ASSET GEOTECHNICAL
geotechnical engineering consultants

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3469-R1-Rev2
8 December 2015

Holdmark (NSW) Pty Ltd
Suite 2 / 2-4 Gifnock Avenue
Macquarie Park NSW 2113

Attention: Mr George Youseff

Dear Sir,

PROPOSED MULTI-STOREY MIXED USE DEVELOPMENT, 8 PARSONAGE ST, RYDE, NSW
GEOTECHNICAL DESK STUDY

1. INTRODUCTION

1.1 General

This report presents the results of a desktop study and walkover geotechnical investigation for the above project. The investigation was commissioned by Mr George Youseff of Holdmark (NSW) P/L on 17 November 2015. The work was carried out in accordance with a proposal by Asset Geotechnical Engineering Pty Ltd dated 16 November 2015 reference 3469-P1.

We understand that the project involves the demolition of a number of existing buildings and construction of a 24-storey multi-storey mixed use tower with six basement levels with an anticipated bulk excavation dig depth of approximately 24m. We have been provided with scheme drawings from Cox and Kennedy Architects (no references given).

The objective is to provide information on the surface conditions and likely subsurface conditions in order to provide preliminary recommendations for the development, to support a Section 75W submission.

1.2 Scope of Work

The main objectives of the investigation were to assess the surface and subsurface conditions and to provide comments and recommendations relating to:

- Excavation requirements and batter slopes.
- Subgrade preparation.
- Site Classification to AS2870–2011 “Residential Slabs and Footings”.
- Suitable footing systems and geotechnical design parameters for the footing systems.
- Groundwater levels and dewatering requirements.

In order to achieve the project objectives, the following scope of work was carried out:

- A review of existing regional maps and reports relevant to the site, held within our files.
- Visual observations of surface features.
- Engineering assessment and reporting.

This report should be read in conjunction with the attached Information Sheets. Particular attention is drawn to the limitations inherent in site investigations and the importance of verifying the subsurface conditions inferred herein.

2. FIELDWORK

The site walkover inspection was undertaken on 23 November 2015.

3. SITE DESCRIPTION

The site is located in Ryde, bounded by Church Street, Well Street / former alignment of Parsonage Street, and the Loop Road, as shown in Figure 1. The site is formed of Lots 7, 13, 15 and 100 of DP738232. It is a broadly rectangular block. Ryde Bridge and its approach structures (Heritage structure (Ryde Ref 33) is to the south.

The site is located on the slope of a gentle to moderately dipping hill, broadly dipping towards Parramatta River, which is located about 55m south-west of this site Ground surface levels immediately adjacent to the site range from about RL 15m around Well St to about RL 11m on the south-western boundary dropping to 6m on the edge of the river.

Sandstone bedrock is exposed beyond the south-western corner of the site, in a small cut on the north side of The Loop Road and on the river side of the roundabout at the western corner of the site. Sandstone bedrock outcrop is very low to low strength; highly to moderately weathered. The reserve land to the south-west of the site is largely tree covered and includes a driveway in to the site. A high pressure gas main (Viva Energy) appears to run across Church St and parallel to the site boundary in this area next to the RMS storage area. Oil pipelines also appear to be present and a Dial Before You Dig search is therefore recommended.

The buildings on site refer to the sale of golf equipment and particularly golf buggies including their maintenance. The building closest to Church St is brick built, two-storey with a pitched roof. The other two warehouse buildings are two storey steel clad workshop type buildings. The external area is concrete paved. RMS stores/offices in a fenced off reserve are present on the south-west boundary of the site closer to the bridge. A retaining wall forming part of the approach abutment to the Ryde bridge is noticeably cracked from tree root action.

The aerial photo for 1943 on SIX Maps indicated the site to be surrounded by low density housing and open fields but undeveloped on the site itself. The earlier eastern Ryde Bridge appears in that photo.

4. SUBSURFACE CONDITIONS

4.1 Geology

The 1:100,000 Sydney Geological Map indicates the site is underlain Hawkesbury Sandstone comprising medium to course grained quartz sandstone, very minor shale and laminate lenses.

