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Level 6, 5 Martin Place
SYDNEY, NSW 2000

Project 92225.10
27 March 2024
R.001.Rev1
HDS

Attention: Paul Hourigan
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Geotechnical Review

South Creek West, Sub-Precinct 5, Cobbitty

670 The Northern Road, Cobbitty NSW

1. Introduction

This report presents a geotechnical review undertaken by Douglas Partners Pty Ltd (Douglas) for a proposed residential sub-division at 670 The Northern Road, Cobbitty, also referred to as 'Cobbitty Sub-Precinct 5', in the 'South Creek West Land Release Area'. The review was commissioned in an email dated 20 March 2024 by Mr. Paul Hourigan of BHL Group Pty Ltd, and was undertaken in accordance with our email proposal dated 18 March 2024 (proposal reference 92225.10.P.001.Rev0). It is understood that this review will accompany a 'Planning Proposal' for a proposed amendment to the State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (Parkland City SEPP).

The scope of work included a site walkover of steep slopes within the south-eastern portion of the proposed development area, a review of the updated 'indicative layout plan' for the development together with previous geotechnical investigation and assessment reports prepared for the development, and preparation of an opinion on whether the steep hillside slopes can be made suitable for residential development.

2. Planning Proposal Preamble (Supplied)

The planning proposal is seeking to re-zone 172.74 hectares (ha) of land, which forms 57% of the development area known as 'Precinct 5'. The remainder of Precinct 5 (130.41 ha, 43%) is owned by a separate landowner, which is not the subject of the Planning Proposal. The intended outcome of the planning proposal is to make the following amendments to the Parkland City SEPP:

- Incorporate the site on the 'Land Application Map' for the Parkland City SEPP;
- Re-zone the land, to include:
 - o 'E1': Local Centre,
 - o 'MU1': Mixed Use,

- o 'C2': Environmental Conservation,
- o 'C4': Environmental Living,
- o 'R2': Low Density Residential, and
- o 'R3': Medium Density Residential,
- Introduce the following building heights:
 - o 'Low-density residential': 9 metres, allowing for developments of up to two storeys height,
 - o 'Medium-density residential': 12 metres, allowing for developments of up to three storeys height, and
 - o 'Mixed-use development': 21 metres for the 'village centre', allowing for developments up to five storeys in height.

The planning proposal is supported by a revised 'indicative layout plan' (ILP) for approximately 2,312 dwellings, together with a local centre and 19.97 ha of 'active' and 'passive' open spaces.

The revised ILP also seeks to incorporate the Government Architect's 'Connecting with Country' design framework, including protection of ridgelines, creeks and 'view corridors', celebrating the riparian corridors and waterways through incorporation into open space, and positioning 'key uses' on flatter parts of the site to minimise cut and fill earthworks.

The proposed amendments to the Parkland City SEPP seek to transition the existing rural landscape into a residential community. This is in keeping with the vision and aspirations of the 'Western Sydney Growth Areas' program of the NSW Government, which includes a diverse range of residential housing types for south-western Sydney.

3. Proposed Development

The supplied Indicative Layout Plan (ILP) for the development (prepared by Design and Planning Pty Ltd) is entitled 'Draft Indicative Layout Plan – BHL Land Holding, Cobbitty', drawing reference 'BHLCO-2-001a-2', Rev N, dated 26 March 2024.

A sub-area of the site near the southern development boundary, adjacent to Lot 1 in deposited plan DP1273487 (where construction of two water storage reservoirs is in progress), is denoted on the ILP as 'Hilltop Investigation Area' and is bounded to the west by a 'collector road' and by 'local roads' to both the north and north-east.

In accordance with the revised ILP (Rev N), the footprint of the 'Hilltop Investigation Area' covers areas of proposed 'Environmental Living' and 'Low Density Residential' land use and corresponds with slope stability risk Zones 2 and 3 set out in our previous report (Douglas, 2023b – refer Section 4.1). Indications of previous soil movement (e.g. sliding or creep) were observed in these zones, with the thickness of movement-affected soils (colluvium) of up to 0.9 m.

Based on an assessment of historical slope instability, geological mapping, subsurface investigations, and a qualitative risk assessment, the assessed slope stability risk for these slope stability risk Zones 2 and 3 range between 'Moderate risk' for Zone 2 and 'High to Very High risk' for Zone 3.

