TERM CONSULTANCY FOR AIR VENTILATION ASSESSMENT SERVICES

Cat. A Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment (PLNQ 37/2007)

Final Report – Tsim Sha Tsui

March 2008

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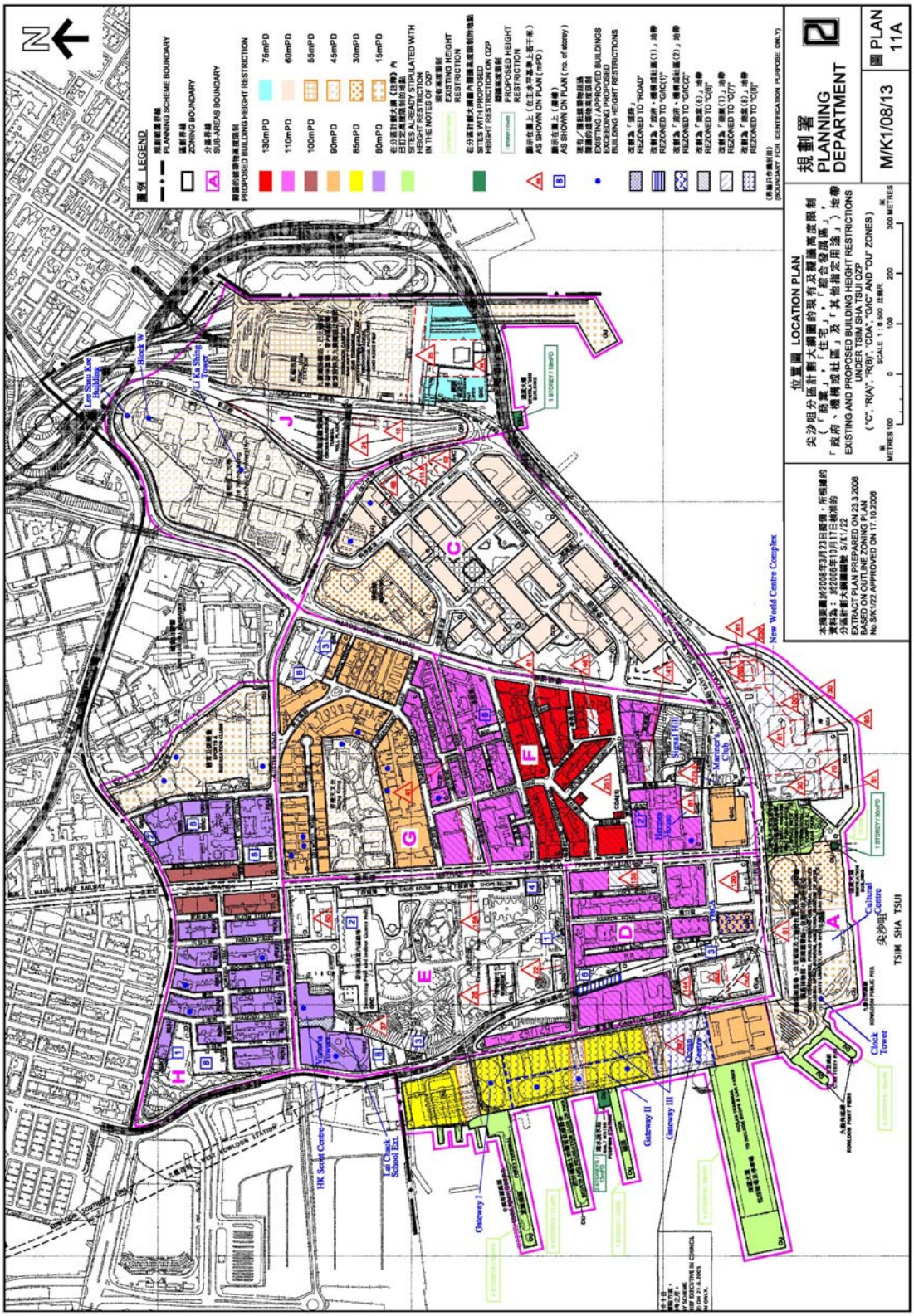
The Study Area

The Recommended Scenario



Expert Evaluation Report of Tsim Sha Tsui

Executive summary

0.1 Wind Availability:

(a) The prevailing summer wind of the study area comes from the east with a high probability also from the south-west to south east quarters. The prevailing annual wind of the study area comes from the east and north-east. In general, since the study area fronts the Victoria Habour to its east, south and west, wind availability to the study area is good.

0.2 Existing Scenario:

(a) Chatham Road South, Nathan Road and Salisbury Road are the major air paths of the study area.

(b) The study area has a number of green and open areas; they are very useful for the study area's air ventilation.

(c) For air ventilation assessment, the study area can largely be divided into 7 zones (Figure 0.1).

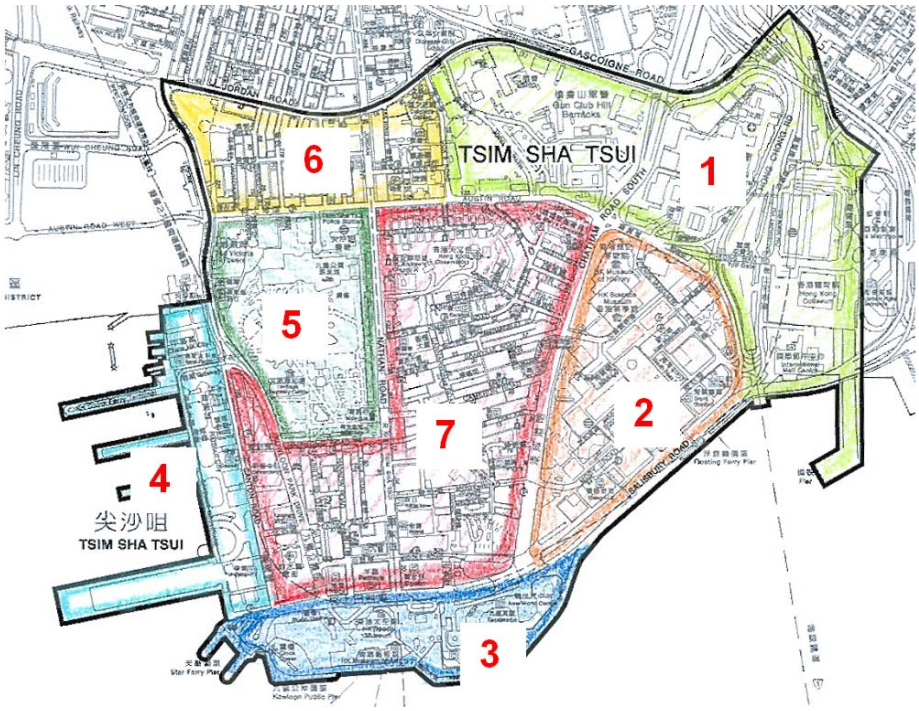


Figure 0.1 The seven main zones of the study area

(i) Zone 1, no major air ventilation issues.

(ii) Zone 2, it has no major air ventilation issues. The zone is important to air ventilation of zone 7.

(iii) Zone 3, it has no major air ventilation issues. The zone is important to air ventilation of zone 7.
(iv) Zone 4, it has no major air ventilation issues. The large podium structure reduces air ventilation of Canton Road.
(v) Zone 5, Kowloon Park is the "air lung" of the study area.
(vi) Zone 6, the parallel streets are perpendicular to the wind from the east. This zone has weak air ventilation.
(vii) Zone 7, this zone is at the heart of TST. It has weak air ventilation.

0.3 The Study Area with Potential Re-Development

(a) The air ventilation in some denser parts of the study area can be poor (for example Zone 6 and 7 of the study area), and will worsen further due to the potential re-development. Given the congested building environment of the study area with lots of tall buildings already and the possibility of having many more taller and bulkier buildings, height restrictions by itself may not be the most effective planning consideration for air ventilation. Introducing air paths and non-building areas, preserving open spaces, limiting site coverage, widening roads and streets are some of the more effective mitigation measures.

0.4 Initial Planned Scenario:

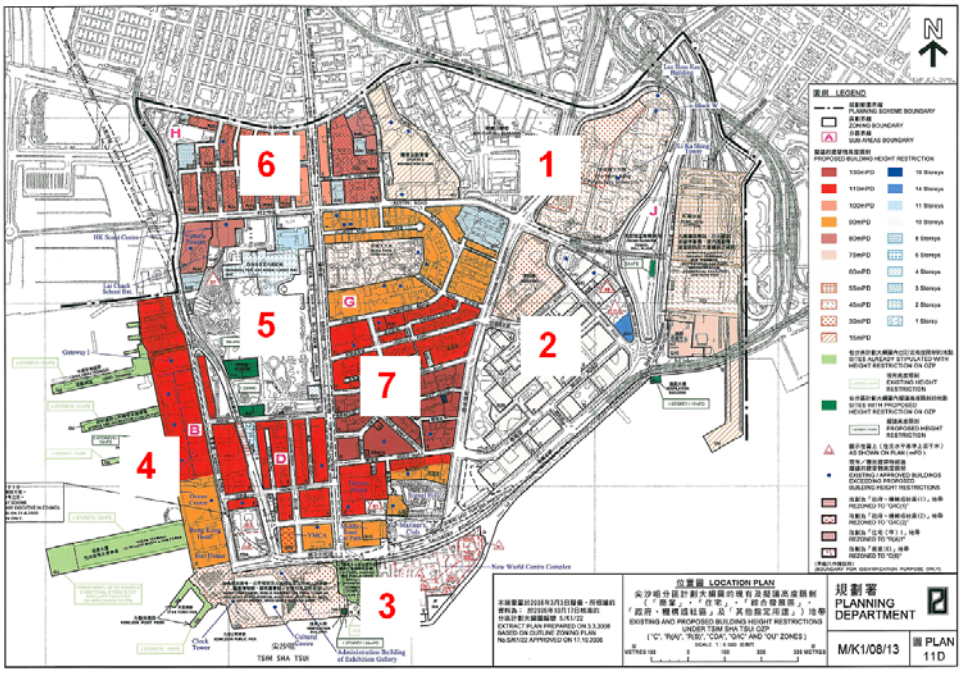


Figure 0.2 The initial planned scenario

(a) The assessment is based on the information supplied by Planning Department on the initial planned scenario (Figure 0.2).

(i) Zone 1, no major air ventilation issues.
(ii) Zone 2, the proposal largely follows the existing conditions and will retain current air ventilation performance.

