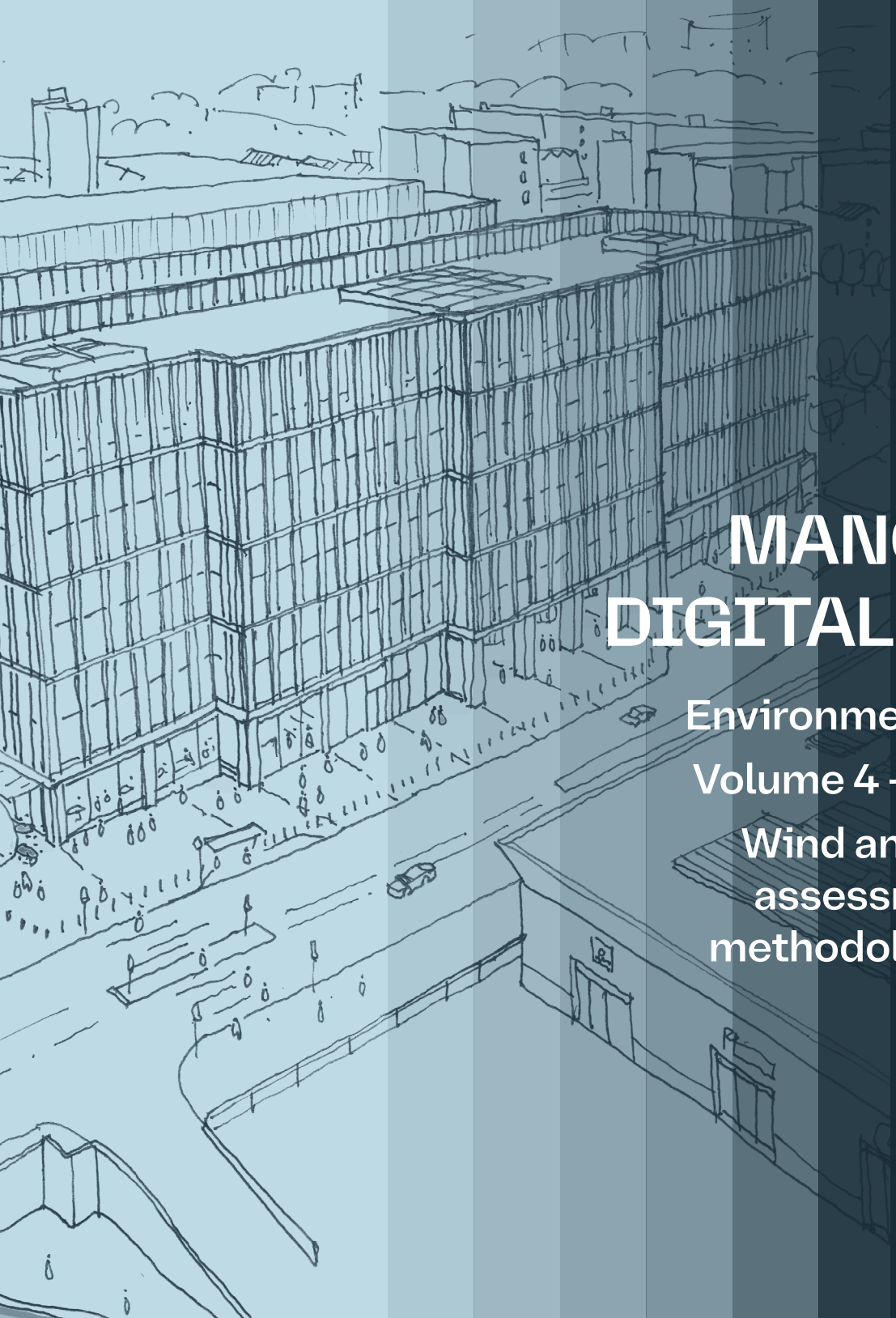
Government Property Agency

AtkinsRéalis



MANCHESTER DIGITAL CAMPUS

Environmental Statement

Volume 4 - Appendix 20.1: Wind and Microclimate assessment modelling methodology and results

NOVEMBER 2024

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This document has 15 pages including the cover.

Document history

Document title: Environmental Statement Volume 4 - Appendix 20.1 Wind and Microclimate Report

Document reference: MDCX-ATR-XX-XX-RP-Z-000051

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Planning submission	MB	IL	AS	TC	25/11/2024

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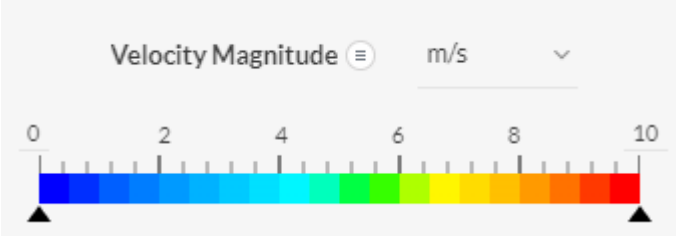
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Appendix A. Single Wind Direction Scenario

