Hong Kong Housing Authority

Detailed Air Ventilation Assessment for Public Housing Development Batch C3

Proposed Public Housing Development at Choi Wan Road Site 2, 3A and 3B

ISSUE

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Executive Summary

In April 2009, Arup was commissioned by the Hong Kong Housing Authority (HKHA) to undertake an Detailed AVA Study (the Study), in collaboration with the CLP Power Wind/Wave Tunnel Facility (WWTF) of the Hong Kong University of Science and Technology (HKUST), to study the building design for air ventilation of areas both within and surrounding the site for the benefit of the occupants and pedestrians. The wind tunnel study was conducted to assess the air ventilation impacts of the Baseline Scheme and Proposed Scheme on pedestrian level wind conditions in the Project Area and Assessment Area.

Overall wind performance

The overall air ventilation performance for the Choi Wan Road Sites is summarised in the following table. In general, the site and its surroundings could enjoy good wind environment with average Velocity Ratio (VR) greater than 0.2.

Design Schemes	Overall Assessment Area VR Results			
	Site Velocity Ratio (SVR)		Local Velocity Ratio (LVR)	
	Annual	Summer	Annual	Summer
Baseline Scheme	0.24	0.25	0.21	0.21
Proposed Scheme	0.25	0.25	0.22	0.22

The table above shows no significant difference in the wind performance between the two studied schemes. It is mainly due to the similar building layout and building disposition between two schemes. The Proposed Scheme provides better wind performance than the Baseline one with around 5% improvement in Local Velocity Ratio (LVR), in both summer and annual conditions.

The improvement is due to design optimizations (Figure 3 and Figure 4):

- Omission of Block 13 in Baseline Scheme at Site 3B, which is replaced by the low-rise carpark block in the Proposed Scheme and one wind corridor is created under the prevailing wind condition;
- Louvre effect shape of block layout at Site 3A in order to achieve better wind penetration;
- Change of building block shape for Block 1, 2, 3, 4, 6, 7, 8, 9, 11 and 12;
- Widening of wind corridors between Block 1&4, 2&3, and 5&6.

Wind performance of functional areas within the site

The functional areas in Site 2, 3A and 3B have been studied to assess the wind performance in these outdoor activity zones and sensitive areas, which has been summarized as follows:

- **Site 2 –**

  i. The Proposed Scheme has generally better wind performance in most areas as compared with the Baseline Scheme (overall 4.3% improvement under annual condition);

  ii. Although the Proposed Scheme attains a less VR value than the Baseline Scheme at Community Play Area II, the VR of 0.22 is considered acceptable.

- **Site 3A –**

  i. The Proposed Scheme has generally better wind performance as compared with the Baseline Scheme (overall 12.5% improvement for annual condition);

  ii. Windy condition at Refuse Collection Point (RCP) is likely to happen during annual and summer prevailing wind condition, which could help to dissipate the odour from the RCP;

  iii. Although the annual VR values for the Proposed Scheme are lower than the Baseline one at Open Space & Sitting Area and RCP, the VR values in these areas are equal to or above 0.29, which is considered acceptable.

- **Site 3B –**

  i. Moderate wind condition with VR equal to or above 0.2 for both schemes occurred in most of the functional areas, which indicates the overall wind performance for the Site 3B is acceptable;

  ii. Although in some functional areas, the VR values for the Proposed Scheme are lower than that of the Baseline Scheme, e.g. Bus Stop, Open Space II and Open Space IV, the reduction of VR values in these areas would lead to the increase of wind flow at the surrounding areas. Furthermore, the VR values for the annual condition are maintained above 0.2 and the Proposed Scheme enhances the wind environment of the surrounding areas (Table 4 refers) due to the wind corridor design (Figure 14 refers).

1 Introduction

1.1 Background of the Study

In December 2006, Ove Arup & Partners Hong Kong Ltd (Arup) was commissioned by HKHA to conduct an Air Ventilation Assessment (AVA) Initial Study for the Choi Wan Road Public Housing Development. The Air Ventilation performance for the Proposed Scheme was considered in the study. It was concluded that the Proposed Scheme would achieve good air ventilation performance.

In April 2009, Arup was commissioned by HKHA to further undertake an Detailed AVA Study (the Study), in collaboration with the CLP Power Wind/Wave Tunnel Facility (WWTF) of the Hong Kong University of Science and Technology (HKUST), to study the building design for air ventilation of areas both within and surround the site for the benefit of the occupants and pedestrians. The wind tunnel study was conducted to assess the air ventilation impacts of the Baseline Scheme and Proposed Scheme (Figure 3 and Figure 4) on pedestrian level wind conditions in the Project Area and Assessment Area (Figure 2).

1.2 Objective of the Study

The objective of the study is to evaluate the air ventilation performance of the proposed master layout design scheme for the Public Housing Development at Choi Wan Road Site 2, 3A and 3B using the methodology for Detailed Air Ventilation Assessment.

The wind tunnel testing techniques used for this study has satisfied the quality assurance requirements stipulated in the Australasian Wind Engineering Society Quality Assurance Manual, AWES-QAM-1-2001 (2001) and the American Society of Civil Engineers Manual and Report on Engineering Practice No. 67 for Wind Tunnel Studies of Buildings and Structures (1999). The study was also conducted in accordance with the recommendations of Planning Department's Feasibility Study for Establishment of Air Ventilation Assessment System – Final Report (2005) and Technical Guide for Air Ventilation Assessment for Developments in Hong Kong (2006).

1.3 Scope of the Study

The main scope of the Study is to carry out an Detailed AVA Study to assess the ventilation performance of the Baseline and Proposed Schemes at Choi Wan Road Site 2, 3A & 3B and its surrounding environment including Site 1.

The deliverables of the study could be summarized as follows:

- Identify the ventilation performance of the development sites as well as the surrounding areas;
- Analyse the effectiveness of the environmental design features adopted.

2 Study Background

2.1 Site Characteristics

The Proposed Public Housing Development at Choi Wan Road Sites 2, 3A and 3B is located at the northern part of Ngau Tau Kok and adjacent to Choi Ying Road and Choi Ha Estate. The total site area is approximately 7.1 hectares.

The new development may impose potential impact on the wind environment of the surroundings. Because of its strategic location and the scale of the development, an effective urban planning for air ventilation is crucial.

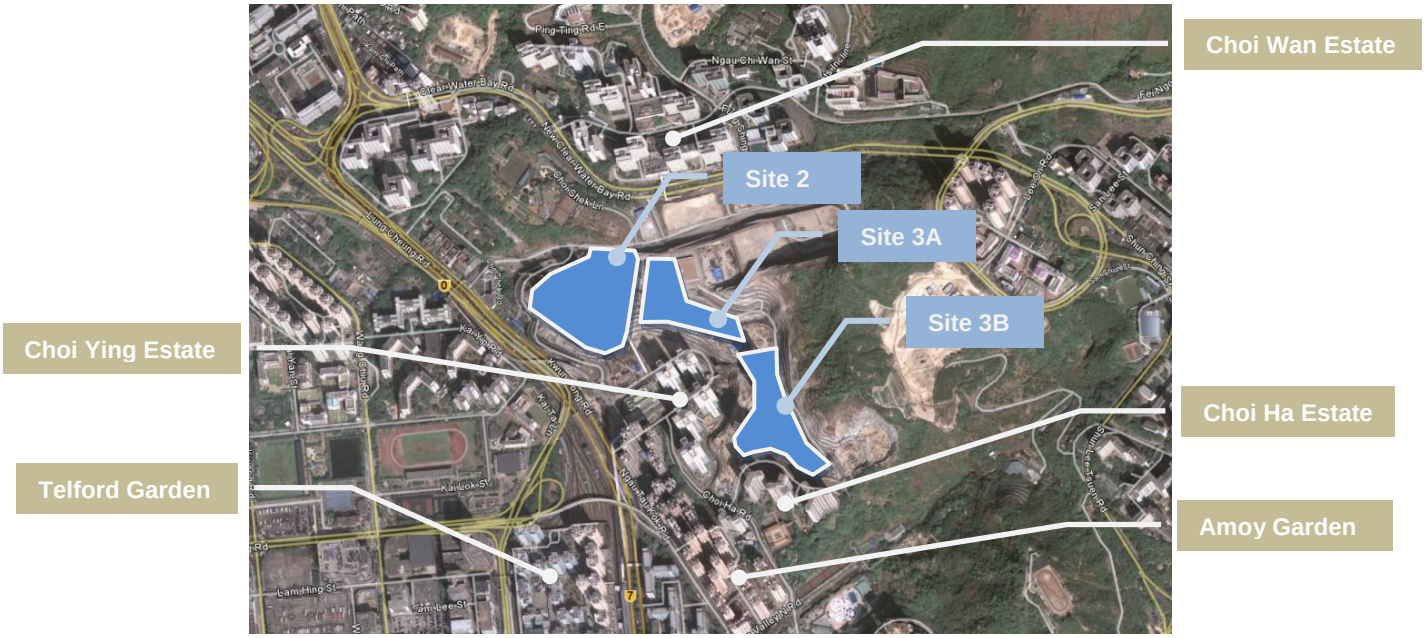

Figure 1 Location of Choi Wan Road Sites 2, 3A, 3B Development

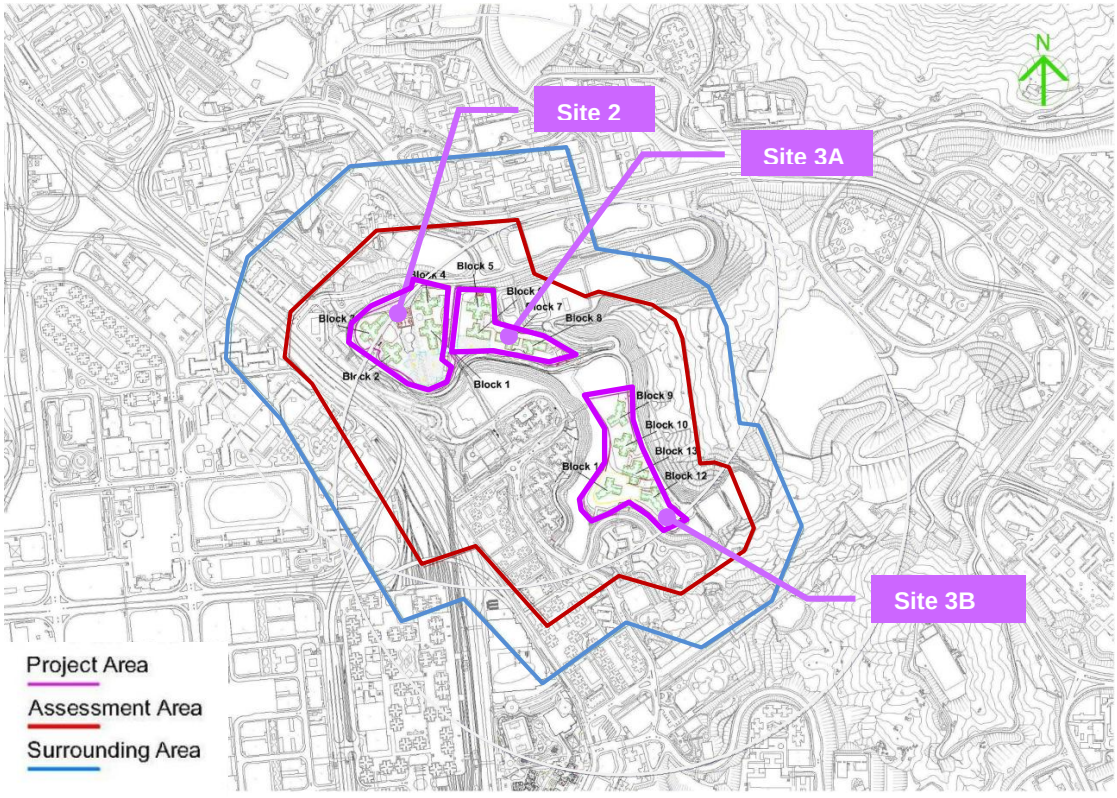

Figure 2 Study Area of Choi Wan Road Site 2, 3A and 3B

2.2 Design Schemes

There are two design schemes presented in the Detailed AVA Study, i.e. Baseline and Proposed Schemes.

Baseline Scheme

- **Thirteen** 34 to 40 domestic storey site specific design domestic blocks;
- One multi-storey retail/carpark block in Site 2.

