

Executive Summary

Agreement No. PLNQ 9/2007

**Consultancy Study for
Air Ventilation Assessment for Tsuen Wan Town Lot 393,
Tsuen Wan**



**Planning Department,
The Government of the Hong Kong Special Administrative Region**

by

Star Vision Limited

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1 INTRODUCTION

1.1 Background

1.1.1 Planning Department commissioned Star Vision Limited to undertake the Consultancy Study for Air Ventilation Assessment for Tsuen Wan Town Lot (TWTL) 393 (the Study) with a view to deriving a recommended development design scheme with appropriate development parameters for the subject lot (the Site).

1.2 The Objective

1.2.1 The objective of this Study is to conduct an air ventilation assessment (AVA) on the Site and the surrounding area to facilitate the Government to determine an appropriate development scheme with better air ventilation in the area. The Study includes Expert Evaluations and Computational Fluid Dynamics (CFD) tests on five design options on the Site.

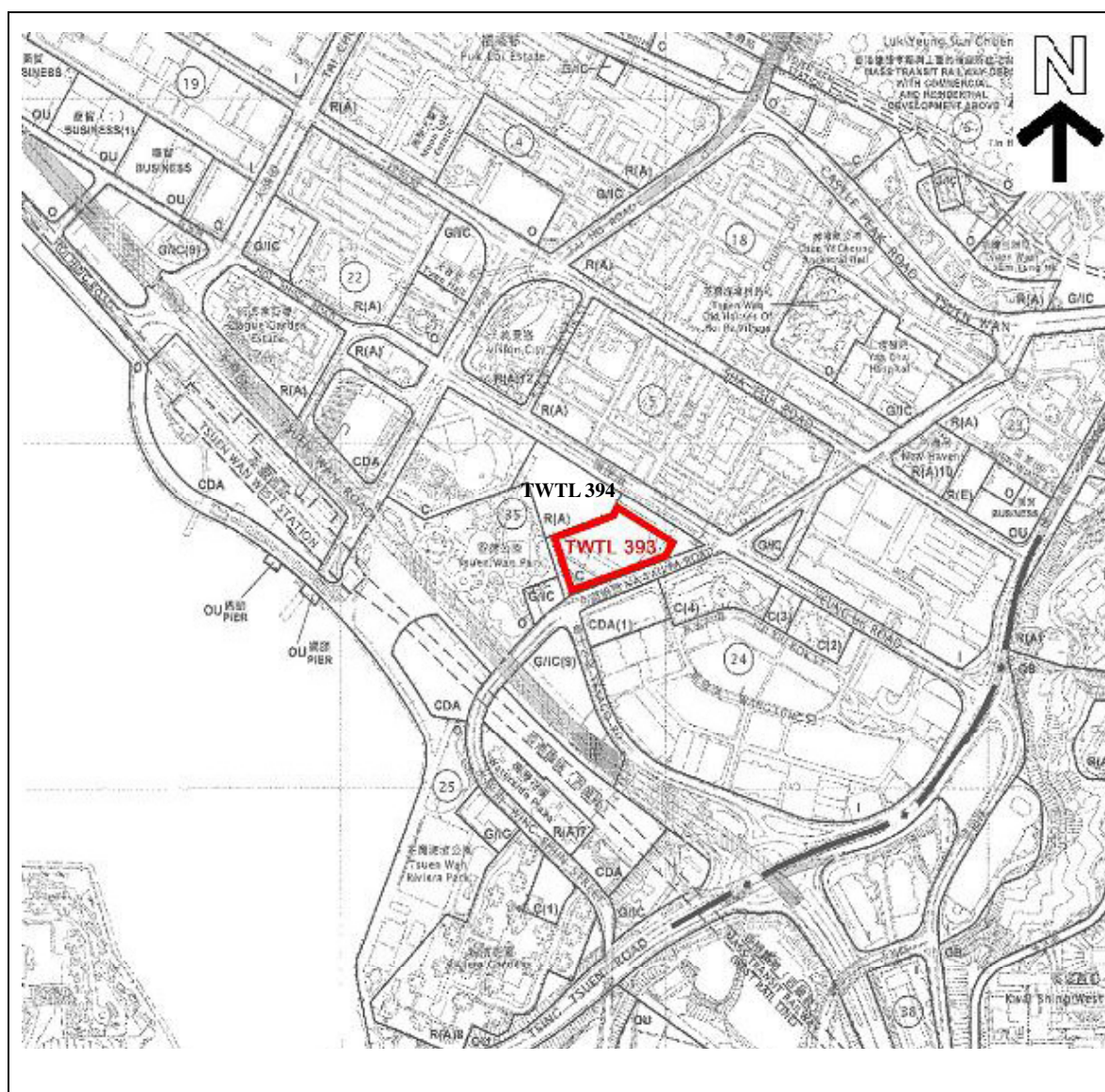
1.3 The Site and Surroundings

1.3.1 The Site, TWTL 393, with an area of about 14,160m², is located at the junction of Yeung Uk Road and Ma Tau Pa Road, and in between Tsuen Wan Park and the Tsuen Wan Town Centre. The Site falls within an area zoned “Commercial” (“C”) on the approved Tsuen Wan Outline Zoning Plan (OZP) No. S/TW/26. The “C” zone is intended for commercial developments including shop and services, hotel, office and etc, with a maximum non-domestic plot ratio (PR) of 9.5. There is no restriction on the maximum site coverage and maximum building height under the OZP. **Figure 1** shows the location of the Site.

1.3.2 To the north and northeast of the Site is the existing Tsuen Wan Town Centre comprises low-rise commercial/residential buildings with single façade. To the northwest and southeast of the Site are high-rise podium-tower

developments with large site coverage. In particular, the adjoining TWTL 394 immediately northwest of the Site is a nearly completed commercial/residential development with a large site coverage podium and two residential towers. The highest development, Nina Tower with a building height of 321m, is located at the further northwest.

Figure 1 - Location of TWTL 393



1.3.3 To the immediate southeast and east of the Site are the medium-rise industrial developments with large site coverage connected by narrow streets and service lanes. To the west and southwest of the Site are the Tsuen Wan Park and a temporary Government, institution or community site being used as an organic farm. The three proposed major commercial/residential developments at the Sites TW5, TW6 and TW7 of the West Rail Tsuen Wan West Station are found along the Tsuen Wan Waterfront.

