WINDTECH

PEDESTRIAN WIND ENVIRONMENT STATEMENT

900 LAKESHORE ROAD WEST, MISSISSAUGA ONTARIO

WI002-02F02(REV0)- WS REPORT

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the 900 Lakeshore Road West development, located in Mississauga Ontario, Canada, on the local wind environment at the critical outdoor areas within and around the subject site. The effect of wind activity has been examined for the predominant wind direction for the region, namely the east-north-easterly and west-north-westerly to south-westerly. Year-round wind conditions, as well as wind conditions during the summer and winter seasons, are considered in this assessment. The analysis of the wind effects relating to the proposed development have been carried out in the context of the local wind climate, building morphology and land topography. This study assesses compliance with the controls for wind comfort and safety as stipulated in the City of Mississauga: Pedestrian Level Wind Studies, Urban Design Terms of Reference Guide, 2023.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the latest architectural drawings. No wind tunnel testing has been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection of the architectural drawings received 15 January 2024. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that the development has incorporated several design features and wind mitigating strategies and is expected to be suitable for the intended use for the majority of the outdoor trafficable areas. However, there are some areas that are likely to be exposed to stronger winds. It is expected that the wind effects identified in the report can be ameliorated with the consideration of the following treatment strategies into the design of the development:

Ground Floor Areas:

- Addition of tree planting on the eastern and southern edges of the site.
- Addition of 1.8m high impermeable privacy screens along the northern aspect, separating the residential unit townhouses.
- Addition of impermeable deflector canopy on the northern façade, above the through-site link, at a height of 3 to 3.2m above the Ground Floor.
- One of the following two options to be considered:
    - Option 1: Inclusion of an impermeable straight-line deflector canopy, to be included along the southern aspect of the development, at 5-5.2m above Ground Floor (along the 2nd Floor slab).
    - Option 2: Inclusion of an impermeable wrap-around deflector canopy, to be included along the southern aspect of the development, at 3-3.2m above Ground Floor.

Private Balconies and Terraces:

- Second Floor Balconies:
    - Addition of a 1.8m high impermeable screen on the eastern corner balcony.

- Third Floor Balconies:
    - Addition of a 1.8m high impermeable screen on the eastern corner balcony.
    - Addition of a 2m high impermeable screen on the south-eastern corner balcony.
- Fourth Floor Balconies/Terrace:
    - Addition of a 1.8m high impermeable screen on the eastern corner balcony.
    - Addition of a 2m high impermeable screen on the south-eastern corner balcony.
    - Addition of 1.8m high impermeable privacy screens separating the exposed residential units along the northern, western and southern aspects of the development.
- Fifth and Sixth Floor Balconies:
    - Addition of a 1.8m high impermeable screen on the eastern corner balcony.
    - Addition of 2m high impermeable screens on both ends of the southern-most balcony.
- Seventh Floor Balconies/Terrace:
    - Addition of a 1.8m high impermeable screen on the eastern corner balcony and eastern terrace corner.
    - Addition of 2m high impermeable screens on the south-eastern corner balcony.
    - Addition of 1.8m high impermeable privacy screens separating the exposed residential units along the northern, western and southern aspects of the development.
    - Inclusion of vertical fins along the north-eastern corner. The depth of the fins are to be at least half of the spacing between two adjacent fins.
    - Inclusion of a baffle arrangement along the southern corner of terrace area. It is recommended to include a full-height screen which abuts the building façade and a standard height screen which abuts the balustrade.
- Eighth to Tenth Floor Balconies/Terrace:
    - Addition of 1.8m high impermeable screens on the eastern corner balconies.
    - Addition of a 2m high impermeable screen on the south-eastern corner balcony.

Mechanical Penthouse Terrace and Outdoor Amenity Areas

- Retention of the landscape planting.
- Addition of three 3m high and 30% porous screens at the outdoor amenity area in a baffle screen arrangement.

- One of the following two options to be considered:
    - Option 1: A 2m high impermeable wrap around screen to the north and east of the amenity area, as well as a 1m high planter box with 1m tall planting on the north-western edge.
    - Option 2: A 2m high impermeable wrap around screen (larger than Option 1) to the north, east and west of the amenity area, as well as a 1m high planter box with 1m tall planting on the north-western edge (smaller than Option 1).

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be suitable for their intended uses, and that the wind speeds will satisfy the applicable criteria for pedestrian comfort and safety. It should be noted that Wind tunnel testing will be undertaken at a later stage to quantitatively assess the wind conditions along the Ground Floor and to optimise the size and extent of the treatments (if required).

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Appendix A Wind Effects Glossary

1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development has been carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects.

No wind tunnel testing has been undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection of the architectural drawings received 15 January 2024 (as shown in Table 1), and any recommendations in this report are made only in-principle.

Table 1: List of Architectural Drawings Referenced

A000	COVER PAGE
A001	SITE STATISTICS & CONTEXT
A002	SITE PLAN
A003	SITE PLAN (GF)
A004	3D VIEWS
A101	P4 PLAN
A102	P3 PLAN
A103	P2 PLAN
A104	P1 PLAN
A105	GROUND FLOOR PLAN
A106	2ND FLOOR PLAN
A107	3RD FLOOR PLAN
A108	4TH FLOOR PLAN
A109	5TH FLOOR PLAN
A110	6TH FLOOR PLAN
A111	7TH FLOOR PLAN
A112	8TH TO 10TH FLOOR PLAN
A113	MECHANICAL PENTHOUSE PLAN
A114	ROOF PLAN
A201	NORTH ELEVATION
A202	SOUTH ELEVATION
A203	EAST ELEVATION
A204	WEST ELEVATION
A301	SECTION AA
A302	SECTION BB
A901	SUN/SHADOW STUDY JUNE 21ST
A901.2	SUN/SHADOW STUDY JUNE 21ST
A902	SUN/SHADOW STUDY SEPTEMBER 21ST
A902.2	SUN/SHADOW STUDY SEPTEMBER 21ST
A903	SUN/SHADOW STUDY DECEMBER 21ST

2 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The site is located at 900 Lakeshore Road West, Mississauga, Ontario, and is bounded by Lakeshore Road West to the north and west, and dense tree planting to the south and east. The buildings surrounding the subject development are predominately low-rise residential buildings. Lake Ontario is located further away from the site to the east.

The existing site consists of a 1-2 storey residential building. The proposed development includes the construction of an 11 storeys high, residential building. A parking garage is located within the basement floors. Various amenity spaces are included throughout the development.

A survey of the land topography indicates a gradual incline towards the south-west, however, there are no major elevation changes in the area immediately surrounding the site. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The critical outdoor trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are listed as follows:

- Ground Floor areas.
- Private balconies and terraces.
- Mechanical Penthouse Terrace and outdoor amenity areas.

Figure 1: Aerial Image of the Site Location

3 REGIONAL WIND

The characteristics of the regional winds were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained from the meteorological station located at Billy Bishop Toronto City Airport (YTZ). A combined total of 28 years of wind climate data has been collected from this station, and the data from the station has been corrected so that it represents winds over standard open terrain at a height of 10m above ground. From this data, directional probabilities of exceedance and directional wind speeds for the region are determined. The results of this analysis are presented in Figures 2 for the all-year, summer and winter cases, in the form of directional plots of the annual and 20% exceedance mean winds for the region. The frequency of occurrence of these winds are also shown in Figures 2.

