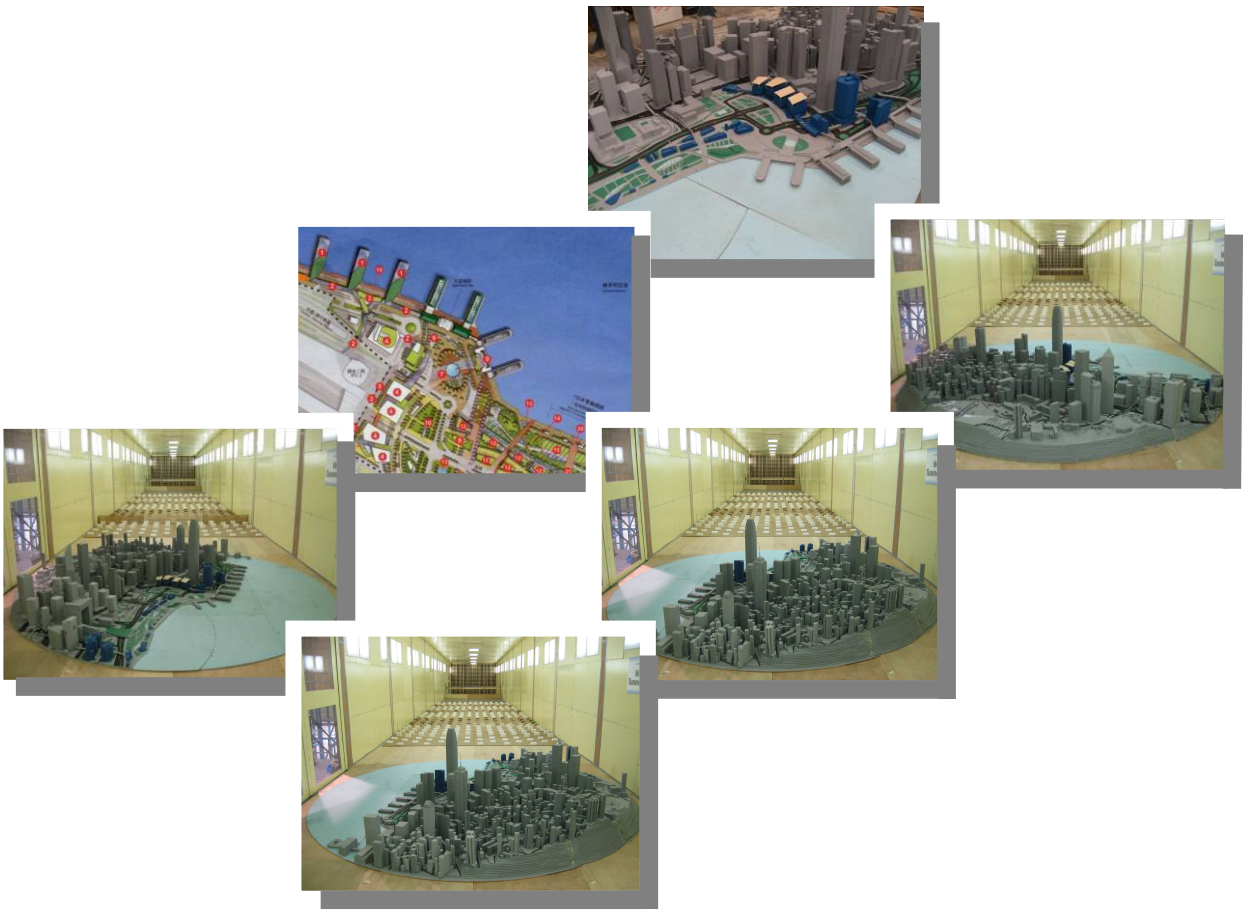
Planning Department

Final Report on Air Ventilation Assessment for Design Scheme A, B and C of New Central Waterfront



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EXECUTIVE SUMMARY

CH2M HILL Hong Kong Limited was commissioned by Planning Department of The Government of the Hong Kong Special Administrative Region to conduct an Air Ventilation Assessment (AVA) for the New Central Waterfront development, under the "Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Central Waterfront Site Study". Expert evaluation and wind tunnel model tests were conducted in collaboration with the CLP Power Wind/Wave Tunnel Facility (WWTF) at The Hong Kong University of Science and Technology for the AVA of the New Central Waterfront development, Design Schemes A, B and C.

The Project Site for the New Central Waterfront Study covers 16.2 ha along the Central waterfront bordering Victoria Harbour. The Project Site includes 4 key Sites, i.e. Sites 1 and 2, Site 3 and Site 4, shown in Figure A. The Assessment Area covers 48.2 ha with the following boundaries: Victoria Harbour due north, the Tamar Central Government Complex due east, Connaught Road Central, including Statue Square, due south, and IFC and the Central Piers due west.

Scheme A

For Design Scheme A, proposed buildings for Sites 1 and 2 comprise three piers earmarked for retail (18 mPD), a hotel building (77 mPD), an office and retail complex (139 mPD) with a public transport interchange (PTI), and an elevated covered walkway linking Central to the ferry terminals. Proposed buildings for Site 3 comprise a cluster of five office and retail buildings (44 to 50 mPD) linked by covered walkways and a landscaped podium, and a retail building (16 mPD) at the south end of the Site on Connaught Road Central. Proposed buildings for Site 4 comprise a cluster of seven buildings (10 to 20 mPD) designated for commercial and leisure use.

Scheme B

For Design Scheme B, proposed buildings for Sites 1 and 2 comprise three piers earmarked for retail (18 mPD), a hotel building (81 mPD), an office and retail complex (140 mPD) with a public transport interchange (PTI), and an elevated covered walkway linking Central to the ferry terminals. Proposed buildings for Site 3 comprise a cluster of four office and retail buildings (43 to 50 mPD) linked by covered walkways and a landscaped podium, and gallery building (10 mPD) close to the centre of the Site. Proposed buildings for Site 4 comprise a cluster of four buildings (15 to 20 mPD) designated for commercial and leisure use.

Scheme C

For Design Scheme C, proposed buildings for Sites 1 and 2 comprise three piers, a 60 mPD building with an irregular plan-form that is located to the north of the Two IFC tower, and two shorter buildings with heights of approximately 25 mPD. The 60 mPD building replaces the proposed 30 storey office building in Sites 1 and 2 of Design Schemes A and B. An extensive landscaped deck, with an elevation of 14 mPD and a total area of approximately 27,300 m^2 (16,000 m^2 excluding voids and buildings) in Sites 1 and 2, has been proposed for the Project Site of Design Scheme C, linking the ferry piers, Sites 1 and 2, and Site 3. Proposed buildings for Site 3 comprise five buildings with heights ranging from 30 mPD to 50 mPD, that are similar in number, height, layout and plan-form as those proposed for Design Scheme A. For Design Scheme C, minimum separations of approximately 20 m are

reserved between the buildings in Site 3. The 14 mPD landscaped deck in Site 3 connects the five proposed buildings in Site 3. The landscaped deck extends from Connaught Place to the south of Site 3 to Sites 1 and 2 to the north of Site 3. It has a total area of approximately 29,000 m^2 (15,800 m^2 excluding voids and buildings) in Site 3, which is larger than the landscaped deck of Design Scheme A at Site 3 (approximately 20,000 m^2) but smaller than the landscaped deck of Design Scheme B at Site 3 (approximately 34,900 m^2). Proposed buildings for Site 4 comprise a row of three low-rise buildings with consistent heights of 20 mPD. The proposed buildings in Site 4 of Design Scheme C have similar heights to those previously tested for both Design Schemes A and B with a revised building configuration based on a "courtyard" design scheme. The proposed buildings and structures of Design Scheme C are unlikely to have adverse impacts on pedestrian level wind speeds in the Assessment Area.

Expert Evaluation

An expert evaluation was conducted for the Focus Areas: Sites 1 and 2, Site 3 and Site 4, and the Assessment Area. The objectives of the expert evaluation were to:

- Analyse key features of the Project Site and the surrounding areas that may likely affect the wind characteristics at the Project Site;
- Make reference to any existing wind data and comment on their reliability for qualitative assessment of the prevailing wind conditions of the Project Site;
- Identify possible problems and issues in air ventilation terms which may affect the design of the proposed development; and
- Provide qualitative assessment of the prima facie merits or demerits of the design schemes.

Based on the non-typhoon probabilistic wind model derived from long-term wind data collected at Waglan Island and the results of a wind tunnel topographical model wind study, the site wind availability for the New Central Waterfront Project Site and the Assessment Area is expected to be dominated by easterly winds, northerly winds and, to a lesser degree, southerly winds which typically occur in summer. The Project Site and the Assessment Area are also likely to benefit from their generally unobstructed harbour frontage and exposure to northerly and easterly winds.

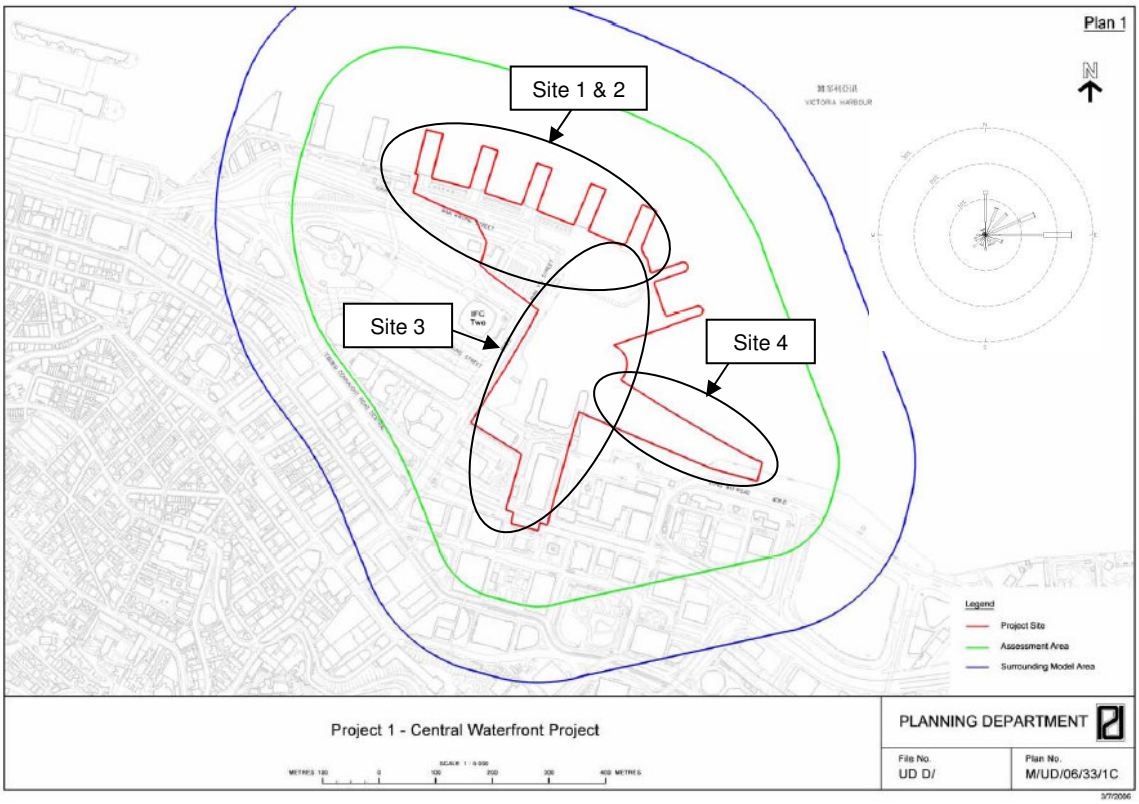

Figure A: Project Site and Assessment Area – The New Central Waterfront Study.

An initial expert evaluation was conducted for Design Schemes A and B for Sites 1 and 2, Site 3 and Site 4 in the Project Site. The proposed layout and building forms of the proposed Design Schemes A and B are characterised by a mix of high-rise, medium-rise and low-rise buildings that are well separated from one another and from the surrounding buildings. Large portions of the Sites are open areas with waterfront promenades, public plazas, gardens, parks, landscaping and trees, allowing relatively unimpeded wind penetration through the Project Site and the Assessment Area. The proposed building form and layout also avoid tall slab-like building forms, thus preventing undesirable blockage to the available wind resources.

Overall, Design Schemes A and B for the Project Site are unlikely to adversely affect the pedestrian level wind conditions within the Project Site and the Assessment Area, Central, Admiralty and the surrounding areas. The alternative design concepts for Sites 1 and 2, Site 3 and Site 4 are expected to have a similar overall air ventilation performance.

Some minor blockage effects are expected to produce some localised stagnant zones in the lee of the proposed buildings. Nevertheless, apart from the proposed 16/18 storey hotel/office building and the 30 storey office building in Sites 1 and 2, all other proposed buildings are low-rise to medium-rise buildings less than 50 m high (up to 48 mPD), allowing wind penetrations into the Project Site and the Assessment Area for winds from all directions.

Due to the exposed nature of the Project Site, uncomfortable pedestrian level wind conditions may occur in exposed areas of the proposed buildings, landscaped podium, pedestrian overpass and surrounding open areas during periods of strong prevailing northerly and easterly winds. Some remedial measures, such as the inclusion of appropriate landscaping and trees, may be required to minimise the impacts of those strong wind conditions on pedestrian comfort.

A subsequent expert evaluation was conducted for Design Scheme C. In general, the overall characteristics of Design Scheme C, including the mixture of building heights, spaces between buildings, open areas and waterfront exposures, are similar to those of Design Schemes A and B. Therefore, a similar overall air ventilation performance is expected.

For Design Scheme C, the proposed 16/18 storey hotel/office building and the proposed 30 storey office building in Sites 1 and 2 for Design Schemes A and B were replaced by a shorter building with height of 60 mPD, preventing the occurrence of high wind speeds in Sites 1 and 2 of Design Schemes A and B. The spacings between the building blocks in Site 3 were increased from approximately 10 m for Design Scheme A to about 20 m for Design Scheme C, providing localised improvements in air ventilation conditions at some nearby locations for certain wind directions. A landscaped deck was introduced in Sites 1 and 2, which is likely to moderate the pedestrian level wind speeds at ground level. The plan dimensions of the proposed landscaped deck for Site 3 of Design Scheme C are larger than those for Design Scheme A and less than those for Design Scheme B. The landscaped deck in Site 3 is also likely to create areas of low wind speed directly underneath it and in other areas at ground level that are in close proximity to it. However, this is not expected to create significant adverse air ventilation effects on pedestrians if the majority of pedestrian traffic is directed to the higher elevation of the landscaped deck.

Detailed Air Ventilation Assessment

For the detailed Air Ventilation Assessment, wind tunnel model tests were undertaken in accordance with the requirements stipulated in the Australasian Wind Engineering Society Quality Assurance Manual, AWES-QAM-1-2001 (2001) and the American Society of Civil Engineers Manual and Report on Engineering Practice No. 67 for Wind Tunnel Studies of Buildings and Structures (1999). The study was also conducted in accordance with the recommendations of Planning Department's Feasibility Study for Establishment of Air Ventilation Assessment System – Final Report (2005) and Technical Guide for Air Ventilation Assessment for Developments in Hong Kong (2006).

A 1:2000 scale site wind availability study has been undertaken previously (WWTF Investigation Report WWTF007-2006) to determine the effects of local topography on mean wind direction, mean wind speed and turbulence intensity of non-typhoon winds approaching the proposed development site at the New Central Waterfront. The results of that study were combined with a probabilistic model of the Hong Kong non-typhoon wind climate, based on wind speed and direction measurements taken by Hong Kong Observatory (HKO) at Waglan Island during the period of 1953 – 2000 inclusive, to determine the site wind availability for the proposed development site.

1:400 scale models of the study areas and surrounding areas for Design Schemes A, B and C were fabricated to include all known existing and proposed surrounding buildings, structures and topographical features within a diameter of approximately 1760 m. The models were fabricated in accordance with plans, drawings and information supplied by CH2M Hill Hong Kong Limited, Aedas Limited and Planning Department during the period of 28 November 2007 to 5 December 2007 inclusive for Design Schemes A and B, and 29 June 2009 to 20 November 2009 inclusive for Design Scheme C.

For Design Scheme A, wind speeds were measured at 142 test points, including 14 special test points. For Design Scheme B, wind speeds were measured at 144 test points, including 17 special test points. For Design Scheme C, wind speeds were measured at 101 test points,

including 12 special test points. For all of the tested design schemes, wind speeds were measured for 16 wind directions ranging from 22.5º to 360º (north) at increments of 22.5º using a multi-channel thermal anemometer system. Directional wind velocity ratios were measured at each individual test point and subsequently combined with the site wind availability data to determine annual overall wind velocity ratios, spatial averaged wind velocity ratios for the region, i.e. the Assessment Area and Project Site, and for each of the Sites 1, 2, 3 and 4 and functional areas, namely a High-rise Development Area, Existing Development Area, Open Area, North Harbourfront, East Harbourfront and West Harbourfront.

Scheme A

For Design Scheme A, overall wind velocity ratios within Sites 1 and 2 were the highest among the designated sites and functional areas, which is attributed to a combination of the presence of tall buildings within the Sites and their proximity to Victoria Harbour. The medium-rise buildings within Site 3 had localised effects on the measured velocity ratios and low-rise buildings in Site 4 influenced wind conditions in the open space on the eastern side of Site 3 due to their effects on winds from the north-east quadrant. Overall wind velocity ratios to the north and to the south of the low-rise buildings in Site 4 were also significantly different due to these effects.

However, the relatively low height of the buildings in Site 4, the North Harbourfront and the West Harbourfront allowed upper level winds from the north-east and north-west quadrants to penetrate further into the built environment of the Existing Development Area and the High-rise Development Area. Overall wind velocity ratios were enhanced by the penetration of upper level winds and their subsequent interaction with the tall buildings in those Areas. The proposed buildings and structures of Design Scheme A are unlikely to have adverse impacts on pedestrian level wind speeds in the Assessment Area.

Scheme B

For Design Scheme B, overall wind velocity ratios within Sites 1 and 2 were the highest among the designated sites and functional areas, which is attributed to a combination of the presence of tall buildings within the Sites and their proximity to Victoria Harbour. The medium-rise buildings within Site 3 had localised effects on the measured velocity ratios. In particular, air ventilation conditions were adversely affected at the southern end of Site 3 which is attributed to the relatively enclosed area formed by the large landscaped podium and adjacent structures. Low-rise buildings in Site 4 and the nearby landscape features, and the piers in the North Harbourfront and the West Harbourfront influenced the winds from north east quadrant, reducing the overall wind velocity ratios over those areas.

The relatively low height of the buildings in Site 4, the North Harbourfront and the West Harbourfront allowed upper level winds from the north-east and north-west quadrants to penetrate further into the built environment of the Existing Development Area and the High-rise Development Area. Overall wind velocity ratios were enhanced by the penetration of upper level winds and their subsequent interaction with the tall buildings in those Areas. The proposed buildings and structures of Design Scheme B are unlikely to have adverse impacts on pedestrian level wind speeds in the Assessment Area.

Scheme C

For Design Scheme C, the introduction of a 14 mPD landscaped deck, and the replacement of the proposed hotel/office development (+70 mPD/+130 mPD) of Design Schemes A and B

with lower building blocks (+25 mPD/+60 mPD) generally lowered the pedestrian level wind speeds in Sites 1 and 2 relative to Design Schemes A and B. Relatively low pedestrian level wind speeds are expected underneath the landscaped deck, particularly at locations adjacent to the proposed buildings in Sites 1 and 2. Similar results were measured for a limited number of test points in the West Harbourfront. However, other locations that are relatively unobstructed are likely to benefit from wind flowing underneath the landscaped deck. Public areas on top of the landscaped deck will be relatively exposed to winds from the north-west and north-east quadrants which will be of benefit to pedestrians. The proposed 16/18 storey hotel/office building and the proposed 30 storey office building in Sites 1 and 2 have been replaced by shorter buildings whose heights are comparable to those in Site 3.

For Site 3, the increased permeability of the buildings was achieved by reserving building separations of approximately 20 m for Design Scheme C, as compared to the approximately 10m seperations in Design Schemes A and B. The proposed building layout of Site 3 of Design Scheme C allows general enhancements of pedestrian level wind speed in adjacent areas on Man Yiu Street for easterly winds. Some moderation of pedestrian level wind speed are likely to occur at areas in close proximity to the landscaped deck. However, the wind tunnel test results indicate that these effects are localised. Overall pedestrian level wind speeds in the open spaces in Site 3 are similar for Design Scheme C and Design Schemes A and B. Pedestrian level wind conditions in Site 4 are also similar for Design Scheme C and Design Schemes A and B.

In the Assessment Area, overall pedestrian level wind conditions are similar for Design Scheme C and Design Schemes A and B in the East Harbourfront, North Harbourfront, Open Area, High-rise Development Area and Existing Development Area.

Overall, the wind tunnel test results indicated that the pedestrian level wind speeds for Design Scheme C are comparable to Design Schemes A and B. The proposed buildings and structures of Design Scheme C are unlikely to have adverse impacts on pedestrian level wind speeds in the Assessment Area.

However, the configuration of the 14 mPD landscaped deck at Site 1, 2 and 3 in Design Scheme C moderated pedestrian level wind speeds at areas underneath and in close proximity to the landscaped deck. In contrast, pedestrians on the top of landscaped deck will benefit from relatively unobstructed wind flow.

Potential improvement measures may be required to enhance pedestrian level wind speeds underneath the 14 mPD landscaped deck at Site 1, 2 and 3 in Design Scheme C. Good design features and ventilation mitigation measures such as the introduction of mechanical ventilation devices underneath the landscaped deck may need to be considered to alleviate the effects of stagnant wind conditions for locations that are sheltered from the north-easterly winds bringing forth localized areas with low wind flow. The requirements and form of potential improvement measures underneath the landscaped deck may be further investigated in the detailed design stage.

NOMENCLATURE

F wind speed scaling factor;

M the total number of test points at pedestrian level;

p_i annual probability of occurrence of winds approaching the study site (%);

SAVR Spatial Averaged Velocity Ratio;

$\overline{u}_{500,open}$ directional non-typhoon mean wind speed at 500 mPD above open water terrain (m/s);

$\overline{u}_{ref}$ mean wind speed measured at the nominated reference height (m/s);

$\overline{u}_z$ mean wind speed measured at a height z (m/s);

$V_{p,i,j}$ wind speed at pedestrian level, i.e. at 2 m above ground at each test point and under the influence of buildings and other urban features (m/s);

$VR_{500,i,j}$ directional wind velocity ratio, with respect to the reference mean wind speed at 500 m, for a particular wind direction (i) at the j-th test point, $VR_{500,i,j} = \frac{V_{p,i,j}}{V_{500,i}}$;

V_∞ wind speed at the top of the atmospheric boundary layer, taken as the wind velocity at 500 mPD in this study, denoted as $V_{500,i}$ (m/s);

$VR_{w,j}$ overall wind velocity ratio of the j-th test point, $VR_{w,j} = \sum_{i=1}^{16} p_i \times VR_{500,i,j}$

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1.1.1.1 CH2M HILL Hong Kong Limited was commissioned by Planning Department of The Government of the Hong Kong Special Administrative Region to conduct an Air Ventilation Assessment for the New Central Waterfront development, under the "Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Central Waterfront Site Study". Expert evaluation and wind tunnel model tests were conducted in collaboration with the CLP Power Wind/Wave Tunnel Facility (WWTF) at The Hong Kong University of Science and Technology.

1.1.1.2 The objectives of the expert evaluation are to:

- Analyse key features of the site and the surrounding areas that are likely affect the wind characteristics at the site;
- Make reference to any existing wind data and comment on their reliability for qualitative assessment of the prevailing wind conditions of the site;
- Identify possible problems and issues in air ventilation terms which may affect the design of the proposed development; and
- Provide qualitative assessment of the prima facie merits or demerits of the design schemes.

1.1.1.3 The outcomes of the expert evaluation were aided by an appreciation of the project site characteristics through a site visit, an examination of CLP Power Wind/Wave Tunnel Facility's 1:2000 scale topographical model and 1:400 scale detailed model of the Project Site and Surrounding Area, and a study of plans and drawings supplied by Planning Department.

1.2 Wind Tunnel Studies

1.2.1.1 Wind tunnel model tests were conducted in the low speed test section of the CLP Power Wind/Wave Tunnel Facility (WWTF) at The Hong Kong University of Science and Technology (HKUST) for a detailed air ventilation assessment (AVA) to investigate the pedestrian level wind environment within and around the proposed Design Schemes A, B and C at the New Central Waterfront. The Assessment Areas and the Project Site are shown in Figure 1 (a) to 1 (c). The Project Site comprises Sites 1, 2, 3 and 4 as indicated in Figure 2. In accordance with the instructions of Planning Department on 17 April 2008, the Project Site and Assessment Area were further subdivided into a number of functional areas, namely a High-rise Development Area, Existing Development Area, Open Area, North Harbourfront, East Harbourfront and West Harbourfront for the air ventilation assessment study.

1.2.1.2 1:400 scale models of the Project Site, Assessment Areas and the Surrounding Area were fabricated to include all known existing and proposed surrounding buildings, structures and topographical features within a diameter of approximately 1760 m, in accordance with plans, drawings and information supplied by CH2M Hill Hong Kong Limited, Aedas Limited and Planning Department during the period of 28 November 2007 to 5 December 2007 inclusive for Design Schemes A and B, and 29 June 2009 to 20 November 2009 inclusive for Design Scheme C.

1.2.1.3 Wind speed measurements were taken at 22.5º increments for the full 360º azimuth (i.e. 16 wind directions), where a wind direction of 0º or 360º corresponds to an incident wind approaching the proposed development site directly from the north, 90º

corresponds to an incident wind approaching the proposed development site directly from the east, etc. A multi-channel thermal anemometer was used to measure wind speeds at 142 test points for Design Scheme A, 144 test points for Design Scheme B and 101 test points for Design Scheme C. The test point locations were jointly selected by WWTF, Planning Department and CH2M Hill Hong Kong Limited.

1.2.1.4 Wind tunnel test results were combined with WWTF's statistical model of the Hong Kong non-typhoon wind climate based on measurements of wind speed and direction taken by Hong Kong Observatory (HKO) at Waglan Island during the period of 1953 to 2000 inclusive (Hitchcock et al., 2003) to determine the wind velocity ratios at each test point.

1.2.1.5 The wind tunnel model studies were undertaken in accordance with the requirements stipulated in the Australasian Wind Engineering Society Quality Assurance Manual, AWES-QAM-1-2001 (2001) and the American Society of Civil Engineers Manual and Report on Engineering Practice No. 67 for Wind Tunnel Studies of Buildings and Structures (1999). The study was also conducted in accordance with the recommendations of Planning Department's Feasibility Study for Establishment of Air Ventilation Assessment System – Final Report (2005) and Technical Guide for Air Ventilation Assessment for Developments in Hong Kong (2006).

2. PROJECT SITE CHARACTERISTICS

2.1 The New Central Waterfront Study Site Boundary

2.1.1.1 The Project Site for the New Central Waterfront covers an area of 16.2 ha bordering Victoria Harbour, as shown in Figure 1 (a) to 1 (c). The Project Site comprises four key Focus Areas, i.e. Sites 1 and 2, Site 3 and Site 4. The Assessment Area covers 48.2 ha with the following boundaries: Victoria Harbour due north, Central Government Complex due east, Connaught Road Central, including Statue Square, due south, and IFC and the ferry piers due west. The expert evaluation concentrated on the Focus Areas and the Assessment Area. The key sites in the New Central Waterfront are shown in Figure 2.

2.2 Buildings and Streetscape within and adjacent to the Project Site and Assessment Area

2.2.1.1 Victoria Harbour forms the northern boundary of the Project Site. A large part of the waterfront of the Project Site is reclaimed land. Areas south and west of the Project Site are bounded by the Central and Admiralty business districts, including the New Central Government Complex, PLA Hong Kong Garrison Headquarters, City Hall, Jardine House, Exchange Square and IFC.

2.2.1.2 The adjacent Central and Admiralty business districts comprise a mixture of parks (including Hong Kong Park, Chater Garden and Status Square), roads and overpasses, and high-rise buildings. The vast majority of buildings are newer buildings. The landscape further south of the Project Site is characterised by hilly terrain, dominated by the 552 m Victoria Peak.

3. SITE WIND AVAILABILITY

3.1 Hong Kong Non-typhoon Wind Climate

3.1.1.1 Waglan Island, located approximately 5 km southeast of Hong Kong Island, has been used by Hong Kong Observatory (HKO), known previously as Royal Hong Kong Observatory, for the collection of long-term wind data since December 1952. Due to its small area, isolated location, relative lack of development and generally uninterrupted exposure to winds, data collected at Waglan Island is considered to be representative of winds approaching the Hong Kong region.

3.1.1.2 HKO data, measured at Waglan Island during the period of January 1953 to May 2000 inclusive, have been combined with wind tunnel measurements to determine a probabilistic model of mean speed and direction of non-typhoon winds affecting Hong Kong (Hitchcock et al. 2003). The wind rose representing annual, non-typhoon winds at Waglan Island, corrected to 500 m, is presented in Figure 3, which indicates that the prevailing non-typhoon winds affecting Hong Kong occur mainly from northerly, easterly and south to south-westerly directions.

3.2 Site Wind Availability for Expert Evaluation of the New Central Waterfront

3.2.1.1 Site wind availability at the New Central Waterfront Project Site has been determined from a wind tunnel topographical model study. The site wind availability at the heights of 100 m and 50 m are presented as wind roses in Figures 4 and 5 respectively. Evidently, surrounding topography modifies the prevailing winds observed at Waglan Island, which have been found to be predominantly from northerly, easterly and southerly directions.

3.2.1.2 Victoria Harbour, Kowloon Peninsula and distant hilly terrain and urban fabric north of the Project Site create some shielding effects, but these only have a minimal impact on the northerly winter monsoon. Victoria Harbour, being surrounded by hilly terrain and with its narrow Lei Yue Mun eastern entrance, creates significant channelling effects which enhance easterly monsoon winds. However, the hilly terrain south of the Project Site provides shielding effects which significantly moderate southerly sea breezes.

3.2.1.3 Overall, by considering the effects of the surrounding topography, the site wind availability for the Project Site and Assessment Areas is expected to be dominated by easterly winds and northerly winds, with lesser contributions by southerly winds.

4. EXPERT EVALUATION OF PEDESTRIAN LEVEL WIND CONDITIONS WITHIN AND ADJACENT TO THE PROJECT SITE AND ASSESSMENT AREA

4.1 Existing Pedestrian Level Wind Conditions

4.1.1.1 A large part of the waterfront areas of the Project Site lies on reclaimed land. As those areas were formerly in Victoria Harbour and not generally accessible to pedestrians their existing pedestrian level wind conditions are not considered in this study.

4.1.1.2 Existing buildings and streetscape within the Assessment Area comprise a mixture of parks, roads and overpasses, and high-rise buildings. Environmental wind effects do not appear to have been seriously considered in previous planning guidelines. As a result, the building distribution and configuration within Central and Admiralty business districts are haphazard. The alignments of existing arterial roads within Central and Admiralty business districts are governed by and follow closely the coastline with feeder roads and narrower streets branching from the harbour towards the hills.

4.1.1.3 At present, northerly and particularly easterly winds are the dominant prevailing winds delivering air ventilation. Wind penetrations through the existing built-up areas are limited to those through the arterial roads and feeder roads and streets, open spaces such as parks, and available gaps and openings between existing buildings. Beyond the narrow strip of flat terrain close to the waterfront, as the terrain rises according to the hill slope towards the Mid-levels, the cascade effect of the buildings creates better wind penetration to enhance air ventilation.

4.1.1.4 An EPD road-side monitoring station is located in Central. Regular media reporting of this road side pollution index has drawn constant public attention to pedestrian level air quality at Central. This directly reflects the pedestrian level wind climate and air ventilation performance within Central and surrounding areas. Overall, the impression of air ventilation performance of Central in its current state is poor.

4.2 Assessment of Pedestrian Level Wind Climate within the Project Site and Assessment Areas in Terms of Air Ventilation

4.2.1.1 The assessment of pedestrian wind climate within the Project Site and Assessment Area, in terms of air ventilation, focuses on the characteristics of the Project Site, proposed building layout and their interactions with the prevailing winds for the Site. The prevailing winds for the Project Site and Assessment Area are dominated by northerly and particularly easterly winds, with lesser contributions by southerly winds, according to the results of a wind tunnel model study of site wind availability for the New Central Waterfront. The assessment focuses on identifying site characteristics, building design features and other special characteristics that engage winds from prevailing directions to enhance air ventilation.

4.2.1.2 The Project Site occupies unobstructed harbour frontage, allowing wind penetrations through the Project Site and Assessment Area for winds from easterly and particularly northerly directions. However, hilly terrain and existing tall buildings in the Central and Admiralty business districts significantly block air flows from southerly directions. Hence air ventilation within the Project Site and Assessment Area is relying heavily on wind penetrations by northerly and easterly winds.

4.3 Design Scheme A

4.3.1 Proposed building layout

4.3.1.1 The layout of proposed buildings within the Project Site for Scheme A is shown in Figures 6 and 7. Proposed buildings for Sites 1 and 2 comprise three piers earmarked for retail (18 mPD), a hotel building (77 mPD), an office and retail complex (139 mPD) with a public transport interchange (PTI), and an elevated covered walkway linking Central to the ferry terminals.

4.3.1.2 Proposed buildings for Site 3 comprise a cluster of five office and retail buildings (44 to 50 mPD) linked by covered walkways and a landscaped podium, and a retail building (16 mPD) at the south end of the Site on Connaught Road Central.

4.3.1.3 Proposed buildings for Site 4 comprise a cluster of seven buildings (10 to 20 mPD) designated for commercial and leisure use.

4.3.1.4 Large portions of the Sites are open areas with public plazas, board walks, gardens/parks, landscaping and trees, allowing unimpeded wind penetrations through the Project Site and Assessment Area. The proposed building form and layout also avoided tall slab-like building forms, thus preventing undesirable blockage to the available wind resources. Furthermore, with the exception of the proposed hotel building and the office and retail complex in Sites 1 and 2, all other proposed buildings are low-rise to medium-rise buildings less than 50 m high (up to 50 mPD), allowing wind penetrations into the Project Site and the Assessment Area for winds from all directions.

4.3.2 Assessment of pedestrian level wind climate in terms of air ventilation: Sites 1 and 2:

4.3.2.1 The retail space above the piers comprises low-rise retail buildings (18 mPD) that are well separated and present little blockage to winds and facilitate wind penetrations for winds from all directions. Hence, those buildings are not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area. However, due to its exposure, uncomfortable pedestrian level wind conditions may occur in exposed areas of the retail buildings and surrounding open areas during periods of strong prevailing northerly and easterly winds.

4.3.2.2 Sites 1 and 2 are served by a network of elevated covered walkways that present little blockage to winds and facilitate wind penetrations for winds from all directions. Hence the elevated covered walkways are not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area. However, the covered pedestrian walkways are elevated and exposed to higher wind speeds than at street level. Due to this exposure, uncomfortable wind conditions for pedestrians may occur in exposed sections of the elevated covered walkways during periods of strong prevailing northerly and easterly winds.

4.3.2.3 The hotel is well separated from surrounding buildings, thus facilitating wind penetrations for winds from all prevailing wind directions. The hotel has a height of about 77 mPD and has avoided a tall slab-like building form, thereby lessening wind blockage effects compared with taller and/or more closely spaced buildings. Depending on wind direction, some localised stagnant zones will appear in the lee of the building. Due to its exposure, uncomfortable pedestrian level wind conditions may also occur in exposed areas of the hotel and surrounding open areas during periods of strong prevailing northerly and easterly winds. Overall, the hotel is not expected to adversely affect the pedestrian level wind climate within the Project Site

and Assessment Area.

4.3.2.4 The 139 mPD office and retail complex avoided a tall slab-like building form and is well separated from surrounding buildings, thus facilitating wind penetrations from all prevailing wind directions. Depending on wind direction, some localised stagnant zones will appear in the lee of the office and retail complex. Due to exposure, uncomfortable pedestrian level wind conditions may also occur in exposed areas of the office and retail complex and surrounding open areas during periods of strong prevailing northerly and easterly winds. Overall, the office and retail complex is not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

4.3.2.5 The public transportation interchange (PTI) at street level underneath the office and retail complex with large openings around the perimeter will facilitate wind penetrations into the PTI and provide air flow at pedestrian accessways/footpaths around the PTI perimeter. Air ventilation within the PTI can be further improved by employing mechanically forced ventilation.

4.3.3 Assessment of pedestrian level wind climate in terms of air ventilation: Site 3

4.3.3.1 The office and retail buildings, ranging in height from 44 to 50 mPD, are arranged in a cluster of five building blocks and aligned approximately north-south, well separated from each other with a gap of 10 m or more, and also well separated from surrounding buildings. These compact size medium-rise buildings offer less wind blockage effects than taller bulkier high-rise buildings. Furthermore, the building configuration facilitates wind penetrations for north winds and air flow through building gaps for east winds. Depending on wind direction, some localised stagnant zones will appear in the lee of the office and retail buildings. Due to their exposure, uncomfortable pedestrian level wind conditions may also occur in exposed areas of the landscaped podium, the pedestrian overpass and surrounding open areas during periods of strong prevailing northerly and easterly winds.

4.3.3.2 The low-rise retail building (16 mPD) on Connaught Road Central presents little blockage to winds and facilitates wind penetrations for winds from all directions.

4.3.3.3 Overall, the office and retail buildings are not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

4.3.4 Assessment of pedestrian level wind climate in terms of air ventilation: Site 4

4.3.4.1 The low-rise buildings, ranging in heights from 10 to 20 mPD, are designated for commercial and leisure use. They are arranged in two rows of three and four building blocks and aligned approximately east-west, well separated from each other with a gap of 10 m or more, and also well separated from surrounding buildings. These low-rise buildings present little blockage to winds and facilitate wind penetrations for winds from all directions. Hence these low-rise buildings are not expected to adversely affect the local pedestrian level wind climate.

4.3.4.2 Due to their exposure, uncomfortable pedestrian level wind conditions may occur in exposed areas of the low-rise buildings and surrounding open areas during periods of strong prevailing northerly and easterly winds.

4.3.5 Assessment of pedestrian level wind climate in terms of air ventilation: The Assessment Area

4.3.5.1 All the proposed buildings in the Project Site are basically low to medium rise (with the exception of the proposed hotel and office building in Sites 1 and 2), well separated and avoiding slab-like building forms. They present little blockage to winds and facilitate wind penetrations for winds from all directions. Scheme A is not expected to adversely affect the pedestrian level wind climate within the Assessment Area.

4.4 Design Scheme B

4.4.1 Proposed building layout

4.4.1.1 The layout of proposed buildings within the Project Site for Scheme B is shown in Figures 8 and 9. Proposed buildings for Sites 1 and 2 comprise three piers earmarked for retail (18 mPD), a hotel building (81 mPD), an office and retail complex (140 mPD) with a public transport interchange (PTI), and an elevated covered walkway linking Central to the ferry terminals.

4.4.1.2 Proposed buildings for Site 3 comprise a cluster of four office and retail buildings (43 to 50 mPD) linked by covered walkways and a landscaped podium, and gallery building (10 mPD) close to the centre of the Site.

4.4.1.3 Proposed buildings for Site 4 comprise a cluster of four buildings (15 to 20 mPD) designated for commercial and leisure use.

4.4.1.4 Large portions of the Sites are open areas with public plazas, board walks, gardens/parks, landscaping and trees, allowing unimpeded wind penetration through the Project Site and Assessment Area. The proposed building form and layout also avoided tall slab-like building forms, thus preventing undesirable blockage to the available wind resources. Furthermore, with the exception of the proposed hotel building and the office and retail complex in Sites 1 and 2, all other proposed buildings are low-rise to medium-rise buildings less than 50 m high (50 mPD or less), allowing wind penetrations into the Project Site and the Assessment Area for winds from all directions.

4.4.2 Assessment of pedestrian level wind climate in terms of air ventilation: Sites 1 and 2

4.4.2.1 The retail space above the piers comprises low-rise retail buildings (18 mPD) that are well separated and present little blockage to winds and facilitate wind penetrations for winds from all directions. Hence the retail space above the piers is not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area. However, due to its exposure, uncomfortable pedestrian level wind conditions may occur in exposed areas of the retail buildings and surrounding open areas during periods of strong prevailing northerly and easterly winds.

4.4.2.2 Sites 1 and 2 are served by a network of elevated covered walkways that presents little blockage to winds and facilitates wind penetrations for winds from all directions. Hence the elevated covered walkways are not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area. However, the covered pedestrian walkways are elevated and exposed to higher wind speeds than at street levels. Due to this exposure, uncomfortable wind conditions for pedestrians may occur in exposed sections of the elevated covered walkway during periods of strong prevailing northerly and easterly winds.

4.4.2.3 The office is well separated from surrounding buildings, thus facilitating wind penetrations for winds from all prevailing wind directions. The office is about 77 m

in height above ground (81 mPD) and has avoided a tall slab-like building form, thereby lessening wind blockage effects compared with taller and/or more closely spaced buildings. Depending on wind direction, some localised stagnant zones will appear in the lee of the building. Due to its exposure, uncomfortable pedestrian level wind conditions may also occur in exposed areas of the office and surrounding open areas during periods of strong prevailing northerly and easterly winds. Overall, the office is not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

4.4.2.4 The 140 mPD office and retail complex avoided a tall slab-like building form and is well separated from surrounding buildings, thereby facilitating wind penetrations from all prevailing wind directions. Depending on wind direction, some localised stagnant zones will appear in the lee of the office and retail complex. Due to exposure, uncomfortable pedestrian level wind conditions may also occur in exposed areas of the office and retail complex and surrounding open areas during periods of strong prevailing northerly and easterly winds. Overall, the office and retail complex is not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

4.4.2.5 The public transportation interchange (PTI) at street level underneath the office and retail complex maintains large openings around the perimeter which will facilitate wind penetrations through the PTI and provide air flow at pedestrian accessways/footpaths around the PTI perimeter. Air ventilation within the PTI can be further improved by employing mechanically forced ventilation.

4.4.3 Assessment of pedestrian level wind climate in terms of air ventilation: Site 3

4.4.3.1 The office and retail buildings, ranging in height from 43 to 50 mPD, are arranged in a cluster of four and aligned approximately north-south, well separated from each other with a gap of 10 m or more, and also well separated from surrounding buildings. These compact size medium-rise buildings offer less wind blockage effects than taller bulkier high-rise buildings. Furthermore, the building configuration facilitates wind penetrations for north winds and air flow through building gaps for east winds.

4.4.3.2 The large landscaped podium will limit air ventilation at pedestrian level underneath the podium to air flows through the roads and openings on the podium, although openings on the large landscaped podium are expected to facilitate some upper level air flows reaching street level below. However, the impact of the large landscaped podium on air ventilation is expected to be localised. Furthermore, the majority of pedestrian traffic is expected to be through retail arcades and along the large landscaped podium and pedestrian overpass where air ventilation is expected to be more satisfactory.

4.4.3.3 Depending on wind direction, some localised stagnant zones will appear in the lee of the office and retail buildings. Due to their exposure, uncomfortable pedestrian level wind conditions may also occur in exposed areas of the landscaped podium, the pedestrian overpass and surrounding open areas during periods of strong prevailing northerly and easterly winds.

4.4.3.4 The reconstructed old star ferry clock tower (20mPD) and the low-rise gallery building (10 mPD) near the centre of the Site presents little blockage to winds and facilitates wind penetrations for winds from all directions.

4.4.3.5 Overall, the office and retail buildings are not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

4.4.4 Assessment of pedestrian level wind climate in terms of air ventilation: Site 4

4.4.4.1 The low-rise buildings, ranging in heights from 15 to 20 mPD, are designated for waterfront-related commercial and leisure use. They are aligned approximately east-west, well separated from each other with a gap of 10 m or more, and also well separated from surrounding buildings. These low-rise buildings present little blockage to winds and facilitate wind penetrations for winds from all directions. Hence these low-rise buildings are not expected to adversely affect the local pedestrian level wind climate.

4.4.4.2 Due to their exposure, uncomfortable pedestrian level wind conditions may occur in exposed areas of the low-rise buildings and surrounding open areas during periods of strong prevailing northerly and easterly winds.

4.4.5 Assessment of pedestrian level wind climate in terms of air ventilation: The Assessment Area

4.4.5.1 All the proposed buildings in the Project Site are basically low to medium rise (with the exception of the proposed hotel and office building in Sites 1 and 2), well separated and avoiding slab-like building forms. They present little blockage to winds and facilitate wind penetrations for winds from all directions. Scheme B is not expected to adversely affect the pedestrian level wind climate within the Assessment Area.

