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31 January 2017

SHADING ASSESSMENT
PROPOSED MORAY PLACE DUNEDIN HOTEL

These notes accompany the shade diagram plans that form part of the resource consent application for the proposed Dunedin Moray Place Hotel. The purpose of these notes is to describe the methodology used to determine the shading effects and any other relevant matters.

1.0 Methodology

The critical heights of the proposed building have been determined from the architectural concept plans, with a correction applied to convert these levels to Otago Datum.

The critical levels are-

1. Top of main building. This is shown on the architectural plans as having a level of 59.600m (this is the level at the top of the garret/roof terrace). The conversion to Otago Datum is a static +112.500m, which gives a resulting Reduced Level (RL) of 172.100m.
2. Top of ring feature. This has been scaled from the architectural plans as having a level of 64.350. The conversion to Otago Datum is a static +112.500m, which gives a resulting Reduced Level (RL) of 176.850m.

I note that there is a 0.200m difference in the elevation levels between the architectural concept plans and the unit title subdivision plans. This appears to be a rounding difference resulting from independent design processes. While this difference exists, it is not of a size that is considered to either i) materially affect the various assessments that have been undertaken, or ii) materially affect the accurate interpretation of the proposed activity.

The shading assessment has taken into account four principal forms of the proposed Hotel structure, these being-

- The service shaft and ring feature at the top of the building.
- The extent of the structure at its upper level floor (at RL 172.100). Note that this shape ignores the small bite that is shown on Section AA of the architectural plans removed for the left-hand-side of the structure.
- The extent of the structure at its widest 'bulge' point (Level 8).
- The extent of the structure at its various ground level elevations (Levels 1 to 4) as it retracts from the bulge point at Level 8.

The combination of these four principal forms, at their respective elevations, provides the 3-dimensional block that has been used as the basis of the shading assessment.

Ground levels of the surrounding landscape have been adopted from Dunedin City Council LiDAR information (sourced as contour lines at 0.500m intervals). This LiDAR information has been corrected by +100.000m to convert from Mean Sea Level to Otago Datum.

The elevation and orientation of the sun has been interpreted in the conventional manner using the diagram titled 'Elevation and Bearing to Sun in Dunedin (45°53'S 170°30'E) – FIG. A', a copy of which is attached.

Using the above information, an assessment has been carried out for each of the three significant annual occurrences – Summer Solstice (at Daylight Savings Time), Winter Solstice and at the Equinox.

The earliest time of the day assessed for each of the above instances has been determined as being the earliest hour at which the sun has risen above the eastern horizon. The latest time of the day assessed for each of the above instances has been determined as being the latest hour at which the sun is still visible above the western horizon (prior to setting). Various hours have then been assessed between the rise and set times to provide a suitable range of shading scenarios.

The extent of the shadows has been determined as being the intersection of the line from the sun's positon (centre of the sun) in the sky across the top of the proposed building to where this intersects with the existing ground surface.

The assessment has also identified a number of nearby existing structures that will influence the extent of the anticipated shading from the proposed Hotel structure. In these instances the existing structures are expected to interrupt the new shadow, preventing it from extending beyond the existing structure (i.e. the new shadow will terminate on the wall or roof of the interrupting structure). The instances where this occurs have been marked on the assessment diagrams as a yellow line on the periphery of the shading areas. I note that not all existing structures have been included in this part of the assessment. There are many small existing structures, and other features such as established trees, that are likely to interrupt the anticipated Hotel shading, which have not been assessed. It is considered that the influences of these elements on the shading assessment will be relatively minor. The structures that have been taken into account are those that I expect will have a moderate to substantial effect on the shading assessment, these generally being large structures located near to the Hotel site and medium-large structures located near to the limits of the projected shading effect.

