Term Consultancy under Category A for Expert Evaluation on Air Ventilation Assessment Services

Expert Evaluation on Air Ventilation Assessment of Shau Kei Wan

PLANNING DEPARTMENT

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Contents

1 Introduction

WSP HK was commissioned by the Planning Department of HKSARG under Category A Service of the Term Consultancies for Air Ventilation Assessment Services. The objective is to assess the air ventilation impacts of the plot ratio/ gross floor area and building height restrictions under the draft OZP and recommend mitigation measures to alleviate the impacts.

The main tasks are to provide the followings:

- Site inspection and analysis of the wind data and environment of the project area in Figure 1;
- A qualitative evaluation of the air ventilation impacts of the development as illustrated under the planned scenario as compared to the existing scenario;
- Recommendations of mitigation and improvement measures.

Figure 1 shows the project area. Figures 2 to 4 show photographs of the project area taken from Locations A, B and C in Figure 1 respectively. Figures 5 to 9 show various views and developments in the project area.

The methodology adopted here follows that for an expert evaluation in the "Technical Guide for Air Ventilation Assessment for Developments in Hong Kong" as well as those requirements in the Project Brief.

2 Site Information

The project area covers Shau Kei Wan area of Hong Kong Island, with an area of approximately 201 hectares. (Figures 1 to 4). It is bounded by the Shau Kei Wan Typhoon Shelter to the north and Tai Tam Country Park to the south. To its east is the residential development of Heng Fa Chuen, and to its west are the residential developments of Lei King Wan, Taikoo Shing and Kornhill.

The area has largely been developed with the majority of the developments being both large–scale public housing and private residential estates. The A Kung Ngam industrial area is undergoing gradual transformation to become a commercial office area. The terrain of the area is flat mostly in the centre and the western part, with a knoll at the eastern border and hill slopes to the south of Shau Kei Wan Road.

Figure 5 shows the main road and street going through the centre of Shau Kei Wan, Shau Kei Wan Road and Sai Wan Ho Street. The former is surrounded by low to mid-rises on both sides of the road, with some alleys to allow for cross-flow. In comparison, Sai Wan Ho Street is narrower and has new developments such as the Grand Garden which may worsen localised stagnant regions.

Figure 1 The AVA Project Area

Figure 2 View Towards Project Area from Location A in Figure 1

Figure 3 View Towards Project Area from Location B in Figure 1

Figure 4 View Towards a relatively built-up Project Area from Location C (Lei Yue Mun Park and Holiday Village) in Figure 1

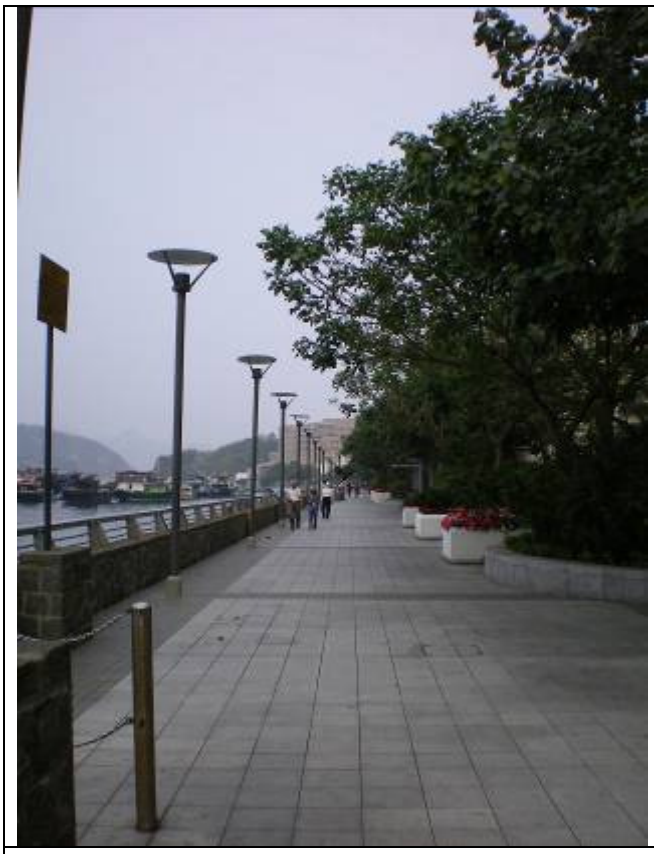
Views of Shau Kei Wan Road Looking Westward

Views of Shau Kei Wan Road Looking Eastward

Views of Alley along Shau Kei Wan Road

Views of Sai Wan Ho Street (narrow streets with tall buildings (such as Grand Garden) as wind blocks)

Figure 5 Views of Shau Kei Wan Road (Shau Kei Wan centre with low to mid-rises already with limited breeze)and Sai Wan Ho Street



View of Oi Kan Road Seafront Promenade

View of Oi Kan Road

Tung Yuk Court (obstruction to breeze)

Figure 6 Promenade is the entry point for wind from the north east

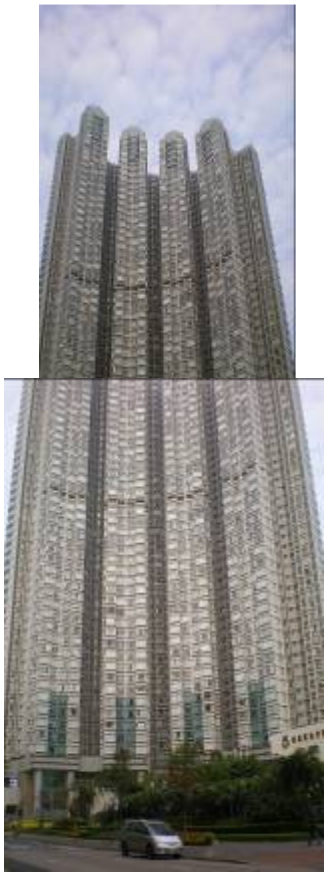


Figure 7 View of Les Saisons (Obstruction to breeze)

Figure 8 View of Grand Promenade (Obstruction to breeze)

Figure 9 View of Yiu Tung Estate and Tung Chun Court

3 Wind Environment

The wind data was obtained for several locations in the Project Area from MM5 simulation from Institute for the Environment (IENV), the Hong Kong University of Science and Technology (HKUST)[1]. Figure 1 shows the project area. The diversity of the massing of developments of the project area may cause some local re-adjustment of wind distribution. The annual wind data at eight selected locations numbered 1 to 8 as shown in Figure 1 was therefore analysed. Furthermore, the wind data at heights of 120m, 230m and 450m were also analysed to identify the sensitivity of wind directions with variation in height for these selected locations. These heights were chosen to verify the impact of developments on the wind regime. Typically the height of 450m gives an overall picture of the prevailing winds with less disturbance caused by the urban canopy, whilst the wind data at the height of 120m is subject to the variations in the urban canopy. The intermediate height of 230m usually gives a representative picture of the wind regime of the project area. Figure 10 compares the wind data at these locations and heights.

It can be seen from Figure 10(a to d) that the prevailing wind direction is north-east at 120m, 230m and 450m for all eight locations. There is no discrepancy among the wind data at various locations. **It can therefore be concluded that the annual prevailing wind direction for the project area is: north-easterlies.**

The next step is to investigate the seasonal behaviour of the wind regime. Since the data at the locations 1, 5 and 7 do not vary significantly, the seasonal wind data of location 5 (centre of Shau Kei Wan, Figure 1) is selected to be representative of the project area. Figure 11 summarises the seasonal characteristic of the wind regime at 230m. **It can be seen that the easterlies and southerlies dominate the spring and summer months, whilst the north-easterlies dominate the autumn and winter months.**

1. This MM5 data here was adopted from the Institute for the Environment (IENV), the Hong Kong University of Science and Technology (HKUST).