A.1. Existing Scenario



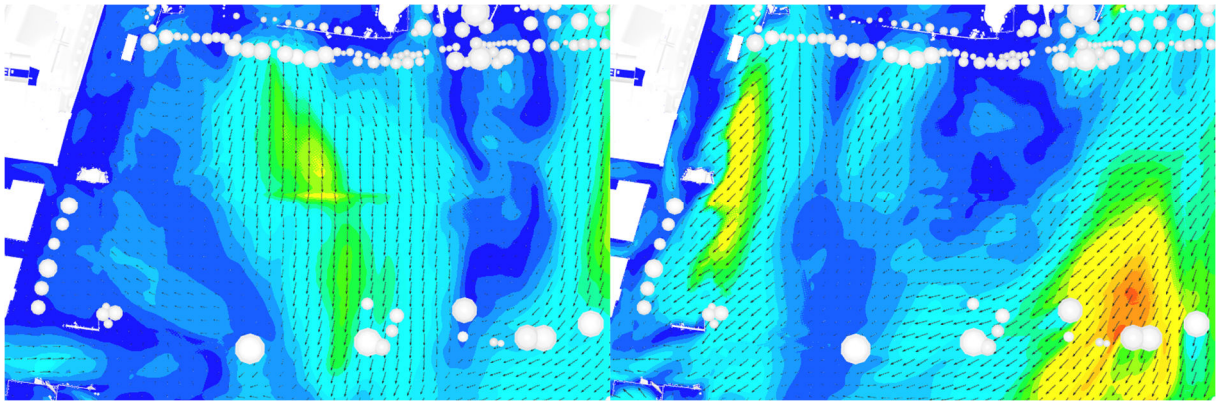


Figure A1-1 – Existing Phase, wind speed contours for direction 0º (Left) and 22.5º (Right)

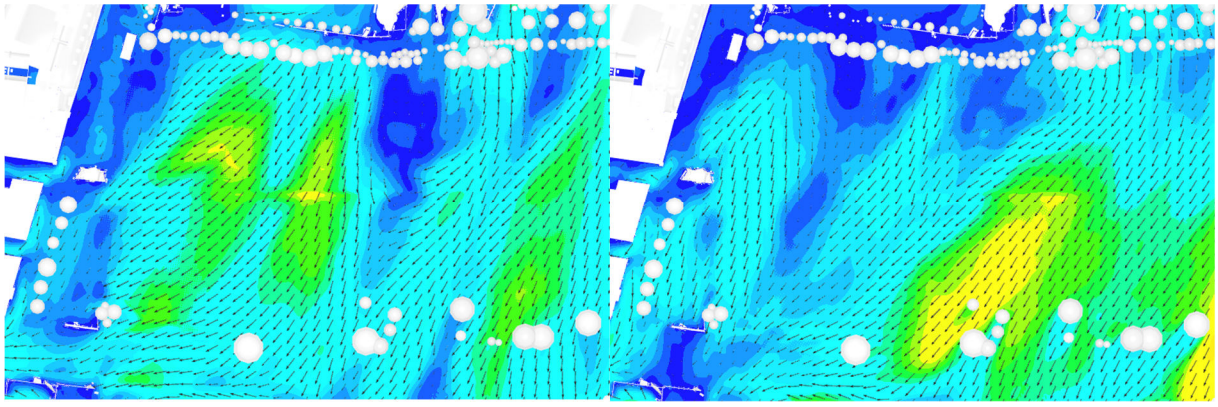


Figure A1-2 - Existing Phase, wind speed contours for direction 45º (Left) and 67.5º (Right)

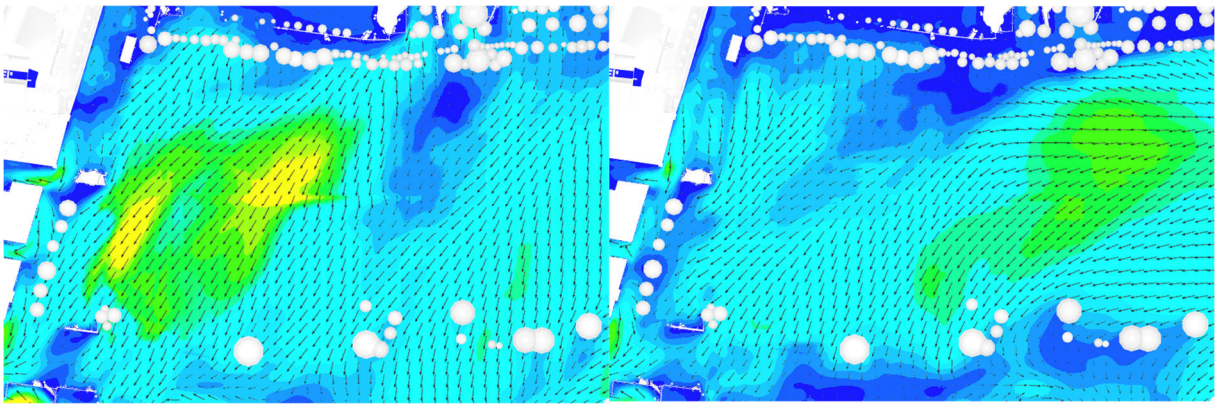


Figure A1-3 - Existing Phase, wind speed contours for direction 90º (Left) and 112.5º (Right)

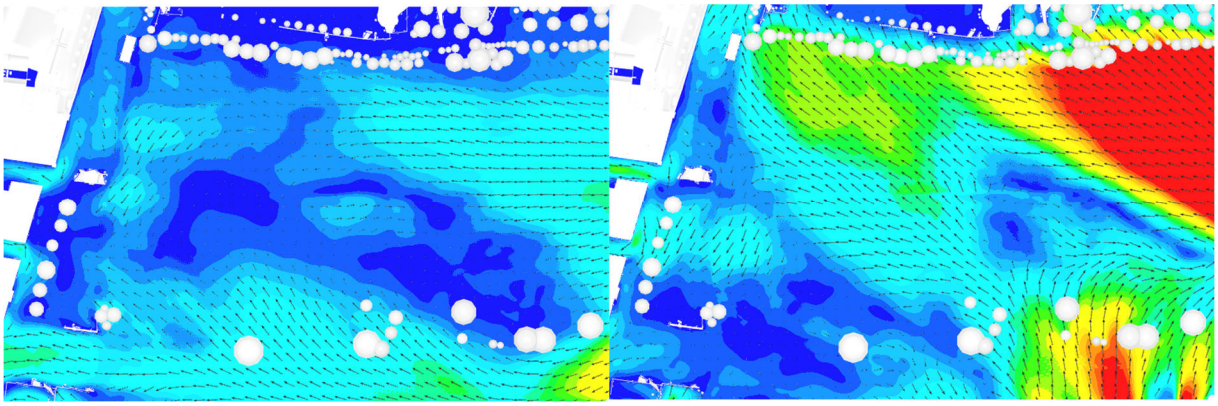


Figure A1-4 - Existing Phase, wind speed contours for direction 135º (Left) and 157.5º (Right)

