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# AIR VENTILATION INITIAL STUDY FOR PROPOSED PUBLIC HOUSING DEVELOPMNT AT TSUENG KWAN O AREA 65B AND ITS SOUTH SPACE

Report Prepared by :
**Allied Environmental Consultants Ltd.**

**COMMERCIAL-IN-CONFIDENCE**

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# AIM

To conduct an Air Ventilation Assessment (AVA) as per the Technical Circular No. 1/06 (TC) using Computational Fluid Dynamics (CFD) modeling to predict the wind environment of the site and determine the effects from the surrounding buildings and topography. The AVA also acts as a design tool to enhance the air ventilation performance in the proposed development scheme.

# 1 INTRODUCTION

Allied Environmental Consultants Limited (AEC) has been appointed by Housing Authority to undertake an air ventilation study for the proposed public housing development located at Tsueng Kwan O Area 65B.

## 1.1 BACKGROUND

The subject site is located to south of Po Yap Road in the Tsueng Kwan O Town Center South area as shown on ***Figure 1***. The development site consists of three residential complex buildings, and its southern open space area. The site area is approximately 23,092 m2. The building heights for the proposed development will be no more than 100 mPD which includes the roof and water tower structure. The master layout plan is indicated in ***Figure 2***.

As the site is currently vacant and there are no buildings or infrastructure at the site, comparison of the current situation with the proposed development indicates that the development footprint may have the potential to affect the air ventilation performance in the immediate vicinity of the subject site.

The effect on wind environment in the surrounding areas of the subject development shall be elaborated by comparing the wind velocity ratio simulated for the before and after-development scenarios in the Initial Study.

## 1.2 SURROUNDING BUILT ENVIRONMENT

The adjacent land use is predominantly residential, with residential tower blocks located to the west and north of the project area. Two educational institutes are located to the south of the project area.

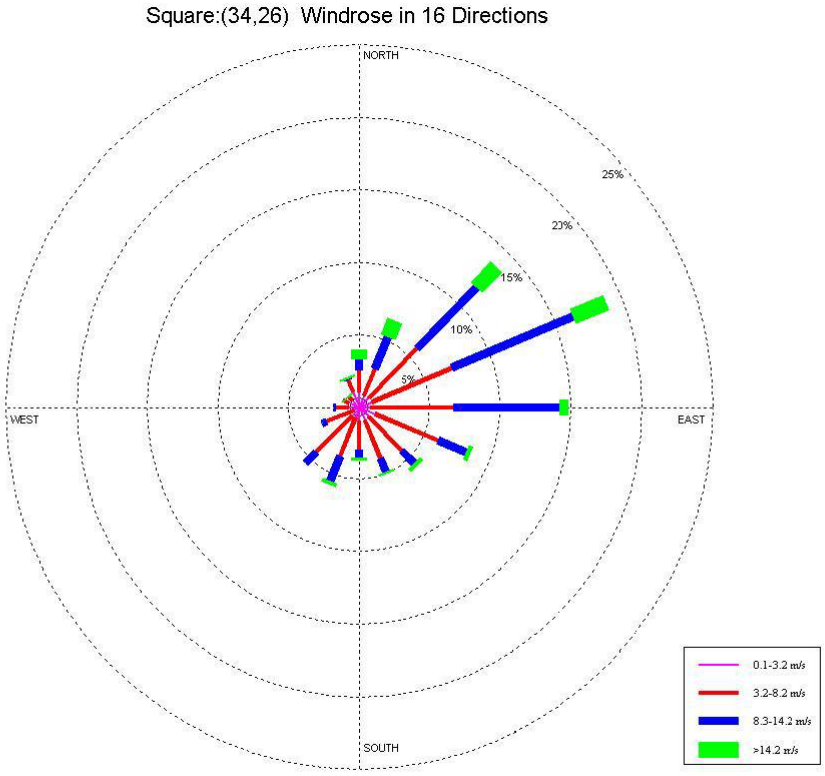
According to the site wind availability data provided published by the Hong Kong Planning Department, the dominant wind direction is from the east to northeast. As infrastructure and buildings located to the east of subject site are at a low elevation, this can potentially result in increased wind permeability.

# 2 SITE WIND AVAILABILITY DATA

## 2.1 WIND DATA FROM MM5

The assumption of wind data refers to the "Site Wind Availability Data" published by the Planning Department [1] which is simulated by Fifth-Generation NCAR/ Penn State Mesoscale Model (MM5), as recommended in "Technical Guide for Air Ventilation Assessment for Developments in Hong Kong" [2] published by Housing, Planning and Lands Bureau (HPLB) and Environment, Transport and Works Bureau (ETWB). It indicates wind velocity ranges from 0 to 22m/s from 16 wind directions, predicted at the nearest grid (34, 26) to the site and at 596m above the terrain level. The eight most probable wind directions which exceed 75% of a year at this grid are summarized in ***Table 1*** and the wind velocity was summarized in ***Table 2***. The wind rose diagram of MM5 data is shown in ***Plate 1***.

Plate 1 Wind Rose of Grid (34, 26)




The following eight wind directions which exceed 75% of a year were chosen for modeling.

Table 1 Summary of the Most Probable Wind Directions which Exceed 75% of a Year

| **Prevailing Wind Direction** | **Degree of Wind Direction** | **Probability** |
|---|---|---|
| NNE | $22.5^0$ | 6.2% |
| NE | $45^0$ | 13.4% |
| ENE | $67.5^0$ | 18.4% |
| East | $90^0$ | 14.6% |
| ESE | $112.5^0$ | 8% |
| SE | $135^0$ | 5.6% |
| SSW | $202.5^0$ | 5.7% |
| SW | $225^0$ | 5.3% |
| | **Total Probability:** | 77.2% |

Table 2 Summary of the Wind Velocity of the 8 Most Probable Wind Directions

| **Velocity infinity (m/s)** | **NNE** | **NE** | **ENE** | **East** | **ESE** | **SE** | **SSW** | **SW** |
|---|---|---|---|---|---|---|---|---|
| 0 to 1 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1 to 2 | 0.002 | 0.003 | 0.004 | 0.002 | 0.003 | 0.003 | 0.002 | 0.003 |
| 2 to 3 | 0.003 | 0.004 | 0.003 | 0.005 | 0.005 | 0.004 | 0.004 | 0.003 |
| 3 to 4 | 0.006 | 0.009 | 0.009 | 0.008 | 0.007 | 0.006 | 0.005 | 0.004 |
| 4 to 5 | 0.006 | 0.009 | 0.012 | 0.009 | 0.007 | 0.006 | 0.005 | 0.007 |
| 5 to 6 | 0.004 | 0.011 | 0.012 | 0.013 | 0.009 | 0.008 | 0.006 | 0.008 |
| 6 to 7 | 0.002 | 0.008 | 0.014 | 0.014 | 0.012 | 0.008 | 0.006 | 0.009 |
| 7 to 8 | 0.003 | 0.01 | 0.013 | 0.013 | 0.012 | 0.006 | 0.006 | 0.007 |
| 8 to 9 | 0.003 | 0.008 | 0.015 | 0.013 | 0.01 | 0.004 | 0.007 | 0.005 |
| 9 to 10 | 0.005 | 0.009 | 0.013 | 0.02 | 0.008 | 0.004 | 0.005 | 0.003 |
| 10 to 11 | 0.004 | 0.01 | 0.013 | 0.02 | 0.003 | 0.002 | 0.004 | 0.001 |
| 11 to 12 | 0.004 | 0.01 | 0.019 | 0.014 | 0.001 | 0.002 | 0.002 | 0.001 |
| 12 to 13 | 0.004 | 0.012 | 0.019 | 0.006 | 0.002 | 0 | 0.002 | 0.001 |
| 13 to 14 | 0.003 | 0.009 | 0.013 | 0.004 | 0 | 0.001 | 0.001 | 0 |
| 14 to 15 | 0.002 | 0.009 | 0.011 | 0.002 | 0 | 0.001 | 0 | 0 |
| 15 to 16 | 0.001 | 0.003 | 0.006 | 0.001 | 0 | 0 | 0 | 0 |
| 16 to 17 | 0.001 | 0.003 | 0.003 | 0.001 | 0 | 0 | 0 | 0 |
| 17 to 18 | 0.002 | 0.002 | 0.002 | 0 | 0 | 0 | 0.001 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 18 to 19 | 0.002 | 0.001 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 to 20 | 0.002 | 0.001 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 to 21 | 0.001 | 0.001 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 to 22 | 0.001 | 0 | 0.001 | 0 | 0 | 0 | 0 | 0 |
| 22 to 23 | 0 | 0.001 | 0.001 | 0 | 0 | 0 | 0 | 0 |
| 23 to 24 | 0 | 0 | 0.001 | 0 | 0 | 0 | 0 | 0 |

*Note: Height of Anemometer is 596mPD.*

## 2.2 WIND DATA FROM HONG KONG OBSERVATORY

The assumption of wind data refers to the wind stations of Hong Kong Observatory (HKO) which can be found in the area of Tseung Kwan O. The locations of the wind stations are shown on ***Plate 2***. The elevation of anemometer at HKO Tseung Kwan O Station is 52mPD while the ground level is 38mPD. The wind rose diagram of HKO data is shown in ***Plate 3***. The site wind availability is studied as in ***Table 3***.

Plate 2 Locations of wind stations in Hong Kong

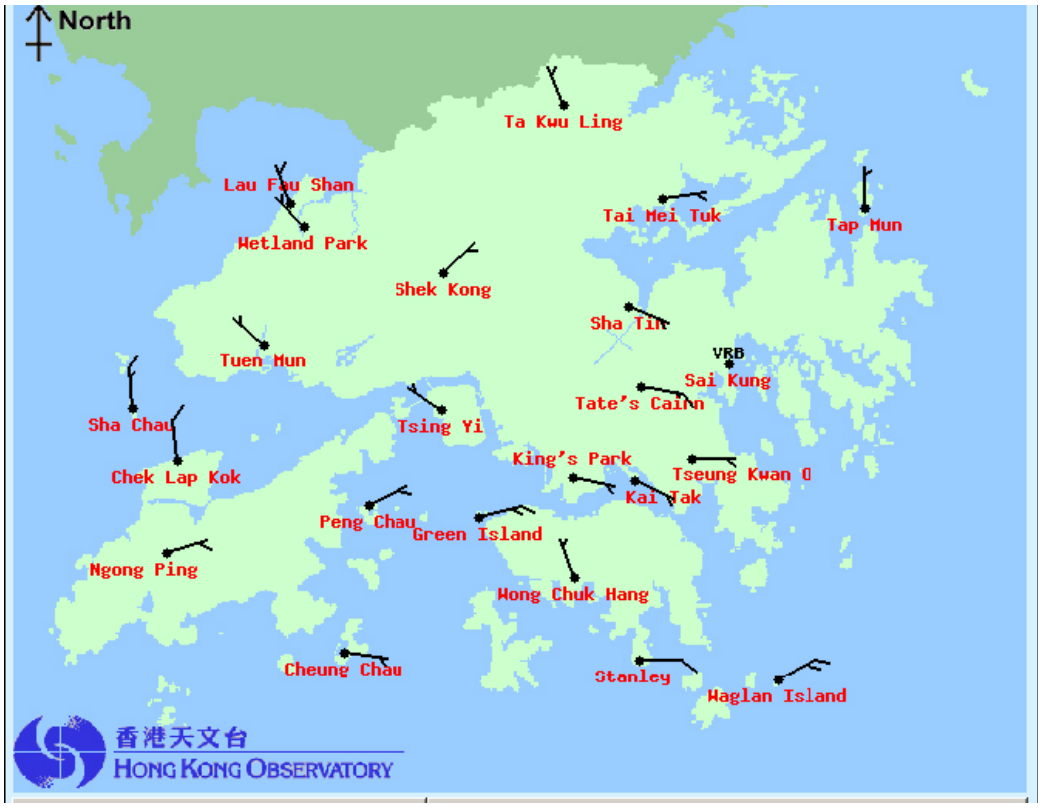


Plate 3 Wind Rose Diagram of HKO Data

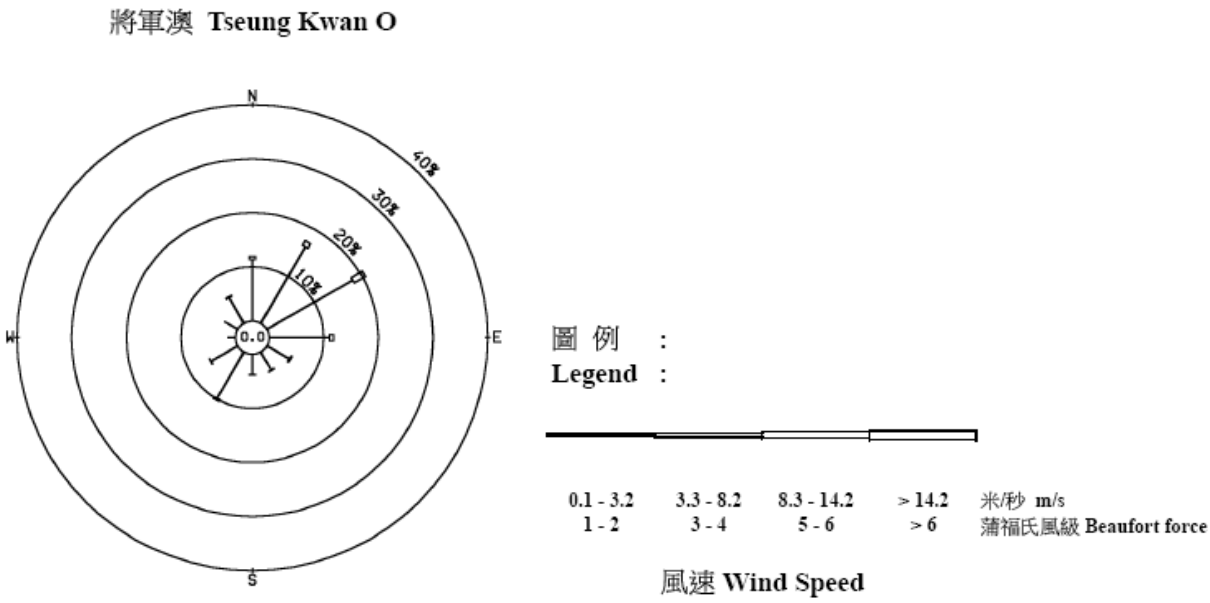



Table 3 Site Wind Availability Data of Tseung Kwan O, HKO, Jan-Dec 2007

| **Wind Direction** | **Frequency of Occurrence (Dec – Feb)** | **Frequency of Occurrence (Mar – May)** | **Frequency of Occurrence (Jun – Aug)** | **Frequency of Occurrence (Sep – Nov)** | **Total Annual Frequency** |
|---|---|---|---|---|---|
| N | 12.1% | 9.8% | 0% | 14.3% | 9.6% |
| NNE | 35.2% | 19.5% | 2.8% | 19.8% | 20.3% |
| NE | 3.3% | 1.2% | 0% | 4.4% | 2.4% |
| ENE | 31.9% | 26.8% | 2.8% | 33.0% | 24.8% |
| E | 12.1% | 4.9% | 8.5% | 9.9% | 9.0% |
| ESE | 0% | 0% | 7.0% | 0% | 1.5% |
| SE | 0% | 1.2% | 7.0% | 4.4% | 3.3% |
| SSE | 0% | 2.4% | 0% | 2.2% | 1.2% |
| S | 1.1% | 3.6% | 5.6% | 1.1% | 2.7% |
| SSW | 1.1% | 19.5% | 40.8% | 2.2% | 14.3% |
| SW | 0% | 0% | 12.7% | 1.1% | 3.0% |
| WSW | 0% | 2.4% | 11.3% | 1.1% | 3.3% |
| W | 0% | 0% | 0% | 1.1% | 0.3% |
| WNW | 0% | 0% | 0% | 3.3% | 0.9% |
| NW | 0% | 0% | 0% | 0% | 0% |
| NNW | 2.2% | 8.5% | 1.4% | 2.2% | 3.6% |

The wind data from HKO reveals the wind pattern during summer and non-summer periods. In ***table 3***, the pattern of wind availability from June to August (summer) is apparently different from the other three periods. A higher probability of South-South-West (SSW) wind is indicated in summer, while the other columns show low probability of SSW wind. Therefore, SSW wind is the most prevailing wind direction in summer. For the non-summer period, East-north-east is the most prevailing wind direction.

As the wind data from HKO is the resultant wind dissipated by actual topographical situations of surrounding, wind data from MM5 is adopted to do simulation.

# 3 EXPERT EVALUATION FOR AIR VENTILATION ASSESSMENT

## 3.1 EXISTING WIND CONDITION

The existing area is occupied by medium-density and high-rise buildings. Tseung Kwan O Plaza is located to the north of site with heights range from 13mPD to 143mPD (2 to 46 storeys). The Grandiose is located to the north-west of the site with heights range from 19mPD to 176mPD (3 to 57 storeys). Bauhinia Garden is located to the west of the site with heights of 125mPD (40 storeys). Tseung Kwan O Methodist School with 19mPD (4 storeys) and Evagel College with 26mPD (6 storeys) are located to the south of the site.

Although the area is medially occupied, wind can be highly permeable though the currently vacant subject site. Po Yap Road and Chi Shin Street can serve as wind corridors. Moreover, the orientation of streets are regular, it facilitates air penetrates along streets.

During non-summer period, the prevailing wind directions are North-East and East-North-East. The north easterly winds enter the south Tseung Kwan O through Chiu Shun Road between the hilly forms of Pak Shing Kok and Hang Hou. Po Yap Road acts as the main wind corridor delivering wind to south and west part of the area. The vacant space of the subject site facilitates wind penetration.

During summer period, the prevailing wind direction is South-South-West. The southern winds flow into south Tseung Kwan O without obstructions by hilly formations or tall building structures. Chi Shin Street serves as the main wind corridor delivering wind to east and north part of the area. The vacant space of the subject site facilitates wind penetration.

The prevailing wind flow into south Tseung Kwan O during summer and non-summer period is indicated in ***Plate 4***. The wind penetration in the wind corridors formed by major roads is indicated in ***Plate 5*** during non-summer period and ***Plate 6*** during summer period.

