PLANNING DEPARTMENT
Term Consultancy for Air Ventilation Assessment Services

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

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Contents

1 Introduction

In the Team Clean report published in August 2003, the Government undertook to examine the practicality of stipulating Air Ventilation Assessment (AVA) as one of the considerations for all major development or redevelopment proposals and in future plan making. Subsequently, a strategic objective to promote sustainable urban planning and design practices has been set out. One of the objectives is to look at issues such as buildings restricting air flow.

2 Objective of the Study

To facilitate better planning control, it is helpful to have a better understanding on the air ventilation characteristics of the Study Area (the Area), namely the area of the Quarry Bay "Outline Zoning Plan No. S/H/21/24". The objective of this assignment is to carry out an expert evaluation (EE) to assess the likely impact of the proposed building height restrictions of the development/redevelopment sites within the study area on the pedestrian wind environment and compared to the existing condition.

This expert evaluation is carried out based on the Air Ventilation Assessment framework as set out in the Housing, Planning and Lands Bureau, and Transport and Works Bureau Technical Circular No. 1/06 and its Annex A – Technical Guide for Air Ventilation Assessment for Development in Hong Kong.

2.1 Materials for study

This expert evaluation report is based on the materials supplied by the Planning Department to the Consultant on 30th May 2008, listed as follows:

- Aerial photo
- Existing and committed building height profile
- Planned building height profile
- Existing building height restrictions
- Proposed building height restrictions
- Postulated podium & building footprint
- Summary of development parameters
- Existing scenario - Spot height & No. of storeys
- Existing scenario - Spot height & No. of storeys for podium
- Planned Scenario - Spot height & No. of storeys
- Planned Scenario - Spot height & No. of storeys for podium
- Location & view points of site photo
- Site photos
- MM5 wind data over site

2.2 Site visit

The consultant visited the Area and carried out site inspections between 31st May 2008 and 6th June 2008. Special features of the site are referred to and photographs are given in the later part of the report.

3 Study Scope

The scope of work includes the tasks as follows.

- To identify good building design features;
- To identify any key ventilation corridors;
- To identify any potential problem areas;
- To provide recommendation for mitigation measures; and
- To advise if any further detailed study is required and the scope of the detailed study required.

4 Study Area

4.1 Site boundary and coverage

The Study Area covers the Quarry Bay area of Hong Kong Island with a total area of about 207 hectares. It is bounded by the Victoria Harbour to the north; Lei King Wan to the east; Hoi Chak Street, Java Road and Mansion Street to the West; and the Tai Tam Country Park to the south.

The Area is primarily a mixed residential and commercial area. There are a number of large-scale private residential developments to the north of King's Road extending towards the Harbour Waterfront/Quarry Bay Park (i.e. Taikoo Shing and Lei King Wan), and on the uphill towards the south (i.e. Kornhill and Nam Fung Sun Chuen). Higher density and comparatively smaller-scale residential developments are mainly found along King's Road. Major commercial activities are concentrated in Taikoo Place, along King's Road and at Cityplaza. Majority of buildings (commercial and residential) is medium-rise at about 100mPD, except the more recent residential development at north-east of the area (Grand Promenade of about 219mPD) and the office development at Taikoo Place (One Island East of about 301mPD). A map of the Area is given in Figure 4.1.

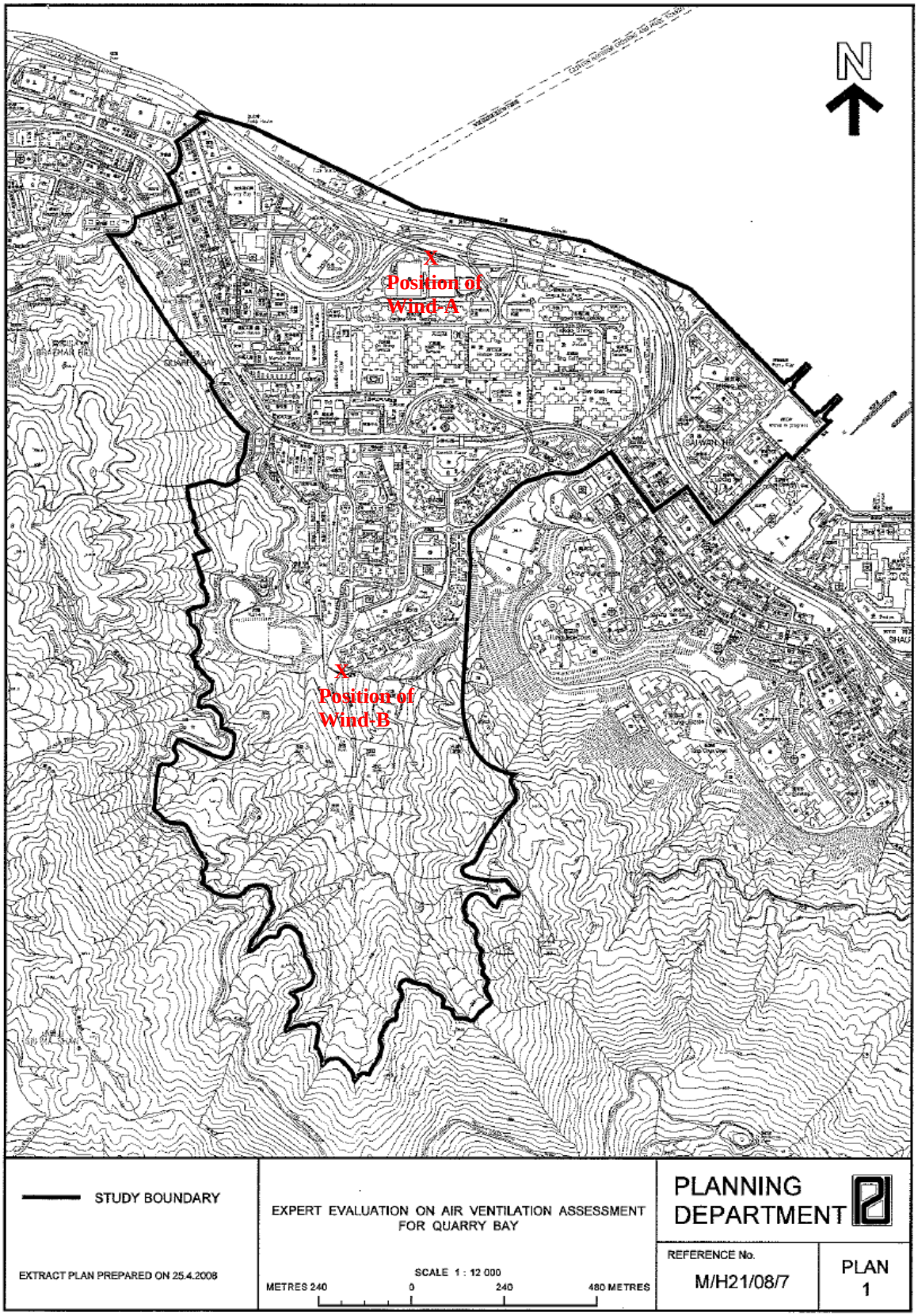


Figure 4.1 Map of Study Area

4.2 Site characteristics

Topography:

As mentioned, the site is bounded on the north by the Victoria Harbour and on the south by the Tai Tam Country Park. Therefore, the northern part of the site is at about 4mPD whereas the southern end of the site is at about 200mPD (Figure 4.2). The buildings at the southern part of Hong Shing Street have a site level of about 65-70mPD. However if we go further south, there is the Mount Parker (532m high) and the Siu Ma Shan (about 410m high) respectively on the SSE and SSW of the Area (Figure 4.3). The general site of the Area lies at the lower part of a valley stretching from south to north. Area north of the King's Road is relatively flat. From King's Road southwards, the land gradually slopes upwards.

Figure 4.2 Contour map of the area (source from Google Map)

Figure 4.3 Tall mountains further south of the Study Area

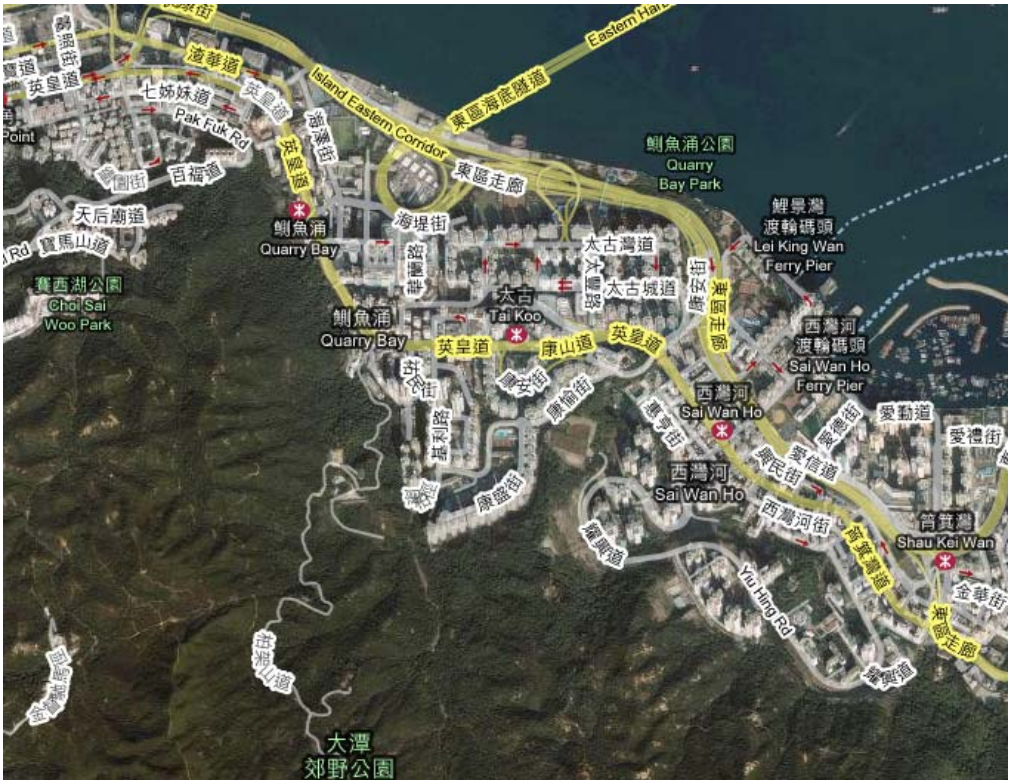


Figure 4.4 Mountain, wooded and greenery areas (from Google map)

Greenery and open space:

The southern part of the Area is part of the Tai Tam Country Park (P1) which evidently provides plenty of trees and greenery. The Area is also surrounded by greenery on its east and west. On the east, it covers about one half of the length of the site boundary, and on the west about three quarters of the site boundary (Figure 4.4). Other than this natural greenery area, the largest greenery and open space is the long stretch of parks and sport grounds along the waterfront next to the Island Eastern Corridor. From the east end, there is the Lei King Wan Park, and the Quarry Bay Park which extends almost the entire length of the northern border of the site (P2, P3). There are areas for sports (e.g. soccer field, tennis courts & etc.) at about the centre of the park (P4). Towards the west is a relatively open space formed by the big round-about of the Island Eastern Corridor. At the western end of the park (next to Hoi Chak Street) there are also areas for sports (P5). From this description, it can be seen that there are some form of greenery or open space on almost all sides of the study area. Other than these larger open spaces, there are some smaller green areas dotted here and there in the Area: (The major greenery areas are high-lighted in Figure 4.5)

- A rectangular patch of green area north of Taikoo Shing Road next to One Island East, this area is relatively big at more than 3000m^2.
- The strip of land running north-south along One Island East, Oxford House and Dah Chong Hong, to the understanding of the consultant, this strip of land is being developed into an open greenery space (P6).
- Strip of tree-lined green area along Hong Yue street and Hong Pak Path and areas along hillside between building developments in the northern sector of the Area (P7).
- There are also a few small open spaces, e.g. badminton court, pedestrian sitting area, dotted around the area (P8).
- On the roof of podium of many building complexes, there is some form of roof garden with trees and open space (P9).