2.0 Other Relevant Matters

It is relevant to note that the shading assessments undertaken at this time do not take into account the following influences-

1. No transitional shading has been illustrated on the assessment diagrams.
   Transitional shading occurs along the inside and outside edges of the shading areas, where the sun is partially obscured by the edge to the structure. This creates a 'fade' between full sunlight to full shadow, with a transition range between. The

average apparent diameter of the sun is 0°32'02", which creates a transitional shading wedge that widens at a rate of 0.932m for every 100m that the full shadow extends away from the subject structure. The 'hard' lines shown on the assessment plan at the edges of the shading areas illustrate the centre of the transitional fade wedges (due to these lines having a bearing to the centre of the sun). Thus the transitional wedges, if depicted on the assessment diagrams, would project on both the inside and the outside of the illustrated lines at a rate of 0.466m per 100m. As an example, if we consider the longest of the assessed shadows, occurring at 4pm on the Winter Solstice diagram and having a shadow that extends a distance of close to 710m, we can determine that the total width of the transitional shading width at its maximum is 6.617m. This wedge would extend to a maximum distance of 3.309m on either side of the shadow edge illustrated, this width equating to a diagram distance of 1.3mm when plotted at the 1:2500 scale of the Winter Solstice assessment diagram.

2. No assessment has been made to-date of the shading that might be expected to be created by the establishment of a non-fanciful permitted baseline structure within the development site.
3. No assessment has been made to-date of the shading that is presently generated across the application land (and beyond the application land) by existing structures and environment.

Assessment report prepared by:

Kurt Bowen
Registered Professional Surveyor
Paterson Pitts Group

30 June 2017

SHADING ASSESSMENT
PROPOSED MORAY PLACE DUNEDIN HOTEL

These notes accompany the shade diagram plans that form part of the resource consent application for the proposed Dunedin Moray Place Hotel. The purpose of these notes is to describe the methodology used to determine the shading effects and any other relevant matters.

These notes have been updated as at the above date. The updated notes include discussion around the additional set of shading diagrams dated 30 June 2017 (refer section 3.0 below). These notes also address a minor adjustment to sheets 2 and 3 of the shading diagrams that were supplied with the original application documents.

1.0 Methodology

The critical heights of the proposed building have been determined from the architectural concept plans, with a correction applied to convert these levels to Otago Datum.

The critical levels are-

1. Top of main building. This is shown on the architectural plans as having a level of 59.600m (this is the level at the top of the garret/roof terrace). The conversion to Otago Datum is a static +112.500m, which gives a resulting Reduced Level (RL) of 172.100m.
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I note that there is a 0.200m difference in the elevation levels between the architectural concept plans and the unit title subdivision plans. This appears to be a rounding difference resulting from independent design processes. While this difference exists, it is not of a size that is considered to either i) materially affect the various assessments that have been undertaken, or ii) materially affect the accurate interpretation of the proposed activity.

The shading assessment has taken into account four principal forms of the proposed Hotel structure, these being-

- The service shaft and ring feature at the top of the building.
- The extent of the structure at its upper level floor (at RL 172.100). Note that this shape ignores the small bite that is shown on Section AA of the architectural plans removed for the left-hand-side of the structure.
- The extent of the structure at its widest 'bulge' point (Level 8).
- The extent of the structure at its various ground level elevations (Levels 1 to 4) as it retracts from the bulge point at Level 8.

The combination of these four principal forms, at their respective elevations, provides the 3-dimensional block that has been used as the basis of the shading assessment.

Ground levels of the surrounding landscape have been adopted from Dunedin City Council LiDAR information (sourced as contour lines at 0.500m intervals). This LiDAR information has been corrected by +100.000m to convert from Mean Sea Level to Otago Datum.

The elevation and orientation of the sun has been interpreted in the conventional manner using the diagram titled 'Elevation and Bearing to Sun in Dunedin (45°53'S 170°30'E) – FIG. A', a copy of which is attached.

Using the above information, an assessment has been carried out for each of the three significant annual occurrences – Summer Solstice (at Daylight Savings Time), Winter Solstice and at the Equinox.

The earliest time of the day assessed for each of the above instances has been determined as being the earliest hour at which the sun has risen above the eastern horizon. The latest time of the day assessed for each of the above instances has been determined as being the latest hour at which the sun is still visible above the western horizon (prior to setting). Various hours have then been assessed between the rise and set times to provide a suitable range of shading scenarios.

