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REMEDIATION ACTION PLAN

32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

prepared for

32 Joseph Street Pty Ltd

October 2017

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ABBREVIATIONS

AIP	*Australian Institute of Petroleum Ltd*	**QA/QC**	*Quality Assurance, Quality Control*
ANZECC	*Australian and New Zealand Environment and Conservation Council*	**RAC**	*Remediation Acceptance Criteria*
AST	*Aboveground Storage Tank*	**RAP**	*Remediation Action Plan*
BGL	*Below Ground Level*	**RPD**	*Relative Percentage Difference*
BTEX	*Benzene, Toluene, Ethyl benzene and Xylene*	**SAC**	*Site Assessment Criteria*
COC	*Chain of Custody*	**SVC**	*Site Validation Criteria*
DA	*Development Approval*	**TCLP**	*Toxicity Characteristics Leaching Procedure*
DP	*Deposited Plan*	**TPH**	*Total Petroleum Hydrocarbons*
DQOs	*Data Quality Objectives*	**UCL**	*Upper Confidence Limit*
EPA	*Environment Protection Authority*	**UST**	*Underground Storage Tank*
ESA	*Environmental Site Assessment*	**VHC**	*Volatile Halogenated Compounds*
HIL	*Health-Based Soil Investigation Level*	**VOC**	*Volatile Organic Compounds*
LGA	*Local Government Area*		
NEHF	*National Environmental Health Forum*		
NEPC	*National Environmental Protection Council*		
NHMRC	*National Health and Medical Research Council*		
OCP	*Organochlorine Pesticides*		
OPP	*Organophosphate Pesticides*		
PAH	*Polycyclic Aromatic Hydrocarbon*		
PCB	*Polychlorinated Biphenyl*		
PID	*Photo Ionisation Detector*		
PQL	*Practical Quantitation Limit*		

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1.0 INTRODUCTION

Benviron Group (Benviron) was appointed by 32 Joseph Street Pty Ltd, to prepare a Remediation Action Plan (RAP) for the property located at 32 Joseph Street & 1 Vaughan Street, Lidcombe NSW ("the site"). The site is currently occupied by an active service station with attached mechanical workshop area and a freestanding commercial premises currently occupied by a law firm. The site is proposed to be redeveloped into a mixed use multi-storey building with commercial space on the ground floor, residential apartments, four level basement and landscape areas.

One previous report was identified at the time of writing this report and is listed below:

- Benviron Group (2017), "Detailed Site Investigation", 32 Joseph Street & 1 Vaughan Street, Lidcombe NSW, Ref: E1191, dated 29th June 2017.

Benviron Group is utilising the above information in the current investigation.

This RAP has been prepared in order to be part of the Development Application (DA) for this site. Work and reporting were conducted in general accordance with the Benviron Group proposal, Benviron Group environmental protocols and with reference to relevant environmental regulatory criteria including the guidelines issued or endorsed by the NSW EPA.

2.0 OBJECTIVES, SCOPE & DEVIATIONS

2.1 Objectives

The primary objective of this RAP is to inform and guide site remediation and validation through the following:

- Summary of the current contamination status of the site;
- Providing a description of the remediation strategy(s) that will effectively manage the environmental concerns identified, in a manner that protects both human health and the environment;
- Provide a preliminary sampling and analytical quality plan to be used for site validation;
- Comply with DA Conditions for Development;

2.2 Scope

The scope is outlined below:

- Establish remediation goals and criteria
- Evaluation of remedial technologies and selection of appropriate remedial strategy(s)
- Facilitate guidance on approvals, licences, contractor WHS Plan & any other site management plans required for the remedial works.
- Provide an outline of the additional investigations (if required) to be carried out in order to address the recommendations identified in the previous

investigation;

- Develop sampling, analysis and quality plan for additional works, remedial works and proposed validation.

2.3 Deviation from this RAP

It is recommended that an experienced and qualified Environmental Engineer / Scientist be appointed to the project to enable:

- Coordination and implementation of the staged approach to the proposed remediation / validation works;
- Any proposed deviations from the works specified in this RAP are documented and approved as required under OEH 2011 Guidelines for Consultants Reporting on Contaminated Sites;

Completion of remedial works without adequate supervision from a qualified Environmental Engineer / Scientist could leave to project delays and extra costs due to additional requirements imposed by a third party, to confirm the environmental status of site.

Any waste material removed from site without sufficient characterisation and/ or waste classification may lead to regulatory actions.

3.0 BACKGROUND INFORMATION

3.1 Site identification and zoning

The site is identified as follows:

Table 1: Site Identification

Site Identifier	Site Details	
Site Location	32 Joseph Street & 1 Vaughan Street, Lidcombe NSW 2144	
Lot/DP	Lot 4 in DP217872 Lots 108, 109, 110, 111 & 112 in DP 220296 Lot 6 in DP217872 (Proposed Development Plans altered and therefore not included in the DSI)	
Site Coordinates #	NE corner: Latitude: -33.864806, Longitude: 151.043493 NW corner: Latitude: -33.864691, Longitude: 151.043059 SE corner: Latitude: -33.865116, Longitude: 151.043435 SW corner: Latitude: -33.864989, Longitude: 151.042999	
Parish	Liberty Plains	
County	Cumberland	
Nearest Survey Marker	SS54207D 16m East	
Site Area ###	1,629.3 m^2	
Local Government Area (LGA)	Cumberland Council	
Zoning##	B4 – Mixed Use	
Surrounding Land Uses	*North*	Commercial including shops and restaurants
	South	Vaughan Street then cleared redevelopment site
	East	Joseph Street the commercial (Shops) & Park

	West	Commercial bitumen car park part of large commercial property

Notes: # Six Maps
refer to NSW Planning Portal
https://www.planningportal.nsw.gov.au/find-a-property
Refer to Appendix B – KannFinch Survey

3.2 Site description

The site is located at 32 Joseph Street & 1 Vaughan Street, Lidcombe NSW, in the Cumberland Council municipality.

The property at 32 Joseph Street is irregular in shape and is currently in use as an active service station. The buildings and structures consisted of a rendered commercial building with metal roof including the shop and mechanical workshop area, metal shed on concrete, metal awning over the bowser area, garden beds & concrete paved areas. The property also contained vent pipes, fill points and UST infrastructure. An underground water culvert runs through the property.

The property at 1 Vaughan Street is irregular in shape and is currently in use by a law firm. The buildings and structures consisted of a one & two storey brick and clad building with metal roof, paved and concrete rear area. This area was not inspected during the site inspection.

The site also contained a bitumen driveway running along the western boundary of the entire site and this driveway also provides access to commercial shops to the north of the site.

The topography viewed on NSW ESPADE indicated the following for the Birrong Soil Landscape:
Level to gently undulating alluvial floodplains with local relief <5m and slope gradients <3%. Broad concave valleys. Most drainage lines have been converted to lined concrete and brick channels.

Based on the site inspection it was determined that the site had an approximate slope of 2-3^{o} to the west.

The site features are reported on **Figure 2** – Site Features, Borehole & Hotspot Locations & Exceedance Plan.

3.3 Summary of site history

Examination of the historical titles, aerial photographs and other searches for the site has revealed the following information:

- The land titles have indicated the property at 32 Joseph Street has been owned by private individuals from 1823 to 1963. The property had also been leased from 1939 by commercial owners. From 1963 to the current date the property has been owned and/or leased by both private and commercial proprietors. The property at 1 Vaughan Street has been owned by private individuals from 1823 to 1963. The property had also been leased from 1939 by commercial owners. From 1963 to the current date the property has been owned by both private and commercial proprietors.

- The land titles have revealed the following concerns in relation to potential land use;
    - The property at 32 Joseph Street was leased in 2010 by a company listed as a service station.
    - The site had the following potential commercial uses; cinemas & shops.
- The aerial photographs indicated the site had been occupied by commercial type buildings from the 1930s to the current date. Sometime from the 1950s to 1970s the site was redeveloped into a commercial type property indicative of a service station. An open stormwater channel / culvert is visible running through the mid-section of site from the 1930 to the 1950s, in the 1970s the stormwater channel / culvert had been sealed and appears to run beneath the site.
- The aerial photographs suggest the surrounding land had been a mixture of residential and commercial in the 1930 aerial photograph. The surrounding land has remained mixed use in nature to the current date.
- NSW EPA Records reveal that the subject site is not listed.
- The DBYD Sydney Water plan indicates a sewer main running across Lot 110 in an east to western direction & a large stormwater channel / culvert (underground). It is noted that these underground services are considered a potential preferential pathway.
- The Council records have not been searched, received and/or reviewed as part of this investigation.
- A site search on the storage of hazardous chemicals was requested from SafeWork NSW. The USTs and other hazardous chemicals relating to the licence 35/024694 are summarised below:
    - 2 x 17,000L Petrol USTs
    - 3 x 42,000L Petrol USTs
    - 1 x 10,000L Diesel UST

- 1 x 27,000L Petrol UST
- 760L Decanting LPG cylinders
- 360L LPG Cylinder storage

3.4 Proposed development

The site is currently occupied by an active service station with attached mechanical workshop area and a freestanding commercial premises currently occupied by a law firm. The site is proposed to be redeveloped into a mixed use multi-storey building with commercial space on the ground floor, residential apartments, four level basement and landscape areas.

- The proposed RL of basement 4 is 3.30
- The proposed RL of basement 3 is 6.10
- The proposed RL of basement 2 is 8.90
- The proposed RL of basement 1 is 11.70
- The proposed RL of the ground floor is 16.30
- The proposed basement floor levels are confirmed to contain car spaces & lift pits.
- The proposed ground floor is confirmed to confirmed commercial tenancies, loading dock, plant rooms, residential lobby and waste storage areas.
- The development contains multi levels of residential apartments and landscape areas.

Refer to **Appendix B** - Proposed Development Plans

3.5 Local geology, hydrogeology, surface waters

The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates the residual soils within the site to be underlain by Triassic Age Shale of the Wianamatta Group, comprising black to dark grey shale and laminite.

The nearest watercourse is a stormwater channel running underground and through the property at 32 Joseph Street and appears to connect with Haslam's Creek. Haslam's Creek is located approximately 541m west of the site.

3.6 Previous environmental investigations

One previous report was identified at the time of writing this report and is listed below:

- Benviron Group (2017), "Detailed Site Investigation", 32 Joseph Street & 1 Vaughan Street, Lidcombe NSW, Ref: E1191, dated 29th June 2017.

Benviron Group DSI January 2017

Soils sampled across the Site were assessed against the Site Acceptance Criteria (SAC) provided by the National Environment Protection (Assessment of Site Contamination) Measure (NEPM 2013) Table 1A - Residential B.

The investigation revealed the following areas of environmental concern:

- The Xylene, benzo(a)pyrene & benzo(a)pyrene TEQ concentrations within BH1 is located in the fill layer to a depth of 0.3m BGL. Analysis of the deeper soil in BH1 (1.7-1.9m) has indicated concentrations of Xylene, benzene, TRH F1 & F2, Ethylbenzene, Naphthalene & 1,2,4-Trimethylbenzene.
- The benzo(a)pyrene concentrations within BH3 is located in the fill layer to a depth of 0.4m BGL. Analysis of the deeper soil in BH3 has indicated suitable material.
- The nickel concentrations within BH5 is located in the fill layer to a depth of 0.3m BGL. Analysis of the deeper soil in BH5 has indicated suitable material.
- The benzo(a)pyrene TEQ concentrations within SS1 (BH6) is located in the fill layer to a depth of 0.4m BGL. Analysis of the deeper soil in BH6 has indicated suitable material.
- The groundwater monitoring undertaken by Benviron Group has indicated no concerns with HM, BTEX, TRH, PAH, Phenol & VOC from the monitoring locations GW2, GW3, GW4 and the associated duplicates and splits. These wells were pre-existing at the time of the site investigation.
- The groundwater monitoring undertaken at GW1 by Benviron Group has indicated no concerns with Heavy Metals & Phenol. The groundwater at GW1 is impacted by a groundwater plume and the concerns are outlined below:
    - Benzene, toluene, ethylbenzene, O-Xylenes & M+P Xylenes exceeded the ANZECC Fresh Water Guidelines.
    - Benzene exceeded the HSLs and Naphthalene, TRH F1 & F2 exceeded the HSLs Solubility Limits therefore it is likely that an LNAPL plume exists within the site, however further delineation is required.
    - The proposed basement is likely to be in contact with groundwater.
    - Naphthalene, anthracene, phenanthracene, fluoranthene, benzo(a)pyrene exceeded the ANZECC 2000 Fresh Water guidelines.

  - VOC analysis indicated detections of Chlorinated Benzenes in the monitoring well designated as GW1. Isopropylbenzene (cumene) exceeded the ANZECC fresh water trigger values. 1,3,5 Trimethylbenzene & 1,2,4-Trimethylbenzene exceeded the US EPA RSLs for Tapwater.

- GW1 is located downgradient of the workshop and USTs. Based on the Groundwater RLs, groundwater is inferred to flow to the south east. However there are multiple underground structures (USTs, large stormwater culvert) which may be impacting the site groundwater flow. The regional groundwater flow is expected to be in a north western direction.

The following data gaps were identified:

- The lateral extent of BH3, BH5 & BH6 is currently unknown and an appropriate remediation strategy should be devised as part of the remediation works to be carried out.
- The lateral AND vertical extent of BH1 is currently unknown and an appropriate remediation strategy should be devised as part of the remediation works to be carried out.
- It is recommended that all groundwater monitoring wells and/or future soil vapour wells be surveyed by a registered surveyor.
- The potential impact underneath each bowser, UST, hoist and pipelines is unknown.
- Hydraulic permeability of the subsurface.
- The extent of the groundwater contaminated plume around GW1.
- The Council records have not been searched, received and/or reviewed as part of this investigation.

Based on the results of the investigation, the abovementioned locations BH1, BH3, BH5 & BH6 and groundwater require remediation in order to render the site suitable for the proposed development, subject to the following:

- It is considered that the site would be deemed suitable for the proposed development subject to the implementation of a Remediation Action Plan (RAP) including a vapour intrusion assessment to manage the abovementioned environmental concerns and data gaps.
- Based on the level of contamination encountered at the site it is recommended that the site owner(s) notify the NSW EPA.
- Any soil requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

If during any potential site works, significant odours and / or evidence of gross contamination (including asbestos) not previously detected are encountered, or any other significant unexpected occurrence, site works should cease in that area, at least temporarily, and the environmental consultant should be notified immediately to set up a response to this unexpected occurrence.

4.0 REMEDIATION CRITERIA

4.1 Soil

4.1.1 Health Investigation Levels (HIL)

To assess the contamination status of soils at a site, the NSW EPA refers to the document entitled National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) (Amendment 2013).

The site is currently occupied by an active service station with attached mechanical workshop area and a freestanding commercial premises currently occupied by a law firm. The site is proposed to be redeveloped into a mixed use multi-storey building with commercial space on the ground floor, residential apartments, four level basement and landscape areas.

The site will be assessed against the NEPM exposure scenario 'Residential B' Health Investigation Levels of the above mentioned guidelines and specifically refers to the following:

HIL 'B' Residential with minimal opportunities for soil access: includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments

The soil regulatory guidelines are presented in the table below.

Table 2: Health Investigation Levels (HIL) Criteria for Soil Contaminants

	Residential B	Reference
Heavy Metals		
Arsenic	500	NEPM 2013 - Table 1(A)1 HILs
Beryllium	90	NEPM 2013 - Table 1(A)1 HILs
Boron	40000	NEPM 2013 - Table 1(A)1 HILs
Cadmium	150	NEPM 2013 - Table 1(A)1 HILs
Chromium (VI)	500	NEPM 2013 - Table 1(A)1 HILs
Cobalt	600	NEPM 2013 - Table 1(A)1 HILs
Copper	30000	NEPM 2013 - Table 1(A)1 HILs
Lead	1200	NEPM 2013 - Table 1(A)1 HILs
Manganese	14000	NEPM 2013 - Table 1(A)1 HILs
Mercury (Inorganic)	120	NEPM 2013 - Table 1(A)1 HILs
Methyl Mercury	30	NEPM 2013 - Table 1(A)1 HILs
Nickel	1200	NEPM 2013 - Table 1(A)1 HILs
Selenium	1400	NEPM 2013 - Table 1(A)1 HILs
Zinc	60000	NEPM 2013 - Table 1(A)1 HILs
Cyanide (Free)	300	NEPM 2013 - Table 1(A)1 HILs
Polycyclic Aromatic Hydrocarbons (PAHs)		
Carcinogenic PAHs (as Bap TEQ)	4	NEPM 2013 - Table 1(A)1 HILs
Total PAHs	400	NEPM 2013 - Table 1(A)1 HILs
Organochlorine Pesticides		
DDT + DDE + DDD	600	NEPM 2013 - Table 1(A)1 HILs
Aldrin + Dieldrin	10	NEPM 2013 - Table 1(A)1 HILs
Chlordane	90	NEPM 2013 - Table 1(A)1 HILs
Endosulfan	400	NEPM 2013 - Table 1(A)1 HILs
Heptachlor	10	NEPM 2013 - Table 1(A)1 HILs
HCB	15	NEPM 2013 - Table 1(A)1 HILs
Phenols		
Phenols	45000	NEPM 2013 - Table 1(A)1 HILs
Pentachlorophenol	130	NEPM 2013 - Table 1(A)1 HILs
Cresols	4700	NEPM 2013 - Table 1(A)1 HILs
Polychlorinated Biphenyls (PCBs)		
PCBs	1200	NEPM 2013 - Table 1(A)1 HILs
Other Pesticides		
Atrazine	470	NEPM 2013 - Table 1(A)1 HILs
Chlorpyrifos	340	NEPM 2013 - Table 1(A)1 HILs
Bifenthrin	840	NEPM 2013 - Table 1(A)1 HILs
Herbicides		
2,4,5-T	900	NEPM 2013 - Table 1(A)1 HILs
2,4-D	1600	NEPM 2013 - Table 1(A)1 HILs
MCPA	900	NEPM 2013 - Table 1(A)1 HILs
MCPB	900	NEPM 2013 - Table 1(A)1 HILs
Mecoprop	900	NEPM 2013 - Table 1(A)1 HILs
Picloram	6600	NEPM 2013 - Table 1(A)1 HILs
Other Organics		
PDBE (Br1-Br9)	2	NEPM 2013 - Table 1(A)1 HILs

Note - All values are in mg/kg

4.1.2 Health Screening Levels (HSLs)

For selection of the health screening criteria an assessment of the in-situ soil profile should be undertaken. The soil criteria indicates that the upper soil profile is more consistent with clay.

Table 3: Health Screening Levels (HSL) Criteria

	HSL A & HSL B	HSL A & HSL B	HSL A & HSL B	HSL A & HSL B	Soil Saturation Concentration (Csat)	Reference
	0m to <1m	1m to <2m	2m to <4m	4m+		
CLAY						
Toluene	480	NL	NL	NL	630	NEPM 2013 - Table 1(A) 3 HSLs
Ethylbenzene	NL	NL	NL	NL	68	NEPM 2013 - Table 1(A) 3 HSLs
Xylenes	110	310	NL	NL	330	NEPM 2013 - Table 1(A) 3 HSLs
Naphthalene	5	NL	NL	NL	10	NEPM 2013 - Table 1(A) 3 HSLs
Benzene	0.7	1	2	3	430	NEPM 2013 - Table 1(A) 3 HSLs
F1	50	90	150	290	850	NEPM 2013 - Table 1(A) 3 HSLs
F2	280	NL	NL	NL	560	NEPM 2013 - Table 1(A) 3 HSLs
SAND						
Toluene	160	220	310	540	560	NEPM 2013 - Table 1(A) 3 HSLs
Ethylbenzene	55	NL	NL	NL	64	NEPM 2013 - Table 1(A) 3 HSLs
Xylenes	40	60	95	170	300	NEPM 2013 - Table 1(A) 3 HSLs
Naphthalene	3	NL	NL	NL	9	NEPM 2013 - Table 1(A) 3 HSLs
Benzene	0.5	0.5	0.5	0.5	360	NEPM 2013 - Table 1(A) 3 HSLs
F1	45	70	110	200	950	NEPM 2013 - Table 1(A) 3 HSLs
F2	110	240	440	NL	560	NEPM 2013 - Table 1(A) 3 HSLs
SILT						
Toluene	390	NL	NL	NL	640	NEPM 2013 - Table 1(A) 3 HSLs
Ethylbenzene	NL	NL	NL	NL	69	NEPM 2013 - Table 1(A) 3 HSLs
Xylenes	95	210	NL	NL	350	NEPM 2013 - Table 1(A) 3 HSLs
Naphthalene	4	NL	NL	NL	10	NEPM 2013 - Table 1(A) 3 HSLs
Benzene	0.6	0.7	1	2	440	NEPM 2013 - Table 1(A) 3 HSLs
F1	40	65	100	100	910	NEPM 2013 - Table 1(A) 3 HSLs
F2	230	NL	NL	NL	570	NEPM 2013 - Table 1(A) 3 HSLs

Note - All values are in mg/kg

4.1.3 Ecological Investigation Levels (EILs)

Any applicable validation samples in the future will be assessed against the site derived EILs determined from the Benviron Group DSI dated June 2017. A copy of the site derived EILs is provided below.

Table 4: Site Derived EIL Criteria

	EIL Analytes (mg/kg)							
	ARSENIC	CHROMIUM (VI)[a]	COPPER	LEAD	NICKEL	ZINC	NAPHTHALENE	DDT
Site Derived Ecological Investigation Levels (EILs)								
Fill BH6 (0.2-0.4m)	100	410	100	1,100	30	240	170	180
Site Derived Ecological Investigation Levels (EILs)								
Natural BH6 (0.6-0.7m)	100	410	210	1,100	180	450	170	180

Notes: a **Chromium VI has been used in lieu of Chromium III**

4.1.4 Ecological Screening Levels (ESLs)

Ecological screening levels (ESLs) are presented based on a review of Canadian guidance for petroleum hydrocarbons in soil and application of the Australian methodology (Schedule B5b) to derive Tier 1 ESLs for BTEX, benzo(a)pyrene and F1 and F2 (Warne 2010a, 2010b)

The Canadian Council of the Ministers of the Environment (CCME) has adopted risk-based TPH standards for human health and ecological aspects for various land uses in the *Canada-wide standard for petroleum hydrocarbons (PHC) in soil* (CCME 2008) (CWS

PHC). The standards established soil values including ecologically based criteria for sites affected by TPH contamination for coarse- and fine-grained soil types.

Table 5: (EIL) and (ESL) Criteria

Benviron group	Contaminant Age/Soil Texture	National parks and areas of high conservation value	Urban residential and open public spaces	Commercial and industrial	Reference
Ecological Investigation Levels (EILs)					
Heavy Metals					
Arsenic	**Fresh**	20	50	80	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	40	100	160	NEPM 2013 - Table 1(B) 1-5 EILs
Chromium (III)	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Copper	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Lead	**Fresh**	110	270	440	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	470	1100	1800	NEPM 2013 - Table 1(B) 1-5 EILs
Nickel	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Zinc	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Polycyclic Aromatic Hydrocarbons (PAHs)					
Naphthalene	**Fresh**	10	170	370	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	10	170	370	NEPM 2013 - Table 1(B) 1-5 EILs
Organochlorine Pesticides					
DDT	**Fresh**	3	180	640	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	3	180	640	NEPM 2013 - Table 1(B) 1-5 EILs
Ecological Screening Levels (ESLs) and Management Limits					
F1 (C_6-C_{10})	**Coarse**				NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	125*	180*	215*	NEPM 2013 - Table 1(B) 6-7 EILs
F1 (C_6-C_{10}) *(Management Limits)*	**Coarse**		700	700	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	800	800	NEPM 2013 - Table 1(B) 6-7 EILs
F2 (>C_{10}-C_{16})	**Coarse**				NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	25*	120*	170*	NEPM 2013 - Table 1(B) 6-7 EILs
F2 (>C_{10}-C_{16}) *(Management Limits)*	**Coarse**		1000	1000	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	1000	1000	NEPM 2013 - Table 1(B) 6-7 EILs
F3 (>C_{16}-C_{34})	**Coarse**	-	300	1700	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	1300	2500	NEPM 2013 - Table 1(B) 6-7 EILs
F3 (>C_{16}-C_{34}) *(Management Limits)*	**Coarse**		2500	3500	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	3500	5000	NEPM 2013 - Table 1(B) 6-7 EILs
F4 (>C_{34}-C_{40})	**Coarse**	-	2800	3300	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	5600	6600	NEPM 2013 - Table 1(B) 6-7 EILs
F4 (>C_{34}-C_{40}) *(Management Limits)*	**Coarse**		10000	10000	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	10000	10000	NEPM 2013 - Table 1(B) 6-7 EILs
Benzene	**Coarse**	10	50	75	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	10	65	95	NEPM 2013 - Table 1(B) 6-7 EILs
Toluene	**Coarse**	10	85	135	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	65	105	135	NEPM 2013 - Table 1(B) 6-7 EILs
Ethylbenzene	**Coarse**	1.5	70	165	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	40	125	185	NEPM 2013 - Table 1(B) 6-7 EILs
Xylenes	**Coarse**	10	105	180	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	1.6	45	95	NEPM 2013 - Table 1(B) 6-7 EILs
Benzo(a)pyrene	**Coarse**	0.7	0.7	0.7	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	0.7	0.7	0.7	NEPM 2013 - Table 1(B) 6-7 EILs

Notes

1 Urban residential/public open space is broadly equivalent to the HIL-A, HIL-B and HIL-C land use scenarios in Table 1A(1) Footnote 1 and as described in Schedule B7.

2 Aged values are applicable to arsenic contamination present in soil for at least two years. For fresh contamination refer to Schedule B5c.

3 Insufficient data was available to calculate aged values for DDT and naphthalene, consequently the values for fresh contamination should be used.

4 Insufficient data was available to calculate ACLs for As, DDT and naphthalene. The EIL should be taken directly from Table 1B(5).

5 ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability.

6 '-' indicates that insufficient data was available to derive a value.

7 To obtain F1, subtract the sum of BTEX concentrations from C6-C10 fraction and subtract naphthalene from >C10-C16 to obtain F2.

8 Management limits are applied after consideration of relevant ESLs and HSLs

9 Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.

4.1.5 Asbestos

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 7 in Schedule B1. The following health screening levels for asbestos can be seen below:

Table 6: Health Screening Levels for Asbestos

	Health Screening Levels (w/w)			
Form of Asbestos	**Residential A**	**Residential B**	**Recreational C**	**Commercial/Industrial D**
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF (Friable Asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

4.1.6 Export of waste

Any additional soil material requiring offsite disposal will analysed against the NSW EPA refers to the NSW EPA (2014) "*Waste Classification Guidelines, Part 1: Classifying Waste".*

4.2 Groundwater

The NSW DECC has endorsed the use of the Groundwater Investigation Levels (GILs) given in the 1999 NEPM '*Schedule B(1) Guideline on the Investigation Levels for Soil and Groundwater*' (Amendment 2013) and the water quality trigger levels given in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000). These Guidelines provide criteria for:

- Aquatic ecosystems – both marine and fresh waters

The NEPM advises that 'when assessing groundwater contamination, the GILs are to be applied at the point of extraction and as response levels at the point of use, or where there is a likelihood of an adverse environmental effect at the point of discharge'.

For assessing groundwater quality, it is first necessary to assess the potential uses of groundwater downgradient of the site being assessed.

Potential uses of groundwater downgradient of the site include:

- Discharge to water bodies sustaining aquatic ecosystems particularly Fresh Water.
- Extraction of groundwater by local users.

The threshold concentrations presented in the ANZECC (2000) Fresh and Marine Waters Quality Guidelines are considered applicable for the protection of aquatic ecosystems of the receiving waters. As these guidelines apply to receiving waters, it is generally conservative to apply these to groundwater discharging to receiving waters. It is important to note that these are not threshold values at which an environmental

problem is likely to occur if exceeded, rather, if the trigger values are exceeded, then further action is required which may include either further site-specific investigations to assess whether or not there is an actual problem or management / remedial action should be undertaken.

It is considered that ***fresh water trigger*** values are applicable for investigating chemical concentrations in groundwater at the site, as the receiving body. The nearest watercourse is a stormwater channel running underground and through the property at 32 Joseph Street and appears to connect with Haslam's Creek. Haslam's Creek is located approximately 541m west of the site. It is understood that the NSW EPA policy is that the trigger values for the protection of 95% of aquatic ecosystems should be used as groundwater assessment criteria when considering moderately or highly disturbed receiving environments. The receiving waters for groundwater at the site are considered to be moderately disturbed ecosystems and the ANZECC (2000) 95% protection values are therefore considered appropriate groundwater assessment criteria for the site.

4.3 Soil Vapour

Soil vapour concentrations of the following analytes will be compared to Schedule B1 of the Interim NEPM guidelines for the preliminary assessment of human health risks via the inhalation pathway:

- Chlorinated compounds will be compared against Table 1A (2) Interim Soil Vapour HILs A.
- Soil Vapour Health Screening Levels for vapour intrusion (HSL D)

The soil vapour screening criteria are presented below:

Table 7: Interim Soil Vapour Health Investigation Levels for VOCs

Chemical	Interim soil vapour HIL (mg/m^3)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial / Industrial[1] D
TCE	0.02	0.02	0.4	0.08
1,1,1-TCA	60	60	1200	230
PCE	2	2	40	8
cis-1,2-dichloroethene	0.08	0.08	2	0.3
Vinyl chloride	0.03	0.03	0.5	0.1

Notes:

1. Land use settings are equivalent to those described in Table 1A(1) Footnote 1 and Schedule B7, though secondary school buildings should be assessed using residential 'A/B' for vapour intrusion purposes.
2. Interim HILs for VOCCs are conservative soil vapour concentrations that can be adopted for the purpose of screening sites where further investigation is required on a site-specific basis. They are based on the potential for vapour intrusion using an indoor air-to-soil vapour attenuation factor of 0.1 and an outdoor air-to-soil vapour attenuation factor of 0.05.
3. Application of the interim HILs is based on a measurement of shallow (to 1 m depth) soil vapour (or deeper where the values are to be applied to a future building with a basement) or sub-slab soil vapour.
4. The applicability of the interim HILs needs to be further considered when used for other building types such as homes with a crawl-space and no slab, which may require site-specific assessment.
5. Use of the interim HILs requires comparison with data that has been collected using appropriate methods and meets appropriate data quality requirements.
6. Oral and dermal exposure should be considered on a site-specific basis where direct contact exposure is likely to occur.

