

#### **GEOTECHNICAL ASSESSMENT**

**FOR** 

**CONCEPT PLAN** 

**AT** 

# UNIVERSITY OF TECHNOLOGY SYDNEY (UTS) BROADWAY

6 March 2009

Ref: 22549SPrptFinalRev1

### Jeffery and Katauskas Pty Ltd

**CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS** 



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FIGURE 1: PLAN SHOWING EXISTING BUILDING NUMBERS

FIGURE 2: PLAN SHOWING PROPOSED WORKS

APPENDIX A: SELECTED INFORMATION FROM NEARBY PROJECTS



#### 1 INTRODUCTION

This report presents the results of a geotechnical investigation for a proposed redevelopment of the Broadway Campus of the University of Technology, Sydney (UTS). The assessment was completed in accordance with our proposal dated 28 October 2008 (Ref: P30206S) and the acceptance by Mr Clive Gunton of UTS in a letter dated 12 November 2008 (Ref: 7052k-00).

The locations of the existing buildings are shown in the attached Figure 1.

The Concept Plan involves the demolition, construction and extension of certain buildings on the Broadway Precinct to enable UTS to provide an additional 84,750m² of gross floor area (note that gross floor area and building height are measured in accordance with the definition applying to Ultimo-Pyrmont in Sydney Local Environmental Plan 2005 [see Section 4.4]) of education, social and sporting facilities, including student housing. The proposal will also enhance existing open space and improve pedestrian, bicycle and vehicular access into the Campus. The project will deliver facilities for up to 15,000 EFTSL (equivalent full time student load) on the campus by 2015, up from 12,200 in 2008.

Concept approval is sought for the following at the UTS Broadway Campus, as illustrated in Figure 2:

- Demolition of existing Building 11 (81 Broadway), Building 12 (113 Broadway)
   and Building 13 (115 Broadway).
- Building 1 extension to podium of existing building to a height of 22.47 metres (m) to provide an additional 4,050m<sup>2</sup> of gross floor area for educational and cultural uses.
- Building 2 extension to, and refurbishment of, existing building to a height of 24.24m to provide an additional 6,750m<sup>2</sup> of gross floor area for educational uses.



- Building 3 modifications to existing building to provide café or retail uses on Level 1.
- Building 4 modifications to existing building to provide café, retail uses or public facilities on Level 1.

#### Building 6:

- extension and modifications to Levels 1-7 of the existing building to provide approximately 5,950m² of gross floor area for education, retail or café uses;
- construction of a new 69.20m high extension to provide approximately
   19,300m² of gross floor area for student accommodation;
- new pedestrian link between Harris Street and the Ultimo Pedestrian Network through Building 6.
- Building 10 modifications to existing building to provide vehicular access into the new Broadway Building at basement level, and pedestrian access at ground and upper levels.
- Broadway Building construction of a new 44.47m high building to provide 34,650m² of educational, and café or retail uses plus basement car parking for approximately 160 relocated spaces.
- Thomas Street Building construction of new 27.10m high building to provide 10,000m² of gross floor area for educational, cultural and café or retail uses.

#### Alumni Green:

- landscaping;
- below ground book storage vault (2,250m<sup>2</sup> of gross floor area);
- below ground multi-purpose sports hall (1,800m² of gross floor area).
- Public domain improvements to Broadway and Thomas, Harris, Wattle and Jones Streets.

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The purpose of the assessment was to obtain an understanding of the existing development of the site, to infer the subsurface conditions from existing rock outcrops and from information gathered during previous investigations, and to use this information as a basis for comments and recommendations of geotechnical issues associated with the proposed development.

A Stage environmental assessment was completed for the proposed redevelopment by Environmental Investigation Services (EIS) in conjunction with this geotechnical assessment. Reference should be made to the EIS report for potential contamination issues associated with the proposed development.

#### 2 INVESTIGATION PROCEDURE

The fieldwork for the investigation comprised a walkover of the site, including walking through several of the basements, by a Senior Associate. During the walkover, items of geotechnical significance were mapped.

In addition, we have recovered information from nearby previous projects, and have included some of the more relevant data in Appendix A.

#### 3 RESULTS OF THE INVESTIGATION

#### 3.1 Site Description

The site is located at and near the broad crest of a hill in a region of very gently sloping topography. The local high point is approximately at the south-eastern corner of the site, with the land sloping generally to the north and west at about 2° to 3°, though there are localised steeper slopes in various portions of the site resulting from previous and existing development of the site. Wattle Street and the area immediately to the north of the street is the local low point and from prior

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knowledge represents an infilled creek and mangrove swamps which previously bordered Blackwattle Bay further to the west.

The site is currently substantially developed with numerous buildings ranging from two storey brick structures to multi-level concrete framed buildings. There are three existing buildings on the Broadway site (South of Building 10) older than 50 years that are proposed to be demolished. These are two and three storey brick structures. There are three heritage buildings on the south-east corner of the site. These are of 2, 3 and five storeys. The buildings generally appear to be in good structural condition from a brief inspection of their exteriors. The multi-storey buildings appeared to be in good structural conditions from a brief inspection of their exteriors.

The remainder of the buildings on the site are generally multi-level concrete framed buildings, many of which have basements extending to reduced levels ranging between 3.0m and 8.5m AHD, which correspond with maximum cuts of the order of 9m.

There are several lawn areas located toward the central northern portion of the site, including one where a building has been demolished just to the south-east of the intersection of Jones and Thomas Streets.

There is an on-grade car-park toward the south-west corner of the site, to the south of Building 10. Some of the car park has a concrete surfacing, though the majority is covered with a gravel surface.

The site is bounded by Broadway to the south, Thomas Street to the north, Wattle Street to the west and Harris Street to the east. Jones Street runs through the site.

