UTS

Bon Marche and Sciences Precinct Master Plan

Preliminary Stormwater Management Concept Plan

Final | 27 August 2018

Job number

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 10 201 Kent Street
PO Box 76 Millers Point
Sydney 2000
Australia
www.arup.com

ARUP

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Appendices

Executive Summary

The University of Technology Sydney are seeking modifications to the approved Campus Masterplan through a Section 75W application. The project relates to the Bon Marche and Science Precinct (Buildings 3, 4, 9 and 18) and includes changes to building GFA and height limits. This report summarises the proposed stormwater management concept plan in support of the Section 75W modification application.

A review of available information for the proposed redevelopment of the UTS Bon Marche and Sciences Precinct has been undertaken to determine stormwater management requirements at the site. As part of this review relevant stormwater management legislation, including the Sydney LEP and DCP, was considered to determine requirements for the proposed development.

This review also included as assessment of previous stormwater and flooding investigations completed for the site. This investigation determined that the site is not anticipated to be affected by flooding in events up to the 1% Average Exceedance Probability (AEP).

A proposed stormwater management strategy for the site has also been developed which includes the following:

- The proposed development is to include a combination of stormwater quality strategies including green roofs, rainwater harvesting and reuse, gross pollutant traps and filtration systems to meet Council water quality requirements. The final configuration of these features will be determined at later design stages.
- Based on advice from Sydney Water it is not anticipated that OSD will be required as part of the proposed development.
- Stormwater discharge from the site will utilise existing connections to the adjacent street stormwater network.

1 Introduction

This report supports a Section 75W modification application submitted to the Minister for Planning pursuant to the *Environmental Planning and Assessment Act 1979* (EP&A Act) and more specifically, Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*.

The Application relates to the Concept Plan Approval for the University of Technology Sydney (UTS) City Campus Broadway Precinct, which was approved in December 2009 (MP08_0116).

More specifically the modification application relates to the Bon Marche and Science Precinct (Buildings, 3, 4, 9 and 18) and includes establishing new building envelopes with corresponding height and Gross Floor Area (GFA).

This Preliminary Stormwater Management Concept Plan prepared by Arup summarises the proposed stormwater management strategies to be implemented as part of the development. The following stormwater requirements have been evaluated as part of this report:

- Flooding;
- Stormwater detention;
- Trunk drainage; and
- Water Sensitive Urban Design (WSUD).

1.1 Overview of Proposed Modifications

The s75W Application seeks the following key modifications to the approved Concept Plan:

- Conceptual demolition of existing Building 4, and rear section of Building 3,
- Conceptual modification to heritage items, Building 3, Building 9, and Building 18;
- Creation of a new building envelope for Building 4, Building 3 (part) and Building 9 (cantilevering over only), resulting in a maximum height of RL 86.55, an increase of approximately 45m above existing Building 4 and approximately 50m above existing Building 3;
- Corresponding increase in GFA for Building 4 and Building 3, comprising an additional increase of up to 36,500m^2;
- Consequential amendments to the Urban Design Quality Controls/Principles to guide the future development of the Bon Marche and Science Precinct; and
- Indicative landscape and public domain concept for the precinct.

The proposed new envelope for the Bon Marche and Science Precinct will accommodate a future building that will have an effective maximum height of 16/17 storeys above Harris Street and six (6) storeys above Thomas Street (i.e. excluding basement levels and plant). The resulting total GFA for the Bon Marche and Science Precinct (new building envelope and existing buildings) is some 65,000m^2.

No physical works are proposed as part of this s75W modification application, with detailed application(s) to follow any approval granted.

1.2 Background

1.2.1 Evolution of UTS

UTS was formed in 1988 from the former NSW Institute of Technology, and was restructured in 1990 with the merger of the Kuring-gai College of Advanced Education, the School of Design, and the Institute of Technical and Adult Teacher Education to form the current UTS. This change in profile, combined with the University's predominantly CBD location in Sydney, created a new identity. During its early evolution, student numbers increased at UTS without any significant increase in student facilities.

UTS recognised the need to upgrade the City Campus back in 2000, and undertook a number of visioning and master planning projects culminating in the City Campus Masterplan 2020 (BVN, 2008) which provided a framework for refurbishments and new building works across the campus (comprising the Broadway Precinct and other sites in the Sydney CBD) in order to provide improved facilities and to accommodate future expected student and staff growth.

On 23 December 2009 a critical step in realising UTS's vision and identity for the Broadway Precinct was realised,

with approval of the UTS City Campus Broadway Precinct Concept Plan (BPCP).

Since approval of the Concept Plan in 2009 UTS has secured the necessary detailed planning approvals and delivered a number of state of the art and iconic learning, research and social facilities across the Broadway Precinct, including (refer to Figure 1):

- Faculty of Engineering and IT Building, designed by Denton Corker Marshall Architects.
- Multi-Purpose Sports Hall, designed by PTW Architects.
- Alumni Green, designed by ASPECT Studios Landscape Architects.
- Faculty of Science and Graduate School of Health Building, designed by Durbach Block Jaggers in association with BVN Architecture.
- Library Retrieval System, designed by Hassell Architects.
- Great Hall and Balcony Room Upgrade, Designed by DRAW Architects in association with Kann Finch Architects.
- Student Housing Building, designed by nettletontribe architects.

The UTS Central Project (designed by fjmt in collaboration with Lacoste + Stevenson in association with Darryl Jackson Robin Dyke Architects) represents the latest project being delivered by UTS to meet the needs of staff and students. The first phase of the UTS Central Project, which required a modification to the Concept Plan (MOD 5), is expected to be completed in 2019. The second phase

of this project will include an extension to the podium of Building 1 addressing Broadway.

UTS currently has less than 2% of space across campus unallocated which is insufficient to accommodate forecast continued growth in student and staff numbers in the future. The educational facilities within the existing Bon Marche Building 3 are outdated and inadequate to meet the needs of contemporary teaching and learning environments.

The existing Science buildings (Building 4) are nearing the end of their lifecycle, which together with the continued growing demands from students locally and abroad and growth in both Science and Design, Architecture and Building (DAB) faculties presents an opportunity for UTS to progress with plans to support additional and much needed teaching and research space.

UTS plays an important role in the success of Sydney and NSW, with the Greater Sydney Commission's recently released Sydney Regional and District plans acknowledging this importance and identifying the need to protect and support the growth of education activity within the Harbour CBD Innovation Corridor.

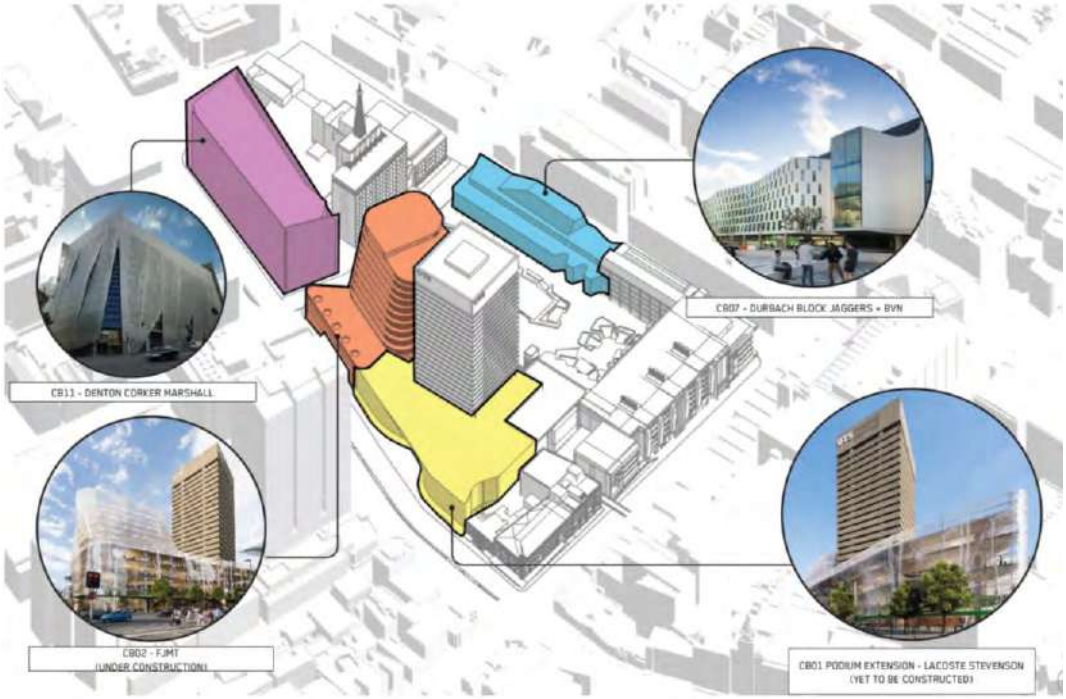


Figure 1 Key UTS projects approved/delivered under the Concept Plan (Source: BVN)

1.2.2 Evolution of Concept Plan

The UTS City Campus Broadway Precinct Concept Plan (BPCP, as illustrated in Figure 2) was approved by the then Minister for Planning on 23 December 2009 (MP08_0116). The Concept Plan initially included:

- New Broadway Building and Thomas Street Building with a combined gross floor area (GFA) of 44,650m^2;
- Expansion of Buildings 1 and 2 with a combined additional GFA of 10,800m^2;

- Expansion of Building 6 for the provisions of student housing with an additional 25,250m^2 GFA;
- Modifications to Buildings 3, 4 and 10;
- Modifications to Alumni Green with a new Multi Purpose Sports Hall and book vault beneath; and
- Public domain improvements to Broadway and Thomas, Harris, Wattle and Jones Streets.

The Minister also granted Project Approval for the following works:

- Construction of a new underground Multi Purpose Sports Hall; and
- Demolition of Buildings 11, 12 and 13.

The Concept Plan did not set new maximum heights and GFA for the Bon Marche and Science Precinct as demand for growth or redevelopment of these buildings was not identified at the time. The Concept Plan (2009) was informed by UTS's Growth Plan at the time to 2020, which had not foreseen that additional floor area and significant modifications and upgrades to existing buildings was required in the Bon Marche and Science Precinct. The 2009 Concept Plan also did not take into account the lifecycle status of Building 4, which was recently investigated and reported to be nearing end of life in 2026.

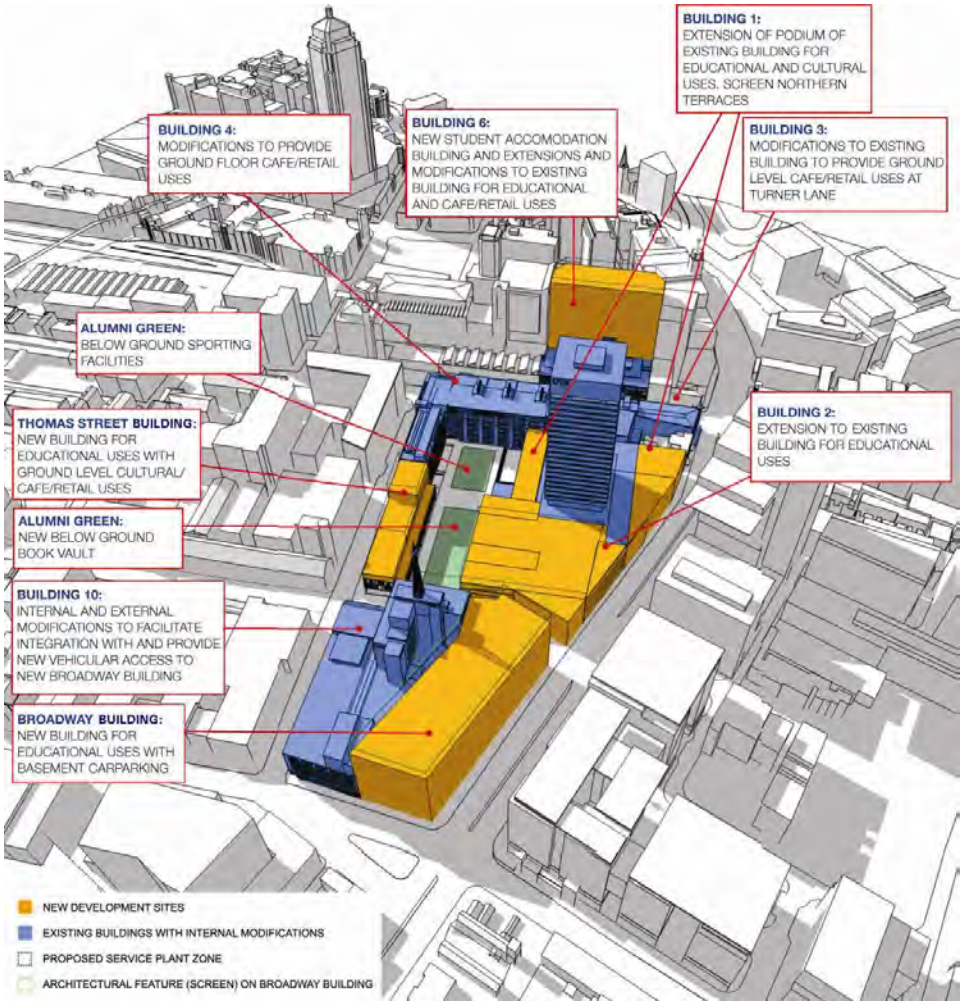


Figure 2 3D Model of approved concept plan (Source: BVN, DCM and JBA)

Since the Concept Plan was approved, five (5) subsequent modifications have been approved.

Modification No 1

Modification No 1 (MP 08_0116 Mod 1), approved in March 2011, sought to include bulk excavation works for the Broadway Building as part of the Project Approval works granted under the Concept Plan approval (enabling these works to be undertaken ahead of the Project Application for the building).

Modification No 2

Modification No 2 (MP 08_0116 Mod 2), approved in March 2011, related to an administration amendment to Concept Plan condition B2.

Modification No 3

Modification No 3 (MP 08_0116 Mod 3), approved in July 2011, sought to include the excavation, construction and operation of the Library Retrieval System (LRS) and Storage Building together with bulk excavation works for the Thomas Street Building as part of the Project Approval works granted under the

Concept Plan approval (enabling these works to be undertaken without any further environmental assessment).

The modification also included a revised breakdown of GFA across the UTS Broadway site, with the Environmental Assessment submitted in support of the S75W identifying an increased GFA for the Thomas Street building of 12,150m^2 (corresponding with a decreased GFA for the Broadway Building of 34,650 m^2).

Modification No 4

Modification No 4 (MP 08_0116 Mod 4), approved in March 2012, related to an administration amendment to Concept Plan condition E3 (approved truck route plan for excavation of Thomas Street building and the library retrieval system).

Modification No 5

Modification No 5 (MP 08_0116 MOD 5) was approved by the then Minister for Planning in March 2016 and facilitated an expanded Building 2 envelope (maximum RL of 79.5) and corresponding increase in GFA for a new Building 2 and the Building 1 podium extension (resulting in a total maximum allowance of 64,407m^2). The modification provided the planning framework for the UTS Central project currently under construction.

Modification No 6

This report has been prepared in support of proposed Modification No 6 (MP 08_0116 Mod 6) to the Concept Plan.

1.3 SEARs

Secretary's Environmental Assessment Requirements (SEARs) were issued by the Department of Planning and Environment (DP&E) on 1 February 2018. Specifically, this report responds to the following SEARs requirements:

8. Flooding and Drainage

- Provide a stormwater report which identifies the impacts, if any, of the proposed modification and how water quality and quantity impacts on the drainage system would be managed.
- Asses any flood risk on the site including consideration of any relevant provisions of the NSW Floodplain Development Manual (2005).

1.4 The Site

The Broadway Precinct of the UTS City Campus is located on the southern edge of the Sydney Central Business District (CBD). The UTS City Campus is located entirely within the Sydney Local Government Area.

The Campus has frontages to Broadway, Thomas, Wattle and Harris Streets, and the Goods Line and is less than 700 metres from Central Railway Station. Jones Street runs through the Precinct. The area covered by the Concept Plan (MP 08_0116) is shown in Figure 3.

