Planning Department

Term Consultancy for Air Ventilation Assessment Services

Executive Summary – Proposed Residential Site at Sheung Shing Street, Ho Man Tin

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1. Introduction

1.1 Ove Arup & Partners Hong Kong Ltd. (Arup) was commissioned by Planning Department (PlanD) to carry out an Air Ventilation Assessment for a Proposed Residential Site at Sheung Shing Street, Ho Man Tin. The Project Site is currently the Hong Kong Police Force Vehicle Pound Ho Man Tin.

1.2 The Project Site has a site area of 9,087m^2 at Sheung Shing Street, Ho Man Tin which is zoned "Open Space" on the approved Ho Man Tin Outline Zoning Plan (OZP No. S/K7/22) (refer to Figure 1). It has been identified as a potential site to be rezoned for private residential use. However, the Project Site is located close to the localized wind corridors between Ma Tau Wai and Mong Kok Areas (refer to Figure 2 and Figure 3 in summer and non-summer conditions respectively) as highlighted in the consultancy study on Air Ventilation Assessment by Expert Evaluation for Ho Man Tin Area (January 2008). Therefore, the proposed residential development may affect the function of the localized wind corridors and a quantitative assessment on the possible air ventilation impacts to support the rezoning proposal of the site to be submitted for the Town Planning Board (TPB)'s consideration is therefore required.

1.3 An Air Ventilation Assessment by Computational Fluid Dynamics (CFD) is conducted. The Study aims to assess the air ventilation impacts of the proposed high-rise development with the stipulate development parameters. It is also the purpose of this Project to recommend any design improvements and/or mitigation measures which may be adopted to minimize any adverse air ventilation impacts.

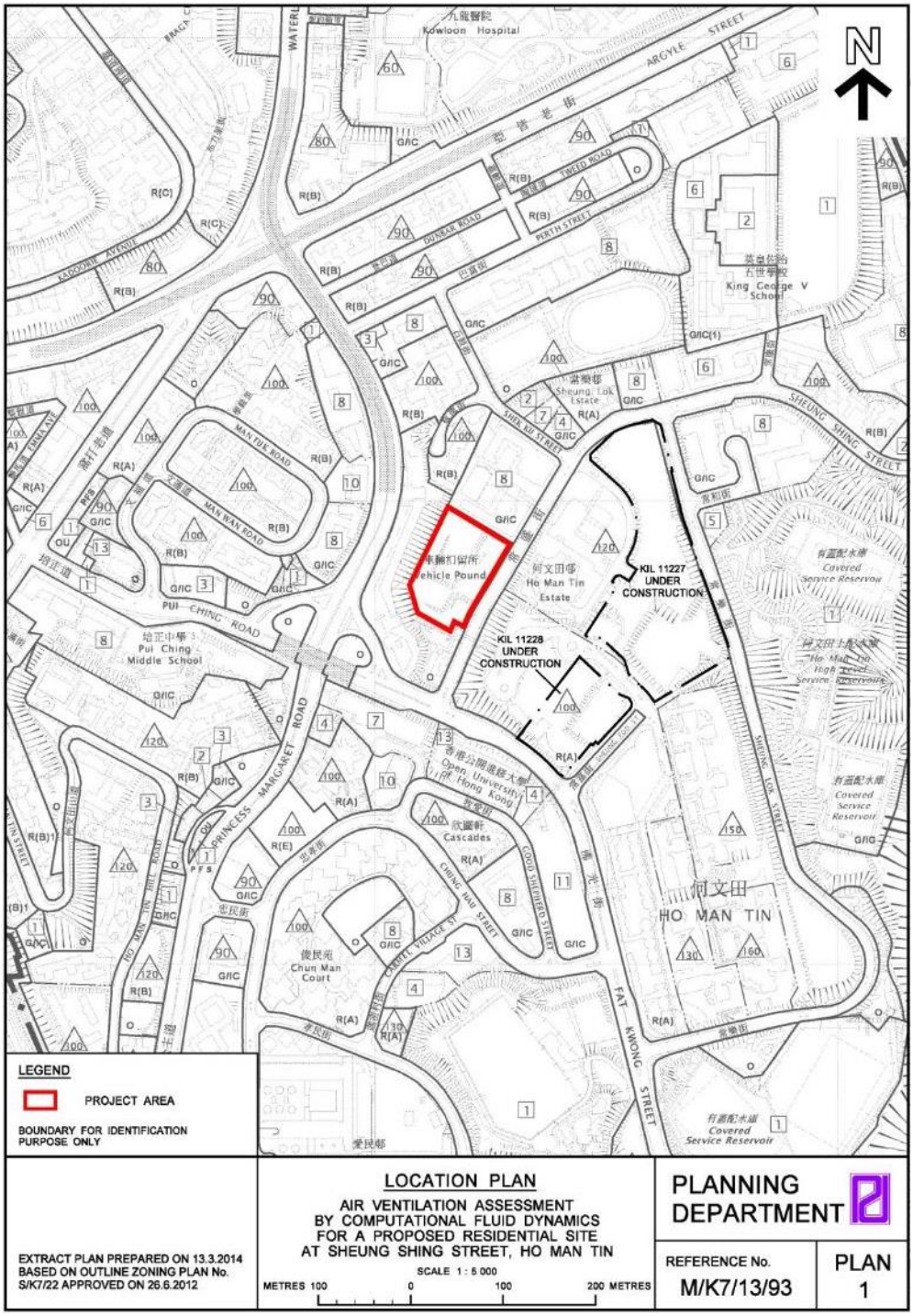

Figure 1 Project Site boundary with OZP zoning (Image Source: Planning Department)