Note: Photographs of the areas described are given in the Photograph Section at Annex I.

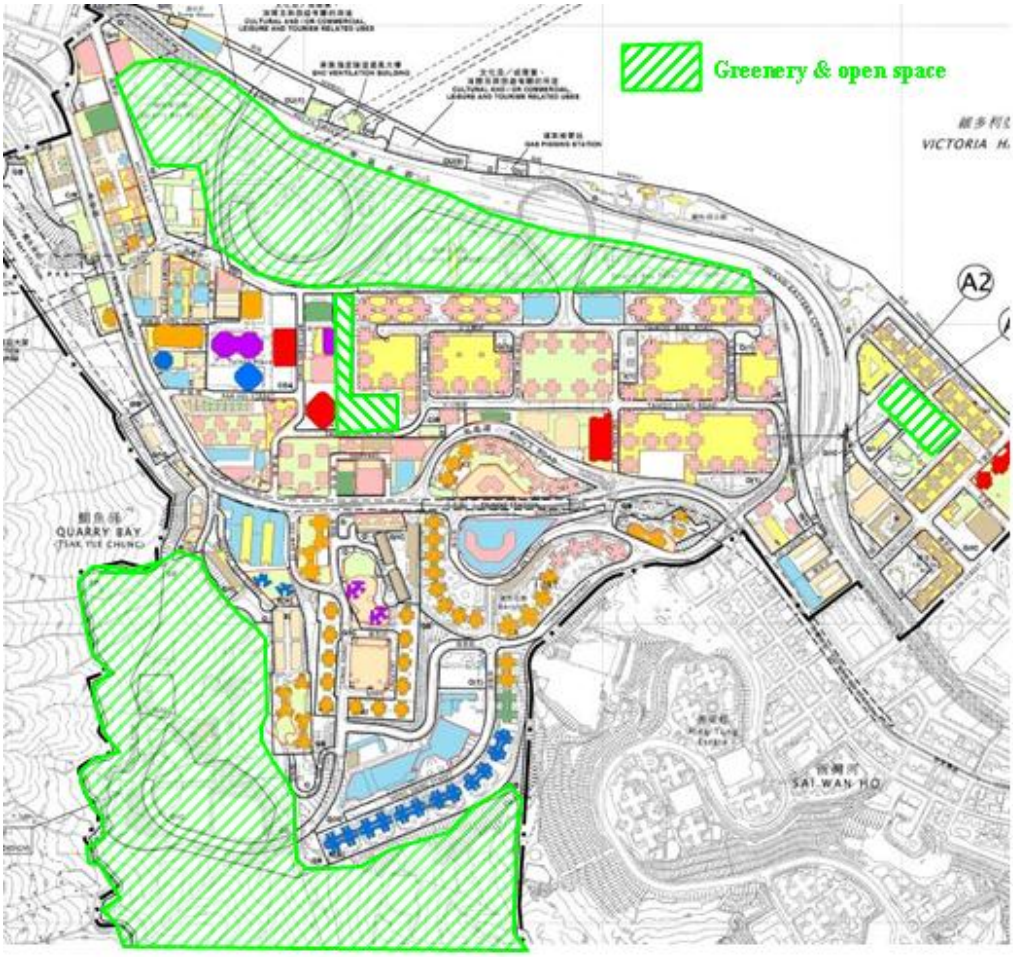


Figure 4.5 Greenery and open space

Layout of building development and street pattern:

Overall, layout of building developments within the Area can broadly be classified into three types:

1) Building complex with several tall towers and large podium of rectangular or near rectangular shapes. The various phases of Taikoo Shing north of King's Road belong to this type of development (P10). As such, the street layout around these developments are of rectangular grid pattern. Nam Fung Sun Chuen on the southern portion of the study area also has such rectangular pattern.
2) Building development where groups of tall towers (with or without podium) are constructed along a curve. The Kornhill (Upper, Middle and Lower) blocks, and the Kornhill Gardens blocks are arranged in such manner. The Kornhill (Middle and Lower) blocks together with the Kornhill Gardens blocks almost form an entire circle. Roads adjacent to these developments run along the curve (P11).
3) The third type is the older developments. They are adjoining rectangular blocks of medium-rise buildings typically found along King's Road (P12).

Due to the development pattern as mentioned, the streets of the Taikoo Shing area north of King's road are of rectangular grid pattern. They are two lane streets and with the tall towers around them having heights of around 70m-80m (P13), the street canyon formed is with height to width (H:W) ratio of about 4:1 and over. These streets run in the north-south and east-west directions. However as the King's Road on the western part of the Area bends northwards, most of the east-west running streets are blocked on their west ends and cannot run straight through. For the north-south running streets, many of them are blocked by building developments along King's Road and cannot run straight through at their southern ends. On the southern part of the Area, namely the area south of King's Road, the streets run in curves along building developments (except for Nam Fung Sun Chuen which is rectangular). The pattern of streets varies. Some, for example Greig Road, run in a more or less north-south direction and exit at the north end to King's Road. While others, for example Hong Yue Street and Hong Shing Street runs partly north but diverted to north-east before hitting King's Road.

5 The Wind Environment

Hong Kong is situated on the southern coast of Asia. The wind climate in Hong Kong can broadly be described as follows. There are the two monsoon seasons, the north-east monsoon in the winter months and the south-west monsoon in the summer months. Besides monsoon wind, Hong Kong is also subject to typhoons and thunderstorms.

Wind data are measured by the Hong Kong Observatory (HKO) at more than 40 stations spreading out all over Hong Kong. These stations measure the low level wind. One of the station where the wind is least affected by surrounding terrain and topography is Waglan station (WGL). The station is situated on top of a small island far off the south-eastern side of Hong Kong. Wind data from WGL are usually referred to by wind engineers as the more representative of Hong Kong wind condition. Figure 5.1 shows the probability distribution of wind in direction and speed for the year 2004. It can be seen that the wind from the east and north-east sectors has the higher probability of occurrence, with east being the highest. It can also be observed that the south-west sector has a small peak reflecting the occurrence of the south-west wind. Despite Figure 5.1 shows that the easterly wind as being the most frequent, wind-rose for the summer season is very different. For summer months with the south-west monsoon, a typical distribution looks like Figure 5.2 which gives the distribution for the month July 2004. It can be seen that wind from the south-west sectors has the highest probability of occurrence. From these figures, it can be concluded that wind conditions in Hong Kong is such that, for the whole year majority of the wind comes from the east and north-east. However during the summer months, majority of the wind comes from the south-west.

While the wind condition as described is the wind condition for Hong Kong not, or minimally, affected by obstructions, terrain and topography, for a specific site, however, the site wind is always affected by terrain and topography. It is therefore necessary to have the site wind data. The nearest HKO wind station to the Area is the North Point (NP) station which is slightly to the west of the Area and deeper inside Victoria Harbour. Figure 5.3 shows the annual wind directional distribution for North Point (NP) Station in 2004. It can be seen the pattern is very different from that of Figure 5.1 for WGL. The

wind for NP comes primarily from the east with a probability of occurrence much greater than other sectors. On the west sector there is also a small peak. The difference between the distribution of WGL and NP is due to the topographic effect. Winds for NP are channeled through Victoria Harbour which runs in the east-west direct at NP.

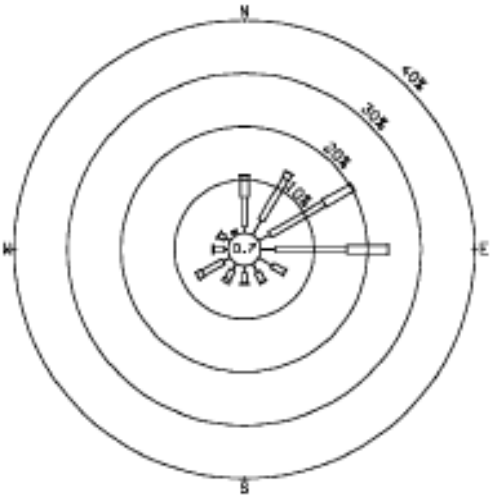


Figure 5.1 Wind rose for WGL
Annual for year 2004 (HKO)

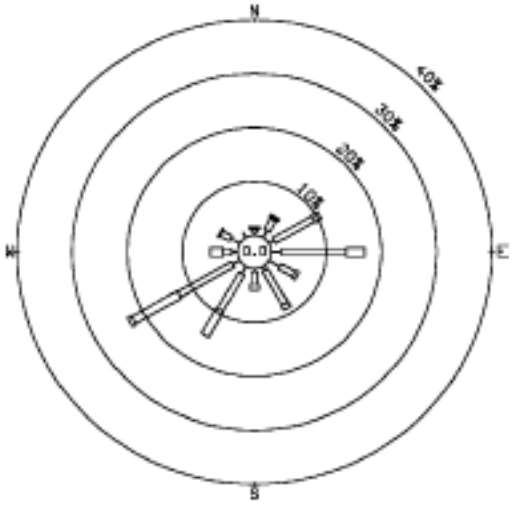


Figure 5.2 Wind rose for WGL
monthly for July 2004 (HKO)

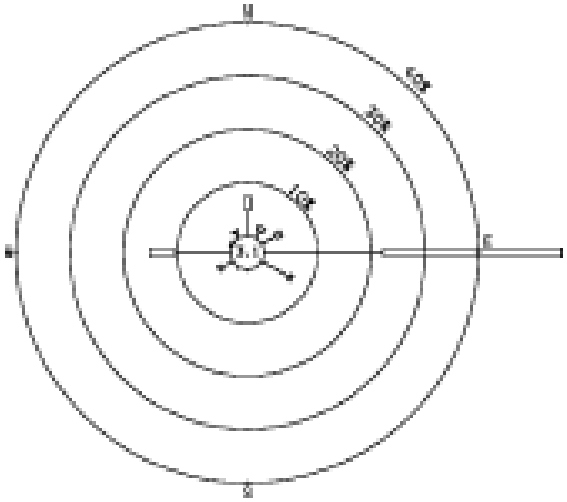


Figure 5.3 Wind rose for North Point
Annual for year 2004 (HKO)

5.1 Wind data from MM5 simulation result and site wind availability

In the previous section, it is pointed out that the local site topography can affect strongly the wind condition of the site. Thus it would be desirable to have wind data measured at the Area to investigate the wind performance of the developments. The wind station from

HKO is some distance away from the Area; thus other means must be employed to estimate the site available wind. One method is by using mathematical modeling. The Institute of Environment, Hong Kong University of Science and Technology has produced a set of Hong Kong wind field simulated data using the Fifth-Generation NCAR/Penn State Mesoscale Model (MM5). The simulation period is for the whole year 2004. As this set of data covers the whole of Hong Kong, it is used for the present study.