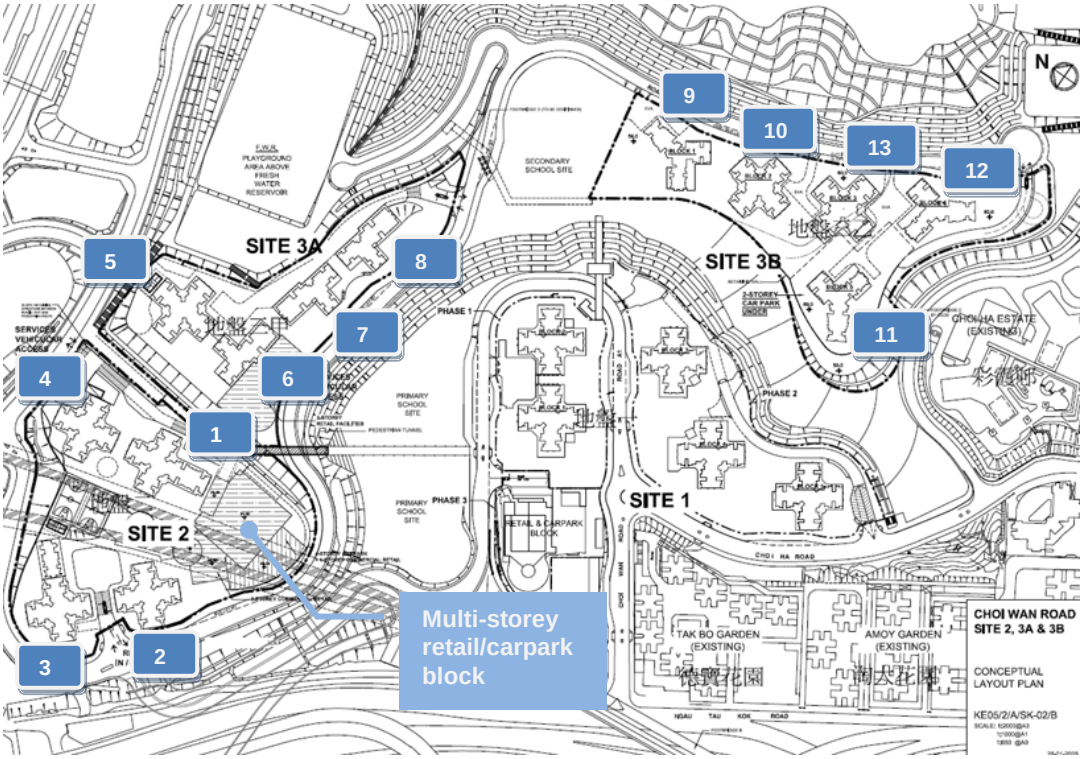

Figure 3 Master Layout for the Baseline Scheme

Proposed Scheme

- **Twelve** 34 to 40 domestic storey site specific design domestic blocks;
- One multi-storey retail/carpark block in Site 2; and
- One multi-storey carpark block in Site 3B.

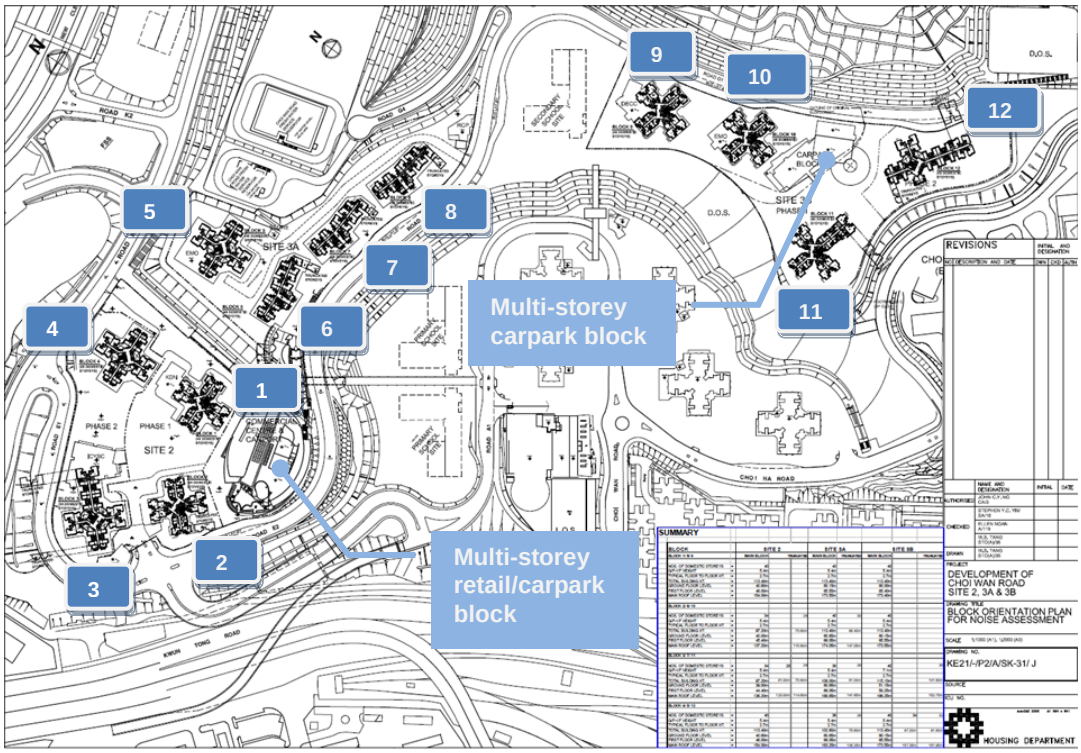

Figure 4 Master Layout for the Proposed Scheme

The major differences of Proposed Scheme as compared with Baseline Scheme are shown as below:

- Omission of Block 13 in Baseline Scheme at Site 3B, which is replaced by the low-rise carpark block in the Proposed Scheme and one wind corridor is created under the prevailing wind condition;
- Louvre effect shape of block layout at Site 3A in order to achieve better wind penetration;
- Change of building block shape for Block 1, 2, 3, 4, 6, 7, 8, 9, 11 and 12;
- Widening of wind corridors between Block 1&4, 2&3, and 5&6.

3 Study Methodology

3.1 Site Wind Availability Study

Physical Model of the Study Area

Due to the size of the area covered by Choi Wan Road Sites 2, 3A and 3B, two Study Areas were tested to cover the extent of the Assessment Area and Surrounding Area required for the later air ventilation studies.

A 1:2000 scale topography study was conducted in WWTF's low speed test section to determine the effectiveness of topography on local wind conditions at the proposed site developments as shown in Appendix A1.

While measurements were taken at Study Area A, all buildings within a diameter of 1000 m of the centre of the Study Area were removed from the wind tunnel model for all measured wind directions. All buildings within the diameter of 1000 m will be included in the proximity model for the subsequent 1:400 scale detailed AVA to directly account for their effects on the wind flow within Study Area A. The same procedure was also used for the measurements taken for Study Area B.

Measurements were taken at 9 different height levels above the site, and at 22.5° intervals for the full 360° azimuth, using a miniature dynamic pressure probe (Figure 5) to determine the vertical profiles of mean wind speed, turbulence intensity and mean yaw and pitch angles of winds at the proposed development site.

Experimental Equipment and Procedures

A miniature dynamic pressure (Cobra) probe was used to take measurements of the longitudinal, lateral and vertical components of wind speed. The results were used as input boundary conditions for subsequent detailed air ventilation studies to be conducted for the proposed Choi Wan Road Sites 2, 3A and 3B.

Figure 5 Hardware of the miniature dynamic pressure (Cobra) probe

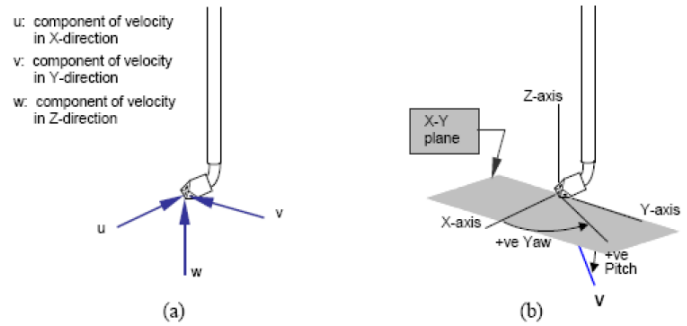

Figure 6 Usage of the miniature dynamic pressure (Cobra) probe

Mean wind speeds were measured in 1:2000 scale topographical model and matched with a larger scale model to be used for the detailed air ventilation assessment studies through a wind speed scaling factor (F), averaged over a range of heights that were considered likely to influence pedestrian level wind conditions, as shown in Equation (1).

$$F = \left[\frac{V_z}{V_{500,open,i}} \right]_{site\ wind\ availability\ model} \left[\frac{V_{ref}}{V_z} \right]_{detailed\ model} \quad (1)$$

where:

V_z = mean wind speed measured at a height z;

V_{ref} = wind speed measured at the reference height (z_{ref}) in the larger scale tests; and

$V_{500,open,i}$ = directional mean wind speed at 500 mPD above open terrain for the i-th wind direction.

The measured site wind characteristics was combined analytically with WWTF's probabilistic models of the annual and summer non-typhoon wind climate of Hong Kong, corrected to an appropriate height, for use in the subsequent air ventilation studies. Deviations in the mean wind direction determined in the 1:2000 scale topography study were averaged over a range of heights that were considered likely to influence pedestrian level wind conditions. If the average mean wind direction deviated by more than ±11.25° from the approach wind direction, those winds were treated as having shifted to an adjacent sector. Therefore, the probability of occurrence of the corresponding approach wind direction was added to that of the adjacent sector and the directional probabilities of occurrence were adjusted accordingly.

Experimental Results

Based on the wind tunnel test results, a number of representative approach wind conditions were identified for the tested site to rationalise and characterise the effects of the various topographical and terrain features for the 16 measured wind directions as illustrated in Appendix A2.

In general, the annual prevailing wind characteristics corresponding to non-typhoon winds at a height of 500 m above the Choi Wan Road Study Areas were similar to the overall characteristics of non-typhoon winds approaching the Hong Kong region, although the magnitudes of the directional wind speeds were reduced. Significant reductions in the measured magnitudes of wind speed were caused by the mountains ranging from the north to the east of the Choi Wan Road Study Areas. The mountains on Hong Kong Island, located to the south and south-west of the Study Areas, had a moderating effect on the magnitude of wind speeds from those directions.

3.2 Detailed AVA Study

Due to the large size of the Choi Wan Road Project Area, it would be necessary for wind tunnel tests for the detailed air ventilation assessment to be conducted in two separated models. These separate detailed models, expected to be 1:400 scale, had a radius of approximately 500 m to 600 m in prototype scale and they were fabricated to include all known buildings, structures and significant topographical features within the Project Areas, Assessment Areas and Surrounding Areas as illustrated in Appendix A4.

In the Detailed AVA Study, the test points in the Project Area and Assessment Area were consistent with the Initial AVA Study. Besides, additional test points were employed in order to study the ventilation performance in more detail. Test points were categorised into perimeter test points, overall test points and special test points in accordance with Planning Department's Technical Guide for Air Ventilation Assessment for Developments in Hong Kong (2006):

- **Perimeter test points** were located at regular intervals around the boundary of the Project Area, including the junctions of all roads leading to the project site, at main entrances to the project site and at the corners of the project site;
- **Overall test points** were distributed on streets and in open spaces within the Assessment Area that are readily and frequently accessible by the public;
- **Special test points** were located in areas where localised wind issues were expected, such as in stagnant zones or in regions with the potential for strong winds, or at locations where the pedestrian level wind environment was of special interest.

The detailed locations of the test points were shown in Appendix A5.

4 Detailed Study Result Analysis

4.1 Site functional areas

In this section, the wind performance at specific functional areas inside the development was assessed. Individual site evaluation for both Baseline Scheme and Proposed Scheme was conducted.

4.1.1 Site 2 – Block 1, 2, 3 and 4

The test points representing the wind performance of the functional areas in Site 2 for both schemes are illustrated in Figure 7 and Figure 8.