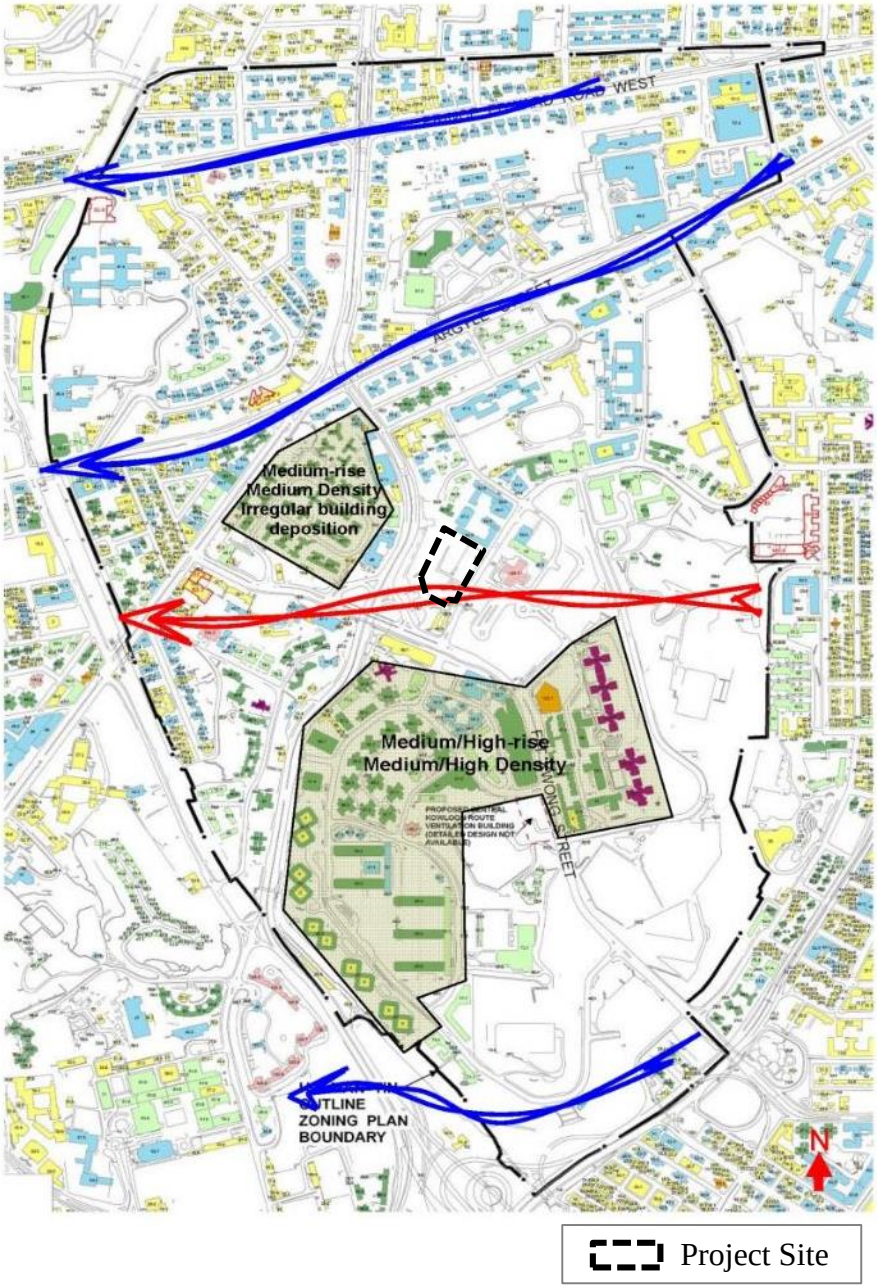

Figure 2 Localized wind corridors identified in the *EE Report* [1] under Summer Condition

[1] Planning Department, Term Consultancies for Air Ventilation Assessment Services – Expert Evaluation on Ho Man Tin Area (Revision 3), January 2008.