Figure 5.4 shows the annual (2004) wind rose of the simulation result of the higher level wind (230m) for WGL. Figure 5.5 show a similar result but for low level wind (60m).

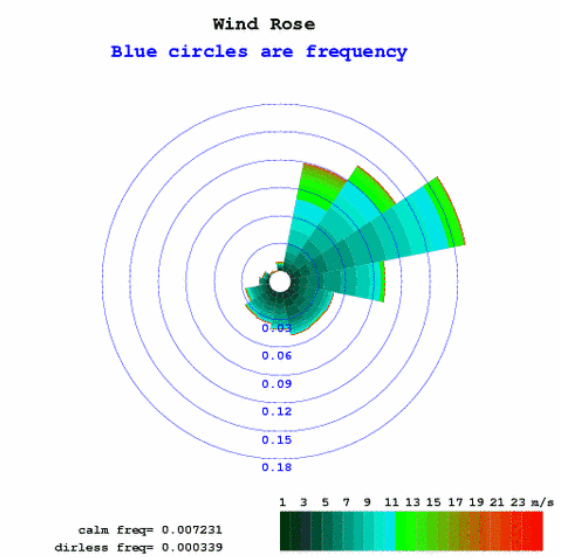


Figure 5.4 WGL (230m) annual

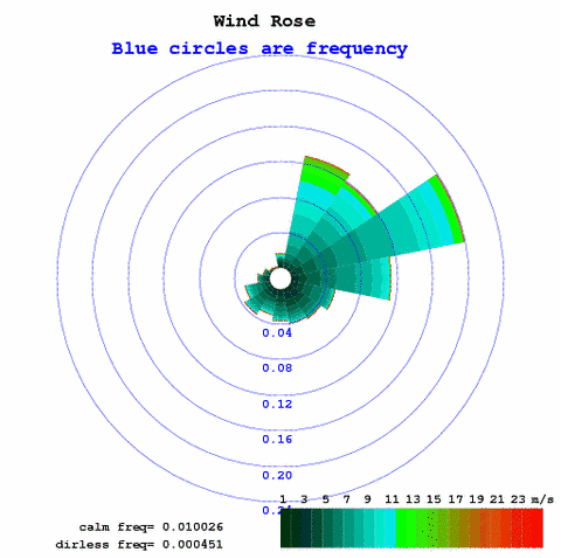


Figure 5.5 WGL (60m) annual

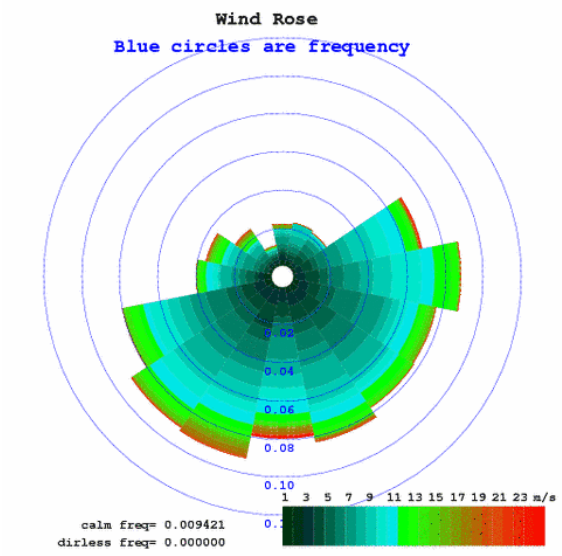


Figure 5.6 WGL (230m) summer

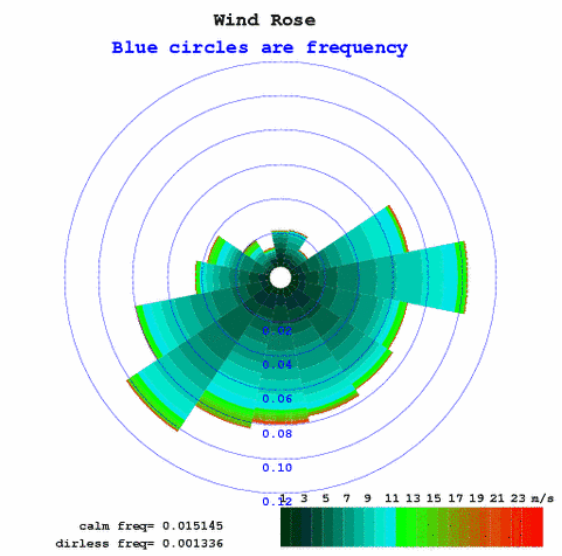


Figure 5.7 WGL (60m) summer

Comparing the simulated data, Figure 5.4 and even the low level result of Figure 5.5, with the measured data, Figure 5.1, there are some discrepancies. Although both result have the majority of the wind coming from the N-NE-E sectors, the highest probability of the simulated data is from ENE; while that of the measured data is from E. Figures 5.6 and 5.7 are the result of the simulated data for the summer months (June, July and August). Some discrepancies can also be observed when compared with Figure 5.2. Although discrepancies are observed, the main pattern of variation is produced by the MM5 simulation. Without having a better data source, the MM5 simulated data is used for the Area.

MM5 simulation data at various location of the Area was investigated. Result for two locations, point Wind-A at the northern part of the site and point Wind-B at the south middle third of the site are selected for presentation (locations of Wind-A and Wind-B are shown in Figure 4.1). The annual and summer directional and speed distributions of winds at height of 230m and 120m for Wind-A and Wind-B are shown respectively in Figure 5.8 and Figure 5.9. The 120m wind was selected as it is about the height of the urban canopy. A higher elevation was also selected for comparison and 230m was used as it is less affected by buildings but still under the influence of topographic effect. Looking at the figures, the following points can be observed:

- Comparing the annual wind for 230m with that of WGL (figure 5.4) the pattern is similar. However, the wind from the eastern sector has a higher occurrence in the study area than WGL. This is probably due to the channeling effect of Victoria Harbour.

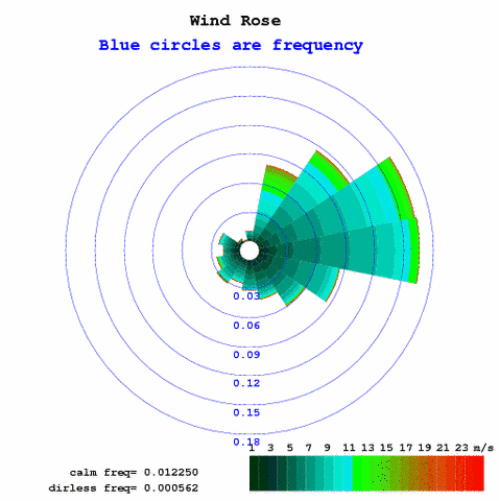
- Comparing the summer wind for 230m with that of WGL (figure 5.6) the pattern is also similar. Except that winds from the SW sector and the wind from SE-ESE sectors occur more often over the study area than WGL, due to the local topography of the site.

- Comparing the lower level result (120m) with those of the higher level (230m) of locations Wind-A & Wind-B, other than that wind speeds at the lower level being slightly lower, the local topographic effect is more pronounced at the lower level. That is, for the annual distribution, there is a larger component on the eastern sector at lower level. And, for the summer wind, a more pronounced ESE component for Wind-A and SW for Wind-B.

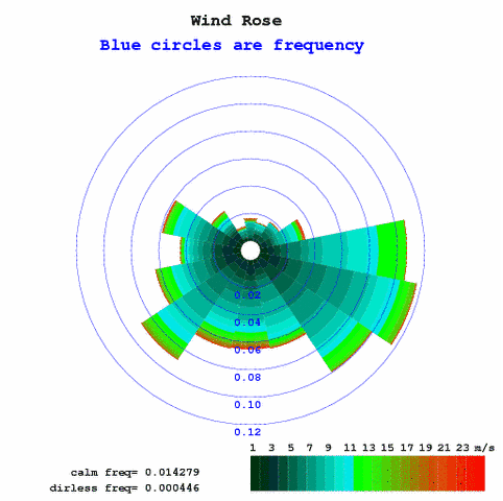
- Comparing the 120m winds for Wind-A (coastal, low elevation) and Wind-B (up the hill slope, higher elevation), the distribution patterns seem to be quite similar. However if we do a difference of the two locations (i.e. Values from Wind-B minus those of Wind-A), the following plots are generated. Figure 5.10 is plotted according to wind speed (+ve values indicate Wind-B has a higher probability). It can be seen that consistently Wind-B has higher probability for the larger wind speeds and lower probability for the lower wind speed. That is to say, wind speed in general is higher at Wind-B than Wind-A. This follows as Wind-B is on higher ground than Wind-A. For the summer wind, the pattern varies a bit; but the same trend of higher wind speed for Wind-B can be seen. Figure 5.11 is plotted in according to wind direction. It can be seen that location

wind-A has higher probability of wind from ESE and WNW sectors (wind parallel to the Victoria harbour); while location Wind-B has higher probability of wind from SSW. (wind aligning the valley direction).

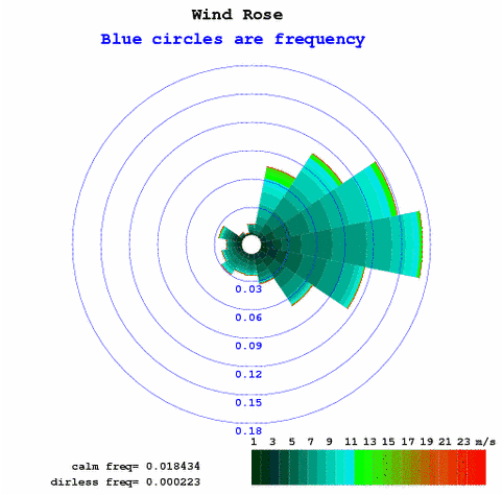
- To summarize, the general wind pattern for the Area is that for the whole year, wind is more probable from the eastern sector with also high probability from the ENE sector. A smaller ESE component also occurs on the northern part of the Area. In the summer months, winds are more probable in two directions, from the SW sector and SE – E sectors. It has also been demonstrated that the middle and southern part of the study area is having higher wind speed than the northern part of the study area.