Plate 4 Wind Flow into South Tseung Kwan O during Summer and Non-summer Period

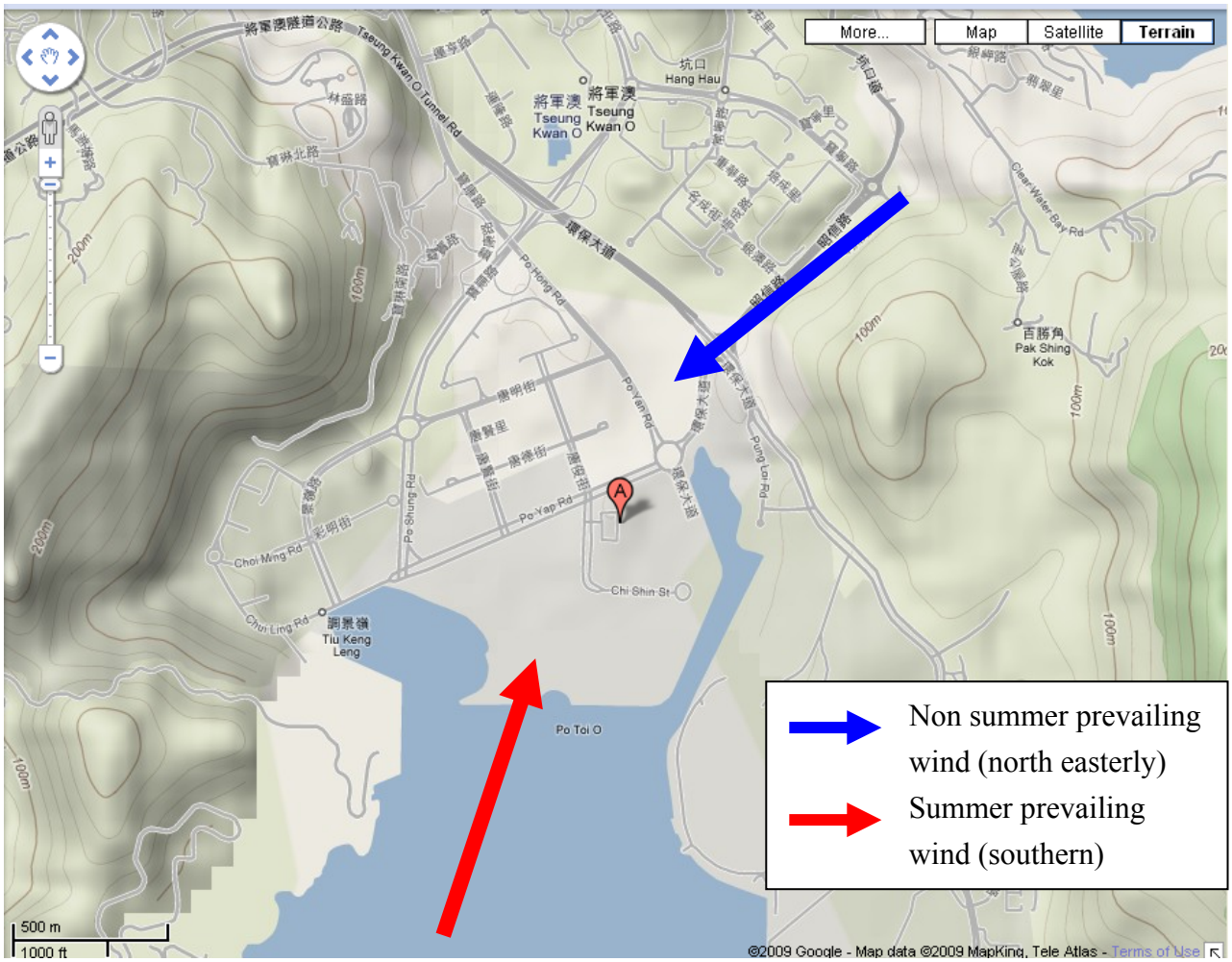


Plate 5 The Wind Flow Patterns in Non-summer period

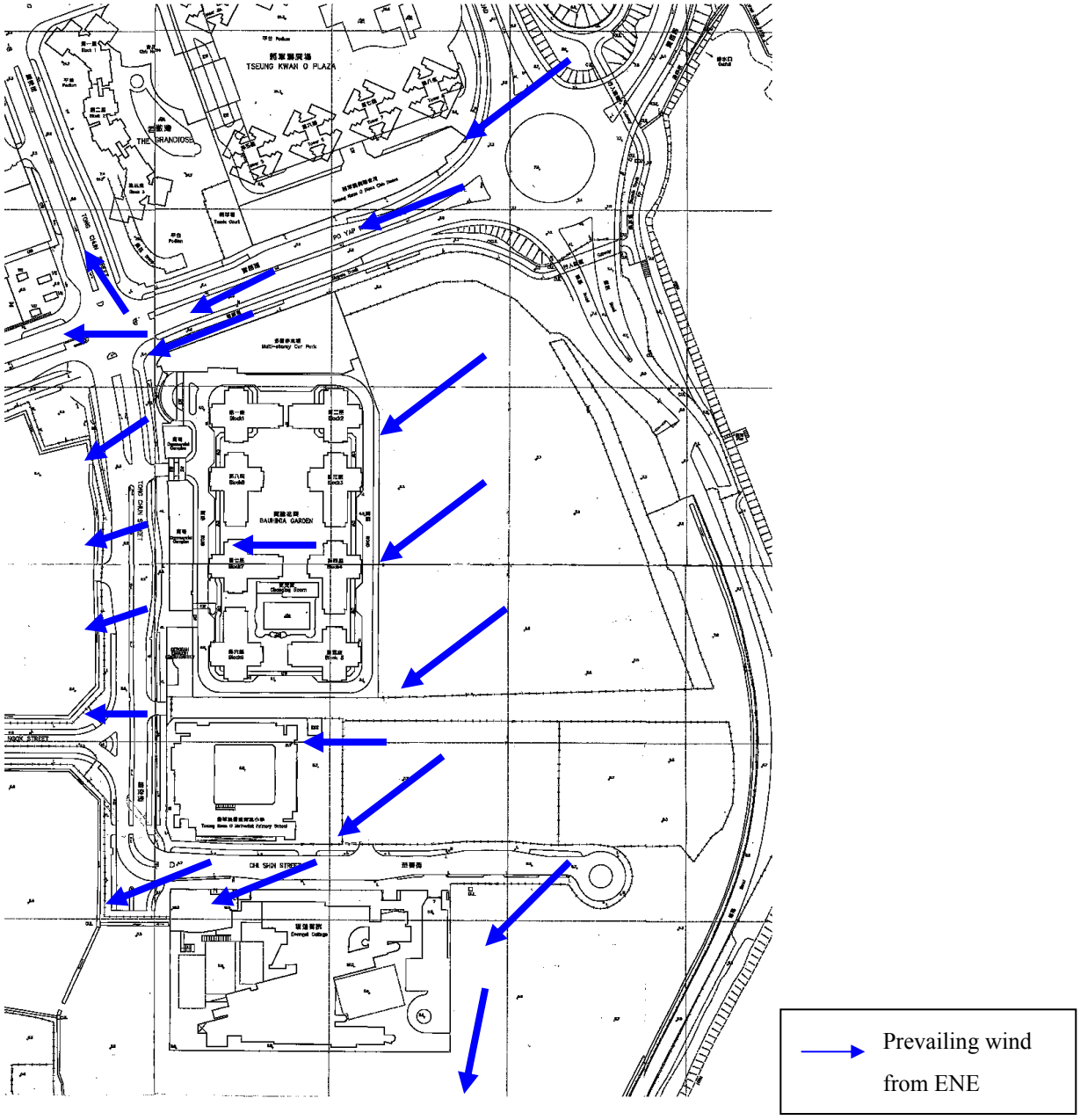
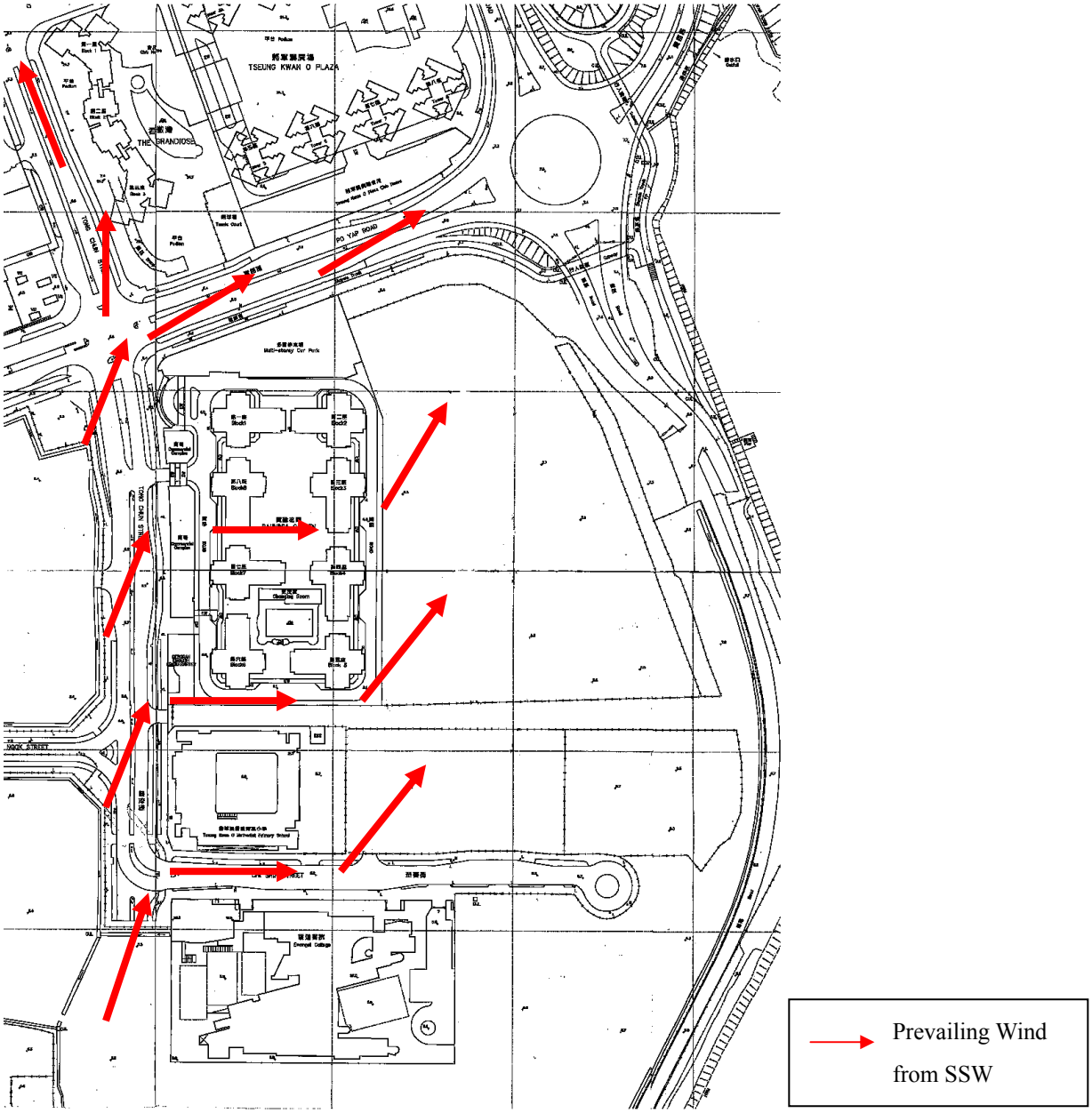


Plate 6 Wind Flow Pattern in Summer Period




## 3.2 CONDITION WITH PROPOSED BUILDING

The wind environment of Tseung Kwan O is built up by its unique urban morphology. The area is made up of wide streets, high density buildings, large low level podiums and open spaces. The new development shall be designed to harmonize the surrounding environment and allow wind penetration to the neighbour.

The proposed development has incorporated the following design measures to allow desirable wind penetration:

1. Orientation: The orientations of the three residential complexes take advantage to the prevailing wind from ENE in non-summer period. The complexes orientates in a downwind position, so that wind blows easily from east to west.

2. Improve permeability: The proposed housing development shall consist of two big separations between buildings. The separation of buildings will be about 25m, which is equivalent to 37 % of the building width. The separations become wide wind corridor allowing wind penetration to surrounding areas.

3. Open Space: There is an open space at southern part of site. No obstruction by tall building structure on south facilitates summer wind penetration.

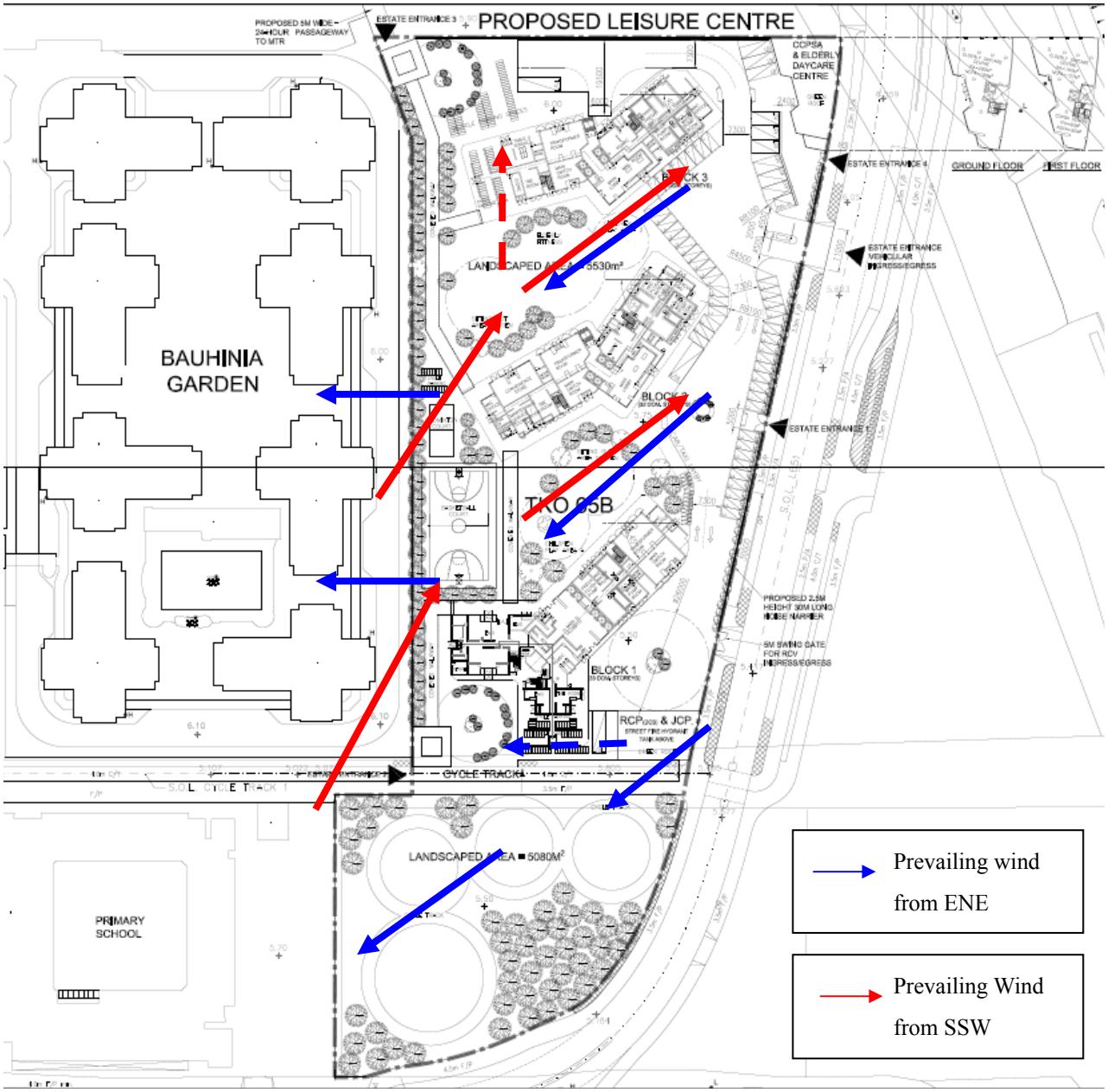
4. Openings at Ground Floor: Openings at Ground Floor in Block 1 and Block 3 allows wind flow to neighbouring open space area.

During non-summer period, the buildings to the south and west of subject development would be the sensitive receivers to air ventilation impact. The north-easterly winds blows through the downwind orientations of the proposed buildings. The set back from Bauhinia Garden and the schools on south allows a wide wind corridor for the north easterly wind flow. Therefore, the impact on air ventilation from north easterly winds during non-summer period is not anticipated.

During summer period, the buildings to the north of subject development would be the sensitive receivers to air ventilation impact. The separations between buildings allow southern wind penetrates to the north of subject site easily. The openings on ground floor in block 3 direct southern winds to the northern neighbourhoods.

The wind flow pattern with proposed buildings during summer and non-summer period are demonstrated in ***Plate 7***.

Plate 7 Wind Flow Pattern with Proposed Development during Summer and Non-summer Period




# 4 ASSESSMENT APPROACH AND METHODOLOGY

Air Ventilation Assessment (AVA) aims to assess the impacts of the proposed development on the pedestrian wind environment. Computational fluid dynamics (CFD) computer simulation model, PHOENICS-VR 2007, has been utilized for the initial study. It is a sophisticated modelling method, which takes into account the usual fluid dispersion calculation method under both laminar and turbulence flow simulation. The equations that

the CFD model solves are algebraic equations which result from applying the conservation laws of physics to finite volumes of space and time.

The related wind environment around the development was assessed by setting up a scaled model of the development with surrounding building structures. Moreover, this model has the ability to capture the after-building vortices which takes into account the effect of different roof shapes and ambient building structures, which is important in determining the wind flow pattern and wind velocity. The useful functions of this widely used CFD model can certainly "fit for the purpose" of the AVA.

The geometry and simulation options for subject development and surrounding environment have been set up to calculate the wind speed at around the development and surrounding ambient. Related wind speeds around the development were assessed by setting up a scaled model of the development with surrounding building structures. The setting of the CFD modelling is shown as follow:

1) Domain size: x-direction = 2200.9m; y-direction = 1818.4m; z-direction = 284.5m
2) Grid size:
   Inside assessment area: x-direction = 5m; y-direction = 5m; z-direction = 0.5m
   Outside assessment area: x-direction = 10m; y-direction = 10m; z-direction = 4m
3) Turbulence model: Chen-Kim modified KE-EP turbulence model
4) Wind Profile: Power law wind profile, Power law exponent of 0.5; roughness coefficient of 3.0

The wind velocity at the top of the wind boundary layer can be estimated by the Power Law:

$$\frac{U_z}{U_G} = \left(\frac{Z_Z}{Z_G}\right)^{\alpha}$$

Where $U_Z$ is the wind speed at height z from ground;

$U_G$ is the wind speed at reference height (top of wind boundary layer);

$Z_Z$ is the height z from ground;

$Z_G$ is the reference height (top of wind boundary layer); and

$\alpha$ is the power law exponent.

With the terrain crossed by approaching wind classified as city centre or high-rise for the current study, a power law exponent of 0.50 and a wind boundary layer with height of 600m is suggested.

The geometry and simulation options for subject development and surrounding buildings such as Bauhinia Garden Block 1 to 8, Tseung Kwan O Plaza, The Grandiose, Tseung Kwan O Methodist Primary School and Evangel College have been set up in the model. ***Plate 8*** and ***Plate 9*** indicates the CFD model setting.

Plate 8 CFD Model Setting (case without development)

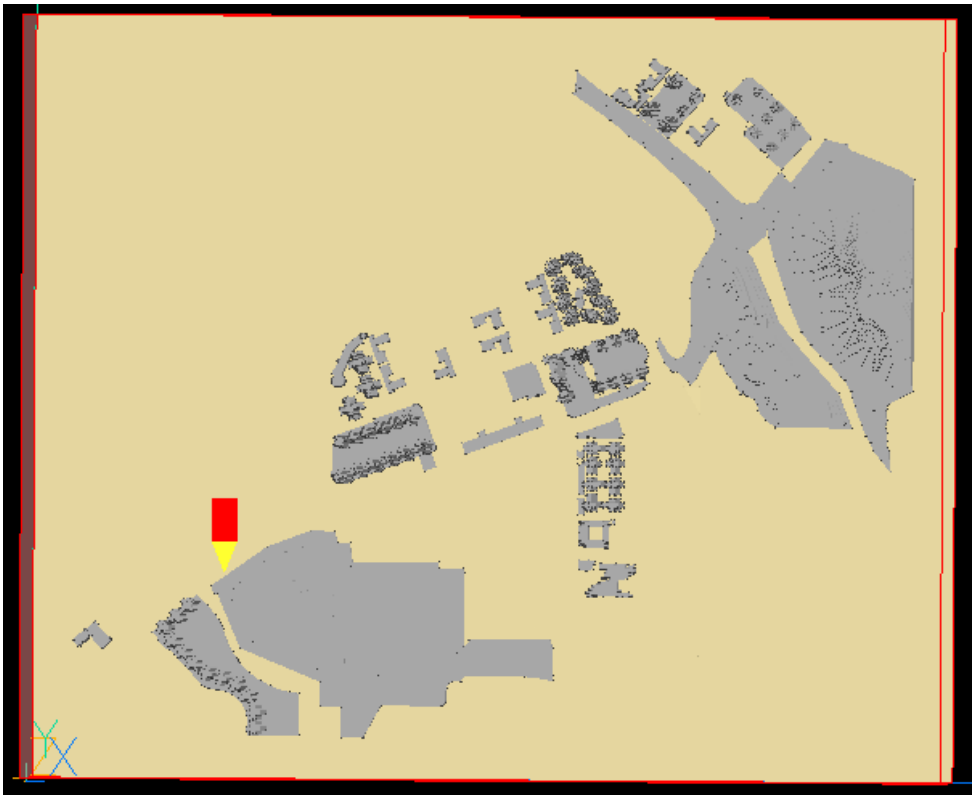
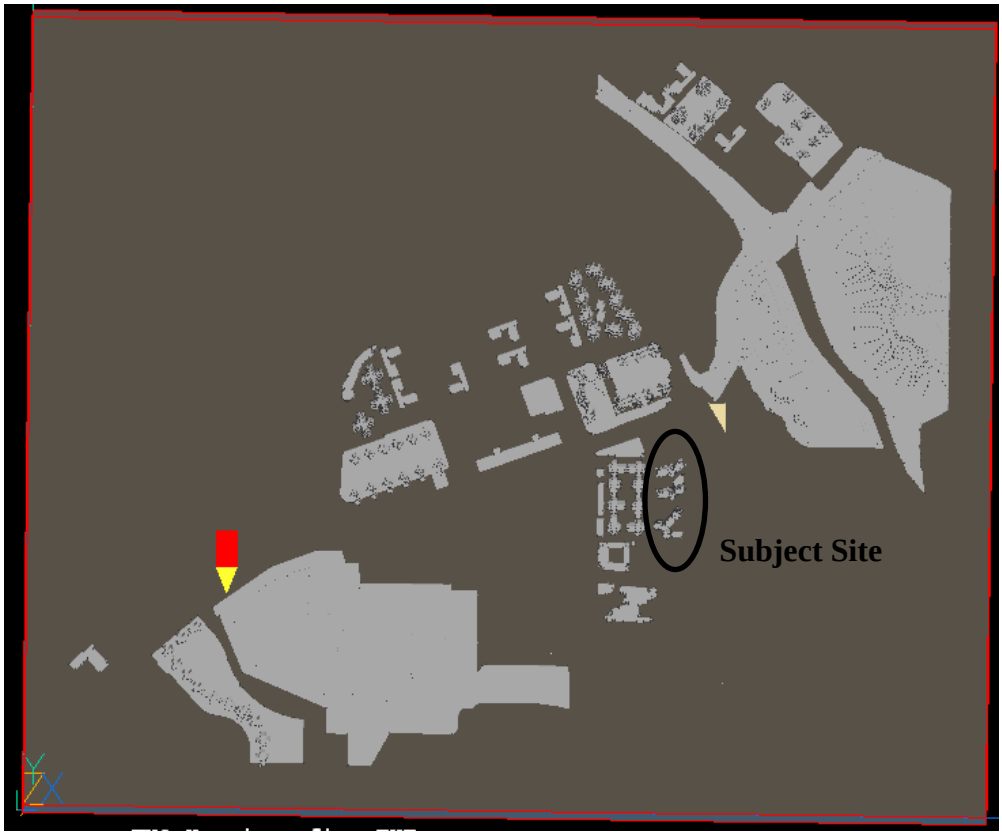


Plate 9 CFD Model Setting (case with development)



According to the "Technical Guide for Air Ventilation Assessment for Developments in Hong Kong" [2] published by Housing, Planning and Lands Bureau (HPLB) and Environment, Transport and Works Bureau (ETWB), the assessment area shall include the project's surrounding up to a perpendicular distance H from the project boundary, where H is the height of the tallest building on site. The study area (surrounding area) shall include a perpendicular distance of 2H from the project boundary. Based on information provided by the Housing Authority, the maximum height of the proposed development will be limited to approximately 100mPD.

50 overall test points are evenly distributed on the streets, open space and places where pedestrians frequently access in the assessment area, which is within 120m radius of the site and 32 perimeter test points are taken around the project site boundary, including entrances, corners and pedestrian sitting-out area as shown in ***Figure 3***.

Wind velocity is assessed at 2m above ground level and podium level of the proposed residential tower. Wind Velocity Ratio (VR) should be used as an indicator of wind performance for the AVA. It indicates how much of the wind availability of a location could be experienced and enjoyed by pedestrians. The higher the wind velocity ratio, the less likely would be the impact of the proposed development on the wind availability.

Wind Velocity Ratio is defined as follows:

$$VR_w = \frac{V_p}{V_\infty}$$

where

Vp is the wind velocity at the pedestrian level (2m above ground) after taking into account the effects of buildings; and

$V_\infty$ is the wind availability of the site, i.e. wind velocity at the top of the wind boundary layer (typically assumed to be around 400m to 600m above city centre).

In the "Feasibility Study for Establishment of Air Ventilation Assessment System" [3], it is suggested that in general, "the more air ventilation through the city fabric, the better", taken into account the climatic and urban considerations of Hong Kong. The higher the value of the ratio means the better the proposed development in not affecting the wind environment.

Moreover, spatial average VR including Site spatial average Velocity Ratio (SVR) and Local spatial average Velocity Ratio (LVR) are recommended in the Technical Guide to be used for comparing performances. For this particular project, a 'before' scenario was assessed with respect to the existing site conditions, and compared against the 'after' scenario with the inclusion of the proposed buildings in notional scheme or and improved scheme. SVR indicates the impact from the lower portion of the buildings on the project site to the immediate surroundings, while LVR indicates the impact from the upper portion

of the buildings on the project site to the surroundings. The increase in SVR and LVR means improvements in the wind environment of the immediate surroundings and surroundings respectively, and vice versa.