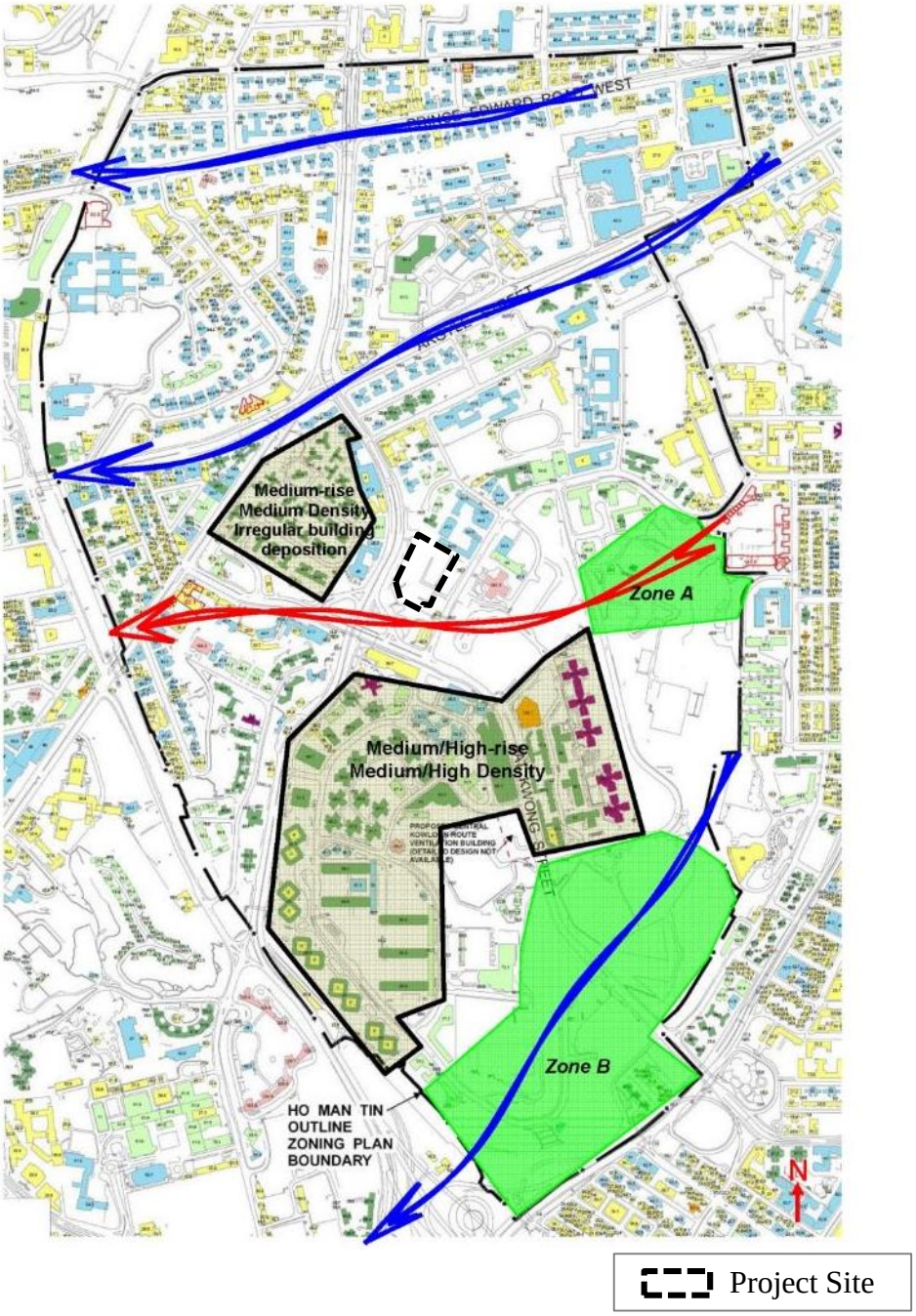

Figure 3 Localized wind corridors identified in the *EE Report* [1] under Non-Summer Condition

2. Study Area

2.1 The Project Site is currently Hong Kong Police Force Vehicle Pound Ho Man Tin at Sheung Shing Street in Ho Man Tin, Hong Kong. The following committed/ planned/ proposed developments are indicated by the blue spots in Figure 4:

- A proposed GIC (higher educational) development at 85.25mPD to the south of Project Site;
- A planned school (70mPD) and community hall (72mPD) to the southeast of the Project Site;
- A committed residential development at KIL11228 at 100mPD to the further southeast of the Project Site;
- A committed residential development at KIL11227 at about 120mPD to the east of the Project Site;
- A committed residential cum GIC (sports training centre) development at 72.65mPD to the northwest of the Project Site; and
- A committed residential development at 100mPD to the farther northwest of the Project Site.

2.2 Auxiliary Medical Services Headquarters and Open University of Hong Kong (OUHK) campus building are situated to its south and Pui Ching Middle School to its southwest. Various large-scale public rental housing estates, i.e. Sheung Lok Estate, Lok Man Sun Chuen, Ho Man Tin Estate and Chun Man Court, are located to its northeast, east, southeast and southwest, respectively. Besides, an open area, Sheung Shing Street Park, is positioned to its west. Various schools (Hoi Ping Chamber of Commerce Secondary School, St. Teresa Secondary School and Chan Sui Ki (La Salle) Primary School) are located to its north and northeast. These sites and building clusters are indicated in Figure 4 for easy reference.

