

ISSUE NO. : 3
ISSUE DATE : DECEMBER 2010
PROJECT NO. : 913A

EXPERT EVALUATION

FOR

**AIR VENTILATION ASSESSMENT FOR
PROPOSED PUBLIC HOUSING
DEVELOPMENT IN SHA TIN AREA 52
(SHUI CHUEN O)**

COMMERCIAL-IN-CONFIDENCE

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1. INTRODUCTION

Allied Environmental Consultants Limited (AEC) has been commissioned by the Hong Kong Housing Authority to provide an environmental consultancy service on the proposed public housing development at Sha Tin Area 52 (Shui Chuen O) with the perspective of air ventilation. The consultancy study has been carried out in accordance with the “*Technical Circular No. 1/06 – Air Ventilation Assessments (AVA)*” which is jointly issued by Housing, Planning and Lands Bureau (HPLB) and Environment, Transport and Works Bureau (ETWB) in 2006.

2. OBJECTIVE OF THE STUDY

The objective of this Expert Evaluation (EE) is to qualitatively evaluate the likely impact of the proposed public housing development on the pedestrian wind environment within the study area.

3. STUDY SCOPE

The scope of this Expert Evaluation will include the following:

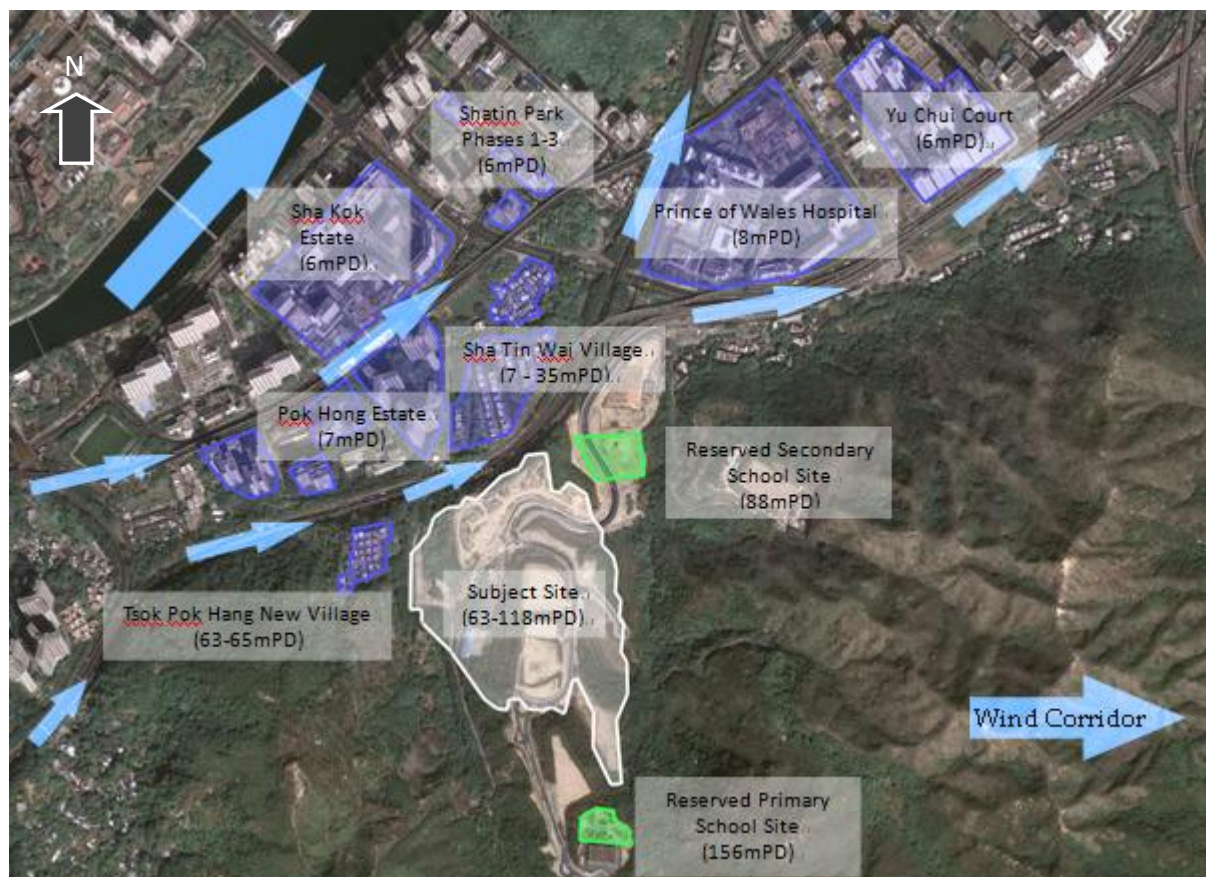
- Review the prevailing wind condition and general wind availability with reference to wind data from Hong Kong Observatory (HKO), Mesoscale Model (MM5) published on the Planning Department’s website;
- Qualitatively assess the wind performance of the development under initial design layout and improved design scheme;
- Identify good design features; and
- Identify focus areas.

4. SITE CHARACTERISTICS

The proposed public housing development is located on terrain of different elevations alongside the Sha Tin Road with Lion Rock Country Park to the west and Ma On Shan Country Park to the south / south-east. The proposed development consists of 18 domestic blocks, two covered carparks, public transport interchange and a commercial centre. It is located on stepped platforms ranging from 63 to 118mPD and separated from the surrounding built-up area by Shatin Road.

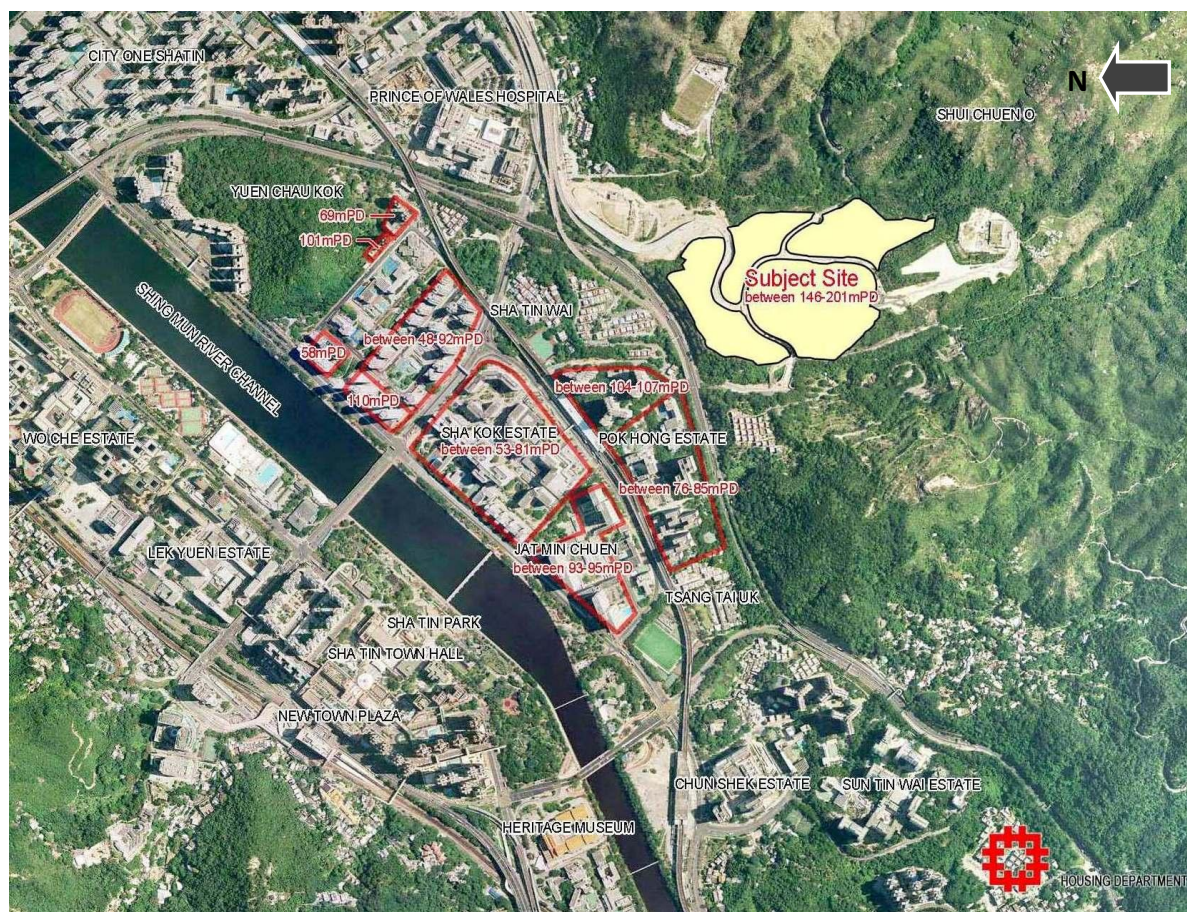
The built up area in the vicinity of the subject site is located to its north and on a much lower elevation, starting from 6mPD, than the subject site as shown in *Plate 1* below. These existing developments include Pok Hong Estate and Sha Kok Estate, which lie to the north-west of the proposed site; Sha Tin Wai Village and Shatin Park Phases 1-3, which lie to the north. Prince of Wales Hospital and Yu Chui Court lie further to the north-east of the site. On a higher ground elevation, Tsok Pok Hang New Village is located to the west of the site across Shui Chuen Au Street. A reserved secondary school site is located to the north-east of the site and a reserved primary school site to the south.