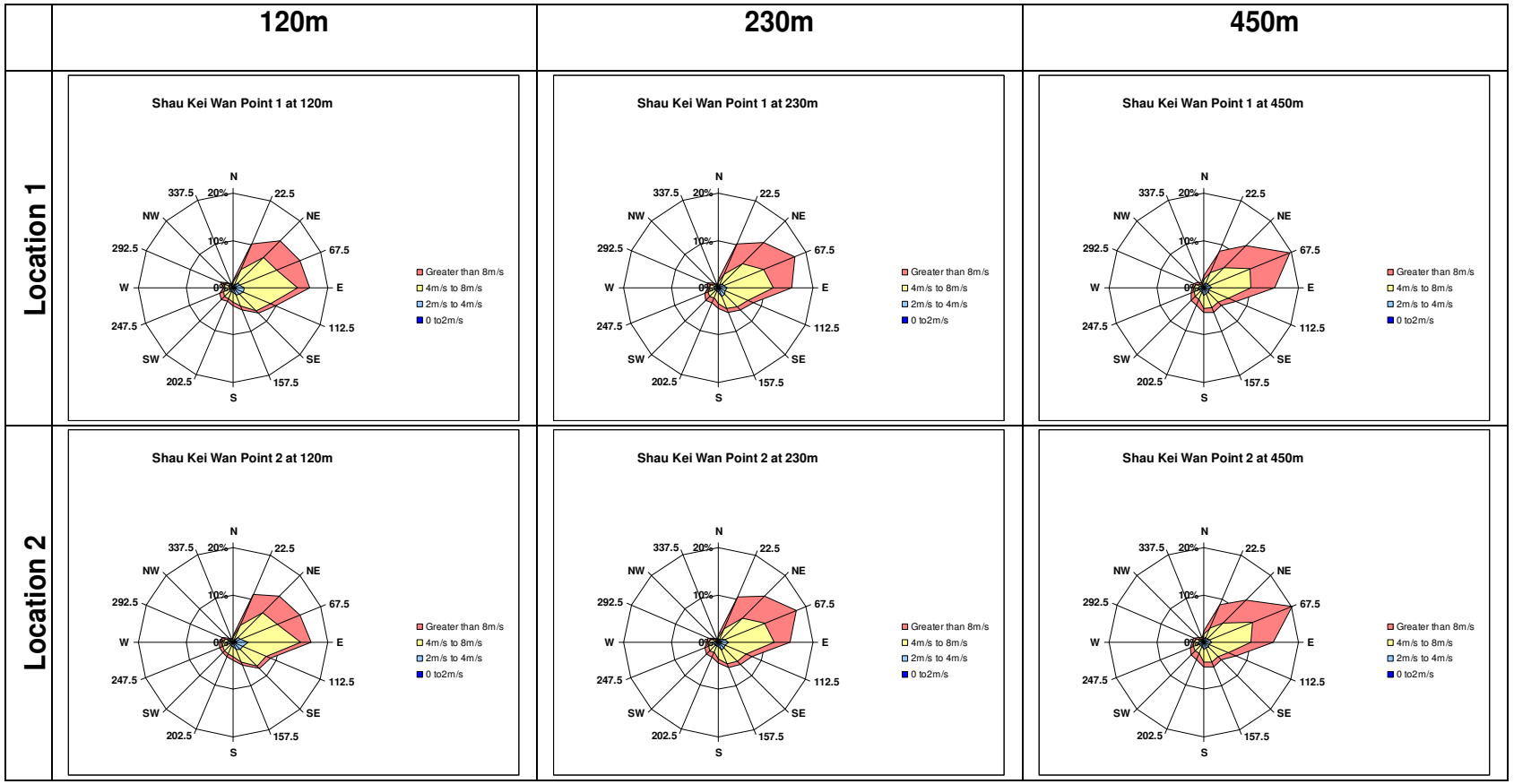


Figure 10a Annual Wind Roses at Locations 1 and 2 at Various Heights (see Figure 1 for locations)

Greater than 8m/s
4m/s to 8m/s
2m/s to 4m/s
0 to2m/s

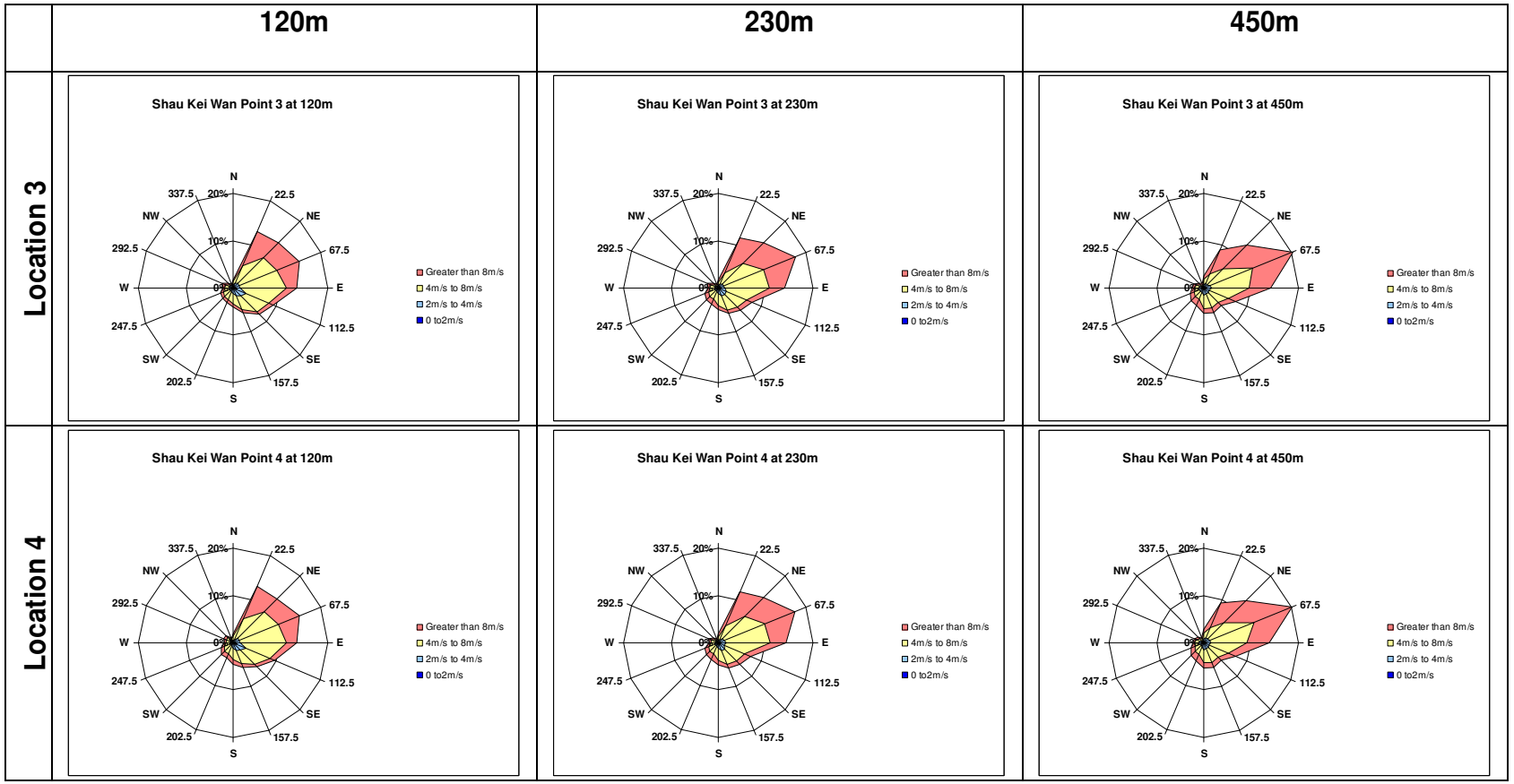


Figure 10b Annual Wind Roses at Locations 3 and 4 at Various Heights (see Figure 1 for locations)