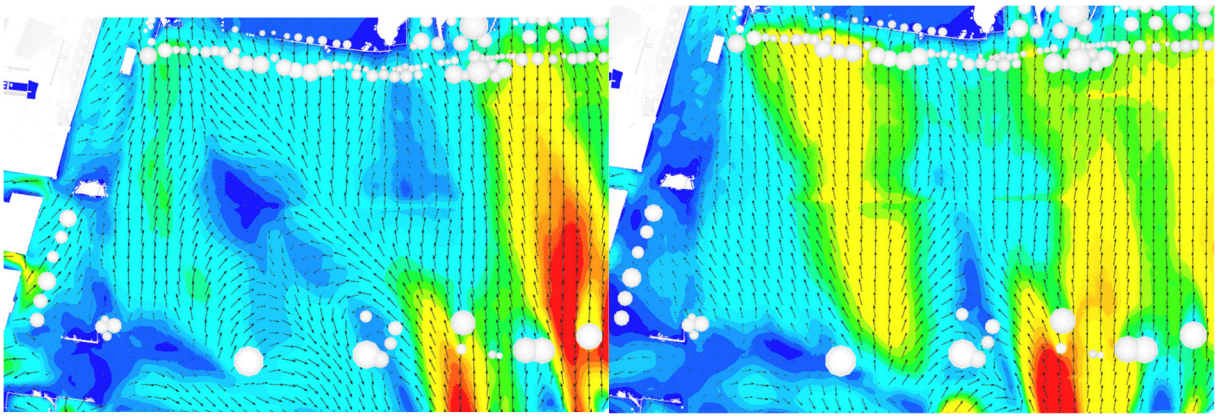


Figure A1-5 - Existing Phase, wind speed contours for direction 180º (Left) and 202.5º (Right)

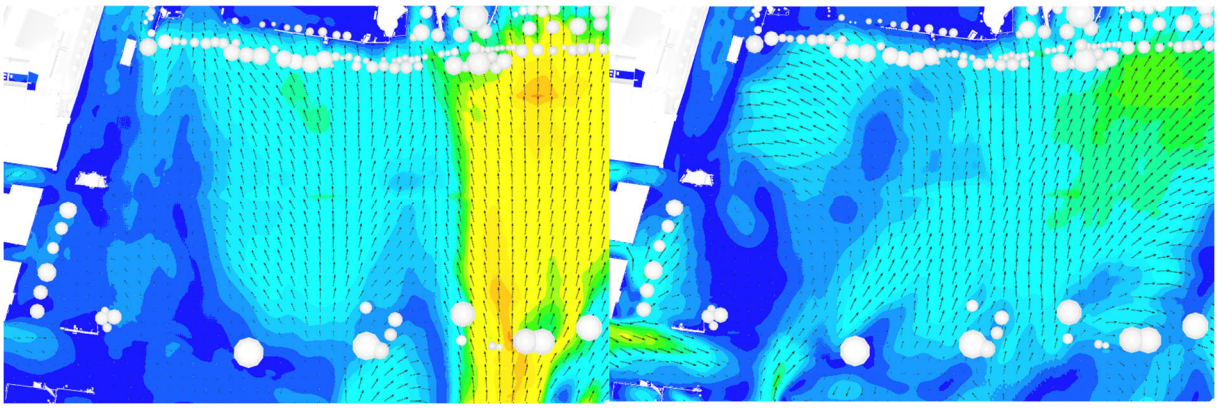


Figure A1-6 - Existing Phase, wind speed contours for direction 225º (Left) and 247.5º (Right)

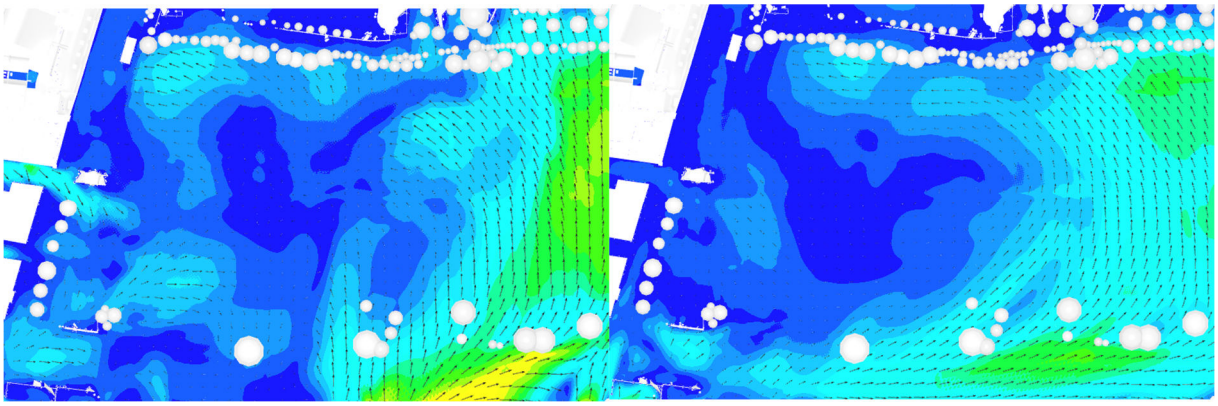


Figure A1-7 – Existing Phase, wind speed contours for direction 270º (Left) and 292.5º (Right)