The extent of the shadows has been determined as being the intersection of the line from the sun's positon (centre of the sun) in the sky across the top of the proposed building to where this intersects with the existing ground surface.

The assessment has also identified a number of nearby existing structures that will influence the extent of the anticipated shading from the proposed Hotel structure. In these instances the existing structures are expected to interrupt the new shadow, preventing it from extending beyond the existing structure (i.e. the new shadow will terminate on the wall or roof of the interrupting structure). The instances where this occurs have been marked on the assessment diagrams as a yellow line on the periphery of the shading areas. I note that not all existing structures have been included in this part of the assessment. There are many small existing structures, and other features such as established trees, that are likely to interrupt the anticipated Hotel shading, which have not been assessed. It is considered that the influences of these elements on the shading assessment will be relatively minor. The structures that have been taken into account are those that I expect will have a moderate to substantial effect on the shading assessment, these generally being large structures located near to the Hotel site and medium-large structures located near to the limits of the projected shading effect.

2.0 Other Relevant Matters

It is relevant to note that the shading assessments undertaken at this time do not take into account the following influences-

1. No transitional shading has been illustrated on the assessment diagrams. Transitional shading occurs along the inside and outside edges of the shading areas, where the sun is partially obscured by the edge to the structure. This creates a 'fade' between full sunlight to full shadow, with a transition range between. The average apparent diameter of the sun is 0°32'02", which creates a transitional shading wedge that widens at a rate of 0.932m for every 100m that the full shadow extends away from the subject structure. The 'hard' lines shown on the assessment plan at the edges of the shading areas illustrate the centre of the transitional fade wedges (due to these lines having a bearing to the centre of the sun). Thus the transitional wedges, if depicted on the assessment diagrams, would project on both the inside and the outside of the illustrated lines at a rate of 0.466m per 100m. As an example, if we consider the longest of the assessed shadows, occurring at 4pm on the Winter Solstice diagram and having a shadow that extends a distance of close to 710m, we can determine that the total width of the transitional shading width at its maximum is 6.617m. This wedge would extend to a maximum distance of 3.309m on either side of the shadow edge illustrated, this width equating to a diagram distance of 1.3mm when plotted at the 1:2500 scale of the Winter Solstice assessment diagram.
2. No assessment has been made to-date of the shading that is presently generated across the application land by existing structures and environment.

3.0 Additional Shading Diagrams

The additional shading diagrams, in 13 sheets, serve to illustrate the shading impact from a number of different scenarios.

The shading extents on the additional sheets have been determined using the same methodology as applied to the original shading diagrams (as described above).

Sheets 1-3 illustrate the shading from the proposed Hotel at the three principle times of the year (Summer Solstice at Daylight Savings Time, Equinox, and Winter Solstice). These mirror the original shading diagrams, however include the extent of shading that would be expected to occur at several selected levels of the Hotel (shown and labelled in orange). The selected levels are-

- Level 16, 168.3m
- Level 14, 161.1m
- Level 10, 146.7m

Sheets 4-7 illustrate the impact of shading from the proposed Hotel on the Octagon at various times in the afternoon of the Winter Solstice. The times used are: 2pm, 2:25pm, 3pm and 4pm. The time at 2:25pm corresponds to the angle of the sun matching the orientation of Harrop Street.

Sheets 4-7 show the extents of shading from existing buildings within the Octagon. This existing shading is shown in a dotted pattern to distinguish it from the Hotel shading, which is shown in a more solid grey pattern. Where the two sources of shading overlap, the

existing shading has been given priority. The purpose of these diagrams is to illustrate the additional shading that the proposed Hotel will generate beyond the existing shading that occurs through this period of the Winter Solstice.

