CONSULTANCY STUDY FOR AIR VENTILATION ASSESSMENT SERVICES

Cat. A1– Term Consultancy for Expert Evaluation on Air Ventilation Assessment (PLN AVA 2015)

Final Report

For an Instructed Project For Ngau Tau Kok and Kowloon Bay Planning Area

January 2019

INSTITUTE OF Future Cities

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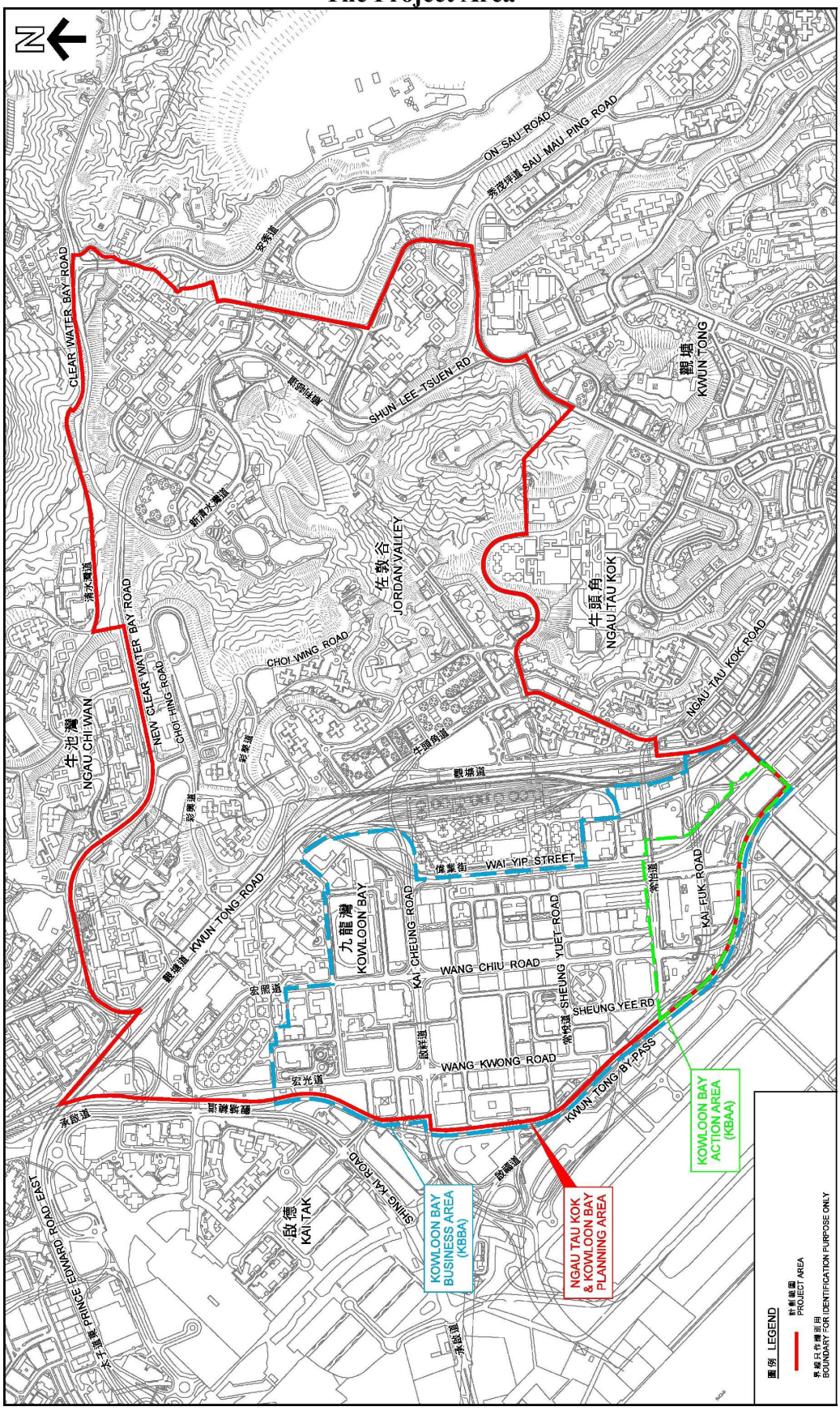
The Project Area



Expert Evaluation Report

for an Instructed Project for Ngau Tau Kok and Kowloon Bay Planning Area

Executive summary

0.1 Wind Availability

(a) The annual prevailing winds of Ngau Tau Kok and Kowloon Bay Planning Area (the Project Area) are mainly from the N, NNE, NE, ENE, E, ESE and SE. The summer winds of the Project Area mainly come from the E, ESE, SE, S, SSW, SW and WSW.

0.2 Topography, Urban Morphology and Wind Environment / Major Ventilation Paths

(a) The ground coverage (an indication of how buildings reduce urban air ventilation potentials) in the western part of the Project Area, that includes Kowloon Bay Business Area (KBBA) and Telford Gardens and Telford Plaza is high (Figure 4.4).

(b) The Building Volume Ratio (BVR) (an indication of how buildings reduces air movement) in the western part of the Project Area, that includes KBBA and Telford Gardens and Telford Plaza is medium to high (Figure 4.5).

(c) Due to the high ground coverage and BVR, the wind condition in the area identified in Sections 0.2(a) and (b) is weak and needed to be improved. Furthermore, it is likely that in the future the building coverage and BVR will increase in this area with committed projects and future new developments. Mitigation measures, such as establishing and/or widening air paths/breezeways through the area, are needed to improve/maintain the urban air ventilation performance in this region.

0.3 Expert Evaluation of Baseline Scenario

(a) The current non-building area (NBAs) and building gaps (BGs) on the Outline Zoning Plan (OZP) were based on the recommendations of an Expert Evaluation on Air Ventilation conducted in 2010 (the AVA EE 2010). Most NBAs and BGs were imposed in the area identified in paragraphs 0.2(a) and (b) with high ground coverage and BVR.

(b) Due to dense and tall urban developments and narrow streets, the built-up areas in this OZP are generally subject to poor air ventilation. Most of the suggested NBAs and BGs in paragraph 0.3(a) above are good features for urban air ventilation at the district level in the Project Area and are therefore necessary to be maintained in the Baseline Scenario.

(c) In general, the width/location of the NBAs on the OZP are appropriate for the air paths/breezeways in the Project Area. Creation/maintenance of connected air paths/breezeways of district significance at strategic location would be important and

necessary. Sustainable building design (SBD) will be necessary at the site design stage to improve the localised wind environment inside the site and for the surrounding areas but will not be effective alternative measures.

0.4 Expert Evaluation of Initial Scenario

(a) Kowloon Bay Action Area (KBAA) is located at the southern tip of the Project Area. It should not block the prevailing winds coming into the Project Area. A separate AVA has been conducted for the on-going feasibility study of KBAA to alleviate the potential air ventilation impact created by the planned developments in KBAA. Some major air paths have been identified in this AVA (Figure 6.3) and some major design features of Preliminary Outline Development Plan (PODP) for wind enhancement have been proposed such as a designated NBA on Lot 2 (Figure 6.2). Given major design features of PODP for wind enhancement as recommended in the AVA study for KBAA and the building separation requirements under the SBD Guidelines would be fulfilled in the building design stage, the KBAA may not significantly affect the ventilation performance of its surrounding areas.

0.5 Recommendations and Further Work

(a) From the district level urban air ventilation point of view, the development restrictions/requirements in both the Baseline Scenario (namely NBAs and BGs) as indicated in Figure 5.3 and the Initial Scenario (namely NBAs, BGs and building setback) are important features for urban air ventilation of the Project Area and should therefore be maintained/pursued.

(b) From the building design point of view, the sustainable building design (SBD) Guidelines establish key building design elements to increase permeability and improve the localised wind environment at the pedestrian level near to and around the buildings.

(c) The further work of the KBAA's AVA on the Recommended Outline Development Plan (RODP) would be conducted and covered by a separate study.

(d) Amalgamated sites with bulkier buildings and longer building frontage should be carefully planned and follow the design principles set out in the Hong Kong Planning Standards and Guidelines (HKPSG), especially those listed below, and the SBD Guidelines:

- introduce variations in building height across the area;
- avoid long and continuous façades;
- reduce site coverage at grade and minimise ground coverage of podia;
- maintain "Open Space" ("O") and "Government, Institution or Community" ("G/IC") sites as air spaces and connect breezeways; and
- maximise planting of greenery in open spaces, preferably at grade.

Expert Evaluation Report

for an Instructed Project for Ngau Tau Kok and Kowloon Bay Planning Area

1.0 The Assignment

1.1 The development restrictions for the Ngau Tau Kok and Kowloon Bay Planning Area (the Project Area) are being reviewed to take account of the relevant principles and considerations set out in the court judgments on the judicial reviews (JR) in respect of the draft Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (OZP) No. S/K13/26 which was gazetted on 19.11.2010 incorporating amendments mainly to impose building height restrictions (BHRs) and designation of non-building areas (NBAs) and building gaps (BGs) on various development zones. The OZP has been amended three times subsequently and the latest one is OZP No. S/K13/29 gazetted on 13.4.2017.

1.2 Two JR applications were filed by The Real Estate Developers Association of Hong Kong (REDA) (JR case HCAL No. 58 of 2011) and Oriental Generation Limited (JR cases HCAL No. 62 of 2011, HCAL No. 109 of 2011, HCAL No. 34 of 2012, CACV No. 127 of 2012 and CACV No. 129 of 2012) against the Town Planning Board's (the Board) decisions on their representations in respect of the draft Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (OZP) No. S/K13/26 concerning issues like BHRs, NBAs, BGs, air paths, Sustainable Building Design (SBD) Guidelines, etc.

1.3 The development restrictions on the OZP including BHRs, NBAs and BGs are required to be reviewed taking into account the changing circumstances, the SBD Guidelines and updated assessments. The current NBAs and BGs on the OZP were based on the recommendations of an Expert Evaluation on Air Ventilation Assessment conducted in 2010 (the AVA EE 2010[1]). To facilitate the review of the development restrictions on the OZP, it is necessary to conduct an Expert Evaluation on Air Ventilation Assessment (AVA EE) for updating assessment on the air ventilation impacts of the development restrictions and on whether these restrictions are appropriate from air ventilation viewpoint. This assessment had taken into account the changes in the planning environment within the Planning Area (e.g. the proposed developments in the Kowloon Bay Action Area (KBAA)) and in its surrounding areas (e.g. Kai Tak Development (KTD)), and possible alternative air ventilation measures under the SBD Guidelines.

1.4 The study aims to assess the potential air ventilation impacts of the development restrictions on the OZP, to identify possible wind potential and problem areas, to examine whether the development restrictions are appropriate, and to explore and recommend alternative development restrictions/air ventilation improvement or mitigation measures where appropriate to enhance or address the possible wind potential or problems identified or improve the wind environment. The

[1] AVA EE for Ngau Tau Kok and Kowloon Bay Area (November 2010)

Project Area should be covered by a self-contained Air Ventilation Assessment (AVA) report.

1.5 This expert evaluation report is based on all previous AVA studies relating to the concerned areas, the court judgements of concerned JR cases and the materials given by Planning Department (PlanD) to the Consultant (Appendix C).

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

2.0 Background

2.1 PlanD's study "Feasibility Study for Establishment of Air Ventilation Assessment System" (Feasibility Study) 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 Feasibility 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, NBAs, waterfront sites, scales of podium, building heights, building dispositions, and greeneries are all important strategic considerations.

2.4 The Feasibility Study also suggests that AVA could be conducted in three stages: Expert Evaluation, Initial Study, and Detailed Study. The suggestion has been adopted and incorporated into Housing Planning and Lands Bureau (HPLB) and Environment, Transport and Works Bureau (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; and
(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 analysis:

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

Based on the analysis of site context and topography:

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

Based on the analysis of the EXISTING urban conditions:

(h) evaluate the strategic role of the study area in air ventilation term;
(i) identify problematic areas which warrant attention; and
(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 different development restrictions as proposed by PlanD on air ventilation;
(l) highlight problem areas, if any. Recommend improvements and mitigation measures if possible; and
(m) identify focus areas or issues that may need further studies. Recommend appropriate technical methodologies for the study if needed.

2.6 In this particular AVA EE, the focus is put to assess the air ventilation performance of (i) the Baseline Scenario, which refers to the scenario under the draft Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (OZP) No. S/K13/29 with BHRs, NBAs and BGs; and (ii) the Initial Scenario, which refers to the changes introduced to the Baseline Scenario at the KBAA. It will review whether the SBD Guidelines could serve similar function without the need for imposing the current restrictions.

3.0 The Wind Environment

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

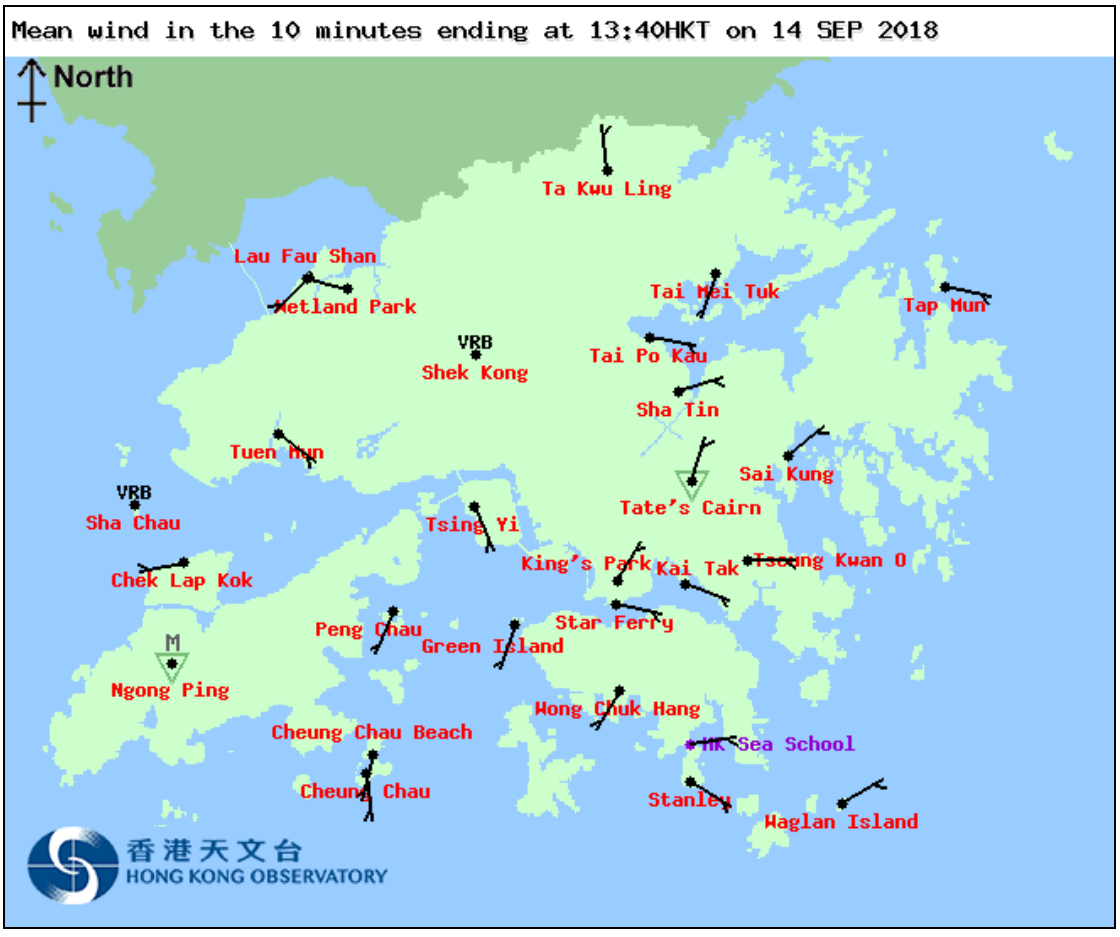


Figure 3.1 Some of the HKO weather stations in Hong Kong (a screen capture at 13:40 on 14 Sept 2018 from the HKO website)

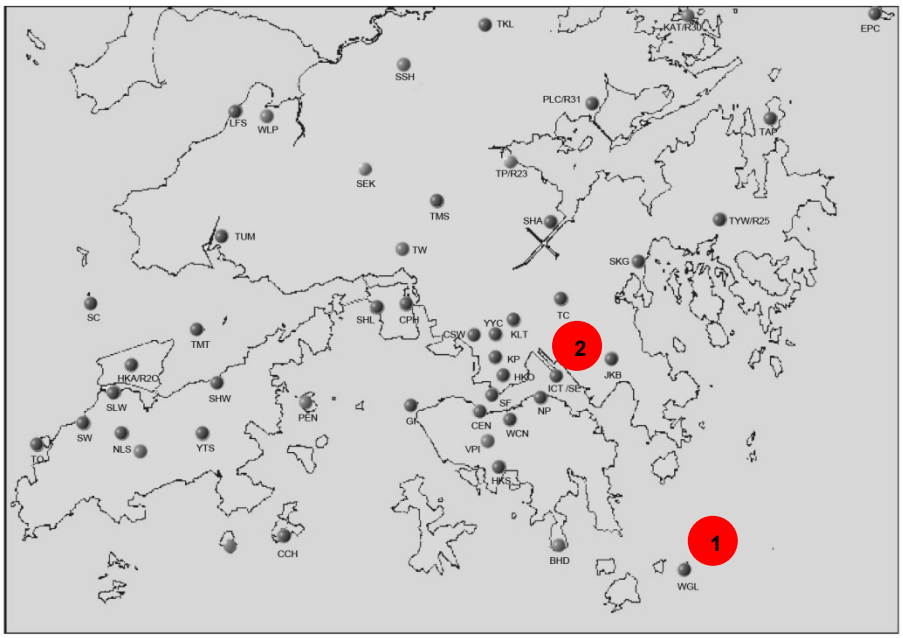


Figure 3.2 The HKO weather stations at 1: Waglan Island (WGL), 2: Kai Tak

3.2 The HKO weather 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. However, it is known not to be able to capture the thermally induced local wind circulation like sea breezes very well. Based on WGL wind data, AVA studies are typically employed to estimate the site wind availability taking into account the topographical features around the site.

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

3.4 For the AVA study, seasonally or monthly wind environment should be understood (Figures 3.4 and 3.5). During winter, the prevailing wind comes from the NE, whereas it comes from the SW during summer. 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 SW) into the urban fabric.

3.5 Apart from WGL, the wind data of Kai Tak weather station (Figure 3.2) have also been extracted from HKO for reference (Figure 3.6 to Figure 3.8) as the nearest station measuring wind environment for the Project Area. It can be observed that the annual prevailing winds are mainly from the E and SE. The summer prevailing winds are mainly from the SE and SW.

3.6 Noting the limitation of the wind data of WGL weather station mentioned in paragraph 3.2, wind characteristic from the web-based database system available on PlanD's website[1] (i.e. RAMS wind data) has also been referred[2]. Data from 16 locations (i.e. x:087, y:042; x:087, y:043; x:087, y:044; x:087, y:045; x:088, y:042; x:088, y:043; x:088, y:044; x:088, y:045; x:089, y:043; x:089, y:044; x:089, y:045; x:090, y:043; x:090, y:044; x:090, y:045; x:091, y:044 and x:091, y:045), which cover the Project Area, were simulated at 200m, 300m and 500m above the ground (Figures A-1 to A-16 at Appendix A). These locations, according to the application of Regional Atmospheric Modeling System (RAMS), were selected to reflect the general wind patterns of the Project Area induced by topography. Prevailing wind directions are summarised in Table 1. As the HKO weather station at Kai Tak is not within the Project Area and the surroundings of Kai Tak are different from those of Project Area, the RAMS wind data extracted from PlanD's website is more representative to reflect the wind availability of the Project Area. It can be observed that the annual prevailing winds of the Project Area are mainly from NE, ENE, E and ESE in accordance with the RAMS wind data extracted from PlanD's website. The summer prevailing winds of Project Area are mainly from the E, SSW, SW and WSW. In general, the wind data from PlanD's website are consistent with those of Kai Tak and WGL.

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

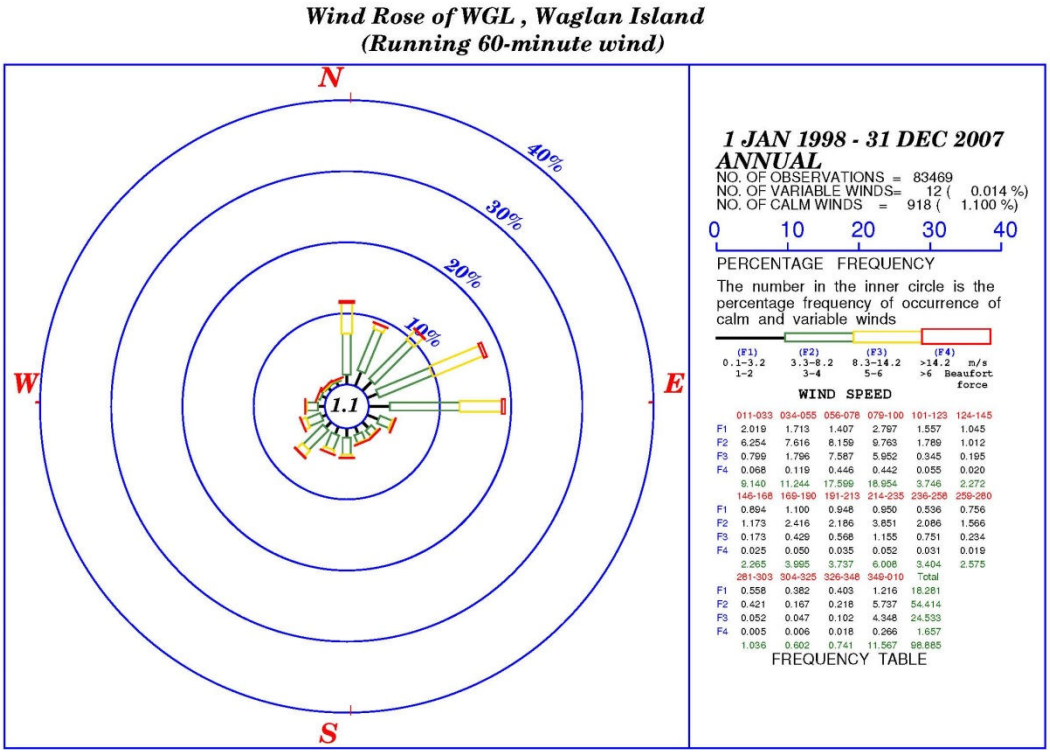


Figure 3.3 Wind rose of WGL weather station from 1998 to 2007[1] (annual)

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

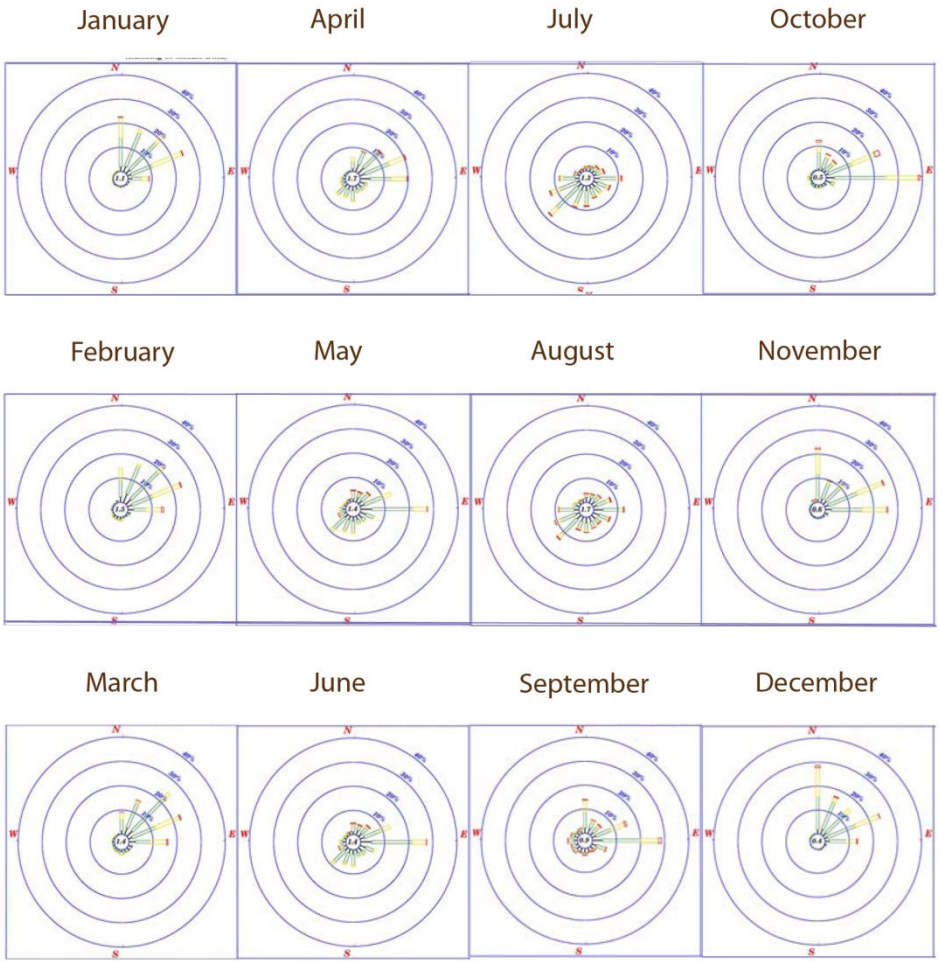


Figure 3.4 Monthly wind roses of WGL weather station from 1998 to 2007

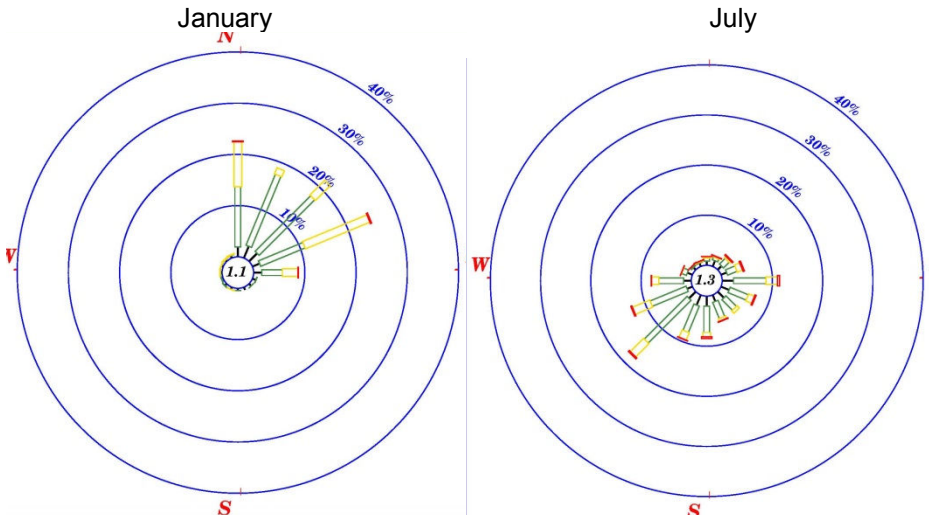


Figure 3.5 Wind roses of WGL weather station from 1998 to 2007 (Jan and July)

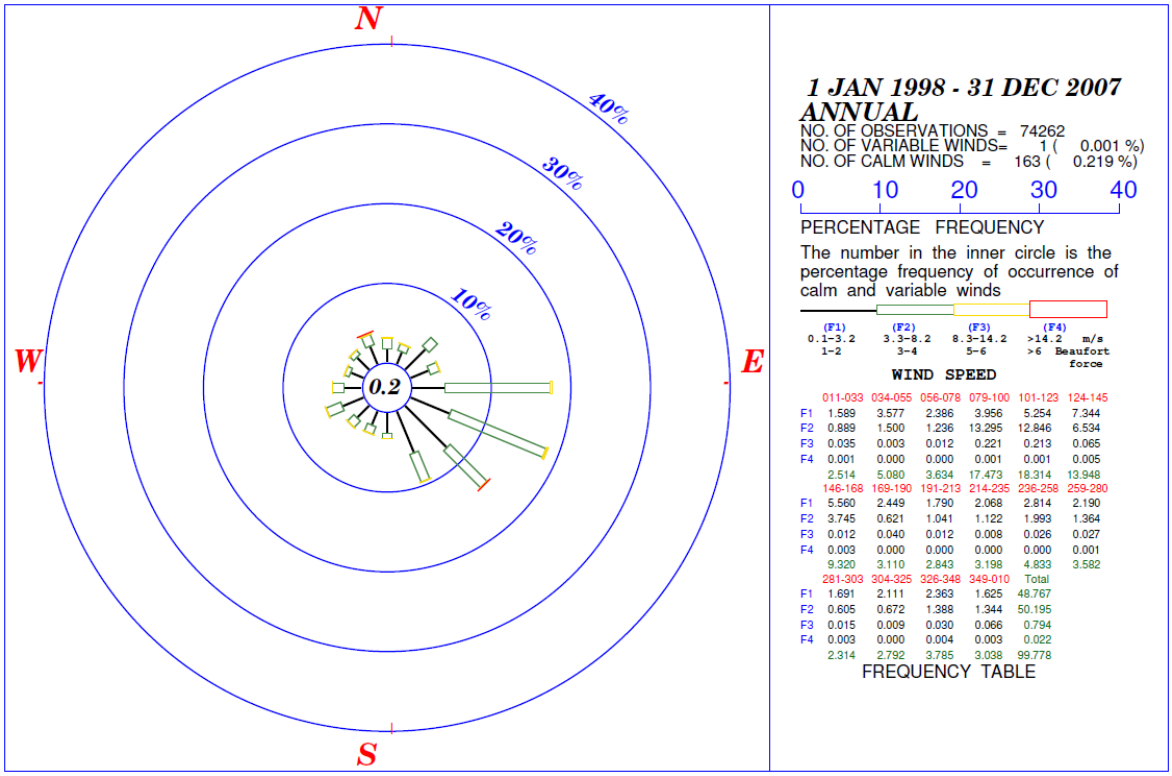


Figure 3.6 Wind rose of SE, Kai Tak weather station from 1998 to 2007 (annual)

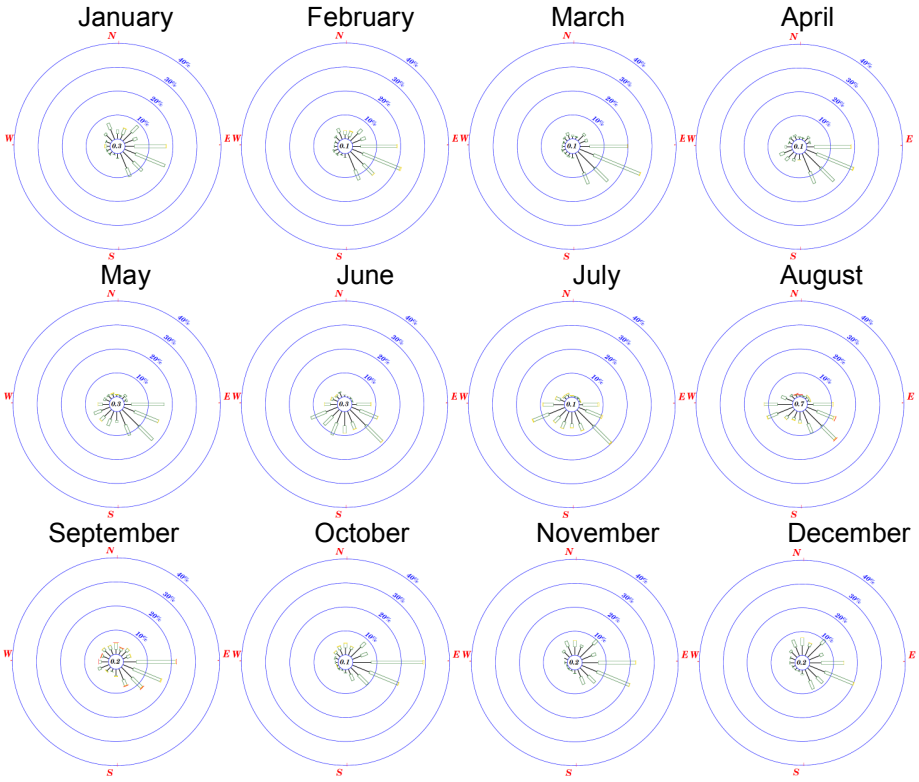


Figure 3.7 (as an example) monthly wind roses of SE, Kai Tak weather station from 1998 to 2007

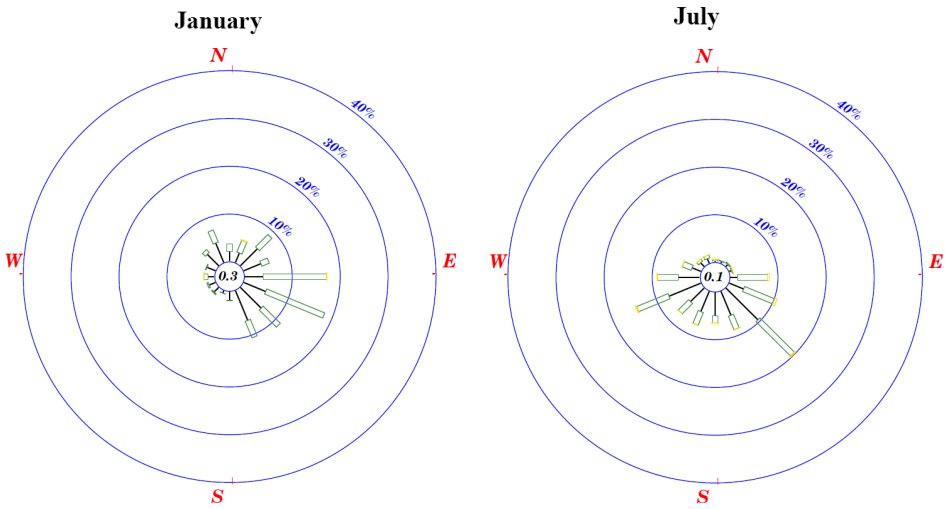


Figure 3.8 (as an example) Wind roses of SE, Kai Tak weather station from 1998 to 2007 (Jan and July)

3.7 With reference to the AVA EE 2010 for the Project Area and AVA IS 2015[1], wind availability data were also obtained from MM5 simulation performed by Hong Kong University of Science and Technology (HKUST) (Figure 3.9) and wind tunnel (Figures 3.10 and 3.11) respectively. Based on the simulated wind availability data, annual prevailing winds were identified from the E and NE quadrants, while summer prevailing winds were identified from E, SE and SW quadrants. Based on the wind tunnel data for Choi Fook Estate Phase 3 and Sport Centre, the annual prevailing winds are from N, ENE and E directions while the summer prevailing winds mainly come from E, S, SW and WSW directions.

