Hong Kong Housing Authority

Proposed Public Rental Housing Development at Tai Wo Hau Road Phase 1 & 2

Air Ventilation Assessment - Initial Study Report

Rev. F | 7 Nov 2022

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number

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ARUP

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1 INTRODUCTION

1.1 Background

Ove Arup & Partners Hong Kong limited (Arup) was appointed to conduct an Air Ventilation Assessment (AVA) for the Proposed Public Housing Development at Tai Wo Hau Road Phase 1 and Phase 2.

The *Technical Guide for Air Ventilation Assessment for the Developments in Hong Kong (Annex A of Technical Circular No.1/06 for Air Ventilation Assessments)*[1] *(termed as AVA Technical Circular hereafter)* dated 19 July 2006 lay down the foundation of methodology in this AVA Initial Study.

1.2 Objective of AVA Study

The main scope of the study is to conduct a quantitative AVA Initial Study to assess the ventilation performance of the proposed developments. It serves as a supporting assessment to substantiate the s.16 planning application for minor relaxation of plot ratio and building heigh of the Proposed Development lodged by HKHA. The deliverables of this study can be summarised as follows:

- Initially assesses the characteristics of the wind availability of the site; and
- Gives a general pattern and a rough quantitative estimate of the wind performance at the pedestrian level using Velocity VR; and
- Identify good design features and problematic areas if any.

[1] Annex A of Technical Circular No. 1/06 issued by the Housing, Planning and Lands Bureau pertaining specifically to Air Ventilation Assessments (19th July, 2006)

2 LOCATION AND SITE CHARACTERISTICS

2.1 General

A public housing development concerning two sites, i.e. Tai Wo Hau Road Phase 1 & Phase 2, is considered in this Study. The proposed developments are located at Kwai Chung which is on a relatively high elevation which gradually increases towards the north where Tai Mo Shan locates. The proposed development site is also located on a slope, and as a result, the ground floors of Phases 1 & 2 are +37.5 mPD and +77.05 mPD respectively.

The Phase 1 Site is located next to Kwai Chung Estate (approximately +164mPD) and bounded by the Kwai Chung Estate Yan Kwai House (approximately +102mPD) to the east and Tai Wo Hau Road to the north and west, with a site area of about 0.31 hectare. For Phase 2 Site, it is located at the existing site for the Kwai Shing Driving Test Centre at Kwai Shing Circuit, with a site area of about 0.31 hectare. It is located to the north of Kwai Shing East Estate, with the nearest block being Shing Wo House (approximately +137mPD).

The surrounding areas are dominant by high-rise residential towers and school cluster. The major high-rise residential clusters located at the surroundings are Kwai Chung Estate to the north and north-east, Kwai Hing Estate (ranging from approximately +83mPD to +106mPD) to the East, school clusters (ranging from approximately +86mPD to +95mPD) to the south-east, Kwai Shing East Estate (ranging from approximately +124mPD to +187mPD) to the south and Tai Wo Hau Estate (ranging from approximately +57mPD to +148mPD) to the north-west.

To the southwest and west, is relatively open with playground and open spaces, including the Tai Wo Hau Estate Playground No.7 and Tai Wo Hau Road South Playground to the west of the Development.

The location of the Study Site and its surrounding context is shown in Figure 1.

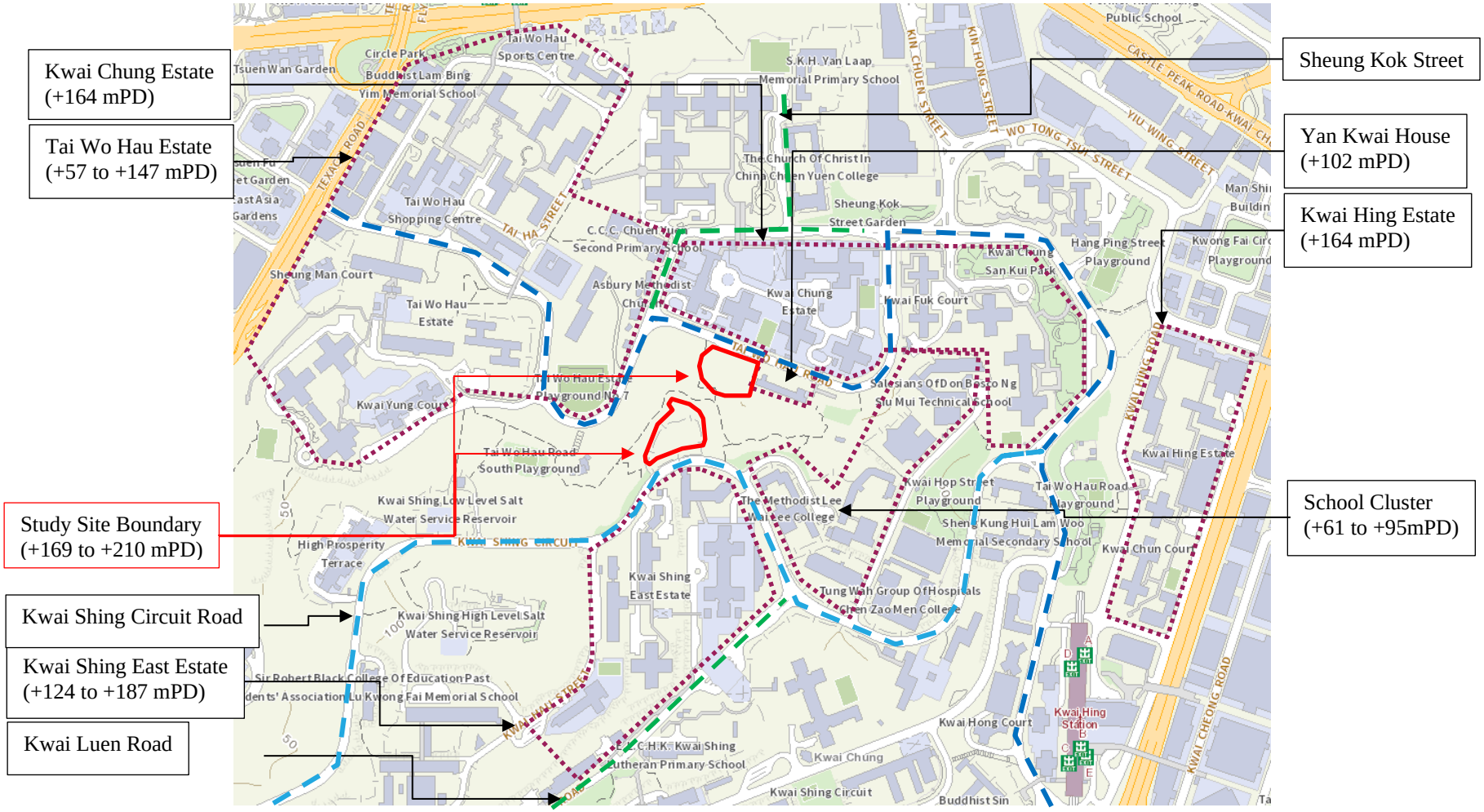


Figure 1 Site Location and existing surrounding developments (Image Source: GeoInfo Map)

3 WIND AVAILABILITY DATA

As per the *AVA Technical Circular*, at least 75% of the time in a typical reference year (frequency of occurrence) would be studied under both annual and summer wind condition in the Initial Study when using a Computational Fluid Dynamics (CFD) modelling technique. Since the CFD approach is adopted for the present project's AVA, this criterion together with the following selected wind data are to be applied as the methodology.

The site wind availability of the Study Site and its surrounding is an essential parameter for AVA. As stipulated in the *AVA Technical Circular* [1] the site wind availability would be presented by using appropriate mathematical models. Planning Department (PlanD) has set up a set of simulated meso-scale data of Regional Atmospheric Modelling System (RAMS) of the territory for AVA study, which could be downloaded at Planning Department Website. Simulated meso-scale data of Regional Atmospheric Modelling System (RAMS) from PlanD will therefore be adopted in this AVA Study. The location of the Development falls within the location grid (x:071, y:053) in the RAMS database as indicated in Figure 2 The wind rose for annual condition is presented in Figure 3 and the wind rose for summer condition is presented in Figure 4.

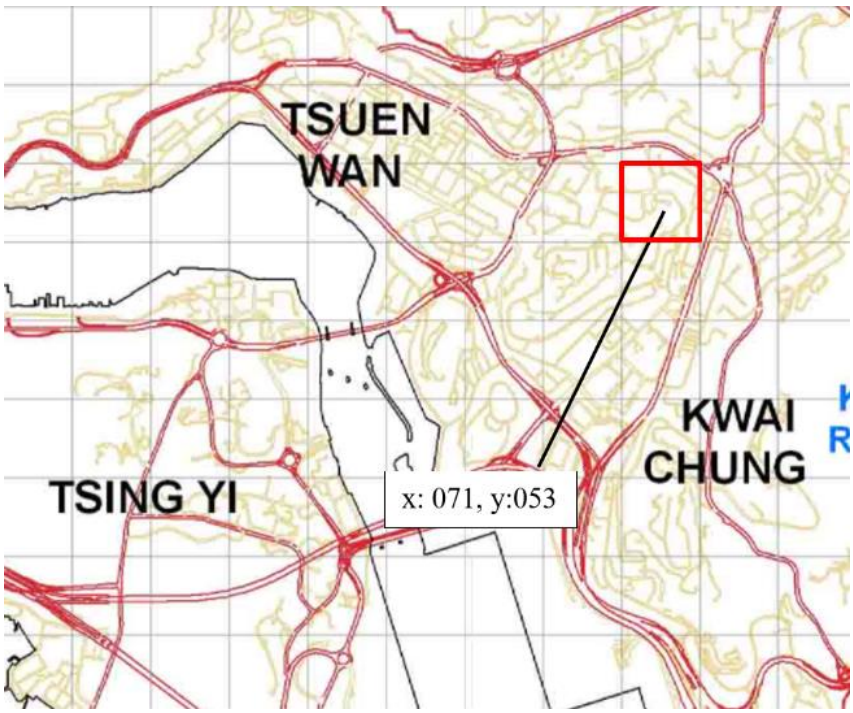


Figure 2 RAMS Grid and the Development Location

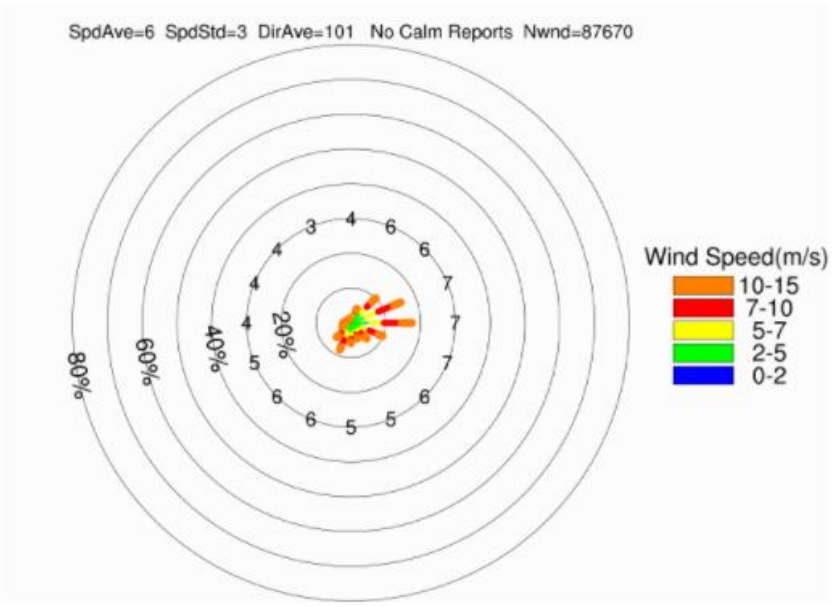


Figure 3 Project Site Annual Wind Rose at 500mPD (x:071, y:053)

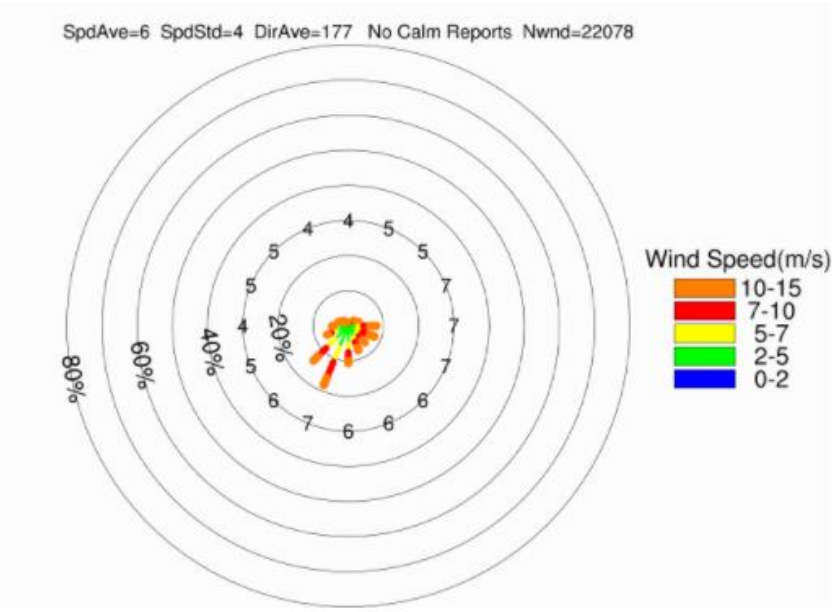


Figure 4 Project Site Summer Wind Rose at 500mPD (x:071, y:053)

3.1 Prevailing Wind Direction

3.1.1 Annual Prevailing Wind

For annual condition, eight prevailing wind directions (highlighted in red in Table 1) are considered in the Initial Study, which covers 80.1% of the total annual wind frequency. They are north-easterly (10.3%), east-north-easterly (15.7%), easterly (17.8%), east-south-easterly (9.9%), south-easterly (6.4%), southerly (5.9%), south-south-westerly (8.3%), and south-westerly (5.8%) winds.

Table 1. Annual Wind Frequency Table

Wind Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	
Frequency	1.5%	4.6%	10.3%	15.7%	17.8%	9.9%	6.4%	4.9%	
Wind Direction	S	SSW	SW	WSW	W	WNW	NW	NNW	**SUM**
Frequency	5.9%	8.3%	5.8%	2.7%	2.3%	1.5%	1.3%	1.0%	**80.1%**

Note [1] The wind frequency showing in red colour represents the selected winds for the CFD simulation.

3.1.2 Summer Prevailing Wind

For summer condition, eight prevailing wind directions (highlighted in red in Table 2) are considered in the Initial Study, which covers 81.3% of the total annual wind frequency. They are easterly (8.3%), east-south-easterly (8.3%), south-easterly (6.9%), south-south-easterly (7.6%), southerly (10.9%), south-south-westerly (18.5%), south-westerly (14.2%) and west-south-westerly (6.6%) winds.

Table 2. Summer Wind Frequency Table

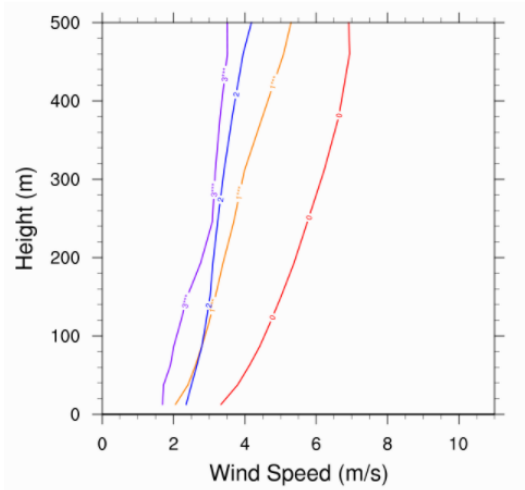
Wind Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	
Frequency	0.9%	1.2%	2.2%	3.3%	8.3%	8.3%	6.9%	7.6%	
Wind Direction	S	SSW	SW	WSW	W	WNW	NW	NNW	**SUM**
Frequency	10.9%	18.5%	14.2%	6.6%	4,7%	3.0%	2.0%	1.2%	**81.3%**

Note [1] The wind frequency showing in red colour represents the selected winds for the CFD simulation.

3.2 Wind Profiles

The wind profile calculated from RAMS is adopted in this AVA study. The profiles of wind speed from the PlanD RAMS database at (x:071, y:053) are shown in Figure 5. RAMS wind profile data from 10 – 500m is extracted directly for as it can reflect the exact wind data. For the near ground wind speed from 0 – 10m, the power law equation is used to approximate near ground wind profile. For wind data above 500m height, the velocity is assumed to be the same as the data at 500m. These wind data will be input parameters in the CFD simulation.

The wind profiles of the 16 wind directions are categorized into 4 wind profiles. The wind profile used in the CFD simulation are presented in Figure 5.



0: 22.5°-112.4°

1: 112.5°-202.4°

2: 202.5°-292.4°

3: 292.5°-22.4°

***: <10% total sample size in 2009, i.e. number of samples < 876

Figure 5 Wind Profile from RAMS at the Project Site (x:071, y:053)

3.3 Assessment and Surrounding Areas

With reference to the *AVA Technical Circular*, the areas of evaluation and assessment should include all area within the Project Area, as well as a belt up to 1H, where H is the height of the tallest building of the Proposed Development, around the site boundary.

Considering the major high-rise development and open spaces in the vicinity of the Study Site, the Assessment Area (shown in green line) is extended to cover 2H (300m) from the site boundary with H being the building height round up to 150m. The Surrounding Area covers a further 1H from the Assessment Area (shown in red line). In addition, the model domain covered the hilly terrain beyond the Surrounding Area as shown in Figure 6. The Golden Hill to the east and the edge of Tai Mo Shan to the north of the Project Site have been incorporated into the CFD model.

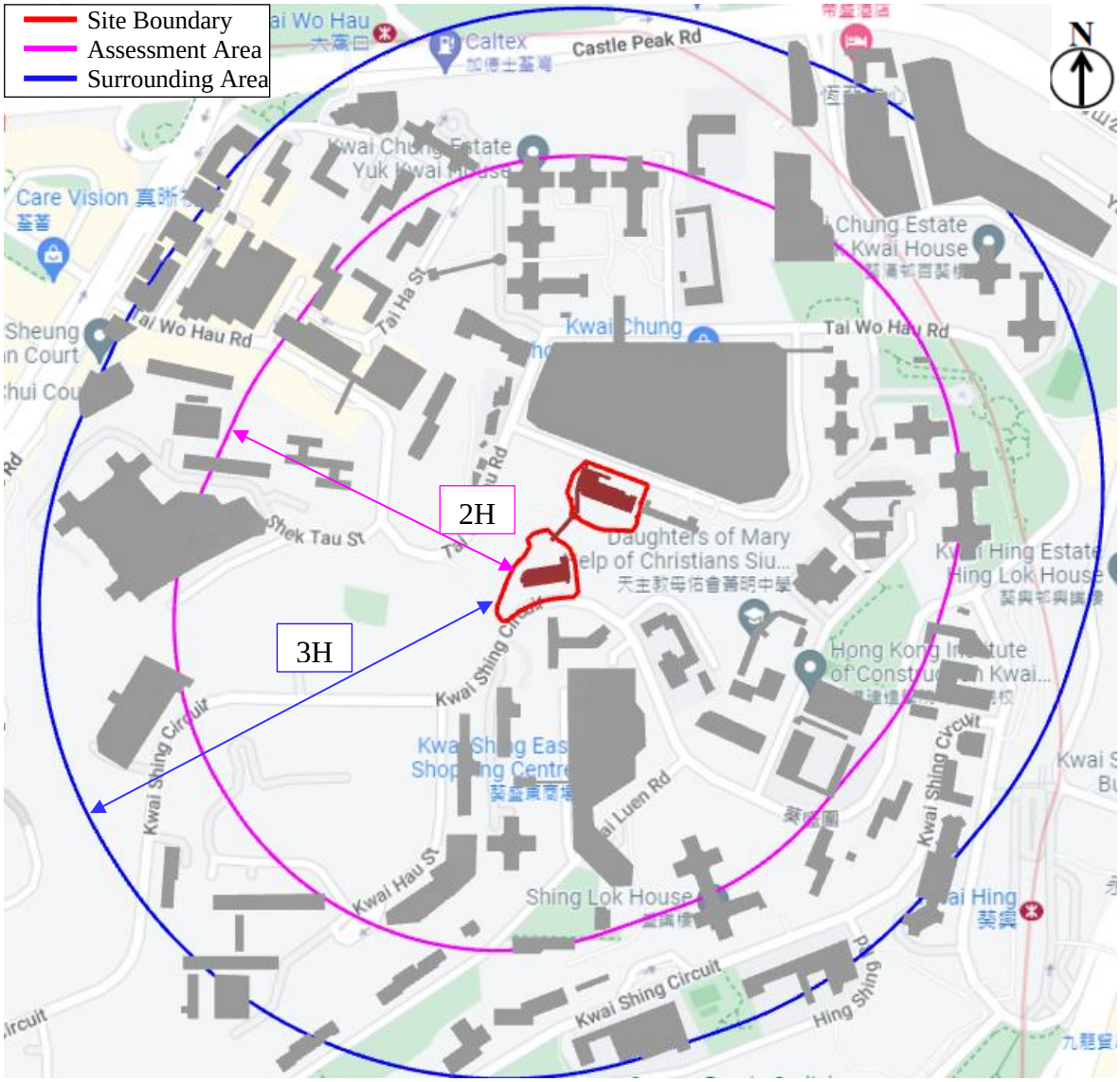


Figure 6 Site Boundary, Assessment Area, and Extended Surrounding Area of Study (Image Source: Google Map)

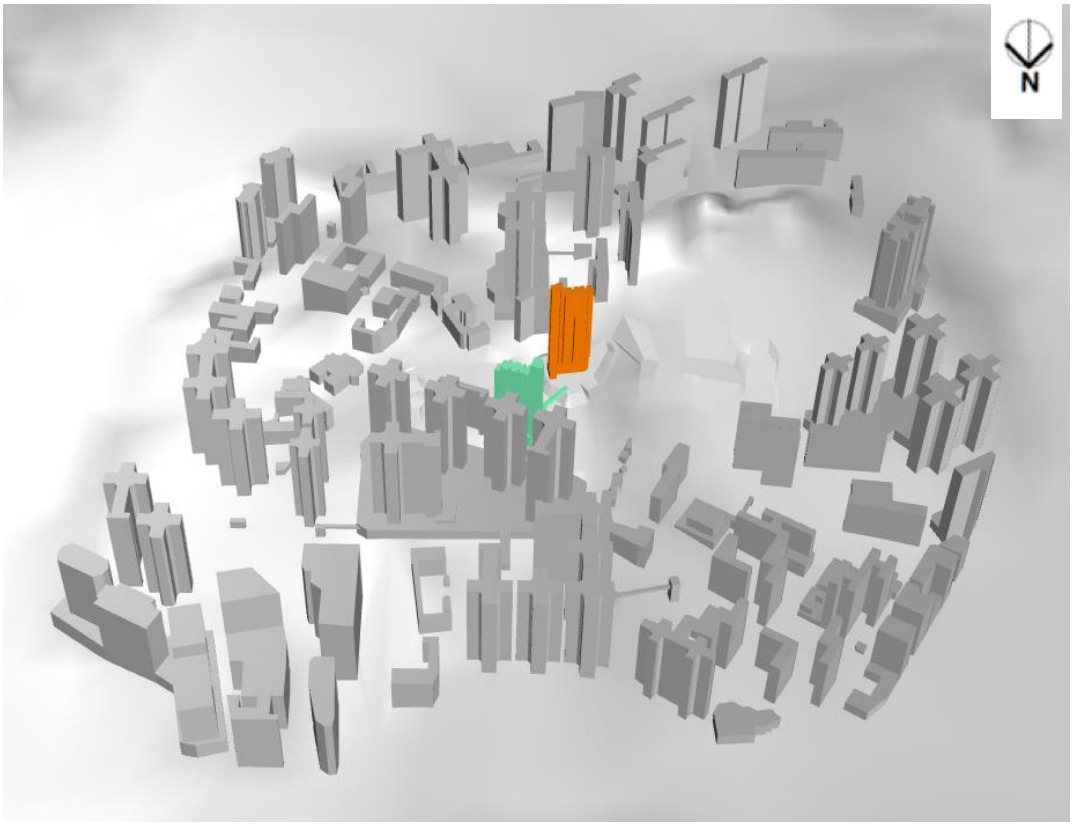


Figure 7 Northerly View of Surrounding Buildings

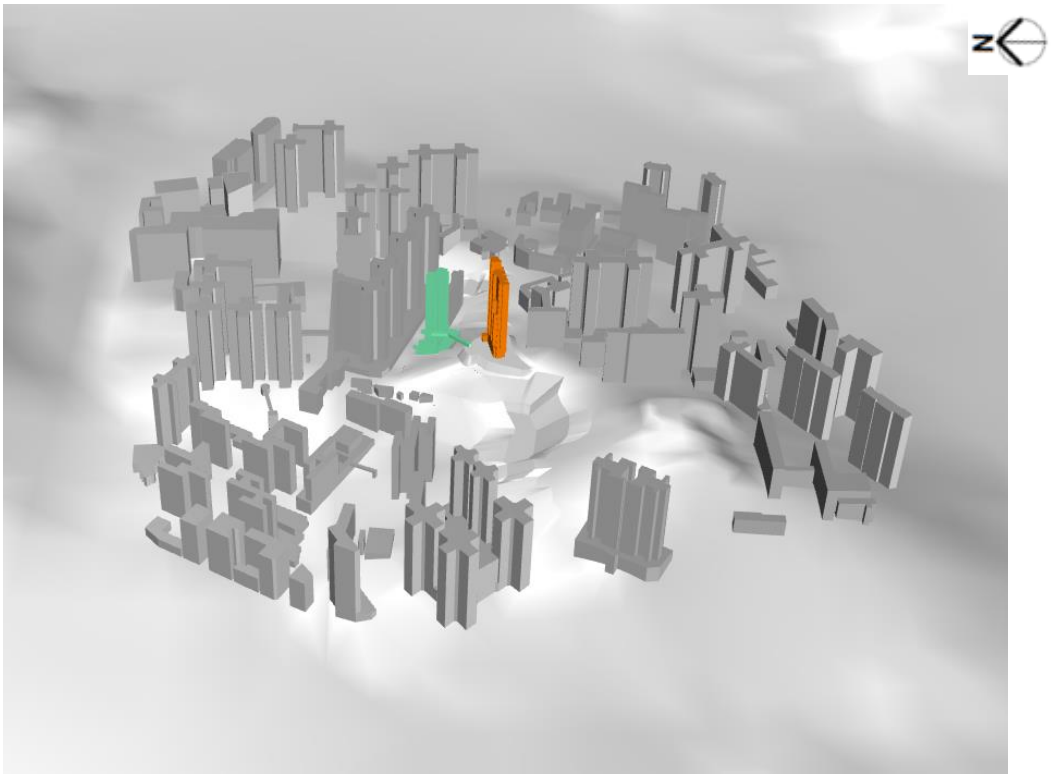


Figure 8 Easterly View of Surrounding Buildings (Baseline Scheme)

Figure 9 Southerly View of Surrounding Buildings (Baseline Scheme)

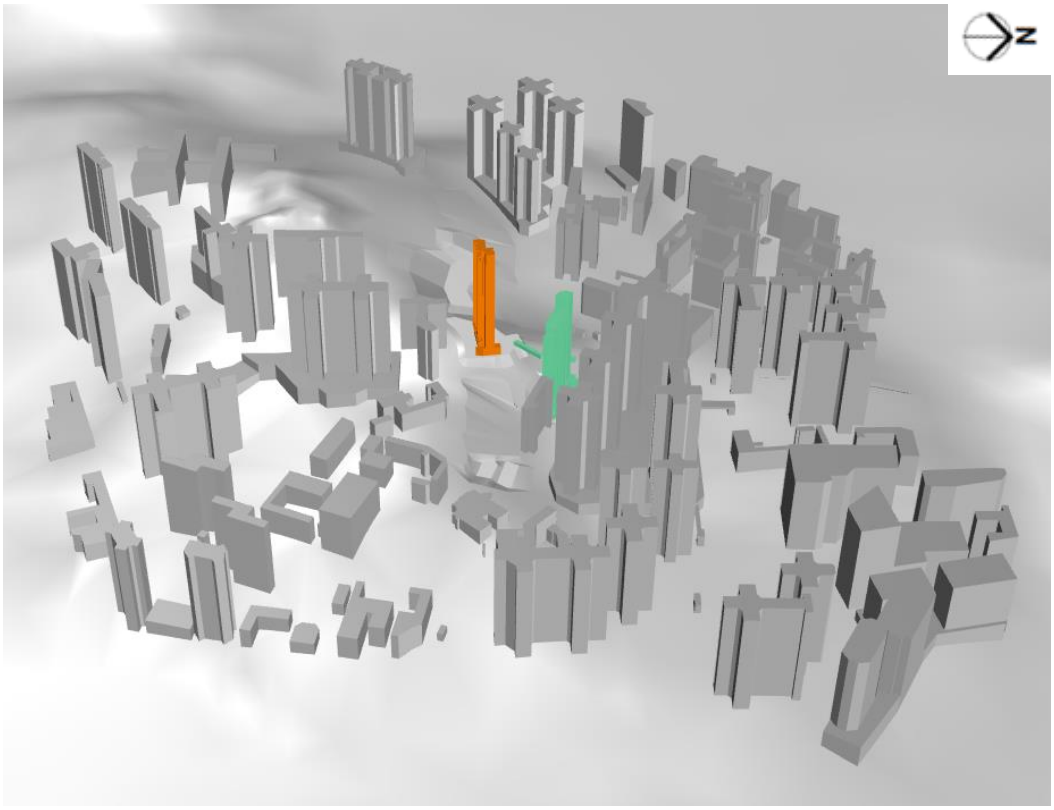


Figure 10 Westerly View of Surrounding Buildings (Baseline Scheme)

3.4 Technical Details for CFD Simulation

Since there is no internationally recognized guideline or standard on using CFD for outdoor urban scale studies, reference was made to other CFD guidelines on different wind flow aspects to suggest a study approach for current study. The detail parameters are summarized in Table 3. The 3D model of the domain is given in below.

3.4.1 Assessment Tools

Computational Fluid Dynamics (CFD) technique is utilized for this AVA Initial Study. The CFD package ANSYS ICEM-CFD and Ansys Fluent were used in this study. With the use of three-dimensional CFD method, the local airflow distribution can be visualised in detail. The air velocity distribution within the flow domain, being affected by the site-specific design and the surrounding buildings, has been simulated under the prevailing wind conditions round the year.

3.4.2 CFD Model

Following the *AVA Technical Circular*, buildings within Surrounding Area shall be built in the CFD model. In addition, the model domain is built far beyond the Surrounding Area as required in the *AVA Technical Circular* in order to eliminate the boundary effects. The CFD model for the Study is approximately 3800m (L) x 3800m (W) x 1300m (H). Buildings included in the model and the topography of the domain are taken via the Geographical Information System (GIS) platform.

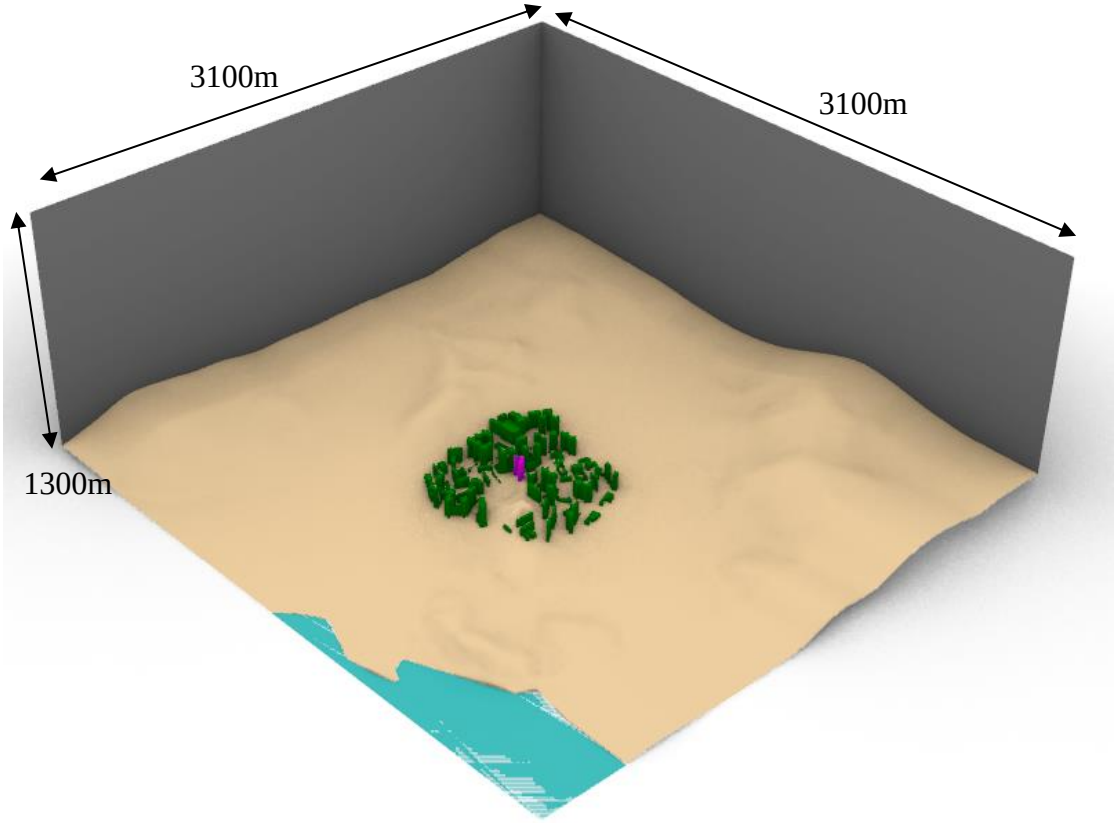


Figure 11 Domain of the CFD Model

Body-fitted unstructured grid technique is used to fit the geometry and to reflect the complexity of the development geometry. A prism layer of 3m above ground, including a total of 6 layers, each 0.5m thick) is incorporated in the meshing so as to better capture the approaching wind profile and the wind condition at pedestrian level. The expansion ratio is 1.3 while the maximum blockage ratio is 3%.

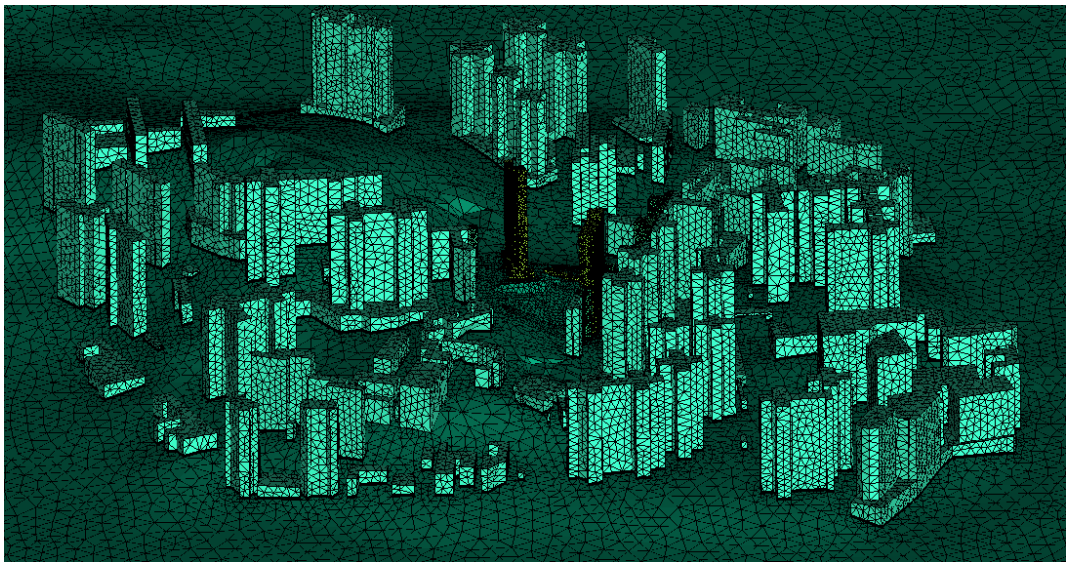


Figure 12 Mesh of the CFD Model

Finer grid system is applied to the most concerned area based on preliminary judgement, while coarse grid system is applied to the area of surrounding buildings for better computational performance while maintaining satisfactory result.

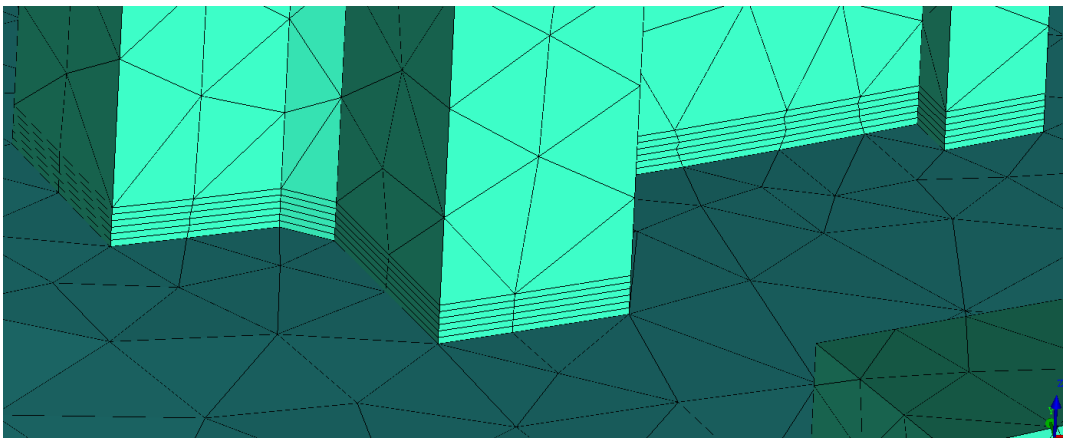


Figure 13 Prism layer of mesh

The prevailing wind direction is set to inlet boundary with wind profile, as mentioned in Section 3.2, whereas the downwind boundary is set to pressure with environmental pressure value. The top and side boundaries are set to symmetry.

Table 3. Key Parameters of CFD Model

Parameters	CFD Model
Physical Model Scale	Real scale model, 1:1 scale
Model details	Only include Topography, Buildings blocks, Streets/Highways, no landscape is included
Domain	3100m (L) x 3100m (W) x 1300m (H)
Assessment Area	2H area
Surrounding building Area	3H area
Grid Expansion Ratio	The grid should satisfy the grid resolution requirement with maximum expansion ratio = 1.3
Prismatic layer	6 layer of prismatic layers and 0.5m each (i.e. total 3m above ground)
Inflow boundary Condition	Incoming wind profile as extracted from RAMS
Outflow boundary	Pressure boundary condition with dynamic pressure equal to zero
Wall boundary condition	Logarithmic law boundary
Solving algorithms	Rhie and Chow SIMPLE for momentum equation Hybrid model for all other equations
Blockage ratio	< 3%
Convergence criteria	Below 1.0×10^{-4}

3.4.3 Turbulence Model

As highlighted in recent academic and industrial research literatures by CFD practitioners, the widely used standard k - ε turbulence model technique may not adequately model the effects of large-scale turbulence around buildings and ignores the wind gusts leading to the relatively poor prediction in the recirculation regions around building. Therefore, in this CFD simulation, realizable k – ε turbulence modelling method is applied. This technique provides more accurate representation of the levels of turbulence that can be expected in an urban environment.

3.4.4 Calculation Method

The Segregated Flow model solves the flow equations in a segregated manner. The linkage between the momentum and continuity equations adopted the predictor-corrector approach. A collocated variable arrangement and a Rhie-and-Chow-type pressure-velocity coupling combined with a SIMPLE-type algorithm. A higher order differencing scheme is applied to discretize the governing equations. The convergence criterion is set to 1.0×10^{-4} on mass conservation. The calculation will repeat until the solution satisfies this convergence criterion.

The prevailing wind direction as mentioned in Section 3.1 is set to inlet boundary of the model with wind profile as detailed in Section 3.2. The downwind boundary is set to pressure with value of atmospheric pressure. The top and side boundaries are set to symmetry. In addition, to eliminate the boundary effects, the model domain is built beyond the Surrounding Area as required in the *AVA Technical Circular*.

3.5 Data Representation

The wind speed information at pedestrian level (2m above ground) will be acquired to determine the Wind Velocity Ratio (*VR*) as stipulated in the *AVA Technical Circular* [1] and as defined as follows:

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

where V_p is the wind speed at the pedestrian height (2m above ground) and V_∞ is the wind velocity at the top of the boundary layer (defined as the height where wind is unaffected by urban roughness and determined by the topographical studies). Measurement will be taken in the following areas within the "Assessment Area":

Along the boundary of Development Area (defined as "Perimeter" test-points), such that the Site-Spatial Average Velocity Ratio (*SVR*) can be determined (as per the *AVA Technical Circular)*; and

Throughout the Assessment Area other than the perimeter test-points (defined as "Overall" Test-points), such that the Local Spatial Average Velocity Ratio (LVR) can be determined by taking an average of all overall and perimeter test-points (as the *AVA Technical Circular).*

3.6 Test Point Location

As per the technical circular, three types of test point – perimeter test point, overall test point and special test point will be adopted to assess the wind performance. The allocation of these test points will be distributed evenly as stated in the *AVA Technical Circular*.

3.6.1 Perimeter Test Points

Perimeter test points are the points positioned at the site boundary of the proposed development. In accordance with the *AVA Technical Circular*, perimeter test points are positioned at an interval of 10-15m alongside the site boundary where pedestrians can frequently access. In total there are **60** perimeter test points in this study.

3.6.2 Overall Test Points

Overall test points are the points evenly positioned in the open area on the streets and places where pedestrian frequently access within the assessment area. In total there are **223** overall test points within the assessment area.

Within the proposed Assessment Area and the Development Area given in Table 4, a total of **30** focus areas are proposed. The focus areas are tabulated below and their associated test points and location for each focus area are shown in Figure 14, Figure 15 and Figure 16.

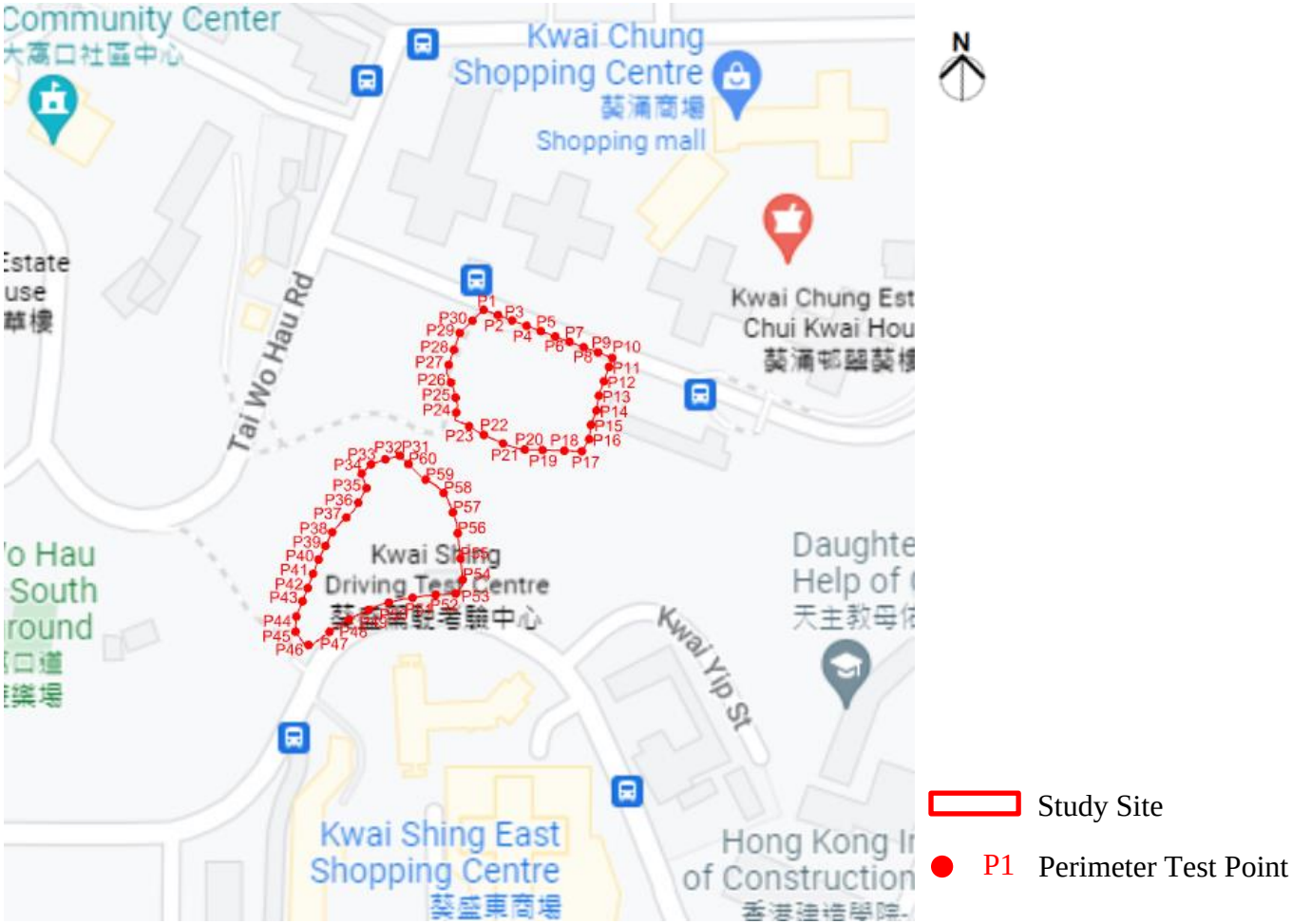


Figure 14 Perimeter Test Points

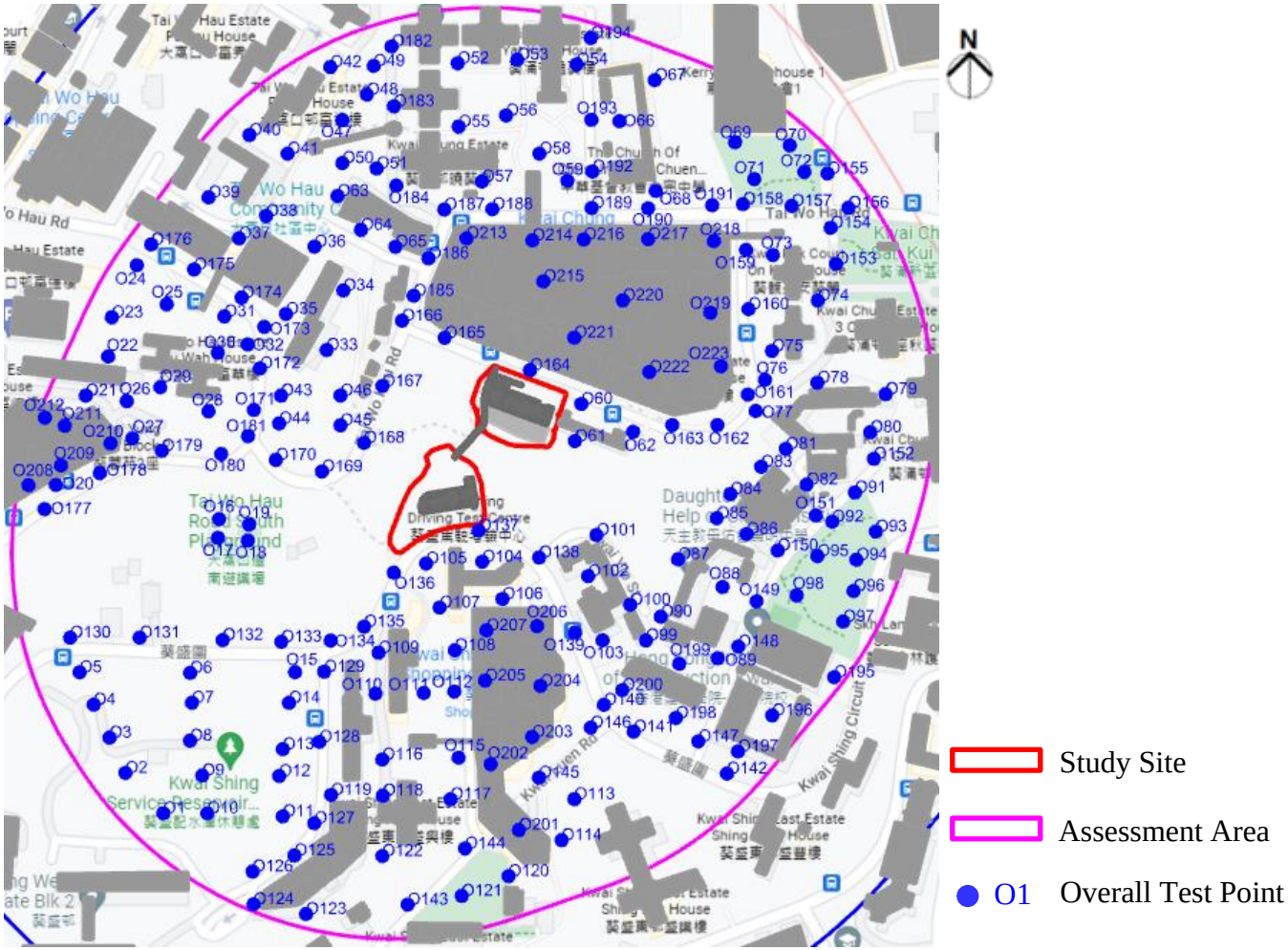


Figure 15 Overall Test Points

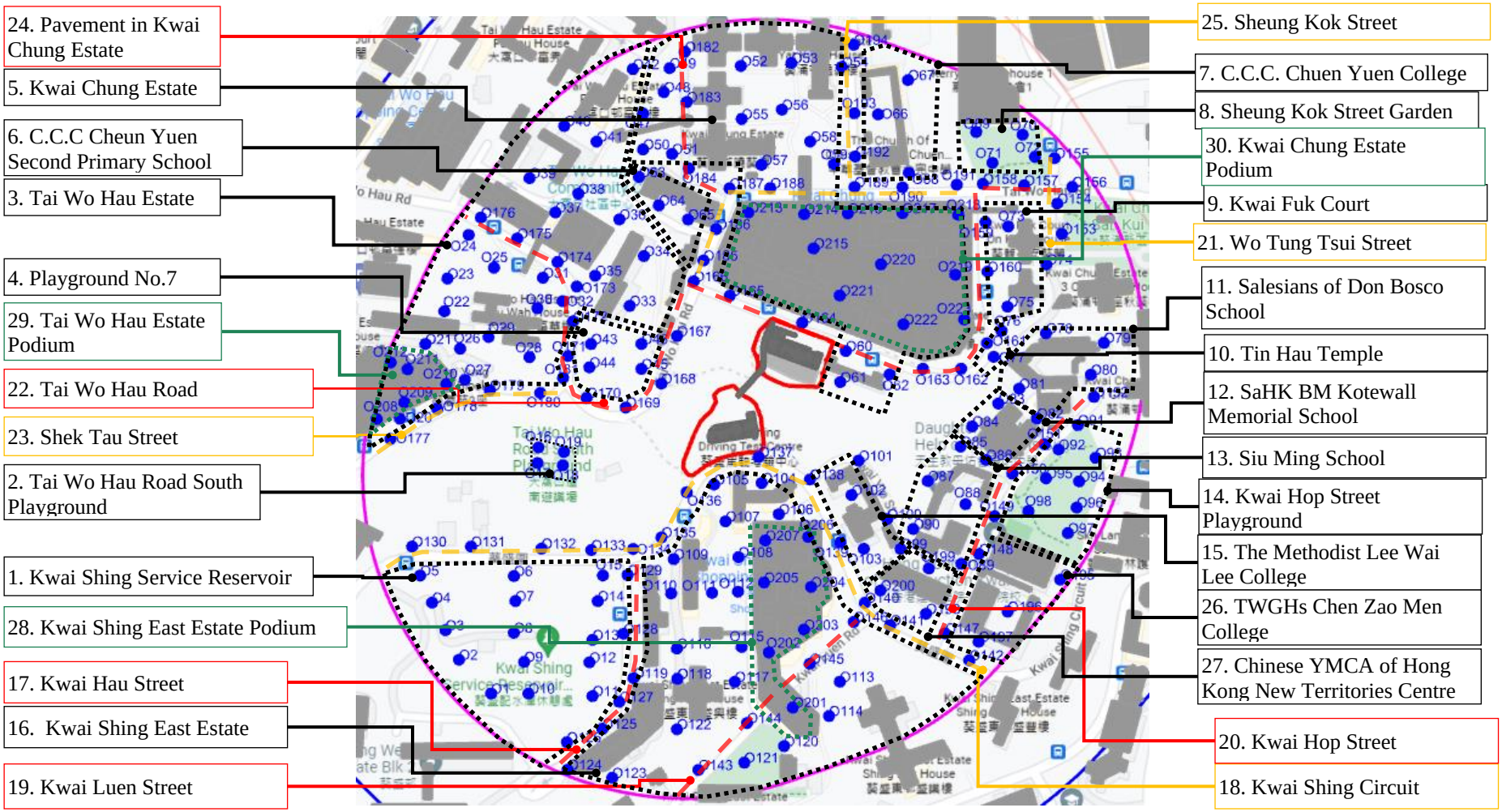


Figure 16 Focus Areas and Corresponding Test Points

Table 4 Focus Areas and Corresponding Test Points

Focus Areas		Test Points
1	Kwai Shing Service Reservoir	O1-O15
2	Tai Wo Hau Road South Playground	O16-O19
3	Tai Wo Hau Estate	O20-O42
4	Playground No.7	O43-O46
5	Kwai Chung Estate	O47-O62
6	C.C.C Chuen Yuen Second Primary School	O63-O65
7	C.C.C. Chuen Yuen College	O66-O68
8	Sheung Kok Street Garden	O69-O72
9	Kwai Fuk Court	O73-O75
10	Tin Hau Temple	O76-O77
11	Salesians of Don Bosco School	O78-O81
12	SaHK BM Kotewall Memorial School	O82-O84
13	Siu Ming School	O85-O90
14	Kwai Hop Street Playground	O91-O98
15	The Methodist Lee Wai Lee College	O99-O103
16	Kwai Shing East Estate	O104-O125
17	Kwai Hau Street	O126-O129
18	Kwai Shing Circuit	O130-O142 P46-P53
19	Kwai Leun Road	O143-O146
20	Kwai Hop Street	O147-O152
21	Wo Tung Tsui Street	O153-O155
22	Tai Wo Hau Road	O156-O176 P1-P10
23	Shek Tau Street	O177-O181
24	Pavement in Kwai Chung Estate	O182-O184
25	Sheung Kok Street	O185-O194
26	TWGHs Chen Zao Men College	O195-O197
27	Chinese YMCA of Hong Kong New Territories Centre	O198-O200
28	Kwai Shing East Estate Podium	O201-O207
29	Tai Wo Hau Estate Podium	O208-O212
30	Kwai Chung Estate podium	O213-O223

4 DESIGN SCHEMES FOR AVA STUDY

Two schemes will be analysed and compared in this AVA Initial Study, namely the Baseline Scheme and the Proposed Scheme.

