

CONSULTANCY STUDY FOR AIR VENTILATION ASSESSMENT SERVICES

**CAT. A1 – TERM CONSULTANCY FOR EXPERT EVALUATION ON AIR
VENTILATION ASSESSMENT (PLNQ A1-4/AVA 2015)**

AIR VENTILATION ASSESSMENT EXPERT EVALUATION REPORT

FOR

PROPOSED PUBLIC HOUSING DEVELOPMENT AT ON MUK STREET, SHEK MUN

(PLNQ A1-4/AVA 2015)

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EXECUTIVE SUMMARY

BeeXergy Consulting Limited was commissioned by the Planning Department of Hong Kong Special Administrative Region Government to undertake an Air Ventilation Assessment (AVA) – Expert Evaluation (EE) for the proposed public housing development at On Muk Street, Shek Mun (the Development). Qualitative assessment of the wind environment of the Development at On Muk Street, Shek Mun was conducted. The Development consists of three domestic blocks and a GIC building under Proposed Scheme and one domestic block with carpark under Revised Scheme. According to the analysis, the annual and summer prevailing wind were studied. The findings of the EE study are summarized in below:

Annual Wind Condition

- NNE wind would mainly flow along On Sum Street and On Kwan Street. With the provision of three NBAs, setback from north-western site boundary and adoption of podium-free design under the Proposed Scheme, it is expected the development would not induce significant disturbance on the NNE wind flow from On Sum Street and On Kwan Street to the open space at Siu Lek Yuen Road. For the Revised Scheme, NNE wind is expected to travel along On Sum Street and skim over the 1-storey carpark. No significant adverse impact has been identified for the Revised Scheme.
- E and ESE winds mainly flow along On Muk Street and Shing Mun Nullah. As the Proposed Scheme and revised scheme is in alignment with the adjacent air paths along On Muk Street and Shing Mun Nullah, thus it is expected the Proposed Scheme and Revised Scheme would not likely disturb the air flow along these air paths. Setback from north-western site boundary should be incorporated to minimize the wind shadow imposed on On Muk Street Garden induced by the proposed development. Similar observation is valid for the Revised Scheme.

Summer Wind Condition

- Under E wind, similar to annual easterly wind condition, the incoming wind mainly flow along On Muk Street and Shing Mun Nullah. As the Proposed Scheme and Revised Scheme is in alignment with the adjacent air paths along On Muk Street and Shing Mun Nullah, thus it is expected the Proposed Scheme and Revised Scheme would not likely disturb the air flow along these air paths.
- Under S, SSW and SW wind, the wind mainly flow along Ngan Shing Street and Chap Wai Kon Street / On Ming Street. As the NBAs in Proposed Scheme are in alignment with On Sum Street and On Kwan Street, it is expected that the Proposed Scheme would not induce significant disturbance to the air flow except a section of On Muk Street close to the development. For the Revised Scheme, due to its small development footprint, it is expected that its impact on wind flow is minimal.

Proposed Scheme

For the Proposed Scheme, in addition to the NBAs, setback and podium-free design, it is recommended that a ground floor level empty bay could further facilitate wind penetration across the development in enhancing the pedestrian wind environment of the surrounding, particularly for On Muk Street under summer SW quadrant wind. As for the school site, it is recommended to align the building mass with the wind corridor of On Kwan Street to allow more effective wind penetration under SW quadrant wind.

It is recommended that a quantitative AVA should be conducted at the detailed design stage for scheme optimization including the effectiveness of the suggested measures of ground floor empty bays and revised disposition of the primary school.

Revised Scheme

For the Revised Scheme, with the provision of building setback and building height of the carpark maintained at 1-storey, no significant impact has been identified due to the relatively small development scale.

If the good design measures (i.e. 13m setback from the north-western site boundary and building height restriction of 1-storey carpark) cannot be provided in the future development, further quantitative assessments should be conducted to demonstrate that the performance of any future development would be no worse off than the scenario with these measures.

1. INTRODUCTION

1.1. PROJECT BACKGROUND

BeeXergy Consulting Limited (BXG) was commissioned by the Planning Department (PlanD) of Hong Kong Special Administrative Region Government to undertake an Air Ventilation Assessment (AVA) – Expert Evaluation (EE) for the proposed public housing development at On Muk Street, Shek Mun (the Development). In response to the public concerns, rezoning of the land occupied by the football training centre (i.e. Phase 2 and primary school) is postponed until the relocation arrangement for the football training centre is settled. In view of the above, Housing Department (HD) has prepared a Proposed Scheme (i.e. Phases 1, 2 and primary school) and Revised Scheme (i.e. Phase 1 only) for air ventilation assessment.

Air Ventilation Assessment Study for Fo Tan and Siu Lek Yuen Industrial Areas (December 2015) and Shek Mun Land Use Plan B16 are also referenced in current EE Report

1.2. OBJECTIVE

The objective of this study is to evaluate the wind performance of the Development using the methodology of Air Ventilation Assessment, based on the “Housing Planning and Lands Bureau – Technical Circular No. 1/06, Environment, Transport and Works Bureau – Technical Circular No. 1/06” issued on 19th July 2006 (the Technical Circular) and “*Technical Guide for Air Ventilation Assessment for Development in Hong Kong – Annex A*” (the Technical Guide). This report presents the findings for the study of Stage 1 – Expert Evaluation.

1.3. STUDY TASKS

The major task of this study is to carry out an Expert Evaluation on the characteristics of the site wind availability data of the development area and assessment of the wind performance under existing development situation and the proposed building design option in a qualitative way. The expert evaluation will cover the following tasks:

- Review the existing wind environment of the Development Site and the surrounding
- Assess qualitatively the air ventilation impacts of the proposed housing developments on the surrounding areas
- Identify major breezeway(s), air-path(s), problematic area(s)
- Comment on the localized wind effects of the proposed developments within the surrounding area
- Identify if any wind stagnation and wind amplification causing uncomfortable and unsafe wind environment
- Recommend the improvement and mitigation measures
- Recommend if any further study as may be necessary

2. SITE CHARACTERISTICS

The Development Site at about 1.52 ha in area is currently occupied by Jockey Club Kitchee Centre with open pitches and some low-rise structures (about 7.2mPD to 7.6mPD). It is located at On Muk Street at junctions of On Sum Street and On Kwan Street as shown in Figure 1. It is situated to the southwest of Shek Mun Business Area (SMBA) next to the river channel. The subject Area is a flat built-up urban area in the vicinity of Shing Mun Nullah reclamation and gradually slope up towards the north-east with Turret Hill (Nui Po Shan) of approximately 399mPD in height. Yuen Chau Kok, a hill of approximately 70mPD in height is situated to the south-west of subject Area.

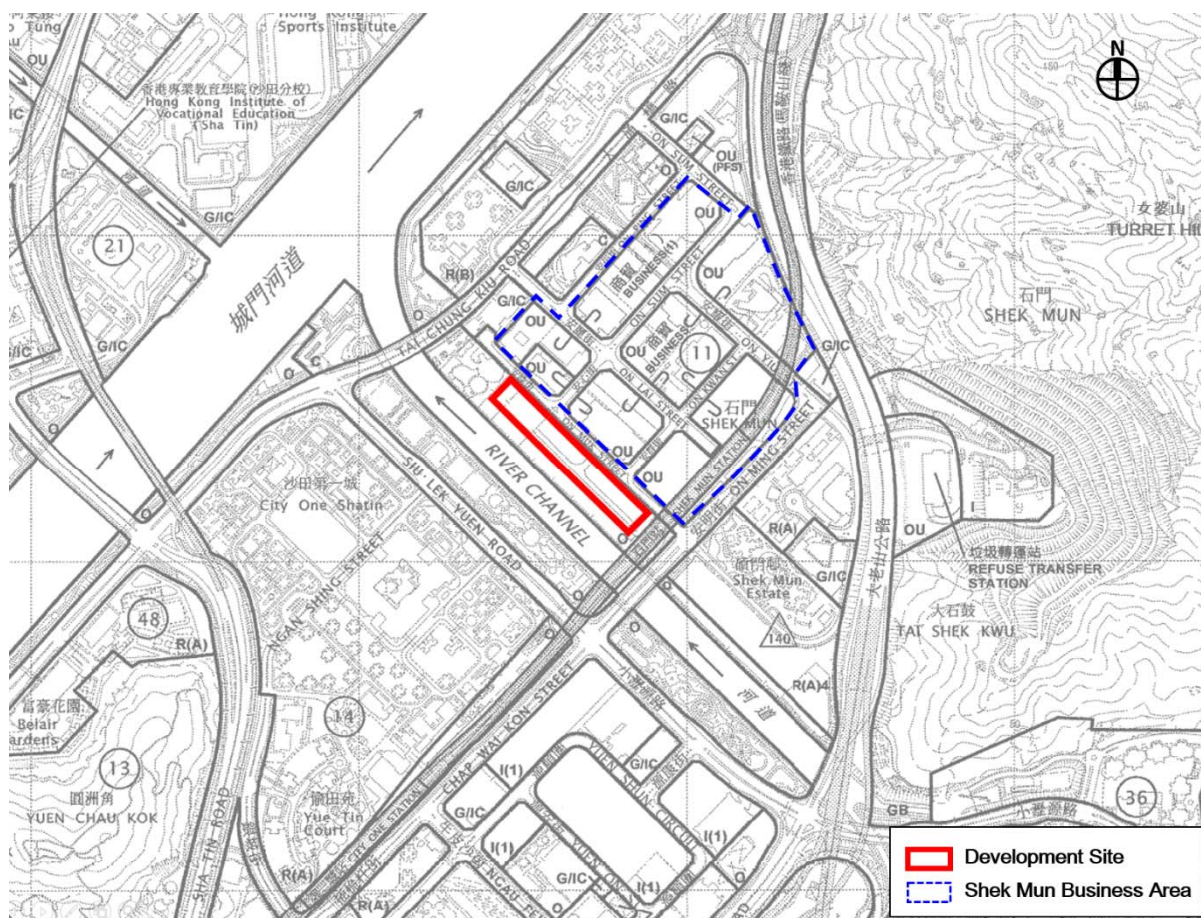


Figure 1 Shek Mun Area(Source: PlanD)

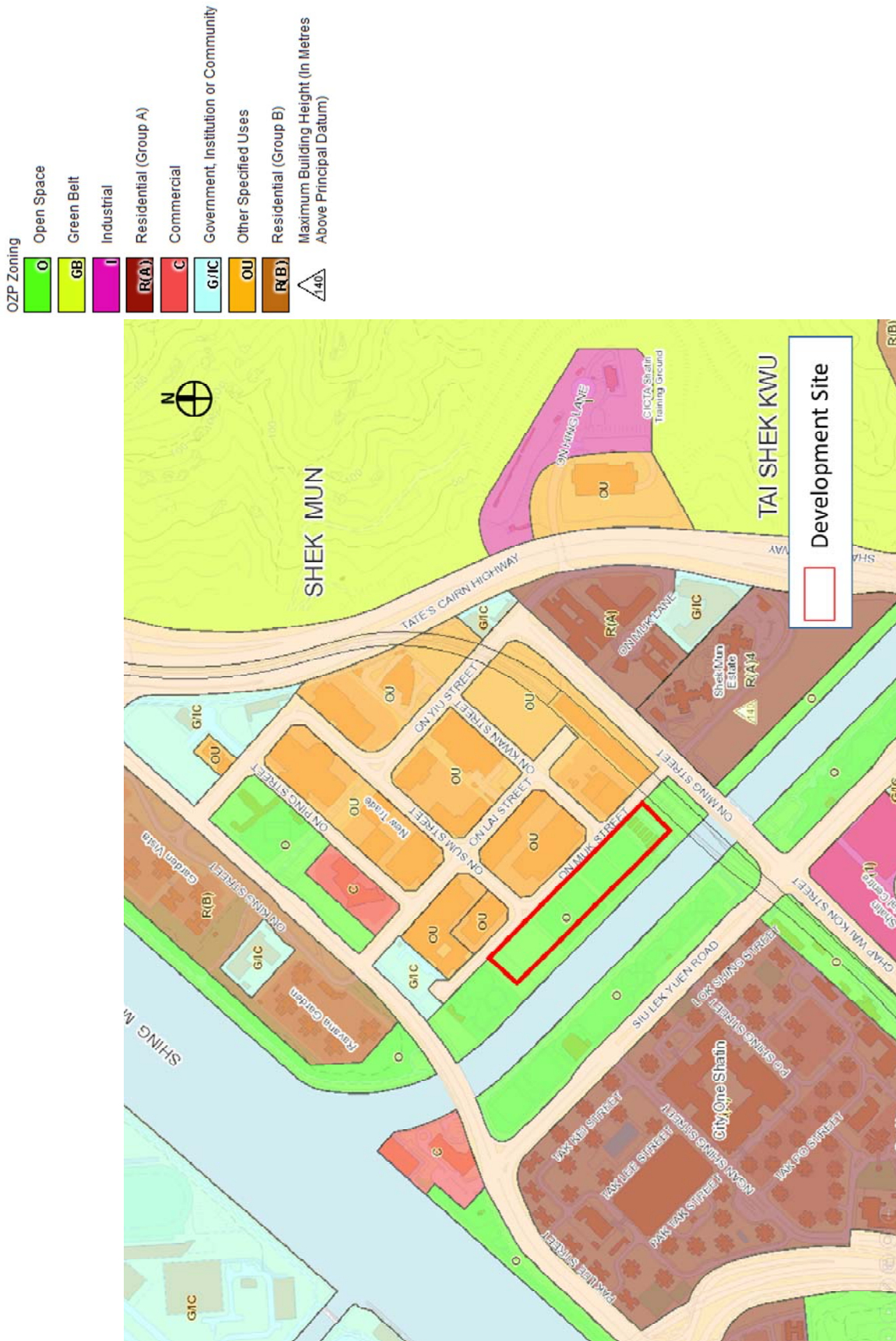


Figure 2 Land Use Plan of the Development Site and its Surrounding based on the approved Sha Tin Outline Zoning Plan No. S/ST/32 (Source: Town Planning Board)