(iii) Zone 3, It is too general to propose a building height restriction of 30 mPD from the Star Ferry Terminal to the Cultural Centre public open space. Air paths and non-building areas are recommended.

(iv) Zone 4, A general 90 mPD to 110 mPD proposed height restriction of the zone is not recommended. It is important to specify some air paths through it as non-building areas.

(v) Zone 5, The height restrictions largely follow the existing characteristics. There should be no air ventilation issues.

(vi) Zone 6, the existing building heights are in the range of around 30 mPD to 80 mPD. With taller buildings up to 100 mPD, poorer air ventilation is anticipated. It is important to consider measures, like air paths, to mitigate.

(vii) Zone 7, the existing building heights are in the range of around 30 mPD to 80 mPD. Taller buildings up to 130 mPD under the proposed building height restrictions are anticipated. This will greatly reduce the already poor air ventilation of the area. It is very useful to find ways to introduce non-building areas, building setbacks, open spaces and building perforations.

0.5 The Recommended Scenario:

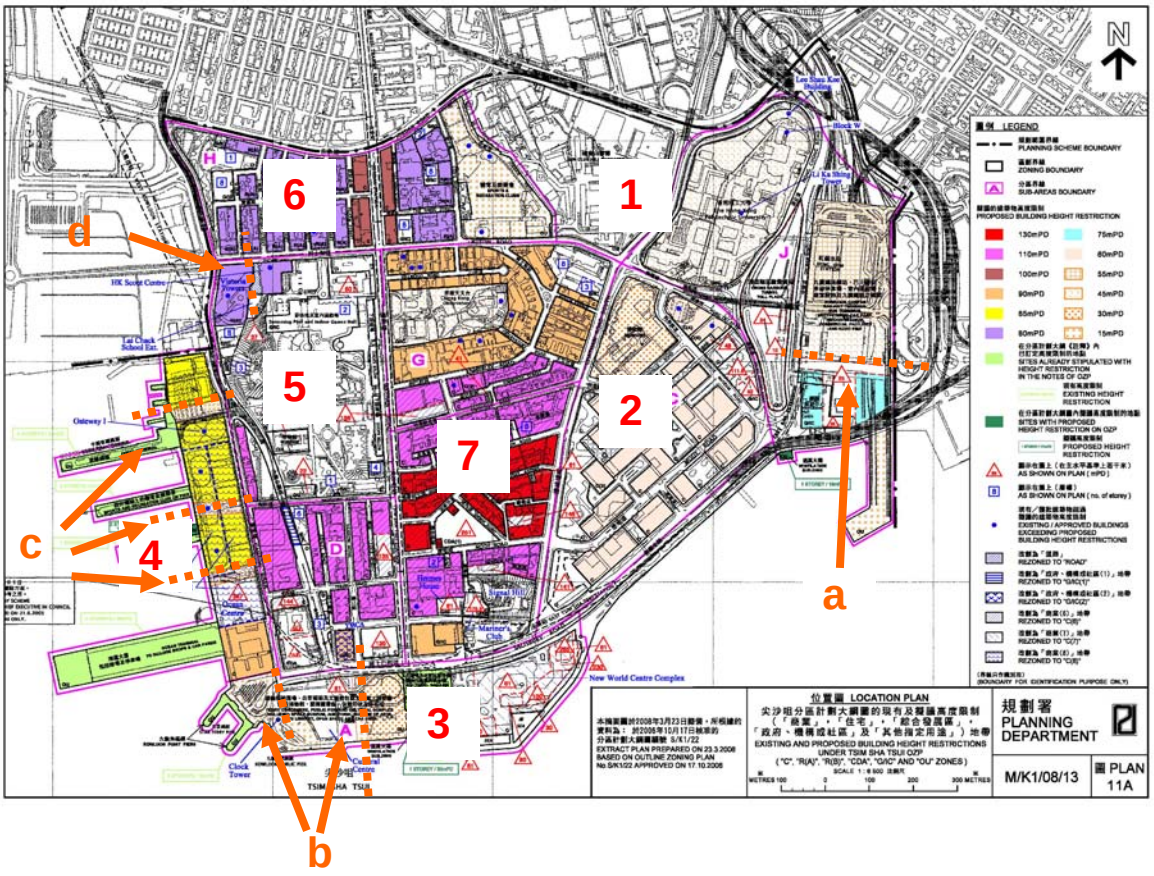


Figure 0.3 The Recommended Scenario

(a) The assessment is based on the information supplied by Planning Department on the initial planned scenario (Figure 0.3) A number of improvements have been incorporated to address the recommendations of the initial planned scenario. .

(i) Zone 1, an additional 20m wide air path (position a) has been incorporated.
(ii) Zone 3, two areas at a proposed building height of 15mPD (position b) have been added; one of them a 20m wide air path aligning Hankow Road.
(iii) Zone 4, three 30m wide strips of area at a proposed maximum building height of 15mPD (position c) have been added.
(iv) Zone 5, a strip of land has been re-zoned to road to ensure preserving the existing air path.
(v) Zone 7, an 1.5 non-building area from the lot boundary abutting road/street for sites to be rezoned to C(6) has been incorporated.

(b) The Recommended Scenario has, as far as practically feasible, incorporated the experts' recommendations.

0.6 Further Studies:
(a) Further AVA studies comparing the "with" and "without" height restrictions options may not be necessary or even beneficial as it is not possible to specify the more important parameters (e.g. building geometry and block disposition within each of the building sites) in any such studies.

(b) Should any further studies of AVA be needed beyond the consideration of height control restrictions be OPTIONALLY considered, it may be useful to concentrate on Zone 7 and test parametrically at least the following:

(i) as existing; and
(ii) with potential re-developments and height restrictions, and with:
option 1: no non-building area from the lot boundary
option 2: 1.5m non-building area from the lot boundary
option 3: 3m non-building area from the lot boundary
option 4: 5m non-building area from the lot boundary

Expert Evaluation Report of Tsim Sha Tsui

1.0 The Assignment

1.1 In order to provide better planning control on the building heights upon development/redevelopment, the approved Tsim Sha Tsui Outline Zoning plan (OZP) No. SK1/22 is being reviewed with a view to incorporating appropriate development restrictions in the Notes for various development zones of the OZP to guide future development/redevelopment. It is necessary to conduct an expert evaluation to assess the broad Air Ventilation (AV) impacts of the proposed building height restrictions.

1.2 This expert evaluation report is based on the materials given by Planning Department to the Consultant on 26 Feb 08 including:

Existing building Heights in storeys and in mPD
Information of committed / approved developments
Initial Planned scenario – proposed building height restrictions

AND the following information forwarded to the Consultant electronically:

Information of Greening Master Plan – TST
Information of Area Improvement Plan – TST
Estimated building heights – controlled
Estimated building heights – uncontrolled
Initial Planned Scenario – proposed building height restrictions (revised)
Recommended Scenario

1.3 The consultant has studied the above mentioned materials, and has conducted site inspection on 3 March 08. During the writing of the report, the consultant has working sessions with colleagues at Planning Department on 26 Feb, 10 Mar, 20 Mar 08.

2.0 The wind environment

2.1 Hong Kong Observatory (HKO) stations provide useful and reliable data of the wind environment in Hong Kong (Figure 2.1). There are some 46 stations operated by HKO in Hong Kong. Together, they allow a very good general understanding of the wind environment especially close to ground level.

2.2 The HKO station at Waglan Island (WGL) is normally regarded by wind engineers as the reference station for wind related studies (Figure 2.1). The station has a very long measuring record, and it is unaffected by Hong Kong's complex topography. Based on WGL wind data, studies are typically employed to estimate the site wind availability taking into account the topographical features around the site. Examining the annual wind rose of WGL, it is apparent that the annual prevailing wind in Hong Kong is from the East. There is also a major component of wind coming from the North-

East; and there is a minor, but nonetheless observable component from the South-West.

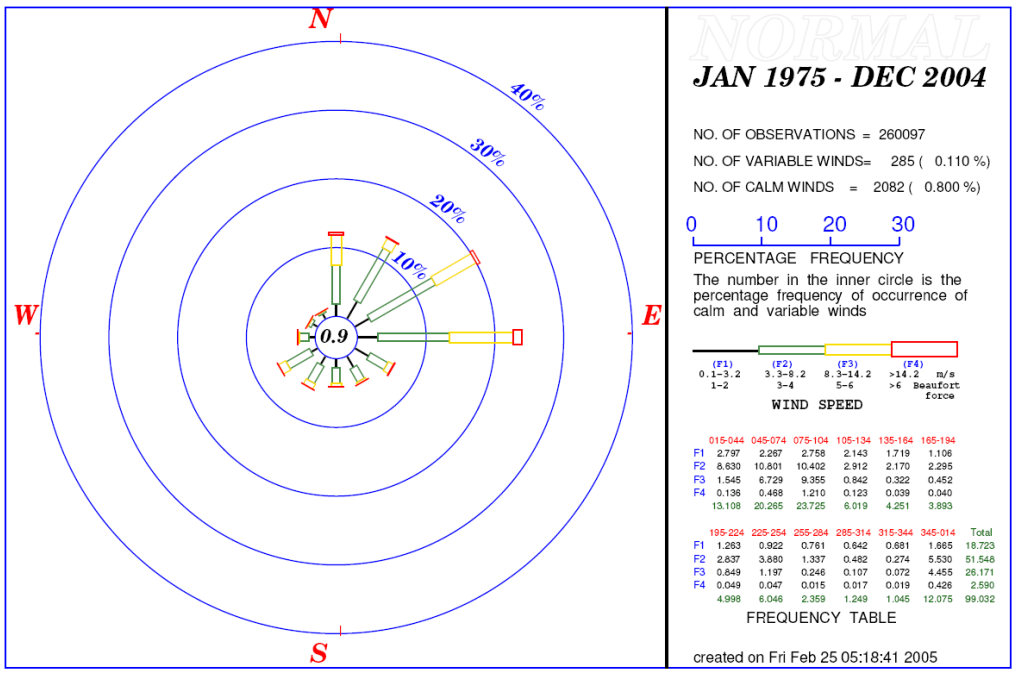


Figure 2.1 Wind rose of WGL 2006 (annual).