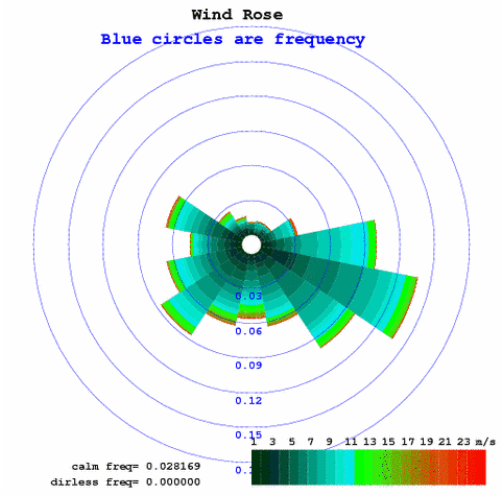
Annual (230m)



Summer (230m)

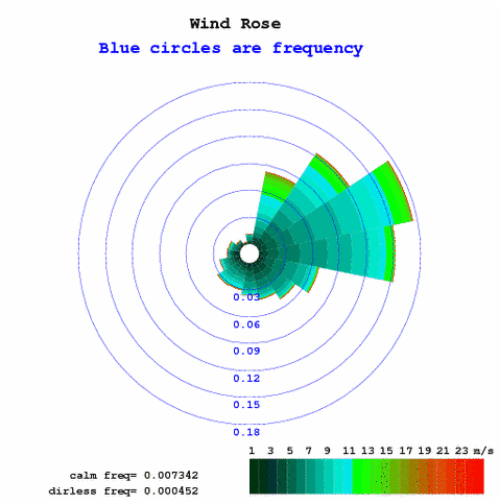


Annual (120m)

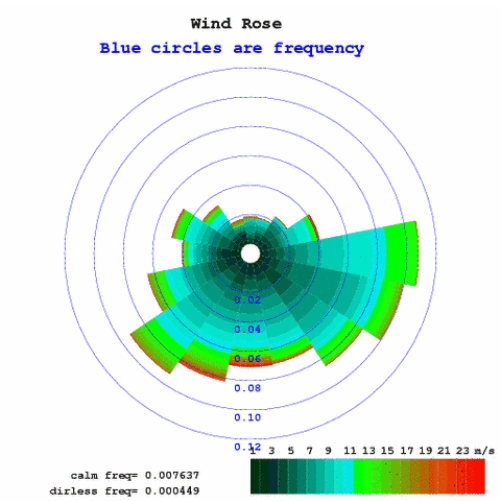


Summer (120m)

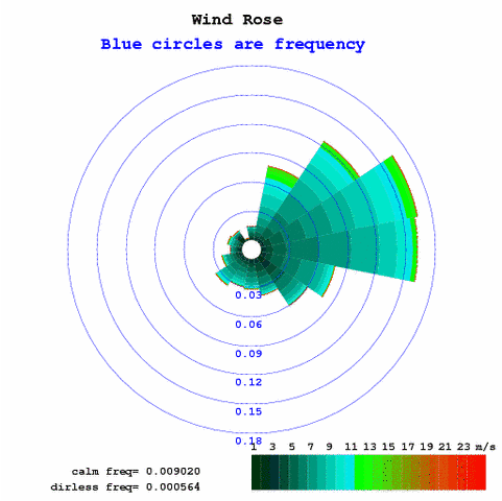
Figure 5.8 Wind rose of point Wind-A in the study area



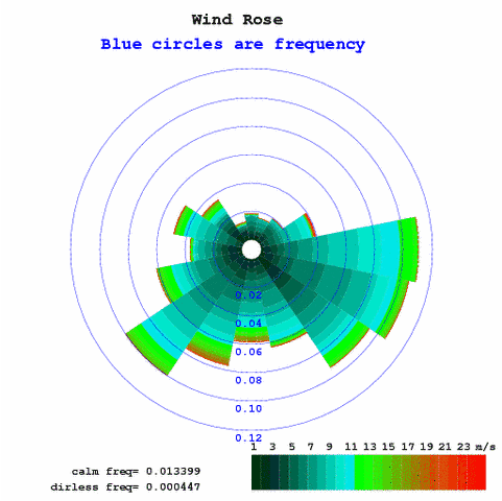
Annual (230m)



Summer (230m)

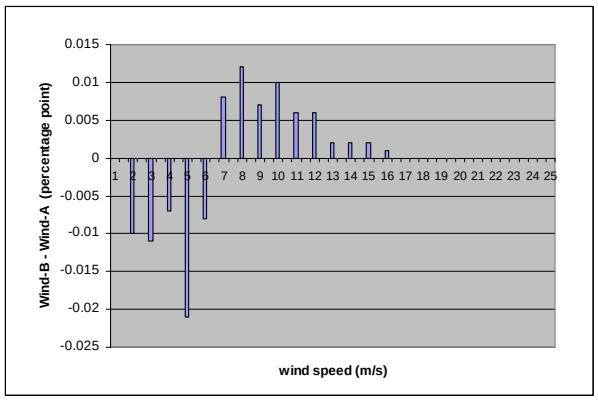


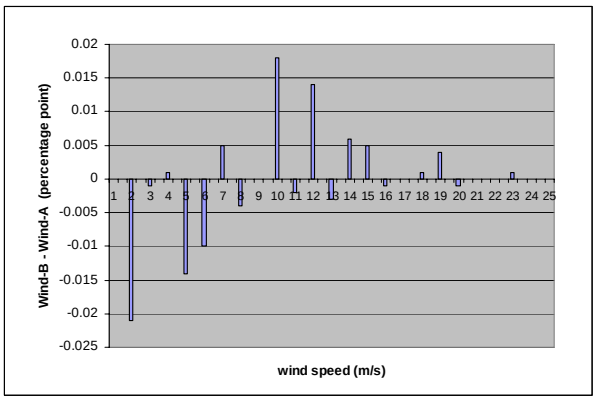
Annual (120m)



Summer (120m)

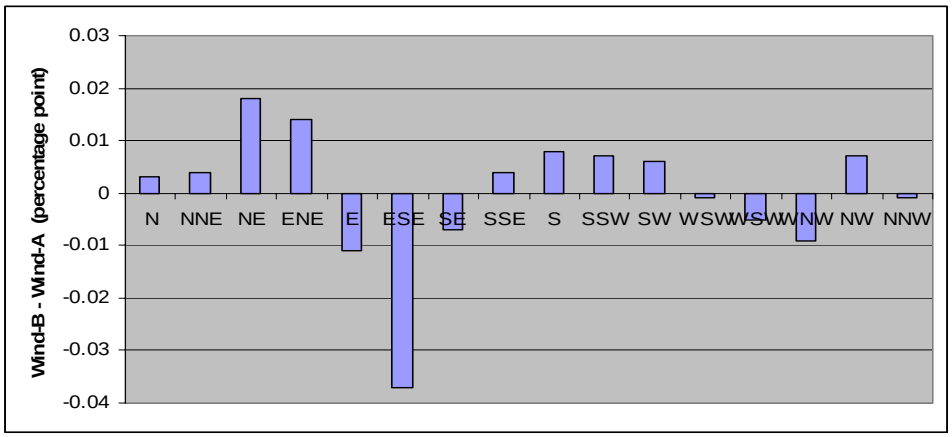
Figure 5.9 Wind rose of point Wind-B in the study area



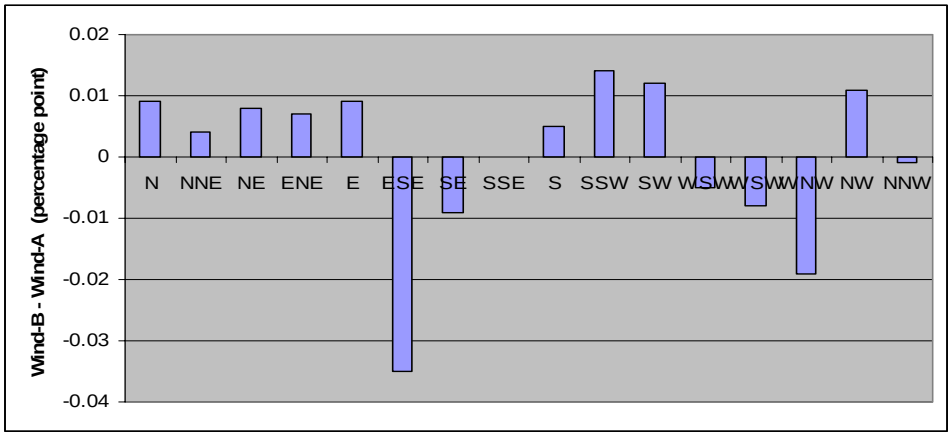


Annual (120m) Summer (120m)

Figure 5.10 Difference between Wind-A and Wind-B according to wind speed



Annual (120m)



Summer (120m)

Figure 5.11 Difference between Wind-A and Wind-B according to wind direction

6 Flow Evaluation

6.1 Topographic effect

Winds blowing onto the site from the general E - NE directions reach the site almost directly from the sea. At the height of 120m, the annual average available wind speed (from MM5) is about 6.3m/s. This is to say, at the sea front for an unobstructed site, the pedestrian wind may have wind speeds around 2m/s - 3m/s. But as wind moves inland over rougher terrains, i.e., buildings and obstructions, it will be slowed down. It is therefore important to preserve this available wind.

Over the southern part of the study area (Wind-B), the most probable annual winds are from the E - NE sectors; the annual average wind speed at 120m (from MM5) is about 6.6m/s. This slightly higher wind speed is probably due to the higher ground elevation (heights of MM5 are measured from ground level). For a rougher terrain, this translates to about 1.5m/s - 2m/s at pedestrian level (without obstruction). Similarly it is important that this available wind should be preserved.

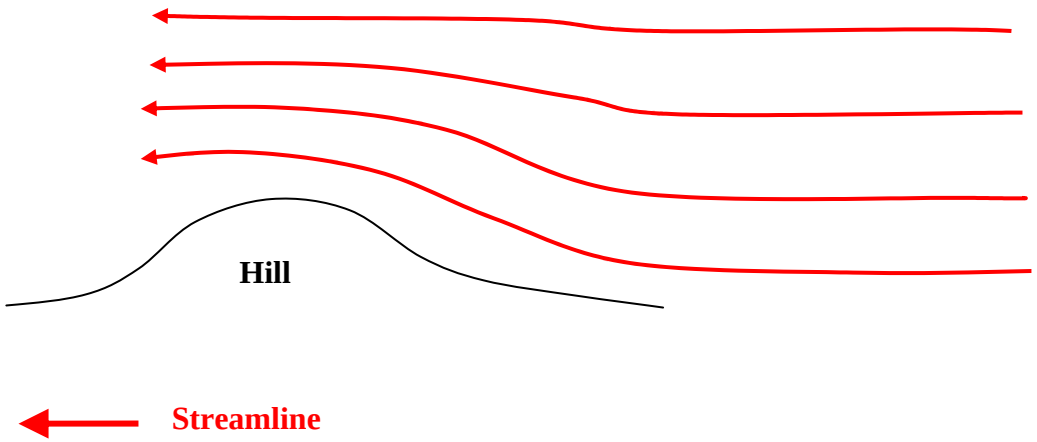


Figure 6.1 Wind blow up hill

From Figure 6.1 it can be seen that as the wind blows uphill, the stream-lines gets closer to one another. With closer spacing of the stream-lines, a higher flow rate is required to maintain continuity. This results a higher wind speed at higher altitudes (even at the same height above ground).

