Cleveland Group Holdings Pty Ltd

Geotechnical Desktop Study

Lot 1/194419, Lot A/156446, Lot 313/1188000, Cleveland Road, Dapto, NSW.

Report No. E23822.G01

28 May 2018

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EI Report No. *E23822.G01*

Date: *28 May 2018*

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Revision	Details	Date	Amended By
0	Original	28 May 2018	-

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1 INTRODUCTION

1.1 BACKGROUND

At the request of Mr Patrick Touma on behalf of Cleveland Group Holdings Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Desktop Study (GDS) for the proposed mixed use development at Lot 1/194419, Lot A/156446, Lot 313/1188000, Cleveland Road, Dapto, NSW. (the Site).

This GDS report has been undertaken to assess the likely Site surface and subsurface conditions and anticipated geotechnical factors associated with the proposed development, in support of a Development Application to the Local Council, and the preparation of the initial design of the proposed development.

We note that intrusive works (i.e. boreholes) were not carried out at the Site as these were outside the agreed scope of work.

1.2 PROPOSED DEVELOPMENT

EI were supplied preliminary subdivision plan for Lot Ain DP156466 to assist with preparation of this report.

It is understood that the site covers an area of approximately 136Ha and is currently vacant rural land with two residential dwellings (within Lot 1 in DP 194419, and Lot 313 in DP 1188000). The future proposed site redevelopment would involve subdivision of the site for low density dwellings.

1.3 OBJECTIVES

This GDS report has been undertaken to assess the likely Site surface and subsurface conditions for the development of a preliminary conceptual ground model of soil, rock and groundwater conditions beneath the site based on our experience and previous investigations within the vicinity of the site. This model is to assist in providing preliminary geotechnical advice and recommendations for consideration in the preparation of concept designs and construction methodologies for the proposed development including:

- Dilapidation surveys;
- Excavation assessment;
- Groundwater considerations;
- Excavation retention;
- Preliminary building foundation options including preliminary design parameters;
- The requirement for specific geotechnical investigations for detailed design post-DA and following site clearance.

2 SITE DESCRIPTION

2.1 SITE DESCRIPTION AND IDENTIFICATION

The site identification details and associated information are presented in Table 2-1 below while the site locality is shown on Figure 1.

Table 2-1 Summary of Site Information

Information	Detail
Street Address	Lot 1/194419, Lot A/156446, Lot 313/1188000, Cleveland Road, Dapto, NSW.
Lot and Deposited Plan (DP) Identification	Lot 1 in DP 194419, Lot A in DP156446, and Lot 313 in DP 1188000
Local Government Authority	Wollongong City Council
Brief Site Description	The site is currently a vacant rural land. Transmission towers are scattered the around the site. It consisted of large rural and vacant lands, Mullet Creek run through the entire site. The site is also comprised two residential dwellings, large open fields with ancillary structures (sheds, storages, and access tracks), localised areas of trees and dams.
Site Area	Approximately 136Ha (Measured from Sixmaps: https://maps.six.nsw.gov.au/)

2.2 LOCAL LAND USE

The site is situated within an area of agricultural use. Current uses on surrounding land are described in Table 2-2.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
North	A vacant rural land (Lot 293 in DP 751278 and Lot 312 in DP1188000), and Cleveland Road, a single lane asphaltic-concrete paved driveway, Beyond the driveway, a vacant rural land.
East	A vacant rural land (Lot 293 in DP 751278, Lot2 in DP1167701).
South	A vacant rural land (Lot1 in DP565745, Lot2 in DP565745, Lot 29 inDP23265, Lot21 in DP31023, Lot15 in DP252336, Lot112 in DP260318, Lot100 in DP1158249, Lot100 in DP1179920, Lot2 in DP527226, Lot1001 in DP1045942, Lot203 in DP624863), and the SP92594
West	A vacant rural land (Lot 32 AND 33 in DP809267).

2.3 REGIONAL SETTING

The site topography, geological and hydrogeological information for the locality is summarised in Table 2-3.