2.3 For the study, it is important to understand the wind environment both seasonally and monthly (Figures 2.2 and 2.3). In the winter months of Hong Kong, the prevailing wind comes from the North-East. In the summer months, prevailing wind mainly comes from the South-West. As far as AVA is concerned, in Hong Kong, the summer wind is very important and beneficial to thermal comfort. Hence, based on WGL data, it is very important to plan our city, on the one hand, to optimize the ventilation potential based on 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.

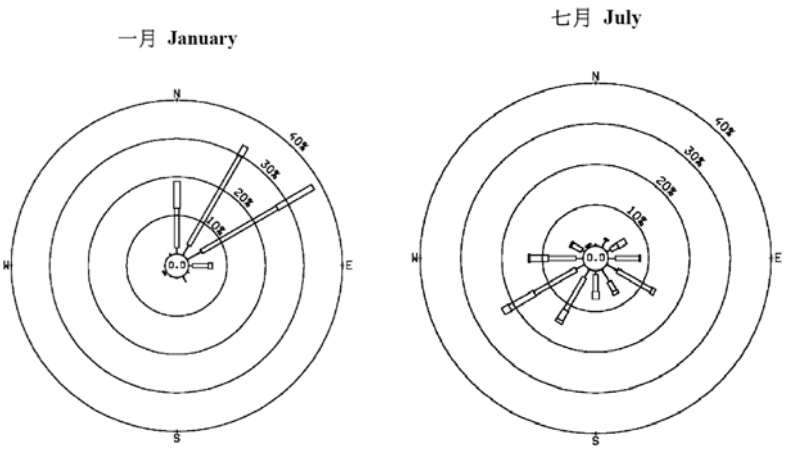


Figure 2.2 (as an example) Wind roses of WGL 2006 (Jan and July).

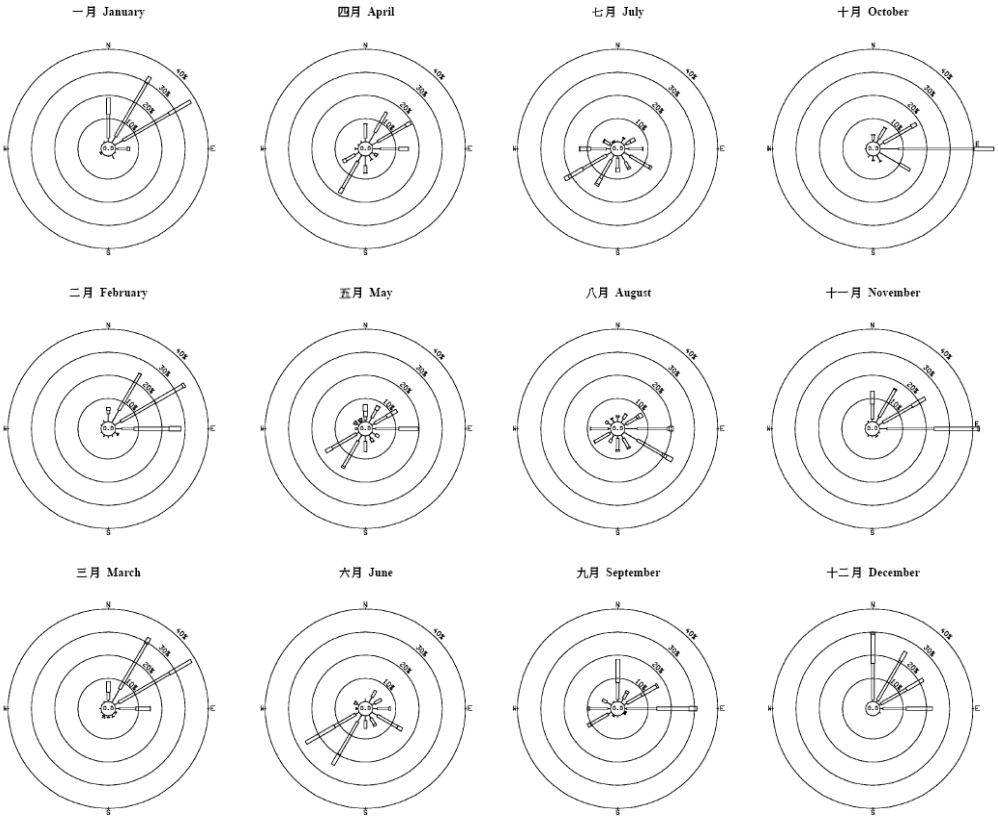
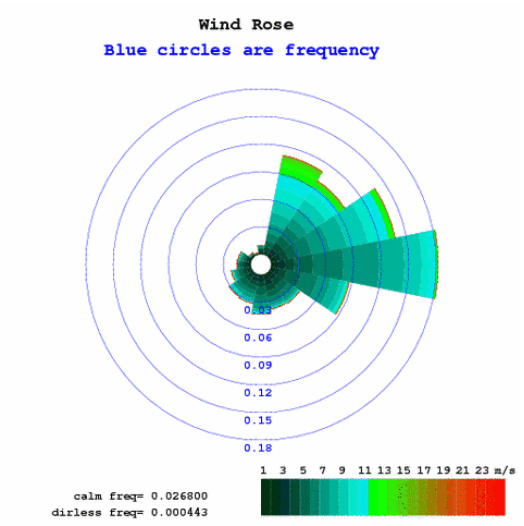


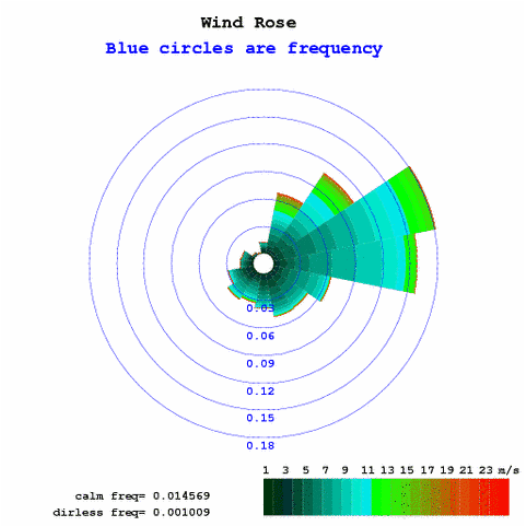
Figure 2.3 (as an example) monthly wind roses of WGL 2006.

2.4 Researchers at Hong Kong University of Science and Technology (HKUST),) led by Prof Alexis Lau and Prof Jimmy Fung, have simulated a set of wind field of Hong Kong using MM5. The simulated period cover the whole year of 2004. Based on this dataset, a location within the study area is extracted at 120m and 450m above ground (Figures 2.4 and 2.5).

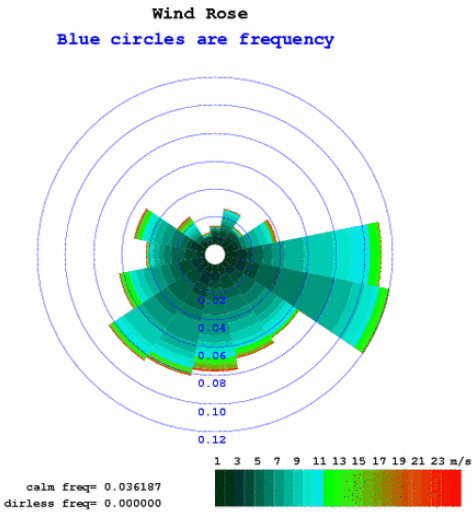
Figure 2.4 The location of MM5 extracted data.



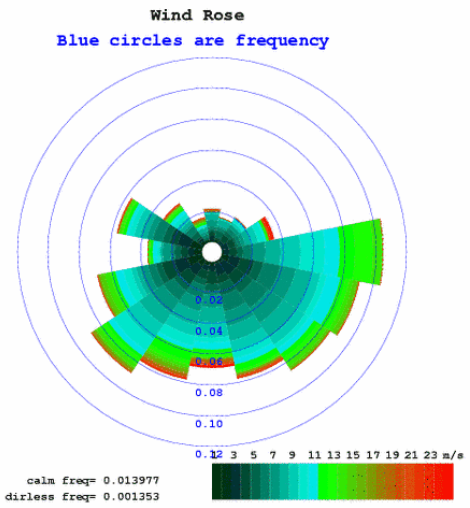
120m (Annual)



450m (Annual)



120m (Summer)



450m (Summer)

Figure 2.5 Wind roses in the study area at location A. 120m is the approximate urban canopy layer (UCL) height. 450m is the approximate wind boundary layer height.

2.5 Using the simulated MM5 data, the summer and the annual prevailing wind directions of the study area and the surroundings are presented in Figure 2.6, 2.7.

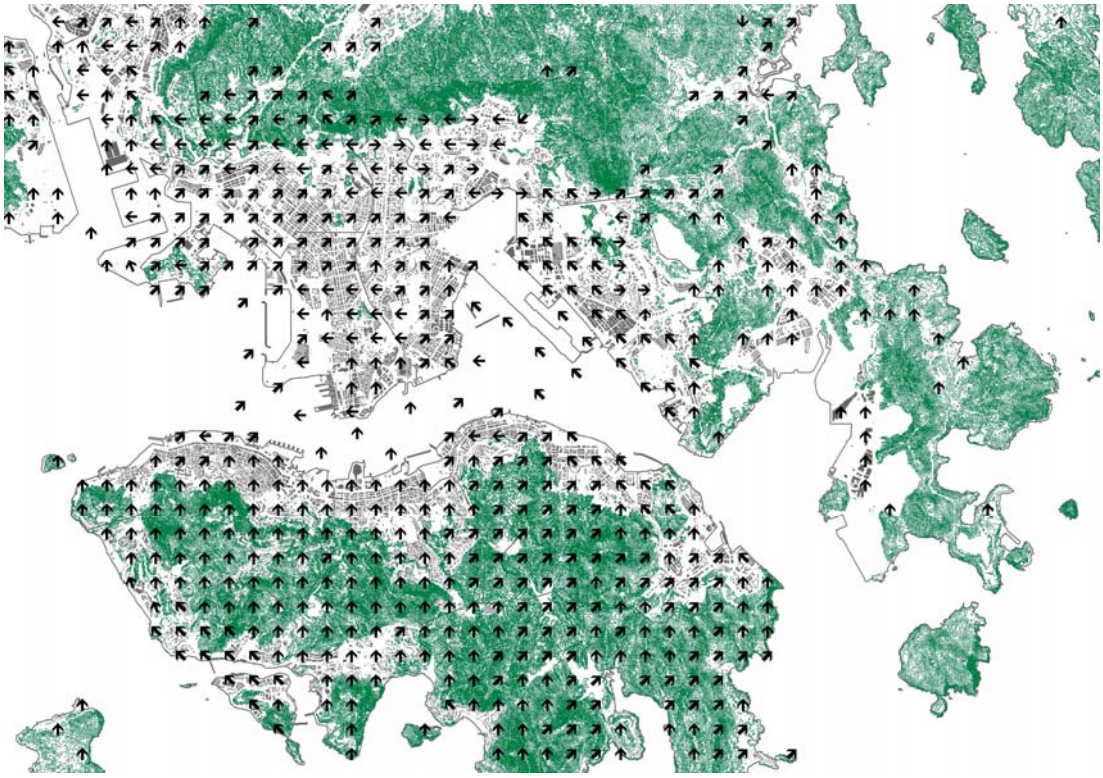


Figure 2.6 Prevailing wind directions of the summer months (Jun-Aug) based on MM5 (60m for showing the near ground prevailing wind vectors).

