

Planning Department

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**Category A1 - Term Consultancy for  
Expert Evaluation and Advisory Services on  
Air Ventilation Assessment**

**For an Instructed Project for Potential  
Housing Sites in Ma On Shan Area**

**Expert Evaluation – Final Report**

March 2015

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## 1 INTRODUCTION

### Background

- 1.1 To increase land supply to meet the housing needs of Hong Kong, the Government has continued reviewing various land uses and rezoning sites as appropriate and, where the original intended use is no longer required, converting the land for housing development.
- 1.2 There are two potential development sites in Ma On Shan area namely the Whitehead site and Hang Kin Street site. The Whitehead site (namely Study Area A hereafter) is located near the existing Whitehead Golf Driving Range, north of Wu Kai Sha MTR Station while the Hang Kin Street site (namely Study Area B hereafter) is located to the west vicinity of Heng On MTR Station.
- 1.3 In November 2014, AECOM Asia Company Ltd. was commissioned by the Hong Kong Planning Department (PlanD) to undertake an Expert Evaluation Study for the Development Schemes within Study Area A and Study Area B to examine the air ventilation performance of various development building designs and layouts qualitatively.
- 1.4 This expert evaluation report is based on the following materials given by the PlanD to the Consultant:
- Ma On Shan Outline Zoning Plan
  - Indicative Layouts of Potential Residential Developments at Hang Kin Street Site and Whitehead site which are the schemes adopted for assessment within the Study Areas
  - Base Map of Ma On Shan Area
  - Indicative Layouts of Existing and Committed Developments within Ma On Shan Area
  - Term Consultancy for Expert Evaluation on Air Ventilation Assessment for Ma On Shan Area (February 2009)
  - Public Rental Housing Development at Ma On Shan Area 86B (September 2010)
  - Technical Assessment to Support Section 16 Application under the Town Planning Ordinance for “CDA(3)” Site at Whitehead, Ma On Shan (1st Quarter 2014)
- 1.5 In the preparation stage of the expert evaluation report, the Consultant has studied the given materials listed in paragraph 1.4 and carried out site visit and inspection.

### Objectives of the Expert Evaluation Study

- 1.6 The expert evaluation study has made reference to Technical Circular No. 1/06 issued jointly by the Housing, Planning and Lands Bureau and Environment, Transport and Work Bureau.
- 1.7 The key purposes of the Expert Evaluation are to identify the good design features of the proposed development layouts, identify obvious problematic areas (if any) and propose appropriate mitigation measures if necessary. Determination of whether further Initial Study or Detailed Study is required would be based on the findings of the Expert Evaluation.
- 1.8 This Expert Evaluation Report aims to present the following findings in a systematic approach as follows:
- Analyse the relevant wind data to understand the wind environment of the Study Areas and its surroundings;

- Identify and analyse the major topographical features of the Study Areas and their immediate vicinity. In addition, greeneries/landscape characteristics of the Study Areas as well as its surroundings will also be identified;
- Identify and analyse the land use and built form of the Study Areas as well as its immediate surrounding areas including existing developments and committed future developments;
- Based on the wind data, identify wind paths and wind flow characteristics of the Study Areas through open spaces, streets, gaps and non-building areas between buildings and also identify stagnant/shadow zones if they exist;
- Based on the analyses of existing urban conditions, identify existing good features that shall be retained/strengthened at the same time spotting wind problematic regions that warrant attention;
- Based on the understanding of existing urban conditions, evaluate and compare qualitatively the prima facie impact, merits or demerits of different development restrictions within the Study Areas as proposed by the PlanD on pedestrian wind environment, focusing on public areas frequented by pedestrians in the existing/committed/planned condition, and advise on whether the pedestrian wind environment could likely be better, similar or worsen under each restriction. In addition, problematic areas will be highlighted and improvements/mitigation measures will be proposed with reference to the Urban Design Guidelines in the “Hong Kong Planning Standards and Guidelines” and also relevant statutory plans, building regulations and planning briefs; and
- Recommend if further initial study/detailed study for the Study Areas is required.

#### **Content of this Report**

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

- Section 2 on evaluation of the Whitehead Site (Study Area A);
- Section 3 on evaluation of the development site at Hang Kit Street (Study Area B) and
- Section 4 is the Summary and Conclusion

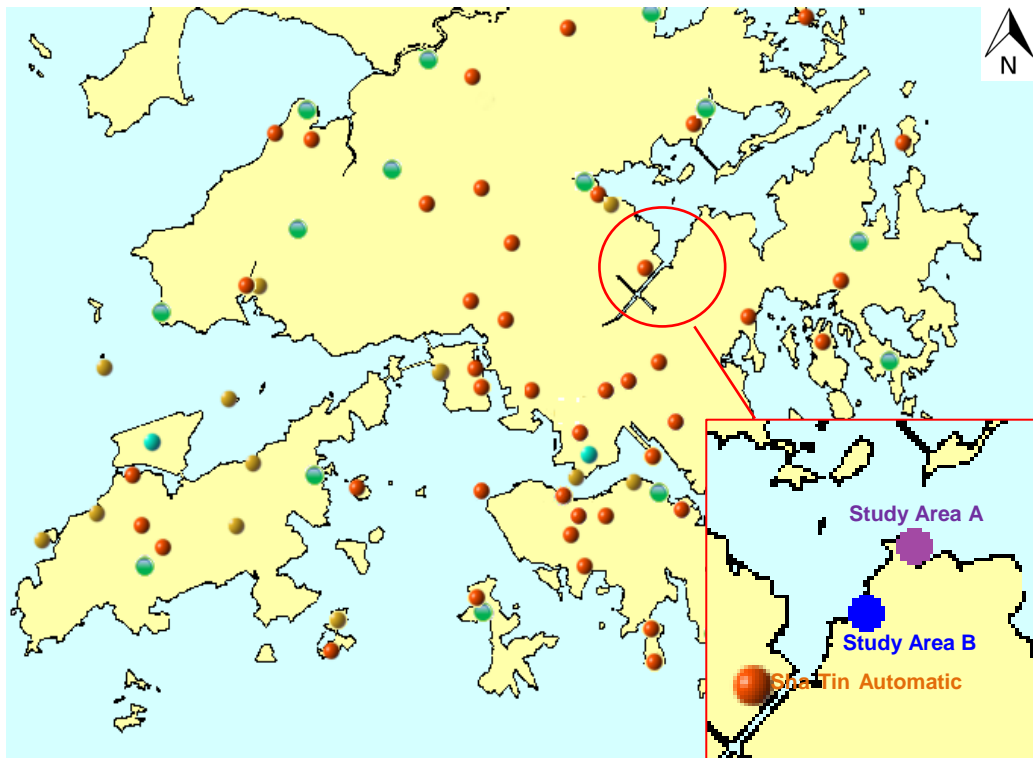
## 2 EVALUATION ON WHITEHEAD SITE – STUDY AREA A

### 2.1 Natural Wind Availability (Whitehead Site – Study Area A)

2.1.1 Natural wind availability is crucial to the investigation of wind ventilation performance. In this section, relevant measured wind data from the Hong Kong Observatory (HKO) weather stations and computed wind data from the MM5 model near the Study Area are analysed and compared to identify the prevailing wind directions.

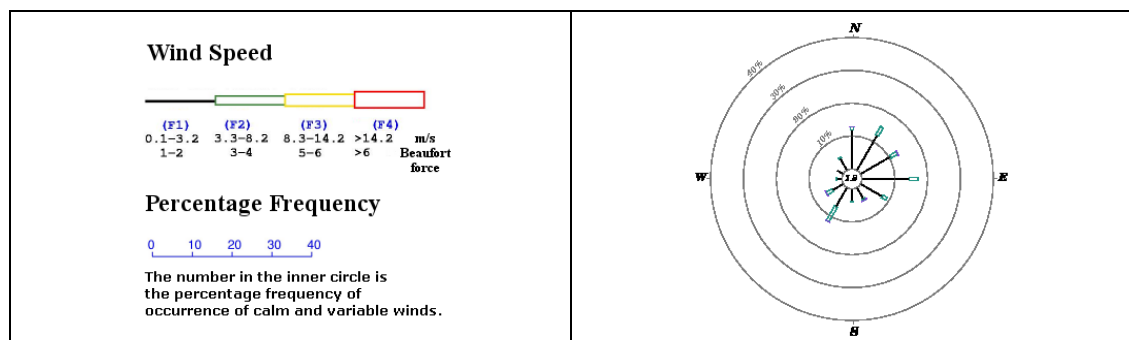
#### Wind Direction Analysis based on HKO Weather Stations' Data

2.1.2 There are a total of 46 weather stations (See **Figure 2.1**) operated by HKO which provide reliable data on the wind environment in Hong Kong. The wind information and weather data from these stations provide reference to aid a general understanding of the surface wind environment especially near pedestrian level.

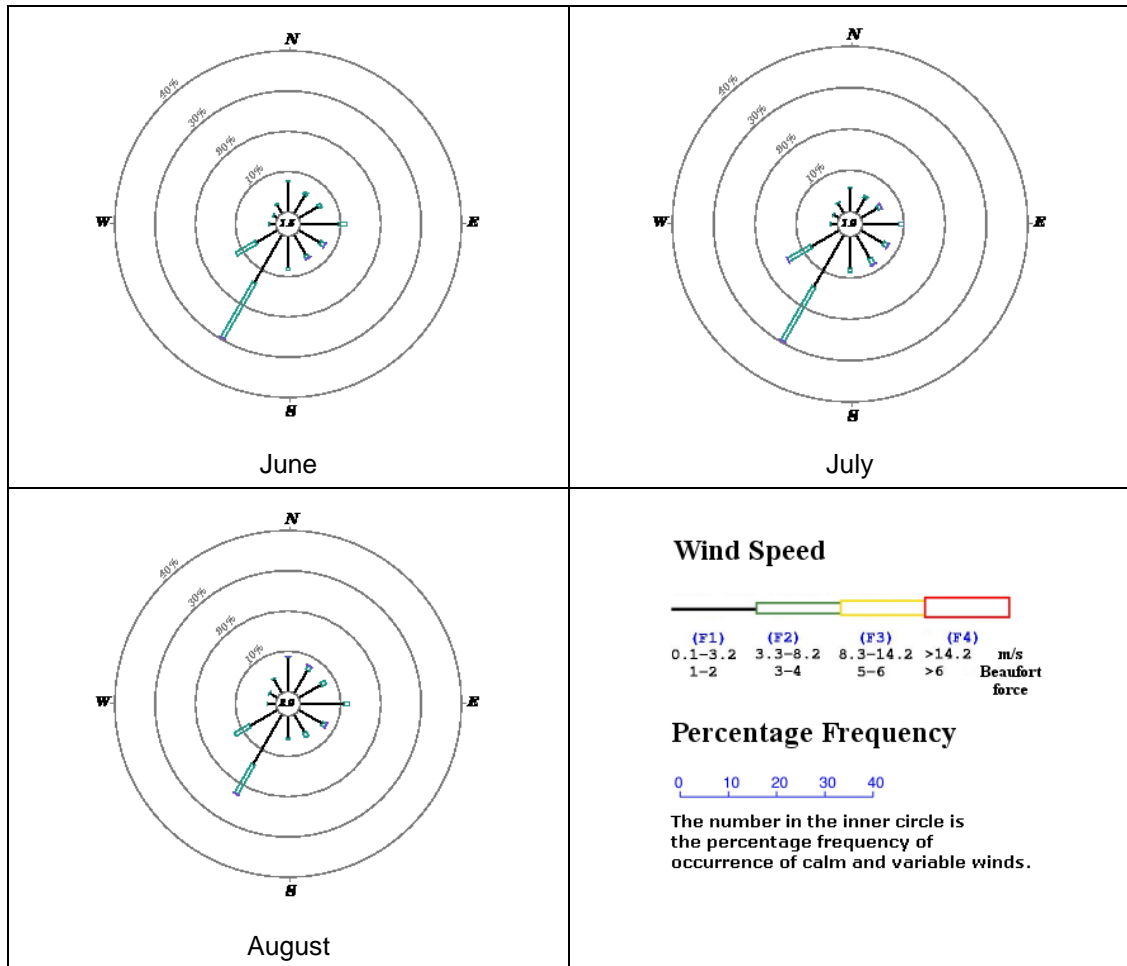


**Figure 2.1** Locations of the Weather Stations and the Study Areas

2.1.3 Study Area A (Whitehead Site) is located in Ma On Shan District, to the south eastern part of Whitehead headland. **Figure 2.1** shows the approximate location of Study Area A and the locations of various automatic weather stations with Sha Tin Automatic Weather Station nearest to the Study Area.