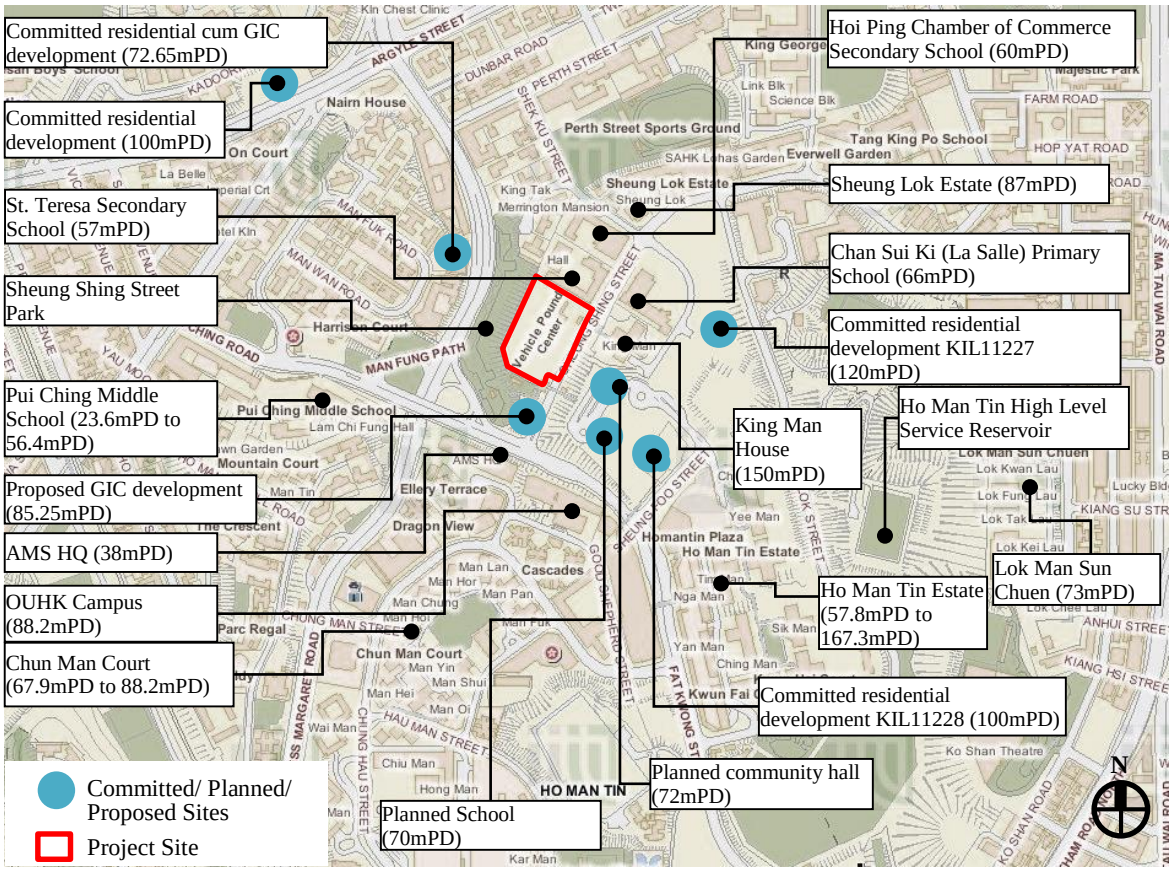

Figure 4 Project Site and its surroundings (image source: Lands Department)

3. Site Wind Availability

3.1 The wind availability of the Project Site and its surrounding is an essential parameter for the Air Ventilation Assessment. In this study, site wind availability data published in the AVA Expert Evaluation Report titled "*Term Consultancies for Air Ventilation Assessment Services – Expert Evaluation on Ho Man Tin Area (Revision 3)*" (termed *EE Report* hereafter) will be used in which the site wind availability study had adopted the MM5 wind data from the Institute for the Environment (IENV), the Hong Kong University of Science and Technology (HKUST). The MM5 data shows that the annual and summer wind conditions are dominated by NNE, ENE & E and E, ESE & SE winds respectively.

3.2 The prevailing annual wind comes from north-north-easterly (12.1%), north-easterly (10.1%), east-north-easterly (14.6%), easterly (15.8%), east-south-easterly (7.7%), south-easterly (5.4%), south-south-easterly (3.6%), southerly (3.6%) and south-westerly (3.9%) winds.

3.3 The prevailing summer wind comes from north-north-easterly (7.5%), east-north-easterly (4.4%), easterly (11.4%), east-south-easterly (11.4%), south-easterly (7.9%), south-south-easterly (5.0%), southerly (5.5%), south-south-westerly (6.1%), south-westerly (7.7%), west-south-westerly (6.7%) and westerly (3.9%) winds.

4. Qualitative Assessment of the Existing Wind Condition

4.1 The Project Site would experience relatively calm wind environment under NE wind, given that two committed high-rise residential developments to its east, i.e. KIL11227 and KIL11228, would shield the prevailing wind from reaching the Project Site. However, no major wind problem would be expected under E and SW wind directions.

4.2 Under North- North-Easterly (NNE) and North-Easterly (NE) Wind Directions

4.2.1 The localized wind corridor would function under NE wind that would allow incoming wind at open area of Ho Man Tin High Level Service Reservoirs passing to further distribute to southern part of Mong Kok Area as discussed in the *EE Report* for Ho Man Tin Area.

4.2.2 The committed developments at KIL11227 and KIL11228 would cast a wind shadow at its downwind side. The adjacent high-rise King Man House would further block the incoming wind towards the Project Site. Therefore, relatively calm wind environment would be expected at the Project Site.

4.3 Under East-North-Easterly (ENE) and Easterly (E) Wind Directions

4.3.1 The committed developments at KIL11227 and KIL11228 at the east of Project Site would dominate the approaching wind direction of E wind which would cast a wind shadow over the Project Site. In the presence of relatively low pressure zone of the wind shadow, the identified localized wind corridor in the *EE Report* and the building gap between two high-rise committed developments would become the air path for E wind to ventilate the Project Site. Therefore, no significant wind stagnant problem would be expected at the Project Site.

4.4 Under East-South-Easterly (ESE) and South-Easterly (SE) Wind Directions

4.4.1 The committed development at KIL11227 would shield the incoming wind towards the downwind site. However, in the presence of building gap between KIL11227 and KIL11228, the wind availability of Project Site would only be slightly limited.

4.5 Under South-Westerly (SW) Wind Direction

4.5.1 The high-rise residential clusters, such as Chun Man Court and Dragon View, would potentially shield the SW wind and cast a wind shadow on the leeward side. The incoming wind would then travel via the existing road network and the green spaces towards the Project Site. No major wind problem would be expected.

5. Quantitative Assessment – Initial Study (Stage 1)

5.1 Studied Scenarios

5.1.1 Three indicative scenarios, namely Baseline Scenario, Scenario A and Scenario B have been derived for assessment purpose.

5.1.2 **Baseline Scenario -** The Baseline Scenario represents an open space facility with no above-ground structures.

5.1.3 **Scenario A -** Scenario A presents a residential development with podium design. The site coverage of towers and whole development are 32% and 56% respectively. The podium is 4.5m in height. It consists of 7 towers with building height of 99mPD. The total plot ratio is 6.0.