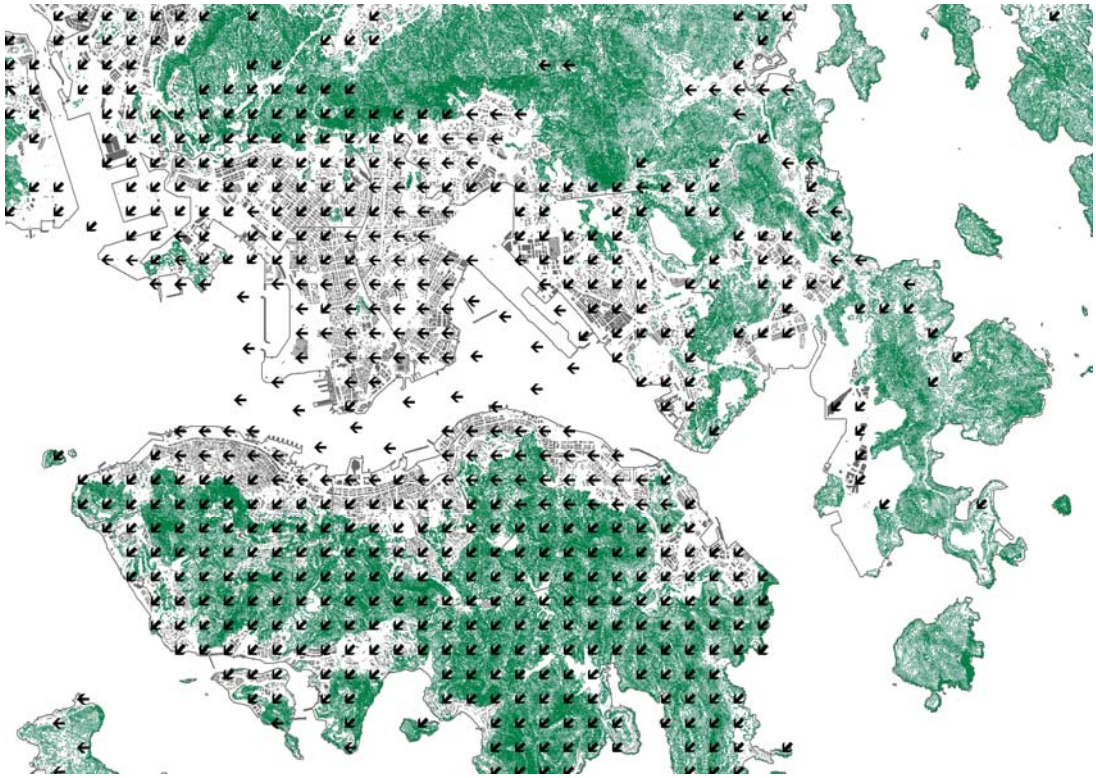


Figure 2.7 Prevailing wind directions (annual) based on MM5 (60m for showing the near ground prevailing wind vectors).

2.6 In summary, based on the available wind data, one may conclude that the annual wind of the study area is mainly from the East and the North-East. The summer wind is mainly coming from the East and the South West to South-East quarters (Figure 2.8).

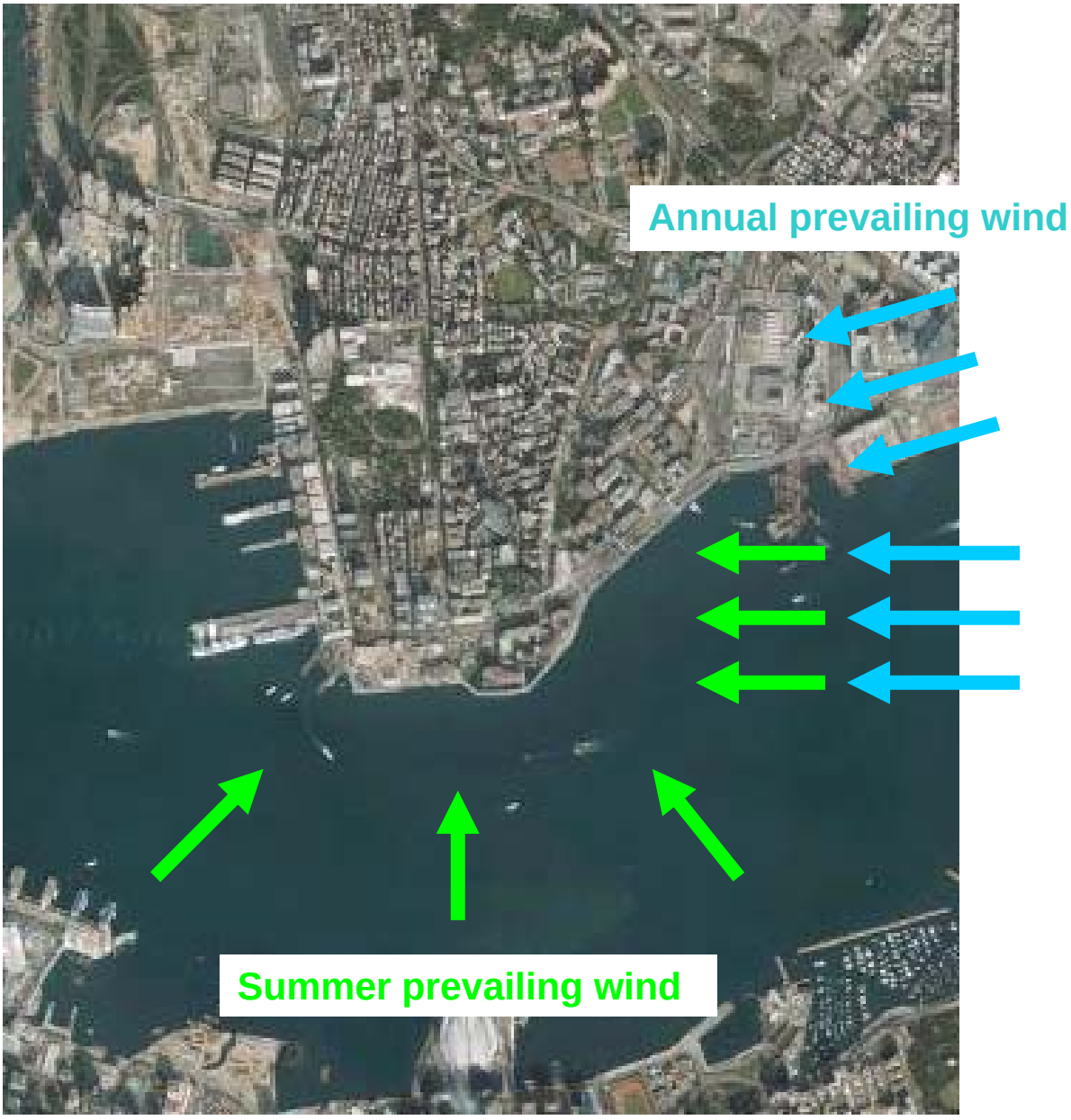


Figure 2.8 Annual and summer prevailing winds of the study area.

3.0 The Existing Scenario

3.1 The assessment is based on the information supplied by Planning Department on existing building heights with committed and approved developments (Figure 3.1).

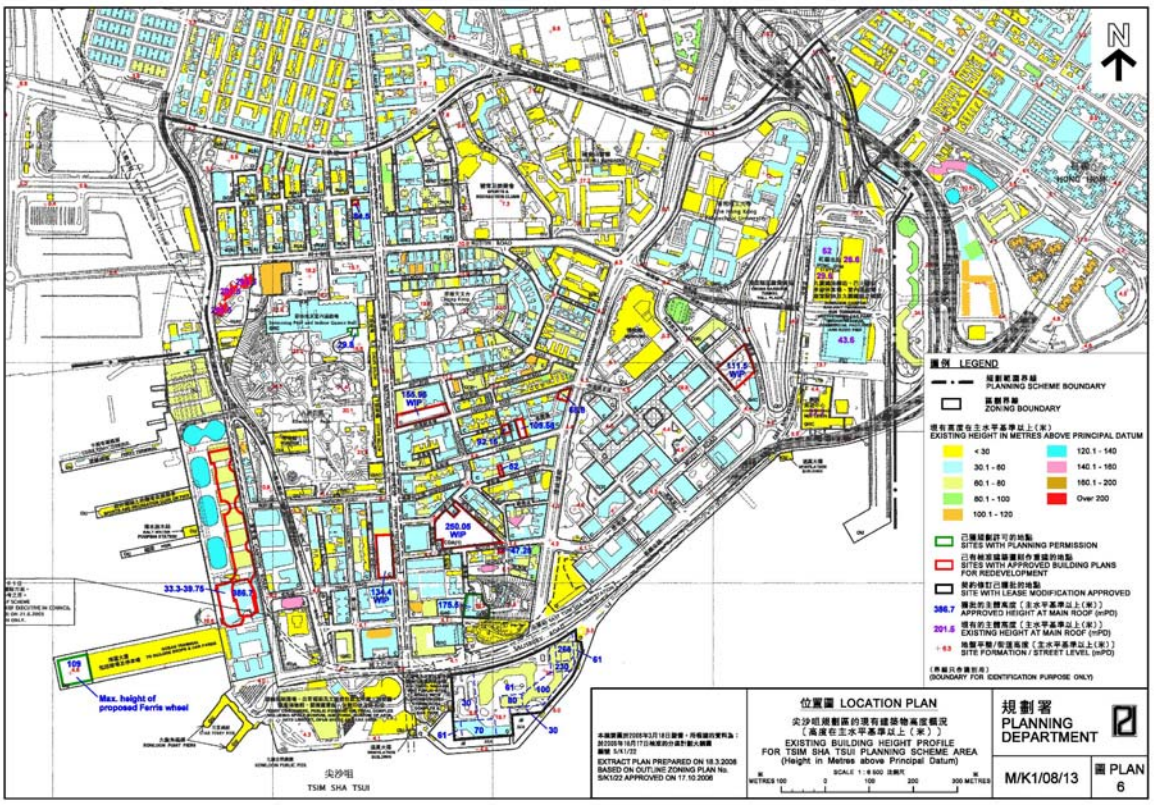


Figure 3.1 The Existing Scenario – Existing + Committed/Approved buildings.

