TERM CONSULTANCY FOR AIR VENTILATION ASSESSMENT SERVICES

Cat. A1– Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment (PLNQ 35/2009)

Final Report

Western Part of Kennedy Town

April 2013

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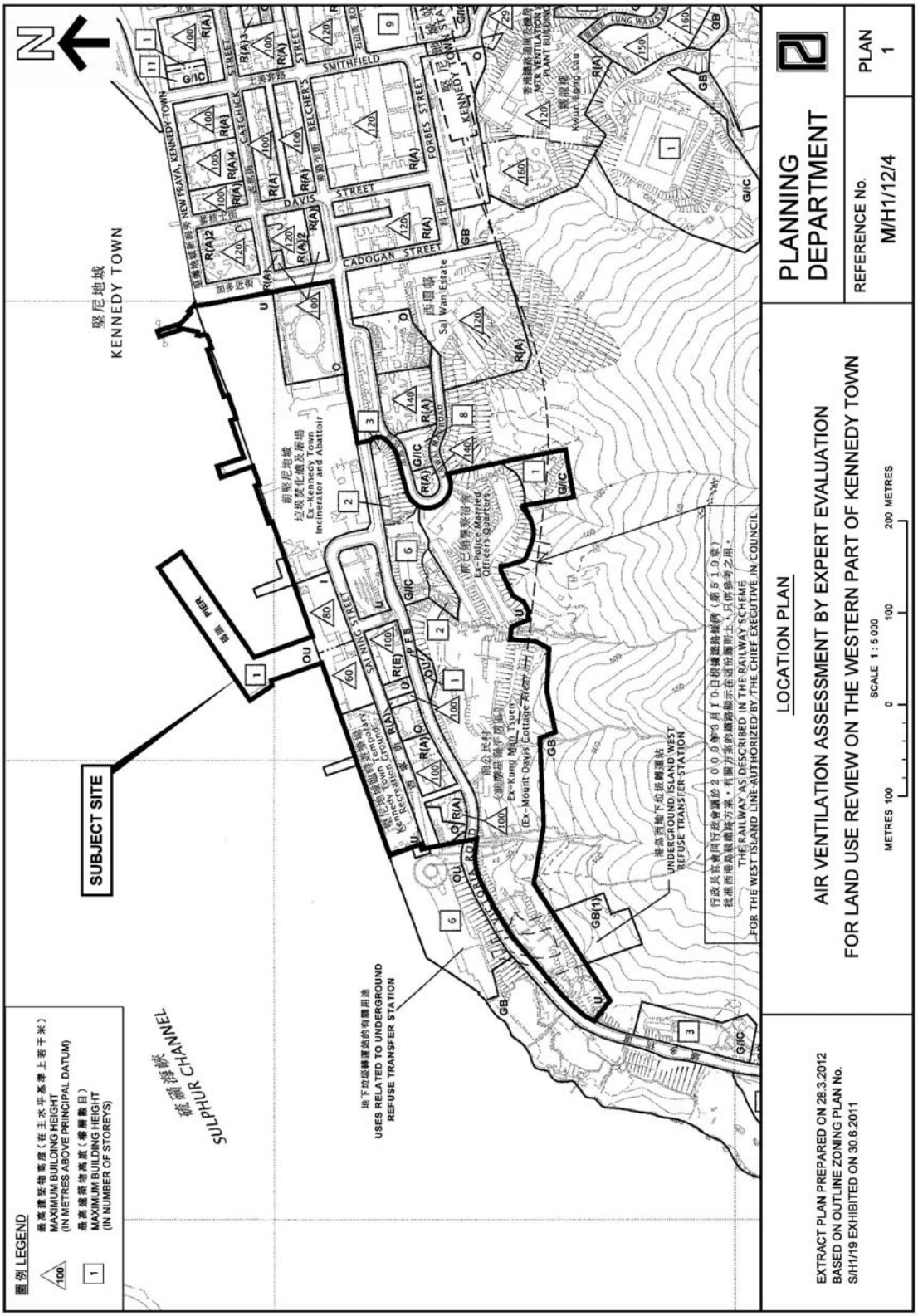
The Study Area



Expert Evaluation Report
of Western Part of Kennedy Town

Executive summary

0.1 Wind Availability

(a) Annual wind in the study area mainly comes from the Northeast, East and South. The summer wind mainly comes from the East and southerly quarters including Southwest, South and Southeast.

0.2 Existing Conditions

(a) The study area has some mid-rise to high-rise developments from 10 to 40 storeys. The buildings blocks are rather isolated with open spaces and low-rise G/IC facilities in between. As such, severe air ventilation problem are not anticipated.

0.3 The Existing Conditions with Planned Developments

(a) The study area is located to the west of the existing developments in Kennedy Town. It is located downwind under the annual and summer prevailing wind situations. In general, its development would not cause air ventilation concern on the existing developments in the neighbourhood. There are some planned developments within the study area that may cause localized air ventilation issues. In general, from an urban district based perspective, adding further building mass to an urban area increases the thermal load of the area; increases urban roughness, diminishes air ventilation potentials; and if not properly designed with permeability, form deep street canyons and wall-like barriers.

(b) Site No.1a, No. 1b and No. 4b are leisure and recreation uses with BH of 10 mPD. Because of their low heights, it is unlikely that they will impose adverse effect on the air ventilation performance of the inland areas.

(c) Site No. 3a is a private residential development. It has 4 towers with BH from 100 to 120 mPD on a podium with BH of around 10 – 15m. The bulky and extensive podium and the closely packed tower blocks will have some effects on air ventilation performance of the immediate surroundings – especially for the sea breezes coming perpendicular to the shoreline. When wind comes from the North, it is likely to create wake areas on its leeward side.

(d) Site No. 3b is a primary school with BH of 8 storeys. Because of its relatively low heights and partial coverage of the site, it will impose little adverse effect on the air ventilation.

(e) Site No. 7 is a private residential development. It has 2 towers with BH of 100 mPD on a podium. The bulky and extensive podium and the closely packed tower blocks will have some effects on air ventilation performance of the immediate surroundings. When wind comes from the Northeast, it is likely to create wake areas on its leeward side.

(f) Site No. 8 is a private residential development. It has a single tower with BH of 100 mPD. Because of its relatively small size (frontal area), it will impose little adverse effect on the air ventilation.

(g) Site No. 8a is a private residential development. It has a single tower with BH of 100 mPD. Because of its relatively small size (frontal area), it will impose little adverse effect on the air ventilation.

(h) Site No. 9 is a public residential development. It has 5 blocks with BH from 120 to 140 mPD on two separate but extensive podiums. When wind comes from the northeast, its wake areas are on the south-west side of the development. When wind comes from the southwest, wind will flow along Victoria Road and also through the gap between Block 3 and 4 over the GIC site on its north-east. The closely packed Blocks 1, 2 and 3 will create wake areas to its northeast.

More importantly the continuous east-west orientated blocks will reduce/block the beneficial land-sea air mass exchange from the waterfront to the vegetated hillside. This will have adverse effect to the air ventilation performance of the area especially in weak wind days. It is recommended that the development consider better building permeability on the north-south axis, and intensify greening with green fingers through the development so that the cold katabatic air mass from the hill side can benefit further towards the north.

0.4 Expert Evaluation and Recommendations of the Initial Planned Scenario

(a) Due to Hong Kong's high-density urban morphology, it is not advisable to only rely on building height restriction (or minor changes of building heights) to maintain and/or improve air ventilation. For most of the areas, air ventilation will achieve better performance if more effective measures, such as breezeways, air paths, open spaces, gaps between buildings and building permeability especially near ground level, are also applied,

(b) The initial planned scenario keeps most of the existing G/IC and O zones. It also rezones one U zone to O zone and G/IC zone (site No. 2 and 3b) and part of one U zone to GB zone (site No. 9). These open spaces, GB and G/IC sites that function as 'air spaces' are recommended to be maintained to ensure the air ventilation performance of the surrounding areas. For example, the low-rise G/IC site next to site No. 9 functions as an important air path for the northeast wind flowing

into site No. 9.

(c) The initial planned scenario proposes some planned developments which are evaluated in Section 6. However, from an urban planning perspective, the following should be taken into consideration in future development / redevelopment as far as possible for better air ventilation.

It is recommended to consider “green fingers” and “urban permeability” through the sites towards the waterfront in the study area.

NBA1 (about 15m) is suggested in the middle of Site 3a to mitigate the wind wake due to the proposed development in this site. Given that there is a proposed bus terminus on G/F, adding a building gap above the podium level can improve the urban permeability. During detailed design stage, reference should be made to Chapter 11 of the Hong Kong Planning Standards and Guidelines on the podium design to help increase the permeability as far as practicable. The urban permeability can help to alleviate any air ventilation issues of the site.

NBA 2 (about 15m) on ground or podium level passing through Sites 4, 7 and 9 is suggested to mitigate the wind wake due to the proposed development in these sites. This NBA will facilitate katabatic air movement to the waterfront and sea breezes from the north.

NBA 3 (about 15m) on ground or podium level extending towards the harbourfront via Site 9 and two open spaces along Sai Ning Street is suggested to facilitate katabatic air movement to the waterfront and sea breezes from the north.

NBA 4 (about 15m) in the northeast-southwest direction along Ka Wai Man Road is suggested to facilitate south-westerly wind on ground level.

Site 9 currently is vegetated. Should it need to be replaced with artificial materials, surfaces and building masses, it is recommended to intensify the greenery (especially tree planting) on site in general (30% green coverage should be the minimum requirement).

0.5 Further Work

Based on the expert assessment and subject to implementation of the proposed mitigation measures, the study area would have no major air ventilation issue at urban planning level. Further AVA study for the study area at planning stage is not necessary.

Given the large site area and any insensitive layout and building design may result in adverse air ventilation, AVA studies (initial/detail studies) are recommended for Site No. 3a and Site No. 9 at detailed design stage to maintain/enhance the air ventilation performance in the study area.

Expert Evaluation Report
of Western Part of Kennedy Town

1.0 The Assignment

1.1 An area in the western part of Kennedy Town is under an ongoing land use review. The area falls within the Kennedy Town and Mount Davis Outline Zoning Plan (OZP) and a comprehensive review of building height (BH) restrictions for various development zones on the OZP was undertaken in 2010-2011. An Initial Planned Scenario with proposed development intensity and BH has been worked out for the review area. The current study aims to assess the likely air ventilation impact of the land use proposals in the Initial Planned Scenario.

1.2 This expert evaluation report is based on the materials given by Planning Department to the Consultant including:

Draft Outline Zoning Plan of Kennedy Town & Mount Davis
Existing Building Height (in storeys)
Existing Spot Height
Planned Developments
Land Use Review on the Western Part of Kennedy Town
Aerial Photo

1.3 The consultant has studied the foregoing materials. During the preparation of the report, the consultant has visited the site and conducted working sessions with Planning Department.

2.0 Background

2.1 Planning Department's study: "Feasibility Study for Establishment of Air Ventilation Assessment System" has recommended that it is important to allow adequate air ventilation through the built environment for pedestrian comfort.

2.2 Given Hong Kong's high density urban development, the study opines that: "more air ventilation, the better" is the useful design guideline.

2.3 The Feasibility Study summarizes 10 qualitative guidelines for planners and designers. For the OZP level of consideration, breezeways/air paths, street grids and orientations, open spaces, non-building areas, waterfront sites, scales of podium, building heights, building dispositions, and greeneries are all important strategic considerations.

