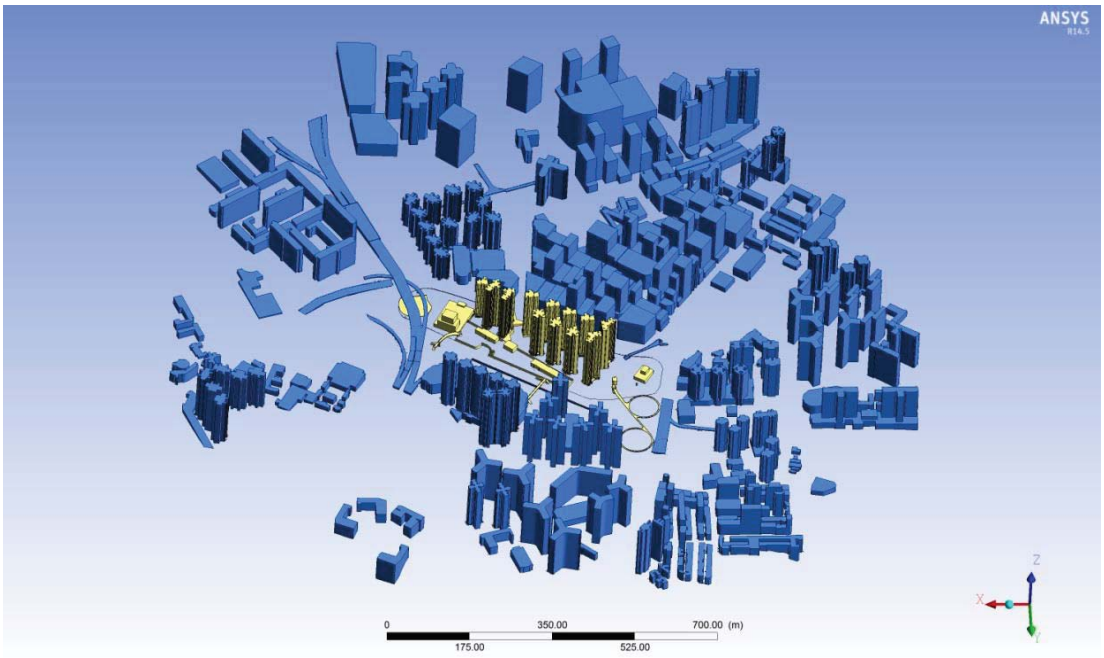
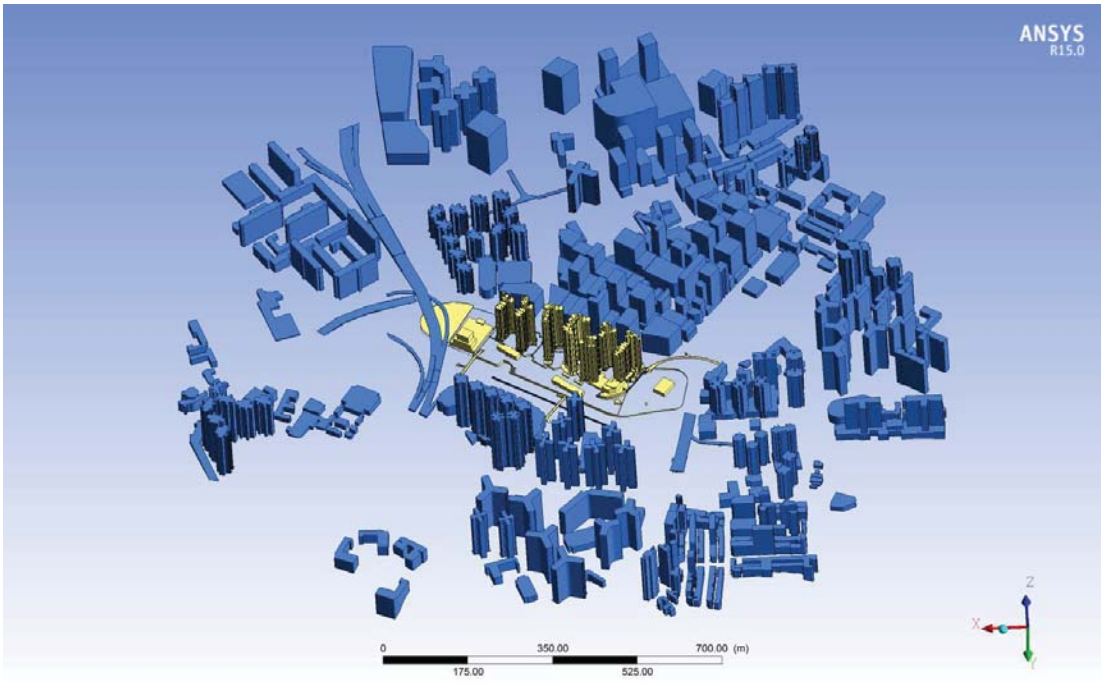
Baseline Scheme	
Proposed Scheme	

Figure 13 CFD Geometry Set-up (Side View from North)

4.2.2. The size of the computational domain of the 3D model is illustrated below:

x-direction (L) = 5,500m;

y-direction (W) = 5,500m; and

z-direction (H) = 1,100m

4.2.3. It is calculated that the blockage ratio of the model is less than 3.0%.

4.3 Meshing Setting

4.3.1. Unstructured grid is constructed by ANSYS FLUENT version 15 and the grid size can be manually adjusted in the aforesaid meshing tools. Within the assessment area, cells located across the x-axis and y-axis are positioned with smaller intervals than those located further from the site location in order to produce a more precise result at higher resolution where it is required.

4.3.2. The CFD model is developed with the combination of tetrahedral and prism cells. Approximately 14.7 million cells are constructed for the study. The grid arrangement within the assessment height of 2m above ground has been refined to facilitate the pedestrian wind environment study. In order to improve accuracy, smaller gird has been adopted in order to achieve a higher resolution at low levels of z-axis and thus capable of resolving small scale height structures and changes in topography at pedestrian level. The expansion ratio between two consecutive cells is less than 1.3. Four prism layers at prism ratio of 1.00 are created at 2m above ground to increase modelling accuracy at pedestrian level. ***Figure 14*** and ***Figure 15*** shows the meshing details of the geometries.

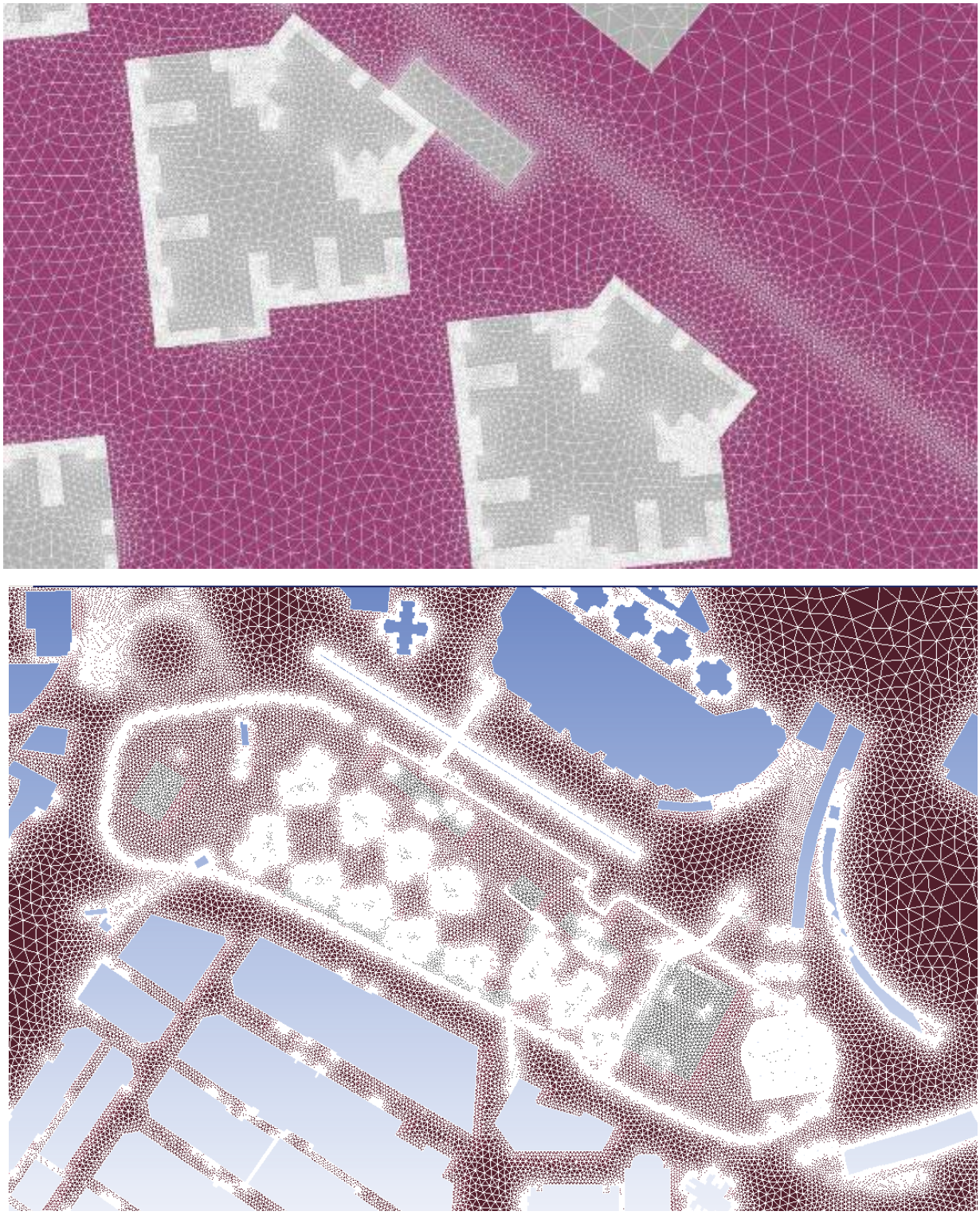


Figure 14 CFD Mesh Model

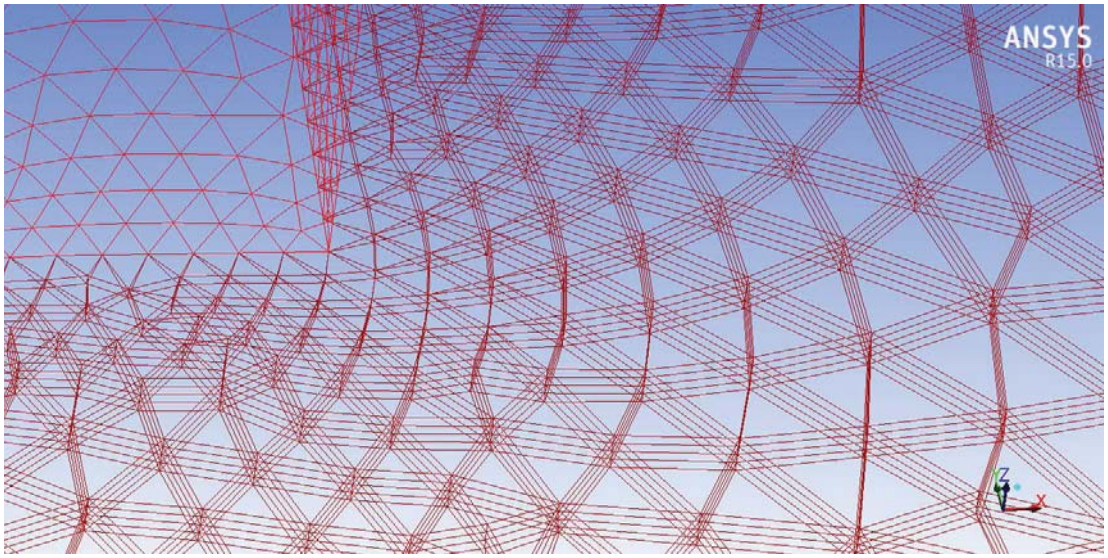


Figure 15 CFD Prsim Layers

4.4 Numeric Scheme Setting

4.4.1. ANSYS FLUENT offers an unparalleled breadth of turbulence models such as k-epsilon turbulence model and the Reynolds stress model (RSM). In this study, the realizable k-epsilon model and a second order discretization scheme are adopted for simulation.

4.4.2. FLUENT uses iterative methods to solve the algebraic system of equations. The termination criterion is usually based on the residuals of the corresponding equations. The termination criterion of 0.001 has been used in this study.

4.4.3. The boundary conditions under various winds are tabulated in ***Table 4***.

Table 4 Boundary Condition Setting for CFD Modelling

	Wind Directions	East	North	South	West	Top	Terrain
Annual Prevailing Winds	E	Velocity inlet	Symmetry	Symmetry	Pressure outlet	Symmetry	Wall
	ENE	Velocity inlet	Velocity inlet	Pressure outlet	Pressure outlet	Symmetry	Wall
	NE	Velocity inlet	Velocity inlet	Pressure outlet	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
	SE	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

	Wind Directions	East	North	South	West	Top	Terrain
Summer Prevailing Winds	SW	Pressure outlet	Pressure outlet	Velocity inlet	Velocity inlet	Symmetry	Wall
	SSW	Pressure outlet	Pressure outlet	Velocity inlet	Velocity inlet	Symmetry	Wall
	E	Velocity inlet	Symmetry	Symmetry	Pressure outlet	Symmetry	Wall
	SE	Velocity inlet	Pressure outlet	Velocity inlet	Pressure outlet	Symmetry	Wall
	S	Symmetry	Pressure outlet	Velocity inlet	Symmetry	Symmetry	Wall
	WSW	Pressure outlet	Pressure outlet	Velocity inlet	Velocity inlet	Symmetry	Wall
	ESE	Velocity inlet	Pressure outlet	Velocity inlet	Pressure outlet	Symmetry	Wall
	SSE	Velocity inlet	Pressure outlet	Velocity inlet	Pressure outlet	Symmetry	Wall

4.5 Wind Profile

4.5.1. Wind data used in CFD simulation should be referred to the latest simulated data published by Planning Department. The wind profiles from the simulated data are demonstrated in ***Figure 16***.

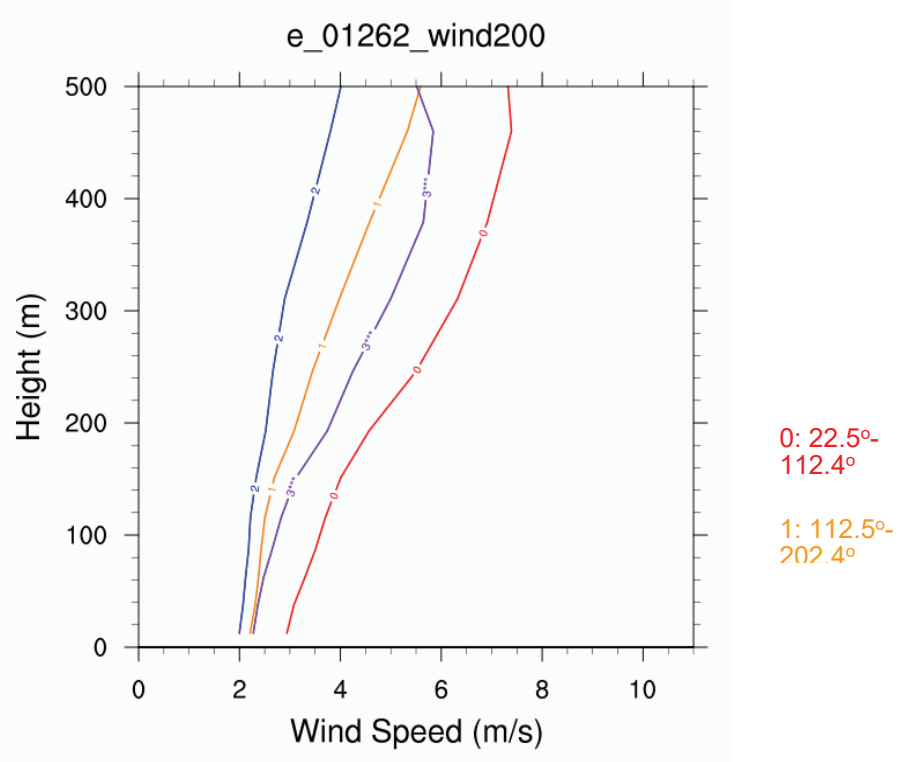


Figure 16 Wind Profile of the First 8 Prevailing Wind Directions at Grid (086, 047)

4.5.2. Detailed wind profiles are provided in ***Appendix C***.

4.6 Test Point

4.6.1. Test points are the locations where Wind VRs are determined and reported. Based on the VR of the test points, the resultant wind environment of the project can be assessed.

4.6.2. Both perimeter test points and overall test points were positioned within the assessment area in order to assess the immediate impact of the Proposed Development to the surrounding area (i.e. Site Air Ventilation Assessment) and local areas (i.e. Local Air Ventilation Assessment) respectively.

4.6.3. Perimeter Test Points are distributed along the project site boundary, which are likely to be accessed by pedestrians. Test Points in this group are named with prefix "P" (i.e. P01, P02…). There are a total of 48 Perimeter Test Points well spaced out and located at around 28 m centre to centre.

4.6.4. Overall Test Points are evenly distributed at a distance of around 70 m in the open streets, open space and places of the project and Assessment Areas where pedestrians frequently access. Test points in this group are named with prefix "O" (i.e. O01, O02…). There are a total of 102 overall test points in this study.

4.6.5. Special Test Points are positioned in the water feature park, religious building, public transport interchange and in the PRH and SSF site such as reserved air path, building opening and the plaza within the Subject Site. Test points in this group are named with prefix "S" (i.e. S01, S02…). There are a total 34 and 28 special test points for the Baseline and Proposed Scheme respectively.

4.6.6. All test points are the locations where Wind Velocity Ratio (VR) at pedestrian level (2m above ground) is reported.

4.6.7. Locations of the perimeter test points, local test points and special test points are shown in ***Figure 17*** and ***Figure 18***. Coordinates of these special test points are tabulated in ***Table 5*** and ***Table 6***.

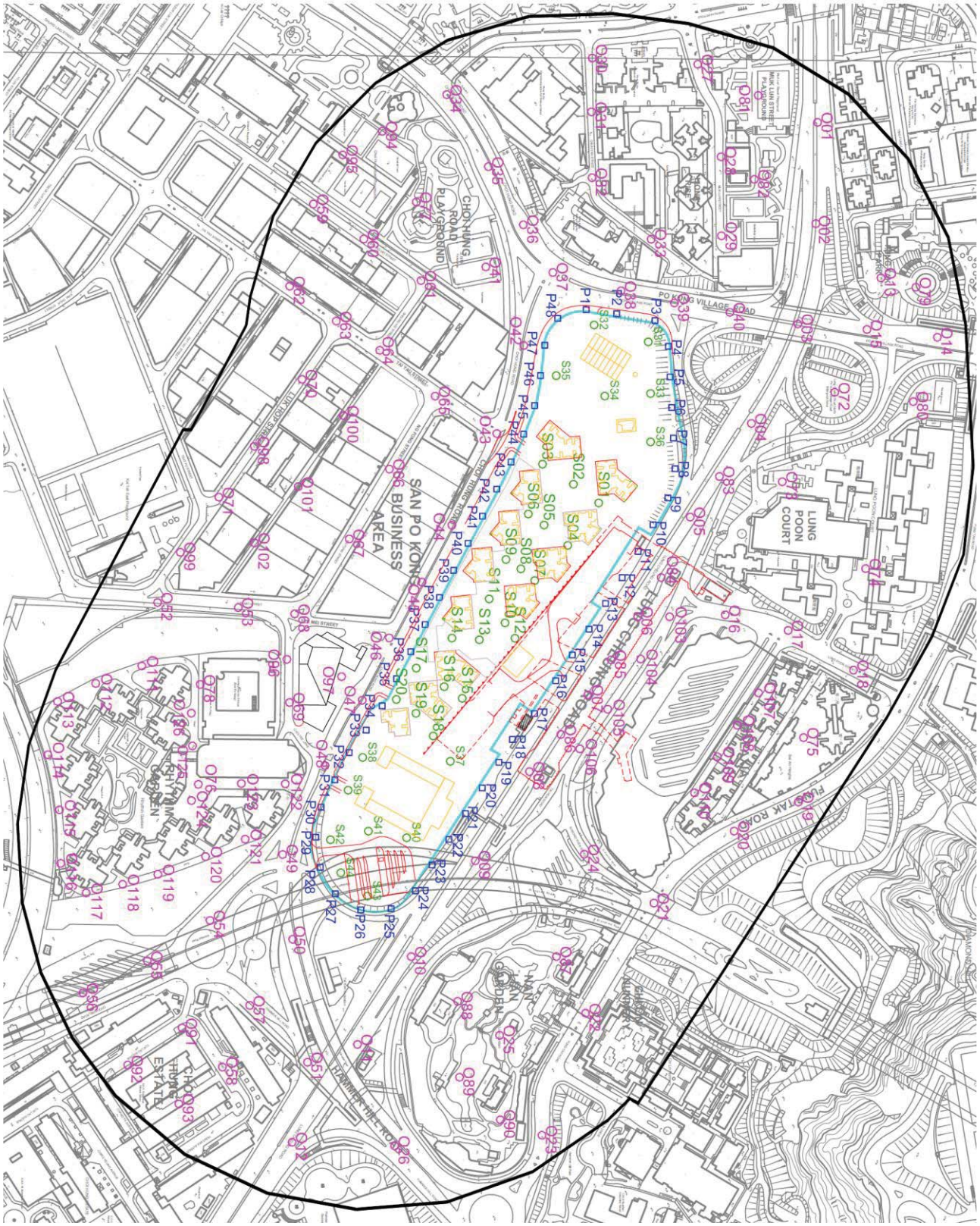


Figure 17 Positions of Perimeter, Overall and Special Test Points in the Baseline Scheme

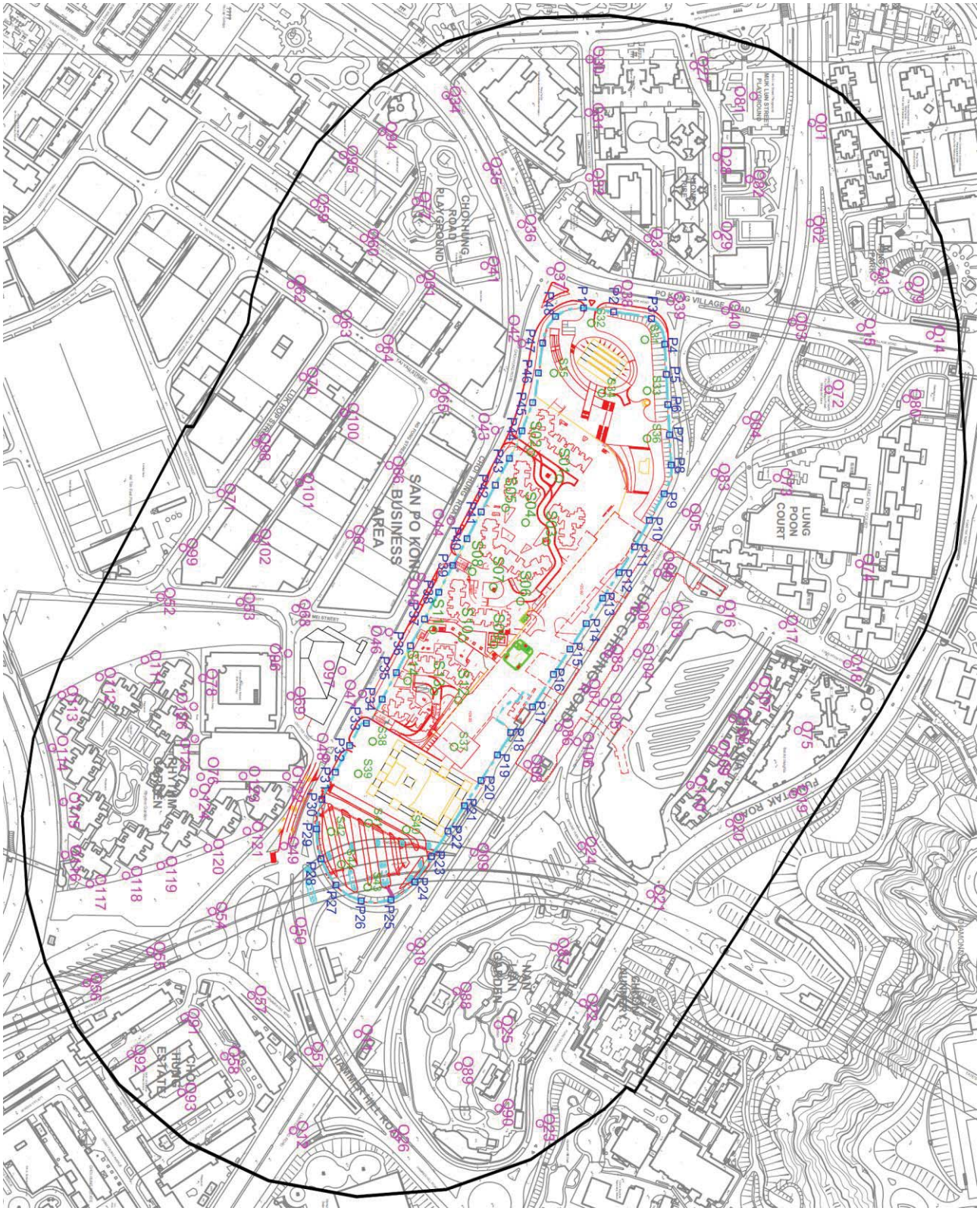


Figure 18 Positions of Perimeter, Overall and Special Test Points in the Proposed Scheme

Table 5 Coordinates of Perimeter and Overall Test Points

Test Point	X	Y	Z (meter above ground)	Location	Description
P01	838460.4	822311.1	2	Site Perimeter	Pedestrian Walkway
P02	838461.4	822340.6	2	Site Perimeter	Pedestrian Walkway
P03	838469.9	822378.1	2	Site Perimeter	Pedestrian Walkway
P04	838506.0	822395.6	2	Site Perimeter	Pedestrian Walkway
P05	838535.0	822398.1	2	Site Perimeter	Pedestrian Walkway
P06	838561.5	822399.1	2	Site Perimeter	Pedestrian Walkway
P07	838590.5	822401.1	2	Site Perimeter	Pedestrian Walkway
P08	838619.0	822404.1	2	Site Perimeter	Pedestrian Walkway
P09	838650.5	822397.1	2	Site Perimeter	Pedestrian Walkway
P10	838673.5	822382.6	2	Site Perimeter	Pedestrian Walkway
P11	838699.5	822368.6	2	Site Perimeter	Pedestrian Walkway
P12	838722.5	822355.1	2	Site Perimeter	Pedestrian Walkway
P13	838744.5	822339.1	2	Site Perimeter	Pedestrian Walkway
P14	838766.5	822325.1	2	Site Perimeter	Pedestrian Walkway
P15	838790.5	822310.1	2	Site Perimeter	Pedestrian Walkway
P16	838814.5	822292.6	2	Site Perimeter	Pedestrian Walkway
P17	838845.0	822275.1	2	Site Perimeter	Pedestrian Walkway
P18	838872.1	822260.1	2	Site Perimeter	Pedestrian Walkway
P19	838894.1	822245.6	2	Site Perimeter	Pedestrian Walkway
P20	838915.1	822230.1	2	Site Perimeter	Pedestrian Walkway
P21	838936.6	822213.6	2	Site Perimeter	Pedestrian Walkway
P22	838961.1	822200.6	2	Site Perimeter	Pedestrian Walkway
P23	838985.1	822183.6	2	Site Perimeter	Pedestrian Walkway
P24	839008.6	822169.6	2	Site Perimeter	Pedestrian Walkway
P25	839034.6	822140.6	2	Site Perimeter	Pedestrian Walkway
P26	839036.1	822115.0	2	Site Perimeter	Pedestrian Walkway
P27	839019.6	822084.5	2	Site Perimeter	Pedestrian Walkway
P28	838994.6	822066.0	2	Site Perimeter	Pedestrian Walkway
P29	838961.6	822059.0	2	Site Perimeter	Pedestrian Walkway
P30	838928.6	822062.5	2	Site Perimeter	Pedestrian Walkway
P31	838902.1	822073.5	2	Site Perimeter	Pedestrian Walkway
P32	838876.6	822087.0	2	Site Perimeter	Pedestrian Walkway
P33	838851.5	822102.5	2	Site Perimeter	Pedestrian Walkway
P34	838832.0	822118.0	2	Site Perimeter	Pedestrian Walkway
P35	838804.0	822132.6	2	Site Perimeter	Pedestrian Walkway
P36	838780.5	822146.1	2	Site Perimeter	Pedestrian Walkway
P37	838753.0	822159.6	2	Site Perimeter	Pedestrian Walkway
P38	838731.0	822172.1	2	Site Perimeter	Pedestrian Walkway
P39	838703.5	822185.1	2	Site Perimeter	Pedestrian Walkway
P40	838678.5	822197.6	2	Site Perimeter	Pedestrian Walkway
P41	838656.5	822209.6	2	Site Perimeter	Pedestrian Walkway
P42	838632.5	822221.1	2	Site Perimeter	Pedestrian Walkway
P43	838606.0	822236.1	2	Site Perimeter	Pedestrian Walkway
P44	838583.0	822247.1	2	Site Perimeter	Pedestrian Walkway
P45	838558.5	822257.1	2	Site Perimeter	Pedestrian Walkway
P46	838528.0	822261.1	2	Site Perimeter	Pedestrian Walkway
P47	838497.5	822265.6	2	Site Perimeter	Pedestrian Walkway
P48	838466.9	822280.1	2	Site Perimeter	Pedestrian Walkway
O001	838299.5	822526.0	2	Lung Cheung Road	Pedestrian Walkway
O002	838399.9	822529.8	2	Lung Cheung Road	Pedestrian Walkway
O003	838492.0	822514.6	2	Lung Cheung Road	Pedestrian Walkway
O004	838560.8	822458.6	2	Lung Cheung Road	Pedestrian Walkway
O005	838660.4	822401.8	2	Lung Cheung Road	Pedestrian Walkway
O006	838739.4	822352.0	2	Lung Cheung Road	Pedestrian Walkway
O007	838811.4	822309.1	2	Lung Cheung Road	Pedestrian Walkway
O008	838884.2	822259.3	2	Lung Cheung Road	Pedestrian Walkway
O009	838963.9	822221.0	2	Lung Cheung Road	Pedestrian Walkway
O010	839050.5	822169.7	2	Lung Cheung Road	Pedestrian Walkway
O011	839134.3	822119.7	2	Lung Cheung Road	Pedestrian Walkway

Test Point	X	Y	Z (meter above ground)	Location	Description
O012	839224.0	822063.7	2	Lung Cheung Road	Pedestrian Walkway
O013	838432.2	822588.4	2	Fung Tak Park	Pedestrian Walkway
O014	838500.4	822647.2	2	Po Kong Village Road	Pedestrian Walkway
O015	838486.4	822592.1	2	Po Kong Village Road	Pedestrian Walkway
O016	838756.2	822429.7	2	Lung Poon Street	Pedestrian Walkway
O017	838769.3	822500.6	2	Lung Poon Street	Pedestrian Walkway
O018	838807.6	822567.8	2	Lung Poon Street	Pedestrian Walkway
O019	838919.6	822521.2	2	Fung Tak Road	Pedestrian Walkway
O020	838953.2	822465.1	2	Fung Tak Road	Pedestrian Walkway
O021	839002.7	822402.6	2	Fung Tak Road	Pedestrian Walkway
O022	839102.6	822332.6	2	Fung Tak Road	Pedestrian Walkway
O023	839193.3	822288.0	2	Fung Tak Road	Pedestrian Walkway
O024	838974.5	822320.4	2	Sheung Yuen Street	Pedestrian Walkway
O025	839124.1	822259.7	2	Nan Lian Garden	Pedestrian Walkway
O026	839228.7	822158.9	2	Hammer Hill Road	Pedestrian Walkway
O027	838239.0	822417.5	2	Muk Lun Street	Pedestrian Walkway
O028	838317.4	822429.6	2	Muk Lun Street	Pedestrian Walkway
O029	838399.6	822443.7	2	Muk Lun Street	Pedestrian Walkway
O030	838233.4	822312.0	2	Chun Yan Street	Pedestrian Walkway
O031	838290.3	822311.1	2	Chun Yan Street	Pedestrian Walkway
O032	838349.1	822312.9	2	Chun Yan Street	Pedestrian Walkway
O033	838413.6	822371.8	2	Chun Yan Street	Pedestrian Walkway
O034	838270.7	822182.2	2	Choi Hung Road	Pedestrian Walkway
O035	838331.4	822223.3	2	Choi Hung Road	Pedestrian Walkway
O036	838384.6	822256.0	2	Choi Hung Road	Pedestrian Walkway
O037	838429.4	822288.7	2	Choi Hung Road	Pedestrian Walkway
O038	838464.9	822354.0	2	Po Kong Village Road	Pedestrian Walkway
O039	838474.2	822399.8	2	Po Kong Village Road	Pedestrian Walkway
O040	838485.5	822458.6	2	Po Kong Village Road	Pedestrian Walkway
O041	838422.9	822225.2	2	Choi Hung Road Playground	Pedestrian Walkway
O042	838479.9	822250.4	2	Choi Hung Road	Pedestrian Walkway
O043	838575.1	822237.3	2	Choi Hung Road	Pedestrian Walkway
O044	838666.6	822199.0	2	Choi Hung Road	Pedestrian Walkway
O045	838735.7	822165.4	2	Choi Hung Road	Pedestrian Walkway
O046	838783.3	822135.6	2	Choi Hung Road	Pedestrian Walkway
O047	838830.0	822112.2	2	Choi Hung Road	Pedestrian Walkway
O048	838885.1	822076.7	2	Choi Hung Road	Pedestrian Walkway
O049	838979.4	822048.7	2	Choi Hung Road	Pedestrian Walkway
O050	839052.2	822071.1	2	Hammer Hill Road	Pedestrian Walkway
O051	839168.0	822067.4	2	Hammer Hill Road	Pedestrian Walkway
O052	838752.8	821929.0	2	Sze Mei Street	Pedestrian Walkway
O053	838751.8	821999.6	2	Sze Mei Street	Pedestrian Walkway
O054	839027.5	821983.9	2	Prince Edward Road East	Pedestrian Walkway
O055	839057.9	821924.1	2	Prince Edward Road East	Pedestrian Walkway
O056	839079.5	821864.2	2	Prince Edward Road East	Pedestrian Walkway
O057	839111.8	822020.2	2	Hammer Hill Road	Pedestrian Walkway
O058	839180.5	821996.7	2	Choi Hung Estate	Pedestrian Walkway
O059	838383.0	822069.2	2	Sheung Hei Street	Pedestrian Walkway
O060	838418.3	822123.2	2	Sheung Hei Street	Pedestrian Walkway
O061	838448.7	822169.3	2	Sheung Hei Street	Pedestrian Walkway
O062	838462.5	822042.8	2	Tai Yau Street	Pedestrian Walkway
O063	838496.8	822090.8	2	Tai Yau Street	Pedestrian Walkway
O064	838520.3	822126.1	2	Tai Yau Street	Pedestrian Walkway
O065	838564.5	822182.0	2	Tai Yau Street	Pedestrian Walkway
O066	838619.4	822140.9	2	Ng Fong Street	Pedestrian Walkway
O067	838680.2	822105.5	2	Ng Fong Street	Pedestrian Walkway
O068	838754.8	822055.5	2	Sze Mei Street	Pedestrian Walkway
O069	838833.3	822036.9	2	Choi Yee Lane	Pedestrian Walkway
O070	838539.0	822057.5	2	Luk Hop Street	Pedestrian Walkway
O071	838653.7	821979.0	2	Luk Hop Street	Pedestrian Walkway
O072	838552.7	822552.8	2	Po Kong Village Road Sitting-	Pedestrian Walkway

Test Point	X	Y	Z (meter above ground)	Location	Description
				out Area	
O073	838619.4	822505.8	2	Lung Poon Court	Pedestrian Walkway
O074	838719.5	822560.7	2	Lung Poon Court	Pedestrian Walkway
O075	838850.9	822515.6	2	Bel Air Heights	Pedestrian Walkway
O076	838916.6	821977.0	2	Rhythm Garden	Pedestrian Walkway
O077	838384.0	822164.4	2	Choi Hung Road Playground	Pedestrian Walkway
O078	838827.4	821958.4	2	Canossa Primary School	Pedestrian Walkway
O079	838448.7	822631.3	2	Fung Tak Park	Pedestrian Walkway
O080	838548.8	822622.5	2	Lung Poon Court	Pedestrian Walkway
O081	838273.2	822456.7	2	Muk Lun Street Playground	Pedestrian Walkway
O082	838346.7	822477.3	2	Muk Lun Street Playground	Pedestrian Walkway
O083	838611.4	822433.3	2	Lung Cheung Road	Pedestrian Walkway
O084	838703.3	822377.3	2	Lung Cheung Road	Pedestrian Walkway
O085	838775.4	822331.4	2	Lung Cheung Road	Pedestrian Walkway
O086	838849.7	822283.8	2	Lung Cheung Road	Pedestrian Walkway
O087	839065.3	822299.9	2	Nan Lian Garden	Pedestrian Walkway
O088	839084.9	822227.1	2	Nan Lian Garden	Pedestrian Walkway
O089	839152.1	822213.0	2	Nan Lian Garden	Pedestrian Walkway
O090	839207.2	822241.0	2	Nan Lian Garden	Pedestrian Walkway
O091	839124.6	821957.4	2	Choi Hung Estate	Pedestrian Walkway
O092	839156.0	821907.4	2	Choi Hung Estate	Pedestrian Walkway
O093	839202.1	821947.6	2	Choi Hung Estate	Pedestrian Walkway
O094	838321.2	822117.3	2	Choi Hung Road Playground	Pedestrian Walkway
O095	838352.6	822091.8	2	Choi Hung Road Playground	Pedestrian Walkway
O096	838798.0	822037.9	2	Choi Yee Lane	Pedestrian Walkway
O097	838832.3	822092.8	2	GIC Building	Pedestrian Walkway
O098	838600.8	822013.3	2	Luk Hop Street	Pedestrian Walkway
O099	838697.9	821948.6	2	Luk Hop Street	Pedestrian Walkway
O100	838574.3	822093.8	2	Lane between Ng Fong Street and Luk Hop Street	Pedestrian Walkway
O101	838629.2	822058.5	2	Lane between Ng Fong Street and Luk Hop Street	Pedestrian Walkway
O102	838685.1	822016.3	2	Lane between Ng Fong Street and Luk Hop Street	Pedestrian Walkway
O103	838765.5	822385.5	2	Tai Hom Road	Pedestrian Walkway
O104	838795.3	822363.7	2	Tai Hom Road	Pedestrian Walkway
O105	838830.0	822342.8	2	Tai Hom Road	Pedestrian Walkway
O106	838866.8	822321.0	2	Tai Hom Road	Pedestrian Walkway
O107	838827.3	822475.7	2	Internal street between Halazia and Hollywoond Plaza	Pedestrian Walkway
O108	838857.3	822456.3	2	Internal street between Halazia and Hollywoond Plaza	Pedestrian Walkway
O109	838889.4	822435.8	2	Internal street between Halazia and Hollywoond Plaza	Pedestrian Walkway
O110	838919.4	822416.4	2	Internal street between Halazia and Hollywoond Plaza	Pedestrian Walkway
O111	838809.0	821907.2	2	Rhythm Garden	Pedestrian Walkway
O112	838825.1	821853.4	2	Rhythm Garden	Pedestrian Walkway
O113	838841.7	821820.7	2	Rhythm Garden	Pedestrian Walkway
O114	838890.0	821827.3	2	Rhythm Garden	Pedestrian Walkway
O115	838934.3	821832.9	2	Rhythm Garden	Pedestrian Walkway
O116	838973.7	821837.3	2	Rhythm Garden	Pedestrian Walkway
O117	839015.9	821849.0	2	Rhythm Garden	Pedestrian Walkway
O118	839005.9	821887.2	2	Rhythm Garden	Pedestrian Walkway
O119	838994.8	821921.0	2	Rhythm Garden	Pedestrian Walkway
O120	838979.3	821963.2	2	Rhythm Garden	Pedestrian Walkway
O121	838966.0	822003.1	2	Rhythm Garden	Pedestrian Walkway
O122	838933.8	822045.3	2	Rhythm Garden	Pedestrian Walkway
O123	838919.4	821996.5	2	Rhythm Garden	Pedestrian Walkway
O124	838925.5	821959.9	2	Rhythm Garden	Pedestrian Walkway
O125	838883.9	821954.3	2	Rhythm Garden	Pedestrian Walkway

Test Point	X	Y	Z (meter above ground)	Location	Description
O126	838847.8	821956.0	2	Rhythm Garden	Pedestrian Walkway

Table 6 Coordinates of Special Points

Test Point	X	Y	Z (meter above ground)	Location	Description
Baseline Scheme					
S01	838656.6	822320.3	2	PRH and SSF Site	Pedestrian Walkway
S02	838637.8	822297.7	2	PRH and SSF Site	Pedestrian Walkway
S03	838615.9	822265.4	2	PRH and SSF Site	Pedestrian Walkway
S04	838698.5	822298.3	2	PRH and SSF Site	Pedestrian Walkway
S05	838683.1	822272.8	2	PRH and SSF Site	Pedestrian Walkway
S06	838670.7	822253.6	2	PRH and SSF Site	Pedestrian Walkway
S07	838731.8	822268.3	2	PRH and SSF Site	Pedestrian Walkway
S08	838719.0	822247.0	2	PRH and SSF Site	Pedestrian Walkway
S09	838707.8	822230.5	2	PRH and SSF Site	Pedestrian Walkway
S10	838766.6	822242.3	2	PRH and SSF Site	Pedestrian Walkway
S11	838749.8	822223.7	2	PRH and SSF Site	Pedestrian Walkway
S12	838783.8	822243.0	2	PRH and SSF Site	Pedestrian Walkway
S13	838785.0	822213.4	2	PRH and SSF Site	Pedestrian Walkway
S14	838784.8	822185.2	2	PRH and SSF Site	Pedestrian Walkway
S15	838836.7	822197.3	2	PRH and SSF Site	Pedestrian Walkway
S16	838823.1	822179.8	2	PRH and SSF Site	Pedestrian Walkway
S17	838806.7	822157.3	2	PRH and SSF Site	Pedestrian Walkway
S18	838865.5	822175.1	2	PRH and SSF Site	Pedestrian Walkway
S19	838851.3	822156.2	2	PRH and SSF Site	Pedestrian Walkway
S20	838837.8	822137.7	2	PRH and SSF Site	Pedestrian Walkway
S31	838511.5	822368.5	2	Water Feature Park	Pedestrian Walkway
S32	838497.3	822318.3	2	Water Feature Park	Pedestrian Walkway
S33	838553.6	822375.5	2	Water Feature Park	Pedestrian Walkway
S34	838564.9	822331.8	2	Water Feature Park	Pedestrian Walkway
S35	838526.5	822283.1	2	Water Feature Park	Pedestrian Walkway
S36	838600.6	822385.4	2	Water Feature Park	Pedestrian Walkway
S37	838891.8	822205.7	2	Plaza	Pedestrian Walkway
S38	838881.0	822115.7	2	Religious Building	Pedestrian Walkway
S39	838907.9	822101.0	2	Religious Building	Pedestrian Walkway
S40	838964.0	822140.5	2	Public Transport Interchange	Pedestrian Walkway
S41	838955.5	822108.0	2	Public Transport Interchange	Pedestrian Walkway
S42	838968.2	822079.0	2	Public Transport Interchange	Pedestrian Walkway
S43	839015.7	822128.1	2	Public Transport Interchange	Pedestrian Walkway
S44	839009.8	822096.5	2	Public Transport Interchange	Pedestrian Walkway
Proposed Scheme					
S01	838629.5	822279.1	2	PRH and SSF Site	Pedestrian Walkway
S02	838613.1	822256.1	2	PRH and SSF Site	Pedestrian Walkway
S03	838709.4	822290.2	2	PRH and SSF Site	Pedestrian Walkway
S04	838682.7	822259.8	2	PRH and SSF Site	Pedestrian Walkway
S05	838669.6	822236.2	2	PRH and SSF Site	Pedestrian Walkway
S06	838749.8	822250.5	2	PRH and SSF Site	Pedestrian Walkway
S07	838736.3	822231.5	2	PRH and SSF Site	Pedestrian Walkway
S08	838717.7	822202.2	2	PRH and SSF Site	Pedestrian Walkway
S09	838788.0	822239.8	2	PRH and SSF Site	Pedestrian Walkway
S10	838783.3	822204.5	2	PRH and SSF Site	Pedestrian Walkway
S11	838780.8	822168.2	2	PRH and SSF Site	Pedestrian Walkway
S12	838851.2	822188.6	2	PRH and SSF Site	Pedestrian Walkway
S13	838836.9	822170.5	2	PRH and SSF Site	Pedestrian Walkway
S14	838824.1	822147.3	2	PRH and SSF Site	Pedestrian Walkway
S31	838511.5	822368.5	2	PRH and SSF Site	Pedestrian Walkway
S32	838497.3	822318.3	2	Water Feature Park	Pedestrian Walkway
S33	838553.6	822375.5	2	Water Feature Park	Pedestrian Walkway

Test Point	X	Y	Z (meter above ground)	Location	Description
S34	838564.9	822331.8	2	Water Feature Park	Pedestrian Walkway
S35	838526.5	822283.1	2	Water Feature Park	Pedestrian Walkway
S36	838600.6	822385.4	2	Water Feature Park	Pedestrian Walkway
S37	838891.8	822205.7	2	Water Feature Park	Pedestrian Walkway
S38	838881.0	822115.7	2	Plaza	Pedestrian Walkway
S39	838907.9	822101.0	2	Religious Building	Pedestrian Walkway
S40	838964.0	822140.5	2	Religious Building	Pedestrian Walkway
S41	838955.5	822108.0	2	Public Transport Interchange	Pedestrian Walkway
S42	838968.2	822079.0	2	Public Transport Interchange	Pedestrian Walkway
S43	839015.7	822128.1	2	Public Transport Interchange	Pedestrian Walkway
S44	839009.8	822096.5	2	Public Transport Interchange	Pedestrian Walkway

4.7 Wind Velocity Ratio

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

4.7.2. The assessment on the overall wind performance of the current situation and the proposed developments are analysed by comparing the weighted-mean wind velocity ratio (VR_w) to account for wind coming from the wind directions for which the sum of occurrence frequency is > 75%. VR_w is the sum of the Wind Velocity Ratio of wind from direction (VR_i) multiplied by the probability (Fi) of wind coming from that direction.

$$VRi = \frac{V_{pi}}{V_{\infty i}}$$

$$VR_w = \sum_{i=1}^{n} F_i \times VR_i$$

where VR_i is the velocity ratio of the location when wind comes from direction i;

V_{pi} is the wind velocity at the pedestrian level (2m above ground) when wind comes from direction i;

$V_{\infty i}$ is the wind availability of the site when wind comes from direction i, i.e. wind velocity at the top of the wind boundary layer;

F_i is the frequency occurrence of wind from direction i

n is the number of wind from 16 wind directions with sum of occurrence frequency > 75%

4.7.3. The normalized weighting (F_i) for each wind direction under annual and summer prevailing conditions is in ***Table 7***.

Table 7 Weighted Occurrence Frequency (Fi) of Annual Prevailing Wind Directions

Annual Prevailing Wind condition			Summer Prevailing Wind condition		
Wind Direction	**Occurrence frequency of the wind direction**	**Normalized weighting (Fi)**	**Wind Direction**	**Occurrence frequency of the wind direction**	**Normalized weighting (Fi)**
E	23.1%	29.3%	SW	14.5%	17.8%
ENE	12.4%	15.7%	SSW	12.8%	15.7%
NNE	10.3%	13.1%	E	10.4%	12.8%
ESE	8.6%	10.9%	SE	9.9%	12.2%
NE	7.0%	8.9%	S	9.3%	11.4%
SE	6.5%	8.2%	WSW	8.7%	10.7%
SSW	5.5%	7.0%	ESE	8.6%	10.6%
SW	5.4%	6.9%	SSE	7.1%	8.7%
Total	**78.8%**	**100%**	**Total**	**81.3%**	**100%**

4.7.4. For the Site Air Ventilation Assessment, the Site spatial average Velocity Ratio (SVR) is reported, which takes into account the perimeter test points evenly positioned on the project site boundary as shown in ***Figure 17*** and ***Figure 18.***

4.7.5. 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 as shown in ***Figure 17*** and ***Figure 18.***

5. Results and Findings

5.1 Air Ventilation Performance Result

5.1.1. The simulation results of VR at all test points are provided in ***Appendix D***. VR demonstrated in terms of contour and arrow plots for all prevailing wind directions are provided in ***Appendix E***.

5.1.2. For air ventilation assessment of the Baseline and Proposed Scheme, perimeter test points, overall test points and special test points are assigned at the pedestrian level. The performance under annual and summer prevailing wind conditions are discussed below.

Annual Wind Ventilation Performance

5.1.3. The differences of VRw at each perimeter test point between Baseline Scheme and Proposed Scheme under annual condition are presented in ***Figure 19***, while differences of VRw at each overall test point are presented in ***Figure 20*** and ***Figure 21***.

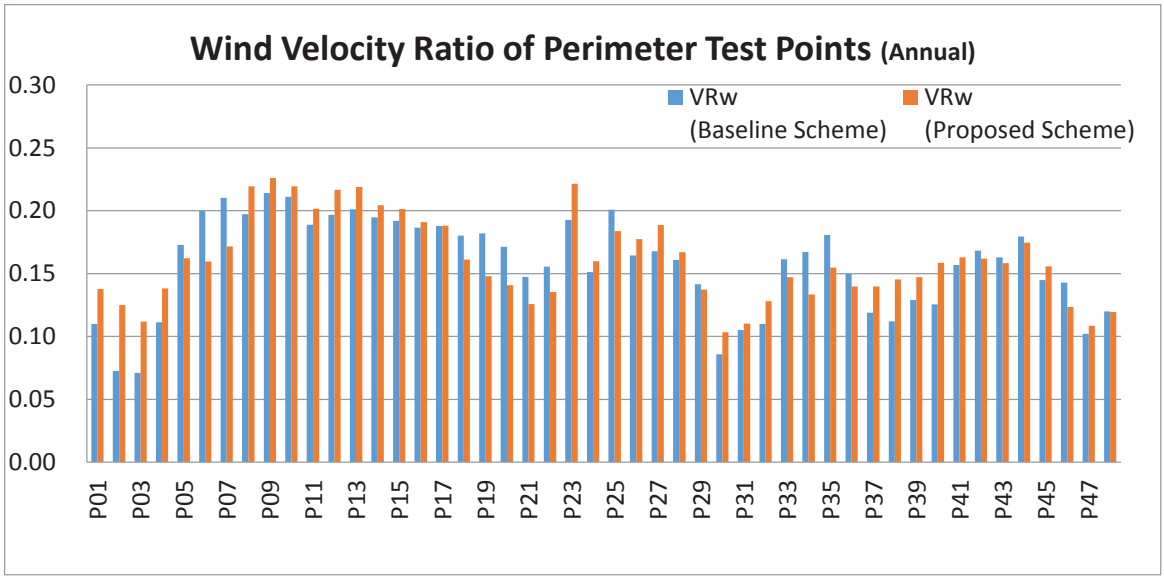


Figure 19 Weighted Wind Velocity Ratio (VRw) of Perimeter Test Points for Baseline Scheme and Proposed Scheme under Annual Condition (P01-P48)

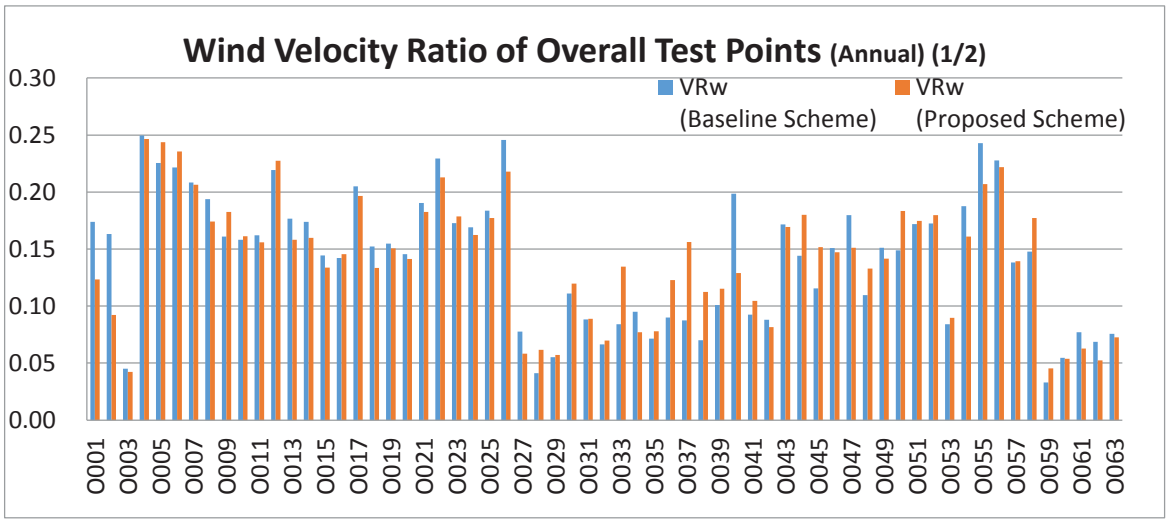


Figure 20 Weighted Wind Velocity Ratio (VRw) of Overall Test Points for Baseline Scheme and Proposed Scheme under Annual Condition (O01-O63)

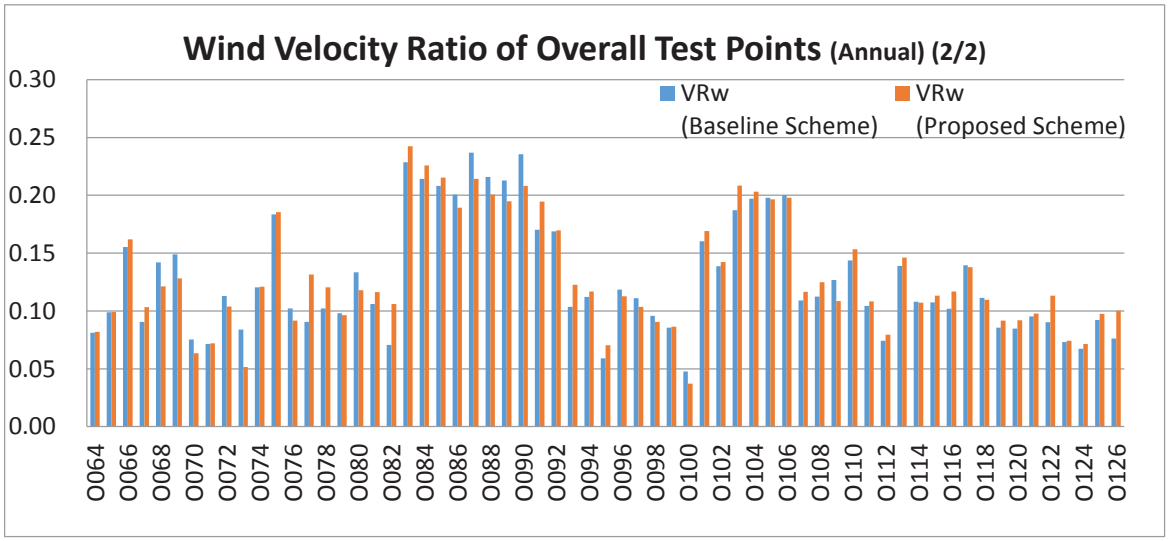


Figure 21 Weighted Wind Velocity Ratio (VRw) of Overall Test Points for Baseline Scheme and Proposed Scheme under Annual Condition (O64-O126)

Summer Wind Ventilation Performance

5.1.4. The differences of VRw at each perimeter test point between Baseline Scheme and Proposed Scheme under summer condition are presented in ***Figure 22***, while differences of VRw at each overall test point are presented in ***Figure 23*** and ***Figure 24***.