Plate 1 Areas Surrounding the Proposed Development (Ground Elevation)



As shown in **Plate 2** below, the surrounding built environment is characterized by varying building heights, with relatively high-rise areas such as Pok Hong Estate and Sha Kok Estate and low-rise villages (e.g. Sha Tin Wai Village and Tsok Pok Hang New Village). There are also other institutional developments such as the Prince of Wales Hospital, Christ College and outdoor recreational areas.

Plate 2 Height of Buildings in the Surrounding Area



The characteristics of the surrounding area are summarized as follows:

- Majority of the built-up areas are located on flat land at a lower elevation and separated from the subject site by Shatin Road;
- Varying building heights, with large-scale medium to high-rise development located to the north of the site and small-scale low-rise development located to its west;
- Road network and Shing Mun River acting ventilation corridors as shown on **Plate 1**. It is anticipated that Shatin Road and Sha Lek Highway, with a width of 31m and 36m respectively and align with the prevailing wind direction, shall continue to be the major ventilation corridor dissipating wind into surrounding area.

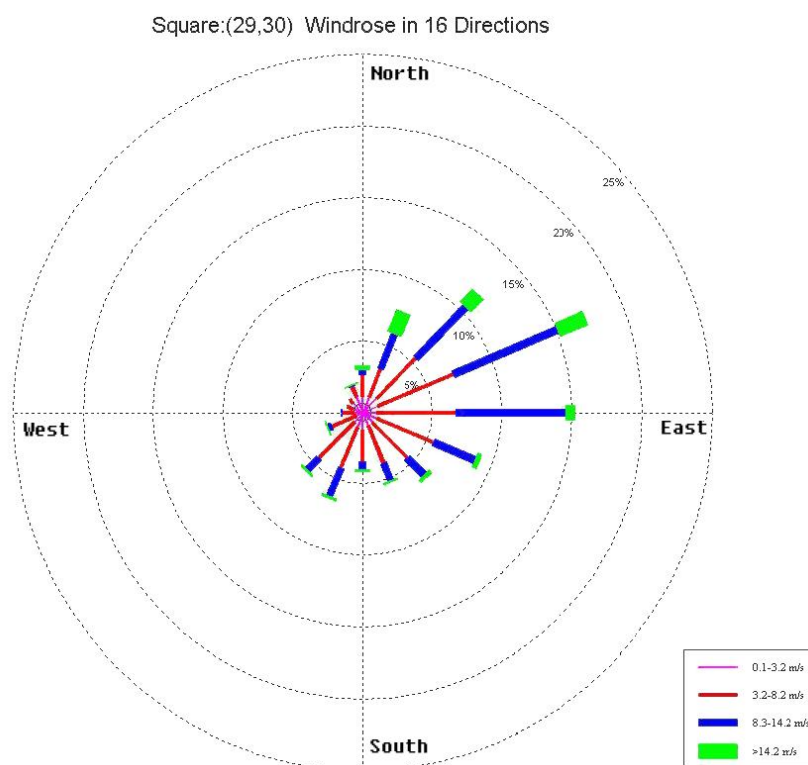
5. SITE WIND AVAILABILITY

Wind availability of the subject site is essential information to the investigation of the effects of the proposed development on the surrounding pedestrian wind environment. In the AVA Technical Guide, it is recommended that wind data from nearby weather station(s), simulated wind data or experimental site wind data should be referenced. Two sets of wind data will be referenced in this study, including wind data from MM5 simulation data published by the Planning Department and the Sha Tin Automation Weather Station operated by the Hong Kong Observatory (“HKO”).

5.1. WIND DATA FROM MM5 SIMULATION RESULT

The “*Site Wind Availability Data*” published by the Planning Department, simulated by Fifth-Generation NCAR / Penn State Mesoscale Model (MM5) is taken into consideration in this Expert Evaluation. **Plate 3** shows the annual wind rose of grid (29, 30) which is the nearest grid to the subject site, at an elevation of 596mPD. The mean speed simulated at the nearest grid by MM5 is approximately 7.78m/s at 596m above ground. According to the provided wind speed and wind probability data, the most probable wind direction is East-Northeast.

Plate 3 Annual Wind Rose of Square (29, 30), MM5 Data from the Planning Department



5.2. WIND DATA FROM HONG KONG OBSERVATORY

The Sha Tin Automatic Weather Station, operated by HKO, located approximately 3.5 km north-east of the site at 6 mPD, is the nearest station to the subject site (location as shown in **Plate 4** below). The annual wind roses of the Sha Tin Anemometer Station of year 2007 – 2008 (as shown in **Plate 5**), obtained from the *Summary of Meteorological and Tidal Observations in Hong Kong* published by the HKO shows that wind mostly comes from the northeast quadrant throughout a year. The summer and winter wind roses (**Plate 6**) further show that in summer wind predominantly comes from the southwest and south-southwest whereas in winter prevailing wind is mainly from the northeast quadrant. The monthly wind data (**Table 1**) also shows that in the summer the prevailing wind direction is southwest.