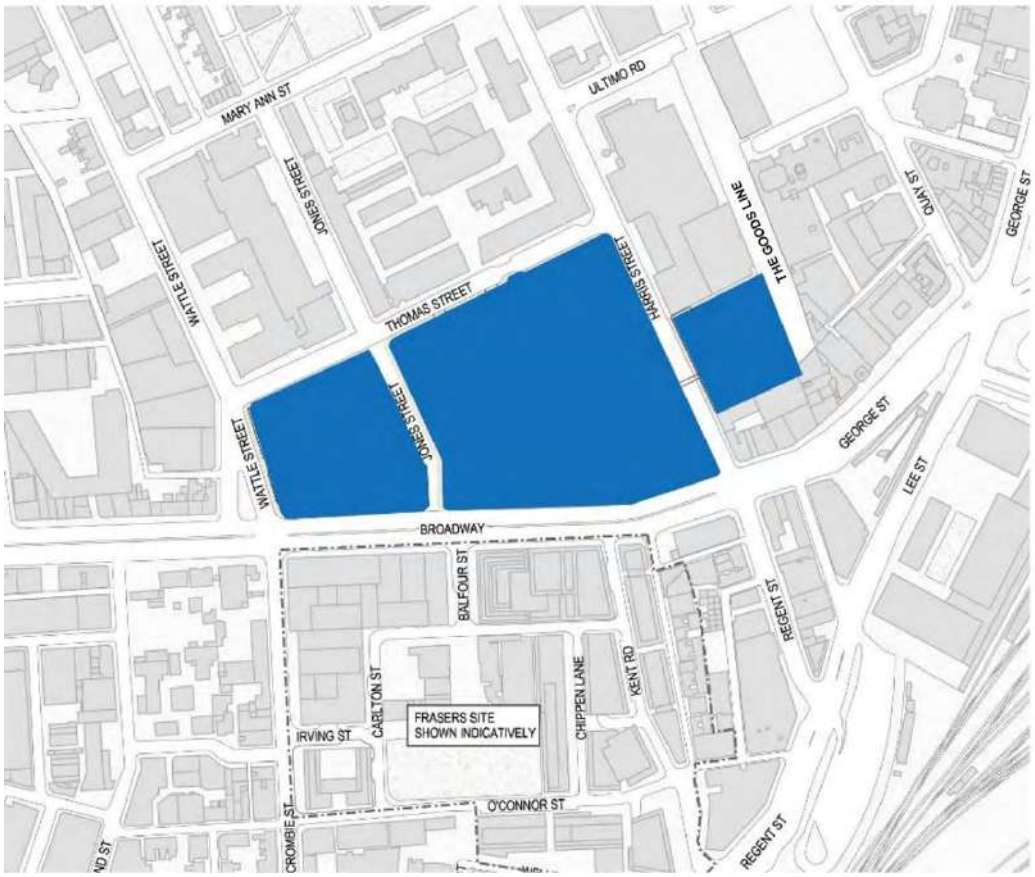


Figure 3 Site Context (Source: BVN)

More specifically, the Bon Marche and Science Precinct is located within the eastern part of the Broadway campus between Thomas Street and Broadway with frontage to Harris Street. It incorporates Buildings 3, 4, 9 and 18. Buildings 3, 9 and 18 are identified as heritage items under the *Sydney Local Environmental Plan 2012* (SLEP 2012). Refer to Figure 4 and Figure 5 for the location of the Bon Marche and Science Precinct.

Figure 4 Aerial image of Bon Marche and Science Precinct (outlined in red) – May 2018 (Source: NearMap)

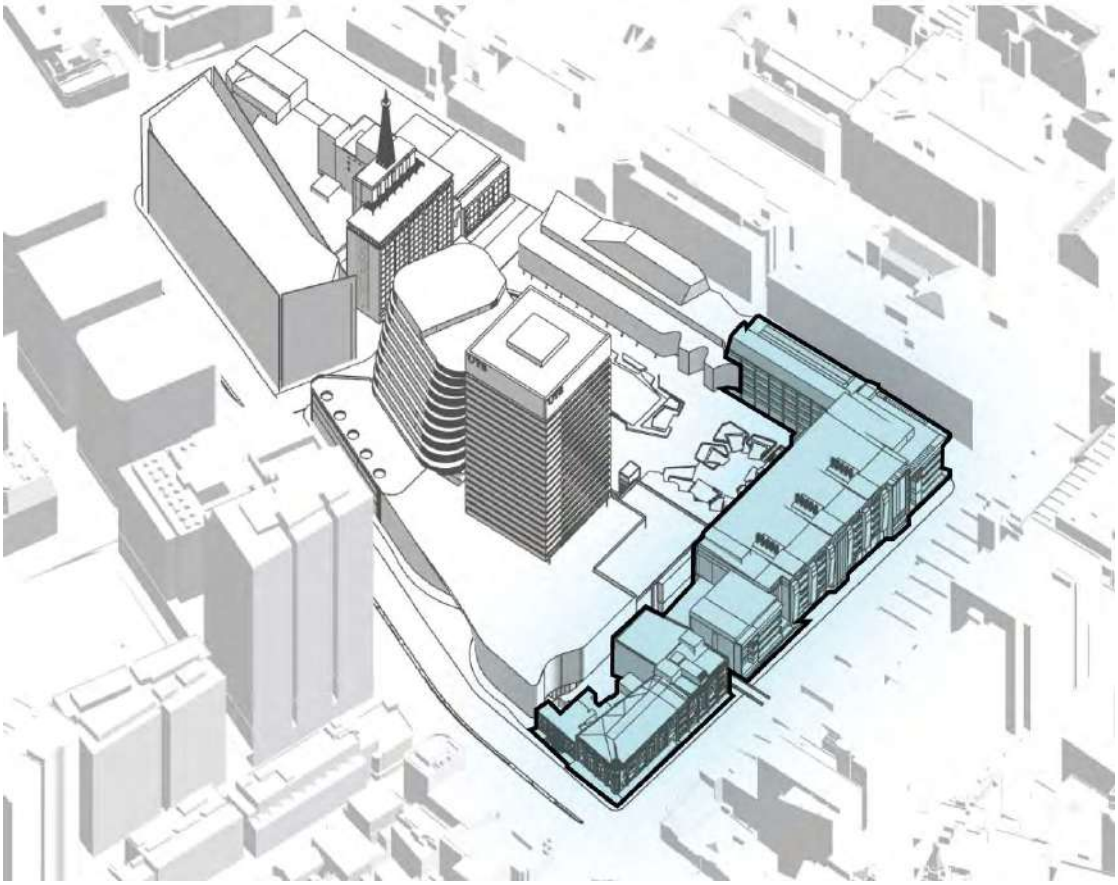


Figure 5 3D perspective of the existing Bon Marche and Science Precinct (Source: BVN)

2 Relevant Stormwater Management Legislation

2.1 Sydney Local Environment Plan 2012

The Sydney Local Environment Plan 2015 (LEP) is the City of Sydney's principal planning document that applies to the development site. The LEP includes the following requirements related to flood planning.

7.15 Flood planning

(1) The objectives of this clause are as follows:

(a) to minimise the flood risk to life and property associated with the use of land,

(b) to allow development on land that is compatible with the land's flood hazard, taking into consideration projected changes as a result of climate change,

(c) to avoid significant adverse impacts on flood behaviour and the environment.

(2) This clause applies to land at or below the flood planning level.

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

(4) A word or expression used in this clause has the same meaning as it has in the NSW Government's *Floodplain Development Manual* (ISBN 0 7347 5476 0) published in 2005, unless it is otherwise defined in this clause.

(5) In this clause:

flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metres freeboard.

2.2 EPA Act and NSW Floodplain Development Manual

Direction 4.3 of Section 117(2) in the *EPA Act 1979*, details the objectives and requirements with which developments in flood prone land must comply, making reference to the New South Wales Floodplain Development Manual (2005) (the FDM). The FDM outlines the NSW Government's Flood Prone Land Policy. The

primary objective of this policy is to reduce the impact of flooding and flood liability on owners and occupiers of flood prone properties whilst recognising the benefits from the use, occupation and development of flood prone land.

2.3 Sydney Development Control Plan 2012

The Sydney Development Control Plan 2012 (DCP) applies to the development of the site. It includes controls related to flooding and stormwater management, in addition to other planning controls, that must be adhered to. Particular controls related to stormwater and flood management are included in Section 3.7 of the DCP.

Flooding

Section 3.7.1 includes a summary of controls related to flooding for development proposals. Where sites include land below the flood planning level, a site-specific flood study is required.

Drainage and Stormwater Management

Section 3.7.2 includes a summary of controls related to stormwater management for development proposals. The key requirements of this section include that a local drainage management plan is required for sites greater than 1,800m^2 in size. Minor drainage systems for sites greater than 1,000m^2 are required to convey the 5% average exceedance interval event, with the major drainage network conveying larger events.

The DCP requires that post-development stormwater volumes during an average rainfall year are the greater of a) 70% of the volume if no measures were applied to reduce stormwater volume or, b) the equivalent volume generated if the site were 50% pervious. Stormwater detention devices are to be designed to ensure that overland flow paths have sufficient capacity in all design rainfall events, discharge to the public stormwater system without affecting adjoining properties.

Stormwater Quality

Section 3.7.3 includes a summary of controls related to stormwater quality for development proposals. The following stormwater quality reduction targets apply to developments greater than 1,000m^2 in size:

- Reduce the baseline annual pollutant load for litter and vegetation larger than 5mm by 90%;
- Reduce the baseline annual pollutant load for total suspended solids by 85%;
- Reduce the baseline annual pollutant load for total phosphorus by 65%;
- Reduce the baseline annual pollutant load for total nitrogen by 45%.

This performance is to be confirmed in a site stormwater quality assessment including water quality modelling.

2.4 Sydney Water On-site Stormwater Detention Policy

The requirements for on-site detention (OSD) in the City of Sydney Local Government Area are outlined in the Sydney Water On-site Stormwater Detention Policy (2014). This policy states that, “the OSD system must be site-specific and offset the stormwater run-off due to the development”. It is a requirement that any OSD system store runoff up to the 100-year Average Recurrence Interval (1% AEP equivalent) and that runoff is discharged in a controlled manner that downstream stormwater assets can handle.

Some developments may be exempt from providing OSD based on their site area, location in the catchment or where an existing building is being refurbished and the existing drainage system is being maintained.

3 Existing Site Stormwater Management

3.1 Existing Topography and Stormwater Infrastructure

The existing site topography falls from south to north along Harris Street. The high point at Broadway is approximately 16.5m AHD, while the high point along Thomas Street is approximately 13m AHD. The low point of the site is located at the corner of Harris Street and Thomas Street and is approximately 8.9m AHD.

Stormwater runoff from the existing buildings discharge to the street stormwater network via numerous connection points and kerb outlets along Harris Street and Thomas Street. From the corner of Thomas Street and Harris Street, the Sydney Water/City of Sydney stormwater network drains to the north. A sketch of the existing street stormwater network near the project is shown in Figure 6.

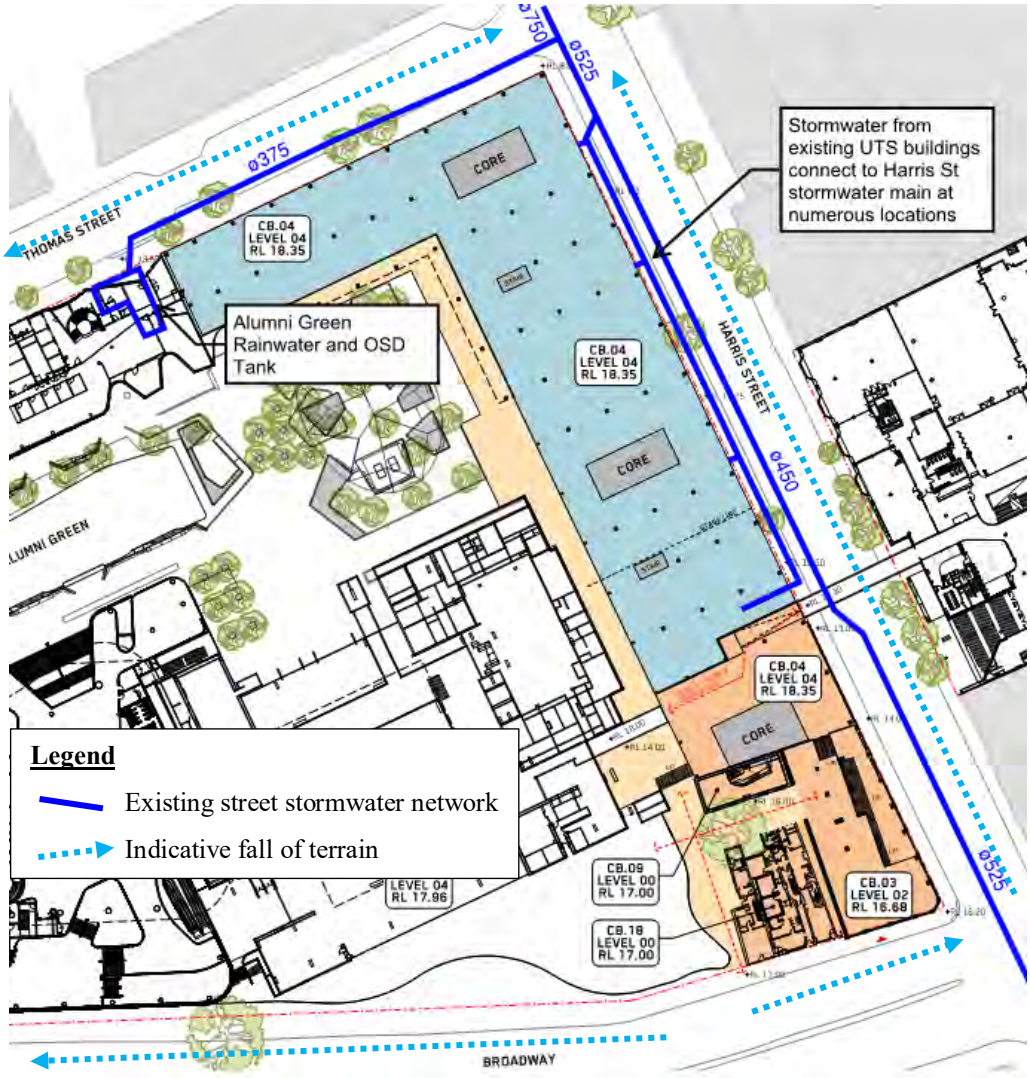


Figure 6 Sketch of existing street stormwater network in study area

3.2 Previous Flood Studies

A review of previous flood studies relevant to the site has been undertaken to gain an understanding of existing stormwater drainage and flooding behaviour. The following studies were identified as being relevant to the site:

- City of Sydney Darling Harbour Catchment Flood Study (BMT WBM, 2014)
- Rainwater Reuse System Concept Design Report for University of Technology – Alumni Green (Warren Smith & Partners 2013)

A summary of information relevant to the development site from each of these reports is included in the following sections.

3.2.1 City of Sydney Darling Harbour Catchment Flood Study (BMT WBM, 2014)

This report was undertaken to determine the flood behaviour within the City of Sydney Darling Harbour catchment area. The development site falls within this catchment area.

As part of the flood study a hydrologic and hydraulic two-dimensional TUFLOW flood model was developed for the study area. A direct rainfall approach was used to model catchment hydrology (commonly referred to as "rainfall on the grid"). A one-dimensional pit and pipe network was also included as part of the study. The extent of the pit and pipe network in the vicinity of the study area is shown in Figure 7 in red. Trunk stormwater drains along Harris Street were included in the model, however, no stormwater drainage infrastructure within the UTS campus was included as part of the study.

Figure 7 Excerpt of Figure 2-5 Darling Harbour Catchment Stormwater Pit/Pipe Dataset from City of Sydney Darling Harbour Catchment Flood Study (BMT WBM, 2014)

Flood mapping in this report showed Broadway, Thomas Street and Harris Street adjacent to the proposed development to be free of flooding up to the 1% Average Exceedance Probability (AEP) event. Some localised flooding was shown within the Alumni Green, however, as noted, the flood model did not include any drainage within this area. As the model used the direct rainfall method, rainfall onto the Alumni Green area would accumulate in the model without an escape route. Therefore, the flooding of this area is not considered representative of hydraulic behaviour at this location.

An extract from the 1% AEP flood depth map presented in the report is shown in Figure 8, which shows the extent of reported flooding in the area of the subject site.

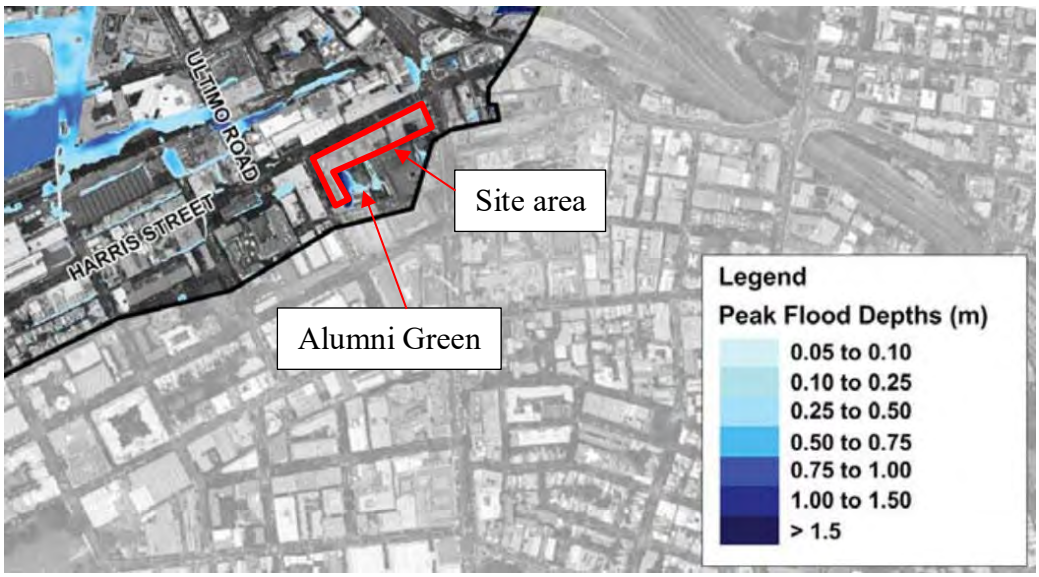


Figure 8 1% AEP peak flood depth map from Darling Harbour Catchment Flood Study (BMT WBM, 2014)

In the Probable Maximum Flood (PMF), the Council flood maps show flooding to a depth of approximately 0.1m at Harris Street adjacent to the site. Flooding to a depth of greater than 1m is shown within the Alumni Green; however, as discussed, the model did not include any site drainage in this area and therefore the results are not considered representative. An extract of the flood map for the PMF presented in the Council flood study is shown in Figure 9.