1 Garden Vista (86.8mPD)	8 Topsail Plaza & Delta House (108.8mPD)	15 HKBU College of International Education (81mPD)	22 Shatin Industrial Building Block B (39.5mPD)
2 Ravana Garden (104.9mPD)	9 Metropole Square, Corporation Park & HSBC Shek Mun (109.9mPD)	16 HKBU Affiliated School Wong Kam Fai Primary School Proposed School Annex (34.3mPD)	23 Chiaphua Centre & Siu Lek Yuen Telephone Exchange (49.7mPD)
3 Courtyard by Marriott Hong Kong Sha Tin (104.5mPD)	10 New Commerce Centre, Technology Park & Ever Gain Centre (111.8mPD)	17 Shek Mun Estate (120mPD)	24 SHK Proposed Hotel at 20-22 Siu Lek Yuen Road (109.3mPD)
4 Heung Yee Kuk N.T. (37.1mPD)	11 SHK Proposed Commercial Building on STTL 617 (123.6mPD)	18 Shek Mun Estate Ph. 2 WIP (110-140mPD)	25 KMB Bus Depot (20.8mPD)
5 Grandtech Centre (112mPD)	12 1 On Kwan Street (123.5mPD)	19 City One Shatin (107.5mPD)	
6 New Trade Plaza & Li Fung Centre (94.5mPD)	13 Kings Wing Plaza 1 (97.8mPD)	20 Sunshine Grove (118.1mPD)	
7 CLP Power Hong Kong Limited-Shatin Centre & Ever Gain Building No.3 (122.4mPD)	14 HKBU Affiliated Wong Kam Fai Secondary and Primary School & International Christian School (23.4-39.3mPD)	21 Yue Tin Court (105.7mPD)	

Figure 3 Major Roads and Developments around the Development Site (Source: Geoinfo Map)

High-rise Shek Mun business clusters (“5” – “13” in Figure 3) including two planned non-residential developments (“11” & “12” in Figure 3) are at the north-east of the Development Site. To the far eastern of the Development Site is the school site (“14” in Figure 3) including low-rise HKBU Affiliated School Wong Kam Fai Secondary and Primary School, and International Christian School while HKBU College of International Education is a high-rise building (“15” in Figure 3). To the north of the Development Site is a site zoned “G/IC” for the Heung Yee Kuk New Territories (“4” in Figure 3). The high-rise hotel, Courtyard by Marriott Hong Kong Sha Tin, is located further north (“3” in Figure 3)

Major high-rise residential developments in the vicinity of the Development Site include Shek Mun Estate (“17” in Figure 3) and Shek Mun Estate Phase 2 (under construction) (“18” in Figure 3) to the south-east, City One Shatin (“19” in Figure 3), Sunshine Grove (“20” in Figure 3) and Yue Tin Court (“21” in Figure 3) to the south-west, and Ravana Garden (“2” in Figure 3) to the north-west. These developments are densely built with high-rise building blocks.

To the south of the Development Site are mid-rise industrial and GIC buildings (“22” and “23” in Figure 3). A planned development at Yuen Hong Street (“24” in Figure 3) will be a high-rise hotel building. The low-rise KMB Bus Depot is located further south (“25” in Figure 3).

3. SITE WIND AVAILABILITY

To investigate the wind performance of the Development site, the characteristic of the natural wind availability of the site is essential. Site wind availability data presented in the wind rose could be used to assess the wind characteristics in terms of the magnitude and frequency of approaching wind from different wind directions. There are three sources of site wind data available for this Study, including wind tunnel test, simulated RAMS and the nearest Hong Kong Observatory (HKO) Weather Station – Shatin Weather Station.

3.1. WIND TUNNEL TEST

A wind tunnel experiment was previously conducted for the *Experimental Site Wind Availability Study for Sha Tin, Hong Kong* by the CLP Power Wind/Wave Tunnel Facility (WWTF) (August 2009) at The Hong Kong University of Science and Technology. The study area of the wind tunnel test was centred at City One Plaza and has a radius of approximately 500m, which covers the Development Site as shown in Figure 4. Wind roses at 200mPD are adopted in this study as it gives a better representation on the topographical effect in proximity while compared with wind roses from higher levels. The 200mPD wind roses under annual and summer conditions are shown in Figure 5 and Figure 6 respectively representing the localized wind conditions.

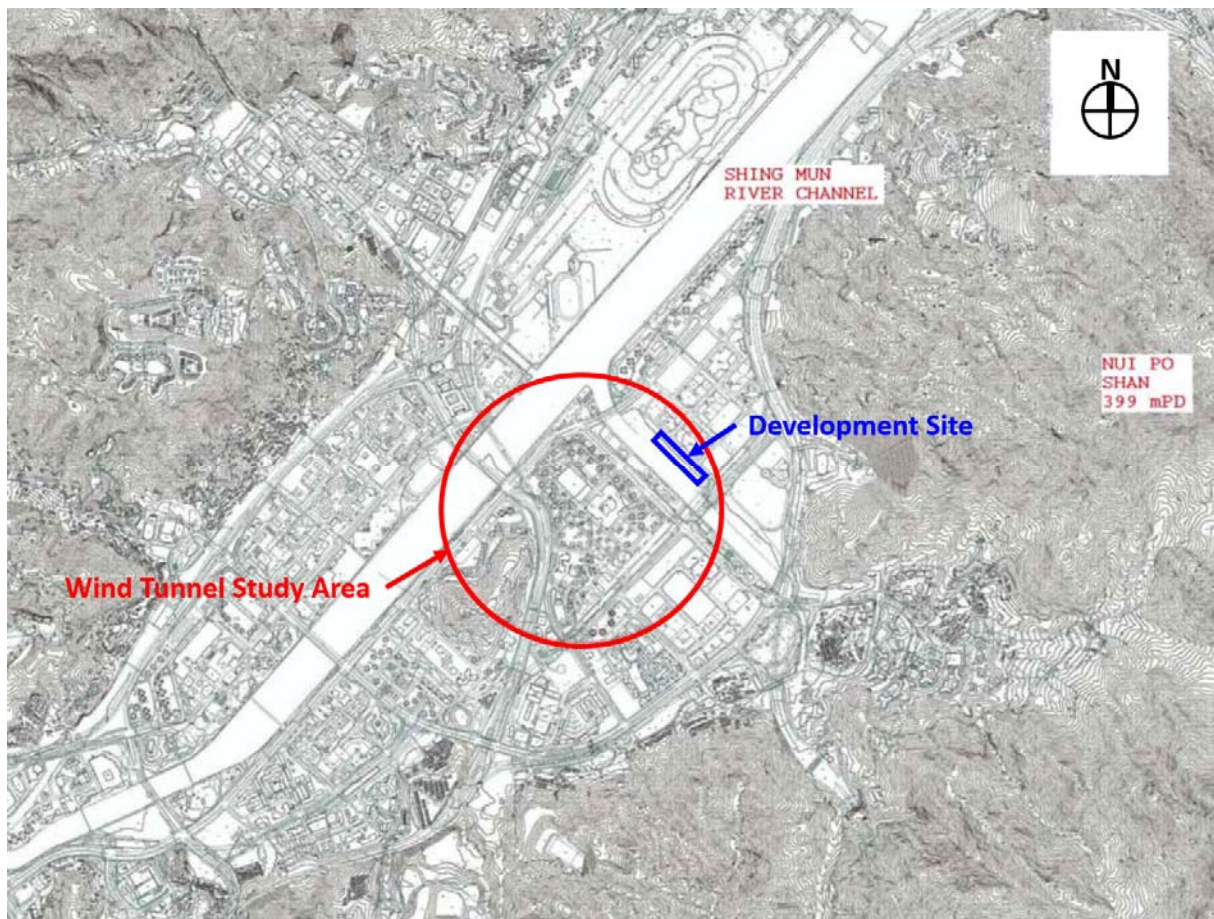


Figure 4 Location of the Wind Tunnel Test for Shatin Study Area
(Source: http://www.pland.gov.hk/pland_en/info_serv/site_wind/index.html)

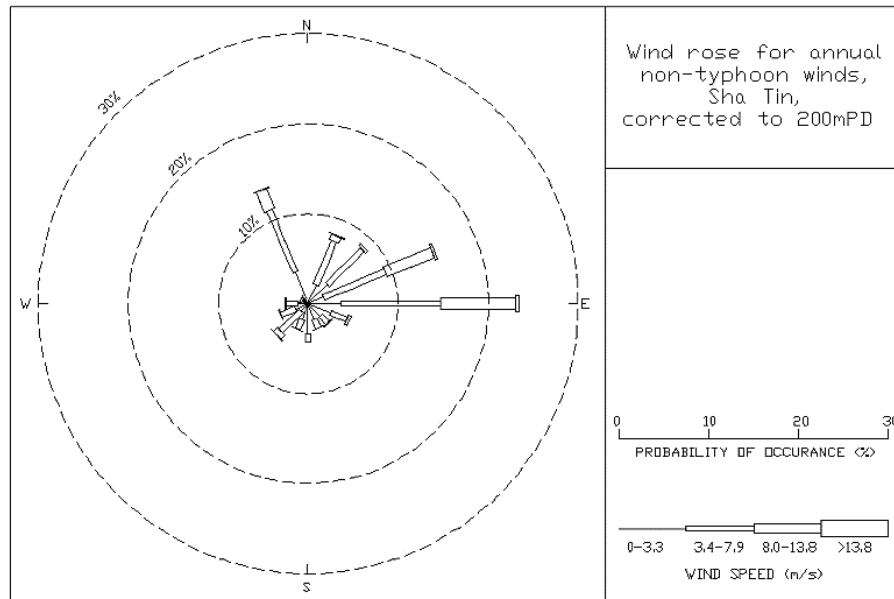


Figure 5 Wind Rose for Shatin Study Area from Wind Tunnel Test under Annual Wind Condition at 200m

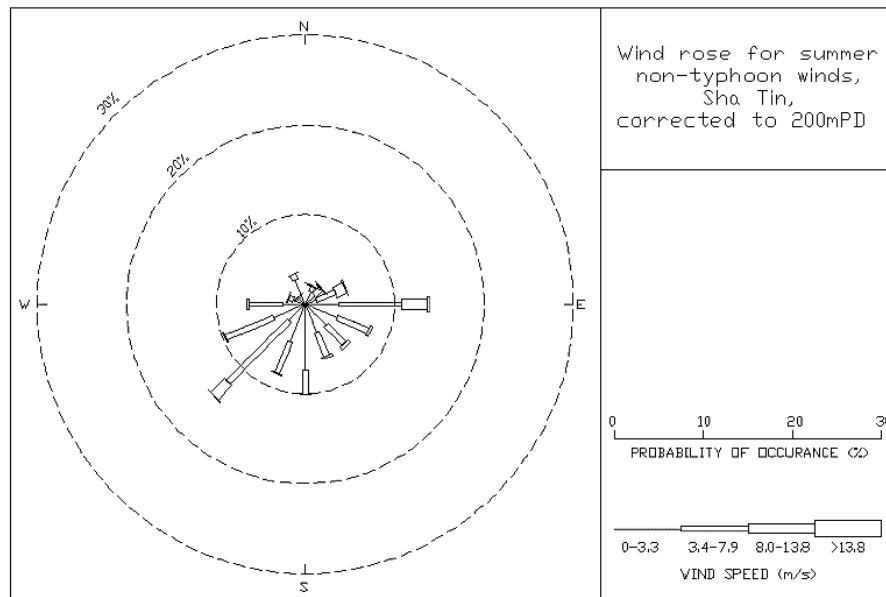


Figure 6 Wind Rose for the Shatin Study Area from Wind Tunnel Test under Summer Wind Condition at 200m

Table 1 Prevailing Wind Frequency by Wind Tunnel Test

Prevailing Wind	Annual	Summer
Wind Direction	ENE, E, NNW	E, S, SW, WSW

According to the wind data from the wind tunnel test, ENE, E and NNW winds are identified as the annual prevailing wind directions while E, S, SW and WSW winds are identified as the summer prevailing wind directions.