Table 8: Health Screening Levels for Soil Vapour (mg/m^3)

	HSL D Commercial / Industrial				
CHEMICAL	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m to <8 m**	**8 m+**
CLAY					
Toluene	6,500	100,000	NL	NL	NL
Ethylbenzene	1,800	31,000	NL	NL	NL
Xylenes	1,200	21,000	NL	NL	NL
Naphthalene	4	85	240	560	1,200
Benzene	5	80	230	530	1,100
F1[8]	1,000	19,000	55,000	130,000	270,000
F2[9]	800	NL	NL	NL	NL

Notes

1. Land use settings are equivalent to those described in Table 1A(1) Footnote 1 and Schedule B7. HSLs for vapour intrusion for high density residential assume residential occupation of the ground floor. If communal car parks or commercial properties occupy the ground floor, HSL D should be used,
2. The key limitations of the HSLs should be referred to prior to application and are presented in Friebel and Nadebaum (2011b and 2011d).
3. Detailed assumptions in the derivation of the HSLs and information on how to apply the HSLs are presented in Friebel and Nadebaum (2011a and 2011b).
4. The maximum possible soil vapour concentrations have been calculated based on vapour pressures of the pure chemicals. Where soil vapour HSLs exceed these values a soil-specific source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.
5. Soil vapour HSLs should be compared with measurements taken as laterally close as possible to the soil or groundwater sources of vapour (i.e. within or above vapour sources). Consideration is required of where the sample is taken, the current condition of the site and the likely future condition of the site. Shallow gas measurements in open space (less than 1 m below ground surface) may be subject to influences of weather conditions and moisture.
6. The figures in the above table may be multiplied by a factor to account for biodegradation of vapour. A factor of 10 may apply for source depths from 2 m to <4 m or a factor of 100 for source depths of 4 m and deeper. To apply the attenuation factor for vapour degradation, a number of conditions must be satisfied. Firstly, the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15 m, as this would prevent oxygen penetrating to the centre of the slab. Secondly, measurement of oxygen in the subsurface is required to determine the potential for biodegradation. Oxygen must be confirmed to be present at >5% to use these factors.

7. For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit >50% respectively as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.
8. To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.
9. To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

5.0 ADDITIONAL INVESTIGATION – VAPOUR INTRUSION

The following additional works are recommended to address the TRH, BTEXN, PAH & VOC detections identified during the Benviron Group DSI dated June 2017.

The sampling strategy is based on our current level of understanding of the site conditions. However, the fieldwork and the sampling and analysis program may be subject to change based on the observations made during field work, such as depth of groundwater, actual geology beneath the site and visual extent of contamination.

Field measurements will be recorded on relevant Benviron Group soil vapour monitoring record forms.

For any unexpected findings during the assessment, the unexpected findings protocol provided in **Appendix A** shall be followed.

5.1 General Methodology

In order to meet the Data Quality Objectives, the investigation will comprise fieldwork and sample collection carried out in general accordance with the procedures outlined in the

- CRC Care Technical Report No. 13 – Field assessment of vapours (August 2009)
- National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)
- CRC Care “Technical Report No. 23 - Petroleum hydrocarbon vapour intrusion assessment Australian guidance” (July 2013)

- NSW DECCW, "Vapour Intrusion: Technical Practice Note", (September 2010)
- Benviron Group fieldwork protocols, which are based on industry accepted standard practice

5.2 Sampling Density & Location Rationale

The sampling density and location rationale is described below:

- Nine (9) additional boreholes (SV1 to SV9) will be drilled at the proposed locations shown in Figure 4 to allow for the installation of nine (9) new soil vapour monitoring wells.
- SV1 to SV9 will be drilled to a minimum depth of approximately 0.5m to 1m above the groundwater table. The approximate level of the groundwater is RL 12.32 to 12.67.
- Nine (9) additional boreholes (BH201 to BH209) will be drilled at the proposed location shown in Figure 4 to allow for the installation of nine (9) new groundwater monitoring wells (delineation wells).

5.3 Soil Vapour Network

Table 9: Soil Vapour Well Network

Well ID	Site	Status	Depth (BGL)	Approximate RL	COPC
SV1	Lidcombe	Proposed	0.5m to 1m above the groundwater level	14.62	VOCs, TRH & BTEXN
SV2	Lidcombe	Proposed	0.5m above the groundwater level	14.75	VOCs, TRH & BTEXN
SV3	Lidcombe	Proposed	0.5m to 1m above the groundwater level	14.72	VOCs, TRH & BTEXN
SV4	Lidcombe	Proposed	0.5m to 1m above the groundwater level	15.18	VOCs, TRH & BTEXN
SV5	Lidcombe	Proposed	0.5m to 1m above the groundwater level	15.05	VOCs, TRH & BTEXN
SV6	Lidcombe	Proposed	0.5m to 1m above the groundwater level	14.98	VOCs, TRH & BTEXN
SV7	Lidcombe	Proposed	0.5m to 1m above the groundwater level	14.97	VOCs, TRH & BTEXN
SV8	Lidcombe	Proposed	0.5m to 1m above the groundwater level	14.85	VOCs, TRH & BTEXN
SV9	Lidcombe	Proposed	0.5m to 1m above the groundwater level	15.21	VOCs, TRH & BTEXN

- Analysis of general gases such as methane, CO_2 and oxygen will also be included.
- RLs was taken from the closest point on the survey plan provided in Appendix B from KannFinch dated 23.2.2016.

5.3.1 Soil Vapour Well Installation Methodology

The soil vapour wells will be installed as described below:

- Well gauging in the immediate area of the soil vapour implant locations prior to bore development is recommended as a check on current groundwater conditions.
- Borehole diameters of 50 mm will be drilled at each proposed monitoring location.
- The maximum depth will be determined by site conditions, presence of PSH and groundwater. Soil vapour implants should be installed as close as possible to the impact but not in the saturated zone, the smear zone, the capillary fringe or into soil contamination.
- A common depth may be useful if this can be achieved or structured depth profiling for closely located wells to provide information on potential attenuation.
- Sand-pack thickness of approximately 0.3m should be adopted.
- An additional 0.5 m of tubing connected to the soil vapour implant should be allowed for the surface extension and tracer shroud testing. A Swagelok fitting with a cap should be used to seal the end of the Teflon tube or equivalent plastic caps that come with the tubing.
- Bentonite pellets will be placed in the annulus above the sand to form an impermeable seal within the overlying sand to prevent contamination of the aquifer from any potential surface level contamination migrating vertically.

- 100mm diameter stainless steel flushed covers will be used for all well finishes and concreted onto the ground surface to prevent any surface water ingress.

5.3.2 Soil Vapour Well Sampling Methodology

The soil vapour sampling methodology will be carried out in accordance the NEPM 2013 and CRC Care Technical Report No. 13, "Field Assessment of Vapours", August 2009.

The general methodology adopted will comprise the following:

- Sampling would be carried out during stable weather conditions to avoid significant wind and barometric impacts on vapour intrusion rates.
- No initial or subsequent sampling will be carried out before 2 days have elapsed following a heavy rainfall event of >25mm in order to minimise impacts associated with soil moisture.
- Prior to sampling, leak and integrity checks would be carried out in accordance with the soil vapour monitoring QA/QC procedures outlined in Section 6. Wells will be purged and measurements recorded using a PID and LGM.
- The sampling will be carried out approximately 1 week following installation of the soil vapour monitoring wells to reach equilibrium.
- Soil vapour samples will be collected using Soil Gas canisters through a constant flow rate and analysed in for TRH, BTEXN & VOC.
- Analysis of general gases such as methane, CO_2 and oxygen will also be included.

5.3.3 Survey

The following elements are to be surveyed (in m AHD) by a registered Surveyor:

- The coordinates of soil vapour monitoring well locations; and
- Reduced levels of the gatic or raised covers for each monitoring locations and the adjacent ground level.

5.4 Groundwater Network

Table 10: Groundwater Well Network

Well ID	Total Depth	Screening (m)	Surface Level (RL)	Water Bearing	Status	Function
BH1 / GW1	4.5	1.4-4.5	14.62	Clay	Current	Up gradient
GW2	5.8	-	14.72	-	Pre-existing	Up gradient
GW3	5.0	-	14.93	-	Pre-existing	Down gradient
GW4	3.0	-	14.82	-	Pre-existing	Down Gradient
BH201-D	-	1.5 on TC bedrock refusal	14.66	-	Proposed	Delineation
BH202	TBC	TBC	14.75	-	Proposed	Delineation
BH203	TBC	TBC	14.61	-	Proposed	Delineation
BH204	TBC	TBC	14.48	-	Proposed	Delineation
BH205	TBC	TBC	15.34	-	Proposed	Delineation
BH206	TBC	TBC	14.99	-	Proposed	Delineation
BH207	TBC	TBC	14.93	-	Proposed	Delineation
BH208	TBC	TBC	14.59	-	Proposed	Delineation

BH209	TBC	TBC	15.21	-	Proposed	Delineation

Notes:

1. RLs was taken from the closest point on the survey plan provided in Appendix B from KannFinch dated 23.2.2016.
2. GW2, GW3 & GW4 were pre-existing monitoring wells located on the service station site (not installed by Benviron Group).
3. TBC – to be confirmed during fieldwork operations.

5.4.1 Groundwater Methodology

Proposed additional monitoring wells will be constructed by adopting the following methodology:

- 50mm diameter, Class 18PVC threaded and flush joined casing and 0.45 machine-slotted screens were used;
- Coarse, washed sand and gravel to be placed in the annulus surrounding the piping to a height of the screen;
- Bentonite pellets to be placed in the annulus to form an impermeable plug near the top of the well to prevent surface runoff from entering directly into the well;
- Bentonite pellets to be placed in the annulus to form an impermeable plug near the top of the encountered rock;
- A PVC cap placed on the casing;
- 100mm diameter stainless steel flushed covers to be used for all well finishes and concreted onto the ground surface.

Deep well (designated –D)

- 50mm diameter, Class 18PVC threaded and flush joined casing and 0.45 machine-slotted screens were used;
- Coarse, washed sand and gravel was placed in the annulus surrounding the piping to a height of the screen;
- Bentonite pellets were placed in the annulus to form an impermeable plug near the top of the well to prevent surface runoff from entering directly into the well;
- A PVC cap was placed on the casing;
- 100mm diameter stainless steel flushed covers were used for all well finishes and concreted onto the ground surface.
- The wells will be consisted of 1.5m screen installed from the interface between the top of the bedrock AND residual soil;

5.4.2 Groundwater Sample Collection Methodology

Prior to groundwater sampling, the resting water level will be recorded within the well while checking for the presence of phase separated hydrocarbon.

Sampling will be completed using a low flow pump – a low flow/minimum drawdown sampling technique used to minimise any disturbance to the aquifer.

Field measured parameters will be collected using a certified and calibrated water quality meter. Samples will be collected when field measured parameters (pH, electrical conductivity, redox potential, dissolved oxygen and temperature) have stabilised. The samples will be placed into appropriate laboratory supplied bottles and preserved on ice. The low flow pump and other sampling equipment will be decontaminated before

and after use to avoid possible cross contamination. All samples collected will be preserved on ice and couriered directly to the laboratory under COC documentation.

5.4.3 Survey

The following elements are to be surveyed (in m AHD) by a registered Surveyor:

- The coordinates of all groundwater monitoring well locations; and
- Reduced levels of the gatic or raised covers for each monitoring locations and the adjacent ground level.

5.5 Summary of Proposed Additional Investigation Works

The following is a summary of the works to be completed:

- The additional investigation will recover soil vapour samples from nine (9) new locations (designated SV1 to SV9), targeting impacted groundwater, UST areas, lift pits and site boundaries. Laboratory analysis will include the contaminants of concern, those being TRH, BTEXN, VOCs & general gases.
- Nine additional boreholes (designated BH201 to BH209) will be drilled at the proposed locations shown in Figure 4 to allow for the installation of nine (9) new groundwater monitoring wells (delineation wells). An additional round of groundwater monitoring should be conducted once all underground infrastructure related to the USTs is removed to determine whether a vapour proof membrane or similar is required for the proposed basement and/or

ground water remediation. Laboratory analysis will include the contaminants of concern, those being the Heavy Metals, TRH, BTEXN, PAH, Phenol & VOC.

The additional investigation is detailed in the following summary table as below.

Table 11: Additional Investigation

Item	Sampling Frequency	Analytes
Soil Vapour Well installation and sampling	Nine (9) soil vapour samples from nine (9) new locations 1 intra-laboratory duplicate	TRH, BTEXN & VOCs Plus general gases
Installation of nine new monitoring wells & another round of groundwater sampling from the three existing & one current well	13 groundwater samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate Spike / Blank	HM, TPH, BTEXN, PAH, Phenol & VOC. TRH (C6-C10) & BTEXN

It should be noted that the RAP may need to be revised and/ or addendum report provided, subject to the review of the results from the additional investigation.

Refer to **Figure 4** – Addition Investigation Location Plan.

6.0 REMEDIATION STRATEGY

6.1 General

All works undertaken during the remediation program must be monitored by a suitably qualified person experienced in the assessment and remediation of contaminated sites. The RAP must be adhered to by all personnel and sub-contractors involved in the remediation program.

6.2 NSW EPA preferred hierarchy of options for site remediation

The NSW EPA has a preferred hierarchy of options for site remediation and/or management which is outlined below:

- If practicable, on-site treatment of the contamination so that it is destroyed and the associated risk is reduced to an acceptable level; and
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level.

If the above is not practicable:

- Consolidation and isolation of the soil on-site by containment with a properly designed barrier; and
- Removal of contaminated material to an approved facility followed, if necessary, by replacement with appropriate materials; or

- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse effect, implementation of an appropriate management strategy.

6.3 Remediation option review

6.3.1 Available remediation / management technologies

There is a range of different remediation technologies that are available for remediation of contaminated sites. Some of these technologies are proven while others have not been successfully implemented, particularly in Australia and / or there is limited local expertise for implementation.

A review of the available soil remediation methods and technologies indicated that the following strategies may be applicable to the remediation of fill material contaminated at concentrations exceeding health-based threshold concentrations:

- Excavation and off-site disposal of contaminated soil to landfill.
- Treatment (on-site or off-site).
- Managing the risks posed by contaminants by preventing any direct exposure pathway between the known and potential contaminated soil and users of the proposed development (through capping).
- Further assessment of phytotoxic and health risks.

6.3.2 Excavation and off-site disposal

This method involves the excavation of contaminated materials and disposal of the materials off-site to a landfill licensed by the NSW EPA.

Excavated soils must be classified before disposal to an appropriate landfill. Depending on the levels of contamination, soil may require pre-treatment (to reduce contaminant levels or immobilise contaminants) prior to off-site disposal to the licensed landfill.

6.3.3 Treatment

There is a range of soil treatment technologies available depending on the type of contaminant including in-situ and ex-situ remediation methods. Most commonly, for contamination, the technologies adopted are ex-situ, requiring excavation of the contaminated material. In-situ remediation technologies generally require a longer timeframe for completion than ex-situ technologies. Most of the treatment technologies that require excavation of the contaminated material could be undertaken on or off-site, subject to obtaining licences.

Some possible treatment methods for heavy metals include soil washing and stabilisation of soil.

6.3.4 Managing risks by preventing any direct exposure pathway between contaminated soil and site users (through capping)

On-site capping is used to isolate areas in the subsurface from the surrounding uncontaminated environment. A physical barrier such as a layer of clean soil, synthetic material liners, asphalt and concrete layers may be installed to cap the contaminated material. A cap is typically used where it is required to remove exposure to the contaminated soils and where the contaminated soils are not mobile or there is no contact with groundwater and / or groundwater is not contaminated.

A site management plan is required with any cap and contain strategy. The site management plan identifies the party responsible for adhering to the plan, and includes commitments for ongoing monitoring and maintenance of the cap as well as control of future excavations, which must be minimised or if required, the appropriate occupational health and safety procedures are adopted and permits acquired before work is carried out.

6.4 Rationale for selection of remedial strategy

Usual considerations in selecting and implementing a remediation strategy for a site include:

- **Proven technology**: the remediation method should have a proven track record of success/failure;
- **Reliability**: this is a measure of the degree of certainty that the remediation method will succeed in meeting the site remediation goals in the short and long term;

- **Regulatory approvals**: the remediation method needs to be endorsed by the relevant regulatory authorities. The difficulty in obtaining regulatory approvals will be largely dependent upon the nature of the remediation method proposed;
- **Cost**: provides an indication as to the likely costs involved in implementing each type of remediation method;
- **Implementation time:** provides an indication as to the likely time frame involved in implementing each type of remediation strategy;
- **Land use restrictions:** if contaminated material is left on-site, the regulatory authority may place restrictions on the land use and/or require notification of the contamination on the property title;
- **Ongoing liabilities (maintenance and monitoring requirements):** a remediation strategy that does not involve the complete removal of all contaminants from the site will necessitate some form of ongoing maintenance and/or monitoring to ensure the longer term integrity of the remediation strategy adopted;
- **Future liability:** any remediation strategy that does not involve the complete removal of all contaminants from the site will result in future liability for the contamination;
- **Local contractor experience:** the success and cost effectiveness of any remediation method will be at least partially dependent upon the experience local contractors have in undertaking the type of remediation works proposed;
- **On-site space requirements:** some remediation techniques (e.g. land farming) require relatively large amounts of space to spread soil and will only be feasible if sufficient land is available;

- **Disruptions to site structures and activities:** remediation of the site is likely to create some disturbance, both to the existing site operations and structures, as well as to underground services which may pass through the remediation area (e.g. any work involving excavation of the contaminated soil mass will involve the removal of any structures located atop the excavation zone);
- **Human health risks during remediation:** the remediation workers, site users and the general public may be exposed to hazards posed by contamination during the remediation (e.g. significant levels of vapours may be released when disturbing soil contaminated with volatile organic compounds); and
- **Availability of appropriate disposal sites (for remediation techniques involving excavation and off-site disposal)**: landfill disposal of contaminated soil will only be feasible if a landfill licensed to accept the contaminated soils excavated from the site is available at a reasonable distance from the site.

The table below presents an evaluation of the various options for general remediation projects in Australia based on the above. The table also includes a number of limitations and risks associated with each method.

Table 12: Remediation options

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Cost	Low- Medium	Medium	High	Low
Technical feasibility	Possible for a range of contaminants including those encountered at the site during the investigations	Not possible for heavy metal contaminated material	Not possible for heavy metal contaminated material	Possible for a wide range of contaminants including those encountered at the site
Human Health Risks	Relatively low – excavation and direct offsite disposal will minimise personal contact	Variable – relatively low risk associated with in-situ bioremediation but greater with ex-situ, as soil needs to be excavated	Significant – excavation and handling of contaminated materials will create a volatile contaminant release hazard	Relatively low – only minimal soil disturbance involved

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Reliability	Excellent – system ensures the removal of all contaminated materials	Variable – in-situ bioremediation presents only a low potential to adequately remediate all organic species. Ex-situ is more reliable, due to the more complete mixing of organisms, nutrients and oxygen with the contamination	Moderate – thermal processes have been successfully implemented on most organic contaminant species	Moderate – some potential may exist for contaminant breakthrough if containment wall not properly keyed into bedrock. Care also needs to be taken to prevent preferential gas venting.
Regulatory Approval	Satisfactory – Compliance with Regulatory Authorities. Licensed landfills available for day cover	Satisfactory – on-site treatment is generally the EPA's preferred strategy for site remediation	May be difficult. May require an EIS	Generally satisfactory – whilst on-site containment is not the EPA's preferred option, it is often accepted as a feasible option

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Disruption to Site Structures and Activities	Significant – all existing site structures need to be demolished or relocated to allow excavation of contaminated soils	Variable – disturbance relatively minor for in-situ bioremediation, but ex-situ would require existing structures to be demolished or relocated	Significant – all existing site structures need to be demolished or relocated to allow excavation of contaminated soils	Moderate – some disruption likely to proposed underground services
Ongoing Liabilities	Minimal – all heavily contaminated materials removed	Variable – need for ongoing monitoring will be largely dependent upon the success of bioremediation in destroying contaminants	Variable – need for ongoing monitoring will be largely dependent upon the success of thermal desorption in destroying contaminants	Moderate to high – capping system need to be maintained, and ongoing monitoring necessary to ensure the integrity of the cap and cut-off wall
Contractor Experience	Good – relatively simple strategy involving only basic technologies	Very Limited – technology is still developing, and only a limited amount of trials undertaken in Australia	Very Limited – technology is still developing, and only a limited amount of trials undertaken in Australia	Moderate – contractors available with experience in the implementation of cap and contain systems

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Availability of Disposal Sites	Good – landfills available to accept solid waste	Not Applicable	Not Applicable	Not Applicable (assuming all materials excavated to form the cut-off wall are retained on-site)
Implementation Time Frame	Short	Long	Short to Moderate	Short to Moderate

6.5 Preferred remediation strategy

For this site, on- and off-site treatment of contaminants, which are the most preferred remedial strategies of the NSW EPA, were ruled out for the following reasons:

- Materials have to be removed from site so if land farming took place, materials would ultimately be removed; and
- The costs of reuse and treatment for more sensitive sites would be substantially higher than off-site disposal to landfill.

The next most preferred strategy of on-site containment was ruled out for the following reasons:

- The site requires a reduction of soils as excavation is required within the site.

The next most preferred NSW EPA strategy of removal of contaminated material to a licensed landfill and is the selected strategy for the following reasons:

- The costs of off-site disposal to landfill are considerably less than treatment costs.
- The method fits in with the proposed development.

Relative benefits of the "excavate and dispose" strategy are as follows:

- The costs associated with the 'excavate and dispose' remediation method are low to medium;
- The 'excavate and dispose' remediation method may be implemented only if a relatively small amount of soil is to be removed;
- The 'excavate and dispose' remediation method is a proven technology for the type of contaminants identified at the site, likely to be approved by the regulatory bodies;
- The 'excavate and dispose' remediation method is dependent upon the cost and availability of suitable landfill disposal sites. These are readily available and cost-effective;
- After completion of the remediation works by the 'excavate and dispose' remediation method, the site would continue to be suitable for ongoing commercial use and the proposed residential use, and there would be no ongoing liabilities, and very limited (if any) ongoing maintenance / monitoring required;
- As part of the site development, a net reduction of soils is required thus fitting into this remediation strategy; and
- The timeframe for implementation of the 'excavate and dispose' remediation method is relatively short compared to other possible remediation methods.

7.0 REMEDIATION WORKS

7.1 Remediation Goals

The remediation goal is to render the site suitable for the proposed development upon completion of the remediation and validation works. This would be achieved by remediating the heavy metals, TRH, BTEXN, VOC & PAH impacted hotspot at BH1, BH3, BH5 & BH6.

It should be noted that the RAP may need to be revised or addendum provided, subject to the review of the results from the additional investigation.

7.2 Remediation program

Assuming appropriate permits have been granted, the remediation of the site is to take place in the following stages:

Stage One -Site Preparation

- Prepare the site with fences, erosion controls, signage and environmental controls.
- Demolish site structures (which have development consent) and concrete slabs to make way for remedial works and under slab observations.

Stage Two – Underground Storage Tank Removal & Validation

- Decommission the UST's and associated piping in accordance with AS4976-2008, UPSS Regulation 2008, NSW EPA Technical Guidance 2014, and WorkCover requirements.
- As described above the preferred remediation strategy for the site is excavation and off-site disposal of the fill materials / bedding sands and the UST's.
- Based on the results of the DSI, up to seven (7) UST's exist within the site that require removal followed by remediation and validation. It should be noted that there is likely to be more USTs located on site. The volume of tank pit spoil (bedding sands, fill materials and contaminated natural soils) can be approximated as follows:
    - Tanks Pit 1 Area (17,000L) – 4m long x 2.5m wide x 2m deep = 20m^3
    - Tanks Pit 2 Area (17,000L) – 4m long x 2.5m wide x 2m deep= 20m^3
    - Tanks Pit 3 Area (42,000L) – 8m long x 3.5m wide x 3m deep = 84m^3
    - Tanks Pit 4 Area (42,000L) – 8m long x 3.5m wide x 3m deep = 84m^3
    - Tanks Pit 5 Area (42,000L) – 8m long x 3.5m wide x 3m deep = 84m^3
    - Tanks Pit 6 Area (27,000L) – 6m long x 3.5m wide x 3m deep = 63m^3
    - Tanks Pit 7 Area (10,000L) – 3m long x 2m wide x 1.5m deep = 9m^3
- Any soil requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

It is noted that the total void space occupied by USTs is expected to reduce the amount of soil requiring excavation.

If contaminated material is found during the remediation works, these materials will be chased up and removed. Soils extending deeper will be removed as part of the site basement excavation.

Stage Three – Additional Investigation

- The additional investigation will recover soil vapour samples from nine (9) new locations (designated SV1 to SV9), targeting impacted groundwater, UST areas, lift pits and site boundaries. Laboratory analysis will include the contaminants of concern, those being TRH, BTEXN, VOCs & general gases.
- Nine additional boreholes (designated BH201 to BH209) will be drilled at the proposed locations shown in Figure 4 to allow for the installation of nine (9) new groundwater monitoring wells (delineation wells). An additional round of groundwater monitoring should be conducted once all underground infrastructure related to the USTs is removed to determine whether a vapour proof membrane or similar is required for the proposed basement and/or ground water remediation. Laboratory analysis will include the contaminants of concern, those being the Heavy Metals, TPH, BTEXN, PAH, Phenol & VOC.
- It should be noted that the RAP may need to be revised and/ or addendum report provided, subject to the review of the results from the additional investigation.
- Results and findings will be provided in the final validation report including any deviations from this RAP.

Stage Four – Removal of soil impacted Hotspots (BH1, BH3, BH5 & BH6)

Hotspot BH1

- Excavate BH1 ---5m long x 5m wide x 2.5m vertically deep (total= 62.5m3) and dispose of at an EPA licensed landfill that can accept the waste. The material should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).
- The floors and walls of BH1 will be validated by taking 2 floor samples and 8 wall samples. Recovery of appropriate QA/QC samples.

Hotspot BH3

- Excavate BH3 ---2m long x 2m wide x 1m vertically deep (total= 4m3) and dispose of at an EPA licensed landfill that can accept the waste. The material should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).
- The floors and walls of BH3 will be validated by taking 1 floor samples and 4 wall samples. Recovery of appropriate QA/QC samples.

Hotspot BH5

- Excavate BH5 ---2m long x 2m wide x 1m vertically deep (total= 4m3) and dispose of at an EPA licensed landfill that can accept the waste. The material should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).
- The floors and walls of BH5 will be validated by taking 1 floor samples and 4 wall samples. Recovery of appropriate QA/QC samples.

Hotspot BH6

- Excavate BH6 ---2m long x 2m wide x 1m vertically deep (total= 4m3) and dispose of at an EPA licensed landfill that can accept the waste. The material should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).
- The floors and walls of BH6 will be validated by taking 1 floor samples and 4 wall samples. Recovery of appropriate QA/QC samples.

Stage Five – Validation Report Preparation

- Remediation will occur by managing soil for offsite disposal to landfill for contaminated soils.
- A validation report will be prepared to present the remediation works undertaken and confirm that the objectives of the remediation works have been attained.
- The Council records will included in the final validation report.
- The land title records for Lot 6 in DP217872 will be included in the final validation report. Updated proposed plans have included this area as part of the proposed development.

The extent of the remediation works would be extended whether additional USTs, associated infrastructure & further contaminated material are identified during remediation works.

7.3 Extent of remediation works required

As described above the preferred remediation strategy for the site is excavation and off-site disposal of the fill materials.

If contaminated material is found during the remediation works, these materials will be chased up and removed.

7.4 Regulatory requirements such as licenses and approvals

Approval from a licensed disposal facility will be required prior to removal of any contaminated material from the site.

7.5 Disposal of excavated contaminated material

The contaminated fill or soil excavated from the site will be disposed of at a licensed landfill facility. If disposal of contaminated liquids is required, this will be undertaken by a licensed contractor. The weighbridge and truck dockets will be retained by the contractor and made available to the principal's environmental representative.

7.6 Contingencies during Remedial Works

7.6.1 Contaminated Soils

Follow the unexpected finds protocol as detailed in Section 15.2 & Appendix A. Works to be suspended until the environmental project manager can further assess impacted soils / materials.

7.6.2 USTs

Systems to be removed and the excavations appropriately validated and backfilled by experienced contractor. Refer to Section 15.3 for more details.

7.6.3 Contaminated Groundwater

Review of groundwater conditions on site, may warrant further groundwater investigations / remediation and longer term management plans.

Any dewatering may require approval under the Water Management Act 2000.

Remedial measure may include; source removal, natural attenuation, bioremediation, PSH recovery using active pumping, groundwater permeability barrier, in-situ oxidation / stabilisation.

If a groundwater contaminant plume is identified and migrating offsite or increasing in contaminant concentrations the following is required:

- Review contaminant increase and analytes;
- Review remediation alternatives;
- Undertake downgradient monitoring;
- Complete fate / transport modelling if required; and
- Assess the need for further action.

8.0 VALIDATION PLAN (DATA QUALITY OBJECTIVES)

Data quality objectives have been developed for the validation assessment.

8.1 State the problem

The site is proposed to be redeveloped, however, previous investigations identified the following concerns:

- Soil remediation is currently limited to the heavy metals, TRH, BTEXN, PAH & VOC impacted hotspots at BH1, BH3, BH5 & BH6.

8.2 Identify the issue

Based on the decision making process for assessing urban redevelopment sites, the following decisions must be made:

- Are there any unacceptable risks to likely future onsite receptors from soil?
- Are there any impacts of chemical mixtures?
- Are there any aesthetic issues?
- Is there any evidence of, or potential for, migration of contaminants from the site?
- Is a site management strategy required?
- Is the site suitable for the proposed residential land use?

The following decision is also required to assess the remediation works as a whole:

- Have the excess materials, if any, removed from site been disposed to a landfill lawfully licenced to receive such material?