# 5 SUMMARY OF RESULTS AND DISCUSSIONS

An Initial Study for air ventilation was conducted to assess the potential impact of the proposed development to the wind environment of the neighbouring surrounding of the site on pedestrian level. In this AVA, wind directions from 22.5°, 45°, 67.5°, 90°, 112.5°, 135°, 202.5° and 225° were assessed individually by 8 cases. Wind Velocity Ratio (VRw) was used as an indicator of performance for each test point to show how much wind available on pedestrian level taking into account the topography and the structure of the proposed development and surrounding buildings. Detailed assessment results, wind velocity contour and vector diagrams at the pedestrian level simulated for each wind direction are illustrated in ***Appendices A to H***.

The 50 overall test points scattering on the neighborhood of the site and the 42 perimeter test points are indicated on Figure 3.

The assessment results of each wind direction were analysed to find out the weighted-mean wind velocity ratio (VRw') of the current situation and the proposed development scheme. The assessment on the overall wind performance of the current situation and the proposed development was analysed by comparing the weighted-mean wind velocity ratio (VRw') to account for wind coming from the 8 wind directions. The weighted-mean wind velocity ratio (VRw') of the 42 perimeter test points and 50 overall test points for the scheme with and without development are tabulated in Table 4. Difference below 0.01 is considered to be unchanged.

Table 4 VRw' for Current Situation and Proposed Development Scheme

| Test Point No. | VRw' for "Before" Development Scenario | VRw' for "After" Development Scheme | Difference in VRw' between Current Situation and Proposed Development Scheme |
|---|---|---|---|
| Perimeter Test Points | | | |
| P51 | 0.24 | 0.19 | (0.05) |
| P52 | 0.27 | 0.26 | (0.009) |
| P53 | 0.25 | 0.23 | (0.02) |
| P54 | 0.24 | 0.26 | 0.02 |
| P55 | 0.27 | 0.29 | 0.02 |
| P56 | 0.28 | 0.32 | 0.04 |

| | | | |
|---|---|---|---|
| P57 | 0.35 | 0.39 | 0.05 |
| P58 | 0.36 | 0.23 | (0.13) |
| P59 | 0.35 | 0.23 | (0.12) |
| P60 | 0.31 | 0.23 | (0.09) |
| P61 | 0.30 | 0.23 | (0.07) |
| P62 | 0.30 | 0.23 | (0.07) |
| P63 | 0.30 | 0.23 | (0.07) |
| P64 | 0.32 | 0.25 | (0.07) |
| P65 | 0.34 | 0.28 | (0.06) |
| P66 | 0.35 | 0.30 | (0.05) |
| P67 | 0.35 | 0.31 | (0.04) |
| P68 | 0.36 | 0.33 | (0.03) |
| P69 | 0.36 | 0.33 | (0.03) |
| P70 | 0.36 | 0.33 | (0.03) |
| P71 | 0.36 | 0.32 | (0.04) |
| P72 | 0.35 | 0.28 | (0.07) |
| P73 | 0.35 | 0.32 | (0.03) |
| P74 | 0.34 | 0.31 | (0.03) |
| P75 | 0.33 | 0.30 | (0.04) |
| P76 | 0.33 | 0.32 | (0.009) |
| P77 | 0.33 | 0.31 | (0.024) |
| P78 | 0.33 | 0.31 | (0.02) |
| P79 | 0.16 | 0.14 | (0.013) |
| P80 | 0.33 | 0.30 | (0.04) |
| P81 | 0.32 | 0.27 | (0.05) |
| P82 | 0.30 | 0.17 | (0.12) |
| P83 | 0.26 | 0.19 | (0.08) |
| P84 | 0.26 | 0.26 | (0.00) |
| P85 | 0.25 | 0.25 | (0.006) |
| P86 | 0.24 | 0.25 | 0.01 |
| P87 | 0.27 | 0.30 | 0.02 |
| P88 | 0.31 | 0.37 | 0.06 |
| P89 | 0.39 | 0.35 | (0.04) |
| P90 | 0.33 | 0.24 | (0.10) |
| P91 | 0.31 | 0.23 | (0.08) |
| P92 | 0.31 | 0.23 | (0.08) |
| Overall Test Point | | | |
| O1 | 0.28 | 0.22 | (0.06) |

| | | | |
|---|---|---|---|
| O2 | 0.24 | 0.18 | (0.07) |
| O3 | 0.25 | 0.17 | (0.08) |
| O4 | 0.29 | 0.22 | (0.08) |
| O5 | 0.24 | 0.22 | (0.02) |
| O6 | 0.21 | 0.17 | (0.04) |
| O7 | 0.28 | 0.26 | (0.03) |
| O8 | 0.21 | 0.17 | (0.04) |
| O9 | 0.29 | 0.25 | (0.04) |
| O10 | 0.11 | 0.13 | 0.02 |
| O11 | 0.29 | 0.26 | (0.03) |
| O12 | 0.20 | 0.11 | (0.08) |
| O13 | 0.15 | 0.17 | 0.02 |
| O14 | 0.18 | 0.12 | (0.06) |
| O15 | 0.39 | 0.29 | (0.09) |
| O16 | 0.22 | 0.22 | (0.00) |
| O17 | 0.24 | 0.19 | (0.05) |
| O18 | 0.18 | 0.20 | 0.02 |
| O19 | 0.27 | 0.22 | (0.05) |
| O20 | 0.32 | 0.30 | (0.01) |
| O21 | 0.33 | 0.27 | (0.07) |
| O22 | 0.32 | 0.22 | (0.10) |
| O23 | 0.27 | 0.23 | (0.03) |
| O24 | 0.25 | 0.22 | (0.03) |
| O25 | 0.30 | 0.32 | 0.02 |
| O26 | 0.33 | 0.30 | (0.04) |
| O27 | 0.33 | 0.30 | (0.03) |
| O28 | 0.34 | 0.31 | (0.03) |
| O29 | 0.35 | 0.33 | (0.02) |
| O30 | 0.30 | 0.28 | (0.02) |
| O31 | 0.28 | 0.24 | (0.04) |
| O32 | 0.17 | 0.12 | (0.06) |
| O33 | 0.34 | 0.31 | (0.03) |
| O34 | 0.24 | 0.27 | 0.02 |
| O35 | 0.31 | 0.26 | (0.043) |
| O36 | 0.30 | 0.30 | 0.01 |
| O37 | 0.15 | 0.19 | 0.04 |
| O38 | 0.31 | 0.28 | (0.04) |
| O39 | 0.12 | 0.06 | (0.05) |

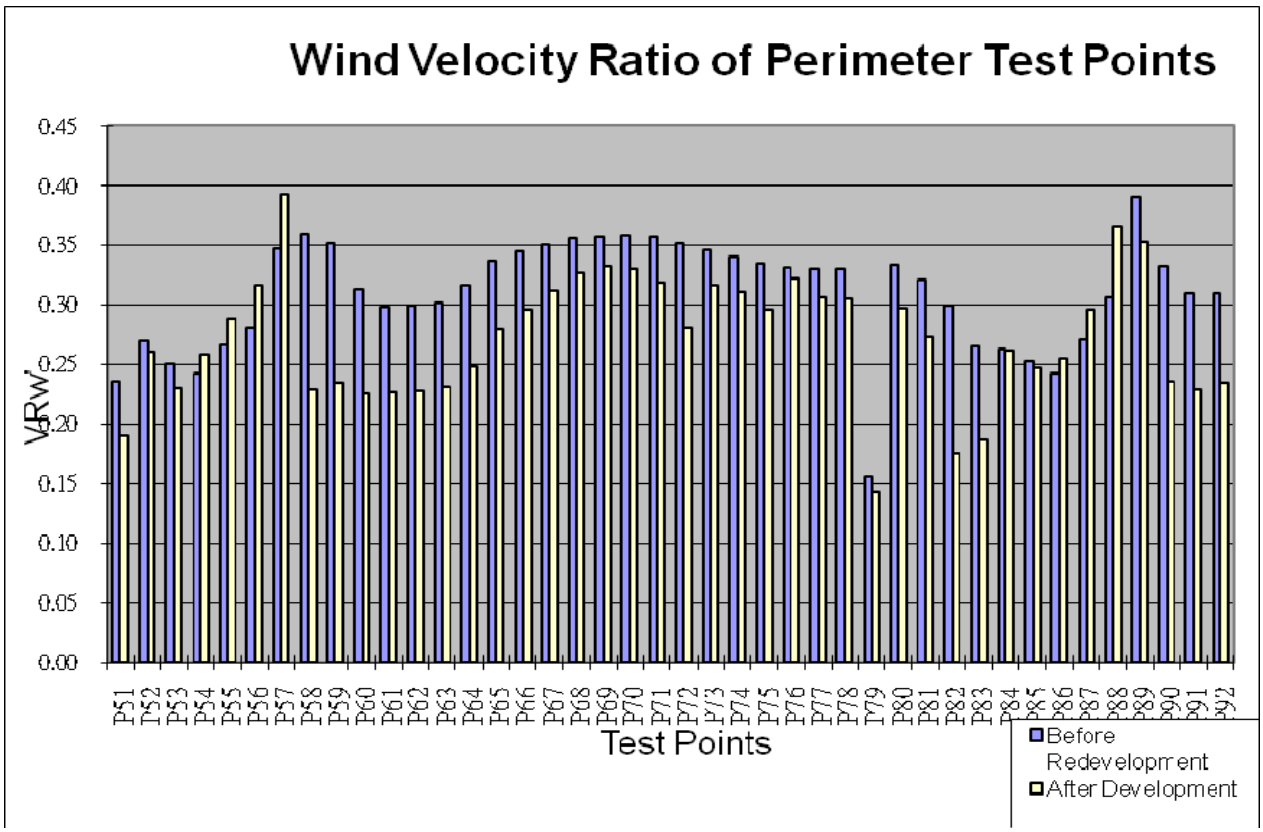
| | | | |
|---|---|---|---|
| O40 | 0.05 | 0.09 | 0.04 |
| O41 | 0.37 | 0.34 | (0.02) |
| O42 | 0.35 | 0.32 | (0.03) |
| O43 | 0.30 | 0.25 | (0.05) |
| O44 | 0.27 | 0.26 | (0.008) |
| O45 | 0.34 | 0.32 | (0.03) |
| O46 | 0.15 | 0.17 | 0.01 |
| O47 | 0.28 | 0.21 | (0.07) |
| O48 | 0.33 | 0.24 | (0.09) |
| O49 | 0.31 | 0.21 | (0.09) |
| O50 | 0.36 | 0.33 | (0.03) |

*(0.0) – red bracketed numbers are negative*

*Site Air Ventilation Assessment (SAVA)*

11 out of 42 perimeter test points have increased and unchanged VR and 31 points have decreased VR. The deteriorated points are distributed on the north, south and east of the site. The deterioration on east of site is mainly attributing to less wind flow through site during summer SSW wind. Yet, there are no sensitive receivers immediate next to the east of site. Therefore, impact should be insignificant. The wind exchange between north and south would be decreased due to the orientation of residential blocks. However, the wind velocities at north and south of site are generally about 1m/s or above which is at comfortable level. Moreover, the orientation design could hardly response to winds from all directions. The orientation effectively allows wind penetration to west of site where sensitive receivers of Bauhinia Garden are. Therefore, VR improvements can be found on west side of site. In view of no sensitive receivers on immediate east and acceptable wind speed, the air ventilation impact around site is considered to be insignificant. The comparison of VRw' of the assessment points between current situation and proposed development scheme is illustrated in ***Chart 1***.

*Chart 1*




*Local Air Ventilation Assessment (LAVA)*

40 out of 50 overall test points have deteriorated VR. The 10 improved and unchanged test points are mainly at the corners of Po Yap Road between Tong Chun Street and Po Hong Road. The comparison of VRw' of the assessment points between current situation and proposed development scheme is illustrated in ***Chart 2*** and ***3***. The overall deterioration of VR would happen in different period of time with different prevailing wind directions. During the prevailing wind direction in non summer period (ENE wind), only 9 out of 50 the overall test points show deteriorated VR and their wind speeds are about 1m/s or above. During the prevailing wind direction in summer period (SSW), 10 test points are improved while 40 test points are deteriorated. It shows summer contributes mainly to the overall deterioration. However, all these deteriorated test points have wind speeds about 1m/s or above. Although the area would be less well ventilated after development, as long as wind speed is still at a comfortable level, it is considered that the air ventilation impact to the surroundings is insignificant.

*Chart 2*

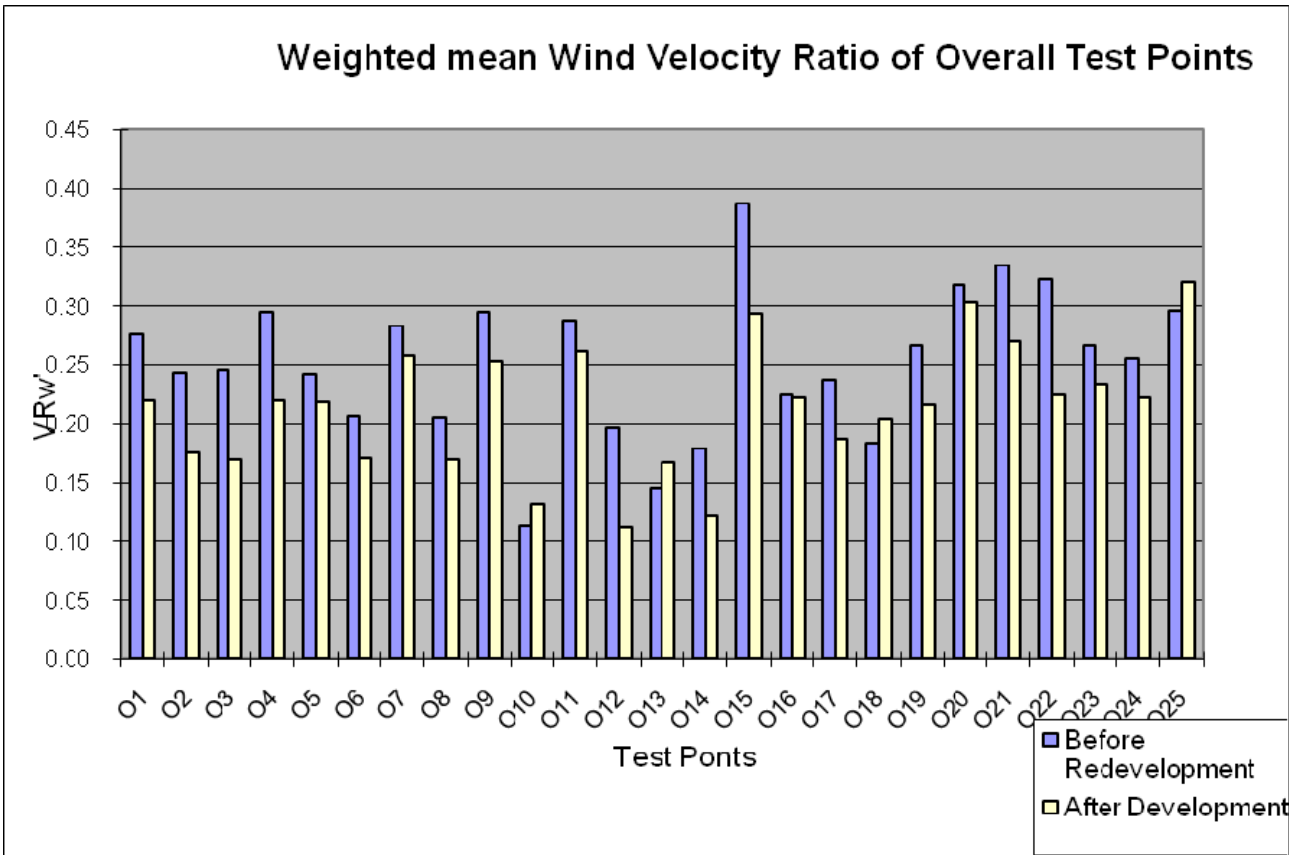



*Chart 3*

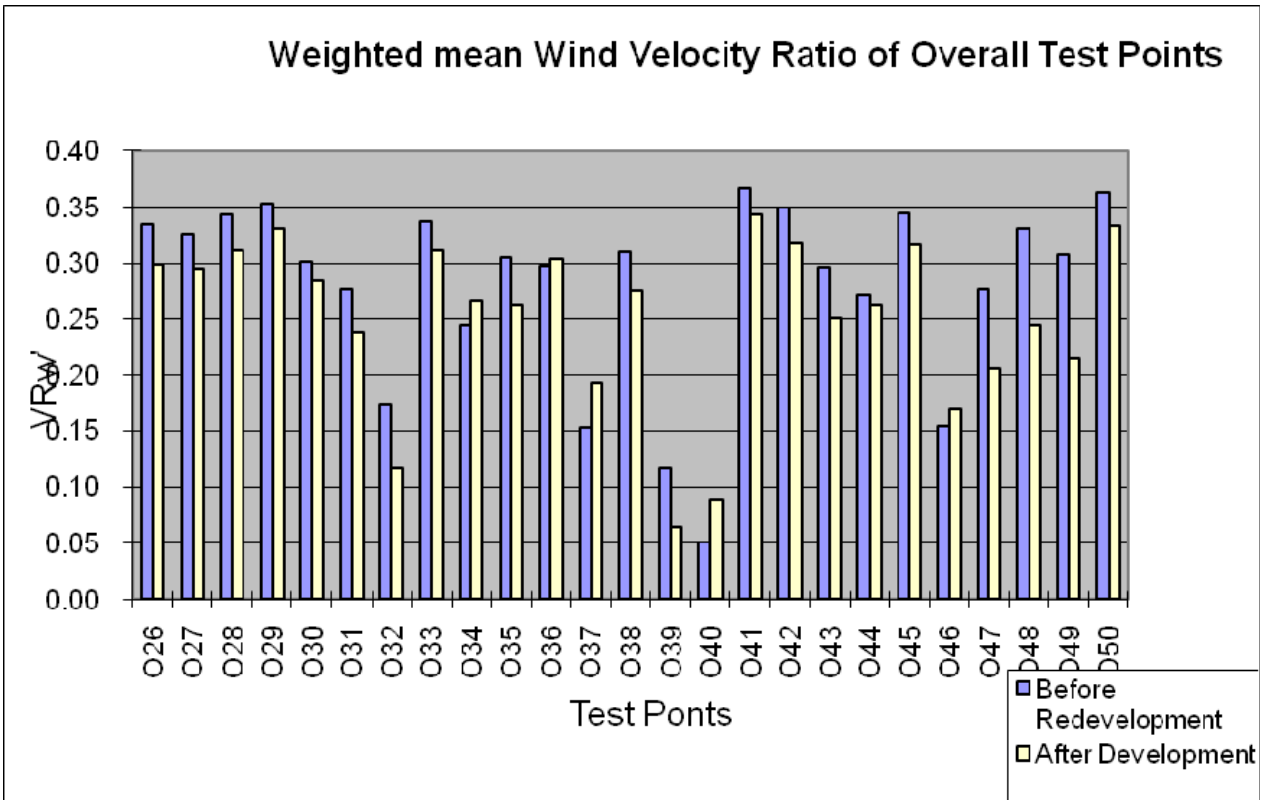


***Table 5*** summarizes the changes on SAVA and LAVA by Site Velocity Ratio (SVR') and Local Velocity Ratio (LVR') of before and after scenario. SVR' is the average of the VR of perimeter test points. LVR' is the average of the VR of overall test points.

Table 5 SVR' and LVR' in Current Situation and Proposed Development Scheme

| | **Before Scenario** | **After Scenario** |
|---|---|---|
| SVR' | 0.31 | 0.27 |
| LVR' | 0.28 | 0.25 |

In view of wind velocity at reference height (600m) is about 7.63m/s, the average site wind velocity after development would be about 2.06m/s and the average local wind velocity would be about 1.9m/s. Although SVR' and LVR' are deteriorated after development, the wind velocities are at acceptable range most of the time.

# 6 CONCLUSION

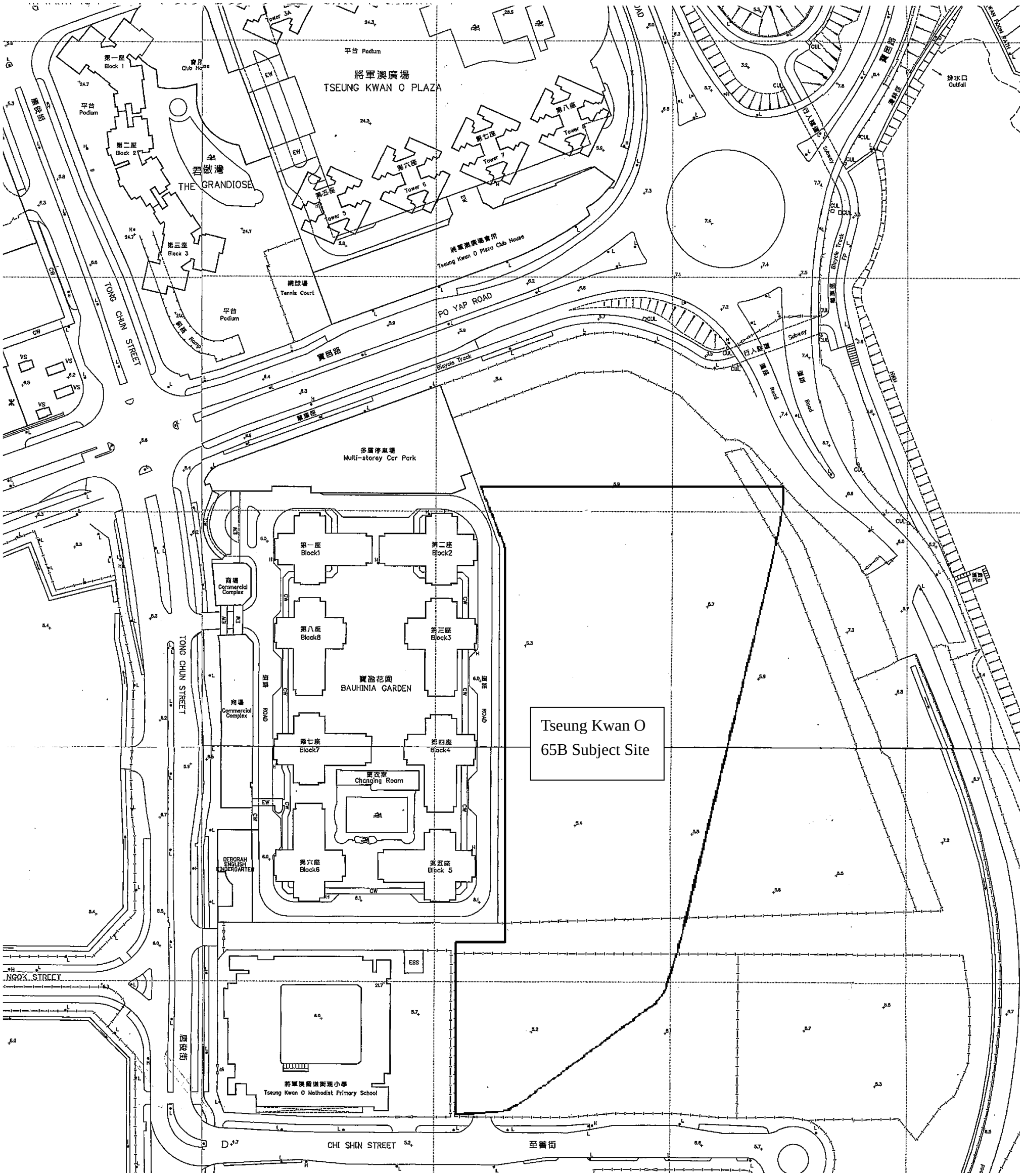
The AVA results indicate that the proposed development may decrease air ventilation to the surroundings when comparing to the current situation. The SVR's and LVR' is expected to be decreased. However, the general wind velocities of VR decreased test points would be about 1m/s or above, so it is still considered as a comfortable wind environment. Hence, the air ventilation impact due to the development is considered to be insignificant. While significant impact on air ventilation is not anticipated, detailed study of air ventilation is considered not necessary.

