26 Donald & 37 Cambell Streets

Audit of the Assessment of the Wind Effects

BUILDING ENVIRONMENTAL PERFORMANCE SIMULATION

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Summary

This report describes an analysis of the proposed development from 5 points of view. In my original audit of the wind effects of the proposed development on the Ryman Karori site, three principal issues were identified:

1) Much of the development is sufficiently distant from public streets that the potential deleterious effects of the taller buildings will be restricted to the site itself and thus will not affect the passers-by;
2) There seemed no awareness in the landscape plan of the function of the planting as wind screening – not so much in the wind-hardiness of the planting as in its orientation, required size from the outset to ensure safety and comfort, and placement;
3) The planned entries to the buildings seemed to take no cognizance of the potential wind effects of the proposed building forms.

This review returns to these questions, but adds the following two issues:

1) The potential impact of the proposed development on the wind experienced by the neighbouring properties, as raised by a number of submissions on the proposed plans;
2) The degree to which the proposed building forms show evidence of awareness of the WCC "*Design Guide for Wind*".

The general conclusion that I have reached is that:

1) The distance of the largest proposed buildings from the surrounding streets makes it extremely unlikely that the site-adjacent public footpaths alongside Campbell and Donald Streets will be affected by these buildings. However, the public path along the North boundary past the site linking Campbell and Donald Streets adjacent to the Karori Normal School and to the Huntleigh Home will likely be affected at least in the area where it passes by the tallest building on site. The impact of this tallest building on site will likely affect the rear of the Karori Kids adjacent facility, and on the properties of 27A Campbell Street, and 221A, B and C Karori Road. While all these properties are outside the worst zone of wind acceleration as they are more than 2x the width of the proposed tall building away from it, the wind speeds on these properties is likely to increase in the wake of this building, because the proposed car parking spaces next to the building provide none of the shelter previously afforded by the 3-5m tall trees on the site adjacent to their properties.
2) There is no clear connection in my view between the potential wind issues created on site by the wind interacting with the proposed buildings and the landscape plan; nor do the proposed boundary fences seem designed to provide the aerodynamic shelter functions required by the wind analysis submitted with the design proposal. This is especially true of the fences adjacent to this tall building, but are also true of the 3 storey buildings adjacent to Donald and Campbell Streets. Te picket fence proposed between the Scarpa Terrace houses and the site is of similarly poor aerodynamic design, but the proposed buildings near these buildings will likely significantly improve the wind on their properties, with or without a fence with improved aerodynamic shelter design.
3) The building entries do not seem to acknowledge the likely wind accelerations due to the planned building forms, or the prevailing wind directions.
4) While the detailing of the fences as wind shelter, and the landscape provisions do not seem to recognise in their placement and scale any wind shelter function whatsoever, the likely impact of the proposed buildings on the neighbours is likely to be small IF the proposed fences were to be redesigned as genuine wind shelter devices. This shelter is most critical on the boundary adjacent to the tallest proposed building. If the improved aerodynamics of the wind fences were combined with planting of trees of a 3-

5m height along the North and West boundaries of the site, the risk of deleterious effects on the neighbours would be very low.

5) The form of the largest building on the campus takes no cognisance whatsoever of design guidance in the City's *Design Guide For Wind* on the likely impact of the architectural form on the local wind. No clear consideration has been given to the potential for improving the impact of this building on the wind on the site and the potential for some form of impact, however low, on the Karori Kids adjacent facility, and on the properties of 27A Campbell Street, and 221A, B or C Karori Road.

The wind analysis presented with this proposal suggests that all the buildings be constructed and that any issues then be resolved via installation of screens and planting. It is difficult to see how this could lead to a positive outcome. Screens to help the plants to survive seldom provide a positive long-term outcome. It seems unlikely to lead to a positive outcome without a very extensive measurement programme of before and after conditions because the dynamic variation of wind speeds from day to day, and year to year make genuine comparison without measurement nigh on impossible.