Table 2-3 Topographic, Geological and Hydrogeological Information

Attribute	Description
Topography	The local topography is described, as Rolling low hills. Relief 20–50 m. Slope gradient <20%. Broad convex crests with long ridges. Long moderately inclined side slopes with concave foot slopes grading into broad drainage plains. Scattered occasional rock outcrops.
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Kiama 1:50,000 Geological Sheet Series Sheet 9028-1 (DMR 1974) indicates the site is underlain by Quaternary aged Alluvium, which typically consist of gravel, beach and dune Sand. The regional stratigraphy is for the alluvial soil to overlie rocks of the Budgong Sandstone of Shoalhaven Group, which typically comprises red-brown and grey volcanic sandstone.

2.4 CONCEPTUAL GROUND MODEL

A summary of subsurface ground conditions likely to be encountered at the Site is presented in Table 2-4 below. Information presented in Table 2-4 below is inferred from a review of our in house database and our knowledge of the area.

Table 2-4 Conceptual Ground Model

Unit	Material	Comment
1	Fill / Topsoil	Fill material is inferred to be uncontrolled and poorly compacted. Filling may be deeper beneath existing structures and in landscaped areas of the site.
2	Alluvium	Mixed soil of gravel and sand, grading into extremely weathered material at depth.
3	Sandstone	The sandstone is expected to be initially of distinctly weathered. The strength generally increases in strength and decreases in weathering with depth.

Based on our experience within sites underlain by alluvial soil, groundwater is expected to be encountered at within the Unit 2 profile. However, groundwater levels at the site should be confirmed by intrusive investigation prior to the finalisation of designs.

3 DISCUSSIONS AND RECOMMENDATIONS

3.1 OVERVIEW

Considering the proposed development and likely subsurface conditions that may be encountered, we consider the following to be the main geotechnical issues for the proposed development:

- Site Classification;
- Basement Excavatability;
- Excavation Retention;
- Depth to rock and rock quality for foundation design;
- Depth of groundwater.

Further discussions on the above issues are provided in the following sections.

3.2 DILAPIDATION SURVEYS

Dilapidation surveys should be carried out on the adjoining structures and infrastructures that fall within the zone of influence of the excavation. The zone of influence of the excavation can be defined as a horizontal distance back from the edge of the excavation of at least twice the excavation depth.

3.3 EXCAVATION METHODOLOGY AND VIBRATION MONITORING

3.3.1 Preliminary Excavation Assessment

No details were provided regarding any proposed excavation depths for the proposed developments. However, some excavations may be required for basements. It is assumed that the proposed development will therefore extend through all Units as described in Table 2-3 above.

Prior to any excavation commencing:

- An appropriate full depth retention system must be installed; and
- Reference must be made to the WorkCover Excavation Work Code of Practice – July 2015.

Units 1 and 2 can be excavated using the bucket of a hydraulic excavator. Further Geotechnical Investigation should be undertaken on the site, to confirm the quality of bedrock within the excavation depth. Should rock breakers be used to excavate Unit 3 material, vibration monitoring must be carried out and further advice must be sought from the geotechnical engineer.

Groundwater seepage monitoring should be carried out during bulk excavation prior to finalising the design of a pump out facility. Outlets into the stormwater system will require Council approval.

3.3.2 Excavation Monitoring

Consideration should be made to the impact of the proposed development upon neighbouring infrastructures, roadways and services. Basement excavation retention systems should be designed so as to limit lateral deflections.

Contractors should also consider the following limits associated with carrying out excavation and construction activities:

- Limit lateral deflection of temporary or permanent retaining structures; and
- Limit vertical settlements of ground surface at common property boundaries and services easement.

- Limit Peak Particle Velocities (PPV) from vibrations, caused by construction equipment or excavation, experienced by any nearby structures and services.