4.1 Baseline Scheme

The Baseline Scheme is a previously approved scheme according to Outline Zoning Plan No. S/KC/27[2]. The Baseline Scheme is an Enhanced Public Rental Housing (PRH) Scheme which consists of two phases with one block at each phase comprising domestic flats and community facilities. In addition, there is also a footbridge linking the two phases. The residential blocks are arranged in linear shape aligned with ESE-WNW direction (Phase 1) and E-W direction (Phase 2) with a separation of 65m between Phase 1 and Phase 2. The layout plan of Baseline Scheme is shown in Figure 17 and the 3D model of Baseline Scheme is shown in Figure 18 to Figure 21. The building height and planning parameter is shown in Table 5.

Table 5 Baseline PRH Scheme Development Parameters

	Phase 1	**Phase 2**
Maximum Building Height (mPD)	160	190
Level of Ground Floor (mPD)	37.5	76.6
Building height (m)	122.5	113.4

[2] Plan-making issued by Town Planning Board
https://www.info.gov.hk/tpb/en/plan_making/S_KC_27.html

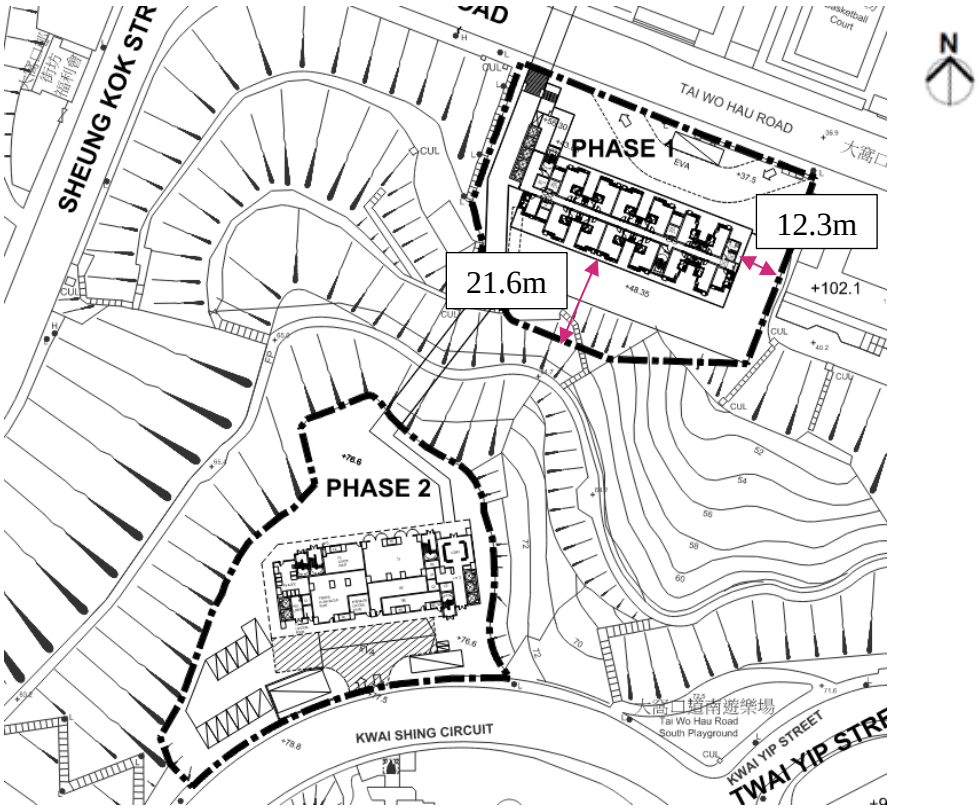


Figure 17 Master Layout Plan of Baseline Scheme

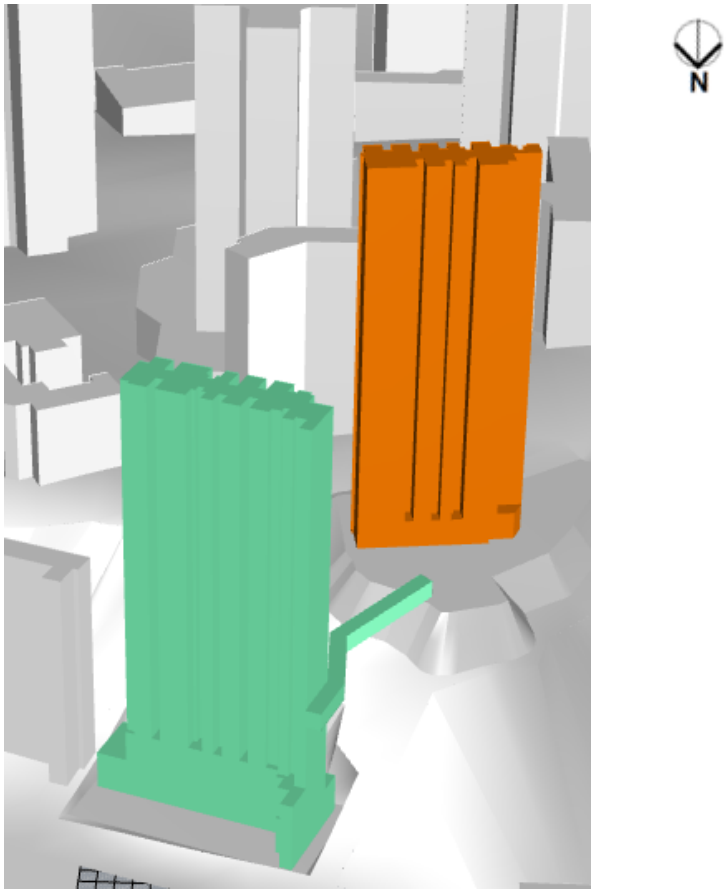


Figure 18 Northerly View of Baseline Scheme

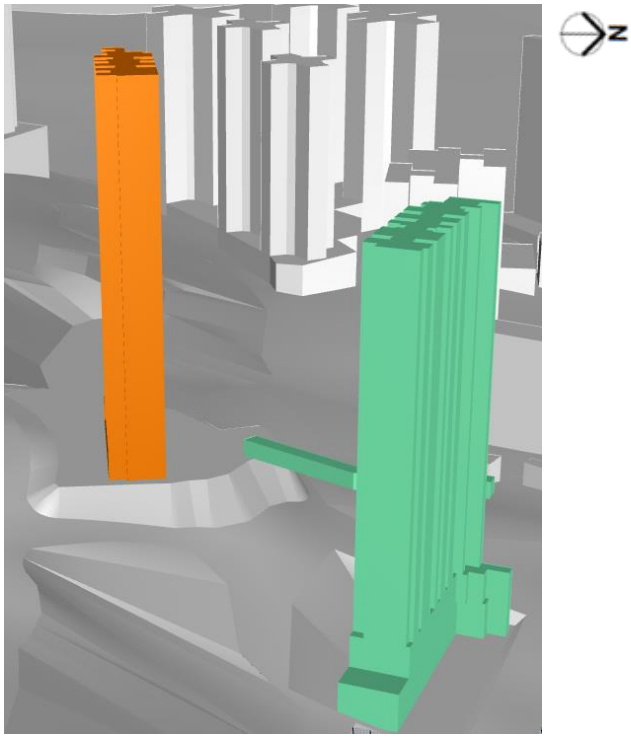


Figure 19 Easterly View of Baseline Scheme

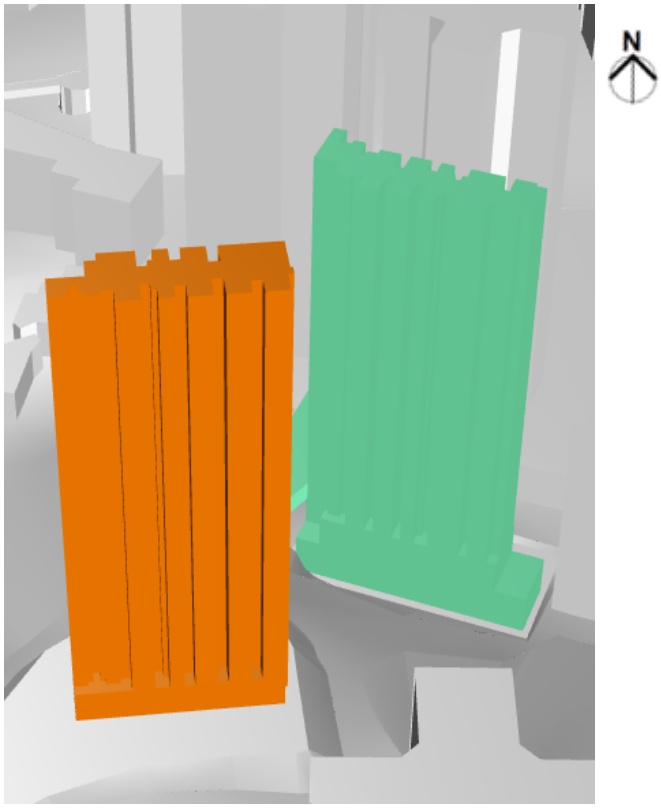


Figure 20 Southerly View of Baseline Scheme

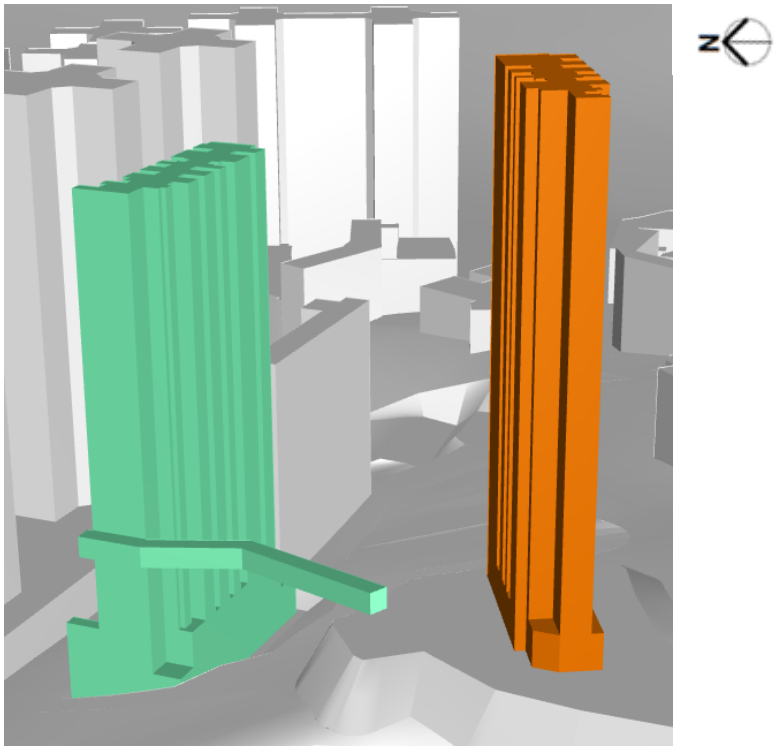


Figure 21 Westerly View of Baseline Scheme

4.2 Proposed Scheme

On making reference to the CAD drawings of the Proposed Scheme, the 3D model was constructed and shown in Figure 24 to Figure 27.

Similar building layout has been maintained as compared with Baseline Scheme. Following difference has been identified and highlighted in Figure 22:

- Phase 1 – Landscape deck at 2F
- Phase 2 – Increased Building Height
- Phase 1 – Additional tower setback from south-eastern boundary of 3.2m above 35/F
- Phase 1 – Additional tower setback from south-western boundary of 1.7m above podium

The layout plan of Proposed Scheme is shown in Figure 22 and the 3D model of Proposed Scheme is shown in Figure 24 to Figure 27.The building height and planning parameter is shown in Table 6.

Table 6 Proposed PRH Scheme Development Parameters

	Phase 1	Phase 2
Maximum Building Height (mPD)	154.50	198.00
Level of Ground Floor (mPD)	37.50	77.05
Building height (m)	117.00	120.95

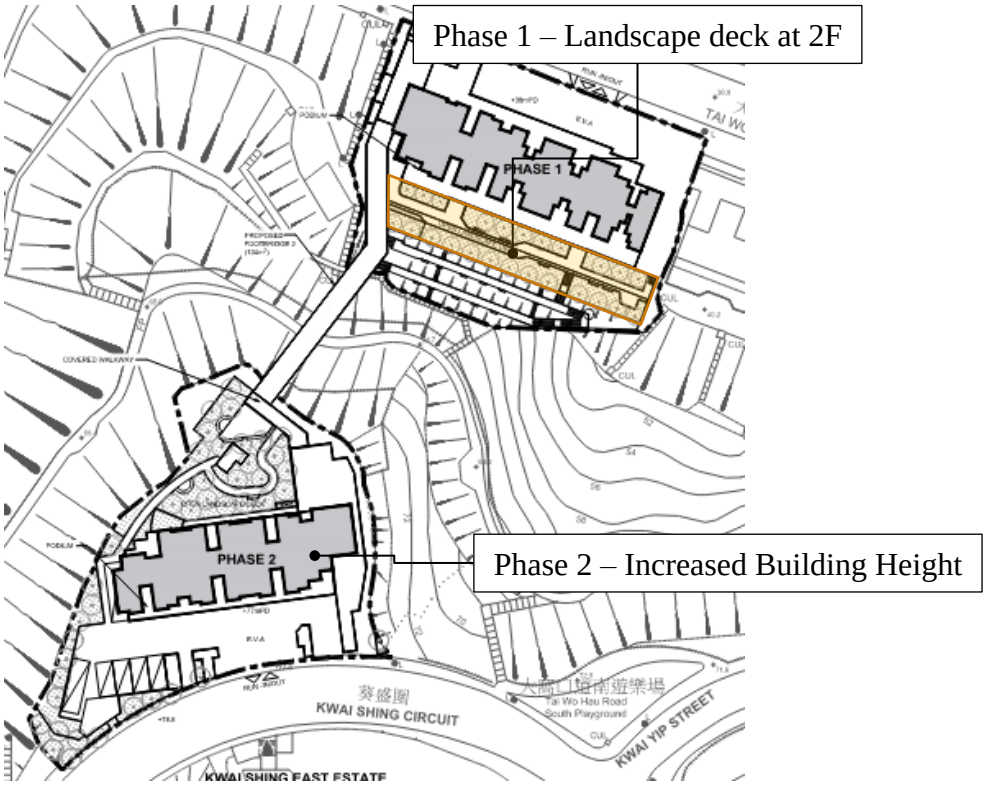


Figure 22. Ground Floor Layout Plan of Proposed Scheme

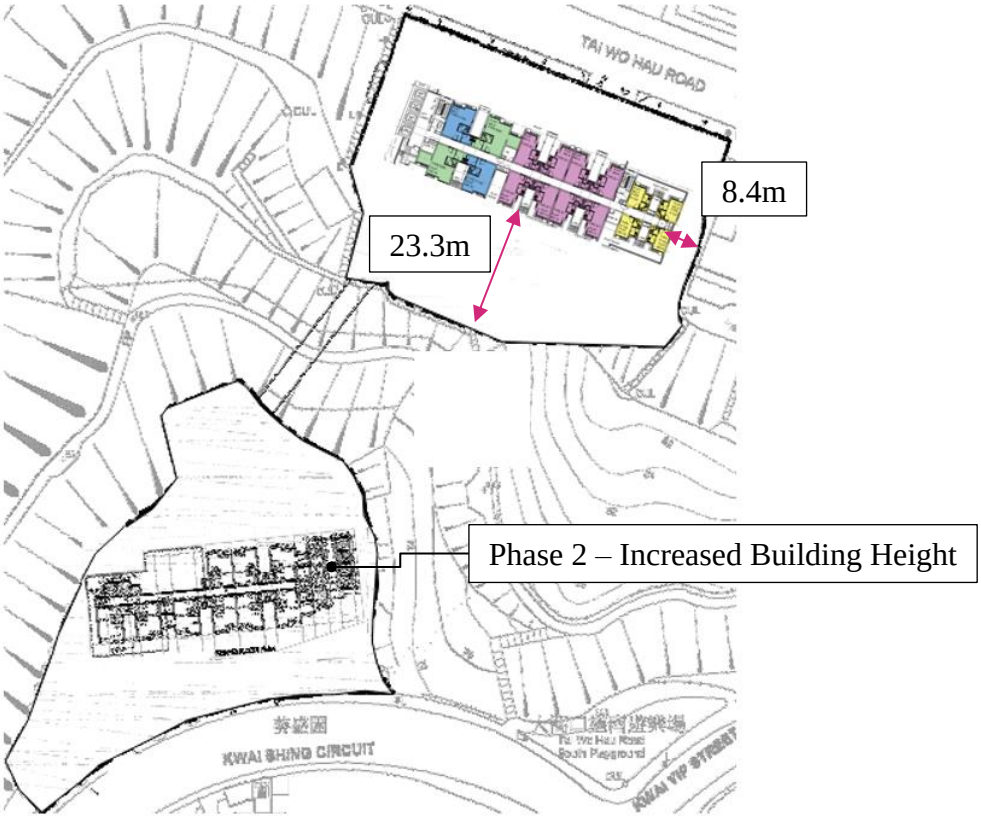


Figure 23. Typical Floor Layout Plan of Proposed Scheme

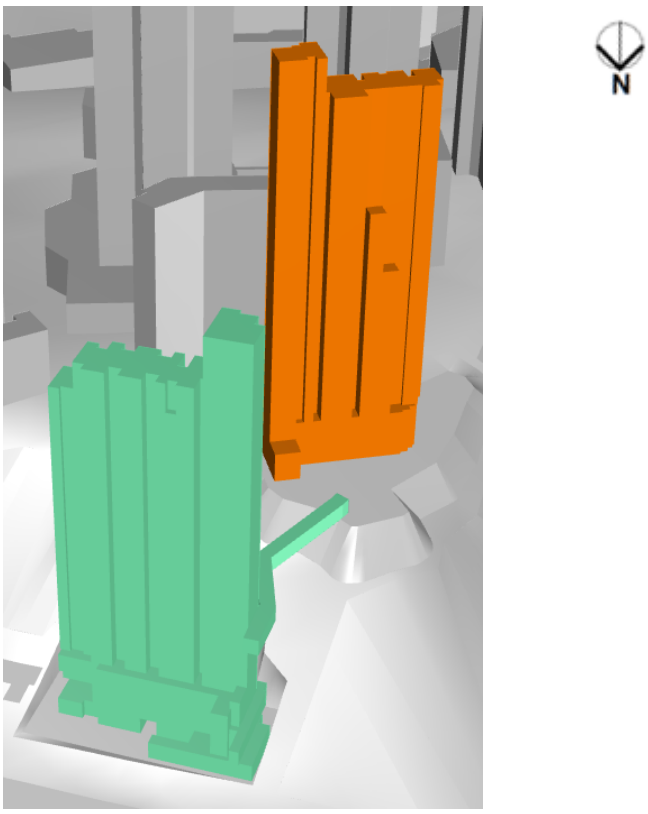


Figure 24. Northerly view of Proposed Scheme

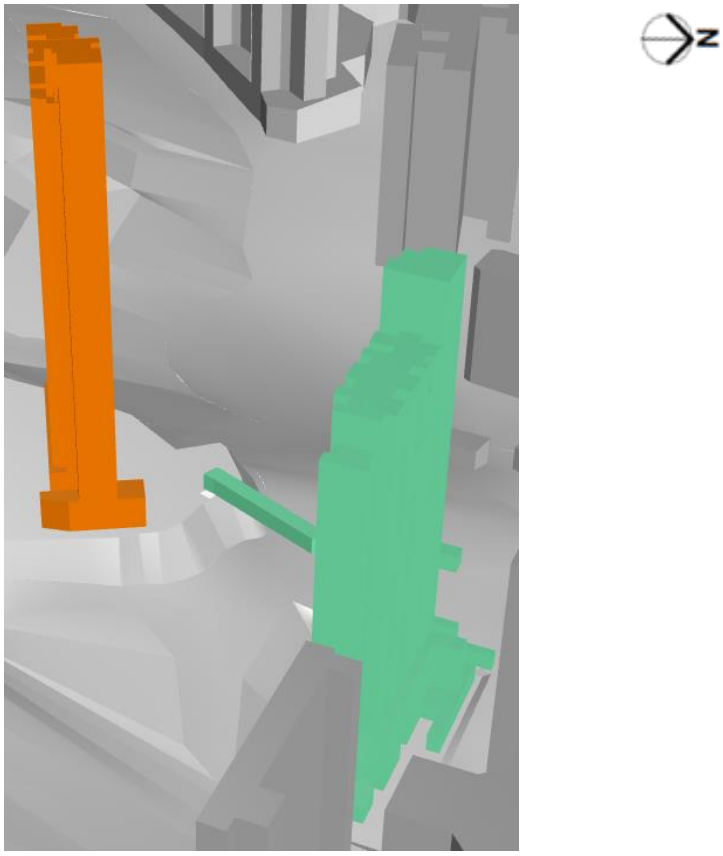


Figure 25. Easterly view of Proposed Scheme

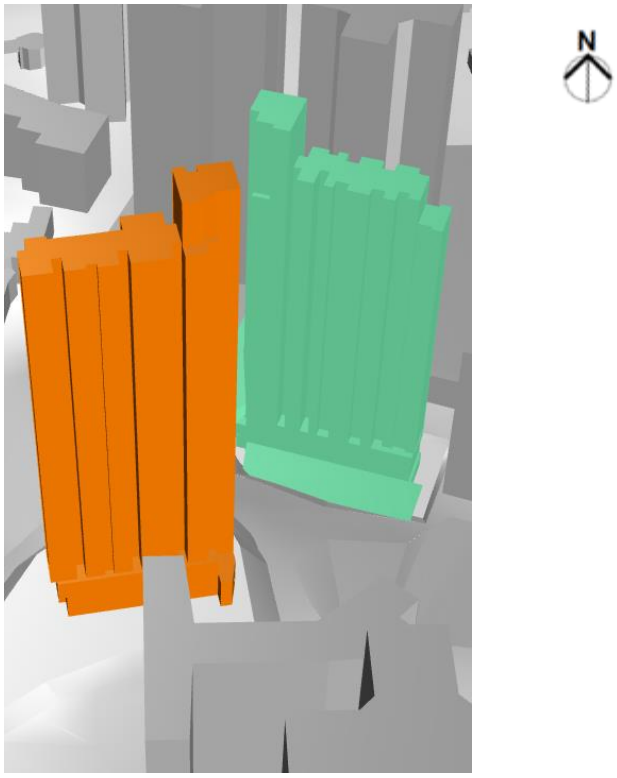


Figure 26. Southerly view of Proposed Scheme

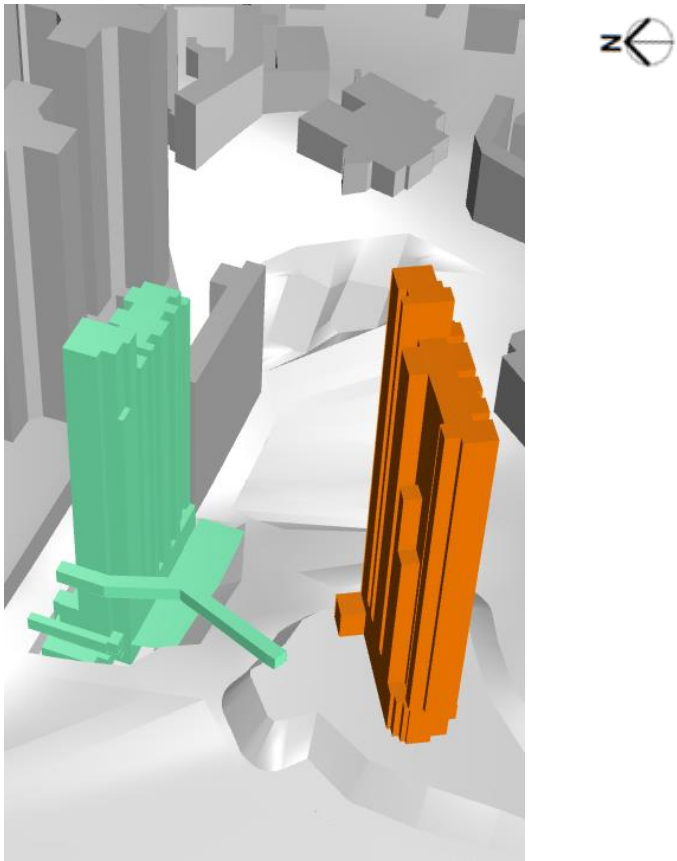


Figure 27. Westerly view of Proposed Scheme

5 RESULTS AND DISCUSSION

5.1 Annual Overall Wind Performance

The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 28 and Figure 29. The result of SVR and LVR are summarized in table below.

Table 7. Annual Wind Condition's SVR and LVR

Annual	Baseline Scheme	Proposed Scheme
SVR	0.16	0.16
LVR	0.15	0.15

Both schemes achieved similar SVR and LVR, which indicate that similar ventilation performance would be achieved around the Study Site as well as in the surrounding areas.

Under annual wind condition, the prevailing wind would normally come from NE and SE quadrant. The high-rise residential towers, such as Tai Wo Hau Estate, Kwai Chung Estate, Kwai Shing East Estate, would dominate and condition the wind environment. In addition, both Baseline and Proposed Scheme adopt similar linear building layout, the ventilation impact would be similar under both schemes, especially under NE quadrant winds.

Under SE quadrant winds, the Kwai Shing East Estate would divert the incoming wind and result in some wind to by the south-western façade of Phase 1 and Phase 2. Under Proposed Scheme, the landscape deck in Phase 1 would allow the wind to skim over at high elevation over the slope area. In addition, the taller building in Phase 2 would induce slightly stronger downwash effect and result in slightly higher VR near the site boundary.

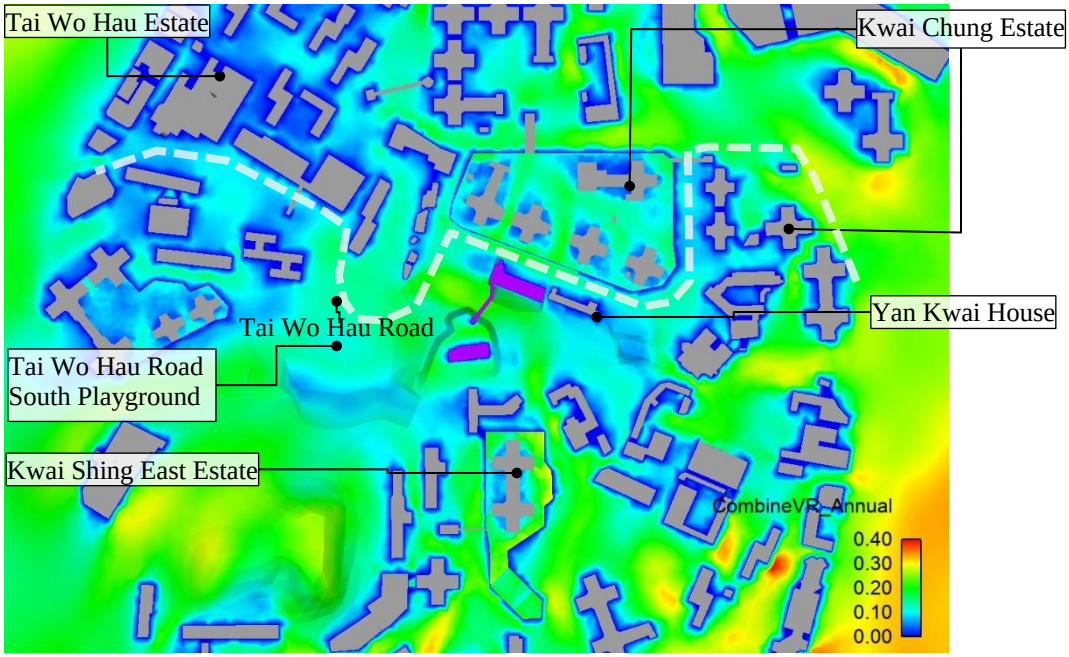


Figure 28 Average Annual VR Contour Plot for Baseline Scheme

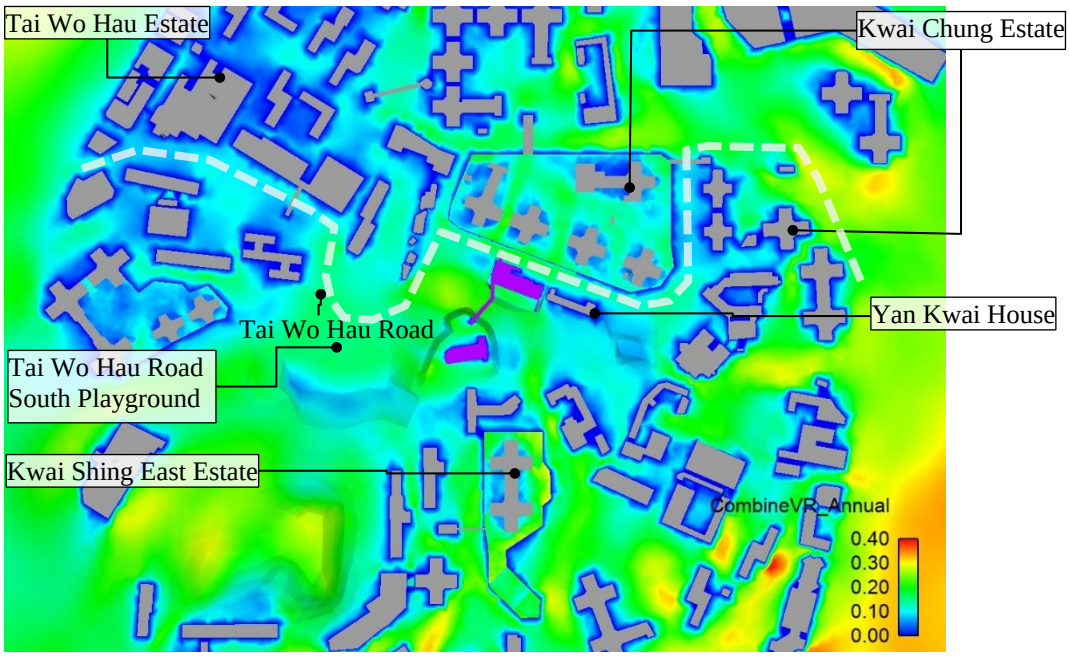


Figure 29 Average Annual VR Contour Plot for Proposed Scheme

5.2 Summer Overall Wind Performance

The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 30 and Figure 31. The result of SVR and LVR are summarized in table below.

Table 8. Summer Wind Condition's SVR and LVR

Summer	Baseline Scheme	Proposed Scheme
SVR	0.21	0.21
LVR	0.17	0.17

Both schemes achieved similar SVR and LVR, which indicate that similar ventilation performance would be achieved around the Study Site as well as in the surrounding areas.

The summer prevailing wind would generally come from SE and SW quadrant. The high-rise residential towers, such as Tai Wo Hau Estate, Kwai Chung Estate, Kwai Shing East Estate, would dominate and condition the wind environment. In addition, both Baseline and Proposed Scheme adopt similar linear building layout, the ventilation impact would be similar under both schemes,

Under SE quadrant winds, the Kwai Shing East Estate would divert the incoming wind and result in some wind to by the south-western façade of Phase 1 and Phase 2. Under Proposed Scheme, the landscape deck in Phase 1 would allow the wind to skim over at high elevation over the slope area.

Under SW quadrant winds, the incoming wind generally reach the Study Site by travelling down the hill of Kwai Shing Service Reservoir and Kwai Shing Circuit. The landscape deck in Phase 1 would allow the wind to skim over at high elevation over the slope area under Proposed Scheme.

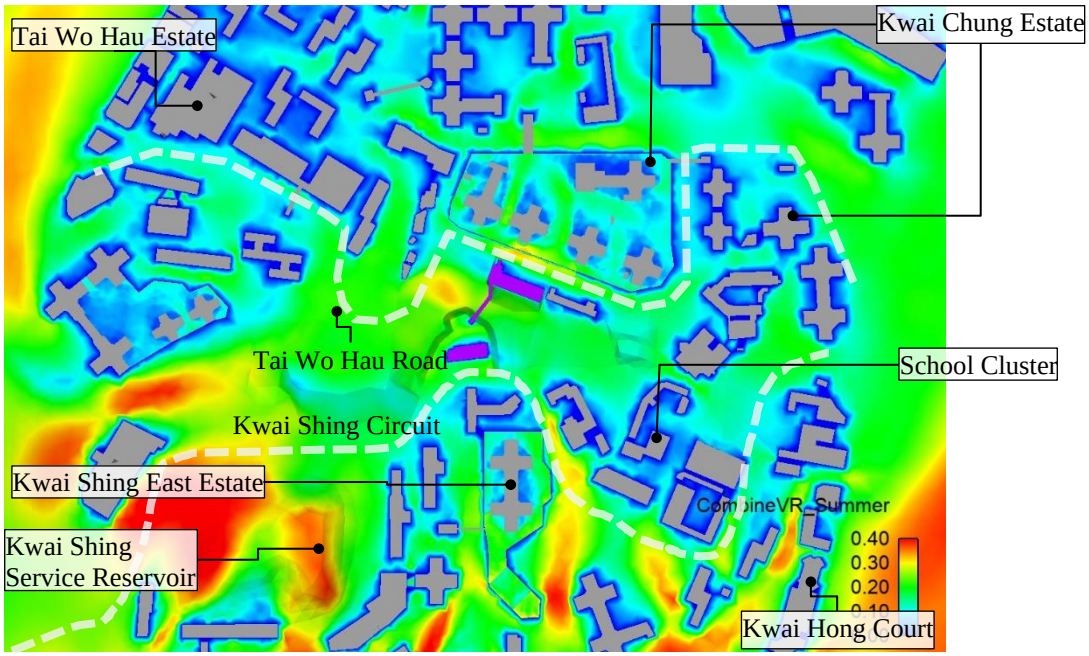


Figure 30. Average Summer VR Contour Plot for Baseline Scheme

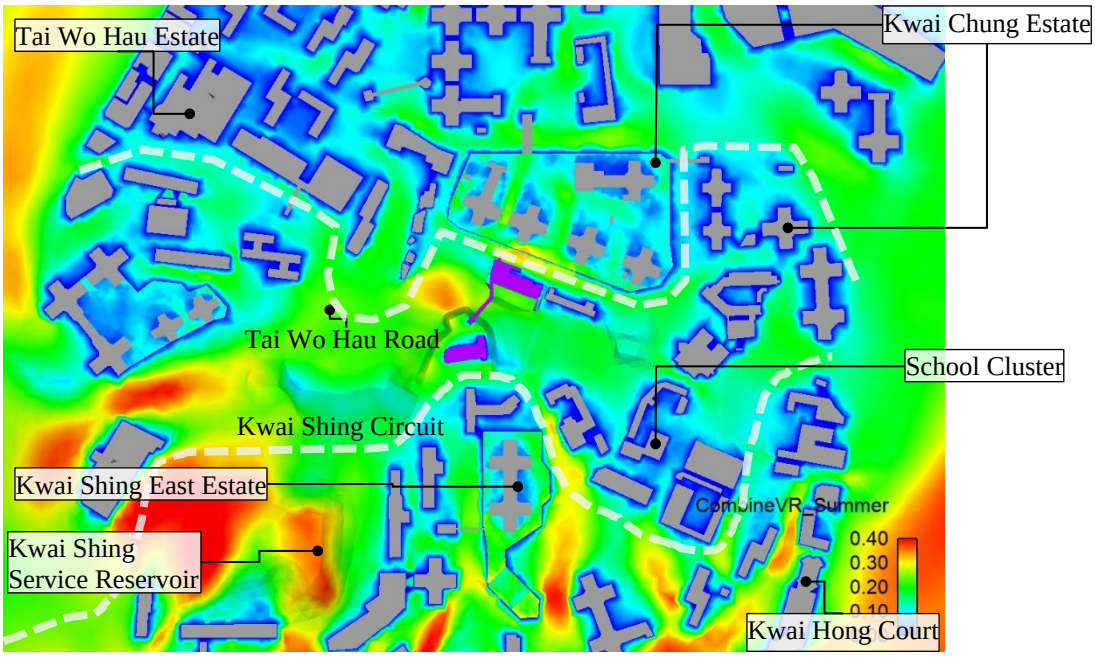


Figure 31 Average Summer VR Contour Plot for Proposed Scheme

5.3 Directional Analysis

5.3.1 NE Wind

NE wind has an annual frequency of 10.3%. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown below.

The NE wind flows down from Tai Mo Shan and reaches the high-rise Kwai Chung Estate with large podium, which would shield the incoming wind to the Study Site. The wind environment would be dominated by these buildings. The wind environment in the Study Site and Surrounding area are calm. With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes apart from some localized difference as discussed below.

However, some of the wind could still reach the Study Site from Tai Wo Hau Road or by travelling through the building separations in Kwai Chung Estate, illustrated by black arrows in Figure 32 and Figure 33.

The stream of air coming from Kwai Chung Estate would be captured by north-eastern façade of Phase 1 to ventilate pedestrian level. Under Proposed Scheme, the north-eastern façade would shield some wind to travelling through the building separation towards the slope area at the leeward side of Phase 1 (white arrow in Figure 33), slightly lower VR would be observed at the slope area between Phase 1 and Phase 2 would be slightly affected (orange dotted region in Figure 32 and Figure 33).

Under both schemes, some wind shadow would be casted by Study Site at Kwai Shing East Estate.

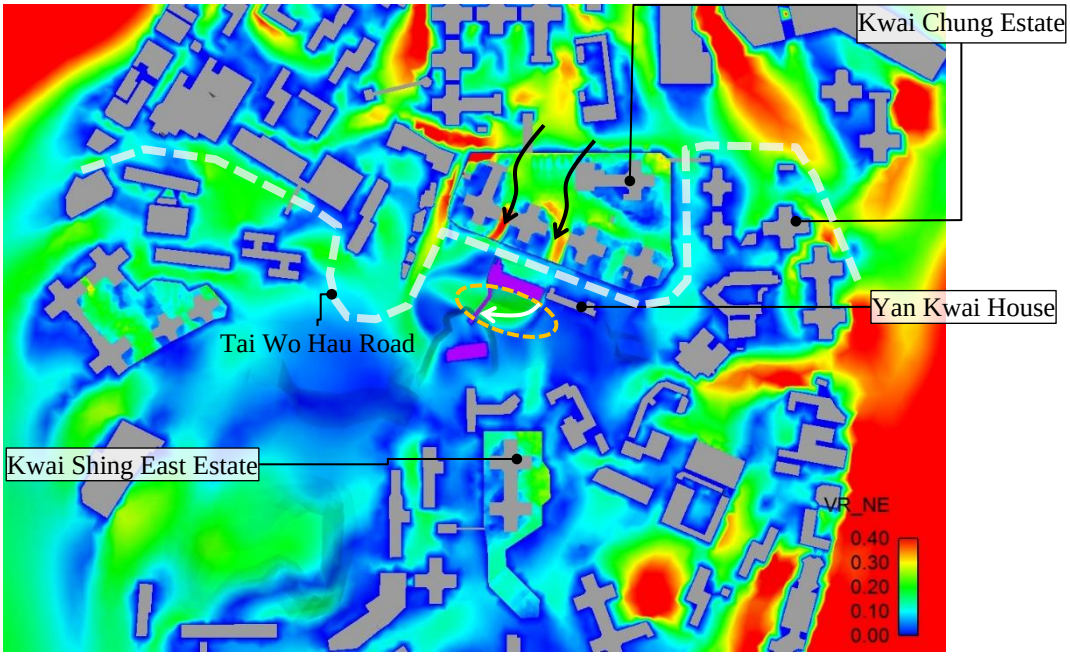


Figure 32 VR Contour Plot of NE Direction for Baseline Scheme

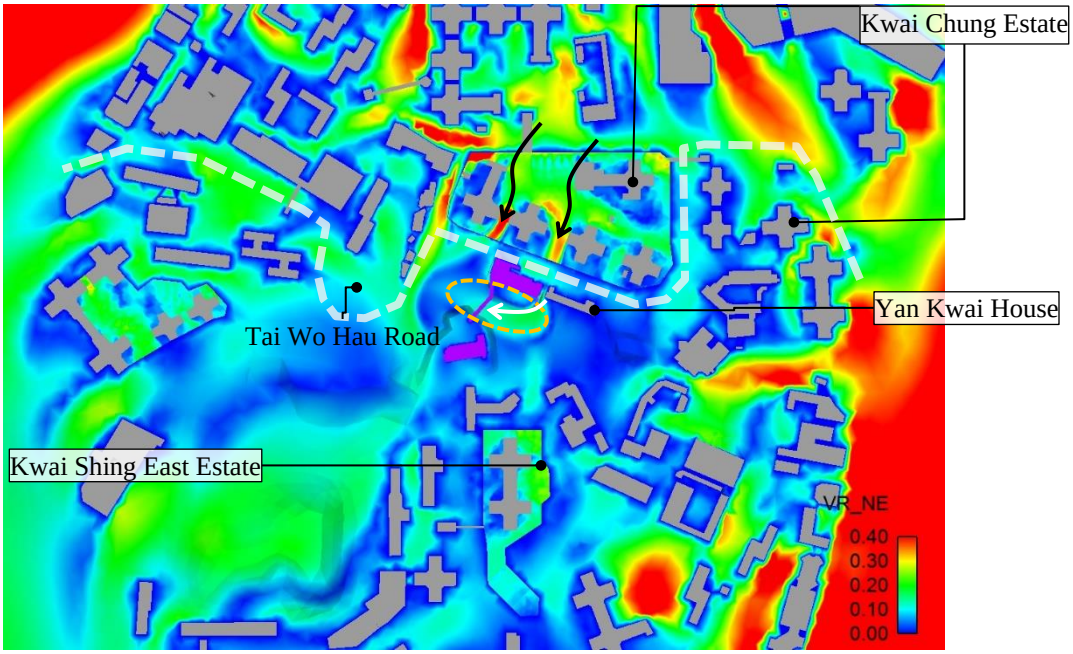


Figure 33 VR Contour Plot of NE Direction for Proposed Scheme

5.3.2 ENE Wind

The ENE wind contributes to 15.7% of the annual wind rose. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 34 and Figure 35.

Similar to NE wind condition, the ENE wind flows down and reaches the high-rise Tai Wo Hau Estate, Kwai Chung Estate with large podium, which would shield the incoming wind to the Study Site. The wind environment would be dominated by these buildings. The wind environment in the Study Site and Surrounding area are calm. With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes.

Some of the wind could still reach the Study Site by travelling through the building separations in Kwai Chung Estate, illustrated by black arrows in Figure 34 and Figure 35.

Under both schemes, the cumulative effect from Study Site and surrounding buildings would create wind shadow over the slope area and Tai Wo Hau Road South Playground.

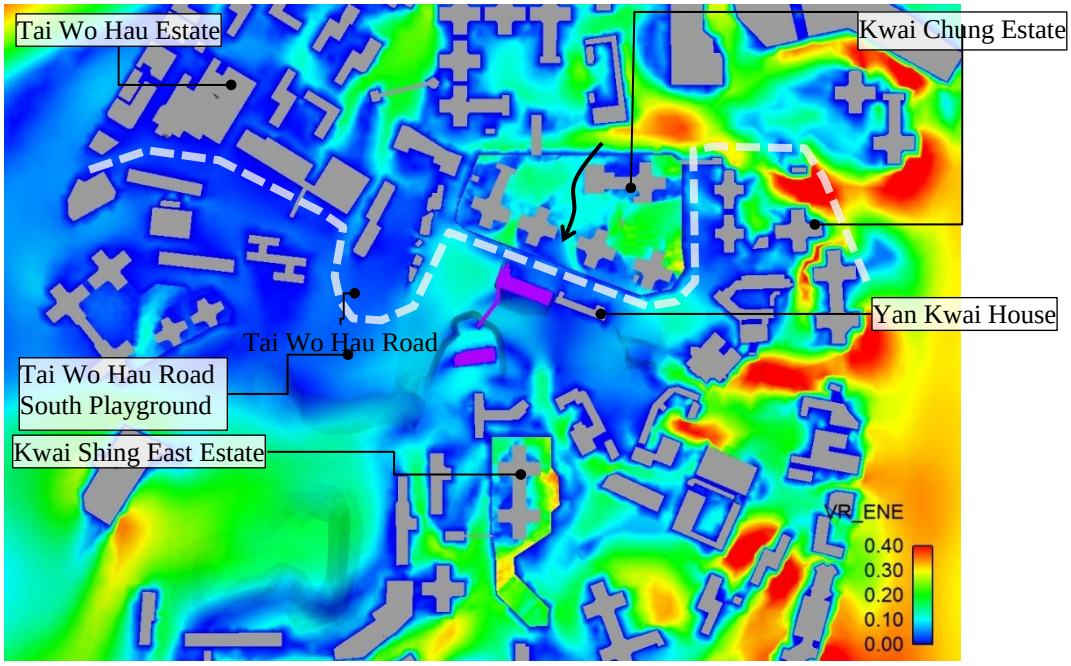


Figure 34 VR Contour Plot of ENE Direction for Baseline Scheme

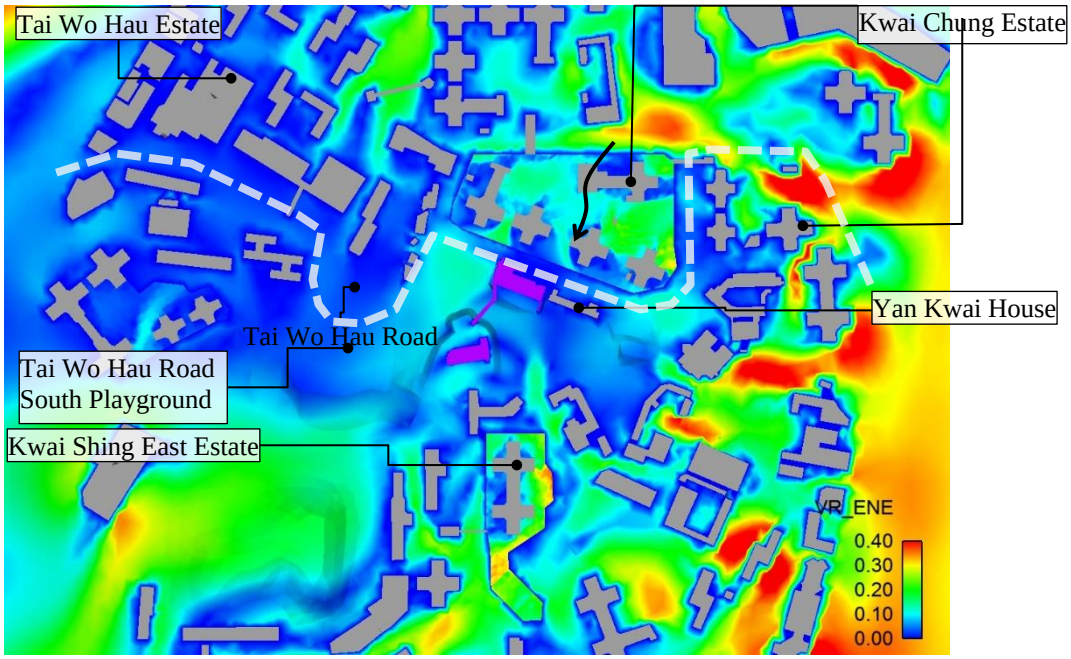


Figure 35 VR Contour Plot of ENE Direction for Proposed Scheme

5.3.3 E Wind

The E wind contributes to 17.8% of the annual wind rose which is the most frequent wind and 8.3% of the summer wind rose. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 36 and Figure 37.