From a purely aerodynamics point of view, two recommendations seem likely to produce a positive overall outcome:

1) The general layout of buildings and the scale and placement of most buildings is, as suggested by the submitted aerodynamics analysis, likely to produce an overall improvement of wind conditions in the neighbourhood, so long as the aerodynamic properties of the proposed fences match those intended by the submitted aerodynamics analysis.
2) A more thorough analysis of the wind effects of the selected form of the tallest building on site is recommended. This should consider alternate forms and the potential effect on the nearest properties, and potentially the nearby public thoroughfare alongside the site, if it is retained.

Wind Situation

In normal circumstances, for a development as complex and tall as proposed here, I would be assessing the impact of a building as documented in a wind tunnel test of the before and after situation. The evidence would be far more definitive. In this project, we are trying to rely on experience and 'professional judgement' which in an area as complex as wind flows around buildings is typically far more conservative than a fact-based wind tunnel assessment. The complexity arises from the huge variability of wind speed and direction and the multiple effects of the terrain and local buildings altering the wind that actually impacts the site; but it also arises from the near impossibility of assessing precisely the frequency of occurrence of winds of different strengths. Almost inevitably, assessments must be conservative, because to make a mistake is to condemn site users and neighbours to incurable problems for the lifetime of the buildings – at least the next 50+ years.

As an illustration of that complexity, the following plots are variations on so-called "wind roses". A wind rose plots the frequency of occurrence of direction and speed of the wind on a circle representing the 360 degrees of the compass. In the following plots, the critical Wellington situations are explored: an overall plot for the year; a winter month; and a summer month. For each timeframe, 3 plots are presented: the first, plotting conventional wind speed and direction; the second, plotting the frequency of occurrence of temperatures when the wind is blowing from that direction; and the third plotting sunshine against wind direction. The purpose is to identify the likely critical winds in cold weather when people might not be outside so often, and in warm weather, when people might have a reasonable expectation of using outdoor spaces for extended periods of time.

Figure 1 shows the full year. As with all the other wind roses, the daytime hours from 9am-6pm are plotted, rather than early morning or night hours. The most frequent winds annually (left rose) are from the North; strong storms arrive from the South/Southwest; and on average during these hours of each day it is calm 7 hours a year. Most of the Southerly winds are cooler than those from the North (centre rose); which, in corollary means, when it is comfortable outside (> 15C) the wind is most often blowing from the North. Similarly sunny conditions occur most often when it is windy from the North (right rose); however, also, it looks like there are times when it is sunny during Southerly winds though the proportion of Southerlies that are sunny is smaller.

