REPORT

TO
TELSTRA CORPORATION LIMITED
C/- CHARTER KECK CRAMER

ON
GEOTECHNICAL INVESTIGATION

FOR
PROPOSED MIXED-USE DEVELOPMENT

AT
122 BRONTE ROAD, BONDI JUNCTION, NSW

5 May 2015
Ref: 28302Srpt

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1 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed mixed-use development at 122 Bronte Road, Bondi Junction, NSW. This investigation was commissioned by Peter Kirkpatrick of Charter Keck Cramer, on behalf of Telstra Corporation, by signed 'Acceptance of Proposal' dated 9 April 2015 and was carried out in accordance with our proposal (Ref: P40319S).

In preparing this report we have referred to the following relevant documents:

- Survey plan prepared by Brunskill, McClenahan and Associates Pty Ltd, dated 23 November 2007, Reference No. 92184-1.
- A number of Telstra or Department of Works issued building layout documents for building extensions dating back to 1964.

At the time of the investigation, there were no plans for the proposed development provided. It is currently understood that a five to six-storey apartment building is proposed to replace the existing carpark area, and that the street façade will remain due to heritage value. It may therefore be required for the new building to cantilever over the heritage portion. The proposed structure will have to be constructed around the existing stairwell of the adjoining Waverly Telephone Exchange building which will remain operational, unless the stairwell is relocated. The proposed building may also incorporate a basement level, requiring at least 3m of excavation.

The scope of the investigation was to obtain geotechnical information on subsurface conditions at the site and to use this as a basis for comments and recommendations on geotechnical aspects of the proposed development, including demolition, excavation, retention, vibrations, and potential foundation strata and footing systems.

Environmental Investigation Services (EIS) conducted an Environmental Site Assessment concurrently with the geotechnical investigation. For further information refer to the EIS report (Ref: E28302K).

2 INVESTIGATION PROCEDURE

The field work was conducted on 16 March 2015 and consisted the drilling of three boreholes to depths of 0.25m and 4.99m below existing ground levels. BH1 and BH2 were completed using our portable hand-operated drilling equipment, and BH3 was completed using hand augering techniques. All boreholes were drilled within the existing building.

Prior to commencement of the fieldwork the borehole locations were electromagnetically scanned by a specialist subcontractor so that the boreholes could be located clear of buried services. The borehole locations, as shown on the attached Figure 1, were set out by taped measurements from features shown on the supplied survey plan. The approximate reduced levels of the ground at borehole locations were interpolated from spot levels shown on the supplied plans. The survey datum is assumed to be Australian Height Datum (AHD).

All boreholes were initially advanced through the floor slab using a diatube, and then hand augered to refusal. Dynamic Cone Penetrometer (DCP) tests were completed adjacent to all boreholes to assess the strength of the fill and soils and probe to rock. Upon hand auger refusal, BH1 and BH2 were advanced using portable diamond coring techniques and a TT56 double tube core barrel and water flush. BH3 experienced immediate DCP and hand auger refusal on sandstone, which may be bedrock or potentially sandstone rubble.

The strength of the bedrock was assessed by examination of the recovered rock core, together with correlations with subsequent laboratory Point Load Strength Index ($I_{S(50)}$) tests. Using established correlations the unconfined compressive strength (UCS) of the bedrock was then calculated from the $I_{S(50)}$ results. These Point Load strength test results are summarised in the attached Table A and on the borehole logs. Colour photographs of the rock were taken and are attached to the logs. The strength of the rock in the augered portion of the boreholes was estimated from the drilling resistance and by examination of auger cuttings and hence is only approximate.

Selected soil samples were also sent to a NATA registered laboratory for pH, sulphate and chloride content and electrical conductivity testing. The results are presented in the attached Envirolab Certificate of Analysis 127017.

Groundwater observations were made in the boreholes both during drilling and on completion of drilling.

Our engineering geologist, Ms. CJ Mackay, was present on a full-time basis during the fieldwork, to direct the electromagnetic scanning, set out the borehole locations, nominate testing and sampling and prepare the borehole logs. The borehole logs, which include field test results and groundwater observations, are attached to this report together with a set of explanatory notes, which describe the investigation techniques and their limitations and define the logging terms and symbols used.