Sheets 8-10 illustrate the shading effect that might be expected to be generated from a permitted baseline structure (under the operative District Plan) that could be erected within the 'Lot 1' portion of the subject site. To evaluate a 'non-fanciful' structure, I have adopted a building that is stepped across the site, with four different roof levels that are 3.5m apart. Each of the roof levels used by these sheets have then been set at a height that is 11m above a position on the ground that is located at the lowest point on a line running across the site perpendicular to the building steps and located near the Moray Place corridor (this line is the same line shown as 'A-A' on the 'Occupied Space' image sheet dated 30 June 2017, supplied with the Anticipated Views Assessment). For the portions of the building that are located south of the 'A-A' profile line, I have recognised that these portions will also step lower, as the building moves towards Moray Place, due to the ground level reducing in this direction. Accordingly the non-fanciful structure has roof levels that have been set 11m above appropriate ground levels in these regions and this is reflected in the resulting shading assessment diagrams. Overall, it is my consideration that a new building constructed to the levels described would comply with the 11m heights as anticipated by the operative District Plan and that such a building would be non-fanciful in nature.

Having determined the shape of a non-fanciful structure, the shading impacts have been determined in the same way as the standard methodology above, for various times of day at each of the three principle times of year.

Sheet 11 illustrates the shading impact that would be expected to be generated from a permitted baseline structure (under the proposed District Plan) that could be erected within the 'Lot 1' portion of the subject site. This diagram has been determined in the same way as the previous 3 sheets, however this scenario applies a building height of 16m instead of 11m. This assessment has been carried out for various times of day at only the Winter Solstice instance.

Sheet 12 illustrates the shading effect that might be expected to be generated from a permitted baseline structure (under the operative District Plan) that could be erected along the northern boundary of the Kingsgate property. To evaluate a 'non-fanciful' structure, I have adopted a building that is stepped along the northern side of the subject boundary line, with different roof levels that are 3.0m apart.

Each of the roof levels used by these sheets have then been set at a height that is 11m above the lowest point on the ground within the relevant building section. The lowest point of each section has been determined at a distance of at least 6m to the north of the boundary line (rather than on the boundary itself), in recognition that a non-fanciful structure must have a useable width associated with it. The small region of bank at the Moray Place end of the boundary has also been taken in to account, with the shading that would be generated from a permitted building at this location being restricted to reflect a structure that extends no more than 11m in height above an appropriate ground level in this region.

The building heights have been determined to comply with the operative District Plan provisions, which allow an 11m high building along the eastern half of the subject boundary and a 9m high building along the western half (due to differences in the applicable zone provisions).

Having determined the shape of a non-fanciful structure, the shading impacts on the adjacent Kingsgate property have been determined in the same way as the standard methodology above, for times at 9am and 10am on the Winter Solstice.

Sheet 13 illustrates the vertical extent to which the shading impact assessed on sheet 12 is expected to occupy the northern face of the Kingsgate building, at both the 9am and 10am instances. The height of this shading has been determined from calculations made using the various permitted building heights that have been established for the non-fanciful structure, the elevation of the sun at each of the assessed times, and the position and height of the Kingsgate building (as adopted from DCC aerial photography and LiDAR information). This resultant height has then been transposed onto the photographic image in the correct proportional relationship.

To aid in assessment purposes, the shading impact of the proposed Hotel structure has been included on sheet 13, at it would appear at the same times assessed. The proposed Hotel shading is shown in a solid grey pattern, while the permitted structure shading is shown in a dotted pattern. Where the two sources of shading overlap, the permitted baseline shading has been given priority.

4.0 Shading Adjustment

The sheets numbered 2 and 3 of the information dated 30 June 2017 include a minor adjustment to the shading lines that were shown on the original application information sheets 2 and 3. This adjustment serves to improve the accuracy of the shadow paths by a small margin. The new sheets have plotted the proposed Hotel at a horizontal location several meters more accurately than the original sheets, and the shadow paths have been improved accordingly. This has resulted in the shading impacts being plotted approximately 1mm differently on the new sheets that they appeared on the original sheets (when printed in A3 size format). Sheet 1 has not required any adjustment in this regard.

Assessment report prepared by:

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