Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Remediation Action Plan for SSD

Proposed UNSW D14 Building
High Street, Kensington

Prepared for
The University of New South Wales
(Developer and Applicant)

UNSW SYDNEY

Lendlease
(Design and Construct Partner)

lendlease

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UNSW Hall (D14)
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1. Introduction

This remediation action plan (RAP), has been prepared for the UNSW Hall (D14) at the University of New South Wales at High Street, Kensington (UNSW). The RAP was commissioned by Ms Tania Costa of The University of New South Wales (the development and applicant) and Lendlease (Design and Construct Partner) and was undertaken in accordance with Douglas Partners' proposal SYD180599.P.001.Rev1 dated 18 June 2018.

The objectives of the RAP are to describe the works which are necessary to undertake data gap investigations and to provide protocols to remediate the site (if necessary) and to provide a scope of validation works which is sufficient to demonstrate that the site has been made suitable for the intended land use if remedial works are deemed necessary.

The RAP is not a specification and should not be used to generate one or to specific quantities.

2. Site Identification

The site comprises a broadly rectangular shaped area the general layout of which is shown on Drawing 1, Appendix B. The site is part of Lot 3 in Deposited Plan 1104617 with an area of approximately 5,200 m^2. Currently the site is occupied by the UNSW Hall (formerly Phillip Baxter College).

UNSW Hall is a four storey brick building which is currently occupied by student accommodation. The building features include:

- 208 fully furnished dorm rooms (with an average size of 10 x 12 m);
- Shared bathrooms;
- Social and group study rooms on each floor;
- Breakfast and dinner service;
- A large common room;
- Outdoor BBQ area and courtyard;
- A central lawn; and
- Coin operated laundry facilities.

The site slopes to the west from an RL of approximately 34.5 m AHD in the east to an RL of 30.5 m AHD in the west. The site is bounded by The UNSW Village and then High Street to the north,

The White House and Goldstein Dining Hall to the east, The Business School (formerly chemistry) to the south and Alumni Park to the west.

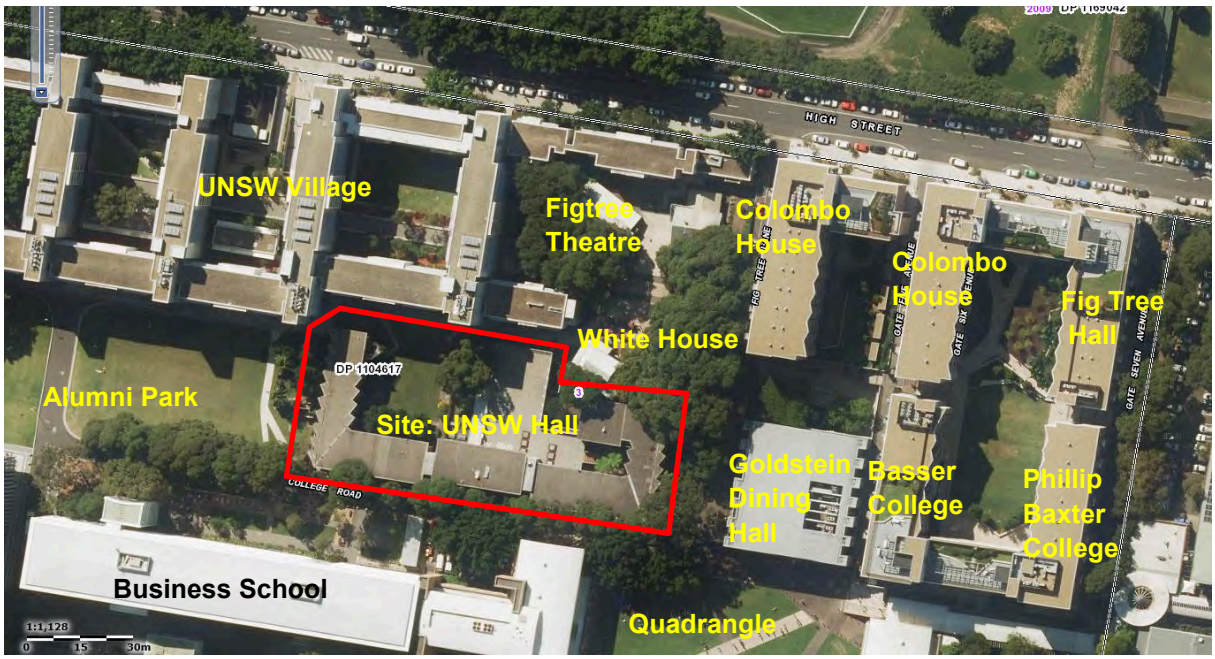


Figure 1: Site Boundary

3. Proposed Development

Preliminary concept plans of the proposed development are provided in Appendix A. In general, the SSD works includes the following:

- The construction of a 7 storey building with an approximate ground floor area of 15,000 m^2 comprising of flexible student study space, faculty office space, function space and ground level retail; and
- Associated public domain, ramps and landscaping works.

4. Objectives and Scope of the RAP

The scope of the RAP has been established on the basis of the findings of the previous investigations, site observations and proposed development details.

The objective of the remedial works (if required based on the outcome of proposed data gap assessment) is to remove and/or to mitigate associated risks of potential environmental and human health impacts posed by the contaminated material such that the site can be rendered suitable for the proposed development.

If the proposed data gap assessment does not identify contaminated soils and no unexpected finds are encountered during construction then the unexpected finds protocols provided herein would not be required to be implemented and subsequently no remedial action (or validation assessment) would be required.

5. Geology, Topography and Hydrogeology

Reference to the *Sydney* 1:100 000 Geology of Sydney Geological Series Sheet indicates that the site is located on Quaternary transgressive dunes. The transgressive dunes typically comprise medium to fine grained, marine sand with podsols. The dunes overly Hawkesbury Sandstone which typically comprises medium to coarse grained quartz sandstone with some shale bands or lenses.

The *Sydney* 1:100,000 Soils Landscape Sheet indicates that the site is underlain by the Tuggerah soil landscape group. The soil landscape group typically occurs on gently undulating rises. Local relief to 20 m and slopes are usually <1-10%. The soils typically comprise Deep (>200 cm) Podzols on dunes and Podzol/Humus Podzol intergrades on swales. The typical limitations of the group include extreme wind erosion hazard, non-cohesive, highly permeable soil, very low soil fertility, localised flooding and permanently high water tables.

The NSW National Resource Atlas *Acid Sulfate Soil Risk* Map indicates that the site is located in an area of no known occurrence of acid sulfate soil.

Based on local topography it is anticipated that the general regional groundwater flow direction would be west and north west. The nearest sensitive water receiving bodies are in Centennial Park and the East Lakes system. However, it is not considered likely that groundwater from the site would have any impact on these water bodies, given the distance (at least 1.5 km to Centennial Park) from the subject site and the receiving bodies.

A review of registered groundwater bores indicates that there are no registered bores within the site. There are a number of registered bores within UNSW and in the Randwick / Kensington area. The registered use of the bores within UNSW is for monitoring, recreational and industrial uses. The bores were drilled to depths of between 28.5 and 41 m bgl. Groundwater was recorded at depths of between 7.2 and 7.5 m bgl. It is understood that groundwater is extracted at UNSW for irrigation of the gardens and playing fields.

6. Preliminary Contamination Assessment

DP has previously undertaken a preliminary contamination assessment at the site, DP Report on Contamination Assessment for SSD, Proposed UNSW D14 Building, High Street, Kensington, Prepared for The University of New South Wales, (Developer and Applicant) and Lendlease (Design and Construct Partner), Project 86457.01.R.02.Rev01 dated November 2018 (DP 2018).

The investigation included a review of site history, three rock cored bores, drilling of three shallow augered bores, and cone penetration tests (CPTs) at four of the borehole locations. Two groundwater monitoring wells were installed for geotechnical investigation purposes (measurement of groundwater

levels). Soil Samples were analysed for the identified contaminants of concern based on the preliminary conceptual site model (CSM).

The site history indicated that the site formed part of the site the Kensington Racecourse until circa 1952 before being redeveloped for the University of New South Wales. Several structures were demolished following the transfer to the site to the university. Over the course of the past 70 years the University has undergone a number of expansions and redevelopments. Within the subject area the Phillip Baxter College (now University Hall) was opened in 1966 and is still onsite in largely its original form.

The risk of contamination at the site was generally considered to be low to moderate with the primary potential source of contamination that was identified being imported fill and demolition waste from previous site buildings / structures.

Soil samples were analysed for the identified contaminants of concern identified in the conceptual site model, being heavy metals, asbestos, total recoverable hydrocarbons (TRH), monocyclic aromatic hydrocarbons (benzene, toluene, ethyl benzene and xylenes, BTEX), volatile organic compounds (VOC), organochlorine pesticides (OCP), organophosphate pesticides (OPP), polychlorinated biphynels (PCBs), phenols and asbestos.

The sub-surface conditions encountered in DP (2018) generally were:

Pavement	An asphaltic concrete pavement was present at the surface in BH5 to 0.05 m bgl;
Filling	Fill was encountered in all test bores. The fill was typically present to a depth of between 0.5 to 0.7 m bgl. BH3 & BH3A (drilled with hand tools) encountered refusal at 0.2 m bgl and 0.5 m bgl respectively on sandstone boulders. The depth of fill in BH2 was greater than 3 m (the maximum depth reached in the test bore). Fill was typically described as brown and grey fine to medium grained sand and sandy gravel; The following anthropogenic inclusions were noted in the fill: – Terracotta and tile fragments in BH1 at 0.5 m bgl; – A buried asphaltic concrete layer in BH2 at 0.3 m bgl and concrete and steel wire in BH2 at 0.3-0.6 m bgl; and – Slag in BH4 at 0.3 m bgl.
Sand	Sand was encountered in BH1, BH4, BH5 and BH6. The sand was typically described as loose, (becoming dense at depth) yellow mottled grey and brown fine to medium grained sand with a trace of sandstone gravel. The depth of the base of the sand unit generally increases to the west from 5.4 m bgl in BH5 to 10.7 m bgl in BH4; and A thin layer of sandy clay was observed in BH4 at a depth of 8.0 m bgl.
Sandstone	Test bores BH4, BH5 and BH5 were extended to and into bedrock using NMLC rock coring techniques. Sandstone was encountered at a depth of 10.7 m bgl, 5.4 m bgl and 5.83 m bgl in BH4, BH5 and BH6 respectively. Sandstone was described as yellow brown, light grey orange and red very low strength, fractured, medium to coarse sandstone, becoming medium strength and then high strength at increasing depth.

No signs of significant contamination such as significant building rubble or chemical odours were noted although various traces were present as noted above which can be an indicator of asbestos. Photo-ionisation detector (PID) screening results were all below 1 ppm indicating a low potential for volatile contaminants.

Groundwater monitoring wells were installed in two locations. Groundwater ranged in depth 5.9 m to 7.4 m bgl two weeks after the installation of the wells. The observed direction of groundwater flow was to the west. Groundwater levels may be transient and can be affected by climate and other factors.

The results of the laboratory analysis undertaken in DP (2018) are presented in the following tables attached in Appendix B:

Table B1: Summary of Laboratory Results for Soil Analysis;

Table B2: Summary of Laboratory Results for Analysis of Asbestos in Soil; and

Table B3: Summary of Laboratory Results for Waste Classification

The results of soil analysis were all were within human health and ecological based investigation levels adopted for the investigation and proposed landuse with the following exception:

- Benzo(a)pyrene [B(a)P] recorded above the ESL of 1.4 mg/kg in sample 6/0.5 (at 2.5 mg/kg).

Following further assessment and statistical analysis the recorded B(a)P concentrations was not considered to significantly impact the suitability of the site for the proposed development due based statistical analysis.

No asbestos was observed during drilling or detected in laboratory analysis. Traces of building rubble were noted in filling in the test bore logs. Some risk of asbestos being present cannot therefore be discounted.

The fill (including surface soils) described was preliminarily classified as General Solid Waste (non-putrescible), as defined in EPA (2014). The natural sands and sandstone within the area subject to classification was classified as VENM.

It was recommended that an unexpected finds protocol be prepared. It was also recommends that following demolition of the existing structures (after a detailed hazardous building materials survey is completed), further (data gap) investigations be undertaken within the footprint of those structures to fully characterise the site. Furthermore, validation of the removal of any hazardous building materials encountered prior to or during demolition was recommended.

The conceptual site model prepared in DP (2018) is summarised in Table 1 below.

Table 1: Summary of Potential Complete Pathways

Source	Transport Pathway	Receptor	Risk Management Action Recommended
S1 – Filling and building rubble: Associated with site redevelopment;	P1 – Ingestion and dermal contact P2 – Inhalation of dust and/or vapours	R1: Maintenance and construction	The potential for contamination from the identified sources is generally considered to be

Source	Transport Pathway	Receptor	Risk Management Action Recommended
COPC TPH, BTEX, PAH, PCB,OCP, phenols, and asbestos S2 – Previous activities related to Kensington Racecourse. COPC include metals, TPH, PAH. It is possible that animals may have also been dosed for pests such as ticks. S3 – Chemical Stores COPC include metals, VOC, TPH, BTEX, PAH and phenols. S4 – Substations within the site COPC include metals, asbestos, OCP and PCB		workers R2: Current and future users	low to moderate. Further testing within building footprints is recommended (when structures are demolished).
	P2 – Inhalation of dust and/or vapours	R3 – Adjacent users (residential and commercial)	
	P3 – Leaching of contaminants and vertical mitigation into groundwater	R4 – Groundwater	
	P4 – Surface water run-off P5 – Lateral migration of groundwater. P6 – Contact with extracted groundwater used for irrigation		

7. Remediation Action Criteria

The remediation action criteria (RAC) are based on the investigation levels in DP (2018) and primarily comprise (Tier 1) investigation levels, screening levels and management limits sourced from Schedule B1 of NEPC, 2013. This guideline has been endorsed by the NSW EPA under the Contaminated Land Management (CLM) Act 1997. Schedule B of NEPC (2013) provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.
In addition to RAC sourced from NEPC (2013), screening levels (for direct contact) have been adopted from the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) *Technical Report no.10 Health screening levels for petroleum hydrocarbons in soil and groundwater* (2011). The following sub-sections outline the adopted SAC for soil as documented in NEPC (2013) and CRC CARE, 2011.