3.2. RAMS WIND DATA

As stipulated in the Technical Guide, the site wind availability would be presented by using appropriate mathematical models. PlanD has set up a set of wind availability data of the Territory for AVA study, i.e. RAMS simulation, which could be downloaded at PlanD's Website¹.

The wind availability data at 200mPD obtained from the grid of (X087, Y058) of the RAMS simulation can better represent the localized wind condition taking into account topography and morphology is used for this Expert Evaluation, as shown in Figure 7.

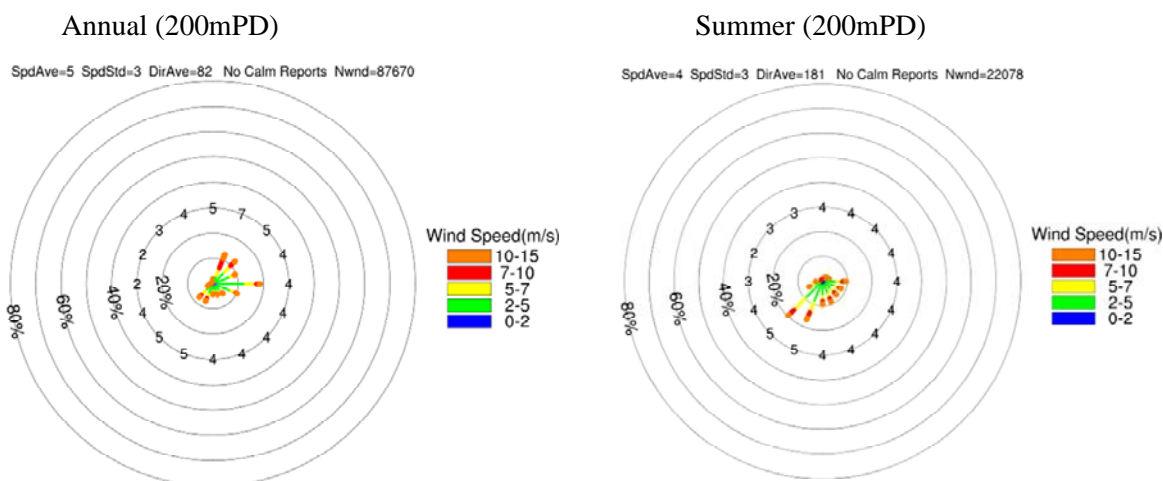


Figure 7 Wind Roses of Grid X087, Y058 by RAMS Wind Data

Table 2 Prevailing Wind Frequency by RAMS Wind Data

Prevailing Wind	Annual			Summer			
Wind Direction	NNE	E	ESE	E	S	SSW	SW
Wind Frequency	12.4%	18.6%	10.3%	9.5%	9.4%	17.0%	19.7%

According to the RAMS wind data, NNE, E and ESE winds contribute to 12.4%, 18.6% and 10.3% of the annual wind frequency respectively while the E, S, SSW and SW winds contribute to 9.5%, 9.4%, 17.0% and 19.7% of the summer wind frequency respectively. Hence, NNE, E and ESE winds are identified as the annual prevailing wind directions while E, S, SSW and SW winds are identified as the summer prevailing wind directions.

¹ http://www.pland.gov.hk/pland_en/info_serv/site_wind/site_wind/index.html

3.3. HONG KONG OBSERVATORY

The prevailing wind direction for each month measured at the nearest weather station - Shatin Weather Station from the Hong Kong Observatory² as shown in Figure 8 is tabulated in Table 3. The E wind is the annual prevailing wind direction while the SW wind is the summer prevailing wind direction.

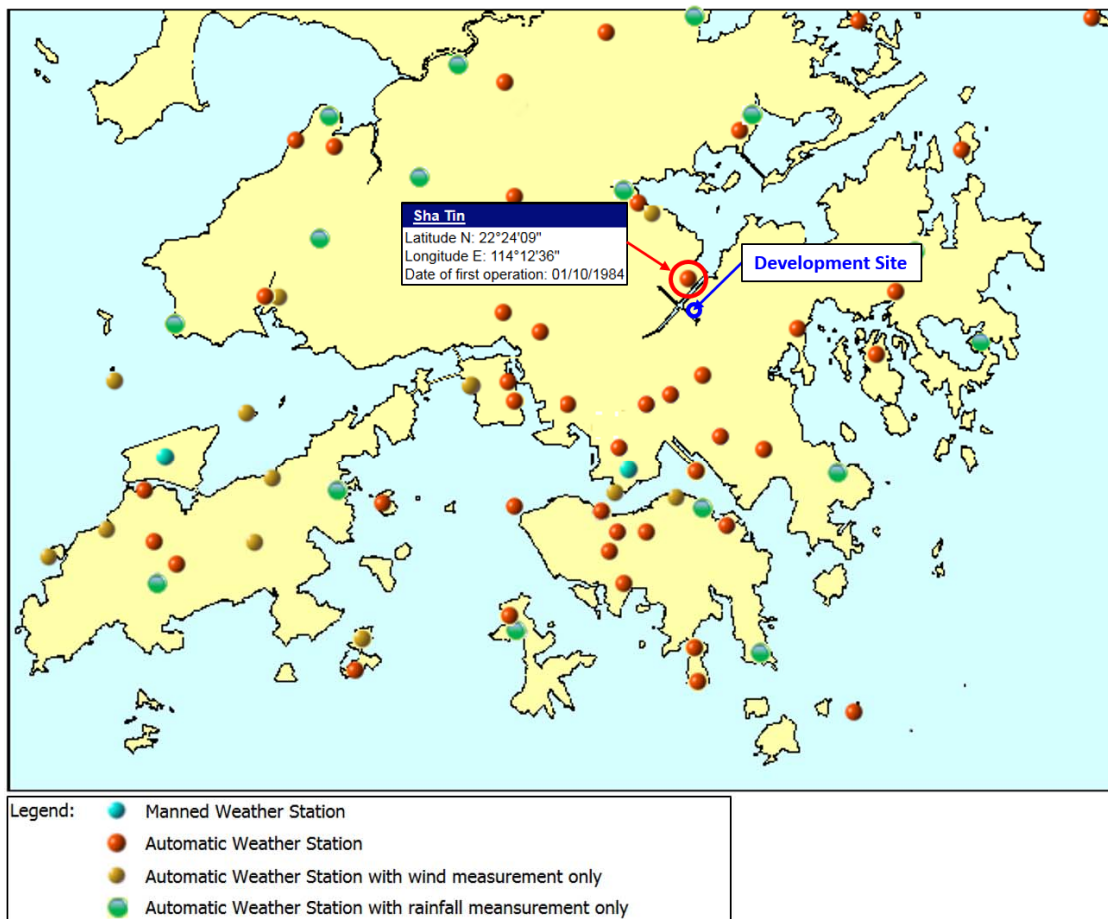


Figure 8 Location of HKO Shatin Weather Station
(Source: http://www.weather.gov.hk/cis/annex/hkwxstn_e.htm)

Table 3 Monthly Wind Direction Recorded at Shatin Weather Station from 1985 to 2015 (Source: Hong Kong Observatory)

Month	Prevailing Wind Direction (°)
January	30
February	90
March	80
April	90
May	90
June	(Summer) 220
July	
August	
September	90
October	90
November	30
December	30
Annual	90

² Summary of Meteorological and Tidal Observations in Hong Kong

3.4. SUMMARY OF ANNUAL AND SUMMER PREVAILING WINDS

The three sets of wind data have been studied. The wind data from the relevant wind tunnel report, RAMS and Shatin Weather Station indicated prevailing winds directions are tabulated in Table 4.

Since RAMS Wind Data is the most relevant to the Development Site in terms of location and topography, it is concluded that the annual prevailing winds of the Development Site are coming from NNE, E and ESE directions, while the summer prevailing winds are coming from E, S, SSW and SW directions.

Table 4 Prevailing wind directions for the Study Area

Prevailing Wind Direction	Wind Tunnel Test	RAMS	HKO Shatin Weather Station
Annual	ENE/E/NNW	NNE/E/ESE	E
Summer	E/S/SW/WSW	E/S/SSW/SW	SW

4. QUALITATIVE ASSESSMENT OF EXISTING CONDITION OF THE DEVELOPMENT SITE WITH PLANNED DEVELOPMENTS

The Development Site is located in a flat built-up area facing the river channel in the south-west and surrounded by building clusters in the east and north. With consideration of the existing and planned developments near the Development Site, the wind environments under both annual and summer conditions are qualitatively assessed below based on the wind data presented in Section 3.

4.1 NNE Wind

The incoming NNE wind would mainly enter the SMBA from On Sum Street and On Kwan Street (Figure 9). Part of the wind would be diverted by the planned development into the opening of the noise barriers and ventilate the area along On Ming Street (green arrow). Wind travelling along On Ping Street will be blocked by Heung Yee Kok Building at pedestrian level (orange arrow). The NNE wind would adopt the major breezeway near Tai Chung Kiu Road to reach Siu Lek Yuen Road Playground (black arrow). The noise barrier of approximately 5m in height along Tate's Cairn Highway would shield the HKBU institutions and International Christian School sites from pedestrian level wind. As the existing condition of the Development Site comprises Jockey Club Kitchee Centre which is mainly an open area with no major wind obstructing structures, the incoming wind would be able to flow across the Development Site resulting in good ventilation performance along Siu Lek Yuen Road Playground and the perimeter of City One Shatin (blue arrows).

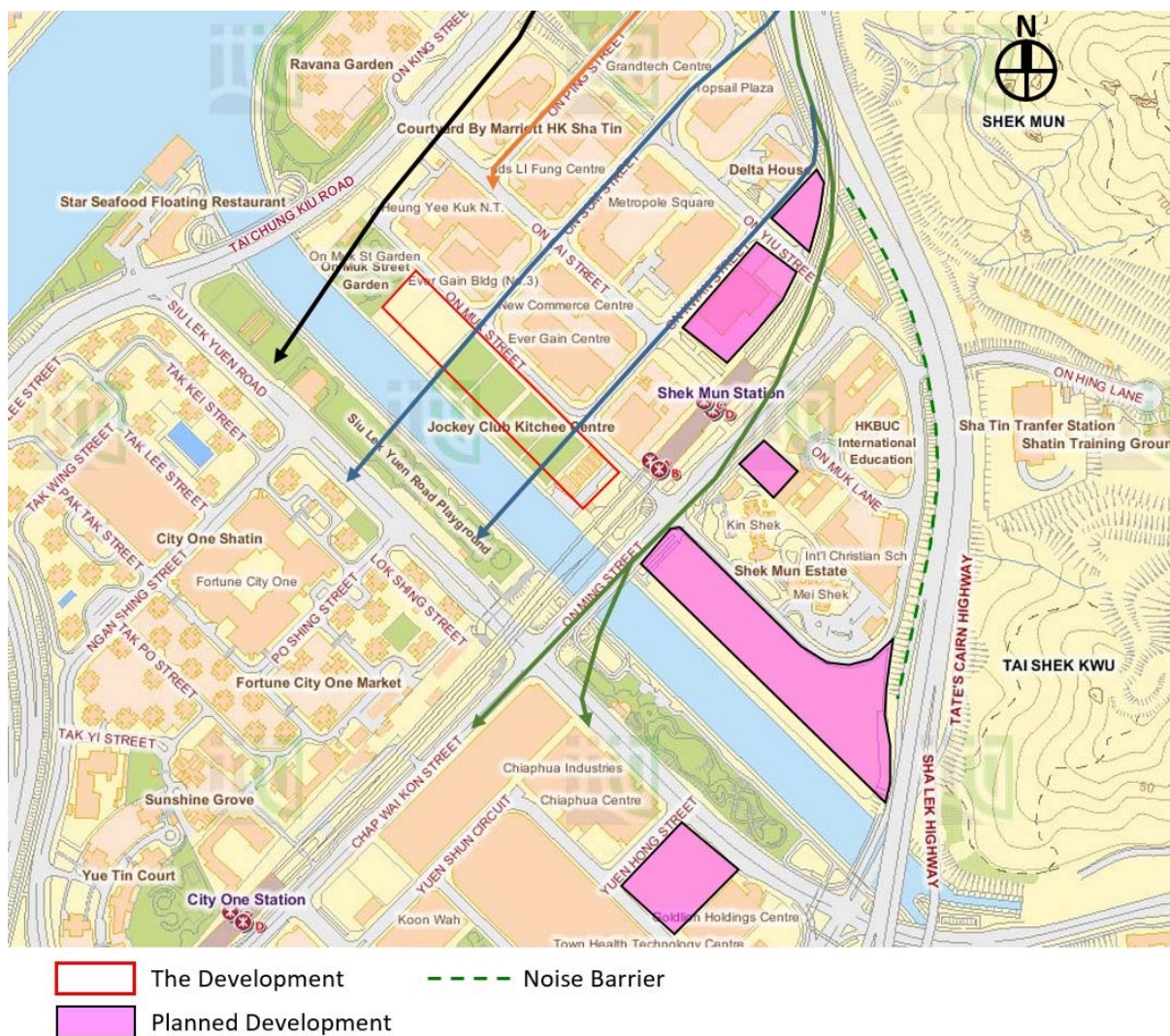


Figure 9 Breezeways around the Development Site (NNE wind)