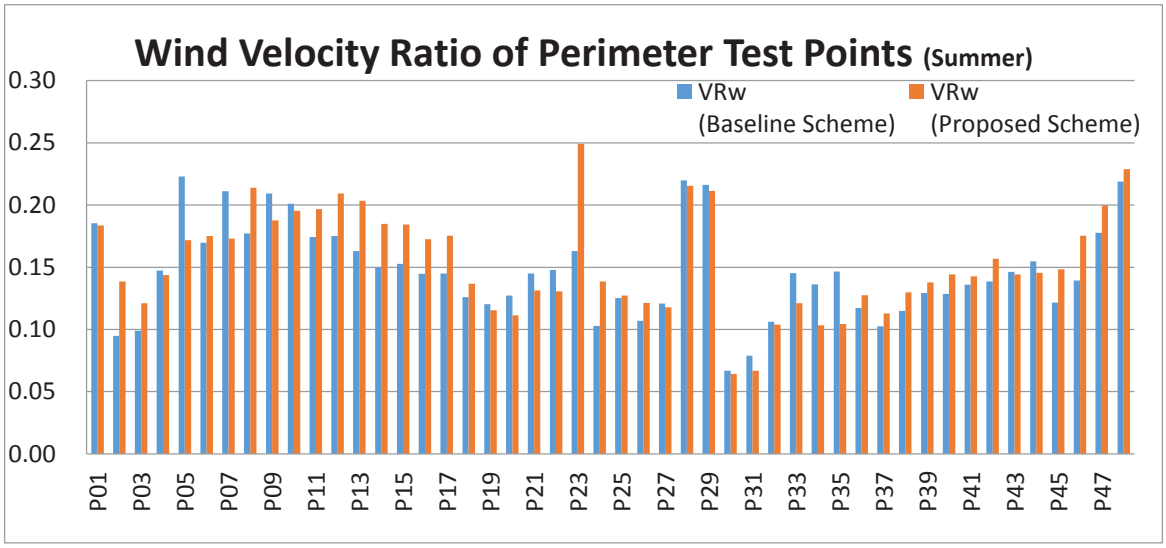


Figure 22 Summer VRw of Perimeter Test Points for Baseline and Proposed Scheme (P01-P48)

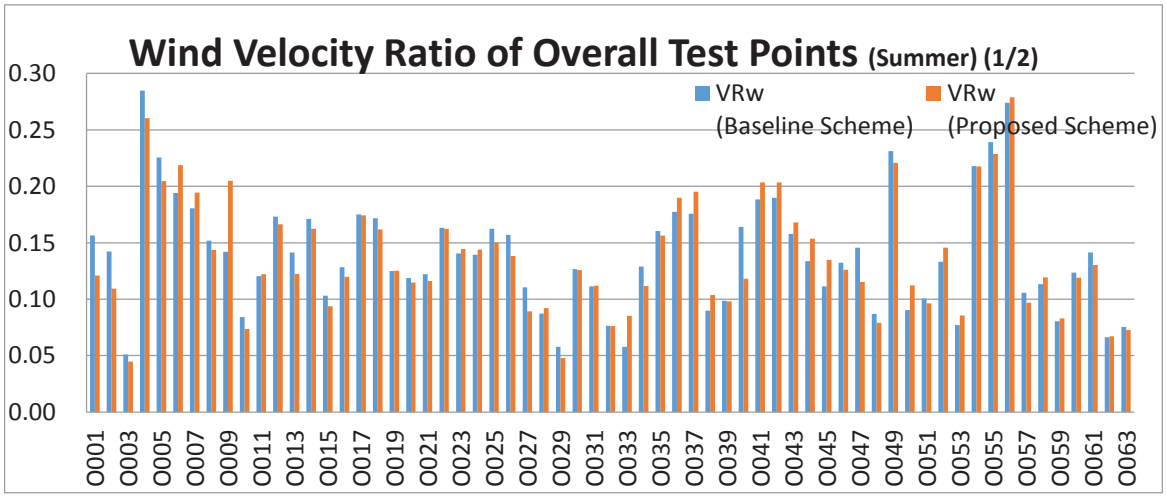


Figure 23 Summer VRw of Overall Test Points for Baseline and Proposed Scheme (O01-O63)

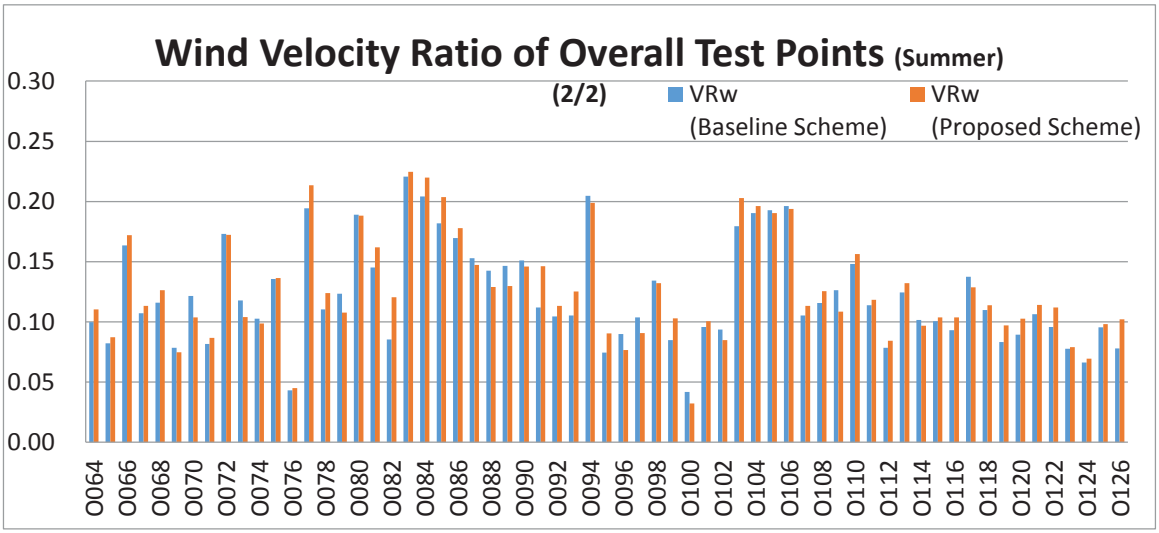


Figure 24 Summer VRw of Overall Test Points for Baseline and Proposed Scheme (O64-O126)

5.2 Site Air Ventilation Assessment Results

5.2.1. Site Velocity Ratios (SVR) under annual and summer prevailing winds are evaluated by considering the average Velocity Ratio of all Perimeter Test Points (48 points) along the boundary of the Subject Site where frequently accessible by pedestrians. Weighted Site Velocity Ratios (SVR_w) are determined by taking into account the wind probability of the assessed annual and summer prevailing wind directions. The SVR_w results including the percentage changes for the Baseline and Proposed Schemes are summarized in ***Table 8*** below.

Table 8 Summary of Weighted Site Velocity Ratios (SVRw)

Annual Wind Directions	$VR_{average}$ (Baseline Scheme)	$VR_{average}$ (Proposed Scheme)	$VR_{average}$ Change	Summer Wind Directions	$VR_{average}$ (Baseline Scheme)	$VR_{average}$ (Proposed Scheme)	$VR_{average}$ Change
E	0.165	0.169	0.004	SW	0.144	0.165	0.021
ENE	0.180	0.180	0.000	SSW	0.106	0.107	0.001
NNE	0.129	0.130	0.001	E	0.165	0.169	0.004
ESE	0.171	0.179	0.008	SE	0.184	0.197	0.013
NE	0.142	0.126	-0.016	S	0.104	0.108	0.004
SE	0.184	0.197	0.013	WSW	0.165	0.146	-0.019
SSW	0.106	0.107	0.001	ESE	0.171	0.179	0.008
SW	0.144	0.165	0.021	SSE	0.150	0.173	0.023
SVRw	0.157	0.161	0.004	**SVRw**	0.147	0.154	0.007

5.2.2. As shown in ***Table 8***, the SVRw show change in the range of -0.016 to 0.021 under annual prevailing wind conditions. The weighted average SVR is found to be 0.157 and 0.161 in the Baseline and Proposed Schemes respectively, reflecting an overall positive change of 0.004 in SVRw.

5.2.3. The predicted SVRw values for summer prevailing wind conditions also show change in the range of -0.020 to 0.022. The weighted average SVR is found to be 0.147 and 0.154 in the Baseline and Proposed Schemes respectively, reflecting an overall positive change of 0.007 in SVRw. The findings indicated Proposed Scheme resulted in a slightly better wind ventilation performance within the subject site and in its immediate vicinity under both annual and summer wind conditions.

5.3 Local Air Ventilation Assessment Results

5.3.1. Local Velocity Ratios (LVR) under annual and summer prevailing winds are evaluated by considering the average Velocity Ratio of at all Perimeter Test Points (48 points) and Overall Test Points (126 test points). Weighted Local Velocity Ratios (LVR_w) are determined by taking into account the wind probability of the assessed annual and summer prevailing wind directions. The LVR_w results including the percentage changes for the Baseline and Proposed Schemes are summarized in ***Table 9*** below.

Table 9 Summary of Weighted Local Velocity Ratios (LVRw)

Annual Wind Directions	$VR_{average}$ (Baseline Scheme)	$VR_{average}$ (Proposed Scheme)	$VR_{average}$ Change	Summer Wind Directions	$VR_{average}$ (Baseline Scheme)	$VR_{average}$ (Proposed Scheme)	$VR_{average}$ Change
E	0.151	0.153	0.002	SW	0.137	0.141	0.004
ENE	0.150	0.150	0.000	SSW	0.119	0.119	0.000
NNE	0.132	0.129	-0.003	E	0.151	0.153	0.002
ESE	0.149	0.153	0.004	SE	0.162	0.168	0.006
NE	0.135	0.129	-0.006	S	0.121	0.125	0.004
SE	0.162	0.168	0.006	WSW	0.139	0.129	-0.010
SSW	0.119	0.119	0.000	ESE	0.149	0.153	0.004
SW	0.137	0.141	0.004	SSE	0.128	0.140	0.012
LVRw	0.145	0.145	0.000	**LVRw**	0.138	0.140	0.002

5.3.2. As shown in ***Table 9***, the LVRw show change in the range of -0.006 to 0.005 under annual prevailing wind conditions. The weighted average LVRw is found to be 0.145 and 0.145 under Baseline and Proposed Scheme respectively, reflecting an overall change of 0.000 in LVRw. The predicted LVR for summer prevailing wind condition also show change in the range of -0.010 to 0.012. The weighted average LVRw is found to be 0.138 and 0.140 respectively, reflecting an overall change of 0.002 in LVRw.

5.3.3. As indicated in ***Table 8*** and ***Table 9***, the higher values in both SVRw and LVRw in Proposed Scheme under annual and summer prevailing wind conditions indicate improvement of air ventilation performance.

5.4 Annual Overall Ventilation Pattern Assessment

5.4.1. The air ventilation performance of Baseline and Proposed Scheme under annual wind condition are shown in ***Figure 25*** are discussed below.

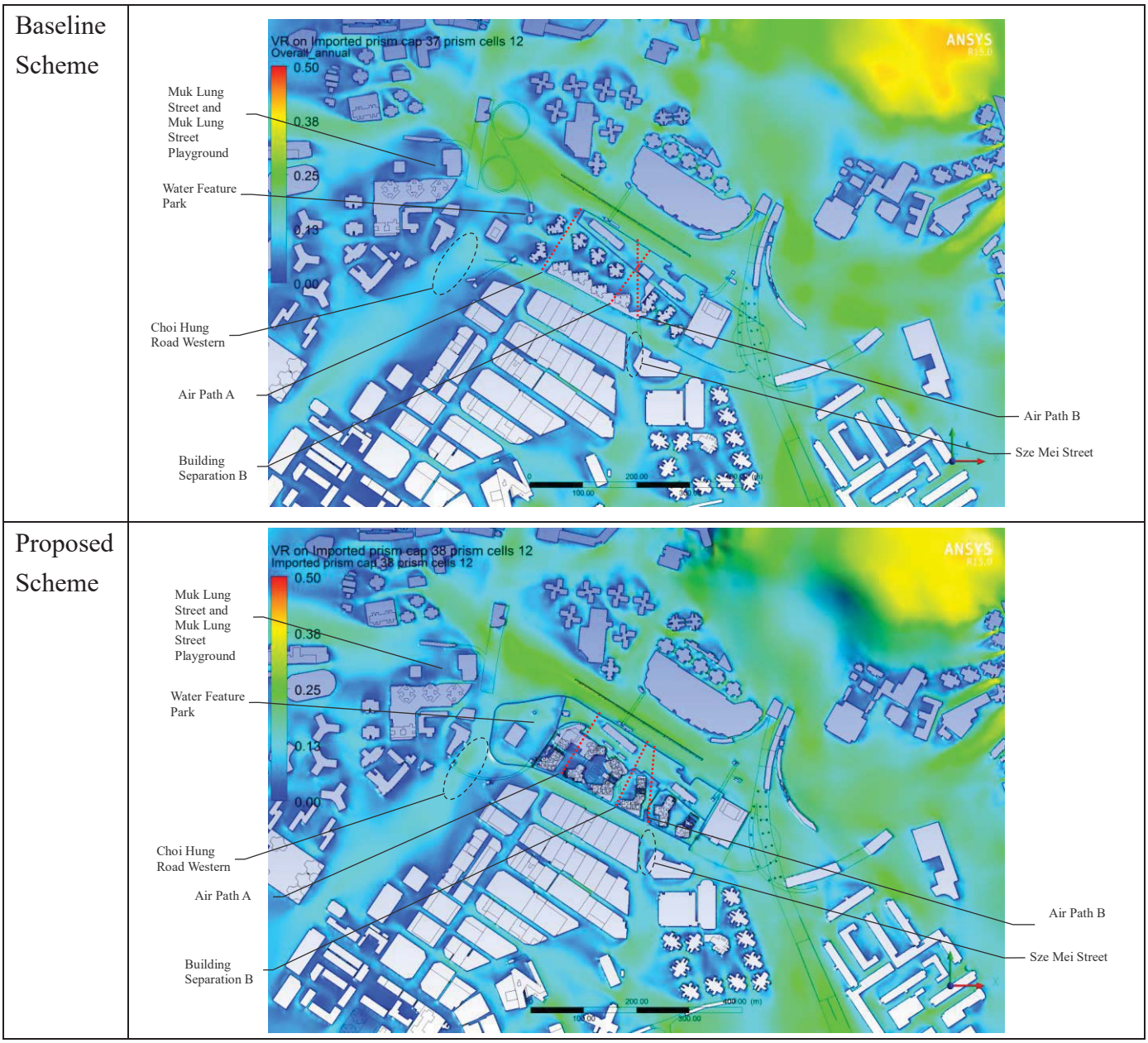


Figure 25 Contour Plot of VRw in under Annual Wind

5.4.2. Under annual wind condition, the eight most probable wind directions contributing to 78.8% occurrence has indicated the overall ventilation performance throughout the year. Major prevailing winds under annual condition are mainly from north-east quarter where E wind accounted for the most occurrence of frequency. The prevailing winds from north-east quarter first flow from Kwun Ton Bypass and Hammer Hill Road and reach the Subject Site. The winds would then divert into Lung Cheung Road and western part of

Choi Hung Road constrained by high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood, the 5m noise barrier along Lung Cheung Road and southern building groups in San Po Kong Business area. Air path and building separation in the Subject Site enhance wind penetration via Lung Cheung Road and Western Part of Choi Hung Road, as well as Tai Yau Street and Sze Mei Street.

5.4.3. The below summarize some significant ventilation patterns and problematic areas under annual wind condition.

- The overall ventilation performances of the Baseline and Proposed Scheme are similar for under annual condition.
- The wind environment of western part of Choi Hung Road has a high VR in the Proposed Scheme as shown in ***Figure 25***. The setback of the religious building would allow more wind to flow through western part of Choi Hung Road.
- The wind environment of Water Features Park of the Subject Site has a noticeably higher VR in the Proposed Scheme as shown in ***Figure 25***. It is due to curvy design in Block 1 Podium and the enhanced setback distance of the block with the site boundaries which would allow downstream flow to reach the Water Features Park.
- Similarly, the ventilation performance of Muk Lun Street and Muk Lun Street Playground are slightly better under Proposed Scheme as shown in ***Figure 25***.
- Sze Mei Street near the Subject Site has a higher VR in the Proposed Scheme as it is enhanced by the Air Path B while the Air Path B in the baseline scheme is obstructed by retail block between Block 9 and Block 10.
- Potential problematic area in Air Path A is identified as a lower VR in the Proposed Scheme. The wind environment would be obstructed by a retail block between Block 1 and Block 3. However, annual winds from north-east quarter would provide a similar to slightly poor wind environment in Air Path B. Due to the domination of probability of annual winds, VR of Air Path B under the annual condition in the Proposed Scheme is slightly lower than Baseline Scheme.
- Building Separation B in the proposed scheme has a higher VR to as the separation is wider than the baseline scheme.
- Both schemes have similar VR in Tai Yau Street, Po Kong Village Road and Lung Cheung Road, Lung Poon Street and Lung Poon Court.

5.5 Summer Overall Ventilation Pattern Assessment

5.5.1. The air ventilation performance of Baseline and Proposed Scheme under summer wind condition are shown in ***Figure 26*** are discussed below.

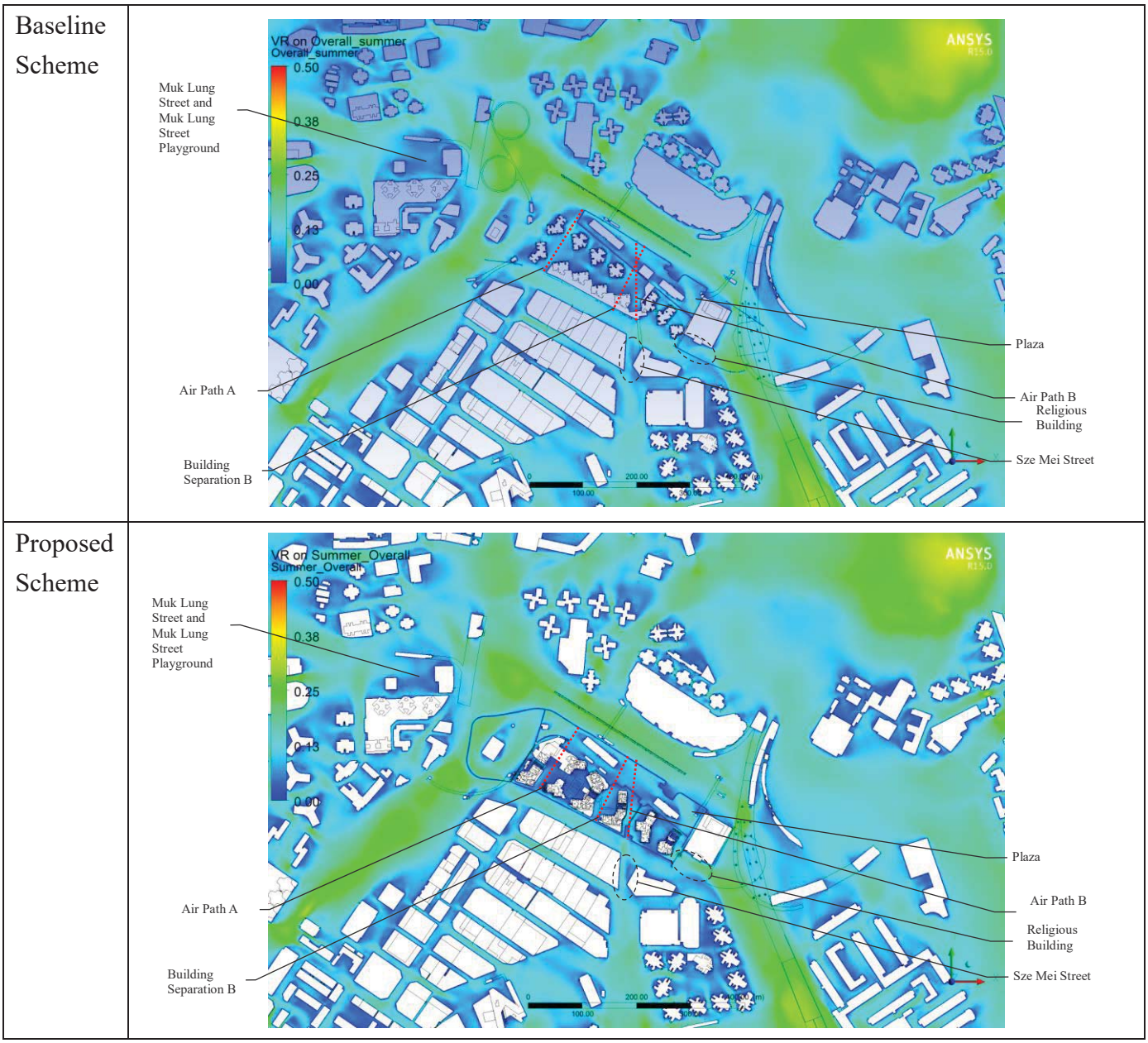


Figure 26 Contour Plot of VRw under Summer Wind

5.5.2. Under summer wind condition, the eight most probable wind direction contributing to 81.3% occurrence has indicated the overall ventilation performance during summer months of the year. Major prevailing winds under summer condition are mainly from south-west quarter where SW wind accounted for the most occurrence of frequency. The prevailing winds from south-west quarter first flow from eastern part of Choi Hung Road and reach the Subject Site. The winds would then divert into Lung Cheung Road and Western part of

Choi Hung Road constrained by high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood, the 5m noise barrier along Lung Cheung Road and southern building groups in San Po Kong Business area. Air path and building separation in the Subject Site enhance wind penetration via Lung Cheung Road and Western Part of Choi Hung Road, as well as Tai Yau Street and Sze Mei Street.

5.5.3. The below summarize some significant ventilation patterns and problematic areas under summer wind condition.

- The overall ventilation performances among Baseline and Proposed Scheme are quite similar under summer condition.
- Sze Mei Street near the Subject Site has a slightly higher VR in Proposed Scheme as shown in ***Figure 26***. As Air Path B is aligned with Sze Mei Street and penetrate into Subject Site through Air Path B in Propsoed Scheme. However, Air Path B in the Baseline Scheme is obstructed by retail block between Block 9 and Block 10 which would resist wind flowing from upstream area of Sze Mei Street.
- Potential problematic area in air path A is identified as a low VR in the Proposed Scheme. The wind environment would be block obstructed by a retail block between Block 1 and Block 3. Air Path B in the Proposed Scheme has a higher VR as the Air Path B in the baseline scheme is obstructed by retail block between Block 9 and Block 10.
- Building Separation B in the Proposed Scheme has a higher VR to as the separation is wider than the baseline scheme.
- The plaza and religious building in has a high VR in the Proposed Scheme. The setback of religious building away from western part of Choi Hung Road reserves a larger area at the front and improve the air ventilation. Besides, its separation with Block 7 would reserve a larger opening area for the plaza where the air ventilation would be improved.
- Both schemes have similar VR in Tai Yau Street, Po Kong Village Road and Lung Cheung Road, Muk Lun Street and Muk Lun Street Playground.

5.6 Special Test Points

5.6.1. Special test points in the Subject Site are defined for further analysis, including Air Path A and B, Building Separation A, B and C, Water Feature Park, Plaza, Religious Building and Public Transport Interchange as shown in ***Figure 17***, ***Figure 18*** and ***Table 11***.

Table 10 Special Test Points Weighted Average Velocity Ratio

Focus Area	Annual Prevailing Wind Condition		Summer Prevailing Wind Condition	
	VR_w (Baseline Scheme)	VR_w (Proposed Scheme)	VR_w (Baseline Scheme)	VR_w (Proposed Scheme)
Air Paths A (Baseline:S01-S03, Proposed S01-02)	0.112	0.049	0.094	0.058
Air Path B (Baseline:S12-S14, Proposed S09-S11)	0.105	0.092	0.073	0.082
Building Separation A (Baseline:S04-S09, Proposed S03-S05)	0.066	0.070	0.059	0.057
Building Separation B (Baseline:S010-S11, Proposed S06-S08)	0.089	0.118	0.076	0.082
Building Separation C (Baseline:S15-S20, Proposed S12-S14)	0.096	0.111	0.090	0.064
Water Feature Park (S31-S36)	0.110	0.131	0.145	0.155
Plaza (S37)	0.136	0.164	0.103	0.158
Religious Building (S38-S39)	0.084	0.136	0.096	0.159
Public Transport Interchange (S40-S44)	0.169	0.152	0.160	0.146

Air Path A

5.6.2. The wind environment in Air path A under annual and summer wind conditions has a lower VR in the Proposed Scheme as the air path would be block obstructed by a retail block between Block 1 and Block 3.

Air Path B

5.6.3. Annual winds from north-east quarter would provide a similar to slightly poor wind environment in Air Path B. Due to the domination of probability of annual winds, VR of Air Path B under the annual condition in the Proposed Scheme is slightly lower than Baseline Scheme. However, summer winds from south-west quarter would provide a higher VR in Proposed Scheme as the Air Path B in the baseline scheme is obstructed by retail block between Block 9 and Block 10.

Building Separation B

5.6.4. Building Separation B under annual and summer wind conditions has a higher VR in the Proposed Scheme as the the separation is wider than baseline scheme.

Building Separation A and C

5.6.5. Building Separation A and C has a similar VR in the Proposed Scheme and Baseline Scheme under annual wind condition. However, Building Separation C under summer wind conditionhas a lower VR in the Proposed Scheme.

Water Feature Park

5.6.6. The water feature park under annual and summer wind conditions has a higher VR in the Proposed Scheme as the curvy design in Block 1 Podium and setback distance of the block with the site boundaries would allow more wind to flow through.

Plaza

5.6.7. The wind environment in the Plaza and Religious Building under annual and summer wind conditions has a higher VR in the Proposed Scheme as the setback of the Religious Building away from the SSF site and western part of Choi Hung Road.

Religious Building and PTI

5.6.8. Religious Building has a higher VR in the Proposed Scheme under annual and summer wind conditions. The setback of Religious Building away from western part of Choi Hung Road reserve a larger area at the front and improve the air ventilation. However, the separation distance of the Religious Building and Public Transport Interchange (PTI) would be reduced leading to a lower VR under annual and summer wind conditions.

5.7 Focus Area

5.7.1. Within the assessment area, different areas that potentially raise concern after the development of the proposed building or within major activity zones are labeled as focus areas for further wind environment analysis. The areas are listed below and labeled in ***Figure 27***. The VRw of the focus areas under annual and summer prevailing wind conditions are tabulated in ***Table 11***.

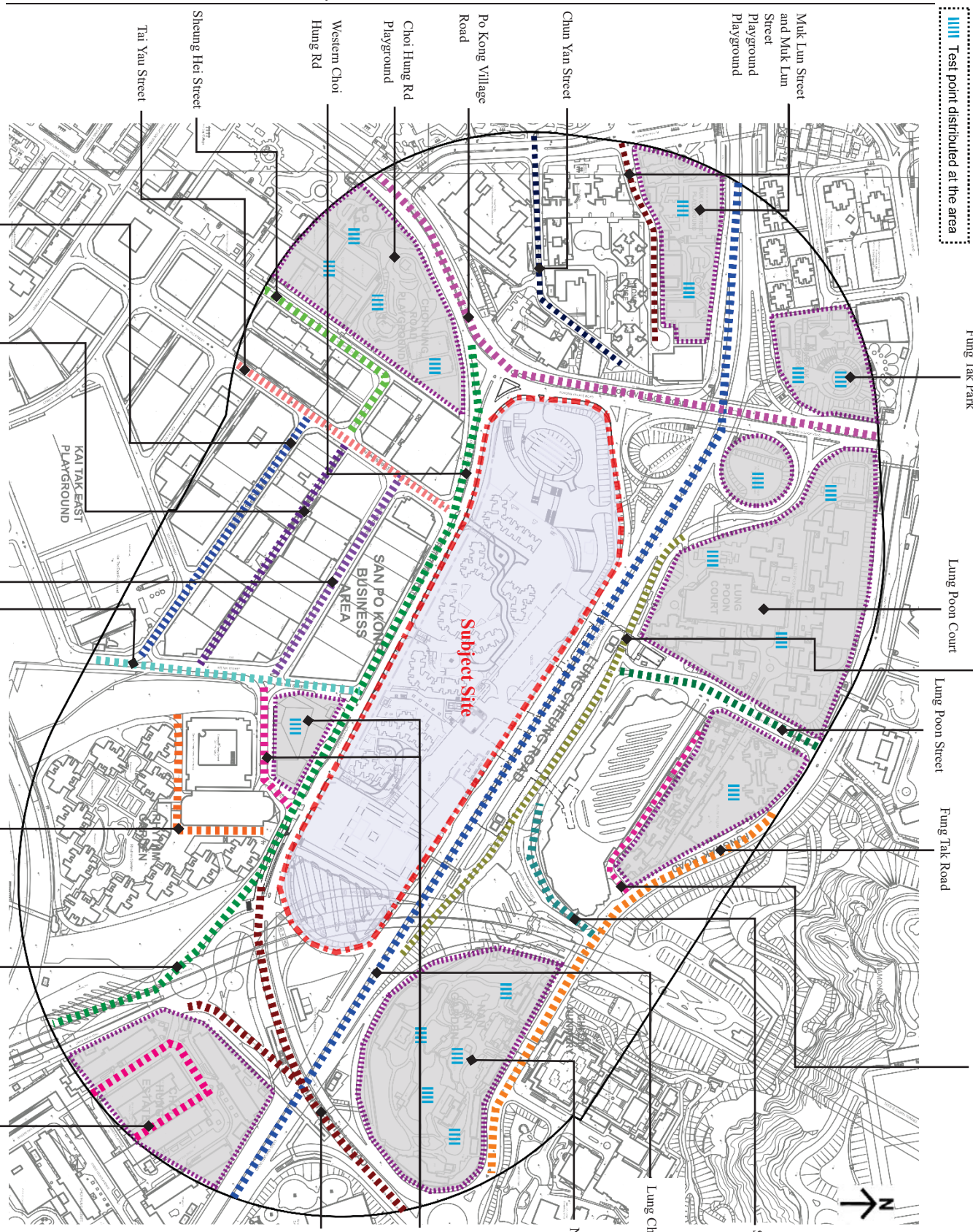


Figure 27 Focus Area for the study

Table 11 Focus Area Weighted Average Velocity Ratio

Focus Area	Annual Prevailing Wind Condition		Summer Prevailing Wind Condition	
	VR_w (Baseline Scheme)	VR_w (Proposed Scheme)	VR_w (Baseline Scheme)	VR_w (Proposed Scheme)
Lung Poon Court (O73,O74,O80)	0.18	0.18	0.13	0.13
Lung Poon Street (O16-O18)	0.17	0.16	0.16	0.15
Po Kong Village Road (O14-O15, O38-O40)	0.14	0.13	0.12	0.12
Sze Mei Street (O52-O53, O68)	0.13	0.15	0.11	0.12
Tai Yau Street (O62-O65)	0.08	0.08	0.08	0.08
Choi Hung Road Western (O34-37)	0.09	0.11	0.16	0.16
Choi Hung Road Eastern (O42-O49)	0.14	0.14	0.15	0.15
Choi Hung Road Playground (O41, O77, O94-O95)	0.08	0.08	0.17	0.18
Lung Cheung Road (O01-O12, O83-O86)	0.15	0.14	0.17	0.17
Tai Hom Road (O103-O106)	0.20	0.20	0.21	0.22
Fung Tak Road (O19-O23)	0.18	0.17	0.13	0.13
Fung Tak Park (O13, O79)	0.21	0.18	0.13	0.12
Internal street between Galaxia and Hollywood Plaza (O107-O110)	0.12	0.12	0.08	0.08
Nan Lian Garden (O25, O87-O90)	0.12	0.12	0.15	0.14
Muk Lun Street and Muk Lun Street Playground (O27-O29, O81-O82)	0.09	0.10	0.10	0.10
Chun Yan Street (O30-O33)	0.09	0.10	0.09	0.10
Sheung Hei Street (O59-O61)	0.05	0.05	0.12	0.11
Ng Fong Street (O66-O67)	0.16	0.17	0.14	0.14
Internal street between Ng Fong Street and Luk Hop Street (O100-O102)	0.11	0.12	0.08	0.07
Luk Hop Street (O71-O71, O98-O99)	0.16	0.15	0.11	0.11
GIC Development at Choi Yee Lane (O69, O96-O97)	0.10	0.10	0.09	0.08
Rhythm Garden (O111-O126)	0.10	0.10	0.09	0.10
Canossa Primary School (O76, O78)	0.18	0.17	0.08	0.08
Kwun Tong Bypass (O54-O56)	0.22	0.21	0.24	0.24
Choi Hung Estate (O51, O57, O91-O93)	0.13	0.13	0.11	0.12

Annual Wind Condition

5.7.2. Under annual wind condition, some of the areas have no change in wind environment including Lung Poon Court, Tai Yau Street, Choi Hung Road Estern, Tai Hom Road, Internal street between Galaxia and Hollywood Plaza, Nan Lian Garden, Sheung Hei Street, GIC Development at Choi Yee Lane and Rhym Garden.

5.7.3. The wind environment of Sze Mei Street would be improved under the Proposed Scheme. Setback of religious building away from western part of Choi Hung Road and larger separation between Block 6 and Block 7 would allow more wind to flow through.

5.7.4. Curvy podium design and setback of Block 1 in the Proposed Scheme Subject Site would allow more wind to divert into the Subject Site and finally reach the western part of Choi Hung Road.

5.7.5. Similarly, due to curvy podium design and setback of the Block 1, more wind would reach Muk Lun Street and Muk Lun Street Playground and thus enhance the pedestrian wind environment. However, Fung Tak Park had a lower VR in Proposed Scheme, which may attribute to the curvy podium design and setback of the Block 1. Wind flowing along Lung Cheung Road from east would divert to south-west areas such as Muk Lun Street and Muk Lun Street Playground and water feature park, as well as western part of Choi Hung Road. Thus, less wind would reach the downstream north-west area of Fung Tak Park and would give a lower VR in Proposed Scheme.

5.7.6. Others areas would have similar wind environment under annual wind condition.

Summer Window Condition

5.7.7. Under summer wind condition, some of the areas have no change in wind environment including Lung Poon Court, Po Kong Villiage Road, Tau Yau Street, Tai Yau Street, Choi Hung Road Western & Eastern, Lung Cheung Road, Fung Tak Road, Internat Street between Galaxia and Hollywood Plaza, Muk Lun Street and Muk Lun Street Playground, Ng Fong Street, Luk Hop Street, Canossa Primary School and Kwun Tong Bypass.

5.7.8. Although some of the summer wind directions are parallel to the air path such as Tai Yau Street and Sze Mei Street which are aligned with the Air Path A and B in the Subject Site, the wind environment of these street are similar under the Baseline and Proposed Scheme. Summer wind flowing through the Tai Yau Street and Sze Mei Street would be diverted and attenuated by the San Po Kong Industrial Building Blocks.

5.7.9. Others areas would have similar wind environment under summer wind condition.

6. Directional Analysis

6.1 ENE Wind

6.1.1. The ENE wind flows down from Hammer Hill Road, then passes through Nan Lian Garden before reaching the subject site. The contour plot graph of the wind is provided in ***Figure 28***.

6.1.2. The Air Path A aligned with Tai Yau Street and Air Path B aligned with Sze Mei Street in the Baseline and Proposed schemes shown in ***Figure 28*** allow wind penetration from Lung Cheung Road to Choi Hung Road. San Po Kong Industrial Area along Choi Hung Road would be benefitted from improved ventilation under both schemes. Air Path A in the Proposed Scheme results a lower VR as it is obstructed by the retail block between Block 1 and Block 3 while Air Path B has similar VR under both schemes.

6.1.3. The building openings in the Baseline and Proposed schemes shown in ***Figure 28*** allow wind penetrates from Lung Cheung Road to Choi Hung Road. The VR results show that ventilation on pedestrian level of Choi Hung Road is improved slightly under the Proposed Scheme due to the strip retail block in the Baseline Scheme that refrain wind penetration. Others building openings in the Proposed and Baseline schemes demonstrate a similar VR.

6.1.4. In the Proposed Scheme, the curvy design of Block 1 podium and setback of Block 1 from Lung Chung Road would allow wind to flow around Block 1 podium to water feature park through landscape walk area and flow further to Choi Hung Road Playground and Kowloon Wall City Community Hall (Please refer to red arrow in ***Figure 29***); which contributes to a more effective air ventilation. In addition, the setback also allows downstream flow to Muk Lun Street, Muk Lun Street Playground and Chun Yan Street which provide a better VR when compared with the Baseline Scheme.

6.1.5. The air ventilation performance for both schemes under ENE wind direction would be similar for other surrounding sites, including Bel Air Heights, Choi Hung Estate, Lung Poon Court Tai Yau Street and Sze Mei Street.

6.1.6. The air path along Sze Mei Street facilitates the air flow from Sheung Yuen Street to flow downstream under the Proposed Scheme. Nevertheless, the air path along Tai Yau Street will subject to slight decrease in wind at pedestrian level compared to Baseline Scheme due to the flat podium between Block 1 and Block 3.

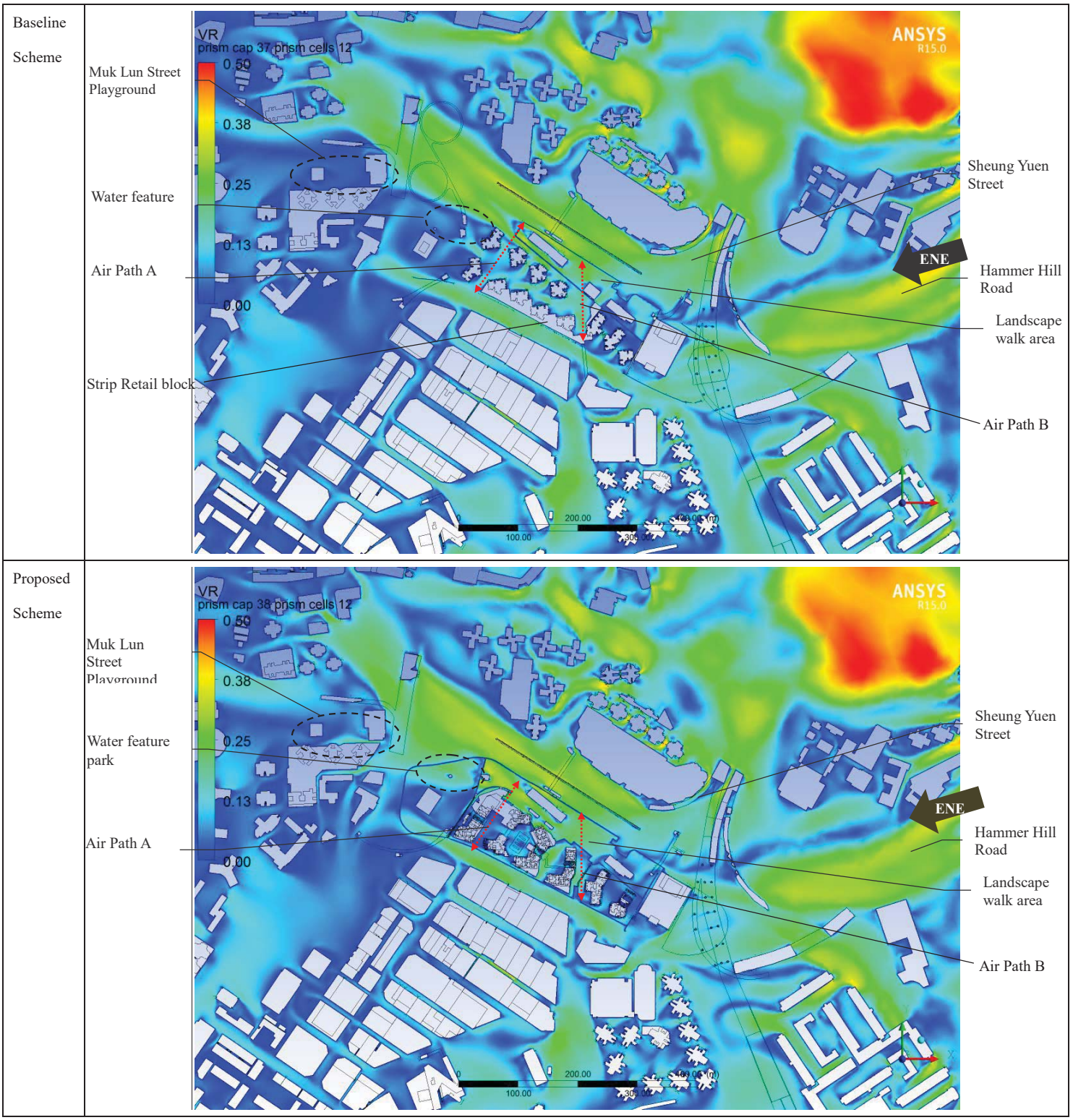


Figure 28 Contour Plot of VR under ENE wind

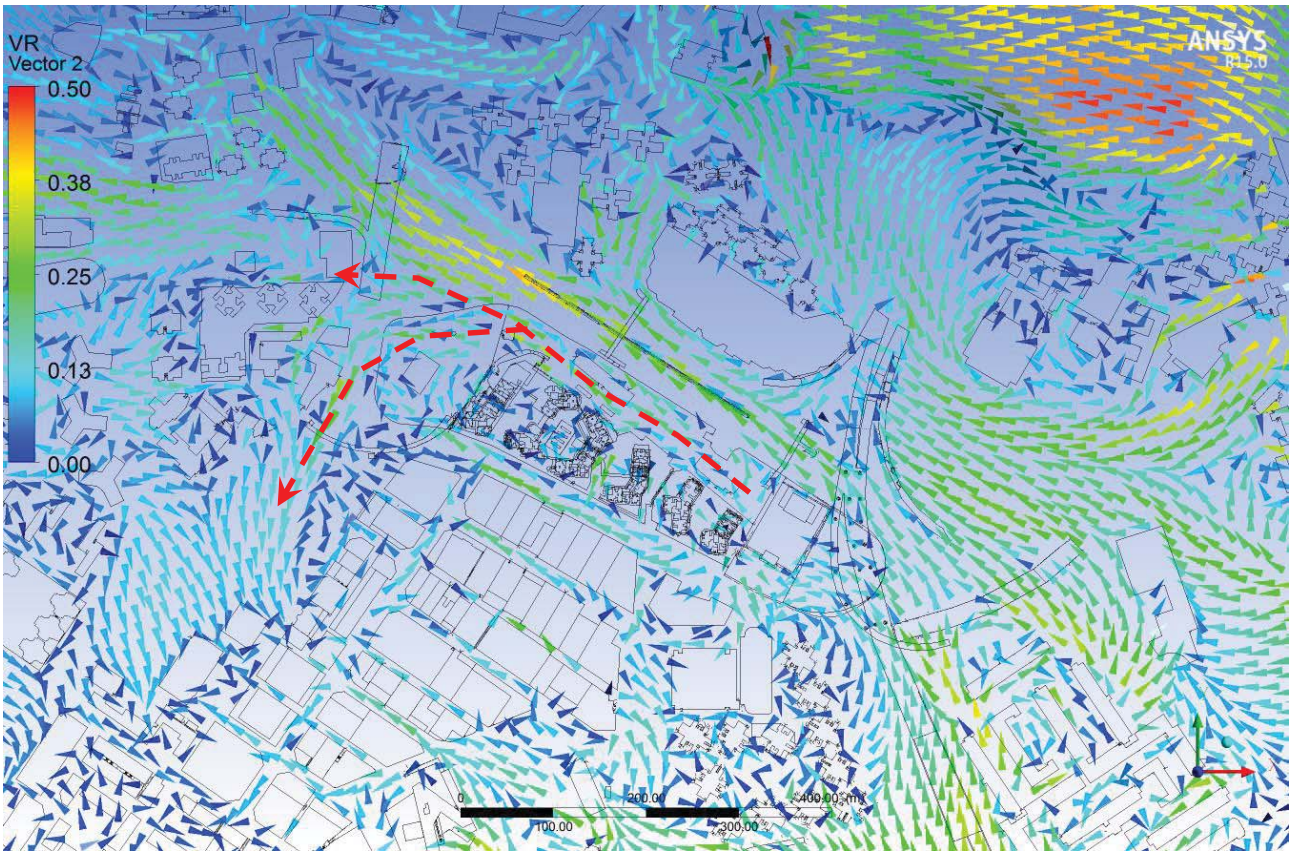


Figure 29 Vector Plot of VR under ENE wind in Proposed Scheme

6.2 E Wind

6.2.1. The E wind flows down from Hammer Hill Road, and then passes through Nan Lian Garden before reaching the subject site. The contour plot graph of the wind is provided in ***Figure 30***.

6.2.2. The E wind is observed to be channelized along Lung Cheung Road by the high-rise northern building groups such as Lung Poon Court, Galaxia, Plaza Hollywood and the subject site. Similar to ENE wind, Air Path A in the Proposed Scheme results a lower VR due to the obstruction of retail block between Block 1 and Block 3. Air Path B and most of the other building openings under both schemes would result in similar VR. Nevertheless, building opening B in the Proposed Scheme has a slight better VR which improve ventilation in landscape walk area due to the wider building separation.

6.2.3. Block 1 in the Proposed Scheme provides a wider setback distance to Lung Chung Road than in the Baseline Scheme. Wind would flow around the podium of Block 1 and to water feature park from landscape walk area and continue along the western part of Choi Hung Road to areas including Choi Hung Road Playground and Kowloon Wall City Community Hall (Please refer to red arrow in ***Figure 31***). In addition, the setback of Block 1 could also allow downstream flow at Muk Lun Street, Muk Lun Street Playground and Chun Yan Street which provide a better VR compared with the Baseline Scheme.

6.2.4. In the Proposed Scheme, the setback distance between Block 7 and religious building would improve the ventilation at the entrance of the religious buildings. It also allows more wind flowing upstream to the plaza. More, the setback has further facilitates wind curving into Sze Mei Street through Choi Yee Lane, enhancing the ventilation of the area (Please refer to ***Figure 31***).

6.2.5. Nevertheless at the Proposed Public Transport Interchange (PTI), better ventilation is observed in the Baseline Scheme which is caused by its greater separation between the PTI and the religious building.

6.2.6. The air ventilation performance for both schemes under E wind direction would be similar for other surrounding sites, including Bel Air Heights, Choi Hung Estate, Lung Poon Court Tai Yau Street and Sze Mei Street.

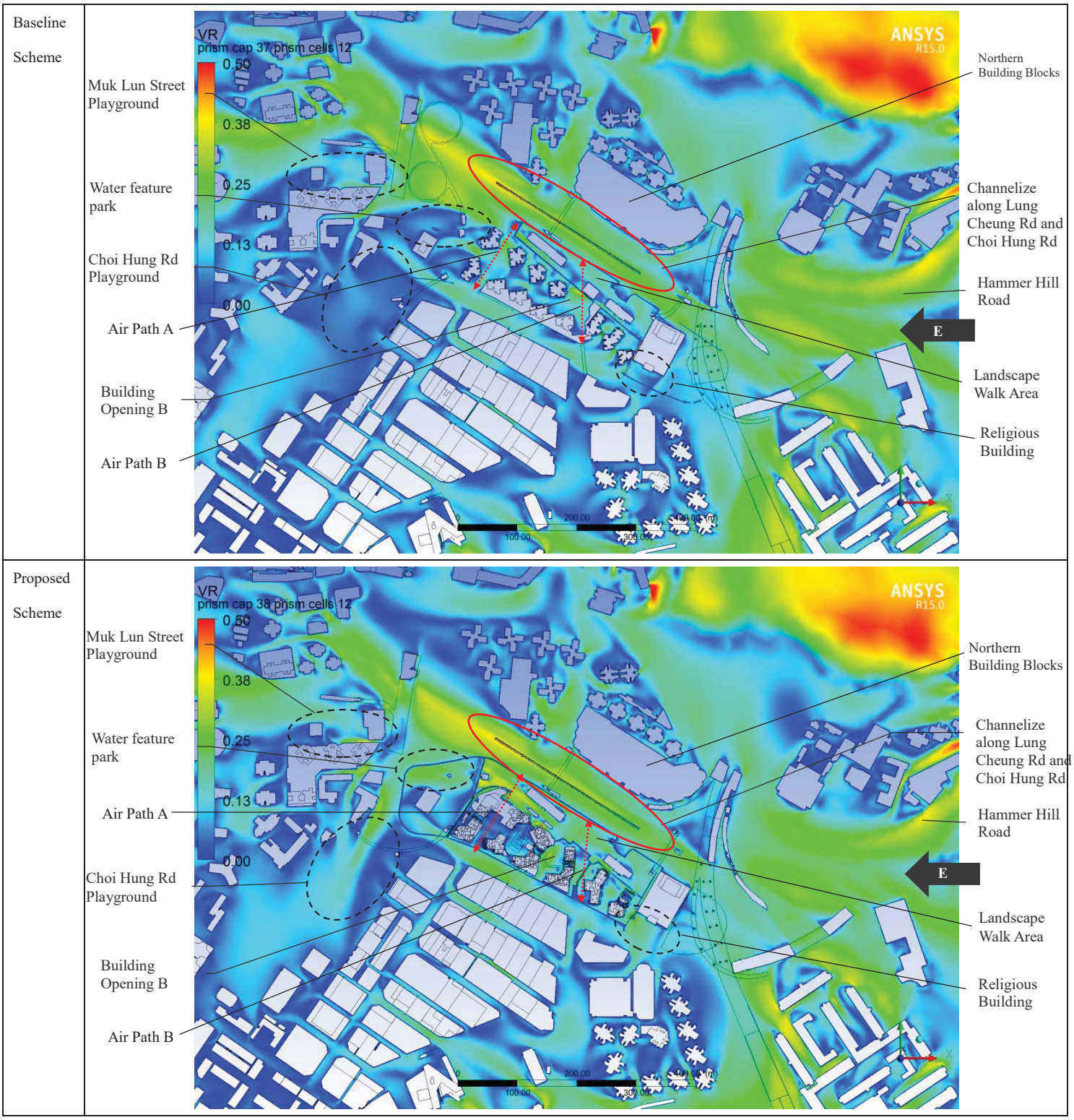


Figure 30 Contour Plot of VR under E wind

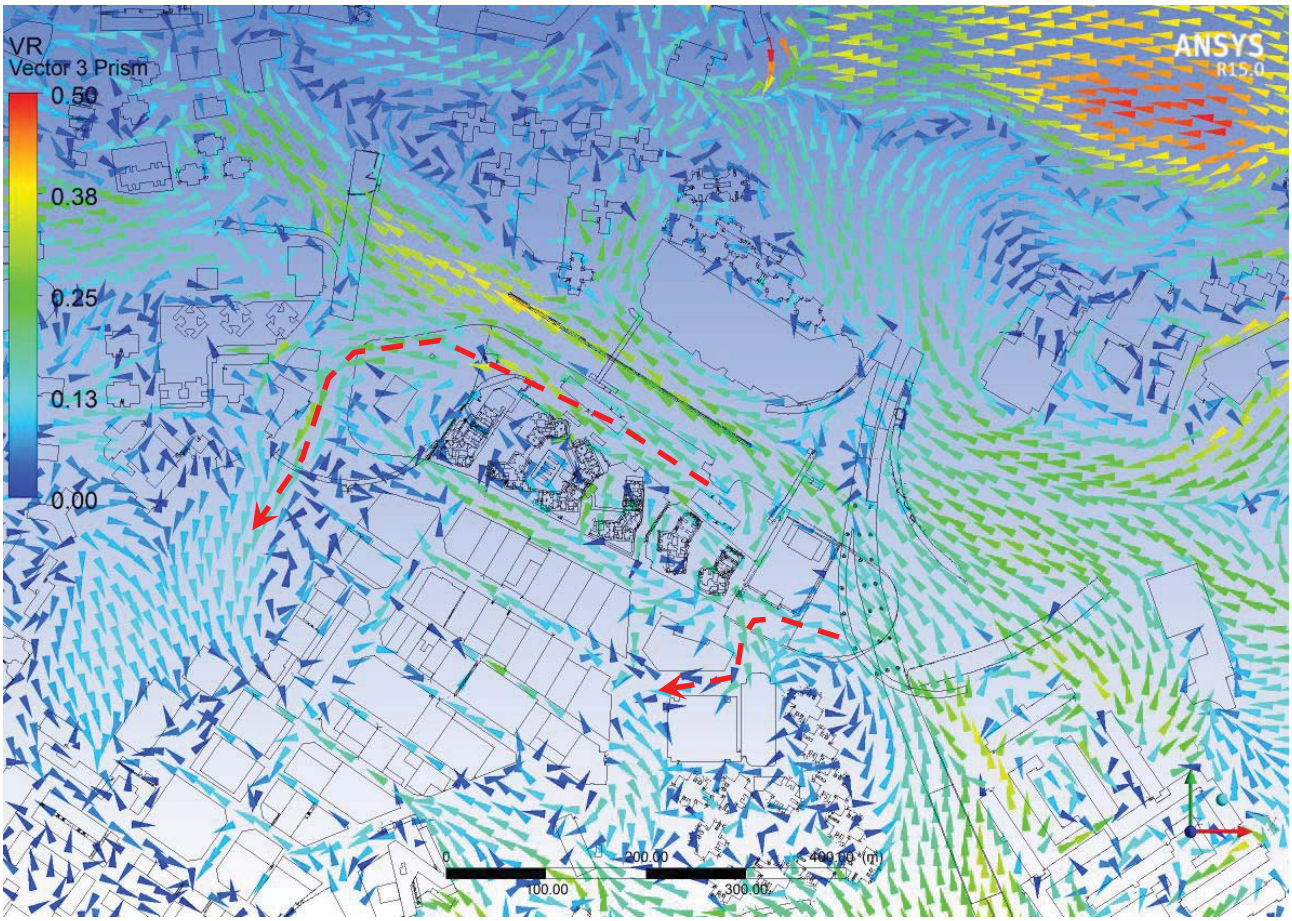


Figure 31 Vector Plot of VR under E wind in Proposed Scheme

6.3 NE Wind

6.3.1. The NE wind flows down from Hammer Hill Road and Kwun Tong Bypass to reach the subject site. The contour plot graph of the wind is provided in ***Figure 32***.