In general, based on the non-residential, university use proposed at the site, and the use of hardstand covering the majority of the site, it is considered that the land use scenario assumptions most consistent with the development are those of the commercial land use scenario.

7.1 Health Investigation Levels

Table 2 shows the health investigation levels (HIL) that have been adopted as RAC for assessing the human health risk from a contaminant via all relevant pathways of exposure. HIL D, for commercial/ industrial land use, has been adopted as discussed above.

The relevant HIL D Are provided in Table 4, below (note: the table does not contain the complete list of HIL provided in NEPC (2013)).

Table 2: Health Investigation Levels

Contaminant	HIL – D (mg/kg)
Metals	
Arsenic	3,000
Cadmium	900
Chromium (VI)	3,600
Copper	240,000
Lead	1,500
Mercury (inorganic)	730
Nickel	6,000
Zinc	400,000
PAH	
Carcinogenic PAH (as Benzo(a)pyrene TEQ)	40
Total PAH	4,000
OCP	
DDT+DDE+DDD	3,600
Aldrin + Dieldrin	45
Chlordane	530
Endosulfan	2,000
Endrin	100
Heptachlor	50
HCB	80
Methoxychlor	2,500
OPP	
Chlorpyrifos	2,000
PCB	7
Phenols	
Phenol	240,000

Contaminant	HIL – D (mg/kg)
Pentachlorophenol	660
Cresols	25,000

7.2 Health Screening Levels for Vapour Intrusion

Table 3 shows the health screening levels (HSL) for petroleum hydrocarbon compounds adopted as RAC and are based on the exposure to petroleum hydrocarbons through the dominant vapour inhalation exposure pathway only (i.e. not direct contact to soils). The HSL have been adopted from Column HSL D (for commercial/industrial sites). As sand has been identified at the site, the most conservative HSL for the three soil types have been listed in Table 3.

Table 3: Soil Health Screening Levels for Vapour Intrusion

Contaminant	HSL – D (mg/kg)
	Depth 0 m to <1 m
Naphthalene	NL
TPH C_6-C_{10} less BTEX	250
TPH >C_{10}-C_{16} less	NL
Benzene	3
Toluene	NL
Ethylbenzene	NL
Xylenes	230

Notes: NL is 'not limiting' (where the derived soil HSL exceeds the soil saturation concentration)

7.3 Health Screening Level for Direct Contact

Table 4 shows the HSL for direct contact for commercial and industrial sites (HSL D), sourced from CRC CARE (2011), which are mentioned but not presented in NEPC (2013).

Table 4: Soil Health Screening Levels for Direct Contact

Contaminant	HSL – D (mg/kg)
Naphthalene	11,000
TPH C_6-C_{10}	26,000
TPH >C_{10}-C_{16}	20,000
TPH >C_{16}-C_{34}	27,000
TPH >C_{34}-C_{40}	38,000
Benzene	430
Toluene	99,000
Ethylbenzene	27,000
Xylenes	81,000

7.4 Ecological Investigation Levels and Ecological Screening Levels

Ecological Investigation Levels (EIL) have been derived for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems (NEPC, 2013). EIL depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which corresponds to the root zone and habitation zone of many species. EILs and ESL would only be applied in specific circumstances where the conceptual model identifies a potential ecological risk or exposure. The EIL is determined for a contaminant based on the sum of the ambient background concentration (ABC) and an added contaminant limit (ACL). The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ACL is the added concentration (above the ABC) of a contaminant above which further appropriate investigation and evaluation of the impact on ecological values is required.

The EIL is calculated using the following formula:

EIL = ABC + ACL,

The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al *Trace element concentrations in soils from rural and urban areas of Australia*, Contaminated Sites monograph no. 4, South Australian Health Commission, Adelaide, Australia 1995 (Olszowy, 1995) or Hamon et al, *Geochemical indices allow estimation of heavy metal background concentrations in soils*, Global Biogeochemical Cycles, vol. 18, GB1014, (Hamon, 2004). ACL is based on the soil characteristics of pH, CEC and clay content.

EIL (and ACLs where appropriate) have been derived in NEPC (2013) for only a short list of contaminants comprising arsenic, copper, chromium (III), DDT, naphthalene, nickel, lead and zinc. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EIL for these contaminants, and has been provided in the ASC NEPM Toolbox available on the SCEW (Standing Council on Environment and Water) website (http://www.scew.gov.au/node/941).

The adopted EIL, derived from Tables 1B(1) to 1B(5), Schedule B1 of NEPC (2013) the *Interactive (Excel) Calculation Spreadsheet* are shown in Table 5. The following site specific data and assumptions have been used to determine the EILs:

- A protection level of 60% typical for commercial / industrial land use;
- The EILs apply to the top 2 m of the soil profile;
- Given the likely source of soil contaminants (i.e. historical site use/fill) the contamination is considered as “aged” (>2 years);
- ABCs have been derived using the *Interactive (Excel) Calculation Spreadsheet* using input parameters of NSW for the State in which the site is located, and high for traffic volumes;
- A pH of 8.5 has been used as an input value based on site specific data. This input value is the (rounded) average of the results (see laboratory certificate, Appendix F);
- A CEC of 15.47 cmol/kg has been used as an input value based on site specific data. This input value is the (rounded) average of the results; and
- In the absence of site specific data, a conservative clay content value of 10% and a conservative organic carbon content value of 1% have been used.

Table 5: Ecological Investigation Levels (EIL)

Analyte		EIL – D (mg/kg)
Metals	Arsenic	160
	Copper	320
	Nickel	320
	Chromium III	680
	Lead	1,800
	Zinc	1,000
PAH	Naphthalene	370
OCP	DDT	640

Ecological Screening Levels (ESL) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESL apply to the top 2 m of the soil profile as for EIL.

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and benzo(a)pyrene. The adopted ESL, from Table 1B(6), Schedule B1 of NEPC (2013) are shown in Table 6. ESL are for commercial and industrial land use with coarse grained soils as the soil types encountered were primarily fine grained (silts and clays).

Table 6: Ecological Screening Levels (ESL) in mg/kg

Analyte		ESL Commercial / Industrial	Comments
TRH	C6 – C10 (less BTEX) [F1]	215*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	>C10-C16 [F2]	170*	
	>C16-C34 [F3]	1,700	
	>C34-C40 [F4]	3,300	
BTEX	Benzene	75	
	Toluene	135	
	Ethylbenzene	165	
	Xylenes	180	
PAH	Benzo(a)pyrene	1.4	

With respect to the ESL for benzo(a)pyrene [B(a)P], It is also noted that NEPC (2013) states:

- *A further review of Canadian soil quality guidelines was undertaken for BTEX and benzo(a)pyrene (Warne 2010b) and the Australian methodology applied to the ecotoxicological data as far as possible to derive equivalent ESLs. However, data limitations did not allow the full*

use of the EIL derivation methodology and the resulting values are adopted as low reliability ESLs [Schedule B1]; and

- *In the Australian and NZ WQGs (ANZECC & ARMCANZ 2000), low reliability TVs were only used for interim guidance. A similar approach should be adopted regarding low reliability EILs—that such values should be considered to be a knowledge or data gap that requires further work to resolve* [Schedule B5b].

It is noted that work towards the development of a higher reliability threshold has been undertaken since the publication of the low reliability ESL for benzo(a)pyrene in NEPC (2013). CRC CARE Technical Report No. 39, *Risk-based management and remediation guidance for benzo(a)pyrene* (2017) [CRC CARE (2017)] includes a literature review of the source of the NEPC (2013) ESL and subsequent developments, as well as development of high reliability ESL for BaP. Specifically, CRC CARE (2017) notes:

- *The NEPM[1] provides ecological screening levels (ESLs) for B(a)P based on the* [then applicable] *Canadian soil quality guidelines (SQG);*
- *The* [then applicable] *Canadian guidelines for B(a)P stated that a limited toxicity data set was available including one invertebrate bioassay and two plant bioassays;*
- *The* [then applicable] *Canadian guideline was based on toxicity data generated from one data point that accounts for biomagnification;*
- *Because the ESLs in the NEPM are classified as low reliability, it is useful to consider whether there is additional and more recent information that allows higher reliability values to be estimated. Note that values derived in this way are intended to assist in informing an assessment of B(a)P following NEPM ecological risk assessment guidelines, but as they have not been developed through the NEPM review process, they should not be cited as NEPM ESLs;*
- For the ESL derived in CRC CARE (2017):
    - *The number of species … allows a more reliable ESL to be derived using the* [species sensitivity distribution] *SSD method – with chronic data of 13 species from five taxa reported;*
    - [the derived ESL are] *conservative higher reliability ecological guideline derived from the SSD for each land use for fresh B(a)P when compared to the NEPM low reliability guidelines. Given that the curve fit is good and that the database included only chronic data, the derived values can be considered to have high reliability;*
    - *The standard species protection for each use has been adjusted to take into account biomagnification following Heemsbergen et al. (2009);*
    - *The values ….. have been calculated from results of bioassays using fresh B(a)P and do not take into account the changing bioavailability that occurs with ageing or* [Total organic carbon] *TOC concentration in soils;*
    - *The guidelines derived above are of a similar order of magnitude to the revised Canadian guidelines (CCME 2010).*

Based on the above, the CRC CARE (2017) derived ecological guidelines have also been referenced herein to assist in assessing the significance of B(a)P exceedances. These derived ecological guidelines are as follows:

[1] NEPC (2013)

- Commercial and industrial (65% protection): 172 mg/kg.

7.5 Management Limits

In addition to appropriate consideration and application of the HSL there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. The adopted management limits, from Table 1B(7), Schedule B1 of NEPC (2013) are shown in Table 7. Management Limits are available for 'fine' and 'coarse' soil textures, with the 'coarse' texture Management Limits being the same or lower than the 'fine' texture limits. Given that various soil types were encountered, the more conservative management limits (for 'coarse' soil textures) have been adopted as a preliminary screen.

Table 7: Management Limits

Contaminant	Management Limit - Commercial and Industrial (mg/kg) (coarse soil texture)
TPH $C_6 – C_{10}$	700
TPH $>C_{10}$-C_{16}	1,000
TPH $>C_{16}$-C_{34}	3,500
TPH $>C_{34}$-C_{40}	10,000

7.6 Asbestos is Soil

Bonded asbestos-containing material (ACM) is the most common form of asbestos contamination across Australia, generally arising from:

- Inadequate removal and disposal practices during demolition of buildings containing asbestos products;
- Widespread dumping of asbestos products and asbestos containing fill on vacant land and development sites; and
- Commonly occurring in historical fill containing unsorted demolition materials.

Mining, manufacturing or distribution of asbestos products may result in sites being contaminated by friable asbestos including free fibres. Severe weathering or damage to bonded ACM may also result in the formation of friable asbestos comprising fibrous asbestos (FA) and/or asbestos fines (AF).

Asbestos only poses a risk to human health when asbestos fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage. Bonded ACM in sound condition represents a low human health risk,

whilst both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres. Consequently, FA and AF must be carefully managed to prevent the release of asbestos fibres into the air.

For 40 gram asbestos samples the presence or absence of asbestos at a limit of reporting of 0.1 g/kg as well as a visual assessment for the presence or absence of ACM has been adopted as the RAC.

NEPC (2013) defines the various asbestos types referred to above as follows:

Bonded ACM: Asbestos containing material which is in sound condition, bound in a matrix of cement or resin, and cannot pass a 7 mm x 7 mm sieve;

FA: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically unbonded or was previously bonded and is now significantly degraded and crumbling; and

AF: Asbestos fines including free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.

For 500 gram bag samples the adopted RAC for AF / FA will be 0.001% w/w and for ACM 0.05 % w/w (applicable to any fill soils retained on site) will be adopted consistent with the commercial/ industrial D threshold.

7.7 Waste Classification

Waste classification of the fill material must be undertaken in accordance the NSW EPA Waste Classification Guidelines (2014).

The assessment of the natural soils must be undertaken with reference to the Protection of the Environment Operations (POEO) Act which defines virgin excavated natural material (VENM) as:

'natural material (such as clay, gravel, sand, soil or rock fines):

(a) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities and

(b) that does not contain any sulfidic ores or soils or any other waste

8. Data Quality Objectives

In order to attain the remediation goals the following 7 step data quality objective (DQO) process, as defined in Australian Standard *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 2005) has been adopted. The DQO process is outlined as follows:

(a) State the Problem

The site is to be redeveloped for a 7 storey building with an approximate ground floor area of 15,000 m^2 comprising of flexible student study space, faculty office space, function space and ground level retail and associated public domain, ramps and landscaping works. The 'problem' under consideration is the implementation of an appropriate remediation action plan on the basis of the findings of the previous environmental site investigations to ensure that the remediated site will be suitable for the proposed development and that the remedial works pose no unacceptable risks to human health or to the environment.