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing building foundations/ services/ pavements and other structures located within or near the zone of influence of the excavation. Owners of existing services adjacent to the site should be consulted to assess appropriate deflection limits for their infrastructure. Measurements should be taken:

- Prior to commencement of excavations;
- Immediately after installation of any temporary or permanent retaining structures;
- Immediately after the excavation has reached a depth of 1.5 m, and each 1.5 m depth increment thereafter;
- Immediately after the excavation has reached bulk excavation level; and
- Immediately after backfilling behind retaining structures.

3.4 Subgrade Preparation and Engineering Fill

3.4.1 Subgrade Preparation and Earthworks

For lightly loaded structures requiring subgrade preparation, we preliminarily recommend the following earthworks. Earthworks recommendations provided in this report should be complemented by reference to AS3798.

1. Strip the upper layer of topsoil and/or fill (if encountered) that contains deleterious materials or organics, and stockpile this separately since these materials are not suitable for re-use as engineered fill.
2. The remaining existing topsoil and/or fill (if encountered) should be fully excavated down to surface of the residual soils and replaced with engineered fill, if required.
3. The exposed subgrade at the base of the excavation should be proof rolled with a smooth drum roller (say 12 tonne) used in static or non-vibratory mode of operation. Caution is required when proof rolling near existing infrastructures and utilities (where present). The purpose of the proof rolling is to detect any soft or heaving areas, and to allow for some further improvement in strength or compaction.
4. The final pass should be undertaken in the presence of a geotechnician or geotechnical engineer, to detect any unstable or soft subgrade areas, and to allow for some further improvement in strength/compaction.
5. If dry conditions prevail at the time of construction then any exposed residual clay subgrade may become desiccated or have shrinkage cracks prior to pouring any concrete slabs. If this occurs, the subgrade must be watered and rolled until the cracks disappear.
6. Unstable subgrade detected during proof rolling should be locally excavated down to a sound base and replaced with engineered fill or further advice should be sought. Any fill placed to raise site levels should also be engineered fill.

3.4.2 Engineered Fill Specifications

Any fill used to backfill unstable subgrade areas, raise surface levels or backfill service trenches should be engineered fill. Materials preferred for use as engineered fill are well-graded granular materials, such as ripped or crushed shale, free of deleterious substances and having a maximum particle size not exceeding 75 mm. such fill should be compacted in layers not greater than 200 mm loose thickness, to a minimum density of 98% of SMDD.

Density tests should be regularly carried out on the fill to confirm the above specifications are achieved. The frequency of density testing should be as per AS 3798-2007, depending on the size of the development. Preferably, the

geotechnical testing authority (GTA) should be engaged directly on behalf of the client and not by the earthworks subcontractor.

During construction of the fill, platform runoff should be enhanced by providing suitable falls to reduce ponding of water on the surface of the fill. Ponding of water may lead to softening of the fill and subsequent delays in the earthworks program.

3.5 Excavation Retention and Retaining Walls

From a geotechnical perspective, it is critical to maintain the stability of the adjacent structures and infrastructures during demolition and excavation works. Excavations and retention systems will need to take into consideration the stability of adjoining structures so as not to have any adverse effects on the buildings and structures adjoining the excavation.

For deep excavations, a suitable full depth retention system will be required for the support of the entire excavation. The retention system must be installed to below Bulk Excavation Level (BEL) (including footings, service trenches and lift overrun pits) and socketed into suitable material.

Temporary batters may be possible given that space is available. Following a geotechnical investigation, further advice regarding the design of temporary batters may be available.

Working platforms for construction plant, placed on in-situ materials or on new fill, may be required and should be designed by a geotechnical engineer.

3.6 Groundwater Considerations

Based on the limited in-house information available for the area, the depth to groundwater is expected to be within the alluvium soil profile. Notwithstanding, we recommend that groundwater wells be installed for monitoring of the groundwater levels and completion of pump out tests at the site. The purpose of the groundwater monitoring is to estimate the groundwater seepage into the excavation to assist in finalisation of the drainage system. Groundwater aggressivity towards steel and concrete should also be assessed against the criteria set out in AS 2159:2009, which gives guidelines for steel and concrete foundation susceptibility to soil and groundwater aggressivity.