6.3.2. The NE wind is constrained by the high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood and the 5m noise barrier along Lung Cheung Road. The wind leaving the site would be blocked by the southern building groups in San Po Kong Business area and flow toward northwest along Choi Hung Road. Similar to E wind, Air Path A in the Proposed Scheme results a lower VR due to the obstruction of retail block between Block 1 and Block 3. Small building openings at Block 4 G/F in the Proposed Scheme may also contribute to poorer cross ventilation performance at Building Opening A; meanwhile larger building separation between Block 3 and Block 7 in the Baseline Scheme would provide a better cross ventilation performance for Building Opening A1 and A2. Air Path B and most of the other building openings under the Proposed and Baseline schemes result in similar VR. Other building openings VR are similar for both schemes.

6.3.3. With similar feature as E wind, wider setback distance to Lung Chung Road in Block 1 in comparison to the Baseline Scheme would cause the wind to flow around the podium of Block 1 to water feature park from landscape walk area (Please refer to red arrow in ***Figure 33***). In the Baseline Scheme, the wind will be diverted by the building blocks and joining the mainstream at Choi Hung Road, thus poorer ventilation at water feature park. In accordance with Table 10, the annual average VRw in water feature park is improved from 0.110 to 0.131 by the Proposed Scheme.

6.3.4. The proposed Public Transport Interchange (PTI) in the Baseline Scheme has a better VR compared to the Proposed Scheme due to the greater separation distance with the religious building which would allow the upstream NE wind to flow through. Therefore, more wind would reach downstream through the Choi Yee Lane in the Baseline Scheme and further divert to the junction of Sze Mei Street and Ng Fong Street which would provide good ventilation to the area. However, the separation between the religious building and Block 7 would be reduced, leading to less wind penetration.

6.3.5. The entrance of the religious building would suffer from relatively lower VR under both schemes as the building itself has block the wind penetration.

6.3.6. The air ventilation performance for both schemes under NE wind direction would be similar for other surrounding sites, including Bel Air Heights, Choi Hung Estate, Lung Poon Court Tai Yau Street and Sze Mei Street.

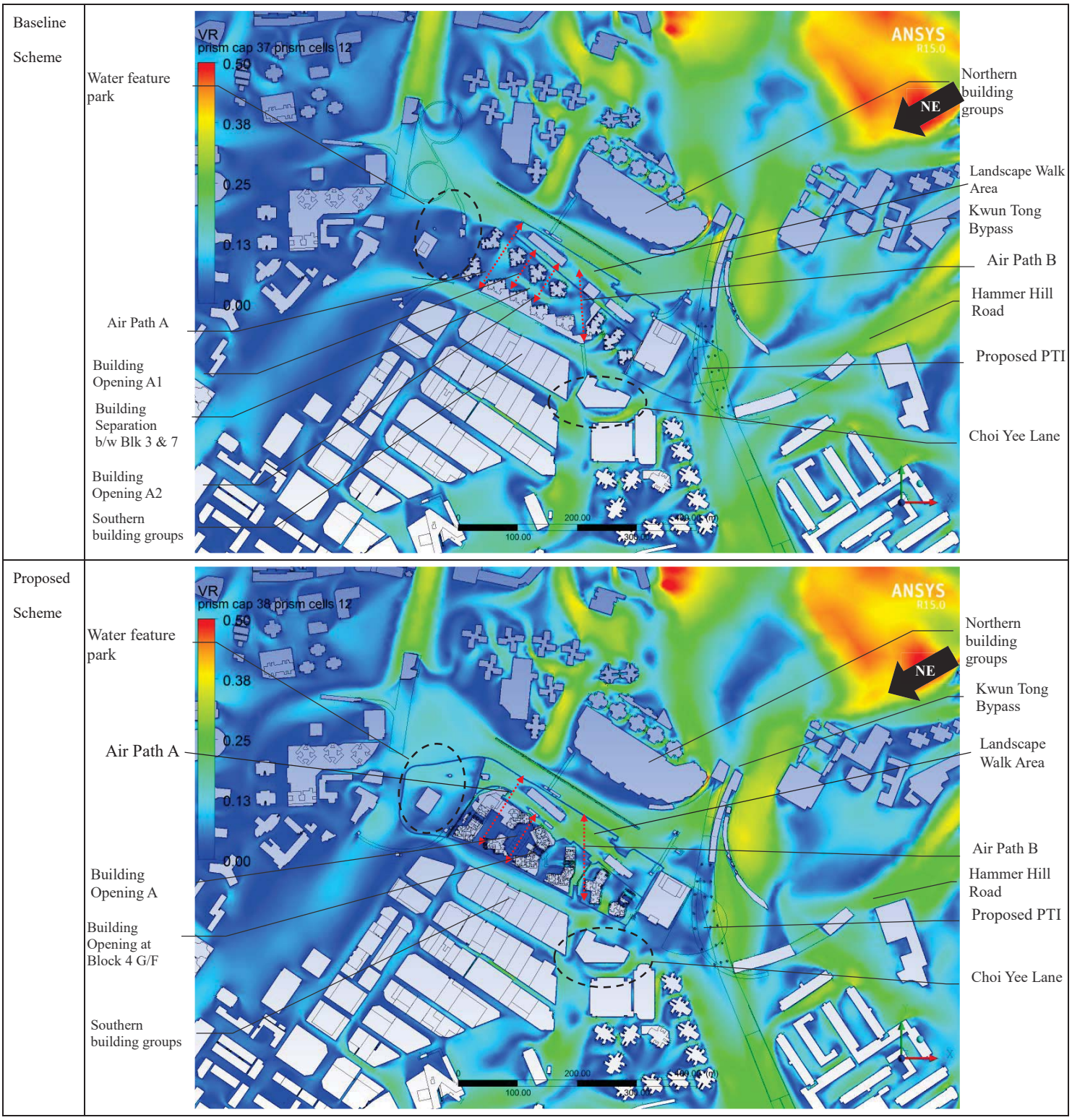


Figure 32 Contour Plot of VR under NE wind

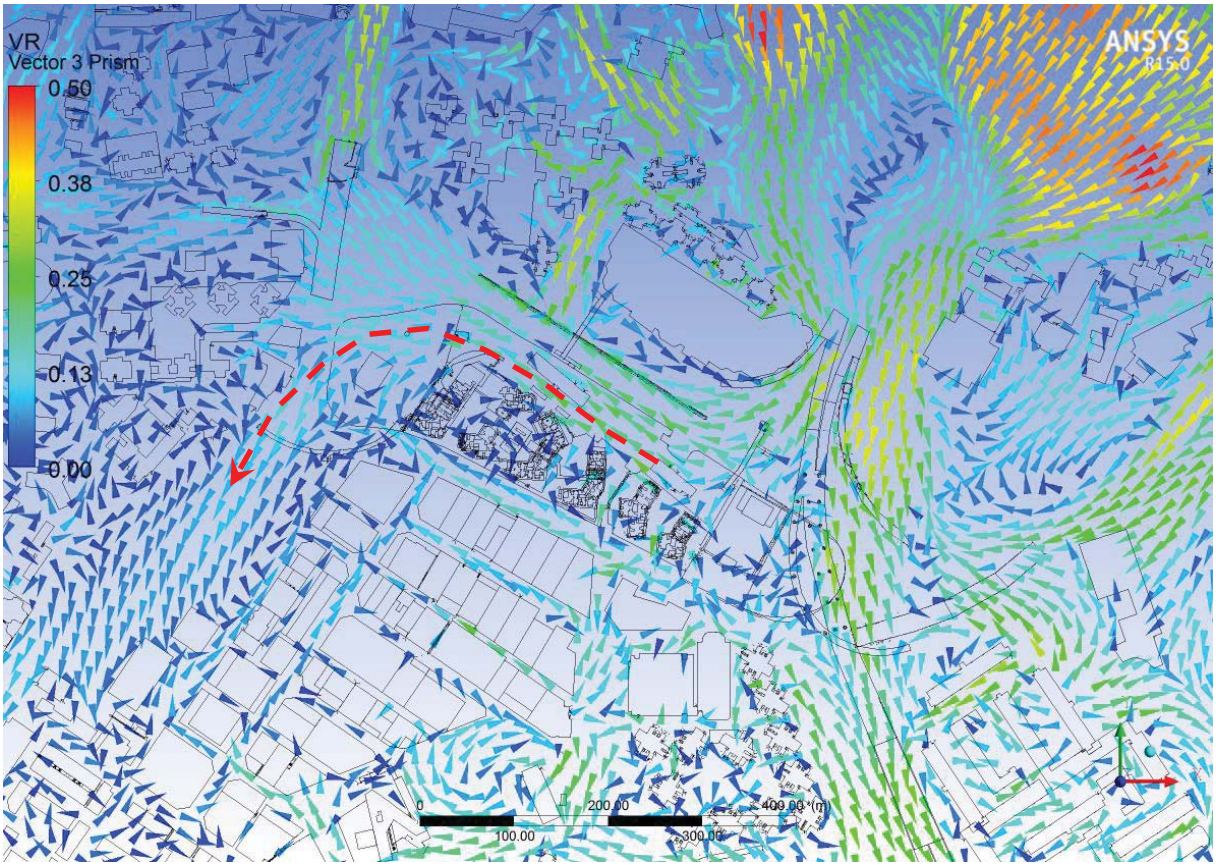


Figure 33 Vector Plot of VR under NE wind in Proposed Scheme

6.4 ESE Wind

6.4.1. The ESE wind would flow along the eastern part of Choi Hung Road before reaching the subject site. The contour plot graph of the wind is provided in ***Figure 34***.

6.4.2. The ESE wind would be channelized along Lung Cheung Road and Choi Hung Road by the high-rise northern building groups such as Lung Poon Court, Galaxia, Plaza Hollywood, the subject site and southern building group in San Po Kong industrial area. The upstream wind would flow along the Lung Cheung Road and Choi Hung Road which are parallel to the ESE wind direction. The proposed religious building would also block the upstream wind flow to the subject site. Therefore, the air paths and openings designed in both schemes would be least effective under ESE wind. Similar ventilation performance is observed for Air Path A under both schemes despite their difference flowing pattern. Slight better performance at Air Path B under Proposed Scheme is observed.

6.4.3. Again, the Proposed Scheme incorporate curvy podium design and setback of Block 1 that contributes to more effective air ventilation in areas including Lionrise, Muk Lun Street and Muk Lun Street Playground (Please refer to red arrow in ***Figure 35***).

6.4.4. The water feature park and PRH site wind environment is slightly better in the Baseline Scheme. ESE wind would flow to water feature park and reach the site through building separation between Block 1 and Block 5. However, PRH site in the Proposed Scheme would subject a poor wind environment as there is only a building separation on G/F of Block 1.

6.4.5. In the Proposed Scheme, the setback of religious building from Choi Hung Road reserves a larger area at the front and hence better VR performance. Besides, its separation with Block 7 would reserve a larger opening area for the plaza (Please refer to red arrow in ***Figure 35***). The ventilation performance of the proposed Public Transport Interchange (PTI) at the southeast of the religious building is similar under both schemes. Nevertheless, in Proposed Scheme, the backward movement of religious building reduces its setback distance to Lung Cheung Road when compared with Baseline Scheme, which would worsen the ventilation performance of northern area of religious building.

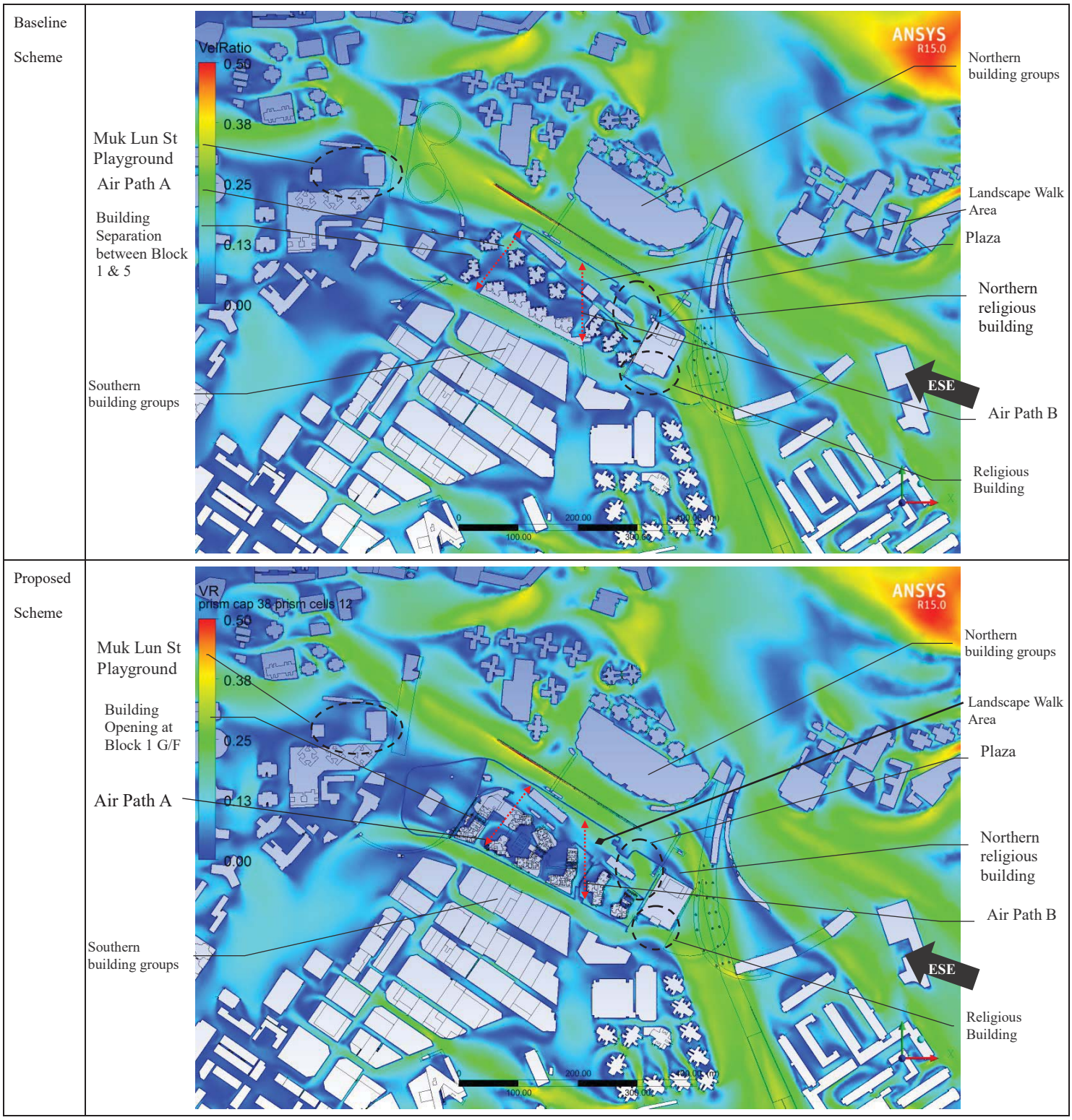


Figure 34 Contour Plot of VR under ESE wind

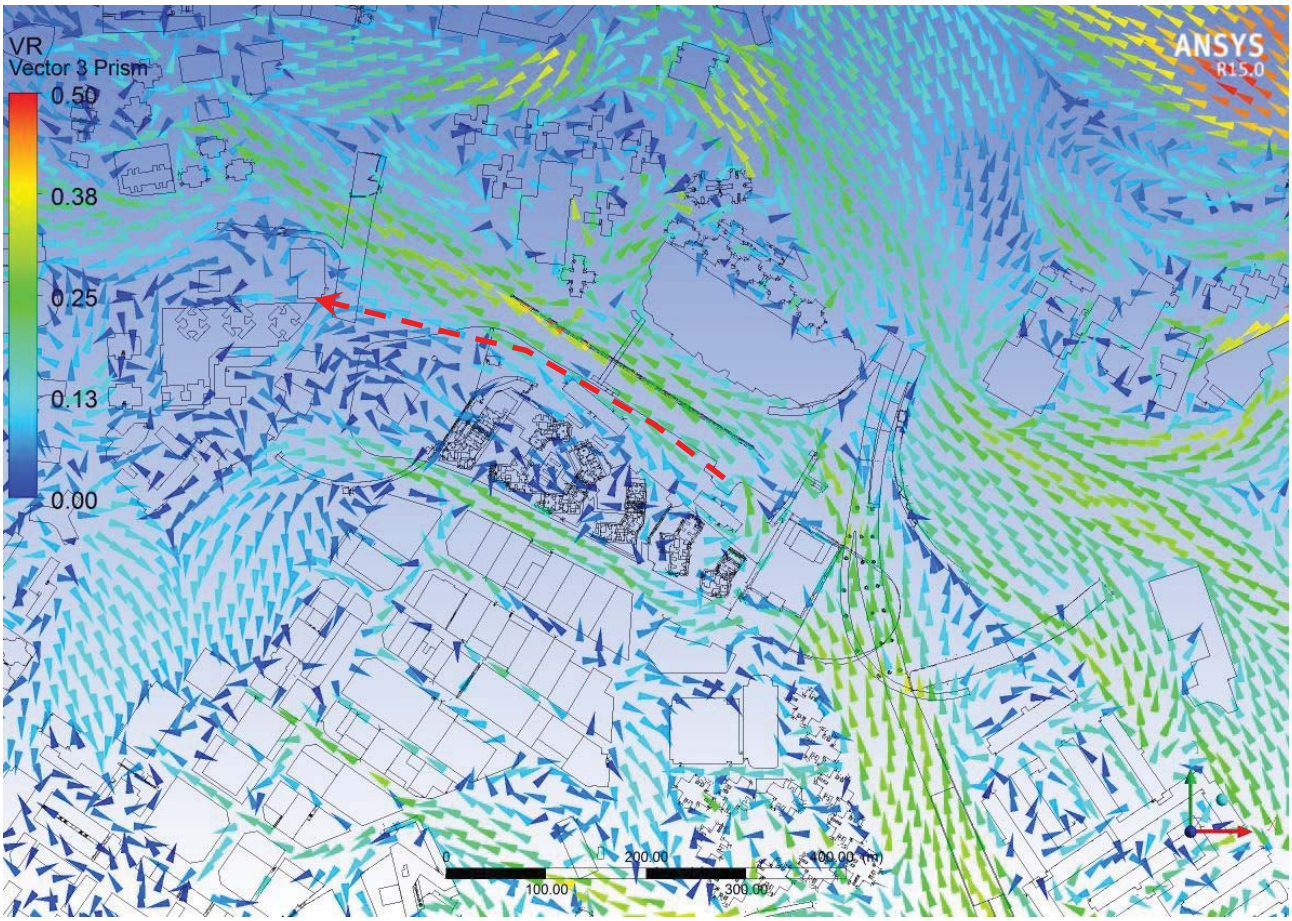


Figure 35 Vector Plot of VR under ESE wind in Baseline Scheme

6.5 NNE Wind

6.5.1. The NNE wind is blocked by Tate Cairn and flow downhill along Po Kong Village Road and Kwun Tong Bypass. The contour plot graph of the wind is shown in ***Figure 36***.

6.5.2. The NNE wind is constrained by the high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood and the 5m noise barrier along Lung Cheung Road. The NNE wind downflow from Po Kong Village Road will partly reach the site via the water feature park and partly diverted downstream to western part of Choi Hung Road. Another stream of NNE wind will flow from Kuwn Tong Bypass and partly reach the site via the plaza and partly diverted to eastern part of Choi Hung Road. The wind leaving the site would be blocked by the southern building groups in San Po Kong Business area and flow along Choi Hung Road to northwest.

6.5.3. The water feature park and PRH site wind environment is slightly better in the Baseline Scheme. NNE wind would flow to water feature park and reach the site through building separation between Block 1 and Block 5. However, PRH site in the Proposed Scheme would subject a poor wind environment as these is only a building opening on G/F of Block 1.

6.5.4. Air Paths and Building Openings in both schemes has similar VR as the upstream wind from Kwun Tong Bypass is constrained by the high-rise northern structure groups. Nevertheless, Building Opening C in the Proposed Scheme as shown in ***Figure 36*** has better ventilation because of the wider building opening compared with the Baseline Scheme (Building Opening C1&C2) and larger plaza area. On the other hand, the proposed Public Transport Interchange (PTI) under Proposed Scheme suffered from poorer ventilation due to smaller setback distance with the religious building.

6.5.5. Similar VR result is observed in Choi Hung Road Playground under the Proposed and Baseline scheme as the NNE wind from Po Kong Village Road would flow downhill to Choi Hung Road Playground via the water feature park which would not be affected by the proposed development.

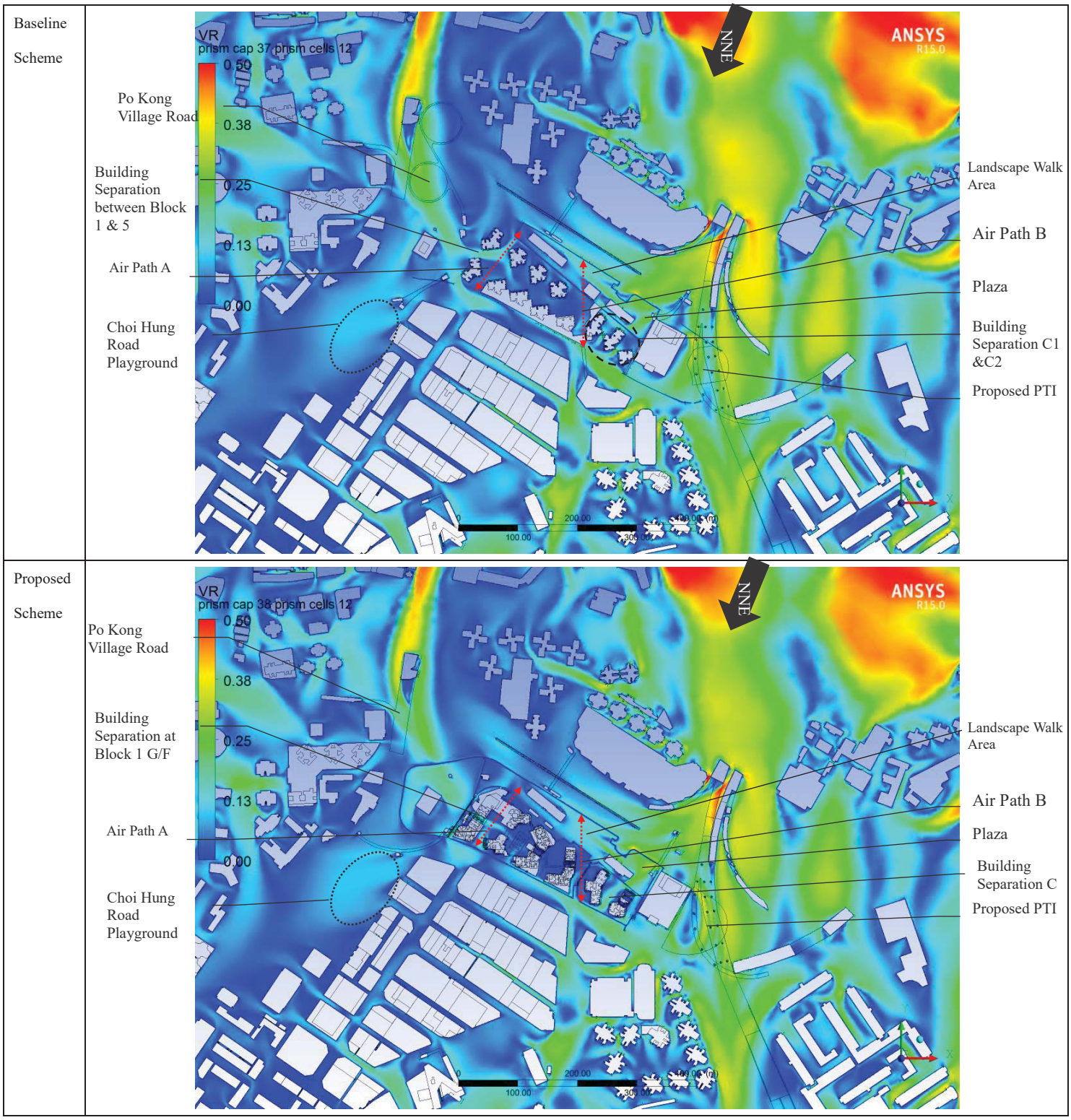


Figure 36 Contour Plot of VR under NNE wind

6.6 SSW Wind

6.6.1. The SSW wind is diverted by surrounding development groups and flow to the site along western and eastern part of Choi Hung Road respectively. The contour plot graph of the wind is provided in ***Figure 37***.

6.6.2. The wind from eastern parts of Choi Hung Road would flow through the proposed Public Transport Interchange (PTI) at the east of the site and majority of the wind would flow to uphill along Po Kong Village Road while the remain would turn easterly into Lung Cheung Road, which is constrained by the high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood and 5m noise barrier along Lung Cheung Road. Another upstream from eastern part of Choi Hung Road would reach the subject site and flow uphill through Kwun Tong Bypass. Similar directional pattern is observed under both schemes.

6.6.3. Air Path B in the Proposed Scheme would provide a higher VR by the wind flowing from Sze Mei Street as the Air Path B in the Baseline Scheme is obstructed by retail block between Block 9 and Block 10. Relatively low ventilation effectiveness for building opening under both schemes are observed due to poorer wind penetration from Choi Hung Road and Lung Cheung Road. Other air path and building openings under both schemes would result in similar VR.

6.6.4. In the Proposed Scheme, building setback of Block 1 away from Lung Cheung Road would allow more upstream wind flowing from western parts of Choi Hung Road and turn easterly into Lung Cheung Road which would provide a higher VR in Lung Cheung Road (Please refer to red arrow in ***Figure 38***). The water feature park also benefit from the easterly of Lung Cheung Road and results in slightly better VR performance.

6.6.5. Moreover, the wider area at the entrance of religious buildings in the Proposed Scheme has allowed upstream wind from eastern part of Choi Hung Road to penetrate from the front of religious building to the plaza (Please refer to red arrow in ***Figure 38***). It enhances the wind penetration of the front of religious buildings and the plaza.

6.6.6. The air ventilation performance of both schemes for other areas under SSW wind would be generally similar.

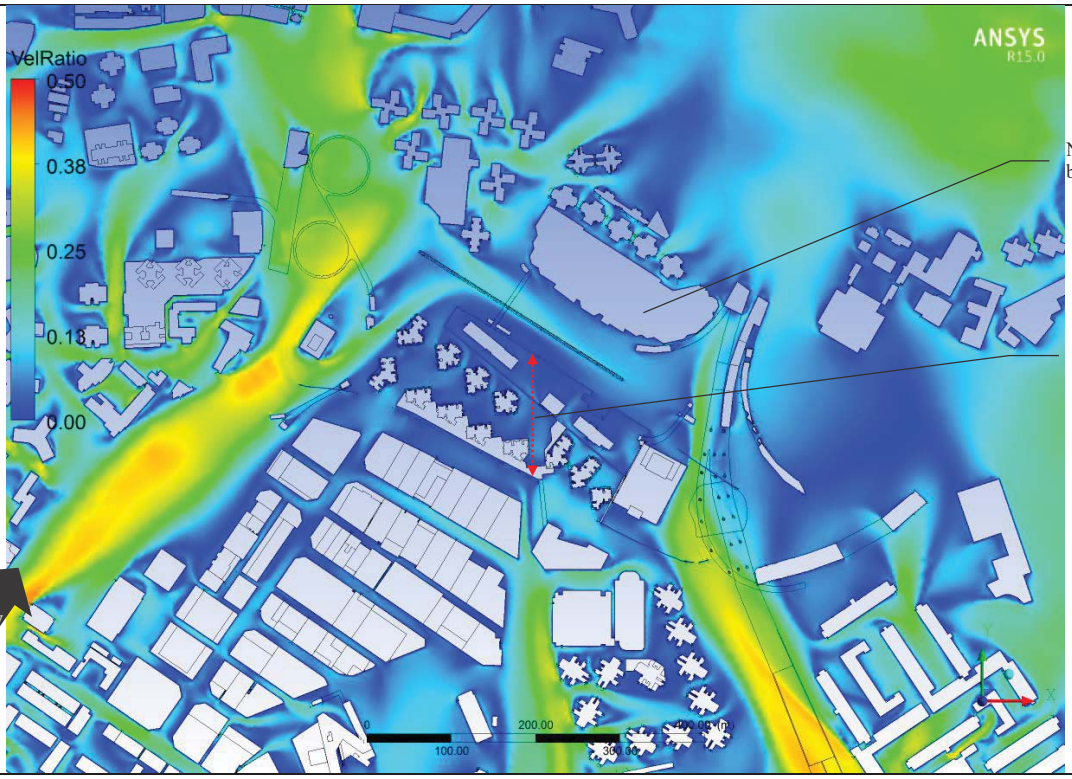
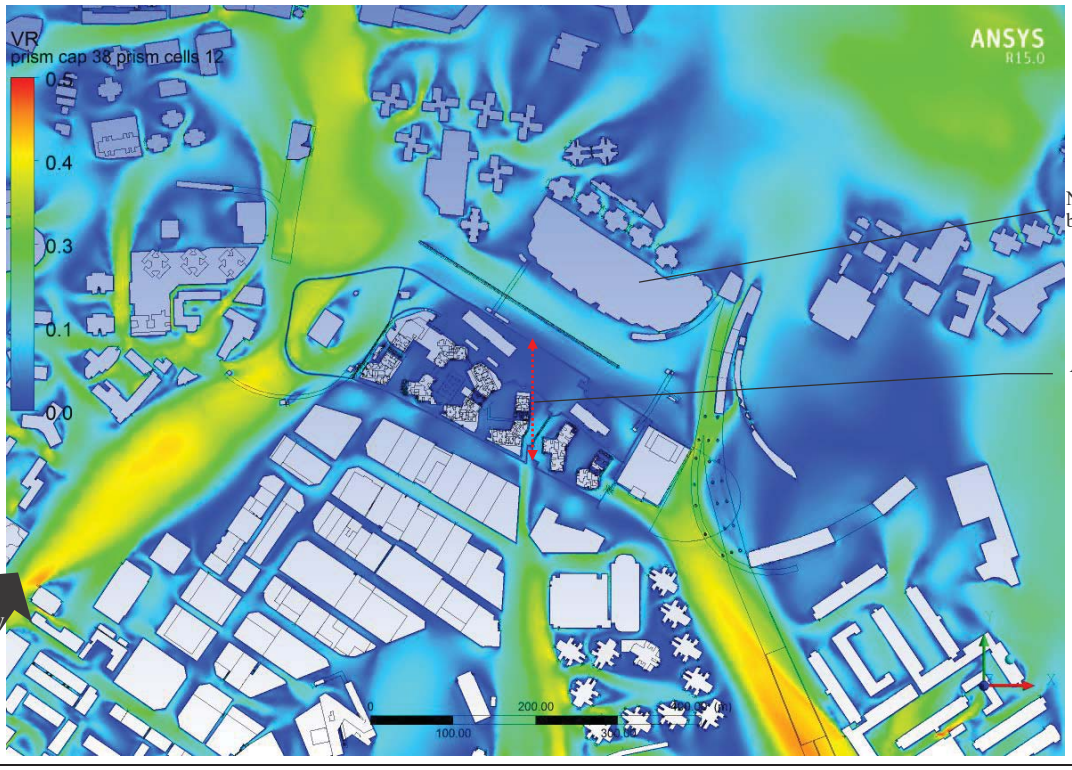
Baseline Scheme	
Proposed Scheme	

Figure 37 Contour Plot of VR under SSW wind

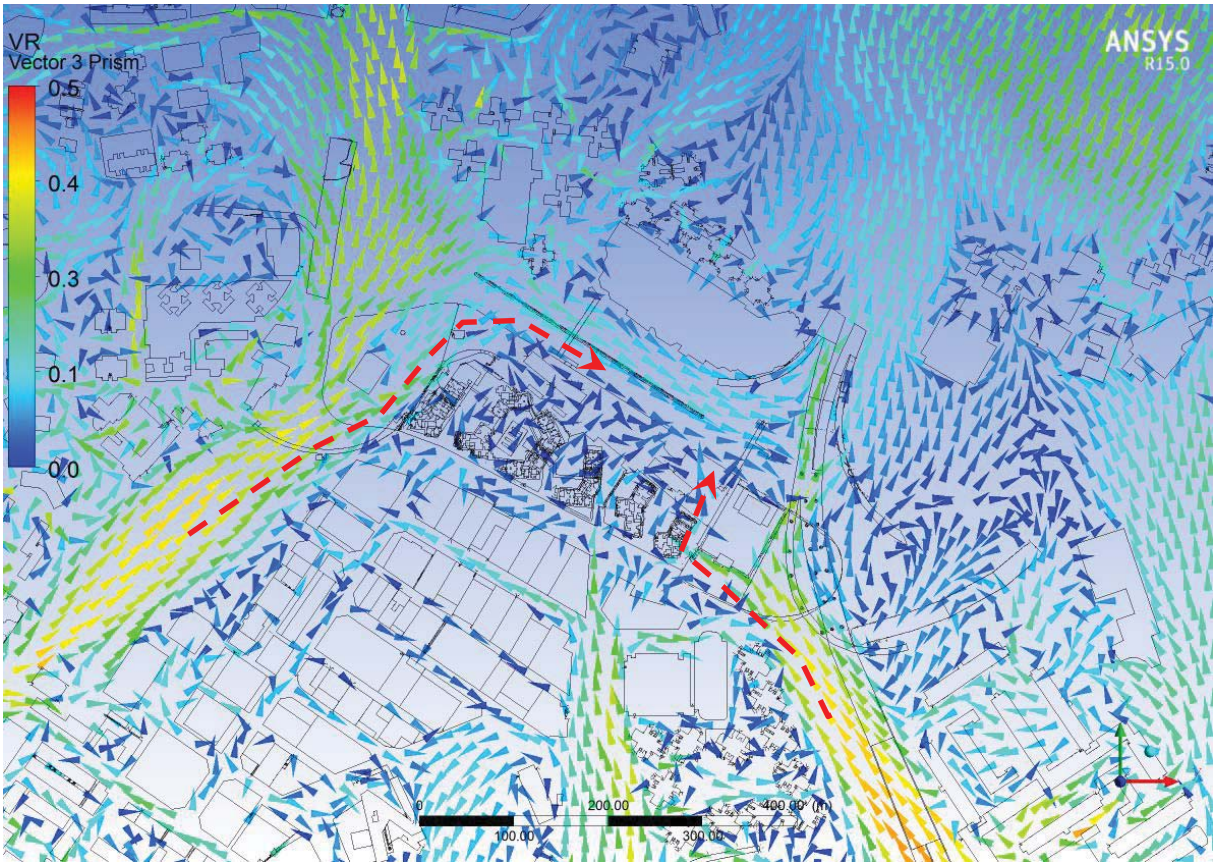


Figure 38 Vector Plot of VR under SSW wind in Proposed Scheme

6.7 S Wind

6.7.1. Similar to SSW Wind, the S wind is diverted by surrounding development groups and flow to the site along western and eastern part of Choi Hung Road respectively. The contour plot graph of the wind is provided in ***Figure 39***.

6.7.2. The wind from eastern part of Choi Hung Road would flow through the proposed Public Transport Interchange (PTI) at the east of the site (Please refer to red arrow in ***Figure 40***). The wind would then turn westerly into Lung Cheung Road which is constrained by the high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood and 5m noise barrier along Lung Cheung Road; while remaining wind would flow uphill through Kwun Tong Bypass. Another upstream from western part of Choi Hung Road would reach the subject site and flow uphill through Po Kong Village Road (Please refer to red arrow in ***Figure 40***).

6.7.3. Air Path B in the Proposed Scheme would provide a higher VR by the wind flowing from Sze Mei Street as the Air Path B in the Baseline Scheme is obstructed by retail block between Block 9 and Block 10. Relatively low ventilation effectiveness for building opening under both schemes are observed due to poorer wind penetration from Choi Hung Road and Lung Cheung Road. Other air path and building openings under both schemes would result in similar VR.

6.7.4. Similar to E and ESE wind, in the Proposed Scheme, the religious building would be setback from Choi Hung Road and Block 7 which would reserve a larger opening area for the plaza which results in a higher VR. Besides, the setback of religious building would allow more wind flow through Choi Hung Road and provide a better VR at the south of the religious building.

6.7.5. The pedestrian wind environment in Lung Cheung Road, western part of Choi Hung Road, Sze Mei Street and Tai Yau Street would experience a relatively lower VR in both schemes under S wind. Thus, the performance of air paths and building opening under both schemes would not function effectively under S wind.

6.7.6. The air ventilation performance of both schemes for other areas under S wind would be generally similar.

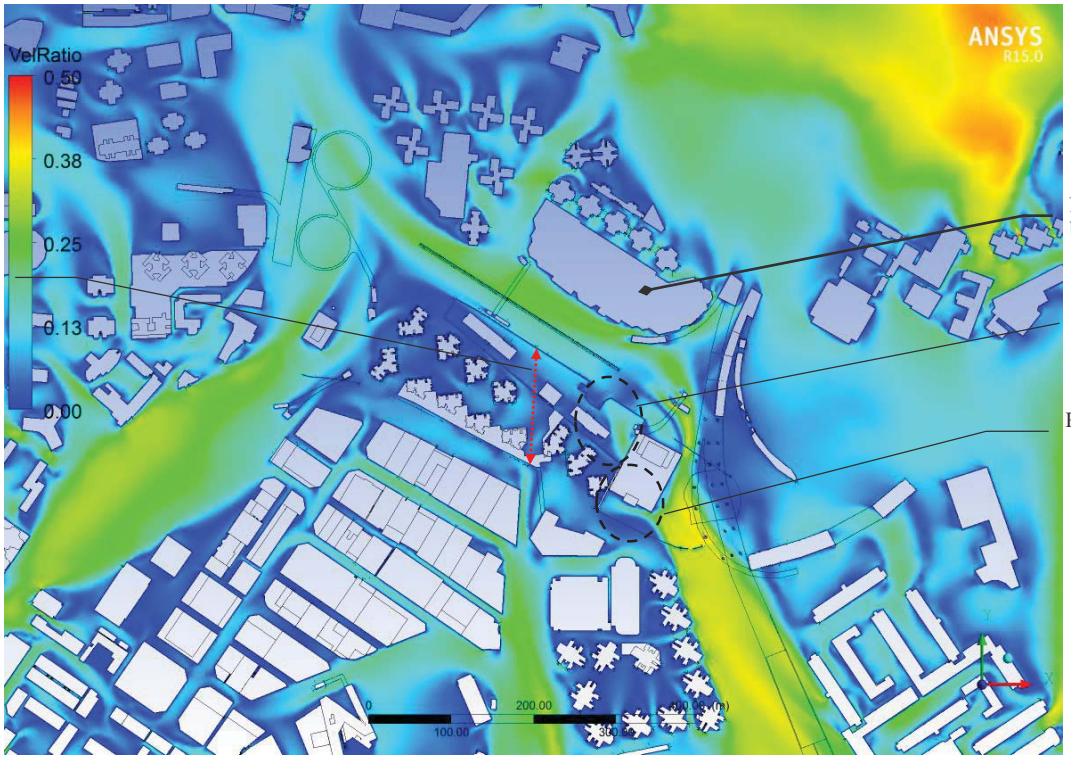
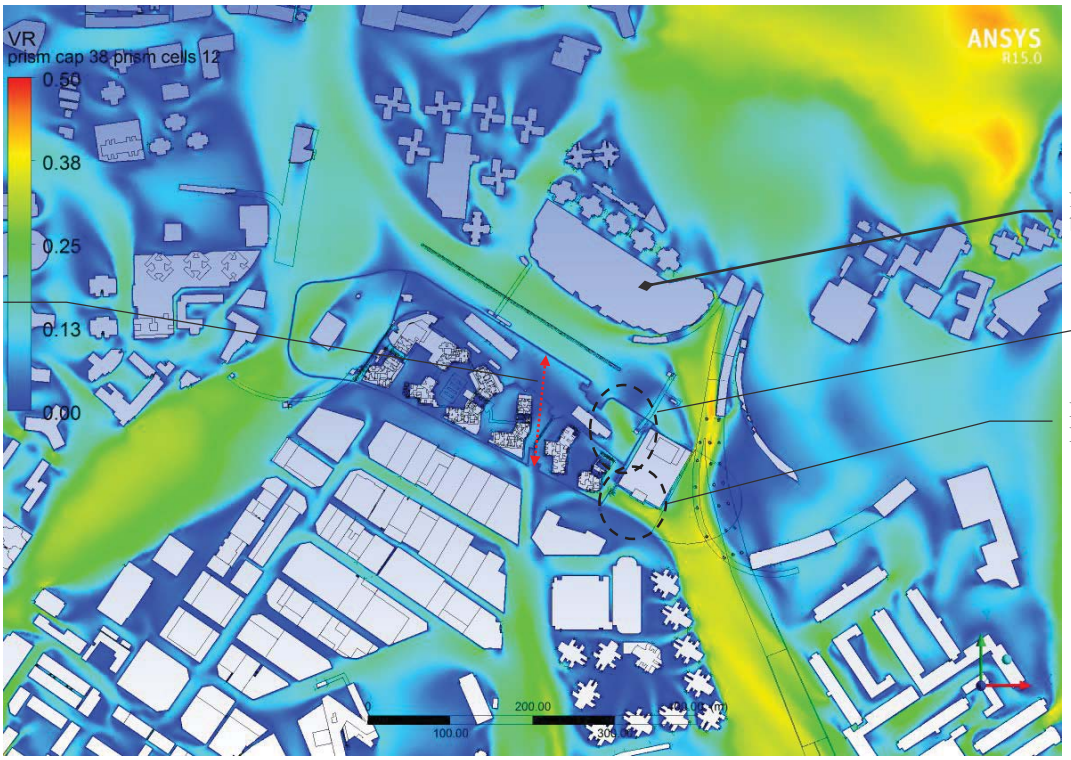
Baseline Scheme	Air Path B	
Proposed Scheme	Air Path B	

Figure 39 Contour Plot of VR under S wind

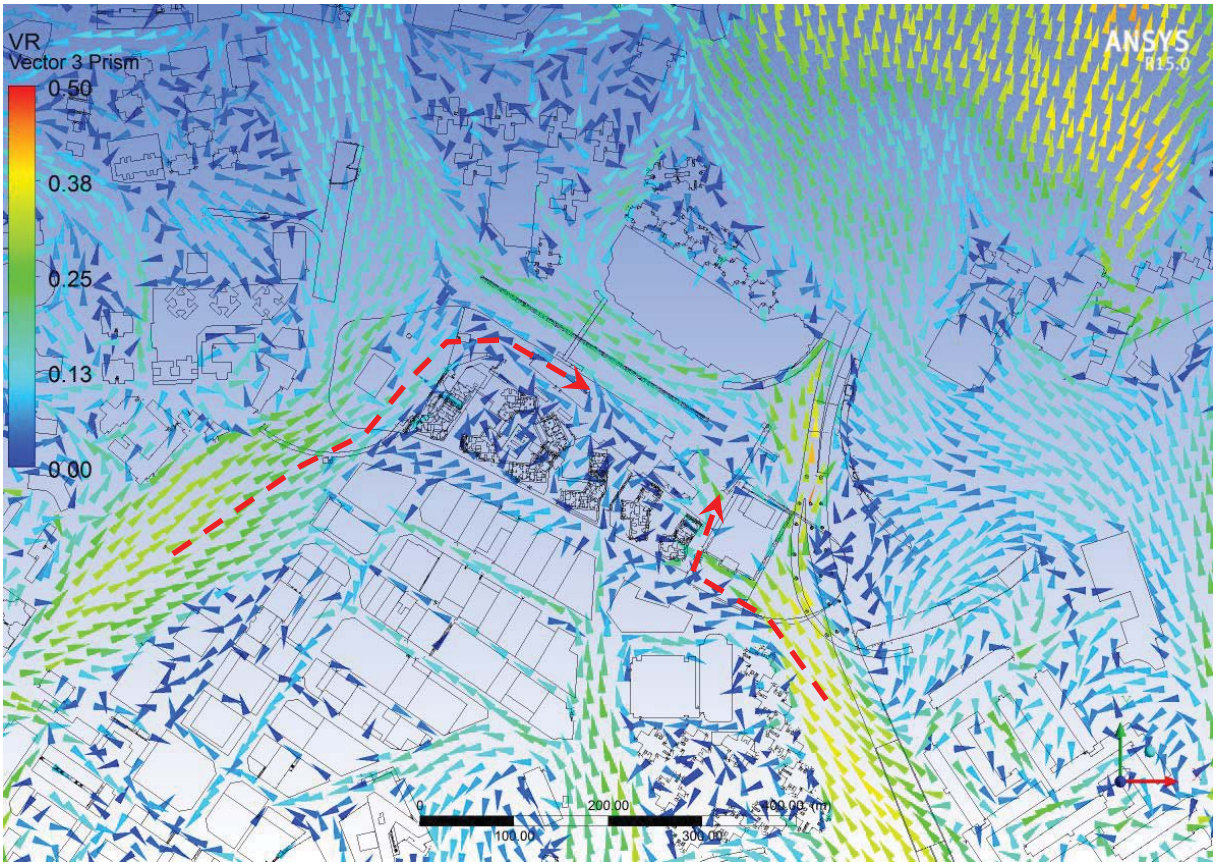


Figure 40 Vector Plot of VR under S wind in Proposed Scheme

6.8 SE and SSE Wind

6.8.1. SE and SSE winds have similar stream pattern and would primarily flow in east-west direction along the Kwun Tong Bypass and then turn west flowing along both Lung Cheung Road and western part of Choi Hung Road. Again, the winds will be constrained by the high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood and the 5m noise barrier along Lung Cheung Road. The contour plot graph of SE and SSE wind is provided in ***Figure 41*** and ***Figure 42*** respectively.

6.8.2. Air paths in the Proposed Scheme would allow wind flowing between Sze Mei Street/ Tai Yau Street and the subject site. Air Path A in the Proposed Scheme would provide a lower VR as the Air Path A is obstructed by the retail block between Block 1 and Block 3. Air Path B in proposed scheme would provide a higher VR as the Air Path B in baseline scheme is obstructed by retail block between Block 9 and Block 10. Building Opening in proposed and baseline schemes would provide a similar VR. Building Opening B in proposed scheme would provide a better VR to landscape walk area as the separation is wider than baseline scheme.

6.8.3. Similar to E, ESE and S wind, in the Proposed Scheme, the religious building would be setback from Choi Hung Road and Block 7 which would reserve a larger opening area for landscape walkway and therefore results in a higher VR. Besides, the setback of religious building would allow slightly better ventilation for Choi Hung Road and the south of the religious building which is more obvious under SSE wind (Please refer to red arrow in ***Figure 43***).