8.3 Identify the inputs to the decision

The inputs to the decisions are:

- Physical observations, including visual and olfactory results during site activities;
- The results of previous investigations (Sections 3.6);
- Soil analytical data from any imported fill;
- Soil analytical data for waste classification purposes for materials requiring off-site disposal; and
- Waste disposal documentation for excess materials disposed off-site

8.4 Define the study boundaries

The study boundary is defined as follows:

- The lateral extent of the study boundary is defined by the site boundaries as shown in Figure 1 - Site Location & Figure 2 - Site Features & Borehole Location Plan; and
- The vertical extent of the soil removal is at least 3.0m BGL (USTs) up to clean underlying material;

8.5 Decision Rules

The following outlines the decision rules for the project:

Table 13: Summary of Decision Rules

Decisions	Decision Rule
Are there any unacceptable risks to likely future onsite receptors from soil or groundwater?	If there is the decision is *Yes* then control measures are required to manage the risk. Otherwise the decision is *No*
Are there any chemical mixtures?	Are there more than one group of contaminants presents which increase the risk of harm? If there is the decision is *Yes* Otherwise the decision is *No*
Any aesthetic issues?	If there are any soil discolouration and/or unacceptable odours the decision is *Yes* Otherwise the decision is *No*
Is there any evidence of, or potential for, migration of contaminants from the site?	Evidence and/or potential will be outlined and the decision is *Yes* Otherwise the decision is *No*
Site Management Strategy required?	Was the answer to any of the above decisions *Yes*? If *yes*, a site management strategy is required. If *no*, a site management strategy is not required. The requirement for site management can typically be precluded by remediation of the areas of environmental impact that causes a site decision to be yes.
Is the site suitable for the proposed residential land use	Soil, soil vapour and groundwater data will be compared to the remediation criteria outlined in Section 4. Statistics may be undertaken where appropriate. If the material is suitable the decision is *Yes* Otherwise the decision is *No*
Have the excess materials, if any, removed from site been disposed to a landfill lawfully licenced to receive such material?	Fill/soil analytical data will be compared against adopted criteria. Statistical analysis of the data in accordance with relevant guidance documents will be undertaken, where appropriate, to facilitate the decisions (as detailed above).

	Documentation from the operation receiving the material including the dates, tonnage and classification of the accepted material will be required to facilitate the decision. If the statistical criteria stated above are satisfied, the decision is *Yes*, and if receipts are provided recording the disposal of material to an off-site licensed facility, the decision is *Yes*. If the material fail the criteria, and no disposal receipts are provided, the answer is *No*.

8.6 Specify Limits of Decision Error

This step is to state the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data.

Data collected and generated during this project must be considered appropriate to allow decisions to be made with confidence. Specific limits for this project have been applied in accordance with the appropriate guidance documents from the NSW EPA, NEPM 2013, appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard operating Benviron Group procedures for field sampling and handling.

8.7 Optimising the Design for Obtaining Data

This step enables decision maker's to identify a resource-effective field investigation sampling design that generates data that are expected to satisfy the site manager's decision performance criteria, as specified in the preceding steps of the DQO Process. The output of this step is the sampling design that will guide development of the field

sampling and analysis plan. This step provides a general description of the activities necessary to generate and select data collection designs that satisfy decision performance criteria.

Validation data is required to be collected to verify:

- The effectiveness of the remediation works;
- Any contaminated soils retained on-site have been appropriately contained and managed;
- Any material imported to backfill excavations are suitable for the proposed site use; and
- Document the condition of the site as being suitable for the proposed future use.

The proposed validation soil sampling program is outlined in Section 10.

9.0 VALIDATION SAQP & METHODOLOGY

Remediation of the impacted area will be considered validated following the achievement of the two validation objectives;

- Validation of the remedial excavations will continue to the extent of the impacts and resulting samples are within the adopted criteria.
- In the event of backfilling, validation of the imported fill materials used is required to confirm the suitability for the intended land use.

9.1 Soil Validation Methodology

Soil sampling and handling is outlined in the table below:

Table 14: Sampling and Handling

Action	Outline
Sample collection	Soil validation sampling will be collected directly from exposed surface of excavation, or from the material scraped from the excavator bucket. Data shall be recorded in accordance with COC requirements
Sampling, handling, transport and tracking	Validation soil samples to be transferred directly into appropriately labelled clean laboratory supplied containers. Validation soil samples to be transferred into chilled eskies for sample preservation. *A PID should be used during the collection of each validation soil sample.*

	All equipment used in the sampling program was decontaminated prior to use and between samples to prevent cross contamination. Decontamination of equipment involved the following procedures: -Cleaning equipment in potable water to remove gross contamination; -Cleaning in a solution of Decon 90; -Rinsing in clean demineralised water then wiping with clean lint free cloths; A Chain of Custody to be completed and forwarded to the laboratory to ensure sample tracking.
Sampling Frequency	*Remedial Hotspot Excavation (Validation Sampling):* 1 sample per 100m2, with one sample per 10 lineal metres along each wall (with a minimum of one sample per excavation wall) *Stockpile sampling:* Small Volumes (<200m^3)- 1 sample every 25m^3 Large Volumes (>200m^3) as per Table 3 of the Victoria Sampling Guidelines June 2009 (IWRG702)
Laboratory Quality Assurance and Quality Control	The contracted laboratory to conduct in-house QA/QC procedures involving by not limiting to: Blanks, spike recoveries, laboratory duplicates & analysis.
Assessment of DQOs	Provide analysis of the QA/QC samples and procedures & provide assessment of the overall data quality.

9.2 Soil Validation Reporting

All fieldwork, chemical analysis, discussions, conclusions and recommendations will be provided in the final validation report for the site. The validation report will be prepared in accordance with the NSW EPA 2011 Guidelines for Consultants Reporting on Contaminated Sites and NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme and will confirm the site is suitable for the proposed development. Waste tracking documentation and disposal details will be provided in the validation report.

10.0 VALIDATION WORKS

10.1 Objectives

The objective of the validation program is to ensure that at completion of the remediation works, the site is suitable for continued use and the proposed redevelopment.

Table 15: Soil Validation Sampling Program

Item	Sampling Frequency	Analytes
Validation BH1	2 floor sample, 8 wall samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate 1 set of spikes / blanks per day of sampling	Heavy Metals, TRH, BTEXN, PAH & VOC
Validation BH3	1 floor sample, 4 wall samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate	PAH
Validation BH5	1 floor sample, 4 wall samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate	Heavy Metals
Validation BH6	1 floor sample, 4 wall samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate	PAH
Validation Basement Floor	8 floor samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate 1 set of spikes / blanks per day of sampling	HM, TRH, BTEXN, PAH & VOC

USTs	The minimum sampling protocols to be used for UST areas include: 1 sample per 25m3 backfill UST sands or minimum 3 samples per backfill UST sands per UST pit; 1 sample per tank line; 1 sample per vent pipe area; 1 sample per spill box (currently not present but may be found); 2 base samples and 8 wall (2 samples per wall face) of each tank pit 1 inter-laboratory duplicate 1 intra-laboratory duplicate Trip Spike & Trip Blank / day	Heavy Metals, TRH, BTEXN & PAHs. TRH (C6-C10) & BTEXN
Backfill Material (if required)	Certified VENM or 1 sample per 100m^3	HM, TPH, BTEX, PAH, OCP, PCB, Phenol, Cyanide & Asbestos. Additional COPC may need to be included in the testing suite depending on

	Certified ENM as per NSW EPA Resource Recovery Order 2014	the source site. HM, TPH, BTEX, PAH, EC, PH & Foreign Materials & Asbestos
Unexpected Finds	<u>Excavation Floor</u> 1 sample every 25m^3, with a minimum of 3 samples <u>Excavation Wall</u> 1 sample every 5m (from each distinct horizon / material type)	Dependent on the location, type and characteristic of the unexpected find.

10.2 Waste classification of the fill, hotspots & UST spoil

As part of future site works, any soil to be removed from site will be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

<u>USTs</u>

The excavated fill material / bedding sands from the tanks will be temporarily stockpiled on a heavy duty plastic sheet or a sealed surface such as concrete, and covered with an impermeable plastic sheet to prevent rain infiltration. In order to classify this material,

samples will be collected from the stockpile and analysed for total concentrations of either BTEX, TPH, PAH and/or heavy metals, and where required TCLP concentrations.

Remaining Fill and Hotspots

The fill layer has already been sampled as part of the previous works and these samples will be included within the sampling density for characterisation. Further samples will be recovered either in-situ or from stockpiles. Any excavated fill will be temporarily stockpiled on a heavy duty plastic sheet or a sealed surface such as concrete, and covered with an impermeable plastic sheet to prevent rain infiltration.

10.3 Underground Storage Tank Validation Works

The UST works is outlined below:

- Decommission the UST's and associated piping in accordance with AS4976-2008, UPSS Regulation 2008, NSW EPA Technical Guidance 2014, and WorkCover requirements.
- Based on the results of the DSI, up to seven (7) UST's exist within the site that require removal followed by remediation and validation. It should be noted that there is likely to be more USTs located on site once excavation works are commenced. The volume of tank pit spoil (bedding sands, fill materials and contaminated natural soils) can be approximated as follows:

  - Tanks Pit 1 Area (17,000L) – 4m long x 2.5m wide x 2m deep = 20m^3
  - Tanks Pit 2 Area (17,000L) – 4m long x 2.5m wide x 2m deep= 20m^3
  - Tanks Pit 3 Area (42,000L) – 8m long x 3.5m wide x 3m deep = 84m^3
  - Tanks Pit 4 Area (42,000L) – 8m long x 3.5m wide x 3m deep = 84m^3
  - Tanks Pit 5 Area (42,000L) – 8m long x 3.5m wide x 3m deep = 84m^3
  - Tanks Pit 6 Area (27,000L) – 6m long x 3.5m wide x 3m deep = 63m^3
  - Tanks Pit 7 Area (10,000L) – 3m long x 2m wide x 1.5m deep = 9m^3
- Any soil requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

If any further USTs are located on-site they should be removed in accordance with NSW WorkCover requirements, AS1940 and AS4976-2008 and UPSS Regulation 2008. In the event of conflict between the regulation and NSW WorkCover requirements, the latter shall prevail. Due to the volatile nature of petroleum storage tanks should be purged prior to excavation in order to reduce the risk of explosion, and also it is recommended that the USTs be excavated and disposed of by an experienced contractor.

The minimum sampling protocols to be used for UST areas include:

- 1 sample per 25m3 backfill UST sands or minimum 3 samples per backfill UST sands per UST pit;
- 1 sample per tank line;
- 1 sample per vent pipe area;
- 1 sample per spill box (currently not present but may be found);
- 2 base samples and 8 wall (2 samples per wall face) of each tank pit

10.4 Validation of hotspot BH1

Following removal of soils from the hotspot BH1, photographic records of the floor and wall of the excavation will be taken for reference in the Validation Report.

Two (2) sample will be taken from the floor and eight (8) samples from the walls of the excavation. Soil validation samples will be collected and analysed for Heavy Metals, TRH, BTEXN, PAH & VOC.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

10.5 Validation of hotspot BH3

Following removal of soils from the hotspot BH3, photographic records of the floor and wall of the excavation will be taken for reference in the Validation Report.

One (1) sample will be taken from the floor and four (4) samples from the walls of the excavation. Soil validation samples will be collected and analysed for PAH.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

10.6 Validation of hotspot BH5

Following removal of soils from the hotspot BH5, photographic records of the floor and wall of the excavation will be taken for reference in the Validation Report.

One (1) sample will be taken from the floor and four (4) samples from the walls of the excavation. Soil validation samples will be collected and analysed for Heavy Metals.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

10.7 Validation of hotspot BH6

Following removal of soils from the hotspot BH6, photographic records of the floor and wall of the excavation will be taken for reference in the Validation Report.

One (1) sample will be taken from the floor and four (4) samples from the walls of the excavation. Soil validation samples will be collected and analysed for PAH.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

10.8 Validation of Basement Floor

Following removal of the fill at the site, photographic records of the basement floor of the excavation will be taken for future reference.

General site validation samples taken from the basement floor will be collected following a systematic pattern and analysed for the contaminants of concern identified at these locations, including heavy metals, TPH, BTEX, PAH & VOC. The soil samples will be collected from between 0-150 mm depth from freshly excavated surfaces

Samples will be recovered from eight (8) locations and is outlined in **Figure 5** – Validation Basement Floor Location Plan.

If the site is excavated to the boundary of the adjacent properties and shotcrete or wall restrictions occur, these areas will not be collected as the walls of the excavated areas will be the responsibility of the adjacent site owners as no access will be available. Wall samples will be collected where excavations do not extent to the boundary of the neighbouring properties – i.e. where the soil of the excavation walls originates from the site. If samples are not collected, however, a management plan for potentially contaminated soils that may remain on-site may be required.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

10.9 Validation of areas where fill has been temporarily stockpiled

The excavated contaminated fill will be temporarily stockpiled on a plastic sheet and covered with an impermeable plastic sheet to prevent rain infiltration. In order to confirm that cross-contamination of the soil underneath has not occurred during stockpiling; testing of the soils underneath stockpiles will be required after disposal of the stockpile off-site (where necessary).

10.10 Validation of imported fill

If importation of fill is required it must be certified VENM material and will also be tested in accordance with the requirements of the NSW EPA waste classification guidelines (including testing for asbestos) at a rate of 1 sample per 100 m^3. Certified ENM material is also acceptable and will be tested in accordance with the NSW EPA Resource Recovery Order 2014 for ENM. VENM and/or ENM will also be visually assessed for fibro sheeting and samples analysed for asbestos if detected.

10.11 Duration of remediation and validation works

Based on the proposed scope of the remediation and validation works, it is expected that the works should be completed within approximately four to eight weeks following receipt of the regulatory approvals. This timeframe does not include reporting which should be completed approximately three to five weeks after completion of the remediation and validation works.

11.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The quality assurance/quality control (QA/QC) program aims at ensuring that the data collected is sufficiently accurate, precise and reproducible to be used for the purpose of the validation report. QA/QC should be in accordance with the NEMP 2013 and with the Australian Standard AS4482.1-2005.

11.1 General QA/QC

The frequency required for each field quality assurance / quality control (QA/QC) sample is presented in the table below.

Table 16: QA/QC Frequencies

	Intra Lab	Inter Lab	Rinsate	Spikes	Blanks
Sampling Frequency	1 in 20	1 in 20	1/day	1/day	1/day

During the contamination assessment the integrity of data collected is considered vital. With the assessment of the site, a number of measures were taken to ensure the quality of the data. These are as follows:

11.2 Sample Containers

Soil samples to be collected remediation work are to be placed immediately into laboratory prepared glass jars with Teflon lid inserts. Standard identification labels are

to be used for each individual container and labelled according to depth, date, sampling team and media collected.

11.3 Decontamination

All equipment used in the proposed sampling program are to be decontaminated prior to use and between samples to prevent cross contamination. Decontamination of equipment involved the following procedures:

- Cleaning equipment in potable water to remove gross contamination;
- Cleaning in a solution of Decon 90;
- Rinsing in clean demineralised water then wiping with clean lint free cloths;

Benviron Group adopts a sampling gradient of lowest to highest potential contamination to minimise the impact of cross contamination. This gradient is determined from the historical review and the on-site inspection that was carried out prior to sampling.

11.4 Sample Tracking, Identification and Holding Times

All samples are to be forwarded to NATA Accredited laboratories under recognised chain of custodies with clear identification outlining the date, location, sampler and sample ID. All samples are required to comply with the laboratories respective holding times. The sample tracking system is considered adequate for the purposes of sample collection.

11.5 Sample Transport

All samples are to be packed into an esky with ice from the time of collection. A trip blank and trip spike are collected where appropriate. Samples were kept below 4°C at all times, soil samples submitted for asbestos analysis are not required to be kept below 4°C.

11.6 Data Quality Indicators

The pre-determined data quality indicators for the validation program are discussed below in relation to precision, accuracy, representativeness, comparability and completeness and are summarised in the table below:

Table 17: Data Quality Indicator for the proposed Validation Program

Data Quality Indicator	Frequency	DQI Indicator
Completeness		
Data from critical samples is considered valid	All samples	All samples
Satisfactory frequency / result for QC samples	All samples	95%
Field documentation completed	All samples	All samples
Boreholes logs & COCs completed and holding times complied with.	All samples	All samples
Comparability		
Standard operating procedures used	All samples	All samples
Consistent field conditions, sampling staff and laboratory analysis	All samples	All samples
Same analytical methods used	All samples	All samples
Limit of reporting appropriate and consistent	All samples	All samples
Representativeness		
Sampling appropriate for media and analytes	All samples	All samples
Samples adequately preserved	All samples	All samples

Data Quality Indicator	Frequency	DQI Indicator
Precision		
SOPs appropriate and complied with in relation to field duplicates	All samples	All samples
RPDs of the field duplicates within control limits	1/20 samples	<50% RPD
RPDs of the laboratory duplicates within control limits	All samples	All samples
Accuracy		
SOPs appropriate and complied with in relation to field blanks	All samples	All samples
Rinsate Blanks, trip blanks & laboratory blanks free of contaminants	Laboratory blanks (LB) = 1 per batch Rinsate Blanks (RB) = 1 / day Trip Blank (TB)= 1/day	LB = <LOR RB= <LOR TB= <LOR
Surrogate spikes within control limits	All organic analytes	70-130%
Laboratory control spikes within control limits	Yes	Yes
Matrix Spike recoveries within control limits	1 /20 samples	70-130%
Trip spike recoveries within control limits	1/day	>70%

12.0 ENVIRONMENTAL MANAGEMENT PLAN

A site specific Construction Environmental Management Plan (CEMP) should be prepared for the construction phase for the proposed development. The CEMP should set out the requirements for environmental management during the works including:

- Management structure and responsibilities;
- Approval and licensing requirements;
- Environmental induction and training;
- Emergency contacts;
- Environmental incident response;
- Implementation of the plan;
- Community consultation process; and
- Monitoring required during the works and the process for review of the CEMP, if required.

13.0 SITE MANAGEMENT PLAN

Adherence to the SMP will be monitored by an on-site Environmental Scientist who will be present during all critical remediation / validations works. The Site Management Plan (SMP) for the remediation will address:

- Site access;
- Working hours;
- Stormwater and soil management;
- Traffic management;
- Noise, dust and odour control; and
- Work health and safety.

Each of the issues to be addressed in the site management plan is briefly discussed in the following sections.

13.1 General

The remediation and validation works must be undertaken in accordance with applicable statutory requirements. The site manager/foreman of the remediation contractor should have a thorough understanding of the contents of the RAP, corresponding Site Management Plan (SMP), Work Health & Safety Plan (WHS) and should ensure that each employee or sub-contractor is familiarised with the requirements of these plans.

The remediation and validation works will be undertaken under the monitoring of the principal's environmental representative, who will be represented on-site by a field environmental scientist.

13.2 Site access

The contractor will ensure that adequate barriers have been placed around the site to prevent access of unauthorised personnel to areas where contaminated material is exposed. The contractor will also place adequate warning signs around the site.

13.3 Working hours

The working hours for the remediation / validation works will be between 7.00am to 5.00pm Mondays to Fridays and 7.00am to 1.00pm on Saturdays. No work will be carried out on Sundays and public holidays.

13.4 Demolition (including Asbestos Management)

Demolition works are to be completed in accordance with NSW WorkCover Standards and Codes of Practice. Any asbestos identified within the building materials should be managed in accordance with the NSW WorkCover Codes of Practice and Australian Standards.

13.5 Surface water and soil management

The contractor will put in place adequate stormwater runoff, run-on and sediment control measures for the remedial works. These requirements are outlined in Schedule B (9) of the (*site contamination*) NEPM (2013).

These include stockpiling excavated soil in a manner that will prevent contamination from being transported off-site by stormwater, and include the following measures:

- Divert stormwater runoff outside the site so that it does not flow through the site;
- Control drainage on the site by intercepting and redirecting runoff in a controlled manner;
- Stormwater collected at the site in trenches and sumps should be appropriately managed; and
- Silt stop fences should be erected at locations where stormwater may flow outside the site.

The presence of sediment in surface water or runoff must be minimised by the use of sediment controls such as diversion drains, hay bales and silt fencing.

Soils that require stockpiling must be managed in such a manner that these materials remain well contained and easily identifiable and that the effects of wind and rain have minimal impact on their integrity. Subsequently, if adverse weather conditions are anticipated, or if the stockpile is to remain on-site for an extended period, stockpiles must be protected and covered. Stockpile records must be maintained to track the re-use of soils at the site (if any).

Any plant or equipment that comes into contact with soils must be inspected prior to leaving the site, and cleaned as necessary.

13.6 Groundwater management

If groundwater is encountered during excavation works, the groundwater is to be directed to and collected in trenches and sumps. No discharge of groundwater will occur without approval of appropriate regulatory bodies.

13.7 Traffic management

The management of the material leaving the site will be under the monitoring of the principal's environmental representative, who will record the details of these materials.

Vehicular movement is to be conducted in accordance with Council requirements. The contractor will install a vehicle wheel washing or shaking facility and will manage all vehicles as indicated by the principal's environmental representative (Benviron Group) to minimise tracking of any materials onto public roads. The wheels of the vehicles will be washed and brushed prior to leaving the site. Loads leaving the site should be maintained moist and must be covered to prevent materials from the site being spilled or left on public or private roadway or adjacent areas. Particular care should be taken if UST or any unexpected material have been encountered and are to be removed from the site.

13.8 Noise Control

The contractor should keep noise levels to a minimum and levels should not exceed limits indicated in AS 2436 1981. Noise levels must also comply with Council and NSW EPA requirements. It is expected that the equipment to be used in the remediation works will not generate noise levels above these requirements.

13.9 Dust control

Works must comply with the requirements listed in Schedule B (9) of the NEPM (2013), Council and the NSW EPA. The generation of dust should be kept to a minimum. Stockpiled contaminated material should be bunded and covered. Water sprays may be used to minimise dust. Water used for this purpose should not be allowed to flow off-site through the stormwater system, sewer, or any other way.

13.10 Odour control

The level of odours generated during remedial activities must be monitored and local Council and NSW EPA requirements must be complied with. Due to the nature of contamination, odours may be encountered. It is noted however that it is expected only small volumes of fill will be excavated at one time and this should minimise the generation of significant odours.

Should odorous compounds be encountered, the remediation contractor should take measures to mitigate them and to prevent their migration outside the site boundaries. This may involve placing the odorous materials as soon as possible in a bunded area,

covered with plastic membrane, and spraying with an odour suppressant approved by the environmental consultant.

13.11 Work Health and Safety Plan

As personnel on-site may be exposed to potentially toxic or hazardous compounds, the Contractor will prepare a site-specific Work Health and Safety Plan (WHS) prior to commencement of remediation and validation work in accordance with relevant legislation. The WHS will identify hazards, assess the risks posed by the hazards and recommend measures to control the hazards. This should include detailed descriptions of vehicle decontamination, protective clothing, equipment and appropriate safety controls that will be adopted during remediation and validation works carried out at the site.

If odours are detected at areas around the site PID measurements will be collected by the on-site Environmental Scientist. If PID readings >30 ppm are recorded breathing masks should be worn by workers in the vicinity of the odour and >300 ppm odour suppressants as well as controlled excavations should be applied.

Personnel working on the site are required to read, understand and apply the requirements of the WHS. All staff working on the site must be inducted by an authorised induction trainer and must sign the relevant induction form.

13.12 Waste / Soil Management Plan (Importation, stockpiles, tracking & disposal)

13.12.1 Imported Soil

Importation of any soil, rock or aggregate is required to meet the following requirements:

- They must be legally able to be imported onto the site in accordance with the Protection of the Environment Operations (Waste) Regulation 2014 and any required consent approvals;
- The soils must meet the remediation criteria for the site (refer to Section 4);
- The soils must be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM) or other materials legally able to be imported onto the site based on a Resource Recovery Exemptions. Where available VENM should be imported in preference to ENM. Soils must be assessed in accordance with the EPA requirements;
- Prior to importation appropriate documentation needs to be provided to, and approved by, the Environmental Consultant and the materials must be inspected at the source site to confirm that there are no signs of contamination;
- The material must be inspected during importation by the Contractor, and any materials not meeting the description given in the provided documentation or displaying signs of contamination will be rejected.

13.12.2 Stockpiles

Stockpiles should be managed to minimise the risk of dust generation, erosion and leaching. The measures required to achieve this should include:

- Restrict the height of stockpiles to reduce dust generation;
- Construct erosion, sediment and runoff control measures;
- Cover stockpiles of contaminated soils to be left on site for more than 24 hours, or if windy conditions are expected;
- Manage the potential for leaching

13.12.3 Waste Tracking

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 with the appropriate approvals obtained from the EPA, if required. Details of all soils removed from the site (**including VENM**) shall be documented by the Contractor with copies of weighbridge slips, tip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and the contractor.

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 contractor.

13.12.4 Waste Disposal

All off-site disposal of wastes, where appropriate, will be undertaken in accordance with the POEO Act.

Any soil and rock to be 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 2014.

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

All materials excavated and removed from the site shall be disposed in accordance with the POEO Act to a facility/site legally able to accept the material. Copies of all necessary approvals from the receiving site shall be given to the contactor prior to any contaminated material being removed from the site.

A record of the disposal of materials will be maintained. Copies of all consignment notes for the transport, receipt, landfill receipts and disposal of all materials (**including VENM**) will be maintained as part of the site log and made available to the Environmental Consultant for inspection and reporting purposes upon request.

13.13 Community Engagement

Community engagement should be carried out in accordance with Schedule B (8) of NEPM (2013). Prior to the start of any remediation works at the site, every owner and occupier of any land located either wholly of partly within 100m of the boundary of the premises should be notified at least 30 days in advance.

14.0 OPERATIONAL CONTROLS

14.1 Fire and explosion hazard

Explosive atmospheres may be present where any petroleum products or other potentially flammable or explosive substance is encountered / used, including machinery. Therefore, the contractor will put into place measures to prevent fires and explosions, which include:

- pumping and degassing of tanks prior to removal:
- preventing access to the site by unauthorised persons;
- forbidding smoking or using naked flame at the site;
- cutting of concrete to be carried out under a blanket of water in proximity to any underground storage tanks;
- approved fire extinguishers to be maintained in proximity to excavations;
- ensuring that no free product or fuel used for refuelling equipment enters a confined space or drainage/sewer system; and
- using only certified flameproof equipment in proximity to locations where free petroleum fuel is present or is expected to be present.

14.2 Public complaints registry

Given the nature of the remediation and validation works, it is considered that a community relations plan is not required.

14.3 Duties of the on-site environmental scientist

The duties of the on-site environmental scientist include:

- ensure adherence to the Remediation Action Plan, the Work Health and Safety Plan and other plans applicable to the site;
- monitor the excavation of contaminated material undertaken at the site;
- ensure environmental compliance of contractors;
- monitoring with a PID the areas adjacent to open excavated pits at least three times throughout the day, and at additional times if strong or unusual odours or if unusual substances are encountered during the excavations part of the remediation works;
- inspection of the integrity of the sediment controls placed around the site;
- inspection at approximately two hourly intervals of the roadway in the vicinity of the site used by the vehicles leaving the site to ensure that no significant amounts of materials have been tracked off-site by vehicles;
- immediately report actual or potential non-compliances to the principal's environmental representative who will report those to appropriate regulatory bodies ;
- note weather conditions, approximate temperature, direction and velocity of the wind, and rainfall at the commencement of work, at about midday and at the end of the day;
- collect samples for validation or other purposes as required by the principal's environmental representative;
- maintain a site diary which will record the following information:
    - date
    - weather conditions
    - presence of odours at the site and at the site boundaries

- PID measurements
- details of materials excavated during the remediation works, and details of actions taken if unexpected materials are encountered
- details of accidents, near misses or incidents, which may have resulted in injury, and the actions taken to prevent their recurrence
- details of environmental issues, which may result in environmental incidents and measures taken to correct them
- details of visitors to the site or other matters relating to environmental or health issues

14.4 Unexpected occurrences

If during remediation works, significant odours and/or evidence of gross contamination not previously detected are encountered, or any other significant unexpected occurrence, site works should cease in that area, at least temporarily, and immediate action taken to abate the odours or prevent / manage cross-contamination occurring. If required, the administering authority will be notified in writing within two working days of significant unexpected occurrence and informed of the remediation actions implemented.

14.5 Non-compliances

If the on-site environmental scientist suspects that some works carried out at the site do not comply with the requirements of the RAP, the WHS or other plans applicable to the site, this should be reported immediately to the principal's environmental representative. If the principal's environmental representative cannot be contacted or if immediate action is required, the on-site environmental scientist has authority to stop

the work or request appropriate action to be taken. This is particularly the case under the following circumstances:

- injury to person due to exposure to materials excavated from the site;
- spillage of materials at the site or on areas adjacent to the site; and
- other events that the environmental scientist believes could give rise to unacceptable risk to human health or to adverse impact to the site or to areas adjacent to the site.

15.0 CONTINGENCY MANAGEMENT

The conditions that may be encountered when excavating are uncertain. As unknown and variable subsurface conditions impose a degree of uncertainty for the project a set of anticipated conditions has been assumed in developing the excavation plan. However, because field conditions vary, flexibility has been built into the excavation plan to adapt to differing conditions.

Table 18: Contingency Management

Anticipated Problem	Corrective Action By Contractor
Asbestos cement sheeting, lagging, pipping etc.	Stop excavations if there is the potential for people to inhale airborne asbestos fibres. Contact Benviron Group immediately to assess whether the material is asbestos. Cover the area with plastic and suppress dust by wetting down if needed. Place a warning sign at the entrance to the site where asbestos removal or site remediation is taking place. Adhere to WHS regulations and follow the unexpected finds protocol outlined in 15.2 & Appendix A.
Discovery of USTs	Stop excavations, contact Benviron Group immediately. Follow the unexpected finds protocol and UST finds protocol outlined in section 15.2 & 15.3 & Appendix A.
Chemical spill / exposure	Stop work, refer to Occupational Health, Safety and Rehabilitation Plan and immediately contact Benviron Group.
Excessive rain	Maintain access roads, cover high-traffic areas with gravel; or cover working areas/stockpiles with plastic during off-shifts; or shut down operations until runoff is more manageable. Inspect & maintain sediment control pond & filter fences.
Unmanageable mud in excavation zone	Improve drainage collection system; add geotextile/gravel in problem areas; or strip off mud/slurry materials; or excavate from the top of the fill.