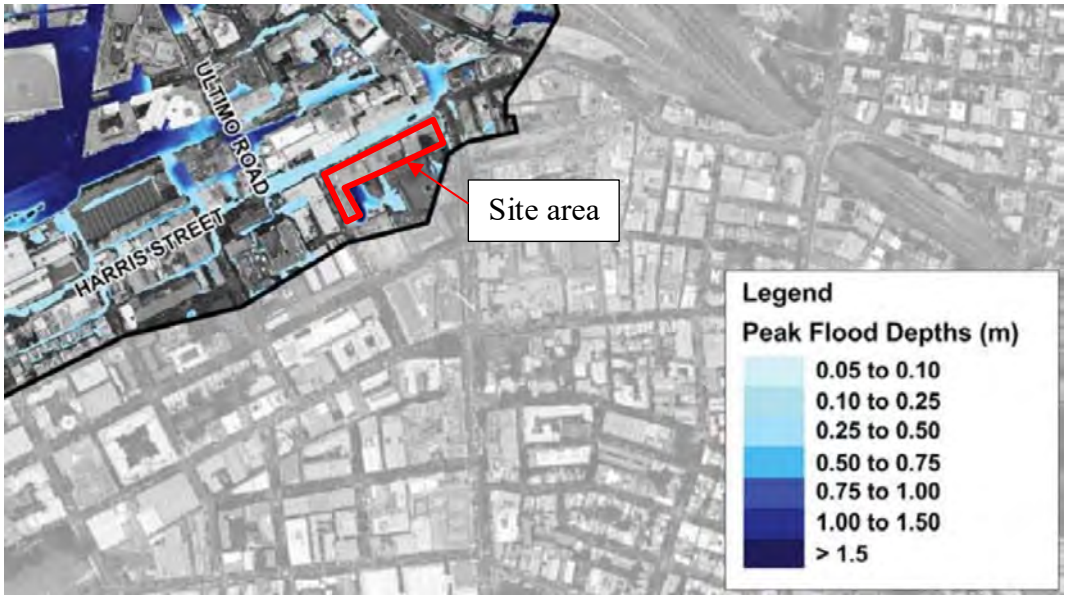


Figure 9 PMF peak flood depth map from Darling Harbour Catchment Flood Study (BMT WBM, 2014)

3.2.2 Rainwater Reuse System Concept Design Report for University of Technology – Alumni Green (Warren Smith & Partners, 2013)

This report summarised the proposed upgrade of stormwater drainage for the Alumni Green area at the university. The proposed upgrade also included the installation of a rainwater harvesting and reuse system and an on-site detention tank. These recommended upgrades were subsequently completed in 2015. Modelling summarised in the design report showed that the drainage network and on-site detention tank were sized for the 1% AEP storm event. An excerpt from this report showing the tender drawings of the proposed upgraded stormwater network is shown in Figure 10.

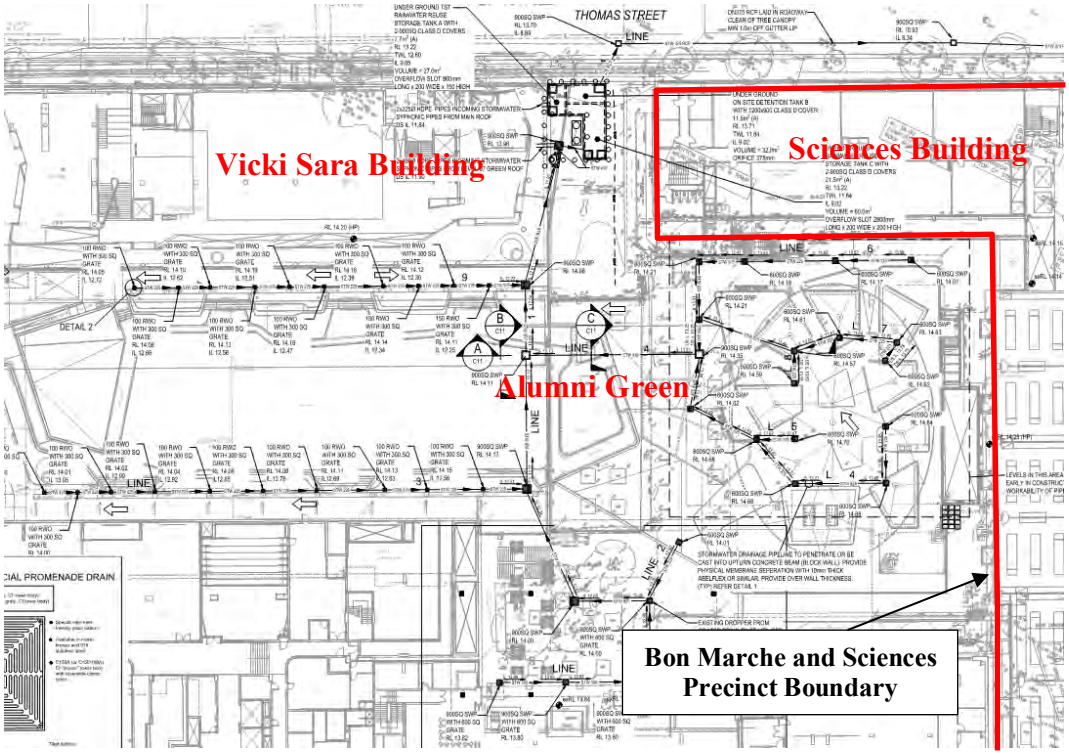


Figure 10 Proposed upgraded stormwater drainage network at Alumni Green (source: Warren Smith & Partners, 2013)

As noted in Section 3.2.1, because no local stormwater drainage within the campus was included in the City of Sydney Darling Harbour Catchment Flood Study (BMT WBM, 2014), the flooding shown in the Alumni Green area in the Council flood study is not considered representative of current conditions. However, the modelling presented in the Rainwater Reuse System Concept Design Report for University of Technology – Alumni Green (Warren Smith & Partners, 2013) is considered to better represent the hydraulic behaviour of the drainage network in this area. As this concept plan demonstrated that the local drainage network was designed to safely convey the 1% AEP storm event, surface flooding in the Alumni Green area adjacent to the proposed development is not anticipated.

Based on a review of these two studies it can be concluded that the development site is not flood affected in events up to the 1% AEP event. Therefore, the site would not be subject to specific flood related development controls.

4 Post-Development Concept Stormwater Management Plan

4.1 Flood Management

As discussed in this report, the site is not at risk of flooding. Therefore, specific flood-related development controls would not apply to the proposed development of the site.

4.2 Stormwater Quantity Management

The proposed development of the site will not alter the overall building footprint of the site and thus will not result in an increase in the current impervious fraction of the site.

Sydney Water were contacted directly on 15 August 2018 for advice as to whether the development would require on-site detention. Sydney Water responded on 17 August 2018 to inform us that provided stormwater discharge from the site is directed to Harris Street, OSD will not be required. This correspondence with Sydney Water is included in Appendix C.

Design of the stormwater network may be required to limit annual post-development stormwater volumes to the equivalent volume generated if the site were 50% pervious in accordance with the Sydney DCP 2012 (Section 3.7.2 clause (12)). This could be achieved through the application of green roofs to part of the roof area and rainwater tanks. The adherence of the final stormwater quantity system with these requirements will be confirmed by modelling at later design stages.

It is proposed that runoff from the building roofs would be ultimately collected in rainwater tanks for reuse within buildings and landscaped podium levels. Excess flows from tanks would be discharged to the City of Sydney/Sydney Water stormwater network via existing connection points.

4.3 Stormwater Quality Management

In order to meet City of Sydney water quality reduction targets, it is proposed that the development would include a combination of the following treatment methods:

- Rainwater collection and reuse
- Green roofs
- Gross pollutant traps including
- Cartridge filtration systems

These strategies would be considered in more detail as part of the future detailed design DA. A summary of these strategies and their associated benefits is included in Table 1.

Table 1 Summary of best practice WSUD devices

WSUD Technology	Description	Contribution to WSUD Strategies	Typical Images
Rainwater Harvesting	Roof water can be collected in above-ground or below-ground rainwater tanks for re-use.	Water conservation by reducing the demand for potable water. Reduction in stormwater runoff	 (Concept Design Guidelines for WSUD pp 63, Water by Design, 2009)
Gross Pollutant Traps	Many types of devices which can be located at point of entry to subsurface network or on-line in a pit or at a discharge point	Removal of visually obtrusive litter and depending on the device, some coarse sediment Most suitable at locations that generate high levels of litter (e.g. commercial areas)	 (Rocla, http://www.rocla.com.au/CleansAll.php)
Filtration Systems	Stormwater filtration devices that can be installed in stormwater pits. Devices typically using cartridges to filter nutrients from stormwater runoff.	Removal of litter, oil, suspended solids and particulate-bound pollutants such as phosphorus and nitrogen	 (Stormwater360)
Green Roofs	Multi-layered systems that cover the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants	 (Chicago Ciy Hall, New York Times via Domain, http://www.domain.com.au/news/diy-rooftop-gardens-20120829-250aa/)

The final arrangement and design of these features would be determined at later design stages, with the performance of the proposed treatment train to be confirmed using MUSIC water quality modelling.

5 Summary

A review of available information for the proposed redevelopment of the UTS Bon Marche and Sciences Precinct has been undertaken to determine stormwater management requirements at the site. A proposed stormwater management strategy for the site has also been prepared. The key outcomes of this review include:

- Based on previous flood studies the site is not affected by surface flooding in flood events up to 1% AEP
- The proposed development is to include a combination of stormwater quality strategies including green roofs, rainwater harvesting and reuse, gross pollutant traps and filtration systems to meet Council water quality requirements. The final configuration of these features will be determined at later design stages.
- Based on advice from Sydney Water it is not anticipated that OSD will be required as part of the proposed development.
- The proposed development does not include an increase in impervious area. Stormwater discharge from the site will utilise existing connections to the adjacent street stormwater network.

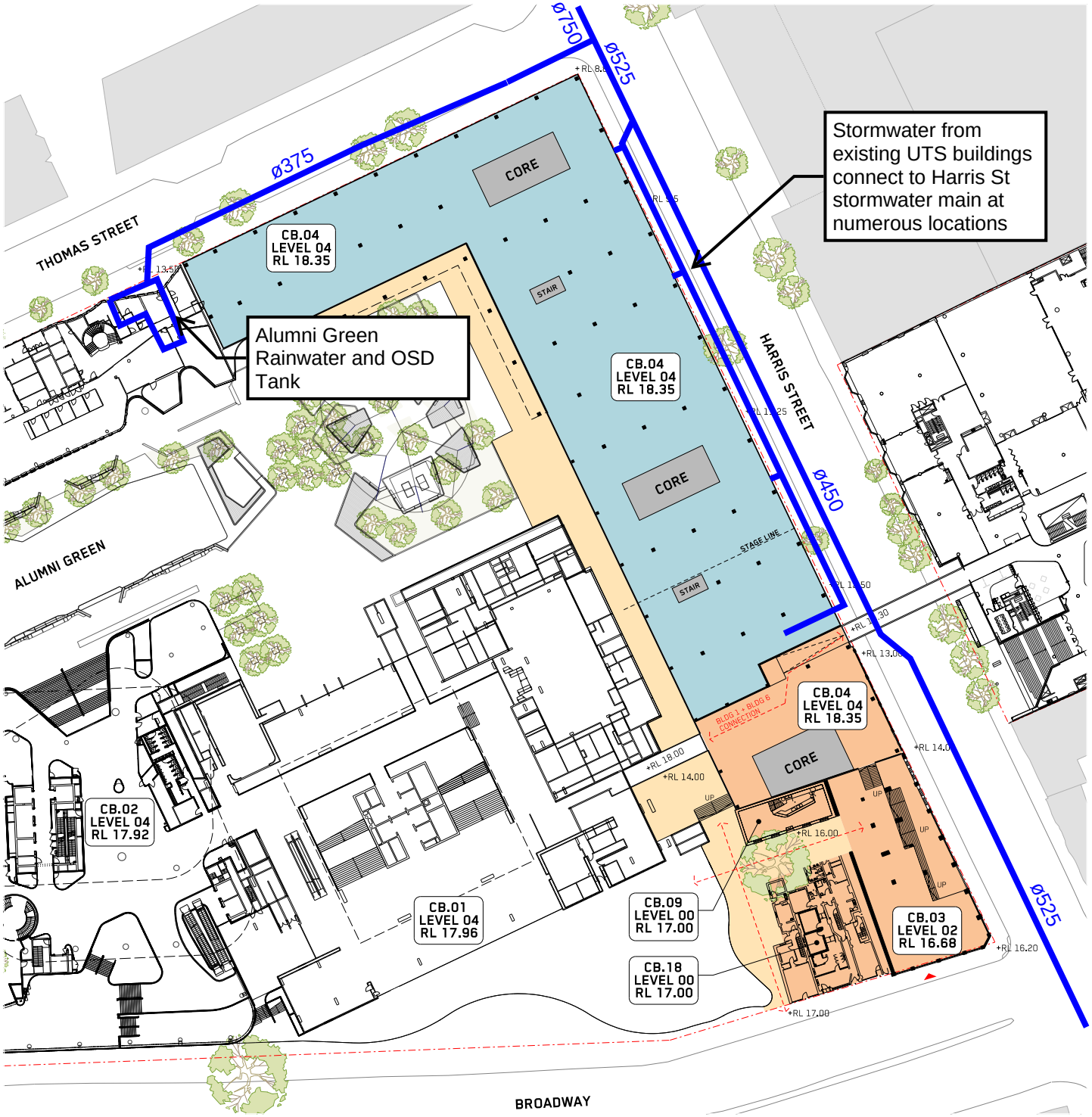
Appendix A

Stormwater Concept Plan

Notes:

1. Existing stormwater network information is approximate only and is based on the following sources:
   a. City of Sydney Dial Before You Dig information
   b. Sydney Water Dial Before You Dig information
   c. UTS Alumni Green Proposed Stormwater System Design Drawing
   d. Site inspection on 9/8/2018

2. Internal stormwater drainage at the UTS Ultimo campus is not shown except for the Alumni Green Rainwater and OSD Tank



UTS Bon Marche and Sciences Precinct Masterplan

SK01
Existing Council Stormwater Network
14/08/2018

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Appendix B

Rainwater Reuse System Concept Design Report for University of Technology – Alumni Green

Warren Smith & Partners Pty Ltd

RAINWATER REUSE SYSTEM
CONCEPT DESIGN REPORT FOR
UNIVERSITY OF TECHNOLOGY – ALUMNI GREEN

University of Technology, Sydney

Client: University of Technology Sydney

Consultant:

Warren Smith & Partners Pty Limited
Consulting Civil, Hydraulic & Fire Protection Engineers
Level 1, 123 Clarence St
Sydney, NSW 2000
Ph: +61 2 9299 1312 W: www.warrensmith.com.au

A	22nd-July-2013	Issue for Client Review/Comment
B	13th-September-2013	Issue for Tender
C	4th-December-2013	Issue for Tender
Rev	Date	Description of Change

APPROVALS	Prepared by: Civil Engineer	L. Shaughnessy	04/12/13
	Approved by: Manager of Civil & Water Engineering	M. Cahalane	04/12/13

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SCHEDULES

1.0 INTRODUCTION

Warren Smith & Partners (WS&P) have been engaged by the University of Technology Sydney (UTS) to report on the feasibility of providing a rainwater reuse system for the irrigation of Alumni Green at 64 Thomas Street, Ultimo, NSW. The site is located east of Jones Street, and to the south of Thomas Street. Please see Figure 1 below for aerial view of site boundary.