The principal wind directions for the Mississauga region, which can potentially affect the subject development, is from the east-north-east and the west-north-west to south-west sector, as indicated in the following figures.

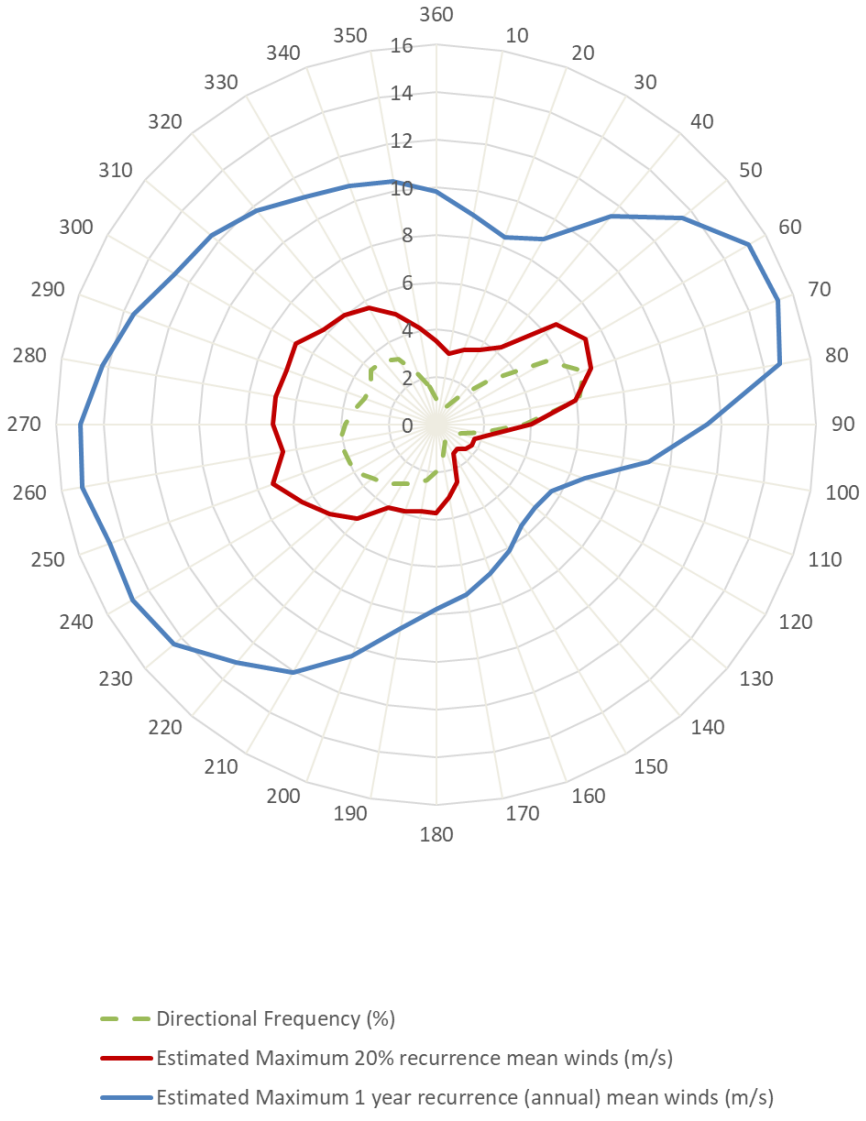

Figure 2a: Directional Annual and 20% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Mississauga Region (all-year)

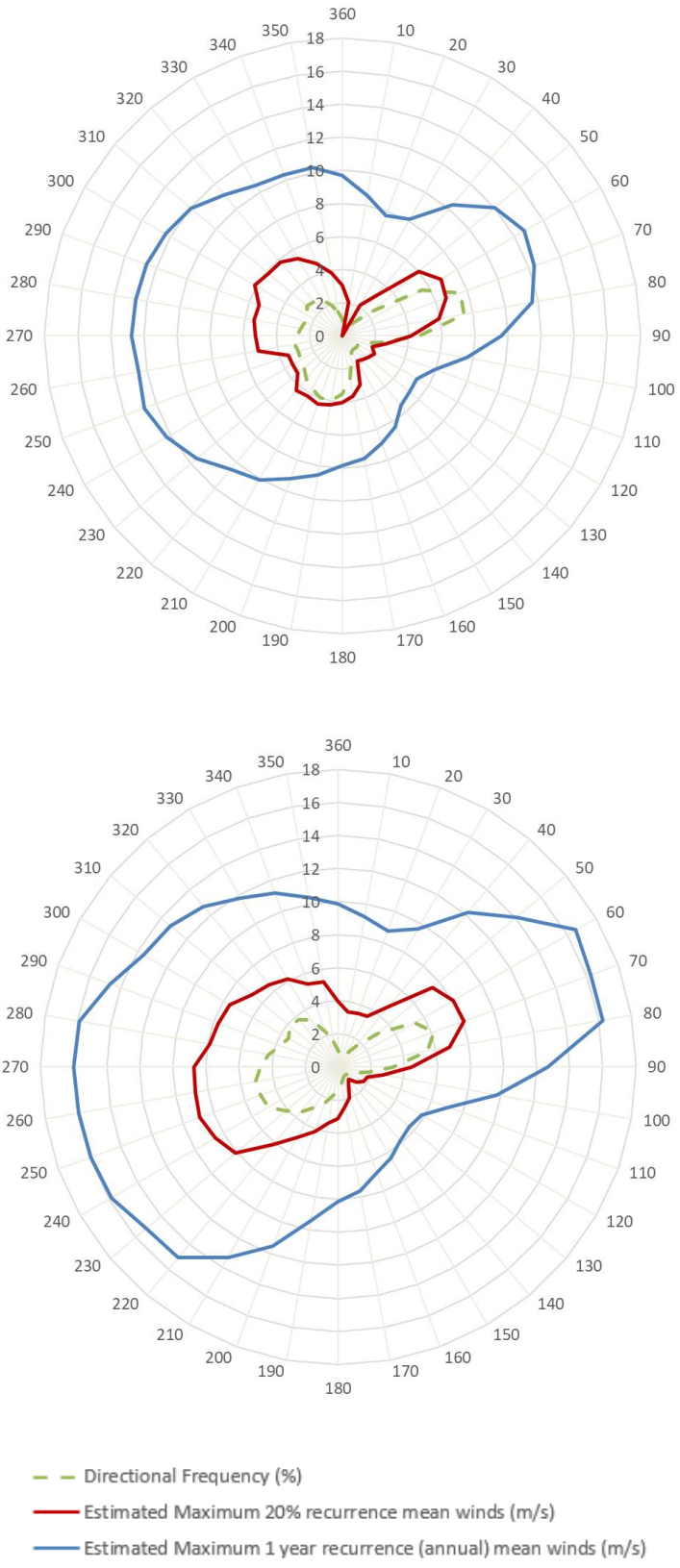

Figure 2b: Directional Annual and 20% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Mississauga Region (summer top, winter bottom)

4 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking, or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 2 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 2: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

It should be noted that wind speeds affecting this particular development can only be accurately quantified with a wind tunnel study. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

5 RESULTS AND DISCUSSION

The expected wind conditions affecting the development are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report. A glossary of the different wind effects described in this report included in Appendix A.