4.2 E and ESE Winds

The E and ESE winds would be weakened by the existing building cluster including Shek Mun Estate, HKBU Affiliated Wong Kam Fai Secondary School (HKBUAS), Shek Mun Estate Phase 2 (under construction), and also, the noise barrier of approximately 5m in height at the perimeter (Figure 10) located in the eastern side of the Development Site. Wind from On Hing Lane would skim over the noise barriers to flow into SMBA via On Yiu Street (blue arrow). A portion of incoming wind would be expected to be channelled into On Muk Lane and skim over the low-rise structures in HKBUAS sites to reach On Lai Street (green arrow). The presence of Shek Mun Estate and Shek Mun Estate Phase 2 (under construction) with maximum building height of 140mPD would modulate incoming wind into On Muk Street to penetrate through the Development Site to reach On Muk Street Garden without much blockage (black arrow). Shing Mun Nullah will form the major wind corridor under E and ESE wind condition (red arrow).

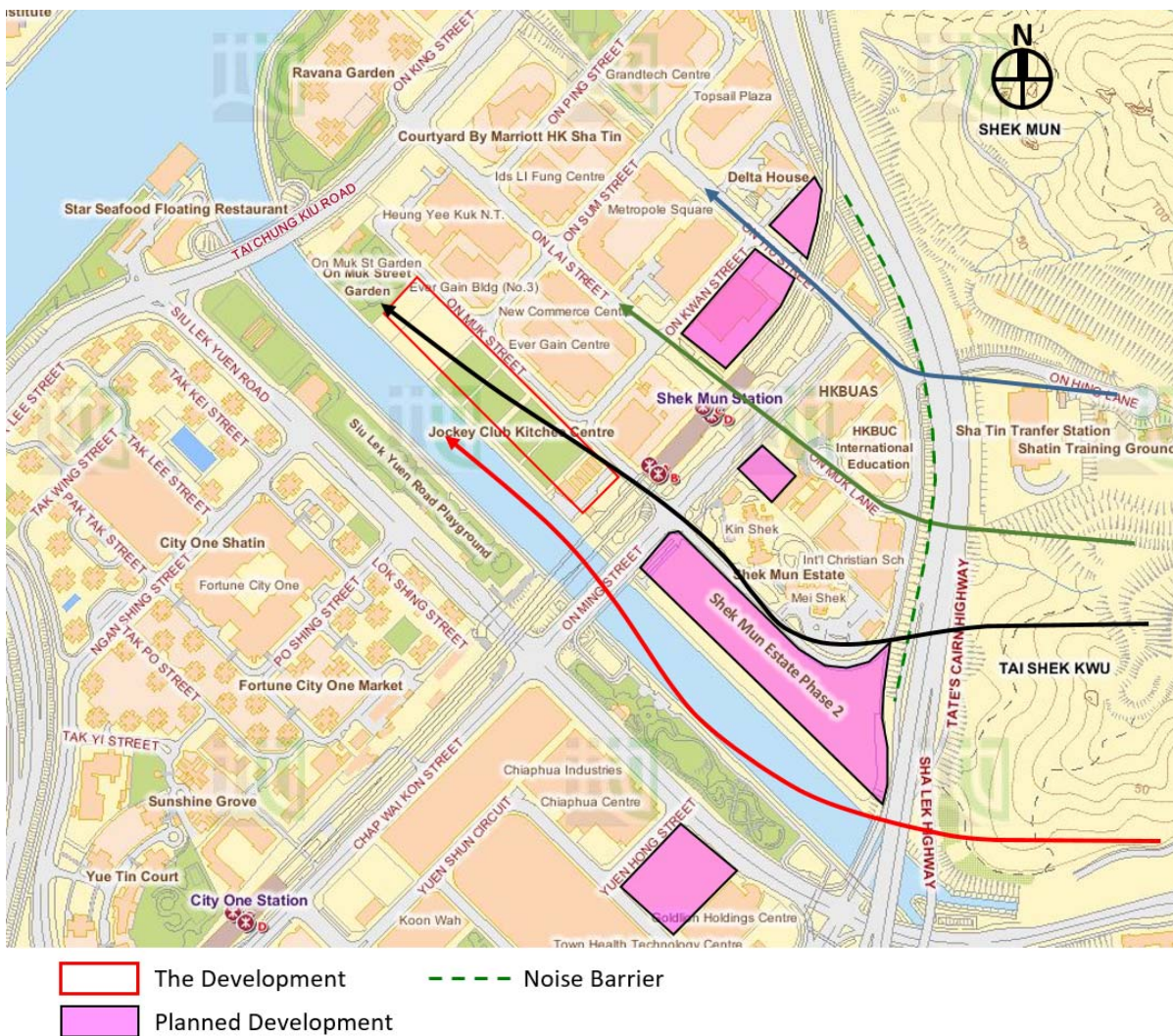
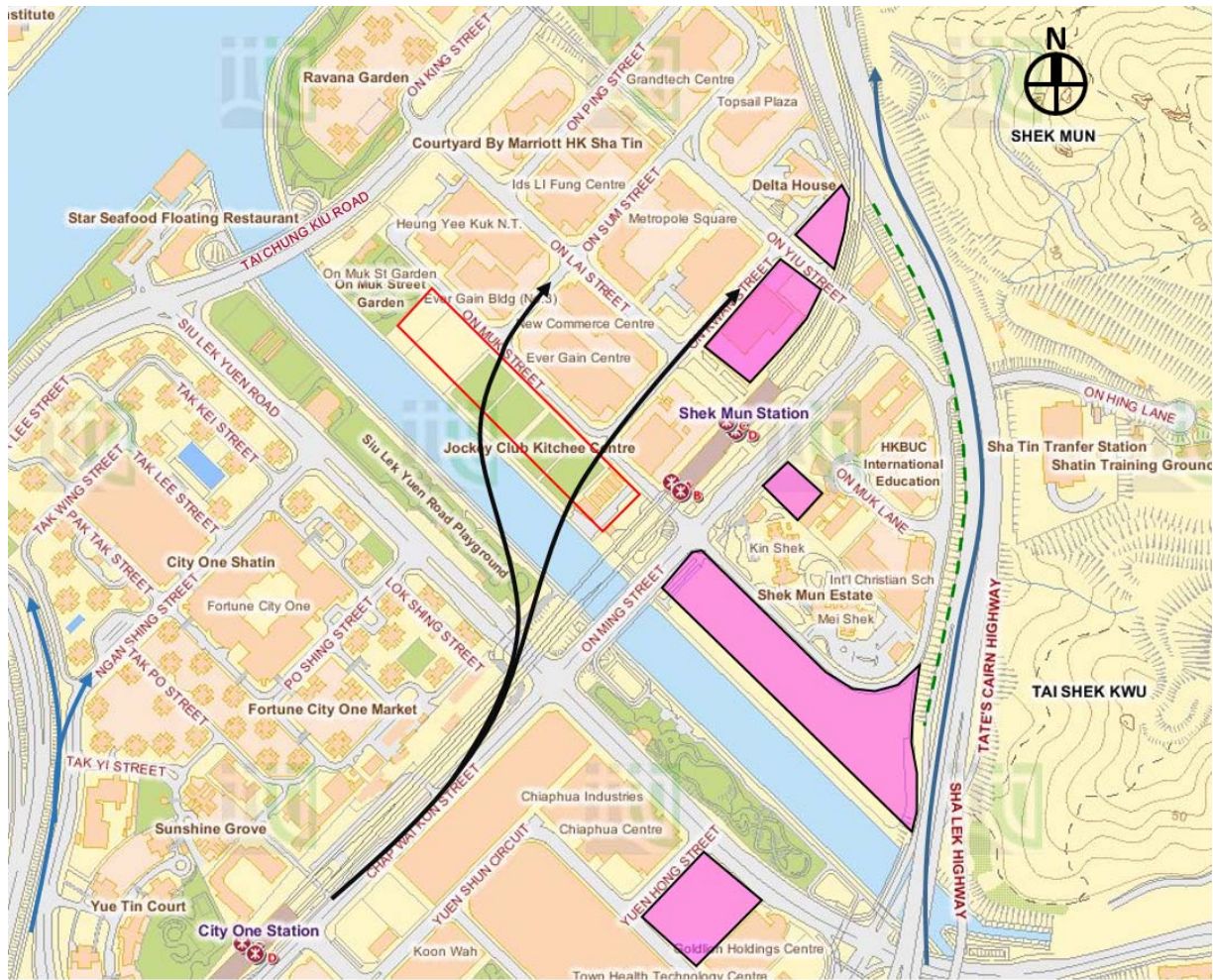


Figure 10 Breezeways around the Development Site (E and ESE winds)

4.3 S Wind

S wind would flow freely along the Tate's Cairn Highway to the east of the Development Site (blue arrow). Majority of the S wind would be modulated by City One Shatin and the industrial cluster at the south to flow along Ngan Shing Street and Chap Wai Kon Street. Wind entered Ngan Shing Street and Tak Wing Street would be expected weakened by the dense built area (i.e. City One Shatin) (green arrow). Incoming wind from Chap Wai Kon Street would be redirected at open areas along the River Channel and reach the Development Site (black arrow).



- The Development
- Noise Barrier
- Planned Development

Figure 11 Breezeways around the Project Area Development Area (S wind)

4.4 SSW and SW Winds

The incoming SSW and SW winds from Shing Mun River would travel along Tai Chung Kiu Road towards the open lot adjacent to the Courtyard by Marriott Hong Kong Sha Tin (blue arrow). The large cluster of existing high-rise residential buildings of City One Shatin located to the immediate south west of the Development Site would block the winds coming from south western quadrant (Figure 12). A small portion of the incoming wind would be able to penetrate through this cluster via Ngan Shing Street and reach On Muk Street Garden and On Sum Street (green arrow). Majority of flow will flow along Chap Wai Kon Street and start disperses once reaching the open space (river channel). The main stream would continue to flow along On Ming Street while a portion of wind may be diverted towards the Development Site and enter On Kwan Street (black arrow).