[1] Hong Kong Housing Authority: Public Rental Housing of Choi Fook Estate Phase 3 and Sports Centre - Air Ventilation Assessment (AVA) - Initial Study (2015)

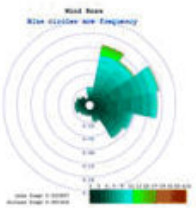
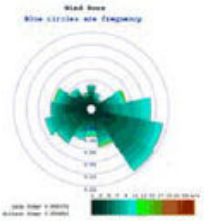
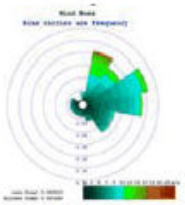
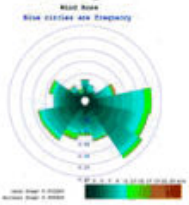
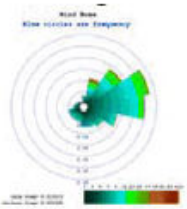
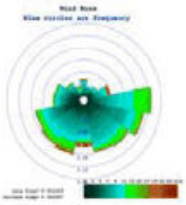
Height	Annual	Summer
60m	 Height: 60m, Angle: 16 intervals	 Height: 60m, Angle: 16 intervals
120m	 Height: 120m, Angle: 16 intervals	 Height: 120m, Angle: 16 intervals
450m	 Height: 450m, Angle: 16 intervals	 Height: 450m, Angle: 16 intervals

Figure 3.9 The wind data based on MM5 simulation (taken from AVA EE 2010)

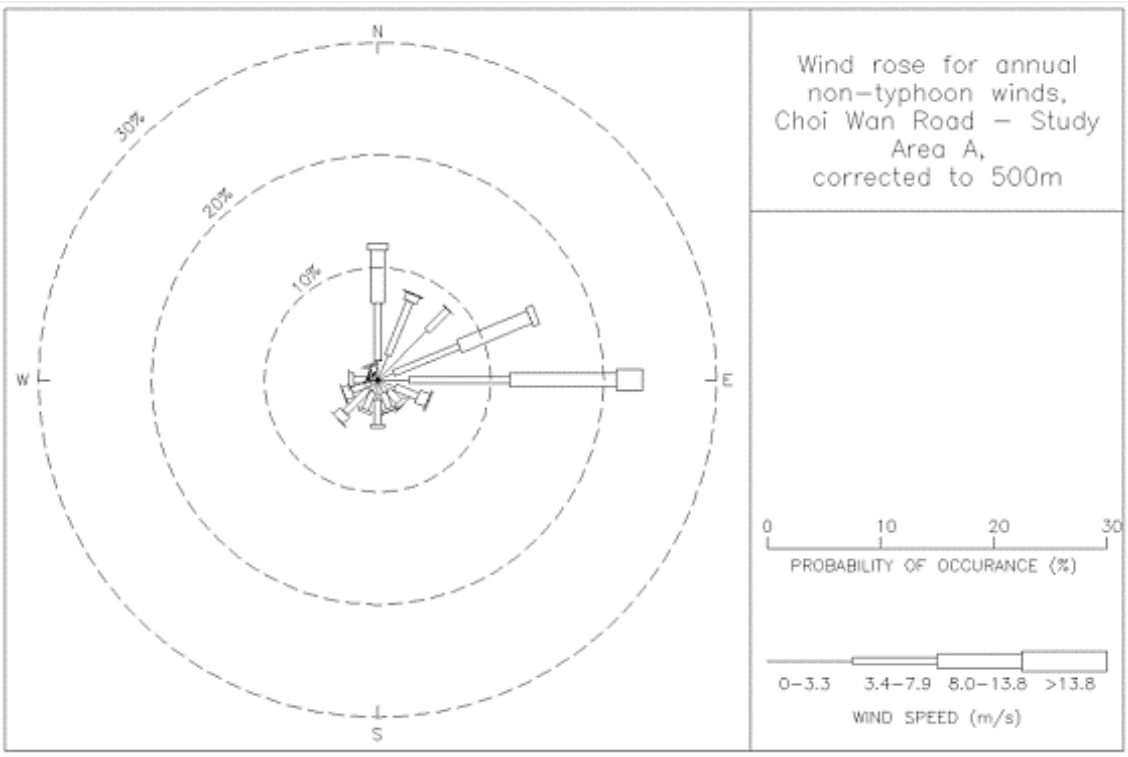


Figure 3.10 Wind rose for annual non-typhoon winds for Public Rental Housing of Choi Fook Estate Phase 3 and Sports Centre (at 500 mPD) (taken from AVA IS 2015)

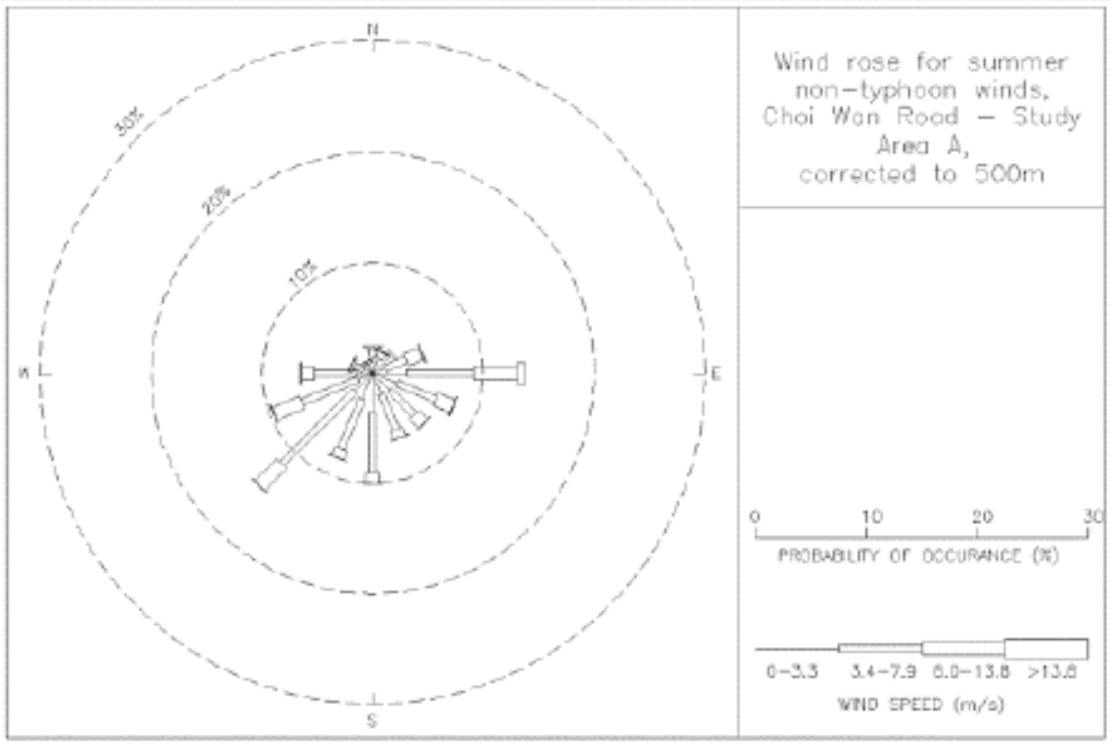


Figure 3.11 Wind rose for summer non-typhoon winds for Public Rental Housing of Choi Fook Estate Phase 3 and Sports Centre (at 500 mPD) (taken from AVA IS 2015)

3.8 In summary, based on the available wind data (Table 1) by considering that wind data provided by PlanD is likely to be more representative to reflect the wind availability of the Project Area elaborated in paragraph 3.6, it can be concluded the annual prevailing winds of the Project Area are mainly from the N, NNE, NE, ENE, E, ESE and SE. The summer winds of the Project Area mainly come from the E, ESE, SE, S, SSW, SW and WSW (Figure 3.12). This is in agreement with the previous AVA EE reports [1].

Table 1 Summary of Prevailing Wind Directions

			Period	
			Annual	Summer
HKO weather station	Kai Tak weather station		E, SE	SE, SW
RAMS Wind data provided by Planning Department	x:087; y:042	200m	E, ENE, ESE	SW, WSW, E
		300m	E, ENE, ESE	SW, WSW, E
		500m	E, ENE, ESE	SW, SSW, WSW
	x:087; y:043	200m	E, ENE, ESE	SW, E, WSW
		300m	E, ENE, ESE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:087; y:044	200m	E, ENE, ESE	SW, E, WSW
		300m	E, ENE, ESE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:087; y:045	200m	E, ENE, ESE	SW, E, WSW
		300m	E, ENE, ESE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:088; y:042	200m	E, ENE, NE	SW,WSW, E
		300m	E, ENE, NE	SW, WSW, E
		500m	E, ENE, ESE	SW, SSW, WSW
	x:088; y:043	200m	E, ENE, NE	SW, WSW, E
		300m	E, ENE, NE	SW, WSW, E
		500m	E, ENE, ESE	SW, SSW, WSW
	x:088; y:044	200m	E, ENE, ESE	SW, E, WSW
		300m	E, ENE, ESE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:088; y:045	200m	E, ENE, ESE	SW, E, WSW
		300m	E, ENE, ESE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:089;	200m	E, ENE, NE	SW, WSW, E

[1] AVA EE for Ngau Tau Kok and Kowloon Bay Area (November 2010);
AVA EE for Public Housing Development at Wang Chiu Road (September 2016); and
AVA EE for Kai Tak Mansion (KTM) (March 2017)

	y:043	300m	E, ENE, NE	SW, WSW, E
		500m	E, ENE, ESE	SW, SSW, WSW
	x:089; y:044	200m	E, ENE, NE	SW, E, WSW
		300m	E, ENE, NE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:089; y:045	200m	E, ENE, NE	SW, E, WSW
		300m	E, ENE, NE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:090; y:043	200m	E, ENE, NE	SW, WSW, E
		300m	E, ENE, NE	SW, WSW, E
		500m	E, ENE, ESE	SW, SSW, WSW
	x:090; y:044	200m	E, ENE, NE	SW, WSW, E
		300m	E, ENE, NE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:090; y:045	200m	ENE, E, NE	SW, WSW, E
		300m	E, ENE, NE	SW, WSW, E
		500m	E, ENE, ESE	SW, SSW, WSW
	x:091; y:044	200m	E, ENE, NE	SW, WSW, E
		300m	E, ENE, NE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
	x:091; y:045	200m	ENE, E, NE	SW, E, WSW
		300m	ENE, E, NE	SW, E, WSW
		500m	E, ENE, ESE	SW, SSW, WSW
MM5 simulation (from AVA EE 2010)		60m	E, ENE, NNE	SE, ESE, E
		120m	E, ENE, NNE	SE, E, ESE
		450m	ENE, E, NE	E, ESE, SW, SE
Wind tunnel data (from AVA IS 2015)		500m	N, ENE, E	E, S, SW, WSW
Summary of wind directions			**N, NNE, NE, ENE, E, ESE, SE**	**E, ESE, SE, S SSW, SW, WSW**

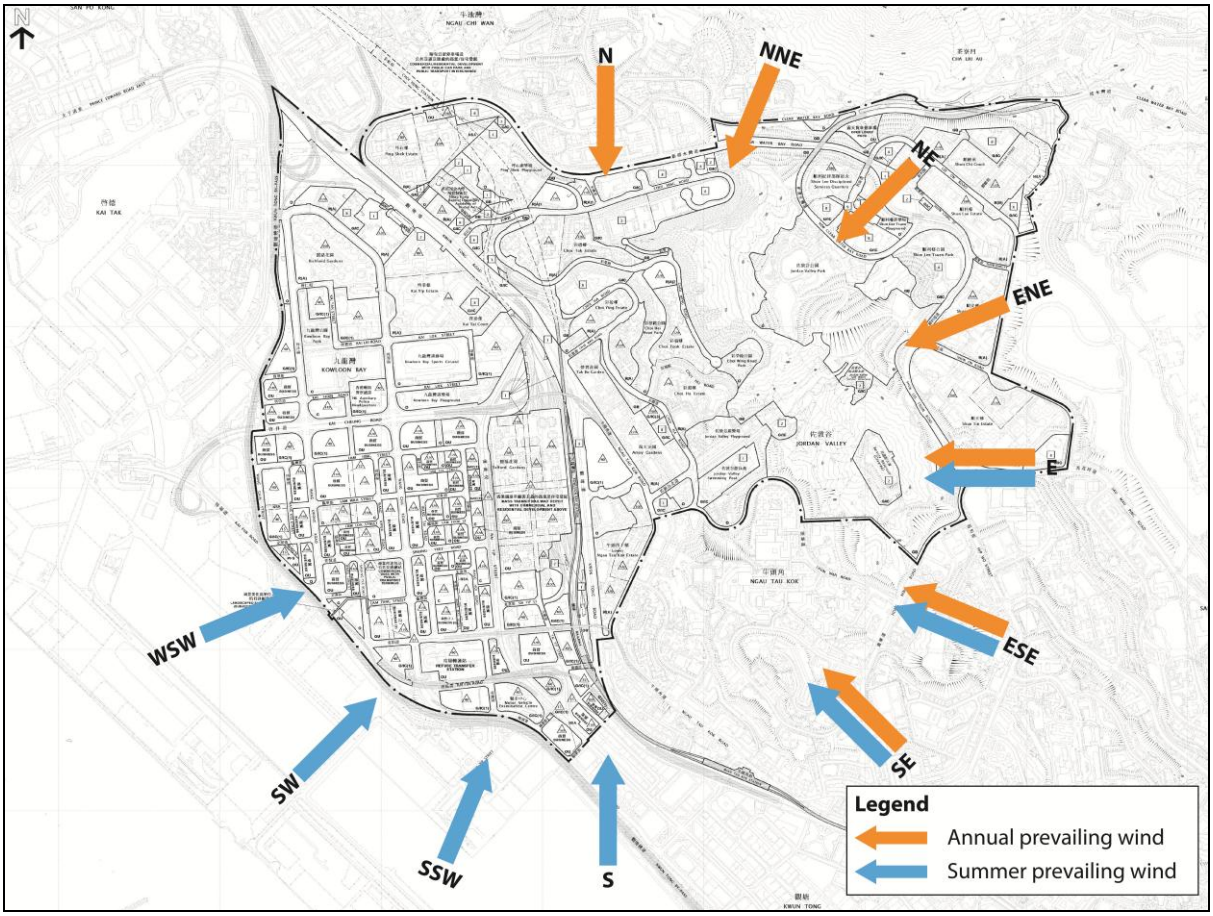


Figure 3.12 A summary of the prevailing winds of Ngau Tau Kok and Kowloon Bay Planning Area

4.0 Topography, Urban Morphology and Wind Environment / Major Ventilation Paths

4.1 The Project Area is surrounded by Hammer Hill, Kowloon Peak and Ping Shan, ascending from the low level at southwest to the high level at northeast (Figure 4.1). It includes hilly Ngau Tau Kok and Jordan Valley. The area, west of the Kwun Tong Road, is relatively flat. The area, east of the Kwun Tong Road, is hilly, and consists of Jordan Valley with vast open space areas and green belts. Katabatic (downhill) air movements at night time can be expected from the vegetated hill valleys from the northeast (Figure 4.1). Sea breeze during the daytime from the south is not significant due to the small waterbody south of the Project Area.

4.2 Prevailing winds from the north, north-easterlies and easterlies will be slowed down and weakened by the shielding effects of the hills surrounding the Project Area.

4.3 When prevailing winds come from the south-easterlies, the Project Area will not be affected by the topography but the surrounding urban developments in Ngau Tau Kok and Kwun Tong to the southeast.

4.4 KTD to the south and southwest of the Project Area is currently under construction and mostly occupied by open areas or construction sites with existing developments ranging from smaller scale low-rise/mid-rise developments to larger scale high-rise and high-density developments. Major building and park developments completed or under construction include the public rental housing (existing Kai Ching Estate and Tak Long Estate) and Home Ownership Scheme developments, government buildings (existing Trade and Industry Tower and Kai Tak Community Hall as well as planned Kowloon East Regional Headquarters and Operational Base cum Ngau Tau Kok Divisional Police Station) and 2 existing schools at the former North Apron area; the existing Kai Tak Cruise Terminal/Park, Runway Park (Phase 1)/Pier at the former Runway area; the existing fire station and Hong Kong Children's Hospital (HKCH) at the former South Apron area. When prevailing winds come from the south and south-westerlies, the Project Area will not be affected by the topography but the KTD in future.

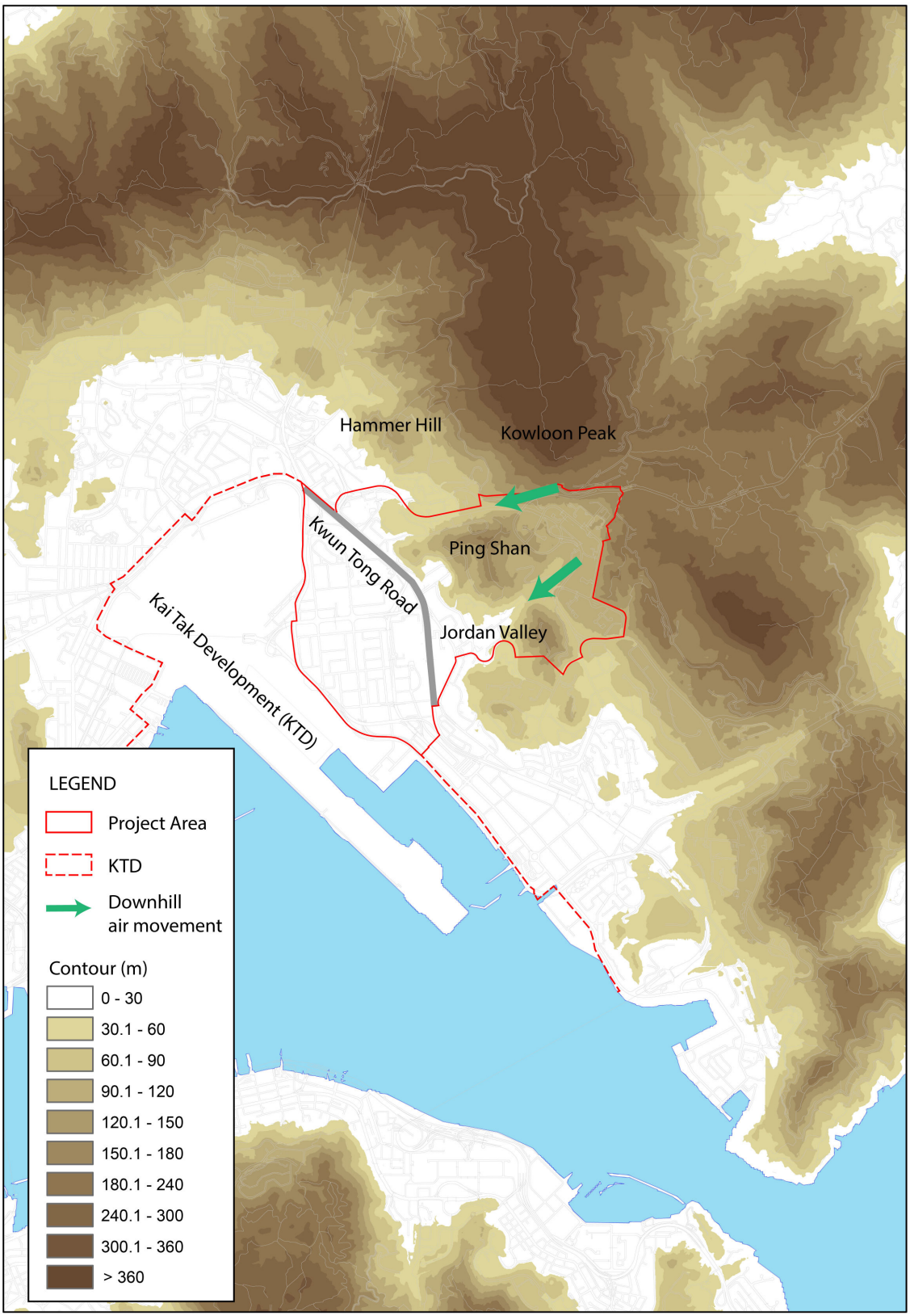


Figure 4.1 Topography surrounding the Project Area

Urban Morphology and Wind Environment / Major Ventilation Paths

4.5 The region to the west of Kwun Tong Road consists of Kowloon Bay Business Area (KBBA) with maximum building heights for commercial/business developments up to 170 mPD; the large scale commercial and residential development (Telford Plaza and Telford Gardens) to the east of KBBA with maximum building height up to 100 mPD; and residential developments to the north of KBBA with maximum building height up to 100 mPD for existing residential towers and BHR of 120 mPD for a proposed public housing development (Figure 4.2). This region also includes some "Government, Institution or Community" ("GIC"), "Open Space" ("O"), and "Green Belt" ("GB") zones as 'air spaces', which contribute to the air ventilation, such as Kowloon Bay Park, Kowloon Bay Sports Ground, Kowloon Bay Playground, Lam Wah Street Playground and Zero Carbon Building (Figure 4.3).

4.6 The region to the east of Kwun Tong Road is hilly. It consists of Ngau Tau Kok Valley to the east of Kowloon Bay and Jordan Valley with vast open space areas and green belts (Figure 4.3). This region is adjacent to Kowloon Peak and Tan Shan in the respective north and east, and should enjoy the downhill winds (i.e. katabatic wind). The centre of this region is the natural green belt of Jordan Valley, areas of larger-scale medium-rise residential developments are located along the eastern and western boundaries of this region, with existing building heights from 80mPD to 250mPD (Figures 4.2 and 4.3).

4.7 High ground coverage reduces urban porosity at the pedestrian level, thus reducing the potentials of air ventilation. As a whole, the ground coverage ratio in the eastern part of the Project Area is generally low (<30%). Ground coverage at Tak Bo Garden and Amoy Gardens is relatively high but it is isolated and surrounded by low ground coverage cells. The ground coverage ratio in the western part of the Project Area that includes KBBA and Telford Gardens and Telford Plaza is high with clusters of red cells (>50%) (in Figure 4.4). Thus, lesser wind from the west could reach the Project Area when compared with wind from the east.

4.8 High building volume increases the thermal capability and reduces urban Sky View Factor (SVF) (see Figure B-1 in Appendix B), which reduces long wave radiation back to the sky causing urban heat island. This creates higher thermal stress during the summer and a need for good air ventilation to mitigate the negative thermal effects. Researchers at Chinese University of Hong Kong (CUHK) have resolved a set of understanding based on Building Volume Ratio (BVR)[1] and SVF for Hong Kong. A decrease of 0.15 average of SVF in a 100m radius neighbourhood may result in 1 °C temperature increase[2]. As a whole, the BVR in the eastern part of

[1] Building Volume Ratio is the ratio between the cubic volume of buildings in a 100mx100m grid and the maximum building volume in Hong Kong – currently 1.2 million m3

[2] Chen, L., Ng, E., An, X., Ren, C., Lee, M., Wang, U., & He, Z. (2012). Sky view factor analysis of street canyons and its implications for daytime intra-urban air temperature differentials in high-rise, high-density urban areas of Hong Kong: a GIS-based simulation approach. International Journal of Climatology, 32(1), 121-136.

the Project Area is low (<10%) to medium (<25%) (Figure 4.4). The BVR in the western part of the Project Area that includes KBBA and Telford Gardens and Telford Plaza are ranged from medium (10-25%) to high (>25%) (Figure 4.5).

4.9 Due to the high ground coverage ratio and BVR, the wind condition in the area (centre of KBBA and Telford Gardens and Telford Plaza in Figures 4.4 & 4.5) identified in paragraphs 4.7 and 4.8 is weak and needs to be improved. Furthermore, there are some existing vacant sites or committed "Other Specified Uses" ("OU") sites for business use with BHRs up to 120 mPD at the junction of Sheung Yuet Road and Wang Tai Road in this area. It is likely that in the future the ground coverage ratio and BVR will be increased in this area with committed projects and future new developments. Mitigation measures, such as establishing and/or widening air paths through the area, are needed to improve/maintain the urban air ventilation performance in this region[1].

[1] Ng, E., Yuan, C., Chen, L., Ren, C., & Fung, J. C. (2011). Improving the wind environment in high-density cities by understanding urban morphology and surface roughness: a study in Hong Kong. Landscape and Urban planning, 101(1), 59-74.