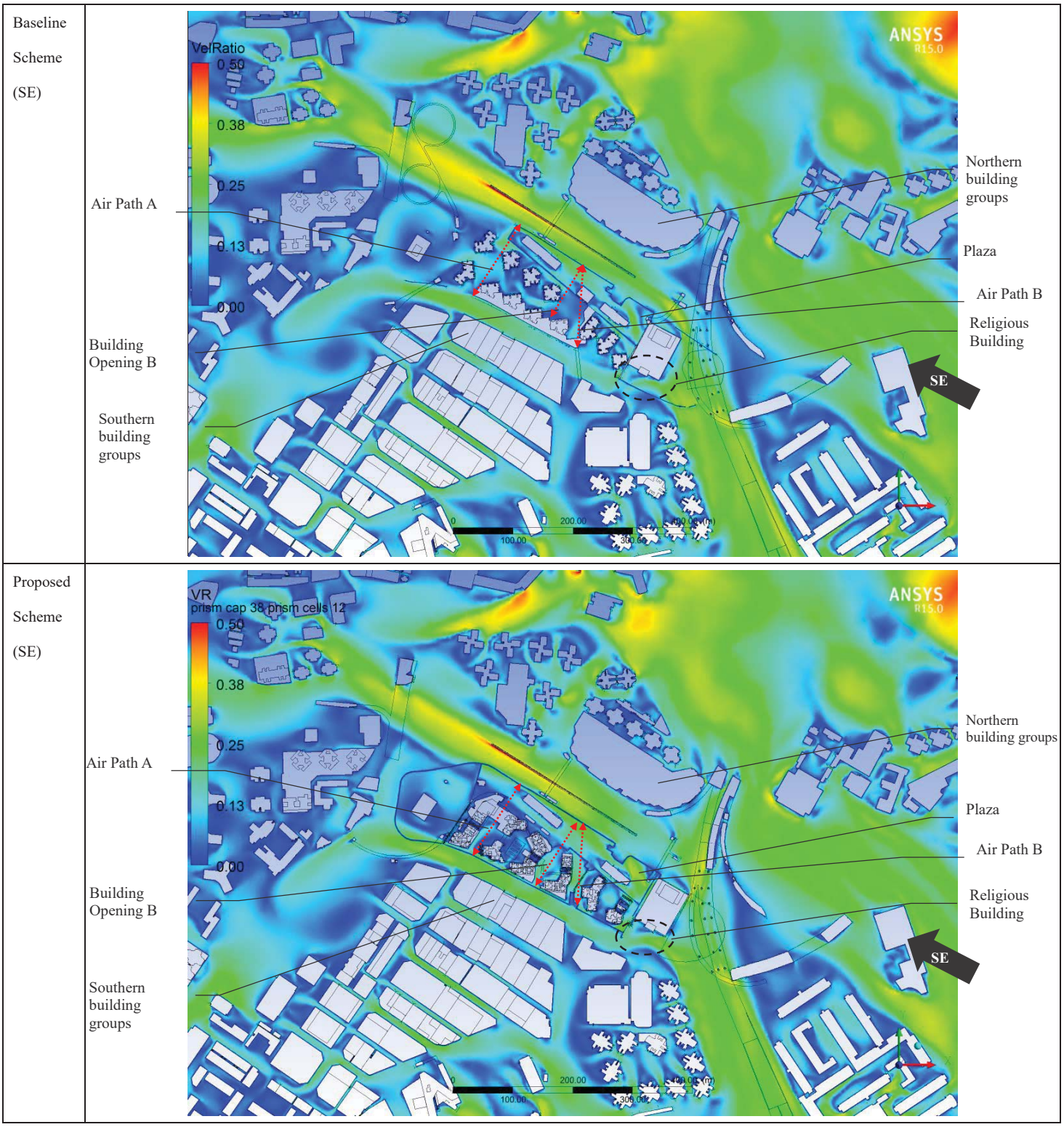


Figure 41 Contour Plot of VR under SE wind

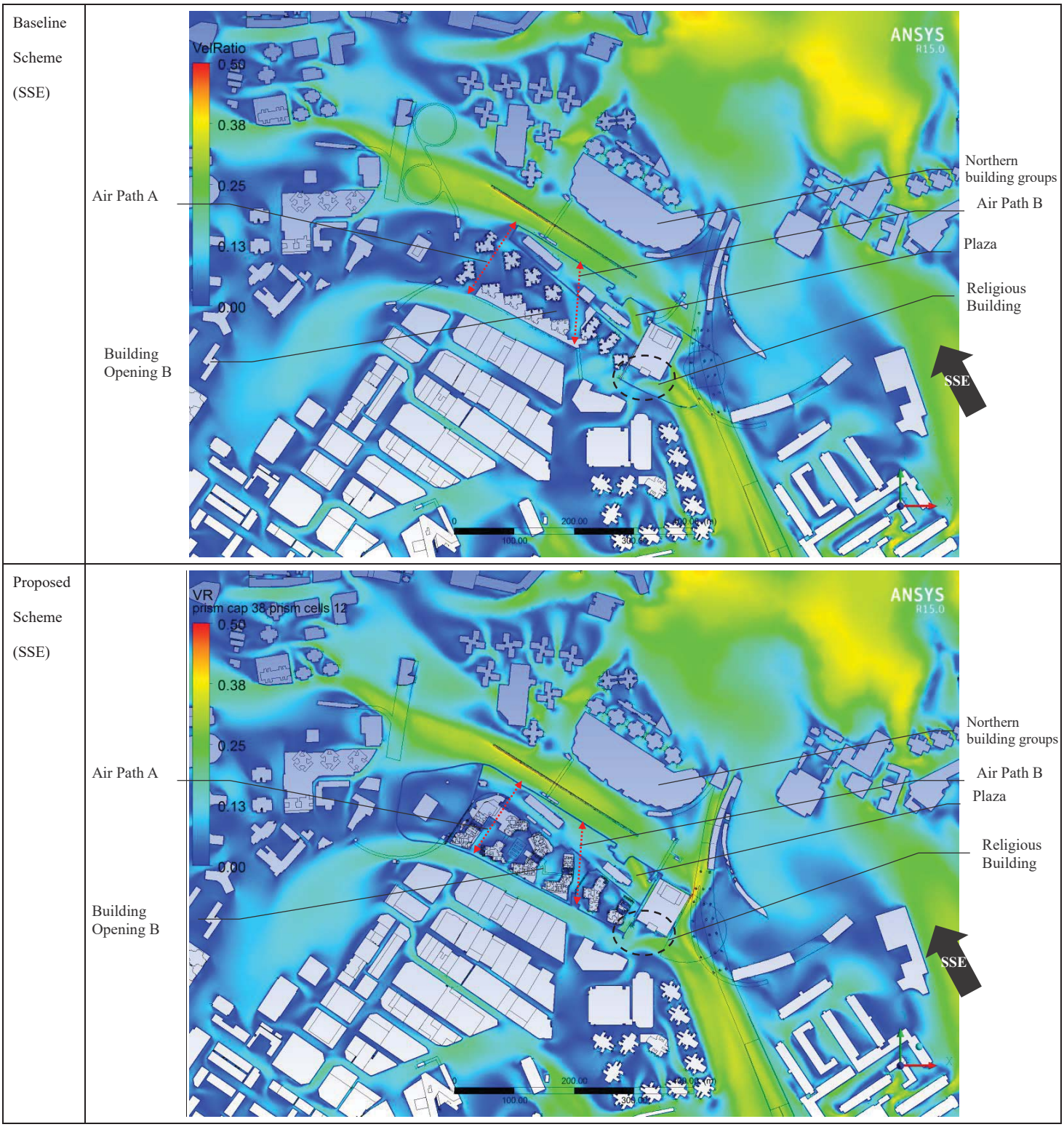


Figure 42 Contour Plot of VR under SSE wind

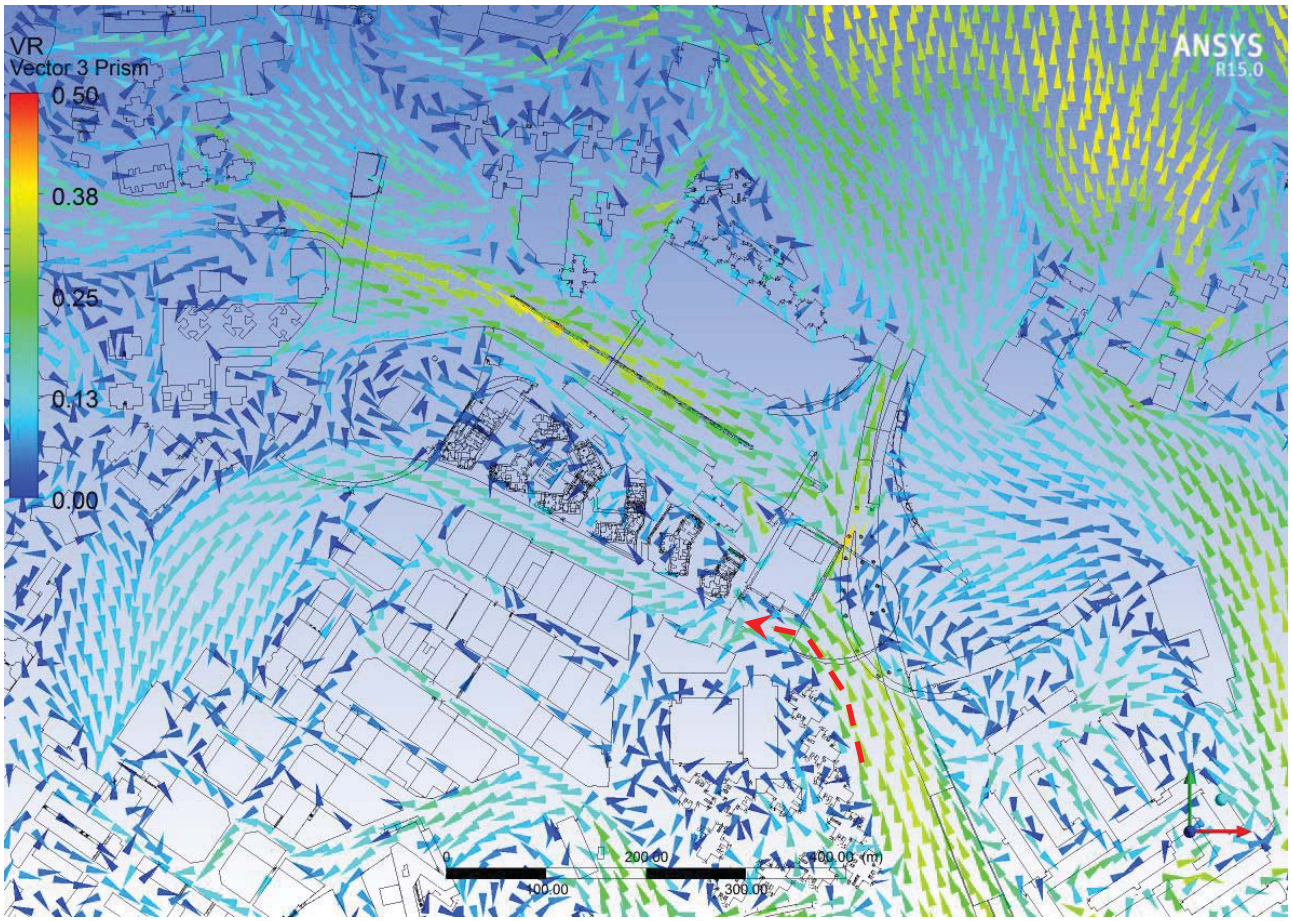


Figure 43 Vector Plot of VR under SSE wind in Proposed Scheme

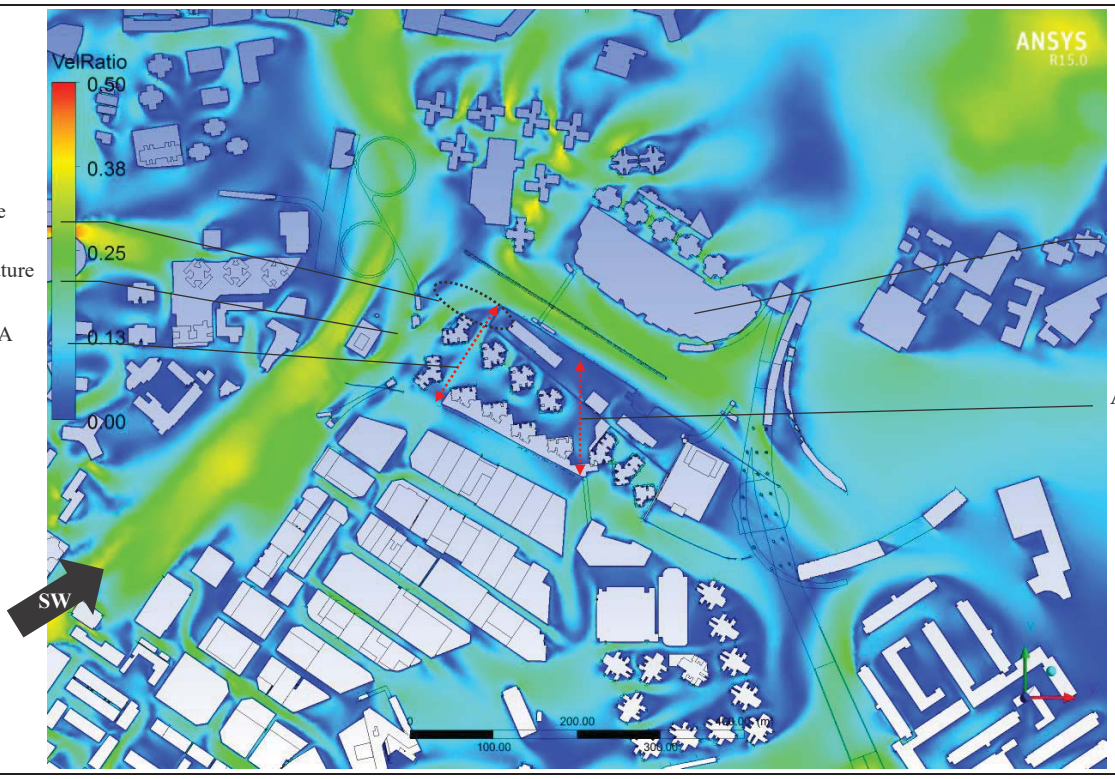
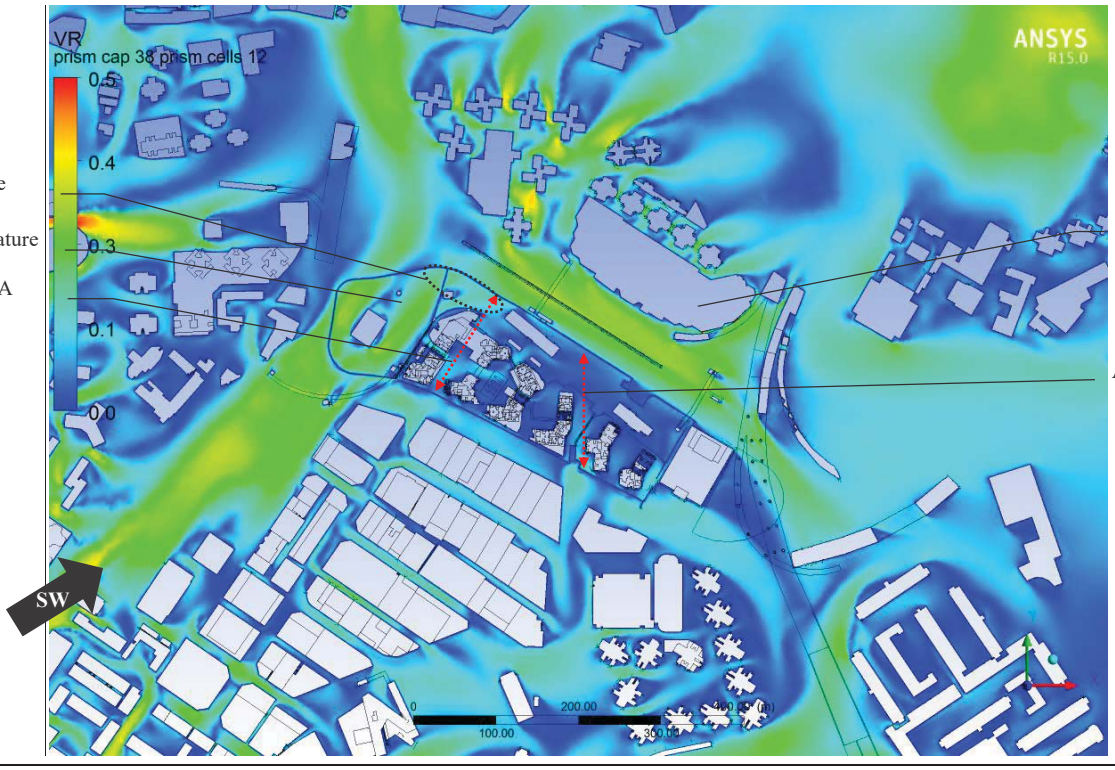
6.9 SW and WSW Wind

6.9.1. SW and WSW winds would primarily flow upstream from Kai Tak River and western part of Choi Hung Road; then turn east and flow along Lung Cheung Road and Choi Hung Road. Similar to SE and SSE winds, the winds will be constrained by the high-rise northern structure groups such as Lung Poon Court, Galaxia, Plaza Hollywood and 5m noise barrier along Lung Cheung Road. The contour plot graph of SW and WSW wind is provided in ***Figure 44*** respectively.

6.9.2. Air paths in the Proposed Scheme would allow wind flowing between Sze Mei Street/Tai Yau Street and the subject site. Air Path A in the Proposed Scheme would provide a lower VR under the obstruction by the retail block between Block 1 and Block 3. Air Path B in the Baseline Scheme would provide a lower VR as it is obstructed by the retail block between Block 9 and Block 10. Building Opening B in the Proposed Scheme would provide slightly better VR to landscape walk area as the separation is wider than in the Baseline Scheme.

6.9.3. The building opening design in both schemes have reserved air paths for cross ventilation under SW and WSW winds. Most of adjacent areas will experience similar wind condition for both schemes.

6.9.4. The Block 1 in the Proposed Scheme provides a further setback distance to Lung Chung Road compared with the Baseline Scheme. More wind would flow through the curvy podium of Block 1 and turn into Lung Cheung Road which would provide a high VR in Lung Cheung Road, part of landscape walk area and water feature park.

Baseline Scheme (SW)	
Proposed Scheme (SW)	

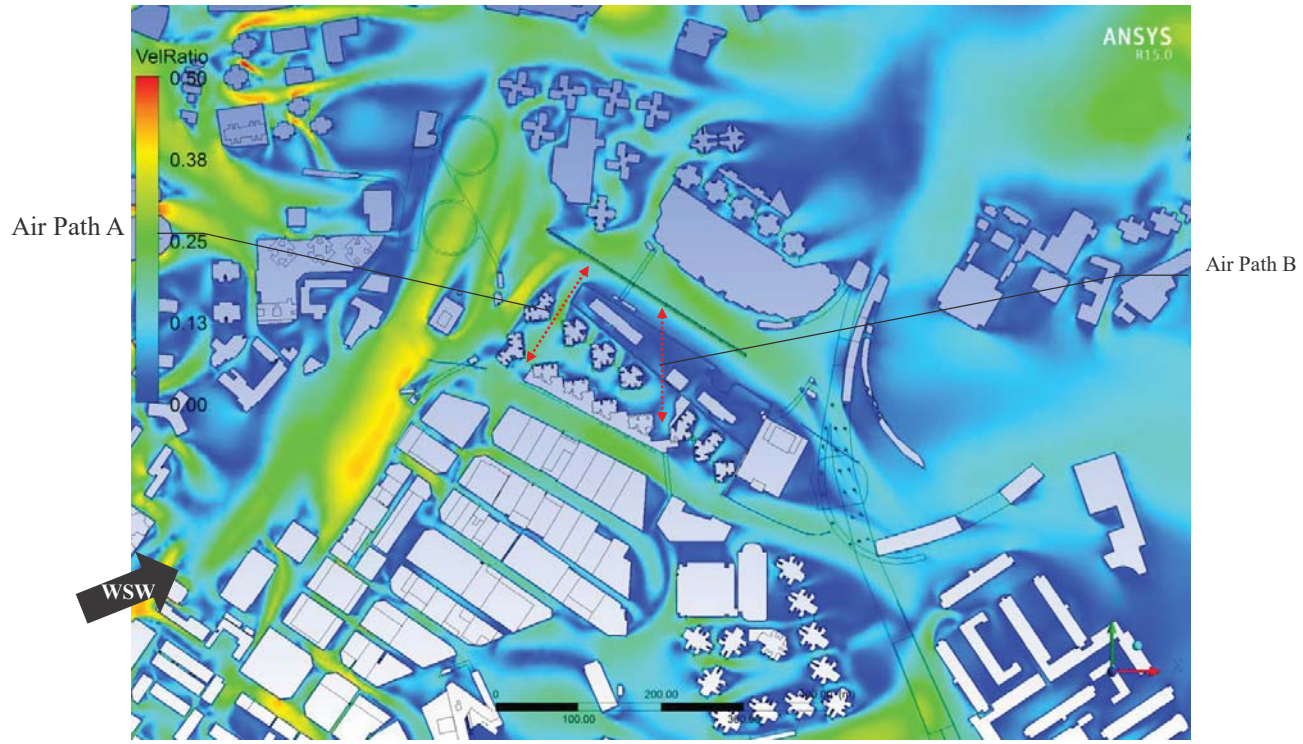
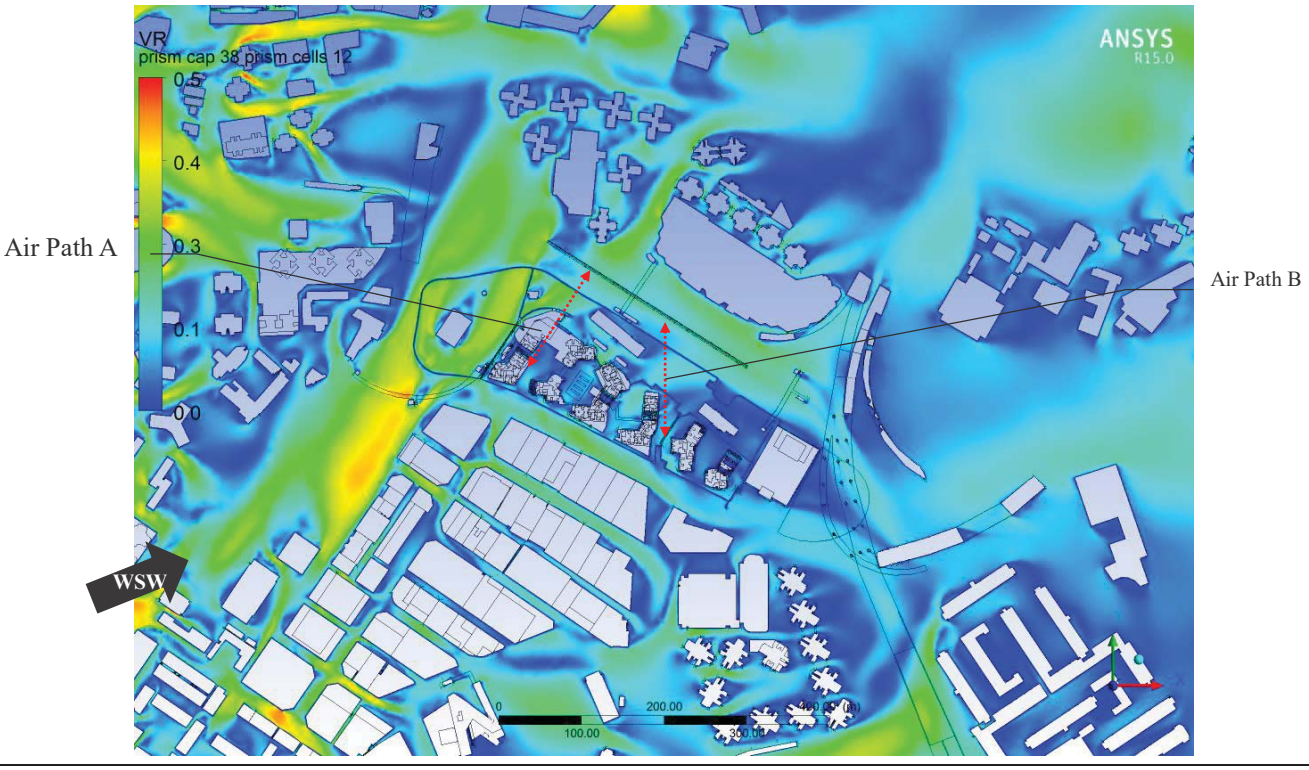
Baseline Scheme (WSW)	
Proposed Scheme (WSW)	

Figure 44 Contour Plot of VR under SW and WSW wind

7. Conclusion

7.1.1. In this Initial AVA Study, two scenarios, Baseline Scheme (Scheme 74A) and Proposed Scheme (Scheme 95) for the subject site being assessed by CFD modelling are investigated.

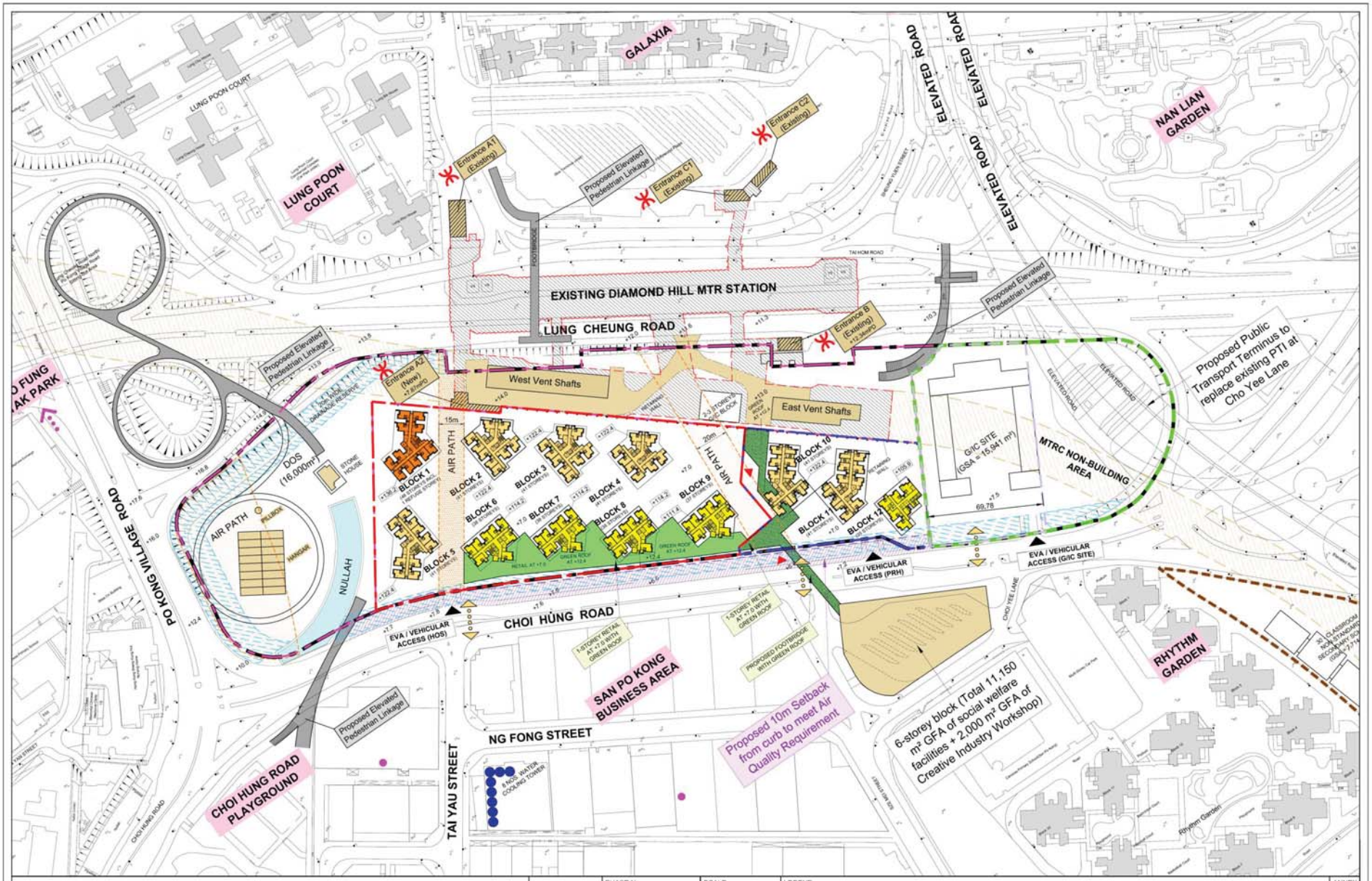
7.1.2. Based on the result of the wind rose analysis, the wind directions for the Subject Site and the surrounding area representative of the prevailing situations are determined to be mainly E, ENE, NNE, ESE, NE, SE, SSE and SW for annual condition and SW, SSW, E, SE, S, WSW, ESE and SSE for summer condition. These 8 of the 16 wind directions which occur for respective about 78.8% and 81.3% of time in a year are adopted in the Initial Study.

7.1.3. According to the CFD modelling results, it concludes that SVRw is improved under both annual and summer wind conditions from Baseline Scheme to Proposed Scheme. LVRw is improved under summer condition while remain unchanged under annual condition from Baseline Scheme to Proposed Scheme.

7.1.4. The wind environment in Air Path A under annual and summer wind conditions would subject to a lower VR in Proposed Scheme. The wind environment in Air Path B under annual wind condition would have a lower VR in Proposed Scheme meanwhile it would have a higher VR under summer wind condition.

7.1.5. The Proposed Scheme maintains a proper wind environment within the development by increasing its air permeability where the wind environment is maintained to a level comparable to the existing condition. Besides, with the proposed mitigation measures of maximizing building separations and reducing the maximum height of the development; mitigation measures have been provided as far as practicable where the impact to the surroundings have been minimized and the overall wind environment at Diamond Hill and San Po Kong Area is maintained as far as practicable. As result, the Proposed Scheme maintains a proper wind environment within the development and at its near vicinity where the wind environment is maintained to a level comparable to the Baseline Scheme.

Appendix A. Site Layout Plan for CDA Development (Baseline Scheme)



Master Layout Plan (Scheme 74A)

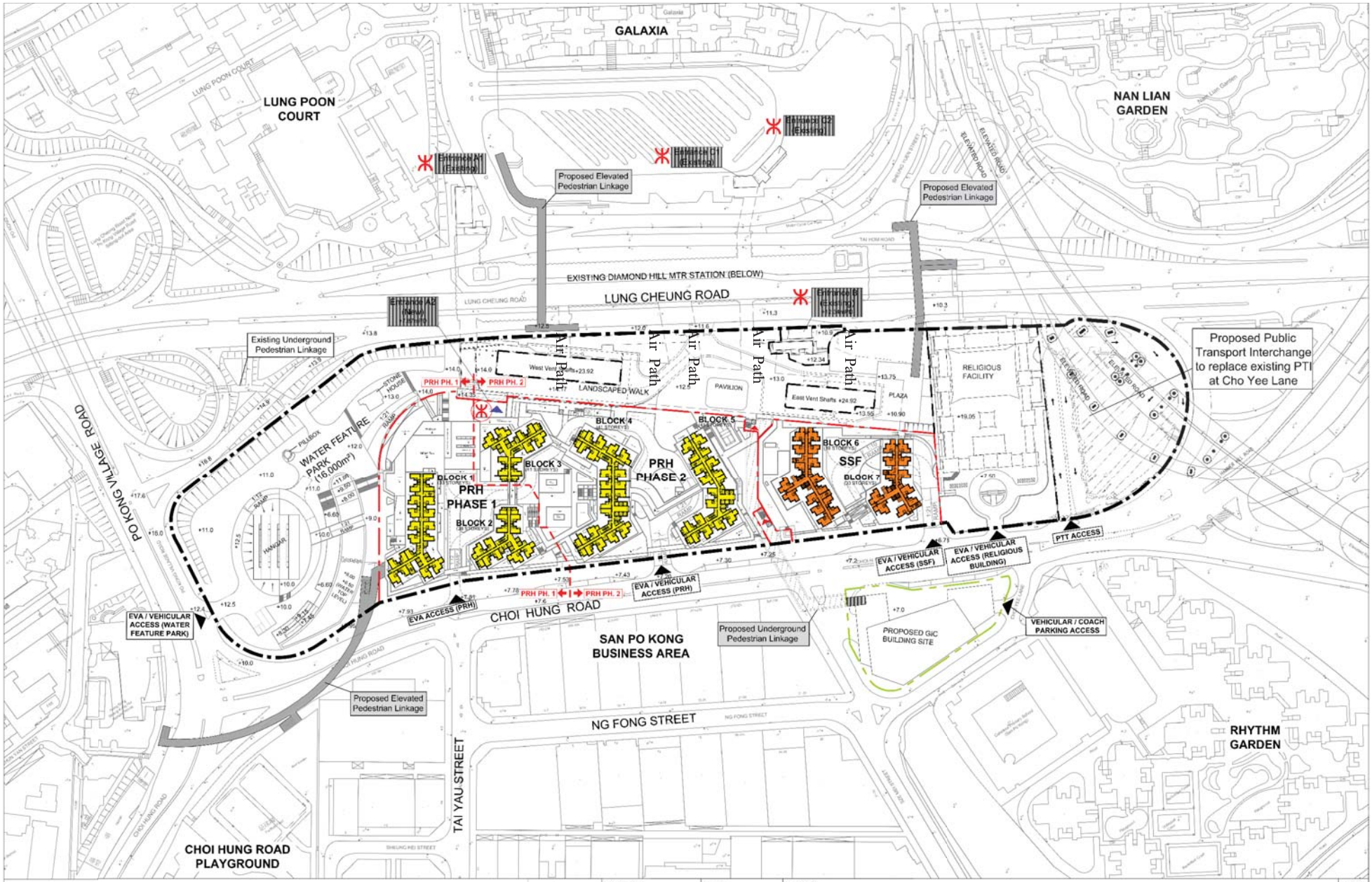
PHASE No.	SCALE	
PRH PHASE 1, 2 & SSF	1:1000 (A1); 1:2000 (A3)	
DRAWING No.	DATE	SERIAL
	12-11-2015	

LEGEND

- CDA Site Boundary
- PRH Site Boundary
- HOS Site Boundary
- School Site Boundary
- Proposed Domestic Blocks 105.9-114.2 mPD (35 - 39 storeys)
- Proposed Domestic Blocks 119.7-122.4 mPD (40 - 41 storeys)
- Proposed Domestic Blocks 136.2 mPD (46 storeys)
- Retail with Green Roof
- Existing Drainage Reserve
- Diamond Hill Station
- MTRC Non-Building Area
- Underground Shops
- Chimney
- Water Cooling Tower
- Proposed Pedestrian Crossing (AT-GRADE)
- Proposed Access to Underground Shopping Street

ANNEX

Appendix B. Site Layout Plan for CDA Development (Proposed Scheme)



Master Layout Plan
(Scheme 95)

PHASE No.	SCALE	
PRH PHASE 1, 2 & SSF	1:1000 (A1); 1:2000 (A3)	
DRAWING No.	DATE	SERIAL
	12-11-2015	

LEGEND

- Public Housing Site Boundary (PRH & SSF)
- CDA Site Boundary
- Proposed GIC Building Site
- PRH
- SSF
- Subway
- Subway Entrance
- MTR Entrance

ANNEX 1

Appendix C. Velocity Profiles of Prevailing Winds

C.1. Prevailing Wind Profiles Extracted from PlanD's Simulated Wind Data

	Type 0	Type 1	Type 2	Type 3
Height	Velocity	Velocity	Velocity	Velocity
0	2.8	2.2	2	2.2
20	3	2.3	2.1	2.3
40	3.2	2.4	2.1	2.4
60	3.3	2.4	2.1	2.5
80	3.5	2.5	2.2	2.7
100	3.7	2.5	2.2	2.8
120	3.8	2.6	2.3	2.9
140	4	2.7	2.3	3
160	4.2	2.8	2.4	3.3
180	4.4	3	2.5	3.6
200	4.8	3.2	2.6	3.8
220	5.1	3.3	2.6	4
240	5.5	3.4	2.7	4.3
260	5.7	3.6	2.7	4.5
280	6	3.8	2.8	4.7
300	6.3	3.9	2.9	4.9
320	6.4	4.1	3	5.2
340	6.7	4.3	3.2	5.3
360	6.8	4.4	3.3	5.5
380	6.9	4.7	3.4	5.6
400	7.1	4.8	3.5	5.7
420	7.2	5	3.6	5.7
440	7.3	5.2	3.7	5.8
460	7.4	5.4	3.8	5.9
480	7.4	5.5	3.9	5.7
500	7.3	5.6	4	5.5

0: 22.5°-112.4°

1: 112.5°-202.4°

2: 202.5°-292.4°

3: 292.5°-22.4°

Appendix D. Detailed Velocity Ratio (VR) Results for All Test Points

D.1. E

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.06	0.21	0.14
P02	0.05	0.19	0.14
P03	0.04	0.15	0.11
P04	0.13	0.19	0.06
P05	0.21	0.18	-0.03
P06	0.30	0.18	-0.12
P07	0.29	0.24	-0.05
P08	0.26	0.28	0.02
P09	0.26	0.27	0.01
P10	0.24	0.26	0.02
P11	0.21	0.23	0.03
P12	0.22	0.25	0.03
P13	0.22	0.23	0.02
P14	0.20	0.20	0.00
P15	0.20	0.20	0.00
P16	0.20	0.20	-0.01
P17	0.22	0.20	-0.02
P18	0.22	0.16	-0.06
P19	0.25	0.16	-0.09
P20	0.25	0.18	-0.07
P21	0.25	0.17	-0.08
P22	0.23	0.19	-0.05
P23	0.22	0.18	-0.04
P24	0.22	0.16	-0.06
P25	0.22	0.15	-0.07
P26	0.16	0.14	-0.01
P27	0.10	0.19	0.08
P28	0.10	0.13	0.03
P29	0.09	0.06	-0.03
P30	0.07	0.10	0.04
P31	0.06	0.12	0.06
P32	0.08	0.15	0.07
P33	0.12	0.14	0.02
P34	0.13	0.09	-0.03
P35	0.16	0.13	-0.03
P36	0.15	0.11	-0.05
P37	0.12	0.12	0.00
P38	0.12	0.14	0.01
P39	0.13	0.15	0.02
P40	0.11	0.18	0.07
P41	0.17	0.20	0.03
P42	0.18	0.21	0.02
P43	0.15	0.17	0.01
P44	0.19	0.20	0.01
P45	0.18	0.19	0.01
P46	0.13	0.08	-0.05
P47	0.01	0.04	0.02
P48	0.04	0.05	0.01
O001	0.26	0.16	-0.10
O002	0.22	0.08	-0.14
O003	0.05	0.05	0.00
O004	0.29	0.33	0.04
O005	0.28	0.31	0.03
O006	0.25	0.27	0.02
O007	0.25	0.24	-0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.25	0.21	-0.04
O009	0.22	0.23	0.01
O010	0.19	0.18	-0.01
O011	0.22	0.21	-0.01
O012	0.27	0.27	-0.01
O013	0.27	0.23	-0.04
O014	0.10	0.06	-0.04
O015	0.09	0.06	-0.03
O016	0.19	0.19	0.01
O017	0.22	0.22	-0.00
O018	0.17	0.10	-0.07
O019	0.18	0.17	-0.01
O020	0.19	0.18	-0.02
O021	0.16	0.15	-0.00
O022	0.22	0.19	-0.03
O023	0.21	0.18	-0.04
O024	0.14	0.13	-0.01
O025	0.26	0.22	-0.03
O026	0.28	0.24	-0.04
O027	0.08	0.05	-0.03
O028	0.01	0.05	0.03
O029	0.10	0.10	-0.00
O030	0.10	0.15	0.05
O031	0.09	0.10	0.02
O032	0.07	0.10	0.03
O033	0.19	0.27	0.08
O034	0.12	0.07	-0.05
O035	0.03	0.07	0.04
O036	0.06	0.13	0.07
O037	0.02	0.20	0.19
O038	0.03	0.19	0.16
O039	0.19	0.14	-0.04
O040	0.23	0.09	-0.14
O041	0.07	0.09	0.02
O042	0.04	0.03	-0.01
O043	0.19	0.16	-0.03
O044	0.15	0.23	0.08
O045	0.12	0.16	0.04
O046	0.17	0.13	-0.03
O047	0.15	0.11	-0.04
O048	0.08	0.17	0.09
O049	0.10	0.06	-0.04
O050	0.15	0.19	0.04
O051	0.29	0.28	-0.01
O052	0.12	0.16	0.04
O053	0.04	0.06	0.02
O054	0.15	0.09	-0.06
O055	0.22	0.17	-0.05
O056	0.26	0.21	-0.05
O057	0.13	0.17	0.04
O058	0.09	0.19	0.10
O059	0.02	0.06	0.03
O060	0.03	0.03	0.01
O061	0.08	0.05	-0.02
O062	0.06	0.02	-0.03
O063	0.08	0.09	0.00
O064	0.10	0.10	0.01
O065	0.13	0.14	0.01
O066	0.18	0.21	0.02
O067	0.07	0.12	0.05

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.10	0.11	0.00
O069	0.11	0.10	-0.02
O070	0.05	0.04	-0.01
O071	0.03	0.06	0.03
O072	0.11	0.07	-0.04
O073	0.09	0.04	-0.04
O074	0.04	0.07	0.02
O075	0.14	0.13	-0.00
O076	0.05	0.01	-0.04
O077	0.05	0.14	0.09
O078	0.04	0.09	0.05
O079	0.07	0.03	-0.04
O080	0.07	0.02	-0.05
O081	0.16	0.16	-0.00
O082	0.12	0.18	0.06
O083	0.31	0.33	0.02
O084	0.25	0.27	0.02
O085	0.24	0.24	0.00
O086	0.26	0.23	-0.03
O087	0.24	0.18	-0.05
O088	0.26	0.24	-0.02
O089	0.25	0.24	-0.02
O090	0.26	0.24	-0.02
O091	0.27	0.33	0.06
O092	0.31	0.31	-0.00
O093	0.10	0.14	0.04
O094	0.08	0.10	0.02
O095	0.06	0.08	0.02
O096	0.09	0.08	-0.01
O097	0.08	0.07	-0.00
O098	0.10	0.12	0.02
O099	0.04	0.05	0.01
O100	0.02	0.01	-0.01
O101	0.17	0.20	0.03
O102	0.13	0.16	0.02
O103	0.22	0.24	0.02
O104	0.22	0.23	0.01
O105	0.21	0.21	0.01
O106	0.20	0.20	0.00
O107	0.12	0.11	-0.00
O108	0.06	0.08	0.02
O109	0.08	0.07	-0.01
O110	0.07	0.07	0.01
O111	0.06	0.06	0.00
O112	0.07	0.07	0.01
O113	0.24	0.25	0.01
O114	0.17	0.18	0.01
O115	0.15	0.16	0.01
O116	0.16	0.19	0.03
O117	0.16	0.18	0.02
O118	0.11	0.07	-0.04
O119	0.09	0.05	-0.05
O120	0.06	0.02	-0.03
O121	0.04	0.01	-0.03
O122	0.05	0.10	0.06
O123	0.03	0.03	-0.00
O124	0.06	0.07	0.01
O125	0.05	0.08	0.03
O126	0.06	0.07	0.01
S01	0.22	0.03	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.12	0.02	
S03	0.18	0.12	
S04	0.15	0.07	
S05	0.03	0.10	
S06	0.03	0.18	
S07	0.13	0.27	
S08	0.03	0.21	
S09	0.07	0.06	
S10	0.18	0.19	
S11	0.11	0.08	
S12	0.22	0.14	
S13	0.16	0.22	
S14	0.07	0.14	
S15	0.07	Not exist in Proposed Scheme	
S16	0.14	Not exist in Proposed Scheme	
S17	0.10	Not exist in Proposed Scheme	
S18	0.11	Not exist in Proposed Scheme	
S19	0.11	Not exist in Proposed Scheme	
S20	0.18	Not exist in Proposed Scheme	
S31	0.06	0.23	
S32	0.08	0.05	
S33	0.03	0.23	
S34	0.13	0.09	
S35	0.11	0.16	
S36	0.27	0.17	
S37	0.16	0.16	
S38	0.09	0.22	
S39	0.04	0.13	
S40	0.12	0.08	
S41	0.09	0.10	
S42	0.10	0.12	
S43	0.18	0.16	
S44	0.14	0.18	

D.2. ENE

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.11	0.06	-0.05
P02	0.08	0.08	0.00
P03	0.08	0.12	0.03
P04	0.07	0.18	0.11
P05	0.03	0.20	0.17
P06	0.22	0.22	-0.01
P07	0.25	0.19	-0.05
P08	0.24	0.27	0.03
P09	0.27	0.30	0.03
P10	0.26	0.29	0.03
P11	0.25	0.26	0.01
P12	0.28	0.28	0.01
P13	0.30	0.30	-0.00
P14	0.29	0.27	-0.02
P15	0.27	0.25	-0.02
P16	0.24	0.22	-0.02
P17	0.18	0.15	-0.03
P18	0.14	0.14	-0.01
P19	0.12	0.11	-0.01
P20	0.11	0.11	-0.01
P21	0.07	0.05	-0.01
P22	0.08	0.15	0.06
P23	0.15	0.20	0.05
P24	0.19	0.20	0.01
P25	0.21	0.12	-0.08
P26	0.11	0.11	-0.00
P27	0.15	0.17	0.02
P28	0.16	0.17	0.01
P29	0.11	0.15	0.04
P30	0.15	0.19	0.04
P31	0.19	0.18	-0.00
P32	0.14	0.14	-0.00
P33	0.19	0.15	-0.04
P34	0.21	0.20	-0.02
P35	0.23	0.22	-0.01
P36	0.19	0.19	-0.00
P37	0.21	0.18	-0.02
P38	0.18	0.17	-0.01
P39	0.21	0.18	-0.03
P40	0.20	0.20	0.00
P41	0.21	0.21	-0.00
P42	0.21	0.21	0.01
P43	0.19	0.20	0.01
P44	0.20	0.21	0.00
P45	0.19	0.20	0.01
P46	0.21	0.14	-0.07
P47	0.15	0.07	-0.08
P48	0.14	0.06	-0.08
O001	0.15	0.12	-0.03
O002	0.18	0.03	-0.14
O003	0.04	0.04	-0.00
O004	0.27	0.29	0.02
O005	0.27	0.30	0.03
O006	0.32	0.33	0.00
O007	0.25	0.24	-0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.15	0.14	-0.00
O009	0.08	0.12	0.05
O010	0.18	0.22	0.04
O011	0.19	0.22	0.03
O012	0.26	0.28	0.01
O013	0.21	0.22	0.01
O014	0.10	0.04	-0.06
O015	0.12	0.13	0.01
O016	0.14	0.18	0.04
O017	0.27	0.20	-0.06
O018	0.17	0.17	-0.01
O019	0.13	0.13	0.00
O020	0.08	0.09	0.01
O021	0.23	0.23	-0.00
O022	0.18	0.12	-0.05
O023	0.06	0.18	0.13
O024	0.19	0.14	-0.04
O025	0.04	0.08	0.05
O026	0.29	0.29	-0.00
O027	0.07	0.06	-0.01
O028	0.01	0.05	0.04
O029	0.03	0.05	0.02
O030	0.07	0.05	-0.02
O031	0.06	0.03	-0.03
O032	0.07	0.04	-0.03
O033	0.02	0.11	0.09
O034	0.11	0.10	-0.01
O035	0.00	0.01	0.00
O036	0.02	0.07	0.05
O037	0.09	0.10	0.01
O038	0.09	0.09	-0.01
O039	0.04	0.17	0.13
O040	0.21	0.18	-0.03
O041	0.04	0.03	-0.01
O042	0.02	0.03	0.01
O043	0.22	0.19	-0.03
O044	0.22	0.22	0.01
O045	0.19	0.20	0.01
O046	0.16	0.18	0.02
O047	0.22	0.20	-0.02
O048	0.16	0.15	-0.01
O049	0.06	0.09	0.02
O050	0.15	0.17	0.01
O051	0.23	0.28	0.05
O052	0.25	0.24	-0.01
O053	0.12	0.08	-0.03
O054	0.14	0.06	-0.08
O055	0.19	0.09	-0.10
O056	0.13	0.17	0.04
O057	0.11	0.12	0.01
O058	0.26	0.28	0.02
O059	0.01	0.04	0.03
O060	0.04	0.03	-0.01
O061	0.02	0.03	0.02
O062	0.10	0.07	-0.02
O063	0.09	0.07	-0.01
O064	0.05	0.05	0.00
O065	0.10	0.11	0.01
O066	0.14	0.16	0.01
O067	0.10	0.11	0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.18	0.08	-0.10
O069	0.21	0.21	0.00
O070	0.06	0.02	-0.04
O071	0.10	0.10	-0.00
O072	0.03	0.05	0.02
O073	0.08	0.02	-0.06
O074	0.18	0.15	-0.03
O075	0.26	0.25	-0.01
O076	0.14	0.12	-0.02
O077	0.04	0.07	0.04
O078	0.08	0.07	-0.01
O079	0.10	0.16	0.07
O080	0.05	0.04	-0.01
O081	0.05	0.00	-0.05
O082	0.01	0.07	0.06
O083	0.28	0.30	0.02
O084	0.28	0.29	0.01
O085	0.28	0.27	-0.01
O086	0.17	0.16	-0.02
O087	0.22	0.18	-0.03
O088	0.08	0.10	0.02
O089	0.27	0.26	-0.01
O090	0.25	0.19	-0.06
O091	0.22	0.18	-0.03
O092	0.18	0.20	0.02
O093	0.03	0.08	0.04
O094	0.08	0.08	-0.00
O095	0.06	0.07	0.01
O096	0.15	0.18	0.03
O097	0.11	0.12	0.01
O098	0.08	0.05	-0.03
O099	0.15	0.12	-0.03
O100	0.09	0.09	-0.00
O101	0.22	0.23	0.01
O102	0.18	0.20	0.02
O103	0.23	0.27	0.04
O104	0.26	0.29	0.03
O105	0.27	0.28	0.01
O106	0.28	0.28	0.00
O107	0.14	0.17	0.03
O108	0.26	0.27	0.01
O109	0.27	0.20	-0.06
O110	0.33	0.34	0.01
O111	0.15	0.16	0.01
O112	0.09	0.07	-0.02
O113	0.03	0.03	0.00
O114	0.02	0.02	0.00
O115	0.07	0.09	0.03
O116	0.05	0.07	0.02
O117	0.05	0.07	0.03
O118	0.09	0.07	-0.02
O119	0.06	0.05	-0.01
O120	0.05	0.07	0.02
O121	0.09	0.08	-0.01
O122	0.18	0.17	-0.01
O123	0.09	0.07	-0.02
O124	0.06	0.07	0.00
O125	0.13	0.10	-0.04
O126	0.02	0.11	0.09
S01	0.14	0.05	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.09	0.02	
S03	0.14	0.20	
S04	0.16	0.07	
S05	0.11	0.08	
S06	0.10	0.16	
S07	0.16	0.23	
S08	0.05	0.20	
S09	0.05	0.04	
S10	0.16	0.16	
S11	0.14	0.09	
S12	0.19	0.07	
S13	0.18	0.03	
S14	0.17	0.08	
S15	0.03	Not exist in Proposed Scheme	
S16	0.13	Not exist in Proposed Scheme	
S17	0.08	Not exist in Proposed Scheme	
S18	0.03	Not exist in Proposed Scheme	
S19	0.07	Not exist in Proposed Scheme	
S20	0.06	Not exist in Proposed Scheme	
S31	0.05	0.14	
S32	0.02	0.02	
S33	0.06	0.19	
S34	0.07	0.04	
S35	0.06	0.15	
S36	0.23	0.17	
S37	0.11	0.09	
S38	0.06	0.06	
S39	0.10	0.08	
S40	0.19	0.15	
S41	0.14	0.15	
S42	0.16	0.18	
S43	0.18	0.11	
S44	0.16	0.15	

D.3. NNE

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.08	0.07	-0.01
P02	0.05	0.05	-0.00
P03	0.04	0.04	-0.00
P04	0.10	0.07	-0.03
P05	0.22	0.16	-0.06
P06	0.08	0.10	0.02
P07	0.03	0.03	-0.00
P08	0.03	0.06	0.02
P09	0.05	0.09	0.03
P10	0.07	0.08	0.01
P11	0.07	0.06	-0.02
P12	0.09	0.07	-0.01
P13	0.11	0.09	-0.01
P14	0.13	0.11	-0.02
P15	0.12	0.11	-0.02
P16	0.14	0.13	-0.01
P17	0.18	0.17	-0.01
P18	0.25	0.21	-0.03
P19	0.27	0.25	-0.02
P20	0.23	0.24	0.01
P21	0.10	0.16	0.06
P22	0.07	0.06	-0.01
P23	0.27	0.29	0.01
P24	0.14	0.16	0.03
P25	0.33	0.33	0.00
P26	0.32	0.33	0.00
P27	0.27	0.24	-0.03
P28	0.06	0.15	0.08
P29	0.10	0.06	-0.04
P30	0.15	0.16	0.01
P31	0.18	0.20	0.01
P32	0.17	0.18	0.01
P33	0.24	0.21	-0.03
P34	0.25	0.21	-0.03
P35	0.24	0.20	-0.03
P36	0.14	0.18	0.04
P37	0.05	0.17	0.12
P38	0.00	0.12	0.12
P39	0.02	0.11	0.09
P40	0.01	0.10	0.09
P41	0.06	0.07	0.01
P42	0.14	0.02	-0.12
P43	0.16	0.11	-0.05
P44	0.14	0.13	-0.01
P45	0.01	0.01	-0.00
P46	0.06	0.03	-0.04
P47	0.06	0.03	-0.03
P48	0.10	0.07	-0.03
O001	0.03	0.02	-0.01
O002	0.10	0.13	0.03
O003	0.00	0.00	-0.00
O004	0.06	0.04	-0.02
O005	0.05	0.09	0.04
O006	0.10	0.08	-0.01
O007	0.11	0.08	-0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.21	0.21	0.00
O009	0.14	0.21	0.07
O010	0.27	0.26	-0.01
O011	0.14	0.06	-0.08
O012	0.17	0.17	0.00
O013	0.06	0.07	0.00
O014	0.34	0.37	0.03
O015	0.37	0.37	-0.01
O016	0.06	0.06	0.01
O017	0.04	0.05	0.01
O018	0.03	0.07	0.03
O019	0.20	0.16	-0.04
O020	0.09	0.08	-0.01
O021	0.29	0.30	0.01
O022	0.34	0.31	-0.03
O023	0.31	0.24	-0.06
O024	0.28	0.30	0.02
O025	0.15	0.17	0.01
O026	0.29	0.25	-0.03
O027	0.08	0.05	-0.04
O028	0.04	0.09	0.04
O029	0.05	0.06	0.01
O030	0.19	0.20	0.01
O031	0.10	0.12	0.01
O032	0.05	0.06	0.01
O033	0.08	0.08	0.00
O034	0.02	0.03	0.00
O035	0.05	0.05	0.00
O036	0.06	0.06	0.00
O037	0.06	0.06	0.00
O038	0.05	0.05	0.00
O039	0.05	0.04	-0.01
O040	0.20	0.19	-0.01
O041	0.09	0.09	0.00
O042	0.09	0.08	-0.01
O043	0.09	0.13	0.03
O044	0.04	0.08	0.05
O045	0.05	0.08	0.03
O046	0.10	0.12	0.02
O047	0.25	0.22	-0.03
O048	0.19	0.21	0.02
O049	0.14	0.12	-0.02
O050	0.27	0.27	0.00
O051	0.10	0.08	-0.01
O052	0.25	0.23	-0.01
O053	0.11	0.11	0.00
O054	0.23	0.24	0.02
O055	0.32	0.30	-0.02
O056	0.14	0.12	-0.01
O057	0.24	0.22	-0.01
O058	0.12	0.12	-0.00
O059	0.01	0.02	0.01
O060	0.03	0.04	0.01
O061	0.04	0.05	0.01
O062	0.03	0.05	0.02
O063	0.03	0.01	-0.02
O064	0.08	0.05	-0.03
O065	0.05	0.03	-0.01
O066	0.13	0.06	-0.06
O067	0.14	0.10	-0.05

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.23	0.21	-0.02
O069	0.32	0.24	-0.08
O070	0.05	0.05	-0.01
O071	0.09	0.08	-0.02
O072	0.05	0.02	-0.03
O073	0.04	0.03	-0.01
O074	0.14	0.15	0.01
O075	0.17	0.22	0.05
O076	0.21	0.24	0.02
O077	0.09	0.09	0.00
O078	0.22	0.21	-0.01
O079	0.09	0.10	0.01
O080	0.03	0.05	0.02
O081	0.10	0.14	0.04
O082	0.07	0.03	-0.04
O083	0.01	0.06	0.05
O084	0.07	0.06	-0.01
O085	0.10	0.08	-0.02
O086	0.15	0.13	-0.02
O087	0.38	0.33	-0.05
O088	0.36	0.31	-0.05
O089	0.25	0.20	-0.05
O090	0.34	0.28	-0.06
O091	0.14	0.13	-0.00
O092	0.09	0.09	0.00
O093	0.11	0.09	-0.02
O094	0.06	0.05	-0.00
O095	0.04	0.03	-0.01
O096	0.19	0.16	-0.03
O097	0.19	0.13	-0.05
O098	0.06	0.03	-0.03
O099	0.07	0.09	0.02
O100	0.08	0.06	-0.02
O101	0.18	0.16	-0.02
O102	0.20	0.18	-0.03
O103	0.09	0.07	-0.01
O104	0.11	0.08	-0.03
O105	0.12	0.10	-0.02
O106	0.16	0.15	-0.00
O107	0.08	0.11	0.04
O108	0.15	0.19	0.04
O109	0.19	0.17	-0.02
O110	0.18	0.25	0.06
O111	0.10	0.11	0.01
O112	0.07	0.08	0.01
O113	0.14	0.14	0.00
O114	0.04	0.05	0.01
O115	0.08	0.10	0.02
O116	0.10	0.11	0.01
O117	0.15	0.15	0.00
O118	0.19	0.24	0.05
O119	0.14	0.20	0.06
O120	0.12	0.16	0.04
O121	0.09	0.14	0.05
O122	0.07	0.14	0.07
O123	0.16	0.19	0.04
O124	0.09	0.09	0.00
O125	0.14	0.13	-0.00
O126	0.16	0.16	-0.00
S01	0.12	0.07	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.02	0.10	
S03	0.04	0.03	
S04	0.05	0.01	
S05	0.02	0.09	
S06	0.05	0.01	
S07	0.06	0.01	
S08	0.04	0.00	
S09	0.02	0.02	
S10	0.00	0.06	
S11	0.02	0.02	
S12	0.05	0.10	
S13	0.04	0.15	
S14	0.05	0.18	
S15	0.13	Not exist in Proposed Scheme	
S16	0.15	Not exist in Proposed Scheme	
S17	0.07	Not exist in Proposed Scheme	
S18	0.05	Not exist in Proposed Scheme	
S19	0.10	Not exist in Proposed Scheme	
S20	0.05	Not exist in Proposed Scheme	
S31	0.13	0.15	
S32	0.14	0.12	
S33	0.17	0.20	
S34	0.19	0.19	
S35	0.06	0.02	
S36	0.03	0.04	
S37	0.23	0.27	
S38	0.12	0.09	
S39	0.10	0.14	
S40	0.25	0.11	
S41	0.25	0.08	
S42	0.16	0.19	
S43	0.30	0.24	
S44	0.20	0.24	