Former ground investigations undertaken for the Stage 4 and 5 Shepherds Bay Development to the west (Asset Refs 3066 and 1755-3-R1 dated 30/12/14) indicated fill and Residual Clay to a maximum of 2m depth overlying Hawkesbury Sandstone

4.2 Landscape

The site is located within a Gymea Landscape environment, typical of banks of the Parramatta River. Soils are typically formed on localised steep slopes of Hawkesbury Sandstone. The soil hazards include high soil erosion, rock outcrop, shallow permeable soil and soils of low fertility.

4.3 Groundwater

No subsurface investigation was conducted to assess groundwater levels. However, a discontinuous and intermittent, perched water table could occur within the soils and backfill overlying the bedrock. Earlier aerial photos from SIX Maps indicated perched water within excavations to the north of Well St. These may be in continuity with the river. Well St may indeed refer to local water supply wells.

A regional groundwater is expected to occur below the proposed excavations and within fractures and other defects in the underlying sandstone bedrock.

5. DISCUSSIONS & RECOMMENDATIONS

5.1.1 Excavation

The excavation for the proposed development is anticipated to be predominantly within bedrock. The rock is likely to be continuous across adjoining properties. Excavation requirements will be governed by the presence of the rock, and the sensitivity of nearby residential structures buried services to vibrations caused by the rock excavation. Particular note should be made of the sensitivity of the adjacent high pressure gas main and oil pipelines.

The building constructions on the adjacent properties are sensitive to vibrations above certain threshold levels (regarding potential for cracking). Close controls by the excavation contractor over the rock excavation are necessary, and are recommended, so that excessive vibration effects are not generated.

Excavation methods should be adopted which limit ground vibrations at the adjoining developments to not more than 10mm/sec. Vibration monitoring will be required to verify that this is achieved. However, if the contractor adopts methods and / or equipment in accordance with the recommendations in Table 1 for a ground vibration limit of 5mm/sec, vibration monitoring may not be required.

The limits of 5mm/sec and 10mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 1.

Table 1 – Recommendations for Rock Breaking Equipment

Distance from adjoining structure (m)	Maximum Peak Particle Velocity 5mm/sec		Maximum Peak Particle Velocity 10mm/sec*	
	Equipment	Operating Limit (% of Maximum Capacity)	Equipment	Operating Limit (% of Maximum Capacity)
1.5 to 2.5	Hand operated jackhammer only	100	300 kg rock hammer	50
2.5 to 5.0	300 kg rock hammer	50	300 kg rock hammer or 600 kg rock hammer	100 50
5.0 to 10.0	300 kg rock hammer or 600 kg rock hammer	100 50	600 kg rock hammer or 900 kg rock hammer	100 50

* Vibration monitoring is recommended for 10mm/sec vibration limit.

At all times, the excavation equipment must be operated by experienced personnel, according to the manufacturer's instructions, and in a manner consistent with minimising vibration effects.

Use of other techniques (e.g. chemical rock splitting, rock sawing), although less productive, would reduce or possibly eliminate risks of damage to adjoining property through vibration effects transmitted via the ground. Such techniques may be considered if an alternative to rock breaking is necessary. If rock sawing is carried out around excavation boundaries in not less than 1m deep lifts, a 900 kg rock hammer could be used at up to 100% maximum operating capacity with an assessed peak particle velocity not exceeding 5 mm/sec, subject to observation and confirmation by a Geotechnical Engineer at the commencement of excavation.

Excavation contractors should directly inspect exposed rock outcrops at this site, and should not rely solely on the rock classifications presented in geotechnical engineering reports, when assessing the suitability of their excavation equipment for the proposed development. Further geotechnical advice must be sought if rock excavation characteristics are critical to the proposed development.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments.