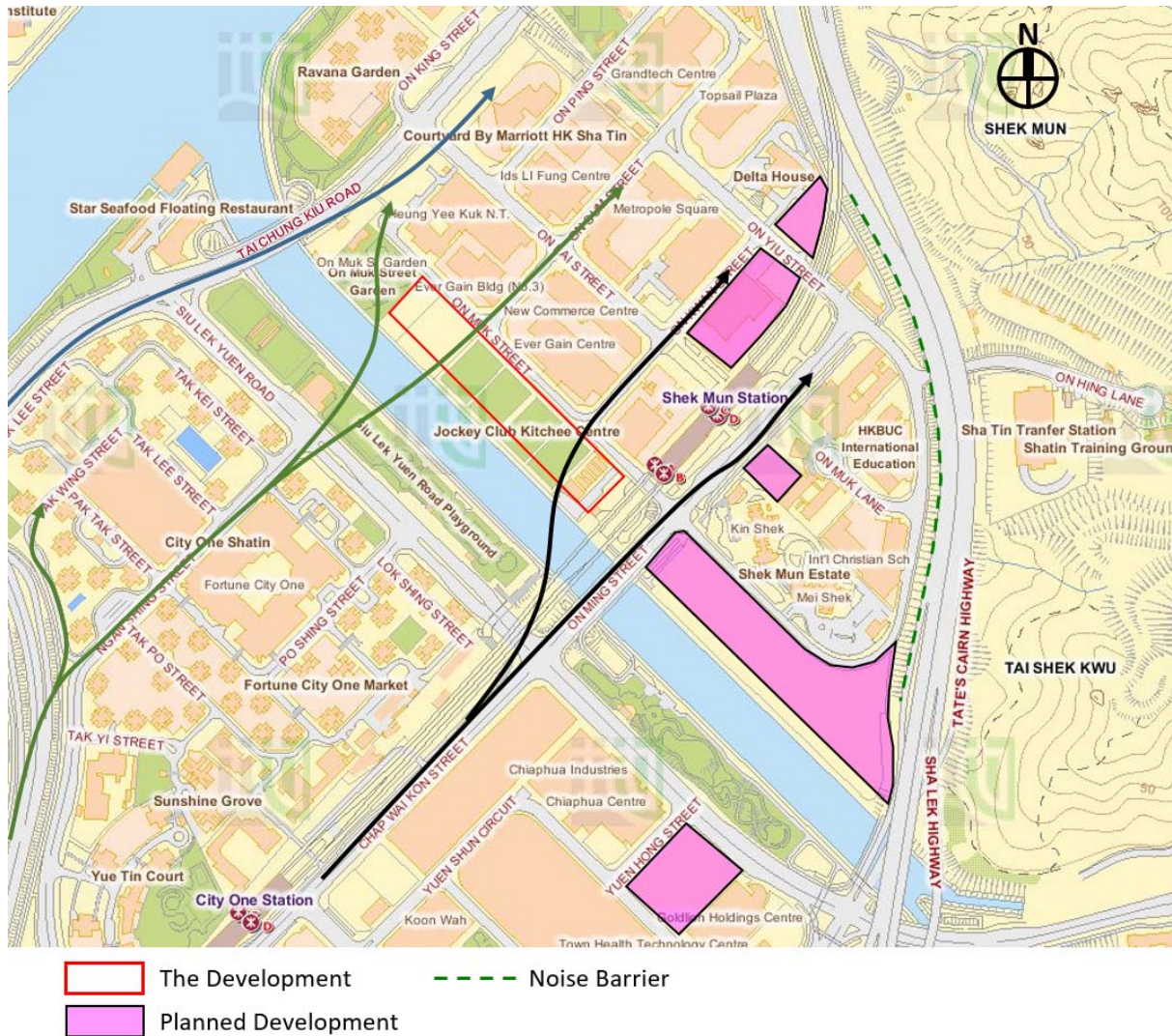


Figure 12 Breezeways around the Development Area (SSW and SW winds)

5. PRELIMINARY PLAN

5.1. PROPOSED SCHEME (PHASES 1, 2 & PRIMARY SCHOOL)

Under the preliminary plan, the proposed public housing development has a plot ratio of 6 and consists of three domestic blocks sitting at grade with a maximum building height of 116mPD and a primary school (approximate 35mPD) to the east of the Development Site. Block 1 makes up Phase 1 of the development, while Blocks 2 and 3 are of Phase 2. The preliminary disposition of the building blocks and the open lot carpark at grade of 5.2mPD provides separation gaps of approximately 57m between Blocks 1 & 2, 15m between Blocks 2 & 3, 26m between Block 3 and the primary school. The 57m and 26m gaps more or less align with the air paths along On Sum Street and On Kwan Street. Figure 13 shows the indicative layout plan of the Development Site.

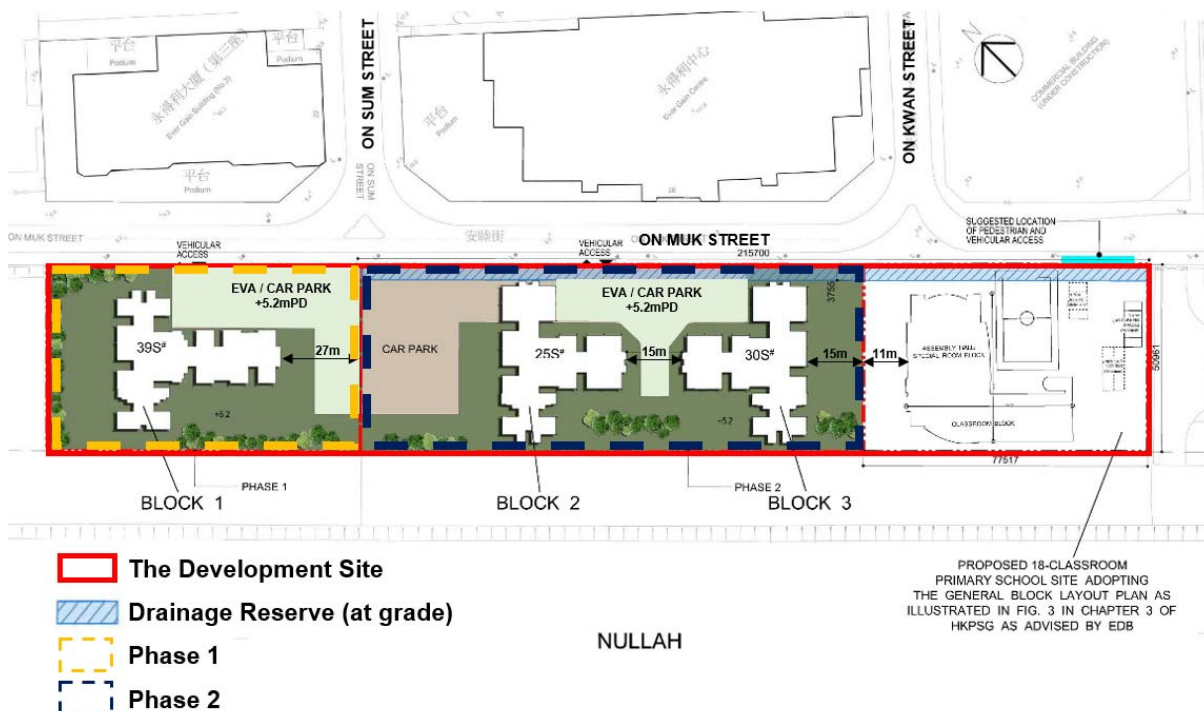


Figure 13 Indicative Layout Plan of Proposed Development (site layout subject to detailed design)

5.2. REVISED SCHEME (PHASE 1 ONLY)

In response to the public concerns, rezoning of the land occupied by the football training centre (i.e. Phase 2 and primary school) is postponed until the relocation arrangement for the football training centre is settled. In view of the above, HD has prepared a revised layout plan by adding new structures (i.e. car park, roof garden and recreation area) at the southern half of the Phase 1 site. As shown in the indicate layout plan of the Revised Scheme (Figure 14), one 32-storey building block (not more than 110mPD) with 1-storey car park of about 7.7mPD located to the south of Ever Gain Building is proposed.



 The Development Site

Figure 14 Indicative Layout Plan of Revised Scheme (site layout subject to detailed design)

6. VENTILATION PERFORMANCE OF PROPOSED SCHEME ON THE SURROUNDING

6.1 NNE Wind

Figure 15 demonstrates anticipated flow of NNE wind. As the proposed scheme provides a gap which aligns with the air path of On Sum Street, the NNE wind would mainly enter from On Sum Street and flow freely via the open lot carpark, the waterfront, Siu Lek Yuen Road Playground and reach City One Shatin (black arrow). Incoming wind from On Kwan Street flows through the 26m separation between Block 3 and the proposed primary school to Siu Lek Yuen Road Playground. A small portion of wind could skim over the proposed low-rise school development (~35mPD) at mid-level and reattach at Siu Lek Yuen Road Playground as the nullah provides sufficient separation for reattachment (green arrow). Two building separations (i.e. 57m-wide building separation between Blocks 1 and 2 and 26m-wide building separation between Block 3 and proposed primary school) adopted in the proposed layout could allow continuous NNE wind flow from the existing air paths to the leeward region. However, the proposed high-rise residential blocks at grade would extend the wake area from Ever Gain Centre when compared with the existing condition. It is expected that the wake would extend to the nullah and reattached at Siu Lek Yuen Playground.

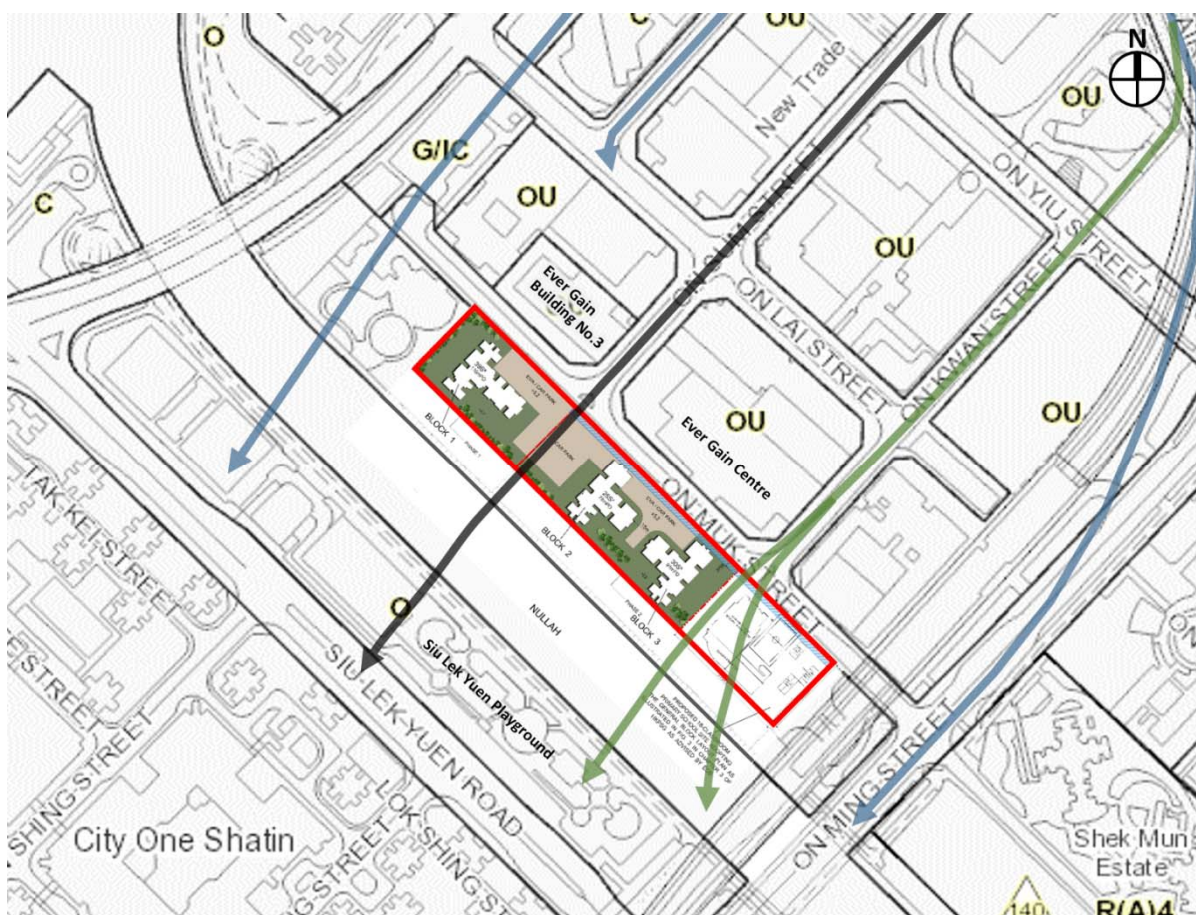


Figure 15 Wind Environment under NNE Wind (site layout subject to detailed design)

6.2 E and ESE Winds

The E and ESE winds would mainly enter from On Muk Street and Shing Mun Nullah (black arrow). With the proposed development, the effective width of the existing wind corridor along the nullah and abutting open spaces would be narrowed down. However, the Development Site is linear in shape and its alignment runs parallel to the adjacent major air paths along On Muk Street and Shing Mun Nullah (Figure 16). In this connection, it is expected that the presence of the Proposed Scheme would not induce significant disturbance to the air flow along On Muk Street and Shing Mun Nullah. However, E and ESE winds would be diverted by the proposed development such that it may unavoidably impose a wake area on On Muk Street Garden. This impact could be reduced by the setback of Block 1 from the northwestern site boundary.