Excessive drainage	Minimise active/contaminated work area; or improve diversion clean run-on; or maintain sufficient on-site wastewater storage capacity; or mobilise additional storage and/or treatment systems as needed.
Excessive dust	Use water sprays or biodegradable dust sprays, or cease dust-generating activity until better dust control can be achieved, or apply interim capping systems.
Sediment pond water for discharge – analytical results exceed site response levels	Perform in-situ treatment, e.g. flocculants dosing, until response levels are met. Alternatively arrange off-site disposal by a licensed Contractor.
Excessively wet materials	Stockpile and dewater on-site; or add absorbents.
Equipment failures	Maintain spare equipment or parts; or maintain alternate rental options; or shut down affected operations until repairs are made.
Release of fuel/oil from machinery	Remove source, use absorbent booms to remove oil and make any repairs as required.
Silt fence fails	Stop work and repair fence to specifications.
Excessive noise	Identify source and review noise attenuation equipment and as necessary provide silencers on noisy equipment.

Excessive odours / vapours	If excessive organic odours / vapours are generated, stop works and monitor for volatiles at the site boundaries using PID and upgrade PPE if necessary. Implement control measures including respirators for on-site workers, wetting down excavated material, use of odour and volatile suppressing agents to eliminate or reduce odours as required and/or cover odorous material if practicable. Benviron Group notes that no nuisance odours shall be detected at any site boundary as part of the remedial works. If odours/vapours are detected then it is recommended, as part of the CEMP & community consultation procedure, that the project manager, client and remediation contractor: 1. Notify the owners / occupiers of the adjoining premises in writing regarding the potential odour issues. Include contact details for any concerns in relation to the odour emissions during remediation. 2. Temporarily pause site works to allow excessive odour to subside whilst implementing the control measures. 3. Record logs for volatile emissions and odours.
Excavation extends below water table into natural materials which are assessed and confirmed to comprise potential acid sulphate soils (PASS).	Implement Acid Sulphate Soils management plan. This will include on-site treatment of the soils in the excavation area. Treatment would likely involve lime addition at a rate to be calculated using methods specified in the ASS Manual (1998).
Unearthing drummed material	Isolate and contact Superintendent. Arrange temporary storage in a secure part of the remediation site (to be nominated).
Identification of cultural or building heritage items	Stop work and notify project manager. Follow the unexpected finds protocol as detailed in section 15.2 & Appendix A.

Complaint Management	Notify client, project managers, and environmental consultant following complaint. Report complaint as per internal procedures, implement control measures to address complaint and notify complainant of the results of the remedial actions.

In addition to the above listed contingencies, the following steps may need to be undertaken should non-spadeable sludge's or buried drums be discovered during the remediation works:

- upgrade of personal protective equipment (PPE), for workers within the active work zone, in accordance with the site Occupational Health, Safety and Rehabilitation Plan;
- segregation and bunding of discovered material;
- use of odour suppressants (where appropriate);
- cover the discovered material with plastic sheeting;
- appropriate sampling and analysis to assess potential contaminants; and
- appropriate off-site disposal of the materials following receipt of analytical results and any associated regulatory approvals required.

15.1 Contact Persons

Table 19: Contact Persons

Responsible Party	Details
Principal Environmental Representative	Benviron Group PO Box 4405, East Gosford NSW 2250 Benjamin Buckley
Project Manager and Client	32 Joseph Street Pty Ltd 32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

15.2 Unexpected Finds Protocol

The sampling strategy for each "unexpected find" shall be designed by a suitably qualified environmental consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance / materials shall meet the following minimum requirements:

- Excavation Floor
  - 1 sample every 25m^3, with a minimum of three samples recovered.
  - Samples should be analysed for the chemicals of concern.
- Excavation Wall
  - 1 sample every 5m (from each distinct horizon / material type)
  - Samples should be analysed for the chemicals of concern.

All additional works should be documented by the use of field notes, site photographs, site plans and reporting.

Refer to **Appendix A** for a copy of the Unexpected Finds Protocol.

15.3 USTs

Any unexpected UST's found within the site should be removed in accordance with NSW WorkCover & UPSS Regulation 2014 requirements, and AS4897-2008: The design, installation and operation of underground petroleum storage systems. In the event of conflict between the guidance documents, the latter shall prevail. Due to the volatile nature of petroleum storage tanks, it is recommended that the USTs be excavated and disposed of by an experienced contractor and with an environmental representative present.

Following the removal of any USTs and associated visibly stained or odorous soils, in samples should be collected from the walls and floor of the tank-pits/hotspots and submitted to a NATA accredited laboratory for analysis. The targeted analytes should be, but not be limited to, heavy metals, TPH, BTEX & PAH.

The minimum sampling protocols to be used for unexpected UST areas include:

- 3 samples per backfill UST sands per UST pit;
- 1 sample per tank line;
- 1 sample per vent pipe area;
- 1 sample per spill box (currently not present but may be found);
- 2 base samples and 8 wall (2 samples per wall face) of each tank pit

15.4 Groundwater Contingency

If groundwater contamination is observed during the remediation process, it is recommended to assess the potential impact on the proposed development.

16.0 REGULATORY APPROVALS AND LICENSES

16.1 State Environmental Planning Policies

State Environmental Planning Policy No 55 (SEPP 55) – Remediation of Land sets the regulatory framework for contaminated land and remediation works in NSW. SEPP 55 defines the regulations for Category 1 and Category 2 remediation works. The remedial works to be undertaken at the site constitute Category 2 works (as defined in SEPP 55). Appropriate permissions for remediation should be obtained prior to commencement.

16.2 State Protection of the Environmental Operations (UPSS) Regulation 2014

UPSS Regulation requires if a storage system is decommissioned, a report for the storage system must be served on the relevant authority within 60 days of decommissioning or remediation is completed. The report must be prepared by a duly qualified person in accordance with EPA guidelines, and must describe the processes used to decommission the storage system and assess contamination at the storage site.

16.3 Duty to Report

Under Section 60 of the Contaminated Land Management Act 1997, the owner of the land is required to notify contamination in circumstances as indicated in the NSW EPA (2015) *Guidelines on Duty to Report Contamination under the Contaminated Land Management Act 1997*.

Sites that are significantly impacted by soil, groundwater and ground gases are likely to require notification to the NSW EPA under section 60 of the CLM Act. A decision process

for use by site owners or responsible persons considering reporting contamination under section 60 is provided in Appendix 1 (Figure 1) of the aforementioned guidelines.

16.4 Development Consent and Control Plans

All works should be in accordance with the Cumberland Council Development Control Plans and any development consent issued by Cumberland Council for the development.

16.5 Asbestos Removal Regulations / Work Health Safety Regulations

16.5.1 General

The removal and disposal of asbestos will be managed in accordance with the Work Health and Safety Act (2011) and Work Health and Safety Regulation (2011), "How to Safely Remove Asbestos: Code of Practice (WorkCover 2012), the, NSW WorkCover Guidelines and the NSW EPA Waste Classification Guidelines.

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 7 in Schedule B1.

The WHS Regulations require a person conducting a business or undertaking who commissions the removal of asbestos at the workplace must also ensure asbestos removal work is carried out only by a licensed asbestos removalist who is appropriately licensed to carry out the work, unless specified in the WHS Regulations that a licence is not required.

If asbestos is non-friable, is more than 10m² and has been determined that it should be removed, it must be removed by a licensed asbestos removalist as soon as reasonably practicable. Where it is not reasonably practicable to remove it, control measures must be put in place to eliminate any exposure, so far as is reasonably practicable, or to minimise exposure so far as is reasonably practicable, but always ensuring the exposure standard is not exceeded.

Class A License can remove any amount or quantity of asbestos or ACM, including:

- any amount of friable asbestos or ACM
- any amount of ACD
- any amount of non-friable asbestos or ACM

Class B Licence can remove:

- any amount of non-friable asbestos or ACM
    - Note: A Class B licence is required for removal of more than 10 m2 of non-friable asbestos or ACM but the licence holder can also remove up to 10 m2 of non-friable asbestos or ACM)

- ACD associated with the removal of non-friable asbestos or ACM
    - Note: A Class B licence is required for removal of ACD associated with the removal of more than 10 m² of non-friable asbestos or ACM but the licence holder can also remove ACD associated with removal of up to 10m² of non-friable asbestos or ACM

16.5.2 Notification of Asbestos Removal Works

WorkCover must be notified five days before licensed asbestos removal work is commenced.

Asbestos removalists licensed in NSW can lodge the notification electronically using WorkCover's Asbestos and demolition online notification system or complete the form.

Interstate asbestos removalists who hold an asbestos removal licence issued under another Work Health and Safety Regulation must lodge the notification by completing the notification form.

16.5.3 Notification of Respirable Asbestos Fibre Levels at more than 0.02 fibres / ml

WorkCover must be notified within 5 days when the respirable asbestos fibre levels exceed 0.02 fibres/ml in the removal area.

NSW licensed asbestos removalists and interstate asbestos removalists who hold an asbestos removal licence issued under a work health and safety regulation must lodge the notification by completing the notification form.

16.5.4 Notification of the Emergency Demolition of a Structure or plant involving Asbestos

Notification of the demolition or refurbishment of a structure or plant is required for the following:

- that was constructed or installed before 31 December 2003;
- is located in either a workplace or a residential premises where an emergency has occurred;
- the structure or plant must be demolished; and
- asbestos is fixed or installed in the structure or plant before the emergency has occurred.

Demolition or refurbishment does not include minor or routine maintenance work or other minor work.

An emergency is defined if:

- a structure or plant is structurally unsound
- collapse of the structure or plant is imminent.

The person with management or control of the workplace or, if in residential premises, the licensed asbestos removalist must notify WorkCover by completing the notification form.

Interstate asbestos removalists who hold an asbestos removal licence issued under another work health and safety regulation must also notify WorkCover if the work is located in NSW.

Completed notification forms can be lodged by:

- fax to (02) 9281 7486
- email to adu@workcover.nsw.gov.au

- delivery to, Level 10, Centennial Plaza, Building C, 300 Elizabeth Street, Sydney or any WorkCover office
- post to the Asbestos Demolition Unit, WorkCover NSW, PO Box 1476, Strawberry Hills NSW 2012.

Asbestos notifications are free and the asbestos and demolition hotline number is (02) 8260 5885.

16.6 Protection of the Environment Operations (Waste) Regulations 2005

The regulations make requirements relating to non-licensed waste activities and waste transporting.

Section 42 of the Regulation stipulates special transportation, re-use or recycling requirements relating to asbestos waste and must be complied with regardless whether the activity is licensed.

The requirements for the transportation of asbestos waste include:

- bonded asbestos material must be securely packaged at all times,
- friable asbestos material must be kept in a sealed container,
- asbestos-contaminated soils must be wetted down,
- all asbestos waste must be transported in a covered, leak-proof vehicle.

The requirements relating to the off-site disposal of asbestos waste are as follows:

- asbestos waste in any form must be disposed of only at a landfill site that may lawfully receive the waste,

- when asbestos waste is delivered to a landfill site, the occupier of the landfill site must be informed by the person delivering the waste that the waste contains asbestos,
- when unloading and disposing of asbestos waste at a landfill site, the waste must be unloaded and disposed of in such a manner as to prevent the generation of dust or the stirring up of dust,
- asbestos waste disposed of at a landfill site must be covered with virgin excavated natural material or other material as approved in the facility's environment protection licence.

Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded.

16.7 Other licences required

Transporters of contaminated waste are required to be licensed to transport contaminated waste to licensed landfills. Landfills are required to be licensed for the category of waste they are scheduled to receive.

Waste classification documentation and waste dockets from the receiving landfill should be kept on file for site validation purposes.

If water is discharged as part of any dewatering activities, the relevant discharge consents must be obtained.

The appointed site contractor should prepare appropriate Construction Environmental Management Plans CEMP, work health safety plans & other plans required by the Council DA and DCPs. Where asbestos removal is required, the contractor must be appropriately licensed to carry out the designated works.

17.0 CONCLUSION

It is considered that the site will be suitable for the proposed mixed use multi-story development, subject to the implementation of remediation and validation works in accordance with this RAP.

REFERENCES

- Australian and New Zealand Environment and Conservation Council (ANZECC) (1996) – *Drinking Water Guidelines*.
- Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) – *Guidelines for Fresh and Marine Waters*.
- Benviron Group (2017), "Detailed Site Investigation", 32 Joseph Street & 1 Vaughan Street, Lidcombe NSW, Ref: E1191-2, dated June 2017.
- Department of Urban Affairs and Planning – EPA (1998) "*Managing Land Contamination – Planning Guidelines – SEPP 55 – Remediation of Land*".
- National Environmental Protection Council (NEPC) (1999) – *National Environmental Protection (Assessment of Site Contamination) Measure. Amendment 2013*
- NSW EPA (2014) "*Technical Note: Investigation of Service Station Sites*".
- NSW EPA (2009) "*Guidelines on Significant Risk of Harm from contaminated land and the duty to report*".
- NSW OEH "Guidelines for Consultants Reporting on Contaminated Sites" (2011). NSW Environment Protection Authority, Sydney.
- NSW DEC, "Guidelines for the Assessment and Management of Groundwater Contamination" (March 2007).
- NSW DEC "Guidelines for the NSW Site Auditor Scheme" (2006, 2nd edition). NSW Environment Protection Authority, Sydney.
- NSW EPA (2014) – "Waste Classification Guidelines, Part 1: Classifying Waste";
- NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites" (2011). NSW Environment Protection Authority, Sydney.

- NSW EPA (2014) "Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997";
- NSW EPA "Sampling Design Guidelines" (1995). NSW Environment Protection Authority, Sydney.

18.0 LIMITATIONS

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue, although subsurface conditions, including groundwater levels and contaminant concentrations, can change in a limited time. This should be borne in mind if the report is used after a protracted delay.

There is always some disparity in subsurface conditions across a site that cannot be fully defined by investigation. Hence it is unlikely that measurements and values obtained from sampling and testing during environmental works carried out at a site will characterise the extremes of conditions that exist within the site.

There is no investigation that is thorough enough to preclude the presence of material that presently or in the future, may be considered hazardous at the site. Since regulatory criteria are constantly changing, concentrations of contaminants presently considered low may, in the future, fall under different regulatory standards that require remediation.

Opinions are judgements, which are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions.

FIGURE 1 SITE LOCATION

Key Site Location ———	Benviron group simple sustainable solutions	**DRAWN** MS	SITE LOCATION
		FIGURE 1	32 Joseph Street Pty Ltd
		Job # E1191-2	32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

FIGURE 2: SITE FEATURES AND BOREHOLE LOCATION PLAN

Feature No	Details
1	Service Station (Shop)
2	Bowsers
3	Mechanic Workshop
4	Car parking areas
5	Driveway (entrance & exit)
6	Two storey commercial building
7	Paved Backyard
8	Driveway (poor condition)

* GW2, GW3 & GW4 are existing groundwater wells

Key	
Site Location	
GW & Soil BH	
Soil BH	
USTs	

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DRAWN MS	**Site Features & Borehole Location Plan**
FIGURE 2	32 Joseph Street Pty Ltd
Job # E1191-2	32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

FIGURE 3: HOTSPOTS AND EXCEEDANCE PLAN

Key Inferred GW Flow Site Location GW & Soil BH Soil BH USTs Hotspots	Benviron group simple sustainable solutions	**DRAWN** MS	**Hotspots and Exceedance Plan**
		FIGURE 3	32 Joseph Street Pty Ltd
		Job # E1191-2	32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

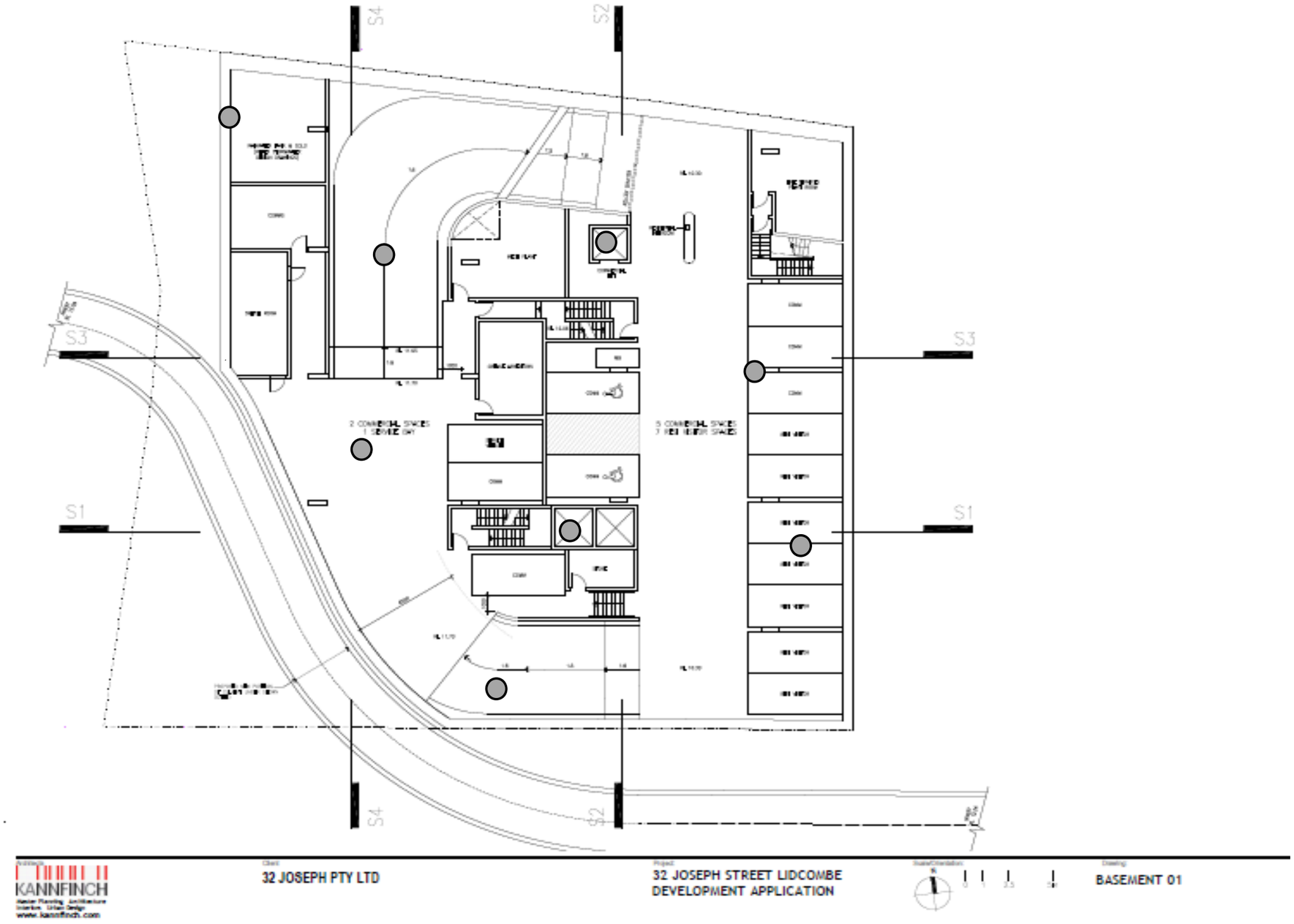
FIGURE 4: PROPOSED ADDITIONAL INVESTIGATION PLAN

Proposed Additional Works

- Soil Vapour Wells
- GW Delineation

Key Inferred GW Flow Site Location GW & Soil BH Soil BH USTs Hotspots	Benviron group simple sustainable solutions	**DRAWN** MS	**Proposed Additional Investigation Plan**
		FIGURE 4	32 Joseph Street Pty Ltd
		Job # E1191-2	32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

FIGURE 5: VALIDATION BASEMENT FLOOR PLAN



Source:

KannFinch Basement Plan dated 15.6.2017 Ref: 6546 DA13

Key

Site Location

Validation Basement

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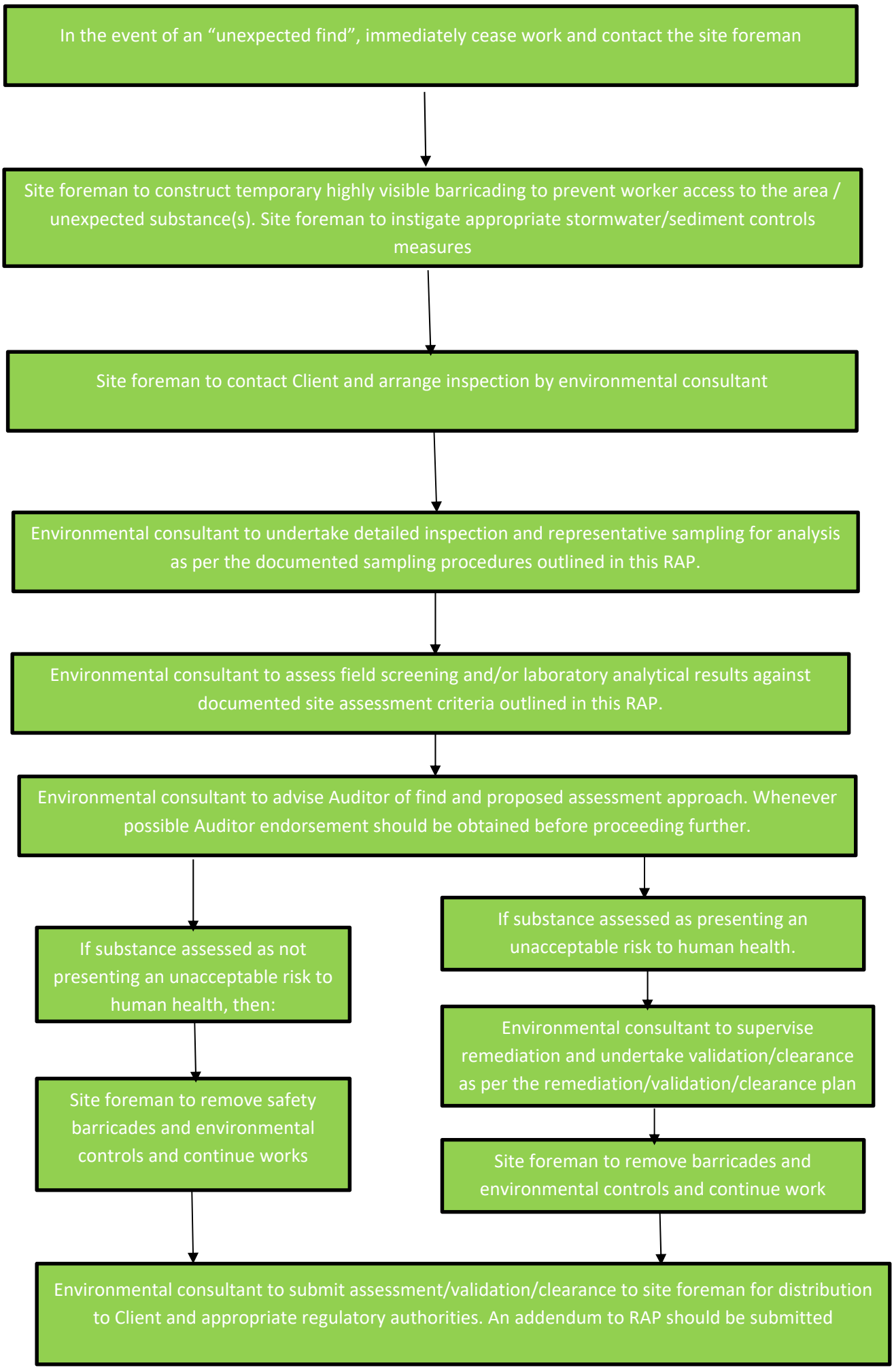
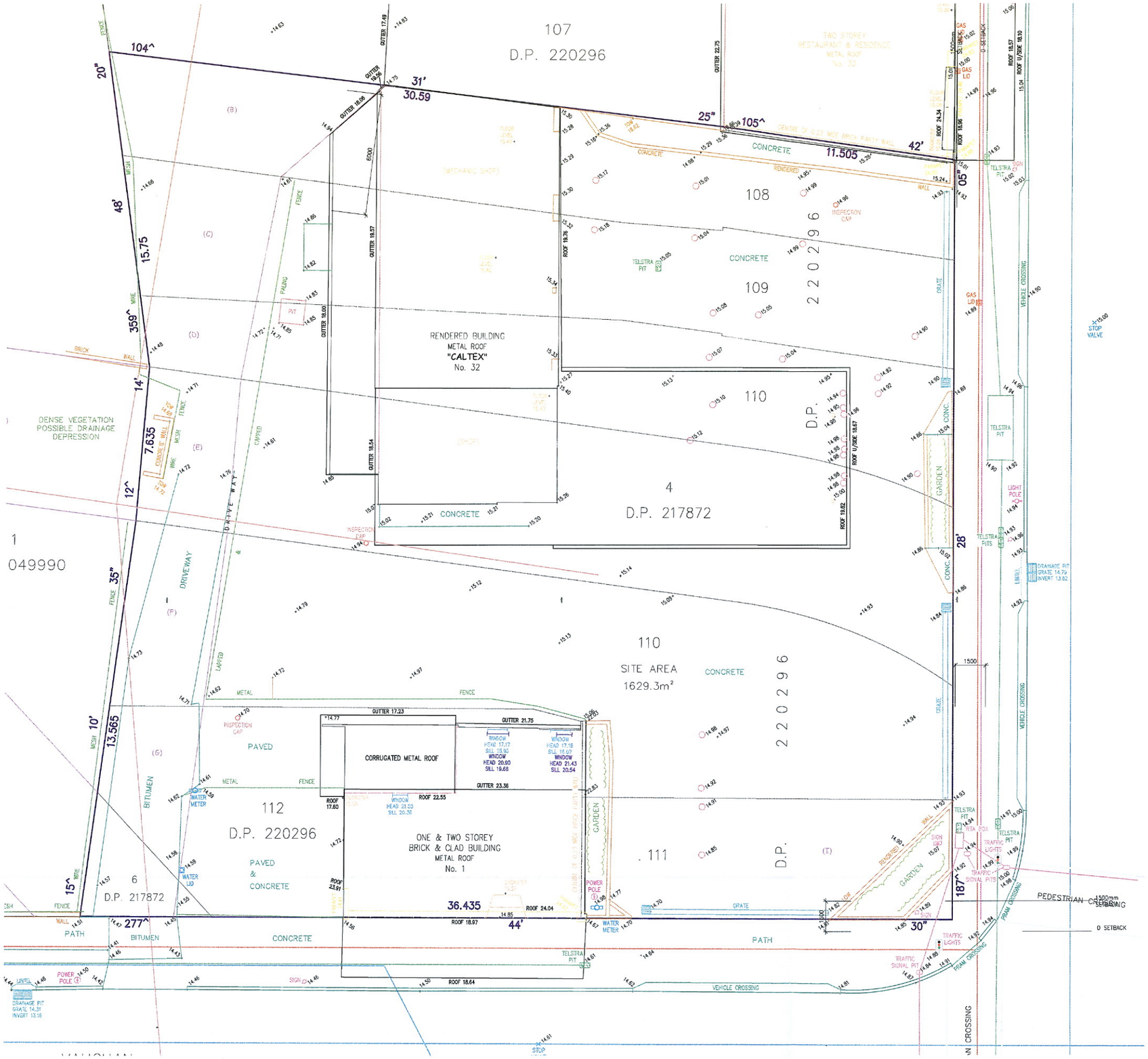
DRAWN MS	**Validation Basement Floor Plan**
FIGURE 5	32 Joseph Street Pty Ltd
Job # E1191-2	32 Joseph Street & 1 Vaughan Street, Lidcombe NSW

APPENDIX A: UNEXPECTED FINDS PROTOCOL


In the event of an “unexpected find”, immediately cease work and contact the site foreman
Site foreman to construct temporary highly visible barricading to prevent worker access to the area / unexpected substance(s). Site foreman to instigate appropriate stormwater/sediment controls measures
Site foreman to contact Client and arrange inspection by environmental consultant
Environmental consultant to undertake detailed inspection and representative sampling for analysis as per the documented sampling procedures outlined in this RAP.
Environmental consultant to assess field screening and/or laboratory analytical results against documented site assessment criteria outlined in this RAP.
Environmental consultant to advise Auditor of find and proposed assessment approach. Whenever possible Auditor endorsement should be obtained before proceeding further.
If substance assessed as not presenting an unacceptable risk to human health, then:
Site foreman to remove safety barricades and environmental controls and continue works
If substance assessed as presenting an unacceptable risk to human health.
Environmental consultant to supervise remediation and undertake validation/clearance as per the remediation/validation/clearance plan
Site foreman to remove barricades and environmental controls and continue work
Environmental consultant to submit assessment/validation/clearance to site foreman for distribution to Client and appropriate regulatory authorities. An addendum to RAP should be submitted

APPENDIX B: PROPOSED DEVELOPMENT PLANS



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Client
32 JOSEPH STREET PTY LTD
C/- PROVENT GROUP PTY LTD

Project
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation: N | 0 | 1 | 2.5 | 5m

Drawing
SURVEY

Project Number: 6546
Drawing Number: DA01

Issue & Date: 23.02.2016

32 JOSEPH STREET, LIDCOMBE

DEVELOPMENT APPLICATION

JUNE 2017

BASIX COMMITMENTS

WATER

- 10,000L RAINWATER TANK TO COLLECT RUNOFF FROM AT LEAST 200m2 OF THE ROOF, CONNECTED TO OUTDOOR TAPS FOR IRRIGATION.
- 3 STAR SHOWERHEADS
- 4 STAR TOILETS
- 4 STAR KITCHEN TAPS
- 5 STAR BASIN TAPS
- 3.5 STAR DISHWASHERS

ENERGY

- HOT WATER SYSTEM – CENTRAL ELECTRIC PUMP (GAS BOOSTED)
- HEATING / COOLING FOR 2 & 3 BED UNITS – 1–PHASE AC EER 3.0–3.5
- HEATING / COOLING FOR 1 BED UNITS – 1 PHASE AC EER 2.5 (LIVING ONLY)
- KITCHEN VENTILATION – INDIVIDUAL FAN, NOT DUCTED, MANUAL ON/OFF
- BATHROOM & LAUNDRY VENTILATION – INDIVIDUAL FAN, DUCTED, MANUAL ON/OFF.
- GAS COOKTOPS, ELECTRIC OVENS
- 3 STAR DISHWASHER
- FLUORESCENT/LED LIGHTING TO ALL BEDROOMS, LIVINGS, KITCHENS, BATHROOMS, LAUNDRIES & HALLWAYS
- CARPARK VENTILATION – SUPPLY & EXHAUST, CARBON MONOXIDE MONITOR & VSD FAN
- OTHER COMMON AREAS VENTILATION – EXHAUST ONLY, TIME CLOCK OR BMS CONTROLLED
- COMMON AREA LIGHTING – FLUORESCENT OR COMPACT FLUORESCENT LIGHTING, TIME CLOCK & MOTION SENSORS OR MANUAL ON/OFF
- LIFTS – GEARED TRACTION WITH V V A C MOTOR

DRAWING LIST

INDICATIVE FSR

	LEVEL	PROPOSED GFA	ALLOWABLE
RESIDENTIAL	GF (LOBBY)	43.4m2	
	L01	807.7m2	
	L02	807.7m2	
	L03	807.7m2	
	L04	807.7m2	
	L05	807.7m2	
	L06	807.7m2	
	L07	807.7m2	
	L08	807.7m2	
	L09	807.7m2	
	L10	494.6m2	
	TOTAL	7807.3m2	
COMMERCIAL	TOTAL	238.3m2	
	SITE AREA	1629.3m2	
	TOTAL GFA	8045.3m2	8146.5m2
	FSR	4.94 : 1	5.00 : 1

APARTMENT MIX

	LEVEL	1BED	2 BED	3 BED	TOTAL
RESIDENTIAL	L01	4	6		10
	L02	4	6		10
	L03	4	6		10
	L04	4	6		10
	L05	4	6		10
	L06	4	6		10
	L07	4	6		10
	L08	4	6		10
	L09	4	6		10
	L10		2	2	4
	TOTAL	36 38%	56 60%	2 2%	94 100%

CAR PARKING (RTA GUIDE TO TRAFFIC GENERATING DEVELOPMENTS)

OBJECTIVE 3J–1 OF THE APARTMENT DESIGN GUIDE STATES 'ON SITES THAT ARE WITHIN 800 METRES OF A RAILWAY STATION OR LIGHT RAIL STOP IN THE SYDNEY METROPOLITAN AREA; THE MINIMUM CAR PARKING REQUIREMENT FOR RESIDENTS AND VISITORS IS SET OUT IN THE 'GUIDE TO TRAFFIC GENERATING DEVELOPMENTS', OR THE CAR PARKING REQUIREMENT PRESCRIBED BY THE RELEVANT COUNCIL, WHICHEVER IS LESS".

