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NIFITSA PTY LTD

GEOTECHNICAL DESKTOP STUDY REPORT

31 STANTLEY CRESCENT, KINGSWOOD, NSW

Report E23153 GA_Rev1
27 October 2016

Report Distribution

Geotechnical Desktop Study Report

31 Santley Crescent, Kingswood, NSW

EI Report No. *E23153 GA_Rev1*

Date: *27 October 2016*

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1 INTRODUCTION

1.1 BACKGROUND

At the request of Nifitsa Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Desktop Study (GDS) for the proposed development at 31 Santley Crescent, Kingswood, NSW (the Site).

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. This model is to assist in providing preliminary geotechnical advice and recommendations

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

The following documents were supplied by the Client and were used to assist in the preparation of this GDS report:

- Architectural drawings of the proposed development prepared by CD Architects, - Project No. J16374D, Drawing Nos. DA 000 to DA 004, DA 100 to DA 108, DA 200, DA 201, DA 300, DA 600, DA 700 to DA 704, DA 710, and DA 730, Rev. P1, dated October 2016; and
- Site survey plan prepared by Daw & Walton Pty Ltd – Job No. 3192-16, dated 17 May 2016.

Based on the above drawing, EI understands that the Site comprises of demolition of existing structures and a proposed development will comprise of the construction of a six-storey residential development over a two level basement carpark. The lowest basement level is indicated to have a finish floor level ranging between Reduced Level (RL) 37.55m to 36.51m Australian Height Datum (AHD). A Bulk Excavation Level (BEL) ranging between RL 37.25 to 36.21m AHD is assumed to be required. To achieve the BEL, excavation depths of about 7.0m Below Existing Ground Level (BEGL) will be required. Locally deeper excavations for lift overrun pits, footings and service trenches may be required.

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. 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	31 Santley Crescent, Kingswood, NSW 2747
Lot and Deposited Plan (DP) Identification	Lot 5 in DP 215200
Local Government Authority	Penrith City Council
Parish	Castlereagh
County	Cumberland
Current Zoning	B4 – Mixed Use (Penrith Local Environment Plan, 2010)
Brief Site Description	The site is rectangular in shape. The southern portion of the site is currently occupied by a single-storey fibro residential development, with an associated garage adjacently east of the building. A shed is located at the rear of the building, in the north western corner of the site. The remaining portions of the site are grass covered
Site Area	693m^2 (based on the provided survey plan)

2.2 LOCAL LAND USE

The site is situated within the neighbourhood centre. 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 single storey fibro residential building with no basement level, with an offset of about 1m from the northern site boundary.
East	A three storey brick commercial building with no basement level, with an offset of about 6m from the eastern site boundary.
South	Santley Crescent, a two-lane asphaltic-concrete road. Beyond Santley Crescent is a three storey residential development, inferred to have at least a one level basement, with an offset of about 26m from the southern boundary.
West	A single storey brick commercial building with no basement level, immediately adjacent to the common western site boundary.

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 site is located on a gentle slope falling from the north to the south, at an angle of about 1-5 degrees. The site levels range from RL 44.2m AHD at the northern end to RL 43.2m AHD at the southern end of the site.
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR 1991) indicates the site to be underlain by Bringelly Shale. Bringelly Shale typically comprises shale, carbonaceous claystone, claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff.

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. Based on regional information, the subsurface conditions around the site are comprised of residual soils over Bringelly Shale.

Table 2-4 Conceptual Ground Model

Unit	Material	Comment
1	Fill	Fill material is inferred to be 'uncontrolled' and poorly compacted. Filling may be deeper beneath the brick residential building.
2	Residual Soils	CLAY; medium to high plasticity, typically stiff to hard
3	Shale	The depth to weathered shale bedrock is expected to be between about 2 to 4m BEGL, based on various previous investigations by EI within the vicinity of the site. The shale is expected to be of extremely low strength and extremely weathered. The strength generally increases in strength and decreases in weathering with depth.

Based on our experience within the area, groundwater is expected to be encountered at depths ranging between about 2 to 3m BEGL. 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:

- Basement Excavatability;
- Depth to rock and rock quality for foundation design; and
- 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

In order to achieve the BEL ranging between RL 37.25 to 36.21m AHD for the proposed two-level basement, excavation depths of up to about 7.0m BEGL is expected across the site. It is presumed that the proposed development will therefore extend through Units 1, 2, and 3 described in **Table 2-4** above.

Prior to any excavation commencing:

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

Units 1, 2, and 3 may be excavated by buckets of medium to large hydraulic excavators. Unit 3 may require a high capacity and heavy bulldozer of at least D9 or similar for effective production should shale of at least low to medium strength be encountered. Further Geotechnical Investigation should be undertaken on the site, to confirm the quality of bedrock within the excavation depth.

Should rock breakers are to be used, 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 structures, 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.

3.3.3 Site Preparation and Earthworks

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.

3.4 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.

Unsupported vertical cuts are not recommended for this site as these carry the risk of potential slump failure especially after a period of wet weather. Slumping of the material may result in injury to personnel and/or damage to nearby structures/infrastructures and equipment.

Based on the provided drawings, the basement design extends close to the site boundaries and thus temporary batters are considered to be not suitable for this site. Hence, a suitable full depth retention system will be required for the support of the entire excavation. The retention system must be installed below BEL (including footings, service trenches and lift overrun pits) and socketed into low strength shale or better.

EI considers an intrusive geotechnical investigation in the form of at least two cored boreholes be necessary to assist in the design of the proposed development.

3.5 Groundwater Considerations

Based on the limited in-house information available for the area, and few registered groundwater bores in the region, the depth to groundwater is inferred to be at about 2 to 3m BEGL. Notwithstanding, we recommend that groundwater wells be installed to monitoring the groundwater levels at the site. 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.