The E wind flows down the hill from Kam Shan and reaches the surrounding areas, with the high-rise residential developments, such as Kwai Chung Estate, Kwai Hong Court, Kwai Shing East Estate in the windward side, the wind environment would be dominated by these buildings. With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes apart from some localized difference as discussed below.

The Kwai Shing East Estate and school cluster at windward side would divert the incoming wind to reach the Study Site from Kwai Shing Circuit, illustrated by black arrows in Figure 36 and Figure 37.

The stream of air coming from Kwai Shing Circuit would be captured by south-western façade of Phase 1 and reach the slope area between Phase 1 and Phase 2 (white arrows in Figure 36 and Figure 37). With the landscape deck at 2F of Phase 1 under Proposed Scheme, instead of reaching the site level (at lower elevation) within Phase 1 in Baseline Scheme, the downwashed wind would continue to travel westwards and reach the slope area where slightly higher VR would be observed, (highlighted in black circled area in Figure 36 and Figure 37).

In addition, another stream of air coming from Kwai Shing Circuit would be captured by the south-eastern façade of Phase 2 to ventilate pedestrian level (pink arrows in Figure 36 and Figure 37. Under Proposed Scheme, with the higher building of Phase 2, more wind would be captured and reach pedestrian level. The difference in the built form in the western tip would allow the captured wind to continue to travel westwards and slightly higher VR would be observed at Tai Wo Hau Road South Playground, highlighted in orange circled area in Figure 37. However, the wind pattern at nearby area would be affected, slightly lower VR would be observed near the junction of Tai Wo Hau Road and Shek Tau Road (orange circled area in in Figure 36), Kwai Shing Circuit and Tai Wo Hau Estate located at the further leeward side.

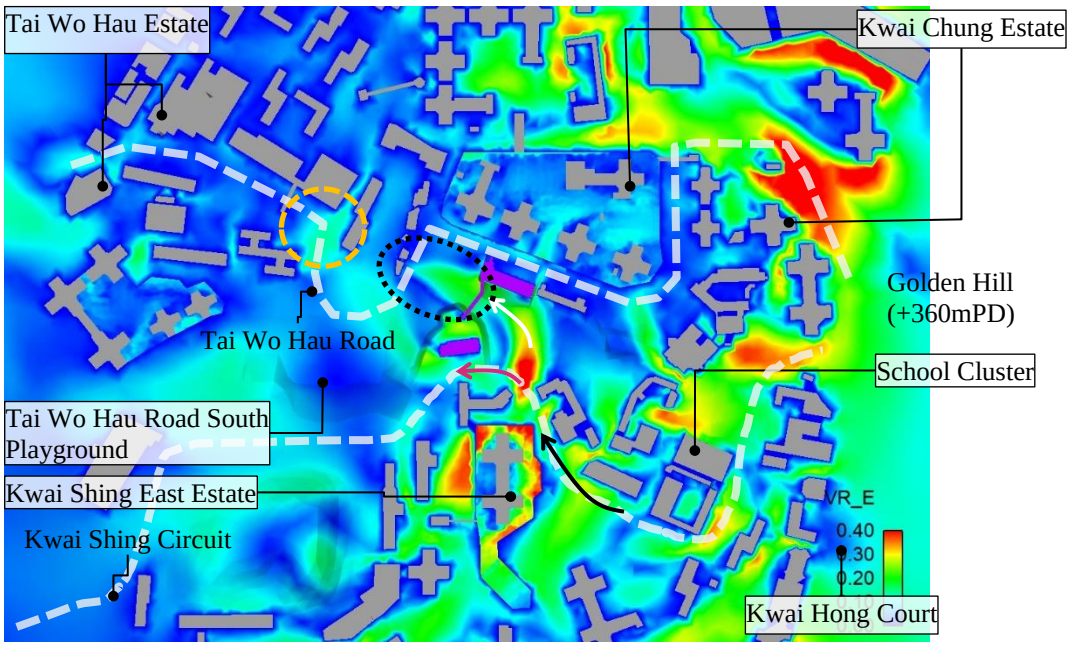


Figure 36 VR Contour Plot of E Direction for Baseline Scheme

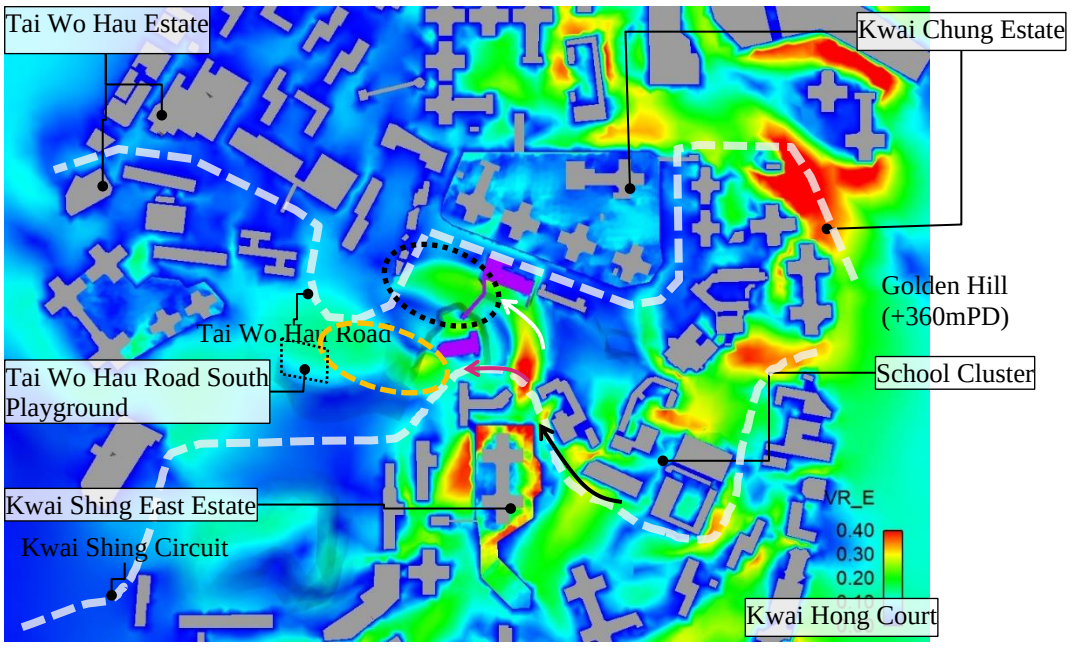


Figure 37 VR Contour Plot of E Direction for Proposed Scheme

5.3.4 ESE/SE Wind

The ESE wind contributes to 9.9% of the annual wind rose and 8.3% of the summer wind rose, whereas the SE wind contributes to 6.4% of the annual wind rose and 6.9% of the summer wind rose.

Similar to E wind condition, the ESE wind and SE wind flow down the hill from Kam Shan would reaches the high rise Kwai Chung Estate, Kwai Shing East Estate and Kwai Hong Court, which would dominate the wind environment in the surrounding area. With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes apart from some localized difference as discussed below.

With the mid-rise school clusters with some openness located to the immediate southeast of Study Site, some of the wind would skim over the school buildings to reach the Study Site as well as from Kwai Shing Circuit, illustrated by black arrows in Figure 38 to Figure 41.

The wind reaching the site would be captured by south-western façade of Phase 1 and Phase 2 to ventilate the pedestrian levels near Kwai Shing Circuit and between the slope area between Phase 1 and Phase 2, illustrated by pink arrows in Figure 38 and Figure 41. Under Proposed Scheme, with the landscape deck at 2F of Phase 1, the wind would continue to travel at high-elevation and result in slight enhancement at some of the slope area (black circled area in Figure 38 and Figure 41). In addition, with the taller building height in Phase 2, more wind would be captured and enhance the VR in nearby area (orange dotted region in Figure 38 and Figure 41). The down washed wind would induce stronger airflow at pedestrian level towards westwards and result in slightly higher VR along Shek Tau Road (white circled area in Figure 39) and Tai Wo Hau Road South Playground.

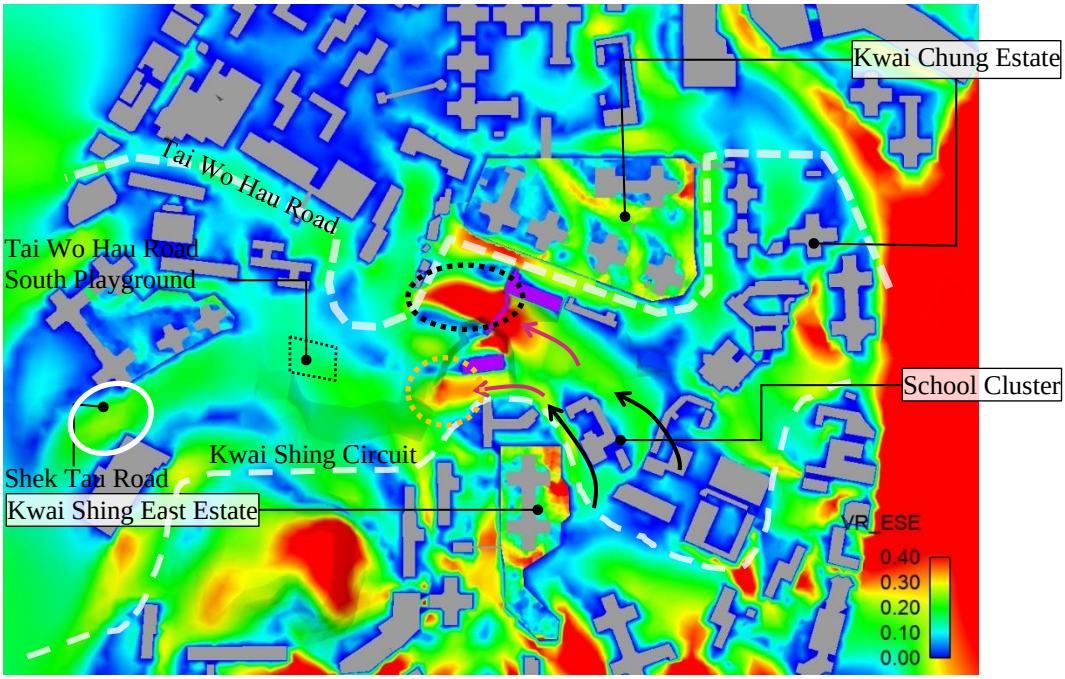


Figure 38 VR Contour Plot of ESE Direction for Baseline Scheme

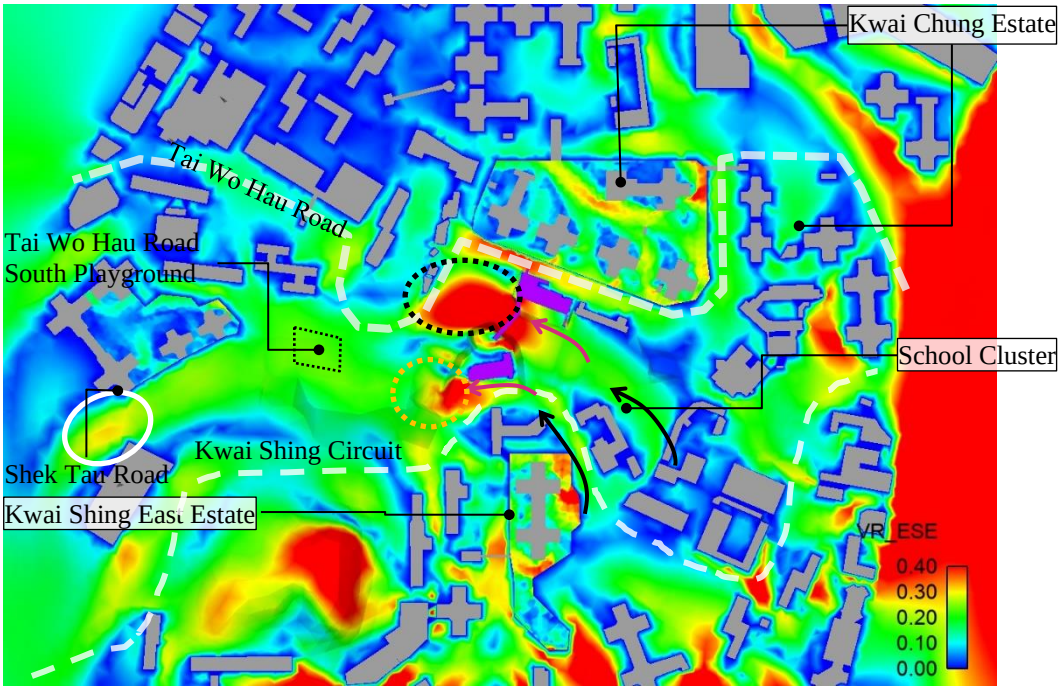


Figure 39 VR Contour Plot of ESE Direction for Proposed Scheme

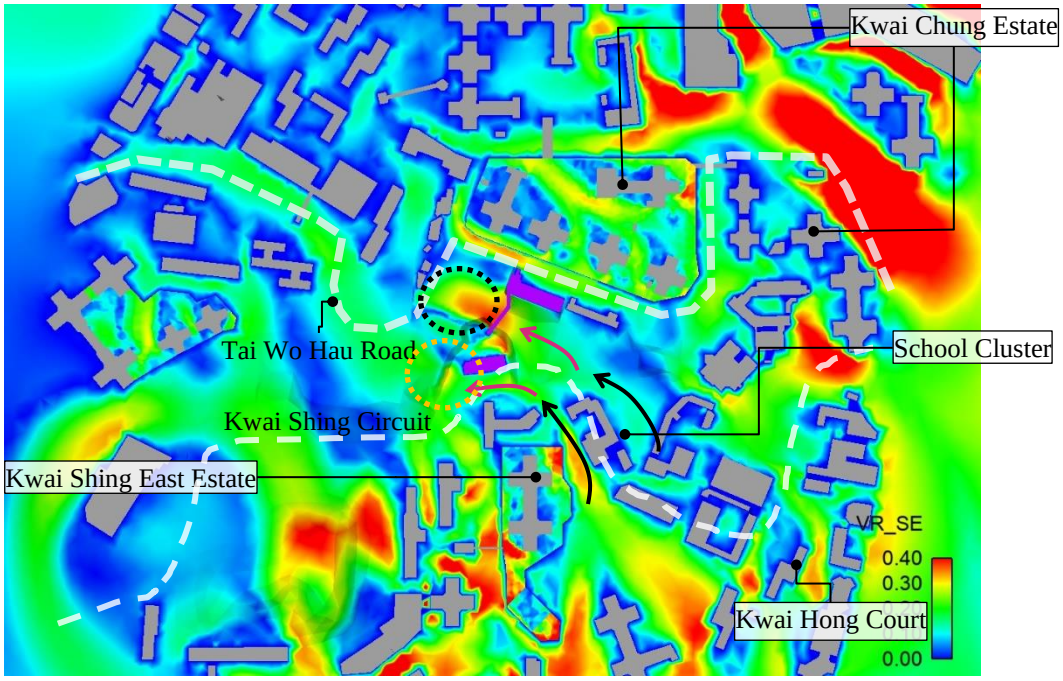


Figure 40 VR Contour Plot of SE Direction for Baseline Scheme

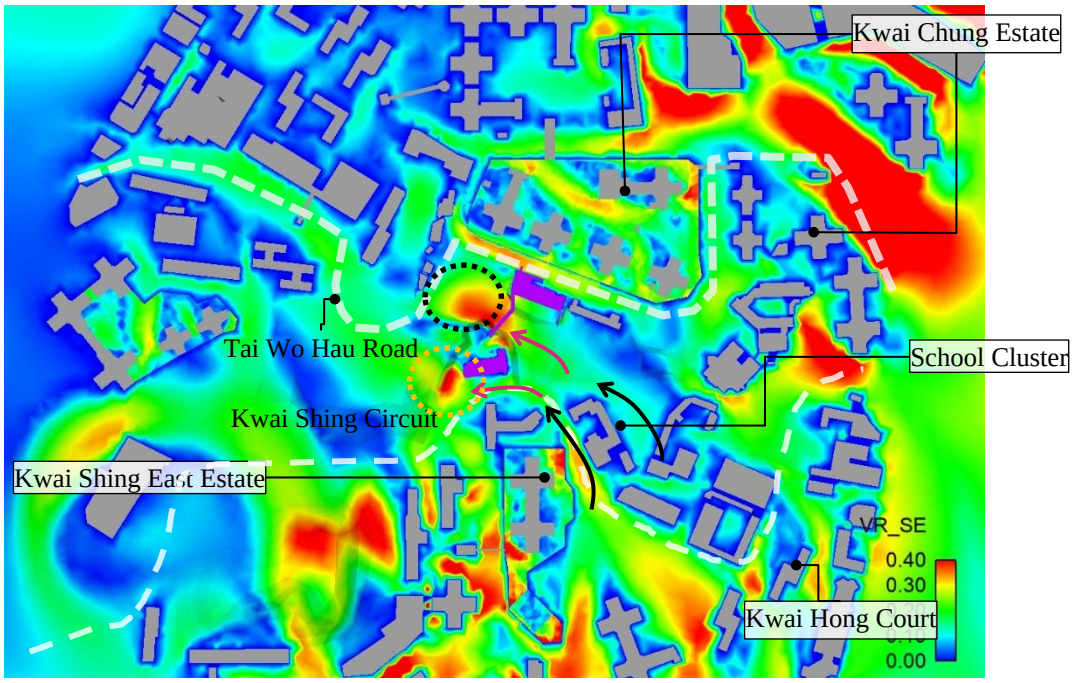


Figure 41 VR Contour Plot of SE Direction for Proposed Scheme

5.3.5 SSE Wind

The SSE wind contributes to 7.6% of the summer wind rose. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 42 and Figure 43.

With the high-rise residential towers, such as Kwai Shing East Estate, Kwai Hong Court, Kwai Chung Estate and Tai wo Hau Estate in the surrounding area, the wind environment would be dominated by these buildings. With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes apart from some localized difference as discussed below.

The SSE wind would be diverted by Kwai Shing East to reach the site from Kwai Shing Circuit and building separations within Kwai Shing East Estate, illustrated by black arrows in Figure 42 and Figure 43.

The incoming wind at Kwai Shing Circuit would be captured by south-western façade of Phase 1 to ventilate the slope area between Phase 1 and Phase 2, illustrated by (white arrow in Figure 43). Under Proposed Scheme, with the landscape deck at 2F of Phase 1, the wind would continue to travel at high-elevation and result in slight enhancement at some of the slope area, highlighted in black circled area in Figure 42 and Figure 43.

The stream of air coming from Kwai Shing East Estate and Kwai Shing Circuit would be diverted by Phase 2 and continue to travel down the hill towards Tai Wo Hau Road. With the taller building height in Phase 2, more wind would be diverted towards the leeward side at Tai Wo Hau Road, where slightly higher VR would be observed.

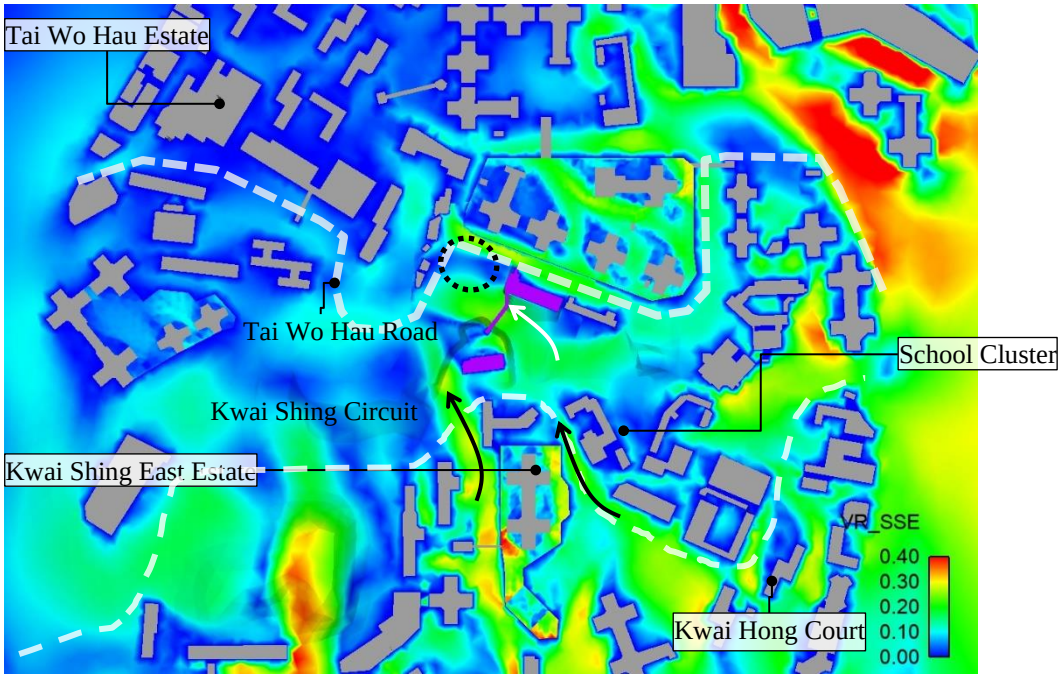


Figure 42 VR Contour Plot of SSE Direction for Baseline Scheme

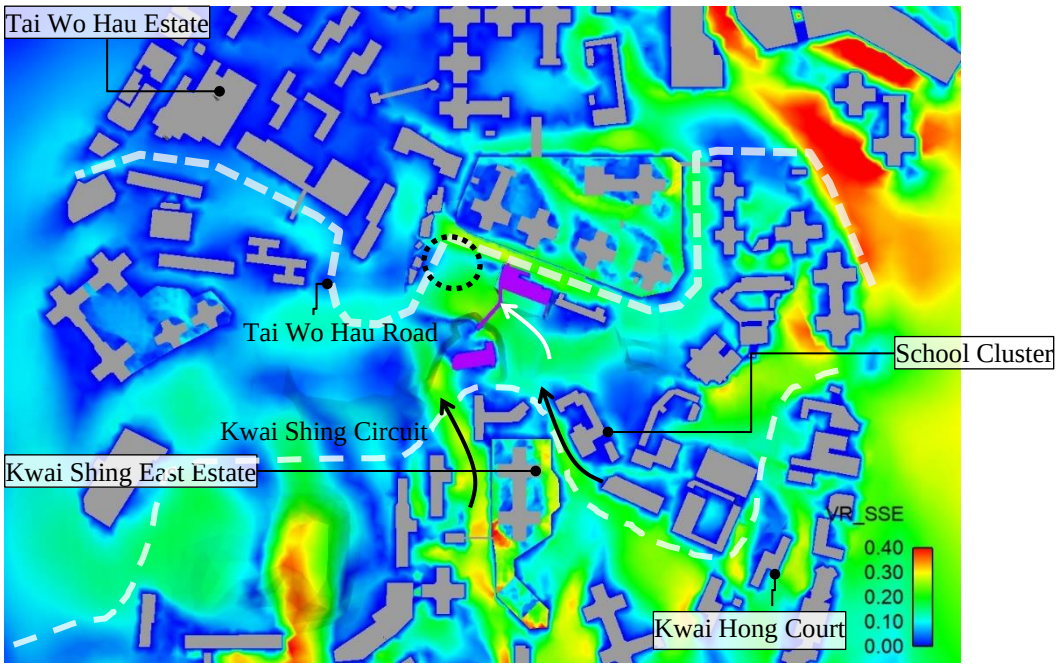


Figure 43 VR Contour Plot of SSE Direction for Proposed Scheme

5.3.6 S Wind

The S wind contributes to 5.9% of the annual wind rose and 10.9% of the summer wind rose. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 44 and Figure 45.

The incoming wind would travel down the hill from south. With the high-rise residential towers, such as Kwai Shing East Estate, and school clusters located at higher elevation. The terrain and surrounding buildings would shield some incoming wind and dominate the wind environment. The incoming wind would travel down the hill from Kwai Shing Circuit and building separation within the Kwai Shing East Estate and down the hill from Kwai Shing Reservoir, illustrated by black arrows in Figure 44 and Figure 45. The wind environment in the Study Site would be generally calm while the stream of air down the hill would continue to travel along Tai Wo Hau Road, illustrated by pink arrows in in Figure 44 and Figure 45.

With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes.

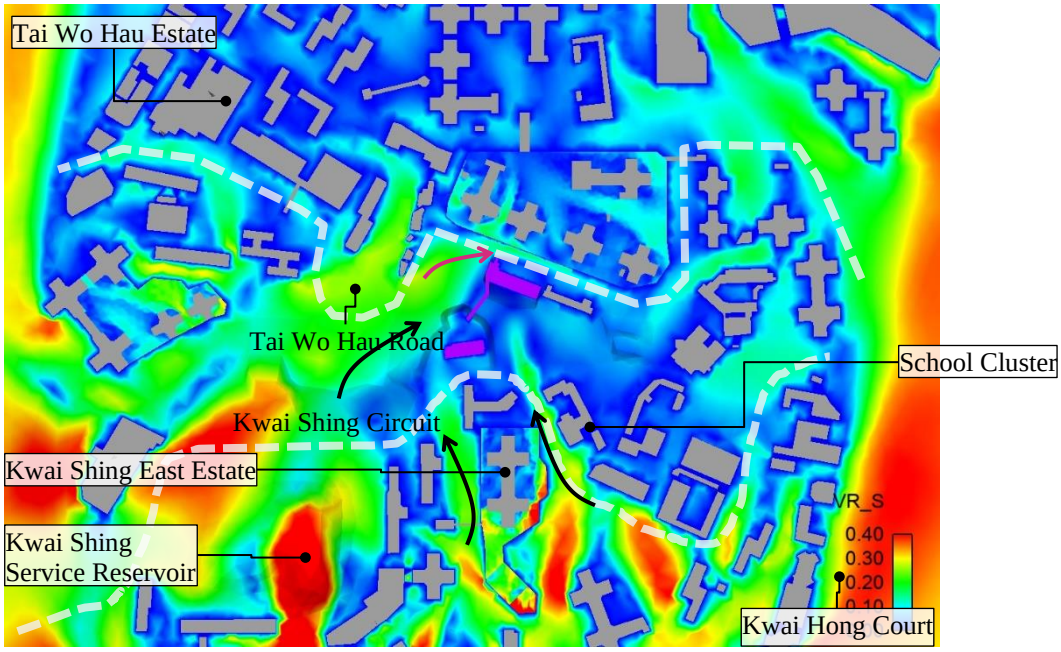


Figure 44 VR Contour Plot of S Direction for Baseline Scheme

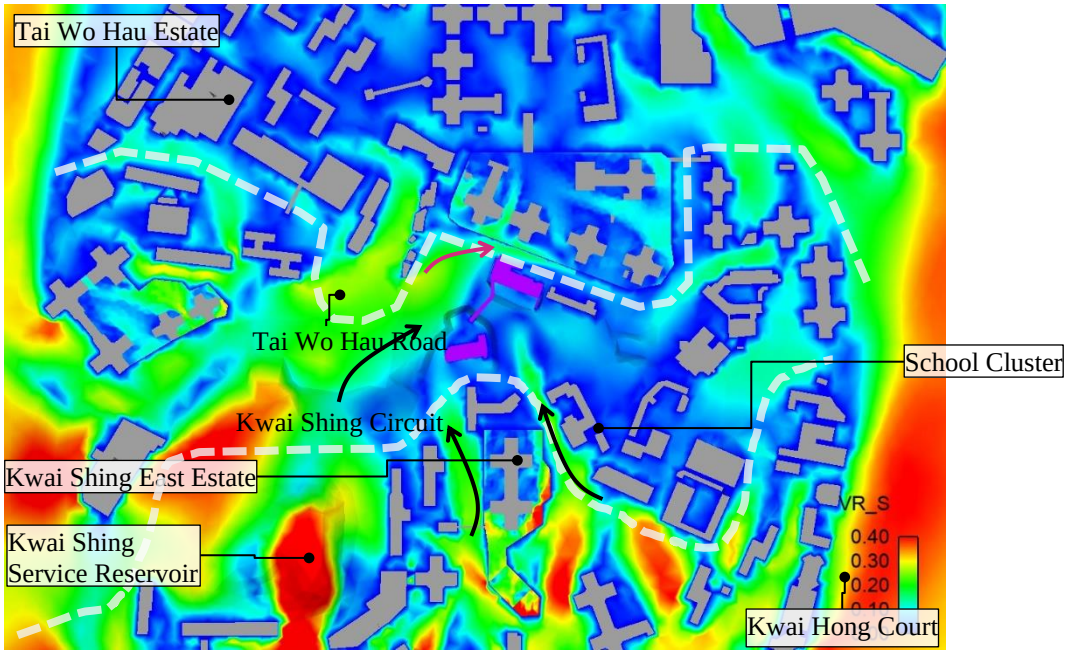


Figure 45 VR Contour Plot of S Direction for Proposed Scheme

5.3.7 SSW/SW Wind

The SSW wind contributes to 8.3% of the annual wind rose and 18.5% of the summer wind rose which is the most frequent wind direction in summer. The SW wind contributes to 5.8% of the annual wind rose and 14.2% of the summer wind rose. The wind pattern under SSW and SW winds are similar and will be discussed together. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 46 to Figure 49

With the openness to the south-west of Study Site, the incoming wind would reach the site by travelling down the hill of Kwai Shing Service Reservoir. Another stream of air would reach the Study Site from Kawi Shing Circuit, illustrated by black arrows in Figure 46 to Figure 49.

Some wake zone would be casted by Phase 2 buildings on the slope area, where not frequently accessed by pedestrian. The stream of air coming from Kwai Shing Reservoir would reach the south-western façade of Phase 1 and ventilate the slope area at the leeward side within Phase 1 (highlighted in black circled area in Figure 46 to Figure 49).

On the other hand, another stream of air would travel around the Phase 1 and reach Tai Wo Hau Road, highlighted with white arrow in Figure 46 to Figure 49. With the similar layout for Baseline and Proposed Scheme, the wind environment in surrounding area would be similar under both schemes.

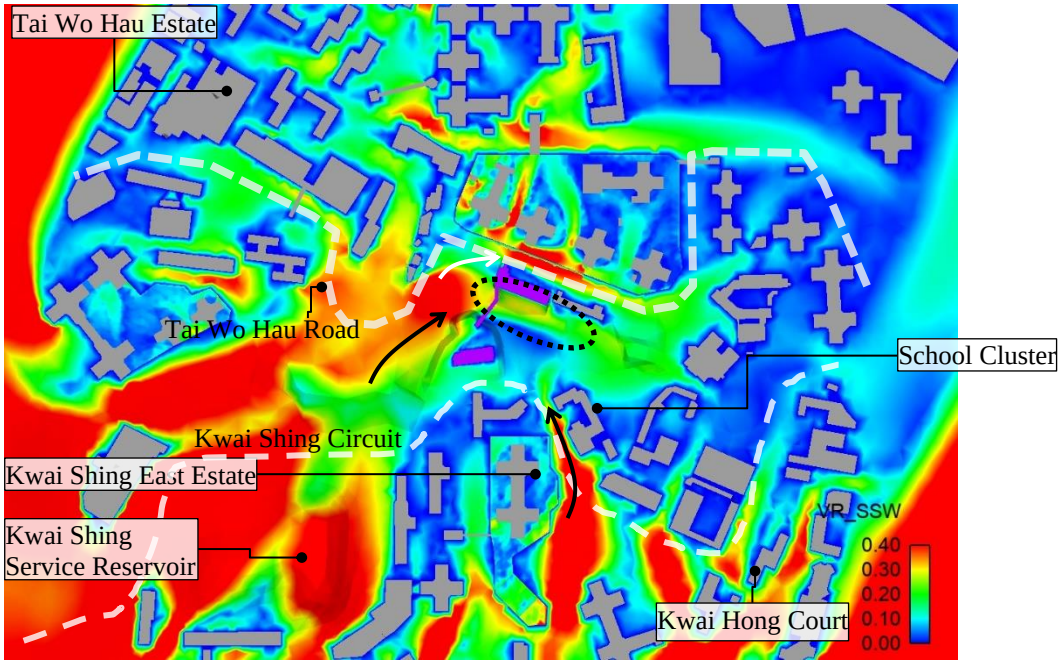


Figure 46 VR Contour Plot of SSW Direction for Baseline Scheme

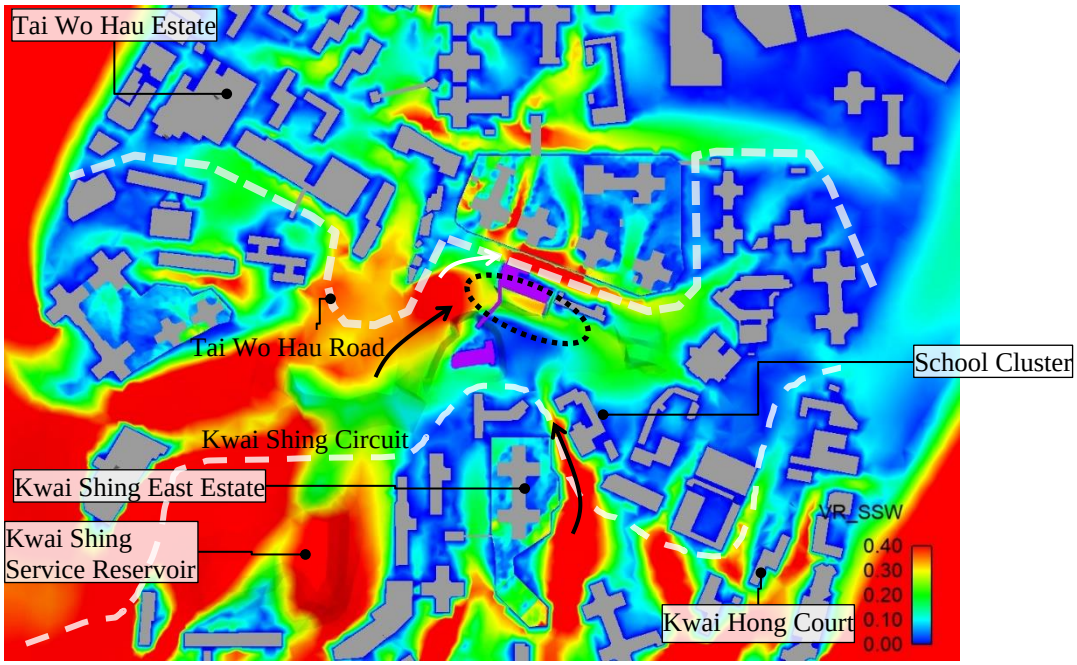


Figure 47 VR Contour Plot of SSW Direction for Proposed Scheme

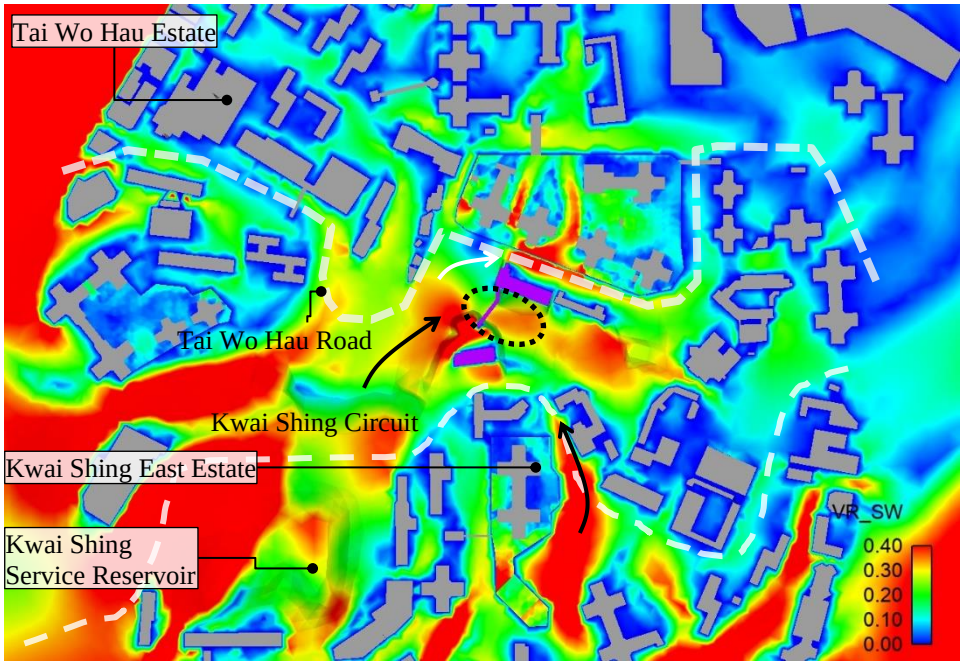


Figure 48 VR Contour Plot of SW Direction for Baseline Scheme

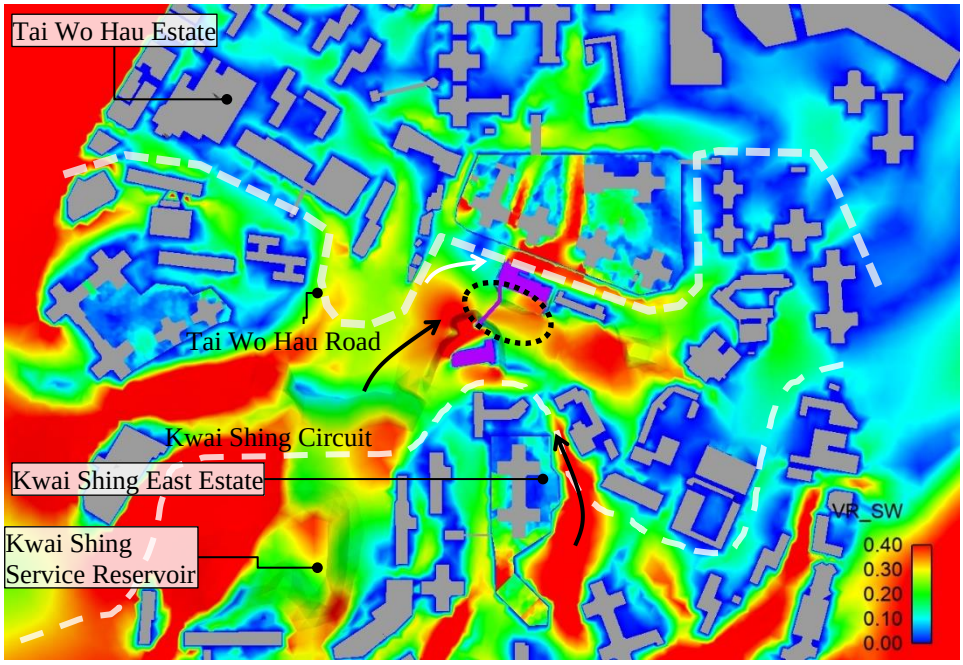


Figure 49 VR Contour Plot of SW Direction for Proposed Scheme

5.3.8 WSW Wind

WSW wind contributes to 6.6% of the summer wind rose. The contour plots of VR value for Baseline Scheme and Proposed Scheme are shown in Figure 50 to Figure 51.

Similar to SSW/SW wind condition, the WSW wind would travel down the hill to reach the Study Site through the open area in Kwai Shing Service Reservoir at higher elevation, illustrated by black arrows in Figure 50 to Figure 51. The incoming wind would continue to penetrate Phase 1 in the western part and travel along Tai Wo Hau Road, illustrated by white arrows in Figure 50 to Figure 51.

With the high-rise towers, such as Kwai Shing East Estate, Tai Wo Hau Estate, Kwai Chung Estate, the surrounding wind environment would be conditioned. In addition, with similar layout for Baseline and Proposed Scheme, the ventilation impact from both schemes would be similar under both schemes.

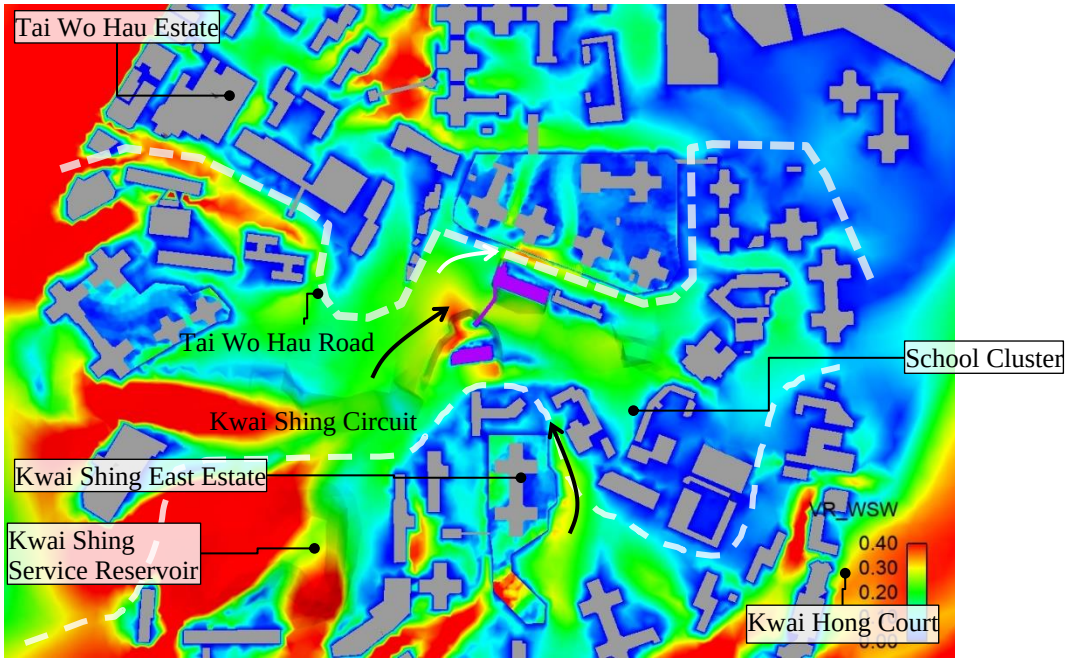


Figure 50 VR Contour Plot of WSW Direction for Baseline Scheme

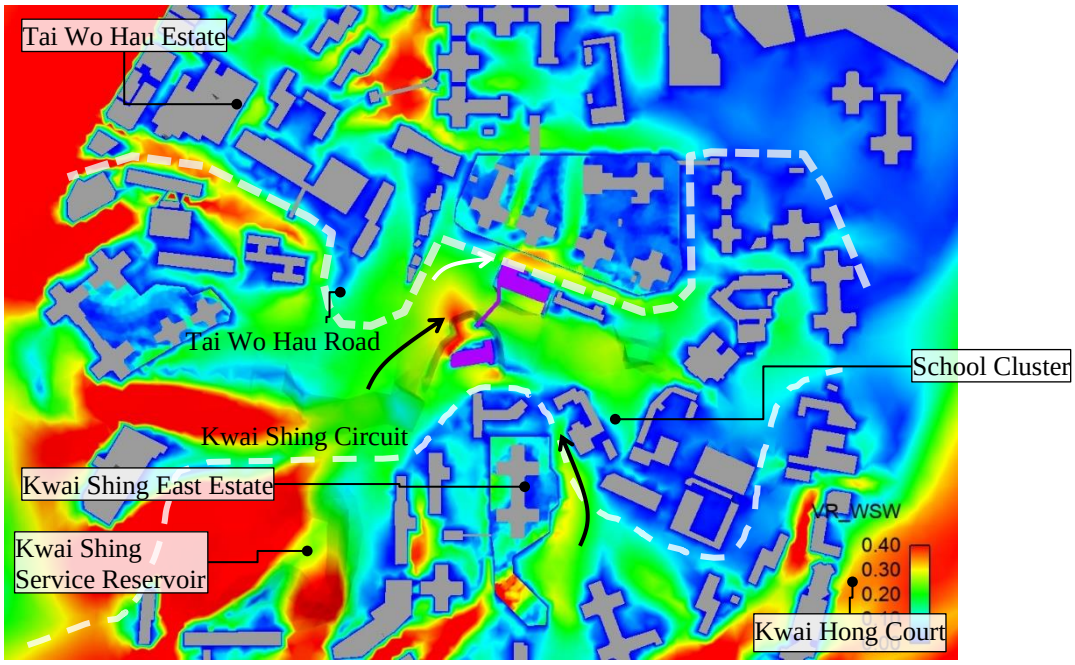


Figure 51 VR Contour Plot of WSW Direction for Proposed Scheme

5.4 Focus Areas

Various Focus Areas with frequent pedestrian access and major activity zones were defined, these areas are shown in Figure 16 under Section 3.6. The results of the focus areas are shown in Table 9.

Table 9. VR Results for Focus Areas

Focus Areas		Test Points	Annual Average VR		Summer Average VR	
			Baseline	Proposed	Baseline	Proposed
1	Kwai Shing Service Reservoir	O1-O15	0.20	0.20	0.29	0.29
2	Tai Wo Hau Road South Playground	O16-O19	0.09	0.09	0.13	0.13
3	Tai Wo Hau Estate	O20-O42	0.10	0.10	0.12	0.12
4	Playground No.7	O43-O46	0.14	0.14	0.22	0.22
5	Kwai Chung Estate	O47-O62	0.12	0.12	0.13	0.13
6	C.C.C Chuen Yuen Second Primary School	O63-O65	0.08	0.08	0.08	0.08
7	C.C.C. Chuen Yuen College	O66-O68	0.21	0.21	0.18	0.18
8	Sheung Kok Street Garden	O69-O72	0.15	0.15	0.11	0.11
9	Kwai Fuk Court	O73-O75	0.10	0.10	0.09	0.09
10	Tin Hau Temple	O76-O77	0.12	0.12	0.16	0.16
11	Salesians of Don Bosco School	O78-O81	0.14	0.14	0.14	0.14
12	SaHK BM Kotewall Memorial School	O82-O84	0.12	0.12	0.13	0.13
13	Siu Ming School	O85-O90	0.17	0.17	0.14	0.14
14	Kwai Hop Street Playground	O91-O98	0.21	0.21	0.15	0.15
15	The Methodist Lee Wai Lee College	O99-O103	0.14	0.14	0.13	0.13
16	Kwai Shing East Estate	O104-O125	0.16	0.16	0.18	0.18
17	Kwai Hau Street	O126-O129	0.13	0.13	0.19	0.19

18	Kwai Shing Circuit	O130-O142 P46-P53	0.17	0.17	0.21	0.21
19	Kwai Leun Road	O143-O146	0.20	0.20	0.26	0.26
20	Kwai Hop Street	O147-O152	0.19	0.19	0.17	0.17
21	Wo Tung Tsui Street	O153-O155	0.16	0.16	0.11	0.11
22	Tai Wo Hau Road	O156-O176 P1-P10	0.14	0.14	0.20	0.20
23	Shek Tau Street	O177-O181	0.11	0.12	0.17	0.17
24	Pavement in Kwai Chung Estate	O182-O184	0.15	0.15	0.14	0.14
25	Sheung Kok Street	O185-O194	0.19	0.19	0.18	0.18
26	TWGHs Chen Zao Men College	O195-O197	0.13	0.13	0.11	0.11
27	Chinese YMCA of Hong Kong New Territories Centre	O198-O200	0.15	0.15	0.17	0.17
28	Kwai Shing East Estate Podium	O201-O207	0.16	0.16	0.15	0.15
29	Tai Wo Hau Estate Podium	O208-O212	0.07	0.07	0.09	0.09
30	Kwai Chung Estate Podium	O213-O223	0.12	0.12	0.11	0.11

5.4.1 Annual Condition

In general, the Proposed Scheme would achieve a similar VR for most of the focus area near Proposed Tai Wo Hau Road Phase 1 and Phase 2 as compared to Baseline Scheme, indicating the ventilation performances is considered comparable under both schemes.

The Proposed Scheme would achieve a slightly higher VR as compared to Baseline Scheme for the Shek Tau Street (#23). This would be due to the changed building design of Phase 1. With the landscape deck at 2F, the downwashed wind captured by Phase 2 would be diverted by the tower façade and travel westwards subsequently ventilate Shek Tau Street (#23) to the west under SE quadrants winds.

5.4.2 Summer Condition

In general, the Proposed Scheme would achieve a similar VR for all of the focus areas near Proposed Tai Wo Hau Road Phase 1 and Phase 2 as compared to Baseline Scheme, indicating the ventilation performances is considered comparable under both schemes.

6 CONCLUSION

6.1 Overview

An AVA – Detailed Study was conducted using CFD modelling to assess the ventilation performance of the Proposed Scheme of the Proposed Tai Wo Hau Road Phase 1 and Phase 2, in accordance with the *AVA Technical Circular* No. 1/06, "*Environment, Transport and Works Bureau - Technical Circular No. 1/06*" issued on 19th July 2006 and "*Annex A of Technical Circular - Technical Guide for Air Ventilation Assessment for Development in Hong Kong*".