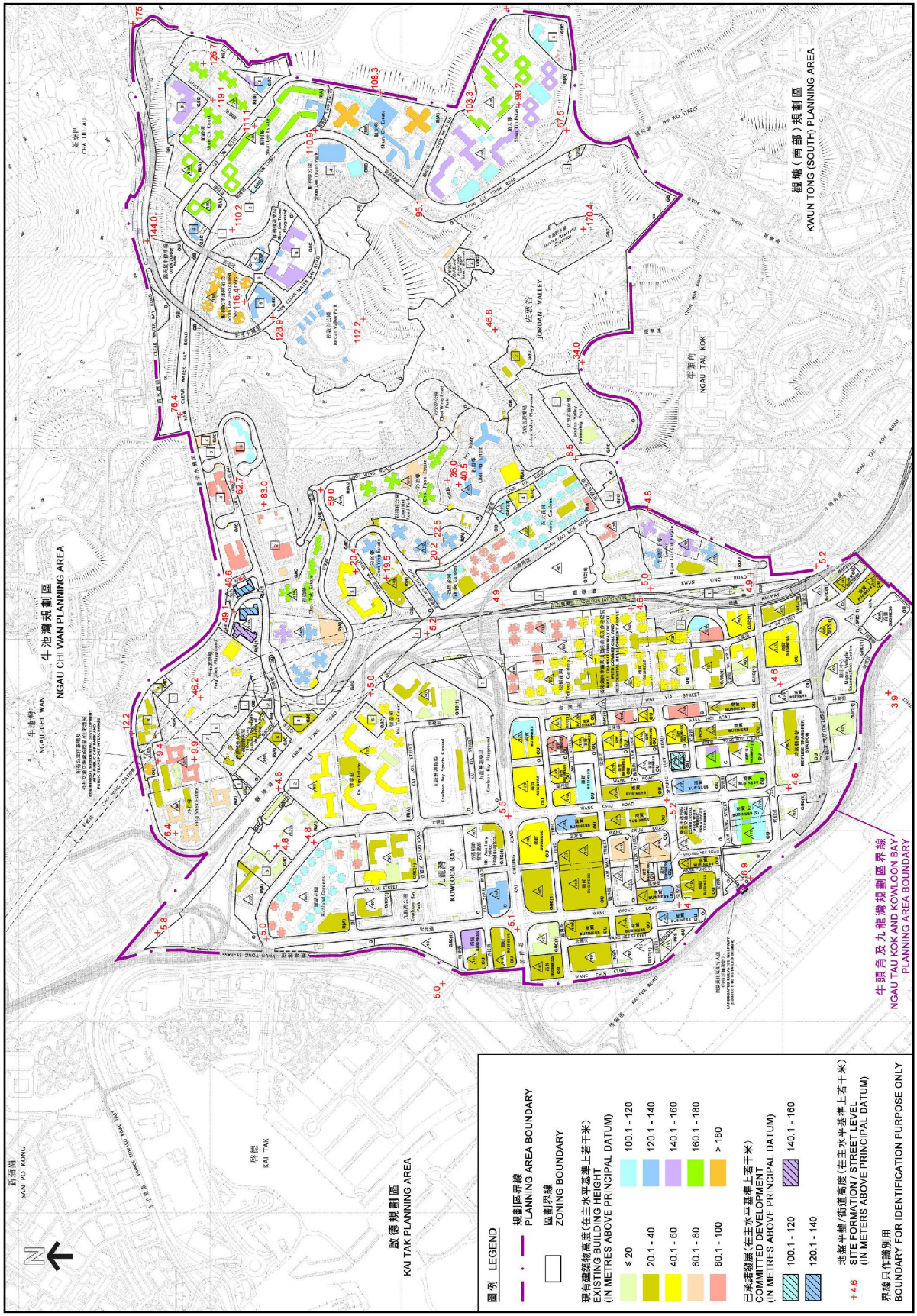


Figure 4.2 Existing building height (mPD)

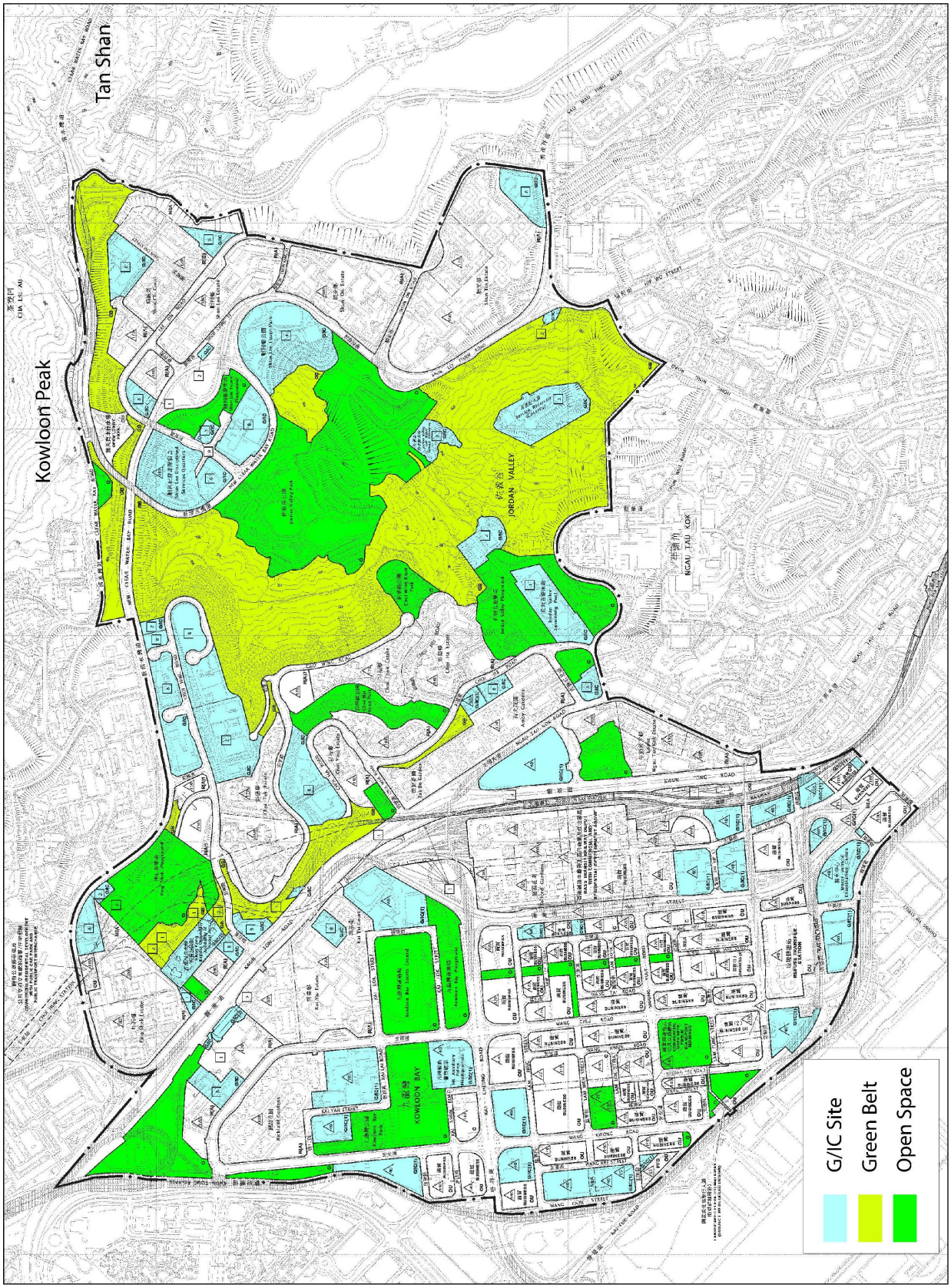


Figure 4.3 "Government, Institution or Community", "Open Space", and "Green Belt" zones

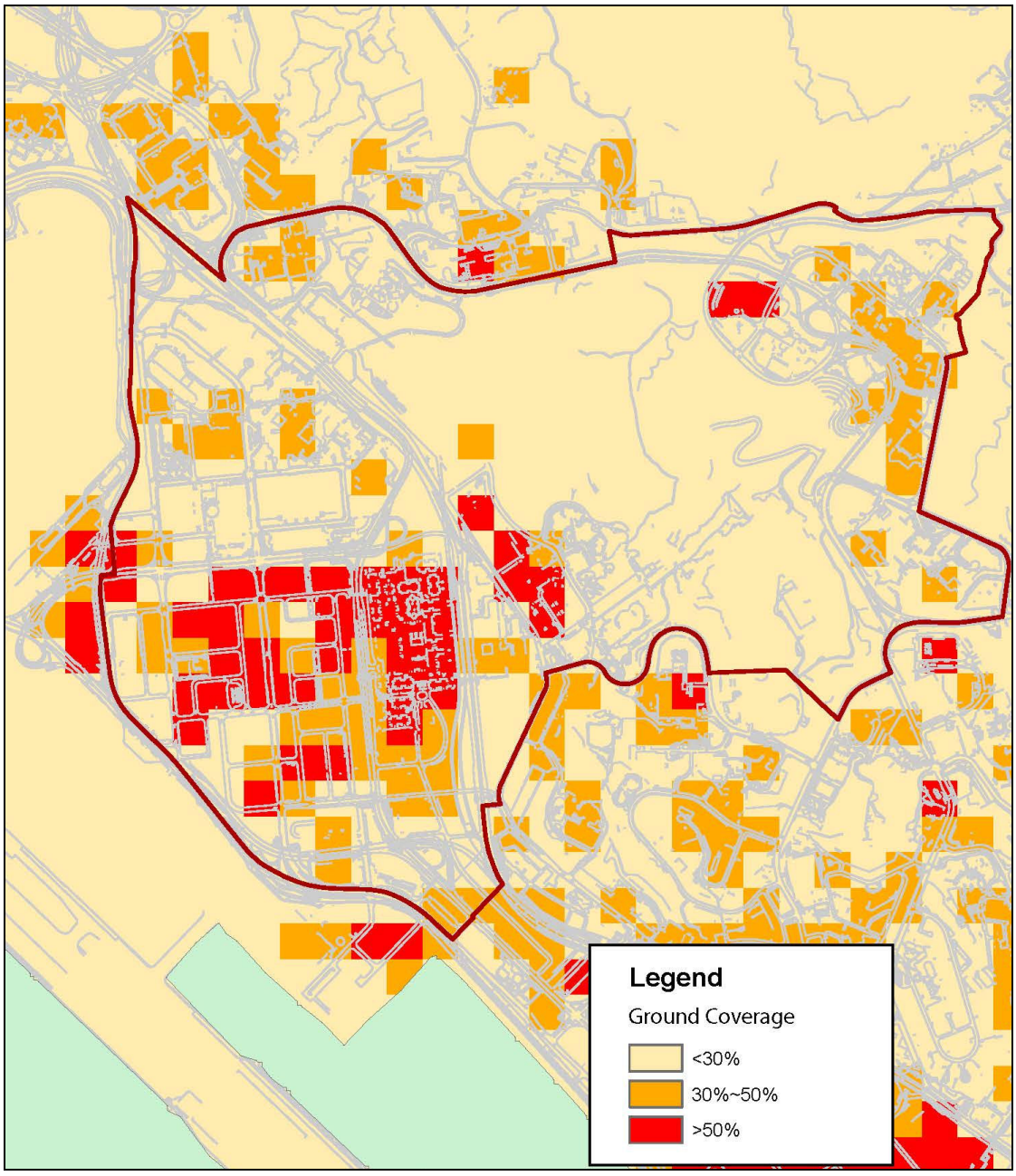


Figure 4.4 Ground Coverage Ratio map of the Project Area resolved to 100mx100m cell area (including roads, open spaces and ground area covered by buildings and podia)

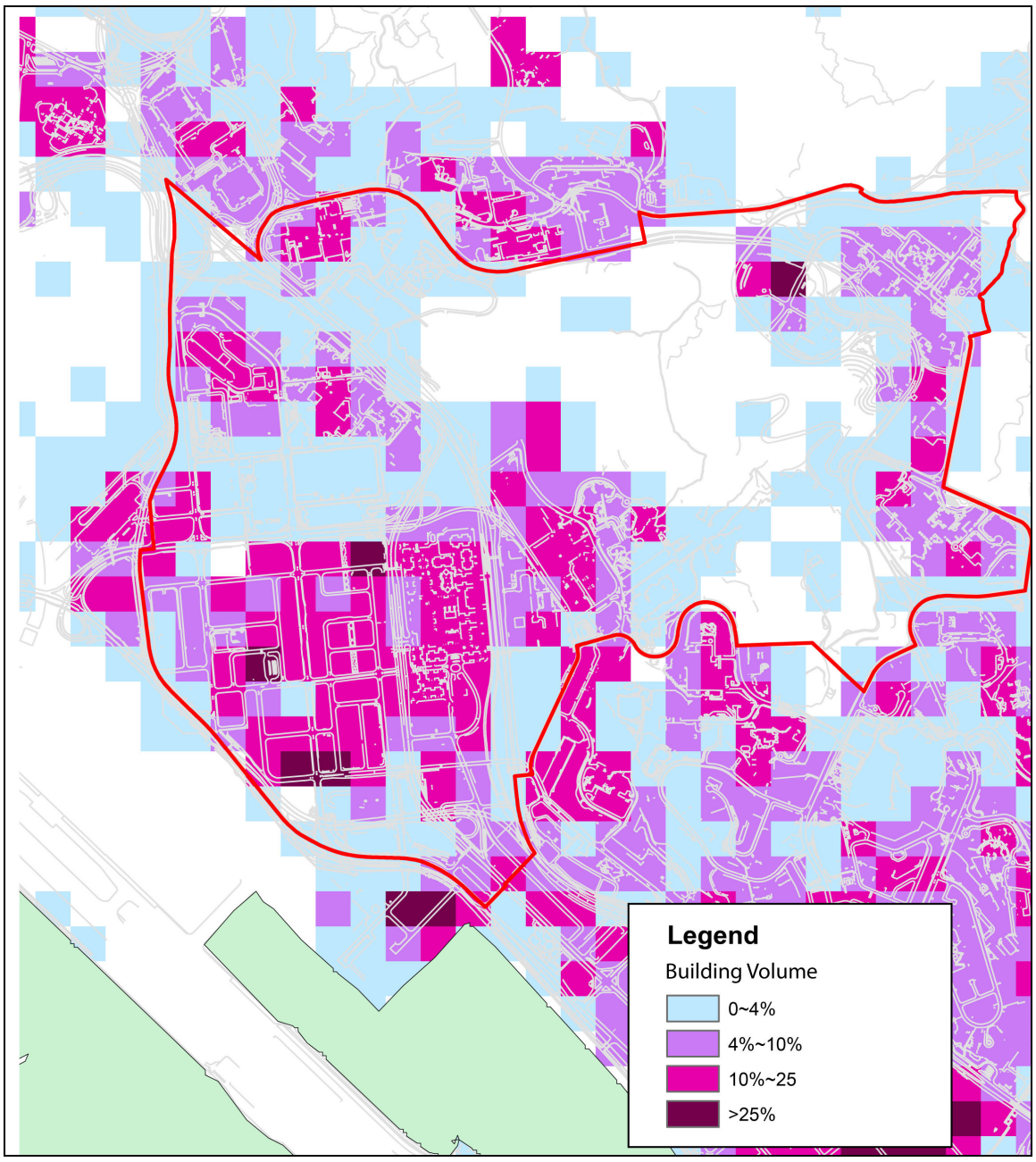


Figure 4.5 Building Volume Ratio map of the Project Area resolved to 100m x 100m cell

4.10 Major roads/streets in parallel with or less than 30 degrees to the prevailing wind directions together with open spaces and low-rise buildings can form air paths (Figures 4.6 and 4.9). The existing wind condition in the Project Area mainly relies on the existing road network and open spaces.

4.11 The area east of the Kwun Tong Road consists of large areas of open spaces. Prevailing winds can flow relatively freely through the open spaces, major roads, and over the low-rise developments (Figures 4.6 to 4.9).

4.12 The area west of the Kwun Tong Road especially KBBA is a densely built-up area. When prevailing winds come from the NE, ENE, E, ESE, WSW and SW, air movements will mostly follow the east-west direction roads and streets (Figures 4.6 and 4.7). The developments of Telford Gardens will weaken the winds from the easterlies coming into the centre of KBBA. When prevailing winds come from the N, NNE, SE, S and SSW, air movements will mostly follow the north-south direction roads and streets (Figures 4.8 and 4.9). The major north-south direction roads and streets are important for the winds from the southerly quadrant coming into the centre of KBBA and further into the area north of KBBA.

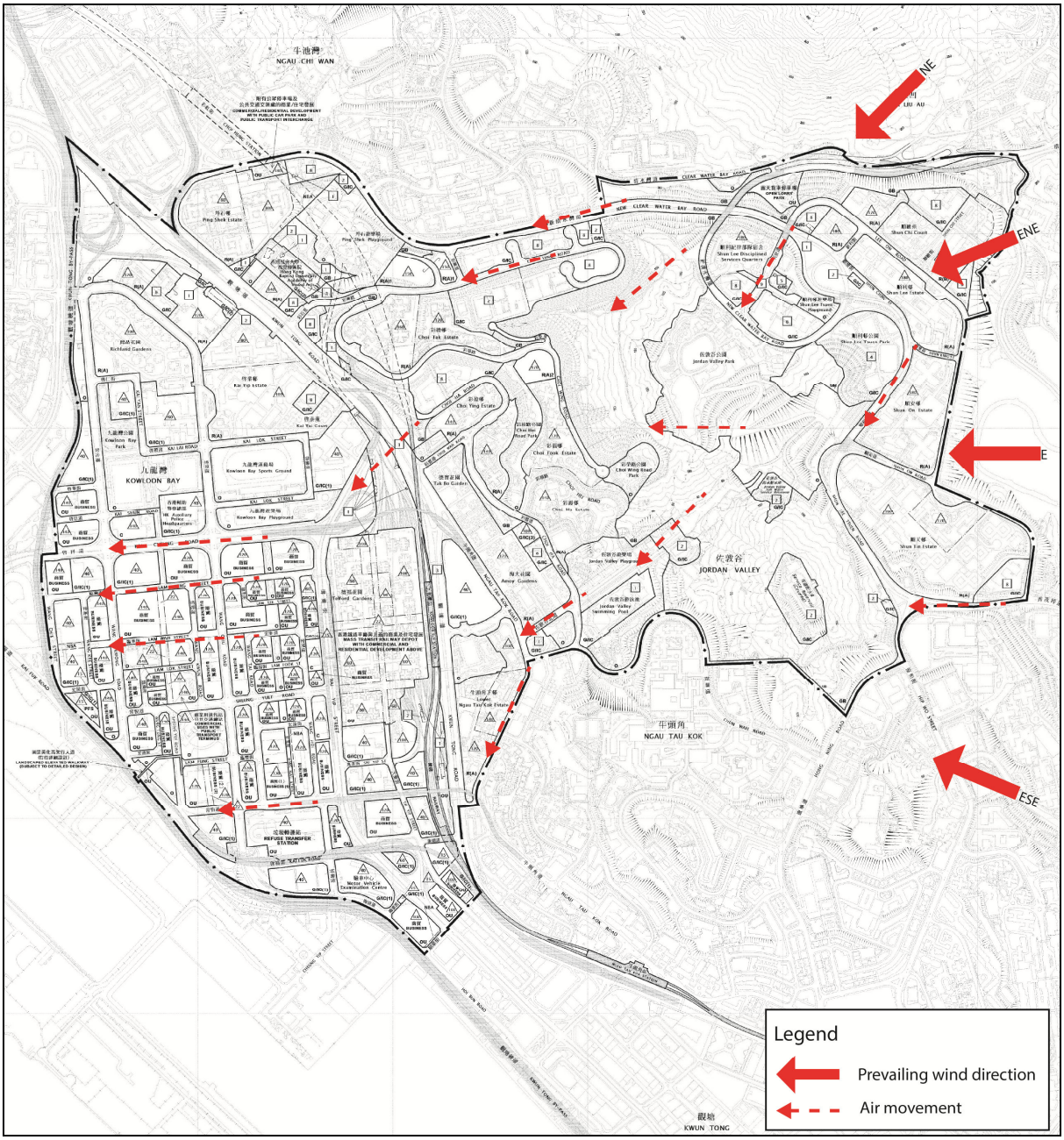


Figure 4.6 Air movement in the Project Area under prevailing winds from the NE, ENE, E and ESE

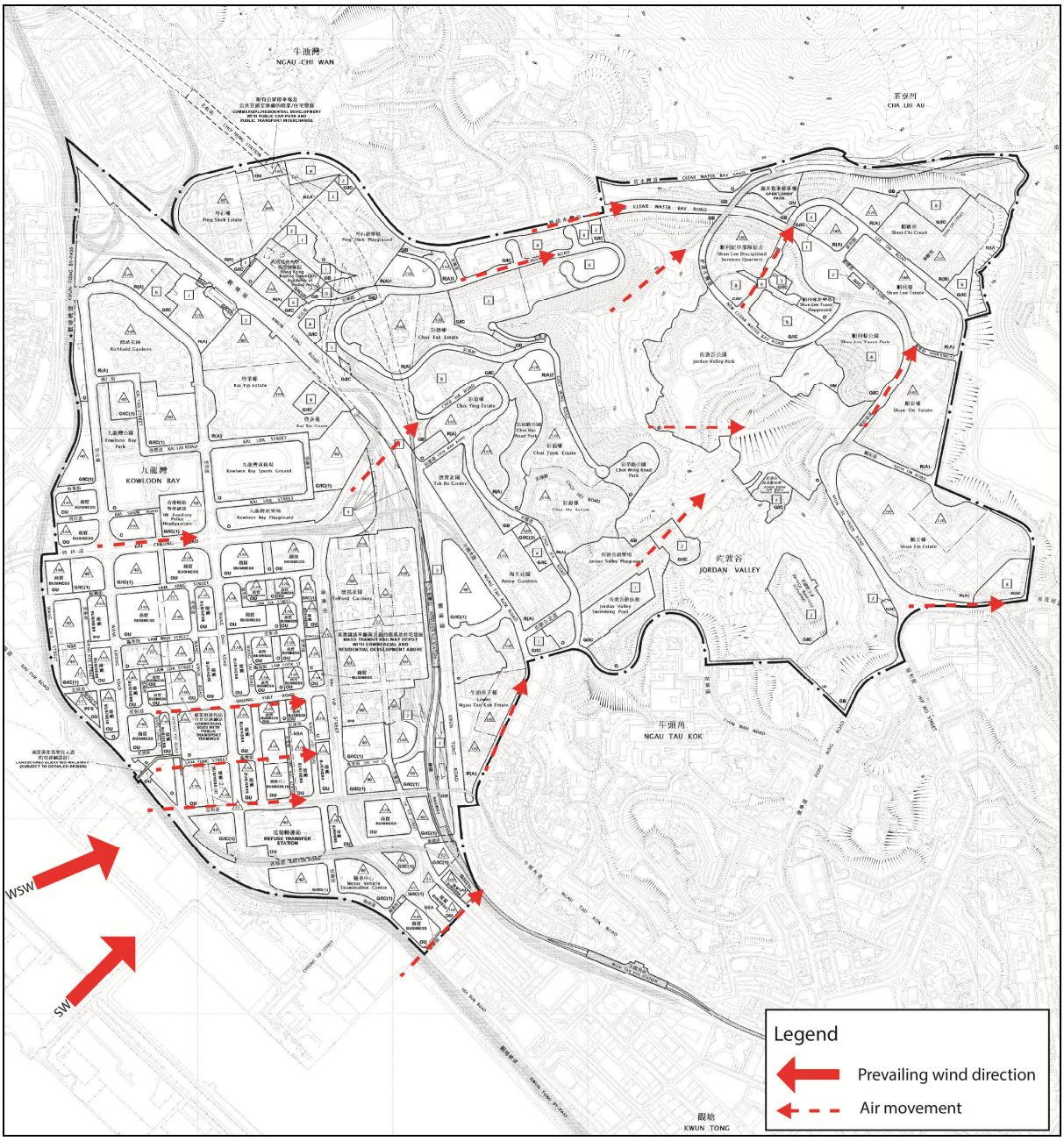


Figure 4.7 Air movement in the Project Area under prevailing winds from the SW and WSW

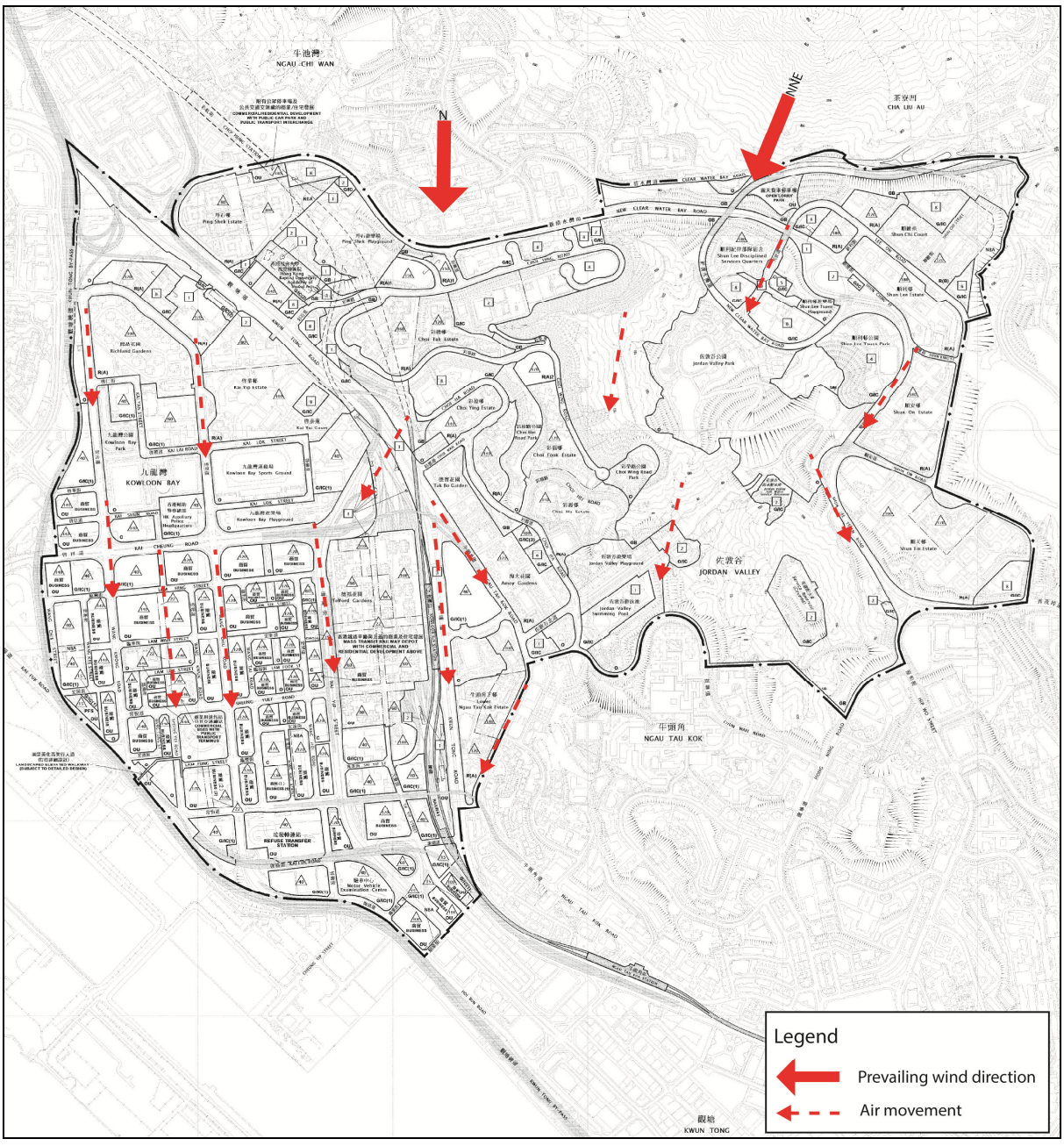


Figure 4.8 Air movement in the Project Area under prevailing winds from the N and NNE

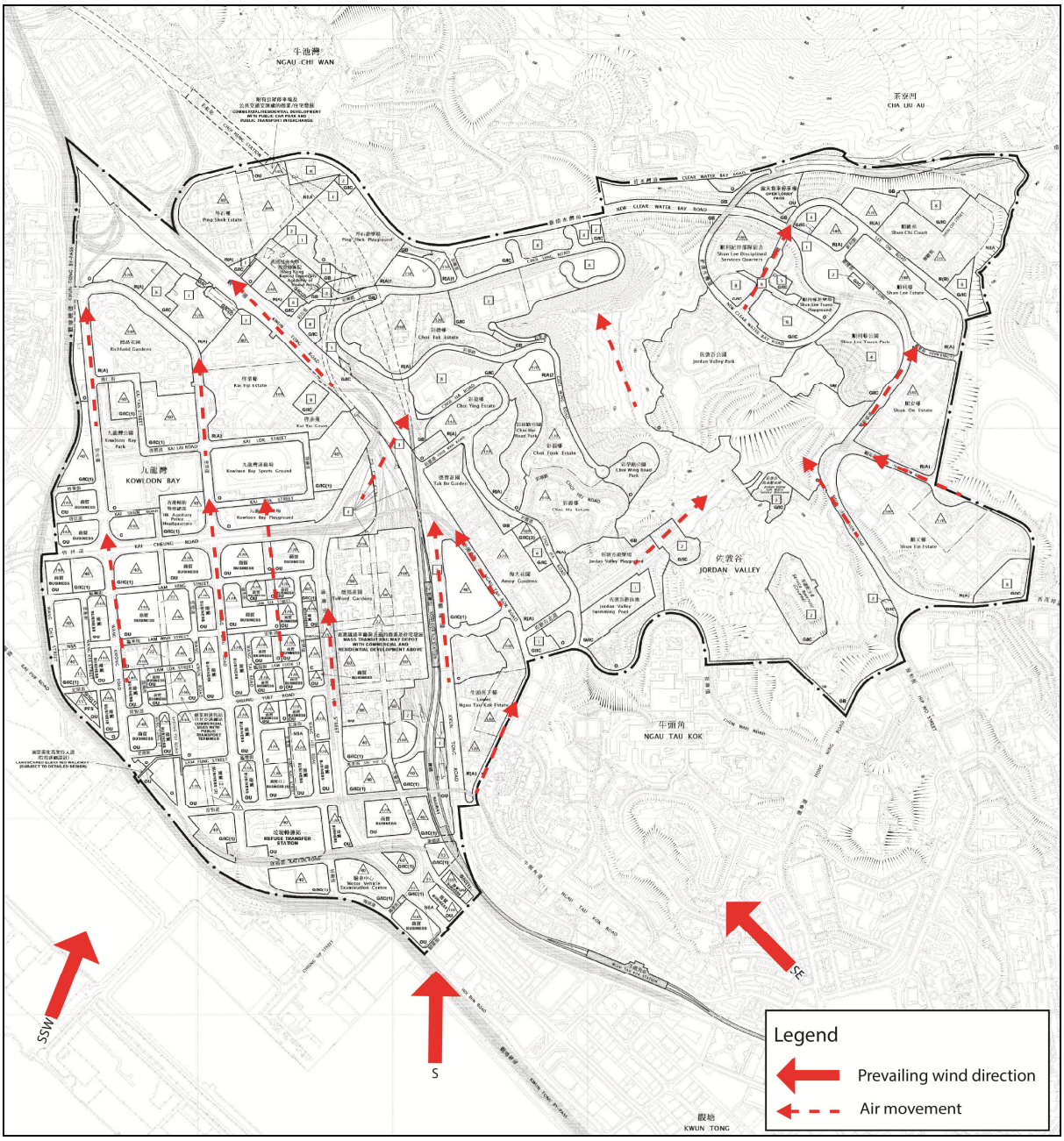


Figure 4.9 Air movement in the Project Area under prevailing winds from the SE, S and SSW

5.0 Expert Evaluation of Baseline Scenario

The major changes since the last AVA EE 2010 / OZP No.S/K13/26

5.1 The Baseline Scenario refers to the draft Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (OZP) No. S/K13/29 with BHRs, NBAs and BGs (Figure 5.1). In comparison with the OZP No. S/K13/26, the Project Area has some changes in land use and development restrictions in the OZP No. S/K13/29 and adjoining KTD. One of the aims of this AVA is to update the findings of previous AVA EE 2010 that was conducted for OZP No. S/K13/26 by taking into account the major changes. These changes are mainly covered by zoning amendments to the OZPs and planning applications resulting in change in land use and increase in development intensity and building height. Technical assessments including AVAs had been conducted to support these changes. BHRs, BGs and NBAs are imposed in the OZP or required in the planning briefs of public housing developments.

Public Housing Developments at Choi Hing Road and Choi Wing Road

5.2 Three sites for public housing developments at Choi Hing Road and Choi Wing Road have been rezoned from mainly "G/IC" and/or "GB" to "Residential Group (A)" "R(A)" (Sites 1-3 in Figure 5.2 (a)) and are under construction. Separate AVAs have been conducted for these sites at the rezoning/planning application stages. Site 1 and Site 2 at Choi Hing Road are not on the existing E-W air paths under prevailing easterly winds. According to the AVA study (2014)[1], building gap and disposition are recommended to improve the wind penetration in the N-S and NE-SW directions. An Initial Study on Air Ventilation Assessment (AVA IS) at the detailed design stage for Choi Hing Road development was conducted to incorporate wind enhancement features such as NBA and empty bay to further improve local wind performance. Site 3 at Choi Wing Road is not on the air paths under all prevailing wind directions. According to the AVA IS (2015)[2] submitted for a planning application for minor relaxation of BHR from 170 mPD to 190 mPD, the planned development on Site 3 has incorporated various good air ventilation measures such as building setback, reduced façade length, podium empty bay design, etc. It is unlikely to impose significant air ventilation impacts on the surrounding areas.