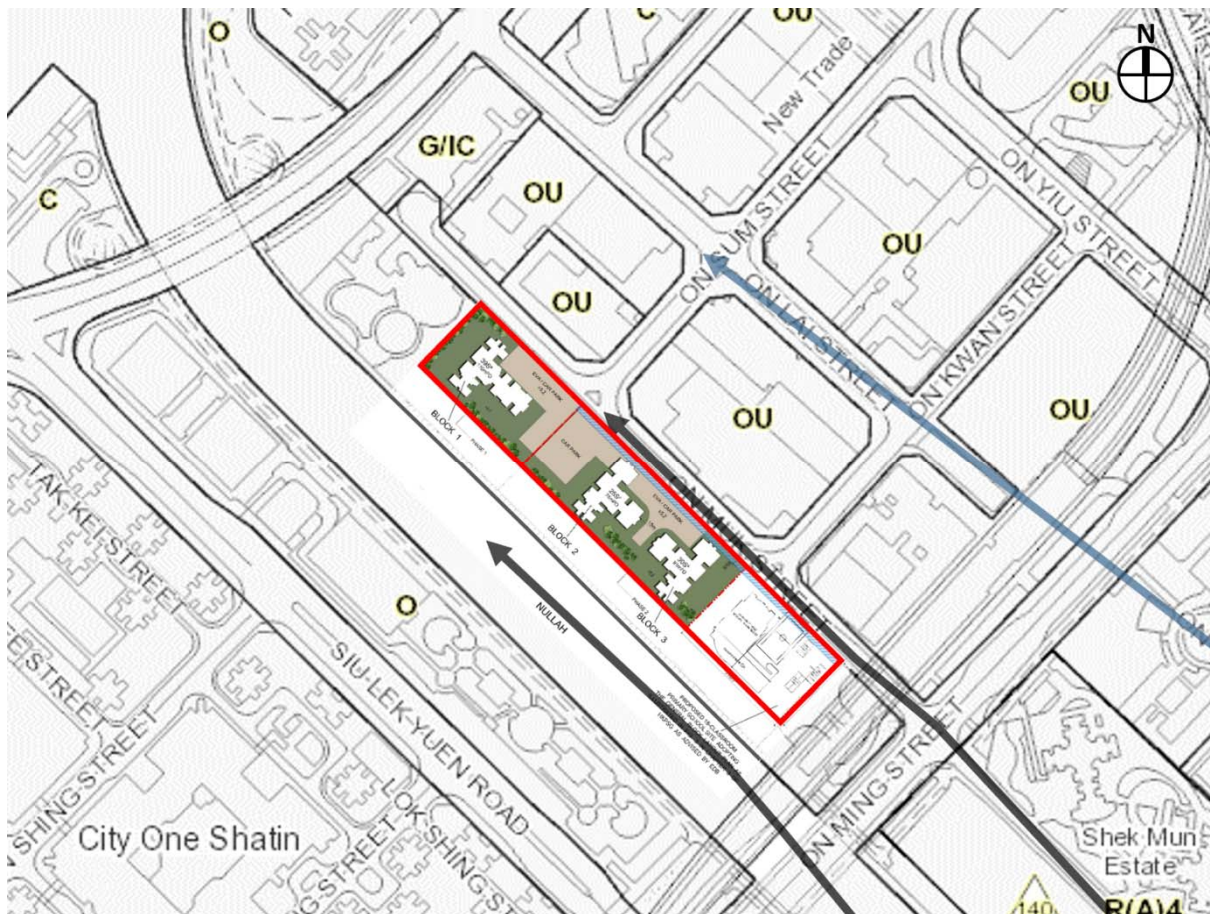


Figure 16 Wind Environment under E and ESE Winds (site layout subject to detailed design)

6.3 S Wind

Majority of the S wind that would reach the Development Site passes through Chap Wai Kon Street and open spaces beside the nullah. The proposed development would potentially shield the incoming wind from entering the air paths of SMBA including On Sum Street and On Kwan Street (black arrow). However, provision of building separations (i.e. 15m-wide gap between Blocks 2 and 3 and 26m-wide gap between Block 3 and proposed primary school) would allow wind penetration to reach On Muk Street and mitigate the potential adverse air ventilation impact at the leeward side. A small portion of S wind would skim over the proposed low-rise school in the Development Site in reaching On Kwan Street (red dash line).

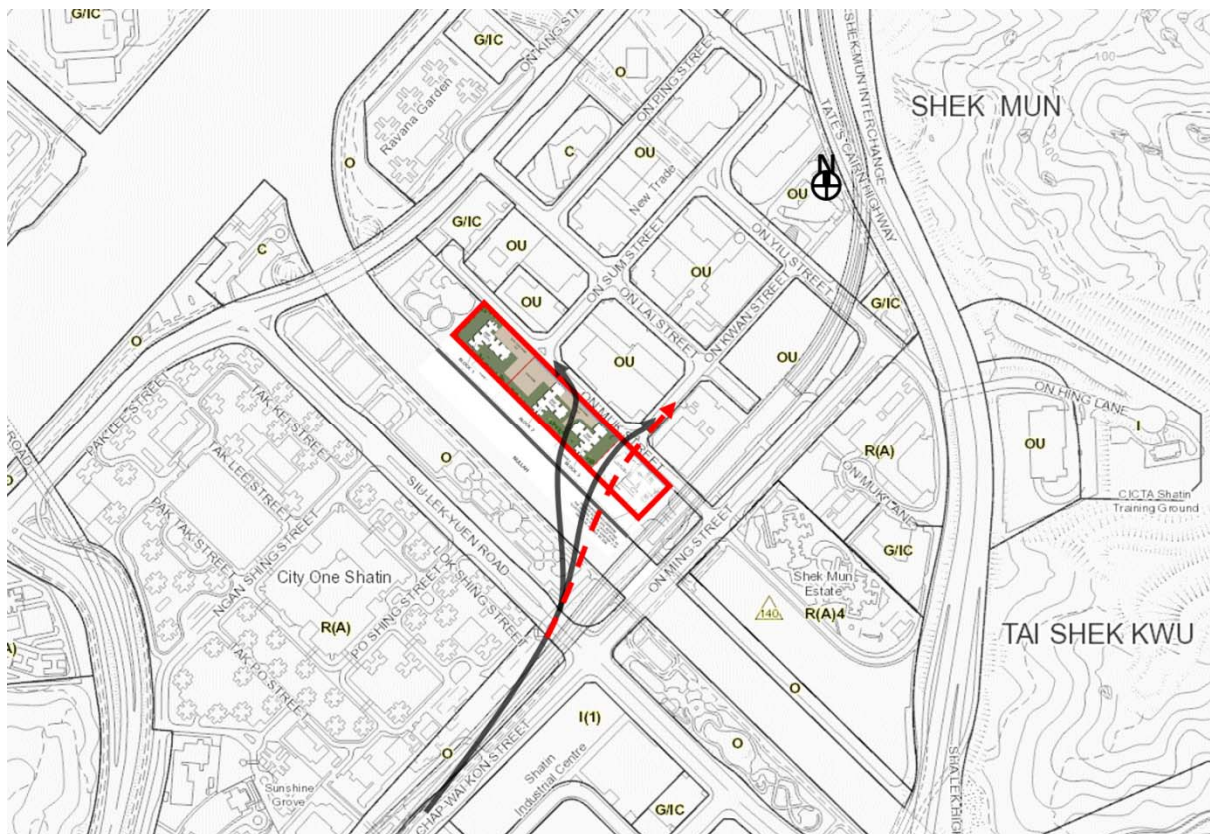


Figure 17 Wind Environment under S Wind (site layout subject to detailed design)

7. VENTILATION PERFORMANCE OF REVISED SCHEME ON THE SURROUNDING

7.1 NNE Wind

Figure 19 demonstrates the anticipated flow of NNE wind under Phase I of the Revised Scheme. As there is only one residential block which is setback from the air path of On Sum Street at the downstream of Ever Gain Building No.3, the NNE wind would mainly enter from On Sum Street and skim over the 1-storey carpark in reaching City One Shatin (black arrow). Incoming wind from On Kwan Street flows freely to Siu Lek Yuen Road Playground as the football court at Jockey Club Kitchee Centre would be retained in the Revised Scheme (green arrow). Although the proposed development would inevitably create some localised impact on the immediate southwest of the Development Site, it is not expected that other wind paths (blue arrows) would be affected.

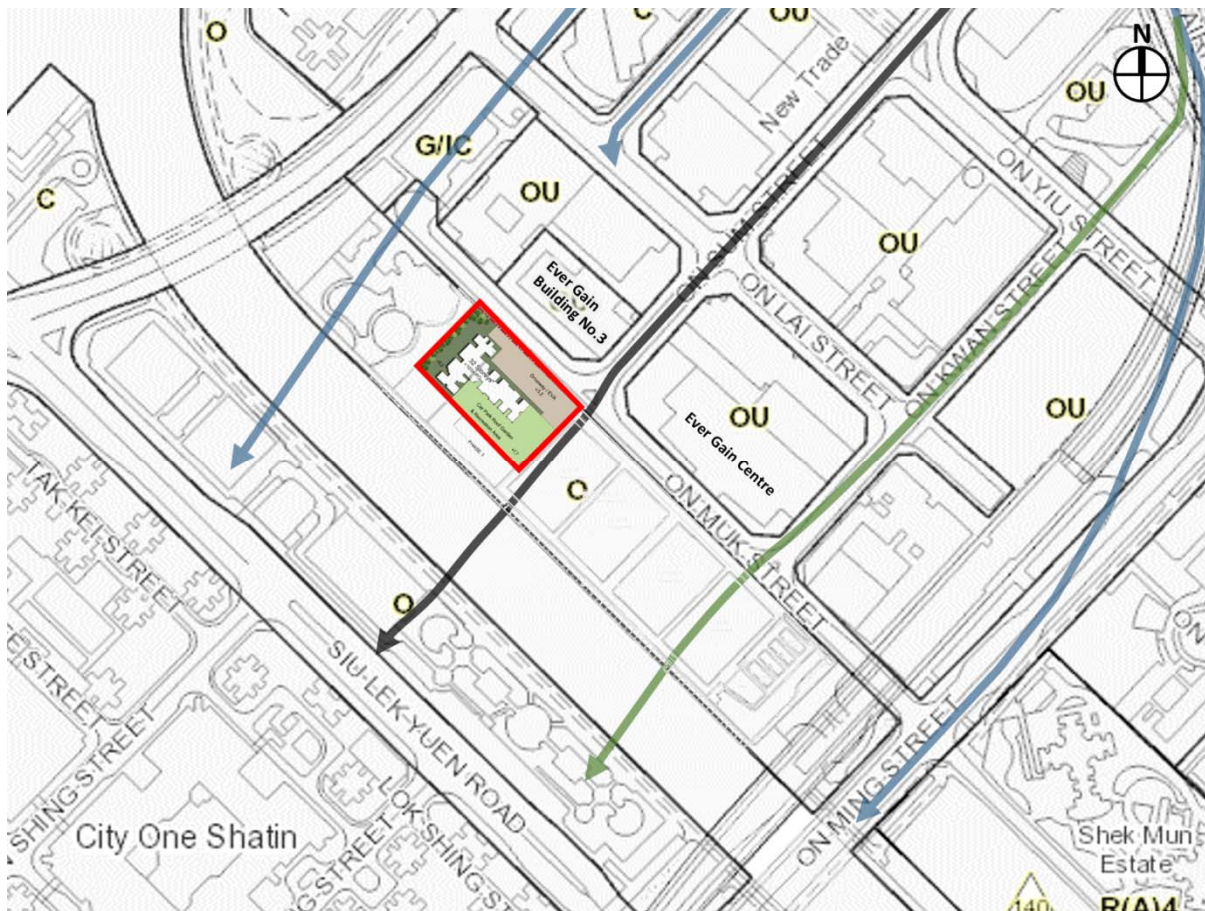


Figure 19 Wind Environment under NNE Wind (site layout subject to detailed design)

7.2 E and ESE Winds

The E and ESE winds would mainly enter from On Muk Street and Shing Mun Nullah (black arrow). The development footprint for the Revised Scheme is small and its alignment runs parallel to the adjacent major air paths along On Muk Street and Shing Mun Nullah (Figure 20). In this connection, it is expected that the presence of the Revised Scheme would have minimal impact on the effectiveness of these air paths under E and ESE winds. However, similar to the Proposed Scheme, it is inevitable that the Revised Scheme would create wake on the immediate part of On Muk Street Garden. Such impact could be reduced by setback of the residential block from the northwestern boundary.