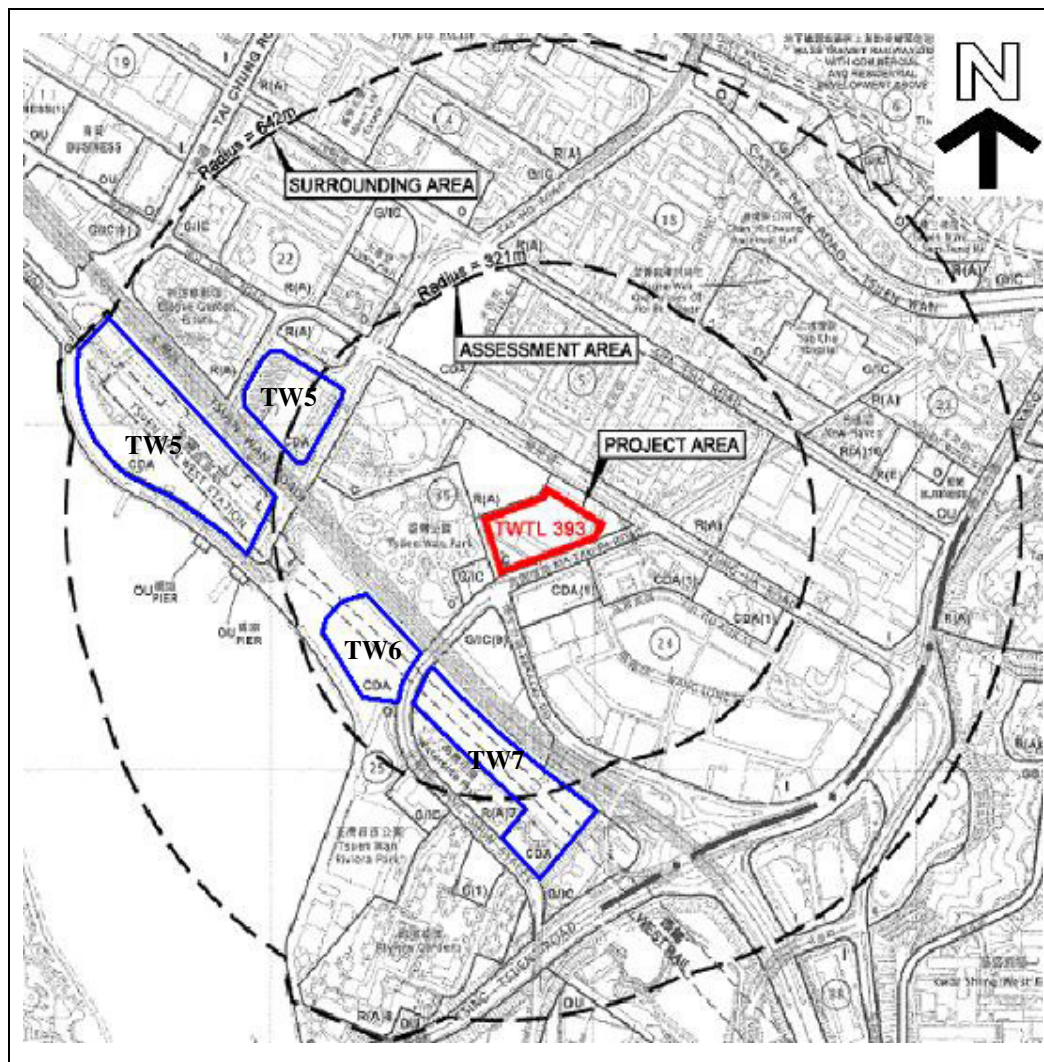
- 1.3.4 Yeung Uk Road, Sha Tsui Road, Ma Tau Pa Road, Texaco Road and Tai Ho Road are the five major roads in the area with various degrees of pedestrian activities and vehicular traffic serving the area.

2 ASSESSMENT APPROACH

2.1 Study Areas

- 2.1.1 The study methodology follows that being set out in the “Technical Guide for Air Ventilation Assessment for Developments in Hong Kong” (the “Technical Guide” hereafter) and taking due considerations of the requirements set out in the Assignment Brief.
- 2.1.2 In accordance with the Technical Guide, the Project Area of an AVA study is defined by the project site boundaries and includes all open areas within the project site that pedestrians are likely to access. For this Study, the Project Area is TWTL 393 (**Figure 2**).
- 2.1.3 The Assessment Area is identified with reference to the existing highest building in Tsuen Wan (i.e. Nina Tower with a building height of 321m). The Assessment Area generally covers area up to 321m from the boundary of the Project Area (**Figure 2**). The Assessment Area extends from the Project Area to Wang Lung Street in the east, Waterside Plaza in the south, West Rail Tsuen Wan West Station in the west and Lady Trench Polyclinic in the north.
- 2.1.4 The Surrounding Area generally includes the surrounding of the Project Area up to 642m from the boundary of the Project Area (**Figure 2**). The western and southern boundaries of the Surrounding Area have been slightly extended to cover the entire committed developments at the West Rail Tsuen Wan West Station, the existing Riviera Gardens and the Tsuen Wan Riviera Park. The Surrounding Area extends from the Project Area to Fu Yin House of Tai Wo Hau Estate in the east, Hoi Sing Mansion of Riviera Gardens in the south, West Rail Tsuen Wan West Station in the west, and the junction of Tai Ho Road and Castle Peak Road in the north.