5.2 Subgrade Preparation

The following general recommendations are provided for subgrade preparation for earthworks, pavements, slab-on-ground construction, and minor structures:

- Strip existing fill and topsoil. Remove unsuitable materials from site (e.g. material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate natural soils and rock, stockpiling for re-use as engineered fill or remove to spoil. Rock could be stockpiled separately from clayey soils, for select use beneath pavements.
- Where rock is exposed in bulk excavation level beneath pavements, rip a further 150mm.
- Where rock is exposed at footing invert level, it should be free of loose, “drummy" and softened material before concrete is poured.
- Where soil is exposed in bulk excavation level, compact the upper 150mm depth to a density index (AS1289.5.6.1–1998) not less than 80%. Areas which show visible heave under compaction equipment

should be over-excavated a further 0.3m and replaced with approved fill compacted to a density index not less than 80%.

Further advice should be sought where filling is required to support major structures.

Any waste soils being removed from the site must be classified in accordance with current regulatory authority requirements to enable appropriate disposal to an appropriately licensed landfill facility. Further advice should be sought from a specialist environmental consultant, such as our alliance partner SLR Consulting, if required.

5.2.1 Filling

Where filing is required, place in horizontal layers not more than 0.3m loose thickness over the prepared subgrade and compact to a density index not less than 70% beneath pavements and 80% beneath structures. Soils should be kept moist but not wet during compaction. Compact the upper 150mm of subgrade to a density index not less than 80%.

Filling within 1.5m of the rear of any retaining walls should be compacted using light weight equipment (e.g. hand-operated plate compactor or ride-on compactor not more than 3 tonnes static weight) in order to limit compaction-induced lateral pressures. The layer thickness should be reduced to 0.2m maximum loose thickness.

Any soils to be imported onto the site for the purpose of back-filling and re-instatement of excavated areas should be free of contamination and deleterious material, and should include appropriate validation documentation in accordance with current regulatory authority requirements which confirms its suitability for the proposed land use. Further advice should be sought from a specialist environmental consultant if required.

5.3 Batter Slopes

Recommended maximum slopes for permanent and temporary batters are presented in Table 2.

Table 2 – Recommended Maximum Batter Slopes

Unit	Maximum Batter Slope (H : V)	
	Permanent	**Temporary**
Soils and extremely weathered Sandstone	2 : 1	1 : 1
Class 4 or better Sandstone	vertical *	vertical *

* subject to inspection by a Geotechnical Engineer and carrying out remedial works as recommended (e.g. shotcrete, rock bolting).

5.4 Site Classification

Due to the presence of shallow bedrock the site is classified as a Class A Site in accordance with AS 2870–2011 “Residential Slabs and Footings” assuming any overlying fil or Residual Clay is removed. Footings should be designed as per the recommendations given in Section 5.6.

5.5 Temporary and Permanent Shoring

Where there is insufficient room to accommodate temporary batters, or temporary batters are not desired, temporary shoring will be required in the soils and weather bedrock. The deeper, higher strength rocks should (subject to ground investigation and site inspection) be capable of standing unsupported. Depending on the design of the shoring, it could also be incorporated into the permanent foundation and retaining works.

Design of retaining walls will need to consider both long–term (i.e. permanent) and short–term (i.e. during construction) loading conditions, as well as the possible impact on adjoining developments. In particular, the effects on the heritage listed Ryde Bridge, the high pressure gas main and oil pipelines will need addressing as these will both be sensitive to lateral movement, settlement and vibration effects.

A number of possible temporary shoring systems could be considered for the site. These are summarised in Table 3 together with advantages and disadvantages.

5.5.1 Temporary Shoring

The type of shoring to be adopted will depend on the depth of groundwater at the site. Based on the advantages and disadvantages listed in Table 3 below, we recommend a contiguous or secant bored pile wall (Option 3a or 3b), or a soldier pile wall with shotcrete infill panels (Option 1b) for the basement excavation where temporary batters cannot be accommodated above the higher strength bedrock. Options 1a and 2 are not likely to be suitable due to the depth of excavation support and influence of vibration on adjacent structures.