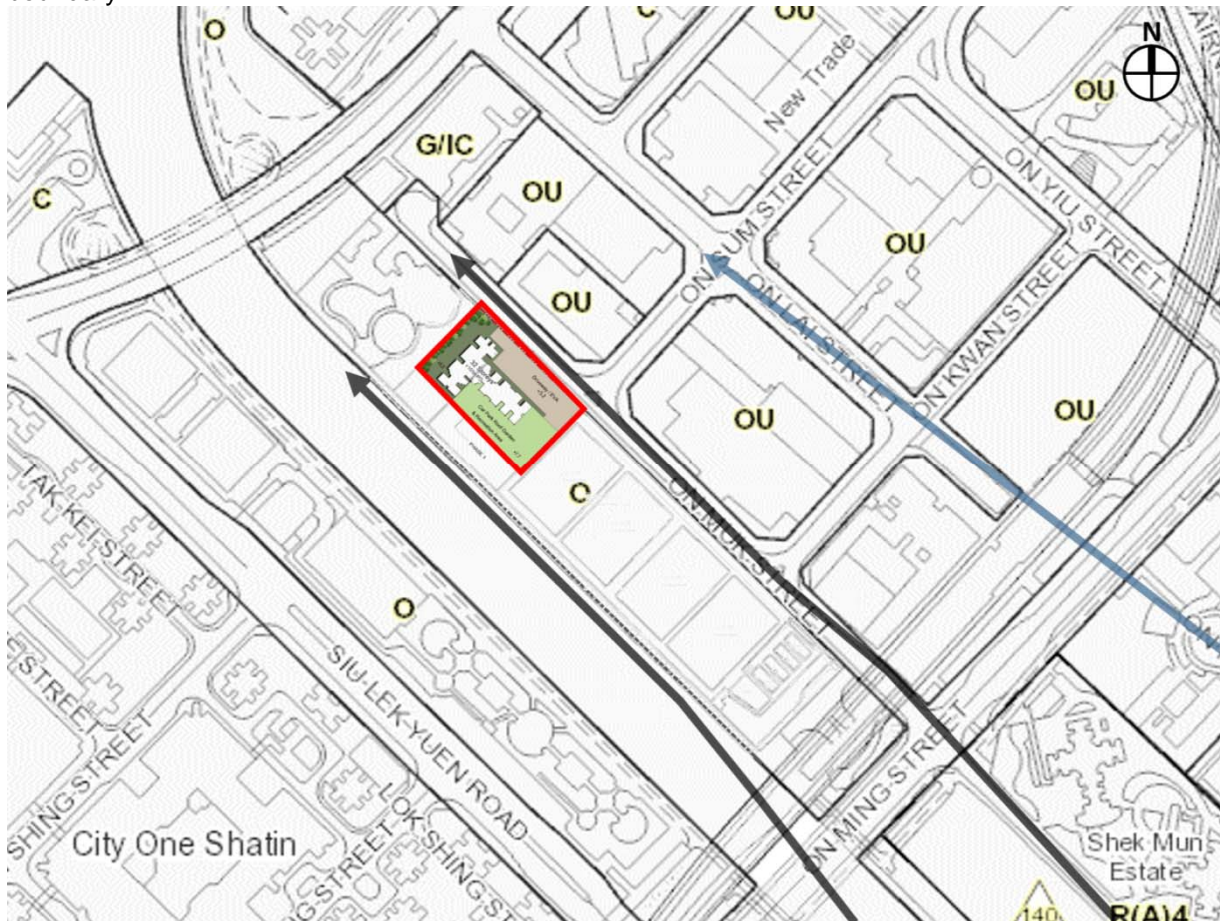


Figure 20 Wind Environment under E and ESE Winds (site layout subject to detailed design)

7.3 S Wind

Majority of the S wind that would reach the Development Site passes through Chap Wai Kon Street and open spaces beside the nullah. The retained football court at Jockey Club Kitchee Centre allows the incoming wind from entering the air paths of the SMBA including On Muk Street, On Sum Street and On Kwan Street (black arrows). It is anticipated that the development under the Revised Scheme is not likely to induce adverse impact under S wind condition.



Figure 21 Wind Environment under S Wind (site layout subject to detailed design)

7.4 SSW and SW Winds

The high-rise building clusters of City One Shatin at the south-west of the Development Site would potentially block the incoming wind to the Development Site and its leeward region. The SSW and SW winds would mainly travel along Ngan Shing Street / On Ming Street to reach the Development Site (black arrow). The presence of proposed development would adversely affect the ventilation performance of its downwind vicinity such as the section of On Muk Street between the subject development and Ever Gain Building 3 as compared to the existing scenario. However, compared with the Proposed Scheme, the wake zone created by the Revised Scheme would be much smaller. As SSW and SW incoming winds would freely flow through the retained football court towards On Kwan Street into SMBA and ventilate On Muk Street (green arrow). It is not expected that the other air paths such as that along Tai Chung Kiu Road would be affected by the Revised Scheme. It is also anticipated that SSW and SW winds travel along Tai Chung Kiu Road would not be affected by the proposed development (red arrow).

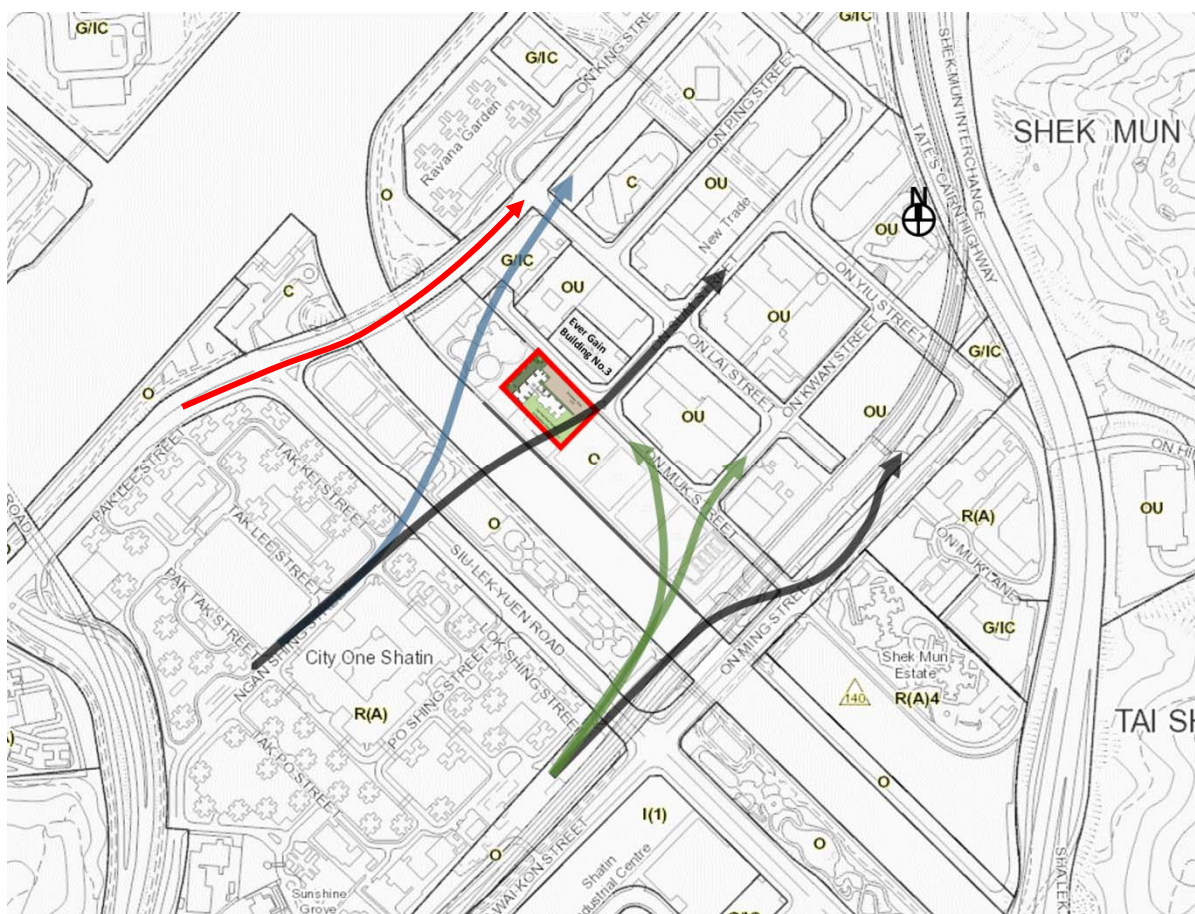


Figure 22 Wind Environment under SSW and SW Winds (site layout subject to detailed design)

8. GOOD DESIGN FEATURES AND FURTHER ENHANCEMENTS

According to the analysis from previous section, the proposed development shall have certain localized wind impact while compared with the existing condition. To alleviate the potential adverse wind impact and improve the wind performance of the Development and its surrounding areas, the following good design features are identified and further enhancement measures are recommended.

8.1. PROPOSED SCHEME

Building Separation

With the provision of the three building separations (i.e. 57m-wide between Blocks 1 and 2, 15m-wide between Blocks 2 and 3, and 26m-wide between Block 3 and proposed primary school), wind penetration through the Proposed Scheme is facilitated to reach the downstream areas.

All proposed building separations should be designated as Non-Building Areas (NBAs) for effective wind penetration.

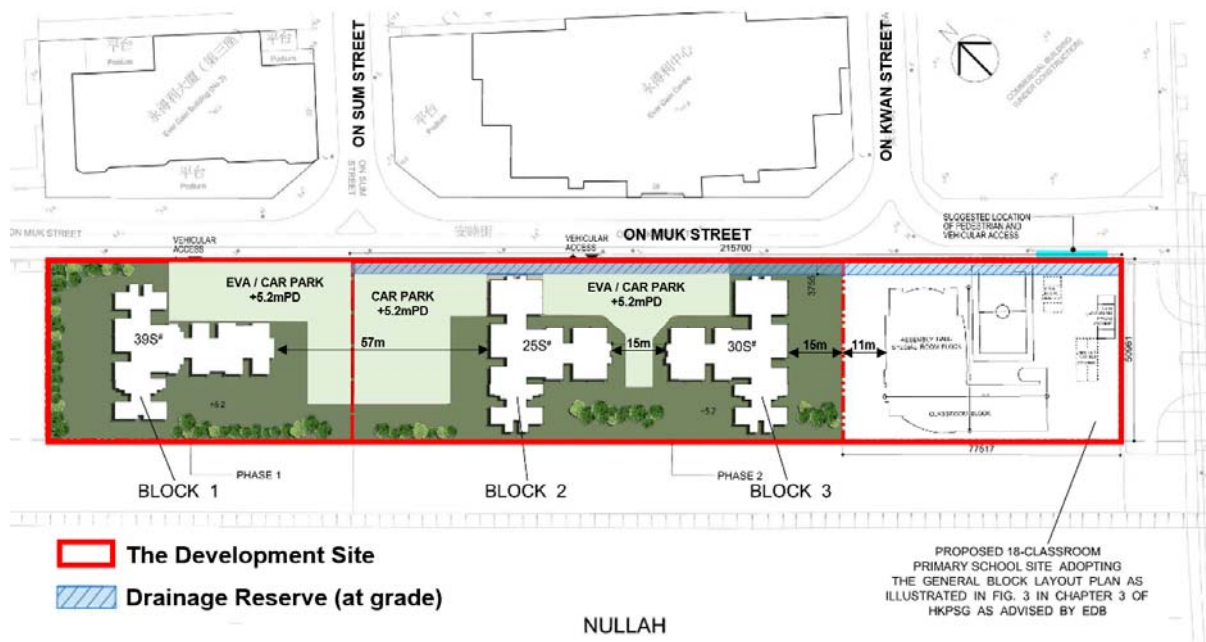


Figure 23 Proposed building separations

Building Setback

Provision of 18m building setback from north-western site boundary of the Proposed Scheme could help in minimizing the wake area imposed on On Muk Street Garden.

Podium-free Design

Without podium design, low level permeability is enhanced which is beneficial to pedestrian air flow.

High Permeability

Based on the above analysis, it is recommended that the future high-rise development at the Development Site should avoid long building frontage along the Development boundary at nullah frontage. In general, further recommended design principles for scheme optimization to be considered at the detailed design stage to facilitate wind penetration could include:

- Building Permeability equivalent to 20% to 33.3% of total frontal area with reference to PNAP APP-152;

- Minimization of podium bulk with ground coverage of no more than 65%;
- Greenery (preferably tree planting) of no less than 30% for sites larger than 1 ha, and 20% for sites below 1 ha at lower levels, preferably at grade;
- Building setback with reference to PNAP APP-152;
- Avoidance of long continuous façades; and
- Reference could also be made to recommendations in the Hong Kong Planning Standards and Guidelines.

Empty Bay at Ground Floor Level

To further alleviate the potential adverse air ventilation impact at pedestrian wind environment, ground floor empty bays of at least 3m in height are suggested at the east wing of Blocks 1 (22.5m-wide) & 2 (10.5m-wide) and at the west wing of Block 3 (10.5m-wide). These could increase wind permeability area and facilitate wind penetration to the immediate surrounding along On Muk Street under SW quadrant wind as well as the promenade under NNE wind.