In the summer seasons, the most probable winds are from SW and ESE; these directions are wind blowing down slopes. When wind blows down-slope, there are two scenarios. If the slope is not steep, it will be the reverse to the up-slope case with the stream-lines getting wider apart as the wind blows down hill. If the slope is very steep, vortices will be generated down-wind of the slope forming a turbulent zone of low wind speed (Figure 6.2). In the case of the Area with wind blowing down the valley, the slope

is not that steep (Figure 6.3). The 120m-height average wind speed (average for the summer months) for Wind-A and Wind-B are respectively 6.7m/s and 7.0m/s. This again reflects the higher wind speed at the higher elevation. That means the result doesn't seem to indicate that there is a low speed zone for the present case.

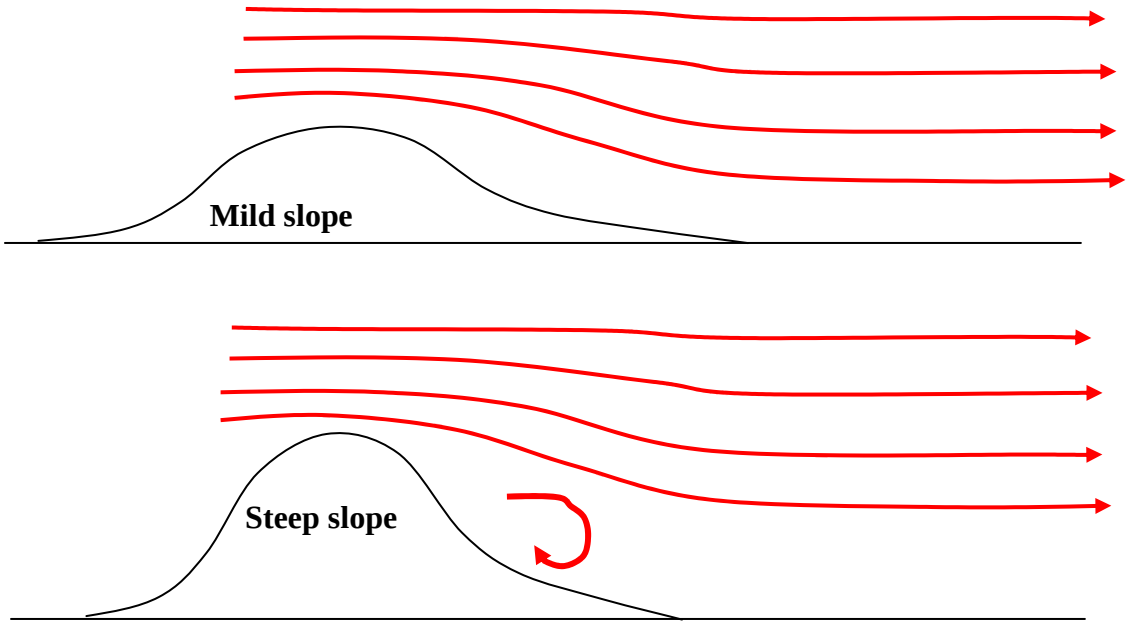


Figure 6.2 Wind blowing down hill (mild or steep slope)

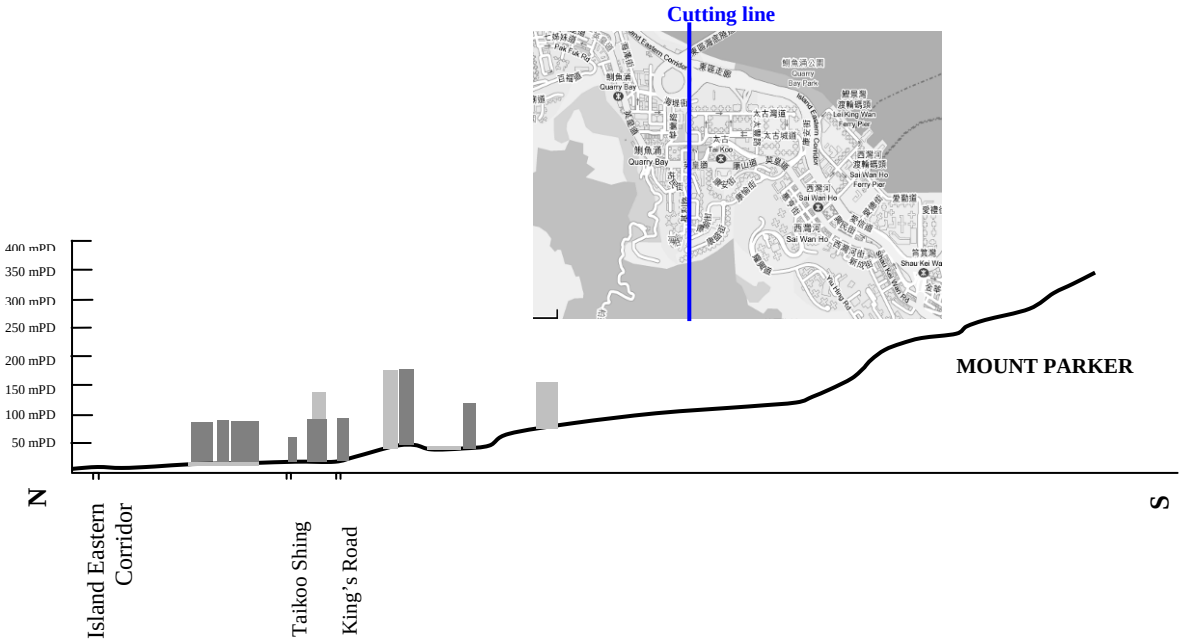


Figure 6.3 Profile of Study area cutting along a N-S line showing the slope

6.2 Effect of greenery and open space

It has been discussed in the previous section that there are ample greeneries of the Tai Tam Country Park to the south of the Area. The differences between the urban developments and the vegetated slopes will create temperature difference and this will induce the Katabatic air movement. This is very useful in the summer months with the wind coming from the general southerly sectors.

The various small patches of greenery areas spread out over the Area as mentioned in the previous section, though not very effective, play a part in helping the general ventilation situation, as they help to reduce the general density of development.

One particular strip of green area that would be of important is the strip of land running north-south along One Island East, Oxford House and Dah Chong Hong, this strip of land is being developed into an open greenery space (Figure 4.5). It runs south from the open area off the sea front into the interior of the Taikoo Shing Developments. The consultant believes that this strip of green space (if not blocked) will be effective in providing an air path from the sea to inland. At the moment it stops short of Taikoo Shing Road; there are buildings at its southern end blocking it from connecting up the King's Road.

6.3 Effect of building layout and street pattern

6.3.1 Existing condition

Annual condition

With the highest probability of the annual wind coming from the eastern sectors, the one major breeze way is the King's Road, Kornhill Road as shown in Figure 6.4. It is relatively wide with six-lane carriage way. It enters the Area from the east and running westward for almost the entire width of the site. It turns north-west and exits the Area at the north-west corner.

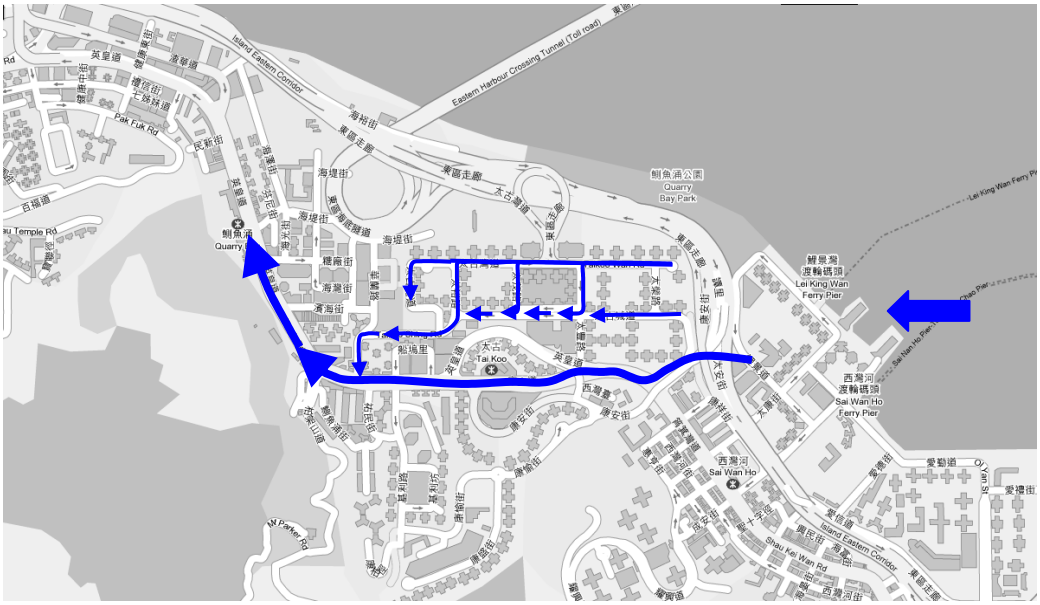


Figure 6.4 Main flow path along King's Road

On the part of the Area north of King's Road, as discussed earlier, the streets are of rectangular grid running east-west and north-south. However it was pointed out that the streets, Taikoo Wan Road and Taikoo Shing Road cannot run straight through the site width. They are blocked at their western end. Thus any wind blowing along these roads would need to turn at right angle. The wind would need to twist a few turns before exit to King's Road. This will largely increase the wind drag and slow down the wind flow.

It was also discussed that the H:W ratio of these streets is around 4:1 and over at the towers. This deep street canyon configuration is also bad for air ventilation.

Another feature of this part of Area is that there are large bulky rectangular podiums covering significant portion of the area. This together with the previous two observations will result in forcing the wind to skim above the podiums without reaching the ground (Figure 6.5). This affects largely the air ventilation at pedestrian level. An example is the big gap between the Cityplaza Three and Four, which

provides good entry/exit air flow connecting to the sea front. However immediately south of the gap is the Cityplaza Two residential development with a large podium (P14).