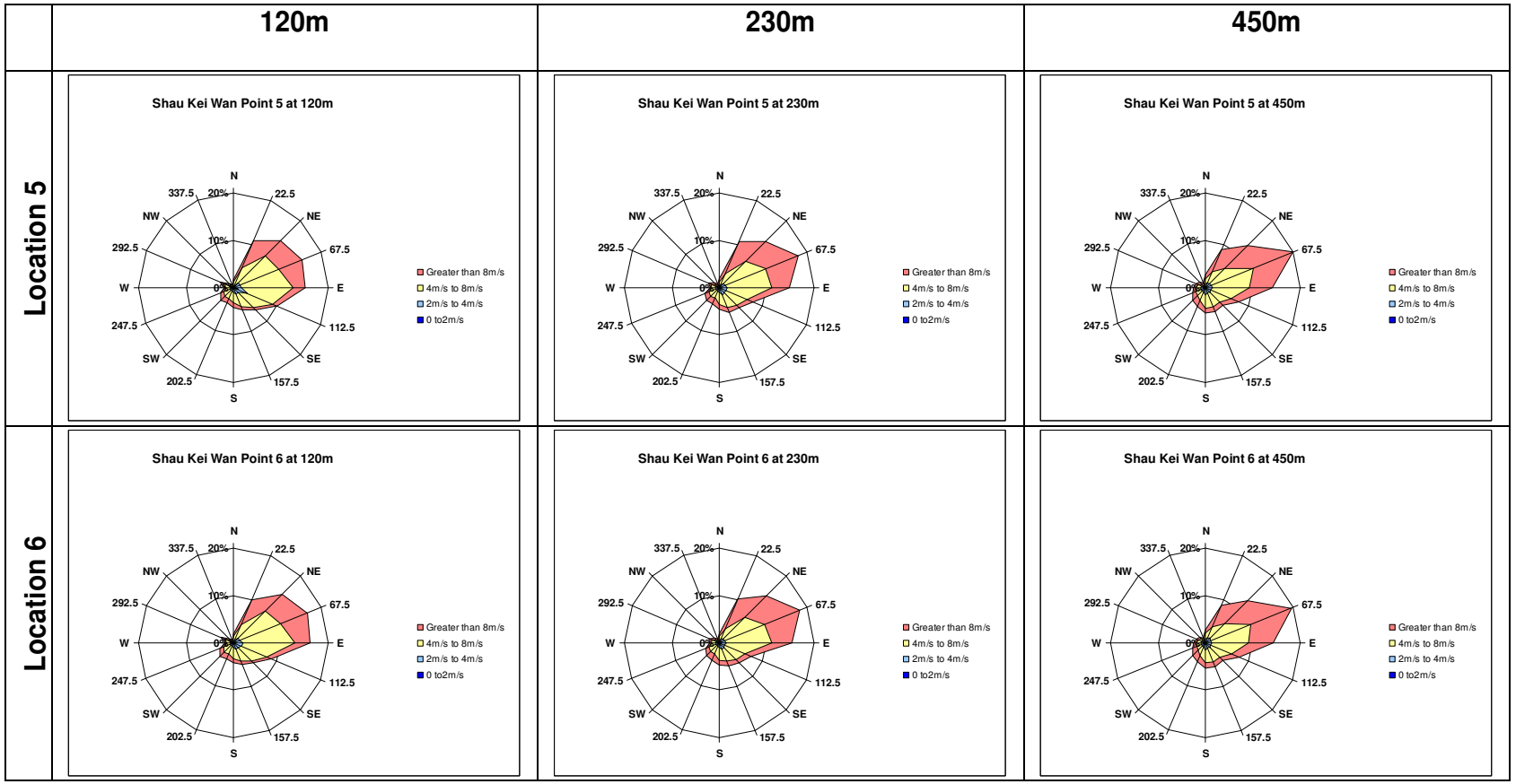


Figure 10c Wind Roses at Locations 5 and 6 at various heights (see Figure 1 for locations)

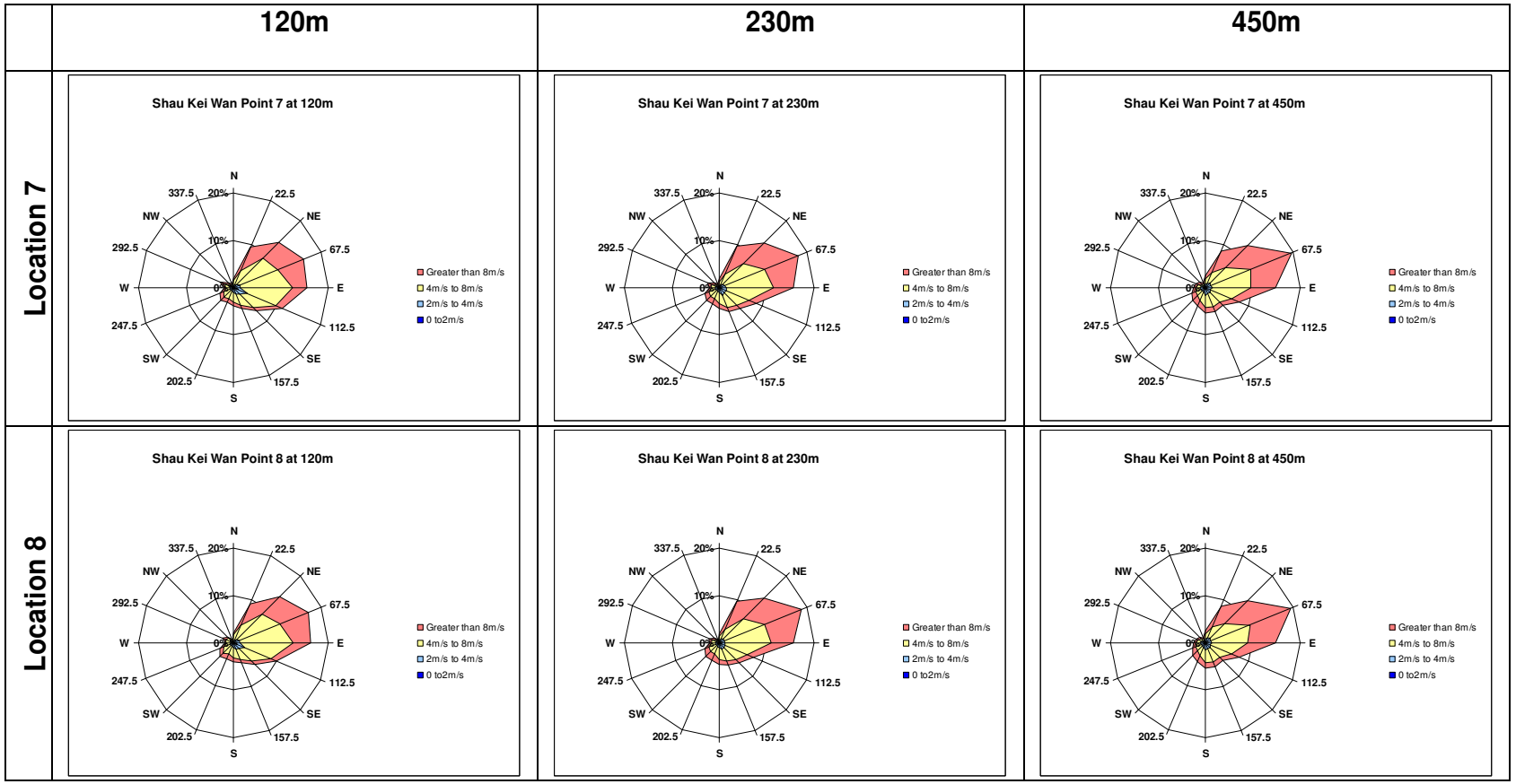


Figure 10d Annual Wind Roses at Locations 7 and 8 at Various Heights (see Figure 1 for locations)