**Figure 2.2** Annual wind rose for Sha Tin, 1985-2013

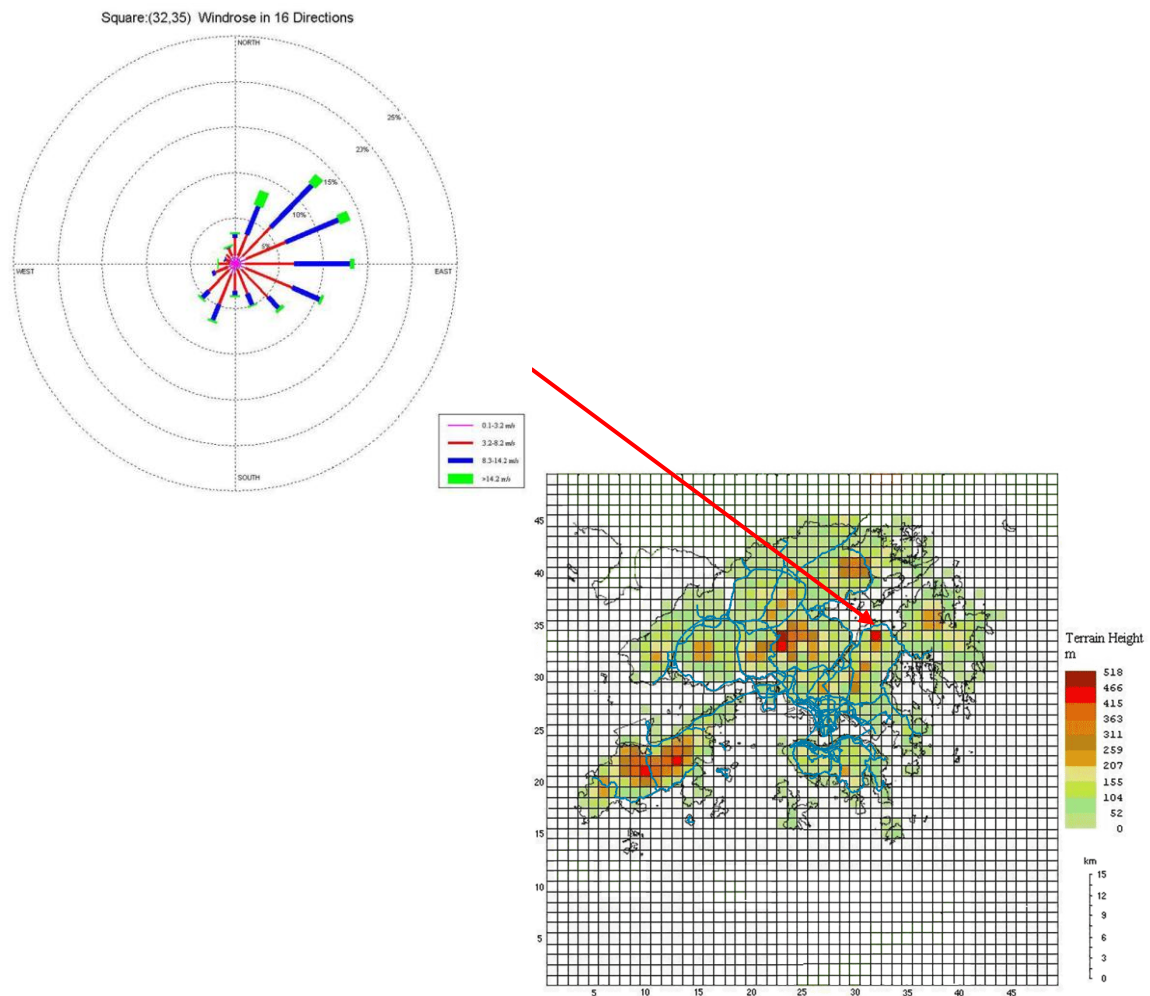


**Figure 2.3 Summer wind roses (June to August) for Sha Tin, 1985-2013**

- 2.1.4 **Figure 2.2** shows the averaged annual wind rose from 1985 to 2013 extracted from the Sha Tin automatic weather station. From the averaged annual wind rose, it is observed that the winds from the north, east and north easterly quadrants (i.e. N, NNE, ENE and E) have more than 10% of frequency occurrence. It is discovered there is an amount of wind from the SSW direction with an approximate frequency occurrence of 10%.
- 2.1.5 In Hong Kong, summer wind is very important and beneficial for thermal comfort; and identification of summer wind characteristics is crucial. By referring to the summer monthly (June to August) wind roses at Sha Tin weather station from 1985 to 2013 as shown in **Figure 2.3**, the summer prevailing winds mainly come from the easterly, south-westerly directions (i.e. E, SSW and WSW) each with frequency occurrence exceeding 10%. There is also an observable amount of wind from the south eastern quadrant. Furthermore, the easterly wind has an occurrence frequency of approximately 10% which should also be considered as one of the dominant summer seasonal winds.
- 2.1.6 By summarizing paragraphs 2.1.4 to 2.1.5, the annual prevailing winds come from the N, NNE, ENE, E, and SSW directions while the summer winds are from E, WSW and SSW directions based on the data from Sha Tin Automatic weather station.

### **Wind Direction Analysis based on MM5 model simulation**

- 2.1.7 Apart from the HKO wind data, PlanD has released a set of wind availability data of different locations in Hong Kong using MM5 mesoscale model simulation for AVA studies. This set of wind availability data can be obtained at the official website of PlanD. (<http://www.pland.gov.hk/pland/en/misc/MM5/index.html>).
- 2.1.8 For Study Area A, wind rose from grid (32, 35) shown in Figure 2.4 is appropriate to be used to identify the annual prevailing wind directions. From the figure, winds coming from NE, ENE and E are considered as the prevailing annual winds to Study Area A.



**Figure 2.4 Wind Rose from PlanD Website obtained from MM5 Model (Grid 32, 35)**

- 2.1.9 Apart from the MM5 data from PlanD, the researchers from Hong Kong University of Science and Technology (HKUST) have also simulated a set of wind data using MM5 model, details are found in the Section 3.6 of Cat. A1– Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment (PLNQ 37/2007), Final Report – Ma On Shan Area. Based on the dataset obtained from HKUST, annual and summer wind roses (120m and 450m above ground) at the location near Wu Kai Sha MTR station are presented in **Figure 2.5**, while the location of extraction for wind data is presented in **Figure 2.6**.



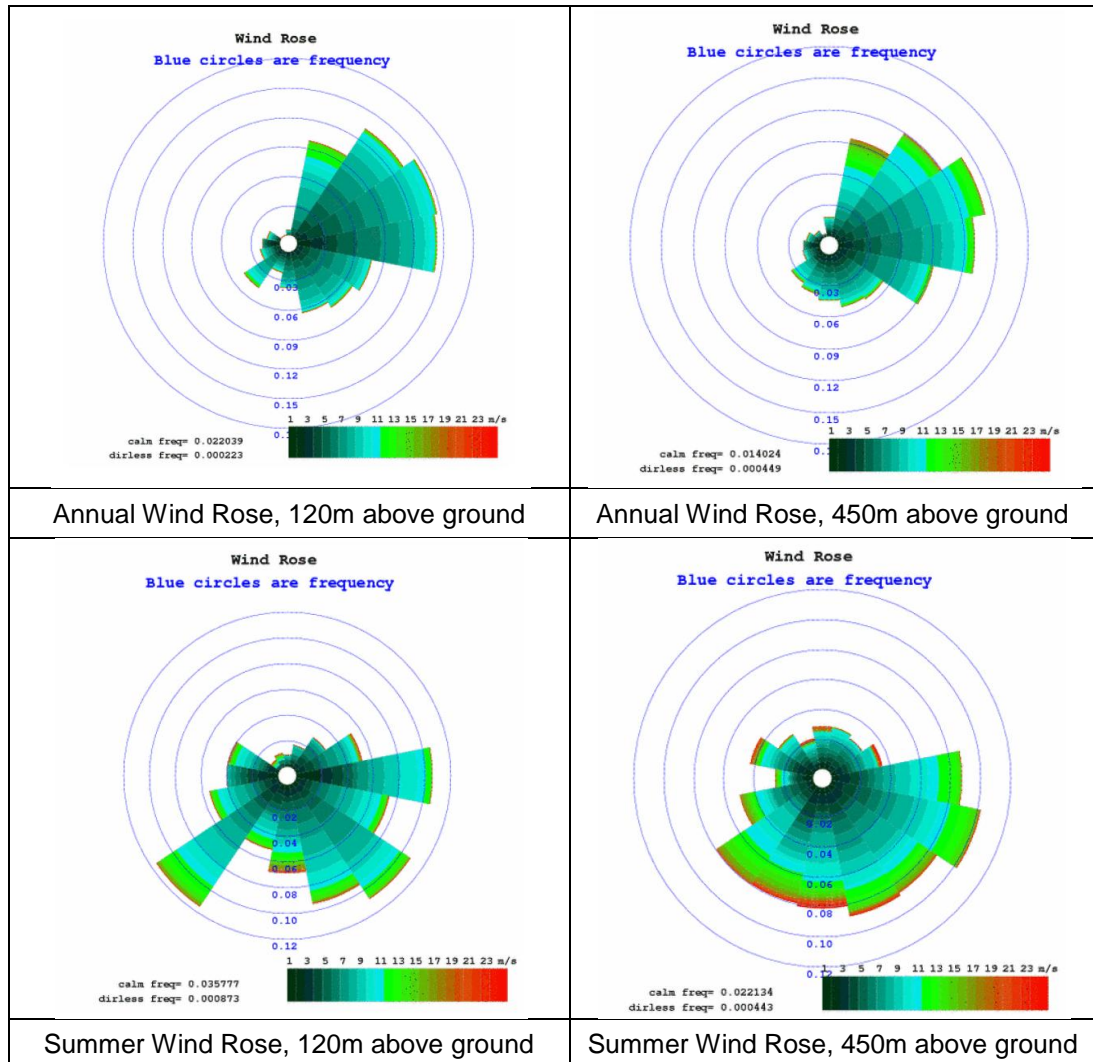


Figure 2.5 Wind Rose from HKUST obtained from MM5 model at Location A near Wu Kai Sha Station

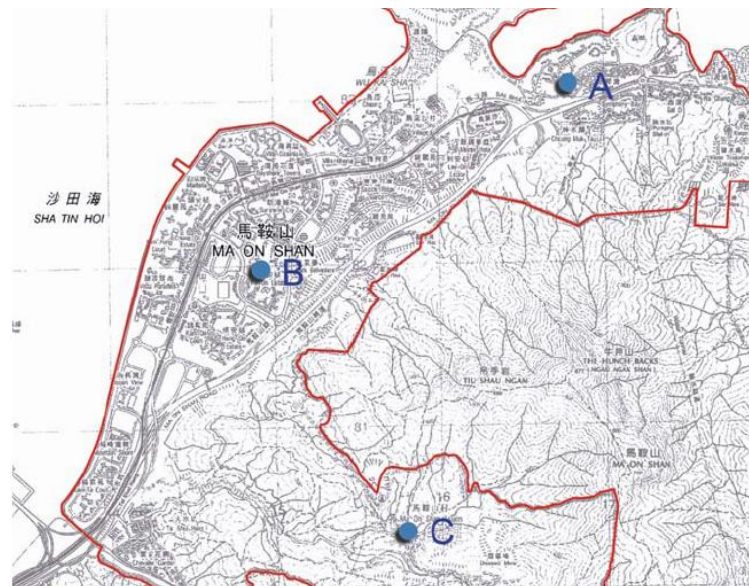


Figure 2.6 Locations of extraction for HKUST MM5 model data

- 2.1.10 The MM5 data (extracted at Location A) from the HKUST shows the annual prevailing winds towards Study Area A are from the north eastern quadrant i.e. NE, ENE and E.
- 2.1.11 The summer MM5 wind rose suggests that the winds during summer seasons towards Study Area A are mainly from E, SE, SSE, and SW.
- 2.1.12 By summarizing paragraphs 2.1.11 to 2.1.12, the annual prevailing winds come from the NE, ENE, E directions while the summer winds are from E, SE, SSE and SW directions based on the data from MM5 model.