2.4 The Feasibility Study also suggests that Air Ventilation Assessment (AVA) be conducted in three stages: Expert Evaluation, Initial Studies, and Detailed Studies. The suggestion has been adopted and incorporated into HPLB and ETWB Technical Circular no. 1/06. The key purposes of Expert Evaluation are to the following:

(a) Identify good design features.
(b) Identify obvious problem areas and propose some mitigation measures.
(c) Define "focuses" and methodologies of the Initial and/or Detailed studies.
(d) Determine if further study should be staged into Initial Study and Detailed Study, or Detailed Study alone.

2.5 To conduct the Expert Evaluation systematically and methodologically, it is necessary to undertake the following information analyses:

(a) Analyse relevant wind data as the input conditions to understand the wind environment of the Area.
(b) Analyse the topographical features of the Area, as well as the surrounding areas.
(c) Analyse the greenery/landscape characteristics of the Area, as well as the surrounding areas.
(d) Analyse the land use and built form of the Area, as well as the surrounding areas.

Based on the analyses:

(e) Estimate the characteristics of the input wind conditions of the Area.
(f) Identify the wind paths and wind flow characteristics of the Area through slopes, open spaces, streets, gaps and non building areas between buildings, and low rise buildings; also identify stagnant/problem areas, if any.
(g) Estimate the need of wind for pedestrian comfort.

Based on the analyses of the EXISTING urban conditions:

(h) Evaluate the strategic role of the Area in air ventilation term.
(i) Identify problematic areas which warrant attention.
(j) Identify existing "good features" that needs to be kept or strengthened.

Based on an understanding of the EXISTING urban conditions:

(k) Compare the prima facie impact, merits or demerits of the building height restrictions as proposed by Planning Department on Air Ventilation.
(l) Highlight problem areas, if any. Recommend improvements and mitigation measures if possible.
(m) Identify focus areas or issues that may need further studies. Recommend appropriate technical methodologies for the study if needed.

3.0 The Wind Environment

3.1 Hong Kong Observatory (HKO) stations provide useful and reliable data on the wind environment in Hong Kong (Figure 3.1). There are some 46 stations operated by HKO in Hong Kong. Together, these stations allow for a very good general understanding of the wind environment especially near ground level.

Figure 3.1 Some of the HKO stations in Hong Kong. This is a screen capture at 11am on 17 May 2012 from the HKO website. The arrows show the wind directions and speeds of the time.

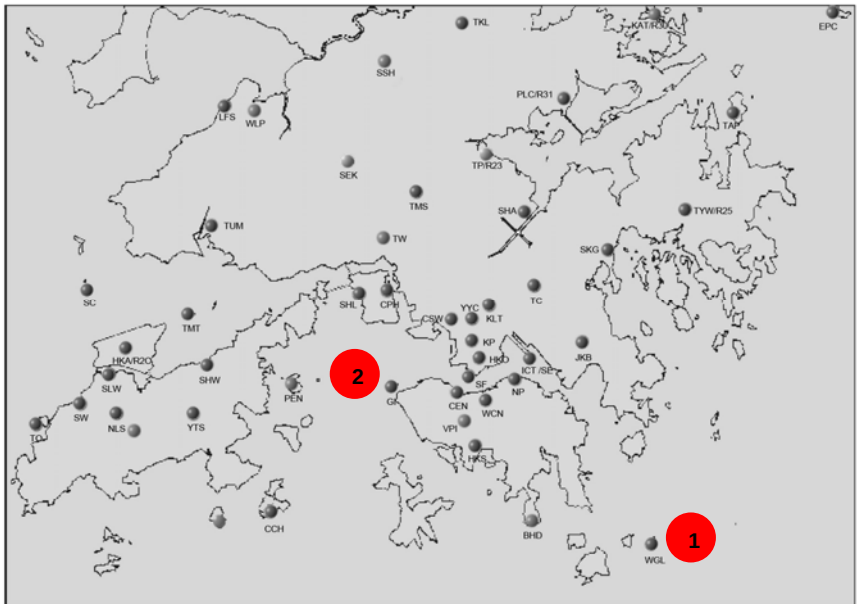


Figure 3.2 The HKO stations at 1: Waglan Island (WGL), 2: Green Island (GI).

3.2 The HKO station at Waglan Island (WGL) is normally regarded by wind engineers as the reference station for wind related studies (Location 1 in Figure 3.2). The station has a very long measurement record, and is unaffected by Hong Kong's complex topography [unfortunately, it is known not to be able to capture the thermally induced local wind circulation like sea breezes too well]. Based on WGL wind data, studies are typically employed to estimate the site wind availability taking into account the topographical features around the site.

3.3 Based from the annual wind rose of WGL (Figure 3.3), it is apparent that the annual prevailing wind in Hong Kong is from the east. A major component of wind also comes from the northeast; and there is a minor, but nonetheless observable component from the southwest. WGL has weak to moderate wind (0.1m/s to 8.2 m/s) approximately 70% of the time,.

3.4 For the study, seasonally or monthly wind environment should be understood (Figure 3.4 and 3.5). During winter, the prevailing wind comes from the northeast, whereas during summer, it comes from the southwest. As far as AVA is concerned, in Hong Kong, the summer wind is very important and beneficial for thermal comfort. Hence, based on WGL data, it is very important to plan our city, on the one hand, to capture the annual wind characteristics, and on the other hand, to maximize the penetration of the summer winds (mainly from the South-West) into the urban fabric.

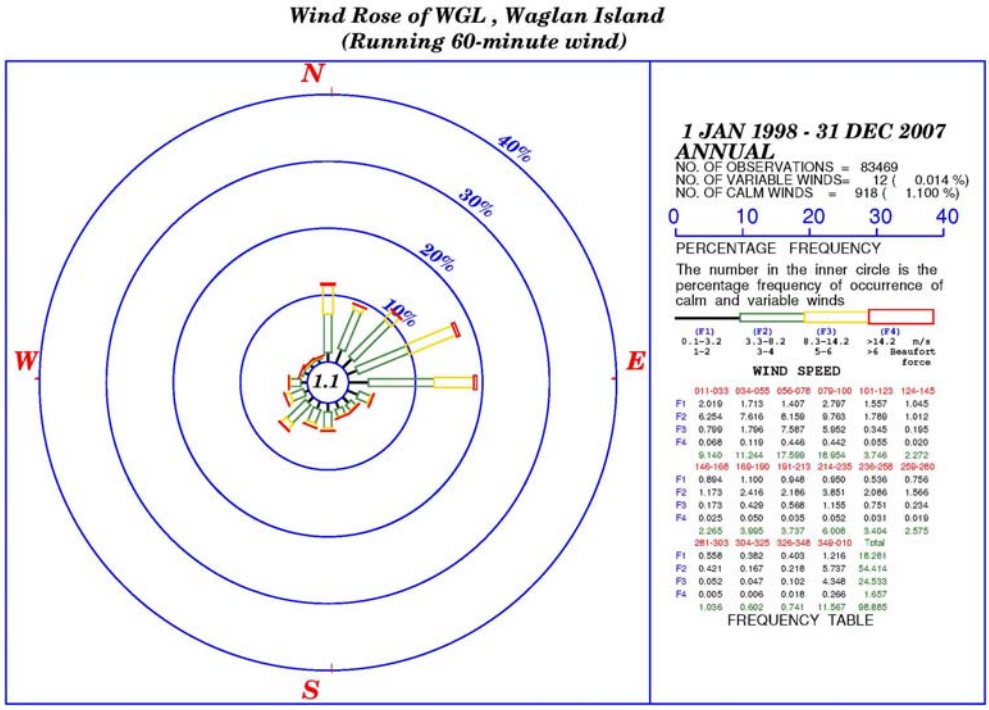


Figure 3.3 Wind rose of WGL 1998 to 2007[1] (annual).

[1] Wind data from 1998 to 2007 are the latest available 10-year data from HKO to the consultant.

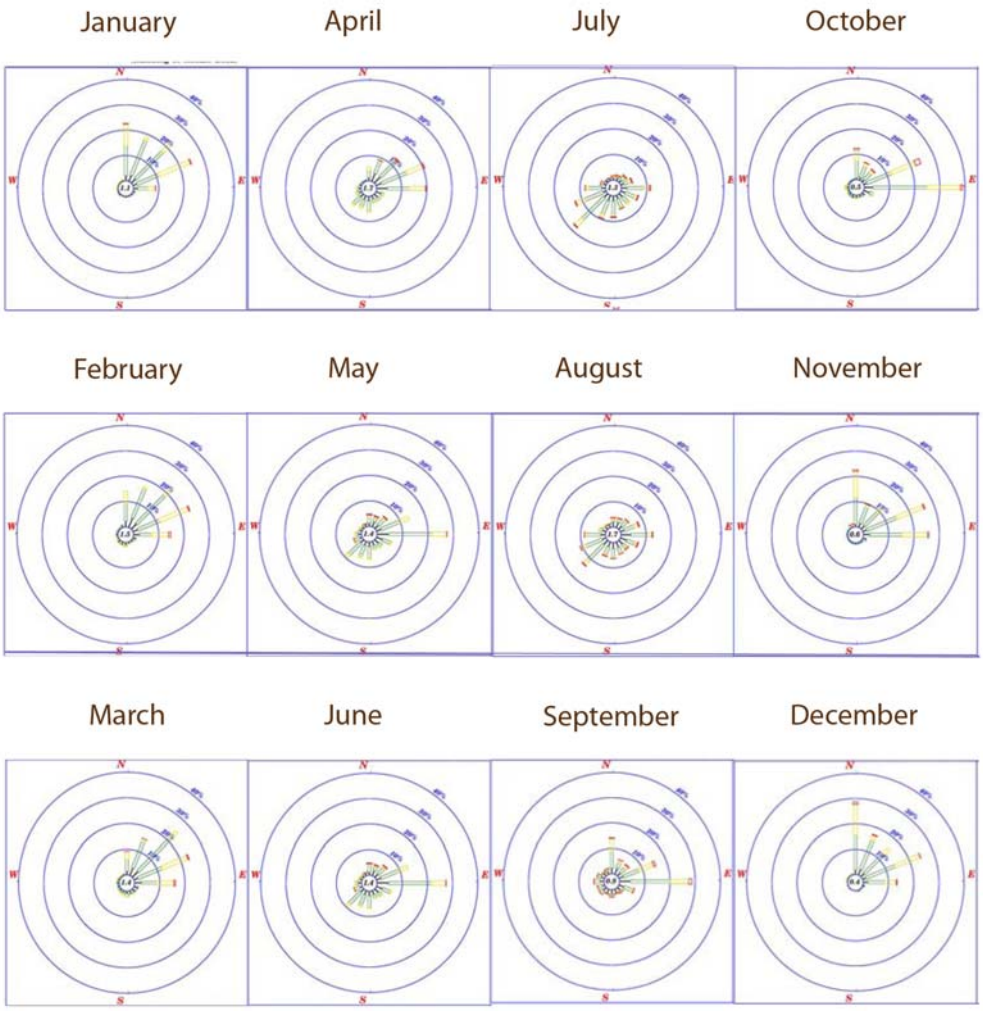


Figure 3.4 Monthly wind roses of WGL from 1998 to 2007.