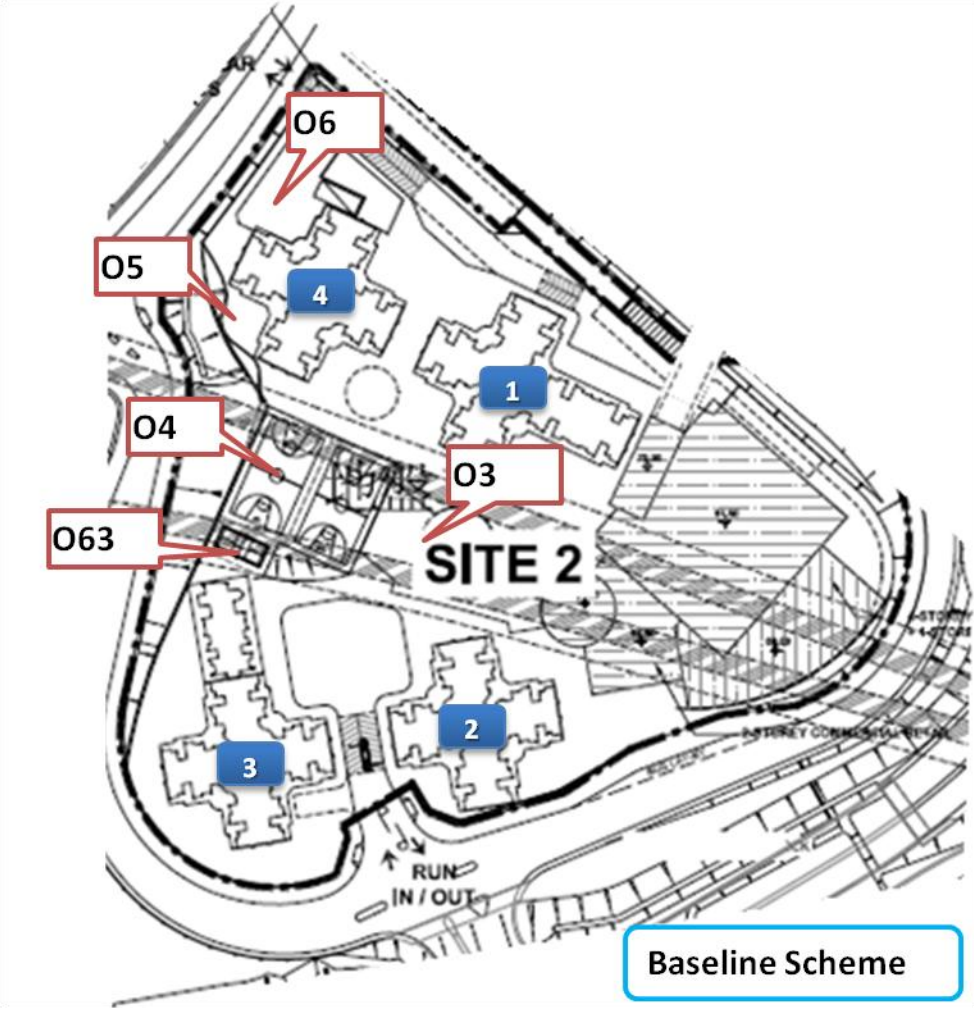

Figure 7 Site 2 Test Points for Baseline Scheme

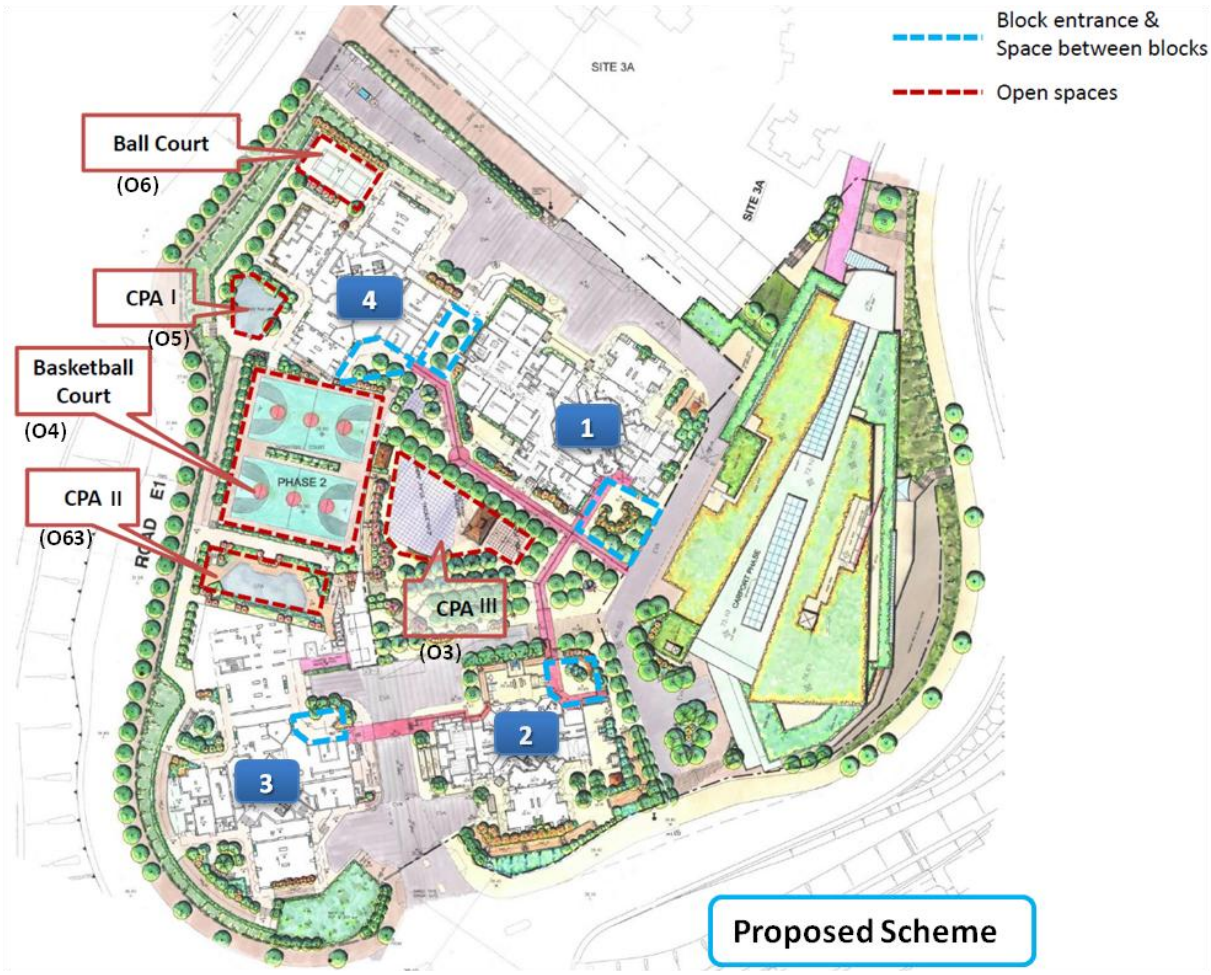

Figure 8 Site 2 Functional Areas and Test Points for Proposed Scheme

	Annual			Summer		
	Baseline	**Proposed**	**% Difference**	**Baseline**	**Proposed**	**% Difference**
Site 2 Overall						
	0.23	0.24	**4.3%**	0.28	0.28	**0.0%**
Functional Area of Site 2						
Ball Court (O6)	0.25	0.26	**4.0%**	0.27	0.26	**-3.7%**
Basketball Court (O4)	0.23	0.26	**13.0%**	0.28	0.30	**7.1%**
Community Play Area I (O5)	0.18	0.23	**27.8%**	0.23	0.27	**17.4%**
Community Play Area II (O63)	0.24	0.22	**-8.3%**	0.27	0.25	**-7.4%**
Community Play Area III (O3)	0.25	0.26	**4.0%**	0.30	0.30	**0.0%**

Table 1 VR values for Site 2 Functional Areas from Detailed Study

The VR values in Table 1 indicate the wind performance for each functional area in Site 2 under annual and summer conditions.

- The Proposed Scheme has generally better wind performance in most areas as compared with the Baseline Scheme (overall 4.3% improvement under annual condition);
- Although the Proposed Scheme attains a less VR value than the Baseline Scheme at Community Play Area II, the VR of 0.22 is considered acceptable.

4.1.2 Site 3A – Block 5, 6, 7 and 8

The test points representing the wind performance of the functional areas in Site 3A for both schemes are illustrated in Figure 9 and Figure 10.