1 BEDROOM APARTMENTS	0.4 SPACES PER APT	15 SPACES
2 BEDROOM APARTMENTS	0.7 SPACE PER APT	40 SPACES
3 BEDROOM APARTMENTS	1.2 SPACES PER APT	3 SPACES
TOTAL RESIDENTIAL SPACES REQUIRED		58 SPACES
TOTAL RESIDENTIAL SPACES PROVIDED (B2/B3/B4)		58 SPACES*
VISITOR SPACES	1 SPACE PER 7 APTS	14 SPACES
VISITOR SPACES PROVIDED (B1/B2)		14 SPACES
COMMERCIAL	1.0 SPACE PER 40m2 (240.2m2)	6 SPACES
TOTAL COMMERCIAL SPACES PROVIDED (B1)		7 SPACES**

* INCLUDES 10 ADAPTABLE CAR SPACES IN ACCORDANCE WITH AS4299.

** INCLUDES 2 ACCESSIBLE CAR SPACES IN ACCORDANCE WITH AS1428.1.
1 X EMPLOYEE MOTORBIKE SPACE AND EMPLOYEE BICYCLE PARKING ALSO PROVIDED.

INDICATIVE OPEN SPACE

	LEVEL	PROPOSED AREA	REQUIREMENT
COMMUNAL OPEN SPACE*	GF	77.6m2	
	L01	42.5m2	
	L10	(TERRACE) 152.6m2 (COMMUNAL ROOM**) 37.7m2	
	TOTAL	310.4m2 19%	407.3m2 25%***

* NOTE: COMMUNAL OPEN SPACE HAS BEEN INFERRED AS INCLUDING DELIBERATELY DESIGNED SOFT AND HARD LANDSCAPED AREAS WHICH ALLOW FOR DIFFERENT TYPES OF RECREATIONAL ACTIVITIES. THEY MAY BE PASSIVE (INACCESSIBLE LANDSCAPED PLANTERS WHICH CAN BE VIEWED FROM PEDESTRIAN AREAS OR ONE OR MORE APARTMENTS) OR ACTIVE (E.G. BBQ AND SEATING AREAS, COMMUNAL VEGETABLE PLANTERS ETC.)

** CALCULATION INCLUDES COMMUNAL ROOM WHICH IS DESIGNED AS A NATURAL EXTENSION OF AND WELL–CONNECTED TO THE COMMUNAL OPEN TERRACE.

*** APARTMENT DESIGN GUIDE – WHERE DEVELOPMENTS ARE UNABLE TO ACHIEVE THE DESIGN CRITERIA, SUCH AS ON SMALL LOTS, SITES WITHIN BUSINESS ZONES, OR IN A DENSE URBAN AREA, THEY SHOULD: PROVIDE COMMUNAL SPACES ELSEWHERE SUCH AS A LANDSCAPED ROOFTOP TERRACE OR COMMON ROOM; PROVIDE LARGER BALCONIES OR INCREASED PRIVATE SPACE FOR APARTMENTS; DEMONSTRATE GOOD PROXIMITY TO PUBLIC OPEN SPACE AND FACILITIES.

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Client
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Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
COVER SHEET

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017

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Client
32 JOSEPH PTY LTD

Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

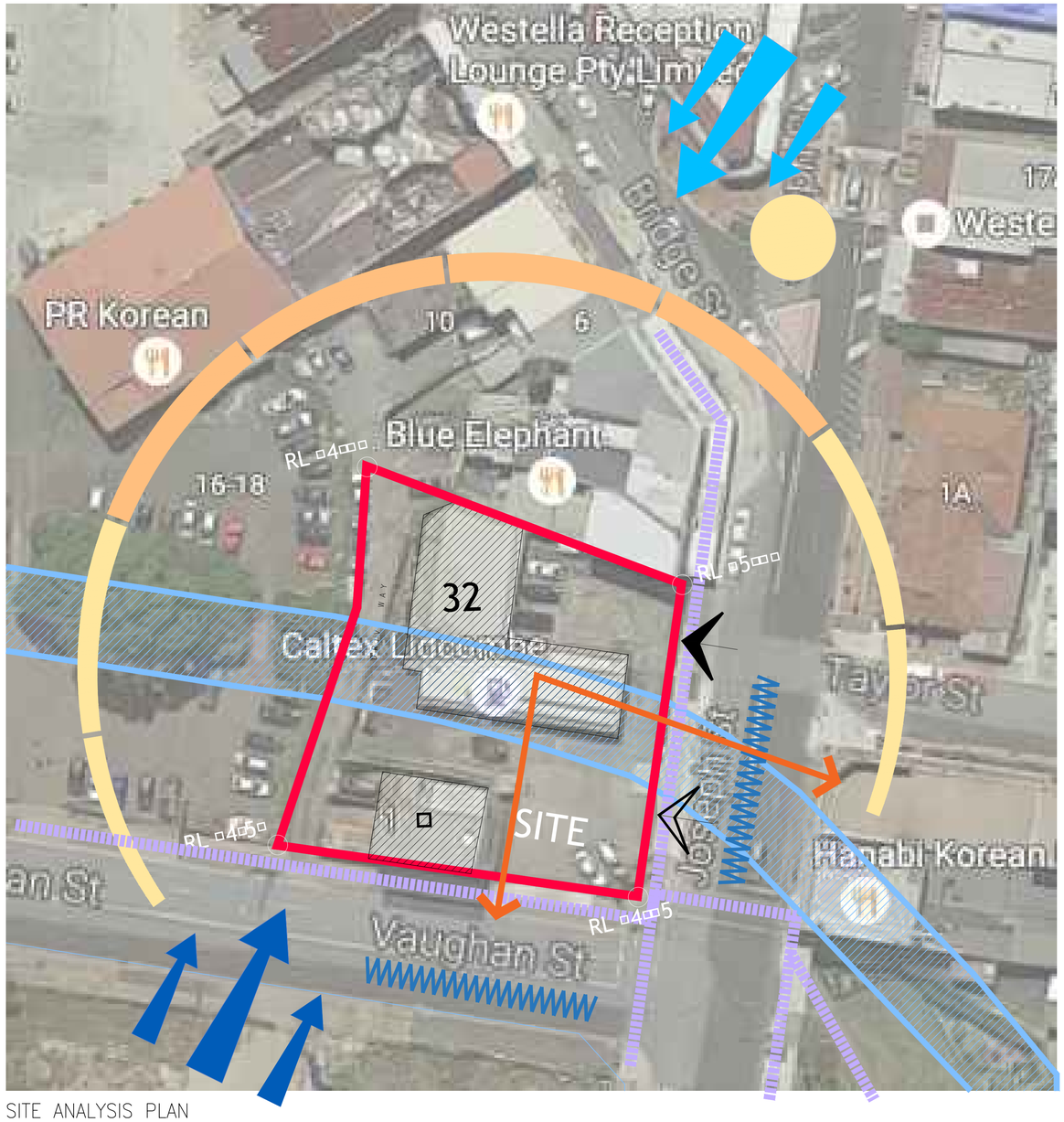
Scale/Orientation:

Drawing:
SURVE□

Project Number: 6546

Drawing Number: DA□ □

Issue & Date: 15.06.2017



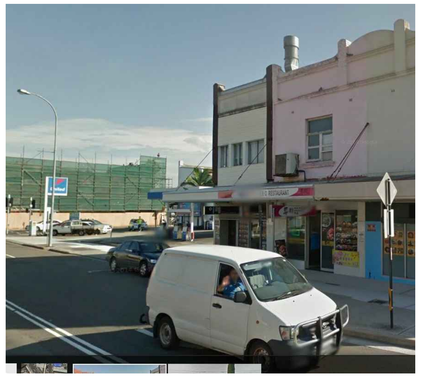
SITE ANALYSIS PLAN

LEGEND

- SITE
- PEDESTRIAN MOVEMENT
- TO BE DEMOLISHED
- EXISTING CULVERT (TO BE RELOCATED)
- SUN PATH
- COLD WINTER SW WINDS
- NE SEE BREEZES IN SUMMER
- POTENTIAL NOISE SOURCE
- DISTRICT VIEWS
- RESIDENTIAL ENTRY
- CARPARK ENTRY

CORNER VAUGHAN St/JOSEPH St LOOKING NORTH

JOSEPH St LOOKING EAST



JOSEPH St LOOKING SOUTH/ EAST

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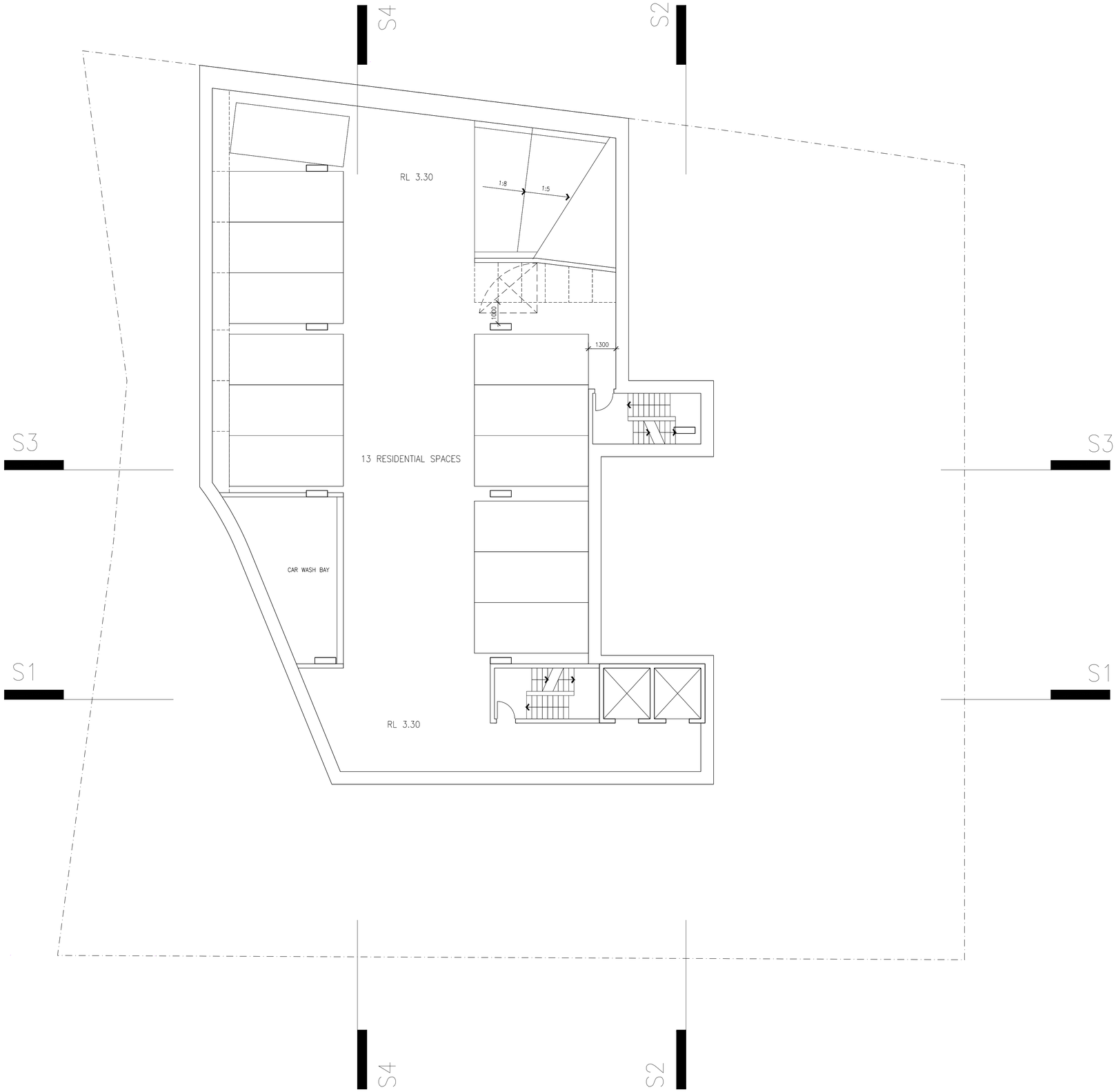
Scale/Orientation: N 0 1 2.5 5m

Drawing:
SITE ANAL□SIS PLAN

Project Number: 6546

Drawing Number: DA□□

Issue & Date: 15.06.2017



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Project:
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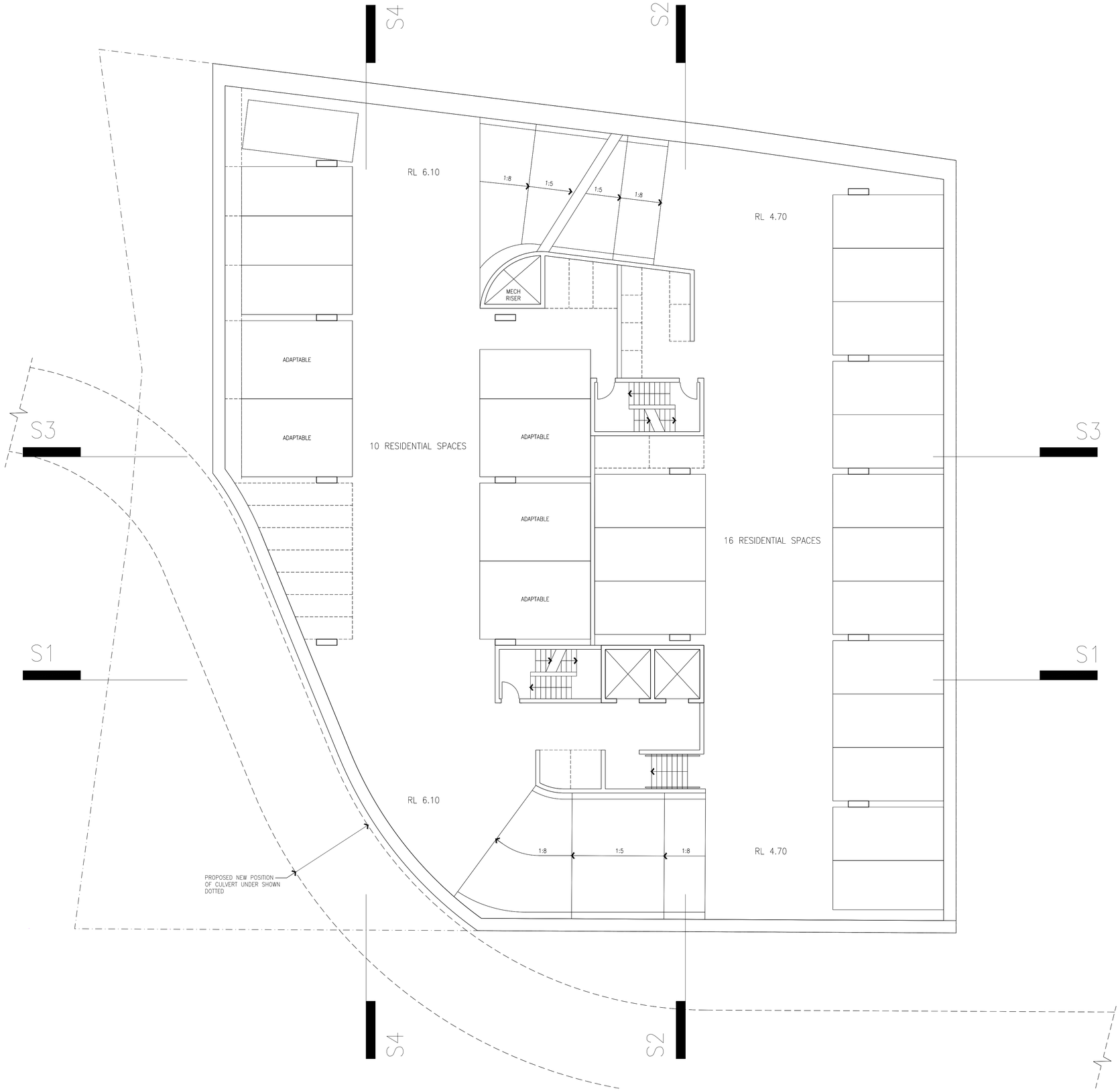
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
BASEMENT □4

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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Project:
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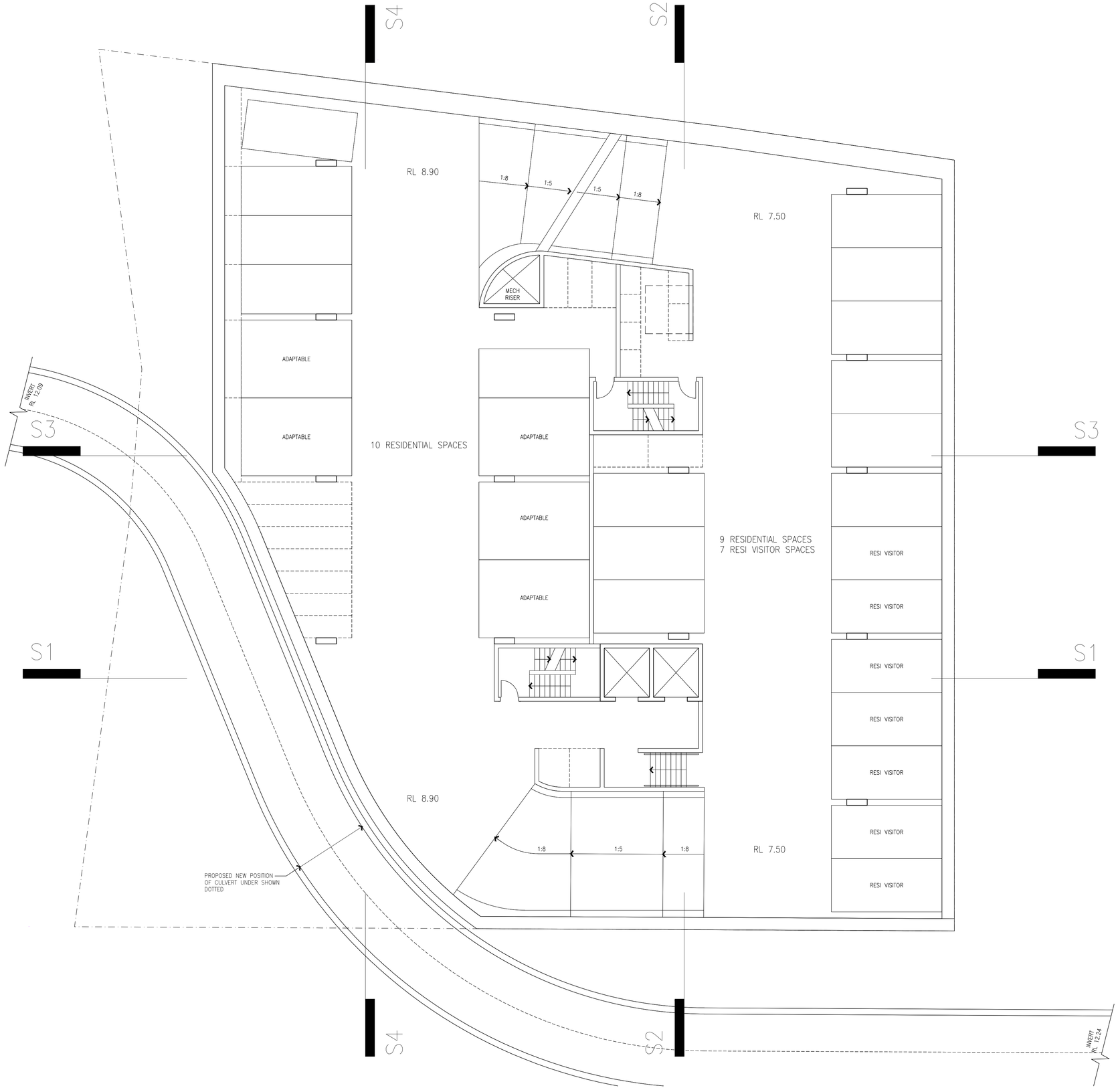
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
BASEMENT □3

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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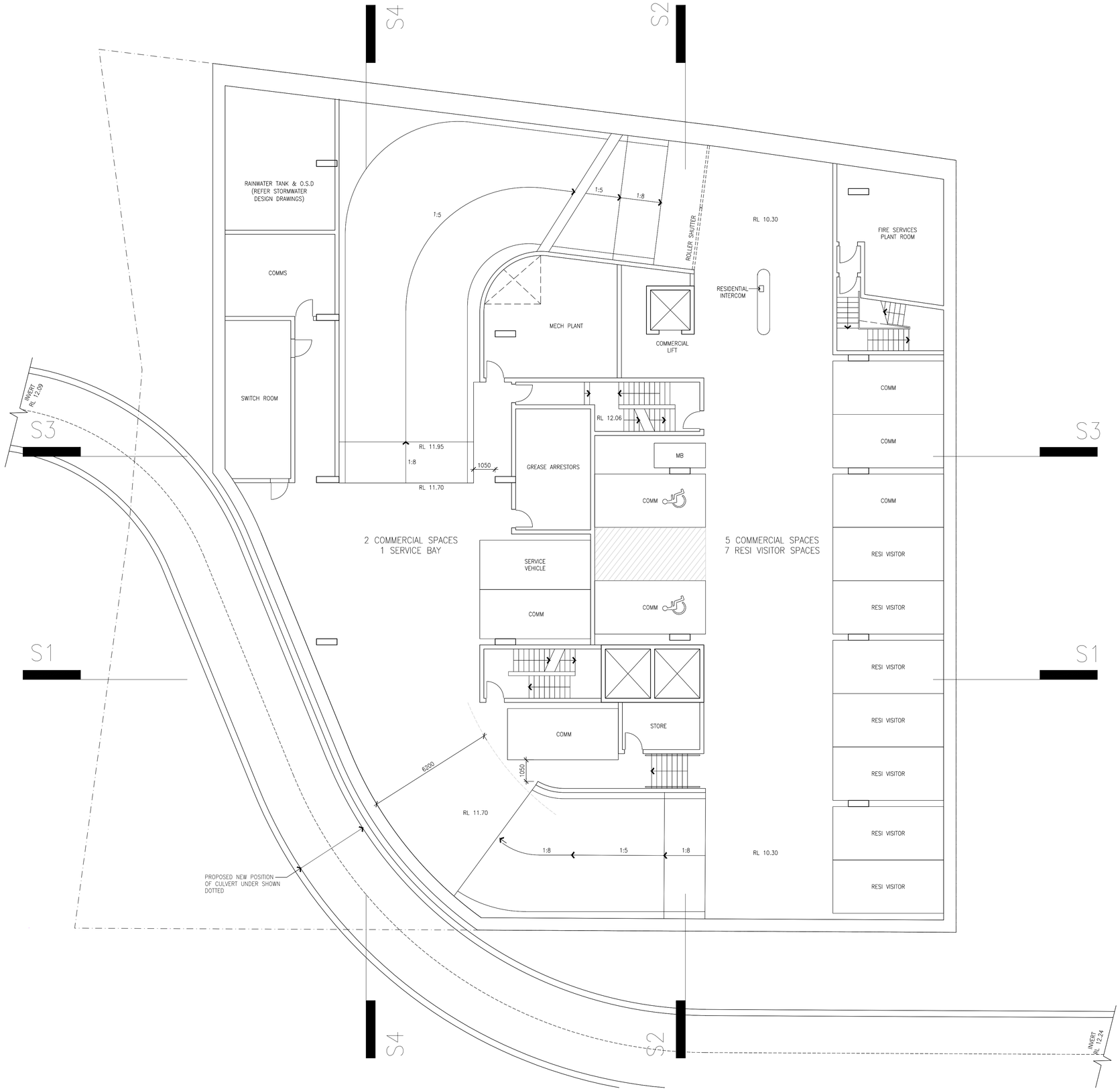
Scale/Orientation:
N
0 1 2.5 5m

Drawing:
BASEMENT □2

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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Project:
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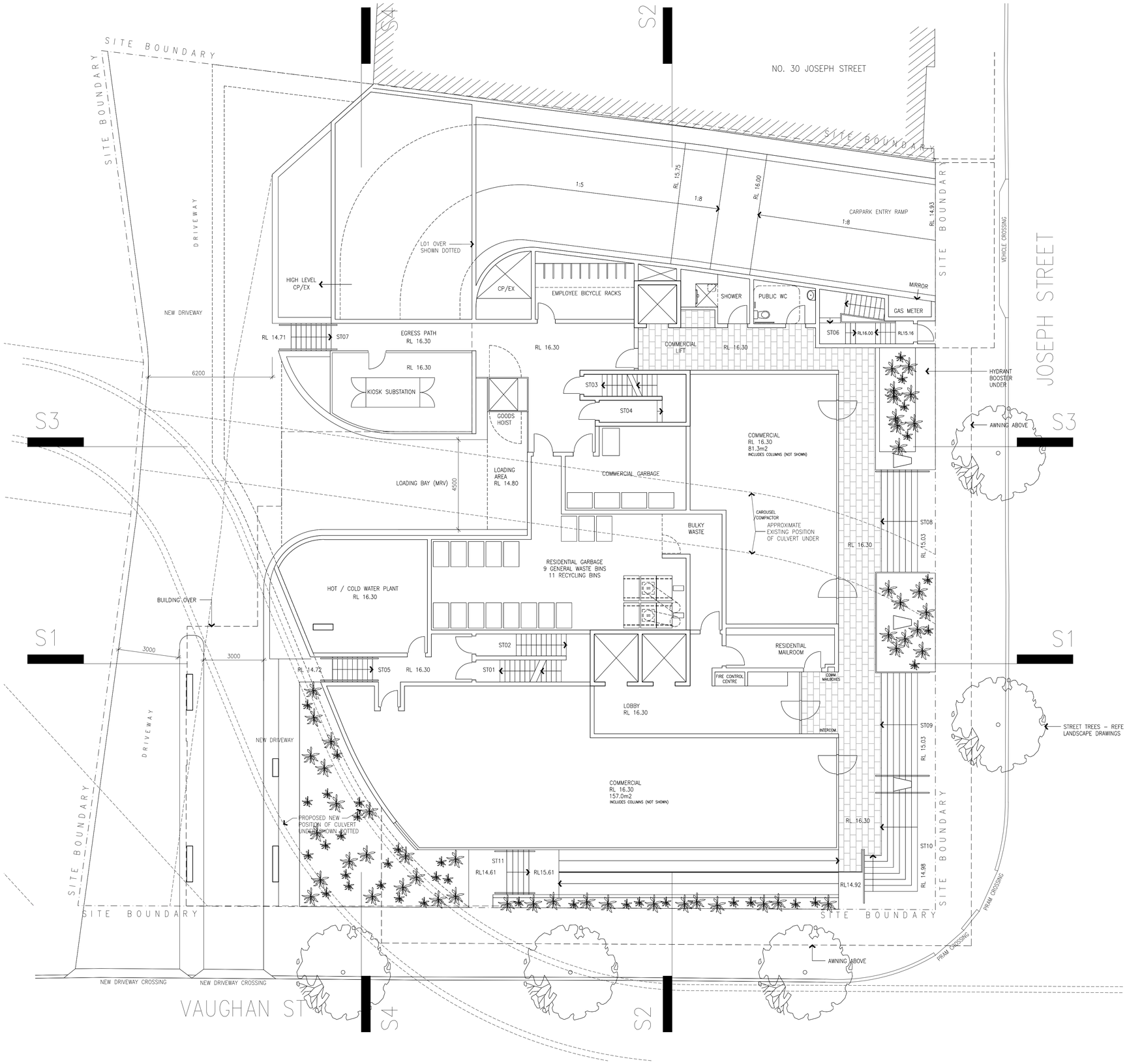
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
BASEMENT □□