**Summary of prevailing winds**

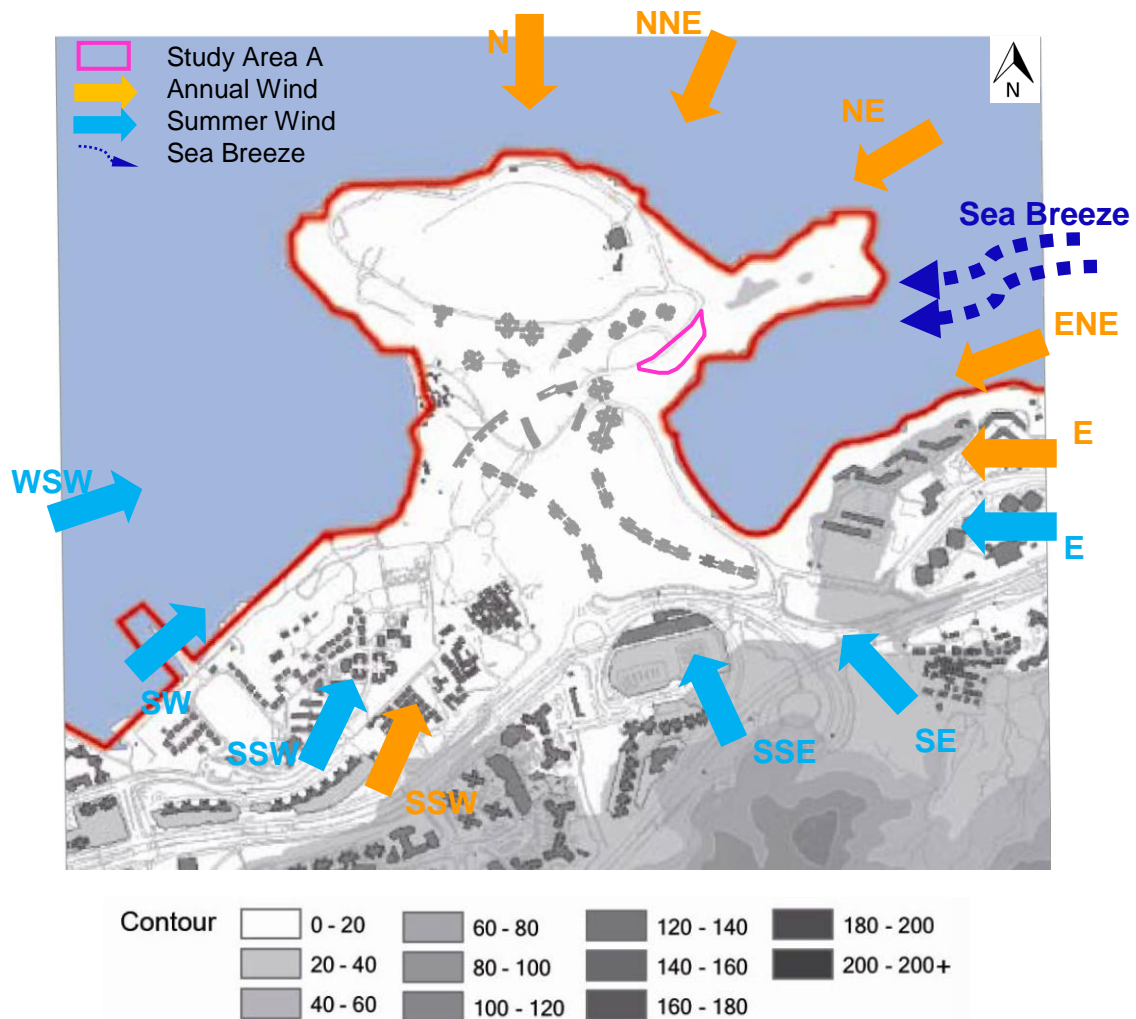
**Table 2.1 Summary Table of Prevailing Winds**

<b>Source</b>	Annual Wind	Summer Wind
HKO Weather Station	N, NNE, ENE, E, SSW	E, WSW, SSW
MM5 Data	NE, ENE, E	E, SE, SSE, SW

- 2.1.13 By comparing the wind data from Sha Tin Weather Station and MM5 model (from both PlanD and HKUST), it is concluded that the prevailing annual winds towards Study Area A are from N, NNE, NE, ENE, E, and SSW. Meanwhile, the summer prevailing winds are mainly from E, SE, SSE, SSW, SW and WSW directions.

## 2.2 Wind Environment due to Topography

- 2.2.1 **Figure 2.7** shows a digital elevation map of the study area. The Whitehead area, where Study Area A is located, is a peninsula surrounded by sea in the east, north and west. It can be seen from the figure that Study Area A is fronting Starfish Bay to its southeast which rises from the sea level to around 3mPD. The Whitehead peninsula is relatively flat and has maximum terrain height of around 23mPD situated to its eastern most regions.
- 2.2.2 The terrain in the region south of the Whitehead area possess a topography profile increasing from north to south, with the terrain heights ranging from around 7mPD to over 60mPD (at the area south of Ma On Shan Bypass). There exists a hilly terrain within 1000m from Study Area A, which is located east-south easterly to it.
- 2.2.3 To the further south is the high hilly terrain (of over 200mPD) of Ma On Shan Country Park, which creates a shelter and weakens the general southerly winds towards Study Area A. However, given the large distance between Study Area A and this hilly terrain, it is not likely this hilly topography will have significant wind impacts on Study Area A.
- 2.2.4 There are no obstacles between Study Area A and Starfish Bay; therefore, sea breeze can reach Study Area A from water front without major obstruction from the east.



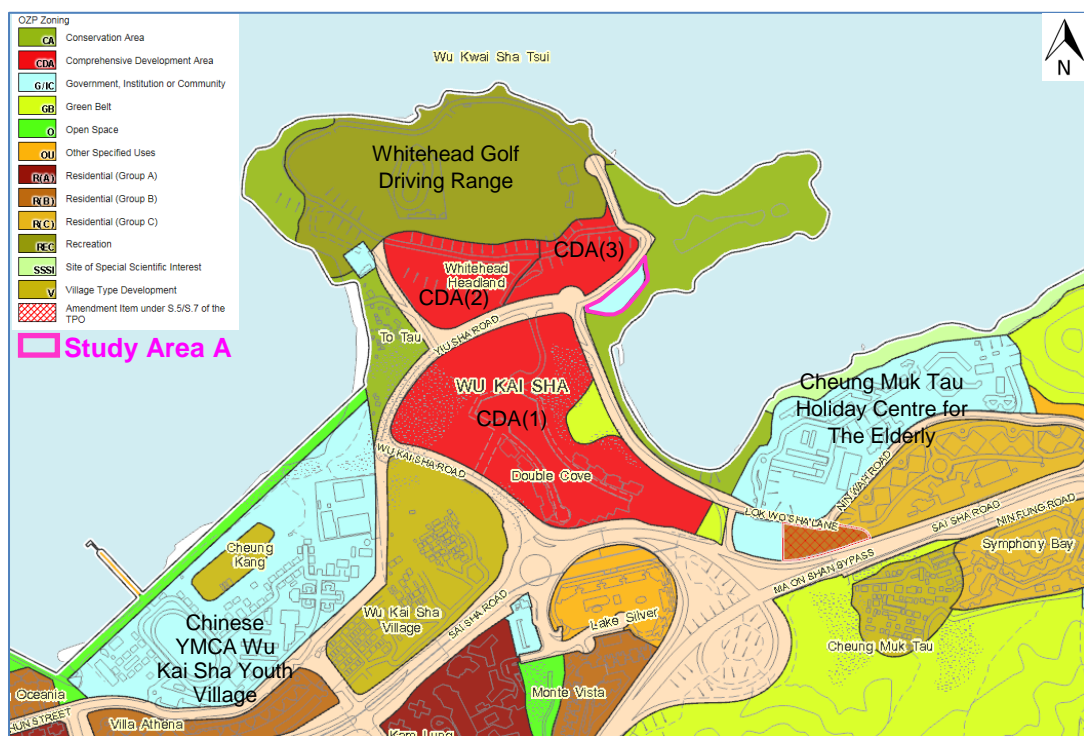
**Figure 2.7 Digital Elevation Map and natural air movement around the Study Area A**

## 2.3 Land Use and Existing Urban Morphology

### Land Use

2.3.1 The Ma On Shan Outline Zoning Plan No. S/MOS/19 (the Plan) is shown in **Figure 2.8**. The portion near Study Area A is presented and the land use types are stated below:

- The areas in brownish green are “Conservation Areas”.
- The areas in red are zoned as “Comprehensive Development Area”
- The areas in light blue are “Government Institution or Community” (G/IC) land uses.
- The areas in reddish brown, brown and light brown are “Residential (Group A)”, “Residential (Group B)” and “Residential (Group C)” respectively.
- The areas coloured in green and yellowish green are “Open Space” and “Green Belt” respectively.
- The areas coloured in dark green are “Recreation” land uses.
- The area in orange is designated for “Other Specified Uses”.



**Figure 2.8 Zoned land uses near Study Area A**

#### Comprehensive Development Areas

2.3.2 The regions in red are “Comprehensive Development Area” (“CDA”) zones. There are three CDAs in the vicinity of Study Area A, located in the south, west and northwest vicinity of the Study Area, designated as “CDA(1)”, “CDA(2)” and “CDA(3)” respectively.

2.3.3 The southern portion of the “CDA(1)” area covers the existing high-rise Double Cove residential developments, while the committed developments within the northern portion are high-rise Student Hostel. On the other hand, the committed developments in “CDA(2)” and “CDA(3)” are all mid-rise residential developments.

Residential Areas

- 2.3.4 The zone in reddish brown is an area zoned “Residential (Group A)”, which is mainly occupied by Kam Lung Court located to the far south of Study Area A
- 2.3.5 The zones in brown are “Residential (Group B)” areas lying south of the Whitehead area, where Monti Vista and Villa Athena are located.
- 2.3.6 The “Residential (Group C)” areas coloured in light brown scattering to the south and southeast of the Whitehead area, are mainly developments of Lake Silver and Symphony Bay.

G/IC Areas

- 2.3.7 The major “G/IC” areas are located both southeast and southwest of the Whitehead area. These areas are mainly occupied by activity / holiday centres, which include the Chinese YMCA Wu Kai Sha Youth Village and Cheung Muk Tau Holiday Centre for The Elderly.

Recreation Area

- 2.3.8 There is one area designated as “Recreation” (dark green), namely the Whitehead Golf Driving Range, located at the north of Study Area A

## Urban Morphology



1. Study Area A	2. "CDA(3)" area (58mPD)	3. "CDA(2)" area (50mPD)
4. "CDA(1)" north (committed Student Hostel) (93mPD)	5. "CDA(1)" south (Double Cove) (131mPD)	6. To Tau (11.5mPD)
7. Wu Kai Sha Village / Wu Kai Sha Youth Village (23.4mPD)	8. Wu Kai Sha MTR Station / Lake Silver (183mPD)	9. Lee Yan Chun United College (41.5mPD)
10. Symphony Bay (42.4mPD)	11. Whitehead Club Golf Driving Range	

**Figure 2.9 Major developments near Study Area A**

2.3.9 The location of major existing and committed developments in the vicinity of Study Area A are marked in **Figure 2.9**. The regions near Study Area A are generally occupied by mid to high-rise and medium-density developments. The height of the highest residential clusters in the immediate vicinity of Study Area A is approximately 131mPD (which is the Double Cove located in "CDA(1)" south).

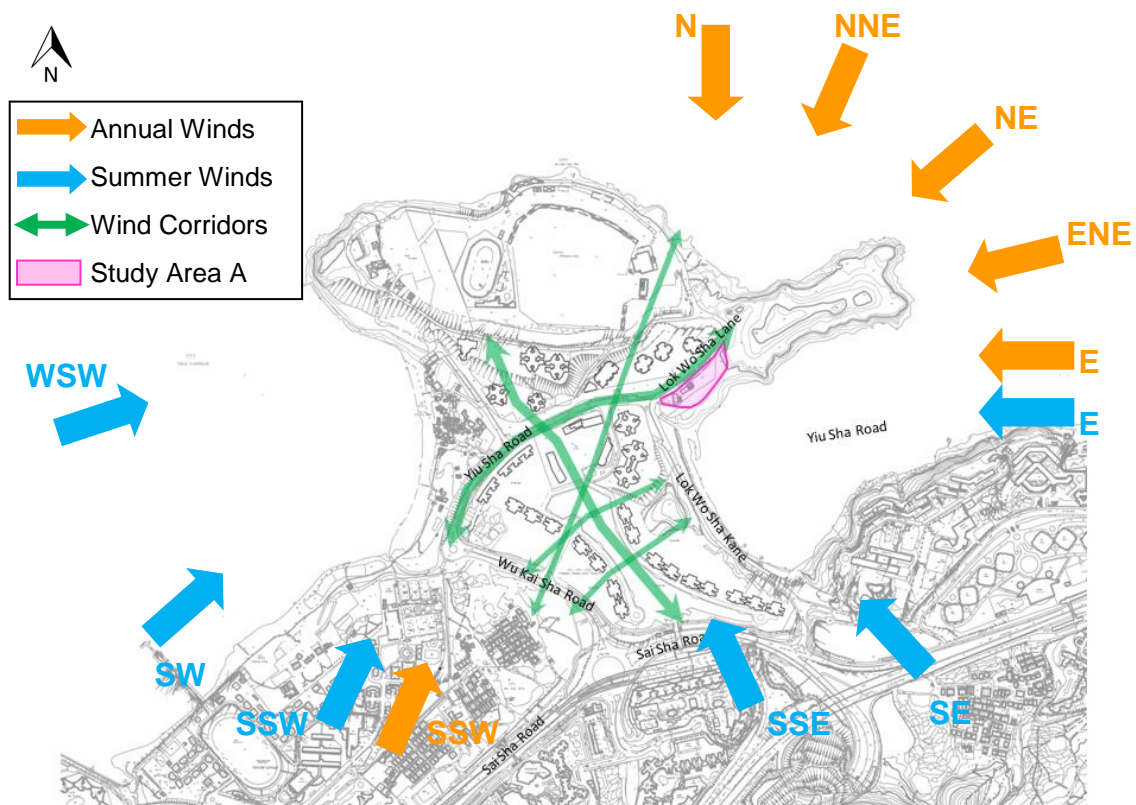
2.3.10 To the immediate north of Study Area A are committed mid-rise and medium-density developments (around 60mPD) of the "CDA(3)" zone. To the further north is the Whitehead Club Golf Driving Range, which is generally open area and consists of low-rise houses only.