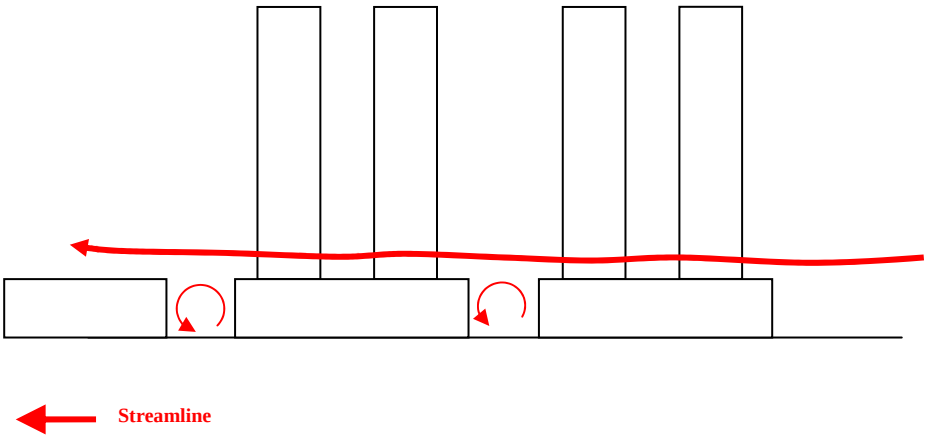


Figure 6.5 Flow over podium

The fact that developers usually maximize the harbour view for their developments results in having buildings aligned parallel to the waterfront. Furthermore, developments at the second row along the sea front always position their buildings exactly facing any gaps between tall towers of the first row of development. This leads to the situation that winds blowing through the gaps will always be blocked by another building and need to flow around it sideways. This will increase the drag on the wind and slow the flow down.

On the part of the Area south of King's Road, there is a almost continuous line of tall towers lining the eastern border of the site. This line of building will largely block the wind from the eastern sectors (the most probable annual direction). The gaps between buildings will be the ventilation paths for areas behind the buildings. Further to the west of this part of the Area is the Nam Fung Sun Chuen; it is a rectangular development enclosed by tall blocks. This area is also situated in a sort of shallow valley situation where the elevation is lower than its east, south and western sides. The pedestrian level wind inside this area is going to be affected.

Summer condition

In summer, the most probable winds are from the SW and ESE directions. As discussed, the katabatic wind flowing down the valley from the southern mountain slopes will help with the ventilation. In general for the area south of King's Road, the general lay-out of the building developments is more favourable for the SW wind; and less for the ESE wind as there is this long line of tall blocks lining the SE border of the Area blocking the wind.

It is useful to point out that the summer wind is blowing from higher elevation downwards. When there are building podiums along its path, it is easier for it to flow over the podium, thus reducing the pedestrian level wind. It is important to make the podiums more permeable so as to allow the wind to blow through at lower levels.

From the higher grounds of this southern part of the Area, there are a few routes in the general south-north direction for the wind to flow, the Mount Parker Road, Greig Road and Hong Shing Street. The wind will blow into the major east-west flow path, the King's Road, at a few points, the Mount Parker Road exit, Yau Man Street, Greig Road and the east and west end of Hong On Street.

On the northern side of King's Road, there are no road (north-south running) exits that corresponds to the road exits on the southern side. This means there are no direct through flow across King's Road. Except perhaps Hong On street facing Tai Fung Avenue (drop in level) and Hong Yue Street connecting to the Taikoo Shing Road at the eastern boundary of the Area.

On the part of the Area north of King's Road, the roads are aligned in rectangular grids. And, similar to the east-west running situation discussed earlier, most of the north-south running streets do not run through the whole area. Their southern ends are blocked. The only road connecting through from King's Road to the open area on the sea front is the Westlands Road. This will provide the north-south wind flow path at low levels.

On the north-western part of the Area (Figure 6.6), Finnie Street and Hoi Chak street serve as flow path from King's Road to the open greenery area on the sea front. Further towards the north-west tip of the Area there is the open greenery spaces next to the HK & China Gas Ltd. which also provides flow path in and out of the area. In general, this part of the Area is a narrow strip of development parallel to King's Road. The width from the sea front greenery space to the foot of the hill on the south side is much less than other parts of the Area. Hence it is easier for the wind to penetrate through. However, the problem of older development along King's Road (continuous construction blocking the wind) is still there.

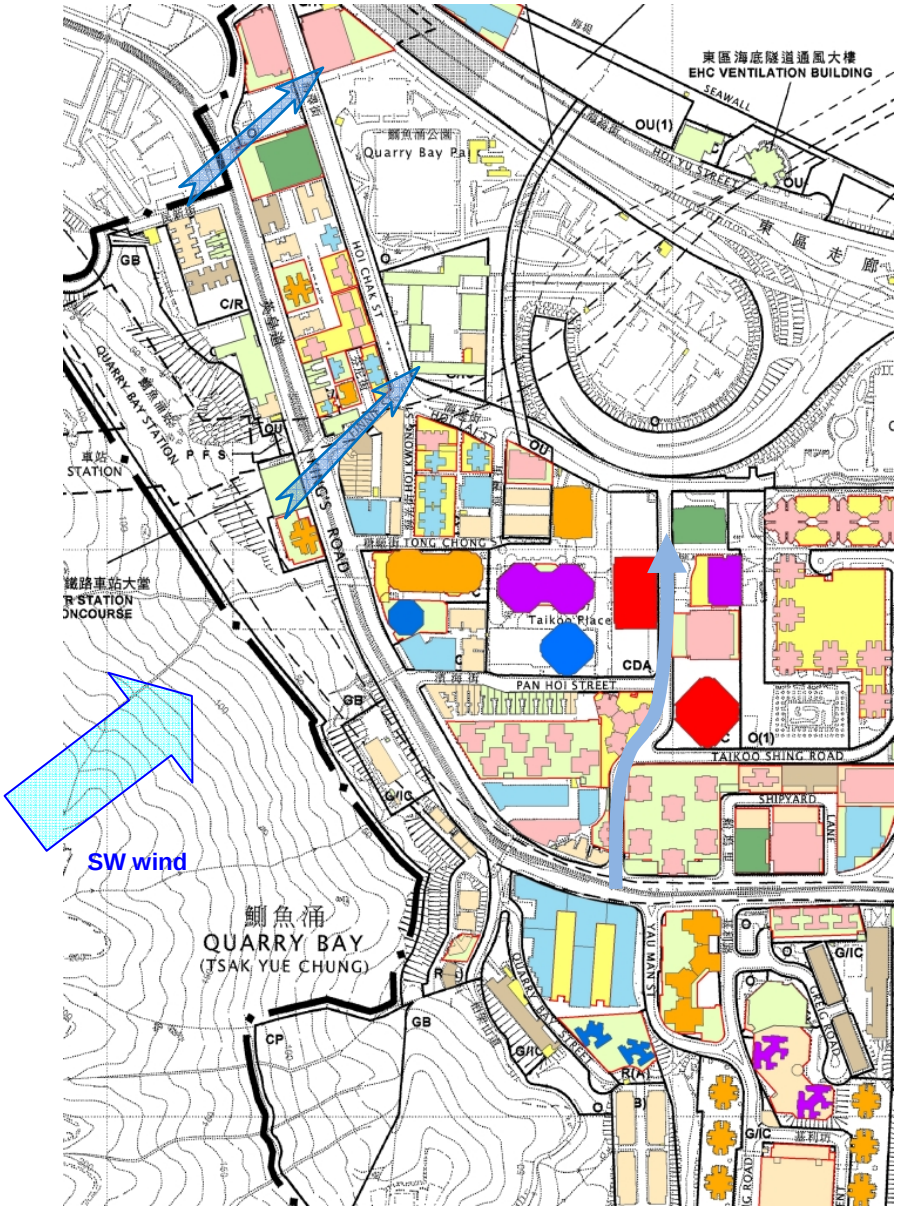


Figure 6.6 Flow path over north-western part of Study area

Another issue with this strip of area (and area extending to Quarry Bay Street), especially developments on the south side of King's Road is that they are situated at the foot of a steep slope. At the foot of the slope, around where the ground starts to be horizontal, there is a zone where the wind is slower (regardless whether the wind is blowing down or up slope) affecting the air ventilation.

For the north-east corner of the Area (Figure 6.7), the distance from the zone boundary, Shau Kei Wan Road, to the sea front is a bit wider than the north-western part of the Area; but similar to the north-western part, there are also older developments along King's Road. There are the Tai Hong Street and the Tai On Street running in the NE-SW direction and the Shau Kei Wan Road and the Island

Eastern Corridor in the NW-SE direction serving as flow path through the area. Close to the sea front there are the newer developments around the Lei King Wan park area. The gap between Kwun Fung Mansion and Yat Sing Mansion allows wind to blow from the sea. There is also a gap between Yee Cheung Mansion and Yat Wah Mansion on the east side of the park area. However, the newer development of Grand Promenade, with super tall towers, blocks the wind from the east. However there may be some slight ESE wind during summer blowing between the building gap.

Figure 6.7 Flow path over north-eastern part of study area

6.4 Evaluation of air ventilation conditions for Proposed Height Restrictions and Potential Redevelopments

The evaluation is carried out based on information supplied by the Planning Department on the Proposed Height Restrictions and the Redevelopment Plan and for the wind environment as discussed above. It is generally understood that taller buildings will increase the drag on the wind and hence resulting in a slower wind speed. However building height is not the only factor that affects the pedestrian wind over the Area. Other factors as important, if not more important, are size and geometry of the podium, permeability of the podium, lay-out and geometry of the tower blocks, greenery and open spaces. The ventilation condition of a location is a function of a matrix of combination of these factors.

In general, from the Proposed Height Restriction Plan and the Redevelopment Plan, it can be seen that all the existing greenery and open spaces are being maintained. The air flow path as discussed are also maintained. On the other hand, neither has these been enlarged and improved.

The proposed height restriction is presented in different height bands. These height bands are arranged more or less parallel to the coast line. The building height specified is in increasing value as the height band gets more inland. The inland areas are also at higher elevation; i.e. the proposed building height restriction (in mPD) increases with elevation. This has the advantage of having the upper portions of the buildings catching the wind as the wind blows inland. The down wash generated over these different layers of buildings helps to increase the air ventilation of the inland areas.

While the progressive increase height arrangement is beneficial, a cluster of buildings of the same height will not be good. It would be useful for air ventilation to have buildings of different heights mixed together while still keeping the progressive increasing height concept.

In the summer months, the wind is from the SW blowing down hills. The wind will encounter the taller buildings first. Thus catching the wind on the upper portion of the building as discussed earlier is not relevant. It is therefore important to have gaps between buildings and podiums for the wind to penetrate into the southern part of the Area (refer to Figure 7.3).

Except for some areas, the proposed height restrictions for the majority of the Area reflects more or less the existing condition. The heights of the existing buildings for many cases are lower by less than several meters than that of the restriction. For many of these developments, e.g. the Taikoo Shing developments and the Kornhill developments, it is unlikely for the buildings to be redeveloped in the near future. That means the pedestrian level ventilation for these areas will not be much different from the existing condition, which has been commented that AV condition is more affected by podium configurations and building gaps.

There are several locations where the height of the existing building is taller than the proposed height restrictions. Some of these are taller by 20m to 40m; while there are a few taller by 50m to 120m. Following the principle that taller building will produce a long

wake, shorter buildings as limited by the height restriction would be beneficial to air ventilation in general.