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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Client
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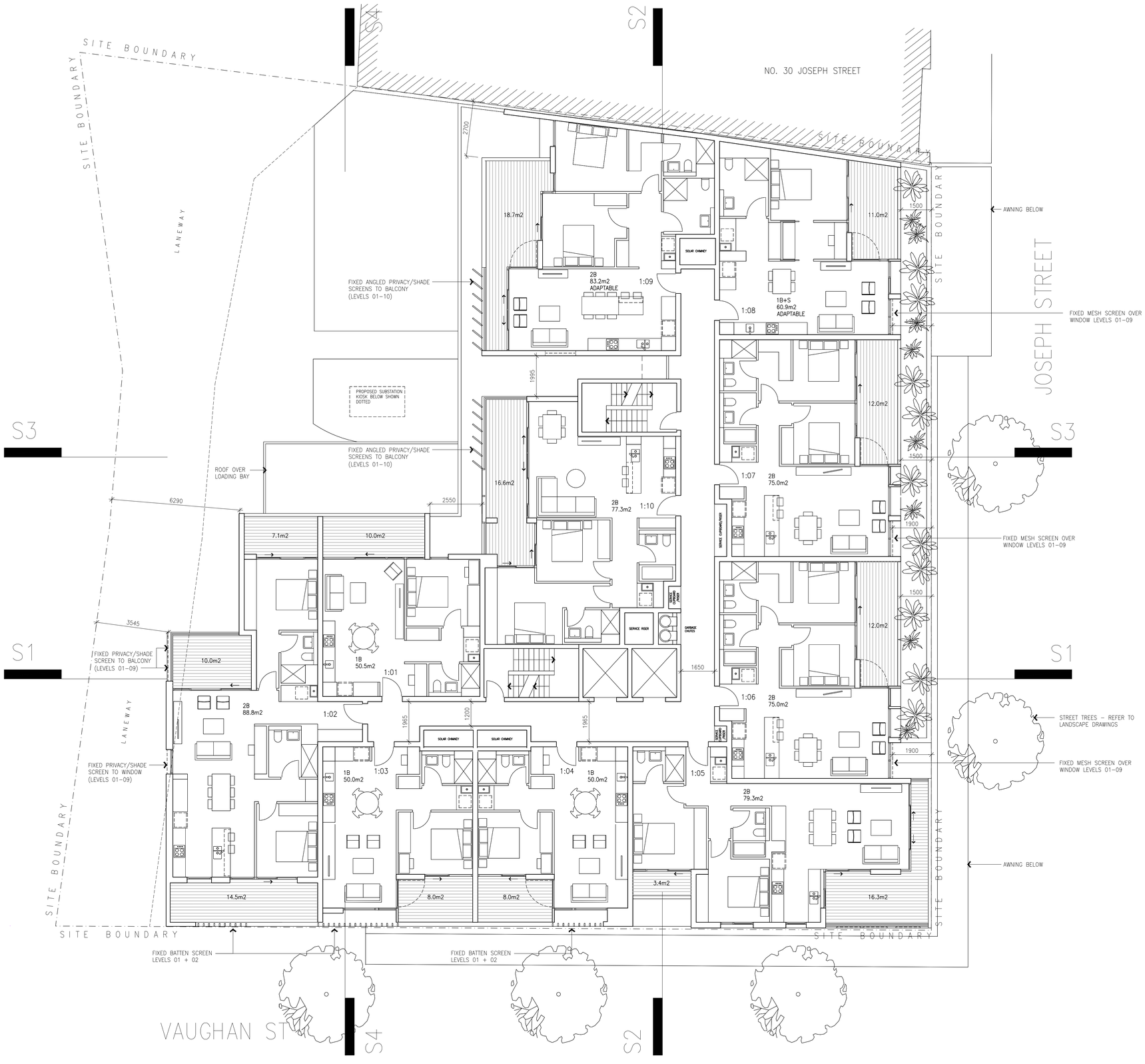
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
GROUND FLOOR

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 28.06.2017



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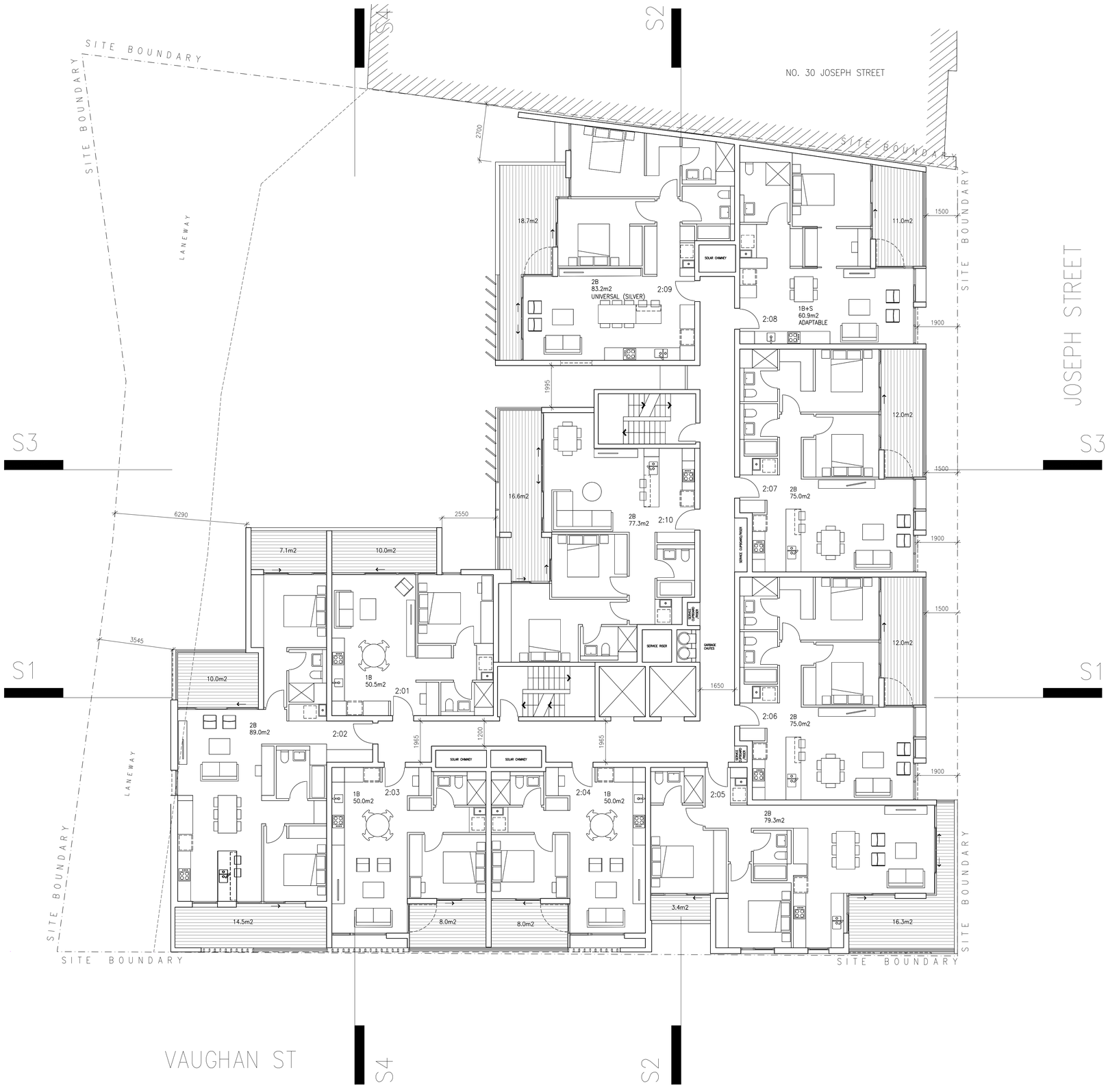
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
LEVEL □□

Project Number: 6546
Drawing Number: DA□ 5

Issue & Date: 15.06.2017



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Client
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Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation: N 0 1 2.5 5m

Drawing:
LEVEL 2

Project Number: 6546
Drawing Number: DA 6

Issue & Date: 15.06.2017

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Client
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Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
LEVEL □3

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017

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Client
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Project:
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DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
LEVEL □4

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017

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Client
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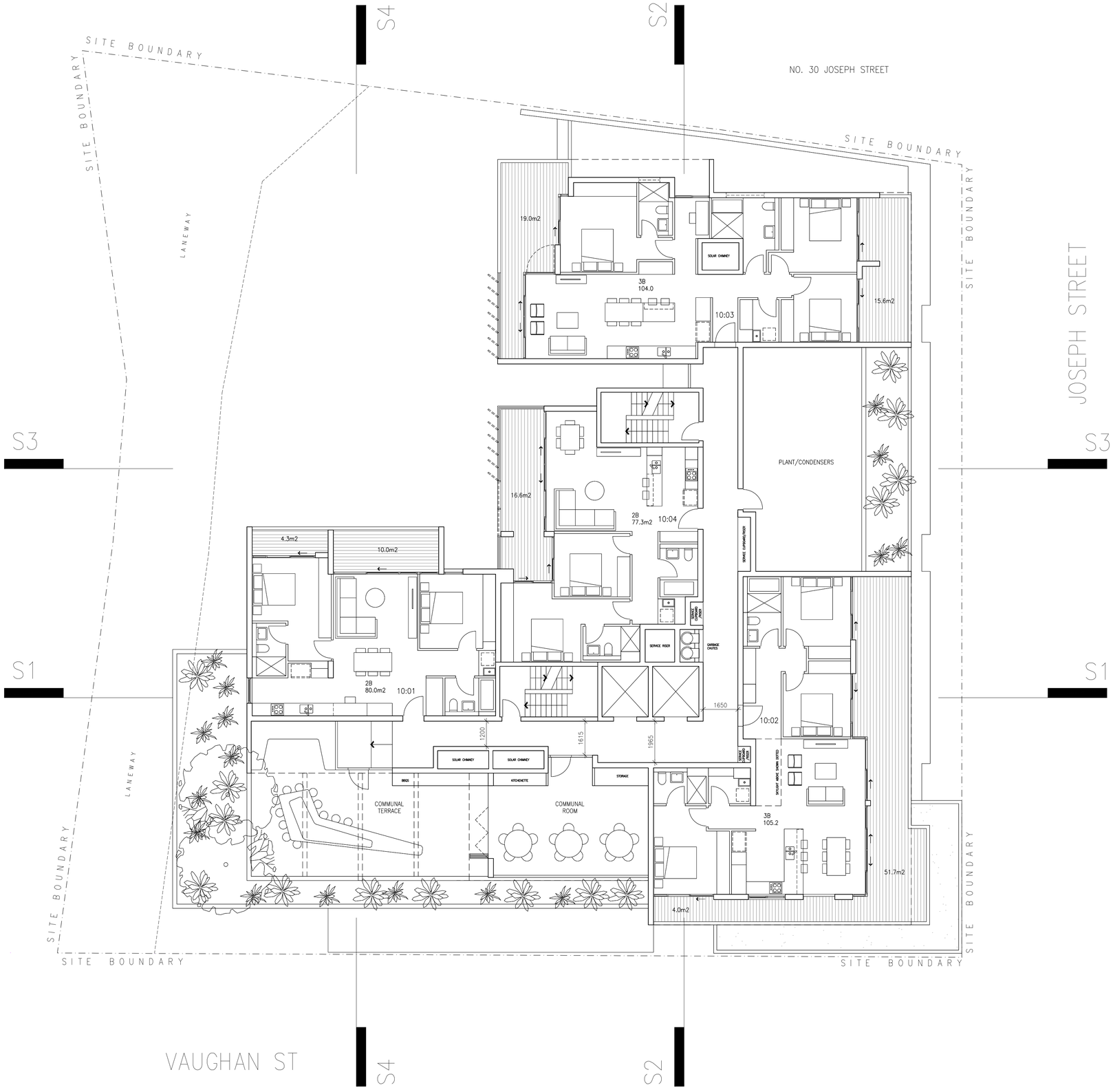
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
LEVELS □5□□

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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Project:
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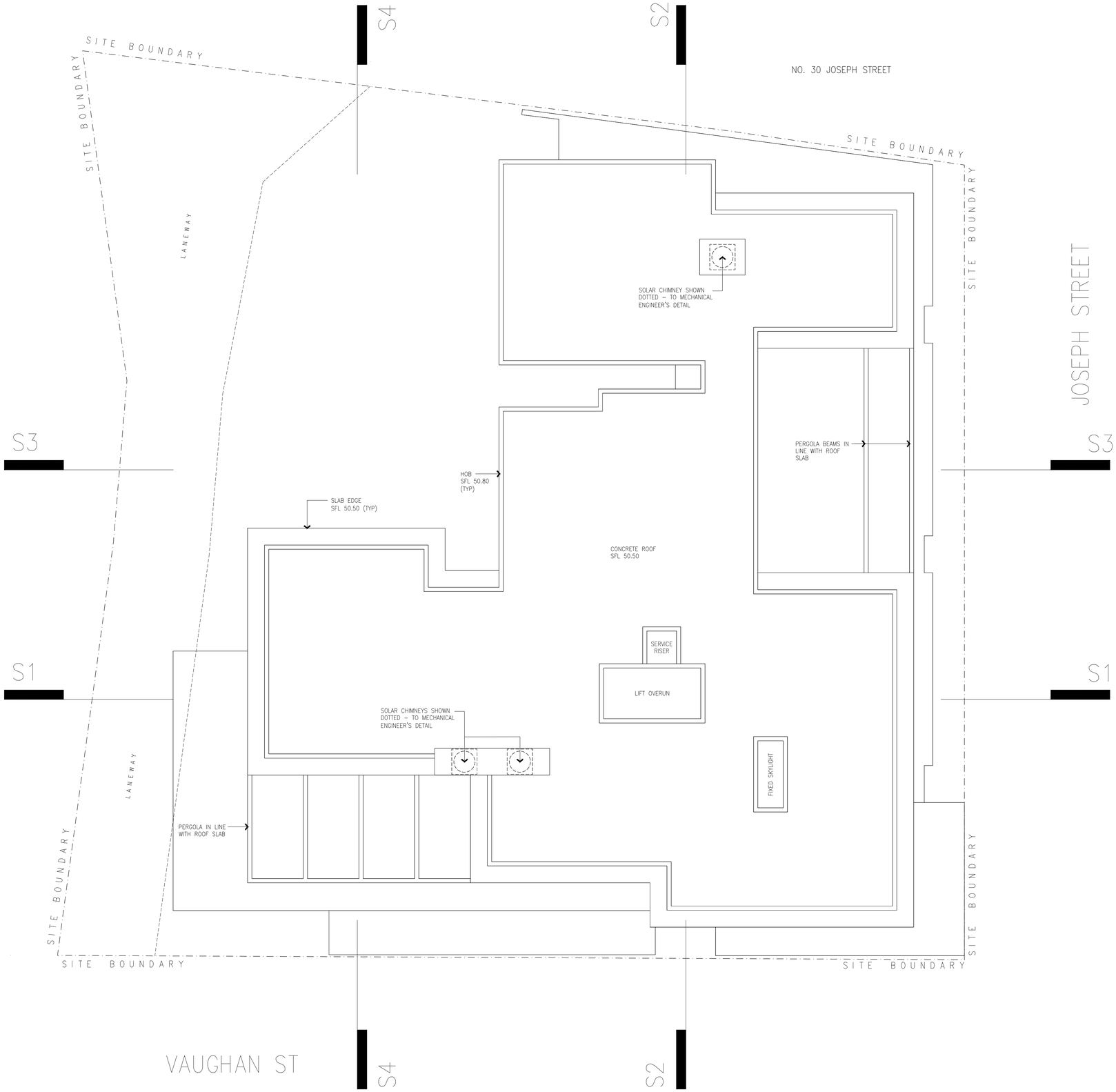
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
LEVEL □□

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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Client
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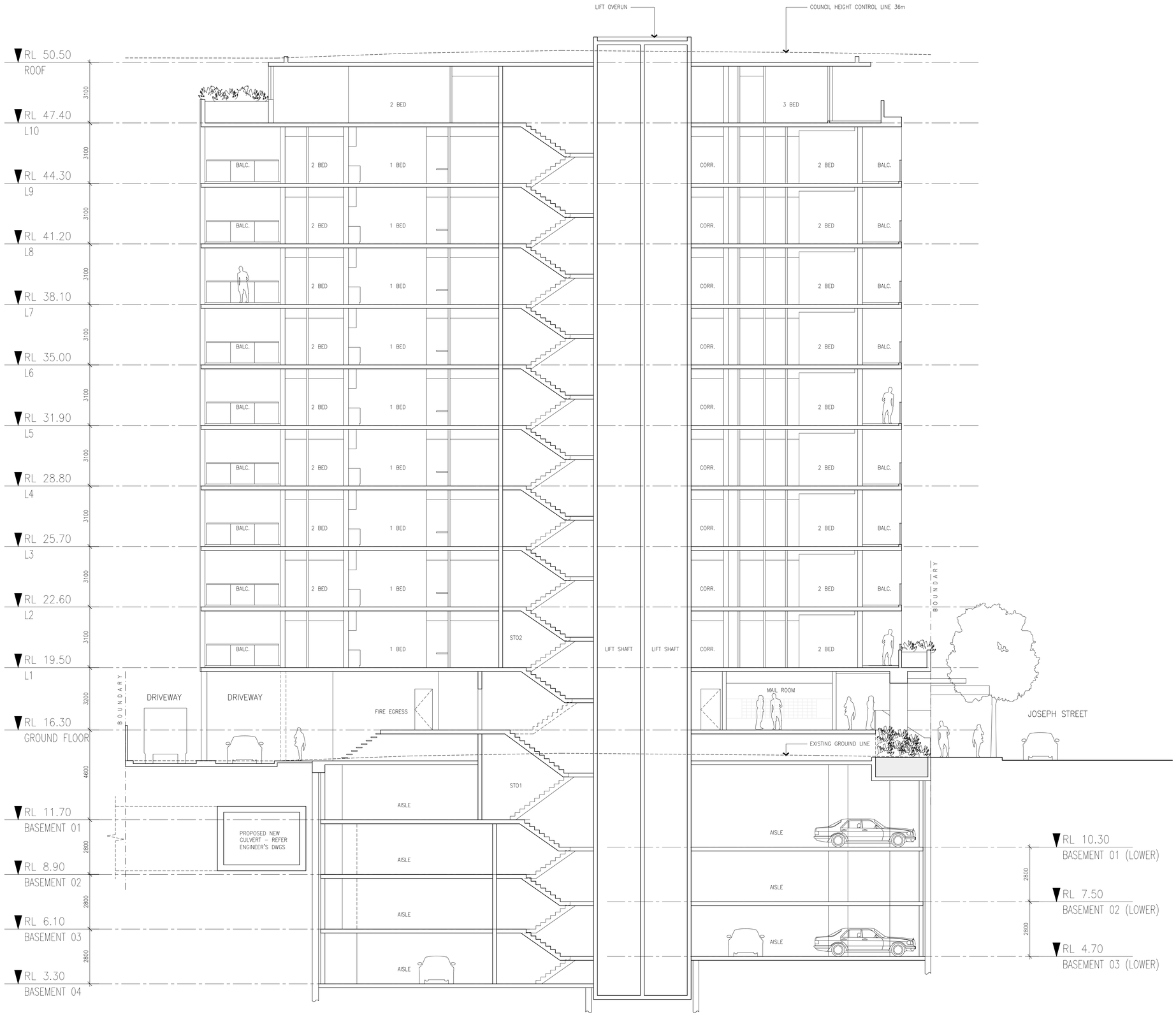
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
ROOF

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



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Client
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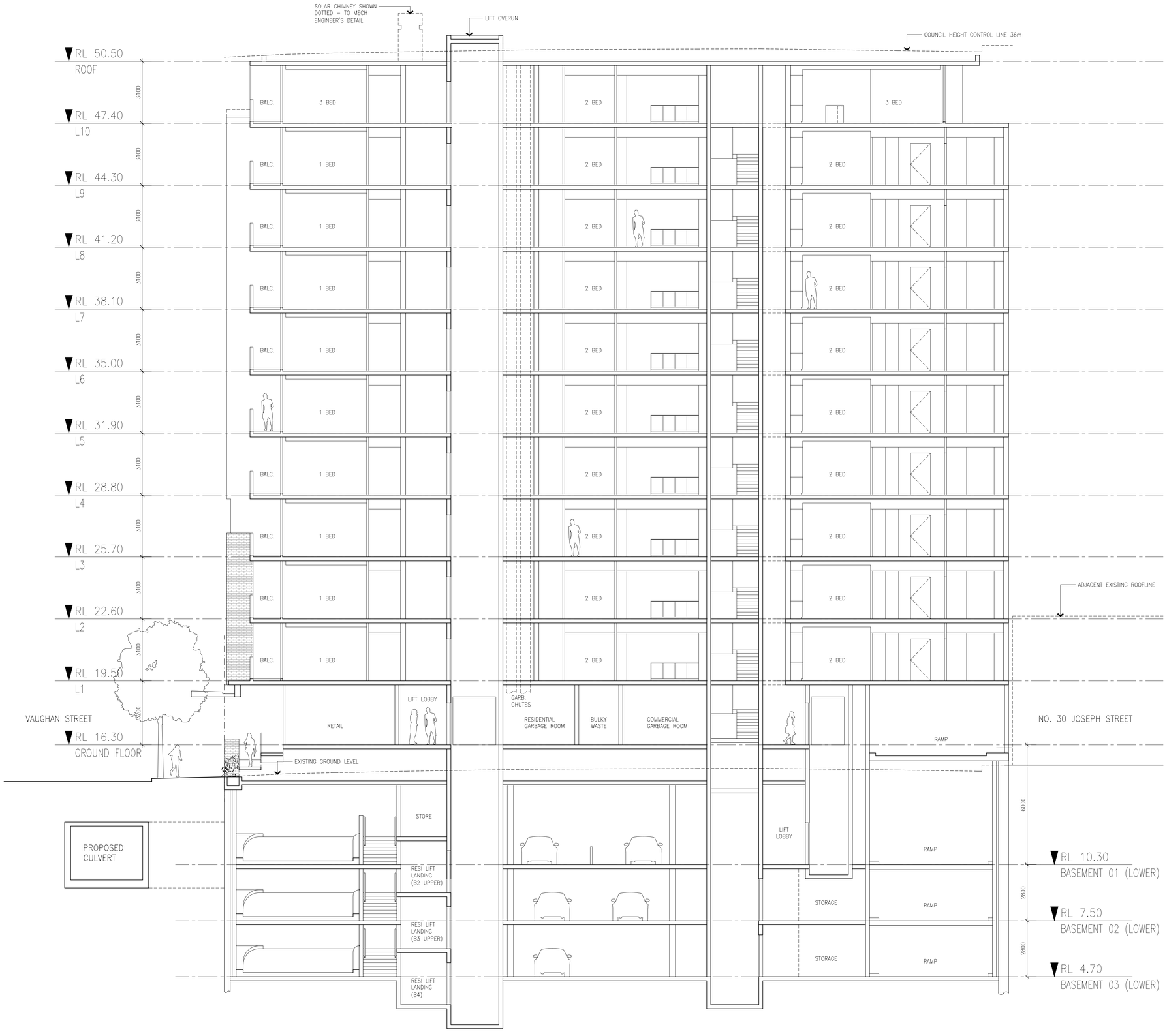
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N

Drawing:
SECTION S□

Project Number: 6546
Drawing Number: DA□ 5

Issue & Date: 15.06.2017



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Client
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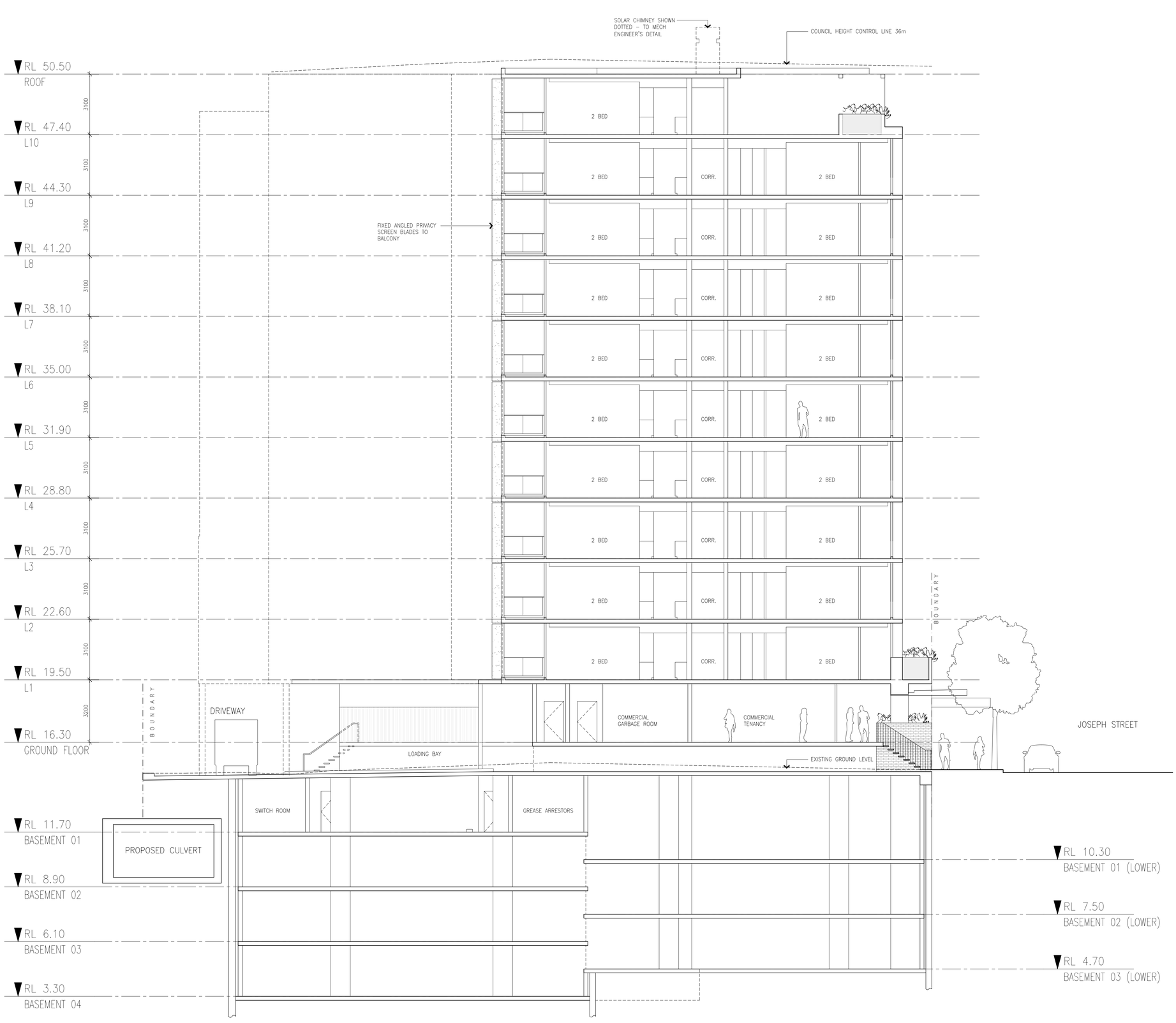
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N

Drawing:
SECTION S2

Project Number: 6546
Drawing Number: DA□ 6

Issue & Date: 15.06.2017



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Client
32 JOSEPH PTY LTD

Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N

Drawing:
SECTION 3

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017

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Client
32 JOSEPH PTY LTD

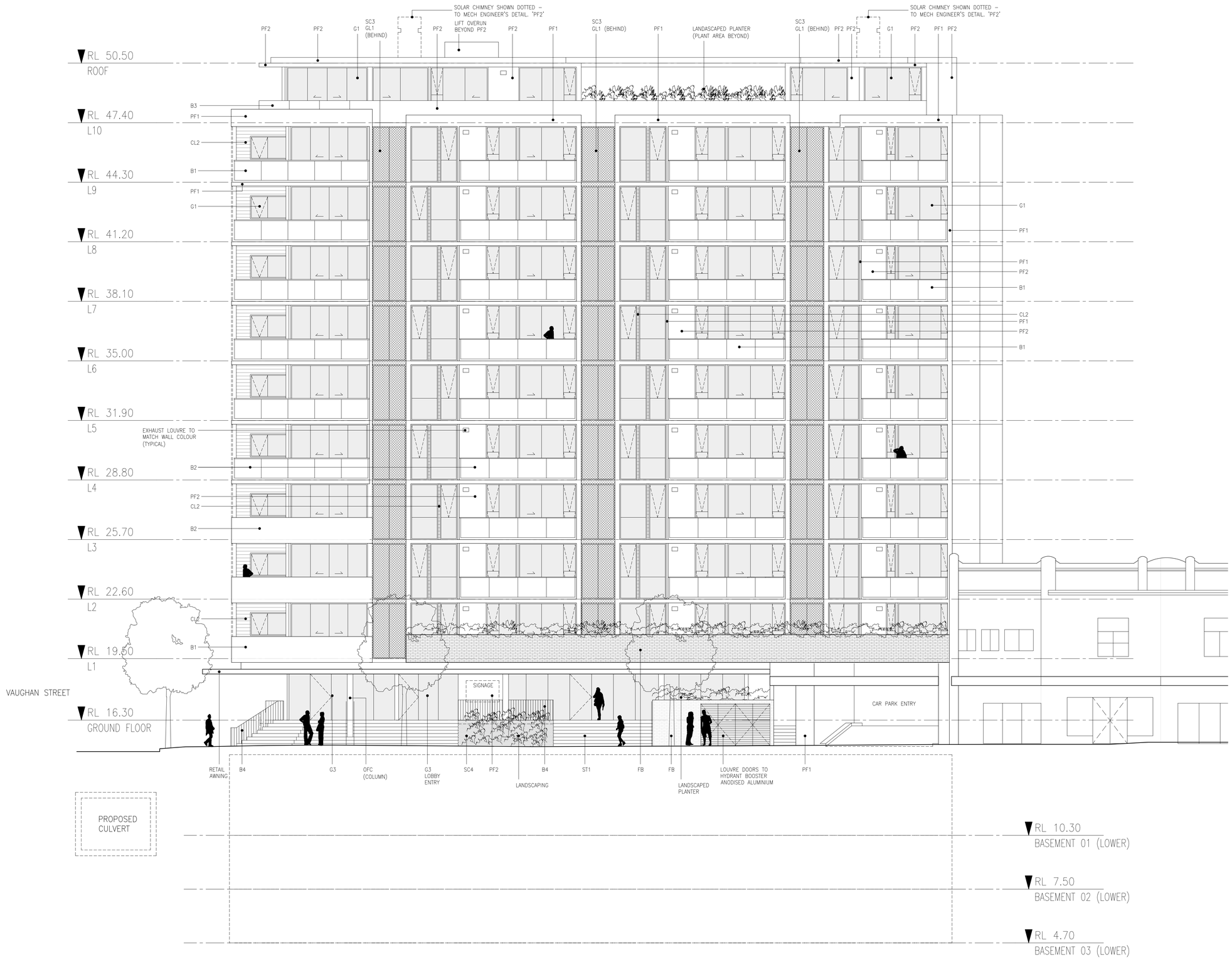
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N