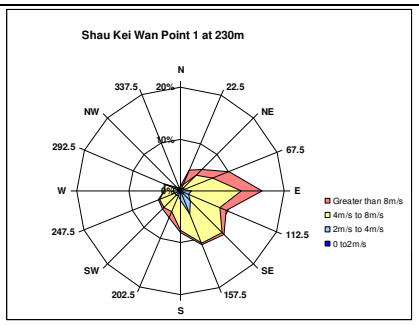
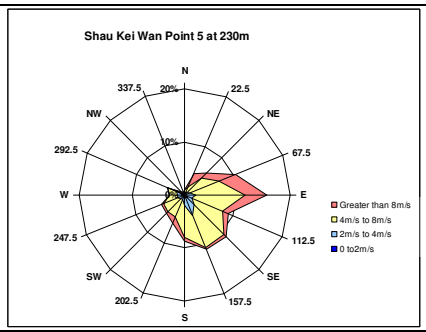
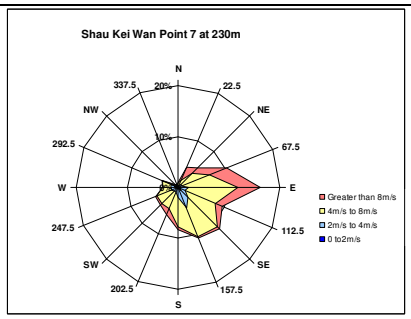
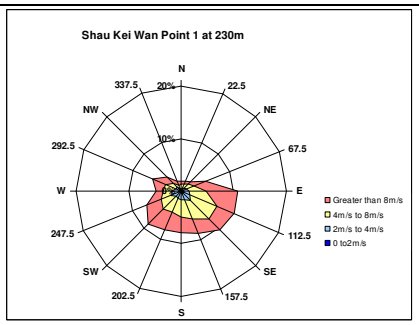
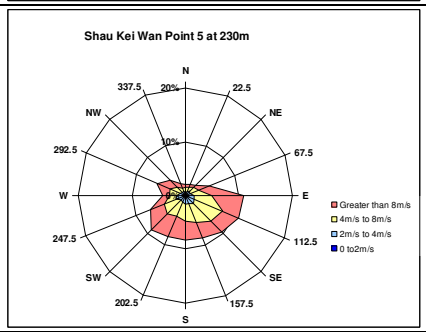
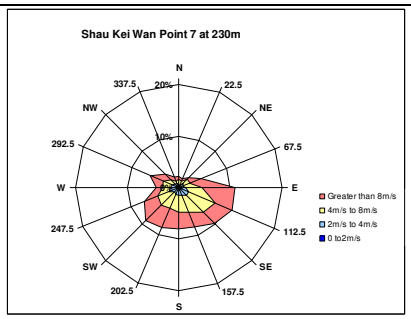
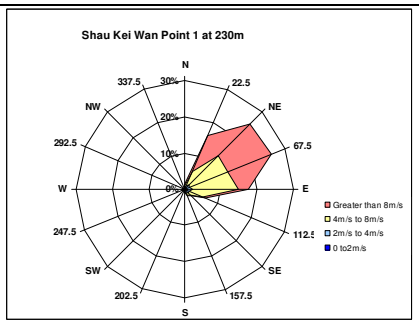
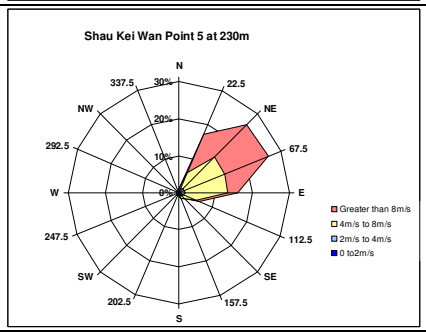
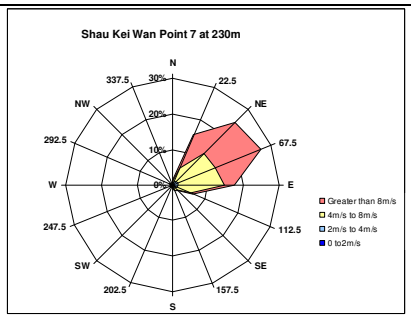
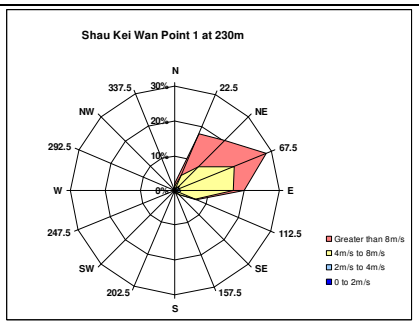
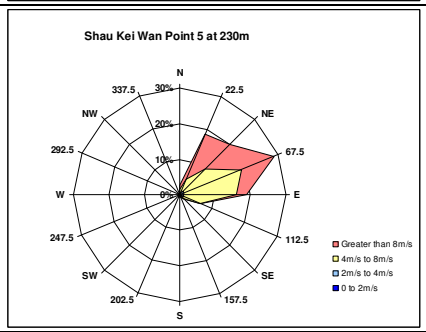
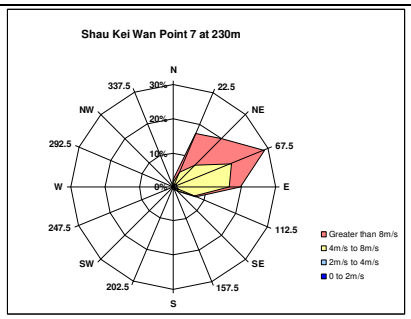
	Location 1	Location 5	Location 7
Spring			
Summer			
Autumn			
Winter			

Figure 11 Seasonal Wind Roses at 230m height at Various Locations (see Figure 1 for locations)

Greater than 8m/s
4m/s to 8m/s
2m/s to 4m/s
0 to2m/s

4 Existing Scenario

4.1 TOPOGRAPHY

The following observations of the characteristics of the project area are noted as follows:

- The terrain of Shau Kei Wan is relatively flat in the centre and western parts, with hill slopes towards the south and a knoll at the eastern fringe.
- The majority of the high rise buildings (over 99 mPD) are scattered on the south-west part and the water front of the project area.
- The developments at the eastern part and central part are mainly low to mid-rise developments (below 79mPD).

The wind flow in the project area is impacted not only by the buildings' disposition, developments' massing, site coverage and building height, but also the water mass nearby, and the surrounding hills. The proximity of water mass will bring cooler breeze. The land heats up more rapidly than the water, causing the air over the land to rise and be replaced by the air from over the water. Existing non-building areas either in the form of Open Space, or G/IC sites are encouraged to be maintained at the northern periphery of the project area to allow penetration of wind inland.

When the wind meets a hill, it creates a high-pressure zone of increased velocity on the windward side of the hill, and a low-pressure region of on the leeward side of the hill. The velocity is increased as the wind sweeps around the sides and over the top of the hill (Figure 12). As the sun warms the hills slopes, there exists a thermal gradient between the top of the hill and its base, the wind tends to flow upwards. By evening, the air cools and descends the hills and brings cooler wind to the base of the hills.