Ventilation performance under Baseline Scheme and Proposed Scheme was assessed using Computation Fluid Dynamics (CFD) techniques. A series of CFD simulation using Realizable k–ε turbulence model were performed with 10 wind directions covering 80.1% and 81.3% of wind frequency for annual and summer conditions respectively.

The Velocity Ratio (VR) as proposed by the *AVA Technical Circular*, was employed to assess the ventilation performance under different schemes and its impact to the surroundings.

With reference to the *AVA Technical Circular*, a total of 60 perimeter test points and 194 overall test points have been allocated within the study site and assessment area to assess the overall and local ventilation performance.

6.2 Results

The results of the SVR, LVR are summarized as below.

	Annual Condition		Summer Condition	
	Baseline Scheme	**Proposed Scheme**	**Baseline Scheme**	**Proposed Scheme**
SVR	0.16	0.16	0.21	0.21
LVR	0.15	0.15	0.17	0.17

- The Proposed Scheme would achieve similar ventilation performance as compared with Baseline Scheme under both annual and summer condition.
- High-rise residential towers, such as Tai Wo Hau Estate, Kwai Chung Estate, Kwai Shing East Estate, would dominate and condition the wind environment for both annual and summer condition.
- Under which the taller building height of Phase 2 would induce slightly stronger downwash effect to ventilate the pedestrian level.
- There would be no adverse ventilation impact on surrounding area from Proposed Scheme.

As AVA-IS has been conducted to assess the ventilation performance of the OZP-compliant Scheme and the Proposed Scheme, It general, the Proposed Scheme would achieve similar ventilation performance as compared with the OZP-complaint Scheme. To maintain and enhance the wind performance of the Proposed Scheme, the following wind enhancement features have been adopted.

- The building separation of 65m between Phase 1 and Phase 2 is maintained to provide wider air path for penetration of prevailing wind, which enhance the environmental quality at pedestrian level and mitigate heat island effects arising from the undesirable screening effect of long buildings at different levels, based on the Sustainable Building Design Guideline (APP-152).
- The additional setback from western boundary would enhance the permeability in the slope area near Tai Wo Hau Road, improve air ventilation, enhance the environmental quality at pedestrian level and mitigate street canyon effect, based on the Sustainable Building Design Guideline (APP-152).
- The Landscape Desk at 2/F of Phase 1 of the Proposed Scheme, the wind would continue to travel at high-elevation and result in slight enhancement at some of the slope area on the west of the site.
- The taller building height of Phase 2 would induce slightly stronger downwash effect to ventilate the pedestrian level.

7 REFERENCE

[1] Annex A of Technical Circular No. 1/06 issued by the Housing, Planning and Lands Bureau pertaining specifically to Air Ventilation Assessments, 19th July, 2006

(https://www.devb.gov.hk/filemanager/en/content_679/hplb-etwb-tc-01-06.pdf)

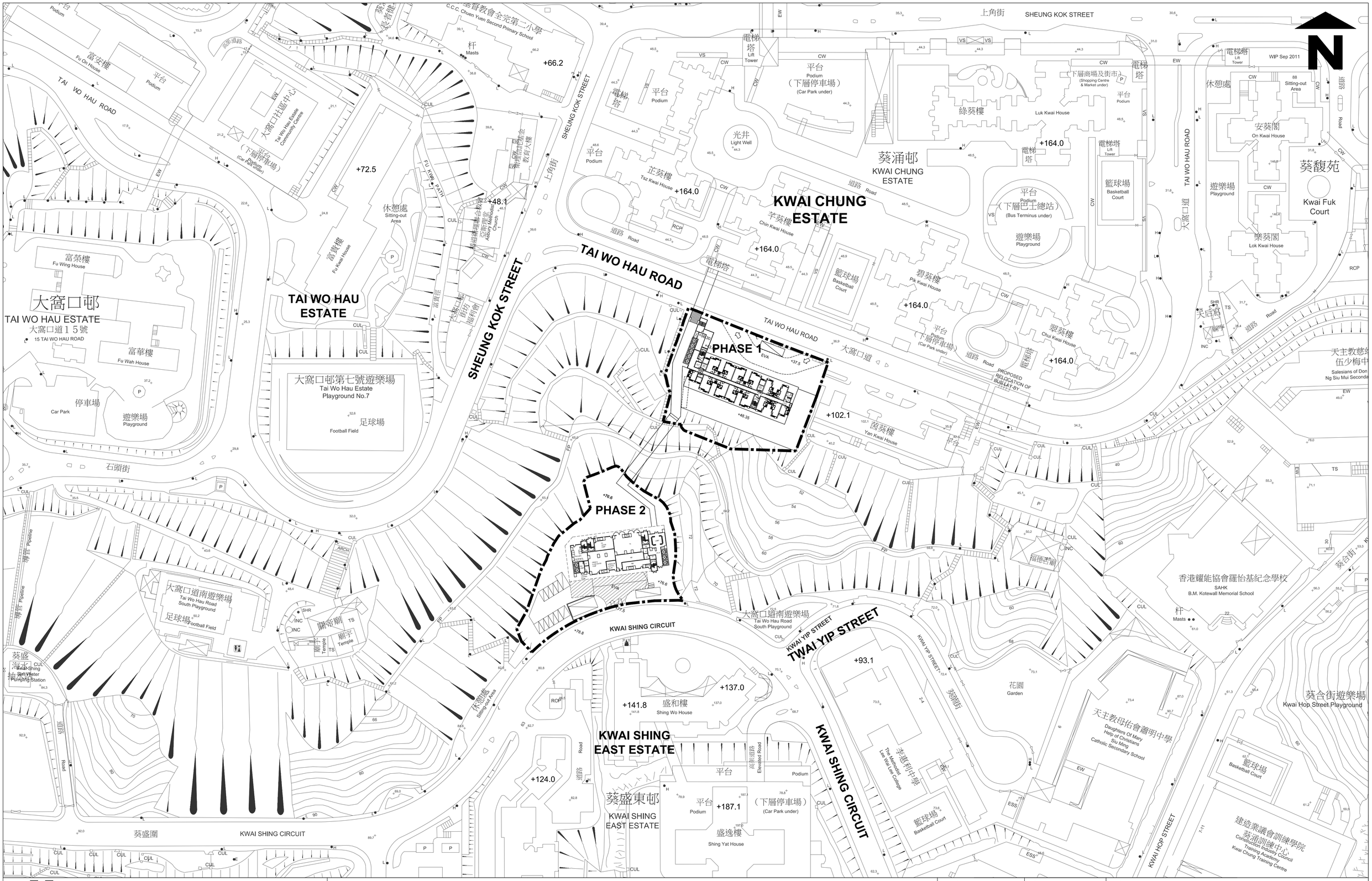
[2] Planning Department RAMS Data

(http://www.pland.gov.hk/pland_en/info_serv/site_wind/site_wind/)

Appendix A

Baseline and Proposed Scheme Layout Plans

A1 Baseline Scheme Layout

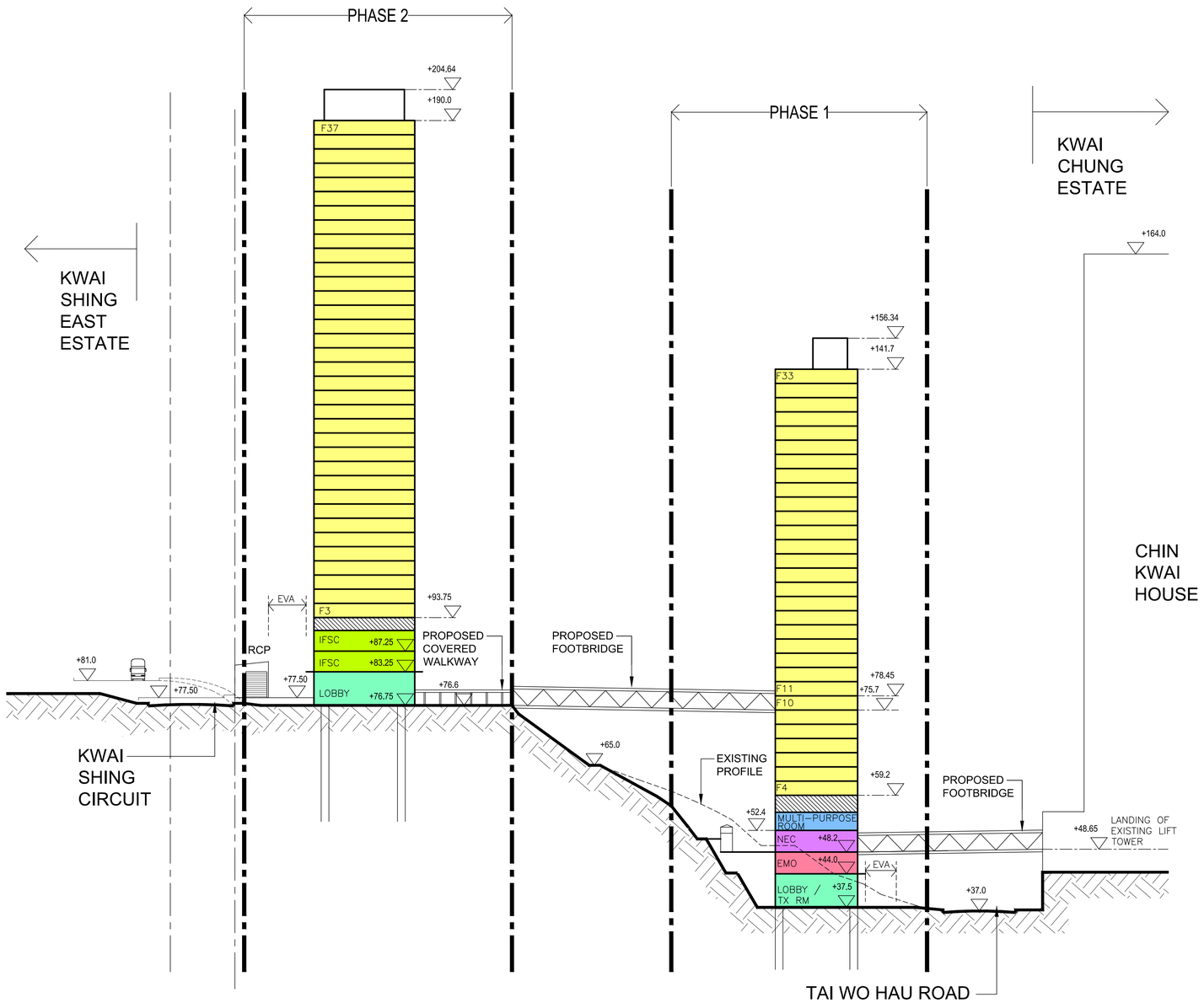


PROPOSED PRH DEVELOPMENT
AT TAI WO HAU ROAD PAHSE 1 & 2

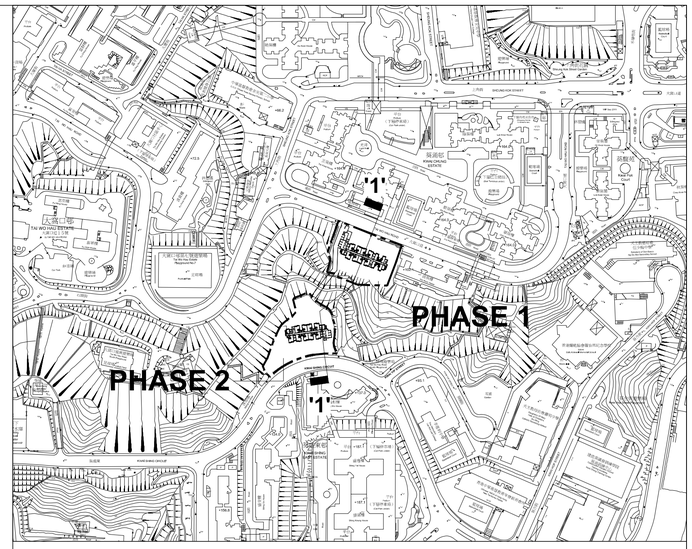
SCHEME 12

SITE LAYOUT PLAN

PHASE No.	SCALE		LEGEND
PHASE 1 & 2	1:750 (A1); 1:1500 (A3)		
DRAWING No.	DATE	PAGE No.	
KS19/SITE/S11/A/LO-01	04-2014	-	



SITE SECTION '1' - '1'



LOCATION PLAN SCALE 1:3000 (A1); 1:6000 (A3)

PROPOSED PRH DEVELOPMENT
AT TAI WO HAU ROAD PAHSE 1 & 2

SCHEME 11

SITE SECTION '1' - '1'

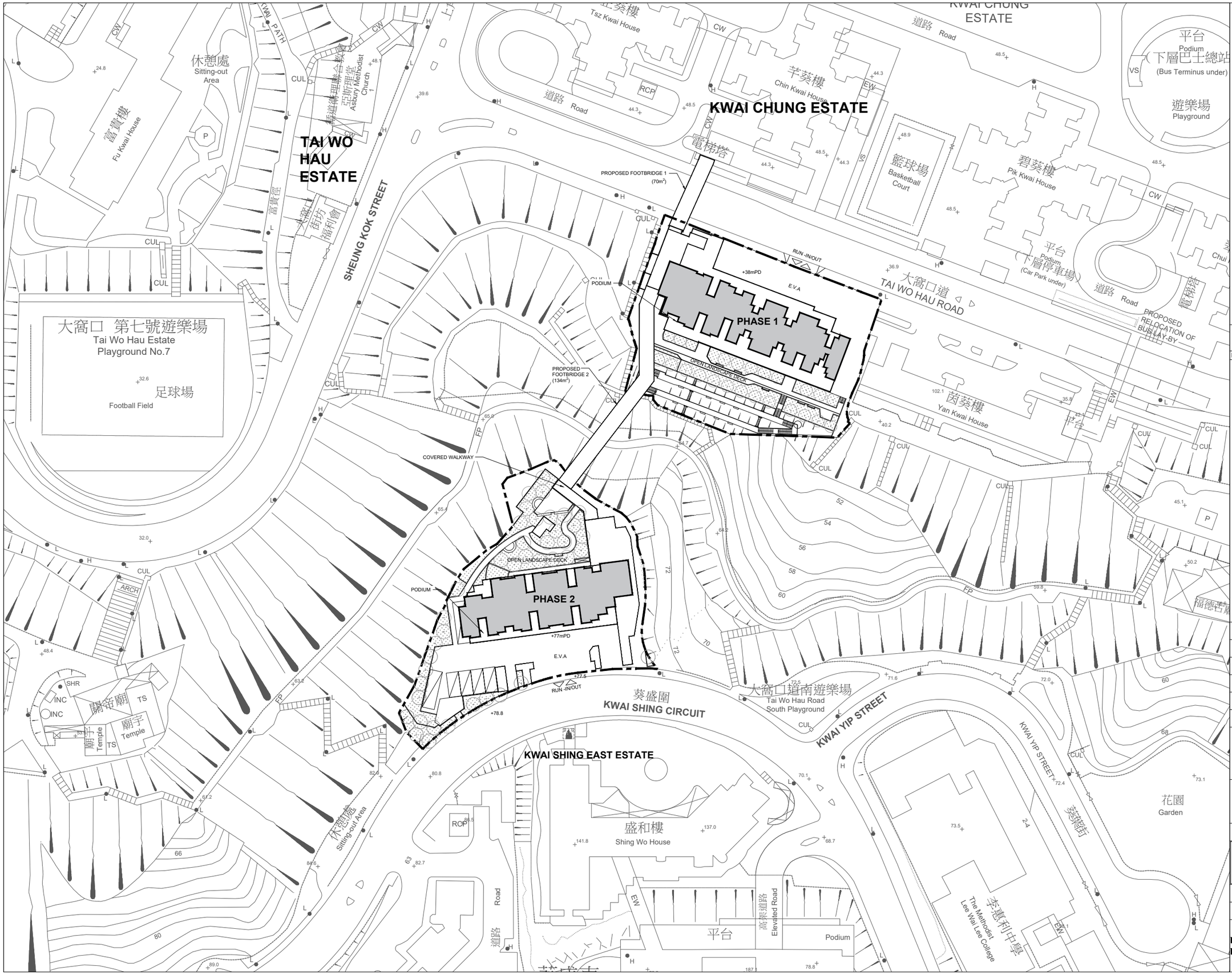
PHASE No.	SCALE	
PHASE 1 & 2	1:500 (A1); 1:1000 (A3)	
DRAWING No.	DATE	PAGE No.
KS19/SITE/S11/A/LO-02	04-2014	-

LEGEND

- PRH SITE BOUNDARY
- LOBBY / TX ROOM
- DOMESTIC FLOOR
- IFSC
- NEC
- MULTI-PURPOSE ROOM
- EMO

A2 Proposed Scheme Layout

ANNEX 3



NOTES

LEGEND

SITE BOUNDARY

REVISIONS

NO	DESCRIPTION AND DATE	DWN	CKD	AUTH

INITIAL AND DESIGNATION

CHAU LAM ARCHITECTS & ASSOCIATES
ARCHITECTS & ENGINEERS (H.K.) LTD.

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	JOSEPH M.K. TANG DD	ORIGINAL SIGNED	12/03/2016
ENDORSED	REMBERT S.K. LAI SDP	ORIGINAL SIGNED	12/03/2016
CHECKED	HOWARD K.K. HUI DP	ORIGINAL SIGNED	12/03/2016
DRAWN	DENNIS W.L. CHAN DOTL	ORIGINAL SIGNED	12/03/2016

PROJECT
PUBLIC HOUSING DEVELOPMENT
TAI WO HAU ROAD PHASE 1 & 2
KWAI CHUNG

DRAWING TITLE
UPDATED MASTER LAYOUT PLAN
(AS AT MARCH 2022)

SCALE 1:500(A1) ; 1:1000(A3)

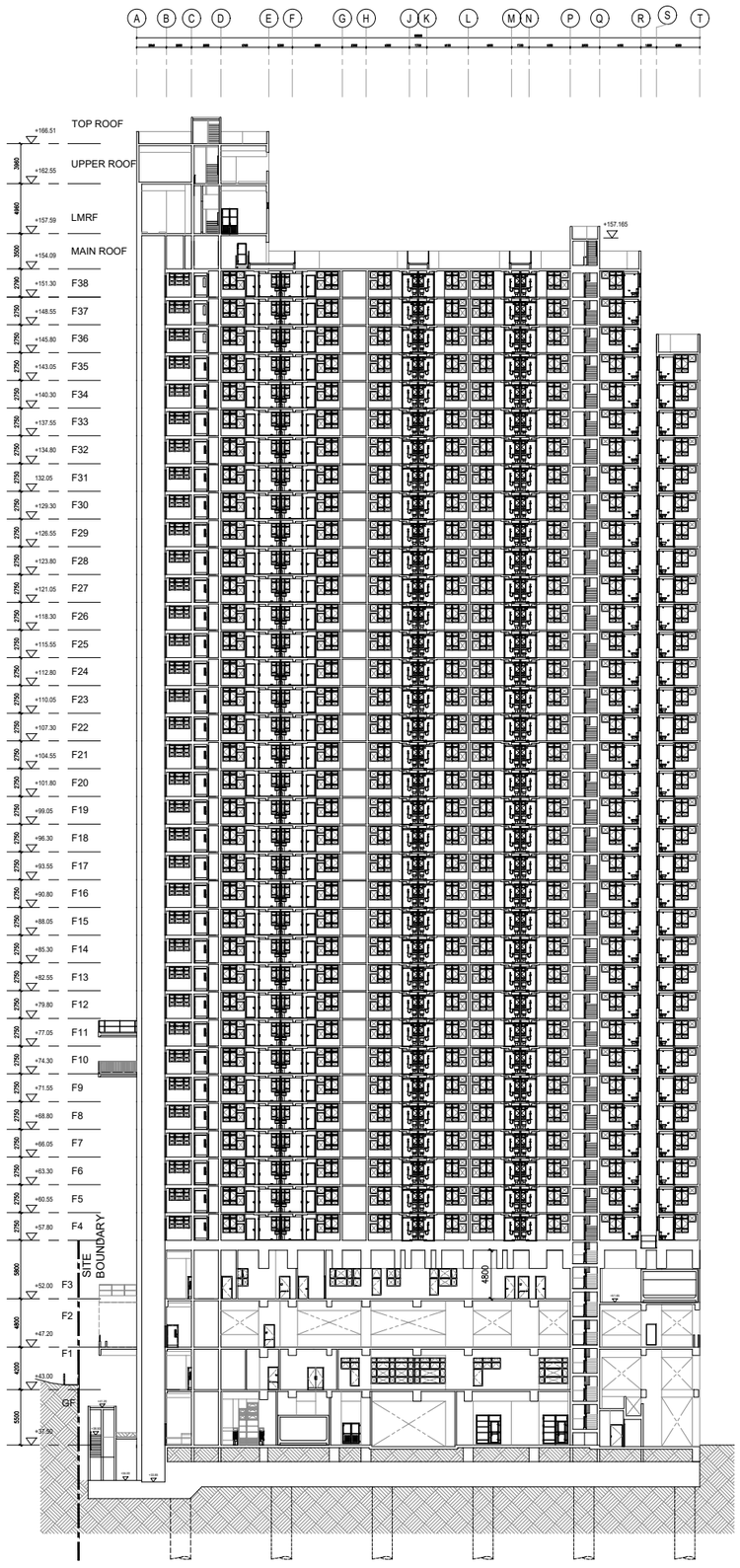
DRAWING NO.
KS19/SITE/A/BC-01

SOURCE

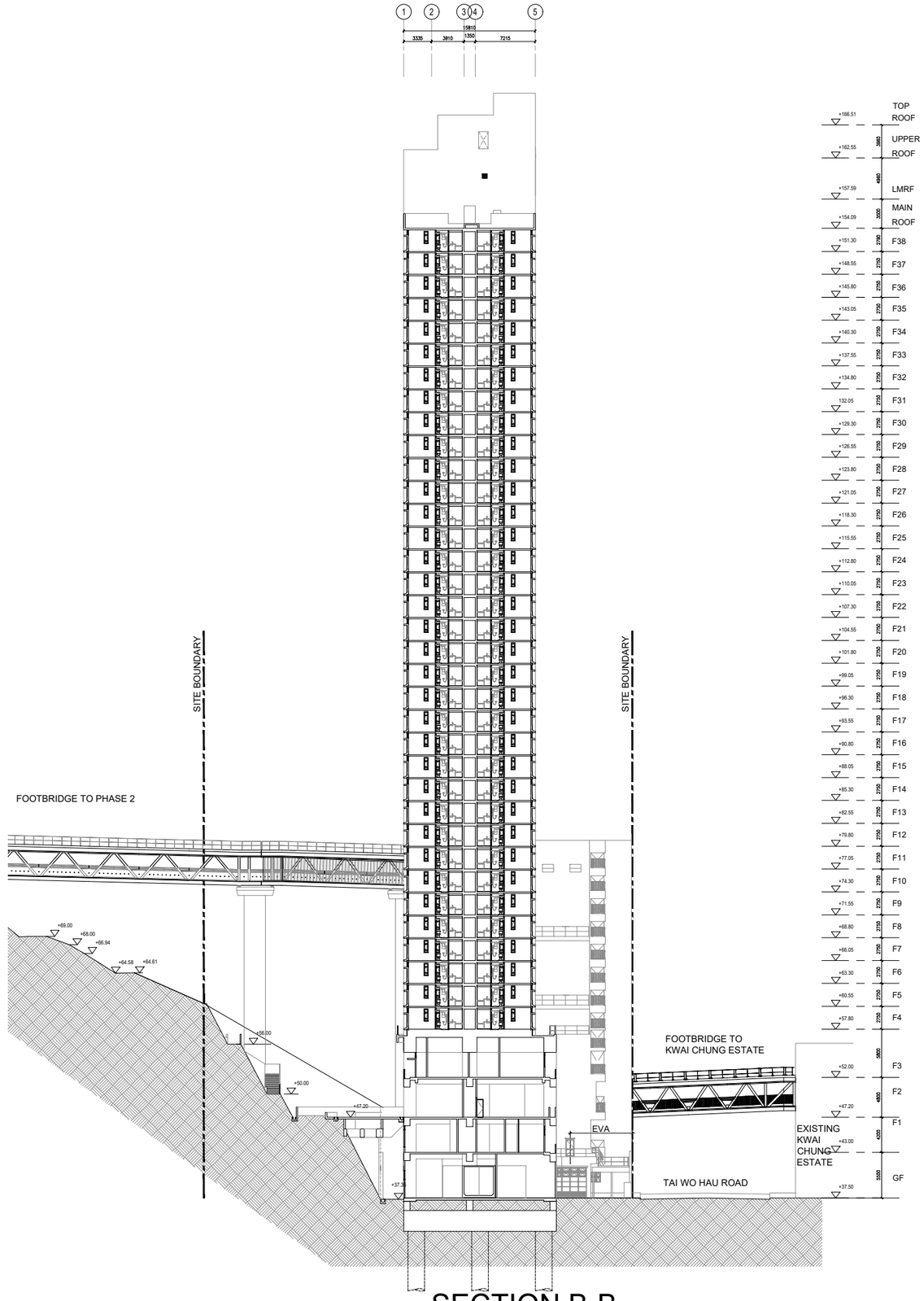
ICU NO.

AutoCAD 2000 A3 297 x 420

HOUSING DEPARTMENT



SECTION A-A



SECTION B-B

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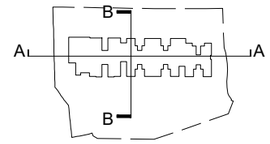


KEY PLAN

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	EDITH P.Y. LI SA/17	ORIGINAL SIGNED	03/2022
ENDORSED	S.H. LO A/74	ORIGINAL SIGNED	03/2022
CHECKED	K.S.SZE STO(A)/31	ORIGINAL SIGNED	03/2022
DRAWN	HC WONG TO(A)/164	ORIGINAL SIGNED	03/2022

PROJECT

PUBLIC HOUSING DEVELOPMENT
TAI WO HAU ROAD PHASE 1
KWAI CHUNG

DRAWING TITLE

PHASE 1 -
SECTION A-A & B-B

SCALE 1:300 (A1) ; 1:600 (A3)

DRAWING NO.

KS19/01/BLK/A/LO-13/A

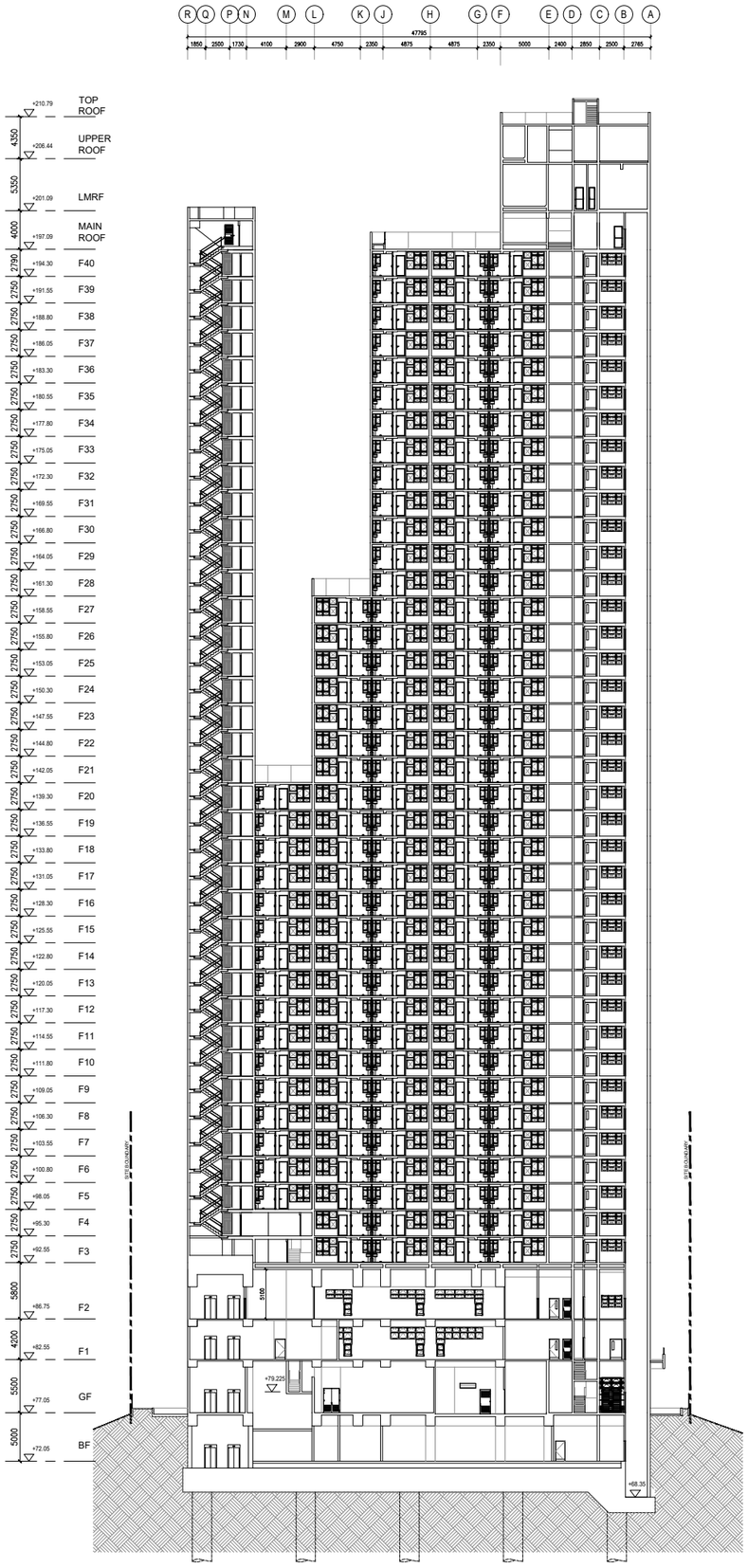
SOURCE

ICU NO.

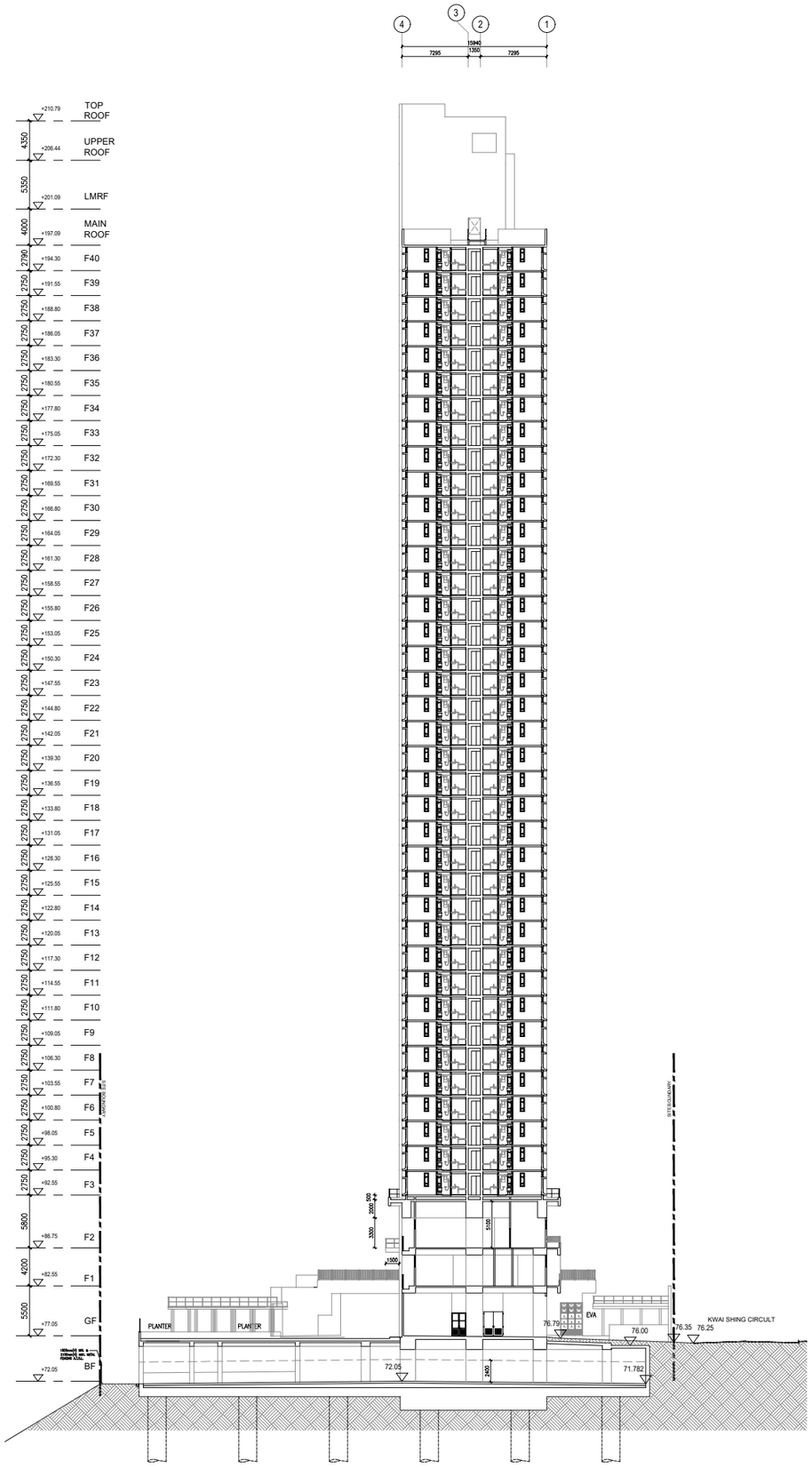
AutoCAD 2000 A1 594 x 841

A31

HOUSING DEPARTMENT



SECTION A-A



SECTION B-B

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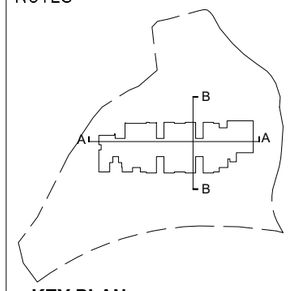

KEY PLAN

REVISIONS

NO	DESCRIPTION AND DATE	DWN	CKD	AUTH

INITIAL AND DESIGNATION

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	EDITH P.Y.LI SA/17	ORIGINAL SIGNED	05/2022
ENDORSED	S.H. LO A/74	ORIGINAL SIGNED	05/2022
CHECKED	K.S. SZE STO(A)/31	ORIGINAL SIGNED	05/2022
DRAWN	H.C. WONG TO(A)/164	ORIGINAL SIGNED	05/2022

PROJECT

PUBLIC HOUSING DEVELOPMENT
TAI WO HAU ROAD PHASE 2
KWAI CHUNG

DRAWING TITLE

PHASE 2 -
SECTION A-A & B-B

SCALE 1:300 (A1) ; 1:600 (A3)

DRAWING NO.

KS19/02/BLK/DLO-08

SOURCE

ICU NO.