Figure 2 - Extents of the Project Area, Assessment Area and Surrounding Area

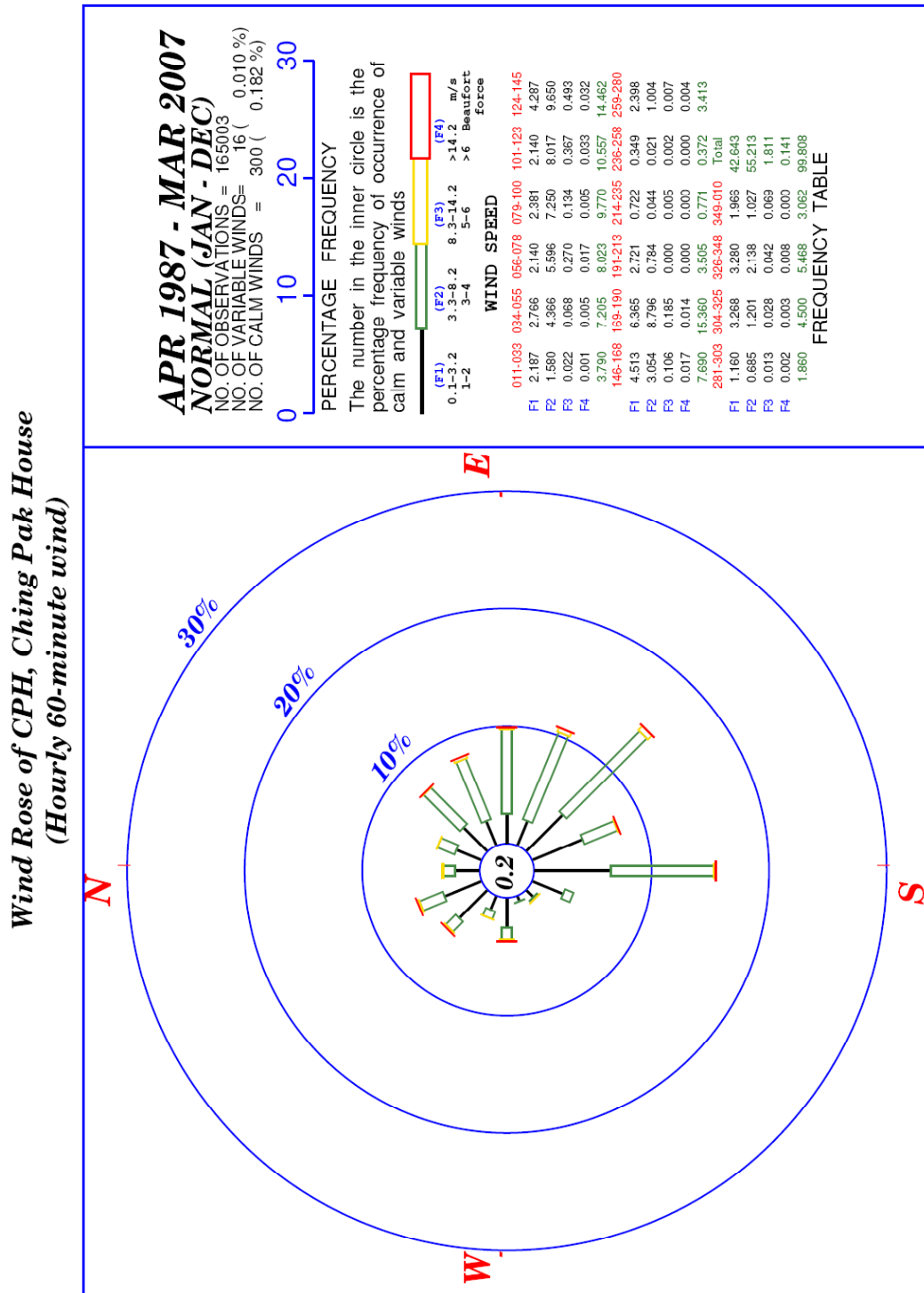


2.2 Wind Characteristics of the Site

2.2.1 The wind availability data is based on the wind rose data collected by the Hong Kong Observatory at the weather station located at Ching Pak House, Cheung Ching Estate, Tsing Yi. The wind rose (**Figure 3**) indicates that:

- the major prevailing wind direction is from the south (i.e. between 169° and 190°) with a frequency of occurrence of 15.4%;
- the secondary prevailing wind direction is from the southeast (i.e. between 124° and 145°) with a frequency of occurrence of 14.5%; and
- the major frequency of occurrence of wind direction is allocated in the first quadrant (i.e. 11.25° to 101.25°) and the second quadrant (i.e. 101.25° to 191.25°) of the compass bearing with approximately 29% and 48% of the total frequency of occurrence respectively.

Figure 3 - Wind Rose of Ching Pak House, Cheung Ching Estate, Tsing Yi



2.3 CFD Testing

- 2.3.1 A CFD computer software named FLUENT version 6.3 was used to carry out the CFD testing. The detached eddies simulation (DES) model of FLUENT was employed and the computation domain was simulated with the unstructured meshing algorithm.
- 2.3.2 The horizontal extent of the computation domain for CFD testing covers the Project Area, Assessment Area and Surrounding Area. In general, it includes the geometry of the proposed development within the Project Area, the existing and planned developments, the elevated highway structures, footbridges and noise barriers along Yeung Uk Road within the Assessment Area. A nominal velocity of 10m/s at 500m above ground is assumed and used as the reference velocity upon calculating the Velocity Ratio (VR).
- 2.3.3 Three types of test points, namely Perimeter, Overall and Special Test Points, are designated to facilitate capturing wind flow information and computation of quantitative wind VRs for the test points. Based on the VR of the test points, the resultant wind environment of the proposed design options at the Project Area can be assessed. The VRs gathered at the Perimeter Test Points are used to calculate a site spatial average velocity ratio (SVR), which helps to assess the air ventilation impacts of the proposed development on its immediate area. The wind flow information of the Perimeter and Overall Test Points distributed in the Project Area and the Assessment Area are used to calculate a local spatial average velocity ratio (LVR), which helps to assess the air ventilation impacts of the proposed development within the Assessment Area.
- 2.3.4 The Expert Evaluation was conducted to provide broad-brush qualitative assessments of the characteristics of air ventilation in the Project Area and Assessment Area, aiming to identify major air ventilation issues and necessary inputs for the establishment of the development baseline situation and subsequent development design options as well as the recommended development design for the Project Area. The evaluation also aims to interpret the wind profiles and define their application in the CFD simulation with emphasis on the wind environment of pedestrian level.

3 DEVELOPMENT DESIGN OPTIONS

3.1 Five Design Options

3.1.1 Five development design options were formulated taking into account the land use compatibility, development intensity and urban design consideration as well as their respective AVA analytical results. They are summarized as follows:

- (a) Baseline Situation (**Figure 4**), i.e. the scheme with development parameters permitted under the OZP, proposed draft sale conditions and the Buildings Ordinance. The proposed development comprises retail, office and hotel uses with a maximum non-domestic PR of 9.5. Assuming 30% of gross floor area (GFA) concession, the total GFA of the proposed design scheme is about 174,876m². There are two closely located high-rise buildings with 129.1mPD and 237.6mPD respectively atop a 4-storey stepped podium with an approximately 62.5% site coverage at the top floor and 92% site coverage on the lowest 3 floors.

- (b) Design Option 1 (**Figure 5**) is drawn up with a splitted podium design (podia separation by 25m) while maintaining the same development intensity (PR of 9.5), site coverage (about 23.7%) and commercial uses (i.e. retails, office and hotel). Assuming a higher GFA concession, (i.e. 43.1% for testing purpose), the total GFA of the proposed scheme is about 192,536m². The two high-rise buildings with a tower separation of 45m and building heights of 134.1mPD and 247.6mPD are built on top of the 5-storey and 6-storey podia respectively. A 15m setback from the adjoining TWTL 394 is also introduced.

- (c) Design Option 2 (**Figure 6**) maintains the same development intensity (PR of 9.5), the non-building area directing to Chung On Street and similar site coverage of about 24% whilst the development is intended for pure hotel use. A 3-tower hotel scheme with curving built-form and wider separations between towers are proposed for the AVA testing purposes. The total GFA of the proposed design scheme is about 174,876m² (assuming a GFA concession of 30%). The three hotel towers with building heights of 131.6mPD, 152.6mPD and 173.6mPD respectively are located at grade level with a communal 3-storey underground basements (adopting a non-podium design).