For this assessment, the wind speed criteria for pedestrian comfort that are considered are listed as follows:

- Sitting (Long Exposure) (≤ 10km/h) - Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away.
- Standing (Short Exposure) Criterion (≤ 15km/h) - Gentle breezes suitable for main building entrances and bus stops.
- Walking Criterion (≤ 20km/h) - Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
- Uncomfortable (>20km/h) - Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Note that the above wind comfort levels are derived from City of Mississauga: Pedestrian Level Wind Studies, Urban Design Terms of Reference Guide, 2023. Although this assessment is qualitative in nature, the abovementioned criteria for pedestrian comfort are considered when assessing the wind environment impacts. However, all areas are also assessed with consideration to a pedestrian safety criterion of <90km/h based on an annual exceedance of 9 hours or 0.1% of the time for 24 hours a day.

5.1 Ground Floor Areas

The pedestrian sidewalks which surround the development are primarily exposed to the east-north-easterly and west-south-westerly prevailing winds. The dense vegetation surrounding the subject development is expected to provide some shielding to the Ground Floor areas from low-level prevailing winds. It is expected that the wind conditions will remain suitable and/or equivalent to the existing conditions for the pedestrian sidewalk areas which are not immediately adjacent to the building form. It is recommended to retain the proposed planting as documented in the architectural drawings.

The sidewalk areas located within the through-site link area are expected to face strong winds from the prevailing west-south-westerly winds. Two options are presented for mitigation measures recommended to be included in the design of the development:

- Option 1: Inclusion of an impermeable straight-line deflector canopy, to be included along the southern aspect of the development, at 5-5.2m above Ground Floor (along the 2nd Floor slab).
- Option 2: Inclusion of an impermeable wrap-around deflector canopy, to be included along the southern aspect of the development, at 3-3.2m above Ground Floor.

These canopies aim to reduce the potentially adverse west-south-westerly winds which are expected to downwash off the southern building façade and transition into a wind funnelling effect along the through-site link. A similar wind effect is likely to occur along the north-western façade from the prevailing east-north-easterly winds. Hence, an additional impermeable deflector canopy is recommended for the northern edge of the development at a height of 3 to 3.2m above the Ground Floor.

The east-north-easterly prevailing winds may accelerate around the north-eastern and south-eastern corners of the development which are likely to affect pedestrian sidewalk areas abutting the building façade/near the abovementioned corners. Therefore, it is recommended to include tree planting on the eastern and southern aspects of the Ground Floor to alleviate these adverse wind effects.

The outdoor patio area may be exposed to the prevailing west-south-westerly winds, and therefore it is recommended to include several 1.8m high impermeable privacy screens along the north-western façade of the development to reduce the impact of wind side-streaming from this prevailing wind direction. The abovementioned mitigation measures are shown in Figures 3 and 4 below.

Figure 3: Recommended Treatment for the Ground Floor (Option 1)

Figure 4: Recommended Treatment for the Ground Floor (Option 2)

5.2 Private Balconies and Terraces

The majority of the balconies of the development are expected to be suitable for their intended use due to the inclusion of various wind mitigation features such as their overall recessed design into the building form and their central positioning along the building façade, both of which combined encourage flow stagnation. These features should be retained in the final design.

The eastern, southern and western corner balconies on Floors 2-10 are exposed to the prevailing west-north-westerly and west-south-westerly winds. Due to the level of exposure of the development, it is expected that these winds will accelerate around the corners of the building and through the porous screening that is currently proposed. In addition, wind side-streaming is likely to occur along the 4th Floor and 7th Floor terraces due to the large length of unobstructed façade. To mitigate these adverse wind effects, it is recommended to include:

Second Floor Balconies:

- Addition of a 1.8m high impermeable screen on the eastern corner balcony.

Third Floor Balconies:

- Addition of a 1.8m high impermeable screen on the eastern corner balcony.
- Addition of a 2m high impermeable screen on the south-eastern corner balcony.

Fourth Floor Balconies/Terrace:

- Addition of a 1.8m high impermeable screen on the eastern corner balcony.
- Addition of a 2m high impermeable screen on the south-eastern corner balcony.
- Addition of 1.8m high impermeable privacy screens separating the exposed residential units along the northern, western and southern aspects of the development.

Fifth and Sixth Floor Balconies:

- Addition of a 1.8m high impermeable screen on the eastern corner balcony.
- Addition of 2m high impermeable screens on both ends of the southern-most balcony.

Seventh Floor Balconies/Terrace:

- Addition of a 1.8m high impermeable screen on the eastern corner balcony and eastern terrace corner.
- Addition of 2m high impermeable screens on the south-eastern corner balcony.
- Addition of 1.8m high impermeable privacy screens separating the exposed residential units along the northern, western and southern aspects of the development.
- Inclusion of vertical fins along the north-eastern corner. The depth of the fins are to be at least half of the spacing between two adjacent fins.

- Inclusion of a baffle arrangement along the southern corner of terrace area. It is recommended to include a full-height screen which abuts the building façade and a standard height screen which abuts the balustrade.

Eighth to Tenth Floor Balconies/Terrace:

- Addition of 1.8m high impermeable screens on the eastern corner balconies.
- Addition of a 2m high impermeable screen on the south-eastern corner balcony.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be suitable for their intended uses. The abovementioned mitigation measures are shown in Figures 5 to 11 below.