# 7 REFERENCE

[1] Planning Department Hong Kong SAR. *"Site Wind Availability Data for Hong Kong"* available at http://www.pland.gov.hk/info_serv/site_wind/index_e.html

[2] Housing, Planning and Lands Bureau and Environment, Transport and Works Bureau Technical Circular No.1/06 *"Technical Guide for Air Ventilation Assessment for Developments in Hong Kong"* issued on 19 July 2006

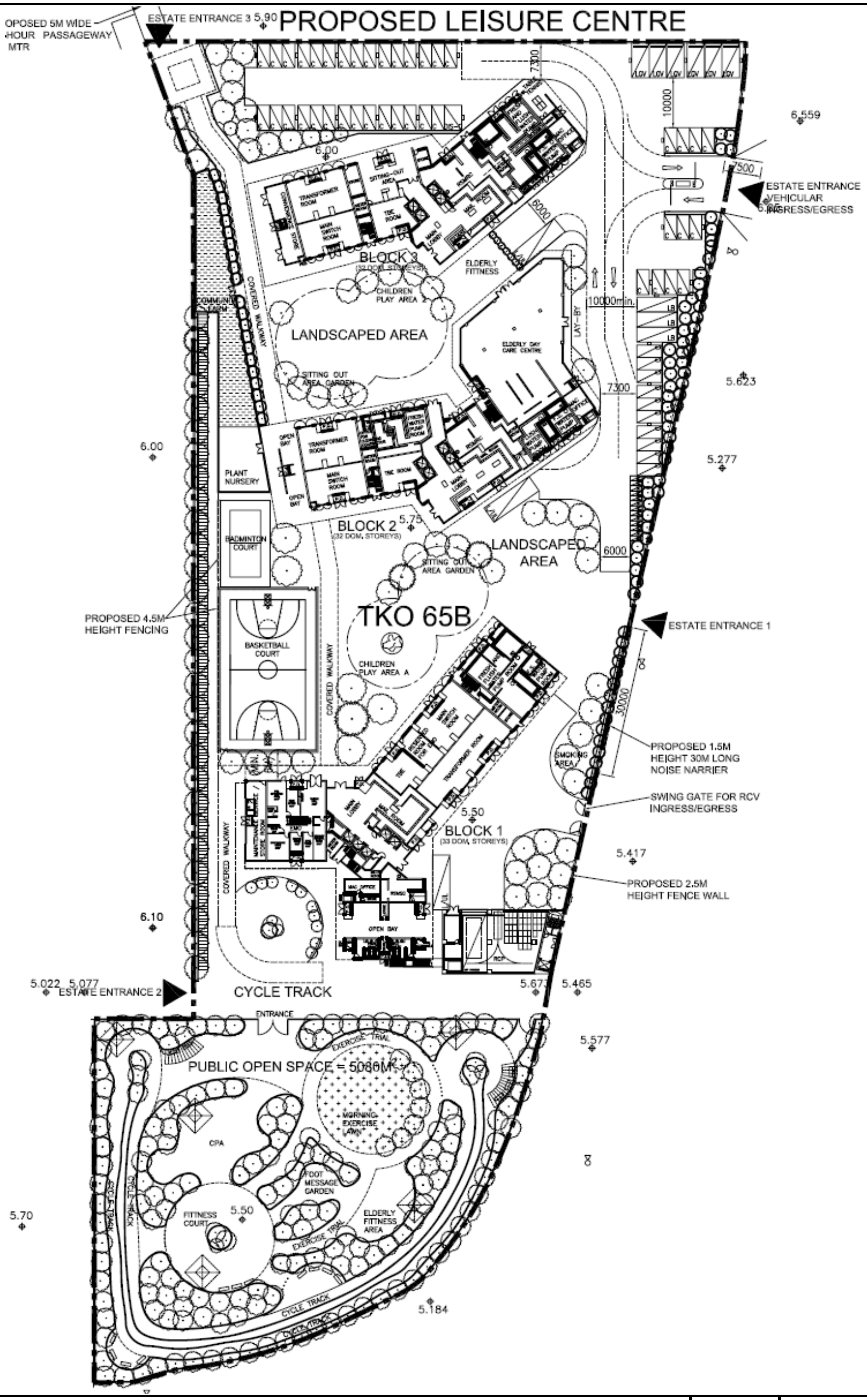
[3] Planning Department Hong Kong SAR. "Feasibility Study for Establishment of Air Ventilation Assessment System" Retrieved on 8 September 2005, from http://www.pland.gov.hk/p_study/prog_s/air_vent/avas_eng.html




**AIR VENTILATION INITIAL STUDY FOR PROPOSED DEVELOPMENT OF PUBLIC RENTAL HOUSING DEVELOPMENT AT TSUENG KWAN O AREA 65B AND ITS SOUTHERN SPACE**

Site Location

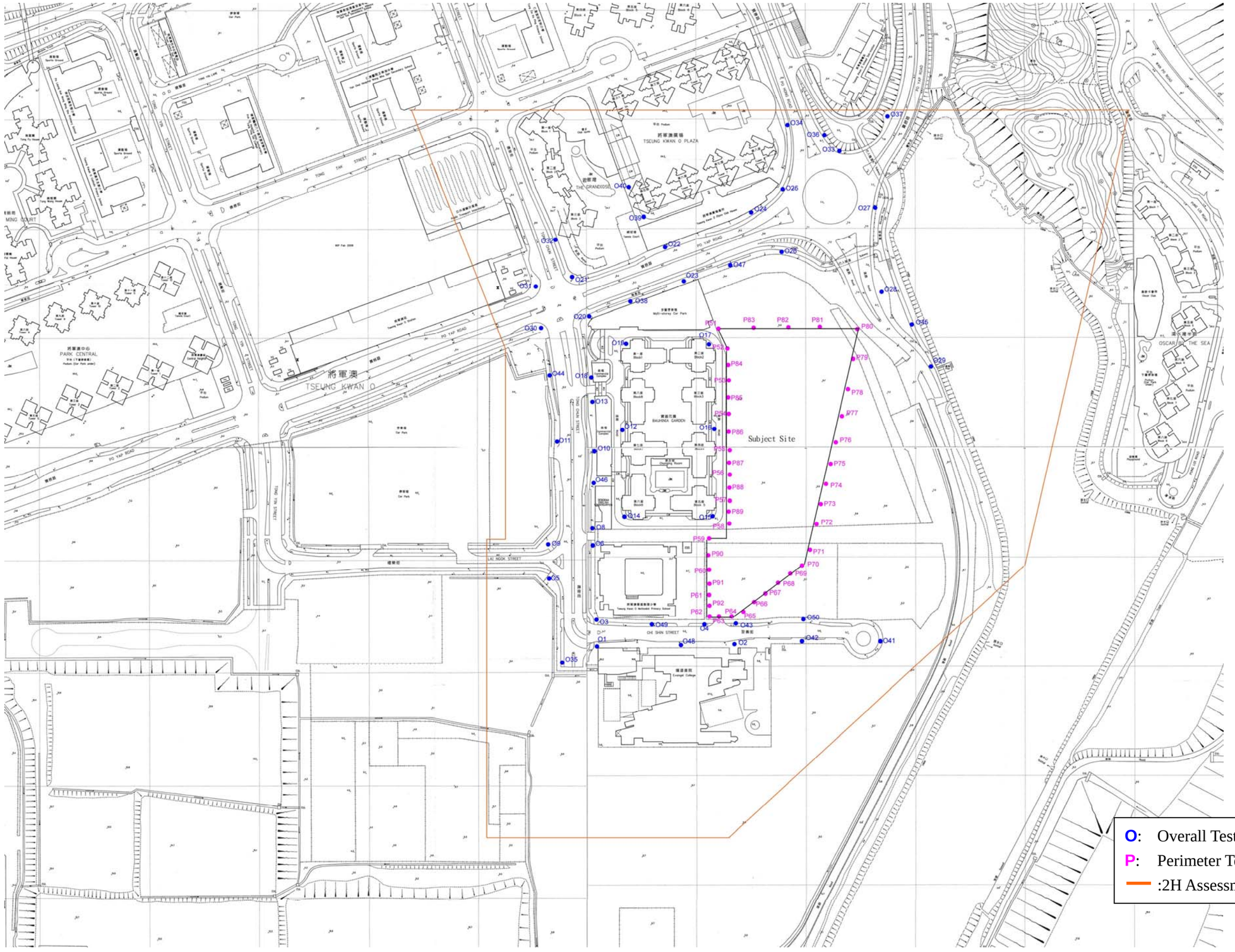
| Figure No. | Rev: |
|---|---|
| 1 | 0 |
| Scale: NTS | Date: 12/09 |




**AIR VENTILATION INITIAL STUDY FOR PROPOSED DEVELOPMENT OF PUBLIC RENTAL HOUSING DEVELOPMENT AT TSUENG KWAN O AREA 65B AND ITS SOUTHERN SPACE**

Master Layout Plan

| Figure No. | Rev: |
|---|---|
| 2 | 0 |
| **Scale** | **Date** |
| NTS | 12/09 |




**AIR VENTILATION INITIAL STUDY FOR PROPOSED DEVELOPMENT OF PUBLIC RENTAL HOUSING DEVELOPMENT AT TSUENG KWAN O AREA 65B AND ITS SOUTHERN SPACE**

Locations of Test Points

| Figure No. | Rev: |
|---|---|
| 3 | 0 |
| Scale: NTS | Date: 12/09 |

AEC

# *Appendices*

**KTSPC&KTRG AVA Results**

Case E

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 90 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| O1 | 0.43 | 0.19 | (-0.24) |
| O2 | 0.43 | 0.15 | (-0.28) |
| O3 | 0.41 | 0.11 | (-0.30) |
| O4 | 0.43 | 0.23 | (-0.20) |
| O5 | 0.26 | 0.18 | (-0.08) |
| O6 | 0.30 | 0.13 | (-0.17) |
| O7 | 0.27 | 0.22 | (-0.05) |
| O8 | 0.26 | 0.11 | (-0.15) |
| O9 | 0.34 | 0.22 | (-0.12) |
| O10 | 0.07 | 0.01 | (-0.06) |
| O11 | 0.26 | 0.23 | (-0.03) |
| O12 | 0.35 | 0.14 | (-0.21) |
| O13 | 0.09 | 0.13 | 0.04 |
| O14 | 0.30 | 0.04 | (-0.26) |
| O15 | 0.51 | 0.42 | (-0.09) |
| O16 | 0.20 | 0.23 | 0.03 |
| O17 | 0.36 | 0.18 | (-0.18) |
| O18 | 0.11 | 0.17 | 0.06 |
| O19 | 0.29 | 0.29 | 0.00 |
| O20 | 0.38 | 0.32 | (-0.06) |
| O21 | 0.50 | 0.30 | (-0.20) |
| O22 | 0.47 | 0.26 | (-0.21) |
| O23 | 0.32 | 0.31 | (-0.01) |
| O24 | 0.32 | 0.29 | (-0.03) |
| O25 | 0.26 | 0.32 | 0.06 |
| O26 | 0.35 | 0.33 | (-0.02) |
| O27 | 0.34 | 0.30 | (-0.04) |
| O28 | 0.36 | 0.32 | (-0.04) |
| O29 | 0.37 | 0.33 | (-0.04) |
| O30 | 0.36 | 0.28 | (-0.08) |

| | | | |
|---|---|---|---|
| O31 | 0.39 | 0.27 | (-0.12) |
| O32 | 0.31 | 0.06 | (-0.25) |
| O33 | 0.33 | 0.32 | (-0.01) |
| O34 | 0.18 | 0.19 | 0.01 |
| O35 | 0.38 | 0.25 | (-0.13) |
| O36 | 0.23 | 0.26 | 0.03 |
| O37 | 0.14 | 0.14 | 0.00 |
| O38 | 0.41 | 0.33 | (-0.08) |
| O39 | 0.16 | 0.05 | (-0.11) |
| O40 | 0.05 | 0.04 | (-0.01) |
| O41 | 0.39 | 0.35 | (-0.04) |
| O42 | 0.38 | 0.33 | (-0.05) |
| O43 | 0.40 | 0.24 | (-0.16) |
| O44 | 0.28 | 0.23 | (-0.05) |
| O45 | 0.36 | 0.32 | (-0.04) |
| O46 | 0.04 | 0.14 | 0.10 |
| O47 | 0.39 | 0.27 | (-0.12) |
| O48 | 0.48 | 0.30 | (-0.18) |
| O49 | 0.42 | 0.21 | (-0.21) |
| O50 | 0.39 | 0.35 | (-0.04) |
| | | **Average** | **(-0.09)** |
| P51 | 0.27 | 0.22 | (-0.05) |
| P52 | 0.23 | 0.22 | (-0.01) |
| P53 | 0.19 | 0.23 | 0.04 |
| P54 | 0.14 | 0.27 | 0.13 |
| P55 | 0.17 | 0.33 | 0.16 |
| P56 | 0.23 | 0.33 | 0.10 |
| P57 | 0.30 | 0.43 | 0.13 |
| P58 | 0.55 | 0.31 | (-0.24) |
| P59 | 0.51 | 0.34 | (-0.17) |
| P60 | 0.42 | 0.32 | (-0.10) |
| P61 | 0.39 | 0.29 | (-0.10) |
| P62 | 0.42 | 0.24 | (-0.18) |
| P63 | 0.42 | 0.24 | (-0.18) |
| P64 | 0.42 | 0.26 | (-0.16) |
| P65 | 0.41 | 0.30 | (-0.11) |

| | | | |
|---|---|---|---|
| P66 | 0.40 | 0.32 | (-0.08) |
| P67 | 0.40 | 0.33 | (-0.07) |
| P68 | 0.39 | 0.34 | (-0.05) |
| P69 | 0.38 | 0.35 | (-0.03) |
| P70 | 0.37 | 0.35 | (-0.02) |
| P71 | 0.36 | 0.35 | (-0.01) |
| P72 | 0.35 | 0.34 | (-0.01) |
| P73 | 0.34 | 0.34 | 0.00 |
| P74 | 0.33 | 0.33 | 0.00 |
| P75 | 0.32 | 0.32 | 0.00 |
| P76 | 0.32 | 0.32 | 0.00 |
| P77 | 0.33 | 0.31 | (-0.02) |
| P78 | 0.33 | 0.31 | (-0.02) |
| P79 | 0.34 | 0.31 | (-0.03) |
| P80 | 0.35 | 0.31 | (-0.04) |
| P81 | 0.34 | 0.30 | (-0.04) |
| P82 | 0.32 | 0.27 | (-0.05) |
| P83 | 0.30 | 0.22 | (-0.08) |
| P84 | 0.19 | 0.24 | 0.05 |
| P85 | 0.16 | 0.25 | 0.09 |
| P86 | 0.16 | 0.26 | 0.10 |
| P87 | 0.21 | 0.33 | 0.12 |
| P88 | 0.25 | 0.37 | 0.12 |
| P89 | 0.41 | 0.45 | 0.04 |
| P90 | 0.44 | 0.37 | (-0.07) |
| P91 | 0.39 | 0.33 | (-0.06) |
| P92 | 0.40 | 0.28 | (-0.12) |
| | | **Average** | **(-0.02)** |
| | | **Overall average** | **(-0.06)** |

***Remark***

*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

**Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")**

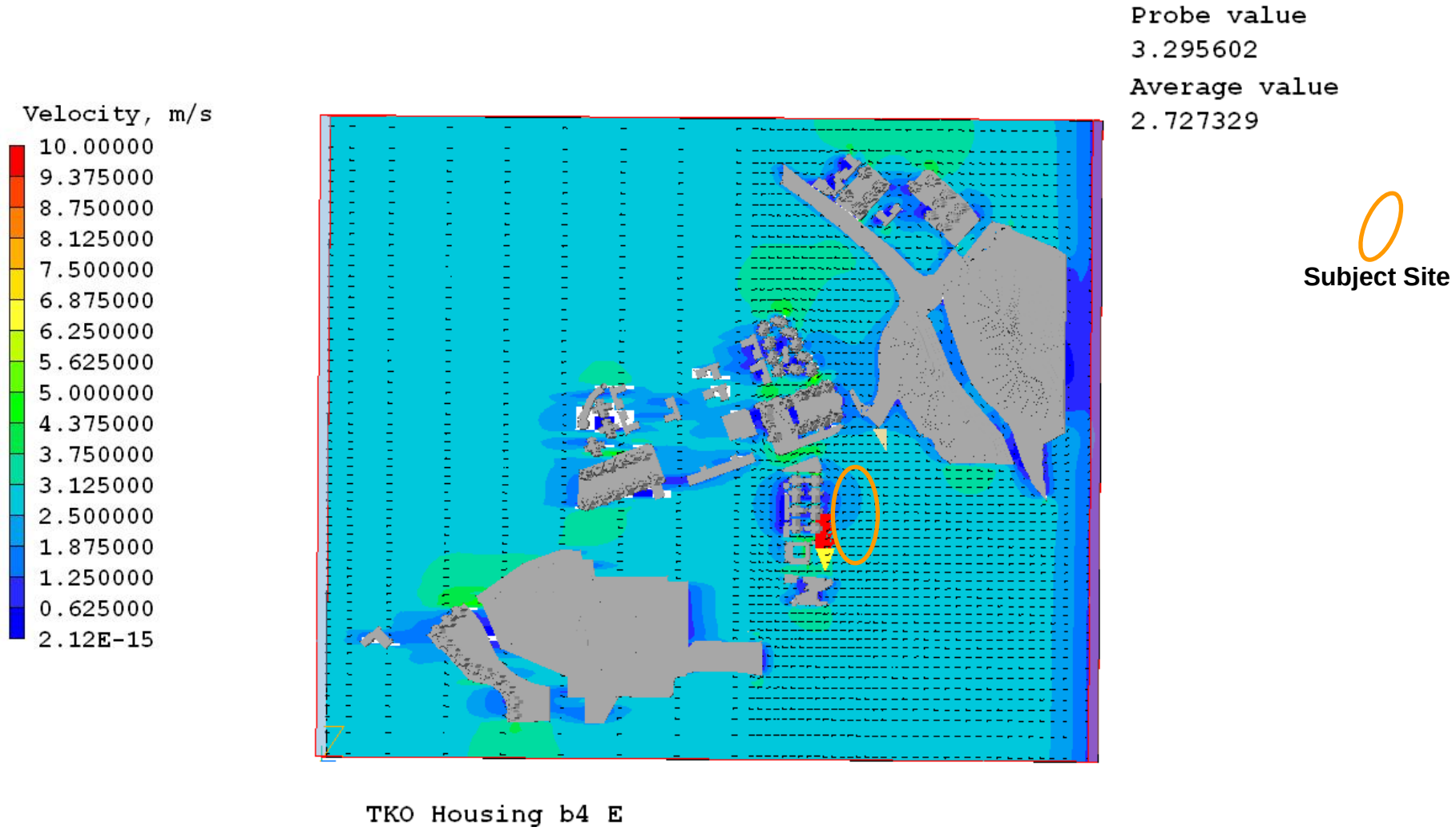
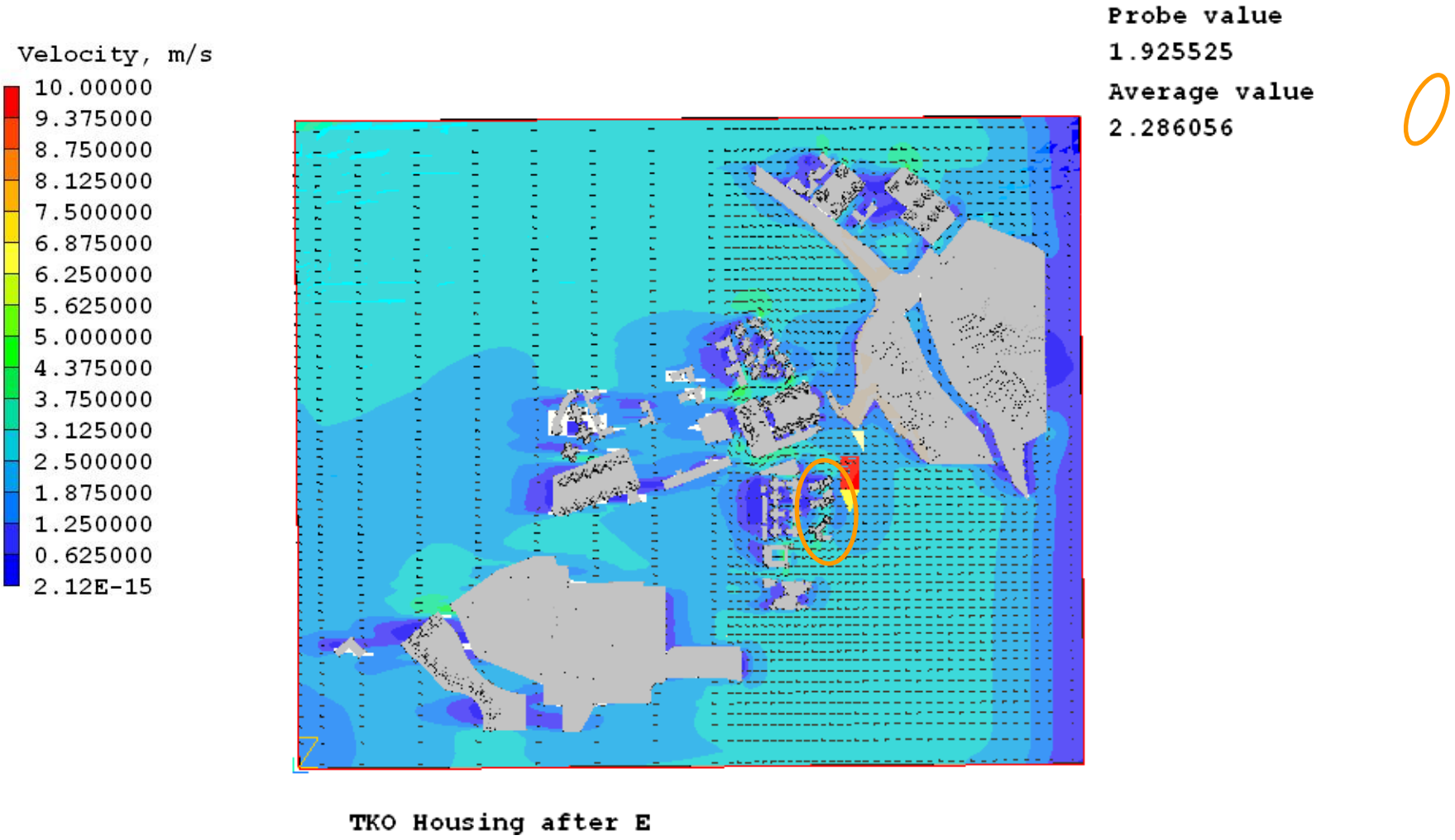


**Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")**



## KTSPC&KTRG AVA Results

Case ENE

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 67.5 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| Q1 | 0.19 | 0.20 | 0.01 |
| O2 | 0.15 | 0.18 | 0.03 |
| O3 | 0.11 | 0.12 | 0.01 |
| O4 | 0.23 | 0.23 | 0.00 |
| O5 | 0.18 | 0.19 | 0.01 |
| O6 | 0.13 | 0.13 | 0.00 |
| O7 | 0.22 | 0.23 | 0.01 |
| O8 | 0.11 | 0.11 | 0.00 |
| O9 | 0.22 | 0.23 | 0.01 |
| O10 | 0.01 | 0.13 | 0.12 |
| O11 | 0.23 | 0.24 | 0.01 |
| O12 | 0.14 | 0.15 | 0.01 |
| O13 | 0.13 | 0.12 | (-0.01) |
| O14 | 0.04 | 0.04 | 0.00 |
| O15 | 0.42 | 0.31 | (-0.11) |
| O16 | 0.23 | 0.24 | 0.01 |
| O17 | 0.18 | 0.20 | 0.02 |
| O18 | 0.17 | 0.17 | 0.00 |
| O19 | 0.29 | 0.30 | 0.01 |
| O20 | 0.32 | 0.36 | 0.04 |
| O21 | 0.30 | 0.32 | 0.02 |
| O22 | 0.26 | 0.29 | 0.03 |
| O23 | 0.31 | 0.32 | 0.01 |
| O24 | 0.29 | 0.31 | 0.02 |
| O25 | 0.32 | 0.33 | 0.01 |
| O26 | 0.33 | 0.32 | (-0.01) |
| O27 | 0.30 | 0.30 | 0.00 |
| O28 | 0.32 | 0.31 | (-0.01) |
| O29 | 0.33 | 0.34 | 0.01 |
| O30 | 0.28 | 0.30 | 0.02 |

| | | | |
|---|---|---|---|
| O31 | 0.27 | 0.28 | 0.01 |
| O32 | 0.06 | 0.07 | 0.01 |
| O33 | 0.32 | 0.32 | 0.00 |
| O34 | 0.19 | 0.19 | 0.00 |
| O35 | 0.25 | 0.25 | 0.00 |
| O36 | 0.26 | 0.26 | 0.00 |
| O37 | 0.14 | 0.15 | 0.01 |
| O38 | 0.33 | 0.35 | 0.02 |
| O39 | 0.05 | 0.06 | 0.01 |
| O40 | 0.04 | 0.06 | 0.02 |
| O41 | 0.35 | 0.36 | 0.01 |
| O42 | 0.33 | 0.34 | 0.01 |
| O43 | 0.24 | 0.25 | 0.01 |
| O44 | 0.23 | 0.25 | 0.02 |
| O45 | 0.32 | 0.31 | (-0.01) |
| O46 | 0.14 | 0.14 | 0.00 |
| O47 | 0.27 | 0.29 | 0.02 |
| O48 | 0.30 | 0.28 | (-0.02) |
| O49 | 0.21 | 0.20 | (-0.01) |
| O50 | 0.35 | 0.36 | 0.01 |
| | | **Average:** | **0.008** |
| P51 | 0.22 | 0.23 | 0.01 |
| P52 | 0.22 | 0.23 | 0.01 |
| P53 | 0.23 | 0.20 | (-0.03) |
| P54 | 0.27 | 0.26 | (-0.01) |
| P55 | 0.33 | 0.27 | (-0.06) |
| P56 | 0.33 | 0.32 | (-0.01) |
| P57 | 0.43 | 0.43 | 0.00 |
| P58 | 0.31 | 0.20 | (-0.11) |
| P59 | 0.34 | 0.24 | (-0.1) |
| P60 | 0.32 | 0.24 | (-0.08) |
| P61 | 0.29 | 0.24 | (-0.05) |
| P62 | 0.24 | 0.23 | (-0.01) |
| P63 | 0.24 | 0.24 | 0.00 |
| P64 | 0.26 | 0.26 | 0.00 |
| P65 | 0.30 | 0.30 | 0.00 |

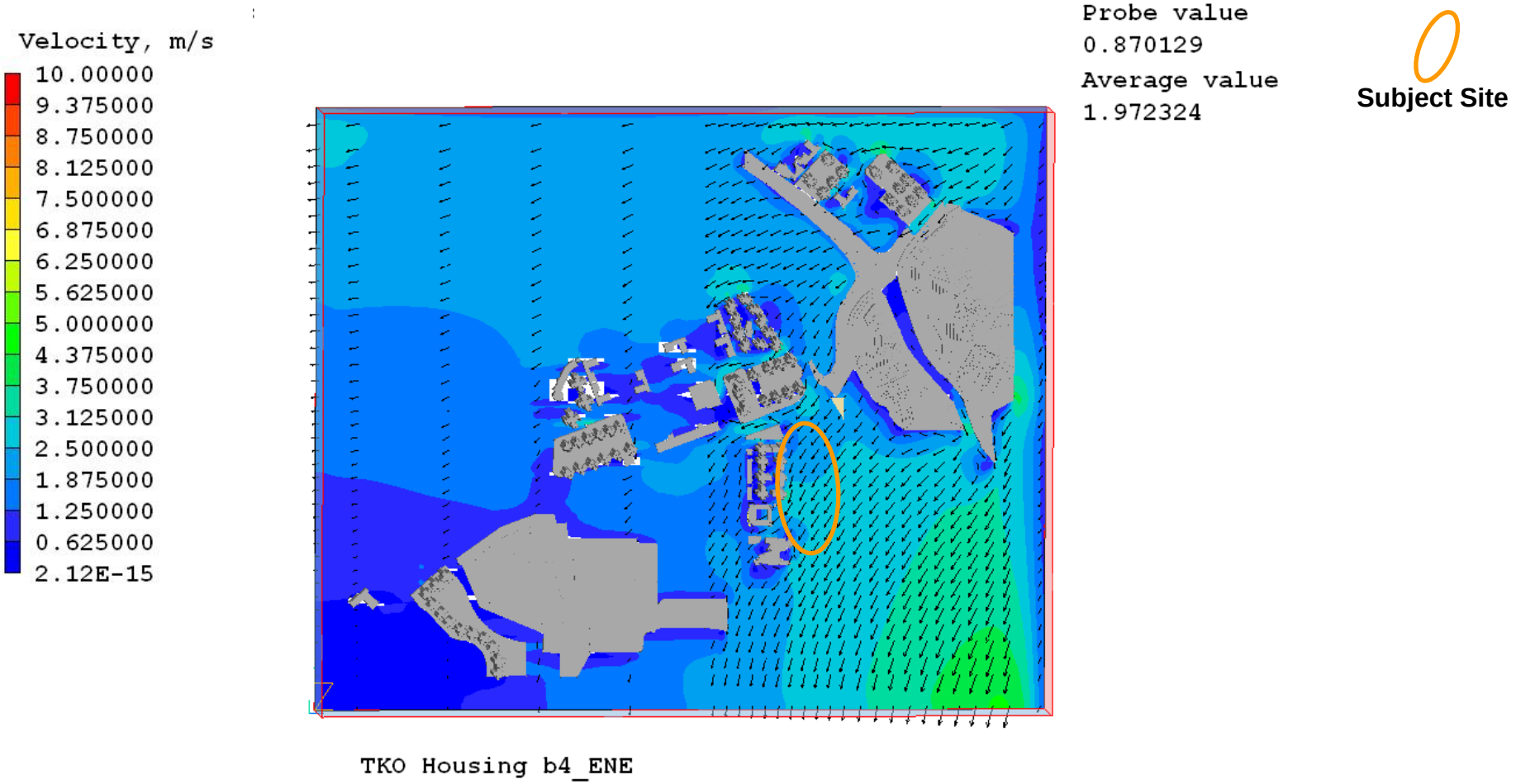
| | | | |
|---|---|---|---|
| P66 | 0.32 | 0.33 | 0.01 |
| P67 | 0.33 | 0.35 | 0.02 |
| P68 | 0.34 | 0.37 | 0.03 |
| P69 | 0.35 | 0.38 | 0.03 |
| P70 | 0.35 | 0.38 | 0.03 |
| P71 | 0.35 | 0.38 | 0.03 |
| P72 | 0.34 | 0.35 | 0.01 |
| P73 | 0.34 | 0.37 | 0.03 |
| P74 | 0.33 | 0.34 | 0.01 |
| P75 | 0.32 | 0.33 | 0.01 |
| P76 | 0.32 | 0.36 | 0.04 |
| P77 | 0.31 | 0.31 | 0.00 |
| P78 | 0.31 | 0.30 | (-0.01) |
| P79 | 0.31 | 0.31 | 0.00 |
| P80 | 0.31 | 0.28 | (-0.03) |
| P81 | 0.30 | 0.23 | (-0.07) |
| P82 | 0.27 | 0.23 | (-0.04) |
| P83 | 0.22 | 0.23 | 0.01 |
| P84 | 0.24 | 0.23 | (-0.01) |
| P85 | 0.25 | 0.23 | (-0.02) |
| P86 | 0.26 | 0.25 | (-0.01) |
| P87 | 0.33 | 0.29 | (-0.04) |
| P88 | 0.37 | 0.39 | 0.02 |
| P89 | 0.45 | 0.39 | (-0.06) |
| P90 | 0.37 | 0.24 | (-0.13) |
| P91 | 0.33 | 0.23 | (-0.1) |
| P92 | 0.28 | 0.24 | (-0.04) |
| | | **Average** | **(-0.0171)** |
| | | **Overall average** | **(-0.0046)** |

***Remark***

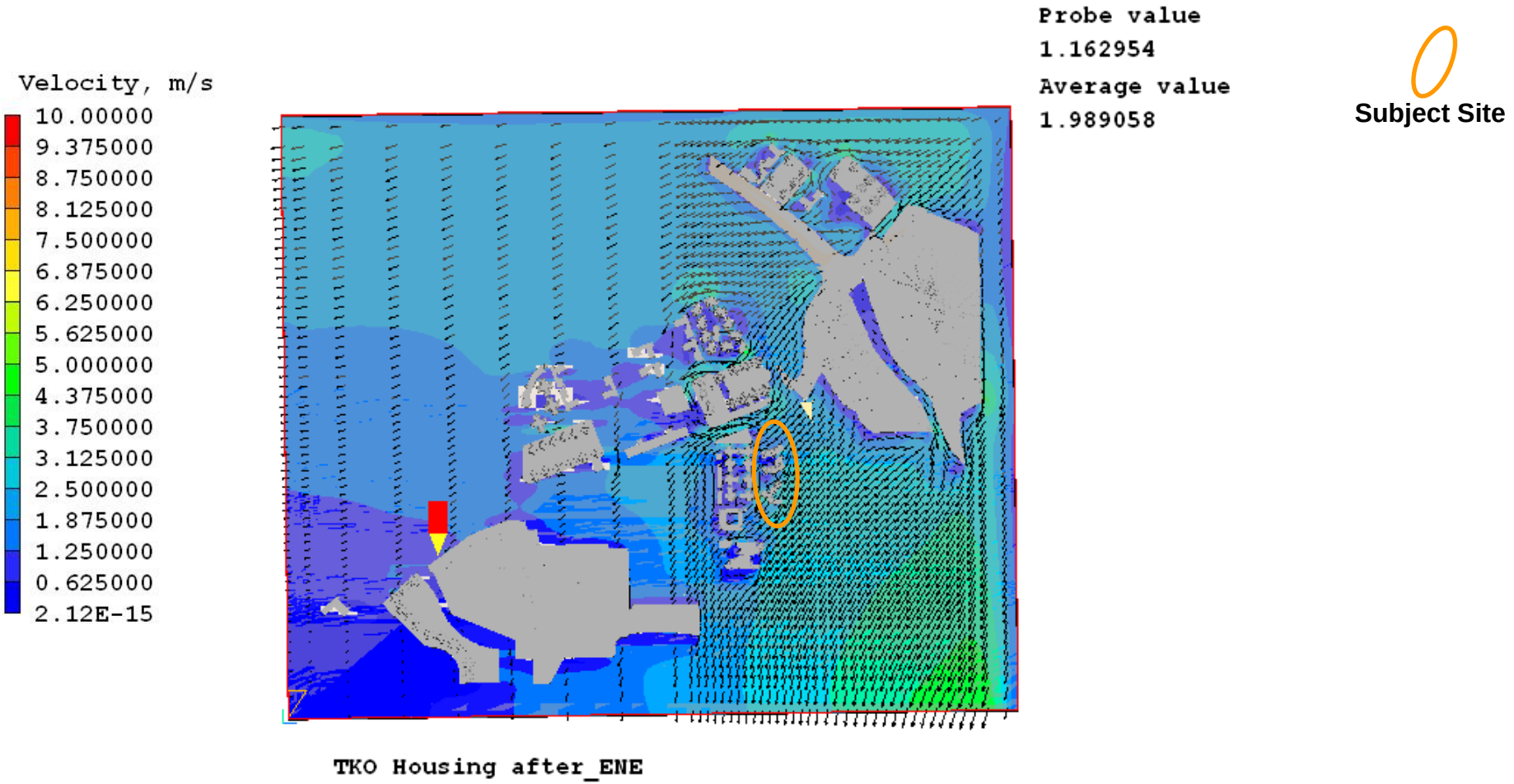
*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")



## KTSPC&KTRG AVA Results

Case NE

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 45 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| Q! | 0.20 | 0.20 | 0.00 |
| O2 | 0.12 | 0.12 | 0.00 |
| O3 | 0.12 | 0.12 | 0.00 |
| O4 | 0.21 | 0.16 | (-0.05) |
| O5 | 0.21 | 0.24 | 0.03 |
| O6 | 0.12 | 0.17 | 0.05 |
| O7 | 0.26 | 0.25 | (-0.01) |
| O8 | 0.14 | 0.17 | 0.03 |
| O9 | 0.25 | 0.25 | 0.00 |
| O10 | 0.15 | 0.15 | 0.00 |
| O11 | 0.26 | 0.26 | 0.00 |
| O12 | 0.15 | 0.05 | (-0.10) |
| O13 | 0.16 | 0.19 | 0.03 |
| O14 | 0.05 | 0.08 | 0.03 |
| O15 | 0.39 | 0.27 | (-0.12) |
| O16 | 0.24 | 0.27 | 0.03 |
| O17 | 0.19 | 0.19 | 0.00 |
| O18 | 0.20 | 0.24 | 0.04 |
| O19 | 0.32 | 0.14 | (-0.18) |
| O20 | 0.33 | 0.32 | (-0.01) |
| O21 | 0.29 | 0.22 | (-0.07) |
| O22 | 0.22 | 0.20 | (-0.02) |
| O23 | 0.30 | 0.27 | (-0.03) |
| O24 | 0.28 | 0.12 | (-0.16) |
| O25 | 0.34 | 0.37 | 0.03 |
| O26 | 0.35 | 0.26 | (-0.09) |
| O27 | 0.31 | 0.28 | (-0.03) |
| O28 | 0.34 | 0.30 | (-0.04) |
| O29 | 0.34 | 0.34 | 0.00 |
| O30 | 0.30 | 0.30 | 0.00 |

| | | | |
|---|---|---|---|
| O31 | 0.22 | 0.19 | (-0.03) |
| O32 | 0.05 | 0.06 | 0.01 |
| O33 | 0.35 | 0.30 | (-0.05) |
| O34 | 0.26 | 0.34 | 0.08 |
| O35 | 0.27 | 0.25 | (-0.02) |
| O36 | 0.31 | 0.35 | 0.04 |
| )O37 | 0.15 | 0.26 | 0.11 |
| O38 | 0.32 | 0.31 | (-0.01) |
| O39 | 0.04 | 0.05 | 0.01 |
| O40 | 0.04 | 0.09 | 0.05 |
| O41 | 0.35 | 0.34 | (-0.01) |
| O42 | 0.33 | 0.31 | (-0.02) |
| O43 | 0.24 | 0.22 | (-0.02) |
| O44 | 0.25 | 0.29 | 0.04 |
| O45 | 0.34 | 0.31 | (-0.03) |
| O46 | 0.16 | 0.18 | 0.02 |
| O47 | 0.26 | 0.14 | (-0.12) |
| O48 | 0.28 | 0.20 | (-0.08) |
| O49 | 0.20 | 0.14 | (-0.06) |
| O50 | 0.34 | 0.32 | (-0.02) |
| | | **Average:** | **(-0.015)** |
| P51 | 0.24 | 0.18 | (-0.06) |
| P52 | 0.27 | 0.33 | 0.06 |
| P53 | 0.27 | 0.25 | (-0.02) |
| P54 | 0.29 | 0.29 | 0.00 |
| P55 | 0.36 | 0.31 | (-0.05) |
| P56 | 0.35 | 0.32 | (-0.03) |
| P57 | 0.44 | 0.40 | (-0.04) |
| P58 | 0.28 | 0.18 | (-0.1) |
| P59 | 0.32 | 0.19 | (-0.13) |
| P60 | 0.31 | 0.18 | (-0.13) |
| P61 | 0.28 | 0.19 | (-0.09) |
| P62 | 0.22 | 0.18 | (-0.04) |
| P63 | 0.22 | 0.18 | (-0.04) |
| P64 | 0.25 | 0.19 | -0.06 |
| P65 | 0.30 | 0.23 | (-0.07) |

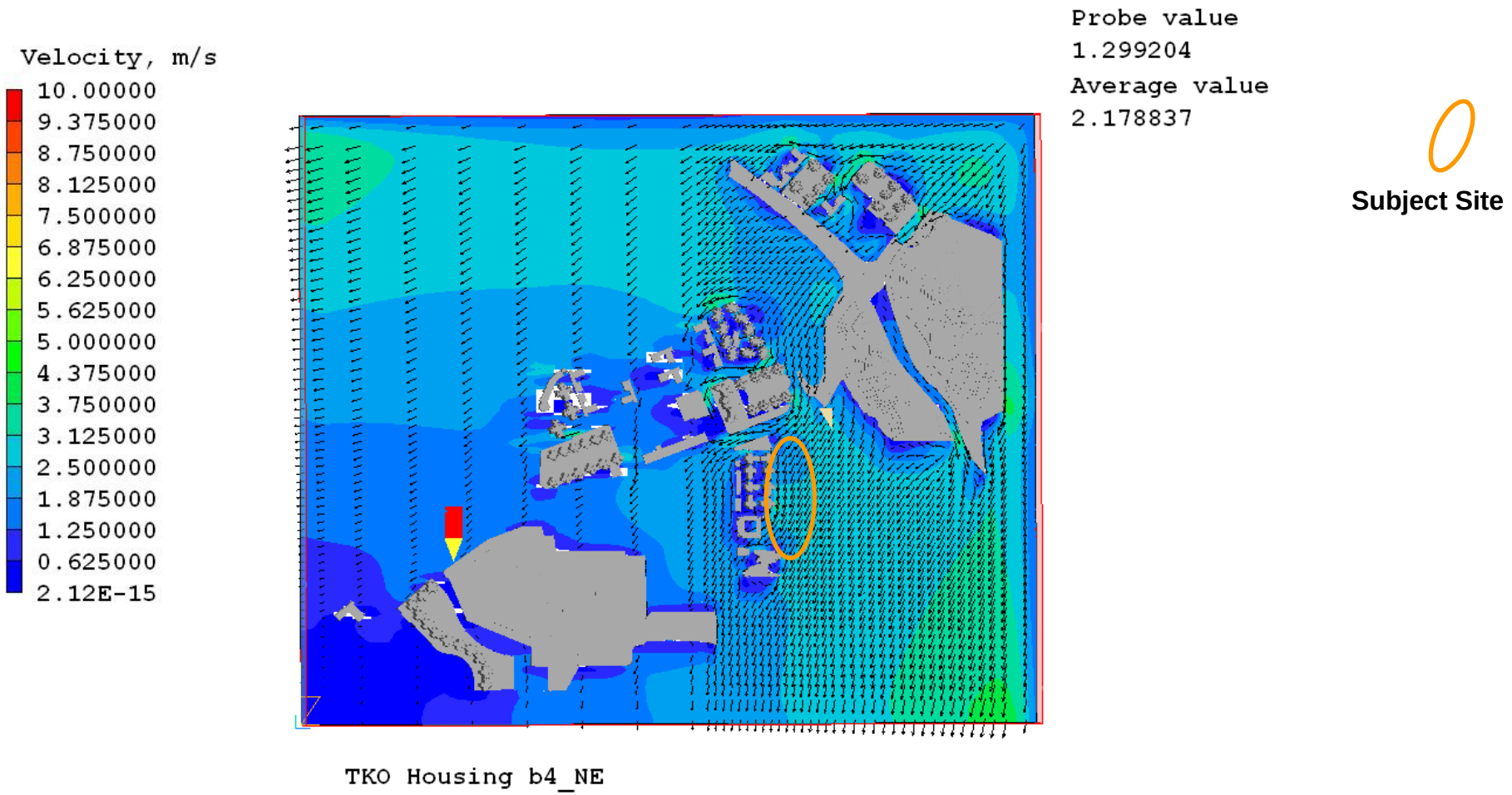
| | | | |
|---|---|---|---|
| P66 | 0.32 | 0.25 | (-0.07) |
| P67 | 0.33 | 0.28 | (-0.05) |
| P68 | 0.34 | 0.30 | (-0.04) |
| P69 | 0.35 | 0.31 | (-0.04) |
| P70 | 0.35 | 0.31 | (-0.04) |
| P71 | 0.36 | 0.32 | (-0.04) |
| P72 | 0.35 | 0.28 | (-0.07) |
| P73 | 0.35 | 0.37 | 0.02 |
| P74 | 0.34 | 0.35 | 0.01 |
| P75 | 0.34 | 0.32 | (-0.02) |
| P76 | 0.33 | 0.39 | 0.06 |
| P77 | 0.33 | 0.33 | 0.00 |
| P78 | 0.33 | 0.33 | 0.00 |
| P79 | 0.00 | 0.00 | 0.00 |
| P80 | 0.33 | 0.29 | (-0.04) |
| P81 | 0.32 | 0.27 | (-0.05) |
| P82 | 0.29 | 0.14 | (-0.15) |
| P83 | 0.24 | 0.17 | (-0.07) |
| P84 | 0.28 | 0.31 | 0.03 |
| P85 | 0.29 | 0.27 | (-0.02) |
| P86 | 0.29 | 0.27 | (-0.02) |
| P87 | 0.35 | 0.30 | (-0.05) |
| P88 | 0.39 | 0.37 | (-0.02) |
| P89 | 0.45 | 0.35 | (-0.1) |
| P90 | 0.32 | 0.18 | (-0.14) |
| P91 | 0.30 | 0.18 | (-0.12) |
| P92 | 0.26 | 0.19 | (-0.07) |
| | | **Average** | **(-0.045)** |
| | | **Overall average** | **(-0.03)** |