Public Housing and School Developments at Wang Chiu Road

5.3 A proposed site at Wang Chiu Road has been rezoned from "O" to "R(A)" and "G/IC" for public housing and school developments (Site 4 in Figure 5.2 (a)) respectively. A separate AVA EE has been conducted for the rezoning[3]. With the provision of various good air ventilation measures (e.g. NBA, building separation and

[1] Proposed Public Housing at Choi Hing Road - Air Ventilation Aspect (2014) (available at https://www.info.gov.hk/tpb/en/papers/MPC/508-mpc_6-14.pdf)
[2] Hong Kong Housing Authority: Public Rental Housing of Choi Fook Estate Phase 3 and Sports Centre - Air Ventilation Assessment (AVA) - Initial Study (2015)
[3] AVA report for Wang Chiu Road Public Housing Site (September 2017) (available at http://www.info.gov.hk/tpb/en/papers/MPC/577-mpc_1-17.pdf)

setback, etc.), the committed/planned development on this site is unlikely to impose significant air ventilation impacts on the surrounding areas. A quantitative AVA has been required in the planning brief to further explore effective mitigation measures at the detailed design stage.

Residential Development at Former Kai Tak Mansion Site

5.4 The development restrictions for the proposed residential development at former Kai Tak Mansion site (Site 5 in Figure 5.2 (a)) have been reviewed and a BHR of 140 mPD on the OZP is imposed only while air ventilation and visual impacts are to be considered at the detailed design stage. To address the localised air ventilation impact, a quantitative AVA will be required to explore effective mitigation measures at the detailed design stage[1].

Business Development at Shun Yip Street/Hung Yip Street

5.5 Two sites have been amalgamated for business development at Shun Yip Street/Hung Yip Street in KBAA by incorporating the road area between the sites into the "OU(Business)" zone (Site 6 in Figure 5.2 (b)). A separate AVA IS has been conducted for this site[2]. With the recommendation of various good air ventilation measures (e.g. setback, chamfered corner of buildings, etc.), the development which is under construction with the application of SBD Guidelines on the site is unlikely to impose significant air ventilation impacts on the surrounding areas. To enhance the ventilation performance, the AVA IS recommended incorporating building setback along Shun Yip Street which has been incorporated as NBA on the OZP (paragraph 5.17 refers).

Kai Tak Development

5.6 As discussed in paragraph 4.4, construction works for the KTD is undergoing. Having regard to the annual and summer prevailing winds of the Project Area (paragraph 3.8 and Figure 3.12), the developments in the South Apron and Runway areas would affect the wind environment of the Project Area. There have been major change in land use, increase in development intensity and building height in the South Apron and Runway areas (Figure 5.2(c)). An AVA IS for the KTD and AVA EE for the Runway area have been conducted to assess the air ventilation impacts both in KTD and on the surrounding areas. According to the AVA studies for the KTD[3], careful designs and mitigation measures to alleviate the potential air ventilation impact have been proposed for some focus areas in KTD including the

[1] Term Consultancy for Expert and Advisory Services on Air Ventilation Assessment for Instructed Project for a Proposed Residential Site at 53,53A, 55 and 55A Kwun Tong Road, Kowloon (August 2016)
[2] Executive Summary of AVA Report for the Ex-Kowloon Bay Flatted Factory site (October 2013)
[3] AVA report for Kai Tak Development Engineering Study cum Design and Construction of Advance Works - Investigation, Design and Construction (Further Review of Development Intensity) (January 2017) and AVA Report - EE Proposed Residential and Commercial Development at Kai Tak Runway (June 2017)

area to the south and southwest of the Project Area. They are summarised as follows:

- suitable building disposition to align with the prevailing winds and avoid creating blockage against existing wind corridors and the air paths;
- building height variations to promote air movements;
- further quantitative AVAs to be conducted for some sites including sites in the South Apron area adjacent to the Project Area to facilitate penetration of prevailing winds;
- NBAs, building separation and setbacks along the Runway Area to be maintained;
- building separation adopted in the design of the Twin Tower design of HKCH[1]; and
- the disposition of the 3 blocks of New Acute Hospital (NAH) has due respect to the breeze corridor across HKCH and Road D4 in KTD to enhance permeability between the waterfront and KBBA[2].

Review of BHRs, NBAs and BGs

5.7 The building height bands vary from 15mPD to 180mPD adopted for the "Commercial" ("C"), "R(A)", "R(A)1", "R(A)2", "Residential (Group B)" "R(B)", "G/IC(1)", "G/IC(3)" and "OU" zones on the OZP No. S/K13/29 (Figure 5.1). The Project Area has high average height-to-width (H/W) ratio, high Frontal Area Density (FAD). Especially, the existing wind condition in the area west to the Kwun Tong Road is weak as discussed in paragraphs 4.7 and 4.8.

5.8 For high-density cities with tall buildings, the H/W ratio is already high (normally greater than 2:1), it is difficult for winds from above the rooftops to reach the pedestrian level. For H/W greater than 2:1, a double air circulation vortex will begin to form within the street canyon and air ventilation at the ground level will be poor (See Figures B-2, B-3 and B-4 in Appendix B).

5.9 The current H/W ratio of the Project Area is already high and hence the wind condition at the pedestrian level is weak as discussed in paragraph 5.8. As such, it is more effective to introduce gaps between buildings, enlarge the air space nearer to the ground levels, introducing NBAs and BGs to allow winds to benefit the pedestrian wind environment.

5.10 The current NBAs and BGs on the OZP (Figure 5.3) were based on the recommendations of the AVA EE 2010. Most NBAs and BGs were imposed in the area identified in paragraphs 4.7 and 4.8 to mitigate the problem areas.

[1] AVA Report for Establishment of Centre of Excellence in Paediatrics in Kai Tak Development (Programme Nos.: 76MM) (February 2012)
[2] Harbourfront Commission Presentation: New Acute Hospital (2018)

BGs at Telford Gardens and Telford Plaza

5.11 Within the "OU" zone covering Telford Gardens and Telford Plaza, three BGs with BHR of 22mPD are imposed (Figure 5.3). As discussed in paragraph 4.12, the developments of Telford Gardens have weakened the winds from the easterly quadrant to reach the centre of KBBA. The northern 22m-wide BG running in an east-west direction that connect Wang Tai Road and the G/IC site west of Kwun Tong Road facilitates easterly prevailing winds flowing along Wang Tai Road and Lam Wah Street further into KTD through 15m-wide NBA G/IC(1) site south of the Hongkong Post Central Mail Centre. The southern 22m-wide BG running in an east-west direction that connect Sheung Yuet Road to facilitate easterly prevailing winds flowing along Sheung Yuet Road. The 15m-wide BG running in a north-south direction facilitates penetration of southerly prevailing winds flowing from Tai Yip Street to Kai Cheung Road. Not only improving the building permeability within Telford Gardens and Telford Plaza, the three BGs are important for linking the surrounding roads to form air paths to achieve the intended air ventilation performance of district significance.

BGs extending from Sheung Yee Road for Sites between Lam Wah Street and Sheung Yuet Road

5.12 Three 15m/16m-wide BGs at 22mPD are imposed on three sites zoned "C", "OU(Business)" and "OU(Commercial Uses with Public Transport Terminus") which serve as effective air paths to extend the existing air paths at Sheung Yee Road northwards to Lam Hing Street for facilitating penetration of the southerly prevailing winds (Figure 5.3). While 15m is the minimum width for an effective air path, one 16m-width was designated due to the site circumstance.

BGs at Enterprise Square Five (Mega Box)

5.13 A 15m-wide BG at 22mPD was stipulated on the "OU(Business)2" zone (the Mega Box) to form a wind corridor mainly for incoming southerly winds upon its redevelopment to connect through the "O" zone to Wang Kwun Road in the north (Figure 5.3). Under the current AVA Study, the worst case scenario has been assumed that there would be wake area on the leeward side of the building upon encountering the impermeable building. Without providing this 15m-wide BG, the developments in the subject site are likely to create some wake areas under prevailing southerly wind on the leeward side north of the site. In general, the depth of the possible wake area could be at least the height or the width of the frontal area of the building (see Figures B-3 and B-5 in the Appendix B). The proposed BG in the middle of the site could minimize the wake areas by reducing the width of the frontal area of the building.

NBA south of Hong Kong Post Central Mail Centre

5.14 A 15m-wide NBA is stipulated within the "G/IC(1)" zone that is designated for the Hongkong Post Headquarters (Figure 5.3). This NBA has district significance to extend the air path for the easterly prevailing winds along Lam Wah Street and

further into KTD and to let the westerly winds flow into KBBA through the Kwun Tong Bypass and the open space between Kwun Tong Bypass and Kai Fuk Road in KTD.

NBAs at Wang Chiu Road and Wang Kwong Road

5.15 3m-wide NBAs are imposed along both sides of Wang Chiu Road and Wang Kwong Road (Figure 5.3). Wang Chiu Road and Wang Kwong Road are in the centre of the area with high ground coverage and BVR identified in paragraphs 4.7 and 4.8. They are major breezeways running in north-south direction for the summer prevailing winds from the southerly quadrant. The proposed 3m NBAs would further widen the breezeways at Wang Chiu Road and Wang Kwong Road which are considered as major wind corridors in KBBA. In addition, the NBAs that widen the breezeways of the north-south oriented Wang Chiu Road and Wang Kwong Road can aid the lateral flow induced by corner eddies (see Figure B-6 in Appendix B) to enter into the east-west oriented street canyons. For long street canyons, air ventilation effects by corner vortices fade with increasing length-to-width (L/W) ratios of streets[1]. Due to the tall height of buildings along Wang Chiu Road and Wang Kwong Road, it is difficult for southerly winds from above the rooftops to penetrate down to the street level for the east-west oriented street canyons as mentioned in paragraph 5.8. Lateral flow induced by horizontal vortices at lower levels become important for the penetration of air movement into the east-west street canyons under prevailing summer winds from the southerly quadrant.

NBA at Wang Mau Street

5.16 The 5m-wide NBA is stipulated along Wang Mau Street (Figure 5.3) serves to widen the air path of the street for more effective air ventilation by connecting with the row of linear open space in the north up to Kai Cheung Road.

NBA at Shun Yip Street

5.17 A 5m-wide NBA is stipulated along Shun Yip Street (Figure 5.3). It can reduce the overall building bulk and widen the air path at pedestrian level[2], and thus further enhance the ventilation performance of the surrounding areas.

NBAs at Ping Shek Estate and Shun Chi Court

5.18 Two sloping areas within the "R(A)" zone of Ping Shek Estate and the "R(B)" zone of Shun Chi Court are demarcated as NBAs in order to preserve the vegetated slopes and serve as air ventilation pocket in these areas (Figure 5.3).

[1] Theurer, W. Typical building arrangements for urban air pollution modelling. Atmospheric Environment 33.24-25 (1999): 4057-4066.
[2] AVA IS Report for Term Consultancies for AVA Services - Ex-Kowloon Bay Flatted Factory Site (Oct 2013)

Implementation of Sustainable Building Design Guidelines

5.19 The SBD Guidelines aims to enhance the quality and sustainability of the built environment in Hong Kong by granting Gross Floor Area (GFA) concessions for new building developments that comply with the SBD Guidelines. It establishes three key building design elements, namely building separation, setback, and site coverage of greenery, to achieve better air ventilation, mitigate the heat island effect, and enhance the environmental quality of our living space.

5.20 The SBD Guidelines benefit the pedestrian wind environment by widening streets to avoid the development of deep street canyons (see Figure B-7 in Appendix B). According to the SBD Guidelines, buildings fronting a street less than 15m wide should be setback so that no part of the building up to a level of 15m above the street level should be within 7.5m from the centreline of the street. The potential improvement on air ventilation caused by sites adopting setback can be quite significant for those streets which are currently less than 15m wide.

5.21 According to the SBD Guidelines, building sites that are (a) 20,000m^2 or above, or (b) less than 20,000m^2 and proposed with buildings having a continuous projected façade length (L_p) of 60m or above, should comply with the building separation requirements (see Figure B-8 in Appendix B). The maximum permissible L_p for such building sites should not exceed five times the mean width of street canyon (U) (see Figure B-9 in Appendix B). A minimum permeability (P) of 20% is required for each plane in each assessment zone (see Figure B-10 in Appendix A).

5.22 For better air ventilation to achieve the intended air ventilation performance of district significance, the disposition of open space, BGs and NBAs should be linked while widening of air space along roads and connection of major roads and minor roads should be planned in such a way to form some air paths/major breezeways to further enhance wind penetration into inner parts of urbanised areas (see Figure B-11 in Appendix B). The NBAs to widen Wang Chiu Road and Wang Kwong Road are necessary as they are major breezeways in the centre of the KBBA as discussed in the paragraph 5.15. The two 22m-wide BGs on Telford Gardens running in east-west direction are also major air paths for easterly prevailing winds (both annual and summer prevailing winds as indicated in Figure 3.12) flowing to the centre of the KBBA. The 15m-wide BG on Telford Gardens running in a north-south direction is also an important air path to connect Tai Yip Street and the open space to the north. In general, the width of the NBAs and BGs on the current OZP are appropriate. The location of the NBAs and BGs are appropriate for the air paths/major breezeways in the Project Area as discussed in paragraphs 5.11 to 5.18. Creation/maintenance of connected air paths/major breezeways of district significance at strategic location would be important and necessary. SBD Guidelines will be necessary at the site design stage to improve the localised wind environment at site level and for the surrounding areas but may not serve as effective alternative measures which have district significance.

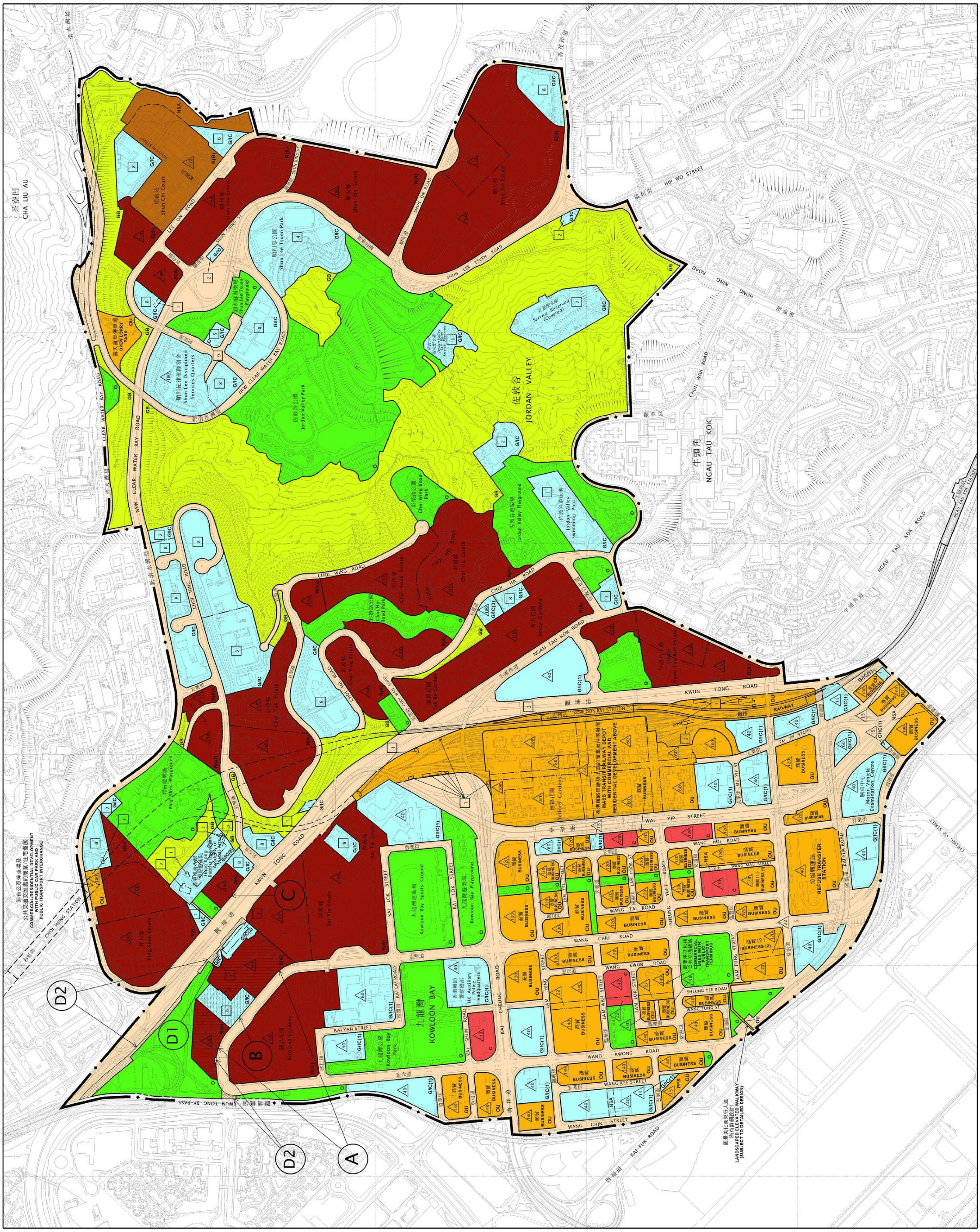
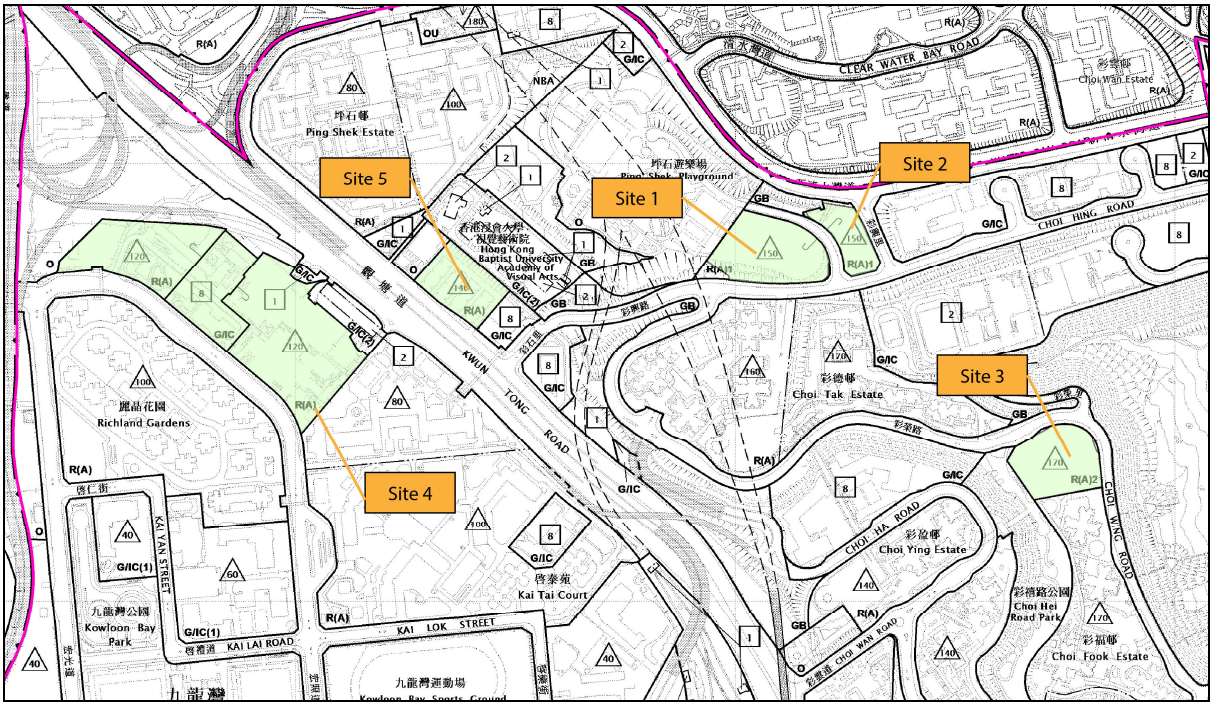
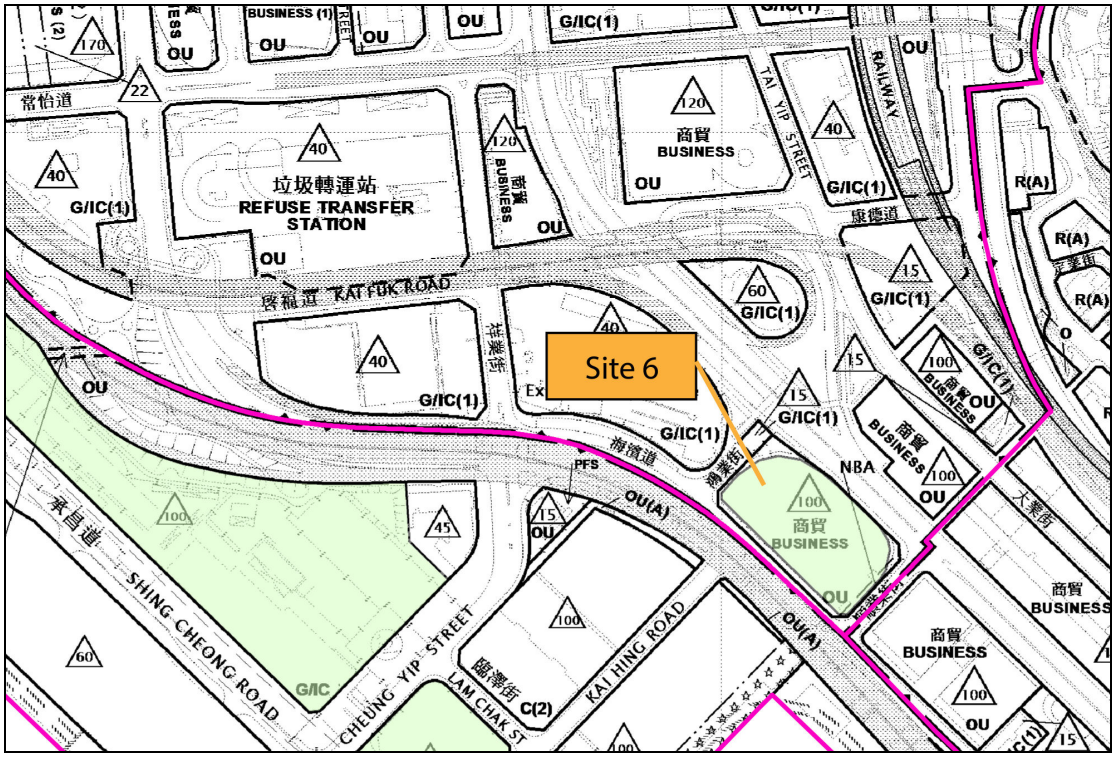


Figure 5.1 The draft Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (OZP) No. S/K13/29

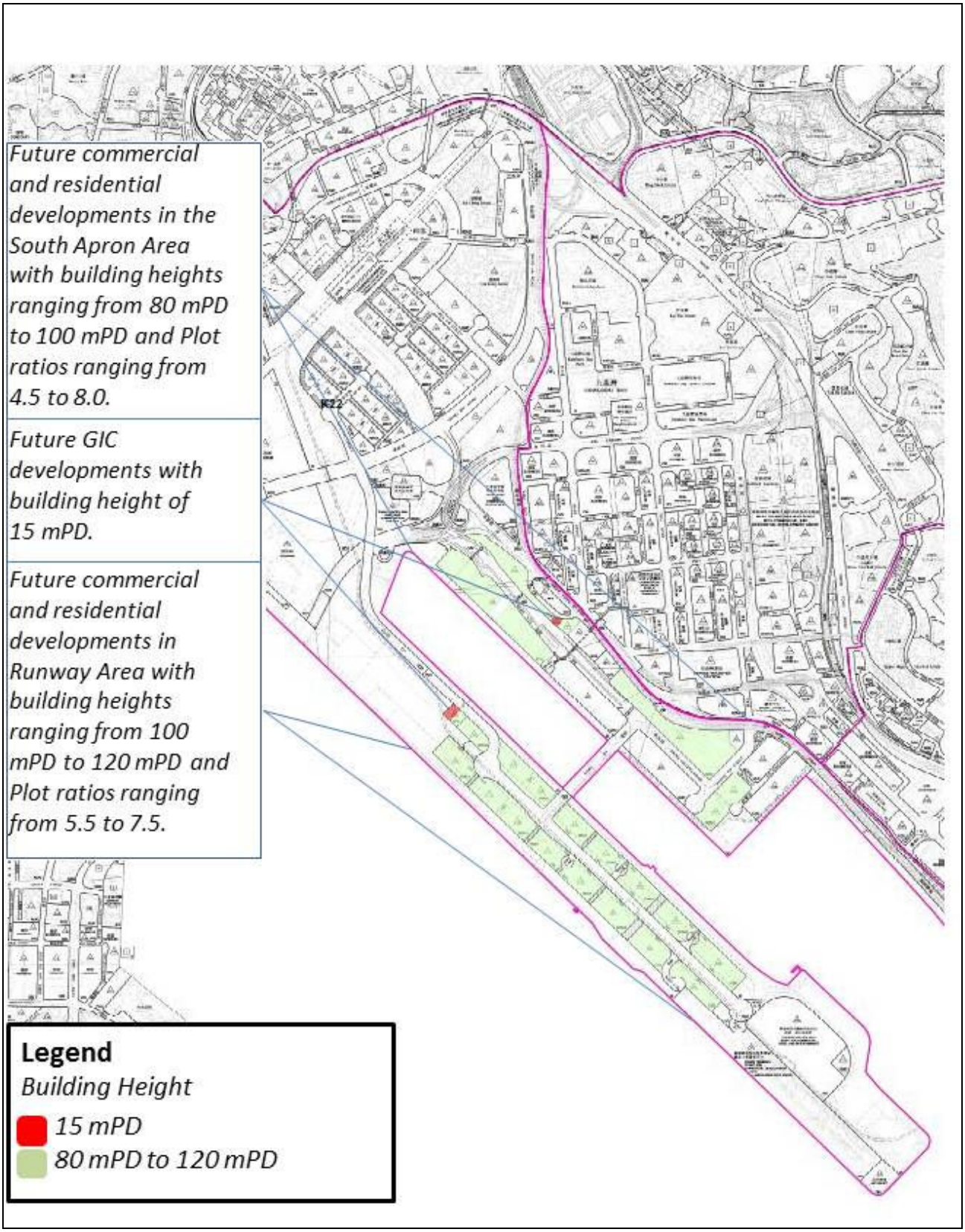


(a) Part 1



(b) Part 2

Figure 5.2 Current OZP with committed/planned developments



(c) Part 3

Figure 5.2 Current OZP with committed/planned developments

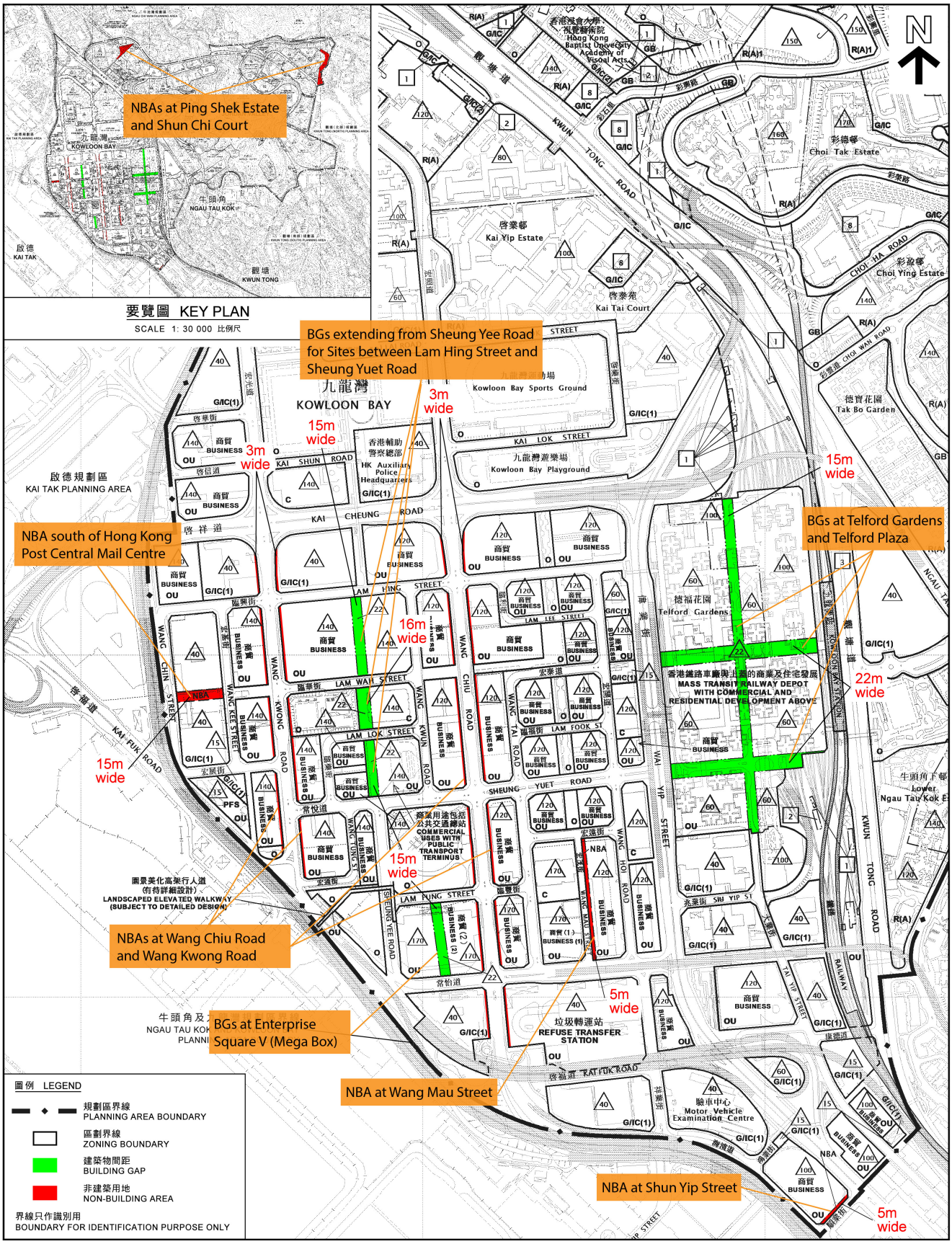


Figure 5.3 Proposed Non-building Areas and Building Gaps in the OZP

6.0 Expert Evaluation of Initial Scenario

6.1 The KBAA is located at the southern part of the Project Area and is mainly planned for G/IC and business uses under the current OZP with BHRs of 40mPD and 100mPD respectively. The G/IC sites are currently occupied by a police vehicle detention and examination centre (Lot 1), Transport Department's vehicle examination centres (Lot 4), Environmental Protection Department's waste recycling centre (Lot 2) while two sites for business use is under construction (Figure 6.1). In view of the potential of KBAA to become a commercial / office hub of Kowloon East, it is covered by the ongoing Planning and Engineering Study for the Development at KBAA (KBAA Study) of Energising Kowloon East Office to review the land use of the area taking into account various planning considerations including the connectivity between KBAA and the surrounding area.