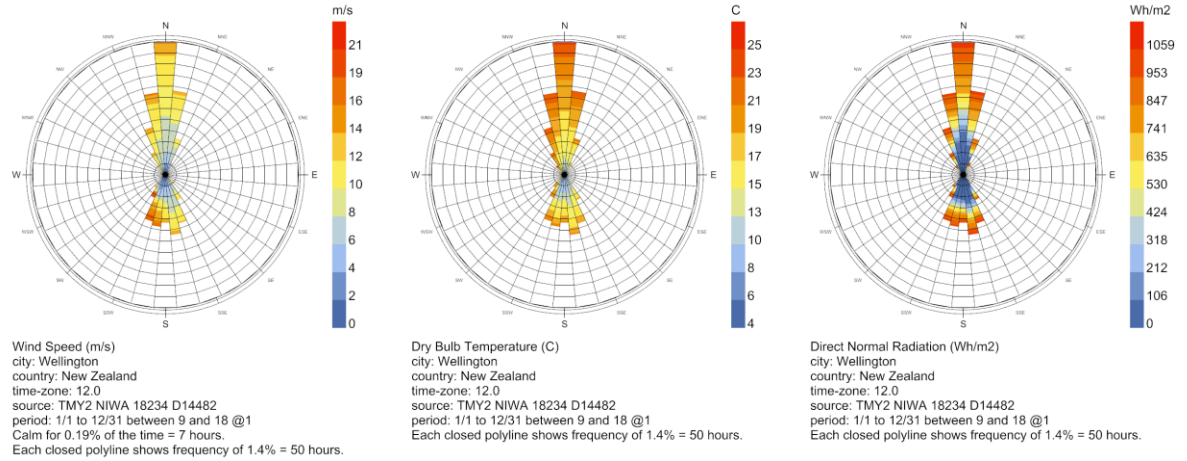

FIGURE 1 9AM - 6PM WIND SPEED, TEMPERATURE AND SUNSHINE "WIND ROSES" FOR THE **WHOLE YEAR**

Figure 2 shows winter (June, from 9am to 6pm). The most frequent winds (left rose) are still (just) from the North; strong storms from the South/Southwest are during winter of almost the same frequency; and on average during these hours it is calm 2 hours in June. Most of the Southerly winds are cooler than those from the North (centre rose); which, in corollary means, when it is warmer outside (> 12C) the wind is most often blowing from the North. Similarly sunny conditions occur most often when it is windy from the North (right rose); also, it looks like most Southerly winds are not on sunny days. The most crucial shelter for those days when it might be pleasant to be outside during winter is protection against Northerly winds.

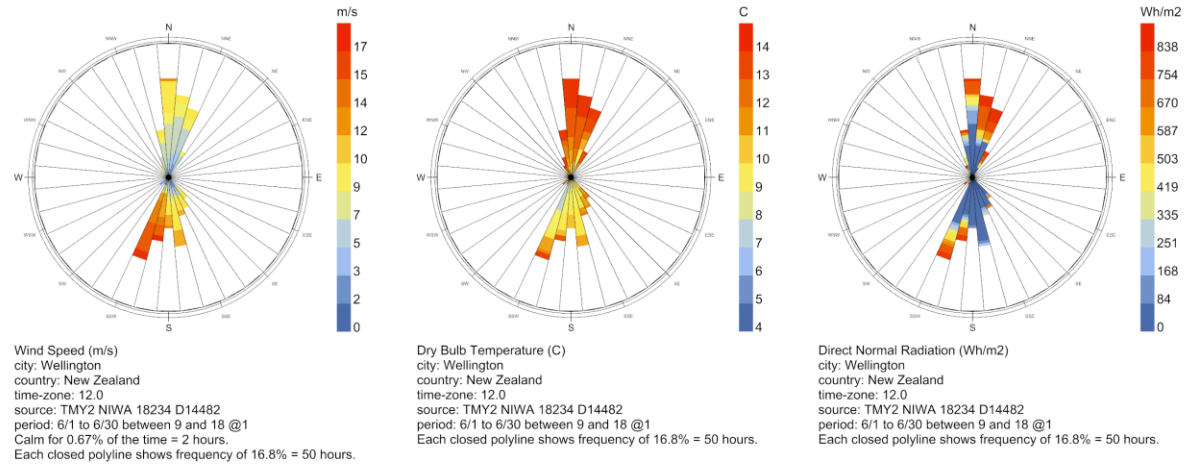

FIGURE 2 9AM - 6PM WIND SPEED, TEMPERATURE AND SUNSHINE "WIND ROSES" FOR **JUNE (WINTER)**

Figure 3 shows summer (December, from 9am to 6pm). The most frequent winds (left rose) are almost exclusively from the North; and on average during these hours it is never calm in December. The Southerly winds are cooler than those from the North (centre rose); in other words, when it is warmer outside (> 17C) the wind is most often blowing from the North. Similarly sunny conditions occur most often when it is windy from the North (right rose); and it looks like on those few times when there is a Southerly wind it is sunny. Protection from the North seems a priority in summer as well, but it does seem that protection from South winds would enable being outside on a significant a number of summer days.