AutoCAD 2000 A1 594 x 841

HOUSING DEPARTMENT

Appendix B

Directional VR Contour Plots

B1 Baseline Scheme

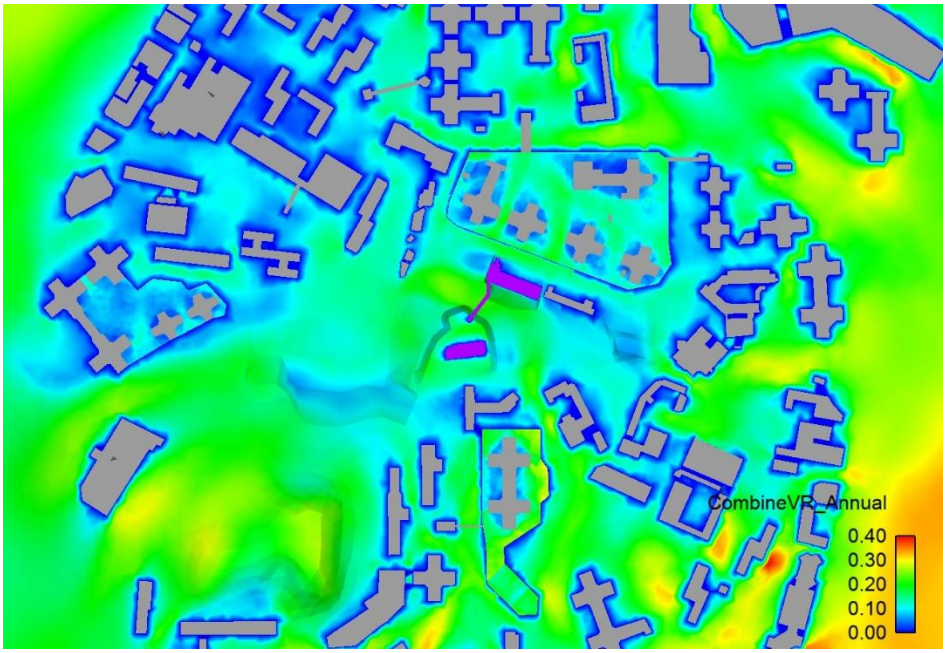

Figure B1.1.1 Annual Weighted VR Contour Plot for Baseline Scheme

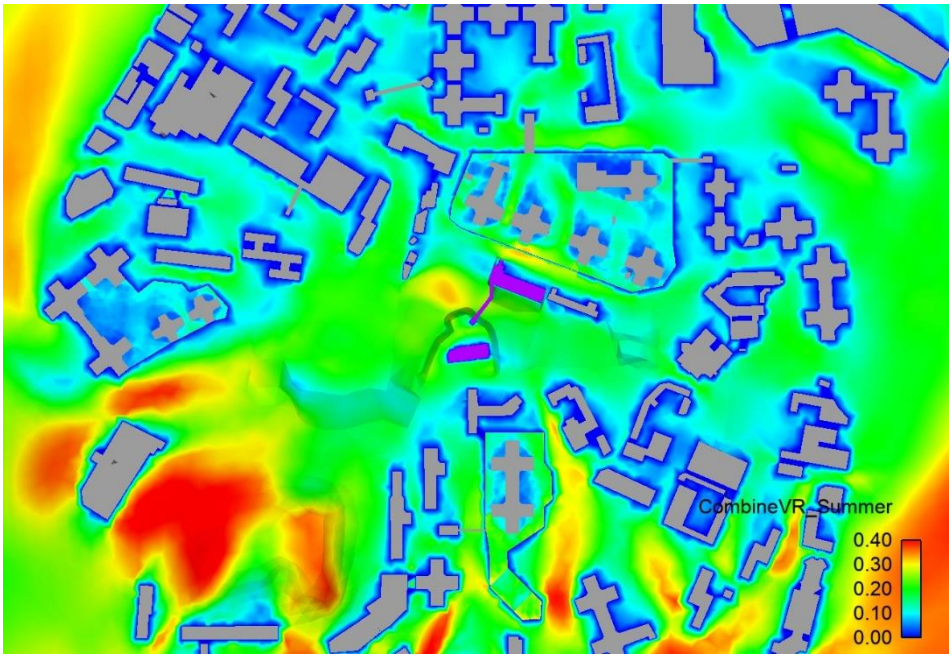

Figure B1.2.1 Summer Weighted VR Contour Plot for Baseline Scheme

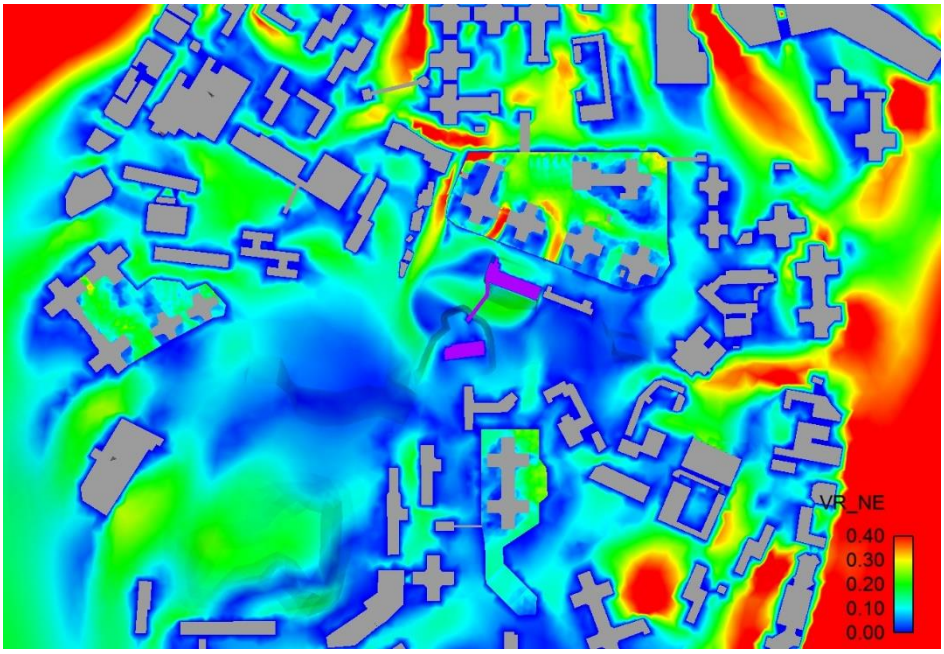

Figure B1.3.1 NE Direction VR Contour Plot for Baseline Scheme

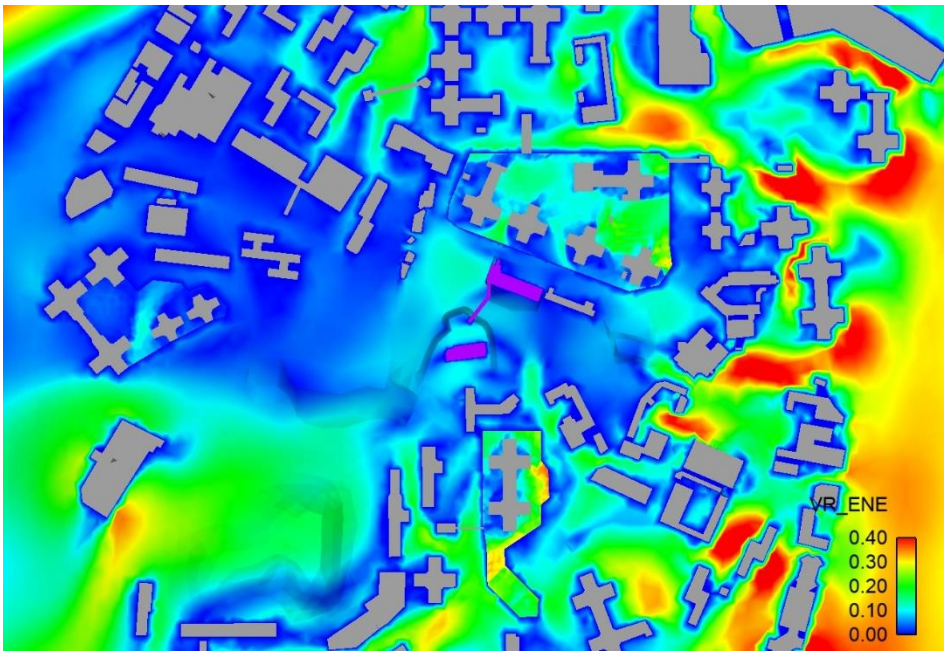

Figure B1.4.1 ENE Direction VR Contour Plot for Baseline Scheme

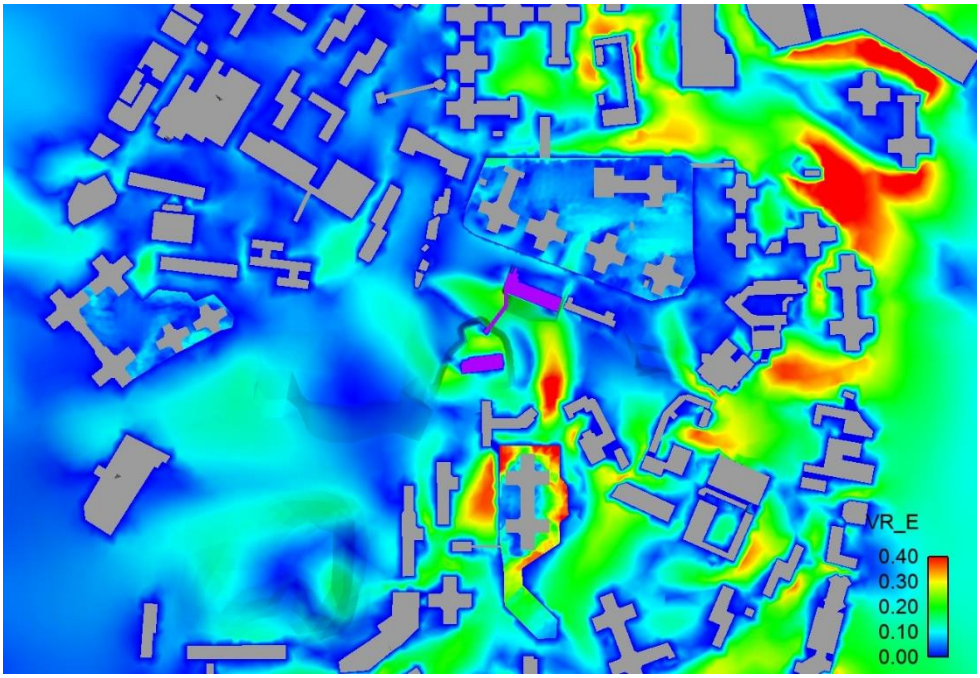

Figure B1.5.1 E Direction VR Contour Plot for Baseline Scheme

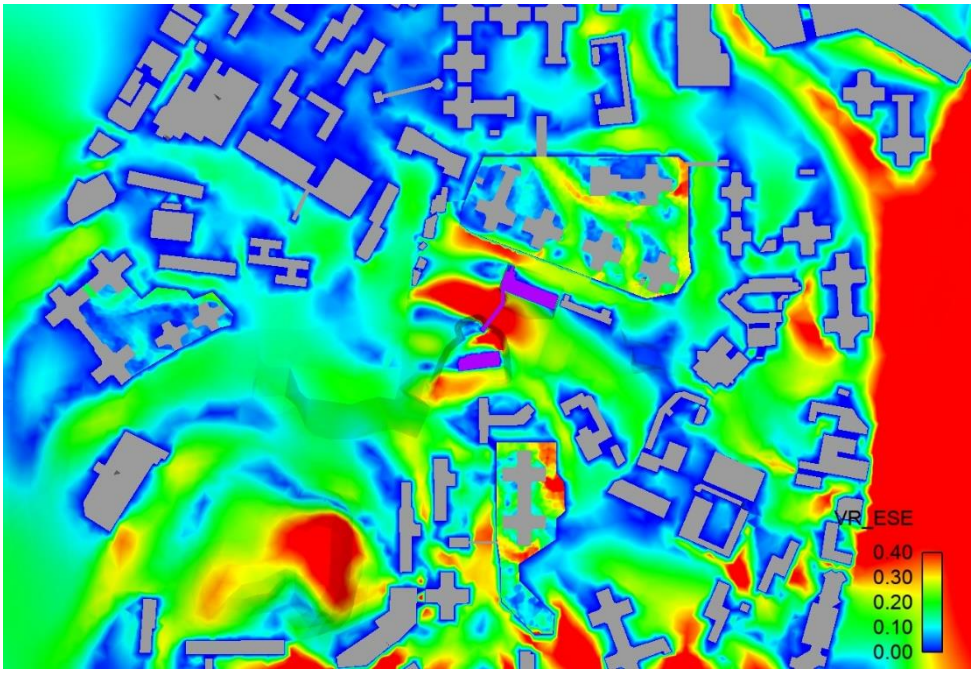

Figure B1.6.1 ESE Direction VR Contour Plot for Baseline Scheme

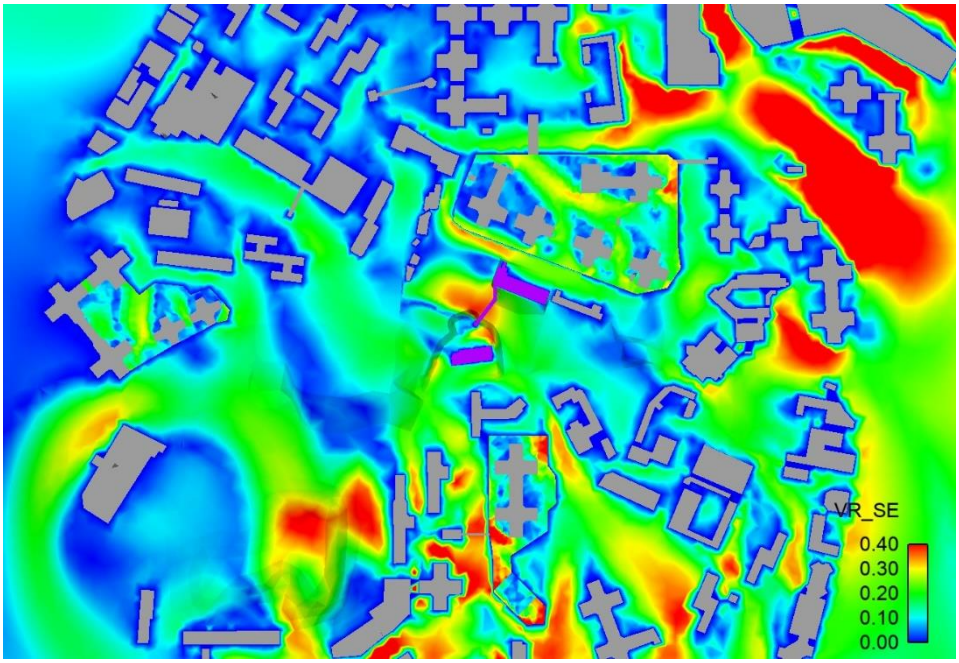

Figure B1.7.1: SE Direction VR Contour Plot for Baseline Scheme

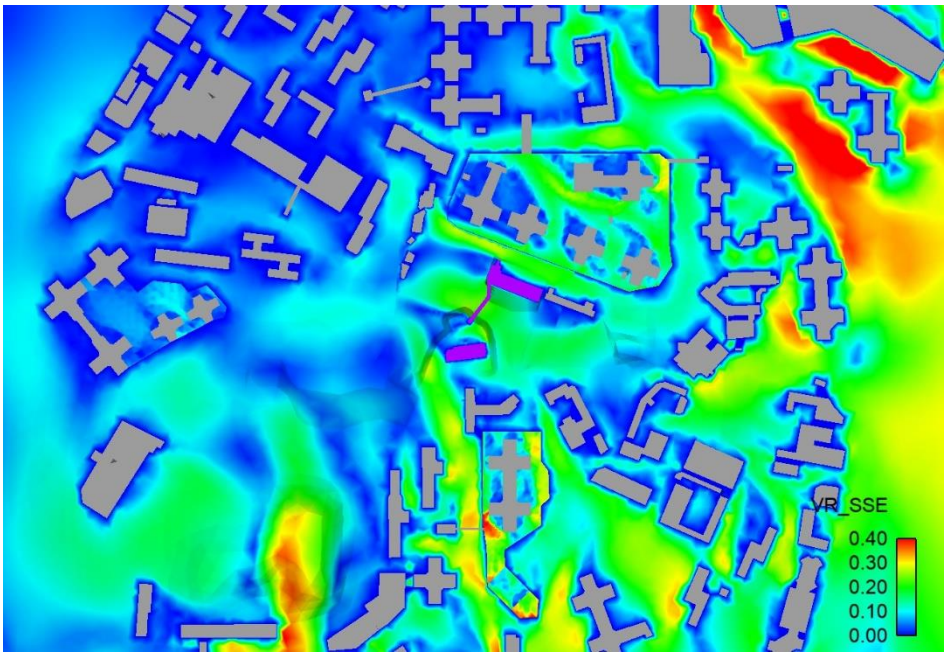

Figure B1.8.1: SSE Direction VR Contour Plot for Baseline Scheme

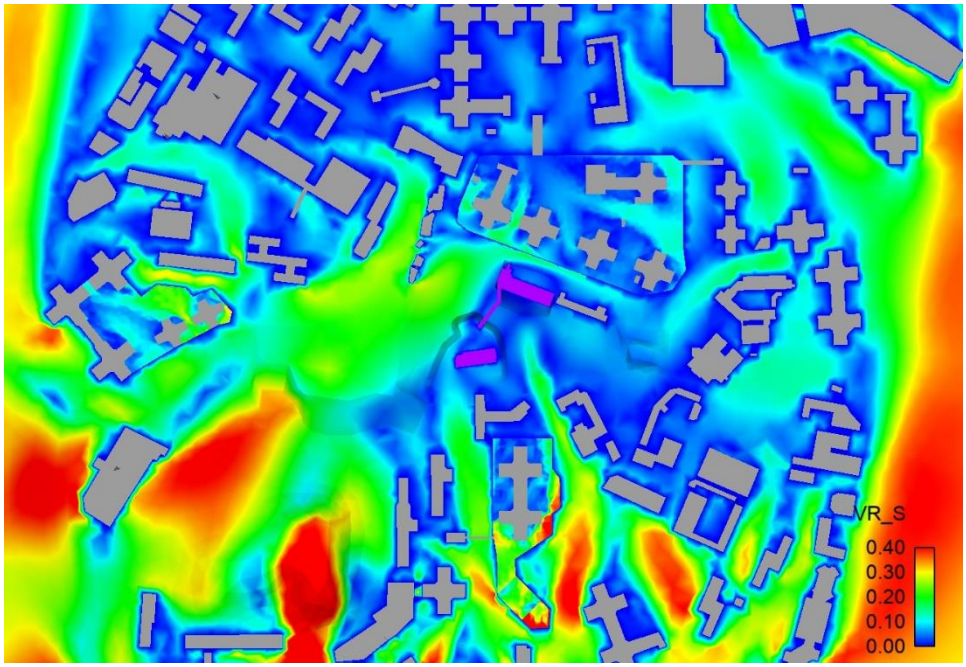

Figure B1.9.1 S Direction VR Contour Plot for Baseline Scheme

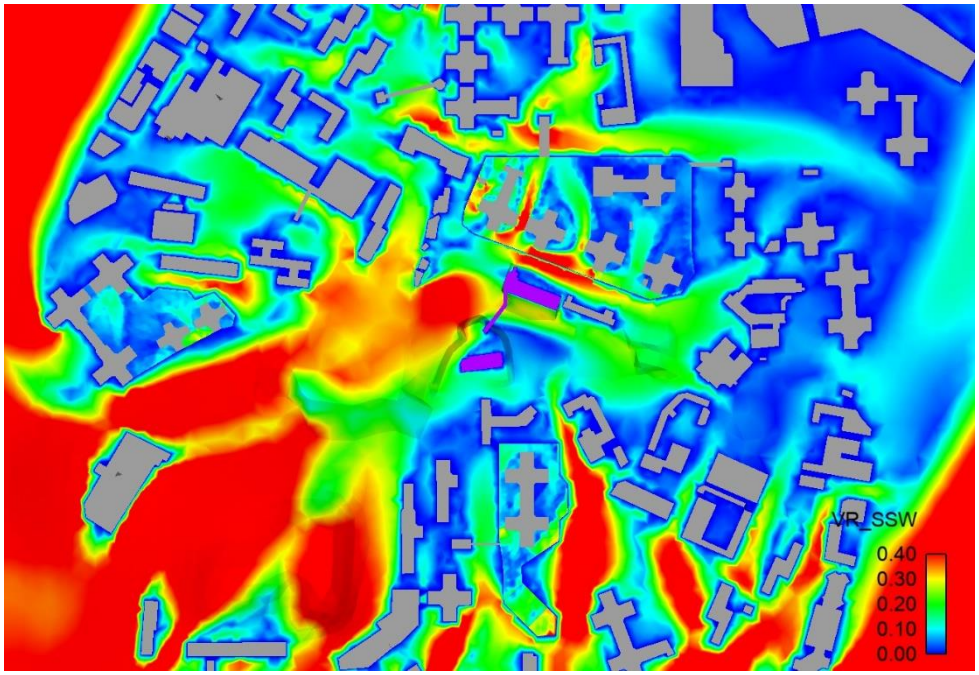

Figure B1.10.1 SSW Direction VR Contour Plot for Baseline Scheme

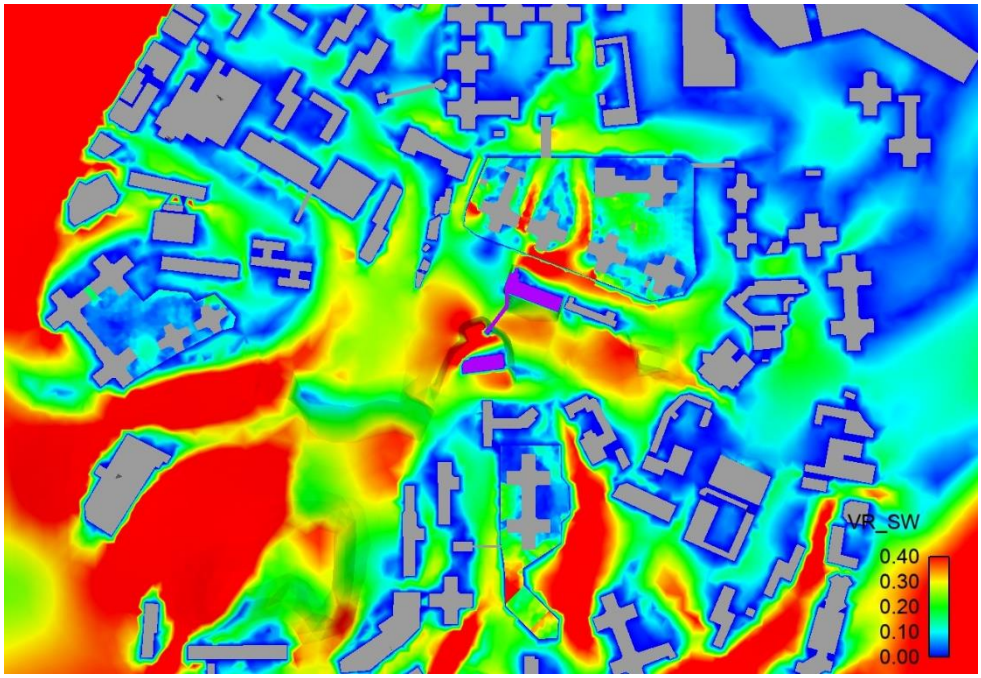

Figure B1.11.1 SW Direction VR Contour Plot for Baseline Scheme

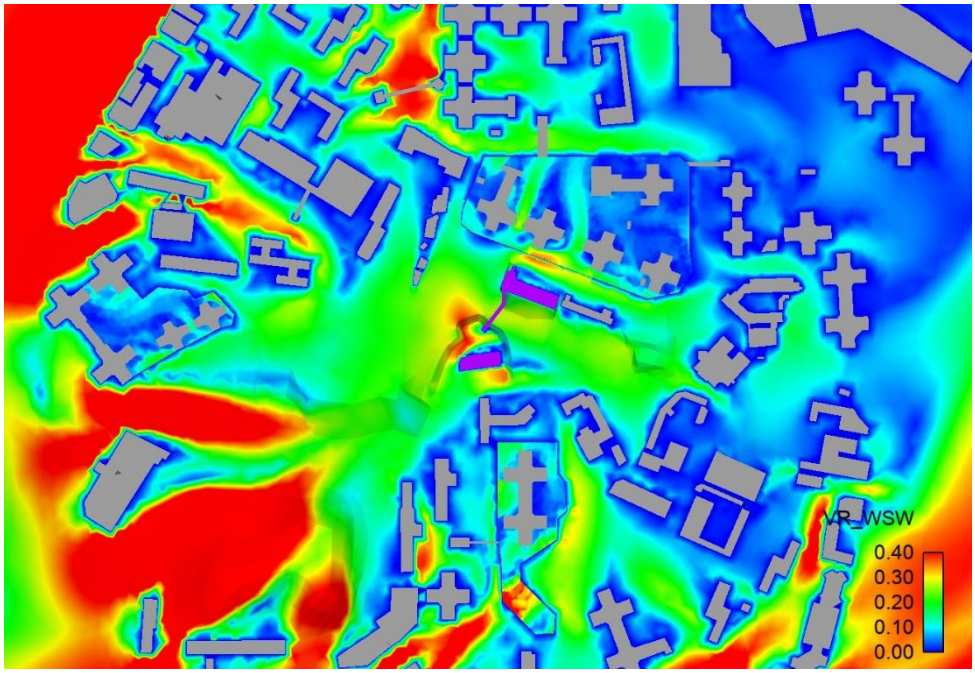

Figure B1.12.1 WSW Direction VR Contour Plot for Baseline Scheme

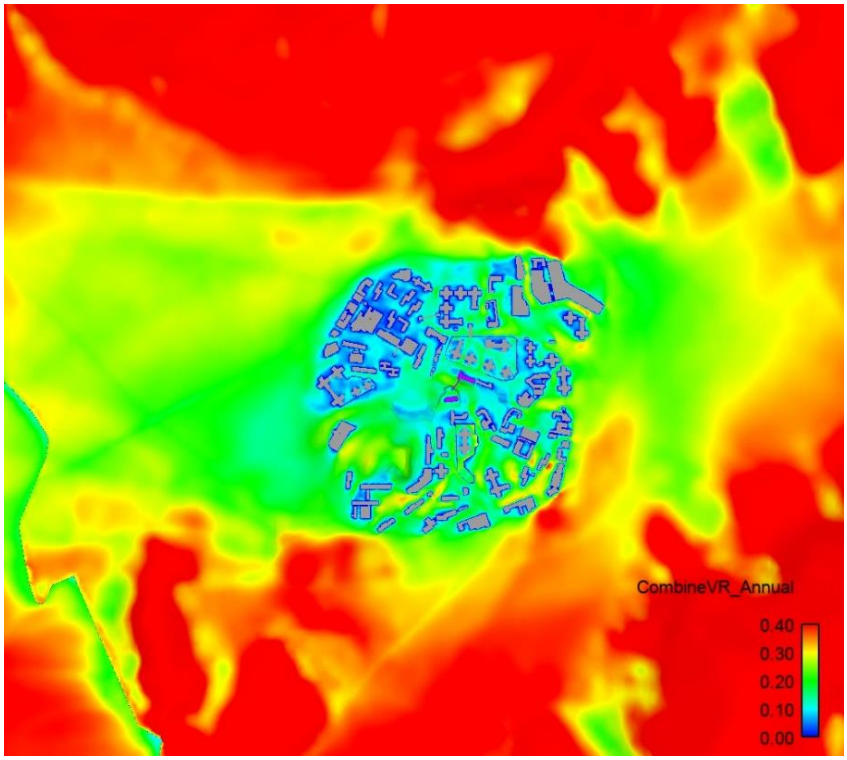

Figure B1.1.2 Annual VR Contour Plot for Baseline Scheme - Domain

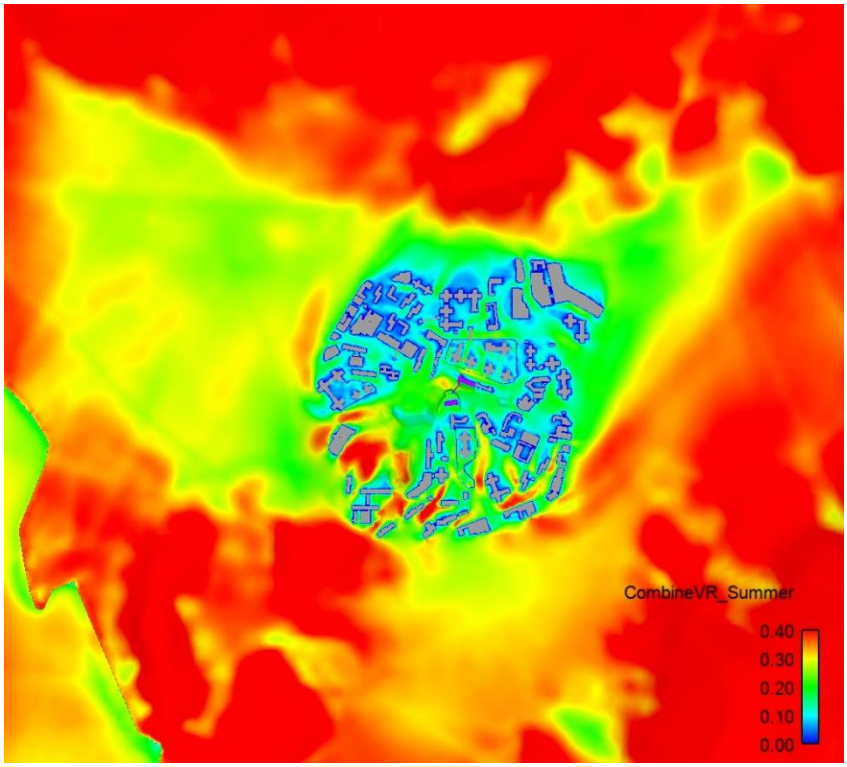

Figure B1.2.2 Summer VR Contour Plot for Baseline Scheme - Domain

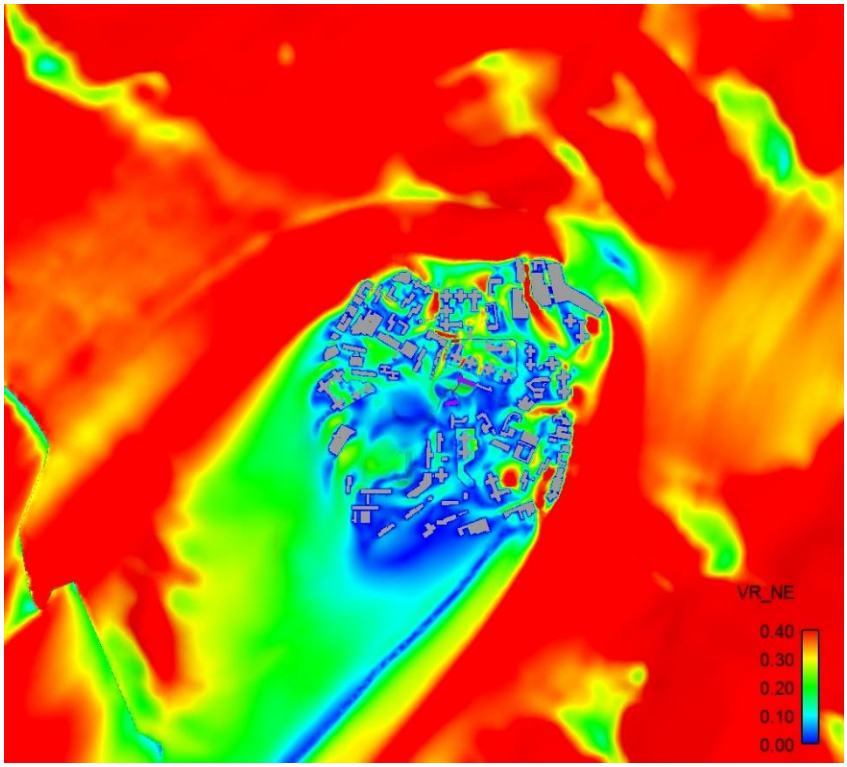

Figure B1.3.2 NE Direction VR Contour Plot for Baseline Scheme - Domain

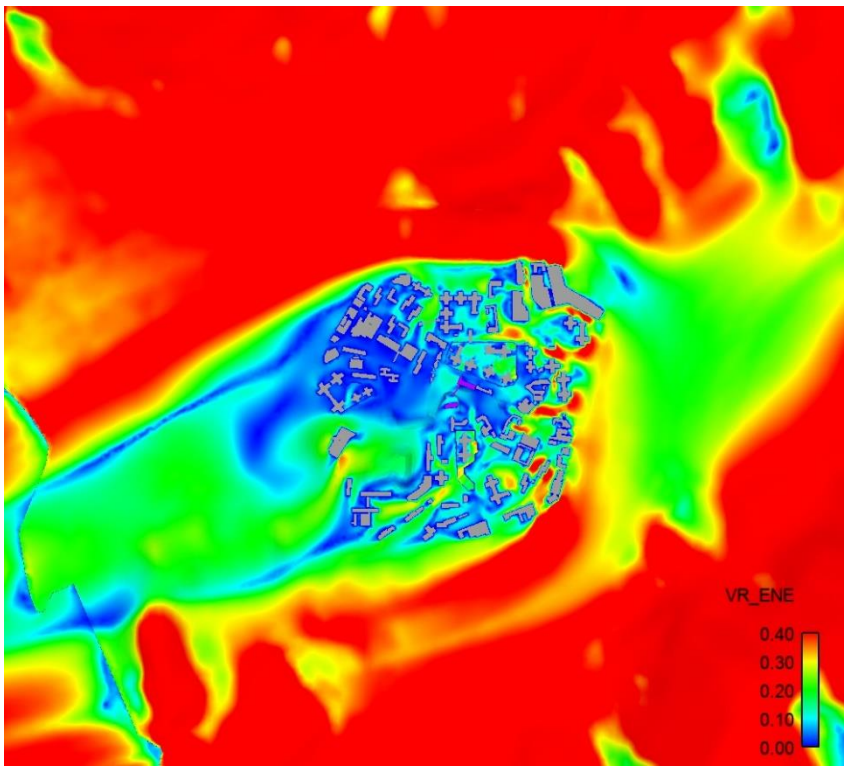

Figure B1.4.2 ENE Direction VR Contour Plot for Baseline Scheme - Domain

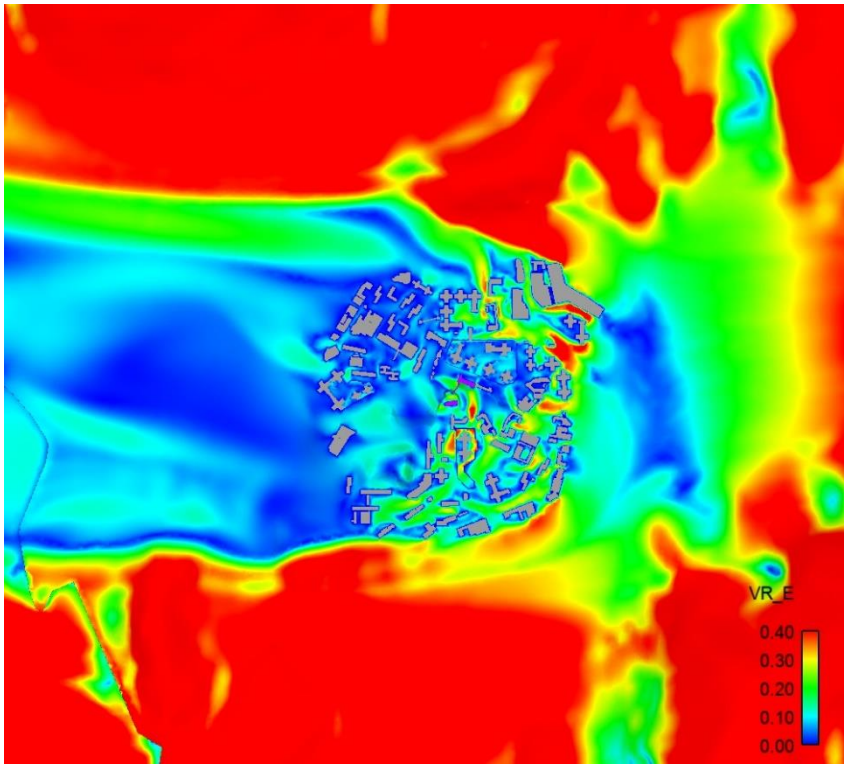

Figure B1.5.2 E Direction VR Contour Plot for Baseline Scheme - Domain

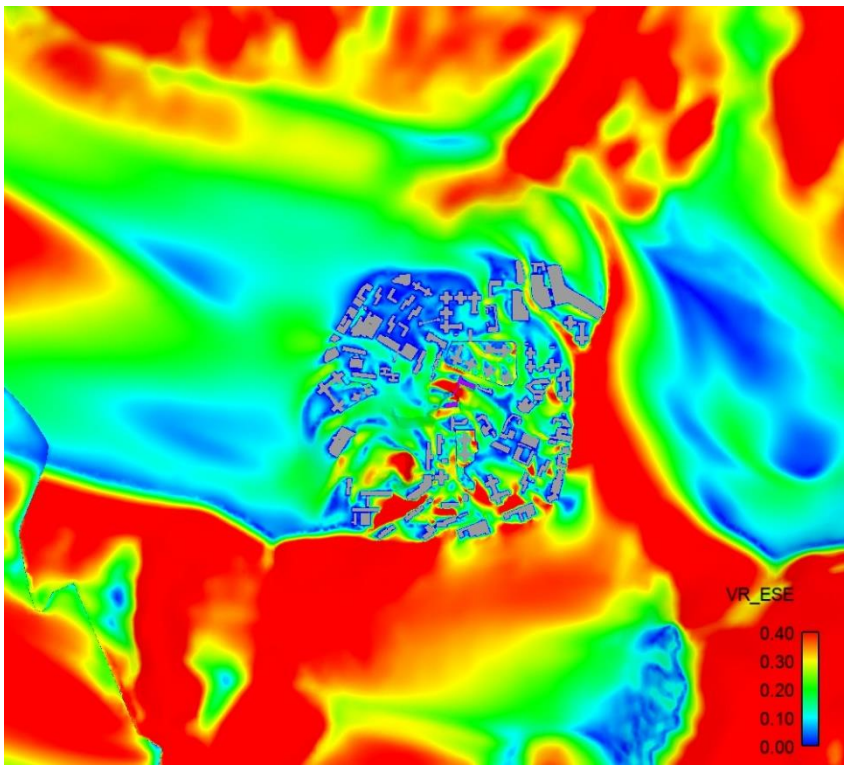

Figure B1.6.2 ESE Direction VR Contour Plot for Baseline Scheme - Domain

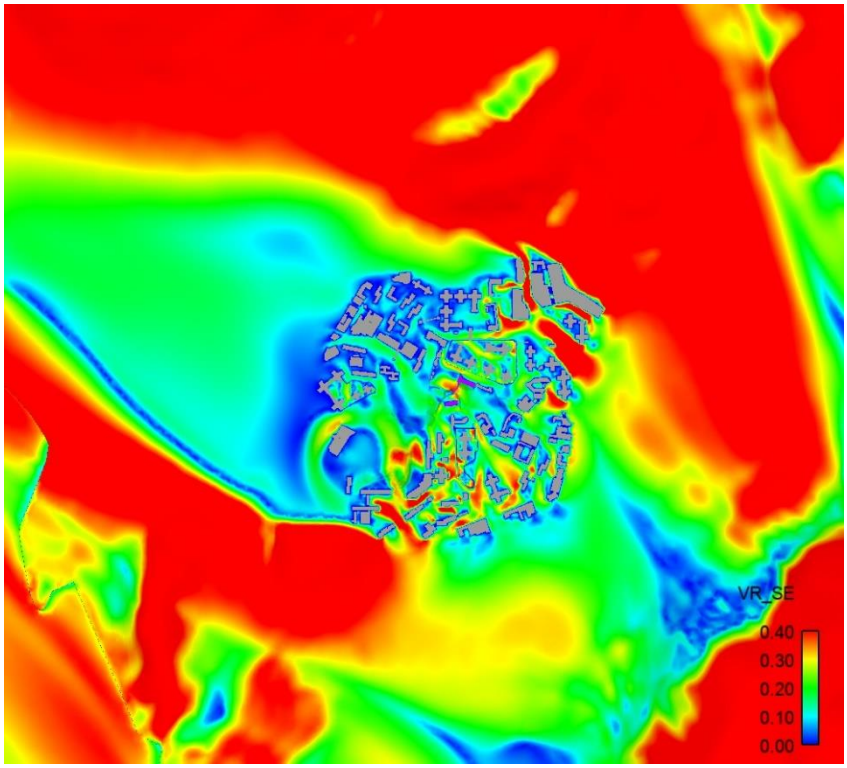

Figure B1.7.2 SE Direction VR Contour Plot for Baseline Scheme - Domain

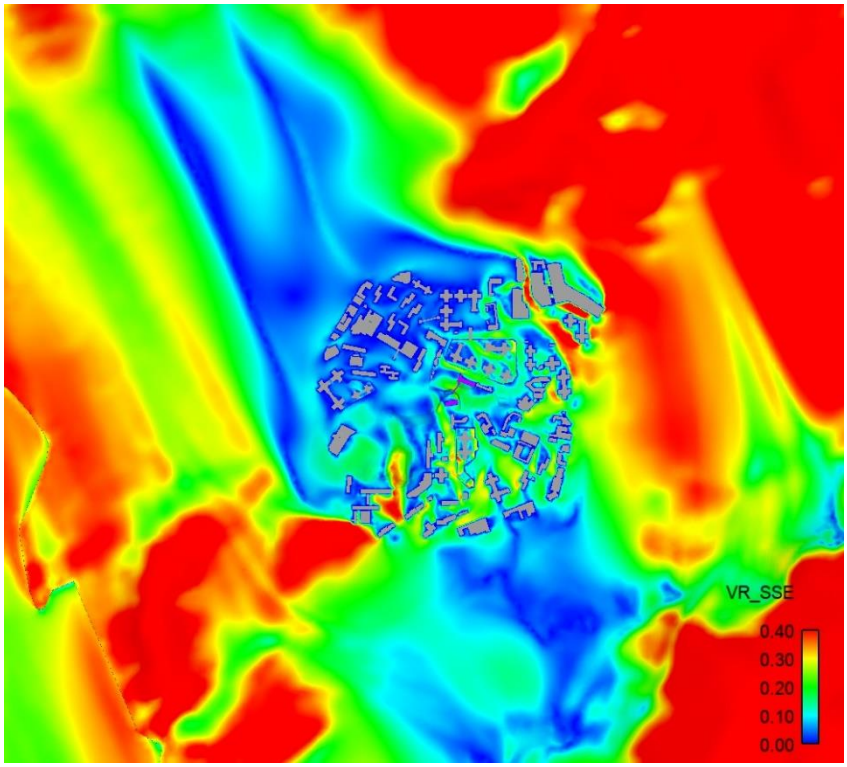

Figure B1.8.2 SSE Direction VR Contour Plot for Baseline Scheme - Domain

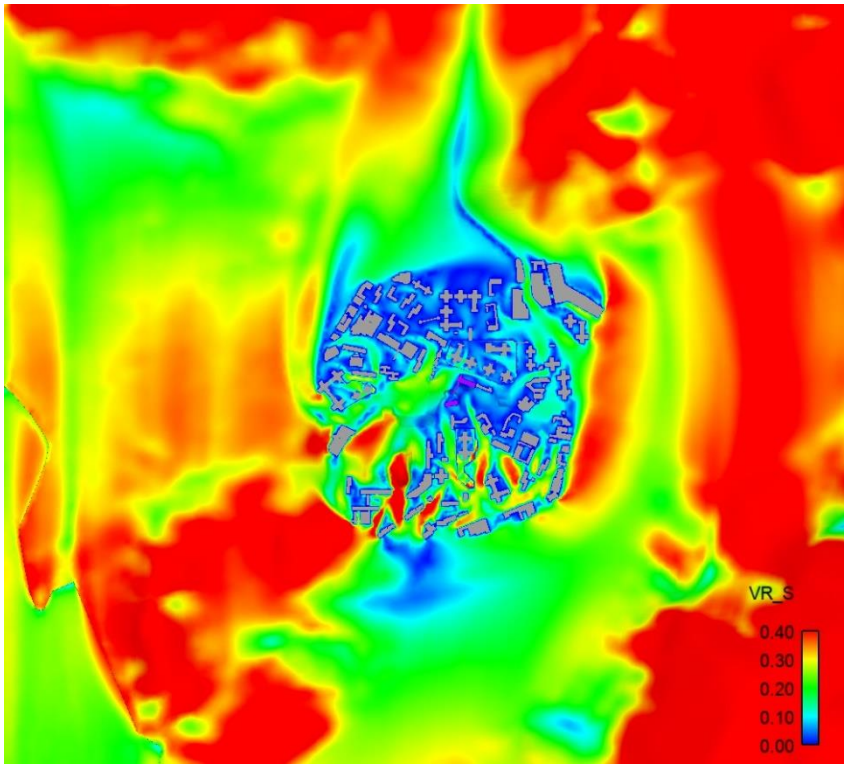

Figure B1.9.2 S Direction VR Contour Plot for Baseline Scheme - Domain

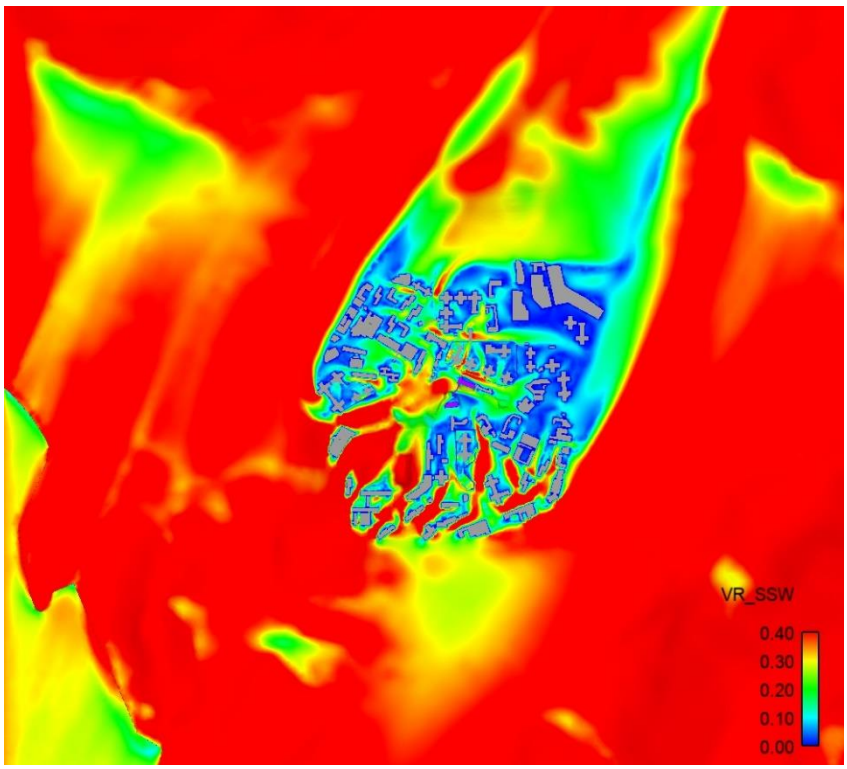

Figure B1.10.2 SSW Direction VR Contour Plot for Baseline Scheme - Domain

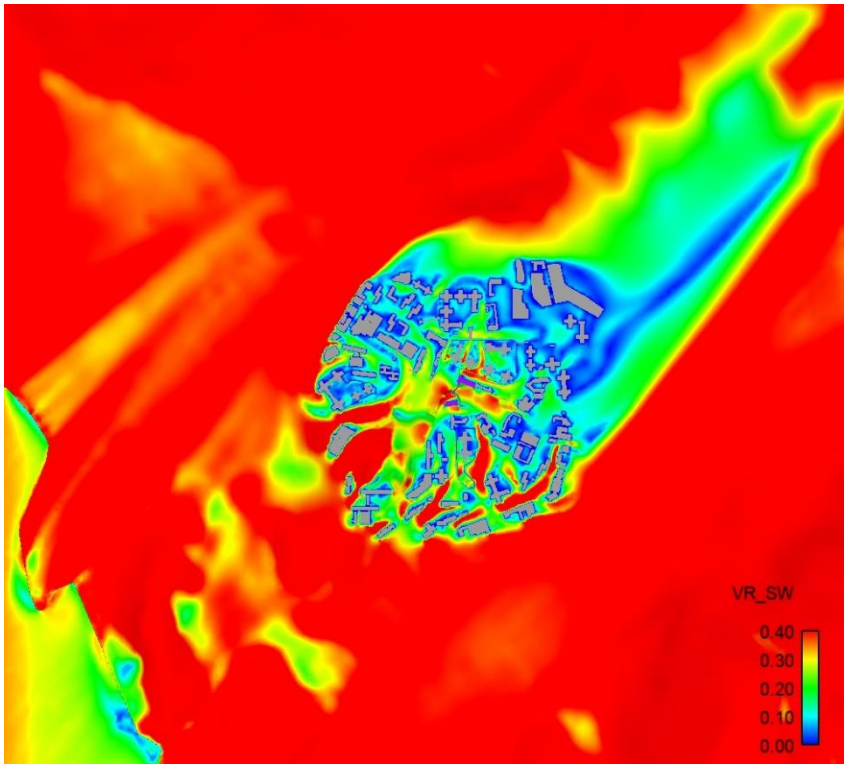

Figure B1.11.2 SW Direction VR Contour Plot for Baseline Scheme - Domain

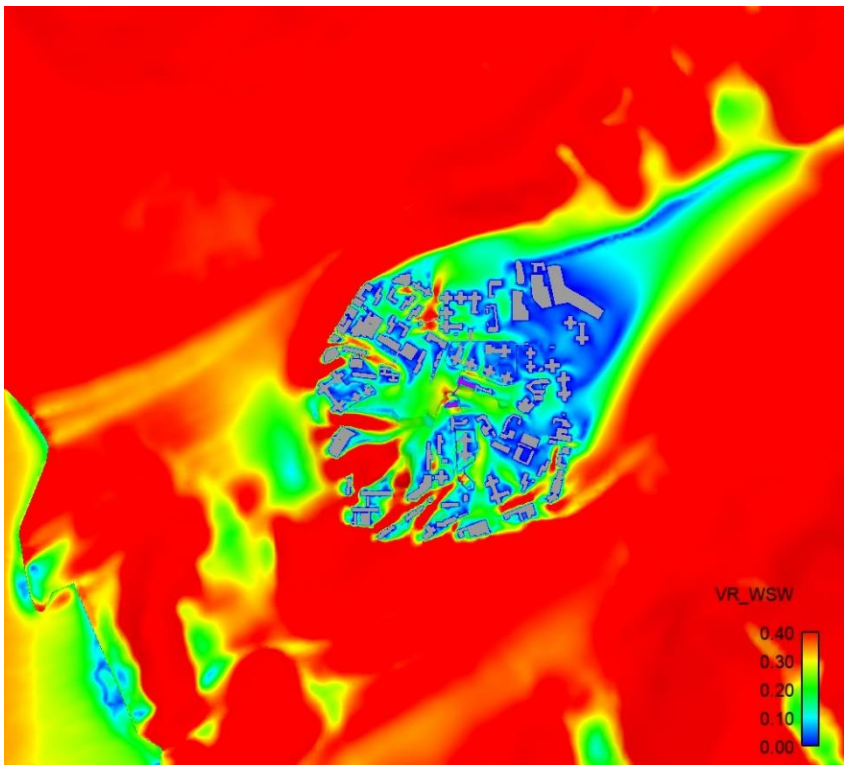

Figure B1.12.2 WSW Direction VR Contour Plot for Baseline Scheme- Domain

B2 Propose Scheme

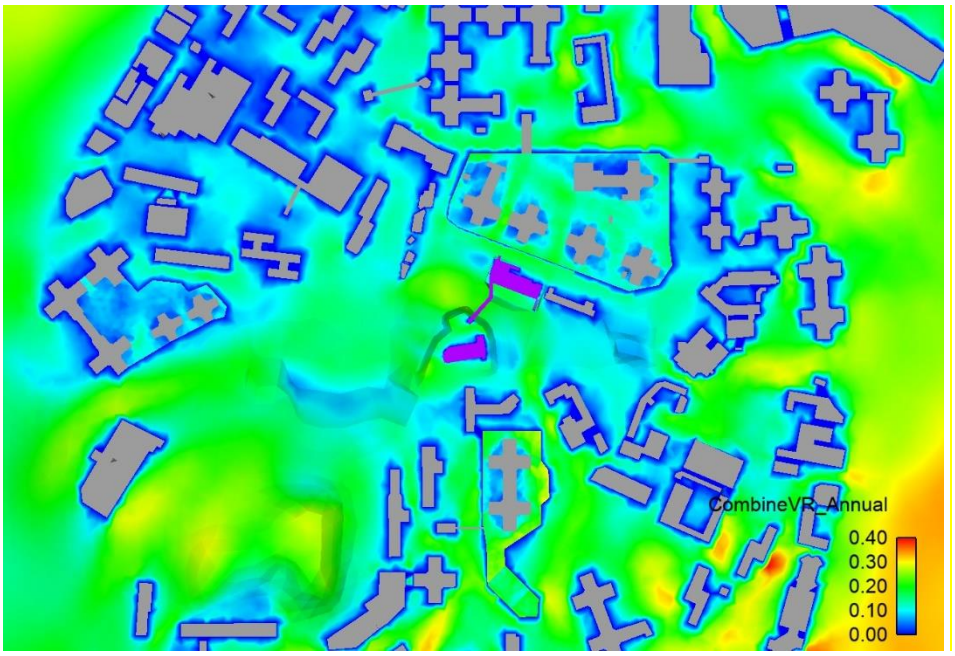

Figure B2.1.1 Annual Weighted VR Contour Plot for Proposed Scheme

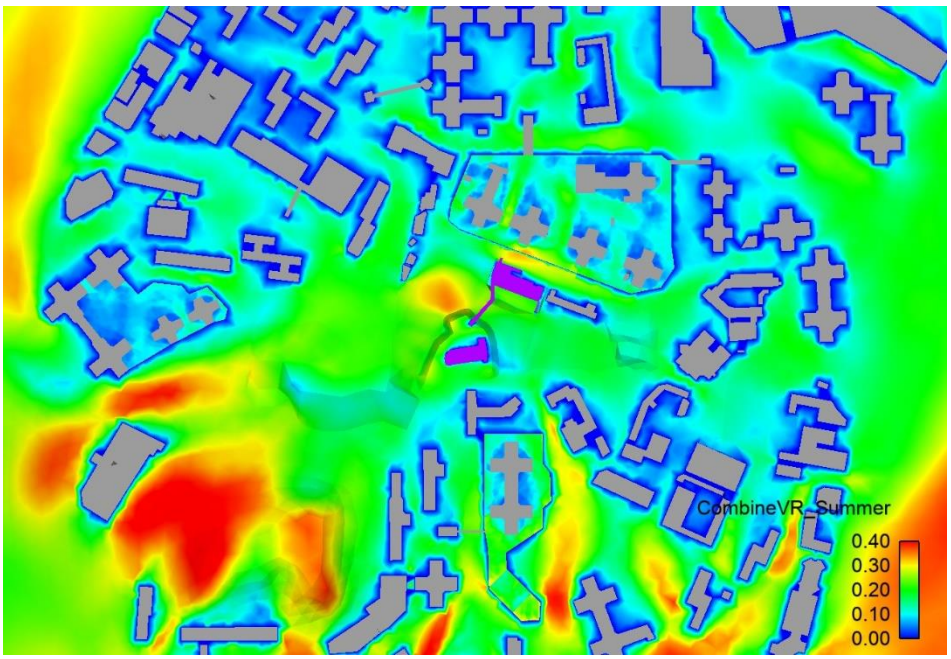

Figure B2.2.1 Summer Weighted VR Contour Plot for Proposed Scheme

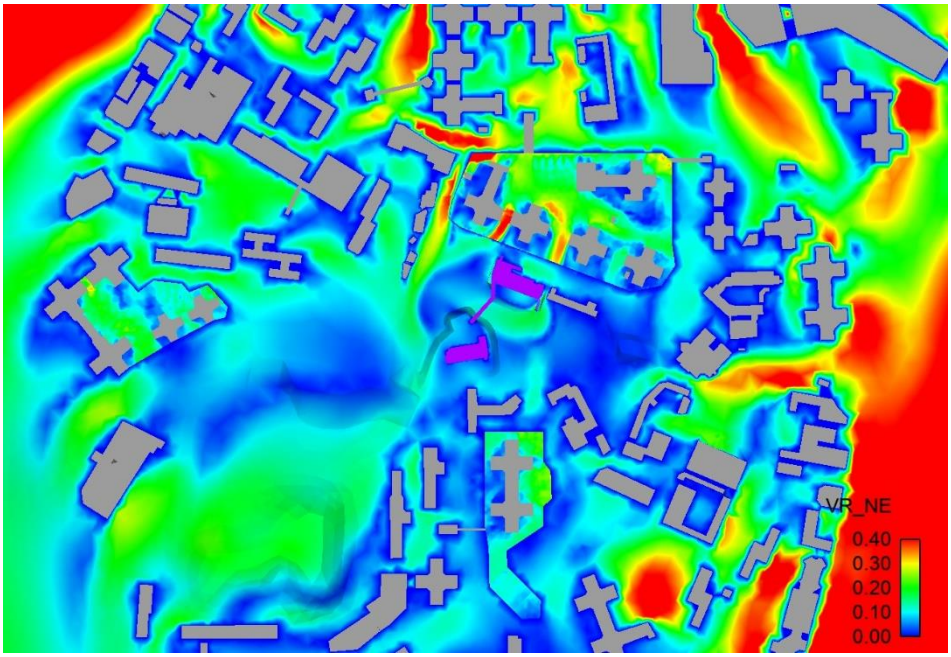

Figure B2.3.1 NE Direction VR Contour Plot for Proposed Scheme

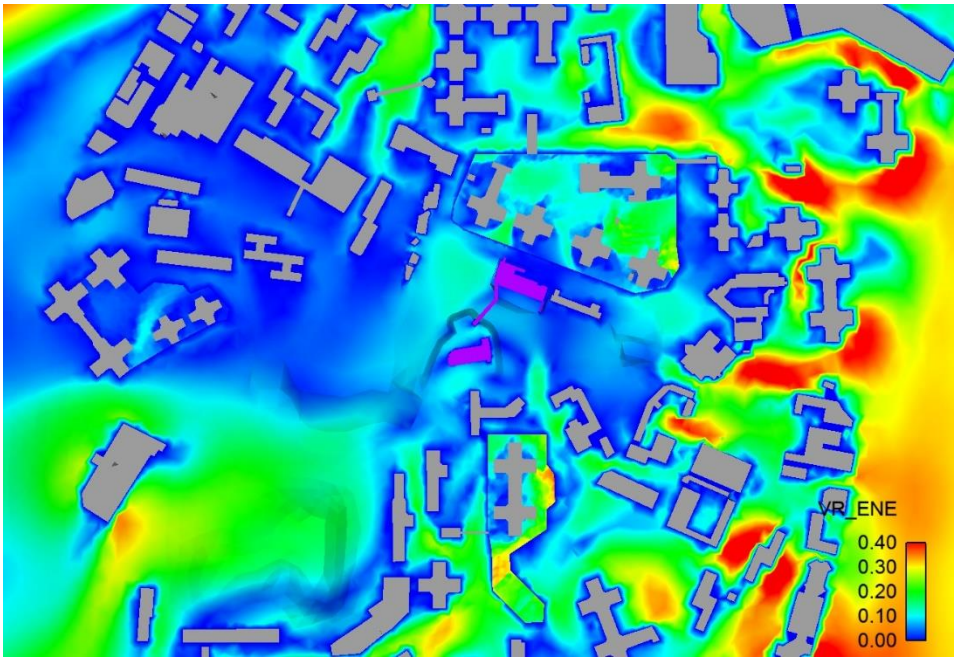

Figure B2.4.1 ENE Direction VR Contour Plot for Proposed Scheme

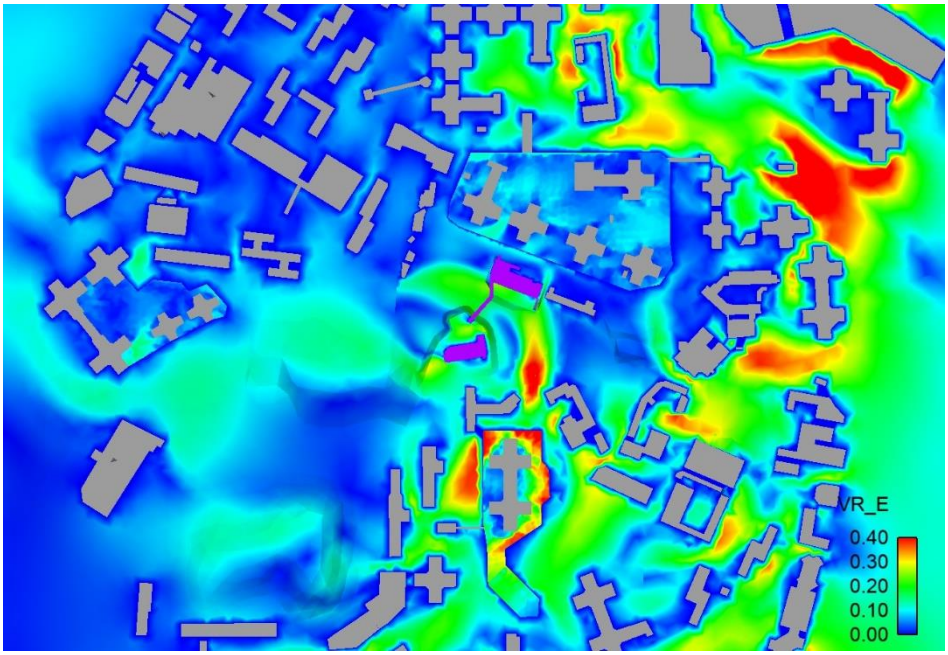

Figure B2.5.1 E Direction VR Contour Plot for Proposed Scheme

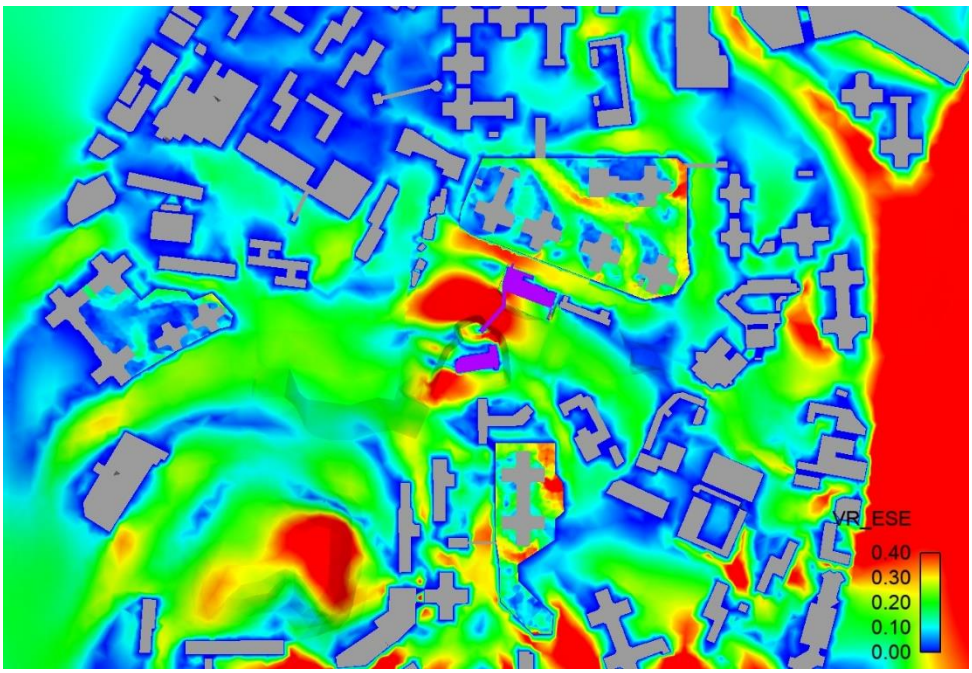

Figure B2.6.1 ESE Direction VR Contour Plot for Proposed Scheme

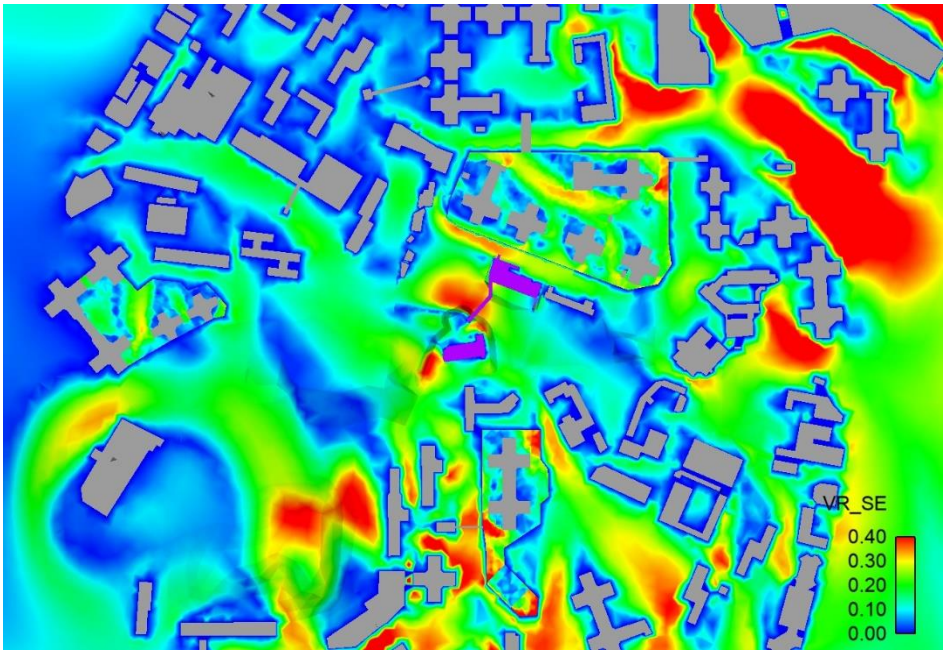

Figure B2.7.1 SE Direction VR Contour Plot for Proposed Scheme

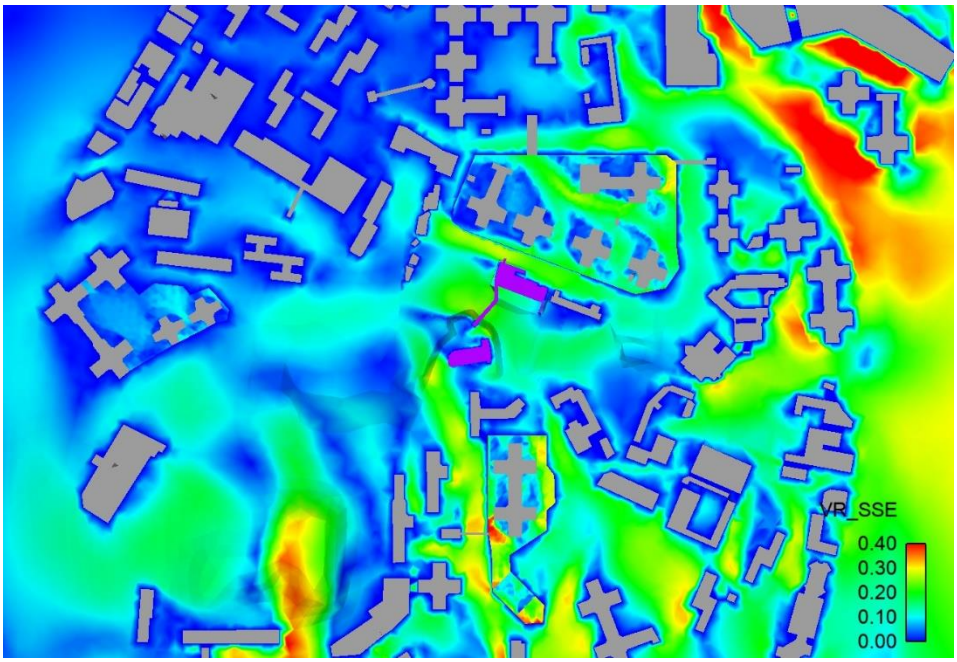

Figure B2.8.1 SSE Direction VR Contour Plot for Proposed Scheme

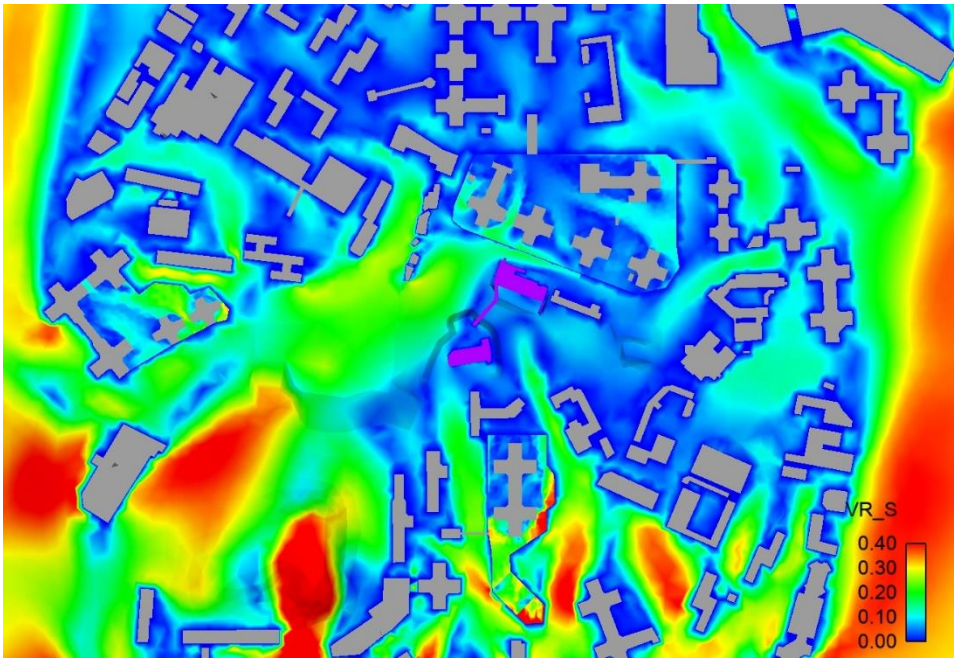

Figure B2.9.1 S Direction VR Contour Plot for Proposed Scheme

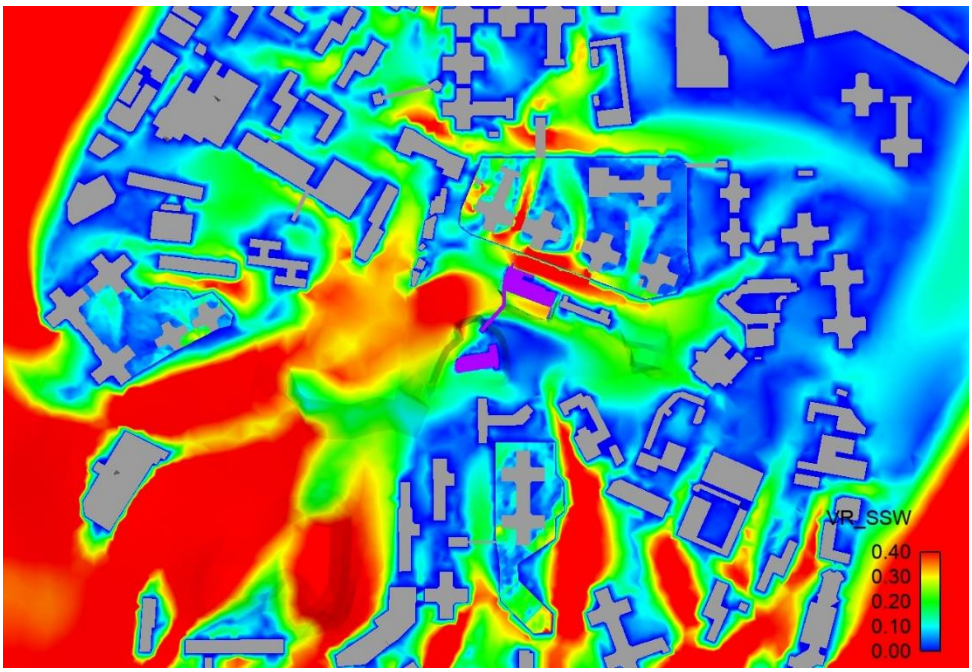

Figure B2.10.1 SSW Direction VR Contour Plot for Proposed Scheme

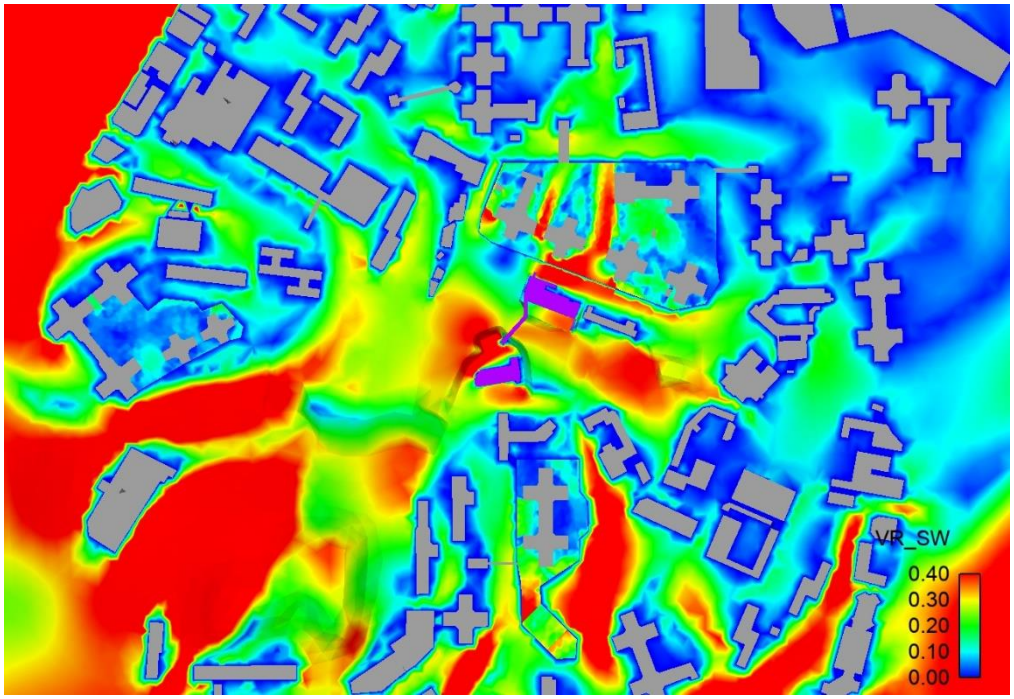

Figure B2.11.1 SW Direction VR Contour Plot for Proposed Scheme

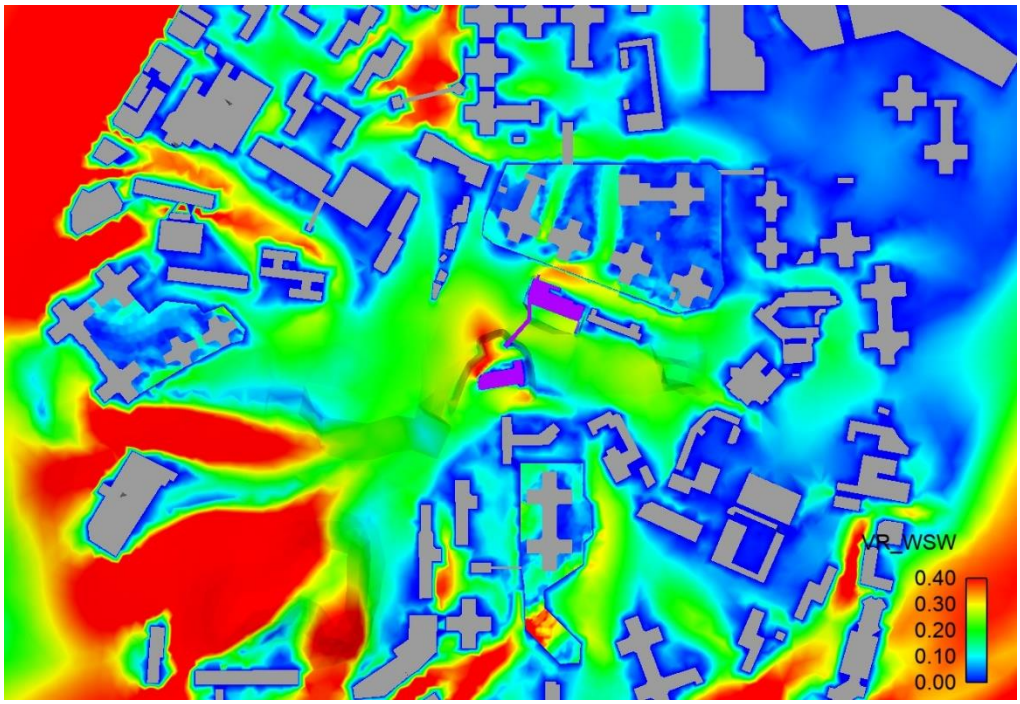

Figure B2.12.1 WSW Direction VR Contour Plot for Proposed Scheme

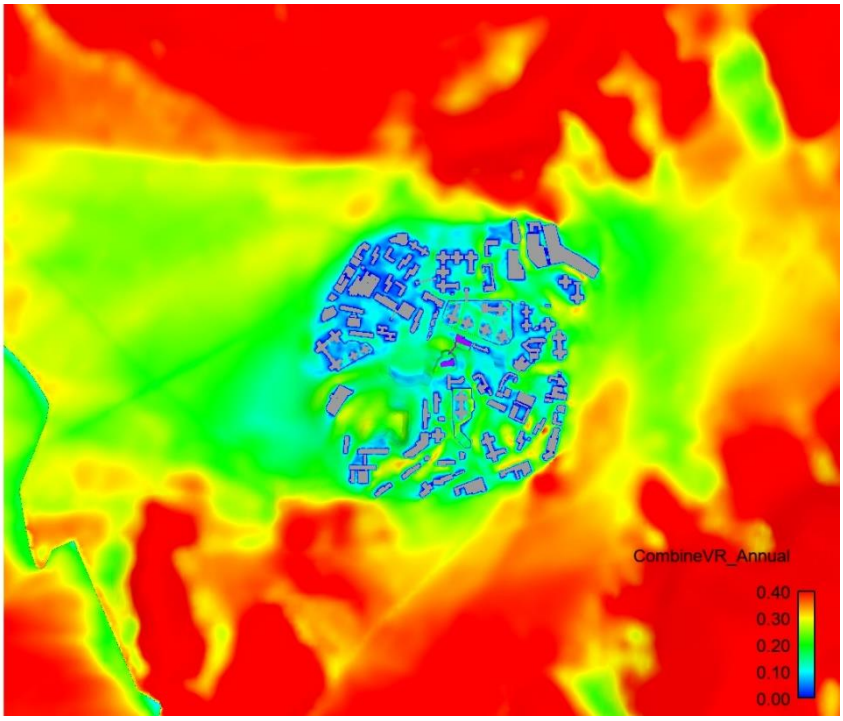

Figure B2.1.2 Annual Weighted VR Contour Plot for Proposed Scheme - Domain

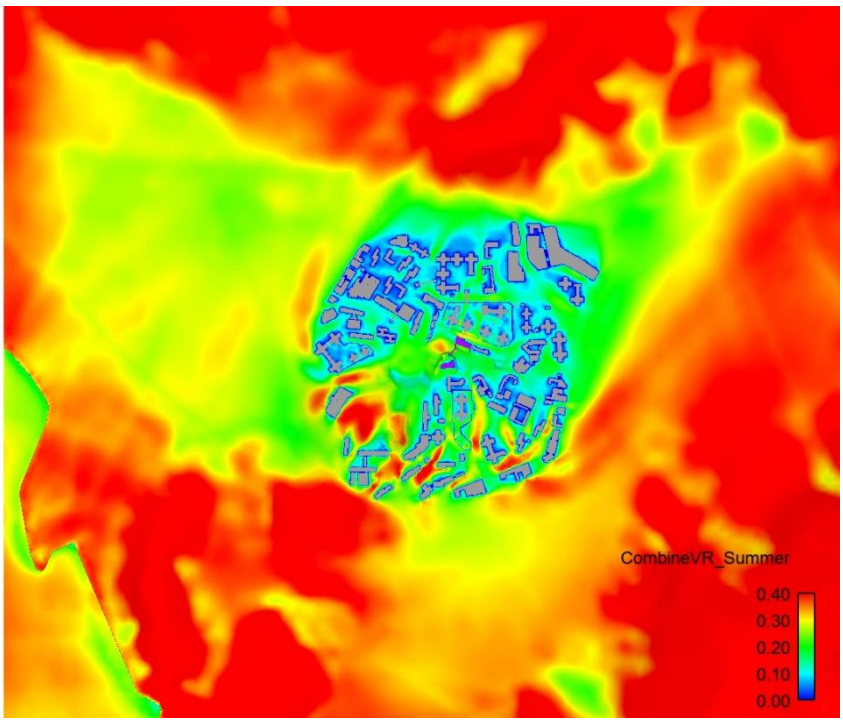

Figure B2.2.2 Summer Weighted VR Contour Plot for Proposed Scheme - Domain

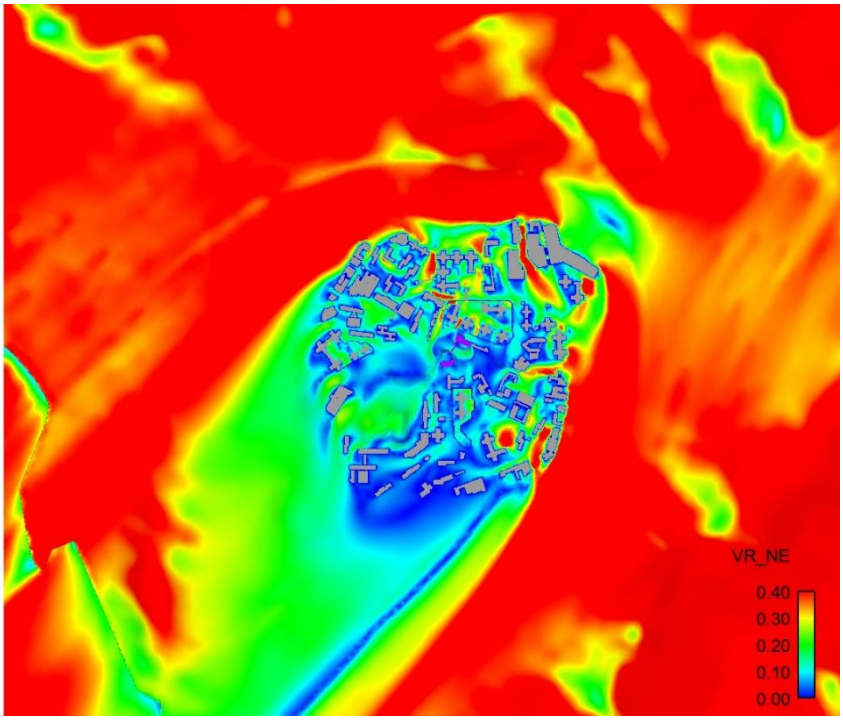

Figure B2.3.2 NE Direction VR Contour Plot for Proposed Scheme- Domain

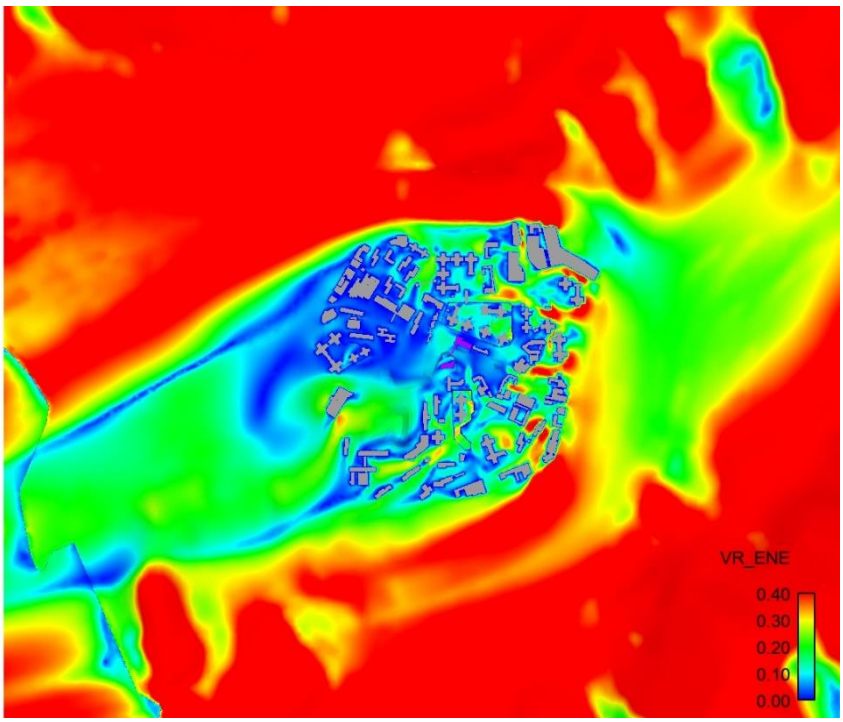

Figure B2.4.2 ENE Direction VR Contour Plot for Proposed Scheme - Domain

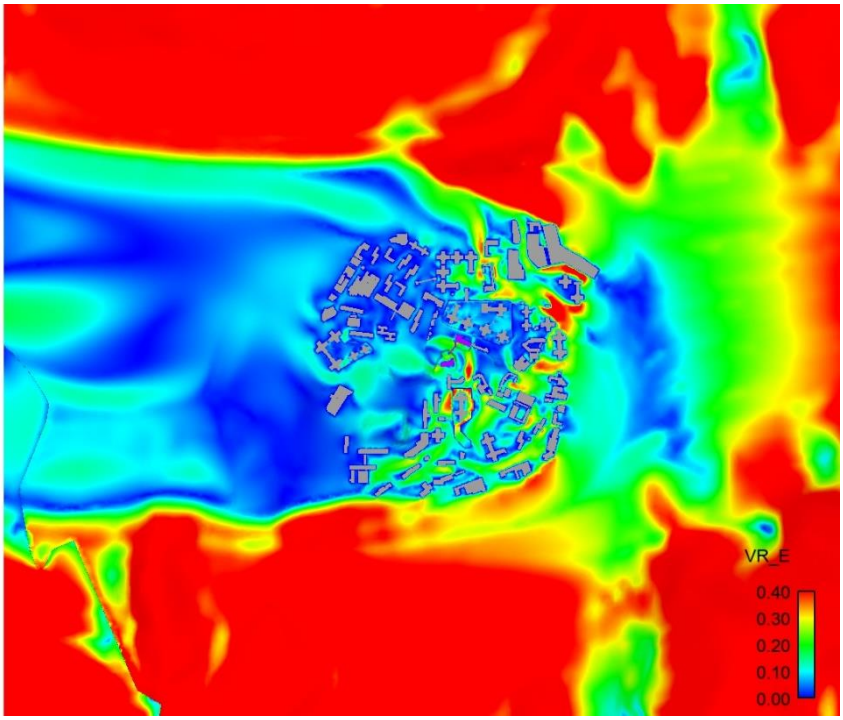

Figure B2.5.2 E Direction VR Contour Plot for Proposed Scheme - Domain

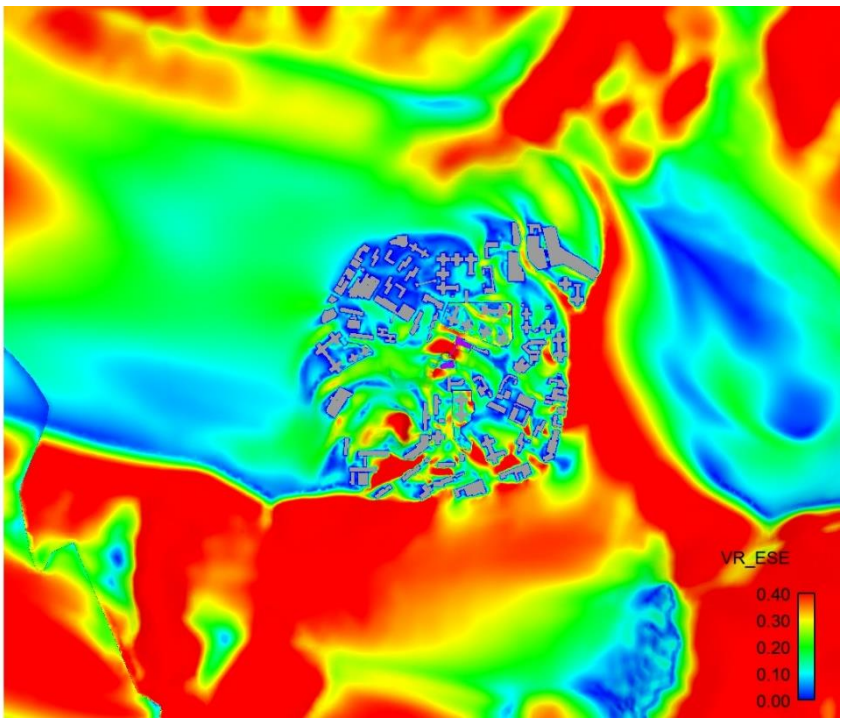

Figure B2.6.2 ESE Direction VR Contour Plot for Proposed Scheme - Domain

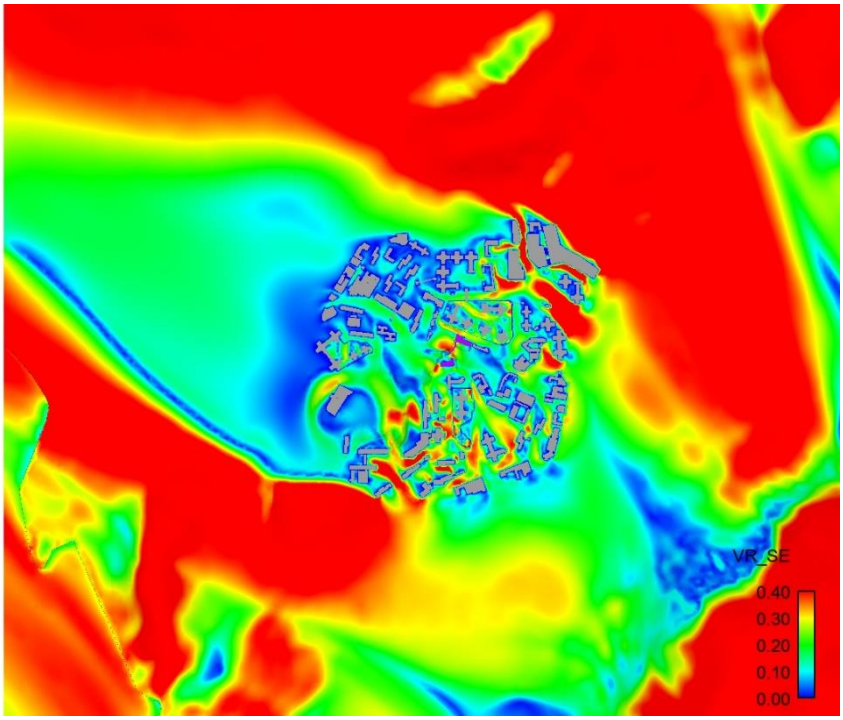

Figure B2.7.2 SE Direction VR Contour Plot for Proposed Scheme - Domain

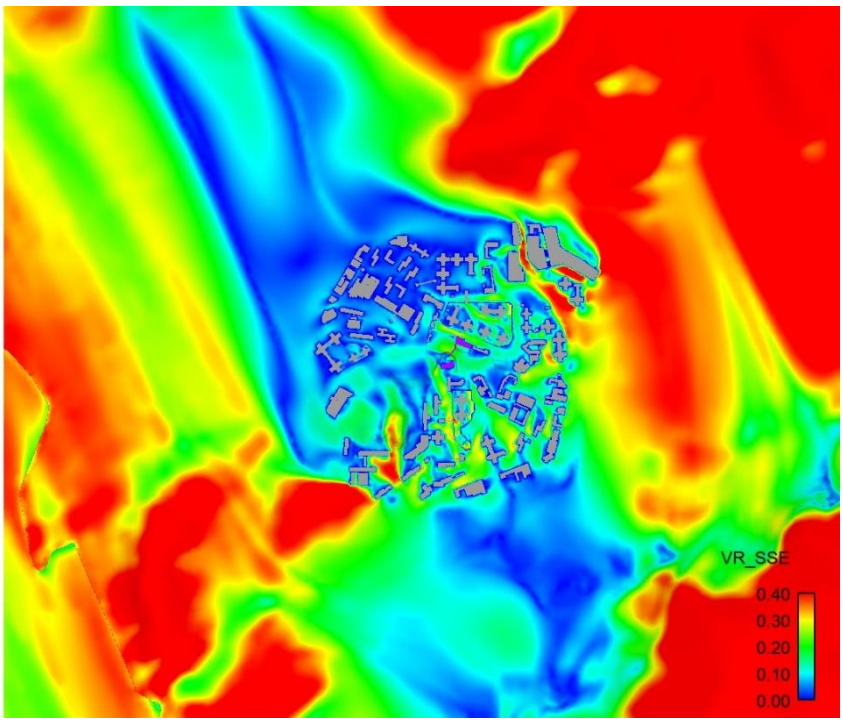

Figure B2.8.2 SSE Direction VR Contour Plot for Proposed Scheme - Domain

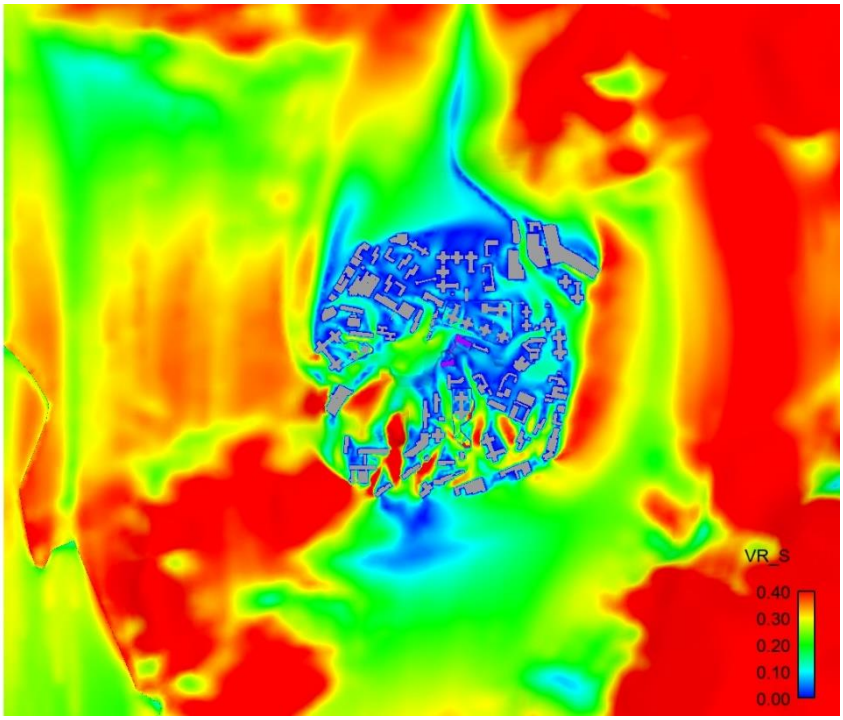

Figure B2.9.2 S Direction VR Contour Plot for Proposed Scheme - Domain

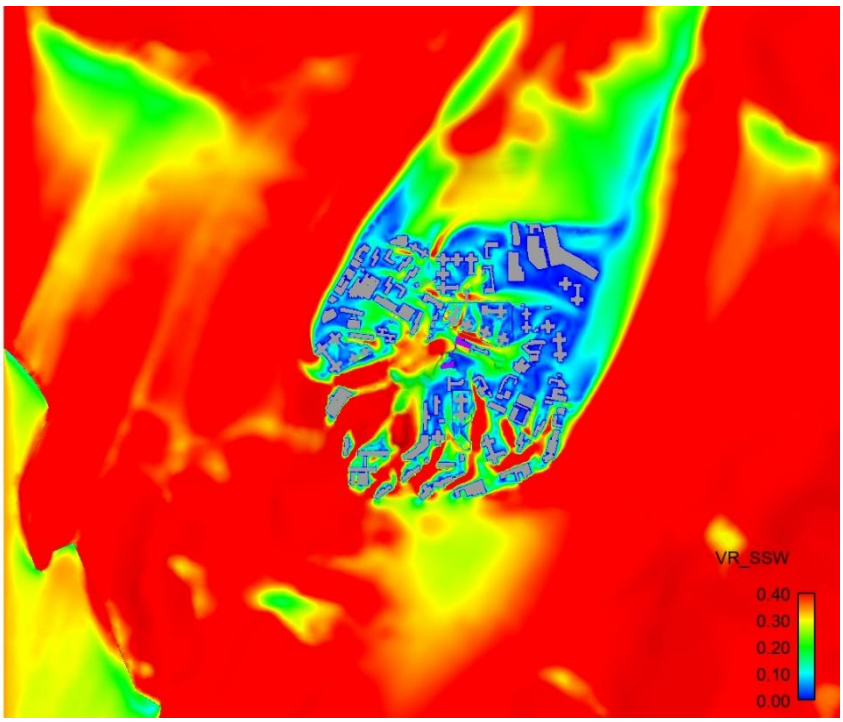

Figure B2.10.2 SSW Direction VR Contour Plot for Proposed Scheme - Domain

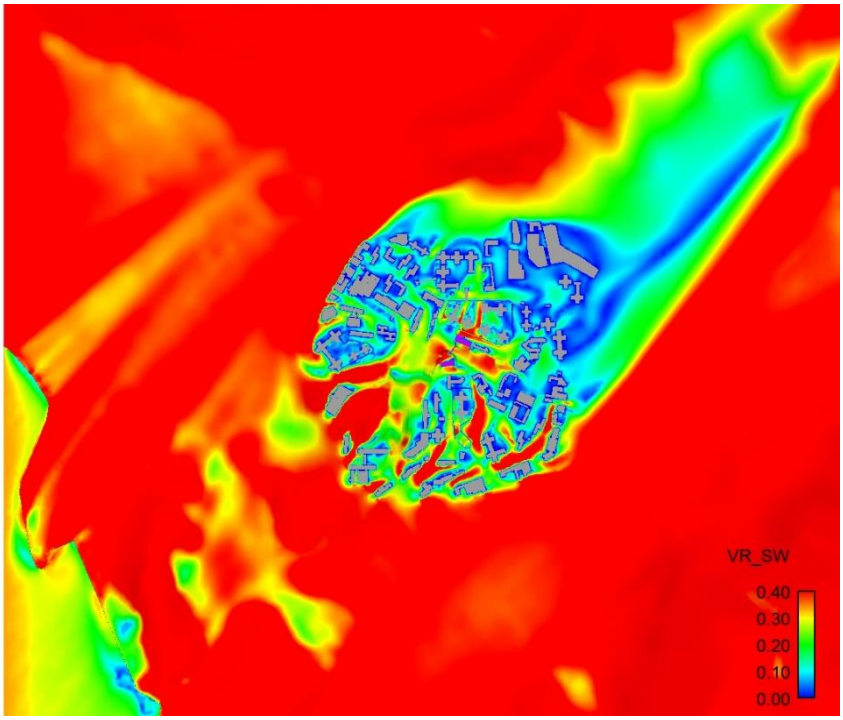

Figure B2.11.2 SW Direction VR Contour Plot for Proposed Scheme - Domain

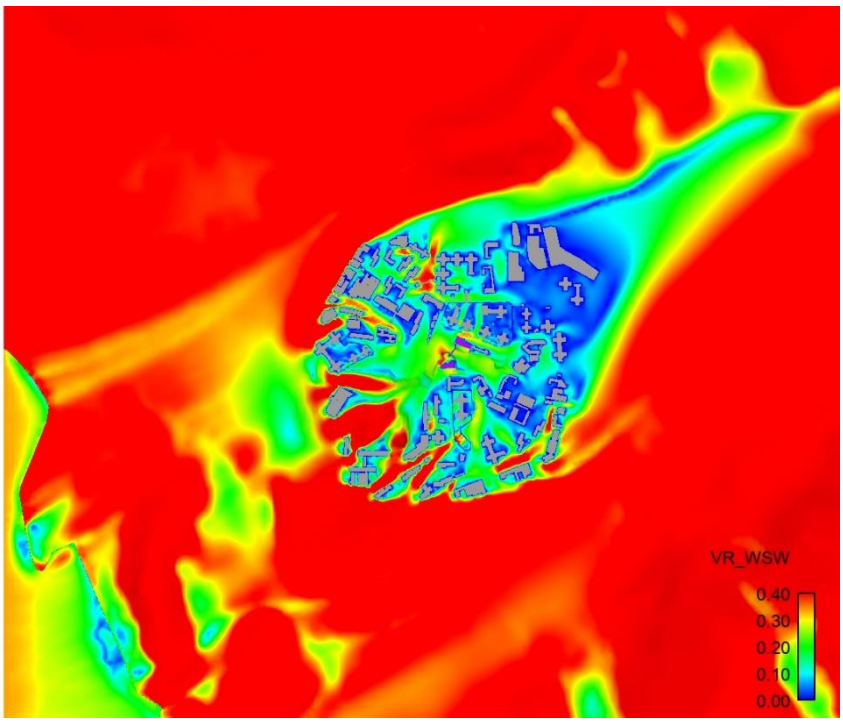

Figure B2.12.2 WSW Direction VR Contour Plot for Proposed Scheme - Domain

Appendix C

Directional VR Vector Plots

C1 Baseline Scheme

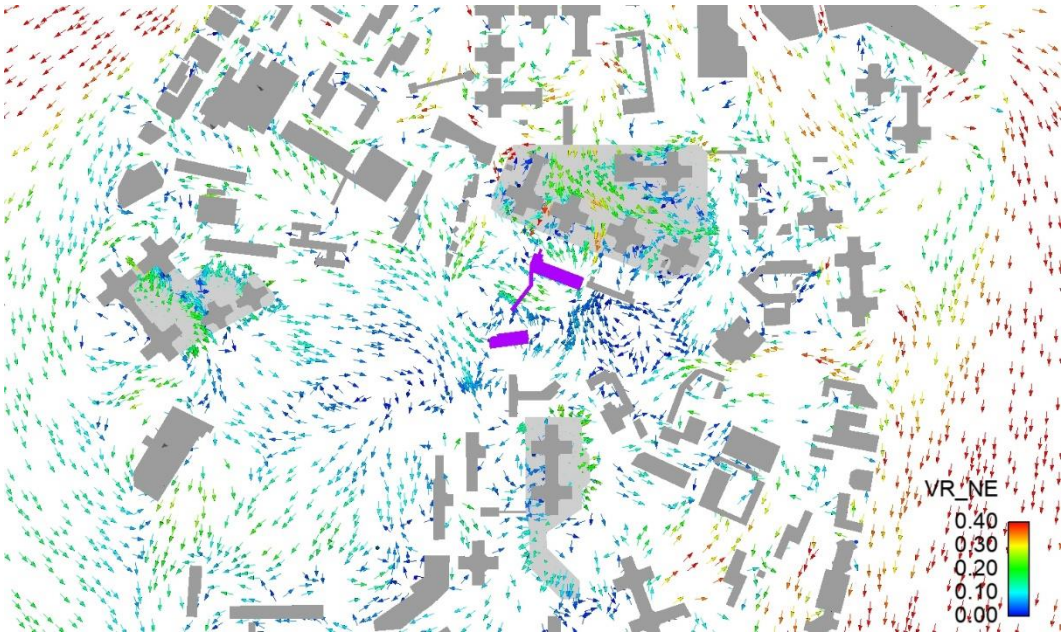

Figure C1.1: NE Direction VR Vector Plot for Baseline Scheme

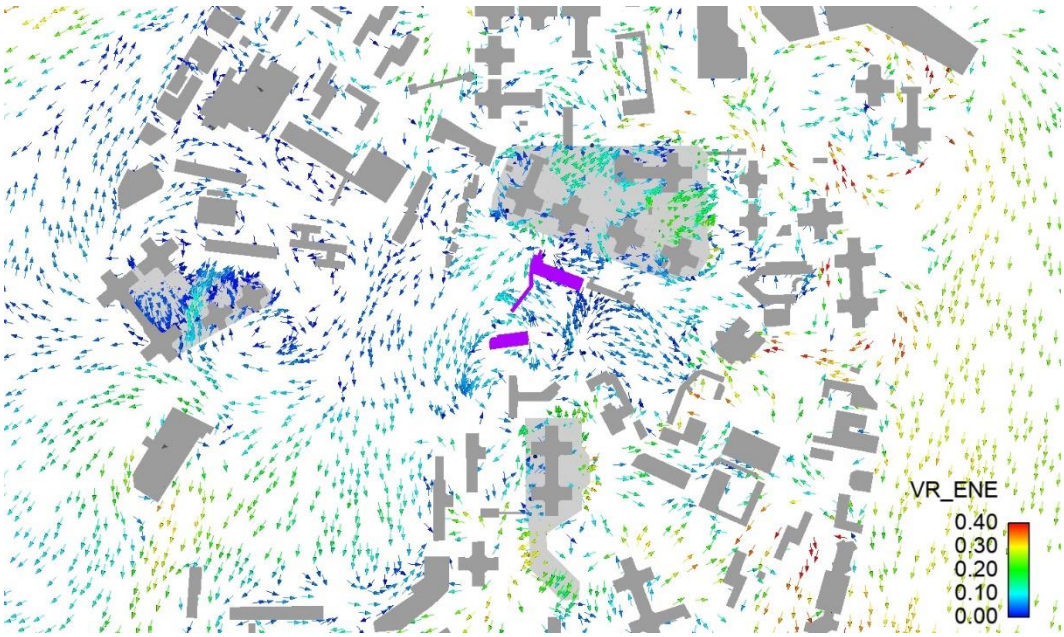

Figure C1.2: ENE Direction VR Vector Plot for Baseline Scheme

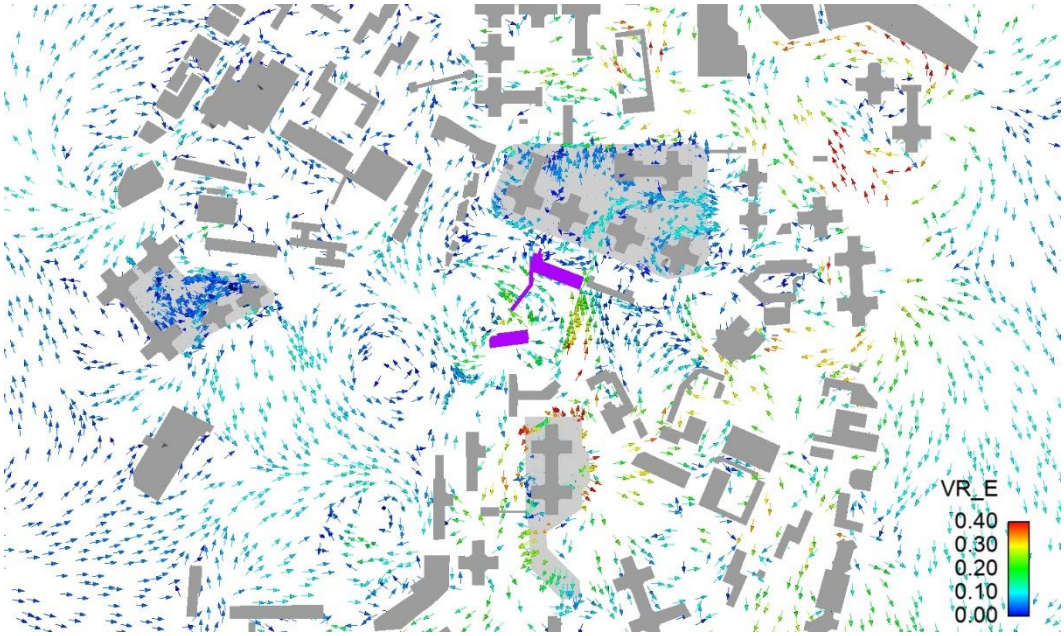

Figure C1.3: E Direction VR Vector Plot for Baseline Scheme

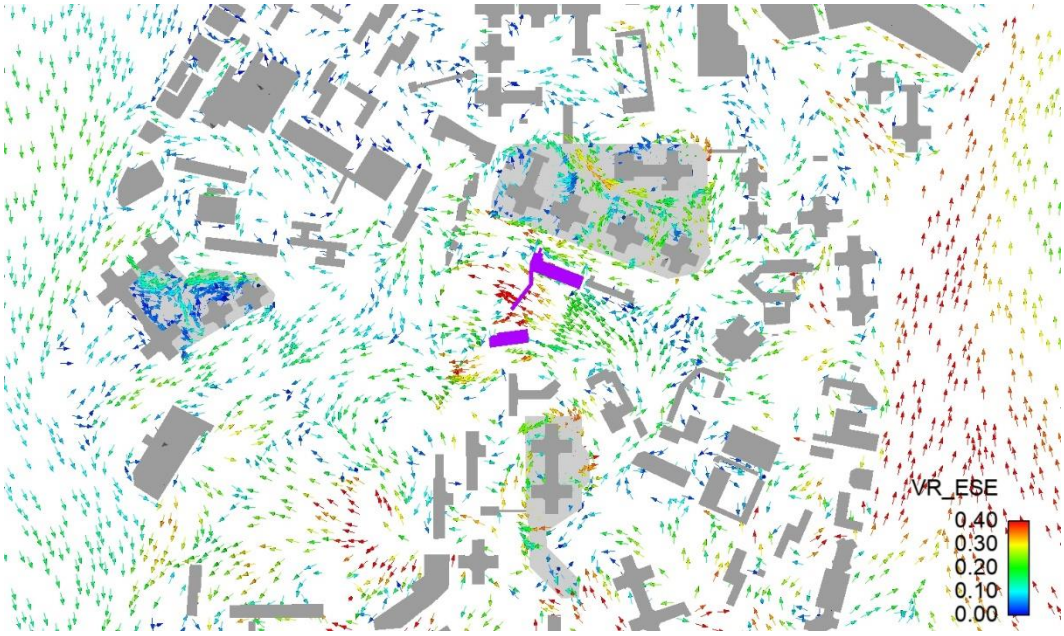

Figure C1.4: ESE Direction VR Vector Plot for Baseline Scheme

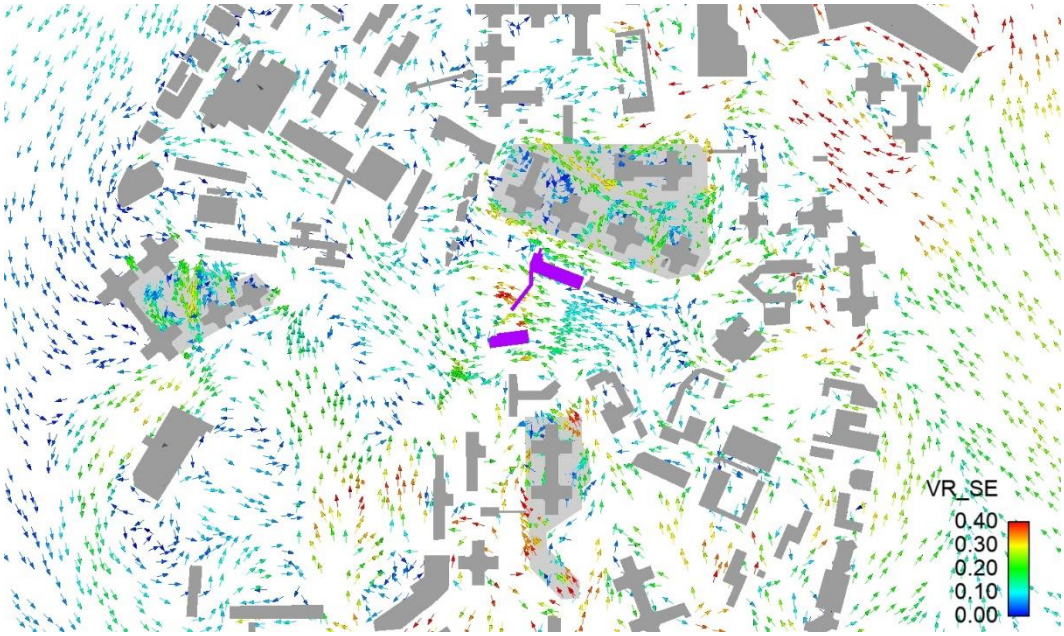

Figure C1.5: SE Direction VR Vector Plot for Baseline Scheme

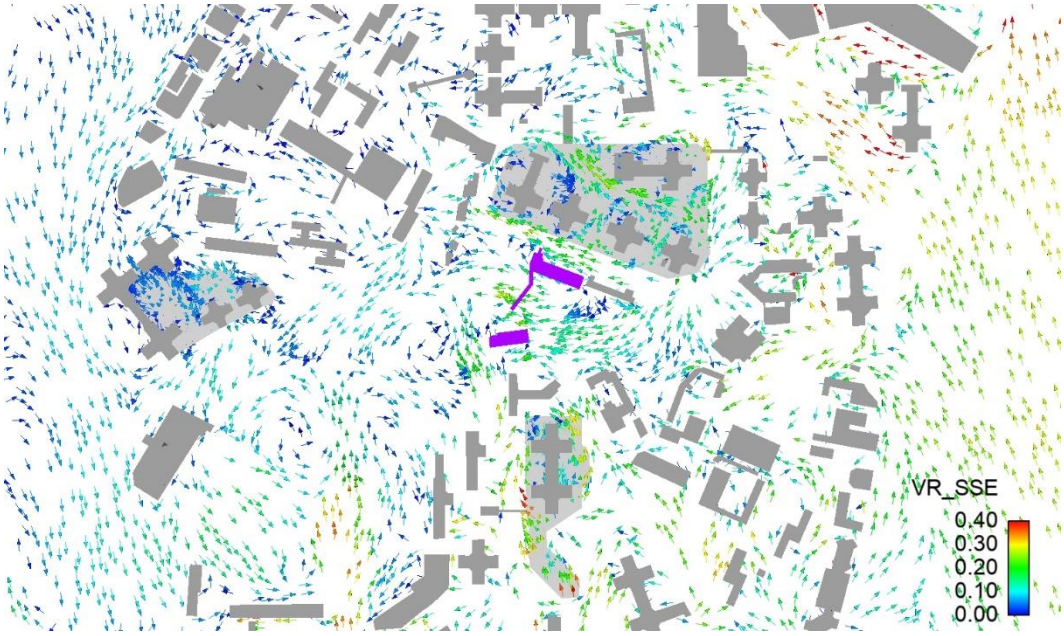

Figure C1.6: SSE Direction VR Vector Plot for Baseline Scheme

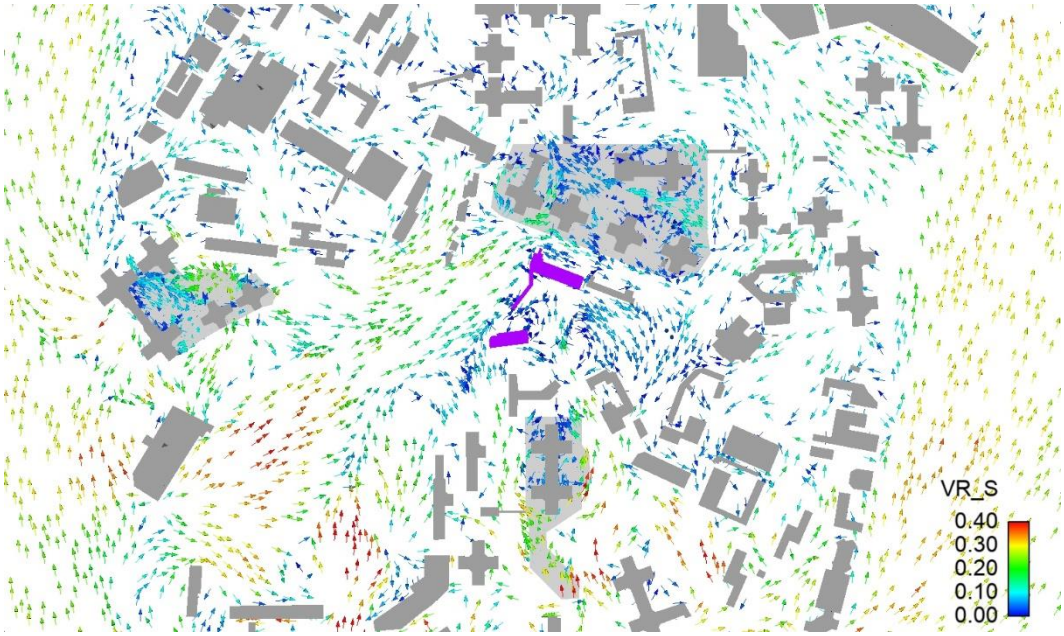

Figure C1.7: S Direction VR Vector Plot for Baseline Scheme

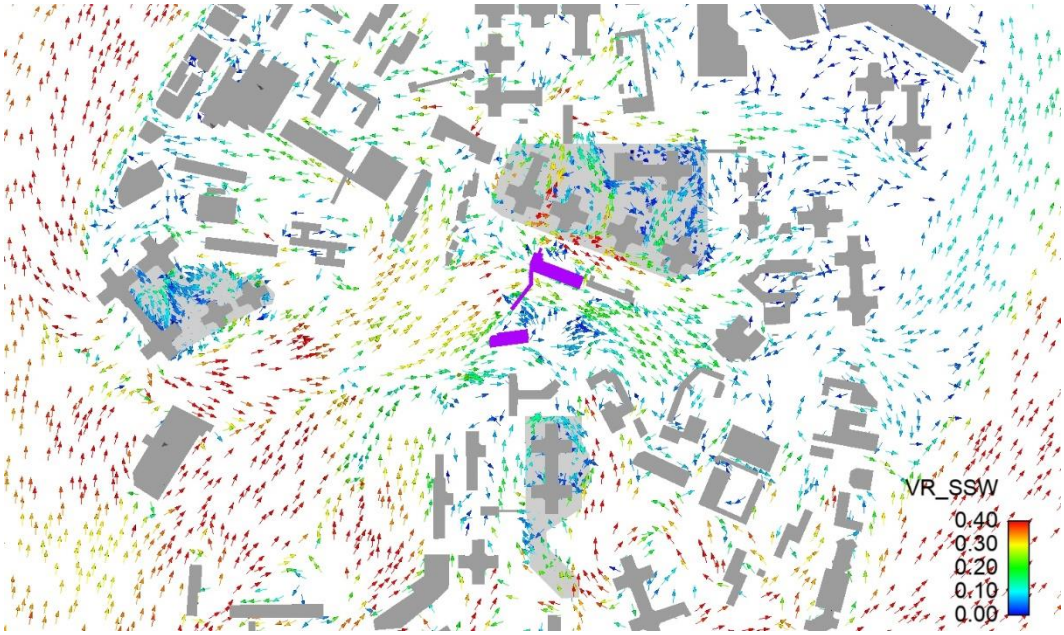