2.3.11 To the immediate west of Study Area A are committed mid-rise development of the “CDA(2)” area, and the developments within are around 50mPD in height. To the further west is To Tau with village-type houses of maximum 12mPD in height.

2.3.12 To the further south are high-rise developments including building clusters of Lake Silver, (183mPD) located south of the Wu Kai Sha Station with a distance of around 600m away from Study Area A. These developments are relatively far from Study Area A and are unlikely to influence the wind environment there.

## 2.4 Wind corridors near Study Area A

2.4.1 As mentioned in **Section 2.1**, the annual prevailing wind comes from the north, east, north eastern quadrant as well as south - southwest directions. Meanwhile, the summer prevailing winds are mainly comprised of east, south eastern quadrant winds and south western quadrant winds. By understanding the prevailing wind directions and studying the building morphology in the vicinity of Study Area A, the major wind corridors are identified and illustrated in **Figure 2.10**.



**Figure 2.10 Major Wind Corridors near Study Area A**

2.4.2 Under the N and NNE annual winds, the wind corridor passing through the “REC”, “CDA(3)” and “CDA(1)” allows the prevailing winds to penetrate through the whole Whitehead area. It also helps the summer SSW wind to ventilate the Whitehead area.

2.4.3 Yiu Sha Road and part of Lok Wo Sha Lane facilitate the annual NE and ENE to flow across the Whitehead area and also help the summer SW wind to penetrate through.

2.4.4 Apart from the roads mentioned in Paragraph 2.4.3 above, there are separation gaps incorporated in the building clusters of Double Cove developments, which serve as air paths through “CDA(1)”, as illustrated in **Figure 2.10**. These separations between buildings would enhance penetration of winds through the “CDA(1)” area under NE and ENE winds while also benefiting the penetration of SW and SSW winds.

- 2.4.5 A visual corridor passing through the building cluster of the Double Cove and “CDA(2)”, which aligns approximately in the SE-NW direction, is considered as an important wind corridor under the SE and SSE winds.

## **2.5 Existing wind environment of Study Area A**

### **Under the Annual Prevailing Winds**

- 2.5.1 It is understood that a building of height H is generally possible to induce a wind wake of approximately H from the building. Inside the wake region, there exist weaker and more turbulent winds which are collectively referred to as a “wind shadow region” behind the building.
- 2.5.2 Under the N and NNE annual wind, the wind wakes generated by the committed developments in “CDA(3)” are likely to reach Study Area A, and may slightly reduced the wind resources. However, there are two 15m width separation gaps aligning in the north-south direction incorporated between the buildings of “CDA(3)”, which will enhance the penetration of wind through the committed developments to the proposed developments within Study Area A. Unfavourable impact in terms of wind environment is expected to be reduced.
- 2.5.3 Under the NE, ENE and E winds, the mid to high-rise developments within Whitehead area are all on the sideways or on the downwind side of Study Area A. The geographical location of the existing and committed developments would not cause adverse impact on the wind environment near Study Area A.
- 2.5.4 Under SSW annual winds, the northern developments in “CDA(1)” (with a building height of around 93mPD) may provide certain obstruction against Study Area A.

### **Under the Summer Prevailing Winds**

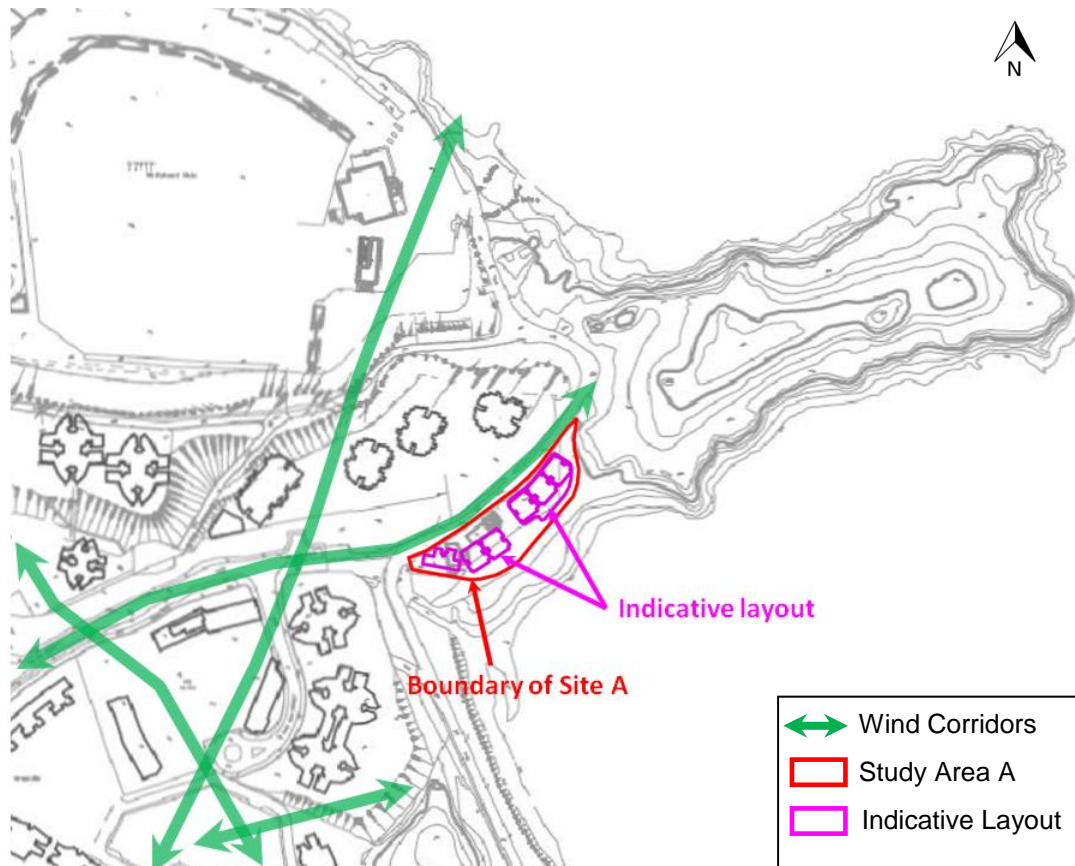
- 2.5.5 Under the E, SE and SSE summer winds, the developments in the vicinity of Study Area A are not expected to cause impacts in terms of wind environment on the Study Area, similar to discussion in Paragraph 2.5.3.
- 2.5.6 Under the SW and WSW summer winds, the wind wakes generated by the buildings in the mid and northern portions of “CDA(1)” would reach Study Area A. Yiu Sha Road and Lok Wo Sha Lane help to divert some of the WSW wind to Study Area A.



## 2.6 Expert Evaluation on the proposed development at Study Area A

### Under the Annual Prevailing Winds

- 2.6.1 The maximum proposed building height of Study Area A is around 39mPD. The indicative proposed building layout is shown in the **Figure 2.11**.



**Figure 2.11 Indicative proposed building layout at Study Area A**

- 2.6.2 The prevailing annual wind directions are mainly from north, east, north eastern quadrant and southwest direction as mentioned in **Section 2.1**. Under the N, NNE prevailing wind condition, the incoming wind can reach the site through the building separation of the “CDA(3)”. The wind shadow area generated by the 39mPD tall building in Study Area A is not expected to extend to the area west of Lok Wo Sha Lane and “CDA(1)” which is the most likely affected pedestrian frequent access area (“CDA(1)” area to the west / southwest of Lok Wo Sha Lane) located downwind under the N, and NNE annual wind directions.
- 2.6.3 The slight hilly terrain at the north eastern side of Study Area A may slightly diverts the NE and ENE wind approaching. However, as the hilly terrain is not high, most of incoming wind could enter Study Area A.
- 2.6.4 Under the NE and ENE annual prevailing winds, the proposed developments at Study Area A is likely to provide partial blockage of incoming winds against the northern committed buildings in “CDA(1)” area. However, the site alignment reduces the building frontage toward these prevailing wind directions and helps to minimize the potential impact of the proposed development. Moreover, the low-rise, low-density nature of developments in Study Area A also helps to reduce the possible impact on the downstream “CDA(1): area. The proposed developments in Study Area A form a stepping building height profile with the buildings in “CDA(1)” (over 90mPD in height). Such profile is expected to introduce some down washed wind to the pedestrian level and enhance the local wind environment.

- 2.6.5 Under the E wind, as the upstream area of Study Area A is vacant, the wind from these directions can enter freely. The area located at the downwind side to Study Area A under E annual prevailing winds is the southern portion of “CDA(3)” area. The separations between the building clusters allow the incoming wind to penetrate through the Study Area and ventilate the downstream “CDA(3)” and minimize the impact on “CDA(3)” area.
- 2.6.6 Although the SSW wind can penetrate the Whitehead area by the wind corridor passing through the “REC”, “CDA(1)” and “CDA(3)”, it may not able to serve Study Area A and the upstream residential blocks of Double Cove also block some of the incoming wind. The wind resources of Study Area A under SSW are limited. Thus, the potential impact due to the proposed development of Study Area A on the downstream eastern region of the “CDA(3)” is relatively minimal.

**Under Summer Prevailing Winds**

- 2.6.7 E and SSW are the prevailing wind for both annual and summer. The relevant discussion can be referred to Paragraph 2.5.8 and 2.5.9.
- 2.6.8 Under the summer SE and SSE winds, the incoming wind enters the site from the Star Bay area. The 15m building separation between the building clusters allow the incoming wind to enter the downstream CDA(3) area and reduce the potential impact of the proposed development. The low rise nature of the Study Area A also helps to minimize the potential impact. Furthermore, the proposed developments in Study Area A formed a stepping building height profile with the buildings in CDA(3) (which would be around 60mPD in height), such profile are expected to redirect the incoming southern quadrant winds to the pedestrian level and further promote airflow there and further reduce the potential impact of Study Area A.
- 2.6.9 Similar the SSW condition, under the SW summer wind, the Study Area A is located at the downstream area of the high rise residential development of CDA(1). The prevailing wind enters the site through the wind corridor which consists of the Yiu Sha Road and Lok Wo Sha Lane. The wind shadow of the Study Area A will fall to the CA zone with less pedestrian accessed. The impact due to the proposed development is minimal.
- 2.6.10 The low rise To Tau Village allow the WSW prevailing wind to enter the Yiu Sha Road and reach the downstream CDA(3) and Study Area A. similar to the SW wind condition, the wind shadow area cast to the CA region with less pedestrian accessed. Thus the impact of the proposed development to the surrounding area is minimal.
- 2.6.11 Based on the above discussions, the potential impact due to the proposed development which have a low building profile with a 15m separation between the building clusters would be minimal to the surrounding environment. These features should be kept in order to minimize the potential impact to the vicinity. Provided that these features could be maintained in the future development in Study Area A, no further AVA Initial Study is required.