Drawing:
SECTION 4

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



LEGEND

B1	SEMI–FRAMED ALUMINIUM FRAMED TRANSLUCENT GLASS BALUSTRADE. SILVER METALLIC
B2	RENDERED AND PAINTED SOLID BALUSTRADE COLOUR TO MATCH 'PF1'
B3	PREFINISHED PANELLISED CLADDING BALUSTRADE. DARK CHARCOAL METALLIC
B4	POWDERCOATED STEEL BALUSTRADE, HANDRAIL TO RAMPS & STAIRS
CL1	PREFINISHED PANELLISED CLADDING, LIGHT GREY CEMENT TEXTURE
CL2	HORIZONTAL TONGUE & GROOVE CLADDING, TIMBER EFFECT
CT1	STONE PAVING TO GROUND FLOOR RETAIL WALKWAY
FB	FACE BRICK – EQUAL TO BOWRAL BLUE
G1	POWDERCOATED ALUMINIUM FRAMED GLAZING – BLACK (APARTMENTS)
G2	POWDERCOATED ALUMINIUM FRAMED GLASS LOUVRES – BLACK (LOBBIES)
G3	POWDERCOATED ALUMINIUM COMMERCIAL GLAZING – BLACK (RETAIL)
OFC	OFF FORM CONCRETE COLUMNS
PF1	RENDER AND PAINT FINISH OFF–WHITE COLOUR
PF2	RENDER AND PAINT FINISH DULUX "DOMINO"
PF3	RENDER AND PAINT FINISH DULUX "TIMELESS GREY"
SC1	PREFINISHED PANELLISED SLIDING OR FIXED SCREEN TO MATCH 'CL1', PERFORATED FOR PRIVACY AND/OR SUN CONTROL.
SC2	TIMBER EFFECT BATTEN SCREEN
SC3	FIXED PRIVACY SCREEN, PERFORATED POWDERCOATED ALUMINIUM, BLACK
SC4	FLOOD CONTROL BARRIER SCREEN UNDER GROUND FLOOR RETAIL SLAB AND EXTERNAL STAIR RISERS, TO ENGINEER'S SPECIFICATIONS. POWDERCOAT METAL, BLACK
ST1	PRECAST CONCRETE EXTERNAL STAIR TREADS WITH 'SC4' RISER INSERTS

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Client
32 JOSEPH PTY LTD

Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation: N
0 1 2.5 5m

Drawing:
EAST ELEVATION (JOSEPH ST)

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017

LEGEND

B1	SEMI–FRAMED ALUMINIUM FRAMED TRANSLUCENT GLASS BALUSTRADE. SILVER METALLIC
B2	RENDERED AND PAINTED SOLID BALUSTRADE COLOUR TO MATCH 'PF1'
B3	PREFINISHED PANELLISED CLADDING BALUSTRADE. DARK CHARCOAL METALLIC
B4	POWDERCOATED STEEL BALUSTRADE, HANDRAIL TO RAMPS & STAIRS
CL1	PREFINISHED PANELLISED CLADDING, LIGHT GREY CEMENT TEXTURE
CL2	HORIZONTAL TONGUE & GROOVE CLADDING, TIMBER EFFECT
CT1	STONE PAVING TO GROUND FLOOR RETAIL WALKWAY
FB	FACE BRICK – EQUAL TO BOWRAL BLUE
G1	POWDERCOATED ALUMINIUM FRAMED GLAZING – BLACK (APARTMENTS)
G2	POWDERCOATED ALUMINIUM FRAMED GLASS LOUVRES – BLACK (LOBBIES)
G3	POWDERCOATED ALUMINIUM COMMERCIAL GLAZING – BLACK (RETAIL)
OFC	OFF FORM CONCRETE COLUMNS
PF1	RENDER AND PAINT FINISH OFF–WHITE COLOUR
PF2	RENDER AND PAINT FINISH DULUX "DOMINO"
PF3	RENDER AND PAINT FINISH DULUX "TIMELESS GREY"
SC1	PREFINISHED PANELLISED SLIDING OR FIXED SCREEN TO MATCH 'CL1', PERFORATED FOR PRIVACY AND/OR SUN CONTROL.
SC2	TIMBER EFFECT BATTEN SCREEN
SC3	FIXED PRIVACY SCREEN, PERFORATED POWDERCOATED ALUMINIUM, BLACK
SC4	FLOOD CONTROL BARRIER SCREEN UNDER GROUND FLOOR RETAIL SLAB AND EXTERNAL STAIR RISERS, TO ENGINEER'S SPECIFICATIONS. POWDERCOAT METAL, BLACK
ST1	PRECAST CONCRETE EXTERNAL STAIR TREADS WITH 'SC4' RISER INSERTS

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Client
32 JOSEPH PTY LTD

Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
SOUTH ELEVATION
(VAUGHAN ST)

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017

LEGEND

B1	SEMI–FRAMED ALUMINIUM FRAMED TRANSLUCENT GLASS BALUSTRADE. SILVER METALLIC
B2	RENDERED AND PAINTED SOLID BALUSTRADE COLOUR TO MATCH 'PF1'
B3	PREFINISHED PANELLISED CLADDING BALUSTRADE. DARK CHARCOAL METALLIC
B4	POWDERCOATED STEEL BALUSTRADE, HANDRAIL TO RAMPS & STAIRS
CL1	PREFINISHED PANELLISED CLADDING, LIGHT GREY CEMENT TEXTURE
CL2	HORIZONTAL TONGUE & GROOVE CLADDING, TIMBER EFFECT
CT1	STONE PAVING TO GROUND FLOOR RETAIL WALKWAY
FB	FACE BRICK – EQUAL TO BOWRAL BLUE
G1	POWDERCOATED ALUMINIUM FRAMED GLAZING – BLACK (APARTMENTS)
G2	POWDERCOATED ALUMINIUM FRAMED GLASS LOUVRES – BLACK (LOBBIES)
G3	POWDERCOATED ALUMINIUM COMMERCIAL GLAZING – BLACK (RETAIL)
OFC	OFF FORM CONCRETE COLUMNS
PF1	RENDER AND PAINT FINISH OFF–WHITE COLOUR
PF2	RENDER AND PAINT FINISH DULUX "DOMINO"
PF3	RENDER AND PAINT FINISH DULUX "TIMELESS GREY"
SC1	PREFINISHED PANELLISED SLIDING OR FIXED SCREEN TO MATCH 'CL1', PERFORATED FOR PRIVACY AND/OR SUN CONTROL.
SC2	TIMBER EFFECT BATTEN SCREEN
SC3	FIXED PRIVACY SCREEN, PERFORATED POWDERCOATED ALUMINIUM, BLACK
SC4	FLOOD CONTROL BARRIER SCREEN UNDER GROUND FLOOR RETAIL SLAB AND EXTERNAL STAIR RISERS, TO ENGINEER'S SPECIFICATIONS. POWDERCOAT METAL, BLACK
ST1	PRECAST CONCRETE EXTERNAL STAIR TREADS WITH 'SC4' RISER INSERTS

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Client
32 JOSEPH PTY LTD

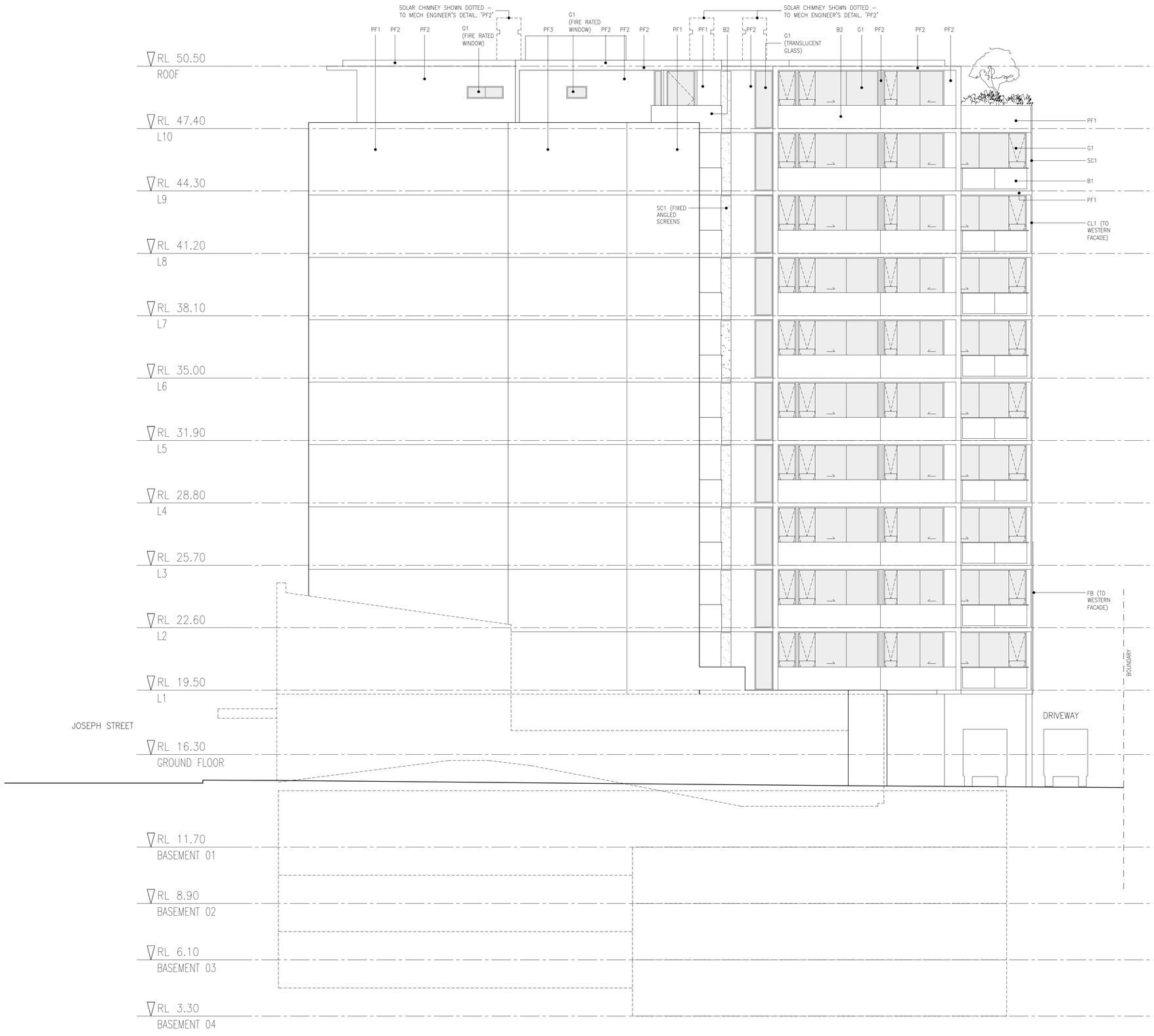
Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
WEST ELEVATION (DRIVEWA□)

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



LEGEND

B1	SEMI–FRAMED ALUMINIUM FRAMED TRANSLUCENT GLASS BALUSTRADE. SILVER METALLIC
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SC4	FLOOD CONTROL BARRIER SCREEN UNDER GROUND FLOOR RETAIL SLAB AND EXTERNAL STAIR RISERS, TO ENGINEER'S SPECIFICATIONS. POWDERCOAT METAL, BLACK
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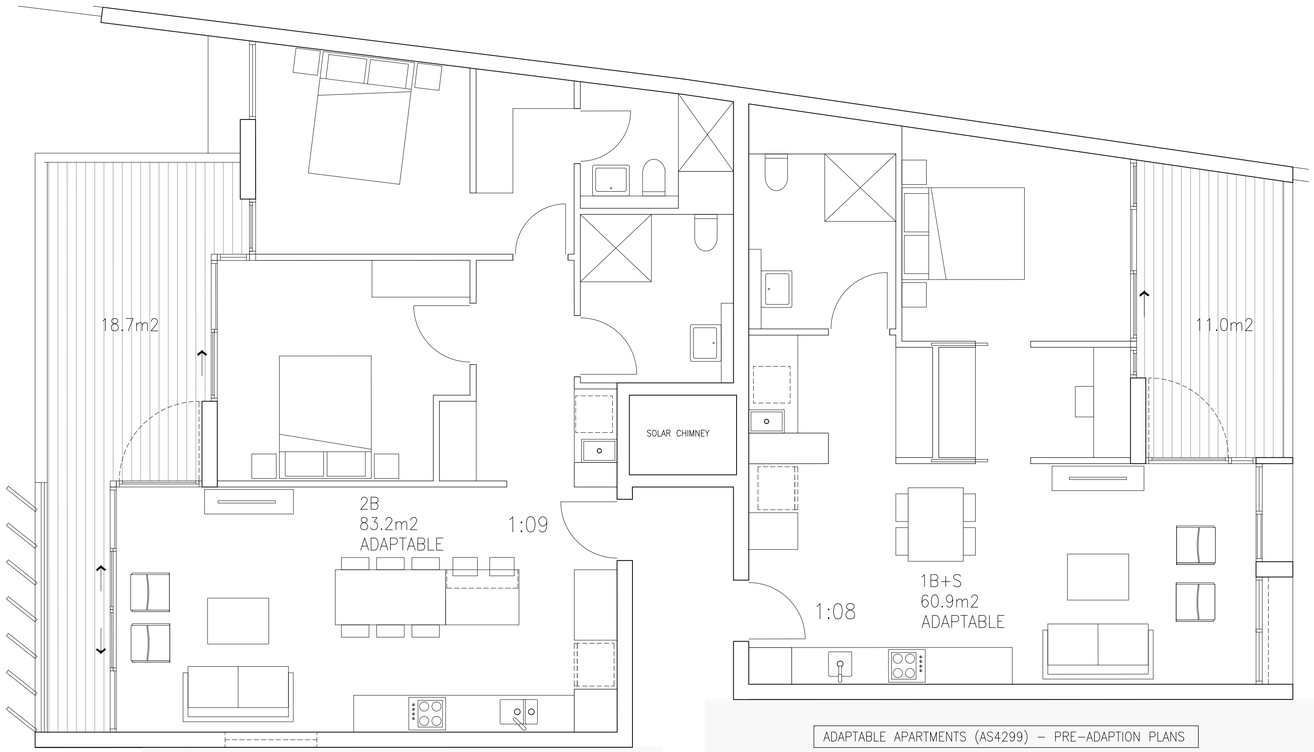
DEVELOPMENT APPLICATION

Scale/Orientation: N
0 1 2.5 5m

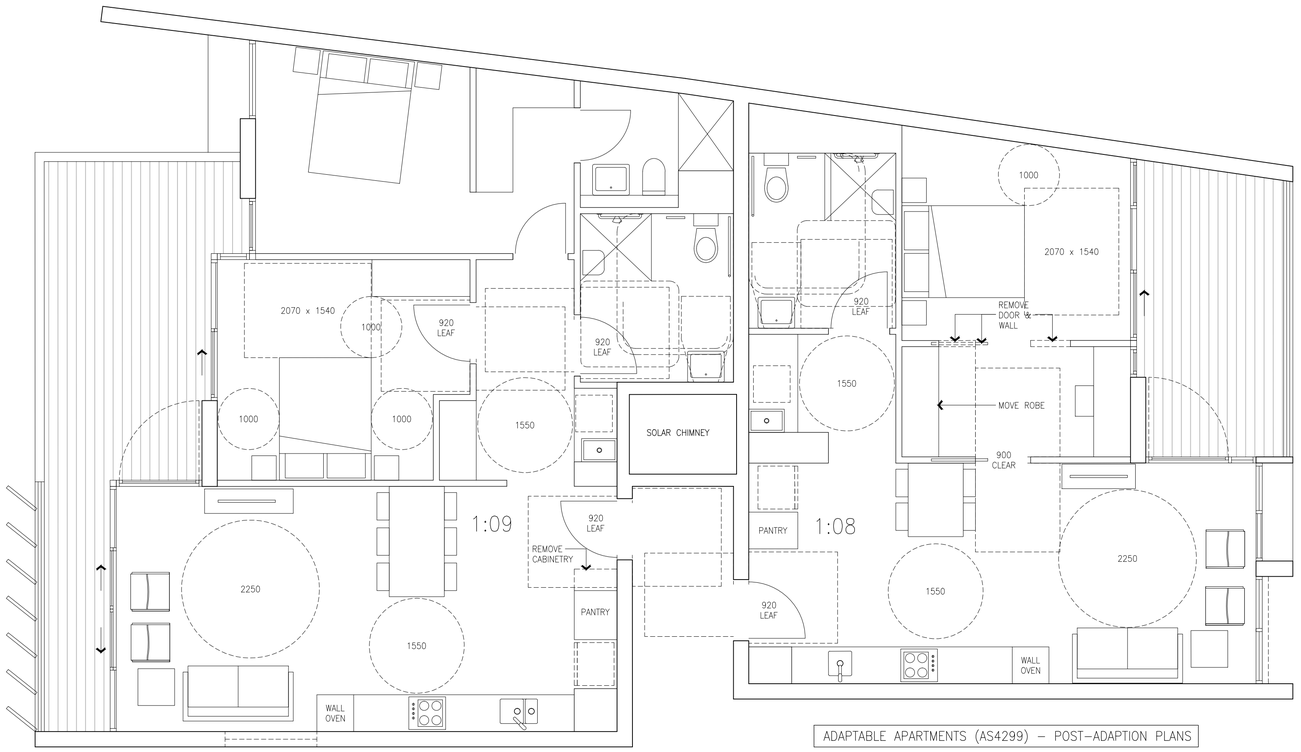
Drawing:
NORTH ELEVATION

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



ADAPTABLE APARTMENTS (AS4299) – PRE–ADAPTION PLANS



ADAPTABLE APARTMENTS (AS4299) – POST–ADAPTION PLANS

NOMINATED ADAPTABLE APARTMENTS (AS4299):

1.08, 2.08, 3.08, 4.08, 5.08, 6.08, 7.08, 8.08, 9.08
1.09

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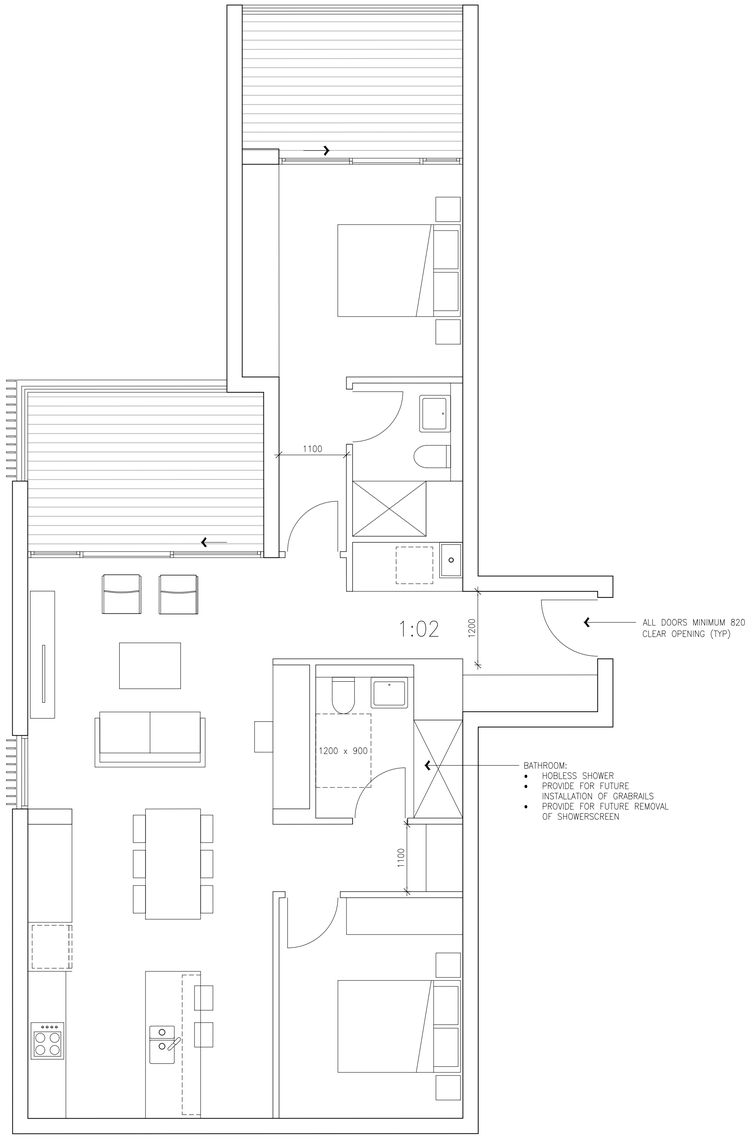
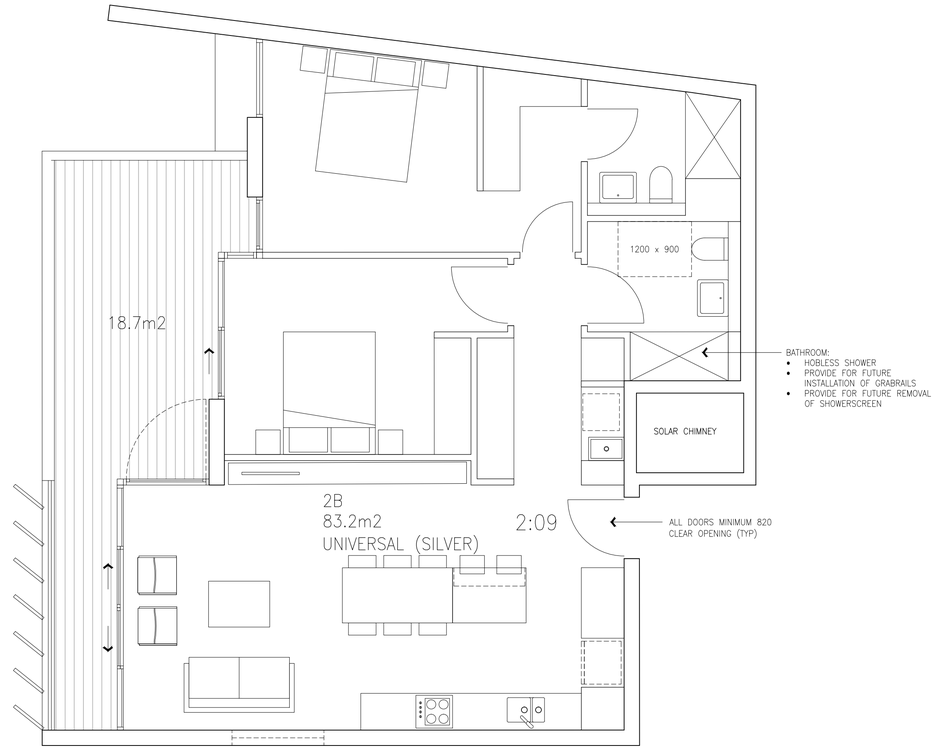
N
0 1 2.5 5m

Drawing:
ADAPTABLE APARTMENTS
PRE □ POST ADAPTION PLAN

Project Number: 6546
Drawing Number: DA□□
Issue & Date: 15.06.2017



SILVER LEVEL UNIVERSAL APARTMENT (LIVABLE HOUSING AUSTRALIA)



SILVER LEVEL UNIVERSAL APARTMENT (LIVABLE HOUSING AUSTRALIA)

NOMINATED SILVER LEVEL UNIVERSAL APARTMENTS (LIVABLE HOUSING AUSTRALIA):

1.02
2.09, 3.09, 4.09, 5.09, 6.09, 7.09, 8.09, 9.09

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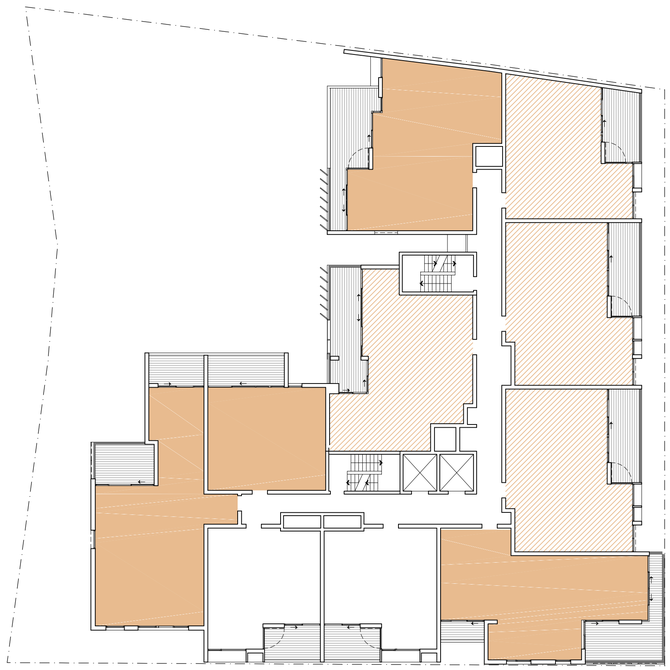
Scale/Orientation:
N
0 1 2.5 5m

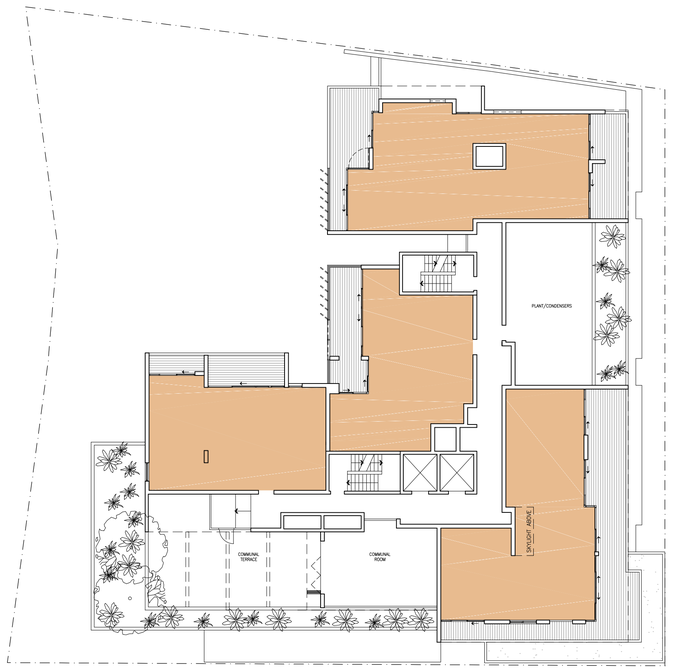
Drawing:
UNIVERSAL APARTMENTS

Project Number: 6546
Drawing Number: DA□□

Issue & Date: 15.06.2017



LEVELS 01–09



LEVEL 10

APARTMENT RECEIVES A MINIMUM OF 2 HOURS SOLAR ACCESS BETWEEN 9AM AND 3PM IN MID–WINTER

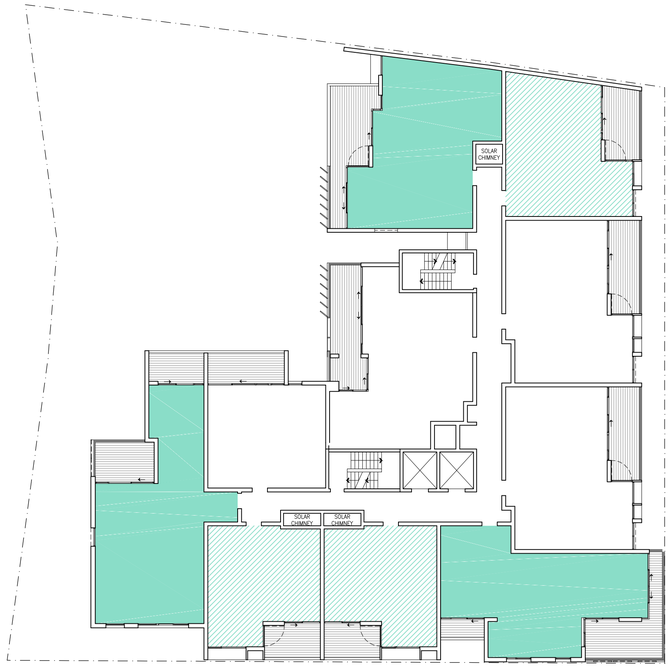
APARTMENT RECEIVES A MINIMUM OF 2 HOURS SOLAR ACCESS BETWEEN 8.30AM AND 3.30PM IN MID–WINTER

SOLAR ACCESS CALCUATIONS

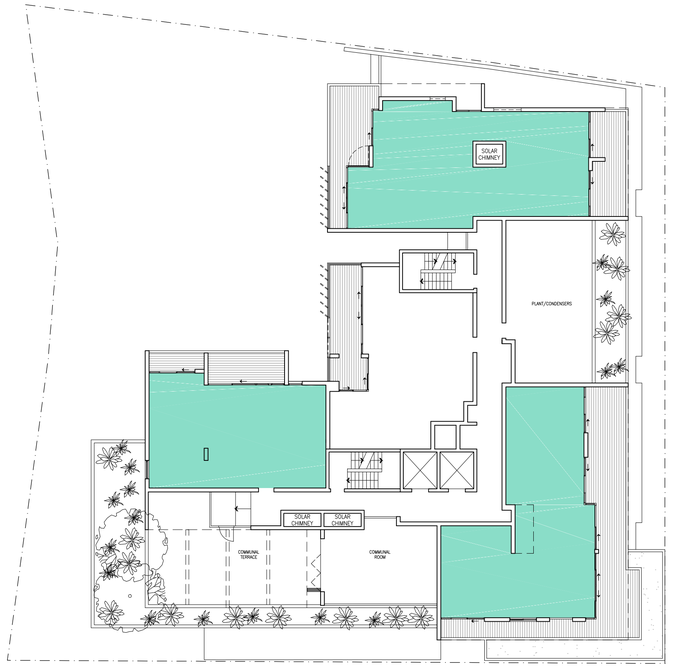
LEVEL	NO. APARTMENTS RECEIVING NP. 2 HOURS SOLAR ACCESS*	NO. TOTAL NO. APARTMENTS
01	8	10
02	8	10
03	8	10
04	8	10
05	8	10
06	8	10
07	8	10
08	8	10
09	8	10
10	4	4
TOTAL	76 (81%)	94 (100%)

* NOTE: APARTMENTS RECEIVING 2 HOURS SOLAR ACCESS BETWEEN 8.30AM AND 3.30PM HAVE BEEN INCLUDED AND ARE CONSIDERED TO BE REASONABLY 'COMPLYING' DUE TO THE LIMITATIONS IMPOSED BY SITE CONSTRAINTS (ORIENTATION OF MAIN STREET BOUNDARIES).