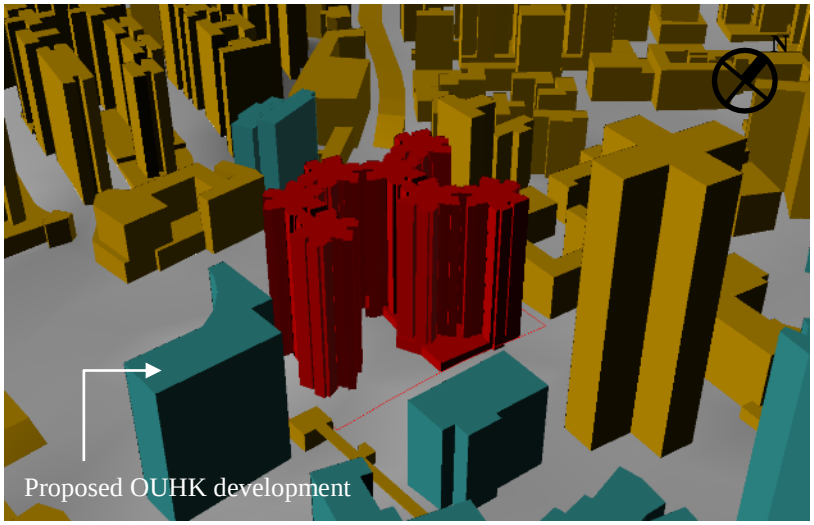

Figure 5 South-Easterly View of Scenario A

5.1.4 **Scenario B -** Scenario B is another option for the residential developments with podium design. The site coverage of towers and whole development are 28% and 45% respectively. The podium is 4.5m in height. It consists of 4 towers, two of which sit on the podia and will have building height of 118mPD. The other two towers reach 99mPD. The total plot ratio is 6.0.

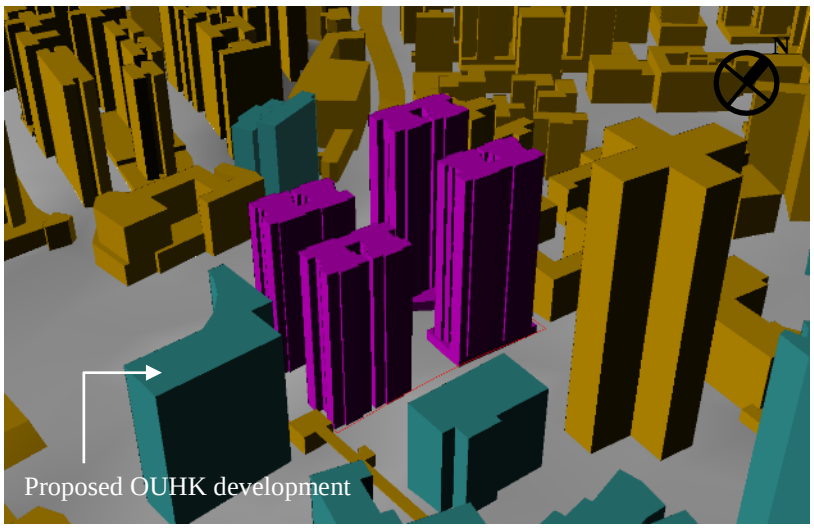

Figure 6 South-Easterly View of Scenario B

5.2 SVR and LVR

5.2.1 In total, 38, 171 and 11 numbers of perimeter, overall and special test points, respectively, have been placed at pedestrian level in accordance with the

Technical Circular for AVA. The Velocity Ratio (VR) as proposed by the Technical Circular was employed to assess the ventilation performances of the Proposed Development and surrounding environment. The Site spatial average velocity ratio (SVR) represents the average VR of all perimeter test points at the site boundary. The Local spatial average velocity ratio (LVR) represents the average VR of all points, i.e. perimeter and overall test points.

	Annual Wind Condition			Summer Wind Condition		
	Baseline Scenario	Scenario A	Scenario B	Baseline Scenario	Scenario A	Scenario B
SVR	0.09	0.08	0.08	0.09	0.09	0.09
LVR	0.11	0.11	0.11	0.10	0.10	0.10

5.3 Annual Wind Condition

5.3.1 The wind performance among 3 indicative scenarios is similar, except the area near the Project Site. The open nature of Baseline Scenario would lead to relatively higher VR than other scenarios. The overall ventilation performance of both Scenarios A and B are similar, except for some localized areas under certain wind directions. The differences in these localized areas are mainly due to the changes of the built form of both scenarios. Furthermore, the towers in Scenario A are interconnecting with one another and together with the presence of podia would induce a large wind shadow at the leeward regions, whereas the presence of the cruciform building gaps in Scenario B would facilitate the wind penetration through the Project Site. In this connection, some localized areas at Sheung Shing Street Park would achieve a slightly better ventilation performance under Scenario B as compared to Scenario A under SSE and S winds.

5.4 Summer Wind Condition

5.4.1 Similar to the annual wind condition, in the absence of large-scale structures of Baseline Scenario within the Project Site, the summer-weighted VR within the Project Site was generally highest amongst the three scenarios. The overall ventilation performance of both Scenarios A and B are similar, except for some localized areas under certain wind directions. The cruciform building gaps between podia under Scenario B would enable wind penetration, while the building arrangement of Scenario A would be less favourable for wind penetration. In this connection, some localized areas at Sheung Shing Street Park would achieve a slightly better ventilation performance under Scenario B as compared to Scenario A under SSE, S and SSW winds. In addition, the results also show that a part of Sheung Shing Street would achieve a slightly better ventilation performance under Scenario B as compared to Scenario A under WSW and W winds.