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The site also encompasses the Faculty of Design, Architecture and Building which is on the east side of Harris Street. This is a multi-level concrete framed building with a basement extending to a reduced level of about 7.0m which correlates with a depth of the order of 4.5m. Immediately to the north and south of the site are concrete framed buildings of several levels each. To the west is Harris Street, while the Ultimo Pedestrian Network (formerly the Darling Harbour Goods rail line) passes along the eastern side of the site.

#### 3.2 Subsurface Conditions

Based upon the results of nearby investigations, and our walkover of the site during which several rock faces were inspected, it appears the site is underlain by clayey soils and in some places a thin band of shale, overlying sandstone bedrock of the Hawkesbury Sandstone Group. The depth to rock appears to be limited to about 3m toward the eastern side of the site (near Harris Street), and possibly 6m to 8m toward the western side of the site (near Wattle Street). Whilst the soils over the majority of the site appear to be of residual origin, investigations close to the western boundary of the site have disclosed alluvial soils of relatively low strength (firm to stiff clays and wet loose and medium dense sands).

It appears that the sandstone bedrock is generally of good quality, with several existing cuts for basements disclosing vertically cut sandstone bedrock.

It is likely that there will be areas of the site containing fill, particularly where there has been previous development such as the backfilled basement of the previous Building T adjacent to Jones and Thomas Streets. It is likely that the old basement walls will still be in place below the old Building T.

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#### 4 COMMENTS AND RECOMMENDATIONS

#### 4.1 Feasibility of the Proposed Redevelopment

Based upon the results of our walkover assessment, desktop review and the provided plans of the proposed new works, we consider that the proposed development is feasible from a geotechnical perspective.

There are several geotechnical issues associated with the proposed development, including:

- Excavation of the soils and bedrock;
- Installation and support of shoring;
- Potential requirement for underpinning existing structures where proposed new basements will extend below the existing footing level;
- Design bearing pressures for new footings;
- Potential upgrading of existing footings for increased structural loading.

Further details of these issues for each phase of the redevelopment are provided below.

All of the recommendations provided below are based upon the results of nearby investigations and information gathered during our walkover assessment. These recommendations must therefore be considered as preliminary and are subject to confirmation following further investigation completed at a later stage of the project.

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4.2 **Building 6 Extensions** 

Building 6 houses the Faculty of Design, Architecture and Building on the eastern side of Harris Street, immediately south of the ABC building. The existing multilevel building contains a 'void' area over a basketball court in the north-east corner of the site. The basement level for this building extends to a level of about 7.0m AHD. It is proposed to construct a multi-level building over this void space and the eastern part of this building.

The proposed building in this area will use the existing basement level and so no additional excavation will be required apart from possible extension of the existing footings or construction of new footings. We understand that the building to the south of the site has involved excavation in the bedrock to a reduced level of -1.4m to allow the construction of five basement levels. We understand that the ABC Building to the north of the site also contains five basement levels, and so the excavation for this building probably included excavation to a reduced level of the order of -5m.

As the adjacent basements have undermined the existing footings close to the perimeter of the site, it will be necessary to obtain further information on the design and construction of the basements. In particular, a review should be made of the design drawings for the adjacent buildings, and any other correspondence with UTS regarding the design and construction. Further, the engineers for the adjacent developments should be asked for further information regarding conditions exposed during the construction. When all this information is available, an assessment can be made of whether the capacity of the existing footings near the site perimeter have been compromised.

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If this information is inconclusive, or if the load capacity of the footings has been compromised it is likely to be necessary to use bored piles to underpin the existing footings where they fall within the zone of influence of the adjacent excavation (say within a line drawn upward at 1V in 1H from toe of the cut face).

Based upon our inspection records from the construction of this building, it appears that the footings within this portion of the building were generally about 1.8m by 1.8m, and were approved for an allowable bearing pressure of 3500kPa. This would relate to an allowable load capacity of about 11,000kN. Further review of the records would be required when further details of the proposed design and loading are available. A typical borehole from the investigation for Building 6, along with the borehole location plan, are provided in Appendix A.

#### 4.3 New Building on the Broadway Site South of Building 10

It is proposed to demolish the existing low rise structures between Building 10 and Broadway, and to construct a new ten level concrete framed building over basement levels which extend as deep as RL-0.3m AHD. This will result in excavation to depths of about 10m and 15.5m at the western and eastern ends of the building respectively.

It is likely that there will be about 4m of soil above the sandstone bedrock toward the eastern end of the building, and maybe of the order of 8m of soil and extremely weathered rock toward the western end of the building. As the basement will extend close to the eastern, southern and western site boundaries, it will be necessary to install a shoring system prior to the commencement of excavation. It is likely that this would extend through the soils and have a nominal penetration into bedrock of at least medium strength, and be supported by several levels of temporary anchors. An anchored soldier pile wall with reinforced shotcrete infill panels is likely to be a suitable shoring system where the residual soils are present.

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Toward the western end, where the alluvial soils are likely, it is more likely that a secant pile wall or diaphragm wall system will be required. We expect that the majority of the sandstone would be self supporting when cut vertically, though it will be necessary to undertake frequent geotechnical investigations during the excavation to detail any portions of bedrock which require additional stabilisation such as with rock bolts and possibly reinforced shotcrete panels.

Along the northern side of the proposed building, the excavation for the basement will extend to a depth of the order of 7.5m below the existing Building 10 basement. As the excavation approaches the level of the Building 10 basement, it will be necessary to excavate test pits to expose the footings of the existing building. It may be necessary to underpin the footings of the existing building, or to install very stiff shoring adjacent to the existing footings. These details would need to be determined at a later stage of the project.