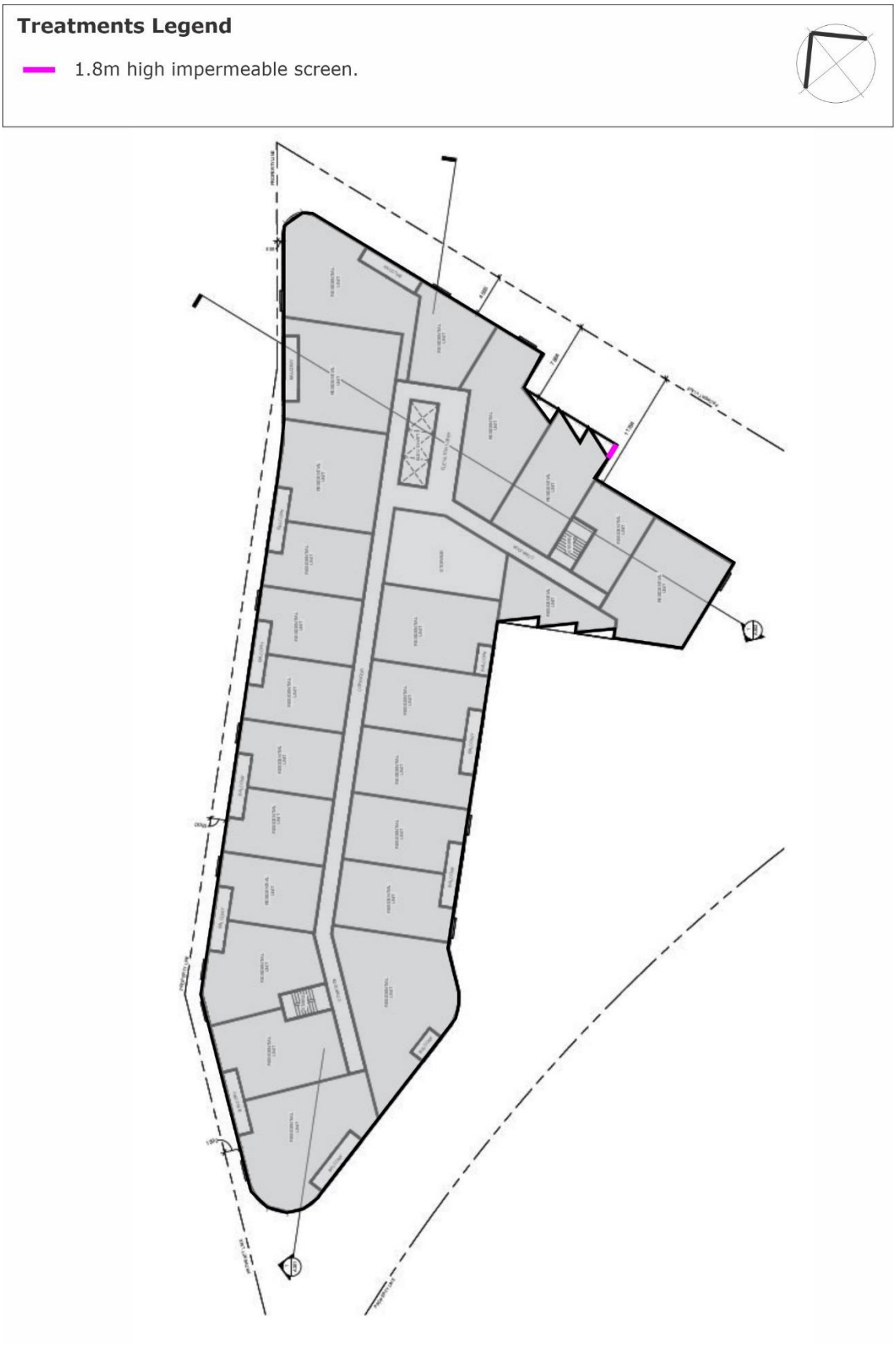

Figure 5: Recommended Treatment for the 2nd Floor

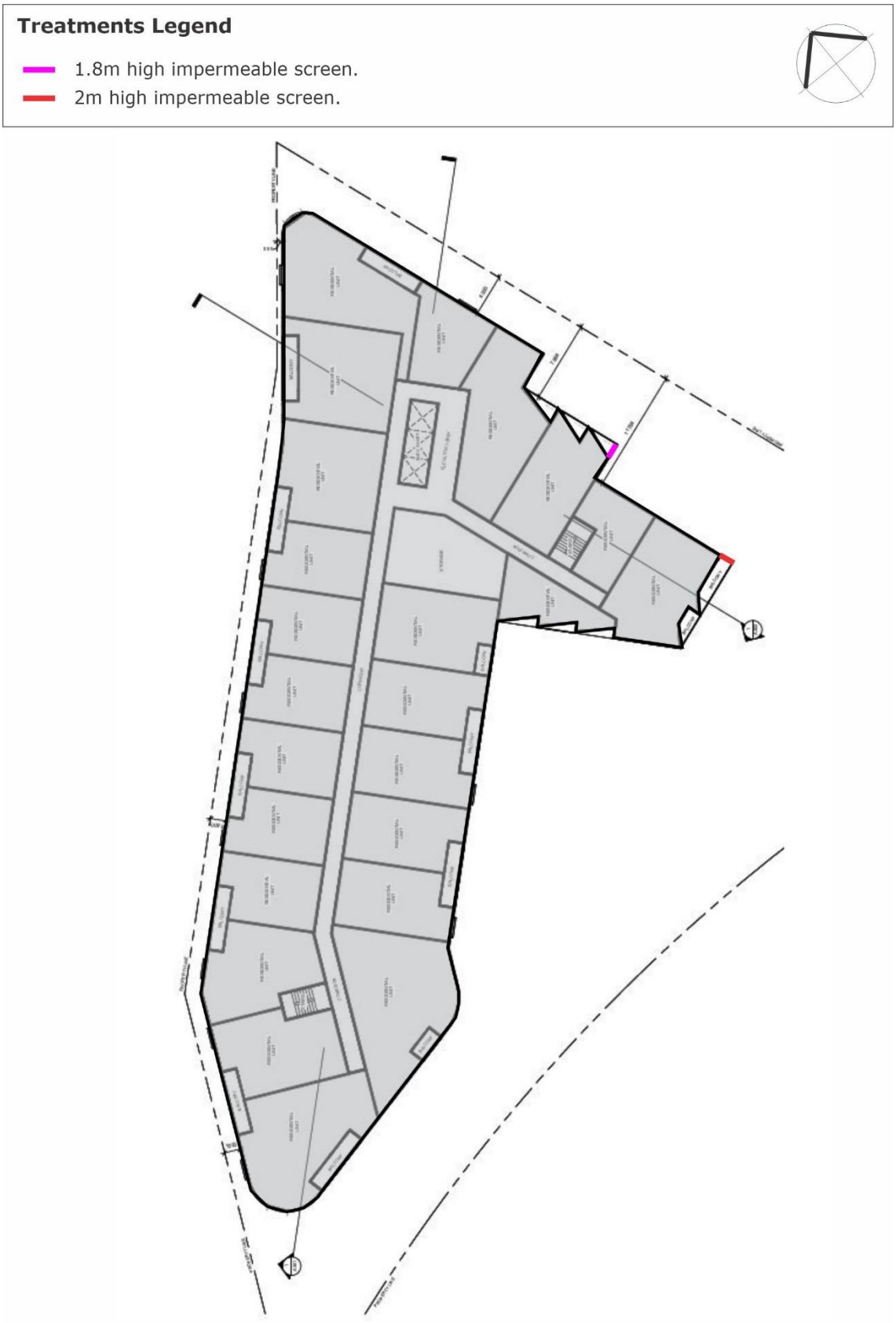

Figure 6: Recommended Treatment for the 3rd Floor

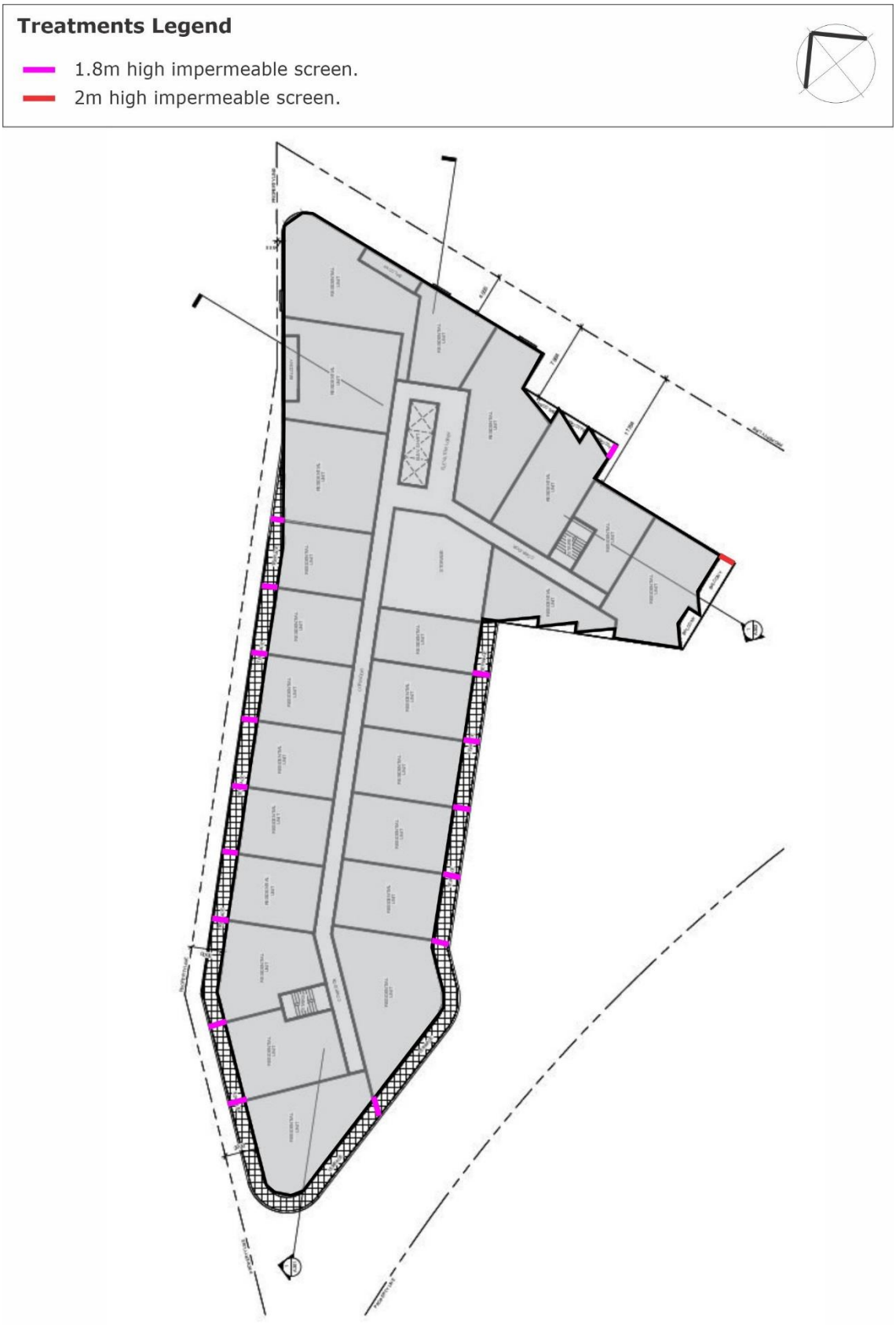

Figure 7: Recommended Treatment for the 4th Floor

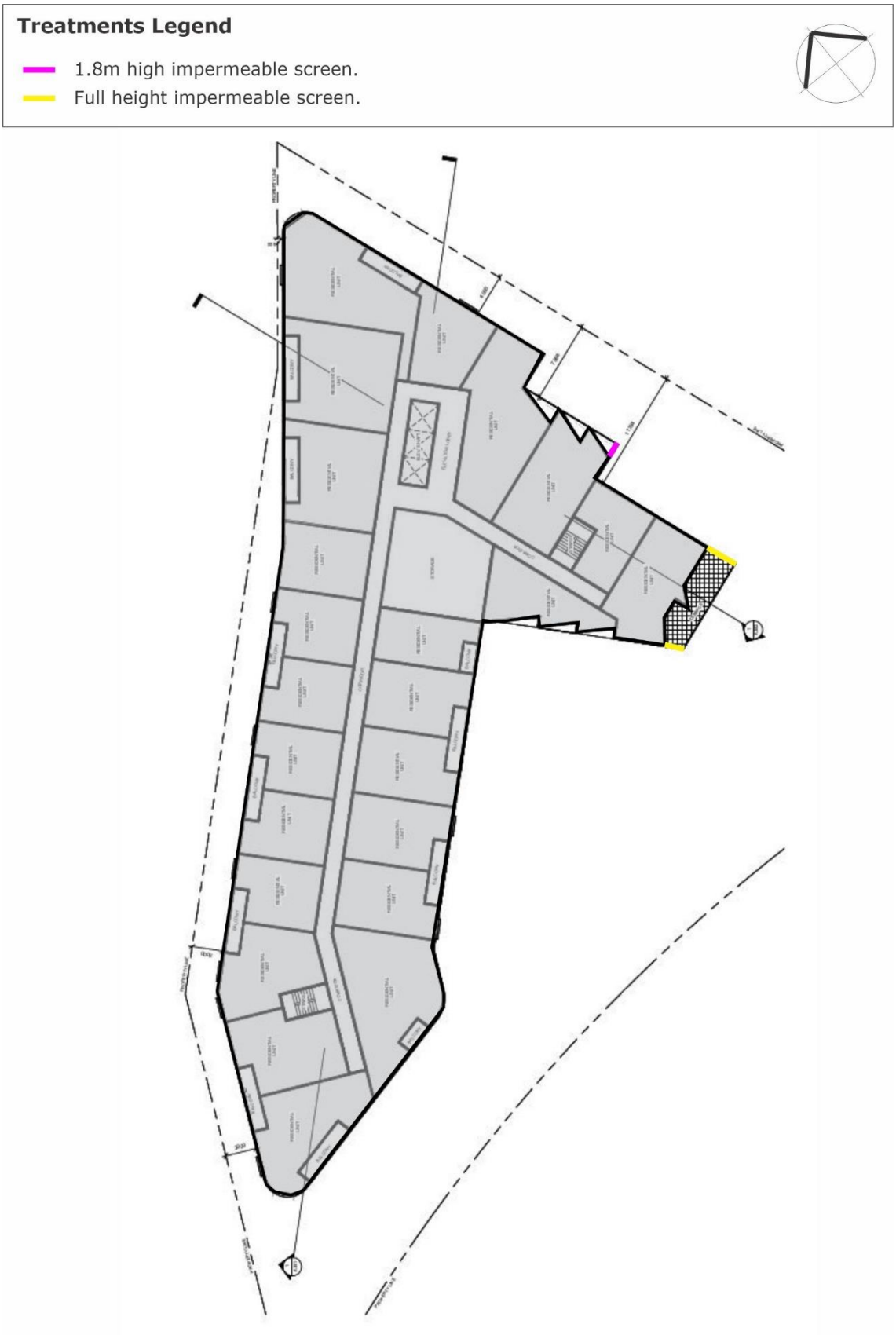