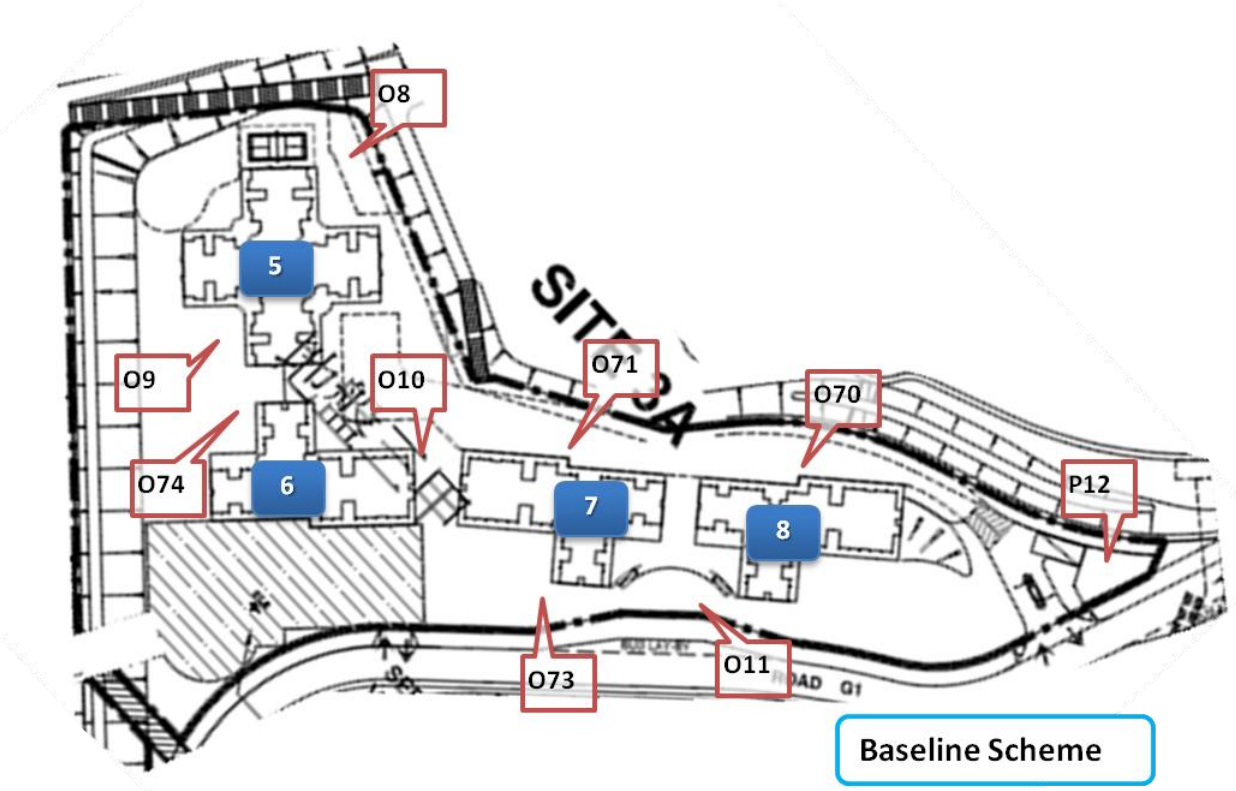

Figure 9 Site 3A Test Points for Baseline Scheme

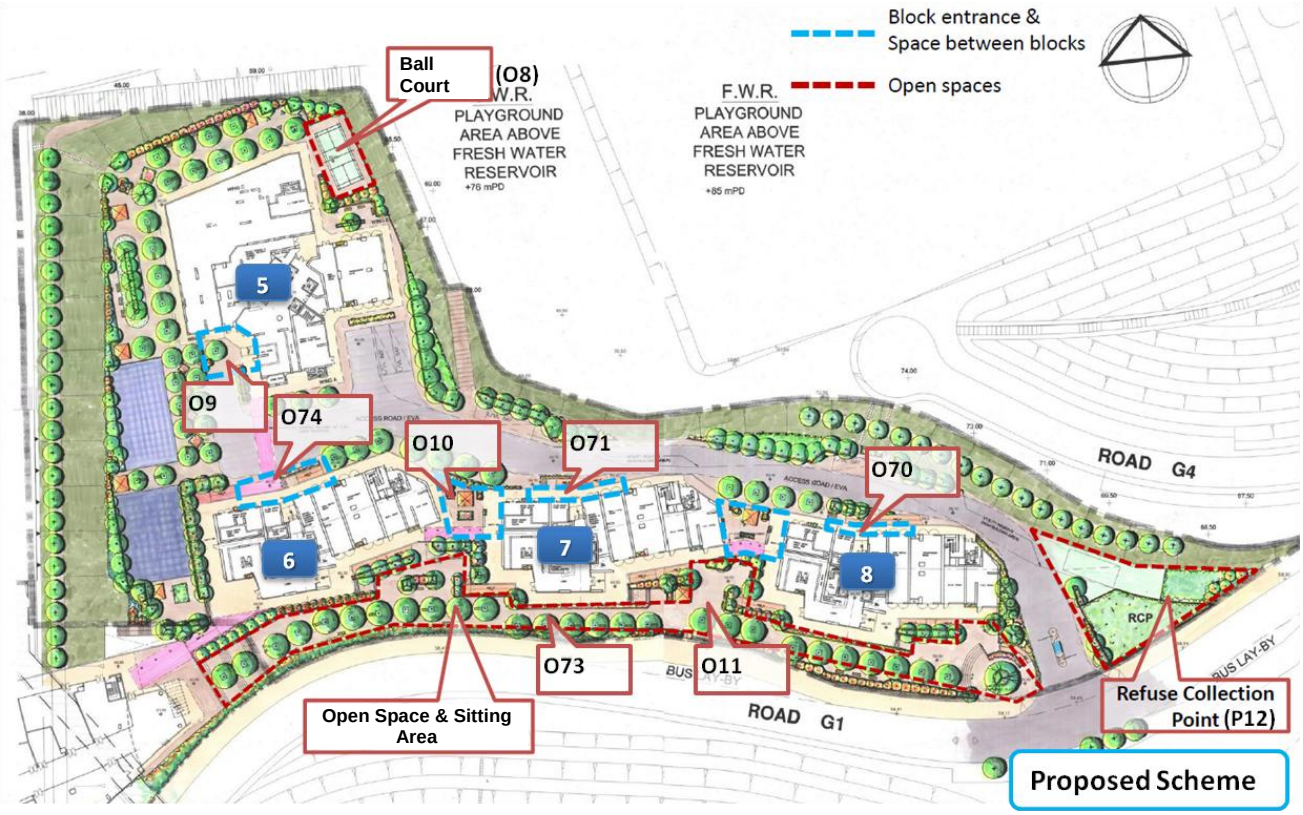

Figure 10 Site 3A Functional Areas and Test Points for Proposed Scheme

	Annual			Summer		
	Baseline	Proposed	% Difference	Baseline	Proposed	% Difference
Site 3A Overall						
	0.24	0.27	**12.5%**	0.27	0.28	**3.7%**
Functional Area of Site 3A						
Block 5 Entrance (O9)	0.27	0.29	**7.4%**	0.31	0.33	**6.5%**
Block 6 Entrance (O74)	0.28	0.36	**28.6%**	0.29	0.36	**24.1%**
Block 7 Entrance (O71)	0.16	0.19	**18.8%**	0.19	0.23	**21.1%**
Block 8 Entrance (O70)	0.20	0.26	**30.0%**	0.20	0.23	**15.0%**
Ball Court (O8)	0.25	0.28	**12.0%**	0.21	0.23	**9.5%**
Open Space & Sitting area (O10)	0.31	0.29	**-6.5%**	0.31	0.24	**-22.6%**
Open Space & Sitting area (O11)	0.27	0.3	**11.1%**	0.29	0.26	**-10.3%**
Open Space & Sitting area (O73)	0.16	0.17	**6.3%**	0.21	0.21	**0.0%**
RCP (P12)	0.34	0.33	**-2.9%**	0.34	0.34	**0.0%**

Table 2 VR values for Site 3A Functional Areas from Detailed Study

The VR values in Table 2 indicate the wind performance for each functional area in Site 3A under annual and summer condition:

- The Proposed Scheme has generally better wind performance as compared with the Baseline Scheme (overall 12.5% improvement for annual condition);
- Windy condition at RCP (P12) is likely to happen during annual and summer prevailing wind condition, which could help to dissipate the odour from the RCP;
- Although the annual VR values for the Proposed Scheme are lower than the Baseline one at Open Space & Sitting Area (O10) and RCP (P12), the VR values in these areas are equal to or above 0.29, which is considered acceptable.

4.1.3 Site 3B – Block 9, 10 11, 12 (and 13 in Baseline Scheme)

The test points representing the wind performance of the functional areas in Site 3B for both schemes are illustrated in Figure 11 and Figure 12.

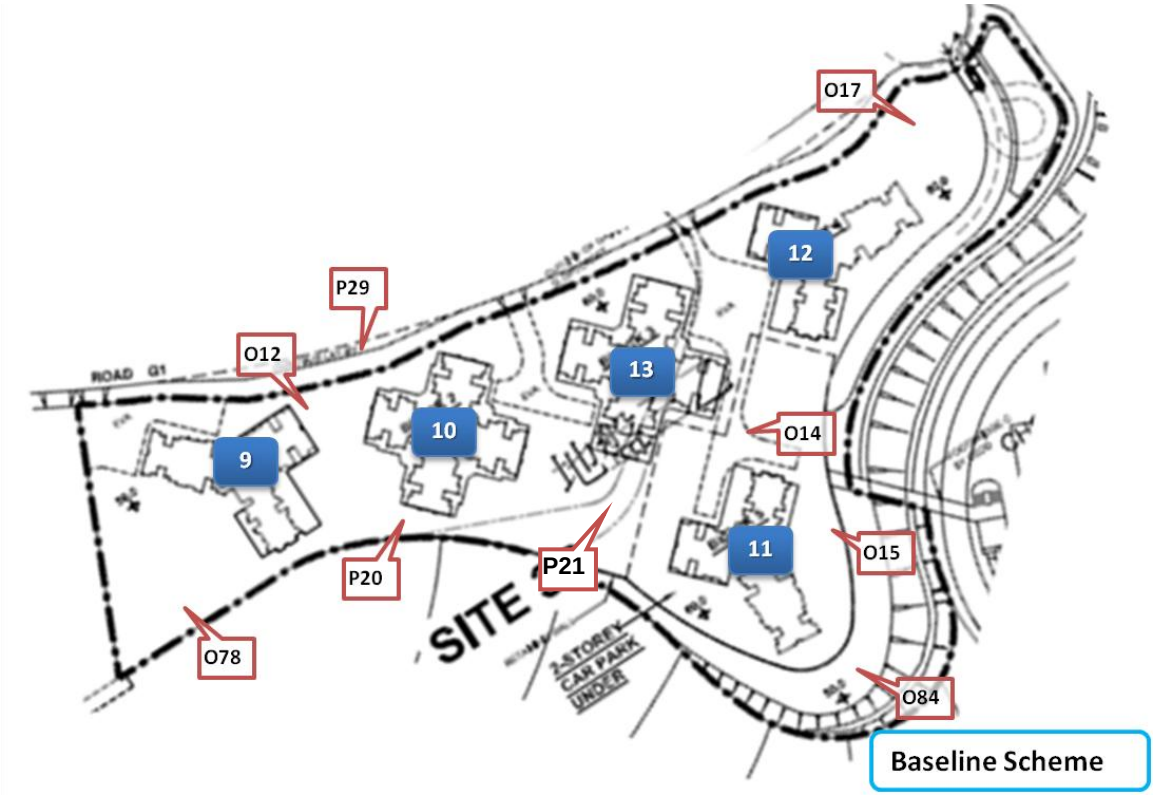

Figure 11 Site 3B Test Points for Baseline Scheme

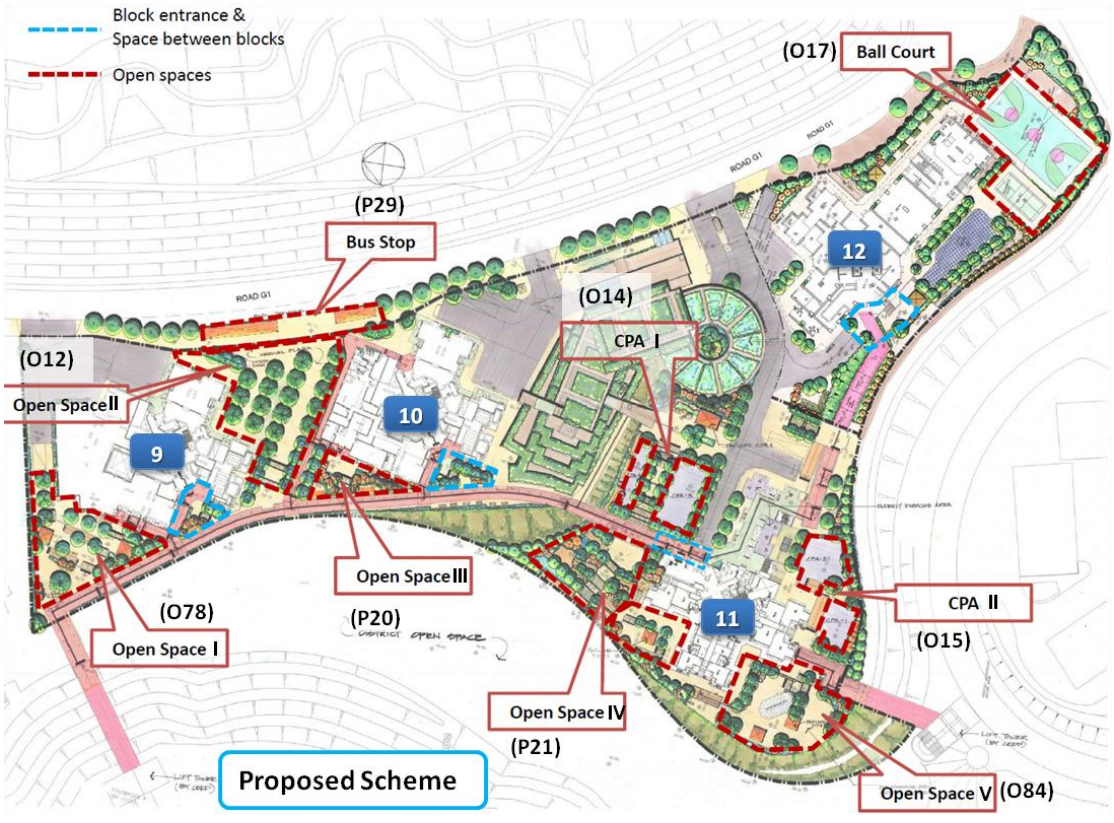

Figure 12 Site 3B Functional Areas and Test Points for Proposed Scheme

	Annual			Summer		
	Baseline	**Proposed**	**%Difference**	**Baseline**	**Proposed**	**% Difference**
Site 3B Overall						
	0.26	0.25	**-3.8%**	0.22	0.21	**-4.5%**
Functional Area of Site 3B						
Ball Court (O17)	0.22	0.22	**0.0%**	0.21	0.21	**0.0%**
Bus Stop (P29)	0.28	0.27	**-3.6%**	0.21	0.20	**-4.8%**
CPA I (O14)	0.26	0.28	**7.7%**	0.24	0.26	**8.3%**
CPA II (O15)	0.23	0.26	**13.0%**	0.21	0.22	**4.8%**
Open Space I (O78)	0.23	0.24	**4.3%**	0.18	0.19	**5.6%**
Open Space II (O12)	0.36	0.34	**-5.6%**	0.29	0.29	**0.0%**
Open Space III (P20)	0.29	0.30	**3.4%**	0.20	0.24	**20.0%**
Open Space IV (P21)	0.28	0.23	**-17.9%**	0.23	0.20	**-13.0%**
Open Space V (O84)	0.12	0.20	**66.7%**	0.15	0.19	**26.7%**

Table 3 VR values for Site 3B Functional Areas from Detailed Study

The VR values in Table 3 indicate the wind performance for each functional area in Site 3B under annual and summer conditions:

- Moderate wind condition with VR equal to or above 0.2 for both schemes occurred in most of the functional areas, which indicate the overall wind performance for the Site 3B is acceptable;
- Although in some functional areas, the VR values for the Proposed Scheme are lower than that of the Baseline Scheme, e.g. Bus Stop (P29), Open Space II (O12) and Open Space IV (P21).
- Furthermore, the VR values for the annual condition are maintained above 0.2 and the Proposed Scheme enhances the wind environment of the surrounding areas (Table 4 refers) due to the wind corridor design (Figure 14 refers).

4.2 Surrounding Areas

The Assessment Area was subdivided into the following representative zones according to their geographical locations and characteristics as shown in Figure 13. Wind performance of each focus area is summarized in Table 4.

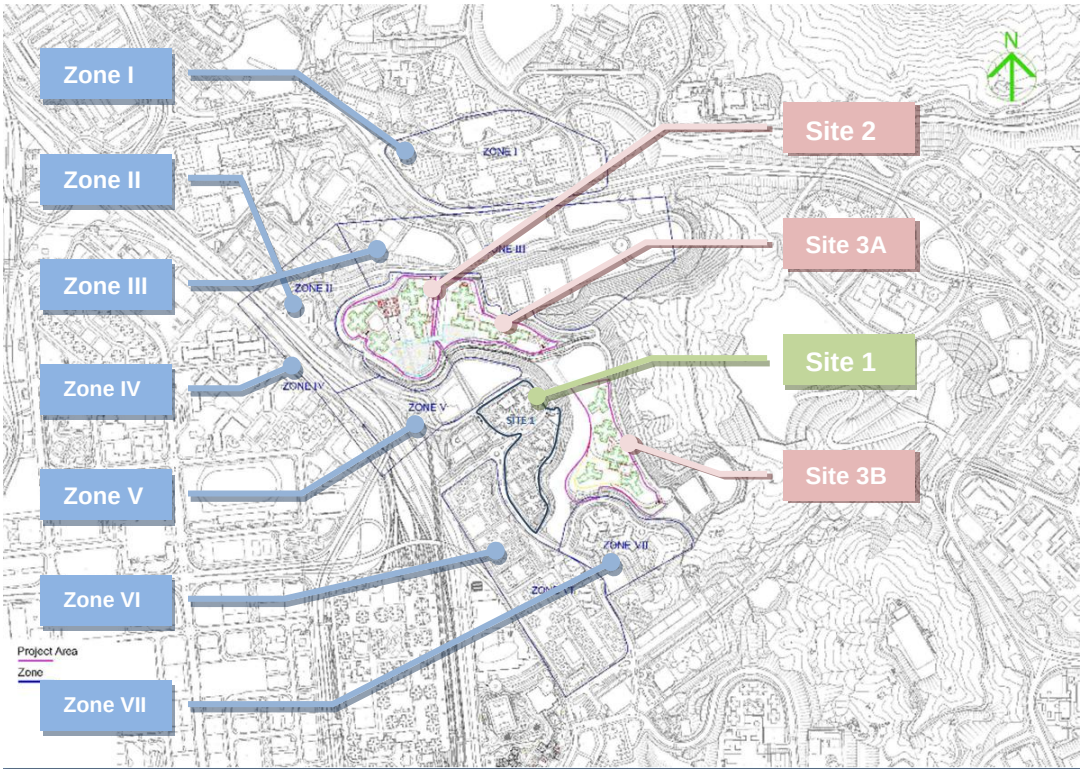

Figure 13 Focused Assessment Areas

	Average Velocity Ratio (VR)					
	Annual			Summer		
Zone	**Baseline**	**Proposed**	**% Difference**	**Baseline**	**Proposed**	**% Difference**
Site 1	0.18	0.19	**5.6%**	0.19	0.19	**0.0%**
Zone I	0.17	0.17	**0.0%**	0.20	0.20	**0.0%**
Zone II	0.17	0.17	**0.0%**	0.20	0.20	**0.0%**
Zone III	0.24	0.25	**4.2%**	0.25	0.26	**4.0%**
Zone IV	0.18	0.18	**0.0%**	0.19	0.19	**0.0%**
Zone V	0.15	0.15	**0.0%**	0.17	0.17	**0.0%**
Zone VI	0.16	0.16	**0.0%**	0.17	0.17	**0.0%**
Zone VII	0.22	0.22	**0.0%**	0.21	0.21	**0.0%**