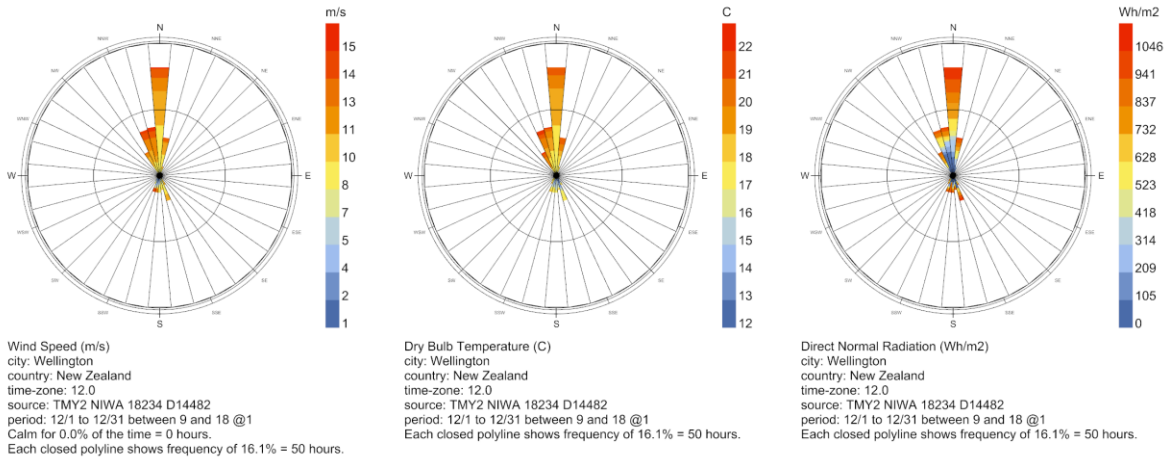

FIGURE 3 9AM - 6PM WIND SPEED, TEMPERATURE AND SUNSHINE "WIND ROSES" FOR **DECEMBER (SUMMER)**

Summary of the impact of the design

Figure 4shows the landscape plan, overlaid with two temperature wind roses – Winter and Summer.

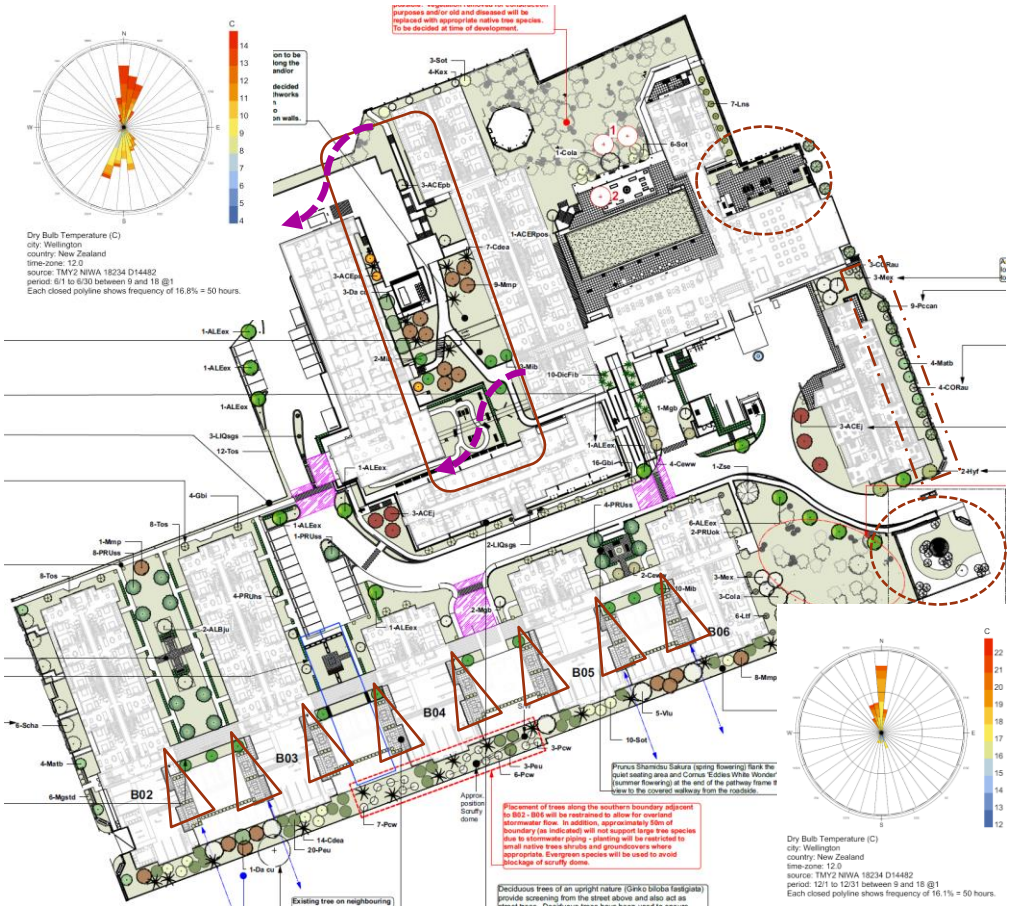

FIGURE 4 LANDSCAPE CONCEPT PLAN OVERLAID WITH WIND ROSES FOR WINTER (TOP LEFT) AND SUMMER (BOTTOM RIGHT)

It is difficult to see how this landscape plan relates to the wind directions. It should be remembered that the local terrain and the trees and buildings on neighbouring sites will alter these flows that show the wind recorded at Wellington Airport. However, local site survey information is not provided. The two areas circled in dashed

lines seem likely to be exposed to the sun and also to the most frequent wind. The proposed landscaping does not seem to recognise this.