3.2 Main Air Paths of the study area: Chatham Road South, Nathan Road and Salisbury Road are the major air paths of the study area. Austin Road and Jordon Road are also useful for the area (Figure 3.2).

3.3 Open Spaces and Greeneries of the study area: The study area has a number of green and open areas; they are very useful for the study area's air ventilation (Figure 3.2). In particular, the series of open and green areas along the Hong Kong Cultural Centre, Signal Hill Garden, Chatham Road South and the Kowloon Bowling Green Club and Kowloon Cricket Club provide a useful continuous air path.

3.4 The study area can largely be divided into 7 zones (Figure 3.3)

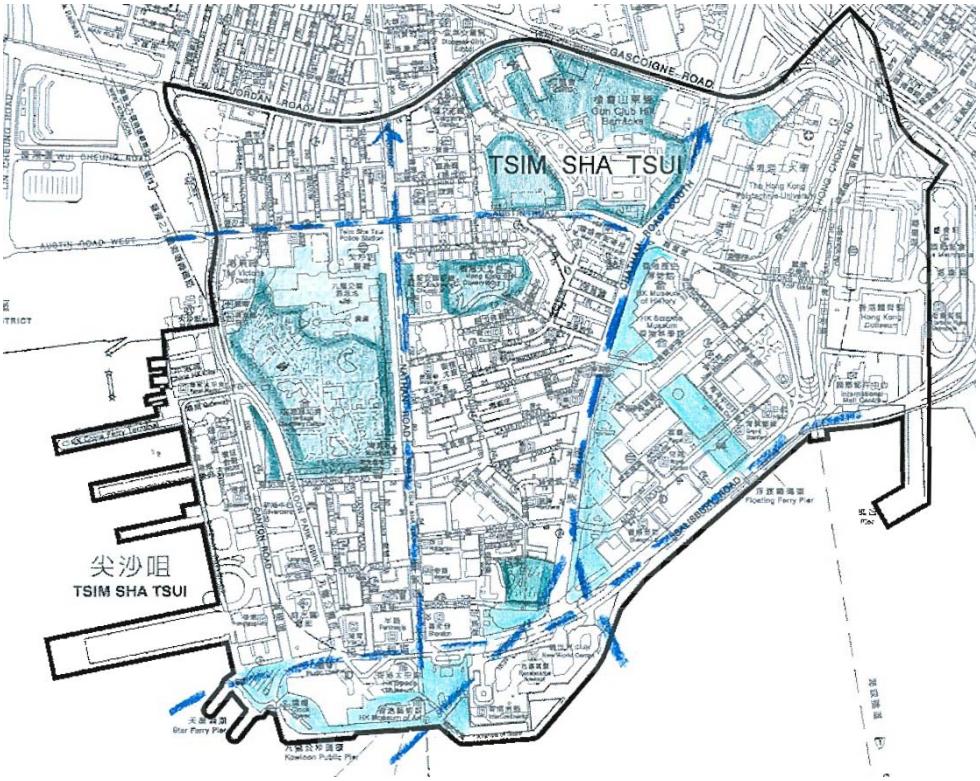


Figure 3.2 Green and Open spaces and potential air paths of the study area.

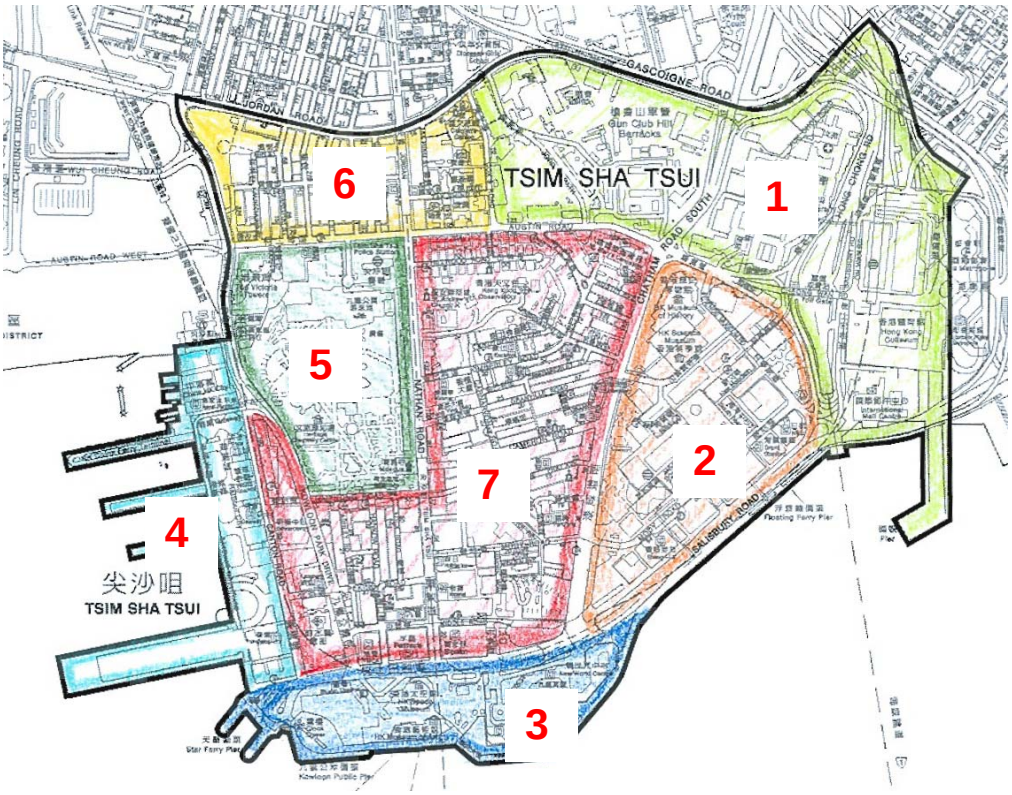


Figure 3.3 The seven main zones of the study area

3.5 Zone 1: In general, the easterly and south-easterly winds move over the zone unobstructed from the Victoria Habour. Under the southerly winds, buildings to its south generally reduce the air ventilation availability. Nonetheless, with low rise buildings of low density development and a fair amount of open spaces, this zone has little air ventilation issues. The easterly wind can penetrate Zone 1 and benefit Zone 6.

3.6 Zone 2: Tsim Sha Tsui East has buildings more or less of uniform building heights of around 60 mPD. The building height to street width (H/W) ratio is low – around 2:1. There are useful open spaces from the waterfront to Chatham Road South for air ventilation to the inland. This zone has little air ventilation issues. The easterly and south-easterly wind can penetrate and benefit Zone 7. Zone 2 is strategically important providing air ventilation to the eastern areas of Zone 7.

3.7 Zone 2: The strip of open space on the western boundary of Zone 2 along Chatham Road South is very useful. Together with Salisbury Road, they create a wide air path allowing the south winds to channel into the city.

3.8 Zone 2: Open spaces along Mody Road between Science Museum Road and Salisbury Road are extremely useful air paths for the easterly and south-easterly winds to penetrate the study area.

3.9 Zone 3: The waterfront south of Salisbury Road has no air ventilation issues. This zone is strategically important providing air ventilation to the southern areas of Zone 7.

3.10 Zone 4: This zone is at the leeward side of the north-easterly, easterly and south-easterly winds. Nonetheless, it enjoys good south-westerly wind in the summer. This zone has little air ventilation issues. However, the zone's permeability is strategic to air ventilation to zone 5.

3.11 Canton Road East of Zone 4 has weak air ventilation as the road stops short of the water front. The bulky Cultural Centre blocks a lot of the southerly winds entering Canton Road. Buildings and their large podiums at Canton Road East reduces air ventilation in the area.

3.12 Zone 5: Kowloon Park is the air lung of the study area.

3.13 Zone 5: Kowloon Park can potentially provide a lot of air ventilation benefits to Zone 6 especially under the summer southerly winds. There are already a few tall buildings on the north-west corner of Kowloon Park reducing this potential.

3.14 Zone 6: The areas between Jordon Road and Austin Road have parallel streets that are perpendicular to the easterly wind. It has narrow streets. The H/W ratio is around 2:1 to 3:1. This area has weak air ventilation performance. For the summer southerly winds, the north-south orientated streets are useful air paths.

3.15 Zone 7: The easterly and south-easterly winds generally pass easily through Zone 2. However, due to the wall like buildings along the western side of Chatham

Road South, instead of entering the zone via Granville Road, Cameron Road and Mody Road, the winds will mostly just re-circulate in the open space east of Chatham Road South (refer to Figure 6.2); only limited wind will enter these roads.

3.16 Zone 7: This zone is at the heart of TST. In general, this area has weak air ventilation performance for the following reasons. Firstly, it is surrounded by the other zones and thus not enjoying directly the incoming winds from the Harbour. Secondly, it has narrow streets and roads. Thirdly, many Streets and Roads, like Hillwood Road, Kimberley Road, Prat Avenue, and so on, do not run through the zone from one end to the other, and thus are not useful air paths for the zone. Some air path potentials come from Granville Road, Cameron Road, Mody Road and Middle Road. Currently, they are too narrow; and due to tall buildings on both side and a high H/W ratio of 4:1 and above, their air path potentials are not optimized.

3.17 Zone 7: The greeneries of Hong Kong Observatory are beneficial. However, due to the fact that it is surrounded on three sides, its benefits are localized.

3.18 Zone 7: The areas bounded by Kimberley Road, Salisbury Road, Chatham Road South and Nathan Road have very high ground coverage. The area has no open spaces, buildings generally occupy the entire site, and streets are very narrow. These urban morphologies are not conducive to air ventilation performance in the area.