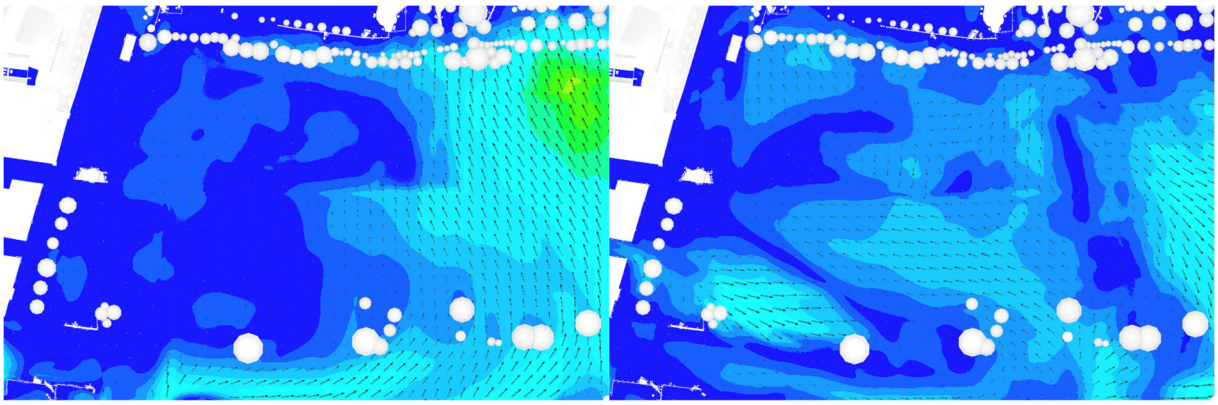


Figure A1-8 - Existing Phase, wind speed contours for direction 315º (Left) and 337.5º (Right)

A.2. Proposed Scenario

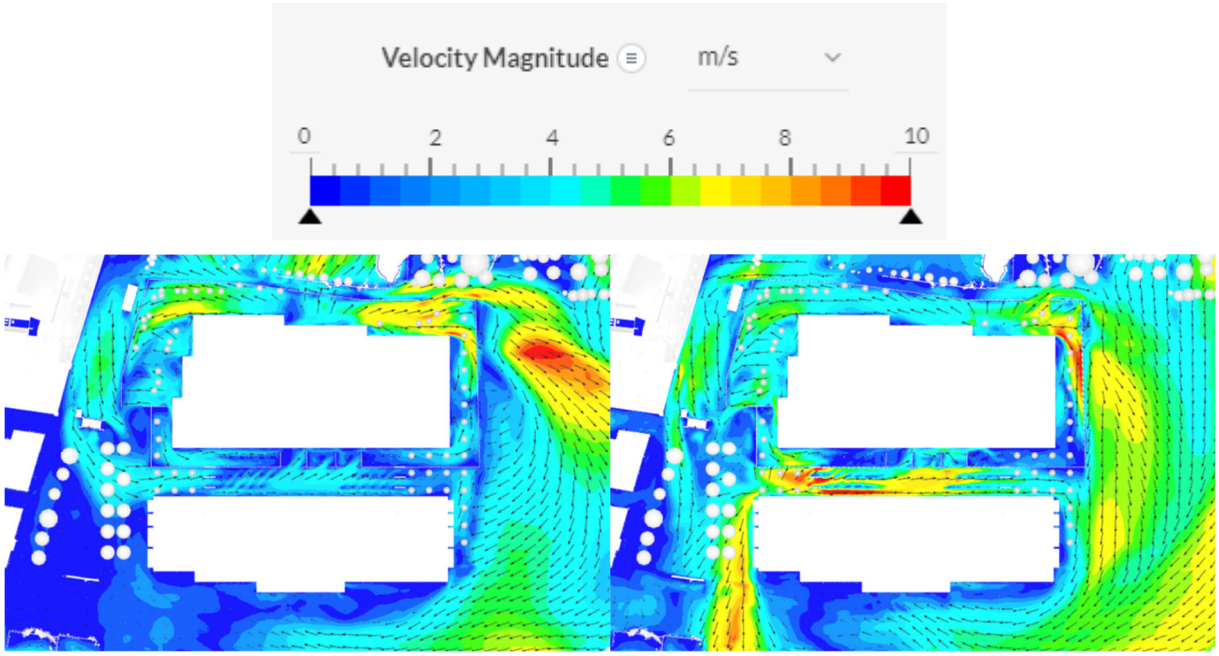


Figure A2-1 – Phase 1, wind speed contours for direction 0º (Left) and 22.5º (Right)

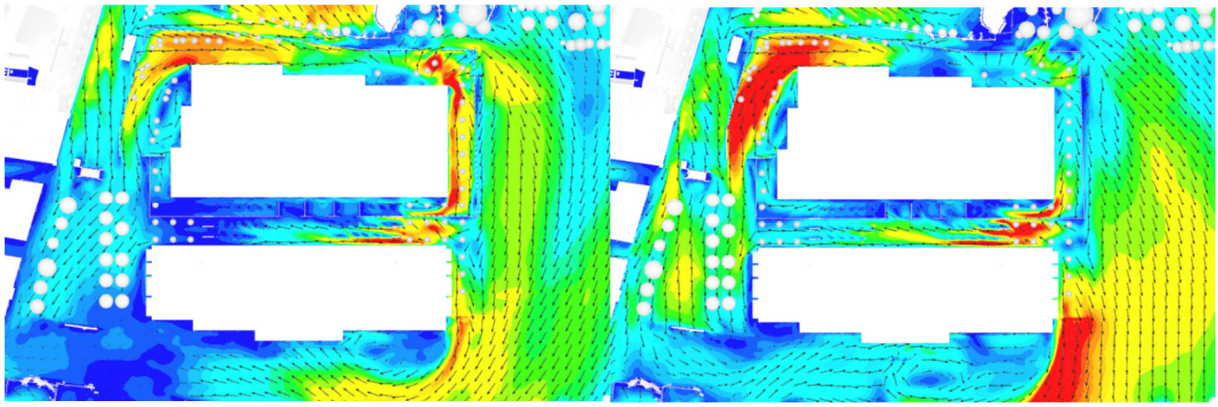


Figure A2-2 – Phase 1, wind speed contours for direction 45º (Left) and 67.5º (Right)