The flood conditions of the local area should be investigated to assist in groundwater drainage design.

3.7 Foundation Options

Footings may be founded on Unit 2 alluvium, subject to the results of an intrusive geotechnical investigation. Depending on the encountered soil and its consistency/density, shallow footings may be possible for lightly loaded structures. Piles within the alluvium may also be possible.

Alternatively, the proposed developments may be founded within Unit 3 shale. Bored piers or shallow pad/strip footings founded within Unit 3 shale bedrock may be preliminarily designed for a maximum allowable bearing capacity of 600kPa. For piles, an allowable shaft adhesion equal to 10% of the allowable bearing pressure in compression may also be used.

At least the initial drilling of piles should be completed in the presence of a geotechnical engineer to verify that ground conditions meet design assumptions.

Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremmie system could be used. Concrete must be poured on the same day as drilling, inspection and drilling.

EI highly recommends a geotechnical investigation to be carried out, involving site classification across the site, with a few deep boreholes to determine the depth to bedrock.

The design of piles should consider the aggressivity of the soil and groundwater in accordance with Sections 6.4 and 6.5 of AS2159-2009.

4 CONCLUSIONS

This GDS report provides preliminary advice for construction at the site based on available information prior to intrusive geotechnical investigations. Geotechnical factors which may influence development of the site include:

- Site classification;
- Depth to rock and rock quality for foundation design; and
- Depth of groundwater.

Further geotechnical investigation and design input are required during the detailed design phase prior to and during construction. These are detailed further in Section 5 of this report.

5 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL WORKS

Detailed geotechnical subsurface investigation prior to final design to determine the site specific subsurface profile and geotechnical parameters for design of footings is recommended.

The geotechnical investigation should involve boreholes drilled across the site to assist in the design of each lot.

We do not recommend that the final design be carried out based on this GDS report. The GDS report must be reviewed following the completion of the intrusive geotechnical investigation.

In addition, geotechnical footing inspections should be carried out during the construction stage (if new footings are necessary) to check initial assumptions about foundations conditions and likely variations that may occur between borehole locations and to provide additional advice.

6 STATEMENT OF LIMITATIONS

This report has been prepared for the exclusive use of Cleveland Group Holdings Pty Ltd who is the only intended beneficiary of EI's work. The scope of the investigations carried out for the purpose of this report is limited to those agreed by Cleveland Group Holdings Pty Ltd.

This GDS report is purely a desktop assessment and no intrusive works were carried out at the Site. Further geotechnical investigation and design input are required during the detailed design phase prior to and during construction. These are detailed further in Section 5 of this report.

No other party should rely on the document without the prior written consent of EI, and EI undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EI's approval.

EI has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the geotechnical industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions, with specific sampling locations chosen to be as representative as possible under the given circumstances.

EI's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EI may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EI.

EI's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during remedial activities. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

We draw your attention to the document "Important Information", which is included in Appendix A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by EI, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Should you have any queries regarding this report, please do not hesitate to contact EI.