The two blocks of land to the east and west of Westlands Road is set at a height restriction of 170mPD. These taller buildings (depending on the actual layout) will increase the blockage effect affecting the easterly wind blowing towards King's Road on the west and also has the effect of blocking the SW wind in summer.

During windy days, the super tall towers, e.g. One Island East, adjacent Westlands Road may induce very strong down wash leading to very gusty pedestrian wind. This will be uncomfortable to pedestrians and appropriate measures (e.g. using canopy) should be taken.

The **Redevelopments** are spread out and mainly located on the sides of King's Road. There are two clusters; the larger one along King's Road on the north-western part of the Area and a smaller one at the eastern side. These redevelopments obviously replace the older buildings with redevelopment potentials. The configurations of these redevelopments are podium and tall tower constructions and the height of the tall towers are higher than those of the existing old buildings. While the towers are higher, the podiums are lower. Furthermore, there are gaps between towers which allow wind to flow through. The consultant believes that this layout is better (from AV's point of view) than the continuous solid line(s) of buildings of the older developments. It is however important to control the size of the podium and, most important, to maintain air permeability of the podium lower levels.

To summarize, the AV condition for the Planned Scenario is expected to be quite similar to that of the Existing Scenario which has been discussed in detail in the previous section. A few of the main points are re-iterated as follows:

- ✧ A major flow path running east-west across the study area is along King's Road, Kornhill Road.
- ✧ Many other streets running east-west and north-south do not run all the way through the Area; that means winds are blocked or has to blow sideways.
- ✧ There are many large and bulky podiums located around the Area, this will induce the wind to skim over the podium.
- ✧ A long line of tall towers flanking the south-east border of the site, this blocks the easterly winds blowing onto areas downwind.
- ✧ A circular line of building en-circling Kornhill Plaza, generally blocking wind from the southwest.
- ✧ There are not many (side street) openings on the northern side of King's Road. Thus the summer SW winds blowing down the slope will find it difficult to penetrate into the area north of King's Road.
- ✧ The AV condition of the Area is not so much controlled by building heights, but more dependent on the podium size, geometry and permeability, gaps and layout of building blocks and open areas.

7 Problematic areas and mitigation measures

7.1 Problematic areas

- Many large bulky podiums inducing wind to skim over the podium and reducing ventilation in street level.
- Many roads running east-west could have been the flow path for air to get to inner areas and to flow through to adjacent zones. However they are blocked such that the flow path of the wind at pedestrian level is either completely blocked or needs to twist several turns before exit to another zone.
- A similar situation with the north-south wind flow, wind blowing from the south finds it difficult to enter into the area north of King's Road at pedestrian level.

7.2 Mitigation measures

Many of the tall towers in the Area are already very tall with building height to street width ratio (H:W) in excess of 4:1; in general, controlling building height may not be the most effective means to improve pedestrian level air ventilation. Controlling the size and permeability of podiums, providing flow path, greenery and open space and gaps between buildings are measures to be considered.

Since majority of the developments and redevelopments in the study area are of podium and tower construction, a factor which can play an important role on pedestrian level air ventilation is the permeability of the podium. It is important to ensure that the lower floors of the podium be made permeable and that wind can blow directly through. There are some existing podiums having car parks at the lower floors; this would be suitable for letting air to flow through. However, many of these podiums have either one side or the other side blocked such that air cannot flow directly through. Podiums which allow cross ventilation from street on one side to street on the other side would help significantly the AV condition.

More set-backs are to be provided such that the width of streets can be larger. Hence reducing the H:W ratio.

In general, several flow-through air paths for wind to blow through the Area are to be introduced. Providing and reserving greenery and open space to unblock flow paths. Some cases are:

For the east-west direction, suggested flow-through air paths are shown in Figure 7.1. To maintain these flow paths, the following would be desirable:

Flow path along Taikoo Wan Road – Retain existing gap at both ends of Taikoo Wan Road and gap to the north of Oxford House. Set back should be provided in Summerset House. Such that creating a flow path from eastwards along Taikoo Wan Road all the way continuously through Tong Chong Street and exit to King's Road (refer to area encircle marked 'A' Figures 7.4a & b).

Flow path along Taikoo Shing Road – Set back should be provided to the immediate north of "One Island East", so as to connect up Pan Hoi Street from King's Road to the open greenery space east of "One Island East" and continue on to Taikoo Shing Road (refer to area encircle marked 'B' Figure 7.4a).

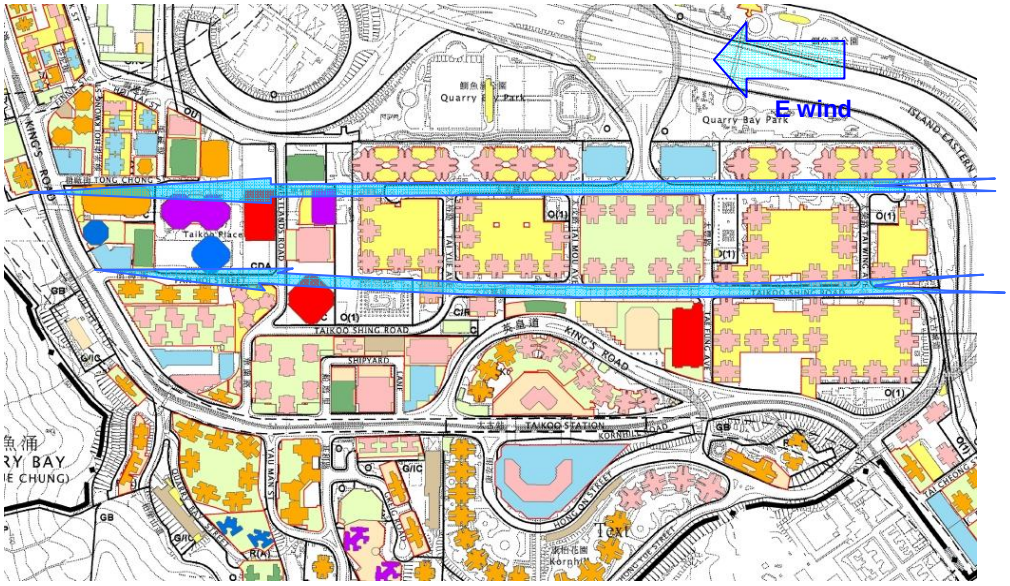


Figure 7.1 Flow paths in the E-W direction over the northern part of study area

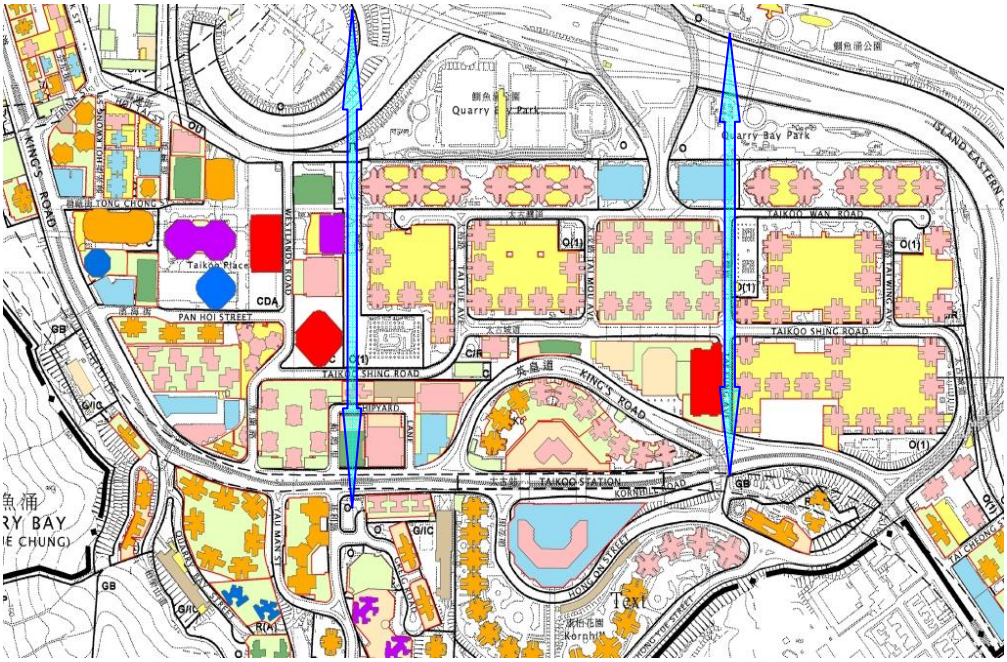


Figure 7.2 Flow paths in the N-S direction over the northern part of study area

For the north-south flow wind (figure 7.2), it will be very useful to connect up the open space east side of “One Island East” all the way to King’s Road. Open area should be provided south of Taikoo Shing Road around the Shipyard Lane area. Failing that, gaps between buildings should be provided. Building gap east of Cityplaza Four north of Tai Fung avenue should be maintained. (refer to area encircle marked ‘C’ Figures 7.4a & b).

For the Area south of King’s Road, the street pattern is more complicated as pointed out earlier. It is useful to make use of existing gaps between buildings for the SW summer wind to blow through. It is important to further develop and enhance flow paths in the general SW and southerly directions by arranging building gaps such that flow paths south of King’s Road can meet up with the flow paths north of King’s Road as shown in Figure 7.3 and area encircled marked ‘D’ in Figure 7.4a.