4.5 Design Scheme C

4.5.1.1 The layout of proposed buildings within the Project Site for Design Scheme C is shown in Figures 10 and 11. It is noted that the proposed Design Scheme C includes the following changes:

- Sites 1 and 2: The proposed 16/18 storey hotel/office building and the proposed 30 storey office building in Sites 1 and 2 have been replaced by shorter buildings ranging from +25 mPD to +60 mPD, whose heights are comparable to those in Site 3.
- Sites 1, 2 and 3: The top level of the landscaped deck has been increased from +12.0 mPD for Design Schemes A and B to +14.0 mPD for Design Scheme C.
- Site 3: The space between the building blocks can be increased from 11 m for Design Scheme A to 15 m or up to about 20 m.
- The size of the landscaped deck/podium has been changed:

  Design Scheme A at Site 3 = 20,000 m^2
  Design Scheme B at Site 3 = 34,900 m^2
  Design Scheme C at Sites 1 and 2 = 27,300 m^2
  Design Scheme C at Site 3 = 29,000 m^2

4.5.1.2 In general, the overall characteristics of Design Scheme C, including the mixture of building heights, spaces between buildings, open areas and waterfront exposures, are similar to those of Design Schemes A and B. Therefore, a similar overall air ventilation performance is expected. These features allow generally unimpeded wind penetration through the Project Site and the Assessment Area and into the adjacent areas. The exposed nature of the Project Site may also cause uncomfortable pedestrian level wind conditions in exposed areas during periods of strong prevailing northerly and easterly winds. The modifications proposed for Design Scheme C are

likely to have localised effects on the pedestrian level wind environment.

4.5.1.3 The combination of the reduced building heights in Sites 1 and 2 and the enlarged landscaped deck is likely to prevent the occurrence of high wind speeds at pedestrian level in between the proposed high-rise buildings in Sites 1 and 2, for both Design Schemes A and B. The introduction and extent of the proposed landscaped deck in Sites 1 and 2 is likely to have a significant effect on wind conditions at ground level, particularly directly underneath the deck. Natural air ventilation at the public transport interchange in the north of Sites 1 and 2 is likely to be limited. The proposed voids in the deck in the vicinity of this and other areas may be of moderate benefit to conditions at ground level.

4.5.1.4 The increased spacing between the buildings in Site 3 is likely to provide localised improvements in air ventilation conditions at some nearby locations. However, these are only likely to be of moderate magnitude and only noticeable for certain wind directions. As pedestrians are likely to be engaged in various activities or passing through locations in the open spaces east of the buildings and deck in Site 3, and to the west of Site 3 on Man Yiu Street, moderate wind conditions are likely to be acceptable in those areas.

4.5.1.5 The plan dimensions of the landscaped deck/podium in Site 3 are larger than those for Design Scheme A and less than those for Design Scheme B. Similar to the effects of the landscaped deck in Sites 1 and 2, the extent of the landscaped deck in Site 3 is likely to create areas of low wind speed directly underneath it and in other areas at ground level that are in close proximity to it. Nevertheless, directing the majority of pedestrian traffic to the higher elevation of the landscaped deck will enable a large portion of pedestrians in the area to be exposed to enhanced wind speeds. However, windy conditions are likely to occur on the landscaped deck during periods of strong winds from the north-east quadrant and it is recommended that significant landscaping and/or tree planting be used to provide local areas of refuge and shelter on the landscaped deck during those periods.

4.5.1.6 The revised courtyard shaped building design in Site 4 is likely to provide sheltered spaces in the private areas adjoining those buildings, particularly for winds from the north-east quadrant, which is likely to result in localised regions of low wind flow. Mechanical ventilation may need to be considered by the proprietors in those locations to alleviate the effects of stagnant wind conditions. As the overall dimensions and height of the buildings proposed for Site 4 under Design Scheme C are similar to those tested for Design Schemes A and B, they are not expected to inhibit the ingress of upper level winds deeper into the adjacent city areas.

5. WIND TUNNEL MODELLING FOR DETAILED AVA

5.1 Modelling the Natural Wind

5.1.1.1 In conducting wind tunnel model tests of structures on the surface of the Earth, it is necessary to adequately simulate the lowest layer of the atmosphere, known as the atmospheric boundary layer. It is within this layer that the surface of the Earth imparts drag forces on the moving air, generally resulting in mean wind speed increasing with height to a point where the effects of surface drag become negligible. In wind engineering, a convenient measure of the thickness of the atmospheric boundary layer is commonly referred to as the gradient height and its magnitude depends on the surrounding surface roughness over which the air must flow. Obstacles to air flow can vary from relatively large expanses of smooth, open water, to vegetation such as forests, built-up environments such as city centres, and large, rugged mountain ranges. The resulting gradient heights are typically in the range of several hundred metres to in excess of 1000 m.

5.1.1.2 A 1:2000 scale site wind availability study has been undertaken previously (WWTF Investigation Report WWTF007-2006) to determine the effects of topography on local wind conditions and the site wind availability close to the proposed development site. In that study, all buildings and structures within the proposed development site were removed for all measured wind directions, and measurements were taken at eight (8) heights above the study area. Measurements were taken at 22.5° intervals for the full 360o azimuth to determine the characteristics of winds approaching the site.

5.1.1.3 Due to the similarities between both mean wind speed and turbulence intensity profiles for certain wind directions, three representative approach profiles (denoted here as approach conditions A, B and C) are considered to be adequate to represent the range of wind conditions affected by the local terrain for the full 360° azimuth. The approach conditions corresponding to each of the 16 wind directions tested are presented in Table 1. Mean wind speed profiles, turbulence intensity profiles and longitudinal velocity spectra for the approach conditions A, B and C are presented in graphical form in Figures 12 to 17.

5.1.1.4 For all tests, reference wind speeds were measured at a height of 300 mPD. Wind speed scaling factors (F) were applied to relate the non-typhoon wind speed at 500 mPD above open water terrain to wind speeds at the reference height, as shown in Equation (1).

$$\bar{u}_{ref} = F\bar{u}_{500,open} \qquad (1)$$

where:

F = wind speed scaling factor;

$\bar{u}_{ref}$ = the mean wind speed measured at the reference height (equivalent to 300 mPD in this 1:400 scale study); and

$\bar{u}_{500,open}$ = directional non-typhoon mean wind speed at 500 mPD above open water terrain.

5.1.1.5 The wind speed scaling factors (F) are based on the matching of mean wind speeds between the 1:2000 scale topographical model and the 1:400 scale model as shown in Equation (2), averaged over four heights equivalent to 25 mPD, 50 mPD, 75 mPD and 100 mPD at prototype scale.

$$F = \left[\frac{\overline{u}_z}{\overline{u}_{500,open}} \right]_{1:2000} \left[\frac{\overline{u}_{ref}}{\overline{u}_z} \right]_{1:400} \qquad (2)$$

where:

$\overline{u}_z$ = mean wind speed measured at a height z (i.e. where z is equivalent to 25 mPD, 50 mPD, 75 mPD and 100 mPD respectively at prototype scale);

$\overline{u}_{ref}$ = wind speed measured at the reference height (z_{ref}) in the 1:400 scale tests, taken as 300 mPD for this study; and

$\overline{u}_{500,open}$ = directional mean wind speed at 500 mPD above open water terrain.

5.1.1.6 The wind speed scaling factors presented in Table 2 for each of the 16 measured wind directions were determined as an average from the wind speeds measured in the 1:2000 and 1:400 scale tests at 25 mPD, 50 mPD, 75 mPD and 100 mPD.

5.2 Non-typhoon Wind Climate for the New Central Waterfront

5.2.1.1 In the assessment of the pedestrian level wind environment, the primary concerns are of pedestrian comfort and safety. The main objective for conducting an AVA is to investigate and determine the likely impact of buildings on air flow at pedestrian level within the proposed development sites at the New Central Waterfront. Although the current AVA framework does not provide absolute criteria by which wind conditions may be quantitatively assessed as acceptable or unacceptable on the basis of comfort or safety, it does provide a relative indicator of potential wind conditions that are likely to occur on a relatively frequent basis. Typhoons affect Hong Kong, on average, several times per year during the summer months and, from the point of view of safety, it is expected that people would remain indoors during typhoon wind events. Hence, typhoon winds have been excluded from this study and only non-typhoon winds have been considered in the current assessment and prediction of pedestrian level wind conditions for the proposed development site.

5.2.1.2 Waglan Island, located approximately 5 km south-east of Hong Kong Island, has been used by HKO for the collection of long-term wind data since December 1952. Due to its location, relative lack of development and its generally uninterrupted exposure to winds, data collected at Waglan Island is considered to be representative of winds approaching the Hong Kong region.

5.2.1.3 HKO data, measured at Waglan Island during the period of January 1953 to May 2000 inclusive, have been combined with wind tunnel measurements to determine a probabilistic model of mean speed and direction of non-typhoon winds affecting Hong Kong (Hitchcock et al. 2003). The wind rose representing annual, non-typhoon winds at Waglan Island, corrected to 500 m, is presented in Figure 3, which indicates that the prevailing non-typhoon winds affecting Hong Kong occur mainly from northerly, easterly and south to south-westerly directions.

5.2.1.4 The results obtained from the previously conducted 1:2000 scale site wind availability study (WWTF Investigation Report WWTF007-2006) correspond to 22.5º sectors, for example the east sector corresponds to winds from 90º ± 11.25º, and some deviations were noted for certain approach wind directions. For this study, those deviations, or wind shifts, were averaged over heights of 25 mPD, 50 mPD, 75 mPD, 100 mPD, 150 mPD and 200 mPD, i.e. the range of heights in the current study that are considered likely to influence pedestrian level wind conditions. If the average wind shift determined in the 1:2000 scale study deviated by more than ±11.25º from the

approach wind direction, those winds were treated as having shifted to an adjacent sector. Therefore, the probability of occurrence was added to that of the adjacent sector and the annual directional probabilities of occurrence were adjusted accordingly, as presented Table 3.

5.2.1.5 A probabilistic model of mean speed and direction of non-typhoon winds at the New Central Waterfront was then determined by combining the adjusted annual directional probabilities of occurrence with wind speed data from the previously conducted 1:2000 scale site wind availability study (WWTF Investigation Report WWTF007-2006) to determine the annual wind rose, corrected to a height of 100 m and incorporating the wind shifts averaged over heights of 25 mPD, 50 mPD, 75 mPD, 100 mPD, 150 mPD and 200 mPD, for the New Central Waterfront, as presented in Figure 4. Corresponding data are also presented in tabular form in Appendix A.

5.2.1.6 In Figure 4, mean wind speeds are segregated into four categories (0 – 3.3 m/s, 3.4 – 7.9 m/s, 8.0 – 13.8 m/s and greater than 13.8 m/s) that are indicated by the thickness of the bars for the 16 cardinal wind directions. The length of the bars indicates the average probability of occurrence per year. For example, Figure 4 illustrates that, on an annual basis at a height of 100 m, east winds occur approximately 24.0% of the time and hourly mean wind speeds for east winds are in the range of 3.4 m/s to 7.9 m/s for approximately 14.6% of the time.

5.2.1.7 It is obvious from Figure 4 that, on an annual basis, the prevailing winds approach the proposed development site from the north, east-north-east and east (0°, 67.5° and 90°) with a total percentage occurrence of more than 50%. In the previously conducted site wind availability study (WWTF Investigation Report WWTF007-2006), significant wind shifts were recorded for winds approaching the proposed development site from 135°, 157.5°, 202.5°, 225° and 337.5°, thereby affecting the average annual probability of occurrence for winds approaching the proposed development site from 112.5°, 135°, 157.5°, 202.5°, 225°, 247.5°, 315° and 337.5°.

5.3 Physical Model of the New Central Waterfront

5.3.1.1 1:400 scale models of the New Central Waterfront Design Schemes A, B and C were tested in WWTF's low speed test section, as shown for various illustrative views in Figures 18 to 20. The models of the tested design schemes were fabricated to include all known existing and proposed buildings, structures and topographical features within a radius of approximately 880 m from the centre of the proposed development site at the New Central Waterfront. The modelled Assessment Area covered an area of 48.2 ha and was bounded by Victoria Harbour to the north, the Central Government Complex to the east, Connaught Road Central, including Statue Garden, to the south, and International Finance Centre (IFC) to the west.

5.3.1.2 The Project Site is bounded by Victoria Harbour to the north while the areas to the south and west of the Project Site are bounded by the Central and Admiralty business districts, including the People's Liberation Army Hong Kong Garrison Headquarters, City Hall, Connaught Centre, Exchange Square and the International Finance Center complex. The adjacent Central and Admiralty business districts comprise a mixture of parks (including Hong Kong Park, Chater Garden and Statue Square), roads and overpasses, and high-rise buildings. The effects of the mountainous terrain to the south of the Project Site, such as the 552 m Victoria Peak, were measured in the previously undertaken site wind availability study (WWTF Investigation Report WWTF007-2006) and hence those topographical features were not included in the 1:400 scale models for the detailed AVA.

5.3.2 Proposed building layout within the Project Site – Design Scheme A

5.3.2.1 The layout of proposed buildings within the Project Site for Design Scheme A is shown in Figures 6 and 7. Proposed buildings for Sites 1 and 2 comprise three piers earmarked for retail (18 mPD), a hotel building (77 mPD), an office and retail complex (139 mPD) with a public transport interchange (PTI), and an elevated covered walkway linking Central to the ferry terminals.

5.3.2.2 Proposed buildings for Site 3 comprise a cluster of five office and retail buildings (44 mPD to 50 mPD) linked by covered walkways and landscaped podia, and a retail building (16 mPD) at the south end of the Site on Connaught Road Central.

5.3.2.3 Proposed buildings for Site 4 comprise a cluster of seven buildings (10 mPD to 20 mPD) designated for commercial and leisure use.

5.3.3 Proposed building layout within the Project Site – Design Scheme B

5.3.3.1 The layout of proposed buildings within the Project Site for Design Scheme B is shown in Figures 8 and 9. Proposed buildings for Sites 1 and 2 comprise three piers earmarked for retail (18 mPD), an office building (81 mPD), an office and retail complex (140 mPD) with a public transport interchange (PTI), and an elevated covered walkway linking Central to the ferry terminals.

5.3.3.2 Proposed buildings for Site 3 comprise a cluster of four office and retail buildings (43 mPD to 50 mPD) linked by covered walkway and landscaped podium, and gallery building (10 mPD) close to the centre of the Site.

5.3.3.3 Proposed buildings for Site 4 comprise a cluster of four buildings (15 mPD to 20 mPD) designated for commercial and leisure use.

5.3.4 Proposed building layout within the Project Site – Design Scheme C

5.3.4.1 The layout of proposed buildings within the Project Site for Design Scheme C is shown in Figures 10 and 11. The height, plan-form and layout of the proposed buildings in Sites 1 and 2 of Design Scheme C are significantly different to those of Design Schemes A and B

5.3.4.2 Proposed buildings for Sites 1 and 2 of Design Scheme C comprise three piers, a 60 mPD building with an irregular plan-form that is located to the north of the Two IFC tower, and two shorter buildings with heights of approximately 25 mPD. The 60 mPD building replaces the proposed 30 storey office building in Sites 1 and 2 of Design Schemes A and B. An extensive landscaped deck at +14mPD, a total area of approximately 27,300 m^2 (16,000 m^2 excluding voids and buildings) in Sites 1 and 2, has been proposed for the Project Site of Design Scheme C, linking the ferry piers, Sites 1 and 2, and Site 3.

5.3.4.3 Proposed buildings for Site 3 of Design Scheme C comprise five buildings with heights ranging from 30 mPD to 50 mPD, those are similar in number, height, layout and plan-form as those proposed for Design Scheme A. For Design Scheme C, minimum separations of approximately 20 m are reserved between the buildings in Site 3. The 14 mPD landscaped deck in Site 3 connects the five proposed buildings in Site 3 south with Connaught Place and northwest to Sites 1 and 2. It has a total area of approximately 29,000 m^2 (15,800 m^2 excluding voids and buildings) in Site 3, which is larger than the landscaped deck of Design Scheme A at Site 3 (approximately 20,000 m^2) but smaller than the landscaped deck of Design Scheme B at Site 3 (approximately 34,900 m^2).

5.3.4.4 Site 4 comprises of a row of three low-rise buildings in courtyard design with consistent heights of 20 mPD. The proposed buildings in Site 4 of Design Scheme C have similar heights to those previously tested for both Design Schemes A and B.

6. EXPERIMENTAL AND ANALYSIS PROCEDURE FOR DETAILED AIR VENTILATION ASSESSMENT

6.1 Wind Tunnel Testing

6.1.1.1 Detailed wind tunnel tests were conducted in WWTF's low speed test section using 1:400 scale models of the proposed Design Schemes A, B and C for the New Central Waterfront.

6.1.1.2 For Design Scheme A, wind speeds were measured at a total of 142 test points, as shown in Figure 21, for 16 wind directions ranging from 22.5º to 360º (i.e. north) at increments of 22.5º using a multi-channel thermal anemometer. Of the 142 test points, 15 were located in Sites 1 and 2, one of which was a special test point located on the elevated covered walkway (C113); 46 test points were located in Site 3, seven of which were special test points located on the podia of the site and covered elevated walkway (A05 to A08, A10, C076 and C077); 17 test points were located in Site 4; 7 test points were located at the East Harbourfront; 10 test points were located at the North Harbourfront, two of which were special test points, with one located above a pier (C096) and one on the elevated covered walkway (C120); 6 test points were located at the West Harbourfront, two of which were special test points located above piers (C002 and C126); 16 test points were located in the High-rise Development Area, with special test points located under a bridge (C083) and on the podium of Two IFC (C006); 19 test points were located in the Existing Development Area; 6 test points were located in the Open Area. Measurements were taken at a height of approximately 2 m above ground level at prototype scale, i.e. 5 mm at model scale. For test points located on podia, piers and elevated covered walkway, measurements were taken at a height of 2 m above the local surface at prototype scale.

6.1.1.3 For Design Scheme B, wind speeds were measured at a total of 144 test points, as shown in Figure 22, for 16 wind directions ranging from 22.5º to 360º (i.e. north) at increments of 22.5º using a multi-channel thermal anemometer. Of the 144 test points, 15 were located in Sites 1 and 2, one of which was a special test point located on the elevated covered walkway (C113); 48 test points were located in Site 3, nine of which were special test points located on the podia of the site and covered elevated walkway (B05, B08 to B11, B13, B14, C076 and C077); 17 test points were located in Site 4; 7 test points were located at the East Harbourfront, one of which was a special test point (C039) located at the top of a small hill; 10 test points were located at the North Harbourfront, two of which were special test points, with one located above a pier (C096) and one on the elevated covered walkway (C120); 6 test points were located at the West Harbourfront, two of which were special test points located above piers (C002 and C126); 16 test points were located in the High-rise Development Area, with special test points located under a bridge (C083) and on the podium of Two IFC (C006); 19 test points were located in the Existing Development Area; 6 test points were located in the Open Area. Measurements were taken at a height of approximately 2 m above ground level at prototype scale, i.e. 5 mm at model scale. For test points located on podia, piers and elevated covered walkway, measurements were taken at a height of 2 m above the local surface at prototype scale.

6.1.1.4 For Design Scheme C, wind speeds were measured at a total of 101 test points, as shown in Figure 23, for 16 wind directions ranging from 22.5º to 360º (i.e. north) at increments of 22.5º using a multi-channel thermal anemometer system. Of the 101 test points, 14 were located in Sites 1 and 2, three of which were special test points

located on the landscaped deck (C122, C123 and S01); 30 test points were located in Site 3, four of which were special test points located on the landscaped deck (A04, A07, A09 and C105) and one of which was a special test point located in the covered public transport interchange underneath the 30 mPD building (S03); 14 test points were located in Site 4; 7 test points were located at the East Harbourfront; 9 test points were located at the North Harbourfront, one of which was special test point located above a pier (C096); 3 test points were located at the West Harbourfront, one of which was a special test point located above a pier (C126); 13 test points were located in the High-rise Development Area, with special test points located under a bridge (C083) and on the landscaped deck connecting Two IFC and Sites 1 and 2 (S02); 7 test points were located in the Existing Development Area; 4 test points were located in the Open Area. Measurements were taken at a height of approximately 2 m above ground level at prototype scale, i.e. 5 mm at model scale. For test points located on the landscaped deck, piers and elevated covered walkways, measurements were taken at a height of 2 m above the local surface.

6.1.1.5 For Design Schemes A and B, the test points located at pedestrian level were evenly distributed and positioned inside the Assessment Area and Project Site. The test points were located at the junctions of roads, in open spaces, on the streets and in public places that are likely to be frequented by pedestrians. For Design Scheme C, the test point locations were mainly selected based on those for Design Scheme A, as the characteristics of the proposed buildings of Design Scheme C are similar to those of Design Scheme A.

6.2 Wind Speed Measurement and Analysis Procedures

6.2.1 Determining Directional and Overall Wind Velocity Ratios

6.2.1.1 Wind speeds at each test point were measured using a multi-channel thermal anemometer whose signals were sampled using a dedicated computer for a period corresponding to approximately one hour at prototype scale. The measurements were used to determine the average wind speed at each test point and subsequently related to approaching upper level winds as a directional wind velocity ratio ($VR_{500,i,j}$).

6.2.1.2 Directional wind velocity ratios are defined as the ratio V_p / V_∞, where V_p is the wind velocity at the pedestrian level (i.e. measured at 2 m above ground at each test point in the 1:400 scale models) and V_∞ is the wind velocity at the top of the atmospheric boundary layer (taken as the wind velocity at 500 mPD in this study, and denoted as $V_{500,i}$ in the following sections). Directional wind velocity ratios are used as an indicator of the wind characteristics at each of the test points in the Assessment Area and Project Site.

6.2.1.3 Directional wind velocity ratios were measured at 22.5º intervals for the full 360º azimuth (i.e. 16 wind directions) for each test point. At a particular wind direction (i), the wind velocity ratio of the j-th test point is expressed in Equation (3).

$$VR_{500,i,j} = \frac{V_{p,i,j}}{V_{500,i}} \qquad (3)$$

6.2.1.4 The overall wind velocity ratio of the j-th test point ($VR_{w,j}$) is defined in Equation (4), which accounts for the probability of occurrence (pi) of winds approaching the proposed development site at the New Central Waterfront from each of the 16

measured wind directions. The annual probabilities of occurrence (pi) of the approach winds to the site are expressed as percentages in Table 3 and in Figure 4.

$$VR_{w,j} = \sum_{i=1}^{16} p_i \times VR_{500,i,j} \qquad (4)$$

6.2.2 Definition of Spatial Average Wind Velocity Ratio (SAVR)

6.2.2.1 Spatial average wind velocity ratios (SAVR), defined in Equation (5) as the average of the VRw,j of the test points at pedestrian level, excluding all of the indicated special test points, in the corresponding Sites or functional areas. The SAVR were determined for each of the Sites and functional areas and indicate the pedestrian level wind conditions within each of those Sites and functional areas.

$$SAVR = \sum_{j=1}^{M} \frac{VR_{w,j}}{M} \qquad (5)$$

where:

6.2.2.2 M is the total number of test points at pedestrian level. In Sites 1 and 2 of Design Schemes A and B were installed with 14 test points and Design Scheme C was installed with 11 test points. For Site 3, Design Schemes A and B had 39 test points and Design Scheme C had 25 test points. For Site 4, Design Schemes A and B had 17 test points and Design Scheme C had 14 test points. For the East Harbourfront, Design Schemes A and C had 7 test points and Design Scheme B had 6 test points. For the North Harbourfront, Design Schemes A, B and C each had 8 test points. For the West Harbourfront, Design Schemes A and B were installed with 4 test points and Design Scheme C was installed with 2 test points. 14 test points were installed in the High-rise Development Area of Design Schemes A and B, with 11 test points installed for Design Scheme C. For the Existing Development Area, Design Schemes A and B had 19 test points and Design Scheme C had 7 test points. For the Open Area, Design Schemes A and B had 6 test points and Design Scheme C had 4 test points.

6.2.2.3 For the purposes of comparison, SAVR of the Sites and functional areas for Design Schemes A and B were calculated using the same test points that were used for Design Scheme C.

7. DETAILED AIR VENTILATION ASSESSMENT RESULTS AND DISCUSSION

7.1 Topography Effects on Overall Wind Velocity Ratios

7.1.1.1 The air ventilation characteristics of a particular site are heavily influenced by the effects of the surrounding topography on the ability of wind to penetrate into the site and adjacent areas, hence playing an important role in governing the magnitudes of the overall wind velocity ratios at the test points. The topography to the south of the New Central Waterfront is dominated by the mountainous terrain that spans Hong Kong Island, including the 552 m tall Victoria Peak. The previously undertaken site wind availability study (WWTF Investigation Report WWTF007-2006) demonstrated that winds approaching the New Central Waterfront from the south-east and south-west quadrants were generally slowed down, thereby inhibiting wind penetration to the site from those directions. Those characteristics are reflected in the magnitudes of $VR_{500,i,j}$ measured at the majority of the test points, where winds approaching the proposed development site from the south-east and south-west quadrants have smaller $VR_{500,i,j}$ than those for winds approaching the site from the north-east and north-west quadrants.

7.2 Effects of Annual Directional Probabilities of Occurrence on Overall Wind Velocity Ratios

7.2.1.1 Annual directional probabilities of occurrence of winds for the proposed development site are also an important factor affecting the overall wind velocity ratios at the test points. One of the main aims of good air ventilation design is to capture and/or convey the available and reliable wind resources, which are indicated by high probabilities of occurrence, to pedestrian level.

7.2.1.2 As shown in Figure 4, the annual wind rose for the proposed development site at the New Central Waterfront, corrected to a height of 100 m, indicates that prevailing non-typhoon winds approach the site from the north, east-north-east and east (0°, 67.5° and 90°), with a total percentage occurrence of more than 50% on an annual basis. Therefore, those test points with higher $VR_{500,i,j}$ for winds approaching the proposed development site from the north, east-north-east and east also tend to have higher overall wind velocity ratios.

7.3 Annual Spatial Average Wind Velocity Ratios (SAVR) – Design Scheme A

7.3.1.1 SAVR were determined to quantify the general air ventilation conditions within the Assessment Area and the Project Site and they are summarised in Table 4. The SAVR of all the test points, including all of the special test points, in the Assessment Area and Project Site of Design Scheme A at the New Central Waterfront was **0.18**. SAVR for Sites 1 and 2, Site 3, and Site 4 are **0.22**, **0.15** and **0.17**, respectively. The SAVR for the East Harbourfront, North Harbourfront and West Harbourfront functional areas are **0.22**, **0.17** and **0.16**, respectively. The SAVR for the High-rise Development Area, Existing Development Area and Open Area are **0.21**, **0.19** and **0.16**, respectively. The overall wind velocity ratios of all test points for Design Scheme A are shown in Figure 24 and in Table 5. The overall wind velocity ratios and the directional wind velocity ratios, VR500,i,j, for each test point are summarised and classified in Tables B1 to B10 of Appendix B in accordance with the instructed functional areas.

7.4 Air Ventilation Conditions within the Project Site – Design Scheme A

7.4.1 Air Ventilation Conditions within the East Harbourfront – Design Scheme A

7.4.1.1 The SAVR for the East Harbourfront is **0.22**, which is higher than the SAVR of all test points (0.18), including all the special test points.

7.4.1.2 The East Harbourfront area is relatively open with test points C039, C040, C041 and C047 located at positions where effects from adjacent buildings or structures are negligible. The average directional wind velocity ratios of those test points, summarised in Table B11, are representative of the directional wind velocity ratios at pedestrian level at the New Central Waterfront site that are largely unaffected by localised effects caused by buildings. Therefore, for the purposes of comparison in this study, those test points are convenient locations against which other wind velocity ratios within the Assessment Area and Project Site can be benchmarked. The SAVR of these benchmark test points C039, C040, C041 and C047 is **0.24**.

7.4.2 Air Ventilation Conditions within North Harbourfront and West Harbourfront – Design Scheme A

7.4.2.1 The SAVR of the North Harbourfront and West Harbourfront functional areas are **0.17** and **0.16**, respectively. The overall wind velocity ratios for test points within the two areas ranged from 0.14 to 0.19 and 0.14 to 0.20 for North Harbourfront and West Harbourfront, respectively.

7.4.2.2 Although the North Harbourfront and the West Harbourfront areas are located adjacent to Victoria Harbour, the SAVR of the North Harbourfront and West Harbourfront are considerably lower than that of the benchmark test points (0.24). By comparing the directional wind velocity ratios of test points within the North Harbourfront and West Harbourfront areas with the average directional wind velocity ratios of the benchmark test points, it is found that the directional wind velocity ratios, for winds approaching from north-east quadrant, of test points within the North Harbourfront and West Harbourfront are generally reduced by about 40%. The reduction of directional wind velocity ratios for winds approaching from north-east quadrant is likely to be due to the effects of nearby structures, such as the piers to the north-east of the measurement locations.

7.4.3 Air Ventilation Conditions within Sites 1 and 2 – Design Scheme A

7.4.3.1 The SAVR of Sites 1 and 2 is **0.22** and hence within approximately 10% of the SAVR of the benchmark test points. The overall wind velocity ratios for Sites 1 and 2 ranged from 0.17 to 0.37.

7.4.3.2 Sites 1 and 2 are characterised by the presence of tall buildings both within the sites and in the adjacent areas, with the tallest building in the Assessment Area, the 420 m tall Two IFC located to the south of Sites 1 and 2. The SAVR of Sites 1 and 2 is one of the highest within the Assessment Area and Project Site, with 10 out of 14 test points having overall wind velocity ratios greater than 0.20.

7.4.3.3 The largest overall wind velocity ratio was recorded at test point C114 (VRw,j = 0.37), located approximately at the centre of the area covered by Sites 1 and 2. High directional wind velocity ratios were measured at test point C114 for wind directions ranging from 45° to 112.5° inclusive and 292.5° to 337.5° inclusive, and this is attributed to the effects of the two proposed tall buildings adjacent to that location. The next highest overall wind velocity ratio was recorded at C107 ($VR_{w,j}$ = 0.26), located at the southern end of Site 2, which showed a similar trend to the directional wind velocity ratios of test point C114, albeit with smaller magnitudes.

7.4.3.4 The lowest overall wind velocity ratios measured in Sites 1 and 2 were at test points C117 and C123 ($VR_{w,j}$ = 0.17). The directional wind velocity ratios at both of the test points indicated that both locations were somewhat sheltered from winds approaching the area from the north-east quadrant.

7.4.3.5 Comparisons between the directional wind velocity ratios of test points within Sites 1 and 2 and the average directional wind velocity ratios of the benchmark test points indicate a general increase in the directional wind velocity ratios for Sites 1 and 2 for winds approaching the proposed development site from the south-east and south-west quadrants.

7.4.4 Air Ventilation Conditions within Site 3 – Design Scheme A

7.4.4.1 The SAVR for the test points within Site 3 is **0.15**. The overall wind velocity ratios of those test points ranged from 0.08 to 0.21.

7.4.4.2 Site 3 includes five medium-rise (i.e. approximately 50 m high) buildings located on two common podia that are linked by an elevated pedestrian bridge. Air is able to flow between the buildings and roads provide additional potential air paths between and around the buildings. The area to the east of the medium-rise buildings is largely comprised of open space that extends north to the piers in the North Harbourfront and east to Site 4. A number of tall buildings are located close to the western and southern boundaries of Site 3, whereas the eastern aspect comprises the low-rise buildings in Site 4 and East Harbourfront.

7.4.4.3 The test points in Site 3 were divided into two groups for convenience in their assessment, namely: test points that located in the open space and other test points that are generally located in closer proximity to the medium-rise buildings. The SAVR for the test points in open space is 0.16 and the SAVR for the remaining test points is 0.15.

7.4.4.4 The directional wind velocity ratios for Site 3 are summarised in Tables B16 and B17 for the open space and other test points respectively. The directional wind velocity ratios of the test points in open space generally exhibit similar directional characteristics and magnitudes to those for the test points to the south of the low rise buildings in Site 4. In particular, for winds approaching the site from the east-north-east and east, the directional wind velocity ratios are typically within ±10% of the corresponding values for the test points to the south of the low rise buildings in Site 4. Therefore, it is apparent that the air ventilation conditions in the open space of Site 3 are similar to those in the area to the south of the low-rise buildings in Site 4, largely due to the effects of those buildings on winds from the north-east quadrant.

7.4.4.5 The lowest overall wind velocity ratio in Site 3 was recorded at C066 ($VR_{w,j}$ = 0.08), located at the covered walkway to the west of City Hall. The largest overall wind velocity ratios measured in Site 3 occurred close to its western boundary and north of the medium-rise buildings. Directional velocity ratios at those test points (C087, C088 and C089) demonstrated that winds from the north-west and north-east quadrants were able to penetrate beyond Sites 1 and 2.

7.4.4.6 From the directional wind velocity ratios of the test points summarised in Table B2, it is evident that for most wind directions, and particularly for east-north-east and east directions, the directional wind velocity ratios in Site 3 are significantly less than those of the benchmark test points in the East Harbourfront.

7.4.5 Air Ventilation Conditions within Site 4 – Design Scheme A

7.4.5.1 The SAVR for the test points within Site 4 is **0.17**. The overall wind velocity ratios of those test points ranged from 0.12 to 0.23.

7.4.5.2 A line of low-rise buildings is located within Site 4 along its northern boundary and aligned approximately east-west, adjacent to the East Harbourfront. Test points located to the north and to the south of the low-rise buildings clearly demonstrate the local effects that they have on air ventilation conditions at test points that are in close proximity to the low-rise buildings. The SAVR for test points to the north of the low-rise buildings (C038, C042, C046, C050, C058 and C061) is approximately 0.20, whereas the corresponding value for the test points to the south of the low-rise buildings (A01, A02, C043, C044, C045, C049, C051, C055 to C057 and C062) is approximately 0.16. Directional wind velocity ratios for the test points to the north and to the south of the low-rise buildings are summarised in Tables B14 and B15, respectively.

7.4.5.3 The directional wind velocity ratios of test points located to the south of the low-rise buildings are generally smaller than those of test points located to the north of the low-rise buildings. This is attributed to the sheltering effects of those buildings on the positions immediately to their south or south-west (A01 and C062) for winds approaching from north-east and north-west quadrants. As a large percentage of the prevailing winds approach from the north-east quadrant, this has the effect of reducing the overall wind velocity ratios at those positions.

7.5 Air Ventilation Conditions within the Assessment Area – Design Scheme A

7.5.1.1 The SAVR for the Open Area, High-rise Development Area and Existing Development Area are **0.16**, **0.21** and **0.19**, respectively. The overall wind velocity ratios for test points within the Open Area, High-rise Development Area and Existing Development Area ranged from 0.14 to 0.21, 0.12 to 0.30 and 0.14 to 0.20, respectively. The directional wind velocity ratios are summarised in Tables B7 to B9, respectively.

7.5.1.2 The Open Area essentially comprises four points around the People's Liberation Army Hong Kong Garrison Headquarters. Test points along Lung Wui Road, located south of Site 4, have similar exposures to nearby test points to the south of the low-rise buildings in Site 4, and hence similar overall wind velocity ratios. The exception is test point C130, where wind conditions were evidently strongly influenced by the presence of the adjacent Hutchison and Bank of America buildings, with enhanced directional velocity ratios measured for the north-east quadrant.

7.5.1.3 Enhanced wind speeds were also measured at test points located near Two IFC, Exchange Square, etc., in the High-rise Development Area. High overall wind velocity ratios were recorded at C082 and C110 ($VR_{w,j}$ = 0.29 and 0.30, respectively). The directional wind velocity ratios of those test points, as summarised in Table B8, were increased for winds approaching from east-north-east and east directions relative to the corresponding directional velocity ratios for the benchmark test points.

7.5.1.4 Although test points located at C023, C024 and C025 are close to the relatively open areas of Chater Garden and Statue Square in the Existing Development Area, their overall wind velocity ratios are quite low, having magnitudes of 0.13, 0.12 and 0.12 respectively. A comparison between the benchmark test points in the East Harbourfront and the directional wind velocity ratios presented in Table B8 for the Existing Development Area highlights the significant attenuation of winds approaching from north-east quadrant. Tall buildings, such as AIG Tower, located to the north-east of test points C023, C024 and C025, shield those test points from winds

approaching from the corresponding directions and result in lower overall wind velocity ratios for those test points.

7.5.1.5 The overall wind velocity ratios of test points along Connaught Road Central ranged between 0.18 and 0.28, with a corresponding SAVR of 0.22. The directional wind velocity ratios of those test points are summarised in Table B18. Comparisons between the directional wind velocity ratios and the SAVR of those test points located in the area to the south of the low-rise buildings in Site 4 indicate that test points with overall wind velocity ratios above 0.25 generally have higher directional wind velocity ratios for the north-east quadrant. Winds from those directions were effectively captured by the surrounding structures and conveyed to pedestrian level at the measurement locations.

7.5.1.6 The lowest overall wind velocity ratio in the Existing Development Area was recorded for test point C013 located on Chater Road near its junction with Des Voeux Road Central and Pedder Street. Test point C013 was located near the staircase of a footbridge and Alexandra House, which provided significant shielding to the measurement location from the prevailing wind directions.

7.6 Recommendations for improving wind conditions at relevant locations within the Project Site – Design Scheme A

7.6.1.1 In general, the low-rise buildings in the Project Site allow upper level winds to penetrate into the Assessment Area.

7.6.1.2 At Site 3, wind conditions on the landscaped podium are similar to those in the open spaces within the Project Site. However, relatively low $VR_{w,j}$ were measured at several locations in the vicinity of the buildings and landscaped podium in Site 3: test point A04, located at pedestrian level adjacent to the podium; test point C073, located at pedestrian level on the southern side of the buildings in Site 3; test point A05, located on the podium adjacent to the southern building in Site 3; and test points A08 and C077, located at podium level in gaps between the buildings. Wind conditions at each of these test points are likely to be caused by small gaps between the buildings and the solidity of the podium. Therefore, increasing the gaps between the buildings and increasing the porosity of the podium may improve the relatively weak wind conditions at these test points.

7.6.1.3 Relatively high $VR_{w,j}$ were measured at test point C114, located at pedestrian level in between the proposed buildings high-rise buildings in Sites 1 and 2, which is attributed to the influence of the buildings on local wind conditions. The inclusion of trees in this general area is likely to moderate these effects as pedestrians move through the area.

7.6.1.4 Location of the test points of concern as mentioned above are marked in Photo 1 and Photo 2 below.

Photo 1 Location of test points with relatively low VRw,j

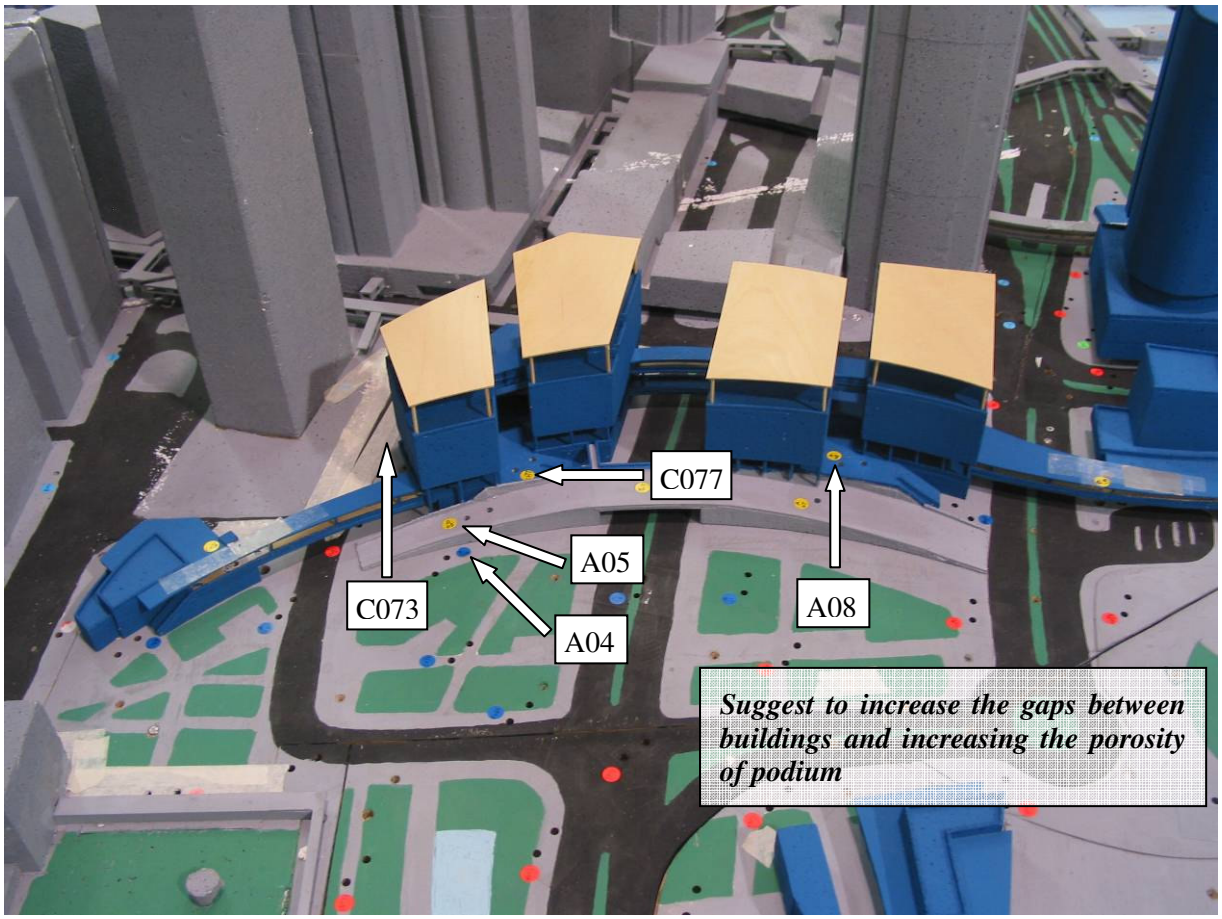
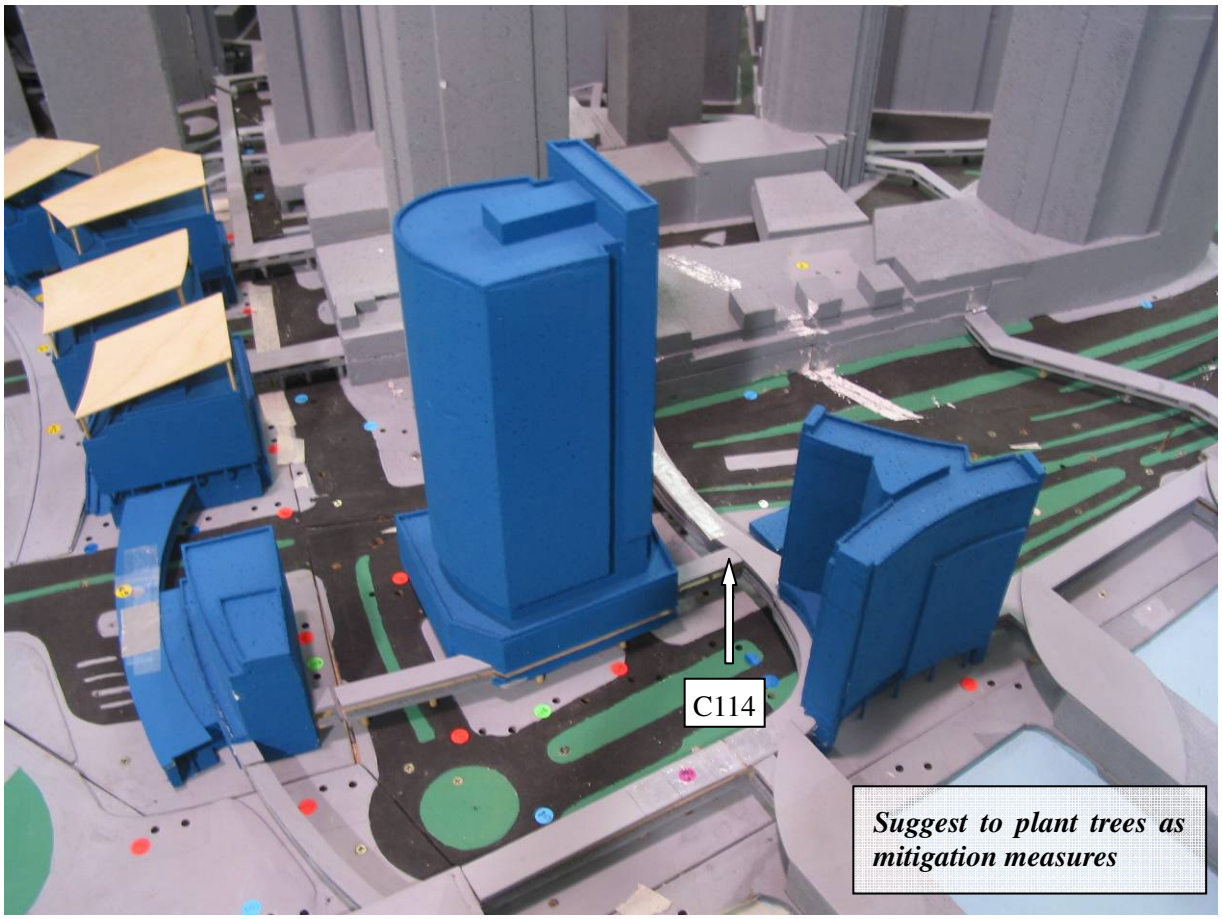


Photo 2 Location of test point with relatively high VRw,j



7.7 Annual Spatial Average Wind Velocity Ratios (SAVR) – Design Scheme B

7.7.1.1 SAVR were determined to quantify the general air ventilation conditions within the Assessment Area and the Project Site and they are summarised in Table 6. The SAVR of all the test points, including all of the special test points, in the Assessment Area and Project Site of Design Scheme B at the New Central Waterfront was **0.18**. SAVR for Sites 1 and 2, Site 3, and Site 4 are **0.24**, **0.15** and **0.17**, respectively. The SAVR for the East Harbourfront, North Harbourfront and West Harbourfront functional areas are **0.19**, **0.17** and **0.16**, respectively. The SAVR for the High-rise Development Area, Existing Development Area and Open Area are **0.22**, **0.19** and **0.16**, respectively. The overall wind velocity ratios of all test points for the current study are shown in Figure 22 and in Table 7. The overall wind velocity ratios and the directional wind velocity ratios, VR500,i,j, for each test point are summarised and classified in Tables C1 to C10 of Appendix C in accordance with the instructed functional areas.