7 REFERENCES

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

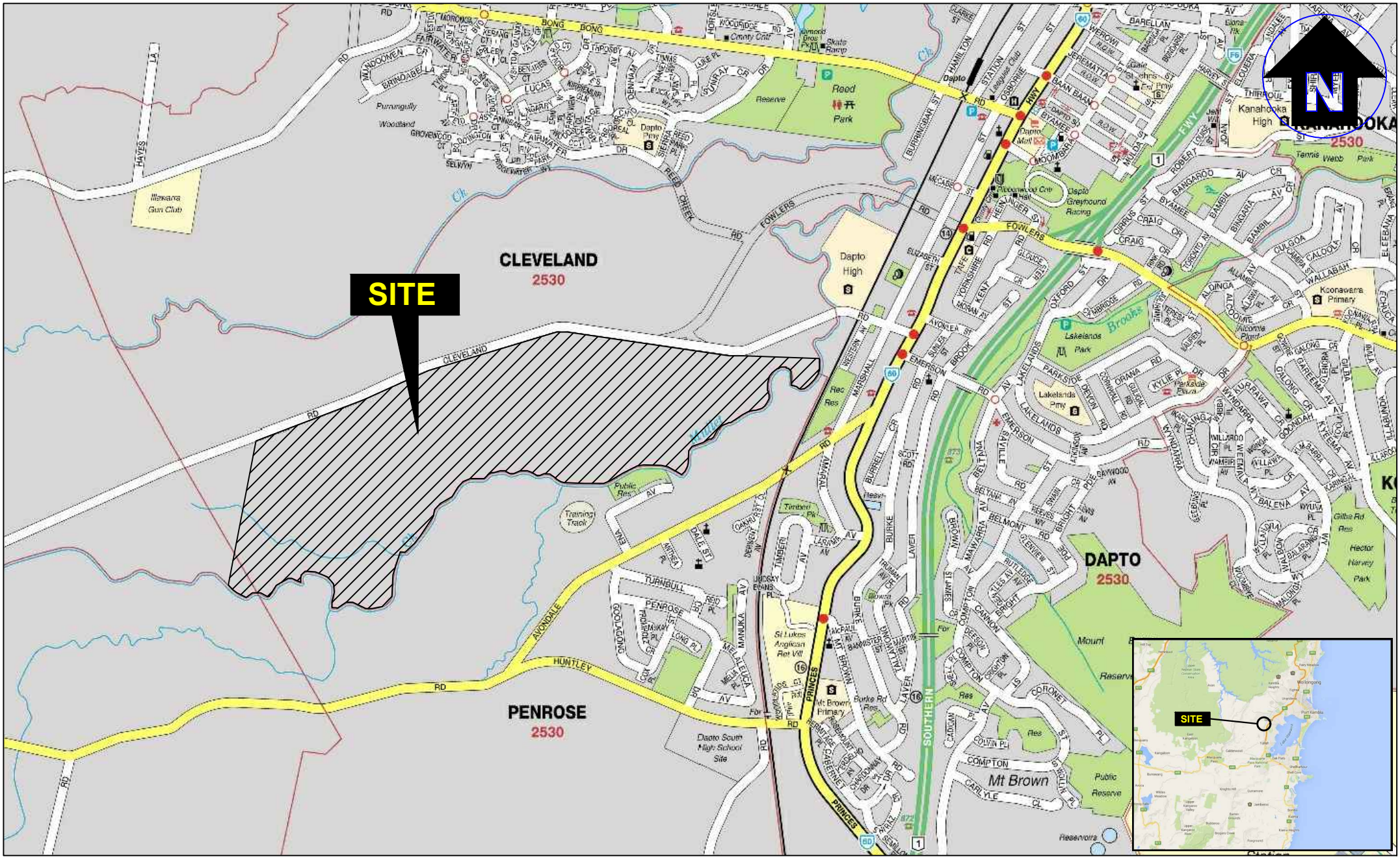
NSW Department of Mineral Resources (1983) Sydney 1:100,000 Geological Series Sheet 9031 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

WorkCover Excavation Work Code of Practice – July 2015

8 ABBREVIATIONS

AHD	Australian Height Datum
BEGL	Below Existing Ground Level
DP	Deposited Plan
EI	EI Australia
GDS	Geotechnical Desktop Study

FIGURES



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Cleveland Group Holdings Pty Ltd

Geotechnical Desktop Study
Lot 1/194419, Lot A/156446, Lot 313/1188000,
Cleveland Road, Dapto, NSW
Site Locality Plan

Figure: 1

Project: E23822.G01

APPENDIX A

IMPORTANT INFORMATION

Important Information

SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client And EI Australia ("EI"). The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

EI has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. EI has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, EI will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to EI.

GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

LIMITATIONS OF SITE INVESTIGATION

The investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. EI should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that EI be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

REPRODUCTION OF REPORTS

 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. EI assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of EI or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

EI will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.