Table 3 – Summary of Shoring Options

Option	Method	Advantages	Disadvantages
1a **1b**	Soldier piles and steel walers or Soldier piles and shotcrete infill panels	Relatively low cost. Strip drains can be installed behind walers / shotcrete panels to facilitate construction dewatering.	Risk of instability and loss of ground. Significant retained height will require shoring to be anchored.
2	Steel sheet pile (driven or hydraulically installed)	Rapid installation. Lower cost that Option 3. Low permeability water barrier. Amenable to joint caulking.	Vibration may not be acceptable for adjoining developments. Permanent wall required. Will require soil anchors.
3a **or** **3b**	Contiguous or Secant bored piles	Can form part of the permanent structure. Minimum noise and vibration. Can maximise site building space as no temporary wall is required. Permanent water proofing can be incorporated. Low permeability water barrier (secant piling very low permeability compared to contiguous piling)	For secant piles, ensuring complete contact of all piles over full pile length may be difficult. Additional finishing may be required following excavation if a 'smooth' internal wall is required. Relatively high cost (Secant more expensive than Contiguous). May require soil anchors along boundaries where high level footings are located.

For the retained heights proposed or where control of lateral deflections is required due to adjacent buildings, temporary rock anchors are likely to be required. Rock anchors should be inclined below horizontal and should be designed to have a free length that extends beyond an imaginary line drawn upwards at an angle

of 45° from the toe of the wall. The minimum free length should be 6 m. Rock anchor holes should be clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with normal good practice.

Bored pile walls should be drilled to a depth of at least 1m below basement floor level. Consequently, these piles may be required to penetrate through the variable strength rock into Class 3 (or better) sandstone in some areas. Alternatively, bored piles may be terminated above bulk excavation level provided that they are drilled to not less than 1m into Class 3 sandstone and two rows of rock anchor are provided for lateral support. Further investigation would be required to confirm the presence of the Class 3 (or better) sandstone at this depth. Also, a competent Geotechnical Engineer will be required to carry out inspection of the rock face from the pile toe level down to bulk excavation level. The need for rock bolting or any other stabilisation measures can be considered should these be required to ensure stability to the exposed rock face.

The prevalence of groundwater in the bedrock is currently unknown. However, it should be noted that the overlapping of secant piles creates a low permeability barrier, which substantially limits groundwater seepage occurring during excavation. Contiguous pile walls have slightly more widely spaced piles and soldier pile walls with shotcrete infill panels typically have spacing ranging from 1m to about 2.5m, which could allow significant groundwater ingress during excavation. If only minor seepages are expected, it is considered that a contiguous piled wall arrangement or a soldier pile with shotcrete infill panels would provide a suitable solution for the temporary shoring. In this case, strip drainage could be adopted behind the piles and shotcrete may be required between the piles in some locations, to limit the occurrence of any seepage. Higher seepage flows from fractures and joints within the bedrock may necessitate the use of secant piled walls to minimise groundwater inflow.

5.5.2 Permanent Retaining Walls

In the long–term, the basement floor slabs will provide bracing over the height of the wall. Therefore, the basement retaining wall should be designed as a braced wall for the long–term loading condition. Depending on the retained height and the sensitivity of adjacent structures to lateral movement, it may be necessary to incorporate the temporary ground anchors into the permanent works, to provide further resistance against lateral earth pressures and control horizontal movement. Further advice should be sought once the pile loads and layout are known.

5.6 Foundations

Due to the likely shallow rock conditions, all foundations are anticipated to be founded on sandstone bedrock. Foundations on Class 3 sandstone may be founded at an allowable bearing pressure of 3,500kPa. Higher allowable bearing pressures may be possible if invasive ground investigation including rock coring and laboratory strength testing is undertaken in advance of the development. With all foundations taken down on to sandstone, total and differential settlement is unlikely to be an issue.