4. Background Information

4.1 Previous Reports

Geotechnical, groundwater and salinity investigations have previously been carried out for the proposed development area (or broader areas incorporating 'Cobbitty Sub-Precinct 5'), including:

- *'Report on Land Capability and Contamination Assessment, Oran Park Precinct, Oran Park and Cobbitty, Report 40740'*, dated February 2007 (Douglas, 2007);
- *'Report on Preliminary Geotechnical and Salinity Assessment, Proposed Rezoning, Sub Precinct 5, South Creek West, NSW, Report 92225.02.R.001.Rev3'*, dated December 2022 (Douglas, 2022a);
- *'Report on Preliminary Groundwater Investigation, Proposed Rezoning, 621-705 The Northern Road, Cobbitty NSW, Report 92225.04.R.002.Rev4'*, dated December 2022 (Douglas, 2022b);
- *'Report on Salinity Investigation and Salinity Management Plan, Proposed Rezoning, Sub Precinct 5, South Creek West, NSW, Report 92225.05.R.001.Rev0'*, dated March 2023 (Douglas, 2023a); and
- *'Report on Stability Assessment, Proposed Residential Subdivision, South Creek West, Precinct 5, Cobbitty, Report 92225.06.R.002.Rev1'*, dated March 2023 (Douglas, 2023b).

The steeper hillside slopes within the south-eastern part of the site were assessed (in Douglas, 2022a) to have 'intermediate' or 'major' slope constraints to development (delineated as either slope stability risk zones 'Zone 2' or 'Zone 3'). Further site investigations (including site walkover mapping and test pits) were carried out in response to a Camden Council request for information (RFI) in August 2022, to *"delineate slope stability risk 'Zone 2' and 'Zone 3' areas of the site which may be subject to existing or potential slope constraints, assess the risk of slope instability, and to provide recommendations and guidelines for residential development"* (reported in (Douglas, 2023b)).

The slope stability risk zones near Lot 1 in DP1273487 (i.e. the ridgeline with the water storage reservoirs) are shown together with the revised indicative layout plan on Drawing 1 (revision N, dated 26 March 2024). A notional landslide travel distance runoff 'buffer zone' line has been added 20-30 m downslope of the mapped interface between Zone 2 and Zone 3, to conservatively represent the possible downslope runoff limit. Additional geotechnical works (including field mapping and modelling) will be required to refine this notional boundary.

The land uses previously proposed for slope stability risk zone 3 ('major' slope constraints: in Douglas, 2023b) mainly included 'open space', on this basis it was considered that landscaping

and use as 'open space' was appropriate within this zone, provided slope integrity was maintained and erosion control measures were implemented.

4.2 Recommended Geotechnical Remediation and Hazard Reduction Works

The stability assessment report (Douglas, 2023b) recommended geotechnical remediation and hazard reduction works to be carried out in Zone 2, to reduce and/or maintain the current risk of slope instability, and to facilitate residential development within the steep hillside, whilst keeping the risk of slope instability within acceptable risk levels.

The remediation and hazard reduction works included:

- Removal of all movement-affected materials down to the top of rock, installation of sub-surface drainage to control soil pore water pressures, followed by replacement with 'Level 1' engineered fill;
- Improvements to surface drainage for controlled disposal of stormwater to the Council stormwater system;
- Implement erosion control (soil stabilisation) measures in reserves, parks and other green spaces (such as retention of existing trees and planting of additional deep-rooted shrubs or trees);
- Transfer of structural loads (such as from dwellings) to a uniform bearing stratum of weathered bedrock; and
- Ongoing site maintenance and inspections for the developed lots and infrastructure within the steep hillside (e.g. property owners for individual Lots, and by Council within public reserves).

Previously the land use within Zone 3 was mainly 'Open Space'. As such Douglas did not provide rectification approaches as it was not necessary to support the 'Open Space' rezoning.

4.3 Conclusion for Proposed Re-Zoned Land Use

The previous report (i.e. Douglas, 2023b) concluded that the lower and mid-slopes within the southern part of the site (inclusive of Zones 1 and 2) are considered suitable for residential development (from a geotechnical perspective) provided that design and construction is undertaken in accordance with good practice for hillside construction and with the recommendations presented in the report. Additional work was recommended to be carried out to provide further inputs to design and construction, including assessment of potential landslide run-out distances and delineation of the downslope extent of movement-affected areas.

The previous report concluded that the upper areas of hillside slopes (Zone 3) have major constraints to residential development due to the potential for instability (or re-activation of previous instability), and that slope stabilisation measures will be required for residential development together with implementation of engineering works, both of which may need to be substantial.