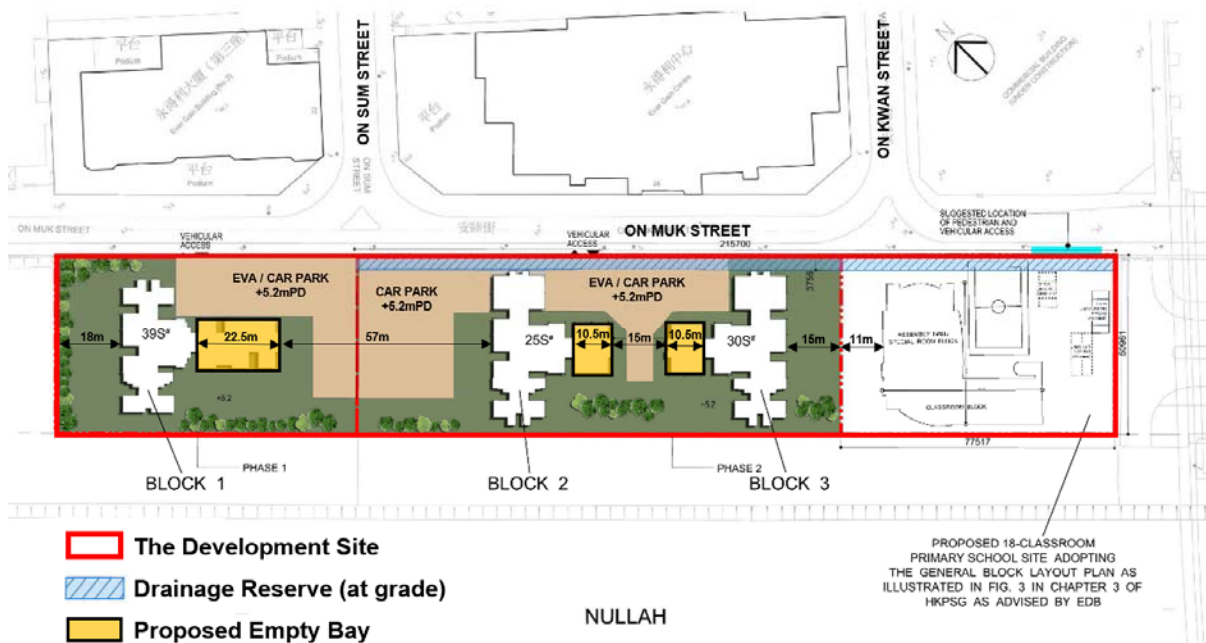


Figure 24 Recommended Location of Ground Floor Empty Bay (site layout subject to detailed design)

Shift of school-site building towards On Ming Street

Another further mitigation measure is recommended to align the school-site building with the wind corridor of On Kwan Street by shifting the building mass towards On Ming Street., This would allow a wider and more effective wind corridor for wind to penetrate and ventilate the leeward region under NNE and SW quadrant wind.

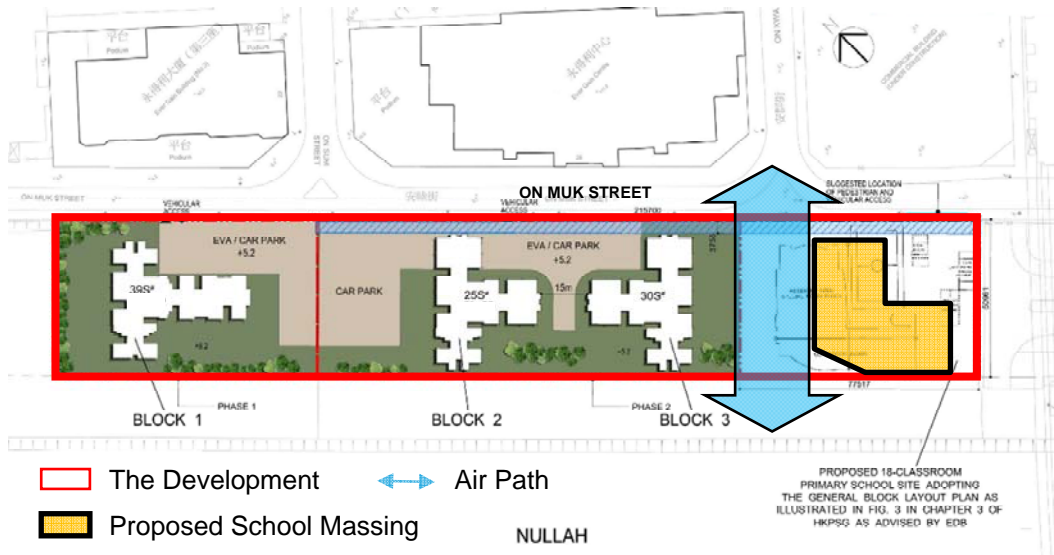


Figure 25 Recommended Shift of School Massing (site layout subject to detailed design)

8.2. REVISED SCHEME

Building Setback

Provision of 13m building setback from the north-western site boundary of the Revised Scheme could help in minimizing the wake area imposed on On Muk Street Garden (Figure 26.)

Building height of 1-storey carpark

The carpark under the Revised Scheme is only 1-storey in height at absolute building height of 2.5m. It allows wind from/to On Sum Street to skim over it easily. As such, the building height of carpark should not exceed 1-storey.



Figure 26 Football court provide open space (site layout subject to detailed design)

Retained football court at Jockey Club Kitchee Centre

The football court at Jockey Club Kitchee Centre provides a large wind entrance for On Sum Street and On Kwan Street under most of the prevailing wind directions. Also, retaining football court reduces the development scale and the potential adverse air ventilation impact on the surrounding would be minimized.

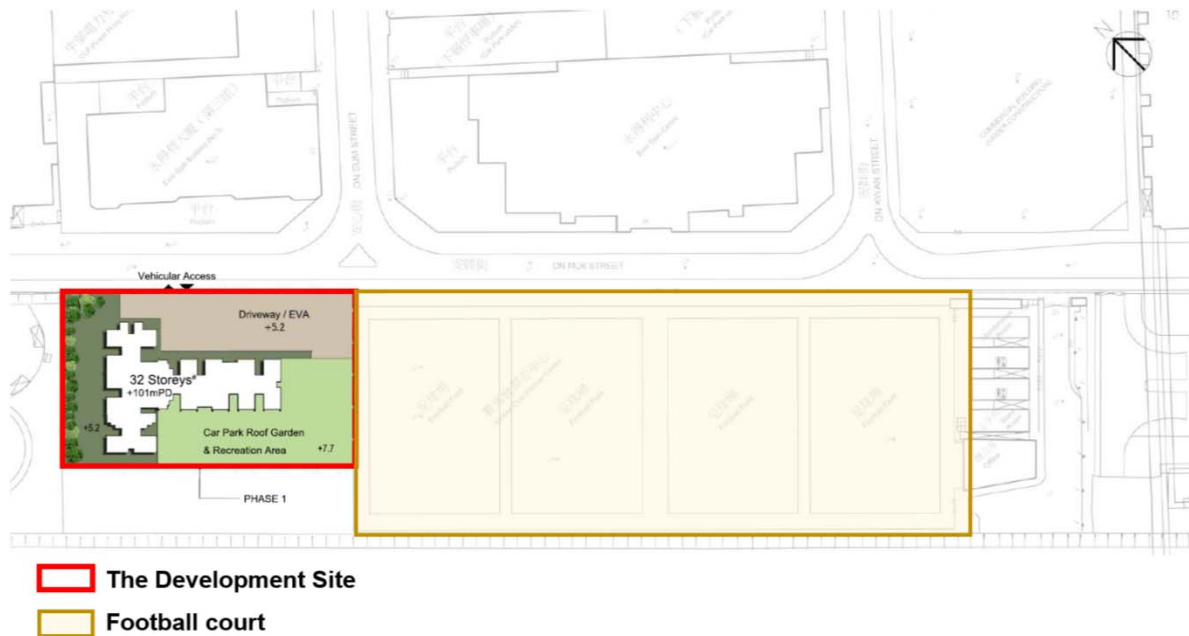


Figure 27 Football court provide open space (site layout subject to detailed design)

9. FURTHER STUDY

Proposed Scheme

For the Proposed Scheme, it is anticipated that with the provision of the proposed mitigation measures (i.e. three NBAs, setback from north-western site boundary, podium-free design), the Proposed Scheme would not create significant adverse air ventilation impact on the surrounding of the proposed development. Nevertheless, it is recommended that a quantitative AVA should be conducted at the detailed design stage for scheme optimization including the effectiveness of the suggested measures of ground floor empty bays and revised disposition of the primary school.

Revised Scheme

For the Revised Scheme, considering the small scale of development as well as provision of mitigation measures (i.e. 13m setback from the north-western site boundary and building height restriction of 1-storey carpark), it is not expected such Revised Scheme would create significant adverse air ventilation impact on the pedestrian wind environment in the surrounding of the site. If these measures cannot be provided in the future scheme, further quantitative assessments should be conducted to demonstrate that the performance of any future development would be no worse off than the scenario with these measures.

10. CONCLUSION

Qualitative assessment of the wind environment of the Development at On Sum Street, Shek Mun was conducted. The Development consists of three domestic blocks and a GIC building for Proposed Scheme while one domestic blocks with a carpark for Revised Scheme.

According to the analysis, the annual prevailing wind comes from E, NNE and ESE directions and the summer prevailing wind is from SW, SSW, S and E direction. The findings of the EE study are summarized in below:

Annual Wind Condition

- NNE wind would mainly flow along On Sum Street and On Kwan Street. With the provision of three NBAs, setback from north-western site boundary and adoption of podium-free design under the Proposed Scheme, it is expected the development would not induce significant disturbance on the NNE wind flow from On Sum Street and On Kwan Street to the open space at Siu Lek Yuen Road. For the Revised Scheme, NNE wind is expected to travel along On Sum Street and skim over the 1-storey carpark. No significant adverse impact has been identified for the Revised Scheme.
- E and ESE winds mainly flow along On Muk Street and Shing Mun Nullah. As the Proposed Scheme is in alignment with the adjacent air paths along On Muk Street and Shing Mun Nullah, thus it is expected the Proposed Scheme would not likely disturb the air flow along these air paths. Setback from north-western site boundary should be incorporated to minimize the wind shadow imposed on On Muk Street Garden induced by the proposed development. Similar observation is valid for Revised Scheme.

Summer Wind Condition

- Under E wind, similar to annual easterly wind condition, the incoming wind mainly flows along On Muk Street and Shing Mun Nullah. As the Proposed Scheme is in alignment with the adjacent air paths along On Muk Street and Shing Mun Nullah, thus it is expected the Proposed Scheme would not likely disturb the air flow along these air paths but create wind shadow to On Muk Street Garden. Similar observation is also obtained for Revised Scheme
- Under S, SSW and SW wind, the wind mainly flows along Ngan Shing Street and Chap Wai Kon Street / On Ming Street. As the NBAs in the Proposed Scheme are in alignment with On Sum Street and On Kwan Street, it is expected that the Proposed Scheme would not induce significant disturbance to the air flow except a section of On Muk Street close to the development. Since the football court at Jockey Club Kitchee Centre is retained in Phase II, it is not expected that a single housing block with 1-storey carpark proposed in Phase I would create significant impact under the Revised Scheme

Proposed Scheme

For the Proposed Scheme, in addition to the NBAs, setback and podium-free design, it is recommended that a ground floor level empty bay could further facilitate wind penetration across the development in enhancing the pedestrian wind environment of the surrounding, particularly for On Muk Street under summer SW quadrant wind. As for the school site, it is recommended to align the building mass with the wind corridor of On Kwan Street to allow more effective wind penetration under SW quadrant wind.

It is recommended that a quantitative AVA should be conducted at the detailed design stage for scheme optimization including the effectiveness of the suggested measures of ground floor empty bays and revised disposition of the primary school.

Revised Scheme

For the Revised Scheme, with the provision of building setback and building height of the carpark maintained at 1-storey, no significant impact has been identified due to the relatively small development scale.

If the good design measures (i.e. 13m setback from the north-western site boundary and building height restriction of 1-storey carpark) cannot be provided in the future development, further quantitative assessments should be conducted to demonstrate that the performance of any future development would be no worse off than the scenario with these measures.

11. REFERENCE

Experimental Site Wind Availability Study for Sha Tin, Hong Kong (August 2009)

Air Ventilation Assessment Study for Fo Tan and Siu Lek Yuen Industrial Areas (December 2015)

Shek Mun Land use Plan B16

(http://www.pland.gov.hk/pland_en/p_study/comp_s/industrial_report_2014/appendices/b16.pdf)