Figure C1.8: SSW Direction VR Vector Plot for Baseline Scheme

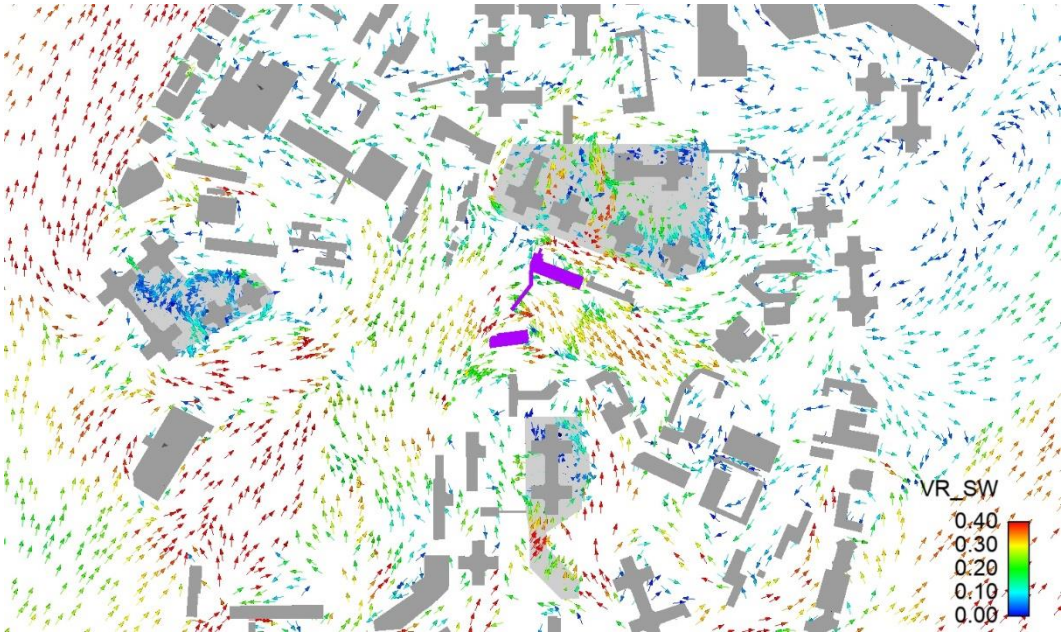

Figure C1.9: SW Direction VR Vector Plot for Baseline Scheme

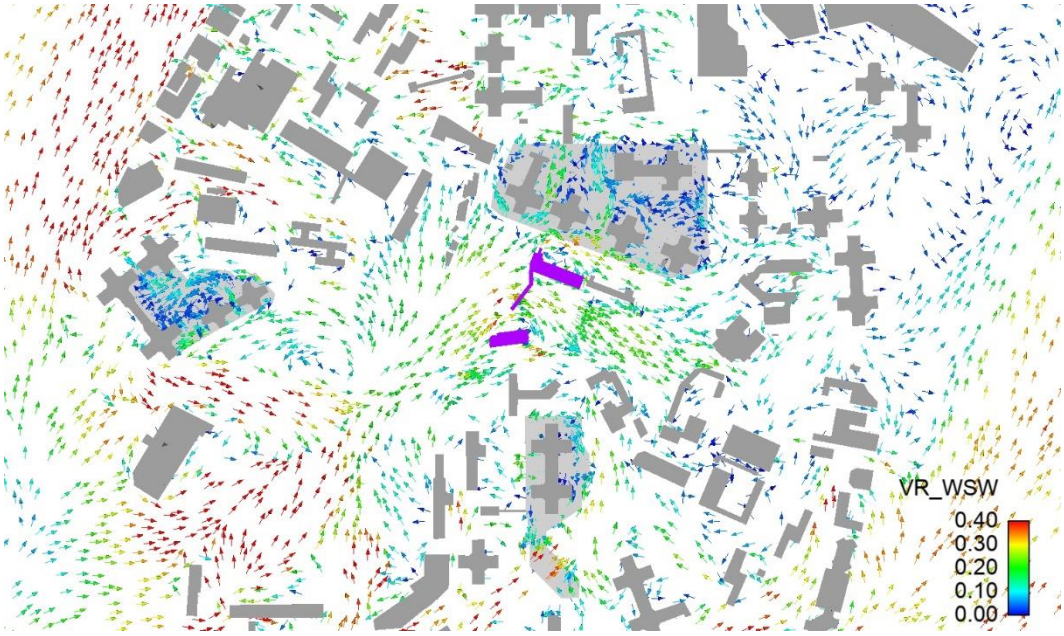

Figure C1.10: WSW Direction VR Vector Plot for Baseline Scheme

C2 Proposed Scheme

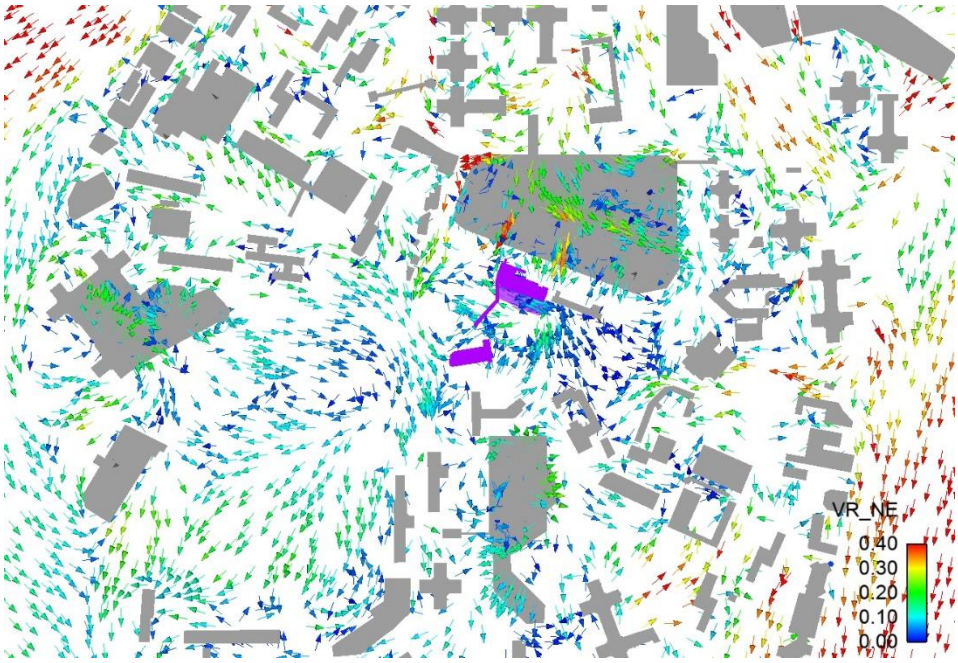

Figure C2.1: NE Direction VR Vector Plot for Proposed Scheme

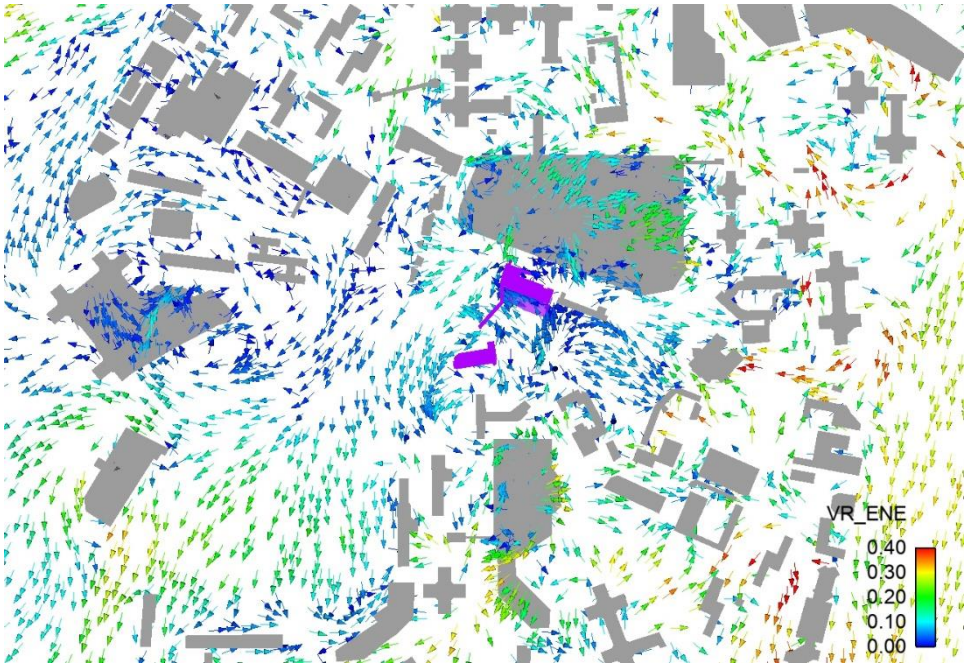

Figure C2.2: ENE Direction VR Vector Plot for Proposed Scheme

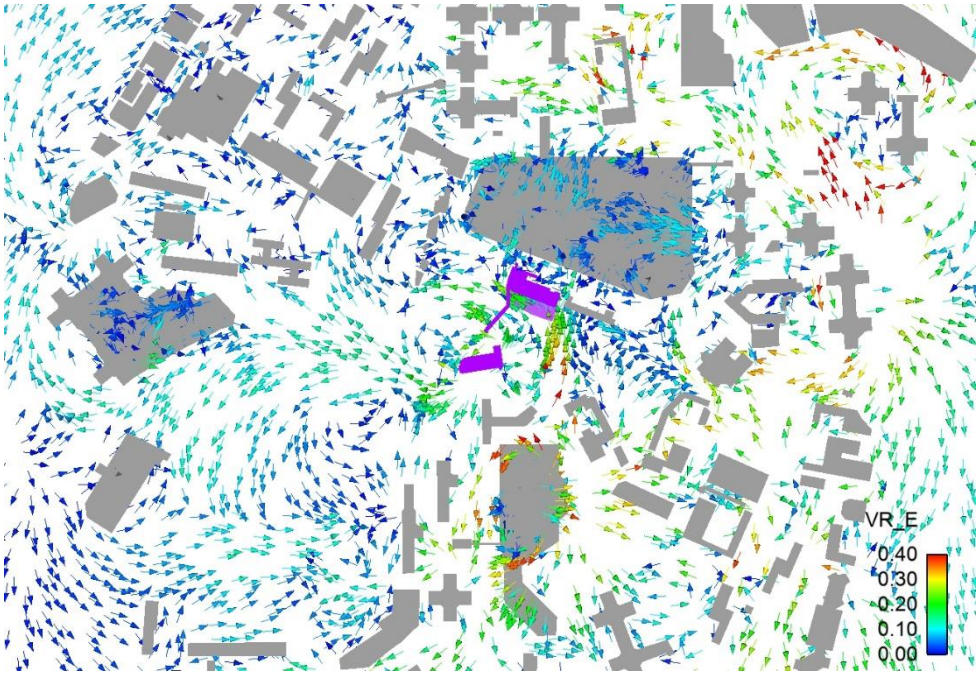

Figure C2.3: E Direction VR Vector Plot for Proposed Scheme

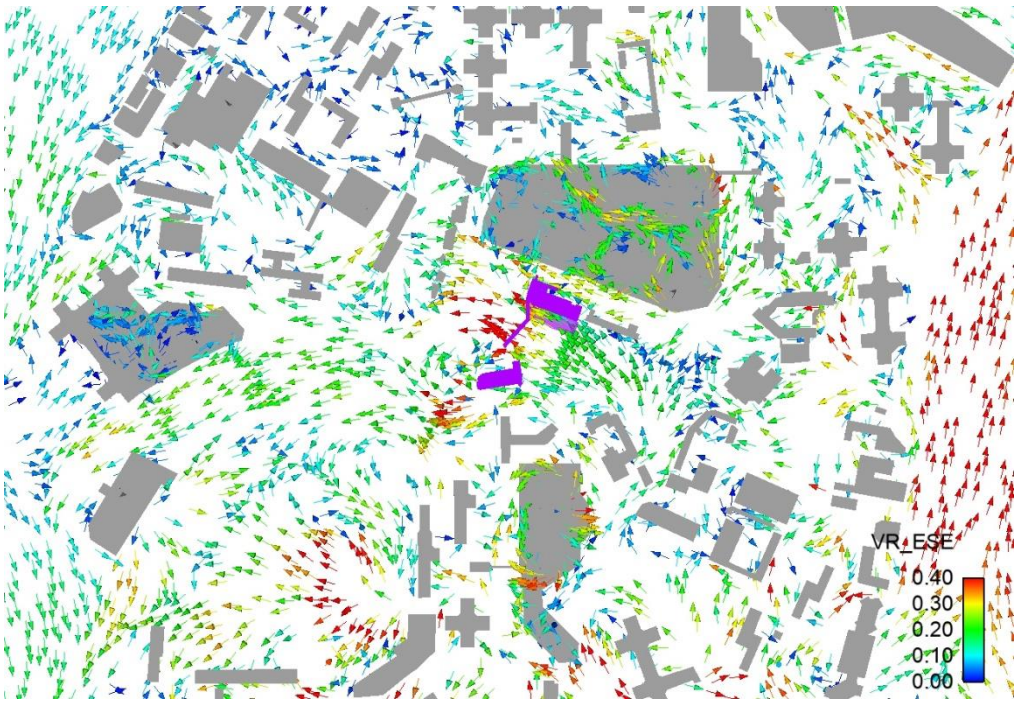

Figure C2.4: ESE Direction VR Vector Plot for Proposed Scheme

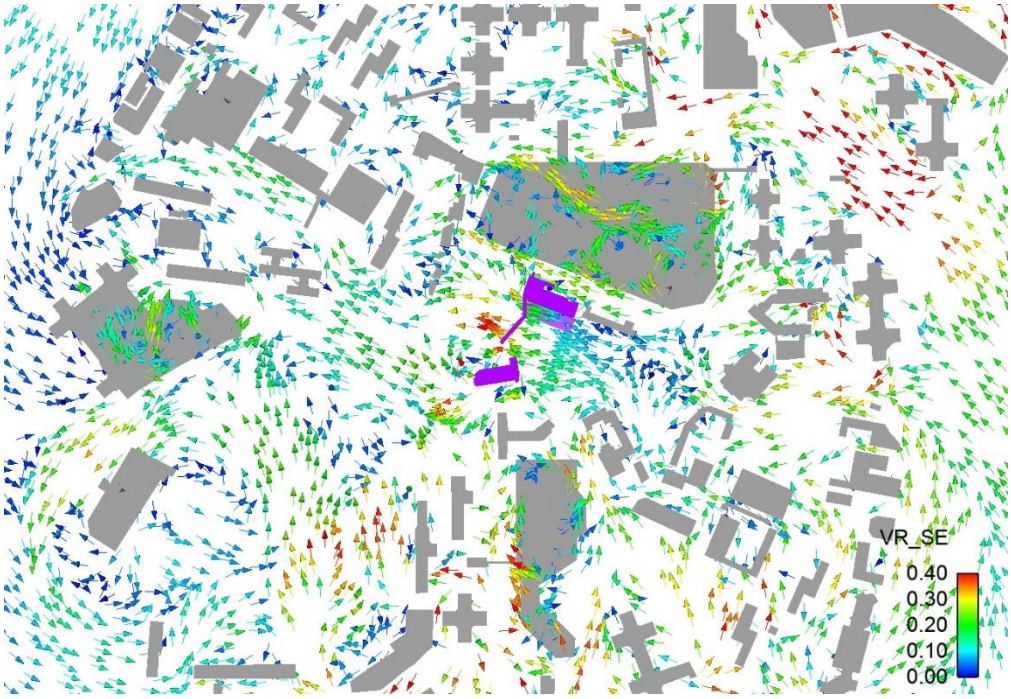

Figure C2.5: SE Direction VR Vector Plot for Proposed Scheme

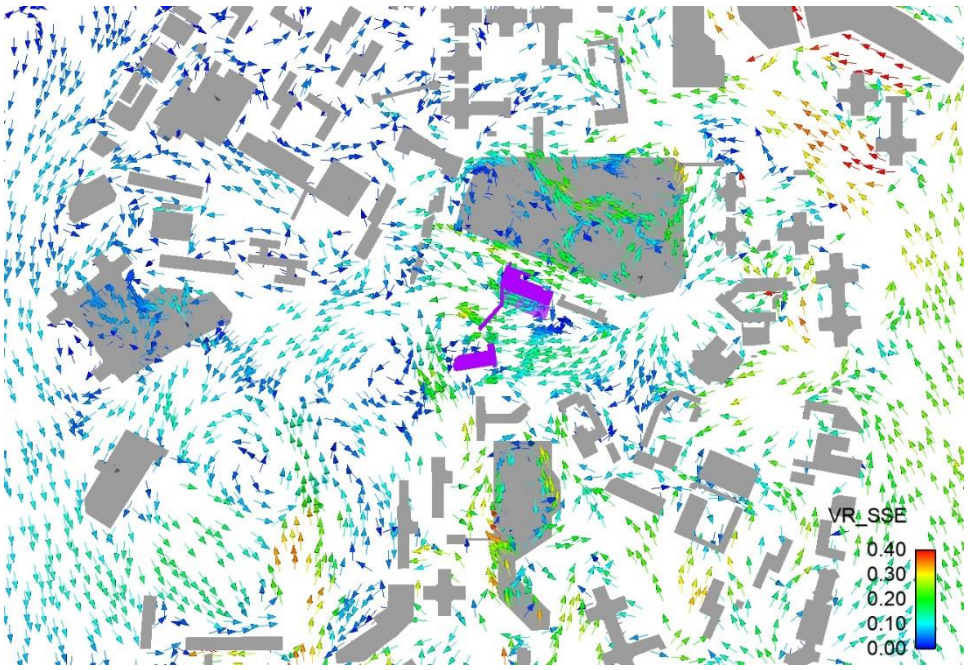

Figure C2.6: SSE Direction VR Vector Plot for Proposed Scheme

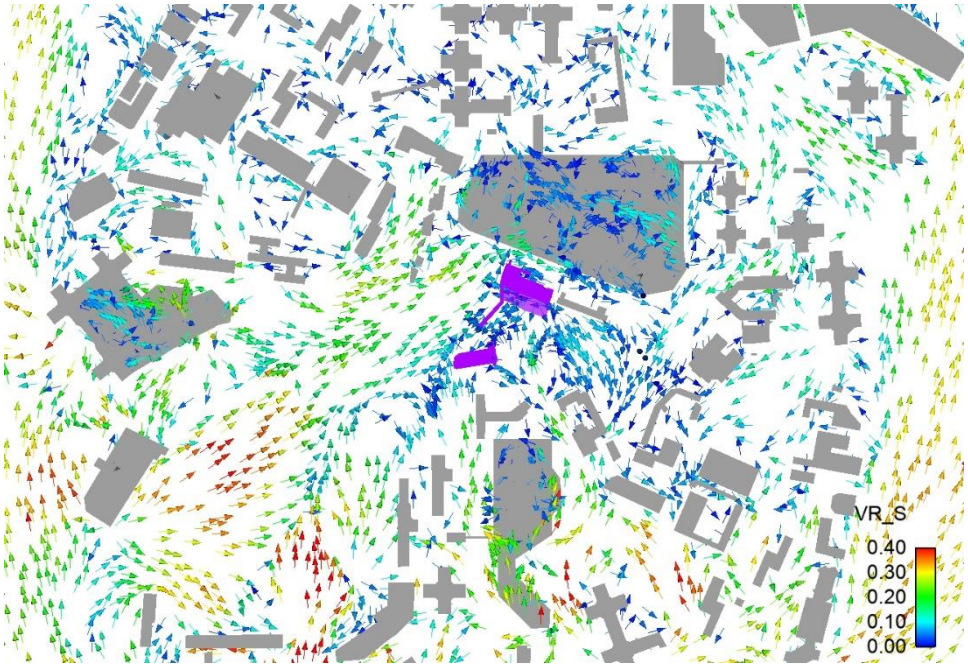

Figure C2.7: S Direction VR Vector Plot for Proposed Scheme

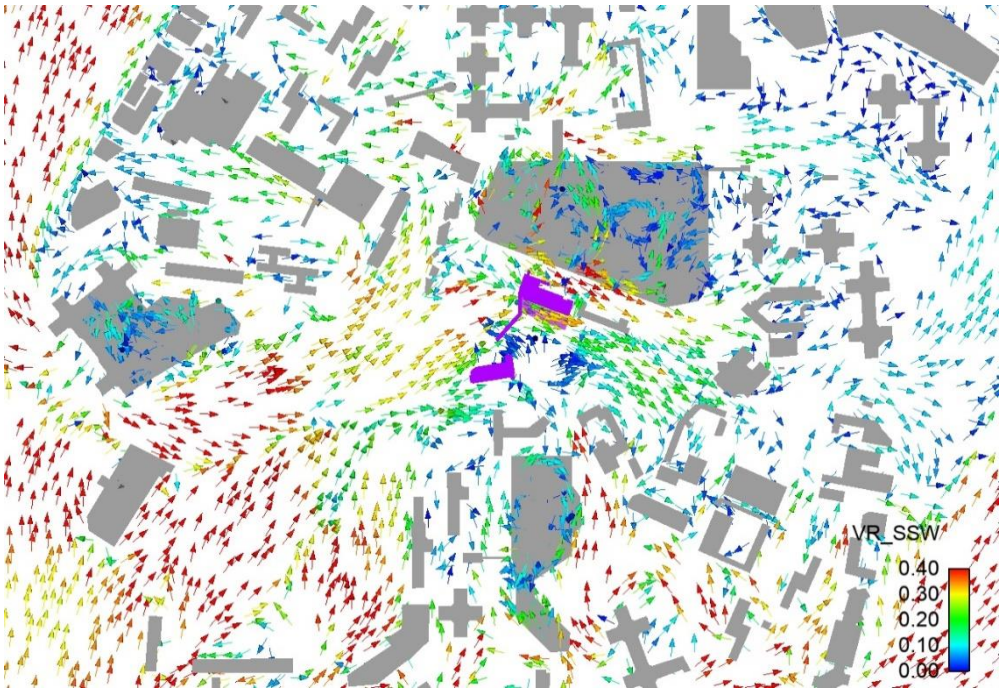

Figure C2.8: SSW Direction VR Vector Plot for Proposed Scheme

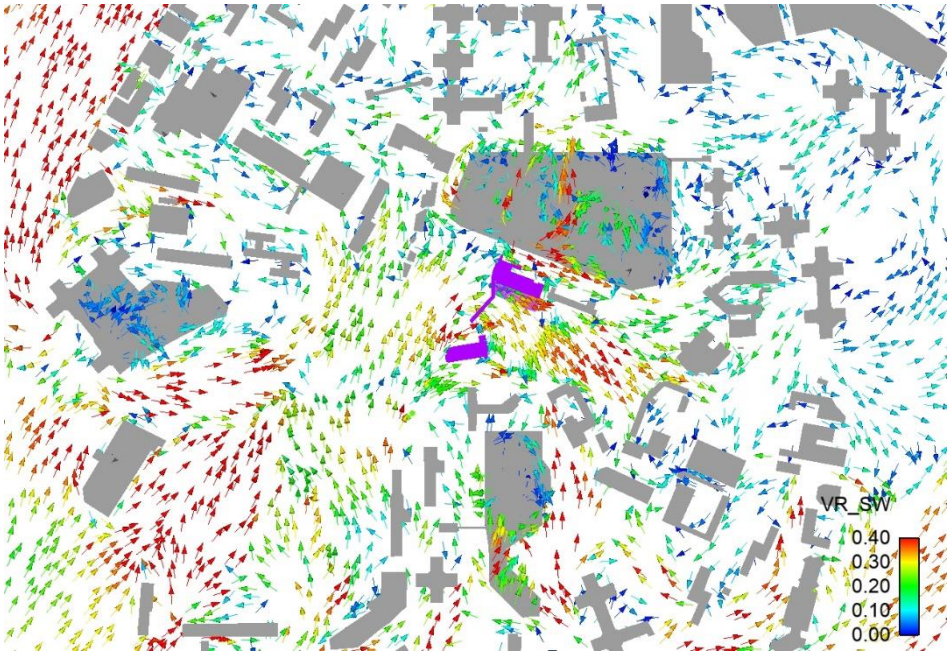

Figure C2.9: SW Direction VR Vector Plot for Proposed Scheme

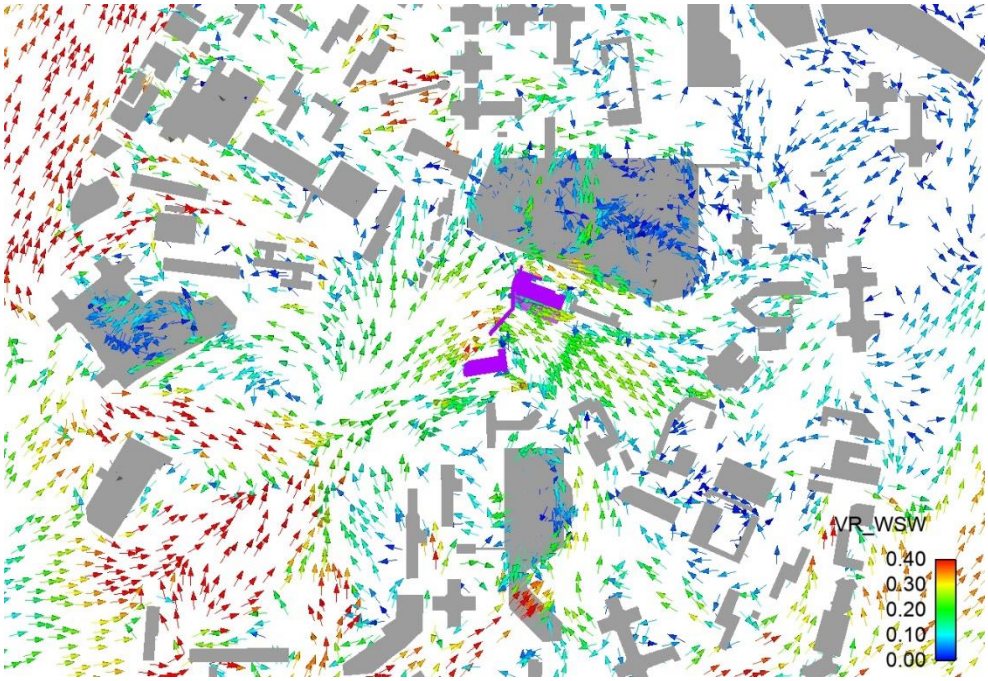

Figure C2.10: WSW Direction VR Vector Plot for Proposed Scheme

Appendix D

Velocity Ratio Table of the Test Points

D1 Baseline Scheme

D1.1 Perimeter Test Points

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
P1	0.11	0.04	0.05	0.36	0.31	0.25	0.12	0.33	0.36	0.30	0.17	0.27
P2	0.18	0.03	0.04	0.31	0.27	0.22	0.08	0.36	0.40	0.22	0.17	0.26
P3	0.17	0.04	0.04	0.30	0.26	0.22	0.06	0.34	0.39	0.19	0.16	0.25
P4	0.14	0.05	0.05	0.29	0.25	0.21	0.03	0.35	0.42	0.20	0.16	0.25
P5	0.14	0.05	0.04	0.28	0.24	0.21	0.02	0.35	0.42	0.22	0.16	0.25
P6	0.13	0.05	0.03	0.28	0.24	0.21	0.01	0.36	0.41	0.24	0.15	0.25
P7	0.13	0.05	0.02	0.28	0.24	0.21	0.01	0.37	0.40	0.24	0.15	0.25
P8	0.11	0.04	0.02	0.28	0.24	0.21	0.01	0.37	0.37	0.23	0.15	0.24
P9	0.09	0.04	0.03	0.27	0.24	0.21	0.03	0.36	0.34	0.23	0.14	0.24
P10	0.10	0.03	0.10	0.27	0.24	0.21	0.05	0.36	0.34	0.23	0.16	0.24
P11	0.12	0.03	0.14	0.25	0.22	0.21	0.02	0.19	0.24	0.14	0.14	0.18
P12	0.11	0.03	0.15	0.17	0.15	0.15	0.01	0.05	0.13	0.06	0.10	0.10
P13	0.03	0.03	0.18	0.17	0.11	0.02	0.02	0.16	0.14	0.12	0.11	0.12
P14	0.10	0.01	0.21	0.13	0.09	0.01	0.02	0.21	0.18	0.16	0.12	0.14
P15	0.14	0.02	0.18	0.09	0.07	0.05	0.05	0.27	0.26	0.22	0.13	0.17
P16	0.03	0.02	0.16	0.18	0.12	0.05	0.07	0.25	0.22	0.20	0.12	0.17
P17	0.01	0.03	0.21	0.21	0.12	0.05	0.07	0.29	0.29	0.24	0.15	0.20
P18	0.12	0.05	0.24	0.26	0.15	0.09	0.05	0.29	0.34	0.27	0.18	0.22
P19	0.19	0.07	0.23	0.30	0.17	0.12	0.03	0.27	0.36	0.28	0.20	0.23
P20	0.20	0.08	0.19	0.33	0.20	0.15	0.02	0.24	0.37	0.28	0.19	0.23
P21	0.21	0.08	0.15	0.37	0.24	0.17	0.03	0.25	0.34	0.28	0.19	0.23
P22	0.21	0.08	0.15	0.39	0.26	0.19	0.04	0.25	0.33	0.28	0.20	0.24
P23	0.19	0.07	0.17	0.41	0.28	0.20	0.05	0.27	0.26	0.24	0.20	0.24
P24	0.18	0.06	0.22	0.49	0.35	0.24	0.05	0.34	0.25	0.27	0.23	0.27
P25	0.16	0.04	0.27	0.51	0.36	0.24	0.04	0.35	0.22	0.26	0.23	0.28
P26	0.12	0.08	0.26	0.45	0.32	0.20	0.03	0.28	0.12	0.18	0.21	0.22
P27	0.05	0.11	0.12	0.22	0.16	0.10	0.06	0.22	0.10	0.14	0.13	0.14
P28	0.03	0.11	0.04	0.06	0.05	0.04	0.06	0.11	0.14	0.14	0.07	0.09
P29	0.04	0.10	0.07	0.10	0.07	0.04	0.07	0.05	0.16	0.16	0.08	0.09
P30	0.04	0.08	0.05	0.10	0.07	0.05	0.06	0.14	0.23	0.20	0.09	0.12
P31	0.08	0.05	0.05	0.02	0.05	0.04	0.03	0.20	0.50	0.27	0.10	0.17
P32	0.07	0.05	0.13	0.05	0.08	0.06	0.03	0.22	0.47	0.29	0.12	0.19

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
P33	0.05	0.07	0.18	0.06	0.09	0.06	0.09	0.32	0.49	0.36	0.15	0.24
P34	0.06	0.07	0.18	0.08	0.10	0.06	0.11	0.35	0.50	0.39	0.16	0.26
P35	0.06	0.09	0.19	0.07	0.10	0.04	0.12	0.35	0.49	0.41	0.17	0.26
P36	0.06	0.10	0.15	0.06	0.13	0.06	0.09	0.29	0.42	0.37	0.15	0.22
P37	0.08	0.10	0.14	0.13	0.13	0.06	0.09	0.27	0.49	0.37	0.16	0.23
P38	0.10	0.09	0.09	0.20	0.10	0.02	0.09	0.27	0.47	0.35	0.15	0.22
P39	0.13	0.07	0.09	0.18	0.16	0.15	0.08	0.26	0.41	0.31	0.15	0.22
P40	0.13	0.05	0.21	0.10	0.27	0.21	0.07	0.24	0.37	0.28	0.17	0.23
P41	0.14	0.04	0.28	0.16	0.35	0.26	0.06	0.24	0.35	0.28	0.19	0.25
P42	0.13	0.04	0.26	0.37	0.33	0.29	0.05	0.24	0.33	0.28	0.21	0.26
P43	0.12	0.05	0.22	0.40	0.30	0.28	0.05	0.22	0.31	0.26	0.20	0.25
P44	0.12	0.06	0.17	0.40	0.26	0.27	0.03	0.22	0.30	0.27	0.18	0.23
P45	0.10	0.07	0.11	0.39	0.23	0.17	0.02	0.18	0.27	0.22	0.16	0.20
P46	0.07	0.08	0.08	0.31	0.15	0.19	0.06	0.16	0.25	0.20	0.13	0.17
P47	0.07	0.09	0.11	0.32	0.16	0.20	0.09	0.13	0.24	0.16	0.14	0.17
P48	0.05	0.10	0.13	0.34	0.17	0.15	0.08	0.13	0.24	0.17	0.15	0.17
P49	0.05	0.10	0.12	0.34	0.19	0.06	0.05	0.12	0.26	0.20	0.15	0.16
P50	0.07	0.11	0.11	0.33	0.21	0.06	0.04	0.13	0.30	0.24	0.15	0.17
P51	0.08	0.09	0.13	0.31	0.22	0.11	0.06	0.16	0.34	0.29	0.16	0.20
P52	0.07	0.07	0.17	0.29	0.24	0.14	0.08	0.17	0.36	0.32	0.16	0.22
P53	0.06	0.07	0.16	0.29	0.24	0.15	0.08	0.16	0.37	0.34	0.16	0.22
P54	0.04	0.08	0.14	0.27	0.23	0.17	0.07	0.13	0.37	0.36	0.15	0.21
P55	0.04	0.08	0.15	0.17	0.15	0.14	0.05	0.11	0.24	0.23	0.12	0.15
P56	0.06	0.06	0.20	0.30	0.23	0.16	0.01	0.04	0.11	0.06	0.13	0.12
P57	0.07	0.10	0.24	0.52	0.40	0.26	0.02	0.07	0.06	0.03	0.19	0.17
P58	0.08	0.10	0.24	0.48	0.37	0.25	0.06	0.04	0.36	0.26	0.21	0.23
P59	0.05	0.09	0.20	0.40	0.30	0.20	0.08	0.06	0.44	0.24	0.19	0.23
P60	0.04	0.03	0.04	0.10	0.11	0.07	0.04	0.19	0.45	0.17	0.10	0.17

D1.2 Overall Test Points

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O1	0.15	0.09	0.05	0.25	0.09	0.05	0.06	0.08	0.18	0.07	0.11	0.11
O2	0.21	0.19	0.09	0.31	0.04	0.13	0.10	0.47	0.59	0.66	0.22	0.33
O3	0.22	0.22	0.12	0.25	0.07	0.14	0.34	0.64	0.74	0.63	0.28	0.43
O4	0.16	0.25	0.11	0.17	0.07	0.16	0.34	0.71	0.68	0.82	0.27	0.44
O5	0.15	0.20	0.07	0.13	0.08	0.17	0.39	0.60	0.66	0.62	0.24	0.40
O6	0.12	0.17	0.10	0.04	0.27	0.08	0.21	0.45	0.38	0.44	0.19	0.28
O7	0.15	0.17	0.13	0.26	0.29	0.12	0.18	0.44	0.36	0.52	0.22	0.31
O8	0.16	0.17	0.06	0.41	0.36	0.29	0.24	0.30	0.30	0.49	0.22	0.30
O9	0.20	0.17	0.05	0.32	0.27	0.35	0.50	0.37	0.28	0.23	0.23	0.31
O10	0.04	0.07	0.05	0.10	0.26	0.37	0.51	0.41	0.21	0.35	0.16	0.30
O11	0.07	0.01	0.12	0.34	0.02	0.09	0.06	0.46	0.25	0.08	0.15	0.22
O12	0.05	0.12	0.12	0.30	0.10	0.01	0.06	0.41	0.18	0.17	0.16	0.20
O13	0.04	0.14	0.03	0.43	0.18	0.08	0.17	0.39	0.15	0.17	0.17	0.22