### 3 EVALUATION ON HANG KIN STREET SITE – STUDY AREA B

#### 3.1 Natural Wind Availability (Hang Kin Street Site – Study Area B)

3.1.1 Study Area B (Hang Kin Street Site), is at Hang Kin Street located next to Hang On Station.

##### Wind Direction Analysis based on HKO Weather Stations' Data

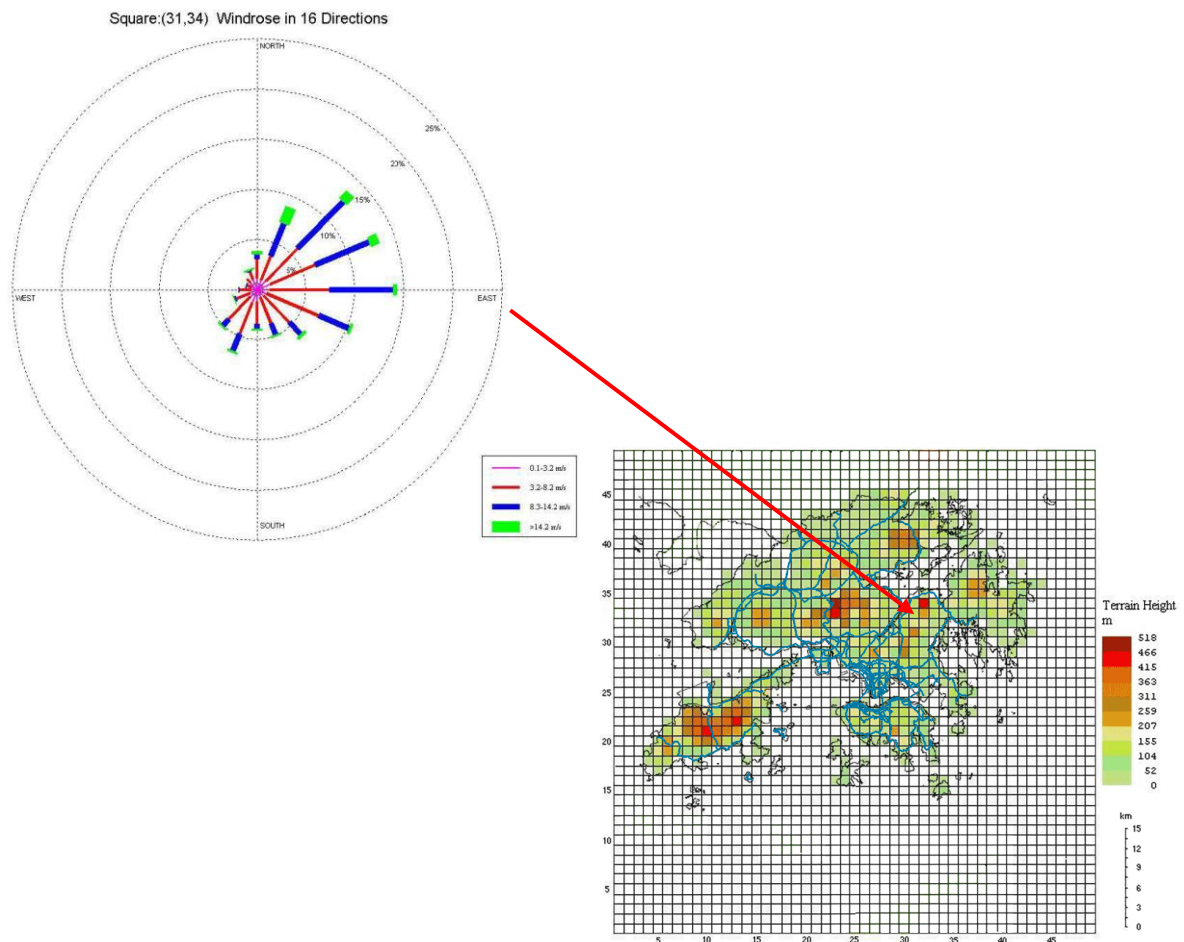
3.1.2 The automatic weather station nearest to Study Area B is also the Sha Tin automatic weather station. Therefore, the discussion on automatic station wind data in **Section 2.1** for Study Area A is also valid for Study Area B. Locations of Study Area B and Sha Tin automatic weather station are shown in **Figure 2.1**. Relevant Sha Tin automatic station wind roses are shown in **Figure 2.2** and **Figure 2.3**.

3.1.3 The annual prevailing winds are from the N, NNE, ENE, E, and SSW directions while the summer winds are from the E, SSW and WSW directions based on the data from Sha Tin Automatic weather station.

##### Wind Direction Analysis based on MM5 model simulation

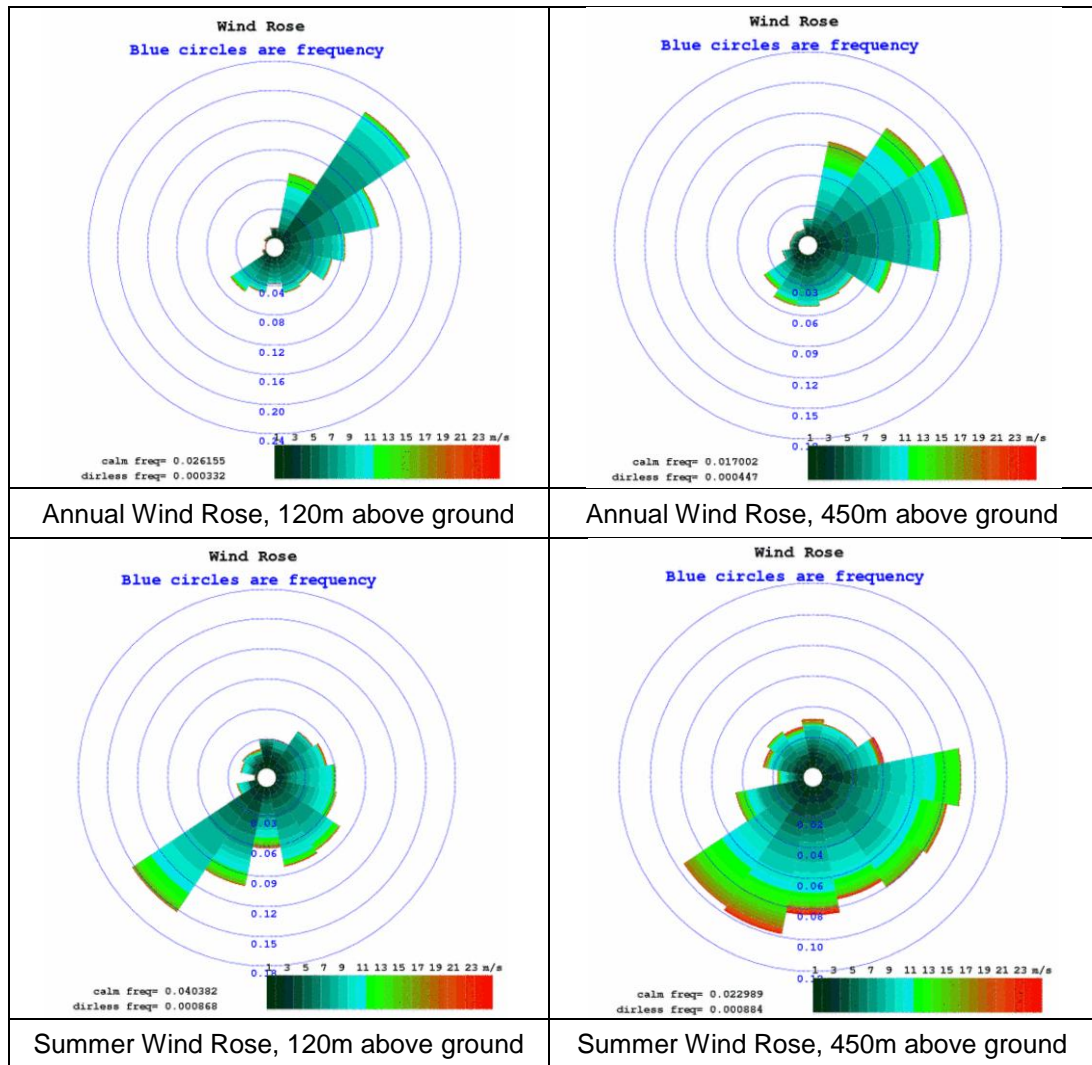
3.1.4 For the Study Area B, wind data from grid (31, 34) as shown in **Figure 3.1** is used as the site wind availability data from PlanD's website for identification of prevailing winds.

3.1.5 By referring to the wind rose (31, 34) as shown in **Figure 3.1**, winds coming from E, ENE and NE are considered as the annual predominate winds.



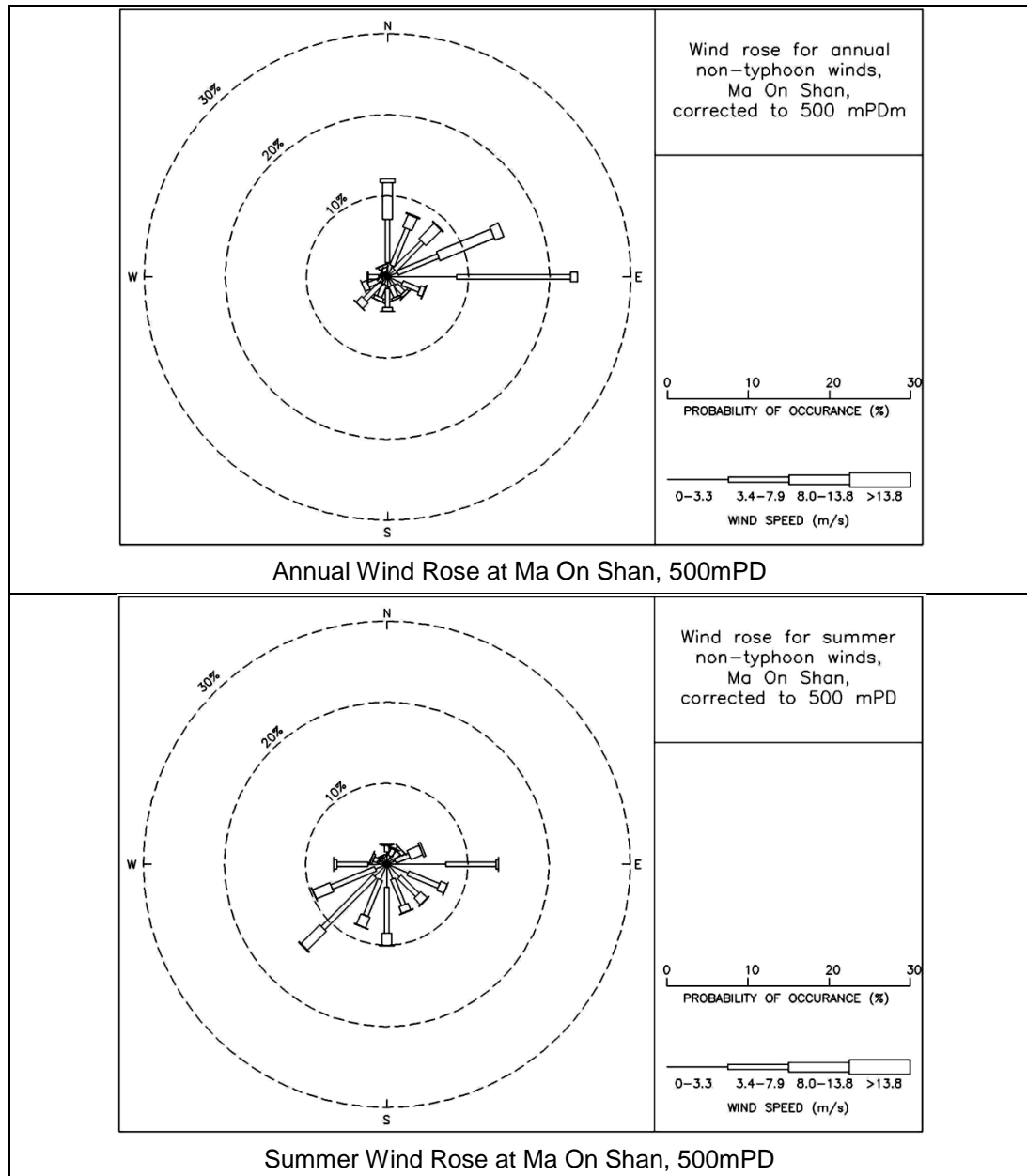
**Figure 3.1** Wind Rose from PlanD Website obtained from MM5 Model (Grid 31, 34)

- 3.1.6 Based on the dataset obtained from HKUST, the annual and summer wind roses (120m and 450m above ground) at the location near Yiu On Estate are presented in **Figure 3.2**, while the locations of the extracted wind data is presented in **Figure 2.6**.
- 3.1.7 The MM5 data from the HKUST reveals the annual prevailing winds near Study Area B are coming from the north eastern quadrant. NE, ENE and E are considered as the major annual prevailing wind under this set of wind data.
- 3.1.8 The summer prevailing winds near Study Area B are mainly formed by south eastern and south western quadrant winds and the major summer prevailing wind would be SE, SSE, SW and SSW wind.



**Figure 3.2 Wind Rose from HKUST obtained from MM5 model at Location B near Yiu On Estate**

- 3.1.9 In 2009, an AVA detailed study for Ma On Shan Area 86B through wind tunnel experiment. Details can be found in AVR/G/19 Public Rental Housing at Ma On Shan Area 86B. According to the wind tunnel result, the annual and summer wind rose at the location of current Yan On Court are illustrated as in **Figure 3.3** below.