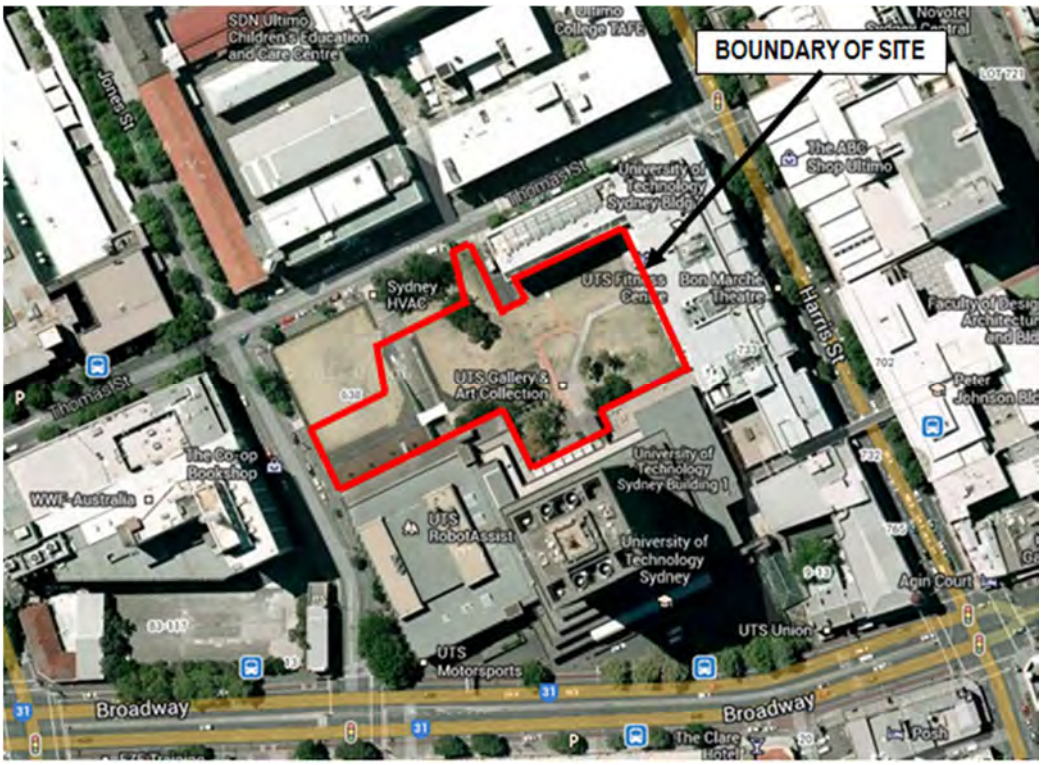

Figure 1: Aerial View of Site Boundary (Source: Google Map)

This report has been produced to address the following items:-

- Provide an overview of the option available to intercept the rainwater that will be collected on the Alumni Green site and for the purpose of reusing the water for irrigation to the Alumni Green turf and garden areas.

- Provide a description of the design provisions that would be incorporated into the proposed rainwater reuse system including system configuration, water treatment methods and the application for which the water would be utilised for.

- Describe the methodology applied for calculating the estimated utilisation of the Alumni Green rainwater reuse storage tank.

- Provide indicative sketch plans and sections of the feasible option put forward.

2.0 INVESTIGATION & DOCUMENTATION REVIEW

The following investigative actions have been taken:-

- Discussions with Aspect Studios and UTS took place in order to determine a suitable location for the installation of the rainwater reuse tank and treatment system.

- WS&P obtained 'Daily Weather Observation' data from the Bureau of Meteorology (BOM) for the past eleven (11) years and 'Monthly Climate Statistics' from BOM for the past one hundred and fifty five (155) years. This data was recorded at Sydney Observatory Hill, which is the closest BOM weather station to UTS Alumni Green.

  Calculations produced within this document use rainfall figures extracted from the fore mentioned 'Daily Weather Observation' data and 'Monthly Climate Statistics'.

3.0 REGULATORY REQUIREMENTS

'Managing Urban Stormwater: Harvesting and Reuse, April 2006' by the Department of Environment and Conservation NSW (DEC) has been adopted as the primary guideline for the storage, treatment and irrigation of reuse water at Alumni Green.

Please refer to Table 1, Table 2 and Table 3 below for the set criteria for the treatment and monitoring of the reuse system.

Application	Access restrictions	Stormwater quality criteria	Specific operational practices
Residential (non-potable)	Nil	Level 1	Above-ground storage design and management Additional plumbing controls
Irrigation of open spaces	Nil	Level 2	Irrigation scheme design and operational controls
	Controlled public access or subsurface irrigation	Level 3	

Table 1: DEC Management Guidelines on Harvesting & Reuse (Source: DEC)

For the irrigation of open spaces such as Alumni Green where no access restrictions are in place, Level 2 stormwater quality criteria is required along with an irrigation scheme design and operational controls, as set out by Table 1 above.

Level	Criteria[1]	Applications
Level 1	*E. coli* <1 cfu/100 mL Turbidity ≤ 2 NTU[2] pH 6.5–8.5 1 mg/L Cl_2 residual after 30 minutes or equivalent level of pathogen reduction	Reticulated non-potable residential uses (e.g. garden watering, toilet flushing, car washing)
Level 2	*E. coli* <10 cfu/100 mL Turbidity ≤ 2 NTU[2] pH 6.5–8.5 1 mg/L Cl_2 residual after 30 minutes or equivalent level of pathogen reduction	Spray or drip irrigation of open spaces, parks and sportsgrounds (no access controls) Industrial uses – dust suppression, construction site use (human exposure possible) Ornamental waterbodies (no access controls) Fire-fighting

Table 2: DEC Water Quality Parameters for Reuse (Source: DEC)

Level 2 stormwater quality criteria consisting of the following parameters, as set out by Table 2 above:

- E.coli < 10 cfu/100 mL
- Turbity ≤ 2 NTU[2]
- pH 6.5 - 8.5
- 1 mg/L Cl_2 residual after 30 minutes or equivalent level of pathogen reduction

This criteria is applicable in the irrigation of open spaces such as Alumni Green.

Stormwater quality criteria	Monitoring frequency
Level 1[1]	*E. coli* – five days in every week
	turbidity – continuous
	pH – weekly
	Cl_2 – daily (for chlorine disinfection systems)
Level 2[2]	*E. coli* – weekly
	pH – weekly
	turbidity – continuous
	Cl_2 – daily (for chlorine disinfection systems)

Table 3: DEC Water Quality Monitoring Requirements (Source: DEC)

Level 2 stormwater quality criteria require the following monitoring frequencies, as set out by Table 3 above:

- E.coli – weekly
- pH – weekly
- turbidity – continuous
- Cl2 – daily (for chlorine disinfection systems)

Essential water quality parameters are incorporated, as required by recycled water legislation, which include monitoring total flow rates from each source, turbidity, electrical conductivity and pH. E.coli is the only parameter that will require manual sampling.

4.0 IRRIGATION REQUIREMENTS

The rainwater reuse system is required to store and treat the water required to irrigate both the Alumni Green turf and gardens areas whom have total areas of 0.1142 ha and 0.0985 ha respectively. Please refer to Table 4 below for irrigation requirements provided by ASPECT Studio on behalf of UTS.

Area	Total Area (ha)	Rate of Irrigation Required l/m²/week
Alumni Green		
Turf	0.1442	30
Gardens	0.0985	40

Table 4: Irrigation Requirements

5.0 WATER DEMAND

The water demand for the Alumni Green irrigation system is based on information supplied by Aspect Studio on behalf of UTS, refer Section 4.0. An estimation of the irrigation system water consumption is subject to many variables, such as the time of year and weather conditions.

As it is not possible to predict exact future weather conditions and climate patterns, it is difficult to accurately calculate the volume of water that will be consumed by the irrigation system. However, we can establish a 'best guess' for future weather conditions, based on historical weather data.

Please refer to *Schedule 4 Rainwater Reuse Tank Utilisation Calculations* for the input parameters for daily water demand.

6.0 PROPOSED ALUMNI GREEN STORMWATER WORKS

The proposed development at Alumni Green is to have a total catchment area of 0.5448 ha. The proposed stormwater works consist of a total of forty five (45) stormwater pits which are to be installed in strategic locations in the Alumni Green area. The proposed stormwater pit and pipe system will capture the rainfall and runoff and reticulate it to the proposed Alumni Green rainwater reuse tank located beneath the basement access ramp off Thomas Street. Please refer to *Schedule 1 WSP Stormwater Works Design Drawings* for details.

When the Alumni Green rainwater reuse tank reaches its Top Water Level (TWL), it will overflow via an overflow weir, into the Thomas Street building (TST) On-Site Detention (OSD) tank also located beneath the basement access ramp off Thomas Street. Please refer to *Schedule 1 Drawing C-10 OSD & Rainwater Reuse Tank Layout Plan & Sections* for details. The TST OSD tank will allow the stormwater to reticulate through an orifice plate and into the City of Sydney's stormwater system in Thomas Street.

7.0 PROPOSED RAINWATER REUSE SYSTEM

The proposed rainwater reuse system for the Alumni Green irrigation involves the reuse of the stormwater runoff collected from the Alumni Green catchment and the Thomas Street building Level 6 and Level 7 roof catchments. The stormwater runoff enters the Alumni Green rainwater reuse tank where a transfer pump, located on Level 00 of the Library Retrieval System (LRS), will pump the stormwater in to a buffer tank, also located on Level 00. Please refer to *Schedule 2 Hassel - City Campus Broadway Building Level 00 LRS – GA Plan Drawing*.

Booster pumps, one (1) duty and one (1) standby will be installed on Level 00 and will pump the stormwater required for reuse from the buffer tank through the treatment system for irrigation of the Alumni Green turf and garden areas. Irrigation is proposed to be unrestricted with no exclusion/buffer areas enforced during watering events.

7.1 RAINWATER REUSE SYSTEM COMPONENTS, CONFIGURATION & DESCRIPTION

7.1.1 DESCRIPTION OF PROPOSED RAINWATER REUSE SYSTEM

The following is a summary of the proposed rainwater reuse system for Alumni Green:

- The Alumni Green stormwater collection system captures the stormwater and transports it via the pipe system to the proposed Alumni Green rainwater reuse tank. Stormwater from the Thomas Street building Level 6 and Level 7 roof catchments also reticulate to the proposed Alumni Green rainwater reuse tank.

- The stormwater passes through a Gross Pollutant Trap (GPT) to remove gross pollutants prior to entering the Alumni Green rainwater reuse tank and is then pumped from the rainwater reuse tank to a buffer tank located on Level 00 of the LRS. The buffer tank will have a potable water top-up system to ensure that in the event of low rainfall, the tank maintains a minimum capacity of 10%.

- The rainwater is then pumped through the treatment system, as required and is ready for reuse.

Please refer to *Schedule 3 UTS Proposed Rainwater Reuse System Schematic Sketches* for an illustration of the proposed rainwater reuse system.

7.1.2 PROPOSED TREATMENT SYSTEM

The stormwater captured on the Alumni Green catchment and the Thomas Street building Level 6 and Leve 7 roof catchments will need to be treated prior to its reuse for the irrigation of Alumni Green. A three (3) stage process is proposed as the system requirements for irrigation is relatively high, refer Section 3.0.

Primary Stage

In the primary stage of treatment, prior to harvested rainwater discharging into the storage tank, all stormwater will pass through a GPT to remove gross pollutants, suspended solids, organic debris and free floating oils. The GPT will remove up to:-

- 98% of gross pollutants
- 50% of suspended solids all, organic debris and free floating oils.

Secondary Stage

The second stage of treatment would take place on the outlet side of the storage tanks, where rainwater will pass through a multi-media filtration unit with an automatic back wash cycle in order to remove fine particles and nutrients. The rainwater on completion of this stage of treatment would generally be considered adequate for use in in-ground irrigation systems.

Third Stage

For water disinfection and the control of bacteria, the third stage of treatment will involve UV treatment and electro chlorination on the outlet delivery pipework of the tank. UV treatment is an added precaution to aid in the control of bacteria such as Legionella while electro chlorination will be required to provide a residual disinfection dose to the system.

Treated stormwater will be supplied to the irrigation pipework in Alumni Green via a cold water pressure booster set. The pressure set shall be fitted with variable speed dual pumps to allow for sufficient redundancy in the system.

An automatic domestic water make up system will be provided to the buffer tank in order to maintain a minimum capacity of 10%, should the Alumni Green rainwater reuse tank be empty or out of service. This will ensure that the water supply to all points is available at all times.

It is also proposed that wired or wireless interface be provided to alert facility management of any failures in the water treatment and pumping system.

7.1.3 MAINTENANCE

It is of the utmost importance that the tanks, pump equipment and treatment system devices are properly maintained, and that regular inspections be carried out in order to identify any issues or hazards.

We strongly recommend that UTS enter a formal long-term maintenance contract with a suitable qualified maintenance company who will provide adequate maintenance to all elements of the Alumni Green rainwater reuse system.

The actions shown in Table 5 below outline the minimum expectations for checks that should be regularly undertaken on pumping equipment. It is recommended that supplier-required maintenance tasks be considered and added to this schedule, if required.

Item	Action	Frequency in Months	
		1	6
Rainwater and Non-potable Water Pumps	Check motors electrically		X
	Check amp		X
	Grease motor bearings		X
	Check panel lights and check valves	X	
	Check pressure vessel	X	
	Check all mounting bolts	X	
	Check pressure gauges work	X	
	Check float switch operation	X	
	Check solenoid operation	X	

Table 5: Pumping Equipment Maintenance Schedule

The tasks shown in Table 6 below outline the minimum expectations for checks that should be regularly undertaken on water treatment devices. It is recommended that supplier-required maintenance tasks be considered and added to this schedule, if required.

Item	Action	Frequency in Months			
		1	3	6	12
Automatic Backwash Filters	Visual inspection of brushed and O-rings		X		
	Replace brushed and O-rings				X
UV Filters	Replace filters				X
	Inspect port sleeves and bulbs/lamps	X			
	Check UV intensity		X		
Bag Filters	Check condition of bag	X			
	Replace bag			X	
Electro Chlorination Unit	Check pH controller	X			
	Check chlorine controller	X			
	Check chlorine back-up	X			

Table 6: Treatment System Maintenance Schedule

The tasks shown in Table 7 below outline the minimum expectations for checks that should be regularly undertaken on water storage tanks. It is recommended that supplier-required maintenance tasks be considered and added to this schedule, if required.

Item	Action	Frequency in Months	
		6	12
Float/Ultrasonic Level Sensors	Verify the operation of float/ultrasonic level sensors.	X	
Tank Cleaning	Drain down and clean the tank		X
Float Valve	Verify the operation of the float valve by exercising the valve	X	
Level indicator	Verify the water level indicator is operating properly by exercising the indicator	X	
Leakage	Check for water leakage from all joints, flanges and fittings		X
Loose components	Check for loose bolts, anchors and fittings throughout the tank		X
Damage	Check for any physical damage caused by impact		X
Foundation	Check foundation and check for earth subsidence		X
Vermin, foreign objects & algae	Visual check	X	

Table 7: Water Storage Tanks Maintenance Schedule

8.0 RAINWATER REUSE STORAGE TANK UTILISATION

8.1 STORAGE TANK UTILISATION

WS&P have prepared a model to calculate and ascertain the utilisation of the Alumni Green rainwater reuse tank based on historical rainfall data recorded at Sydney Observatory Hill over the past eleven (11) years.

The daily rainfall figures are entered into the model for each day of the past eleven (11) years. The model will only consider rainfall collected for days with more that 5mm precipitations as rainfall events of this intensity tend to yield insignificant volumes of water due to subsequent evaporation into the atmosphere.

The model also takes into account the consumption of water per day. For irrigation, the model takes into account the difference in water consumption between the winter months and summer months. The model assumes that no water is used for irrigation when the rainfall exceeds the required water demand. It is therefore important that proper soil moisture or rain sensors are provided to the irrigation system. The water consumption percentages taken for the winter and summers months are based on monthly averages calculated from the 'Monthly Climate Statistics' recorded at Sydney Observatory Hill.

8.2 UTILISATION CRITERIA

A number of criteria need to be evaluated when calculating the utilisation of a rainwater tank. These are described in the following:-

Water Demand

The daily water demands for the Alumni Green irrigation are summaried in Table 8 below.

Purpose	Location	Area m²		Daily Water Demand (Litres)
		Turf	Garden	
Irrigation	Alumni Green	1142	985	10,523

Table 8: Summary of Daily Water Demands

Available Catchment

Alumni Green has an estimated total catchment of 5,448 m² and the Thomas Street building Level 6 and Level 7 roof catchment is 1,094 m². Therefore the total catchment reticulating to the proposed Alumni Green rainwater reuse tank is 6,542 m².

Rainfall

The average annual rainfall median recorded over the past eleven (11) years at Sydney Observatory Hill is 1074 mm. Please refer to Table 9 below for details.