3.19 Zone 7: Likewise, the areas bounded by Haiphong Road, Canton Road, Salisbury Road and Nathan Road also suffer from the urban morphologies identified in 3.16 above. The north-south roads channels some southerly winds through the areas. The east-west roads are not effective air paths.

3.20 In general, Zones 1, 2, 3, 4 and 5 have little or no air ventilation issues. They should be further designed to retain this quality, as well as not to adversely affect its neighbouring zones or the city beyond. Zone 6 and 7 require design and planning interventions to mitigate or to improve their air ventilation.

4.0 The Study Area with Committed, Approved and Work in Progress (WIP) Developments

4.1 The key problems of tall buildings are that they add to the roughness of the city fabric and thus reduce air ventilation. A tall and slab like building directly blocking an air path can greatly reduce the efficacy of the air path. Likewise, a tall and slab like building on the windward side of the city can create a large wake area to its rear. The wake area can have weak air ventilation and stagnant zones.

4.2 There are a few isolated committed and WIP developments in the study area (Figure 3.1)

4.3 The WIP buildings at the junction of Nathan Road and Peking Road and the large building and podium on Mody Road greatly further reduce the efficacy of Mody Road as an air path.

4.4 Other tall, committed and WIP, buildings, for example the development on Science Museum Road (111.5 mPD), Middle Road (175.5 mPD) and Canton Road (386.7mPD), are isolated towers. They will create their own wind wakes, but their impact to the wider city fabric is not significant.

4.5 The water front sites east of the Cultural Centre and south of Salisbury Road needs very careful design so as not to block the incoming summer southerly winds into Chatham Road South.

4.6 The slab like building on Granville Road will create a wake area to its north when the summer wind is from the south. Some benefits can be felt on Granville Road due to the possibility of some downwashes.

4.7 Apart from the concern of tall building creating wind wakes, tall buildings produce wind amplification not conducive to pedestrian comfort in strong wind conditions. The approved towers on Canton Road (386.7 mPD) and on the water front on Salisbury Road (265 mPD) may need further studies to mitigate possible wind amplifications at the ground level near their bases.

5.0 The Initial Planned Scenario

5.1 The assessment is based on the information supplied by Planning Department on the initial planned scenario (Figure 5.1), and the zones defined in Figure 3.3.

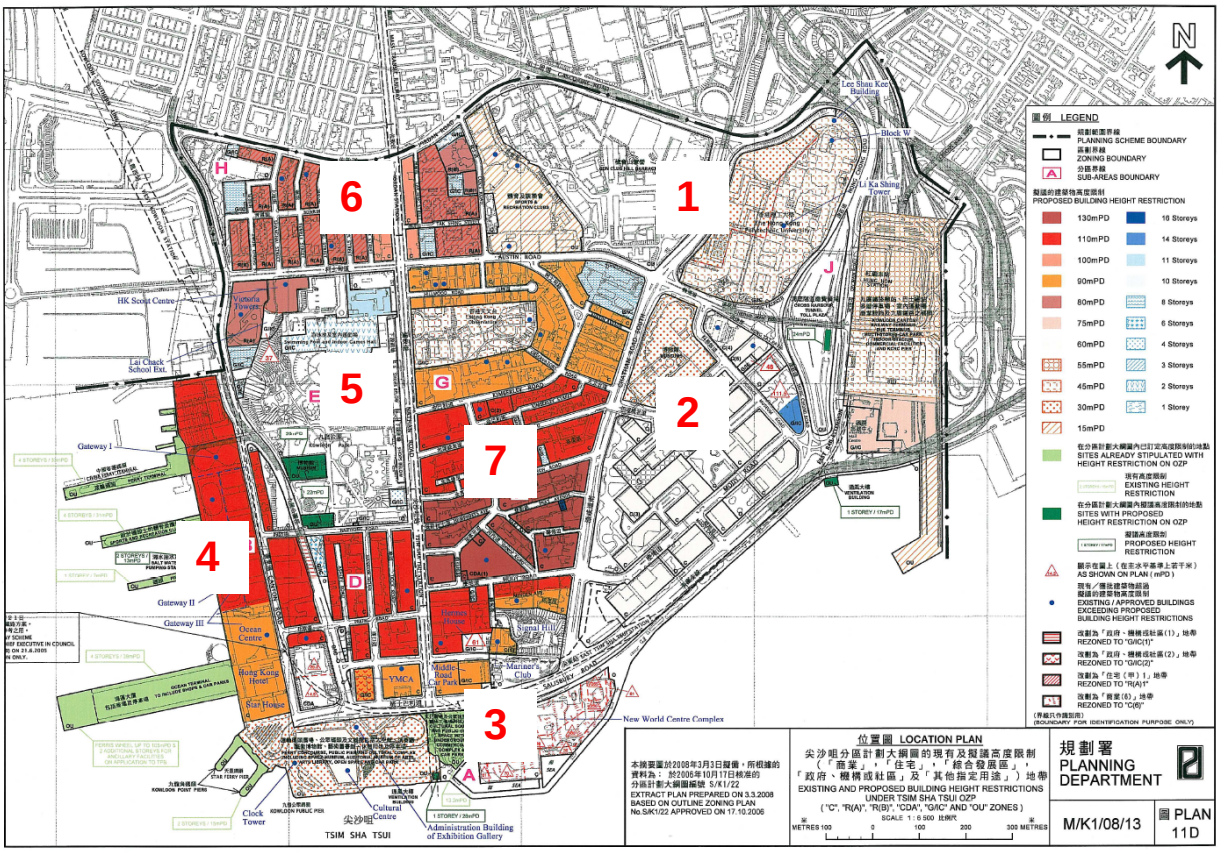


Figure 5.1 The initial planned scenario

5.2 Zone 1: The proposed height restrictions (between 15 mPD and 55 mPD) will largely conserve the existing characteristics. This is reasonable.

5.3 Zone 2: The proposed height restriction of 30 mPD over the museums is reasonable. For the rest of zone 2, the proposed height restrictions (60 mPD) will retain the existing conditions. To further improve air ventilation, it is recommended that some non-building areas be specified allowing the summer east and south-easterly wind to pass through this zone so as to benefit Zone 7.

5.4 Zone 3: It is too general to propose a building height restriction of 30 mPD from the Star Ferry Terminal to the Cultural Centre public open space. It is very important (a) to specify non-building areas as air paths to benefit Canton Road, Kowloon Park Drive, Hankow Road, and most importantly Nathan Road, (b) in general to ensure that the building footprints are small, and (c) that there are plenty of green open spaces.

5.5 Zone 3: The recommendations of 5.4 above generally apply also to the areas west of the public open space of Cultural Centre.

5.6 Zone 4: Currently, the podium covers the zone entirely. This podium reduces air ventilation across it from east to west and vice versa. A general 90 mPD to 110 mPD proposed height restriction of the zone is not recommended. It is important to specify some air paths through it as non-building areas.

5.7 Zone 5: The height restrictions largely follow the existing characteristics. There are no air ventilation issues.

5.8 Zone 5: It may be useful to specify a non building area forming an air path between Hong Kong Scout Centre and Victoria Tower. This will benefit air ventilation of Kwun Chung Street and Shanghai Street on the northern side of Austin Road.

5.9 Zone 6: Existing building heights are in the range of around 30 mPD to 80 mPD. Taller buildings up to 100 mPD under the proposed building height restrictions are anticipated. This will generally increase the building height to street width ratio (H/W) from around 2:1 to around 5:1. This will greatly reduce air ventilation especially when the winds come from the east. In addition, the added building bulks will decrease the efficacy of the north-south orientated streets as air paths in the area when the summer winds come from the southerly quarters. It is useful to widen them.

5.10 Zone 6: It is useful to specify a non building area extending Bowring Road eastward all the way to the ground of Sports and Recreation Club.

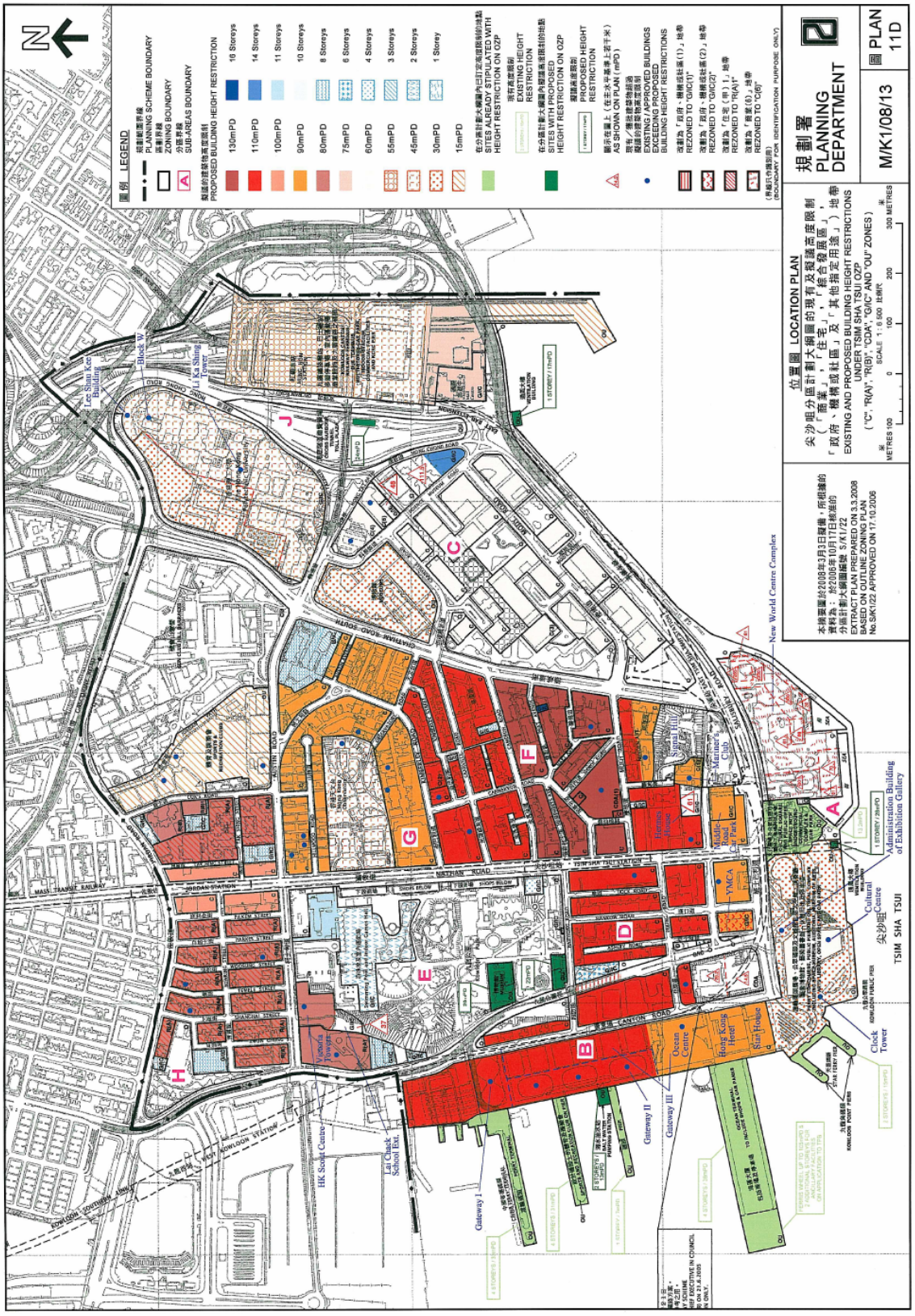
5.11 Zone 7: Existing building heights are in the range of around 30 mPD to 80 mPD. Taller buildings up to 130 mPD under the proposed building height restrictions are anticipated. This will greatly increase the building height to street width ratio (H/W) from around 2:1 to more than 10:1 in some cases. This will greatly reduce the already poor air ventilation of the area. It is very important to consider measures to mitigate.