Table 4 VR values for the Surrounding Areas

The VR values in Table 4 illustrate the wind performance for each surrounding area within the assessment area under annual and summer conditions:

- The VR values for most of the surrounding areas for Proposed Scheme and Baseline Scheme are the same, which means that their impacts to the surrounding areas are similar in terms of ventilation performance;
- Improvement in ventilation performance is found in Zone III and Site 1 by 4% to 6% in the Proposed Scheme.

4.3 Effectiveness of Wind Corridor and Louvre Design

4.3.1 Wind Corridors

Three main wind corridors for the Choi Wan Road Development identified in the Initial Study are shown in Figure 14 below:

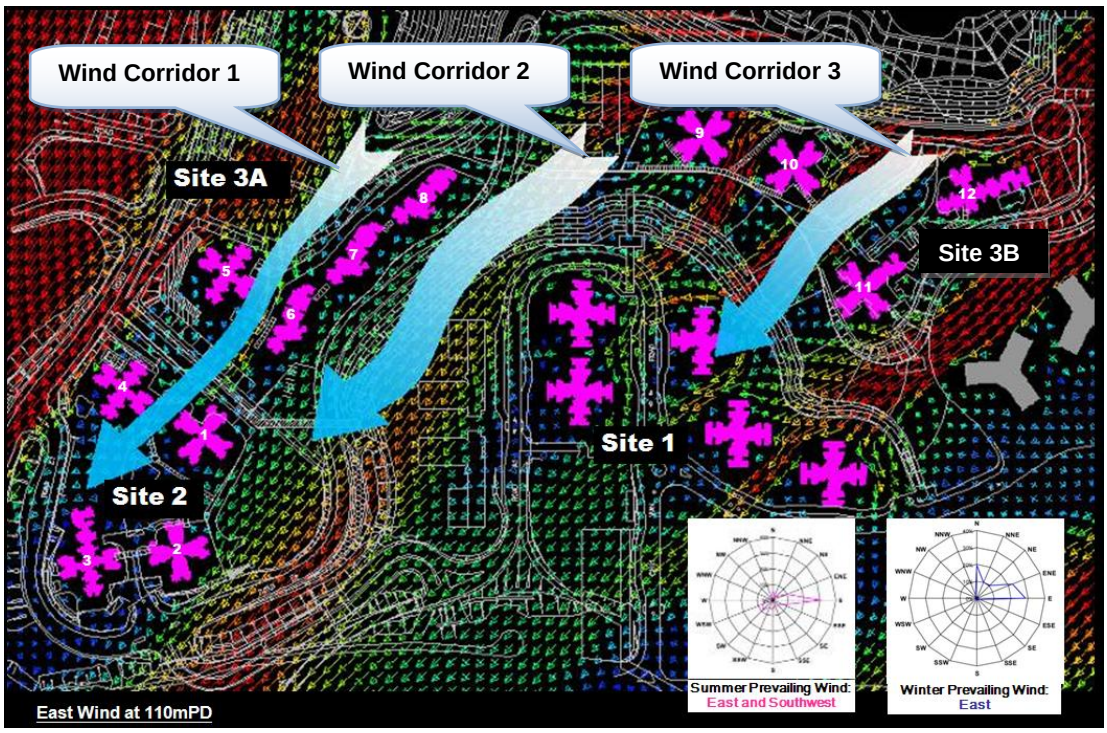

Figure 14 Main wind corridor proposed in the Initial AVA Study

To illustrate the effectiveness of the proposed wind corridors, the wind tunnel VR values of the three wind corridors in the Proposed Scheme are compared with the Local Velocity Ratio (LVR) value. The VR values for the three wind corridors are shown in Table 5:

Wind Corridor	Average VR
1	0.25
2	0.24
3	0.24

Table 5 VR of wind corridors in the Proposed Scheme (annual prevailing wind condition)

The average VR values of these proposed wind corridors are all greater than the LVR (0.22) of the Proposed Scheme, which proves that the wind corridor design contributes 10% -15% enhancement in ventilation.

4.3.2 Block Louvre Shape Design

The louvre shape building block proposed in the Initial Study stage is shown in Figure 15. Four wind fingers are created in this design to enhance air ventilation:

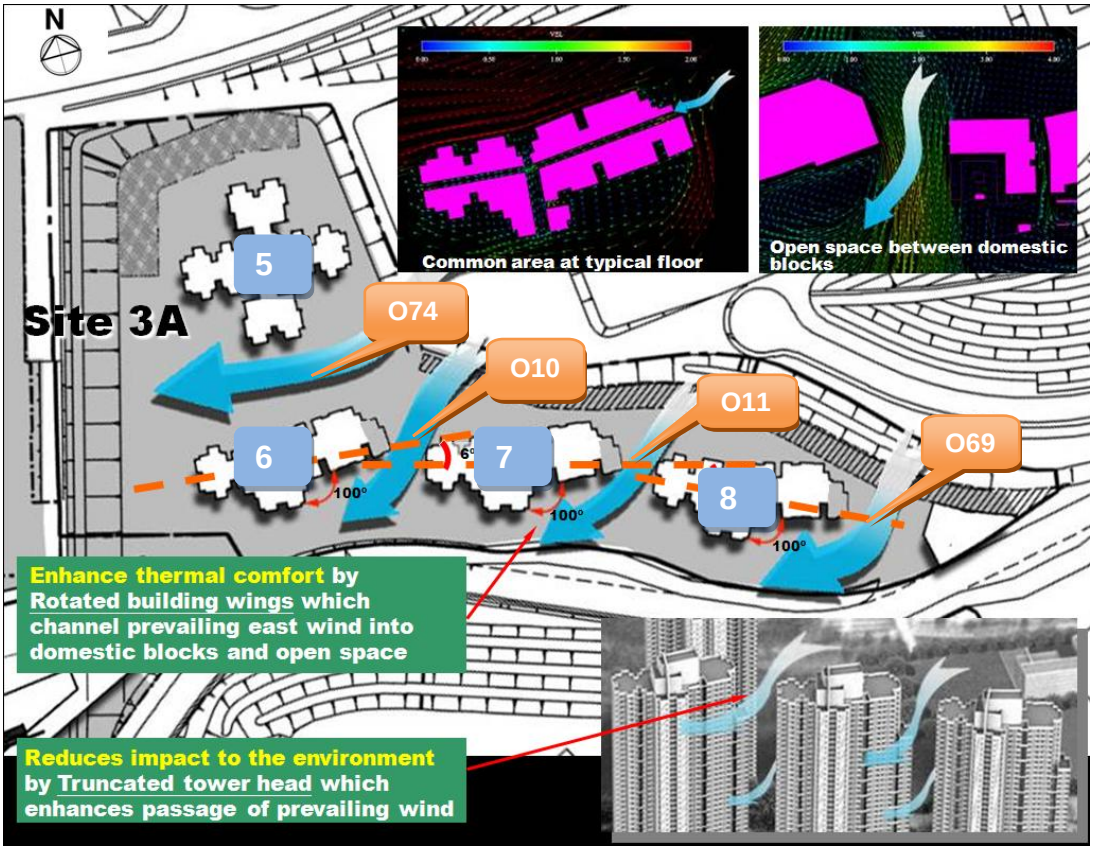

Figure 15 Louvre shape building design in the Initial AVA Study

Wind Fingers	Test point	VR
I (Between Block 5 & 6)	O74	0.36
II (Between Block 6 & 7)	O10	0.29
III (Between Block 7 & 8)	O11	0.30
IV (between Block 8 and Site 3A boundary)	O69	0.33

Table 6 VR of wind fingers in Site 3A of the Proposed Scheme (annual prevailing wind condition)

As shown in Table 6, the VR values of all wind fingers exceed the LVR (0.22) of the Proposed Scheme, which demonstrates that the louvre shape building design could effectively enhance the local air ventilation.

5 Conclusion

Based on the Detailed AVA Study for Public Housing Development at Choi Wan Road Site 2, 3A and 3B (with study area covering Site 1), the wind performance of the overall site and its surrounding areas and effectiveness of the wind enhancement design are summarized as below:

In general, the site and its surroundings could enjoy good wind environment with average VR greater than 0.2.

Design Schemes	Overall Assessment Area VR Results			
	SVR		LVR	
	Annual	Summer	Annual	Summer
Baseline Scheme	0.24	0.25	0.21	0.21
Proposed Scheme	0.25	0.25	0.22	0.22

The table above shows no significant difference between the two tested schemes. It is mainly due to similar building layout and building disposition between two schemes. The Proposed Scheme provides better wind performance than the Baseline Scheme with around 5% improvement, in both summer and annual conditions.

The improvement is due to design optimizations:

- Omission of Block 13 in Baseline Scheme at Site 3B, which is replaced by the low-rise carpark block in the Proposed Scheme and one wind corridor is created under the prevailing wind condition;
- Louvre effect shape of block layout at Site 3A in order to achieve better wind penetration;
- Change of building block shape for Block 1, 2, 3, 4, 6, 7, 8, 9, 11 and 12;
- Widening of wind corridors between Block 1&4, 2&3, and 5&6.

Appendix A

Wind Tunnel Test for Detailed AVA Study

A1 1:2000 Scale Physical models for Choi Wan Site Wind Availability Study

Figure 16 1:2000 scale topographical model in the low speed test section (Study Area A, north wind direction, 360°)

Figure 17 1:2000 scale topographical model in the low speed test section (Study Area B, north wind direction, 360°)

A2 Wind Rose from the Wind Availability Study

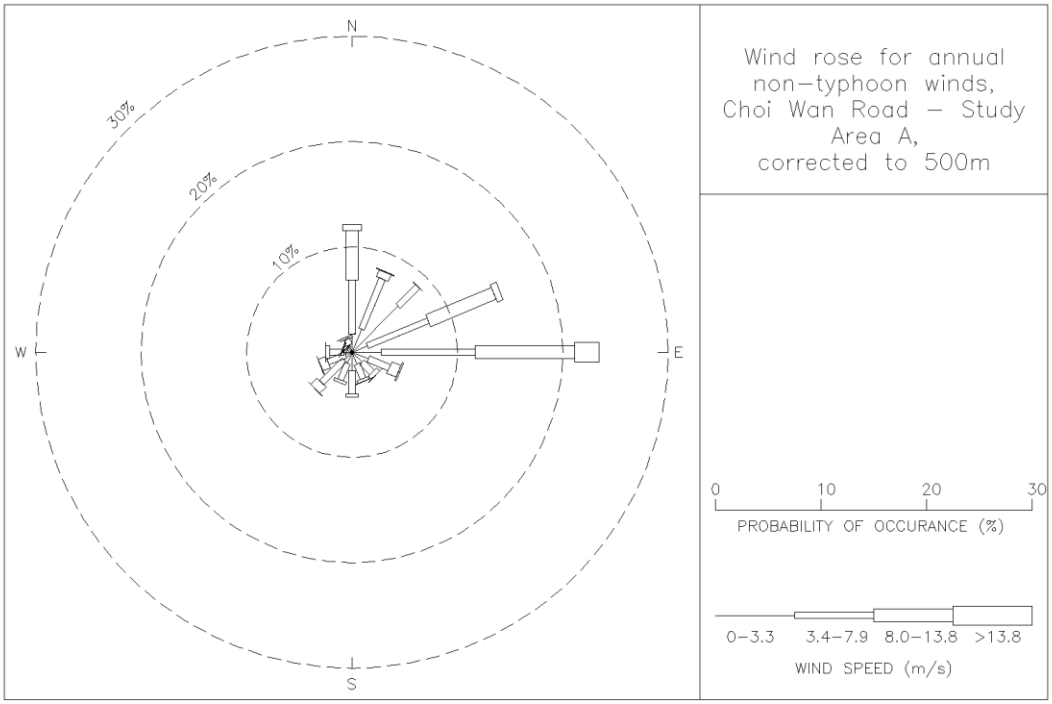

Figure 18 Wind rose for annual, non-typhoon winds for Choi Wan Road Study Area A, corrected to 500 m