5.7 Acid Sulfate Soils

A review of acid sulphate risk maps for Ryde Council indicates the site is within a Class 5 zone for acid sulphate soils. ASSMAC[1] recommends the following geomorphic or site criteria be used to determine if acid sulfate soils are likely to be present:

1. Sediments of recent geological age (Holocene)
2. Soil horizons less than 5m AHD
3. Marine or estuarine sediments and tidal lakes
4. In coastal wetlands or back swamp areas; waterlogged or scalded areas; interdunal swales or coastal sand dunes (if deep excavation or drainage is proposed)
5. In areas where the dominant vegetation is mangroves, reeds, rushes and other swamp-tolerant or marine vegetation
6. In areas identified in geological descriptions or in maps as bearing acid sulfide minerals, coal deposits or former marine shales/sediments
7. Deep older estuarine sediments >10 metres below ground surface, Holocene or Pleistocene age (only an issue if deep drainage is proposed)

We note that none of the above criteria are met for the subject site. We also note that ASSMAC considers that soils of older geological age or those not derived from sedimentary deposition (e.g. residual soils) can be excluded from further investigation. The geological map and the anticipated subsurface profile indicates that site is not underlain by sedimentary deposition.

From the above, we consider it highly unlikely that there are acid sulfate soils present on site, and therefore no further testing or preparation of a soil management plan is required.

6. GEOTECHNICAL AND HYDROGEOLOGICAL MONITORING PROGRAM

6.1 Acceptable Vibration and Deflection Limits

The contractor shall carry out excavation and construction activities so that the limits in Table 4 are not exceeded:

Table 4 – Vibration and Deflection Limits

Parameter	Limit
vertical settlement of ground surface at adjoining boundaries	5 mm
lateral deflection of temporary or permanent retaining works (measured at the top or any point of the retaining works)	5 mm
peak particle velocity at any sensitive adjoining structure	5 mm/sec

[1] Stone, Y, Ahern CR, and Blunden B (1998). Acid Sulfate Soils Manual 1998. Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia.

6.2 Monitoring System

6.2.1 Deflections / Settlement

Church St is of particular interest to this project. Any excavation over 5m depth within the zone of influence along this boundary will be very closely looked at by Roads and Maritime Services (RMS) and by Ryde council due to its status as a Main Road and a heritage structure. The High Pressure Gas main (Viva Energy) and reported oil pipeline should also be addressed at this stage. There may be other sensitive buried utilities that have not been identified at the time of preparing this report. Monitoring of deflections and settlements shall be carried out by a registered surveyor and the introduction in wall deflection inclinometers may also be required. Survey points shall be established along the site boundaries where excavation is proposed, at a spacing of not more 5m. A Geotechnical Monitoring Plan should be developed to determine the requirement for inclinometers in addition to the optimum location of Survey Targets.

Survey measurements shall be taken:

- prior to the commencement of excavation
- immediately after bulk excavation
- immediately after installation of temporary retaining works
- immediately after construction of permanent retaining works
- immediately after backfilling of retaining works

6.2.2 Vibration

Adopting suitable excavation methodology (see Section 5.1.1) to achieve a maximum peak particle velocity of 5 mm/s, a vibration monitoring system will not be required. Tactile assessment of vibration can be carried out by a Geotechnical Engineer during commencement of rock excavation, and where construction equipment varies from that used at the commencement of rock excavation.

6.3 Hold Points

Hold points shall be provided at the following stages to allow for inspection by a Geotechnical Engineer:

- At commencement of shoring / pile installation.
- At the commencement of rock anchor installation.
- At the commencement of rock excavation.
- At commencement of dewatering (if required)
- At the completion of bulk excavation.
- At completion of detail footing excavation.

6.4 Contingency Plan

In the event that the above listed acceptable limits are exceeded, the following works shall be carried out:

- The project Geotechnical Engineer shall be notified immediately.
- Excavations adjacent to areas that have settled shall be backfilled with spoil or other suitable material.
- Additional bracing shall be installed adjacent to areas of temporary or permanent shoring.

- Excavation equipment shall cease work immediately, and vibration monitoring equipment shall be installed at locations selected by the Geotechnical Engineer to measure vibrations. If the vibration limit exceeds 10 mm/second, alternative equipment and/or methodology shall be used.