Year	January (mm)	February (mm)	March (mm)	April (mm)	May (mm)	June (mm)	July (mm)	August (mm)	September (mm)	October (mm)	November (mm)	December (mm)	Total Yearly Rainfall (mm)
2002	98.4	348.2	45.4	68.4	92.8	28.4	24.2	19.8	21.8	5.8	31.8	75	860.0
2003	13.6	59.4	132	192.2	348.6	76.4	58.2	43	5.8	102.8	108.8	59.6	1,200.4
2004	50.8	129.4	100.8	33.2	8	39	43.8	153.4	60.2	234	66.8	75.8	995.2
2005	67.8	125	153.6	33.4	48.4	79	62.8	1.6	51.2	43	125	25.2	816.0
2006	121.4	51.2	40.2	9.8	40.4	176.8	140.2	86	192	17.2	44.6	74.2	994.0
2007	45.4	107.6	65.4	188.2	9.8	510.6	67.2	152.2	41.2	27	170	123.2	1,507.8
2008	57	258.4	63.4	146.6	2.6	127.2	89.6	44.2	99.2	66.6	73.2	54.2	1,082.2
2009	24.8	127.6	60.6	158	132.8	135.2	135.2	6	16	180	14.3	67	1,057.1
2010	36	239.4	51.4	30	168.4	147.2	114.4	27	42.2	85	129.6	82.2	1,152.8
2011	53.8	18	191.6	209.8	135.6	93.8	282.2	52.2	71.6	37.4	148.4	78.4	1,372.8
2012	138.8	111	269.8	92.2	37.2	244.2	56.2	19	23.8	29.4	52	45.2	1,118.8
2013	137.8	165.4	65.6	199.8	110.2	49.2	0	0	0	0	0	0	728.0
Mean monthly rainfall (mm) 2002-2013	**70.5**	**145.1**	**103.3**	**113.5**	**94.6**	**142.3**	**89.5**	**50.4**	**52.1**	**69.0**	**80.4**	**63.3**	**1,073.8**
Mean monthly rainfall (mm) 1858-2010	**101.2**	**118.7**	**128.9**	**125.8**	**121.1**	**130.7**	**97.4**	**80.8**	**68.9**	**77.6**	**83.4**	**77.9**	**1,212.4**
Decile 5 (median) monthly rainfall (mm) 1965-2002	**80**	**91**	**101**	**91.4**	**90.8**	**94.6**	**76.2**	**56.9**	**52.8**	**55.6**	**66.8**	**58.4**	**915.5**

Table 9: Monthly Recorded Rainfall Data (mm)

Median Monthly Rainfall Collection

Based on the above roof area and weather data this would average out to be 585,509 litres per month.

Average Monthly Water Usage

The average monthly water usage (non-potable supplies) for the summer months is 186,195 litres and for the winter months is 117,039 L.

Irrigation System Management

Utilising soil moisture and installing rain sensors can help in maintaining a productive irrigation system. Isolation of the irrigation system can be programmed so that no water is supplied from the tank during wet weather, which shall ensure more rainwater is available during dry periods.

Tank Size

The calculated rainwater storage capacity of the Alumni Green rainwater reuse tank is 56,700 litres. The buffer tank located on Level 00 has a storage capacity of 10,000 litres giving a combined storage capacity of 66,700 litres for the irrigation of Alumni Green. Please refer *Schedule 1 Drawing C-10 OSD & Rainwater Reuse Tank Layout Plan & Sections*. Detailed calculations were carried out in order to determine the performance of the tank when utilised for the irrigation of Alumni Green. Please refer to Section 9.0 for details.

9.0 RAINWATER REUSE SYSTEM AND TANK PERFORMANCE

The rainwater reuse system involves the construction and installation of a rainwater reuse tank and a treatment system to be utilised for the purpose of Alumni Green irrigation.

9.1 TANK PERFORMANCE

The rainwater reuse tank would provide a yearly average of 87% of the total usage demand from rainwater if utilised for the purpose of Alumni Green irrigation. Table 10 and Figure 2 below show the relationship between the tank size, the average monthly water storage volume and the water consumed and are based on the detailed calculations that can be found in *Schedule 4 Rainwater Reuse Calculations*.

Combined Tank Capacity	Non potable water required (average) per month	Rainwater used (average) per month	Rainwater volume re-used as % of total demand	Average rainwater storage level in tank	Volume of stored rainwater in tank (average) per month	Volume of mains water top-up required (average) per month	Est. Cost of Required Mains Water Top-up Supply (average) per month	Estimated value of rainwater re-used (average) per month
Litres (L)	Litres (L)	Litres (L)	%	%	Litres (L)	Litres (L)	$	$
66,700	152,751	132,499	86.7%	40.8%	27,184	20,252	$44	$287

Note: Weather Conditions & Usage Patterns for Period from January 2002 to May 2013

Table 10: Relationship between Tank Size, Average Monthly Water Storage Volume and Water Consumed

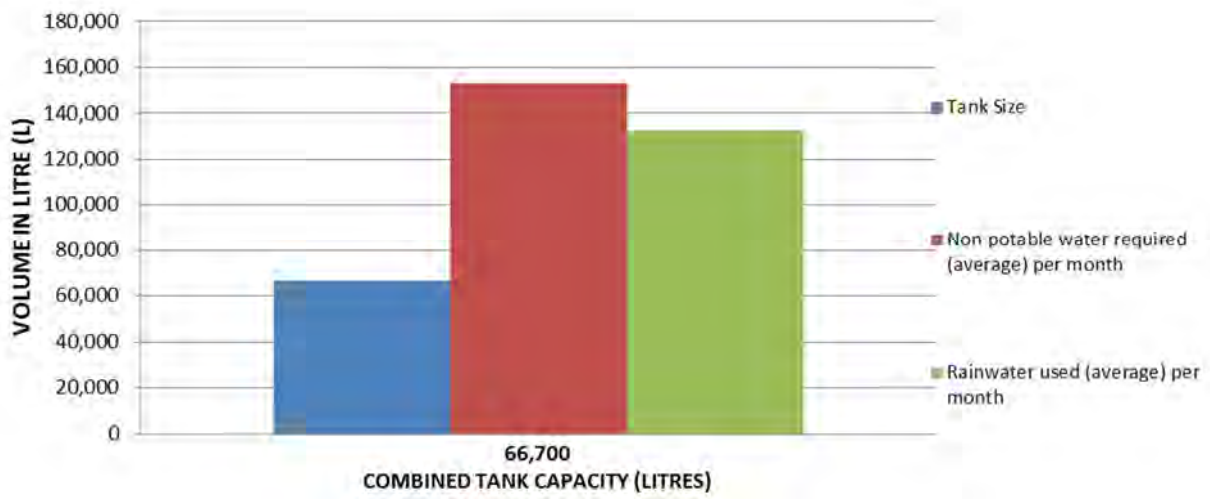

Figure 2: Relationship between Tank Size, Average Monthly Water Storage Volume and Water Consumed

Figure 3, Figure 4 and Figure 5 located on the following page shows graphs which have also been produced to indicate the differing weather conditions and usage patterns for seasonal period.

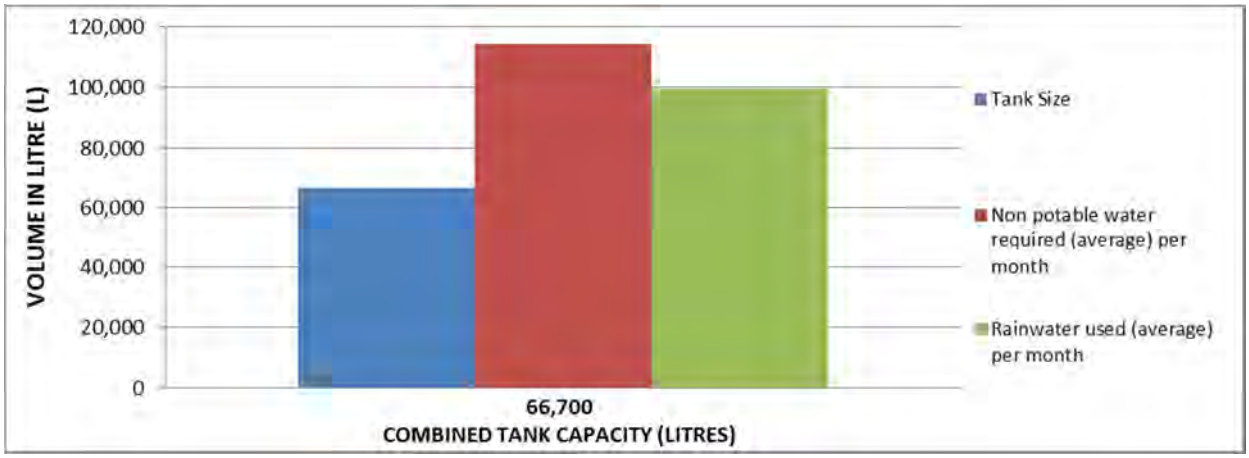

Figure 3: Summer Weather Conditions & Usage Patterns for November, December, January & February

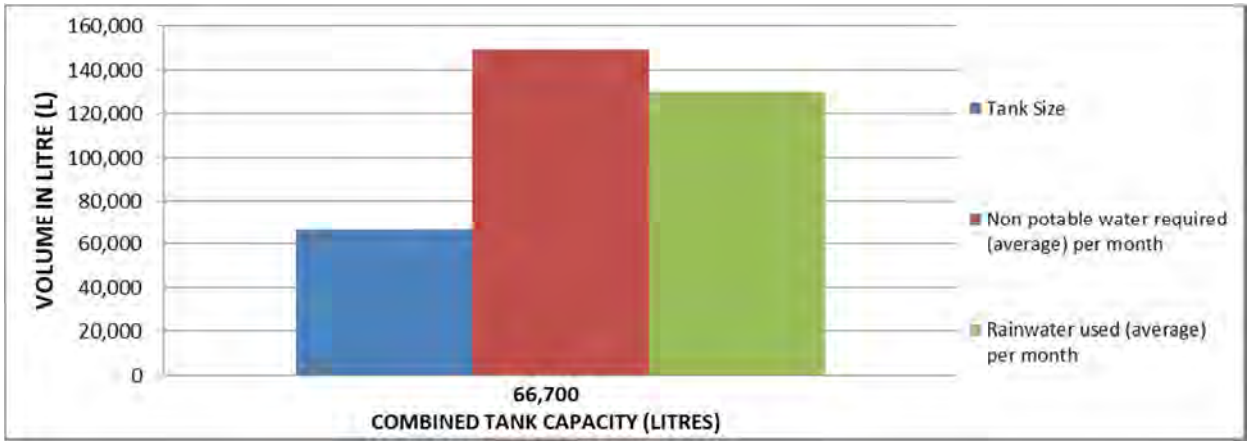

Figure 4: Autumn & Spring Weather Conditions & Usage Patterns for March, April, May, September & October

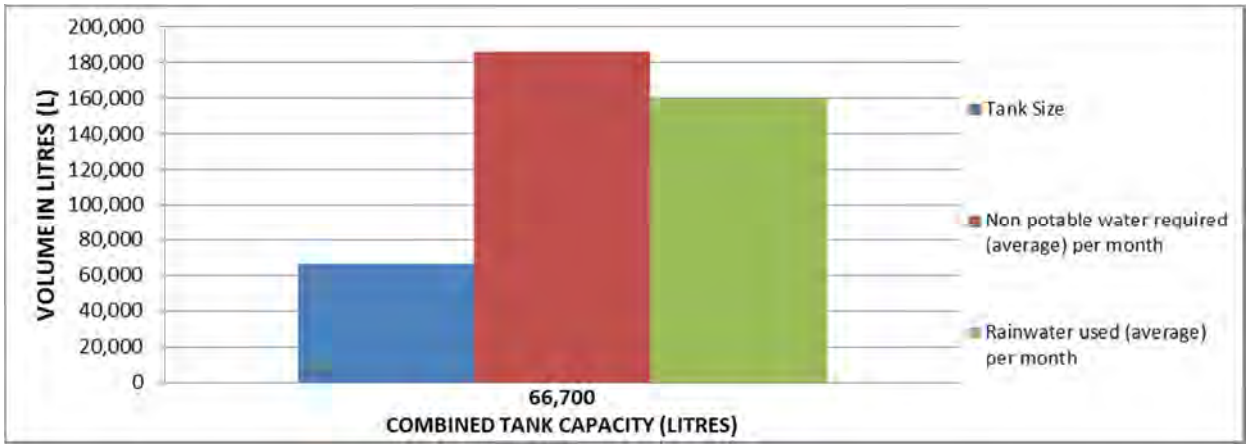

Figure 5: Winter Weather Conditions & Usage Patterns for June, July & August

There graphs can also be found within *Schedule 4 Rainwater Reuse Calculations* along with their corresponding tables indicating the relationship between tank size, average monthly water storage volume and water consumed.

9.1.1 PAYBACK

The rainwater reuse system could be installed as part of the current Alumni Green development or alternatively at a later date. The advantage of including the works within a single construction phase package would be the savings associated with project construction site set up, facilities and amenities costs.

Richard Crookes Construction(RCC) have undertaken a preliminary estimation of the cost of installing the proposed Alumni Green rainwater reuse system and have estimated that it would cost approximately two hundred thousand dollars ($200,000). Please see Figure 6 for payback on the construction cost, maintenance costs and running costs. The cost will need to be confirmed upon a detailed design.

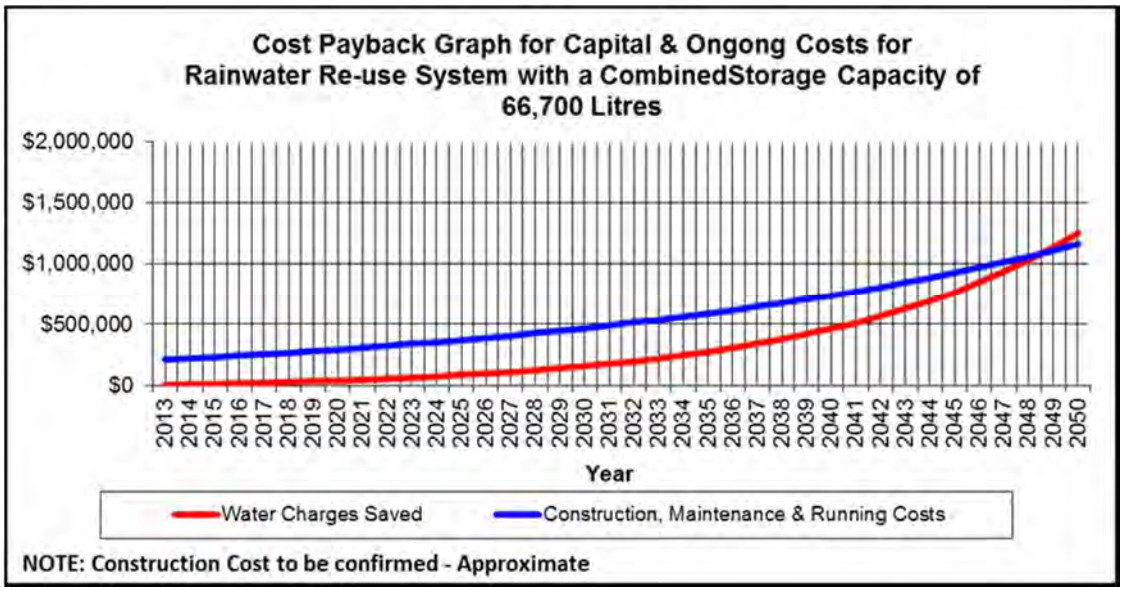

Figure 6: Payback Graph for Construction Cost, Maintenance Costs and Running Costs

In calculating the water charges saved, the water use charge for commercial use was obtained from Sydney Water and is currently $2.168 per kilolitre. The calculations assumed that this cost will have an average inflationary rate per year of 10% based on observed rises in previous years.

In calculating the annual maintenance and running costs it was assumed that this cost will have an average inflationary rate per year of 4.5% based on observed rises in previous years.

Figure 6 above shows the saving made over time due to water charges and estimates that after twenty one (21) years, the savings made on potable water would be equal to the estimate initial construction cost of the rainwater reuse system. Please note construction cost is to be confirmed by Richard Crookes Construction.

Figure 6 above also estimates that after thirty seven (37) years, the savings made on potable water would be equal to the estimated initial cost, maintenance costs and running costs of the rainwater reuse system. Please refer to *Schedule 4 Rainwater Reuse Calculations* for detailed payback calculations.

10.0 CONCLUSION

The Alumni Green rainwater reuse system with a combined storage capacity of 66,700 litres will provide 87% of the total usage demand from rainwater for Alumni Green irrigation.

The non-potable water required for Alumni Green irrigation is 152,751 litres per month. The combined 66,700 litre storage capacity for the Alumni Green rainwater reuse system has estimated to provide 132,499 litres per month which is 87% of the total required per month and is therefore shown to be high efficient.

SCHEDULE 1 WARREN SMITH & PARTNER – ALUMNI GREEN STORMWATER WORKS DESIGN DRAWINGS

UNIVERSITY OF TECHNOLOGY SYDNEY - ALUMNI GREEN
67 THOMAS STREET, ULTIMO
STORMWATER UPGRADE WORKS

LEGEND

CIVIL DRAINAGE SYMBOLS

- STW — STORMWATER DRAINAGE PIPE
- STWRM — STORMWATER RISING MAIN
- STORMWATER DRAINAGE CHANNEL
- RW — RAINWATER
- CO SS — SUB SOIL DRAINAGE WITH CLEAN OUT
- SSRM — SUB SOIL RISING MAIN
- EB-LF — EARTH BANK LOW FLOW
- EB-HF — EARTH BANK HIGH FLOW
- EM — EXCAVATED MATERIAL
- FLUME
- DD — DIVERSION DRAIN
- DIVERSION DRAIN
- OFP — OVERFLOW PATH
- OFD — OVERFLOW DRAIN
- CLD — CONCRETE LINED DRAIN
- RLD — ROCK LINED DRAIN
- TD — TABLE DRAIN
- V DRAIN (L)
- V DRAIN (R)
- SWALE or SPEED HUMP
- OVERLAND FLOW DIRECTIONAL ARROW
- OVERLAND FLOW PATH
- DP — DOWN PIPE
- PAVED AREA DRAIN.