Figure 8: Recommended Treatment for the 5th Floor

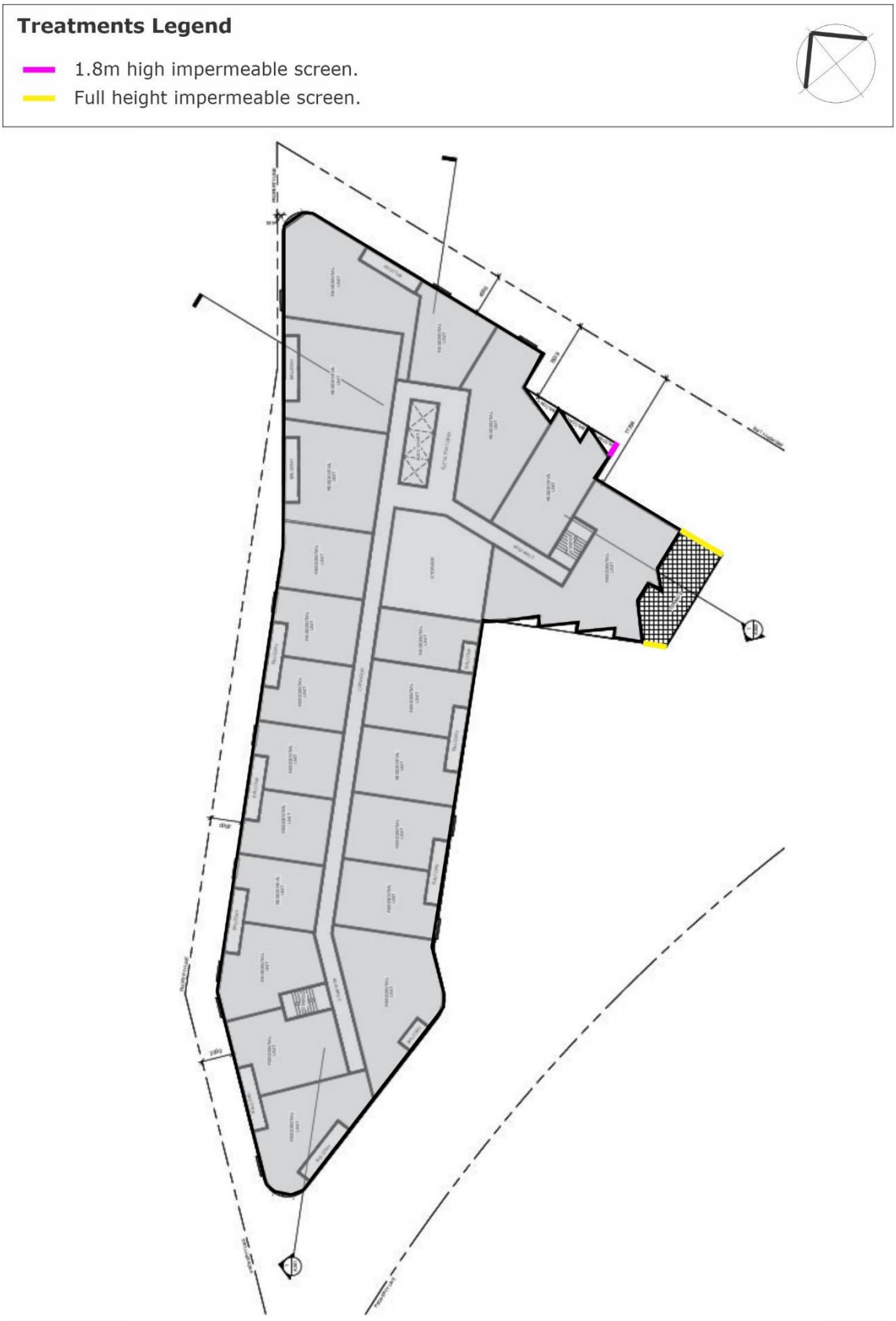

Figure 9: Recommended Treatment for the 6th Floor

Figure 10: Recommended Treatment for the 7th Floor

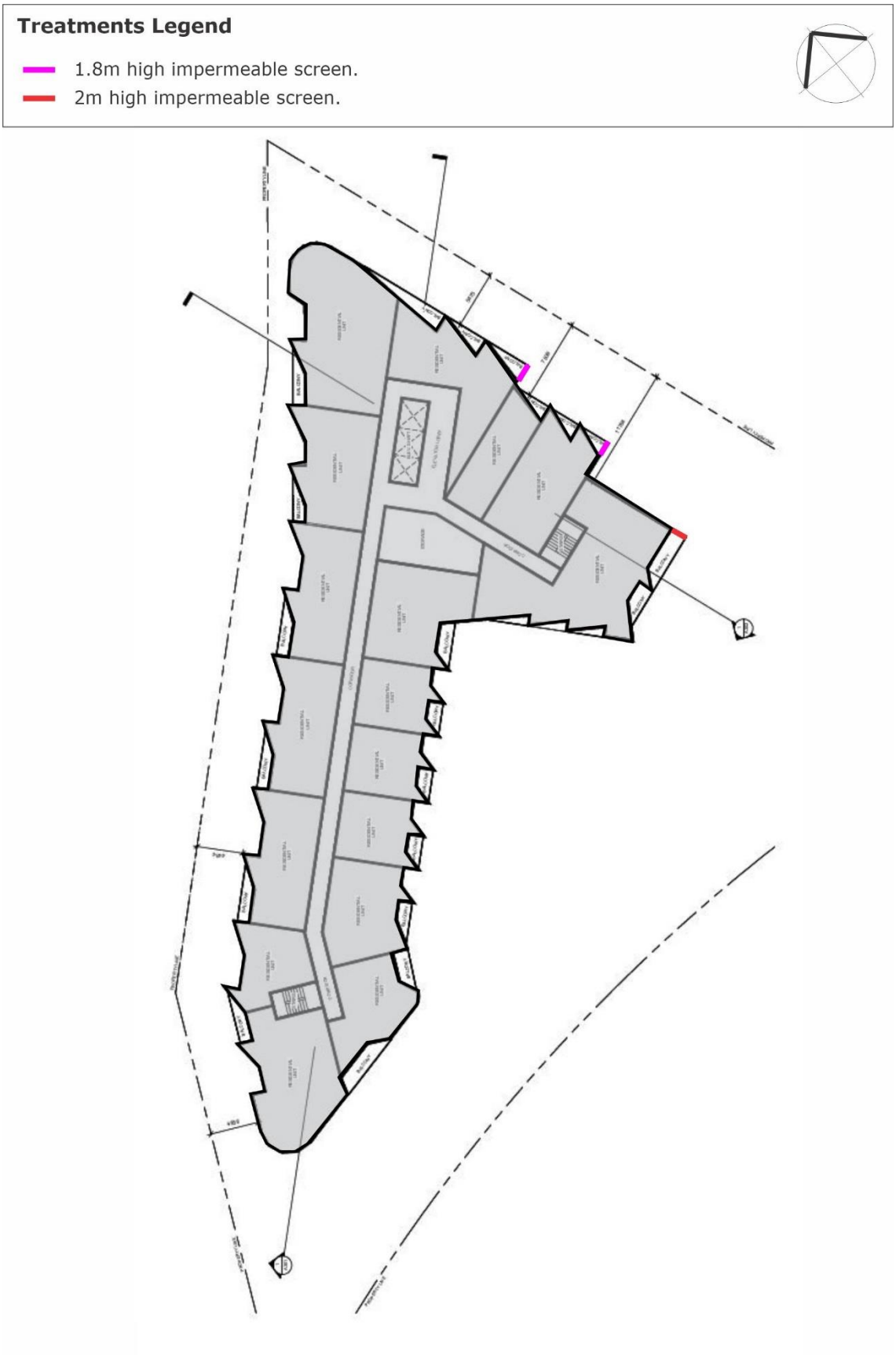

Figure 11: Recommended Treatment for the 8-10th Floor

5.3 Mechanical Penthouse Terrace and Outdoor Amenity Areas

The 11th Floor Mechanical Penthouse incorporates a terrace area which is connected to the mechanical plant room and an outdoor amenity area. The perimeter landscaping around the mechanical plant room terrace is expected to shield this area from the prevailing west-south-westerly prevailing winds and is therefore recommended to be retained.