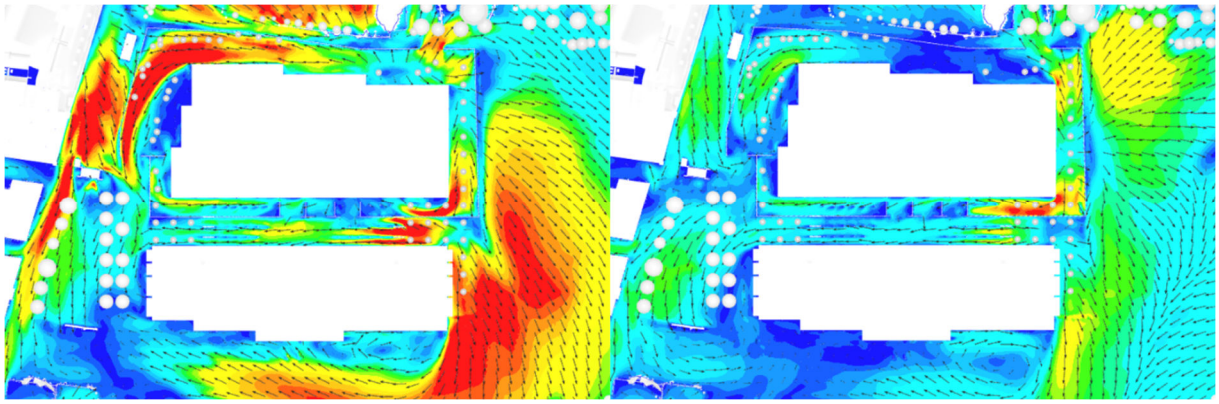


Figure A2-3 – Phase1, wind speed contours for direction 90º (Left) and 112.5º (Right)

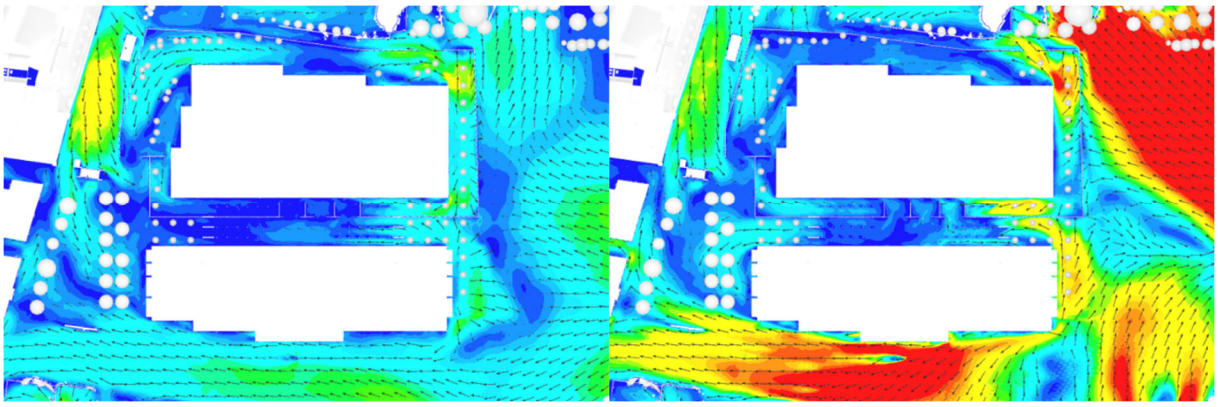


Figure A2-4 – Phase1, wind speed contours for direction 135º (Left) and 157.5º (Right)

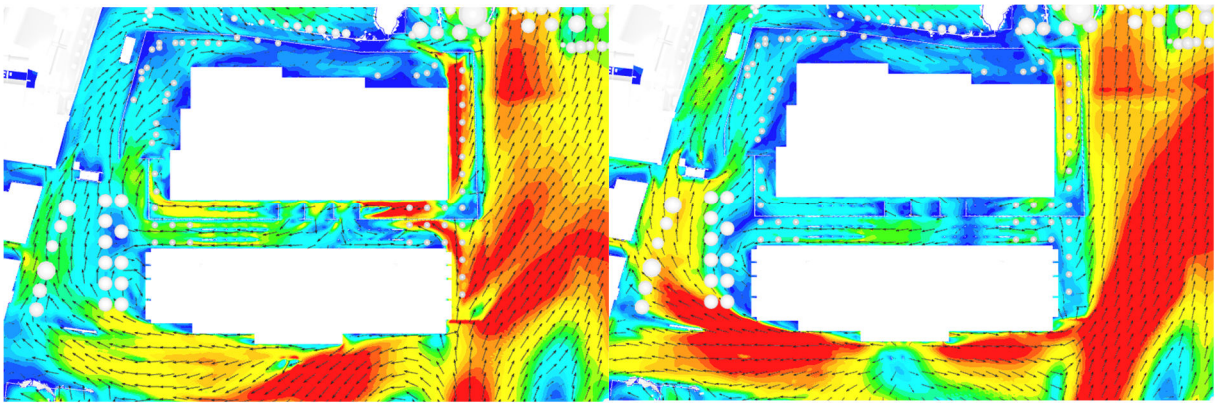


Figure A2-5 – Phase1, wind speed contours for direction 180º (Left) and 202.5º (Right)