(b) Identify the Decision

Based on the findings of the previous assessments, site observations and the proposed development details, the principal decision is to adopt an appropriate remediation strategy to remove areas of environmental concern in order to remove and/or mitigate associated risks of potential environmental and human health impacts.

(c) Identify Inputs to the Decision

Inputs to the decision include:

- Previous reports cited in Section 6; and
- Guidelines cited in Section 7.

The primary inputs in adopting a remediation strategy are as follows:

- The areas of potential contamination deriving from known historical site activities identified from the site history review outlined in previous DP reports;
- Published guidelines appropriate to the proposed future land use;
- Published soil guidelines appropriate to the proposed future land use (commercial/residential) and published guidelines for protection of the environment;
- Field investigation techniques to assess contamination as per DP's standard field procedures;
- Field observations and analytical results; and
- Proposed land use and design of the proposed development.

(d) Define the Boundary of the Assessment

The site boundary is shown in Drawing 1 in Appendix A. The site is described in Section 2.

(e) Develop a Decision Rule

The successful implementation of the RAP is assessed on the investigation levels provided in Section 7. The decision rule is the comparison of the analytical results against the relevant guidelines and background concentrations where relevant.

(f) Specify Acceptable Limits on Decision Errors

Specific limits for this project will generally be in accordance with the appropriate guidelines from NEPC (2013) for the collection of environmental samples. In order that the results are accurate and reproducible, appropriate and adequate quality assurance and quality control (QA/QC) measures and evaluations will be incorporated into the validation sampling and testing regime.

(g) Optimize the Design for Obtaining Data

In order to ensure the collection of representative data, the sampling regime is based on the areas and their extent of environmental concern. In addition, in order to attain an acceptable level of data quality, QA/QC procedures will be adopted as part of the RAP requirements.

If the DQOs are not met, then the reasons as to why they were not achieved will be critically examined. If the situation cannot be easily rectified or is unique to the site, then consultation with the Site Auditor will take place, and assessment of future actions required will be discussed and implemented where applicable.

8.1 Data Quality Indicators

DP's quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy and prevent cross contamination.

The quality controls of documentation completeness, data completeness, data comparability, data representativeness, precision and accuracy for sampling and analysis, if required, are described in Table 8.

Table 8: Data Quality Indicators

Quality Control	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of validation sample plans.
Data completeness	Sampling density according to provisions in the approved RAP, and analysis of appropriate determinants based on site history and on-site observation.
Data comparability and representativeness	Use of NATA accredited laboratories, use of consistent sampling technique.
Precision and accuracy for sampling and analysis	Achievement of 30-50% RPD for heavy metals and organics respectively for replicate analysis, acceptable levels for laboratory QC criteria.

9. Remedial Action Plan

9.1 Remediation Goals

Generally, site remediation works have been designed that the remediated site will be suitable for the proposed development and that the works will pose:

- No unacceptable risk to human health; and
- No unacceptable risk to the environment.

Possible remedial options to achieve the remedial goals are identified as follows:

- No action;
- On-site treatment of contaminated material;
- Removal of contaminated material to landfill; and
- Capping/on-site containment of contaminated materials.

The following is a summary of the review of remediation options.

9.1.1 No Action

The “No Action” option involves no remedial response to the contamination identified on the subject site. In the event that the proposed data gap assessment does not identify contaminated soils and no unexpected finds are encountered during construction then no remedial action (or validation assessment) would be appropriate to assess site suitability.

9.1.2 On-site Treatment of Contaminated Material

On-site treatment of the contaminated material would typically involve the excavation, stockpiling, treatment and replacement of the treated contaminated material.

9.1.3 Removal of Contaminated Material to Landfill

Off-site disposal of contaminated material (if encountered) is considered a suitable option for managing human health and environmental impacts from the contaminated, if contamination is identified. This option would adequately address the remediation goals via the complete (or partial) removal of the contaminants of environmental concern from the affected areas of the subject site.
The removal of the contaminated material would involve the stockpiling, waste classification and transport of contaminated material to an EPA licensed landfill.

9.1.4 Capping/On-site Containment of Contaminated Materials

Physical barrier (or encapsulation) systems involve the placement/installation of a layer of suitable capping material such as verified virgin excavated natural materials (VENM), or permanent pavement over the contaminated filling that would limit the exposure of site users to contaminants.

On-site capping of any contaminated material may be considered subject to the quantity and type of contamination identified. For small volumes of material removal of contaminated material would be the preferred option

9.2 Selected Remediation Option

The selected remedial option will be either removal of any contaminated material to landfill (i.e. identified during the data gap assessment – see Section 9.3.1) or capping / on-site containment of contaminated materials subject to the nature and extent of contamination identified.

It is noted that if the proposed data gap assessment does not identify contaminated soils and if no unexpected finds are encountered during development works (that would trigger the unexpected finds protocols provided herein, then no remedial works would be required to render the site suitable for the proposed development.

9.3 Remediation Implementation

The remedial strategy will involve the undertaking of a data gap assessment as outlined in Section 9.3.1 and the implementation of unexpected finds protocols as required.

9.3.1 Data Gap Assessment

A data gap assessment is required within the building footprint post demolition. The required scope of data gap assessment is as follows:

- A site walk over post demolition will be conducted to identify current site features and visually apparent areas of environmental concern. This will be conducted prior to drilling to identify areas of environmental concern (AECs) to be targeted during sampling;
- Excavation of five test pits within the former the building footprint to a depth of between 1.5 m to 3.0 m or prior refusal using a an excavator. Collection of soil samples at regular intervals;
- Collection of soil samples from auger returns of four rock-cored boreholes proposed for detailed geotechnical investigations (proposed to a depth of approximately 6 m into bedrock);
- Screening of soil samples for volatile organic compounds (VOC) using a photo-ionisation detection (PID) instrument;
- Laboratory analysis selected soil samples for analysis by a NATA accredited laboratory for the contaminants of concern including Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) (HM);, TRH, PAH, BTEX, OCP, OPP, PCB, VOC, CEC and asbestos; and
- QA/ QC analysis in accordance with Section 9.4.3.

In addition to the above testing requirements one sample of fill per meter or strata of fill (whichever is greater) in the test pits will be tested for the following:

- One, 500 ml sample to be tested for asbestos fines / asbestos fibres (AF / FA) as defined in NEPC (2013); and
- One, 10L sample to be sieved on site through a 7 mm sieve to determine the ACM content.

In the event that the data gap assessment does not identify any contaminated soils and no unexpected finds are encountered then no soil remediation and/or validation works would be required to confirm the site suitability for the proposed development.

In the event that soil contamination is identified then groundwater investigation may be required as detailed in Section 10.2.

9.3.2 Remediation of Unexpected Finds

In the event that contaminated soil is identified during the data gap assessment the unexpected finds protocol outlined in Section 10 would be enacted.

9.3.3 QA / QC Analysis

QA/QC testing in conjunction with must also be undertaken including:

- Inter-laboratory duplicate samples for the full analytical suite of the primary sample at a rate of 5% of the primary sampling or a minimum of one sample per sampling day / source material;
- Intra-laboratory duplicate samples for the full analytical suite of the primary sample at a rate of 5% of the primary sampling or a minimum of one sample per sampling day / source material;
- One trip spike (BTEX) and trip blank (BTEX) per sampling day; and
- One rinsate sample per sampling day (PAH and heavy metals), if non-disposable sampling equipment is used.

10. Unexpected Finds Protocol

10.1 General Protocol

A general “Unexpected Finds Protocol” (UFP) has been established for non-asbestos related finds to deal with unexpected findings and/or unplanned situations. A separate asbestos unexpected finds protocol is provided in Section10.5. This protocol is also applicable to any unexpected finds relating to potentially contaminated soils (associated with any historical uncertainty) that may be encountered during excavation works within the entire Site. The protocol is as follows:

1. The contractor(s) undertaking any remediation, civil or construction works will be provided with a copy of the RAP, including this UFP. The contractor(s) will nominate their site (project) manager who will be responsible for implementing the UFP;
2. Upon discovery of suspected contaminated material, the site (project) manager is to be notified and the affected area closed off by the use of barrier tape and warning signs (if appropriate) and sediment controls. Warning signs shall be specific to the findings and potential hazards and shall comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;
3. A qualified environmental consultant is to be notified by the site manager to inspect the area and confirm the presence or otherwise of hazards or contamination, and to determine the method and extent of investigation or remediation works to be undertaken. A report detailing this information

will be compiled by the environmental consultant and provided to the site manager, who will disseminate to the Principal (or their representative) and the site auditor;

4. All work associated with the contaminated soil will be undertaken by an appropriately licensed contractor, as stipulated by the environmental consultant;
5. All works must comply with the provisions of the relevant legislation and guidelines;
6. Documentary evidence (weighbridge dockets) of appropriate disposal of the material is to be provided to the Principal (or their representative) if disposal occurs;
7. Details of all relevant activities are to be recorded in the site record system; and
8. Details of the remediation and validation works undertaken with respect to the unexpected find must be incorporated into al Validation Assessment Report prepared by a suitably qualified environmental consultant.

10.2 Contaminated Soil Identified in Data Gap Assessment

In the event that the data gap investigation identified contaminated soil that exceeds the RAC the following procedure will be adopted:

- Step out test bores / pits will be undertaken to determine the extent of contamination / remedial excavation required. Initially step out samples will be undertaken 2 m from the identified contamination hotspot;
- Once the extent of the contaminated soil is identified excavation and disposal of the contaminated soil will be the preferred option where practical (where small volumes of contaminated soil is expected);
- If significant soil contamination is identified then groundwater investigation may be required. If necessary, groundwater monitoring wells would be installed. Groundwater samples will be analysed for the identified contaminants of concern, or a minimum of analytical requirement including PAH, TRH, BTEX, VOC and heavy metals;
- The contaminated soil will be excavated and stockpiled per the requirements of Section 12.3 for off-site disposal. The excavated material will be subject to waste classification assessment in accordance with the NSW Waste Classification Guidelines 2014 (NSW EPA 2014); and
- Following the removal of the removal of contaminated material the remedial excavation will be subject to validation testing in accordance with the below validation testing programme.

The following validation testing programme must be adopted following the removal of the contaminated soil:

- 1 validation sample per 50 m^2 of the excavation base (or a minimum of one sample of the excavation base);
- 1 validation sample per 10 m of the excavation wall (or a minimum of one sample per excavation wall), and one sample per vertical metre;
- Additional validation samples must be collected from any fill soil retained on site at a rate of 1 sample per 25 m^3 (or minimum 3 samples);

- Validation samples will be analysed at a NATA accredited laboratory for contaminant of concern identified in the data gap assessment; and
- In addition to the above, if fill soils are retained on-site that exceed the RAC additional TCLP and Australian Standard Leaching Procedure (ASLP) analysis for heavy metals and PAH (plus any additional contaminants of concern identified) on the retained fill at a rate of 1 sample per 25 m^3 (or minimum 3 samples) to confirm that the risk to groundwater in low.

QA/QC testing in conjunction with must also be undertaken per Section 9.4.3.

10.3 Discovery of Underground Storage Tanks

In the event that an underground storage tank (UST) is unexpectedly discovered during site excavation works the following procedure should be adopted.

1. Works in the area should cease and the Site Manager informed. The area should be closed off by the use of barrier tape and warning signs that comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;
2. Prior to the removal of a UST, any residual product (liquid/vapour) will be removed from the tank and disposed of appropriately in accordance with Australian Standard (AS 4976 – 2008 *The Removal and Disposal of Petroleum Underground Storage Tanks*). Records of disposal should be provided for the validation report;
3. The UST will be exposed and examined for potential leaks and general condition. A suitably qualified environmental consultant should be engaged to inspect the UST prior to its removal;
4. The UST will be removed and the structures disposed of by a qualified contractor in accordance with AS 4976 – 2008. Disposal records should be provided to the environmental consultant for inclusion in the validation report;
5. All associated infrastructure (i.e. the remnants including fuel lines etc.) will be removed and disposed in a similar manner if present;
6. Excavate and stockpile impacted materials (based on field observations to the practical extent possible based on structural engineers recommendations and materials backfilled around the tank for classification. Materials which meet the remediation criteria in the RAP can be retained on site. Materials that fail the remediation criteria in the RAP will require off-site disposal to a licensed landfill unless otherwise advised by the environmental consultant. Land farming of impacted soils may be considered upon further advice from the environmental consultant based on the nature and extent of impacted soils;
7. Collect validation samples from the tank pit at a minimum rate of one location per side wall or one sample per soil type and at the depth of observed groundwater, whichever is the greater and at least one sample in the excavation base. Note that the actual number of samples may vary depending on the size of the tank pit excavation and the degree of contamination, the soil profile encountered and the presence of groundwater;
8. Collect validation samples below the fuel lines (following removal). Validation samples should be collected at a rate of one sample per 5 m linear metres of the fuel lines;
9. The validation samples will be analysed at a NATA accredited laboratory for the following analytical scope; Total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons

(PAH), monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX), lead and volatile organic compounds (VOC). Additional analysis may be required as advised by the environmental consultant based on the contents of the tank;

10. Excavated material from the tank pits/fuel line will be placed into a stockpile for assessment for potential reuse and/or waste classification as appropriate. If excavated soils exhibit signs of contamination during excavation (such as hydrocarbon odours or staining) then the soil should be segregated from soils that are not impacted into a separate stockpile and placed on impermeable surface (concrete or plastic) and bunded to prevent leachate generation. Measures to prevent sedimentation should also be put in place (see S.12.3). All stockpile samples will be analysed for heavy metals, PAH, TPH, BTEX, phenols, polychlorinated biphynels (PCB), organochlorine pesticides (OCP) and asbestos (to determine if the materials are suitable to be retained on site and/or disposed to landfill;
11. If water is encountered in the pit, a grab sample will be collected. The grab sample will be analysed for heavy metals, TPH, BTEX, PAH, VOC and hardness;
12. If a groundwater contaminant risk is identified then groundwater investigation may be required. If necessary, groundwater monitoring wells would be installed. Groundwater samples will be analysed for PAH, TRH, BTEX, VOC and heavy metals; and
13. A UPSS validation report will be prepared by a suitably qualified environmental consultant in accordance with the *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (UPSS Regulation)* under the POEO Act 1997.