- DROP TO OR RISE FROM
- RISE TO OR DROP FROM
- TEE DROP
- TEE RISE
- VERT — VERTICAL RISER IN DRAINAGE
- FLOW DIRECTIONAL ARROWS ON ALL PIPING SERVICES
- PIPELINE TERMINATED WITH BLANK FLANGE
- PIPELINE PLUGGED OFF
- CO — CLEAROUT
- F.P. — FLUSHING POINT
- NEW PIPE

- RISER
- SERVICE
- SIZE
- DROPPER

- NON-RETURN FLAP VALVE ON INSIDE FACE OF PIT AT ALL DOWN PIPES & SUB SOIL DRAINAGE LINES TO OSD SYSTEM

CIVIL ABBREVIATIONS

DRAINAGE LEVELS

BWL	BOTTOM WATER LEVEL
IL	INVERT LEVEL
OL	OBVERT LEVEL
SL	SURFACE LEVEL
TWL	TOP WATER LEVEL

GRATES & COVERS

LD	LIGHT DUTY CLASS 'B'
MD	MEDIUM DUTY CLASS 'C'
HD	HEAVY DUTY CLASS 'D'
EHD	EXTRA HEAVY DUTY CLASS 'E'
MP	MULTI PART COVER OR GRATE

PITS

CDS	CDS TECHNOLOGIES, STORMWATER TRAPS
DCP	DISCHARGE CONTROL PIT
DGGP	DOUBLE GRATED GULLY PIT (CAST IRON)
GPT	GROSS POLUTANT TRAP
JP	JUNCTION PIT
KEP	KERB ENTRY PIT
KEU	KERB ENTRY UNIT
MPC	MULTI PART COVER
MPG	MULTI PART GRATE
RR	RAINWATER REUSE
SGGP	SINGLE GRATED GULLY PIT (GMS)
SWP	STORMWATER PIT

DRAINAGE LINES

RW	RAIN WATER (REUSE)
SS	SUBSOIL DRAINAGE
STRM	STORMWATER RISING MAIN
STW	STORMWATER DRAIN
GD	GRATED DRAIN
OLD	OPEN LINED DRAIN
OUD	OPEN UNLINED DRAIN

FEATURES

CO	CLEAROUT
DP	DOWN PIPE
FP	FLUSHING POINT
IO	INSPECTION OPENING
OF	GUTTER OVERFLOW PIPE
RO	RAINWATER OUTLET
DTU	DRAINAGE TURNUP

OSD

OSD	ONSITE DETENTION
PSD	PERMISSIBLE SITE DISCHARGE
OFP	OVERFLOW PATH
SWMP	STORM WATER MANAGEMENT PLAN
ESCP	EROSION & SEDIMENT CONTROL PLAN

- OSD ABOVE GROUND
- KEP - KERB ENTRY PIT
- DOUBLE GRATED GULLY PIT
- JUNCTION PIT WITH COVER
- SURFACE INLET PIT (FLUSH/RAISED)
- SURFACE INLET PIT (DEPRESSED)
- GRATED TRENCH DRAIN

EROSION & SEDIMENTATION SYMBOLS

FENCES
- B — BARRIER FENCE
- X — SEDIMENT FENCE
- SILT FENCE ON LEVEL
- SILT FENCE ON GRADE
- W — WIND FENCE

BANKS
- DIVERSION CHANNEL/BANK
- LEVEL SPREADER
- EB — EARTH BANK
- EBLF — EARTH BANK LOW FLOW
- EBHF — EARTH BANK HIGH FLOW
- EM — EXCAVATED MATERIAL

TRAPS
- GEOTEXTILE SEDIMENT TRAP
- CHECK DAMS (STRAW BALE OR ROCK)
- CONCRETE ENERGY DISSIPATOR
- STABALISED CONSTRUCTION SITE VEHICLE ENTRY/EXIT GRID
- SEDIMENT TRAP
- GEOTEXTILE FILTER BAGS OR SOCK

ROAD LANE MARKING SYMBOLS

- C1 CONTINUITY LINE 1m, 3m, w0.200
- E1 EDGE LINE 35m, 1m, w0.120
- L1 LANE LINE 3m, 9m, w0.080
- S1 SEPARATION LINE 3m, 9m, w0.100
- S2 SEPARATION LINE 6m, 6m, w0.100
- S3 SEPARATION LINE 3m, 3m, w0.100
- T1 TURN LINE 0.6m, 0.6m, w0.100
- TB GIVEWAY LINE 0.6m, 0.6m, w0.200
- PAVEMENT MARKERS SQ, 1m CTS

LEGEND

SURVEY & MAPPING SYMBOLS

- PROPERTY BOUNDARY
- EASEMENT
- FENCE OFF BOUNDARY
- FENCE ALONG BOUNDARY
- FENCE ON BOUNDARY
- + — STATE BOUNDARY
- X — COUNTY BOUNDARY
- . — PARISH BOUNDARY
- +++ — SHIRE/MUNICIPLE BOUNDARY
- P — NATIONAL PARK BOUNDARY
- R — STATE RECREATION BOUNDARY
- : — STATE FOREST BOUNDARY
- * — TELSTRA EXCHANGE BOUNDARY

GENERAL ABBREVIATIONS

CTS	CENTERS
℄	CENTRE LINE
DIA	DIAMETER
DMR	DEPARTMENT OF MAIN ROADS
DWG	DRAWING
EX.	EXISTING
GALV	GALVANIZED
HD GALV	HOT DIPED GALVANIZED
ID	INTERNAL DIAMETER
L.O.C.	LIMIT OF CONTRACT
MAX	MAXIMUM
MIN	MINIMUM
NB	NOMINAL BORE
N.I.C.	NOT IN CONTRACT
No.	NUMBER
NOM	NOMINAL
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
REV	REVISION
RTA	ROADS AND TRAFFIC AUTHORITY
SQ	SQUARE
SRA	STATE RAIL AUTHORITY
STD	STANDARD
UNO	UNLESS NOTED OTHERWISE
VERT	VERTICAL

LEVELS ABBREVIATIONS

CL	CEILING LEVEL
FFL	FINISHED FLOOR LEVEL
FGL	FINISHED GROUND LEVEL
GL	EXISTING GROUND LEVEL
HL	HIGH LEVEL
HP	HIGH POINT
LL	LOW LEVEL
ML	MID LEVEL
NS	NATURAL SURFACE LEVEL
PL	PLATFORM LEVEL
RL	REDUCED LEVEL
US	UNDER SIDE
USFL	UNDERSIDE FLOOR

ROAD PAVEMENT ABBREVIATIONS

AC	ASPHALTIC CONCRETE
CBR	CALIFORNIA BEARING RATIO
DGB	DENSELY GRADED BASE COURSE
DGS	DENSELY GRADED SUB BASE
DSL	DESIGN SUBGRADE LEVEL
F.C.R.	FINE CRUSHED ROCK
O.T.R.	OTHER THEN ROCK
RC	REINFORCED CONCRETE
SF	STRIP FOOTING
?	RECYCLED CONCRETE

JOINTS

BJ	BUTT JOINT
CIJ	CRACK INDUCED JOINT
CJ	CONSTRUCTION JOINT
CJ	CONTRACTION JOINT
CJ	CONTROL JOINT
DJ	DOWELLED JOINT
DKJ	DOWELLED KEY JOINT
EJ	EXPANSION JOINT
IJ	ISOLATION JOINT
KJ	KEYED JOINT
SC	SAW CUT
TJ	TOOL JOINT
TKJ	TOBY KEYED JOINT

FEATURES

JK	NEW JERSEY KERB BARRIER
LP	LIGHT POLE
NKL	NOMINAL KERB LINE
PP	POWER POLE
SL	STREET LIGHT
TL	TRAFFIC LIGHT

SURVEY ABBREVIATIONS

AHD	AUSTRALIAN HEIGHT DATUM
BK	BOTTOM OF KERB
BM	BENCH MARK
CL	CENTRE LINE
D.E.	DRAINAGE EASEMENT
DH&W	DRILL HOLE & WING
FD	FOUND
INV	INVERT
K & G	KERB & GUTTER
R.O.W.	RIGHT OF CARRIAGEWAY
SSM	STATE SURVEY MARK
TK	TOP OF KERB

- RL 165.40 — PROPOSED SURFACE LEVEL

SERVICES & UTILITIES SYMBOLS

- A — AIR
- C — CABLES
- D — DRAINS
- E — ELECTRICAL
- LV — LOW VOLTAGE
- HV — HIGH VOLTAGE
- V — TRANSMISSION POWER LINES
- EFF — COMMON EFFLUENT
- ERM — EFFLUENT RISING MAIN
- F — FUEL
- G — GAS
- G(HP) — GAS HIGH PRESSURE
- G(MP) — GAS MEDIUM PRESSURE
- G(LP) — GAS LOW PRESSURE
- GAS — GAS
- NG — NATURAL GAS
- H — HYDRAULIC POWER
- I — IRRIGATION
- RTA — RTA ROADS & TRAFFIC AUTHORITY
- SRA — SRA STATE RAIL SERVICE
- S — SEWER
- SRM — SEWER RISING MAIN
- T — TELECOMMUNICATIONS TELSTRA
- OF — OPTICAL FIBRE OF
- SMOF — OPTICAL FIBRE CABLE SMOF
- OP — OPTUS
- OCC — OVERHEAD COMMUNICATION CABLE
- W — WATER
- WRM — WATER RISING MAIN
- MS — MISCELLANEOUS SERVICE
- X — X
- Y — Y
- Z — Z
- DRAINAGE CULVERTS & PIPE SIZES GREATER THAN & INCLUDING 450 DIA TO BE SHOWN IN FULL WIDTH

NOTE:-
'e' ON SERVICE LINE REPRESENTS EXISTING SERVICE OR THE USE OF LOWER CASE LETTER.

'x' ON SERVICE LINE REPRESENTS SERVICE TO BE ABANDONED.

DRAFTING SYMBOLS

SCALE BARS — D — AMENDMENT No.

2 0 4 8 12m
SCALE 1:200

2000 0 4000 8000 12000mm
SCALE 1:200

SECTION SYMBOL
- A / C-03 — SECTION No. / REFERENCE DRAWING
- 22 / 33 — PIT No. / LINE No.

WATER & SEWER ABBREVIATIONS

AC	ACCESS CHAMBER
BT	BOUNDARY TRAP
GM	GRAVITY MAIN
HYD	HYDRANT
IO	INSPECTION OUTLET
LH	LAMP HOLE
MH	MAN HOLE
PS	PUMP STATION
RM	RISING MAIN
SV	STOP VALVE
SWW	SYDNEY WATER WATERMAIN
WM	WATER METER

WATER & SEWER SYMBOLS

- S — PROPOSED SYDNEY WATER SEWER
- S — FUTURE SYDNEY WATER SEWER
- S — EXISTING SYDNEY WATER SEWER
- S — EXISTING SYDNEY WATER SEWER
- S — EXISTING SYDNEY WATER SEWER TO BE DISUSED.

MATERIALS

Br	BRASS
CI	CAST IRON
CICL	CAST IRON CEMENT LINED
CONC	CONCRETE
CP	CHROMIUM PLATED
Cu	COPPER
DICL	DUCTILE IRON CEMENT LINED
FRC	FIBRE REINFORCED CEMENT GALVANISED
GMS	MILD STEEL
MS	MILD STEEL
NY	NYLON
PE	POLYETHYLENE
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RHS	RECTANGULAR HOLLOW SECTION
SS	STAINLESS STEEL

CATCHMENT SYMBOLS

- X — PIT CATCHMENT
- XX — LINE CATCHMENT
- XXX — MAJOR CATCHMENT
- SUB CATCHMENT
- LIMIT OF CATCHMENT

CATCHMENT ABBREVIATIONS

P( )	PAVED CATCHMENT AREA
R( )	ROOFED CATCHMENT AREA
A( )	LANDSCAPE CATCHMENT AREA
T( )	TERRACE CATCHMENT AREA
ARI	AVERAGE RECURRENCE INTERVAL
CA	CATCHMENT AREA
Ha	HECTARE
L/s	LITRES PER SECOND (VELOCITY)
m/s	METRES PER SECOND (VELOCITY)
CUMECS	CUBIC METRES PER SECOND
Q	QUANTITY OF FLOW

DRAWING LIST

CLIENT
UNIVERITY OF TECHNOLOGY SYDNEY
FACILITIES MANAGEMENT UNIT
BUILDING 10, LEVEL 6
235 JONES ST
BROADWAY NSW 2007
T: +61 2 9514 2830
F: +61 2 9514 4690

PROJECT MANAGER

LANDSCAPE ARCHITECT
ASPECT STUDIOS
STUDIO 61, LEVEL 6
61 MARLBOROUGH ST
SURRY HILLS, NSW 2010
T: +61 2 9699 7182
F: +61 2 9699 7192
E: ASPECTSYDNEY@ASPECT.NET.AU

Warren Smith & Partners Pty Ltd
ABN 36 300 430 126
A 1st Floor, 123 Clarence Street, Sydney 2000 NSW Australia
T 02 9299 1312 F 02 9290 1295 E wsp@warrensmith.com.au

Consulting Engineers
SERVING THE CONSTRUCTION INDUSTRY SINCE 1981
Hydraulic Services I Civil Engineering I Fire Protection I Sydney Water Accredited • Water Servicing Co-ordinator • Design and Project Management

QUALITY ASSURED COMPANY ISO 9001 International Standards Certification
FEQA07/R61/0771

ISSUED FOR TENDER

TITLE.
TITLE, DRAWING LIST, LEGEND, ABBREVIATIONS

DATE.	DRAWN BY.	APPROVED BY.
FEBRUARY 2013	M.H.	L.P.

JOB No.	DRAWING No.	ISSUE.
3724000	C-01	G

Plot Date: Tuesday, 3 December 2013 4:56:13 PM

Xref's:
Plot Date: (D.12.2013@16:56:13 Login Name: MMarshall Cad File: T:\3724\CAD\Civil\Revision G\3724-C01.dwg

NOTES

GENERAL

G1. DESIGN HEREIN HAS BEEN PREPARED BY WARREN SMITH AND PARTNERS PTY LTD
CONSULTING CIVIL ENGINEERS,
LEVEL 1, 123 CLARENCE ST, SYDNEY NSW 2000.
TEL:- (02) 9299 1312, FAX:- (02) 9290 1295.

G2. THE DRAWINGS HEREIN SHALL BE READ AS REQUIRED IN CONJUNCTION WITH ARCHITECTURAL DRAWINGS BY
HASSELL LTD
TEL:- (02) 9101 2000 FAX:- (02) 9101 2100
AND LANDSCAPE ARCHITECTURAL DRAWINGS BY
ASPECT STUDIOS PTY LTD
TEL:- (02) 9417 6844 FAX:- (02) 9417 6855

G3. ALL DIMENSIONS IN MILLIMETRES UNO.
REDUCED LEVELS AND CHAINAGES ARE IN METRES.
DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS.

G4. THE PROPOSED WORKS DETAILED HEREIN SHALL BE CONSTRUCTED TO THE REQUIREMENTS OF COUNCIL GENERALLY AS DETAILED HEREUNDER.

G5. ALL EXISTING SERVICES SHALL BE VERIFIED FOR DEPTH AND HORIZONTAL POSITION BY PHYSICAL MEANS PRIOR TO EXCAVATION. ANY DISCREPANCIES SHALL BE BROUGHT FORTHWITH TO THE PROJECT MANAGER'S ATTENTION.

STORMWATER & SUB-SOIL DRAINAGE

MATERIALS:

STW1. PIPES AND FITTINGS FOR STORMWATER DRAINAGE SHALL BE AS FOLLOWS UNO ON THE DRAWINGS:

A. ALL STORMWATER DRAINAGE CAST INTO CONCRETE SHALL BE HDPE PIPES AND FITTINGS, AND BE WRAPPED IN FLEXIBLE AND COMPRESSIBLE MATERIAL.

B. ALL STORMWATER DRAINAGE 300mm DIAMTER OR SMALLER ARE TO BE SEWER GRADE uPVC PIPES AND FITTINGS.

C. ALL STORMWATER DRAINAGE LARGER THAN 300mm DIAMETER ARE TO BE HDPE.

D. ALL STORMWATER DRAINAGE IN THOMAS STREET (COUNCIL LAND) SHALL BE REINFORCED CONCRETE PIPES (RCP) AND FITTINGS.

E. REINFORCED CONCRETE WHERE REQUIRED BY AS 3500 FOR EXCESSIVE DEPTH.

F. INSTALL IN ACCORDANCE WITH AUSTRALIAN STANDARD AS3500 EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

STW2. PIPES & FITTINGS FOR SUBSOIL DRAINAGE SHALL BE CORFLOW RIBBED HDPE PIPE & FITTINGS

STW3. IN GROUND DRAINAGE PIPEWORK SERVING DP's SHALL BE MINIMUM 150mm DIA. UNO.