D.4. ESE

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.13	0.05	-0.08
P02	0.11	0.04	-0.07
P03	0.08	0.03	-0.05
P04	0.06	0.03	-0.02
P05	0.11	0.06	-0.05
P06	0.19	0.10	-0.10
P07	0.25	0.17	-0.08
P08	0.28	0.26	-0.02
P09	0.28	0.28	-0.01
P10	0.27	0.27	-0.00
P11	0.24	0.24	0.01
P12	0.24	0.26	0.02
P13	0.24	0.25	0.02
P14	0.23	0.24	0.02
P15	0.22	0.25	0.03
P16	0.21	0.23	0.03
P17	0.19	0.22	0.03
P18	0.14	0.16	0.02
P19	0.13	0.09	-0.04
P20	0.12	0.02	-0.10
P21	0.17	0.10	-0.07
P22	0.27	0.18	-0.08
P23	0.23	0.27	0.04
P24	0.10	0.21	0.11
P25	0.14	0.20	0.07
P26	0.16	0.21	0.05
P27	0.25	0.25	0.01
P28	0.28	0.26	-0.01
P29	0.26	0.27	0.01
P30	0.04	0.03	-0.02
P31	0.04	0.03	-0.01
P32	0.09	0.08	-0.01
P33	0.13	0.17	0.04
P34	0.16	0.14	-0.02
P35	0.18	0.14	-0.04
P36	0.18	0.18	0.01
P37	0.15	0.20	0.05
P38	0.14	0.22	0.08
P39	0.16	0.23	0.07
P40	0.19	0.23	0.04
P41	0.21	0.24	0.04
P42	0.21	0.24	0.03
P43	0.20	0.22	0.02
P44	0.23	0.22	-0.01
P45	0.21	0.22	0.01
P46	0.15	0.24	0.08
P47	0.02	0.20	0.19
P48	0.02	0.17	0.15
O001	0.25	0.17	-0.08
O002	0.20	0.11	-0.09
O003	0.05	0.05	-0.00
O004	0.29	0.28	-0.01
O005	0.29	0.30	0.01
O006	0.26	0.28	0.02
O007	0.24	0.25	0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.18	0.14	-0.04
O009	0.25	0.26	0.02
O010	0.08	0.06	-0.02
O011	0.15	0.16	0.01
O012	0.22	0.28	0.06
O013	0.19	0.14	-0.04
O014	0.19	0.20	0.01
O015	0.02	0.04	0.01
O016	0.16	0.16	-0.00
O017	0.26	0.25	-0.01
O018	0.19	0.16	-0.03
O019	0.15	0.16	0.00
O020	0.19	0.20	0.01
O021	0.14	0.13	-0.01
O022	0.24	0.24	0.01
O023	0.20	0.21	0.02
O024	0.11	0.12	0.01
O025	0.25	0.24	-0.01
O026	0.24	0.22	-0.02
O027	0.06	0.06	-0.00
O028	0.03	0.04	0.01
O029	0.02	0.05	0.02
O030	0.11	0.09	-0.02
O031	0.05	0.05	0.00
O032	0.06	0.04	-0.02
O033	0.03	0.09	0.06
O034	0.13	0.12	-0.00
O035	0.03	0.06	0.03
O036	0.02	0.12	0.10
O037	0.01	0.12	0.11
O038	0.10	0.04	-0.06
O039	0.04	0.05	0.00
O040	0.20	0.10	-0.10
O041	0.03	0.06	0.02
O042	0.07	0.05	-0.02
O043	0.19	0.24	0.04
O044	0.18	0.25	0.07
O045	0.10	0.22	0.12
O046	0.17	0.19	0.02
O047	0.16	0.16	-0.00
O048	0.04	0.08	0.03
O049	0.28	0.28	0.00
O050	0.15	0.20	0.04
O051	0.06	0.02	-0.03
O052	0.13	0.12	-0.01
O053	0.09	0.08	-0.01
O054	0.27	0.27	0.00
O055	0.27	0.28	0.01
O056	0.26	0.28	0.02
O057	0.11	0.11	0.00
O058	0.16	0.13	-0.03
O059	0.10	0.04	-0.06
O060	0.05	0.08	0.03
O061	0.12	0.05	-0.07
O062	0.09	0.04	-0.05
O063	0.09	0.09	-0.00
O064	0.12	0.12	-0.00
O065	0.15	0.15	-0.00
O066	0.21	0.22	0.01
O067	0.02	0.02	-0.00

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.08	0.10	0.01
O069	0.03	0.03	-0.00
O070	0.09	0.08	-0.02
O071	0.05	0.04	-0.01
O072	0.16	0.16	0.00
O073	0.09	0.05	-0.04
O074	0.11	0.10	-0.01
O075	0.18	0.18	-0.00
O076	0.08	0.09	0.01
O077	0.09	0.10	0.01
O078	0.09	0.11	0.02
O079	0.15	0.16	0.01
O080	0.24	0.24	0.00
O081	0.02	0.08	0.05
O082	0.06	0.07	0.01
O083	0.30	0.28	-0.02
O084	0.26	0.27	0.01
O085	0.24	0.26	0.02
O086	0.22	0.22	0.00
O087	0.19	0.20	0.00
O088	0.21	0.18	-0.03
O089	0.24	0.21	-0.03
O090	0.30	0.29	-0.01
O091	0.13	0.09	-0.05
O092	0.08	0.04	-0.04
O093	0.17	0.15	-0.02
O094	0.11	0.12	0.00
O095	0.08	0.09	0.01
O096	0.06	0.06	-0.01
O097	0.10	0.13	0.03
O098	0.06	0.08	0.02
O099	0.06	0.08	0.02
O100	0.02	0.02	0.00
O101	0.15	0.17	0.02
O102	0.10	0.11	0.00
O103	0.23	0.23	-0.00
O104	0.24	0.25	0.00
O105	0.24	0.25	0.01
O106	0.23	0.23	-0.00
O107	0.14	0.14	0.00
O108	0.02	0.03	0.01
O109	0.09	0.09	0.00
O110	0.11	0.11	-0.00
O111	0.08	0.06	-0.01
O112	0.03	0.03	0.00
O113	0.08	0.09	0.01
O114	0.22	0.22	-0.00
O115	0.17	0.15	-0.01
O116	0.10	0.12	0.02
O117	0.17	0.22	0.05
O118	0.07	0.12	0.05
O119	0.01	0.08	0.07
O120	0.12	0.14	0.02
O121	0.17	0.18	0.01
O122	0.06	0.07	0.02
O123	0.06	0.06	0.00
O124	0.14	0.15	0.01
O125	0.14	0.16	0.02
O126	0.07	0.10	0.04
S01	0.08	0.05	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.03	0.09	
S03	0.07	0.06	
S04	0.07	0.04	
S05	0.08	0.01	
S06	0.03	0.02	
S07	0.04	0.01	
S08	0.05	0.02	
S09	0.01	0.10	
S10	0.07	0.06	
S11	0.01	0.08	
S12	0.12	0.07	
S13	0.02	0.14	
S14	0.07	0.07	
S15	0.08	Not exist in Proposed Scheme	
S16	0.02	Not exist in Proposed Scheme	
S17	0.14	Not exist in Proposed Scheme	
S18	0.13	Not exist in Proposed Scheme	
S19	0.08	Not exist in Proposed Scheme	
S20	0.02	Not exist in Proposed Scheme	
S31	0.07	0.02	
S32	0.10	0.02	
S33	0.05	0.03	
S34	0.06	0.11	
S35	0.14	0.09	
S36	0.15	0.07	
S37	0.16	0.24	
S38	0.03	0.14	
S39	0.16	0.21	
S40	0.22	0.19	
S41	0.27	0.20	
S42	0.29	0.28	
S43	0.17	0.21	
S44	0.23	0.22	

D.5. NE

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.04	0.12	0.08
P02	0.04	0.08	0.04
P03	0.04	0.09	0.05
P04	0.09	0.12	0.03
P05	0.12	0.12	-0.00
P06	0.16	0.11	-0.05
P07	0.16	0.12	-0.05
P08	0.17	0.15	-0.02
P09	0.17	0.18	0.00
P10	0.17	0.17	0.00
P11	0.15	0.14	-0.01
P12	0.14	0.14	0.00
P13	0.17	0.18	0.01
P14	0.21	0.21	0.01
P15	0.21	0.23	0.01
P16	0.22	0.23	0.01
P17	0.23	0.25	0.01
P18	0.20	0.22	0.02
P19	0.18	0.19	0.00
P20	0.13	0.16	0.03
P21	0.07	0.11	0.04
P22	0.05	0.12	0.06
P23	0.10	0.13	0.03
P24	0.10	0.08	-0.03
P25	0.21	0.28	0.07
P26	0.20	0.28	0.08
P27	0.20	0.20	0.00
P28	0.22	0.07	-0.14
P29	0.07	0.10	0.03
P30	0.08	0.09	0.01
P31	0.14	0.04	-0.11
P32	0.04	0.08	0.04
P33	0.15	0.10	-0.05
P34	0.15	0.05	-0.09
P35	0.17	0.19	0.02
P36	0.16	0.02	-0.14
P37	0.13	0.12	-0.01
P38	0.11	0.12	0.01
P39	0.15	0.09	-0.06
P40	0.15	0.08	-0.07
P41	0.17	0.07	-0.10
P42	0.16	0.05	-0.11
P43	0.15	0.05	-0.10
P44	0.16	0.08	-0.07
P45	0.15	0.09	-0.05
P46	0.14	0.05	-0.09
P47	0.12	0.05	-0.07
P48	0.11	0.09	-0.01
O001	0.03	0.05	0.02
O002	0.03	0.03	-0.00
O003	0.02	0.01	-0.00
O004	0.14	0.13	-0.01
O005	0.16	0.16	-0.00
O006	0.15	0.15	0.00
O007	0.20	0.22	0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.20	0.21	0.02
O009	0.09	0.03	-0.06
O010	0.18	0.24	0.06
O011	0.15	0.15	-0.00
O012	0.16	0.23	0.08
O013	0.07	0.07	0.01
O014	0.20	0.24	0.03
O015	0.21	0.24	0.03
O016	0.20	0.21	0.01
O017	0.30	0.32	0.02
O018	0.11	0.13	0.02
O019	0.11	0.15	0.03
O020	0.23	0.24	0.01
O021	0.28	0.23	-0.05
O022	0.33	0.34	0.02
O023	0.10	0.08	-0.02
O024	0.20	0.21	0.01
O025	0.21	0.17	-0.04
O026	0.23	0.17	-0.06
O027	0.03	0.04	0.01
O028	0.04	0.01	-0.03
O029	0.01	0.02	0.01
O030	0.04	0.03	-0.01
O031	0.04	0.03	-0.00
O032	0.03	0.04	0.01
O033	0.06	0.08	0.02
O034	0.03	0.02	-0.00
O035	0.06	0.02	-0.04
O036	0.09	0.05	-0.04
O037	0.08	0.14	0.06
O038	0.04	0.06	0.03
O039	0.09	0.12	0.03
O040	0.13	0.11	-0.02
O041	0.04	0.07	0.03
O042	0.06	0.03	-0.03
O043	0.14	0.08	-0.06
O044	0.17	0.12	-0.05
O045	0.14	0.14	0.00
O046	0.17	0.16	-0.01
O047	0.18	0.12	-0.05
O048	0.13	0.08	-0.05
O049	0.08	0.10	0.02
O050	0.13	0.25	0.12
O051	0.20	0.23	0.04
O052	0.26	0.22	-0.05
O053	0.13	0.13	0.01
O054	0.14	0.13	-0.01
O055	0.22	0.20	-0.02
O056	0.26	0.26	0.00
O057	0.20	0.12	-0.08
O058	0.25	0.30	0.05
O059	0.03	0.05	0.02
O060	0.05	0.04	-0.01
O061	0.05	0.04	-0.01
O062	0.09	0.08	-0.01
O063	0.06	0.08	0.01
O064	0.04	0.05	0.01
O065	0.07	0.06	-0.01
O066	0.09	0.12	0.03
O067	0.08	0.10	0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.22	0.14	-0.08
O069	0.25	0.18	-0.07
O070	0.04	0.04	0.00
O071	0.11	0.07	-0.04
O072	0.10	0.07	-0.02
O073	0.05	0.00	-0.05
O074	0.23	0.25	0.01
O075	0.25	0.25	0.01
O076	0.20	0.20	0.00
O077	0.03	0.08	0.05
O078	0.14	0.17	0.02
O079	0.07	0.07	0.01
O080	0.15	0.09	-0.06
O081	0.03	0.07	0.03
O082	0.05	0.09	0.04
O083	0.13	0.12	-0.01
O084	0.16	0.16	0.00
O085	0.19	0.20	0.01
O086	0.22	0.23	0.01
O087	0.30	0.34	0.04
O088	0.30	0.31	0.01
O089	0.05	0.06	0.01
O090	0.14	0.09	-0.04
O091	0.10	0.20	0.10
O092	0.18	0.14	-0.05
O093	0.16	0.18	0.02
O094	0.05	0.07	0.02
O095	0.02	0.05	0.03
O096	0.17	0.12	-0.04
O097	0.12	0.10	-0.02
O098	0.07	0.04	-0.03
O099	0.14	0.09	-0.05
O100	0.10	0.07	-0.03
O101	0.21	0.19	-0.02
O102	0.20	0.18	-0.01
O103	0.07	0.12	0.05
O104	0.08	0.02	-0.06
O105	0.11	0.01	-0.10
O106	0.15	0.06	-0.09
O107	0.17	0.15	-0.01
O108	0.19	0.17	-0.02
O109	0.17	0.15	-0.02
O110	0.22	0.20	-0.02
O111	0.06	0.08	0.03
O112	0.02	0.07	0.05
O113	0.16	0.17	0.01
O114	0.03	0.02	-0.01
O115	0.07	0.09	0.02
O116	0.06	0.07	0.00
O117	0.20	0.08	-0.12
O118	0.18	0.17	-0.00
O119	0.14	0.15	0.01
O120	0.13	0.16	0.02
O121	0.10	0.16	0.06
O122	0.12	0.11	-0.01
O123	0.15	0.16	0.01
O124	0.03	0.01	-0.01
O125	0.05	0.05	-0.00
O126	0.12	0.13	0.00
S01	0.14	0.02	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.08	0.03	
S03	0.08	0.13	
S04	0.06	0.02	
S05	0.11	0.02	
S06	0.06	0.07	
S07	0.07	0.06	
S08	0.11	0.04	
S09	0.02	0.06	
S10	0.01	0.17	
S11	0.08	0.10	
S12	0.02	0.02	
S13	0.09	0.10	
S14	0.08	0.28	
S15	0.05	Not exist in Proposed Scheme	
S16	0.20	Not exist in Proposed Scheme	
S17	0.13	Not exist in Proposed Scheme	
S18	0.04	Not exist in Proposed Scheme	
S19	0.08	Not exist in Proposed Scheme	
S20	0.10	Not exist in Proposed Scheme	
S31	0.04	0.13	
S32	0.01	0.08	
S33	0.01	0.13	
S34	0.05	0.09	
S35	0.04	0.05	
S36	0.15	0.10	
S37	0.11	0.09	
S38	0.07	0.09	
S39	0.06	0.05	
S40	0.08	0.10	
S41	0.01	0.04	
S42	0.07	0.01	
S43	0.23	0.30	
S44	0.23	0.20	

D.6. SE

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.08	0.12	0.04
P02	0.12	0.13	0.01
P03	0.11	0.12	0.01
P04	0.10	0.10	-0.00
P05	0.10	0.09	-0.02
P06	0.05	0.06	0.01
P07	0.17	0.21	0.04
P08	0.31	0.31	-0.01
P09	0.32	0.32	-0.01
P10	0.31	0.31	-0.00
P11	0.27	0.29	0.01
P12	0.29	0.32	0.02
P13	0.27	0.31	0.04
P14	0.27	0.30	0.03
P15	0.26	0.29	0.03
P16	0.24	0.26	0.02
P17	0.22	0.23	0.01
P18	0.18	0.13	-0.04
P19	0.17	0.10	-0.06
P20	0.16	0.08	-0.08
P21	0.19	0.13	-0.05
P22	0.26	0.06	-0.20
P23	0.17	0.31	0.14
P24	0.08	0.15	0.08
P25	0.11	0.15	0.04
P26	0.11	0.12	0.02
P27	0.25	0.25	-0.01
P28	0.26	0.22	-0.04
P29	0.27	0.26	-0.00
P30	0.01	0.02	0.01
P31	0.03	0.06	0.03
P32	0.15	0.14	-0.00
P33	0.19	0.18	-0.01
P34	0.15	0.16	0.01
P35	0.14	0.16	0.02
P36	0.12	0.20	0.08
P37	0.13	0.19	0.06
P38	0.16	0.23	0.07
P39	0.18	0.21	0.03
P40	0.21	0.22	0.01
P41	0.22	0.24	0.02
P42	0.22	0.25	0.03
P43	0.22	0.25	0.03
P44	0.24	0.26	0.01
P45	0.17	0.26	0.09
P46	0.22	0.27	0.05
P47	0.21	0.26	0.05
P48	0.17	0.22	0.05
O001	0.28	0.21	-0.07
O002	0.26	0.26	-0.01
O003	0.07	0.06	-0.00
O004	0.34	0.33	-0.01
O005	0.34	0.34	0.00
O006	0.30	0.33	0.03
O007	0.26	0.27	0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.21	0.14	-0.07
O009	0.23	0.22	-0.01
O010	0.05	0.04	-0.01
O011	0.10	0.13	0.03
O012	0.17	0.15	-0.02
O013	0.20	0.16	-0.04
O014	0.16	0.15	-0.01
O015	0.05	0.07	0.01
O016	0.13	0.12	-0.02
O017	0.28	0.28	0.00
O018	0.22	0.20	-0.02
O019	0.18	0.19	0.01
O020	0.20	0.18	-0.02
O021	0.19	0.16	-0.03
O022	0.28	0.30	0.02
O023	0.20	0.22	0.03
O024	0.12	0.07	-0.04
O025	0.26	0.26	-0.01
O026	0.26	0.25	-0.01
O027	0.04	0.05	0.01
O028	0.04	0.05	0.01
O029	0.02	0.03	0.01
O030	0.07	0.07	-0.01
O031	0.07	0.07	0.00
O032	0.06	0.05	-0.01
O033	0.03	0.07	0.04
O034	0.01	0.03	0.02
O035	0.17	0.17	-0.01
O036	0.19	0.19	-0.00
O037	0.12	0.17	0.05
O038	0.13	0.14	0.01
O039	0.07	0.12	0.05
O040	0.19	0.11	-0.07
O041	0.07	0.10	0.03
O042	0.14	0.14	0.00
O043	0.26	0.28	0.02
O044	0.22	0.24	0.02
O045	0.16	0.22	0.06
O046	0.14	0.19	0.06
O047	0.17	0.18	0.01
O048	0.06	0.08	0.02
O049	0.28	0.27	-0.02
O050	0.09	0.10	0.01
O051	0.07	0.06	-0.00
O052	0.10	0.13	0.02
O053	0.11	0.13	0.02
O054	0.26	0.25	-0.01
O055	0.28	0.27	-0.01
O056	0.27	0.26	-0.00
O057	0.07	0.06	-0.02
O058	0.06	0.05	-0.01
O059	0.02	0.02	0.00
O060	0.10	0.07	-0.03
O061	0.11	0.11	-0.01
O062	0.02	0.04	0.02
O063	0.14	0.14	0.00
O064	0.05	0.04	-0.00
O065	0.14	0.15	0.00
O066	0.20	0.20	0.00
O067	0.09	0.09	-0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.10	0.11	0.01
O069	0.02	0.02	-0.00
O070	0.23	0.23	0.00
O071	0.18	0.18	-0.00
O072	0.14	0.14	0.00
O073	0.09	0.08	-0.01
O074	0.17	0.15	-0.02
O075	0.20	0.18	-0.02
O076	0.05	0.04	-0.01
O077	0.04	0.07	0.03
O078	0.06	0.08	0.02
O079	0.14	0.15	0.00
O080	0.25	0.27	0.01
O081	0.09	0.11	0.02
O082	0.07	0.08	0.01
O083	0.35	0.34	-0.01
O084	0.30	0.32	0.01
O085	0.28	0.31	0.03
O086	0.24	0.20	-0.03
O087	0.25	0.24	-0.01
O088	0.20	0.20	-0.00
O089	0.26	0.25	-0.01
O090	0.23	0.24	0.01
O091	0.07	0.09	0.02
O092	0.09	0.12	0.03
O093	0.12	0.16	0.04
O094	0.11	0.08	-0.03
O095	0.11	0.10	-0.01
O096	0.08	0.07	-0.00
O097	0.14	0.13	-0.00
O098	0.23	0.23	0.00
O099	0.14	0.15	0.01
O100	0.03	0.03	-0.01
O101	0.13	0.14	0.01
O102	0.08	0.10	0.02
O103	0.27	0.26	-0.00
O104	0.27	0.27	-0.00
O105	0.25	0.25	-0.00
O106	0.21	0.22	0.01
O107	0.03	0.04	0.01
O108	0.06	0.05	-0.01
O109	0.08	0.08	0.00
O110	0.09	0.09	0.00
O111	0.10	0.11	0.01
O112	0.09	0.09	-0.00
O113	0.17	0.19	0.03
O114	0.14	0.14	-0.00
O115	0.13	0.11	-0.01
O116	0.11	0.10	-0.01
O117	0.23	0.23	-0.00
O118	0.12	0.15	0.04
O119	0.12	0.18	0.06
O120	0.15	0.18	0.03
O121	0.19	0.18	-0.01
O122	0.09	0.10	0.00
O123	0.06	0.06	-0.00
O124	0.09	0.10	0.00
O125	0.12	0.14	0.02
O126	0.06	0.08	0.02
S01	0.07	0.09	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.12	0.08	
S03	0.06	0.03	
S04	0.03	0.04	
S05	0.04	0.11	
S06	0.06	0.10	
S07	0.06	0.16	
S08	0.03	0.15	
S09	0.02	0.14	
S10	0.05	0.21	
S11	0.04	0.09	
S12	0.05	0.03	
S13	0.05	0.14	
S14	0.13	0.05	
S15	0.08	Not exist in Proposed Scheme	
S16	0.14	Not exist in Proposed Scheme	
S17	0.09	Not exist in Proposed Scheme	
S18	0.13	Not exist in Proposed Scheme	
S19	0.02	Not exist in Proposed Scheme	
S20	0.07	Not exist in Proposed Scheme	
S31	0.06	0.06	
S32	0.03	0.02	
S33	0.10	0.11	
S34	0.04	0.10	
S35	0.09	0.11	
S36	0.07	0.04	
S37	0.09	0.29	
S38	0.06	0.11	
S39	0.21	0.26	
S40	0.20	0.13	
S41	0.24	0.16	
S42	0.29	0.25	
S43	0.16	0.14	
S44	0.23	0.21	

D.7. SSW

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.27	0.23	-0.04
P02	0.16	0.17	0.01
P03	0.22	0.21	-0.01
P04	0.25	0.25	-0.00
P05	0.36	0.26	-0.09
P06	0.26	0.28	0.01
P07	0.16	0.20	0.03
P08	0.05	0.15	0.09
P09	0.08	0.07	-0.01
P10	0.12	0.08	-0.04
P11	0.03	0.08	0.05
P12	0.02	0.07	0.05
P13	0.00	0.06	0.06
P14	0.01	0.03	0.02
P15	0.00	0.03	0.03
P16	0.01	0.04	0.02
P17	0.04	0.05	0.01
P18	0.05	0.04	-0.01
P19	0.04	0.03	-0.01
P20	0.04	0.04	-0.00
P21	0.05	0.04	-0.01
P22	0.02	0.05	0.03
P23	0.18	0.30	0.12
P24	0.05	0.07	0.02
P25	0.07	0.06	-0.01
P26	0.09	0.07	-0.02
P27	0.11	0.06	-0.05
P28	0.31	0.30	-0.02
P29	0.28	0.31	0.03
P30	0.02	0.04	0.02
P31	0.06	0.03	-0.03
P32	0.07	0.01	-0.05
P33	0.11	0.04	-0.07
P34	0.12	0.08	-0.03
P35	0.12	0.06	-0.06
P36	0.06	0.08	0.02
P37	0.04	0.05	0.01
P38	0.04	0.05	0.01
P39	0.05	0.06	0.01
P40	0.04	0.04	0.00
P41	0.03	0.02	-0.01
P42	0.04	0.09	0.05
P43	0.07	0.06	-0.01
P44	0.06	0.05	-0.01
P45	0.03	0.02	-0.01
P46	0.12	0.12	0.01
P47	0.28	0.26	-0.02
P48	0.40	0.35	-0.05
O001	0.17	0.11	-0.06
O002	0.12	0.09	-0.02
O003	0.15	0.12	-0.03
O004	0.35	0.28	-0.07
O005	0.12	0.09	-0.03
O006	0.04	0.07	0.03
O007	0.03	0.06	0.03

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.07	0.05	-0.02
O009	0.12	0.06	-0.06
O010	0.07	0.05	-0.02
O011	0.07	0.05	-0.01
O012	0.23	0.17	-0.06
O013	0.17	0.15	-0.02
O014	0.26	0.27	0.02
O015	0.25	0.20	-0.05
O016	0.09	0.03	-0.07
O017	0.08	0.08	-0.00
O018	0.12	0.12	-0.00
O019	0.05	0.04	-0.01
O020	0.08	0.10	0.02
O021	0.03	0.04	0.02
O022	0.09	0.09	0.00
O023	0.02	0.05	0.03
O024	0.09	0.10	0.01
O025	0.05	0.06	0.00
O026	0.06	0.02	-0.05
O027	0.03	0.03	0.00
O028	0.07	0.06	-0.01
O029	0.05	0.02	-0.04
O030	0.24	0.24	0.00
O031	0.27	0.29	0.02
O032	0.13	0.15	0.02
O033	0.05	0.07	0.02
O034	0.23	0.23	0.01
O035	0.34	0.29	-0.05
O036	0.29	0.26	-0.03
O037	0.33	0.24	-0.09
O038	0.18	0.16	-0.01
O039	0.19	0.18	-0.01
O040	0.26	0.26	0.00
O041	0.32	0.33	0.01
O042	0.29	0.30	0.01
O043	0.07	0.09	0.02
O044	0.04	0.03	-0.00
O045	0.04	0.05	0.01
O046	0.10	0.01	-0.08
O047	0.12	0.10	-0.02
O048	0.06	0.03	-0.02
O049	0.32	0.35	0.02
O050	0.07	0.05	-0.02
O051	0.04	0.05	0.01
O052	0.13	0.17	0.04
O053	0.09	0.14	0.05
O054	0.38	0.37	-0.00
O055	0.40	0.40	0.00
O056	0.40	0.42	0.02
O057	0.06	0.07	0.00
O058	0.16	0.14	-0.02
O059	0.00	0.02	0.01
O060	0.04	0.01	-0.03
O061	0.05	0.03	-0.03
O062	0.03	0.03	-0.01
O063	0.01	0.01	0.00
O064	0.06	0.10	0.03
O065	0.03	0.02	-0.00
O066	0.10	0.13	0.03
O067	0.13	0.16	0.03

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.13	0.15	0.03
O069	0.16	0.18	0.03
O070	0.03	0.03	0.00
O071	0.01	0.01	-0.00
O072	0.24	0.28	0.05
O073	0.21	0.18	-0.03
O074	0.07	0.06	-0.01
O075	0.14	0.13	-0.01
O076	0.05	0.08	0.03
O077	0.32	0.32	0.01
O078	0.11	0.11	0.01
O079	0.19	0.16	-0.04
O080	0.31	0.33	0.03
O081	0.17	0.15	-0.01
O082	0.01	0.04	0.03
O083	0.15	0.22	0.07
O084	0.05	0.10	0.04
O085	0.01	0.07	0.06
O086	0.06	0.06	0.01
O087	0.09	0.09	0.00
O088	0.07	0.05	-0.01
O089	0.02	0.03	0.00
O090	0.01	0.02	0.01
O091	0.06	0.12	0.06
O092	0.06	0.10	0.05
O093	0.15	0.15	0.00
O094	0.33	0.33	0.00
O095	0.08	0.06	-0.01
O096	0.18	0.18	-0.00
O097	0.07	0.05	-0.02
O098	0.05	0.04	-0.02
O099	0.01	0.09	0.08
O100	0.01	0.01	0.01
O101	0.04	0.04	-0.00
O102	0.02	0.00	-0.02
O103	0.09	0.14	0.05
O104	0.08	0.12	0.04
O105	0.07	0.11	0.04
O106	0.08	0.11	0.03
O107	0.03	0.05	0.02
O108	0.06	0.06	-0.00
O109	0.04	0.03	-0.01
O110	0.05	0.04	-0.00
O111	0.26	0.28	0.01
O112	0.22	0.23	0.01
O113	0.07	0.08	0.01
O114	0.14	0.08	-0.07
O115	0.09	0.05	-0.04
O116	0.07	0.04	-0.04
O117	0.07	0.02	-0.05
O118	0.08	0.07	-0.01
O119	0.04	0.03	-0.01
O120	0.07	0.09	0.02
O121	0.17	0.19	0.02
O122	0.08	0.08	0.00
O123	0.04	0.04	0.00
O124	0.02	0.01	-0.01
O125	0.05	0.05	-0.00
O126	0.05	0.05	0.00
S01	0.05	0.04	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.04	0.03	
S03	0.06	0.02	
S04	0.07	0.01	
S05	0.04	0.02	
S06	0.02	0.04	
S07	0.06	0.04	
S08	0.01	0.03	
S09	0.01	0.02	
S10	0.06	0.09	
S11	0.04	0.06	
S12	0.04	0.02	
S13	0.06	0.06	
S14	0.04	0.02	
S15	0.07	Not exist in Proposed Scheme	
S16	0.10	Not exist in Proposed Scheme	
S17	0.09	Not exist in Proposed Scheme	
S18	0.06	Not exist in Proposed Scheme	
S19	0.09	Not exist in Proposed Scheme	
S20	0.06	Not exist in Proposed Scheme	
S31	0.36	0.32	
S32	0.34	0.30	
S33	0.09	0.19	
S34	0.18	0.15	
S35	0.23	0.23	
S36	0.04	0.15	
S37	0.07	0.10	
S38	0.02	0.11	
S39	0.06	0.15	
S40	0.26	0.26	
S41	0.29	0.26	
S42	0.31	0.32	
S43	0.10	0.05	
S44	0.12	0.07	

D.8. SW

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.32	0.26	-0.06
P02	0.01	0.20	0.18
P03	0.04	0.12	0.08
P04	0.11	0.05	-0.05
P05	0.29	0.20	-0.09
P06	0.13	0.22	0.09
P07	0.23	0.13	-0.11
P08	0.04	0.16	0.11
P09	0.13	0.16	0.03
P10	0.20	0.20	0.00
P11	0.22	0.24	0.02
P12	0.20	0.25	0.05
P13	0.18	0.26	0.08
P14	0.12	0.23	0.11
P15	0.15	0.23	0.08
P16	0.13	0.19	0.06
P17	0.12	0.21	0.09
P18	0.12	0.20	0.08
P19	0.13	0.20	0.07
P20	0.12	0.20	0.07
P21	0.12	0.18	0.05
P22	0.13	0.16	0.03
P23	0.13	0.19	0.05
P24	0.16	0.20	0.04
P25	0.19	0.22	0.03
P26	0.13	0.18	0.05
P27	0.07	0.07	0.00
P28	0.07	0.11	0.04
P29	0.13	0.12	-0.01
P30	0.13	0.12	-0.02
P31	0.15	0.12	-0.03
P32	0.17	0.15	-0.03
P33	0.21	0.16	-0.06
P34	0.19	0.12	-0.07
P35	0.19	0.09	-0.10
P36	0.13	0.16	0.03
P37	0.06	0.05	-0.01
P38	0.09	0.07	-0.02
P39	0.11	0.10	-0.02
P40	0.11	0.11	0.00
P41	0.09	0.10	0.01
P42	0.09	0.12	0.02
P43	0.13	0.15	0.02
P44	0.14	0.16	0.02
P45	0.11	0.16	0.05
P46	0.12	0.20	0.08
P47	0.25	0.25	0.00
P48	0.32	0.27	-0.05
O001	0.09	0.10	0.01
O002	0.05	0.07	0.02
O003	0.02	0.01	-0.01
O004	0.26	0.17	-0.09
O005	0.15	0.16	0.01
O006	0.23	0.25	0.02
O007	0.21	0.23	0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.17	0.20	0.04
O009	0.06	0.21	0.15
O010	0.09	0.10	0.01
O011	0.12	0.12	0.01
O012	0.11	0.11	0.00
O013	0.04	0.04	-0.00
O014	0.24	0.20	-0.03
O015	0.10	0.07	-0.03
O016	0.07	0.07	0.00
O017	0.13	0.15	0.02
O018	0.21	0.23	0.02
O019	0.12	0.13	0.01
O020	0.04	0.02	-0.02
O021	0.18	0.16	-0.01
O022	0.12	0.13	0.01
O023	0.18	0.19	0.01
O024	0.25	0.25	0.00
O025	0.17	0.15	-0.02
O026	0.12	0.12	0.00
O027	0.26	0.17	-0.09
O028	0.20	0.22	0.02
O029	0.07	0.03	-0.03
O030	0.11	0.10	-0.01
O031	0.09	0.05	-0.03
O032	0.08	0.05	-0.03
O033	0.00	0.00	-0.00
O034	0.10	0.04	-0.07
O035	0.12	0.10	-0.02
O036	0.22	0.21	-0.02
O037	0.29	0.24	-0.05
O038	0.05	0.06	0.01
O039	0.02	0.04	0.02
O040	0.07	0.02	-0.04
O041	0.26	0.26	-0.00
O042	0.26	0.28	0.03
O043	0.14	0.19	0.05
O044	0.11	0.10	-0.00
O045	0.09	0.07	-0.02
O046	0.17	0.16	-0.01
O047	0.20	0.14	-0.06
O048	0.15	0.12	-0.04
O049	0.12	0.12	-0.00
O050	0.07	0.15	0.08
O051	0.10	0.09	-0.01
O052	0.16	0.16	-0.01
O053	0.02	0.03	0.00
O054	0.05	0.08	0.03
O055	0.09	0.07	-0.01
O056	0.16	0.18	0.02
O057	0.17	0.11	-0.06
O058	0.10	0.09	-0.01
O059	0.12	0.12	-0.00
O060	0.23	0.22	-0.00
O061	0.21	0.23	0.02
O062	0.13	0.14	0.01
O063	0.09	0.08	-0.01
O064	0.13	0.15	0.01
O065	0.03	0.03	-0.00
O066	0.14	0.13	-0.01
O067	0.12	0.12	-0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.11	0.11	-0.00
O069	0.04	0.03	-0.01
O070	0.16	0.15	-0.01
O071	0.05	0.03	-0.02
O072	0.22	0.23	0.02
O073	0.07	0.10	0.03
O074	0.12	0.13	0.01
O075	0.20	0.19	-0.01
O076	0.02	0.02	-0.01
O077	0.31	0.29	-0.02
O078	0.21	0.21	0.00
O079	0.06	0.04	-0.02
O080	0.28	0.27	-0.01
O081	0.19	0.26	0.07
O082	0.11	0.19	0.08
O083	0.15	0.09	-0.06
O084	0.25	0.25	-0.00
O085	0.23	0.24	0.02
O086	0.18	0.22	0.03
O087	0.13	0.14	0.01
O088	0.14	0.11	-0.03
O089	0.15	0.12	-0.02
O090	0.16	0.14	-0.02
O091	0.09	0.10	0.01
O092	0.03	0.04	0.01
O093	0.05	0.03	-0.02
O094	0.30	0.28	-0.02
O095	0.03	0.08	0.05
O096	0.05	0.05	-0.00
O097	0.13	0.11	-0.03
O098	0.18	0.17	-0.01
O099	0.12	0.09	-0.04
O100	0.05	0.01	-0.04
O101	0.04	0.03	-0.01
O102	0.13	0.09	-0.04
O103	0.20	0.27	0.06
O104	0.23	0.28	0.06
O105	0.24	0.29	0.05
O106	0.24	0.28	0.04
O107	0.11	0.09	-0.02
O108	0.08	0.10	0.02
O109	0.03	0.03	-0.00
O110	0.09	0.09	-0.01
O111	0.13	0.12	-0.01
O112	0.05	0.05	-0.00
O113	0.07	0.06	-0.01
O114	0.03	0.04	0.01
O115	0.02	0.02	0.00
O116	0.06	0.08	0.02
O117	0.07	0.03	-0.03
O118	0.02	0.02	-0.00
O119	0.04	0.06	0.02
O120	0.03	0.03	-0.00
O121	0.03	0.01	-0.01
O122	0.12	0.10	-0.02
O123	0.04	0.02	-0.02
O124	0.03	0.06	0.03
O125	0.08	0.08	0.00
O126	0.11	0.12	0.00
S01	0.14	0.09	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.10	0.05	
S03	0.06	0.10	
S04	0.16	0.02	
S05	0.08	0.02	
S06	0.02	0.05	
S07	0.12	0.01	
S08	0.09	0.00	
S09	0.01	0.04	
S10	0.10	0.07	
S11	0.07	0.12	
S12	0.04	0.01	
S13	0.06	0.05	
S14	0.06	0.04	
S15	0.11	Not exist in Proposed Scheme	
S16	0.14	Not exist in Proposed Scheme	
S17	0.16	Not exist in Proposed Scheme	
S18	0.12	Not exist in Proposed Scheme	
S19	0.15	Not exist in Proposed Scheme	
S20	0.10	Not exist in Proposed Scheme	
S31	0.32	0.27	
S32	0.29	0.24	
S33	0.10	0.12	
S34	0.23	0.23	
S35	0.19	0.22	
S36	0.09	0.18	
S37	0.02	0.02	
S38	0.10	0.12	
S39	0.15	0.14	
S40	0.03	0.05	
S41	0.05	0.02	
S42	0.09	0.11	
S43	0.13	0.13	
S44	0.08	0.03	

D.9. S

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.18	0.15	-0.04
P02	0.09	0.10	0.01
P03	0.11	0.13	-0.01
P04	0.14	0.14	-0.00
P05	0.19	0.17	-0.09
P06	0.08	0.16	0.01
P07	0.07	0.06	0.03
P08	0.08	0.07	0.09
P09	0.11	0.11	-0.01
P10	0.12	0.11	-0.04
P11	0.11	0.12	0.05
P12	0.14	0.14	0.05
P13	0.14	0.15	0.06
P14	0.14	0.15	0.02
P15	0.14	0.15	0.03
P16	0.14	0.15	0.02
P17	0.13	0.15	0.01
P18	0.08	0.10	-0.01
P19	0.02	0.03	-0.01
P20	0.11	0.08	-0.00
P21	0.16	0.15	-0.01
P22	0.02	0.13	0.03
P23	0.11	0.32	0.12
P24	0.03	0.11	0.02
P25	0.04	0.02	-0.01
P26	0.02	0.02	-0.02
P27	0.09	0.06	-0.05
P28	0.35	0.34	-0.02
P29	0.33	0.32	0.03
P30	0.06	0.04	0.02
P31	0.04	0.04	-0.03
P32	0.01	0.03	-0.05
P33	0.05	0.04	-0.07
P34	0.08	0.04	-0.03
P35	0.10	0.03	-0.06
P36	0.07	0.06	0.02
P37	0.07	0.07	0.01
P38	0.07	0.09	0.01
P39	0.09	0.09	0.01
P40	0.09	0.07	0.00
P41	0.09	0.06	-0.01
P42	0.08	0.05	0.05
P43	0.07	0.05	-0.01
P44	0.06	0.04	-0.01
P45	0.02	0.02	-0.01
P46	0.07	0.10	0.01
P47	0.16	0.17	-0.02
P48	0.24	0.25	-0.05
O001	0.03	0.03	-0.00
O002	0.05	0.06	0.01
O003	0.02	0.02	0.00
O004	0.16	0.16	0.00
O005	0.14	0.12	-0.01
O006	0.15	0.16	0.01
O007	0.15	0.16	0.01

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.06	0.07	0.01
O009	0.09	0.31	0.22
O010	0.05	0.03	-0.02
O011	0.10	0.11	0.01
O012	0.18	0.16	-0.02
O013	0.11	0.08	-0.03
O014	0.14	0.13	-0.01
O015	0.13	0.14	0.01
O016	0.13	0.12	-0.01
O017	0.19	0.16	-0.02
O018	0.17	0.15	-0.01
O019	0.13	0.14	0.01
O020	0.12	0.13	0.01
O021	0.08	0.07	-0.01
O022	0.16	0.16	0.00
O023	0.12	0.10	-0.02
O024	0.17	0.17	0.00
O025	0.10	0.10	0.00
O026	0.11	0.07	-0.04
O027	0.03	0.03	0.00
O028	0.05	0.04	-0.00
O029	0.03	0.05	0.02
O030	0.15	0.15	0.01
O031	0.11	0.12	0.02
O032	0.09	0.09	-0.00
O033	0.04	0.05	0.01
O034	0.29	0.29	0.00
O035	0.30	0.30	0.00
O036	0.27	0.28	0.01
O037	0.21	0.24	0.02
O038	0.08	0.10	0.01
O039	0.11	0.11	0.01
O040	0.13	0.13	0.00
O041	0.22	0.24	0.03
O042	0.18	0.22	0.03
O043	0.08	0.05	-0.03
O044	0.09	0.07	-0.02
O045	0.07	0.08	0.01
O046	0.02	0.04	0.02
O047	0.08	0.02	-0.06
O048	0.05	0.03	-0.01
O049	0.34	0.34	-0.01
O050	0.05	0.04	-0.01
O051	0.09	0.10	0.01
O052	0.19	0.17	-0.02
O053	0.21	0.19	-0.02
O054	0.34	0.34	0.00
O055	0.31	0.31	-0.00
O056	0.36	0.37	0.00
O057	0.11	0.11	0.01
O058	0.14	0.13	-0.01
O059	0.03	0.03	0.00
O060	0.10	0.10	-0.00
O061	0.15	0.16	0.01
O062	0.09	0.10	0.01
O063	0.06	0.06	-0.00
O064	0.11	0.10	-0.01
O065	0.10	0.10	-0.00
O066	0.20	0.19	-0.01
O067	0.18	0.16	-0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.18	0.18	-0.01
O069	0.15	0.14	-0.01
O070	0.13	0.13	0.00
O071	0.15	0.15	0.00
O072	0.17	0.18	0.01
O073	0.06	0.08	0.03
O074	0.11	0.07	-0.03
O075	0.03	0.05	0.02
O076	0.03	0.03	-0.01
O077	0.23	0.26	0.03
O078	0.05	0.06	0.01
O079	0.12	0.12	-0.01
O080	0.10	0.16	0.06
O081	0.16	0.16	-0.00
O082	0.08	0.10	0.02
O083	0.11	0.07	-0.04
O084	0.14	0.14	0.00
O085	0.15	0.16	0.01
O086	0.13	0.14	0.01
O087	0.11	0.13	0.02
O088	0.08	0.08	-0.00
O089	0.09	0.05	-0.04
O090	0.11	0.10	-0.01
O091	0.13	0.22	0.09
O092	0.12	0.18	0.05
O093	0.14	0.24	0.11
O094	0.24	0.26	0.02
O095	0.13	0.16	0.02
O096	0.11	0.09	-0.02
O097	0.05	0.04	-0.01
O098	0.13	0.13	0.00
O099	0.19	0.20	0.01
O100	0.07	0.06	-0.00
O101	0.11	0.11	-0.01
O102	0.12	0.09	-0.02
O103	0.23	0.21	-0.03
O104	0.25	0.21	-0.04
O105	0.26	0.21	-0.05
O106	0.24	0.19	-0.05
O107	0.15	0.12	-0.02
O108	0.14	0.11	-0.03
O109	0.10	0.09	-0.01
O110	0.12	0.10	-0.02
O111	0.05	0.09	0.03
O112	0.09	0.08	-0.01
O113	0.11	0.11	0.00
O114	0.11	0.12	0.01
O115	0.10	0.11	0.01
O116	0.14	0.15	0.01
O117	0.22	0.22	0.00
O118	0.22	0.20	-0.02
O119	0.31	0.30	-0.01
O120	0.28	0.29	0.01
O121	0.30	0.30	-0.01
O122	0.08	0.08	-0.00
O123	0.04	0.05	0.00
O124	0.01	0.02	0.01
O125	0.05	0.06	0.01
O126	0.04	0.05	0.01
S01	0.03	0.05	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.04	0.04	
S03	0.06	0.02	
S04	0.03	0.03	
S05	0.05	0.05	
S06	0.01	0.07	
S07	0.07	0.07	
S08	0.07	0.03	
S09	0.04	0.02	
S10	0.09	0.07	
S11	0.07	0.04	
S12	0.04	0.06	
S13	0.03	0.01	
S14	0.05	0.02	
S15	0.05	Not exist in Proposed Scheme	
S16	0.07	Not exist in Proposed Scheme	
S17	0.08	Not exist in Proposed Scheme	
S18	0.04	Not exist in Proposed Scheme	
S19	0.03	Not exist in Proposed Scheme	
S20	0.03	Not exist in Proposed Scheme	
S31	0.19	0.20	
S32	0.20	0.20	
S33	0.07	0.11	
S34	0.14	0.12	
S35	0.13	0.16	
S36	0.04	0.06	
S37	0.19	0.25	
S38	0.12	0.21	
S39	0.07	0.24	
S40	0.29	0.25	
S41	0.33	0.25	
S42	0.36	0.33	
S43	0.02	0.01	
S44	0.09	0.06	

D.10. WSW

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.30	0.30	-0.01
P02	0.18	0.12	-0.06
P03	0.13	0.08	-0.05
P04	0.27	0.26	-0.00
P05	0.29	0.23	-0.06
P06	0.16	0.18	0.02
P07	0.26	0.19	-0.07
P08	0.24	0.28	0.04
P09	0.29	0.07	-0.22
P10	0.12	0.12	0.00
P11	0.10	0.13	0.03
P12	0.06	0.13	0.07
P13	0.07	0.11	0.05
P14	0.06	0.09	0.03
P15	0.06	0.09	0.03
P16	0.06	0.12	0.06
P17	0.07	0.15	0.08
P18	0.09	0.14	0.06
P19	0.10	0.13	0.03
P20	0.10	0.11	0.01
P21	0.10	0.09	-0.01
P22	0.12	0.08	-0.04
P23	0.09	0.09	0.01
P24	0.12	0.11	-0.01
P25	0.12	0.12	-0.01
P26	0.11	0.14	0.02
P27	0.09	0.05	-0.03
P28	0.16	0.11	-0.05
P29	0.16	0.12	-0.04
P30	0.15	0.11	-0.04
P31	0.18	0.09	-0.09
P32	0.16	0.10	-0.06
P33	0.16	0.10	-0.06
P34	0.13	0.08	-0.05
P35	0.15	0.10	-0.04
P36	0.18	0.08	-0.10
P37	0.22	0.15	-0.07
P38	0.23	0.16	-0.07
P39	0.24	0.19	-0.05
P40	0.21	0.23	0.01
P41	0.20	0.19	-0.01
P42	0.21	0.18	-0.03
P43	0.21	0.13	-0.08
P44	0.20	0.11	-0.09
P45	0.17	0.19	0.02
P46	0.19	0.26	0.07
P47	0.30	0.24	-0.06
P48	0.34	0.34	0.00
O001	0.02	0.04	0.02
O002	0.06	0.01	-0.04
O003	0.00	0.00	0.00
O004	0.28	0.27	-0.01
O005	0.28	0.08	-0.20
O006	0.08	0.13	0.05
O007	0.10	0.12	0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.12	0.16	0.04
O009	0.02	0.13	0.11
O010	0.07	0.05	-0.01
O011	0.12	0.13	0.00
O012	0.10	0.09	-0.01
O013	0.05	0.07	0.02
O014	0.15	0.14	-0.01
O015	0.01	0.05	0.04
O016	0.19	0.22	0.03
O017	0.05	0.05	0.00
O018	0.08	0.11	0.04
O019	0.04	0.02	-0.01
O020	0.04	0.03	-0.01
O021	0.10	0.11	0.01
O022	0.07	0.05	-0.02
O023	0.11	0.09	-0.02
O024	0.15	0.13	-0.02
O025	0.09	0.08	-0.01
O026	0.14	0.15	0.01
O027	0.29	0.27	-0.02
O028	0.22	0.21	-0.01
O029	0.11	0.09	-0.02
O030	0.12	0.08	-0.04
O031	0.12	0.11	-0.00
O032	0.06	0.06	0.00
O033	0.02	0.03	0.01
O034	0.06	0.03	-0.03
O035	0.14	0.12	-0.02
O036	0.20	0.20	0.00
O037	0.25	0.22	-0.03
O038	0.09	0.05	-0.04
O039	0.04	0.01	-0.03
O040	0.02	0.04	0.02
O041	0.32	0.33	0.01
O042	0.32	0.39	0.07
O043	0.20	0.17	-0.03
O044	0.21	0.22	0.01
O045	0.25	0.19	-0.06
O046	0.20	0.15	-0.06
O047	0.14	0.09	-0.05
O048	0.15	0.07	-0.09
O049	0.14	0.11	-0.03
O050	0.09	0.08	-0.01
O051	0.08	0.09	0.01
O052	0.18	0.18	0.00
O053	0.02	0.01	-0.01
O054	0.03	0.06	0.03
O055	0.07	0.05	-0.01
O056	0.22	0.24	0.02
O057	0.09	0.07	-0.02
O058	0.08	0.10	0.02
O059	0.32	0.33	0.01
O060	0.37	0.37	-0.00
O061	0.33	0.35	0.01
O062	0.03	0.07	0.04
O063	0.06	0.04	-0.02
O064	0.19	0.21	0.03
O065	0.04	0.07	0.03
O066	0.19	0.20	0.00
O067	0.16	0.18	0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.14	0.17	0.03
O069	0.03	0.03	0.01
O070	0.16	0.02	-0.14
O071	0.13	0.15	0.01
O072	0.16	0.06	-0.10
O073	0.20	0.16	-0.04
O074	0.05	0.06	0.01
O075	0.11	0.14	0.03
O076	0.03	0.04	0.01
O077	0.31	0.31	0.00
O078	0.25	0.25	-0.00
O079	0.16	0.13	-0.03
O080	0.11	0.06	-0.05
O081	0.27	0.26	-0.00
O082	0.18	0.23	0.05
O083	0.17	0.25	0.08
O084	0.14	0.16	0.02
O085	0.09	0.11	0.02
O086	0.10	0.15	0.05
O087	0.07	0.07	-0.01
O088	0.07	0.07	-0.00
O089	0.08	0.08	0.00
O090	0.09	0.08	-0.01
O091	0.03	0.04	0.01
O092	0.05	0.02	-0.03
O093	0.01	0.01	0.00
O094	0.24	0.19	-0.05
O095	0.05	0.07	0.02
O096	0.09	0.02	-0.07
O097	0.15	0.09	-0.06
O098	0.17	0.14	-0.03
O099	0.05	0.06	0.01
O100	0.13	0.13	-0.00
O101	0.07	0.08	0.01
O102	0.10	0.09	-0.01
O103	0.20	0.15	-0.05
O104	0.22	0.15	-0.07
O105	0.23	0.17	-0.06
O106	0.22	0.20	-0.02
O107	0.05	0.06	0.01
O108	0.08	0.08	0.00
O109	0.03	0.02	-0.00
O110	0.05	0.07	0.02
O111	0.09	0.09	-0.00
O112	0.15	0.13	-0.02
O113	0.17	0.14	-0.03
O114	0.07	0.05	-0.02
O115	0.02	0.03	0.01
O116	0.06	0.09	0.03
O117	0.02	0.02	0.00
O118	0.04	0.02	-0.02
O119	0.08	0.09	0.01
O120	0.06	0.06	0.01
O121	0.06	0.07	0.01
O122	0.07	0.06	-0.01
O123	0.05	0.06	0.01
O124	0.02	0.03	0.01
O125	0.10	0.11	0.00
O126	0.15	0.15	0.00
S01	0.23	0.06	

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.18	0.08	
S03	0.13	0.20	
S04	0.22	0.07	
S05	0.14	0.09	
S06	0.01	0.14	
S07	0.18	0.12	
S08	0.11	0.07	
S09	0.02	0.03	
S10	0.11	0.09	
S11	0.12	0.10	
S12	0.06	0.02	
S13	0.08	0.06	
S14	0.08	0.04	
S15	0.08	Not exist in Proposed Scheme	
S16	0.16	Not exist in Proposed Scheme	
S17	0.04	Not exist in Proposed Scheme	
S18	0.07	Not exist in Proposed Scheme	
S19	0.11	Not exist in Proposed Scheme	
S20	0.04	Not exist in Proposed Scheme	
S31	0.33	0.29	
S32	0.35	0.27	
S33	0.14	0.13	
S34	0.28	0.28	
S35	0.23	0.25	
S36	0.13	0.31	
S37	0.03	0.02	
S38	0.07	0.09	
S39	0.14	0.10	
S40	0.03	0.01	
S41	0.01	0.03	
S42	0.16	0.11	
S43	0.10	0.10	
S44	0.06	0.04	

D.11. SSE

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
P01	0.01	0.06	0.04
P02	0.04	0.06	0.02
P03	0.04	0.07	0.03
P04	0.09	0.11	0.02
P05	0.12	0.13	0.00
P06	0.15	0.16	0.01
P07	0.28	0.23	-0.05
P08	0.29	0.28	-0.01
P09	0.29	0.28	-0.01
P10	0.28	0.28	-0.01
P11	0.26	0.28	0.02
P12	0.27	0.28	0.01
P13	0.25	0.27	0.02
P14	0.25	0.28	0.02
P15	0.25	0.28	0.02
P16	0.24	0.25	0.01
P17	0.22	0.23	0.01
P18	0.15	0.17	0.02
P19	0.13	0.16	0.03
P20	0.14	0.17	0.03
P21	0.17	0.22	0.05
P22	0.18	0.23	0.04
P23	0.19	0.39	0.19
P24	0.04	0.07	0.03
P25	0.06	0.06	0.01
P26	0.06	0.07	0.01
P27	0.02	0.04	0.01
P28	0.31	0.31	-0.00
P29	0.28	0.28	-0.00
P30	0.03	0.04	0.01
P31	0.04	0.02	-0.03
P32	0.10	0.18	0.09
P33	0.16	0.15	-0.00
P34	0.10	0.11	0.01
P35	0.12	0.16	0.03
P36	0.06	0.16	0.10
P37	0.09	0.14	0.06
P38	0.11	0.15	0.04
P39	0.12	0.14	0.02
P40	0.13	0.14	0.01
P41	0.14	0.16	0.01
P42	0.15	0.16	0.01
P43	0.16	0.16	0.01
P44	0.17	0.16	-0.01
P45	0.11	0.16	0.05
P46	0.13	0.16	0.02
P47	0.10	0.13	0.03
P48	0.11	0.14	0.03
O001	0.18	0.17	-0.00
O002	0.25	0.24	-0.01
O003	0.03	0.03	-0.00
O004	0.29	0.31	0.01
O005	0.30	0.31	0.01
O006	0.28	0.29	0.01
O007	0.25	0.27	0.02

Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O008	0.17	0.19	0.02
O009	0.20	0.28	0.07
O010	0.07	0.06	-0.01
O011	0.11	0.07	-0.03
O012	0.08	0.11	0.02
O013	0.13	0.14	0.01
O014	0.04	0.06	0.02
O015	0.11	0.12	0.01
O016	0.11	0.12	0.01
O017	0.27	0.26	-0.00
O018	0.23	0.20	-0.02
O019	0.17	0.17	0.01
O020	0.14	0.15	0.01
O021	0.10	0.09	-0.01
O022	0.18	0.16	-0.02
O023	0.09	0.11	0.02
O024	0.02	0.13	0.11
O025	0.14	0.10	-0.03
O026	0.06	0.07	0.00
O027	0.03	0.03	-0.00
O028	0.01	0.01	-0.01
O029	0.05	0.04	-0.01
O030	0.06	0.07	0.00
O031	0.03	0.04	0.00
O032	0.04	0.04	0.00
O033	0.14	0.13	-0.00
O034	0.06	0.06	0.00
O035	0.08	0.10	0.01
O036	0.09	0.09	-0.00
O037	0.04	0.04	0.00
O038	0.05	0.07	0.02
O039	0.14	0.12	-0.02
O040	0.24	0.21	-0.03
O041	0.12	0.14	0.02
O042	0.16	0.17	0.01
O043	0.18	0.18	0.00
O044	0.14	0.15	0.01
O045	0.10	0.16	0.05
O046	0.07	0.16	0.09
O047	0.11	0.11	0.00
O048	0.08	0.04	-0.04
O049	0.32	0.28	-0.04
O050	0.07	0.09	0.02
O051	0.08	0.07	-0.01
O052	0.02	0.03	0.01
O053	0.03	0.04	0.01
O054	0.32	0.31	-0.01
O055	0.31	0.30	-0.00
O056	0.27	0.28	0.01
O057	0.08	0.07	-0.01
O058	0.10	0.11	0.01
O059	0.05	0.07	0.02
O060	0.05	0.07	0.02
O061	0.06	0.05	-0.01
O062	0.04	0.07	0.02
O063	0.08	0.09	0.01
O064	0.03	0.04	0.02
O065	0.08	0.10	0.02
O066	0.12	0.13	0.02
O067	0.03	0.01	-0.02

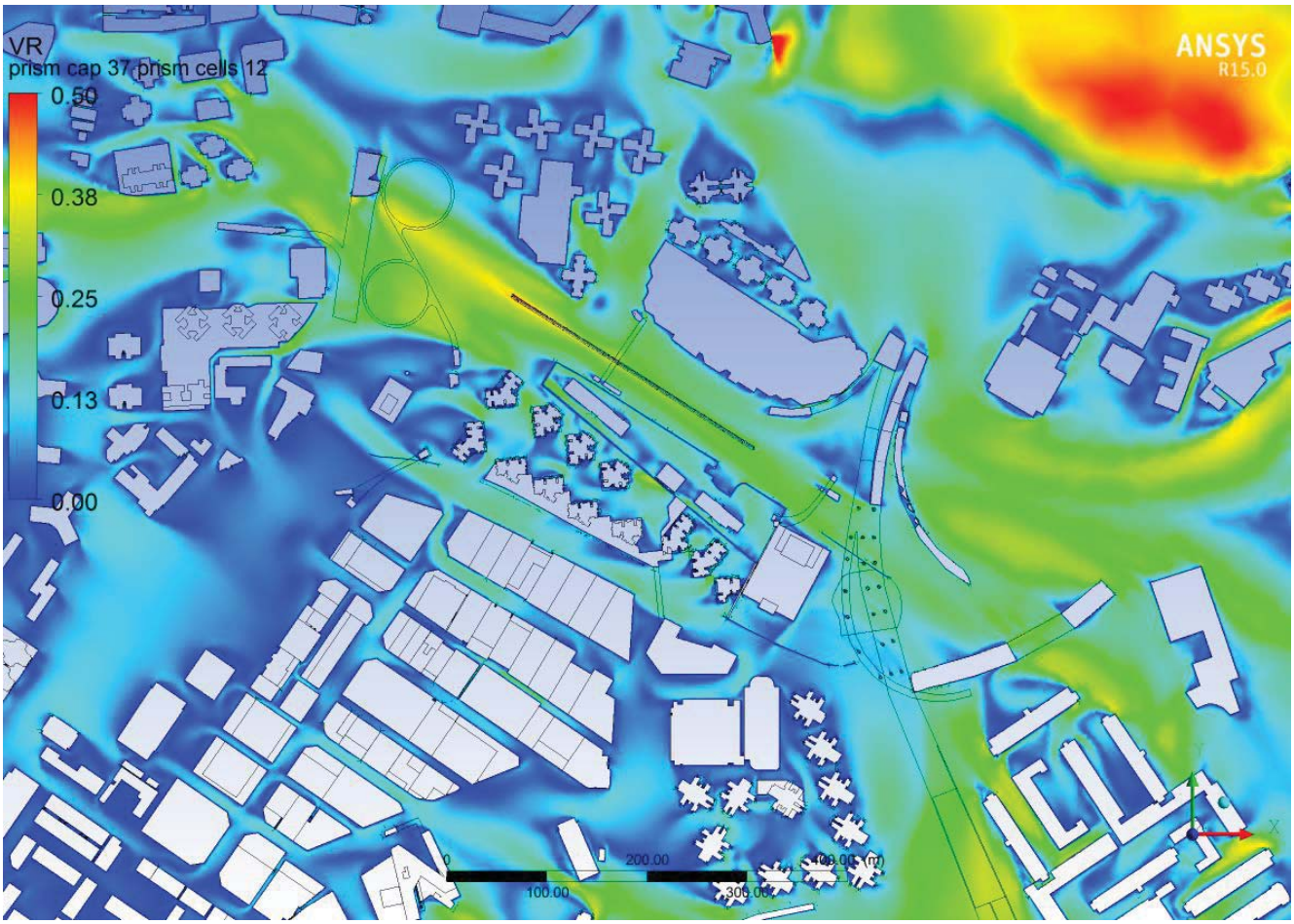
Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
O068	0.08	0.10	0.02
O069	0.07	0.03	-0.03
O070	0.15	0.17	0.02
O071	0.10	0.14	0.05
O072	0.14	0.18	0.04
O073	0.14	0.12	-0.03
O074	0.17	0.15	-0.01
O075	0.03	0.04	0.01
O076	0.01	0.06	0.04
O077	0.12	0.13	0.01
O078	0.03	0.02	-0.01
O079	0.10	0.11	0.01
O080	0.02	0.03	0.01
O081	0.04	0.05	0.00
O082	0.07	0.06	-0.01
O083	0.30	0.30	0.00
O084	0.28	0.29	0.01
O085	0.27	0.28	0.01
O086	0.21	0.23	0.02
O087	0.16	0.13	-0.03
O088	0.13	0.12	-0.01
O089	0.10	0.07	-0.02
O090	0.07	0.08	0.02
O091	0.12	0.17	0.05
O092	0.14	0.12	-0.02
O093	0.14	0.17	0.03
O094	0.13	0.13	-0.00
O095	0.08	0.09	0.02
O096	0.04	0.02	-0.02
O097	0.11	0.10	-0.00
O098	0.15	0.17	0.02
O099	0.06	0.13	0.07
O100	0.01	0.01	-0.00
O101	0.08	0.08	0.00
O102	0.07	0.06	-0.00
O103	0.24	0.28	0.03
O104	0.26	0.29	0.04
O105	0.24	0.28	0.04
O106	0.21	0.24	0.03
O107	0.15	0.16	0.01
O108	0.14	0.14	-0.00
O109	0.10	0.13	0.02
O110	0.09	0.10	0.01
O111	0.06	0.07	0.00
O112	0.04	0.04	-0.00
O113	0.04	0.03	-0.01
O114	0.18	0.17	-0.01
O115	0.21	0.19	-0.02
O116	0.17	0.14	-0.02
O117	0.22	0.23	0.01
O118	0.11	0.12	0.01
O119	0.06	0.09	0.03
O120	0.04	0.09	0.06
O121	0.09	0.14	0.04
O122	0.07	0.06	-0.01
O123	0.07	0.05	-0.02
O124	0.01	0.04	0.04
O125	0.02	0.02	-0.00
O126	0.02	0.01	-0.00
S01	0.05	0.09	

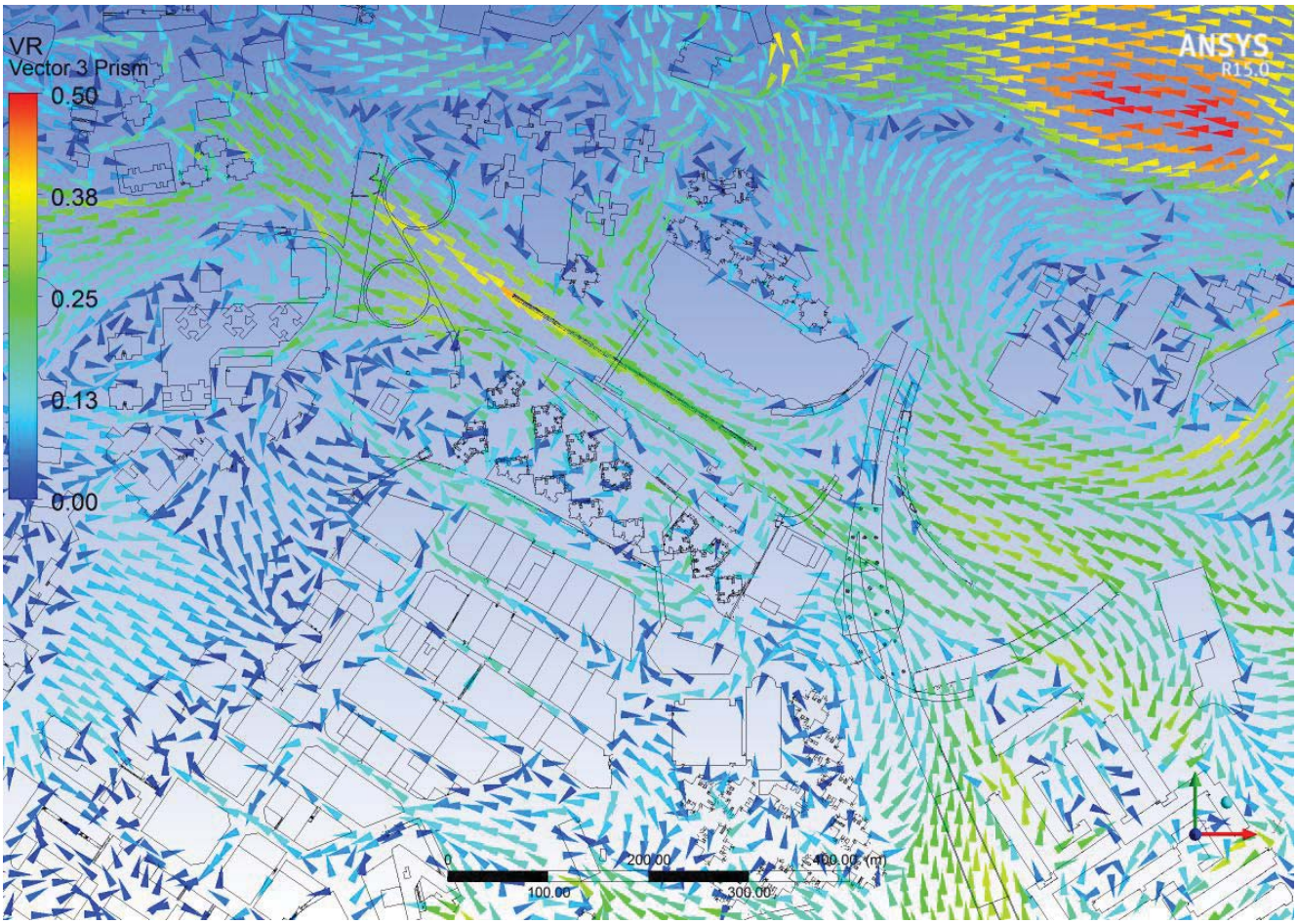
Test point	VR (Baseline Scheme)	VR (Proposed Scheme)	VR Change
S02	0.06	0.07	
S03	0.04	0.04	
S04	0.01	0.06	
S05	0.04	0.10	
S06	0.01	0.06	
S07	0.03	0.10	
S08	0.07	0.10	
S09	0.04	0.07	
S10	0.06	0.10	
S11	0.04	0.05	
S12	0.08	0.04	
S13	0.09	0.10	
S14	0.09	0.02	
S15	0.05	Not exist in Proposed Scheme	
S16	0.06	Not exist in Proposed Scheme	
S17	0.08	Not exist in Proposed Scheme	
S18	0.08	Not exist in Proposed Scheme	
S19	0.06	Not exist in Proposed Scheme	
S20	0.11	Not exist in Proposed Scheme	
S31	0.02	0.03	
S32	0.03	0.03	
S33	0.01	0.02	
S34	0.03	0.07	
S35	0.02	0.06	
S36	0.14	0.09	
S37	0.18	0.30	
S38	0.05	0.11	
S39	0.19	0.25	
S40	0.03	0.25	
S41	0.32	0.27	
S42	0.28	0.25	
S43	0.05	0.05	
S44	0.01	0.04	

Appendix E. Contour and Vector Plots of CFD Analysis Result of Velocity Ratio

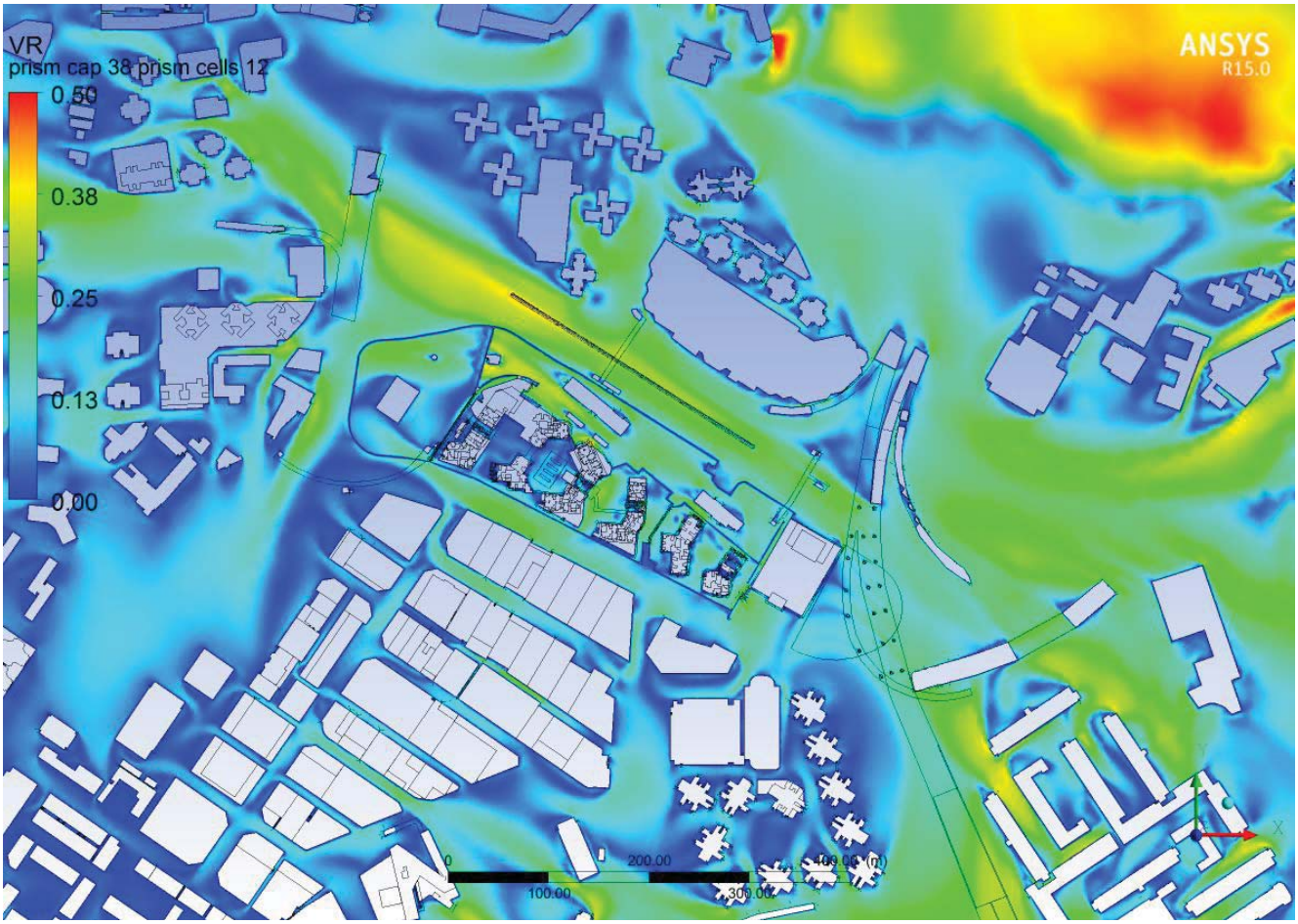
E.1. E Wind

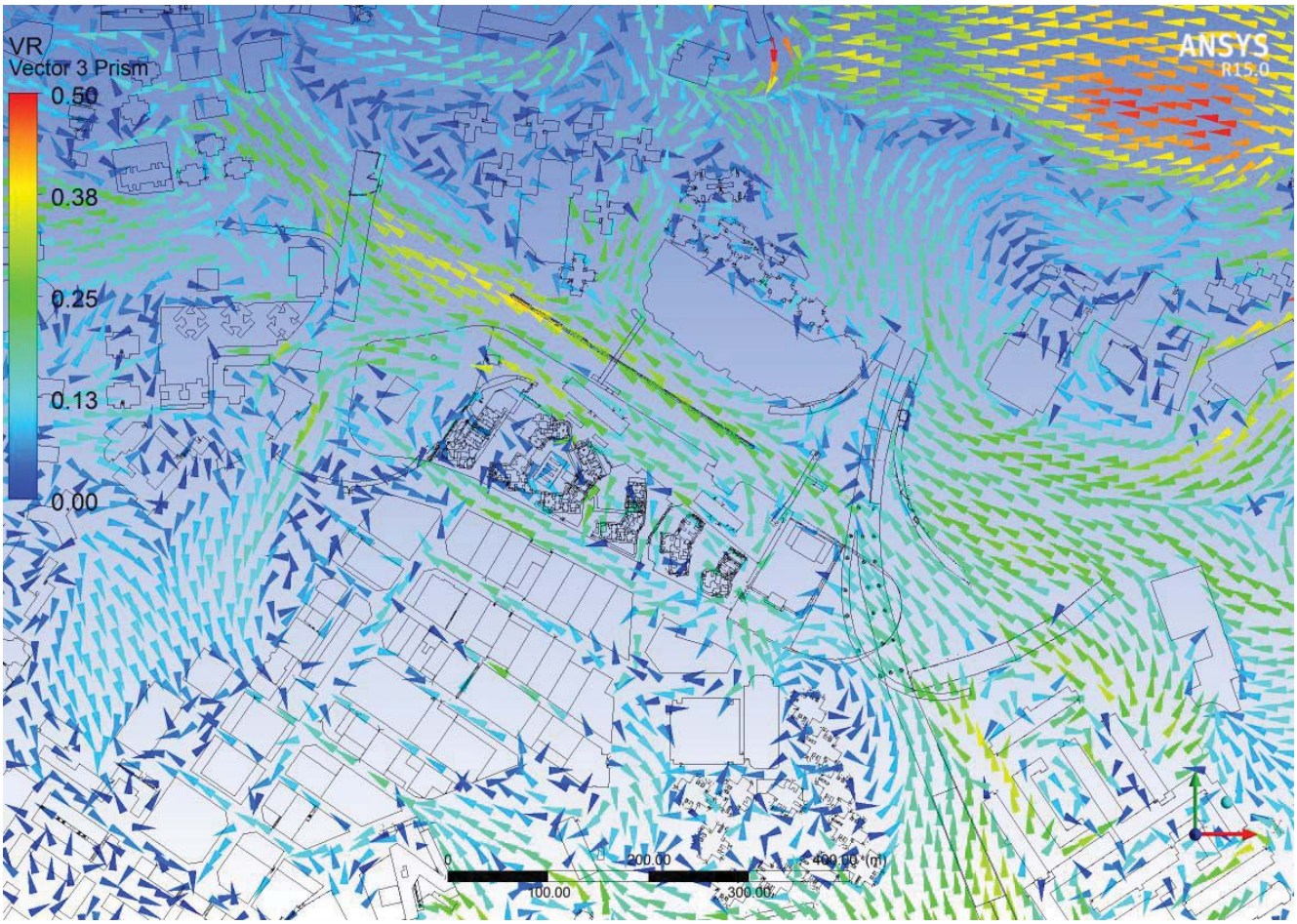
E.1.1. E Wind (Baseline Scheme)





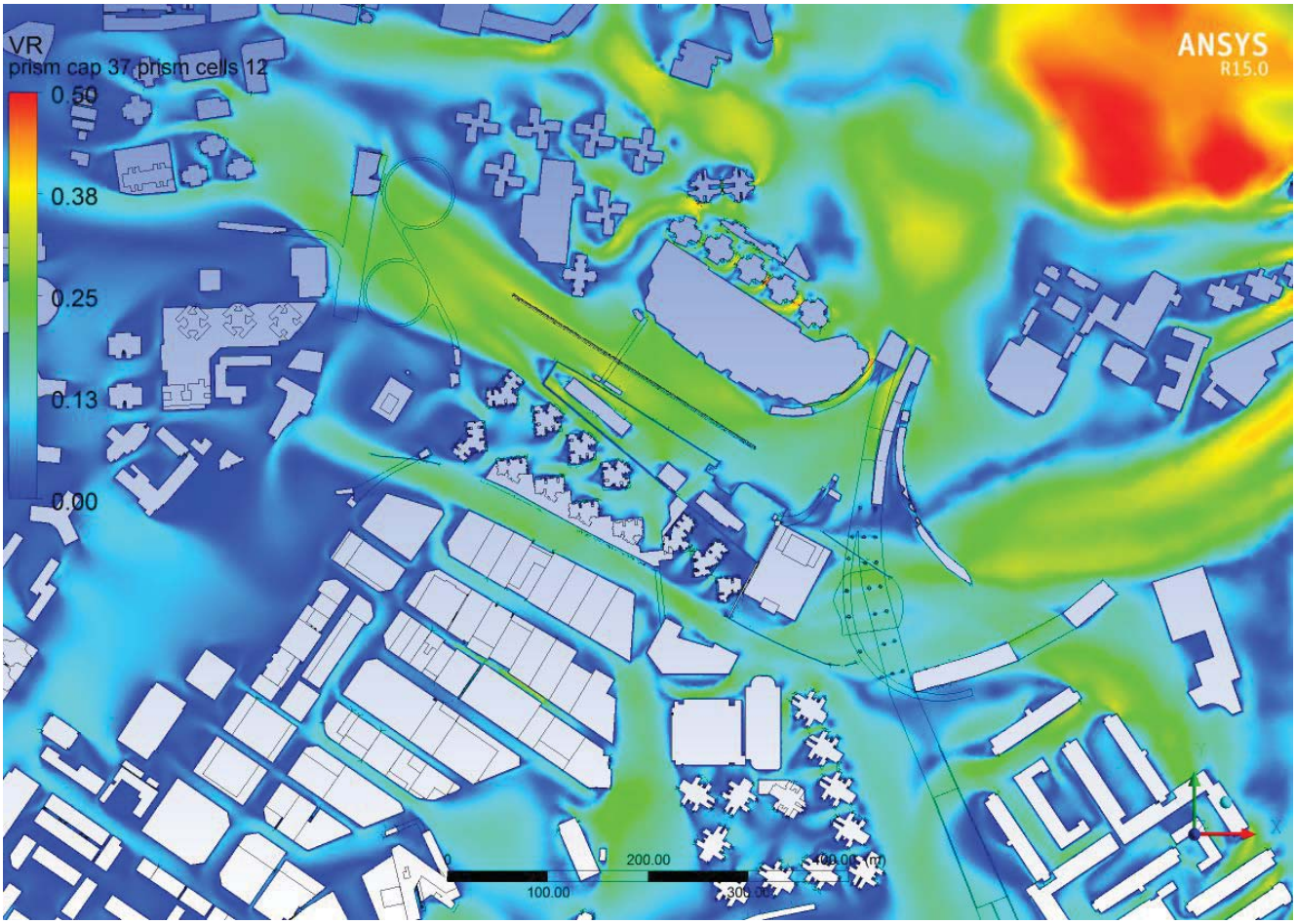
E.1.2. E Wind (Proposed Scheme)

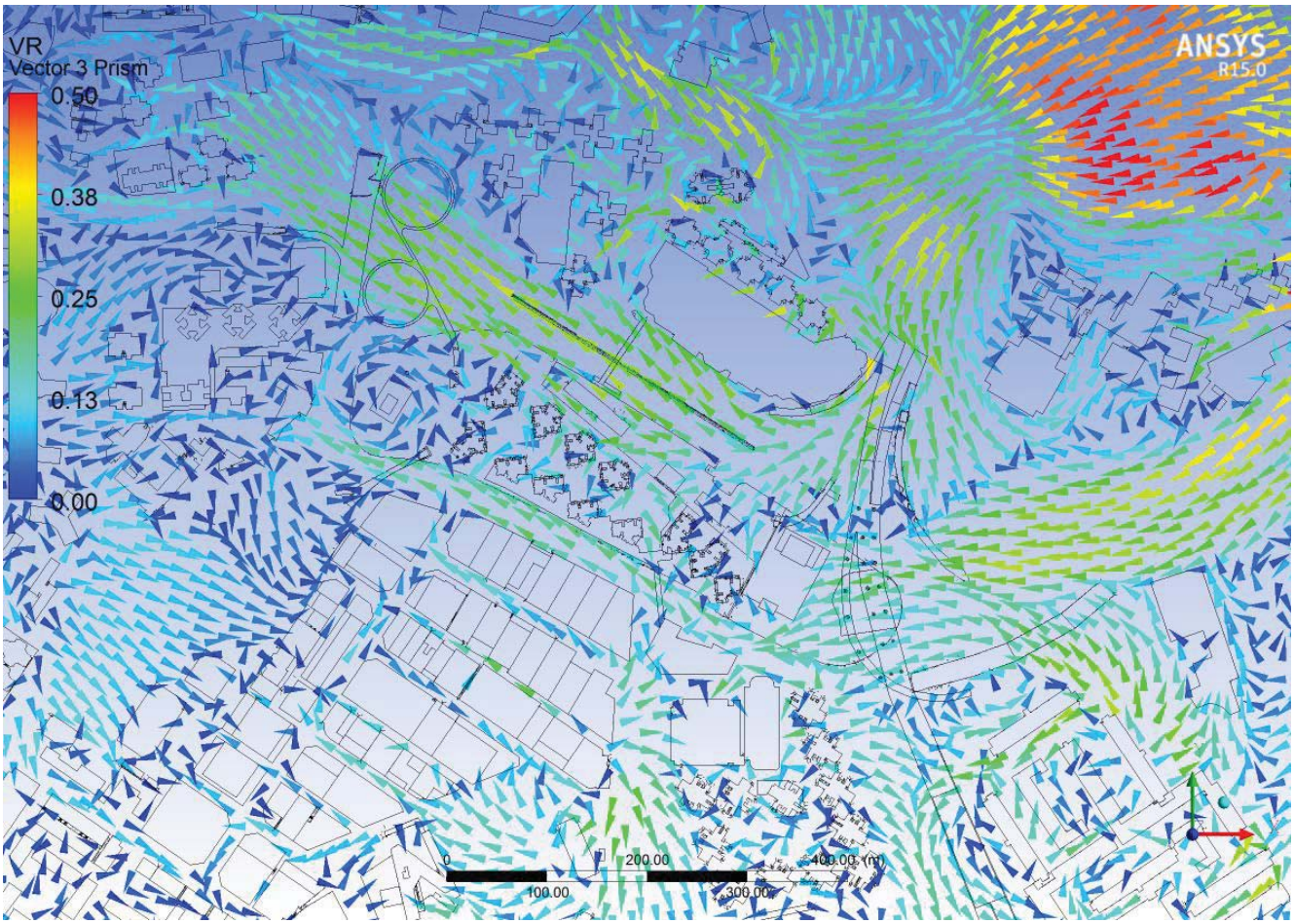




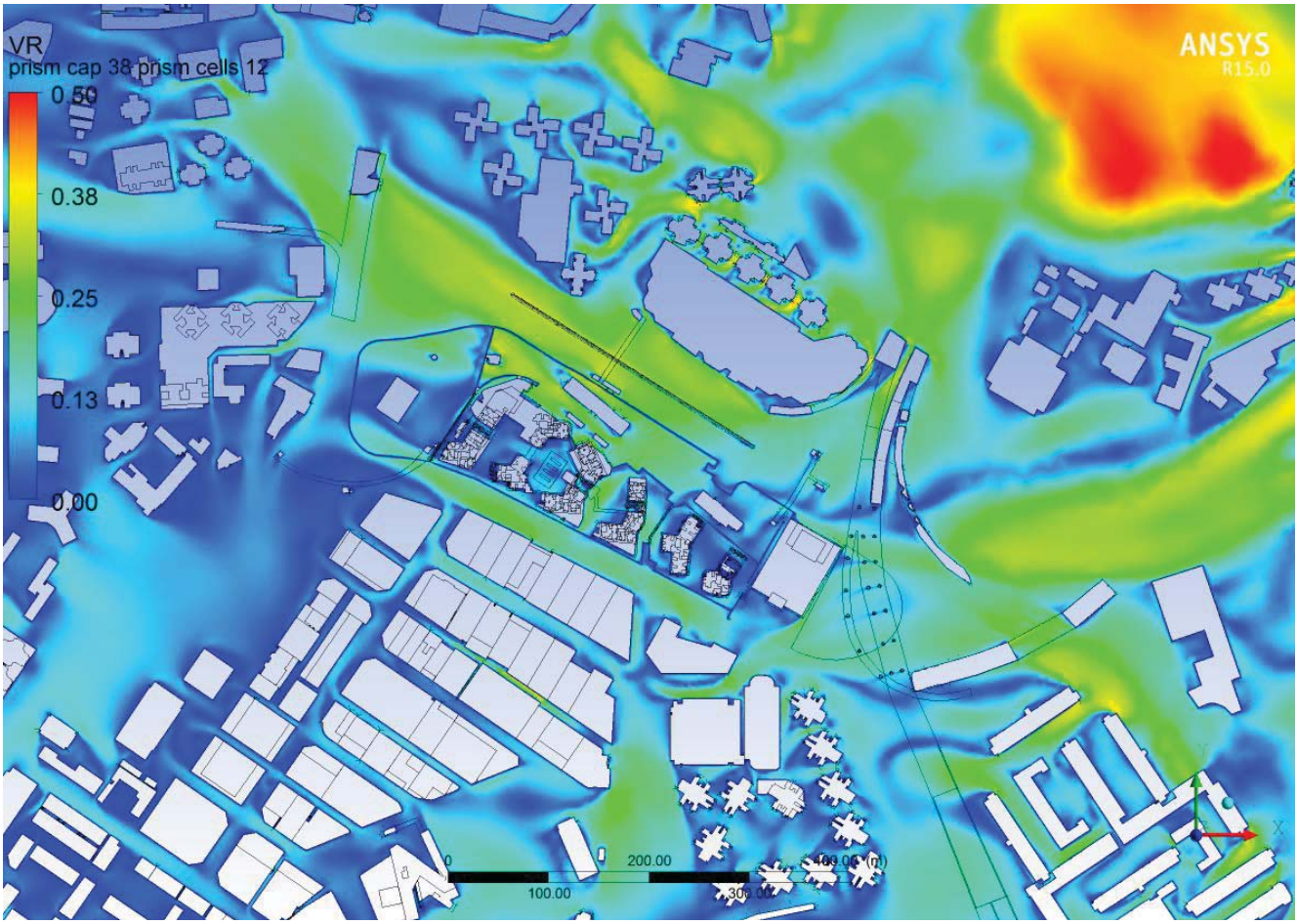
E.2. ENE Wind

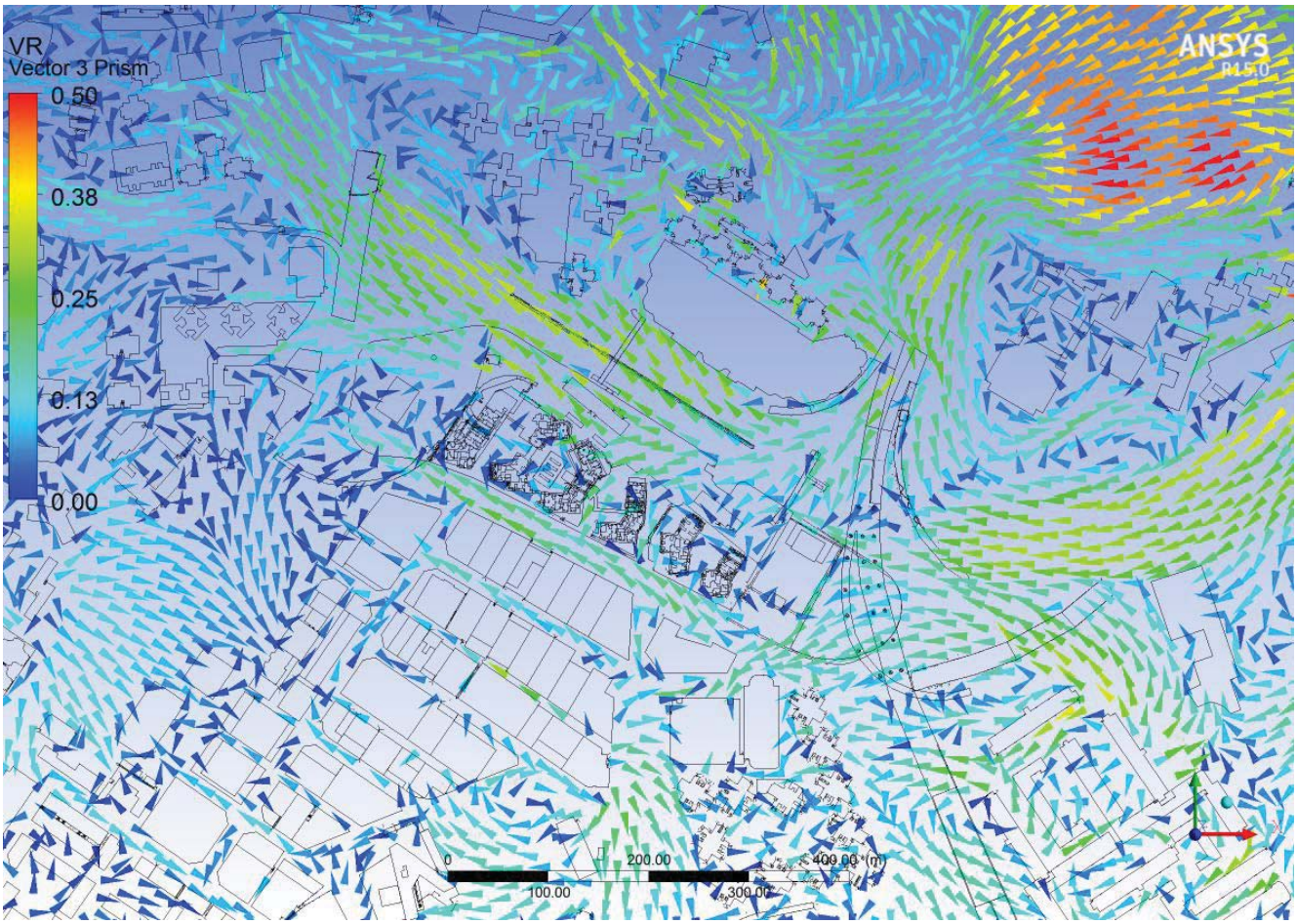
E.2.1. ENE Wind (Baseline Scheme)





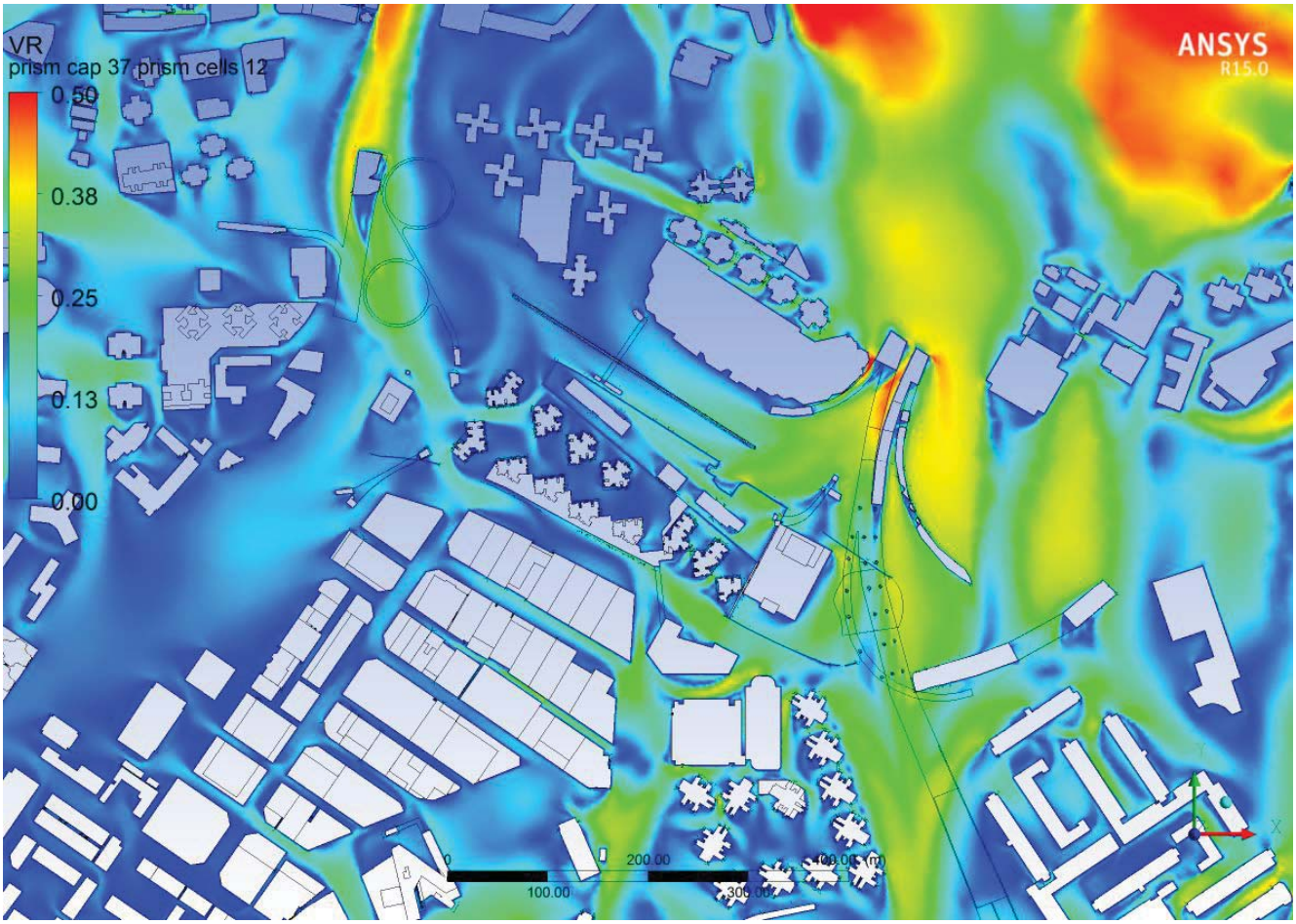
E.2.2. ENE Wind (Proposed Scheme)

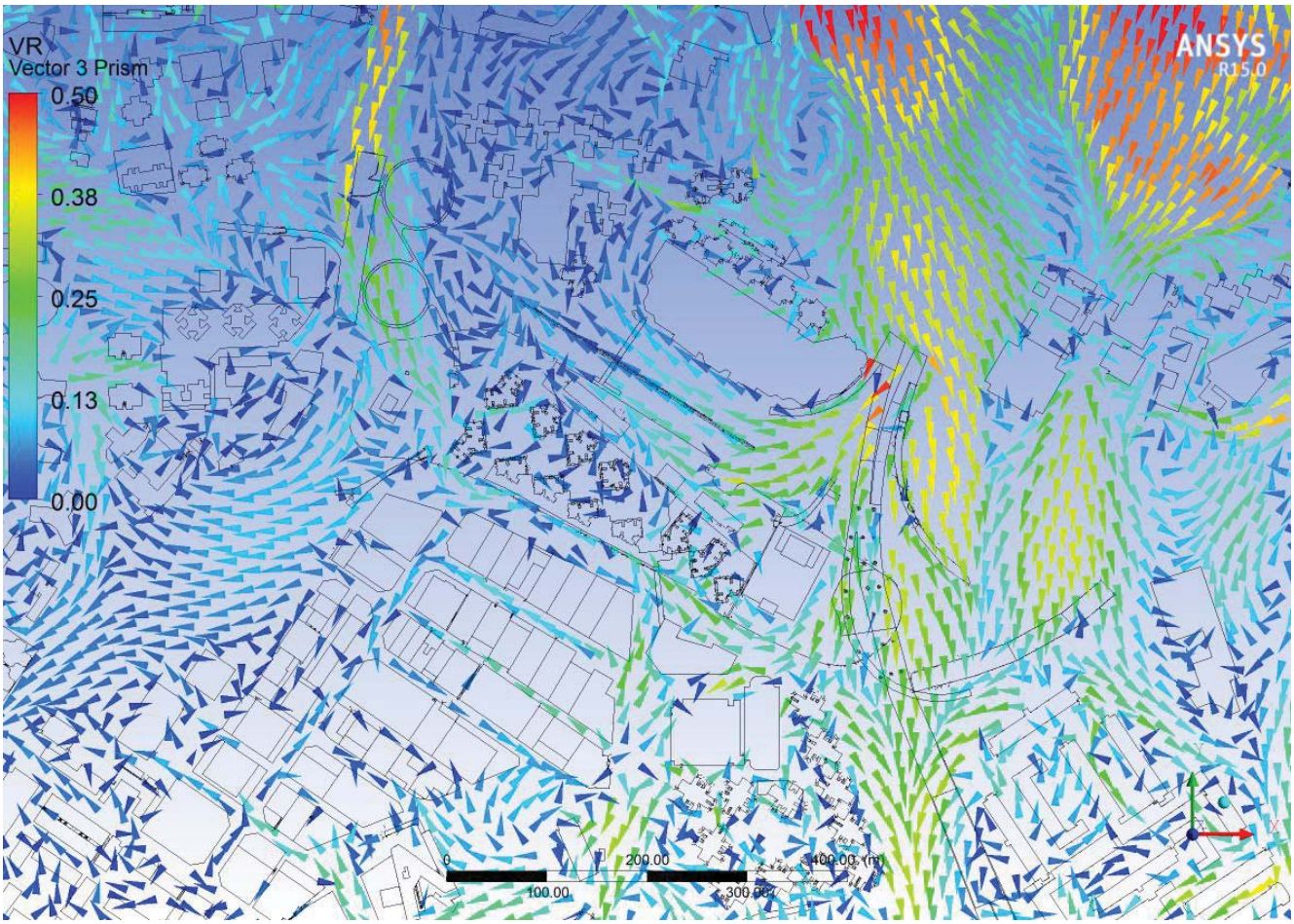




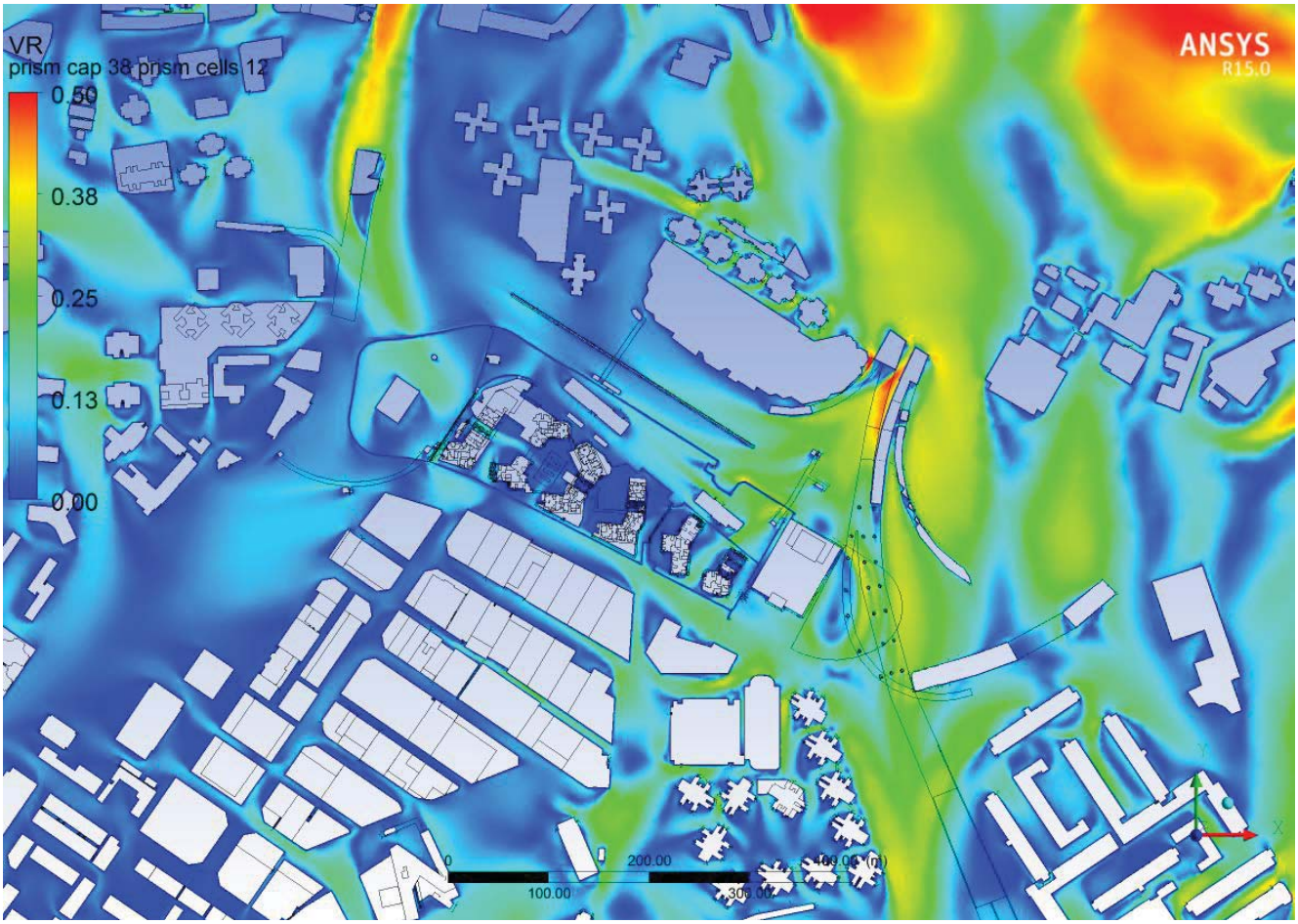
E.3. NNE Wind

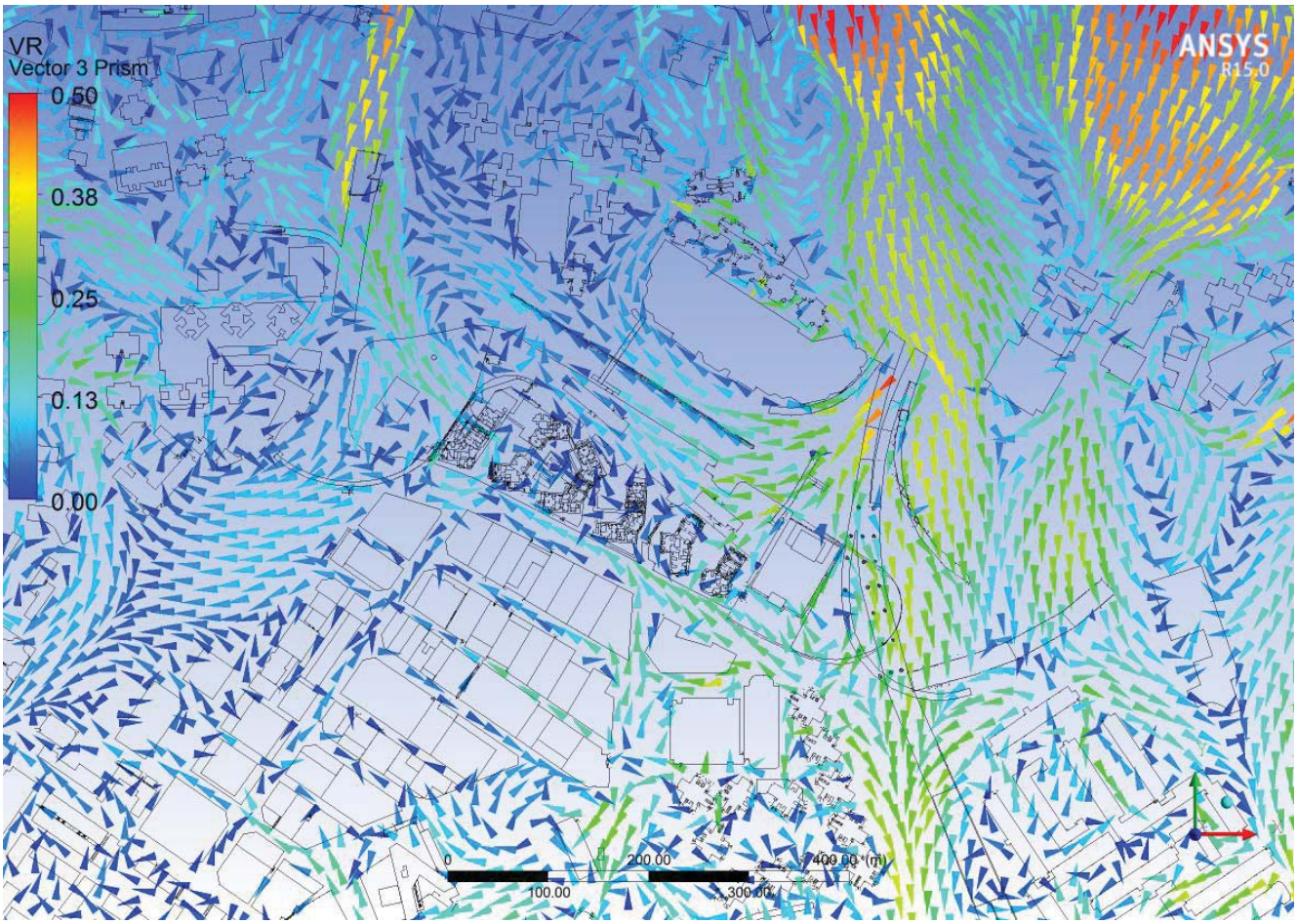
E.3.1. NNE Wind (Baseline Scheme)





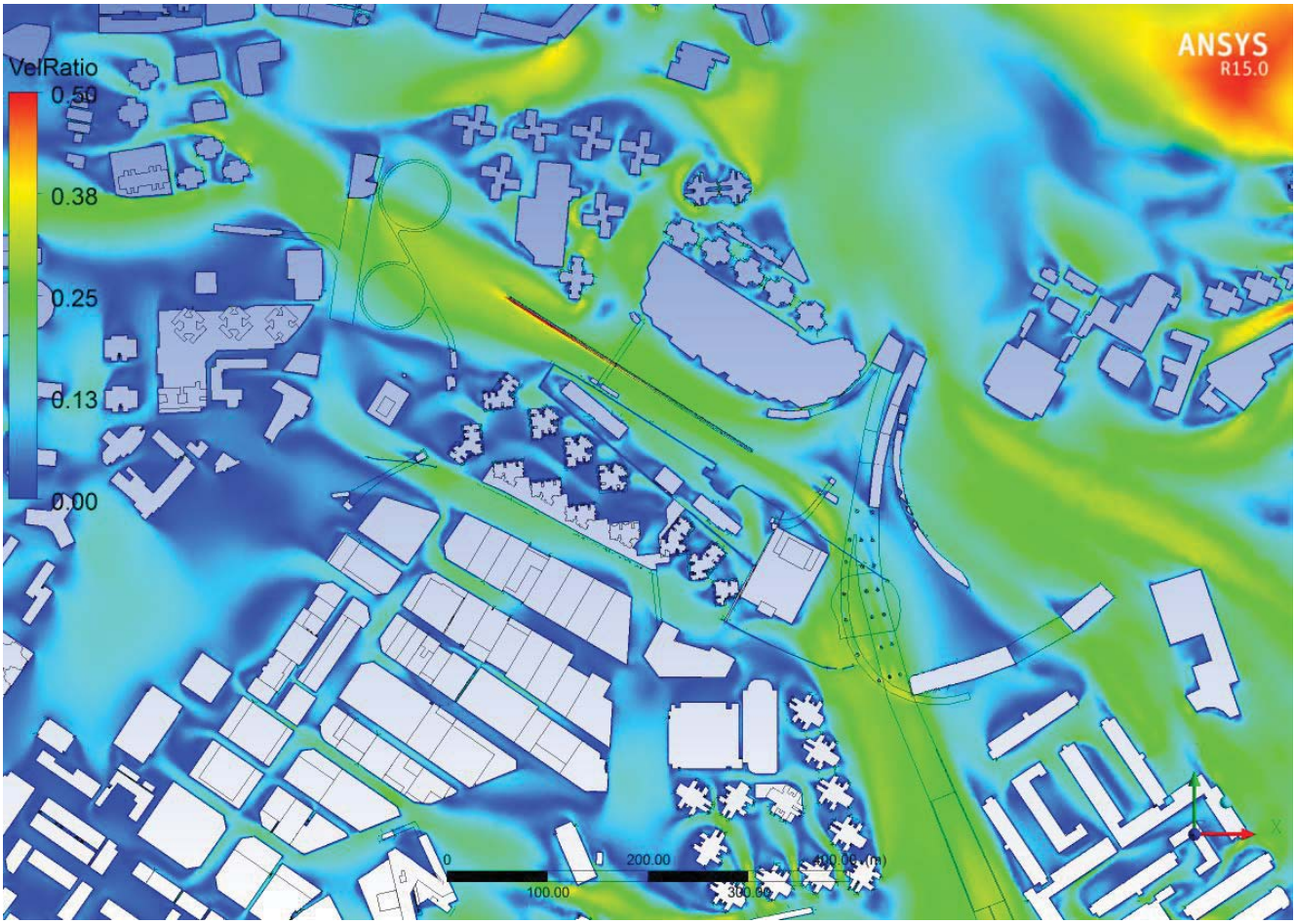
E.3.2. NNE Wind (Proposed Scheme)