Plate 4 Location of Sha Tin Automatic Weather Station

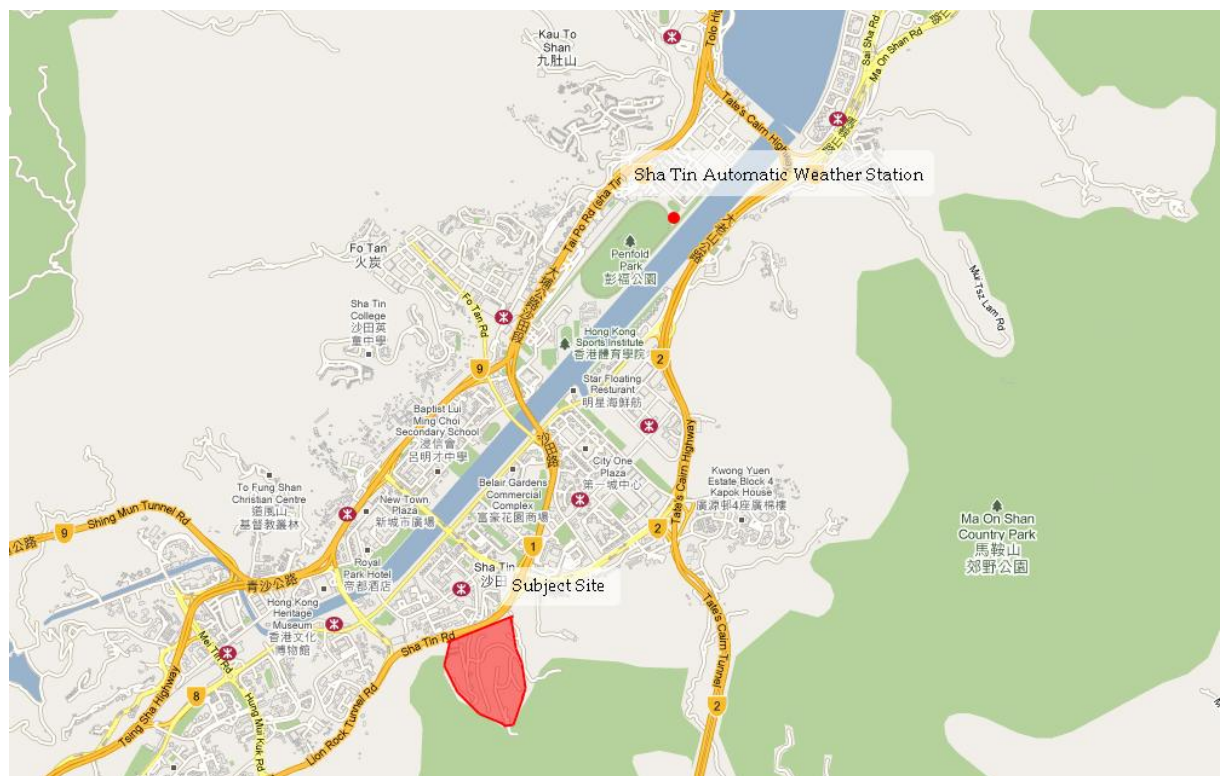


Table 1 Monthly Wind Data of Sha Tin Automation Weather Station

Month	Monthly Prevailing Wind Direction (Degrees)	
	2007	2008
January	360	40
February	90	350
March	90	80
April	30	90
May	100	220
June	220	220
July	220	220
August	220	220
September	90	360
October	20	90
November	40	30
December	30	30

Plate 5 Annual Wind Roses at Sha Tin Automation Weather Station

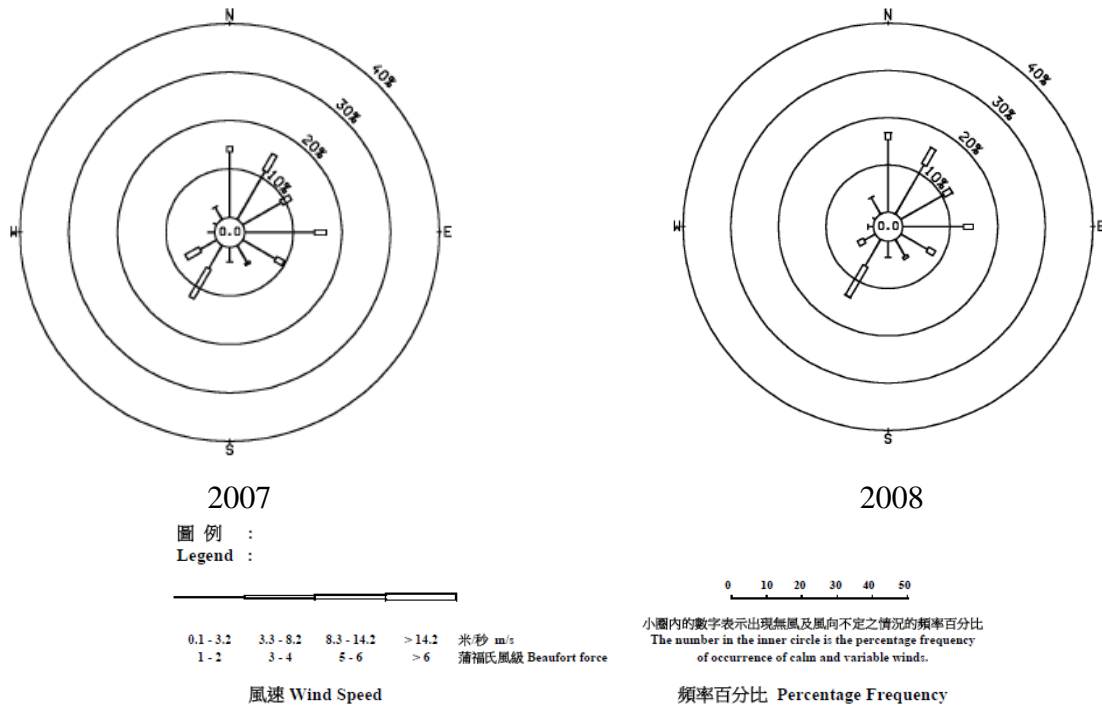
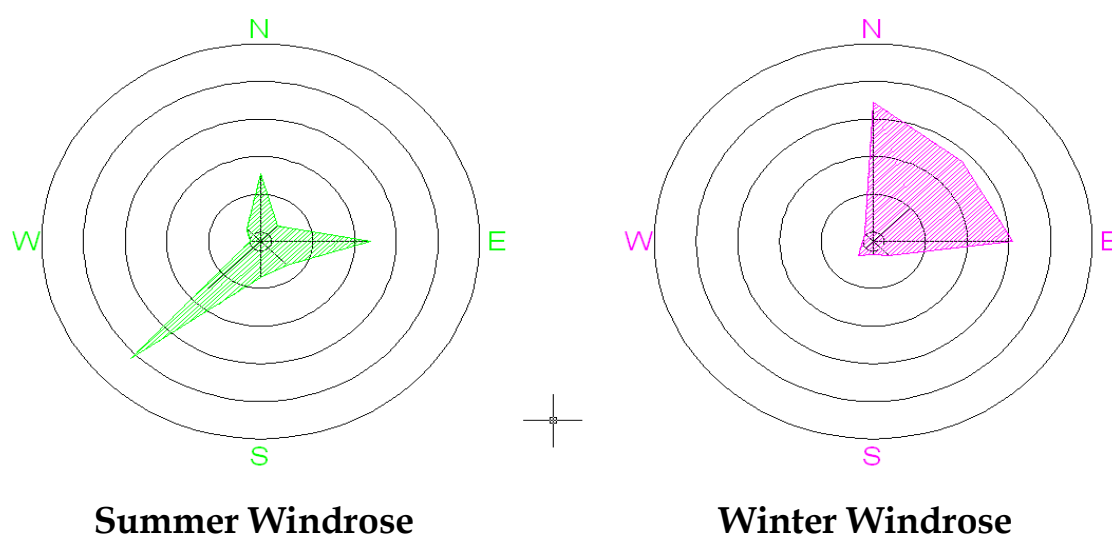


Plate 6 Summer and Winter Wind Roses at Sha Tin Automation Weather Station**5.3. TOPOGRAPHICAL EFFECTS ON WIND AVAILABILITY**

Since the subject site is located on a hillside to the south of the existing built area, its surrounding is relatively free of high-rise buildings. As a result, the wind availability of the site is largely affected by the surrounding topography. The Lion Rock to the southwest of the site is steep and smooth adjustment of boundary layer flow over the mountain is unlikely. It is therefore expected that flow separation would occur and wind availability at the site will be affected by the lee eddy before the wind flow reattaches. In the non-summer period when wind mainly comes from the northeast, this effect is expected to be less significant.