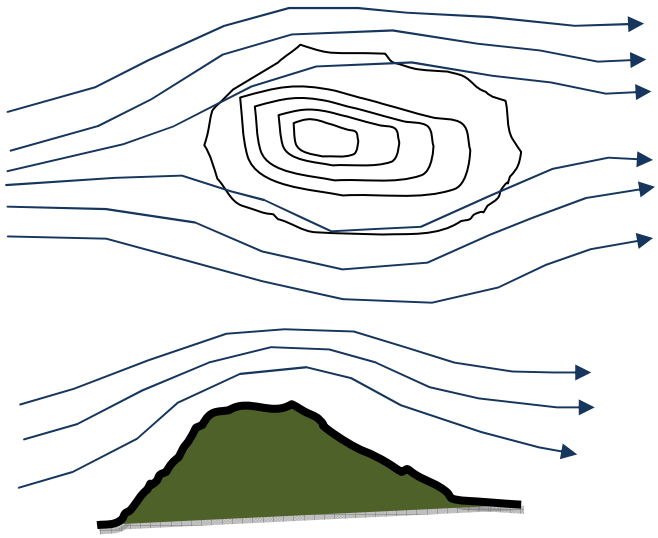


Figure 12 Influence of Terrain on Wind Flow

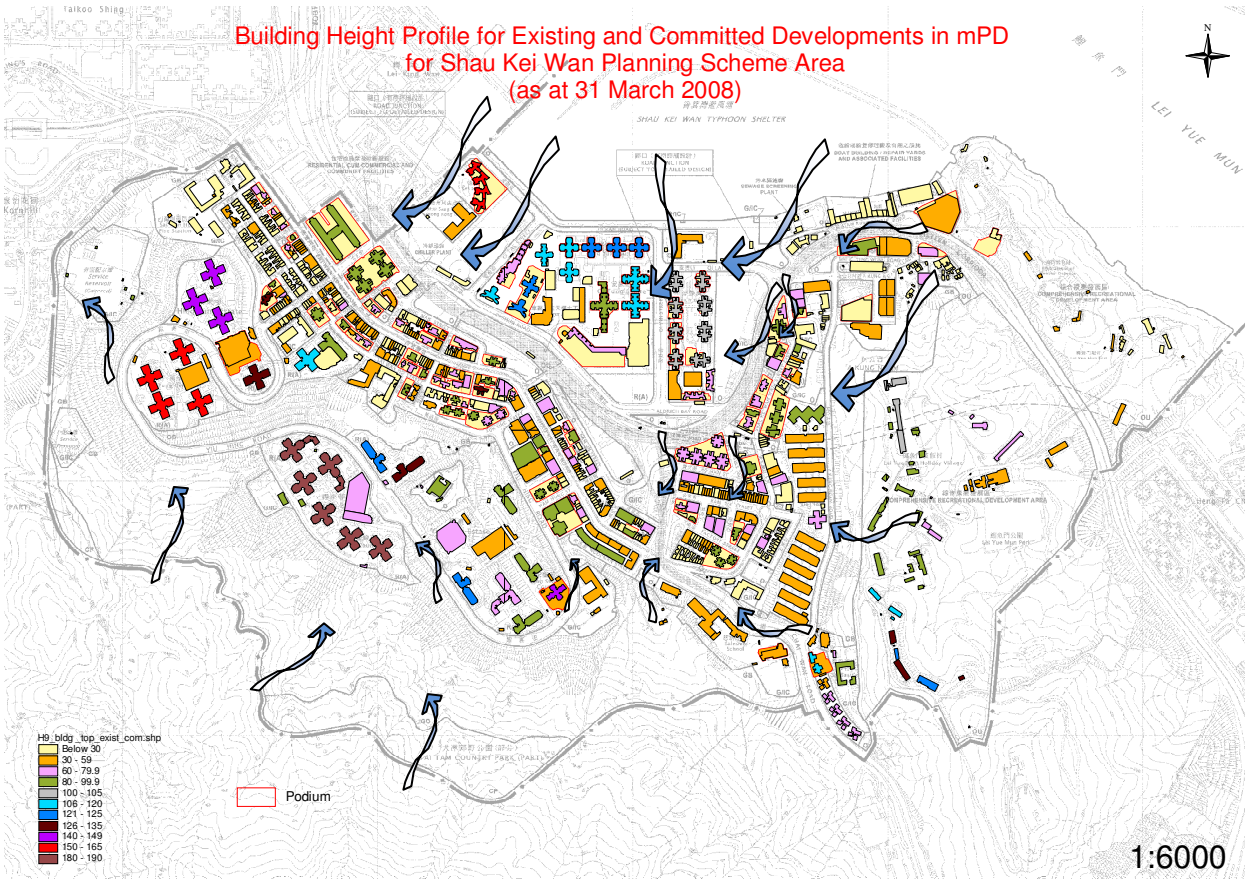


Figure 13 The project area is adjacent to the water body and at the base of surrounding hills, these features will help to bring cool breeze to the project area.

Since developments along the waterfront and at the foothill areas are generally enjoying good ventilation, the prime concern is whether wind can penetrate into the central part of the project area.

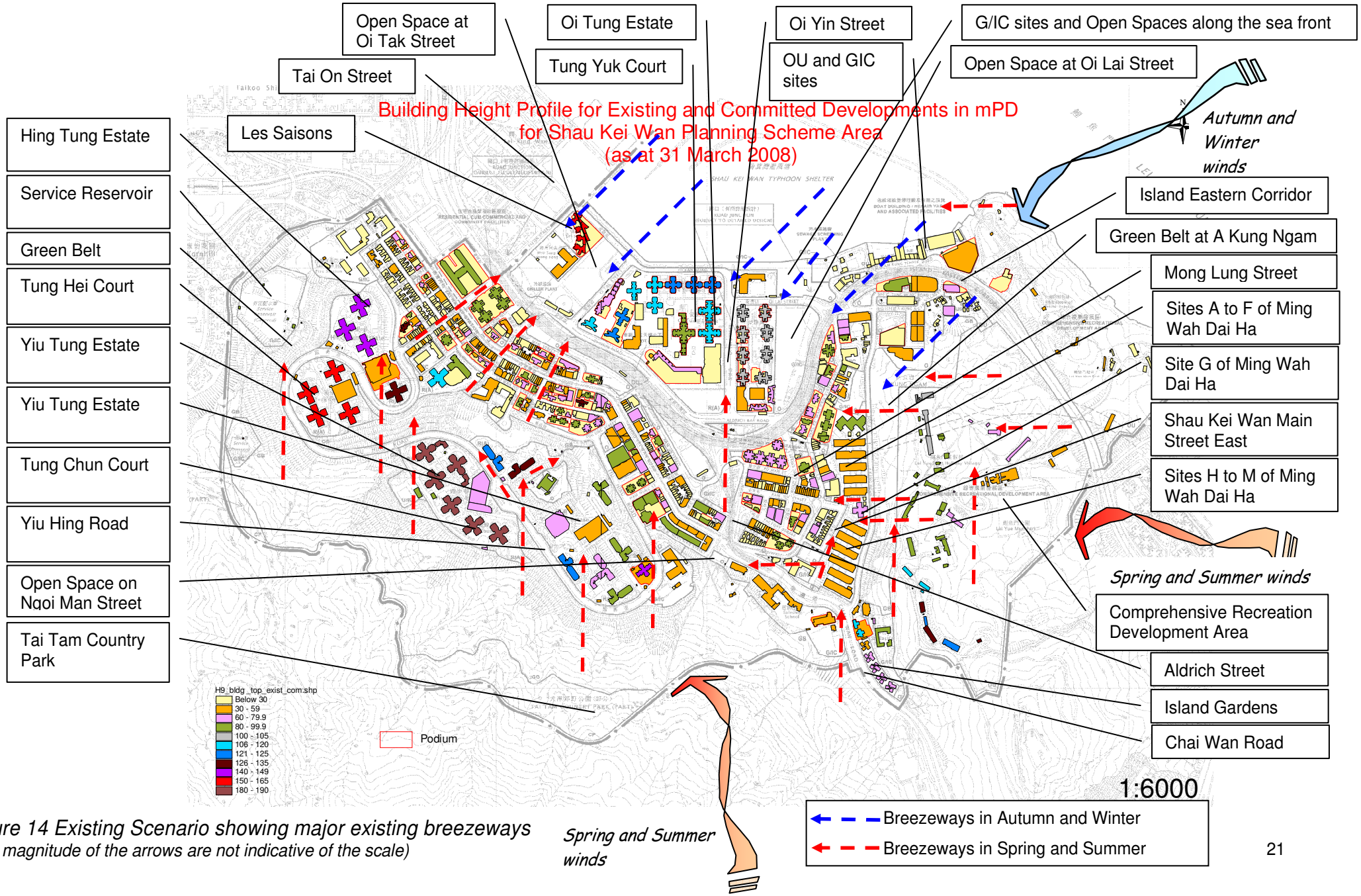


Figure 14 Existing Scenario showing major existing breezeways
(The magnitude of the arrows are not indicative of the scale)

4.2 EXISTING SCENARIO IN SPRING AND SUMMER

Section 3 has identified the annual prevailing wind directions as north-easterlies, easterlies and southerlies. It has been shown that the southerlies and easterlies dominate the spring and summer months.