- (d) Design Option 3 (**Figure 7**) proposes a 2-tower rectangular blocking scheme with a reduction of PR by 20% from 9.5 to 7.6 and an incorporation of 3 non-building areas. Assuming 30% of GFA concession, the total GFA of the proposed scheme is about 139,901m². Accommodating this level of development intensity whilst keeping the building height at a level comparable with the surrounding areas and similar site coverage of Design Options 1 and 2, two tower blocks with building heights of about 114.1mPD and 149.1mPD respectively are proposed. An opening traversing Tower 2 (25m wide and 20m vertical clearance) is introduced to test the ventilation effects on the Tsuen Wan Park.

- (e) Recommended Design Option (**Figure 8**) has the same PR and total GFA of Design Option 3 and maintaining the building gaps and separation proposed in the Design Option 3. The site coverage is reduced to about 21.6% while the building heights of the two tower blocks are revised to 114.1mPD and 180.6mPD respectively. The opening traversing Tower 2 is shifted toward the southwest with an aim to further improve air ventilation at Tsuen Wan Park.

3.2 Major Features of Five Design Options

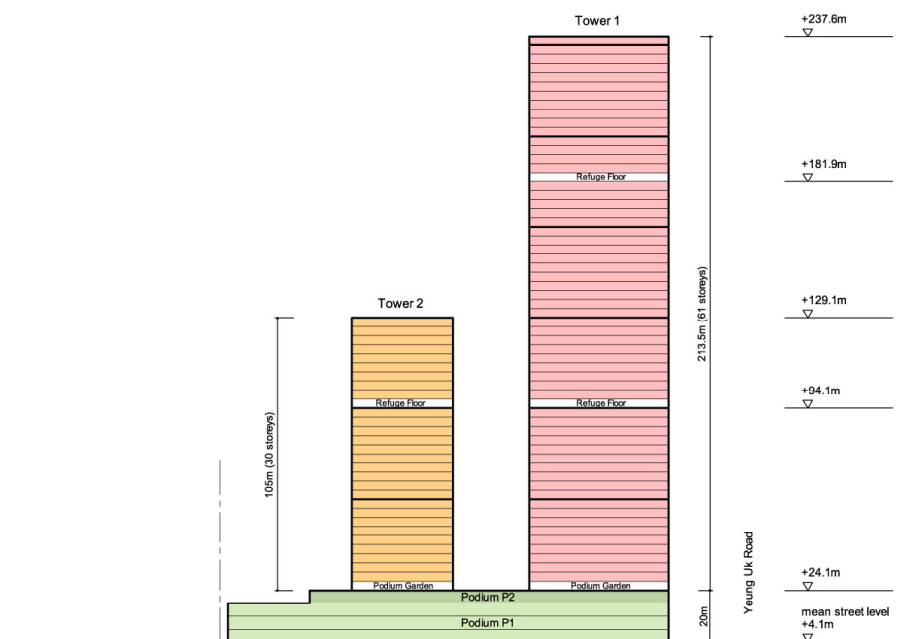
3.2.1 The major features of the Baseline Situation are:

- (a) the proposed podium at the Site would block the air flow at pedestrian level and would significantly reduce southerly winds, which is the prevailing wind in the area flowing towards Chung On Street;
- (b) the wind flow at Tsuen Wan Park to the immediately west of the Site would be reduced under the north-easterly wind;
- (c) localised strong wind is observed in the 4.5m wide service lane between the Site and the adjoining TWTL 394; and
- (d) the 15m building gap between the two towers is not likely to have sufficient ventilation effects on Chuen Lung Street, Chung On Street, Ham Tin Street and not even on the section of Yeung UK Road along the Site.

Figure 4 - Baseline Situation



SCHEMATIC PLAN



SCHEMATIC SECTION

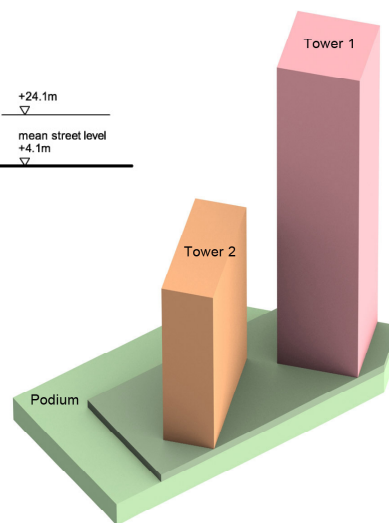
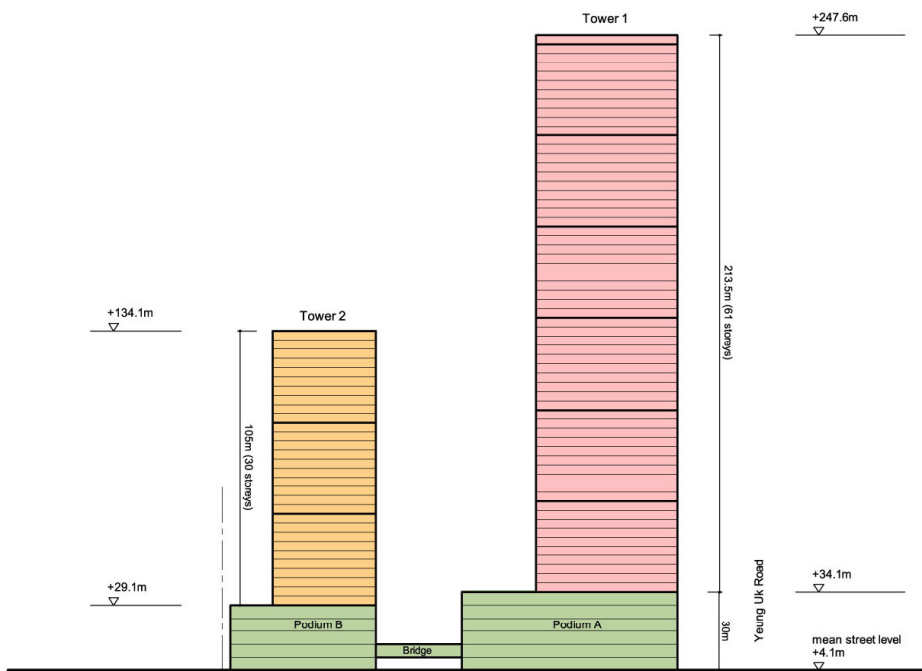