3 RESULTS OF INVESTIGATION

3.1 Site Description

The site is located in a region of undulating topography, towards the base of a south-west facing hill which falls towards Centennial Park.

The site is currently used as the parking area for the Waverley Telstra Telephone Exchange which is fully operational in the adjoining building. Along the Bronte Road and Birrell Street sides are a number of small rooms, including lunch room, bathroom and small offices, which are currently unused. The emergency generator and diesel room, with possible underground tank, is located at the southern end and remains semi-functional. The rooms are accessed through a fire door and the stair well area for the three-storey telephone exchange building, with a street access off Bronte Road. There is a sub-floor pit partway along the northern wall of the parking area which extends to the west and is accessed via a manhole. The enclosed parking area, accessed off Adams Lane, appears in moderate condition, with the pavement displaying minor cracking in some areas. The floor level throughout the parking area and adjoining rooms is level, with a roughly 2m drop down to street level along the south-western side. The façade of the car park building is brick and cement rendered in parts, with some moulded concrete detail around the windows. It generally appears in good external condition, with some minor cracking in the rendered sections.

The operational telephone exchange building is a three-storey brick building, and contains a narrow cable chamber basement level which extends slightly under the Bronte Street footpath, but does not appear to continue under the carpark area. This building contains a network of rooms housing air conditioning units, various equipment and other Telstra operations.

The telephone exchange building adjoins a two storey mixed-use development to the north. The subject site is surrounded by roads on all other sides. Across Adams Lane are two brick apartment blocks, both two-storey and appear in fine external condition.

3.2 Subsurface Conditions

The 1:100,000 geological map of Sydney indicates that the site is underlain by Hawkesbury Sandstone with the possibility of igneous dykes located in the area. Generally, the boreholes revealed a subsurface profile comprising a shallow fill layer overlying some natural sands, overlying sandstone bedrock. For details of subsurface conditions at each borehole location, reference should be made to the attached borehole logs.

Pavement

All boreholes were drilled through the floor slab, encountering concrete between 130mm and 150mm thick.

Fill

Beneath the concrete slab, silty sand fill was found in BH1 and BH2. This fill was up to 0.4m thick and was assessed to be poorly compacted. The fill contained inclusions of slag, charcoal and concrete fragments.

Natural Sand

Natural sand was encountered below the fill in BH1 and BH2, and immediately below the floor slab in BH3 (possibly fill). This sand was fine to coarse grained and contained some cemented nodules.

Sandstone Bedrock

Sandstone bedrock was encountered in both boreholes, at depths of 0.56m (BH2) and 0.58m (BH1) below existing surface levels. In first contact the sandstone was distinctly weathered and of medium strength, however the zone of core loss in BH1 suggests lower strength and more weathered sandstone which was probably disturbed and lost when the casing was installed and when drilling commenced. The sandstone improved to distinctly weathered and medium to high strength at depths of 4.2m (BH1) to 4.8m (BH2).

As the hand auger and DCP tests refused immediately in BH3, the subsurface profile cannot be confirmed, but it appears that sandstone bedrock is at a depth of 0.2m below the existing floor level, however it is possible that there may be sandstone rubble below the floor slab along the western and southern portion of the building where the floor slab is elevated above street level.

Groundwater

Groundwater seepage was not encountered during or on completion of drilling. Due to the limited period of the investigation groundwater levels are not likely to have stabilised during the period of the investigation. Based on our experience near to the subject site, standing groundwater level could be at relatively shallow depth that may be within the proposed depth of excavation.

3.3 Laboratory Test Results

Estimated unconfined compressive strength correlations made from point load test results on core samples of rock varied between 10MPa and 26MPa, but were generally around 18MPa, and showed reasonably good correlation with our field assessment of rock strength. The Point Load Strength Index test results can be found in the attached Table A.

The test results on the selected sand sample sent to Envirolab yielded a pH of 9.1 indicating the sand is slightly alkaline. The chloride content was 21mg/kg and sulphate content 240mg/kg. The resistivity result was 5000ohm.cm.

When assessed in accordance with the criteria for concrete piling exposure classifications given in Table 6.4.2 (C) and Table 6.5.2 (C) of AS2159-2009 "Piling-Design and Installation", the laboratory tests have revealed that the sample has a non-aggressive exposure classification to buried concrete and a non-aggressive exposure classification to buried steel. Any concrete or steel exposed to these conditions (e.g. piles) should have a characteristic concrete strength and cover as recommended in Table 6.4.3 of the standard.