7.8 Air Ventilation Conditions within the Project Site – Design Scheme B

7.8.1 Air Ventilation Conditions within the East Harbourfront – Design Scheme B

7.8.1.1 The SAVR for the East Harbourfront is **0.19**, which is similar to the corresponding SAVR of all test points (0.18), including all the special test points.

7.8.1.2 The East Harbourfront area is relatively open with test points C040 and C047 located at positions where effects from adjacent buildings or structures are negligible. The average directional wind velocity ratios of those test points, summarised in Table C11, are representative of the directional wind velocity ratios at pedestrian level at the New Central Waterfront site that are largely unaffected by localised effects caused by buildings. Therefore, for the purposes of comparison in this study, those test points are convenient locations against which other wind velocity ratios within the Assessment Area and Project Site can be benchmarked. The SAVR of these benchmark test points C040 and C047 is **0.24**.

7.8.1.3 A relatively low overall wind velocity ratio was measured at test point C059 ($VR_{w,j}$ = 0.13) that is located close to a canopy at the western part of the East Harbourfront. The directional wind velocity ratios, summarised in Table C4, indicated that the position was effectively shielded from winds from north-east quadrant. Hence, the $VR_{w,j}$ of test point C059 is less than the average VRw,j of the benchmark test points.

7.8.2 Air Ventilation Conditions within the North Harbourfront and West Harbourfront – Design Scheme B

7.8.2.1 The SAVR of the North Harbourfront and West Harbourfront functional areas are **0.17** and **0.16**, respectively. The overall wind velocity ratios for test points within the two areas ranged from 0.15 to 0.23 and 0.14 to 0.21 for the North Harbourfront and West Harbourfront, respectively.

7.8.2.2 Although the North Harbourfront and the West Harbourfront areas are located adjacent to Victoria Harbour, the SAVR of the North Harbourfront and West Harbourfront are considerably lower than that of the benchmark test points (0.24). By comparing the directional wind velocity ratios of test points within the North Harbourfront and West Harbourfront areas with the average directional wind velocity

ratios of the benchmark test points, it is found that the directional wind velocity ratios, for winds approaching from north-east quadrant, of test points within the North Harbourfront and West Harbourfront are generally reduced by about 40%. The reduction of directional wind velocity ratios for winds approaching from north-east quadrant is likely to be due to the effects of nearby structures, such as the piers to the north-east of the measurement locations.

7.8.3 Air Ventilation Conditions within Sites 1 and 2 – Design Scheme B

7.8.3.1 The SAVR of Sites 1 and 2 is **0.24** and hence is approximately equal to the SAVR of the benchmark test points. The overall wind velocity ratios for Sites 1 and 2 ranged from 0.18 to 0.32.

7.8.3.2 Sites 1 and 2 are characterised by the presence of tall buildings both within the sites and in the adjacent areas, with the tallest building in the Assessment Area, the 420 m tall Two IFC located to the south of Sites 1 and 2. The SAVR of Sites 1 and 2 is the highest within the Assessment Area and Project Site, with 13 out of 14 (about 93%) test points having overall wind velocity ratios greater than 0.20.

7.8.3.3 Comparisons between the directional wind velocity ratios of test points within Sites 1 and 2 and the average directional wind velocity ratios of the benchmark test points indicate a general increase in the directional wind velocity ratios for Sites 1 and 2 for winds approaching the proposed development site from the south-east, south-west and north-west quadrants.

7.8.3.4 The largest overall wind velocity ratio was recorded at test point C114 ($VR_{w,j}$ = 0.32), located approximately at the centre of the area covered by Sites 1 and 2. High directional wind velocity ratios were measured at test point C114 for wind directions ranging from 45° to 112.5° inclusive and 202.5° to 315° inclusive, and this is attributed to the effects of the two adjacent proposed buildings on wind conditions at that location. The next highest overall wind velocity ratio was recorded at C107 ($VR_{w,j}$ = 0.27), located at the southern end of Site 2, for which the directional wind velocity ratios showed a similar trend to those of test point C114, albeit with smaller magnitudes.

7.8.3.5 The lowest overall wind velocity ratio measured in Sites 1 and 2 was at test point C117 ($VR_{w,j}$ = 0.18) which was sheltered from winds from the north-east quadrant.

7.8.4 Air Ventilation Conditions within Site 3 – Design Scheme B

7.8.4.1 The SAVR for the test points within Site 3 is **0.15**. The overall wind velocity ratios of those test points ranged from 0.09 to 0.21, with 28 out of 39 test points (about 70%) ranging from 0.12 to 0.18, i.e. within one standard deviation of the mean value.

7.8.4.2 Site 3 comprises four medium-rise (i.e. approximately 50 m high) buildings linked by covered walkways and a large landscaped podium. To the east of the medium-rise buildings, an area of relatively open space extends north to the piers in the North Harbourfront and east to Site 4. A number of tall buildings are located close to the western and southern boundaries of Site 3, whereas the eastern aspect comprises the low-rise buildings in Site 4.

7.8.4.3 Low overall wind velocity ratios were measured at test points B03 ($VR_{w,j}$ = 0.12), B04 ($VR_{w,j}$ = 0.09), C65 ($VR_{w,j}$ = 0.12), C66 ($VR_{w,j}$ = 0.11) and C072 ($VR_{w,j}$ =0.09). The average of the overall wind velocity ratios of these five test points is approximately equal to 0.11, approximately 30% lower than the SAVR for all test points in Site 3. The test points located within the area at the southern end of the

Site are enclosed by the large landscaped podium of Site 3 and City Hall to the east of the area and are shielded from winds from most of the tested wind directions. The directional wind velocity ratios of those test points, as shown in Table C2, were generally decreased for almost all directions relative to the benchmark test points. In particular, the directional wind velocity ratios for winds from north-east quadrant of those test points were decreased by about 60%, on average, relative to the average of the corresponding directional wind velocity ratios of the benchmark test points.

7.8.4.4 A low overall wind velocity ratio was also measured for test point C078 ($VR_{w,j}$ = 0.10), located on a road underneath the large landscaped podium. Directional wind velocity ratios for winds from the north-east quadrant were reduced by about 60% relative to the corresponding average values of the benchmark test points.

7.8.4.5 Relatively high overall wind velocity ratios were recorded at test points located at C086 ($VR_{w,j}$ = 0.20), C087 ($VR_{w,j}$ = 0.21) and C088 ($VR_{w,j}$ = 0.20). The average overall wind velocity ratio of those test points is approximately equal to 0.21, approximately 40% higher than the SAVR of Site 3. The area in which these test points is located is characterised by the presence of tall buildings located in the High-rise Development Area and Sites 1 and 2. The enhancement of winds approaching from the majority of the tested wind directions for those test points relative to the others within Site 3 were highlighted by the comparisons between the directional wind velocity ratios of those test points and the corresponding average value of the test points within Site 3, excluding all the special test points, as summarised in Table C12.

7.8.5 Air Ventilation Conditions within Site 4 – Design Scheme B

7.8.5.1 The SAVR for the test points within Site 4 is **0.17**. The overall wind velocity ratios of those test points ranged from 0.12 to 0.21, of which 12 out of 17 test points (about 70%) ranged from 0.15 to 0.19.

7.8.5.2 Site 4 is characterised by the presence of a line of low-rise buildings within the site, along its northern boundary and aligned approximately east-west, and a series of small undulating hills located in the north of the Site. Therefore, most of the test points within Site 4 are located close to and under the influence of structures and landscape features with heights up to 20 m. The directional wind velocity ratios of test points within Site 4, summarised in Table C3, were generally less than the average of the benchmark test points for most test directions. In particular, the directional wind velocity ratios for winds from the north-east quadrant, on average, are about 30% smaller than the average of the corresponding directional wind velocity ratios of the benchmark test points. As a large percentage of the prevailing winds approach from the north-east quadrant, the overall wind velocity ratios at those positions are also correspondingly lower.

7.9 Air Ventilation Conditions within the Assessment Area – Design Scheme B

7.9.1.1 The SAVR for the Open Area, High-rise Development Area and Existing Development Area are **0.16**, **0.22** and **0.19**, respectively. The overall wind velocity ratios for test points within the Open Area, High-rise Development Area and Existing Development Area ranged from 0.13 to 0.21, 0.15 to 0.33 and 0.08 to 0.34, respectively. The directional wind velocity ratios are summarised in Tables B25 to B27, respectively.

7.9.1.2 Test points in the Open Area, located south of Site 4, are limited to four locations

around the People's Liberation Army Hong Kong Garrison Headquarters. Three of the four test points have similar exposures to nearby test points to the south of the low-rise buildings in Site 4 and hence they also have similar overall wind velocity ratios. One test point, C130, is located in the vicinity of the Hutchison and Bank of America buildings that evidently have a strong influence on the local wind conditions, with enhanced directional velocity ratios measured for the north-east quadrant.

7.9.1.3 Enhanced wind speeds were also measured at test points located near Two IFC, Exchange Square, etc., in the High-rise Development Area. High overall wind velocity ratios were recorded at C082 and C110 ($VR_{w,j}$ = 0.30 and 0.33, respectively). The directional wind velocity ratios of those test points, as summarised in Table C8, were increased for winds approaching from east-north-east and east directions relative to the corresponding directional velocity ratios for the benchmark test points.

7.9.1.4 The overall wind velocity ratios of test points C023, C024 and C025 are relatively low, with magnitudes of 0.13, 0.12 and 0.12 respectively, in spite of their relatively close proximity to the open areas of Chater Garden and Statue Square in the Existing Development Area. A comparison between the benchmark test points in the East Harbourfront and the directional wind velocity ratios presented in Table C8 for the Existing Development Area highlights the significant attenuation of winds approaching from north-east quadrant. Tall buildings, such as AIG Tower, located to the north-east of test points C023, C024 and C025, shield those test points from winds approaching from the north-east and result in lower overall wind velocity ratios for those test points.

7.9.1.5 The overall wind velocity ratios of test points along Connaught Road Central ranged between 0.15 and 0.27, with a corresponding SAVR of 0.22. The directional wind velocity ratios of those test points are summarised in Table C13. Comparisons between the directional wind velocity ratios and the SAVR of those test points located in the area to the south of the low-rise buildings in Site 4 indicate that test points with overall wind velocity ratios above 0.25 generally have higher directional wind velocity ratios for the north-east quadrant. Winds from those directions were effectively captured by the surrounding structures and conveyed to pedestrian level at the measurement locations.

7.9.1.6 The lowest overall wind velocity ratio in the Existing Development Area was recorded for test point C013 ($VR_{w,j}$ = 0.08) located on Chater Road near its junction with Des Voeux Road Central and Pedder Street. Test point C013 was located near the staircase of a footbridge and Alexandra House, which provided significant shielding to the measurement location from the prevailing wind directions.

7.10 Recommendations for improving wind conditions at relevant locations within the Project Site – Design Scheme B

7.10.1.1 In general, the low-rise buildings in the Project Site allow upper level winds to penetrate into the Assessment Area.

7.10.1.2 At Site 3, relatively low $VR_{w,j}$ were measured at podium level at test points B08, B13 and C077, which are located in close proximity to the office/retail buildings in that site. Relatively low $VR_{w,j}$ were also measured at pedestrian level at test points B07, C054, C063, C092, which are located immediately to the east of the landscaped podium. Similar wind conditions were measured at test points B03, B04, C065, C066 and C072, which are located at pedestrian level in a relatively enclosed area towards the south of the podium. Wind conditions at these test points are mainly attributed to the sheltering effects caused by the nearby buildings

and podium. Therefore, increasing the gaps between the buildings and increasing the porosity of the podium may improve the relatively weak wind conditions at these test points.

7.10.1.3 Relatively high VRw,j were measured at test point C114, located at pedestrian level in between the proposed buildings high-rise buildings in Sites 1 and 2, which is attributed to the influence of the buildings on local wind conditions. The inclusion of trees in this general area is likely to moderate these effects as pedestrians move through the area.

7.10.1.4 Location of test points of concern as mentioned are marked in Photo 3 and 4 below.

Photo 3 Location of test points with relatively low VRw,j

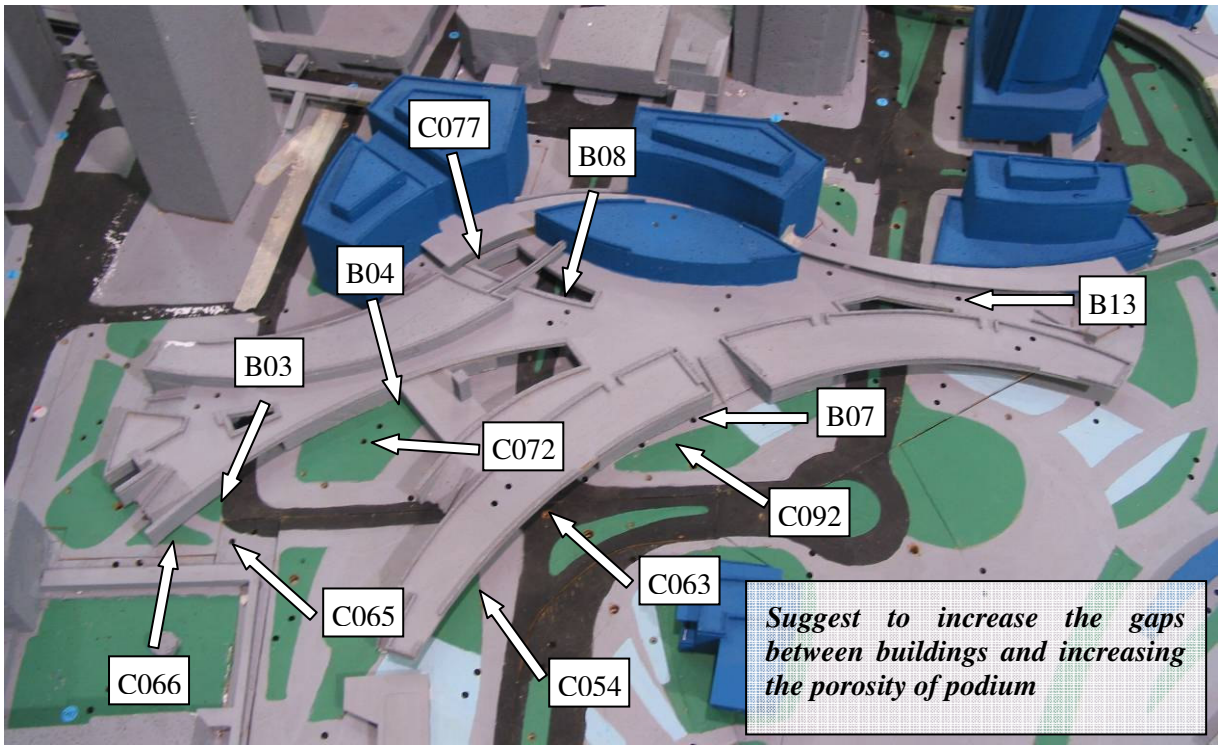
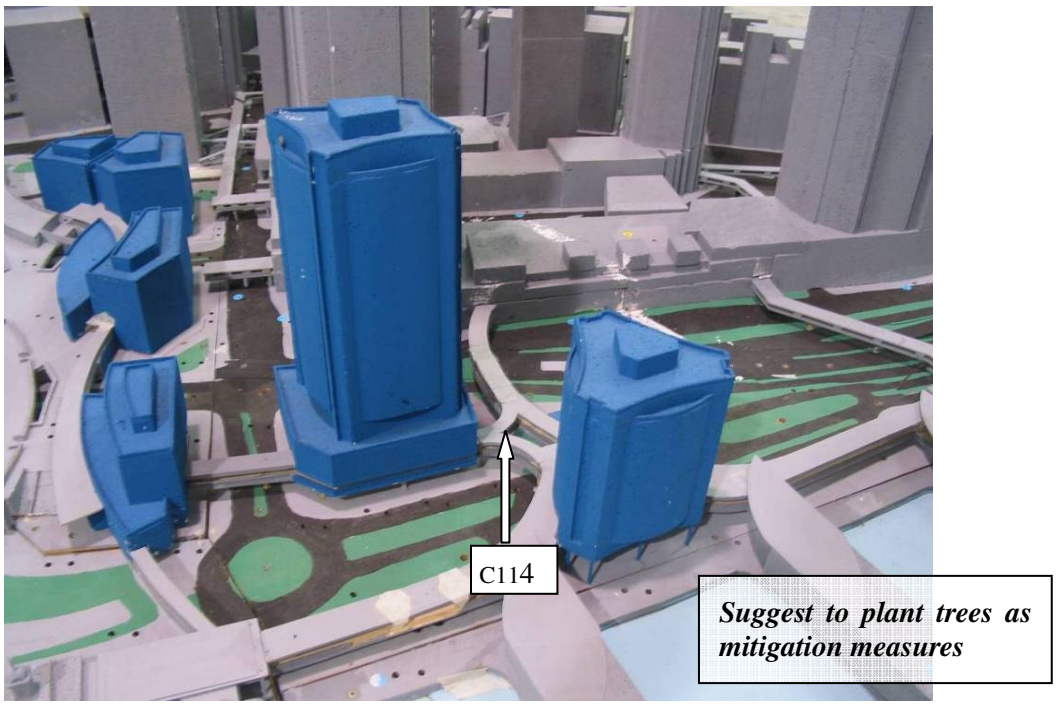


Photo 4 Location of test point with relatively high VRw,j



7.11 Annual Spatial Average Wind Velocity Ratios (SAVR) – Design Scheme C

7.11.1.1 SAVR were determined to quantify the general air ventilation conditions within the Assessment Area and the Project Site for Design Schemes A, B and C and they are summarised in Table 8. The overall wind velocity ratios and the directional wind velocity ratios, $VR_{500,i,j}$, for each test point of Design Schemes A, B and C are included in Tables D1 to D28 of Appendix D and sorted in accordance with the instructed functional areas.

7.11.1.2 For Design Scheme C, the SAVR of all the test points, including all of the special test points, in the Assessment Area and Project Site was **0.17**. SAVRs for Sites 1 and 2, Site 3 and Site 4 are **0.15**, **0.14** and **0.18**, respectively. The SAVR for the East Harbourfront, North Harbourfront and West Harbourfront functional areas are **0.23**, **0.16** and **0.09**, respectively. The SAVR for the Open Area, High-rise Development Area and Existing Development Area are **0.17**, **0.22** and **0.20**, respectively. The overall wind velocity ratios of all test points for Design Scheme C are summarised in Table 9.

7.12 Air Ventilation Conditions within the Project Site – Design Scheme C

7.12.1 Air Ventilation Conditions within the East Harbourfront – Design Scheme C

7.12.1.1 The SAVR for the East Harbourfront of Design Scheme C is **0.23**. The SAVR calculated for the same group of test points for Design Schemes A and B is **0.22** and **0.21**, respectively. The directional wind velocity ratios measured for East Harbourfront of Design Scheme C are summarised in Table D1 and the directional wind velocity ratios measured for the corresponding group of test points for Design Schemes A and B are summarised in Tables D2 and D3.

7.12.1.2 The East Harbourfront of Design Scheme C comprises two rows of low-rise building with heights of 8 mPD and 7.5 mPD respectively to the north of Site 4. Two landscaped slopes with heights of 6.5 mPD and 9 mPD are located on the eastern side of the East Harbourfront and a 6.7 mPD tall landscaped slope is located on the western side of the East Harbourfront. As the buildings and the landscaped slopes have relatively low heights, the East Harbourfront of Design Scheme C is relatively open and unobstructed, thereby facilitating wind penetration into the other areas of the Assessment Area and Project Site.

7.12.1.3 Although the shapes of the proposed buildings in Site 4 were revised in Design Scheme C, the SAVR for the East Harbourfront of Design Scheme C indicated that, in general, pedestrian level wind speeds in the East Harbourfront are not likely to be significantly different to those previously determined for Design Schemes A and B.

7.12.2 Air Ventilation Conditions within North Harbourfront – Design Scheme C

7.12.2.1 The SAVR for the North Harbourfront for Design Scheme C is **0.16** and the corresponding SAVR calculated for the same group of test points for Design Schemes A and B are **0.16** and **0.17**, respectively. The directional wind velocity ratios measured for the North Harbourfront of Design Scheme C and Design Schemes A and B are summarised in Tables D4 to D6 respectively. As test point C120 is a special test point (i.e. a test point located on a covered elevated walkway in Design Scheme A), it has not been included in the calculation of the SAVR for Design Schemes A, B and C.

7.12.2.2 The wind tunnel test results for Design Scheme C exhibited similar directional characteristics as the previously tested Design Schemes A and B, where the highest directional wind velocity ratios for the area were measured for winds from the north-east and north-west quadrants. In general, the overall pedestrian level wind conditions for Design Scheme C were not significantly different to those for Design Schemes A and B in the North Harbourfront.

7.12.2.3 In comparison with the test results for Design Scheme A, the largest variation in the overall wind velocity ratios in the North Harbourfront for Design Scheme C was measured at test point C119 ($VR_{w,j}$ = 0.14), which is located at the north-western end of the North Harbourfront area. The directional wind velocity ratios measured at test point C119 for Design Scheme C indicated that pedestrian level wind speeds were reduced by approximately 30% for south-easterly and approximately 40% for south-westerly directions. This is attributed to the sheltering effects of the nearby 14 mPD landscaped desk for those directions.

7.12.2.4 In comparison with the test results for Design Scheme B, the largest variation in the overall wind velocity ratios in the North Harbourfront for Design Scheme C was measured at test point C098 (VRw,j = 0.18), which is located between Central Piers 8 and 9. This is apparently caused by the 9 mPD building with an elongated plan-form that was present in Design Scheme B, and which significantly accelerated south-easterly winds, but which was removed from Design Scheme C.

7.12.3 Air Ventilation Conditions within West Harbourfront – Design Scheme C

7.12.3.1 The SAVR for the West Harbourfront for Design Scheme C is **0.09** and the corresponding SAVR calculated for the same group of test points for Design Schemes A and B are **0.15**. The directional wind velocity ratios measured for the West Harbourfront are presented in Tables D7 to D9 for Design Scheme C and Design Schemes A and B respectively.

7.12.3.2 The SAVR for the West Harbourfront for Design Scheme C, which is based only on two test points (i.e. C003 and C128), is approximately 40% less than that calculated for the same test points for Design Schemes A and B. The main effects of Design Scheme C were measured at test point C128, which is located to the south of the 14 mPD landscaped deck of Sites 1 and 2 and to the north of the CWB West Ventilation Building. The directional wind velocity ratios measured at test point C128 indicated that wind speeds approaching from all directions were reduced relative to those measured for Design Schemes A and B. Those reductions are caused by the sheltering effects of the 14 mPD landscaped deck of Sites 1 and 2 and the CWB West Ventilation Building.

7.12.3.3 As other areas of the West Harbourfront are in close proximity to the waterfront and have relatively open exposures to winds from the north-east quadrant, the proposed Design Scheme C is not likely to have significant adverse effects on the pedestrian level wind conditions in those areas. Furthermore, Design Scheme C is expected to have a similar effect as Design Schemes A and B on pedestrian level wind conditions in those areas.

7.12.4 Air Ventilation Conditions within Sites 1 and 2 – Design Scheme C

7.12.4.1 The SAVR for Sites 1 and 2 for Design Scheme C is **0.15** and the SAVR for the same group of test points for Design Schemes A and B are **0.22** and **0.24**, respectively. The directional wind velocity ratios measured for Sites 1 and 2 are presented in Tables D10 to D12 for Design Scheme C and Design Schemes A and B respectively.

7.12.4.2 The SAVR for Sites 1 and 2 in Design Scheme C is approximately 30% and 40% less than those for the corresponding group of test points in Design Schemes A and B, respectively. This is predominantly caused by reductions in pedestrian level wind speeds at test points C114, C115, C116, C121, C125 and C127 that are located underneath the 14 mPD landscaped deck and adjacent to a proposed 60 mPD building, which replaced the proposed 30 storey office building in Sites 1 and 2 of Design Schemes A and B, that created regions regions of relatively low wind flow. However, directional wind velocity ratios for test points C117, in Sites 1 and 2, and C118 and C120, in the North Harbourfront, indicate that unobstructed areas underneath the landscaped deck will allow wind flow to pass through.

7.12.4.3 Test points C122, C123 and S01 are located on top of the 14 mPD landscaped deck in Sites 1 and 2 for Design Scheme C. The directional wind velocity ratios at those test points indicate that winds from the north-west and north-east quadrants are able to penetrate to the landscaped deck, which is expected to be of benefit to pedestrians on the public deck areas. Wind speeds at test point S01 were moderated due to the sheltering effects for easterly winds caused by the quadrangular structure located to its east. In contrast, relatively high wind speeds were measured at test point C122 due to the accelerating effects on north-easterly winds caused by the same quadrangular structure.

7.12.5 Air Ventilation Conditions within Site 3 – Design Scheme C

7.12.5.1 The SAVR for Site 3 of Design Scheme C is **0.14** and the SAVR calculated for the corresponding test points for Design Schemes A and B are **0.15** and **0.14**, respectively. The directional wind velocity ratios measured for Site 3 of Design Scheme C are presented in Table D16. The directional wind velocity ratios measured for the corresponding group of test points for Design Schemes A and B are presented in Tables D17 and D18, respectively.

7.12.5.2 The wind tunnel test results for Design Scheme C indicated that easterly winds were generally enhanced at some test points located on Man Yiu Street (i.e. C080 and C086 in Site 3 and C085 in the High-rise Development Area) relative to Design Schemes A and B. This is attributed to the effects of increasing the permeability of Site 3 by introducing a minimum separation of 20 m between buildings in Site 3 of Design Scheme C.

7.12.5.3 The overall wind velocity ratio measured at test point C075, located at the south-western corner of Site 3, was markedly reduced, which is likely to be caused by the sheltering effects of the two 50 mPD buildings located to its east. Reduced overall wind velocity ratios were also measured at test points C079 and C088, which is attributed to the extended landscaped deck of Site 3 of Design Scheme C moderating easterly winds at those locations. Nevertheless, the wider building separations are considered to be an effective means of facilitating the local penetration of the prevailing easterly winds into nearby areas on Man Yiu Street.

7.12.5.4 The wind tunnel test results indicated that test points located on the landscaped deck in Site 3 of Design Scheme C (i.e. A04, A07, A09 and C105) generally experienced higher wind speeds for north-westerly and north-easterly directions, resulting in slightly higher overall wind velocity ratios than other areas in Site 3. This is likely to be beneficial to pedestrians on the landscaped deck.

7.12.5.5 Test points A12, C053, C054, C063, C064, C072, C091, C092, C094, C101 and C103 are located in the open spaces on the northern and eastern sides of Site 3. The wind tunnel test results indicated that overall pedestrian level wind speeds in

the open spaces in Site 3 are similar for Design Scheme C and Design Schemes A and B. Some moderations in pedestrian level wind speed are likely to occur at areas in close proximity to the landscaped deck (i.e. test points C091, C101 and C103). However, the wind tunnel test results indicate that these effects are localised and relatively moderate.

7.12.6 Air Ventilation Conditions within Site 4 – Design Scheme C

7.12.6.1 The SAVR for Site 4 of Design Scheme C is **0.18** and the SAVR calculated for the same group of test points in Site 4 of Design Schemes A and B are both **0.17**. The directional wind velocity ratios measured for Site 4 of Design Scheme C are presented in Table D13 and the corresponding values measured for Design Schemes A and B are presented in Tables D14 and D15.

7.12.6.2 In comparison with Design Schemes A and B, the proposed buildings of Design Scheme C caused significant changes to the directional wind characteristics at test points in Site 4. However, the wind tunnel test results indicated that the overall pedestrian level wind conditions in Site 4 were similar for Design Schemes A and B and Design Scheme C.

7.12.6.3 Test points that are located to the north of the low-rise buildings in Site 4 (C042, C046, C050, C058 and C061) registered relatively higher overall wind velocity ratios, whereas the test points located to the south of the low-rise buildings (A02, C043, C044, C049, C051 and C055) were relatively lower in magnitude. This demonstrates the local effects that the low-rise buildings have on air ventilation conditions at nearby test points. Similar results were also reported in Site 4 for Design Schemes A and B.

7.13 Air Ventilation Conditions within the Assessment Area – Design Scheme C

7.13.1.1 The SAVRs for the Open Area, High-rise Development Area and Existing Development Area of Design Scheme C are **0.17**, **0.22** and **0.20** respectively. The SAVRs calculated for the corresponding test points for Design Scheme A are **0.17**, **0.21** and **0.22** respectively and for the corresponding test points for Design Scheme B the SAVR are **0.17**, **0.23** and **0.21** respectively. Evidently, the overall effects of the three tested design schemes on pedestrian level wind speeds in the Assessment Area are similar. The directional wind velocity ratios measured for the Open Area, High-rise Development Area and Existing Development Area of Design Scheme C are presented in Tables D19 to D21, respectively. The corresponding directional wind velocity ratios are presented in Tables D22 to D24 and Tables D25 to D27 for Design Schemes A and B, respectively.

7.13.1.2 For the Open Area, measurements were taken at four test points, C032, C033, C037 and C130, for Design Scheme C. The overall wind velocity ratios measured at those test points for Design Scheme C have only small differences relative to those measured for Design Schemes A and B. Therefore, the proposed buildings of Design Scheme C are not expected to create significant adverse effects in areas to the east of the Open Area.

7.13.1.3 Overall wind velocity ratios measured at test points C108 and C109, located at the north-eastern corner of the Two IFC tower, in the High-rise Development Area of Design Scheme C were greater than those measured for Design Schemes A and B. The directional wind velocity ratios of test points C085, C086, C108 and C109 indicated that winds from the north-east and south-east quadrants were particularly enhanced for Design Scheme C. The enhancement of north-easterly winds is

likely to be a result of replacing the 16/18 storey building (approximately 80 mPD) and 30 storey office building (approximately 140 mPD) in Sites 1 and 2 for Design Schemes A and B with a shorter 60 mPD building for Design Scheme C. The enhancement of the south-easterly winds is attributed to the widening of building separations in Site 3 to approximately 20 m for Design Scheme C.

7.13.1.4 Reduced pedestrian level wind speeds were measured for north-easterly winds at test point C016 for Design Scheme C. Similar to the reductions measured at the nearby test point C075 in Site 3, this was caused by the sheltering effects of the two 50 mPD buildings located to the north-east of the test points. However, these effects are expected to be localised.

7.13.1.5 For the Existing Development Area, the overall wind velocity ratios are generally higher than those measured at other test point locations in Design Scheme C and they are of similar magnitude to those measured for Design Schemes A and B. Therefore, Design Scheme C is not expected to have adverse effects on pedestrian level wind conditions in the Existing Development Area.

7.14 Recommendations for improving wind conditions at relevant locations within the Project Site – Design Scheme C

7.14.1.1 In general, the low-rise buildings in the Project Site allow upper level winds to penetrate into the Assessment Area.

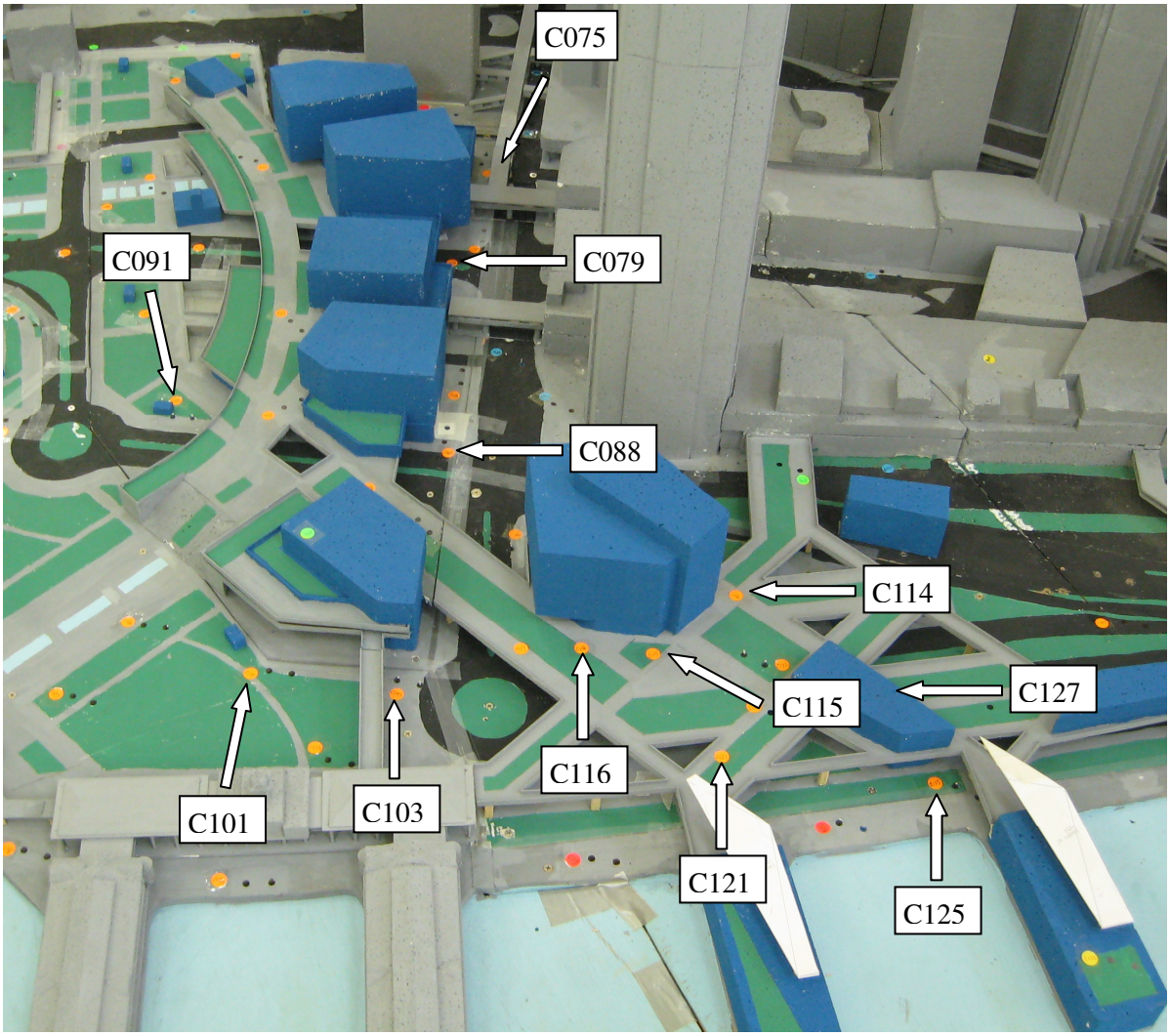
7.14.1.2 Reductions of pedestrian level wind speeds were measured at test points C114, C115, C116, C121, C125 and C127 that are located in Sites 1 and 2. The reduction of wind speeds is attributed to the introduction of the 14 mPD landscaped deck and the proposed 60 mPD building, which replaced the proposed 30 storey office building in Sites 1 and 2 of Design Schemes A and B.

7.14.1.3 In Site 3, pedestrian level wind speeds were also reduced at test point C075 due to the sheltering effects of the two 50 mPD buildings located to its east. The introduction of the 14mPD landscaped deck also reduced pedestrian level wind speeds at test points C079, C088, C091, C101 and C103 in Site 3.

7.14.1.4 Potential improvement measures may be required to enhance pedestrian level wind speeds underneath the 14 mPD landscaped deck at Sites 1, 2 and 3 in Design Scheme C. Good design features and ventilation mitigation measures such as the introduction of mechanical ventilation devices underneath the landscaped deck may need to be considered to alleviate the effects of stagnant wind conditions for locations that are sheltered from the north-easterly winds bringing forth localized areas with low wind flow. The requirements and form of potential improvement measures underneath the landscaped deck may be further investigated in the detailed design stage.

7.14.1.5 Location of test points of concern as mentioned are marked in Photo 5 below.

Photo 5 Location of test points with relatively low VRw,j



8. CONCLUSIONS

8.1 Expert Evaluation

8.1.1.1 Based on an Expert Evaluation of the New Central Waterfront Project Site, the non-typhoon probabilistic wind model derived from long-term wind data collected at Waglan Island and the results of a site wind availability study using a wind tunnel topographical model wind study, the site wind availability for the New Central Waterfront Project Site and Assessment Area is expected to be dominated by northerly and particularly easterly winds, and to a lesser degree by southerly winds. The Project Site: Sites 1 and 2, Site 3 and Site 4 occupies unobstructed harbour frontage, thus allowing wind penetrations through the Project Site and Assessment Area for winds from those prevailing directions.

8.1.1.2 The layout of proposed buildings for Design Scheme A for Sites 1 and 2, Site 3 and Site 4 is a mixture of well separated high-rise, medium-rise and low-rise buildings which facilitate wind penetrations for winds from northerly and easterly directions. While localised stagnation zones will appear in the lee of the proposed buildings, overall, Design Scheme A is not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

8.1.1.3 The layout of proposed buildings for Design Scheme B is similar to Design Scheme A. Hence the overall air ventilation performance for Design Scheme B is also similar to Design Scheme A and is not expected to adversely affect the pedestrian level wind climate within the Project Site and Assessment Area.

8.1.1.4 For Design Scheme B, the proposed large landscaped podium in Site 3 is expected to limit air ventilation at pedestrian level underneath the podium to air flows through the roads and openings on the podium. However, the impact of the podium on air ventilation is expected to be localised. Furthermore, the major pedestrian traffic routes are expected to be through retail arcades and along the large podium and pedestrian overpass where air ventilation is expected to be more satisfactory.

8.1.1.5 Due to the exposed nature of the Project Site, uncomfortable pedestrian level wind conditions may occur in exposed areas of the proposed buildings, landscaped podium, pedestrian overpass and surrounding open areas during periods of strong prevailing northerly and easterly winds.

8.1.1.6 For Design Scheme C, the proposed 16/18 storey hotel/office building and the proposed 30 storey office building in Sites 1 and 2 for Design Schemes A and B were replaced by a shorter building with height of 60 mPD and two shorter buildings with heights of approximately 25mPD, which is expected to prevent the occurrence of high wind speeds that were measured in Sites 1 and 2 of Design Schemes A and B. The spacings between the building blocks in Site 3 were increased from 11 m for Design Scheme A to 20m for Design Scheme C, which is expected to provide localised improvements in air ventilation conditions at some nearby locations for certain wind directions. A landscaped deck has been introduced in Sites 1 and 2, which is likely

to moderate the pedestrian level wind speeds at ground level. The plan dimensions of the proposed landscaped deck for Site 3 of Design Scheme C are larger than those for Design Scheme A and less than those for Design Scheme B. Similar to the landscaped deck of Sites 1 and 2, the landscaped deck in Site 3 is likely to create areas of low wind speed directly underneath it and in other areas at ground level that are in close proximity to it. However, this is not expected to create significant adverse air ventilation effects on pedestrians if the majority of pedestrian traffic is directed to the higher elevation of the landscaped deck.

8.2 Detailed Air Ventilation Assessment of Design Scheme A

8.2.1.1 A 1:400 scale model of the proposed Design Scheme A at the New Central Waterfront was tested in the low speed test section of the CLP Power Wind/Wave Tunnel Facility at The Hong Kong University of Science and Technology. The wind tunnel study was conducted for an air ventilation assessment (AVA) of the pedestrian level wind environment within and around the proposed Design Scheme A at the New Central Waterfront development. The study focussed on Sites 1, 2, 3 and 4 within the Project Site. The Project Site and Assessment Area were further subdivided into a number of instructed functional areas, namely a High-rise Development Area, Existing Development Area, Open Area, North Harbourfront, East Harbourfront and West Harbourfront for this study.

8.2.1.2 Wind speeds were measured at 142 test points, including 14 special test points, for 16 wind directions ranging from 22.5º to 360º (north) at increments of 22.5º using a multi-channel thermal anemometer. Wind tunnel test results were combined with WWTF's statistical model of the Hong Kong non-typhoon wind climate, based on measurements of wind speed and direction taken by Hong Kong Observatory (HKO) at Waglan Island, and the results of a previously undertaken 1:2000 scale topography study (WWTF Investigation Report WWTF007-2006) to determine the site wind availability for the New Central Waterfront. Approximately 70% of the measured annual overall wind velocity ratios were within the range of 0.10 to 0.20.

8.2.1.3 The mountainous terrain that spans Hong Kong Island had a significant effect on the strength of the available winds approaching the New Central Waterfront from the south-east and south-west quadrants. Therefore, the prevailing winds for the proposed development site occurred mainly from the north, east-north-east and east (0°, 67.5° and 90°).

8.2.1.4 Overall wind velocity ratios within Sites 1 and 2 were the highest among the designated sites and instructed functional areas, with 10 out of 14 test points having magnitudes greater than 0.20 and a spatial averaged wind velocity ratio of 0.22. This is attributed to a combination of the presence of tall buildings within the Sites and its proximity to Victoria Harbour.

8.2.1.5 Wind velocity ratios within Site 3 are relatively consistent over its area, with a spatial averaged wind velocity ratio of 0.15, highlighting the effects of a number of medium-rise buildings dispersed throughout the Site. The medium-rise buildings within Site 3 had localised effects on the measured velocity ratios, although test points located to

the north of those buildings, and hence closer to Victoria Harbour, demonstrated winds from the north-west and north-east quadrants were able to penetrate Sites 1 and 2. In the open space of the eastern side of Site 3, overall wind velocity ratios were somewhat lower, apparently due to the effects of the low-rise buildings in Site 4 on winds from the north-east quadrant.

8.2.1.6 Overall wind velocity ratios were significantly different for test points located to the north and to the south of the low-rise buildings aligned approximately east-west in Site 4, where the spatial averaged velocity ratios were 0.20 and 0.16 respectively. These buildings also have an influence on the velocity ratios in the eastern part of Site 3 and in the Open Area around the People's Liberation Army Hong Kong Garrison Headquarters. Likewise, localised effects of the enclosed ferry piers are likely to be responsible for the lower overall velocity ratios measured within the North Harbourfront and West Harbourfront, due to their sheltering effects for north-east winds in particular.

8.2.1.7 It is also apparent that the relatively low height of the buildings in Site 4, the North Harbourfront and the West Harbourfront allows upper level winds from the north-east and north-west quadrants to penetrate further into the built environment of the Existing Development Area. Those winds are then able to be captured by the relatively taller buildings and conveyed to pedestrian level, thus generally enhancing the overall wind velocity ratios. Similarly, in the High-rise Development Area, overall wind velocity ratios were enhanced by the penetration of upper level winds from the north-east quadrant through Site3, Site 4 and the East Harbourfront, and their subsequent interaction with the tall buildings in the High-rise Development Area.