***Remark***

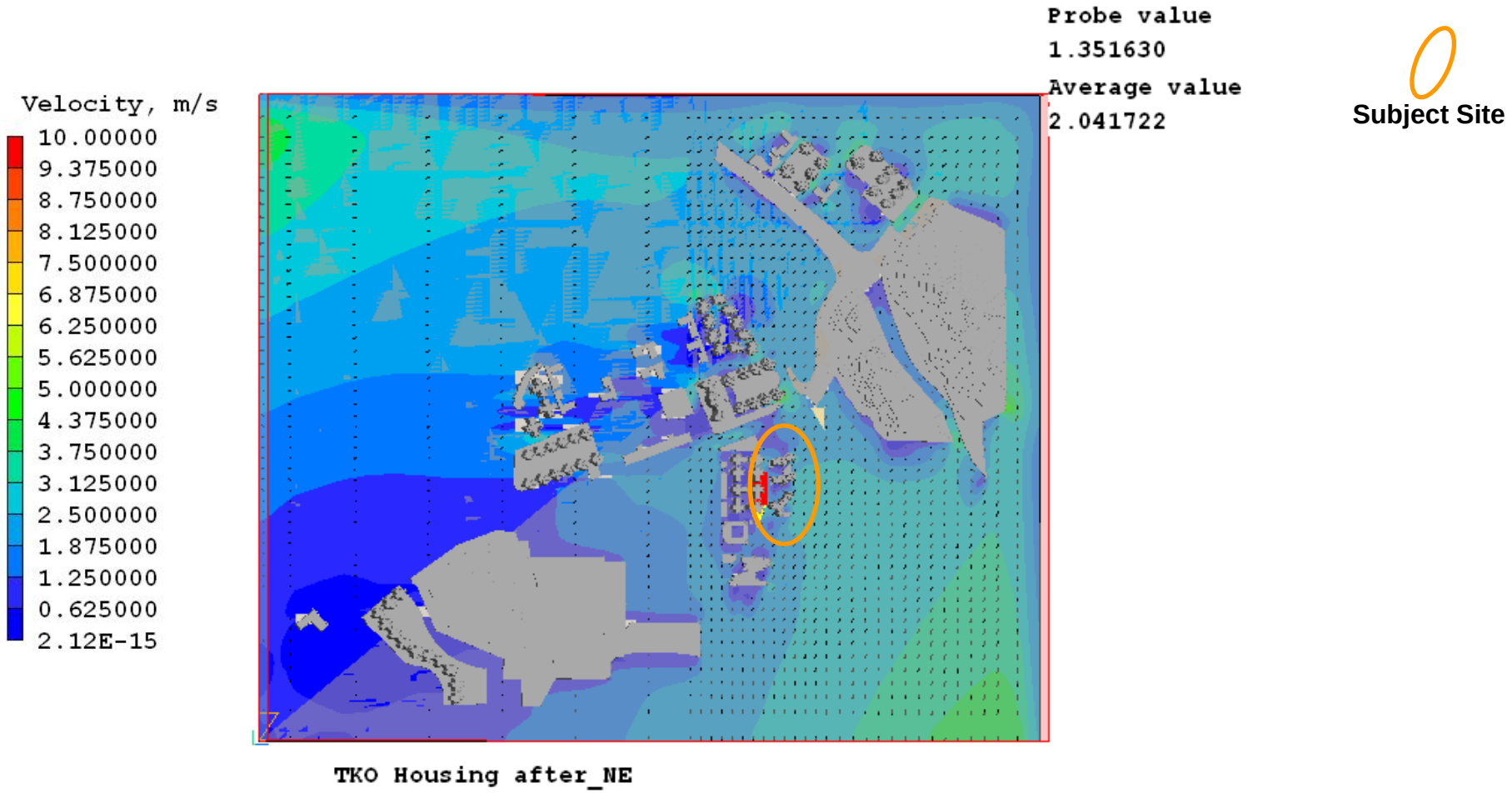
*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")



## KTSPC&KTRG AVA Results

Case NNE

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 22.5 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| Q1 | 0.20 | 0.20 | 0.00 |
| O2 | 0.10 | 0.09 | (-0.01) |
| O3 | 0.12 | 0.12 | 0.00 |
| O4 | 0.18 | 0.14 | (-0.04) |
| O5 | 0.23 | 0.24 | 0.01 |
| O6 | 0.13 | 0.14 | 0.01 |
| O7 | 0.26 | 0.27 | 0.01 |
| O8 | 0.16 | 0.19 | 0.03 |
| O9 | 0.25 | 0.25 | 0.00 |
| O10 | 0.16 | 0.17 | 0.01 |
| O11 | 0.27 | 0.27 | 0.00 |
| O12 | 0.13 | 0.12 | (-0.01) |
| O13 | 0.17 | 0.18 | 0.01 |
| O14 | 0.06 | 0.08 | 0.02 |
| O15 | 0.32 | 0.17 | (-0.15) |
| O16 | 0.21 | 0.27 | 0.06 |
| O17 | 0.18 | 0.18 | 0.00 |
| O18 | 0.20 | 0.21 | 0.01 |
| O19 | 0.30 | 0.29 | (-0.01) |
| O20 | 0.30 | 0.30 | 0.00 |
| O21 | 0.20 | 0.16 | (-0.04) |
| O22 | 0.17 | 0.17 | 0.00 |
| O23 | 0.24 | 0.23 | (-0.01) |
| O24 | 0.22 | 0.21 | (-0.01) |
| O25 | 0.32 | 0.31 | (-0.01) |
| O26 | 0.33 | 0.30 | (-0.03) |
| O27 | 0.29 | 0.27 | (-0.02) |
| O28 | 0.33 | 0.32 | (-0.01) |
| O29 | 0.32 | 0.34 | 0.02 |
| O30 | 0.26 | 0.24 | (-0.02) |
| O31 | 0.13 | 0.13 | 0.00 |

| | | | |
|---|---|---|---|
| O32 | 0.05 | 0.06 | 0.01 |
| O33 | 0.34 | 0.32 | (-0.02) |
| O34 | 0.30 | 0.30 | 0.00 |
| O35 | 0.26 | 0.25 | (-0.01) |
| O36 | 0.32 | 0.32 | 0.00 |
| O37 | 0.15 | 0.15 | 0.00 |
| O38 | 0.26 | 0.24 | (-0.02) |
| O39 | 0.04 | 0.05 | 0.01 |
| O40 | 0.04 | 0.04 | 0.00 |
| O41 | 0.28 | 0.32 | 0.04 |
| O42 | 0.31 | 0.30 | (-0.01) |
| O43 | 0.23 | 0.21 | (-0.02) |
| O44 | 0.25 | 0.26 | 0.01 |
| O45 | 0.32 | 0.33 | 0.01 |
| O46 | 0.18 | 0.19 | 0.01 |
| O47 | 0.22 | 0.21 | (-0.01) |
| O48 | 0.22 | 0.15 | -0.07 |
| O49 | 0.17 | 0.13 | (-0.04) |
| O50 | 0.31 | 0.31 | 0.00 |
| | | **Average:** | **0.01** |
| P51 | 0.23 | 0.21 | (-0.02) |
| P52 | 0.29 | 0.30 | 0.01 |
| P53 | 0.27 | 0.30 | 0.03 |
| P54 | 0.28 | 0.34 | 0.06 |
| P55 | 0.34 | 0.34 | 0.00 |
| P56 | 0.33 | 0.33 | 0.00 |
| P57 | 0.40 | 0.39 | (-0.01) |
| P58 | 0.21 | 0.10 | (-0.11) |
| P59 | 0.26 | 0.08 | (-0.18) |
| P60 | 0.27 | 0.15 | (-0.12) |
| P61 | 0.25 | 0.18 | (-0.07) |
| P62 | 0.20 | 0.16 | (-0.04) |
| P63 | 0.20 | 0.16 | (-0.04) |
| P64 | 0.23 | 0.17 | (-0.06) |
| P65 | 0.27 | 0.20 | (-0.07) |
| P66 | 0.29 | 0.23 | (-0.06) |
| P67 | 0.30 | 0.26 | (-0.04) |

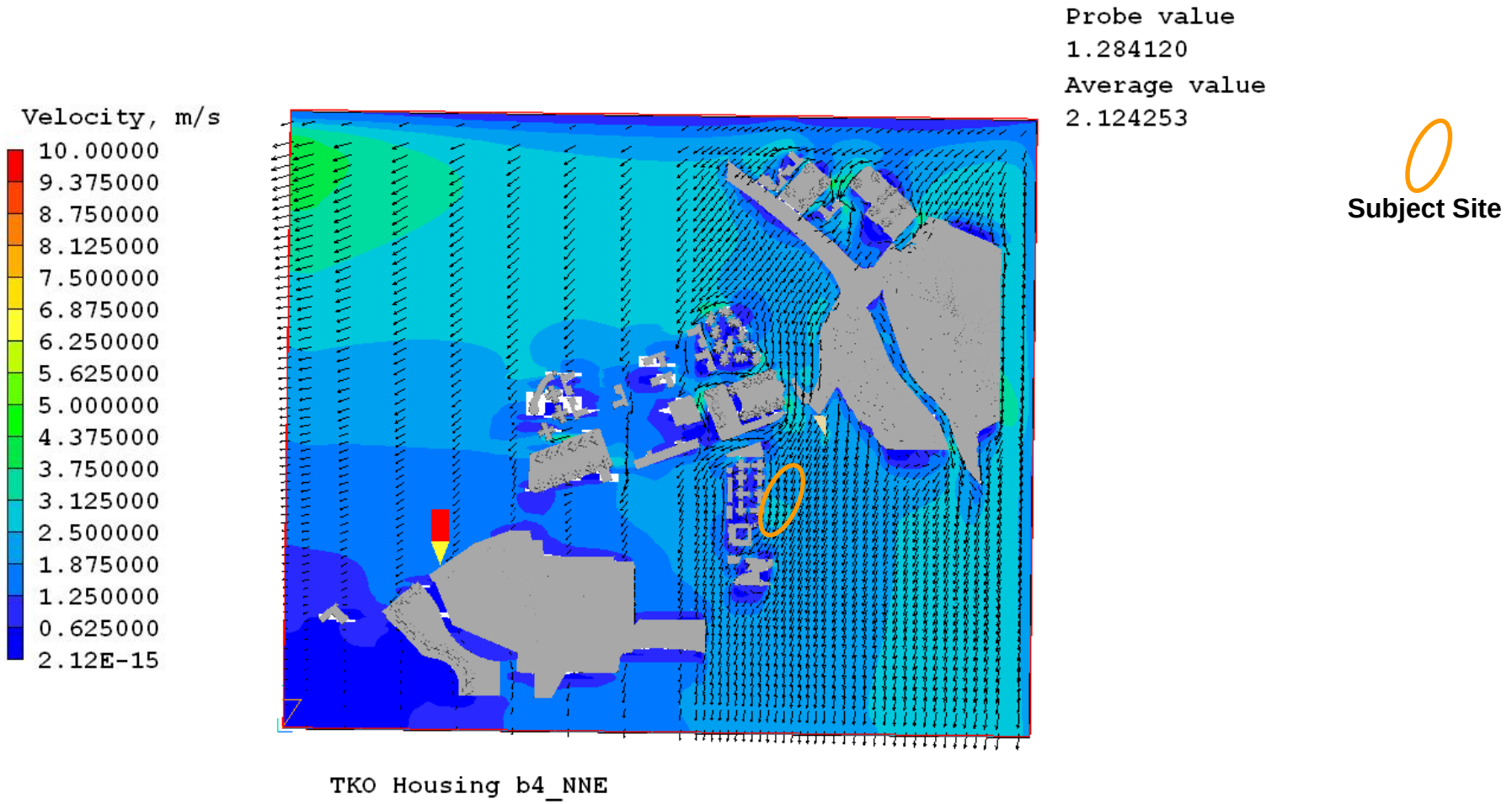
| | | | |
|---|---|---|---|
| P68 | 0.31 | 0.29 | (-0.02) |
| P69 | 0.32 | 0.31 | (-0.01) |
| P70 | 0.32 | 0.31 | (-0.01) |
| P71 | 0.33 | 0.30 | (-0.03) |
| P72 | 0.33 | 0.32 | (-0.01) |
| P73 | 0.33 | 0.32 | (-0.01) |
| P74 | 0.32 | 0.31 | (-0.01) |
| P75 | 0.32 | 0.30 | (-0.02) |
| P76 | 0.32 | 0.35 | 0.03 |
| P77 | 0.31 | 0.36 | 0.05 |
| P78 | 0.31 | 0.35 | 0.04 |
| P79 | 0.00 | 0.00 | 0.00 |
| P80 | 0.31 | 0.32 | 0.01 |
| P81 | 0.30 | 0.31 | 0.01 |
| P82 | 0.28 | 0.14 | (-0.14) |
| P83 | 0.24 | 0.21 | (-0.03) |
| P84 | 0.29 | 0.32 | 0.03 |
| P85 | 0.29 | 0.33 | 0.04 |
| P86 | 0.27 | 0.32 | 0.05 |
| P87 | 0.33 | 0.32 | (-0.01) |
| P88 | 0.36 | 0.36 | 0.00 |
| P89 | 0.40 | 0.35 | (-0.05) |
| P90 | 0.27 | 0.12 | (-0.15) |
| P91 | 0.26 | 0.17 | (-0.09) |
| P92 | 0.23 | 0.18 | (-0.05) |
| | | **Average** | **(-0.026)** |
| | | **Overall average** | **-(0.016)** |

***Remark***

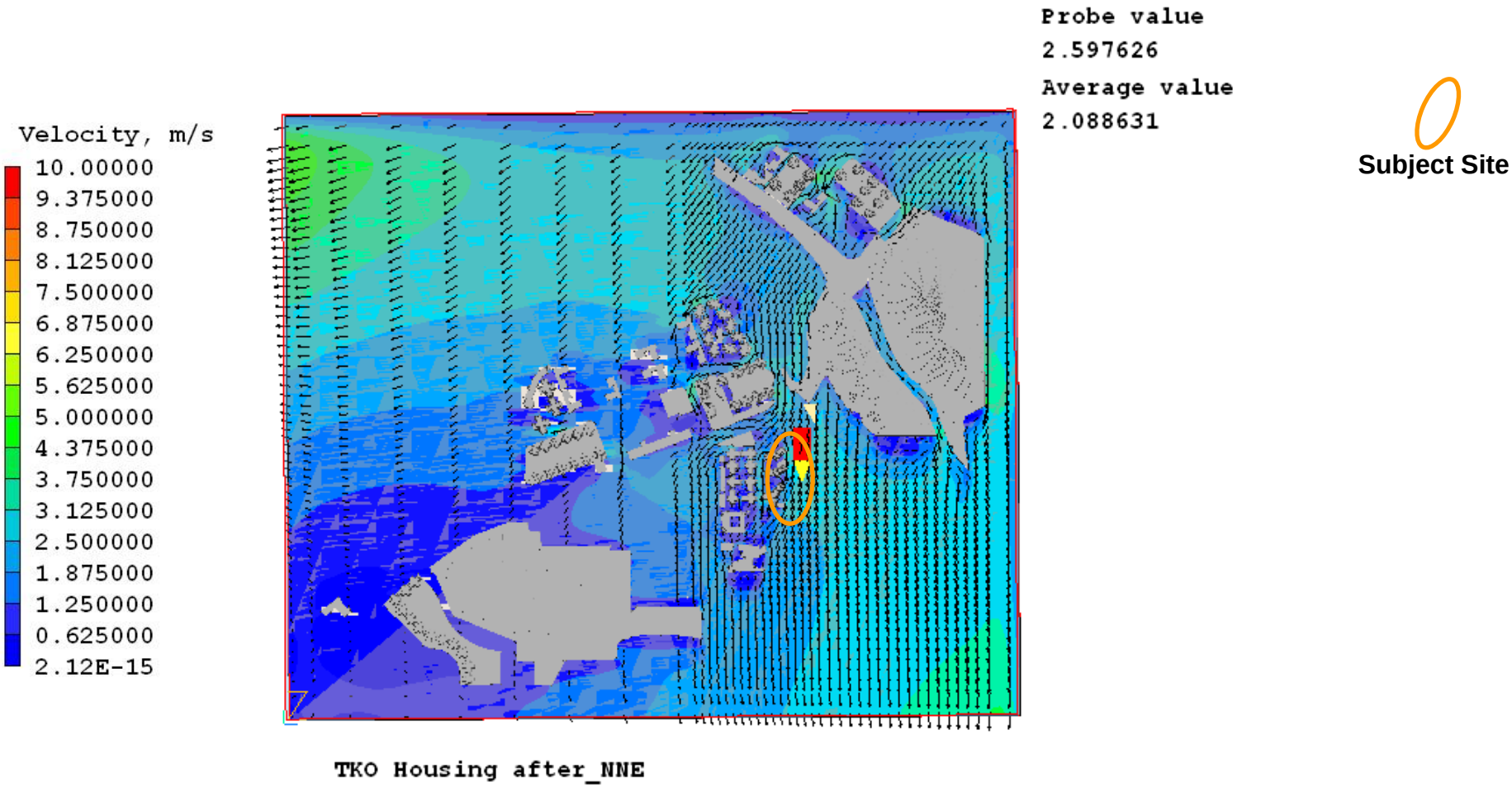
*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")



## KTSPC&KTRG AVA Results

Case ESE

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 112.5 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| O1 | 0.27 | 0.23 | (-0.04) |
| O2 | 0.31 | 0.26 | (-0.05) |
| O3 | 0.40 | 0.31 | (-0.09) |
| O4 | 0.30 | 0.25 | (-0.05) |
| O5 | 0.29 | 0.25 | (-0.04) |
| O6 | 0.23 | 0.20 | (-0.03) |
| O7 | 0.36 | 0.31 | (-0.05) |
| O8 | 0.32 | 0.28 | (-0.04) |
| O9 | 0.36 | 0.30 | (-0.06) |
| O10 | 0.10 | 0.13 | 0.03 |
| O11 | 0.38 | 0.28 | (-0.1) |
| O12 | 0.17 | 0.11 | (-0.06) |
| O13 | 0.12 | 0.14 | 0.02 |
| O14 | 0.38 | 0.32 | (-0.06) |
| O15 | 0.18 | 0.18 | 0.00 |
| O16 | 0.25 | 0.23 | (-0.02) |
| O17 | 0.38 | 0.23 | (-0.15) |
| O18 | 0.14 | 0.17 | 0.03 |
| O19 | 0.09 | 0.05 | (-0.04) |
| O20 | 0.14 | 0.13 | (-0.01) |
| O21 | 0.37 | 0.29 | (-0.08) |
| O22 | 0.42 | 0.24 | (-0.18) |
| O23 | 0.15 | 0.09 | (-0.06) |
| O24 | 0.08 | 0.09 | 0.01 |
| O25 | 0.21 | 0.19 | (-0.02) |
| O26 | 0.32 | 0.33 | 0.01 |
| O27 | 0.38 | 0.37 | (-0.01) |
| O28 | 0.39 | 0.38 | (-0.01) |
| O29 | 0.39 | 0.35 | (-0.04) |
| O30 | 0.24 | 0.24 | 0.00 |

| | | | |
|---|---|---|---|
| O31 | 0.31 | 0.28 | -0.03 |
| O32 | 0.43 | 0.34 | -0.09 |
| O33 | 0.35 | 0.34 | -0.01 |
| O34 | 0.44 | 0.39 | -0.05 |
| O35 | 0.29 | 0.26 | -0.03 |
| O36 | 0.41 | 0.38 | -0.03 |
| O37 | 0.19 | 0.18 | -0.01 |
| O38 | 0.19 | 0.12 | -0.07 |
| O39 | 0.19 | 0.14 | -0.05 |
| O40 | 0.05 | 0.05 | 0.00 |
| O41 | 0.38 | 0.31 | -0.07 |
| O42 | 0.36 | 0.30 | -0.06 |
| O43 | 0.38 | 0.32 | -0.06 |
| O44 | 0.26 | 0.25 | -0.01 |
| O45 | 0.38 | 0.38 | 0.00 |
| O46 | 0.22 | 0.19 | -0.03 |
| O47 | 0.28 | 0.17 | -0.11 |
| O48 | 0.30 | 0.23 | -0.07 |
| O49 | 0.40 | 0.30 | -0.1 |
| O50 | 0.37 | 0.30 | -0.07 |
| | | **Average:** | **(-0.043)** |
| P51 | 0.32 | 0.15 | (-0.17) |
| P52 | 0.43 | 0.29 | (-0.14) |
| P53 | 0.37 | 0.30 | (-0.07) |
| P54 | 0.26 | 0.23 | (-0.03) |
| P55 | 0.25 | 0.18 | (-0.07) |
| P56 | 0.21 | 0.19 | (-0.02) |
| P57 | 0.21 | 0.28 | 0.07 |
| P58 | 0.30 | 0.22 | (-0.08) |
| P59 | 0.29 | 0.25 | (-0.04) |
| P60 | 0.27 | 0.25 | (-0.02) |
| P61 | 0.28 | 0.25 | (-0.03) |
| P62 | 0.30 | 0.26 | (-0.04) |
| P63 | 0.32 | 0.28 | (-0.04) |
| P64 | 0.34 | 0.30 | (-0.04) |
| P65 | 0.35 | 0.30 | (-0.05) |