STW4. GRATED DRAINS SHALL BE 150mm NOM.
A. 150mm NOM. WIDTH IN NON TRAFFICABLE AREAS.
B. 225mm NOM. WIDTH IN TRAFFICABLE AREAS.

STW5. STORMWATER PITS ARE AS SHOWN & SPECIFIED ON THE PLANS . PRECAST TYPE ACCEPTABLE WITH STEP IRONS FOR DEPTH GREATER THAN 1000.
BENCH ALL PITS MIN. 50mm & FORM SMOOTH TRANSITION FROM INLET TO OUTLET

STW6. SELECT FILL SHALL BE MATERIAL OBTAINED FROM EXCAVATION OF THE PIPE TRENCH OR IMPORTED WITH A PARTICLE SIZE FOR ROCK NOT GREATER THAN 75mm OR FOR OTHER THAN ROCK NOT GREATER THAN 150mm.

STW7. IMPORTED FILL SHALL BE EITHER, AND GENERALLY CONSIST OF SINGLE SIZED AGGREGATE WITH PARTICLE SIZE NOT GREATER THAN 5mm WRAPPED ALL ROUND WITH GEOTEXTILE FILTER FABRIC OR APPROVED HIGH COMPACTION SAND OR APPROVED CRUSHED ROAD GRAVEL CONFORMING TO RTA FORM 3051 OR SIMILAR.

STW8. STORMWATER PITS AND GRATES TO CONFORM WITH STANDARD COUNCIL REQUIREMENTS, WHERE ON PUBLIC LAND. GRATES TO BE SUPPLIED IN CLASS SHOWN ON THE DRAWINGS.

INSTALLATION REQUIREMENTS:

STW9. PIPES SHALL BE TRUE TO GRADES SHOWN AND ALIGNED SO THAT THE CENTRES OF THE INLET PIPES INTERSECT WITH THE CENTRE OF THE OUTLET PIPE AT THE DOWNSTREAM FACE OF THE PIT.

STW10. MINIMUM GRADES FOR GRAVITY STORMWATER DRAINAGE SHALL CONFORM TO AS3500 PART3 AS FOLLOWS, UNO:
1% FOR 100 AND 150 mm DIA.
0.5% FOR 225 mm DIA
0.4% FOR 300 mm DIA
0.35% FOR 375 mm DIA

STW11. MINIMUM DEPTH OF COVER SHALL BE :-
- 300mm IN PRIVATE PROPERTY (NON VEHICULAR TRAFFIC).
- 450mm IN PUBLIC AREAS.
- 600mm IN VEHICULAR TRAFFICABLE AREAS (FOOTWAY/ROADWAY).

STW12. BED ALL PIPES FIRMLY AND EVENLY ONTO IMPORTED BEDDING FILL MATERIAL.

STW13. LAY AND JOINT ALL PIPES IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS AND
AS 3725-1989 LOADS ON BURIED CONCRETE PIPES
AS 2566-1998 BURIED FLEXIBLE PIPELINES
AS 1597.2-1996 PRECAST REINFORCED CONCRETE BOX CULVERTS.
AS 3500-1990 NATIONAL PLUMBING & DRAINAGE CODE.
PART 2 SANITARY PLUMBING AND SANITARY DRAINAGE.

CONCRETE WORKS

C1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600, THE STANDARDS ASSOCIATION AUSTRALIA, STANDARDS CITED IN AS3600, THE DRAWINGS AND THE SPECIFICATION.

C2. ALL CONCRETE SHALL BE 80mm NOMINAL SLUMP, 20mm MAXIMUM AGGREGATE WITH NO ADMIXTURES OR FLY ASH, UNLESS OTHERWISE APPROVED.

ALL CONCRETE WORK IN CONTACT WITH SEWER TO HAVE TYPE SL PORTLAND CEMENT, OTHERWISE TYPE A CEMENT

FOR BRIDGE WORKS, A MAXIMUM 56 DAYS SHRINKAGE OF 600 MICROSTRAIN, A MINIMUM CEMENT CONTENT 350kg/m3 AND MAXIMUM WATER:CEMENT RATIO OF 0.40

C3. STRENGTH GRADE OF CONCRETE SHALL BE :
25 MPa (KERBS, EDGE STRIPS & CONCRETE ENCASEMENT)
AND 32 MPa ELSEWHERE.

C4. CONSTRUCTION JOINTS SHALL BE PROPERLY FORMED AND USED ONLY WHERE SHOWN OR APPROVED.
GENERALLY FOR HAND PLACED KERB & GUTTER 6mm THICK APPROVED BITUMINOUS MASTIC JOINTING MATERIAL SHALL BE PROVIDED AT INTERVALS NOT EXCEEDING 6m. FOR MACHINE PLACED KERB & GUTTER 6mm THICK APPROVED BITUMINOUS MASTIC JOINTING MATERIAL SHALL BE PROVIDED AT INTERVALS NOT EXCEEDING 12m & GUILLOTINED DUMMY GROOVED JOINTS, 25mm IN DEPTH, SHALL BE FORMED EVERY 3m OF GUTTER. JOINTS ARE ALSO REQUIRED AT EACH END OF GUTTER CROSSING AND GULLY PITS. JOINTS SHALL BE SET VERTICAL AND SQUARE TO THE KERB.

C5. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND IS NOT NECESSARILY SHOWN IN TRUE PROJECTION.

C6. WELDING OR SPLICES IN REINFORCEMENT SHALL BE USED ONLY IN POSITIONS APPROVED BY THE ENGINEER.

C7. CONCRETE CURING SHALL BE IN ACCORDANCE WITH AS3600. CURING SHALL BE COMMENCED WITHIN TWO HOURS OF FINISHING OPERATIONS AND SHALL BE CONTINUED FOR A MINIMUM OF SEVEN DAYS BY AN APPROVED PROPRIETARY COMPOUND OR BY KEEPING CONTINUOUSLY WET.

C8. FORMWORK SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH AS3610. FORMWORK SHALL NOT BE STRIPPED NOR PROPS REMOVED WITHOUT APPROVAL.

C9. FABRIC LAP DETAILS SHALL BE IN ACCORDANCE WITH FIG.13.2.4 OF AS3600.

C10. HOOKS, LAPS AND BENDS SHALL BE IN ACCORDANCE WITH AS3600 UNO.

C11. ALL CHEMICAL ANCHORS SHALL BE EITHER 'CHEMSET' BY "RAMSET" WITH THE GLASS CAPSULE SYSTEM INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS
OR
HILTI HVU ADHESIVE ANCHOR WITH FOIL CAPSULE SYSTEM INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS INSTRUCTION. ALL CHEMICAL ANCHORS SHALL BE HOT DIPPED GALVANIZED AND BE MIN M16 DIA. U.N.O.

GENERAL EARTHWORKS, SITEWORKS & FILLING:

FILLING:

SGE1. THESE CLAUSES SHALL BE READ IN CONJUNCTION WITH "REPORT ON GEOTECHNICAL INVESTIGATION BY COFFEY GEOSCIENCES P/L REPORT No. S22216/1-AG (2005)
PH 9406 1000 FAX: 9406 1002

SGE2. THE RECOMMENDATIONS CONTAINED IN THE GEOTECH REPORT SHALL OVERRIDE THE CLAUSES PRESENTED HEREIN.

SGE3. STRIP ALL TOPSOIL AND UNDERLYING FILL AND STOCKPILE TOPSOIL FOR LATER REUSE FOR LANDSCAPING PURPOSES.

SGE4. NEW FILL REQUIRED TO REINSTATE CUT LEVELS TO PROPOSED BENCHING LEVELS SHALL BE SOURCED FROM OTHER PARTS OF THE EXCAVATION AS SELECT FILL OR IMPORTED FILL AS SPECIFIED BELOW IN SGE 4 AND SGE 5.

SGE5. SELECT FILL SHALL CONSIST OF LOCALLY DERIVED OR CUT NATURAL CLAYS.

SGE6. IMPORTED FILL SHALL CONSIST OF RIPPED SANDSTONE OR SHALE OR SIMILAR MATERIAL WITH MAXIMUM PARTICLE SIZE NOT GREATER THAN 120mm AND A MOISTURE CONTENT WITHIN 2-3% OF STANDARD OPTIMUM.

SGE7. ALL FILL (COHESIVE SOIL) SHALL BE PLACED IN LAYERS OF 200mm MAXIMUM THICKNESS, COMPACTED BY MACHINE ROLLING TO ACHIEVE A DRY DENSITY RATIO OF NOT LESS THAN 98% STANDARD MAXIMUM AT A CORRESPONDING MOISTURE CONTENT WITHIN 2-3% OF STANDARD OPTIMUM.

SGE8. IN AREAS WHERE HIGH IMPACT ROLLING IS USED TEST EACH FINAL LAYER OF NOT GREATER THAN 300mm TO 400mm TO ACHIEVE A DRY DENSITY RATIO OF NOT LESS THAN 98% STANDARD MAXIMUM AT A CORRESPONDING MOISTURE CONTENT WITHIN 2-3% OF STANDARD OPTIMUM.

EXCAVATION BATTERS:

SGE8. ALL TEMPORARY BATTERS CUT IN CLAY SUBSTRATE SHALL BE 1 HORIZ : 1 VERT.
ALL LONG TERM EXPOSED BATTERS CUT IN CLAY SUBSTRATE SHALL BE 2 HORIZ : 1 VERT.
ALL DETENTION BASIN BATTERS IN CLAY SUBSTRATE SHALL BE 3 HORIZ : 1 VERT.
ALL DETENTION BASIN BATTERS IN ROCK SUBSTRATE SHALL BE NEAR VERTICAL.

SGE9. GEOTECHNICAL TESTING IS TO BE UNDERTAKEN TO AT LEAST LEVEL 1 CONTROL OF FILL COMPACTION STANDARD, AS DEFINED IN AS. 3738 AS FOLLOWS

- FOR GENERAL FILL OR CUT AREAS OVER THE AREA PROVIDE ONE (1) TEST PER 200mm LAYER, OVER AN AREA NOT GREATER THAN 500 m|.

- FOR GENERAL FILL AREAS IN CONCENTRATED AREAS ADJACENT TO AND BEHIND THE STRUCTURE AND ADJACENT TO AND BEHIND RETAINING WALLS PROVIDE ONE (1) TEST PER 200mm LAYER, OVER AN AREA NOT GREATER THAN 50m|.

SGE10. SUBMIT ALL GEOTECHNICAL TEST RESULTS TO WARREN SMITH & PARTNERS FOR REVIEW PRIOR TO CONTINUATION WITH SUBSEQUENT SECTION OF WORK.

EARTH WORKS FOR SERVICES

E1. EXCAVATE TRENCHES AND STOCKPILE ALL MATERIAL FOR INSPECTION WITH REGARD TO RE-USE FOR TRENCH BACKFILL. REMAINING MATERIAL TO BE REMOVED FROM SITE.

E2. BEDDING MATERIAL SHALL CONSIST OF IMPORTED FILL ONLY. THICKNESS OF BEDDING LAYER SHALL BE 75mm IN O.T.R. AND 200mm IN ROCK.

E3. EMBED ALL PIPES WITH IMPORTED FILL. PROVIDE 200mm SIDE SUPPORT AND 150mm OVERLAY ABOVE PIPE CROWN.

E4. TRENCH FILL ABOVE THE EMBEDMENT ZONE TO THE UNDERSIDE OF THE ROAD PAVEMENT OR FOOTWAY FILL MATERIAL SHALL BE AS FOLLOWS :

UNDER ROADWAY
TRENCH FILL MATERIAL SHALL CONSIST OF IMPORTED FILL AS SPECIFIED HEREIN OF EITHER HIGH GRADE COMPACTION SAND OR APPROVED CRUSHED ROAD GRAVEL CONFORMING TO RTA FORM 3051 OR SIMILAR.

OTHER THAN ROADWAY
TRENCH FILL MATERIAL EXCAVATED SHALL CONSIST OF SELECT FILL AS SPECIFIED HEREIN AND SHALL NOT CONTAIN MORE THAN 20% OF STONES OF SIZE BETWEEN 75mm & 150mm AND NONE LARGER THAN 150mm.
PRIOR TO THE USE OF THE EXCAVATED MATERIAL IT SHALL BE INSPECTED AND APPROVED BY THE CONSULTANT.

E5. COMPACT BEDDING, EMBEDMENT AND TRENCH FILL MATERIALS AS FOLLOWS:

EMBEDMENT:-
FOR GRANULAR FILL MATERIAL (NON-COHESIVE SOILS) EG. COARSE AGGREGATE FILL, HIGH GRADE COMPACTION SAND, THE DENSITY INDEX (ID) SHALL BE NOT LESS THAN 70%.

TRENCH FILL:-
FOR GRANULAR MATERIAL (NON-COHESIVE SOILS), THE DENSITY INDEX (ID) SHALL BE NOT LESS THAN 70%.

FOR NON-GRANULAR FILL MATERIAL (COHESIVE SOILS), THE DRY DENSITY RATIO (RD) SHALL BE NOT LESS THAN 95%.

E6. MEASURE OF COMPACTION:-
THE DEGREE OF COMPACTION SHALL BE MEASURED BY ONE OF THE FOLLOWING PARAMETERS :-

GRANULAR FILL (NON-COHESIVE SOILS). THE DENSITY INDEX (ID) DETERMINED IN ACCORDANCE WITH AS 1289.E6.1 BASED ON THE MAXIMUM AND MINIMUM DRY DENSITIES IN ACCORDANCE WITH AS 1289.E5.1 AND THE FIELD DRY DENSITY IN ACCORDANCE WITH AS 1289.5.3.2, AS 1289.E3.5 OR AS 1289.E8.1.

NON-GRANULAR FILL (COHESIVE SOILS). THE DRY DENSITY RATION (RD) DETERMINED IN ACCORDANCE WITH AS 1289.5.4.1 BASED ON THE FIELD DRY DENSITY IN ACCORDANCE WITH AS 1289.5.3.2 AND THE MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289.5.1.1

E7. GEOTECHNICAL TESTING IS TO BE UNDERTAKEN TO AT LEAST LEVEL 1 CONTROL OF FILL COMPACTION STANDARD, AS DEFINED IN AS. 3738 AS FOLLOWS

- TEST EACH 300mm LAYER ABOVE PIPE CROWN.

- TEST BASE & SUB-BASE LAYERS WHERE APPLICABLE.

- TESTS SHALL BE REQUIRED AT EACH 50m CENTRES WHERE THE LENGTH OF TRENCH IS WITHIN THE 50m REQUIREMENT.

E8. SUBMIT ALL GEOTECHNICAL TEST RESULTS TO WARREN SMITH & PARTNERS FOR REVIEW PRIOR TO CONTINUATION WITH SUBSEQUENT SECTION OF WORK.

RESTORATION:

RES1. RESTORE ALL TRAFFIC AREAS TO PRE EXISTING CONDITION.

RES2. FOR ALL SURFACES OTHER THAN IN TRAFFIC AREAS RESTORE DISTURBED SURFACES TO PRE-EXISTING CONDITIONS AND COMPACT AS SPECIFIED.

RES3. RESTORE ALL AUTHORITY OWNED AREAS TO COUNCIL STANDARDS

ROAD WORKS, DRIVEWAYS & CARPARKS

R1. ALLOW FOR LEVEL 2 TESTING AND SUB-GRADE CONDITIONS & PAVEMENT THICKNESS TO BE VERIFIED BY GEOTECHNICAL CONSULTANT AFTER INSPECTION OF PRELIMINARY BOXING.

R2. ALLOW FOR ANY SUB-GRADE REPLACEMENT WORK TO BE DETERMINED AS REQUIRED BY GEOTECHNICAL CONSULTANT AT THE TIME OF PAVEMENT CONSTRUCTION.

R3. MINIMUM DRY DENSITY RATIOS (AS 1289 3.4.1-1993) TO BE:

BASECOURSE	98% MODIFIED
SUB-BASE	95% MODIFIED
SUB-GRADE	100% STANDARD
SUB-GRADE REPLACEMENT	100% STANDARD

R4. PAVEMENT MATERIALS TO COMPLY WITH RTA SPECIFICATION No. 3051 OR SIMILAR AS APPROVED BY GEOTECHNICAL CONSULTANT.

R5. PROVIDE (1) TEST FOR EACH LAYER NOT EXCEEDING 250mm THICK BEING BASECOURSE, SUB-BASE & SUB-GRADE OVER AN AREA NOT GREATER THAN 500m|

R6. SUBMIT ALL GEOTECHNICAL TEST RESULTS TO WARREN SMITH & PARTNERS FOR REVIEW PRIOR TO CONTINUATION WITH SUBSEQUENT SECTION OF WORK.

APPROVALS

A1. THE AS CONSTRUCTED WORKS SHALL BE INSPECTED BY DESIGN CONSULTANT. MINIMUM 48 HOURS NOTICE SHALL APPLY TO ALL INSPECTIONS.