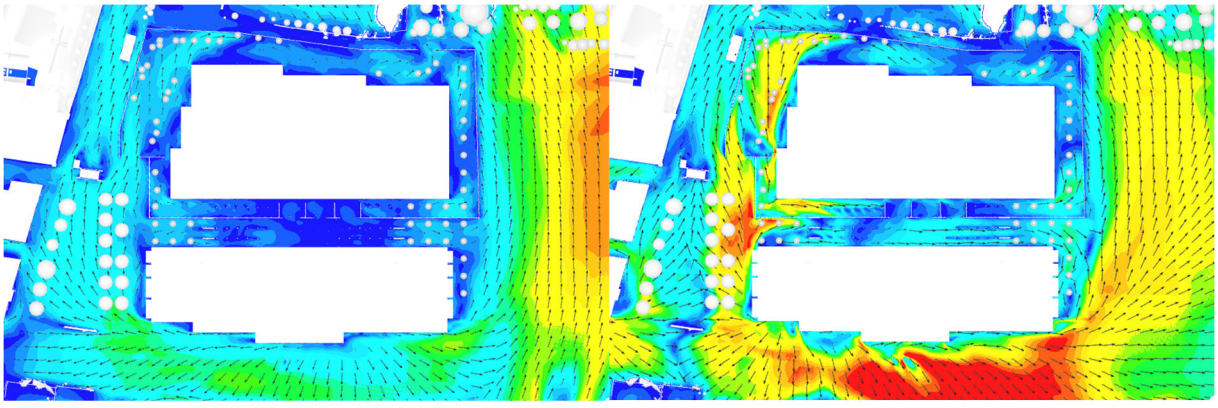


Figure A2-6 – Phase1, wind speed contours for direction 225º (Left) and 247.5º (Right)

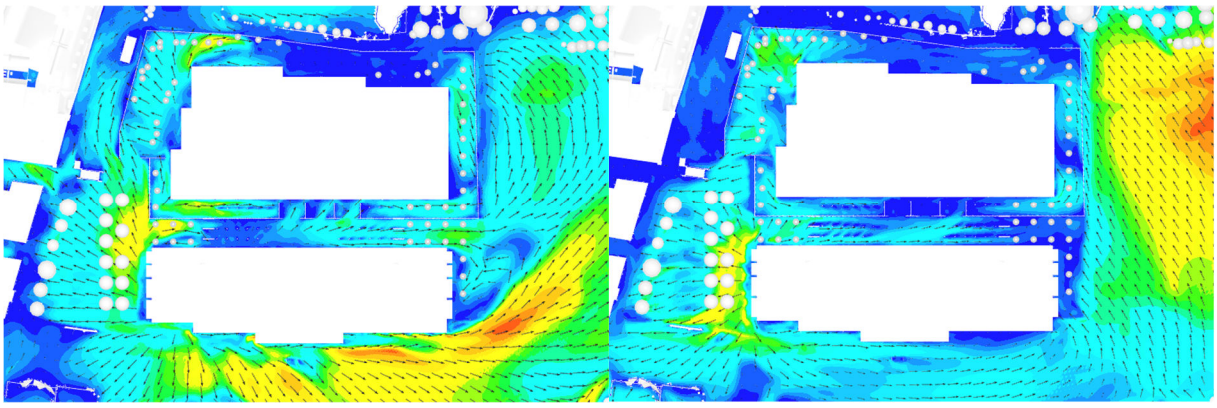


Figure A2-7 – Phase1, wind speed contours for direction 270º (Left) and 292.5º (Right)

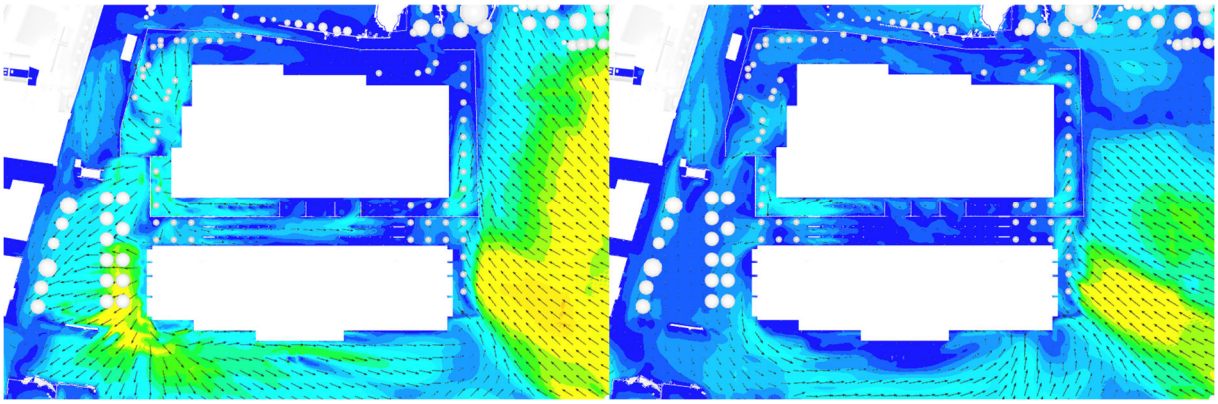


Figure A2-8 – Phase1, wind speed contours for direction 315º (Left) and 337.5º (Right)

Appendix B. CFD Inputs and Assumptions

B.1 - Computational Domain, Mesh and Region of Interest

B.1.1. Computational Domain

The computational domain represents the wind tunnel in which the wind simulation is performed. A rectangular domain was used for the analysis and its dimensions are reported below.