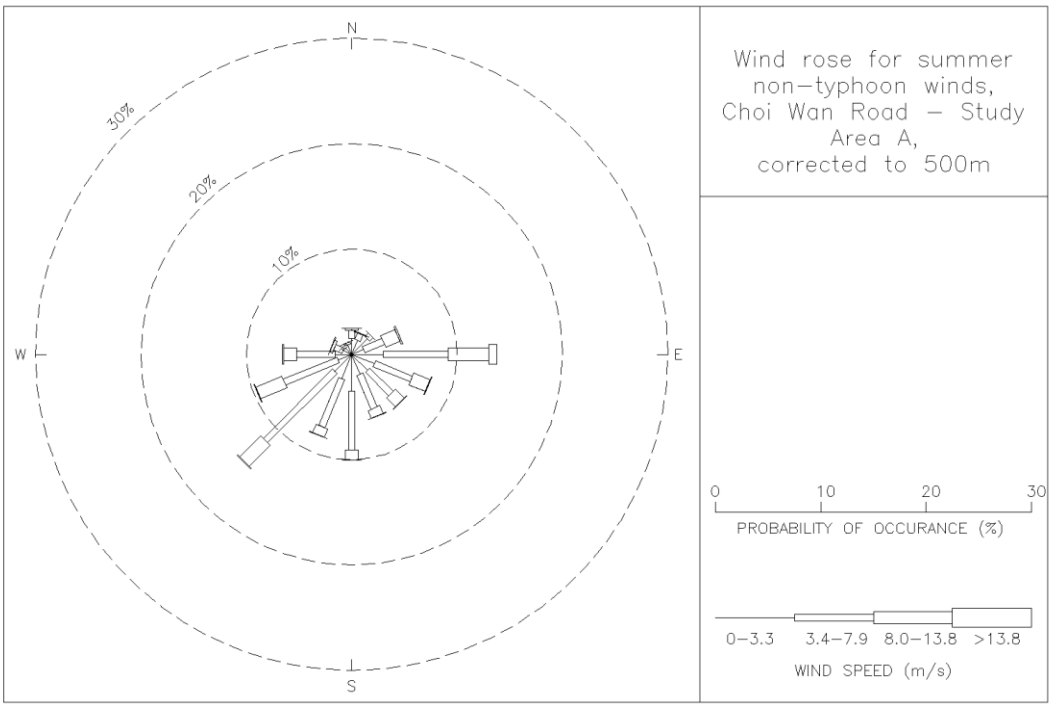

Figure 19 Wind rose for summer, non-typhoon winds for Choi Wan Road Study Area A, corrected to 500 m

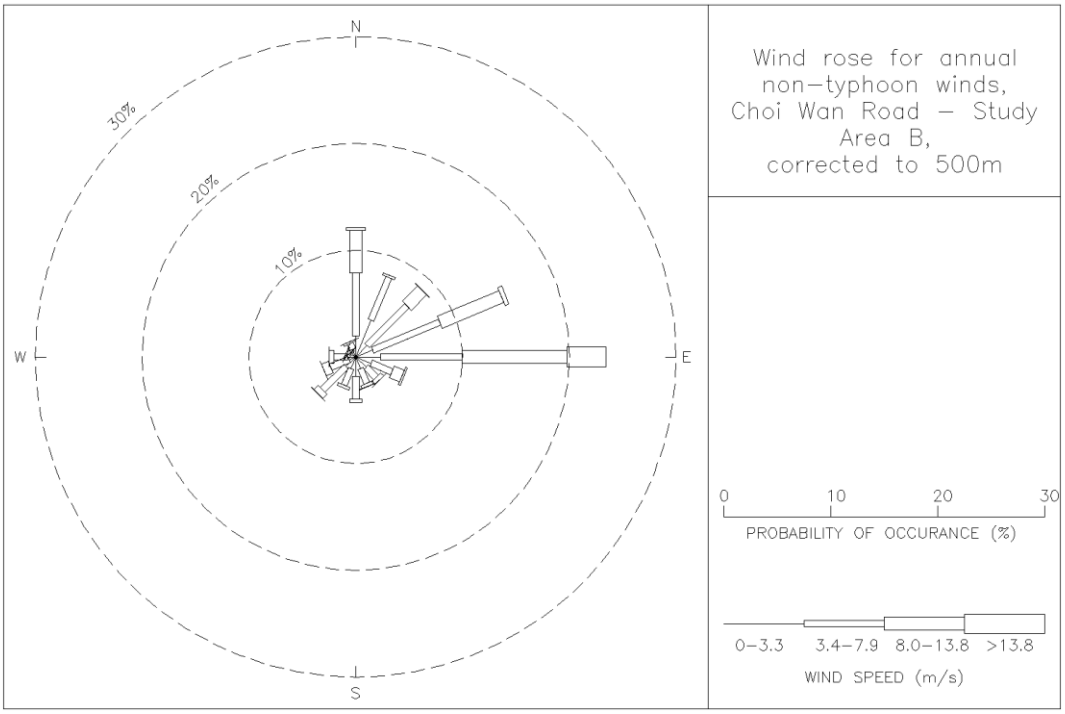

Figure 20 Wind rose for annual, non-typhoon winds for Choi Wan Road Study Area B, corrected to 500 m

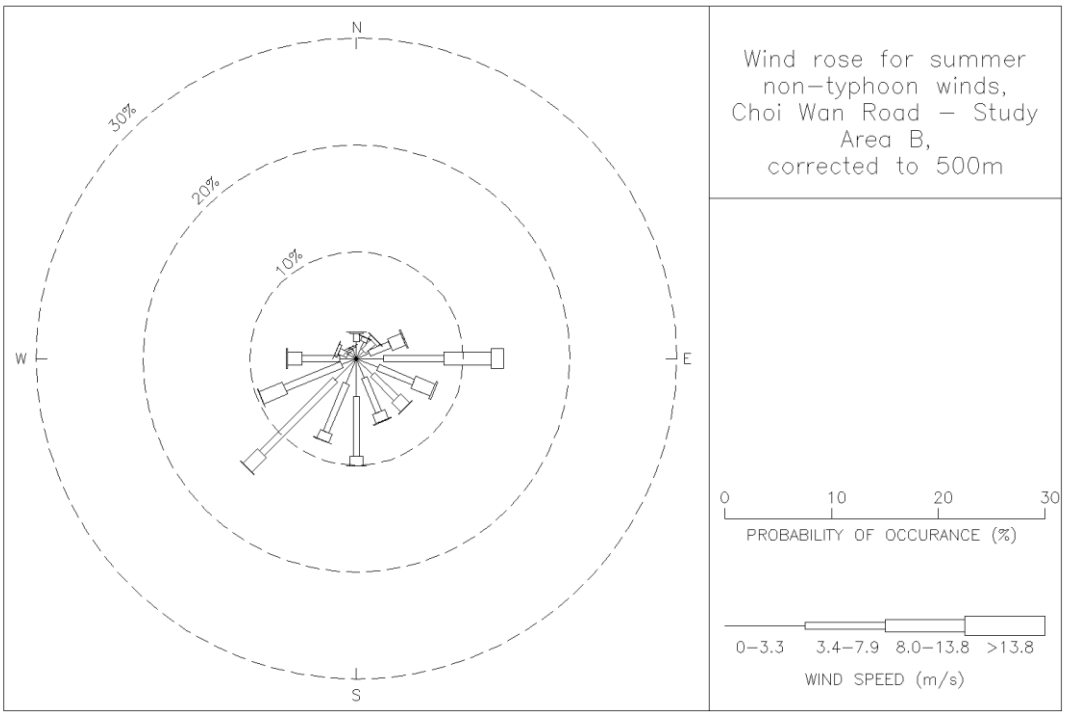

Figure 21 Wind rose for summer, non-typhoon winds for Choi Wan Road Study Area B, corrected to 500 m