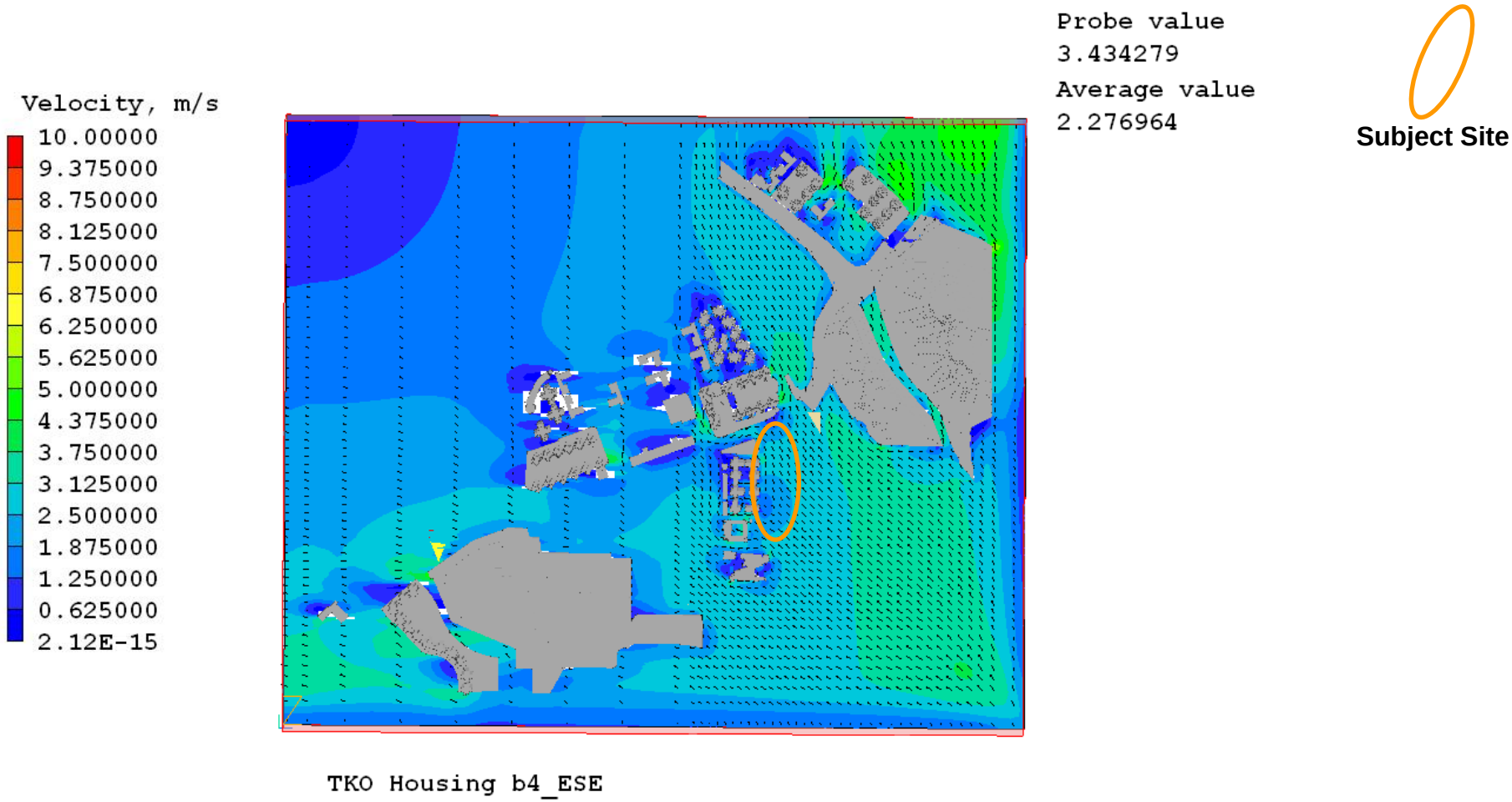
| | | | |
|---|---|---|---|
| P66 | 0.35 | 0.30 | (-0.05) |
| P67 | 0.34 | 0.29 | (-0.05) |
| P68 | 0.34 | 0.28 | (-0.06) |
| P69 | 0.33 | 0.26 | (-0.07) |
| P70 | 0.33 | 0.24 | (-0.09) |
| P71 | 0.32 | 0.20 | (-0.12) |
| P72 | 0.32 | 0.18 | (-0.14) |
| P73 | 0.32 | 0.22 | (-0.1) |
| P74 | 0.33 | 0.28 | (-0.05) |
| P75 | 0.34 | 0.29 | (-0.05) |
| P76 | 0.35 | 0.29 | (-0.06) |
| P77 | 0.36 | 0.36 | 0.00 |
| P78 | 0.36 | 0.36 | 0.00 |
| P79 | 0.00 | 0.00 | 0.00 |
| P80 | 0.37 | 0.39 | 0.02 |
| P81 | 0.36 | 0.46 | 0.10 |
| P82 | 0.36 | 0.07 | (-0.29) |
| P83 | 0.37 | 0.11 | (-0.26) |
| P84 | 0.39 | 0.31 | (-0.08) |
| P85 | 0.36 | 0.28 | (-0.08) |
| P86 | 0.27 | 0.26 | (-0.01) |
| P87 | 0.20 | 0.16 | (-0.04) |
| P88 | 0.23 | 0.27 | 0.04 |
| P89 | 0.18 | 0.22 | 0.04 |
| P90 | 0.27 | 0.25 | (-0.02) |
| P91 | 0.30 | 0.25 | (-0.05) |
| P92 | 0.33 | 0.25 | (-0.08) |
| | | **Average** | **(-0.055)** |
| | | **Overall average** | **(-0.049)** |

***Remark***

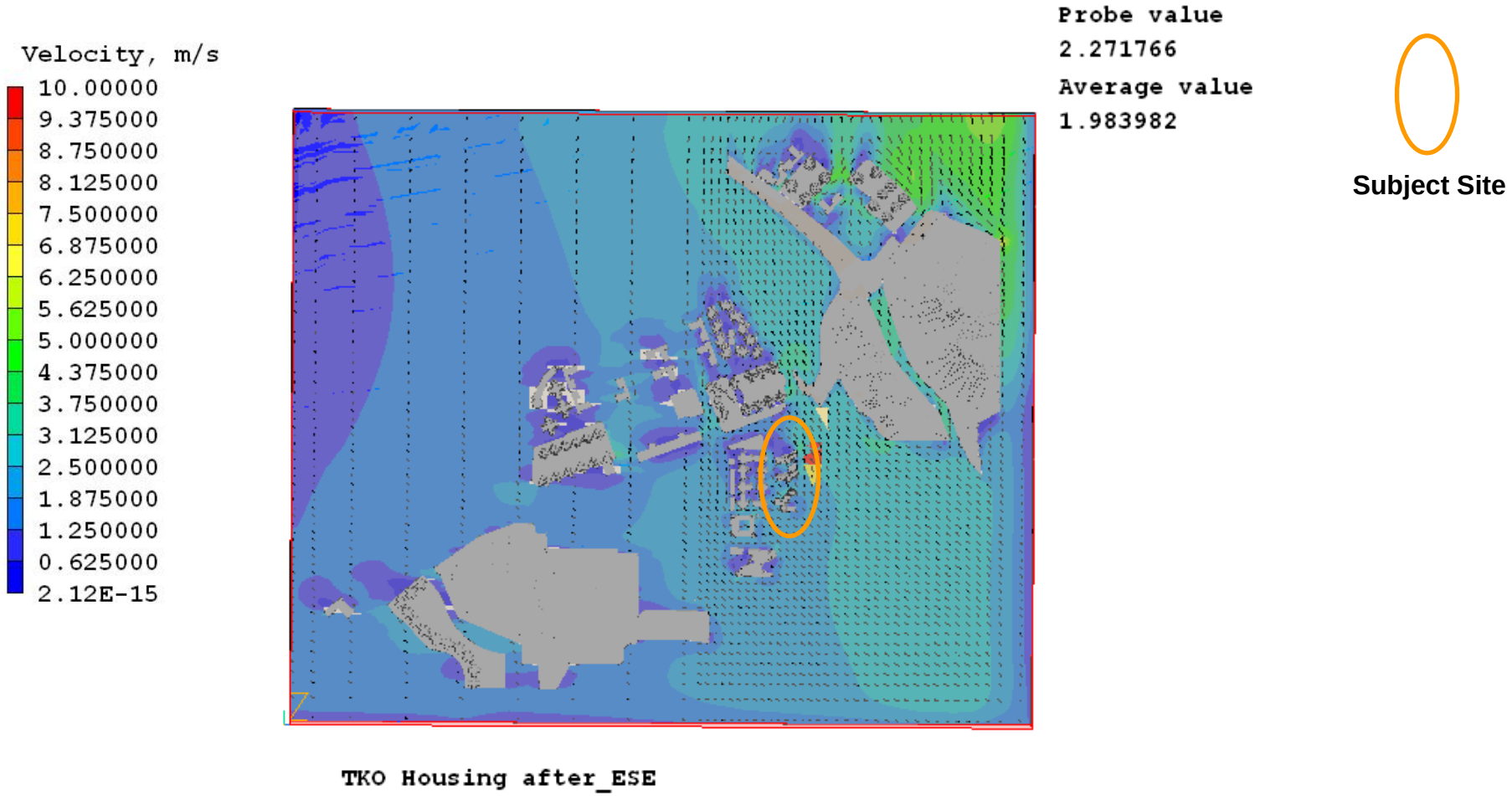
*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")



## KTSPC&KTRG AVA Results

Case SE

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 135 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| Q1 | 0.28 | 0.23 | (-0.05) |
| O2 | 0.32 | 0.23 | (-0.09) |
| O3 | 0.41 | 0.29 | (-0.12) |
| O4 | 0.30 | 0.21 | (-0.09) |
| O5 | 0.35 | 0.26 | (-0.09) |
| O6 | 0.29 | 0.22 | (-0.07) |
| O7 | 0.47 | 0.36 | (-0.11) |
| O8 | 0.41 | 0.32 | (-0.09) |
| O9 | 0.45 | 0.33 | (-0.12) |
| O10 | 0.23 | 0.23 | 0.00 |
| O11 | 0.45 | 0.35 | (-0.1) |
| O12 | 0.18 | 0.07 | (-0.11) |
| O13 | 0.16 | 0.19 | 0.03 |
| O14 | 0.49 | 0.38 | (-0.11) |
| O15 | 0.21 | 0.21 | 0.00 |
| O16 | 0.30 | 0.23 | (-0.07) |
| O17 | 0.42 | 0.26 | (-0.16) |
| O18 | 0.18 | 0.17 | (-0.01) |
| O19 | 0.08 | 0.06 | (-0.02) |
| O20 | 0.11 | 0.11 | 0.00 |
| O21 | 0.38 | 0.24 | (-0.14) |
| O22 | 0.47 | 0.19 | (-0.28) |
| O23 | 0.18 | 0.08 | (-0.1) |
| O24 | 0.11 | 0.09 | (-0.02) |
| O25 | 0.33 | 0.32 | (-0.01) |
| O26 | 0.37 | 0.29 | (-0.08) |
| O27 | 0.44 | 0.35 | (-0.09) |
| O28 | 0.46 | 0.38 | (-0.08) |
| O29 | 0.46 | 0.37 | (-0.09) |
| O30 | 0.31 | 0.25 | (-0.06) |

| | | | |
|---|---|---|---|
| O31 | 0.38 | 0.30 | (-0.08) |
| O32 | 0.50 | 0.37 | (-0.13) |
| O33 | 0.41 | 0.33 | (-0.08) |
| O34 | 0.54 | 0.41 | (-0.13) |
| O35 | 0.38 | 0.29 | (-0.09) |
| O36 | 0.52 | 0.39 | (-0.13) |
| O37 | 0.24 | 0.33 | 0.09 |
| O38 | 0.19 | 0.06 | (-0.13) |
| O39 | 0.24 | 0.07 | (-0.17) |
| O40 | 0.07 | 0.15 | 0.08 |
| O41 | 0.46 | 0.31 | (-0.15) |
| O42 | 0.45 | 0.31 | (-0.14) |
| O43 | 0.45 | 0.32 | (-0.13) |
| O44 | 0.35 | 0.28 | (-0.07) |
| O45 | 0.46 | 0.38 | (-0.08) |
| O46 | 0.29 | 0.26 | (-0.03) |
| O47 | 0.28 | 0.14 | (-0.14) |
| O48 | 0.29 | 0.18 | (-0.11) |
| O49 | 0.40 | 0.17 | (-0.23) |
| O50 | 0.45 | 0.30 | (-0.15) |
| | | **Average:** | (-0.087) |
| P51 | 0.36 | 0.21 | (-0.15) |
| P52 | 0.55 | 0.35 | (-0.20) |
| P53 | 0.50 | 0.33 | (-0.17) |
| P54 | 0.35 | 0.26 | (-0.09) |
| P55 | 0.37 | 0.23 | (-0.14) |
| P56 | 0.34 | 0.27 | (-0.07) |
| P57 | 0.39 | 0.35 | (-0.04) |
| P58 | 0.23 | 0.19 | (-0.04) |
| P59 | 0.26 | 0.22 | (-0.04) |
| P60 | 0.29 | 0.23 | (-0.06) |
| P61 | 0.30 | 0.22 | (-0.08) |
| P62 | 0.31 | 0.22 | (-0.09) |
| P63 | 0.34 | 0.24 | (-0.10) |
| P64 | 0.37 | 0.27 | (-0.10) |
| P65 | 0.41 | 0.29 | (-0.12) |

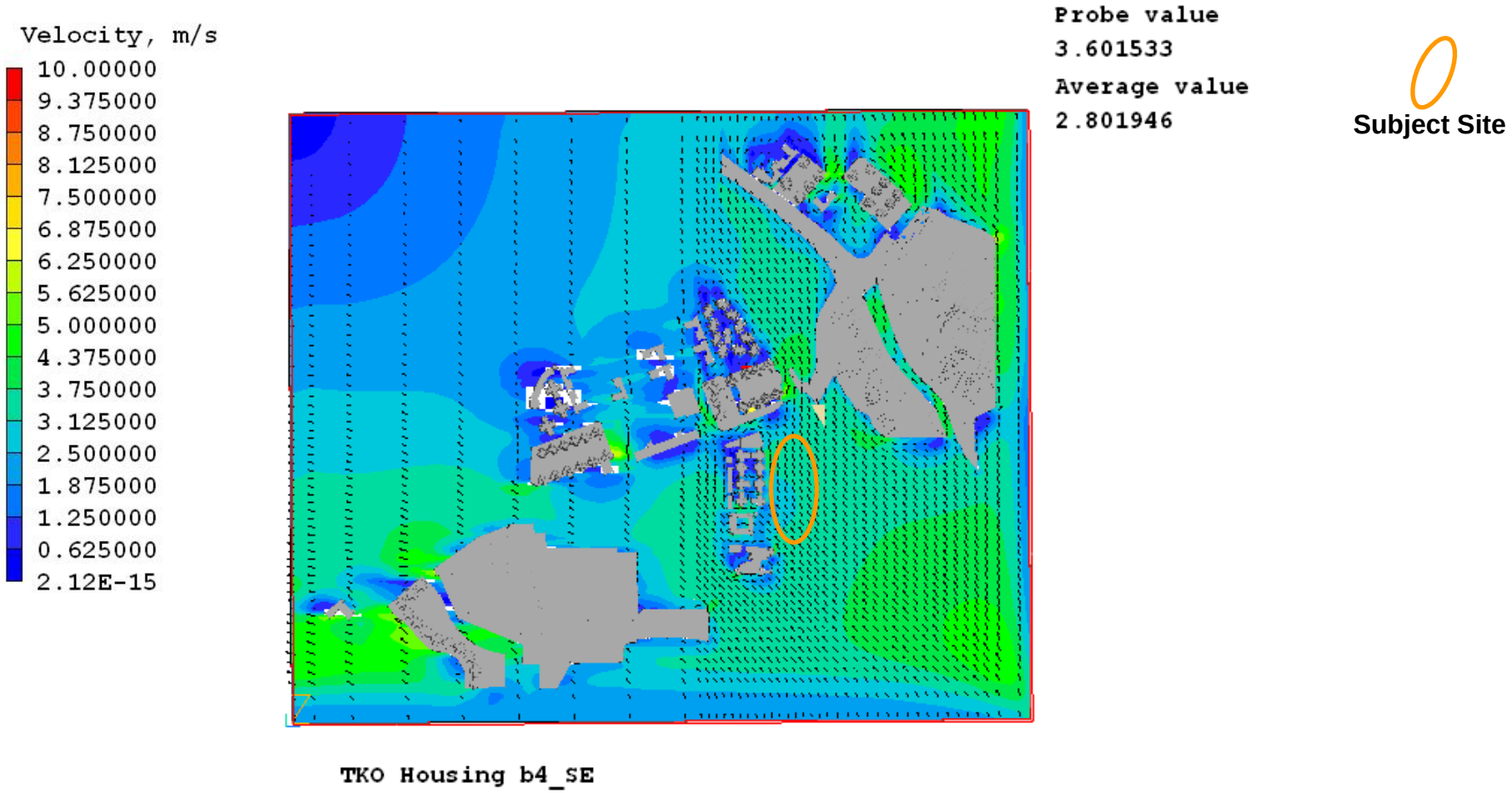
| | | | |
|---|---|---|---|
| P66 | 0.41 | 0.28 | (-0.13) |
| P67 | 0.41 | 0.27 | (-0.14) |
| P68 | 0.41 | 0.25 | (-0.16) |
| P69 | 0.40 | 0.23 | (-0.17) |
| P70 | 0.40 | 0.19 | (-0.21) |
| P71 | 0.40 | 0.16 | (-0.24) |
| P72 | 0.40 | 0.18 | (-0.22) |
| P73 | 0.41 | 0.32 | (-0.09) |
| P74 | 0.42 | 0.39 | (-0.03) |
| P75 | 0.42 | 0.33 | (-0.09) |
| P76 | 0.43 | 0.32 | (-0.11) |
| P77 | 0.44 | 0.40 | (-0.04) |
| P78 | 0.44 | 0.39 | (-0.05) |
| P80 | 0.00 | 0.00 | 0.00 |
| P81 | 0.45 | 0.40 | (-0.05) |
| P82 | 0.44 | 0.42 | (-0.02) |
| P83 | 0.44 | 0.11 | (-0.33) |
| | | **Average** | **(-0.112)** |
| | | **Overall average** | **(-0.096)** |

***Remark***

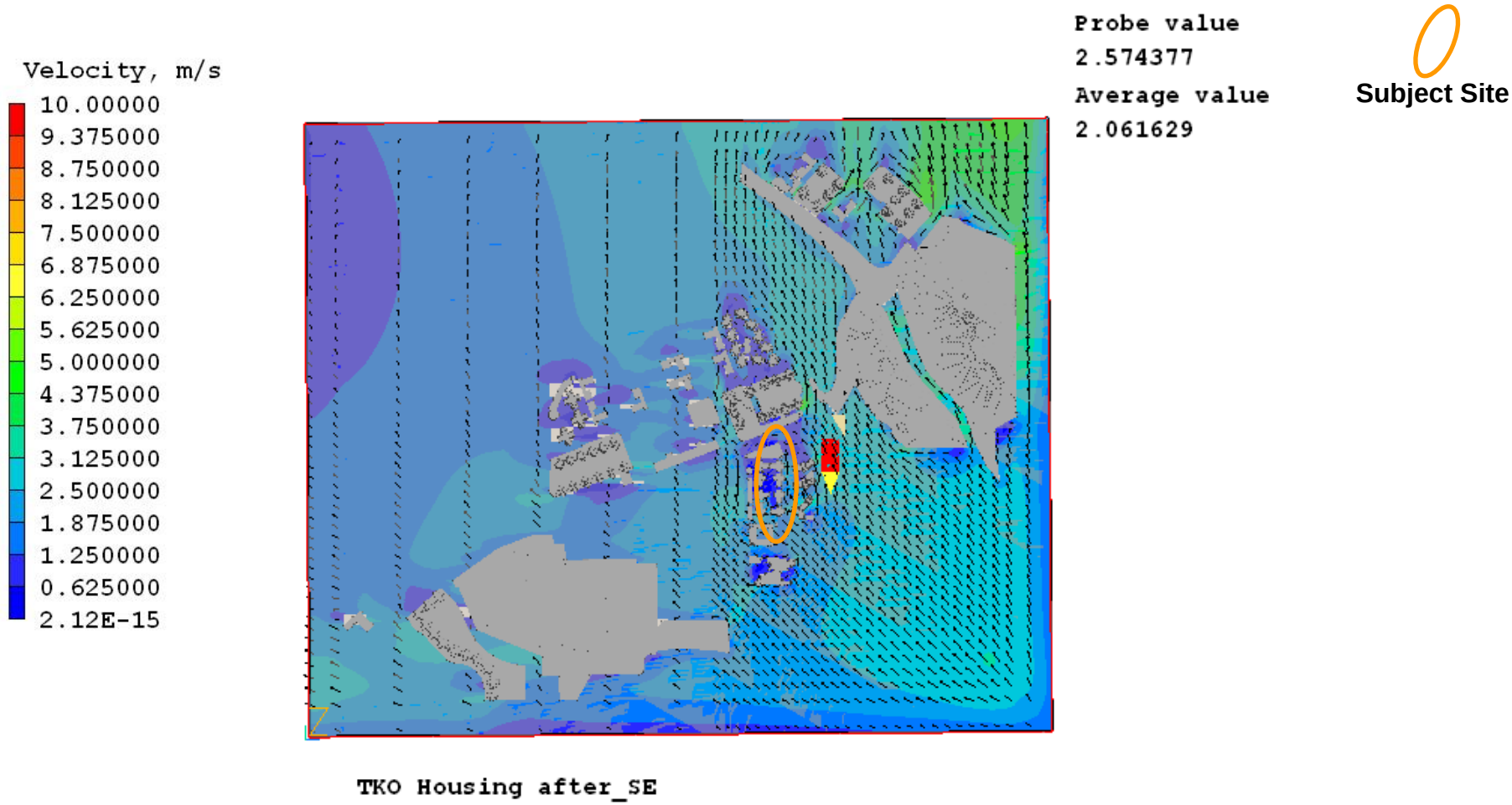
*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")