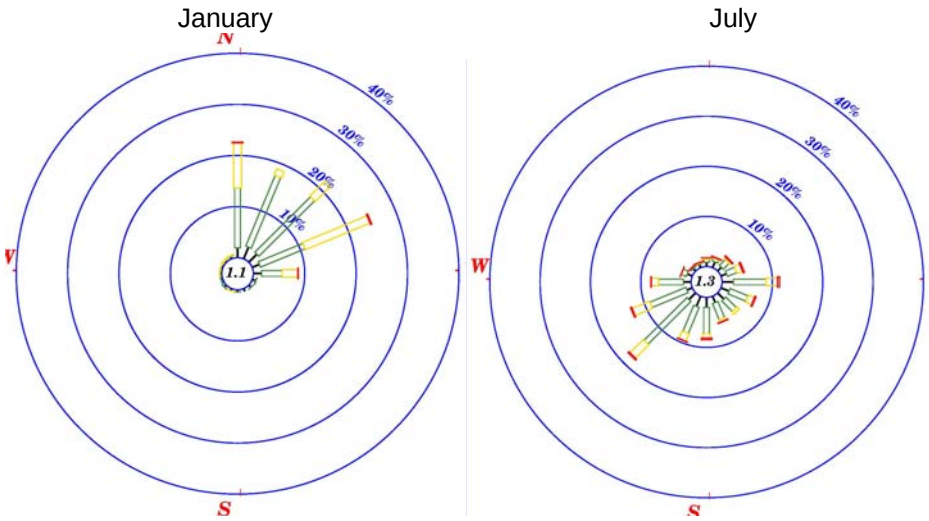


Figure 3.5 Wind roses of WGL from 1998 to 2007 (Jan and July).

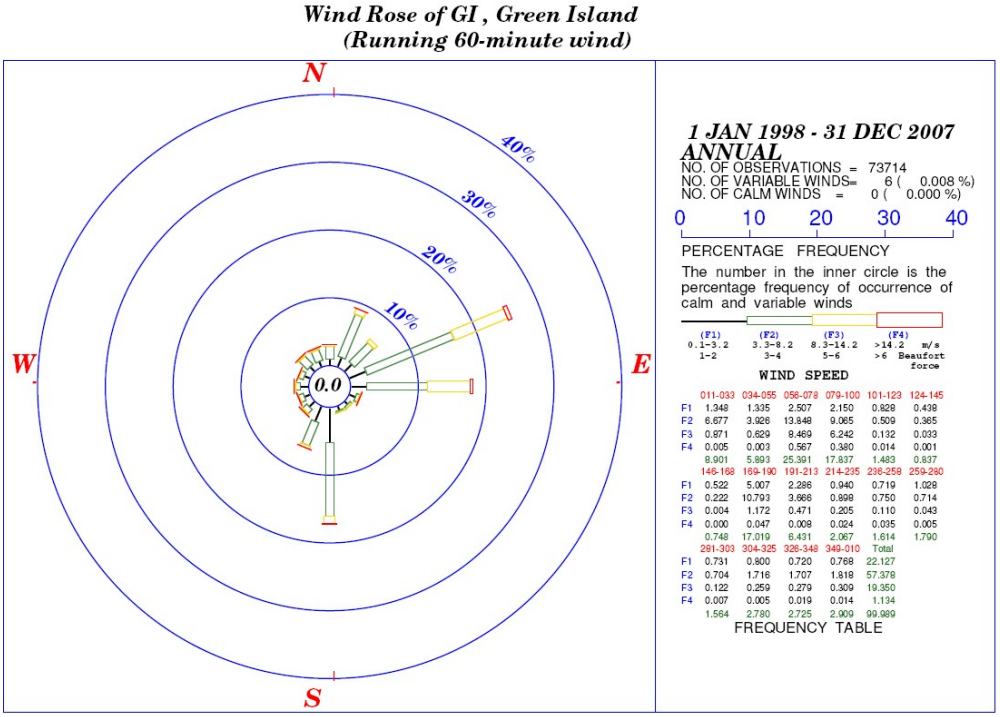


Figure 3.6 Wind rose of Green Island (GI) from 1998 to 2007 (annual).

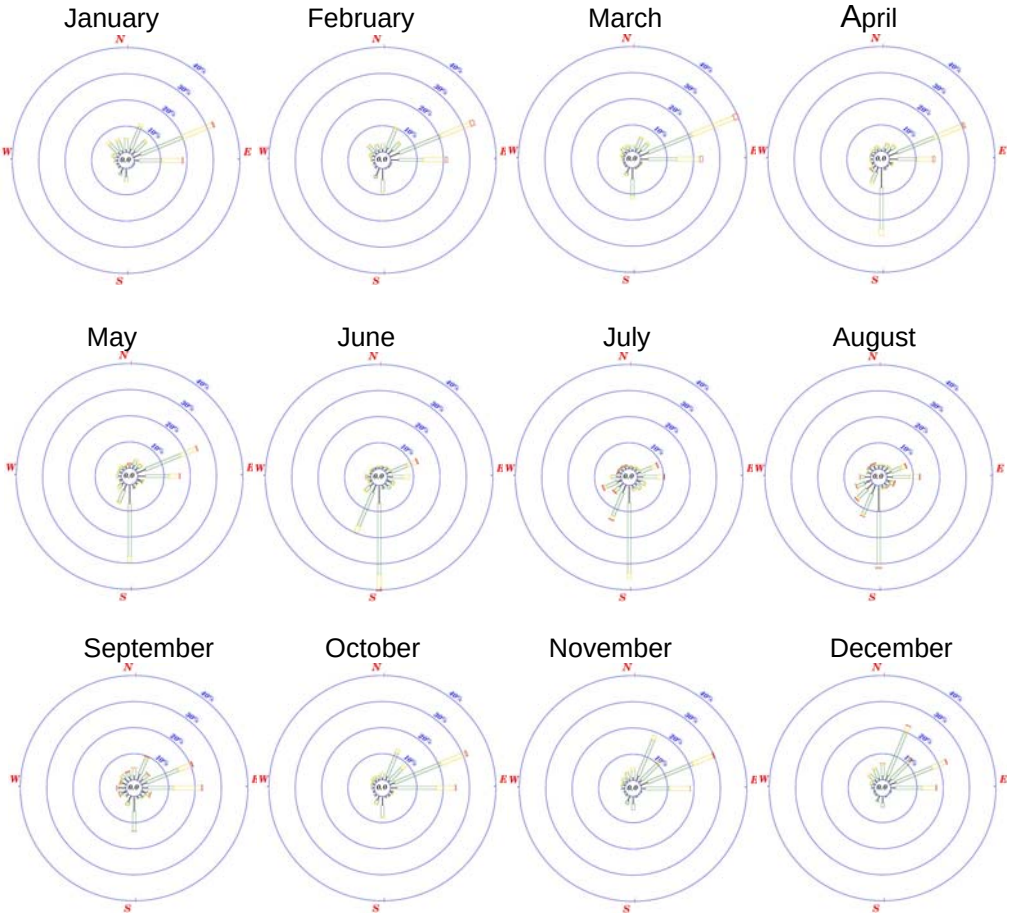


Figure 3.7 Monthly wind roses of Green Island (GI) from 1998 to 2007.

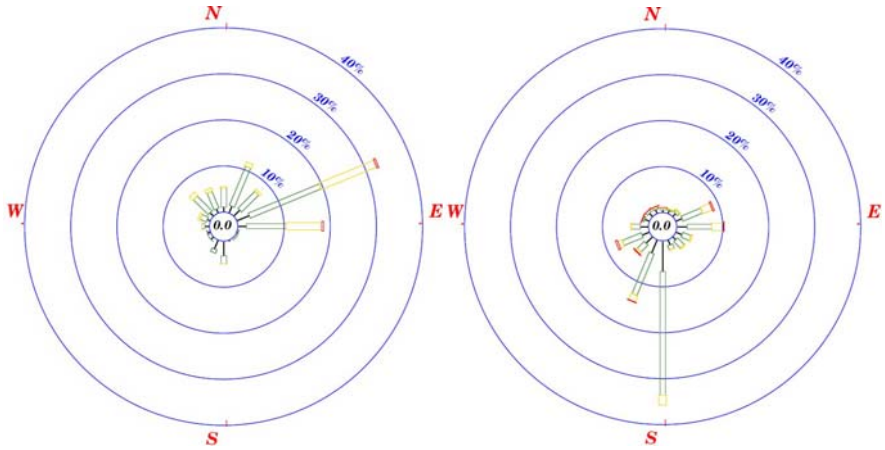


Figure 3.8 Wind roses of Green Island (GI) from 1998 to 2007 (Jan and July).

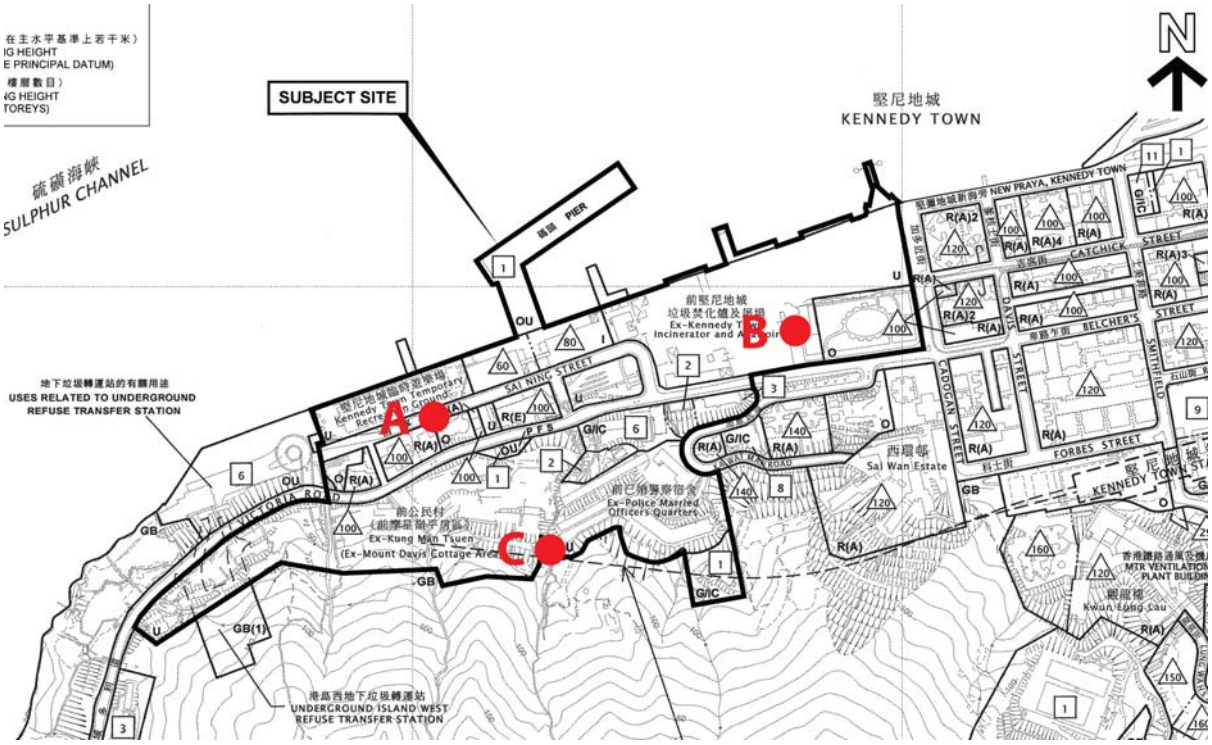


Figure 3.9 The three locations of MM5 extracted data (A, B and C).

3.5 Apart from WGL, the wind data of Green Island (GI) were also extracted from HKO for reference (Figure 3.6 to Figure 3.8) as the nearest station for measuring wind environment for Western Part of Kennedy Town.

3.6 Researchers at Hong Kong University of Science and Technology (HKUST), Prof Alexis Lau and Prof Jimmy Fung, have simulated a set of wind data using MM5. The data covered the entire year of 2004. Data from three locations within the study area were extracted at 60m, 120m and 450m above the ground (Figures 3.9 to 3.15). These three locations, according to the theories of MM5, were selected to representatively reflect the general wind pattern within the study area induced by topography.