A3 Project, Assessment and Surrounding Areas for the Detail AVA Study

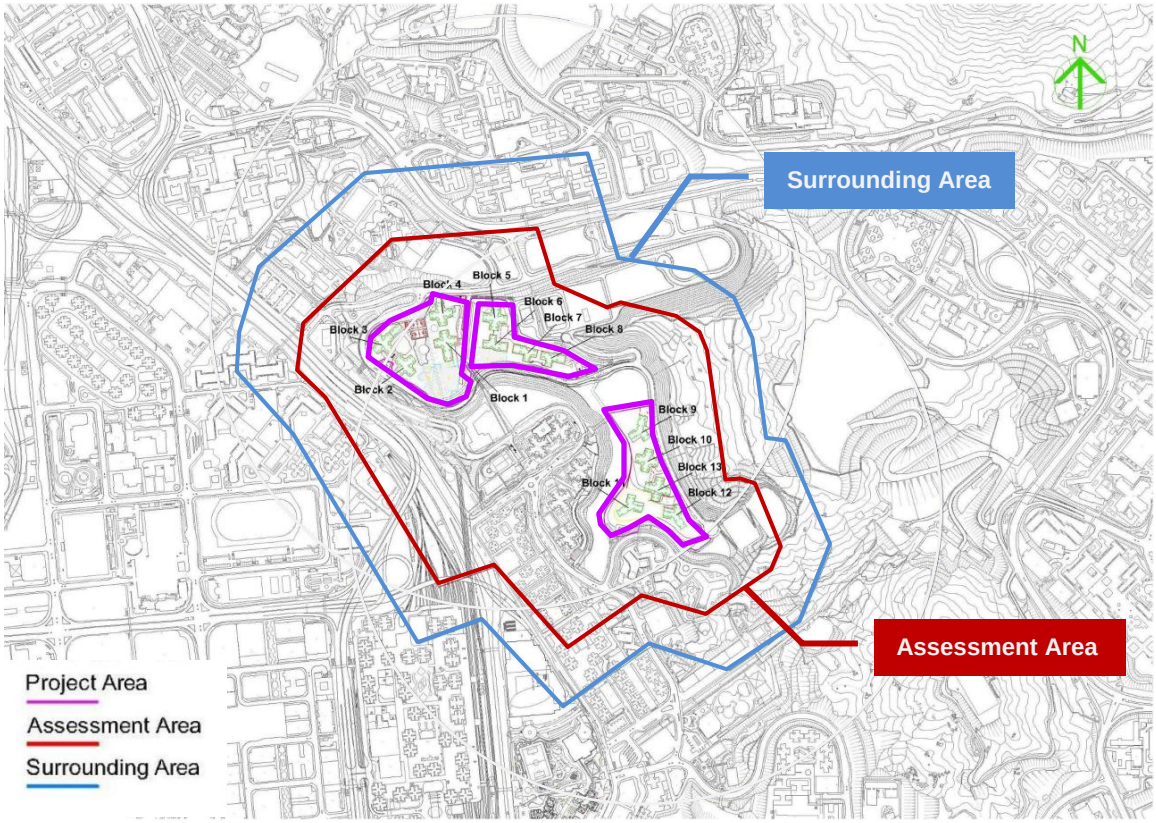

Figure 22 Project, Assessment and Surrounding Areas for the Baseline Scheme

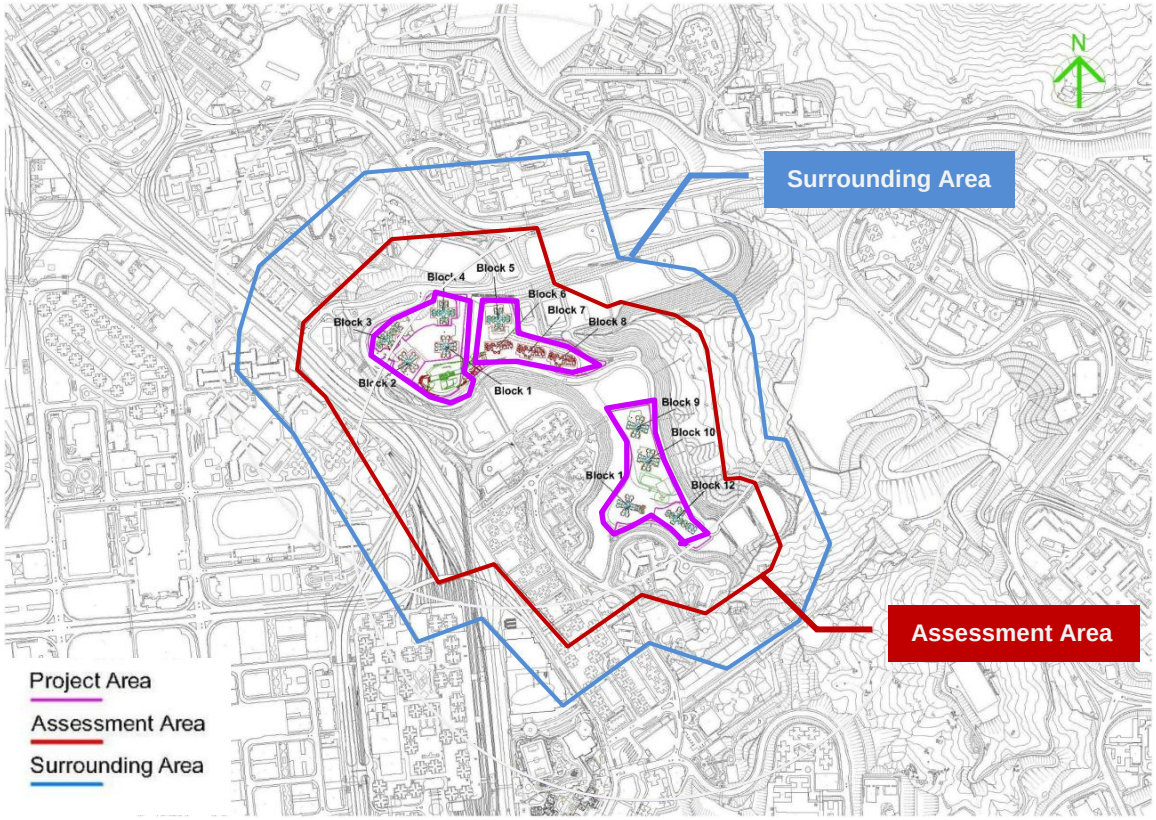

Figure 23 Project, Assessment and Surrounding Areas for the Proposed Scheme

A4 1:400 Scale Physical models for Choi Wan Road Site Detailed AVA Study

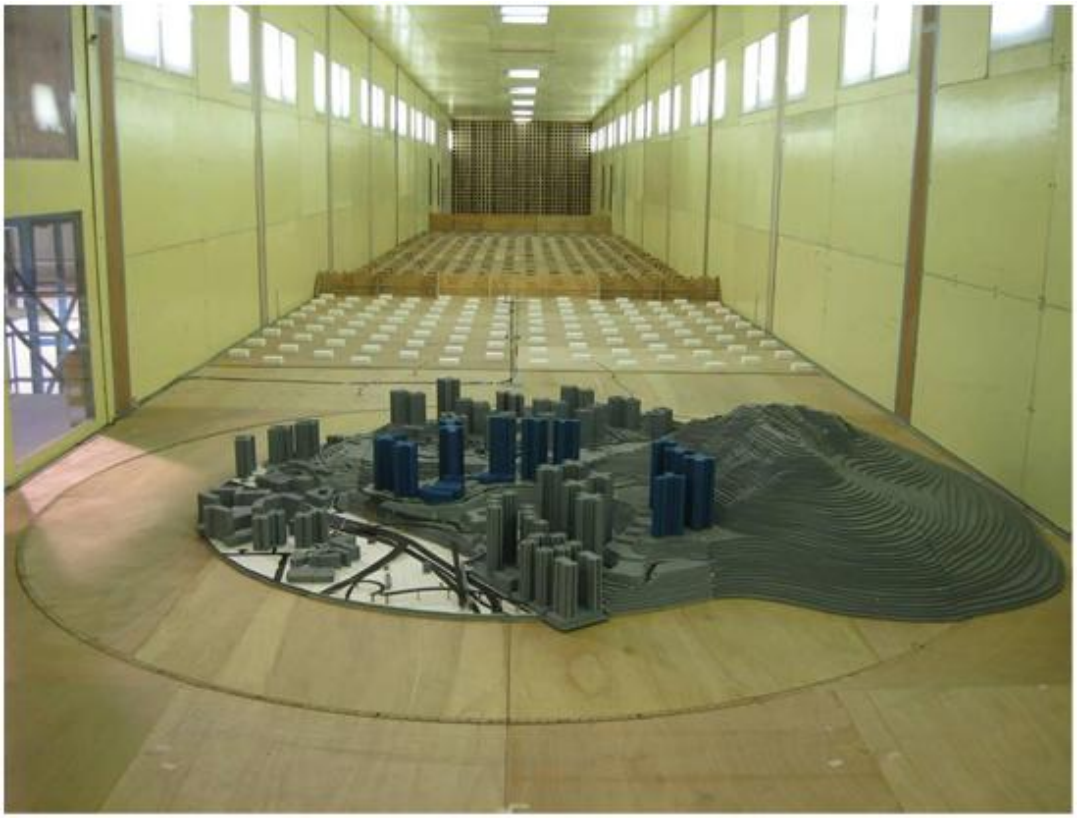

Figure 24 1:400 scale physical model of the Choi Wan Road Sites Study Area A and surrounds, Baseline Scheme, downstream view of north wind direction

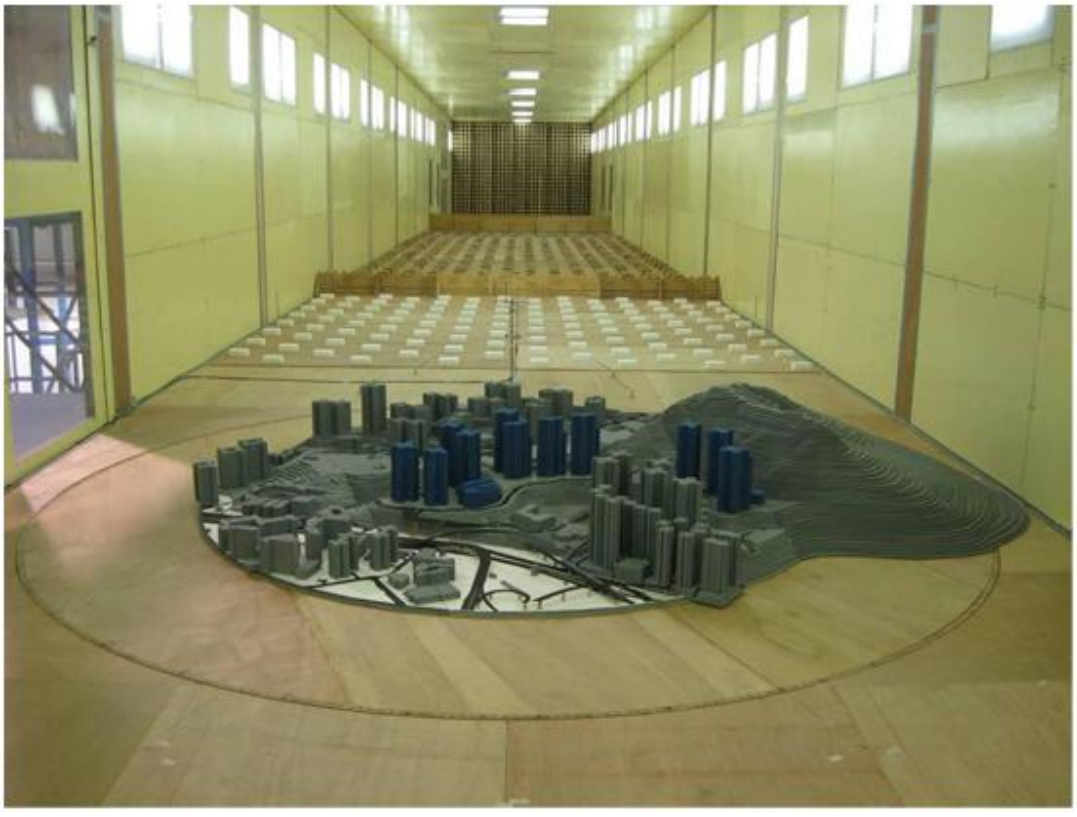

Figure 25 1:400 scale physical model of the Choi Wan Road Sites Study Area A and surrounds, Proposed Scheme, downstream view of north wind direction

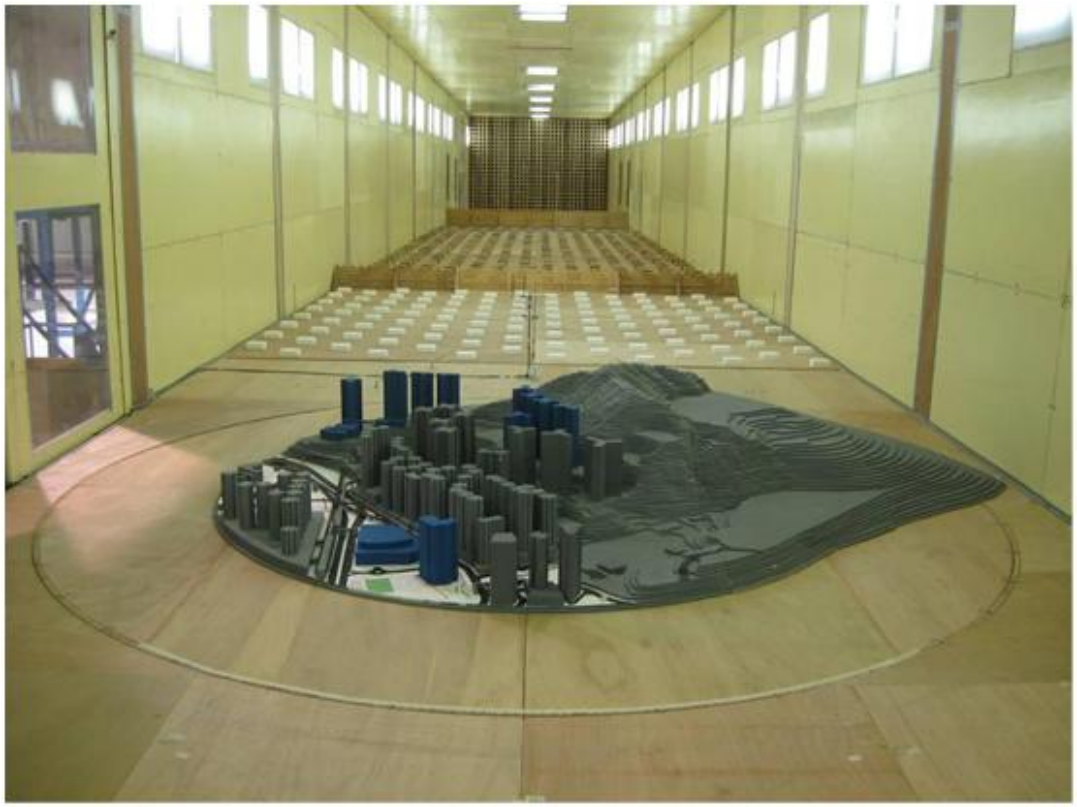

Figure 26 1:400 scale physical model of the Choi Wan Road Sites Study Area B and surrounds, Baseline Scheme, downstream view of north wind direction

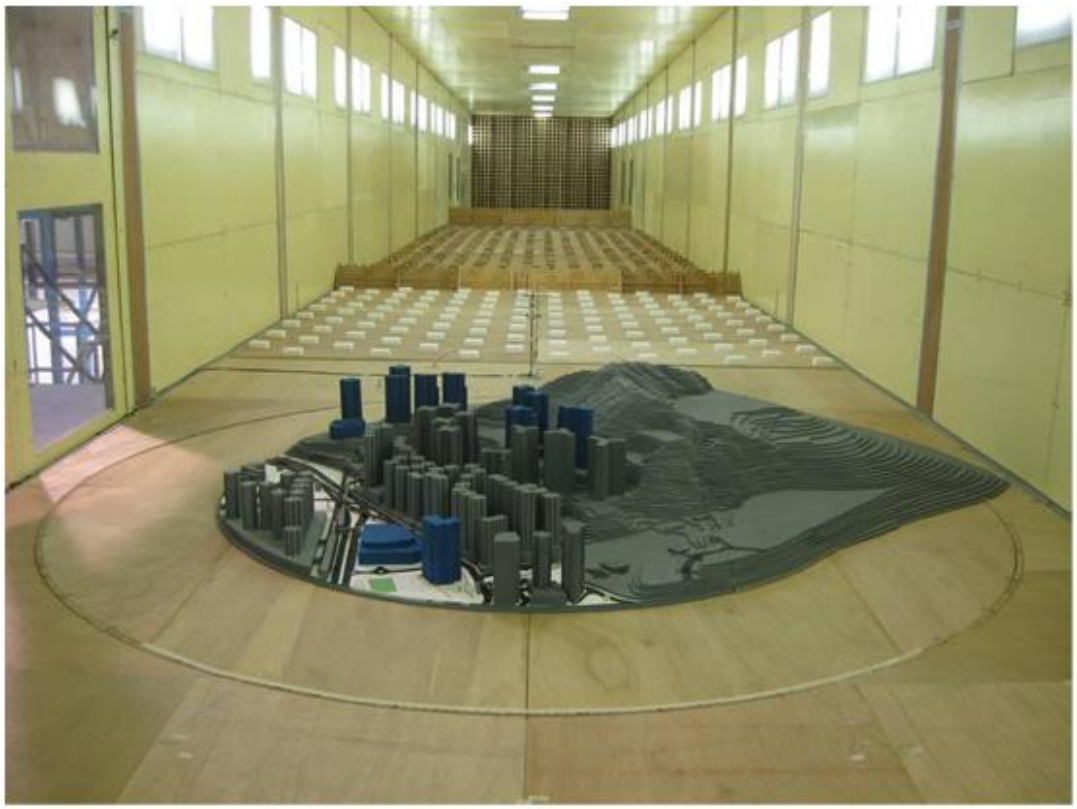

Figure 27 1:400 scale physical model of the Choi Wan Road Site Study Area B and surrounds, Proposed Scheme, downstream view of north wind direction