4 COMMENTS AND RECOMMENDATIONS

Comments and recommendations on likely geotechnical issues are preliminary at this stage as there are no plans available for the proposed development. Other issues may become apparent once more detailed plans are developed.

4.1 Excavation

The proposed structure can be founded close to the current floor levels with minimal excavation required. The surface fill and natural sands overlying the sandstone bedrock can be easily removed with the buckets of small tracked excavators. This would be roughly 0.5m of excavation.

Alternatively, if a basement is proposed, we assume that excavation would occupy the majority of the site footprint and would extend to a depth of at least 3m. Based on the excavation results, we expect that this excavation will encounter roughly 0.5m of variable fill and natural sands, and at least 2.5m of generally medium to high strength sandstone.

If excavation is to extend to the property boundaries, investigations should be carried out to determine whether the existing external walls are founded directly upon competent sandstone bedrock. This will require excavation to reveal the current footings. It is possible that the footings will need to be underpinned, at least in some locations, such that the load is transferred directly to competent bedrock. As there is a cable chamber basement in the neighbouring building running along the shared wall, care must be taken to avoid destabilising the footings of the existing basement (and the existing façade) which is likely to be founded in competent medium to high strength sandstone, however this needs to be confirmed prior to further design works.

Along the south and south-western side of the site, the current floor level of the existing building is roughly 2m higher than the street level. This suggests that either the sandstone has been cut, with the external walls constructed around it, or the building has been infilled with sandstone rubble. Coring through the floor slab on this side of the building indicated that there is sand and sandstone immediately below the floor slab, however it cannot be confirmed whether this is natural or was infilled, and this should be determined prior to further design works.

Excavation of low and lower strength sandstone may be achieved using ripping tyne attachments with the tracked excavators. Rock breaker, rock saw and/or grinder attachments to the tracked excavators will have to be used for most of any proposed rock excavation and may also be required for demolition of existing internal concrete structures.

Care will be required to control ground vibrations associated with the use of rock breakers, such as the provision of rock saw cuts. All perimeter faces of the excavation should be saw cut to minimise disturbance to the structure and supporting rock. The Telstra structures may contain vibration and dust sensitive equipment, in which case the use of rock breakers may be restricted and any resulting dust should be suppressed with water. Vibration monitoring will be essential if rock breakers are used as discussed further in *Section 4.2*.

We note that groundwater was not encountered during this investigation but should be investigated further to confirm whether dewatering of the excavations is required and further works should allow for longer term groundwater monitoring.

4.2 Vibration Monitoring

During demolition and excavation of any sandstone, vibration monitoring is recommended to warn of excessive transmission of ground vibrations to the neighbouring Telstra infrastructure and the building façade.

In the case where a basement level is proposed, percussive excavation through medium to high strength sandstone will give rise to significant risk of damage to nearby structures due to ground borne vibrations. Care should be taken when undertaking heavy ripping and/or when using rock breakers so that ground vibrations do not adversely affect neighbouring structures. If there is any cause for concern then demolition and/or excavation should cease and further geotechnical advice sought.

If a basement is adopted we recommend that full-time quantitative vibration monitoring of the façade and neighbouring Telstra structures to the north be undertaken whilst rock breakers are being used to confirm that peak particle velocities fall within acceptable limits. Subject to the results of the dilapidation reports and any restrictions imposed by Telstra, we recommend that the peak particle velocities along the site boundaries do not exceed 5mm/sec. We note that this vibration limit will reduce the risk of vibration damage to the neighbouring building and structures. If excessive vibrations are occurring, it will be necessary to use lower energy equipment such as smaller breakers, saws, grinder attachments or, in extreme cases, hand held rock splitting techniques.

4.3 Dilapidation Reports

Prior to commencement of demolition, excavation or construction, we recommend that dilapidation survey reports be carried out on the neighbouring buildings and structures/infrastructure that falls within the zone of influence of the excavation, which is defined by a distance back from the excavation perimeter of twice the total depth of the excavation. The reports would provide a record of existing conditions prior to commencement of the work. A copy of each report should be provided to the adjoining property owner who should be asked to confirm that it represents a fair assessment of existing conditions.