5. Current Site Observations

A site walkover was carried out by the undersigned on 21 March 2024, viewed both from the ridgeline crest (adjacent to the water reservoirs) and within the areas of steep hillside slopes denoted in our previous report as being areas of 'intermediate' or 'major' slope constraints (i.e. slope stability risk zones 2 and 3). African olives still cover most of the movement-affected area of steep hillside slope.

No areas of new slope instability or indications of changes to existing movement-affected areas were observed during the site walkover.

6. Comments

As the steep slopes in the site and adjacent areas are unchanged since the preparation of our previous reports, it is considered that the subsurface investigation data and site observations presented in our previous report are still valid (including geological mapping observations and subsurface information from test pits (Douglas, 2023b)), as are the interpreted terrain units presented in the geotechnical model, and the recommended geotechnical remediation and hazard reduction measures.

In some areas, the notional landslide travel distance runout 'buffer zone' (as shown on Drawing 1, to be refined) extends downslope of the Zone 2 boundary and into areas likely to be nominated for urban building structures and infrastructure. This indicates that earthworks will be required in the upslope Zone 3 areas so that slope instability risks can be mitigated for the proposed urban building envelopes.

7. Conclusion

It is our opinion that:

- the conclusions of the stability assessment report (Douglas 2023b) are still valid for the current revision of the ILP;
- the conclusion of the stability assessment report that the lower and mid-slopes within the site can be made suitable for the proposed residential development (inclusive of slope stability risk zones 1 to 2), subject to the implementation of remediation and hazard reduction works, is still valid;
- the upper hillside slope area can be made suitable for residential development following further geotechnical site investigations and the implementation of necessary engineering works;
- engineering works (such as earthworks and construction of retaining walls) will be required upslope of proposed urban building envelopes in Zone 2 areas (i.e. engineering works needed in Zone 3), to mitigate slope instability risks. There will be significant earthworks and subsurface drainage required as part of rectification of Zone 3. Works in Zone 3 will abut Sydney Water's land, and will need to support the Sydney Water land. Douglas recommends early engagement with Sydney Water regarding these works;

- the land re-zoning proposal (to residential land use) is supported, however, supplementary geotechnical works during the upcoming phase of the project (i.e. site investigations, monitoring, modelling and further analysis) are necessary to confirm the engineering works and development controls required to be implemented. The purpose of the controls would be to ensure the stability of adjoining land is maintained (including both water reservoirs in Lot 1 DP1273487). It is noted that development consent will also likely be subject to Sydney Water approval. This may include the need for necessary earthworks and/or engineering works to ensure that development in the steep hillside does not inadvertently affect the Sydney Water site;
- it is expected that the supplementary geotechnical works scope would include:
 - o review of data and documents recently received under subpoena from the Sydney Water Corporation, such as groundwater levels in standpipe piezometers and ground movements measured within inclinometers in the steep slopes and crest of the hillside above the site,
 - o drilling of cored boreholes within and adjacent to slope stability risk Zones 2 and 3, to determine the subsurface profile, depth to rock, and to confirm whether the base of sliding extends into the underlying rock,
 - o installation into completed boreholes of inclinometers and standpipe piezometers, followed by a long-term program (1-2 years) of measurement and monitoring,
 - o excavation of test pits adjacent to and within areas of the site identified as being within slope stability risk Zones 2 and 3, to further delineate the extent and depth of movement-affected materials,
 - o completion of laboratory testing on samples of colluvial and residual soils (such as triaxial testing of undisturbed samples), to confirm soil parameters for slope stability modelling,
 - o calculation of the landslide run-out travel distance for the steep hillside slopes adjacent to the ridgeline, to refine the downslope limits of slope stability risk zones,
 - o stability analysis modelling of multiple sections through the steep hillside slopes, to assess whether these slopes in their current condition or future modified geometry have or will have an 'acceptable' factor of safety, and
 - o preparation of an earthworks methodology for rectification of areas which may be subject to existing or potential slope instability.

8. References

Douglas. (2007). *Report on Land Capability and Contamination Assessment, Oran Park Precinct, Oran Park and Cobbitty*. Macarthur: Douglas Partners Pty Ltd, Report 40740, dated 28 February 2007.

Douglas. (2022). *Preliminary Groundwater Investigation, Proposed Rezoning, 621-705 The Northern Road, Cobbitty, NSW*. Macarthur: Douglas Partners Pty Ltd, Report 92225.04.R.002.Rev4, dated 22 December 2022.