6.2 According to the Preliminary Outline Development Plan (PODP) of the KBAA Study, there would be major changes in land use, building height and development intensity except Lots 5 and 6. The proposed changes are broadly set out below[1] (Figure 6.1) and the PODP of KBAA is shown in Figure 6.2:

(a) Lot 1: to be rezoned from "G/IC" to "OU" annotated "Integrated Waste Handling Facility" ("OU(IWHF)"). The existing BHR of 40mPD would be maintained.
(b) Lot 2: to be rezoned from "OU" annotated "Refuse Transfer Station" to "Commercial" ("C") and "O" with BHRs of 50mPD/150mPD, NBA and building setback requirements for the "C" site.
(c) Lot 3 (space beneath the flyover): to be rezoned to "OU (Cultural and Creative Uses)".
(d) Lot 4: to be rezoned from "G/IC" to "OU (Commercial Development cum Environmentally Friendly Linkage System (EFLS) Depot and Station)" with BHRs of 50mPD/120mPD/135mPD and building gap and setback requirements.
(e) At-grade public open space between Lots 4 and 6.

6.3 Located at the southern tip of the Project Area, the planned development within KBAA may have potential air ventilation impacts on the surrounding pedestrian areas with the changes of development intensity and building height. A separate AVA has been conducted under the on-going KBAA Study to assess the potential air ventilation impact created by the planned developments in KBAA[2]. Some major air paths have been identified in this separate AVA (Figure 6.3) and some major design features of PODP for wind enhancement have been proposed[2] such as a designated NBA on Lot 2 extending the air path from Wang Mau Street (Figure 6.2). Given major design features of PODP for wind enhancement as recommended in the AVA study for KBAA as follows and the building separation

[1] https://www.ekeo.gov.hk/filemanager/content/public/tc/TFKT_06_2016.pdf
[2] Planning and Engineering Study for the Development at Kowloon Bay Action Area of Kowloon East – Feasibility Study Board Cost, Technical, Environmental and Air Ventilation Assessments (WP No. 8)

requirements under the SBD Guidelines to be fulfilled in the building design stage, it is expected that the future development at KBAA may not significantly affect the ventilation performance of its surrounding areas:

- building permeability by means of ventilation bays;
- alignment / patterning of towers;
- creation of 2 additional local air paths;
- widening of local air paths and empty bays; and
- greening and disposition of open space and pedestrian area.

From the district level urban air ventilation point of view, the good features proposed above in KBAA together with the NBAs and BGs on the OZP are important for urban air ventilation in the Project Area and should therefore be maintained/pursued.

6.4 The KBAA Study is still ongoing and is anticipated to complete in 2019. The PODP is still subject to refinement into the Recommended Outline Development Plan (RODP) in the light of public views collected in the consultation conducted in 2016, detailed technical assessments and the findings of the Detailed Feasibility Study for EFLS for Kowloon East. In the preparation of the RODP, AVA IS is to be conducted to explore effective measures to enhance the penetration of prevailing winds inland.

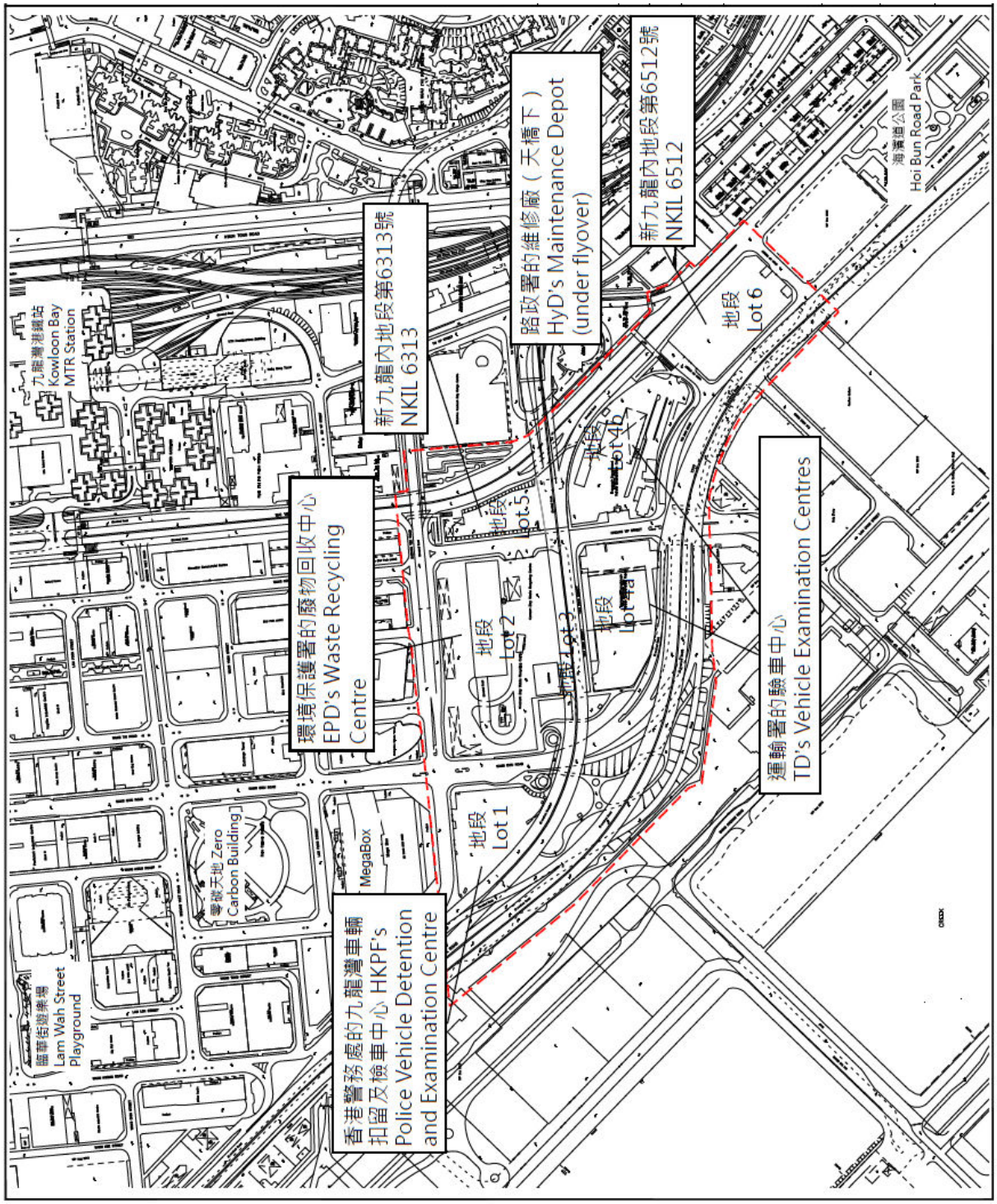


Figure 6.1 Existing developments in KBAA[1]

[1] https://www.ekeo.gov.hk/filemanager/content/public/tc/TFKT_06_2016.pdf

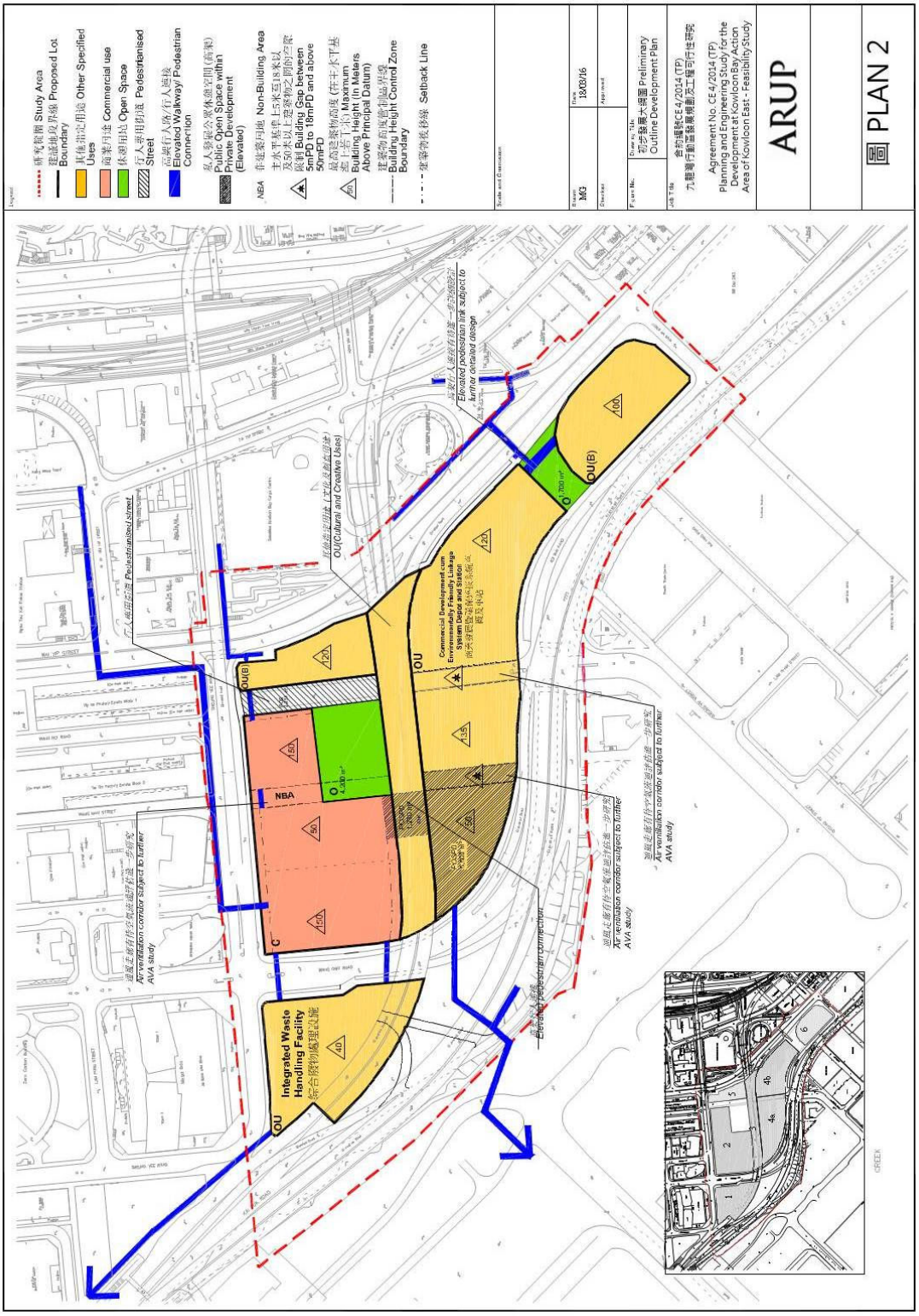


Figure 6.2 Preliminary Outline Development Plan of KBAA[1]

[1] https://www.ekeo.gov.hk/filemanager/content/public/tc/TFKT_06_2016.pdf

Figure 6.3 Air Paths in the Master Layout Plan of PODP[1]

[1] https://www.ekeo.gov.hk/filemanager/content/public/tc/TFKT_06_2016.pdf

7.0 Recommendations and Further Work

7.1 From the district level urban air ventilation point of view, the development restrictions/requirements in both the Baseline Scenario (namely NBAs and BGs) and the Initial Scenario (namely NBAs, BGs and building setback) are all important features for air ventilation in the Project Area and should be maintained/pursued.

7.2 From the building design point of view, the SBD Guidelines establish key building design elements to increase permeability and improve the pedestrian wind environment at site level.

7.3 Any future developments/redevelopments would inevitably add stress to the existing conditions in the Project Area. Therefore, amalgamated sites with bulkier buildings and longer building frontage should be carefully planned and follow the design principles set out in the Hong Kong Planning Standards and Guidelines (HKPSG)[1] and SBD Guidelines at the detailed design stage as the prevailing effort for improvement in pedestrian wind environment and urban climate. The five most important design principles are highlighted below (paragraphs 7.5 to 7.9).

7.4 The further work of the KBAA's AVA on the RODP would be conducted and covered by a separate study for alleviating the potential air ventilation impact on the pedestrian wind environment due to the proposed developments.

Further Design Principles

7.5 Variations in building height should be introduced across the Project Area to help instigate wind flow throughout the district by encouraging downwashes and mixing of air due to pressure differences (see Figure B-12 in Appendix B). Low-rise buildings and open spaces should be located in the windward direction to allow the entry and penetration of prevailing winds. Tall buildings of uniform heights forming deep urban canyons should be avoided as they create skimming flows over the top of buildings and stagnant conditions at pedestrian level (see Figures B-2 and B-3 in Appendix B).

7.6 Long and continuous façades should also be avoided, especially perpendicular to the prevailing wind direction at street level. Suitable building disposition could help effective air flows around building in desirable directions (see Figure B-13 in Appendix B). Ground coverage for buildings, including any podium structures, should be minimised to no more than 65% of the site.

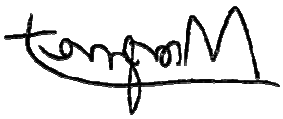
[1] Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011

7.7 To increase the permeability of the urban fabric at street level, site coverage of the podia should be reduced to allow more open space at grade (see Figure B-14 in Appendix B). A terraced podium design should be adopted to facilitate downward airflow to the pedestrian level (see Figure B-15 in Appendix B).

7.8 Existing “O” and “G/IC” sites should be maintained as “air spaces” where air ventilation can be relieved within the dense urban morphology. Open spaces, NBAs, building setbacks, and low-rise building corridors are important in providing urban permeability, moderating the city climate, and connecting breezeways and air paths (see Figures B-16 and B-17 in Appendix B).

7.9 Planting in open spaces should be maximised. Greenery (preferably tree planting) should cover no less than 30% for sites larger than 1 ha and 20% for sites below 1 ha at lower levels, preferably at grade.

Prepared by



Date: 18 January 2019

Kwok Yu Ting

Endorsed by

Date: 18 January 2019

Professor Edward Ng

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Appendix A

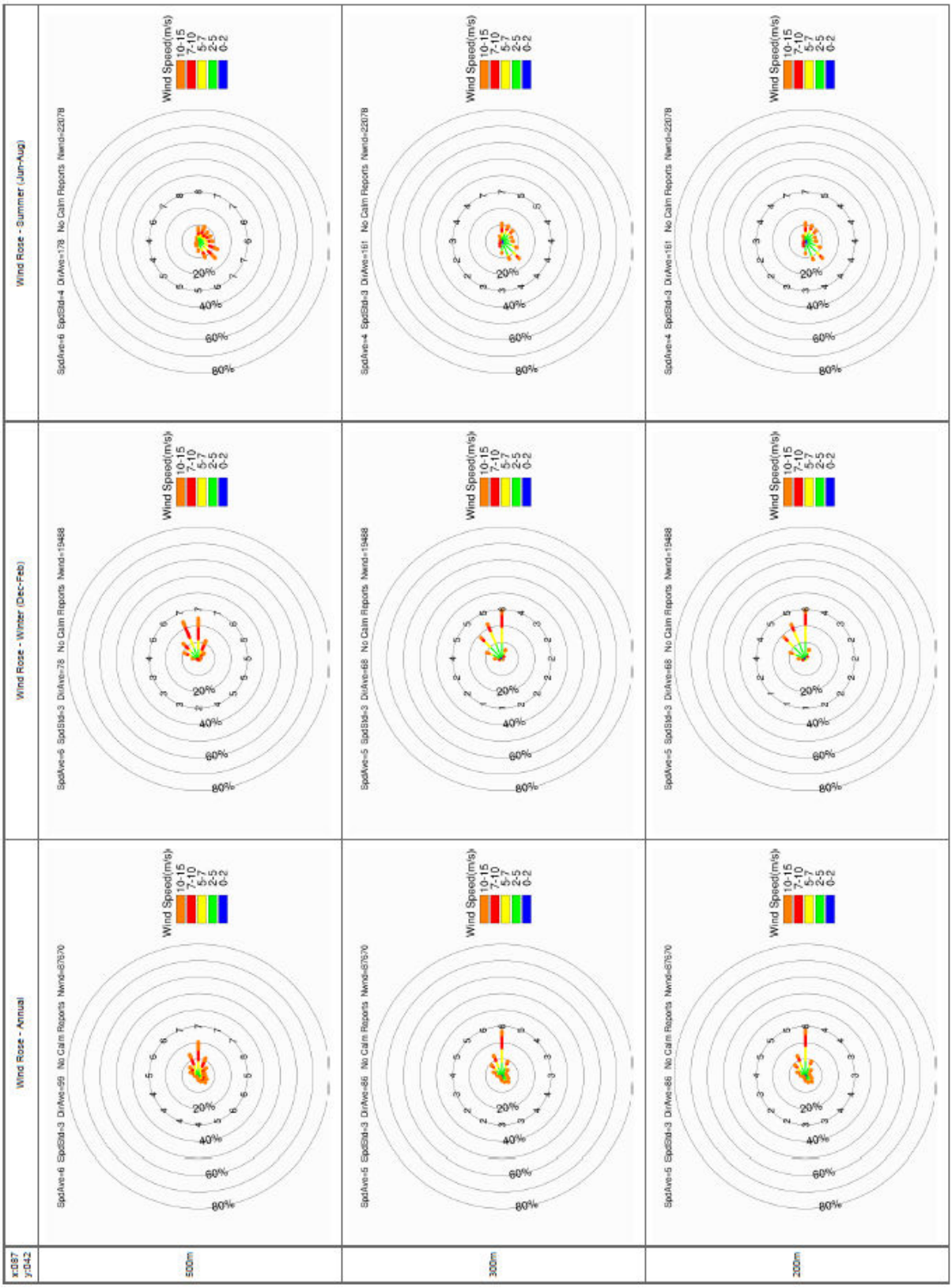


Figure A-1 The RAMS wind data extracted from Planning Department (PlanD's) website at grid x:087; y:042

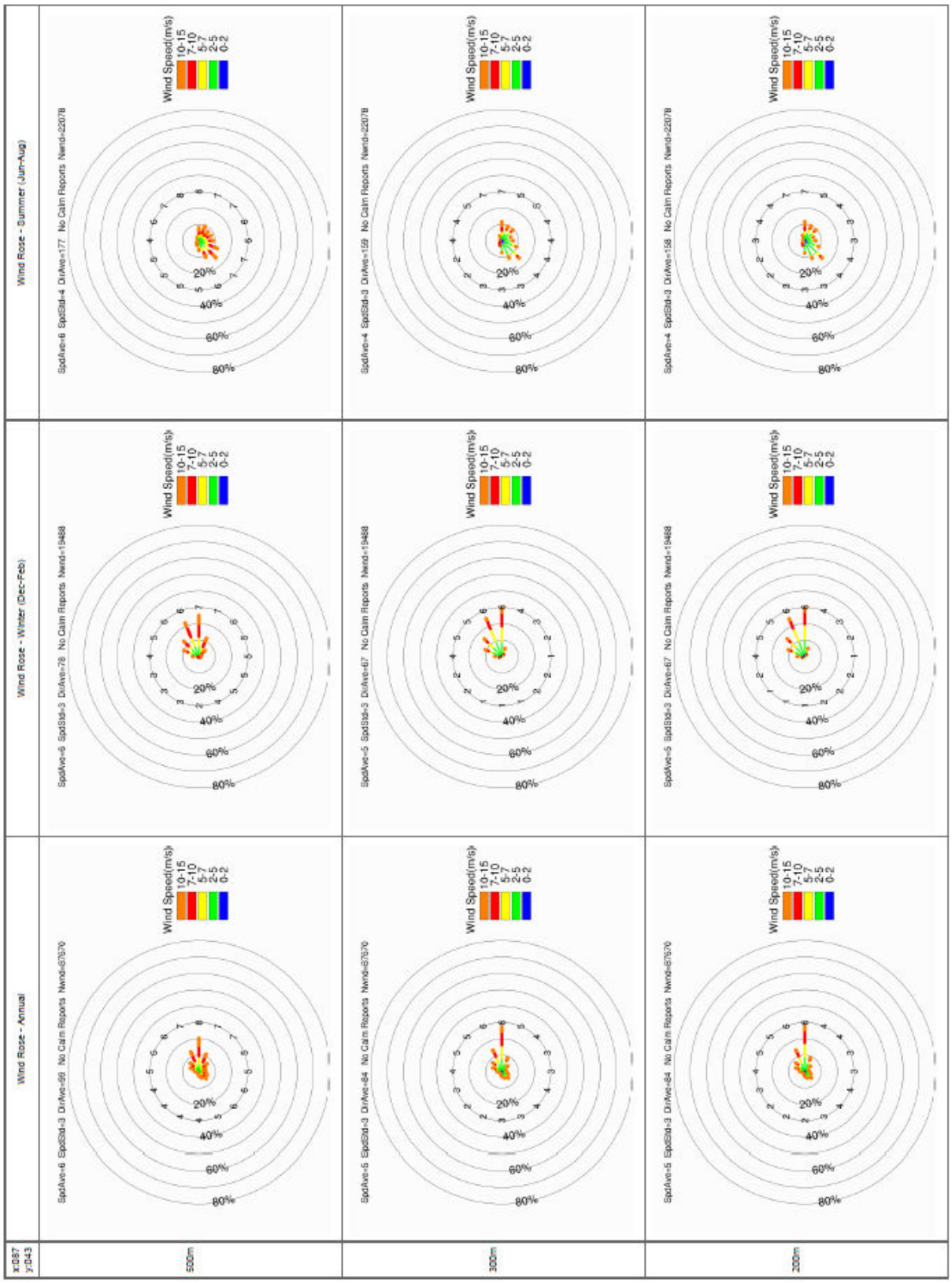


Figure A-2 The RAMS wind data extracted from PlanD's website at grid x:087; y:043

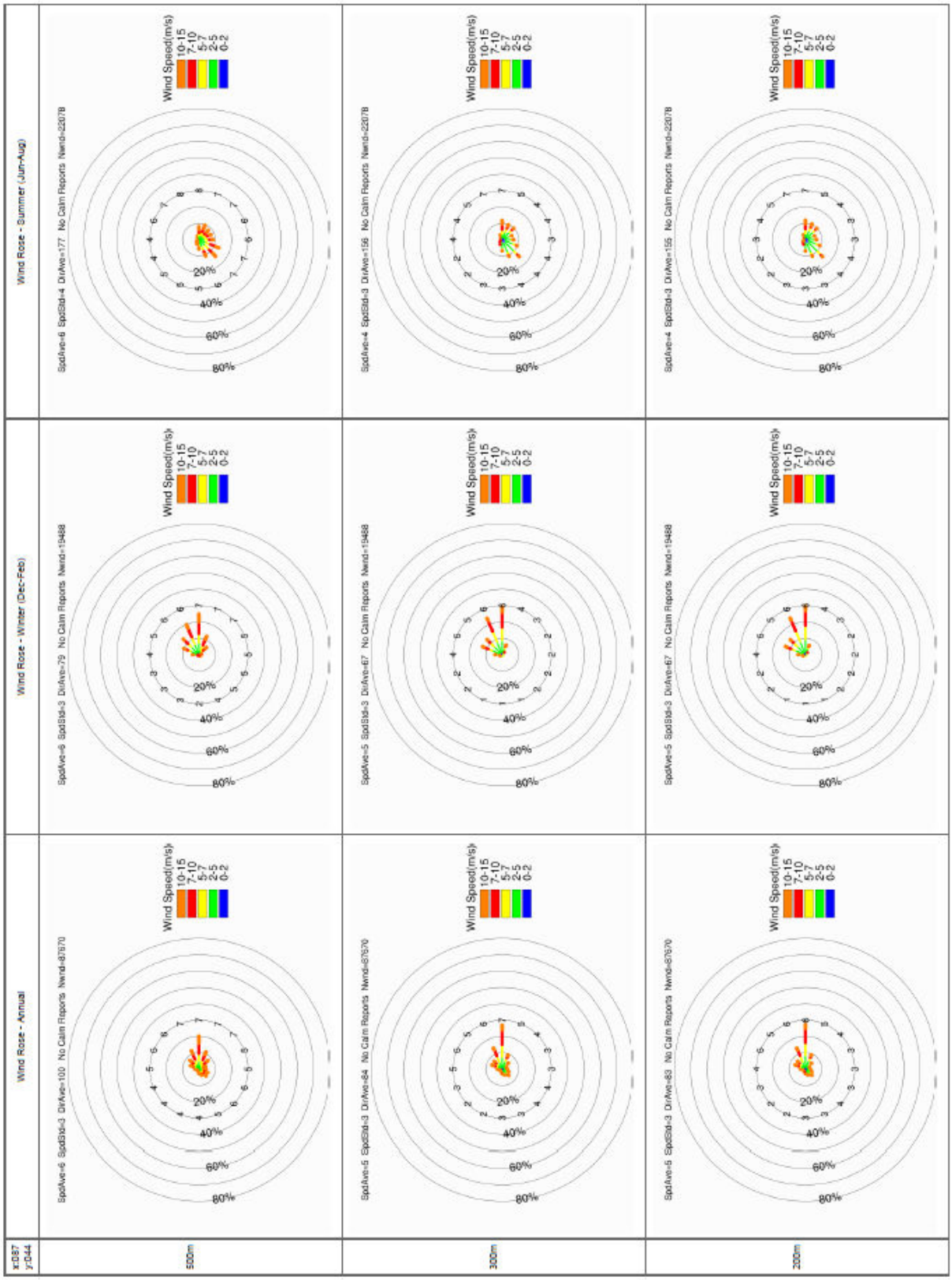


Figure A-3 The RAMS wind data extracted from PlanD's website at grid x:087; y:044

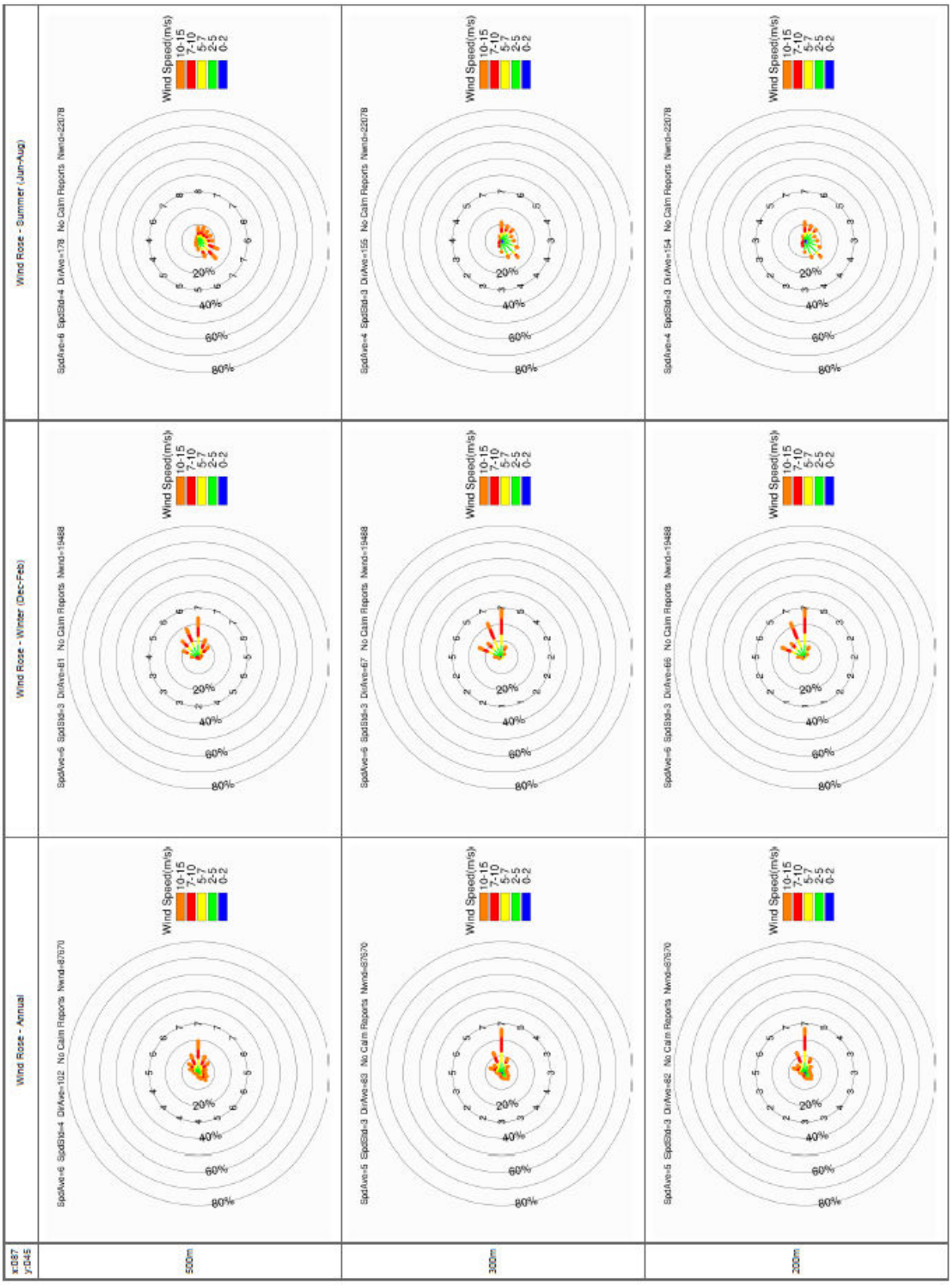


Figure A-4 The RAMS wind data extracted from PlanD's website at grid x:087; y:045