8.3 Detailed Air Ventilation Assessment of Design Scheme B

8.3.1.1 A 1:400 scale model of the proposed Design Scheme B at the New Central Waterfront was tested in the low speed test section of the CLP Power Wind/Wave Tunnel Facility at The Hong Kong University of Science and Technology. The wind tunnel study was conducted for an air ventilation assessment (AVA) of the pedestrian level wind environment within and around the proposed Design Scheme B at the New Central Waterfront development. The study focussed on Sites 1, 2, 3 and 4 from among the eight sites within the Project Site. The Project Site and Assessment Area were further subdivided into a number of instructed functional areas, namely a High-rise Development Area, Existing Development Area, Open Area, North Harbourfront, East Harbourfront and West Harbourfront for this study.

8.3.1.2 Wind speeds were measured at 144 test points, including 17 special test points, for 16 wind directions ranging from 22.5º to 360º (north) at increments of 22.5º using a multi-channel thermal anemometer. Wind tunnel test results were combined with WWTF's statistical model of the Hong Kong non-typhoon wind climate, based on measurements of wind speed and direction taken by Hong Kong Observatory (HKO) at Waglan Island, and the results of a previously undertaken 1:2000 scale topography study (WWTF Investigation Report WWTF007-2006) to determine the site wind availability for the New Central Waterfront. Approximately 70% of the measured

annual overall wind velocity ratios were within the range of 0.10 to 0.20.

8.3.1.3 The mountainous terrain that spans Hong Kong Island had a significant effect on the strength of the available winds approaching the New Central Waterfront from the south-east and south-west quadrants. Therefore, the prevailing winds for the proposed development site occurred mainly from the north, east-north-east and east (0°, 67.5° and 90°).

8.3.1.4 Overall wind velocity ratios within Sites 1 and 2 were the highest among the designated sites and instructed functional areas, with 13 out of 14 test points having magnitudes greater than 0.20 and a spatial averaged wind velocity ratio of 0.24. This is attributed to a combination of the presence of tall buildings within the Sites and its proximity to Victoria Harbour.

8.3.1.5 Wind velocity ratios within Site 3 were relatively consistent over its area, with approximately 70% of the overall wind velocity ratios within one standard deviation of the mean value (0.15), highlighting the effects of a number of medium-rise buildings dispersed throughout the Site. Air ventilation conditions at the southern end of Site 3, which is significantly shielded by the large landscaped podium of Site 3 and adjacent structures, were evidenced by the relatively low wind velocity ratios in the area. Relatively high overall wind velocity ratios were measured at positions near tall buildings within the Site and adjacent areas, highlighting the potential for tall buildings to locally enhance velocity ratios.

8.3.1.6 Overall wind velocity ratios were relatively consistent for test points over Site 4, where the spatial averaged velocity ratio was 0.17, highlighting the influence of low-rise buildings and landscape features with heights up to 20 m. These buildings also have an influence on the velocity ratios in the eastern part of Site 3 and in the Open Area around the People's Liberation Army Hong Kong Garrison Headquarters. Likewise, localised effects of the enclosed ferry piers are likely to be responsible for the lower overall velocity ratios measured within the North Harbourfront and West Harbourfront, due to their sheltering effects for north-east winds in particular.

8.3.1.7 It is also apparent that the relatively low height of the buildings in Site 4, the North Harbourfront and the West Harbourfront allows upper level winds from the north-east and north-west quadrants to penetrate further into the built environment of the Existing Development Area. Those winds are then able to be captured by the relatively taller buildings and conveyed to pedestrian level, thus generally enhancing the overall wind velocity ratios. Similarly, in the High-rise Development Area, overall wind velocity ratios were enhanced by the penetration of upper level winds from the north-east quadrant through Site3, Site 4 and the East Harbourfront, and their subsequent interaction with the tall buildings in the High-rise Development Area.

8.4 Detailed Air Ventilation Assessment of Design Scheme C

8.4.1.1 A 1:400 scale model of the proposed Design Scheme C at the New Central Waterfront was tested in the low speed test section of the CLP Power Wind/Wave Tunnel Facility at The Hong Kong University of Science and Technology. The wind tunnel study

was conducted for an air ventilation assessment (AVA) of the pedestrian level wind environment within and around the proposed Design Scheme C at the New Central Waterfront development. The study focussed on Sites 1, 2, 3 and 4 within the Project Site. The same instructed functional areas, namely a High-rise Development Area, Existing Development Area, Open Area, North Harbourfront, East Harbourfront and West Harbourfront, were used to allow a direct comparison between pedestrian level wind conditions for Design Scheme C and Design Scheme A.

8.4.1.2 Wind speeds were measured at 101 test points, including 12 special test points, for 16 wind directions ranging from 22.5º to 360º (north) at increments of 22.5º using a multi-channel thermal anemometer. Wind tunnel test results were combined with WWTF's statistical model of the Hong Kong non-typhoon wind climate, based on measurements of wind speed and direction taken by Hong Kong Observatory (HKO) at Waglan Island, and the results of a previously undertaken 1:2000 scale topography study (WWTF Investigation Report WWTF007-2006) to determine the site wind availability for the New Central Waterfront. The wind tunnel test results measured at the test points used in the study of Design Scheme C were compared with results at the corresponding test points for Design Schemes A and B.

8.4.1.3 Pedestrian level wind speeds in Sites 1 and 2 were lower for Design Scheme C than those for Design Schemes A and B due to the introduction of a 14 mPD landscaped deck linking the ferry piers, Sites 1 and 2, and Site 3. Relatively low pedestrian level wind speeds are expected underneath the landscaped, particularly at locations adjacent to the proposed buildings in Sites 1 and 2. Other locations that are relatively unobstructed will benefit from wind flowing underneath the landscaped deck. Public areas on top of the landscaped deck will be relatively exposed to winds from the north-west and north-east quadrants.

8.4.1.4 The increased permeability of the buildings in Site 3, achieved by reserving buildings separations of approximately 20 m for Design Scheme C, allowed general enhancements of pedestrian level wind speed in adjacent areas on Man Yiu Street for easterly winds. Some moderation of pedestrian level wind speed are likely to occur at areas in close proximity to the landscape deck. However, the wind tunnel test results indicate that these effects are localised. Overall pedestrian level wind speeds in the open spaces in Site 3 are similar for Design Scheme C and Design Schemes A and B.

8.4.1.5 Test points that are located to the north of the low-rise buildings in Site 4 experienced relatively higher overall wind velocity ratios than the test points located to the south of the low-rise buildings. These effects are similar to those previously measured for Design Schemes A and B.

8.4.1.6 Overall pedestrian level wind conditions in the East Harbourfront, North Harbourfront, Open Area, High-rise Development Area and Existing Development Area were similar to those previously measured for Design Schemes A and B. Measurements taken at a limited number of locations in the West Harbourfront indicated that the landscaped deck will reduce pedestrian level wind speeds in areas

directly underneath it. However, other areas in the West Harbourfront that are in close proximity to the harbourfront and which have relatively open exposures to winds from the north-east quadrant are expected to have a similar air ventilation performance to Design Schemes A and B.

8.4.1.7 In summary, the wind tunnel test results indicated that the pedestrian level wind speeds for Design Scheme C are comparable to Design Schemes A and B. The proposed buildings and structures of Design Scheme C are unlikely to have adverse impacts on pedestrian level wind speeds in the Assessment Area.

8.4.1.8 However, the configuration of the 14 mPD landscaped deck at Site 1, 2 and 3 in Design Scheme C moderated pedestrian level wind speeds at areas underneath and in close proximity to the landscaped deck. In contrast, pedestrians on the top of landscaped deck will benefit from relatively unobstructed wind flow.

8.4.1.9 Potential improvement measures may be required to enhance pedestrian level wind speeds underneath the 14mPD landscaped deck at Sites 1, 2 and 3 in Design Scheme C. Those measures include, but may not be limited to, introducing mechanical ventilation devices underneath the landscaped deck. The requirements and form of potential improvement measures underneath the landscaped deck may be further investigated in the detailed design stage.

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Table 1: Directional approach wind conditions

Wind Direction (°)	Approach Condition	Wind Direction (°)	Approach Condition
22.5	B	202.5	A
45	B	225	B
67.5	C	247.5	A
90	B	270	A
112.5	B	292.5	C
135	A	315	C
157.5	A	337.5	C
180	A	0, 360	B

Table 2: Wind speed scaling factors for the new Central Waterfront

Wind Direction	Wind Angle (o)	Scaling Factor*
north	0 or 360	0.60
north-north-east	22.5	0.57
north-east	45	0.61
east-north-east	67.5	0.79
east	90	0.67
east-south-east	112.5	0.52
south-east	135	0.55
south-south-east	157.5	0.65
south	180	0.40
south-south-west	202.5	0.62
south-west	225	0.37
west-south-west	247.5	0.65
west	270	0.46
west-north-west	292.5	0.69
north-west	315	0.89
north-north-west	337.5	0.82

**The wind speed scaling factors (F) are site specific, including the effects of local topography, and were determined from Equation (2).*

Table 3: Annual probabilities of occurrence for directional winds for the New Central Waterfront

Wind Direction	Wind Angle (º)	Average Angle of Wind Shift (º)	Probability of Occurrence (%), annual
north	0 or 360	3.3	12.3%
north-north-east	22.5	5.6	8.2%
north-east	45	2.6	8.3%
east-north-east	67.5	-3.0	14.7%
east	90	-0.5	24.0%
east-south-east	112.5	10.0	8.3%
south-east	135	11.3	3.1%
south-south-east	157.5	14.6	0.0%
south	180	5.5	4.3%
south-south-west	202.5	-13.3	0.0%
south-west	225	-23.0	3.0%
west-south-west	247.5	1.9	8.0%
west	270	-5.4	2.5%
west-north-west	292.5	3.2	0.9%
north-west	315	7.3	2.3%
north-north-west	337.5	11.4	0.0%

Table 4: SAVRs for the Assessment Area and the Project Site – Design A

Project Sites and Functional Areas	SAVR for Design Scheme A
All test points	0.18
Sites 1 and 2	0.22
Site 3	0.15
Site 4	0.17
East Harbourfront	0.22
North Harbourfront	0.17
West Harbourfront	0.16
High-rise Development	0.21
Existing Development	0.19
Open Area	0.16

Table 5: Overall wind velocity ratios ($VR_{w,j}$) for all test points – Design Scheme A

Test Point	VRw,j	Test Point	VRw,j
A01	0.12	C038	0.20
A02	0.17	C039	0.22
A03	0.15	C040	0.26
A04	0.14	C041	0.23
A05	0.13	C042	0.18
A06	0.18	C043	0.19
A07	0.14	C044	0.16
A08	0.11	C045	0.17
A09	0.15	C046	0.20
A10	0.13	C047	0.23
A11	0.15	C048	0.20
A12	0.13	C049	0.15
C001	0.20	C050	0.18
C002	0.25	C051	0.15
C003	0.14	C052	0.16
C004	0.21	C053	0.14
C005	0.15	C054	0.17
C006	0.17	C055	0.16
C007	0.12	C056	0.17
C008	0.17	C057	0.15
C009	0.21	C058	0.20
C010	0.25	C059	0.17
C011	0.18	C060	0.20
C012	0.22	C061	0.23
C013	0.08	C062	0.12
C014	0.28	C063	0.16
C015	0.22	C064	0.16
C016	0.19	C065	0.13
C017	0.21	C066	0.08
C018	0.21	C067	0.14
C019	0.23	C068	0.13
C020	0.22	C069	0.14
C021	0.23	C070	0.14
C022	0.20	C071	0.21
C023	0.13	C072	0.15
C024	0.12	C073	0.10
C025	0.12	C074	0.16
C026	0.27	C075	0.17
C027	0.10	C076	0.16
C028	0.15	C077	0.12
C029	0.25	C078	0.16
C030	0.34	C079	0.16
C031	0.12	C080	0.10
C032	0.17	C081	0.17
C033	0.14	C082	0.30
C034	0.16	C083	0.23
C035	0.15	C084	0.17
C036	0.17	C085	0.23
C037	0.16	C086	0.15

Table 5 (cont.): Overall wind velocity ratios (VRw,j) for all test points – Design Scheme A

Test Point	VRw,j	Test Point	VRw,j
C087	0.19	C109	0.19
C088	0.21	C110	0.29
C089	0.19	C111	0.23
C090	0.16	C112	0.22
C091	0.17	C113	0.15
C092	0.13	C114	0.37
C093	0.17	C115	0.18
C094	0.16	C116	0.19
C095	0.15	C117	0.17
C096	0.34	C118	0.17
C097	0.17	C119	0.16
C098	0.18	C120	0.15
C099	0.17	C121	0.21
C100	0.19	C122	0.21
C101	0.18	C123	0.17
C102	0.14	C124	0.22
C103	0.14	C125	0.22
C104	0.18	C126	0.29
C105	0.18	C127	0.22
C106	0.23	C128	0.15
C107	0.26	C129	0.15
C108	0.25	C130	0.21

Table 6: SAVRs for the Assessment Area and the Project Site – Design B

Project Sites and Functional Areas	SAVR for Design Scheme B
All test points	0.18
Sites 1 and 2	0.24
Site 3	0.15
Site 4	0.17
East Harbourfront	0.19
North Harbourfront	0.17
West Harbourfront	0.16
High-rise Development	0.22
Existing Development	0.19
Open Area	0.16

Table 7: Overall wind velocity ratios ($VR_{w,j}$) for all test points – Design Scheme B

Test Point	VRw,j	Test Point	VRw,j
B01	0.12	C036	0.17
B02	0.15	C037	0.16
B03	0.12	C038	0.19
B04	0.09	C039	0.27
B05	0.15	C040	0.24
B06	0.15	C041	0.20
B07	0.12	C042	0.18
B08	0.14	C043	0.18
B09	0.17	C044	0.18
B10	0.16	C045	0.17
B11	0.15	C046	0.17
B12	0.13	C047	0.23
B13	0.13	C048	0.19
B14	0.18	C049	0.16
C001	0.21	C050	0.17
C002	0.25	C051	0.14
C003	0.14	C052	0.16
C004	0.22	C053	0.15
C005	0.15	C054	0.11
C006	0.17	C055	0.16
C007	0.15	C056	0.14
C008	0.16	C057	0.18
C009	0.21	C058	0.18
C010	0.25	C059	0.13
C011	0.18	C060	0.18
C012	0.21	C061	0.21
C013	0.08	C062	0.13
C014	0.26	C063	0.12
C015	0.22	C064	0.15
C016	0.20	C065	0.12
C017	0.21	C066	0.11
C018	0.20	C067	0.15
C019	0.23	C068	0.16
C020	0.21	C069	0.12
C021	0.23	C070	0.15
C022	0.20	C071	0.16
C023	0.13	C072	0.09
C024	0.12	C073	0.16
C025	0.12	C074	0.20
C026	0.27	C075	0.18
C027	0.11	C076	0.15
C028	0.15	C077	0.12
C029	0.24	C078	0.10
C030	0.34	C079	0.16
C031	0.12	C080	0.13
C032	0.17	C081	0.16
C033	0.13	C082	0.30
C034	0.16	C083	0.28
C035	0.14	C084	0.20

Table 7 (cont.): Overall wind velocity ratios ($VR_{w,j}$) for all test points – Design Scheme B

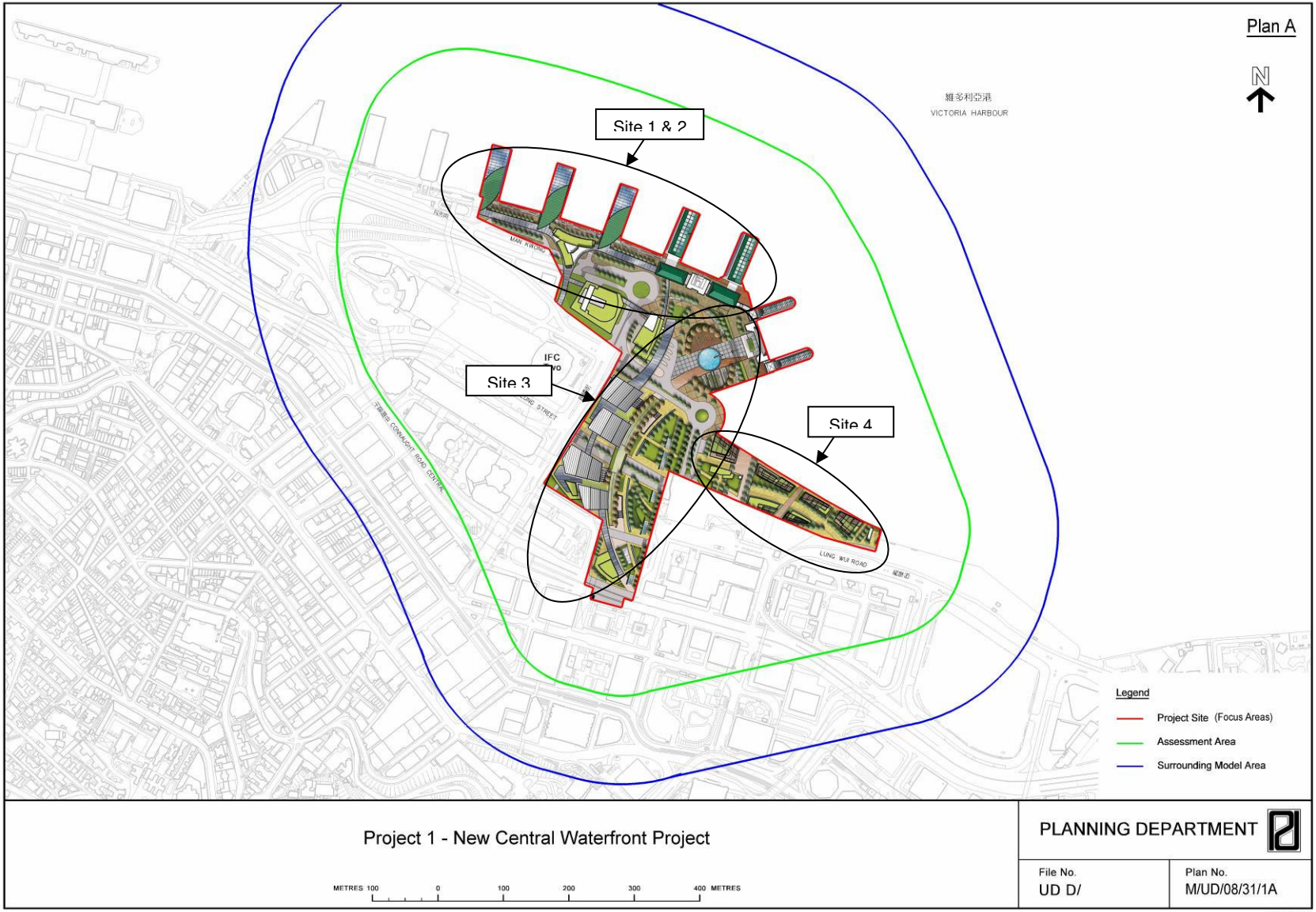
Test Point	VRw,j	Test Point	VRw,j
C085	0.24	C108	0.28
C086	0.20	C109	0.19
C087	0.21	C110	0.33
C088	0.20	C111	0.26
C089	0.15	C112	0.23
C090	0.17	C113	0.16
C091	0.15	C114	0.32
C092	0.12	C115	0.20
C093	0.14	C116	0.23
C094	0.16	C117	0.18
C095	0.15	C118	0.17
C096	0.33	C119	0.15
C097	0.17	C120	0.15
C098	0.23	C121	0.26
C099	0.17	C122	0.23
C100	0.19	C123	0.26
C101	0.16	C124	0.22
C102	0.16	C125	0.26
C103	0.12	C126	0.32
C104	0.19	C127	0.24
C105	0.19	C128	0.15
C106	0.25	C129	0.17
C107	0.27	C130	0.21

Table 8: SAVRs for the Assessment Area and the Project Site – Design C

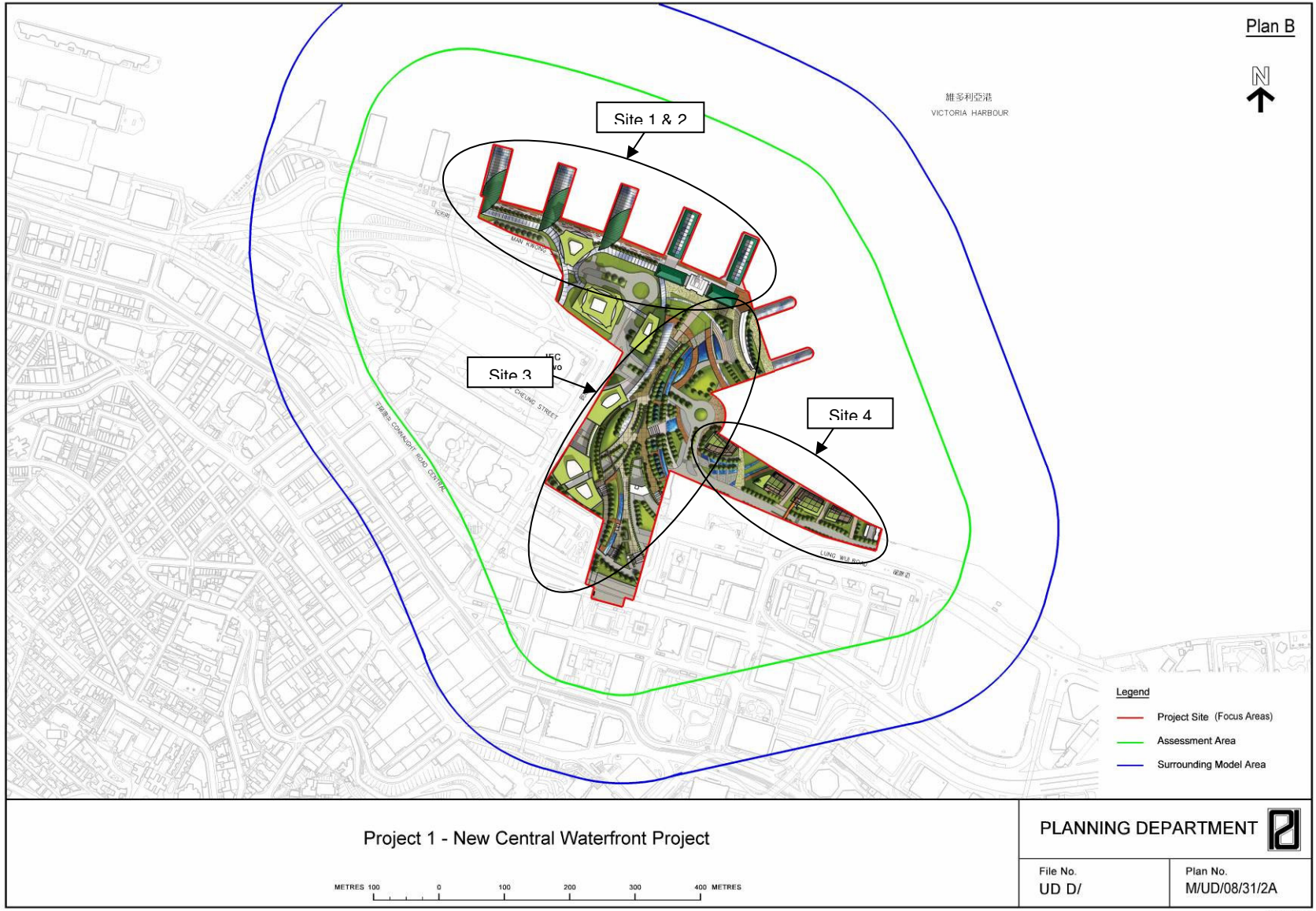
Project Sites and Functional Areas	SAVR for Design Scheme A	SAVR for Design Scheme B	SAVR for Design Scheme C
All test points	0.18	0.19	0.17
Sites 1 and 2	0.22	0.24	0.15
Site 3	0.15	0.14	0.14
Site 4	0.17	0.17	0.18
East Harbourfront	0.22	0.21	0.23
North Harbourfront	0.16	0.17	0.16
West Harbourfront	0.15	0.15	0.09
Open Area	0.17	0.17	0.17
High-rise Development	0.21	0.23	0.22
Existing Development	0.22	0.21	0.20

Table 9: Overall wind velocity ratios ($VR_{w,j}$) for all test points – Design Scheme C

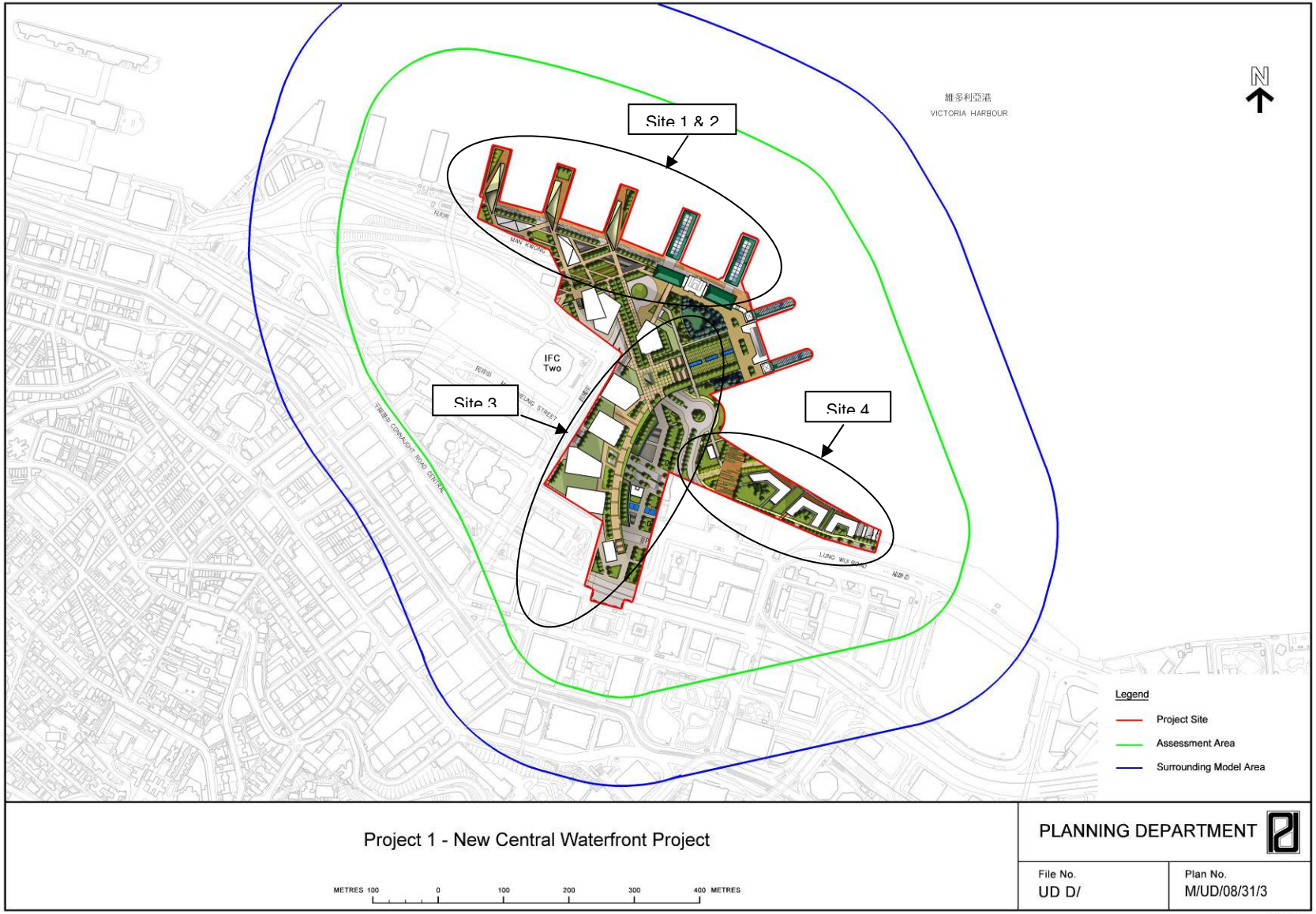
Test Point	VRw,j	Test Point	VRw,j
A02	0.15	C071	0.09
A04	0.14	C072	0.14
A07	0.13	C075	0.10
A09	0.16	C078	0.18
A12	0.12	C079	0.11
C003	0.10	C080	0.17
C004	0.26	C082	0.29
C007	0.11	C083	0.21
C014	0.25	C084	0.17
C015	0.20	C085	0.28
C016	0.16	C086	0.19
C017	0.16	C088	0.15
C018	0.21	C090	0.14
C022	0.17	C091	0.13
C026	0.28	C092	0.16
C027	0.09	C094	0.15
C029	0.22	C095	0.16
C032	0.15	C096	0.35
C033	0.14	C097	0.16
C037	0.17	C098	0.18
C039	0.27	C099	0.16
C040	0.28	C101	0.16
C041	0.23	C102	0.13
C042	0.21	C103	0.12
C043	0.21	C105	0.20
C044	0.14	C106	0.17
C046	0.20	C108	0.31
C047	0.22	C109	0.25
C048	0.22	C110	0.29
C049	0.15	C111	0.30
C050	0.17	C112	0.22
C051	0.13	C114	0.10
C053	0.16	C115	0.09
C054	0.18	C116	0.10
C055	0.18	C117	0.15
C056	0.16	C118	0.18
C057	0.18	C119	0.14
C058	0.21	C120	0.16
C059	0.19	C121	0.15
C060	0.19	C122	0.21
C061	0.20	C123	0.16
C062	0.17	C124	0.15
C063	0.17	C125	0.14
C064	0.17	C126	0.27
C065	0.14	C127	0.08
C066	0.08	C128	0.09
C067	0.13	C129	0.13
C068	0.16	C130	0.21
C069	0.18	S01	0.13
C070	0.13	S02	0.19
		S03	0.12



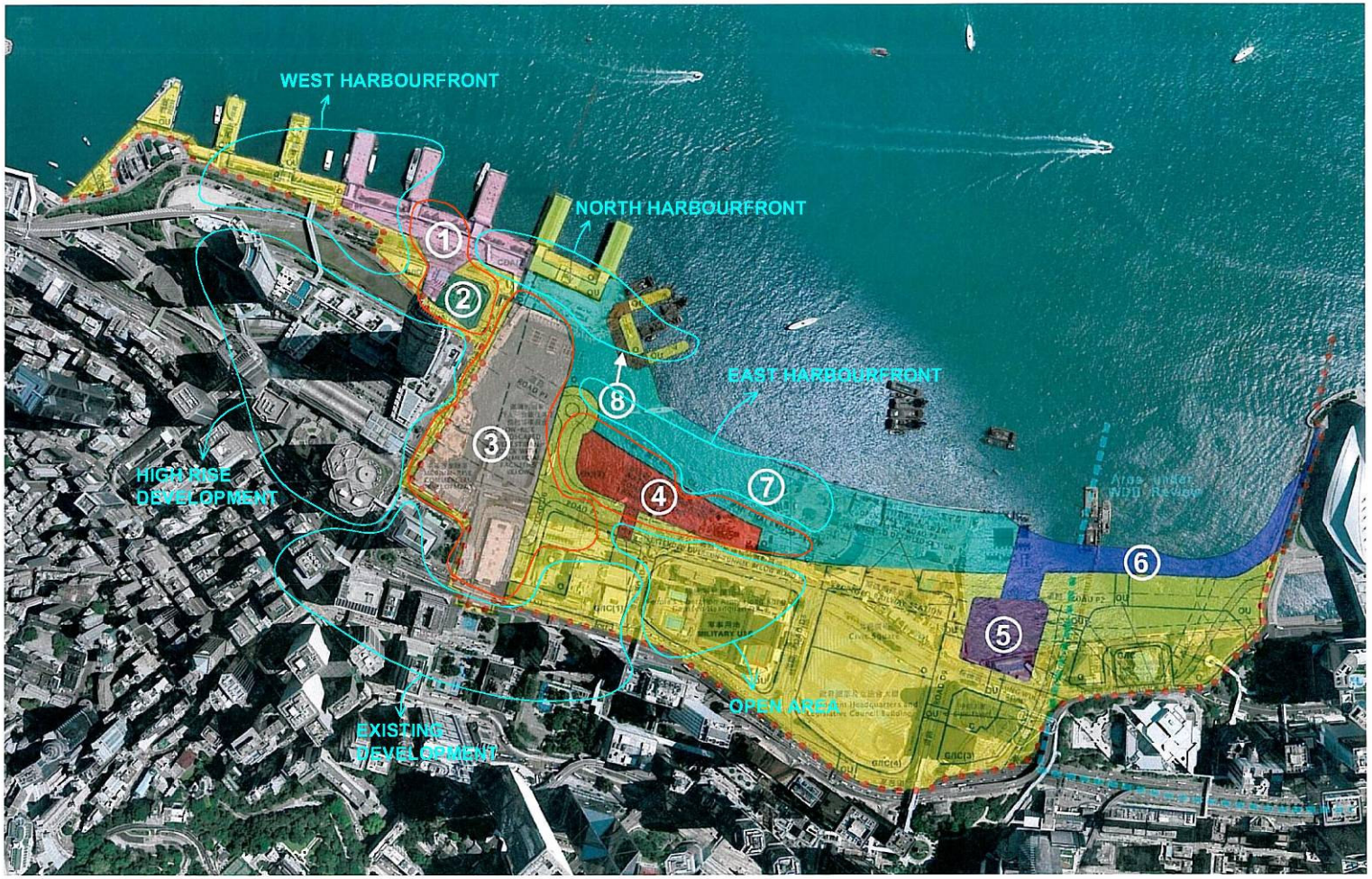
Title:	**Assessment Area and Project Site – New Central Waterfront Study (Scheme A)**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 1 (a)**



Title:	**Assessment Area and Project Site – New Central Waterfront Study (Scheme B)**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 1 (b)**



Title:	**Assessment Area and Project Site – New Central Waterfront Study (Scheme C)**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 1 (c)**



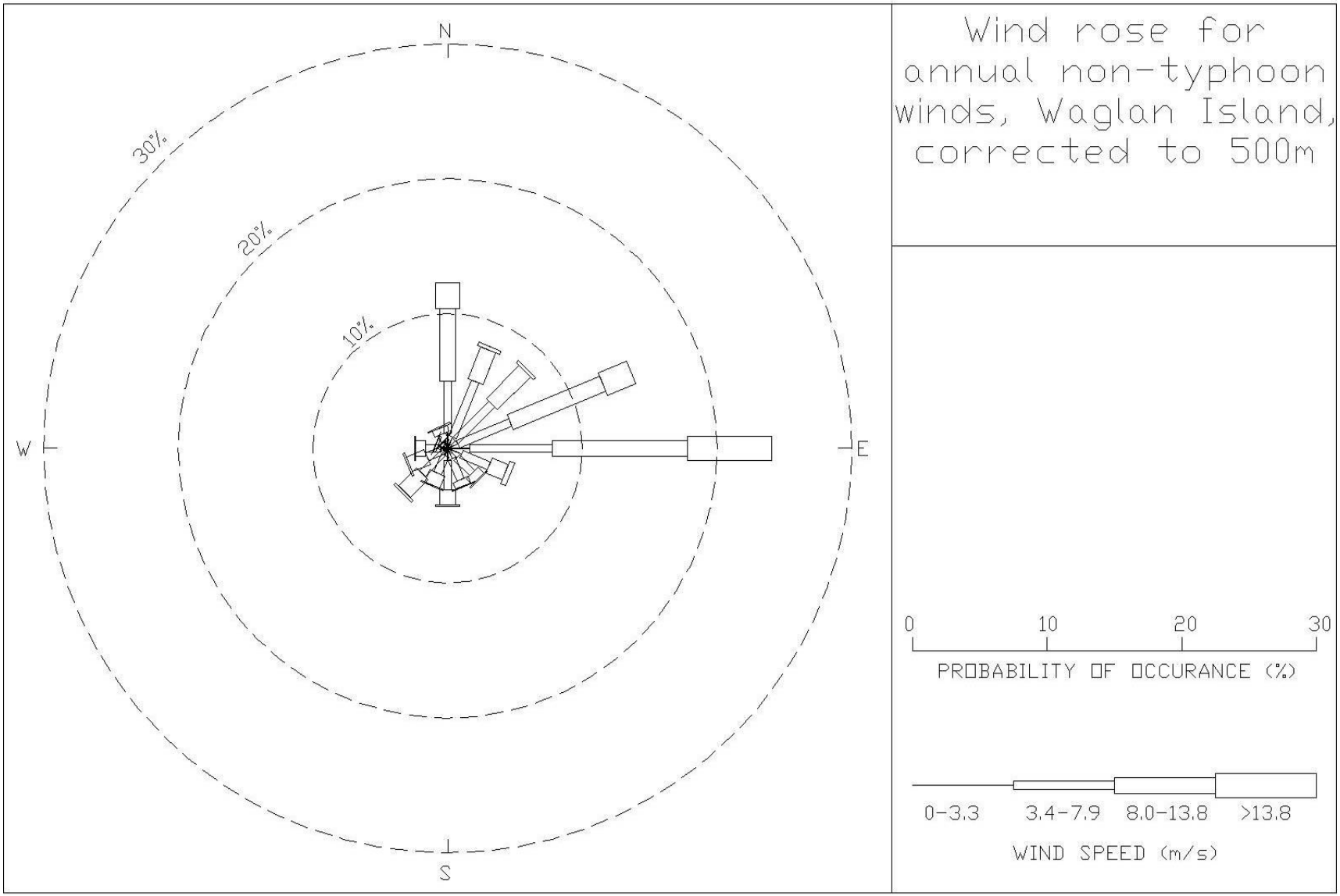
本圖於2007年5月4日擬備，
所根據的資料由凱譚環球有限公司提供
PLAN PREPARED ON 4.5.2007 BASED ON INFORMATION FROM AEDAS LTD.

中環新海濱城市設計研究第一階段公眾參與
Urban Design Study for the New Central Harbourfront Stage 1 Public Engagement
研究範圍和個別主要發展用地（鳥瞰圖）
STUDY AREA AND KEY DEVELOPMENT SITES (AERIAL VIEW)

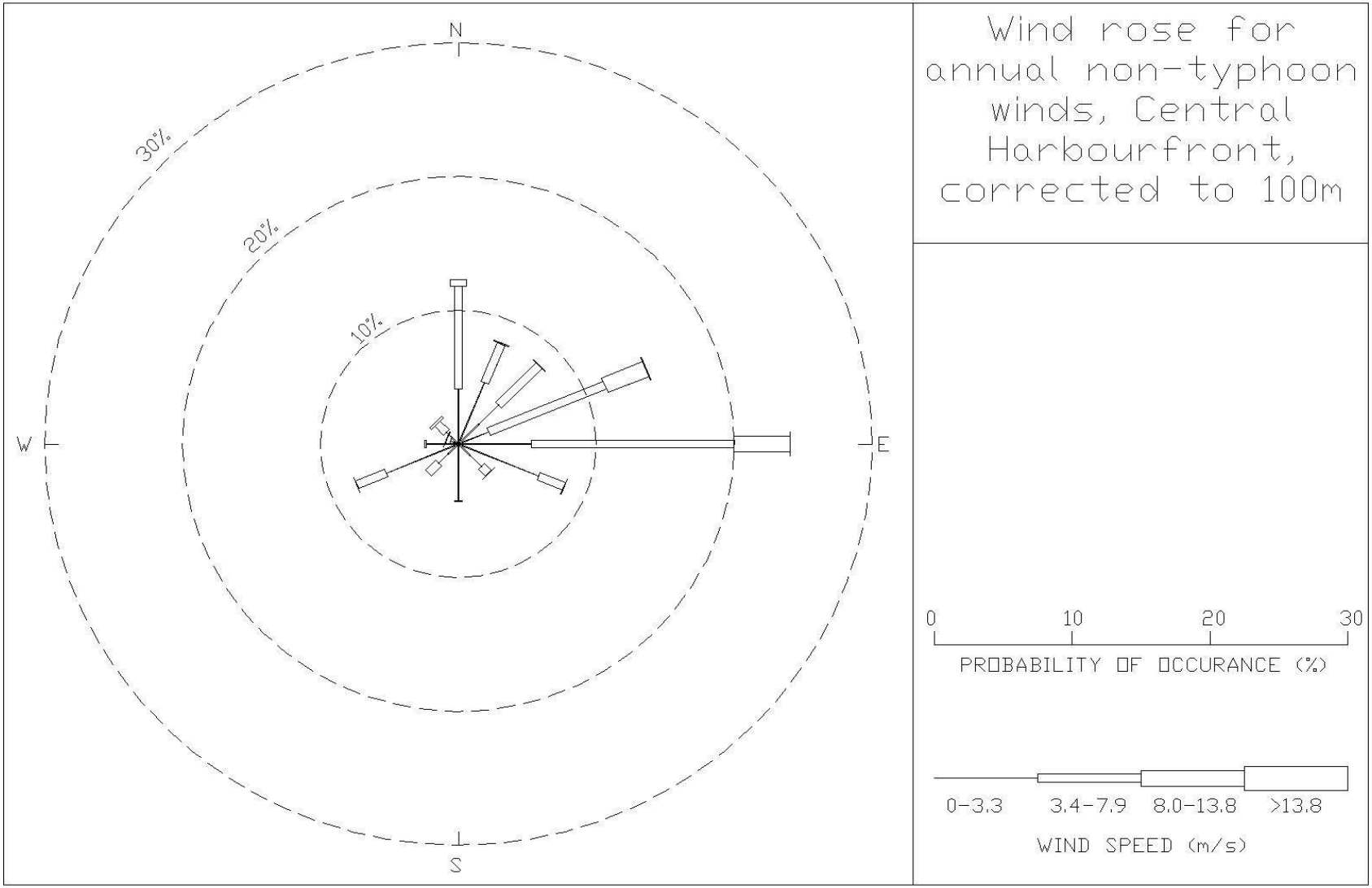
規劃署
PLANNING DEPARTMENT

M/SD/07/50

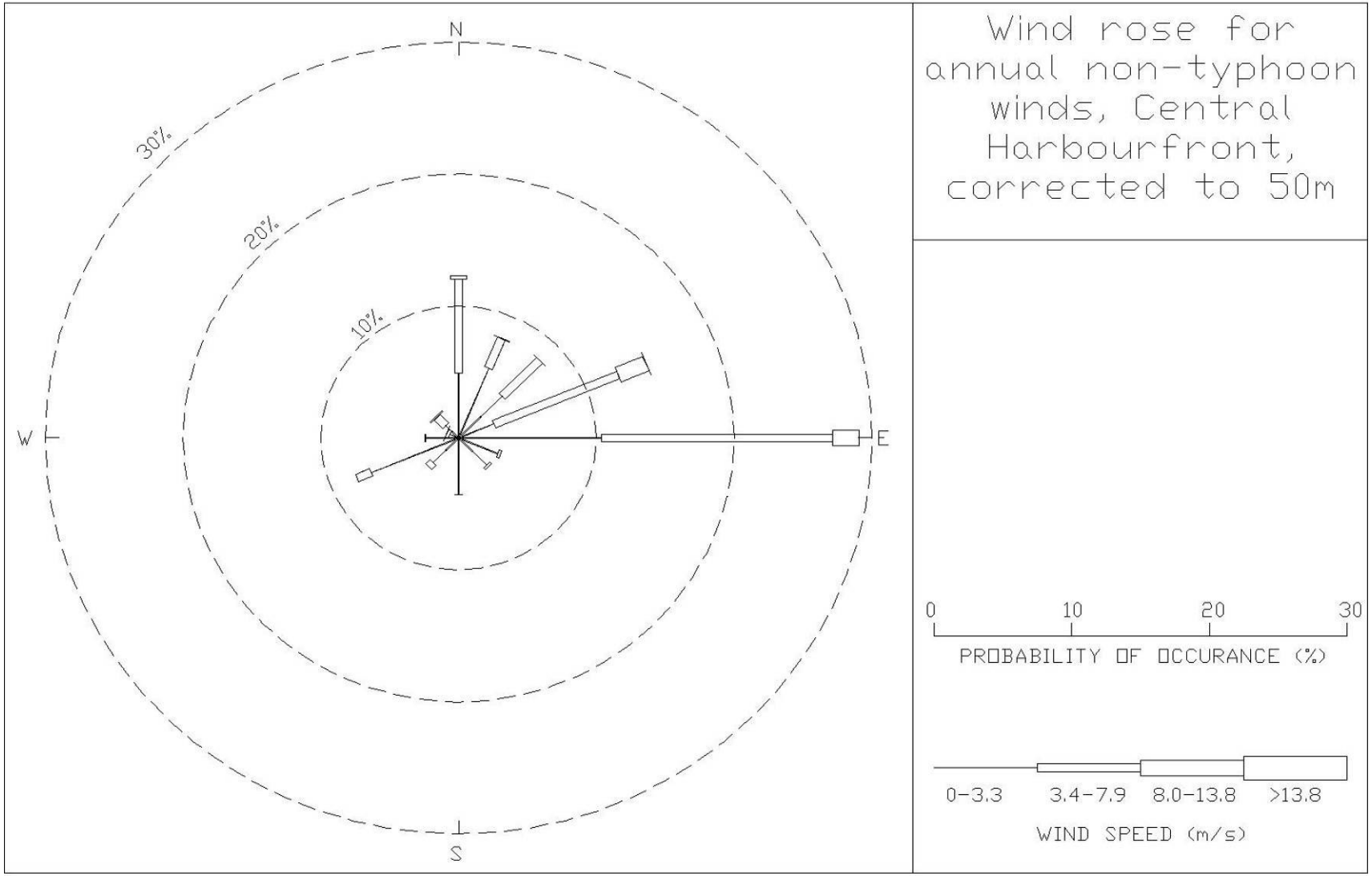
Title:	**Focus Areas and Functional Areas: Sites 1 and 2, Sites 3 and 4 – New Central Waterfront**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 2**