**Figure 3.3 Annual and Summer Wind Roses based on wind tunnel experiment result**

3.1.10 By referring to the annual and summer wind roses of the wind tunnel experiment, the annual prevailing winds near Site B are mainly come from N, ENE and E directions. Meanwhile, the summer prevailing wind is mainly comprised by E and SW incoming winds.

**Summary of prevailing winds**

3.1.11 By summarizing the wind availability data from HKO observation, MM5 model simulation (from both PlanD and HKUST) and the wind tunnel experimental site wind availability, it can be concluded that the prevailing annual winds at the Study Area B comes from the N, NNE, NE, ENE, E, SSW directions. Meanwhile, the summer prevailing winds are mainly comprised by east, south, south eastern quadrant winds and south western quadrant winds which include winds from E, SE, SSE, SSW, SW and WSW.

**Table 3.1 Annual and summer prevailing winds from different sources of information**

Source	Annual	Summer
HKO Sha Tin Weather Station	N, NNE, ENE, E, WSW	E, SSW, WSW
MM5 (Plan D)	NE, ENE, E	-
MM5 (HKUST)	NE, ENE, E	SE, SSE, SSW, SW
Wind Tunnel Experiment	N, ENE, E	E, SW

**3.2 Wind Environment due to Topography**

3.2.1 **Figure 3.3** shows a digital elevation map near Study Area B. It reveals from the figure that Study Area B is fronting Sha Tin Hoi which rises from the sea level to around 6mPD. The region where Study Area B is located is relatively flat, but there are hilly topographies lying to the east and southeast directions beyond the Study Area B boundary with increasing topological heights further away from the water front.



**Figure 3.4 Digital Elevation Map and natural air movement around the Study Area B**

3.2.2 The hilly terrain to the east and southeast directions of the Study Area B will shelter the summer prevailing winds coming from the south eastern directions as well as E annual wind thus weakens the magnitude of these winds towards it. On the other hand, the katabatic (downhill) air movement is expected during summer seasons from the vegetated hill slopes located east and southeast, and may promote the air flow in local regions near Study Area B during summer seasons.

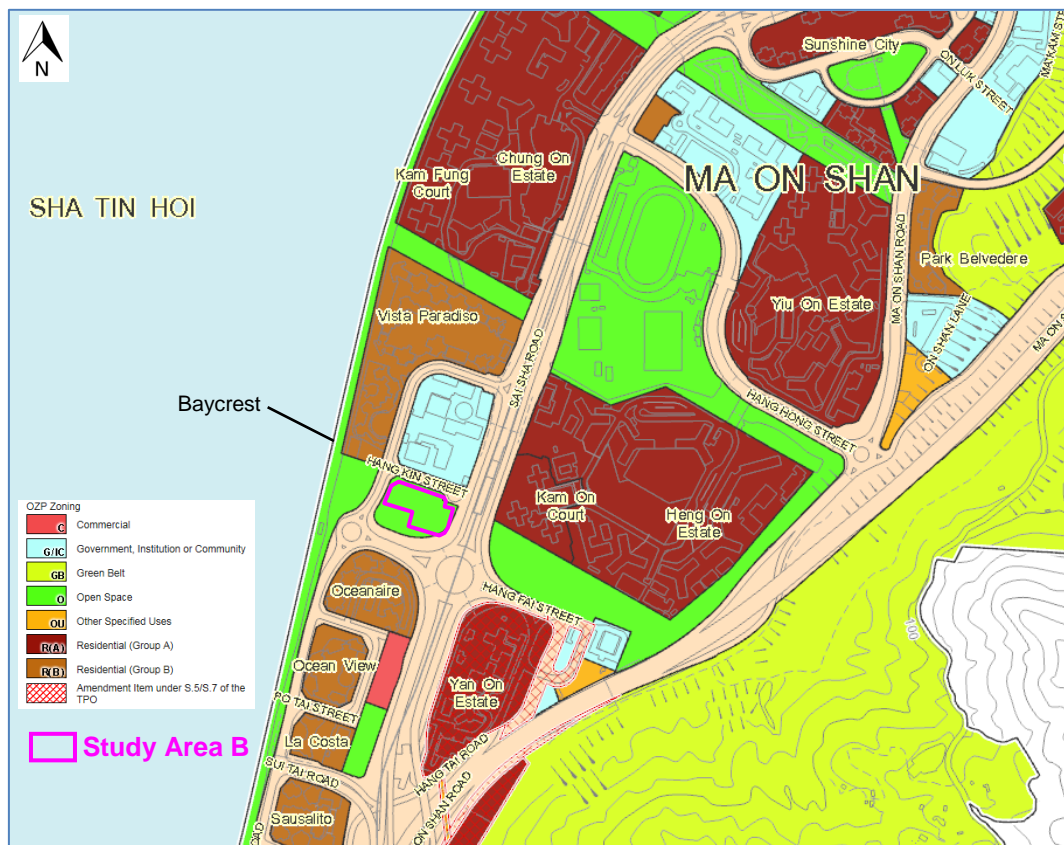
3.2.3 The land where Study Area B is situated is relatively flat with no topographies to hinder the flow of the winds from the open sea towards Study Area B.

### 3.3 Land Use and Existing Urban Morphology

#### Land Use

3.3.1 The Ma On Shan Outline Zoning Plan No. S/MOS/19 (the Plan) is shown in **Figure 3.5**. The land use types located at the surroundings of Study Area B are stated below:

- The areas in light blue are “Government Institution or Community” (G/IC) land uses.
- The areas in reddish brown and brown are “Residential (Group A)” and “Residential (Group B)” respectively.
- The areas coloured in green and yellowish green are “Open Space” and “Green Belt” zones respectively.
- The areas coloured in orange is zoned as “Other Specified Uses” and
- The area in pink is designated as “Commercial” zone.



**Figure 3.5 Zoned land uses near Study Area B**

#### Residential Areas

- 3.3.2 There are four major “Residential (Group A)” (“R(A)”) areas in the near vicinity of Study Area B, located to the southeast, east, northeast and north of Study Area B. They are Yan On Estate, Kam On Court / Heng On Estate, Yiu On Estate, and Kam Fung Court / Chung On Estate.
- 3.3.3 It is noticed that Yan On Estate and the areas to its immediate east are zoned “Residential (Group A)”. This zone comprises the existing Yan On Estate and its proposed extension with maximum BH of 140 mPD.
- 3.3.4 The zones in brown are “Residential (Group B)” (“R(B)”). There are two “R(B)” areas located to both south and north of Study Area B. The one located to south is occupied by residential developments of the Oceanaire, Ocean View, La Costa and Sausalito, while the one to the north is mainly occupied by residential buildings of the Vista Paradiso and Baycrest.

#### G/IC Areas

- 3.3.5 Major “G/IC” areas are located to the northeast of Study Area B. There is one “G/IC” area to the immediate north east of Study Area B where the Renaissance College is located. Other “G/IC” areas are mainly occupied by schools and churches, such as Ma On Shan Methodist Primary School, St. Francis Church and Tsang Pik Shan Secondary School, and YCH Tung Chi Ying Memorial Secondary School.

#### Commercial

- 3.3.6 There is an area zoned as “Commercial” in the vicinity of Study Area B (coloured pink), which is sandwiched between Ocean View and Sai Sha Road. It is currently an open area used as car park.

#### Other Specified Uses

- 3.3.7 There is an area zoned as “Other Specified Uses” in the surrounding of Study Area B (coloured orange), which is located east of Yiu On Estate. It is currently a forested hill slope.

#### Open Spaces

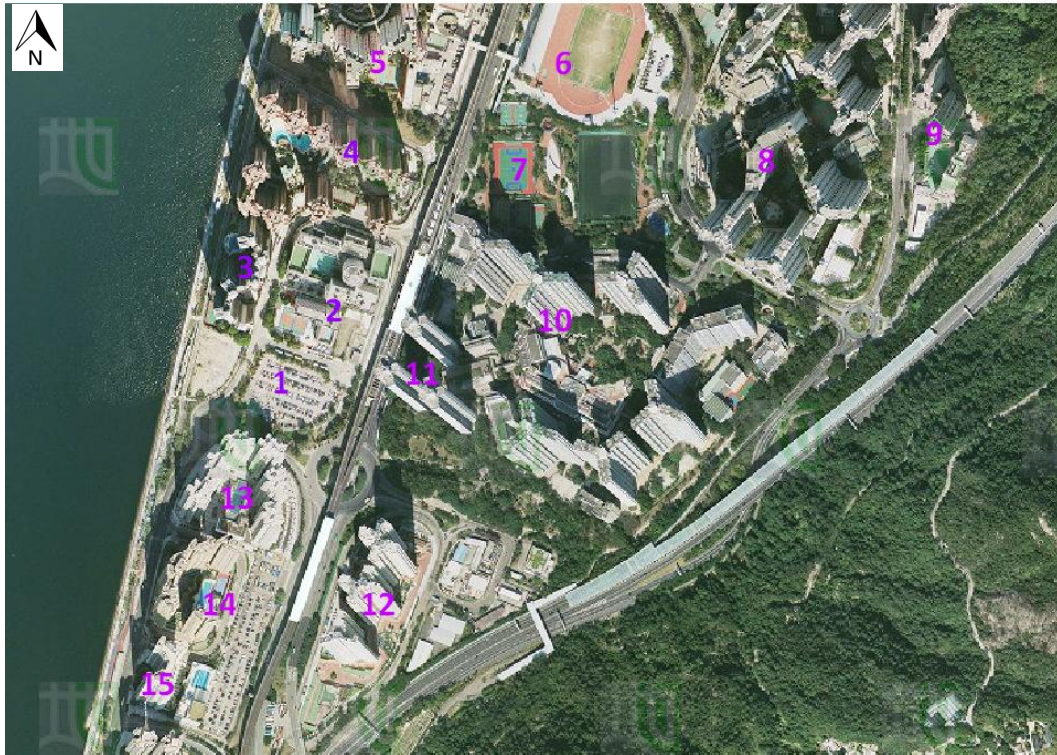
- 3.3.8 Open Spaces are in green in **Figure 3.5**. The major Open Spaces within Ma On Shan area is the Ma On Shan Sports Ground and the Ma On Shan Recreation Field. The Open Space fronting the sea consist an existing waterfront promenade running along the western boundary of the Ma On Shan Area. There are also Open Spaces between the residential developments of the “R(A)” zone (Kam Fung Court) and “R(B)” zone (Vista Paradiso), as well as that between the “G/IC” zone (Tsang Pik Shan Secondary School) and “R(A)” zone (Sun Shine City). It is noticed that currently, Study Area B is also zoned as “Open Space”. It is linking up the open spaces between Kam On Court and Yan On Estate.

#### Green Belt

- 3.3.9 The areas designated as “Green Belt” are in yellowish green. These areas are mainly the forested hilly slopes of Ma On Shan, located to the east/southeast of Ma On Shan Bypass.