O14	0.12	0.15	0.10	0.06	0.41	0.10	0.30	0.37	0.25	0.12	0.19	0.24
O15	0.10	0.13	0.08	0.22	0.39	0.02	0.25	0.34	0.29	0.13	0.19	0.24
O16	0.04	0.02	0.08	0.12	0.07	0.03	0.13	0.13	0.15	0.13	0.08	0.11
O17	0.04	0.02	0.07	0.15	0.05	0.05	0.18	0.15	0.11	0.14	0.08	0.12
O18	0.05	0.03	0.03	0.19	0.04	0.08	0.20	0.22	0.12	0.12	0.09	0.14
O19	0.04	0.03	0.03	0.19	0.04	0.08	0.19	0.21	0.12	0.12	0.09	0.14
O20	0.04	0.08	0.05	0.15	0.03	0.04	0.18	0.07	0.14	0.18	0.08	0.10
O21	0.17	0.04	0.06	0.18	0.17	0.07	0.30	0.39	0.16	0.19	0.15	0.22
O22	0.11	0.01	0.03	0.07	0.04	0.01	0.05	0.26	0.14	0.05	0.08	0.11
O23	0.18	0.04	0.04	0.08	0.08	0.08	0.13	0.17	0.28	0.34	0.10	0.16
O24	0.21	0.02	0.06	0.15	0.15	0.05	0.10	0.19	0.08	0.24	0.11	0.13
O25	0.20	0.02	0.04	0.12	0.09	0.07	0.04	0.15	0.13	0.31	0.09	0.12
O26	0.18	0.04	0.04	0.11	0.16	0.05	0.18	0.40	0.18	0.11	0.13	0.19
O27	0.10	0.02	0.02	0.06	0.20	0.05	0.09	0.25	0.10	0.14	0.08	0.13
O28	0.13	0.01	0.06	0.13	0.10	0.09	0.24	0.27	0.06	0.23	0.11	0.16
O29	0.09	0.01	0.05	0.04	0.07	0.01	0.11	0.19	0.04	0.02	0.07	0.08
O30	0.17	0.03	0.09	0.17	0.07	0.04	0.06	0.10	0.09	0.21	0.09	0.10
O31	0.02	0.02	0.03	0.15	0.21	0.09	0.09	0.13	0.08	0.16	0.07	0.11
O32	0.18	0.02	0.14	0.22	0.22	0.09	0.08	0.18	0.26	0.19	0.15	0.17
O33	0.17	0.01	0.06	0.15	0.11	0.09	0.26	0.34	0.28	0.16	0.14	0.21
O34	0.12	0.03	0.07	0.16	0.14	0.10	0.13	0.23	0.26	0.11	0.12	0.17
O35	0.04	0.07	0.14	0.12	0.11	0.04	0.10	0.10	0.13	0.04	0.10	0.10

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O36	0.12	0.10	0.10	0.03	0.01	0.03	0.01	0.16	0.10	0.12	0.09	0.08
O37	0.11	0.07	0.04	0.02	0.09	0.01	0.06	0.06	0.13	0.14	0.07	0.07
O38	0.18	0.10	0.05	0.02	0.09	0.02	0.10	0.17	0.14	0.10	0.10	0.10
O39	0.05	0.01	0.05	0.03	0.05	0.02	0.03	0.10	0.05	0.10	0.04	0.06
O40	0.03	0.10	0.02	0.03	0.03	0.01	0.04	0.10	0.13	0.08	0.05	0.06
O41	0.11	0.19	0.08	0.07	0.14	0.06	0.03	0.09	0.14	0.05	0.11	0.09
O42	0.10	0.13	0.03	0.03	0.04	0.01	0.07	0.16	0.13	0.29	0.08	0.10
O43	0.13	0.03	0.09	0.10	0.16	0.09	0.25	0.34	0.30	0.07	0.14	0.21
O44	0.09	0.04	0.08	0.07	0.16	0.09	0.27	0.35	0.31	0.13	0.14	0.22
O45	0.13	0.05	0.11	0.22	0.06	0.10	0.24	0.41	0.31	0.21	0.16	0.24
O46	0.13	0.03	0.08	0.19	0.04	0.05	0.24	0.31	0.25	0.22	0.13	0.20
O47	0.31	0.21	0.06	0.05	0.06	0.02	0.02	0.20	0.08	0.41	0.13	0.11
O48	0.38	0.22	0.01	0.05	0.03	0.04	0.06	0.12	0.09	0.44	0.13	0.10
O49	0.43	0.24	0.03	0.04	0.05	0.02	0.06	0.13	0.05	0.33	0.14	0.09
O50	0.22	0.18	0.06	0.10	0.13	0.09	0.06	0.31	0.20	0.38	0.15	0.18
O51	0.04	0.12	0.05	0.05	0.05	0.04	0.08	0.40	0.25	0.37	0.11	0.19
O52	0.18	0.05	0.07	0.02	0.01	0.01	0.03	0.15	0.11	0.19	0.08	0.08
O53	0.22	0.06	0.12	0.09	0.06	0.03	0.04	0.05	0.10	0.04	0.10	0.07
O54	0.09	0.08	0.19	0.17	0.20	0.13	0.05	0.23	0.20	0.06	0.15	0.17
O55	0.18	0.09	0.19	0.06	0.09	0.05	0.03	0.08	0.01	0.25	0.11	0.08
O56	0.16	0.12	0.23	0.11	0.11	0.07	0.07	0.08	0.09	0.19	0.14	0.11
O57	0.34	0.06	0.04	0.05	0.10	0.03	0.09	0.28	0.23	0.18	0.13	0.15
O58	0.29	0.12	0.18	0.12	0.10	0.07	0.03	0.30	0.21	0.12	0.17	0.16
O59	0.28	0.06	0.03	0.05	0.14	0.07	0.05	0.30	0.27	0.17	0.13	0.16
O60	0.05	0.05	0.01	0.24	0.21	0.19	0.06	0.28	0.30	0.20	0.12	0.20
O61	0.02	0.02	0.07	0.09	0.07	0.03	0.07	0.06	0.16	0.07	0.06	0.08
O62	0.06	0.05	0.02	0.21	0.15	0.13	0.09	0.22	0.23	0.19	0.11	0.16
O63	0.17	0.17	0.06	0.04	0.06	0.03	0.03	0.10	0.05	0.17	0.09	0.07
O64	0.15	0.03	0.03	0.11	0.07	0.07	0.10	0.20	0.09	0.08	0.08	0.11
O65	0.10	0.03	0.01	0.06	0.04	0.03	0.03	0.10	0.03	0.03	0.05	0.05
O66	0.16	0.12	0.22	0.13	0.19	0.11	0.05	0.16	0.10	0.05	0.15	0.13
O67	0.08	0.19	0.37	0.27	0.30	0.20	0.08	0.11	0.07	0.14	0.21	0.17
O68	0.05	0.38	0.36	0.31	0.45	0.27	0.13	0.22	0.21	0.14	0.28	0.25
O69	0.03	0.17	0.24	0.15	0.47	0.21	0.13	0.02	0.01	0.04	0.16	0.13
O70	0.19	0.23	0.11	0.05	0.25	0.16	0.09	0.02	0.02	0.07	0.13	0.08
O71	0.03	0.26	0.21	0.07	0.32	0.10	0.10	0.09	0.05	0.04	0.16	0.11
O72	0.25	0.10	0.18	0.09	0.29	0.06	0.13	0.09	0.05	0.07	0.15	0.11

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O73	0.12	0.03	0.09	0.16	0.09	0.13	0.02	0.04	0.03	0.05	0.08	0.07
O74	0.04	0.24	0.20	0.10	0.13	0.18	0.11	0.06	0.11	0.06	0.14	0.11
O75	0.11	0.01	0.03	0.17	0.15	0.12	0.02	0.05	0.16	0.03	0.07	0.09
O76	0.09	0.04	0.03	0.21	0.25	0.14	0.10	0.12	0.16	0.08	0.10	0.13
O77	0.11	0.07	0.06	0.22	0.28	0.14	0.12	0.19	0.22	0.14	0.14	0.18
O78	0.04	0.05	0.14	0.10	0.20	0.11	0.16	0.13	0.15	0.12	0.11	0.14
O79	0.20	0.29	0.21	0.32	0.07	0.13	0.11	0.02	0.11	0.13	0.19	0.12
O80	0.04	0.12	0.10	0.39	0.37	0.32	0.12	0.06	0.18	0.16	0.16	0.18
O81	0.09	0.07	0.14	0.10	0.15	0.08	0.04	0.15	0.16	0.09	0.11	0.12
O82	0.07	0.17	0.32	0.27	0.31	0.26	0.10	0.15	0.21	0.13	0.21	0.21
O83	0.09	0.08	0.03	0.12	0.11	0.09	0.03	0.13	0.20	0.12	0.09	0.11
O84	0.04	0.07	0.05	0.10	0.11	0.09	0.02	0.06	0.03	0.04	0.06	0.06
O85	0.05	0.19	0.24	0.16	0.23	0.07	0.01	0.20	0.32	0.21	0.18	0.19
O86	0.25	0.25	0.32	0.25	0.32	0.23	0.04	0.18	0.34	0.24	0.26	0.23
O87	0.13	0.05	0.14	0.14	0.08	0.07	0.01	0.07	0.19	0.13	0.10	0.10
O88	0.21	0.40	0.35	0.12	0.17	0.16	0.05	0.08	0.05	0.03	0.23	0.11
O89	0.07	0.15	0.12	0.05	0.16	0.11	0.07	0.15	0.01	0.03	0.11	0.09
O90	0.03	0.06	0.25	0.22	0.06	0.02	0.02	0.11	0.15	0.12	0.13	0.12
O91	0.10	0.29	0.36	0.22	0.30	0.23	0.13	0.06	0.20	0.14	0.23	0.18
O92	0.32	0.45	0.37	0.22	0.28	0.27	0.14	0.04	0.16	0.13	0.29	0.18
O93	0.44	0.46	0.35	0.28	0.26	0.25	0.13	0.05	0.16	0.11	0.31	0.17
O94	0.34	0.31	0.18	0.23	0.16	0.25	0.13	0.05	0.15	0.10	0.21	0.14
O95	0.29	0.18	0.22	0.17	0.24	0.22	0.10	0.04	0.09	0.09	0.18	0.13
O96	0.04	0.17	0.20	0.13	0.19	0.16	0.06	0.06	0.12	0.08	0.13	0.11
O97	0.05	0.16	0.15	0.15	0.10	0.06	0.10	0.11	0.09	0.06	0.12	0.10
O98	0.21	0.21	0.31	0.26	0.23	0.17	0.09	0.06	0.16	0.12	0.21	0.16
O99	0.16	0.23	0.36	0.18	0.12	0.10	0.05	0.11	0.03	0.03	0.19	0.12
O100	0.01	0.09	0.21	0.16	0.08	0.04	0.12	0.23	0.14	0.07	0.14	0.15
O101	0.04	0.04	0.05	0.15	0.12	0.13	0.04	0.14	0.26	0.18	0.09	0.14
O102	0.04	0.07	0.13	0.06	0.11	0.06	0.06	0.09	0.06	0.05	0.08	0.08
O103	0.15	0.21	0.29	0.11	0.11	0.07	0.12	0.18	0.20	0.09	0.19	0.16
O104	0.09	0.06	0.15	0.10	0.09	0.03	0.03	0.06	0.06	0.07	0.09	0.07
O105	0.06	0.05	0.05	0.05	0.01	0.21	0.12	0.06	0.10	0.11	0.06	0.09
O106	0.03	0.05	0.19	0.17	0.20	0.10	0.02	0.03	0.07	0.09	0.10	0.09
O107	0.03	0.06	0.11	0.06	0.29	0.28	0.20	0.02	0.11	0.08	0.10	0.13
O108	0.02	0.08	0.36	0.08	0.29	0.26	0.18	0.12	0.17	0.08	0.17	0.18
O109	0.19	0.14	0.07	0.24	0.23	0.04	0.09	0.10	0.02	0.05	0.13	0.10