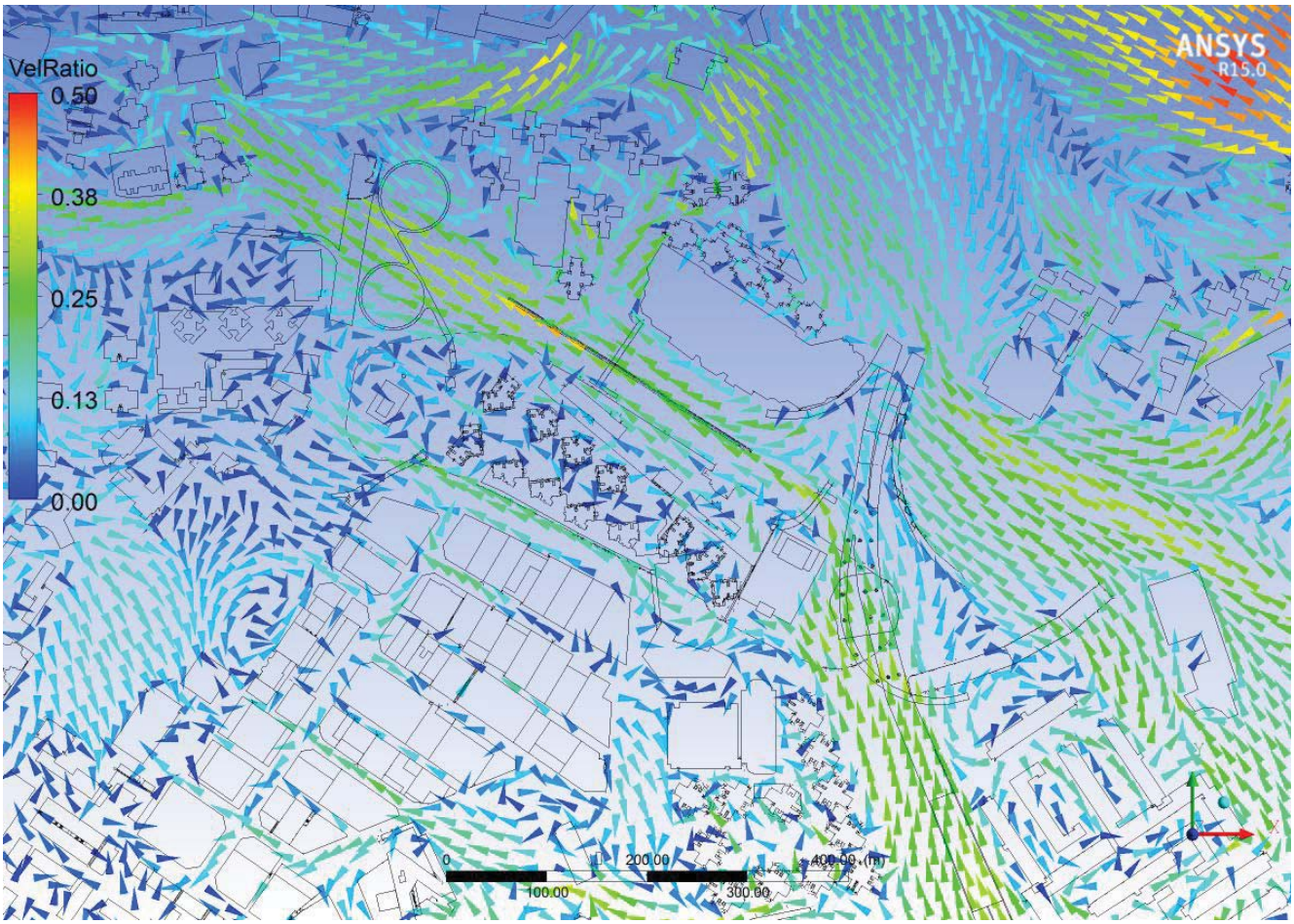




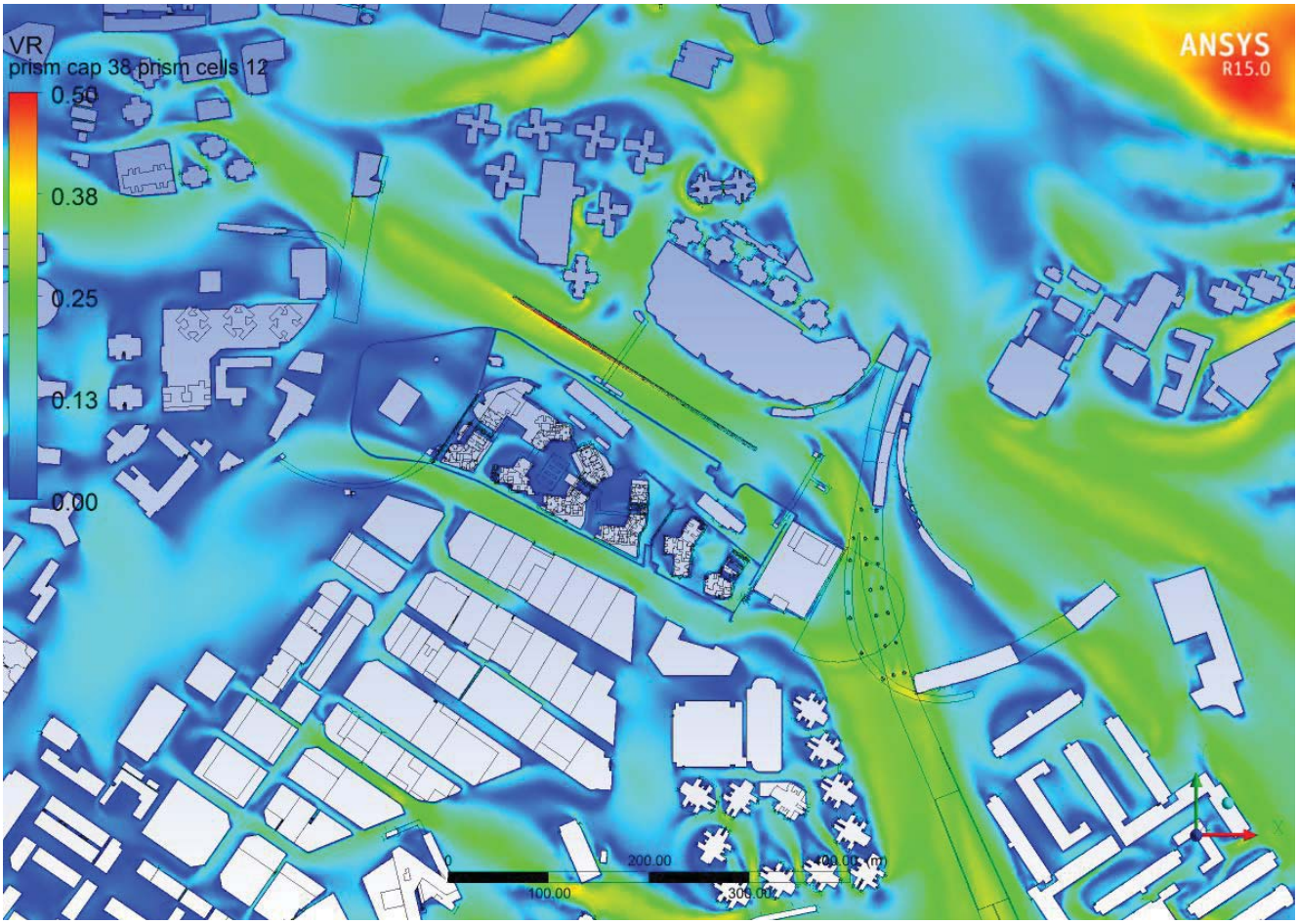
E.4. ESE Wind

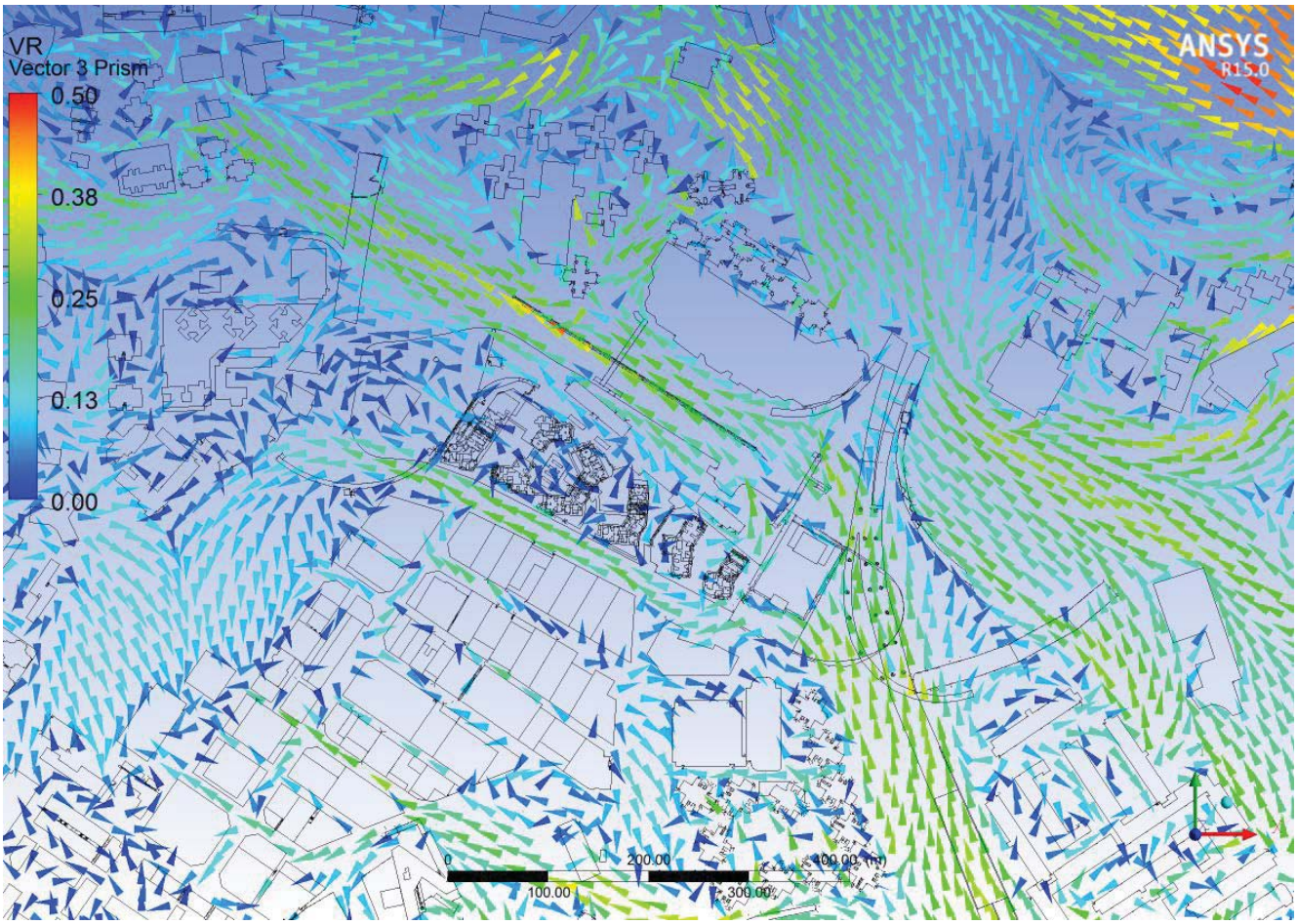
E.4.1. ESE Wind (Baseline Scheme)





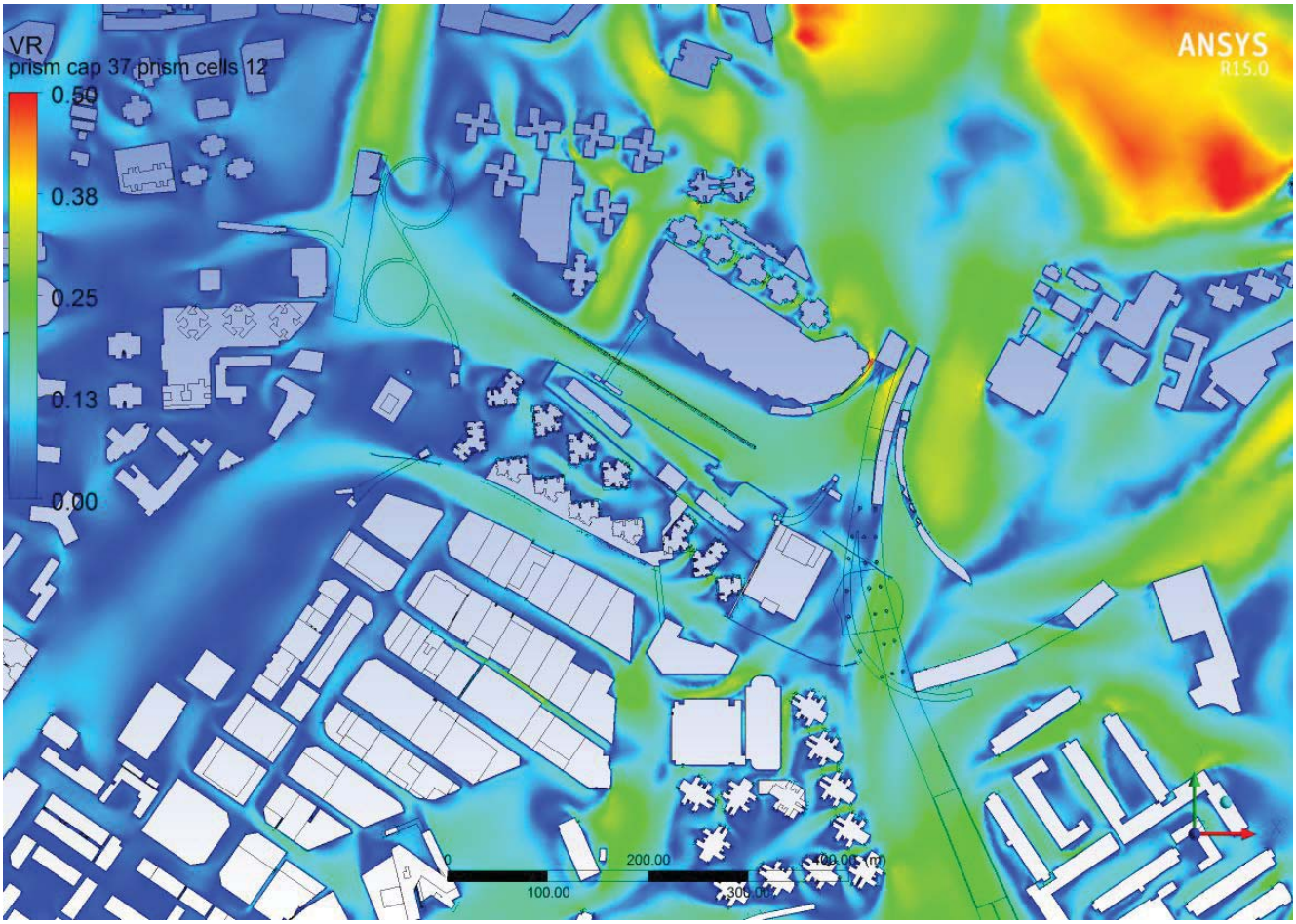
E.4.2. ESE Wind (Proposed Scheme)

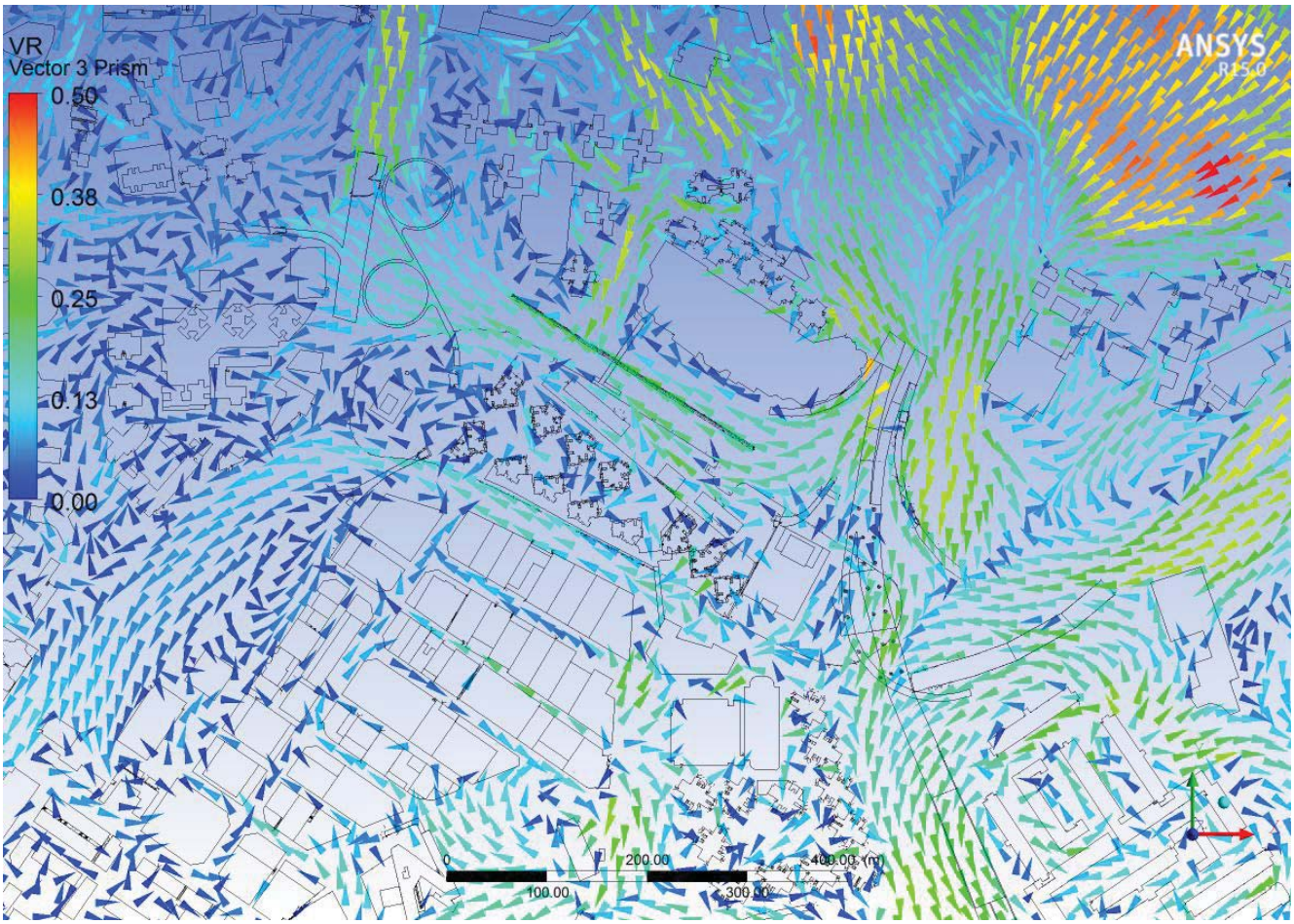




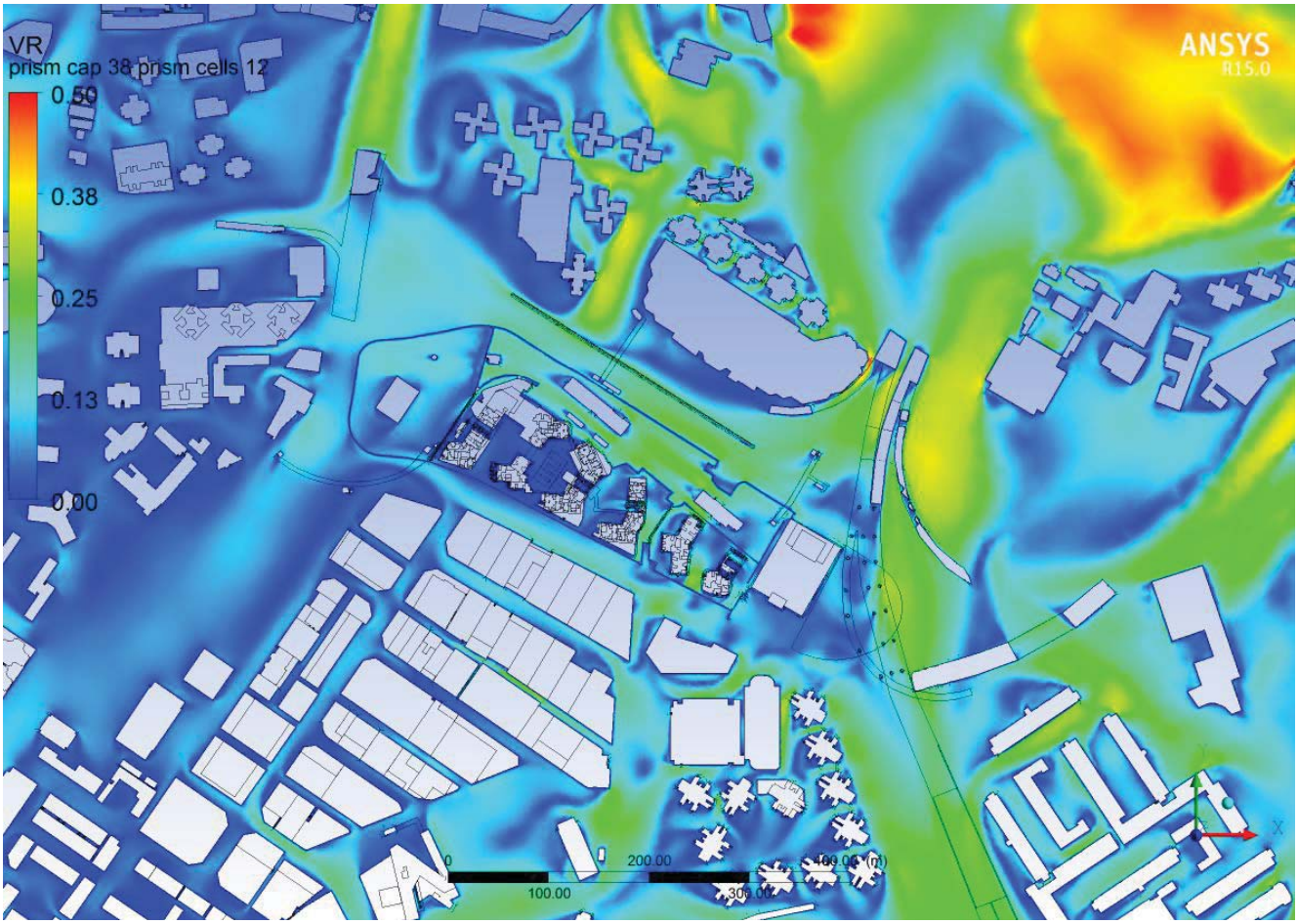
E.5. NE Wind

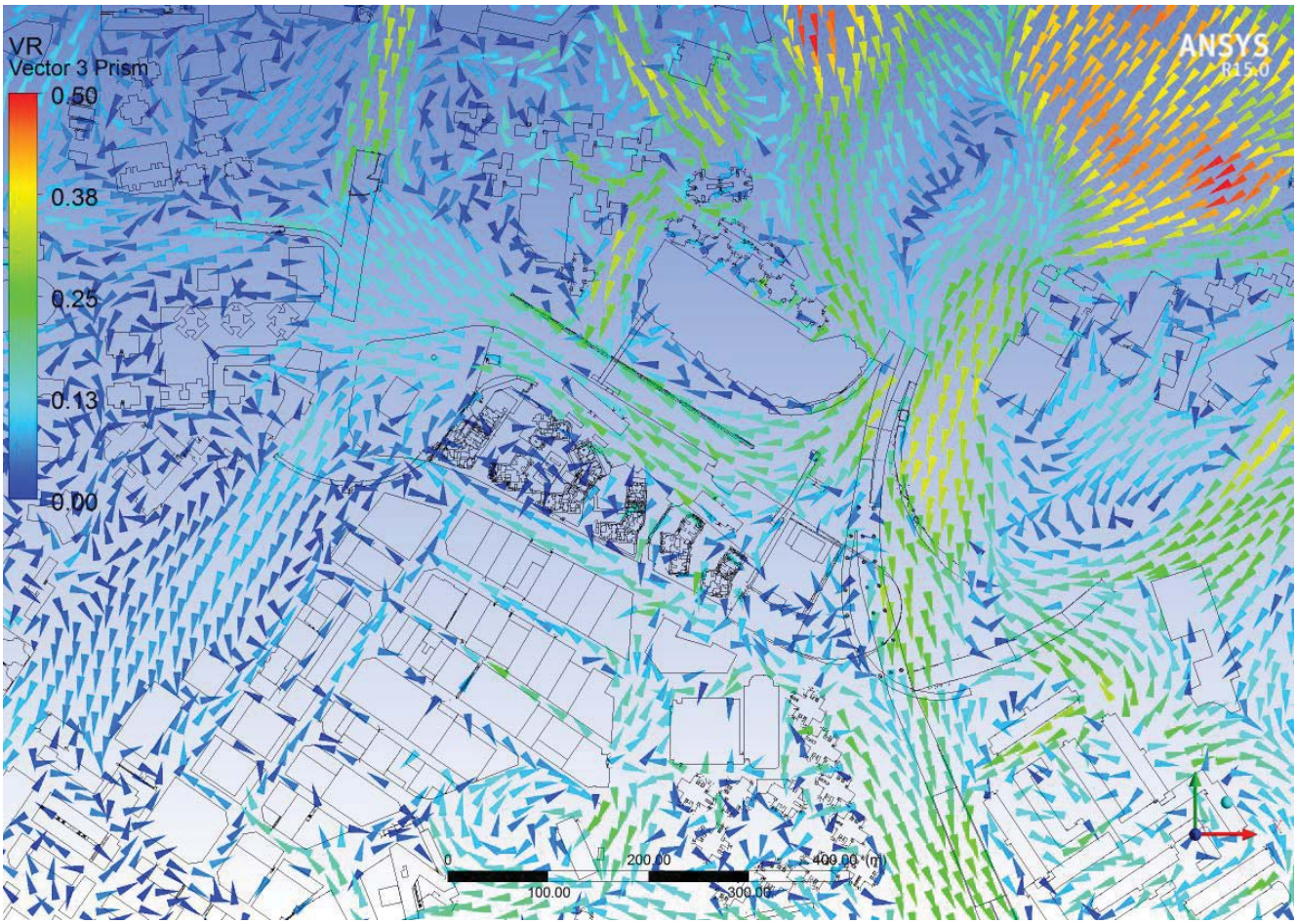
E.5.1. NE Wind (Baseline Scheme)





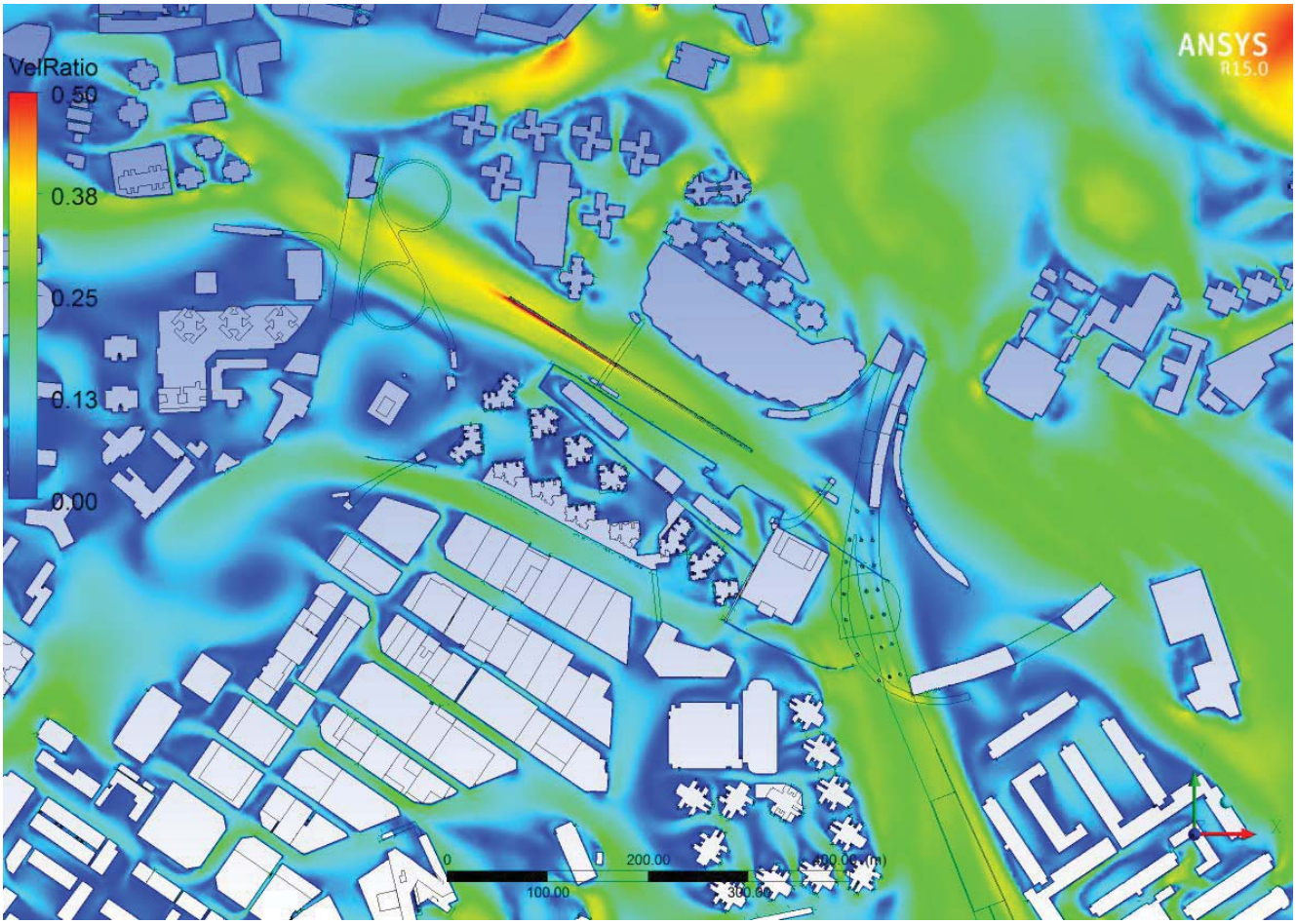
E.5.2. NE Wind (Proposed Scheme)

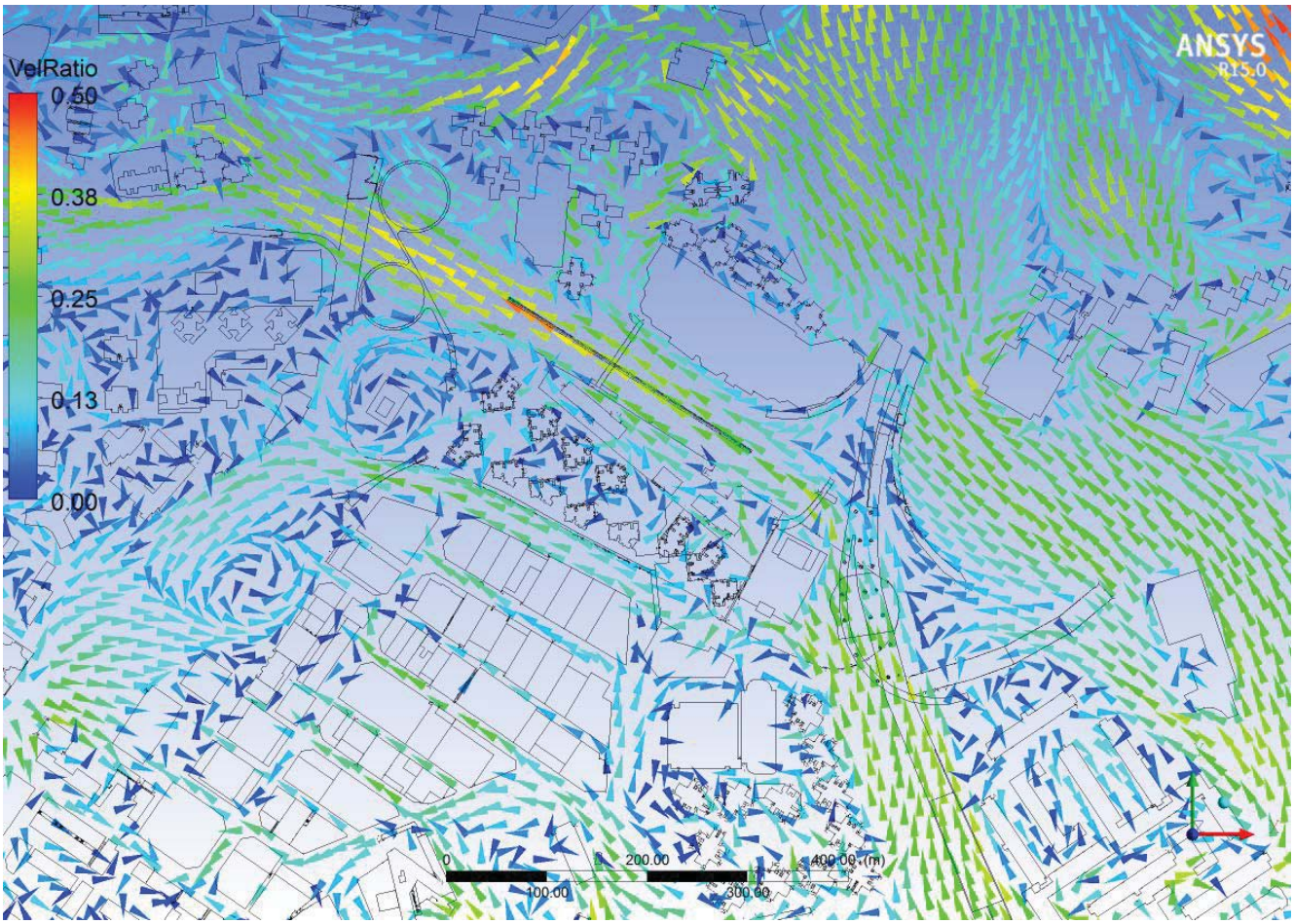




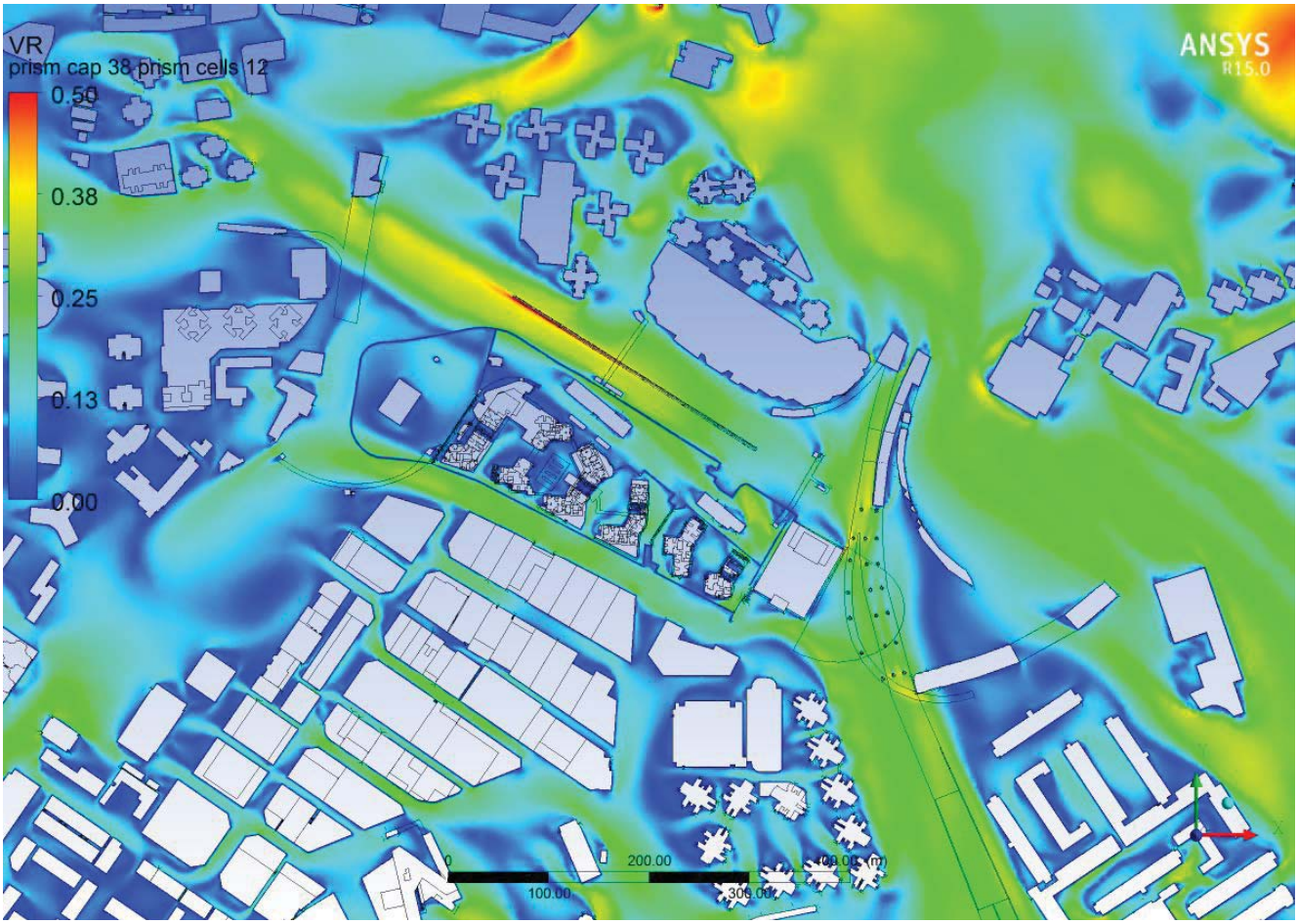
E.6. SE Wind

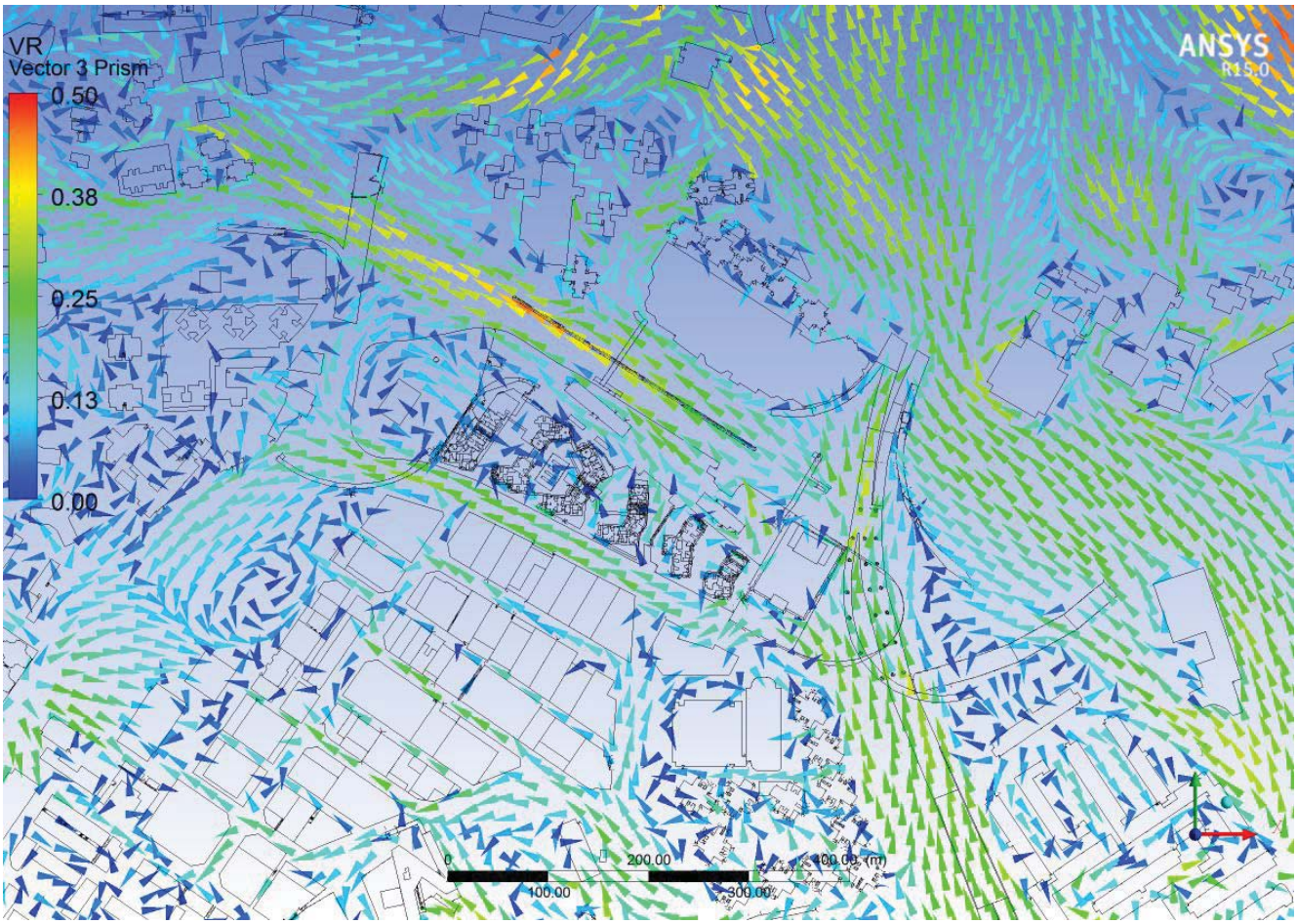
E.6.1. SE Wind (Baseline Scheme)





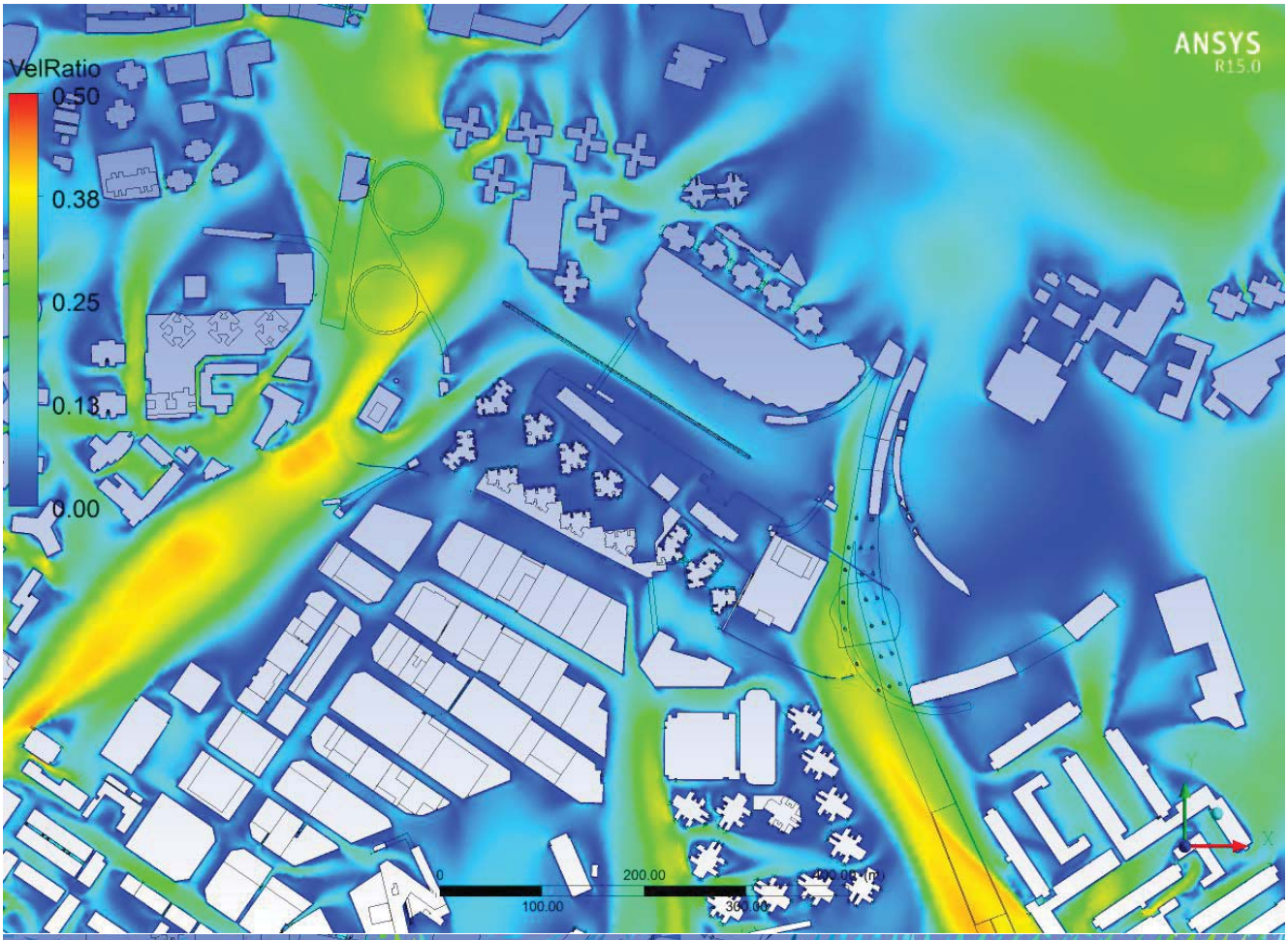
E.6.2. SE Wind (Proposed Scheme)

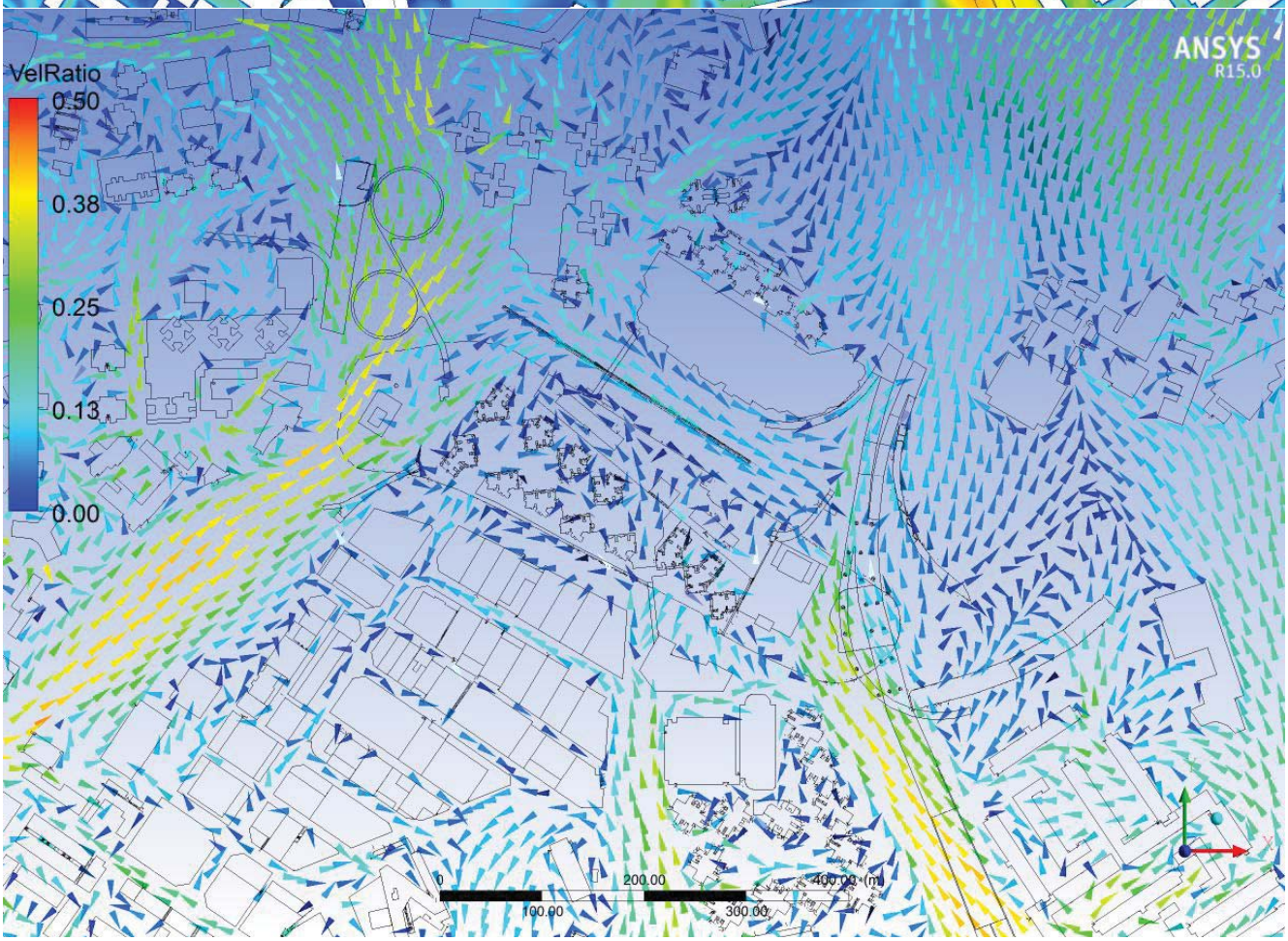




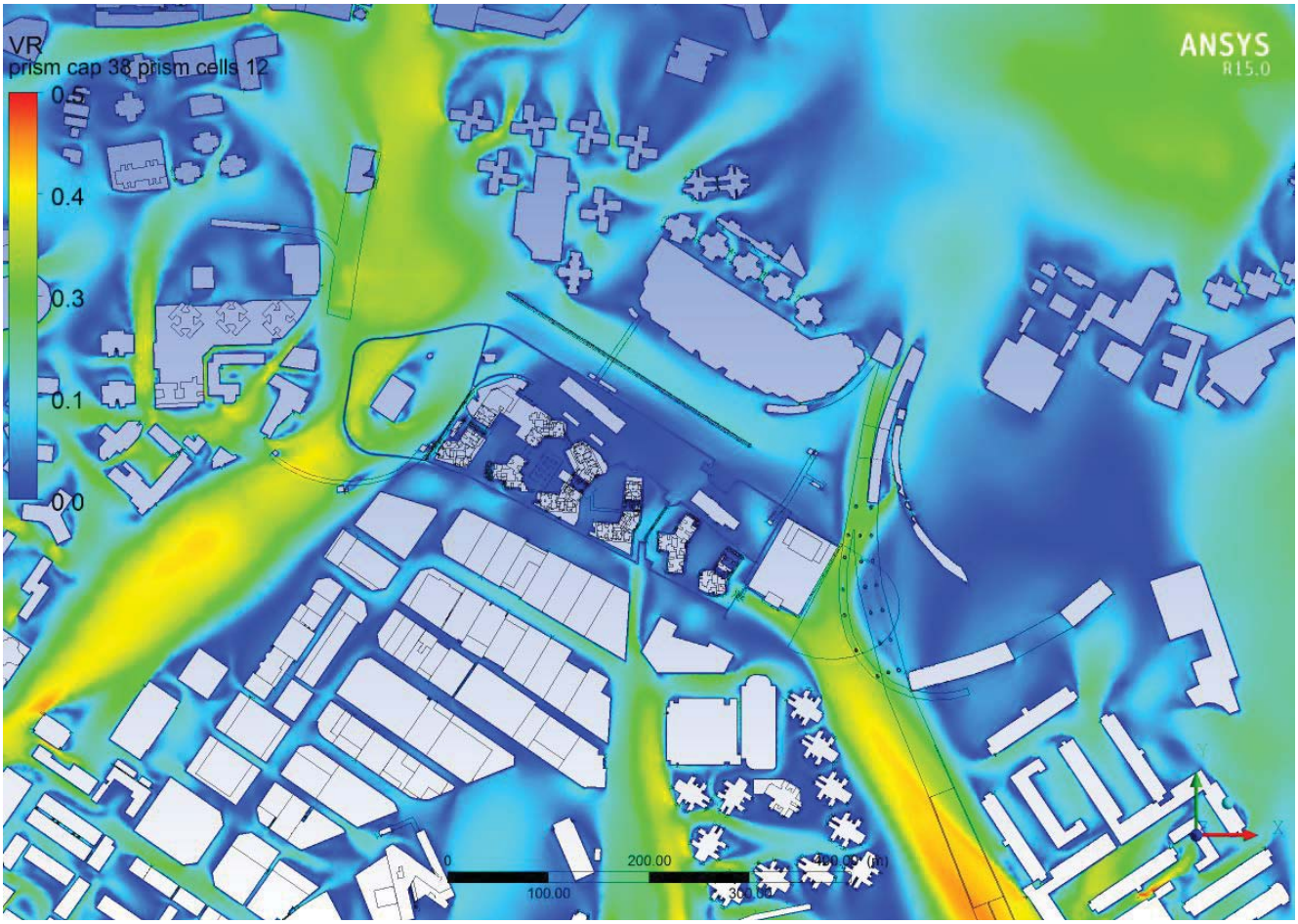
E.7. SSW Wind

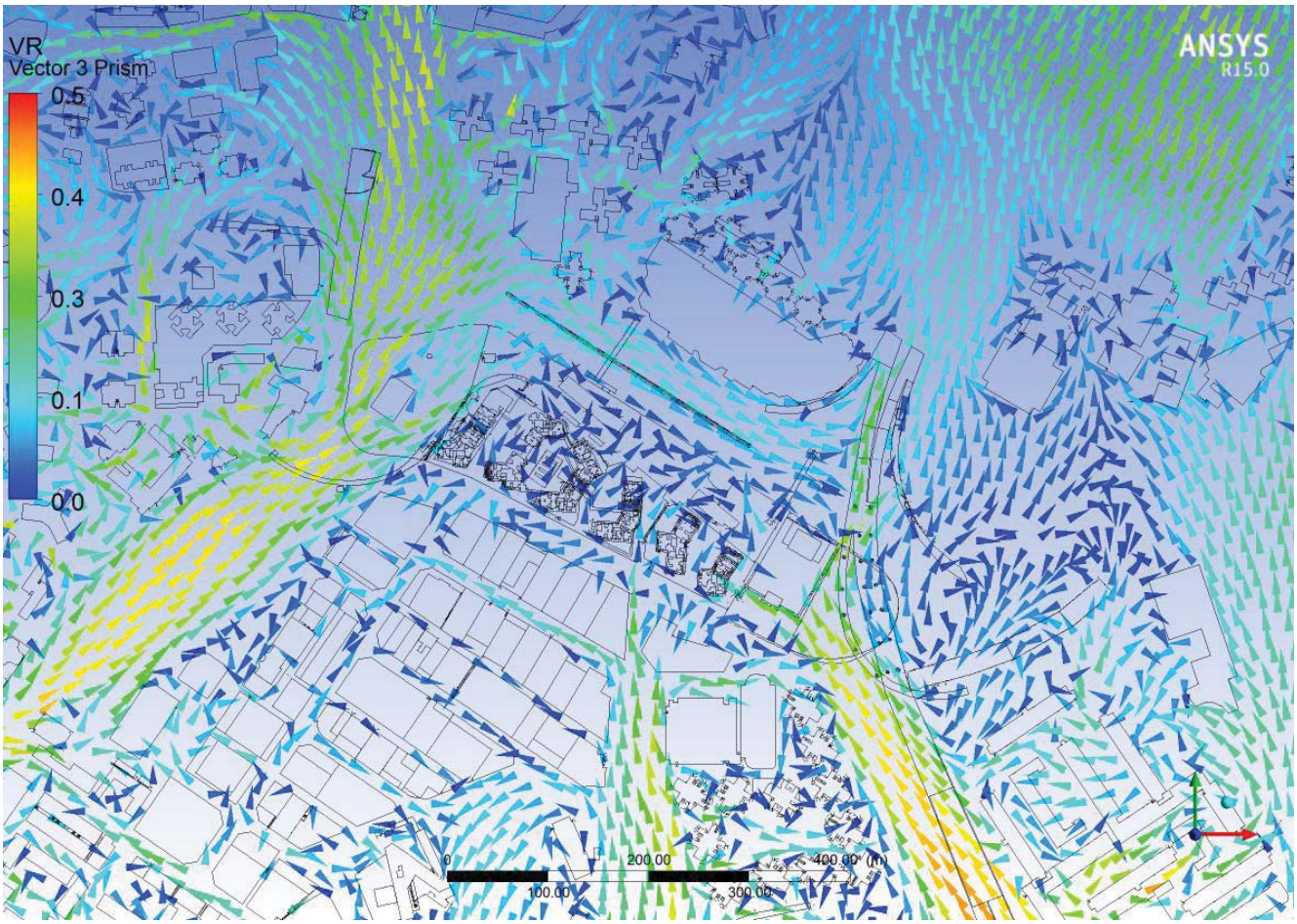
E.7.1. SSW Wind (Baseline Scheme)