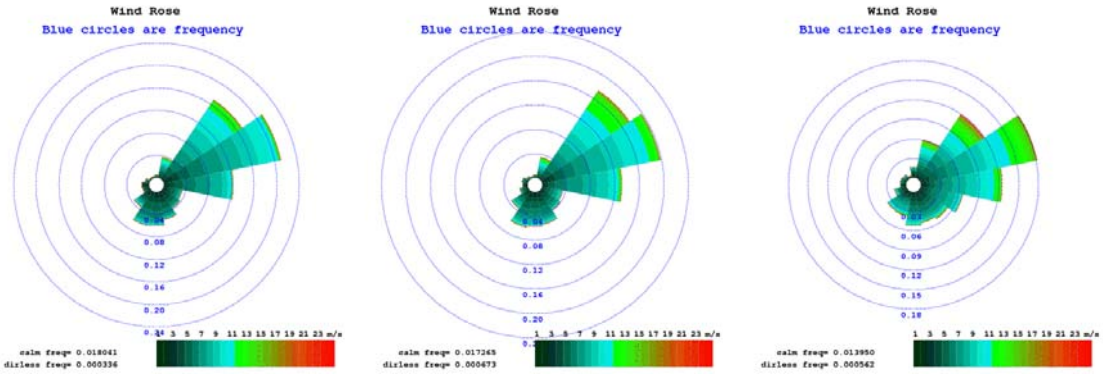


Figure 3.10 Wind roses (annual) at A (left: 60 m; middle: 120 m; right: 450 m).

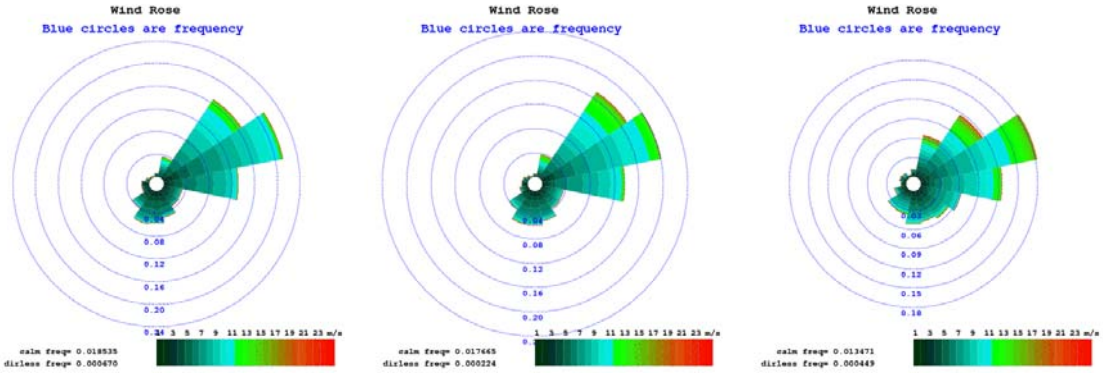


Figure 3.11 Wind roses (annual) at B (left: 60 m; middle: 120 m; right: 450 m).

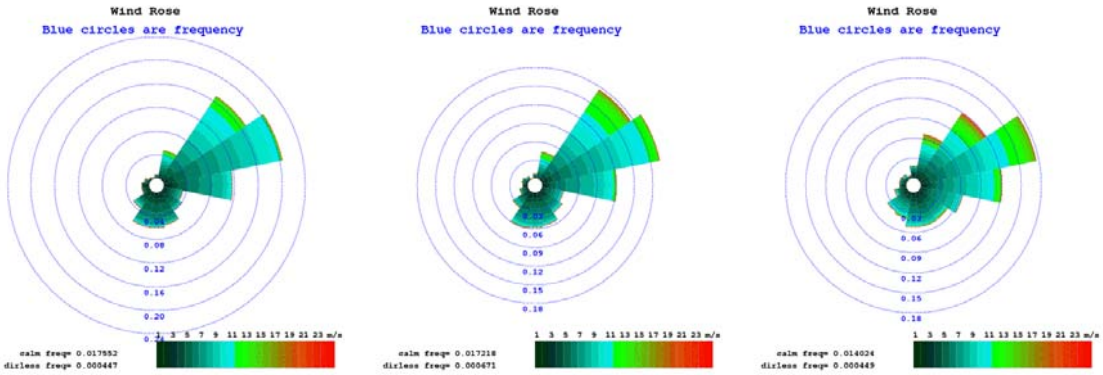


Figure 3.12 Wind roses (annual) at C (left: 60 m; middle: 120 m; right: 450 m).

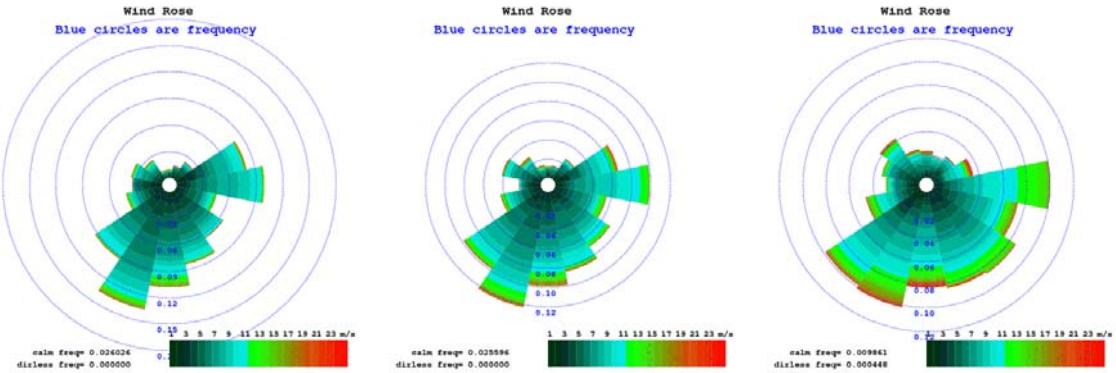


Figure 3.13 Wind roses (summer) at A (left: 60 m; middle: 120 m; right: 450 m).

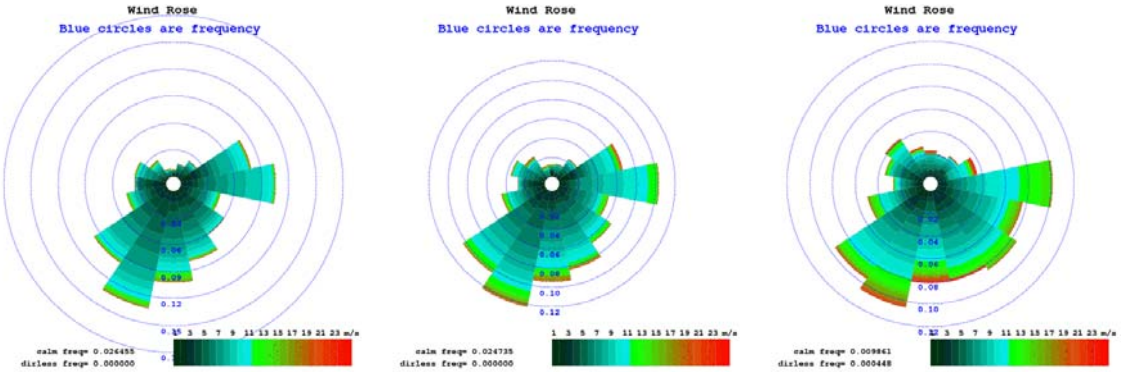


Figure 3.14 Wind roses (summer) at B (left: 60 m; middle: 120 m; right: 450 m).

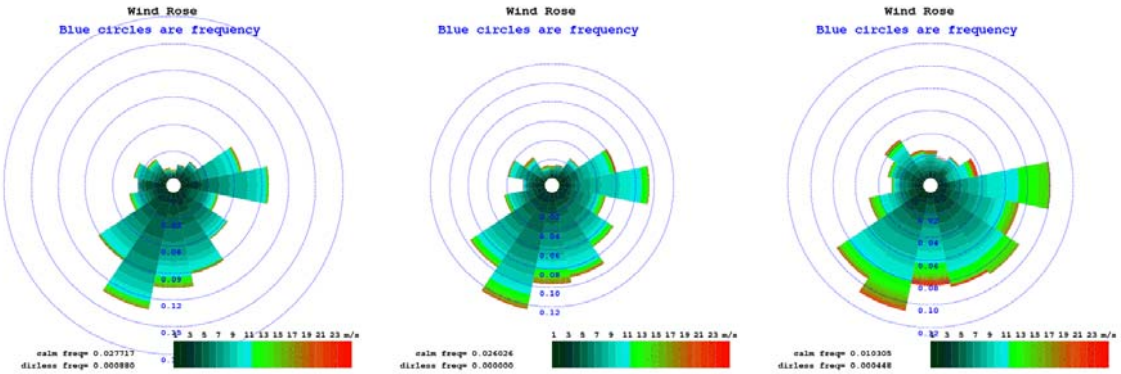


Figure 3.15 Wind roses (summer) at C (left: 60 m; middle: 120 m; right: 450 m).

3.7 In summary, based on the available wind data (Table 1), one may conclude that the annual wind of the study area is mainly from the Northeast, East and South. The summer wind is mainly coming from the East and southerly quarters including Southwest, South and Southeast (Figure 3.16).

Table 1 Summary of Prevailing Wind Directions

Period	Green Island Station (GI)	MM5 Simulation		
		60 m	120 m	450 m
Annual	NE, E, S	NE, E	NE, E	NE, E
Summer	S, SW	E, SE, S, SW	E, SE, S, SW	E, SE, S, SW