10.4 Waste Exceeding the Disposal Threshold

If spoil is assessed to have exceeded the threshold criteria for disposal as Restricted Solid Waste (as defined in EPA 2014) and cannot be directly disposed off-site, these materials will be held on site pending the determination of alternative disposal arrangements.

The contingency plan to manage contaminated spoil materials that fails to meet the above criteria is therefore as follows:

1. Excavated material which cannot be disposed in a landfill directly i.e. those which are awaiting TCLP results or which fail the combined specific concentration and TCLP test, or require storage pending treatment will be placed in separate demarcated stockpiles.
2. Disposal arrangements will be determined based on sampling results as follows:-
    - Material which meets the disposal levels of EPA (2014) shall be collected and disposed directly to a landfill;
    - Material which exceeds the disposal guideline levels shall be tested for TCLP. If the TCLP and total concentration are within the disposal requirements of General Solid Waste or Restricted Solid Waste, the materials will be dispatched off-site. Materials which fail the criteria will be segregated into separate stockpiles for alternate disposal arrangements; and
    - Those materials which exceed the leachability criteria for landfill disposal, shall be stockpiled separately on impermeable surface and bunded to prevent leachate generation and be subject to further treatment.

3. Consent as to the appropriateness of the treatment and disposal method for materials exceeding the leaching guidelines may need to be obtained from the NSW EPA, and if required a disposal consent must be sought from the Authority prior to the removal of such wastes from the site.

10.5 Unexpected Asbestos Finds Protocol

It is possible that asbestos-based materials may be uncovered. In the event that this occurs the following 'Unexpected Asbestos Finds Protocol' has been established:

1. Upon discovery of suspected asbestos containing material, the site manager is to be notified and the affected area closed off by the use of barrier tape and warning signs. Warning signs shall be specific to asbestos hazards and shall comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;
2. An Occupational Hygienist is to be notified to inspect the area and confirm the presence of asbestos (and type of asbestos) and determine extent of remediation works to be undertaken. A report detailing this information will be compiled by the Occupational Hygienist and provided to the site manager;
3. The impacted soil will be stockpiled for waste classification purposes (including sampling and chemical analysis) and will be disposed of, as a minimum, as asbestos waste at an appropriately licensed solid waste landfill site. In dry and windy conditions the stockpile will be lightly wetted and covered with plastic sheet whilst awaiting disposal;
4. All work associated with asbestos in soil will be undertaken by a contractor holding a class AS1 Licence and all workers working in the asbestos impacted zone must meet the following minimum PPE requirement (unless otherwise advised by the hygienist):
    - Steel-capped lace-less boots;
    - Hard hat meeting AS1801-1981 and AS/NZS 1801:1997/Amdt 1:1999 requirements;
    - High visibility clothing;
    - Half-face P2 rated respirator or similar;
    - Disposable full length body coveralls with elasticated hood and cuffs (Tyvek suit or equivalent); and
    - Gloves.
5. Monitoring for airborne asbestos fibres is to be carried out during the soil excavation. Asbestos air monitoring will be undertaken in accordance with *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition* [NOHSC: 3003 (2005)] and sampling density and locations will be determined by the Occupational Hygienist. All filters will be submitted to a NATA accredited laboratory for analysis. Air samples will be collected from the breathing zone of a person, over a minimum of four hours duration;
6. Documentary evidence (weighbridge dockets) of correct disposal is to be provided to the construction manager;
7. At the completion of the excavation, a clearance inspection is to be carried out and written certification is to be provided by the Occupational Hygienist that the area is safe to be accessed and worked. Clearance will include soil samples and asbestos analysis. If required, the filling

material remaining in the inspected area can be covered/sealed by an appropriate physical barrier layer of non-asbestos containing material prior to sign–off;

8. Details of the incident are to be recorded in the site record system; and
9. The area may be reopened for further excavation or construction work.

An Asbestos Work Health and Safety Plan (Appendix C) has also been prepared to assist with potential asbestos works.

10.5.1 Asbestos Validation Testing of Fill Soils

In the event that asbestos contaminated soils are identified and removed from the site within the site, following remedial excavations additional validation sampling will be undertaken for asbestos assessment:

- 1 sample per 25 m^2 of the excavation base where fill is present (or a minimum of one sample of the excavation base); and 1 sample per 10 m of the excavation wall (or a minimum of one sample per excavation wall), and one sample per vertical meter and / or at changes in strata;

Or

1 sample per 25 m^3 with a minimum of three samples whichever is the greater sampling density.

Each sample will include:

- One, 500 ml sample to be tested for asbestos fines / asbestos fibres (AF / FA) as defined in NEPC (2013); and
- One, 10L sample to be sieved on site through a 7 mm sieve to determine the ACM content.

Where encountered the state of the asbestos find must be assessed to determine if asbestos is present as ACM or FA/AF.

10.6 On-Site Capping of Contaminated Material

Under certain circumstances capping and on-site containment of contaminated soil may be considered. Where contaminated soil is capped on site the capping layer should consist of a brightly coloured geotextile marked layer and either a 150 mm concrete pavement or a 500 mm of clean validated soil (that meets the remediation action criteria).

Alternatives may be considered on a case by case basis subject to the approval of the environmental consultant (such as amongst the root base of established trees).

Where contaminated soils are to capped on-site the potential risk to groundwater must be considered (with the exception of asbestos contamination). In this regard leachability analysis of the contaminant of concern must be undertaken. Where leachable concentrations are detected during above the TCLP1 criteria then a groundwater investigation may also be required.

If necessary groundwater monitoring wells would be installed. Groundwater samples will be analysed for the identified contaminants of concern, or a minimum of analytical requirement including PAH, TRH, BTEX, VOC and heavy metals.

A detailed sampling analysis quality plan (SAQP) must be prepared prior to undertaking groundwater investigation works (if deemed necessary). QA/QC requirements and sampling techniques will be detailed in the SAQP.

10.7 Validation Report

In the event that remedial works are deemed necessary as a result of unexpected finds or the findings of the data gap assessment a validation assessment report will be prepared for the site by the Environmental Consultant in accordance with relevant EPA Guidelines. The validation report shall detail the methodology, results and conclusion of the assessment, provide waste classification and disposal information, and make a clear statement regarding the suitability of the site for the proposed land use.

11. Asbestos Work Health and Safety Plan

In the event that asbestos contaminated soils are encountered the asbestos work health and safety plan must also be adopted as shown in Appendix C.

12. Spoil and Environmental Management Plan

12.1 Overview

The work shall be undertaken with all due regard to the minimisation of environmental impacts and to meet all regulatory requirements. The Principal Contractor shall have in place a Construction Environmental Management Plan (CEMP) detailing how the works are to comply with the requirements of relevant legislation.

The contractor shall also be responsible to ensure that the site works comply with the following conditions:

- Wastes arising at the site are disposed in an appropriate manner;
- Fugitive dust potentially leaving the confines of the site is managed appropriately;
- No water containing any suspended matter or contaminants leaves the site in a manner which could pollute the environment; and
- Vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas.

12.2 Hours of Operation

All work should be conducted within the hours specified by the local council and appropriate development conditions.

12.3 Stockpiling of Contaminated Material

It is anticipated that stockpiles will be temporarily placed on the site during remediation works prior to any of the materials being loaded onto trucks for disposal or reused to backfill remedial excavations. Any stockpiles placed on the site must be managed to minimise the risk of dust generation, erosion and leaching. The measures required to achieve this will depend on the stockpile material and the amount of time the stockpile remains on site. Measures should include:

- Restriction of the height of stockpiles (less than 3 m) to reduce dust generation;
- Implementation of control measures for sediment and erosion;
- Temporary stockpiles should be kept moist by using water spray (where required); and
- Stockpiles from different parts of the site should be clearly segregated and placed on plastic / pavements and separated with bunds to avoid cross-contamination.

Should the stockpile remain on site for over 8 hours, geotextile silt fences or hay bales should be erected around each stockpile/ the stockpile area to prevent any egress of contaminated fill by surface erosion, and an appropriate cover must be maintained on all excavated filling stockpiles.

Wherever possible, excavated spoil materials will be excavated and placed as separate stockpiles at demarcated and contained locations to maintain clear and distinct segregation of the stockpiles.

12.4 Loading and Transport of Contaminated Material

Should site restrictions necessitate that some stockpiles of contaminated waste must be removed from site then transport of all material to and from the site shall be via a clearly delineated, pre-defined haul route.

Removal of waste materials (including excavated filling) from the site shall only be carried out by a licensed contractor holding appropriate licences, consents or approvals as required by, and with the appropriate approvals obtained from NSW EPA and SafeWork NSW, if required.

The work will be conducted such that all site vehicles:

- Conduct deliveries during the specified hours of works, or in accordance with Roads and Maritime Services as appropriate;
- Are securely covered to prevent spillage and dust emissions;
- Are securely sealed to prevent any dust or odour emissions during transportation (transport of asbestos contaminated filling);
- Are decontaminated prior to leaving the site to ensure spoil is not tracked/ spilled onto public roads or footpaths; and

- Exit the site in a forward direction where possible.

Details of all soils removed from the site (including VENM) shall be documented by the Contractor in accordance with regulatory requirements and Section 11.

12.5 Waste Classification and Off-Site Disposal

Any fill soils disposed off-site must be consigned to an appropriately licensed landfill facility. All off-site disposal of wastes, where required, will be undertaken in accordance with the POEO Act.

Any stockpiled soils removed from the site will be classified in accordance with either:

- The NSW EPA *Waste Classification Guidelines 2014*; or
- A General or Specific Exemption under the *Protection of the Environment Operations (Waste) Regulation* 2005.

No soils will leave the site without a formal waste classification.

All transport of waste and disposal of materials must be conducted in accordance with the requirements of the POEO Act. All licences and approvals required for disposal of the material will be obtained prior to removal of the materials from the site.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification and the corresponding requirements outlined in the NSW EPA Waste Classification Guidelines 2014, and with the appropriate approvals obtained from the EPA, if required including where required utilising WasteLocate.

Details of all soils removed from the site (including Virgin Excavated Natural Material - VENM) shall be documented by the Contractor with copies of the receiving site environmental management plan (EPL), weighbridge slips, trip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and the PR. A site log shall be maintained by the Contractor to track disposed loads against on-site origin.

Transport of spoil shall be via a clearly delineated, pre-defined haul route. The proposed waste transport route will be notified to the local Council and truck dispatch shall be logged and recorded by the Contractor for each load leaving the Site. A record of the truck dispatch will be provided to the PR.

12.6 Disposal of Material

All materials removed from the site (if any) shall be disposed to a location legally allowed to receive them in accordance with the POEO Act.

12.7 Imported Materials

Materials imported to the site to backfill the site (where required) must be virgin excavated natural material (VENM), excavated natural material (ENM) or other certified materials such as topsoil (not recycled or blended product), mulch (not recycled or blended product) or quarry won products (such as gravel) from a reputable supplier.

The source site must provide VENM / ENM reports which must be provided to the environmental consultant for review and approval prior to importation of the material. If the VENM / ENM reports do not meet the satisfaction of the Environmental Consultant the source site may be rejected or additional analysis requested.

In addition upon receipt of the material a minimum of three check samples (per source site) of the imported material must be collected and analysed for heavy metals, TRH, PAH, OCP, PCB, BTEX, phenols and asbestos.

In addition to VENM / ENM soils meeting the NSW EPA definition of VENM / ENM (including any testing requirements), the analytical results must also meet the RAC provided in Section 7.

Other imported products such as gravel, topsoil and mulch must be either clean, virgin products (i.e. quarried natural stone, VENM classified topsoil, or documented mulching of specific trees) or documented by the supplier as being compliant with a relevant Resource Recovery Order (RRO).

It is highly recommended that no recycled or blended product is used given the risk of asbestos containing materials in such products. Should such products be proposed for use, apart from being required to comply with the relevant RRO, the Environmental Consultant will conduct a more rigorous validation process including:

- A visit to the source site;
- Thorough review of the reports provided confirming compliance with a RRO;
- Inspection of the imported product;
- Verification sampling of the imported product at a rate of at least 1 sample per 25 m^3; and
- Analysis of the verification samples for the contaminants of concern (determine by the source and the information provided in the RRO compliance documentation). Asbestos will be analysed as a minimum for all incoming products.

QA/QC testing must be undertaken in accordance with Section 9.4.3.

12.8 Dust Control

Dust emissions should be confined within the site boundary. The following dust control procedures will be employed to comply with this requirement as necessary:

- Ceasing works during periods of high winds;
- Erection of dust screens around the perimeter of the site;
- Securely covering all loads entering or exiting the site;

- Use of water sprays across the site to suppress dust;
- Covering of all excavated filling stockpiles remaining onsite more than 8 hours;
- Keeping excavation and stockpile surfaces moist; and
- Regular checking of the fugitive dust to ensure compliance. Immediate implement measures to rectify any cases of fugitive dust.