The area highlighted by the box with round corners will likely experience the greatest accelerations due to the size of the highlighted tallest proposed building on site. The flow risk shown in Figure 5 will likely be altered in some manner by the other adjacent buildings on site, and by the terrain. However, it is impossible to estimate their effect with any precision. The courtyard like space between this building and the B01A buildings to the Northeast may well experience swirling winds of lower average speed than at the corners of the taller building. The building entries with no wind lobby opening into this area would probably be less of a safety or cold draft risk than elsewhere on site because of this lower average wind. In many other entrances no screens, landscaping, double entry doors, or other measures are provided to make the building entries safe for the users. This area should receive sun for around 3 hours, even in winter, according to the Site Solar Studies presented in the application. However the planting on plan appears not to recognise the basic swirling wind issues highlighted in the WCC District Plan *Wind Design Guide*.

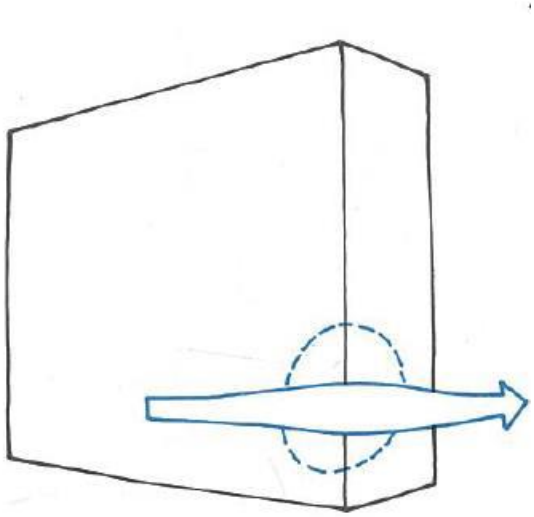

FIGURE 5 ONE OF THE RELEVANT ILLUSTRATIONS FROM THE WCC WIND DESIGN GUIDE SHOWING THE LIKELY ACCELERATION AT CORNERS FOR A BUILDING OF THE PROPOSED SCALE

Near the corners of the taller of the buildings, as highlighted by the pink arrows, there is likely to be significant wind acceleration. For a building of around 20m height, the wind speed at the windward corners would be expected to experience an acceleration of up to 35% compared to the winds experienced with no building in place. Many suggestions to avoid this problem can be found in the Design Guide and in the texts in this field. They include stepping the upper storeys back so the worst accelerated wind dissipates on the roof of the lower storeys; building large verandahs; placing structures and planting in combination at the corners so people walking past are directed away from the problem. None of these solutions to the potential problem seem to be present in the proposed design, or described in the design documentation.

Another example of a lack of recognition in the design of the wind can be observed in the planned outdoor balconies highlighted by triangles in Figure 4. The wind from the North or the South will be accelerated through the gaps between the wings of blocks B02 through B06. These balconies will receive about 2 hours of sun in winter, when the wind blows cool and in equal measure from the North and the South. Again, the landscape plan does not appear to be coordinated with the building aerodynamics: to my eye, the planting plan is more decorative than designed to function as a wind screen.