Much of the sandstone in this excavation is likely to of medium and high strength, and so it is likely that either very large dozers will be required for the excavation, or that rock breaker attachments to large excavators will be required for effective excavation.

The sandstone bedrock in Sydney has a relatively high in-situ horizontal stress, with stresses in excess of 1MPa previous measured in the City area. Excavations into the sandstone where there has not been significant weathering releases these stresses, with associated lateral movements of the cut faces into the excavation. The typical range of these movements is of the order of 1mm per metre depth of excavation into the sandstone which is not heavily weathered. Therefore, lateral movements of the order of 10mm to 15mm should be expected due to stress relief effects; the effect of these movements should be considered with regard to the adjoining Building 10. It may be necessary to undertake finite element analysis to model the stress relief,

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and particularly the variation of lateral movement with distance from the cut line so that differential lateral movements can be considered.

It is likely that there will be some seepage into the excavation, particularly at the soil/rock interface and from defects within the rock mass. We expect that the amount of seepage would be controllable using conventional sump and pump techniques.

It is likely that the sandstone bedrock would be of low to medium strength on first contact, relatively quickly increasing to medium and high strength. It is therefore likely that the building could be supported on pad footings founded within the sandstone bedrock, and also that bearing pressures of the order of 3500kPa to 6000kPa will be feasible.

#### 4.4 New Library Book Storage Vault

It is proposed to construct a new library book storage vault below the Alumni Green. This will involve a building constructed below the ground level with lawn above. The excavation for the building will extend to a depth of the order of 25m below the existing surface levels; that is to a level of about RL-9.5m AHD.

It is likely that there will be about 3m to 4m of soil and weathered shale above the sandstone bedrock in the vicinity of this structure.

It is likely that the soil and weaker bedrock around the majority of the site could be temporarily battered unless existing services are not to be disturbed. The sandstone below about 4m depth is likely to be self supporting, though it will be necessary to undertake frequent geotechnical investigations during the excavation to detail any portions of bedrock which require additional stabilisation. Adjacent to Jones Street,

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there is not likely to be sufficient room to batter the excavation, and so it will be necessary to install a shoring system as described below.

Apart from adjacent to Jones Street where there is unlikely to be sufficient space to batter the upper soils and weathered rock, it may be preferred to use shoring around the remainder of the perimeter excavation to avoid over-excavation of the batters and later replacement with engineered fill. It is likely that such a shoring system would extend through the soils and have a nominal penetration into the bedrock, and be supported by two levels of temporary anchors. An anchored soldier pile wall with reinforced shotcrete infill panels is likely to be a suitable shoring system in this instance.

The sandstone bedrock in Sydney has a relatively high in-situ horizontal stress, with stresses in excess of 1MPa previous measured in the City area. Excavations into the sandstone where there has not been significant weathering releases these stresses, with associated lateral movements of the cut faces into the excavation. The typical range of these movements is of the order of 1mm per metre depth of excavation into the sandstone which is not heavily weathered. Therefore, lateral movements of the order of 20mm to 25mm should be expected due to stress relief effects; the effect of these movements should be considered with regard to the adjoining Building 2 and the new Thomas Street building. It may be necessary to undertake finite element analysis to model the stress relief, and particularly the variation of lateral movement with distance from the cut line so that differential lateral movements can be considered.

This building will extend across part of the backfilled basement excavation from the former Building 7, which appeared to extend to a depth of the order of 4m. At this stage, we do not have any details of the backfill to the basement, and it is likely to be poorly compacted. It is also likely there will be water ponding in the base of the backfill. Piers or excavations through this material are likely to tend to collapse, and

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it is also likely that there will be flow of water into the excavation or into the piers until this storage is depleted. Even after the water has been removed from the previous basement excavation, it is likely that there will be further seepage from the soil/rock interface, and also from defects within the rock mass. It is also possible that the previous basement walls are still present below ground level, and these will have some impact on the construction of new shoring systems. This could possibly be overcome by excavating slots perpendicular to the boundary and locally removing the basement wall, and then backfilling the slot prior to commencing the shoring.

In the design of this building, consideration should be given to the proposed new Thomas Street building between this structure and Thomas Street, particularly with regard to the design of the footings which will be founded close to the northern side of the deep excavation for the library book storage vault building.

Much of the sandstone in this excavation is likely to be of medium and high strength, and so it is likely that either very large dozers will be required for the excavation, or that rock breaker attachments to large excavators will be required for effective excavation.

It is likely that sandstone of relatively high strength and good quality will be encountered below the base of the excavation, and it is therefore likely that the bedrock would be suitable for allowable bearing pressures of the order of 6000kPa.

#### 4.5 New Underground Multi-Purpose Sports Hall Beside Building 4

It is proposed to construct a new multi-purpose hall below the lawn area between Buildings 1 and 4. This will involve a building constructed below the ground level with lawn above, with excavation for the hall extending to a level of 3.4m AHD, or a depth of about 9.5m. This proposed excavation will terminate about 1m above the lowest levels of Building 1, but will be about 6m below the lowest level of

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Building 4. An outcrop of rock in the ramp leading down to the basement of Building 1 suggests the sandstone will be encountered at a reduced level of about 11mAHD, and so the existing Building 4 is likely to be founded on the sandstone bedrock. However, the footing details and loads will need to be further assessed at a later stage of the project so that an assessment can be undertaken of the necessity for underpinning. As a minimum, it is likely that anchoring to laterally restrain the footings in the short term will be required, with final assessment of the need for underpinning being determined during the excavation when the rock quality immediately below the footings can be better assessed.

Based upon the outcrops mentioned above, it is likely there will be of the order of 3m to 4m of soil and/or weathered shale over the sandstone bedrock. The existing excavation for Building 1 will extend along the southern side of the excavation, and rock cut below Building 4 will extend along the eastern and northern sides of the excavation. There will still be soil along the western side of the proposed excavation, and consideration could be given to adopting temporary batters through the soil.