12.9 Odour Control

No odours should be detected at any boundary of the site during works by an authorised Council Officer relying solely on sense of smell. The following procedures should be employed to comply with this requirement as required:

- Use of appropriate covering techniques such as plastic sheeting, polythene or geotextile membranes to cover excavation faces or stockpiles which exhibit odour;
- Fine spray of water on any impacted areas/materials;
- Restriction of uncovered stockpile heights to 2 m above surrounding site level;
- Adequate maintenance of equipment and machinery to minimise exhaust emissions; and
- Regular checking for potential odour issues and implementing remedial measures if odour is detected.

12.10 Contingency Plans to Respond to Site Incidents

The key to effective management of incidents is the effectiveness of the preventative actions taken before any situation reaches a reportable or critical level. Therefore, monitoring and surveillance activities are extremely important, and should be conducted for the measures prescribed herein, and any other measures prescribed in any additional environmental management plan developed subsequently. During construction activities on the site, the following inspection or preventative actions should be performed by the main contractor:

- Inspection of works;
- Completion of routine environmental checklists and follow-up of non-compliance situations;
- Maintenance of supervision on site; and
- An induction process for all site personnel that includes relevant information on environmental requirements, and ensures that all site personnel are familiar with the site emergency procedures.

Appropriate materials such as oil spill kits, absorbent materials, sand bags and flocculating agents will be kept on-site at all times. Auxiliary dust control measures should also be in place in case of excess dust generation.

The Principal's site foreman will be responsible for initiating an immediate emergency response using the resources available on the site. Where external assistance is required, the relevant emergency services will be contacted. A table such as that below, containing contact details for key personnel who may be involved in an environmental emergency response should be completed and be readily

available to personnel at all times. The table should be completed, and thereafter amended as required.

Name	Contact Details
Emergency Services: **Fire Brigade, Ambulance and Police**	
Nearest Doctor's Surgery	
Nearest Medical Centre	
Nearest Hospital	
NSW EPA	
Randwick Council	
Water Authority	
Energy Australia	
Waste Disposal and spill clean-up services	
Neighbours	

Note: **This table should be completed** by the contractor prior to commencement of works and, subsequently, regularly updated.

13. Conclusion

It is considered that the site can be made suitable for the proposed development subject to the implementation of this RAP.

14. Limitations

Douglas Partners (DP) has prepared this report for University of New South Wales, High Street, Kensington in accordance with DP's proposal dated 18 June 2018, and acceptance from the University of New South Wales. This report is provided for the exclusive use of The University of New South Wales (the development and applicant) and Lendlease (Design and Construct Partner) for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to access constraints (as discussed above), or to parts of the site being inaccessible and not available for sampling, or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

Drawings

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

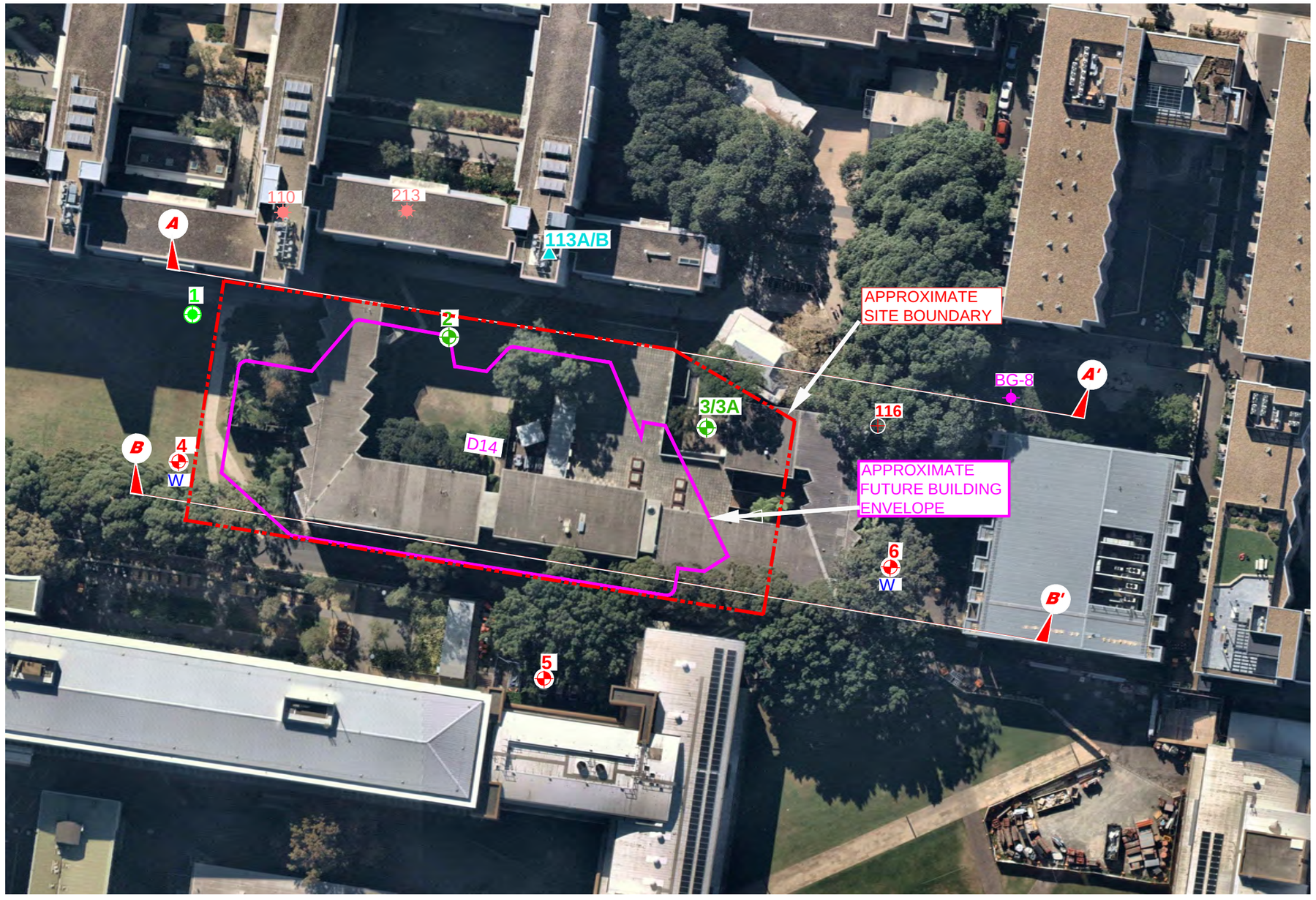
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

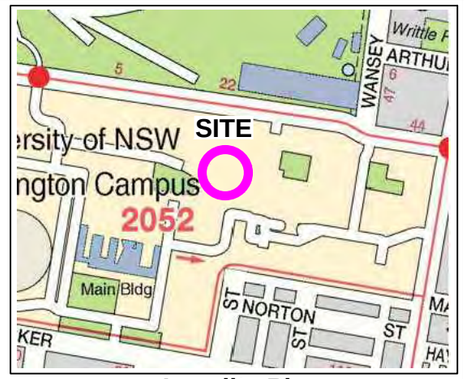
Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.





Locality Plan

LEGEND

PREVIOUS INVESTIGATION

- Borehole (Coffey)
- Borehole (DP Proj. 44301)
- CPT (DP Proj. 44301)
- Borehole and CPT (DP Proj. 44301)

CURRENT INVESTIGATION

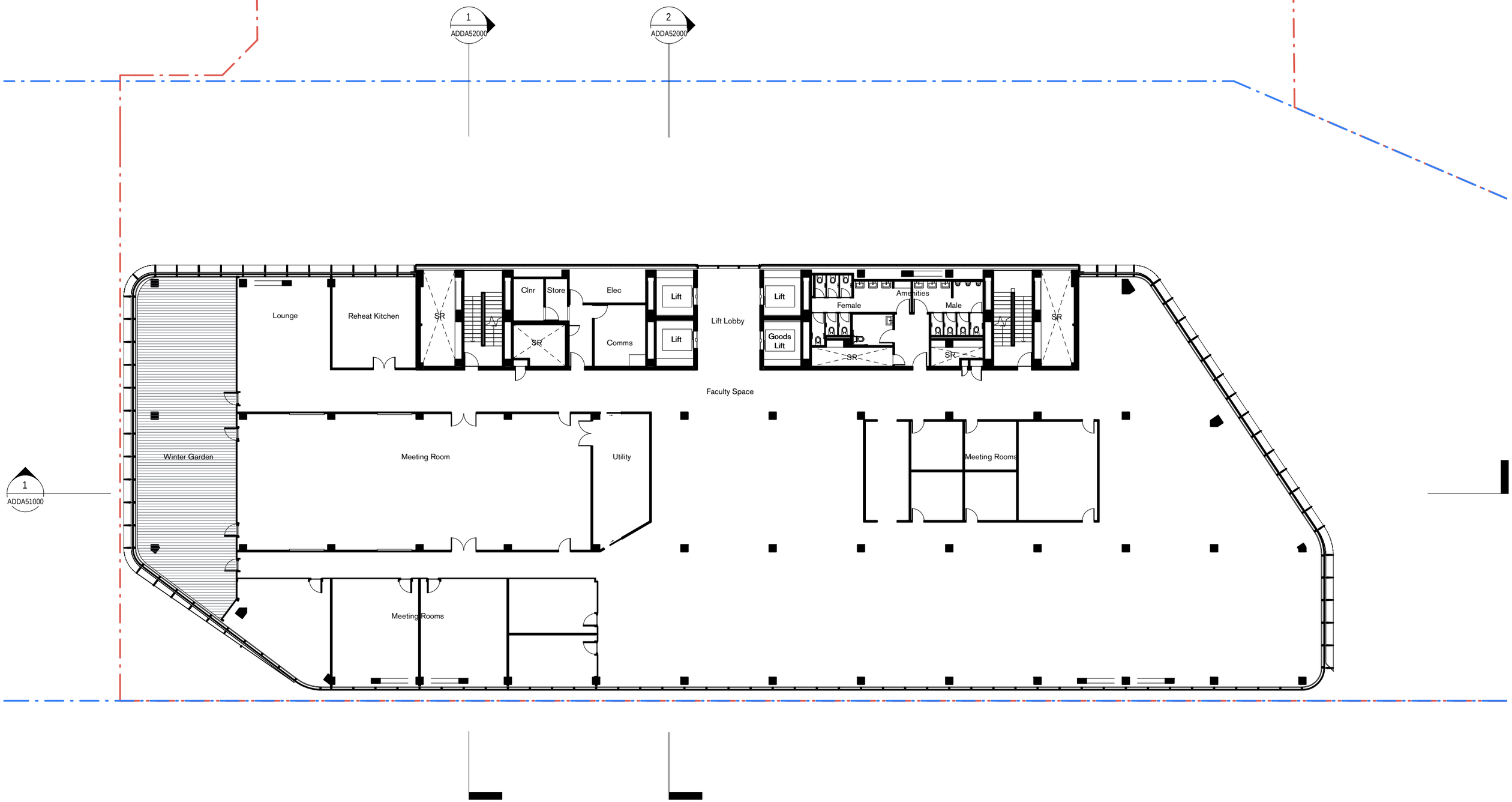
- CPTu & contamination borehole
- Contamination borehole
- W CPTu, cored borehole and well
- CPTu and cored borehole
- A A' Geotechnical Cross Section A-A'

NOTE:
1: Base image from Nearmap.com (Dated 5.5.2018)
2: Test locations are approximate only and are shown with reference to existing features.