Douglas. (2022). *Report on Preliminary Geotechnical and Salinity Assessment, Proposed Rezoning, Sub Precinct 5, South Creek West, NSW*. Macarthur: Douglas Partners Pty Ltd, Report 92225.02.R.001.Rev3, dated 8 December 2022.

Douglas. (2023). *Report on Salinity Investigation and Salinity Management Plan, Proposed Rezoning, Sub Precinct 5, South Creek West, NSW*. Macarthur: Douglas Partners Pty Ltd, Report 92225.05.R.001.Rev0, dated 13 March 2023.

Douglas. (2023). *Report on Stability Assessment, Proposed Residential Subdivision, South Creek West, Precinct 5, Cobbitty*. Macarthur: Douglas Partners Pty Ltd, Report 92225.06.R.002.Rev1, dated 27 March 2023.

9. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at 670 The Northern Road, Cobbitty NSW in accordance with Douglas' proposal dated 18 March 2024 and acceptance received from Mr. Paul Hourigan via email dated 20 March 2024. The work was carried out under Douglas' Engagement Terms. This report is provided for the exclusive use of BHL Group Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or another site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents

The opinion presented in the report is based on a recent site walkover and the results of previous site investigations, which are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed.

Douglas' advice and opinion is based upon the conditions encountered during the previous subsurface investigation. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, a detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached pages and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully

Douglas Partners Pty Ltd

Reviewed by


Huw Smith
Senior Associate


John Braybrooke
Principal

Attachments: About this Report
Drawing 1: Slope Stability Risk Zone plan with proposed sub-division plan overlay

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at

the time of construction as are indicated in the report; and

- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

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About this Report

Site Anomalies

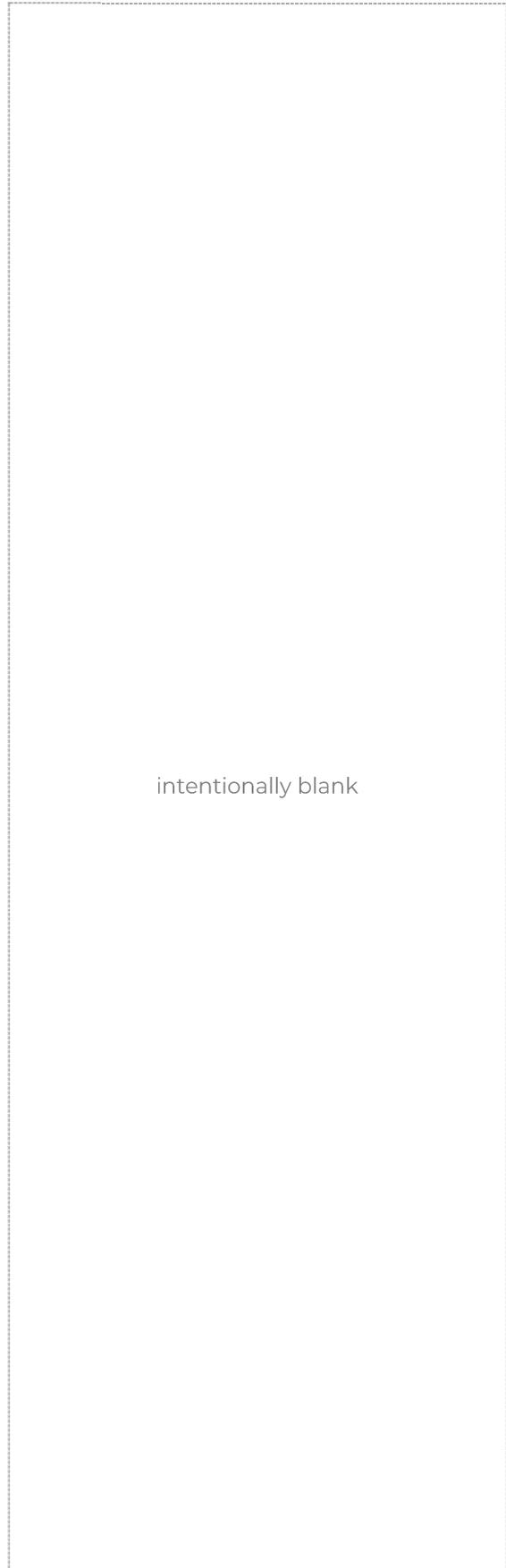
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