NO. APTS RECEIVING NO SOLAR ACCESS	18 (19%)



LEVELS 01–09



LEVEL 10

APARTMENT IS NATURALLY VENTILATED BY DEEMED–TO–SATISFY DESIGN SOLUTION

APARTMENT IS NATURALLY VENTILATED BY PERFORMANCE SOLUTION (SOLAR CHIMNEY)

CROSS VENTILATION CALCUATIONS

LEVEL	NO. APARTMENTS RECEIVING NP. 2 HOURS SOLAR ACCESS*	NO. TOTAL NO. APARTMENTS
01	6	10
02	6	10
03	6	10
04	6	10
05	6	10
06	6	10
07	6	10
08	6	10
09	6	10
10	3	10
TOTAL	57 (61%)	94 (100%)

PART 4B OF THE APARTMENT DESIGN GUIDE STIPULATES THAT NATURAL CROSS VENTILATION IS ACHIEVED WITH DUAL ASPECT, CORNER AND CROSS–THROUGH APARTMENT DESIGNS.

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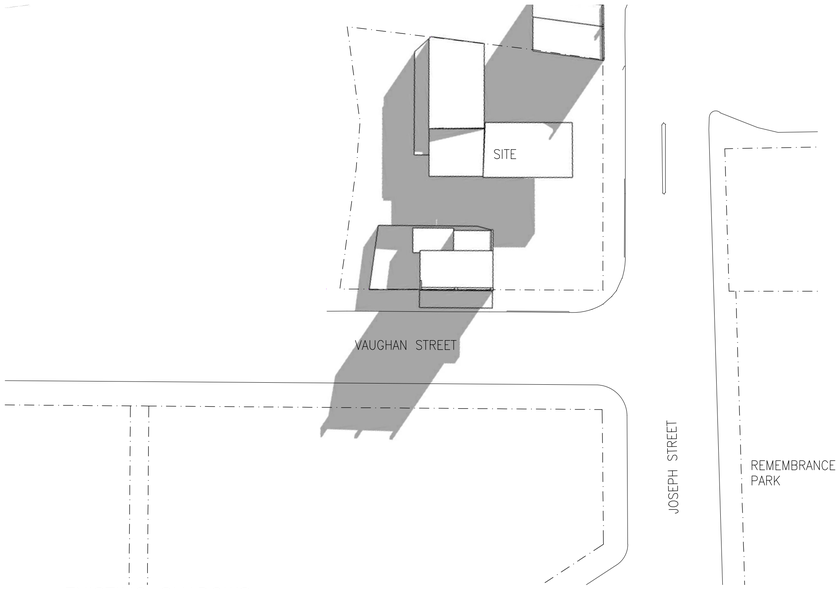
Scale/Orientation:
N

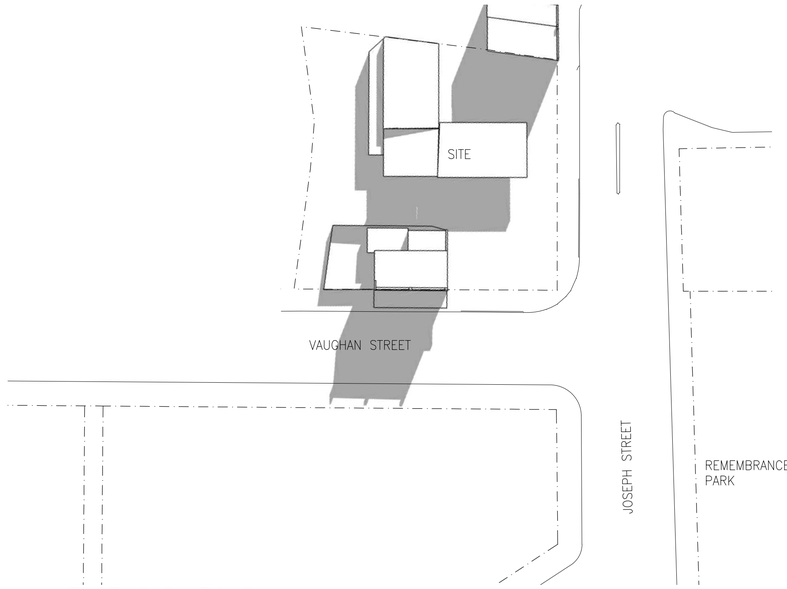
Drawing:
SOLAR ACCESS ▫
CROSS VENTILATION

Project Number: 6546
Drawing Number: DA▫5

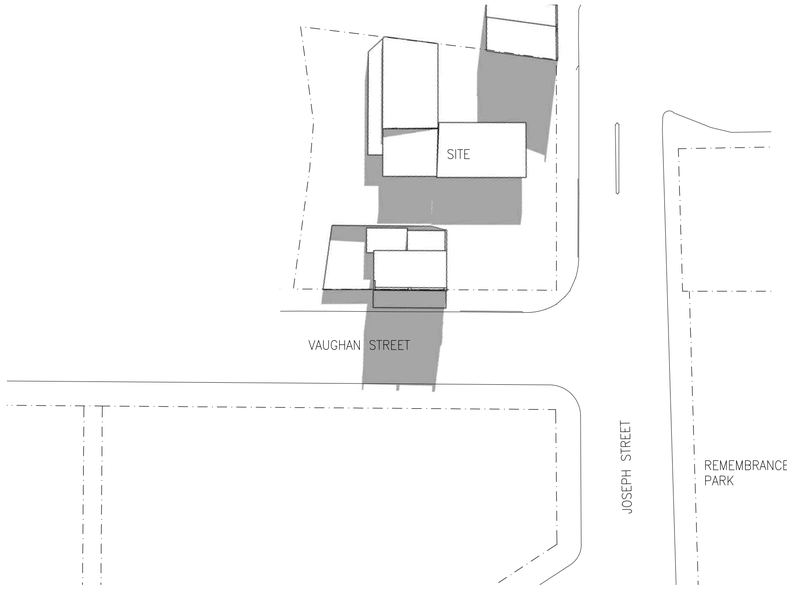
Issue & Date: 15.06.2017



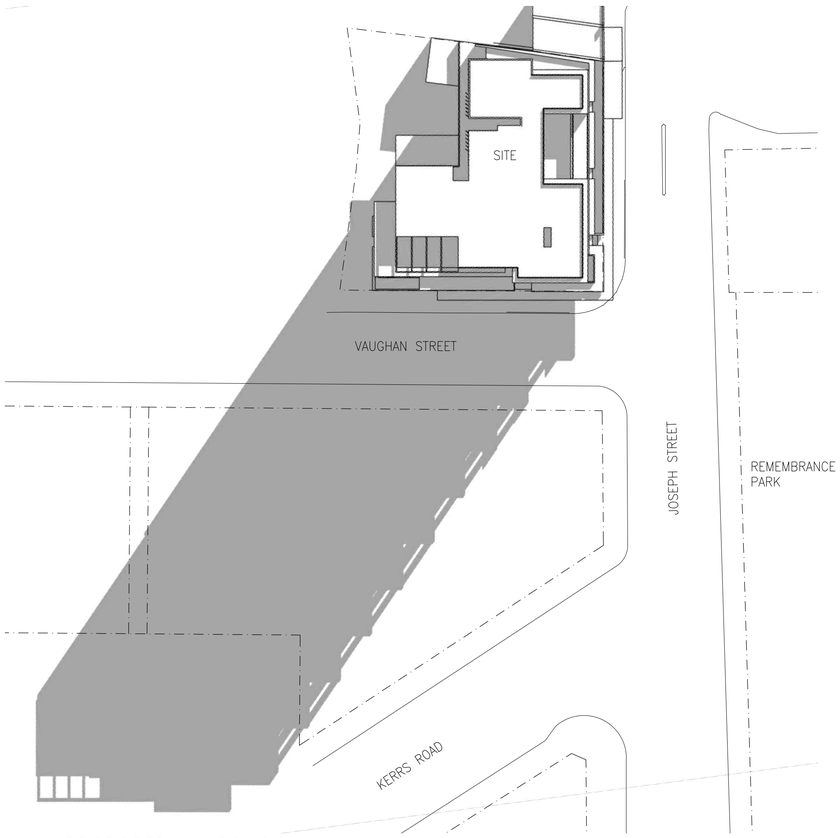
EXISTING SHADOWS
21 JUNE – 9AM



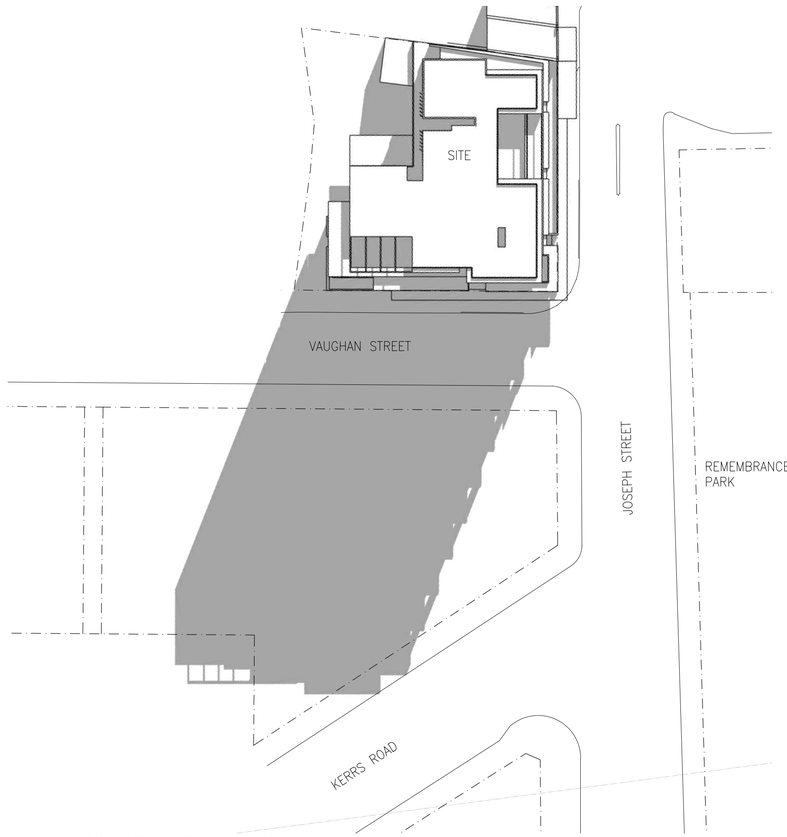
EXISTING SHADOWS
21 JUNE – 10AM



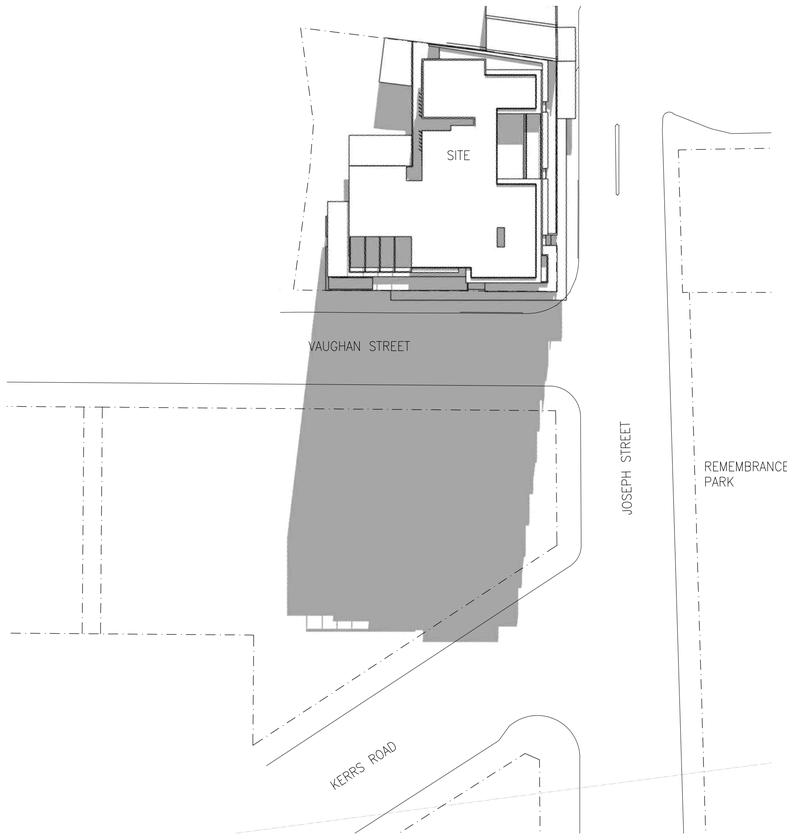
EXISTING SHADOWS
21 JUNE – 11AM



PROPOSED SHADOWS
21 JUNE – 9AM



PROPOSED SHADOWS
21 JUNE – 10AM



PROPOSED SHADOWS
21 JUNE – 11AM

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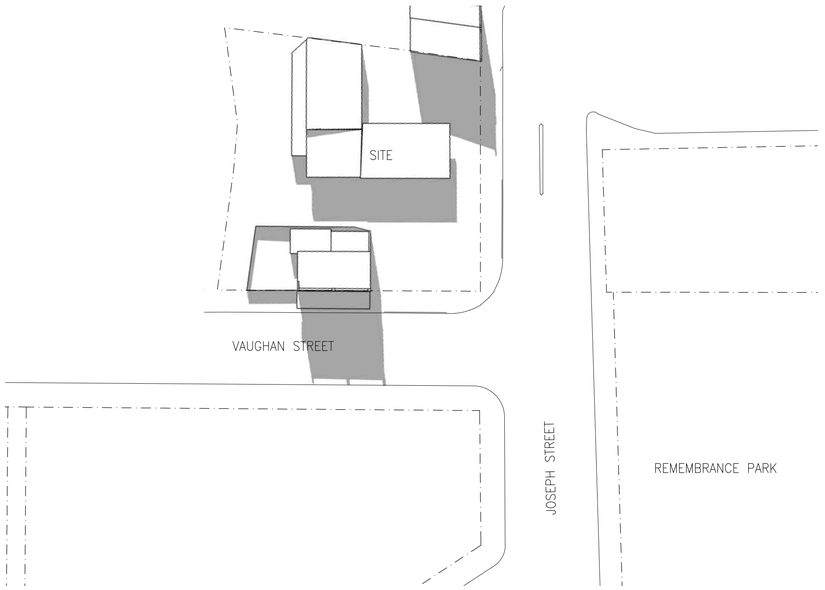
DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 5 12.5 25m

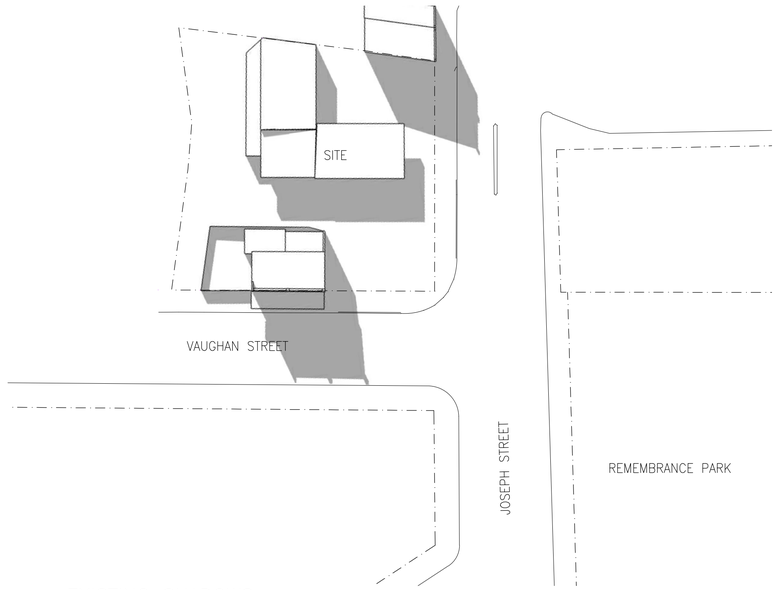
Drawing:
INDICATIVE SHADOW DIAGRAMS
SHEET □

Project Number: 6546
Drawing Number: DA5□

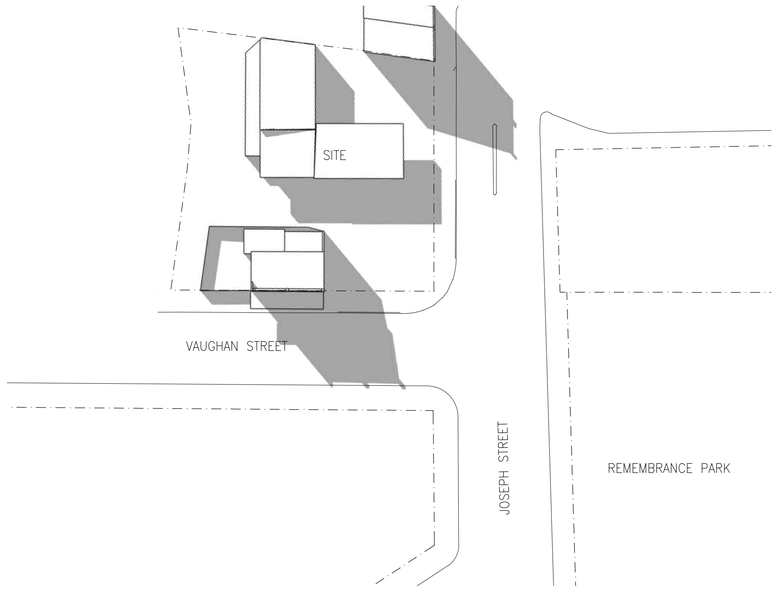
Issue & Date: 15.06.2017



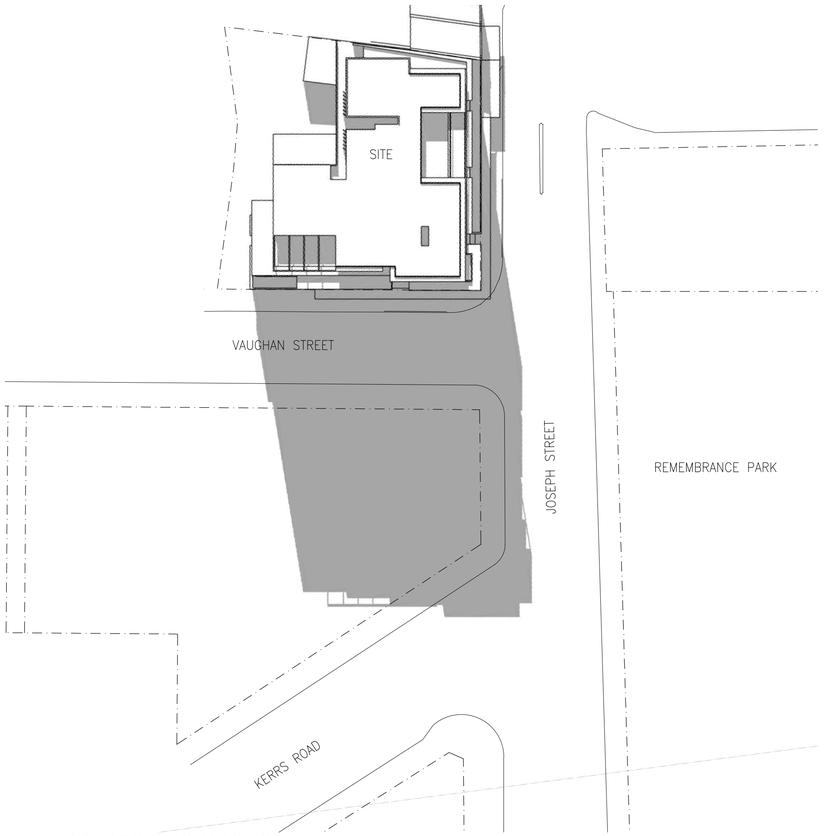
EXISTING SHADOWS
21 JUNE – 12PM



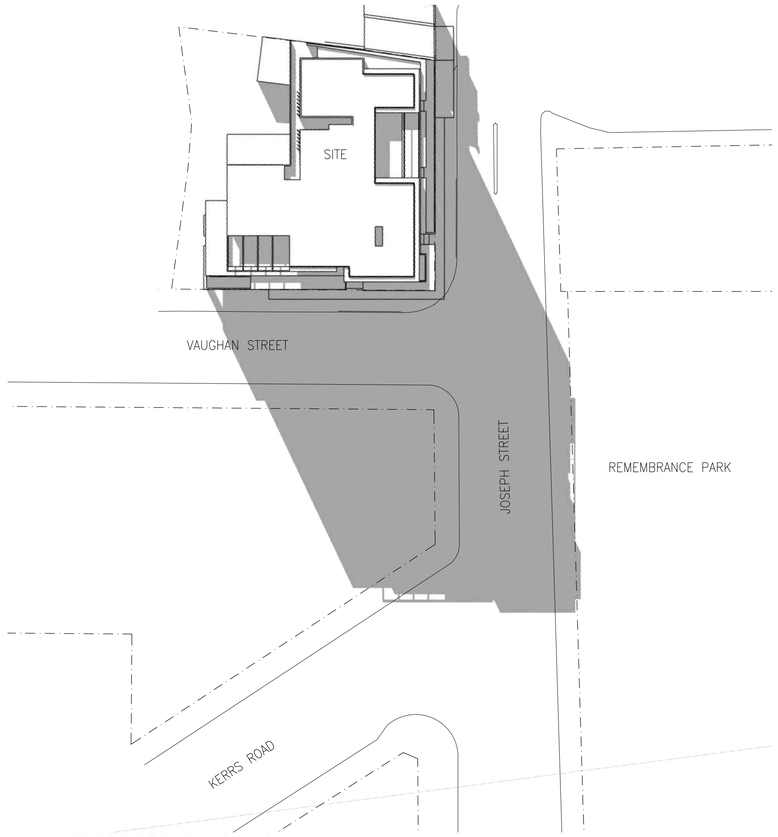
EXISTING SHADOWS
21 JUNE – 1PM



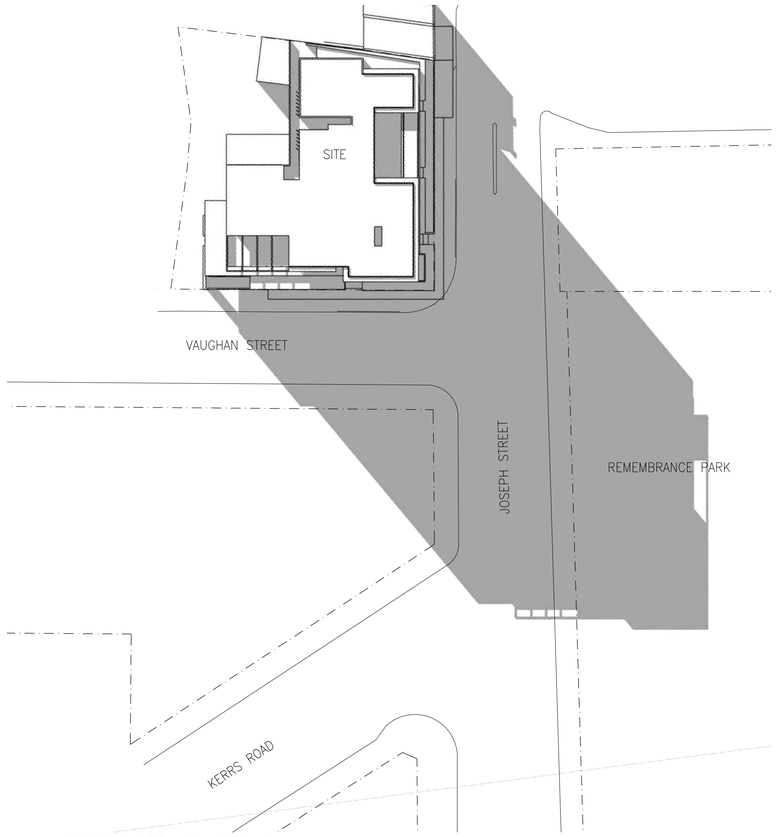
EXISTING SHADOWS
21 JUNE – 2PM



PROPOSED SHADOWS
21 JUNE – 12PM



PROPOSED SHADOWS
21 JUNE – 1PM



PROPOSED SHADOWS
21 JUNE – 2PM

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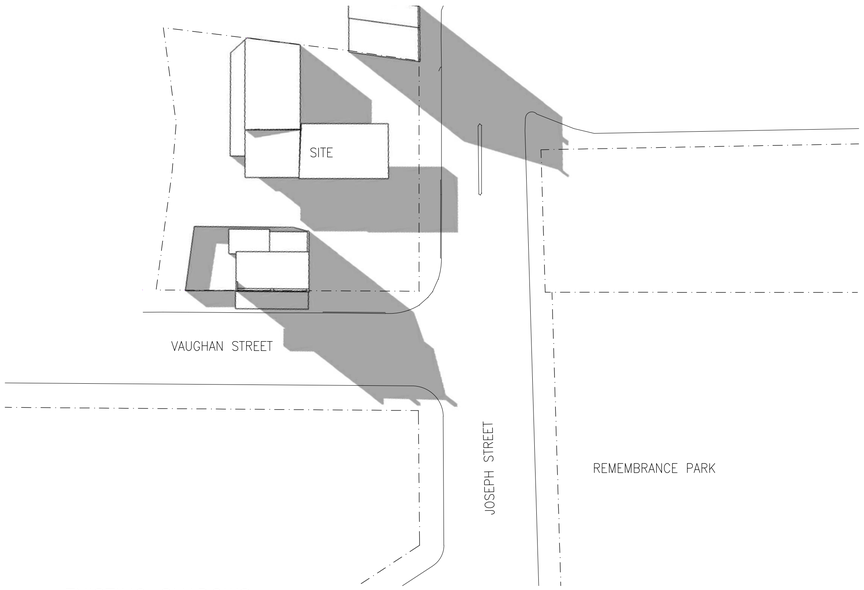
Client
32 JOSEPH PTY LTD

Project:
32 JOSEPH STREET LIDCOMBE
DEVELOPMENT APPLICATION

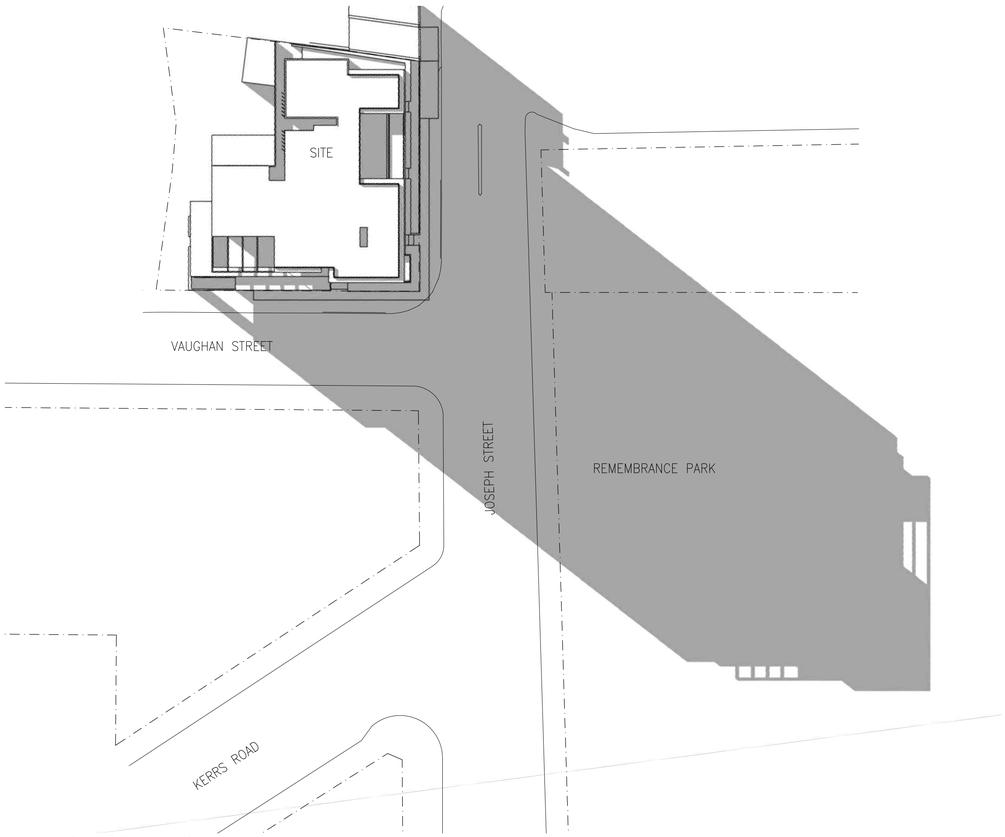
Scale/Orientation:
N
0 5 12.5 25m

Drawing:
INDICATIVE SHADOW DIAGRAMS
SHEET 2

Project Number: 6546
Drawing Number: DA5
Issue & Date: 15.06.2017



EXISTING SHADOWS
21 JUNE – 3PM



PROPOSED SHADOWS
21 JUNE – 3PM

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DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 5 12.5 25m

Drawing:
INDICATIVE SHADOW DIAGRAMS
SHEET 3

Project Number: 6546
Drawing Number: DA5
Issue & Date: 15.06.2017

NOTE: PHOTOMONTAGES EXCLUDE STREET TREES FOR CLARITY

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Project:
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DEVELOPMENT APPLICATION

Scale/Orientation:
N
0 1 2.5 5m

Drawing:
PHOTOMONTAGE SHEET ▫
VIEW FROM SOUTHEAST
CORNER (PAR▫)

Project Number: 6546
Drawing Number: DA55

Issue & Date: 15.06.2017

NOTE: PHOTOMONTAGES EXCLUDE STREET TREES FOR CLARITY

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Scale/Orientation:
N
0 1 2.5 5m

Drawing:
PHOTOMONTAGE SHEET 2
VIEW FROM SOUTHWEST
CORNER (VAUGHAN ST)

Project Number: 6546
Drawing Number: DA56
Issue & Date: 15.06.2017