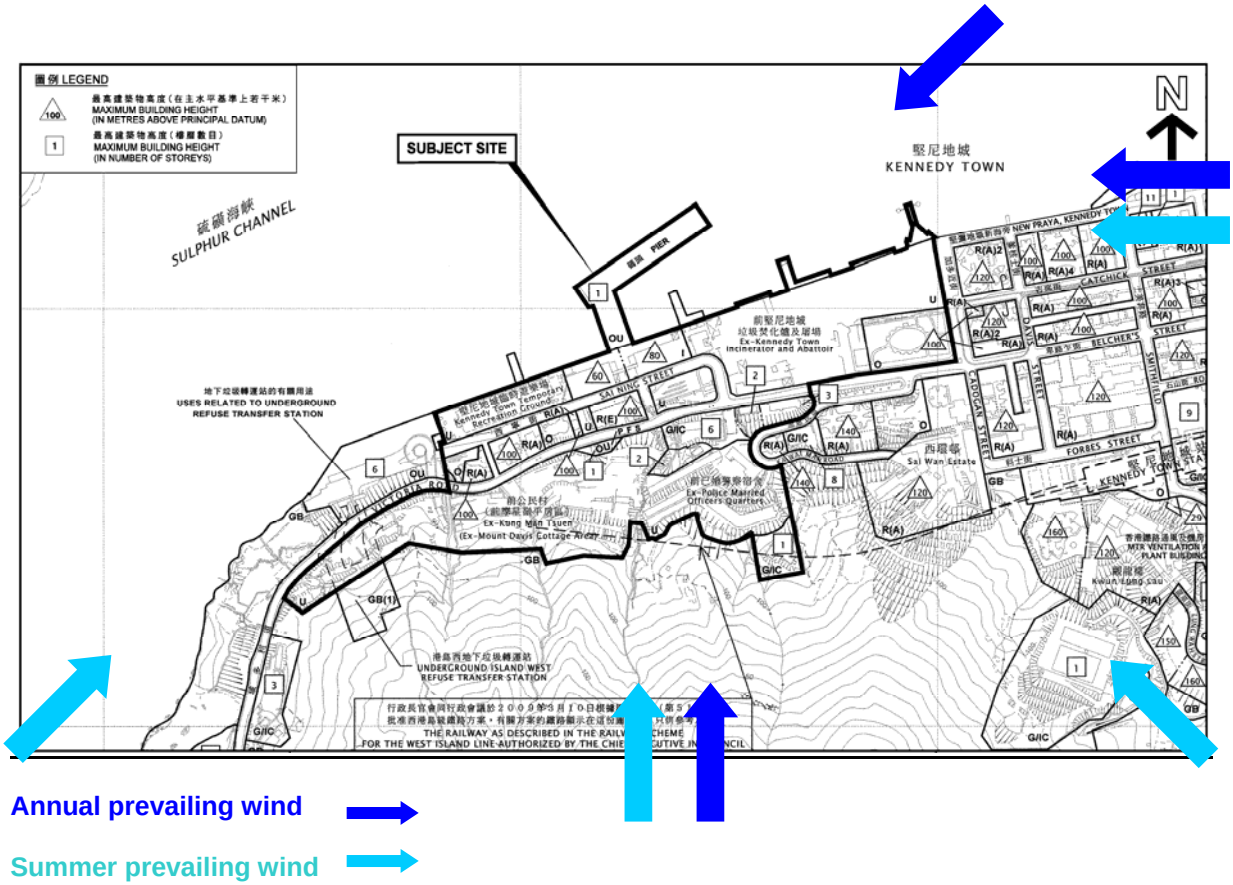


Figure 3.16 A summary of the prevailing winds of the study area

4.0 Topography and the Wind Environment

4.1 The study area is fronting the Victoria Habour. It rises from the sea level to around 60 mPD at the southern boundary, with Mount Davis lying south beyond the southern boundary (Figure 4.1).

4.2 Winds coming from the south will be weakened by the Mount Davis. For winds coming from the Northeast and Southwest over the Victoria Harbour, it is expected that winds from the waterfront can penetrate the study area via the streets and open spaces. Wind from the East will flow over the eastern part of Kennedy Town. It is expected that it will flow along main streets and roads that are parallel to the wind flow.

4.3 Katabatic (downhill) air movements from the vegetative hill slopes south of the study area and sea breezes from the north are beneficial to air ventilation in the study area.

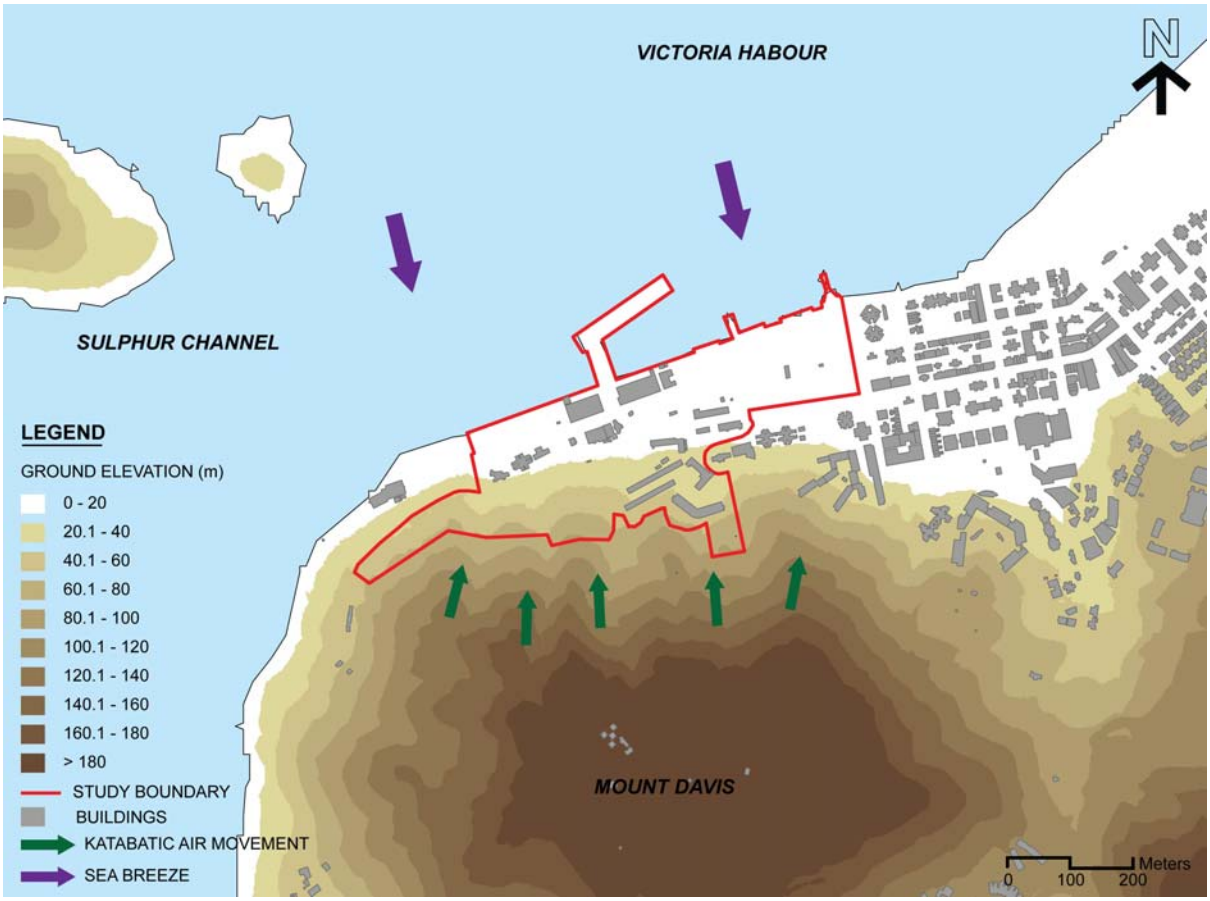


Figure 4.1 A digital elevation map of the study area. The arrows indicate the land-sea breezes directions.

5.0 The Existing Conditions

5.0.1 The existing building heights in storeys are as shown in Figure 5.1. The study area has some mid-rise to high-rise developments from 10 to 40 storeys. The buildings blocks are rather isolated with open spaces and low-rise G/IC facilities in between. As such, severe air ventilation problem are not anticipated.

5.1 G/IC, O and GB sites

5.1.1 The study area has some open green spaces and G/IC sites as 'air spaces' inside the study area, where air ventilation can be relieved (Figure 5.2). There is a large GB zone south of the study area. Cooler air movements from the hills south of the study area are beneficial for air ventilation in the study area.

Figure 5.1 The existing building height profile of the study area (in storeys).

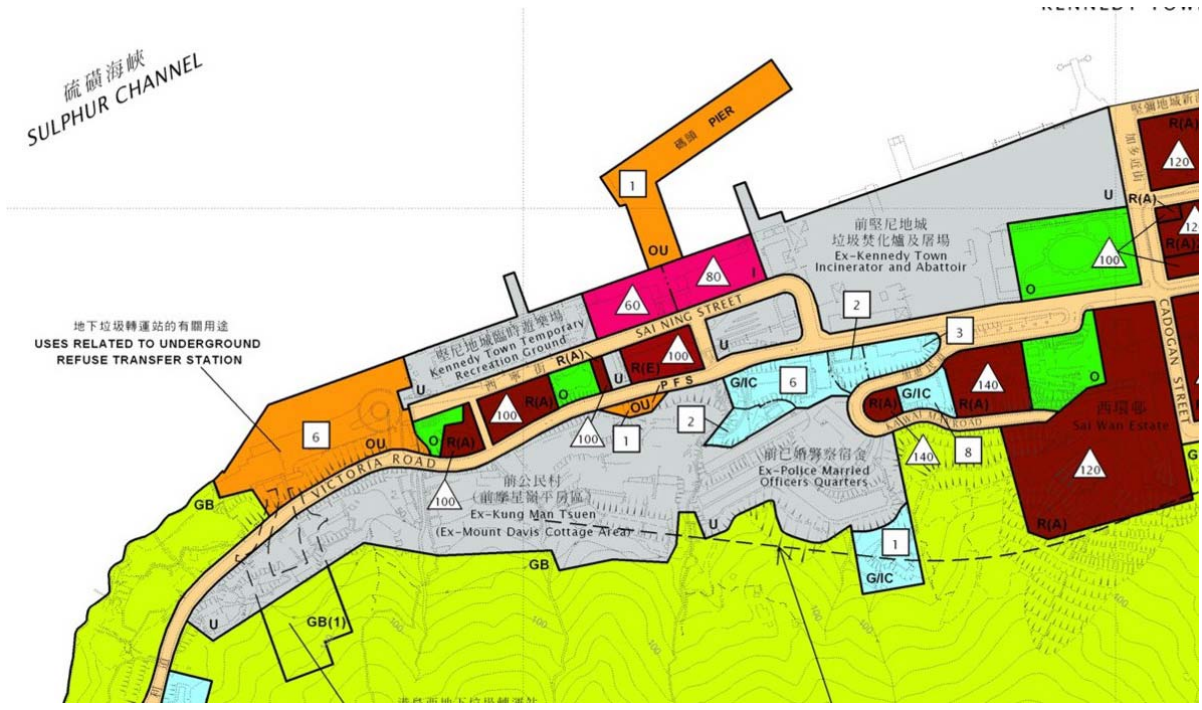


Figure 5.2 GIC, O and GB sites of the study area.

5.2 Air Paths

5.3.1 Analyzing information on the prevailing winds, the topography and existing conditions, the air paths of the study area can be evaluated (Figure 5.3 to 5.5). On the whole, due to the rather isolated buildings with open spaces and low-rise G/IC facilities in between, winds from different directions can easily find their ways to penetrate the study area.

5.3.2 Wind from the East will flow over the eastern part of Kennedy Town. It is expected that it will flow along main streets and roads such as Sai Ning Street, Victoria Road, which are almost parallel to the wind flow.

5.3.3 For winds coming from the Northeast and sea breezes over Victoria Harbour, they will penetrate into the southern part of the study area (ex-Kung Man Tsuen and ex-police married officer's quarters) through the open spaces of Kennedy Town Temporary Recreation Ground and Cadogan Street Temporary Garden, low-rise structures and bus terminus in the "U" sites, as well as GIC uses to the south of Victoria Road.

5.3.4 For southerly winds, they are expected to penetrate the study area to the waterfront via the open spaces of Kennedy Town Temporary Recreation Ground and Cadogan Street Temporary Garden, low-rise structures and bus terminus in the "U" sites, as well as GIC uses to the south of Victoria Road.