A2. THE DESIGN PLANS HEREIN ARE SUBJECT TO COUNCIL APPROVAL PRIOR TO CONSTRUCTION. OBTAIN EXPRESS (WRITTEN) ADVICE TO PROCEED FROM PROJECT MANAGER PRIOR TO COMMENCEMENT.

A3. SUBMIT WORK-AS-EXECUTED DRAWINGS IN CIVILCAD OR DXF DIGITAL FORMAT AND HARD COPY FORMAT. VERIFY ALL CONSTRUCTION WORKS SHOWN HEREON.

A4. CERTIFY THAT THE AS CONSTRUCTED SYSTEM HAS BEEN BUILT IN ACCORDANCE WITH THE APPROVED PLANS ISSUED FOR CONSTRUCTION.

SERVICES UNDER ROAD SURFACES

S1. ALL OTHER SERVICES INCLUDING BUT NOT LIMITED TO WATER, HYDRANT, GAS, SEWER, ELECTRICAL AND COMMUNICATIONS CONDUITS OR CABLES SHALL BE LAID WITH MINIMUM 600mm U.N.O.
COVER BELOW PROPOSED ROAD SURFACE OR APPROVED OTHER MEANS TO PROTECT DURING CONSTRUCTION.

ROAD SIGNS & LINE MARKING

RS1. ALL SIGNS AND LINEMARKING SHALL BE TO ROADS & TRAFFIC AUTHORITY STANDARDS AND SPECIFICATIONS AND AS.1742, MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES

RS2. ALL LINEMARKING SHALL BE AUGMENTED BY RETROREFLECTIVE RAISED PAVEMENT MARKERS (RRPMs) AND ALL SHALL BE TO AS 1742.2 - 1994 AND AS 1742.2 /AMDT 1/1997-10-05

RS3. ALL ROAD SIGNS AND POSTS SHALL BE TO AS 1742.2 - 1994 AND AS 1742.2 /AMDT 1/1997-10-05

CLOSED CIRCUIT COLOUR TV (CCTV)

CCTV 1. UNDERTAKE A CCTV INSPECTION OF ALL THE COMPLETED DRAINAGE IN ACCORDANCE WITH THE GUIDELINES OF THE AUSTRALIAN CONDUIT CONDITION EVALUATION MANUAL (ACCEM)

CCTV 2. APPLY THE FOLLOWING REQUIREMENTS TO THE CCTV INSPECTION:-

A. USE DATA CAPTURE SOFTWARE APPROVED BY SYDNEY WATER

B. USE CERTIFIED CCTV OPERATORS

C. THE CCTV VIDEOTAPE SHALL BE OF QUALITY TO ALLOW ACCURATE ASSESSMENT OF THE INTERNAL CONDITION OF THE PIPE.

CCTV 3. FURNISH TO THE DESIGN CONSULTANT:-
A. TWO (2) VIDEO TAPES
B. ONE SET OF SURVEY DATA ON 3 1/2 DISKETTE
C. ONE HARD COPY PRINTOUT OF THE SURVEY DATA.

HYDRAULIC SERVICES

H1. ALL WORKS CARRIED OUT SHALL COMPLY WITH AS-3500, SYDNEY WATER & COUNCIL REQUIREMENTS. OBTAIN NECESSARY AUTHORITIES APPROVALS PRIOR TO COMMENCING WORKS.

H2. PRIOR TO COMMENCING WORKS SURVEY & INSPECT SITE & CONFIRM LOCATION & LEVELS OF ALL HYDRAULIC SERVICES PIPEWORK.
NO CLAIMS FOR ADDITIONAL COSTS RESULTING FROM THE LACK OF KNOWLEDGE OF SITE CONDITIONS RELATING TO WORKS TO BE DONE OR LOCATIONS AND LEVELS OF EXISTING AND NEW SERVICES WILL BE ACCEPTED.

H3. PRIOR TO CAPPING OFF & REMOVAL OF REDUNDANT SERVICES CONFIRM ON SITE THAT SERVICE IS NOT SUPPLYING EXISTING BUILDINGS OR AMENITIES.

H4. COLD WATER PIPEWORK SHALL CONSIST OF COPPER TUBE & FITTINGS IN ACCORDANCE WITH AS 1432 TYPE B. PIPES AND FITTINGS SHALL BE JOINTED WITH 15% SILVER SOLDER.

H5. ALL NEW UNDERGROUND METAL PIPEWORK SHALL BE INSTALLED WITH POLYETHYLENE SLEEVING OBTAINED FROM "TYCO WATER AUST" AND INSTALLED TO MANUFACTURE'S REQUIREMENTS.

H6. LANDSCAPE IRRIGATION WATERING PIPEWORK SHALL CONSIST OF MEDIUM DENSITY POLYETHYLENE PIPE CLASS PN16 WITH ELECTRO FUSION JOINTS OR EQUAL TO EXISTING PIPEWORK.

COUNCIL STANDARDS

LGA 1. THE DRAWINGS HEREIN SHALL BE READ IN CONJUNCTION WITH COUNCIL'S STANDARDS & SPECIFICATIONS WHICH SHALL OVERRIDE SPECIAL DETAILS SHOWN ON THE DRAWINGS.

TRAFFIC NOTE:

1. A TRAFFIC CONTROL PLAN IS TO BE PREPARED BY AN ACCREDITED RTA TRAFFIC CONTROLLER AND SUBMITTED TO COUNCIL. THIS TRAFFIC PLAN IS TO BE CERTIFIED BY AND IMPLEMENTED TO THE SATISFACTION OF AN ACCREDITED RTA TRAFFIC CONTROLLER PRIOR TO COMMENCEMENT OF WORK

2. ALL TRAFFIC CONTROL WORKS SHALL ONLY BE CARRIED OUT BY ACCREDITED RTA TRAFFIC CONTROLLERS.

REINFORCED CONCRETE

1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3600, THE SAA STANDARDS CITED IN AS3600, THE DRAWINGS AND THE SPECIFICATION.

2. ALL CONCRETE SHALL BE 80mm SLUMP, 20mm MAXIMUM AGGREGATE WITH NO ADMIXTURES OR FLY ASH, UNLESS APPROVED BY THE ENGINEER. ALL CONCRETE TO HAVE TYPE SL PORTLAND CEMENT WITH NO FLY ASH.

3. CONSTRUCTION JOINTS SHALL BE PROPERLY FORMED AND USED ONLY WHERE SHOWN OR APPROVED BY THE ENGINEER.

4. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND IS NOT NECESSARILY SHOWN IN TRUE PROJECTION.

5. WELDING OR SPLICES IN REINFORCEMENT SHALL BE USED ONLY IN POSITIONS APPROVED BY THE ENGINEER.

6. CONCRETE CURING SHALL BE IN ACCORDANCE WITH AS3600. CURING SHALL BE COMMENCED WITHIN TWO HOURS OF FINISHING OPERATIONS AND SHALL BE CONTINUED FOR A MINIMUM OF SEVEN DAYS BY AN APPROVED PROPRIETARY COMPOUND OR BY KEEPING CONTINUOUSLY WET.

7. FORMWORK SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH AS3610. FORMWORK SHALL NOT BE STRIPPED NOR PROPS REMOVED WITHOUT THE APPROVAL OF THE ENGINEER.

8. FABRIC LAP DETAILS SHALL BE IN ACCORDANCE WITH DRAWINGS

9. HOOKS, LAPS AND BENDS SHALL BE IN ACCORDANCE WITH AS3600 UNO.

THE CONCRETE STRENGTH SHALL COMPLY WITH THE FOLLOWING:

ELEMENT	MIN CEMENT CONTENT (kg/m³)	SLUMP (mm)	NOM MAX AGGREGATE SIZE (mm)	GRADE DESIGNATION (Mpa)
REINFORCED CONCRETE	360	80	20	SL32
MASS CONCRETE	260	80	20	N20
PILES	360	80	20	N40

NO PENETRATIONS, RECESSES OR CHASES OTHER THAN THOSE SHOWN ON THE DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS

ALL EDGES TO HAVE 20mm CHAMFERS, WHERE VISIBLE IN THE FINISHED WORK.

ALL CHEMICAL ANCHORS SHALL BE EITHER 'CHEMSET' BY "RAMSET" WITH THE GLASS CAPSULE SYSTEM INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS
OR
HILTI HVU ADHESIVE ANCHOR WITH FOIL CAPSULE SYSTEM INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS INSTRUCTION. ALL CHEMICAL ANCHORS SHALL BE HOT DIPPED GALVANIZED AND BE MIN M16 DIA. U.N.O.

AUSTRALIAN HEIGHT DATUM

DO NOT SCALE FROM DRAWINGS, CHECK & VERIFY ALL DIMENSIONS & LEVELS BEFORE COMMENCEMENT OF ANY WORK.

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NORTH POINT

NOTES
1. FOR TITLE, DRAWING LIST, LEGEND, ABBREVIATIONS & NOTES REFER TO DRAWING C-01 & C-02

ISSUE	AMENDMENT	DATE	ISSUE	AMENDMENT	DATE
A	PRELIMINARY ISSUE	01/03/13			
B	REVISED PRELIMINARY ISSUE	27/03/13			
C	FOR TENDER REVIEW	17/05/13			
D	FOR TENDER REVIEW	16/07/13			
E	FOR TENDER	16/09/13			
F	FOR TENDER (TANK RECONFIGURATION)	14/10/13			
G	FOR TENDER	03/12/13			

CLIENT
University of Technology, Sydney

PROJECT
UTS ALUMNI GREEN
67 THOMAS STREET
ULTIMO, NSW 2007

Warren Smith & Partners Pty Ltd
A 1st Floor, 123 Clarence Street, Sydney 2000 NSW Australia
T 02 9299 1312 F 02 9290 1295 E wsp@warrensmith.com.au
ABN 36 300 430 126

SERVING THE CONSTRUCTION INDUSTRY SINCE 1981

Consulting Engineers
Hydraulic Services I Civil Engineering I Fire Protection I Sydney Water Accredited • Water Servicing Co-ordinator • Design and Project Management

LicQAC/R61/0771

TITLE
SPECIFICATIONS AND NOTES

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
NTS	M.H.	A.M.	L.P.	L.P.

DATE: FEBRUARY 2013
JOB No.: 3724000
DRAWING No.: C-02
ISSUE: G
ISSUED FOR TENDER

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SHEET SIZE: A1

Xrefs: Y:\3724-A1H_Civil
Plot Date: 03.12.2013@16:56:26 Login Name: AKaushal Cad File: Y:\3724\CAD\Civil\Revision G\3724-C02.dwg

DP 1047822

MAJOR ELECTRICAL CABLE RUNS BELOW ROADWAY

THOMAS STREET

JONES STREET

RL -11.04 TO RL 5.37

RL -11.405 TO RL 5.005

RL -12.06 TO RL 4.36

RL -12.6 TO RL 3.83

130.18

137.56

CONSTRUCTION SITE

CONSTRUCTION SITE

CONSTRUCTION SITE

BRICK BUILDING

MULTI STOREY BUILDING

MULTI-STOREY BUILDING

MULTI-STOREY BUILDING

MULTI STOREY BUILDING

MULTI-STOREY BUILDING

BRICK BUILDING

BOTTOM OF STEPS & RAMP MICROBIOLOGY RL 10.70

RL 36.00 COMPUTER SCIENCE LAB ROOF BLD 4 NORTH

BLD 4 NORTH EAST LIFT CORE RL 9.72

RL 10.75 MICROBIOLOGY CORRIDOR TOP OF STEPS

RL 9.74 THOMAS ST ENTRY TO GYM

NORTH FIRE STAIRS BLD 4 EAST LEVEL 5 ROOF RL 35.71

RL 35.80

BASE OF FIRE STAIRS RL 9.83

LANDING TO PAVED AREA RL 14.04

GYM FOYER RL 9.57

RL 9.87 SQUASH COURTS

RL 9.59 GYM

ENTRY

CORRIDOR

STAIRS

ENTRY FACE OF GLASS WALL

ENTRY

(NEW) CONCRETE RAMP

EDGE CONCRETE SLAB 12.86 SHO

CONCRETE AREA

EARTH FLOOR

EDGE OF CONCRETE

RAMP

RAMP

AUSTRALIAN HEIGHT DATUM

SCALE 1:250

3 0 5 10 15m

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EC-QA-CC/R61/0771

TITLE

SITE PLAN
EXISTING SURVEY

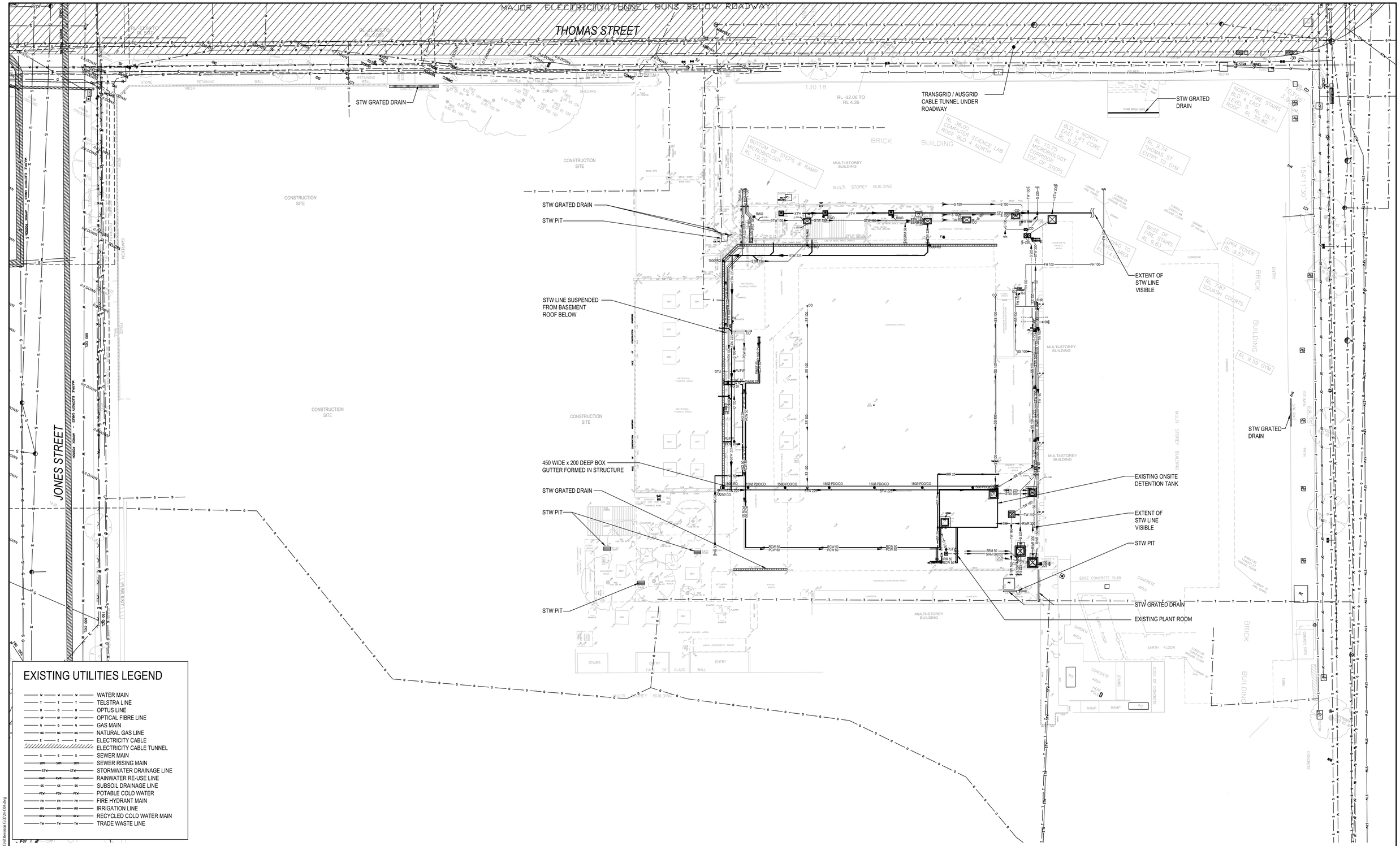
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:250	M.H.	A.M.	L.P.	L.P.

DATE	DRAWING No.	ISSUE
FEBRUARY 2013	C-03	G
JOB No. 3724000	ISSUED FOR TENDER	

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

SHEET SIZE: A1

Xrefs: X-3724-A1H_Civil_X-SURV_X-ABCH
Plot Date: 03.12.2013@16:57:09 Login Name: AMarshall
Cad File: T:\3724\CAD\Civil\Revision G\3724-C03.dwg



AUSTRALIAN HEIGHT DATUM

3 0 5 10 15m

SCALE 1:250

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TITLE
SITE PLAN
EXISTING STORMWATER SYSTEM

SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
1:250	M.H.	A.M.	L.P.	L.P.

DATE FEBRUARY 2013
JOB No. 3724000
DRAWING No. C-04
ISSUE G
ISSUED FOR TENDER

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

SHEET SIZE: A1