5.12 Zone 7: It is important to widen the air space of all the east-west orientated streets and roads. It is also useful to find ways to introduce north-south non-building areas across the building blocks. In particular, for the area between Cameron Road and Mody Road, where buildings will be taller, it is very useful to find ways to introduce non-building areas, building setbacks, open spaces and building perforations.

5.13 It is useful to find ways to extend the Mody Road air path westward across Nathan Road, and all the way to the waterfront to the west of the study area.

5.14 An indication of the recommended air paths to consider creating / enhancing can be summarized in Figure 5.2.

The initial planned scenario – an enlarged version of Figure 5.1



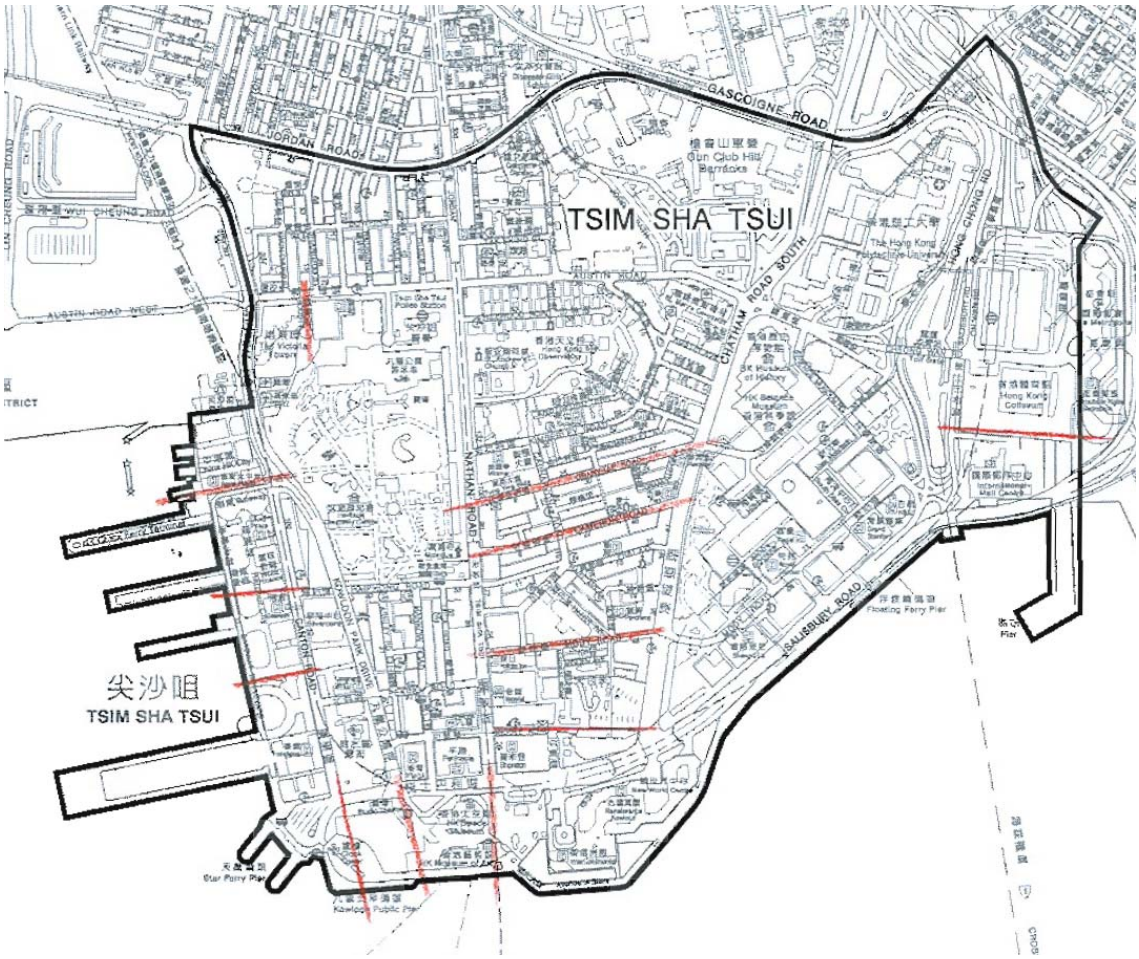


Figure 5.2 Recommended air paths to be considered along with building height restrictions for the study area.

6.0 The Study Area with Potential Re-Development

6.1 The air ventilation in some denser parts of the study area can be poor (for example Zone 6 and 7 of the study area), and will worsen further due to the potential re-development. Given the congested building environment of the study area with lots of tall buildings already and the possibility of having many more taller and bulkier buildings, height restrictions by itself may not be the most effective planning consideration for air ventilation. Introducing air paths and non-building areas, preserving open spaces, limiting site coverage, widening roads and streets are some of the more effective mitigation measures.

6.2 Given that the buildings in Zone 4, 6 and 7 of the study area are already tall, the street canyons are already deep, controlling the building heights a little bit one way or another would not affect ground level air ventilation that much. For example, all else being equal, a street canyon of H/W of 3:1, 4:1 or 5:1 would have very similar air ventilation performance at ground level (Figure 6.1). In this case, the more effective way to improve air ventilation is to introduce building gaps and city permeability.

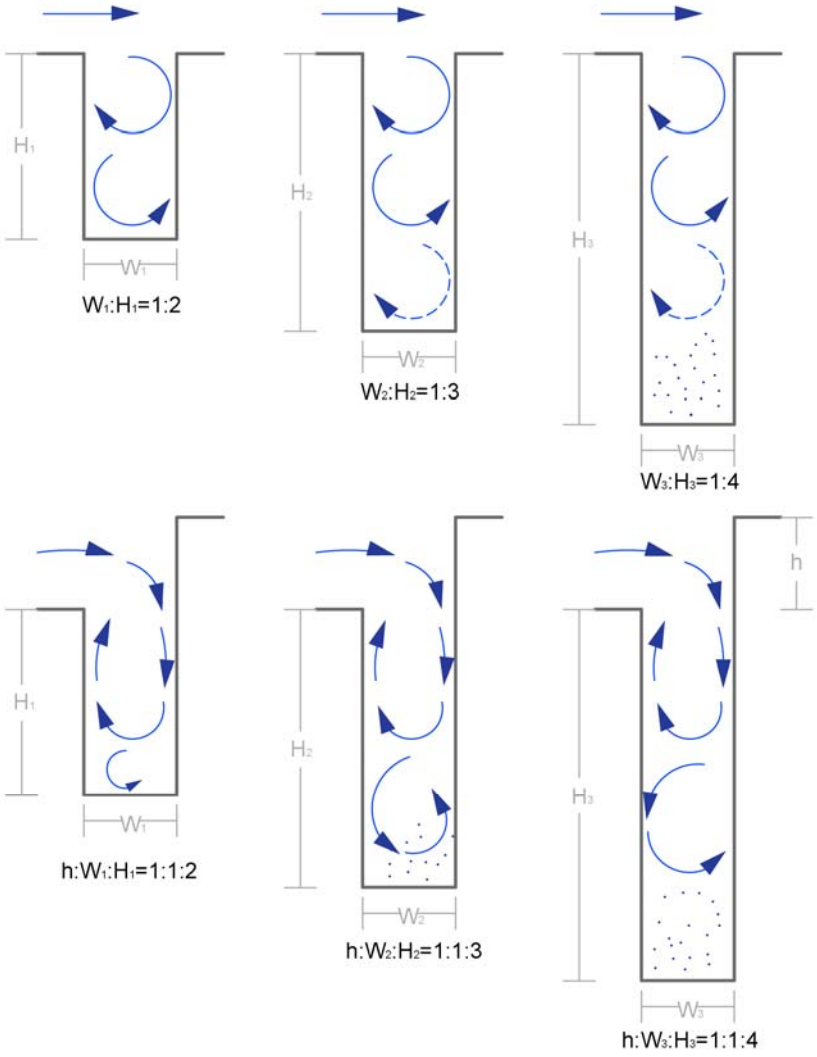


Figure 6.1 Wind regimes in canyons, and canyons with downwashes. Beyond a H/W ratio of 2:1, the ground level of canyons, even with the so call downwash effects, will have very weak eddies and air ventilation.

[Reference: A. KOVAR-PANSKUS, P. LOUKA, J.-F. SINI, E. SAVORY, M. CZECH, A. ABDELQARI, P. G. MESTAYER and N. TOY, INFLUENCE OF GEOMETRY ON THE MEAN FLOWWITHIN URBAN STREET CANYONS – A COMPARISON OFWIND TUNNEL EXPERIMENTS AND NUMERICAL SIMULATIONS, Water, Air, and Soil Pollution: Focus 2: 365–380, 2002, Kluwer Academic Publishers.]

6.3 In this case, the more effective way to improve air ventilation is to introduce building gaps and city permeability. Researchers at CUHK have previously conducted simulation studies to investigate the air ventilation characteristics of the TST areas (Figure 6.2). It was concluded that air paths between Chatham Road South and Nathan Road can be more effective if widened.