5.5 Ventilation performance through the cruciform building gaps

5.5.1 In general, the cruciform building gaps under Scenario B slightly enhance the air ventilation at some of the localized areas at Sheung Shing Street Park

under SSE, S and SSW winds and a part of Sheung Shing Street WSW and W. Furthermore, by comparing with the SVR under Scenario B with the average VR within the cruciform building gaps, the cruciform building gaps generally obtained a higher value than the SVR under NNE, ENE, SSE, S & SW winds and NNE, ENE, SSE, S, SW, WSW & W winds under annual and summer condition, respectively. This suggests that the cruciform building gap would be effective, hence it is recommended to have the cruciform building gap across the Project Site. However, without assessing different locations and widths of the cruciform building gap, the one imposing in Scenario B would be considered one of the possible solutions to provide local benefit in term of air ventilation.

5.6 Focus Area – Initial Study (Stage 1)

5.6.1 Total of 17 frequent pedestrian access areas and/or within major activity zones are identified for further analysis as shown in Figure 7.

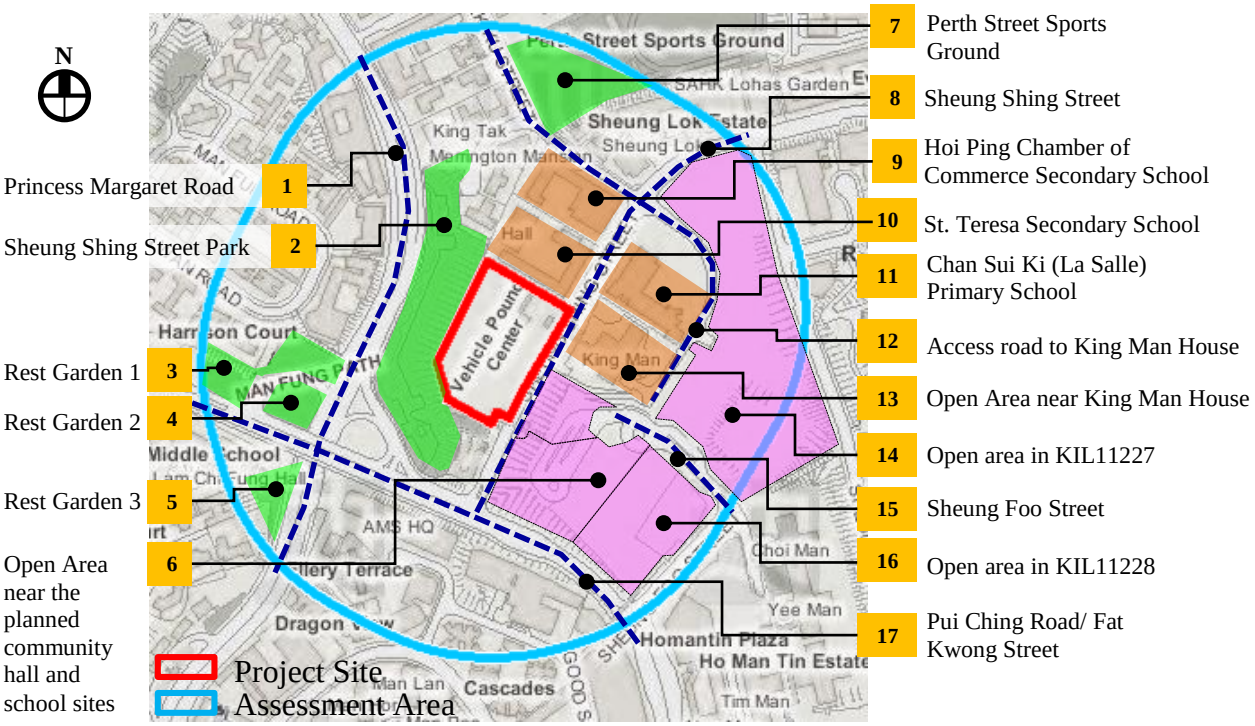

Figure 7 Highlights of the Focus Areas for the study (image Source: Lands Department)

Focus Area	Annual Wind Condition			Summer Wind Condition		
	Baseline Scenario	Scenario A	Scenario B	Baseline Scenario	Scenario A	Scenario B
Major Roads						
Princess Margaret Road	0.12	0.12	0.12	0.11	0.11	0.11
Sheung Shing Street	0.12	0.12	0.12	0.12	0.12	0.12

Focus Area	Annual Wind Condition			Summer Wind Condition		
	Baseline Scenario	Scenario A	Scenario B	Baseline Scenario	Scenario A	Scenario B
Sheung Foo Street	0.25	0.25	0.25	0.23	0.22	0.22
Access road to King Man House	0.13	0.13	0.13	0.12	0.11	0.11
Pui Ching Road/ Fat Kwong Street	0.11	0.11	0.11	0.13	0.12	0.13
Public Open Space						
Rest Garden 1	0.07	0.07	0.07	0.07	0.07	0.07
Rest Garden 2	0.10	0.09	0.10	0.11	0.10	0.11
Rest Garden 3	0.08	0.08	0.08	0.08	0.08	0.09
Perth Street Sports Grounds	0.16	0.16	0.16	0.13	0.13	0.13
Sheung Shing Street Park	0.12	0.12	0.11	0.10	0.10	0.10
School Sites						
Hoi Ping Chamber of Commerce Secondary School	0.09	0.08	0.09	0.08	0.07	0.08
St. Teresa Secondary School	0.07	0.07	0.08	0.07	0.06	0.07
Chan Sui Ki (La Salle) Primary School	0.13	0.13	0.13	0.13	0.12	0.12
Open Area						
Open Area near King Man House	0.15	0.15	0.15	0.16	0.14	0.14
Open Area near the planned community hall and school sites	0.11	0.11	0.11	0.12	0.11	0.11
Open Area in KIL11227	0.17	0.17	0.17	0.16	0.16	0.16
Open Area in KIL11228	0.11	0.11	0.11	0.12	0.11	0.11

5.6.2 From the above table, it shows the VR of all focus areas are generally similar with minor change of ±0.01.

5.6.3 Under annual wind condition, the relatively openness nature under Baseline Scenario would be more favourable for wind permeability and therefore, the ventilation performance area at the leeward side of the Project Site would be slightly enhanced. With building block at the southwest of the Project Site the Scenario B is less setbacked from the site boundary, which diverted the wind towards Princess Margaret Road, slightly lower VR is obtained under Scenario B. In contrast, Scenario B would lead to slightly higher VR in St. Teresa Secondary School which is located to the northeast of the Project Site in the presence of cruciform building gaps.