Due to the high-level of exposure of the outdoor amenity area to the prevailing winds, it is expected that adverse winds will occur in the form of accelerated flow at the corners. Flow upwashing/re-attached flow is expected to occur centrally within the amenity area from both prevailing wind directions. Therefore, it is recommended to include three 3m high and 30% porous screens at the outdoor amenity area in a baffle screen arrangement.

To address the potentially adverse wind effects due to corner accelerating winds, it is suggested to incorporate either of the options below:

- Option 1: A 2m high impermeable wrap around screen to the north and east of the amenity area, as well as a 1m high planter box with 1m tall planting on the north-western edge.
- Option 2: A 2m high impermeable wrap around screen (larger than Option 1) to the north, east and west of the amenity area, as well as a 1m high planter box with 1m tall planting on the north-western edge (smaller than Option 1).

The abovementioned mitigation measures are shown in Figures 12 and 13 below.

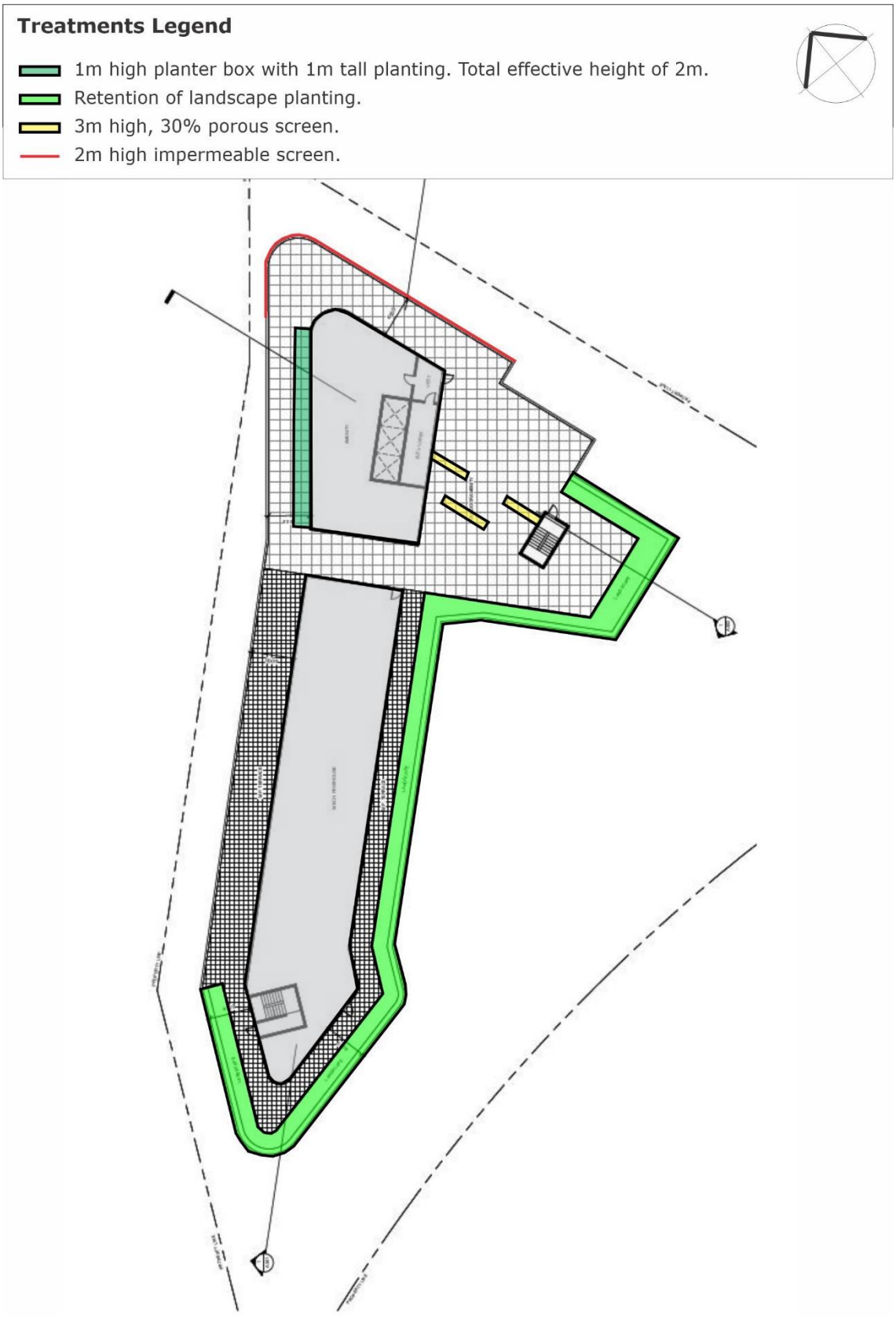

Figure 12: Recommended Treatment for the Mechanical Penthouse Floor (Option 1)