Impact of the amelioration concepts referenced in the WSP wind report

In their assessment of the potential effects of the proposed development on the wind WSP note the following ameliorative features of the design: " *(1) the alignment of the new buildings approximately parallel to the prevailing wind directions, (2) the lower building heights around the perimeter of the site, (3) the setbacks from the site boundaries, (4) the boundary fencing, and (5) the proposed landscaping."*

The tallest of the buildings is indeed oriented largely parallel to the prevailing winds, and thus will have less effect on the wind than if it were placed at right angles to the wind. It is also clear that the likely worst effects of the proposed development, as a result of the height of the tallest of the proposed buildings will be completely confined within the site and will affect mostly the proposed upgraded Lopdell gardens. The gardens have grown surrounded by buildings of this scale in the past, so can be expected to continue to grow well. There is no evidence of consideration of how the design deals with particular local effects near the proposed taller buildings. The removal of protecting trees on the North and Northwest corners of the site seems likely to risk increasing wind speeds in these neighbouring properties. The buildings near most of the other site boundaries are much closer in height to the scale of the neighbouring houses, and are therefore unlikely to cause wind issues on the neighbouring properties due to their height. Their length compared to the neighbouring houses will likely cause more wind to be redirected parallel to their length. This will at times provide beneficial shelter. The redirection along their windward faces will likely remained confined to the site.

Not all the buildings are setback from the boundary. However, it is clearly true of the proposed tallest building as it is situated on the site where a slightly taller building previously existed. The neighbouring properties that the proposed tall building could possibly affect are the adjacent "Karori Kids" facility and 27A Campbell Street, and 221A, B and C Karori Road. From the area site plans on Google, and from the provided proposed site plans, the red roofed building closest to the previous tall buildings shown in Figure 7 is to be removed and this area will be car parking. Given the large area (larger than 2x the width of the proposed building on plan) I do not anticipate that the effect of the proposed central tall building would be experienced at its worst beyond this boundary.

However, the WSP note about the proposed benefit of the boundary fences and landscaping is hard to understand in the context of the proposal submitted. I can accept, IF there is extensive wind resistant underplanting, and IF the boundary fences are made aerodynamically suitable as wind protection, and IF the existing 3-5m tall trees on the boundary as shown in Figure 7 are retained, then they could be effective in retaining the current level of protection of the yards of these neighbouring buildings. However, the sketch shown of the 'timber palisade' fence along these boundaries suggests a wind barrier that is perhaps 1m in height. This will have little or no benefit in sheltering the neighbours from any wind effects.

FIGURE 7 GOOGLE MAP OF THE SITE SHOWING EXISTING VEGETATION OVERLAID WITH OUTLINE PROPOSAL AND WITH AREAS OF EXISTING STRONG WIND PROTECTION TREE COVER THAT IS APPARENTLY NOT REPLACED

This issue of the effectiveness of the boundary fences is also critical when one looks at the boundary fence where the buildings sit next to the street. Along the Donald and Campbell Street façades the fence has no useful aerodynamic properties whatsoever as is illustrated in the inset in Figure 8. Also visible in this figure is a tree that even if it were a wind-hardy Golden Elm would struggle to grow as straight as shown because the long façade to the North and South would channel the wind horizontally so it would be worst, on site at this corner. This is a further example of the difficulty I have had in reconciling the landscape plan, the aerodynamic analysis and the concept drawings. The length of this façade with no breaks to dissipate the wind will probably increase the wind on the adjacent public footpath, and in the main vehicle and pedestrian entry to the development. The proposed fence does not provide the protection during Northerly winds to backwash off the long façade anticipated by the wind analysts.

I remain sceptical that any post construction examination of potential issue could possibly determine how windy the new situation is vis-à-vis what existed previously. This is because wind is widely varying. Wind analysts do not trust single site visits to give a picture of the year wide situation. Storms come and go. Temperatures on a day affect our perceptions of wind nuisance. Recalling what the wind was like on sunny, cloudy, stormy days 5-7 years ago and comparing to experiences today is beyond normal human capacity. To be reliable we would need a set of continuous wind speed readings for the best and worst times of the year at several site locations now; and then another full year of data after completion of the project. It is worth noting that for much of the length of this Donald Street façade, people walking past will experience far less Southerly wind than they currently experience.

FIGURE 8 PROPOSED BUILDING ON DONALD STREET SITE EDGE (INSET THE PROPOSED FENCE)

It should be noted that the street façade in Campbell Street, where a similarly long single structure is likely to channel Southerly winds along the street instead of its current flow across the current open site, the fences are the same as illustrated in Figure 8. Cambell Street (Figure 9) will be significantly less windy here because the long length of the building will impede the more frequent Northerlies. These buildings are set a little further back so the footpath will experience less direct backwash than Donald Street. However, the fence has no wind barrier function, and is not tall enough to be effective. While this façade will provide significant protection from Northerly winds, without these fences having an aerodynamic design, they will do nothing to reduce the Southerly wind accelerations.