7. LIMITATIONS

In addition to the limitations inherent in site investigations (refer to the attached Information Sheets), it must be pointed out that the recommendations in this report are based on assessed subsurface conditions from limited investigations. In order to confirm the assessed soil and rock properties in this report, further investigation would be required such as coring and strength testing of rock, and should be carried out if the scale of the development warrants, or if any of the properties are critical to the design, construction or performance of the development.

It is recommended that a qualified and experienced Geotechnical Engineer be engaged to provide further input and review during the design development; including site visits during construction to verify the site conditions and provide advice where conditions vary from those assumed in this report. Development of an appropriate inspection and testing plan should be carried out in consultation with the Geotechnical Engineer.

This report may have included geotechnical recommendations for design and construction of temporary works (e.g. temporary batter slopes or temporary shoring of excavations). Such temporary works are expected to perform adequately for a relatively short period of time only, which could range from a few days (for temporary batter slopes) up to six months (for temporary shoring). This time period depends on a range of factors including but not limited to: site geology; groundwater conditions; weather conditions; design criteria; and level of care taken during construction. If there are factors which prevent temporary works from being completed and/or which require temporary works to function for periods longer than originally designed, further advice must be sought from the Geotechnical Engineer and Structural Engineer.

This report and details for the proposed development must be submitted to relevant regulatory authorities that have an interest in the property (e.g. Council) or are responsible for services that may be within or adjacent to the site (e.g. Sydney Water, Sydney Trains, Roads and Maritime Services), for their review prior to commencement of construction.

The attached document “Important Information about your Geotechnical Report” provides additional information about the uses and limitations of this report.

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Please do not hesitate to contact the undersigned if you have any questions regarding this report or if you require further assistance.

For and on behalf of
Asset Geotechnical Engineering Pty Ltd

Mark Green
BSc (Hons) RPEQ MIEAust CPEng NPER (Civil) CGeol FGS
Principal Geotechnical Engineer

Encl: Figure 1 – Site Locality
Figure 2 – Site Environs
Important Information about your Geotechnical Report

DOCUMENT CONTROL

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Revision History

Rev	Date of Issue	Revision Details	Author	Reviewer	Approver
0	20 November 2015	Draft issue	MAG	MAG	MAB
1	1 December 2015	Final Issue	MAG	MAG	MAG
2	8 December 2015	Updated structural details	MAG	MAG	MAG