Title:	**Wind rose for annual non-typhoon winds at Waglan Island, corrected to 500 m**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 3**



Title:	**Wind rose for annual non-typhoon winds at Central, corrected to 100 m**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 4**



Title:	**Wind rose for annual non-typhoon winds at Central, corrected to 50 m**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 5**

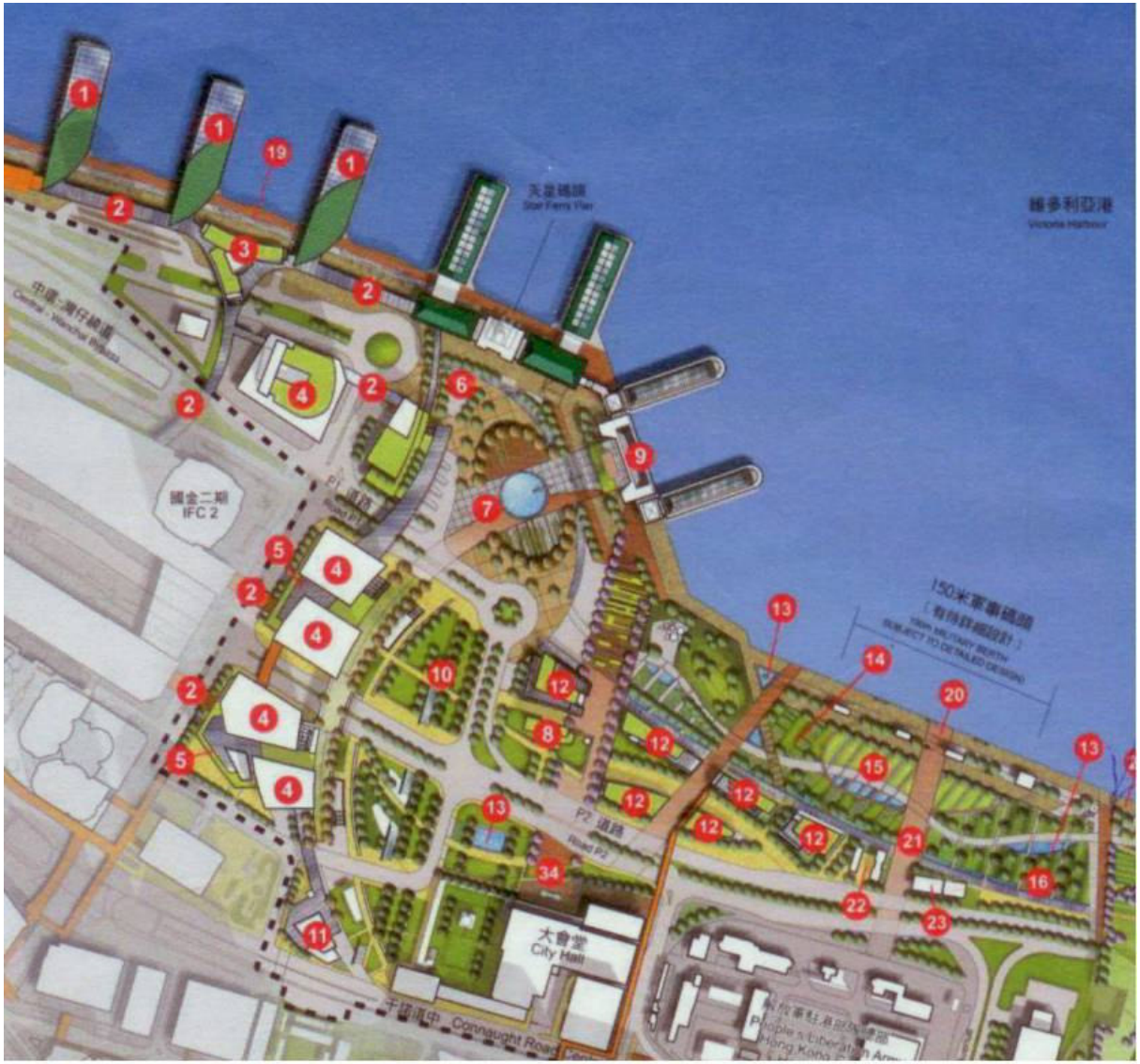
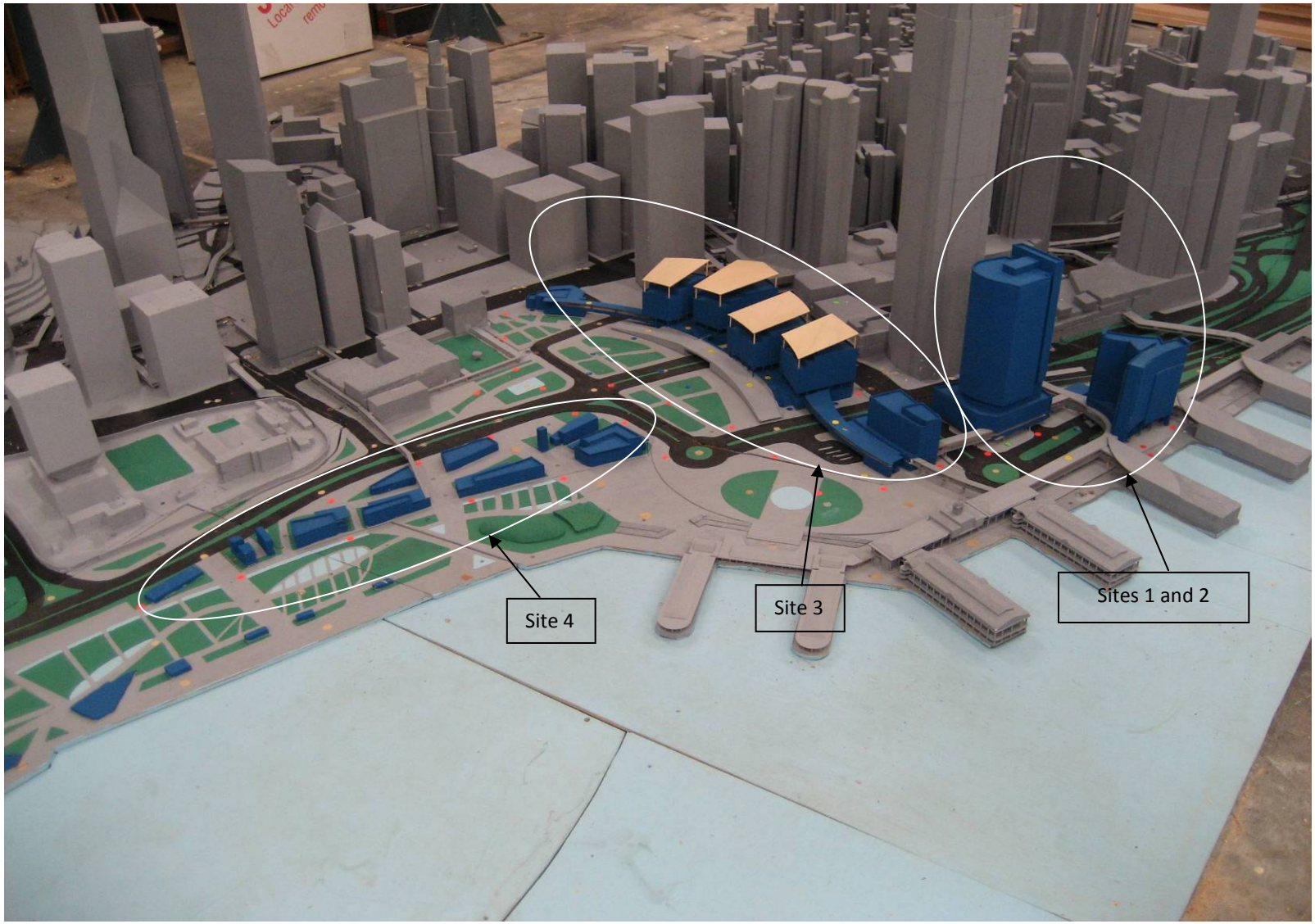
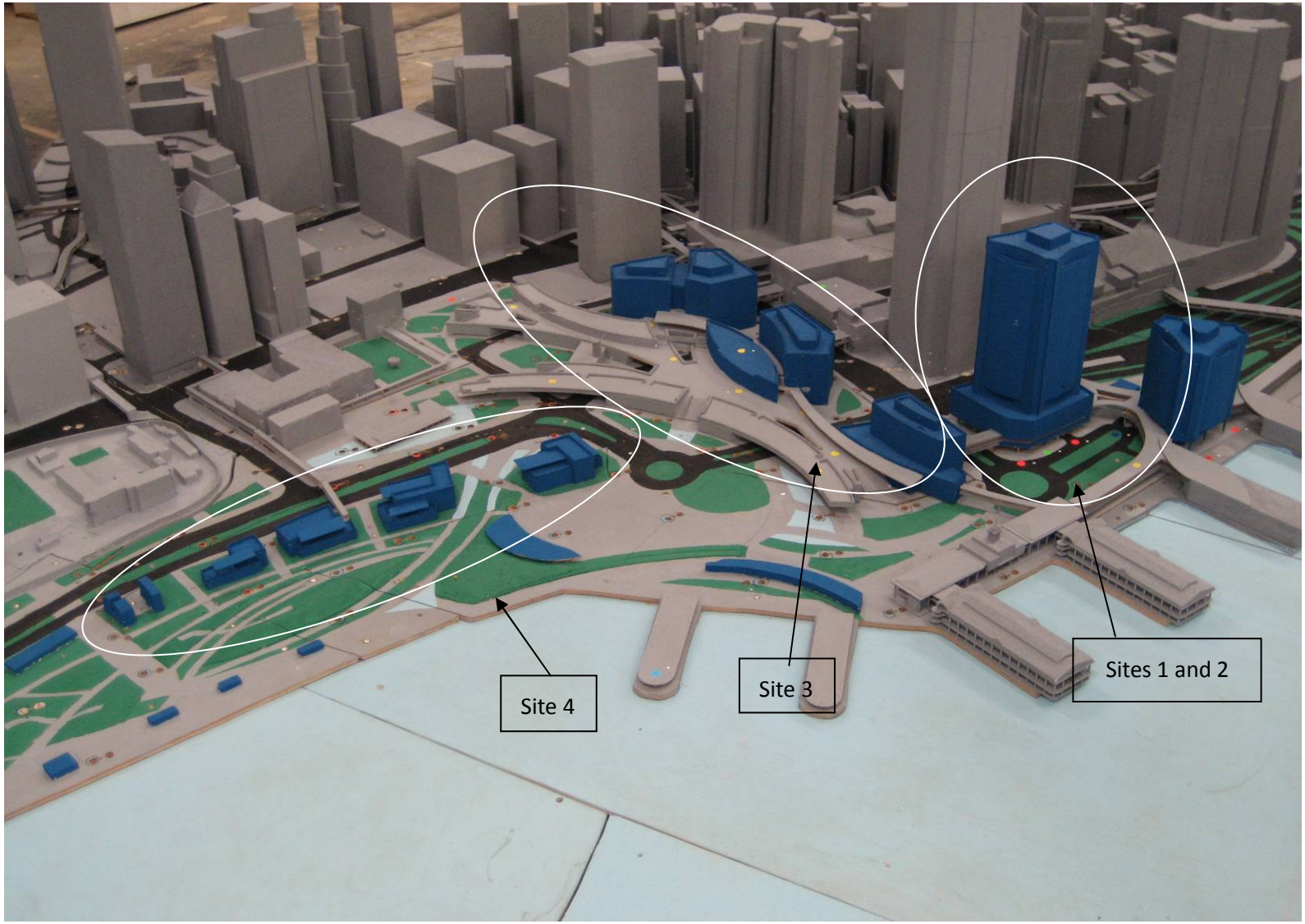


Figure 6 Layout of proposed buildings within the Project Site: Scheme A - Plan



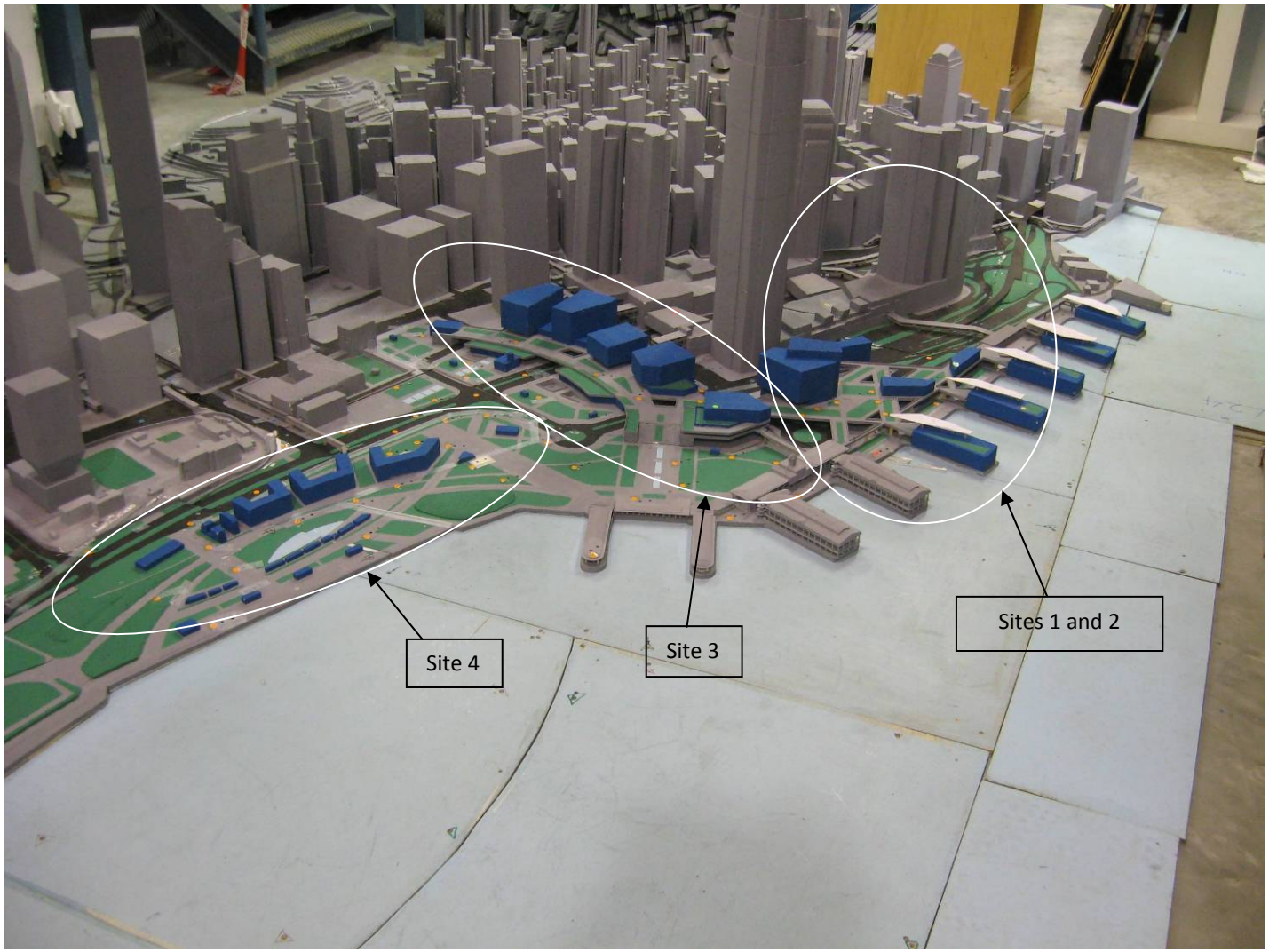
Title:	**Layout of proposed buildings within the Project Site: Scheme A Model**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 7**

Figure 8 Layout of proposed buildings within the Project Site: Scheme B – Plan



Title:	**Layout of proposed buildings within the Project Site: Scheme B – Model**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 9**

Figure 10 Layout of proposed buildings within the Project Site: Scheme C – Plan



Title:	**Layout of proposed buildings within the Project Site: Scheme C – Model**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 11**

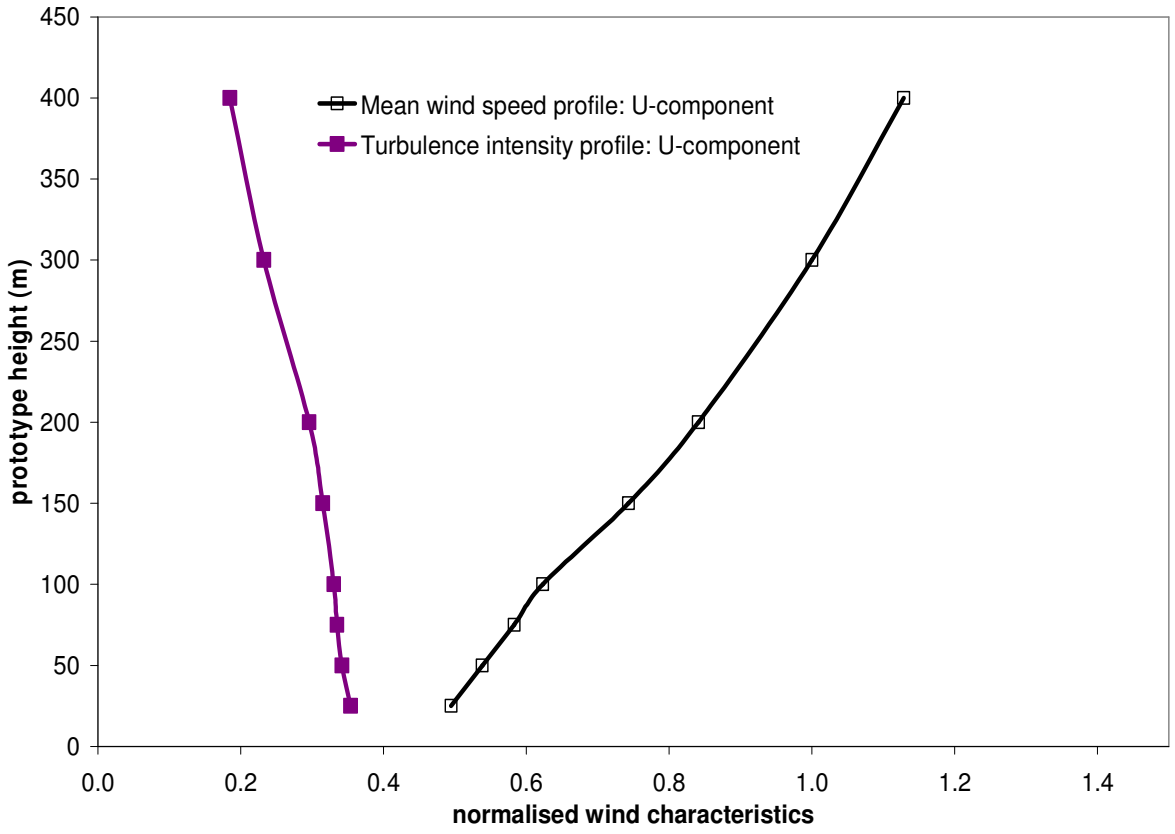


Figure 12 1:400 scale wind characteristics, approach condition A

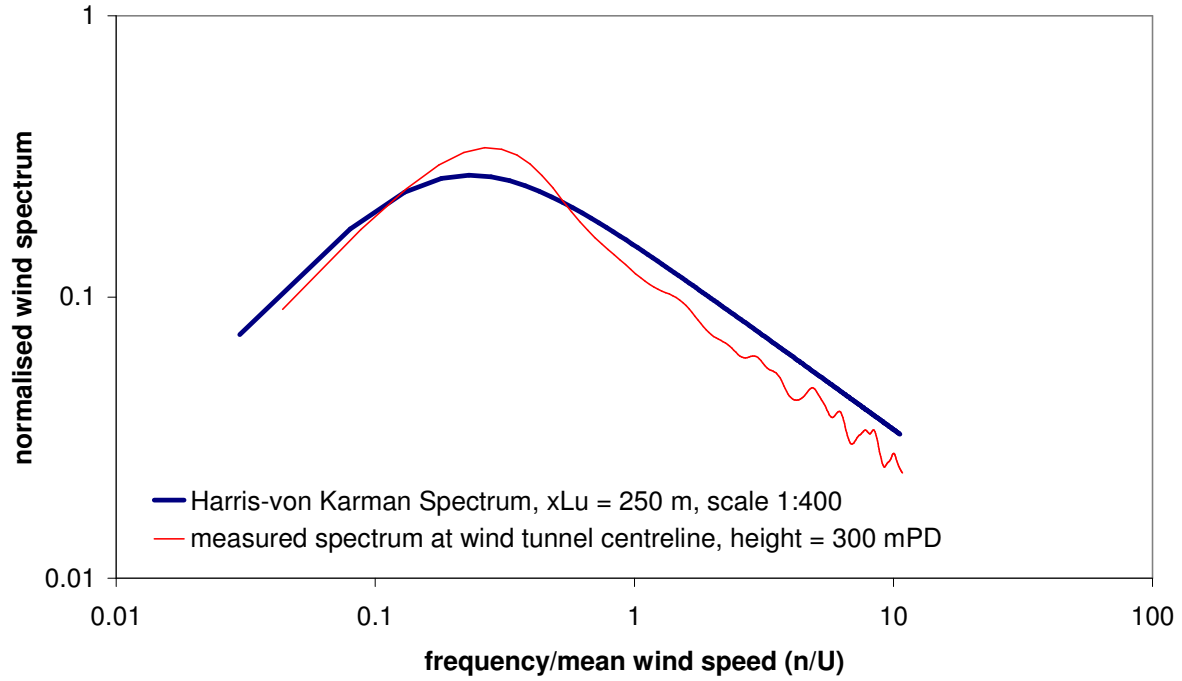


Figure 13 Longitudinal velocity spectrum of 1:400 scale wind, approach condition A

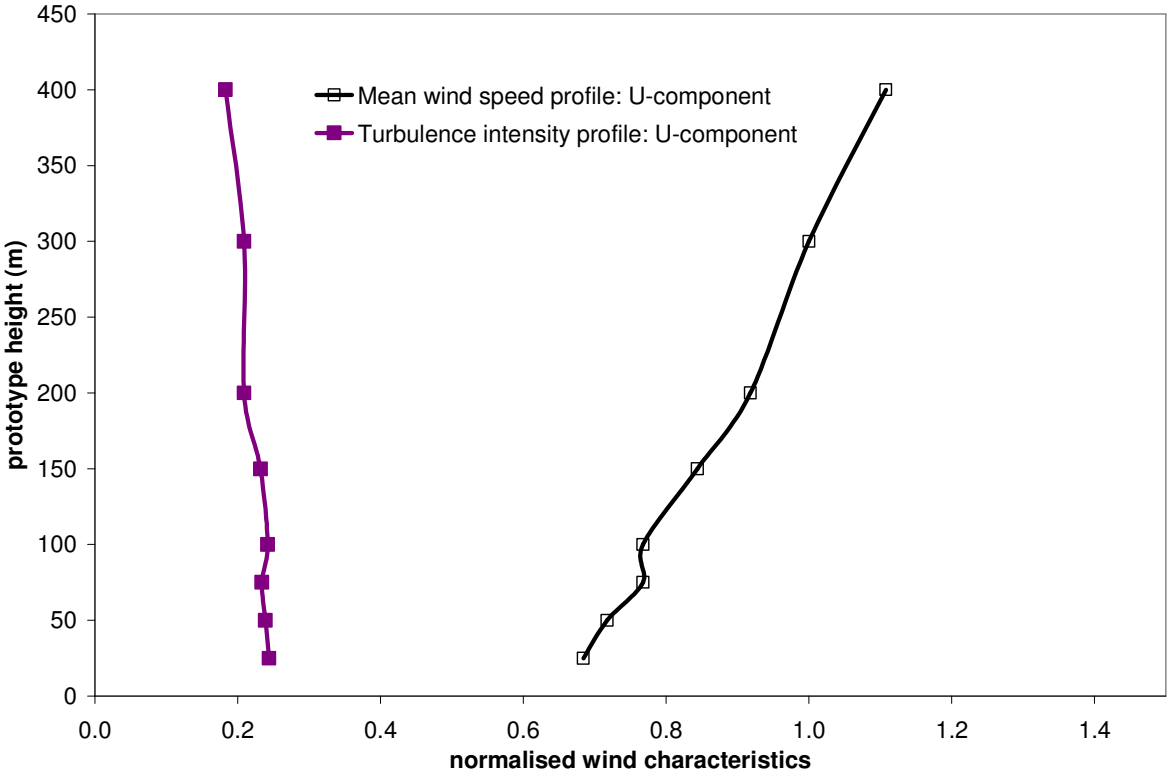


Figure 14 1:400 scale wind characteristics, approach condition B

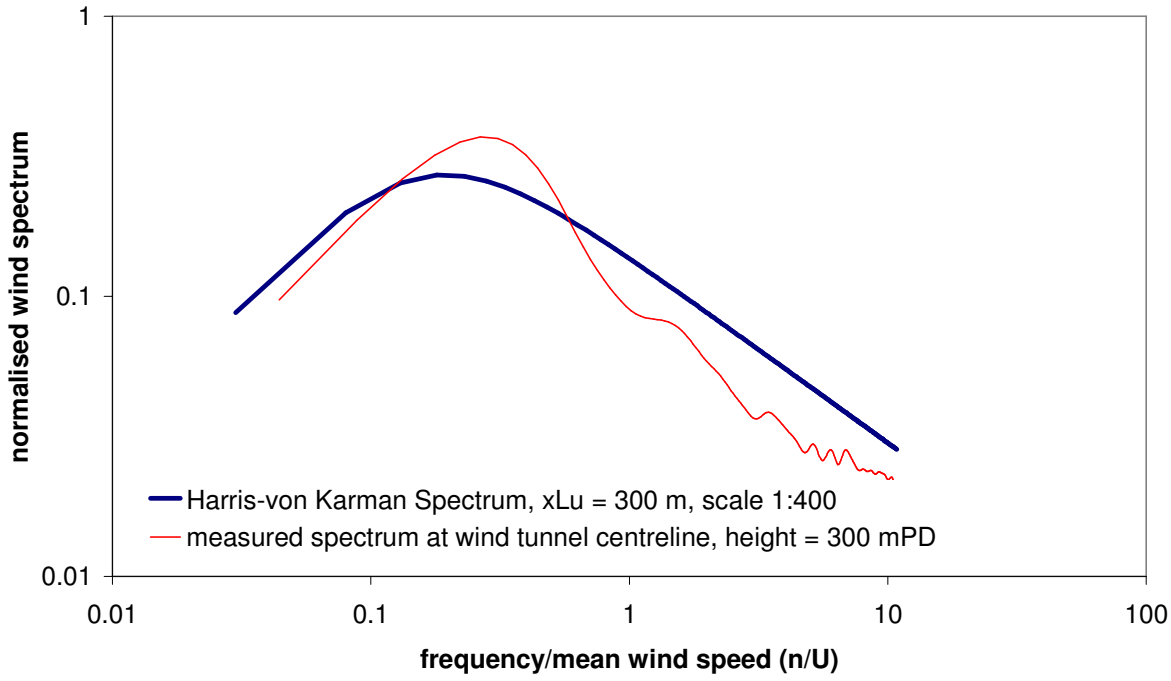


Figure 15 Longitudinal velocity spectrum of 1:400 scale wind, approach condition B

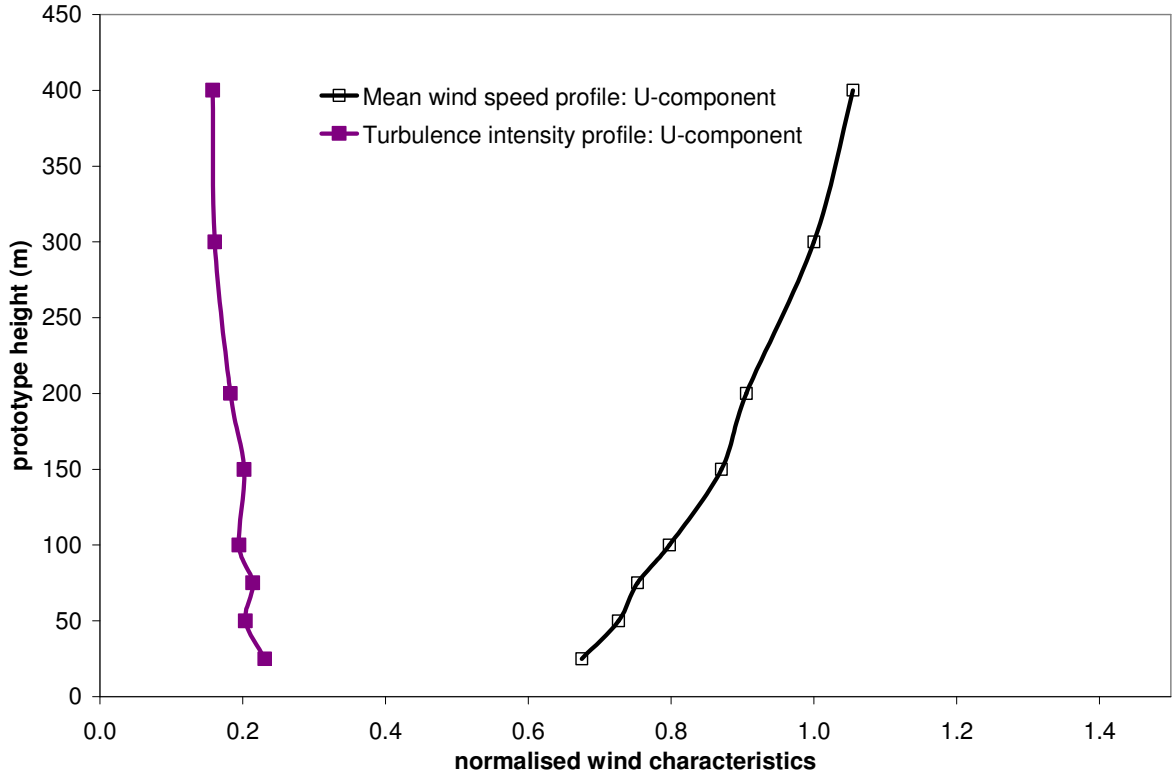


Figure 16 1:400 scale wind characteristics, approach condition C

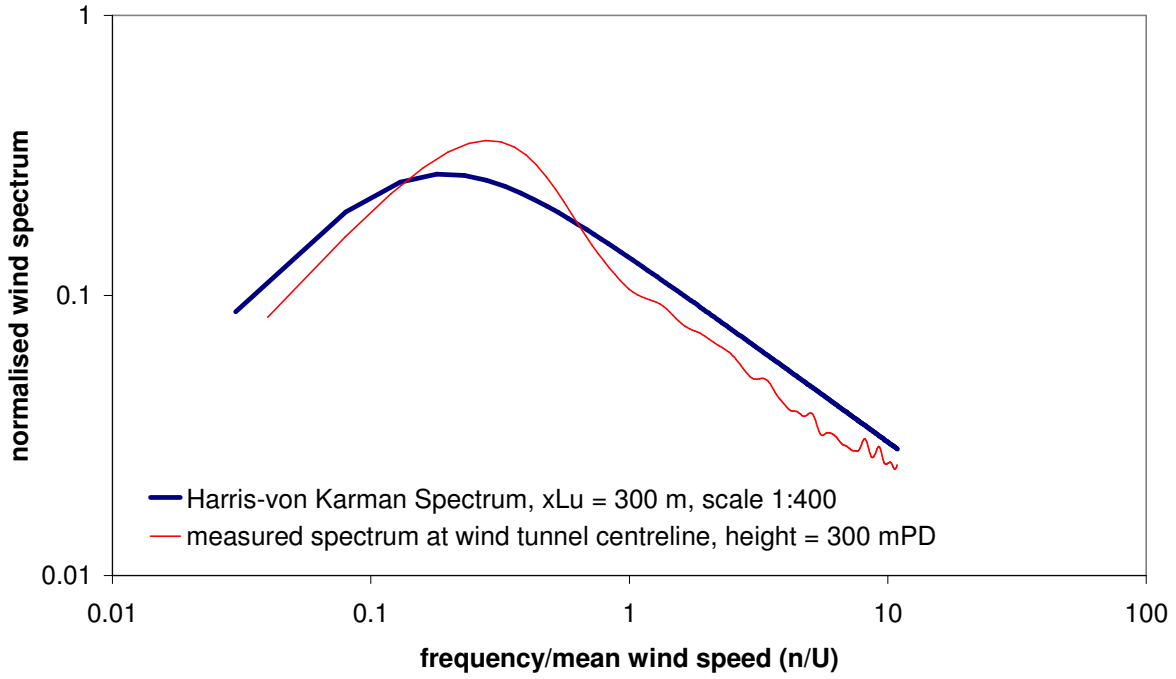


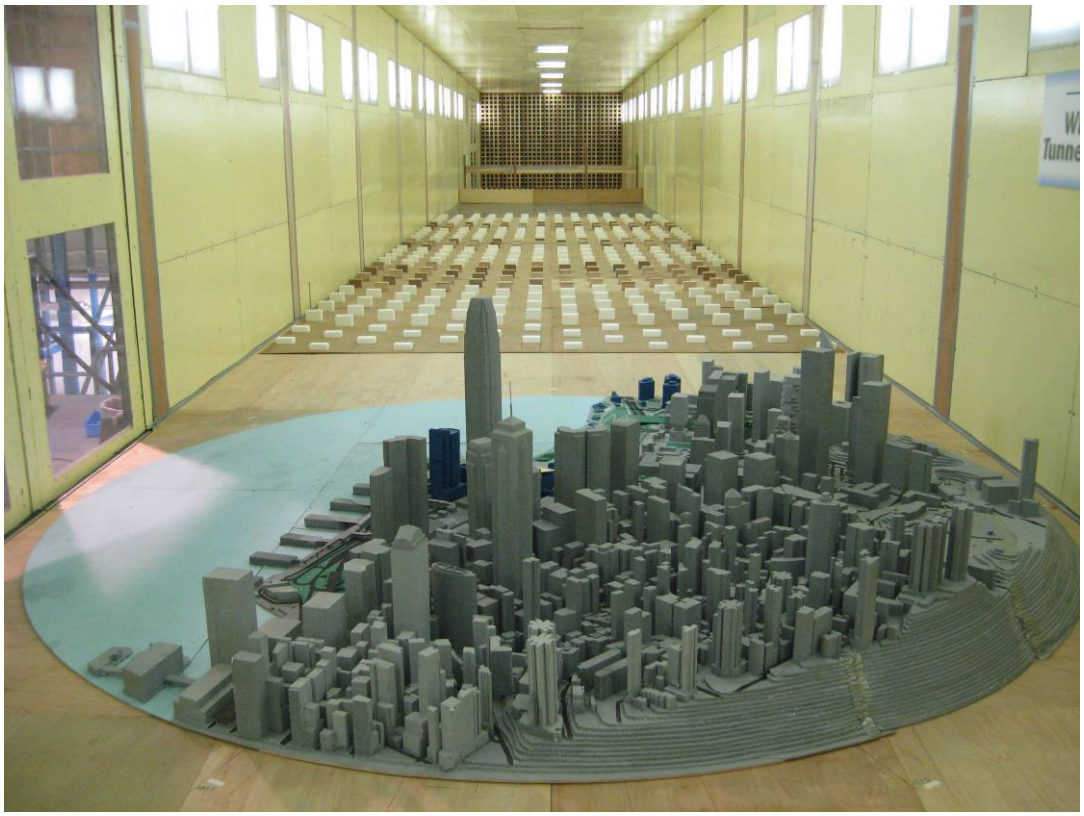
Figure 17 Longitudinal velocity spectrum of 1:400 scale wind, approach condition C

Figure 18 A 1:400 scale model of Design Scheme A at the New Central Waterfront in the low speed test section of the CLP Power Wind/Wave Tunnel Facility

(a) North view

(b) East view

(c) South view



(d) West view

Figure 19 A 1:400 scale model of Design Scheme B at the New Central Waterfront in the low speed test section of the CLP Power Wind/Wave Tunnel Facility

(a) North View

(b) East View

(c) South View

(d) West View

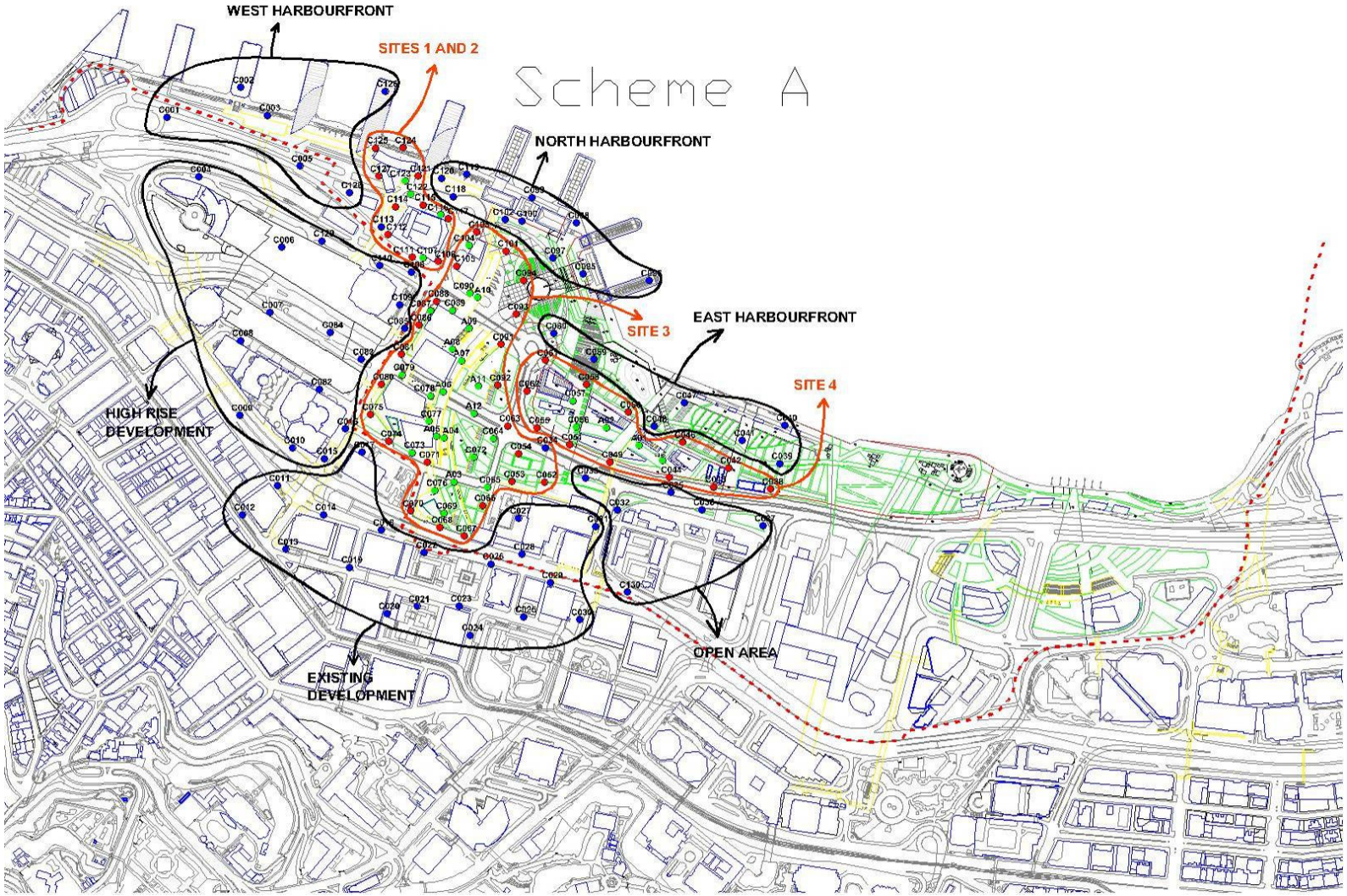
Figure 20 A 1:400 scale model of Design Scheme C at the New Central Waterfront in the low speed test section of the CLP Power Wind/Wave Tunnel Facility