0 5 10 15 20 30 40 60 80m
1:800 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: University of New South Wales		TITLE: **Test Location Plan**	PROJECT No: 86457.00
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed UNSW D14 Building**	DRAWING No: 1
SCALE: 1:800 @ A3	DATE: 2.11.2018	**High Street, KENSINGTON**	REVISION: 1



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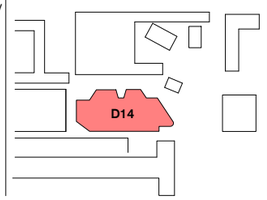
Jonathan Evans 6613
Mladen Pnjatovic 7468
Ben Green 7066
Chi Melhem 7754

Rev	Date	For
01	24.10.18	Draft SSDA
02	02.11.18	Draft SSDA
03	07.11.18	Draft SSDA
04	08.11.18	SSDA Submission

Legend

- Project Boundary
- Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect Tzannes

Scale 1 : 250 @ A3

0 2.5 5 7.5 m

North

Project UNSW D14 Academic Building

Address UNSW Kensington Campus

Status PLANNING APPLICATION

Drawing Level 7 Plan

Date 08.11.18

Project No. 18026

Drawing No. ADDA20700

Revision 04

UNSW D14 ACADEMIC BUILDING PLANNING APPLICATION

DRAWING LIST

Drawing Number	Drawing Title
ADDA00000	Cover Sheet
ADDA00001	Location Plan Lower Campus
ADDA00002	Site Plan
ADDA20000	Ground Plan
ADDA20M00	Upper Ground Plant
ADDA20100	Level 1 Plan
ADDA20200	Level 2 Plan
ADDA20300	Level 3-6 Plan
ADDA20700	Level 7 Plan
ADDA20800	Plant Plan
ADDA29000	Roof Plan
ADDA30000	GFA Randwick Schedule
ADDA41000	Elevation South
ADDA42000	Elevation West
ADDA43000	Elevation North
ADDA44000	Elevation East
ADDA51000	Section E-W
ADDA52000	Section N-S
ADDA90000	Materials & Finishes Schedule
ADDA99000	Shadow Diagram Winter
ADDA99010	Shadow Diagram Winter
ADDA99020	Shadow Diagram Winter
ADDA99030	Shadow Diagram Winter

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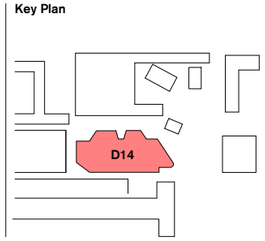
03	07.11.18	Draft SSDA
04	08.11.18	SSDA Submission

Legend

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect

Tzannes

Scale

@ A3

North

Project
UNSW D14 Academic Building

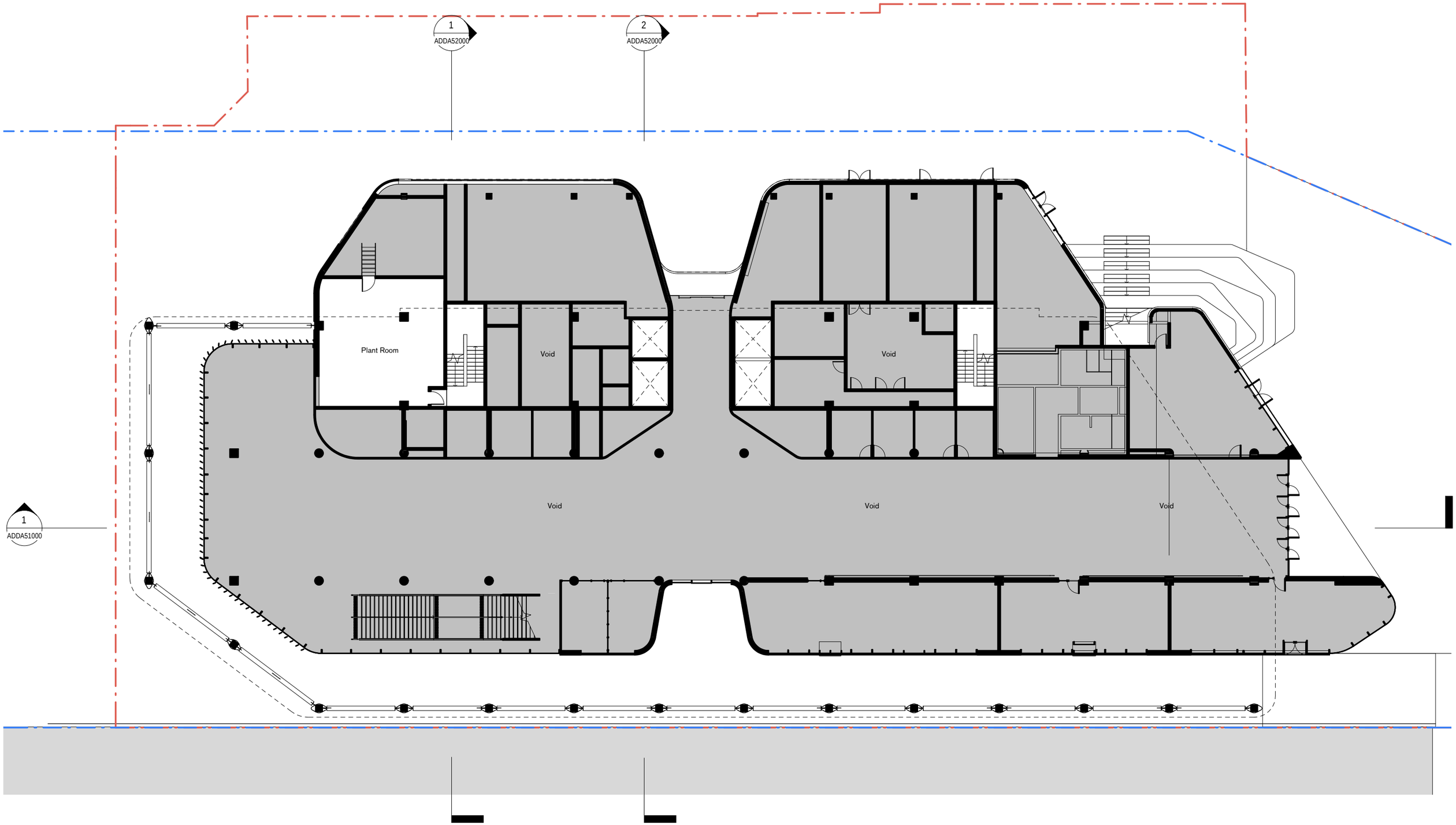
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Cover Sheet

Date
08.11.18

Project No.	Drawing No.	Revision
18026	ADDA00000	04



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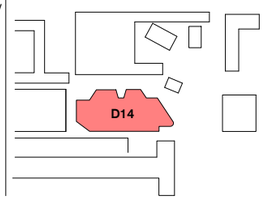
04	08.11.18	SSDA Submission

Legend

Project Boundary
Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

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Architect

Tzannes

Scale 1 : 250 @ A3

North

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

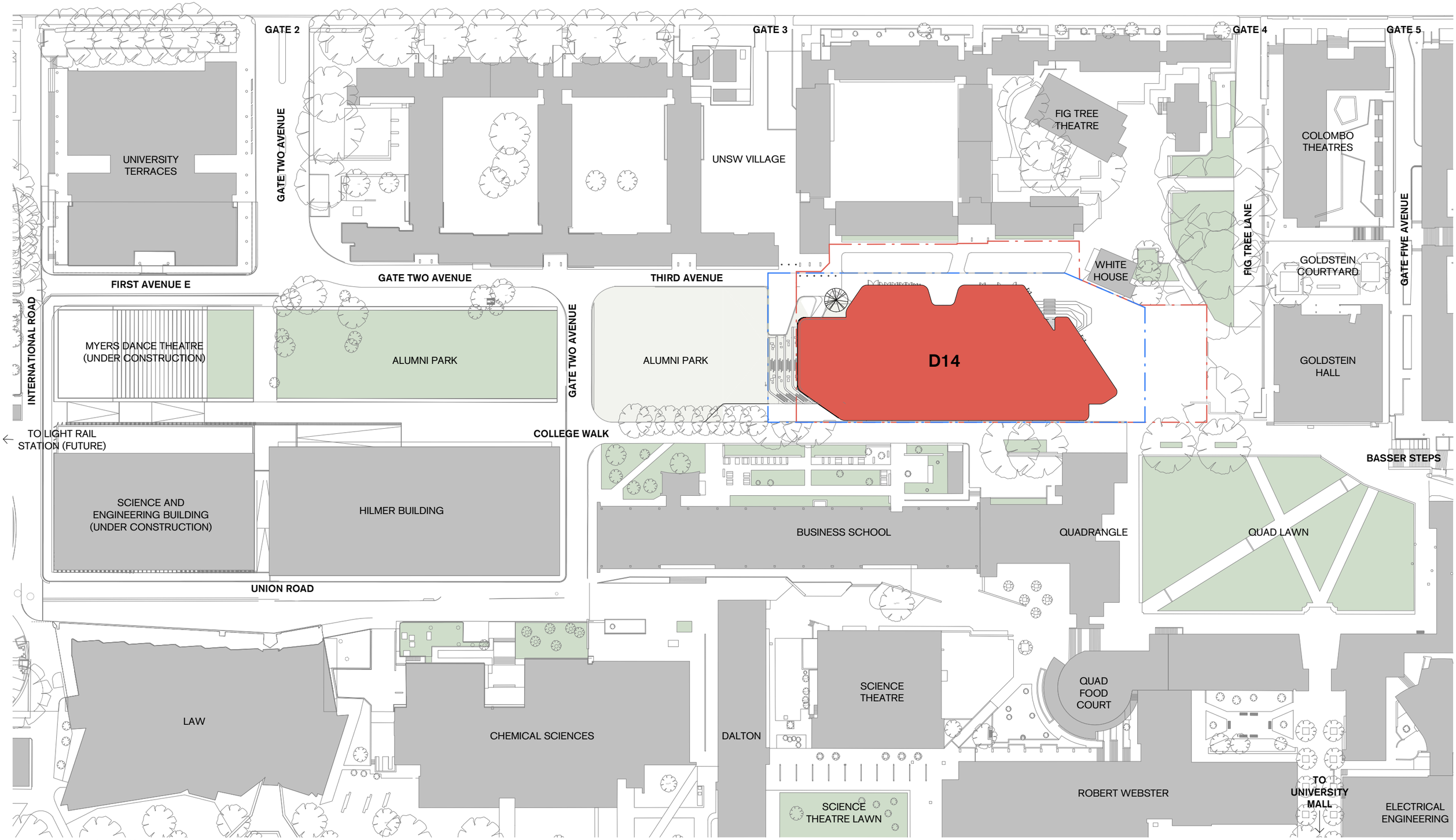
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Upper Ground Plant

Date
08.11.18

Project No. 18026
Drawing No. ADDA20M00
Revision 04



1 | Location Plan
1 : 1000

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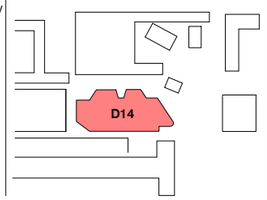
Legend

- Project Boundary
- Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

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Architect Tzannes

Scale As indicated @ A3

North

0 10 20 30 m

Project
UNSW D14 Academic Building

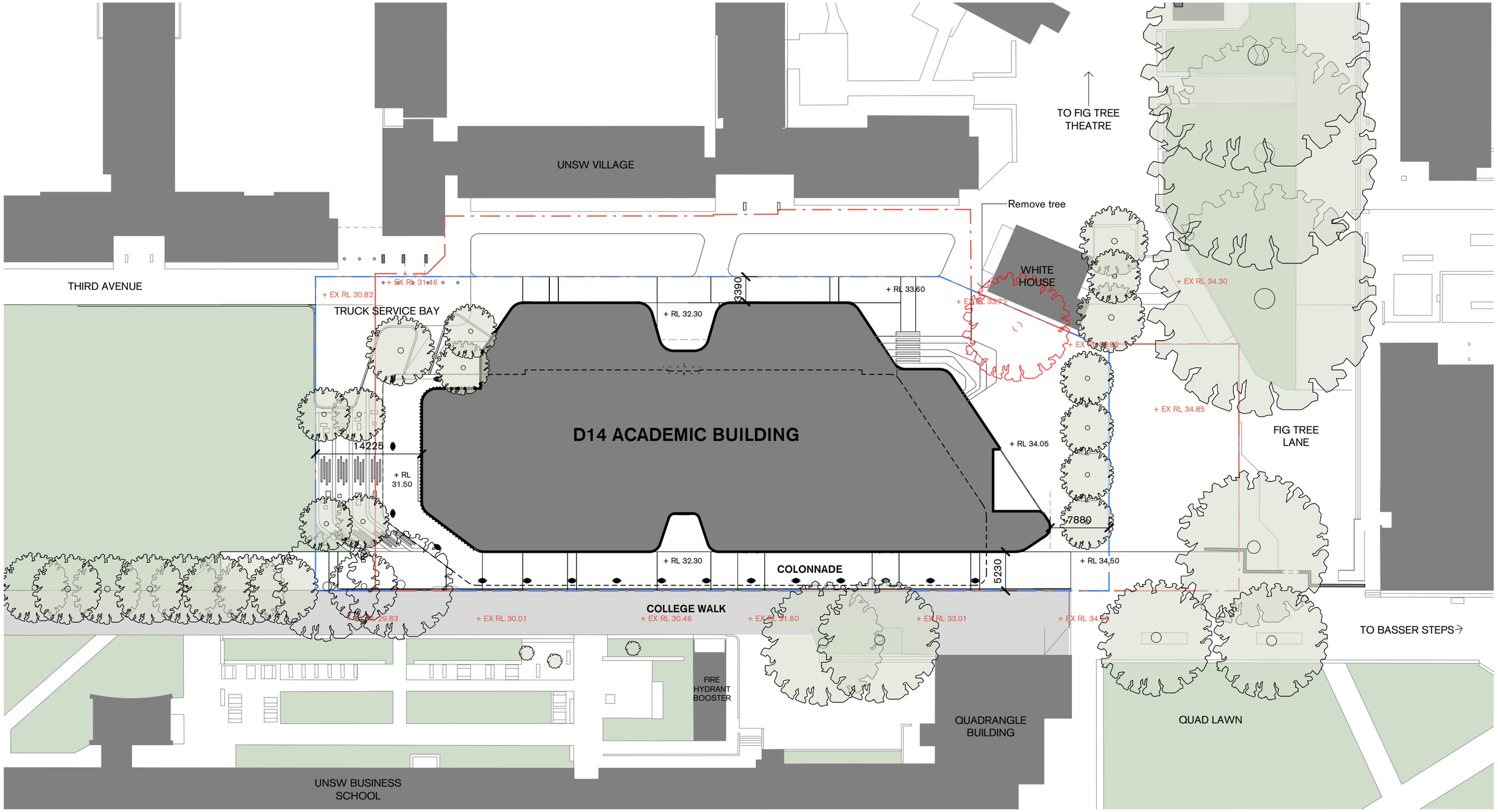
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Location Plan Lower Campus

Date
08.11.18

Project No. 18026
Drawing No. ADDA00001
Revision 04



1 | Site Plan
1 : 500

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01	24.10.18	Draft SSDA
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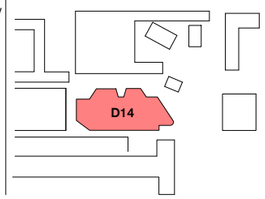
03	07.11.18	Draft SSDA
04	08.11.18	SSDA Submission