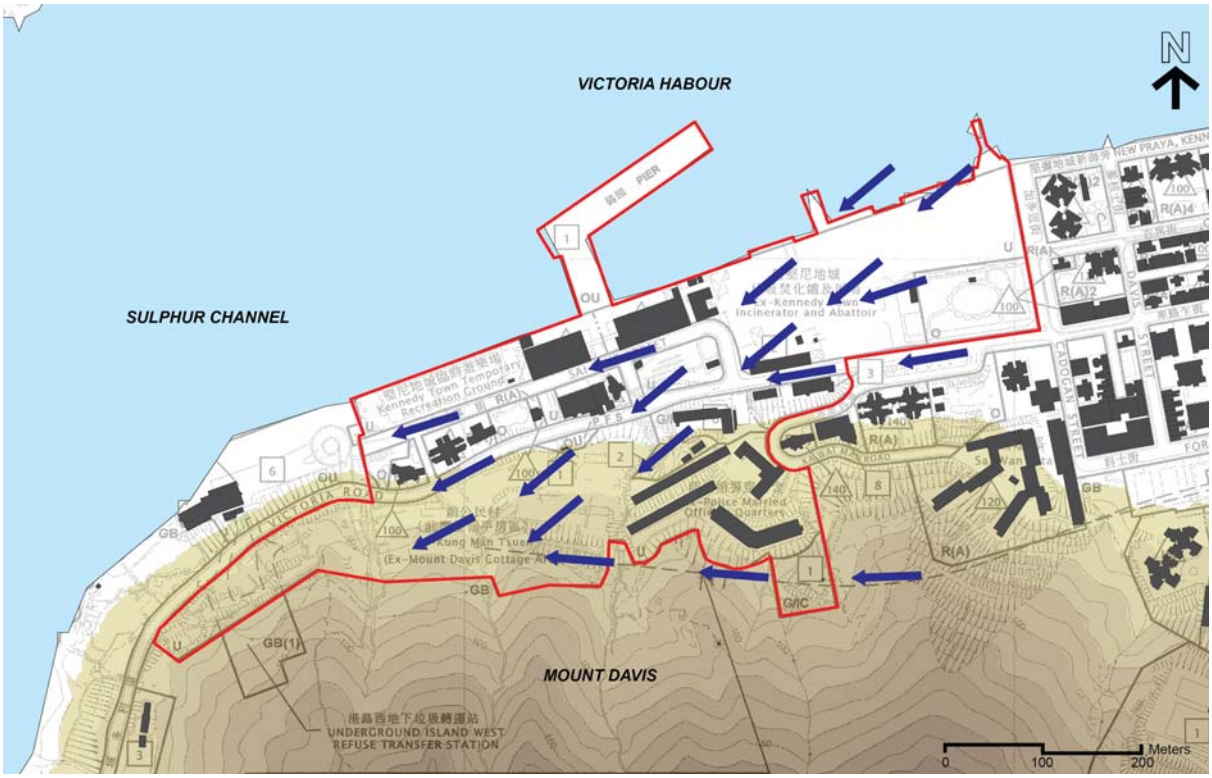


Figure 5.3 Prevailing wind directions (E, NE) of the study area.

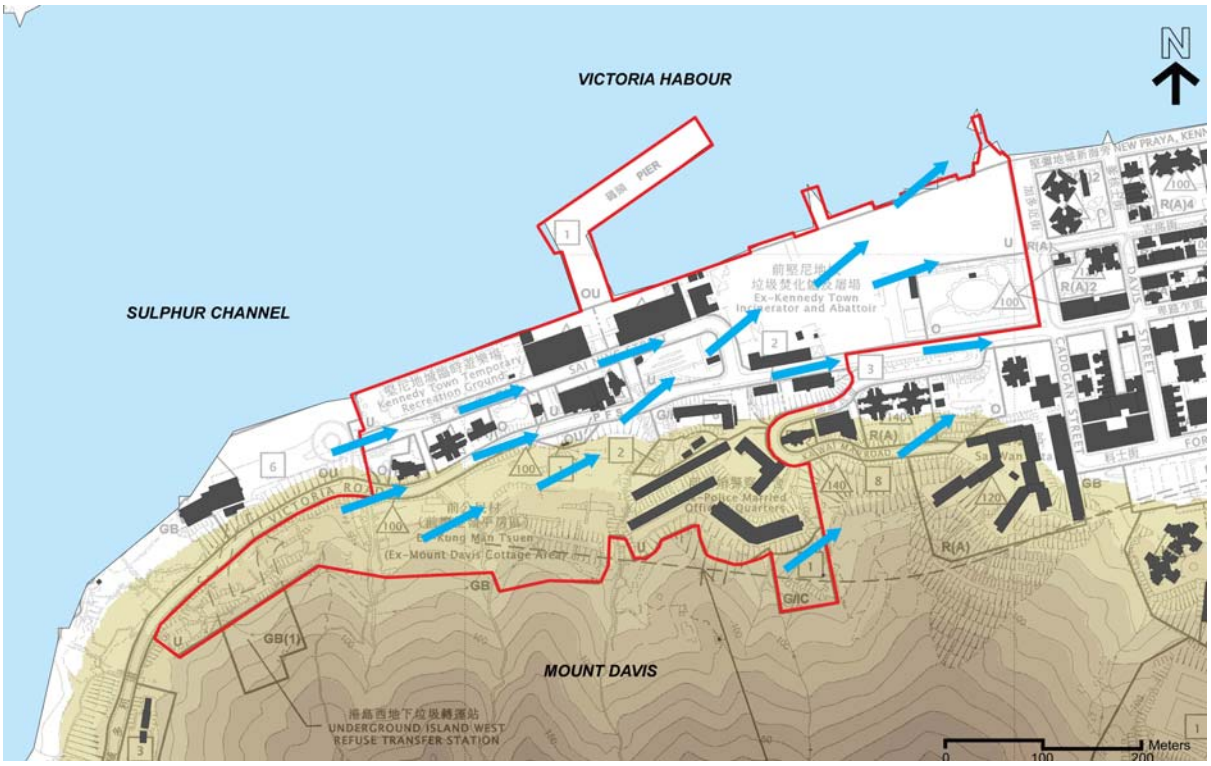


Figure 5.4 Prevailing wind directions (SW) of the study area.

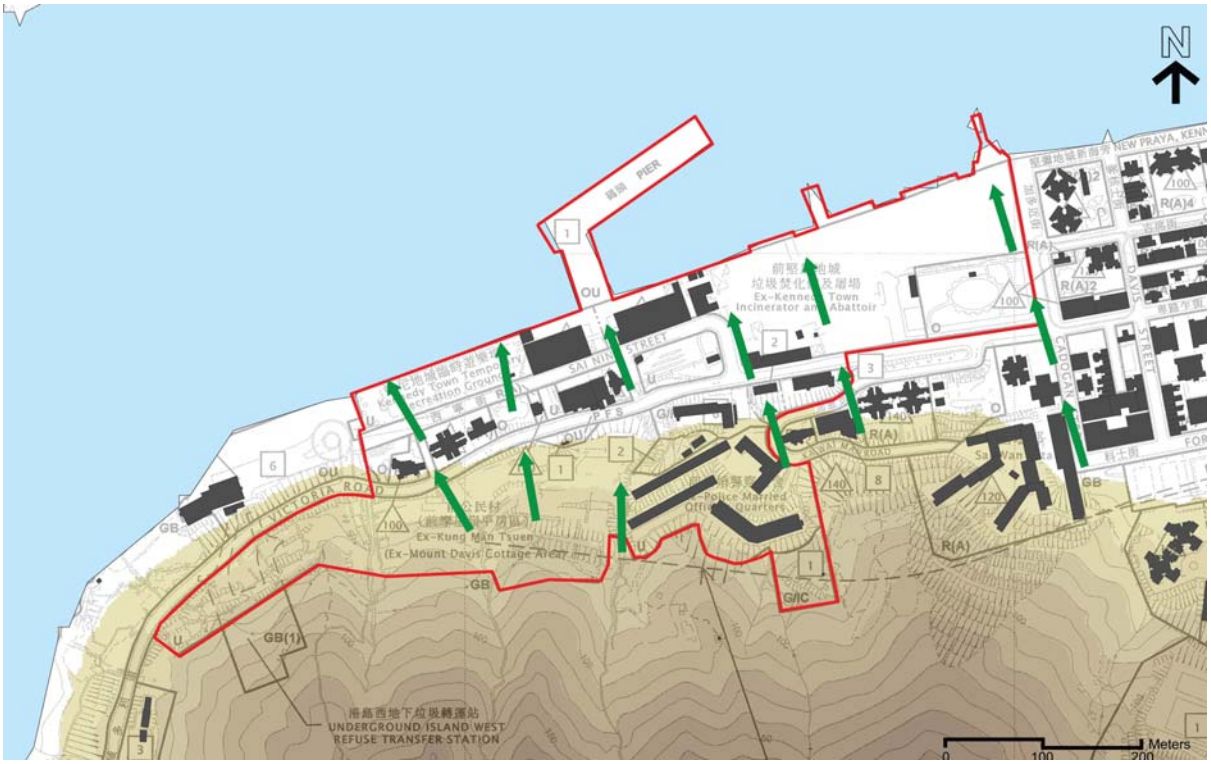


Figure 5.5 Prevailing wind directions (S, SE) of the study area.

6.0 The Existing Conditions with Planned developments

6.1 The study area is located to the west of the existing developments in Kennedy Town. It is located downwind under the annual and summer prevailing wind situations. In general, its development would not cause air ventilation concern on the existing developments in the neighbourhood. There are some planned developments within the study area that may cause localized air ventilation issues (Figures 6.1). These planned developments include commercial, leisure and recreation uses, private residential, public residential and G/IC facilities. On the whole, from an urban district based perspective, they will increase the thermal load of the area; they will increase urban roughness, diminish air ventilation potentials; and they may form deep street canyons and eventually wall-like barriers. These planned developments are evaluated as following with reference to the raw data of 'Preliminary AVA Study on the Proposed Development in Kennedy Town' conducted by PlanD.

6.2 The planned developments in the initial planned scenario are as follows:

(i) Site No.1a, No. 1b and No. 4b are leisure and recreation uses with BH of 10 mPD. Because of their low heights, it is unlikely that they will impose adverse effect on the air ventilation performance of the inland areas.

(ii) Site No. 3a is a private residential development. It has 4 towers with BH from 100 to 120 mPD on a podium with BH of around 10 – 15m. The bulky and extensive podium and the closely packed tower blocks will have some effects on air ventilation performance of the immediate surroundings – especially for the sea breezes coming perpendicular to the shoreline. When wind comes from the North, it is likely to create wake areas on its leeward side.

(iii) Site No. 3b is a primary school with BH of 8 storeys. Because of its relatively low heights and partial coverage of the site, it will impose little adverse effect on the air ventilation.