$$h = 155.4m$$

$$H, S, I = 3h = 240m$$

$$O = 9h = 600m$$

Therefore, the total wind tunnel dimensions are (L*W*H): 2130(m)*1680(m)*513(m)

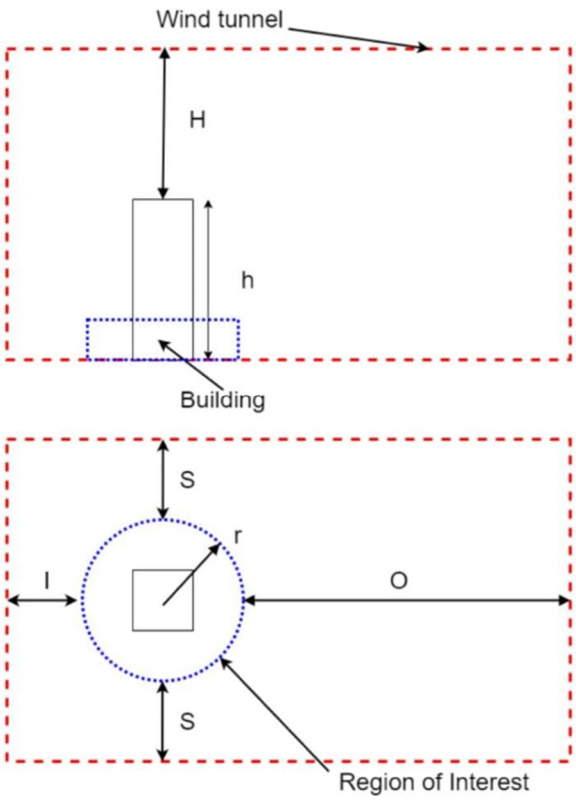


Figure B1-1- Computational Domain dimensions

B.1.2. Mesh

The mesh used by the software for the purpose of this assessment is based on the LBM, which consists of a cartesian background mesh composed only of cube elements that are not necessarily aligned with the geometry of the buildings or the terrain. To consider the exact geometry, a sub-grid model is generated and accounts for the interfaces between

the geometry and the fluid domains. The surface areas identified for analysis are divided in a 0.78 m grid, aligned to the human scale. The identified surfaces are prepared, and the analysis surface is offset to 1.5 m height to assess PWC.

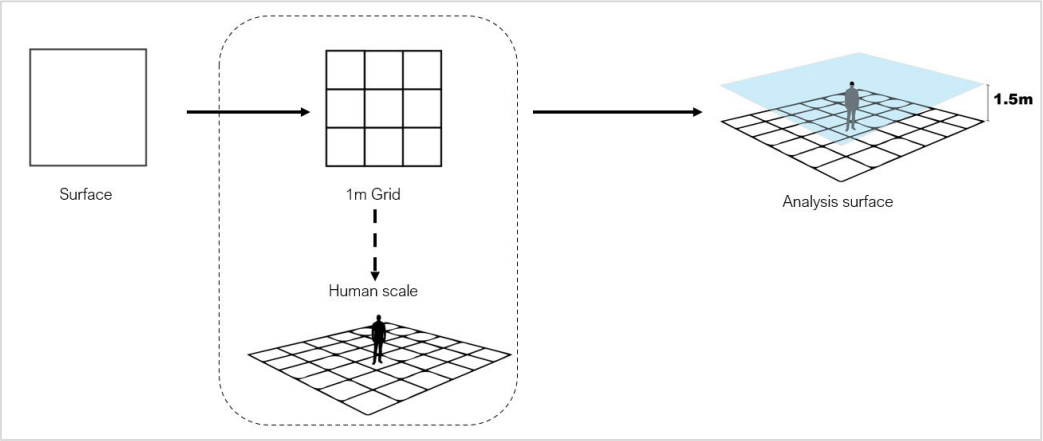


Figure B1-2 - Simulation grid generation

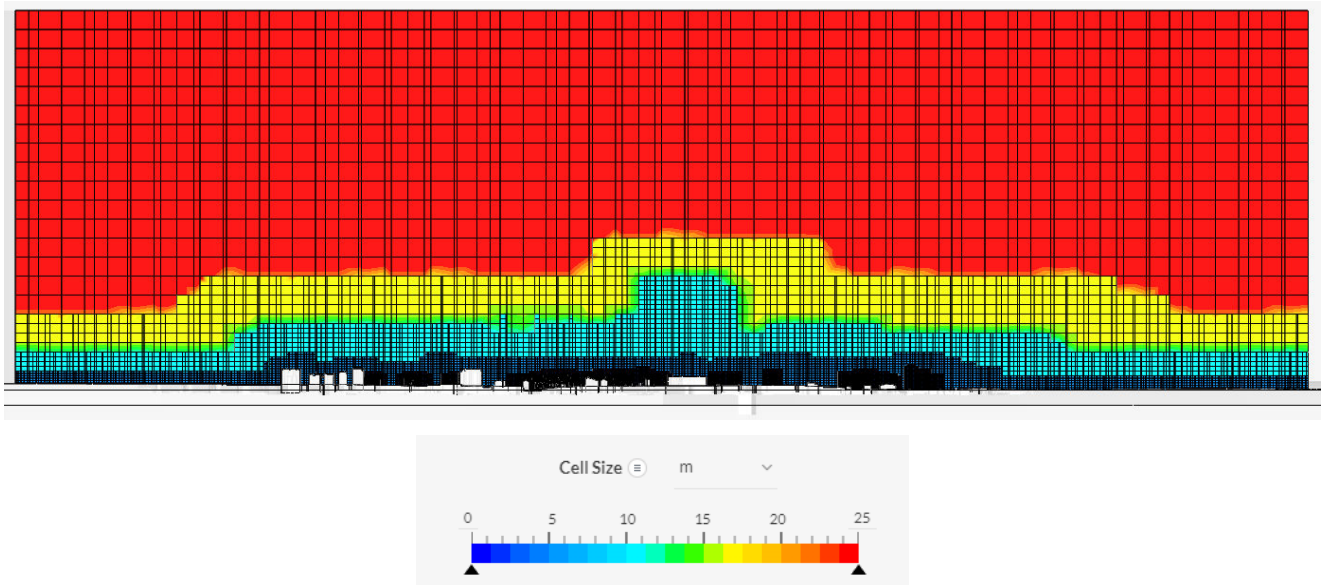


Figure B1-3 - Domain Mesh

Simulation Phase	Min Cell Size (m)	Max Cell Size (m)	Total Number of cells
Existing Phase	0.47	30	48 181 696
Proposed Scenario	0.47	30	49 346 368