## Building Morphology



1. Study Area B	2. Ma On Shan Methodist Primary School / Renaissance College (29.7mPD / 38.1mPD)	3. Baycrest (79.7mPD)
4. Vista Paradiso (106mPD)	5. Kam Fung Court / Chung On Estate (114.8mPD / 108.6mPD)	6. Ma On Shan Sports Ground
7. Ma On Shan Recreation Ground	8. Yiu On Estate (113.1mPD)	9. Park Belvedere (131.5mPD)
10. Heng On Estate (106.1mPD)	11. Kam On Court (105.7mPD)	12. Yan On Estate (119.9mPD)
13. Oceanaire (80mPD)	14. Ocean View (98.8mPD)	15. La Costa (97.8mPD)

**Figure 3.6 Major developments near Study Area B**

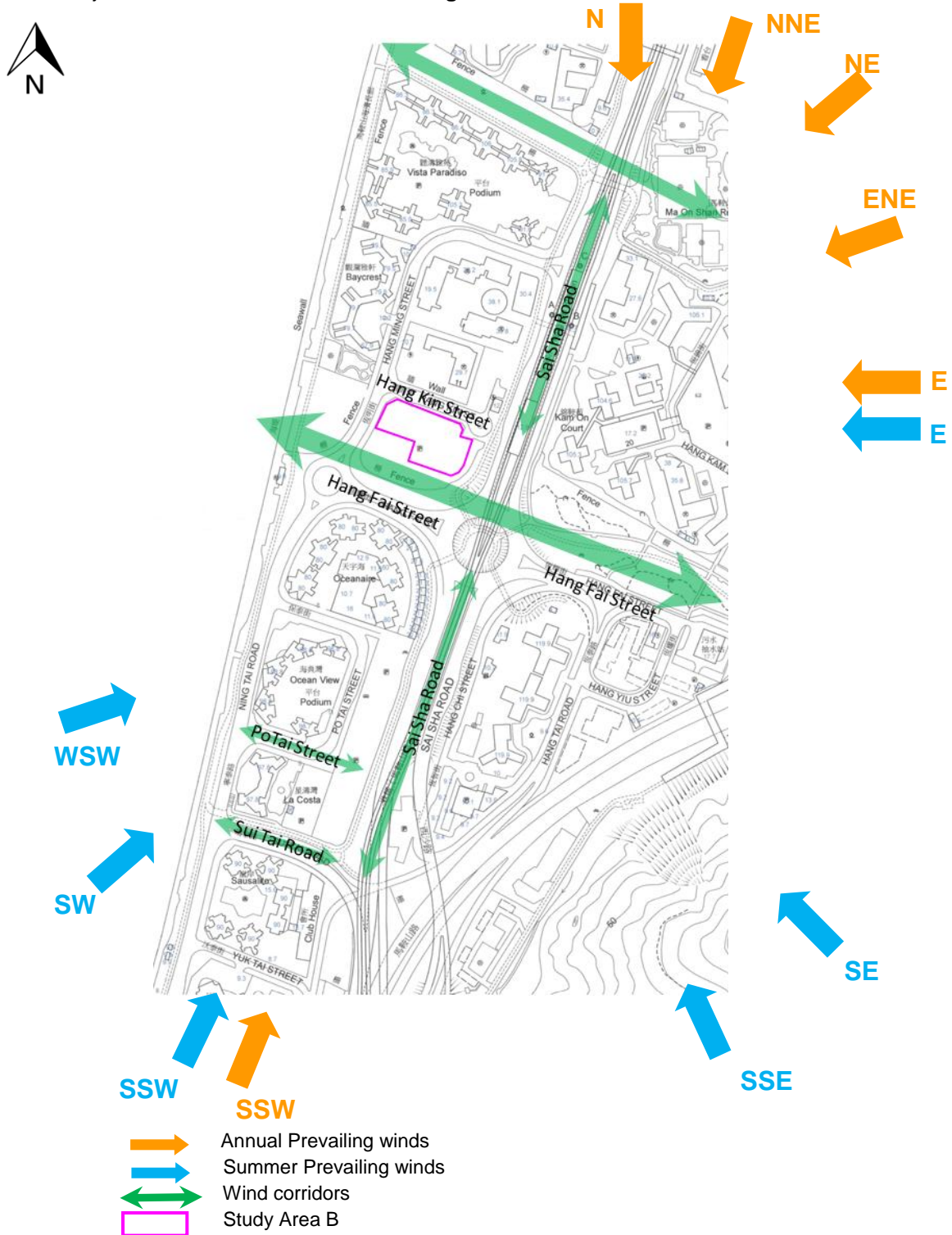
3.3.10 The regions near the Study Area B are generally occupied by high-rise and medium to high-density developments. The maximum building heights of the residential clusters in the vicinity of Study Area B ranges from approximately 68mPD to 120mPD. Meanwhile, the schools (Renaissance College, Tsang Pik Shan Secondary School, etc.) located north and northeast to Study Area B have relatively lower profile (around 30mPD) compared to the residential developments.

3.3.11 The tallest building is located at Yiu On Court. These developments are located to the southeast of Study Area B with a distance of approximately 180m away. It is also noticed that the high-density clusters of Heng On Estate and Kam On Court are located around 90m east and northeast of Study Area B and the building height of these residential developments is approximately 105mPD.

- 3.3.12 To the immediate north of Study Area B are existing low-rise developments (around 30mPD) of Ma On Shan Methodist Primary School and Renaissance College, as well as high-rise residential blocks (around 80mPD to 106mPD) of the Baycrest and Vista Paradiso. To the further north of Study Area B are Chung On Estate and Kam Fung Court with developments at around 115mPD.
- 3.3.13 To the immediate south of Study Area B are the Oceanaire with developments at around 80mPD in height. To the further south are residential blocks of Ocean View, La Costa and Sausalito. These are high-rise buildings with height ranging from 90mPD to 99mPD.

### 3.4 Wind Corridors near Study Area B

3.4.1 Determining the prevailing wind directions in **Section 3.1** is important in identification of wind corridors. The annual prevailing wind comes from the north, east, north eastern quadrant as well as southwest directions. Meanwhile, the summer prevailing winds are mainly comprised of east, south eastern quadrant winds and south western quadrant winds. By understanding the prevailing wind directions and studying the building morphology in the vicinity of Study Area B, the major wind corridors are illustrated in **Figure 3.7**.



**Figure 3.7 Major Wind Corridors near Study Area B**

### **Wind corridors near Study Area B**

- 3.4.2 Major roads are important in maintaining air ventilation in the local region. Sai Sha Road passing acts as an important wind corridor allowing the annual N and NNE wind to ventilate the surrounding area near Study Area B. It also facilitates the summer SSW to flow through the area.
- 3.4.3 Two important wind corridors are also identified. One is the open space between Vista Paradiso and Chung On Estate. The other one is the open space between Heng On Estate and Yan On Estate, together with Hang Fai Street and Hang Kin Street, it becomes an important wind corridor in the area. These two wind corridors allow the E and SE wind, also the land-sea breeze to pass through the area.
- 3.4.4 Apart from the roads mentioned in Paragraph 3.4.2 and 3.4.3, Sui Tai Road and Po Tai Road, aligned in perpendicular to Sai Sha Road act as wind corridors under the annual E wind.

### **3.5 Existing wind condition of Study Area B**

#### **Under the Annual Prevailing Winds**

- 3.5.1 It is understood that a building of height H is generally possible to induce a wind wake of approximately H from the building. Inside the wake region, there exist weaker and more turbulent winds which are collectively referred to as a “wind shadow region” behind the building.
- 3.5.2 Under the N and NNE annual winds, the wind would enter the site along Sai Sha Road. At the same time, the schools located to the north would likely to generate a “wind shadow region” at the downstream side. Study Area B has a distance of approximately 40 meters away from the schools and is not expected to fall within the low wind region. It is also noticed that the residential clusters of Baycrest and Vista Paradiso are located far from Study Area B and are unlikely to cast negative air ventilation impacts on it.
- 3.5.3 As Study Area B is located at the junction of the two wind corridors, Sai Sha Road and the open space between Heng On Estate and Yan On Estate, the wind resources under these prevailing wind is expected to be satisfactory under NE, ENE and E wind condition. However, the wind wake generated by the western most development (around 105mPD in height) of Kam On Court is expected to reach the east portion of Study Area B which lies around 90m west and west-south westerly to Kam On Court.
- 3.5.4 Under the annual SSW wind condition, the prevailing wind enters the site from the promenade area and Sai Sha Road. Slight decline in the wind environment would be expected due to the influence of the Oceanaire which is located the south of Study Area B.

#### **Under the Summer Prevailing Winds**

- 3.5.5 E and SSW are the common prevailing direction under both annual and summer conditions. Relevant discussion can be found in Paragraph 3.5.3 and 3.5.4.
- 3.5.6 Under the south-eastern quadrant prevailing wind (SE and SSE), the wind corridor between the Yan On Estate and the Heng On Estate allows the prevailing wind to enter the study area freely and there would be abundant of wind resources under these two prevailing wind directions.
- 3.5.7 Under the SW and SSW and WSW winds, the upwind side of the Study Area B is the Ma On Shan Promenade and open sea. No significant blockage of these winds towards Study Area B is expected resulting in satisfactory wind performance.

### 3.6 Expert Evaluation on the Proposed Development Schemes within Study Area B

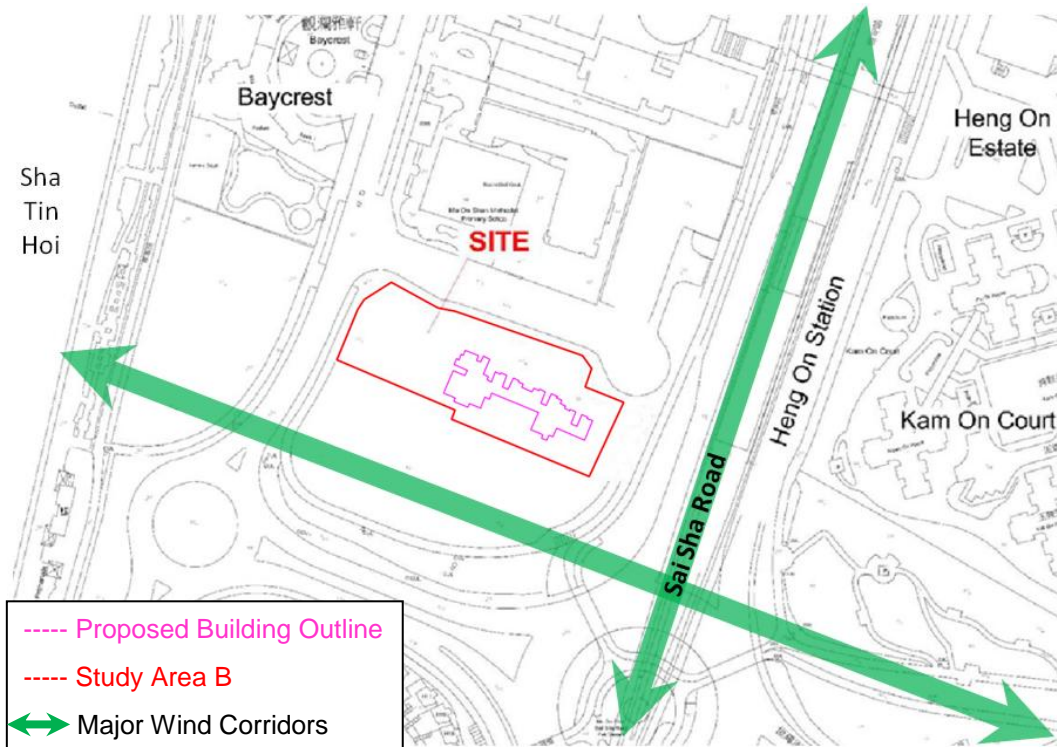
3.6.1 Three different design scenarios are evaluated in this Study and their corresponding parameters are shown in **Table 3.1**.

**Table 3.2 Parameters of Proposed Development under Different Scenarios**

	Scenario A	Scenario B	Scenario C
Maximum Overall P.R.	4.0	6.0	6.0
Maximum Building Height	80mPD	120mPD	120mPD
Gross Site Area	4185m <sup>2</sup>	4185m <sup>2</sup>	5253m <sup>2</sup>
Net Site Area	4185m <sup>2</sup>	4185m <sup>2</sup>	5253m <sup>2</sup>
No. of Storeys	25	38	38

#### Scenario A

3.6.2 The building in Scenario A is a 25-storey building at 80mPD in height and a maximum overall plot ratio 4.0. The longer length of the building block aligns with the ESE /WNW prevailing wind direction. The design outline is shown in **Figure 3.8**.