5.6.4 Under summer wind conditions, open area near King Man House, Sheung Foo Street, Chan Sui Ki (La Salle) Primary School, open area near the Proposed GIC and open area in KIL11228 would obtain slightly better wind performance under Baseline Scenario than the other two scenarios in the absence of structure within the Project Site. Scenario A obtained a slightly lower VR than that under Scenario B in Rest Gardens 2 and 3, Pui Ching Road/ Fat Kwong Street, Hoi Ping Chamber of Commerce Secondary School and St. Teresa Secondary School. The summer prevailing winds would penetrate via the cruciform building gaps of Scenario B that led to better wind penetration to the school sites to the northeast and the rest garden to the west of the Project Site.

5.7 Conclusion – Initial Study (Stage 1)

5.7.1 The developments at the Project Site would not significantly affect the overall wind performance, but have some localized effect. Through the quantitative analysis on the wind performance, the building gaps available under Scenario B would enhance the wind permeability and therefore, Scenario B would lead to better wind performance than that under Scenario A. The presence of cruciform building gap in Scenario B, in particular the NW-SE building gap, would have shown its local benefit in term of air ventilation. The NE-SW building gap is overall less effective due to the existing school building to the NE of the site and the proposed OUHK building to the SW of the site. In case boundary wall is essential, its height is recommended to keep as minimum as possible and should not exceed 2.2m in height and permeable design shall be adopted.

6. Quantitative Assessment – Initial Study (Stage 2)

6.1 Studied Scenarios

6.1.1 Based on the findings of the Quantitative Assessment – Initial Study (Stage 1) above, an Optional Scenario is developed and further compared with the Scenario B.

6.1.2 **Scenario B -** Scenario B is for the residential development with podium design. The site coverage of towers and whole development are 28% and 45% respectively. The podium is 4.5m in height. It consists of 4 towers, two

of which sit on the podia and will have building height of 118mPD. The other two towers reach 99mPD. The total plot ratio is 6.0.

6.1.3 **Optional Scenario** - is modified from Scenario B with setback of buildings by 10m from kerbside of Sheung Shing Street. The site coverage of towers and whole development are 29% and 45% respectively. The height of podium is the same as Scenarios B. It consists of 4 towers, three of which sit on the podia. The building height has two bands, at 99mPD and 118mPD. The total plot ratio is 6.0. Compared with Scenario B, the NW-SE building gap aligns more with Sheung Foo Street in this scenario.

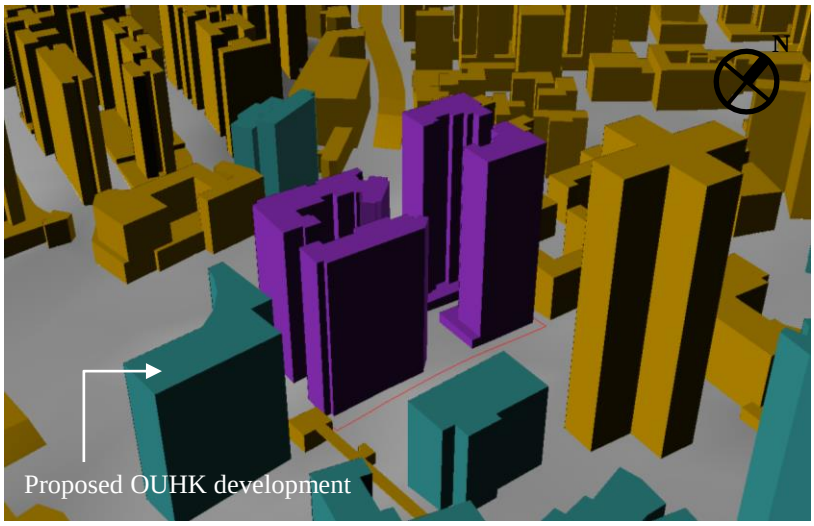

Figure 8 South-Easterly View of Optional Scenario

6.2 SVR and LVR

6.2.1 In total, 38, 171 and 11 numbers of perimeter, overall and special test points, respectively, have been placed at pedestrian level in accordance with the Technical Circular for AVA. The Velocity Ratio (VR) as proposed by the Technical Circular was employed to assess the ventilation performances of the Proposed Development and surrounding environment. The Site spatial average velocity ratio (SVR) represents the average VR of all perimeter test points at the site boundary. The Local spatial average velocity ratio (LVR) represents the average VR of all points, i.e. perimeter and overall test points.