(a) North view

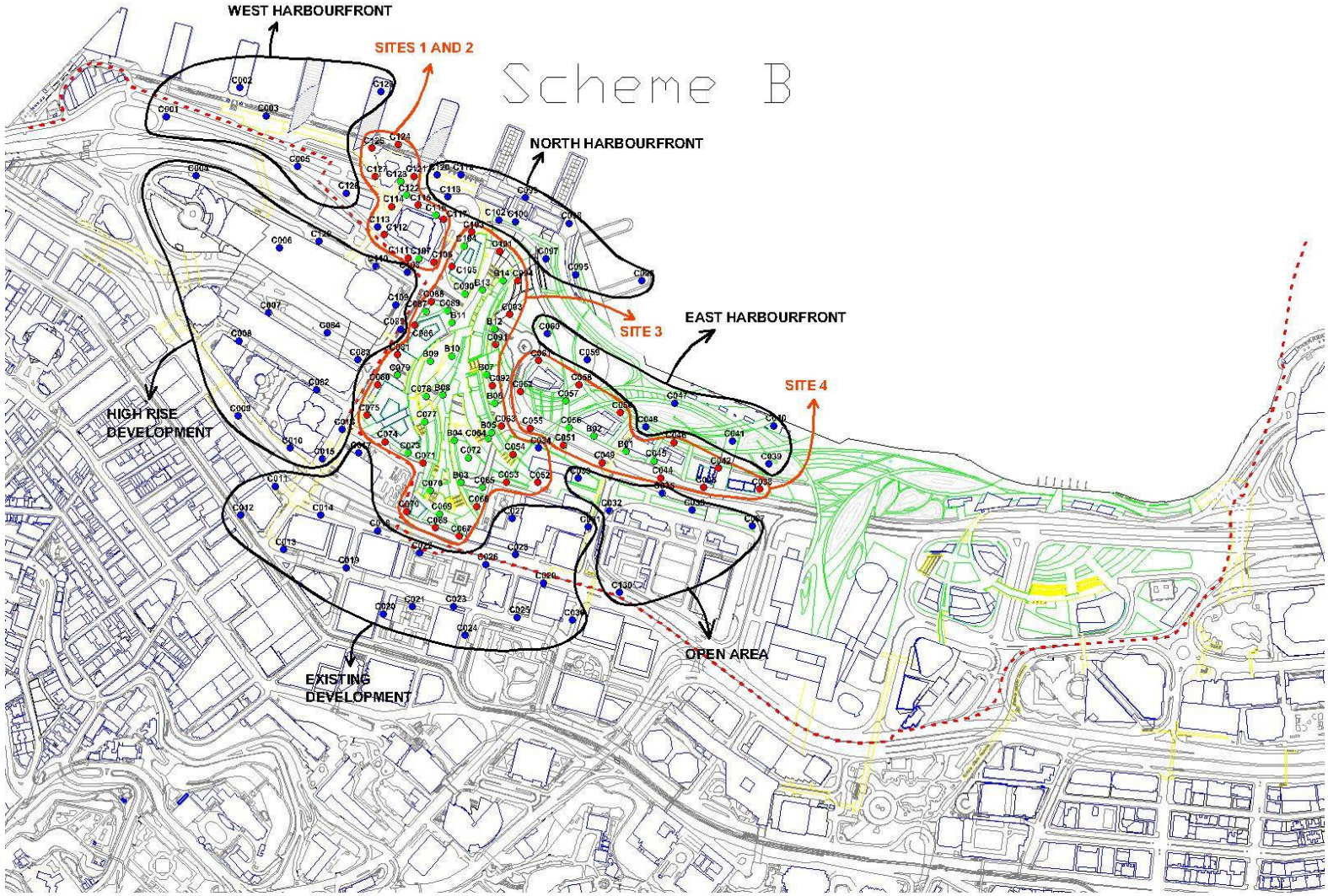
(b) East View

(c) South View

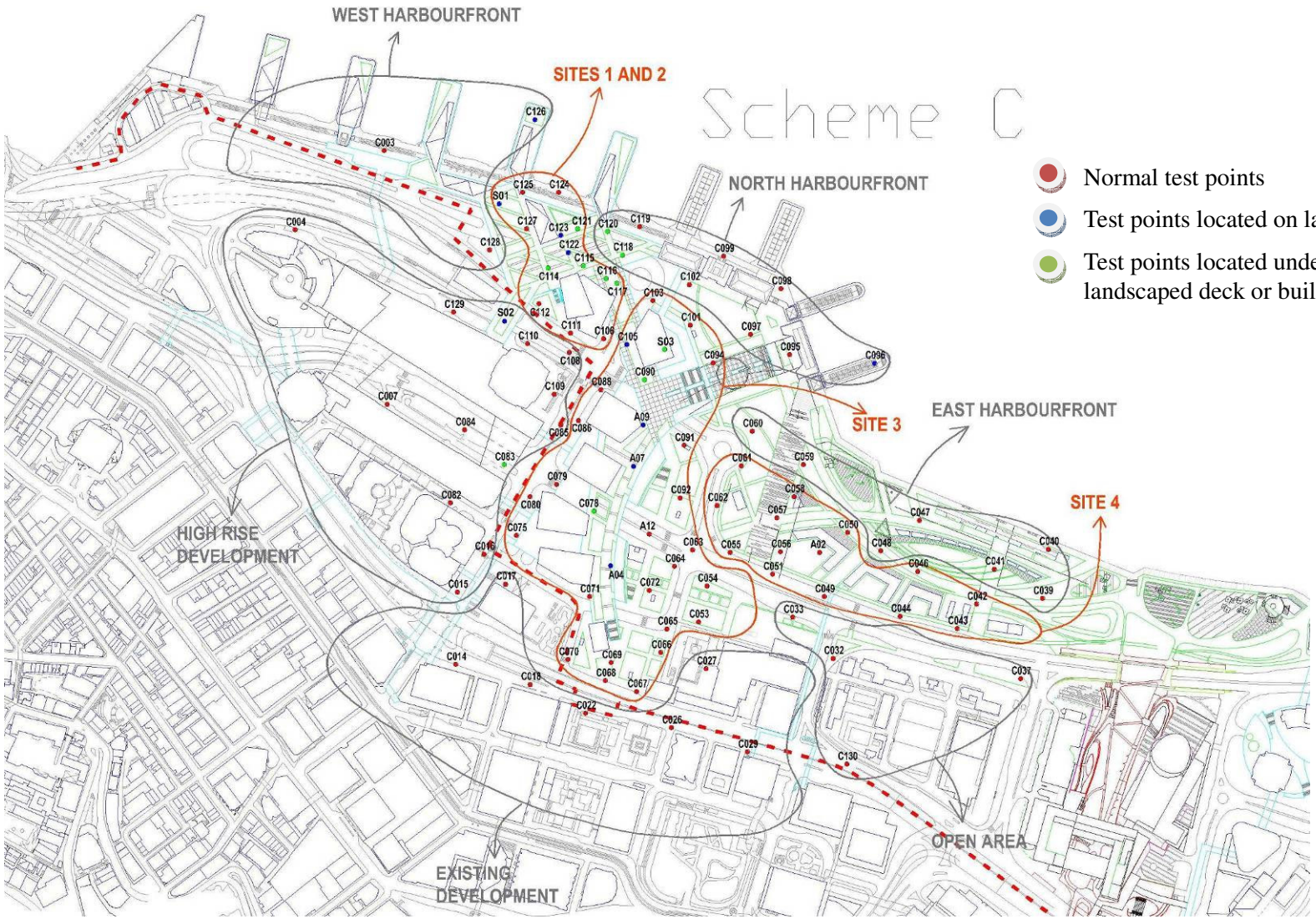
(d) West View



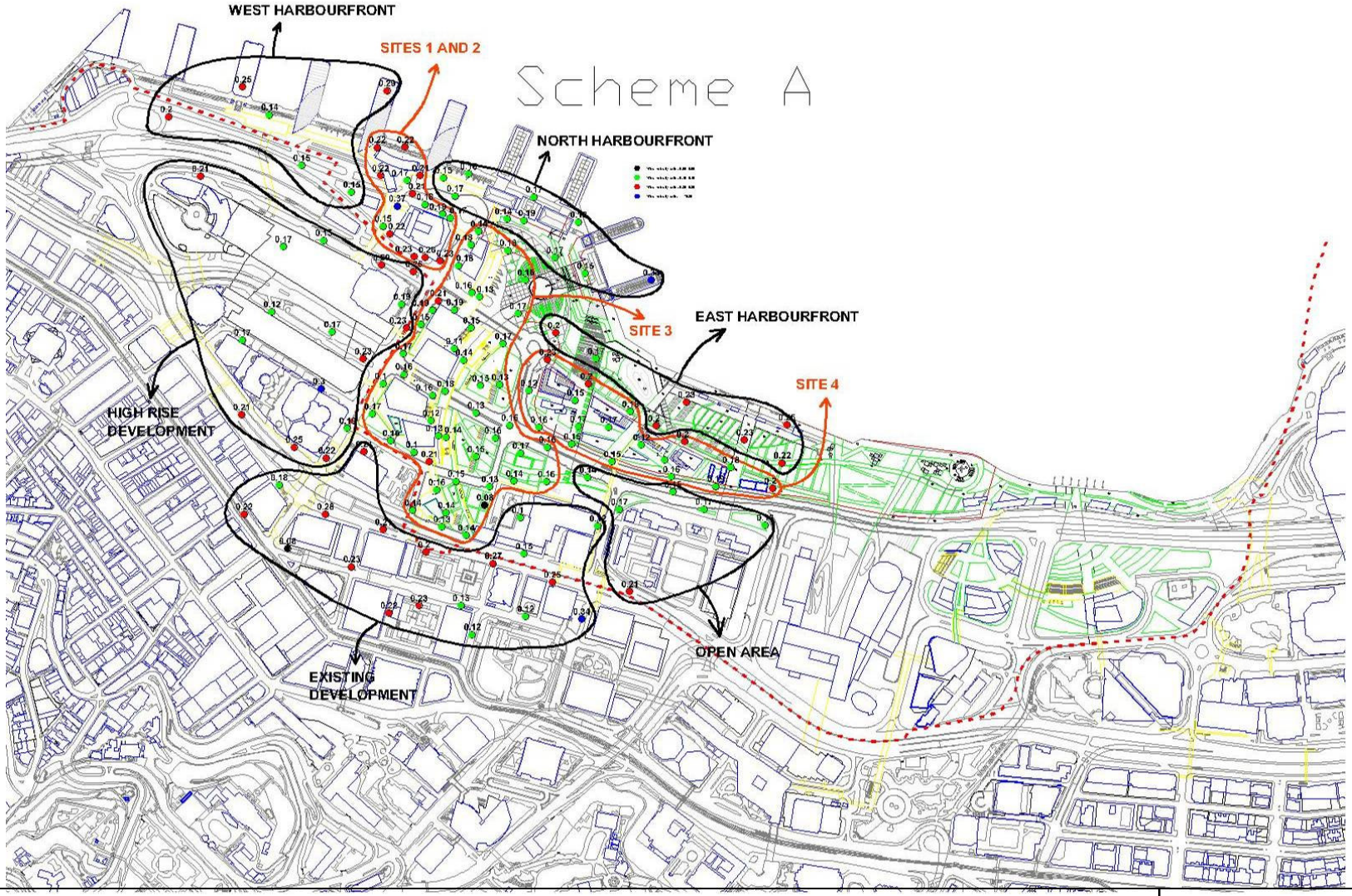
Title:	**Locations of test points: Design Scheme A**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 21**



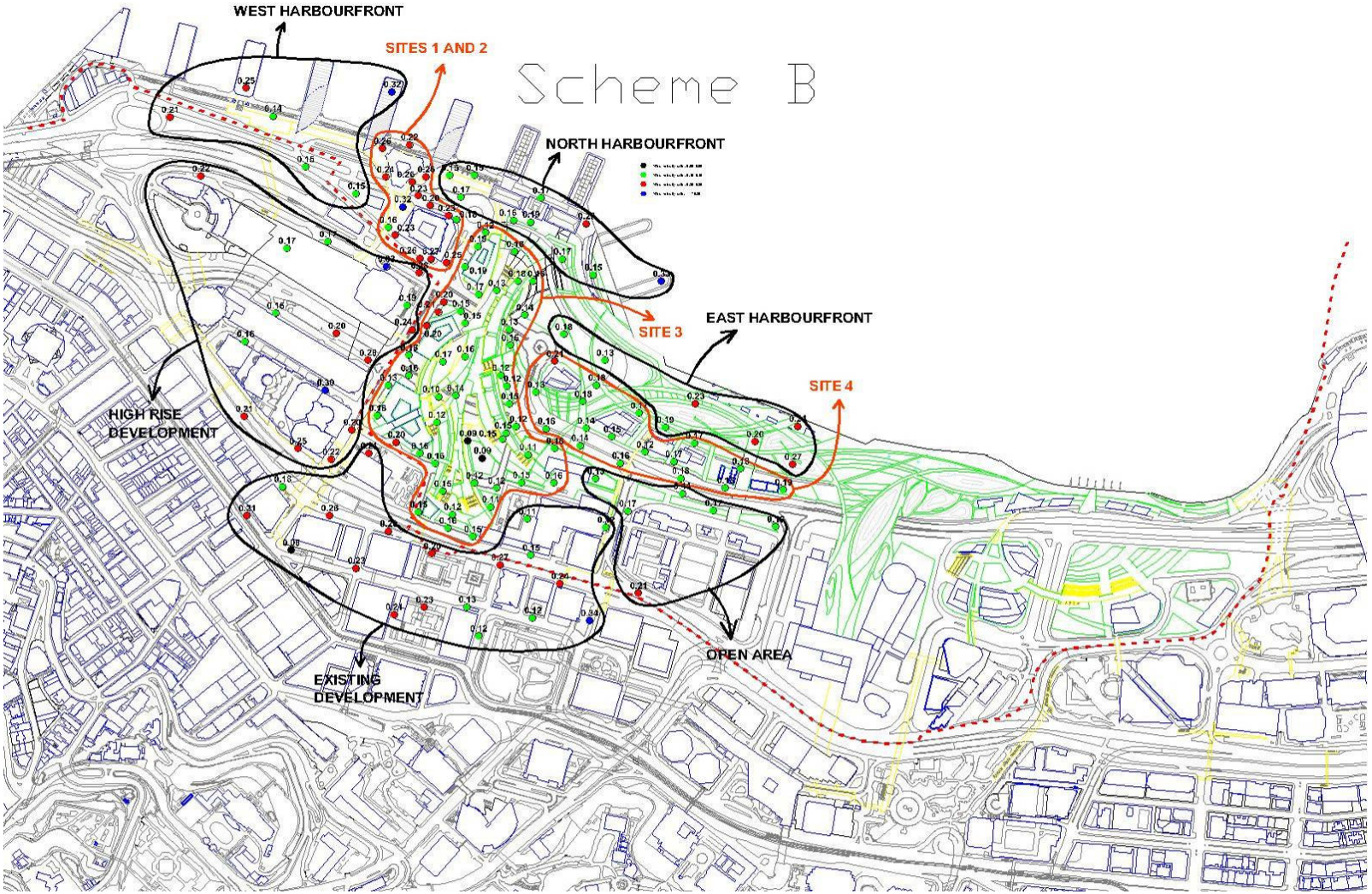
Title:	**Locations of test points: Design Scheme B**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 22**



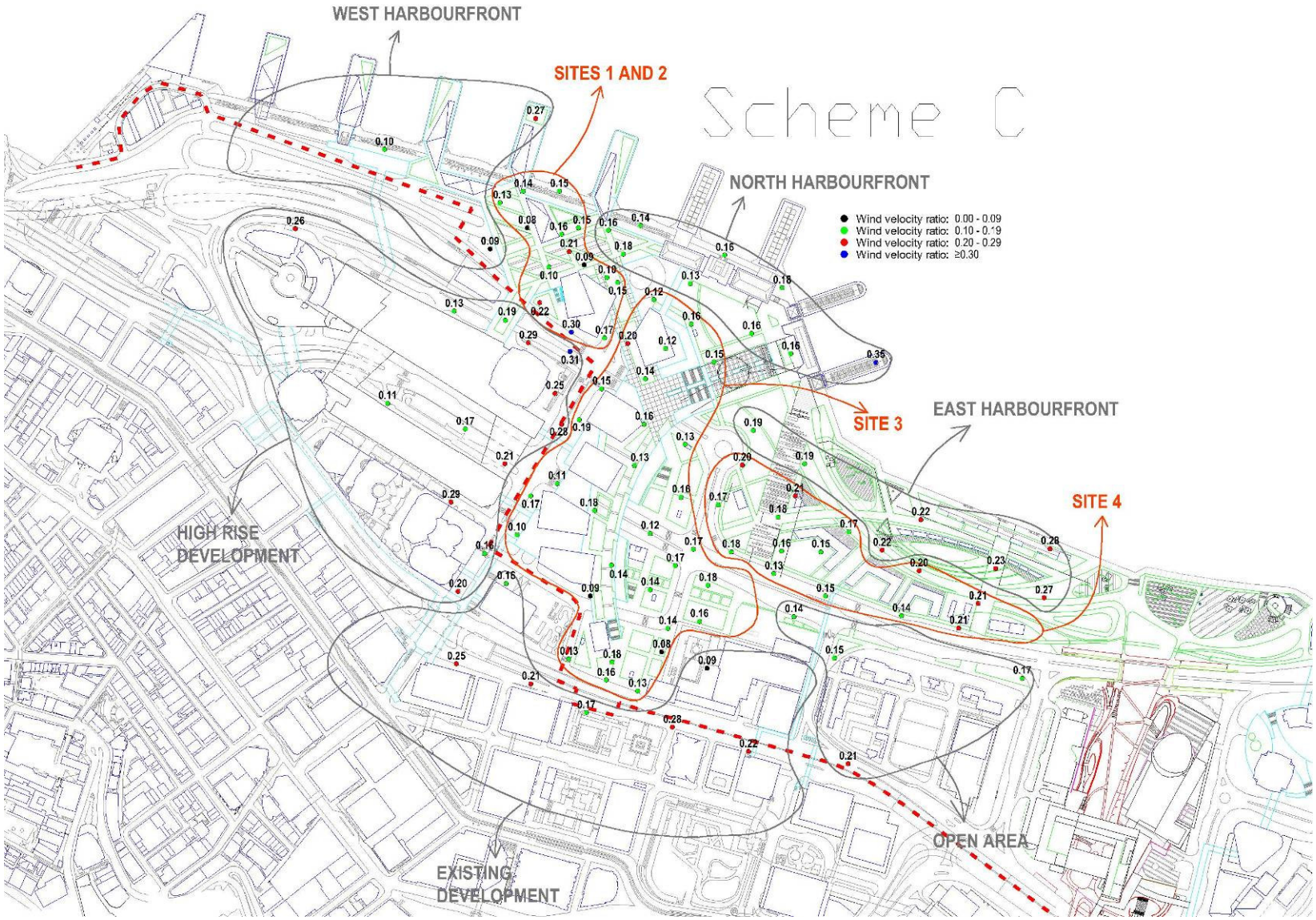
Title:	**Locations of test points: Design Scheme C**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 23**



Title:	**Overall wind velocity ratios: Design Scheme A – annual**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 24**



Title:	**Overall wind velocity ratios: Design Scheme B – annual**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 25**



Title:	**Overall wind velocity ratios: Design Scheme C – annual**	**CH2M HILL Hong Kong Limited**
Project:	**Quotation Ref. PLNQ 33/2006 Term Consultancy for Provision of Services for Undertaking Air Ventilation Assessment for Scheme A, B and C of New Central Waterfront**	**Figure: 26**

Appendix A

Tabulated Wind Rose Data

Table A1: Percentage occurrence of annual non-typhoon winds for the New Central Waterfront, corrected to 100 m

Wind Direction	**Wind Angle (º)**	**Percentage occurrence of mean wind speed (%)**				
		0m/s -3.3m/s	**3.4m/s-7.9m/s**	**8m/s-13.8m/s**	**>13.8m/s**	**Total**
north	0	4.1%	7.7%	0.5%	0.0%	12.3%
north-north-east	22.5	5.0%	3.1%	0.1%	0.0%	8.2%
north-east	45	4.1%	4.2%	0.0%	0.0%	8.3%
east-north-east	67.5	2.4%	9.1%	3.2%	0.0%	14.7%
east	90	5.3%	14.6%	4.1%	0.0%	24.0%
east-south-east	112.5	3.4%	1.5%	0.0%	0.0%	5.0%
south-east	135	5.2%	1.1%	0.0%	0.0%	6.4%
south-south-east	157.5	0.0%	0.0%	0.0%	0.0%	0.0%
south	180	4.2%	0.1%	0.0%	0.0%	4.3%
south-south-west	202.5	0.0%	0.0%	0.0%	0.0%	0.0%
south-west	225	2.0%	1.0%	0.0%	0.0%	3.0%
west-south-west	247.5	5.7%	2.3%	0.0%	0.0%	8.0%
west	270	2.4%	0.1%	0.0%	0.0%	2.5%
west-north-west	292.5	0.6%	0.3%	0.0%	0.0%	0.9%
north-west	315	0.4%	0.2%	0.0%	0.0%	0.6%
north-north-west	337.5	0.8%	0.7%	0.2%	0.0%	1.7%

Appendix B

Directional Wind Velocity Ratios of the Test Points – Design Scheme A

Table B1: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Sites 1 and 2

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C106	0.14	0.17	0.25	0.38	0.31	0.16	0.14	0.12	0.06	0.15	0.09	0.19	0.16	0.24	0.22	0.19	0.23
C107	0.17	0.19	0.30	0.43	0.33	0.20	0.20	0.16	0.06	0.14	0.08	0.17	0.16	0.31	0.31	0.23	0.26
C111	0.22	0.15	0.21	0.27	0.28	0.22	0.22	0.17	0.06	0.13	0.08	0.16	0.16	0.44	0.58	0.48	0.23
C112	0.22	0.15	0.21	0.31	0.25	0.18	0.22	0.18	0.07	0.16	0.07	0.14	0.18	0.51	0.66	0.56	0.22
C114	0.17	0.30	0.43	0.61	0.50	0.33	0.21	0.13	0.05	0.11	0.09	0.19	0.19	0.43	0.51	0.36	0.37
C115	0.17	0.17	0.16	0.24	0.23	0.15	0.15	0.11	0.03	0.07	0.05	0.13	0.15	0.39	0.43	0.28	0.18
C116	0.18	0.14	0.15	0.24	0.27	0.17	0.19	0.15	0.04	0.08	0.06	0.12	0.10	0.30	0.37	0.30	0.19
C117	0.22	0.18	0.16	0.17	0.18	0.18	0.21	0.14	0.04	0.09	0.06	0.10	0.08	0.27	0.38	0.37	0.17
C121	0.28	0.33	0.23	0.20	0.20	0.17	0.17	0.13	0.04	0.10	0.08	0.10	0.13	0.34	0.44	0.37	0.21
C122	0.16	0.22	0.24	0.31	0.27	0.23	0.21	0.14	0.04	0.09	0.07	0.13	0.10	0.15	0.20	0.22	0.21
C123	0.25	0.27	0.23	0.18	0.13	0.12	0.14	0.11	0.03	0.09	0.07	0.09	0.09	0.23	0.46	0.48	0.17
C124	0.23	0.19	0.16	0.24	0.30	0.25	0.21	0.12	0.03	0.09	0.05	0.08	0.11	0.23	0.34	0.34	0.22
C125	0.21	0.23	0.28	0.32	0.24	0.17	0.14	0.09	0.04	0.09	0.06	0.09	0.14	0.32	0.34	0.26	0.22
C127	0.10	0.10	0.18	0.36	0.37	0.23	0.12	0.07	0.03	0.09	0.07	0.09	0.09	0.23	0.27	0.19	0.22
														Mean			0.22
														Standard deviation			0.05

Table B2: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Site 3

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A03	0.15	0.17	0.19	0.23	0.16	0.10	0.10	0.07	0.05	0.07	0.04	0.08	0.06	0.06	0.10	0.11	0.15
A04	0.09	0.16	0.20	0.23	0.17	0.12	0.10	0.06	0.03	0.05	0.03	0.06	0.04	0.05	0.09	0.11	0.14
A09	0.26	0.19	0.17	0.15	0.15	0.12	0.12	0.08	0.03	0.05	0.04	0.07	0.06	0.12	0.25	0.35	0.15
A11	0.16	0.22	0.24	0.22	0.13	0.10	0.09	0.08	0.04	0.06	0.04	0.06	0.04	0.07	0.13	0.16	0.15
A12	0.15	0.20	0.20	0.19	0.14	0.10	0.09	0.07	0.04	0.06	0.05	0.06	0.04	0.06	0.12	0.16	0.13
C034	0.12	0.10	0.16	0.26	0.22	0.12	0.12	0.12	0.05	0.06	0.04	0.10	0.06	0.08	0.12	0.14	0.16
C052	0.14	0.15	0.21	0.28	0.18	0.09	0.12	0.10	0.05	0.06	0.03	0.09	0.06	0.06	0.12	0.13	0.16
C053	0.14	0.15	0.19	0.25	0.16	0.08	0.10	0.07	0.04	0.05	0.03	0.08	0.05	0.06	0.10	0.13	0.14
C054	0.15	0.14	0.16	0.26	0.22	0.12	0.12	0.10	0.05	0.06	0.04	0.10	0.06	0.08	0.13	0.17	0.17
C063	0.20	0.18	0.16	0.21	0.19	0.11	0.12	0.09	0.04	0.06	0.04	0.09	0.05	0.08	0.15	0.19	0.16
C064	0.18	0.19	0.19	0.23	0.19	0.11	0.11	0.09	0.05	0.08	0.05	0.11	0.07	0.08	0.15	0.18	0.16
C065	0.16	0.18	0.17	0.18	0.13	0.08	0.09	0.08	0.05	0.08	0.05	0.10	0.07	0.07	0.13	0.15	0.13
C066	0.09	0.09	0.10	0.11	0.09	0.05	0.06	0.07	0.04	0.07	0.06	0.08	0.06	0.06	0.10	0.09	0.08
C067	0.17	0.18	0.20	0.20	0.11	0.06	0.10	0.12	0.08	0.13	0.09	0.12	0.09	0.07	0.13	0.14	0.14
C068	0.12	0.12	0.17	0.19	0.14	0.07	0.07	0.10	0.06	0.11	0.12	0.13	0.07	0.11	0.14	0.12	0.13
C069	0.11	0.15	0.18	0.23	0.18	0.10	0.06	0.05	0.03	0.04	0.02	0.05	0.05	0.04	0.07	0.07	0.14
C070	0.17	0.16	0.18	0.19	0.15	0.08	0.07	0.12	0.08	0.12	0.13	0.13	0.07	0.11	0.15	0.25	0.14
C071	0.12	0.15	0.23	0.36	0.28	0.16	0.12	0.07	0.04	0.08	0.10	0.14	0.07	0.08	0.18	0.18	0.21
C072	0.15	0.18	0.19	0.23	0.17	0.10	0.10	0.07	0.05	0.06	0.05	0.09	0.05	0.08	0.14	0.15	0.15
C073	0.09	0.12	0.15	0.15	0.11	0.06	0.06	0.06	0.03	0.06	0.06	0.09	0.06	0.07	0.11	0.13	0.10
C074	0.12	0.19	0.26	0.24	0.17	0.08	0.07	0.08	0.04	0.14	0.10	0.16	0.10	0.13	0.14	0.15	0.16
C075	0.17	0.16	0.18	0.27	0.20	0.09	0.07	0.05	0.03	0.08	0.06	0.10	0.06	0.10	0.21	0.21	0.17
C078	0.08	0.12	0.18	0.29	0.23	0.14	0.10	0.06	0.03	0.08	0.07	0.07	0.05	0.06	0.12	0.12	0.16
C079	0.09	0.09	0.13	0.26	0.25	0.15	0.11	0.07	0.04	0.11	0.09	0.11	0.08	0.14	0.21	0.18	0.16
C080	0.13	0.08	0.10	0.14	0.10	0.07	0.06	0.07	0.03	0.12	0.09	0.11	0.07	0.14	0.20	0.20	0.10
C081	0.25	0.14	0.12	0.20	0.19	0.17	0.15	0.12	0.05	0.08	0.06	0.10	0.07	0.14	0.36	0.40	0.17

Table B2 (cont.): Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Site 3

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C086	0.28	0.18	0.11	0.13	0.13	0.11	0.09	0.07	0.03	0.08	0.07	0.11	0.08	0.21	0.47	0.47	0.15
C087	0.22	0.23	0.27	0.28	0.16	0.13	0.15	0.11	0.05	0.12	0.10	0.17	0.10	0.20	0.30	0.28	0.19
C088	0.18	0.18	0.25	0.33	0.25	0.15	0.13	0.11	0.06	0.14	0.11	0.19	0.12	0.22	0.30	0.27	0.21
C089	0.27	0.19	0.16	0.23	0.24	0.17	0.10	0.08	0.03	0.05	0.04	0.07	0.07	0.20	0.42	0.36	0.19
C090	0.12	0.10	0.10	0.16	0.25	0.22	0.18	0.12	0.05	0.10	0.07	0.13	0.12	0.26	0.21	0.15	0.16
C091	0.20	0.22	0.24	0.27	0.17	0.11	0.11	0.10	0.04	0.07	0.05	0.07	0.05	0.10	0.19	0.25	0.17
C092	0.21	0.23	0.21	0.17	0.10	0.08	0.09	0.09	0.04	0.06	0.05	0.07	0.04	0.07	0.13	0.19	0.13
C093	0.18	0.20	0.20	0.23	0.18	0.15	0.13	0.13	0.05	0.08	0.06	0.09	0.07	0.16	0.16	0.17	0.17
C094	0.20	0.17	0.16	0.20	0.18	0.15	0.14	0.15	0.04	0.07	0.06	0.09	0.05	0.11	0.20	0.24	0.16
C101	0.24	0.22	0.18	0.17	0.20	0.19	0.20	0.17	0.05	0.08	0.06	0.08	0.06	0.15	0.27	0.32	0.18
C103	0.15	0.11	0.12	0.15	0.19	0.15	0.13	0.12	0.04	0.08	0.05	0.08	0.06	0.14	0.24	0.32	0.14
C104	0.24	0.22	0.21	0.18	0.19	0.18	0.18	0.14	0.05	0.10	0.07	0.14	0.12	0.18	0.29	0.37	0.18
C105	0.26	0.20	0.15	0.13	0.20	0.20	0.16	0.12	0.04	0.11	0.09	0.17	0.13	0.20	0.22	0.39	0.18
														Mean			0.15
														Standard deviation			0.03

Table B3: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Site 4

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A01	0.13	0.12	0.17	0.19	0.14	0.08	0.07	0.08	0.04	0.06	0.03	0.08	0.04	0.05	0.10	0.15	0.12
A02	0.20	0.20	0.20	0.24	0.20	0.12	0.09	0.11	0.05	0.06	0.04	0.09	0.05	0.07	0.12	0.17	0.17
C038	0.18	0.23	0.25	0.32	0.23	0.14	0.10	0.09	0.04	0.07	0.04	0.09	0.07	0.08	0.17	0.19	0.20
C042	0.26	0.22	0.20	0.25	0.20	0.12	0.08	0.09	0.05	0.07	0.04	0.09	0.06	0.10	0.28	0.36	0.18
C043	0.12	0.16	0.24	0.34	0.26	0.14	0.09	0.09	0.05	0.08	0.04	0.11	0.07	0.08	0.16	0.19	0.19
C044	0.12	0.15	0.18	0.24	0.20	0.10	0.08	0.09	0.05	0.08	0.04	0.13	0.07	0.07	0.15	0.16	0.16
C045	0.16	0.17	0.20	0.28	0.21	0.11	0.10	0.12	0.07	0.10	0.05	0.12	0.07	0.07	0.13	0.18	0.17
C046	0.16	0.14	0.20	0.33	0.27	0.16	0.09	0.09	0.04	0.06	0.03	0.10	0.05	0.10	0.24	0.23	0.20
C049	0.13	0.12	0.13	0.22	0.20	0.10	0.10	0.13	0.06	0.08	0.04	0.10	0.06	0.07	0.12	0.15	0.15
C050	0.22	0.20	0.18	0.24	0.23	0.15	0.10	0.11	0.04	0.05	0.03	0.07	0.04	0.10	0.24	0.25	0.18
C051	0.13	0.13	0.16	0.23	0.21	0.11	0.11	0.13	0.05	0.06	0.03	0.10	0.05	0.08	0.12	0.15	0.15
C055	0.10	0.10	0.14	0.27	0.23	0.14	0.12	0.12	0.04	0.06	0.04	0.09	0.05	0.07	0.12	0.13	0.16
C056	0.18	0.16	0.21	0.27	0.20	0.12	0.09	0.09	0.04	0.05	0.03	0.10	0.05	0.07	0.13	0.15	0.17
C057	0.18	0.17	0.17	0.20	0.19	0.11	0.10	0.13	0.04	0.05	0.03	0.09	0.04	0.07	0.12	0.14	0.15
C058	0.25	0.21	0.23	0.29	0.25	0.16	0.11	0.12	0.04	0.05	0.04	0.08	0.05	0.11	0.25	0.26	0.20
C061	0.22	0.23	0.29	0.38	0.30	0.19	0.11	0.11	0.04	0.06	0.05	0.08	0.05	0.11	0.19	0.18	0.23
C062	0.20	0.13	0.11	0.13	0.12	0.08	0.10	0.10	0.04	0.06	0.04	0.09	0.05	0.09	0.18	0.23	0.12
														Mean			0.17
														Standard deviation			0.03

Table B4: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – East Harbourfront

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C039	0.25	0.20	0.21	0.33	0.28	0.18	0.13	0.10	0.05	0.08	0.04	0.11	0.07	0.15	0.33	0.36	0.22
C040	0.30	0.28	0.30	0.38	0.30	0.21	0.14	0.11	0.06	0.08	0.04	0.14	0.07	0.20	0.38	0.39	0.26
C041	0.24	0.21	0.25	0.34	0.29	0.19	0.11	0.11	0.06	0.08	0.04	0.12	0.07	0.15	0.34	0.37	0.23
C047	0.26	0.25	0.27	0.31	0.28	0.20	0.12	0.13	0.06	0.07	0.04	0.12	0.06	0.15	0.33	0.39	0.23
C048	0.18	0.16	0.21	0.31	0.29	0.18	0.10	0.11	0.05	0.06	0.04	0.10	0.05	0.11	0.25	0.25	0.20
C059	0.23	0.21	0.19	0.21	0.18	0.14	0.12	0.13	0.04	0.06	0.04	0.09	0.05	0.13	0.26	0.27	0.17
C060	0.25	0.21	0.19	0.26	0.24	0.19	0.14	0.14	0.04	0.06	0.05	0.09	0.06	0.13	0.23	0.24	0.20
														Mean			0.22
														Standard deviation			0.03

Table B5: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – North Harbourfront

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C095	0.16	0.15	0.19	0.26	0.16	0.10	0.09	0.10	0.04	0.05	0.05	0.08	0.04	0.13	0.19	0.22	0.15
C097	0.20	0.17	0.16	0.22	0.21	0.18	0.16	0.17	0.05	0.07	0.06	0.09	0.06	0.15	0.25	0.27	0.17
C098	0.22	0.24	0.24	0.28	0.19	0.11	0.10	0.10	0.03	0.06	0.05	0.06	0.05	0.11	0.19	0.16	0.18
C099	0.24	0.20	0.17	0.24	0.15	0.11	0.12	0.12	0.04	0.06	0.04	0.06	0.09	0.21	0.39	0.44	0.17
C100	0.31	0.25	0.20	0.21	0.17	0.18	0.18	0.18	0.04	0.07	0.05	0.08	0.08	0.18	0.36	0.45	0.19
C102	0.13	0.11	0.10	0.13	0.19	0.19	0.17	0.16	0.04	0.07	0.05	0.07	0.06	0.13	0.20	0.21	0.14
C118	0.25	0.23	0.18	0.16	0.17	0.18	0.17	0.16	0.04	0.08	0.07	0.12	0.09	0.19	0.29	0.31	0.17
C119	0.25	0.22	0.18	0.18	0.14	0.11	0.12	0.10	0.04	0.07	0.06	0.09	0.08	0.18	0.29	0.32	0.16
														Mean			0.17
														Standard deviation			0.02

Table B6: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – West Harbourfront

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C001	0.11	0.14	0.22	0.33	0.26	0.14	0.14	0.09	0.08	0.23	0.09	0.13	0.16	0.32	0.28	0.17	0.20
C003	0.15	0.15	0.18	0.19	0.14	0.08	0.07	0.06	0.05	0.09	0.05	0.10	0.08	0.16	0.22	0.22	0.14
C005	0.18	0.16	0.17	0.17	0.15	0.12	0.13	0.11	0.06	0.17	0.10	0.14	0.08	0.19	0.24	0.25	0.15
C128	0.17	0.15	0.14	0.16	0.17	0.15	0.13	0.11	0.05	0.13	0.08	0.11	0.09	0.21	0.25	0.25	0.15
														Mean			0.16
														Standard deviation			0.03

Table B7: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Open Area

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C032	0.14	0.15	0.22	0.29	0.18	0.08	0.12	0.17	0.10	0.15	0.08	0.13	0.09	0.05	0.09	0.15	0.17
C033	0.11	0.11	0.15	0.23	0.19	0.09	0.11	0.11	0.05	0.06	0.03	0.08	0.05	0.06	0.11	0.13	0.14
C035	0.11	0.12	0.15	0.21	0.22	0.09	0.08	0.08	0.04	0.07	0.04	0.10	0.05	0.07	0.14	0.16	0.15
C036	0.12	0.14	0.21	0.30	0.22	0.10	0.07	0.09	0.05	0.07	0.04	0.08	0.06	0.08	0.16	0.15	0.17
C037	0.14	0.14	0.18	0.26	0.20	0.11	0.09	0.08	0.04	0.06	0.04	0.08	0.06	0.09	0.20	0.22	0.16
C130	0.26	0.26	0.28	0.29	0.22	0.16	0.10	0.10	0.07	0.10	0.06	0.11	0.08	0.06	0.12	0.22	0.21
														Mean			0.16
														Standard deviation			0.02

Table B8: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A– High-rise Development Area

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C004	0.18	0.13	0.19	0.35	0.29	0.16	0.11	0.06	0.04	0.07	0.04	0.08	0.10	0.38	0.49	0.34	0.21
C007	0.15	0.17	0.20	0.18	0.08	0.06	0.06	0.06	0.04	0.11	0.07	0.15	0.13	0.14	0.11	0.14	0.12
C008	0.13	0.19	0.16	0.24	0.24	0.11	0.06	0.07	0.07	0.12	0.04	0.10	0.05	0.14	0.26	0.14	0.17
C009	0.16	0.19	0.19	0.38	0.28	0.11	0.07	0.06	0.05	0.09	0.08	0.11	0.05	0.17	0.25	0.20	0.21
C010	0.21	0.17	0.22	0.43	0.34	0.16	0.08	0.06	0.07	0.22	0.15	0.18	0.10	0.20	0.32	0.27	0.25
C015	0.11	0.15	0.21	0.38	0.33	0.18	0.10	0.06	0.04	0.12	0.08	0.11	0.08	0.13	0.13	0.12	0.22
C016	0.13	0.15	0.21	0.33	0.26	0.13	0.08	0.06	0.04	0.14	0.09	0.09	0.05	0.08	0.11	0.14	0.19
C082	0.20	0.13	0.30	0.55	0.46	0.27	0.16	0.05	0.04	0.11	0.07	0.11	0.05	0.10	0.16	0.21	0.30
C084	0.23	0.14	0.14	0.18	0.22	0.13	0.07	0.06	0.04	0.10	0.10	0.12	0.08	0.20	0.29	0.31	0.17
C085	0.27	0.18	0.20	0.31	0.28	0.24	0.22	0.15	0.06	0.09	0.07	0.14	0.10	0.19	0.41	0.45	0.23
C108	0.28	0.18	0.20	0.33	0.29	0.22	0.22	0.16	0.06	0.11	0.07	0.13	0.14	0.35	0.53	0.49	0.25
C109	0.20	0.15	0.19	0.28	0.24	0.17	0.15	0.12	0.05	0.11	0.07	0.11	0.07	0.14	0.23	0.20	0.19
C110	0.32	0.22	0.24	0.43	0.37	0.28	0.23	0.16	0.05	0.10	0.05	0.11	0.14	0.36	0.58	0.57	0.29
C129	0.24	0.22	0.17	0.17	0.12	0.11	0.10	0.09	0.05	0.13	0.06	0.09	0.05	0.08	0.21	0.31	0.15
														Mean			0.21
														Standard deviation			0.05

Table B9: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Existing Development Area

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C011	0.18	0.16	0.19	0.32	0.23	0.09	0.05	0.04	0.04	0.11	0.08	0.09	0.05	0.08	0.10	0.14	0.18
C012	0.12	0.17	0.29	0.41	0.30	0.14	0.06	0.09	0.07	0.12	0.06	0.08	0.05	0.06	0.18	0.08	0.22
C013	0.09	0.06	0.07	0.13	0.10	0.05	0.04	0.06	0.05	0.11	0.08	0.08	0.04	0.06	0.10	0.11	0.08
C014	0.23	0.21	0.26	0.52	0.40	0.20	0.09	0.05	0.03	0.10	0.07	0.07	0.05	0.12	0.18	0.25	0.28
C017	0.13	0.15	0.21	0.32	0.30	0.15	0.09	0.06	0.04	0.09	0.08	0.17	0.11	0.11	0.13	0.19	0.21
C018	0.19	0.23	0.27	0.36	0.25	0.11	0.06	0.05	0.04	0.12	0.11	0.10	0.05	0.11	0.20	0.22	0.21
C019	0.22	0.25	0.30	0.42	0.27	0.12	0.08	0.10	0.06	0.09	0.06	0.09	0.05	0.09	0.14	0.18	0.23
C020	0.13	0.17	0.26	0.44	0.29	0.10	0.07	0.08	0.07	0.12	0.09	0.13	0.04	0.05	0.07	0.10	0.22
C021	0.20	0.24	0.31	0.43	0.26	0.11	0.10	0.17	0.13	0.19	0.12	0.18	0.07	0.08	0.12	0.19	0.23
C022	0.23	0.20	0.24	0.29	0.23	0.11	0.11	0.15	0.10	0.15	0.11	0.15	0.07	0.14	0.25	0.27	0.20
C023	0.16	0.18	0.20	0.20	0.13	0.05	0.09	0.10	0.05	0.09	0.07	0.10	0.05	0.08	0.12	0.13	0.13
C024	0.11	0.12	0.13	0.17	0.11	0.06	0.12	0.14	0.08	0.15	0.11	0.16	0.07	0.12	0.13	0.10	0.12
C025	0.14	0.15	0.15	0.17	0.09	0.05	0.14	0.19	0.09	0.12	0.08	0.15	0.06	0.07	0.08	0.11	0.12
C026	0.38	0.42	0.45	0.51	0.21	0.07	0.08	0.11	0.08	0.12	0.07	0.10	0.07	0.08	0.14	0.26	0.27
C027	0.09	0.10	0.14	0.16	0.11	0.05	0.06	0.08	0.04	0.06	0.04	0.08	0.06	0.05	0.11	0.11	0.10
C028	0.25	0.24	0.22	0.22	0.08	0.05	0.11	0.14	0.08	0.13	0.10	0.13	0.07	0.06	0.09	0.16	0.15
C029	0.23	0.27	0.35	0.48	0.27	0.10	0.12	0.15	0.08	0.12	0.09	0.17	0.09	0.07	0.09	0.18	0.25
C030	0.48	0.46	0.46	0.51	0.28	0.12	0.17	0.24	0.17	0.29	0.21	0.35	0.16	0.09	0.16	0.42	0.34
C031	0.08	0.08	0.17	0.23	0.11	0.07	0.12	0.18	0.11	0.16	0.09	0.13	0.08	0.04	0.06	0.09	0.12
														Mean			0.19
														Standard deviation			0.07

Table B10: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Special Test Points

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A05	0.08	0.14	0.19	0.23	0.16	0.11	0.09	0.06	0.03	0.05	0.03	0.05	0.03	0.05	0.08	0.11	0.13
A06	0.08	0.15	0.24	0.32	0.24	0.17	0.13	0.08	0.04	0.09	0.09	0.08	0.04	0.07	0.10	0.12	0.18
A07	0.10	0.18	0.24	0.25	0.15	0.10	0.09	0.07	0.03	0.06	0.04	0.05	0.03	0.06	0.10	0.17	0.14
A08	0.12	0.08	0.10	0.17	0.16	0.11	0.09	0.07	0.03	0.05	0.03	0.05	0.04	0.06	0.10	0.18	0.11
A10	0.07	0.06	0.07	0.16	0.21	0.15	0.12	0.09	0.03	0.07	0.05	0.09	0.09	0.25	0.20	0.10	0.13
C002	0.21	0.20	0.24	0.39	0.33	0.19	0.14	0.10	0.07	0.11	0.07	0.12	0.19	0.41	0.39	0.28	0.25
C006	0.25	0.21	0.19	0.24	0.13	0.10	0.13	0.13	0.08	0.17	0.09	0.20	0.12	0.16	0.29	0.34	0.17
C076	0.12	0.17	0.21	0.29	0.20	0.11	0.08	0.04	0.03	0.05	0.06	0.07	0.05	0.06	0.09	0.09	0.16
C077	0.08	0.10	0.13	0.20	0.17	0.11	0.08	0.05	0.03	0.06	0.06	0.07	0.04	0.04	0.07	0.11	0.12
C083	0.24	0.11	0.17	0.26	0.36	0.23	0.14	0.06	0.03	0.05	0.03	0.09	0.13	0.31	0.42	0.43	0.23
C096	0.39	0.38	0.38	0.45	0.40	0.34	0.23	0.25	0.09	0.08	0.07	0.13	0.07	0.29	0.48	0.56	0.34
C113	0.16	0.12	0.16	0.25	0.16	0.10	0.11	0.09	0.04	0.10	0.05	0.10	0.11	0.28	0.38	0.33	0.15
C120	0.16	0.15	0.16	0.18	0.16	0.15	0.15	0.13	0.03	0.09	0.09	0.13	0.07	0.14	0.24	0.25	0.15
C126	0.24	0.22	0.32	0.40	0.37	0.32	0.22	0.15	0.05	0.13	0.06	0.15	0.21	0.38	0.48	0.45	0.29

Table B11: Averaged directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – Benchmark test points

0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
0.26	0.24	0.26	0.34	0.29	0.20	0.13	0.11	0.06	0.08	0.04	0.12	0.07	0.16	0.35	0.38	0.24

Table B12: Averaged directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – North Harbourfront

0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
0.22	0.20	0.18	0.21	0.17	0.15	0.14	0.14	0.04	0.07	0.05	0.08	0.07	0.16	0.27	0.30	0.17

Table B13: Averaged directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – West Harbourfront

0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
0.16	0.15	0.18	0.21	0.18	0.12	0.12	0.09	0.06	0.15	0.08	0.12	0.10	0.22	0.25	0.22	0.16

Table B14: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – test points to the north of the low-rise buildings in Site 4

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C038	0.18	0.23	0.25	0.32	0.23	0.14	0.10	0.09	0.04	0.07	0.04	0.09	0.07	0.08	0.17	0.19	0.20
C042	0.26	0.22	0.20	0.25	0.20	0.12	0.08	0.09	0.05	0.07	0.04	0.09	0.06	0.10	0.28	0.36	0.18
C046	0.16	0.14	0.20	0.33	0.27	0.16	0.09	0.09	0.04	0.06	0.03	0.10	0.05	0.10	0.24	0.23	0.20
C050	0.22	0.20	0.18	0.24	0.23	0.15	0.10	0.11	0.04	0.05	0.03	0.07	0.04	0.10	0.24	0.25	0.18
C058	0.25	0.21	0.23	0.29	0.25	0.16	0.11	0.12	0.04	0.05	0.04	0.08	0.05	0.11	0.25	0.26	0.20
C061	0.22	0.23	0.29	0.38	0.30	0.19	0.11	0.11	0.04	0.06	0.05	0.08	0.05	0.11	0.19	0.18	0.23
Mean	0.21	0.21	0.23	0.30	0.25	0.15	0.10	0.10	0.04	0.06	0.04	0.08	0.05	0.10	0.23	0.24	0.20