An alternative to the temporary batters would be to install a shoring system prior to the commencement of excavation, such as an anchored soldier pile wall with reinforced shotcrete infill panels. The soldier piles would extend through the soil and socket into the sandstone bedrock.

It is likely that the majority of the sandstone will be self supporting when cut vertically, though regular geotechnical inspections will be required during excavation so that recommendations can be provided for any necessary stabilisation of the rock faces.

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It is likely that there will be some seepage into the excavation, particularly at the soil/rock interface and from defects within the rock mass. We expect that the amount of seepage would be controllable using conventional sump and pump techniques.

Much of the sandstone in this excavation is likely to of medium and high strength, and so it is likely that either very large dozers will be required for the excavation, or that rock breaker attachments to large excavators will be required for effective excavation.

It is likely that sandstone of medium or high strength will be encountered below the base of the excavation, and it likely that the bedrock would be suitable for allowable bearing pressures of the order of 3500kPa to 6000kPa.

#### 4.6 New Thomas Street Building West of Building 4

It is proposed to construct a new five-level building over a single basement along the Thomas Street frontage between the end of Building 4 and the intersection with Jones Street. This building is proposed to have a basement level of about 11m AHD, which will require excavation to a depth of about 3m below the existing surface level in that area. This lower level will therefore be several metres above the proposed basement levels of both the library book storage vault building and the multi-purpose hall.

The shoring requirements for this building will be dependent upon the staging of this building with the proposed adjacent book storage vault and hall structures. It is likely that the excavation will be through the soils and possibly just into the sandstone bedrock. When within the site boundary, it may be possible to undertake temporary batters through the soils. Where there is insufficient space to batter the soils, such as along the street frontages, or where batters are not preferred, it will be

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necessary to install a shoring system prior to commencing the excavation. It is likely that the shoring system would extend through the soils and have a nominal penetration into the bedrock, and be supported by at least two levels of temporary anchors. An anchored soldier pile wall with reinforced shotcrete infill panels is likely to be a suitable shoring system in this instance.

There could be some difficulties associated with the backfilled basement of Building 7 (formerly Building T). At this stage, we do not have any details of the backfill of the basement, though it is probably poorly compacted, and it is also likely that there is water ponding within the base of the backfill. Piers or excavations through this material are likely to tend to collapse, and it is also likely that there will be flow of water into the excavation or into the piers until this storage is depleted. Even after the water has been removed from the previous basement excavation, it is likely that there will be further seepage from the soil/rock interface, and also from defects within the rock mass.

While the volume of sandstone excavation is likely to be relatively low, the sandstone could be of medium or higher strength, and as such, it is likely that rock breaker attachments to hydraulic excavators would be required for effective excavation.

It is likely that sandstone of low or medium strength will be encountered below the base of the excavation, and it likely that the bedrock would be suitable for allowable bearing pressures of the order of 1000kPa to 3500kPa. Careful consideration must be given to the footings near the edge of the excavation for the proposed book storage vault building and hall. In this regard, it may be necessary to deepen the footings to found on better quality rock, and/or to use relatively low bearing pressures for the footing design. Further investigation of that side of the building will be required to better detail these options.

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4.7 Extensions to Buildings 1 and 2

The existing Buildings 1 and 2 have basements which extend to the north and south beyond the plan extent of the above ground portion of the structures. It is proposed to extend the above ground portions of the buildings to extend over the entire basement area. This will comprise extensions of four to six levels to the north and south of the existing structures.

As there will be no excavation for further basement in this area, the geotechnical issues are limited to the bearing capacity of the existing foundation. It is likely that investigation of the existing footings for the building will be necessary to confirm the footing sizes and founding depths, and also to core boreholes through several of the footings to obtain information on the rock foundation. This will then allow assessment on whether the existing footings will be suitable to support the proposed additional loads, or whether the footings need to be extended, underpinned or At the current excavation levels of about 8.5mAHD (Building 1) and 2.5mAHD (Building 2), we expect that allowable bearing pressures of the order of 3500kPa and 6000kPa respectively would be feasible.

4.8 Building Refurbishment

Apart from the above, several of the buildings will be partly refurbished, though we do not expect that these alterations will have any geotechnical impact. Further geotechnical advice could be provided at a later date if required.

4.9 Other Geotechnical Issues

We note there have been previous projects to the north-northeast of the site which have encountered 'joint swarms' which are near vertical bands of rock which contain closely spaced and near vertical joints within the rock. These are often associated with higher groundwater inflows, and a higher degree of weathering which results in

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lower strengths. There are several of these joint swarms which pass through the city. It appears that the Martin Place joint swarm would pass close to the eastern side of the site, and the GPO Fault zone close to the western boundary. It may be that the site sits between these two zones and remains unaffected. These zones often remain undetected until the construction phase, with measures being implemented following their detection. However, good planning of future investigations should enable their presence or absence to be determined.

Where these features are encountered, it is likely that there will be a greater flow of water to pump from the basement excavations, and stabilisation of excavation faces using reinforced shotcrete and rock bolts is likely to be required. It can be a particular problem if the features occur beneath heavily loaded building footings.

#### 5 GENERAL COMMENTS

The recommendations presented in this report are based upon information gathered from nearby previous investigations and from surface information obtained during our walkover assessment, and so the recommendations are of a general nature and are subject to confirmation following site specific investigations. In the event that further investigations are not undertaken, the general recommendations may become inapplicable and Jeffery and Katauskas Pty Ltd accept no responsibility whatsoever for the performance of the structures.