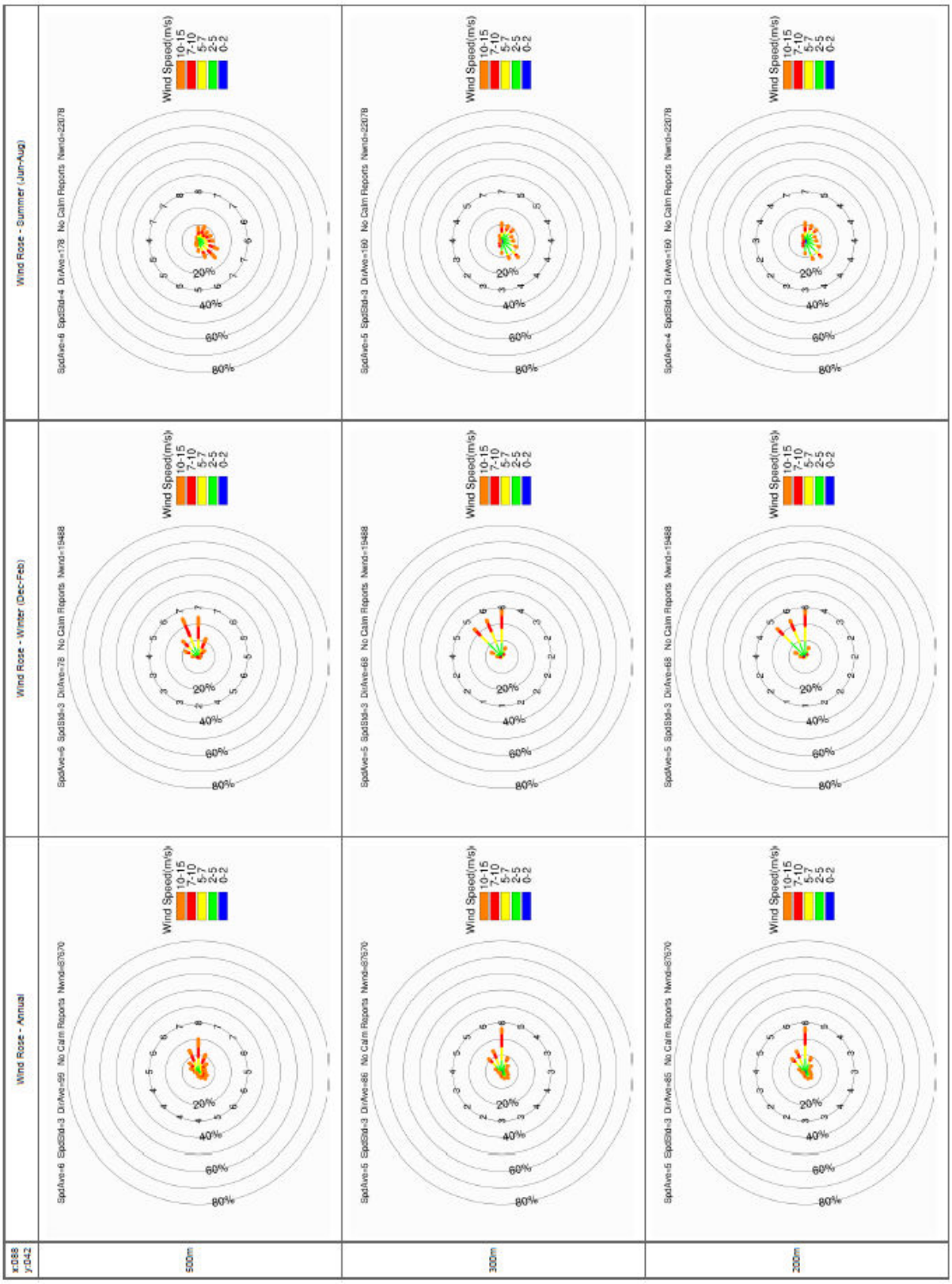


Figure A-5 The RAMS wind data extracted from PlanD's website at grid x:088; y:042

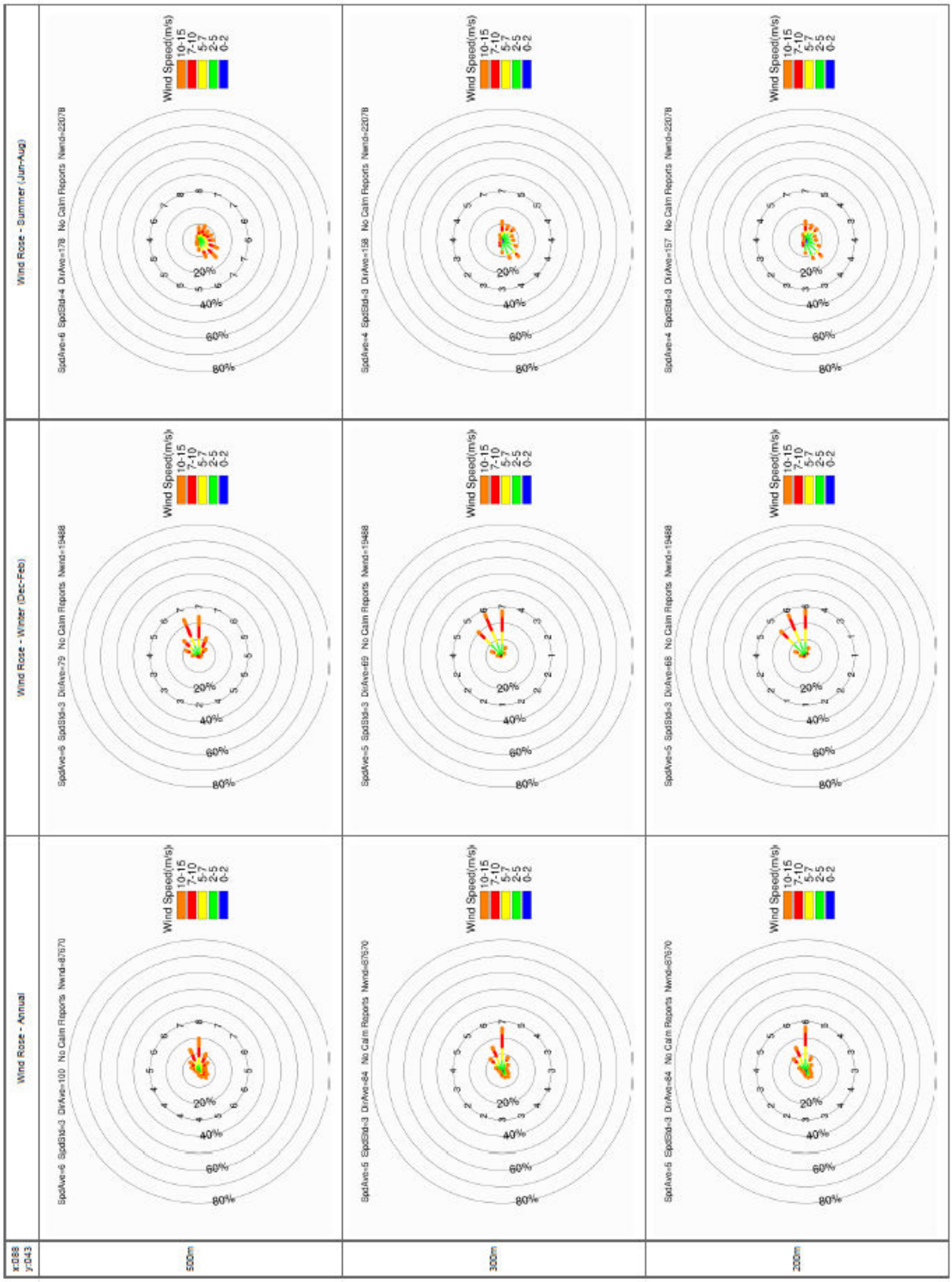


Figure A-6 The RAMS wind data extracted from PlanD's website at grid x:088; y:043

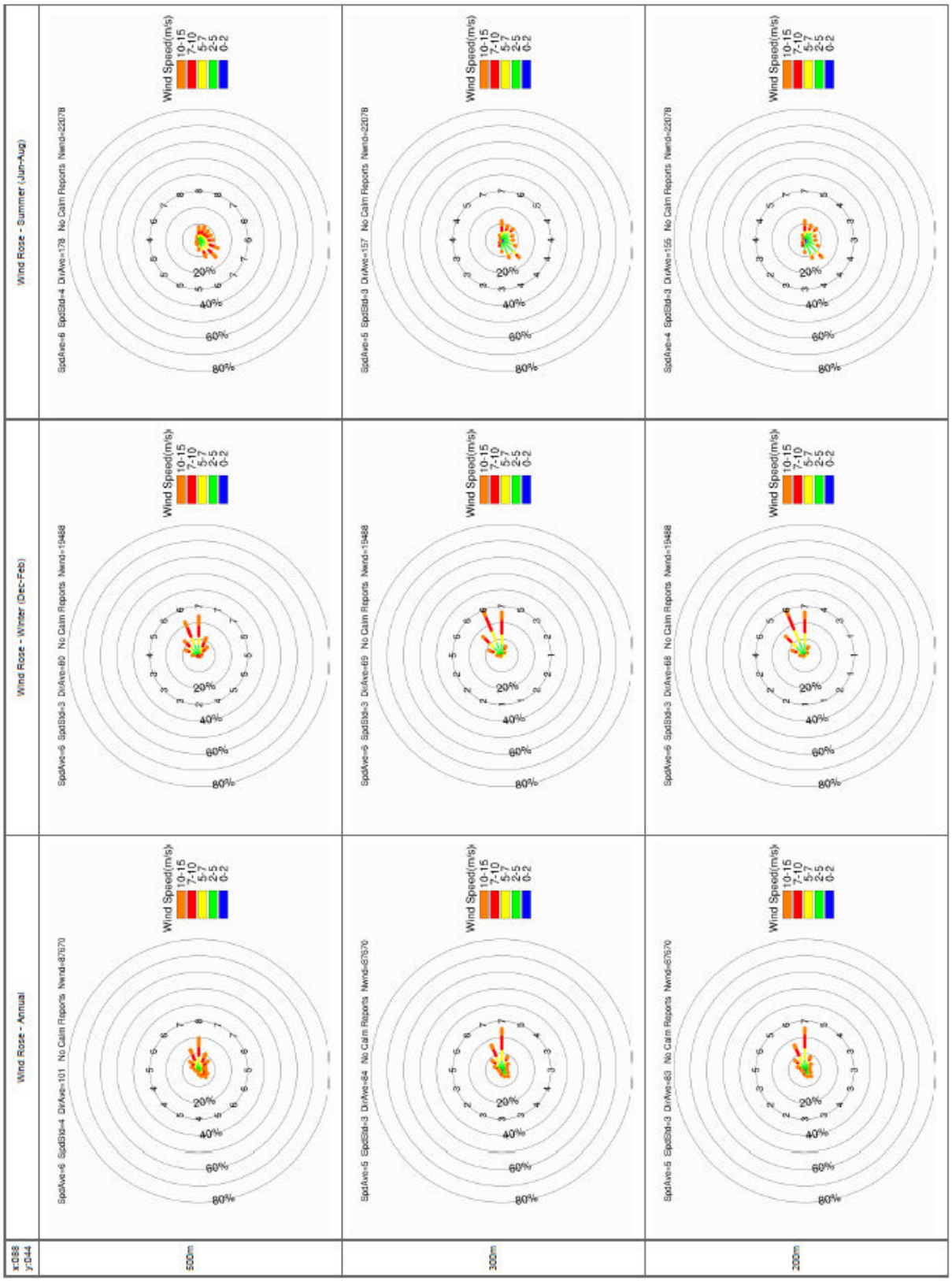


Figure A-7 The RAMS wind data extracted from PlanD's website at grid x:088; y:044

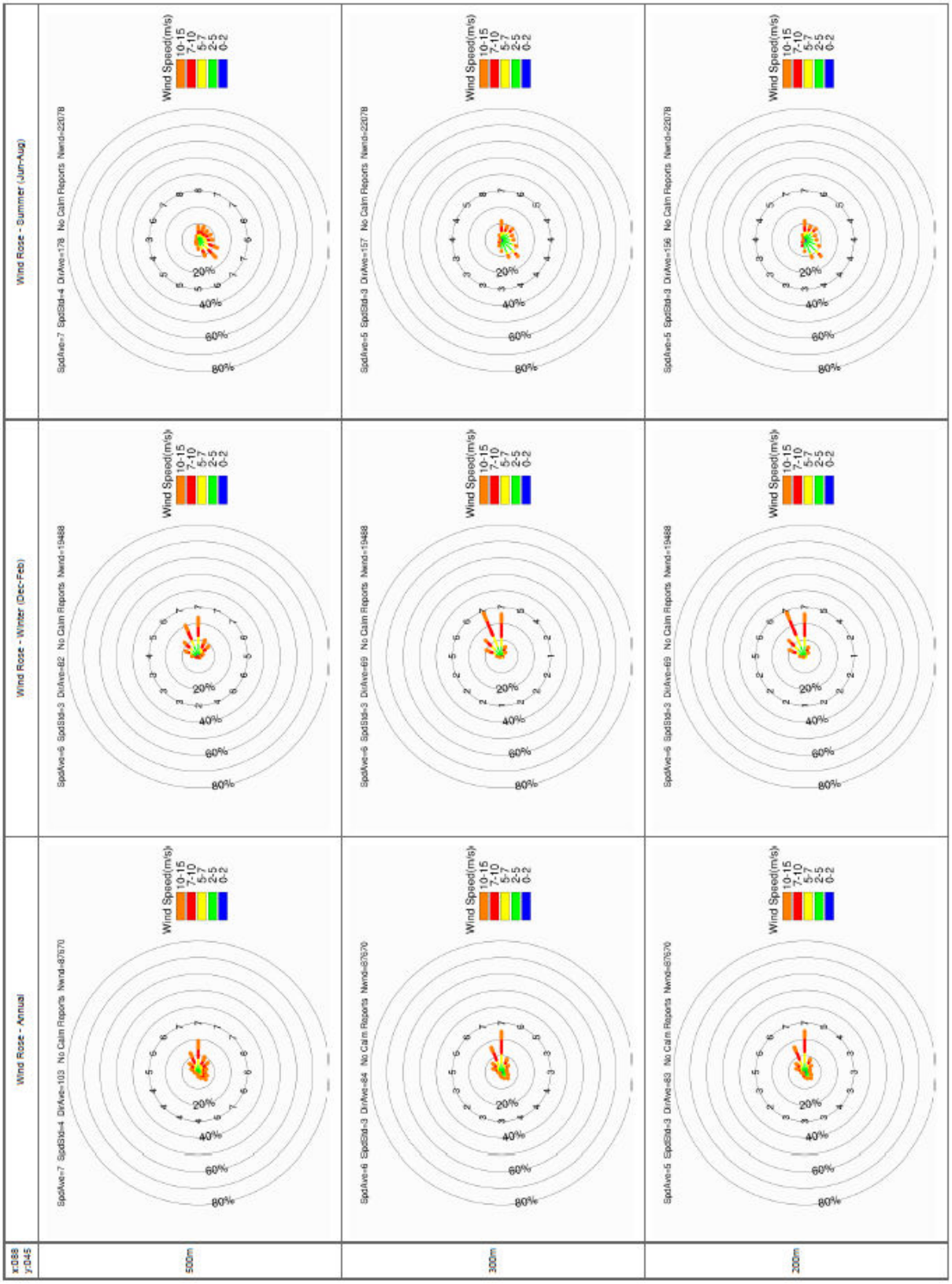


Figure A-8 The RAMS wind data extracted from PlanD's website at grid x:088; y:045

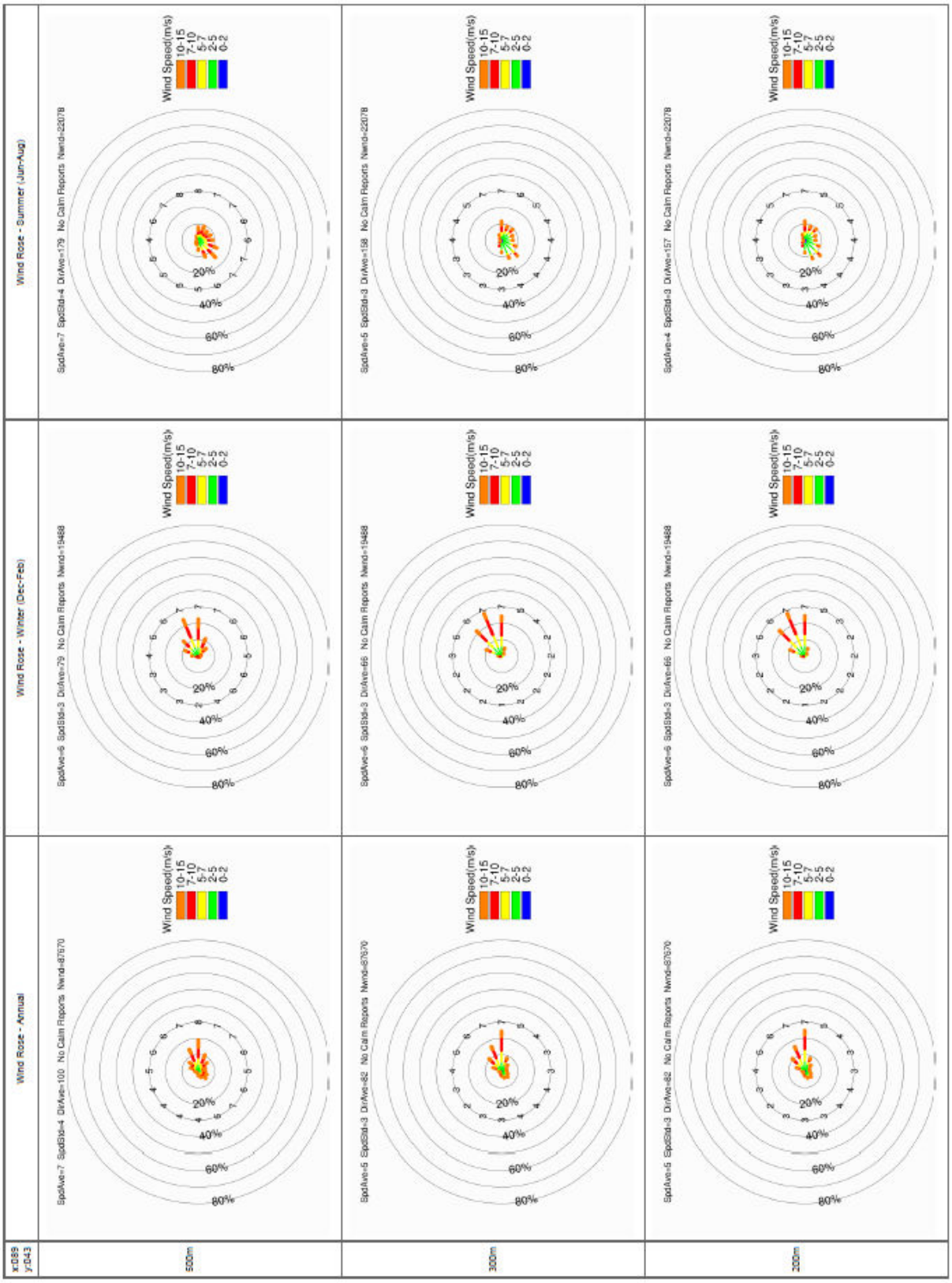


Figure A-9 The RAMS wind data extracted from PlanD's website at grid x:089; y:043

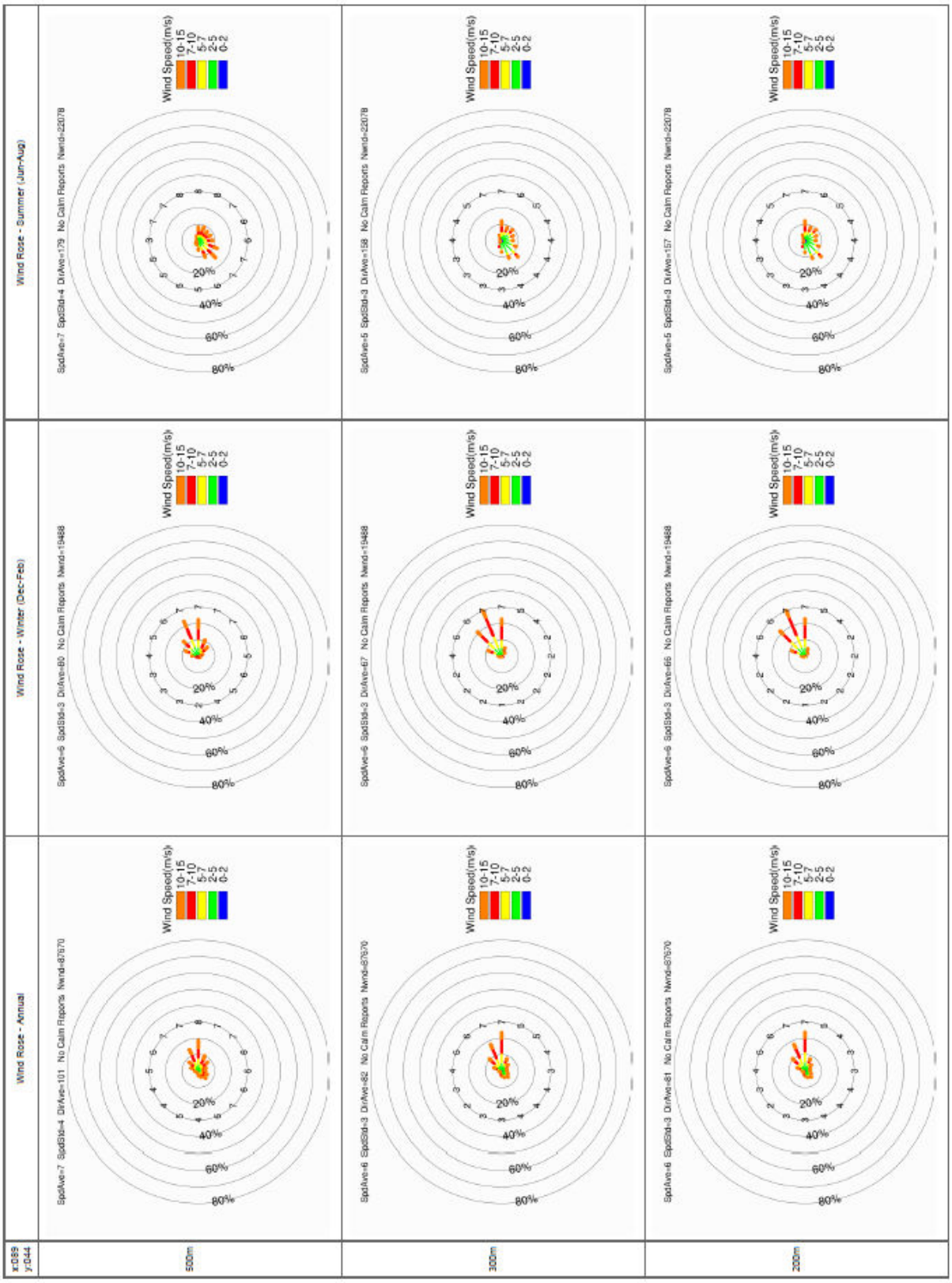


Figure A-10 The RAMS wind data extracted from PlanD's website at grid x:089; y:044

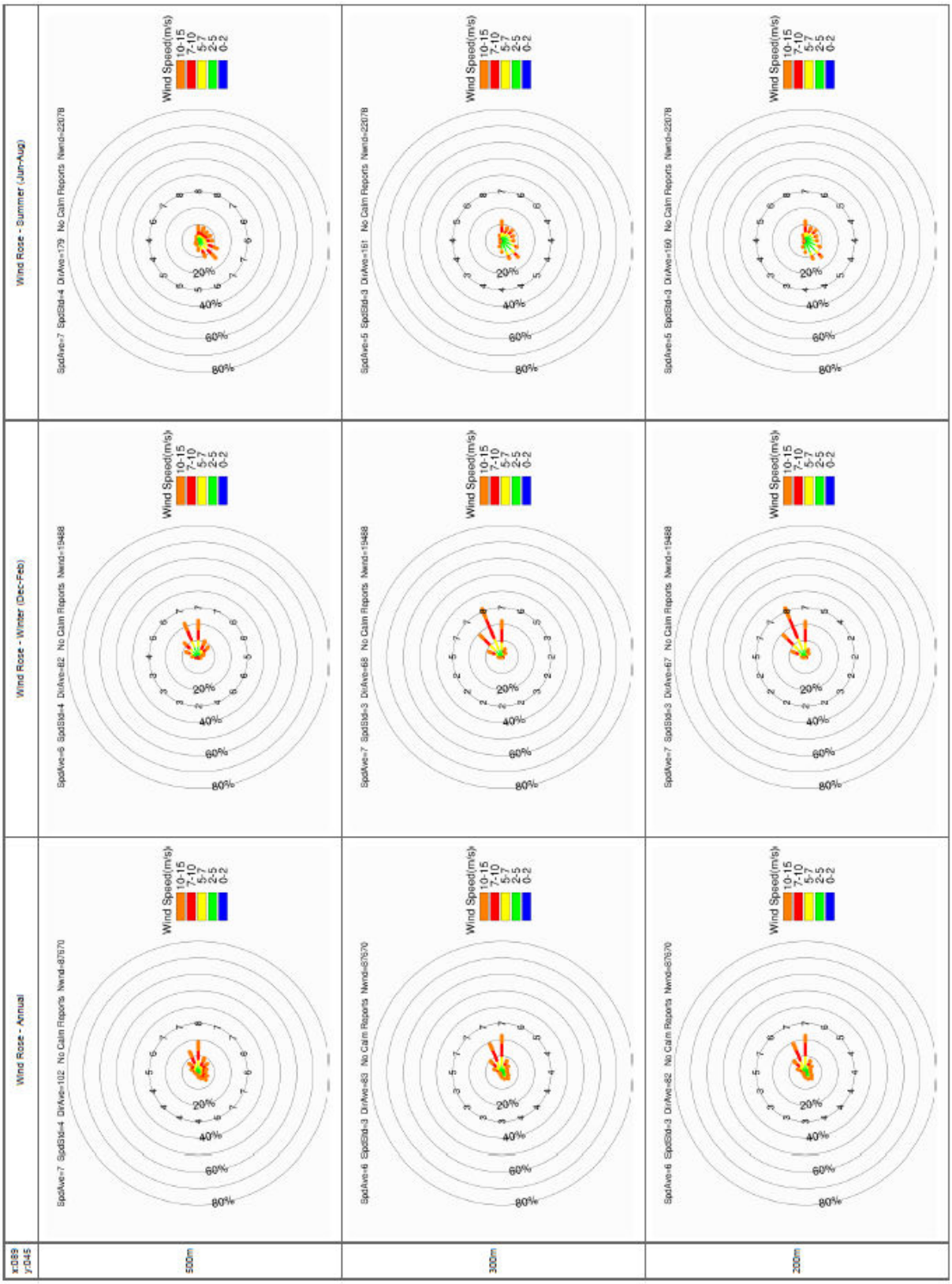


Figure A-11 The RAMS wind data extracted from PlanD's website at grid x:089; y:045

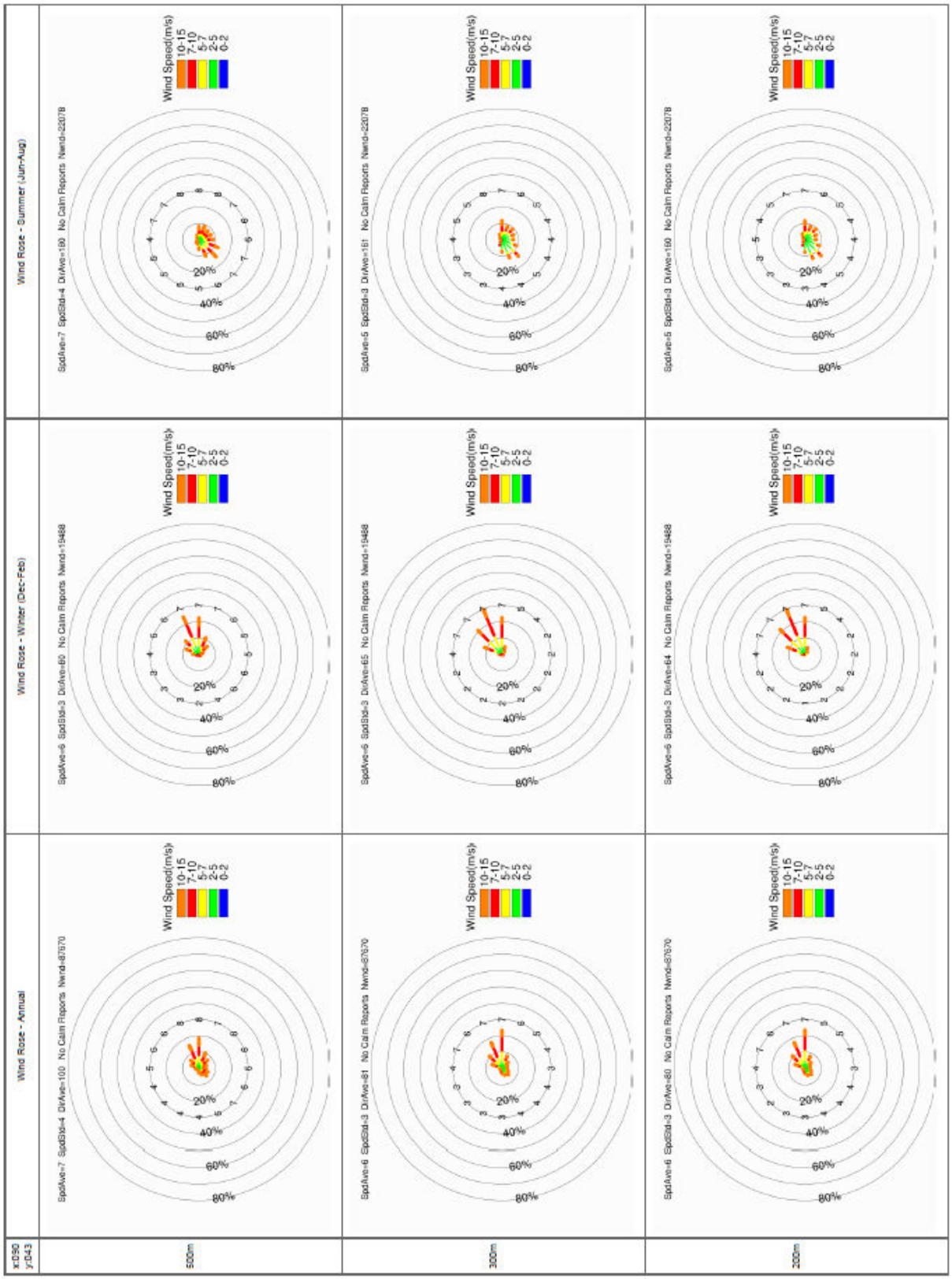


Figure A-12 The RAMS wind data extracted from PlanD's website at grid x:090; y:043