Table B15: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – test points to the south of the low-rise buildings in Site 4

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A01	0.13	0.12	0.17	0.19	0.14	0.08	0.07	0.08	0.04	0.06	0.03	0.08	0.04	0.05	0.10	0.15	0.12
A02	0.20	0.20	0.20	0.24	0.20	0.12	0.09	0.11	0.05	0.06	0.04	0.09	0.05	0.07	0.12	0.17	0.17
C043	0.12	0.16	0.24	0.34	0.26	0.14	0.09	0.09	0.05	0.08	0.04	0.11	0.07	0.08	0.16	0.19	0.19
C044	0.12	0.15	0.18	0.24	0.20	0.10	0.08	0.09	0.05	0.08	0.04	0.13	0.07	0.07	0.15	0.16	0.16
C045	0.16	0.17	0.20	0.28	0.21	0.11	0.10	0.12	0.07	0.10	0.05	0.12	0.07	0.07	0.13	0.18	0.17
C049	0.13	0.12	0.13	0.22	0.20	0.10	0.10	0.13	0.06	0.08	0.04	0.10	0.06	0.07	0.12	0.15	0.15
C051	0.13	0.13	0.16	0.23	0.21	0.11	0.11	0.13	0.05	0.06	0.03	0.10	0.05	0.08	0.12	0.15	0.15
C055	0.10	0.10	0.14	0.27	0.23	0.14	0.12	0.12	0.04	0.06	0.04	0.09	0.05	0.07	0.12	0.13	0.16
C056	0.18	0.16	0.21	0.27	0.20	0.12	0.09	0.09	0.04	0.05	0.03	0.10	0.05	0.07	0.13	0.15	0.17
C057	0.18	0.17	0.17	0.20	0.19	0.11	0.10	0.13	0.04	0.05	0.03	0.09	0.04	0.07	0.12	0.14	0.15
C062	0.20	0.13	0.11	0.13	0.12	0.08	0.10	0.10	0.04	0.06	0.04	0.09	0.05	0.09	0.18	0.23	0.12
Mean	0.15	0.15	0.17	0.24	0.20	0.11	0.09	0.11	0.05	0.07	0.04	0.10	0.05	0.07	0.13	0.16	0.16

Table B16: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – test points in open space in Site 3

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A11	0.16	0.22	0.24	0.22	0.13	0.10	0.09	0.08	0.04	0.06	0.04	0.06	0.04	0.07	0.13	0.16	0.15
A12	0.15	0.20	0.20	0.19	0.14	0.10	0.09	0.07	0.04	0.06	0.05	0.06	0.04	0.06	0.12	0.16	0.13
C034	0.12	0.10	0.16	0.26	0.22	0.12	0.12	0.12	0.05	0.06	0.04	0.10	0.06	0.08	0.12	0.14	0.16
C054	0.15	0.14	0.16	0.26	0.22	0.12	0.12	0.10	0.05	0.06	0.04	0.10	0.06	0.08	0.13	0.17	0.17
C063	0.20	0.18	0.16	0.21	0.19	0.11	0.12	0.09	0.04	0.06	0.04	0.09	0.05	0.08	0.15	0.19	0.16
C064	0.18	0.19	0.19	0.23	0.19	0.11	0.11	0.09	0.05	0.08	0.05	0.11	0.07	0.08	0.15	0.18	0.16
C072	0.15	0.18	0.19	0.23	0.17	0.10	0.10	0.07	0.05	0.06	0.05	0.09	0.05	0.08	0.14	0.15	0.15
C091	0.20	0.22	0.24	0.27	0.17	0.11	0.11	0.10	0.04	0.07	0.05	0.07	0.05	0.10	0.19	0.25	0.17
C092	0.21	0.23	0.21	0.17	0.10	0.08	0.09	0.09	0.04	0.06	0.05	0.07	0.04	0.07	0.13	0.19	0.13
C093	0.18	0.20	0.20	0.23	0.18	0.15	0.13	0.13	0.05	0.08	0.06	0.09	0.07	0.16	0.16	0.17	0.17
C094	0.20	0.17	0.16	0.20	0.18	0.15	0.14	0.15	0.04	0.07	0.06	0.09	0.05	0.11	0.20	0.24	0.16
C101	0.24	0.22	0.18	0.17	0.20	0.19	0.20	0.17	0.05	0.08	0.06	0.08	0.06	0.15	0.27	0.32	0.18
Mean	0.18	0.19	0.19	0.22	0.17	0.12	0.12	0.10	0.04	0.07	0.05	0.08	0.05	0.09	0.16	0.19	0.16

Table B17: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – other test points in Site 3

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A03	0.15	0.17	0.19	0.23	0.16	0.10	0.10	0.07	0.05	0.07	0.04	0.08	0.06	0.06	0.10	0.11	0.15
A04	0.09	0.16	0.20	0.23	0.17	0.12	0.10	0.06	0.03	0.05	0.03	0.06	0.04	0.05	0.09	0.11	0.14
A09	0.26	0.19	0.17	0.15	0.15	0.12	0.12	0.08	0.03	0.05	0.04	0.07	0.06	0.12	0.25	0.35	0.15
C052	0.14	0.15	0.21	0.28	0.18	0.09	0.12	0.10	0.05	0.06	0.03	0.09	0.06	0.06	0.12	0.13	0.16
C053	0.14	0.15	0.19	0.25	0.16	0.08	0.10	0.07	0.04	0.05	0.03	0.08	0.05	0.06	0.10	0.13	0.14
C065	0.16	0.18	0.17	0.18	0.13	0.08	0.09	0.08	0.05	0.08	0.05	0.10	0.07	0.07	0.13	0.15	0.13
C066	0.09	0.09	0.10	0.11	0.09	0.05	0.06	0.07	0.04	0.07	0.06	0.08	0.06	0.06	0.10	0.09	0.08
C067	0.17	0.18	0.20	0.20	0.11	0.06	0.10	0.12	0.08	0.13	0.09	0.12	0.09	0.07	0.13	0.14	0.14
C068	0.12	0.12	0.17	0.19	0.14	0.07	0.07	0.10	0.06	0.11	0.12	0.13	0.07	0.11	0.14	0.12	0.13
C069	0.11	0.15	0.18	0.23	0.18	0.10	0.06	0.05	0.03	0.04	0.02	0.05	0.05	0.04	0.07	0.07	0.14
C070	0.17	0.16	0.18	0.19	0.15	0.08	0.07	0.12	0.08	0.12	0.13	0.13	0.07	0.11	0.15	0.25	0.14
C071	0.12	0.15	0.23	0.36	0.28	0.16	0.12	0.07	0.04	0.08	0.10	0.14	0.07	0.08	0.18	0.18	0.21
C073	0.09	0.12	0.15	0.15	0.11	0.06	0.06	0.06	0.03	0.06	0.06	0.09	0.06	0.07	0.11	0.13	0.10
C074	0.12	0.19	0.26	0.24	0.17	0.08	0.07	0.08	0.04	0.14	0.10	0.16	0.10	0.13	0.14	0.15	0.16
C075	0.17	0.16	0.18	0.27	0.20	0.09	0.07	0.05	0.03	0.08	0.06	0.10	0.06	0.10	0.21	0.21	0.17
C078	0.08	0.12	0.18	0.29	0.23	0.14	0.10	0.06	0.03	0.08	0.07	0.07	0.05	0.06	0.12	0.12	0.16
C079	0.09	0.09	0.13	0.26	0.25	0.15	0.11	0.07	0.04	0.11	0.09	0.11	0.08	0.14	0.21	0.18	0.16
C080	0.13	0.08	0.10	0.14	0.10	0.07	0.06	0.07	0.03	0.12	0.09	0.11	0.07	0.14	0.20	0.20	0.10
C081	0.25	0.14	0.12	0.20	0.19	0.17	0.15	0.12	0.05	0.08	0.06	0.10	0.07	0.14	0.36	0.40	0.17
C086	0.28	0.18	0.11	0.13	0.13	0.11	0.09	0.07	0.03	0.08	0.07	0.11	0.08	0.21	0.47	0.47	0.15
C087	0.22	0.23	0.27	0.28	0.16	0.13	0.15	0.11	0.05	0.12	0.10	0.17	0.10	0.20	0.30	0.28	0.19
C088	0.18	0.18	0.25	0.33	0.25	0.15	0.13	0.11	0.06	0.14	0.11	0.19	0.12	0.22	0.30	0.27	0.21
C089	0.27	0.19	0.16	0.23	0.24	0.17	0.10	0.08	0.03	0.05	0.04	0.07	0.07	0.20	0.42	0.36	0.19
C090	0.12	0.10	0.10	0.16	0.25	0.22	0.18	0.12	0.05	0.10	0.07	0.13	0.12	0.26	0.21	0.15	0.16
C103	0.15	0.11	0.12	0.15	0.19	0.15	0.13	0.12	0.04	0.08	0.05	0.08	0.06	0.14	0.24	0.32	0.14
C104	0.24	0.22	0.21	0.18	0.19	0.18	0.18	0.14	0.05	0.10	0.07	0.14	0.12	0.18	0.29	0.37	0.18
C105	0.26	0.20	0.15	0.13	0.20	0.20	0.16	0.12	0.04	0.11	0.09	0.17	0.13	0.20	0.22	0.39	0.18
Mean	0.16	0.16	0.17	0.21	0.18	0.12	0.11	0.09	0.04	0.09	0.07	0.11	0.07	0.12	0.20	0.22	0.15

Table B18: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme A – test points in the vicinity of Connaught Road

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C009	0.16	0.19	0.19	0.38	0.28	0.11	0.07	0.06	0.05	0.09	0.08	0.11	0.05	0.17	0.25	0.20	0.21
C010	0.21	0.17	0.22	0.43	0.34	0.16	0.08	0.06	0.07	0.22	0.15	0.18	0.10	0.20	0.32	0.27	0.25
C011	0.18	0.16	0.19	0.32	0.23	0.09	0.05	0.04	0.04	0.11	0.08	0.09	0.05	0.08	0.10	0.14	0.18
C014	0.23	0.21	0.26	0.52	0.40	0.20	0.09	0.05	0.03	0.10	0.07	0.07	0.05	0.12	0.18	0.25	0.28
C018	0.19	0.23	0.27	0.36	0.25	0.11	0.06	0.05	0.04	0.12	0.11	0.10	0.05	0.11	0.20	0.22	0.21
C022	0.23	0.20	0.24	0.29	0.23	0.11	0.11	0.15	0.10	0.15	0.11	0.15	0.07	0.14	0.25	0.27	0.20
C026	0.38	0.42	0.45	0.51	0.21	0.07	0.08	0.11	0.08	0.12	0.07	0.10	0.07	0.08	0.14	0.26	0.27
C028	0.25	0.24	0.22	0.22	0.08	0.05	0.11	0.14	0.08	0.13	0.10	0.13	0.07	0.06	0.09	0.16	0.15
C029	0.23	0.27	0.35	0.48	0.27	0.10	0.12	0.15	0.08	0.12	0.09	0.17	0.09	0.07	0.09	0.18	0.25
Mean	0.23	0.23	0.27	0.39	0.25	0.11	0.09	0.09	0.06	0.13	0.09	0.12	0.07	0.11	0.18	0.22	0.22

Appendix C

Directional Wind Velocity Ratios of the Test Points – Design Scheme B

Table C1: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Sites 1 and 2

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C106	0.16	0.19	0.24	0.42	0.32	0.18	0.15	0.13	0.06	0.14	0.09	0.22	0.16	0.24	0.21	0.21	0.25
C107	0.17	0.18	0.29	0.50	0.34	0.22	0.21	0.16	0.06	0.12	0.07	0.19	0.15	0.31	0.31	0.27	0.27
C111	0.22	0.15	0.19	0.36	0.34	0.26	0.24	0.18	0.06	0.13	0.08	0.18	0.16	0.40	0.55	0.47	0.26
C112	0.23	0.16	0.19	0.34	0.26	0.22	0.24	0.19	0.06	0.15	0.07	0.14	0.17	0.45	0.62	0.53	0.23
C114	0.14	0.23	0.38	0.59	0.44	0.23	0.14	0.11	0.04	0.10	0.08	0.18	0.17	0.34	0.44	0.30	0.32
C115	0.20	0.13	0.16	0.28	0.26	0.20	0.18	0.12	0.04	0.07	0.06	0.12	0.13	0.37	0.43	0.33	0.20
C116	0.25	0.20	0.21	0.32	0.28	0.20	0.18	0.15	0.05	0.10	0.06	0.13	0.10	0.24	0.39	0.39	0.23
C117	0.25	0.20	0.16	0.16	0.19	0.22	0.19	0.14	0.04	0.08	0.05	0.10	0.09	0.27	0.44	0.44	0.18
C121	0.33	0.29	0.21	0.29	0.31	0.25	0.26	0.17	0.04	0.11	0.09	0.13	0.14	0.31	0.55	0.55	0.26
C122	0.13	0.14	0.23	0.36	0.29	0.21	0.20	0.13	0.04	0.09	0.08	0.17	0.17	0.36	0.43	0.27	0.23
C123	0.19	0.26	0.23	0.35	0.36	0.28	0.25	0.15	0.04	0.09	0.06	0.13	0.14	0.35	0.35	0.21	0.26
C124	0.18	0.12	0.12	0.32	0.33	0.23	0.20	0.12	0.03	0.07	0.04	0.08	0.14	0.35	0.49	0.36	0.22
C125	0.22	0.24	0.31	0.45	0.29	0.16	0.12	0.08	0.04	0.11	0.09	0.16	0.15	0.30	0.31	0.28	0.26
C127	0.21	0.13	0.17	0.40	0.32	0.20	0.18	0.10	0.04	0.11	0.09	0.13	0.14	0.31	0.38	0.30	0.24
														Mean			0.24
														Standard deviation			0.03

Table C2: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Site 3

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
B03	0.11	0.13	0.15	0.18	0.13	0.08	0.08	0.07	0.04	0.07	0.07	0.09	0.06	0.07	0.12	0.10	0.12
B04	0.09	0.10	0.10	0.14	0.11	0.07	0.07	0.05	0.03	0.04	0.03	0.06	0.04	0.06	0.10	0.11	0.09
B06	0.24	0.22	0.19	0.20	0.13	0.09	0.10	0.09	0.04	0.05	0.04	0.07	0.05	0.09	0.14	0.25	0.15
B07	0.14	0.14	0.14	0.17	0.13	0.09	0.08	0.07	0.03	0.05	0.04	0.06	0.04	0.07	0.12	0.16	0.12
B12	0.16	0.15	0.15	0.17	0.14	0.11	0.11	0.10	0.03	0.07	0.05	0.08	0.06	0.10	0.15	0.17	0.13
C034	0.20	0.19	0.18	0.24	0.19	0.11	0.13	0.11	0.04	0.06	0.04	0.09	0.05	0.09	0.13	0.19	0.16
C052	0.16	0.16	0.21	0.26	0.17	0.09	0.12	0.09	0.04	0.06	0.03	0.10	0.06	0.06	0.11	0.15	0.16
C053	0.18	0.16	0.19	0.23	0.16	0.08	0.10	0.07	0.04	0.05	0.03	0.09	0.05	0.06	0.10	0.14	0.15
C054	0.14	0.12	0.12	0.15	0.13	0.08	0.09	0.07	0.03	0.05	0.03	0.07	0.04	0.07	0.11	0.15	0.11
C063	0.18	0.15	0.13	0.16	0.13	0.08	0.09	0.08	0.04	0.05	0.04	0.07	0.05	0.08	0.12	0.19	0.12
C064	0.15	0.15	0.16	0.22	0.19	0.11	0.10	0.08	0.04	0.05	0.04	0.09	0.05	0.08	0.14	0.16	0.15
C065	0.13	0.13	0.14	0.17	0.14	0.08	0.08	0.07	0.04	0.06	0.05	0.09	0.06	0.06	0.12	0.11	0.12
C066	0.11	0.11	0.12	0.14	0.12	0.07	0.07	0.09	0.05	0.08	0.07	0.09	0.06	0.06	0.11	0.10	0.11
C067	0.19	0.20	0.21	0.21	0.12	0.06	0.10	0.12	0.09	0.13	0.09	0.13	0.09	0.08	0.13	0.15	0.15
C068	0.18	0.17	0.20	0.22	0.16	0.08	0.09	0.12	0.08	0.13	0.12	0.14	0.07	0.10	0.14	0.19	0.16
C069	0.12	0.13	0.15	0.16	0.12	0.06	0.07	0.07	0.05	0.10	0.11	0.12	0.06	0.07	0.10	0.13	0.12
C070	0.15	0.16	0.17	0.20	0.15	0.09	0.08	0.11	0.06	0.13	0.15	0.13	0.07	0.12	0.15	0.21	0.15
C071	0.15	0.13	0.19	0.26	0.17	0.11	0.09	0.06	0.04	0.08	0.09	0.14	0.07	0.06	0.13	0.19	0.16
C072	0.09	0.09	0.10	0.14	0.10	0.07	0.08	0.06	0.03	0.05	0.03	0.07	0.04	0.07	0.13	0.12	0.09
C073	0.13	0.17	0.20	0.22	0.21	0.11	0.09	0.06	0.03	0.09	0.08	0.13	0.07	0.07	0.14	0.17	0.16
C074	0.13	0.21	0.27	0.31	0.26	0.12	0.07	0.08	0.04	0.14	0.12	0.19	0.11	0.13	0.15	0.14	0.20
C075	0.14	0.14	0.18	0.30	0.23	0.11	0.07	0.06	0.03	0.10	0.07	0.12	0.07	0.12	0.22	0.24	0.18
C078	0.11	0.09	0.11	0.15	0.12	0.08	0.07	0.05	0.02	0.07	0.06	0.06	0.04	0.06	0.10	0.11	0.10
C079	0.14	0.11	0.18	0.24	0.19	0.12	0.09	0.07	0.03	0.12	0.09	0.11	0.08	0.14	0.25	0.25	0.16
C080	0.12	0.10	0.18	0.23	0.14	0.10	0.07	0.07	0.03	0.08	0.06	0.09	0.06	0.14	0.21	0.20	0.13
C081	0.19	0.12	0.11	0.18	0.21	0.19	0.15	0.11	0.04	0.09	0.06	0.10	0.08	0.15	0.32	0.34	0.16
C086	0.29	0.24	0.21	0.26	0.20	0.15	0.12	0.08	0.04	0.11	0.08	0.14	0.10	0.22	0.50	0.48	0.20
C087	0.18	0.17	0.21	0.29	0.27	0.20	0.18	0.13	0.06	0.14	0.09	0.17	0.11	0.24	0.30	0.27	0.21
C088	0.15	0.14	0.19	0.26	0.27	0.20	0.15	0.11	0.05	0.13	0.09	0.16	0.11	0.21	0.28	0.24	0.20

Table C2 (cont.): Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Site 3

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C089	0.18	0.12	0.16	0.22	0.16	0.10	0.07	0.06	0.03	0.06	0.04	0.08	0.06	0.12	0.37	0.34	0.15
C090	0.12	0.11	0.13	0.19	0.25	0.20	0.13	0.11	0.03	0.11	0.08	0.15	0.11	0.22	0.27	0.18	0.17
C091	0.20	0.18	0.19	0.22	0.15	0.11	0.10	0.10	0.04	0.08	0.05	0.08	0.06	0.10	0.16	0.21	0.15
C092	0.17	0.16	0.16	0.19	0.12	0.08	0.07	0.07	0.03	0.05	0.03	0.05	0.04	0.07	0.11	0.18	0.12
C093	0.14	0.14	0.16	0.21	0.15	0.11	0.10	0.10	0.04	0.09	0.06	0.11	0.08	0.14	0.18	0.17	0.14
C094	0.22	0.18	0.19	0.21	0.16	0.14	0.14	0.14	0.04	0.06	0.04	0.07	0.05	0.10	0.18	0.26	0.16
C101	0.26	0.22	0.17	0.16	0.16	0.16	0.16	0.14	0.04	0.07	0.05	0.08	0.06	0.13	0.27	0.31	0.16
C103	0.14	0.10	0.10	0.14	0.15	0.13	0.08	0.08	0.04	0.09	0.05	0.09	0.06	0.13	0.19	0.23	0.12
C104	0.27	0.24	0.22	0.20	0.18	0.18	0.15	0.13	0.04	0.10	0.07	0.15	0.11	0.21	0.32	0.38	0.19
C105	0.24	0.18	0.15	0.17	0.25	0.20	0.16	0.12	0.04	0.12	0.09	0.17	0.13	0.23	0.19	0.37	0.19
														Mean			0.15
														Standard deviation			0.03

Table C3: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Site 4

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
B01	0.09	0.10	0.14	0.22	0.15	0.08	0.08	0.09	0.04	0.06	0.04	0.08	0.04	0.06	0.08	0.11	0.12
B02	0.14	0.12	0.14	0.26	0.20	0.11	0.08	0.09	0.05	0.06	0.04	0.08	0.04	0.08	0.10	0.16	0.15
C038	0.19	0.20	0.23	0.31	0.22	0.14	0.10	0.09	0.04	0.06	0.04	0.07	0.06	0.07	0.17	0.19	0.19
C042	0.23	0.18	0.17	0.25	0.22	0.12	0.09	0.09	0.05	0.06	0.03	0.08	0.06	0.11	0.27	0.32	0.18
C043	0.11	0.11	0.20	0.32	0.25	0.13	0.09	0.09	0.05	0.07	0.04	0.10	0.07	0.08	0.14	0.19	0.18
C044	0.14	0.15	0.22	0.31	0.22	0.11	0.09	0.10	0.06	0.08	0.05	0.13	0.07	0.09	0.13	0.16	0.18
C045	0.26	0.19	0.18	0.23	0.16	0.09	0.09	0.12	0.07	0.09	0.05	0.12	0.06	0.10	0.23	0.34	0.17
C046	0.16	0.12	0.15	0.26	0.24	0.14	0.10	0.10	0.05	0.06	0.03	0.10	0.05	0.11	0.23	0.26	0.17
C049	0.16	0.13	0.14	0.25	0.22	0.11	0.12	0.15	0.08	0.10	0.05	0.11	0.06	0.08	0.12	0.18	0.16
C050	0.22	0.17	0.15	0.22	0.23	0.14	0.11	0.13	0.05	0.06	0.04	0.09	0.04	0.11	0.22	0.26	0.17
C051	0.16	0.12	0.13	0.19	0.18	0.11	0.11	0.12	0.05	0.06	0.04	0.09	0.05	0.09	0.15	0.22	0.14
C055	0.17	0.16	0.18	0.22	0.19	0.12	0.12	0.12	0.04	0.06	0.04	0.09	0.05	0.09	0.13	0.16	0.16
C056	0.14	0.10	0.12	0.21	0.18	0.10	0.10	0.14	0.06	0.07	0.04	0.10	0.05	0.10	0.17	0.23	0.14
C057	0.24	0.23	0.25	0.29	0.18	0.11	0.09	0.10	0.04	0.06	0.04	0.10	0.05	0.09	0.16	0.22	0.18
C058	0.28	0.20	0.17	0.20	0.21	0.15	0.11	0.13	0.04	0.06	0.04	0.10	0.05	0.12	0.24	0.32	0.18
C061	0.21	0.21	0.26	0.35	0.27	0.16	0.10	0.10	0.04	0.06	0.05	0.08	0.05	0.12	0.17	0.18	0.21
C062	0.14	0.12	0.13	0.17	0.16	0.11	0.11	0.11	0.04	0.06	0.04	0.08	0.05	0.10	0.14	0.21	0.13
														Mean			0.17
														Standard deviation			0.02

Table C4: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – East Harbourfront

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C040	0.26	0.25	0.31	0.40	0.26	0.15	0.11	0.10	0.05	0.07	0.03	0.13	0.07	0.18	0.35	0.35	0.24
C041	0.25	0.21	0.22	0.29	0.23	0.15	0.11	0.10	0.05	0.07	0.03	0.11	0.06	0.12	0.27	0.33	0.20
C047	0.26	0.22	0.22	0.32	0.30	0.20	0.13	0.12	0.05	0.06	0.04	0.13	0.06	0.15	0.30	0.37	0.23
C048	0.17	0.12	0.16	0.27	0.28	0.17	0.10	0.11	0.05	0.05	0.04	0.11	0.05	0.13	0.24	0.26	0.19
C059	0.25	0.19	0.13	0.12	0.11	0.08	0.09	0.11	0.04	0.05	0.04	0.09	0.05	0.12	0.22	0.30	0.13
C060	0.23	0.19	0.17	0.24	0.22	0.16	0.12	0.13	0.04	0.06	0.05	0.08	0.06	0.09	0.16	0.24	0.18
														Mean			0.19
														Standard deviation			0.04

Table C5: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – North Harbourfront

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C095	0.23	0.17	0.17	0.19	0.15	0.12	0.12	0.15	0.04	0.05	0.04	0.07	0.04	0.11	0.17	0.25	0.15
C097	0.23	0.19	0.19	0.27	0.15	0.16	0.17	0.19	0.05	0.07	0.06	0.09	0.06	0.15	0.24	0.30	0.17
C098	0.24	0.25	0.28	0.35	0.26	0.17	0.15	0.15	0.05	0.07	0.07	0.08	0.06	0.15	0.23	0.19	0.23
C099	0.24	0.19	0.17	0.24	0.16	0.13	0.13	0.12	0.04	0.06	0.04	0.07	0.10	0.21	0.39	0.42	0.17
C100	0.29	0.23	0.20	0.22	0.20	0.19	0.18	0.19	0.05	0.07	0.05	0.08	0.07	0.16	0.32	0.39	0.19
C102	0.15	0.14	0.11	0.16	0.22	0.20	0.19	0.18	0.05	0.07	0.05	0.08	0.07	0.13	0.21	0.25	0.16
C118	0.25	0.20	0.15	0.16	0.16	0.19	0.21	0.16	0.04	0.08	0.07	0.13	0.09	0.21	0.34	0.35	0.17
C119	0.24	0.20	0.17	0.17	0.13	0.13	0.15	0.11	0.04	0.07	0.05	0.09	0.09	0.18	0.25	0.29	0.15
														Mean			0.17
														Standard deviation			0.03

Table C6: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – West Harbourfront

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C001	0.11	0.14	0.23	0.33	0.26	0.14	0.15	0.09	0.08	0.21	0.09	0.19	0.15	0.32	0.29	0.17	0.21
C003	0.16	0.15	0.18	0.21	0.15	0.08	0.07	0.07	0.05	0.08	0.05	0.10	0.08	0.17	0.21	0.21	0.14
C005	0.17	0.14	0.16	0.17	0.14	0.15	0.16	0.12	0.06	0.15	0.09	0.16	0.08	0.20	0.25	0.25	0.15
C128	0.20	0.16	0.11	0.15	0.16	0.18	0.16	0.11	0.05	0.12	0.08	0.11	0.09	0.18	0.26	0.26	0.15
														Mean			0.16
														Standard deviation			0.03

Table C7: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Open Area

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C032	0.13	0.16	0.22	0.29	0.19	0.09	0.12	0.17	0.10	0.16	0.09	0.13	0.09	0.06	0.10	0.18	0.17
C033	0.12	0.11	0.14	0.19	0.16	0.09	0.10	0.11	0.04	0.05	0.03	0.07	0.05	0.06	0.10	0.14	0.13
C035	0.11	0.12	0.17	0.21	0.20	0.10	0.08	0.08	0.05	0.07	0.04	0.10	0.06	0.08	0.13	0.15	0.14
C036	0.12	0.12	0.21	0.31	0.22	0.11	0.08	0.09	0.05	0.06	0.04	0.09	0.06	0.09	0.16	0.17	0.17
C037	0.14	0.12	0.18	0.26	0.21	0.12	0.09	0.09	0.04	0.06	0.04	0.08	0.07	0.10	0.21	0.23	0.16
C130	0.26	0.24	0.28	0.30	0.23	0.17	0.10	0.10	0.06	0.10	0.06	0.12	0.09	0.06	0.13	0.23	0.21
														Mean			0.16
														Standard deviation			0.03

Table C8: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – High-rise Development Area

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C004	0.18	0.13	0.20	0.34	0.32	0.19	0.13	0.06	0.04	0.06	0.04	0.09	0.10	0.38	0.49	0.35	0.22
C007	0.16	0.18	0.21	0.22	0.12	0.08	0.07	0.06	0.04	0.11	0.08	0.17	0.13	0.15	0.13	0.15	0.15
C008	0.14	0.19	0.17	0.21	0.21	0.11	0.06	0.07	0.07	0.11	0.04	0.09	0.05	0.14	0.25	0.15	0.16
C009	0.16	0.19	0.20	0.37	0.29	0.13	0.08	0.06	0.05	0.09	0.08	0.12	0.05	0.17	0.25	0.21	0.21
C010	0.20	0.16	0.22	0.38	0.36	0.18	0.09	0.06	0.07	0.20	0.15	0.24	0.10	0.19	0.31	0.27	0.25
C015	0.11	0.14	0.23	0.40	0.32	0.19	0.10	0.06	0.04	0.11	0.08	0.13	0.08	0.12	0.13	0.11	0.22
C016	0.12	0.14	0.23	0.36	0.27	0.14	0.08	0.06	0.03	0.12	0.08	0.13	0.05	0.08	0.12	0.13	0.20
C082	0.20	0.15	0.31	0.54	0.45	0.27	0.16	0.06	0.04	0.12	0.07	0.11	0.05	0.11	0.17	0.21	0.30
C084	0.23	0.15	0.15	0.29	0.26	0.16	0.08	0.06	0.04	0.09	0.09	0.15	0.08	0.20	0.30	0.32	0.20
C085	0.26	0.19	0.18	0.29	0.33	0.27	0.23	0.15	0.06	0.09	0.07	0.14	0.12	0.23	0.41	0.44	0.24
C108	0.29	0.18	0.21	0.44	0.35	0.27	0.23	0.17	0.06	0.11	0.07	0.15	0.14	0.31	0.53	0.53	0.28
C109	0.22	0.17	0.18	0.30	0.22	0.16	0.14	0.10	0.04	0.10	0.06	0.11	0.07	0.15	0.23	0.20	0.19
C110	0.33	0.24	0.23	0.53	0.42	0.32	0.27	0.17	0.05	0.10	0.06	0.10	0.14	0.36	0.62	0.60	0.33
C129	0.21	0.19	0.18	0.21	0.17	0.15	0.13	0.09	0.05	0.13	0.06	0.11	0.05	0.08	0.22	0.30	0.17
														Mean			0.22
														Standard deviation			0.05

Table C9: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Existing Development Area

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C011	0.17	0.17	0.20	0.30	0.22	0.09	0.05	0.04	0.04	0.10	0.08	0.12	0.05	0.08	0.11	0.15	0.18
C012	0.12	0.16	0.30	0.38	0.30	0.14	0.06	0.10	0.07	0.11	0.06	0.10	0.05	0.06	0.18	0.08	0.21
C013	0.09	0.06	0.07	0.12	0.09	0.05	0.04	0.06	0.05	0.11	0.07	0.13	0.04	0.05	0.10	0.12	0.08
C014	0.23	0.20	0.28	0.46	0.36	0.19	0.09	0.05	0.03	0.09	0.07	0.11	0.04	0.11	0.18	0.24	0.26
C017	0.13	0.14	0.22	0.33	0.30	0.16	0.09	0.06	0.04	0.08	0.09	0.16	0.11	0.11	0.14	0.18	0.21
C018	0.19	0.22	0.26	0.34	0.23	0.10	0.06	0.05	0.04	0.11	0.11	0.17	0.05	0.11	0.20	0.23	0.20
C019	0.22	0.25	0.32	0.42	0.26	0.12	0.08	0.11	0.06	0.08	0.06	0.10	0.05	0.08	0.13	0.17	0.23
C020	0.14	0.16	0.25	0.43	0.27	0.10	0.08	0.09	0.06	0.12	0.09	0.15	0.04	0.05	0.07	0.09	0.21
C021	0.21	0.24	0.33	0.40	0.23	0.12	0.10	0.18	0.12	0.18	0.11	0.19	0.06	0.08	0.12	0.18	0.23
C022	0.25	0.21	0.24	0.28	0.19	0.10	0.11	0.17	0.10	0.14	0.11	0.17	0.07	0.14	0.25	0.28	0.20
C023	0.17	0.18	0.21	0.19	0.12	0.05	0.09	0.09	0.05	0.09	0.06	0.10	0.05	0.08	0.12	0.12	0.13
C024	0.12	0.12	0.13	0.16	0.10	0.06	0.13	0.13	0.08	0.14	0.11	0.18	0.06	0.12	0.14	0.10	0.12
C025	0.14	0.15	0.16	0.16	0.09	0.05	0.14	0.18	0.09	0.12	0.08	0.14	0.06	0.06	0.07	0.10	0.12
C026	0.41	0.42	0.47	0.50	0.21	0.08	0.08	0.11	0.07	0.11	0.07	0.11	0.07	0.08	0.14	0.25	0.27
C027	0.10	0.12	0.15	0.16	0.12	0.06	0.06	0.08	0.04	0.06	0.04	0.08	0.06	0.05	0.10	0.09	0.11
C028	0.26	0.24	0.23	0.20	0.08	0.05	0.11	0.14	0.08	0.13	0.10	0.15	0.07	0.05	0.08	0.17	0.15
C029	0.24	0.27	0.37	0.46	0.26	0.11	0.11	0.16	0.08	0.11	0.08	0.14	0.09	0.07	0.09	0.19	0.24
C030	0.49	0.45	0.47	0.49	0.27	0.12	0.16	0.25	0.17	0.29	0.21	0.34	0.16	0.08	0.16	0.39	0.34
C031	0.08	0.10	0.18	0.22	0.11	0.07	0.11	0.17	0.11	0.15	0.09	0.14	0.07	0.04	0.06	0.10	0.12
														Mean			0.19
														Standard deviation			0.07

Table C10: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Special Test Points

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
B05	0.18	0.19	0.18	0.21	0.17	0.10	0.11	0.08	0.04	0.05	0.04	0.08	0.05	0.08	0.14	0.16	0.15
B08	0.14	0.17	0.16	0.20	0.16	0.12	0.10	0.07	0.03	0.06	0.04	0.06	0.04	0.08	0.11	0.13	0.14
B09	0.10	0.13	0.21	0.33	0.22	0.15	0.11	0.07	0.03	0.07	0.07	0.07	0.04	0.09	0.11	0.14	0.17
B10	0.15	0.21	0.21	0.27	0.18	0.12	0.09	0.07	0.03	0.05	0.04	0.05	0.03	0.06	0.11	0.12	0.16
B11	0.19	0.12	0.12	0.18	0.18	0.13	0.12	0.08	0.03	0.06	0.04	0.08	0.07	0.17	0.43	0.34	0.15
B13	0.13	0.15	0.16	0.19	0.15	0.11	0.10	0.08	0.03	0.06	0.04	0.07	0.05	0.10	0.11	0.12	0.13
B14	0.21	0.20	0.20	0.24	0.21	0.17	0.15	0.13	0.04	0.08	0.07	0.10	0.06	0.12	0.15	0.17	0.18
C002	0.21	0.20	0.24	0.39	0.34	0.19	0.14	0.09	0.07	0.11	0.07	0.13	0.18	0.40	0.39	0.27	0.25
C006	0.24	0.20	0.18	0.21	0.15	0.12	0.14	0.12	0.07	0.16	0.09	0.16	0.12	0.16	0.30	0.35	0.17
C039	0.32	0.28	0.30	0.42	0.32	0.20	0.15	0.11	0.06	0.08	0.05	0.13	0.09	0.18	0.38	0.41	0.27
C076	0.13	0.20	0.20	0.25	0.19	0.10	0.07	0.06	0.04	0.04	0.03	0.08	0.04	0.04	0.09	0.08	0.15
C077	0.11	0.10	0.13	0.17	0.15	0.09	0.07	0.05	0.03	0.07	0.06	0.09	0.04	0.06	0.13	0.21	0.12
C083	0.24	0.12	0.24	0.47	0.43	0.26	0.17	0.06	0.03	0.04	0.03	0.06	0.12	0.32	0.44	0.46	0.28
C096	0.42	0.36	0.36	0.43	0.39	0.33	0.24	0.23	0.08	0.08	0.06	0.12	0.07	0.29	0.45	0.53	0.33
C113	0.17	0.13	0.14	0.19	0.17	0.15	0.17	0.13	0.05	0.12	0.06	0.13	0.15	0.32	0.44	0.39	0.16
C120	0.18	0.17	0.16	0.17	0.15	0.12	0.16	0.13	0.03	0.08	0.09	0.14	0.07	0.17	0.31	0.28	0.15
C126	0.25	0.24	0.36	0.44	0.41	0.31	0.23	0.15	0.06	0.15	0.09	0.17	0.23	0.40	0.52	0.46	0.32

Table C11: Averaged directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Benchmark test points

0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
0.26	0.24	0.27	0.36	0.28	0.18	0.12	0.11	0.05	0.07	0.04	0.13	0.06	0.16	0.33	0.36	0.24

Table C12: Averaged directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Site 3

0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
0.16	0.15	0.17	0.20	0.17	0.11	0.10	0.09	0.04	0.08	0.06	0.10	0.07	0.11	0.18	0.21	0.15

Table C13: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) : Design Scheme B – Test points on Connaught Road Central

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C009	0.16	0.19	0.20	0.37	0.29	0.13	0.08	0.06	0.05	0.09	0.08	0.12	0.05	0.17	0.25	0.21	0.21
C010	0.20	0.16	0.22	0.38	0.36	0.18	0.09	0.06	0.07	0.20	0.15	0.24	0.10	0.19	0.31	0.27	0.25
C011	0.17	0.17	0.20	0.30	0.22	0.09	0.05	0.04	0.04	0.10	0.08	0.12	0.05	0.08	0.11	0.15	0.18
C014	0.23	0.20	0.28	0.46	0.36	0.19	0.09	0.05	0.03	0.09	0.07	0.11	0.04	0.11	0.18	0.24	0.26
C018	0.19	0.22	0.26	0.34	0.23	0.10	0.06	0.05	0.04	0.11	0.11	0.17	0.05	0.11	0.20	0.23	0.20
C022	0.25	0.21	0.24	0.28	0.19	0.10	0.11	0.17	0.10	0.14	0.11	0.17	0.07	0.14	0.25	0.28	0.20
C026	0.41	0.42	0.47	0.50	0.21	0.08	0.08	0.11	0.07	0.11	0.07	0.11	0.07	0.08	0.14	0.25	0.27
C028	0.26	0.24	0.23	0.20	0.08	0.05	0.11	0.14	0.08	0.13	0.10	0.15	0.07	0.05	0.08	0.17	0.15
C029	0.24	0.27	0.37	0.46	0.26	0.11	0.11	0.16	0.08	0.11	0.08	0.14	0.09	0.07	0.09	0.19	0.24
Mean	0.23	0.23	0.27	0.37	0.24	0.11	0.09	0.09	0.06	0.12	0.09	0.15	0.07	0.11	0.18	0.22	0.22

Appendix D

Directional Wind Velocity Ratios of the Test Points – Design Scheme C

Table D1: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – East Harbourfront of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C039	0.27	0.29	0.28	0.39	0.34	0.25	0.17	0.11	0.05	0.08	0.05	0.13	0.09	0.25	0.40	0.40	0.27
C040	0.34	0.31	0.32	0.40	0.32	0.23	0.17	0.10	0.06	0.07	0.04	0.13	0.08	0.26	0.42	0.42	0.28
C041	0.21	0.23	0.21	0.33	0.32	0.24	0.13	0.09	0.05	0.07	0.03	0.12	0.06	0.21	0.32	0.31	0.23
C047	0.22	0.21	0.21	0.32	0.28	0.21	0.12	0.10	0.05	0.06	0.04	0.12	0.05	0.23	0.32	0.33	0.22
C048	0.19	0.14	0.17	0.33	0.33	0.23	0.12	0.10	0.05	0.06	0.04	0.13	0.06	0.19	0.32	0.31	0.22
C059	0.19	0.20	0.20	0.27	0.22	0.19	0.11	0.12	0.05	0.06	0.04	0.09	0.05	0.19	0.24	0.27	0.19
C060	0.24	0.20	0.19	0.23	0.22	0.21	0.14	0.13	0.04	0.06	0.05	0.08	0.04	0.19	0.21	0.31	0.19
														Mean			0.23
														Standard deviation			0.04

Table D2: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – East Harbourfront of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C039	0.25	0.20	0.21	0.33	0.28	0.18	0.13	0.10	0.05	0.08	0.04	0.11	0.07	0.15	0.33	0.36	0.22
C040	0.30	0.28	0.30	0.38	0.30	0.21	0.14	0.11	0.06	0.08	0.04	0.14	0.07	0.20	0.38	0.39	0.26
C041	0.24	0.21	0.25	0.34	0.29	0.19	0.11	0.11	0.06	0.08	0.04	0.12	0.07	0.15	0.34	0.37	0.23
C047	0.26	0.25	0.27	0.31	0.28	0.20	0.12	0.13	0.06	0.07	0.04	0.12	0.06	0.15	0.33	0.39	0.23
C048	0.18	0.16	0.21	0.31	0.29	0.18	0.10	0.11	0.05	0.06	0.04	0.10	0.05	0.11	0.25	0.25	0.20
C059	0.23	0.21	0.19	0.21	0.18	0.14	0.12	0.13	0.04	0.06	0.04	0.09	0.05	0.13	0.26	0.27	0.17
C060	0.25	0.21	0.19	0.26	0.24	0.19	0.14	0.14	0.04	0.06	0.05	0.09	0.06	0.13	0.23	0.24	0.20
														Mean			0.22
														Standard deviation			0.03

Table D3: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – East Harbourfront of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C039	0.32	0.28	0.3	0.42	0.32	0.2	0.15	0.11	0.06	0.08	0.05	0.13	0.09	0.18	0.38	0.41	0.27
C040	0.26	0.25	0.31	0.4	0.26	0.15	0.11	0.1	0.05	0.07	0.03	0.13	0.07	0.18	0.35	0.35	0.24
C041	0.25	0.21	0.22	0.29	0.23	0.15	0.11	0.1	0.05	0.07	0.03	0.11	0.06	0.12	0.27	0.33	0.2
C047	0.26	0.22	0.22	0.32	0.3	0.2	0.13	0.12	0.05	0.06	0.04	0.13	0.06	0.15	0.3	0.37	0.23
C048	0.17	0.12	0.16	0.27	0.28	0.17	0.1	0.11	0.05	0.05	0.04	0.11	0.05	0.13	0.24	0.26	0.19
C059	0.25	0.19	0.13	0.12	0.11	0.08	0.09	0.11	0.04	0.05	0.04	0.09	0.05	0.12	0.22	0.3	0.13
C060	0.23	0.19	0.17	0.24	0.22	0.16	0.12	0.13	0.04	0.06	0.05	0.08	0.06	0.09	0.16	0.24	0.18
														Mean			0.21
														Standard deviation			0.05

Table D4: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – North Harbourfront of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C095	0.15	0.21	0.29	0.17	0.11	0.10	0.10	0.04	0.06	0.05	0.08	0.06	0.14	0.24	0.22	0.15	0.16
C097	0.13	0.15	0.19	0.20	0.16	0.16	0.16	0.04	0.07	0.06	0.08	0.06	0.13	0.26	0.24	0.13	0.16
C098	0.21	0.24	0.28	0.21	0.13	0.11	0.10	0.04	0.07	0.05	0.06	0.05	0.12	0.20	0.16	0.21	0.18
C099	0.18	0.15	0.24	0.14	0.12	0.12	0.11	0.03	0.06	0.03	0.06	0.08	0.18	0.35	0.40	0.18	0.16
C102	0.10	0.11	0.13	0.19	0.19	0.16	0.15	0.04	0.06	0.05	0.07	0.05	0.10	0.21	0.20	0.10	0.13
C118	0.16	0.15	0.15	0.27	0.26	0.19	0.16	0.04	0.07	0.05	0.07	0.06	0.14	0.20	0.26	0.16	0.18
C119	0.19	0.16	0.18	0.13	0.08	0.08	0.08	0.03	0.06	0.04	0.07	0.06	0.16	0.29	0.30	0.19	0.14
C120	0.09	0.15	0.25	0.23	0.20	0.13	0.11	0.04	0.07	0.05	0.06	0.06	0.09	0.14	0.12	0.09	0.16
														Mean			0.16
														Standard deviation			0.02