Figure 5 - Design Option 1



SCHEMATIC PLAN



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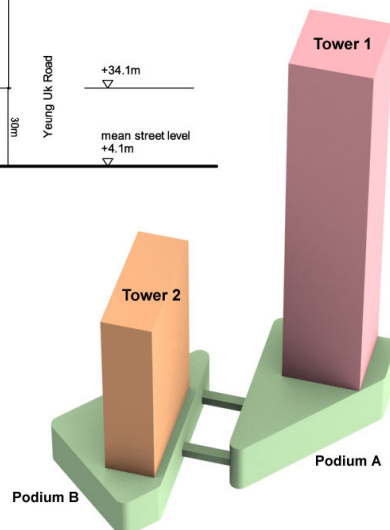
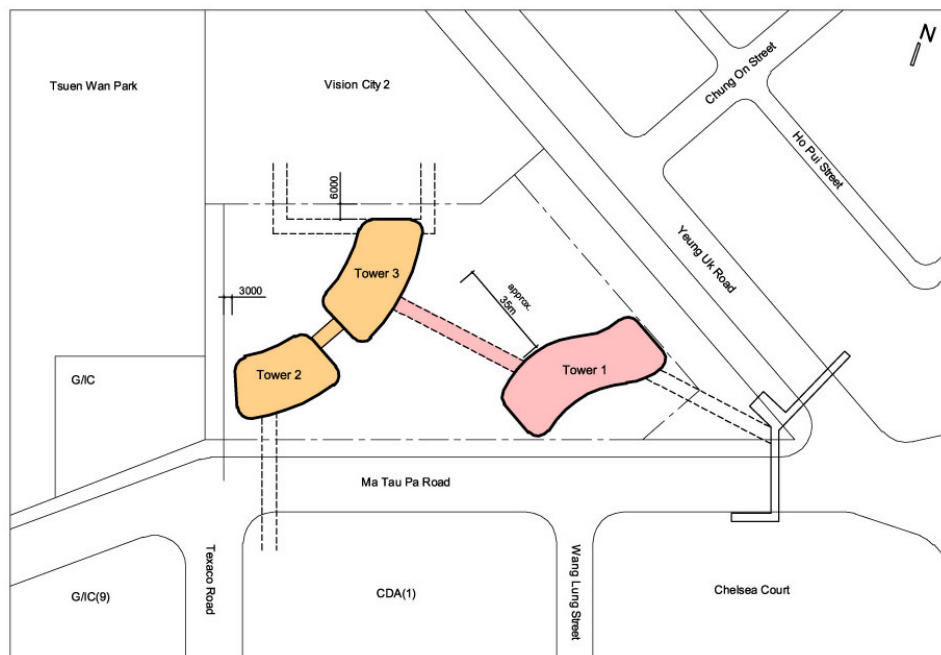
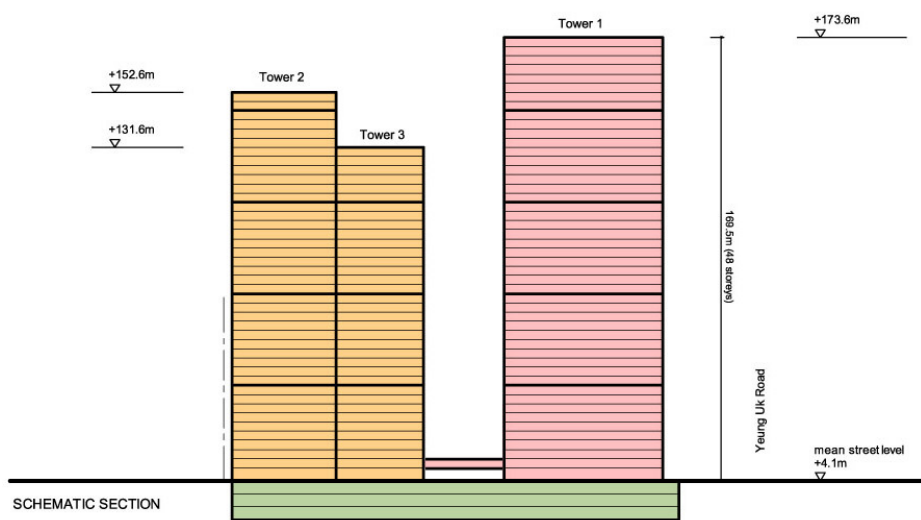


Figure 6 - Design Option 2



SCHMATIC PLAN



SCHMATIC SECTION

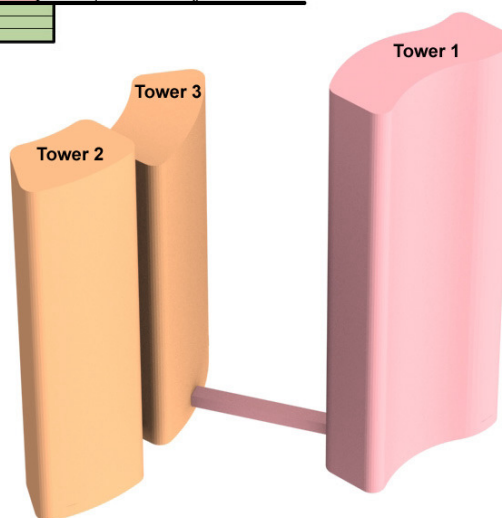
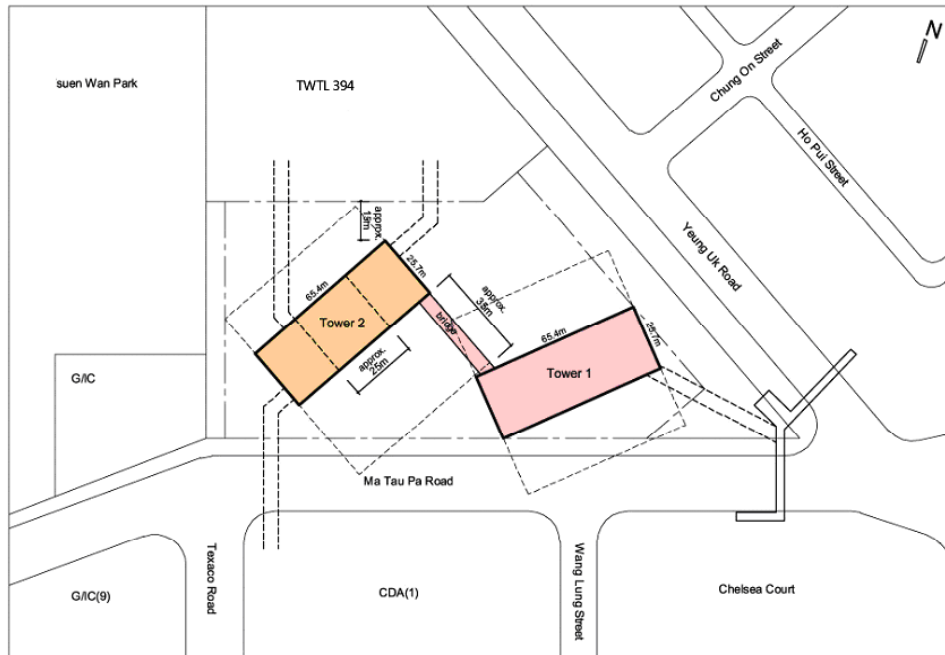