5.4. FINDINGS OF WIND AVAILABILITY AT SUBJECT SITE

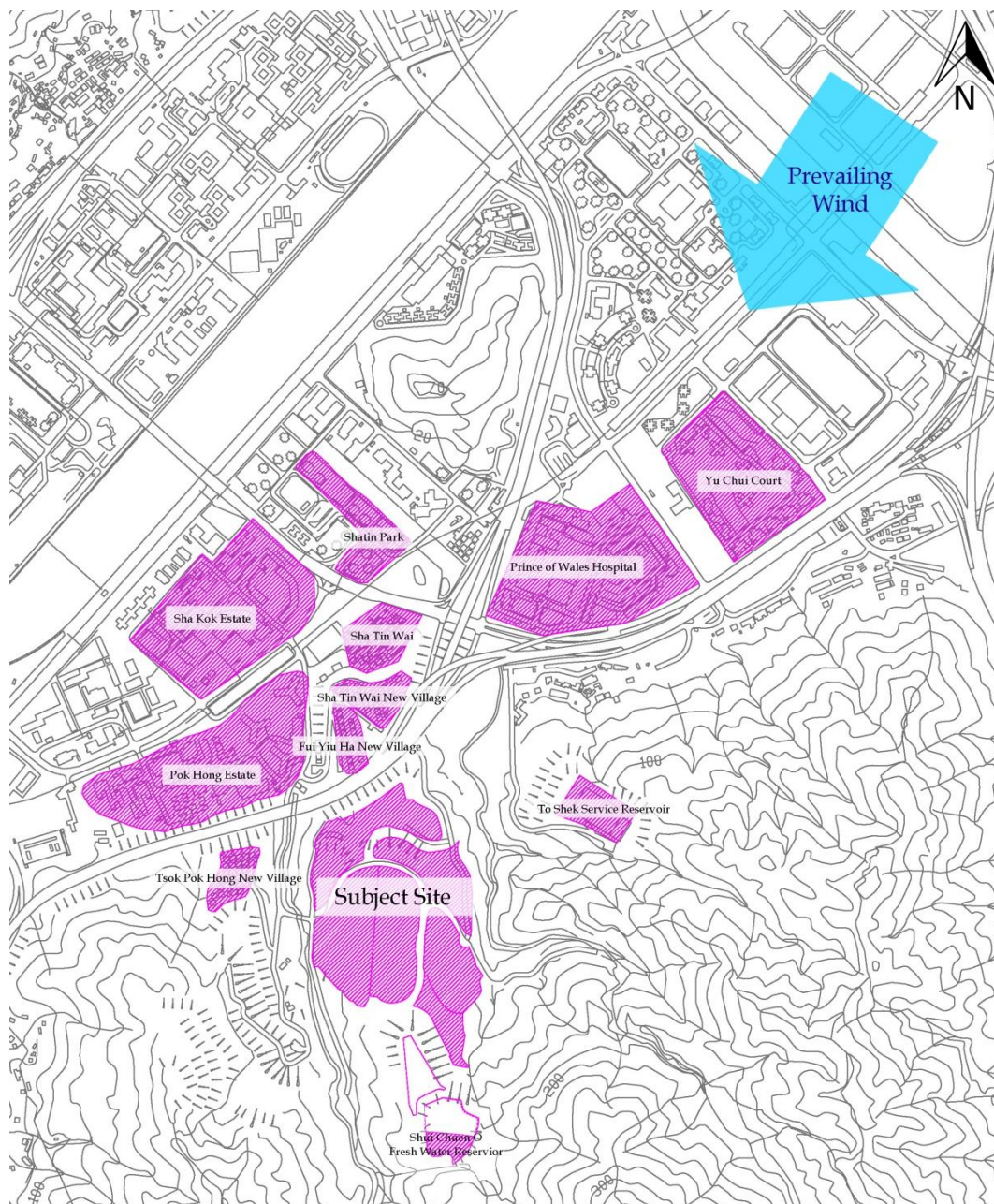
With reference to MM5 data and wind data from the Sha Tin Weather Station, it can be concluded that the prevailing winds for the subject site may come from the northeast quadrant and in summer, the winds mainly come from south-westerly (SW) direction. Similar to the annual wind frequency characteristic, north-north-easterly (NNE) winds dominate in non-summer period.

6. EXPERT EVALUATION

6.1. CHARACTERISTICS OF SURROUNDING WIND ENVIRONMENT

6.1.1. Non-summer Wind

Plate 7 Non-summer Prevailing Wind (Northeast)

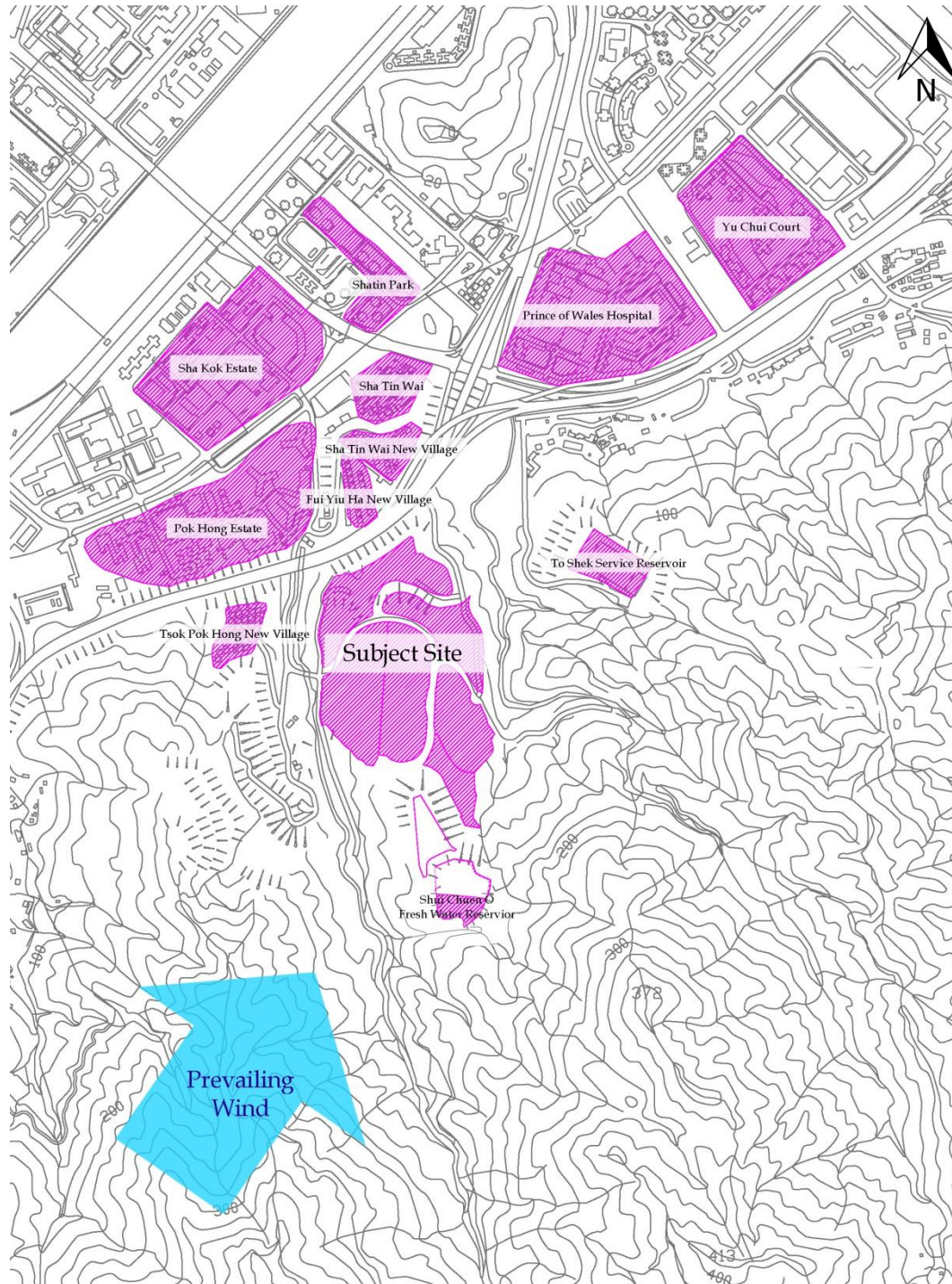


Shatin Road, Sha Lek Highway and Shatin Wai Road which align with the prevailing wind direction shall be the major ventilation corridor to facilitate air ventilation in the area;

- The low-rise Sha Tin Wai, Sha Tin Wai New Village and Fui Yiu Ha New Village to the north of the site across Sha Tin Road are located at a much lower elevation than the subject site and has little influence on the proposed development;
- The high-rise Yu Chui Court may cause some impediment to the incoming northeasterly wind but the wind is reattached to lower levels at the Prince of Wales Hospital and the low-rise Sha Tin Wai Village;
- Elevated ground to the northeast of the Site (including To Shek Street and To Shek Service Reservoir) rises steadily to over 200mPD and may partially impede the incoming northeasterly wind. However, it is anticipated that the effect shall not be significant in the view of the fact that the wind shall be dissipated through the major ventilation pathway, Shatin Road, into the area.