**Figure 3.8 Building Outline for Scenario A**

### **Under the Annual Prevailing Winds**

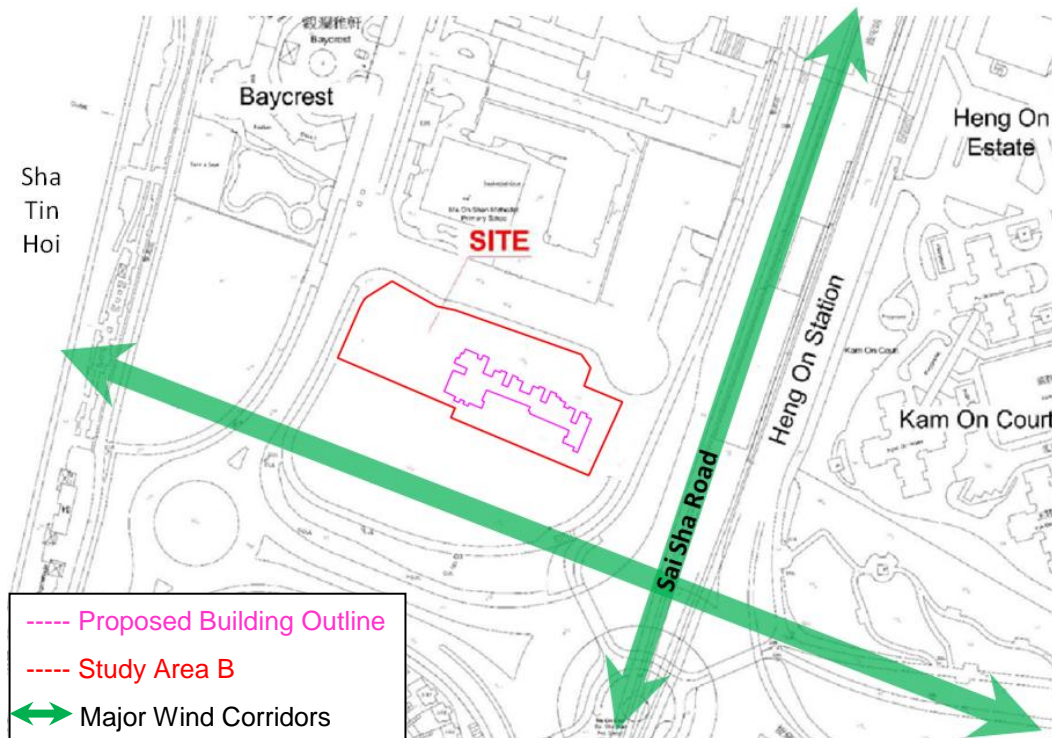
- 3.6.3 Under the N, NNE and NE annual prevailing winds, the Oceanaire residential developments and Hang Fai Road located at the downwind region are most likely to be affected after the proposed development is in place. However, the proposed development in Scenario A is 80mPD in height and the wind shadow region generated is expected to reach Hang Fai Street. The Oceanaire is less affected by the proposed development. Furthermore, the proposed building (80mPD in height) in Study Area B form a stepping building height profile with Ma On Shan Methodist Primary School buildings (around 30mPD in height) located to its upwind side. This helps to redirect the N and NNE prevailing winds to the pedestrian level, maintaining pedestrian wind comfort.
- 3.6.4 The most likely affected pedestrian accessible area located at downwind under the ENE and E annual wind directions is the Ma On Shan Promenade. However, the wind wake region generated by the 80mPD tall building in Scenario A is not expected to reach the Ma On Shan Promenade area and no wind ventilation issues are anticipated.
- 3.6.5 Under the SSW wind, the prevailing wind enters the site from the promenade area and slight decline in wind environment is expected at the Ma On Sha Methodist Primary School when compared to the existing condition.
- 3.6.6 Further to the discussion in paragraph 3.5.7, reduction in width of this major wind corridor will result in a localised channelling effect (i.e. after the development of the proposed building (Scenario A) is in place). Wind magnitude is expected to increase at locations between the proposed development and the Ma On Shan Methodist Primary School buildings (i.e. Hang Kin Street).

### **Under the Summer Prevailing Winds**

- 3.6.7 The SE, SSE summer winds after flowing down the hills of Ma On Shan will be directed into the wind corridor along the open space between Heng On Estate and Yan On Estate and reach the Baycrest and the primary school. There would be slight decline in wind environment at the Baycrest and the primary school.
- 3.6.8 The SW and WSW summer winds coming from the promenade are able to reach Study Area B without obstruction. The proposed development would divert some prevailing wind to the pedestrian level and enhance the localized wind environment. Slight decline in wind environment would be found at the southern region of Kam On Court due to the wind shadow of the proposed development.

## Scenario B

- 3.6.9 The building in Scenario B is increased to a 38-storey building at 120mPD in height and a maximum overall plot ratio 6.0. Similar to Scenario A, the longer length of the building block aligns with the ESE /WNW prevailing wind direction. The design outline is very similar to Scenario A and is shown in **Figure 3.9**.



**Figure 3.9 Building Outline for Scenario B**

### Under the Annual Prevailing Winds

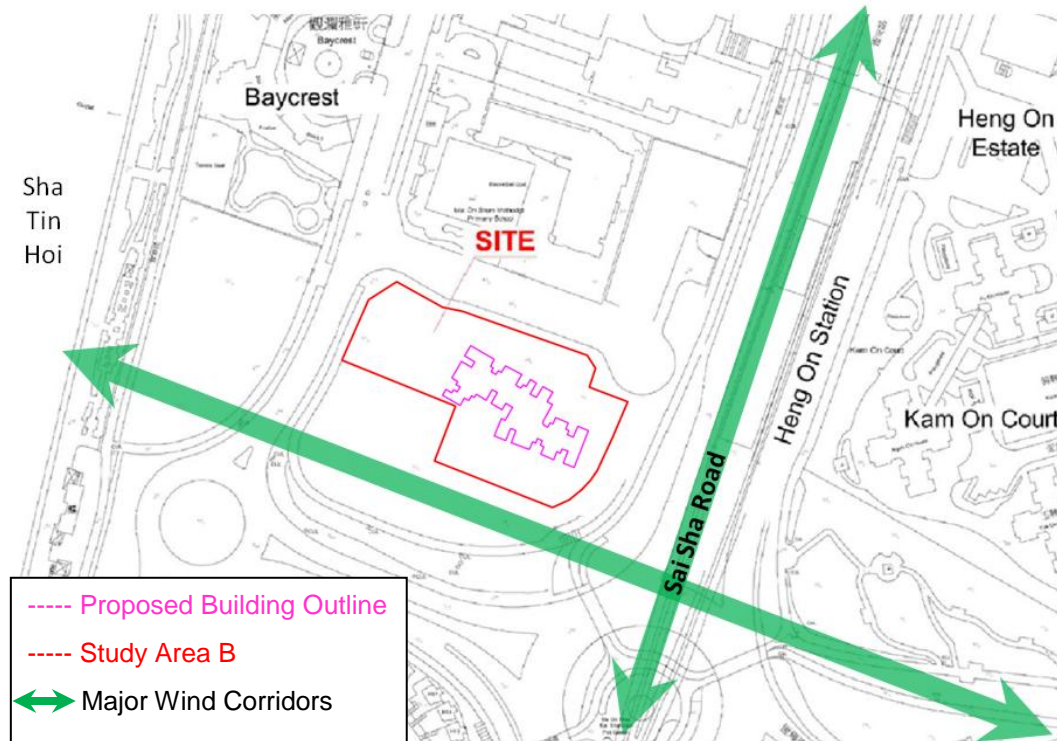
- 3.6.10 Similar phenomena are expected to be observed under Scenario B when compared to Scenario A with a difference that Scenario B is likely to generate a larger wind shadow zone due to the increment in building height.
- 3.6.11 Under the N, NE and NNE annual prevailing winds, the Oceanaire residential developments and the Ma On Shan Promenade located at the downwind region are likely to lie within the shadow zone generated by the proposed development of 120mPD in Scenario B. Further strengthening of downwash wind is expected when compared to Scenario A due to a taller building.
- 3.6.12 The area located at downwind under the ENE and E annual wind directions is the promenade area. Slight decline in wind environment may be introduced when compared to Scenario A.
- 3.6.13 Further decline in wind environment at Ma On Shan Methodist Primary School is expected due to a taller building under Scenario B.

### Under the Summer Prevailing Winds

- 3.6.14 Under SE and SSE, further decline in the Baycrest and the primary school is expected. Under the SW and WSW wind, slight decline in the wind environment is expected near Kam On Court.

### Scenario C

3.6.15 The building in Scenario C is increased to a 38-storey building at 120mPD in height and a maximum overall plot ratio 6.0. Similar to Scenarios A and B, the longer length of the building block aligns with the ESE/WNW prevailing wind direction. However, the design layout of Scenario C has a larger footprint and occupies a greater site area. The design outline of Scenario C is shown in **Figure 3.10**.



**Figure 3.10 Building Outline for Scenario C**

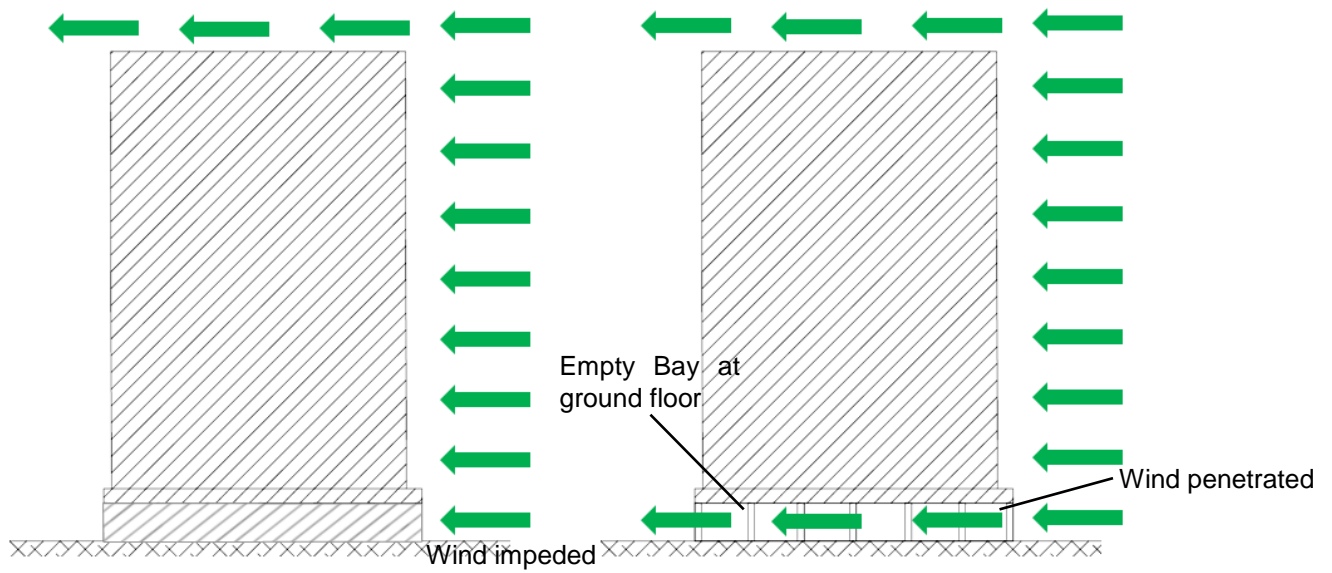
3.6.16 The difference between Scenarios B and C is that Scenario C has a larger footprint. The general wind environment would be very similar between the two schemes but Scenario C would generally create a larger wind shadow area due to larger footprint area. Further decline in the wind environment would be observed under individual wind directions.

#### **Suggested mitigation measures and further study**

3.6.17 Inevitable adverse impact would be induced to the surrounding environment when comparing the existing vacant site condition with any proposed development schemes.

3.6.18 By increasing the ground floor permeability, the adverse impact on the pedestrian wind environment can be alleviated. The entire ground level of the proposed development is suggested to be designed as ground floor empty bay of at least 6m in height. Effect of this design is illustrated in **Figure 3.11**. Quantitative analysis is recommended to further evaluate the potential impacts of the proposed development on the surrounding area and effectiveness of any proposed mitigation measures at a later stage.





**Figure 3.11** Illustration of the empty bay design

## **4 SUMMARY AND CONCLUSION**

- 4.1** There are two Study Areas evaluated in this Expert Evaluation study, the first one is located at Whitehead area (Study Area A), while the second one is situated at Hang Kin Street (Study Area B).
- 4.2** By summarizing the wind data from both the Hong Kong Observatory, the MM5 model and experimental site wind availability data (only Study Area b), it can be concluded that the annual wind for both Study Areas come from the North, East, Northeast quadrant as well as SSW. Meanwhile the summer winds for the two Study Areas come from the East, south eastern and south western quadrant directions.
- 4.3** The major wind corridors near Study Area A include:
- Wind corridor passing through the REC, CDA(3) and CDA(1)
  - Yiu Sha Road and Lok Wo Shan Lane
  - Visual corridor passing through CDA(1) and CDA(2)
- 4.4** The major wind corridors near Study Area B include:
- Sai Sha Road
  - Open space between Heng On Estate and Yan On Estate
  - Open space between Vista Paradiso and Ching On Estate
  - Po Tai Road
  - Sui Tai Road.

### **Summary of the evaluation on Study Area A**

- 4.5** Due to the low rise nature with a 15m building separation between the building clusters of proposed development at Study area A, the impact induced by the proposed development is minimal under all studied prevailing wind directions. No further AVA Initial Study is recommended to be carried out for this Study Area.

### **Summary of the evaluation on Study Area B**

- 4.6** A single block building is proposed to be developed within Study Area B. Three design options (Scenarios A, B and C) are evaluated in this study.
- 4.7** Inevitable impact is expected when comparing the existing vacant condition with any proposed development scenario.
- 4.8** In general, Scenario A is expected to perform the best among all three Scenarios. Scenarios B and C have a taller building height compared to Scenario A, while Scenario C has the largest building footprint among the three Scenarios.
- 4.9** Ground floor empty bay is suggested to alleviate the potential ventilation impact and quantitative assessment is suggested to carry out in the detailed design stage to evaluate the potential impact due to the development. It is suggested that a site-specific quantitative assessment for the proposed housing development at the site should be conducted to assess the possible impact in air ventilation performance of the proposed housing development under different development scenarios.