Figure 7 - Design Option 3



SCHEMATIC PLAN



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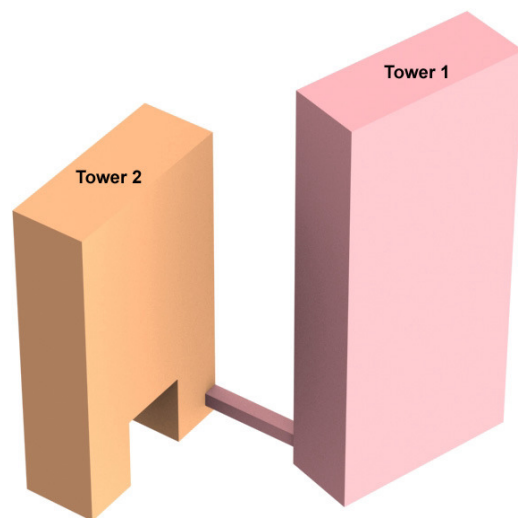
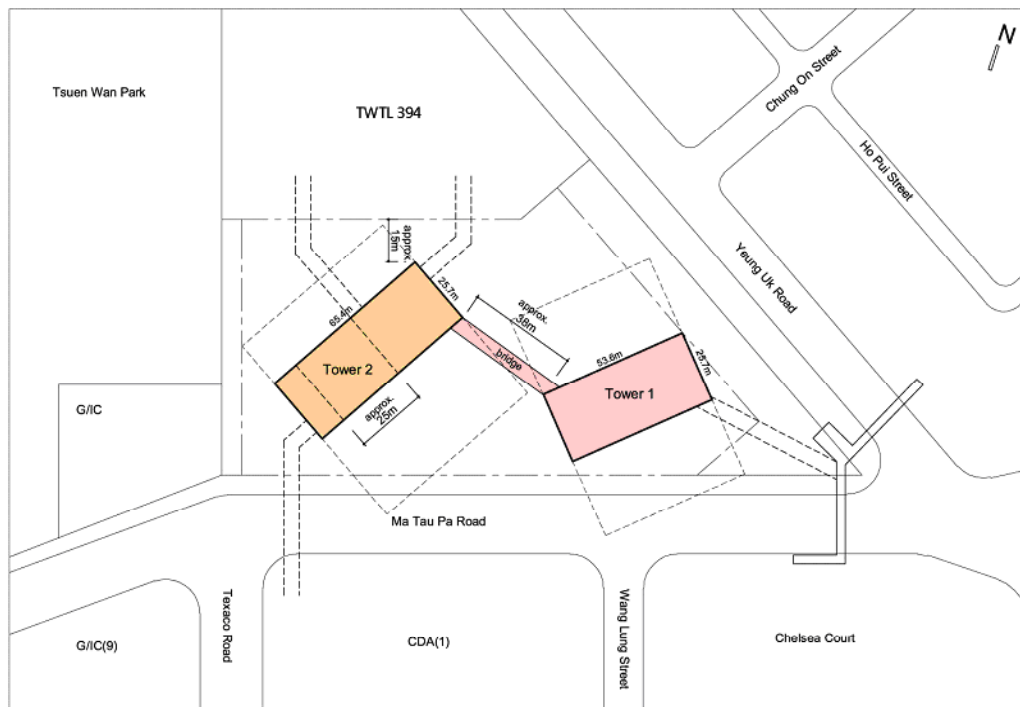
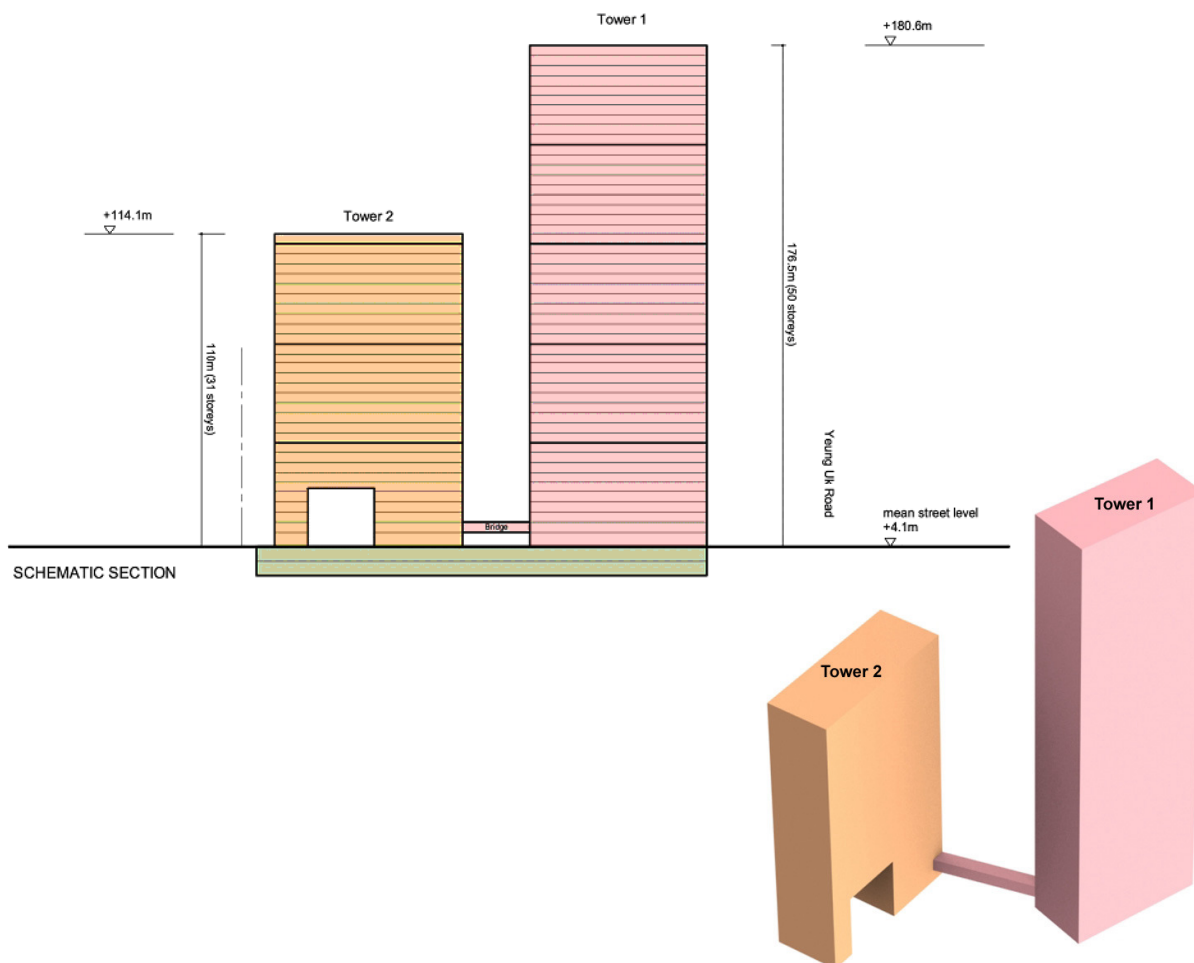