The information on the existing scenario, as provided by the Planning Department, presents the existing building profile including the approved and committed developments. It is used as a basis for appreciating the existing wind environment and understanding the effects of development restrictions (Figure 14).

Figures 13 and 14 shows the prevailing winds for the existing scenario, and the major breezeways are marked by arrows. The southern part of the project area is mainly hilly with developments between 30mPD and 79mpD, with the exception of Yiu Tung Estate and Tung Chun Court with a maximum height of 135mPD. The developments along the southern skirt would enjoy some breeze descending from the hills.

Breezeways refer to the paths which are along major prevailing wind directions. The major breezeways towards the centre of Shau Kei Wan include (See Figure 14).

- A Kung Ngam Road and Green Belt at A Kung Ngam
- Chai Wan Road
- Shau Kei Wan Main Street East
- Mong Lung Street
- Aldrich Street
- Open Space on Ngoi Man Street
- Yiu Hing Road
- Service Reservoir and Green Belt at the west side of the Project Area.
- Comprehensive Recreation Development Area
- Tai Tam Country Park
- Island Eastern Corridor

The alignment of the streets and roads allow penetration of breeze towards the town centre from the south and to a lesser extent from the east. The high-rise developments (above 119mPD) tend to scatter at the periphery of the project area. The centre of Shau Kei Wan is densely built with irregular building disposition and height (below 79mPD). The majority of the developments are between 30mPD to 59mPD.

The existing high-rise developments of Yiu Tung Estate and Tung Chun Court (Figure 9) impede the breezeways reaching Shau Kei Wan Road to a certain extent. Tung Hei Court and Hing Tung Estate also restrict the southerlies reaching towards Sai Wan Ho Fire Station and Police Station at Tai Cheong Street, though the impact is not significant. The air path along the narrow Sai Wan Ho Street is inefficient due to the friction and roughness of buildings on either side of the street, but Shing On Street, Tai Ning Street, Tai Lok Street, Tai Foo Street, Tai Cheong Street and Hoi Ning Street help to ventilate the street by introducing the north easterly sea breezes into the area.

4.3 EXISTING SCENARIO IN AUTUMN AND WINTER

Section 3 has identified the annual prevailing wind directions as north-easterlies and easterlies and southerlies. It has been shown that the north-easterlies dominate the Autumn and Winter months.

Figure 14 shows the prevailing winds for the project area in Autumn and Winter, the major breezeways are marked by arrows. The northern part of the project area along the sea front is scattered with low-rises (below 30mPD), mid-rise developments (30mPD to 79mPD) and high-rise developments (above 119mPD). The open areas and the G/IC sites along the sea front area are important breezeways, and should not be obstructed by development, in particular when Tung Yuk Court, Les Saisons, Oi Tung Estate (Figures 6 and 7) are obstacles to the north-easterlies.

The major breezeways towards the centre of Shau Kei Wan include (Figure 14):

- Island Eastern Corridor
- G/IC sites and Open Spaces along the sea front
- Oi Yin Street
- Oi Tak Street
- Tai On Street

The open spaces on Oi Tak Street and open spaces on Oi Lai Street, as well as the OU and G/IC sites along Tam Kung Temple Road must be preserved. The high-rise developments already impede the prevailing north-easterlies and these existing open areas and low-rise developments help to encourage breeze to reach the centre of Shau Kei Wan.

5 Planned Scenario with Mitigations and Improvement Measures

5.1 OBSERVATIONS

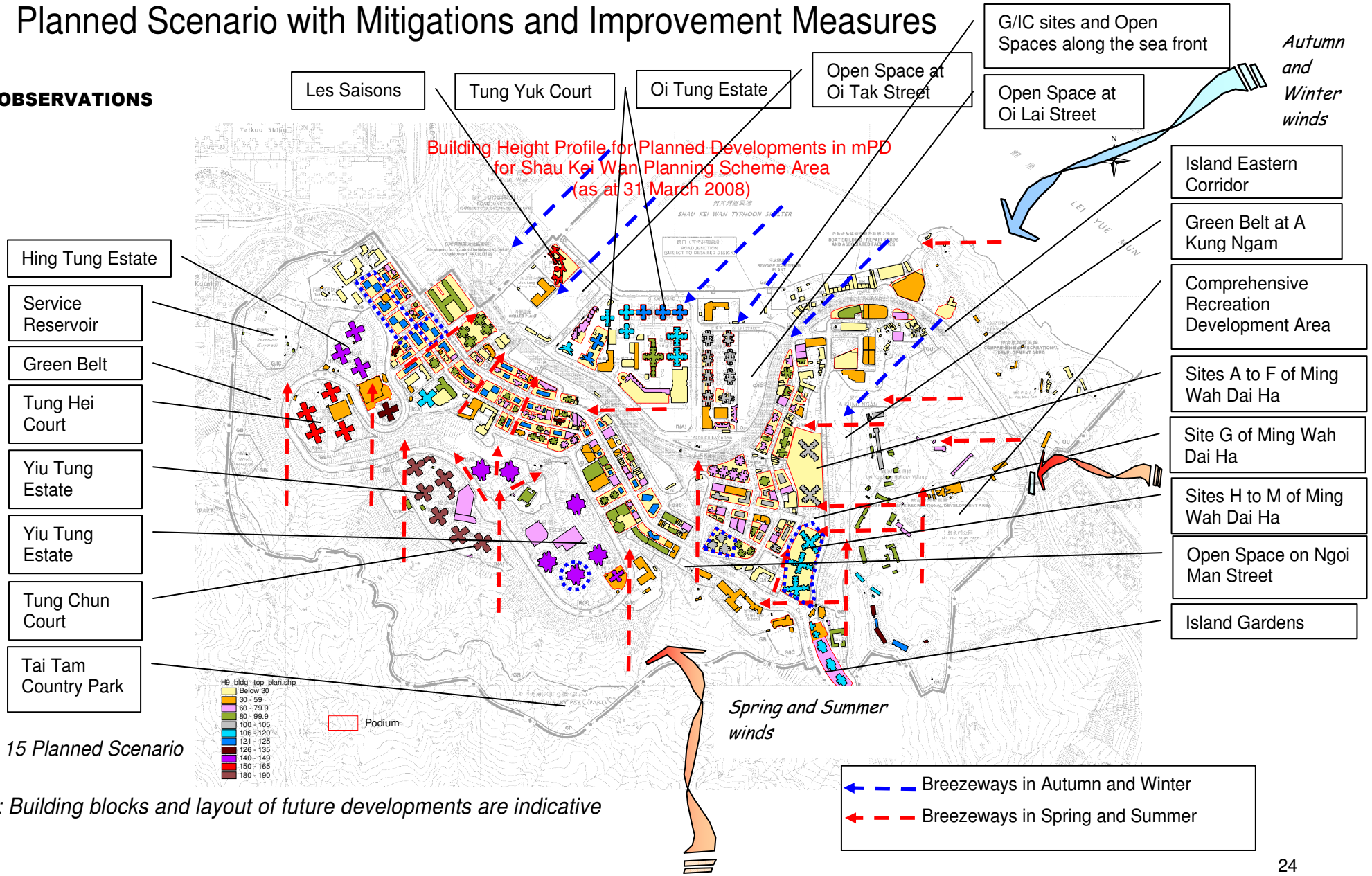


Figure 15 Planned Scenario

Note: Building blocks and layout of future developments are indicative

5.2 AREAS OF CONCERN

Figure 15 shows the indicative development/redevelopment of some sites assuming redevelopment up to the proposed maximum development restrictions on the OZP, in addition to the existing and approved/committed ones. The design, disposition and height of new development shown in this figure are hypothetical.

(1) Yiu Tung Estate

The indicative redevelopment of Yiu Tung Estate (eastern part) is likely to impede the breezeways to the centre of the project area, given that the developments such as Tung Hei Court, Yiu Tung Estate (western part) and Tung Chun Court are already built. It is prudent to ensure upon redevelopment that sufficient gaps would be provided between building blocks within the area fronting the prevailing wind from the south. It is recommended that a more detailed air ventilation assessment should be conducted as part of the redevelopments proposal for the site.