6.1.2. Summer Wind

Plate 8 Summer Prevailing Wind (Southwest)



- Wind coming from the southwest is moderated by local topography, primarily by the Lion Rock located to the south of the Site. The area to the southwest of the Site is the Lion Rock Country Park and wind from the southwest coming down the valley is from open ground and unobstructed.

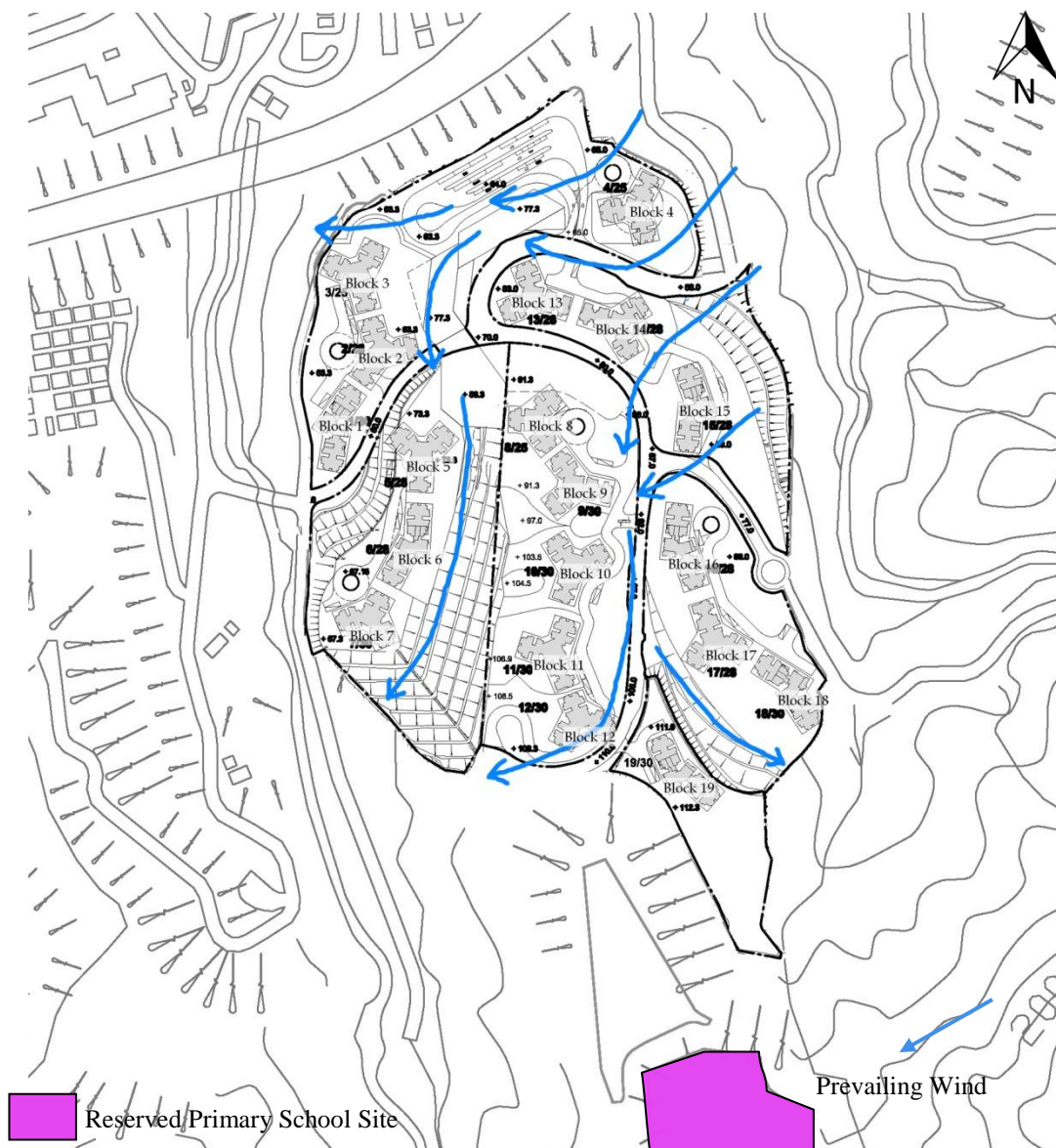
- The wind passing through the densely vegetated terrain is expected to have a moderate velocity.
- After penetrating the Subject Site the wind may reattach and leave the site to Sha Tin Wai, Prince of Wales Hospital and beyond.
- Shatin Road, Sha Lek Highway and Shatin Wai Road which align with the summer prevailing wind direction shall be the major ventilation corridor to facilitate air ventilation in the built-up area located to the north of the site.

6.2. WIND ENVIRONMENT WITH PROPOSED DEVELOPMENT (INITIAL LAYOUT)

The Initial Layout comprises 19 residential buildings of varying height profile (25 to 30 storeys) that are closely located with little separation between buildings. In general, building heights gradually increase from the northern to the southern part of the site. 13 out of 19 buildings are typical Y-shaped public housing blocks while the remaining 6 buildings are longitudinally-shaped. Roads penetrate inside the development site provide vehicle access to each building blocks.

6.2.1. Non-summer Wind

Plate 9 Non-summer Prevailing Wind (Northeast)