Figure 8 - Recommended Design Option



SCHEMATIC PLAN



SCHEMATIC SECTION

3.2.2 The major features of the Design Option 1 are:

- (a) the non-building gap between the split podia would enhance the ventilation performance at pedestrian level along Chung On Street and section of Yeung Uk Road;
- (b) the reduction of podium site coverage may reduce the strong channelling effects at Ma Tau Pa Road and the service lane between the adjoining the Site and TWTL 394; and
- (c) a curvature design may be beneficial to air ventilation.

3.2.3 The major features of the Design Option 2 are:

- (a) the non-podium design is beneficial to the pedestrian level ventilation at Tsuen Wan Park, Ma Tau Pa Road and the open areas between Tower 1 and Towers 2 and 3; and
- (b) the building gap between Tower 2 and Tower 3 is beneficial to the air ventilation at Tsuen Wan Park.

3.2.4 The major features of the Design Option 3 are:

- (a) the overall ventilation performance of Design Option 2 and Design Option 3 are likely to be comparable even the buildings are in different shapes or forms but with a similar design of layout and disposition;
- (b) the ventilation environment of the nearby areas is improved by lowering the development intensity of the Site by 20%; and
- (c) a wide building opening at the near pedestrian level of Tower 2 should be beneficial to the ventilation of the Tsuen Wan Park.

3.2.5 The major features of the Recommended Design Option are:

- (a) the ventilation performance of the immediate surrounding of TWTL 393 is slightly improved; and
- (b) the ventilation at Tsuen Wan Park and Chung On Street is slightly enhanced.

4 SUMMARY OF RESULTS AND DISCUSSION

4.1 Site and Local Spatial Average Velocity Ratios

4.1.1 The weighted VR contour for the development design options and the comparison of the SVR, LVR and spatial average velocity ratio (SAVR) by streets and areas are listed in **Figure 9** and **Tables 1 and 2**. SAVR refers to the grouped individual test points in a local area or along major street so that the averaged ventilation effects of the above mentioned areas can be analyzed.

4.2 Discussion on Assessment Results

4.2.1 From the assessment results in **Table 1**, Design Option 1 with a reduced podium structure can improve the air ventilation at the boundary of the Site by 18%. When podium is removed in Design Option 2, the ventilation performance at the boundary would be further enhanced by 38% and that of the surrounding areas will be improved by 6%. Design Option 3 further demonstrates that the change in building form (but with a similar layout) will likely generate a similar overall ventilation performance at and around the Site. However, when further setback from the site boundary is implemented in the Recommended Design Option, a slight improvement to the boundary and surrounding areas of the Site by 11% and 6% are noticed respectively. Overall speaking, the ventilation performance of the Recommended Design Option at the boundary of the Site has been enhanced by 81.8% when comparing to that of the Baseline Situation and the ventilation performance within the Assessment Area has been improved by 12.5% as well.

4.2.2 By analyzing the SAVRs of the Recommended Design Option, the ventilation performance along Chung On Street and Yeung Uk Road have been improved by around 45% and 3% – 16% respectively. The uncomfortable strong wind environment under certain wind directions along Ma Tau Pa Road has also been mitigated as demonstrated by the reduction of SAVR by around 14%. As such, the problem areas as identified in the first four simulations have been mitigated progressively by providing non-building areas, setting back or increasing the building separation between towers and creating building void.

The poor ventilation areas have been enhanced as far as possible with the consideration of development constraints, design flexibility and air ventilation performance.