Figure 16 Breezeways through Yiu Tung Estate are necessary to ensure penetration of southerlies into the central part of the study area

(2) Ming Wah Dai Ha Site

The assumed redevelopment of 100 mPD at the blocks A to F of Ming Wah Dai Ha (i.e. northern part of the site) is acceptable and should not have significant negative impact to the wind environment. To keep the area at site G of Ming Wah Dai Ha free from buildings will be beneficial to allow breeze to enter Kam Wa street.

However, as the site is of an elongated shape located at the eastern periphery of the Shau Kei Wan core area, it is important that the future development would not create a wall effect blocking the easterlies from entering the centre. As such, it is recommended that a breezeway should be maintained across the site aligning with Kam Wa Street, Factory Street, and buildings be set back from the southern boundary of the site to facilitate a more efficient air path along Chai Wan Road.

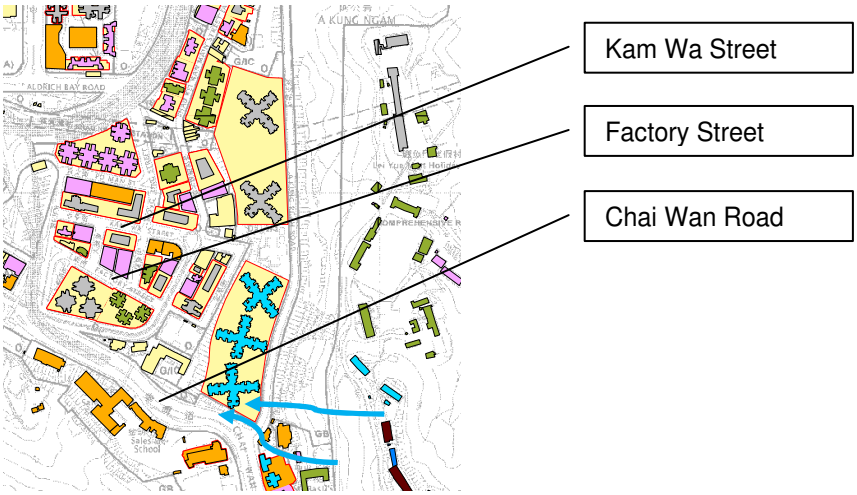


Figure 17 Recommendation for Ming Wah Dai Ha (blocks H to M)

(3) Site Bounded by Church Street, Shau Kei Wan Street East and Factory Street

The indicative development bounded by Church Street, Shau Kei Wan Street East and Factory Street can reach around 100m compared to the approximate existing height of around 55m on a small site. The building height will increase the roughness along Aldrich Street / Church Street and contribute to the obstruction of the wind approaching the centre. To ensure better ventilation at the pedestrian level, permeable podium would be recommended for the site. Consideration could also be given to the disposition and number of tower blocks to avoid wall effect.

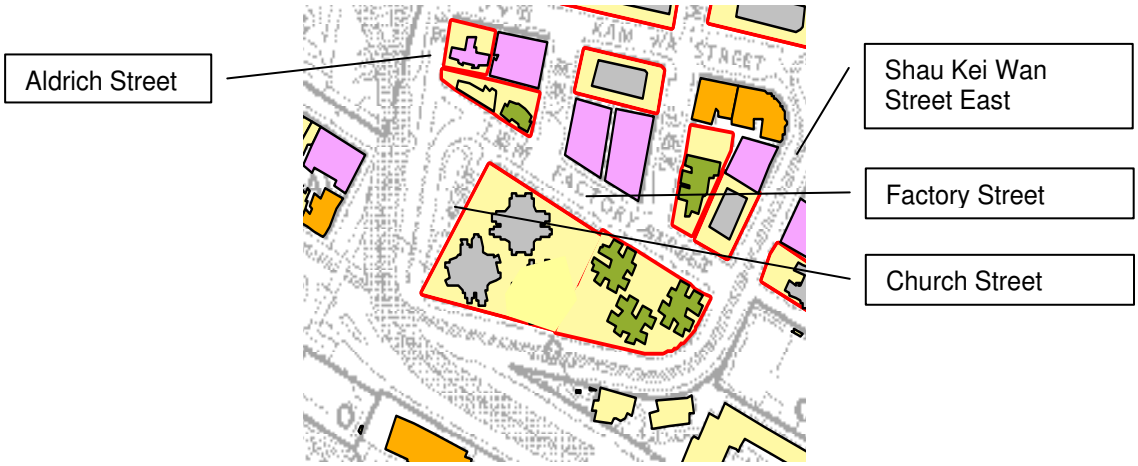


Figure 18 Permeable podium is recommended for the redevelopment bounded by Church Street, Shau Kei Wan Street East and Factory Street.

(4) South of Tai On Building and Hoi Ning Street

The possible development south of Tai On Building, at the corner of Shau Kei Wan Road and Shing On Street could be up to almost five fold taller than the existing development. The existing wind environment along Sai Wan Ho Street is already undesirable although Tai Lok Street / Tai On Street, Shing On Street / Tai On Street and Hoi Ning Street / Oi Yee Street are serving as air paths enabling wind penetration from the sea. The introduction of tall buildings into the dense area will however worsen the skimming flow across the street. It is therefore important that slab type buildings on the sites adjoining these streets be avoided and podiums should be made permeable.

(a) (b)

Figure 19 Recommendation for the redevelopment south of Tai On Building, at the corner of Shau Kei Wan Road and Shing On Street

(5) Wai Hang Street

The three possible redevelopment sites on Wai Hang Street between Tai Cheong Street and Tai Ning Street could be approximately four fold taller than existing developments. The skimming flow across Sai Wan Ho Street will be worsened. In order to minimise the negative impact, whilst recognising the redevelopment demand, it is recommended that there should have only one tower block on each site, and preferably not L-shape. Figure 20 illustrates the preferred building disposition to improve air ventilation. The maximum building height should preferably be no more than 100mPD, such that the skimming flow across Sai Wan Ho Street is not as severe.

Introduction of set-back would be desirable.

Figure 20 Recommendation for three sites on Wai Hang Street between Tai Cheong Street and Tai Ning Street

Height Bands

The key revisions in height bands are in the two strips highlighted in green and red along Shau Kei Wan Road between Tai Cheong Street and Sun Sing Street (Figure 21). The wind will skim across the building roofs and little wind will reach the pedestrian level along Shau Kei Wan Road and Sai Wan Ho Street (the existing ratio of H/W is roughly 3:1 or greater, Figure 22). With the revised height bands, the H/ W ratio is increased to roughly 8 or greater. It is recognised that the skimming flow issue will not be improved unless an impractical step is taken to significantly reduce the site coverage and plot ratio. Alternative implementable measures are therefore explored. One possible way is to create a height difference. It is therefore recommended that a difference of at least 15m to 25m should be maintained between the strip highlighted in green in Figure 21 and the strip highlighted in red along Sai Wan Ho Street between Tai Cheong Street and Sun Sing Street. The recommended 15m to 25m difference apply to building heights of 90/100 mPD to 120/125 mPD. This is to encourage downwash to occur, as illustrated in Figures 24a and b. Downwash occurs when wind stagnates on the building façade and is brought down to the pedestrian level. Different combinations are illustrated with their merits in Figure 23.

Figure 21 Recommendation on Height Difference for Sai Wan Ho Street between Tai Cheong and Sun Sing Streets

Additional measures such as setting back of residential towers, permeable podiums etc for sites along Shing On Street, Hoi Ning Street and Hoi An Street.