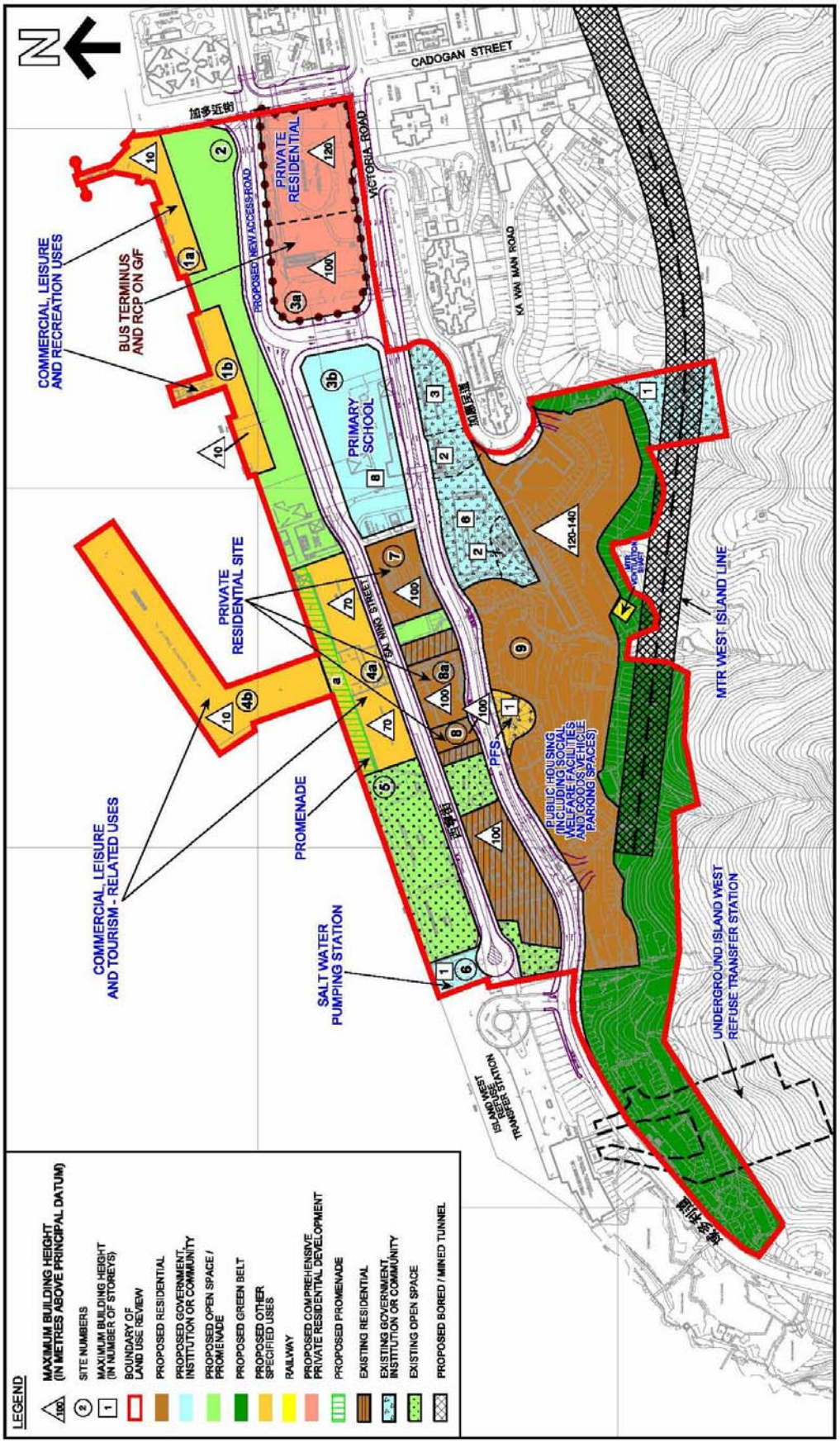
(iv) Site No. 7 is a private residential development. It has 2 towers with BH of 100 mPD on a podium. The bulky and extensive podium and the closely packed tower blocks will have some effects on air ventilation performance of the immediate surroundings. When wind comes from the Northeast, it is likely to create wake areas on its leeward side.

(v) Site No. 8 is a private residential development. It has a single tower with BH of 100 mPD. Because of its relatively small size (frontal area), it will impose little adverse effect on the air ventilation.

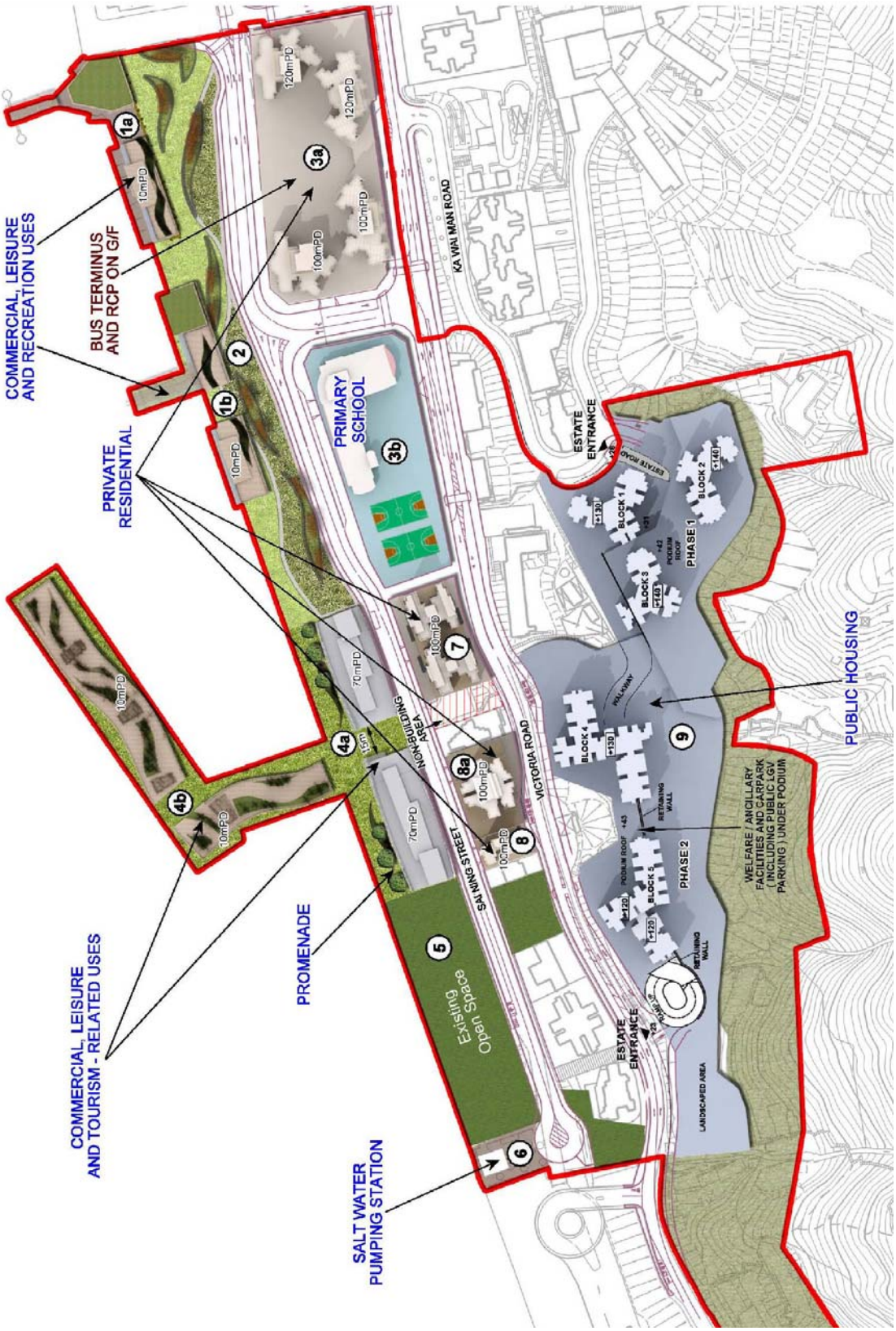
(vi) Site No. 8a is a private residential development. It has a single tower with BH of 100 mPD. Because of its relatively small size (frontal area), it will impose little adverse effect on the air ventilation.

(vii) Site No. 9 is a public residential development. It has 5 blocks with BH from 120 to 140 mPD on two separate but extensive podiums. When wind comes from the northeast, its wake areas are on the south-west side of the development. When wind comes from the southwest, wind will flow along Victoria Road and also through the gap between Block 3 and 4 over the G/IC site on its north-east. The closely packed Blocks 1, 2 and 3 will create wake areas to its northeast.

(viii) More importantly the continuous east-west orientated blocks will reduce/block the beneficial land-sea air mass exchange from the waterfront to the vegetated hillside. This will have adverse effect to the air ventilation performance of the area especially in weak wind days. It is recommended that the development consider better building permeability on the north-south axis, and intensify greening with green fingers through the development so that the cold katabatic air mass from the hill side can benefit further towards the north.



(a) Site numbers



(b) Building layouts

Figure 6.1 The planned developments in the study area.

7.0 Expert Evaluation and Recommendations of the Initial Planned Scenario

7.1 Due to Hong Kong's high-density urban morphology, it is not advisable to only rely on building height restriction (or minor changes of building heights) to maintain and/or improve air ventilation. For most of the areas, air ventilation will achieve better performance if more effective measures, such as breezeways, air paths, open spaces, gaps between buildings and building permeability especially near ground level, are also applied,

7.2 The initial planned scenario rezones most of the waterfront area to "O" and an adjoining site to "G/IC" for primary school use (site 3b). It also rezones part of the "U" zone to the south of Victoria Road to "GB" zone (area to the west and south of site 9) (Figure 7.1). These open spaces, GB and G/IC sites that function as 'air spaces' are recommended to be maintained to ensure the air ventilation performance of the surrounding areas. For example, the low-rise G/IC site next to site No. 9 functions as an important air path for the northeast wind flowing into site No. 9.

7.3 The initial planned scenario proposes some planned developments which are evaluated in Section 6. Since the review area is located to the west of other major sensitive receivers and a number of open space and low-rise GIC uses are proposed, the proposed developments would have no adverse air ventilation impact on its surrounding development. However, the proposed developments would have some localized effects on air ventilation performance as mentioned in section 6. From an urban planning perspective, the following should be taken into consideration in future development / redevelopment as far as possible for better air ventilation.

7.4 It is recommended to consider "green fingers"[1] and "urban permeability"[2] through the sites towards the waterfront in the study area (Figure 7.2). NBAs on ground (preferred) or building gaps above podium levels are also suggested to mitigate the wind wake due to the proposed developments (Figure 7.3):

(i) NBA 1 (about 15m) is suggested in the middle of Site 3a to mitigate the wind wake due to the proposed development in this site. Given that there is a proposed bus terminus on G/F, adding a building gap above the podium level can improve the urban permeability. During detailed design stage, reference should be made to Chapter 11 of the Hong Kong Planning Standards and Guidelines on the podium design to help increase the permeability as far as practicable. The urban permeability can help to alleviate any air ventilation issues of the site.

(ii) NBA 2 (about 15m) on ground or podium level passing through Sites 4, 7 and 9 is suggested to mitigate the wind wake due to the proposed development in these

[1] Green fingers in this report refer to linear green belts (fingers) from the vegetated slopes (palm) of the south extending to the north.
[2] Urban permeability in this report refers to open spaces, roads, gaps between buildings, etc. in urban area, which can serve as air path. Openness reduces the frontal area density (FAD) of the city.

sites. This NBA will facilitate katabatic air movement to the waterfront and sea breezes from the north.

(iii) NBA 3 (about 15m) on ground (preferred) or podium level extending towards the harbourfront via Site 9 and two open spaces along Sai Ning Street is suggested to facilitate katabatic air movement to the waterfront and sea breezes from the north.

(iv) NBA 4 (about 15m) in the northeast-southwest direction along Ka Wai Man Road is suggested to facilitate south-westerly wind on ground level.

7.5 Site 9 currently is vegetated. Should it need to be replaced with artificial materials, surfaces and building masses, it is recommended to intensify the greenery (especially tree planting) on site in general (30% green coverage should be the minimum requirement).

7.6 The above-mentioned NBAs/building gaps can connect to form air paths to allow katabatic air movements from the vegetated hill slopes south of the study area and sea breezes from the north especially on the weak wind days.