Figure 9 - SVR of Five Development Design Options

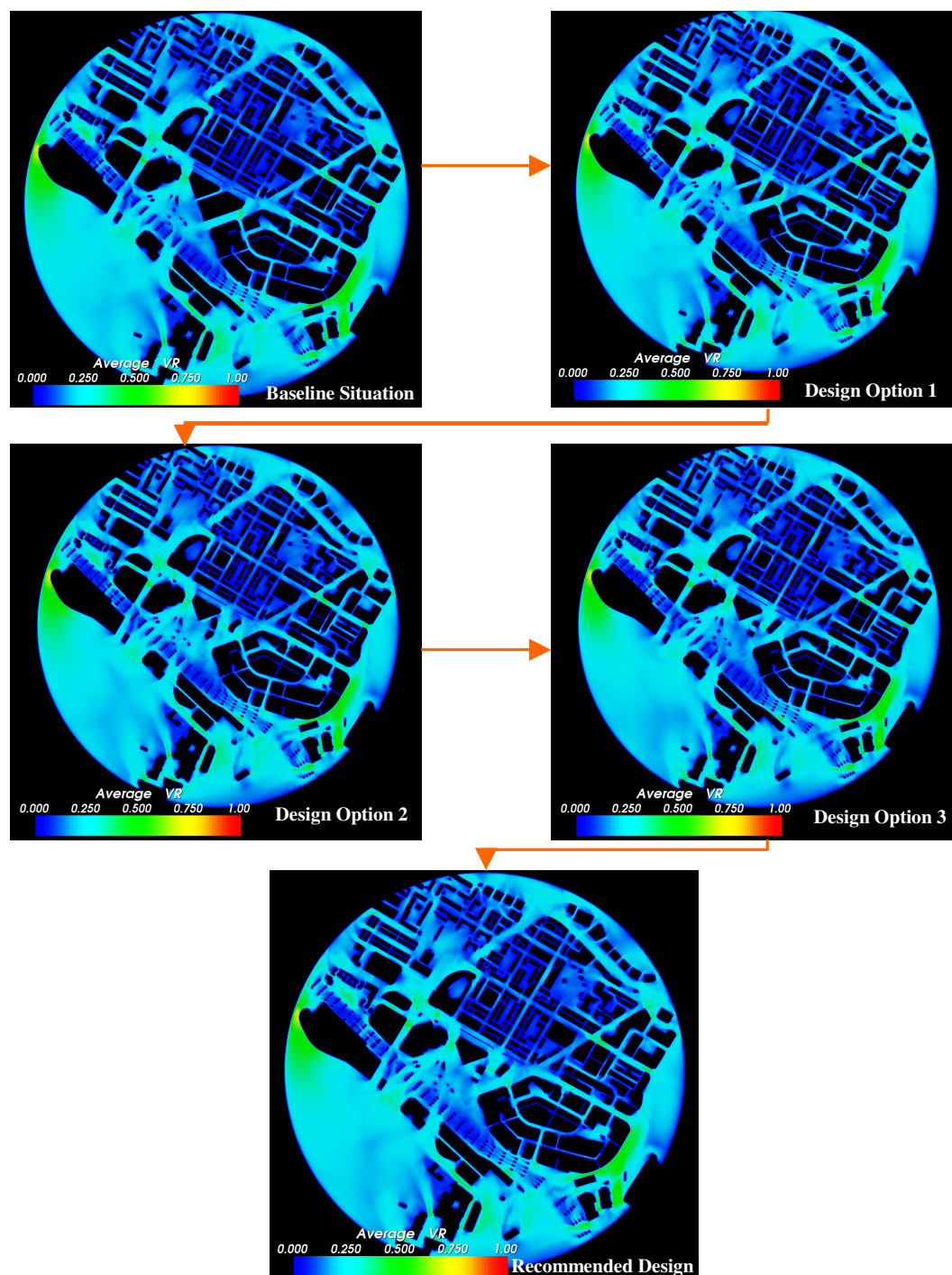


Table 1 - Summary of SVR and LVR of Five Development Options

	Baseline Situation		Design Option 1		Design Option 2		Design Option 3		Recommended Design Option		Difference between Baseline Situation and Recommended Design Option
SVR	0.11	N.A.	0.13	+18%	0.18	+38%	0.18	0%	0.20	+11%	+81.8%
LVR	0.16	N.A.	0.16	0%	0.17	+6%	0.17	0%	0.18	+6%	+12.5%

(Remark: The percentage increase is comparing with the figures of the previous option)

Table 2 - Summary of SAVR by Streets/Areas of Five Development Options (Focus Areas)

	Baseline Situation	Design Option 1	Design Option 2	Design Option 3	Recommended Design Option	Difference between Baseline Situation and Recommended Design Option
1. Chung On Street	0.10	0.12	0.10	0.15	0.14	44.55%
2. Yeung Uk Road (East Section)	0.22	0.23	0.23	0.22	0.23	2.79%
3. Yeung Uk Road (Middle Section – near TWTL 393)	0.14	0.16	0.13	0.17	0.16	16.38%
4. Yeung Uk Road (West Section – near TWTL 394 and Nina Tower)	0.21	0.23	0.24	0.22	0.23	9.39%
5. Luen Yan Street	0.15	0.14	0.13	0.14	0.13	-9.49%
6. Ma Tau Pa Road (TWTL 393 Section)	0.21	0.20	0.17	0.17	0.18	-14.23%
7. Ma Tau Pa Road (Park and Waterfront Section)	0.17	0.18	0.17	0.18	0.18	4.62%
8. Tsuen Wan Park	0.19	0.19	0.20	0.18	0.19	0.76%
9. Around Nina Tower	0.26	0.26	0.25	0.26	0.26	-0.23%

	Baseline Situation	Design Option 1	Design Option 2	Design Option 3	Recommended Design Option	Difference between Baseline Situation and Recommended Design Option
10. Tsuen Wan Waterfront	0.22	0.22	0.23	0.22	0.22	0.19%
11. Industrial Area (North Part)	0.17	0.17	0.18	0.18	0.18	5.34%
12. Industrial Area (Middle Part)	0.21	0.21	0.21	0.21	0.21	-1.19%
13. Industrial Area (South Part)	0.14	0.14	0.13	0.13	0.14	-0.26%
14. Texaco Road	0.14	0.14	0.15	0.14	0.15	4.81%
15. Tai Ho Road (North Section)	0.29	0.29	0.29	0.28	0.28	-1.48%
16. Tai Ho Road (South Section)	0.16	0.18	0.18	0.16	0.16	-4.00%
17. Tsuen Wan Old Town (East Part)	0.07	0.07	0.08	0.08	0.08	5.95%
18. Tsuen Wan Old Town (West Part)	0.11	0.11	0.12	0.11	0.11	-1.82%
19. Sha Tsui Road	0.11	0.12	0.13	0.12	0.11	2.02%
20. Tsuen Wan Road (On Elevated Flyover)	0.15	0.15	0.14	0.15	0.15	0.54%

(Remarks: The calculated percentage difference between Baseline Situation and Recommended Design Option is based on the raw data from the simulation results)

5 RECOMMENDATIONS AND CONCLUSION

Taken into account the planning and urban design considerations and the overall and directional air ventilation performance revealed in the CFD simulations, the following development parameters and restrictions on the development at the Site are recommended:

- (a) A maximum non-domestic plot ratio of 7.6 is recommended for the proposed development at the Site.
- (b) A bulky podium with large site coverage should be avoided to prevent negative ventilation effects on the pedestrian level. The ventilation performance at the boundary of the Site of the Recommended Design is around 81.8% better than that of the Baseline Situation, which has a large podium. This demonstrates a lower site coverage will enhance the pedestrian level air ventilation around the Site. A site coverage of 25% is suggested for the proposed development at the Site.
- (c) Air ventilation near the Site would be enhanced if the Site could be developed into two towers with stepped building heights. For Tower 1, which situates near the junction of Yeung Uk Road and Ma Tau Pa Road, is suggested to have a maximum building height of about 180mPD whilst Tower 2, facing Tsuen Wan Park, is suggested to have a maximum building height of about 120mPD with regard to the building height profile around the Tsuen Wan waterfront.
- (d) The wider frontage of the building blocks should be aligned with the prevailing southerly wind, in order to prevent blockage of wind flow from the waterfront to the Tsuen Wan Town Centre area along Chung On Street. A wider non-building area, which corresponds to wider frontage in alignment to the prevailing southerly winds, could improve the directional air ventilation at Chung On Street by around 40% when compared to that in the Baseline Situation. In order to control the alignment of the building frontage, three non-building areas are therefore suggested to be implemented on the Site:

- i) A non-building area directing to Chung On Street is suggested to be at least 38m wide, as the same in the Recommended Design Option, to direct wind flow to Chung On Street of Tsuen Wan Town Centre;
 - ii) A 15m-wide strip with non-building zoning along the north-western boundary of the Site should be provided to further enhance ventilation between the Site and the adjoining TWTL 394 and avoid the unpleasant wind environment due to the narrow gap between two lots; and
 - iii) A 25m wide and 20m high opening at Tower 2 is proposed to act as an air path at pedestrian level to improve the ventilation at localized areas inside the Tsuen Wan Park under northerly and easterly winds. Ventilation will be doubled along this air path when compared to the no-air-path option.
- (e) Tree planting is also suggested at several high VR areas, such as along Ma Tau Pa Road, section of Yeung Uk Road and along the non-building areas inside the Site to mitigate the unpleasant strong wind environment in different seasons.