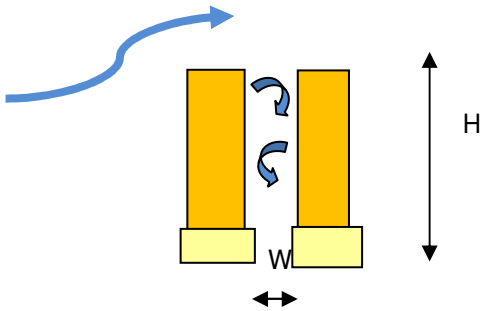
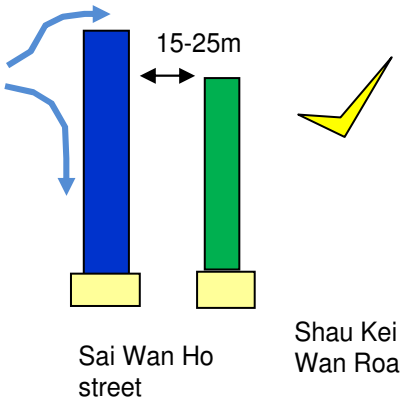
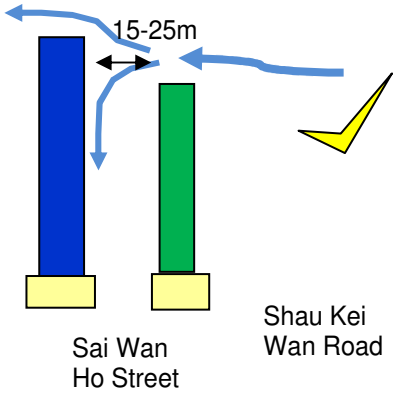


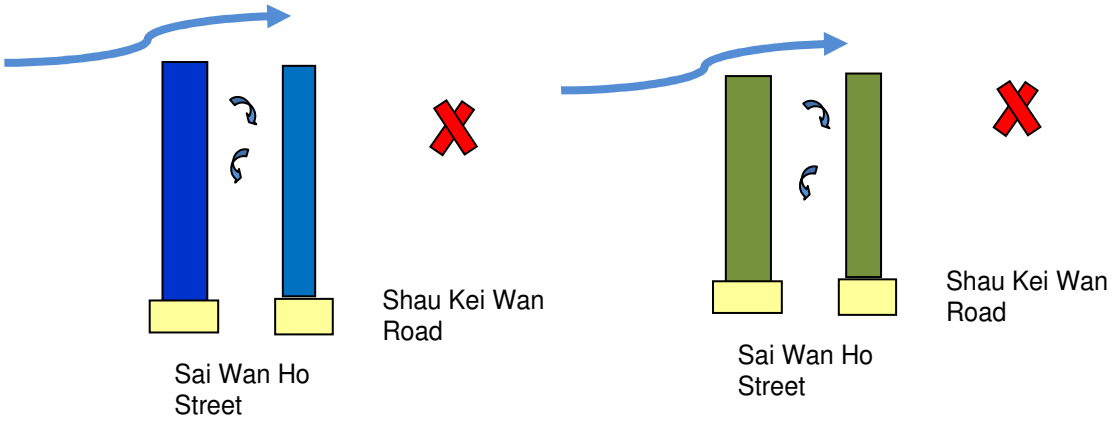
Figure 22 Definition of H/W Ratio



(a) southerlies



(b) north-easterlies



(c) Similar height will not help neither north-easterlies nor southerlies to access the pedestrian level.

Figure 23 Recommendation for Sai wan Ho Street between Tai Cheong and Sun Sing Streets

Furthermore, several quasi non-building areas are recommended to minimise the negative impact of the redevelopment, and these are highlighted as item (6) in Figure 24. These quasi non-building areas are primarily areas with wider building gaps, or low-rise GIC uses or open spaces. Recalling from the discussion in Section 4.1 and Figure 13, the key breezeways bring the cooler sea breeze and descending hill wind to the project area. The existing quasi non-building areas as described are therefore recommended to be preserved. These are summarised in Figure 24. Figure 24 also summarises and prioritises the recommendations made in the study.

5.3 FURTHER STUDY

Given the consideration of development right which will lead to high-rise buildings, control of building height in itself is not an effective means for better air ventilation. This study only provides an overview of the existing wind environment and recommends broad measures to minimise negative impacts and where appropriate, improvement to the existing conditions.

For specific sites where large-scale redevelopment may be possible, including Ming Wah Dai Ha and Yiu Tung Estate, more detailed AVAs on a site-basic should be undertaken upon availability of details on building layout and design.

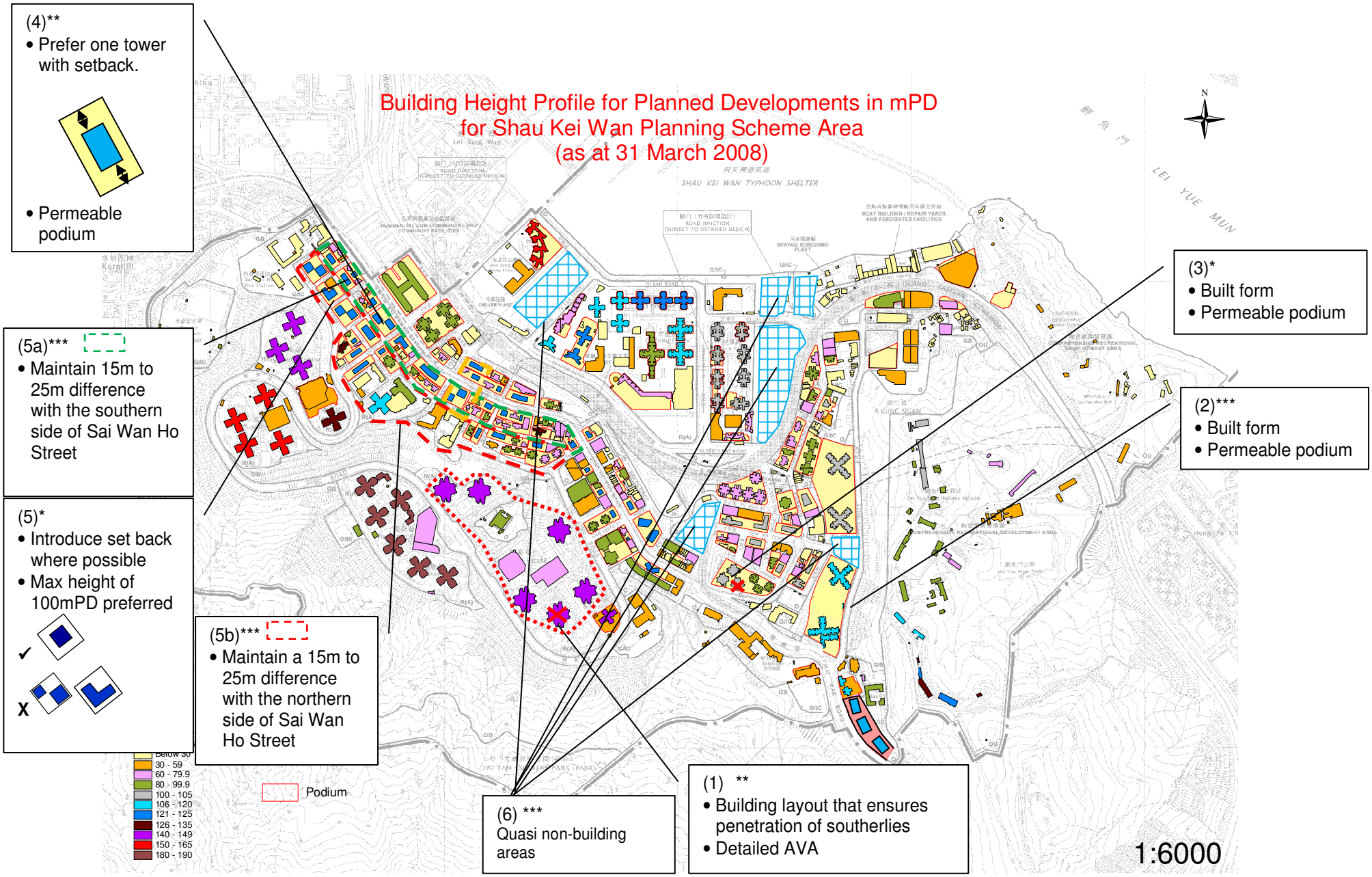


*Figure 24 Summary of Recommendations shown in boxes (The number of * represents desirability in view of mitigation)*