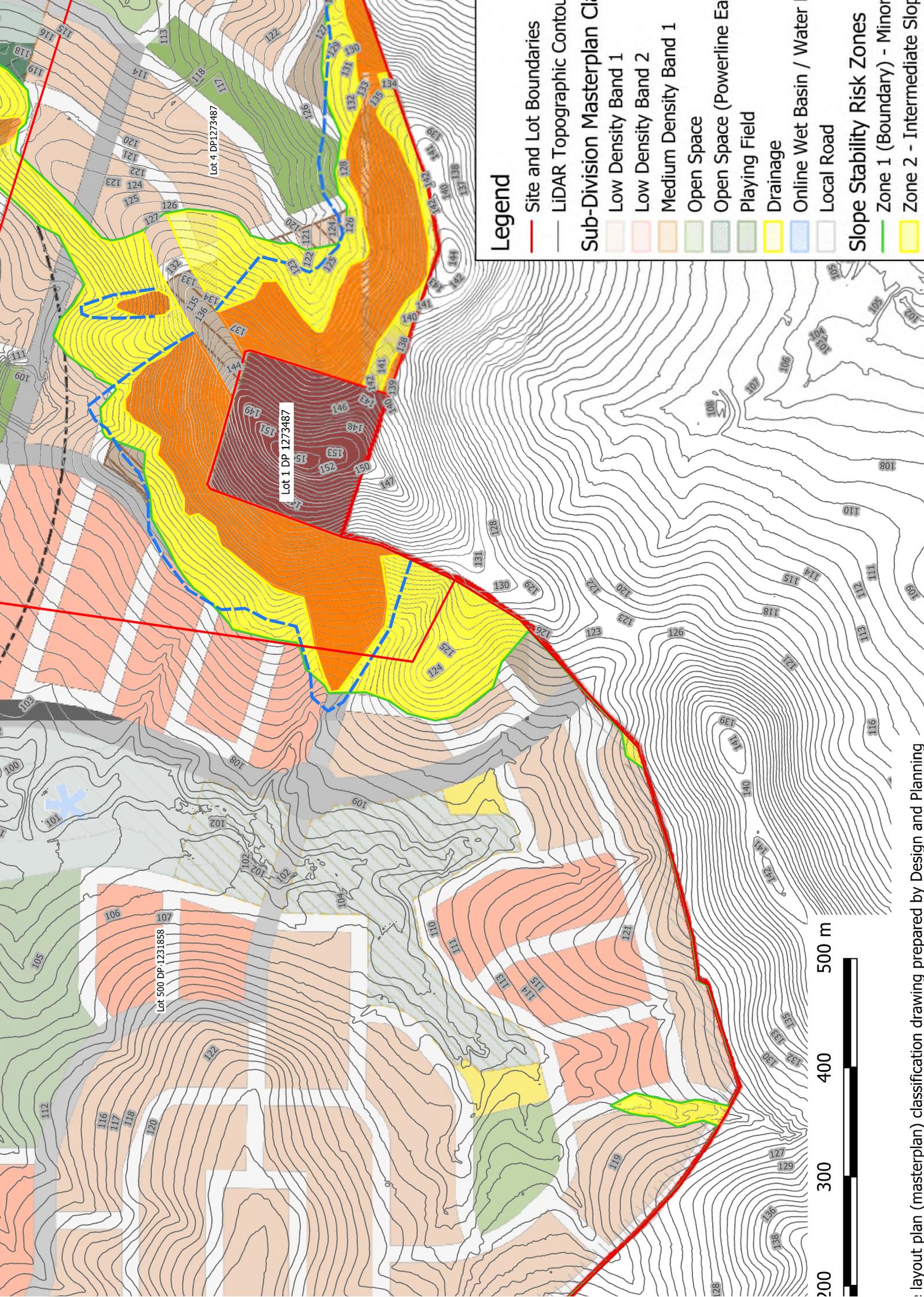
Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.





Legend

- Site and Lot Boundaries
- LiDAR Topographic Contour
- Sub-Division Masterplan Classification**
- Low Density Band 1
- Low Density Band 2
- Medium Density Band 1
- Open Space
- Open Space (Powerline Easement)
- Playing Field
- Drainage
- Online Wet Basin / Water
- Local Road

- Slope Stability Risk Zones**
- Zone 1 (Boundary) - Minor
- Zone 2 - Intermediate Slope

200 300 400 500 m