	Annual Wind Condition		Summer Wind Condition	
	Scenario B	Optional Scenario	Scenario B	Optional Scenario
SVR	0.08	0.09	0.09	0.09
LVR	0.11	0.11	0.10	0.10

6.3 Annual Wind Condition

6.3.1 The wind performance between two scenarios is similar, except the area near the Project Site. The area at the farther east would achieve generally higher VR than that on the farther west of the Project Site under E, ESE and SE wind directions. In addition, two major wind paths along Sheung Foo

Street and along the localized air path allocated in KIL11227 (southern portion) were found. As the results, both air paths achieved a relatively higher VR under E, ESE and SE wind directions, while KIL11227 (southern portion) solely achieved a relatively higher VR under NNE, NE and ENE wind directions. The straight building frontage of Optional Scheme would encourage penetration of wind travel across the cruciform building gap. On the contrary, the larger podium bulk of Scenario B at the northwest of the Project Site would divert the incoming wind towards Princess Margaret Road, as shown under NE and ENE wind directions. Therefore, the ventilation performance at its vicinity would be slightly better under Optional Scenario than that under Scenario B.

6.4 Summer Wind Condition

6.4.1 The Princess Margaret Road would be another major wind path under NNE, ENE, SSE, S, SW, SSW and WSW wind directions. Under Optional Scenario, the SSE wind would travel through King Man House and the planned community hall and then further travel across the NW-SE running building gap and reach Princess Margaret Road. With such continuous building gap, the ventilation performance near the Project Site would be enhanced. On contrary, the building gap between King Man House and the planned community hall would unlikely continue towards the NW-SE running building gap under Scenario B. In this connection, the ventilation performance near the Project Site under Optional Scenario would be slightly better than that under Scenario B.

6.5 Comparison of building gaps under Scenario B and Optional Scenario

6.5.1 As discussed in sections 6.3 and 6.4 above, the location of the cruciform building gap of Optional Scenario was found to be more desirable to form a continuous air path extending from the building gap between the planned community hall and King Man House, which would facilitate wind penetration. Therefore, the averaged VR along NW-SE oriented building gap of Optional Scenario would perform better than that of Scenario B for both annual and summer conditions.

6.5.2 For the NE-SW oriented building gap, Scenario B obtained slightly better than Optional Scenario. While the proposed GIC development to the south of Project Site would potentially prohibit wind penetration reaching the Project Site for both scenarios, the NE-SW oriented building gap of Optional Scenario is narrower than that of Scenario B which would be less favourable for wind penetration.

6.6 Focus Area – Initial Study (Stage 2)

6.6.1 Total of 17 frequent pedestrian access areas and/or within major activity zones are identified for further analysis as shown in Figure 7.

Focus Area	Annual Wind Condition		Summer Wind Condition	
	Scenario B	Optional Scenario	Scenario B	Optional Scenario
Major Roads				
Princess Margaret Road	0.12	0.12	0.11	0.12

Focus Area	Annual Wind Condition		Summer Wind Condition	
	Scenario B	Optional Scenario	Scenario B	Optional Scenario
Sheung Shing Street	0.12	0.13	0.12	0.12
Sheung Foo Street	0.25	0.25	0.22	0.23
Access road to King Man House	0.13	0.13	0.11	0.11
Pui Ching Road/ Fat Kwong Street	0.11	0.11	0.13	0.13
Public Open Space				
Rest Garden 1	0.07	0.07	0.07	0.08
Rest Garden 2	0.10	0.10	0.11	0.11
Rest Garden 3	0.08	0.07	0.09	0.08
Perth Street Sports Grounds	0.16	0.16	0.13	0.13
Sheung Shing Street Park	0.11	0.12	0.10	0.11
School Sites				
Hoi Ping Chamber of Commerce Secondary School	0.09	0.08	0.08	0.08
St. Teresa Secondary School	0.08	0.08	0.07	0.08
Chan Sui Ki (La Salle) Primary School	0.13	0.13	0.12	0.12
Open Area				
Open Area near King Man House	0.15	0.16	0.14	0.15
Open Area near the community hall and school sites	0.11	0.12	0.11	0.11
Open Area in KIL11227	0.17	0.17	0.16	0.16
Open Area in KIL11228	0.11	0.11	0.11	0.11

6.6.2 From the above table, it shows the VR of all focus areas are generally similar with minor change of ±0.01.

6.6.3 Under annual wind condition, Sheung Shing Street obtained a slightly higher VR under Optional Scenario due to the formation of continuous air path extending from the building gap between King Man House and the planned community hall towards the cruciform building gap within the Project Site. Such continuous air path would enhance the wind penetration across the Project Site and therefore, the wind performance at Sheung Shing Street Park and the open area near the planned community hall, community hall and school sites would be slightly higher in Optional Scenario.

6.6.4 Under summer wind condition, a more desirable location of cruciform building gap, which aligns more with Sheung Foo Street, under Optional Scenario led to better wind penetration along Sheung Foo Street and resulted in higher VR than that under Scenario B. In addition, two open spaces closest to the Project Site – Sheung Shing Street Park, Rest Garden 1 and St. Teresa Secondary School obtained slightly higher VR than that under Scenario B.

6.7 Conclusion – Initial Study (Stage 2)

6.7.1 The developments at the Project Site would not significantly affect the overall wind performance, but the location of cruciform building gap would have some localized effect. The cruciform building gap under Optional Scenario with the NW-SE gap aligns more with Sheung Foo Street and more straight building line would enhance the wind permeability of the Project Site and its adjacent area. Therefore, Optional Scenario would generally lead to better wind performance than that under Scenario B. While assessing the effectiveness of the cruciform building gap, the NW-SE oriented building gap was found to more effective than the NE-SW oriented one for air ventilation purpose.

6.7.2 Under the both scenarios, the building gap along Sheung Foo Street through project site's NW-SE running building gap are desirable to preserve flow paths for wind blow through the Project Site. Therefore, it is recommended not to allow building on the NW-SE building gap area.

6.7.3 In case boundary wall is essential, its height is recommended to keep as minimum as possible and should not exceed 2.2m in height and permeable design shall be adopted.