FIGURE 9 ILLUSTRATION OF THE CAMPBELL STREET FACADE OF THE PROPOSED DEVELOPMENT

Wind on Scapa Terrace

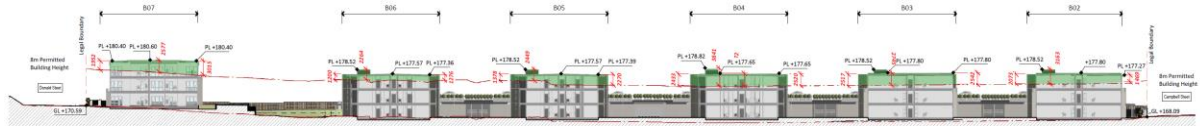

FIGURE 10 SECTION THROUGH THE BUILDINGS FACING THE SCAPA TERRACE PROPERTIES SHOWING THE PROPOSED BUILDING HEIGHTS VS THE "PERMITTED BUILDING HEIGHT"

FIGURE 11 "SOUTH" ELEVATION FACING THE SCAPA TERRACE PROPERTIES

FIGURE 12 DISTANCE OF SOUTH BUILDING EDGE FROM SITE BOUNDARY

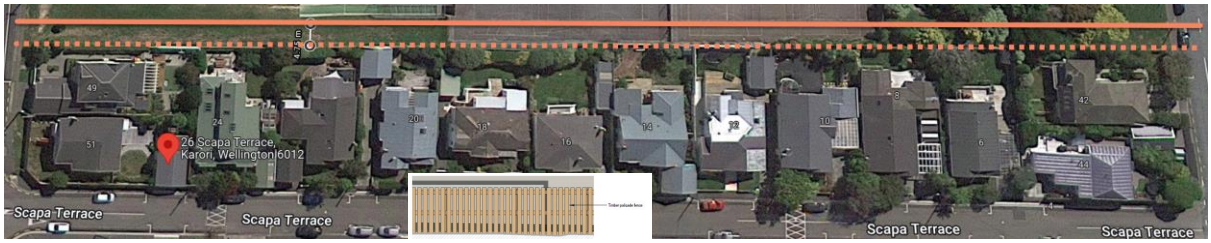

FIGURE 13 DISTANCE OF SOUTH BUILDING EDGE (SOLID LINE) FROM FENCE LINE (DOTTED LINE) AND SCAPA TERRACE HOUSES – WITH PLANNED FENCE TYPE

Figure 10, Figure 11, Figure 12, and Figure 13 examine the physical situation along the South Boundary of the site, where it abuts the properties in Scapa Terrace. Figure 10 highlights the degree to which the proposed buildings exceed an 8m height limit, if it were imposed on the site. In my opinion, this excess height will not contribute significantly to any increase in wind speeds experienced on the site, or on the adjacent properties in Scarpa Terrace. What is likely to affect the wind is the length of barrier to the wind – not its height. Figure 12 shows the likely direction of the wind impacting on the North and South facades of the proposed blocks. As noted by WSP there is nothing about the heights of the planned blocks that is likely to create worse conditions in the neighbouring properties.

With the orientation and horizontal scale of the proposed buildings along the South boundary, there will likely be some redirection of Southerly winds along the face of the buildings. Previously this wind will have flowed unobstructed across the open spaces which will now be built upon. Any significant backwash off this South face of blocks B02 through B07 will likely remain within the 5m space between these buildings and the legal boundary. What planting is proposed in this shady spot will likely not grow quickly, nor does it seem planned to diffuse these wind flows. In addition, the picket fence is of a low height and will be unlikely to contribute to retaining these flows within the site boundary.

This same function of the buildings as a new barrier, largely oriented across the major wind flows, will hugely decrease the wind in the sunny back yards of the people in Scarpa Terrace, though clearly from the submitted sun analyses it will increase the late afternoon shading on the substantial trees in these back yards. There may be some increased turbulence around the Southwest corner of the block near number 49 Donald Street, but the overall effect in the much more common Northerly winds will be a significant reduction in windiness.