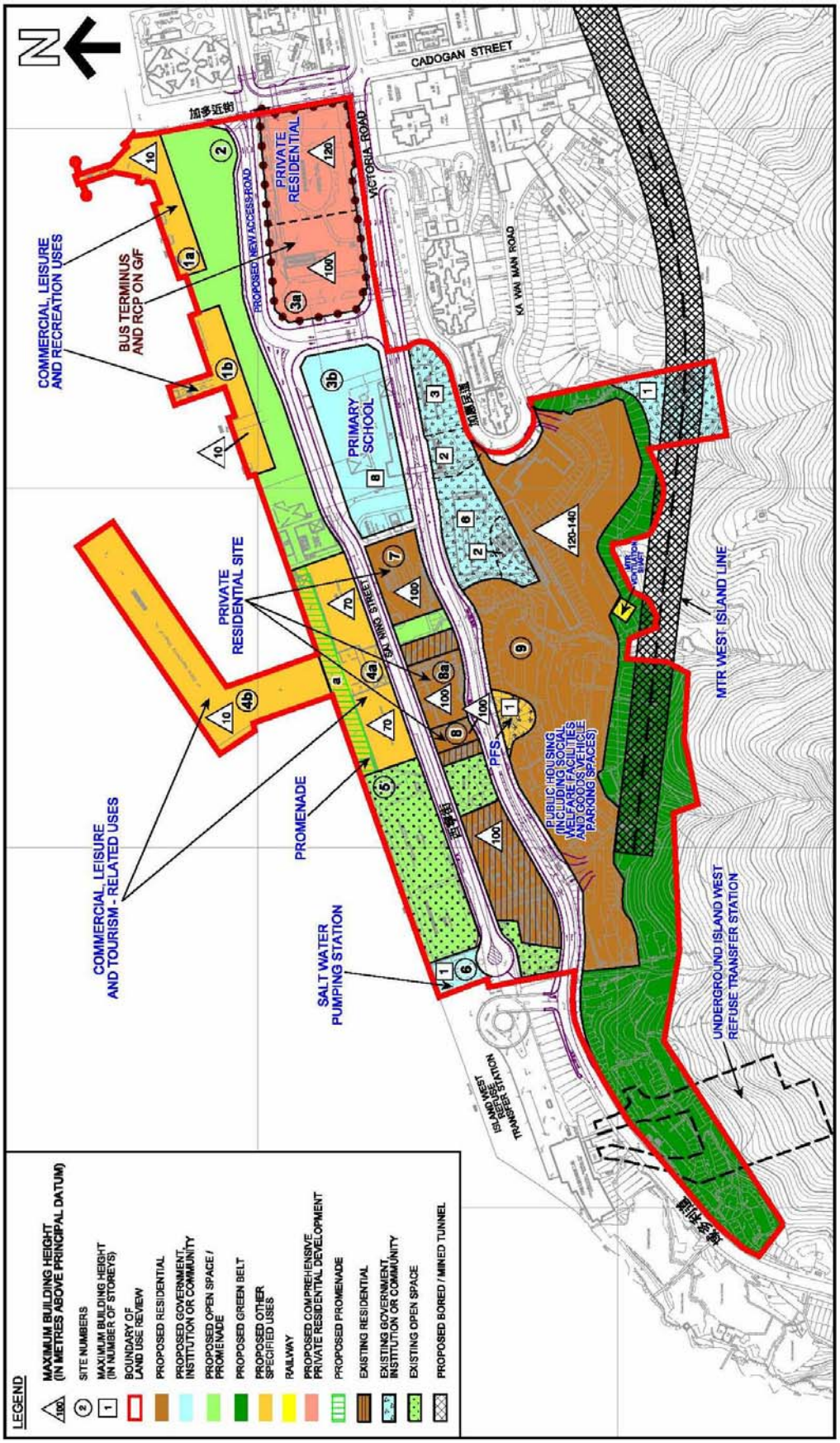


Figure 7.1 The Initial Planned Scenario of the study area.

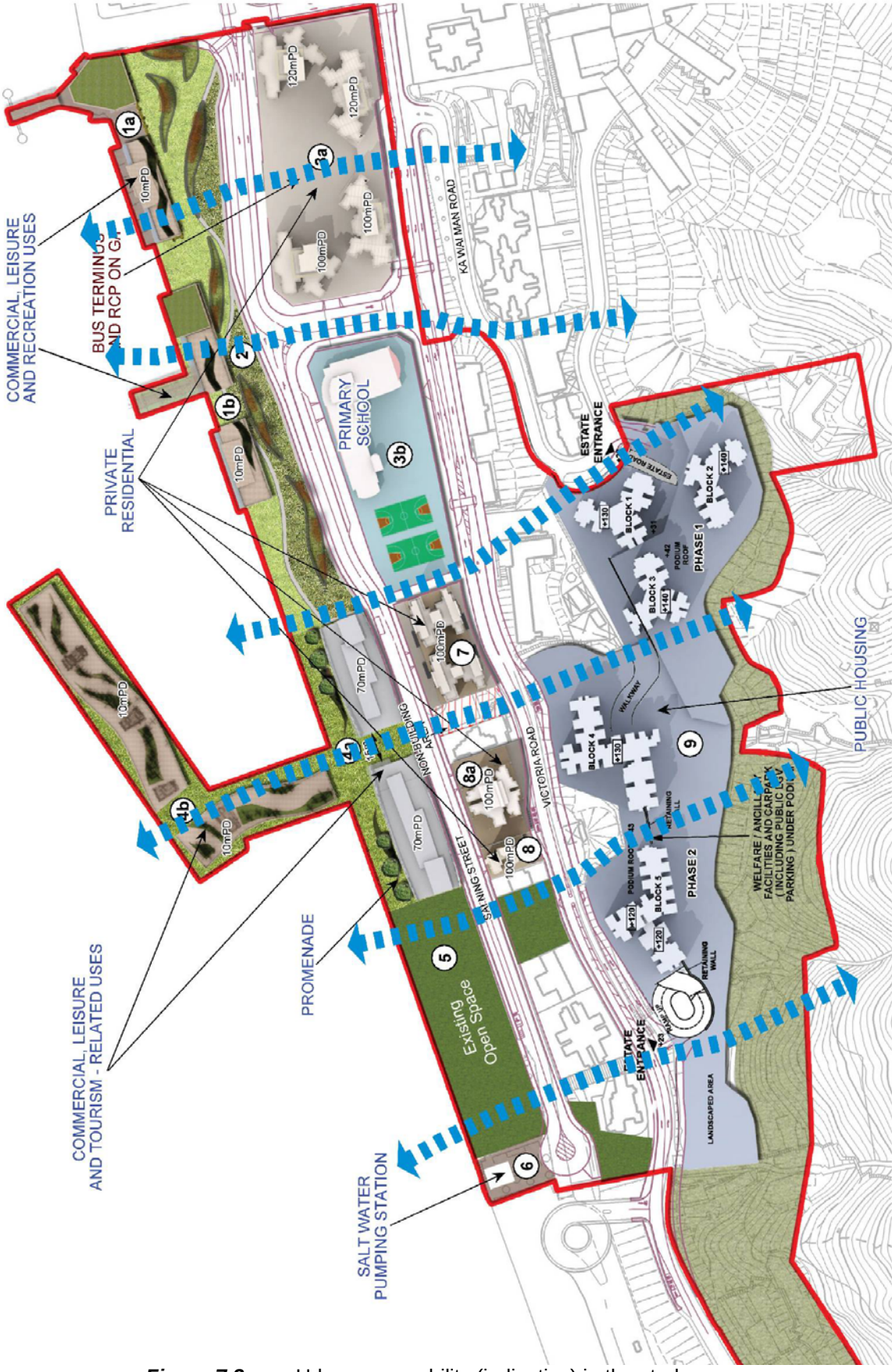


Figure 7.2 Urban permeability (indicative) in the study area.

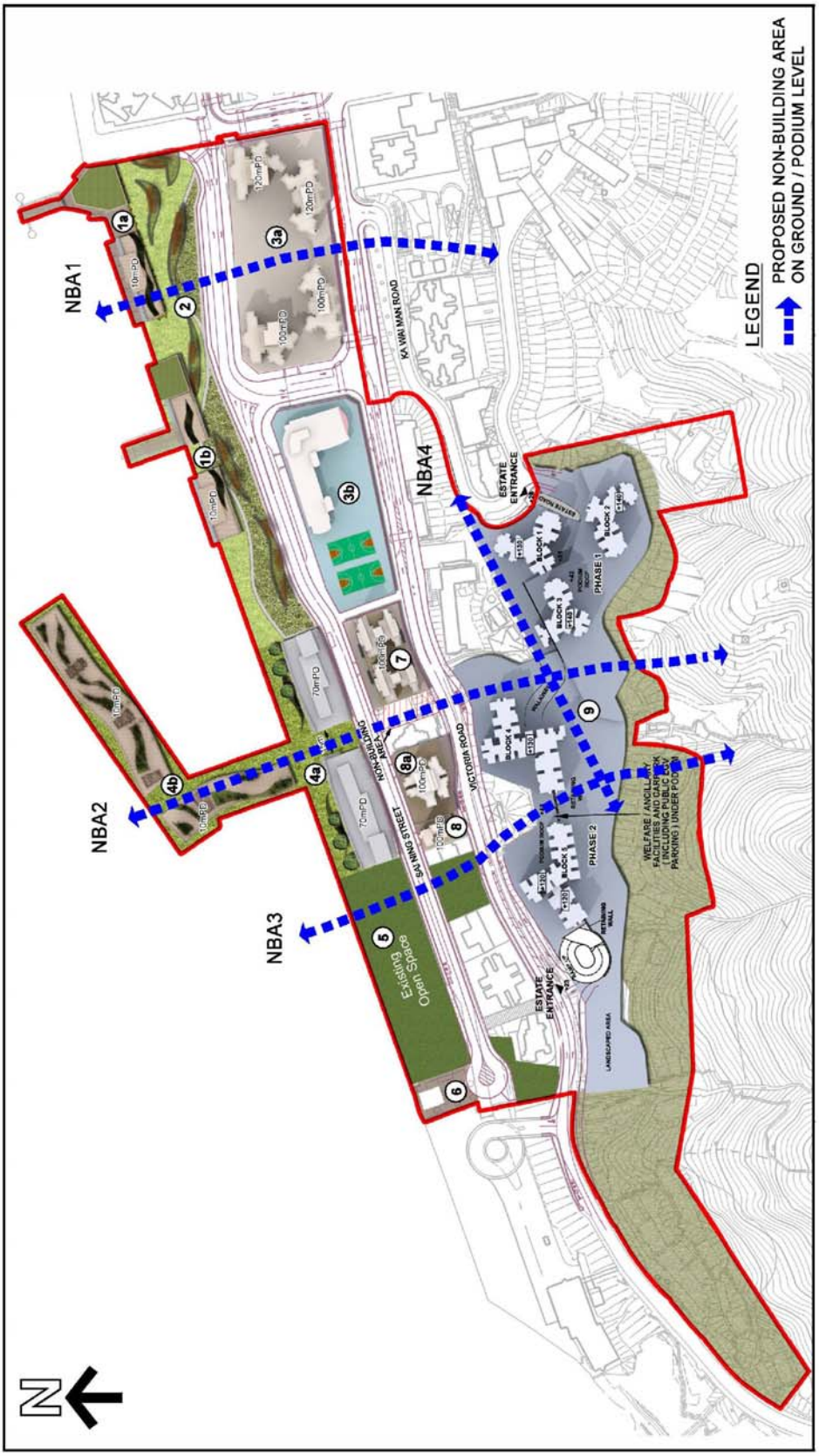
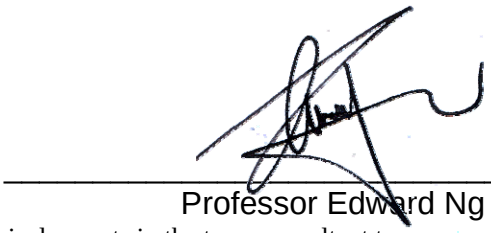


Figure 7.3 Suggested NBAs or Building gaps

8.0 Further Work

Based on the expert assessment and subject to implementation of the proposed mitigation measures, the study area would have no major air ventilation issue at urban planning level. Further AVA study for the study area at planning stage is not necessary.

However, given the large site area and any insensitive layout and building design may result in adverse air ventilation, AVA studies (initial/detail studies) are recommended for Site No. 3a and Site No. 9 at detailed design stage to maintain/enhance the air ventilation performance in the study area.



Date: 12 April 2013

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