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O110	0.16	0.17	0.17	0.31	0.36	0.19	0.06	0.05	0.15	0.17	0.18	0.16
O111	0.05	0.07	0.30	0.11	0.26	0.16	0.14	0.01	0.14	0.11	0.14	0.13
O112	0.04	0.02	0.37	0.17	0.18	0.24	0.23	0.17	0.18	0.11	0.17	0.20
O113	0.11	0.15	0.19	0.10	0.34	0.26	0.42	0.51	0.49	0.24	0.24	0.36
O114	0.13	0.19	0.19	0.38	0.36	0.27	0.38	0.52	0.49	0.27	0.29	0.39
O115	0.06	0.18	0.09	0.32	0.33	0.27	0.19	0.12	0.28	0.05	0.17	0.20
O116	0.14	0.21	0.16	0.24	0.34	0.28	0.08	0.10	0.26	0.37	0.19	0.20
O117	0.06	0.19	0.12	0.30	0.41	0.31	0.34	0.36	0.31	0.15	0.23	0.30
O118	0.07	0.04	0.07	0.05	0.12	0.01	0.03	0.02	0.15	0.13	0.06	0.07
O119	0.12	0.11	0.23	0.36	0.20	0.08	0.08	0.22	0.16	0.12	0.19	0.18
O120	0.04	0.11	0.09	0.18	0.15	0.07	0.22	0.23	0.12	0.14	0.13	0.16
O121	0.06	0.13	0.10	0.20	0.25	0.04	0.06	0.21	0.26	0.13	0.14	0.17
O122	0.06	0.12	0.07	0.14	0.13	0.18	0.07	0.29	0.23	0.23	0.12	0.18
O123	0.14	0.29	0.30	0.66	0.53	0.17	0.11	0.21	0.41	0.53	0.33	0.34
O124	0.01	0.03	0.01	0.10	0.12	0.13	0.25	0.28	0.27	0.26	0.10	0.20
O125	0.02	0.07	0.06	0.06	0.04	0.05	0.07	0.36	0.13	0.17	0.09	0.15
O126	0.05	0.08	0.06	0.12	0.06	0.14	0.31	0.42	0.35	0.35	0.15	0.26
O127	0.02	0.09	0.06	0.26	0.04	0.03	0.04	0.33	0.04	0.03	0.11	0.13
O128	0.05	0.09	0.10	0.06	0.38	0.04	0.22	0.32	0.13	0.09	0.14	0.18
O129	0.10	0.09	0.01	0.02	0.16	0.08	0.16	0.27	0.32	0.19	0.11	0.18
O130	0.13	0.05	0.09	0.30	0.06	0.10	0.40	0.49	0.53	0.12	0.21	0.32
O131	0.06	0.17	0.09	0.08	0.16	0.02	0.37	0.55	0.52	0.17	0.21	0.31
O132	0.08	0.15	0.09	0.19	0.23	0.19	0.11	0.31	0.23	0.37	0.16	0.22
O133	0.08	0.14	0.08	0.21	0.12	0.05	0.22	0.26	0.29	0.18	0.15	0.20
O134	0.04	0.08	0.04	0.05	0.16	0.11	0.07	0.25	0.41	0.23	0.11	0.19
O135	0.05	0.13	0.11	0.30	0.32	0.13	0.09	0.03	0.12	0.14	0.14	0.13
O136	0.05	0.06	0.09	0.12	0.24	0.12	0.02	0.07	0.21	0.20	0.10	0.12
O137	0.07	0.02	0.16	0.29	0.26	0.16	0.06	0.15	0.34	0.30	0.15	0.21
O138	0.14	0.14	0.40	0.26	0.16	0.08	0.19	0.14	0.07	0.04	0.21	0.16
O139	0.04	0.05	0.08	0.21	0.36	0.24	0.23	0.42	0.40	0.25	0.18	0.30
O140	0.10	0.17	0.26	0.08	0.26	0.12	0.29	0.41	0.39	0.19	0.22	0.28
O141	0.12	0.11	0.21	0.08	0.28	0.18	0.05	0.20	0.27	0.13	0.16	0.18
O142	0.30	0.20	0.21	0.14	0.28	0.26	0.36	0.45	0.22	0.08	0.25	0.28
O143	0.09	0.22	0.17	0.34	0.34	0.09	0.25	0.48	0.47	0.41	0.27	0.35
O144	0.10	0.20	0.12	0.08	0.20	0.18	0.21	0.25	0.19	0.35	0.16	0.20
O145	0.08	0.11	0.17	0.08	0.05	0.07	0.04	0.22	0.34	0.24	0.13	0.17
O146	0.07	0.16	0.25	0.06	0.16	0.13	0.37	0.49	0.47	0.27	0.23	0.32

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O147	0.13	0.10	0.05	0.07	0.26	0.25	0.37	0.41	0.23	0.08	0.16	0.25
O148	0.08	0.15	0.13	0.02	0.13	0.13	0.06	0.19	0.07	0.01	0.11	0.10
O149	0.21	0.40	0.34	0.12	0.14	0.15	0.06	0.11	0.01	0.04	0.22	0.11
O150	0.30	0.21	0.26	0.24	0.28	0.25	0.10	0.11	0.23	0.15	0.22	0.19
O151	0.30	0.40	0.30	0.18	0.24	0.26	0.13	0.06	0.12	0.11	0.25	0.16
O152	0.06	0.18	0.13	0.40	0.43	0.34	0.13	0.07	0.21	0.17	0.19	0.21
O153	0.12	0.10	0.16	0.19	0.09	0.12	0.19	0.05	0.07	0.05	0.13	0.11
O154	0.17	0.26	0.22	0.14	0.16	0.05	0.17	0.11	0.05	0.02	0.18	0.11
O155	0.31	0.10	0.19	0.08	0.37	0.16	0.13	0.08	0.05	0.08	0.16	0.12
O156	0.29	0.05	0.21	0.10	0.28	0.04	0.13	0.15	0.02	0.07	0.15	0.12
O157	0.11	0.23	0.24	0.10	0.18	0.04	0.13	0.16	0.12	0.04	0.17	0.13
O158	0.15	0.36	0.27	0.10	0.13	0.05	0.06	0.18	0.13	0.08	0.21	0.13
O159	0.16	0.02	0.02	0.21	0.14	0.16	0.09	0.03	0.05	0.03	0.08	0.08
O160	0.08	0.07	0.07	0.20	0.16	0.16	0.08	0.06	0.11	0.03	0.10	0.10
O161	0.12	0.07	0.01	0.23	0.23	0.13	0.08	0.12	0.16	0.07	0.11	0.13
O162	0.12	0.12	0.02	0.17	0.20	0.12	0.11	0.23	0.27	0.18	0.13	0.18
O163	0.05	0.10	0.06	0.22	0.14	0.13	0.08	0.29	0.33	0.23	0.14	0.20
O164	0.10	0.04	0.10	0.29	0.25	0.21	0.12	0.44	0.46	0.32	0.19	0.30
O165	0.09	0.07	0.08	0.38	0.33	0.27	0.02	0.12	0.08	0.03	0.14	0.15
O166	0.24	0.07	0.02	0.21	0.13	0.15	0.04	0.12	0.18	0.13	0.12	0.12
O167	0.25	0.09	0.08	0.15	0.11	0.06	0.16	0.07	0.29	0.24	0.13	0.14
O168	0.17	0.08	0.11	0.08	0.09	0.08	0.21	0.37	0.30	0.24	0.15	0.22
O169	0.07	0.06	0.10	0.14	0.18	0.08	0.21	0.34	0.27	0.21	0.15	0.22
O170	0.06	0.04	0.07	0.09	0.17	0.11	0.24	0.36	0.33	0.16	0.13	0.23
O171	0.09	0.05	0.06	0.05	0.16	0.09	0.28	0.36	0.33	0.08	0.14	0.22
O172	0.21	0.05	0.11	0.11	0.18	0.07	0.17	0.36	0.29	0.11	0.16	0.21
O173	0.08	0.01	0.13	0.19	0.13	0.05	0.05	0.29	0.30	0.01	0.13	0.18
O174	0.08	0.02	0.04	0.08	0.07	0.04	0.11	0.34	0.27	0.02	0.10	0.16
O175	0.20	0.01	0.05	0.08	0.18	0.06	0.09	0.26	0.17	0.03	0.11	0.14
O176	0.15	0.01	0.05	0.11	0.19	0.03	0.07	0.21	0.18	0.12	0.10	0.13
O177	0.03	0.04	0.06	0.19	0.11	0.10	0.25	0.31	0.30	0.18	0.13	0.22
O178	0.09	0.04	0.02	0.16	0.12	0.02	0.11	0.05	0.13	0.18	0.08	0.10
O179	0.10	0.02	0.05	0.14	0.16	0.08	0.11	0.11	0.05	0.23	0.08	0.11
O180	0.08	0.03	0.07	0.14	0.06	0.11	0.20	0.29	0.21	0.24	0.11	0.19
O181	0.08	0.05	0.06	0.08	0.14	0.12	0.23	0.35	0.33	0.19	0.13	0.22
O182	0.47	0.26	0.07	0.05	0.06	0.03	0.06	0.27	0.12	0.40	0.18	0.14
O183	0.35	0.15	0.10	0.03	0.03	0.03	0.03	0.09	0.05	0.36	0.12	0.08

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O184	0.38	0.08	0.07	0.09	0.12	0.08	0.11	0.41	0.27	0.29	0.17	0.21
O185	0.36	0.07	0.04	0.08	0.25	0.07	0.02	0.08	0.28	0.15	0.13	0.12
O186	0.43	0.09	0.06	0.08	0.19	0.11	0.15	0.19	0.38	0.10	0.17	0.18
O187	0.41	0.10	0.09	0.13	0.20	0.10	0.06	0.33	0.05	0.24	0.17	0.16
O188	0.29	0.12	0.11	0.14	0.20	0.12	0.08	0.27	0.23	0.21	0.17	0.18
O189	0.21	0.21	0.22	0.19	0.27	0.19	0.05	0.34	0.28	0.21	0.22	0.23
O190	0.19	0.24	0.29	0.26	0.31	0.25	0.10	0.29	0.25	0.20	0.25	0.24
O191	0.15	0.34	0.32	0.20	0.16	0.16	0.07	0.23	0.18	0.14	0.24	0.19
O192	0.30	0.09	0.08	0.08	0.03	0.02	0.05	0.23	0.24	0.11	0.13	0.13
O193	0.35	0.24	0.33	0.18	0.20	0.14	0.06	0.28	0.22	0.12	0.25	0.20
O194	0.12	0.08	0.24	0.18	0.16	0.10	0.05	0.21	0.19	0.02	0.16	0.15
O195	0.24	0.06	0.12	0.08	0.06	0.13	0.08	0.26	0.16	0.05	0.13	0.14
O196	0.09	0.10	0.15	0.07	0.12	0.09	0.05	0.04	0.06	0.02	0.09	0.07
O197	0.17	0.20	0.10	0.38	0.11	0.12	0.06	0.11	0.04	0.06	0.16	0.11
O198	0.07	0.06	0.13	0.06	0.21	0.21	0.32	0.23	0.14	0.06	0.13	0.18
O199	0.09	0.14	0.18	0.11	0.18	0.12	0.06	0.03	0.06	0.05	0.12	0.09
O200	0.12	0.17	0.28	0.09	0.27	0.21	0.22	0.32	0.32	0.15	0.21	0.25
O201	0.11	0.17	0.15	0.08	0.04	0.11	0.21	0.17	0.25	0.27	0.15	0.17
O202	0.11	0.24	0.26	0.32	0.25	0.25	0.23	0.05	0.31	0.14	0.22	0.21
O203	0.15	0.24	0.31	0.15	0.07	0.16	0.34	0.24	0.20	0.19	0.22	0.22
O204	0.18	0.19	0.19	0.26	0.07	0.08	0.03	0.08	0.02	0.04	0.15	0.09
O205	0.05	0.05	0.08	0.09	0.06	0.07	0.03	0.06	0.17	0.19	0.07	0.09
O206	0.17	0.13	0.29	0.35	0.30	0.22	0.03	0.09	0.11	0.08	0.20	0.16
O207	0.10	0.12	0.27	0.12	0.11	0.06	0.03	0.12	0.01	0.14	0.13	0.10
O208	0.03	0.03	0.03	0.08	0.10	0.05	0.08	0.10	0.04	0.14	0.05	0.07
O209	0.05	0.02	0.08	0.05	0.06	0.05	0.14	0.21	0.02	0.05	0.07	0.10
O210	0.07	0.01	0.04	0.06	0.21	0.03	0.23	0.06	0.10	0.07	0.08	0.10
O211	0.08	0.01	0.01	0.04	0.04	0.06	0.14	0.09	0.03	0.02	0.05	0.06
O212	0.11	0.03	0.02	0.10	0.15	0.09	0.23	0.09	0.05	0.06	0.08	0.10
O213	0.15	0.04	0.04	0.04	0.03	0.02	0.03	0.21	0.07	0.14	0.07	0.09
O214	0.23	0.13	0.05	0.21	0.27	0.17	0.04	0.23	0.25	0.14	0.16	0.18
O215	0.20	0.13	0.06	0.08	0.15	0.06	0.05	0.08	0.06	0.03	0.10	0.07
O216	0.10	0.11	0.04	0.07	0.06	0.08	0.01	0.01	0.17	0.09	0.07	0.07
O217	0.13	0.02	0.03	0.04	0.15	0.04	0.02	0.01	0.01	0.02	0.05	0.03
O218	0.27	0.21	0.03	0.24	0.25	0.21	0.13	0.05	0.04	0.05	0.15	0.11
O219	0.04	0.15	0.09	0.16	0.11	0.12	0.09	0.03	0.10	0.05	0.10	0.09
O220	0.20	0.11	0.08	0.27	0.27	0.20	0.07	0.03	0.19	0.06	0.14	0.13

Baseline	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O221	0.30	0.10	0.11	0.23	0.22	0.14	0.08	0.11	0.35	0.13	0.17	0.17
O222	0.13	0.04	0.07	0.25	0.24	0.15	0.06	0.14	0.09	0.08	0.11	0.13
O223	0.12	0.23	0.05	0.27	0.17	0.17	0.09	0.02	0.11	0.02	0.14	0.10

D2 Proposed Scheme

D2.1 Perimeter Test Points

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	10.3%	15.7%	17.8%	9.9%	6.4%		5.9%	8.3%	5.8%		80.1%	
Frequency Summer			8.3%	8.3%	6.9%	7.6%	10.9%	18.5%	14.2%	6.6%		81.3%
P1	0.03	0.02	0.05	0.37	0.33	0.27	0.12	0.35	0.34	0.31	0.16	0.28
P2	0.04	0.01	0.05	0.35	0.31	0.25	0.09	0.40	0.40	0.32	0.16	0.29
P3	0.08	0.01	0.05	0.34	0.30	0.24	0.08	0.41	0.40	0.30	0.16	0.28
P4	0.06	0.01	0.04	0.32	0.29	0.23	0.08	0.41	0.40	0.29	0.16	0.28
P5	0.17	0.01	0.03	0.31	0.27	0.22	0.05	0.41	0.41	0.29	0.17	0.27
P6	0.16	0.01	0.01	0.30	0.27	0.22	0.05	0.42	0.41	0.30	0.16	0.27
P7	0.15	0.01	0.02	0.30	0.27	0.22	0.02	0.41	0.40	0.29	0.16	0.26
P8	0.14	0.01	0.03	0.30	0.27	0.22	0.02	0.41	0.39	0.28	0.16	0.26
P9	0.14	0.01	0.06	0.30	0.27	0.22	0.03	0.41	0.37	0.27	0.16	0.26
P10	0.12	0.01	0.12	0.29	0.26	0.22	0.03	0.39	0.35	0.26	0.17	0.26
P11	0.13	0.01	0.13	0.27	0.24	0.21	0.04	0.30	0.25	0.20	0.15	0.22
P12	0.07	0.01	0.15	0.12	0.12	0.12	0.04	0.05	0.10	0.07	0.08	0.09
P13	0.09	0.01	0.14	0.08	0.05	0.02	0.03	0.16	0.14	0.10	0.09	0.10
P14	0.15	0.01	0.15	0.08	0.05	0.04	0.03	0.21	0.19	0.15	0.11	0.13
P15	0.14	0.02	0.16	0.18	0.13	0.06	0.03	0.15	0.11	0.10	0.12	0.12
P16	0.15	0.01	0.17	0.21	0.13	0.06	0.05	0.19	0.09	0.11	0.13	0.13
P17	0.19	0.03	0.24	0.24	0.13	0.06	0.06	0.28	0.31	0.24	0.18	0.21
P18	0.19	0.05	0.20	0.20	0.10	0.07	0.07	0.28	0.36	0.27	0.17	0.22
P19	0.15	0.07	0.21	0.27	0.14	0.11	0.06	0.25	0.37	0.27	0.18	0.22
P20	0.15	0.07	0.19	0.28	0.16	0.12	0.04	0.22	0.36	0.27	0.17	0.21
P21	0.14	0.07	0.14	0.34	0.21	0.16	0.06	0.20	0.34	0.26	0.17	0.21
P22	0.12	0.07	0.14	0.38	0.25	0.18	0.07	0.20	0.32	0.26	0.18	0.22
P23	0.11	0.07	0.15	0.43	0.29	0.20	0.07	0.23	0.31	0.26	0.19	0.24
P24	0.08	0.05	0.22	0.49	0.35	0.24	0.07	0.33	0.27	0.26	0.22	0.28
P25	0.06	0.04	0.25	0.49	0.34	0.23	0.06	0.32	0.25	0.24	0.21	0.27
P26	0.05	0.08	0.26	0.48	0.34	0.22	0.06	0.28	0.17	0.19	0.21	0.24
P27	0.05	0.11	0.16	0.35	0.27	0.18	0.07	0.25	0.13	0.17	0.17	0.19
P28	0.08	0.11	0.07	0.26	0.23	0.15	0.06	0.24	0.14	0.17	0.14	0.17
P29	0.07	0.10	0.03	0.12	0.13	0.04	0.06	0.13	0.14	0.18	0.09	0.11
P30	0.10	0.08	0.05	0.14	0.11	0.10	0.07	0.20	0.24	0.24	0.11	0.15
P31	0.06	0.07	0.08	0.29	0.18	0.13	0.04	0.20	0.52	0.30	0.15	0.23
P32	0.06	0.06	0.13	0.26	0.05	0.05	0.03	0.23	0.50	0.30	0.15	0.22
P33	0.07	0.07	0.17	0.23	0.07	0.06	0.06	0.26	0.48	0.31	0.16	0.23

Proposed	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**Annual**	**Summer**
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
P34	0.09	0.09	0.20	0.36	0.15	0.08	0.13	0.37	0.55	0.41	0.22	0.31
P35	0.09	0.10	0.21	0.31	0.15	0.07	0.11	0.34	0.51	0.42	0.21	0.29
P36	0.09	0.09	0.13	0.07	0.20	0.09	0.09	0.29	0.44	0.38	0.15	0.23
P37	0.08	0.09	0.13	0.17	0.16	0.07	0.07	0.28	0.50	0.39	0.16	0.24
P38	0.07	0.09	0.10	0.23	0.09	0.03	0.09	0.28	0.49	0.37	0.16	0.24
P39	0.09	0.08	0.12	0.19	0.32	0.15	0.08	0.26	0.41	0.32	0.17	0.24
P40	0.08	0.06	0.13	0.16	0.38	0.20	0.08	0.22	0.34	0.25	0.15	0.22
P41	0.11	0.03	0.31	0.50	0.46	0.27	0.06	0.22	0.29	0.25	0.24	0.28
P42	0.12	0.03	0.32	0.53	0.47	0.29	0.05	0.23	0.30	0.26	0.24	0.29
P43	0.11	0.04	0.29	0.52	0.44	0.30	0.05	0.22	0.29	0.26	0.24	0.28
P44	0.12	0.06	0.27	0.51	0.42	0.30	0.04	0.22	0.29	0.26	0.23	0.27
P45	0.13	0.07	0.20	0.44	0.34	0.22	0.01	0.17	0.27	0.22	0.19	0.22
P46	0.09	0.09	0.17	0.34	0.26	0.20	0.06	0.16	0.25	0.20	0.17	0.20
P47	0.08	0.10	0.17	0.35	0.25	0.20	0.09	0.14	0.24	0.17	0.17	0.19
P48	0.06	0.11	0.17	0.37	0.24	0.14	0.08	0.13	0.27	0.19	0.17	0.19
P49	0.07	0.11	0.15	0.35	0.20	0.06	0.05	0.14	0.30	0.22	0.16	0.18
P50	0.08	0.11	0.13	0.32	0.17	0.05	0.04	0.15	0.34	0.26	0.15	0.18
P51	0.09	0.09	0.13	0.29	0.18	0.09	0.06	0.16	0.36	0.29	0.15	0.20
P52	0.08	0.07	0.15	0.27	0.21	0.13	0.07	0.16	0.38	0.31	0.16	0.21
P53	0.06	0.07	0.15	0.27	0.23	0.14	0.08	0.16	0.40	0.33	0.16	0.22
P54	0.04	0.07	0.13	0.26	0.23	0.16	0.08	0.14	0.39	0.32	0.15	0.21
P55	0.04	0.07	0.13	0.09	0.09	0.10	0.02	0.03	0.11	0.08	0.08	0.07
P56	0.06	0.04	0.13	0.16	0.15	0.10	0.01	0.01	0.08	0.04	0.09	0.07
P57	0.08	0.05	0.22	0.27	0.23	0.15	0.02	0.02	0.06	0.04	0.13	0.10
P58	0.08	0.10	0.28	0.50	0.42	0.27	0.05	0.04	0.30	0.24	0.22	0.23
P59	0.02	0.08	0.19	0.40	0.33	0.21	0.09	0.02	0.38	0.20	0.17	0.21
P60	0.05	0.06	0.07	0.19	0.08	0.07	0.05	0.17	0.48	0.23	0.12	0.19

D2.2 Overall Test Points

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O1	0.16	0.10	0.03	0.26	0.10	0.05	0.06	0.08	0.18	0.07	0.11	0.11
O2	0.20	0.19	0.08	0.30	0.05	0.13	0.10	0.47	0.60	0.67	0.22	0.33
O3	0.25	0.23	0.13	0.23	0.06	0.14	0.34	0.64	0.75	0.64	0.28	0.43
O4	0.23	0.26	0.10	0.12	0.07	0.16	0.34	0.71	0.68	0.82	0.27	0.43
O5	0.12	0.22	0.09	0.17	0.08	0.17	0.39	0.60	0.66	0.61	0.25	0.41
O6	0.18	0.18	0.05	0.10	0.27	0.09	0.21	0.45	0.38	0.44	0.19	0.28
O7	0.19	0.18	0.08	0.26	0.29	0.13	0.18	0.44	0.36	0.52	0.22	0.30
O8	0.17	0.16	0.13	0.37	0.32	0.26	0.17	0.31	0.25	0.49	0.22	0.28
O9	0.20	0.17	0.05	0.31	0.29	0.37	0.48	0.36	0.23	0.23	0.22	0.30
O10	0.07	0.07	0.03	0.11	0.25	0.37	0.51	0.41	0.21	0.35	0.16	0.30
O11	0.06	0.01	0.11	0.34	0.04	0.09	0.06	0.45	0.25	0.08	0.15	0.22
O12	0.06	0.11	0.14	0.30	0.07	0.01	0.06	0.41	0.18	0.17	0.16	0.20
O13	0.10	0.14	0.03	0.43	0.17	0.07	0.17	0.39	0.15	0.17	0.18	0.22
O14	0.16	0.15	0.04	0.18	0.43	0.09	0.30	0.37	0.25	0.12	0.19	0.25
O15	0.15	0.13	0.01	0.21	0.40	0.02	0.25	0.34	0.29	0.13	0.18	0.23
O16	0.03	0.02	0.08	0.16	0.03	0.04	0.13	0.13	0.14	0.13	0.08	0.11
O17	0.02	0.02	0.09	0.19	0.04	0.06	0.18	0.15	0.10	0.13	0.09	0.12
O18	0.02	0.03	0.08	0.23	0.05	0.09	0.19	0.21	0.12	0.12	0.10	0.15
O19	0.02	0.03	0.08	0.23	0.05	0.09	0.19	0.21	0.12	0.12	0.10	0.15
O20	0.01	0.06	0.10	0.24	0.01	0.05	0.21	0.07	0.17	0.20	0.10	0.13
O21	0.17	0.04	0.07	0.22	0.17	0.09	0.29	0.39	0.16	0.19	0.16	0.22
O22	0.10	0.01	0.03	0.08	0.04	0.01	0.06	0.26	0.14	0.05	0.07	0.11
O23	0.18	0.04	0.03	0.10	0.08	0.07	0.12	0.16	0.28	0.33	0.10	0.16
O24	0.20	0.02	0.04	0.16	0.16	0.07	0.09	0.19	0.08	0.23	0.10	0.13
O25	0.20	0.03	0.03	0.14	0.10	0.08	0.04	0.15	0.13	0.31	0.09	0.12
O26	0.18	0.04	0.08	0.16	0.16	0.07	0.17	0.40	0.18	0.11	0.15	0.20
O27	0.10	0.02	0.06	0.10	0.19	0.06	0.09	0.24	0.10	0.14	0.10	0.13
O28	0.13	0.01	0.07	0.10	0.15	0.10	0.23	0.26	0.06	0.24	0.11	0.16
O29	0.09	0.01	0.03	0.03	0.03	0.01	0.11	0.19	0.04	0.02	0.06	0.08
O30	0.16	0.03	0.04	0.20	0.07	0.02	0.06	0.10	0.08	0.20	0.09	0.09
O31	0.02	0.03	0.02	0.18	0.21	0.10	0.08	0.13	0.08	0.16	0.08	0.11
O32	0.17	0.03	0.09	0.26	0.23	0.10	0.08	0.17	0.25	0.19	0.14	0.17
O33	0.16	0.02	0.04	0.14	0.12	0.08	0.26	0.34	0.29	0.16	0.14	0.21
O34	0.12	0.04	0.05	0.16	0.14	0.11	0.13	0.23	0.27	0.12	0.12	0.17
O35	0.05	0.07	0.07	0.22	0.13	0.03	0.10	0.10	0.13	0.04	0.10	0.10

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O36	0.13	0.10	0.09	0.07	0.04	0.02	0.01	0.16	0.10	0.12	0.09	0.09
O37	0.08	0.07	0.02	0.05	0.08	0.01	0.06	0.08	0.13	0.13	0.06	0.07
O38	0.18	0.10	0.06	0.04	0.10	0.04	0.10	0.17	0.14	0.10	0.10	0.11
O39	0.05	0.01	0.05	0.04	0.04	0.03	0.03	0.10	0.05	0.10	0.04	0.06
O40	0.03	0.10	0.03	0.02	0.02	0.01	0.04	0.10	0.12	0.08	0.05	0.06
O41	0.11	0.19	0.08	0.06	0.14	0.04	0.03	0.09	0.13	0.05	0.11	0.08
O42	0.10	0.13	0.03	0.02	0.04	0.01	0.07	0.16	0.13	0.29	0.08	0.10
O43	0.13	0.03	0.07	0.10	0.17	0.07	0.26	0.34	0.30	0.07	0.14	0.21
O44	0.09	0.03	0.09	0.09	0.18	0.10	0.27	0.35	0.31	0.13	0.14	0.23
O45	0.13	0.05	0.03	0.26	0.12	0.11	0.24	0.41	0.31	0.21	0.16	0.25
O46	0.13	0.01	0.03	0.14	0.05	0.01	0.25	0.31	0.25	0.22	0.11	0.19
O47	0.31	0.21	0.06	0.04	0.06	0.03	0.02	0.21	0.09	0.42	0.13	0.12
O48	0.37	0.23	0.04	0.06	0.04	0.04	0.06	0.12	0.06	0.44	0.13	0.10
O49	0.43	0.25	0.03	0.02	0.05	0.02	0.06	0.14	0.03	0.33	0.14	0.08
O50	0.22	0.19	0.05	0.10	0.13	0.09	0.06	0.32	0.20	0.38	0.15	0.18
O51	0.04	0.11	0.04	0.05	0.05	0.04	0.08	0.40	0.25	0.37	0.11	0.19
O52	0.18	0.06	0.08	0.03	0.02	0.01	0.03	0.15	0.11	0.19	0.08	0.09
O53	0.22	0.05	0.13	0.10	0.07	0.04	0.04	0.05	0.10	0.04	0.10	0.07
O54	0.12	0.06	0.14	0.13	0.16	0.10	0.04	0.12	0.14	0.03	0.11	0.11
O55	0.18	0.09	0.18	0.06	0.10	0.06	0.03	0.08	0.01	0.26	0.11	0.08
O56	0.16	0.11	0.22	0.11	0.12	0.07	0.07	0.08	0.09	0.20	0.14	0.11
O57	0.34	0.06	0.05	0.05	0.10	0.03	0.09	0.28	0.23	0.18	0.13	0.15
O58	0.29	0.12	0.20	0.12	0.11	0.07	0.03	0.30	0.19	0.11	0.18	0.16
O59	0.28	0.07	0.05	0.05	0.13	0.06	0.05	0.30	0.27	0.17	0.13	0.16
O60	0.10	0.04	0.01	0.24	0.22	0.19	0.04	0.32	0.25	0.22	0.12	0.20
O61	0.03	0.03	0.06	0.09	0.07	0.02	0.07	0.09	0.15	0.10	0.06	0.09
O62	0.05	0.05	0.02	0.22	0.17	0.13	0.07	0.28	0.24	0.22	0.11	0.18
O63	0.17	0.18	0.05	0.02	0.05	0.03	0.03	0.10	0.06	0.17	0.09	0.07
O64	0.15	0.02	0.02	0.09	0.07	0.07	0.10	0.20	0.09	0.08	0.08	0.10
O65	0.10	0.03	0.02	0.06	0.04	0.04	0.03	0.10	0.01	0.03	0.05	0.05
O66	0.16	0.13	0.21	0.14	0.19	0.11	0.05	0.16	0.11	0.04	0.15	0.13
O67	0.04	0.19	0.36	0.27	0.30	0.20	0.08	0.10	0.07	0.14	0.20	0.17
O68	0.05	0.38	0.34	0.32	0.45	0.27	0.13	0.22	0.22	0.15	0.28	0.25
O69	0.03	0.18	0.24	0.16	0.47	0.21	0.13	0.02	0.06	0.03	0.17	0.13
O70	0.19	0.23	0.11	0.04	0.26	0.16	0.09	0.03	0.07	0.05	0.14	0.09
O71	0.03	0.26	0.21	0.07	0.32	0.10	0.10	0.09	0.05	0.04	0.16	0.11
O72	0.25	0.10	0.18	0.09	0.30	0.06	0.13	0.09	0.05	0.06	0.15	0.11

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O73	0.12	0.03	0.10	0.16	0.10	0.13	0.02	0.04	0.02	0.03	0.08	0.07
O74	0.04	0.24	0.21	0.10	0.13	0.18	0.11	0.05	0.10	0.07	0.14	0.11
O75	0.11	0.01	0.02	0.18	0.16	0.12	0.03	0.06	0.15	0.07	0.07	0.09
O76	0.09	0.04	0.03	0.21	0.26	0.14	0.10	0.13	0.18	0.09	0.11	0.14
O77	0.11	0.07	0.03	0.22	0.28	0.14	0.12	0.22	0.23	0.16	0.13	0.18
O78	0.04	0.05	0.14	0.09	0.21	0.11	0.16	0.15	0.07	0.12	0.11	0.13
O79	0.20	0.29	0.21	0.32	0.07	0.13	0.11	0.02	0.10	0.13	0.19	0.12
O80	0.04	0.12	0.10	0.39	0.37	0.32	0.12	0.06	0.17	0.17	0.16	0.18
O81	0.09	0.07	0.14	0.10	0.15	0.08	0.04	0.18	0.18	0.10	0.12	0.13
O82	0.07	0.17	0.31	0.26	0.31	0.26	0.09	0.17	0.22	0.14	0.21	0.21
O83	0.09	0.07	0.02	0.12	0.12	0.08	0.03	0.15	0.20	0.12	0.09	0.11
O84	0.05	0.07	0.07	0.09	0.11	0.09	0.02	0.07	0.04	0.05	0.07	0.06
O85	0.05	0.19	0.23	0.16	0.22	0.07	0.01	0.20	0.35	0.22	0.18	0.19
O86	0.25	0.25	0.33	0.25	0.32	0.23	0.04	0.19	0.36	0.25	0.26	0.24
O87	0.14	0.05	0.14	0.15	0.08	0.08	0.01	0.08	0.21	0.14	0.11	0.11
O88	0.21	0.40	0.36	0.12	0.17	0.16	0.05	0.08	0.02	0.03	0.23	0.11
O89	0.07	0.15	0.12	0.05	0.17	0.11	0.06	0.15	0.01	0.02	0.11	0.09
O90	0.03	0.06	0.25	0.22	0.05	0.02	0.02	0.12	0.17	0.13	0.13	0.13
O91	0.10	0.29	0.36	0.22	0.30	0.23	0.13	0.05	0.21	0.16	0.23	0.18
O92	0.32	0.45	0.38	0.22	0.28	0.27	0.14	0.02	0.15	0.14	0.29	0.17
O93	0.44	0.46	0.35	0.28	0.26	0.25	0.13	0.06	0.16	0.12	0.31	0.18
O94	0.34	0.31	0.18	0.23	0.16	0.25	0.13	0.05	0.15	0.11	0.21	0.14
O95	0.29	0.18	0.22	0.17	0.24	0.22	0.10	0.06	0.08	0.09	0.18	0.13
O96	0.04	0.17	0.20	0.13	0.19	0.16	0.06	0.06	0.12	0.08	0.13	0.11
O97	0.05	0.16	0.15	0.16	0.10	0.06	0.11	0.11	0.10	0.06	0.13	0.11
O98	0.21	0.21	0.31	0.27	0.23	0.17	0.09	0.04	0.16	0.12	0.21	0.15
O99	0.16	0.23	0.36	0.18	0.12	0.10	0.06	0.10	0.02	0.03	0.19	0.11
O100	0.02	0.09	0.21	0.16	0.09	0.04	0.12	0.23	0.13	0.07	0.14	0.15
O101	0.04	0.05	0.05	0.15	0.12	0.12	0.04	0.14	0.30	0.20	0.09	0.15
O102	0.04	0.07	0.13	0.06	0.11	0.05	0.06	0.09	0.07	0.06	0.08	0.08
O103	0.15	0.21	0.29	0.11	0.10	0.07	0.12	0.18	0.20	0.09	0.19	0.16
O104	0.09	0.06	0.15	0.09	0.08	0.02	0.03	0.06	0.06	0.04	0.09	0.07
O105	0.06	0.08	0.07	0.14	0.09	0.24	0.12	0.08	0.12	0.15	0.09	0.12
O106	0.03	0.02	0.15	0.12	0.15	0.07	0.02	0.01	0.08	0.08	0.08	0.07
O107	0.04	0.06	0.13	0.07	0.29	0.28	0.20	0.03	0.12	0.07	0.10	0.13
O108	0.02	0.08	0.37	0.07	0.29	0.26	0.18	0.12	0.17	0.08	0.17	0.18
O109	0.18	0.14	0.09	0.24	0.24	0.04	0.09	0.10	0.02	0.06	0.14	0.10

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O110	0.15	0.17	0.18	0.31	0.36	0.19	0.06	0.06	0.15	0.15	0.18	0.16
O111	0.06	0.07	0.30	0.11	0.26	0.15	0.14	0.01	0.14	0.12	0.14	0.13
O112	0.06	0.02	0.37	0.18	0.18	0.24	0.23	0.17	0.18	0.11	0.18	0.20
O113	0.11	0.15	0.20	0.10	0.34	0.26	0.42	0.51	0.49	0.24	0.25	0.36
O114	0.12	0.19	0.19	0.38	0.36	0.27	0.38	0.52	0.49	0.27	0.29	0.39
O115	0.07	0.18	0.09	0.32	0.32	0.27	0.19	0.12	0.28	0.05	0.17	0.20
O116	0.14	0.21	0.17	0.24	0.33	0.28	0.08	0.09	0.26	0.37	0.19	0.20
O117	0.06	0.19	0.13	0.30	0.40	0.31	0.34	0.36	0.31	0.15	0.23	0.30
O118	0.08	0.05	0.06	0.05	0.12	0.01	0.03	0.02	0.15	0.13	0.06	0.07
O119	0.11	0.11	0.23	0.36	0.21	0.08	0.08	0.22	0.15	0.12	0.19	0.18
O120	0.04	0.11	0.09	0.18	0.15	0.07	0.22	0.23	0.13	0.14	0.13	0.16
O121	0.06	0.13	0.10	0.20	0.25	0.04	0.06	0.21	0.25	0.13	0.14	0.16
O122	0.06	0.12	0.07	0.13	0.13	0.18	0.07	0.29	0.23	0.23	0.12	0.18
O123	0.14	0.29	0.30	0.66	0.53	0.17	0.11	0.21	0.41	0.53	0.33	0.34
O124	0.02	0.03	0.02	0.10	0.12	0.13	0.25	0.28	0.27	0.26	0.10	0.20
O125	0.06	0.07	0.05	0.07	0.04	0.05	0.07	0.36	0.13	0.17	0.10	0.15
O126	0.10	0.08	0.06	0.13	0.06	0.14	0.31	0.42	0.36	0.35	0.16	0.26
O127	0.07	0.09	0.03	0.27	0.04	0.02	0.04	0.33	0.04	0.03	0.11	0.13
O128	0.04	0.09	0.08	0.05	0.39	0.03	0.22	0.32	0.13	0.09	0.14	0.18
O129	0.13	0.09	0.04	0.01	0.11	0.09	0.16	0.27	0.32	0.19	0.11	0.18
O130	0.09	0.07	0.13	0.26	0.05	0.10	0.40	0.49	0.53	0.13	0.21	0.32
O131	0.15	0.19	0.08	0.09	0.20	0.02	0.37	0.55	0.52	0.18	0.22	0.32
O132	0.14	0.16	0.05	0.18	0.20	0.18	0.11	0.30	0.23	0.37	0.15	0.21
O133	0.14	0.14	0.03	0.23	0.15	0.03	0.22	0.26	0.29	0.18	0.16	0.20
O134	0.10	0.08	0.04	0.05	0.16	0.11	0.07	0.25	0.41	0.23	0.12	0.19
O135	0.02	0.13	0.11	0.30	0.33	0.14	0.09	0.03	0.12	0.15	0.14	0.13
O136	0.07	0.06	0.07	0.14	0.25	0.15	0.02	0.06	0.20	0.19	0.10	0.12
O137	0.08	0.04	0.14	0.27	0.22	0.14	0.06	0.14	0.33	0.30	0.14	0.19
O138	0.14	0.14	0.41	0.28	0.22	0.12	0.09	0.03	0.09	0.06	0.21	0.14
O139	0.04	0.05	0.09	0.20	0.35	0.24	0.23	0.42	0.40	0.25	0.18	0.30
O140	0.10	0.17	0.26	0.08	0.26	0.12	0.29	0.41	0.39	0.19	0.23	0.28
O141	0.12	0.11	0.22	0.07	0.28	0.17	0.05	0.20	0.26	0.13	0.16	0.18
O142	0.30	0.20	0.22	0.14	0.28	0.26	0.36	0.45	0.21	0.08	0.25	0.28
O143	0.09	0.22	0.17	0.34	0.34	0.09	0.25	0.48	0.47	0.41	0.27	0.35
O144	0.09	0.20	0.12	0.08	0.20	0.18	0.21	0.25	0.19	0.35	0.16	0.20
O145	0.08	0.11	0.17	0.08	0.06	0.07	0.04	0.22	0.34	0.24	0.13	0.17
O146	0.07	0.16	0.26	0.06	0.16	0.13	0.36	0.49	0.47	0.27	0.23	0.32

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O147	0.13	0.10	0.05	0.07	0.26	0.25	0.37	0.41	0.23	0.07	0.16	0.25
O148	0.08	0.15	0.13	0.04	0.07	0.07	0.07	0.18	0.05	0.02	0.11	0.09
O149	0.21	0.40	0.35	0.12	0.14	0.15	0.06	0.11	0.02	0.04	0.22	0.11
O150	0.30	0.21	0.26	0.24	0.28	0.25	0.10	0.12	0.24	0.15	0.23	0.19
O151	0.30	0.40	0.30	0.18	0.25	0.26	0.13	0.08	0.12	0.12	0.25	0.16
O152	0.06	0.18	0.13	0.40	0.43	0.34	0.13	0.07	0.20	0.18	0.19	0.21
O153	0.12	0.10	0.16	0.19	0.09	0.12	0.19	0.05	0.07	0.06	0.12	0.11
O154	0.17	0.26	0.22	0.14	0.15	0.05	0.17	0.12	0.06	0.03	0.18	0.12
O155	0.31	0.10	0.19	0.08	0.37	0.16	0.12	0.08	0.07	0.06	0.16	0.13
O156	0.29	0.04	0.20	0.10	0.28	0.04	0.13	0.15	0.10	0.06	0.16	0.13
O157	0.11	0.22	0.24	0.10	0.17	0.04	0.13	0.16	0.09	0.04	0.17	0.12
O158	0.15	0.35	0.27	0.11	0.12	0.05	0.06	0.18	0.13	0.08	0.20	0.13
O159	0.16	0.03	0.02	0.21	0.15	0.16	0.09	0.04	0.08	0.02	0.09	0.09
O160	0.08	0.07	0.07	0.21	0.17	0.16	0.08	0.05	0.13	0.03	0.10	0.10
O161	0.12	0.07	0.06	0.23	0.24	0.13	0.08	0.13	0.17	0.09	0.12	0.14
O162	0.12	0.12	0.04	0.17	0.19	0.11	0.11	0.26	0.29	0.20	0.14	0.19
O163	0.09	0.10	0.04	0.22	0.15	0.14	0.08	0.32	0.35	0.25	0.14	0.22
O164	0.11	0.03	0.10	0.31	0.27	0.22	0.16	0.45	0.44	0.34	0.19	0.31
O165	0.10	0.08	0.08	0.37	0.34	0.27	0.05	0.12	0.08	0.04	0.14	0.15
O166	0.23	0.07	0.05	0.22	0.17	0.17	0.03	0.11	0.18	0.13	0.12	0.13
O167	0.25	0.08	0.08	0.24	0.12	0.06	0.17	0.10	0.30	0.24	0.15	0.17
O168	0.14	0.08	0.04	0.12	0.02	0.10	0.21	0.36	0.30	0.23	0.13	0.21
O169	0.07	0.06	0.13	0.06	0.22	0.08	0.20	0.34	0.27	0.21	0.14	0.22
O170	0.06	0.04	0.14	0.12	0.19	0.11	0.24	0.36	0.33	0.16	0.15	0.24
O171	0.09	0.05	0.09	0.09	0.18	0.10	0.27	0.36	0.33	0.08	0.15	0.22
O172	0.20	0.05	0.08	0.25	0.19	0.06	0.17	0.36	0.29	0.11	0.17	0.22
O173	0.07	0.01	0.08	0.23	0.15	0.08	0.07	0.29	0.29	0.01	0.12	0.18
O174	0.08	0.03	0.05	0.09	0.09	0.05	0.12	0.34	0.27	0.02	0.11	0.17
O175	0.20	0.01	0.03	0.06	0.19	0.09	0.09	0.26	0.17	0.03	0.10	0.13
O176	0.15	0.01	0.03	0.11	0.20	0.07	0.07	0.21	0.17	0.12	0.10	0.14
O177	0.02	0.04	0.11	0.27	0.09	0.10	0.25	0.30	0.29	0.17	0.15	0.22
O178	0.08	0.04	0.08	0.21	0.13	0.02	0.11	0.05	0.13	0.17	0.09	0.11
O179	0.10	0.02	0.09	0.18	0.09	0.10	0.11	0.11	0.05	0.22	0.09	0.11
O180	0.08	0.03	0.12	0.17	0.13	0.12	0.20	0.28	0.21	0.24	0.13	0.20
O181	0.08	0.04	0.12	0.11	0.17	0.12	0.22	0.34	0.32	0.18	0.15	0.23
O182	0.46	0.26	0.08	0.05	0.06	0.03	0.06	0.27	0.15	0.40	0.18	0.15
O183	0.35	0.15	0.09	0.03	0.02	0.03	0.03	0.09	0.06	0.35	0.12	0.08

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O184	0.38	0.09	0.05	0.09	0.12	0.08	0.11	0.41	0.27	0.29	0.17	0.21
O185	0.34	0.07	0.06	0.04	0.12	0.05	0.01	0.06	0.27	0.13	0.11	0.10
O186	0.43	0.09	0.05	0.09	0.16	0.11	0.16	0.18	0.38	0.09	0.16	0.17
O187	0.41	0.10	0.09	0.12	0.20	0.10	0.06	0.33	0.05	0.24	0.17	0.16
O188	0.29	0.12	0.14	0.13	0.20	0.12	0.08	0.27	0.24	0.20	0.18	0.19
O189	0.21	0.21	0.17	0.20	0.28	0.19	0.05	0.35	0.26	0.20	0.21	0.23
O190	0.19	0.24	0.29	0.27	0.31	0.25	0.10	0.29	0.25	0.20	0.25	0.24
O191	0.15	0.34	0.32	0.20	0.16	0.16	0.07	0.24	0.17	0.13	0.24	0.19
O192	0.30	0.10	0.12	0.08	0.01	0.02	0.05	0.23	0.23	0.12	0.14	0.13
O193	0.35	0.25	0.35	0.18	0.20	0.14	0.06	0.28	0.23	0.12	0.26	0.21
O194	0.12	0.07	0.25	0.18	0.16	0.10	0.05	0.22	0.19	0.01	0.16	0.16
O195	0.24	0.06	0.12	0.08	0.07	0.13	0.09	0.26	0.16	0.05	0.13	0.14
O196	0.09	0.10	0.15	0.07	0.12	0.09	0.05	0.04	0.06	0.02	0.09	0.07
O197	0.17	0.20	0.10	0.38	0.10	0.12	0.06	0.11	0.04	0.06	0.16	0.11
O198	0.07	0.06	0.13	0.06	0.21	0.21	0.31	0.23	0.15	0.05	0.13	0.18
O199	0.09	0.14	0.18	0.11	0.18	0.12	0.06	0.02	0.07	0.06	0.12	0.09
O200	0.12	0.17	0.28	0.09	0.27	0.20	0.22	0.31	0.32	0.15	0.21	0.25
O201	0.10	0.17	0.15	0.08	0.04	0.11	0.21	0.16	0.25	0.27	0.14	0.17
O202	0.12	0.24	0.28	0.31	0.25	0.25	0.23	0.06	0.31	0.13	0.23	0.21
O203	0.15	0.24	0.31	0.15	0.08	0.16	0.34	0.24	0.20	0.19	0.22	0.22
O204	0.18	0.19	0.19	0.26	0.08	0.08	0.03	0.08	0.02	0.04	0.15	0.09
O205	0.05	0.04	0.07	0.14	0.12	0.11	0.01	0.07	0.18	0.17	0.08	0.10
O206	0.17	0.13	0.29	0.34	0.28	0.22	0.03	0.09	0.10	0.08	0.19	0.16
O207	0.08	0.09	0.19	0.12	0.09	0.07	0.04	0.06	0.03	0.12	0.10	0.08
O208	0.03	0.02	0.05	0.09	0.10	0.04	0.08	0.10	0.04	0.13	0.06	0.08
O209	0.05	0.01	0.06	0.06	0.06	0.05	0.13	0.21	0.02	0.05	0.07	0.10
O210	0.07	0.01	0.06	0.06	0.20	0.01	0.23	0.07	0.10	0.07	0.08	0.10
O211	0.12	0.02	0.03	0.04	0.12	0.09	0.21	0.11	0.06	0.02	0.07	0.09
O212	0.11	0.06	0.03	0.09	0.14	0.09	0.23	0.09	0.05	0.06	0.08	0.10
O213	0.15	0.05	0.04	0.04	0.03	0.02	0.03	0.20	0.08	0.14	0.07	0.09
O214	0.24	0.12	0.05	0.26	0.27	0.18	0.03	0.25	0.26	0.13	0.16	0.19
O215	0.21	0.13	0.09	0.07	0.16	0.05	0.04	0.09	0.05	0.05	0.11	0.07
O216	0.10	0.11	0.05	0.08	0.07	0.08	0.01	0.06	0.30	0.13	0.09	0.11
O217	0.13	0.02	0.02	0.04	0.15	0.04	0.02	0.01	0.02	0.02	0.05	0.03
O218	0.27	0.21	0.04	0.24	0.26	0.21	0.13	0.04	0.07	0.06	0.15	0.11
O219	0.04	0.15	0.09	0.16	0.11	0.12	0.09	0.04	0.03	0.04	0.10	0.08
O220	0.20	0.11	0.05	0.28	0.28	0.20	0.07	0.03	0.17	0.05	0.14	0.13

Proposed	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
Frequency Annual	**10.3%**	**15.7%**	**17.8%**	**9.9%**	**6.4%**		**5.9%**	**8.3%**	**5.8%**		80.1%	
Frequency Summer			**8.3%**	**8.3%**	**6.9%**	**7.6%**	**10.9%**	**18.5%**	**14.2%**	**6.6%**		81.3%
O221	0.30	0.10	0.02	0.21	0.20	0.13	0.06	0.13	0.38	0.18	0.15	0.17
O222	0.13	0.04	0.06	0.25	0.24	0.15	0.06	0.15	0.13	0.06	0.12	0.14
O223	0.12	0.23	0.05	0.28	0.18	0.17	0.09	0.02	0.09	0.05	0.14	0.10