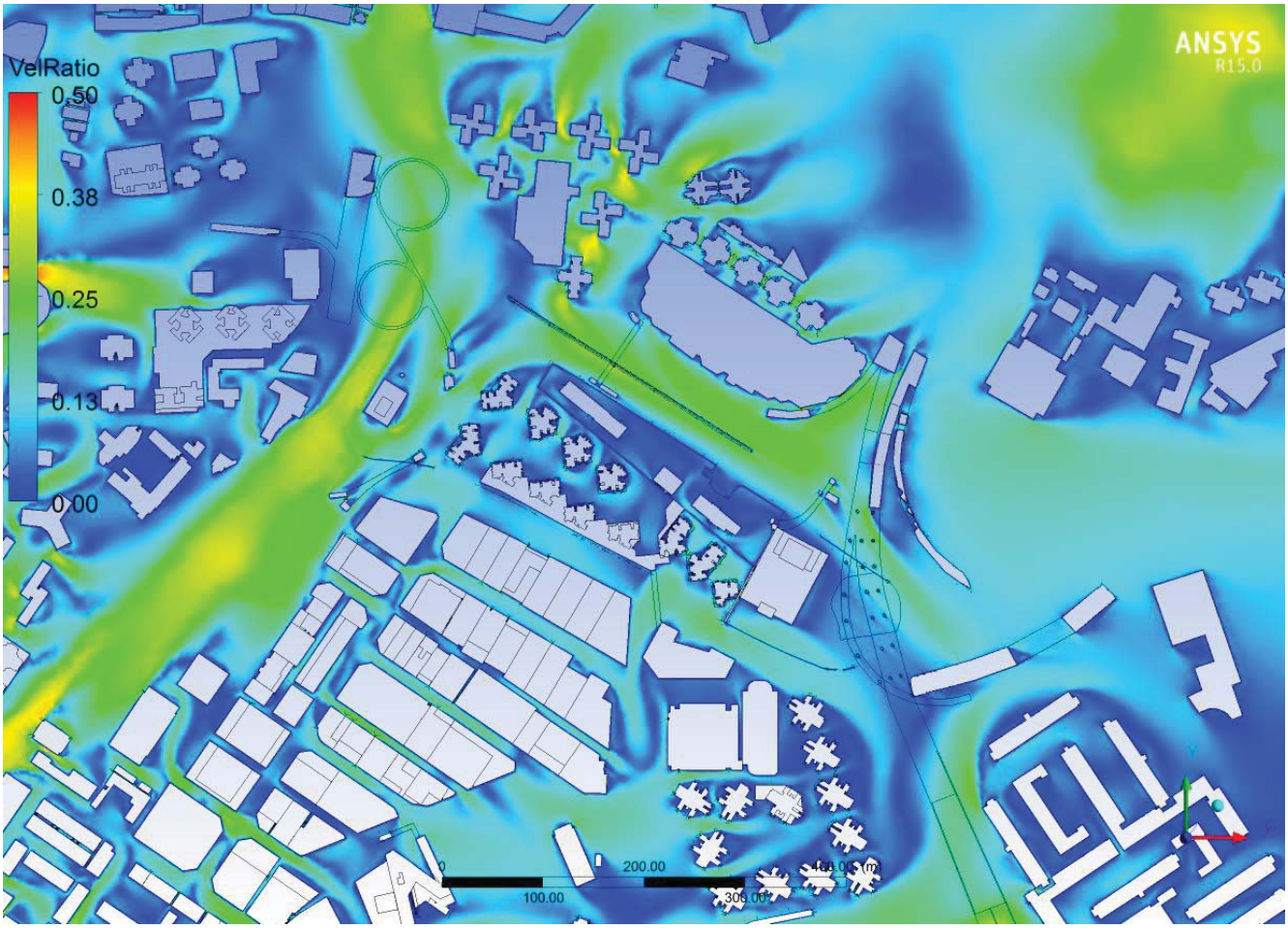
E.7.2. SSW Wind (Proposed Scheme)

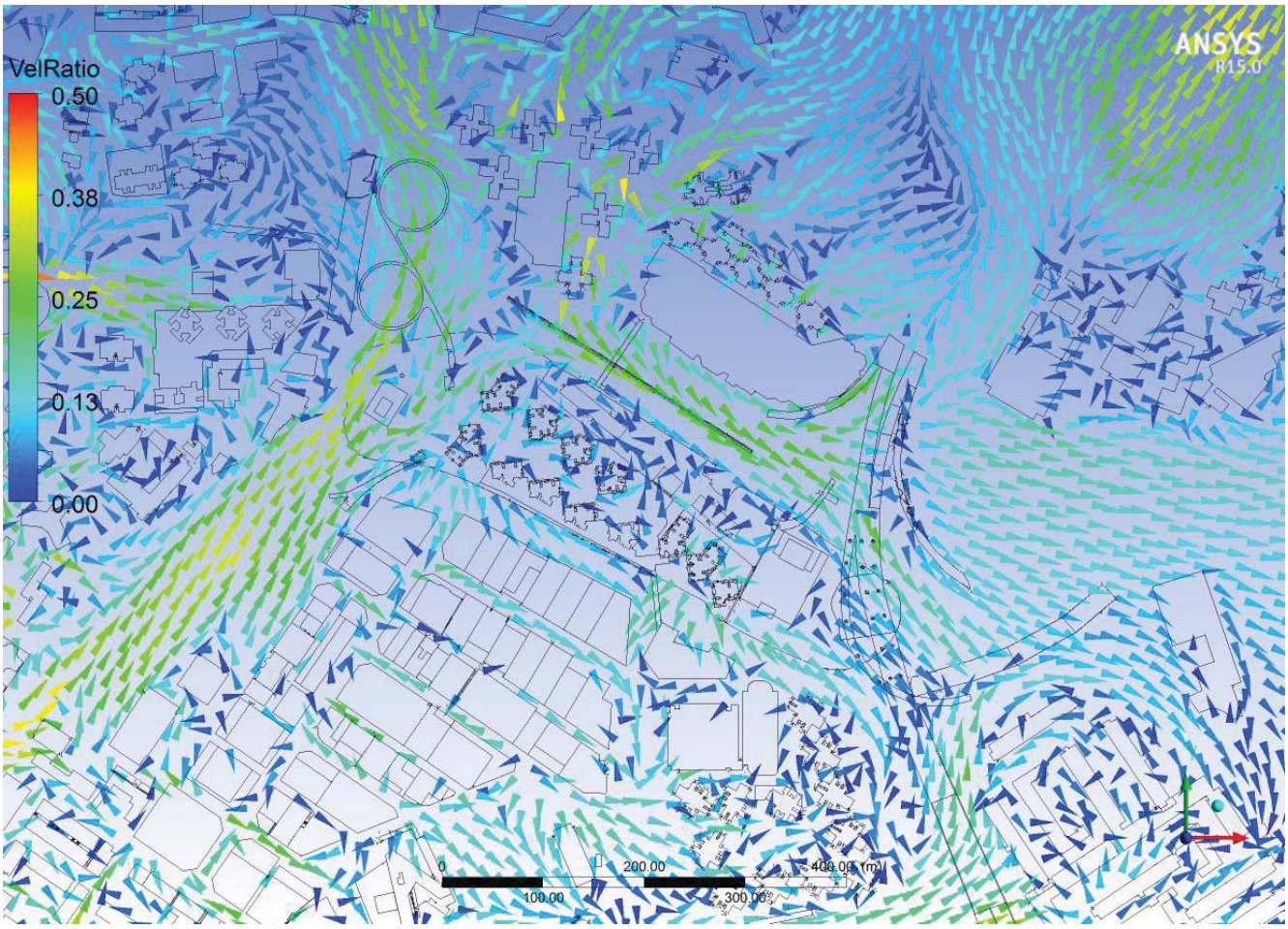




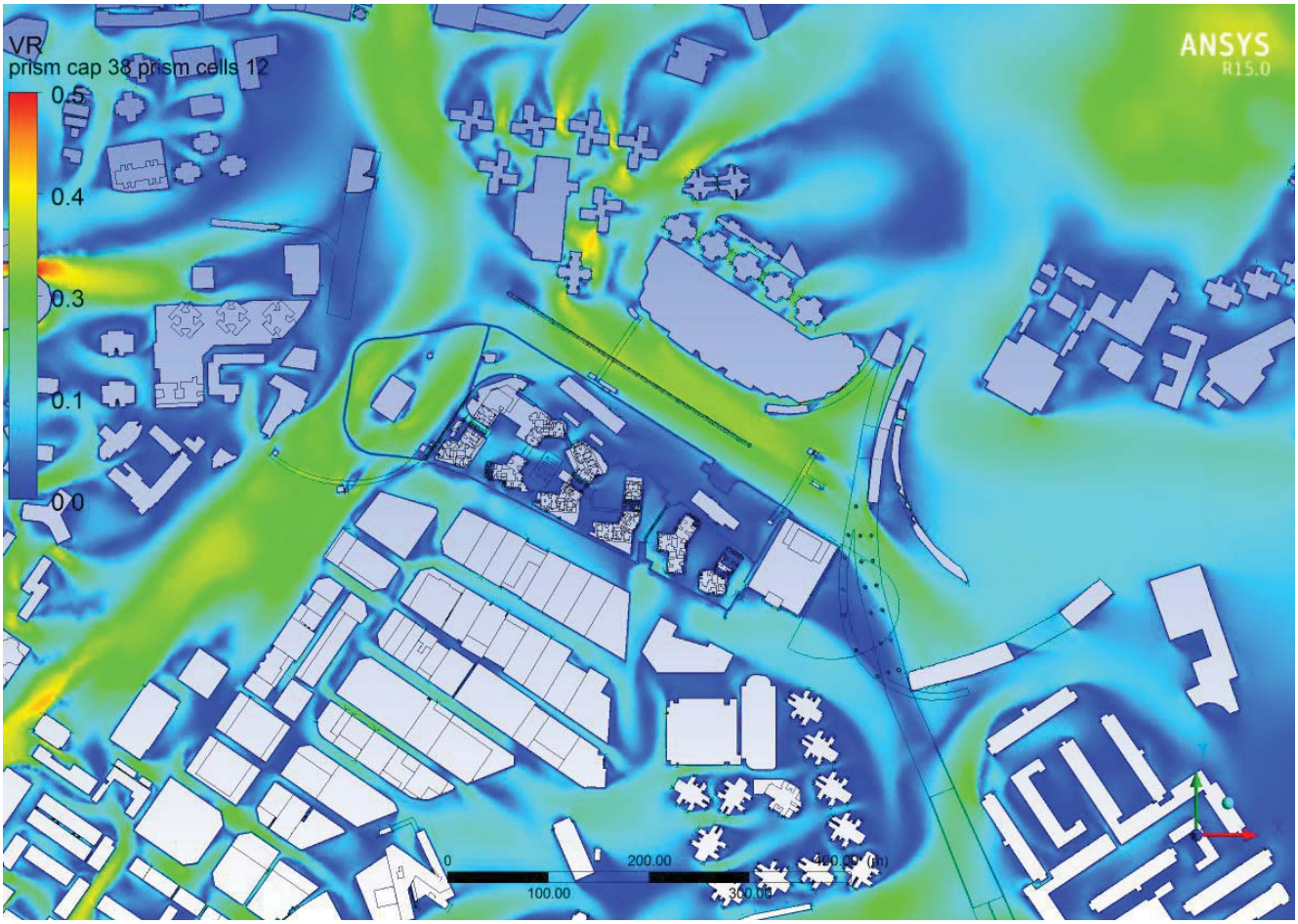
E.8. SW Wind

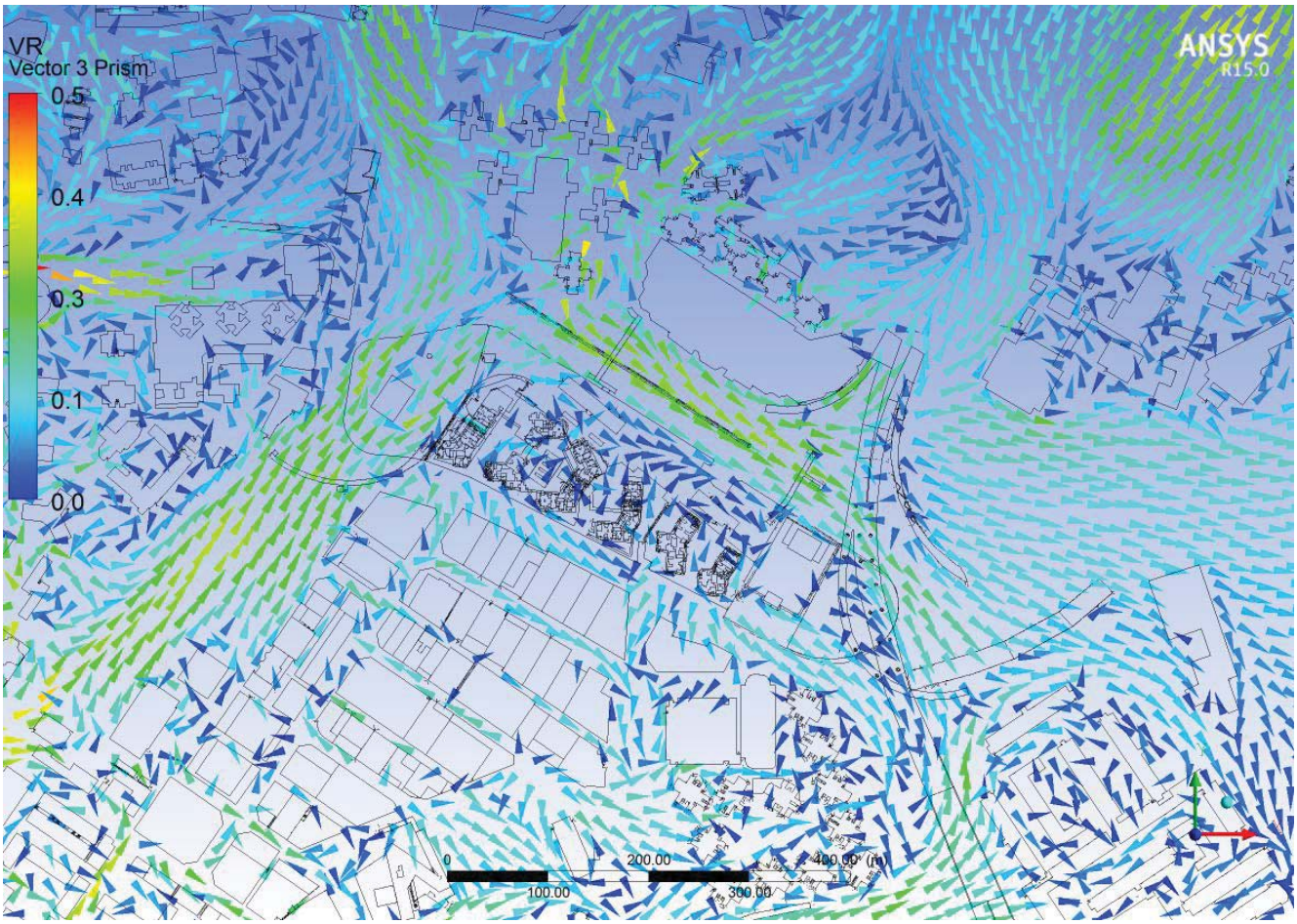
E.8.1. SW Wind (Baseline Scheme)





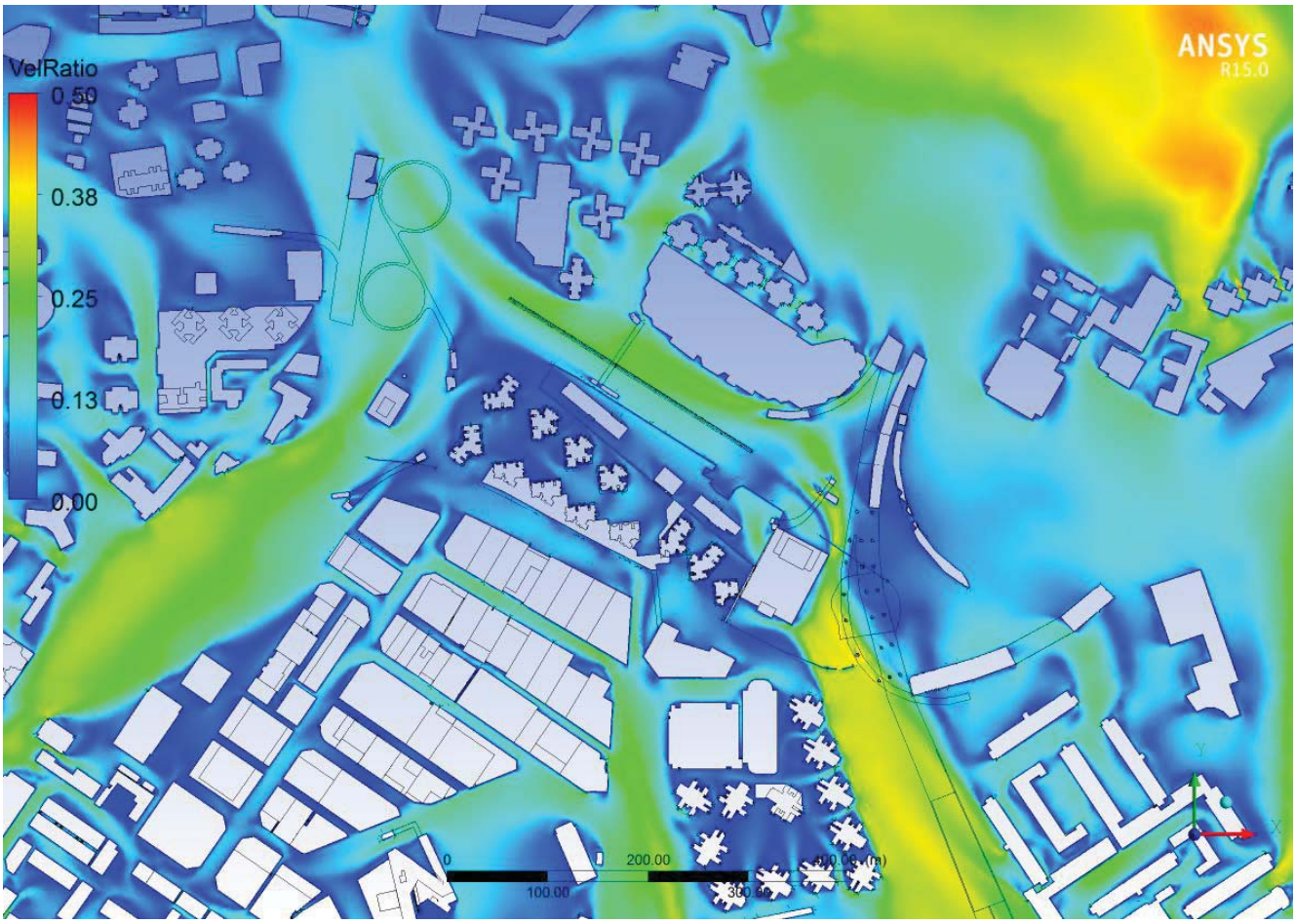
E.8.2. SW Wind (Proposed Scheme)

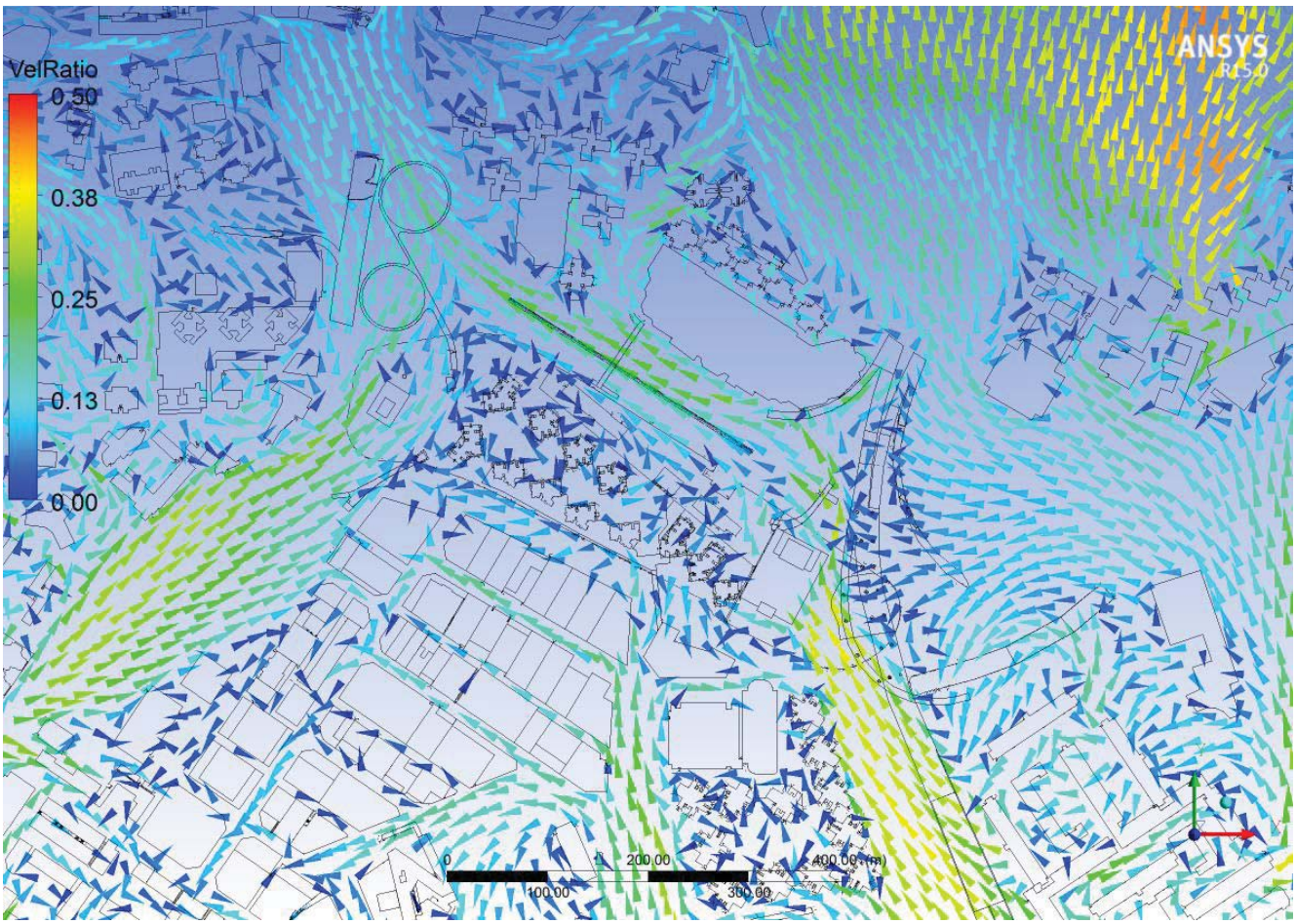




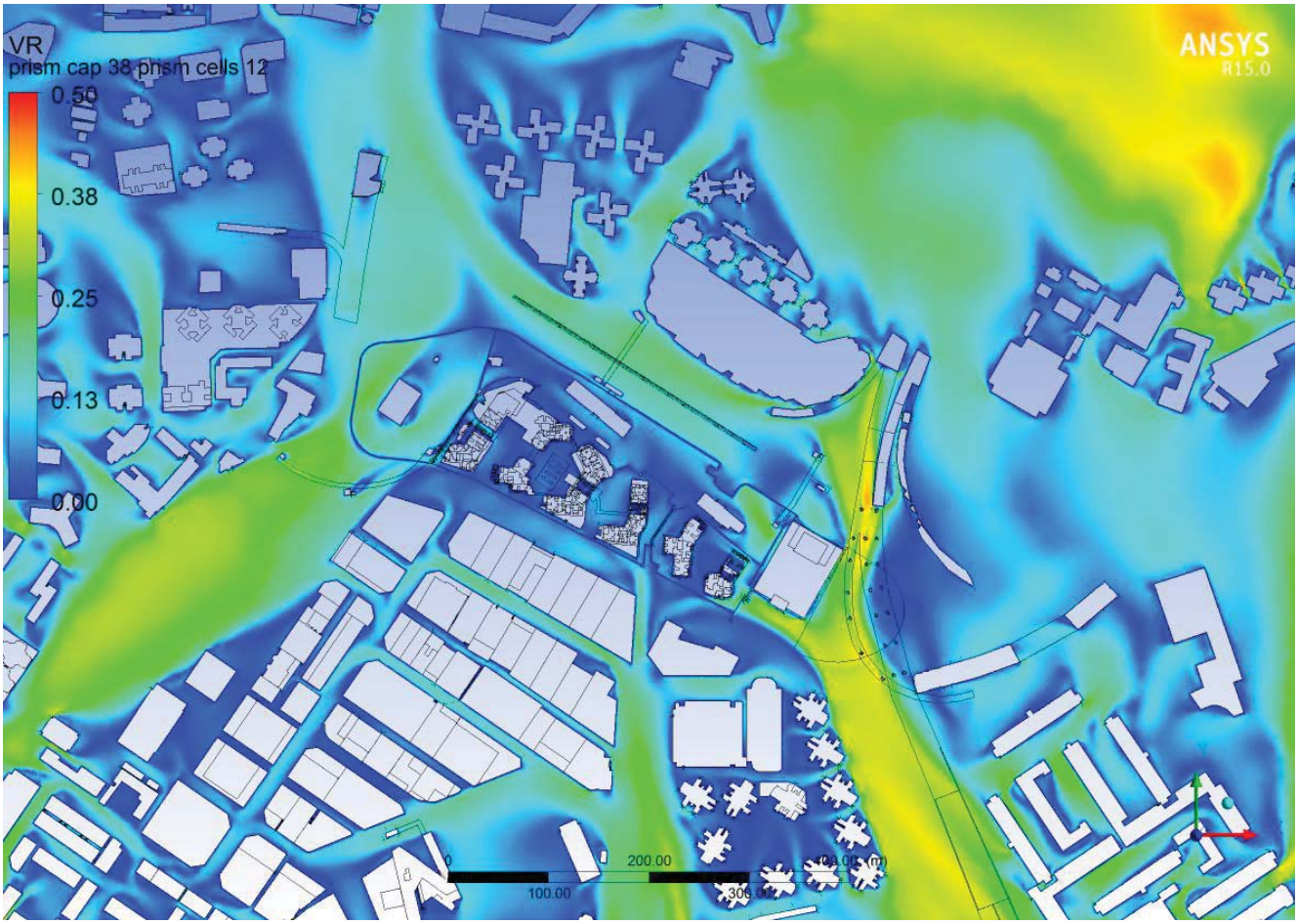
E.9. S Wind

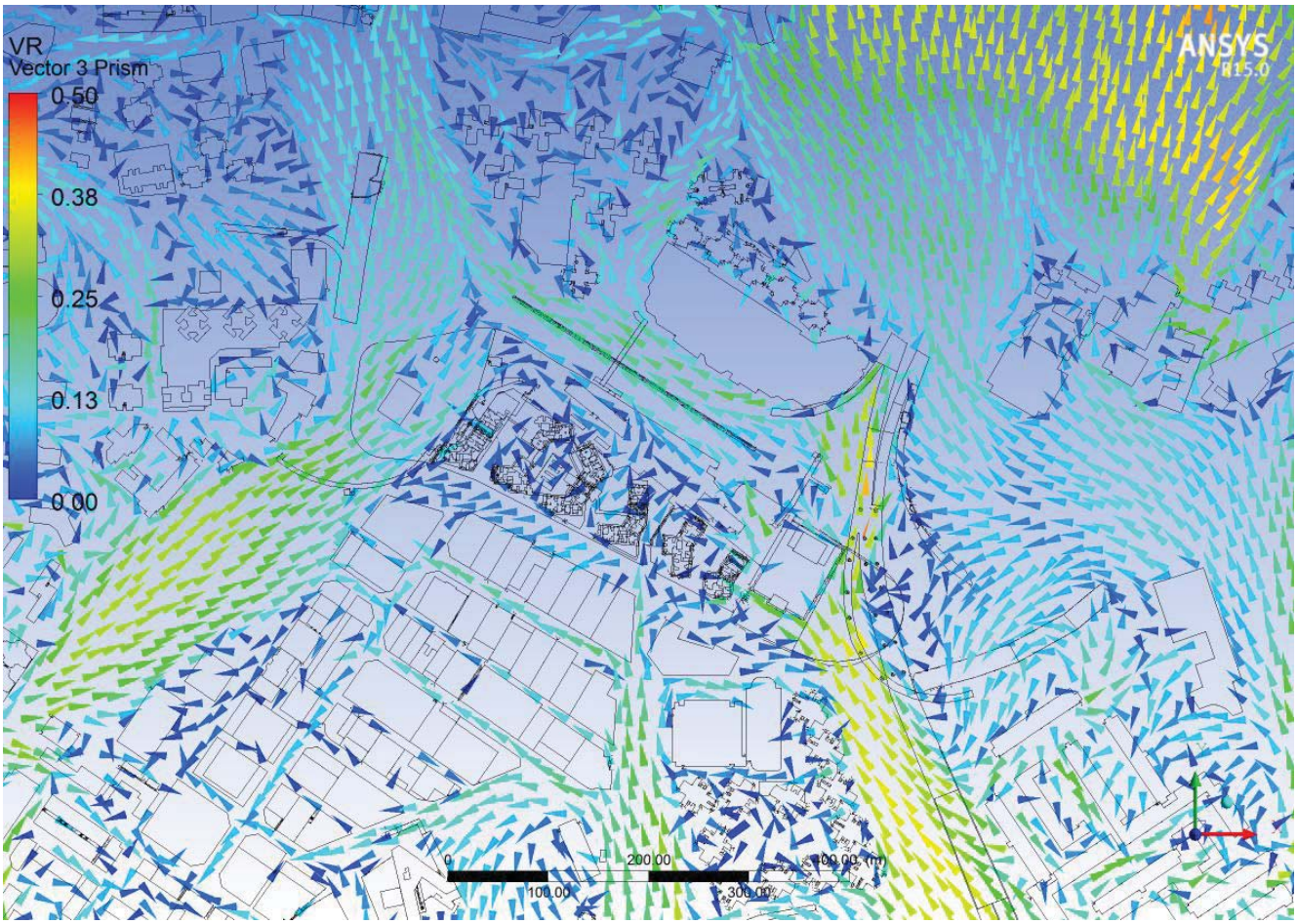
E.9.1. S Wind (Baseline Scheme)





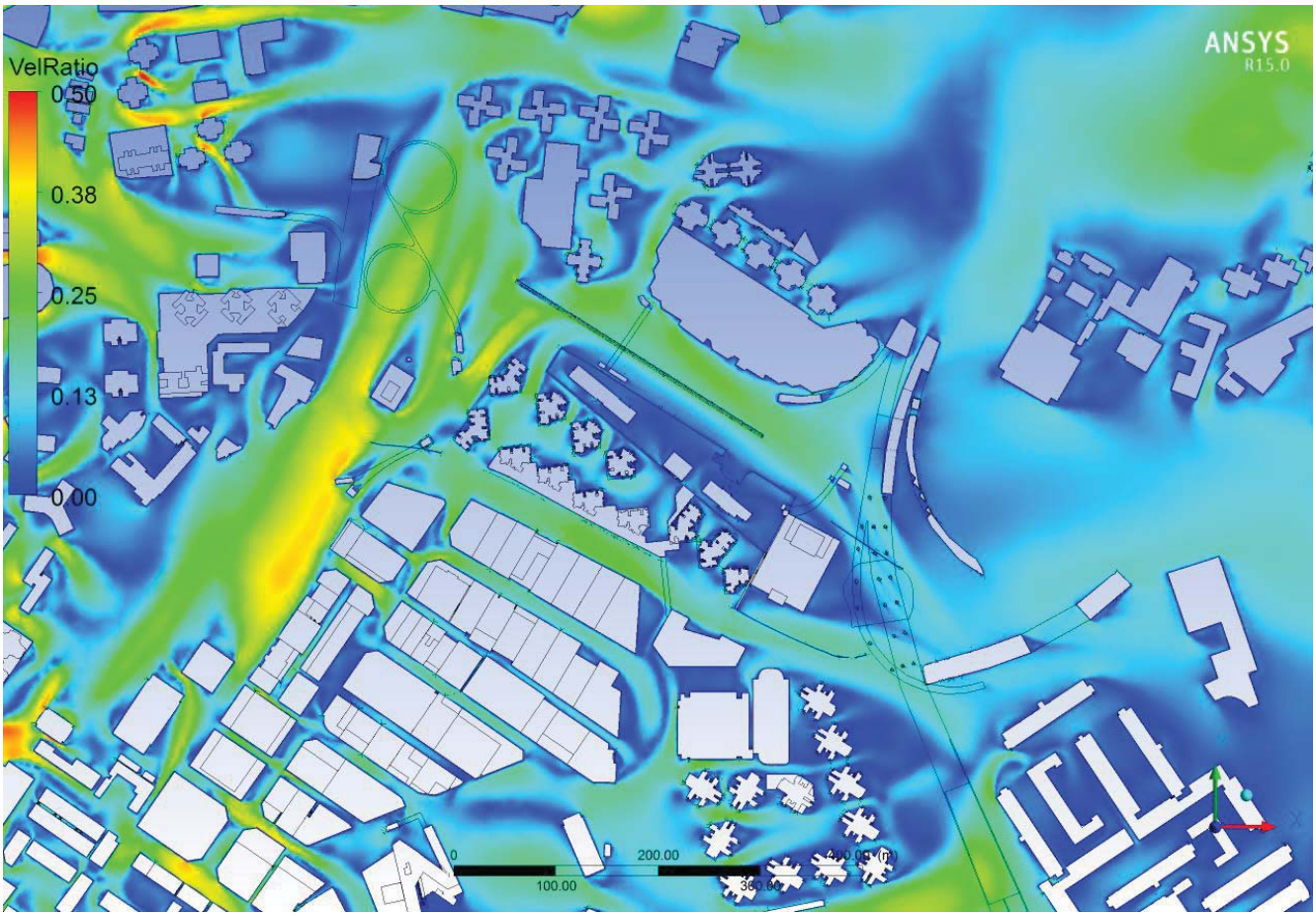
E.9.2. S Wind (Proposed Scheme)

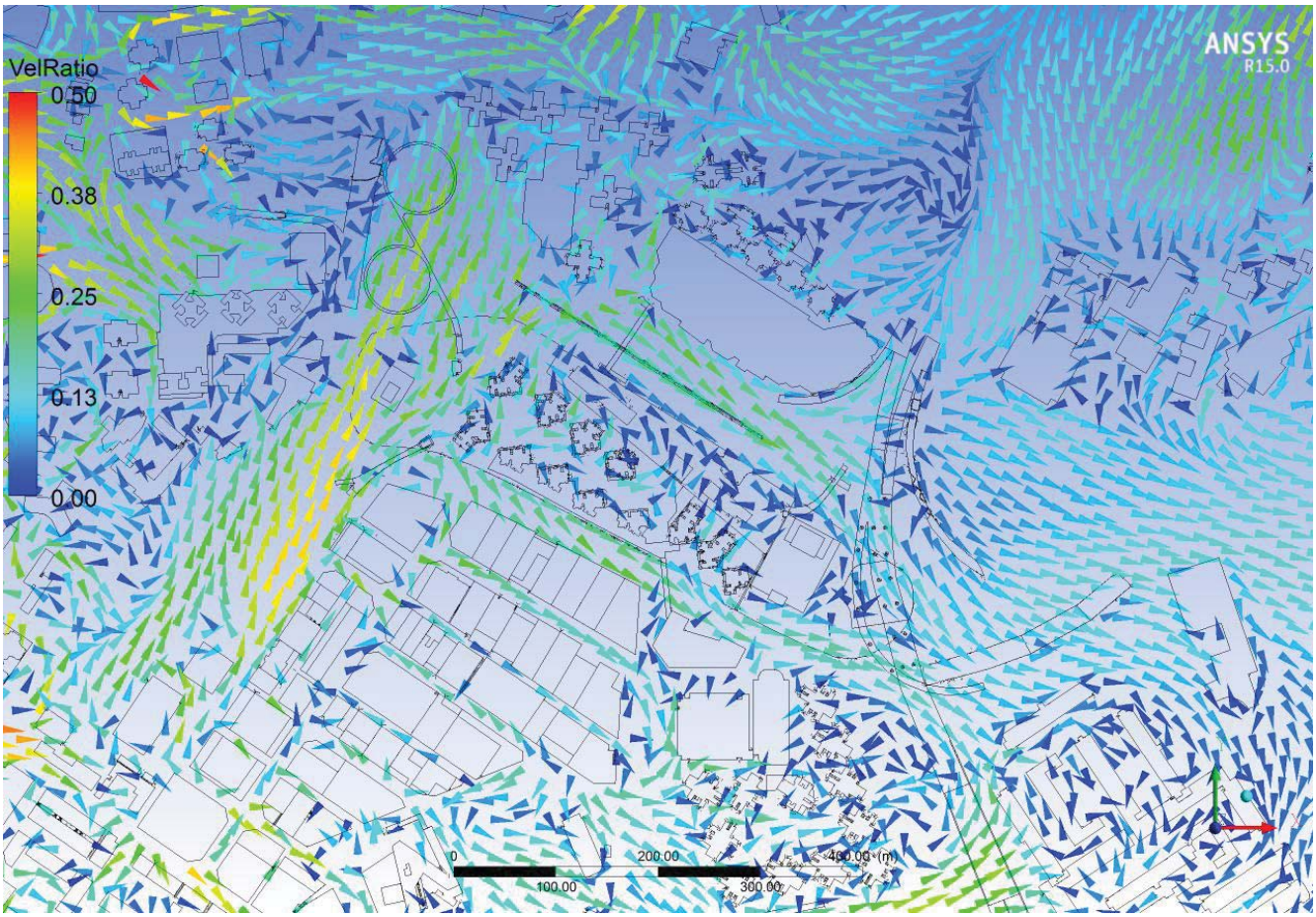




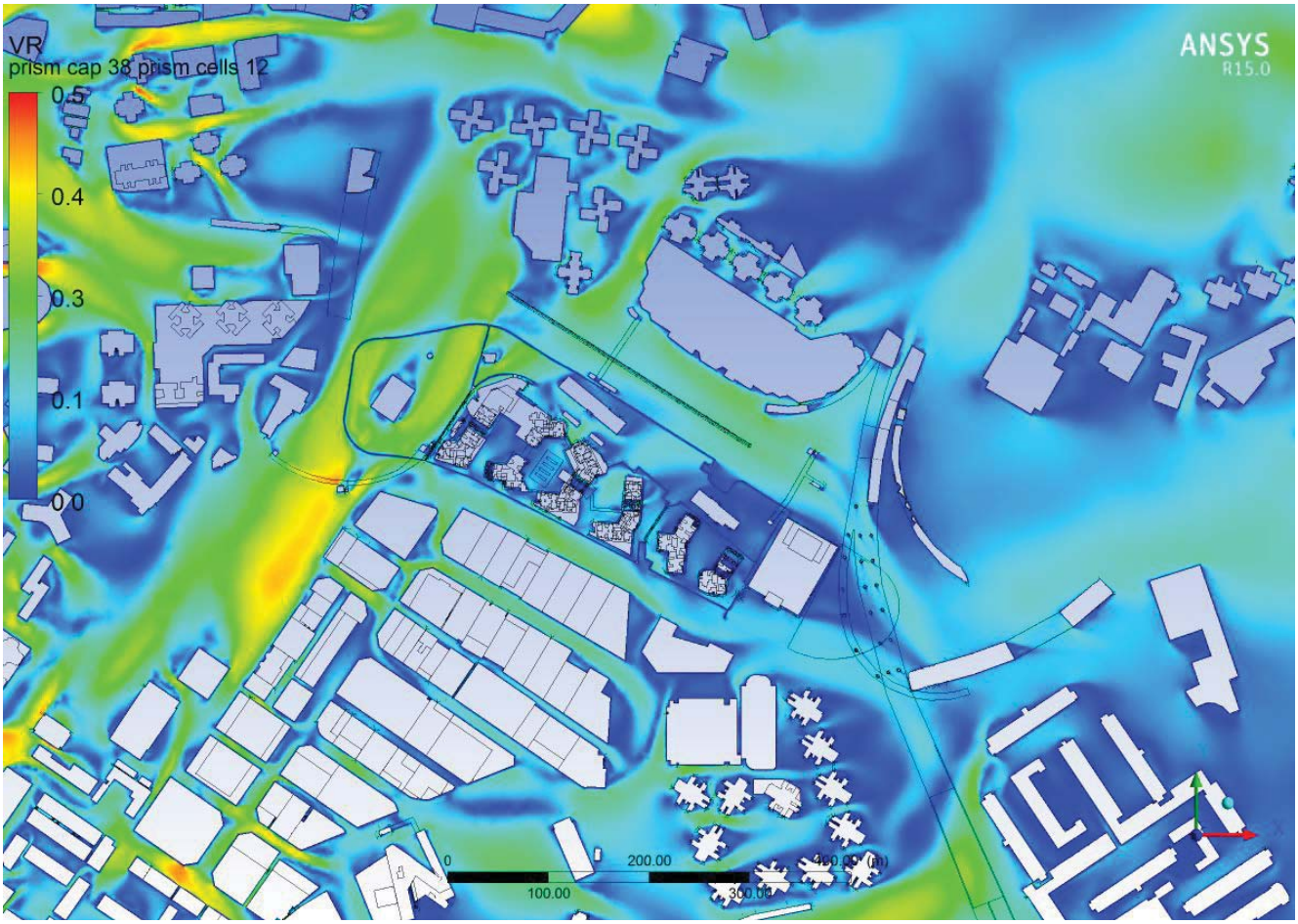
E.10. WSW Wind

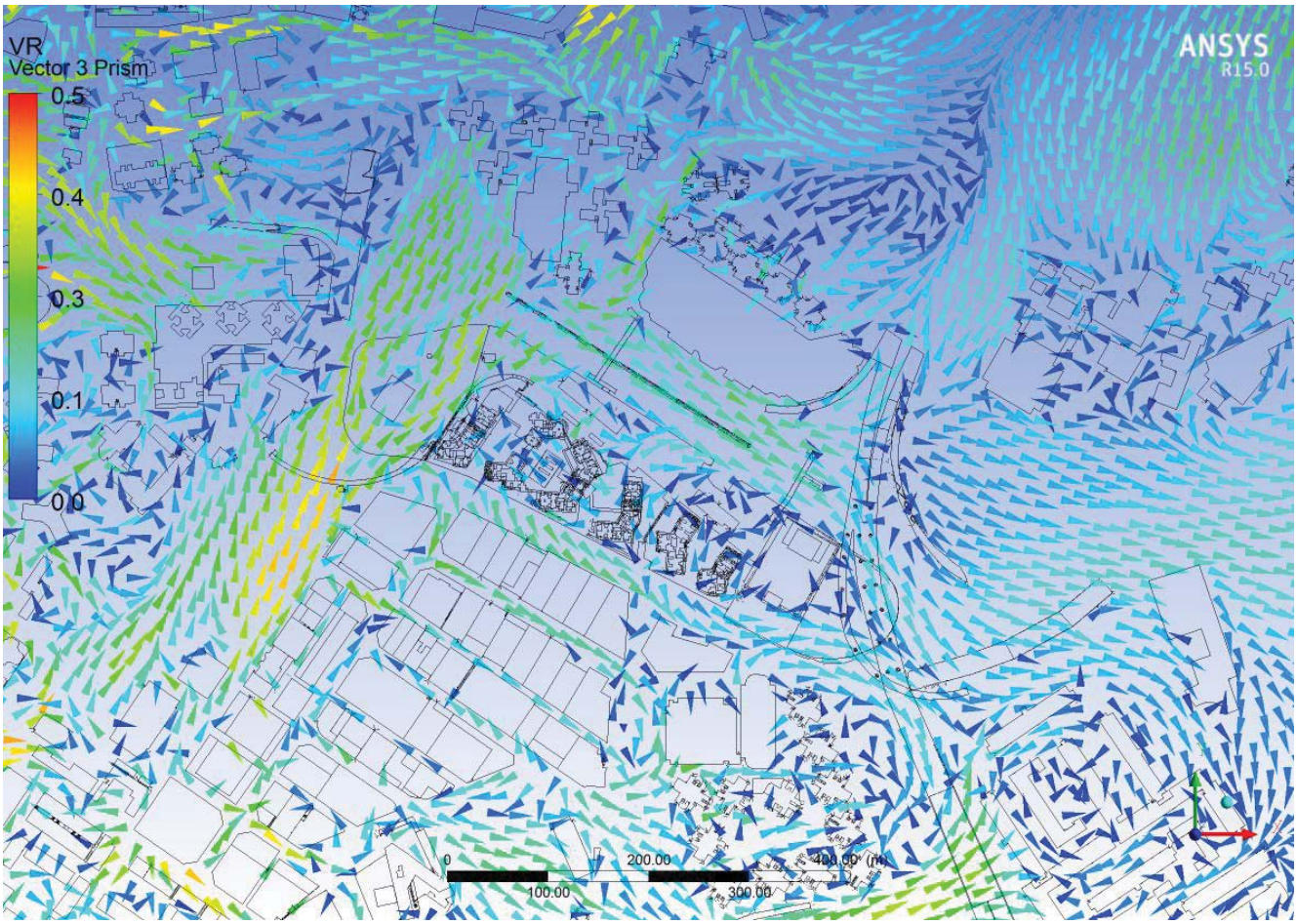
E.10.1. WSW Wind (Baseline Scheme)





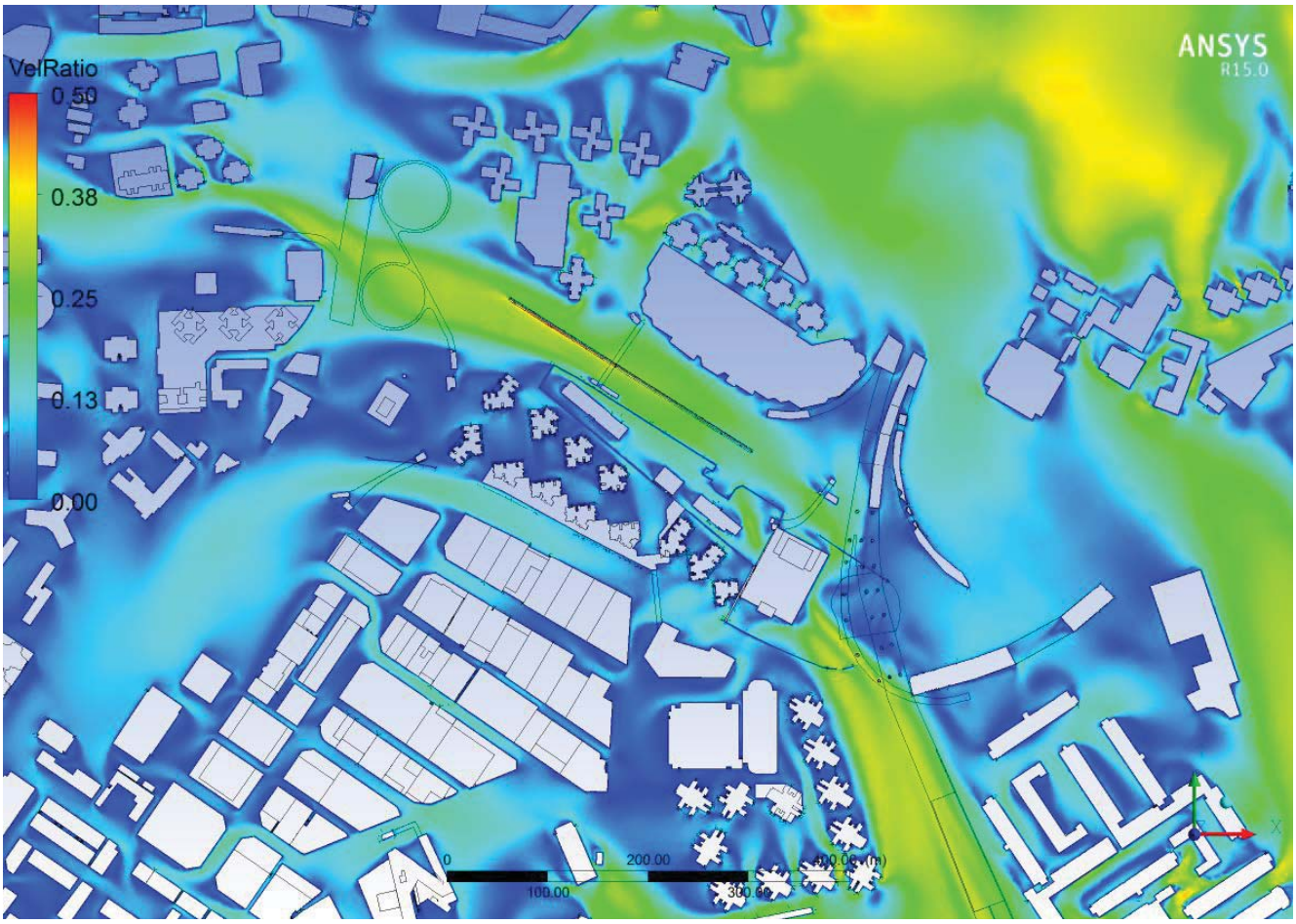
E.10.2. WSW Wind (Proposed Scheme)

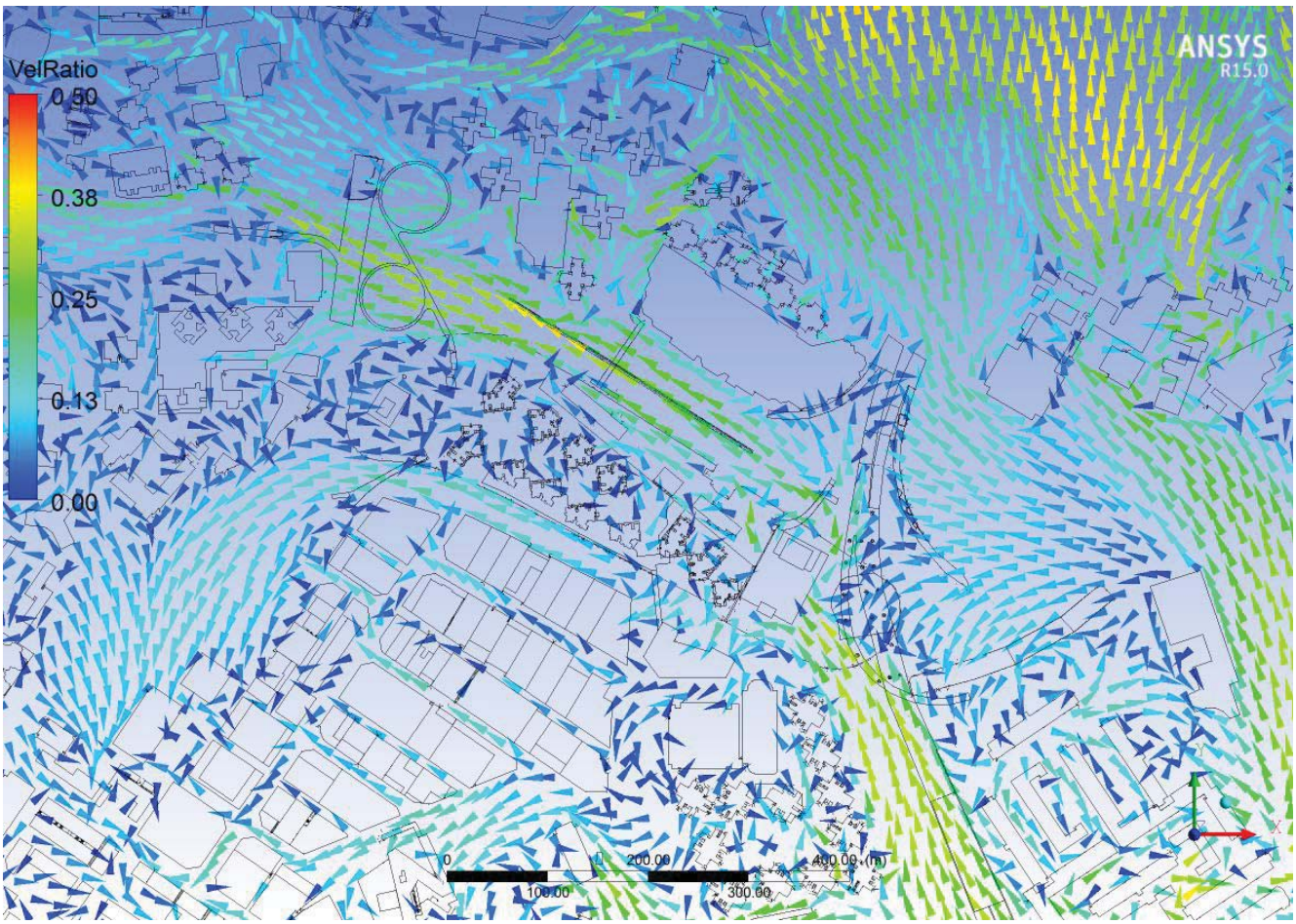




E.11. SSE Wind

E.11.1. SSE Wind (Baseline Scheme)





E.11.2. SSE Wind (Proposed Scheme)