Table D5: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – North Harbourfront of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C095	0.16	0.15	0.19	0.26	0.16	0.10	0.09	0.10	0.04	0.05	0.05	0.08	0.04	0.13	0.19	0.22	0.15
C097	0.20	0.17	0.16	0.22	0.21	0.18	0.16	0.17	0.05	0.07	0.06	0.09	0.06	0.15	0.25	0.27	0.17
C098	0.22	0.24	0.24	0.28	0.19	0.11	0.10	0.10	0.03	0.06	0.05	0.06	0.05	0.11	0.19	0.16	0.18
C099	0.24	0.20	0.17	0.24	0.15	0.11	0.12	0.12	0.04	0.06	0.04	0.06	0.09	0.21	0.39	0.44	0.17
C102	0.13	0.11	0.10	0.13	0.19	0.19	0.17	0.16	0.04	0.07	0.05	0.07	0.06	0.13	0.20	0.21	0.14
C118	0.25	0.23	0.18	0.16	0.17	0.18	0.17	0.16	0.04	0.08	0.07	0.12	0.09	0.19	0.29	0.31	0.17
C119	0.25	0.22	0.18	0.18	0.14	0.11	0.12	0.10	0.04	0.07	0.06	0.09	0.08	0.18	0.29	0.32	0.16
														Mean			0.16
														Standard deviation			0.01

Table D6: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – North Harbourfront of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C095	0.23	0.17	0.17	0.19	0.15	0.12	0.12	0.15	0.04	0.05	0.04	0.07	0.04	0.11	0.17	0.25	0.15
C097	0.23	0.19	0.19	0.27	0.15	0.16	0.17	0.19	0.05	0.07	0.06	0.09	0.06	0.15	0.24	0.3	0.17
C098	0.24	0.25	0.28	0.35	0.26	0.17	0.15	0.15	0.05	0.07	0.07	0.08	0.06	0.15	0.23	0.19	0.23
C099	0.24	0.19	0.17	0.24	0.16	0.13	0.13	0.12	0.04	0.06	0.04	0.07	0.1	0.21	0.39	0.42	0.17
C102	0.15	0.14	0.11	0.16	0.22	0.2	0.19	0.18	0.05	0.07	0.05	0.08	0.07	0.13	0.21	0.25	0.16
C118	0.25	0.2	0.15	0.16	0.16	0.19	0.21	0.16	0.04	0.08	0.07	0.13	0.09	0.21	0.34	0.35	0.17
C119	0.24	0.2	0.17	0.17	0.13	0.13	0.15	0.11	0.04	0.07	0.05	0.09	0.09	0.18	0.25	0.29	0.15
														Mean			0.17
														Standard deviation			0.03

Table D7: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – West Harbourfront of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C003	0.12	0.11	0.11	0.13	0.10	0.08	0.07	0.07	0.05	0.08	0.05	0.09	0.08	0.13	0.18	0.17	0.10
C128	0.08	0.08	0.09	0.13	0.08	0.06	0.05	0.05	0.03	0.07	0.05	0.08	0.07	0.15	0.19	0.17	0.09
														Mean			0.09
														Standard deviation			0.01

Table D8: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – West Harbourfront of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C003	0.15	0.15	0.18	0.19	0.14	0.08	0.07	0.06	0.05	0.09	0.05	0.10	0.08	0.16	0.22	0.22	0.14
C128	0.17	0.15	0.14	0.16	0.17	0.15	0.13	0.11	0.05	0.13	0.08	0.11	0.09	0.21	0.25	0.25	0.15
														Mean			0.15
														Standard deviation			0.01

Table D9: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – West Harbourfront of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C003	0.16	0.15	0.18	0.21	0.15	0.08	0.07	0.07	0.05	0.08	0.05	0.1	0.08	0.17	0.21	0.21	0.14
C128	0.2	0.16	0.11	0.15	0.16	0.18	0.16	0.11	0.05	0.12	0.08	0.11	0.09	0.18	0.26	0.26	0.15
														Mean			0.15
														Standard deviation			0.01

Table D10: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Sites 1 and 2 of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C106	0.14	0.11	0.12	0.26	0.24	0.19	0.13	0.11	0.04	0.12	0.08	0.08	0.04	0.14	0.24	0.22	0.17
C111	0.27	0.22	0.28	0.30	0.42	0.34	0.27	0.19	0.06	0.15	0.11	0.20	0.18	0.45	0.62	0.50	0.30
C112	0.22	0.21	0.23	0.27	0.28	0.24	0.19	0.11	0.05	0.11	0.08	0.16	0.11	0.15	0.22	0.24	0.22
C114	0.13	0.16	0.13	0.16	0.08	0.05	0.08	0.08	0.03	0.07	0.04	0.08	0.07	0.11	0.15	0.19	0.10
C115	0.11	0.08	0.08	0.14	0.11	0.04	0.05	0.06	0.02	0.04	0.04	0.04	0.07	0.18	0.25	0.21	0.09
C116	0.17	0.10	0.06	0.11	0.11	0.04	0.05	0.05	0.02	0.03	0.02	0.04	0.06	0.21	0.33	0.32	0.10
C117	0.20	0.14	0.12	0.17	0.19	0.13	0.11	0.08	0.03	0.05	0.05	0.06	0.07	0.19	0.32	0.34	0.15
C121	0.18	0.11	0.08	0.18	0.21	0.16	0.10	0.10	0.03	0.06	0.05	0.06	0.09	0.17	0.38	0.36	0.15
C124	0.18	0.14	0.13	0.16	0.18	0.16	0.10	0.09	0.04	0.07	0.06	0.08	0.10	0.19	0.29	0.26	0.15
C125	0.10	0.11	0.15	0.23	0.19	0.10	0.07	0.08	0.04	0.08	0.04	0.09	0.08	0.15	0.21	0.15	0.14
C127	0.05	0.04	0.07	0.12	0.11	0.10	0.08	0.06	0.03	0.06	0.03	0.06	0.04	0.08	0.10	0.12	0.08
														Mean			0.15
														Standard deviation			0.06

Table D11: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Sites 1 and 2 of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C106	0.14	0.17	0.25	0.38	0.31	0.16	0.14	0.12	0.06	0.15	0.09	0.19	0.16	0.24	0.22	0.19	0.23
C111	0.22	0.15	0.21	0.27	0.28	0.22	0.22	0.17	0.06	0.13	0.08	0.16	0.16	0.44	0.58	0.48	0.23
C112	0.22	0.15	0.21	0.31	0.25	0.18	0.22	0.18	0.07	0.16	0.07	0.14	0.18	0.51	0.66	0.56	0.22
C114	0.17	0.30	0.43	0.61	0.50	0.33	0.21	0.13	0.05	0.11	0.09	0.19	0.19	0.43	0.51	0.36	0.37
C115	0.17	0.17	0.16	0.24	0.23	0.15	0.15	0.11	0.03	0.07	0.05	0.13	0.15	0.39	0.43	0.28	0.18
C116	0.18	0.14	0.15	0.24	0.27	0.17	0.19	0.15	0.04	0.08	0.06	0.12	0.10	0.30	0.37	0.30	0.19
C117	0.22	0.18	0.16	0.17	0.18	0.18	0.21	0.14	0.04	0.09	0.06	0.10	0.08	0.27	0.38	0.37	0.17
C121	0.28	0.33	0.23	0.20	0.20	0.17	0.17	0.13	0.04	0.10	0.08	0.10	0.13	0.34	0.44	0.37	0.21
C124	0.23	0.19	0.16	0.24	0.30	0.25	0.21	0.12	0.03	0.09	0.05	0.08	0.11	0.23	0.34	0.34	0.22
C125	0.21	0.23	0.28	0.32	0.24	0.17	0.14	0.09	0.04	0.09	0.06	0.09	0.14	0.32	0.34	0.26	0.22
C127	0.10	0.10	0.18	0.36	0.37	0.23	0.12	0.07	0.03	0.09	0.07	0.09	0.09	0.23	0.27	0.19	0.22
														Mean			0.22
														Standard deviation			0.05

Table D12: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Sites 1 and 2 of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C106	0.16	0.19	0.24	0.42	0.32	0.18	0.15	0.13	0.06	0.14	0.09	0.22	0.16	0.24	0.21	0.21	0.25
C111	0.22	0.15	0.19	0.36	0.34	0.26	0.24	0.18	0.06	0.13	0.08	0.18	0.16	0.4	0.55	0.47	0.26
C112	0.23	0.16	0.19	0.34	0.26	0.22	0.24	0.19	0.06	0.15	0.07	0.14	0.17	0.45	0.62	0.53	0.23
C114	0.14	0.23	0.38	0.59	0.44	0.23	0.14	0.11	0.04	0.1	0.08	0.18	0.17	0.34	0.44	0.3	0.32
C115	0.2	0.13	0.16	0.28	0.26	0.2	0.18	0.12	0.04	0.07	0.06	0.12	0.13	0.37	0.43	0.33	0.2
C116	0.25	0.2	0.21	0.32	0.28	0.2	0.18	0.15	0.05	0.1	0.06	0.13	0.1	0.24	0.39	0.39	0.23
C117	0.25	0.2	0.16	0.16	0.19	0.22	0.19	0.14	0.04	0.08	0.05	0.1	0.09	0.27	0.44	0.44	0.18
C121	0.33	0.29	0.21	0.29	0.31	0.25	0.26	0.17	0.04	0.11	0.09	0.13	0.14	0.31	0.55	0.55	0.26
C124	0.18	0.12	0.12	0.32	0.33	0.23	0.2	0.12	0.03	0.07	0.04	0.08	0.14	0.35	0.49	0.36	0.22
C125	0.22	0.24	0.31	0.45	0.29	0.16	0.12	0.08	0.04	0.11	0.09	0.16	0.15	0.3	0.31	0.28	0.26
C127	0.21	0.13	0.17	0.4	0.32	0.2	0.18	0.1	0.04	0.11	0.09	0.13	0.14	0.31	0.38	0.3	0.24
														Mean			0.24
														Standard deviation			0.04

Table D13: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Site 4 of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A02	0.15	0.15	0.17	0.22	0.18	0.11	0.08	0.10	0.05	0.06	0.04	0.08	0.05	0.07	0.17	0.21	0.15
C042	0.29	0.24	0.20	0.27	0.25	0.17	0.10	0.09	0.06	0.08	0.04	0.10	0.07	0.20	0.36	0.40	0.21
C043	0.15	0.15	0.23	0.35	0.30	0.18	0.10	0.10	0.06	0.09	0.05	0.12	0.08	0.10	0.19	0.22	0.21
C044	0.10	0.15	0.24	0.23	0.14	0.08	0.08	0.08	0.05	0.07	0.04	0.11	0.06	0.05	0.11	0.12	0.14
C046	0.15	0.13	0.18	0.32	0.28	0.18	0.10	0.09	0.05	0.07	0.04	0.11	0.06	0.16	0.28	0.28	0.20
C049	0.16	0.12	0.11	0.23	0.21	0.12	0.11	0.12	0.06	0.09	0.05	0.09	0.06	0.06	0.16	0.18	0.15
C050	0.16	0.11	0.11	0.22	0.25	0.17	0.10	0.10	0.04	0.05	0.03	0.10	0.04	0.13	0.27	0.24	0.17
C051	0.15	0.13	0.13	0.15	0.16	0.09	0.11	0.10	0.04	0.05	0.03	0.09	0.05	0.07	0.18	0.22	0.13
C055	0.21	0.21	0.20	0.21	0.23	0.13	0.12	0.11	0.04	0.06	0.04	0.09	0.05	0.07	0.16	0.21	0.18
C056	0.18	0.14	0.16	0.23	0.20	0.12	0.11	0.13	0.05	0.07	0.04	0.10	0.06	0.09	0.28	0.30	0.16
C057	0.27	0.27	0.28	0.28	0.14	0.09	0.10	0.13	0.05	0.07	0.04	0.11	0.06	0.09	0.25	0.32	0.18
C058	0.18	0.18	0.22	0.33	0.28	0.21	0.11	0.10	0.04	0.05	0.04	0.07	0.04	0.13	0.25	0.24	0.21
C061	0.24	0.22	0.22	0.29	0.23	0.18	0.12	0.11	0.04	0.07	0.05	0.08	0.05	0.12	0.20	0.27	0.20
C062	0.21	0.20	0.20	0.23	0.19	0.11	0.11	0.10	0.04	0.06	0.04	0.08	0.04	0.07	0.14	0.18	0.17
														Mean			0.18
														Standard deviation			0.03

Table D14: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Site 4 of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A02	0.20	0.20	0.20	0.24	0.20	0.12	0.09	0.11	0.05	0.06	0.04	0.09	0.05	0.07	0.12	0.17	0.17
C042	0.26	0.22	0.20	0.25	0.20	0.12	0.08	0.09	0.05	0.07	0.04	0.09	0.06	0.10	0.28	0.36	0.18
C043	0.12	0.16	0.24	0.34	0.26	0.14	0.09	0.09	0.05	0.08	0.04	0.11	0.07	0.08	0.16	0.19	0.19
C044	0.12	0.15	0.18	0.24	0.20	0.10	0.08	0.09	0.05	0.08	0.04	0.13	0.07	0.07	0.15	0.16	0.16
C046	0.16	0.14	0.20	0.33	0.27	0.16	0.09	0.09	0.04	0.06	0.03	0.10	0.05	0.10	0.24	0.23	0.20
C049	0.13	0.12	0.13	0.22	0.20	0.10	0.10	0.13	0.06	0.08	0.04	0.10	0.06	0.07	0.12	0.15	0.15
C050	0.22	0.20	0.18	0.24	0.23	0.15	0.10	0.11	0.04	0.05	0.03	0.07	0.04	0.10	0.24	0.25	0.18
C051	0.13	0.13	0.16	0.23	0.21	0.11	0.11	0.13	0.05	0.06	0.03	0.10	0.05	0.08	0.12	0.15	0.15
C055	0.10	0.10	0.14	0.27	0.23	0.14	0.12	0.12	0.04	0.06	0.04	0.09	0.05	0.07	0.12	0.13	0.16
C056	0.18	0.16	0.21	0.27	0.20	0.12	0.09	0.09	0.04	0.05	0.03	0.10	0.05	0.07	0.13	0.15	0.17
C057	0.18	0.17	0.17	0.20	0.19	0.11	0.10	0.13	0.04	0.05	0.03	0.09	0.04	0.07	0.12	0.14	0.15
C058	0.25	0.21	0.23	0.29	0.25	0.16	0.11	0.12	0.04	0.05	0.04	0.08	0.05	0.11	0.25	0.26	0.20
C061	0.22	0.23	0.29	0.38	0.30	0.19	0.11	0.11	0.04	0.06	0.05	0.08	0.05	0.11	0.19	0.18	0.23
C062	0.20	0.13	0.11	0.13	0.12	0.08	0.10	0.10	0.04	0.06	0.04	0.09	0.05	0.09	0.18	0.23	0.12
														Mean			0.17
														Standard deviation			0.03

Table D15: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Site 4 of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	$VRw_{,}j$
C042	0.23	0.18	0.17	0.25	0.22	0.12	0.09	0.09	0.05	0.06	0.03	0.08	0.06	0.11	0.27	0.32	0.18
C043	0.11	0.11	0.2	0.32	0.25	0.13	0.09	0.09	0.05	0.07	0.04	0.1	0.07	0.08	0.14	0.19	0.18
C044	0.14	0.15	0.22	0.31	0.22	0.11	0.09	0.1	0.06	0.08	0.05	0.13	0.07	0.09	0.13	0.16	0.18
C046	0.16	0.12	0.15	0.26	0.24	0.14	0.1	0.1	0.05	0.06	0.03	0.1	0.05	0.11	0.23	0.26	0.17
C049	0.16	0.13	0.14	0.25	0.22	0.11	0.12	0.15	0.08	0.1	0.05	0.11	0.06	0.08	0.12	0.18	0.16
C050	0.22	0.17	0.15	0.22	0.23	0.14	0.11	0.13	0.05	0.06	0.04	0.09	0.04	0.11	0.22	0.26	0.17
C051	0.16	0.12	0.13	0.19	0.18	0.11	0.11	0.12	0.05	0.06	0.04	0.09	0.05	0.09	0.15	0.22	0.14
C055	0.17	0.16	0.18	0.22	0.19	0.12	0.12	0.12	0.04	0.06	0.04	0.09	0.05	0.09	0.13	0.16	0.16
C056	0.14	0.1	0.12	0.21	0.18	0.1	0.1	0.14	0.06	0.07	0.04	0.1	0.05	0.1	0.17	0.23	0.14
C057	0.24	0.23	0.25	0.29	0.18	0.11	0.09	0.1	0.04	0.06	0.04	0.1	0.05	0.09	0.16	0.22	0.18
C058	0.28	0.2	0.17	0.2	0.21	0.15	0.11	0.13	0.04	0.06	0.04	0.1	0.05	0.12	0.24	0.32	0.18
C061	0.21	0.21	0.26	0.35	0.27	0.16	0.1	0.1	0.04	0.06	0.05	0.08	0.05	0.12	0.17	0.18	0.21
C062	0.14	0.12	0.13	0.17	0.16	0.11	0.11	0.11	0.04	0.06	0.04	0.08	0.05	0.1	0.14	0.21	0.13
														Mean			0.17
														Standard deviation			0.02

Table D16: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Site 3 of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A12	0.11	0.10	0.12	0.18	0.17	0.10	0.09	0.06	0.03	0.06	0.05	0.06	0.04	0.07	0.09	0.14	0.12
C053	0.17	0.19	0.19	0.28	0.17	0.09	0.10	0.08	0.04	0.06	0.04	0.09	0.06	0.06	0.11	0.20	0.16
C054	0.23	0.21	0.18	0.24	0.23	0.12	0.12	0.09	0.04	0.06	0.03	0.10	0.06	0.06	0.11	0.21	0.18
C063	0.19	0.20	0.22	0.23	0.21	0.13	0.11	0.09	0.04	0.06	0.04	0.08	0.05	0.06	0.11	0.21	0.17
C064	0.17	0.20	0.21	0.23	0.21	0.11	0.10	0.08	0.04	0.06	0.04	0.09	0.05	0.06	0.10	0.23	0.17
C065	0.21	0.19	0.16	0.19	0.14	0.07	0.08	0.08	0.05	0.07	0.05	0.09	0.06	0.07	0.10	0.22	0.14
C066	0.09	0.09	0.09	0.10	0.10	0.06	0.06	0.07	0.04	0.06	0.06	0.07	0.05	0.05	0.08	0.10	0.08
C067	0.17	0.17	0.18	0.18	0.09	0.04	0.09	0.11	0.08	0.12	0.09	0.11	0.08	0.07	0.09	0.16	0.13
C068	0.18	0.18	0.20	0.25	0.16	0.07	0.08	0.11	0.08	0.12	0.12	0.13	0.08	0.09	0.11	0.16	0.16
C069	0.18	0.21	0.23	0.30	0.18	0.09	0.08	0.10	0.07	0.12	0.08	0.14	0.08	0.08	0.09	0.13	0.18
C070	0.15	0.13	0.15	0.19	0.14	0.07	0.08	0.11	0.07	0.12	0.16	0.14	0.07	0.12	0.14	0.19	0.13
C071	0.07	0.09	0.13	0.12	0.09	0.05	0.06	0.05	0.03	0.06	0.06	0.09	0.05	0.05	0.07	0.10	0.09
C072	0.15	0.15	0.18	0.22	0.18	0.10	0.09	0.06	0.04	0.05	0.03	0.06	0.04	0.06	0.09	0.18	0.14
C075	0.11	0.08	0.12	0.13	0.11	0.06	0.05	0.04	0.03	0.07	0.05	0.08	0.05	0.09	0.14	0.16	0.10
C078	0.11	0.10	0.15	0.28	0.30	0.19	0.14	0.09	0.04	0.08	0.07	0.07	0.06	0.12	0.15	0.12	0.18
C079	0.09	0.08	0.06	0.11	0.17	0.08	0.07	0.06	0.03	0.07	0.07	0.08	0.06	0.12	0.16	0.15	0.11
C080	0.14	0.11	0.14	0.24	0.26	0.16	0.09	0.06	0.03	0.08	0.07	0.09	0.06	0.12	0.19	0.18	0.17
C086	0.31	0.20	0.12	0.14	0.24	0.17	0.14	0.09	0.04	0.08	0.08	0.11	0.10	0.31	0.47	0.51	0.19
C088	0.14	0.15	0.19	0.18	0.15	0.11	0.12	0.09	0.04	0.10	0.08	0.13	0.08	0.19	0.24	0.22	0.15
C090	0.11	0.09	0.08	0.12	0.22	0.23	0.16	0.11	0.04	0.08	0.04	0.07	0.09	0.30	0.33	0.19	0.14
C091	0.14	0.15	0.14	0.20	0.13	0.12	0.09	0.08	0.03	0.07	0.04	0.06	0.05	0.08	0.12	0.17	0.13
C092	0.15	0.16	0.22	0.26	0.18	0.12	0.11	0.08	0.04	0.07	0.04	0.07	0.04	0.07	0.11	0.19	0.16
C094	0.19	0.14	0.13	0.18	0.16	0.17	0.17	0.16	0.05	0.07	0.05	0.08	0.05	0.13	0.22	0.31	0.15
C101	0.18	0.15	0.10	0.14	0.22	0.20	0.17	0.16	0.05	0.08	0.05	0.08	0.06	0.10	0.24	0.30	0.16
C103	0.14	0.09	0.09	0.11	0.17	0.15	0.12	0.11	0.03	0.06	0.04	0.06	0.04	0.10	0.15	0.18	0.12
														Mean			0.14
														Standard deviation			0.03

Table D17: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Site 3 of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A12	0.15	0.20	0.20	0.19	0.14	0.10	0.09	0.07	0.04	0.06	0.05	0.06	0.04	0.06	0.12	0.16	0.13
C053	0.14	0.15	0.19	0.25	0.16	0.08	0.10	0.07	0.04	0.05	0.03	0.08	0.05	0.06	0.10	0.13	0.14
C054	0.15	0.14	0.16	0.26	0.22	0.12	0.12	0.10	0.05	0.06	0.04	0.10	0.06	0.08	0.13	0.17	0.17
C063	0.20	0.18	0.16	0.21	0.19	0.11	0.12	0.09	0.04	0.06	0.04	0.09	0.05	0.08	0.15	0.19	0.16
C064	0.18	0.19	0.19	0.23	0.19	0.11	0.11	0.09	0.05	0.08	0.05	0.11	0.07	0.08	0.15	0.18	0.16
C065	0.16	0.18	0.17	0.18	0.13	0.08	0.09	0.08	0.05	0.08	0.05	0.10	0.07	0.07	0.13	0.15	0.13
C066	0.09	0.09	0.10	0.11	0.09	0.05	0.06	0.07	0.04	0.07	0.06	0.08	0.06	0.06	0.10	0.09	0.08
C067	0.17	0.18	0.20	0.20	0.11	0.06	0.10	0.12	0.08	0.13	0.09	0.12	0.09	0.07	0.13	0.14	0.14
C068	0.12	0.12	0.17	0.19	0.14	0.07	0.07	0.10	0.06	0.11	0.12	0.13	0.07	0.11	0.14	0.12	0.13
C069	0.11	0.15	0.18	0.23	0.18	0.10	0.06	0.05	0.03	0.04	0.02	0.05	0.05	0.04	0.07	0.07	0.14
C070	0.17	0.16	0.18	0.19	0.15	0.08	0.07	0.12	0.08	0.12	0.13	0.13	0.07	0.11	0.15	0.25	0.14
C071	0.12	0.15	0.23	0.36	0.28	0.16	0.12	0.07	0.04	0.08	0.10	0.14	0.07	0.08	0.18	0.18	0.21
C072	0.15	0.18	0.19	0.23	0.17	0.10	0.10	0.07	0.05	0.06	0.05	0.09	0.05	0.08	0.14	0.15	0.15
C075	0.17	0.16	0.18	0.27	0.20	0.09	0.07	0.05	0.03	0.08	0.06	0.10	0.06	0.10	0.21	0.21	0.17
C078	0.08	0.12	0.18	0.29	0.23	0.14	0.10	0.06	0.03	0.08	0.07	0.07	0.05	0.06	0.12	0.12	0.16
C079	0.09	0.09	0.13	0.26	0.25	0.15	0.11	0.07	0.04	0.11	0.09	0.11	0.08	0.14	0.21	0.18	0.16
C080	0.13	0.08	0.10	0.14	0.10	0.07	0.06	0.07	0.03	0.12	0.09	0.11	0.07	0.14	0.20	0.20	0.10
C086	0.28	0.18	0.11	0.13	0.13	0.11	0.09	0.07	0.03	0.08	0.07	0.11	0.08	0.21	0.47	0.47	0.15
C088	0.18	0.18	0.25	0.33	0.25	0.15	0.13	0.11	0.06	0.14	0.11	0.19	0.12	0.22	0.30	0.27	0.21
C090	0.12	0.10	0.10	0.16	0.25	0.22	0.18	0.12	0.05	0.10	0.07	0.13	0.12	0.26	0.21	0.15	0.16
C091	0.20	0.22	0.24	0.27	0.17	0.11	0.11	0.10	0.04	0.07	0.05	0.07	0.05	0.10	0.19	0.25	0.17
C092	0.21	0.23	0.21	0.17	0.10	0.08	0.09	0.09	0.04	0.06	0.05	0.07	0.04	0.07	0.13	0.19	0.13
C094	0.20	0.17	0.16	0.20	0.18	0.15	0.14	0.15	0.04	0.07	0.06	0.09	0.05	0.11	0.20	0.24	0.16
C101	0.24	0.22	0.18	0.17	0.20	0.19	0.20	0.17	0.05	0.08	0.06	0.08	0.06	0.15	0.27	0.32	0.18
C103	0.15	0.11	0.12	0.15	0.19	0.15	0.13	0.12	0.04	0.08	0.05	0.08	0.06	0.14	0.24	0.32	0.14
														Mean			0.15
														Standard deviation			0.03

Table D18: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Site 3 of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C053	0.18	0.16	0.19	0.23	0.16	0.08	0.1	0.07	0.04	0.05	0.03	0.09	0.05	0.06	0.1	0.14	0.15
C054	0.14	0.12	0.12	0.15	0.13	0.08	0.09	0.07	0.03	0.05	0.03	0.07	0.04	0.07	0.11	0.15	0.11
C063	0.18	0.15	0.13	0.16	0.13	0.08	0.09	0.08	0.04	0.05	0.04	0.07	0.05	0.08	0.12	0.19	0.12
C064	0.15	0.15	0.16	0.22	0.19	0.11	0.1	0.08	0.04	0.05	0.04	0.09	0.05	0.08	0.14	0.16	0.15
C065	0.13	0.13	0.14	0.17	0.14	0.08	0.08	0.07	0.04	0.06	0.05	0.09	0.06	0.06	0.12	0.11	0.12
C066	0.11	0.11	0.12	0.14	0.12	0.07	0.07	0.09	0.05	0.08	0.07	0.09	0.06	0.06	0.11	0.1	0.11
C067	0.19	0.2	0.21	0.21	0.12	0.06	0.1	0.12	0.09	0.13	0.09	0.13	0.09	0.08	0.13	0.15	0.15
C068	0.18	0.17	0.2	0.22	0.16	0.08	0.09	0.12	0.08	0.13	0.12	0.14	0.07	0.1	0.14	0.19	0.16
C069	0.12	0.13	0.15	0.16	0.12	0.06	0.07	0.07	0.05	0.1	0.11	0.12	0.06	0.07	0.1	0.13	0.12
C070	0.15	0.16	0.17	0.2	0.15	0.09	0.08	0.11	0.06	0.13	0.15	0.13	0.07	0.12	0.15	0.21	0.15
C071	0.15	0.13	0.19	0.26	0.17	0.11	0.09	0.06	0.04	0.08	0.09	0.14	0.07	0.06	0.13	0.19	0.16
C072	0.09	0.09	0.1	0.14	0.1	0.07	0.08	0.06	0.03	0.05	0.03	0.07	0.04	0.07	0.13	0.12	0.09
C075	0.14	0.14	0.18	0.3	0.23	0.11	0.07	0.06	0.03	0.1	0.07	0.12	0.07	0.12	0.22	0.24	0.18
C078	0.11	0.09	0.11	0.15	0.12	0.08	0.07	0.05	0.02	0.07	0.06	0.06	0.04	0.06	0.1	0.11	0.1
C079	0.14	0.11	0.18	0.24	0.19	0.12	0.09	0.07	0.03	0.12	0.09	0.11	0.08	0.14	0.25	0.25	0.16
C080	0.12	0.1	0.18	0.23	0.14	0.1	0.07	0.07	0.03	0.08	0.06	0.09	0.06	0.14	0.21	0.2	0.13
C086	0.29	0.24	0.21	0.26	0.2	0.15	0.12	0.08	0.04	0.11	0.08	0.14	0.1	0.22	0.5	0.48	0.2
C088	0.15	0.14	0.19	0.26	0.27	0.2	0.15	0.11	0.05	0.13	0.09	0.16	0.11	0.21	0.28	0.24	0.2
C090	0.12	0.11	0.13	0.19	0.25	0.2	0.13	0.11	0.03	0.11	0.08	0.15	0.11	0.22	0.27	0.18	0.17
C091	0.2	0.18	0.19	0.22	0.15	0.11	0.1	0.1	0.04	0.08	0.05	0.08	0.06	0.1	0.16	0.21	0.15
C092	0.17	0.16	0.16	0.19	0.12	0.08	0.07	0.07	0.03	0.05	0.03	0.05	0.04	0.07	0.11	0.18	0.12
C094	0.22	0.18	0.19	0.21	0.16	0.14	0.14	0.14	0.04	0.06	0.04	0.07	0.05	0.1	0.18	0.26	0.16
C101	0.26	0.22	0.17	0.16	0.16	0.16	0.16	0.14	0.04	0.07	0.05	0.08	0.06	0.13	0.27	0.31	0.16
C103	0.14	0.1	0.1	0.14	0.15	0.13	0.08	0.08	0.04	0.09	0.05	0.09	0.06	0.13	0.19	0.23	0.12
														Mean			0.14
														Standard deviation			0.03

Table D19: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Open Area of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C032	0.12	0.10	0.22	0.27	0.16	0.08	0.11	0.15	0.09	0.14	0.08	0.12	0.07	0.05	0.13	0.16	0.15
C033	0.11	0.10	0.15	0.23	0.18	0.09	0.11	0.10	0.04	0.06	0.03	0.08	0.05	0.05	0.14	0.14	0.14
C037	0.14	0.13	0.19	0.29	0.22	0.14	0.10	0.08	0.04	0.07	0.04	0.09	0.07	0.10	0.23	0.22	0.17
C130	0.26	0.25	0.29	0.30	0.23	0.16	0.10	0.10	0.06	0.10	0.07	0.10	0.08	0.05	0.11	0.27	0.21
														Mean			0.17
														Standard deviation			0.03

Table D20: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) – High-rise Development Area of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C004	0.18	0.11	0.18	0.44	0.40	0.22	0.11	0.06	0.03	0.08	0.04	0.08	0.11	0.40	0.52	0.36	0.26
C007	0.13	0.15	0.16	0.19	0.08	0.06	0.05	0.04	0.03	0.09	0.05	0.12	0.11	0.10	0.09	0.12	0.11
C015	0.09	0.13	0.20	0.36	0.32	0.14	0.07	0.05	0.04	0.11	0.07	0.11	0.07	0.08	0.09	0.09	0.20
C016	0.10	0.12	0.16	0.27	0.24	0.10	0.07	0.05	0.04	0.11	0.08	0.07	0.05	0.07	0.11	0.12	0.16
C082	0.20	0.13	0.31	0.51	0.46	0.26	0.14	0.05	0.03	0.08	0.07	0.13	0.06	0.10	0.16	0.20	0.29
C084	0.24	0.13	0.14	0.18	0.22	0.12	0.07	0.06	0.04	0.09	0.11	0.11	0.07	0.16	0.27	0.31	0.17
C085	0.27	0.25	0.18	0.35	0.40	0.31	0.25	0.17	0.06	0.11	0.09	0.13	0.08	0.21	0.43	0.44	0.28
C108	0.37	0.31	0.31	0.33	0.36	0.29	0.28	0.20	0.07	0.13	0.09	0.19	0.18	0.44	0.58	0.53	0.31
C109	0.40	0.31	0.22	0.30	0.28	0.21	0.18	0.13	0.05	0.12	0.10	0.12	0.07	0.12	0.18	0.24	0.25
C110	0.30	0.22	0.21	0.36	0.42	0.33	0.26	0.16	0.05	0.10	0.06	0.09	0.10	0.29	0.49	0.50	0.29
C129	0.22	0.20	0.19	0.14	0.08	0.06	0.07	0.07	0.04	0.11	0.08	0.09	0.06	0.12	0.27	0.33	0.13
														Mean			0.22
														Standard deviation			0.07

Table D21: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Existing Development Area of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	$VRw_{,j}$
C014	0.21	0.20	0.24	0.47	0.35	0.17	0.06	0.04	0.03	0.09	0.06	0.06	0.04	0.09	0.16	0.22	0.25
C017	0.12	0.14	0.19	0.26	0.20	0.09	0.06	0.05	0.03	0.08	0.07	0.14	0.09	0.07	0.11	0.16	0.16
C018	0.17	0.22	0.26	0.39	0.26	0.10	0.05	0.04	0.03	0.10	0.10	0.08	0.04	0.10	0.19	0.19	0.21
C022	0.22	0.18	0.20	0.23	0.18	0.08	0.10	0.14	0.08	0.12	0.08	0.13	0.06	0.11	0.20	0.22	0.17
C026	0.43	0.41	0.46	0.51	0.21	0.07	0.07	0.11	0.07	0.11	0.07	0.10	0.06	0.08	0.14	0.34	0.28
C027	0.08	0.09	0.11	0.13	0.12	0.04	0.05	0.07	0.04	0.06	0.04	0.07	0.05	0.04	0.08	0.13	0.09
C029	0.19	0.24	0.32	0.45	0.24	0.08	0.09	0.12	0.06	0.09	0.06	0.12	0.07	0.05	0.07	0.19	0.22
														Mean			0.20
														Standard deviation			0.06

Table D22: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Open Area of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	$VRw_{,j}$
C032	0.14	0.15	0.22	0.29	0.18	0.08	0.12	0.17	0.10	0.15	0.08	0.13	0.09	0.05	0.09	0.15	0.17
C033	0.11	0.11	0.15	0.23	0.19	0.09	0.11	0.11	0.05	0.06	0.03	0.08	0.05	0.06	0.11	0.13	0.14
C037	0.14	0.14	0.18	0.26	0.20	0.11	0.09	0.08	0.04	0.06	0.04	0.08	0.06	0.09	0.20	0.22	0.16
C130	0.26	0.26	0.28	0.29	0.22	0.16	0.10	0.10	0.07	0.10	0.06	0.11	0.08	0.06	0.12	0.22	0.21
														Mean			0.17
														Standard deviation			0.03

Table D23: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) – High-rise Development Area of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C004	0.18	0.13	0.19	0.35	0.29	0.16	0.11	0.06	0.04	0.07	0.04	0.08	0.10	0.38	0.49	0.34	0.21
C007	0.15	0.17	0.20	0.18	0.08	0.06	0.06	0.06	0.04	0.11	0.07	0.15	0.13	0.14	0.11	0.14	0.12
C015	0.11	0.15	0.21	0.38	0.33	0.18	0.10	0.06	0.04	0.12	0.08	0.11	0.08	0.13	0.13	0.12	0.22
C016	0.13	0.15	0.21	0.33	0.26	0.13	0.08	0.06	0.04	0.14	0.09	0.09	0.05	0.08	0.11	0.14	0.19
C082	0.20	0.13	0.30	0.55	0.46	0.27	0.16	0.05	0.04	0.11	0.07	0.11	0.05	0.10	0.16	0.21	0.30
C084	0.23	0.14	0.14	0.18	0.22	0.13	0.07	0.06	0.04	0.10	0.10	0.12	0.08	0.20	0.29	0.31	0.17
C085	0.27	0.18	0.20	0.31	0.28	0.24	0.22	0.15	0.06	0.09	0.07	0.14	0.10	0.19	0.41	0.45	0.23
C108	0.28	0.18	0.20	0.33	0.29	0.22	0.22	0.16	0.06	0.11	0.07	0.13	0.14	0.35	0.53	0.49	0.25
C109	0.20	0.15	0.19	0.28	0.24	0.17	0.15	0.12	0.05	0.11	0.07	0.11	0.07	0.14	0.23	0.20	0.19
C110	0.32	0.22	0.24	0.43	0.37	0.28	0.23	0.16	0.05	0.10	0.05	0.11	0.14	0.36	0.58	0.57	0.29
C129	0.24	0.22	0.17	0.17	0.12	0.11	0.10	0.09	0.05	0.13	0.06	0.09	0.05	0.08	0.21	0.31	0.15
														Mean			0.21
														Standard deviation			0.06

Table D24: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Existing Development Area of Design Scheme A

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C014	0.23	0.21	0.26	0.52	0.40	0.20	0.09	0.05	0.03	0.10	0.07	0.07	0.05	0.12	0.18	0.25	0.28
C017	0.13	0.15	0.21	0.32	0.30	0.15	0.09	0.06	0.04	0.09	0.08	0.17	0.11	0.11	0.13	0.19	0.21
C018	0.19	0.23	0.27	0.36	0.25	0.11	0.06	0.05	0.04	0.12	0.11	0.10	0.05	0.11	0.20	0.22	0.21
C022	0.23	0.20	0.24	0.29	0.23	0.11	0.11	0.15	0.10	0.15	0.11	0.15	0.07	0.14	0.25	0.27	0.20
C026	0.38	0.42	0.45	0.51	0.21	0.07	0.08	0.11	0.08	0.12	0.07	0.10	0.07	0.08	0.14	0.26	0.27
C027	0.09	0.10	0.14	0.16	0.11	0.05	0.06	0.08	0.04	0.06	0.04	0.08	0.06	0.05	0.11	0.11	0.10
C029	0.23	0.27	0.35	0.48	0.27	0.10	0.12	0.15	0.08	0.12	0.09	0.17	0.09	0.07	0.09	0.18	0.25
														Mean			0.22
														Standard deviation			0.06

Table D25: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Open Area of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	$VRw_{,j}$
C032	0.13	0.16	0.22	0.29	0.19	0.09	0.12	0.17	0.1	0.16	0.09	0.13	0.09	0.06	0.1	0.18	0.17
C033	0.12	0.11	0.14	0.19	0.16	0.09	0.1	0.11	0.04	0.05	0.03	0.07	0.05	0.06	0.1	0.14	0.13
C037	0.14	0.12	0.18	0.26	0.21	0.12	0.09	0.09	0.04	0.06	0.04	0.08	0.07	0.1	0.21	0.23	0.16
C130	0.26	0.24	0.28	0.3	0.23	0.17	0.1	0.1	0.06	0.1	0.06	0.12	0.09	0.06	0.13	0.23	0.21
														Mean			0.17
														Standard deviation			0.03

Table D26: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) – High-rise Development Area of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	$VRw_{,j}$
C004	0.18	0.13	0.2	0.34	0.32	0.19	0.13	0.06	0.04	0.06	0.04	0.09	0.1	0.38	0.49	0.35	0.22
C007	0.16	0.18	0.21	0.22	0.12	0.08	0.07	0.06	0.04	0.11	0.08	0.17	0.13	0.15	0.13	0.15	0.15
C015	0.11	0.14	0.23	0.4	0.32	0.19	0.1	0.06	0.04	0.11	0.08	0.13	0.08	0.12	0.13	0.11	0.22
C016	0.12	0.14	0.23	0.36	0.27	0.14	0.08	0.06	0.03	0.12	0.08	0.13	0.05	0.08	0.12	0.13	0.2
C082	0.2	0.15	0.31	0.54	0.45	0.27	0.16	0.06	0.04	0.12	0.07	0.11	0.05	0.11	0.17	0.21	0.3
C084	0.23	0.15	0.15	0.29	0.26	0.16	0.08	0.06	0.04	0.09	0.09	0.15	0.08	0.2	0.3	0.32	0.2
C085	0.26	0.19	0.18	0.29	0.33	0.27	0.23	0.15	0.06	0.09	0.07	0.14	0.12	0.23	0.41	0.44	0.24
C108	0.29	0.18	0.21	0.44	0.35	0.27	0.23	0.17	0.06	0.11	0.07	0.15	0.14	0.31	0.53	0.53	0.28
C109	0.22	0.17	0.18	0.3	0.22	0.16	0.14	0.1	0.04	0.1	0.06	0.11	0.07	0.15	0.23	0.2	0.19
C110	0.33	0.24	0.23	0.53	0.42	0.32	0.27	0.17	0.05	0.1	0.06	0.1	0.14	0.36	0.62	0.6	0.33
C129	0.21	0.19	0.18	0.21	0.17	0.15	0.13	0.09	0.05	0.13	0.06	0.11	0.05	0.08	0.22	0.3	0.17
														Mean			0.23
														Standard deviation			0.06

Table D27: Directional wind velocity ratios ($VR_{500,i,j}$) and overall wind velocity ratios ($VR_{w,j}$) – Existing Development Area of Design Scheme B

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
C014	0.23	0.2	0.28	0.46	0.36	0.19	0.09	0.05	0.03	0.09	0.07	0.11	0.04	0.11	0.18	0.24	0.26
C017	0.13	0.14	0.22	0.33	0.3	0.16	0.09	0.06	0.04	0.08	0.09	0.16	0.11	0.11	0.14	0.18	0.21
C018	0.19	0.22	0.26	0.34	0.23	0.1	0.06	0.05	0.04	0.11	0.11	0.17	0.05	0.11	0.2	0.23	0.2
C022	0.25	0.21	0.24	0.28	0.19	0.1	0.11	0.17	0.1	0.14	0.11	0.17	0.07	0.14	0.25	0.28	0.2
C026	0.41	0.42	0.47	0.5	0.21	0.08	0.08	0.11	0.07	0.11	0.07	0.11	0.07	0.08	0.14	0.25	0.27
C027	0.1	0.12	0.15	0.16	0.12	0.06	0.06	0.08	0.04	0.06	0.04	0.08	0.06	0.05	0.1	0.09	0.11
C029	0.24	0.27	0.37	0.46	0.26	0.11	0.11	0.16	0.08	0.11	0.08	0.14	0.09	0.07	0.09	0.19	0.24
														Mean			0.21
														Standard deviation			0.05

Table D28: Directional wind velocity ratios (VR500,i,j) and overall wind velocity ratios (VRw,j) – Special Test Points of Design Scheme C

Test Point	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°	VRw,j
A04	0.13	0.15	0.18	0.22	0.16	0.10	0.09	0.07	0.04	0.06	0.05	0.10	0.05	0.06	0.09	0.09	0.14
A07	0.16	0.10	0.13	0.20	0.15	0.10	0.10	0.07	0.03	0.08	0.08	0.08	0.04	0.06	0.12	0.22	0.13
A09	0.27	0.21	0.16	0.18	0.16	0.13	0.13	0.09	0.03	0.06	0.06	0.06	0.04	0.07	0.15	0.36	0.16
C083	0.21	0.10	0.17	0.27	0.33	0.21	0.12	0.05	0.03	0.04	0.03	0.08	0.12	0.27	0.41	0.42	0.21
C096	0.40	0.40	0.37	0.48	0.40	0.36	0.26	0.24	0.10	0.09	0.06	0.12	0.09	0.31	0.53	0.57	0.35
C105	0.33	0.28	0.23	0.20	0.19	0.18	0.13	0.08	0.04	0.08	0.07	0.09	0.06	0.21	0.35	0.41	0.20
C122	0.11	0.19	0.24	0.36	0.27	0.18	0.15	0.11	0.04	0.11	0.07	0.17	0.12	0.22	0.21	0.15	0.21
C123	0.15	0.11	0.12	0.23	0.21	0.16	0.14	0.10	0.04	0.09	0.08	0.13	0.09	0.14	0.26	0.24	0.16
C126	0.30	0.21	0.31	0.38	0.30	0.27	0.21	0.16	0.05	0.11	0.05	0.12	0.22	0.42	0.49	0.50	0.27
S01	0.18	0.19	0.13	0.13	0.14	0.12	0.10	0.08	0.04	0.11	0.07	0.10	0.09	0.19	0.23	0.21	0.13
S02	0.14	0.13	0.21	0.36	0.23	0.16	0.14	0.10	0.04	0.11	0.08	0.10	0.09	0.17	0.26	0.21	0.19
S03	0.07	0.10	0.14	0.16	0.18	0.10	0.10	0.08	0.03	0.07	0.05	0.07	0.04	0.06	0.11	0.08	0.12