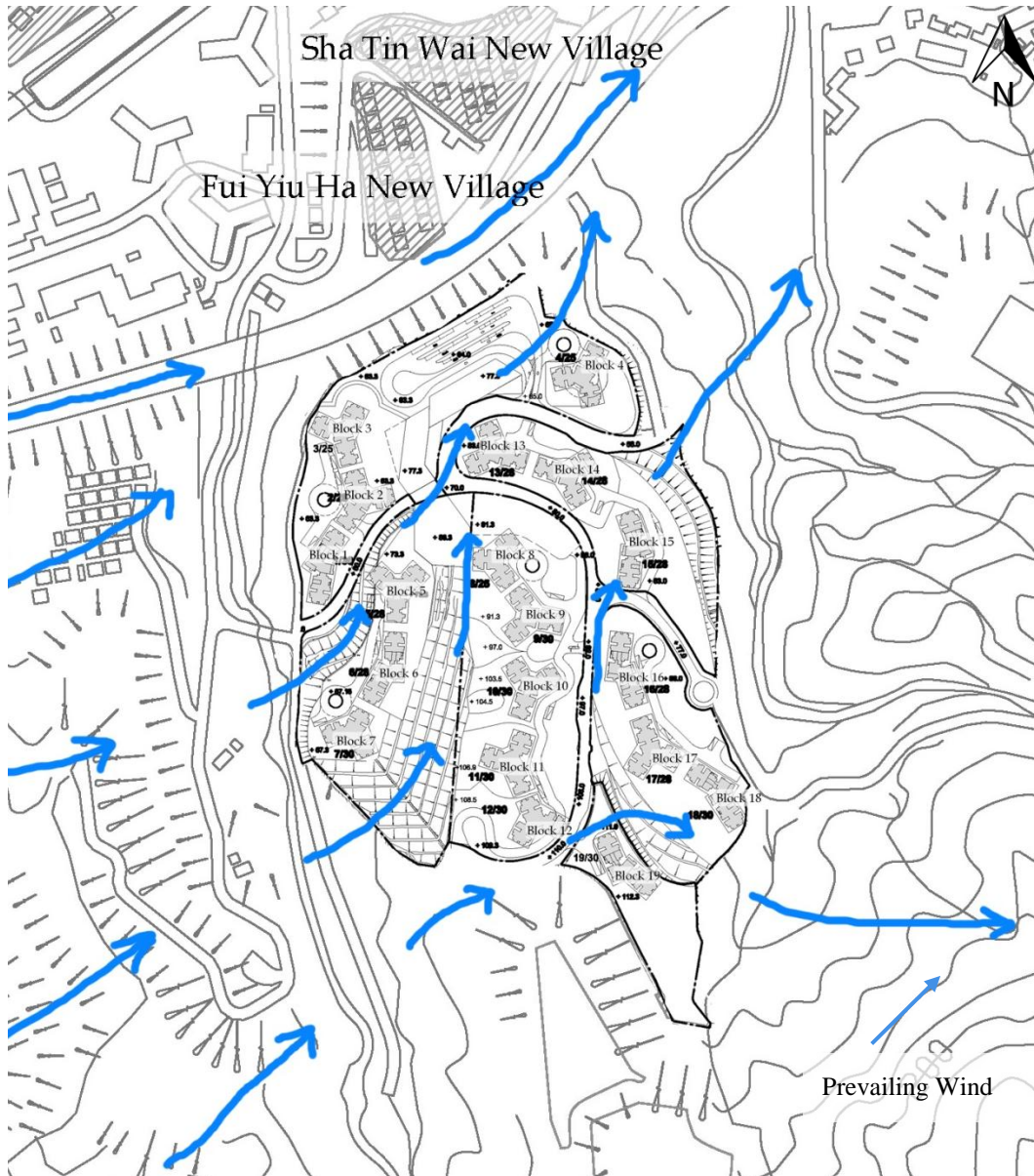


- For prevailing NE wind, the site is situated at downwind location of the surrounding built-up area. Wind flowing from the built-up area shall be dissipated through Shatin Road to further south, which act as ventilation corridor to facilitate air ventilation in the area. Moreover, as the site is located on a higher ground elevation than the surrounding area, the potential obstruction caused by the built-up area has limited effect on incoming wind reaching the site;
- Within the site, the wind from the northeast over the elevated ground is diverted by Block 4. Part of the wind continues flowing to the west over the Public Transport Interchange and part of the wind is diverted south towards Blocks 14 and 15.

- The gap between Blocks 14 and 15 (>24m wide) as well as Blocks 15 and 16 (>36m wide) allows for the penetration of wind to the blocks in the middle of the site, namely Blocks 8-10.
- Despite the lower elevation, the positioning of Blocks 16-18 leads to potential impediment to wind from the northeast, affecting the wind velocity at pedestrian level of Blocks 11, 12 and 19.
- Due to the tight wall-like obstruction formed by Blocks 8-12, wind availability to its downwind locations such as reaching the west of these blocks will have decelerated wind velocities.
- Since the proposed development is relatively high-rise and sited on elevated ground, wind flowing pass the site to Tsok Pok Hang New Village to the west may be partially impeded. However, the effect is expected to be insignificant in view of the fact that Tsok Pok Hang New Village is located at a distance from the site separated by To Shek Street and the prevailing wind shall be dissipated to this area through Shatin Road and after flowing around the subject site;
- The reserved primary school site, being located at a distance to the south of the Subject Site and on a higher elevation, will unlikely be affected by the proposed development.

6.2.2. Summer Wind

Plate 10 Summer Prevailing Wind (Southwest)



- For prevailing summer SW wind, the site is situated at upwind location of the surrounding built-up area. Since the site is located on a higher ground elevation and separated from the built-up area by Shatin Road, wind flowing from SW shall be mainly dissipated through Shatin Road, which acts as major ventilation corridor, to the built-up area. Part of the incoming wind shall reattach to lower ground and continue on the Sha Lek Highway and Shatin Wai Road to further north after flowing pass the site. Given that the major ventilation corridor shall remain unchanged before and after the proposed

development, it is expected that the potential downstream effect to the north / northeast of the subject site shall be insignificant;

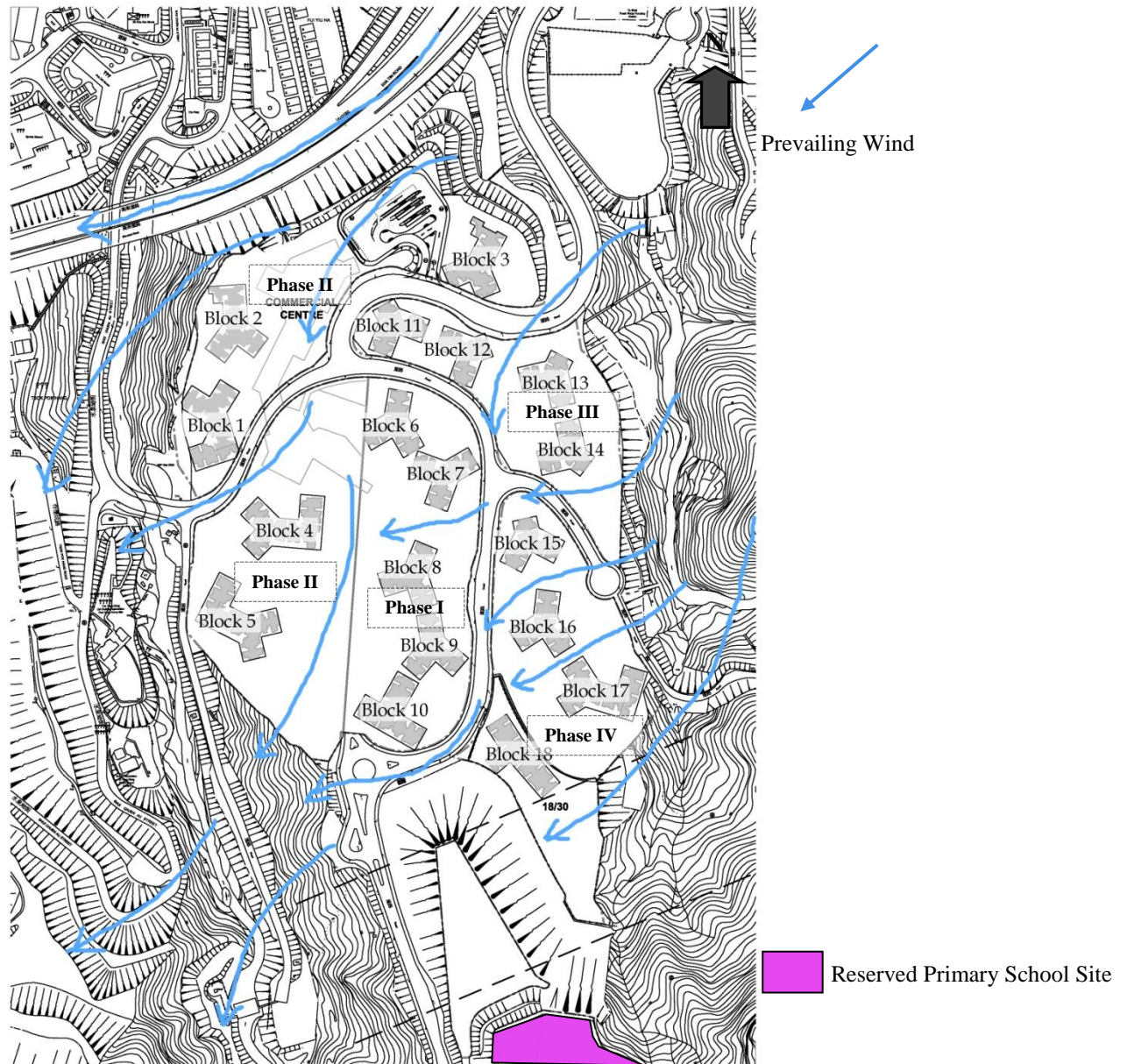
- Within the site, wind from the Lion Rock to the southwest is mainly diverted north by the almost continuous obstruction formed by Blocks 8-12 and the elevated ground to the south of Block 12.
- Part of the wind would flow through the gaps between the buildings as well as the gap between Block 12 and the elevated ground to reach Blocks 14 to 18. However wind velocity will be decelerated by the obstruction and the difference in elevations.
- Part of the wind is diverted north by Blocks 5-7, through the gap between Blocks 1, 2 and 5 then to the north over the Public Transport Interchange.
- Due to the shape of the buildings, the diverted wind flow will likely be turbulent with decelerated wind velocity.