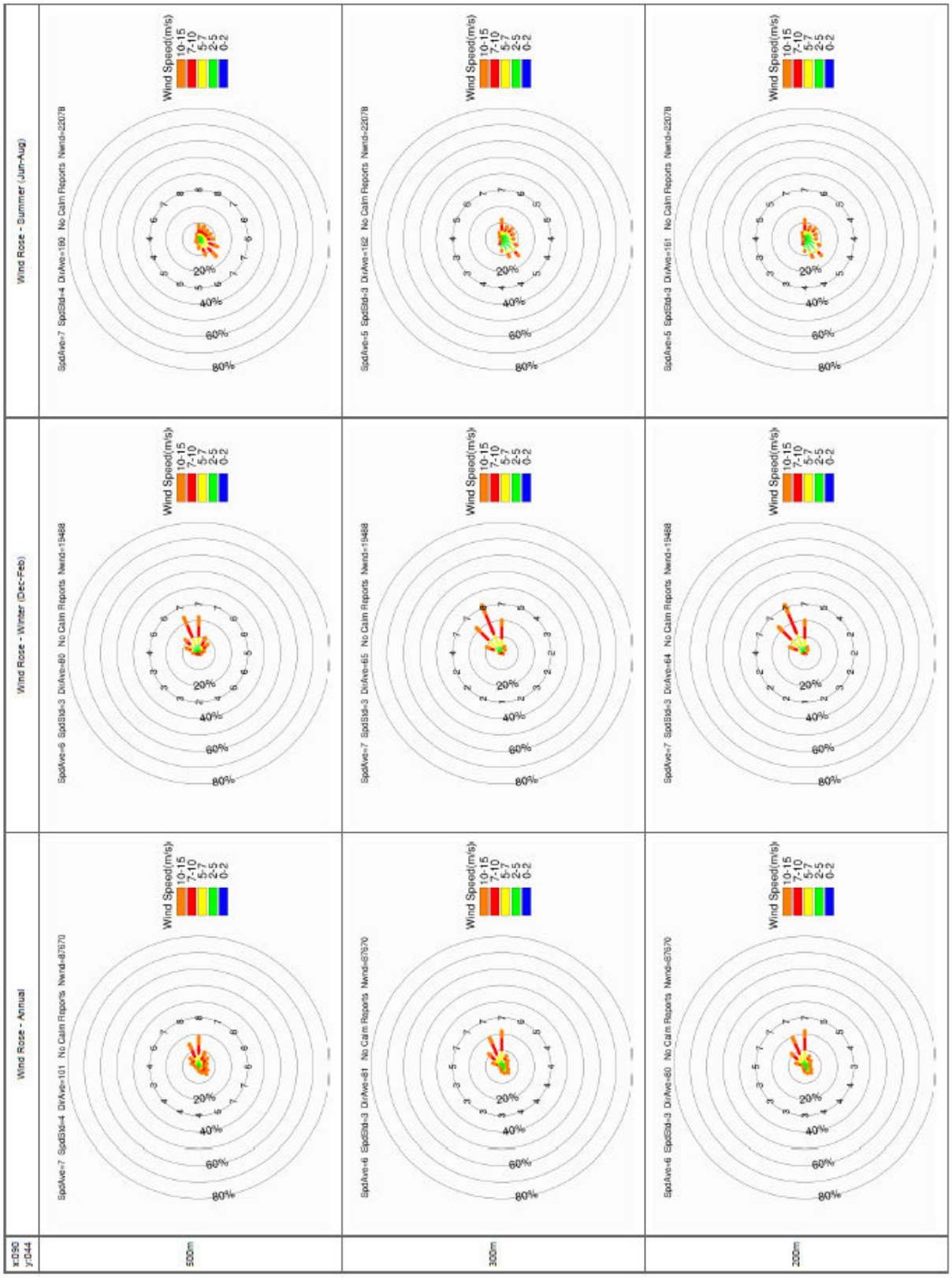


Figure A-13 The RAMS wind data extracted from PlanD's website at grid x:090; y:044

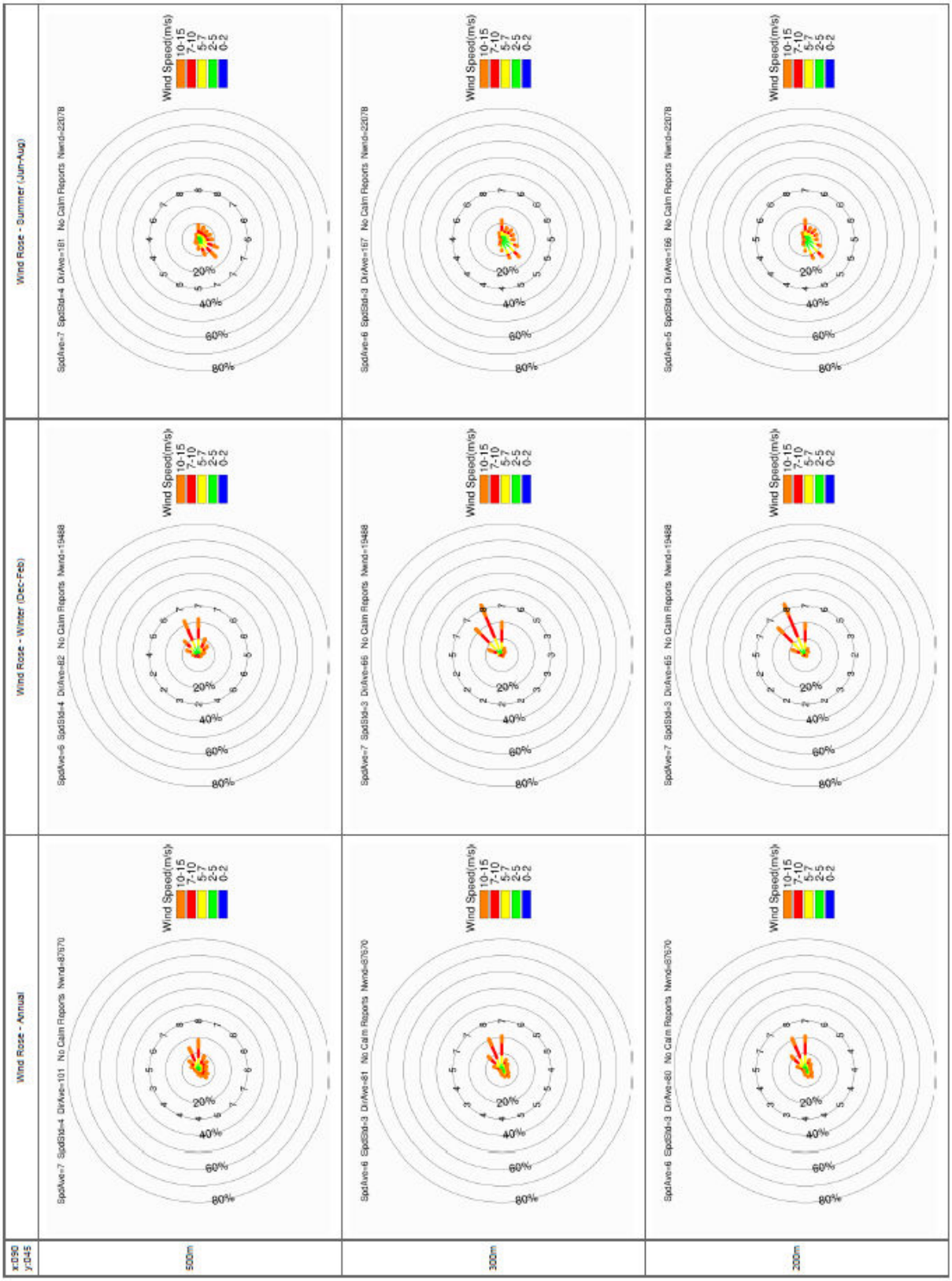


Figure A-14 The RAMS wind data extracted from PlanD's website at grid x:090; y:045

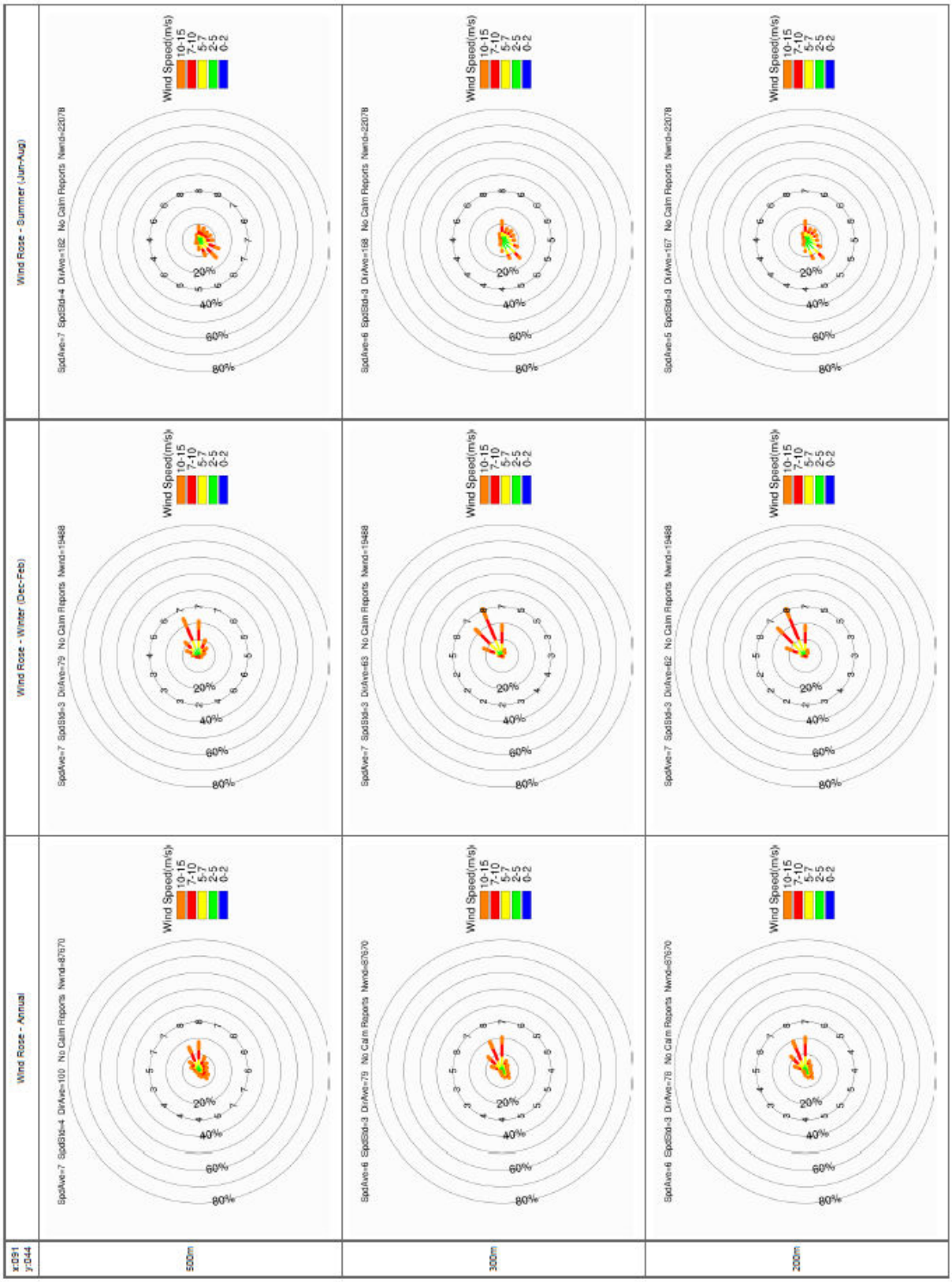


Figure A-15 The RAMS wind data extracted from PlanD's website at grid x:091; y:044

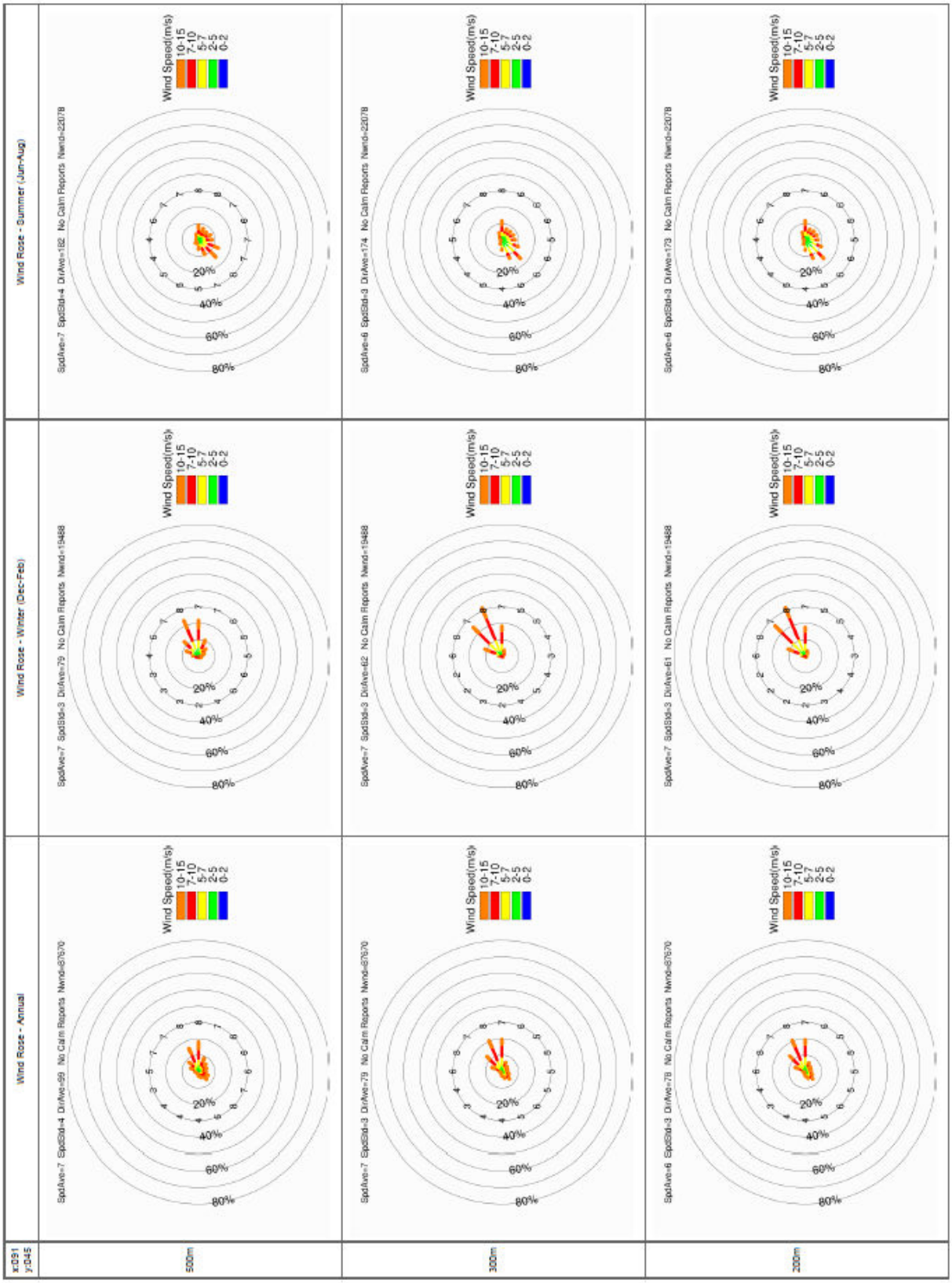
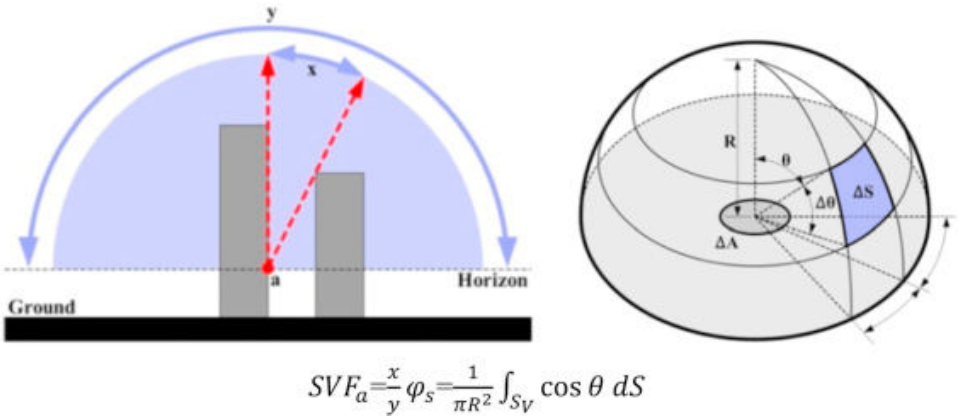


Figure A-16 The RAMS wind data extracted from PlanD's website at grid x:091; y:045

Appendix B

Sky View Factor (SVF) defines the ratio of sky hemisphere visible from the ground (not obstructed by buildings, terrain or trees).



$$SVF_a = \frac{x}{y} \varphi_s = \frac{1}{\pi R^2} \int_{S_V} \cos\theta \, dS$$

Figure B-1 The geometric definition of Sky View Factor

[Reference: Nasrollahi, N., & Shokri, E. (2016). Daylight illuminance in urban environments for visual comfort and energy performance. Renewable and sustainable energy reviews, 66, 861-874.]

For high-density cities with tall buildings, the H/W ratio is already high (normally greater than 2:1), it is difficult for winds from above the roof tops to penetrate down to the street level. For H/W greater than 2:1, a double air circulation vortex will begin to form within the street canyon and air ventilation at the ground level will be poor.

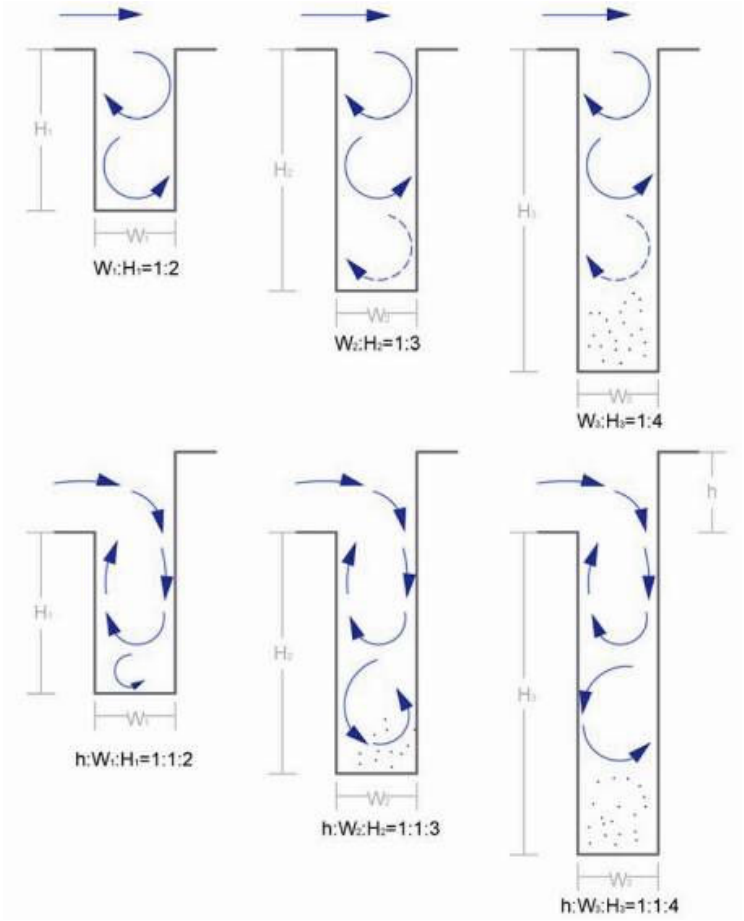


Figure B-2 The figure shows a generic understanding of the wind regimes in canyons

.

[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 OF WIND TUNNEL EXPERIMENTS AND NUMERICAL SIMULATIONS, Water, Air, and Soil Pollution: Focus 2: 365–380, 2002, Kluwer Academic Publishers.]

Air Flow Regimes in Urban Canyons

The mechanisms by which each of the flow regimes occurs may be summarized as follows. When the H/W ratio of a canyon is less than 0.3, i.e., the buildings are well spaced, they act essentially as individual buildings (or 'isolated roughness elements') since the air travels a sufficient distance downwind of the first building before encountering the next obstacle. As buildings become more closely spaced and H/W ratios increase, the disturbed air flow has insufficient distance to readjust before encountering the next obstacle. The result is 'wake interference' flow. With reduced building spacing, the mesoscale flow skims over the top of the canyon.

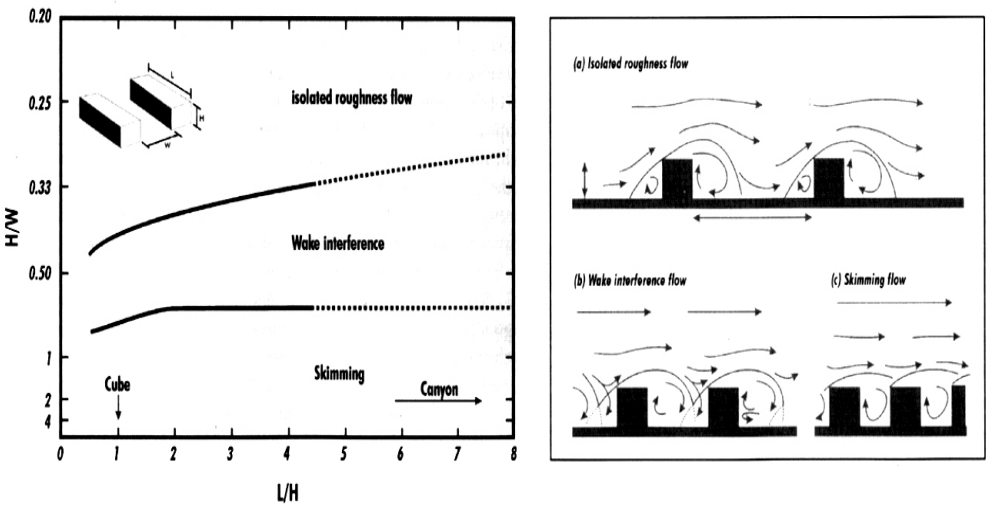


Figure B-3 The relationship between building height and street width ratio and the possible flow regimes

[Reference: Oke, T. R. (1987). Boundary layer climates. Routledge.]

CFD study on street canyon

Studies in Hong Kong show that with the increase of the H/W, the air flow will go up along the long street canyon. The wind at the ground level is weak in the depth of the street canyon.

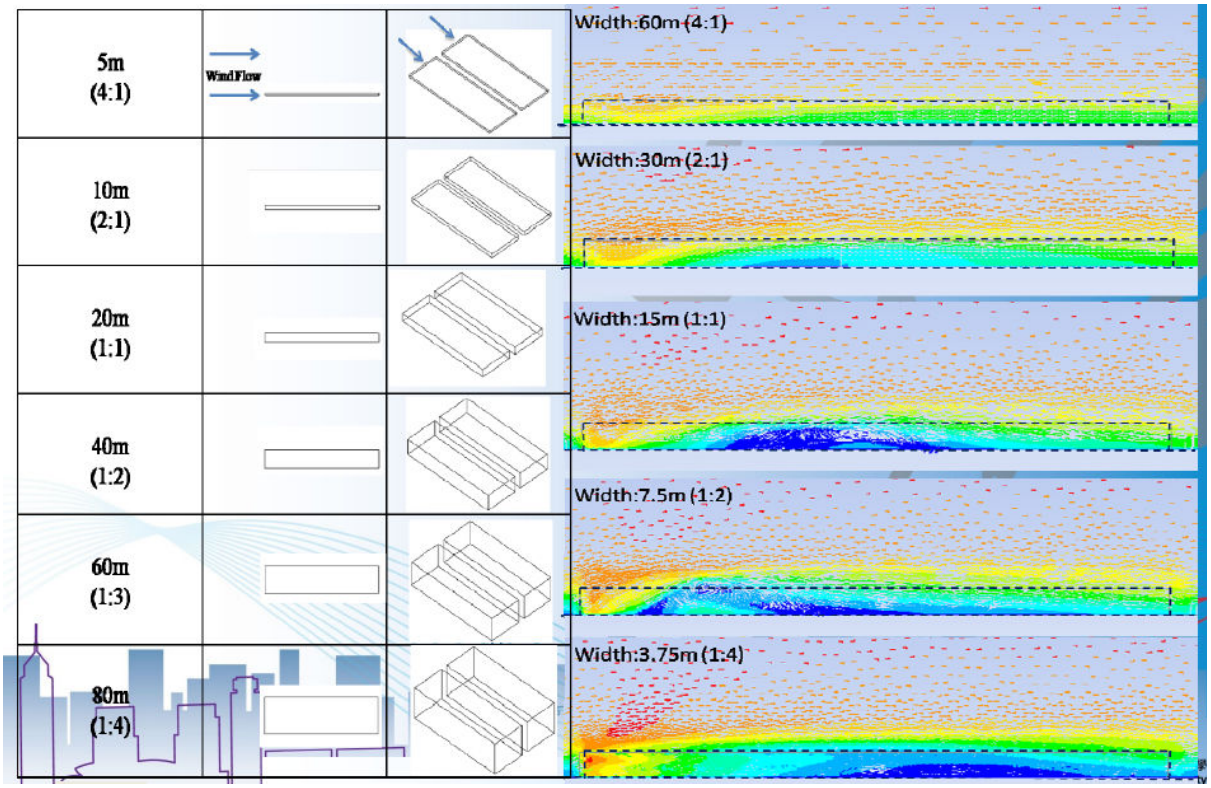
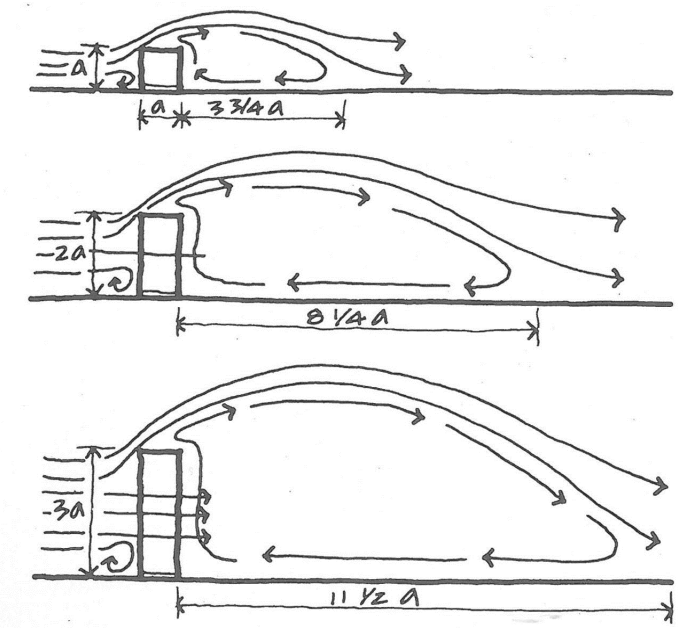
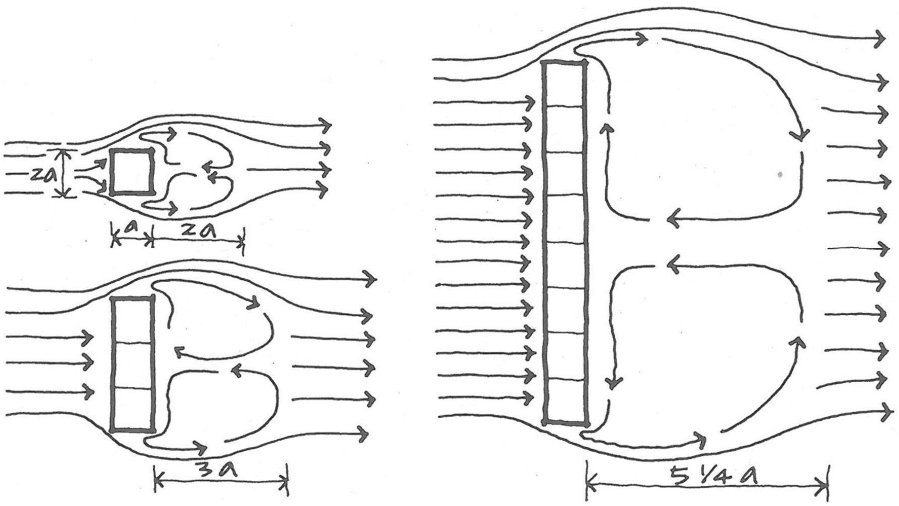


Figure B-4 CFD study on street canyon with varying width/height

[Reference: Choi, E. Air ventilation studies. https://www.housingauthority.gov.hk/hdw/content/static/file/en/aboutus/events/qualityhousing/seminar/07CityUProfEdmundChoi.pdf]



(a) Impact of building height



(b) Impact of building width

Figure B-5 Wind flows around buildings

Note: Arrows represent wind flow patterns, with closer lines indicating increased wind speed. Circular arrows indicate eddies. The low-pressure eddy zones will have markedly decrease wind speeds and are sometimes termed areas of “wind shadow” (wind wake).

[Reference: Brown, G. Z., & Sun, D. M. (2001). Wind, and Light: Architectural Design Strategies. *US: Wiley*.]

The street canyon has the lateral flow induced by corner. For long street canyons, air ventilation effects by corner vortices fade with increasing length-to-width (L/W) ratios of streets. Due to the high H/W ratio, lateral flow induced by horizontal vortices at lower levels become important for the penetration of air movement into the street canyons perpendicular to the prevailing winds.