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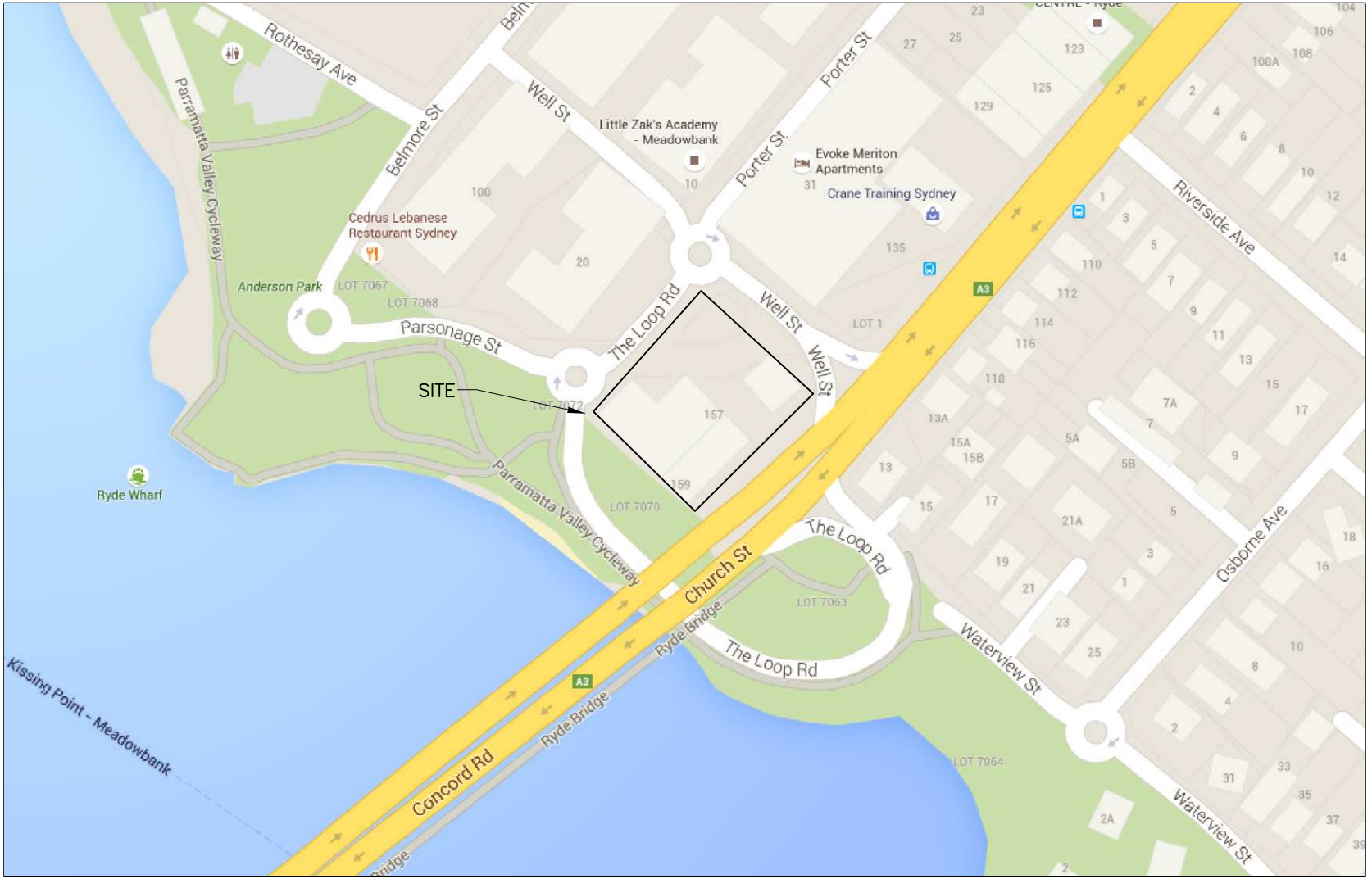

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issue	date	description
A	20.11.15	INITIAL ISSUE

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SHEPHERDS BAY RESIDENTIAL DEVELOPMENT – STAGE A
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for
HOLDMARK CONSTRUCTIONS PTY LTD

SITE LOCALITY

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date: 20.11.15
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fig: 1
issue: A

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SHEPHERDS BAY RESIDENTIAL DEVELOPMENT – STAGE A
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SITE ENVIRONS

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job no.: 3469
fig: 2
issue: A

ASSET GEOTECHNICAL
geotechnical engineering consultants

Important Information about your Geotechnical Report

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 Asset Geotechnical Engineering Pty Ltd ("Asset"), for the specific site investigated. The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

The report should not be used if there have been changes to the project, without first consulting with Asset to assess if the report's recommendations are still valid. Asset does not accept responsibility for problems that occur due to project changes if they are not consulted.

RELIANCE ON DATA

Asset 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. Asset 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, Asset 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 Asset.

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.

Therefore, the recommendations in the report can only be regarded as preliminary. Asset should be retained during the project implementation to assess if the report's recommendations are valid and whether or not changes should be considered as the project proceeds.

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. Asset 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 Asset 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

This report is the subject of copyright and shall not be reproduced either totally or in part without the express permission of this Company. 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. Asset 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 Asset 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.

DATA MUST NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the site assessment, and must not be copied in part or altered in any way.

Logs, figures, drawings, test results etc. included in our reports are developed by professionals based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

PARTIAL USE OF REPORT

Where the recommendations of the report are only partially followed, there may be significant implications for the project and could lead to problems. Consult Asset if you are not intending to follow all of the report recommendations, to assess what the implications could be. Asset does not accept responsibility for problems that develop where the report recommendations have only been partially followed if they have not been consulted.

OTHER LIMITATIONS

Asset 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.