B.1.3 Region of interest

The area of interest indicates the area or the domain around the main building or region over which the PWC has been evaluated. This area is specified in the form of a disk, with a radius of 240 m.

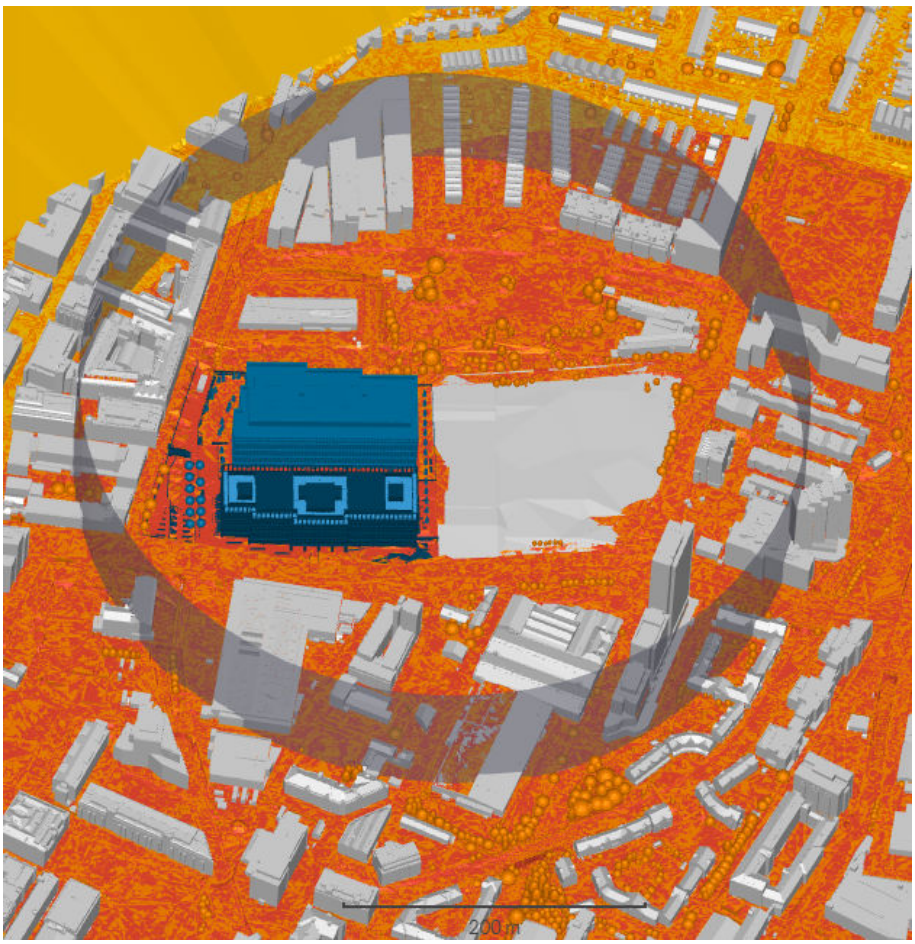


Figure B1-4 Region of interest

The Ground height (z) defines the level at which the floor of the wind tunnel is placed, this has been assumed to be 0 m as no significant difference in altitude is present on the Site.

B.2 - Boundary Conditions and Wind Profile

In wind analyses, the effect of wind over the model with respect to multiple wind directions is simulated simultaneously. Wind speed varies with respect to height, and this is called the Atmospheric Boundary Layer (ABL). ABL depends on the height of the obstacles (buildings, trees, terrain, etc.). For the analysis, these conditions need to be defined, which indicate how a system interacts with the environment. These conditions are calculated using two main parameters:

- Wind exposure category
- Surface roughness

Wind exposures control how the wind speeds vary due to the presence of specific terrain characteristics. Different terrains cause different velocity gradient vertical to the ground commonly referred to as the ABL.

A velocity profile and turbulence parameters have been specified at the domain inlet, considering the wind speed increase with increased distance from the ground.

No slip conditions have been used for the surfaces within the model to ensure the air velocity is 0 at the contact with the solid boundary.



For the pedestrian comfort study, a reference velocity at 10 m height has been considered to be 10 m/s.

The boundary layer wind profile used for the simulation is based on the equation below:

$$u = \frac{u^*}{\kappa} \ln\left(\frac{z - d + z_0}{z_0}\right)$$

Suburban Category has been applied to all wind directions, this corresponds to a terrain category III and Roughness length z0= 0.3 as shown in the table below (CIBSE Guide A).

Table 2.21 Terrain categories and related parameters

Terrain category	Description	K_R	z_0 / m	z_{min} / m
I	Rough open sea; lake shore with at least 5 km fetch up-wind and smooth flat country without obstacles	0.17	0.01	2
II	Farm land with boundary hedges, occasional small farm structures, houses or trees	0.19	0.05	4
III	Suburban or industrial areas and permanent forests	0.22	0.3	8
IV	Urban areas in which at least 15% of surface is covered with buildings of average height exceeding 15 m	0.24	1	16

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