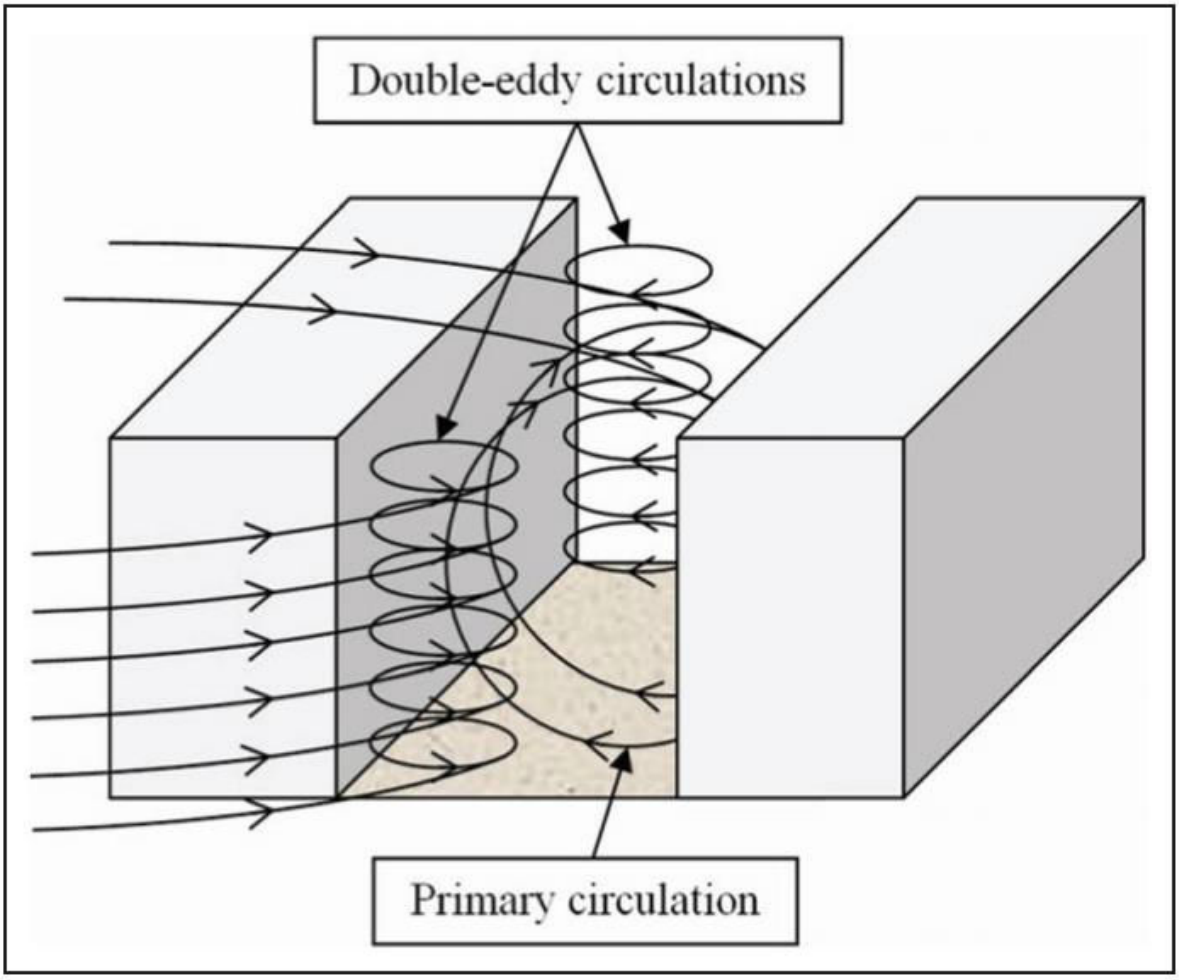
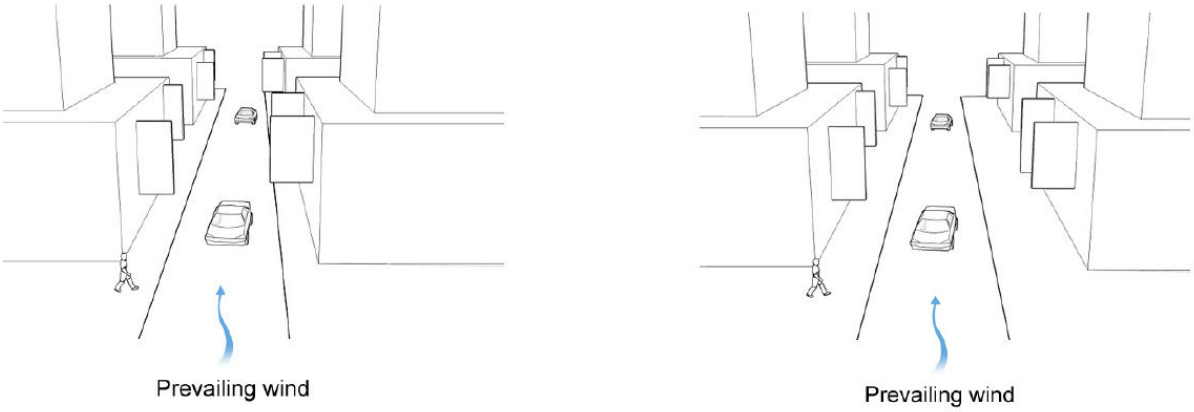


Figure B-6 Flow structures in an isolated street canyon with perpendicular air flow

[Reference: Yazid, A. W. M., Sidik, N. A. C., Salim, S. M., & Saqr, K. M. A review on the flow structure and pollutant dispersion in urban street canyons for urban planning strategies. Simulation 90.8 (2014): 892-916.]



To improve the air ventilation in the urban areas, the widening of streets along the prevailing wind direction is considered of high effectiveness. Especially for large sites facing narrow urban canyon as typically found in old urban district like Mong Kok, the building setback on each side of the street should be provided upon redevelopment or urban renewal.

Figure B-7 Street widening / Building setback

[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]

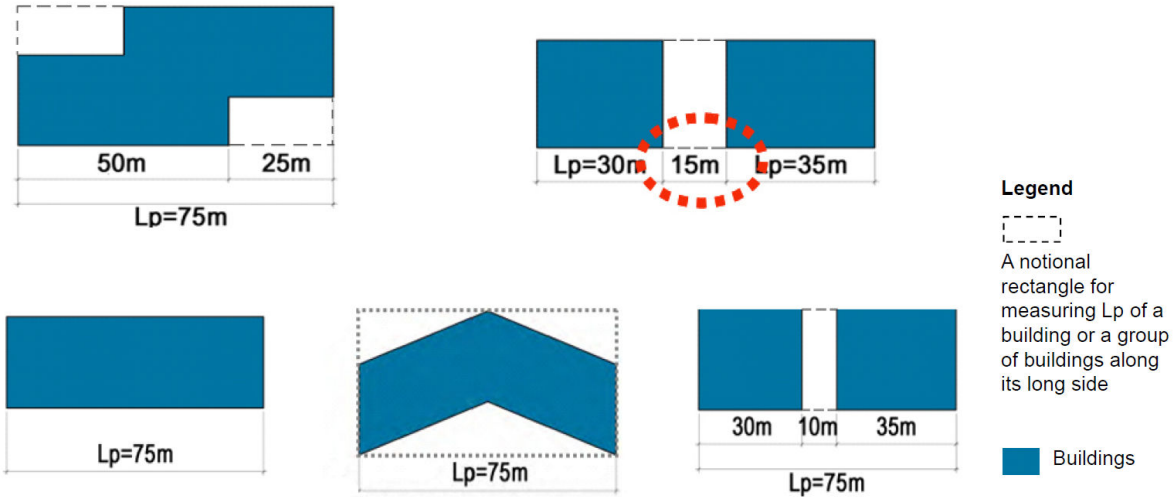


Figure B-8 Determining Lp
(i.e. the total projected length of façade of a building or a group of buildings if separation between them is less than 15m. Building portions at low zone of height ≤6.67m are disregarded in Lp.)

[Reference: Sustainable Building Design Guidelines (PNAP APP-152)]

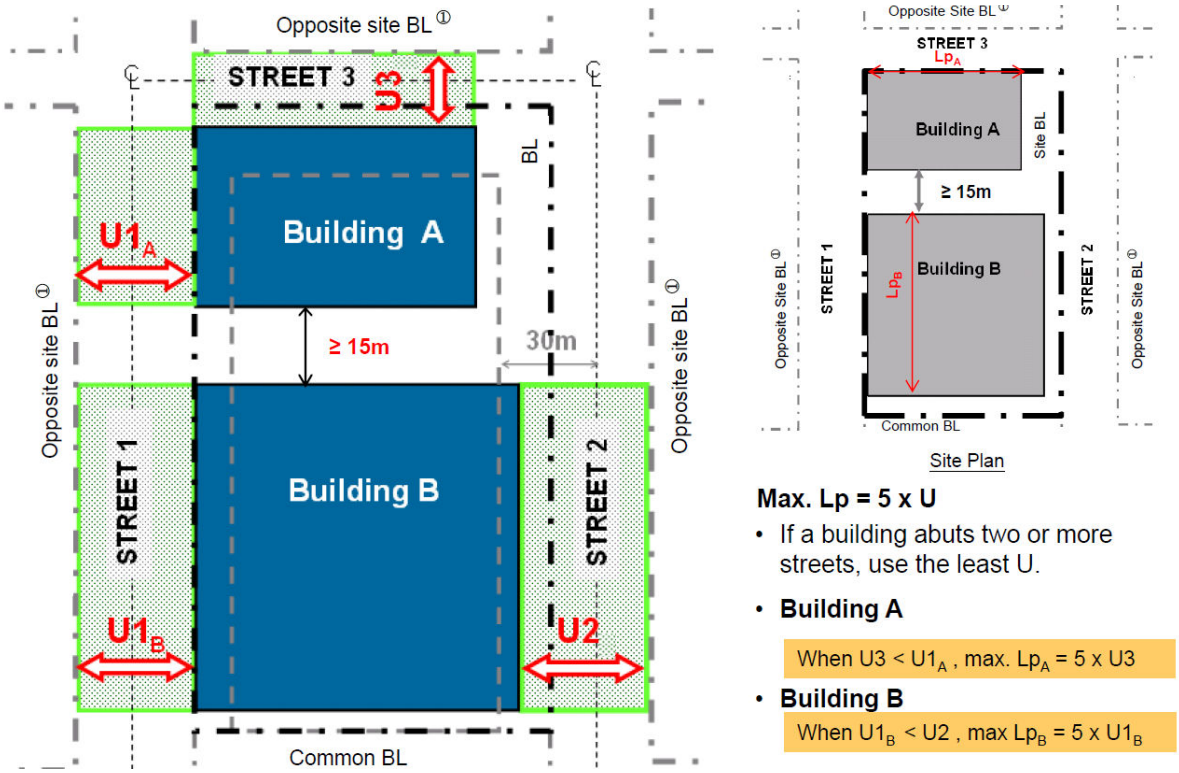


Figure B-9 Defining the mean width of street canyon (U) and the maximum permissible continuous projected façade length (L_P)

[Reference: Sustainable Building Design Guidelines (PNAP APP-152)]

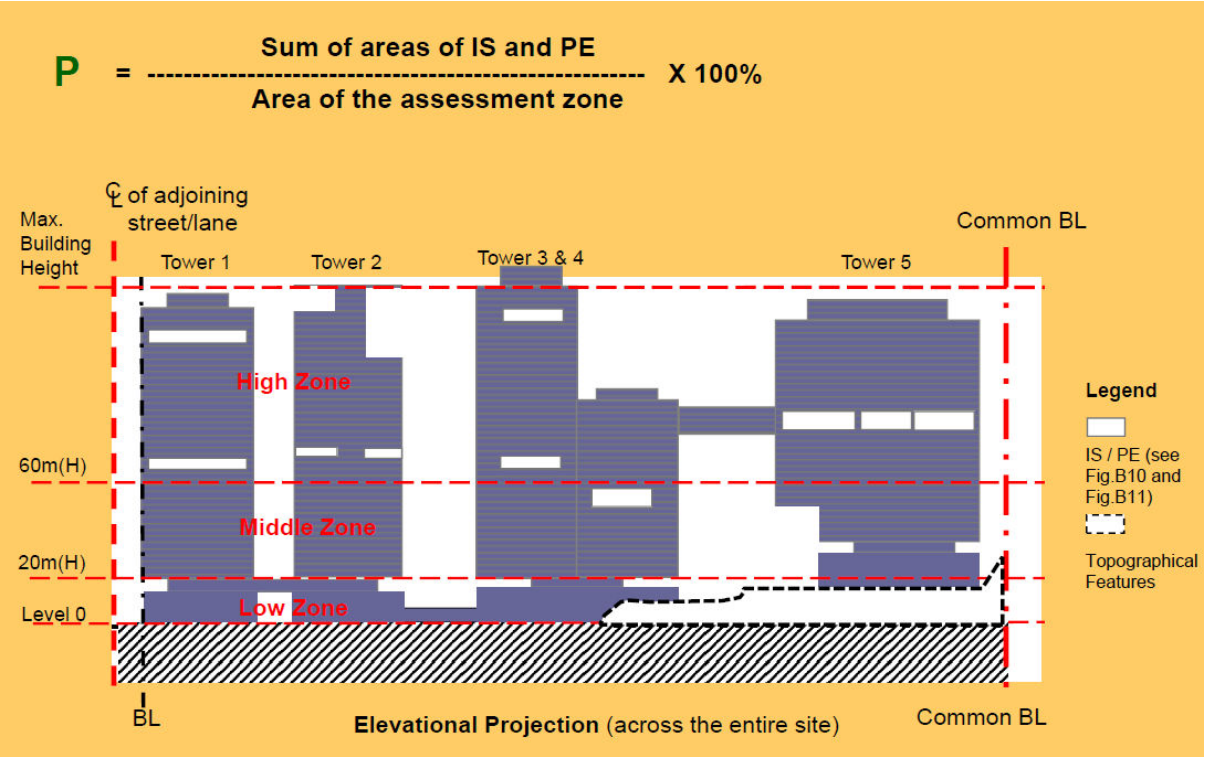
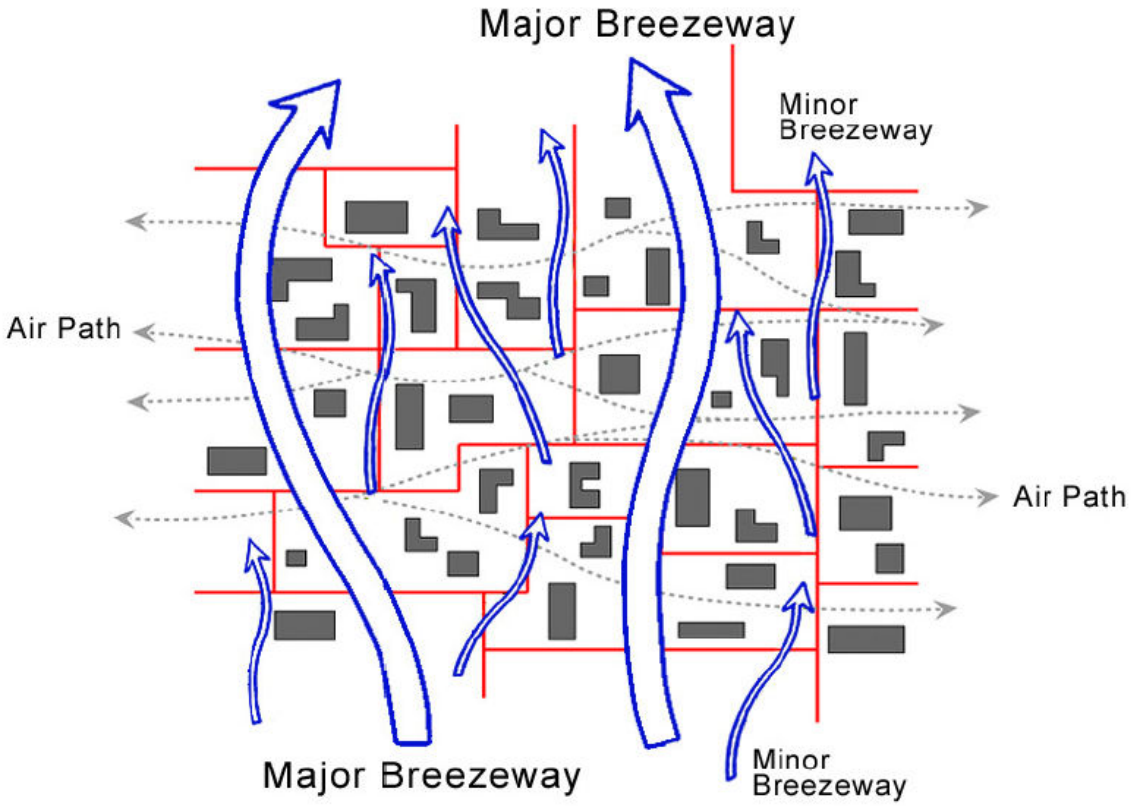


Figure B-10 Assessment of Permeability (P)

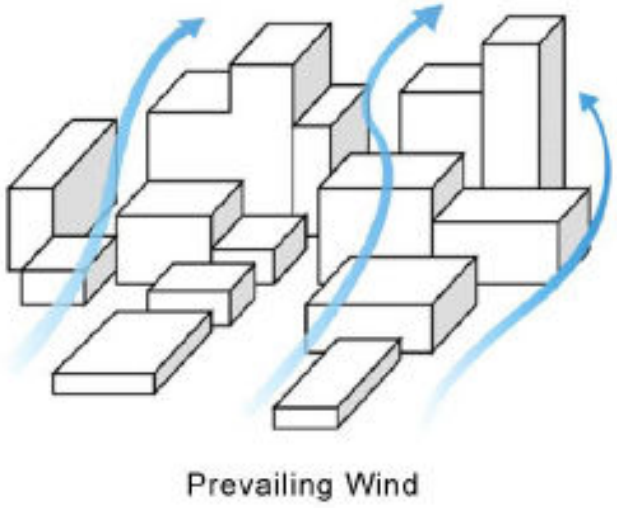
[Reference: Sustainable Building Design Guidelines (PNAP APP-152)]



The disposition of amenity areas, building setbacks and non-building areas should be linked, and widening of the minor roads connecting to major roads should be planned in such a way to form ventilation corridors/air paths to further enhance wind penetration into inner parts of urbanised areas

Figure B-11 Air Paths / Breezeways

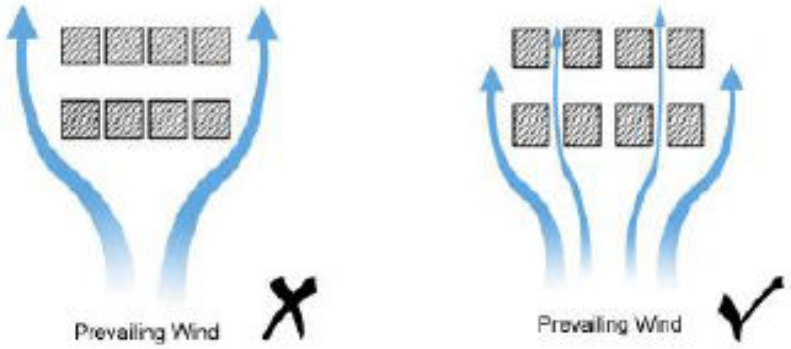
[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]



In general, gradation of building heights would help wind deflection and avoid air stagnation. Where appropriate, height variation across the district with decreasing heights towards the direction where the prevailing wind comes from should be adopted to promote air movements.

Figure B-12 Varying height profile to promote air movements

[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]



Where practicable, adequately wide gaps should be provided between building blocks to maximize the air permeability of development and minimize its impact on wind capturing potential of adjacent developments. The gaps for enhancing air permeability should be at a face perpendicular to the prevailing wind.

Figure B-13 Gaps between Building Blocks to Enhance Air Permeability

[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]

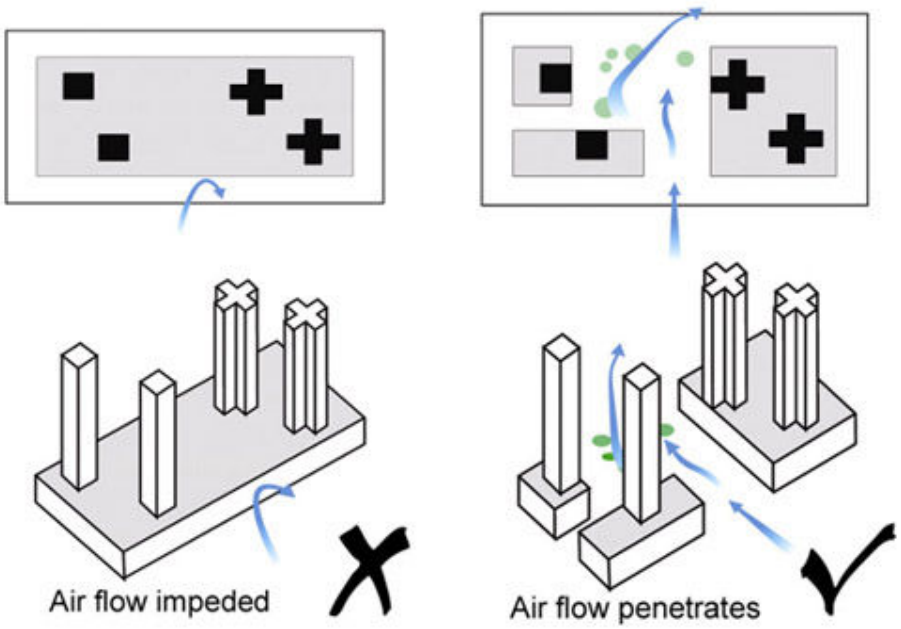


Figure B-14 Reducing Site Coverage of the Podia to Allow More Open Space at Grade

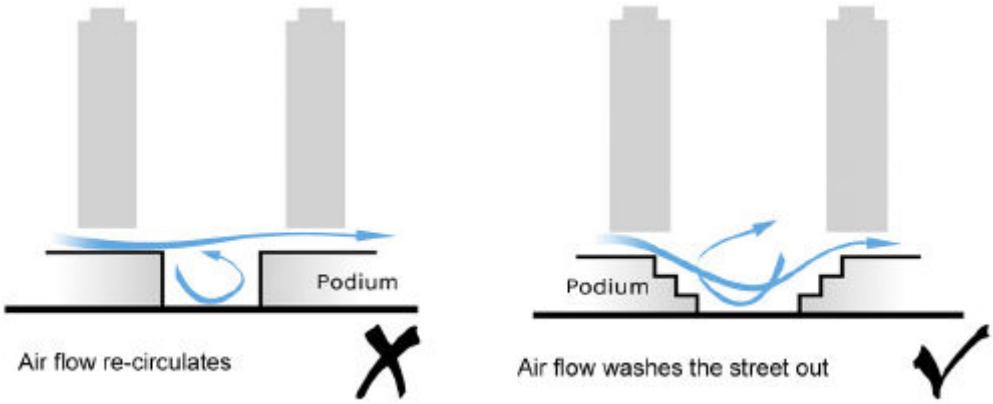
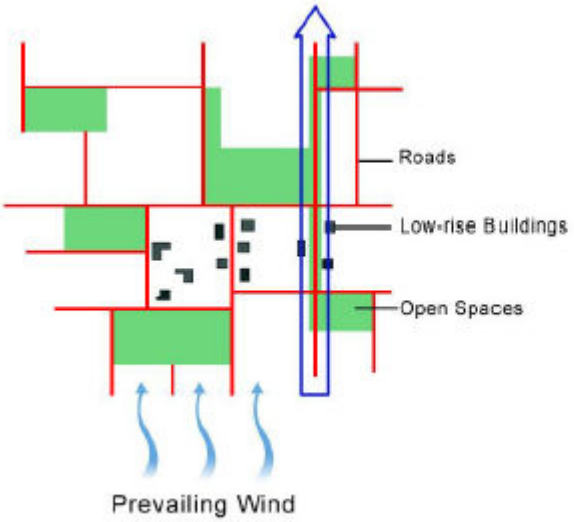


Figure B-15 Terraced Podium Design

[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]



Breezeways should be created in forms of major open ways, such as principal roads, inter-linked open spaces, amenity areas, non-building areas, building setbacks and low-rise building corridors, through the high-density/high-rise urban form. They should be aligned primarily along the prevailing wind direction routes, and as far as possible, to also preserve and funnel other natural air flows including sea and land breezes and valley winds, to the developed area.

Figure B-16 Linkage of Roads, Open Spaces and Low-rise Buildings to form Breezeways

[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]

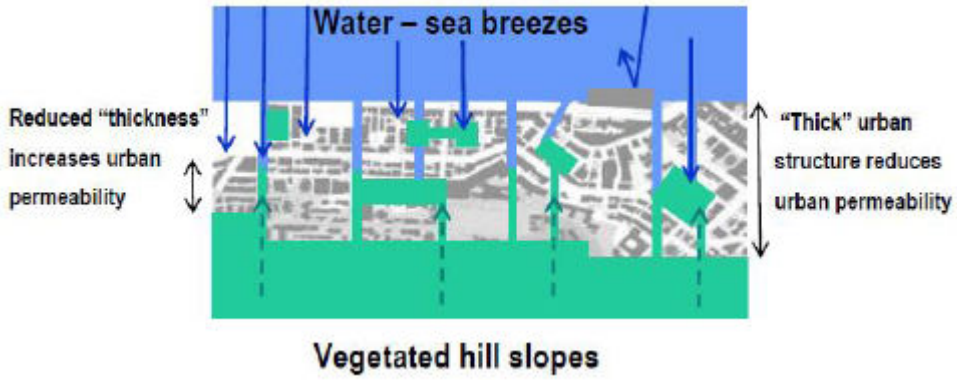


Figure B-17 Ways to create breezeways/air paths to facilitate air ventilation connectivity

[Reference: Hong Kong Planning Department. Hong Kong Planning Standards and Guidelines (HKPSG). 2011]

Appendix C

List of Information provided by Planning Department (PlanD)

BASELINE ANALYSIS
Draft Ngau Tau Kok and Kowloon Bay Outline Zoning Plan (OZP) No. S/K13/29 (Plan, Notes and Explanatory Statement (ES) together with Schedule of Amendments) (Notes and ES available at: https://www2.ozp.tpb.gov.hk/gos/download.aspx?type=ozp&caseno=S/K13/29&lang=0)
Plan 1: Existing building height (in no. of Storeys)
Plan 2: Existing building height (in mPD)
Plan 3: Existing building height and podium height (in mPD) on 1:2,600 survey sheet
Plan 4: Existing spot height on 1:2,600 survey sheet
Plan 5: Committed developments – Approved General Building Plans and Planning Application
Plan 6: Current Building Height Restrictions
Plan 7: Current Non-building Area and Building Gap Requirements
Plan 8: Aerial Photo
Plan 9: Existing Street Width

INITIAL SCENARIO
Kowloon Bay Action Area (KBAA) Preliminary Outline Development Plan (PODP) under the ongoing Planning and Engineering Study for the Development at KBAA of Kowloon East (available at https://www.ekeo.gov.hk/en/activities/planning_engineering_study_kbaa.html); and the associated AVA for the KBAA PODP (extract of Working Paper No. 8 of the Study) (April 2017)

OTHER REFERENCE MATERIALS
K 13 OZP related materials
1. Previous OZPs: • OZP No. S/K13/26 (Plan, Notes & Explanatory Statement together with Schedule of Amendments) • OZP No. S/K13/27 (Plan, Notes & Explanatory Statement together with Schedule of Amendments) • OZP No. S/K13/28 (Plan, Notes & Explanatory Statement together with Schedule of Amendments)

OTHER REFERENCE MATERIALS

2. Proposed Amendments to OZP No. S/K13/25:

- Metro Planning Committee (MPC) Paper No. 25/10 for Proposed Amendments to the approved Ngau Tau Kok and Kowloon Bay OZP No. S/K13/25
- Minutes of MPC Meeting on 12.11.2010

3. Representation Materials and Town Planning Board (TPB) Hearings on 27.5.2011 and 1.6.2011:

- TPB Paper Nos. 8820, 8821 and 8822
- Representation (R2) by The Real Estate Developers Association of Hong Kong (REDA) at TPB Paper No. 8820 Annex III-1
- Minutes of TPB Meetings on 27.5.2011 and 1.6.2011

4. Judicial Reviews

REDA v. TPB

Relevant JR materials submitted by REDA

- Form 86 in respect to HCAL No. 58 of 2011
- Affirmation 1 (Barry WILL)
- Affirmation 2 (Ian BROWNLEE)
- Reply Affirmation (Ian BROWNLEE)

Relevant JR materials submitted by TPB

- Affidavit 1 (Ophelia WONG)
- Affidavit 2 (Eric YUE)
- Affidavit 3 (Yan Yung NG)
- Letter from Department of Justice to REDA's solicitor (power point presentation from REDA for consideration of representations for Leighton Centre & Lee Theatre Plaza and sheets prepared by PlanD listing out the site-specific/generic assessments and assumptions made in relation to the K13 OZP)

Court Judgements

- CFI Judgement (HCAL No. 58 of 2011)
  (available at https://legalref.judiciary.hk/lrs/common/ju/ju_frame.jsp?DIS=96941&currpage=T)

Oriental Generation Limited (OGL) v. TPB

Court Judgments

- CFI Judgement (HCAL No. 62 of 2011, HCAL No. 109 of 2011 and HCAL No. 34 of 2012)
  (available at https://legalref.judiciary.hk/lrs/common/ju/ju_frame.jsp?DIS=81628&currpage=T)
- CA Judgement (CACV No. 127 of 2012 and CACV No. 129 of 2012)
  (available at https://legalref.judiciary.hk/lrs/common/ju/ju_frame.jsp?DIS=95736&currpage=T)

OTHER REFERENCE MATERIALS

5. Review of Draft Ngau Tau Kok and Kowloon Bay OZP No. S/K13/26 in relation to decision of REDA Judicial Review and REDA's supplementary information

- TPB Paper No. 10397
  (available at
  https://www.info.gov.hk/tpb/en/meetings/TPB/Agenda/1166_tpb_agenda_en.html)
- Minutes of TPB Meeting on 9.3.2018
- Supplementary Information and letter from REDA dated 25.5.2018

6. Consideration of Sustainable Building Design Guidelines:

- SBD Guidelines (PNAP APP-151 & 152)
  (available at http://www.bd.gov.hk/english/documents/index_pnap.html)

7. Past Initial Study (IS)/Expert Evaluation (EE) on Air Ventilation Assessments (AVAs):

- EE on AVA for Ngau Tau Kok and Kowloon Bay OZP (November 2010)
  (available at
  https://www.pland.gov.hk/pland_en/info_serv/ava_register/government.html)
- Executive Summary of AVA Report for the Ex-Kowloon Bay Flatted Factory site, air ventilation appraisal reports for Choi Wing Road site, Choi Hing Road and Choi Hing Lane sites (March 2014)
  (available at https://www.info.gov.hk/tpb/en/papers/MPC/508-mpc_6-14.pdf)
- AVA IS Report for Term Consultancies for AVA Services - Ex-Kowloon Bay Flatted Factory Site (Oct 2013)
- IS on AVA for approved planning application No. A/K13/299 for minor relaxation of building height restriction from 170mPD to 190mPD for Public Rental Housing of Choi Fook Estate Phase 3 and Sports Centre (December 2015)
- EE on AVA for Kai Tak Mansion (March 2017)
  (available at http://www.info.gov.hk/tpb/en/papers/MPC/577-mpc_1-17.pdf)
- AVA report for Wang Chiu Road Public Housing Site (September 2017)
  (available at http://www.info.gov.hk/tpb/en/papers/MPC/577-mpc_1-17.pdf)

8. Study

- Executive Summary for Kowloon Bay Business Area (KBBA) Pedestrian Environment Improvement - Feasibility Study (available at https://www.ekeo.gov.hk/kbba-pedestrian/en/Home.html)

Related materials of surrounding area

Kai Tak Development

- AVA report for Kai Tak Development Engineering Study cum Design and Construction of Advance Works - Investigation, Design and Construction (Further Review of Development Intensity) (January 2017)
- EE on AVA Report - Proposed Residential and Commercial Development at Kai Tak Runway (June 2017)
- AVA Report for Establishment of Centre of Excellence in Paediatrics in Kai Tak

OTHER REFERENCE MATERIALS
Development (Programme Nos.: 76MM) (February 2012) (available at: https://www.pland.gov.hk/pland_en/info_serv/ava_register/ProjInfo/AVRG61_Final Report.pdf) • Approved Kai Tak OZP No. S/K22/6 (Plan, Notes and Explanatory Statement) (Notes and ES available at: https://www2.ozp.tpb.gov.hk/gos/download.aspx?type=ozp&caseno=S/K22/6&lang=0)
Related materials of REDA Representation in other areas
Further Consideration of Proposed Amendments to Draft Causeway Bay OZP No. S/H6/15 • TPB Paper No. 10375 (available at http://www.info.gov.hk/tpb/en/papers/TPB/1160-tpb_10375.pdf) **Proposed Amendments to Draft Wan Chai OZP No. S/H5/27** • TPB Paper No. 10415 (available at http://www.info.gov.hk/tpb/en/papers/TPB/1168-tpb_10415.pdf) **Proposed Amendments to Draft Mong Kok OZP No. S/K3/30** • TPB Paper No. 10422 (available at https://www.info.gov.hk/tpb/en/papers/TPB/1177-tpb_10422.pdf)