This report provides general advice on geotechnical aspects for the proposed civil and structural design. 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 there is any change in the proposed development described in this report then all recommendations should be reviewed.

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

P Wright

Senior Associate

Reviewed by:

PWnight.

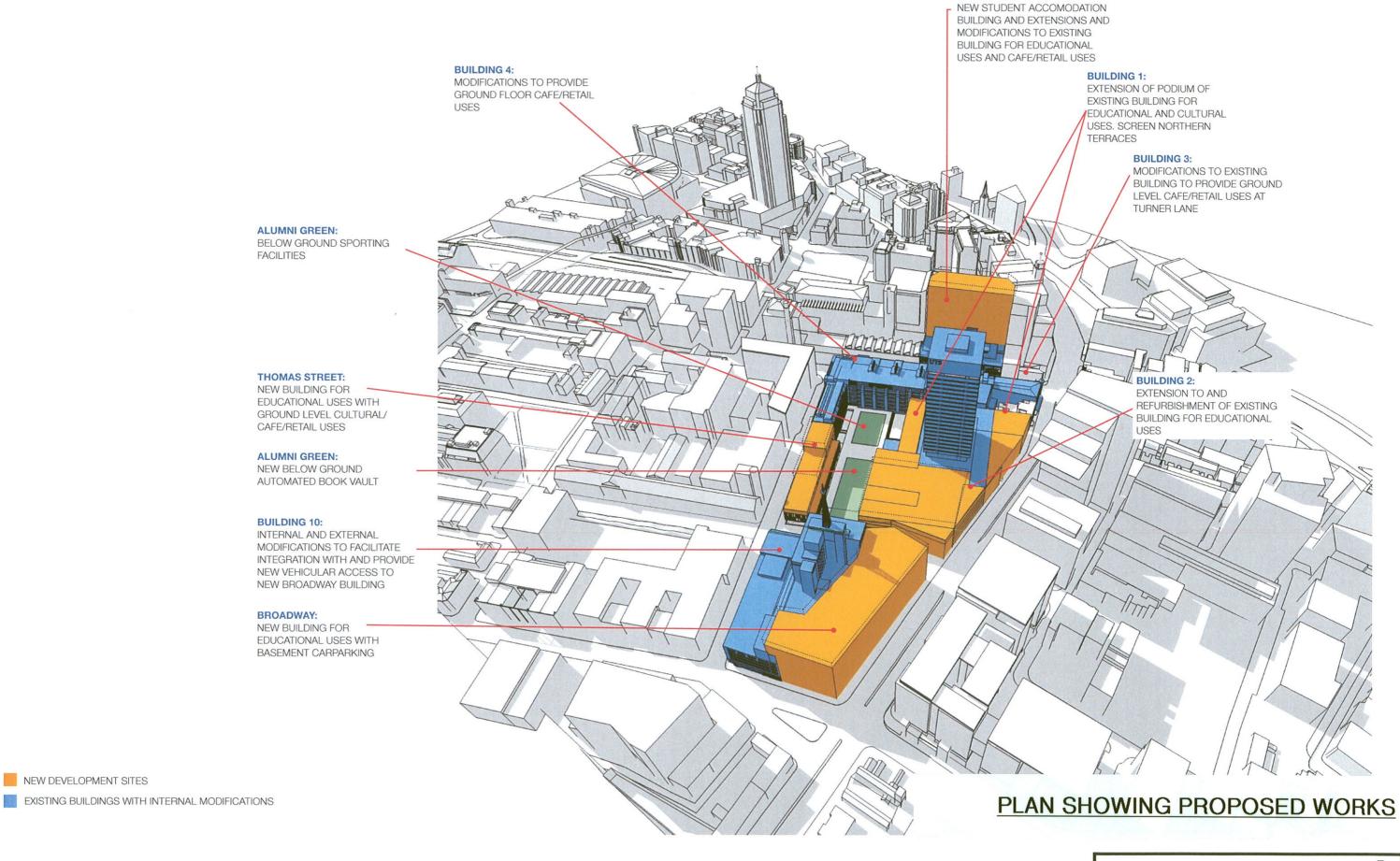
P Stubbs Principal

For and on behalf of

JEFFERY AND KATAUSKAS PTY LTD.



## PLAN SHOWING EXISTING BUILDING NUMBERS



**BUILDING 6:** 

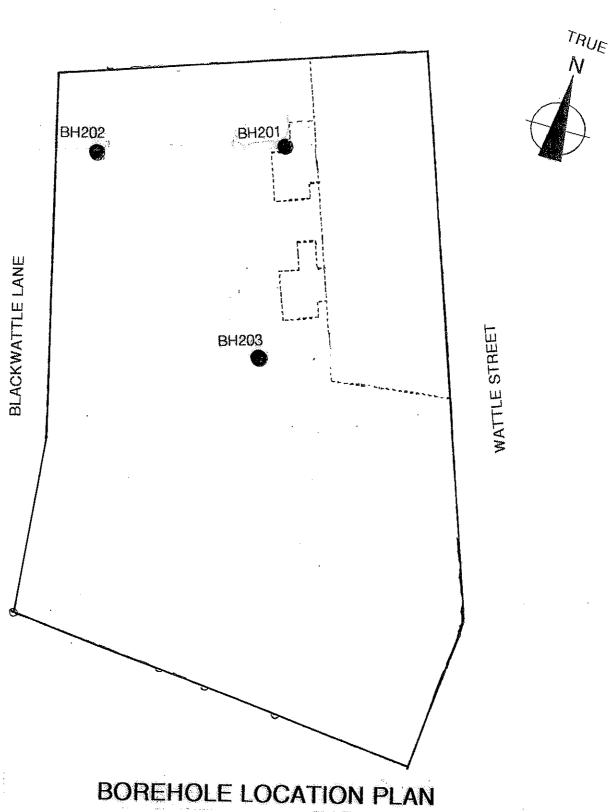
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Report No. 22549SP Fig