A5 Location of the test points for the Detailed AVA Study

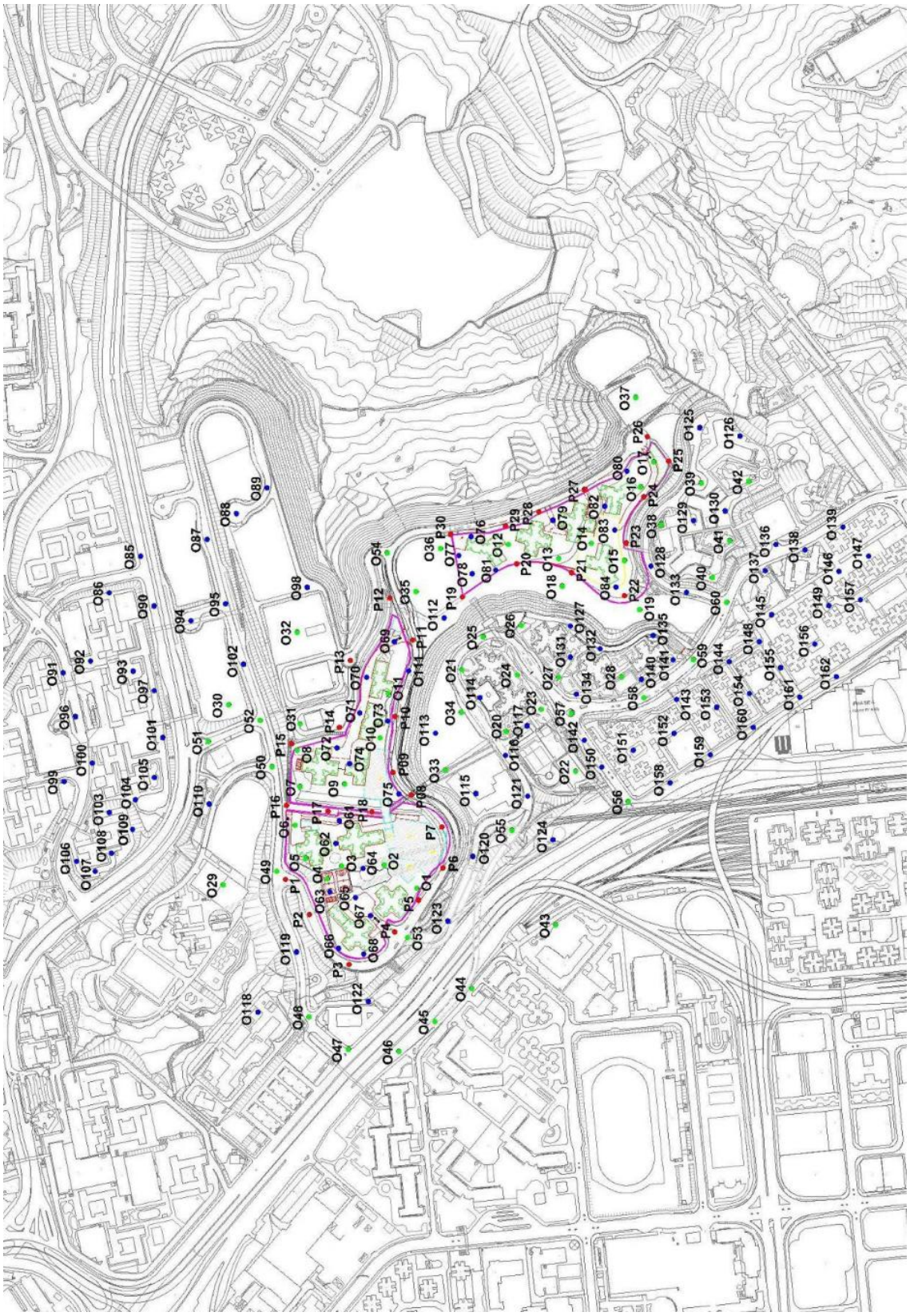

Figure 28 Test point locations for the Baseline Scheme

O = Overall test points

P = Perimeter test points

S = Special test points

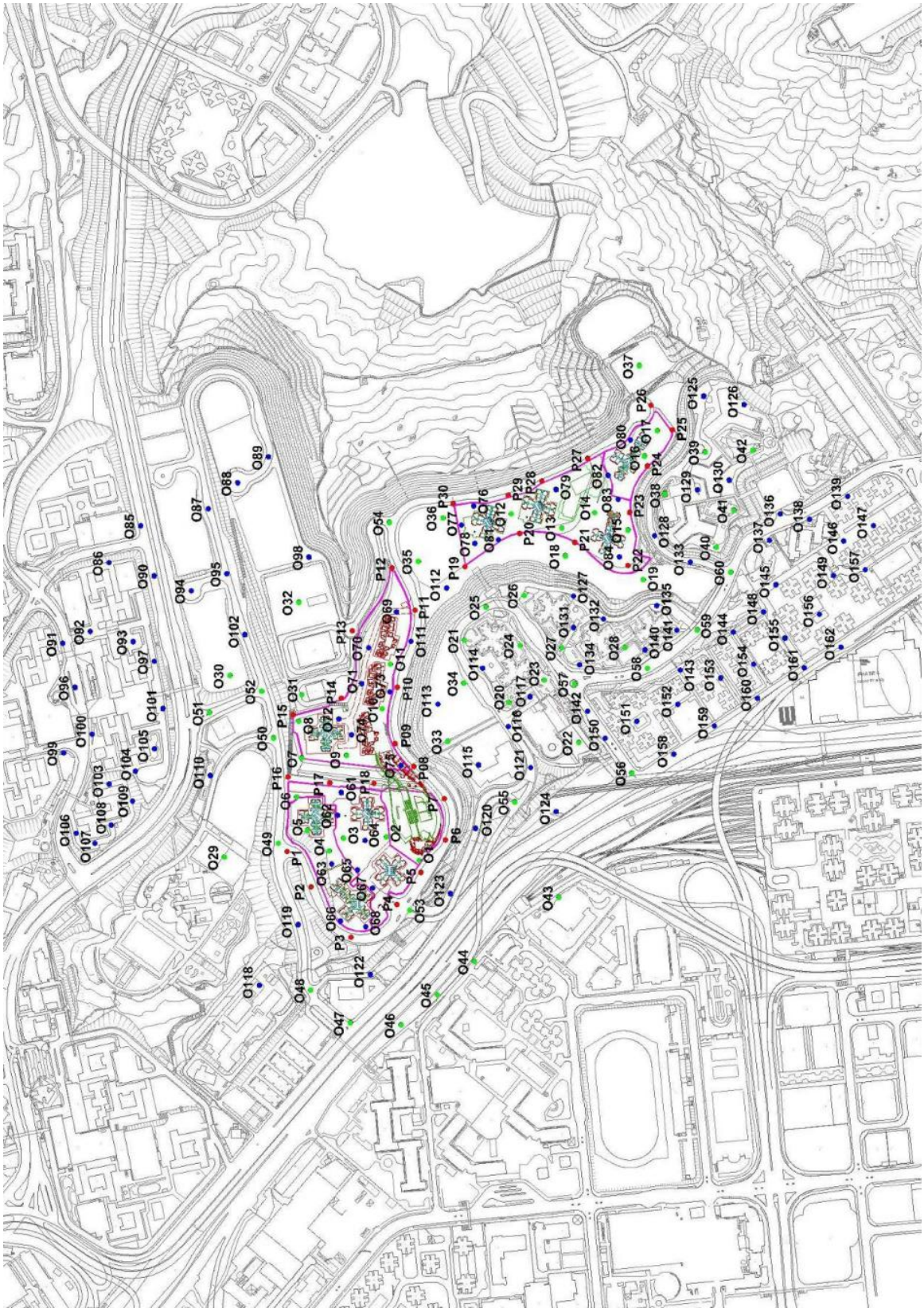

Figure 29 Test point locations for the Proposed Scheme

A6 Annual overall wind velocity for the Baseline and Proposed Schemes

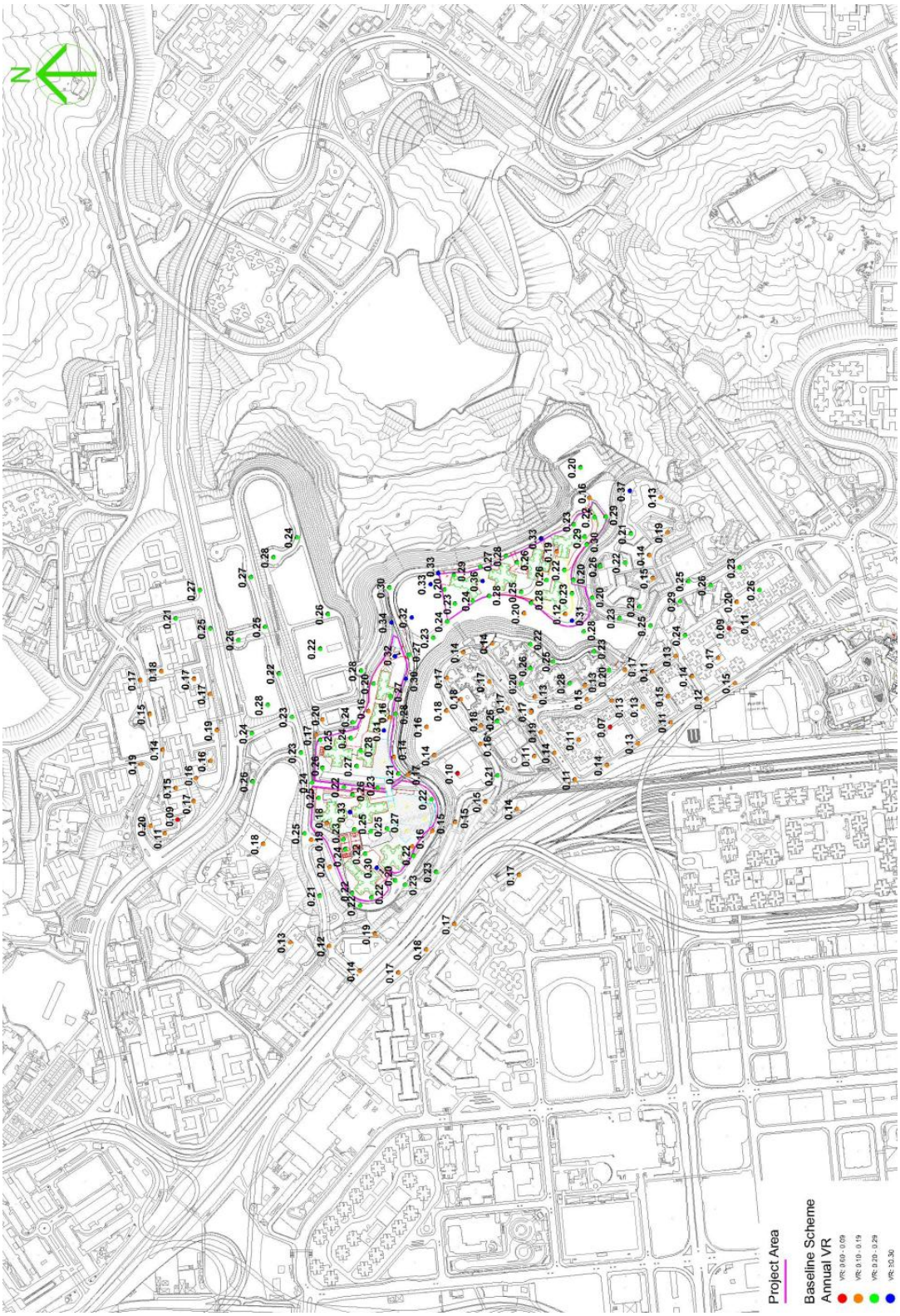

Figure 30 Annual overall wind velocity ratios for all test points, Baseline Scheme

Figure 31 Annual overall wind velocity ratios for all test points, Proposed Scheme

A7 Summer overall wind velocity for the Baseline and Proposed Schemes

Figure 32 Summer overall wind velocity ratios for all test points, Baseline Scheme

Figure 33 Summer overall wind velocity ratios for all test points, Proposed Scheme