Legend

Project Boundary
Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

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Architect Tzannes

Scale As indicated @ A3

North

0 5 10 15 m

Project UNSW D14 Academic Building

Address UNSW Kensington Campus

Status PLANNING APPLICATION

Drawing Site Plan

Date 08.11.18

Project No. 18026

Drawing No. ADDA00002

Revision 04

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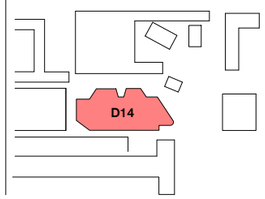
04	08.11.18	SSDA Submission

Legend

Key Plan



Owner and Applicant

UNSW SYDNEY

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Architect

Tzannes

Scale North

1 : 250 @ A3

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

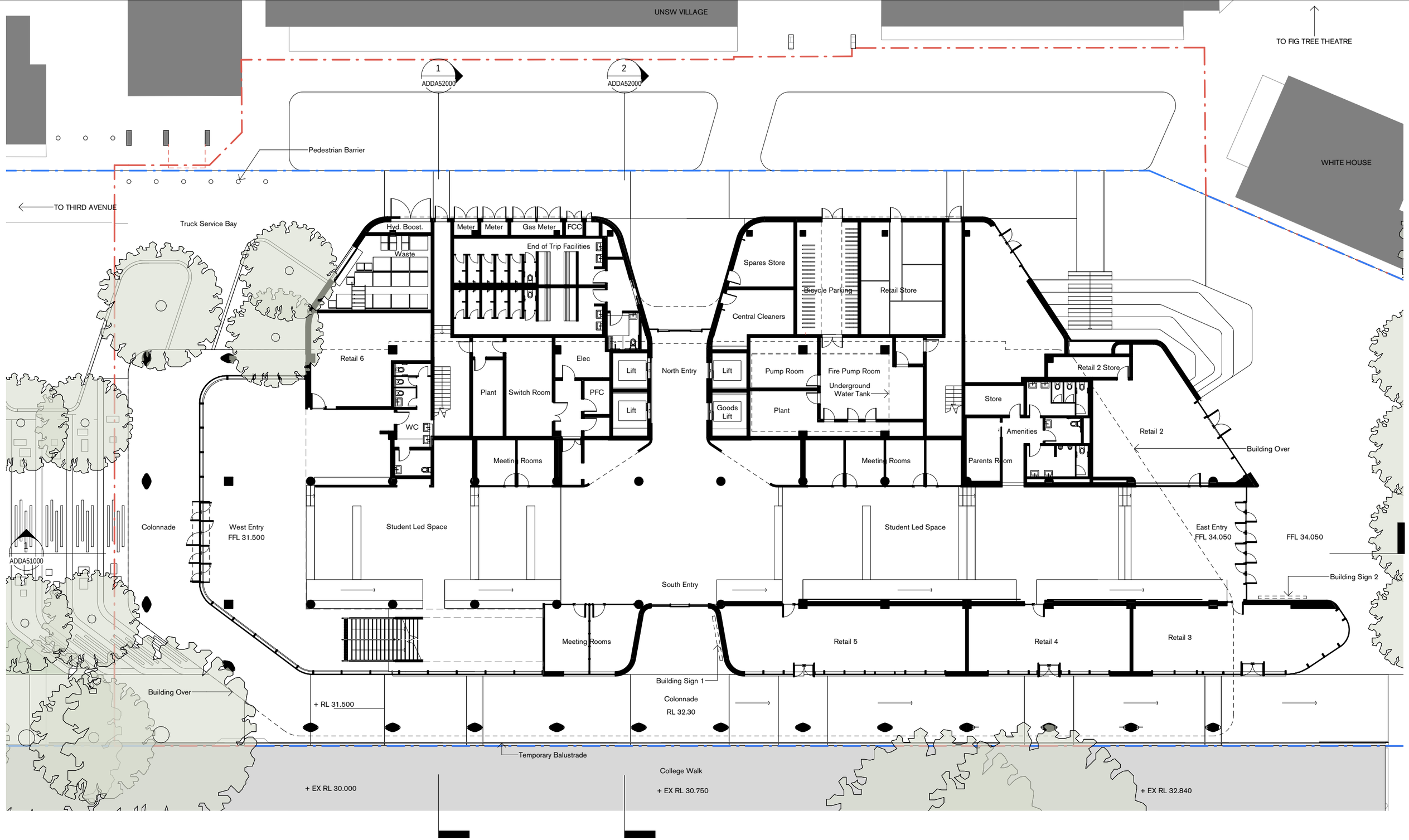
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Elevation North

Date
08.11.18

Project No.	Drawing No.	Revision
18026	ADDA43000	04



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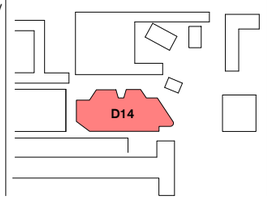
Legend

- Project Boundary
- Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect Tzannes

Scale 1 : 250 @ A3

North

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

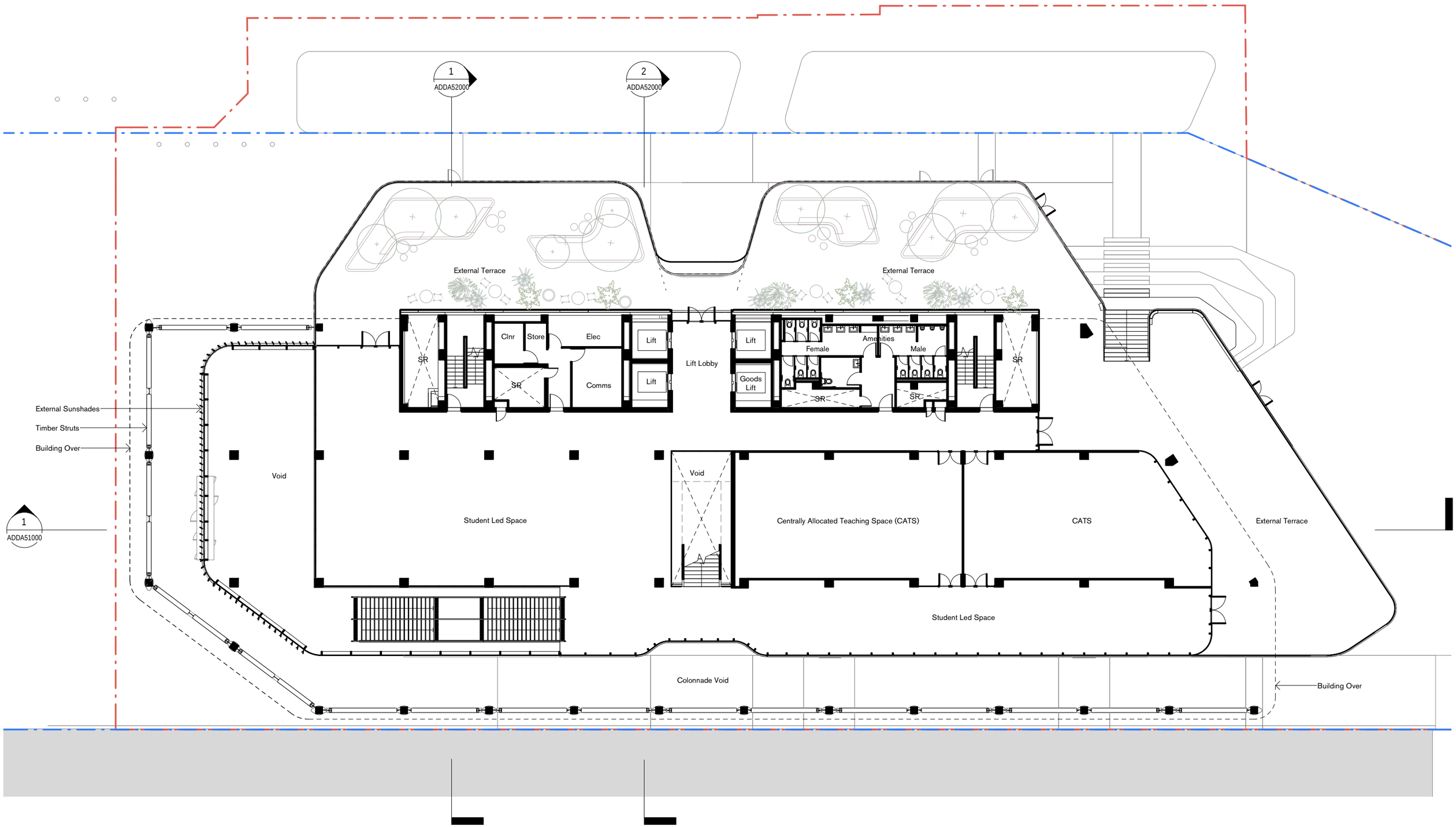
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Ground Plan

Date
08.11.18

Project No.	Drawing No.	Revision
18026	ADDA20000	04



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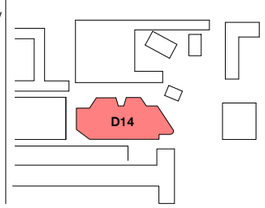
Legend

Project Boundary
Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

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Architect

Tzannes

Scale

1 : 250 @ A3

0 2.5 5 7.5 m

North

Project
UNSW D14 Academic Building

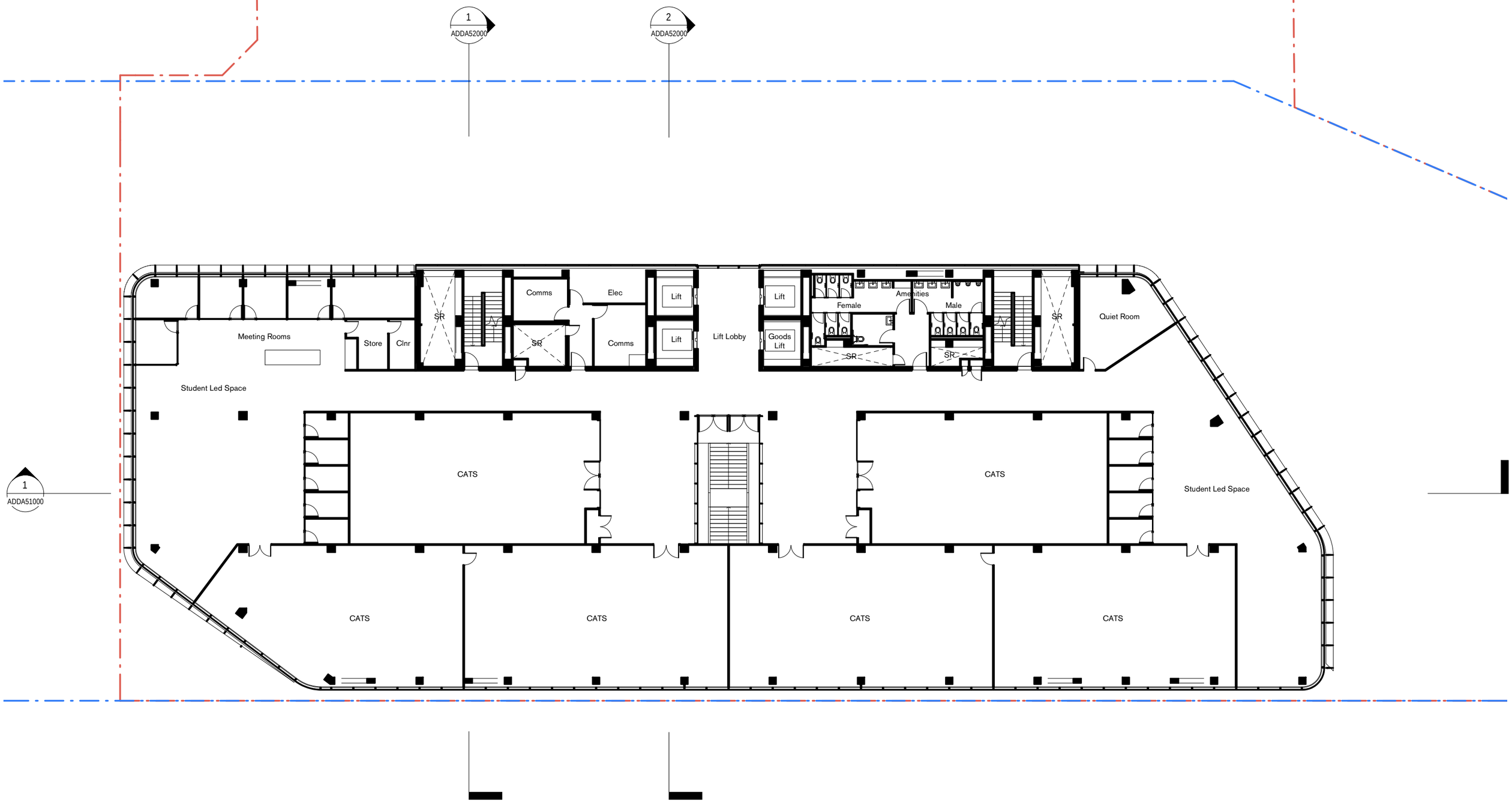
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Level 1 Plan

Date
08.11.18

Project No.	Drawing No.	Revision
18026	ADDA20100	04



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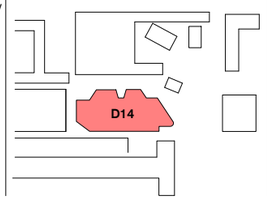
Legend