6.3. WIND ENVIRONMENT WITH PROPOSED DEVELOPMENT (IMPROVED LAYOUT)

The proposed Improved Layout, which has incorporated design measures to facilitate air ventilation based on review of wind performance of the Initial Layout. It comprises 18 residential buildings of varying height profile (25 to 30 storeys). With one building less than the Initial Layout, more building gaps are allowed within the development to facilitate air ventilation. Similar to the Initial Layout, building heights gradually increase from the northern to the southern part of the site. 17 out of 18 buildings are Y-shaped public housing blocks while the remaining building is longitudinally-shaped. Building blocks are arranged to allow ventilation paths across the site and provide more gaps between buildings than the Initial Layout to improve permeability. Moreover, ventilation openings at ground floor levels are incorporated to further enhance localized air ventilation performance.

6.3.1. Non-summer Wind

Plate 11 Non-summer Prevailing Wind (Northeast)



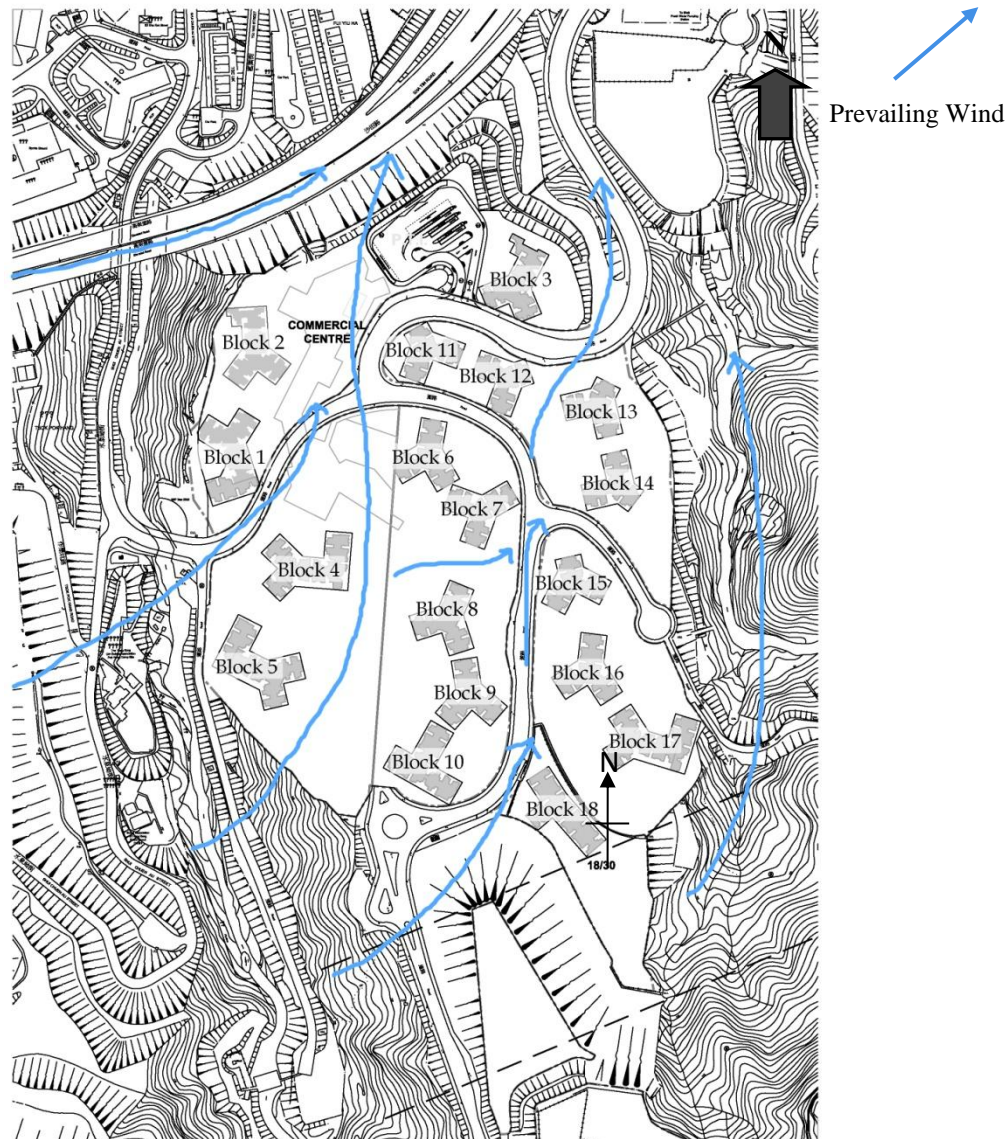
- For prevailing NE wind, the site is situated at downwind location of the surrounding built-up area. Wind flowing from the built-up area shall be dissipated through Shatin Road to further south, which act as ventilation corridor to facilitate air ventilation in the area. Moreover, as the site is located on a higher ground elevation than the surrounding area, the potential obstruction caused by the built-up area has limited effect on incoming wind reaching the site;
- Within the site, the wind from the northeast flowing over the elevated ground is diverted by Block 3. Part of the wind continues flowing to the west over the Public Transport

Interchange and the Commercial Centre and part of the wind is diverted south towards Blocks 12 and 13.

- The widened gaps between Blocks 12 and 13 (~24m wide); Blocks 14 and 15 (~36m wide) and Blocks 15 and 16 (~20m wide) allow for the improved penetration of wind to the blocks in the middle of the site, namely Blocks 6-10. The width of the building gaps are in general maintained despite the increase of number of blocks at Phases 3 and 4.
- Widened gap between Blocks 7 and 8 and ground floor openings at the Blocks 6-10 allows wind reaching the west of the site dissipating to Blocks 4 and 5.
- Since the proposed development is relatively high-rise and sited on elevated ground, wind flowing pass the site to Tsok Pok Hang New Village to the west may be partially impeded. However, the effect is expected to be insignificant in view of the fact that Tsok Pok Hang New Village is located at a distance from the site separated by To Shek Street and the prevailing wind shall be dissipated to this area through Shatin Road and after flowing around the subject site; In the improved layout with the widened gap between Blocks 1, 2 and 4, wind permeability to the west of the site is further facilitated.
- The reserved primary school site, being located at a distance to the south of the Subject Site and at a higher elevation, will unlikely be affected by the public housing development.

6.3.2. Summer Wind

Plate 12 Summer Prevailing Wind (Southwest)



- For prevailing summer SW wind, the site is situated at upwind location of the surrounding built-up area. Since the site is located on a higher ground elevation and separated from the built-up area by Shatin Road, wind flowing from SW shall be mainly dissipated through Shatin Road, which acts as major ventilation corridor, to the built-up area. Part of the incoming wind shall reattach to lower ground and continue on the Sha Lek Highway and Shatin Wai Road to further north after flowing pass the site. Given that the major ventilation corridor shall remain unchanged before and after the proposed development, it is expected that the potential downstream effect to the north / northeast of the subject site shall be insignificant;

- Within the site, the wind from southwest is partially diverted by Blocks 8-10 to flow through the ventilation paths between Blocks 1, 2, 4 and 5 and Blocks 6-10. Part of the wind flows through the gap between Block 10 and the elevated ground and is diverted to the north by the elevated ground.
- At the ground level of Blocks 6-10 the wind flows through the ground floor openings and the gap between Blocks 7 and 8 to reach Blocks 13-16.
- With the widened building gaps and the ventilation pathways allowed within the site, permeability to SW wind is enhanced. After flowing pass the low-rise commercial center and open PTI, the southwesterly wind would leave the site along Sha Tin Road, over the low-rise Sha Tin Wai Village and further dissipate to the built-up area at the north.
- Incoming wind to the reserved secondary school site, located downwind to the proposed development, may be partially impeded. The school site is located at the distance to the northeast from the site and separated by major roadway. Prevailing SW wind shall reach the school site after flowing through the ventilation pathways allowed within the site and the access road to the site as well as Shatin Road shall facilitate wind dissipation to the school site. As such, it is anticipated that the downstream effect to the school site shall be insignificant.