3.6 FOUNDATION OPTIONS

Following the completion of bulk excavations, Unit 3 shale is expected to be exposed at the base. The proposed building may be supported on shallow pad/strips and/or short bored piers founded within Unit 3.

Pads/strip footings and/or piles founded within Unit 3 shale bedrock may be designed for a maximum allowable bearing capacity of 600 kPa. For piles, an allowable shaft adhesion equal to 10% of the allowable bearing pressure may also be used.

EI recommends a geotechnical investigation to be carried out, preferably following demolition, involving at least two cored boreholes drilled to a minimum of 3m below final bulk excavation levels to determine the depth and quality of bedrock to ascertain our assumptions and optimize the bearing pressures.

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:

- 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

A detailed geotechnical subsurface investigation must be carried out prior to final design and issue of the Construction Certificate (CC) to determine the site specific subsurface profile and geotechnical parameters for design of footings.

Preferably the geotechnical investigation should be carried out following the demotion of the existing structures to allow full access for a truck/track mounted drill rig.

The geotechnical investigation should involve at least two cored boreholes to a minimum depth of 3m below the proposed BEL and the installation of at least one groundwater monitoring well.

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 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 Nifitsa 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 Nifitsa 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 havea 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.

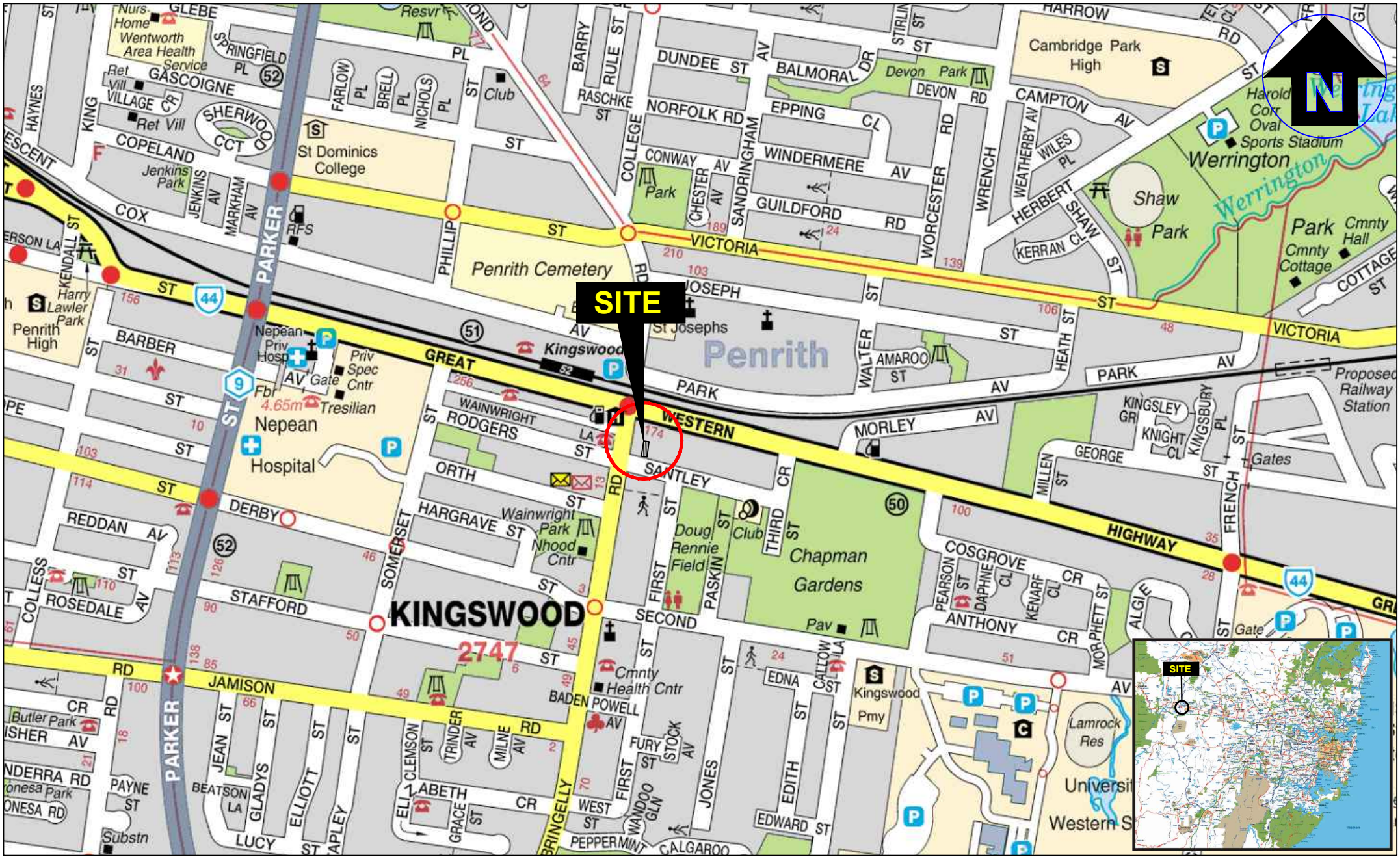
NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

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.

8 ABBREVIATIONS

AHD	Australian Height Datum
BEGL	Below Existing Ground Level
BH	Borehole
DP	Deposited Plan
EI	EI Australia
GDS	Geotechnical Desktop Study
NATA	National Association of Testing Authorities, Australia

FIGURES



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	Approved:	S.K.	
	Date:	21/10/16	
	Scale:	Not To Scale	

Figure: 1

Project: E23153 GA

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.