- Project Boundary
- Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect Tzannes

Scale 1 : 250 @ A3

North

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

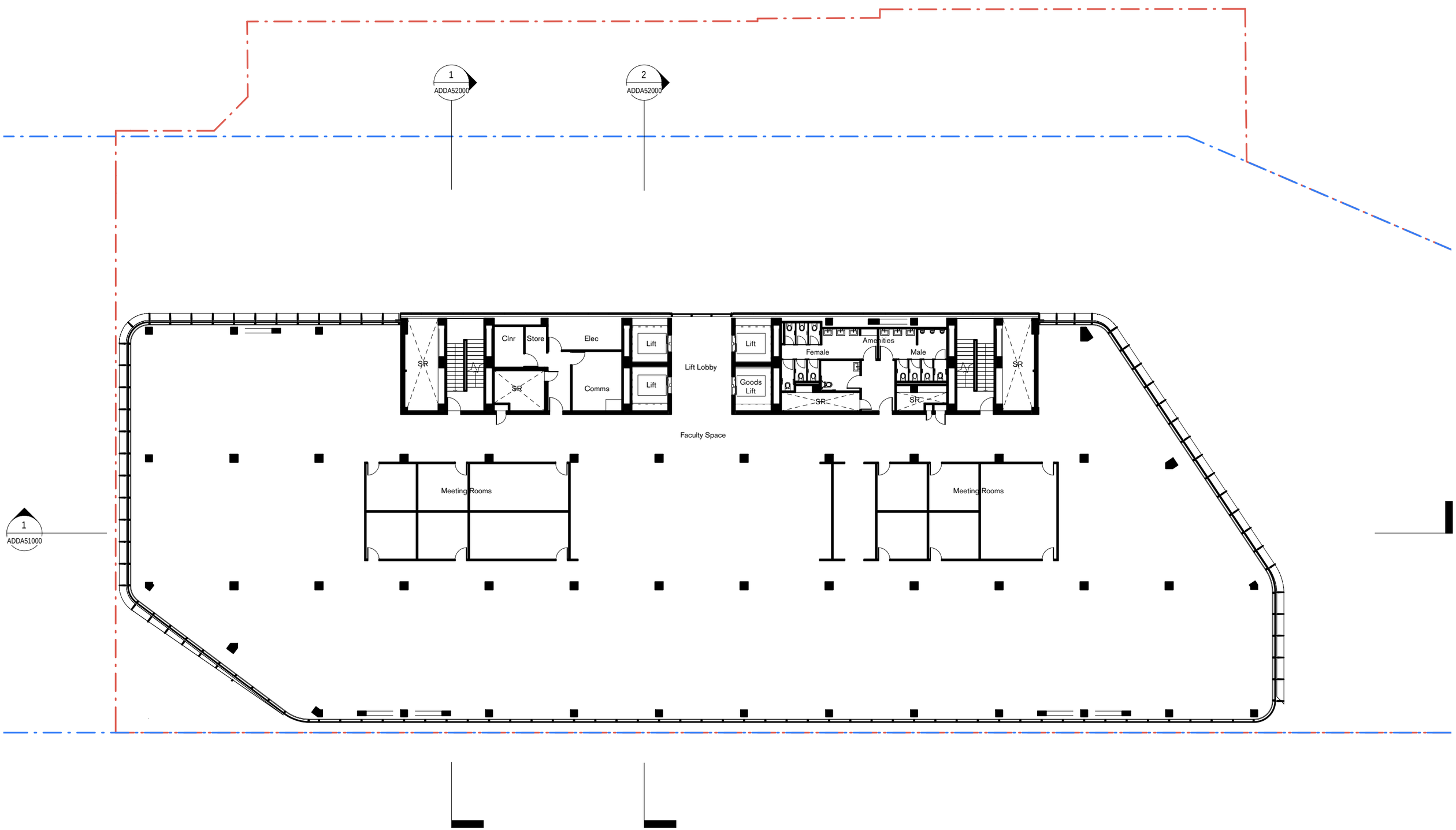
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Level 2 Plan

Date
08.11.18

Project No. 18026
Drawing No. ADDA20200
Revision 04



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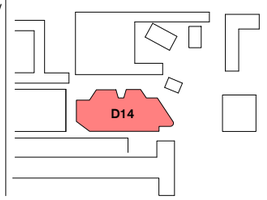
Legend

Project Boundary
Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect Tzannes

Scale 1 : 250 @ A3

North

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

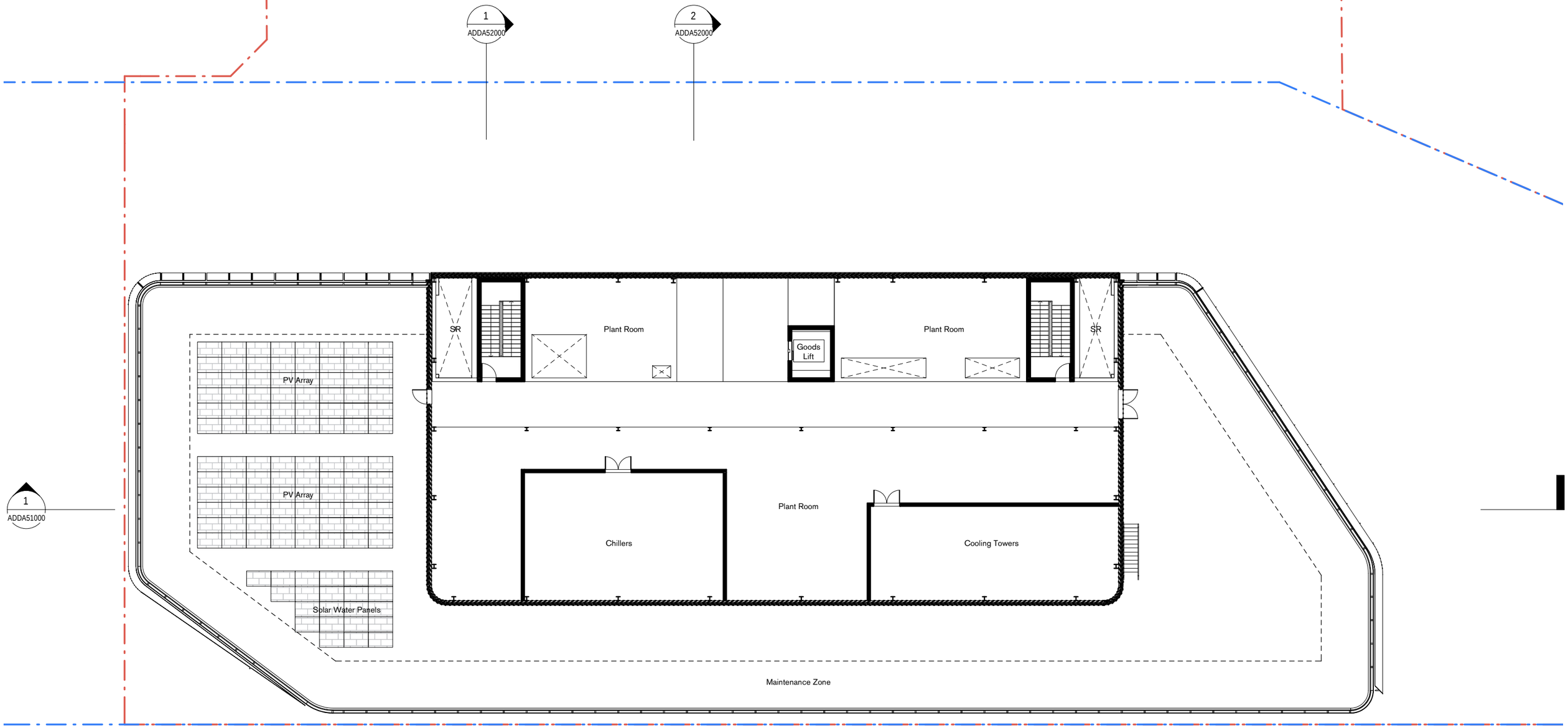
Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Level 3-6 Plan

Date
08.11.18

Project No. 18026
Drawing No. ADDA20300
Revision 04



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Nominated Architects

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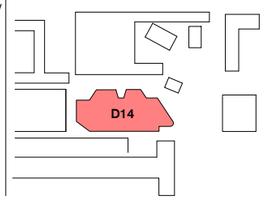
Mladen Prnjatovic 7468
Ben Green 7066
Chi Melhem 7754

Rev	Date	For
01	24.10.18	Draft SSDA
02	02.11.18	Draft SSDA
03	07.11.18	Draft SSDA
04	08.11.18	SSDA Submission

Legend

- Project Boundary
- Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect Tzannes

Scale 1 : 250 @ A3

North

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

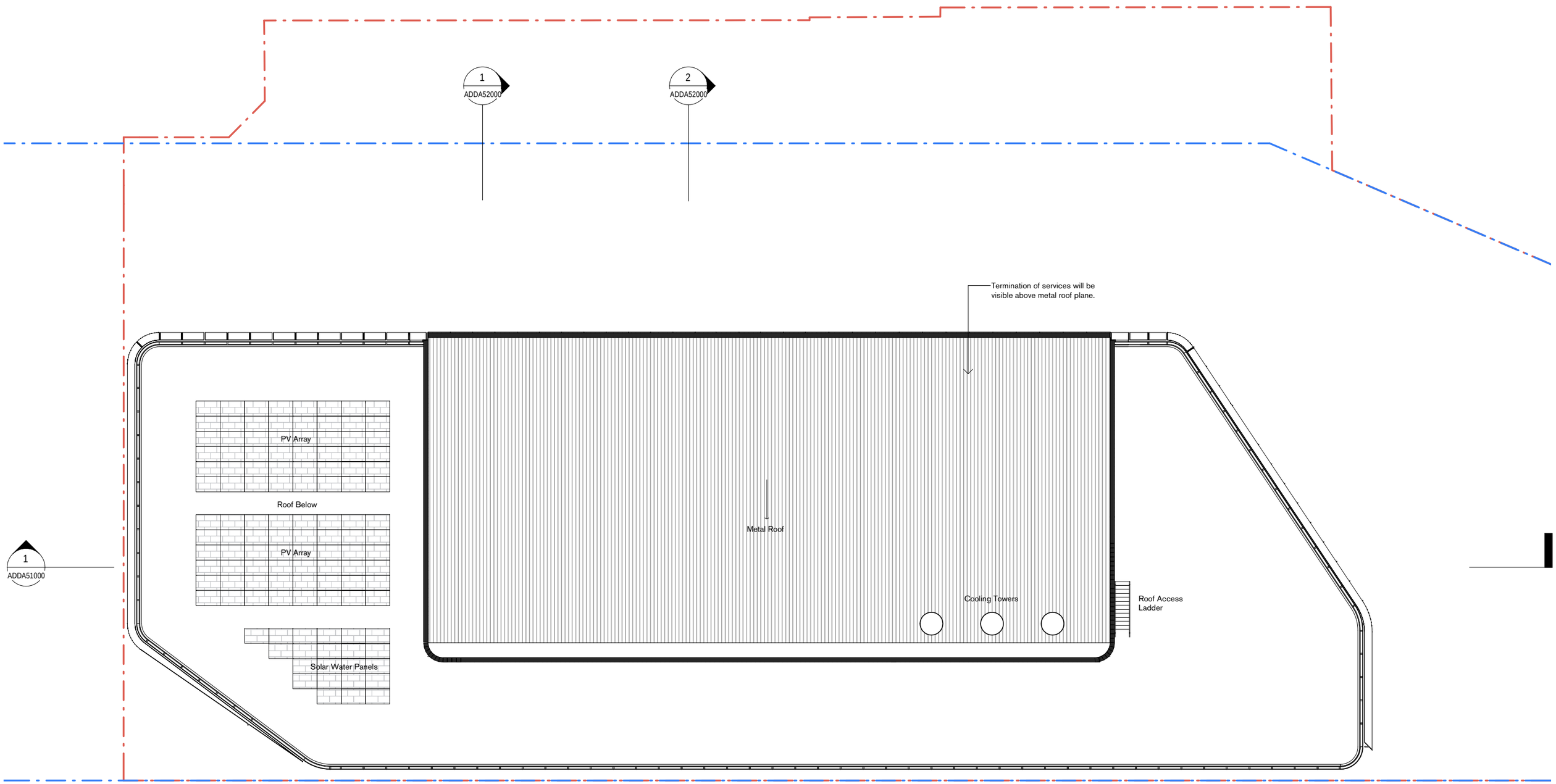
Drawing
Plant Plan

Date
08.11.18

Project No. 18026

Drawing No. ADDA20800

Revision 04



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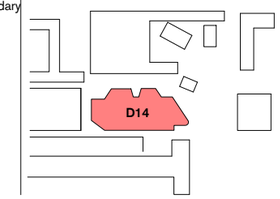
Rev	Date	For
01	24.10.18	Draft SSDA
02	02.11.18	Draft SSDA
03	07.11.18	Draft SSDA
04	08.11.18	SSDA Submission

Legend

Project Boundary
Make Good Boundary

Key Plan



Owner and Applicant

UNSW SYDNEY

D&C Partner

lendlease

Architect Tzannes

Scale 1 : 250 @ A3

North

0 2.5 5 7.5 m

Project
UNSW D14 Academic Building

Address
UNSW Kensington Campus

Status
PLANNING APPLICATION

Drawing
Roof Plan

Date
08.11.18

Project No. 18026
Drawing No. ADDA29000
Revision 04