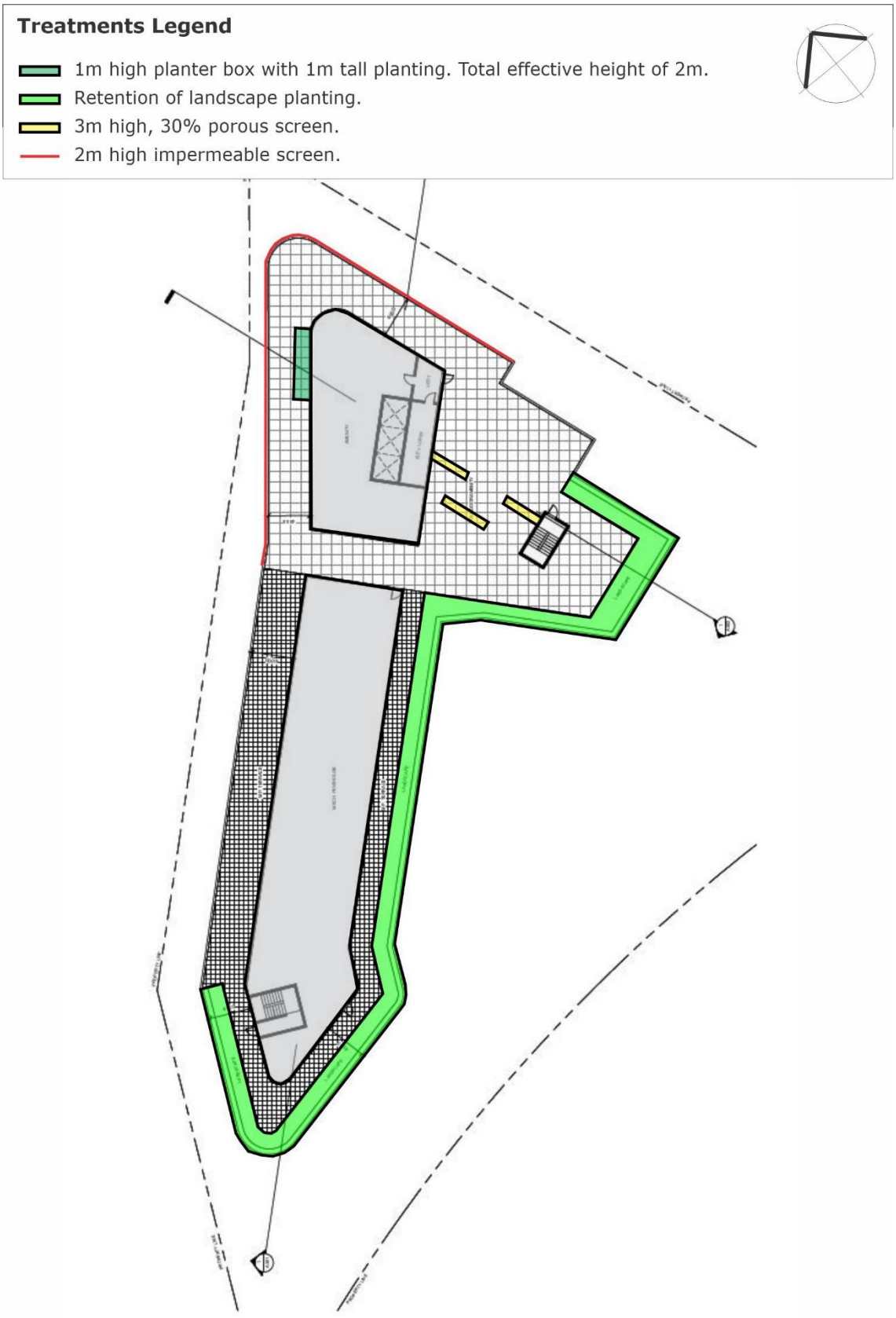

Figure 13: Recommended Treatment for the Mechanical Penthouse Floor (Option 2)

6 REFERENCES

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APPENDIX A WIND EFFECTS GLOSSARY

A.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the windward face of a building, causing accelerated winds at pedestrian level. This can lead to other adverse effects as corner acceleration as the wind attempts to flow around the building, as seen in Figure A.1.

This can also lead to recirculating flow in the presence of a shorter upstream building, causing local ground level winds to move back into the prevailing wind.

The upwash effect occurs near upper level edge of a building form as the wind flows over the top of the building. This has the potential to cause acceleration of winds near the leading edge, as well as potentially reattaching onto the roof area. This effect causes wind issues particularly near the leading edges of tall building and on the rooftop areas if there is sufficient depth along the wind direction. Upwash is more apparent in taller towers and podia.

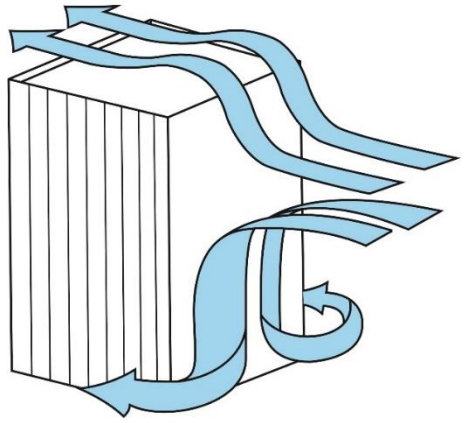

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

A.2 Funnelling/Venturi Effect

Funnelling occurs when the wind interacts with two or more buildings which are located adjacent to each other, which results in a bottleneck, as shown in Figure A.2. This causes the wind to be accelerated through the gap between the buildings, resulting in adverse wind conditions and pedestrian discomfort within the constricted space. Funnelling effects are common along pedestrian links and thoroughfares generally located between neighbouring buildings that have moderate gaps between them.

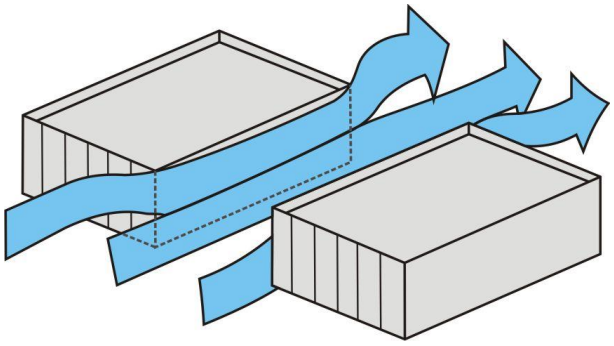

Figure A.2: Funnelling/Venturi Wind Effect

A.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure A.3. This can involve a combination of funnelling and downwash effects. Presenting a small gap in the façade on the windward aspect as the easiest means through which the wind can flow through can result in wind acceleration through this gap. The pressure difference between the windward façade and the leeward façade also tends to exacerbate the wind flow through this gap.

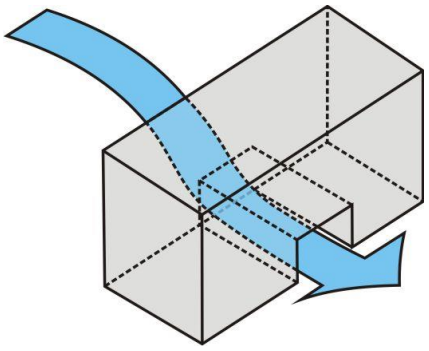

Figure A.3: Gap Wind Effect

A.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of wind shearing along the building façade that eventuates in an acceleration corner effect. The flow is parallel to the façade and can be exacerbated by downwash effects as well, or due to corner effect winds reattaching on the façade.

This is shown in Figure A.4. The corner refers to the acceleration of wind at the exterior vertical edge of a building, caused by the interaction of a large building massing with the incident wind, with the flow at the corner being accelerated due to high pressure differentials sets up between the windward façade and the orthogonal aspects. It can be further exacerbated by downwash effects that build up as the flow shears down the façade.

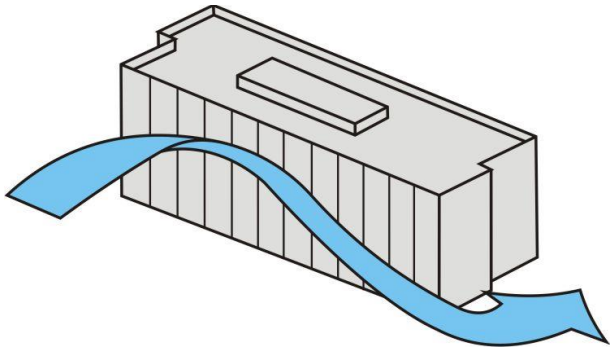

Figure A.4: Sidestream and Corner Wind Effect

A.5 Stagnation

Stagnation in a region refers to an area where the wind velocity is significantly reduced due to the effect of the flow being impeded by the bluff body. For a particular prevailing wind direction, this is typically located near the middle of the windward face of the building form or over a short distance in front of the windward face of a screen or fence. Concave building shapes tend to create an area of stagnation within the cavity, and wind speeds are generally low in these areas.