Figure No. 2

## APPENDIX A



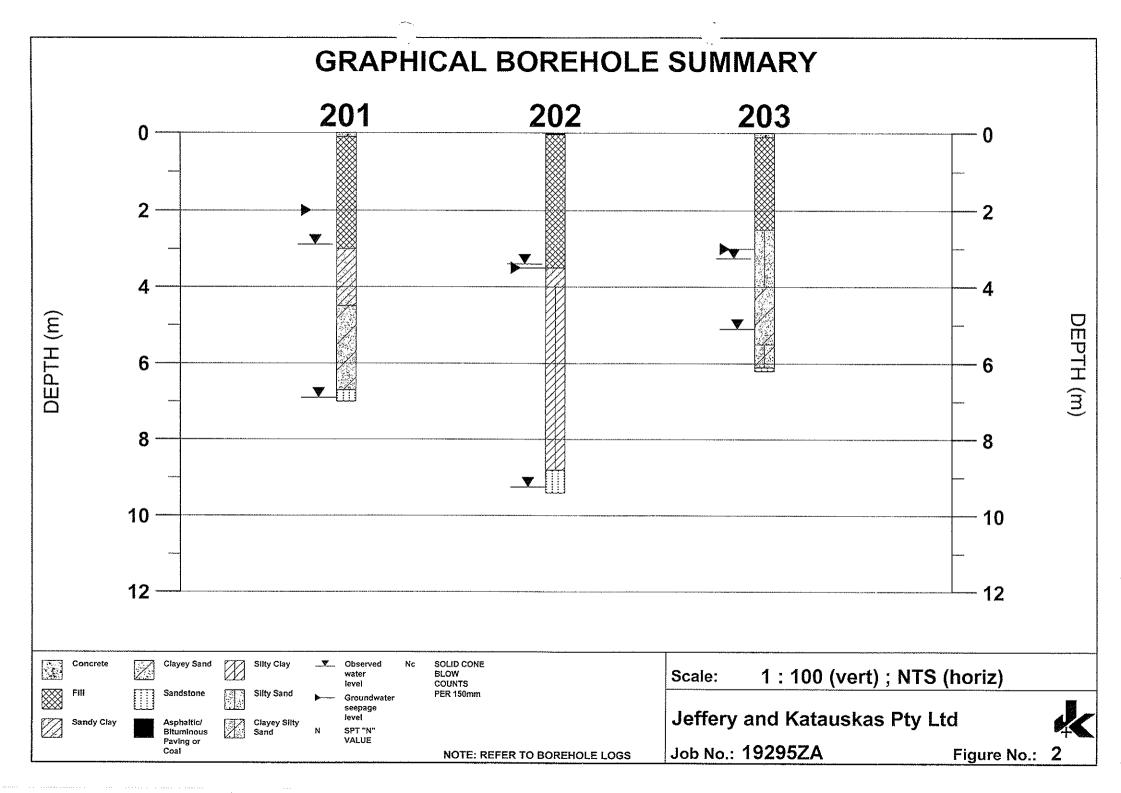


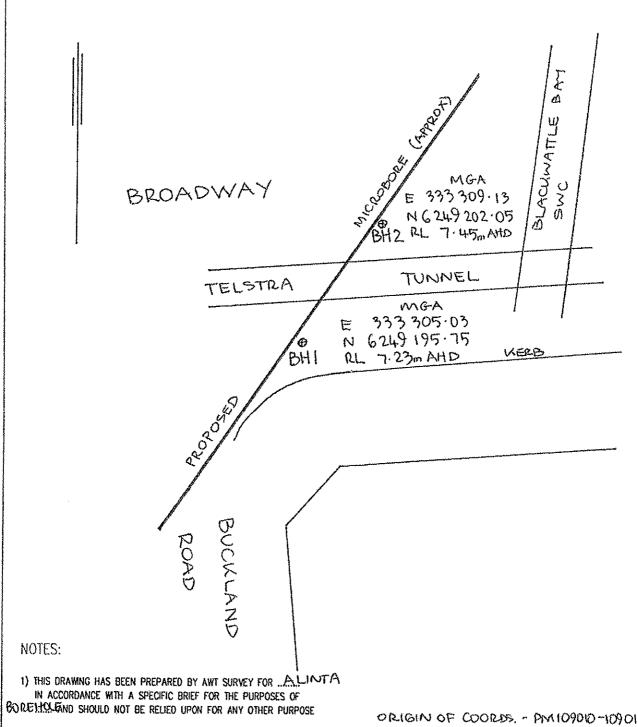
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Figure No. 1





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ORIGIN OF COORDS, - PM109010-109011

ORIGIN OF LEVELS - PM109010

- SEE PROJECT 060415

DATE OF SURVEY 3/12/2007

SURVEYED C.T.

DRAWN R.C.

VERIFIED

DROSSESS SURV.

ANN/T SURVEY

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GEOTECH BOREHOLES TELSTRA TUNNEL BROADWAY

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DATE

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## Jeffery and Katauskas Pty Ltd CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS



Borehole No.