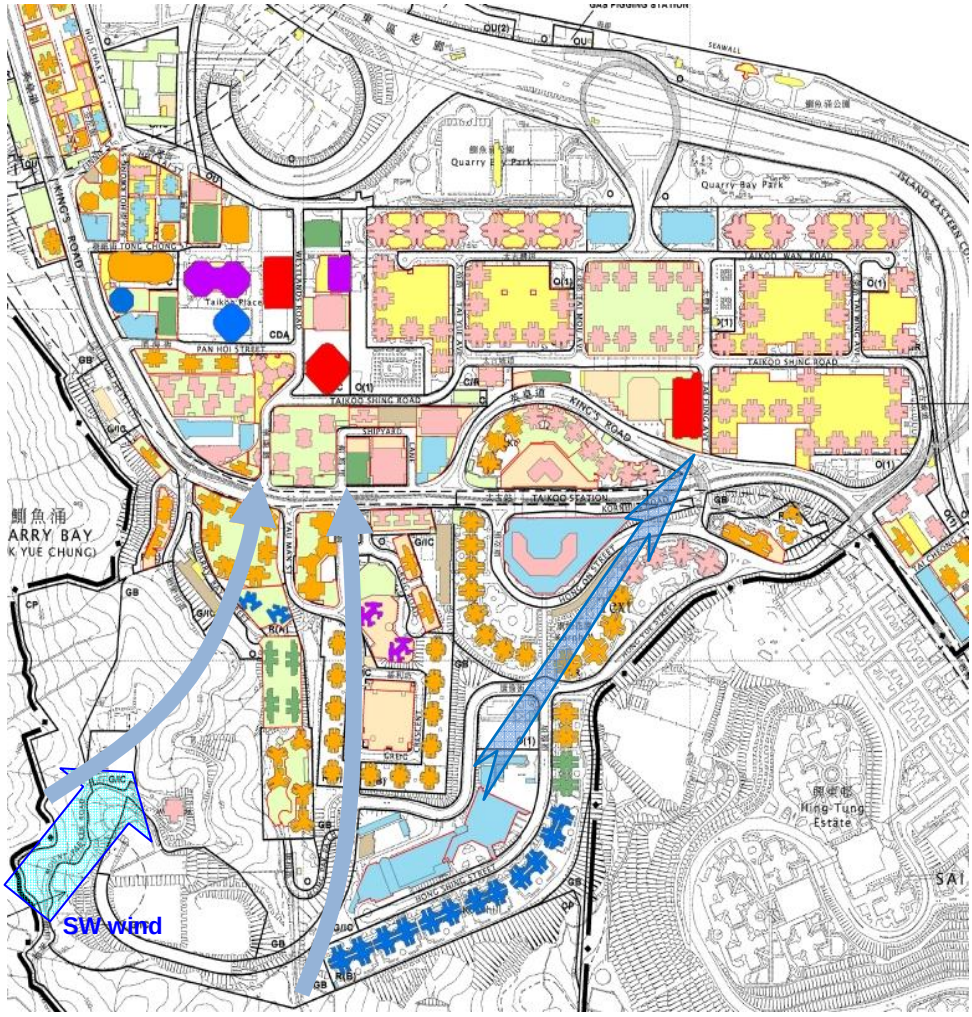


Figure 7.3 Flow path for SW summer wind for area south of King’s Road

When allowing for building gaps and set backs, it is desirable to have a flow path of uniform width so as to create the least resistance to the flow of air. It is therefore desirable to have the width more or less as that of the streets where these gaps are connecting.

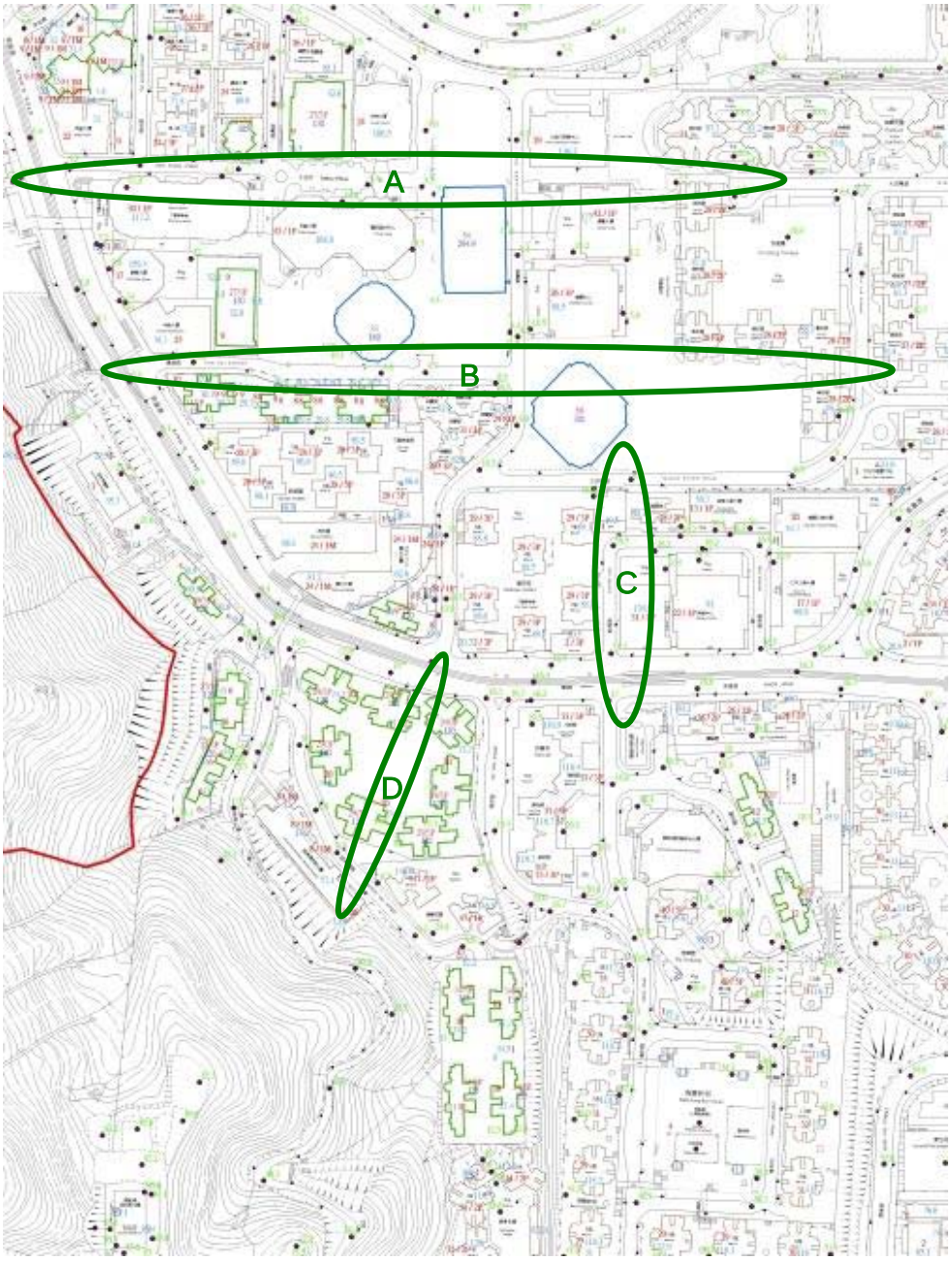


Figure 7.4a Locations for set-backs & building gaps to enhance flow path

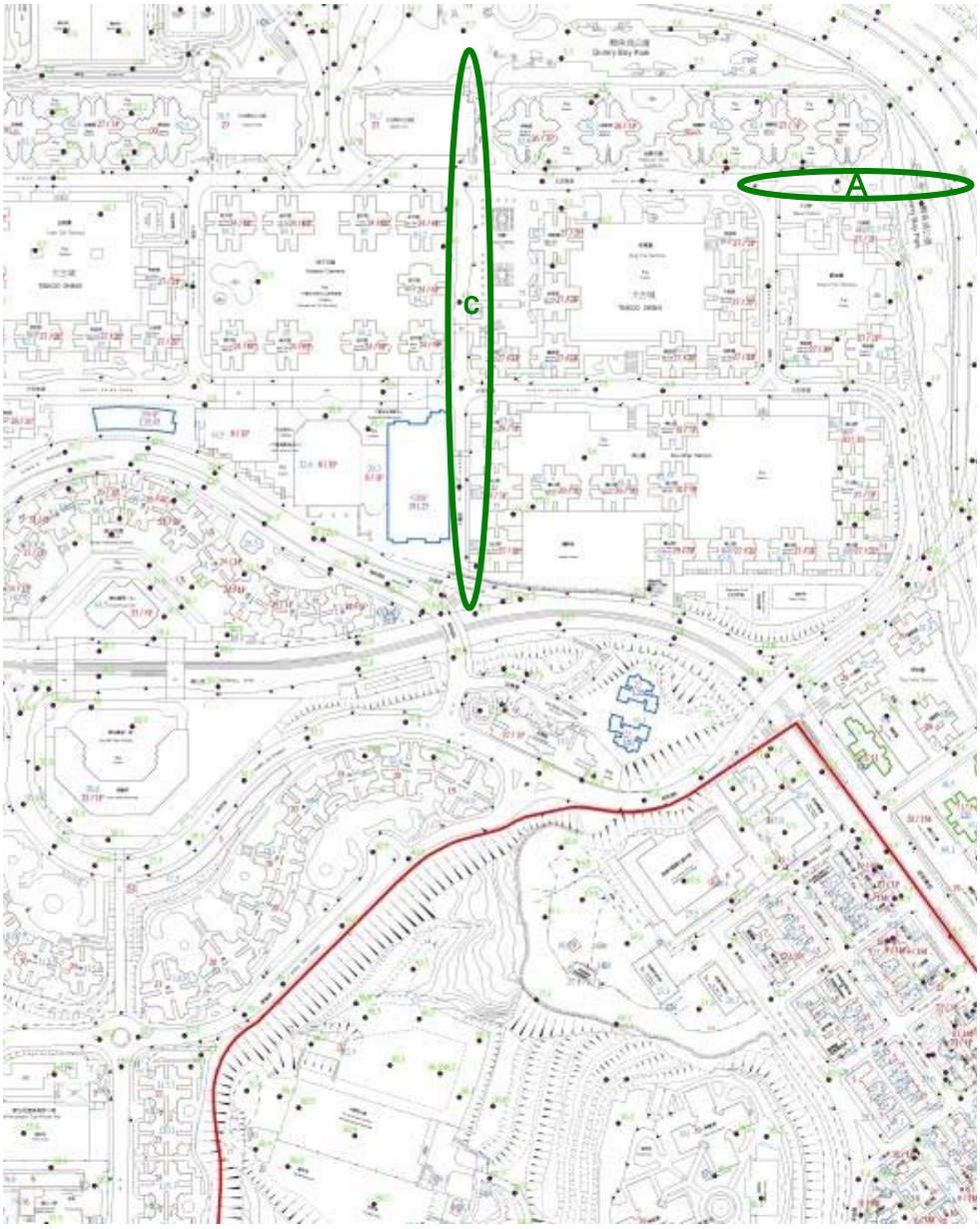


Figure 7.4b Locations for set-backs & building gaps to enhance flow path

8 Further Studies

As discussed earlier, for the major part of the Area, the proposed building height restriction reflects to a certain extent the existing condition. The consultant expects that the AV condition will not differ much from the existing condition. There will not be significant gain in doing detailed tests on different height restrictions.

However to improve on the understanding of air ventilation issues, the following generic studies are suggested.

At present, podium with high-rise is the main form of construction in the Area. The effect of the size, shape, height and layout of the podiums on pedestrian level ventilation is to be studied. A parametric study would give insights to how air flow at pedestrian level will be influenced by these parameters.

Another area that is not well understood is the flow at the foot of a steep slope for wind blowing up as well as down the slope. Parametric study would be useful to see how air ventilation is being affected by the slope.

9 Acknowledgement

The Institute of Environment, Hong Kong University of Science and Technology is acknowledged for extending the use of the MM5 wind data for this study.

ANNEX I – Site Photographs of Quarry Bay Area

P1 Distant view of Tai Tam Country Park

P2 Quarry Bay Park

P3 Quarry Bay Park (looking east)

P4 Sport grounds in Quarry Bay Park

P5 Sport grounds at the west side of Quarry Bay Park

P6 Open greenery space (under construction) along One Island East

P7 Tree lined green space on the hillside between building developments

P8 Small road side green space

P9 Roof garden Kornhill Plaza podium

P10 Tall towers on podium

P11 Tall blocks developed along a curve

P12 Older developments along King's Road

P13 Taikoo Shing Road

P14 Gap between Cityplaza Three and Four facing immediately the podium of Phase 2