## KTSPC&KTRG AVA Results

Case SW

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 225 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| O1 | 0.33 | 0.28 | (-0.05) |
| O2 | 0.29 | 0.23 | (-0.06) |
| O3 | 0.27 | 0.24 | (-0.03) |
| O4 | 0.38 | 0.29 | (-0.09) |
| O5 | 0.26 | 0.22 | (-0.04) |
| O6 | 0.28 | 0.25 | (-0.03) |
| O7 | 0.27 | 0.23 | (-0.04) |
| O8 | 0.20 | 0.17 | (-0.03) |
| O9 | 0.29 | 0.25 | (-0.04) |
| O10 | 0.20 | 0.17 | (-0.03) |
| O11 | 0.28 | 0.24 | (-0.04) |
| O12 | 0.20 | 0.10 | (-0.10) |
| O13 | 0.22 | 0.24 | 0.02 |
| O14 | 0.20 | 0.19 | (-0.01) |
| O15 | 0.40 | 0.31 | (-0.09) |
| O16 | 0.19 | 0.08 | (-0.11) |
| O17 | 0.06 | 0.10 | 0.04 |
| O18 | 0.29 | 0.28 | (-0.01) |
| O19 | 0.35 | 0.22 | (-0.13) |
| O20 | 0.45 | 0.37 | (-0.08) |
| O21 | 0.26 | 0.26 | 0.00 |
| O22 | 0.29 | 0.13 | (-0.16) |
| O23 | 0.24 | 0.12 | (-0.12) |
| O24 | 0.29 | 0.27 | (-0.02) |
| O25 | 0.28 | 0.32 | 0.04 |
| O26 | 0.28 | 0.24 | (-0.04) |
| O27 | 0.27 | 0.23 | (-0.04) |
| O28 | 0.27 | 0.22 | (-0.05) |
| O29 | 0.30 | 0.25 | (-0.05) |
| O30 | 0.31 | 0.29 | (-0.02) |

| | | | |
|---|---|---|---|
| O31 | 0.21 | 0.16 | (-0.05) |
| O32 | 0.03 | 0.10 | 0.07 |
| O33 | 0.29 | 0.25 | (-0.04) |
| O34 | 0.08 | 0.21 | 0.13 |
| O35 | 0.33 | 0.28 | (-0.05) |
| O36 | 0.21 | 0.26 | 0.05 |
| O37 | 0.10 | 0.21 | 0.11 |
| O38 | 0.32 | 0.26 | (-0.06) |
| O39 | 0.19 | 0.06 | (-0.13) |
| O40 | 0.08 | 0.21 | 0.13 |
| O41 | 0.36 | 0.32 | (-0.04) |
| O42 | 0.30 | 0.28 | (-0.02) |
| O43 | 0.23 | 0.23 | 0 |
| O44 | 0.31 | 0.28 | (-0.03) |
| O45 | 0.28 | 0.22 | (-0.06) |
| O46 | 0.16 | 0.14 | (-0.02) |
| O47 | 0.20 | 0.13 | (-0.07) |
| O48 | 0.36 | 0.28 | (-0.08) |
| O49 | 0.41 | 0.34 | (-0.07) |
| O50 | 0.35 | 0.32 | (-0.03) |
| | | **Average:** | **(-0.033)** |
| P51 | 0.314 | 0.240 | (-0.074) |
| P52 | 0.199 | 0.269 | 0.07 |
| P53 | 0.355 | 0.362 | 0.007 |
| P54 | 0.510 | 0.587 | 0.077 |
| P55 | 0.280 | 0.388 | 0.108 |
| P56 | 0.489 | 0.707 | 0.218 |
| P57 | 0.600 | 0.926 | 0.326 |
| P59 | 0.707 | 0.860 | 0.153 |
| P60 | 0.716 | 0.818 | 0.102 |
| P61 | 0.590 | 0.775 | 0.185 |
| P62 | 0.624 | 0.864 | 0.24 |
| P63 | 0.738 | 0.901 | 0.163 |
| P64 | 0.728 | 0.912 | 0.184 |
| P65 | 0.721 | 0.905 | 0.184 |
| P66 | 0.715 | 0.900 | 0.185 |

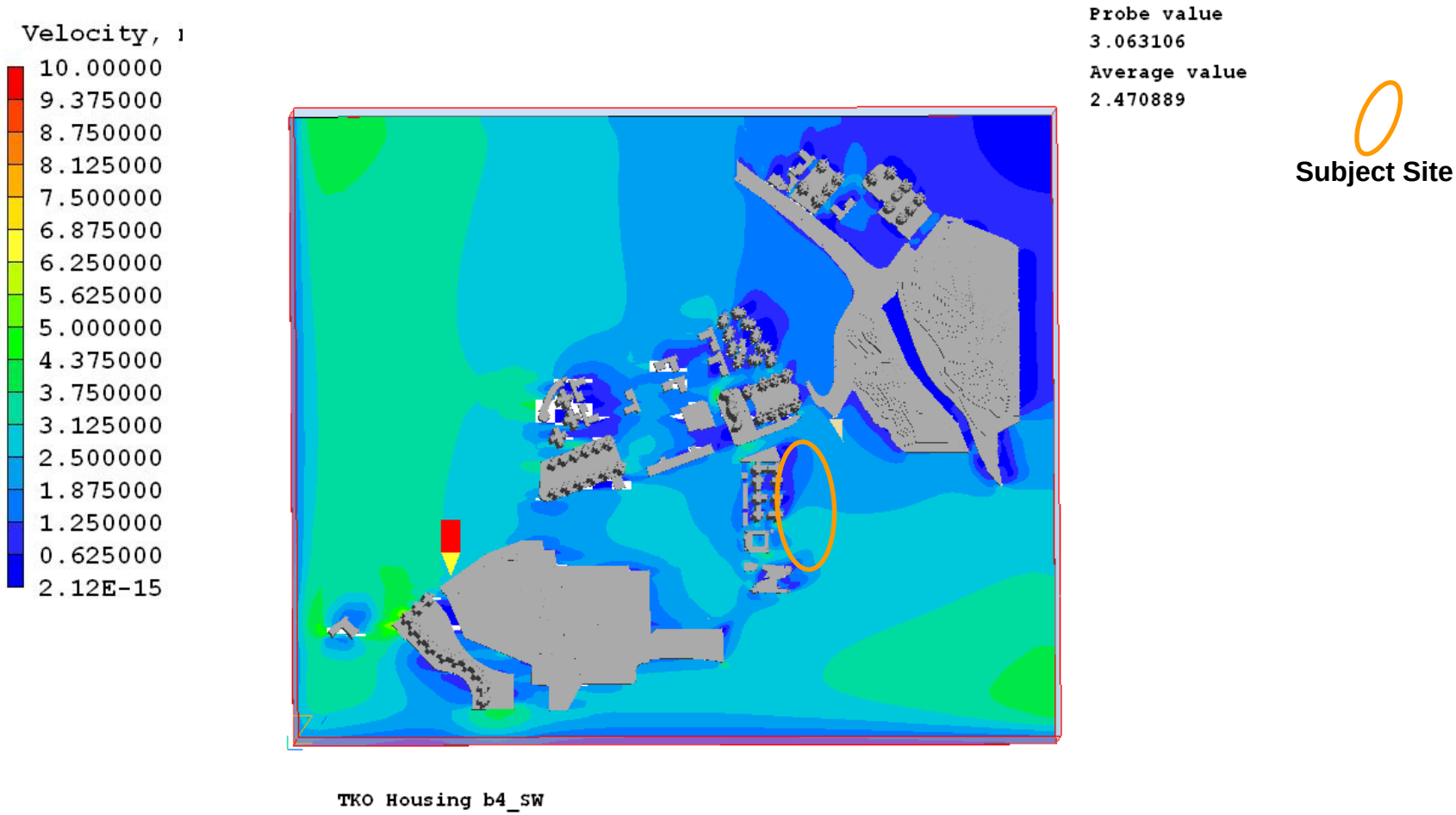
| | | | |
|---|---|---|---|
| P67 | 0.717 | 0.902 | 0.185 |
| P68 | 0.726 | 0.915 | 0.189 |
| P69 | 0.735 | 0.946 | 0.211 |
| P70 | 0.731 | 0.991 | 0.26 |
| P71 | 0.720 | 1.008 | 0.288 |
| P72 | 0.704 | 1.043 | 0.339 |
| P73 | 0.669 | 0.975 | 0.306 |
| P74 | 0.615 | 0.552 | (-0.063) |
| P75 | 0.593 | 0.487 | (-0.106) |
| P76 | 0.560 | 0.403 | (-0.157) |
| P77 | 0.536 | 0.598 | 0.062 |
| P78 | 0.519 | 0.588 | 0.069 |
| P79 | 0.496 | 0.361 | (-0.135) |
| P80 | 0.486 | 0.542 | 0.056 |
| P81 | 0.468 | 0.501 | 0.033 |
| P82 | 0.463 | 0.486 | 0.023 |
| P83 | 0.436 | 0.514 | 0.078 |
| | | **Average** | **0.118** |
| | | **Overall average** | **0.042** |

***Remark***

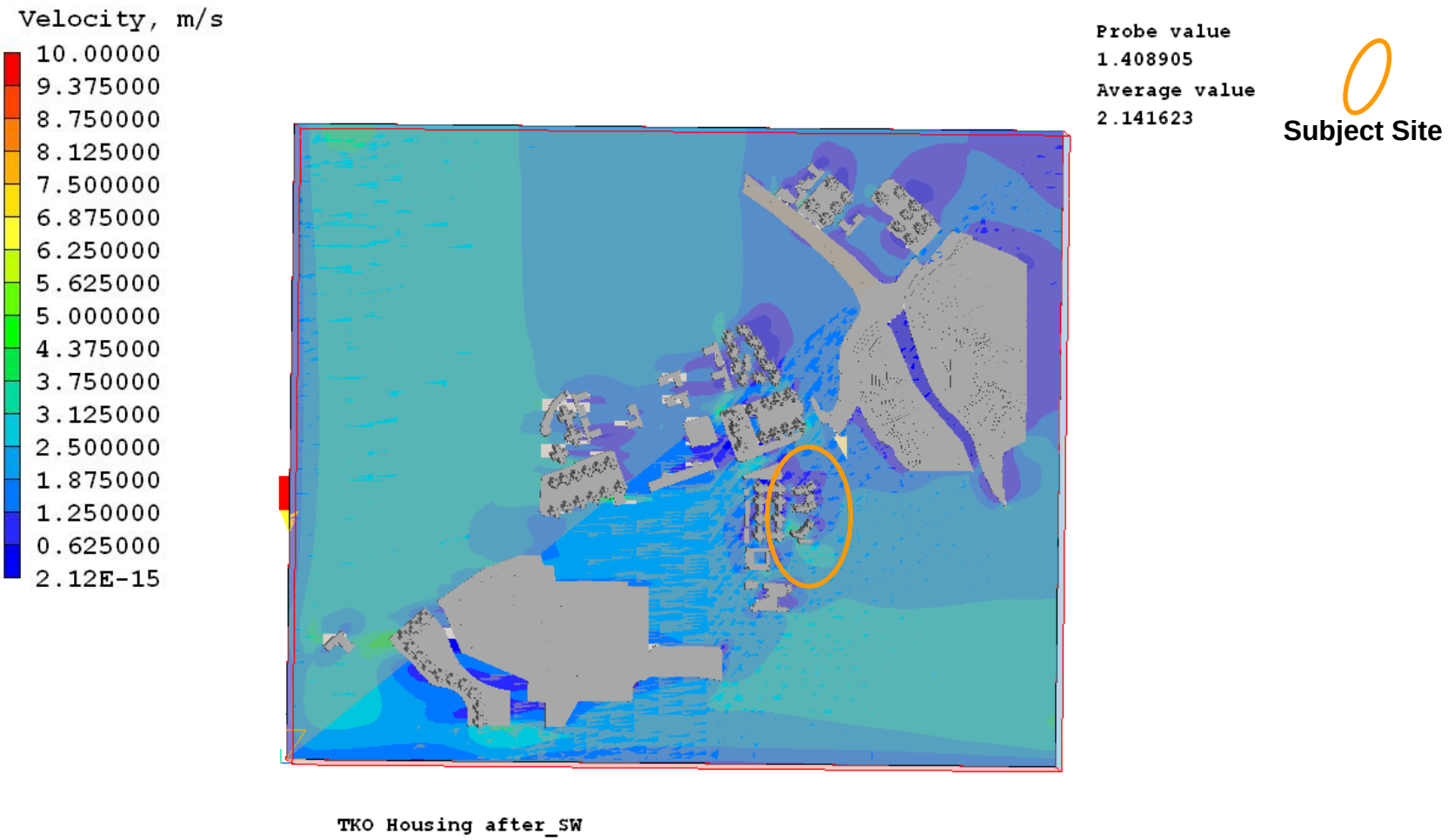
*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")



## KTSPC&KTRG AVA Results

Case SSW

Prevailing wind velocity 7.63 m/s

Prevailing wind direction 202.5 deg

| Test points | VR for "Before" Scenario | VR for "After" Scenario | Different in VR (After - Before) |
|---|---|---|---|
| Q1 | 0.36 | 0.31 | (-0.05) |
| O2 | 0.28 | 0.23 | (-0.05) |
| O3 | 0.28 | 0.24 | (-0.04) |
| O4 | 0.38 | 0.29 | (-0.09) |
| O5 | 0.30 | 0.26 | (-0.04) |
| O6 | 0.30 | 0.27 | (-0.03) |
| O7 | 0.32 | 0.28 | (-0.04) |
| O8 | 0.23 | 0.21 | (-0.02) |
| O9 | 0.33 | 0.29 | (-0.04) |
| O10 | 0.23 | 0.22 | (-0.01) |
| O11 | 0.33 | 0.29 | (-0.04) |
| O12 | 0.21 | 0.12 | (-0.09) |
| O13 | 0.25 | 0.29 | 0.04 |
| O14 | 0.16 | 0.14 | (-0.02) |
| O15 | 0.45 | 0.33 | (-0.12) |
| O16 | 0.20 | 0.09 | (-0.11) |
| O17 | 0.05 | 0.11 | 0.06 |
| O18 | 0.32 | 0.32 | 0.00 |
| O19 | 0.35 | 0.23 | (-0.12) |
| O20 | 0.44 | 0.39 | (-0.05) |
| O21 | 0.24 | 0.26 | 0.02 |
| O22 | 0.28 | 0.12 | (-0.16) |
| O23 | 0.21 | 0.12 | (-0.09) |
| O24 | 0.29 | 0.27 | (-0.02) |
| O25 | 0.30 | 0.35 | 0.05 |
| O26 | 0.30 | 0.24 | (-0.06) |
| O27 | 0.29 | 0.25 | (-0.04) |
| O28 | 0.30 | 0.24 | (-0.06) |
| O29 | 0.33 | 0.29 | (-0.04) |
| O30 | 0.34 | 0.32 | (-0.02) |

| | | | |
|---|---|---|---|
| O31 | 0.24 | 0.19 | (-0.05) |
| O32 | 0.05 | 0.07 | 0.02 |
| O33 | 0.31 | 0.26 | (-0.05) |
| O34 | 0.08 | 0.23 | 0.15 |
| O35 | 0.37 | 0.32 | (-0.05) |
| O36 | 0.24 | 0.29 | 0.05 |
| O37 | 0.11 | 0.23 | 0.12 |
| O38 | 0.29 | 0.26 | (-0.03) |
| O39 | 0.18 | 0.06 | (-0.12) |
| O40 | 0.08 | 0.23 | 0.15 |
| O41 | 0.40 | 0.37 | (-0.03) |
| O42 | 0.31 | 0.30 | (-0.01) |
| O43 | 0.20 | 0.22 | 0.02 |
| O44 | 0.34 | 0.32 | (-0.02) |
| O45 | 0.30 | 0.25 | (-0.05) |
| O46 | 0.19 | 0.19 | 0 |
| O47 | 0.17 | 0.13 | (-0.04) |
| O48 | 0.36 | 0.28 | (-0.08) |
| O49 | 0.41 | 0.34 | (-0.07) |
| O50 | 0.37 | 0.35 | (-0.02) |
| | | **Average:** | **(-0.029)** |
| P51 | 0.08 | 0.10 | 0.02 |
| P52 | 0.13 | 0.20 | 0.07 |
| P53 | 0.11 | 0.13 | 0.02 |
| P54 | 0.14 | 0.20 | 0.06 |
| P55 | 0.08 | 0.32 | 0.24 |
| P56 | 0.17 | 0.42 | 0.25 |
| P57 | 0.22 | 0.40 | 0.18 |
| P58 | 0.50 | 0.34 | (-0.16) |
| P59 | 0.34 | 0.23 | (-0.11) |
| P60 | 0.23 | 0.16 | (-0.07) |
| P61 | 0.26 | 0.19 | (-0.07) |
| P62 | 0.38 | 0.29 | (-0.09) |
| P63 | 0.37 | 0.28 | (-0.09) |
| P64 | 0.35 | 0.28 | (-0.07) |
| P65 | 0.34 | 0.30 | (-0.04) |

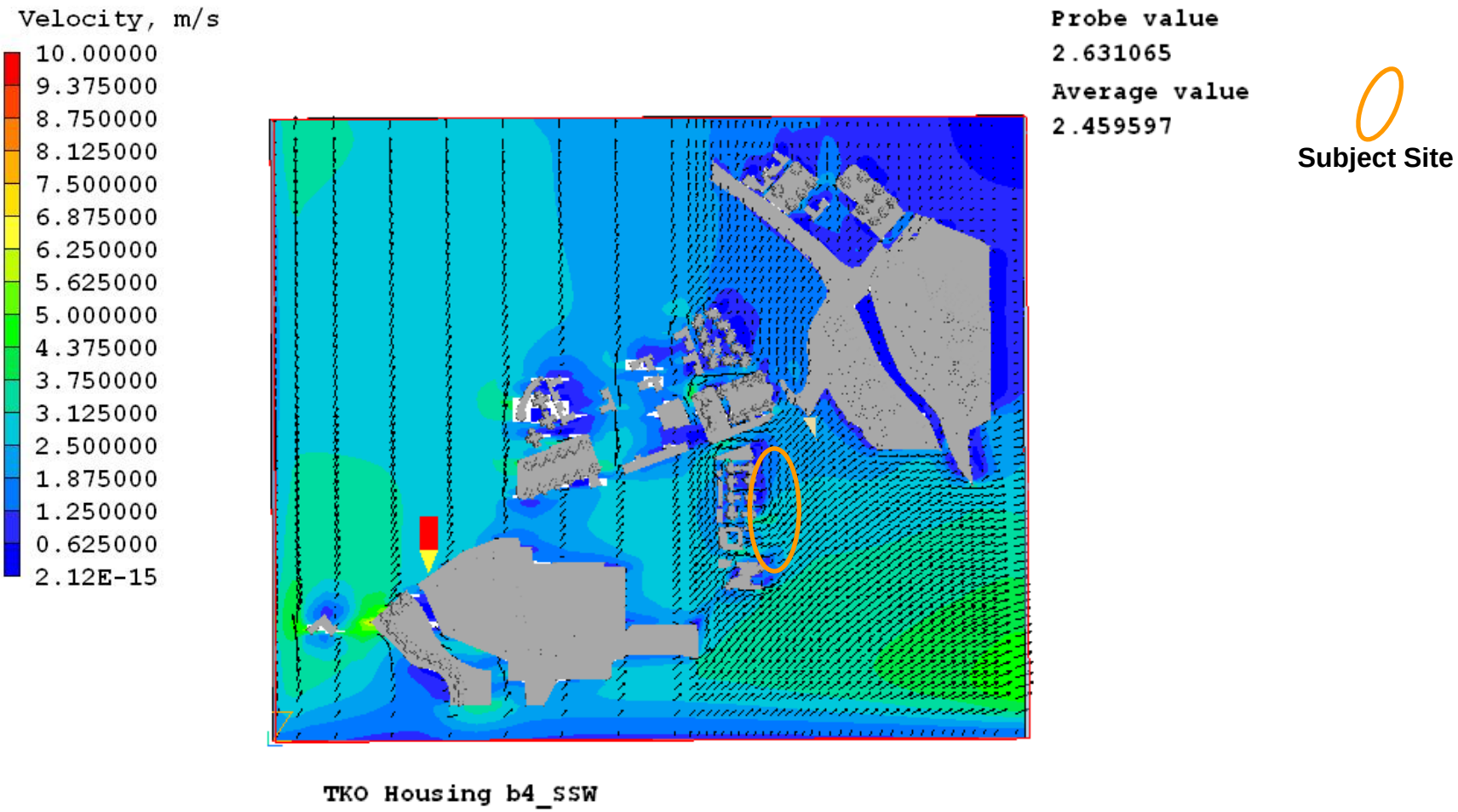
| | | | |
|---|---|---|---|
| P66 | 0.34 | 0.31 | (-0.03) |
| P67 | 0.34 | 0.33 | (-0.01) |
| P68 | 0.36 | 0.36 | 0.00 |
| P69 | 0.38 | 0.38 | 0.00 |
| P70 | 0.39 | 0.40 | 0.01 |
| P71 | 0.40 | 0.37 | (-0.03) |
| P72 | 0.40 | 0.19 | (-0.21) |
| P73 | 0.39 | 0.22 | (-0.17) |
| P74 | 0.37 | 0.17 | (-0.20) |
| P75 | 0.35 | 0.17 | (-0.18) |
| P76 | 0.33 | 0.20 | (-0.13) |
| P77 | 0.31 | 0.16 | (-0.15) |
| P78 | 0.31 | 0.17 | (-0.14) |
| P80 | 0.00 | 0.00 | 0.00 |
| P81 | 0.29 | 0.18 | (-0.11) |
| P82 | 0.27 | 0.08 | (-0.19) |
| P83 | 0.23 | 0.12 | (-0.11) |
| | | **Average** | **(-0.047)** |
| | | **Overall average** | **(-0.038)** |

***Remark***

*1) Test points in bracket show reduced VR in the improved development scheme*

*2) All results are rounded-up to 2 decimal places*

## Plate 1 Wind Velocity Contour Diagram at Pedestrian Level ("Before Scenario")



## Plate 2 Wind Velocity Contour Diagram at Pedestrian Level ("After Scenario")