4.4 Retention

If minimal excavation is proposed, that is less than 0.5m, temporary batters are sufficient and can probably be accommodated within the site.

An important issue is the stability of the neighbouring basement as well as the façade that is proposed to remain due to heritage reasons. It is critical to ascertain the structural details of the external walls and basement walls so that an assessment can be made on their continuing stability and whether or not underpinning may be required. Test pits should be excavated to determine the footing and foundation material, which we infer to be sandstone bedrock, prior to further design works. In the case of a basement, the depth needs to be confirmed to determine whether the neighbouring basement will be located within the zone of influence of the proposed basement, and the designs made accordingly.

The need for underpinning the external building façade will be determined by test pits to expose the existing footings. If the footings for the external walls are founded on competent sandstone, then underpinning may not be required, subject to geotechnical inspection and assessment by the structural engineer. Zones of poorer quality rock would require local areas of underpinning.

In the case of a basement, competent sandstone bedrock of medium or higher strength may be cut vertically, subject to geotechnical inspection. Geotechnical inspections should be completed by an experienced geotechnical engineer or engineering geologist at regular intervals at no more than 1.5m vertical excavation 'lifts'.

The presence of potentially unstable wedges, clay seams and extremely weathered seams within the sandstone bedrock may adversely affect the stability of the cut faces and/or footings located close to the crests of cut faces. Such features may require shotcreting and rock bolting. However, in some instances the prompt construction of full height retaining walls may remove the need for use of shotcrete and rock bolts, although this would only be confirmed following geotechnical inspection. Provision should be made in for such inspections and stabilisation measures.

4.5 Footing Design

As competent sandstone bedrock occurs at shallow depth within the building, pad and strip footings should be feasible whether a basement is constructed or not.

We consider allowable bearing pressures of 3500kPa for sandstone of medium strength or better should generally be applicable based on the current cored borehole information. We recommend at least one additional cored borehole to provide greater coverage over the site, particularly near the south-west corner, in order to confirm the sandstone quality. Depending upon the depth of any basement excavation, deeper boreholes may be required.

All loose or softened debris should be cleaned from the base of all pad and strip footings prior to concreting. All footings should be poured immediately after excavation, removal of water, cleaning and inspection by a geotechnical engineer to confirm that a suitable founding stratum is being achieved.

Depending on the results of the additional cored boreholes, an allowable bearing pressure of 6000kPa may be used within the medium to high strength sandstone. If such a bearing pressure was adopted, additional cored boreholes would be required as well as an increase in spoon testing, likely to comprise spoon testing at all footing locations. Again this bearing pressure and the extent of construction inspection should be confirmed following the drilling of additional cored boreholes.

4.6 On-Grade Floor Slabs

It is likely that the basement floor slabs will be placed on sandstone bedrock whether or not a basement is constructed, and as such no particular subgrade preparation is required apart from laying a sub-base layer of DGB20 or a drainage blanket of 10mm blue metal gravel. Details will depend upon the drainage system and water proofing requirements.

On-grade floor slabs should be separated from all walls, columns, footings, etc., to permit relative movements (i.e. designed as 'floating' slabs). Joints in the concrete on-grade floor slabs should be designed to accommodate shear forces but not bending moments by using dowelled or keyed joints.

4.7 Further Investigation

Following the development of detailed design plans for the proposed structure, we recommend that further geotechnical investigation be undertaken to include as a minimum the following:

- Test pits to expose existing basement walls and the footings of the building to the north, and to confirm the footings of the external building façade.
- At least one additional cored borehole to confirm our assumptions on sandstone quality and to optimise allowable bearing pressures. It is important to determine the nature of the sandstone along the south and south-western portion of the site.
- Installation of at least one standpipe to determine the standing groundwater levels and for ongoing monitoring of groundwater levels.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification will need to be assigned to any soil excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), General Solid, Restricted Solid or Hazardous Waste. If the natural soil has been stockpiled, classification of this soil as Excavated Natural Material (ENM) can also be undertaken, if requested. However, the criteria for ENM are more stringent and the cost associated with attempting to meet these criteria may be significant. Analysis takes seven to 10 working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) should be expected. We strongly recommend that this issue is addressed prior to the commencement of excavation on site.

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