1/3

**BOREHOLE LOG** 

Client: ALINTA ASSET MANAGEMENT

Project:

PROPOSED SEWER

Location:

CNR. BROADWAY & BUCKLAND STREET, CHIPPENDALE, NSW

Job No. 21773S

Method: SPIRAL AUGER

R.L. Surface:

7.45m

Date: 4-12-07							JK300	Datum: AHD				
					2	Logg	ged/Checked by: T.M./					
	Groundwater Record	ES. U50 DB SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks	
ļ				0			ASPHALTIC CONCRETE: 120mmt					
			N = 6 7,3,3	1 —		-	FILL: Clayey gravelly sand, fine to medium grained, brown and red brown, with fine to coarse grained angular to rounded igneous, quartz, granite and sandstone gravel, and sandstone boulders.	M	-	-	6mm DIAMETER REINFOREMENT, 230mm TOP COVER APPEARS POORLY COMPACTED	
			N = 13 7,8,5	2 –			as above, but light yellow brown mottling,  FILL: Clayey sand, fine to medium	M			- APPEARS MODERATELY COMPACTED	
l				-		СН	grained, yellow brown.  SILTY CLAY: high plasticity, grey.	MC>PL	(St)	-	ALLUVIAL	
			N = 11 3,5,6	3-		sc	CLAYEY SAND: fine grained, dark grey, with sandy clay bands.	M	MD		- SLIGHT ORGANIC ODOUR -	
				4-		МН/СН	CLAYEY SILT/SILTY CLAY: high plasticity, dark grey, with a trace of fine to coarse grained sand and occasional sandy clay bands.	MC>PL	F-St	- - - -	-	
			N = 4 2,1,3	5-1						100 130 150 100 80 60	VANE SHEAR 36kPa	
C	ON OMPLET- ION		N = 11 3,4,7	6 -		СН	SILTY CLAY: high plasticity, red brown mottled brown, with fine to medium grained sand and fine to coarse grained angular ironstone gravel.		St- VSt	350 560 300 100 100 150	VANE SHEAR 118kPa	

## Jeffery and Katauskas Pty Ltd consulting geotechnical and environmental engineers



Borehole No.

2/3

**BOREHOLE LOG** 

Client: ALINTA ASSET MANAGEMENT

Project:

PROPOSED SEWER

Location:

CNR. BROADWAY & BUCKLAND STREET, CHIPPENDALE, NSW

Job No. 21773S

Method: SPIRAL AUGER

R.L. Surface:

7.45m

Date: 4-12-07

JK300

Datum: AHD

	,,				~	Logg	ed/Checked by: T.M./p <sub>2</sub>			atum.	AID
Groundwater Record		DB SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	저 Moisture V Condition/ 면 Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			N > 12 7,12/ ∖ 150mm REFUSAL	8		CL-CH	SANDY CLAY: medium to high plasticity, light grey, with ironstone gravel bands.  as above, but mottled dark red brown, with VL strength sandstone bands.	MC > PL	VSt -H	300 460 \ 550	RESIDUAL
			or the second se	9 -			SANDSTONE: fine to medium grained, light grey, with orange brown stained bands.	DW	L-M		LOW TO MODERATE TTC' BIT RESISTANCE
				11			REFER TO CORED BOREHOLE LOG				
				12 -							
				14						_	

## Jeffery and Katauskas Pty Ltd consulting geotechnical and environmental engineers



**CORED BOREHOLE LOG** 

Borehole No.

2

3/3

Client: ALINTA ASSET MANAGEMENT

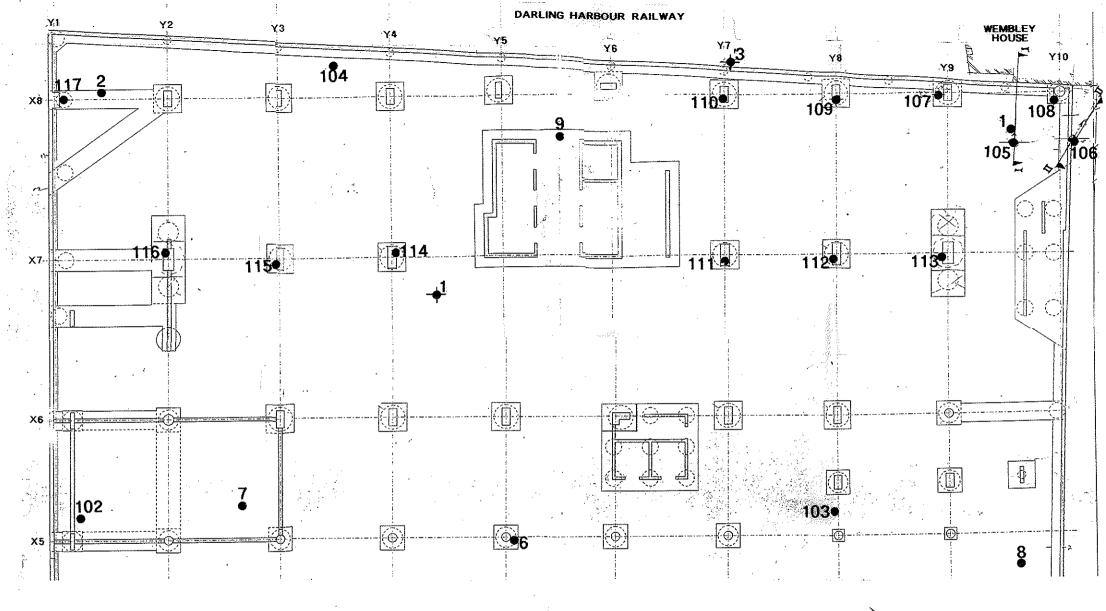
Project:

PROPOSED SEWER

Location:

CNR. BROADWAY & BUCKLAND STREET, CHIPPENDALE, NSW

ı	Location: CNR. BROADWAY & BUCKLAND STREET, CHIPPENDALE, NSW													
	Jo	b N	o. 2	1773	SS Core	Size:	NM	ILC	3	R.L. Surface: 7.45m				
	Da	te:	4-12	2-07	Inclina	ation:	VE	R	TICAL	Datum: AHD				
	Dri	Drill Type: JK300 Bearing								Logged/Checked by: T.M./				
ſ	eve	CORE DESCRIPTION							POINT	DEFECT DETAILS				
	Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	Rock Type, grain character- istics, colour, structure, minor components.	Weathering	Strength		LOAD STRENGTH INDEX I <sub>S</sub> (50)	DEFECT DESCRIPTION SPACING Type, inclination, thickness, planarity, roughness, coating.				
; ;			10		START CORING AT 10.38m		·							
	70% RET- URN		112-		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-20°.	SW-FR	М		* * * * * * * * * * * * * * * * * * *	- J, 50°, P, S - CS, 10mm.t - CS, 10mm.t - J, 75-90°, Un, R, RUNS 540mm				
			14		END OF BOREHOLE AT 13.22m									



#### **BOREHOLE LOCATION PLAN**

#### **LEGEND**

● BOREHOLE BY J & K

BOREHOLE BY ARUP GEOTECHNICS





Jeffery and Katauskas Pty Ltd Report No. 8456WX Figure No. 4

## Jeffery and Katauskas Pty Ltd consulting Geotechnical Engineers



## **BOREHOLE LOG**

Borehole No.

110

1/4

Job	No.	8456 WA	r			GTREET, LILTIMO. N.S. d: SPIRAL AUGER. BCD 450.			Surface	; 10·74m. H.D.
Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand To Penetrometer Peadings	Remarks
			- - - /			FILL: Mixed sand and clayey sand, yellow brown becoming black below 0.5m with some brick fragments. to 0.5m.		<i>(L)</i>		— GLASS FRAGMENT.
			- 2 - - - - -		SC.	CLAYEY SAND: fine to medium grained, black. SANDY CLAY: high plasticit black; Sand, fine to medium grained.	y,MC»PL	(5- F)		-
			4-		CH.	CLAY: high plasticity, yellow brown & grey mottled, some fine sand.	MC >PL	(51)		
			5-		CH. CL	SANDY CLAY: medium to high plasticity, light grey & yellow brown, sand, fine to medium grained.			-	

## Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL ENGINEERS



BOREHOLE LOG

Borehole No.

110

PIER XB/YT

MCLACHLAN CONSULTANTS PTY. LIMITED. Client: PROPOSED U.T.S. SCHOOL OF DESIGN BUILDING. Project: Location: 702 - 730 HARRIS STREET, LILTIMO. N.S.W. Job No. 8456 WX Method: SPIRAL ALIGER. R.L. Surface: 10.74 m. Date: 14 - 8 - 92. BCD 450. Datum: A.H.D. Hand Denetrometer Beadings Unified Classification Groundwater Consistency/ Rel. Density Graphic Log Depth (m.) Field Tests Samples Moisture Condition DESCRIPTION Remarks SANDY CLAY: as above. SANDSTONE: fine to medium grained, yellow brown CLASS 4 8 REFER TO CORED BOREHOLE LOG

9 10 12 13-



### Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL ENGINEERS



### **CORED BOREHOLE LOG**

Borehole No.

110

3/4 PIER X8/Y7

Client: MCLACHLAN CONSULTANTS PTY. LIMITED

Project: PROPOSED U.T.S. SCHOOL OF DESIGN BUILDING.

	oca -oca			20POSED U.T.S. SCHO 2 - 730 HARRIS STRE					DING.
1	Date	Drille	d: <i>14</i>	76 WX.       Core Size         7 - 8 - 92.       Inclination         9 - 450       Bearing:					. L. Surface: IO · 74 m atum: A.H.D.
-evel							POINT LOAD		DEFECT DETAILS
Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION  Rock Type, grain characteristics, colour, structure, minor components	Weathering	Strength	INDEX STRENGTH I <sub>S</sub> (50)	DEFECT SPACING (mm)	DESCRIPTION  Type, inclination, thickness, planarity, roughness, coating.  Specific General
NOTLE SETTING		8- 10- 11- 13- 14		START CORING AT 1.92m.  SANDSTONE: fine to mediui, grained, red brown to yellow brown.  ———————————————————————————————————	MW SW	MS. S	X		- LAMINATED ZONE IOMM †.  - LAMINATED ZONE IOMM †.  - JOINT AT 80° PLANAR SMOOTH FOR 30mm  - ZONE FRAGMENTED FOR 30mm  - POSSIBLE SEAM/CORE LOSS - POSSIBLE SEAM/CORE LOSS - LAMIN ATIONS - LAMIN ATIONS - LO° BEDDING - POSSIBLE EW INFILL ROUGH - CARBONACEOUS - LAMINATIONS - CARBONACEOUS - CARBONACEO

## Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL ENGINEERS



### CORED BOREHOLE LOG

Borehole No.

110

PIER X8/Y7

Client: MCLACHLAN CONSULTANTS PTY. LIMITED Project: PROPOSED U.T.S. SCHOOL OF DESIGN BUILDING. Location: 702 - 730 HARRIS STREET, LILTIMO. N.S.W. Job No: 8456 WX. Core Size: N.M.L.C. R. L. Surface: 10.74 m. Date Drilled: 14 - 8 - 92. Inclination: VERTICAL. Datum: A.H.D. Drill Type: BCD - 450 Bearing: Water Loss/Level **POINT DEFECT DETAILS** LOAD Graphic Log Weathering Ďepth (m) **INDEX DEFECT** Barrel Lift Strength DESCRIPTION STRENGTH SPACING Type, inclination, thickness, CORE DESCRIPTION  $I_{S}(50)$ (mm) planarity, roughness, coating. Rock Type, grain characteristics, VW MS VS colour, structure, minor components. RETURN SANDSTONE: as above "SW : : : : : : : : : : CLASS. 2 *1*5 END OF BOREHOLE AT 15-12m 16 20