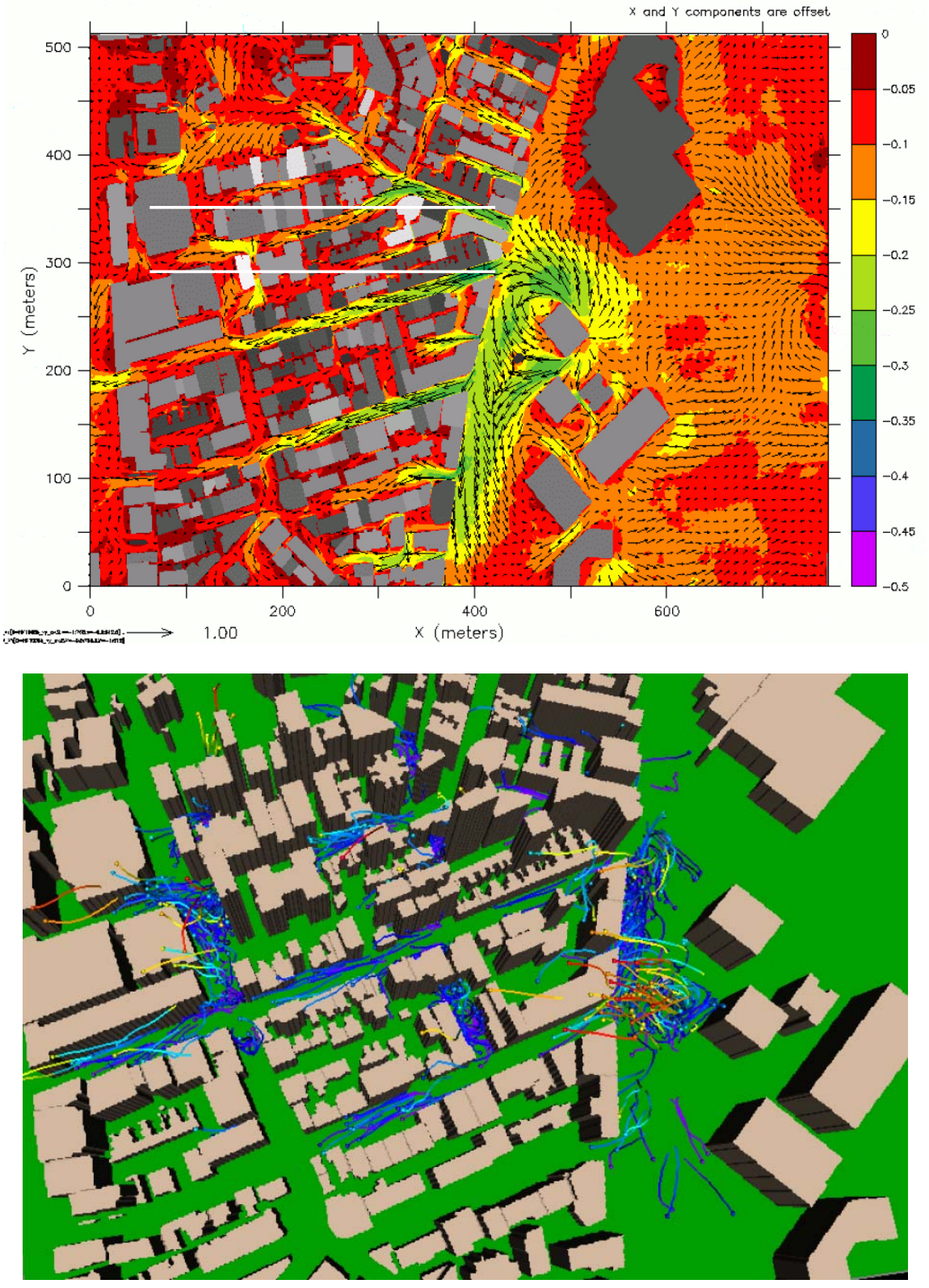


Figure 6.2 Large Eddy Simulation study of TST areas. The study illustrates the reduced usefulness of Granville Road, Cameron Road and Mody Road as air paths. Note also the air ventilation re-circulation along Chatham Road South.

7.0 The Recommended Scenario

7.1 The assessment is based on the information supplied by Planning Department on the Recommended Scenario (Figure 7.1), and the zones defined in Figure 3.3.

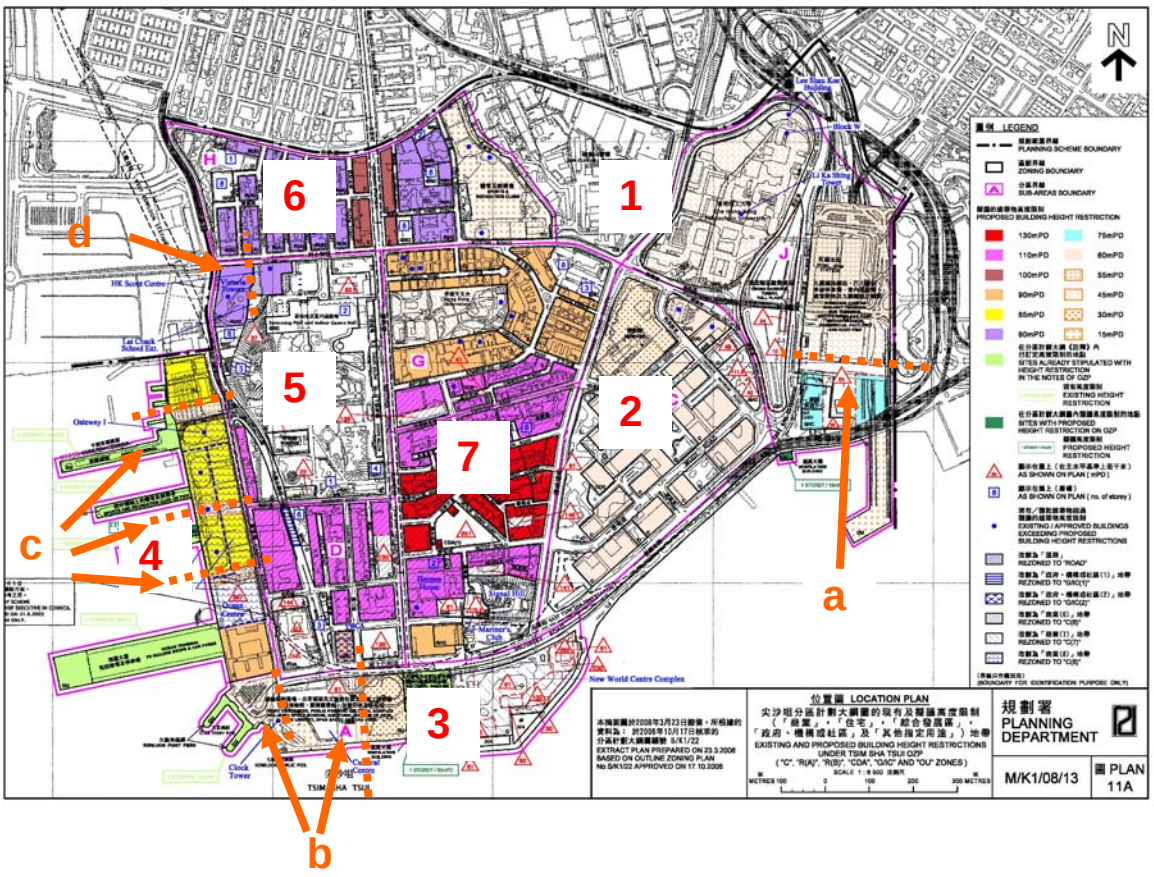


Figure 7.1 The Recommended Scenario

7.2 In response to the recommendations of the AVA expert evaluation, the proposed building height restrictions under the Recommended Scenario have taken the following air ventilation issues into consideration.

7.3 Zone 1: An air path (20m wide) restricting the maximum building height to 25mPD has been introduced at position (a) of Figure 7.1. This will allow the wind from the east penetrating better to the district, as compare to the initial planned scenario. This is welcomed.

7.4 Zone 3: To address the recommendation in 5.4 above, two areas at proposed maximum building height of 15mPD have been incorporated at position (b) of Figure 7.1. The 15mPD air path aligning HanKow Road is 20m wide. They can be useful allowing air ventilation into Canton Road, Kowloon Park Drive and Hankow Road areas of Zone 7.

7.5 Zone 4: To address the recommendation in 5.6 above, three 30m wide strips of area at proposed maximum building height of 15mPD have been incorporated at position (c) of Figure 7.1. They can be useful allowing air ventilation from Kowloon Park, Haiphong Road and Zone 7 to the waterfront.

7.6 Zone 5: To address the recommendation in 5.8 above, the strip of land between Hong Kong Scout Centre and Victoria Towers has been re-zoned to road (position (d) of Figure 7.1).

7.7 Zone 7: To address the recommendation in 5.11 to 5.12 above, an 1.5m non building area from the lot boundary abutting road/street for sites to be re-zoned to C(6) has been incorporated. This will "marginally" but can usefully compensate the adverse effects of poorer air ventilation when lots are re-developed with taller buildings.

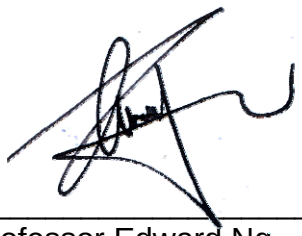
8.0 Further Studies

8.1 Further AVA studies comparing the "with" and "without" height restrictions options may not be necessary or even beneficial as it is not possible to specify the more important parameters (e.g. building geometry and block disposition within each of the building sites) in the tests.

8.2 For air ventilation, the proposed building height restrictions may be considered a "small" step towards the goal. It is important to further the OZP with studies, guidelines and restrictions of the more important design parameters like Open Space, Air Paths, Site Coverage and Non-building Area, and so on. Without these further measures, air ventilation of the study area cannot be secured. Should any further studies of AVA be needed beyond the consideration of height control restrictions be OPTIONALLY considered, it may be useful to concentrate on Zone 7 and test parametrically at least the following:

(i) as existing; and
(ii) with potential re-developments and height restrictions, and with:
option 1: no non-building area from the lot boundary
option 2: 1.5m non-building area from the lot boundary
option 3: 3m non-building area from the lot boundary
option 4: 5m non-building area from the lot boundary

8.3 The key spirit of the further studies is that given the high building height to street ratio in Zone 7, road/street and open spaces as air path are very important design considerations for air ventilation. It is useful to establish the optimum width of these air paths under the given circumstances.



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