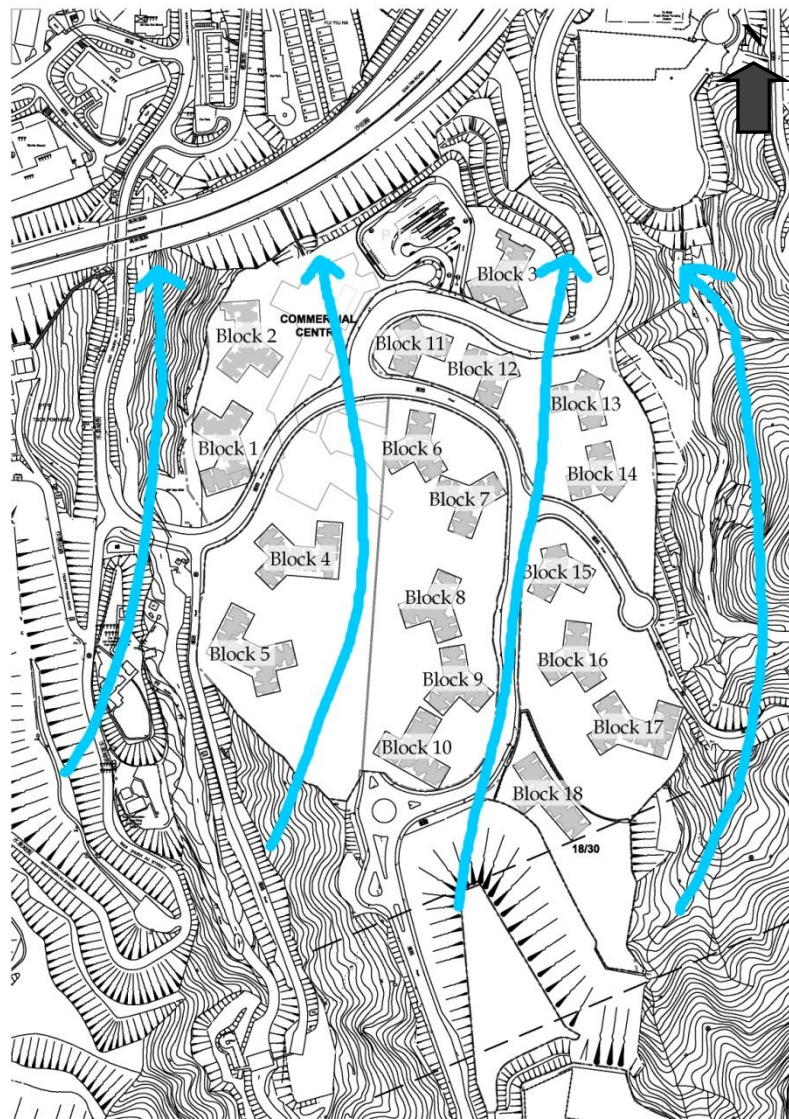
6.4. GOOD DESIGN FEATURES

With consideration of the prevailing wind directions and evaluation of the Initial Layout in terms of air ventilation, a series of design features have been incorporated into the layout to enhance air ventilation and wind comfort of the proposed development and to minimize the potential impact on the surrounding environment. These features include:

- Ventilation / Air Paths
- Height Profiles
- Ground floor openings for domestic blocks
- Building Gaps

6.4.1. Ventilation / Air Paths

Current road configurations and the valley in which the Subject Site is located act as breezeways along prevailing wind directions. As the site is of relatively large scale and is located in the valley, ventilation paths (*Plate 13*) have been maintained through the site to enhance wind permeability and to lower the impact of the development on the downwind built-up area under prevailing southwesterly wind condition. It is anticipated that the wind paths between the aligned proposed residential buildings shall act as the main ventilation pathways along the prevailing wind direction with the proposed development in place.

Plate 13 Ventilation Paths Through Subject Site

6.4.2. Height Profiles

The Shatin district in general has been substantially developed for both public and private housing. Most of the nearby existing public housing was built in the early 1980s, with height between 61mPD and 120mPD, and a few exceptions like Pok Hong Estate. To the north and northwest of the site, the taller residential buildings (i.e. the newly Pok Hong Estate) is surrounded by lower-rise residential areas such as Sha Tin Wai Village and the Christ College. Such gradation of building heights would help wind deflection and instigate wind flowing throughout the region.

Whilst the building height of all residential blocks in the subject site is maintained at 25-30 floors, the blocks are located on platforms of varying heights along the N-S direction. The lowest platforms are located at approximately 63mPD at the northern part of the site and gradually rise to the highest platform at 113mPD at the southern part of the site, following the

natural rising of the valley. Such varying height profile will enhance the capturing of prevailing wind, in particular wind from the north-east quadrant, and enhance wind ventilation of the area.

6.4.3. *Ground Floor Openings at Domestic Blocks*

Ground floor openings would generally allow wind penetration at the pedestrian level of the site to enhance the local wind environment and facilitate air ventilation. In the Improved Layout, ground floor openings are widely incorporated in the buildings, especially for Blocks 6-10 to improve wind permeability.

6.4.4. *Building Gaps*

In the improved layout the number of residential blocks has been reduced from 19 to 18. The number of buildings at the western side of the site has also been reduced from 6 to 4 by relocating one of the blocks to the eastern side of the site. This reduces blockage to the south-westerly prevailing summer wind and improves wind permeability into the site.

7. **RECOMMENDATIONS**

The Expert Evaluation provides an overview of likely impacts associated with the proposed public housing development. As discussed above, the concerns mainly entail the downhill wind and the impact that the proposed development might bring upon to the neighbouring built-up areas. Since the subject site is located on a much higher elevation than the built-up area in the vicinity and the major ventilation corridors within the area remain unaffected, it is expected that the proposed development shall cause insignificant effect on the general air ventilation performance in the area. With the improved layout, it is anticipated localized air ventilation within the site and to its immediate vicinity shall be improved. In order to minimize any negative impacts and improve the existing wind environment, it is essential that the design team shall take into account the recommended good design features in detailed design of the development. Quantitative Initial AVA Study by means of CFD model shall be conducted to refine the scheme and fine-tune the design of the enhancement measures in detailed design development.

8. **CONCLUSION**

An Expert Evaluation has been carried out in accordance with “*Technical Circular No. 1/06 – Air Ventilation Assessments*” and “*Chapter 11 of the Hong Kong Planning Standards and Guidelines*” (HKPSG) for the purpose of assessing air ventilation qualitatively. This report presents findings of Expert Evaluation.

With reference to data from MM5 data from the Planning Department and HKO automatic weather station data, prevailing winds from the northeast quadrant are dominant in non-summer period while wind from the southwest direction are dominant in summer period within the Sha Tin Wai area.

In view of the fact that the subject site is located on a much higher elevation than the built-up area in the vicinity and the major ventilation corridors within the area remain unaffected, it is expected that the proposed development shall cause insignificant effect on the general air ventilation performance in the area. With the improved layout, it is anticipated localized air ventilation within the site and to its immediate vicinity shall be improved. The reduced number of blocks, widened gaps between the buildings and the ground floor openings of the improved layout are expected to facilitate wind permeability and improve local wind environment. The recommended design features shall be adopted in the detailed design of the development and CFD modelling study shall be conducted, where appropriate, to further refine the scheme and fine-tune the design of the enhancement measures for design implementation.